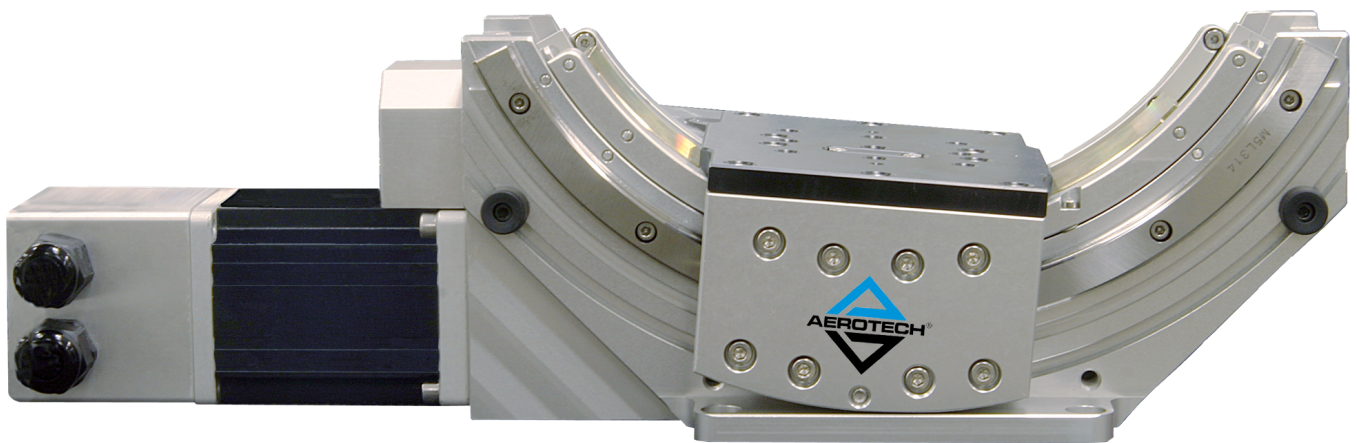




AGC Series Stage Hardware Manual

Revision: 1.03.00



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.

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Safety Procedures and Warnings

This manual tells you how to carefully and correctly use and operate the AGC. Read all parts of this manual before you install or operate the AGC 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NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time.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 AGC 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 AGC must be mounted securely. Improper mounting can result in injury and damage to the equipment.
5. Use care when moving the AGC. Lifting or transporting the AGC improperly can result in injury or damage to the AGC.
6. This product is intended for light industrial manufacturing or laboratory use. Use of this product for unintended applications can result in injury and damage to the equipment.
7. If the product is used in a manner not specified by the manufacturer, the protection provided by the product can be impaired and result in damage, shock, injury, or death.
8. The motor case temperature may exceed 75°C.
9. Operators must be trained before operating this equipment.
10. 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:
AGC 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

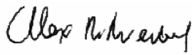
it is not allowed to put the equipment into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of the Directive 2006/42/EC and with national implementing legislation, for example, as a 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):

EU 2015/863

RoHS 3 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 1/20/2020



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Chapter 1: Overview

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 1-1: AGC Model Numbers and Ordering Options

AGC Series Gear-Driven Goniometers	
Series Option (Required)	
AGC85	Gear-driven goniometer, 85 mm radius of curvature
AGC160	Gear-driven goniometer, 160 mm radius of curvature
AGC245	Gear-driven goniometer, 245 mm radius of curvature
Travel (Required)	
-TR010	Limited travel, ± 5 degrees
-TR015	Limited travel, ± 7.5 degrees
-TR020	Limited travel, ± 10 degrees
-TR025	Limited travel, ± 12.5 degrees
-TR030	Limited travel, ± 15 degrees
-TR035	Limited travel, ± 17.5 degrees
-TR040	Limited travel, ± 20 degrees
-TR045	Limited travel, ± 22.5 degrees
-TR050	Limited travel, ± 25 degrees
-TR060	Limited travel, ± 30 degrees
-TR070	Limited travel, ± 35 degrees
-TR080	Limited travel, ± 40 degrees
-TR090	Limited travel, ± 45 degrees
Motor (Optional)	
-M1	Brushless servomotor with digital encoder; AGC85 (BM75 with 2500-line TTL encoder); AGC160 (BM130 with 2500-line TTL encoder); AGC245 (BM200 with 5000-line TTL encoder)
-M2	Brushless servomotor with digital encoder and brake; AGC85 (BM75 with 2500-line TTL encoder); AGC160 (BM130 with 2500-line TTL encoder); AGC245 (BM200 with 5000-line TTL encoder)
-M3	Brushless servomotor, 1000-line 1 Vpp encoder; AGC85 (BM75); AGC160 (BM130); AGC245 (BM200)
-M4	Brushless servomotor, 1000-line 1 Vpp encoder and brake; AGC85 (BM75); AGC160 (BM130); AGC245 (BM200)
Motor Orientation (Required)	
-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
Direct Rotary Feedback (Optional)	
-E1	Incremental encoder, 1 Vpp
-E2	Incremental encoder, digital TTL output, x50 multiplication
Note: If AGC stages have dual feedback loops, it is necessary that the drive motor uses an amplified sine encoder and appropriate encoder interpolation (MXH, MXU or MXR).	

1.1. Environmental Specifications

Table 1-2: Environmental Specifications

Ambient Temperature	Operating: 10° to 35° C (50° to 95° F) The optimal operating temperature is 20° C \pm 2° C (68° F \pm 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
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 AGC stages are not suited for dusty or wet environments. This equates to an ingress protection rating of IP00.
Use	Indoor use only



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.

1.2. Accuracy and Temperature Effects

Aerotech products are designed for and built in a 20°C (68°F) environment. Extreme temperature changes could cause a decrease in performance or permanent damage to the AGC. At a minimum, the environmental temperature must be controlled to within 0.25°C per 24 hours to ensure the AGC specifications are repeatable over an extended period of time. The severity of temperature effects on all specifications depends on many different environmental conditions, including how the AGC is mounted. Contact the factory for more details.

The accuracy specification of AGC series stages is measured at the center of rotation 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](#).

1.3. Basic Specifications

NOTE: Aerotech continually improves its product offerings; listed options may be superseded at any time. Refer to the most recent edition of the Aerotech Motion Control Product Guide for the most current product information at www.aerotech.com.

Table 1-3: AGC Series Specifications

		AGC85	AGC160	AGC245
Travel Range		±45°		
Accuracy ⁽¹⁾		±12 arc sec		
Resolution (Minimum Incremental Motion)		3 arc sec		
Bidirectional Repeatability ⁽¹⁾		±10 arc sec		
Unidirectional Repeatability ⁽¹⁾		±5 arc sec		
Tilt Error Motion		40 arc sec		
Gear Ratio		152:1	192:1	288:1
Maximum Speed		30°/s		
Nominal Radius of Rotation		125 mm	200 mm	300 mm
Distance from Tabletop to Rotation Point		85 mm	160 mm	245 mm
Maximum Torque (Continuous)		18 N-m	24 N-m	44 N-m
Load Capacity ⁽²⁾	Axial	20 kg	30 kg	50 kg
	Moment	20 N-m	30 N-m	50 N-m
Stage Mass ⁽³⁾		5.6 kg	12.5 kg	24.3 kg
Material		Aluminum Body/Clear Anodize Finish		
MTBF (Mean Time Between Failure)		5000 Hours		
<p>1. Certified with each stage. Requires direct encoder feedback with calibration option and is tested with Aerotech controller.</p> <p>2. On-axis loading is listed.</p> <p>3. Load Center of Mass not to exceed bounding volume of 160 mm in diameter by 80 mm above pivot point.</p> <p>Note: Specifications are for single-axis systems measured at the center of rotation; performance of multi-axis system is payload and workpoint dependent. Consult the Aerotech factory for multi-axis or non-standard applications.</p>				

1.4. Vacuum Operation

Aerotech can specially prepare the AGC 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.

