User Manual

A311D0001 Rev 1.5
28-Jan-2019

A-311 Series
Plglide Compact Planar XY Air Bearing Stage
Linear Motor Driven with Encoder Feedback

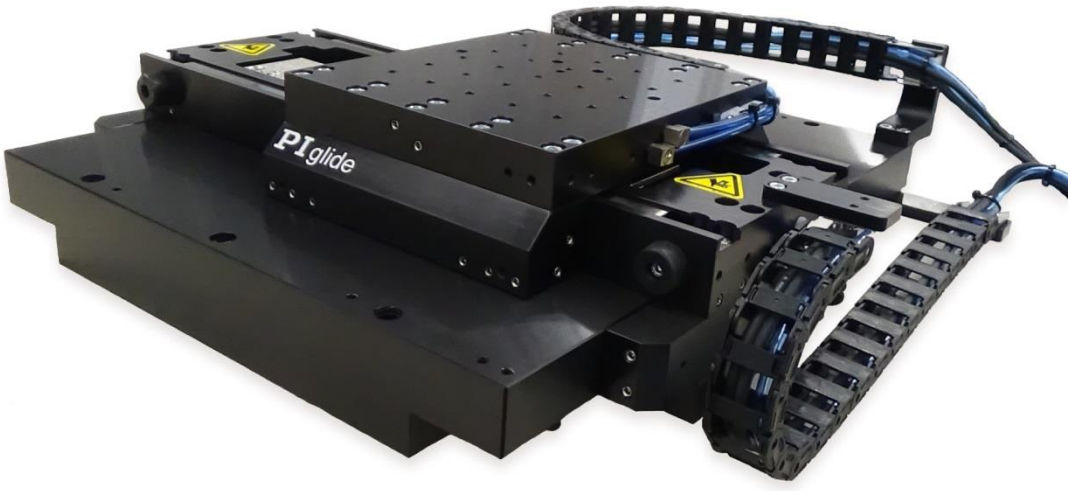

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Table of Contents

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Table of Figures

PI (Physik Instrumente) L.P.
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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-311. 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

2. Safety

2.1. Intended Use

The A-311 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-311 is intended for single-axis positioning of loads at different velocities. The A-311 is not intended for applications in areas in which a failure would present severe risks to human beings or the environment.

The A-311 is intended for horizontal mounting only in which the plane of the stage tabletop is level and parallel to the plane of the ground. The stage cannot be used inverted.

The intended use of the A-311 is only possible when completely mounted and connected.

The A-311 must be operated with a suitable controller. The controller is not included in the scope of delivery of the A-311.

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2.2. General Safety Instructions

The A-311 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-311.

- Only use the A-311 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-311.

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.

 DANGER	To minimize the possibility of electrical shock and bodily injury or death, disconnect all electrical power prior to making any electrical connections.
 DANGER	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.
 DANGER	To minimize the possibility of bodily injury or death, disconnect all electrical power prior to making any mechanical adjustments.
 DANGER	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.
 DANGER	Moving parts of the stage can cause crushing or shearing injuries. All personnel must remain clear of any moving parts.
 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.
 DANGER	Improper use of the stage can cause damage, shock, injury, or death. Read and understand this manual before operating the stage.
 DANGER	If the stage is used in a manner not specified by the manufacturer, the protection provided by the stage can be impaired.
 DANGER	Stage cables can pose a tripping hazard. Securely mount and position all stage cables to avoid potential hazards.
 DANGER	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.

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	The stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.
	Use care when moving the stage. Manually lifting or transporting stages can result in injury.
	Use care when moving the stage. Avoid any shocks, drops or bumps that can cause scratches, dings, dents, or distortion of the stage.
	The stage contains high power magnets that can attract ferrous objects, such as loose screws. Attracted objects can damage the stage. Make sure that there are no movable, ferrous objects within a radius of at least 10 cm around the stage.
	The stage contains high power magnets that can damage magnetically sensitive objects such as magnetic data carriers and electronic devices. Make sure that there are no magnetically sensitive objects within a radius of at least 10 cm around the stage.
	Dirt, oil, lubricants and condensation will damage the stage. Keep the stage clean and free of dirt, debris, oil, lubricants, and moisture.

2.4. Organizational Measures

User manual

- Always keep this user manual available near the A-311.
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.
- If you pass the A-311 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-311 after having read and understood this user manual.

