



# PlanarHD Two-Axis Air-Bearing Direct-Drive Linear Stage

## HARDWARE MANUAL

Revision 2.00



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## EU Declaration of Incorporation

**Manufacturer:** Aerotech, Inc.  
**Address:** 101 Zeta Drive  
 Pittsburgh, PA 15238-2811  
 USA  
**Product:** PlanarHD - linear positioning stage  
**Models:** All

***This is to certify that the aforementioned product is in accordance with the applicable requirements of the following directive.***

2006/42/EC

*Machinery Directive (partially completed machinery)*

1.1 General Remarks

1.1.2 Principles of safety integration

1.1.5 Design of machinery to facilitate handling

1.2 Control Systems

1.2.1 Safety and reliability of control systems

1.3 Protection against mechanical hazards

1.3.1 Risk of loss of stability

1.3.2 Risk of breakup during operation

1.3.3 Risks due to falling or ejected objects

1.3.4 Risks due to surfaces, edges, or angles

1.5 Risks due to other hazards

1.5.4 Error of fitting

1.5.9 Vibrations

1.6 Maintenance

1.6.5 Cleaning of internal parts

1.7 Instructions

1.7.4.1 Instructions

***and that the following harmonized European standards have been applied:***

EN ISO 12100

*Safety of machinery – Basic concepts, general principles for design*

EN 60204-1:2018

*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

***and furthermore declares that***

the equipment shall not be put 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. Technical documentation showing compliance with this declaration in accordance with Annex VII part B will be provided in digital format upon request.

**Authorized Representative:**

Managing Director  
 Aerotech GmbH  
 Gustav-Weißenkopf-Str. 18  
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Jochen Jäger

**Engineer Verifying Compliance:**

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

Alex Weibel

Date: 4/11/2025



# AEROTECH UKCA Declaration of Incorporation

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

*herewith declares that the following Aerotech stage series:*

PlanarHD

**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  
Restricted Substances Directive

**Using the relevant section of the following UK designated standards and other normative documents when installed in accordance with the installation instructions supplied by the manufacturer:**

EN ISO 12100  
*Safety of machinery – Basic concepts, general principles for design*  
EN 60204-1:2018  
*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.

**Authorized Representative:**

Managing Director  
Aerotech Ltd.  
The Old Brick Kiln  
Ramsdell, Tadley  
Hampshire RG26 5PR  
UK

Simon Smith

Date: 4/11/2025

**Engineer Verifying Compliance:**

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

Alex Weibel



## RoHS Conformity Declaration

**Manufacturer:** Aerotech, Inc.  
**Address:** 101 Zeta Drive  
Pittsburgh, PA 15238-2811  
USA  
**Product:** PlanarHD - linear positioning stage  
**Models:** All

***This is to certify that the aforementioned product is in accordance with the applicable requirements of the following directive:***

(EU) 2015/863 restriction of the use of hazardous substances (RoHS3)

## Safety Procedures and Warnings

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

- Read all parts of this manual before you install or operate the stage 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](http://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.
- Make sure that all pneumatic lines are securely connected.
- Use care when you move the stage 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 operate a 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.

- When the system is not electrically energized (disabled), linear stage/motors can still allow a stage carriage to move freely. This can create mechanical hazards such as pinch or crush points.
- 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 in 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

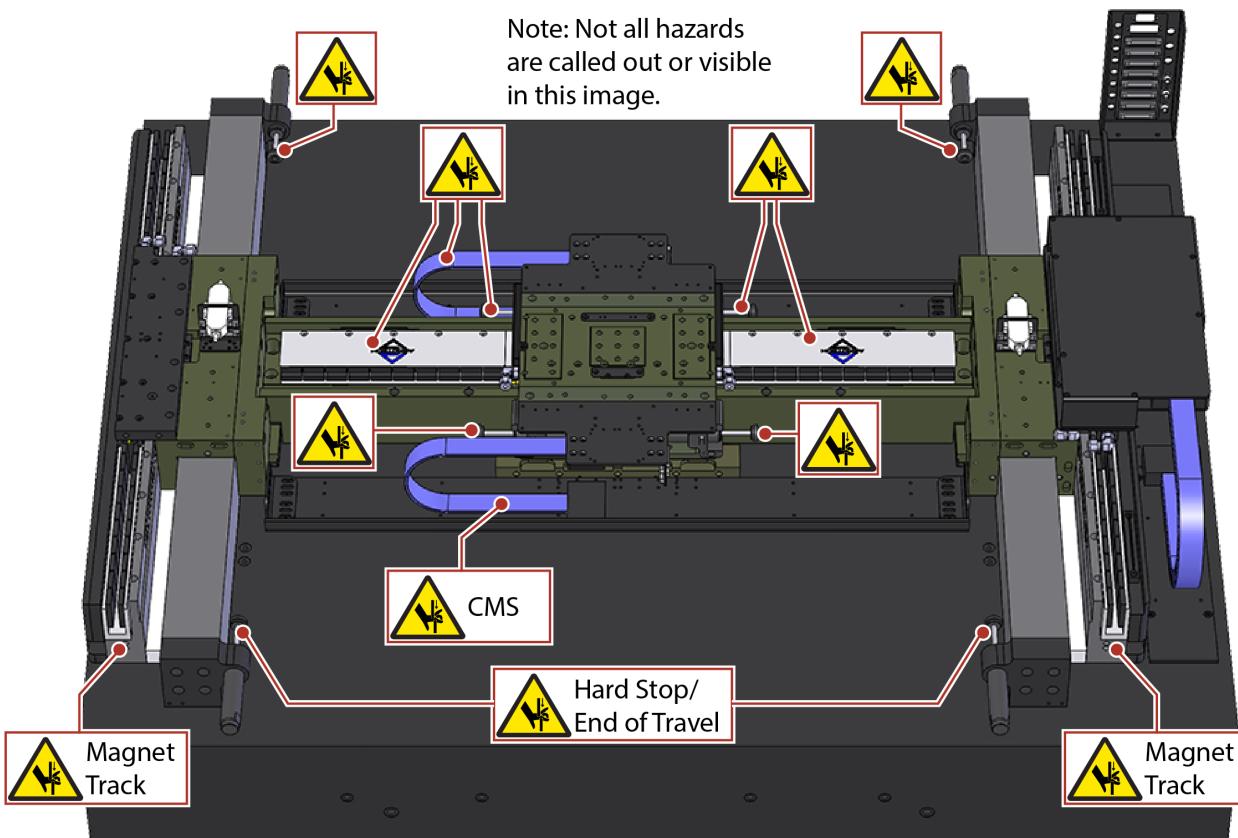
A pinch point is a mechanical hazard that can occur when there are exposed parts of the stage or system that can move. For example, the travel of a stage tabletop could expose the user to a pinch point between the tabletop and the stage housing. The images that follow will show you typical external and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

**DANGER: Pinch Points!** Due to the open-frame design, treat all areas exposed to the operator as possible pinch points. This includes at the hard stops, the stage table during travel, the cable management system, and the magnet tracks.

Figure 1: Typical Pinch Point Locations



## Magnetic Hazards

The magnet tracks are exposed during normal operation or when you do maintenance to the system.



