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THORLABS

MAX604 - November 27, 2018

Item # MAX604 was discontinued on November 27, 2018. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

6-AXIS NANOMAX™ NANOPOSITIONING FLEXURE STAGES

- Six Independent Degrees of Freedom: X, Y, Z, Pitch, Yaw, and Roll
- Modular High-Resolution Drive Options
- Open- and Closed-Loop Piezo Versions

US Patent 6,467,762

Hide Overview

OVERVIEW

Features

- 4 mm (0.16") of X, Y, and Z Travel
- 6° (105 mrad) of θx, θy, θz (Roll, Pitch, and Yaw) Travel
- Common Pivot Point for All Rotational Degrees-of-Freedom Simplifies Alignment and Reduces Cross Talk
- Parallel Flexure Design Ensures Smooth Continuous Motion and Long-Term Stability
- Grooved Top Plate Ensures Alignment of Multi-Axis Stage Accessories
- Piezo Options Provide up to 1 nm Resolution
- High Stiffness Flexure Design:
  - X and Z: 1 N/µm
  - Y: 0.5 N/µm
- High Resonant Frequency: >130 Hz (±10%)
- Monolithic, Single Moving Platform Design
- All Adjusters Coupled to the Base to Minimize Crosstalk
- Modular Design for Interchanging Actuators
- Low Maintenance Mechanism for Low Total Cost of Ownership

Click to Enlarge
In the Above Application, a 3-Axis NanoMax Flexure Stage is Aligned in Front of a 6-Axis Stage at the Proper 112.5 mm Deck Height Using an AMA554 Height Adapter

Common Specifications[a]		
Travel	X, Y, Z	4 mm (0.16")
	θx, θy, θz	6° (105 mrad)
Travel Mechanism		Parallel Flexure
Deck Height (Nominal)		112.5 mm (4.43")
Optical Axis Height (Nominal)		125 mm (4.92")
Load Capacity (Max)		1 kg (2.2 lbs)
Crosstalk (Max)		80 µm
RMS Repeatability		30 nm over 30 µm 0.1% Over Full Travel Range
Thermal Stability		1 µm/°C
Stiffness	X, Z	1 N/µm
	Y	0.5 N/µm
Top Plate Mounting Holes	Imperial Plate	i
	Metric Plate	i

- a. Please see the *Specs* tab for Complete Specifications

Thorlabs' 6-axis NanoMax™ Nanopositioning Flexure Stages are ideal for use in fiber launch systems or applications that require sub-micron resolution. Each unit provides 4 mm (0.16") of X, Y, and Z travel and 6° (105 mrad) of θx, θy, and θz travel with a maximum load capacity of 1 kg (2.2 lbs). Versions are available with or without preconfigured piezo actuators and differential or stepper motor actuators. The nominal deck height of the stage is 112.5 mm (4.43"), which matches that of our 112.5 mm tall 5-axis stage kits. Adapter plates are available for increasing the 62.5 mm deck height of our 3-axis and 4-axis flexure stages to 112.5 mm, enabling compatibility with our 6-axis stages.

The parallel flexure design ensures precise, smooth, continuous motions with negligible friction. For complex, multi-axis positioning, parallel flexure stages that incorporate three or more degrees of freedom into a single compact unit provide significantly improved performance over serialized stacks of translation stages. See the *Design Features* tab for more information.

A powerful tool for nanopositioning, our 6-axis NanoMax stages offer two innovative features: a common point of rotation and a patented design that allows all actuators to be coupled directly to the base to minimize any unwanted motion in the system.

Click to Enlarge
The Tip of a Removable Stainless Steel Probe Marks the Stage's Common Pivot Point for All Rotational Axes

Precision Drives
The modular design of our 6-axis NanoMax stages allows the drives to be removed and replaced at any time. For a list of all of our compatible drive options, please see the *Drives* tab. Pre-configured stages are offered that have differential micrometers or stepper motor actuators for out-of-the-box manual or motorized operation, respectively. Versions are also available without drives in right- or left-handed configurations. All drives are coupled directly to the base to minimize any unwanted motion in the system. This feature is ideal for any application requiring sub-micron resolution. For nanopositioning applications we have versions with internal piezoelectric actuators.

Common Point of Rotation
Each 6-Axis NanoMax stage has a stainless steel probe in front of the moving platform, as shown in the photo to the left, indicating the common pivot point for all roational axes. Having a common pivot point for all rotational axes

Click to Enlarge
In this Fiber Coupling Application, a Laser Diode is Mounted in Front of a 6-Axis Stage Using an AMA029D Extension Platform

reduces alignment time of a system by eliminating need for compensating lateral movement when adjusting θx, θy, and θz. If the moving platform is translated from its position, the pivot point also moves relative to the base, retaining its position relative to the moving platform. The nominal position of this point is in the mechanical drawing, which can be found by clicking on the blue info icon ( ) in the table to the right. See the *Design Features* Tab for more information.

Piezo Options
The option for open- or closed-loop piezos allows these stages to achieve nanometer resolution. The piezoelectric actuators are built into the stage, have 30 µm of travel, and can be controlled using many of our open- or closed-loop piezo controllers (see the *Specs* tab for all compatible controllers). When these stages are coupled with a NanoTrak controller (BNT001/IR, MNA601/IR, or TNA001/IR), the system becomes a powerful auto-alignment solution that maintains optical throughput and eliminates coupling efficiency loss due to thermal drift or other external forces. These piezo stages include six PAA100 Drive Cables and, in the case of closed-loop systems, six PAA622 Feebabck Converter Cables.

