

Pliglide RT Rotary Air Bearings User Manual

Document# A60XD001

For the A-60X.XXXX Series of Non-motorized Rotary Air Bearings

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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-60x series of rotary air bearings. The PIglide A-60x RT Rotary Air Bearing is a family of passive air bearings that provide frictionless motion in one rotational degree of freedom. This product is non-motorized.

1.2. Symbols and Typographic Conventions

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

Symbol	Meaning
 WARNING	If not avoided, the situation could result in damage to the equipment.
   DANGER DANGER DANGER	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

2. Warnings

 WARNING	The air bearing should never be moved without the air supply turned on. Forcing the table to rotate without the air supply turned on may damage the bearing.
 WARNING	Dirt, oil, lubricants and condensation will damage the bearing. Keep the bearing clean and free of dirt, debris, oil, lubricants, and moisture.

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.




3. Air Supply

A clean, filtered, regulated air supply is critical to proper operation of the bearing. We recommend the purchase of a PI Air Preparation Kit (series A-80x.xxx) to be used with your air bearing.

We recommended filtering using 0.5 micron filters or better. Unless the air supply is from a dry nitrogen tank, coalescing filters or dryers should also be used to remove oil and water vapor. A regulator is recommended to optimize the air flow into the bearing for the application loading. The air bearing will operate with pressure ranging from 40 psi to 90 psi, depending on the load applied. It is generally recommended to set the pressure at least 10 psi higher than the pressure required for the bearing to resist all loading without making contact (this can be observed by watching to see that the bearing still moves with zero friction). Operating at pressures higher than this will ensure margin for overloads, but the bearing will consume more air. In some cases, the bearing may vibrate if the pressure is set too high. If this happens, reduce the supply pressure to at least 5-10 psi lower than the pressure at which vibration can be heard or felt.

4. Unpacking

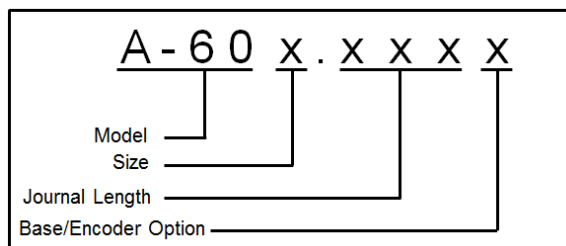
Carefully unpack the air bearing and other components from the shipping packaging. Inspect the contents for signs of damage. If there is any sign of damage or missing parts, contact PI immediately. Keep all packaging materials in case the product needs to be returned.

 DANGER	Use care when moving the bearing. Manually lifting or transporting the bearing can result in injury.
 WARNING	Use care when moving the bearing. Avoid any shocks, drops or bumps that can cause scratches, dings, dents, or distortion of the unit.
 Caution Heavy	The A-60x bearing weighs up to 60 kg in its largest size. Use care when lifting and use two people to lift.

5. Product Description

5.1. Model Overview and Part Numbering

The A-60x series offers various models, defined by the table diameter, journal length, and various options for mounting bases and position encoders.



Model	Table Diameter	Journal Length	Mounting Base / Encoder Option
A-60	1 = 50mm	025 = 25mm	H = Digital incremental, RS-422 Output 4x Interpolation, 4 MHz Clock Includes Mounting Base M = Mounting Base (no Encoder) (Blank) = No encoder or base B = Absolute, BiSS-C Output Includes Mounting Base
	2 = 75mm	038 = 38mm	
	3 = 100mm	025 = 25mm	
		050 = 50mm	
	4 = 150mm	050 = 50mm	
		090 = 90mm	
	5 = 200mm	065 = 65mm	
	7 = 300mm	100 = 100mm	
		075 = 75mm	
		175 = 175mm	

5.2. Accessories

- **Tip-Tilt Tables**

The A-60x series can be ordered with an optional manual tip-tilt tabletop. This option allows the user to manually adjust a payload mounted to the bearing in 4 degrees of freedom, making it easier to align a payload to the bearing's axis of rotation.