To make sure that the AGC 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 AGC from its sealed bag until it is ready to use.
2. Always handle the AGC in a clean environment and use powder-free polyethylene gloves to prevent any contaminants from adhering to the surface of the AGC.
3. During installation, use cleaned, vented, stainless steel fasteners when securing the AGC.
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. Aerotech recommends that customers bake out vacuum systems when first installing them in the vacuum chamber. Contact Aerotech to discuss your application and recommended bakeout temperatures.

Chapter 2: Mechanical Specifications and Installation



WARNING: AGC 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



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



WARNING: Lift the AGC only by the base. Improper handling could adversely affect the AGC's performance.

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

Before operating the AGC, 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-free air to remove any dust or debris that has collected during shipping.

Each AGC 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.

2.2. Dimensions

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.

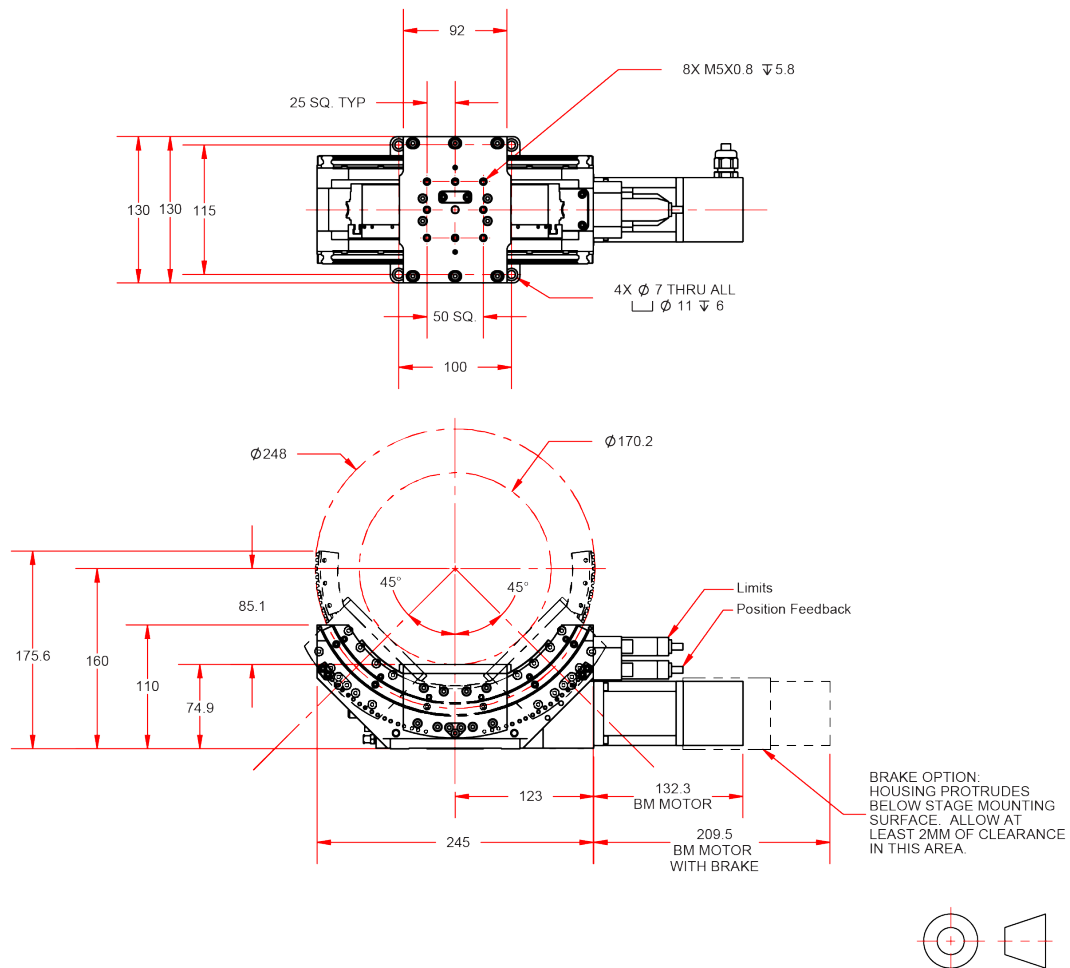


Figure 2-1: AGC85 Dimensions

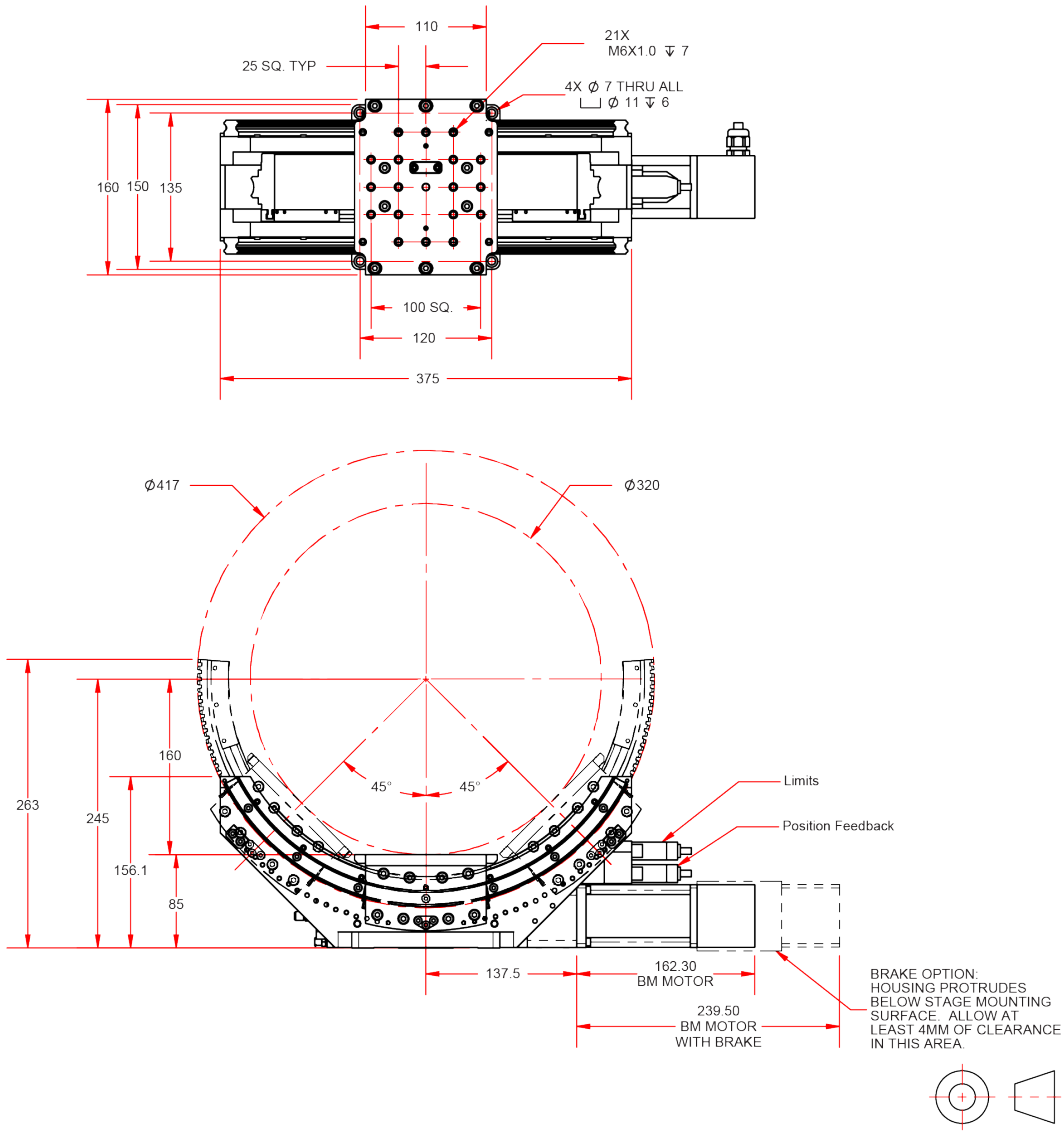


Figure 2-2: AGC160 Dimensions

