AEROTECH

AMG-GR Series Gear-Driven Gimbals

HARDWARE MANUAL

Revision 2.00

GLOBAL TECHNICAL SUPPORT

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EU Declaration of Incorporation

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

herewith declares that the product:

AMG-GR gimbal

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 Directive, Restricted Substances (RoHS 3)

Authorized Representative


/ Simon Smith, European Director
Aerotech Ltd
The Old Brick Kiln, Ramsdell, Tadley
Hampshire RG26 5PR
UK

Engineer Verifying Compliance


/ Alex Weibel
Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2811
USA

Date 12/20/2022

CE

UKCA Declaration of Incorporation

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

herewith declares that the product:

AMG-GR gimbal

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

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

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

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 furthermore declares that it is not allowed to put the product 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 Supply of Machinery (Safety) Regulations 2008 UK Legislation and with national implementing legislation, for example, as a whole, including the equipment referred to in this Declaration.

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

Authorized Representative / Simon Smith, European Director
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The Old Brick Kiln, Ramsdell, Tadley
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UK

Engineer Verifying Compliance / Alex Weibel
Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238-2811
USA

Date 12/20/2022

Safety Procedures and Warnings

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

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

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

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

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

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


Shock/Electrocution Hazard


Pinch, Shear, or Crush Hazard


General/Conditional Awareness


Rotational Machinery Hazard


Hot Surface Hazard


Pinch/Entanglement Hazard


Magnetic Field Hazard


Trip Hazard


Heavy, Bulky Lifting Hazard


Appropriate Equipment Required


Pressure/Explosive Atmosphere Hazard


Electrostatic Discharge Hazard

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


General tip


Read the manual/section


Wear personal protective equipment (PPE): Safety Glasses


If applicable, do not lift unassisted


Wear personal protective equipment (PPE): Gloves


Wear personal protective equipment (PPE): Hearing Protection

Installation and Operation

To decrease the risk of damage to the equipment, you must obey the precautions that follow.

DANGER: General Hazard Warning!

This product can produce high forces and move at velocities that could cause injury. The user is responsible for its safe operation. The following general equation is provided to assist with risk assessments in regards to contact and pinch points:

$$Pressure_{Max}\left[\frac{N}{mm^2}\right] = \frac{Force_{Peak}[N]}{Area_{Contact}[mm^2]}$$

WARNING: General Hazard Warning!

- Only trained operators should operate this equipment.
- All service and maintenance must be done by approved personnel.
- Use this product only in environments and operating conditions that are approved in this manual.
- Never install or operate equipment that appears to be damaged.
- Make sure that the product is securely mounted before you operate it.
- Use care when you move the AMG-GR or you could negatively affect the performance of it.

WARNING: **Trip Hazard!**

Route, house, and secure all cables, duct work, air, or water lines. Failure to do so could introduce trip hazards around the system that could result in physical injury or could damage the equipment.

Electrical Warnings

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

DANGER: Electrical Shock Hazard!

- Stage motor phase voltage levels could be hazardous live.
- Personnel are protected from hazardous voltages unless electrical interconnections, protective bonding (safety ground), or motor/stage enclosures are compromised.
- Do not connect or disconnect stage/motor interconnections while connected to a live electrical power source.
- Before you set up or do maintenance, disconnect electrical power.
- It is the responsibility of the End User/System Integrator to make sure that stages are properly connected and grounded per Engineering Standards and applicable safety requirements.
- It is the responsibility of the End User/System Integrator to configure the system drive or controller within the Aerotech motor/stage electrical and mechanical specifications.

Motor-Related Warnings

Aerotech motors are capable of producing high forces and velocities. Obey all warnings and all applicable codes and standards when you use or operate a stage or system that incorporates Aerotech motors.

DANGER: Mechanical Hazard!

Personnel must be made aware of the mechanical hazards during set up or when you do service to the stage.

- Unintentional manual movement into the stage "end-of-travel" stops, could damage the stage or undo precision alignments.
- Stage movement could create pinch points, entanglement hazards, or rotational mechanical hazards.

DANGER: Hot Surface Hazard!

- The stage/motor frame temperature could exceed 70°C in some applications.
- Do not touch the stage/motor frame while it is in operation.
- Wait until the stage/motor has cooled before you touch it.

DANGER: **Risk of Explosive Atmosphere!**

- Standard Aerotech stage/motors are not rated for applications with explosive atmospheres such as airborne dust or combustible vapors.
- Do not operate stage/motors outside of Aerotech environmental specifications.

DANGER: Magnetic Field Hazard!

Aerotech stage/motors contain magnets which can present a Magnetic Field Hazard.

- Do not disassemble a stage motor under any circumstances.
- Strong magnetic fields could interfere with external/internal medical devices.
- Strong magnetic fields could present mechanical hazards such as pinch points.

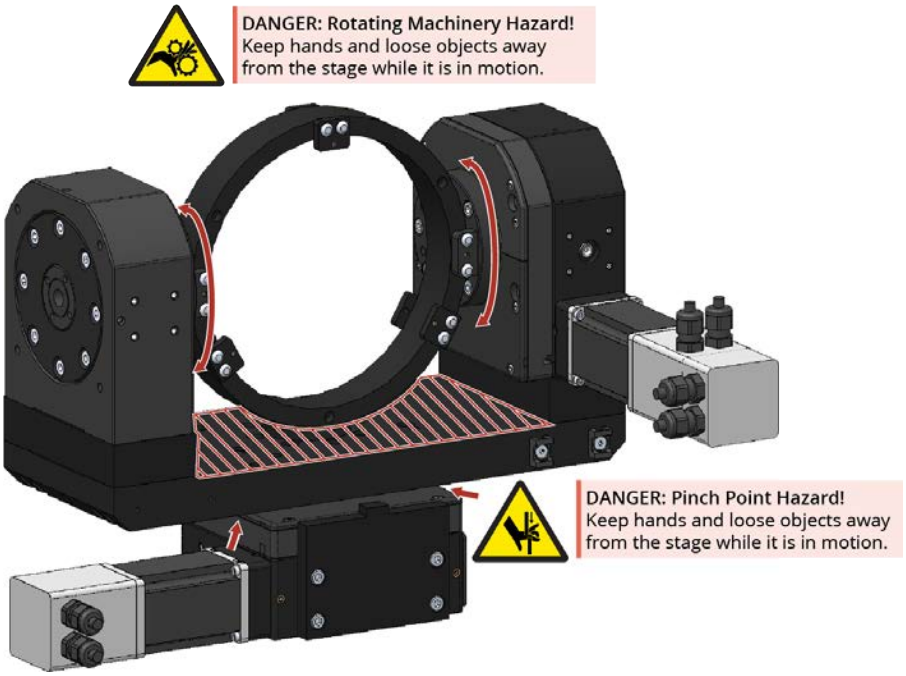
Pinch Points

A pinch point is a mechanical hazard that can occur when there are exposed parts of the stage or system that can move. For example, the travel of a stage tabletop could expose the user to a pinch point between the tabletop and the stage housing. The images that follow will show you typical external and internal pinch point locations.

DANGER: Mechanical Hazard!

- System travel can cause crush, shear, or pinch injuries.
- Only trained operators should operate this equipment.
- Do not put yourself in the travel path of machinery.
- Restrict access to all motor and stage parts
  - when the system moves under power (during normal operation, for example).
  - when the system is moved manually (during the installation process or when you do maintenance, for example).
- Motors are capable of very high speeds and acceleration rates.

Figure 1: Typical Pinch Point Locations



Handling and Storage

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

- Be careful when you move or transport the gimbal.
- Retain the shipping materials for future use.
- Transport or store the gimbal in its protective packaging.

WARNING: Electrostatic Discharge (ESD) Sensitive Components!

Wear an ESD wrist strap when you handle, install, or do service to the system assembly.

You could damage the power supply or drives if you fail to observe the correct ESD practices.

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

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

The documentation for the gimbal is on the included installation device. The documents include manuals, interconnection drawings, and other documentation pertaining to the system. Save this information for future reference.

Each stage has a label listing the system part number and serial number. These numbers contain information necessary for maintenance or system hardware and software updates. Locate this label and record the information for later reference.

Unpacking and Handling

It is the responsibility of the customer to safely and carefully lift and move the gimbal.

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

DANGER: **Lifting Hazard!** Use care when you move the AMG-GR or you could negatively affect the performance of it.

- Use the correct lifting techniques, mechanical assistance, or additional help to lift or move this product.
- Do not use the cables or the connectors to lift or move this product.
- Make sure that all moving parts are secure before you move the gimbal. Unsecured moving parts could shift and cause injury or damage to the equipment.
- If the gimbal is heavy, a single person lift could cause injury. Use assistance when you lift or move it.
  - Refer to Section 2.1. Dimensions for dimensions

Carefully remove the stage from its protective shipping container.

- Lift this product only by the base.
- For multi-axis assemblies, always lift the system by the lower axis.
- Use a cart, dolly, or similar device to move the stage to a new location.

Gently set the stage on a smooth, flat, and clean surface. Use compressed nitrogen or clean, dry, oil-free air to remove any dust or debris that has collected during shipping.

Before you operate the stage, let it stabilize at room temperature for at least 12 hours. This will ensure that all of the alignments, preloads, and tolerances are the same as they were when they were tested at Aerotech.

Each stage has a label listing the system part number and serial number. These numbers contain information necessary for maintenance or system hardware and software updates. Locate this label and record the information for later reference.

Shipping Brackets

Shipping brackets (typically red, anodized aluminum) might have been installed to secure the system prior to shipment. The shipping brackets, if installed, will need to be removed prior to machine start up.