Manual X-Y-Tip-Tilt Tabletop kit. Sold separately.	
Part #	Compatible with models:
A-602.MTT	A-602.xxx 75mm diameter tables
A-603.MTT	A-603.xxx 100mm diameter tables
A-604.MTT	A-604.xxx 150mm diameter tables
A-605.MTT	A-605.xxx 200mm diameter tables
A-607.MTT	A-607.xxx 300mm diameter tables

- **Air Prep Kits**

The A-60x series is compatible with the A-80x.xxx series of air preparation kits. Contact PI for available configurations.

- **Encoder Interfaces**

For A-60x models sold with the optional encoder, PI offers USB converters that can be used to interface the encoder output to a PC.

5.3. Scope of Delivery

The system will include the following components:

1. Rotary Air Bearing
2. Shipping Restraint
3. User Guide (this document)

5.4. Product Features

The basic RT rotary air bearing consists of three main components, shown in the schematic below:

1. Top Table
2. Housing
3. Bottom Table

All the items in grey rotate together relative to the item in blue. In most applications, the housing (2) is held stationary while the tables (1 & 3) rotate. Mounting features are provided on both of the tables as well as the housing.

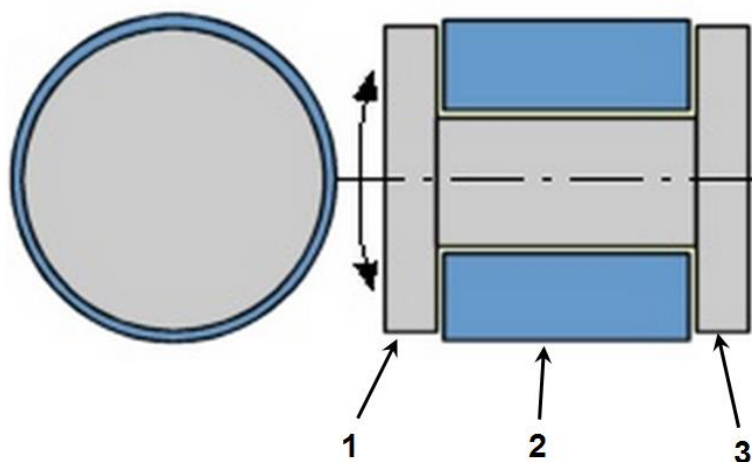


Figure 1 - Rotary Air Bearing Cross Section Schematic

The bearing can be mounted in either a horizontal or vertical orientation.

6. Installation & Assembly (models without mounting bases or encoders)

1. Make sure the bearing is clean and free of debris, dust, and damage.
2. Mount the air bearing housing to your installation fixture or base. Use the mounting holes (Item 3) on the face of the housing. These holes are located on both the top and bottom faces. The screw size and length required will depend on the size bearing. See Section 13.3 Dimensions for mounting-hole sizes.
3. Remove the shipping restraint (see below).
4. Connect the air supply line to the air fitting attached to the housing (Item 1). Use 6mm OD flexible pneumatic tubing.
5. Mount the air preparation kit (if so ordered) in a location convenient to the facility compressed air supply and within 3 meters of the air bearing. If a longer air supply line run is needed, a larger diameter tube may be required. Contact PI if needed.
6. Connect the facility air supply to the input port of the air preparation kit. (if so ordered)
7. Connect the air bearing supply tube to the output port of the air preparation kit. (if so ordered)
8. Turn on the air supply and check that the table of the bearing rotates freely.
9. Adjust the pressure regulator knob on the air preparation kit until the pressure indicator dial reads the desired pressure (80 psi / 550 kPa is nominal).
10. Turn the air supply off.
11. Mount your payload to the bearing table (Item 2) using the proper size and length of screws. Be sure the interface of the payload is flat to no more than 1 μm per 50 mm.
12. Turn the air supply on to operate the bearing.



Figure 2 - RT Rotary Air Bearing

7. Removing the shipping restraint

The bearing may be shipped with a shipping restraint installed to prevent unwanted motion between the table and the 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 bearing ever needs to be moved or transported.



Figure 3 - Shipping Restraint

The shipping restraint kit for the A-60x consists of:

#	Description
1.	Shipping bracket
2.	Flat washer
3.	SHCS
4.	Shipping restraint label

Screw sizes used in shipping restraint kits:

Model	Screw Size and Length
A-601	M3 SHCS, 5mm long
A-602	M4 SHCS, 5mm long
A-603	M5 SHCS, 8mm long
A-604	M6 SHCS, 8mm long
A-605	M6 SHCS, 8mm long
A-607	M8 SHCS, 10mm long

8. Air Exhaust Port



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.