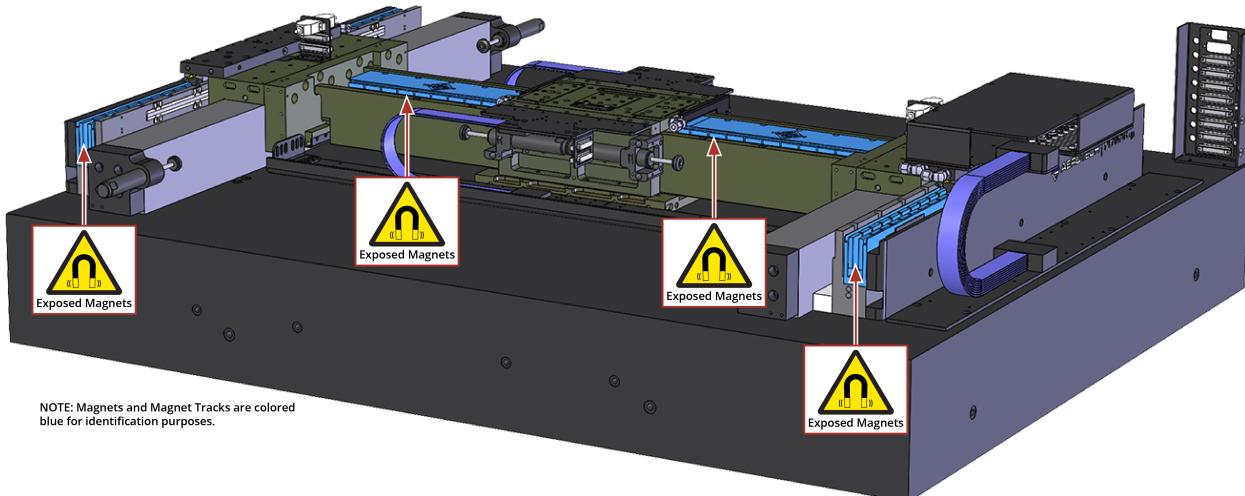
### DANGER: Magnetic Field Hazard!

- Only qualified, trained personnel should be allowed to have access to exposed magnet tracks during setup or when you do maintenance.
- Strong magnetic fields are present near and inside the magnet track assembly.
- Do not disassemble the magnet track components. If you do so, you will expose yourself to mechanical crush, pinch, or impact hazards.
- Magnetic fields could interfere with external or internal medical devices (pacemakers, for example).
- Magnetic fields can create mechanical hazards (crush, impact, or pinch points, for example).
- Loose items such as metallic tools, watches, or keys could get drawn into and damage the magnet track assembly.



**IMPORTANT:** Use non-magnetic tools when you install or do service to the stage.

Figure 2: Exposed Magnet Locations



## Handling and Storage



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

- Be careful when you move or transport the stage.
- Retain the shipping materials for future use.
- Transport or store the stage 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.

Failure to observe the correct ESD practices could cause ESD damage to stage electronics, system drives, and/or power supplies.

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 stage 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 stage.



**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 stage 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 stage. Unsecured moving parts could shift and cause injury or damage to the equipment.
- Use mechanical assistance when you lift or move the stage.
  - Refer to [Section 2.1. Dimensions](#) for dimensions.
  - Refer to the associated approval drawing or contact an Aerotech representative for stage mass specifications.

## Lifting



**IMPORTANT:** Manually lifting and moving the stage is not recommended.

- Lift the stage **only** by the lifting inserts in the granite base (refer to [Figure 3](#)).
- Do not use any of the cables as lifting points.

Carefully remove the stage from its protective shipping container.

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 Clamps



### DANGER: Mechanical Hazard!

The air supply must be connected BEFORE you remove any shipping brackets. You can cause permanent damage to the stage if you move the stage table without the air supply installed. Refer to [Section 1.4](#).



### DANGER: Mechanical Hazard!

- The product can move manually without electrical power connected.
- When the shipping clamps are removed, the operator could be exposed to pinch points.

Red (anodized aluminum or painted steel) shipping clamps have been installed to prevent unwanted motion and potential damage from occurring during shipment. The clamps must be removed before the stage can be operated. Retain the clamps and hardware for future use.

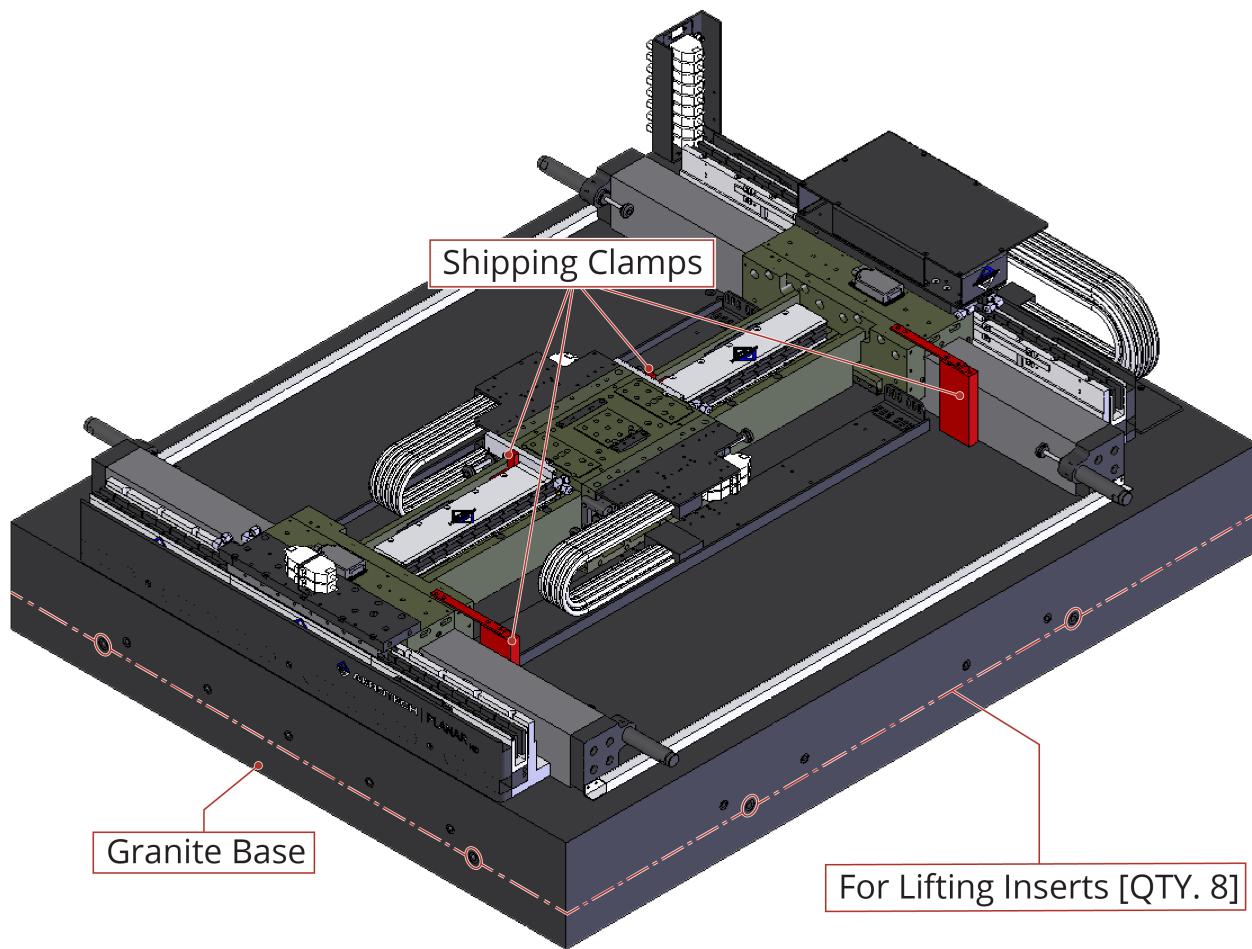
If you must reinstall the shipping clamps: It is important that the clamp is fully seated on both mounting surfaces before the screws are tightened. If this step is not done, the carriage parts will deform when the clamp is mounted, which could adversely affect stage performance or possibly cause a failure during shipment.



### DANGER: Mechanical Hazard!

- The product can move manually without electrical power connected.
- When the shipping brackets are removed, the operator could be exposed to pinch points.