Personnel qualification

The A-311 may only be installed, started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

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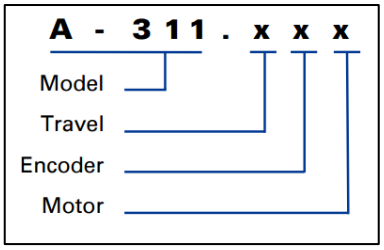
3. Product Description

3.1. Model Overview and Part Numbering

The A-311 series offers various models, defined by the travel range, encoder type, and motor option. The dimensions of the various models vary with travel. Encoder and motor options do not affect the dimensions.



Model	Travel	Encoder	Motor Wiring
A-311	D = 50mm x 50mm	A = 20µm signal period incremental Sine (1 Vp-p) output	1 = Standard motor 48 VDC nominal buss
	A = 100mm x 100mm	B = 1nm resolution absolute BiSS-C serial output	
	B = 150mm x 150m		
	C = 200mm x 200mm		

3.2. Product Features

The PIglide IS planar XY air-bearing stage is a low profile, high precision alternative to stacked XY stages. The fully preloaded air bearing puck floats in both X and Y directions on a common base, proving smooth, frictionless motion.

The A-311 series stages all incorporate completely non-contact air bearing surfaces, linear motors, and feedback devices to provide a maintenance free stage. There is no mechanical contact to wear or require lubrication, making these stages ideal for clean room and medical applications. The A-311 incorporates opposing lateral preload and magnetic vertical preload. The brushless linear motor uses an ironless motor coil, which means there is zero cogging and no attractive forces – resulting in unsurpassed smoothness of motion. This is especially useful in applications where velocity control is important.

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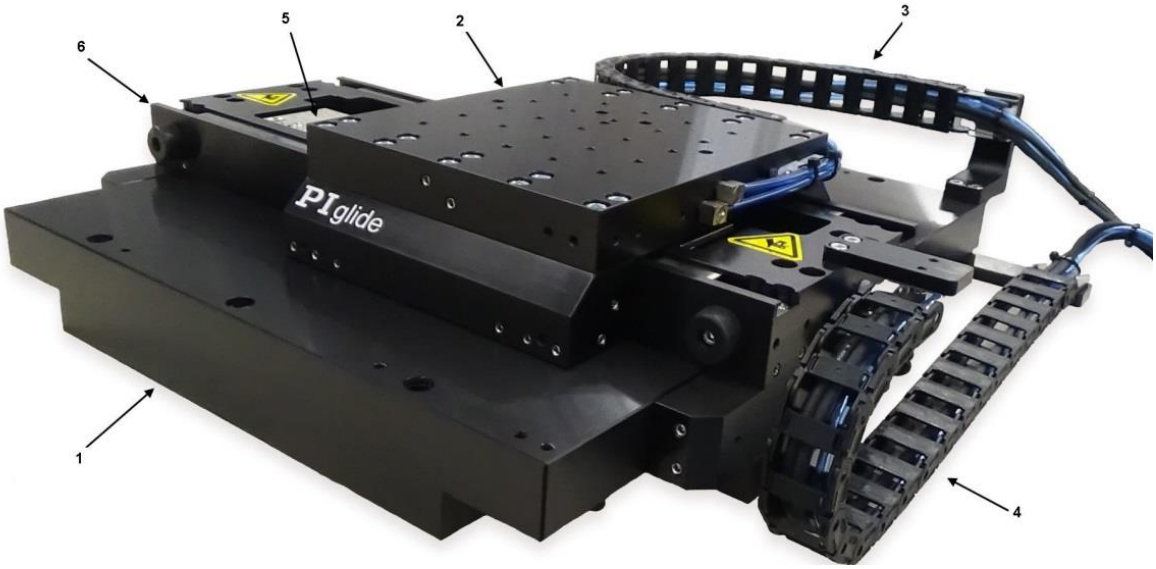

Figure 1 - Product Features, A-311.xxx

Figure 2 - Interconnects, A-311.xxx

#	Description
1.	Stage base plate
2.	Moving table
3.	Moving cable loop – upper axis
4.	Moving cable loop – lower axis
5.	Linear motor – upper axis
6.	Moving beam
7.	Encoder electrical connections
8.	Motor electrical connections
9.	Air supply inlet

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3.3. Product Labeling

Figure 3 -Product Labeling Example

#	Description
1.	A-311.BB1 (Product model number example)
2.	Serial number (example), individual for each A-311 Meaning of the places (counting from left): A = PIglide Air Bearing Product 18 = year of manufacture (i.e. 2018) 223102 = consecutive 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
8.	CE mark

3.4. Scope of Delivery

Item ID	Component
A-311.xxx	Linear stage according to the order
---	Stage Mounting Screws (M6 x 55 SHCS)
---	Transport lock screws (4x), lock bracket, & lock label
A311D0001	User manual (this document)

3.5. Accessories

The following accessories are offered to complement the A-311 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

3.6. Compatible Controllers

The A-311 must be connected to a suitable motion controller to be operated. The following standard controllers are available from PI to operate the A-311. Other controllers are also available, contact PI for options.

