User Manual

A131D001 Rev 1.1
3-Dec-2021

A-131 Series Voice Coil Linear Air Bearing Stage

This document describes the A-131 Series of Linear Air Bearing Motorized Stages.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

Table of Contents

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

Table of Figures

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

1. About this Document

1.1. Objective and Target Audience of this User Manual

This manual contains information on the intended use of the A-131 series of linear motor-driven air bearing stages. It assumes that the reader has a fundamental understanding of basic servo systems as well as motion control concepts and applicable safety procedures.

1.2. Symbols and Typographic Conventions

The following symbols and markings are used in this User Manual:

Symbol	Meaning
	If not avoided, the situation could result in damage to the equipment.
	Failure to observe these precautions could result in serious injury to those performing the procedures and damage to the equipment.
1. 2.	Action consisting of several steps whose sequential order must be observed
➢	Action consisting of one or several steps whose sequential order is irrelevant

1.3. Other Applicable Documents

None at this time

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

2. Safety

2.1. Intended Use

The A-131 is a laboratory device as defined by DIN EN 61010. It is intended to be used in interior spaces and in an environment which is free of dirt, oil and lubricants.

In accordance with its design and realization, the A-131 is intended for single-axis positioning of loads at different velocities. The A-131 is not intended for applications in areas in which a failure would present severe risks to human beings or the environment.

The A-131 is intended for mounting only in which the surface to which the stage is mounted is parallel to the plane of the ground (i.e. horizontal).

The intended use of the A-131 is only possible when completely mounted and connected.

The A-131 must be operated with a suitable controller. The controller is not included in the scope of delivery of the A-131.

2.2. General Safety Instructions

The A-131 is built according to state-of-the-art technology and recognized safety standards. Improper use can result in personal injury and/or damage to the A-131.

- Only use the A-131 for its intended purpose, and only use it if it is in a good working order.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety.
- The operator is responsible for the correct installation and operation of the A-131.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

2.3. Warnings and Safety Notices

The following statements apply throughout this manual. Failure to observe these precautions could result in serious injury to those performing the procedures and damage to the equipment. This manual and any additional instructions included with the stage should be retained for the lifetime of the stage.

	To minimize the possibility of electrical shock and bodily injury or death, disconnect all electrical power prior to making any electrical connections.
	To minimize the possibility of electrical shock and bodily injury or death when any electrical circuit is in use, ensure that no person comes in contact with the circuitry when the stage is connected to a power source.
	To minimize the possibility of bodily injury or death, disconnect all electrical power prior to making any mechanical adjustments.
	To minimize the possibility of bodily injury or death from electric shock in the case of malfunction or failure of the system, make sure a protective earth conductor is properly connected.
	Moving parts of the stage can cause crushing or shearing injuries. All personnel must remain clear of any moving parts.
	The stage table should never be moved without the air supply turned on. Moving the stage table with no air supply, causing sliding metal-to-metal contact, may damage the bearing surfaces.
	Improper use of the stage can cause damage, shock, injury, or death. Read and understand this manual before operating the stage.
	If the stage is used in a manner not specified by the manufacturer, the protection provided by the stage can be impaired.
	Stage cables can pose a tripping hazard. Securely mount and position all stage cables to avoid potential hazards.
	Do not expose the stage to environments or conditions outside the specified range of operating environments. Operation in conditions other than those specified can cause damage to the equipment.
	The stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.
	Use care when moving the stage. Avoid any shocks, drops or bumps that can cause scratches, dings, dents, or distortion of the stage.
	Dirt, oil, lubricants and condensation will damage the stage. Keep the stage clean and free of dirt, debris, oil, lubricants, and moisture.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

2.4. Organizational Measures

User manual

- Always keep this user manual available near the A-131.
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.
- If you pass the A-131 on to other users, also turn over this user manual as well as other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can result in minor injury and property damage.
- Only install and operate the A-131 after having read and understood this user manual.

Personnel qualification

The A-131 may only be installed, started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

3. Product Description

3.1. Model Overview and Part Numbering

Model# A-131.025A1

Description: PIglide VC Voice Coil Linear Air Bearing Stage, 25mm Travel, 20µm Incremental Encoder with Sine (1 Vp-p) Output, 1-phase Voice Coil Motor

3.2. Product Features

The A-131 stage incorporates completely non-contact air bearing surfaces, voice coil motor, and an optical position feedback device to provide a maintenance-free high performance stage. There is no mechanical contact to wear or require lubrication, making these stages ideal for clean room and medical applications. The A-131 incorporates opposing lateral and vertical preloads.