Stages with open-loop piezo actuators do not have a strain gauge displacement sensor and are ideal for applications requiring positioning resolution down to 20 nm. Versions with closed-loop piezo actuators have internal strain gauge displacement sensors that provide a feedback voltage signal that is linearly proportional to the displacement of the piezoelectric element. This feedback signal increases the resolution to 5 nm and can be used to compensate for the hysteresis, creep, and thermal drift that is inherent in all piezoelectric elements, making these stages an excellent choice for applications requiring nanometer resolution.

Please note that the piezo mechanism uses contact with the micrometer drives in order to move the top platform. If for any reason the stage is operated with the micrometer drives removed, blanking plugs must be fitted before the piezo actuators can function. To order blanking plugs, please contact Tech Support.

Easy Alignment of Accessories
A wide range of accessories, shown below, is available to mount items such as microscope objectives, collimation packages, wave guides, fiber, and much more. These accessories can be easily aligned on the top platform of the 6-axis stage using a central keyway. This keyway in the top platform allows for rapid system reconfiguration while maintaining accessory alignment throughout the experiment.

Multi-Axis Stage Accessories											
											
Fiber Mounts	Fiber Rotators	Waveguide Mounts	Diode Mounts	Fixed Mounts	Kinematic Mounts	Top Plates[a]	Extension Platforms	Fiber Chucks	Slide Holders[a]	Kinematic Platforms	Adapter Plates

- These items are not compatible with the 6-Axis NanoMax stage.

Hide Specs

SPECS

Stage Specifications

Item #		MAX601D(/M)	MAX602D(/M)	MAX603D(/M)	MAX604(/M)	MAX605(/M)	MAX606(/M)	MAX607(/M)[a]	MAX608(/M)[a]	MAX609(/M)[a]
Included Drives		DRV3 Differential Micrometer Drives			Legacy DRV001 Stepper Motor Actuators			N/A		
Travel Range	X-Axis Y-Axis Z-Axis	4 mm[b]								
	θx, θy, θz	6° (105 mrad)								
Deck Height (Nominal)		112.5 mm (4.43")								
Optical Axis Height (Nominal)		125 mm (4.92")								
Load Capacity (Max)		1 kg (2.2 lbs)								
Crosstalk (Max)[c]		80 µm								
Thermal Stability		1 µm/°C								
RMS Repeatability		30 nm over 30 µm 0.1% Over full travel range								
Stiffness	X-Axis Z-Axis	1 N/µm								
	Y-Axis	0.5 N/µm								
Moving Top Plate Dimensions	Imperial									
	Metric									
Item #		MAX601D(/M)	MAX602D(/M)	MAX603D(/M)	MAX604(/M)	MAX605(/M)	MAX606(/M)	MAX607(/M)[a]	MAX608(/M)[a]	MAX609(/M)[a]
Theoretical Resolution with External Drives										
X-Axis		1.5 µm			1.8 nm[d]			N/A		
Y-Axis		1.5 µm			1.8 nm[d]					
Z-Axis		1.0 µm			1.2 nm[d]					
θx, θy, θz		17 µrad			0.021 µrad[d]					
Item #		MAX601D(/M)	MAX602D(/M)	MAX603D(/M)	MAX604(/M)	MAX605(/M)	MAX606(/M)	MAX607(/M)[a]	MAX608(/M)[a]	MAX609(/M)[a]
Internal Piezo Specifications										
Control			Open Loop	Closed Loop		Open Loop	Closed Loop		Open Loop	Closed Loop
Drive Voltage Range			0 - 75 V			0 - 75 V			0 - 75 V	
	X-Axis									

Travel Range	**Y-Axis Z-Axis**	N/A	30 µm		N/A	30 µm		N/A	30 µm	
	θx, θy, θz		1.8 arcmin (0.52 mrad)			1.8 arcmin (0.52 mrad)			1.8 arcmin (0.52 mrad)	
Capacitance			1.8 µF			1.8 µF			1.8 µF	
Theoretical Resolution[e]	**X-Axis Y-Axis Z-Axis**		1.0 nm			1.0 nm			1.0 nm	
	θx, θy, θz		0.018 µrad			0.018 µrad			0.018 µrad	
Compatible Piezo Controllers			BPC303 MDT693B MPZ601 KPZ101 MNA601/IR BNT001/IR	BPC303 MPZ601 KPZ101w/ TSG001 MNA601/IR BNT001/IR		BPC303 MDT693B MPZ601 KPZ101 MNA601/IR BNT001/IR	BPC303 MPZ601 KPZ101w/ TSG001 MNA601/IR BNT001/IR		BPC303 MDT693B MPZ601 KPZ101 MNA601/IR BNT001/IR	BPC303 MPZ601 KPZ101w/ TSG001 MNA601/IR BNT001/IR

- Left-Handed Versions are Available
- Please note that for the X- and Y-axes, 1 mm of micrometer travel will translate to 1.5 mm of stage travel due to the 1:1.5 gearing ratio. Other axes have a 1:1 ratio.
- Also Known as Arcuate Motion
- Using BSC201 Controller
- Typical Values Using BPC30x Series Controllers and Based on 16-Bit DAC

Stepper Motor Specifications

Item #	DRV001[a]
Backlash	<7 µm
Acceleration (Max)	4 mm/s^2
Velocity Range	40 µm/s - 4 mm/s
Voltage Stability	±0.04 mm/s
Min Achievable Incremental Movement	60 nm
Bidirectional Repeatability	500 nm
Home Location Accuracy	±1.5 µm
Pitch	X-Axis: 0.015°
	Y-Axis: 0.015°
	Z-Axis: 0.0047°
Yaw	X-Axis: 0.0034°
	Y-Axis: 0.0034°
	Z-Axis: 0.0032°
Limit Switches	Ceramic Tip Mechanical
Manual Over Ride	Yes
Compatible Stepper Motor Controllers	BSC203 MST602

- This legacy item has been superseded by the DRV208.

