User Manual

A620D0001 Rev 1.4
7-May-2021

A-62x Series Rotary Air Bearing Stage

PIglide RM, Direct-drive Torque Motor Driven with Encoder Feedback

This document describes the A-62x.xxxxx Series of Rotary Air Bearing Motorized Stages.

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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-62x 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

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2. Safety

2.1. Intended Use

The A-62x 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-62x is intended for single-axis positioning of loads at different velocities. The A-62x is not intended for applications in areas in which a failure would present severe risks to human beings or the environment.

The intended use of the A-62x is only possible when completely mounted and connected.

The A-62x must be operated with a suitable controller. The controller is not included in the scope of delivery of the A-62x.

2.2. General Safety Instructions

The A-62x 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-62x.

- Only use the A-62x 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-62x.

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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.
 DANGER	The stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.
 DANGER	Use care when moving the stage. Manually lifting or transporting stages can result in injury.
 WARNING	Use care when moving the stage. Avoid any shocks, drops or bumps that can cause scratches, dings, dents, or distortion of the stage.

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	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-62x.
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.
- If you pass the A-62x 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-62x after having read and understood this user manual.

Personnel qualification

The A-62x may only be installed, started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

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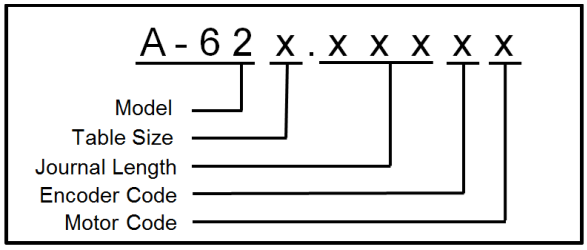
3. Product Description

3.1. Model Overview and Part Numbering

The A-62x series offers various models, defined by the stage size, encoder type, and motor option. The dimensions of the various models vary. Encoder and motor options do not affect the dimensions.



Model	Table Diameter	Journal Length	Encoder Option	Motor
A-62	1 = 50mm	025 = 25mm	A = Incremental, Sine (1 Vp-p) output	1 = Standard motor option, slotless
	3 = 100mm	025 = 25mm	B = Absolute BiSS-C serial output	
		050 = 50mm		
	4 = 150 mm	050 = 50mm		
	5 = 200mm	065 = 65mm		
	7 = 300mm	075 = 75mm		

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3.2. Product Features

The A-62x series stages all incorporate completely non-contact fully preloaded air bearings, direct-drive torque motors, and optical position feedback encoders 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 brushless torque motor uses an ironless slotless 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.

The air bearing, motor, and encoder are housed in the internals of the stage and are not visible to the user.

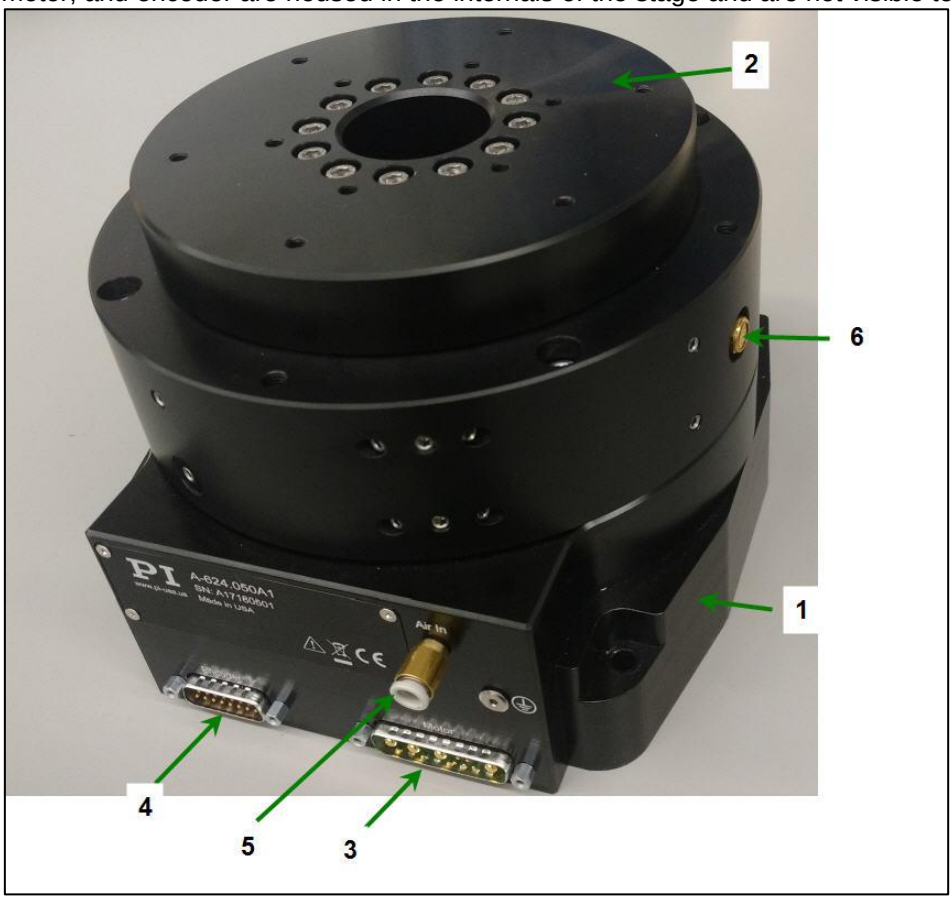

Figure 1 - Product Features, A-62x

#	Description
1.	Stage base
2.	Moving table
3.	Motor electrical connection
4.	Encoder electrical connection
5.	Air supply inlet
6.	Air exhaust port