Figure 3: Shipping Clamps and Granite Lifting Locations



### Storage

Store the stage in the original shipping container. If the original packaging included ESD protective packaging, make sure to store the stage 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

PlanarHD Two-Axis Air-Bearing Direct-Drive Linear Stage	
PLANAR HD-350-350	350 mm Scan Axis Travel, 350 mm Step Axis Travel
PLANAR HD-350-500	350 mm Scan Axis Travel, 500 mm Step Axis Travel
PLANAR HD-350-650	350 mm Scan Axis Travel, 650 mm Step Axis Travel
PLANAR HD-500-350	500 mm Scan Axis Travel, 350 mm Step Axis Travel
PLANAR HD-500-500	500 mm Scan Axis Travel, 500 mm Step Axis Travel
PLANAR HD-500-650	500 mm Scan Axis Travel, 650 mm Step Axis Travel
PLANAR HD-650-350	650 mm Scan Axis Travel, 350 mm Step Axis Travel
PLANAR HD-650-500	650 mm Scan Axis Travel, 500 mm Step Axis Travel
PLANAR HD-650-650	650 mm Scan Axis Travel, 650 mm Step Axis Travel
Encoder Options	
Contact an Aerotech Application Engineer for available options.	

## 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 in 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**

<b>Ambient Temperature</b>	Operating: The optimal operating temperature is $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ( $68^{\circ}\text{F} \pm 4^{\circ}\text{F}$ ). If at any time the operating temperature deviates from $20^{\circ}\text{C}$ , degradation in performance could occur. Storage: $0^{\circ}\text{C}$ to $40^{\circ}\text{C}$ ( $32^{\circ}\text{F}$ to $104^{\circ}\text{F}$ ) in original shipping packaging
<b>Humidity</b>	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.
<b>Altitude</b>	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.
<b>Vibration</b>	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.
<b>Protection Rating</b>	The PlanarHD has some protection from contamination due to the cutting process. However, the stage is not sealed. Dust and chips from the cutting process should be removed from the cut point with blow-off gas and a vacuum. Failure to control this debris could result in damage to the stage. Not suited for dusty or wet environments (IP00 equivalent ingress protection rating).
<b>Use</b>	Indoor use only

### 1.1.1. Accuracy and Temperature Effects

Aerotech products are designed for and built in a  $20^{\circ}\text{C}$  ( $68^{\circ}\text{F}$ ) environment. Temperature changes could cause a decrease in performance or permanent damage to the stage. At a minimum, the environmental temperature must be controlled to within  $0.25^{\circ}\text{C}$  per 24 hours to ensure the stage 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 stage is mounted. Contact the factory for more details.

## 1.2. Basic Specifications

Table 1-3: PlanarHD Series Specifications

		PlanarHD
Travel <sup>(7)</sup>	Scan Axis	500 mm
	Step Axis	500 mm
Accuracy (Zero Expansion Scale) <sup>(1)</sup>		±300 nm
Repeatability (Long Term)		±50 nm
XYZ Position Stability (On Air)		20 nm
Granite Base Thickness		250 mm
Rated Payload (Maintaining Dynamic Specifications)		5 kg
Maximum Payload <sup>(2)</sup>		30 kg
Maximum Velocity with Rated Payload <sup>(3)</sup>	Scan Axis	2000 mm/s
Peak Acceleration with Rated Payload	Scan Axis	5 g
RMS Acceleration with Rated Payload	Scan Axis	1.25 g
Stiffness, First Natural Frequency, Rated Payload		>330 Hz
Pitch		3.5 arc sec
Roll		3.5 arc sec
Yaw		3.5 arc sec
XY Orthogonality <sup>(4)</sup>		1 arc sec
Mean Time Before Failure		>40,000 hours

(1) Available with Aerotech controllers and calibration.  
 (2) Maximum load based on bearing capability. Maximum application load may be limited by acceleration requirements.  
 (3) Maximum speed based on stage capability. Maximum application velocity may be limited by system data rate and system resolution.  
 (4) Requires calibration  
 (5) To protect air bearing against under-pressure, an in-line pressure switch tied to the motion controller/amplifier E-Stop is recommended.  
 (6) Air supply must be clean, dry to 0° F dew point and filtered to 0.25 µm or better. Recommend nitrogen at 99.9% purity.  
 (7) Travel can be customized to meet application-specific requirements. Consult Aerotech for other travel options.

### 1.3. Vacuum Operation

The PlanarHD is an air-bearing stage and is not compatible with operation in a vacuum environment. Contact Aerotech for alternate solutions.

Refer to [Section 1.4.](#) for information about the vacuum connections.

## 1.4. Air Requirements



### DANGER: Compressed Air.

Improper release could result in injury.



Wear appropriate personal protective equipment (PPE) such as safety glasses when in proximity to the stage or the air source.

The air supply to the system should be clean and liquid water should not be present.

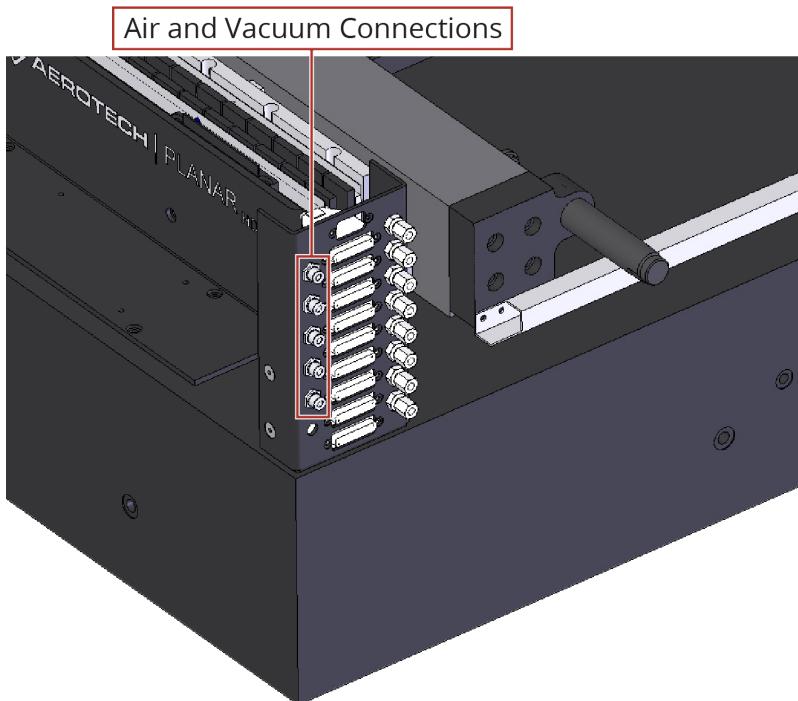
- If nitrogen is used, it must be 99.99% pure and filtered to 0.25 microns. [Recommended]
- If compressed air is used, it must be filtered to 0.25 microns, dry to 0° F dew point, and oil free.

Air pressure must be in the range of  $551 \text{ kPa} \pm 34 \text{ kPa}$  (80 psi  $\pm 5$  psi) with an airflow rate of 45 to 55 SLPM (standard liters per minute) at 551 kPa for a single axis. Aerotech recommends that you connect the air supply with a polyurethane air hose.

Aerotech also recommends that you install a pressure switch (Aerotech P/N: MCA03094) tied to the motion controller's emergency stop (ESTOP) that will remove power to the air bearing if pressure drops below 40 psi (a drop in pressure could result in contact between bearing surfaces which could cause damage to the surfaces). Aerotech's ABF accessory kit incorporates air filtration plus a pressure monitoring switch. The pressure switch should be set to 60 psi for high dynamic applications and no lower than 40 psi for slow speed applications.

Vacuum in the range of 18 to 20 inches of Mercury is necessary for the proper preloading of the scan carriage air bearing. A standard vacuum-flow rate of 4.5 SLPM at 20 inches of Mercury should be observed. Refer to [Figure 1-1](#) for the air and vacuum connection locations.