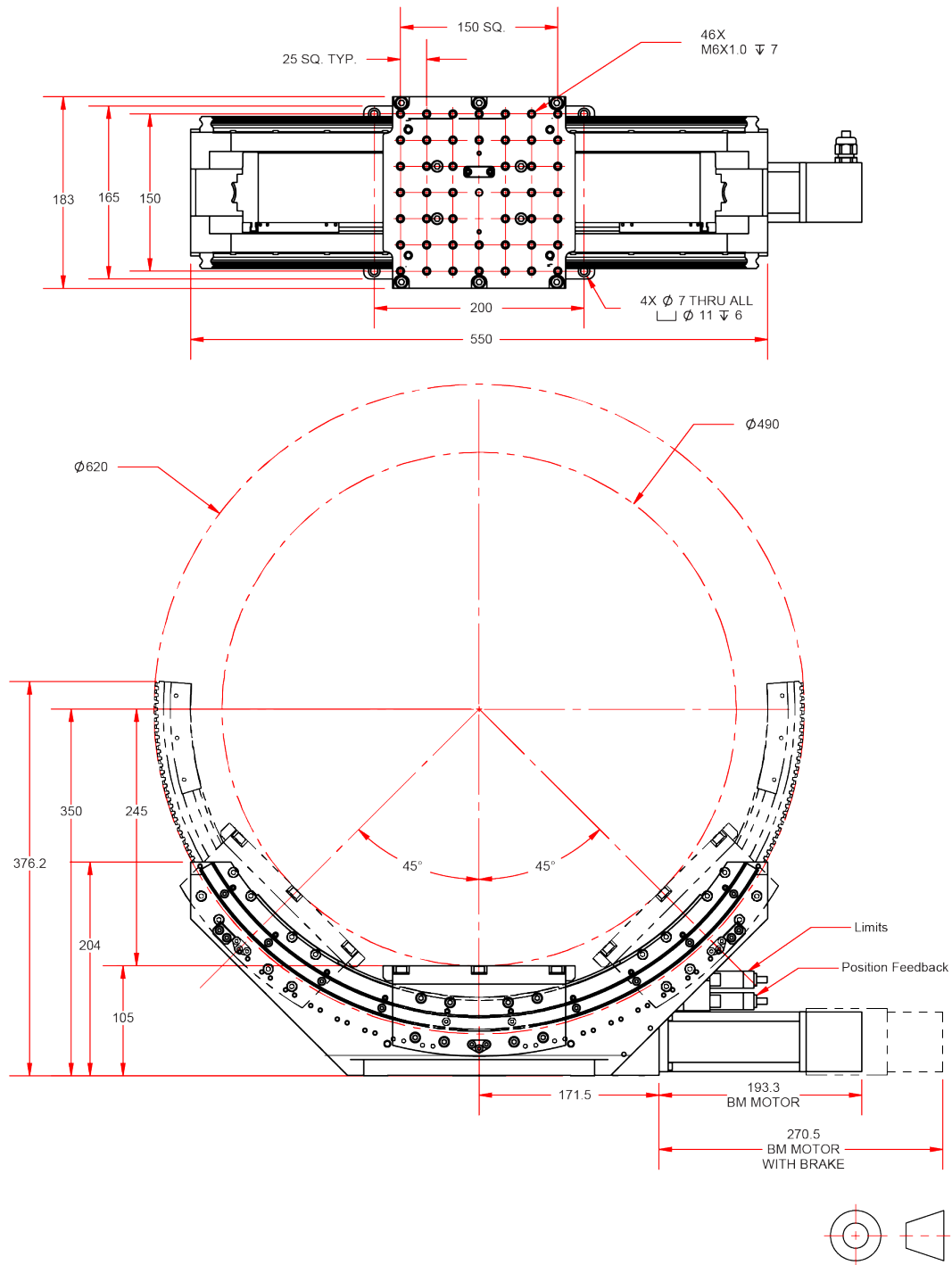


Figure 2-3: AGC245 Dimensions

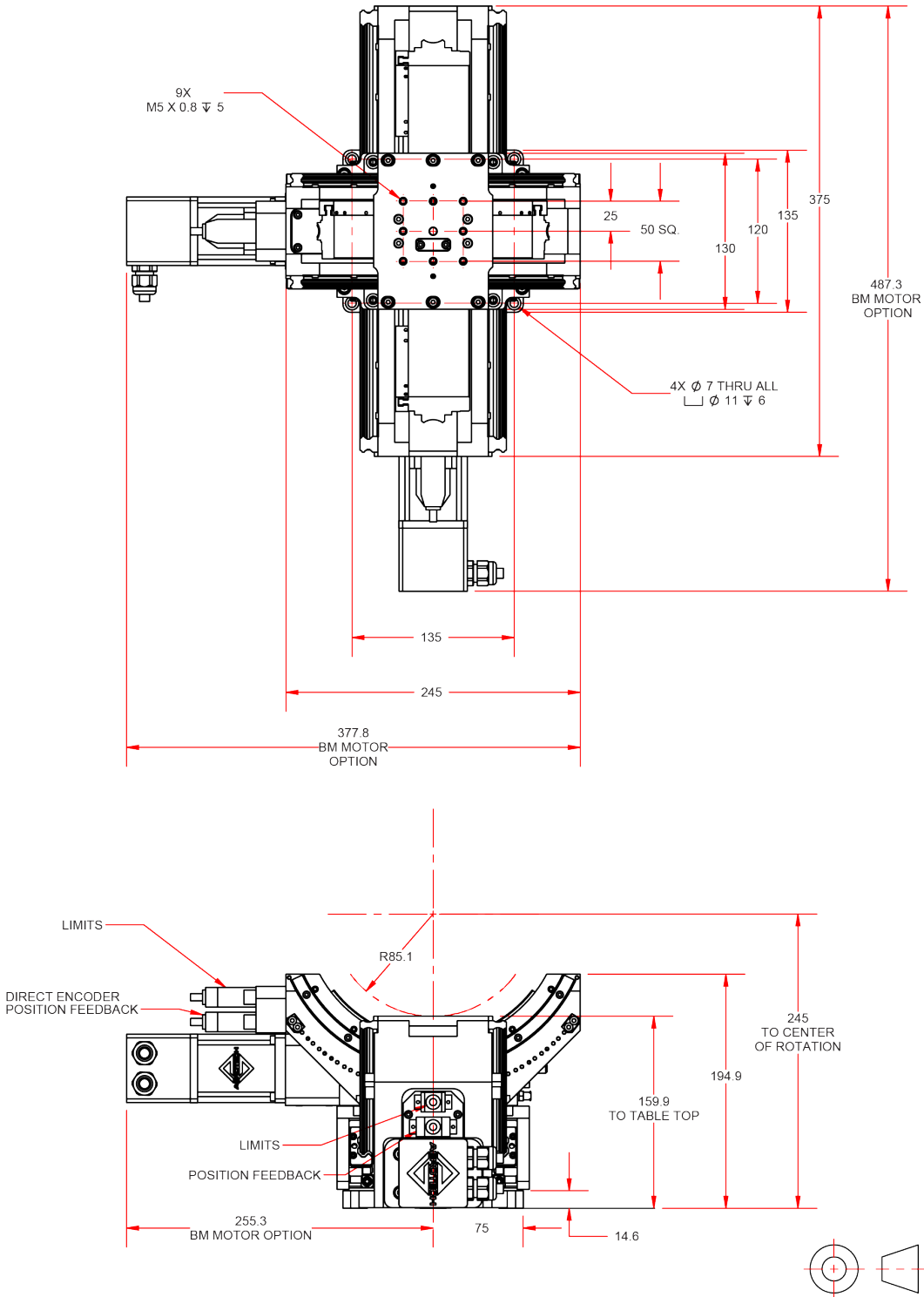


Figure 2-4: AGC160-AGC85 Stack Dimensions

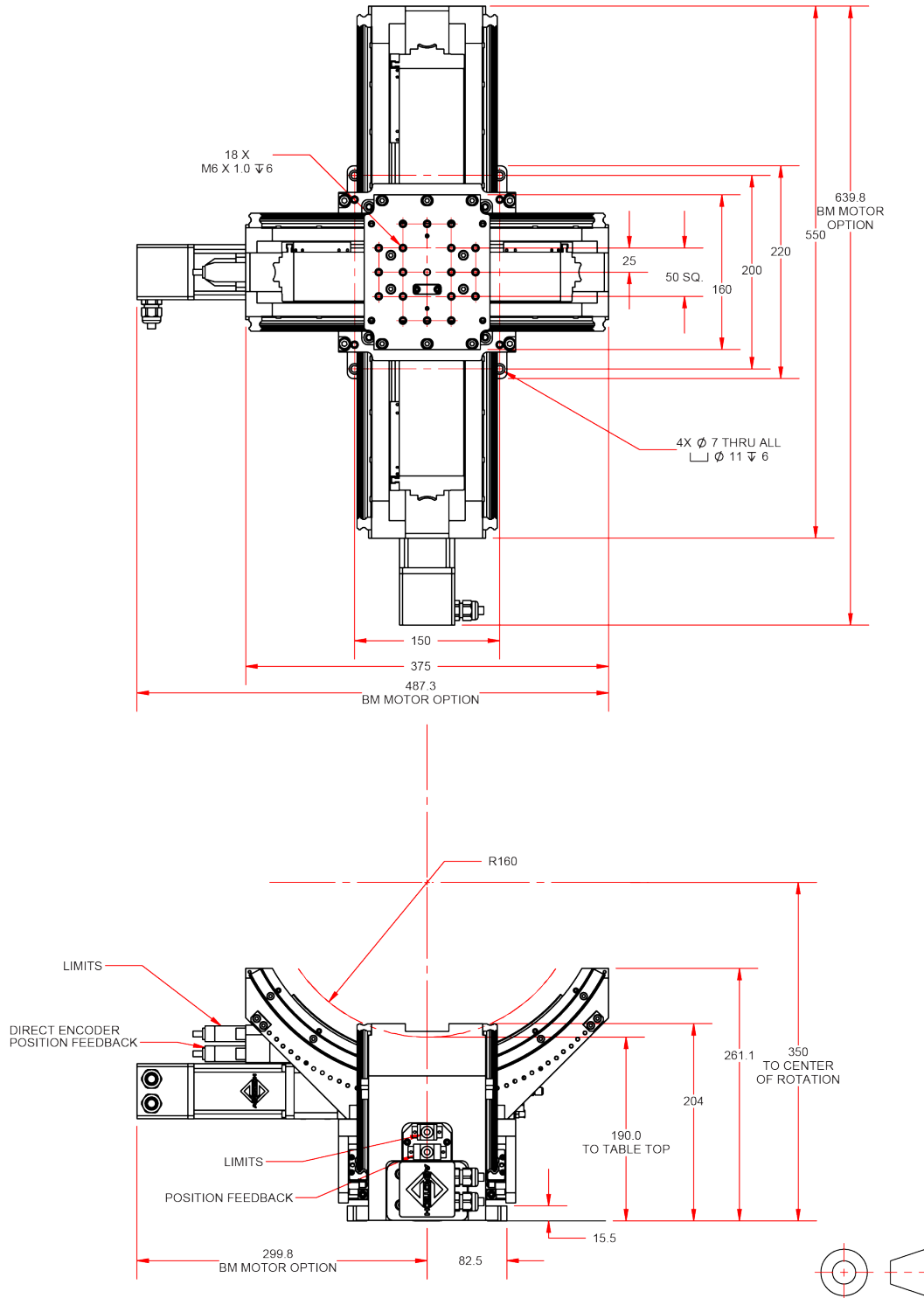


Figure 2-5: AGC245-AGC160 Stack Dimensions

2.3. Securing the Stage to the Mounting Surface



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

The mounting surface should be flat and have adequate stiffness to achieve the maximum performance from the AGC. When the AGC is mounted to a non-flat surface, the stage can be distorted while the mounting screws are tightened. This distortion will decrease the overall accuracy of the stage. 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: To maintain accuracy, the mounting surface must be flat to within 12 μm over the entire stage footprint.

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

AGC series stages have a fixed mounting pattern in the housing of the stage. The AGC is designed to use four M6 or 1/4" socket head cap screws to secure the AGC to the mounting surface.

If necessary, move the stage table to access the mounting holes along the edges of the stage. Torque the mounting screws to 8.0 N·m (5.9 ft·lb). Refer to [Section 2.2](#) for the dimensions associated with the mounting holes.



WARNING: Do not attempt to manually move the AGC if it is connected to a power source.

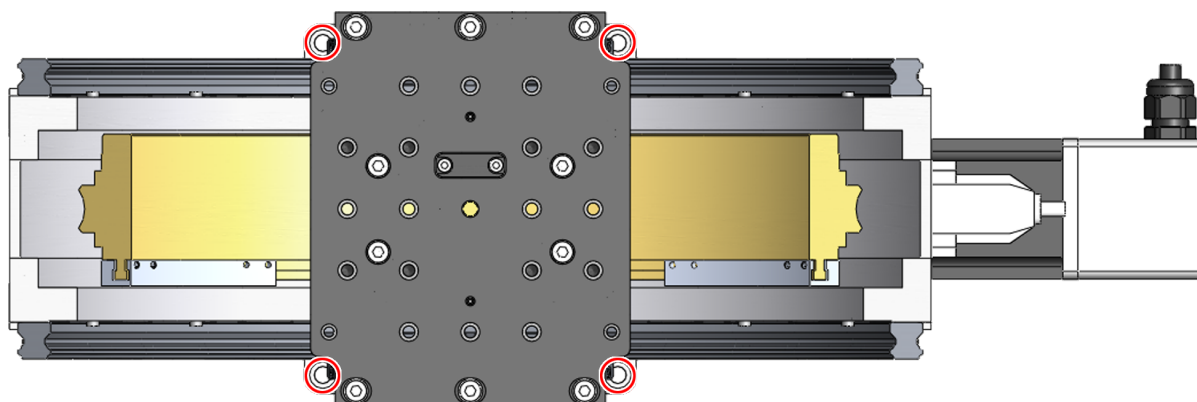


Figure 2-6: Mounting Hole Locations

2.4. Attaching the Payload to the Stage

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 [Electrical Specifications and Installation](#) and the documentation delivered with the stage.

NOTE: If your AGC 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 AGC 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 over the tabletop area.



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.

Chapter 3: Electrical Specifications and 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 AGC 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 AGC is part of a complete Aerotech motion control system, setup usually involves connecting the AGC 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.

If a motor option was purchased, electrical connections to the motor power and the motor encoder are made to the cables exiting the rear of the motor. The connection for the optical limits is made on the stage base directly above the motor. If the direct encoder option was purchased, the direct encoder connection is also made with an additional connection on the stage base above the motor. Refer to [Section 3.1](#) for the motor and encoder wiring and connector pin outputs.



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.



WARNING: Operator access to the base and tabletop must be restricted while connected to a power source. Failure to do so may cause electric shock.



