Motion Control Catalog

Optomechanics	Tables/ Breadboards	Mechanics	Optomechanical Devices	Kits	Lab Supplies
Motion Control	Manual Stages	Motorized Stages	Multi-Axis Platforms	Actuators	Controllers
Optics	Optical Elements	Polarization Optics	Optical Isolators	Optical Systems	Optics Kits
Fiber	Fiber Patch Cables	Bare Fiber	Fiber Optomechanics	Fiber Components	Test and Measurement
Light	Coherent Sources	Incoherent Sources	Covega	Drivers/Mounts	Accessories
Light Analysis	Power Meter	Detectors	Beam Characterization	Polarimetry	Electronics Accessories
Imaging	OCT Imaging Systems	OCT Components	Laser Scanning Microscopy	Adaptive Optics	Microscopy Components

The same categories can be found online: www.thorlabs.com

Motion Control

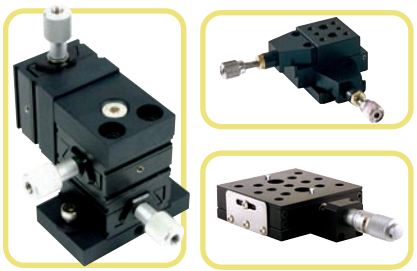
Manual Stages Selection Guide

Pages 420-439

Flexure-Based Translation Stages

- Compact, Steel-Flexure Construction
- 0.06" (1.5 mm) to 0.20" (5 mm) of Overall Travel
- Optional Internal Piezo Drives
- Stackable 2-Axis and 3-Axis Configurations

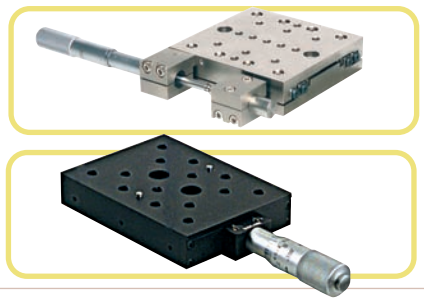
See Pages 420-421



1/2" (12.7 mm) Travel Translation Stages

- Compact, Aluminum Design
- Modular Design
- Dovetail and Ball Bearing Linear Rails
- Stackable 2-Axis and 3-Axis Configurations

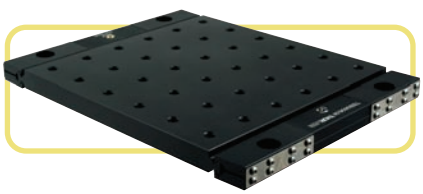
See Pages 422-428



1" (25.4 mm) and 2" (50.8 mm) Travel Stages

- Economical Models
- Large Selection of Drive Options
- Stainless Steel and Aluminum
- Stackable 2-Axis and 3-Axis Configurations

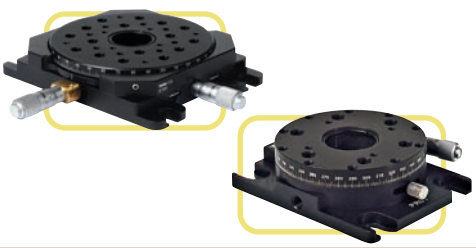
See Pages 429-433



Large-Area, Long-Travel Translation Stage

- 2.5" (63.5 mm) and 5.0" (120 mm) Travel Options
- Aluminum Dovetail Construction
- Rack and Pinion Drive
- 1/4"-20 (M6 x 1.0) Mounting Holes

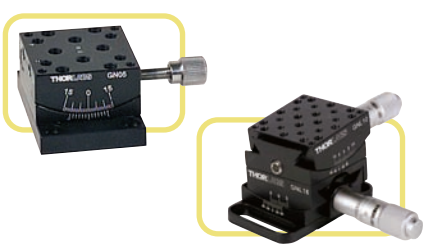
See Pages 434-435



Continuous Rotation Stages

- Small Footprint Models: 2" x 2.1"
- XY Translation with Z-Axis Rotation
- Precision Rotation Platform

See Pages 436-437



Gonimeters

- Two Sizes Available
- Pure Rotational Motion About a Fixed Point Above the Stage
- Stackable

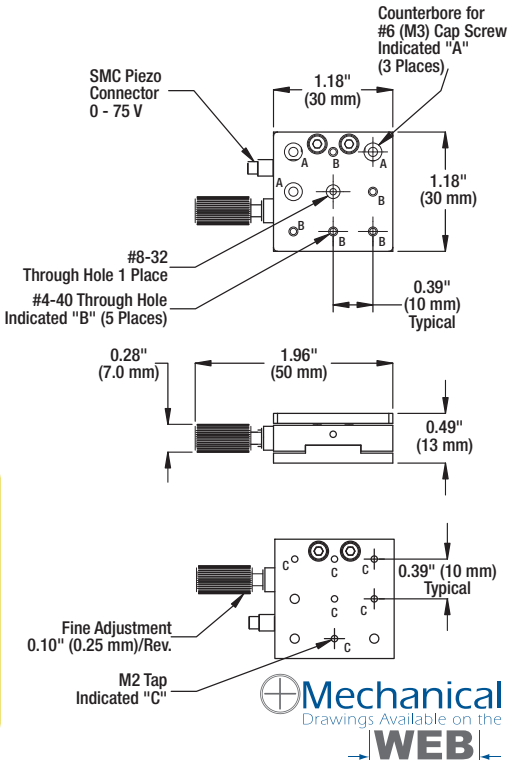
See Pages 438-439

1.5 mm Travel, NanoFlex™ Stage, 25 µm Piezo Actuator

NF15AP25

SMC Piezo Connector

This NanoFlex™ flexure stage is versatile and compact, offering 0.06" (1.5 mm) of overall manual travel and 25 µm of piezoelectric movement. It is designed to carry loads up to 1.1 lbs (0.5 kg). Optical components can be mounted to the moving platform and translated precisely and smoothly along a single axis with minimal arcuate motion. The manual adjustment screw offers 0.25 mm of travel per revolution, and the piezoelectric actuator provides 25 nm resolution. The stage can be driven by the TPZ001 controller, which is sold separately as well as bundled with the stage (see below).



Mechanical Drawings Available on the WEB

Specifications

- **Travel:** 0.06" (1.5 mm)
- **Load Capacity**: 1.1 lbs (0.5 kg)
- **Piezo Travel**: 25 µm
- **Piezo Resolution**: 25 nm
- **Coarse Adjust**: 0.25 mm per Revolution of Thumbscrew
- **Piezo Drive Voltage**: 0 - 75 V

Features

- Flexure Design, No Static or Kinetic Friction
- Thumbscrew and Piezo Adjustment
- Steel Construction, Black Paint Finish
- All Cables Included

NF15AP25 Accessories

The NF15P1 base plate provides a convenient way to attach the stages to an optical system or table.

The NF15P2 angle bracket allows our NanoFlex™ compact stages to be integrated into XY, XZ, and XYZ systems.

NanoFlex™ Stage with Embedded 25 µm Piezoelectric Movement

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NF15AP25	NF15AP25/M	$ 690.00	£ 478.40	€ 612,60	¥ 5,826.40	Thumbscrew and 25 µm Piezo Drive Single-Axis Stage, 0.06" (1.5 mm) Travel
NF15P1	NF15P1/M	$ 46.60	£ 32.40	€ 41,40	¥ 393.50	Mounting Plate for the 0.06" (1.5 mm) NanoFlex™ Series
NF15P2	NF15P2/M	$ 46.60	£ 32.40	€ 41,40	¥ 393.50	Angle Bracket for the 0.06" (1.5 mm) NanoFlex™ Series

1.5 mm (0.06") Travel, NanoFlex™ Stage and Driver Bundle

Features

- Piezo Positioning Kit (Power Supply Not Included)
- Compact Footprint
- Manual Operation via Front Panel
- PC Control for Remote Operation (USB)
- apt™ Software Control Suite Included (See Pages 580-582)

The TPZ001 T-Cube Piezo Controller (see pages 562-563 for full details) is the ideal driver for the NF15AP25 stage. This bundle includes everything needed for a complete piezo positioning system and saves 10% on the combined product price. The power supply is sold separately, as shown in price box.

NanoFlex™ and T-Cube Piezo Driver Bundle

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
TPZNF15	TPZNF15/M	$ 1,156.50	£ 801.80	€ 1.026,80	¥ 9,765.60	NanoFlex™ 0.06" (1.5 mm) Travel Stage and TPZ001 Piezo Driver
TPS002	TPS002	$ 105.00	£ 72.80	€ 93,30	¥ 886.70	Power Supply for TPZNF15

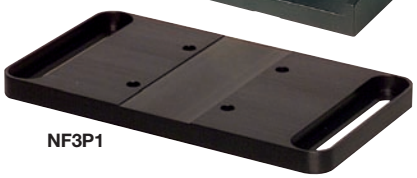
3 mm Travel, NanoFlex™ Stages

NEW product

The NanoFlex™ NF3D2P50 dual-axis flexure stage provides 3 mm of fine positional adjustment along two orthogonal axes. The flexure design is ideal for building optomechanical assemblies that are free from stiction. The central clear aperture is threaded with a 0.8"-36 TPI RMS thread. Both the top moving platform and fixed bottom surface allow the use of standard microscope objectives via the RMS thread. The piezo-electric elements provide 50 µm of displacement with 50 nm resolution.


NF3D2P50


NF3P2


NF3P1

2-Axis NanoFlex Specifications

- **Travel:** 0.12" (3 mm)
- **Max Load:** 1.1 lbs (0.5 kg)
- **Drive Type:** Differential Drive
- **Coarse Adjustment Pitch:** 0.5 mm
- **Fine Adjustment Pitch:** 50 µm (300 µm Range)

Piezo Specifications

- **Piezo Travel:** 50 µm
- **Piezo Resolution:** 50 nm
- **Max Piezo Voltage:** 75 VDC

3 mm NanoFlex™ Stages

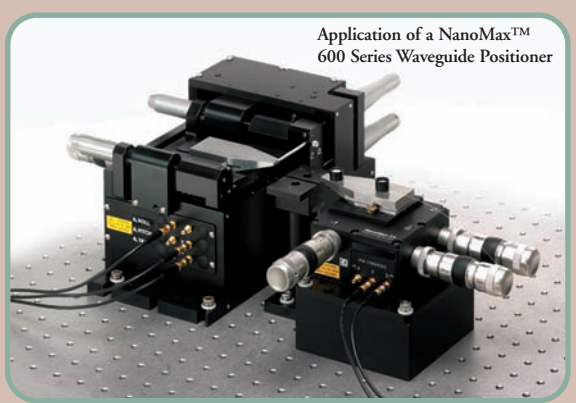
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NF3P1	NF3P1/M	$ 46.60	£ 32.40	€ 41,40	¥ 393.50	NanoFlex 3 mm Translation Stage Base Plate
NF3P2	NF3P2/M	$ 94.10	£ 65.30	€ 83,60	¥ 794.60	3mm Translation Stage Angle Bracket
NF3D2P50	NF3D2P50/M	$ 1,310.00	£ 908.20	€ 1.163,10	¥ 11,062.00	2-Axis Internal Piezos, 3 mm Travel

Manual Stages
Please See Our Multi-Axis Platform Chapter for Details on These Specialized Products
See Page 465-512
Multi-Axis Platforms

Multi-Axis Stages

MicroBlock™ 3-Axis Nested Flexure Stage

An innovative flexure design, the MicroBlock™ yields three orthogonal linear translation degrees of freedom without the severe limitations of kinetic or static friction that are found in traditional bearing based stages.