**Figure 1-1: Air and Vacuum Connections**



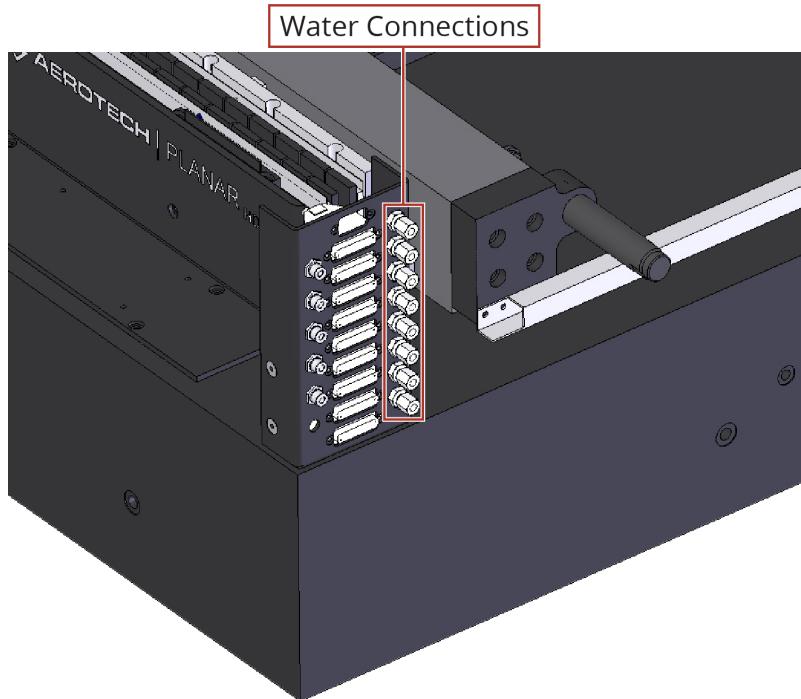
## 1.5. Water Cooling Requirements

There are three water cooling circuits in the PlanarHD that require a source of distilled, temperature controlled water. A chiller will be sized based on the specific duty cycle of the stage for intended process. Refer to [Figure 1-2](#) for the water connection locations.



**IMPORTANT:** Use distilled water with the PlanarHD water cooling system. The use of de-ionized water, un-distilled water, or other coolants may lead to corrosion and failure of certain water cooling system components. Before employing a coolant other than distilled water, contact the factory to discuss the specifics of your application.

**Figure 1-2: Water Connections**



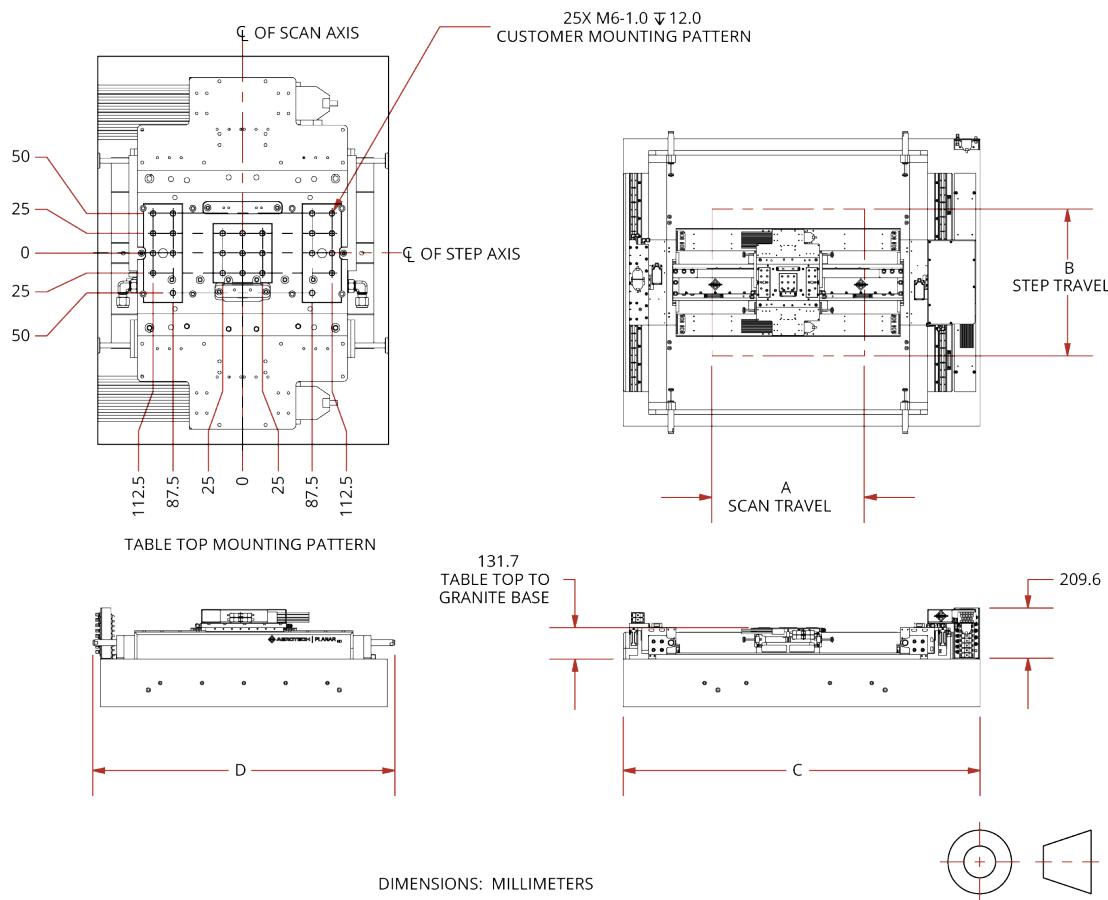
## Chapter 2: Installation

The stage 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: PlanarHD Dimensions

STAGE	A	B	C	D
PLANAR HD-350-350	350	350	1345	1116
PLANAR HD-350-500	350	500	1345	1266
PLANAR HD-350-650	350	650	1345	1416
PLANAR HD-500-350	500	350	1495	1116
PLANAR HD-500-500	500	500	1495	1266
PLANAR HD-500-650	500	650	1495	1416
PLANAR HD-650-350	650	350	1645	1116
PLANAR HD-650-500	650	500	1645	1266
PLANAR HD-650-650	650	650	1645	1416



## 2.2. 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 payload 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 PlanarHD 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 PlanarHD 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.

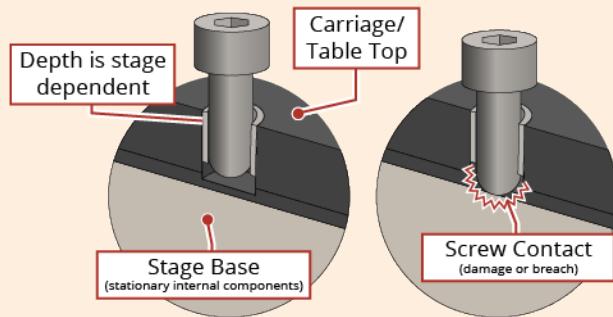
**Table 2-1: Payload Mounting Surface Flatness Requirement**

Stage Travel	Flatness Requirement
All Travels	1 $\mu\text{m}$ per 50 mm

### WARNING: General Hazard Warning!

Be careful when you attach the payload to the stage mounting surface.

- If a mounting screw extends through the carriage/table top, it can affect travel and damage the stage.
- Refer to the dimensions in [Section 2.1.](#) for maximum allowable thread engagement.
- **Mounting Hole Cutaway (Generic):**



Applied loads should be symmetrically distributed whenever possible. The payload should be centered on the stage mounting surface and the entire stage should be centered on the support structure.

## 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 PlanarHD 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 PlanarHD into a completed system. Failure to do so could expose the operator to electrical or mechanical hazards.

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 PlanarHD is part of a complete Aerotech motion control system, setup should only require that you connect the stage 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.