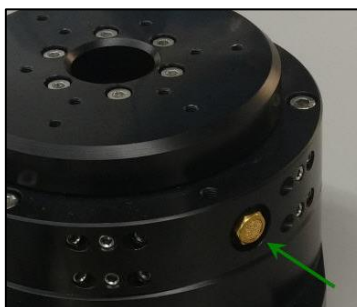


Figure 4 - Air Exhaust Port Location

9. Installation & Assembly (models with mounting bases and encoders)

1. Follow the steps listed above.
2. To mount the bearing to your installation fixture or base, use the 4x counter-bored mounting holes in the bearing base plate. Use the screw size and length indicated in Section 13.3 Dimensions.
3. If the encoder option has been included, connect the encoder connector to your electronics or to the USB adapter (sold separately). See Section 13.5 Pin Assignments.

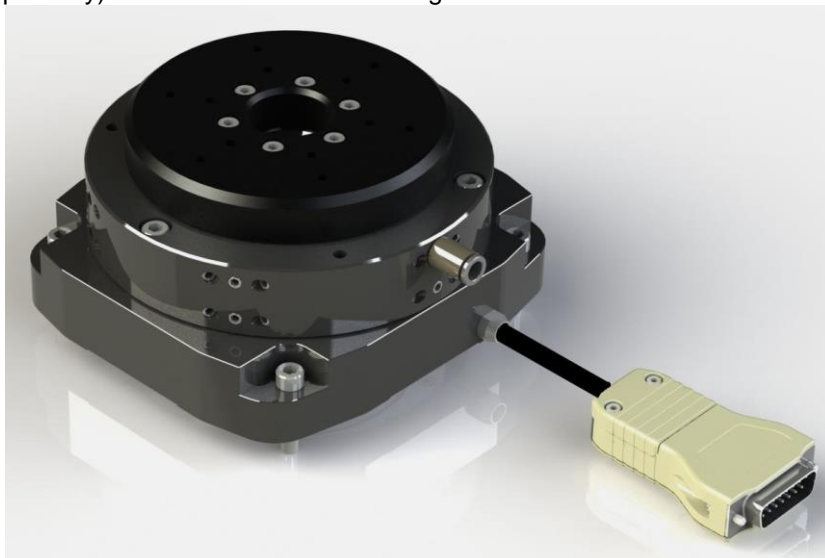


Figure 5 - RT Rotary Air Bearing with optional encoder and mounting base

10. Turbine Torque

All air bearings with low friction exhibit turbine torque, where the air in the bearing has a preferential flow direction that will drive the bearing to accelerate in one direction. This is caused by the finishing process and small inconsistencies between the bearing orifices. Because these bearings are optimized to have the lowest friction possible (drag torque is typically on the order of 2×10^{-9} Nm at a standstill), the bearings typically have a turbine torque larger than the drag torque, typically about 9×10^{-9} Nm. The bearing will accelerate until the turbine torque matches the drag torque at that speed.

To minimize the turbine torque effect, we recommend reducing the supply air pressure until the bearing (with payload) touches down. Increase the pressure just until the bearing floats again, then increase by another 3-5 psi. This would be the minimum recommend operating pressure for that particular payload and will give the smallest possible turbine torque for that bearing and payload configuration.

Since the turbine torque is very consistent with a particular payload and air supply pressure, customers may typically run a calibration experiment to measure and null out the turbine torque from their test results.

11. Storage

When not in use, the air supply can be shut off and the bearing can still carry its design load. However, it is important to make sure that no table movement takes place. Reinstall the shipping restraint if the bearing should be locked in place.

Cover the bearing to prevent dust and other particles from accumulating on the exposed surfaces.

12. Cleaning

To clean the bearing, we recommend using isopropanol or acetone 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 we recommend that you leave the air supply 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.