Application of a NanoMax™ 600 Series Waveguide Positioner

MAX313 3-Axis Parallel Flexure Stage

The MAX313 is the manual version of our NanoMax™ series three-axis platform. It provides an unmatched combination of high stability and high resolution. Each high-precision adjuster is rigidly affixed to the stage base.

NanoMax™ 600 6-Axis Waveguide Positioner

A powerful tool for nanopositioning, the NanoMax™ 600 Series offers two innovative features: a common point of rotation and a patented design that fixes all actuators to the base assembly.

Patent 6,186,016 and 6,467,762

5 mm Travel, NanoFlex™ Stage, 20 µm Piezo Actuator

SMC Piezo Connector

Single-Axis Stage Specifications

- **Travel:** 5 mm
- **Max Load:** 2.2 lbs (1 kg) Horizontal
- Lockable Coarse Adjustment
- **Course Adjustment:** 0.02" (0.5 mm) per Revolution
- **Fine Adjustment:** 50 µm per Revolution
- **Fine Adjustment Range:** 300 µm

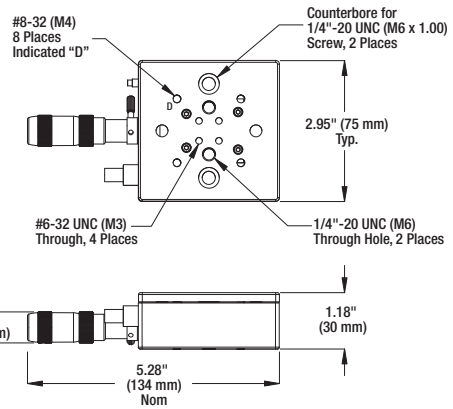
Piezo Specifications

- **Drive Voltage:** 0 - 75 V
- **Drive Connector:** SMC
- **Feedback Connector:** LEMO
- **Travel Range:** 20 µm Range
- **Resolution:** 20 nm (Open Loop), 10 nm (w/ Feedback)

When stability is of the utmost importance, these NanoFlex™ stages provide ultra-smooth translation for applications that are intolerant to the errors inherent in linear bearings. The compound linear flexure design ensures true linear motion over the full range of translation. This is achieved without the use of parts that require controlled contact to maintain their function; all the motion results from the flexing of various structural components within the translator.

The NF5 series stages are supplied with a differential micrometer drive. An optional piezo drive is available, with or without strain gauge feedback. This stage is ideal for a variety of applications, including interferometry, microscopy, and other precise nanopositioning applications. The extra stability offered by these stages means that they are suitable for stacking in XY, XZ, and XYZ configurations when precise planar movement is required. The NF5 series stages can be mounted in an XYZ configuration using the base plate (NF5P1) and angle bracket (NF5P2) featured below.

Mechanical Drawings Available on the WEB



Features

- Flexure Design, No Static or Kinetic Friction
- Differential Micrometer Drive
- Open- and Closed-Loop Piezo Options
- Compact Size
- XYZ Configurable

5 mm NanoFlex™ Stages

Please refer to our website for complete models and drawings.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NF5D	NF5D/M	$ 775.00	£ 537.30	€ 688,10	¥ 6,544.20	Differential Adjuster Single-Axis Stage 5 mm Travel
NF5DP20	NF5DP20/M	$ 945.00	£ 655.10	€ 839,00	¥ 7,979.70	Differential Adjuster and 20 µm Piezo Single-Axis Stage, 5 mm Travel
NF5DP20S	NF5DP20S/M	$ 1,270.00	£ 880.40	€ 1.127,60	¥ 10,724.00	Differential Adjuster and 20 µm Closed-Loop Piezo Single-Axis Stage, 5 mm Travel

5 mm Travel, NanoFlex™ Accessories

Mechanical Drawings Available on the WEB

These accessories allow our compact NanoFlex™ stages to be assembled into XY, XZ, or XYZ systems. The base plate provides a convenient means for attaching a stage to an optical system or table.

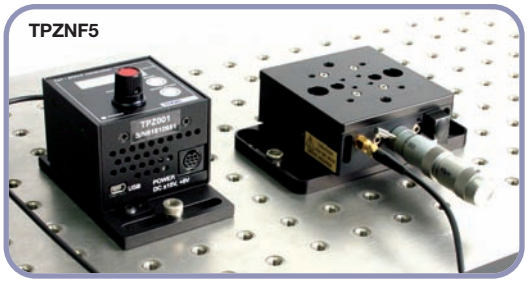
5 mm NanoFlex™ Accessories

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NF5P1	NF5P1/M	$ 46.60	£ 32.40	€ 41,40	¥ 393.50	Mounting Plate for the 5 mm NanoFlex™ Series
NF5P2	NF5P2/M	$ 94.10	£ 65.30	€ 83,60	¥ 794.60	Angle Bracket for the 5 mm NanoFlex™ Series

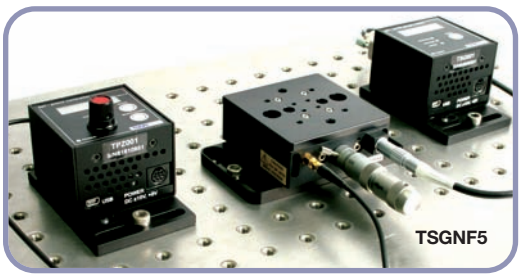
5 mm NanoFlex™ Piezo Stage with Driver Bundle

Features

- Open- and Closed-Loop Piezo Positioning Kit
- Manual Operation via Top Panel
- USB Control for Remote Operation
- Software Control Suite Included (See pages 580-582 for details)



The TPZ001 T-Cube Piezo Driver is the ideal driver for the NF5DP20 stage. This bundle includes everything needed for a complete open-loop piezo positioning system and saves 10% on the combined product price. The power supply is sold separately (See Price Box Item# TPS002)



This bundle has been designed for customers who require precise, closed-loop control. The NF5DP20S stage, together with the T-Cube Piezo Controller (TPZ001, pages 562-563) and Strain Gauge Reader (TSG001, pages 564-565), provides an out-of-the-box high-precision, closed-loop positioning solution. Furthermore, this bundle saves 10% on the combined product price. The power supply is sold separately.

Piezo Driver TPZ001 for Complete Details, See Pages 562-563

The TPZ001 T-Cube Piezo Driver is a compact, single-channel controller that provides manual and automated nanometer-level motion control of Thorlabs' open-loop, piezo-actuated NF5D stage. The controller is capable of delivering up to 150 V of drive voltage at 7.5 mA, thereby allowing an operating bandwidth up to 1 kHz when using a piezo element with 1 µF of capacitance.

Features

- Drive Voltage Digital Display
- Low-Voltage Driver Input (SMA)
- Low-Voltage Monitor Output (SMA)
- Closed-Loop Operation with T-Cube Strain Gauge Reader Unit
- Voltage Ramp/Waveform Generation Capability

Features

- Nanometer-Level Position Resolution with Thorlabs' NF5D Stage
- Strain Gauge AC Bridge Signal Input
- Provides Closed-Loop Operation with TPZ001 Cube Piezo Driver Shown Above
- Position, Force, or Voltage Readout

The TSG001 T-Cube Strain Gauge Reader is a single-channel reader designed to measure, condition, and display the feedback signal derived from the AC bridge strain gauge system contained within the NF5D stage.

Strain Gauge Reader TSG001 Pages 564-565

TPZNF5 Bundle 5 mm NanoFlex™ Stage, Open-Loop Piezo and Driver Bundle

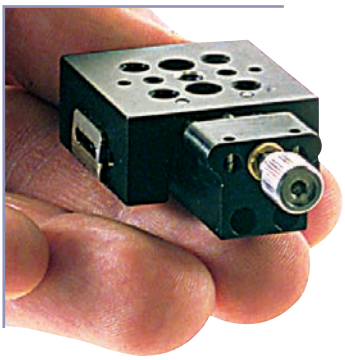
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
TPZNF5	TPZNF5/M	$ 1,386.00	£ 960.90	€ 1.230,50	¥ 11,704.00	NF5DP20 5 mm Travel Stage and TPZ001 Piezo Driver
TPS002	TPS002*	$ 105.00	£ 72.80	€ 93,30	¥ 886.70	Dual T-Cube ±15 V/5 V Power Supply

TSGNF5 Bundle: 5 mm Travel, NanoFlex™Stage, Strain Gauge Feedback and Driver Bundle

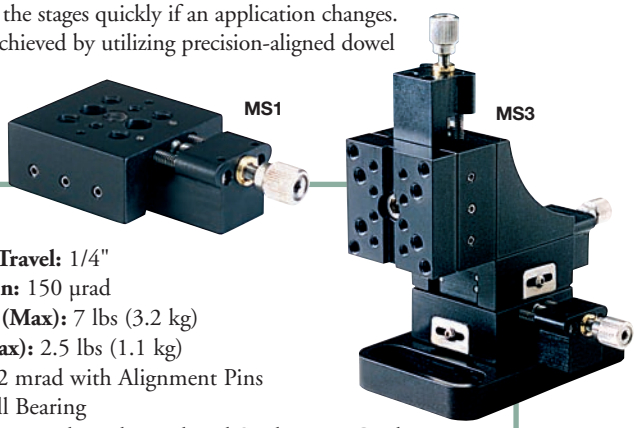
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
TSGNF5	TSGNF5/M	$ 2,169.00	£ 1,503.50	€ 1.925,50	¥ 18,316.00	NF5DP20S 5 mm Travel Stage, TPZ001 Piezo Driver, and TSG001 Stain Gauge Reader
TPS002	TPS002*	$ 105.00	£ 72.80	€ 93,30	¥ 886.70	Dual T-Cube ±15 V/5 V Power Supply

*Both Imperial and Metric parts are equivalent.

1/4" Travel, Miniature Translation Stages



The MS1 translation stage features a ball bearing design for precise motion and long life. Its compact size makes this stage ideal where space is limited. The modular design allows the user to reconfigure the stages quickly if an application changes. This quick-change design is achieved by utilizing precision-aligned dowel pins to ensure orthogonality between stages.