Figure 1-1: Shipping Brackets

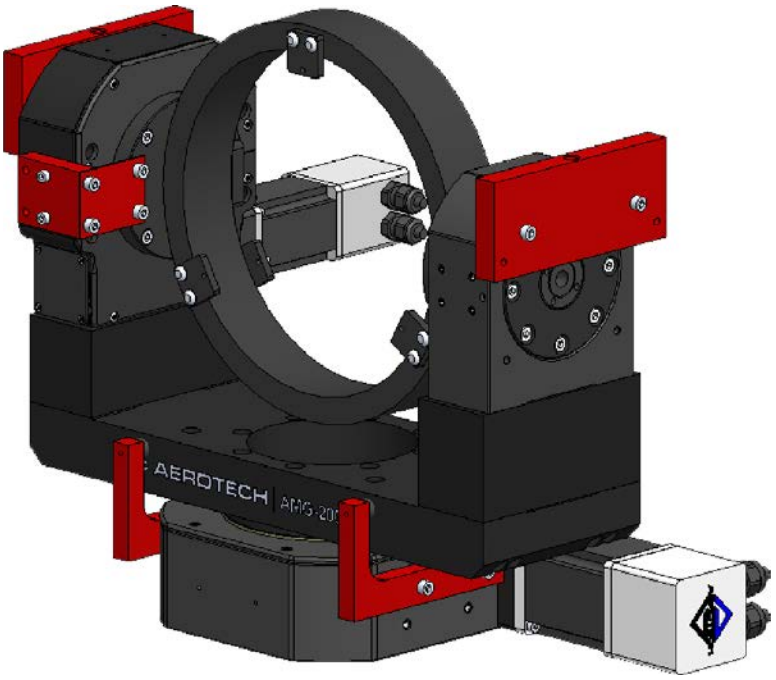
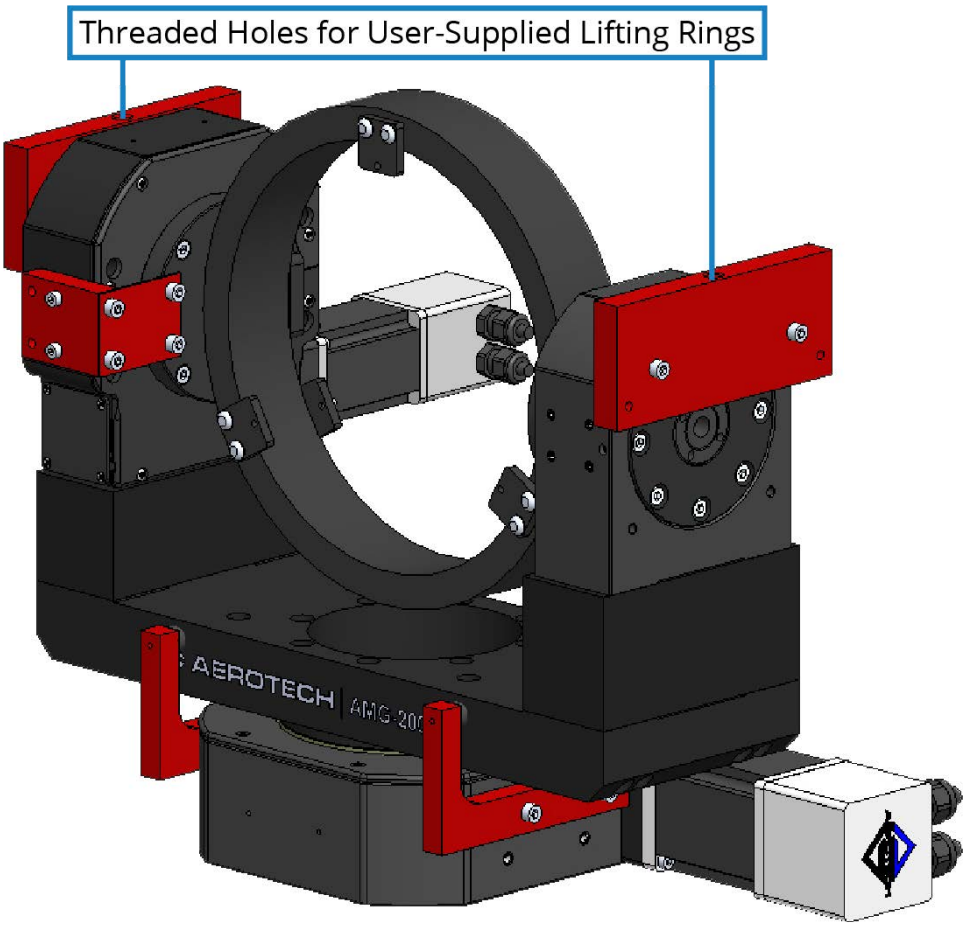


Figure 1-2: Lifting Features



Storage

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

Refer to Section 1.1. Environmental Specifications

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Chapter 1: Overview

Table 1-1: Model Numbers and Ordering Options

AMG-GR Gear-Driven Gimbal		
AMG100GR	100 mm diameter clear aperture	
AMG150GR	150 mm diameter clear aperture	
AMG200GR	200 mm diameter clear aperture	
AMG300GR	300 mm diameter clear aperture	
Cell (Required)		
-CL0	No cell	
-CL1	Front surface reflecting cell	
-CL2	Centered cell	
Direct Rotary Feedback (Optional)		
-E1	Incremental encoders,1 Vpp, one per axis	
-E2	Incremental encoders, digital TTL output, x5 multiplication, one per axis	
-E3	Incremental encoders, digital TTL output, x50 multiplication, one per axis	
Azimuth [AZ] Travel (Required)		
-TR180	Limited travel, ±90 degrees	
-TRCNT	Continuous travel	
Azimuth Motor (Required)		
-M0	No motor	
-M1	AMG100GR / 150GR	BMS35 brushless servomotor with 2000-line TTL encoder
	AMG200GR / 300GR	BMS60 brushless servomotor with 2500-line TTL encoder
-M2	AMG100GR / 150GR	BMS35 brushless servomotor with 2000-line TTL encoder and brake
	AMG200GR / 300GR	BMS60 brushless servomotor with 2500-line TTL encoder and brake
-M3	AMG100GR / 150GR	BMS35 brushless servomotor with 2000-line TTL encoder
	AMG200GR / 300GR	BMS60 brushless servomotor with 1000-line 1 Vpp encoder
-M4	AMG100GR / 150GR	BMS35 brushless servomotor with 2000-line TTL encoder and brake
	AMG200GR / 300GR	BMS60 brushless servomotor with 1000-line 1 Vpp encoder and brake
-M5	AMG100GR / 150GR	BM22 brushless servomotor with 2000-line TTL encoder
	AMG200GR / 300GR	BM75 brushless servomotor with 2500-line TTL encoder
-M6	AMG100GR / 150GR	BM22 brushless servomotor with 2000-line TTL encoder and brake
	AMG200GR / 300GR	BM75 brushless servomotor with 2500-line TTL encoder and brake
-M7	AMG100GR / 150GR	SM35 stepper motor
	AMG200GR / 300GR	BM75 brushless servomotor with 1000-line 1 Vpp encoder
-M8	AMG200GR / 300GR	BM75 brushless servomotor with 1000-line 1 Vpp encoder and brake
-M9	AMG200GR / 300GR	SM60 Stepper Motor

Elevation [EL] Travel (Required)		
-TR090	Limited travel, ± 45 degrees	
-TR315	Limited travel, ± 157.5 degrees	
-TRCNT	Continuous travel	
Elevation Motor (Required)		
-M0	No motor	
-M1	AMG100GR / 150GR / 200GR	BMS35 brushless servomotor with 2000-line TTL encoder
	AMG300GR	BMS60 brushless servomotor with 2500-line TTL encoder
-M2	AMG100GR / 150G / 200GR	BMS35 brushless servomotor with 2000-line TTL encoder and brake
	AMG300GR	BMS60 brushless servomotor with 2500-line TTL encoder and brake
-M3	AMG100GR / 150GR / 200GR	BMS35 brushless servomotor with 2000-line TTL encoder
	AMG300GR	BMS60 brushless servomotor with 1000-line 1 Vpp encoder
-M4	AMG100GR / 150GR / 200GR	BMS35 brushless servomotor with 2000-line TTL encoder and brake
	AMG300GR	BMS60 brushless servomotor with 1000-line 1 Vpp encoder and brake
-M5	AMG100GR / 150GR / 200GR	BM22 brushless servomotor with 2000-line TTL encoder
	AMG300GR	BM75 brushless servomotor with 2500-line TTL encoder
-M6	AMG100GR / 150GR / 200GR	BM22 brushless servomotor with 2000-line TTL encoder and brake
	AMG300GR	BM75 brushless servomotor with 2500-line TTL encoder and brake
-M7	AMG100GR / 150GR / 200GR	SM35 stepper motor
	AMG300GR	BM75 brushless servomotor with 1000-line 1 Vpp encoder
-M8	AMG300GR	BM75 brushless servomotor with 1000-line 1 Vpp encoder and brake
-M9	AMG300GR	SM60 stepper motor
Mounting Plate (Optional)		
-MP	Optical table mounting plate	
Note: -MP option required when continuous azimuth travel option is selected.		
Metrology (Required)		
-PL0	No metrology performance plots	
-PL1	Metrology, uncalibrated with performance plots	
-PL2	Metrology, calibrated (HALAR) with performance plots	

1.1. Environmental Specifications

WARNING: **General Hazard Warning!** Do not expose this product to environments or conditions outside of the listed specifications. You could damage the equipment if you exceed the environmental or operating specifications.

DANGER: **Risk of Explosive Atmosphere!**

- Standard Aerotech stage/motors are not rated for applications with explosive atmospheres such as airborne dust or combustible vapors.
- Do not operate stage/motors outside of Aerotech 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 ±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. Floor or acoustical vibration can affect system performance. Contact Aerotech for information regarding your specific application.
Protection Rating	Limited protection against dust, but not water (IP40 equivalent ingress protection rating).
Use	Indoor use only

1.2. Accuracy and Temperature Effects

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

1.3. Basic Specifications

Table 1-3: AMG Series Specifications

Basic Model		AMG100GR	AMG150GR	AMG200GR	AMG300GR
Total Travel(1)	Azimuth	180° continuous rotation			
	Elevation	90°, 315°, and continuous rotation			
Clear Aperture Diameter		100 mm	150 mm	200 mm	300 mm
Accuracy	Uncalibrated	AZ: 0.87 mrad (180 arc sec) EL: 0.87 mrad (180 arc sec)		AZ: 0.58 mrad (120 arc sec) EL: 0.58 mrad (120 arc sec)	
	Calibrated	AZ: 0.29 mrad (60 arc sec) EL: 0.29 mrad (60 arc sec)		AZ: 0.24 mrad (50 arc sec) EL: 0.24 mrad (50 arc sec)	
	Uncalibrated with Direct Encoder	AZ: 97 µrad (20 arc sec) EL: 97 µrad (20 arc sec)			
	Calibrated with Direct Encoder	AZ: 58 µrad (12 arc sec) EL: 58 µrad (12 arc sec)		AZ: 49 µrad (10 arc sec) EL: 49 µrad (10 arc sec)	
Bidirectional Repeatability(2)	Without Direct Encoder	AZ: 0.22 mrad (45 arc sec) EL: 0.22 mrad (45 arc sec)			
	With Direct Encoder	AZ: 39 µrad (8 arc sec) EL: 39 µrad (8 arc sec)		AZ: 29 µrad (6 arc sec) EL: 39 µrad (8 arc sec)	AZ: 29 µrad (6 arc sec) EL: 29 µrad (6 arc sec)
Tilt Error Motion		49 µrad (10 arc sec)			
Orthogonality		73 µrad (15 arc sec)			
Gear Ratio	Azimuth	51:1	51:1	85:1	117:1
	Elevation	51:1	51:1	67:1	85:1
Maximum Speed(3)	Servomotor	180°/s			
	Stepper Motor	60°/s		40°/s (Azimuth) 60°/s (Elevation)	40°/s
Azimuth Aperture (available only with 180° azimuth travel option)		50 mm	50 mm	100 mm	150 mm
Max. Load Capacity		12 kg	15 kg	25 kg	45 kg
Maximum Torque Load to Azimuth/ Elevation Shaft for Offset Loading		2.5 N·m	2.5 N·m	3.5 N·m	12 N·m
Mass (BMS Servomotor)	Standard	9.7 kg	11.9 kg	18.7 kg	32.2 kg
	Direct Encoder	11.1 kg	13.3 kg	20.8 kg	35.1 kg
Material		Aluminum			

(1) Custom travels available upon request.
(2) Certified with each stage. Specifications are per axis unless specified.
(3) Maximum speed is load dependent. Contact an Aerotech Application Engineer if imbalanced loads are present. Requires the selection of an appropriate amplifier with sufficient voltage and current.