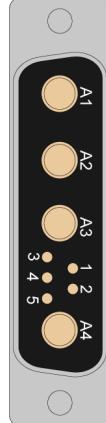
The protective ground connection of the PlanarHD provides motor frame ground protection only. Additional grounding and safety precautions are required for applications requiring access to the stage while it is energized. The System Integrator or qualified installer is responsible for determining and 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**

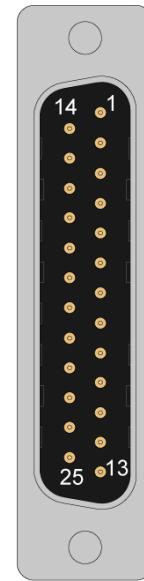
Pin	Description	Connector
Case	Shield Connection	
A1	Motor Phase A	
A2	Motor Phase B	
A3	Motor Phase C	
1	Reserved	
2	Reserved	
3	Reserved	
4	Reserved	
5	Reserved	
A4	Frame Ground (motor protective ground)	

**Table 3-2: 4-Pin Motor Mating Connector Part Numbers**

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: X-Axis Feedback Connector Pinout**

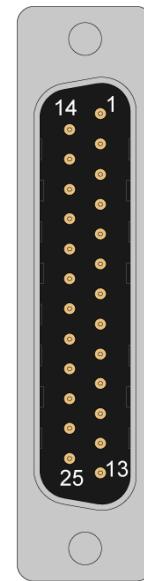
Pin	Description	Connector
Case	Shield Connection	
1	Reserved	
2	Over-Temperature Thermistor Sensor	
3	5V Power Supply Input (connected internally to Pin-16)	
4	Reserved	
5	Hall Effect Sensor (Phase B)	
6	MRK- (Encoder Marker-)	
7	MRK+ (Encoder Marker+)	
8	Reserved	
9	Setup	
10	Hall Effect Sensor (Phase A)	
11	Hall Effect Sensor (Phase C)	
12	+/CW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the "machine positive" or "machine clockwise" direction.)	
13	Brake +	
14	COS+ (Encoder Cosine+)	
15	COS- (Encoder Cosine-)	
16	5V Power Supply Input (connected internally to Pin-3)	
17	SIN+ (Encoder Sine+)	
18	SIN- (Encoder Sine-)	
19	Reserved	
20	Common ground (connected internally to Pin-21)	
21	Common ground (connected internally to Pin-20)	
22	Home Limit	
23	ENC FLT (fault output from the encoder)	
24	-/CCW LMT (End-of travel limit signal that indicates maximum permitted stage travel in the "machine negative" or "machine counter-clockwise" direction.)	
25	Brake -	

**Table 3-4: 25-Pin Feedback Mating Connector Part Numbers**

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: Y-Axis Feedback Connector Pinout**

Pin	Description	Connector
Case	Shield Connection	
1	Reserved	
2	Over-Temperature Thermistor Sensor	
3	5V Power Supply Input (connected internally to Pin-16)	
4	Reserved	
5	Hall Effect Sensor (Phase B)	
6	MRK- (Encoder Marker-)	
7	MRK+ (Encoder Marker+)	
8	Reserved	
9	Setup	
10	Hall Effect Sensor (Phase A)	
11	Hall Effect Sensor (Phase C)	
12	Reserved	
13	Reserved	
14	COS+ (Encoder Cosine+)	
15	COS- (Encoder Cosine-)	
16	5V Power Supply Input (connected internally to Pin-3)	
17	SIN+ (Encoder Sine+)	
18	SIN- (Encoder Sine-)	
19	Reserved	
20	Common ground (connected internally to Pin-21)	
21	Common ground (connected internally to Pin-20)	
22	Reserved	
23	ENC FLT (fault output from the encoder)	
24	Reserved	
25	Reserved	

**Table 3-6: 25-Pin Feedback Mating Connector Part Numbers**

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

### 3.2. Motor and Feedback Wiring

Shielded cables are required for the motor and feedback connections.

**Figure 3-1: X-Axis Motor and Feedback Wiring**

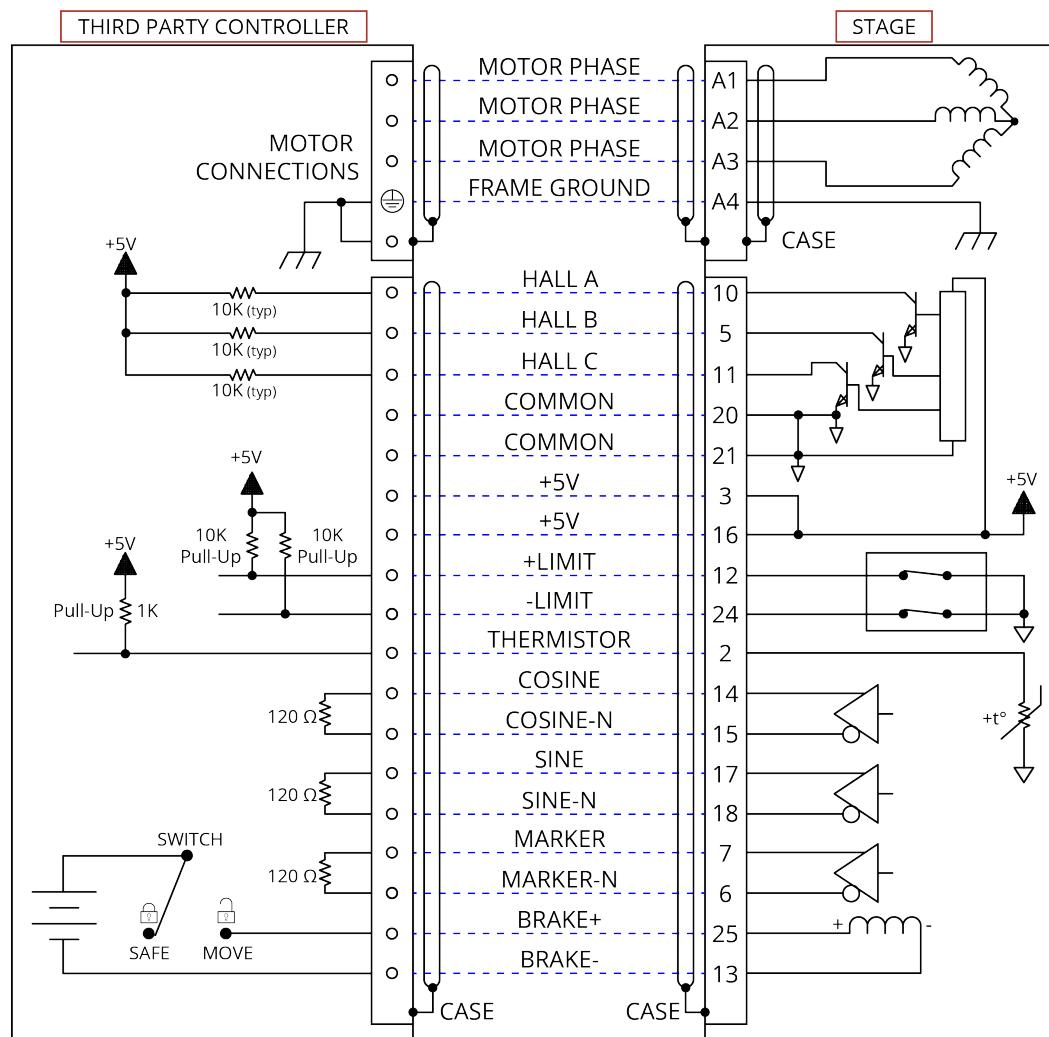
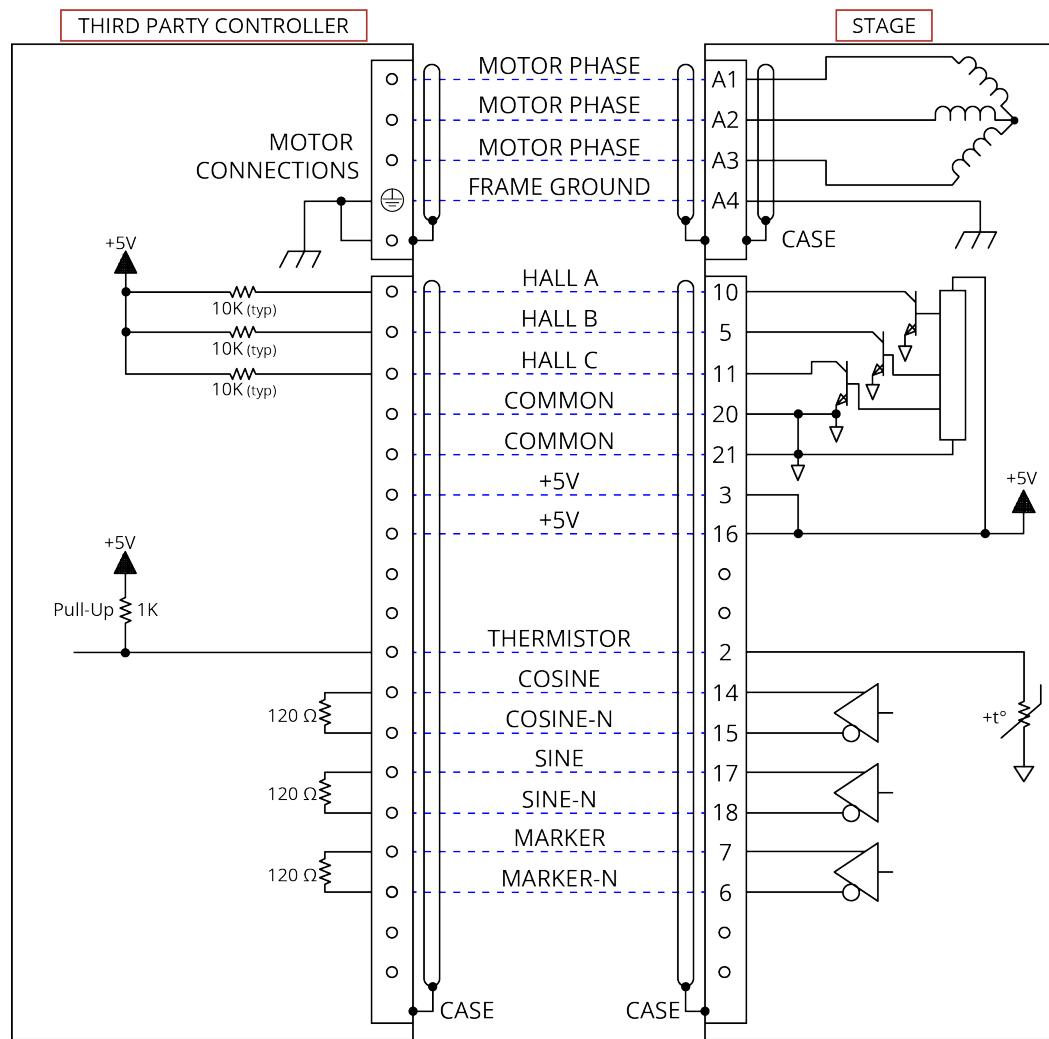