Features

- Compact and Lightweight
- Lockable Design
- Modular Construction
- Good Performance at an Economical Price

Specifications

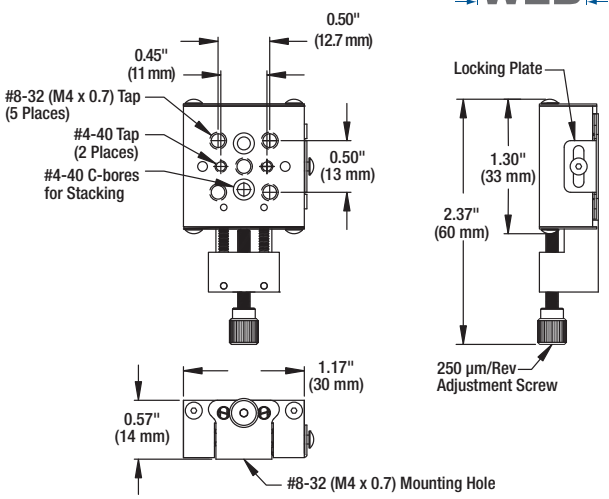
- **Maximum Stage Travel:** 1/4"
- **Angular Deviation:** 150 µrad
- **Horizontal Load (Max):** 7 lbs (3.2 kg)
- **Vertical Load (Max):** 2.5 lbs (1.1 kg)
- **Orthogonality:** <2 mrad with Alignment Pins
- **Bearing Type:** Ball Bearing
- **Material:** Aluminum Body with Hardened Steel Linear Guides
- **Adjuster:** M3 x 0.25 Fine Adjustment Screw Provides 250 µm/rev
- **Mounting Holes:** #8-32 (M4 x 0.7)

Mounting Options

The photographs below show the MS3 with two different accessory mounts. The upper photo shows the MS3 with a 360° rotation mount for Ø1/2" optics, while the lower application photo shows it holding an objective using the CT01 Ø1" optic mount and an adapter.

See Page 171 for These Accessories

Mechanical Drawings Available on the WEB

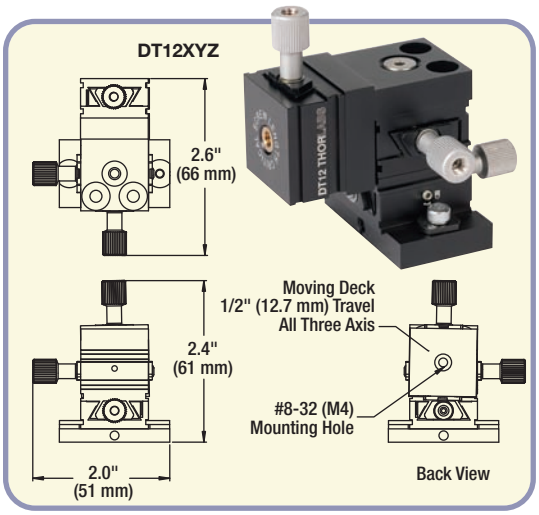


ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MS1	MS1/M	$ 172.40	£ 119.60	€ 153,10	¥ 1,455.80	1/4" Travel Mini Translation Stage
MS3	MS3/M	$ 509.00	£ 352.90	€ 451,90	¥ 4,298.10	1/4" Travel XYZ Mini Translation Stage
MS101*	MS101*	$ 19.40	£ 13.50	€ 17,30	¥ 163.90	Base Plate
MS102*	MS102*	$ 29.60	£ 20.60	€ 26,30	¥ 250.00	Angle Bracket
MS103	MS103/M	$ 26.50	£ 18.40	€ 23,60	¥ 223.80	MS Series Adapter Plate

Both Imperial and Metric parts are equivalent.

1/2" Travel, Miniature Dovetail Stages

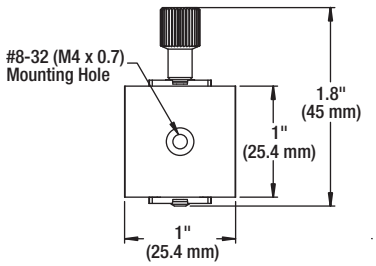
The DT12 dovetail translation stage is a miniature, entry-level positioner, ideal for use in applications where space is limited. Even though its footprint is only 1.0", the stage offers a travel range of 0.5", which is half the size of the stage. The design uses a precision-rolled M3 x 0.35 mm pitch leadscrew for smooth linear positioning along the entire range of travel. The moving platform can be locked using a small setscrew on the side. The modular design allows them to be assembled into 2 or 3-axis configurations. The multi-axis versions are offered preconfigured with all the required accessories. Slotted base plates are available for mounting on an optical table; alternatively, the stage can be mounted to an #8-32 (M4 x 0.7) threaded post.



Mechanical Drawings Available on the WEB

Features

- Modular and Compact Design
- Dovetail Mechanism
- Lockable Moving Platform
- Rapid and Smooth Positioning



Specifications

- **Travel Range:** 0.5" (12.7 mm)
- **Maximum Load:** 2.5 lbs (1.2 kg)
- **Actuator Travel:** 0.014" (0.35 mm) per Revolution
- **Construction:** Aluminum with Precision-Steel Leadscrew


Dovetail Stage Shown on DT12B, See Below

1/2" Miniature Dovetail Stages

Please refer to our website for complete models and drawings.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
DT12	DT12/M	$ 66.50	£ 46.10	€ 59,10	¥ 561.60	0.5" Dovetail Translation Stage, Base Sold Separately
DT12XY	DT12XY/M	$ 150.00	£ 104.00	€ 133,20	¥ 1,266.70	0.5" XY Dovetail Translation Stage, Base Included
DT12XZ	DT12XZ/M	$ 170.00	£ 117.90	€ 151,00	¥ 1,435.50	0.5" XZ Dovetail Translation Stage, Base Included
DT12XYZ	DT12XYZ/M	$ 240.00	£ 166.40	€ 213,10	¥ 2,026.60	0.5" XYZ Dovetail Translation Stage, Base Included

Dovetail Stage Accessories

The DT12A Angle Bracket, which is compatible with both imperial and metric stages, allows two stages to be mounted perpendicular to each other. This bracket is required when assembling stages in a XZ, YZ, or XYZ configuration.


DT12A


DT12B

The DT12B Base Plate, which is also compatible with both imperial and metric stages, provides a convenient method for bolting the stage to the work surface.

Angle Bracket and Base Plate

ITEM#	$	£	€	RMB	DESCRIPTION
DT12A	$ 20.50	£ 14.30	€ 18,30	¥ 173.20	Angle Bracket for DT12 Stages
DT12B	$ 20.50	£ 14.30	€ 18,30	¥ 173.20	Base Plate for DT12 Stages


Example of Rotation Adaptor in use on a 4-Axis Stage.

DT12RA

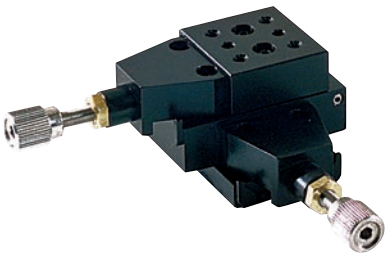
Continuous Rotation Adapter

The DT12RA rotation adapter enables the DT12 stage to be mounted on a rotational axis to provide 360° of movement. The rotation adapter is lockable and can be secured directly to the work surface using the DT12B base plate or two CL6 clamps. It can also be mounted on the DT12CSA cage system adapter described below.

Rotation Adapter

ITEM#	$	£	€	RMB	DESCRIPTION
DT12RA	$ 66.50	£ 46.10	€ 59,10	¥ 561.60	DT12 Rotation Adapter
DT12RA/M	$ 66.50	£ 46.10	€ 59,10	¥ 561.60	DT12 Rotation Adapter, Metric

1/2" Travel, Miniature Translation Stages, Single-Piece Construction (Page 1 of 2)



The T12 Series of Translation Stages features a hardened steel linear rail and recirculating ball bearing carriage for precise linear motion and high load capacity. The compact form factor of this design has been achieved without sacrificing the precision of the translator.

Unlike other linear stages, where multiple axis stages are created using adapter plates, the T12 Series has a unibody construction. For example, the XY stage is constructed by machining the movable carriage of the first axis and the body of second axis out of one part. This design leads to long-term stability and the most compact form with the perpendicularity of the various axes being fixed and accurate. This approach is used for all the configurations offered: XY, XZ, and XYZ.

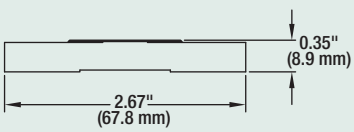
Features

- Miniature Design
- Unibody Construction
- Low Drift
- Hardened Steel Linear Guide Rail
- High Load Capacity
- Smooth Motion Over Entire Range

The T12 Series features a miniature M3 x 0.25 stainless steel adjuster and phosphorous bronze mating nut. This combination provides 250 µm of displacement per revolution of the adjuster screw. Incremental movements on the order of 0.4 µm are readily achievable with this design.

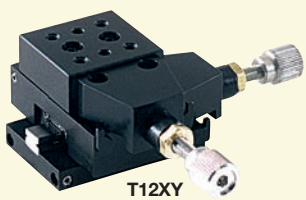
T12XYZ
Right-Handed Configuration

T12B
Adapter Base



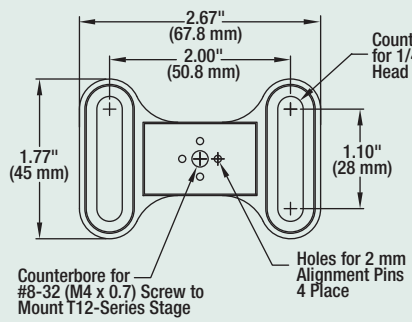
Precision
Linear rail provides smooth, low-friction motion over the entire range.

T12X



T12XY

Stability
Compact XY stage is built from just three main components.



Mechanical Drawings Available on the WEB

Rigidity
One-piece construction of vertical support maximizes rigidity while minimizing drift.

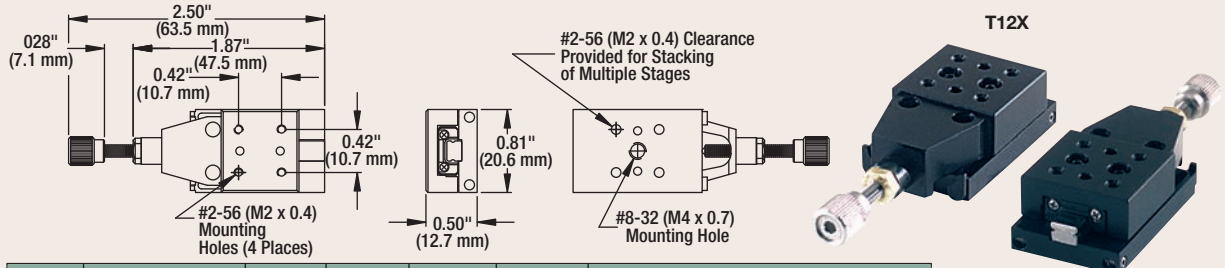
T12XYZ

Perpendicularity
The complete XYZ stage is assembled from just four main components; this ensures perpendicularity between the three axes.