Resonant Frequencies

Resonant Frequency for Given Loads		
Axis	**Mass (g)**	**Resonant Freq (Hz)**
X	25	135
	55	132
	110	128
Y	25	122
	55	119
	110	114
Z	25	118
	55	114
	110	110

Differential Micrometer Specifications

Item #	DRV3
Travel Range	8 mm (0.31") Coarse, 300 µm Fine
Resolution	5.0 µm Coarse, 0.5 µm Fine
Coarse Adjustment (with Vernier Scale)	500 µm/rev
Fine Adjustment (with Vernier Scale)	50 µm/rev

Hide Drives

DRIVES

Modular Drive Options

All 6-Axis NanoMax systems have a modular design that allows the drives to be removed and replaced at any time. This allows for mix-and-match customization of actuators depending on the amount of automation or resolution needed on each axis.

Replacing a drive is simple and can be done in three steps. First, retract the leadscrew of the actuator until it is no longer engaging the moving body of the stage. Then unscrew the knurled knob attaching the existing drive to the stage. Finally, attach the new drive to the stage using the same knurled knob.

The drives compatible with our 6-axis NanoMax stages are summarized below. While some drives have longer travel ranges, in all cases the NanoMax 6-axis stages have a travel range of 4 mm in X, Y, and Z and 6° of roll, pitch, and yaw. For more detailed information on each drive, please see the full presentation for our Stepper Motor Drive, Differential Micrometers and Thumbscrew Drives, or In-line Piezo Actuators.

Removing the Actuators

Click to Enlarge
Step 2
Unscrew the Knurled Knob and Remove the Actuator

Click to Enlarge
Step 1
Rotate the Actuator Counterclockwise to Disengage the Actuator from the Platform

Item #	DRV004	DRV3	DRV208	DRV120
Click Image to Enlarge				

Actuator Type	Thumbscrew	Differential Micrometer[a]	Stepper Motor[b]	Piezoelectric with Feedback
Travel Range	8 mm (0.31")[c]	Coarse: 8 mm (0.31")[c] Fine: 300 µm	8 mm (0.31")[c]	20 µm
Adjustment	500 µm/revolution	Coarse: 500 µm/revolution Fine: 50 µm/revolution	-	
Resolution	1.0 µm	Coarse: 5.0 µm Fine: 0.5 µm	3.2 µm/step 200 steps/rev of Leadscrew	5 nm[d]
Compatible Controllers	-		Benchtop: BSC200 Series Rack Module: MST602	Benchtop: BPC300 Series Rack Mount: MPZ601 K- and T-Cubes: KPZ101 with TSG001

- Included with MAX601D(/M), MAX602D(/M), and MAX603D(/M) Stages
- The legacy DRV001 is included with the MAX604(/M), MAX605(/M), and MAX606(/M) stepper-motor-actuated stages.
- Range Limited to 4 mm (0.16") by the NanoMax Stage
- Closed Loop

Hide Pin Diagrams

PIN DIAGRAMS

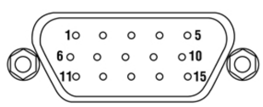
Displacement Sensor
7-Pin LEMO Male
MAX603D(/M), MAX606(/M), MAX609(L)(/M)

Pin	Designation
1	+15 V
2	Oscillator +
3	0 V
4	Signal Out -
5	Signal Out +
6	-15 V
7	Travel

Piezo Drive Input
SMC Male
MAX602D(/M), MAX603D(/M), MAX605(/M), MAX606(/M), MAX608(L)(/M), MAX609(L)(/M)

Nominal Maximum Input Voltage: 75 V
Absolute Maximum Input Voltage: 100 V

DRV001 Stepper Motor Connector Pins
D-Type Male
MAX604(/M), MAX605(/M), MAX606(/M)



Pin	Description	Pin	Description
1	Limit Switch Ground	6	Motor Phase A-
2	Not Connected	7	Motor Phase A+
3	CW Limit Switch	8 to 14	Reserved for Future Use
4	Motor Phase B-		
5	Motor Phase B+	15	Earth GND

Hide Design Features

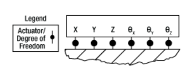
DESIGN FEATURES

6-Axis NanoMax Design Features

Patented Parallel Flexure Design

Parallel Flexure Platforms

For complex, multi-axis positioning, parallel flexure platforms, see Figure 1, that incorporate three or more degrees of freedom into a single compact unit provide significantly improved performance over serialized stacks of translation stages. Thorlabs' patented parallel flexure technology lies at the heart of the NanoMax™ family of nanopositioning platforms. The starting point for the conceptual design is the observation that the motion of a rigid body has six unique degrees of freedom. Each actuator should subtract one degree of freedom from the body, so that the body is fully constrained with six actuators.