1.4. Vacuum Operation

There are two vacuum preparation options:

- Low Vacuum (for use in atmospheric pressures to 10^{-3} Torr)
- High Vacuum (preparation for environments from 10^{-3} to 10^{-6} Torr).

Special preparations include:

- Parts are lubricated with vacuum-compatible lubricants.
- Materials, fasteners, and coatings are selected to be compatible with the specified level of vacuum.
- High-vacuum systems are designed to eliminate trapped volumes.
- Prior to assembly, gimbal parts are thoroughly cleaned in a clean environment.
- The gimbal is packaged in a special polyethylene bag.

Vacuum Guidelines

To ensure that the gimbal 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 gimbal from its sealed bag until it is ready to use.
2. Always handle the gimbal in a clean environment and use powder-free polyethylene gloves to prevent any contaminants from adhering to the surface of the gimbal.
3. During installation, use cleaned, vented, stainless steel fasteners to secure the gimbal.
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. We recommend that you use a small quantity of Braycote® 602EF grease or a compatible substitute of equal quality lubricant in vacuum applications.
6. To reduce outgassing during the initial pump-down to vacuum pressure, Aerotech recommends that you bake out vacuum systems when you first install them into the vacuum chamber. Bake the vacuum components at 60 °C for 24 to 48 hours to desorb water vapor from surfaces and degas polymers (such as cable insulation).

1.5. Export Restrictions

This product is export controlled by United States Commerce Department export regulations.

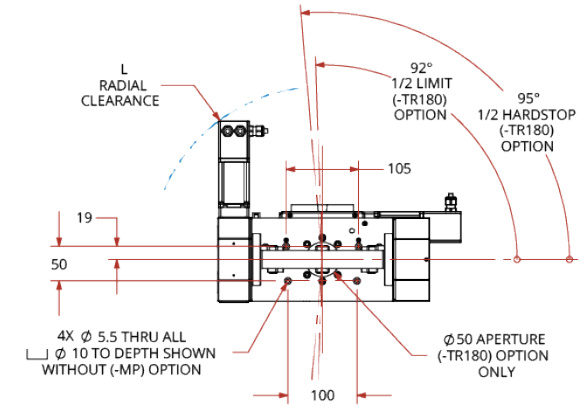
If you are from a non-US country and wish to make a purchase, contact Aerotech to determine if an export license is required. People in countries embargoed by the United States cannot purchase and import one of these products.

Chapter 2: Installation

The gimbal installation must be in accordance with the instructions provided by this manual and any accompanying documentation. Failure to follow these instructions could result in injury or damage to the equipment.

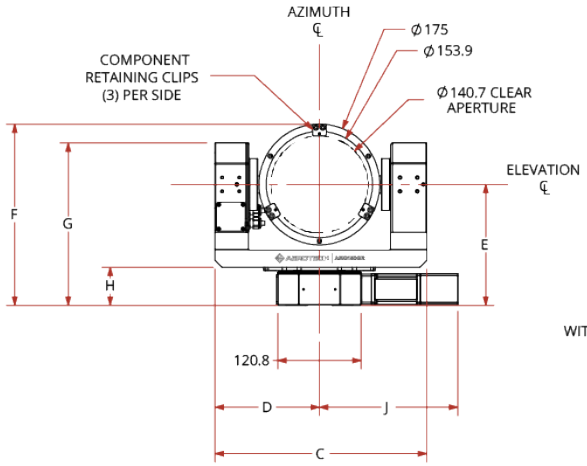
2.1. Dimensions

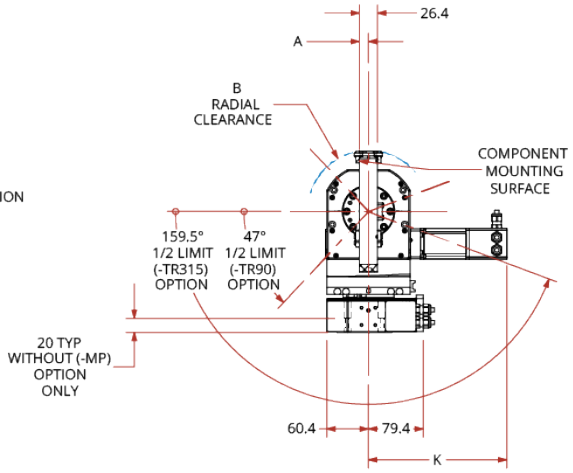
Figure 2-1: AMG150GR Dimensions



DIMENSIONS: MILLIMETERS [INCHES]

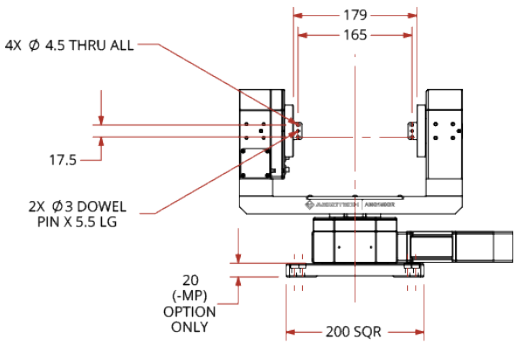
AZIMUTH MOTOR	J	ELEVATION MOTOR	K	L
-M1 -M3	200.4	-M1 -M3	200.4	260.8
-M2 -M4	228.4	-M2 -M4	228.4	282.8
-M5	166.5	-M5	166.5	233.0
-M6	203.4	-M6	203.4	260.7
-M7	202.3	-M7	202.3	262.7

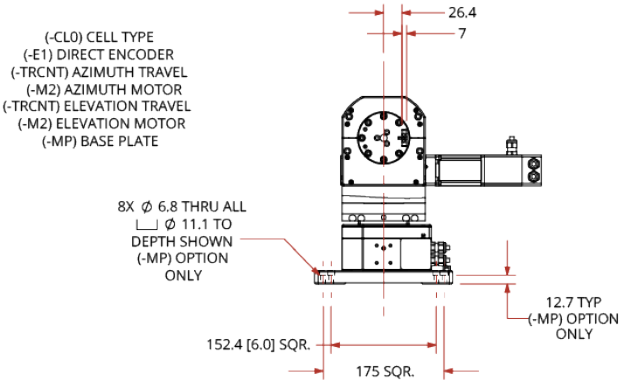




CELL TYPE	A	B
-CL1	0	92.8
-CL2	13.2	89.3

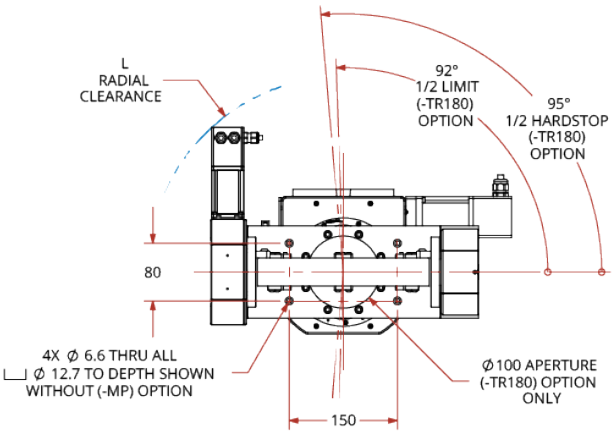
OPTION	C	D	E	F	G	H
WITH DIRECT ENC	323.0	167.5	191.4	278.9	251.8	71.4
WITHOUT DIRECT ENC	306.6	151.1	175	262.5	235.4	55.0





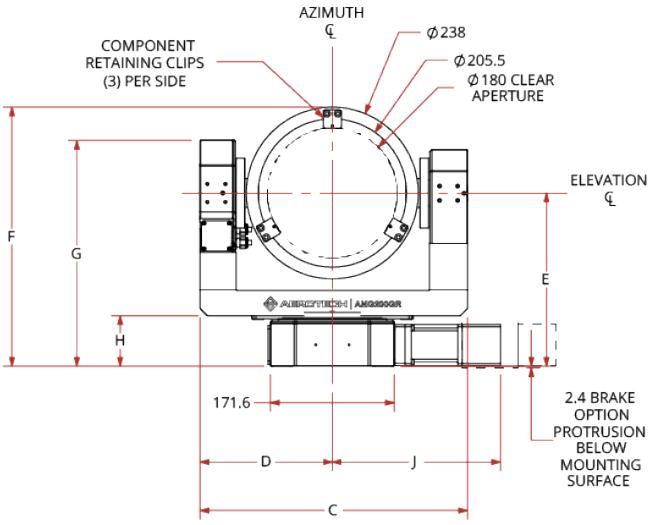
NOTE - WHEN CONFIGURED WITH -ACONT OPTION, THIS PRODUCT IS EXPORT CONTROLLED: ECCN 2B120

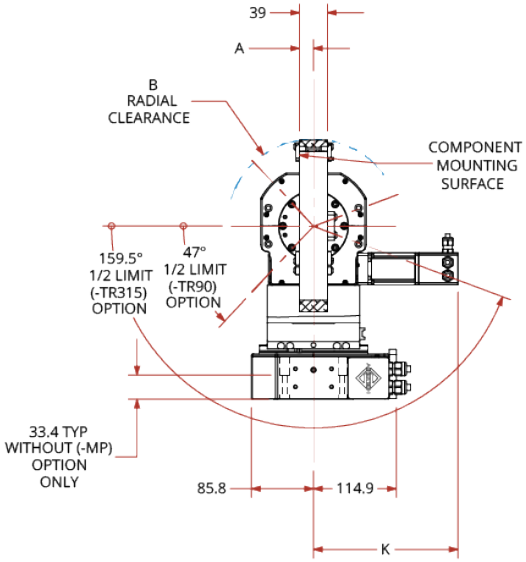
Figure 2-2: AMG200GR Dimensions



DIMENSIONS: MILLIMETERS [INCHES]