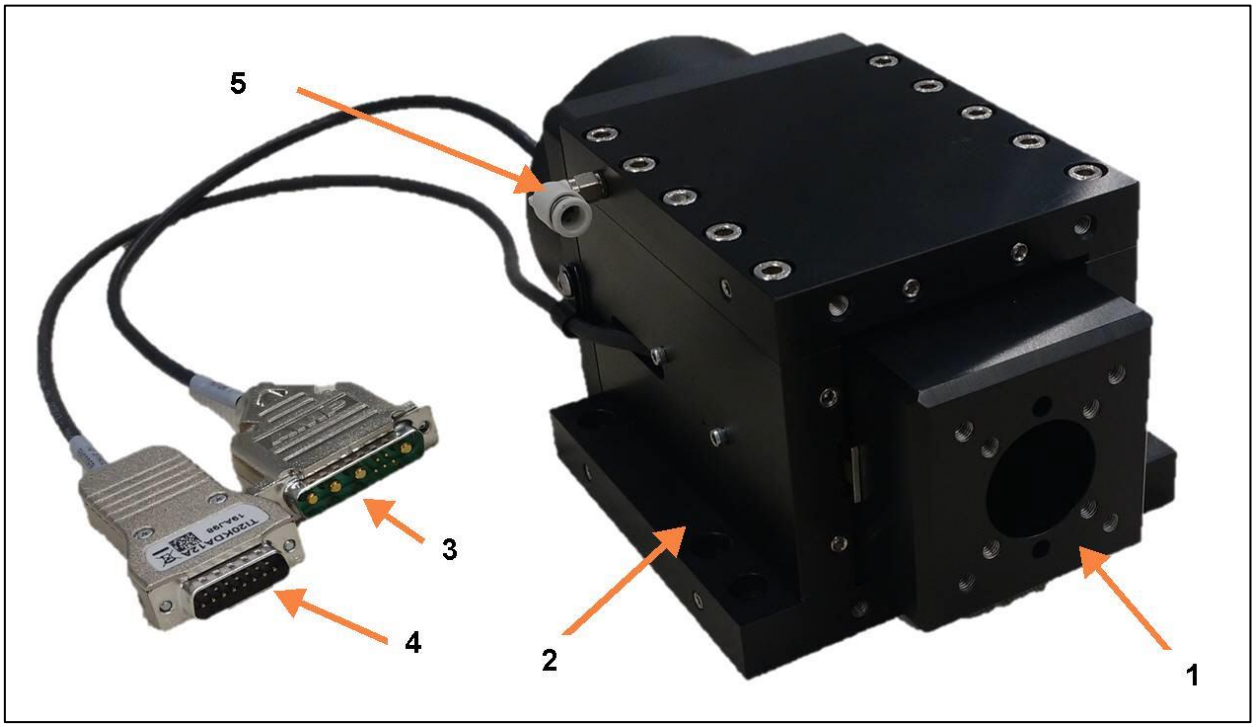


Figure 1 - Product Features, A-131

#	Description
1.	Moving bar
2.	Stage base
3.	Motor electrical connection
4.	Encoder electrical connection
5.	Air supply inlet

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

3.3. Product Labeling

Figure 2 - Product Labeling Example

#	Description
1.	Product model number (example)
2.	Serial number (example), individual for each A-131 Meaning of the places (counting from left): A = PIglide Air Bearing Product 18 = year of manufacture (i.e. 2017) 170903 = unique number, 6-digit
3.	Warning sign "Observe manual"
4.	Old equipment disposal warning sign
5.	Country of origin
6.	Manufacturer's address (website)
7.	Manufacturer's logo

3.4. Scope of Delivery

Item ID	Component
A-131.xxxxxx	Linear stage according to the order
A131D001	User manual (this document)

3.5. Accessories

The following accessories are offered to complement the A-131 stage. Contact PI for all available configurations.

Part #	Description
A-80x.xxx	Air Preparation and Filtration Kit
A-851.xxx	Cable sets for integration with various controllers

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

3.6. Controllers

The A-131 must be connected to a suitable motion controller to be operated. The following standard controllers are available from PI to operate the A-131. Other controllers are also available, contact PI for options.