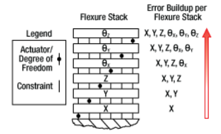
Click to Enlarge
Figure 1: Simplified Parallel Flexure Schematic

The parallel flexure design of the moving platform provides an unmatched combination of high stability and resolution in a six-axis nanopositioner. The mechanical stiffness is an order of magnitude higher than traditional serial flexure designs. In addition to those already mentioned, there are several other intrinsic advantages of the parallel flexure design: a much lower working height compared to stacked axis stages, additional resistance to external forces, and significant improvements to damping capabilities. Also, since there are fewer moving parts, there is a reduction in the inertia of the moving platform. This leads to excellent dynamic performance, making this product ideal for fast automated alignments.

This design also solves the problem of error buildup commonly seen in stacked (serial) designs as discussed below.

It is important to note that parallel flexures, like serial flexures, exhibit crosstalk or arcuate motion. As a stage is moved to either side of its central position, transverse arcuate displacements of approximately 20 µm per millimeter of travel occur. If several axes are moved at once, the combined effect can be greater; however, unlike the random positioning errors found in traditional stages, this crosstalk is highly predictable and hence can be corrected via small adjustments. Although these arcuate displacements are sometimes a concern, they rarely hinder the alignment of fibers or other optical components since optical beams rarely propagate collinearly with the axes of any stage to better than the scale of the arcuate motion. Furthermore, when using a NanoTrak™ Auto-Alignment Controller, these effects are automatically compensated for by the controller itself. However, if arcuate motion is a limiting parameter of a particular alignment or positioning application, its effects can also be compensated for with software.

Traditional, Stacked (Serial) Multi-Axis Platforms



Click to Enlarge
Figure 2: Simplified Stacked (Serial) Flexure Schematic

Multi-axis systems are traditionally built by stacking together a series of single axis mechanisms, as shown in Figure 2. As the number of axes increases, the design grows in complexity and becomes cumbersome. In addition, stacking drives reduces stiffness and can introduce a host of positioning errors.

All traditional designs of multi-axis stages (e.g., roller bearings, ball bearings, or flexures) suffer from the buildup of errors as stages are stacked. For a simple stacking of two stages, two main errors must be considered: cosine and Abbe. The cosine error arises when the axes of two stages are not aligned orthogonally to each other. The Abbe error arises from the finite height of the upper stage. Any angular roll, pitch, or yaw errors in the lower stage will be amplified by the overall height of the stacked system. The situation is particularly pronounced for a six-axis stage, where the mechanism providing the sixth degree of freedom is stacked atop five other stages. All of the errors in the preceding stages combine to make the overall volumetric accuracy of the complete stack far worse than the errors associated with any individual stage.

A parallel platform design solves the problem of error buildup. The design intent was to conceive the flexure as a rigid rod that has a flexible coupling at each end, leading to exactly two rotational degrees of freedom. This rod structure constrains the motion of the top plate by connecting it to the base. Six such rods provide the six independent constraints needed to restrain the stage, neither over- nor under-constraining it.

To actuate movement in the top plate, the ends of the flexure rods not attached to the top plate are connected to linear actuators. Linear translation occurs by moving the appropriate pairs of flexure rods in the same direction, whereas rotation occurs by moving the appropriate pairs of rods in opposite directions.

Reduced Part Count, Low Maintenance, and Long Lifetime

To transmit motion accurately, it has been shown that it is preferable to have as few moving parts acting in series as possible. At each interface between parts, microscopic imperfections can exist which will create friction between the parts. Such friction tends to be unpredictable and uncontrollable, making it the most undesirable element of any high-performance design. Parallel flexure platforms have very few moving parts and can transmit motion very precisely. Tests performed over 30 µm in 1 µm steps have yielded a root-mean-square bidirectional repeatability of 30 nm, or 0.1% of full range for the 6-axis NanoMax stages. These results are made possible by the inherently superior performance of the parallel flexure mechanism that eliminates static and kinematic friction within the platform.

During operation, 6-axis NanoMax platforms do not suffer appreciably from wear and tear due to the minimal number of moving parts. Since there are no bearings in the moving parts, there is no degradation of positioning performance with time. This also reduces the maintenance costs since the only parts that may require servicing are the drive actuators. Moreover, setups do not need to be completely disturbed for stage maintenance. Drives can be very easily and quickly swapped, minimizing system down time and inconvenience. However, when the actuator is removed the platform will move from its position.

Common Pivot Point for All Rotation Axes


Click to Enlarge
Figure 3: The tip of a removable stainless steel probe marks the stage's common pivot point for all rotational axes. Click here to see the mechanical drawing indicating the common pivot point.


Click for Details
Figure 4: The stainless steel probe can be removed at any time by loosening the knurled knob on the front of the stage

A unique mechanical feature of the 6-Axis Nanomax stages is the addition of a single common pivot point, shown in Figure 3, for all three of the rotation axes (θx, θy, θz) to simplify any alignment challenge. In practical terms, this means that the need to compensate lateral movement is nearly eliminated when making rotational adjustments to any axis. For complex alignments of planar optical devices this can vastly reduce the time required for optimizing a system.

Usually a fiber holder is attached so that the tip of the fiber is held at the common rotation point with all of the attached adjusters at the middle of their translation range. For instructions on positioning the top plate please see page 13 of the manual. If the moving platform is translated from its midpoint, the pivot point also moves relative to the base, retaining its position relative to the moving platform. Once the mounted accessories are aligned on the platform, the stainless steel probe can be removed by loosening the knob on the front of the unit, as shown in Figure 4.