Figure 3-2: Y-Axis Motor and Feedback Wiring



### 3.3. Motor and Feedback Specifications

All 5 V supplies share one common connection within the stage. Specifications are per axis.

**Table 3-7: Hall-Effect Sensor Specifications**

Specification	
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)

**Table 3-8: Thermistor Specifications**

Specification	
Polarity	Logic "0" (no fault)
	Logic "1" (over-temperature fault)
Cold Resistance	$\sim 100 \Omega$
Hot Resistance	$\sim 10 \text{ K}$
<b>Note:</b>	1K pull-up to +5V recommended.

**Table 3-9: Encoder Specifications**

Specification	
Supply Voltage	5 V $\pm 10\%$
Supply Current	250 mA (typical)
Output Signals	<b>Sinusoidal Type (Incremental Encoder):</b> Analog: SIN+, SIN-, COS+, COS-, 1V pk-pk; Digital (RS422): MRK+, MRK- signals.
	<b>Digital Output (Incremental Encoder):</b> Digital encoder line-driver signals; RS422/485 compatible

**Table 3-10: Encoder Resolution**

	Fundamental Signal Period	Digital Resolution
1 Vpp	20 $\mu\text{m}$	-
1 Vpp (with x4000 Interpolation <sup>1</sup> )		5 nm
1 Vpp (with x16000 Interpolation <sup>1</sup> )		1.25 nm
0.1 $\mu\text{m}$ Digital Encoder <sup>1</sup>		100 nm
1. Quadrature decoding included in interpolated resolution calculations		

**Table 3-11: Limit Switch Specifications**

Specification	
Supply Voltage	Generated by encoder.
Supply Current	Open Collector connected to pull-up resistor
Output Type	5 V to 24V DC
Max Current (sinking)	Not to exceed 20 mA
Output Polarity (Factory Configured)	<b>Normally Closed (NC)</b> <ul style="list-style-type: none"> <li>Sinks current to ground (Logic "0") when not in limit</li> <li>High impedance (Logic "1") when in limit</li> <li>Requires external pull-up to +5 V (10 k<math>\Omega</math> recommended)</li> </ul>
(1) If the 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.	
(2) Stage limit options are factory-configured as NC (standard) or NO.	

**Table 3-12: BLM-264-A Motor Specifications**

		BLM-264
<b>Performance Specifications</b>		
Winding Designation		-A
Continuous Force, 1.4 bar (20 psi)	N	301.7
Continuous Force, No Forced Cooling	N	197.2
Peak Force	N	1,206.6
<b>Electrical Specifications</b>		
Winding Designation		-A
BEMF Constant (line-line, max)	V/(m/s)	44.46
Continuous Current 1.4 bar (20 psi)	A	7.80
Continuous Current, No Forced Cooling	A	5.10
Peak Current, Stall	A	31.20
Force Constant, Sine Drive	N/A	38.67
Motor Constant	N/ $\sqrt{W}$	16.39
Resistance, 25 °C (line-line)	$\Omega$	5.3
Inductance (line-line)	mH	4.20
Thermal Resistance, 1.4 bar (20 psi)	°C/W	0.30
Thermal Resistance, No Forced Cooling	°C/W	0.69
Magnetic Pole Pitch	mm	30.48
(1) Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature.		
(2) All performance and electrical specifications have a tolerance of $\pm 10\%$ .		
(3) Values shown @ 100 °C rise above a 25 °C ambient temperature, with motor mounted to the specified aluminum heat sink.		
(4) Peak force assumes correct rms current; consult Aerotech.		
(5) Force constant and motor constant specified at stall		
(6) All Aerotech amplifiers are rated $A_{pk}$ ; use force constant in N/ $A_{pk}$ when sizing.		
(7) All Aerotech motors and amplifiers are rated using vector amplitude values. For sinusoidal signals, use sine wave peak value.		

**Table 3-13: BLM-325-A Motor Specifications**

		<b>BLM-325</b>
<b>Performance Specifications</b>		
Winding Designation		-A
Continuous Force, 1.4 bar (20 psi)	N	332.2
Continuous Force, No Forced Cooling	N	230.7
<b>Electrical Specifications</b>		
Winding Designation		-A
BEMF Constant (line-line, max)	V/(m/s)	53.03
Continuous Current 1.4 bar (20 psi)	A	7.20
Continuous Current, No Forced Cooling	A	5.00
Peak Current, Stall	A	28.80
Force Constant, Sine Drive	N/A	46.13
Motor Constant	N/ $\sqrt{W}$	17.66
Resistance, 25 °C (line-line)	$\Omega$	6.5
Inductance (line-line)	mH	5.20
Thermal Resistance, 1.4 bar (20 psi)	°C/W	0.28
Thermal Resistance, No Forced Cooling	°C/W	0.59
(1) Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature. (2) All performance and electrical specifications have a tolerance of $\pm 10\%$ . (3) Values shown @ 100 °C rise above a 25 °C ambient temperature, with motor mounted to the specified aluminum heat sink. (4) Peak force assumes correct rms current; consult Aerotech. (5) Force constant and motor constant specified at stall (6) All Aerotech amplifiers are rated $A_{pk}$ ; use force constant in N/ $A_{pk}$ when sizing. (7) All Aerotech motors and amplifiers are rated using vector amplitude values. For sinusoidal signals, use sine wave peak value.		