Specifications

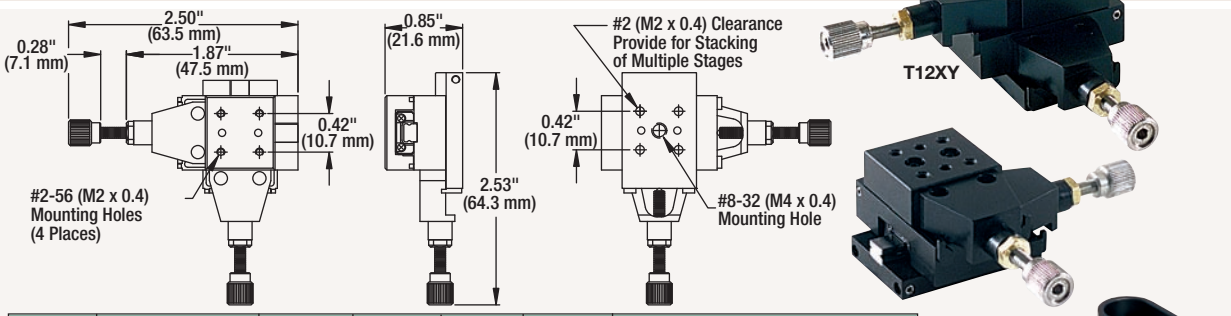
- **Travel Range:** 1/2"
- **Dynamic Load:** 5 lbs (22 N)
- **Static Load:** 8 lbs (3.6 kg)
- **Adjustment:** 250 µm per Revolution
- **Parallelism:** 3 µm Over 1/2"
- **Straightness:** 4 µm Over 1/2"
- **Static Moment Ratings:**
  - Roll: 3 Nm
  - Pitch: 4 Nm
  - Yaw: 3 Nm

1/2" Travel Miniature Translation Stages (Page 2 of 2)



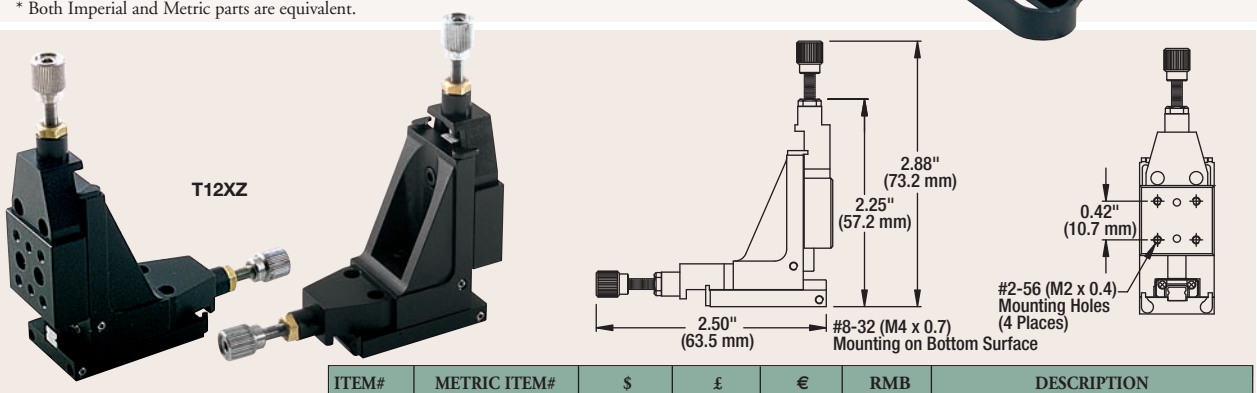
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
T12X	T12X/M	$ 260.00	£ 180.30	€ 230,90	¥ 2,195.50	Miniature 1/2" Linear Translator
T12B*	T12B*	$ 24.50	£ 17.00	€ 21,80	¥ 206.90	T12 Base Plate

* Both Imperial and Metric parts are equivalent.



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
T12XY	T12XY/M	$ 520.00	£ 360.50	€ 461,70	¥ 4,390.90	Miniature 1/2" XY Translator
T12B*	T12B*	$ 24.50	£ 17.00	€ 21,80	¥ 206.90	T12 Base Plate

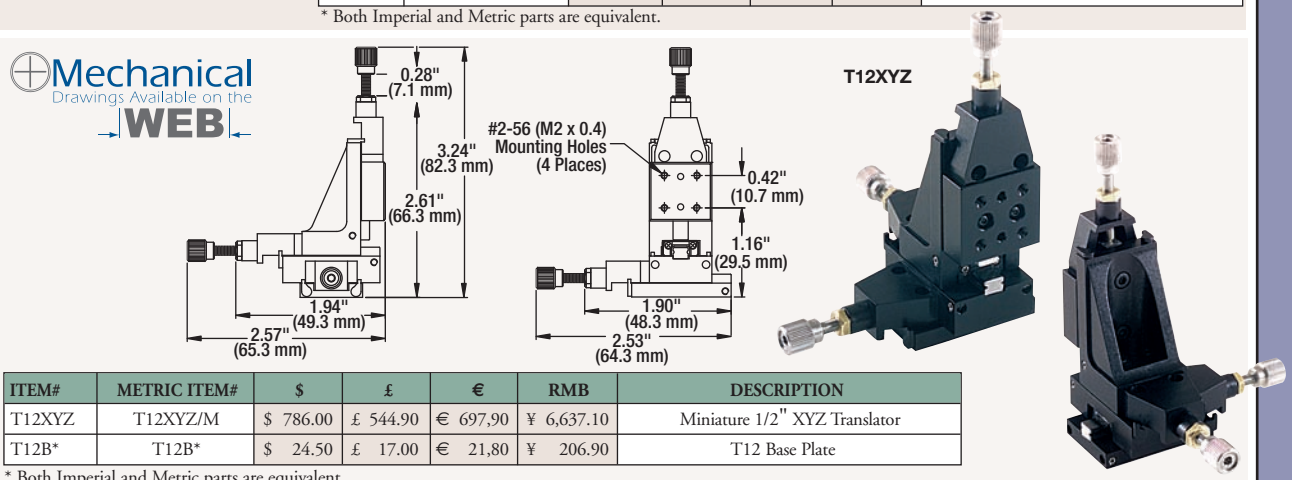
* Both Imperial and Metric parts are equivalent.



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
T12XZ	T12XZ/M	$ 536.00	£ 371.60	€ 475,90	¥ 4,526.00	Miniature 1/2" XZ Translator
T12B*	T12B*	$ 24.50	£ 17.00	€ 21,80	¥ 206.90	T12 Base Plate

* Both Imperial and Metric parts are equivalent.

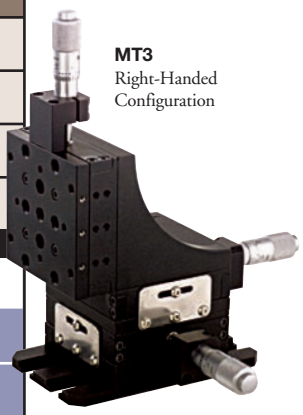
Mechanical Drawings Available on the WEB



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
T12XYZ	T12XYZ/M	$ 786.00	£ 544.90	€ 697,90	¥ 6,637.10	Miniature 1/2" XYZ Translator
T12B*	T12B*	$ 24.50	£ 17.00	€ 21,80	¥ 206.90	T12 Base Plate

* Both Imperial and Metric parts are equivalent.

1/2" Travel Translation Stage, Modular Design



MT3
Right-Handed Configuration

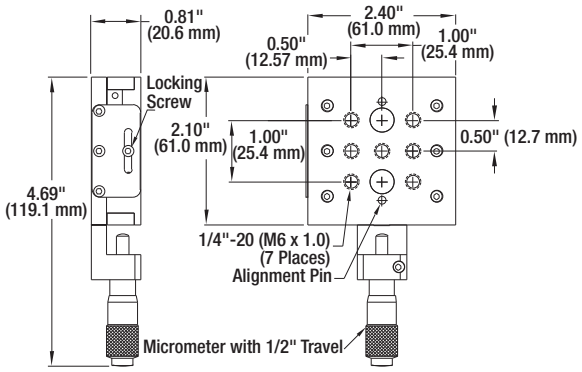
Micrometer Drive:
0.025"per rev (0.001" per Graduation)

Features

- Hardened Steel, Linear Bearings
- Modular Design for XYZ Configuration

Specifications

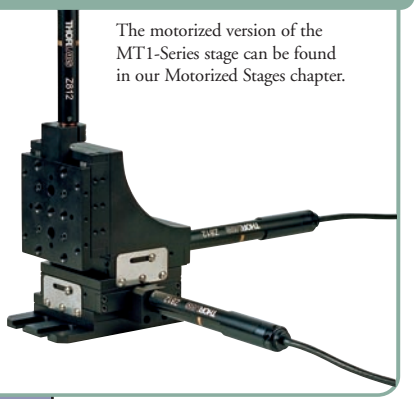
- **Travel Range:** 1/2"
- **Vertical Load (Max) :** 20 lbs (9 kg)
- **Horizontal Load (Max):** 90 lbs (41 kg)
- **Orthogonality:** <2 mrad with Alignment Pins
- **Angular Deviation:** <150 µrad
- **Bearing Type:** Ball on Hardened V-Grooves



Manual Stages
See Our Motorized Stages Chapter for Details on these Specialized Products
Motorized Stages
See Page 444

Motorized Stages

The motorized version of the MT1-Series stage can be found in our Motorized Stages chapter.

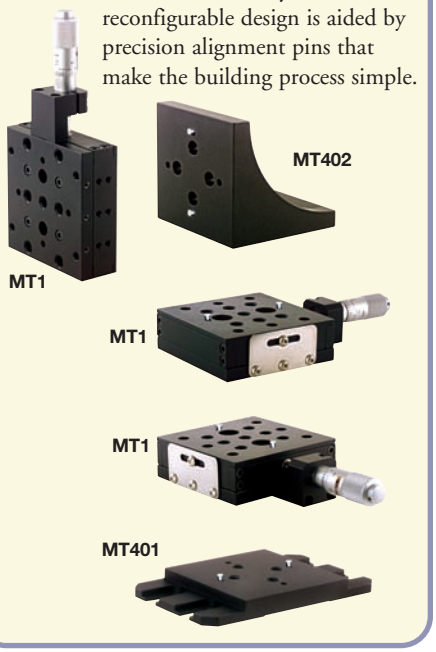


Mechanical Drawings Available on the WEB

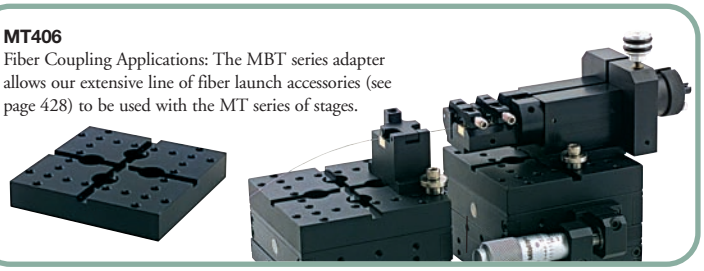
The MT Series of Translation Stages features hardened steel linear bearings for precision motion and long life. We have taken a modular approach to allow the user to quickly reconfigure these stages as applications change.