Fixed, Modular, High-Resolution Actuators


Click to Enlarge
Figure 5: 6-axis stage configured with various actuators. Please see the *Drives t*ab for all options.

All actuators are connected directly to the base of the system rather than the moving top plate, thus minimizing unwanted motion within the system. Consequently, during manual operation, this allows operators to achieve a higher resolution with less skill. In motorized and automated applications, actuator vibration and shocks have little effect on the moving top plate.

The modular design of our 6-axis NanoMax stages allows the drives to be removed and replaced at any time. This allows for mix-and-match customization of actuators depending on the amount of automation or resolution needed on each axis.

Thorlabs offers a number of drive options including fine-thread thumbscrews, differential micrometers, motorized actuators, and piezo extenders. Figure 5 shows various drive options attached to different axes. This modularity allows the stage to be highly versatile for all applications. Versions are also available that have internal piezoelectric actuators giving 30 µm of travel with resolutions down to 1.0 nm, either open-loop or with strain gauge position feedback (closed loop). For increased performance and stability, the drive voltages are also controlled by built-in circuitry to compensate for thermal variations.

For all of our compatible drive options, please see the *Drives* tab. Pre-configured stages are also offered that have differential micrometers or stepper motor actuators for out-of-the-box manual or motorized operation, respectively.

Low Platform Height and Keyway Accessory Alignment

Thorlabs' 6-axis stages have a low platform height of 112.5 mm (4.43") for increased stability. This height also makes the 6-axis stage compatible with our 112.5 mm tall 5-axis stage kits. As shown in Figures 6 and 7, adapter plates are available for increasing the 62.5 mm deck height of our 3-axis and 4-axis flexure stages to 112.5 mm, enabling compatibility with our 6-axis stages.

A central keyway in the top platform allow for rapid system reconfiguration while maintaining accessory alignment. A wide range of accessories is available to mount items such as microscope objectives, collimation packages, wave guides, fiber, and much more.

Click to Enlarge
Figure 6: In the Above Application, a 3-Axis NanoMax Flexure Stage is Aligned in Front of a 6-Axis Stage at the Proper 112.5 mm Deck Height Using an AMA554 Height Adapter

Click to Enlarge
Figure 7: In the Above Application, a 3-Axis MicroBlock Compact Flexure Stage is Aligned in Front of a 6-Axis Stage at the Proper 112.5 mm Deck Height Using an AMA554 Height Adapter

Hide Multi-Axis Stages

MULTI-AXIS STAGES

Multi-Axis Stage Selection Guide

3-Axis Stages
Thorlabs offers three different 3-Axis Stage variations: NanoMax flexure stages, MicroBlock compact flexure stages, and RollerBlock long-travel stages. Each stage features a 62.5 mm nominal deck height. Our NanoMax line of 3-axis stages offers built-in closed- and open-loop piezos as well as modular drive options that include stepper motors, differential drives, or additional piezos. The MicroBlock stages are available with differential micrometer drives or fine thread thumbscrews; these drives are not removable. Finally, our RollerBlock stage drivers can be switched out for any actuator that has a Ø3/8" (9.5 mm) mounting barrel.

Click to Enlarge
In the above application, a 3-Axis NanoMax flexure stage is aligned in front of a 6-axis stage at the proper 112.5 mm deck height using an AMA554 Height Adapter.

4- and 5-Axis Stages
Our 4- and 5-axis stages are ideal for the static positioning of waveguides or complex optical elements with respect to our 3-axis or 6-axis high-performance alignment stages. Thorlabs' 5-axis stages have nominal heights of 62.5 mm or 112.5 mm. The AMA554 Height Adapter can be used to raise the deck height of the 3-axis or 4-axis stages to 112.5 mm for compatibility with our 5-axis MicroBlock or 6-Axis NanoMax Stages.

6-Axis Stages
Thorlabs' 6-Axis NanoMax Nanopositioners are ideal for complex, multi-axis positioning and have a nominal deck height of 112.5 mm. These stages offer a common point of rotation and a patented parallel flexure design that allows all actuators to be coupled directly to the base to minimize any unwanted motion in the system. Built-in closed- and open-loop piezo options are available. A selection of modular drive options allows any axis to be manual or motorized with the option for external piezos. Our units without included actuators are also available in right- or left-handed configurations. To increase the stage height of the 3-axis stages to 112.5 mm, we recommend our AMA554 Height Adapter, shown in the image to the right.

A complete selection and comparison of our multi-axis stages is available below.

3-Axis Stages

Item #	MAX313D	MAX312D	MAX311D	MAX383	MAX381	MAX303	MAX302	MAX301	MBT602	MBT616D	RB13M	RBL13D
Stage Type	NanoMax Flexure Stages								MicroBlock Compact Flexure Stages		RollerBlock Long Travel Stages	
Included Drives	DRV3 Differential Micrometers			DRV208 Stepper Motor Actuators		N/A			Fine Thread Thumbscrews	Differential Micrometers	148-801ST Micrometer Drives	DRV304 Differential Micrometers
Built-in Piezos	N/A	Open Loop	Closed Loop	N/A	Closed Loop	N/A	Open Loop	Closed Loop	N/A		N/A	
Travel (X, Y, Z)	4 mm (0.16")										13 mm (0.51")	
Deck Height (Nominal)	62.5 mm (2.46")											
Optical Axis Height (Nominal)	75 mm (2.95")											
Load Capacity (Max)	1 kg (2.2 lbs)										4.4 kg (9.7 lbs)	
Thermal Stability	1 µm/°C										-	
Weight	1.00 kg (2.20 lbs)								0.64 kg (1.40 lbs)		0.59 kg (1.30 lbs)	