### 3.4. Limits, Marker, and Machine Direction

Aerotech stages have both a positive and negative **Machine Direction** and a positive and negative **Programming Direction**.

**Machine Direction:** The machine direction is defined by how the encoder and motor are mounted and the electrical wiring connections in the stage.

**Programming Direction:** Your system controller defines the programming direction of the stage and is application specific. A positive programmed move may or may not agree with the machine positive direction. Refer to your programming help documentation for more information.

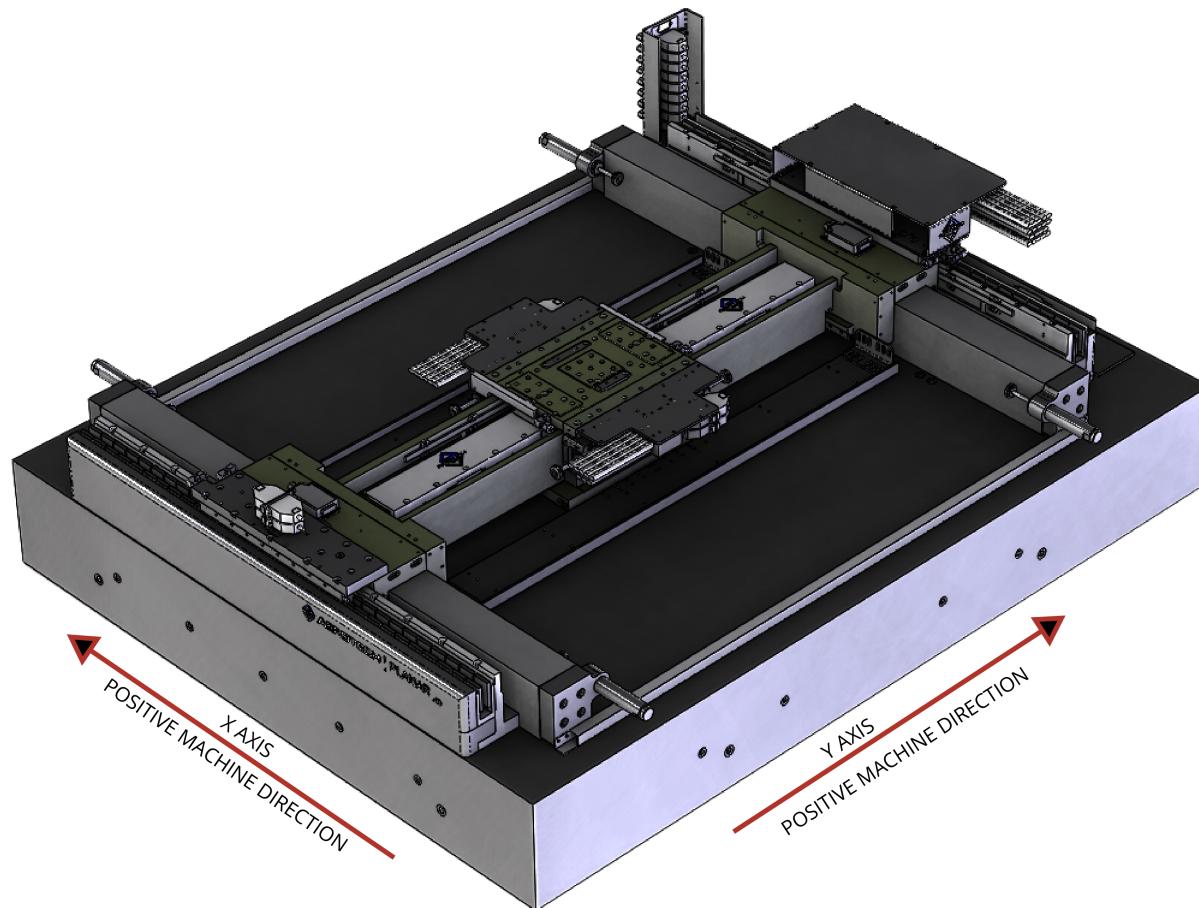


**WARNING:** If the stage is driven beyond the electrical limit, it will encounter a mechanical stop. The approximate distance between the electrical limit and the mechanical stop:

- Scan Axis: 69.4 mm
- Step Axis: 55.9 mm

Impacting the mechanical stop could cause damage to the stage even at low speeds.