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3.3. Product Labeling

Figure 2 - Product Labeling Example

#	Description
1.	Product model number (example)
2.	Serial number (example), individual for each A-62x Meaning of the places (counting from left): A = PIglide Air Bearing Product 17 = year of manufacture (i.e. 2017) 160501 = unique number, 6-digit
3.	Warning sign "Observe manual"
4.	Old equipment disposal warning sign
5.	CE conformity mark
6.	Protective earth grounding location
7.	Air supply inlet location
8.	Motor electrical connection
9.	Encoder electrical connection
10.	Country of origin
11.	Manufacturer's address (website)
12.	Manufacturer's logo

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3.4. Scope of Delivery

Item ID	Component
A-62x.xxxxxx	Stage according to the order
---	Stage Mounting Screws (size will depend on the stage model ordered)
---	Shipping restraint
A620D0001	User manual (this document)

3.5. Accessories

The following accessories are offered to complement the A-62x 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
A-60x.MTT	Manual X-Y-Tip-Tilt Centering Table

3.6. Controllers

The A-62x must be connected to a suitable motion controller to be operated. The following standard controllers are available from PI to operate the A-62x. Other controllers are also available, contact PI for options.

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

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4. Technical Features

4.1. Air Bearing

The A-62x 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-62x incorporates opposing axial and radial preload mechanisms. This sort of preload makes the A-62x suitable for various mounting orientations, such as horizontal, vertical, and inverted. Be careful not to apply excess cantilever loads to the stage table.

4.2. Torque Motor

The A-62x series stage features a brushless, ironless, slotless 3-phase torque motor. 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. Hall Effect sensors are not included, so the drive and/or controller must be capable of encoder-based (sine) commutation.

4.3. Encoder

The A-62x series stage features an optical non-contact position 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-62x series stage offers two 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. Index Mark (Incremental encoders only)

When equipped with either of the incremental encoder options, the A-62x series stage features a non-contact home index marker. The index is integral to the encoder electronics. The index mark is optical; there is one index per revolution of the stage.

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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 24 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-62x stage must always be transported and shipped with the shipping restraint installed. Failure to use the shipping restraint 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-62x, 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-62x stage weighs up to 50 kg in its largest size. Use care when lifting and use two people to lift.

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6. Installation

6.1. Mounting Surface Quality and Preparation

The surface to which the stage will be mounted should be flat and have adequate stiffness in order to achieve the maximum performance from the A-62x. When the A-62x 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. 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.

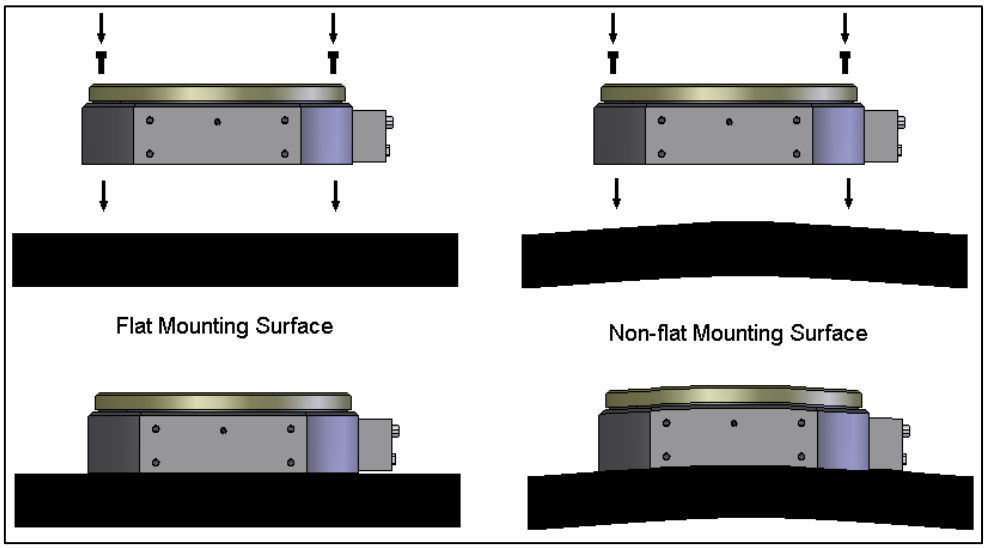

Figure 3 - Mounting Surface Quality

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).

6.2. Mounting Orientation

The A-62x is suitable for various mounting orientations, such as horizontal, vertical, and inverted. PI recommends that you review your payload and orientation conditions with a PI engineer before purchasing this product.

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6.3. Mounting Procedure

1. Place the stage on the mounting surface.
2. Remove the shipping restraint.
3. Connect the compressed air supply and turn on the air.
4. Affix the stage base to the mounting surface using the four mounting screws provided. Screw size and length will depend on the stage model, see the table below.
5. Torque the mounting screws (begin from the center out for best accuracy). The typical maximum torque value for the mounting screws is shown in the table below.