4-Axis Stages

Item #		MBT401D MBT401D/M	MBT402D MBT402D/M
Stage Type		4-Axis Thin-Profile MicroBlock Device Stage	4-Axis Low-Profile MicroBlock Device Stage
Included Drives		Differential Micrometers	
Built-in Piezos		N/A	
Travel	Horizontal Axis (Y)[a]	13 mm (0.51")	
	Vertical Axis (Z)	6 mm (0.24")	
	Pitch (θ_y)	±5°	

	Yaw (θ_z)	±5°
Deck Height (Nominal)		62.5 mm (2.46")
Optical Axis Height (Nominal)		75 mm (2.95")
Load Capacity (Max)		0.5 kg (1.1 lbs)

- Perpendicular to the Optical Axis (X)

5-Axis Stages

Item #		MBT401D (MBT401D/M) or MBT402D (MBT402D/M) with MBT501	PY005
Stage Type		5-Axis MicroBlock Stage System	Compact 5-Axis Stage
Included Drives		Differential Micrometers	100 TPI Actuators
Built-in Piezos		N/A	
Travel	Optical Axis (X)	13 mm (0.51")	3 mm (0.12")
	Horizontal Axis (Y)	13 mm (0.51")	3 mm (0.12")
	Vertical Axis (Z)	6 mm (0.24")	3 mm (0.12")
	Pitch (θ_y)	±5°	±3.5°
	Yaw (θ_z)	±5°	±5°
Deck Height (Nominal)		112.5 mm (4.43")	62.5 mm (2.46")[a]
Optical Axis Height (Nominal)		125 mm (4.92")	75 mm (2.95")[a]
Load Capacity (Max)		0.5 kg (1.1 lbs)	0.23 kg (0.5 lbs)

- Nominal deck height of 62.5 mm and optical axis height of 75 mm can only be achieved using the PY005A2 Height Adapter and MMP1 Mounting Plate.

6-Axis Stages

Item #		MAX601D MAX601D/M	MAX602D MAX602D/M	MAX603D MAX603D/M	MAX604 MAX604/M	MAX605 MAX605/M	MAX606 MAX606/M	MAX607 MAX607/M MAX607L[a] MAX607L/M[a]	MAX608 MAX608/M MAX608L[a] MAX608L/M[a]	MAX609 MAX609/M MAX609L[a] MAX609L/M[a]
Stage Type		6-Axis NanoMax Flexure Stage								
Included Drives		DRV3 Differential Micrometers			Legacy DRV001 Stepper Motor Actuators[b]			N/A		
Built-in Piezos		N/A	Open Loop	Closed Loop	N/A	Open Loop	Closed Loop	N/A	Open Loop	Closed Loop
Travel	X, Y, Z	4 mm (0.16")								
	θ_x, θ_y, θ_z	6°								
Deck Height (Nominal)		112.5 mm (4.43")								
Optical Axis Height (Nominal)		125 mm (4.92")								
Load Capacity (Max)		1.0 kg (2.2 lbs)								

- Left-Handed Version
- This legacy item has been superseded by the DRV208 actuator.

Hide 6-Axis NanoMax Stage with Differential Adjusters

6-Axis NanoMax Stage with Differential Adjusters

- Preconfigured with DRV3 Differential Micrometers for Manual Adjustments
- Available With or Without Internal Closed- or Open-Loop Piezos
- Optional Piezo Actuators Offer 30 µm of Travel
- Modular Design Allows Drives to be Removed and Replaced
- All Adjusters Coupled to the Base to Minimize Crosstalk
- PAA622 Piezo Feedback Cables are Included with the MAX603D(/M) Stage

Thorlabs' 6-Axis NanoMax stages with Differential Adjusters provide 4 mm (0.16") of coarse X, Y, and Z travel with 300 µm of fine travel. They also provide 6° (105 mrad) of θx, θy, and θz (Roll, Pitch, and Yaw) Travel with 18 arcmin (5.2 mrad) of fine travel. The coarse adjuster has a Vernier scale with 10 µm graduations for a resolution of 5 µm. The fine adjuster has a Vernier scale with 1 µm graduations allowing for a resolution of 0.5 µm. This resolution and travel range make these stages ideal for optimizing the coupling efficiency in a fiber alignment or waveguide positioning system. The graduations also allow for a clear reference point for absolute positioning within a system. Please note that for the X- and Y-axis 1 mm of micrometer travel will translate to 1.5 mm of stage travel. Please see page 10 of the manual for more information. The modular design of the included drives allows them to be replaced at any time; please see the *Drives*

Item #[a]		MAX601D(/M)	MAX602D(/M)	MAX603D(/M)
Manual Drive Specifications				
Included Drives		DRV3 Differential Micrometer Drives		
Travel Range	X-Axis Y-Axis Z-Axis	Coarse[b]: 4 mm (0.16") Fine: 300 µm		
	θx, θy, θz	Coarse: 6° (105 mrad) Fine: 18 arcmin (5.2 mrad)		
Coarse Adjustment[c] (with Vernier Scale)		500 µm/rev		
Fine Adjustment[c] (with Vernier Scale)		50 µm/rev		
Piezo Specifications				
Control		N/A	Open Loop	Closed Loop
Drive Voltage Range			0 - 75 V	
Travel Range	X-Axis Y-Axis Z-Axis		30 µm	
	θx, θy, θz		1.8 arcmin (0.52 mrad)	
Theoretical Resolution[d]	X-Axis Y-Axis Z-Axis		1.0 nm	
	θx, θy, θz		0.018 µrad	

tab for more details and our full selection of compatible actuators.