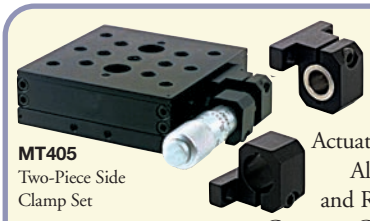
Our quick-change modular design is achieved by utilizing precision-aligned dowel pins to ensure orthogonality between stages. The stages can be purchased individually or as a preconfigured XYZ stage (see the price box below for details). See page 444 for details on the motorized MT1-Z8. Two- and three-axis stages can be made from any combination of manual and motorized stages.

This modular, easily reconfigurable design is aided by precision alignment pins that make the building process simple.



MT406
Fiber Coupling Applications: The MBT series adapter allows our extensive line of fiber launch accessories (see page 428) to be used with the MT series of stages.





MT405
Two-Piece Side Clamp Set

MT405 Side Actuator Clamp Set Allows for Left- and Right-Handed Compact Configurations

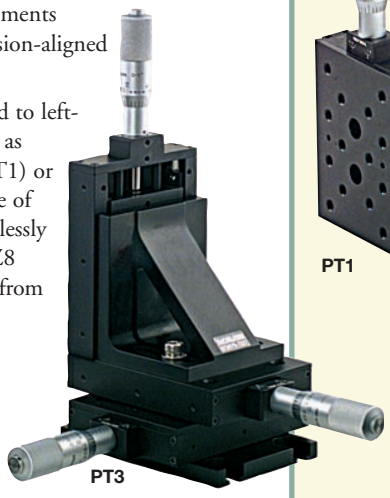
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MT1	MT1/M	$ 272.00	£ 188.60	€ 241,50	¥ 2,296.80	0.5" Translator Stage with Micrometers
MT3	MT3/M	$ 816.90	£ 566.30	€ 725,30	¥ 6,898.00	0.5" XYZ Translator Stage with Micrometers
MT401	MT401*	$ 19.30	£ 13.40	€ 17,20	¥ 163.00	MT Series Base Plate
MT402	MT402*	$ 36.50	£ 25.40	€ 32,50	¥ 308.30	MT Series Right-Angle Bracket
MT405	MT405*	$ 53.10	£ 36.90	€ 47,20	¥ 448.40	MT Series Side Clamp
MT406	MT406*	$ 32.20	£ 22.40	€ 28,60	¥ 271.90	MBT Series Adapter Plate

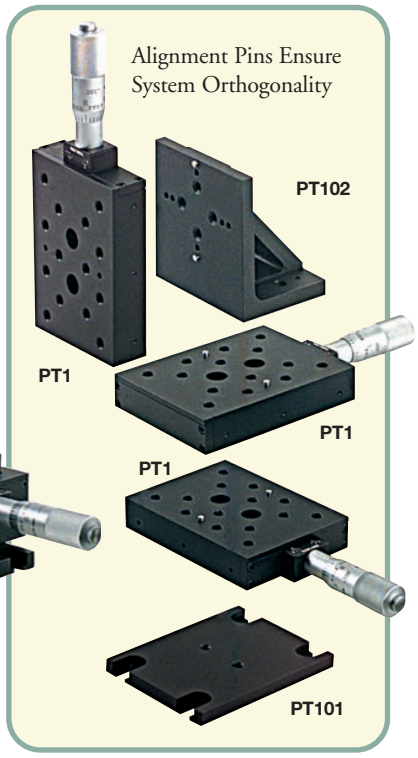
*Both Imperial and Metric parts are equivalent

1" Travel Translation Stage

The PT Series of translation stages features hardened steel linear bearings for precise motion and long life over the full 1" travel range. The modular design allows for quick XZ or XYZ configuration as the application requirements develop. This quick-change design is achieved using precision-aligned dowel pins to ensure orthogonality between stages.

These stages are also easily reconfigured from right-handed to left-handed use. They can be purchased individually (PT1) or as preconfigured 3-axis XYZ translators (PT3). The 3/8" (PT1) or 9.7 mm (PT1/M) mounting barrel allows for a wide range of manual and motorized actuators to be interchanged effortlessly with a single screw. See page 445 for details on the PT1-Z8 motorized option. Two- and three-axis stages can be made from any combination of manual and motorized stages.





PT1A & PT3A both utilize our differential micrometer to provide micron-level control. See page 429.

Features

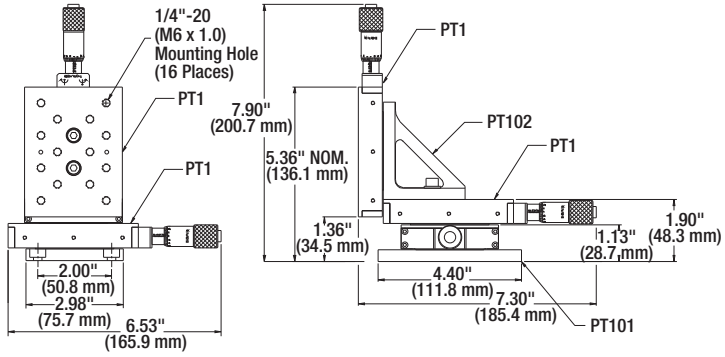
- Easily Configured in XZ and XYZ Orientations
- Wide Range of Compatible Actuators and Adjusters
- 1/4"-20 (M6 x 1.0) Mounting Holes
- Lockable Coarse Adjustment (PT1A Only)
- Left- or Right-Hand Configurable

Micrometer Drive

- **Adjustment Range:** 1.0"
- **Graduation (per Division):** 0.001" (10 µm)

Differential Drive

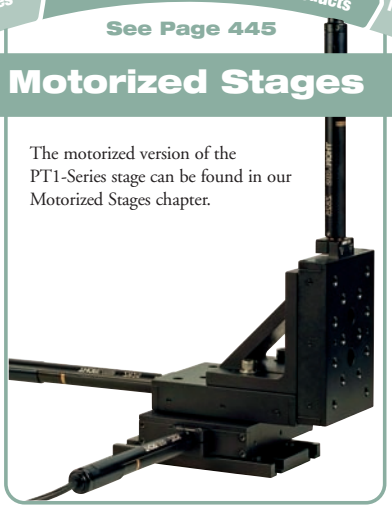
- **Course Adjustment Range:** 1.0"
- **Fine Adjustment Range:** 250 µm
- **Fine Adjustment Graduation (per Division):** 0.5 µm



Manual Stages
See Our Motorized Stages Chapter for Details on these Specialized Products
Motorized Stages
See Page 445

Motorized Stages

The motorized version of the PT1-Series stage can be found in our Motorized Stages chapter.



Specifications

- **Travel Range:** 1"
- **Vertical Load (Max):** 20 lbs (9 kg)
- **Horizontal Load (Max):** 90 lbs (41 kg)
- **Orthogonality:** <5 mrad
- **Angular Deviation:** <250 µrad
- **Bearing Type:** Ball on Hardened V-Grooves

Mechanical Drawings Available on the WEB

Single-Axis Translator Plus Accessories

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
PT1	PT1/M*	$ 259.00	£ 179.60	€ 230,00	¥ 2,187.10	1" Travel Translation Stage, Micrometer Drive
PT101	PT101	$ 15.60	£ 10.80	€ 13,90	¥ 131.80	Base Plate for PT Series
PT102	PT102/M	$ 68.60	£ 47.60	€ 61,00	¥ 579.30	Angle Bracket for PT Series
PT1A	PT1A/M	$ 357.80	£ 248.10	€ 317,70	¥ 3,021.30	1" Travel Translator Stage, Differential Adjuster

*All prices include micrometers as noted in the description box.

XYZ Stages

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
PT3	PT3/M*	$ 829.90	£ 575.40	€ 736,80	¥ 7,007.70	XYZ 1" Travel Translation Stage, Micrometer Drive
PT3A	PT3A/M*	$1,038.00	£ 719.60	€ 921,60	¥ 8,764.90	XYZ 1" Travel Translation Stage, Differential Adjuster

*All prices include micrometers as noted in the description box.

1" Travel Dovetail Stages

The DT25 dovetail translation stages are economical, entry-level positioners ideal for use in general positioning applications. They provide a travel range of 1.0" with 0.04" (1 mm) travel per revolution of the adjuster.

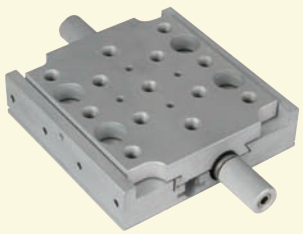
The design uses a precision-rolled, M6 x 1.0 mm pitch leadscrew for smooth, linear positioning along the entire range of travel. The moving platform is lockable to guard against accidental movement.

The modular design allows them to be assembled in 2-axis configurations. Dowel pins are included to maintain perpendicularity when constructing an XY configuration. When mounted to an optical table, the DT25A base plate can be used to increase the deck height by 0.31" (8 mm).