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

Model	Mounting Screw (4x)	Max. Screw Torque (N-m)
A-621.xxxxx	M3 SHCS, 30mm long (minimum)	2
A-623.xxxxx	M6 SHCS, 30mm long (minimum)	20
A-624.xxxxx	M6 SHCS, 40mm long (minimum)	20
A-625.xxxxx	M6 SHCS, 30mm long (minimum)	20
A-627.xxxxx	M8 SHCS, 40mm long (minimum)	48

6.4. Removing the shipping restraint

The stage is shipped with a shipping restraint installed to prevent unwanted motion between the stage table and the stage base. To remove the shipping restraint, unscrew the SHCS using an Allen key. Make sure to safely store the parts for later use, in case the stage ever needs to be moved or transported.

Figure 4 - Shipping Restraint

The shipping restraint kit for the A-62x consists of:

#	Description
1.	Shipping bracket for A-62x
2.	Flat washer
3.	SHCS
4.	Shipping restraint label

Screw sizes used in shipping restraint kits:

Model	Screw Size and Length
A-621	M3 SHCS, 5mm long
A-623	M5 SHCS, 8mm long
A-624	M6 SHCS, 8mm long
A-625	M6 SHCS, 16mm long
A-627	M8 SHCS, 10mm long

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6.5. Air Supply

Air Requirements

The A-62x stage requires clean, oil-free, and dry compressed air to operate properly. See Section 10.2 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 to the A-62x stage accepts flexible polyurethane pneumatic tubing:

- 4mm OD for the model A-621 & A-623
- 6mm OD for the models A-624, A-625 & A-627.

Figure 5 - Air Inlet Fitting Location

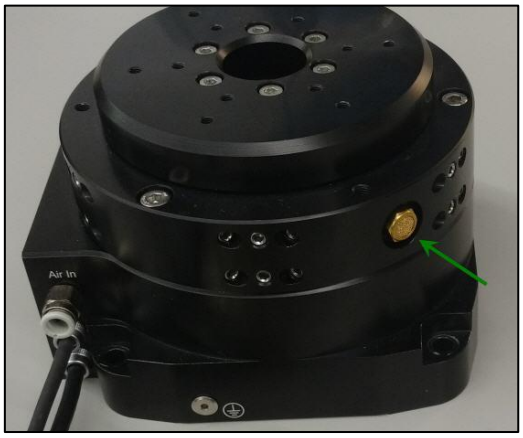

Figure 6 - Air Exhaust Port Location

WARNING	As air flows through the stage, it must eventually exhaust to atmosphere. There is an exhaust port located on the side of the stage. Do NOT allow this exhaust port to become blocked or covered.

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.

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6.6. 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 tapped holes for mounting the user's payload. These are the only features that should be used to attach a payload to the stage. Mounting-hole sizes and patterns will depend on the stage model ordered; see the CAD drawings in Section 10.6 for details.

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).

For optimum performance, the payload center of mass should be centered on the stage tabletop. If the payload is not centered, the rotating mass will not be balanced about the axis of rotation. Imbalance, especially at higher rotational speeds, can cause vibration, excessive error motion, and possibly damage to the stage.

	Do not attempt to modify the stage table in any way. Customer modifications may damage the stage.
	The screws used to attach the payload to the stage table should not thread into the stage tabletop any more than the depth shown on the CAD drawing. Longer screws may damage the table.
	Do not overtighten the payload mounting screws.
	Do not exceed the maximum payload specified for the A-62x stage.

6.7. Multi-Axis Configurations

Multi-axis configurations of the A-62x series stage are not available at this time without customization. Please contact PI for a quote if you require a multi-axis system.

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6.8. 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-62x 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 the end plate of the stage near the air inlet.

Figure 7 - Earth ground connection point location

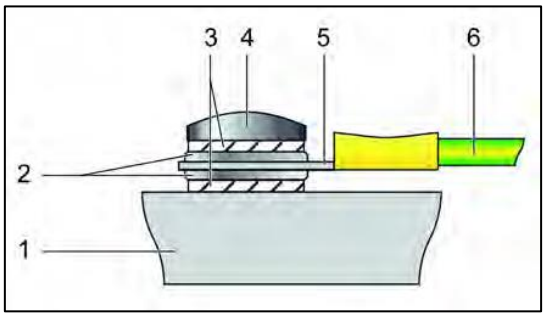

Figure 8 - Mounting of the protective earth conductor (profile view)

#	Description
1.	Base plate of the A-62x
2.	Flat washer (2x)
3.	Internal tooth washer (2x)
4.	M4 Screw
5.	Cable lug
6.	Protective earth conductor

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-62x 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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6.9. Connecting the Cables

Stage interconnect cables are not in the scope of delivery of the A-62x 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 10.7 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.

1. Connect the stage cables for the motor and encoder to the connectors on the end plate of the A-62x stage.
2. Tighten the jack screws with a flat head screwdriver to secure the cables. Do not overtighten the screws.

Figure 9 - Stage Electrical Cable Connectors

On the models A-621 and A-623, the electrical connectors are external to the stage body, as shown on the left photo above. Care should be taken to properly secure the connectors after installation so they do not move and damage the cables or stage body.