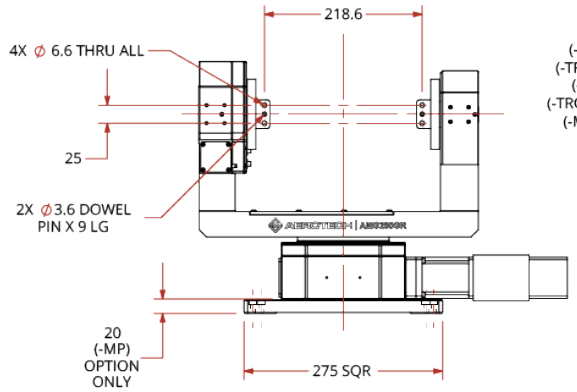
AZIMUTH MOTOR	J	ELEVATION MOTOR	K	L
-M1 -M3	233.1	-M1 -M3	200.4	282.4
-M2 -M4	310.3	-M2 -M4	228.4	302.9
-M5 -M7	233.1	-M5	166.5	256.6
-M6 -M8	310.3	-M6	203.4	281.9
-M9	211.7	-M7	202.3	284.3

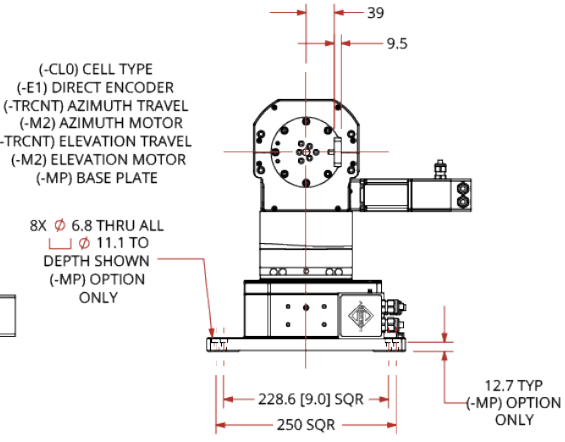




CELL TYPE	A	B
-CL1	0	250.5
-CL2	19.5	241.2

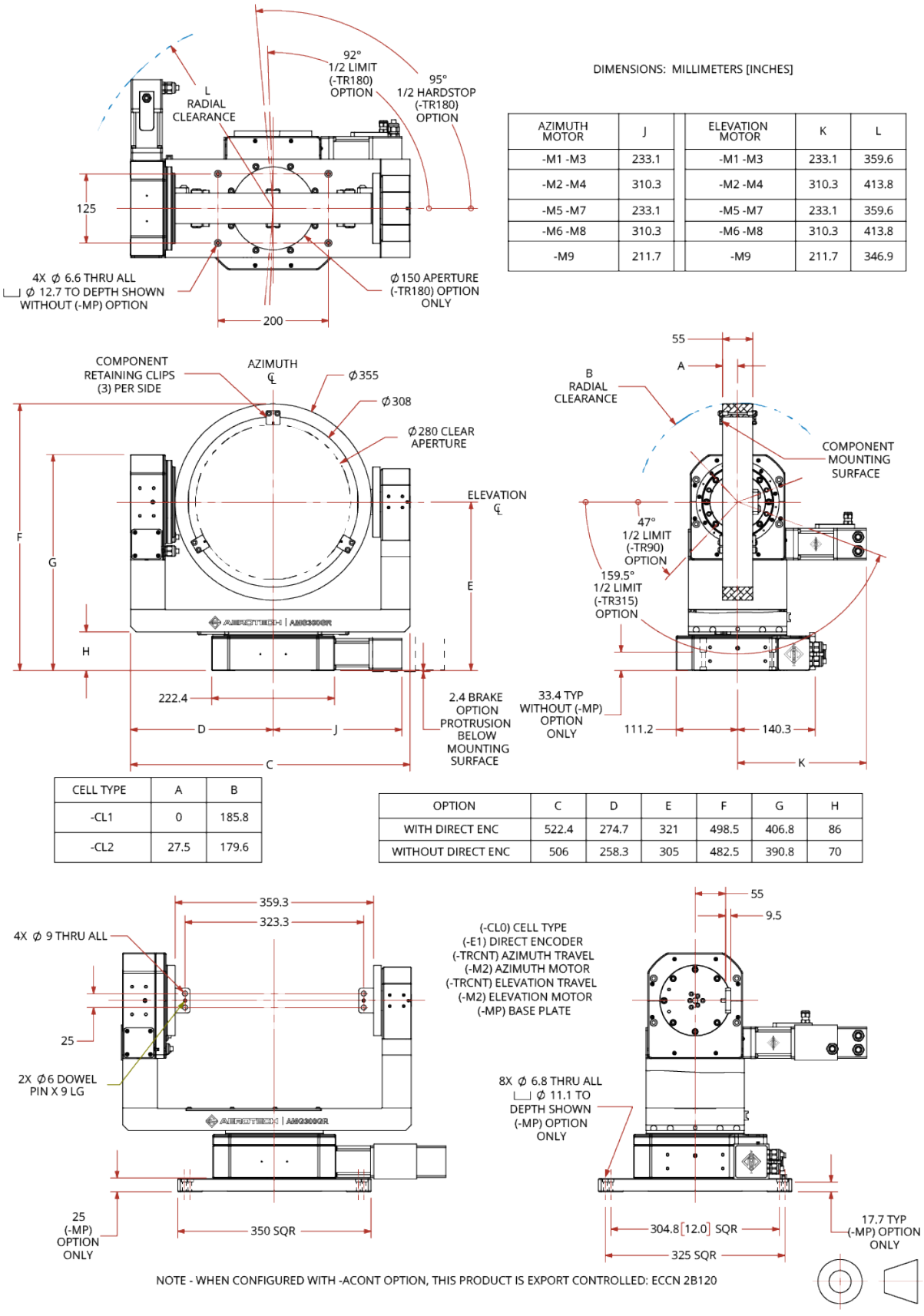
OPTION	C	D	E	F	G	H
WITH DIRECT ENC	387.0	199.7	256.0	375	329.1	86
WITHOUT DIRECT ENC	370.6	183.3	240.0	359	313.1	70





NOTE - WHEN CONFIGURED WITH -ACONT OPTION, THIS PRODUCT IS EXPORT CONTROLLED: ECCN 2B120

Figure 2-3: AMG300GR Dimensions



AZIMUTH MOTOR	J	ELEVATION MOTOR	K	L
-M1 -M3	233.1	-M1 -M3	233.1	359.6
-M2 -M4	310.3	-M2 -M4	310.3	413.8
-M5 -M7	233.1	-M5 -M7	233.1	359.6
-M6 -M8	310.3	-M6 -M8	310.3	413.8
-M9	211.7	-M9	211.7	346.9

CELL TYPE	A	B
-CL1	0	185.8
-CL2	27.5	179.6

OPTION	C	D	E	F	G	H
WITH DIRECT ENC	522.4	274.7	321	498.5	406.8	86
WITHOUT DIRECT ENC	506	258.3	305	482.5	390.8	70

2.2. Securing the Base to the Mounting Surface

DANGER: Mechanical Hazard!

Personnel must be made aware of the mechanical hazards during set up or when you do service to the gimbal.

- Do not manually move the gimbal if it is connected to a power source.
- The gimbal must be mounted securely. Improper mounting can result in injury and damage to the equipment.
- When you move the cell manually to do maintenance, this could expose the operator to pinch points. Refer to Pinch Points on Page 12.

The mounting surface must be flat and have adequate stiffness to achieve the maximum performance from the gimbal. When it is mounted to a non-flat surface, the gimbal 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.

IMPORTANT: The gimbal is precision machined and verified for flatness at the factory.

- Do not machine the gimbal housing. If you must machine a surface to achieve a required flatness, machine the mounting surface.
- Keep the use of shims to a minimum when you mount the gimbal to the mounting surface. The use of shims could reduce the rigidity of the system.

Table 2-1: Stage Mounting Surface Flatness Requirement

Stage	Flatness Requirement
All Frame Sizes	10 µm

AMG-GR series stages have a fixed mounting pattern (refer to Figure 2-4). Refer to Section 2.1. for specific model mounting locations and dimensions.

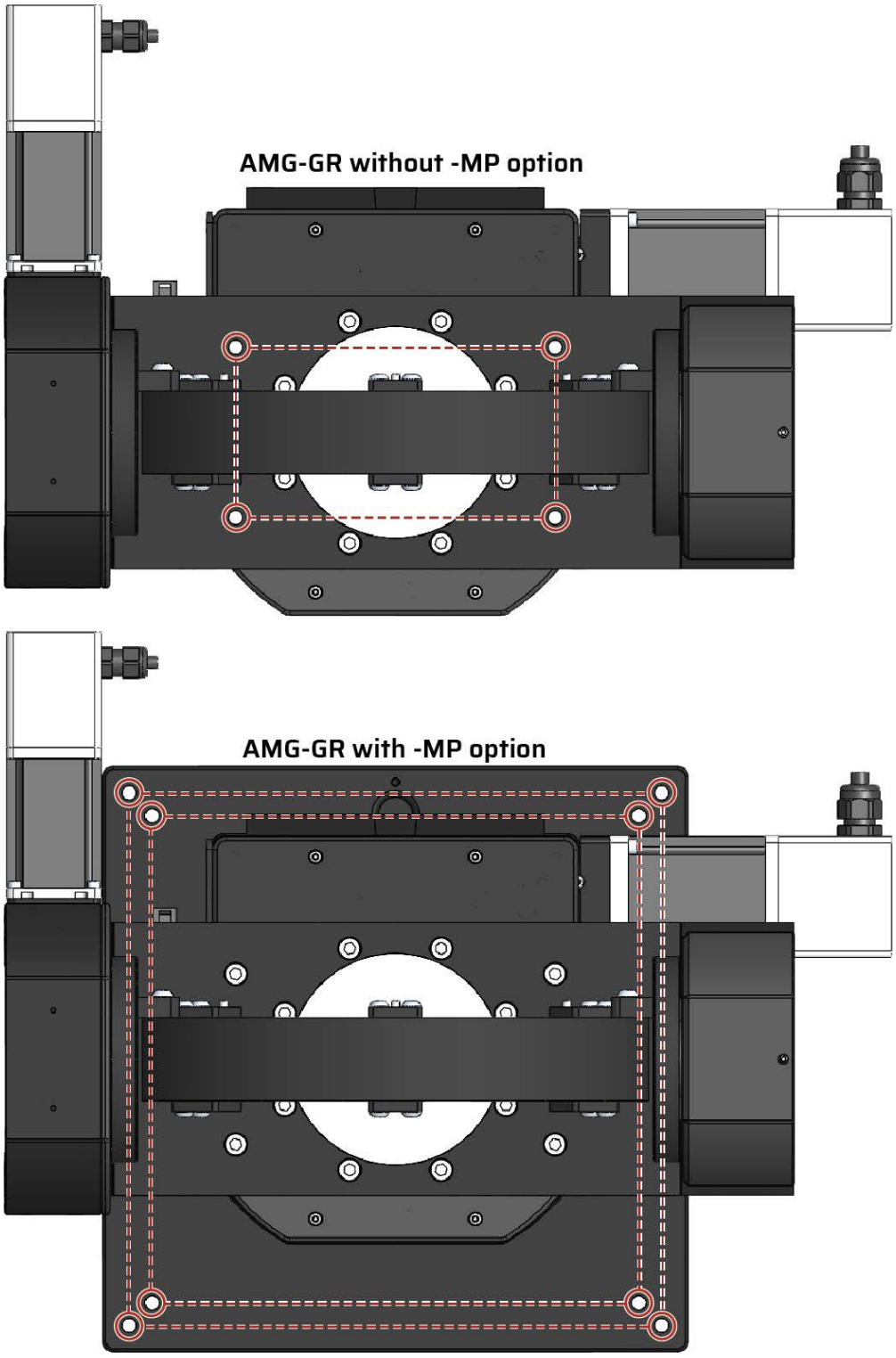
Stages without the optional mounting plate have counter-bored mounting holes that are designed for 5 mm socket head cap screws (SHCS) on the AMG100GR and AMG150GR, and for 6 mm SHCS on the AMG200GR and AMG300GR. Stages with the -MP (mounting plate) option have counter-bored mounting holes that are designed for 6 mm or 1/4" SHCS.