NEW products

DT25

DT25-V Vacuum-Compatible Version Available



Two DT25 Stages in an XY Configuration with DT25A Riser Plate

Features

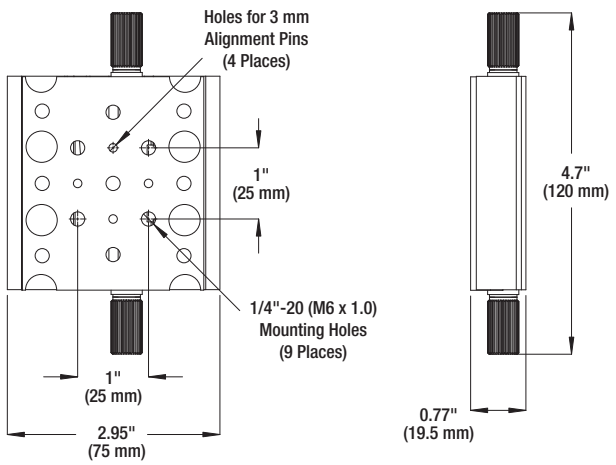
- Modular and Compact Design
- Dovetail Mechanism
- Lockable Moving Platform
- Rapid and Smooth Positioning

Specifications

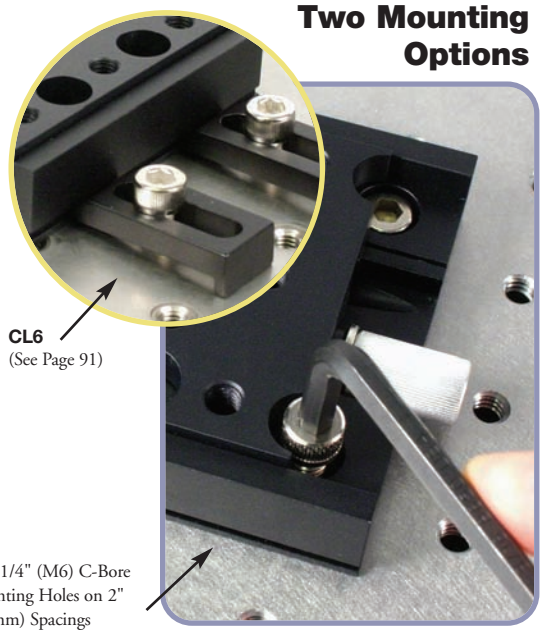
- **Travel Range:** 1.0"
- **Maximum Load:** 5.0 lbs (2.4 kg)
- **Actuator Travel:** 0.04" (1 mm) per Revolution
- **Construction:** Aluminum with Precision Steel Leadscrew
- **Vacuum:** 10^{-6} Torr (V Version Only)

Mechanical Drawings Available on the WEB

Ideal for general purpose low-precision laboratory use.



Two Mounting Options



CL6
(See Page 91)

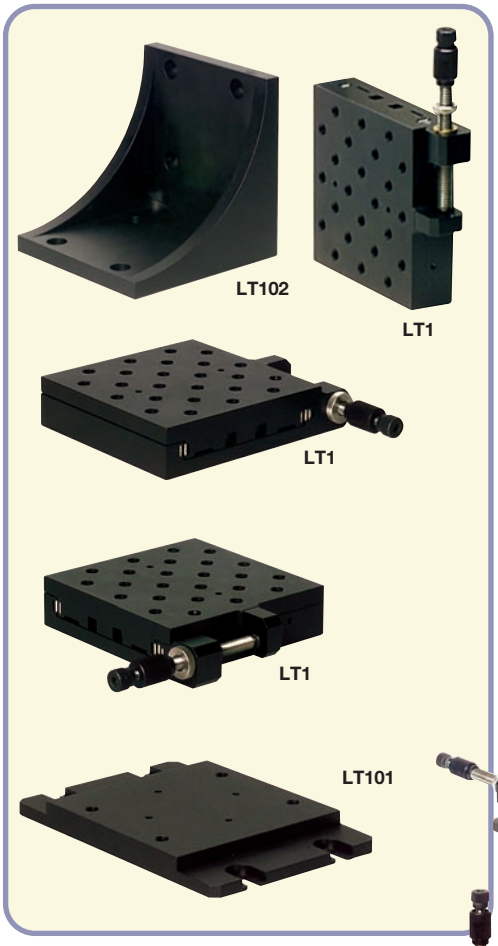
Four 1/4" (M6) C-Bore Mounting Holes on 2" (50 mm) Spacings

1.0" (25 mm) Dovetail Stage

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
DT25	DT25/M	$ 128.00	£ 88.80	€ 113,70	¥ 1,080.90	1.0" Dovetail Translation Stage
DT25A	DT25A*	$ 20.50	£ 14.30	€ 18,30	¥ 173.20	Riser Plate for DT25
NEW DT25-V	DT25/M-V	$ 215.00	£ 149.10	€ 190,90	¥ 1,815.50	1.0" Vacuum Dovetail Translation Stage
NEW DT25A-V	DT25A-V*	$ 25.60	£ 17.80	€ 22,80	¥ 216.20	Vacuum Riser Plate for DT25V

*Universal Design, Imperial and Metric Compatible.

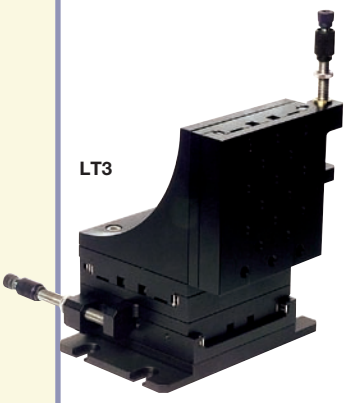
2" Travel Translation Stages



Features

- Dual Resolution Coarse/Fine Drive System
- High Load Capacity
- Large Mounting Surface with Numerous Mounting Features
- Modular Design Allows Assembly of 2- or 3-Axis Stage Within Minutes

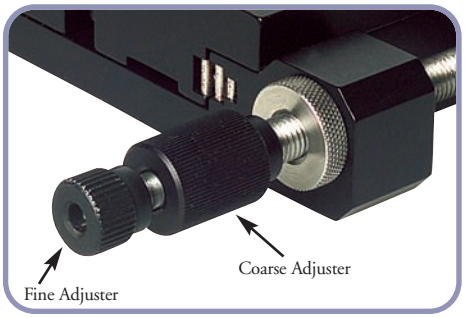
The LT Series of translation stages feature a large mounting surface with a generous supply of 1/4"-20 (M6 x 1.0) tapped mounting holes and precision alignment holes that allow the individual stages to be assembled into multi-axis systems. These stages are intended for general purpose laboratory applications that often benefit from a high degree of adaptability. A dual-action coarse/fine actuator design provides both rapid motion via a coarse pitch leadscrew (18 TPI) and high-resolution motion via an ultrafine leadscrew (100 TPI) that is placed in series with the coarse adjuster.

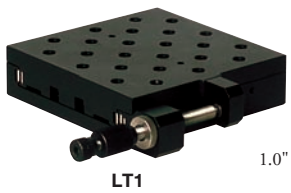


Specifications

- **Travel:** 2.0"
- **Vertical Load (Max):** 40 lbs (18 kg)
- **Horizontal Load (Max):** 70 lbs (32 kg)
- **Coarse Adjustment:** 0.055" (1.4 mm) per Revolution
- **Fine Adjustment:** 0.010" (0.25 mm) per Revolution
- **Fine Adjustment Range:** 0.5" (12.7 mm)
- **Fine Thread Pitch:** 100 TPI
- **Orthogonality:** <2 mrad
- **Angular Deviation:** <150 µrad
- **Coarse Thread Pitch:** 18 TPI

Combined Coarse and Fine Adjustment





The LT series translator is easily configured into XY, XZ, YZ, or XYZ assemblies with the adjusters in either left- or right-handed orientations. The LT101 Base Plate and LT102 Angle Bracket both use 1/4"-20 (M6 x 1.0) mounting screws. All the necessary mounting hardware is included with the accessories.

XYZ Translator

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LT3	LT3/M	$ 1,018.00	£ 705.70	€ 903,80	¥ 8,596.10	XYZ Travel Translation Stage

Single-Axis Translator

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LT1	LT1/M	$ 356.00	£ 246.80	€ 316,10	¥ 3,006.10	Single-Axis Translation Stage
LT101	LT101/M	$ 23.00	£ 16.00	€ 20,50	¥ 194.30	LT Series Base Plate
LT102	LT102/M	$ 79.60	£ 55.20	€ 70,70	¥ 672.20	LT Series Angle Bracket

TravelMax™ 2" Travel, Cross Roller Bearing Stage (Page 1 of 2)

TravelMax™ Cross Roller Bearing Stage

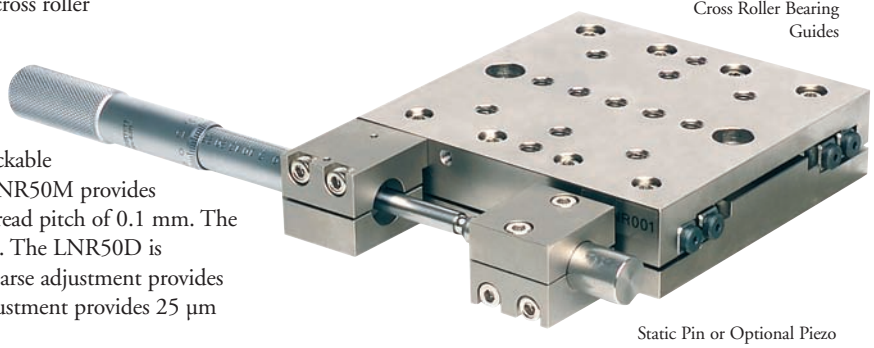
When stability, long travel, and high load capacity are crucial, the TravelMax™ series of stages provide an ideal solution. The precision-ground bearing rails provide excellent straight line accuracy, and the alternately crossed rollers can handle force in any direction. The performance is further enhanced by utilizing thermally matched materials that ensure stability, even in less-than-ideal conditions. The rigidity of the all-stainless-steel construction, along with the heavy-duty cross roller bearings, provides uniform performance over the entire 2" (50 mm) range of motion.

Two drive options are available to suit an array of application requirements. The lockable standard micrometer supplied with the LNR50M provides a 2" (50 mm) translation range with a thread pitch of 0.1 mm. The vernier provides graduations every 10 µm. The LNR50D is equipped with a differential drive. The coarse adjustment provides 0.5 mm per revolution while the fine adjustment provides 25 µm per revolution.