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7. Startup and Operation of the Stage

See the user's manual of the controller being used with the A-62x 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.
 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 A-62x 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-62x 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-62x 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-62x is specified.
 WARNING	The optimum values of the servo-loop parameters in the controller depend on the application and the payload mass/inertia. 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, size, or inertia changes.

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8. Maintenance

Other than basic cleaning, the A-62x series stage is maintenance-free.

8.1. Cleaning the Stage

To clean the stage surfaces, use isopropanol and a clean, lint-free cloth or wipe. Apply the cleaning agent to the cloth and wipe down all of the surfaces. When cleaning the stage 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 surfaces as they attract dust and may tarnish the 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. Turn off the controller power.
2. Disconnect stage cables.
3. Remove the payload.
4. Turn off the air supply and disconnect the air supply line from the stage.
5. Install the shipping restraint and restraint label. Tighten the stage shipping restraint screws using an Allen wrench.

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-62x, 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-62x stage weighs up to 50 kg in its largest size. Use care when lifting and use two people to lift.

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9. Customer Service

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

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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. Sizes and Load Capacities

Model	Table Diameter (mm)	Journal Length (mm)	Load Capacity (N [lb_f])		Tilt Load Capacity (N-m [lb_f-in])	Stiffness (N/µm [lb_f/µin])	
			Axial	Radial		Axial	Radial
A-621.025	50	25	134 [30]	57 [13]	0.57 [5]	26 [0.15]	8 [0.05]
A-623.025	100	25	536 [121]	115 [26]	1.7 [15]	96 [0.55]	18 [0.10]
A-623.050	100	50	536 [121]	229 [51]	4.52 [40]	96 [0.55]	35 [0.20]
A-624.050	150	50	1206 [271]	344 [77]	22.6 [200]	210 [1.2]	64 [0.37]
A-625.065	200	65	2144 [482]	577 [129]	39.6 [350]	385 [2.2]	110 [0.63]
A-627.075	300	75	4244 [954]	1203 [269]	141.3 [1250]	788 [4.5]	204 [1.17]

Values listed assume supply pressure of 80 psi. Please contact PI if alternate pressures are required.

10.2. Performance Specifications

Specification	Units	A-621.025	A-623.025	A-623.050	A-624.050	A-625.065	A-627.075
Drive System	-	Frameless, brushless, slotless, direct-drive torque motor					
Feedback System	-	Non-contact optical rotary encoder					
Travel	-	Unlimited, 360° continuous					
Positioning Accuracy [1]	µrad	< +/- 8					
Repeatability, Bi-directional	µrad	< +/- 4					
Radial Error Motion [2]	nm	< 300	< 175		< 100	< 100	< 75
Axial Error Motion [2]	nm	< 100	< 75		< 50	< 50	< 40
Tilt Error Motion [2]	µrad	< 5	< 3		< 2	< 2	< 1
Max Velocity [3]	RPM	2500	1200		600	500	500
Rotating Moment of Inertia	kg-mm^2	117	1,740	1,780	9,930	31,730	195,200
Rotating Mass	kg	0.4	1.3	1.4	3.7	6.6	18.9
Total Stage Mass	kg	1.0	3.1	3.9	8.9	14	45
Operating Pressure [4]	-	550 +/-35 kPa (80 +/-5 psi)					
Air Consumption	-	< 57 liters/minute (2.0 SCFM)					
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 [5]	-	Hardcoat Aluminum, SS Fasteners					

Notes:
1. Values shown are obtained using controller-based error compensation. Stage must be purchased with a PI controller to achieve this performance. Accuracy values assume short-term time duration and do not consider the long-term effects of thermal drift on the stage.
2. Precision specifications are dependent on quality of mounting surfaces, payload, orientation, and external forces on the stage. Please consult PI for application-specific parameters. Values shown are static (zero rotational velocity during measurement) with no payload.
3. Velocity may be further limited by encoder options, payload imbalance, or controller and drive electronics.
4. To protect stage from damage, an under-pressure air sensor tied to the controller E-stop input is recommended.
5. Alternate custom tabletop materials, such as stainless steel, are available. Please contact PI for a quote.

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10.3. Motor Electrical Specifications

Specification	Units	A-621.025	A-623.xxx	A-624.050	A-625.065	A-627.075
Motor Bus Voltage	VDC	48 VDC nominal, 80 VDC max				
Motor Torque Constant	N-m/A	0.034	0.24	0.59	0.59	0.66
Continuous Current	A	3.3	3.1	2.3	2.3	4.5
Peak Current	A	9.9	9.3	6.9	6.9	13.9
Continuous Torque	N-m	0.12	0.86	1.57	1.57	2.82
Peak Torque	N-m	0.35	2.60	4.71	4.71	8.46
Motor Back EMF	V/kRPM	4.1	29	71	71	80
Motor Resistance (phase-to-phase)	Ω	2.7	4.8	6.7	6.7	4.5
Motor Inductance (phase-to-phase)	mH	0.1	0.26	0.9	0.9	0.6
# Poles	-	12	28	48	48	64

10.4. Encoder Specifications

Option Code	A	B
Type	Incremental	Absolute
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	

Model	Option Code	Units	A-621	A-623	A-624	A-625	A-627
Fundamental Lines/Rev	A	#	8,192	15,744	23,600	31,488	47,200
Resolution	A(1)	µrad (arc-sec)	0.19 (0.04)	0.1 (0.02)	0.06 (0.01)	0.05 (0.01)	0.03 (0.007)
	B		0.0015 (0.0003)				
Max Velocity	A	RPM	See max velocity in table above. Not limited by encoder.				
	B						
Index Mark	A	-	0.8 to 1.2 Vp-p, Differential, 1/rev				
	B	-	None				

Notes:
1. Resolution shown for encoder option “A” assumes 4096x interpolation.