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

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4. Technical Features

4.1. Air Bearing

The A-311 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-311 incorporates opposing lateral preload and magnetic vertical preload. The A-311 is unsuitable for vertical orientations. The planar design of the stage allows motion in both X and Y directions orthogonal to each other.

4.2. Linear Motor

The A-311 series stage features two brushless, ironless linear 3-phase motors. This type of motor technology is completely non-contact and is ideally suited to high speeds; high accelerations; fine resolution positioning; and smooth, constant-velocity scanning. The motor must be commutated by an external motor drive.

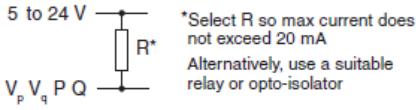
4.3. Linear Encoder

The A-311 series stage features two optical non-contact linear encoders 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.

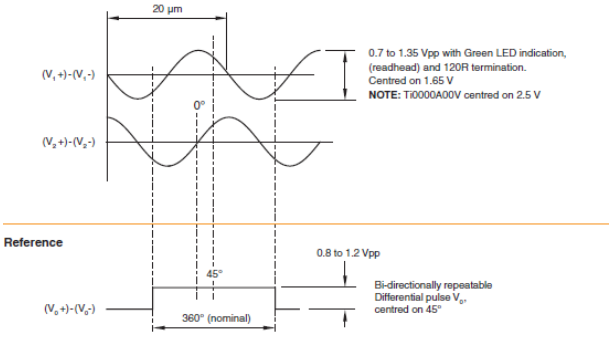
The A-311 series stage offers three types of encoders:
- Incremental with analog (sine) output: Suitable for use with controllers using on-board encoder interpolation.
- Absolute with BiSS-C 32-bit serial output: eliminates the need for startup homing routines and limit switches.

4.4. Limits and Index Mark (incremental encoders only)

When equipped with either of the incremental encoder options, the A-311 series stage features non-contact limit switches and home index markers. 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. They are open collector type, powered by 5 to 24 VDC.



The index mark is optical with signal as shown below..



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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.

	The A-311 stage must always be transported and shipped with the shipping lock engaged. Failure to use the shipping lock when moving, transporting, or shipping the stage may allow movement between the stage table and stage base, causing damage.
	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.
	Use care when moving the stage. Manually lifting or transporting stages can result in injury.
	Use care when moving the stage. Avoid any shocks, drops or bumps that can cause scratches, dings, dents, or distortion of the stage.
	When lifting the A-311, take care to lift only by the base plate of the stage. Do not lift using any other part of the mechanical system, or damage may occur.
	The A-311 stage weighs up to 28 kg in its largest size. Use care when lifting and use two people to lift.

6. Installation

6.1. Mounting Surface Quality and Preparation

The A-311 is intended for horizontal mounting only in which the plane of the stage tabletop is level and parallel to the plane of the ground.

The mounting surface should be flat and have adequate stiffness in order to achieve the maximum performance from the A-311. When the A-311 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 1 µm per 150 mm. A laboratory grade AA granite surface plate is recommended. Do not shim under the stage base.