In addition to the features above, the MAX602D(/M) and MAX603D(/M) NanoMax Stages incorporate open- and closed-loop piezoelectric actuators, respectively, with 30 µm of travel. The open-loop design does not contain an internal strain gauge sensor. The theoretical resolution of the piezo actuators is 1.0 nm for the X-, Y-, and Z-axis and 0.018 µrad for the θx, θy, and θz rotational axes. This feedback loop created when using our closed loop system is ideal for compensating for the hysteresis, creep, and thermal drift that is inherent to all piezoelectric elements. These piezo stages include six PAA100 Drive Cables and, in the case of closed-loop systems, six PAA622 Feebabck Converter Cables.

- Please see the *Specs* Tab for Complete Specifications
- Full coarse travel range of the DRV3 Differential Actuator is 8 mm (0.31"). This range is limited to 4 mm (0.16") or 6° (105 mrad) by the stage.
- Please note that for the X- and Y-axis, 1 mm of micrometer travel will translate to 1.5 mm of stage travel due to the 1:1.5 gearing ratio. Other axes have a 1:1 ratio.
- Typical Values Using BPC30x Series Controllers and Based on 16-Bit DAC

Part Number	Description	Price	Availability
MAX601D/M	6-Axis NanoMax Stage, Differential Drives, No Piezos, Right-Handed, Metric	$6,181.20	Today
MAX602D/M	6-Axis NanoMax Stage, Differential Drives, Open-Loop Piezos, Right-Handed, Metric	$10,225.50	Today
MAX603D/M	6-Axis NanoMax Stage, Differential Drives, Closed-Loop Piezos, Right-Handed, Metric	$12,495.00	3-5 Days
MAX601D	6-Axis NanoMax Stage, Differential Drives, No Piezos, Right-Handed	$6,181.20	Today
MAX602D	6-Axis NanoMax Stage, Differential Drives, Open-Loop Piezos, Right-Handed	$10,225.50	Today
MAX603D	6-Axis NanoMax Stage, Differential Drives, Closed-Loop Piezos, Right-Handed	$12,495.00	Today

Hide 6-Axis NanoMax Stage with Stepper Motor Actuators

6-Axis NanoMax Stage with Stepper Motor Actuators

- Preconfigured with Legacy DRV001 Stepper Motor Actuators for Automated Alignments
- Available With or Without Internal Closed- or Open-Loop Piezos
- Optional Piezo Actuators Offer 30 µm of Travel
- Modular Design Allows Drives to be Removed and Replaced
- All Adjusters Coupled to the Base to Minimize Crosstalk
- PAA622 Piezo Feedback Cables are Included with the MAX606(/M) Stage

Thorlabs' 6-Axis NanoMax Stages with stepper motor actuators provide 4 mm (0.16") of X, Y, and Z travel and 6° (105 mrad) of θx, θy, θz (Roll, Pitch, and Yaw) travel. They are capable of 60 nm step increments with a bidirectional repeatability of 500 nm. Ceramic-tipped high-precision limit switches provide a high repeatability ideal for homing the motors. This is critical for auto alignment applications that rely on a highly repeatable zero point. The high repeatability and small step size make these stages ideal for any high-precision automated fiber launch system or general application. Each actuator also includes an adjuster knob for when manual adjustments are necessary. The modular design of the included drives allows them to be replaced at any time; please see the *Drives* tab for more details and our full selection of compatible actuators.

Item #[a]		MAX604(/M)	MAX605(/M)	MAX606(/M)
Stepper Motor Drive Specifications				
Included Drives		Legacy DRV001[b] Stepper Motor Actuators		
Travel Range[c]	X-Axis Y-Axis Z-Axis	4 mm (0.16")[d]		
	θx, θy, θz	6° (105 mrad)		
Velocity Range		40.0 µm/s to 4 mm/s		
Max Acceleration		4 mm/s²		
Compatible Drivers		BSC203 and MST602		
Piezo Specifications				
Control		N/A	Open Loop	Closed Loop
Drive Voltage Range			0 - 75 V	
Travel Range	X-Axis Y-Axis Z-Axis		30 µm	
	θx, θy, θz		1.8 arcmin (0.52 mrad)	
Theoretical Resolution[e]	X-Axis Y-Axis Z-Axis		1.0 nm	
	θx, θy, θz		0.018 µrad	

- Please see the *Specs* Tab for Complete Specifications
- This legacy item has been superseded by the DRV208.
- Please note that for the X- and Y-axis, 1 mm of micrometer travel will translate to 1.5 mm of stage travel due to the 1:1.5 gearing ratio. Other axes have a 1:1 ratio.
- Full travel range of the DRV001 Stepper Motors is 8 mm (0.31"). This range is limited to 4 mm (0.16") or 6° (105 mrad) by the stage.
- Typical Values Using BPC30x Series Controllers and Based on 16-Bit DAC

In addition to the features above, the MAX605(/M) and MAX606(/M) NanoMax Stages incorporate open- and closed-loop piezoelectric actuators, respectively, with 30 µm of travel. The open-loop design does not contain an internal strain gauge sensor. The theoretical resolution of the piezo actuators is 1.0 nm for the X-, Y-, and Z-axis and 0.018 µrad for the θx, θy, and θz rotational axes. This feedback loop created when using our closed loop system is ideal for compensating for the hysteresis, creep, and thermal drift that is inherent to all piezoelectric elements. These piezo stages include six PAA100 Drive Cables and, in the case of closed-loop systems, six PAA622 Feebabck Converter Cables.