Features

- Heavy-Duty Cross Roller Bearings
- Thermally Matched Stainless Steel Construction
- Right- or Left-Handed XYZ Configurable
- Micrometer or Differential Drives
- Optional Piezo Actuators (See page 530)
- 1/4"-20 (M6 x 1.0) Mounting Holes

LNR50M
All-Stainless Steel 2" (50 mm) Travel Translation Stage with Cross Roller Bearing Guides



Static Pin or Optional Piezo (See next page)

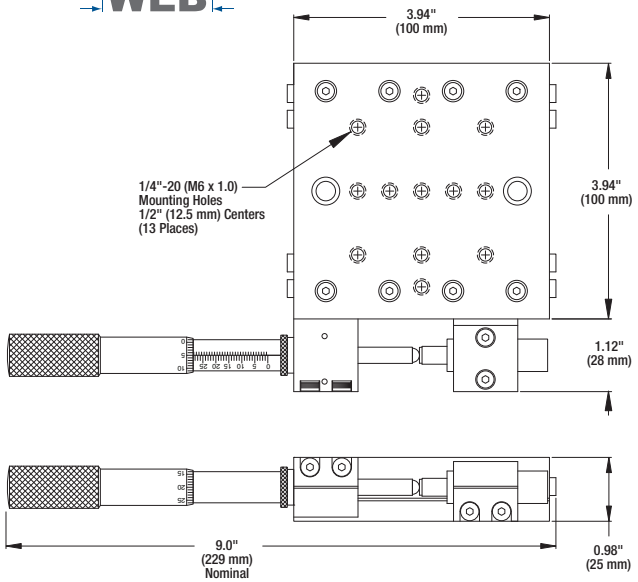
Micrometer Drive Specifications

- **Travel:** 2"
- **Venier Graduations:** 10 µm
- **Micrometer Pitch:** 0.1 mm
- **Micrometer Locking Mechanism:** Collet Style

Stage Specifications

- **Travel:** 2"
- **Horizontal Load Capacity:** 66 lbs (30 kg)
- **Vertical Load Capacity:** 22 lbs (10 kg)
- **Coarse Adjustment:** 0.5 mm/rev
- **Fine Adjustment:** 25 µm/rev
- **Weight with Drive:** 4.8 lbs (2.2 kg)
- **Angular Deviation:** ±10 µm
- **Repeatability** 0.8 µm

Mechanical Drawings Available on the WEB

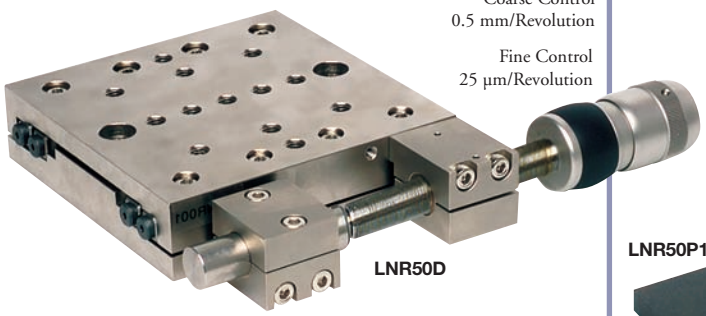


While the LNR series was designed to provide the stability and rigidity required for motorized operation, many customers have requested that the LNR series be made available with manual adjusters. On page 433, in the Motorized Stages chapter, you will find a series of motorized versions of the LNR series stage.

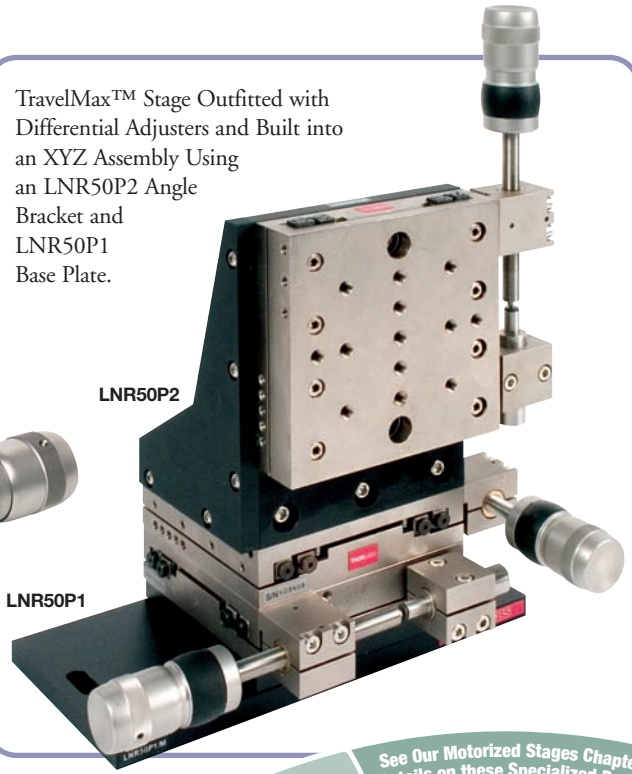
The modular design of the LNR50 family of stages allows optional elements (such as piezo actuators – see page 530) to be added to the platform within minutes, hence it is possible to upgrade your manually-controlled LNR series stage at some future point, if your needs change. The top and bottom surfaces of the LNR series stages are equipped with an array of 1/4"-20 (M6 x 1.0) tapped holes to maximize the mounting flexibility of components. The LNR50P1 baseplate and LNR50P2 angle bracket allow the LNR series to be configured in left- or right-handed XY or XYZ systems – see next page for ordering information on the base plate and angle bracket.

TravelMax™ 2" Travel, Cross Roller Bearing Stage (Page 2 of 2)

Mounting Options and XYZ Configurability
The TravelMax™ was designed with flexibility and functionality in mind. The top and bottom surfaces of the LNR series stages are equipped with a wide array of 1/4"-20 (M6 x 1.0) tapped holes to maximize the mounting flexibility of components. The LNR50P1 Base Plate and LNR50P2 Angle Bracket allow the LNR series to be configured in left- or right-handed XY or XYZ systems using six cap head screws.



TravelMax™ Stage Outfitted with Differential Adjusters and Built into an XYZ Assembly Using an LNR50P2 Angle Bracket and LNR50P1 Base Plate.



Differential Adjuster Specifications

- **Coarse Travel:** 2"
- **Coarse Adjustment:** 0.5 mm per Revolution
- **Fine Adjustment:** 25 µm per Revolution

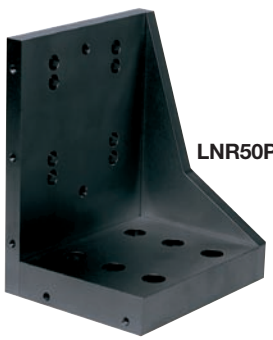
Manual Stages
See Our Motorized Stages Chapter for Details on these Specialized Products
See Page 452
Motorized Stages

Motorized Stages

The LNR Series stages are also offered with high-performance stepper or DC motors. Complete specifications for our TravelMax™ stages outfitted with stepper and DC motors can be found on page 452.

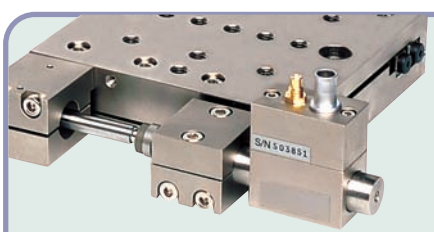
TravelMax™ Base Plate

TravelMax™ Angle Bracket



Micrometer Drive TravelMax™ Stage

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50M	LNR50M/M	$ 895.00	£ 620.50	€ 794,60	¥ 7,557.50	2" TravelMax™ Stage with Micrometer Drive
LNR50D	LNR50D/M	$ 925.00	£ 641.30	€ 821,30	¥ 7,810.80	2" TravelMax™ Stage with Differential Drive
LNR50P1	LNR50P1/M	$ 56.50	£ 39.20	€ 50,20	¥ 477.10	0.8" (20 mm) Thick TravelMax™ Series Adapter Plate
LNR50P2	LNR50P2/M	$ 88.80	£ 61.60	€ 78,90	¥ 749.90	TravelMax™ Series Angle Mounting Bracket



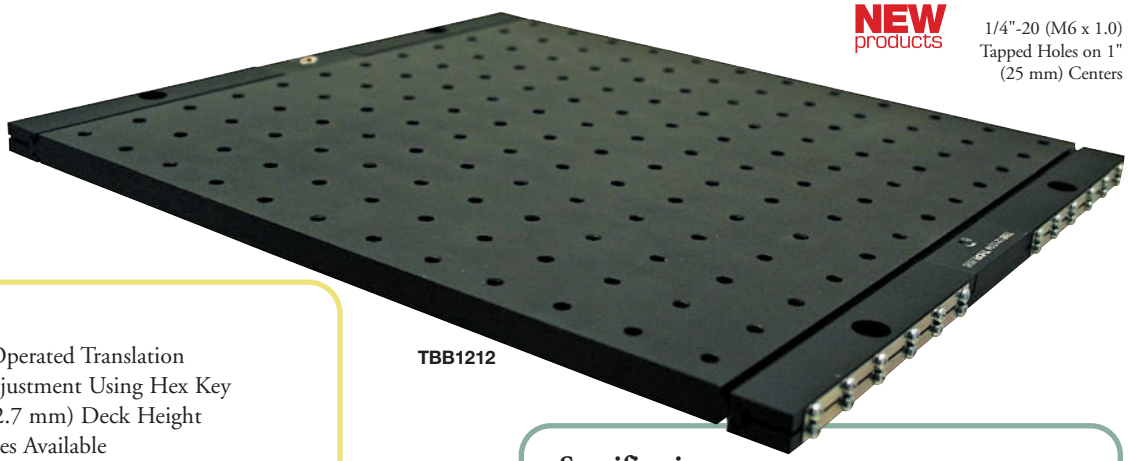
Upgradeable to Piezoelectric-Assisted Drives

Referring to the photograph at the top, the LNR50M stage includes a "static pin" that provides a stop for the manual drive. This pin is easily removable and can be replaced with a piezoelectric transducer to complement the manual drive, as shown on the left. Details of compatible piezo actuators can be found on pages 530-532.

Large-Area, Long-Travel Translation Stages

NEW products

1/4"-20 (M6 x 1.0) Tapped Holes on 1" (25 mm) Centers



TBB1212

Features

- Hand-Operated Translation
- Fine Adjustment Using Hex Key
- 0.5" (12.7 mm) Deck Height
- Two Sizes Available

Specifications

- Travel Range
  - TBB0606: 2.5" (60 mm)
  - TBB1212: 5.0" (120 mm)
- Working Height: 0.5" (12.7 mm)
- Adjuster Pitch: 1.23" (31.4 mm) per Rev of Hex Screw
- Load Capacity: 22 lbs (10 kg)
- Run Out Over Full Travel Range: <50 µm
- Outer Dimensions (W x D)
  - TBB0606: 6" x 7.66" (150 mm x 191.7 mm)
  - TBB1212: 12" x 13.66" (300 mm x 341.4 mm)
- Moving Platform Dimensions (W x D)
  - TBB0606: 6" x 5.95" (150 mm x 147.6 mm)
  - TBB1212: 12" x 11.92" (300 mm x 297.5 mm)
- Weight
  - TBB0606: 1.7 lbs (780 g)
  - TBB1212: 6.7 lbs (3.06 kg)
- Construction: Solid Aluminum
- Finish: Black Anodized

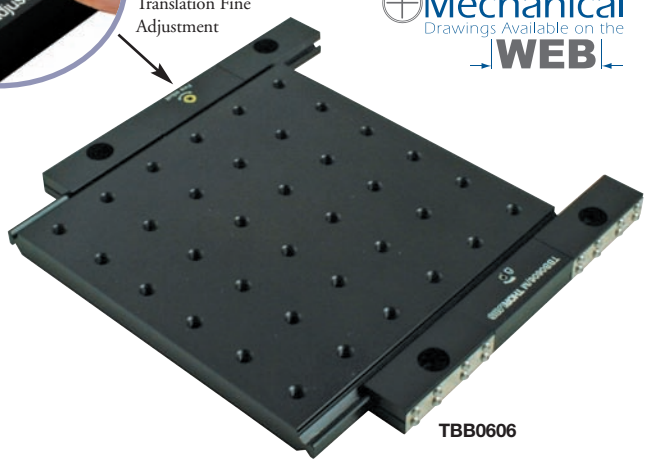
This Large-Area Translation Stage is available in two imperial sizes, 6" x 7.66" (TBB0606) and 12" x 13.66" (TBB1212), and two metric sizes, 150 mm x 191.7 mm (TBB0606/M) and 300 mm x 341.4 mm (TBB1212/M). It has been designed for use in applications requiring adjustable positioning of a complete experiment. The TBB0606 provides 2.5" (60 mm) of travel, whereas the TBB1212 provides 5" (120 mm) of travel. Coarse positioning is achieved simply by pushing the moving platform. Fine positioning over the full range of travel is achieved by adjustment of the rack and pinion using a hex key as shown below.