Part #	Description
A-81x.xxxxx	PIglide Family of Motion Controllers (1, 2, & 4 Axes)
A-82x.xxxxx	PIglide Family of Motion Controllers (4, 6, & 8 Axes)

4. Technical Features

4.1. Air Bearing

The A-131 series stage features fully preloaded, non-contact, frictionless air bearings to guide the motion of the stage and support the payload. This air bearing is a highly accurate precision instrument. The non-contact nature of the air bearings will provide years of accurate and reliable use if treated properly. Keep the bearing clean and avoid any shocks, drops or bumps that can cause scratches, dings or distortion of the bearing.

The A-131 incorporates opposing lateral and vertical preload mechanisms. Be careful not to apply excess cantilever loads to the moving stage table.

4.2. Voice Coil Motor

The A-131 stage features a brushless, ironless linear 1-phase voice coil motor. This type of motor technology is completely non-contact and is ideally suited to fine resolution positioning and smooth, constant-velocity scanning. The voice coil is a force transducer, which means is creates force in the direction of travel proportional to the amount of electrical current supplied to the motor coil. A servo motion controller is required to control position and velocity.

4.3. Linear Encoder

The A-131 series stage features an optical non-contact linear encoder for direct measurement of the stage position. This feedback signal is used by an external motion controller to close the servo loop for position and velocity control.

The A-131 features an incremental encoder with analog (sine) output and is suitable for use with controllers featuring on-board encoder interpolation.

4.4. Limits and Index Mark

The A-131 series stage features non-contact limit switches and a home index marker. Both the limits and the index position are integral to the encoder electronics. The limits are magnetic and active high and are placed near the ends of travel. The index mark is optical.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

5. Unpacking and Handling

Carefully unpack the air bearing stage and other components from the shipping packaging. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI immediately. Compare the package contents to packing list and notify PI immediately if any parts are missing or incorrect. Keep all packaging materials in case the product needs to be returned.

Before mounting or using the stage, it is recommended to let the stage stabilize at room temperature for at least 12 hours. Clean any dust or shipping debris off the stage by blowing it off with pressurized nitrogen or clean, oil-free air.

If the stage will be mounted in such a way as to block the product label, it is recommended to record the stage serial number for future reference.

 WARNING	The stage table should never be moved without the air supply turned on. Moving the stage table with no air supply, causing sliding metal-to-metal contact, may damage the bearing surfaces.
 WARNING	Use care when moving the stage. Avoid any shocks, drops or bumps that can cause scratches, dings, dents, or distortion of the stage.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

6. Installation

6.1. Mounting Surface Quality and Preparation

The A-131 is intended for mounting only in which the surface to which the stage is mounted is parallel to the plane of the ground (i.e. horizontal). The stage can be mounted with the mounting surface below or above the stage (inverted).

The mounting surface should be flat and have adequate stiffness in order to achieve the maximum performance from the A-131. When the A-131 series stage is mounted to a non-flat surface, the stage can be distorted as the mounting screws are tightened. This distortion will decrease the overall accuracy of the stage. Adjustments to the mounting surface must be done before the stage is secured. The effects of flatness on mounting are illustrated below.

To maintain accuracy, the mounting surface should be flat within 2µm. A laboratory grade AA granite surface plate is recommended. Do not shim under the stage base.