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10.5. 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 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.

10.6. Dimensions

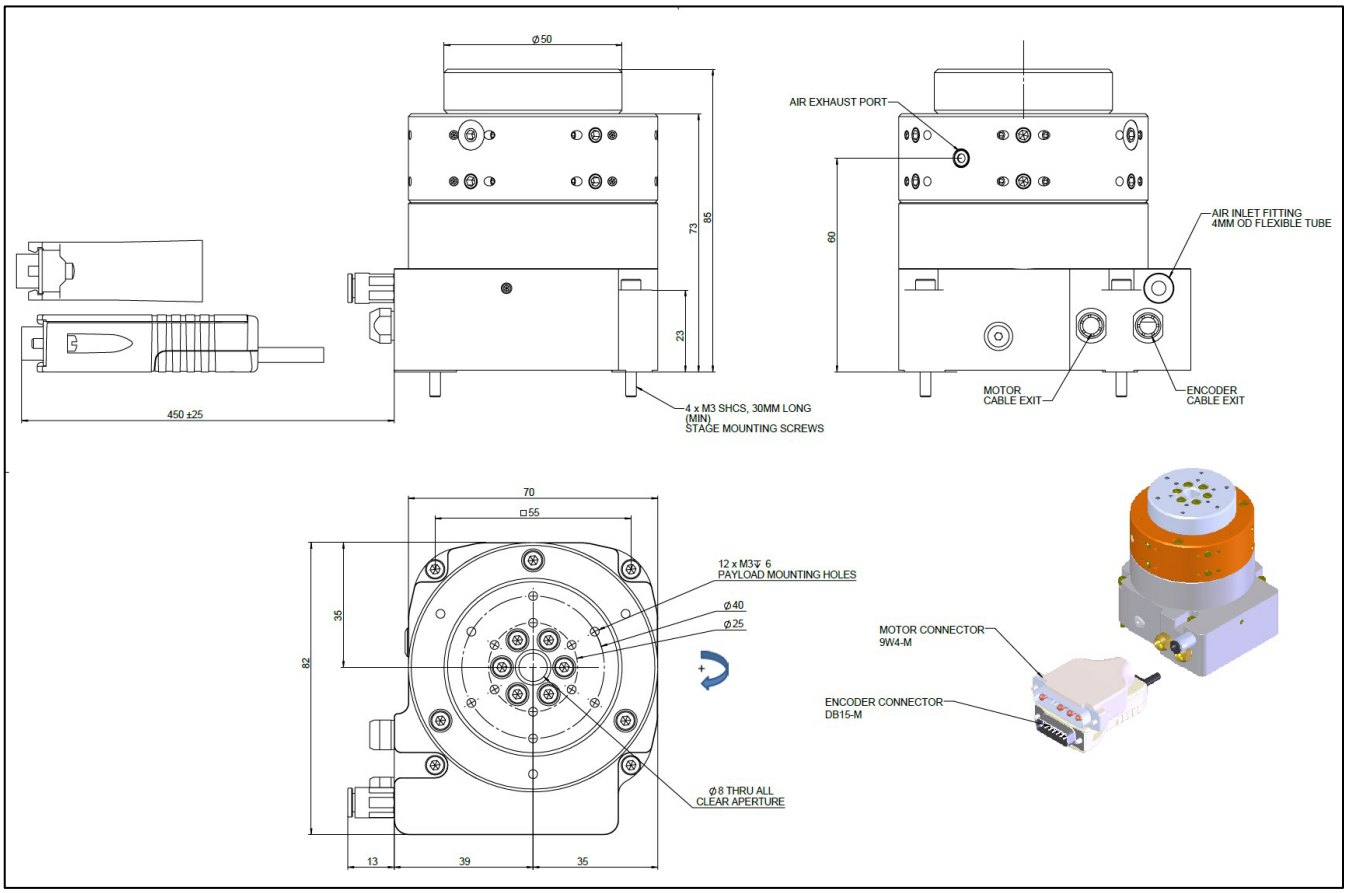

Figure 10 - A-621.025x1 Stage Dimensions