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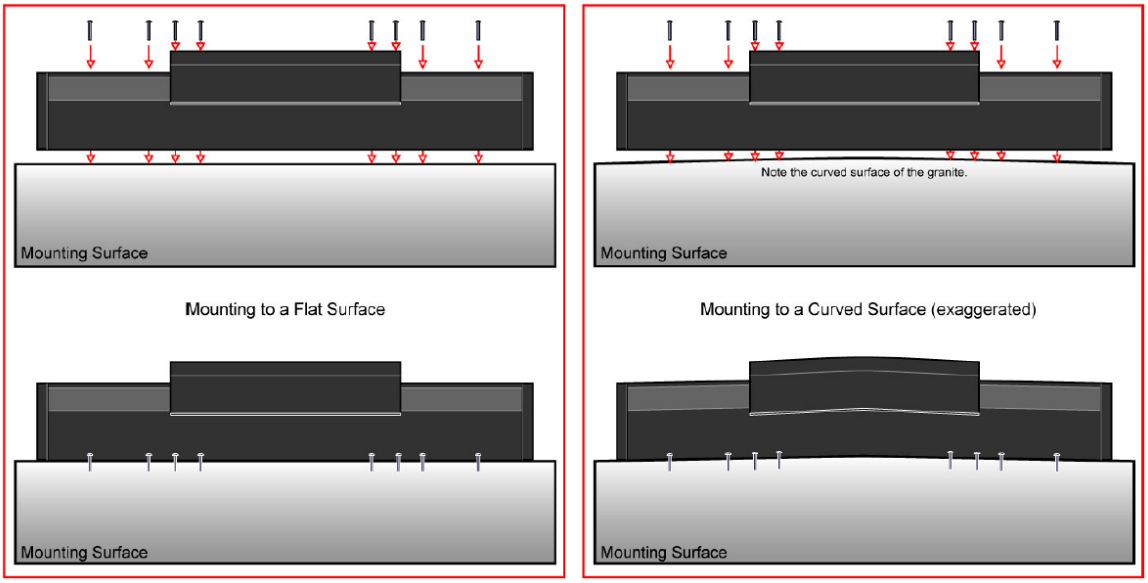

Figure 4 - Mounting Surface Quality

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).

6.2. Mounting Procedure

1. Place the stage on the mounting surface.
2. Remove the shipping lock(s).
3. Connect the compressed air supply and turn on the air.
4. Move the stage table by hand if needed to access the mounting holes in the stage base.
5. Affix the stage base to the mounting surface using 6x M6 SHCS, 55mm long minimum.

DANGER	The stage contains high power magnets that can attract ferrous objects, such as loose screws. Attracted objects can damage the stage. Make sure mounting screws and tools are not pulled into the motor magnet track.

6. Torque the mounting screws (begin from the center out for best accuracy). The typical maximum torque value for M6 socket head cap screws is 15-20 N-m.

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. Removing the shipping lock(s)

The stage is shipped with a shipping lock installed to prevent unwanted motion between the stage table and the stage base. To remove the shipping lock, remove the 4x M5 SHCS shipping bolts using a 4mm Allen key. Make sure to safely store the shipping lock and bolts for future use, should the stage need to be moved or transported.

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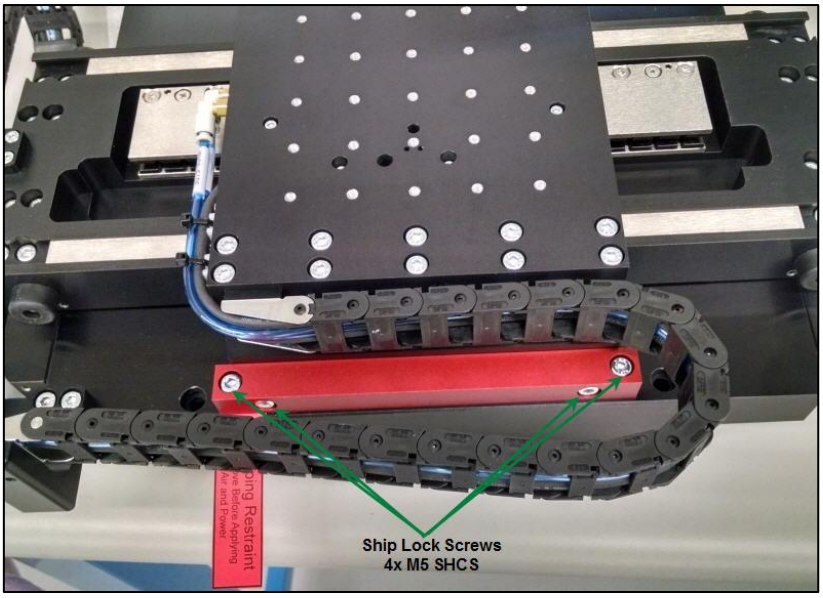

Figure 5 – Shipping Lock

6.4. Air Supply

Air Requirements

The A-311 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 psig to prevent damage to the air bearing surfaces.

The air inlet fitting to the A-311 stage accepts flexible polyurethane pneumatic tubing, 6mm OD. Note that the air fitting combines the three separate bearing lines on the stage into a single input to be used by the customer.