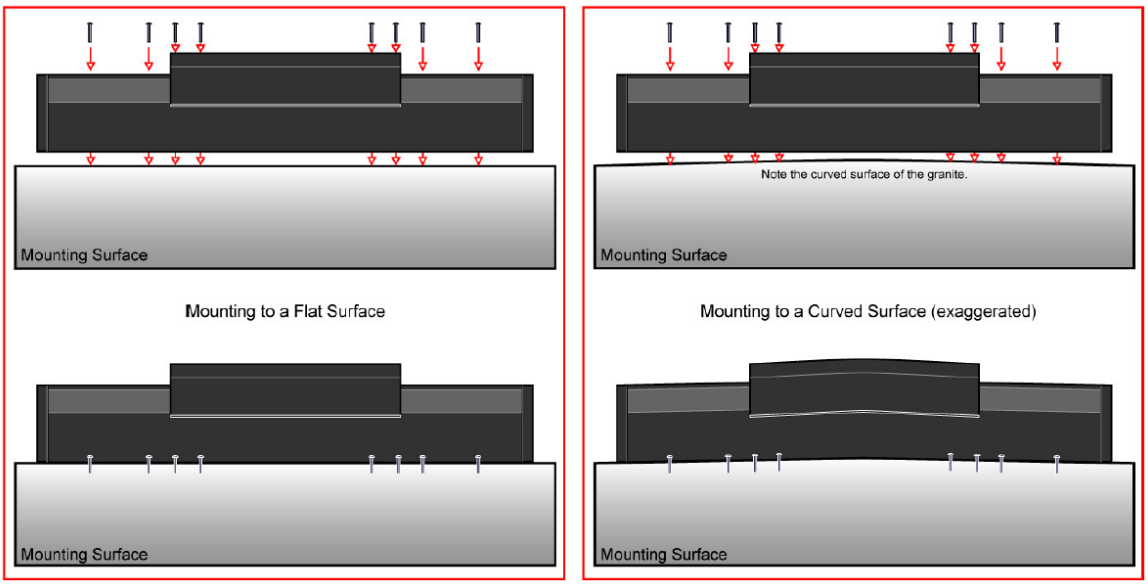


Figure 3 - Mounting Surface Quality

Prepare the mounting surface and bottom of the stage base with precision flat stones to remove any burrs or high spots. Clean the mounting surface and bottom of the stage with the appropriate cleaners (isopropyl alcohol).

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

6.2. Mounting Procedure

1. Place the stage on the mounting surface.
2. Affix the stage base to the mounting surface using 4x M5 SHCS x 20mm long (minimum).
3. Connect the compressed air supply and turn on the air.

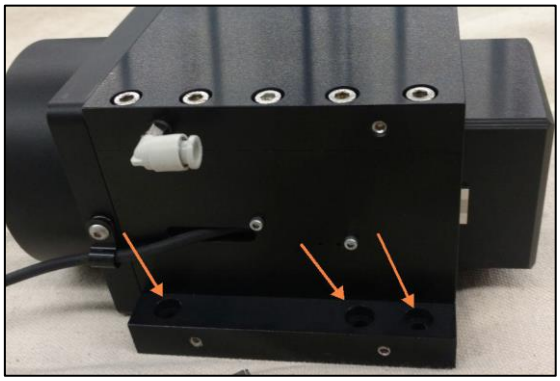


Figure 4 - Mounting Bolt Holes

The stage should now be securely mounted. Make sure to allow sufficient clearance at the end of the stage to attach the motor and encoder cables.

6.3. Air Supply

Air Requirements

The A-131 stage requires clean, oil-free, and dry compressed air to operate properly. See Section 10.1 Basic Specifications for detailed air supply requirements.

It is recommended that a pressure switch is installed to monitor air supply pressure and to remove power from the stage motor if supply pressure drops below 40 psi to prevent damage to the air bearing surfaces.

The air inlet fitting on the A-131 stage accepts flexible polyurethane pneumatic tubing, 6mm OD.

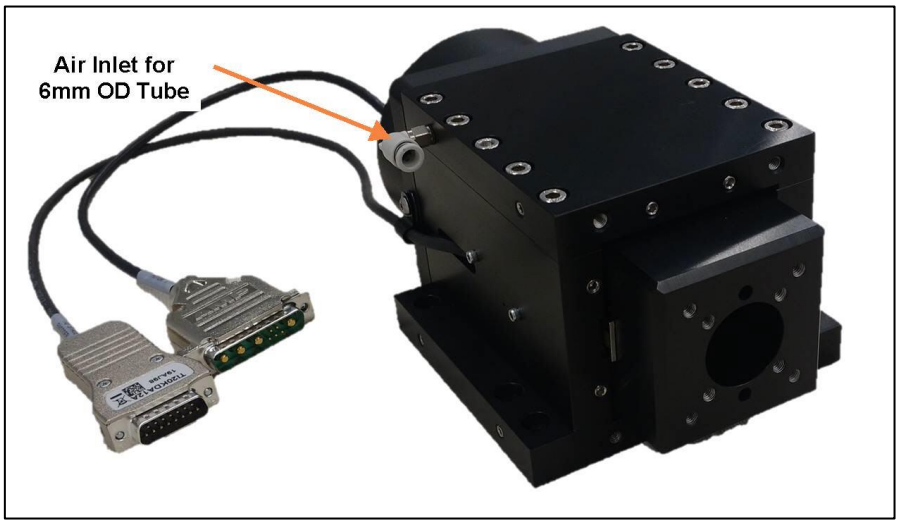


Figure 5 - Air Inlet Fitting

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

Turning off the air supply when not in use

When the stage is not in use, the air supply may be turned off to preserve compressed air and energy.