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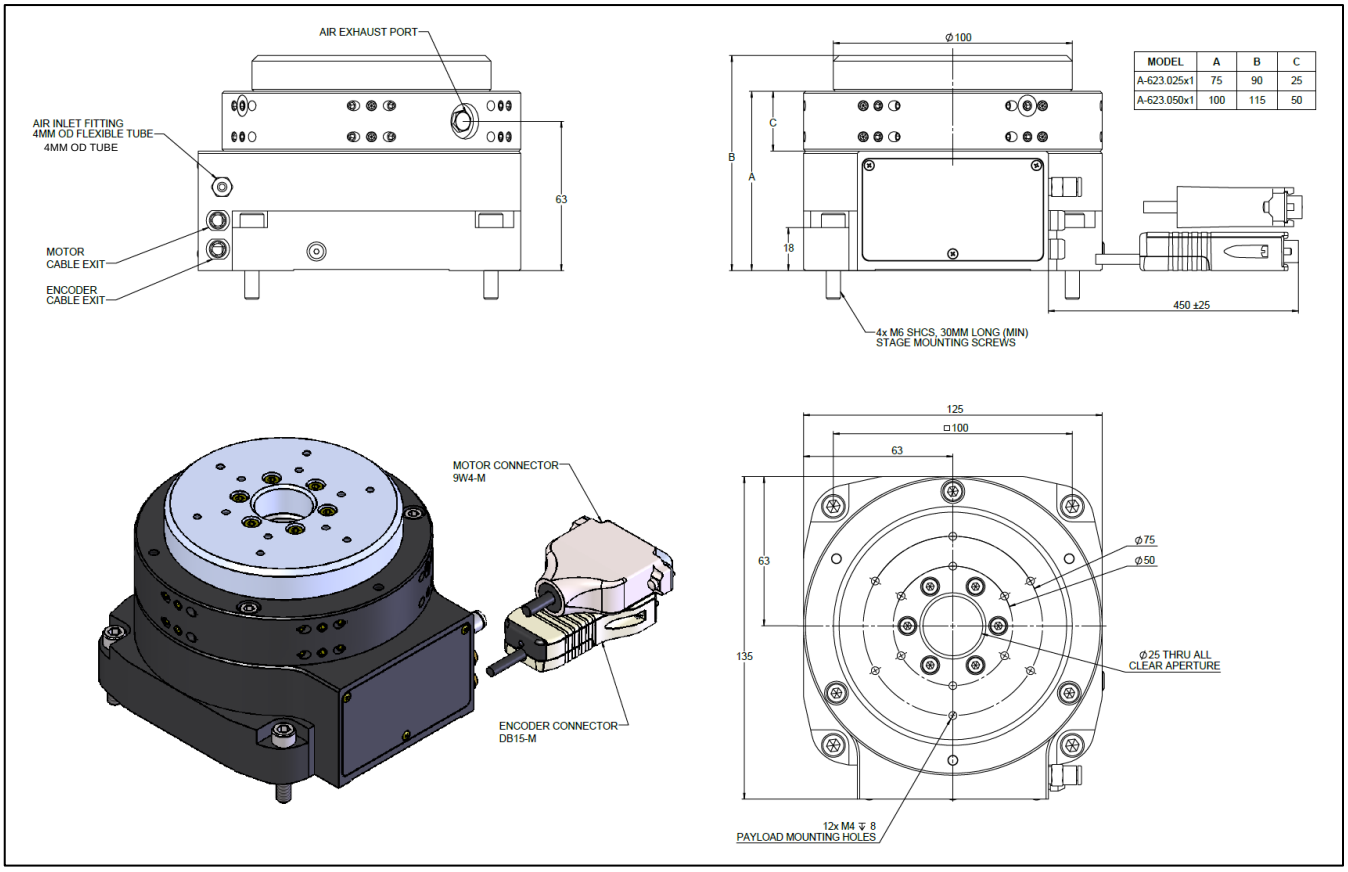

Figure 11 - A-623.xxxx1 Stage Dimensions

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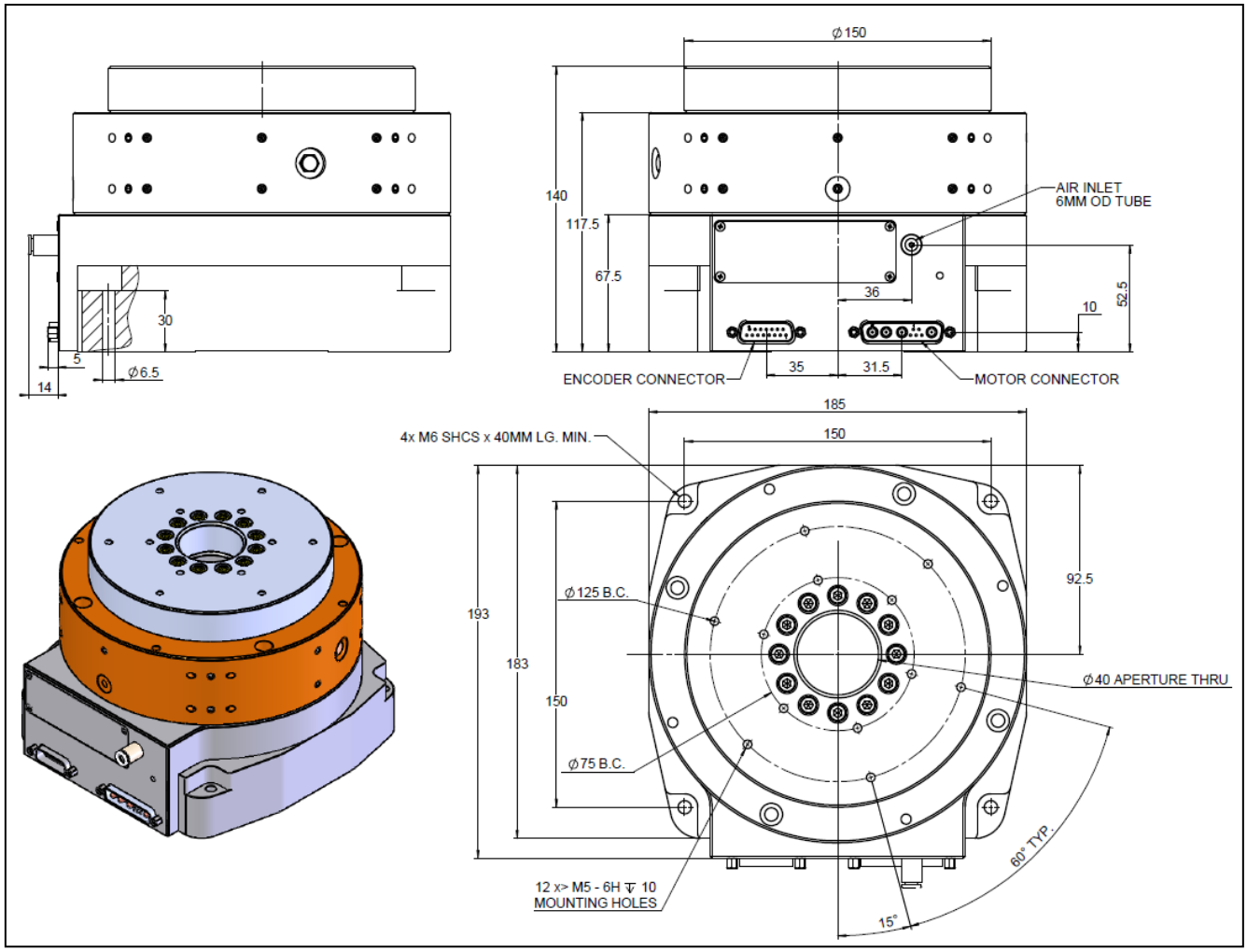