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.

6.5. 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 1 µm per 50 mm.

The stage tabletop features 25x M5x0.8 tapped holes for mounting the user's payload. These are the only features that should be used to attach a payload to the stage.

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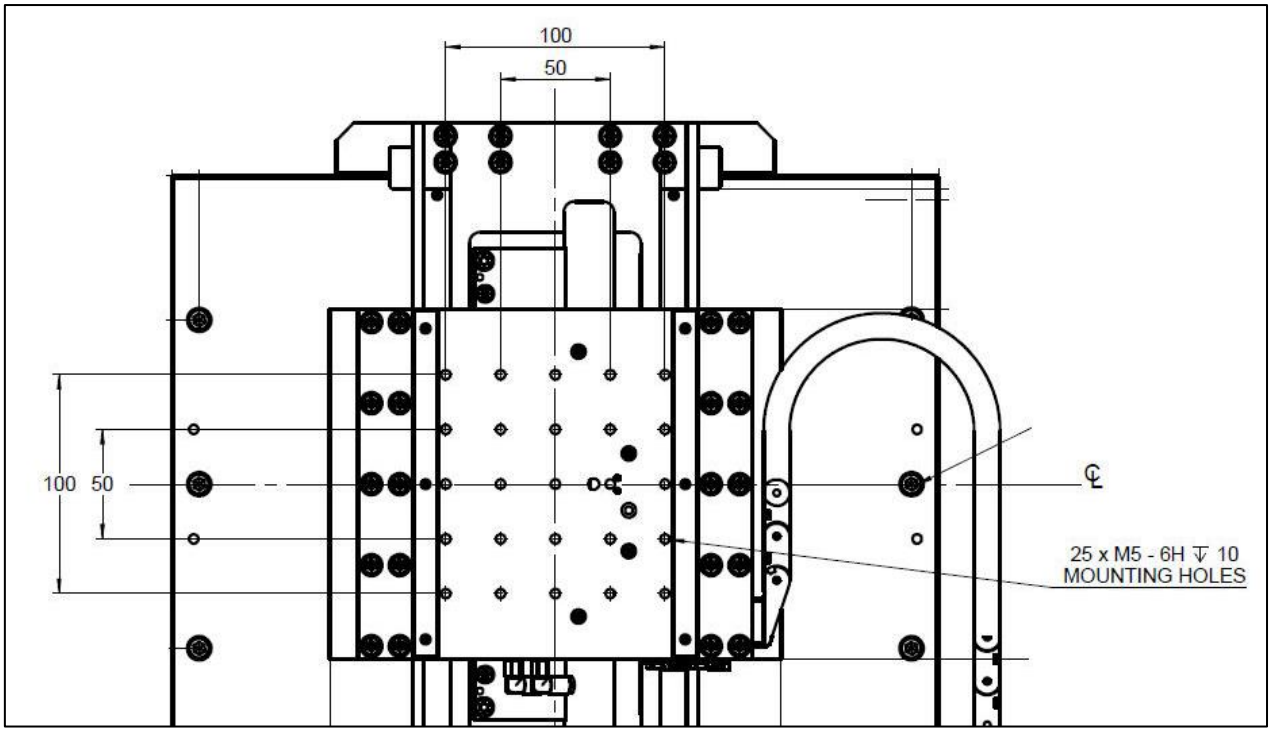

Figure 6 - Payload Mounting Holes

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).

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 tabletop any more than 8mm. Longer screws may damage the table.
WARNING	Do not overtighten the payload mounting screws. A maximum torque of 10 N-m is recommended.
WARNING	Do not exceed the maximum payload specified for the A-311 stage. Payload CG should not be cantilevered beyond the extents of the stage table.
DANGER	The stage contains high power magnets that can attract ferrous objects, such as loose screws. Attracted objects can damage the stage. Make sure mounting screws and tools are not pulled into the motor magnet track.

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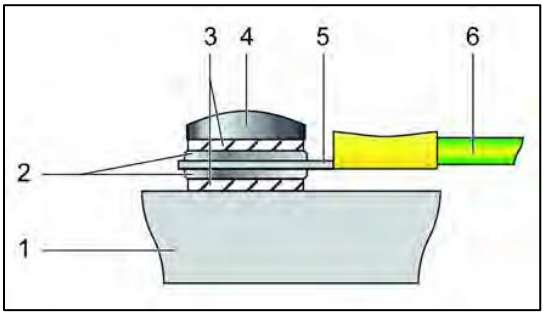
6.6. Connecting the Stage to Protective Earth

DANGER	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.