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

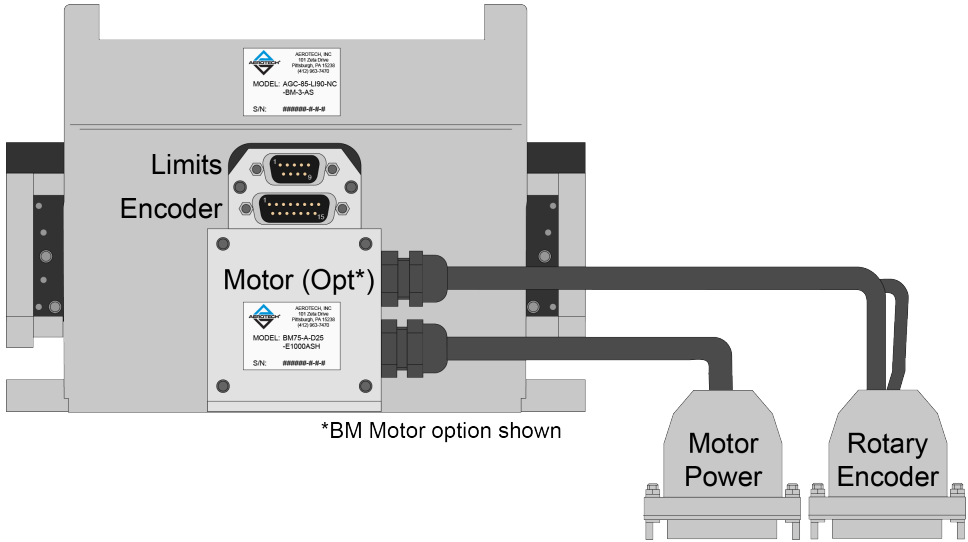


Figure 3-1: Connection Overview

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.

The protective ground connection of the AGC 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.



WARNING: Operator access to the base and tabletop must be restricted while connected to a power source. Failure to do so may cause 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: 4-Pin Motor Connector Pin Assignment [Optional BM Motor]

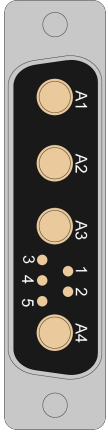
Pin	Description	Connector
Case	Shield Connection	
A1	Motor Phase A	
A2	Motor Phase B	
A3	Motor Phase C	
1	Reserved	
2	Reserved	
3	Reserved	
4	Reserved	
5	Reserved	
A4	Frame Ground (motor protective ground)	

Table 3-2: 4-Pin Motor Mating 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: 25-Pin Rotary Encoder Pinouts [for BM motors]

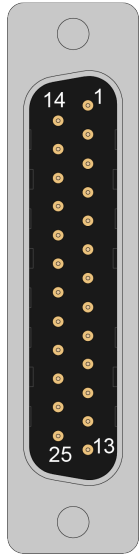
Pin	Description	Connector
Case	Shield Connection	
1	Reserved	
2	Reserved	
3	Encoder +5 V supply input	
4	Reserved	
5	Hall Effect sensor, phase B	
6	Marker-N	
7	Marker	
8	Reserved	
9	Reserved	
10	Hall Effect sensor, phase A	
11	Hall Effect sensor, phase C	
12	Reserved	
13	Brake - (with brake option only)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

Table 3-4: Feedback Connector Mating Connector

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

Table 3-5: 15-Pin Optional Encoder Connector Pinouts [-E1 and -E2]

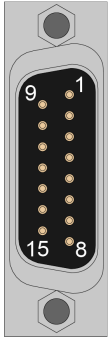
Pin	Description	Connector
Case	Shield Connection	
1	Sine	
2	Cosine	
3	Marker	
4	Encoder +5 V supply input	
5	Reserved	
6	Reserved	
7	Reserved	
8	Reserved	
9	Sine-N	
10	Cosine-N	
11	Marker-N	
12	+5 V Common ground	
13	Reserved	
14	Reserved	
15	Reserved	

Table 3-6: 15-Pin Optional Encoder Mating Connector

Mating Connector	Aerotech P/N	3rd Party P/N
Backshell	ECK01022	Amphenol 17E-1725-2
Connector	ECK00326	Amphenol DA15S064TLF

Table 3-7: 9-Pin Limits Connector Pinouts

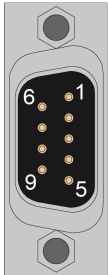
Pin	Description	Limits Connector
1	+5 V power supply limit input	
2	+5V Common ground	
3	Signal indicating maximum travel limit produced by positive/CW stage direction	
4	Reserved	
5	Signal indicating maximum travel limit produced by negative/CCW stage direction	
6	Shield	
7	Reserved	
8	Reserved	
9	Reserved	

Table 3-8: Limits Connector Mating Connector

Mating Connector	Aerotech P/N	3rd Party P/N
Backshell	ECK01021	Amphenol #17E-1724-2
Connector	ECK00340	FCI #DE09S064TLF

3.2. Motor and Feedback Wiring

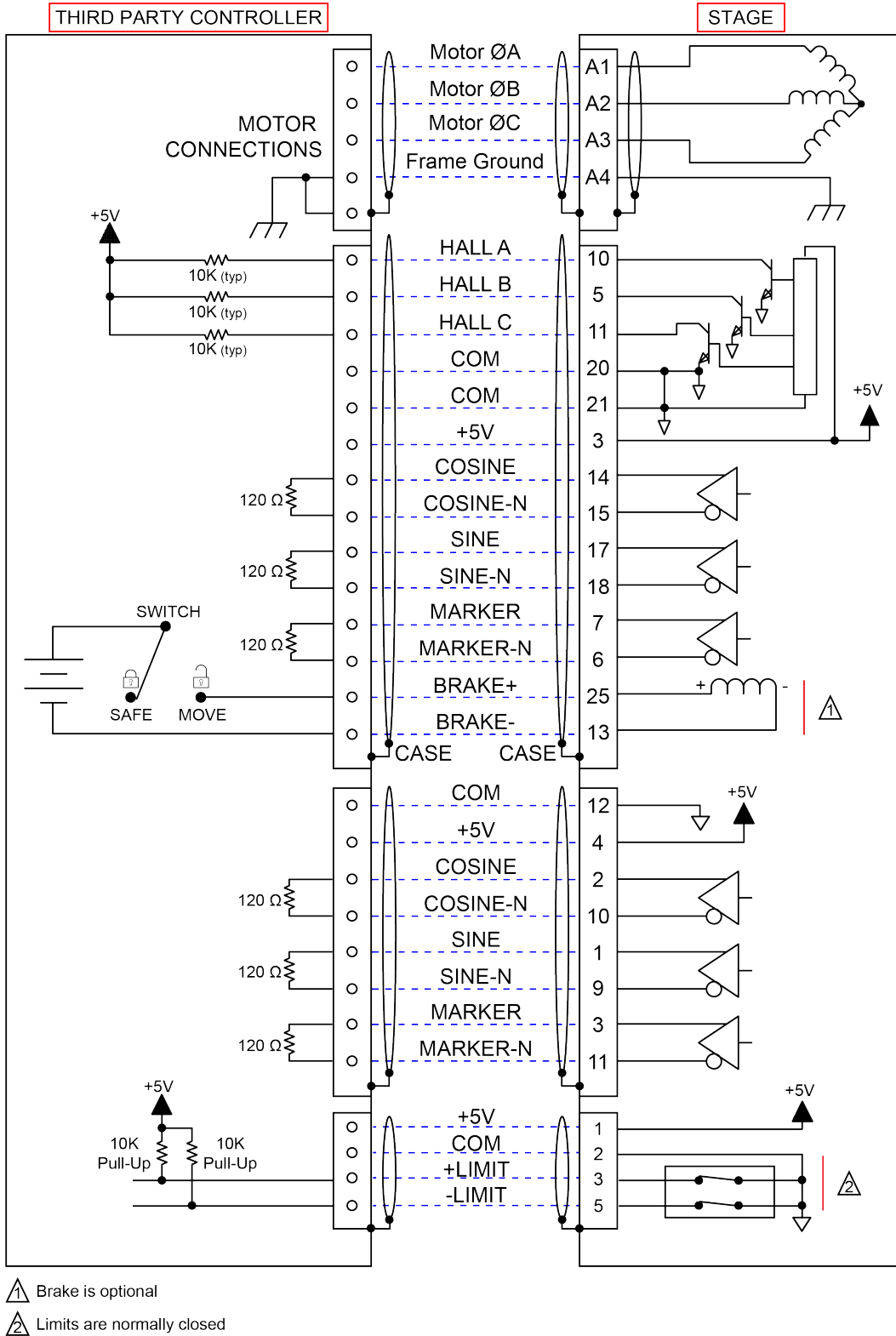


Figure 3-2: Motor and Feedback Wiring

3.3. Motor and Feedback Specifications

Table 3-9: Feedback Specifications

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

Encoder Specifications	
Supply Voltage	5 V \pm 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 0.5 V _{pk-pk} relative to ground.)
	Digital Output (Incremental Encoder): RS422/485 compatible