Part Number	Description	Price	Availability
MAX604/M	6-Axis NanoMax Stage, Stepper Motors, No Piezos, Right-Handed, Metric	$7,578.60	Lead Time
MAX605/M	6-Axis NanoMax Stage, Stepper Motors, Open-Loop Piezos, Right-Handed, Metric	$11,220.00	Lead Time
MAX606/M	6-Axis NanoMax Stage, Stepper Motors, Closed-Loop Piezos, Right-Handed, Metric	$13,948.50	Lead Time
MAX604	6-Axis NanoMax Stage, Stepper Motors, No Piezos, Right-Handed	$7,578.60	Today
MAX605	6-Axis NanoMax Stage, Stepper Motors, Open-Loop Piezos, Right-Handed	$11,220.00	Today
MAX606	6-Axis NanoMax Stage, Stepper Motors, Closed-Loop Piezos, Right-Handed	$13,948.50	Lead Time

Hide 6-Axis NanoMax Stage Without Preinstalled Actuators

6-Axis NanoMax Stage Without Preinstalled Actuators

- No Preinstalled Actuators
- Available With or Without Internal Closed- or Open-Loop Piezos
- Optional Piezo Actuators Offer 30 µm of Travel
- Modular Design Allows Drives to be Removed and Replaced (See *Drives* Tab for Details)

Item #[a]		MAX607(/M) MAX607L(/M)	MAX608(/M) MAX608L(/M)	MAX609(/M) MAX609L(/M)
Piezo Specifications				
Control			Open Loop	Closed Loop
Drive Voltage Range			0 - 75 V	
Travel	X-Axis Y-Axis		30 µm	

- All Adjusters Coupled to the Base to Minimize Crosstalk
- PAA622 Piezo Feedback Cables are Included with the MAX609(L)(/M) Stage

Range	**Z-Axis**	N/A	
	θx, θy, θz		1.8 arcmin (0.52 mrad)
Theoretical Resolution[d]	**X-Axis** **Y-Axis** **Z-Axis**		1.0 nm
	θx, θy, θz		0.018 µrad

- Please see the *Specs* tab for complete specifications. See the *Drives* tab for all compatible drive options.

Click to Enlarge
6-Axis Stage configured with various actuators. Please see the *Drives t*ab for all options.

Thorlabs' 6-axis NanoMax stages, which are designed for those who wish to customize the installed actuators, are able to provide 4 mm (0.16") of X, Y, and Z travel and 6° (105 mrad) of θx, θy, θz (Roll, Pitch, and Yaw) travel when drives are installed. This allows each axis to be configured depending on the precision or automation needed. Whether the application is a multimode fiber launch system using thumbscrews or an automated alignment setup using stepper motor actuators, each axis can be configured to meet the demand. For a list of all compatible actuators, please see the *Drives* tab.

In addition to the features above, item numbers starting with MAX608 or MAX609 incorporate open- and closed-loop piezoelectric actuators, respectively, with 30 µm of travel. The open-loop design does not contain an internal strain gauge sensor. The theoretical resolution of the piezo actuators is 1.0 nm for the X-, Y-, and Z-axis and 0.018 µrad for the θx, θy, and θz rotational axes. This feedback loop created when using our closed loop system is ideal for compensating for the hysteresis, creep, and thermal drift that is inherent to all piezoelectric elements. These piezo stages include six PAA100 Drive Cables and, in the case of closed-loop systems, six PAA622 Feebabck Converter Cables.

Part Number	Description	Price	Availability
MAX607/M	6-Axis NanoMax Stage, No Piezos, Right-Handed, Metric	$4,328.88	Lead Time
MAX607L/M	6-Axis NanoMax Stage, No Piezos, Left-Handed, Metric	$4,328.88	Lead Time
MAX608/M	6-Axis NanoMax Stage, Open-Loop Piezos, Right-Handed, Metric	$8,486.40	3-5 Days
MAX608L/M	6-Axis NanoMax Stage, Open-Loop Piezos, Left-Handed, Metric	$8,486.40	Lead Time
MAX609/M	6-Axis NanoMax Stage, Closed-Loop Piezos, Right-Handed, Metric	$10,837.50	Lead Time
MAX609L/M	6-Axis NanoMax Stage, Closed-Loop Piezos, Left-Handed, Metric	$10,837.50	Lead Time
MAX607	6-Axis NanoMax Stage, No Piezos, Right-Handed	$4,328.88	Lead Time
MAX607L	6-Axis NanoMax Stage, No Piezos, Left-Handed	$4,328.88	3-5 Days
MAX608	6-Axis NanoMax Stage, Open-Loop Piezos, Right-Handed	$8,486.40	Lead Time
MAX608L	6-Axis NanoMax Stage, Open-Loop Piezos, Left-Handed	$8,486.40	Lead Time
MAX609	6-Axis NanoMax Stage, Closed-Loop Piezos, Right-Handed	$10,837.50	Lead Time
MAX609L	6-Axis NanoMax Stage, Closed-Loop Piezos, Left-Handed	$10,837.50	Lead Time