The A-311 has an M4 threaded hole for connecting the protective earth conductor. This hole is marked with the symbol for the protective earth ground. The hole is located on bottom cable track bracket.

Figure 7 - Earth ground connection point location



#	Description
1.	A-311 cable track bracket
2.	Flat washer (2x)
3.	Internal tooth washer (2x)
4.	M4 Screw
5.	Cable lug
6.	Protective earth conductor

Figure 8 - Mounting of the protective earth conductor (profile view)

1. If necessary, fasten a suitable cable lug to the protective earth conductor. Note that the conductor and lug are not in the scope of delivery of the stage.
2. Fasten the cable lug of the protective earth conductor to the protective earth connection of the A-123 as shown in the profile view using the M4 screw proved. You will need a 2mm Allen key.
3. Tighten the M4 screw with a torque of 1.2 Nm to 1.5 Nm.
4. Make sure that the contact resistance at all connection points relevant for mounting the protective earth conductor is <0.1 Ω at 25 A.

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6.7. Connecting the Cables

Stage interconnect cables are not in the scope of delivery of the A-311 series stage. However, PI offers several standard cable sets that can be used, depending on the motion controller being used. See Section 10.6 for connector pin assignments.

 WARNING	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.
 DANGER	To minimize the possibility of electrical shock and bodily injury or death, disconnect all electrical power prior to making any electrical connections.
 DANGER	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.
 DANGER	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 2). We recommend securing the connectors in place with tie-wraps 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.

6.8. Axis Designation

The A-311 stage has two axes of motion. These two axes are often referred to by name and sometimes by number. The table below cross-references the typical naming convention used.

Physical	Type	Coordinate
Upper	Cross	X
Lower	Beam	Y

7. Startup and Operation of the Stage

See the user's manual of the controller being used with the A-311 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 payload mass.

 DANGER	Moving parts of the stage can cause crushing or shearing injuries. All personnel must remain clear of any moving parts.

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 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 lock installed.
 WARNING	The A-311 can develop high forces and accelerations. If the stage has been improperly or incompletely installed, the stage, the payload, and the environment can be damaged during operation.
 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-311 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-311 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-311 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.

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8. Maintenance

Other than basic cleaning, the A-311 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 and the exposed encoder scales. 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.

	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. Disconnect stage cables.
2. Remove the payload.
3. Remove the stage base mounting screws. With the air supply on, move the stage table by hand if needed to access the mounting holes in the stage base.
4. With the air supply on, move the stage table to one end of travel by hand.
5. Install the shipping lock but do NOT fully tighten the lock screws.
6. Turn off the air supply and disconnect the air supply line from the stage.
7. Tighten the 4x stage shipping lock bolts using a 4mm Allen wrench. The bolts should be tight enough to prevent any motion of the bracket, but do not require a specific bolt torque.

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

	Use care when moving the stage. Avoid any shocks, drops or bumps that can cause scratches, dings, dents, or distortion of the stage.
	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.
	Do not attempt to move or transport the stage with the payload attached. This may damage the stage and the payload.
	When lifting the A-311, take care to lift only by the base plate of the stage. Do not lift using any other part of the mechanical system, or damage may occur.
	The A-311 stage weighs up to 28 kg in its largest size. Use care when lifting and use two people to lift.

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-311.Dxx	A-311.Axx	A-311.Bxx	A-311.Cxx
Travel		50 mm x 50 mm	100 mm x 100 mm	150 mm x 150 mm	200 mm x 200 mm
Drive System		Brushless ironless linear servo motor, 3-phase			
Feedback System		Non-contact optical linear encoder			
Maximum Velocity (Unloaded) [1]		2 m/sec			
Maximum Acceleration (Unloaded) [1]	Upper (X) Axis	2.75 g			
	Lower (Y) Axis	1.5 g	1.3 g	1.1 g	1.0 g
Load Capacity in z [2]		110 N			
Permissible torque in θx [2]		10 N-m			
Permissible torque in θy [2]		7 N-m			
Accuracy (Uncompensated) [3]		+/-1.0 µm	+/-1.5 µm	+/-2.0 µm	+/-2.5 µm
Accuracy (with error compensation) [3]		+/-0.2 µm			
Repeatability [4]		+/-0.1 µm			
Straightness [5]		< +/- 10 nm / 10mm			
		< 0.5 µm			< 1.0 µm
Flatness [5]		< +/- 10 nm / 10mm			
		< 0.5 µm		< 1.0 µm	< 1.5 µm
Pitch [5]		20 µrad	25 µrad	35 µrad	40 µrad
Yaw [5]		10 µrad	10 µrad	15 µrad	20 µrad
XY Orthogonality		< 25 µrad			
Stage Mass		14.5 kg	18.5 kg	22.5 kg	27.5 kg
Moving Mass	Upper (X) Axis	3 kg			
	Lower (Y) Axis	5.5 kg	6.5 kg	7.5 kg	8.5 kg
Cabling		External e-chain, moving loops			
Operating Pressure [6]		60 to 70 psig (415 to 485 kPa)			
Air Consumption		< 2 SCFM (56 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 with SS Fasteners			