Tightening torque values for the mounting hardware are dependent on the properties of the surface to which the stage is being mounted. Values provided are typical values and may not be accurate for your mounting surface.

Table 2-2: Stage to Mounting Surface Hardware

Mounting Hardware		Typical Screw Torque
AMG100GR, AMG150GR	5 mm SHCS	4 N·m
AMG200GR, AMG300GR	6 mm SHCS	7 N·m
-MP Option	6 mm or 1/4" SHCS counter-bored mounting holes	7 N·m

Figure 2-4: View of AMG-GR Showing Mounting Holes



2.3. 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. Gently place the stage on the mounting surface.

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: Electrical Installation and the documentation delivered with the stage.

IMPORTANT: If your AMG-GR was purchased with Aerotech controls, it could have been tuned with a representative payload based on the information provided at the time of order. If you start the AMG-GR 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.

The standard AMG-GR is capable of accommodating cells up to 300 mm in diameter. Custom solutions can be designed for non-standard loads.

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Chapter 3: Electrical Installation

DANGER: Electrical Shock Hazard!

- Stage motor phase voltage levels could be hazardous live.
- Personnel are protected from hazardous voltages unless electrical interconnections, protective bonding (safety ground), or motor/stage enclosures are compromised.
- Do not connect or disconnect stage/motor interconnections while connected to a live electrical power source.
- Before you set up or do maintenance, disconnect electrical power.
- It is the responsibility of the End User/System Integrator to make sure that stages are properly connected and grounded per Engineering Standards and applicable safety requirements.
- It is the responsibility of the End User/System Integrator to configure the system drive or controller within the Aerotech motor/stage electrical and mechanical specifications.

WARNING: General Hazard Warning!

Applications that require access to the AMG-GR must be restricted to qualified and trained personnel. The system integrator or qualified installer is responsible for determining and meeting all safety and compliance requirements when they integrate the AMG-GR into a completed system.

Electrical installation requirements will depend on the ordered product options. Installation instructions in this section are for Aerotech products equipped with standard Aerotech motors intended for use with an Aerotech motion control system. Contact Aerotech for further information on products that are otherwise configured.

Aerotech motion control systems are adjusted at the factory for optimum performance. When the AMG-GR is part of a complete Aerotech motion control system, setup should only require that you connect the gimbal to the appropriate drive chassis with the cables provided. Labels on the system components should indicate the appropriate connections.

If system level integration was purchased, an electrical drawing that shows the 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.

IMPORTANT: Refer to the controller documentation to adjust servo gains for optimum velocity and position stability.

3.1. Motor and Feedback Connectors

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

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

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

The protective ground connection of the AMG-GR 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: Electrical Shock Hazard!

- The protective ground connection must be properly installed to minimize the possibility of electric shock.
- The stage controller must provide over-current and over-speed protection. Failure to do so could cause electric shock or damage to the equipment.

Table 3-1: Motor Connector Pinout

Pin	For BM/BMS Motors	For Stepper Motors	Connector
Case	Shield Connection	Shield Connection	
A1	Motor Phase A	Motor Phase A	
A2	Motor Phase B	Motor Phase B	
A3	Motor Phase C	Motor Phase A Return	
1	Reserved	Brake -(1)	
2	Reserved	Brake +(1)	
3	Reserved	Reserved	
4	Reserved	Frame Ground (motor protective ground)	
5	Reserved	Frame Ground (motor protective ground)	
A4	Frame Ground (motor protective ground)	Motor Phase B Return	

(1) With brake option only.

Table 3-2: Mating Connector 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: BM/BMS Feedback Connector Pinout

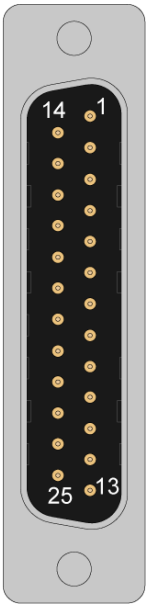
Pin	Description	Connector
Case	Shield Connection	
1	Reserved	
2	BMS Motors: Over-Temperature Thermistor Sensor	
	BM Motors: Reserved	
3	5V Power Supply Input	
4	Reserved	
5	Hall Effect Sensor (Phase B)	
6	MRK- (Encoder Marker-)	
7	MRK+ (Encoder Marker+)	
8	Reserved	
9	Reserved	
10	Hall Effect Sensor (Phase A)	
11	Hall Effect Sensor (Phase C)	
12	Reserved	
13	Reserved	
	Brake - (with Brake Option)	
14	COS+ (Encoder Cosine+)	
15	COS- (Encoder Cosine-)	
16	Reserved	
17	SIN+ (Encoder Sine+)	
18	SIN- (Encoder Sine-)	
19	Reserved	
20	Common ground	
21	Common ground	
22	Reserved	
23	Reserved	
24	Reserved	
25	Reserved	
	Brake + (with Brake Option)	

Table 3-4: Mating Connector Part Numbers for the BM/BMS Feedback Connector

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

Table 3-5: Stepper Feedback Connector Pinout

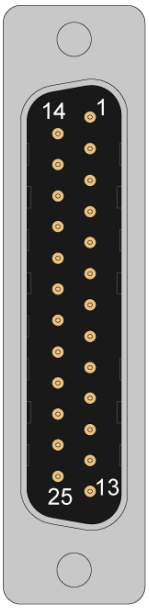
Pin	For Stepper Motors	Connector
Case	Shield Connection	
1	Reserved	
2	Reserved	
3	5V Power Supply Input	
4	Reserved	
5	Reserved	
6	MRK- (Encoder Marker-)	
7	MRK+ (Encoder Marker+)	
8	Reserved	
9	Reserved	
10	Reserved	
11	Reserved	
12	Reserved	
13	Reserved	
14	COS+ (Encoder Cosine+)	
15	COS- (Encoder Cosine-)	
16	5V Power Supply Input	
17	SIN+ (Encoder Sine+)	
18	SIN- (Encoder Sine-)	
19	Reserved	
20	Common ground	
21	Common ground	
22	Reserved	
23	Reserved	
24	Reserved	
25	Reserved	

Table 3-6: Mating Connector Part Numbers for the Stepper Feedback Connector

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

Table 3-7: 9-Pin Limit Connector (-TR90, -TR315, or -TR180 Options)

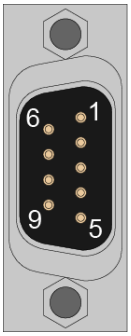
Pin	Description	Limits Connector
Case	Shield Connection	
1	5V Power Supply Limit Input	
2	Limit Common	
3	+/CW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the “machine positive” or “machine clockwise” direction.)	
4	Home Limit	
5	-/CCW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the “machine negative” or “machine counter-clockwise” direction.)	
6	Reserved	
7	Common ground	
8	Reserved	
9	Reserved	

Table 3-8: Mating Connector 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

Table 3-9: 15-Pin Direct Encoder Connector (-E1, -E2, or -E3 Encoder Option)

Pin	Description	Connector
Case	Shield Connection	
1	SIN+ (Encoder Sine+)	
2	COS+ (Encoder Cosine+)	
3	Reserved	
4	+5 V power supply (-TR180 Option only)	
5	Reserved	
6	Reserved	
7	Reserved	
8	Reserved	
9	SIN- (Encoder Sine-)	
10	COS- (Encoder Cosine-)	
11	Reserved	
12	Common ground (-TR180 Option only)	
13	Reserved	
14	Reserved	
15	Reserved	

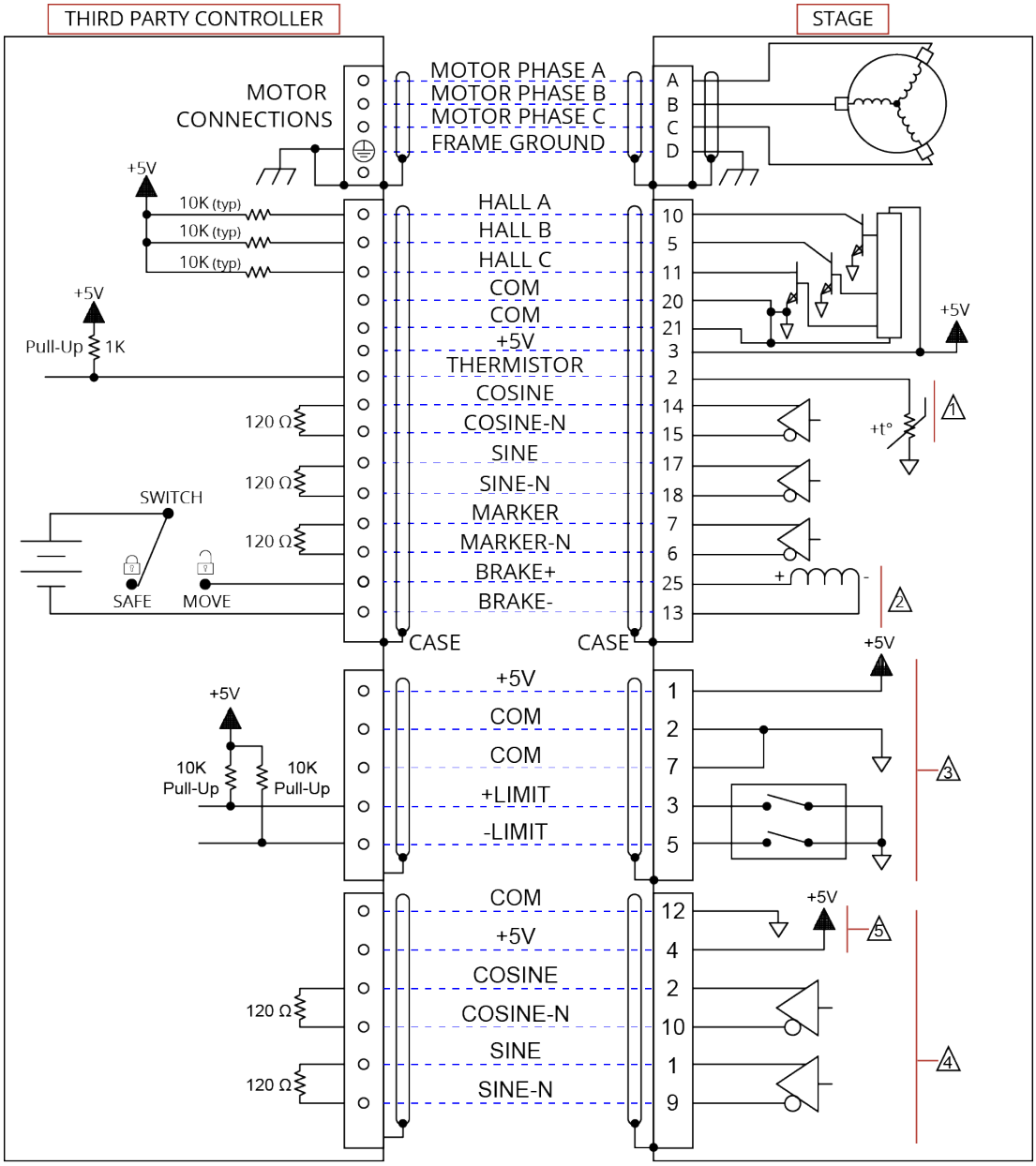
Table 3-10: Mating Connector Part Numbers for the Direct Encoder Connector