Limit Switch Specifications	
Supply Voltage	5 V
Supply Current	25 mA
Output Type	Open Collector
Output Voltage	5 V
Output Current	10 mA (sinking)
Output Polarity	Normally Closed (NC) <ul style="list-style-type: none"> • 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)
Note: If the AGC stage 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 Typical (Current required to release the brake and allow motion)

Table 3-10: BM75 and BM130 Motor Specifications

		BM75	BM130
Performance Specifications (1,2)			
Stall Torque, Continuous (3)	N·m (oz·in)	0.51 (72.0)	1.02 (144.0)
Peak Torque(4)	N·m (oz·in)	1.30 (181.0)	2.50 (361.0)
Rated Power Output, Continuous	W	192	333
Electrical Specifications (2)			
BEMF Constant (Line-Line, Max)	V_{pk}/k_{rpm}	9.0	19.0
Continuous Current, Stall (3)	$A_{pk} (A_{rms})$	9.0 (6.4)	6.9 (4.9)
Peak Current, Stall (4)	$A_{pk} (A_{rms})$	22.5 (15.9)	17.3 (12.2)
Torque Constant (5)	$N·m/A_{pk} (oz·in/A_{pk})$	0.060 (8.00)	0.150 (20.90)
	$N·m/A_{rms} (oz·in/A_{rms})$	0.080 (11.40)	0.210 (29.60)
Motor Constant (3,5)	$N·m/\sqrt{W} (oz·in/\sqrt{W})$	0.055 (7.84)	0.101 (14.30)
Resistance, 25°C (Line-Line)	Ω	1.00	2.00
Inductance (Line-Line)	mH	1.42	3.52
Maximum Bus Voltage	V_{DC}	340	340
Thermal Resistance	$^{\circ}C/W$	1.18	1.04
Number of Poles	--	8	8
<p>1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature</p> <p>2. All performance and electrical specifications $\pm 10\%$</p> <p>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</p> <p>4. Peak torque assumes correct rms current; consult Aerotech</p> <p>5. Torque constant and motor constant specified at stall</p> <p>6. Maximum winding temperature is 130 °C</p> <p>7. Ambient operating temperature range 0 °C - 25 °C; consult Aerotech for performance in elevated ambient temperatures</p> <p>8. All Aerotech amplifiers are rated A_{pk}; use torque constant in $N·m/A_{pk}$ when sizing</p>			

Table 3-11: BM200 Motor Specifications

		BM200
Performance Specifications (1,2)		
Stall Torque, Continuous ⁽³⁾	N·m (oz·in)	1.45 (205.0)
Peak Torque ⁽⁴⁾	N·m (oz·in)	3.60 (512.0)
Rated Power Output, Continuous	W	455
Electrical Specifications (2)		
BEMF Constant (Line-Line, Max)	V_{pk}/k_{rpm}	18.0
Continuous Current, Stall ⁽³⁾	$A_{pk} (A_{rms})$	10.3 (7.3)
Peak Current, Stall ⁽⁴⁾	$A_{pk} (A_{rms})$	25.8 (18.2)
Torque Constant ⁽⁵⁾	$N·m/A_{pk}$ (oz·in/ A_{pk})	0.140 (19.90)
	$N·m/A_{rms}$ (oz·in/ A_{rms})	0.200 (28.10)
Motor Constant ^(3,5)	$N·m/\sqrt{W}$ (oz·in/ \sqrt{W})	0.131 (18.54)
Resistance, 25°C (Line-Line)	Ω	1.10
Inductance (Line-Line)	mH	2.18
Maximum Bus Voltage	V_{DC}	340
Thermal Resistance	$^{\circ}C/W$	0.81
Number of Poles	--	8
1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature 2. All performance and electrical specifications $\pm 10\%$ 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		

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 AGC stages.