Notes:
1. Maximum velocity and acceleration based on unloaded stage capability; may be limited by payload, controller, or drive performance.
2. Assumes and air supply pressure of 65 psig (450 kPa). Assumes payload CG is centered no more than 50mm above the stage table. Stage is only designed for horizontal operation.
3. Improved accuracy can be obtained with controller-based error compensation. Accuracy values assume short-term time duration and do not consider the long-term effects of thermal drift on the stage.
4. Encoder resolution chosen may 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.

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10.2. Motor Electrical Specifications

(A-311.xx1 standard motor option)

Model	A-311.xx1
Bus Voltage	48 VDC nominal, 80 VDC max
Force Constant	12.3 N/A
Peak Current	6.9 A
Continuous Current	3.2 A
Peak Force	85 N
Continuous Force	39.4 N
Back EMF (phase-to-phase)	10.1 V/m/sec
Resistance (phase-to-phase)	3.6 ohms
Inductance (phase-to-phase)	1.24 mH
Electrical Cycle Length (pole pitch, N-N)	24 mm

10.3. Encoder & Limit Specifications

Option Code	A	B
Type	Incremental	Absolute
Resolution	20 µm signal period	1 nm
Output Signal	Analog Quadrature 1 Vp-p, Differential	BiSS-C 32-bit serial
Power Input	5 VDC, <200 mA	5 VC, <250mA
Input Ripple	200 mVp-p max @ up to 500 kHz	
Limits	Open collector output, Asynchronous pulse, Active high	None
Index Mark	0.8 to 1.2 Vp-p, Differential	None

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-311 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.