13. Technical Data

13.1. Basic Specifications

Model	Table Diameter (mm)	Journal Length (mm)	Load Capacity (N [lb _f])		Tilt Load Capacity (N-m [lb _f -in])	Stiffness (N/μm [lb/μin])	
			Axial	Radial		Axial	Radial
A-601.025	50	25	134 [30]	57 [13]	0.57 [5]	26 [0.15]	8 [0.05]
A-602.038	75	38	299 [67]	132 [30]	1.13 [10]	57 [0.33]	22 [0.13]
A-603.025	100	25	536 [121]	115 [26]	1.70 [15]	96 [0.55]	18 [0.10]
A-603.050	100	50	536 [121]	229 [51]	4.52 [40]	96 [0.55]	35 [0.20]
A-604.050	150	50	1206 [271]	344 [77]	22.6 [200]	210 [1.2]	64 [0.37]
A-604.090	150	90	1206 [271]	605 [135]	36.7 [325]	210 [1.2]	113 [0.65]
A-605.065	200	65	2144 [482]	577 [129]	39.6 [350]	385 [2.2]	110 [0.63]
A-605.100	200	100	2144 [482]	917 [205]	67.8 [600]	385 [2.2]	175 [1.0]
A-607.075	300	75	4244 [954]	1203 [269]	141.3 [1250]	788 [4.5]	204 [1.17]
A-607.175	300	175	4244 [954]	2789 [627]	282.5 [2500]	788 [4.5]	475 [2.71]

Model	Units	A-601.025	A-602.038	A-603.025	A-603.050	A-604.050	A-604.090	A-605.065	A-605.100	A-607.075	A-607.175
Radial Error Motion	nm	300	250	175	175	100	100	100	100	75	75
Axial Error Motion	nm	100	75	75	75	50	50	50	50	40	40
Tilt Error Motion	μrad	5	4	2.5	2.5	2	2	1.5	1.5	1	1
Max Velocity	RPM	3000						2000		1000	
Moment of Inertia	kg-mm ²	35	231	705	750	4,715	5,050	17,900	18,800	181,900	206,700
Rotating Mass	kg	0.15	0.4	0.7	0.8	2.1	2.6	4.6	5.3	19.4	26
Total Weight	kg	0.4	1.2	1.5	2.5	5.4	8.2	11.6	16.3	38.1	59.0
Operating Pressure	550 +/-35 kPa (80 +/-5 psi)										
Air Consumption	< 57 liters/minute (2.0 SCFM)										
Air Quality	<ul style="list-style-type: none"> 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										

- Load capacities listed assume supply pressure of 80 psi. Contact PI to determine load capacity if alternate supply pressures are required.
- Precision specifications are dependent on quality of mounting surfaces, payload, orientation, and external forces on the bearing. Please consult PI for application-specific parameters. Values shown are static (zero rotational velocity during measurement).
- Velocity may be limited by encoder options or payload imbalance.

13.2. Specifications – Optional Encoder

Model	Code	Units	A-601.xxx	A-602.xxx	A-603.xxx	A-604xxx	A-605.xxx	A-607.xxx
Resolution	H	μrad	192	133	100	66	50	33
Max Velocity		RPM	2500	2000	1500	1000	800	500
Output Signal		-	Incremental Digital RS-422 A-quadr-B, Differential, 4 MHz Clock					
Index Mark		-	1 / rev, 1 count wide, Synchronized to Output Signal					
Power Input		-	5 VDC, <200 mA					
Input Ripple	B	-	200 mVp-p max @ up to 500 kHz					
Resolution		μrad	0.0015					
Max Velocity		RPM	3500	3000	2000	1500	1000	500
Output Signal		-	BiSS-C 32-bit serial					
Index Mark		-	N/A					
Power Input		-	5 VDC, <250 mA					
Input Ripple		-	200 mVp-p max @ up to 500 kHz					