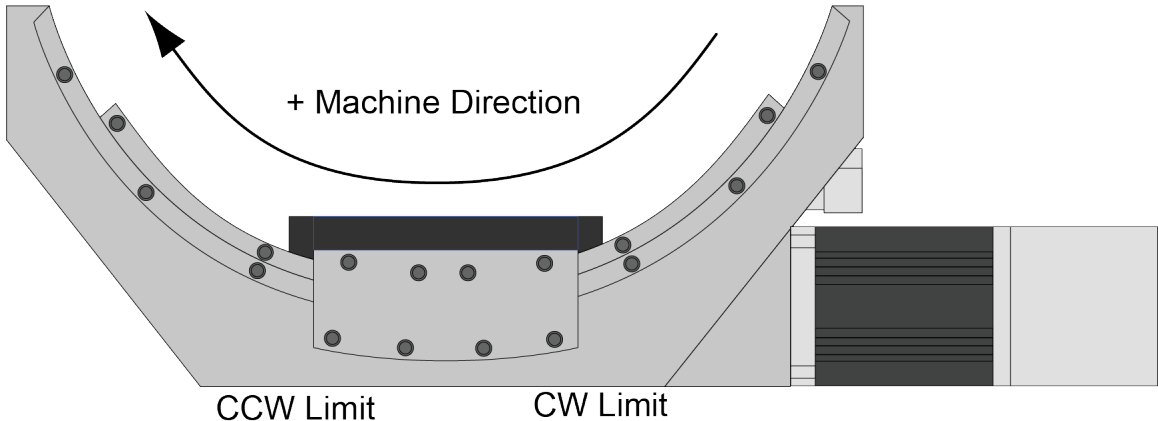


Figure 3-3: Machine Direction

3.5. Motor and Feedback Phasing

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

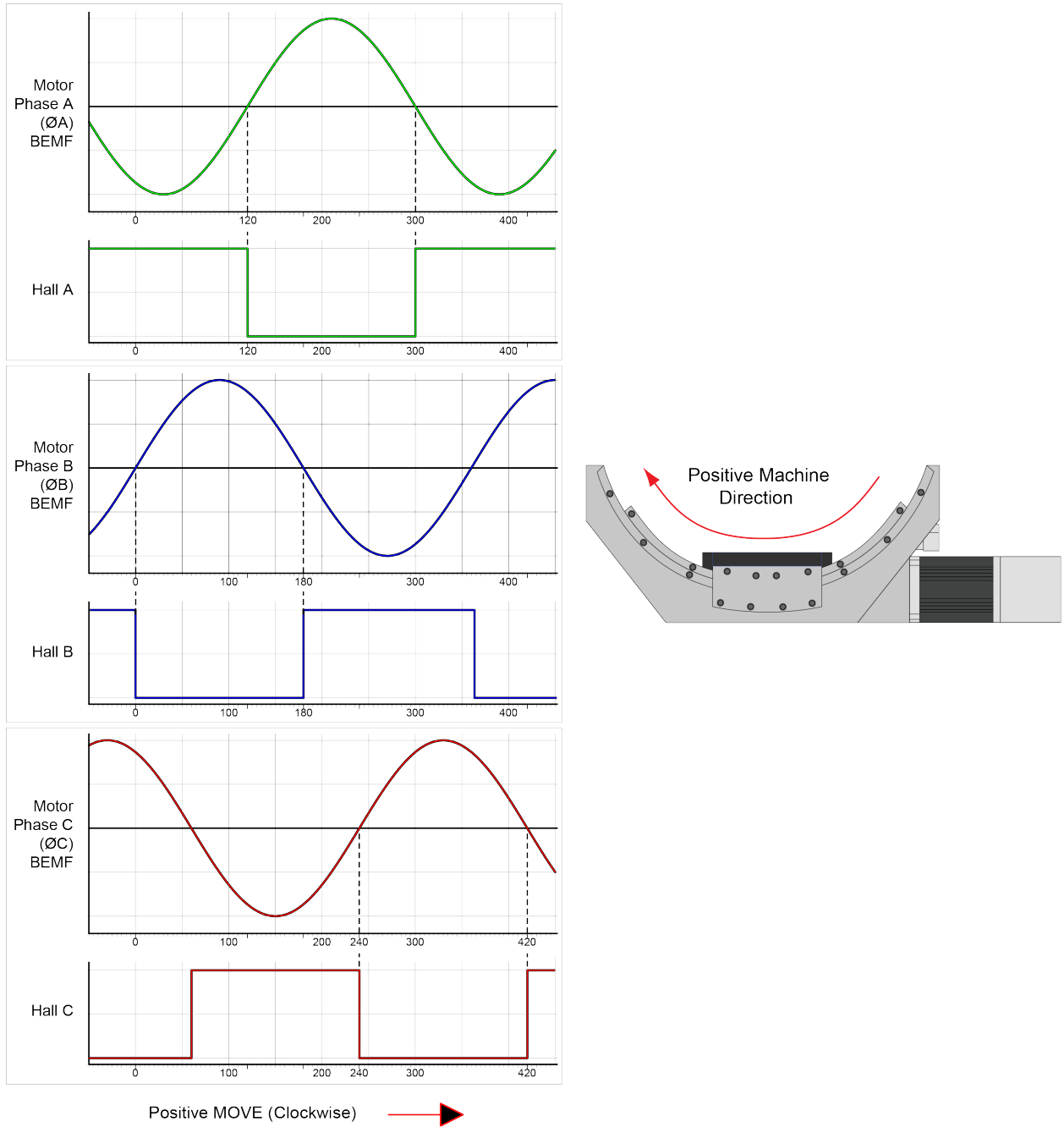


Figure 3-4: Hall Phasing

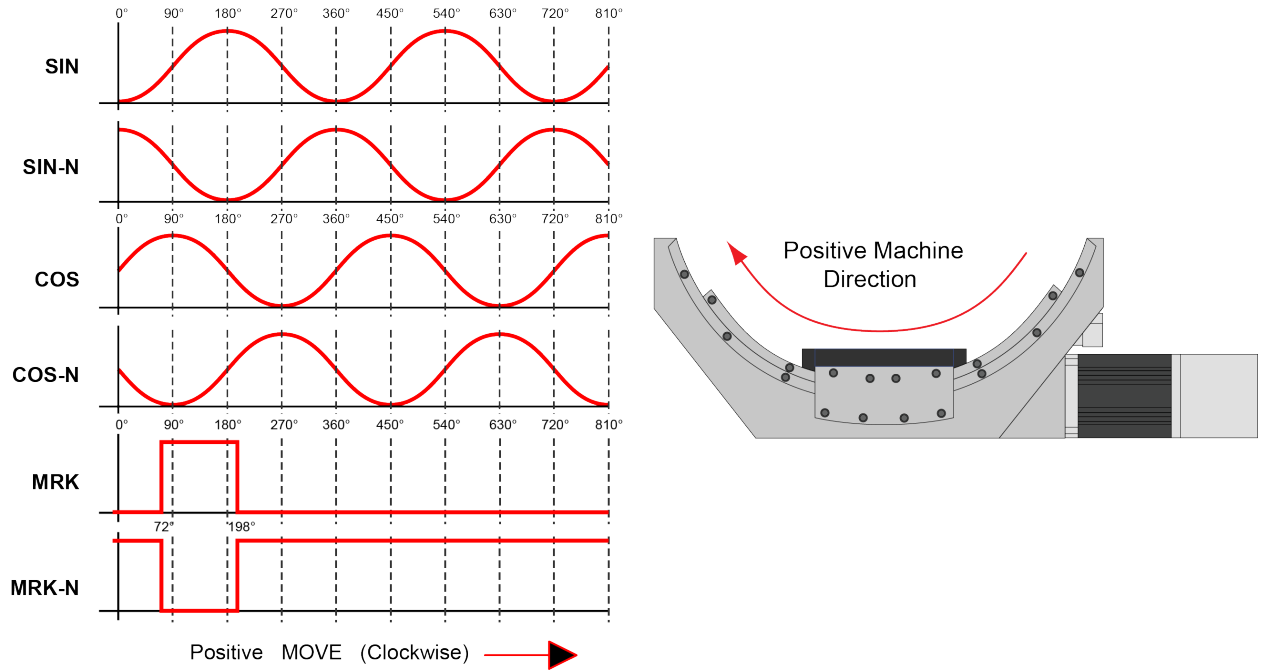


Figure 3-5: Analog Encoder Phasing Reference Diagram

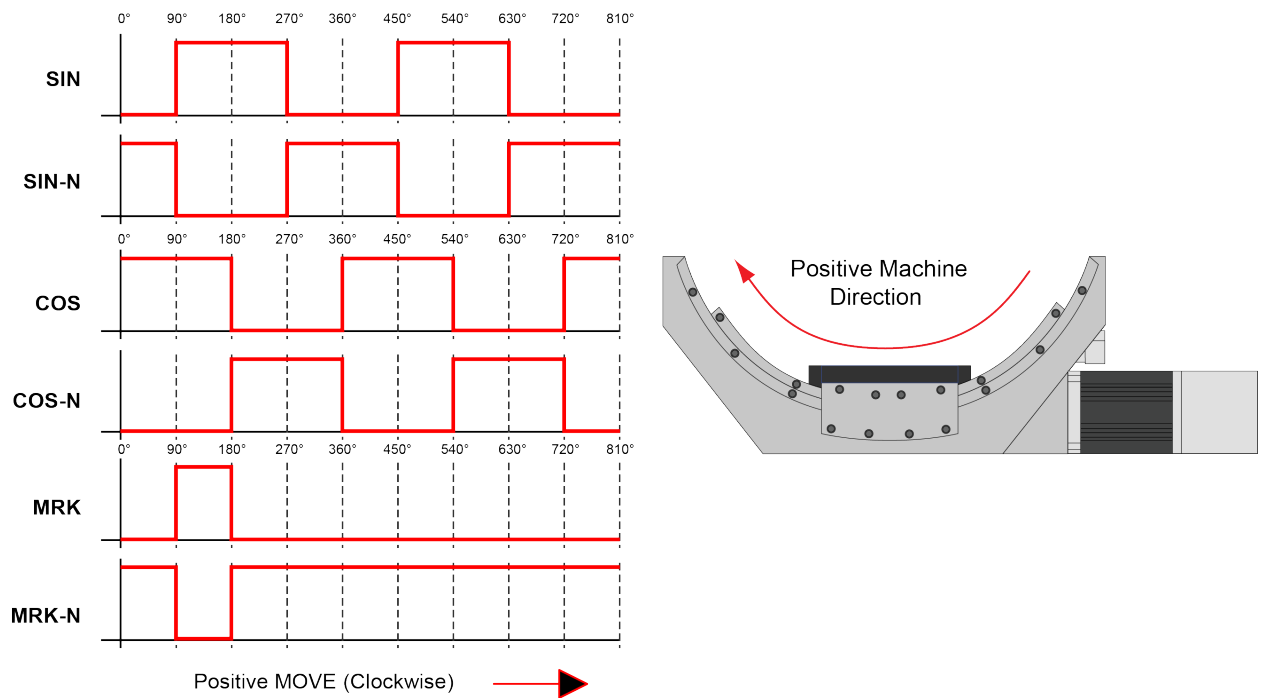


Figure 3-6: Standard Encoder Phasing Reference Diagram

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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.



CAUTION: The stage must be powered during cleaning and relubrication.



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

NOTE: As a general precaution, wear gloves when working with grease.

4.1. Service and Inspection Schedule

Inspect the AGC 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.

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 AGC and any components and cables as needed.
- Repair any damage before operating the AGC.
- Inspect and perform an operational check on all safeguards and protective devices.

The work environment of the AGC will determine the cleaning and lubrication schedule. In general, stages operating in a clean environment should be cleaned and lubricated less frequently than stages operating under conditions involving excessive debris.