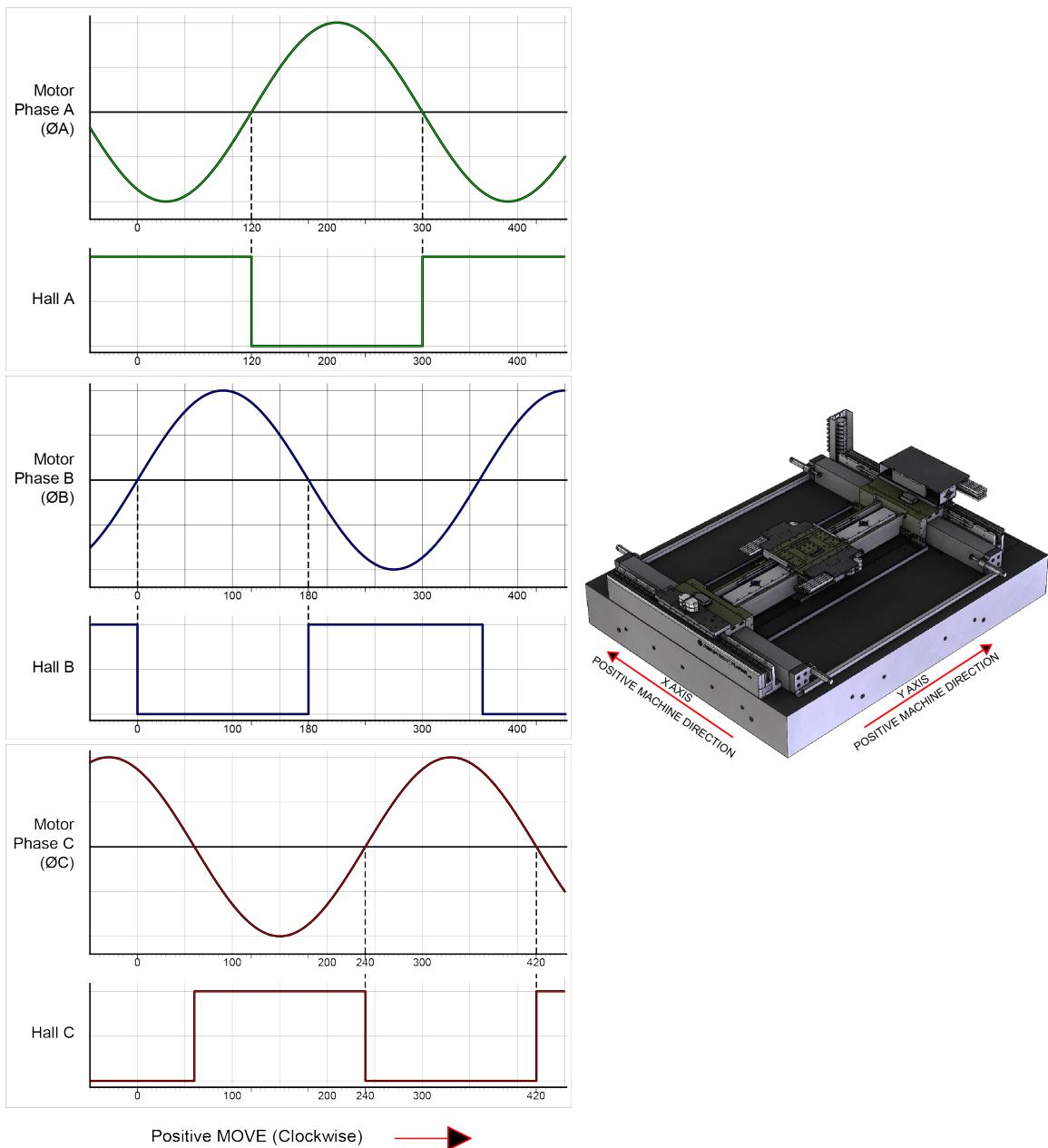
Figure 3-3: Machine Direction

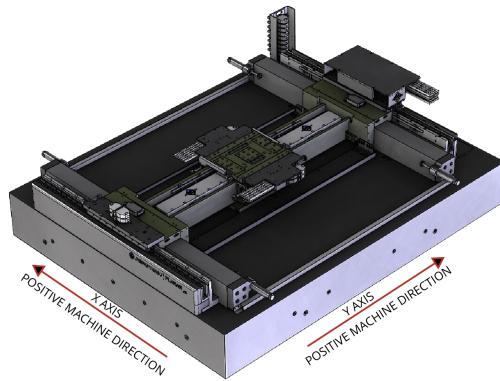
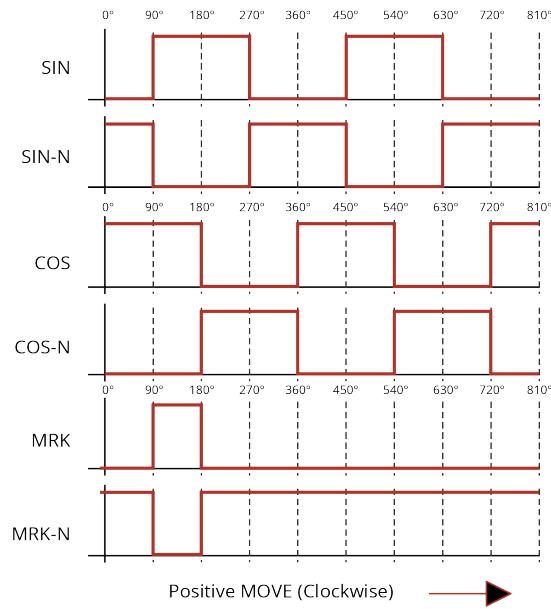
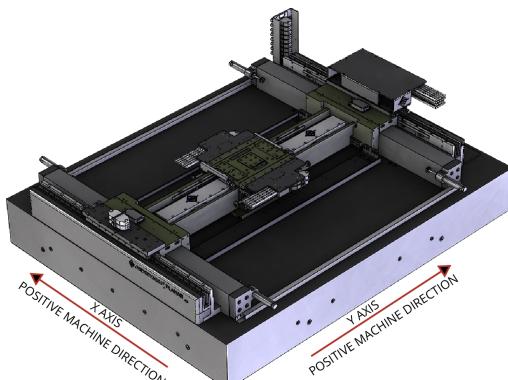
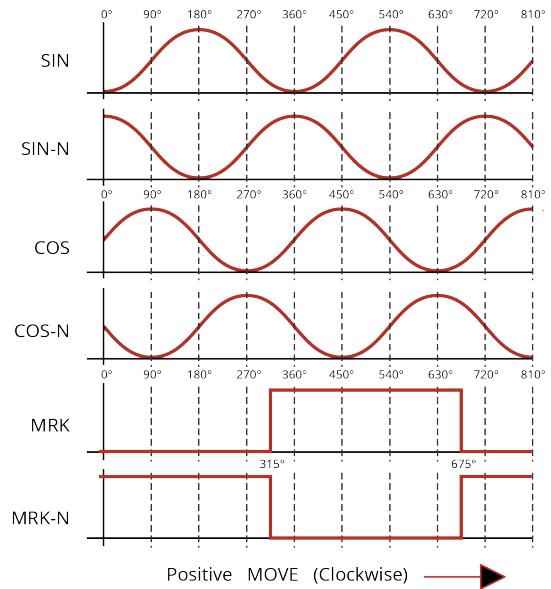


### 3.5. Motor and Feedback Phasing

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: Digital Encoder Phasing Reference Diagram (Sine Wave)**

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## Chapter 4: Maintenance



**IMPORTANT:** Air-bearing systems require precision manufacturing and proprietary assembly techniques. Parts with critical surfaces are not field-serviceable. The standard product warranty does not cover repair service for air-bearing products that have been adjusted, modified, or disassembled outside the Aerotech factory.

**Adjusting, modifying, or disassembling any air bearing-related component will void the product warranty.**

Contact Aerotech Global Technical Support with any questions related to air-bearing products.



**IMPORTANT:** Read the [Safety Procedures and Warnings](#) (on [Page 9](#)) before you do maintenance to the stage.



**IMPORTANT:** Keep the bearing area free of foreign matter and moisture or the performance and life expectancy of the stage will be reduced.

### 4.1. Service and Inspection Schedule

Inspect the PlanarHD 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 PlanarHD and any components and cables as needed.
- Repair any damage before operating the PlanarHD.
- 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.



**DANGER: Mechanical Hazard!** When you move the tabletop manually to do maintenance, this could expose the operator to pinch points. Refer to [Pinch Points on Page 13](#).



**DANGER: Magnetic Field Hazard!** When you move the tabletop manually to do maintenance, this could expose the operator to the magnet track. Refer to [Magnetic Hazards on Page 14](#).



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

In general, stages operating in a clean environment should be cleaned every six months or 100 km (whichever comes first). For stages operating under dirtier or harsher conditions, the cleaning interval should occur more frequently as determined by the end-user monitoring the application. For high-speed applications (those near max speed at a duty cycle of 50%), more frequent maintenance could be required.

When you clean components of the PlanarHD series stage:

1. Use a clean, dry, soft, lint-free cloth for cleaning.
2. Before you use a cleaning solvent on any part of the stage, 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.

### Cleaning

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



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

**Table 4-1: Recommended Cleaning Solvents**

Item	Recommended Cleaner
Encoders, Magnets	Isopropyl Alcohol
Hard-Coated Aluminum	Acetone <sup>(1)</sup>
Granite	Surface plate cleaner <sup>(2)</sup>

(1) Acetone should not be used on:

- Magnet Tracks. It can break down the epoxy that holds the magnets in place.
- Encoder Scales. It can permanently damage the encoder scales.

(2) Surface plate cleaner is available from precision granite manufacturers.

### Lubrication

There are no elements on PlanarHD stages that require lubrication.

### 4.3. Troubleshooting

Symptom	Possible Cause and Solution
Stage will not move	Shipping brackets still installed. Remove the red anodized shipping brackets. Brake not released (if equipped with brake). In Limit condition. Check limits (refer to <a href="#">Chapter 3: Electrical Installation</a> ) 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 <a href="#">Chapter 3: Electrical Installation</a> and Controller documentation). Motor Connections (refer to <a href="#">Chapter 3: Electrical Installation</a> and the Controller documentation).
Stage oscillates or squeals	Gains misadjusted (refer to the Controller documentation). Encoder signals (refer to the 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](http://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	<ul style="list-style-type: none"><li>• General revision</li><li>• Updated Declaration of Incorporation</li><li>• Updated Safety and Warning information</li></ul>
1.01	Revision changes have been archived. If you need a copy of this revision, contact Aerotech
1.00	Global Technical Support.

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