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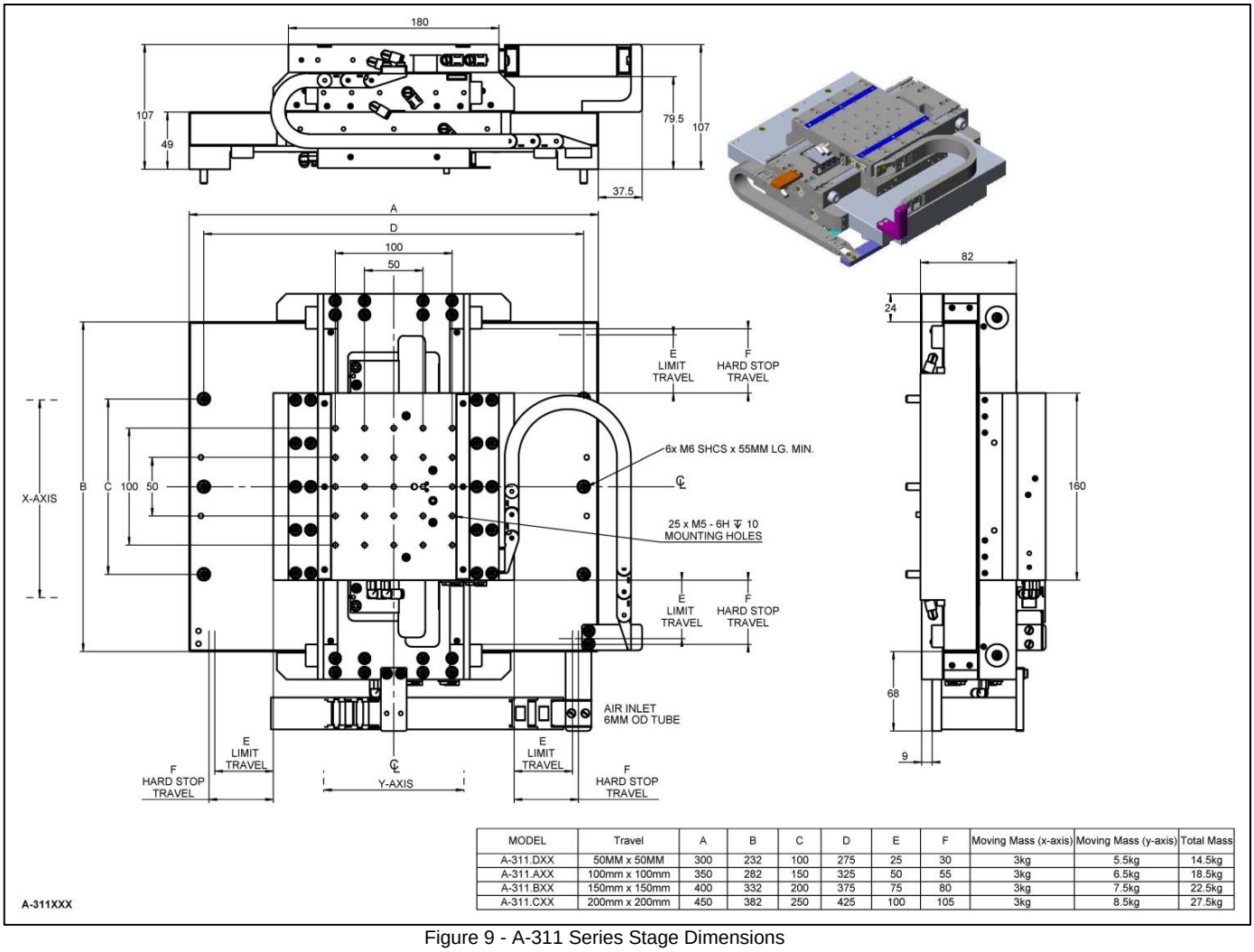
10.5. Dimensions



MODEL	Travel	A	B	C	D	E	F	Moving Mass (x-axis)	Moving Mass (y-axis)	Total Mass
A-311.DXX	50MM x 50MM	300	232	100	275	25	30	3kg	5.5kg	14.5kg
A-311.AXX	100mm x 100mm	350	282	150	325	50	55	3kg	6.5kg	18.5kg
A-311.BXX	150mm x 150mm	400	332	200	375	75	80	3kg	7.5kg	22.5kg
A-311.CXX	200mm x 200mm	450	382	250	425	100	105	3kg	8.5kg	27.5kg

Figure 9 - A-311 Series Stage Dimensions

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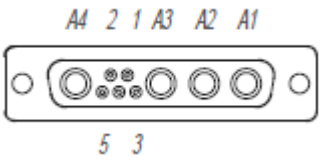
10.6. Pin Assignments (note assignments are same for upper and lower axes)

Pins are assumed to be “N/C” if not shown below

Motor Connector, Motor Option “1”

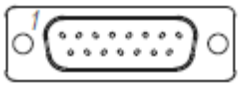
Type: DB9W4M



Pin	Function	Description
A1	PHA	Motor phase A
A2	PHB	Motor phase B
A3	PHC	Motor phase C

Encoder Connector, Encoder Option “A”

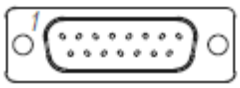
Type: DB15M



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

Encoder Connector, Encoder Option “B”

Type: DB15M



Pin	Function	Description
2	MA+	Encoder CLK+ (MA+)
3	MA-	Encoder CLK- (MA-)
4	+5v	Encoder power
5	+5v	Encoder power
6	SLO+	Encoder Data+ (SLO+)
7	SLO-	Encoder Data- (SLO-)
8	GND	Encoder ground
9	GND	Encoder ground

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11. EC Declaration of Conformity

For the model A-311 (all options and configurations), an EC Declaration of Conformity has been issued in accordance with the following European directives:

- 2004/108/EC, EMC Directive
- 2014/35/EU, Safety/Low Voltage Directive
- 2011/65/EU, RoHS Directive

The applied standards certifying the conformity are listed below.

- EMC: EN 61326-1:2013
- Safety/LVD: EN 61010-1:2010
- RoHS: EN 50581:2012

If an electrical operating device is designed to be integrated in another electrical operating device: The operator is responsible for a standards compliant integration of the electrical device into the overall system.

12. 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

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