Environment/Conditions	Maintenance Schedule
Clean	3 Months (or 100,000 cycles)
Excessive Debris	6 Weeks

4.2. Cleaning and Lubrication



CAUTION: The stage must be powered during cleaning and relubrication.



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

NOTE: As a general precaution, wear gloves when working with grease.

Consult Aerotech for information about cleaning and lubricating an AGC operating in a vacuum environment.

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 and the gear. The servo motor requires no lubrication.

4.2.1. Cleaning

Before using a cleaning solvent on any part of the AGC, blow away small particles and dust with nitrogen or, less preferably, clean, dry, compressed air.

Any external metal surface of the AGC can be cleaned with isopropyl alcohol on a lint-free cloth.

If the grease on the bearings or on the gear has accumulated particles or debris, wipe with a clean, lint-free cloth to remove. To access the gear teeth, slowly rotate the stage through travel until a section is exposed. Once all motion has stopped, the components may be cleaned by hand. Do not attempt to clean any part of the stage while it is moving, and do not remove the hardstops for any reason to access a larger segment of the gear. Damage to the stage resulting from hardstop removal will not be covered under warranty.

4.2.2. Lubrication

For the worm gear drive mechanism, use Klubersynth BEM-44-461-US grease.

For the bearings, use Kluberplex BEM 34-132 grease. Only use the specified grease as other greases may be incompatible.

To lubricate the gear, rotate the stage through travel until a section of the gear is exposed. After stage motion has completely stopped, brush grease onto the exposed teeth of the gear. Rotate the stage to the other end of travel and brush grease onto the gear teeth. To lubricate the bearings, brush a thin layer of grease onto the bearing rails. Rotate the stage through travel several times to distribute the grease on the bearings, the worm, and the worm gear. Do not attempt to relubricate any part of the stage while it is in motion.

If stage travel doesn't expose the gear to allow brush-on access, the AGC stage includes a dedicated grease fitting. [Figure 4-1](#) shows the standard Luer-Lock connector located below the drive shaft. This fitting accepts standard medical syringes to allow accurate, metered dispensing of grease.

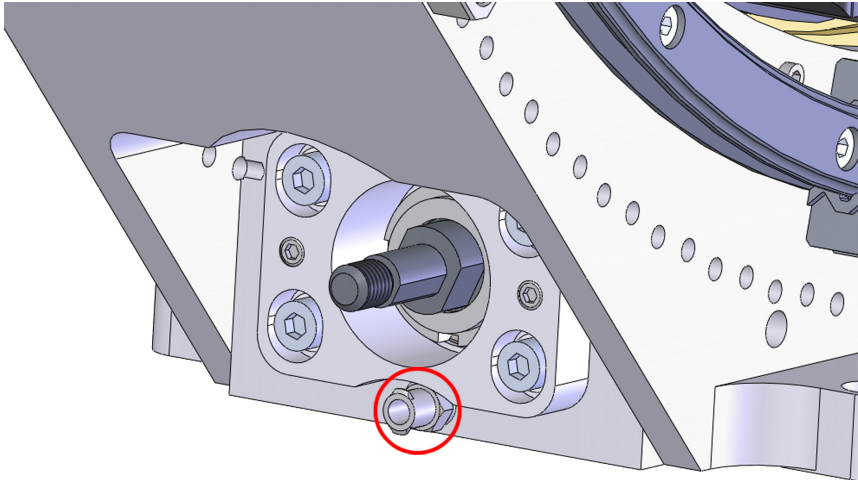


Figure 4-1: Grease Fitting Below Worm Shaft

Prior to relubricating the stage, make sure that the fitting and surrounding surfaces are clean. While the stage rotates slowly through travel (<5 deg/sec), slowly inject 1 cc of lubricant into the stage. Run the stage across travel to evenly dispense the lubricant and wipe clean any excess.

Certain applications may obstruct direct inline access to the fitting, such as mounting the stage on a large base plate. If necessary, the grease fitting may be removed in order to use the provided #10-32 UNF thread with a custom adapter.

Figure 4-2 shows the effect of relubrication on the current draw of a typical worm-gear driven stage. With the added lubricant, the resulting current ripple is much smoother, leading to improved mechanical performance and product lifetime.

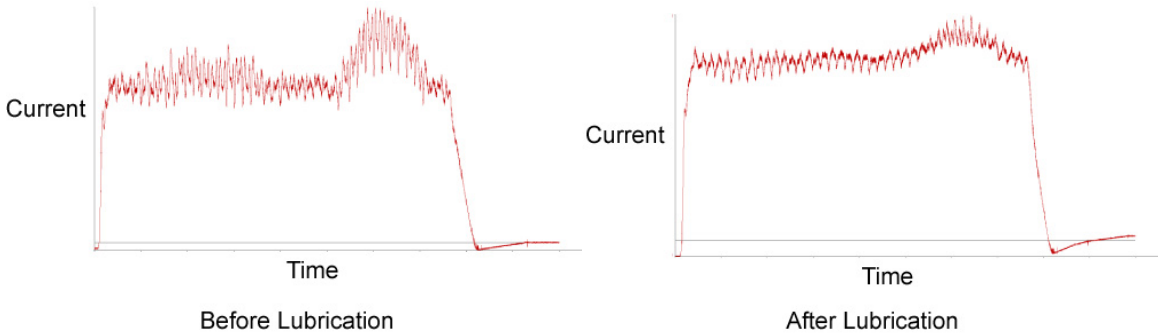


Figure 4-2: View of the Current Draw Before and After Lubrication

4.3. Gear Preload

Over time, the worm gear can wear, causing increased backlash and repeatability error. Load, environment, duty cycle, and lubrication maintenance all have an effect on gear wear. Aerotech customer service can reload the gears, but this is considered non-warranty repair. See [Warranty and Field Service](#) for the conditions of non-warranty repair.

4.4. Troubleshooting

This section provides some information regarding typical stage related problems.

Table 4-1: Troubleshooting

Symptom	Possible Cause and Solution
Stage will not move.	Brake not released (If equipped with brake). See stage documentation. In Limit condition. Check limits. Also refer to controller documentation for polarity and compatibility requirements (Example: voltage requirements). See Section 3.2 . Controller trap or fault. See controller documentation.
Stage moves uncontrollably	Encoder (sine and cosine) signals connections. See Section 3.1 . and Controller documentation. Motor Connections. See Section 3.1 . and Controller documentation.
Stage oscillates or squeals	Gains misadjusted. See Controller documentation. Encoder signals. See Controller documentation.

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Appendix A: Warranty and Field Service

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

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

Return Products Procedure

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

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

Returned Product Warranty Determination

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

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

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

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

Rush Service

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

On-site Warranty Repair

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

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

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

On-site Non-Warranty Repair

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

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

Service Locations

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

USA, CANADA, MEXICO	CHINA	GERMANY
Aerotech, Inc. Global Headquarters Phone: +1-412-967-6440 Fax: +1-412-967-6870	Aerotech China Full-Service Subsidiary Phone: +86 (21) 5508 6731	Aerotech Germany Full-Service Subsidiary Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720
TAIWAN	UNITED KINGDOM	
Aerotech Taiwan Full-Service Subsidiary Phone: +886 (0)2 8751 6690	Aerotech United Kingdom Full-Service Subsidiary Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649	

Have your customer order number ready before calling.

Appendix B: Revision History

Revision	General Information
1.03.00	<ul style="list-style-type: none"> • Updated safety information and warnings • Updated Model Options • Updated dimension drawings: Section 2.2. • Added stack dimension drawings: Section 2.2. • Updated Declaration of Incorporation • Updated Basic Specifications • Updated Motor Specifications • Added Electrical Specifications • Updated Limit Switch section: Section 3.2. • Updated Standard Motor Wiring section: Section 3.1. • Updated Cleaning and Lubrication: Section 4.2. • Added Troubleshooting section: Section 4.4.
1.01.00	<ul style="list-style-type: none"> • Added Declaration of Incorporation • Added Environmental Specifications • Safety information and warnings added • Motor specifications tables added • Note about motor wire current and voltage requirements added: Section 3.1.
1.00.00	New manual

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