Mating Connector	Aerotech P/N	Third Party P/N
15-Socket D-Connector	ECK01022	Amphenol 17E-1725-2
Backshell	ECK00326	Amphenol DA15S064TLF

3.2. Motor and Feedback Wiring

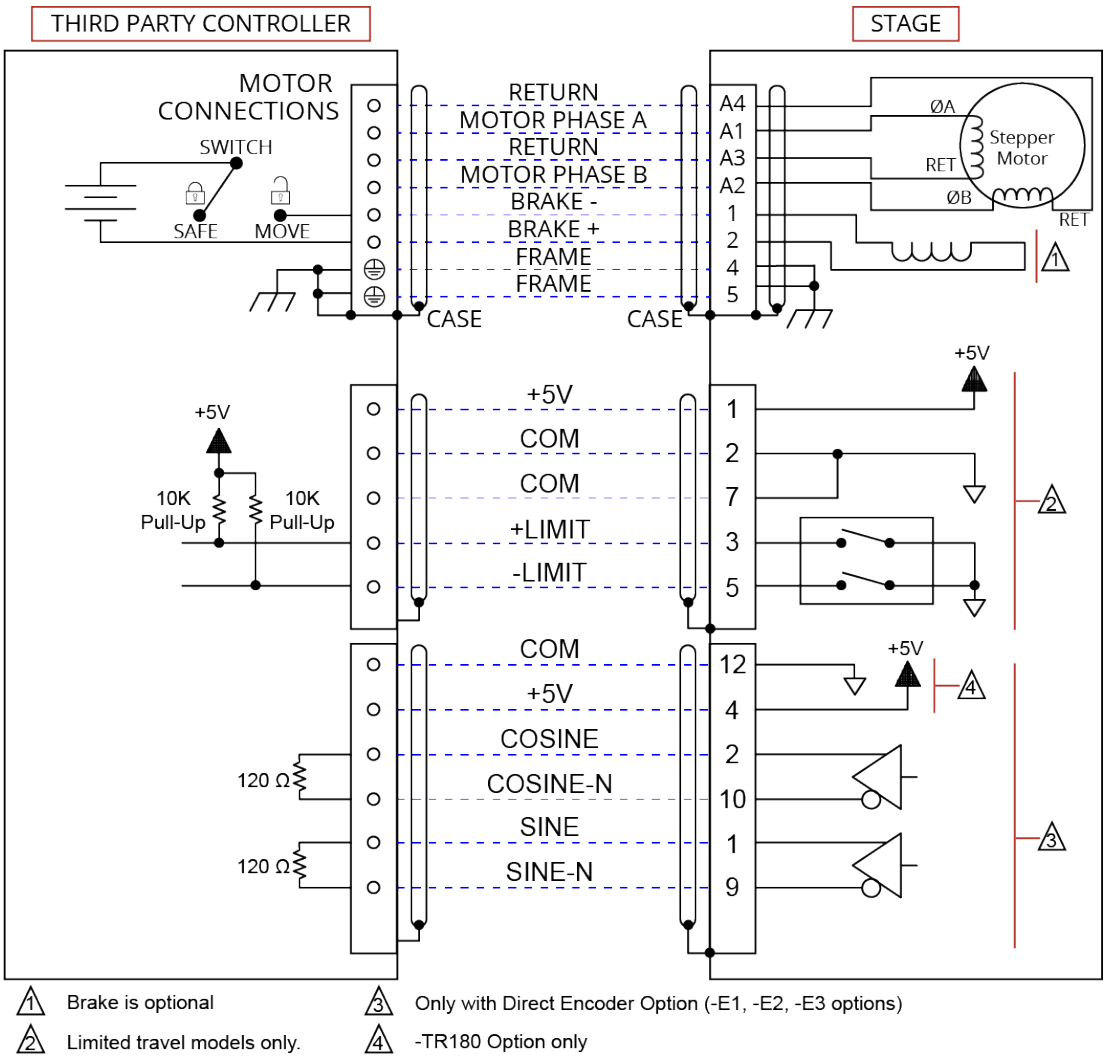
Shielded cables are required for the motor and feedback connections.

Figure 3-1: Motor and Feedback Wiring (BM/BMS Motors)



1. BMS Only
2. Brake is optional
3. Limited travel models only.
4. Only with Direct Encoder Option (-E1, -E2, -E3 options)
5. -TR180 Option only

Figure 3-2: Motor and Feedback Wiring (SM Motors)



3.3. Motor and Feedback Specifications

Table 3-11: Hall-Effect Sensor Specifications

	Specification
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)

Table 3-12: Thermistor Specifications

	Specification
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.	

Table 3-13: Encoder Specifications

	Specification
Supply Voltage	5 V ±5%
Supply Current	250 mA (typical)
Output Signals (-E1)	**Sinusoidal Type (Incremental Encoder)**: Analog: SIN+, SIN-, COS+, COS-, 1V $_{pk-pk}$; Digital (RS422): MRK+, MRK- signals.
Output Signals (-E2, -E3)	**Digital Output (Incremental Encoder)**: TTL Encoder line-driver signals; RS422/485 compatible

Table 3-14: Limit Switch Specifications

	Specification [-TR090, -TR315, and -TRCNT options only]
Supply Voltage	5 V ±5%
Supply Current	25 mA
Output Type	Open Collector
Output Voltage	5 V
Output Current	10 mA (sinking)
Output Polarity	**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)
Notes: If the gimbal 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.	

Table 3-15: Brake Specifications

	Specification
Supply Voltage	24 VDC
Supply Current(1)	500 mA Typical
(1) Required to release the brake and allow motion.	

Table 3-16: Maximum Motor Bus Voltage

	Specification			
AMG	100GR	150GR	200GR	300GR
-BM Motor	80 VDC		EL: 80 VDC AZ: 340 VDC	340 VDC
-BMS Motor	340 VDC			
-SM Motor	40 VDC			
Exception (Notes)	1. If the -TRCNT option has been purchased for the Elevation Axis, the Max Motor Bus Voltage is 80 VDC, superseding the listings above. 2. For -SM motors with Aerotech controllers, amplifier bus voltages are 2X values listed.			

Table 3-17: Resolution Information

				AMG100GR	AMG150GR	AMG200GR	AMG300GR
Standard Rotary Motor Feedback	Gear Ratio		AZ	51:1	51:1	85:1	117:1
			EL	51:1	51:1	67:1	85:1
	-M1, -M2, -M5. -M6	Lines(2)	AZ	2000 lines/rev	2000 lines/rev	2500 lines/rev	2500 lines/rev
			EL	2000 lines/rev	2000 lines/rev	2000 lines/rev	2500 lines/rev
		Stage Resolution	AZ	62 µrad	62 µrad	30 µrad	22 µrad
			EL	62 µrad	62 µrad	47 µrad	30 µrad
	-M3, M4, -M7, -M8	Lines(3)	AZ	1000 lines/rev	1000 lines/rev	1000 lines/rev	1000 lines/rev
			EL	1000 lines/rev	1000 lines/rev	1000 lines/rev	1000 lines/rev
		Stage(1) Resolution	AZ	0.062 µrad	0.062 µrad	0.037 µrad	0.027 µrad
			EL	0.062 µrad	0.062 µrad	0.047 µrad	0.037 µrad
Optional Direct Encoder	Lines		AZ	15744 lines/rev	15744 lines/rev	23600 lines/rev	31488 lines/rev
			EL	15744 lines/rev	15744 lines/rev	18000 lines/rev	23600 lines/rev
	-E1 (1,3)		AZ	0.20 µrad	0.20 µrad	0.13 µrad	0.10 µrad
			EL	0.20 µrad	0.20 µrad	0.17 µrad	0.13 µrad
	-E2		AZ	20 µrad	20 µrad	13 µrad	10 µrad
			EL	20 µrad	20 µrad	17 µrad	13 µrad
	-E3		AZ	2.0 µrad	2.0 µrad	1.3 µrad	1.0 µrad
			EL	2.0 µrad	2.0 µrad	1.7 µrad	1.3 µrad

1. With x500 multiplication on -E1 encoder.
2. Square wave
3. Sine

Table 3-18: Brushless Rotary Motor Specifications

		BM22 (AMG100GR [AZ/EL]) (AMG150GR [AZ/EL]) (AMG200GR [EL])	BM75 (AMG200GR [AZ]) (AMG300GR [AZ/EL])
Performance Specifications (1,2)			
Stall Torque, Continuous (3)	N·m (oz·in)	0.16 (22.5)	0.51 (72.0)
Peak Torque(4)	N·m (oz·in)	0.48 (68)	1.30 (181.0)
Rated Power Output, Continuous	W	50	192
Electrical Specifications (2)			
BEMF Constant (Line-Line, Max)	V_{pk}/k_{rpm}	3.9	9.0
Continuous Current, Stall (3)	A_{pk} (A_{rms})	4.9 (3.5)	9.0 (6.4)
Peak Current, Stall (4)	A_{pk} (A_{rms})	14.7 (10.4)	22.5 (15.9)
Torque Constant (5)	N·m/A_{pk} (oz·in/A_{pk})	0.032 (4.5)	0.06 (8.0)
	N·m/A_{rms} (oz·in/A_{rms})	0.045 (6.4)	0.08 (11.4)
Motor Constant (3,5)	N·m/√W (oz·in/√W)	0.038 (5.41)	0.055 (7.84)
Resistance, 25°C (Line-Line)	Ω	0.67	1.00
Inductance (Line-Line)	mH	0.73	1.42
Maximum Bus Voltage	V_{DC}	80	340
Thermal Resistance	°C/W	4.56	1.18
Number of Poles	--	8	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.