WARNING	The stage table should never be moved without the air supply turned on. Moving the stage table with no air supply, causing sliding metal-to-metal contact, may damage the bearing surfaces.

6.4. Affixing the Payload to the Stage

The payload should be flat, rigid, and comparable to the stage in quality. For valid system performance, the mounting interface surface should be flat within 2µm.

The moving mounting surface is a vertical plane at the end of the moving bar, and includes 4x M5 tapped holes for mounting the user's payload. These are the only features that should be used to attach a payload to the stage.

Prepare the payload mounting surface and the stage table with precision flat stones to remove any burrs or high spots. Clean the payload mounting surface and the stage table with the appropriate cleaners (isopropyl alcohol).

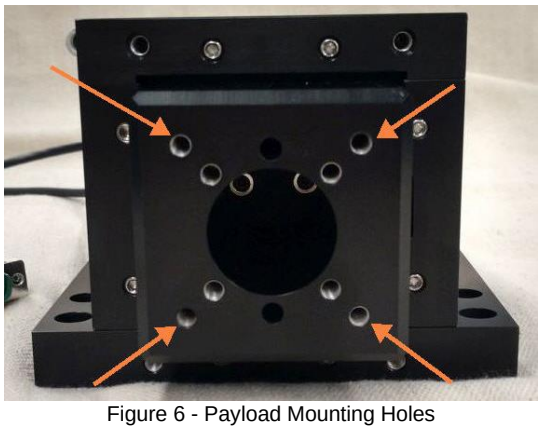


Figure 6 - Payload Mounting Holes

WARNING	Do not attempt to modify the stage table in any way. Customer modifications may damage the stage.
WARNING	The M5 screws used to attach the payload to the stage table should not thread into the stage bar any more than 8mm. Longer screws may damage the stage.
WARNING	Do not overtighten the payload mounting screws.
WARNING	Do not exceed the maximum payload specified for the A-131 stage. The CG of the payload should not be located more than 50mm from the face of the stage mounting surface.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

6.5. XY and Vertical Configurations

XY configurations of the A-131 series stage are not available at this time.

Vertical configurations in which the motor is required to move against the force of gravity are not recommended using the A-131.

6.6. Connecting the Cables

Stage interconnect cables are not in the scope of delivery of the A-131 series stage. However, PI offers several standard cable sets that can be used, depending on the motion controller being used. Contact PI for a quote.

See Section 10.6 for connector pin assignments.

	Only use the interconnect cables that have been designed for the combination of stage and controller being used. Connection using the wrong cable may result in damage to the stage and the controller.
	To minimize the possibility of electrical shock and bodily injury or death, disconnect all electrical power prior to making any electrical connections.
	To minimize the possibility of electrical shock and bodily injury or death when any electrical circuit is in use, ensure that no person comes in contact with the circuitry when the stage is connected to a power source.
	To minimize the possibility of bodily injury or death, disconnect all electrical power prior to making any mechanical adjustments.

The stage electrical connectors are loose and not mechanically affixed to the stage, other than by the cables themselves (see Figure 1). We recommend securing the connectors in place with tie-wraps to a secure, non-moving part of the installation to prevent them from moving once the stage has been installed.

1. Connect the stage cables for the motors and encoders to the connectors.
2. Tighten the jack screws with a flat head screwdriver to secure the cables. Do not overtighten the screws.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

7. Startup and Operation of the Stage

See the user's manual of the controller being used with the A-131 stage for instructions about startup and operation.

Note that the servo tuning values may need to be adjusted if the payload mass or size changes. If PI was not given user application information at the time of order, the servo was tuned with no (zero) payload mass.