Figure 12 - A-624.050x1 Stage Dimensions

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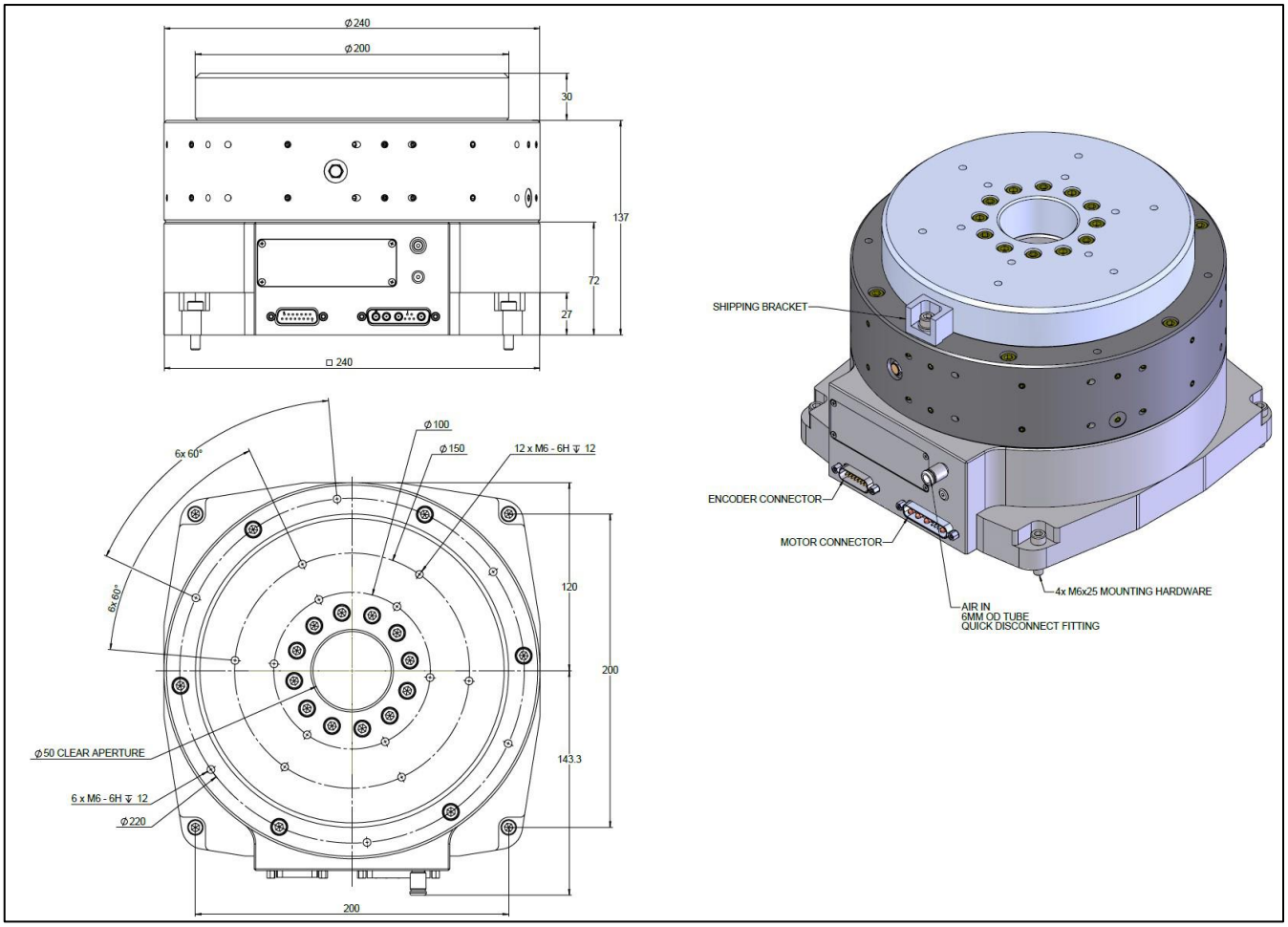