Table 3-19: Brushless, Slotless Rotary Motor Specifications

		BMS35 (AMG100GR [AZ/EL]) (AMG150GR [AZ/EL]) (AMG200GR [EL])	BMS60 (AMG200GR [AZ]) (AMG300GR [AZ/EL])
Performance Specifications (1, 5)			
Stall Torque, Continuous (2)	N·m (oz·in)	0.27 (38.0)	0.33 (46.2)
Peak Torque (3)	N·m (oz·in)	1.07 (152.0)	1.31 (184.9)
Rated Power Output, Continuous	W	96	116
Electrical Specifications (5)			
Winding Designation		-A	-A
BEMF Constant (Line-Line, Max)	V_{pk}/k_{rpm}	12.9	19.0
Continuous Current, Stall (2)	A_{pk} (A_{rms})	2.5 (1.7)	2.3 (1.6)
Peak Current, Stall (3)	A_{pk} (A_{rms})	9.8 (6.9)	9.2 (6.5)
Torque Constant (4, 8)	$N·m/A_{pk}$ ($oz·in/A_{pk}$)	0.110 (15.50)	0.140 (20.10)
	$N·m/A_{rms}$ ($oz·in/A_{rms}$)	0.150 (21.90)	0.200 (28.40)
Motor Constant (2, 4)	N·m/√W (oz·in/√W)	0.046 (6.52)	0.050 (7.02)
Resistance, 25°C (Line-Line)	Ω	5.80	8.40
Inductance (Line-Line)	mH	1.70	1.30
Maximum Bus Voltage	V_{DC}	340	340
Thermal Resistance	°C/W	2.21	1.73
Number of Poles	--	8	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.

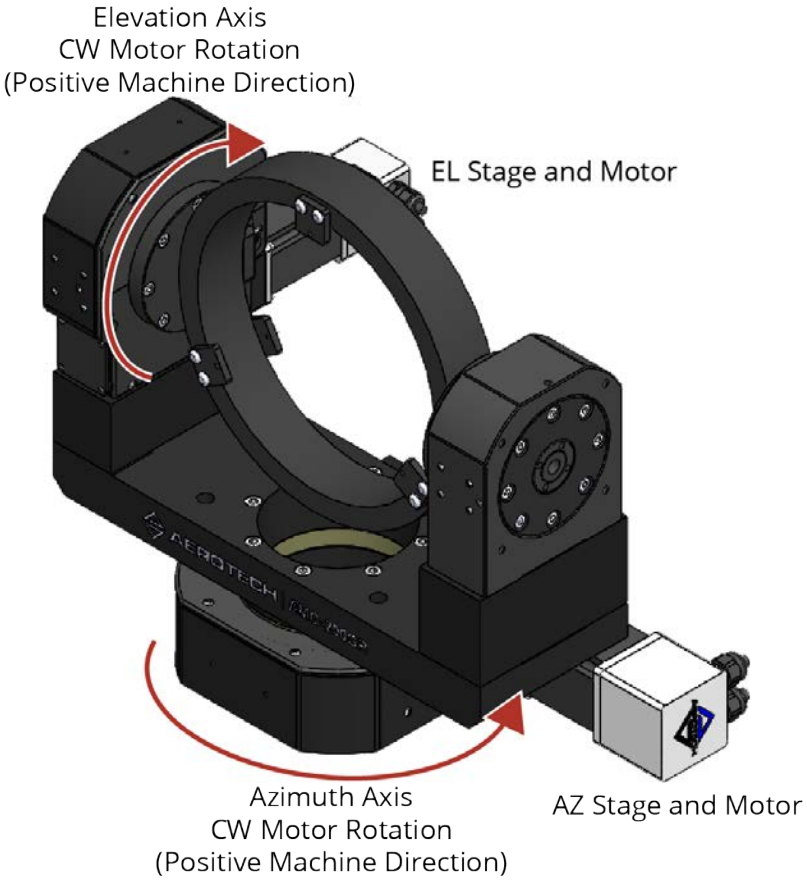
Table 3-20: Stepper Motor Specifications

		SM35 (AMG100GR [AZ/EL]) (AMG150GR [AZ/EL]) (AMG200GR [EL])	SM60-VT2 (AMG200GR [AZ]), (AMG300GR [AZ/EL])
NEMA Motor Frame Size		17	23
Stall Torque	N·m (oz·in)	0.78 (111)	1.41 (200)
Rated Phase Current	A	3	0.84
Recommended Driver Bus Voltage	V	35	160
Rotor Inertia	$kg \cdot m^2$ ($oz \cdot in \cdot s^2$)	1.02×10^{-5} (0.0014)	3×10^{-5} (0.0042)
Full Step Angle	°	1.8	1.8
Accuracy	°	±0.09	±0.09
Maximum Radial Load	N (lb)	28.4 (6.3)	75.4 (17)
Maximum Thrust Load	N (lb)	28.4 (2.2)	14.7 (3.4)
Weight	kg (lb)	0.50 (1.1)	0.70 (1.6)

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 3.2.). 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 AMG-GR 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 Diagram

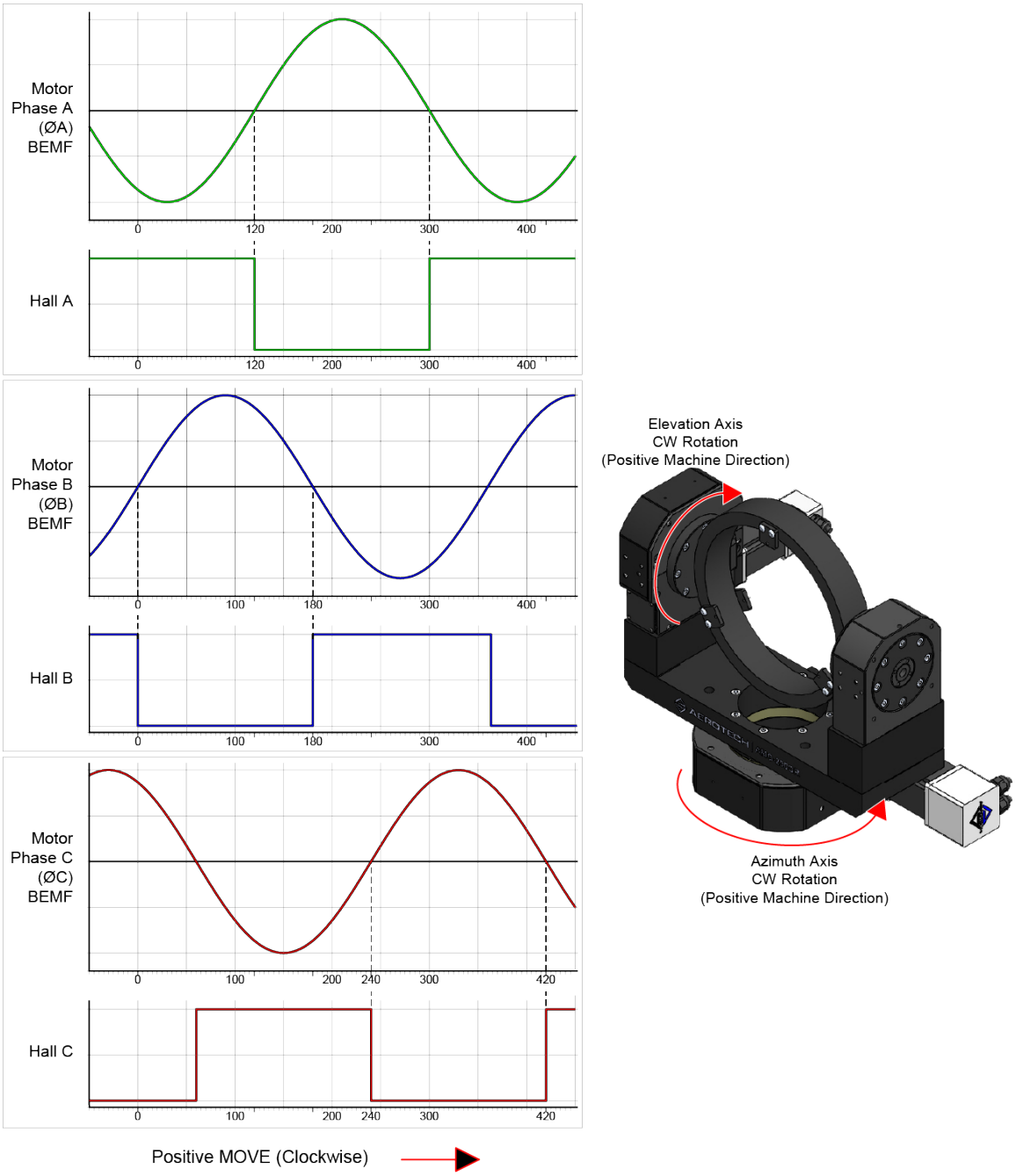


Figure 3-5: Encoder Phasing Reference Diagram (Standard/Square Wave)