13.3. Dimensions

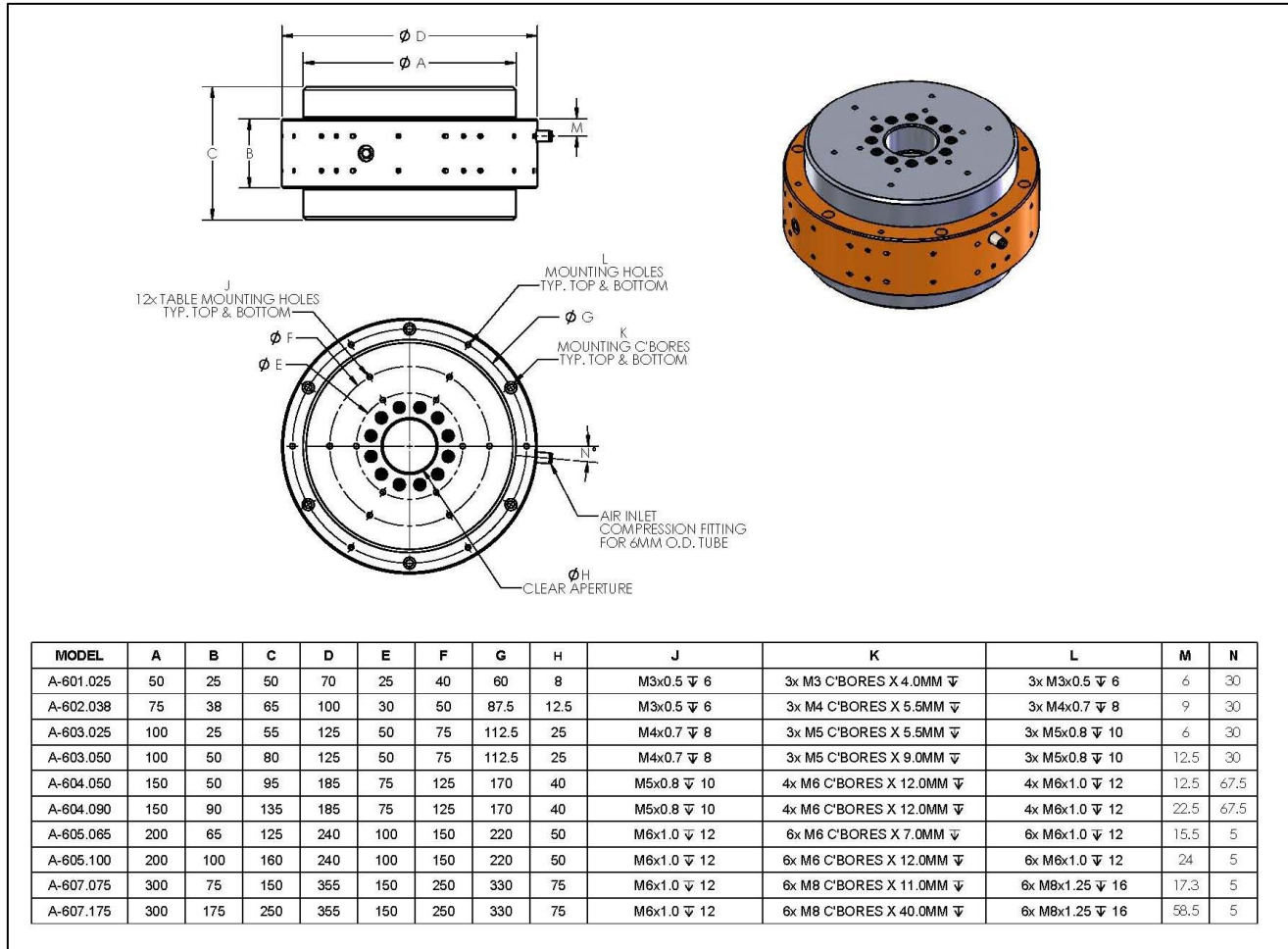


Figure 6 - A-60X Base RT Series Dimensions (mm)