 WARNING	Collisions can damage the stage and the payload. ➢ Take care when operating the stage to ensure that no collisions are possible between the stage, the load to be moved, and the environment in the motion range of the stage. ➢ Do not place any objects in areas where they can be caught by moving parts. ➢ Stop the motion immediately if a controller malfunction occurs.
 WARNING	Do not attempt to operate the stage with the shipping restraint installed.
 WARNING	The stage table should never be moved without the air supply turned on. Moving the stage table with no air supply, causing sliding metal-to-metal contact, may damage the bearing surfaces.
 WARNING	The drive mechanism of the A-131 is not self-locking. The stage can therefore unintentionally move in the following cases: ▪ Switching off or restarting the controller ▪ Switching off the servo mode for the axis Unintentional displacement can damage the stage, the payload to be moved, and the environment. ➢ Only operate the A-131 with a horizontally aligned motion axis. ➢ Before switching off or rebooting the controller, take suitable measures to ensure that no unintentional displacement of the stage table is possible.
 DANGER	Do not exceed the operating voltage range for which the A-131 is specified.
 WARNING	Causing the stage table to hit the hard stop with maximum speed and force can cause damage to the stage and the payload. ➢ Stop the motion immediately if a controller malfunction occurs. ➢ Ensure that the end of the travel range is approached at low velocity. ➢ Setup the motion controller to observe end of travel limits (if applicable). ➢ Determine the maximum velocity for your application. ➢ Set suitable soft limits for closed-loop operation on the controller.
 WARNING	The optimum values of the servo-loop parameters in the controller depend on the application and the payload mass. Unsuitable servo-control parameter settings of the controller can cause the control loop to become unstable and for the stage to vibrate. Oscillations can damage the stage and/or the load affixed to it. ➢ If the stage is oscillating or exhibits unusual operating noise, immediately switch off the servo mode for the axis on the controller or switch off the controller. ➢ Only switch on the servo mode for the axis on the controller after you have modified the servo-control parameter settings; see the manual of the controller. ➢ Note that the servo tuning values may need to be adjusted if the payload mass or size changes.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

8. Maintenance

Other than basic cleaning, the A-131 series stage is maintenance-free.

8.1. Cleaning the Stage

To clean the stage bearing surfaces, use isopropanol and a clean, lint-free cloth or wipe. Apply the cleaning agent to the cloth and wipe down all of the air bearing surfaces. When cleaning the air bearing it is recommended to leave the air supply turned on to help blow any particles out of the bearing and prevent particles from entering the nozzles. Be especially careful of fingerprints on the bearing surfaces as they attract dust and may tarnish the bearing finish.

 WARNING	Do not use cleaning agents other than isopropanol. Agents such as acetone or other detergents can damage certain parts of the stage.

8.2. Preparing the Stage for Transport

If the stage requires movement, transport, or shipping, follow these steps:

1. Turn off the controller power.
2. Disconnect stage cables.
3. Remove the payload.
4. With the air supply on, move the stage table to one end of travel by hand.
5. Turn off the air supply and disconnect the air supply line from the stage.
6. Remove the screws used to mount the stage to the mounting surface.

The stage is now secured and can be safely moved. If the stage needs to be shipped, use the original packing materials.

 WARNING	Use care when moving the stage. Avoid any shocks, drops or bumps that can cause scratches, dings, dents, or distortion of the stage.
 WARNING	The stage table should never be moved without the air supply turned on. Moving the stage table with no air supply, causing sliding metal-to-metal contact, may damage the bearing surfaces.
 WARNING	Do not attempt to move or transport the stage with the payload attached. This may damage the stage and the payload.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

9. Customer Service

For inquiries and orders, contact your PI sales engineer or use the following contacts:

Email: air@pi-usa.us
Address: 16 Albert Street, Auburn, MA 01501, USA
Tel: 508-832-3456
Fax: 508-832-0506

If you have questions concerning your system, have the following information ready:

- Product codes and serial numbers of all products in the system
- Firmware version of the controller (if present)
- Version of the driver or the software (if present)
- Operating system on the PC (if present)
- If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

10. Technical Data

See the PI website for latest published specifications.