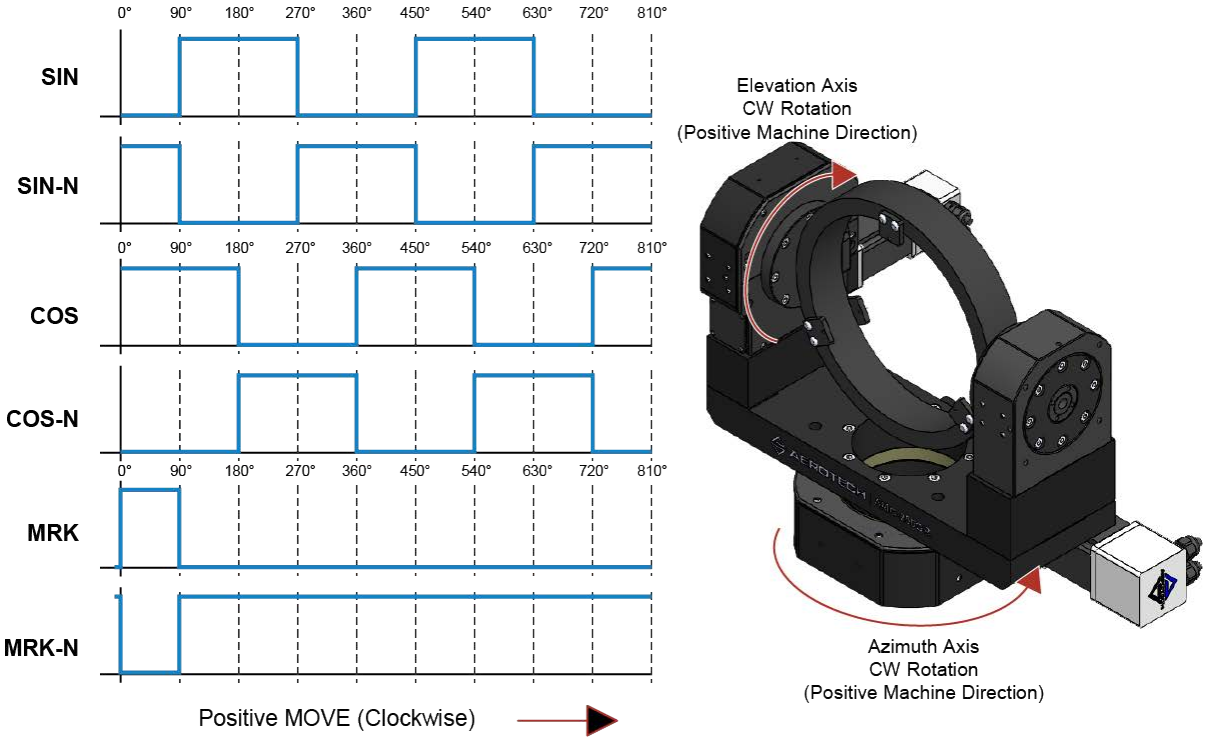
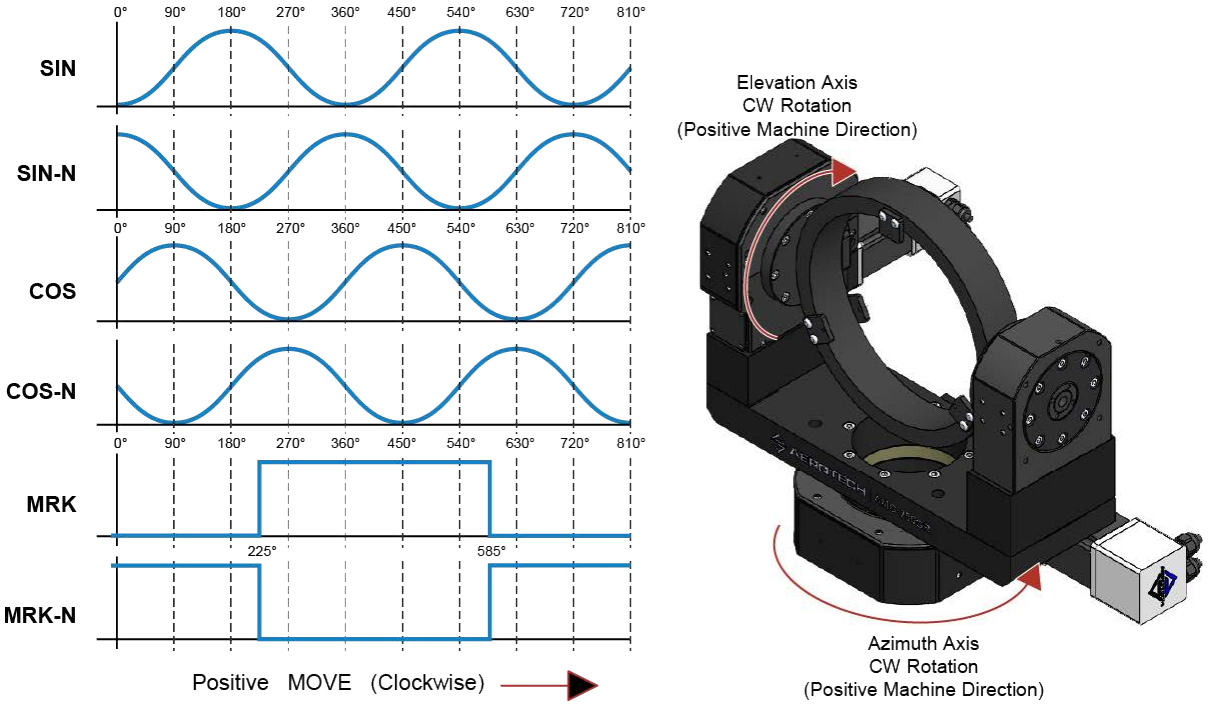


Figure 3-6: Encoder Phasing Reference Diagram (Analog/Sine Wave)



Chapter 4: Maintenance

IMPORTANT: Read the Safety Procedures and Warnings (on Page 8) before you do maintenance to the gimbal.

4.1. Service and Inspection Schedule

Inspect the AMG-GR at least once per month. The need for a longer or shorter inspection interval will depend 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 AMG-GR and any components and cables as needed.
- Repair any damage before operating the AMG-GR.
- Inspect and perform an operational check on all safeguards and protective devices.

4.2. Cleaning and Lubrication

DANGER: **Electrical Shock Hazard!** Before you do maintenance to the equipment, disconnect the electrical power.

IMPORTANT: Wear appropriate personal protective equipment (PPE) when you use cleaning solvents or lubricants.

Cleaning

When you clean components of the AMG-GR series stage:

1. Use a clean, dry, soft, lint-free cloth.
2. Before you use a cleaning solvent on any part of the gimbal, blow away small particles and dust with clean, dry, compressed air.
3. In applications that have multiple stages bolted together to form multi-axis systems, the orthogonality can be lost if the stage tables of the support stages are loosened. Precision aligned stages should not be loosened or disassembled.
4. We recommend that you do not disassemble the stage beyond the instructions given in this manual. Proper assembly and calibration can only be done at the factory. Contact Aerotech for more information.

Use isopropyl alcohol on a lint-free cloth to clean any external metal surface of the AMG-GR.

WARNING: **General Hazard Warning!** Make sure that all solvent has completely evaporated before you move the stage.

Lubrication

For the worm gear drive mechanism, use Mobil Mobilith SHC 100 grease unless otherwise specified.

AMG-GR rotary stages are designed for easy maintenance of the worm drive system. The drive mechanism can be lubricated while the stage is under power and integrated in upper level systems provided that access to the lubrication ports is maintained. Locations of the lubrication ports are shown in Figure 4-1. Prior to adding lubrication at the designated ports, make sure the surrounding surfaces are clean.

While the stages rotate (<5 rpm), slowly inject approximately 6 cc's of lubricant into each of the stage's ports. Wipe clean any excess lubricant.

Figure 4-2 shows the effect of the addition of lubricant to the current draw of a typical AMG-GR stage. With the added lubricant the resulting current pull is much smoother, leading to much better mechanical performance and maximum life of the product.

Figure 4-1: Lubrication Ports

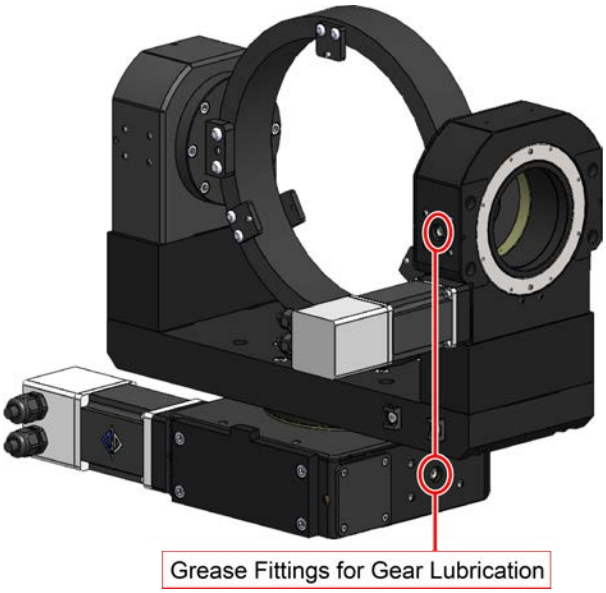
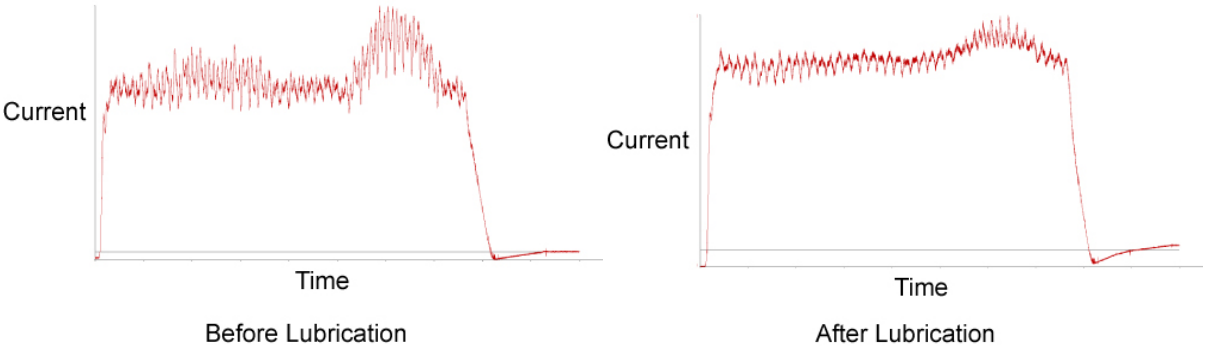


Figure 4-2: View of the Current Draw of a Typical AMG-GR Stage Before and After Lubrication



4.3. Troubleshooting

Table 4-1: 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: Electrical Installation) 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: Electrical Installation and Controller documentation). • Motor Connections (refer to Chapter 3: Electrical Installation and the Controller documentation).
Stage oscillates or squeals	• Gains misadjusted (refer to the Controller documentation). • Encoder signals (refer to the Controller documentation).

Appendix A: Warranty and Field Service

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

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

Return Products Procedure

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

Visit Global Technical Support Portal for the location of your nearest Aerotech Service center.

Returned Product Warranty Determination

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

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

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

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

Rush Service

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

On-site Warranty Repair

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

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

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

On-site Non-Warranty Repair

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

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

Service Locations

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

USA, CANADA, MEXICO
Aerotech, Inc.
Global Headquarters

CHINA
Aerotech China
Full-Service Subsidiary

GERMANY
Aerotech Germany
Full-Service Subsidiary

TAIWAN
Aerotech Taiwan
Full-Service Subsidiary

UNITED KINGDOM
Aerotech United Kingdom
Full-Service Subsidiary

Appendix B: Revision History

Revision	General Information
2.00	General product and manual update
1.01	Revision changes have been archived. If you need a copy of this revision, contact Aerotech Global Technical Support.
1.00	

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