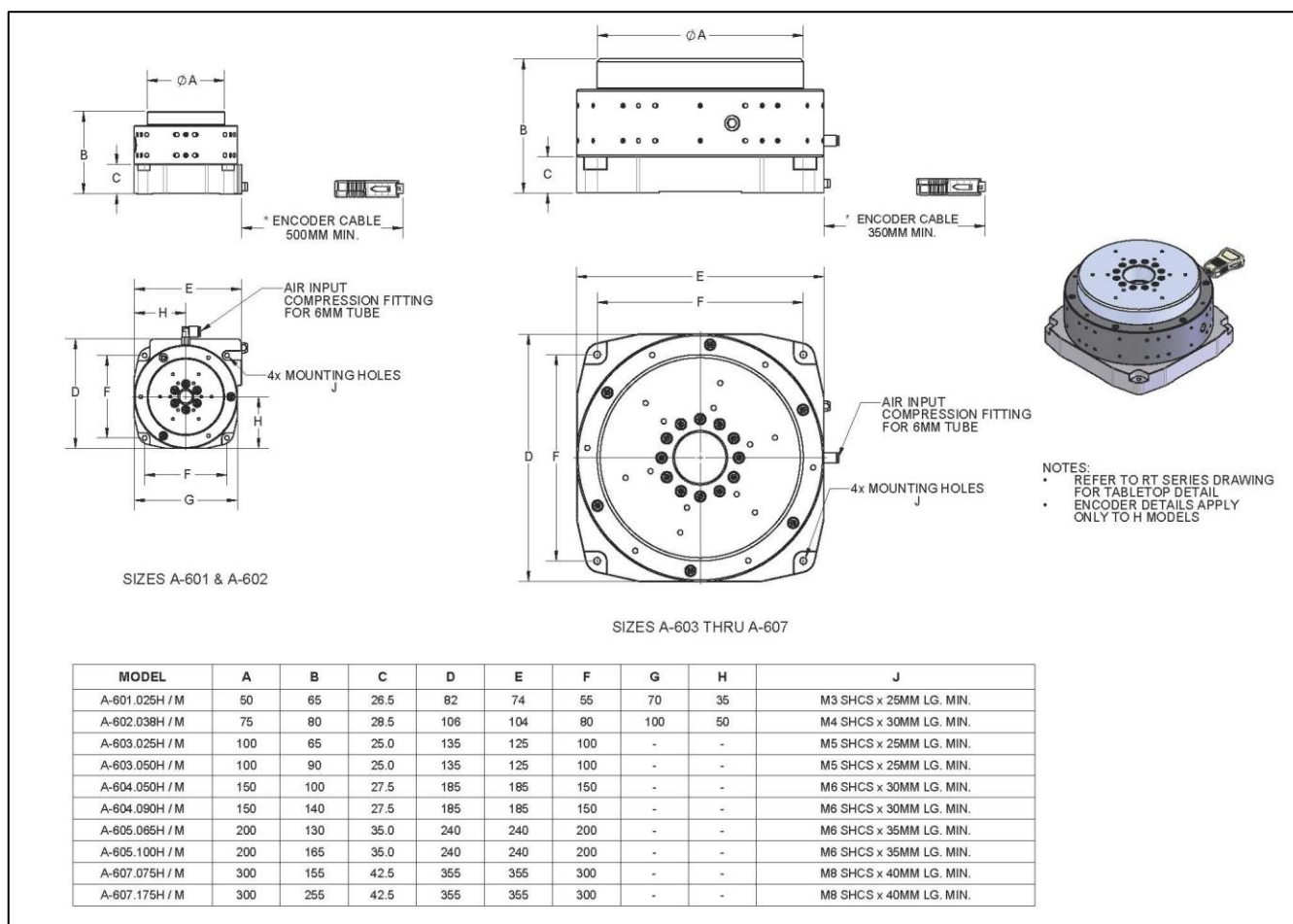


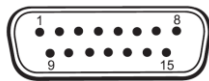
Figure 7 - A-60X Series with Optional Mounting Base and/or Encoder Dimensions (mm)

13.4. Ambient Conditions

Area of use	For indoor use only
Vacuum Operation	This product is not compatible with operation in a vacuum environment.
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	This product is not suited for dusty, dirty, oily, or wet environments.

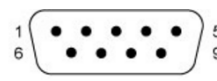
13.5. Pin Assignments

Encoder Connector
Only on Option "H"
Type: DB15M



Pin	Function	Description
1	X	Encoder Setup
2	GND	Encoder ground
3	E-	Alarm signal
4	CHC-	Encoder digital Reference -
5	CHB-	Encoder digital Channel B-
6	CHA-	Encoder digital Channel A-
7	+5v	Encoder power
8	+5v	Encoder power
9	GND	Encoder ground
10	Lim-	Open collector Limit-
11	Lim+	Open collector Limit+
12	CHC+	Encoder digital Reference +
13	CHB+	Encoder digital Channel B+
14	CHA+	Encoder digital Channel A+

Only on Option "B"
Type: DB9M



Pin	Function	Description
1	SHLD	Shield
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

14. Disclaimers

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Subject to change without notice. This manual is superseded by any new release. PI continually improves its product offerings, and listed options and specifications may be superseded at any time.

15. 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