10.1. Basic Specifications

Model	A-131.025A1
Travel	25 mm limit-to-limit
Drive System	Brushless ironless linear voice coil motor, 1-phase
Feedback System	Non-contact optical linear encoder with travel limits and home index Sin/Cos, 1 V peak-peak, 20 µm signal period
Maximum Velocity (1)	1000 mm/sec
Maximum Acceleration (1) (Unloaded)	40 m/sec^2
Maximum Payload (2)	3 kg
Accuracy (3) (uncompensated)	±2.0 µm
Accuracy (3) (with error compensation)	±0.25 µm
Repeatability	±0.1 µm
Encoder Resolution (4)	5nm with 4096x Interpolation Factor
Straightness & Flatness (5)	< 0.5 µm over full travel
Pitch & Yaw (5)	< 10 µrad over full travel
Stage Mass	3.6 kg
Moving Mass	1.63 kg
Cabling	External, non-moving
Operating Pressure (6)	80 +/-5 psi (450 +/-35 kPa)
Air Consumption	< 1.0 SCFM (28 SLPM)
Air Quality	▪ Clean (filtered to 1.0 µm or better) - ISO 8573-1 Class 1 ▪ Oil-free -ISO 8573-1 Class 1 ▪ Dry (-15 °C dew point) - ISO 8573-1 Class 3
Construction	Hardcoat Aluminum SS Fasteners

Notes:
1. Maximum velocity and acceleration based on unloaded stage capability and may be limited by payload, controller, or drive performance.
2. Assumes payload CG is centered no more than 50mm from the stage table. Stage is designed for horizontal operation only.
3. Improved accuracy can be obtained with controller-based error compensation. The stage must be ordered with a controller from PI to reach these values. Accuracy values assume short-term time duration and do not consider the long-term effects of thermal drift on the stage.
4. Encoder resolution depends on interpolation factor chosen. Resolution will impact repeatability specification.
5. Dependent on the flatness of the surface to which the stage is mounted.
6. To protect stage from damage, an under-pressure air sensor tied to the controller E-stop input is recommended.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

10.2. Motor Electrical Specifications

Model	A-131.025A1
Bus Voltage	48 VDC nominal, 80 VDC max
Force Constant	6.9 N/A
Peak Current	10 A
Continuous Current	3 A
Peak Force	70 N
Continuous Force	22 N
Back EMF	6.3 V/m/sec
Resistance	2.7 Ω
Inductance	1.4 mH

10.3. Encoder Specifications

Type	Incremental
Resolution	20 µm signal period
Output Signal	Analog Quadrature 1 Vp-p, Differential
Power Input	5 VDC, <200 mA
Input Ripple	200 mVp-p max @ up to 500 kHz
Limits	Open collector output, Asynchronous pulse, Active high
Index Mark	0.8 to 1.2 Vp-p, Differential

10.4. Ambient Conditions

Area of use	For indoor use only
Vacuum Operation	This product is not compatible with operation in a vacuum environment.
Maximum Altitude	2000m
Relative humidity	40% to 60% non-condensing
Operating temperature (1)	+15°C to +25°C
Storage temperature	0°C to +40°C in original packaging
Dust Exposure	The A-131 stage is not suited for dusty, dirty, oily, or wet environments.
Overvoltage Category	II
Protection Class	I
Degree of Pollution	1
Degree of protection according to IEC 60529	IP20

Notes:
1. For optimum performance, the stage should be operated at 20°C. Any deviation from this temperature could degrade the precision and performance of the stage. Any deviation outside the range shown above may damage the stage.