Figure 13 - A-625.065x1 Stage Dimensions

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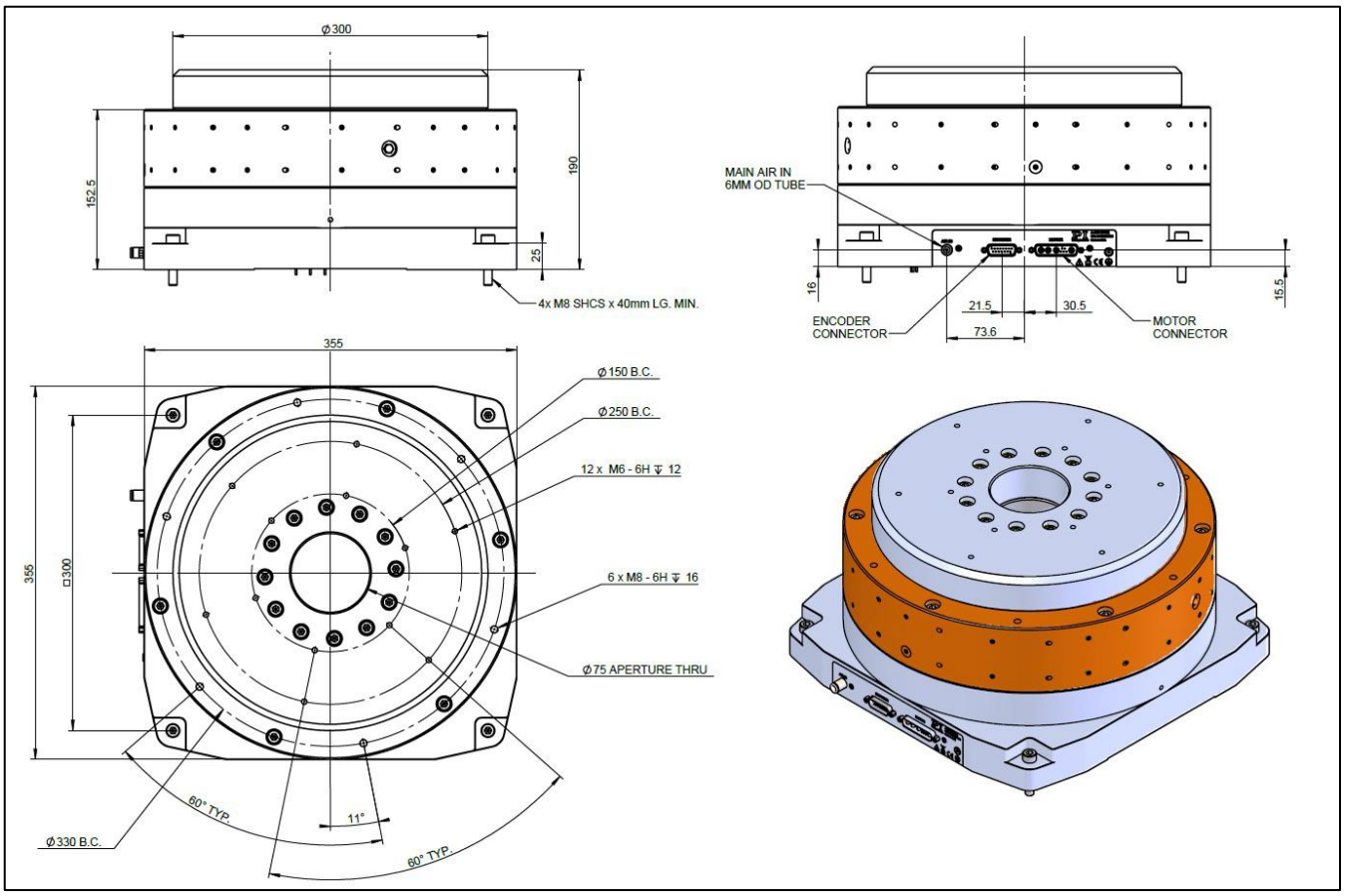

Figure 14 - A-627.075x1 Stage Dimensions

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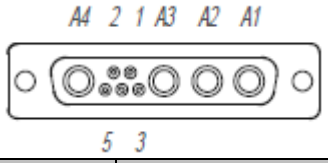
10.7. Pin Assignments

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

Motor Connector

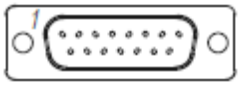
Type: DB9W4M



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

Encoder Connector, Encoder Option “A”

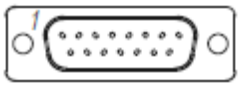
Type: DB15M



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-62x (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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