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

10.5. Dimensions

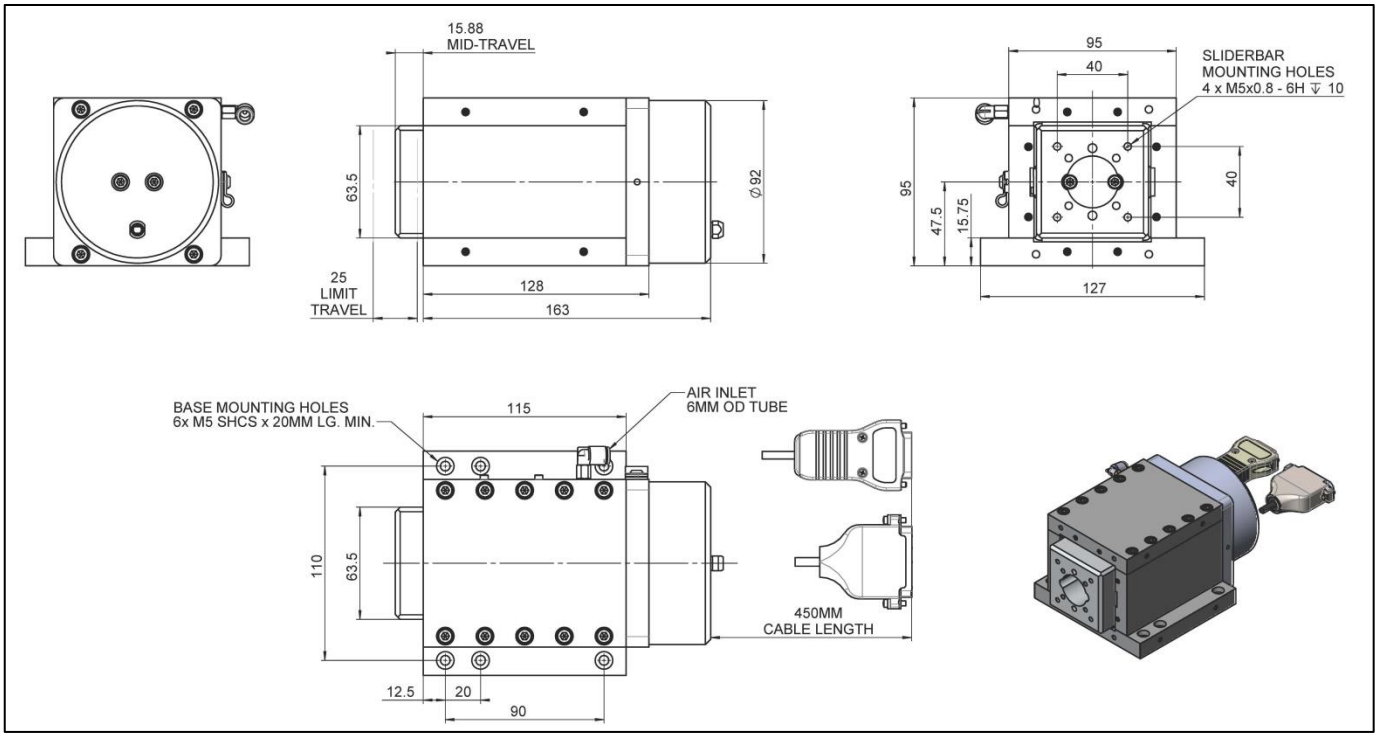


Figure 7 - A-131 Stage Dimensions

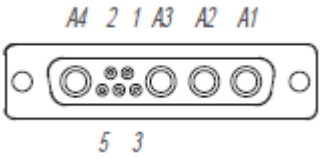
PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

10.6. Pin Assignments

If a pin is not listed, assume it is N/C.

Motor Connector

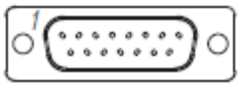
Type: DB9W4M



Pin	Function	Description
A1	PHA	Motor phase A+
A2	PHA-	Motor phase A-

Encoder Connector, Option “A” (Analog SIN/COS 1Vpp)

Type: DB15M



Pin	Function	Description
1	Cos-	Encoder Analog Cosine -
2	Sin-	Encoder Analog Sine -
3	Index+	Encoder Analog Reference +
4	+5v	Encoder power
5	+5v Sense	Encoder power sense line
6	Vx	Encoder Setup
7	Lim+	Open collector Limit+
8	Lim-	Open collector Limit-
9	Cos+	Encoder Analog Cosine +
10	Sin+	Encoder Analog Sine +
11	Index -	Encoder Analog Reference -
12	GND	Encoder ground
13	GND Sense	Encoder ground sense line
14	CAL	Encoder Calibration
15	N/C	

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us

11. Old Equipment Disposal

In accordance with EU law, electrical and electronic equipment may not be disposed of in EU member states via the municipal residual waste.

Dispose of your old equipment according to international, national, and local rules and regulations.

In order to fulfil its responsibility as the product manufacturer, Physik Instrumente (PI) GmbH & Co. KG undertakes environmentally correct disposal of all old PI equipment made available on the market after 13 August 2005 without charge.

Any old PI equipment can be sent free of charge to the following addresses:

Physik Instrumente (PI) GmbH & Co. KG
Auf der Roemerstr. 1
D-76228 Karlsruhe
Germany

PI (Physik Instrumente) L.P.
16 Albert Street
Auburn, MA 01501
USA

PI (Physik Instrumente) L.P.
16 Albert Street, Auburn, MA 01501
Tel: 508-832-3456 Fax: 508-832-0506
Email: air@pi-usa.us