The working height of the breadboard is 0.5" (12.7 mm), making it compatible with the mating height of our standard MB series of breadboards (see page 3). They are tapped with 1/4"-20 (M6 x 1.0) threaded holes in the standard 1" (25 mm) offset hole pattern.

TBB0606 shown with Mounted Optics (Not Included)

Translation Fine Adjustment

Mechanical Drawings Available on the WEB



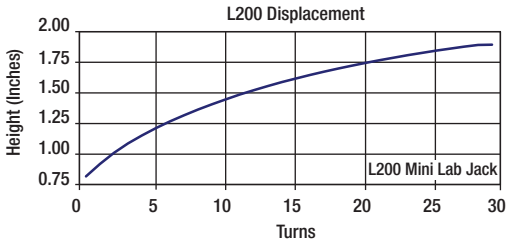
TBB0606

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
TBB0606	TBB0606/M	$ 450.00	£ 312.00	€ 399,60	¥ 3,799.90	Large-Area Translation Stage, 6" x 7.66" (150 mm x 191.7 mm)
TBB1212	TBB1212/M	$ 645.00	£ 447.20	€ 572,70	¥ 5,446.40	Large-Area Translation Stage, 12" x 13.66" (300 mm x 341.4 mm)

Mini Lab Jack

L200

- Compact Design
- Compatible with Mini-Series Breadboards and Components
- 1.03" (21.2 mm) Total Height Adjustment with 1/8" Balldriver (Included)
- 1/4"-20 (M6 x 1.0), #8-32 (M4 x 0.7), and #4-40 (M3 x 0.5) Tapped Holes



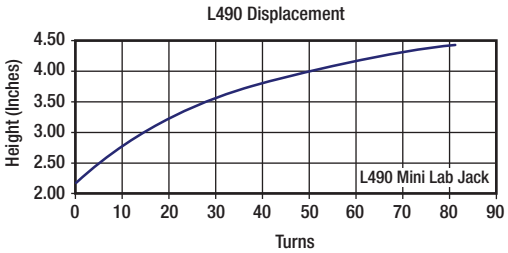
The L200 Mini Lab Jack offers the same highly rigid, dual-pantograph design as the L490 Lab Jack below but in a smaller package size. The adjustment mechanism provides smooth, vertical motion while supporting loads up to 50 lbs (22 kg). The top and bottom plates are each equipped with an array of tapped holes and counterbored slots for added mounting flexibility.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
L200	L200/M	$ 397.80	£ 275.80	€ 353,20	¥ 3,359.10	Mini Lab Jack

Lab Jack

The L490 Lab Jack utilizes a dual-pantograph design, which offers excellent rigidity. The adjustment mechanism uses a leadscrew to close the angle between the opposing pairs of supporting struts. Stainless steel axles and connecting rods allow loads up to 75 lbs (34 kg) to be smoothly elevated over the full range of the L490. The top and bottom plates each have an array of nineteen 1/4"-20 (M6 x 1.0) tapped mounting holes on 1.00" (25.0 mm) centers. Additionally, mounting slots have been added to both the top and bottom plates.

- Heavy-Duty Design Supports Over 75 lbs (34 kg)
- 4.00" x 7.00" (101.6 x 177.8 mm) Mounting Surface
- 1/4"-20 (M6 x 1.0) Mounting Holes, 19 Locations
- Mounting Slots on Top and Bottom Surfaces



L490

4.4" (111.8 mm) Fully Extended Height

2.2" (55.9 mm) Height Fully Retracted

Removable Adjustment Knob Included

Mechanical Drawings Available on the WEB

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
L490	L490/M	$ 550.80	£ 381.90	€ 489,10	¥ 4,651.00	Heavy-Duty Lab Jack

We Offer a Motorized Version!

Please see our Motorized Stages Chapter for the Stepper Motor-Driven Version of the L490.
Page 459

Compact Lab Jack

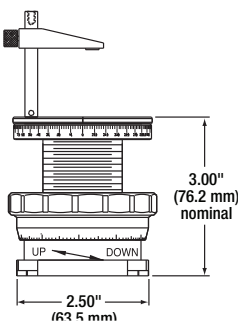
LJ750

Prisms
See Our Expanded Optics Section (Page 737)

PM2 Clamping Arm
(Included with LJ750)

The LJ750 Compact Lab Jack is a mounting platform that provides vertical translation. The large actuator knob is graduated in 10 µm increments, allowing calibrated vertical height changes. A variety of mounting holes [1/4"-20 (M6 x 1.0), #8-32 (M4 x 0.7), and #6-32 (M4 x 0.7)], are provided on the top plate. Additionally, the top platform can be rotated 360° and locked in place once the proper position is reached into place.

- 2.00" Fully Collapsed
- 3.00" Fully Extended
- Parallel to Within ±0.005"
- Static Load Capacity of 200 lbs (90 kg)



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LJ750*	LJ750/M*	$ 314.00	£ 217.70	€ 278,80	¥ 2,651.50	Compact Lab Jack
PM2	PM2/M	$ 14.70	£ 10.20	€ 13,10	¥ 124.20	Large Clamping Arm

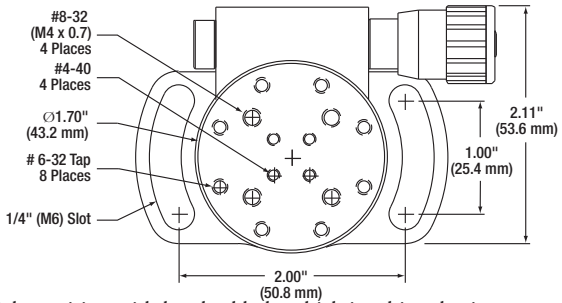
*One PM2 (PM2/M) included

Worm-Driven, Continuous Rotation Stage

Please refer to our website for complete models and drawings.

General Purpose Adapter Plate provides an array of mounting options, including 1/4"-20 (M6 x 1.0) center-mounting.

Compatible with PM1/PM2 Prism Mounting Hardware (Not Included)



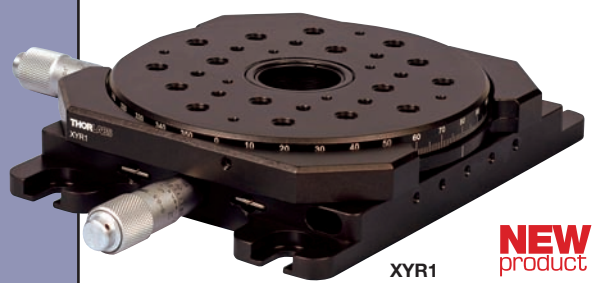
- Driven by Fine Pitch Worm Gear Providing 360° Continuous Motion
- Graduation Marks in 2° Increments
- Vernier Scale Provides Resolution of 10 arcmin
- 15° per Revolution of Adjuster
- Tested to 25 lbs Vertical Load

The CR1 rotation stage provides high precision with low backlash, which is achieved using an antibacklash gear in the worm gear mechanism. The added ability to stack our line of translation stages on the rotation platform makes this stage useful in any lab.

Worm-Driven Rotation Stages

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
CR1	CR1/M	$ 304.10	£ 210.90	€ 270,00	¥ 2,567.90	Continuous Rotation Stage
CR1A	CR1A/M	$ 19.30	£ 13.40	€ 17,20	¥ 163.00	Rotation Stage Adapter Plate
PM1	PM1/M	$ 9.50	£ 6.60	€ 8,50	¥ 80.30	Small Clamping Arm
PM2	PM2/M	$ 14.70	£ 10.20	€ 13,10	¥ 124.20	Large Clamping Arm

XY Translation Plus Z-Axis Rotation



NEW product

The XYR1 is a low-profile XY axis translation stage with continuous rotation about the Z-axis. The central SM1-threaded through hole allows the stage to be used in an imaging application that requires illumination from underneath the sample. The stage contains an array of 1/4"-20 (M6 x 1.0) and #8-32 (M4 x 0.7) tapped holes for mounting samples and components. In addition, the stage has eight #4-40 tapped holes around the central through hole so that it can be used with Thorlabs' 30 mm or 60 mm cage system without the use of adapters.

The X and Y-axis micrometers on the translation stage have a travel range of 1/2" (13 mm). An engraved angular scale along the outer edge of the stage's mounting surface allows the user to set the angular orientation of the stage, which can then be fixed using a locking setscrew. Locking the rotation axis does not prevent translation along the X and Y axes. To prevent attached components from interfering with the stage's rotation or translation, the top surface of the rotation platform is above the frame of the XYR1.

Manual Stages Rotation
See Our Motorized Stages Chapter for Details on these Specialized Products
Motorized Stages Rotation
See Page 460

Motorized Stages Rotation

Thorlabs offers an extensive selection of motorized rotation stages, as well as the manual stages shown in this section. Please see our Motorized Stages chapter, Rotation section for our complete line of motorized rotary mounts. Thorlabs also offers an extensive selection of post-mounted rotation stages, which can be viewed in our Mechanics Technologies section.

Specifications

- **Linear Translation Mechanism:** Bearings in V-Groove
- **Max Load:** 10 lbs (4.5 kg)
- **Mounting Platform Dimension:** Ø4.18" (Ø106 mm)
- **Stage Height:** 1.08" (27.4 mm)
- **Stage Footprint Including Actuators:** 6.33" x 6.1" (160.8 mm x 154.9 mm)
- **Continuous Rotation Range:** 360°
- **Rotation Graduation:** 1°

XY Micrometers

- **Travel:** 0.025" (0.5 mm) per Revolution
- **Translation Range:** 1/2" (13 mm)
- **Graduation:** 0.001" (10 µm) per Division

Mechanical Drawings Available on the WEB

XY Translation Plus Z-Axis Rotation Stage

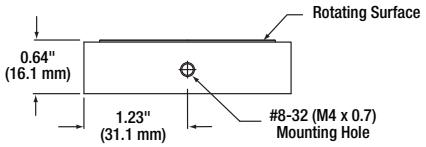
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
XYR1	XYR1/M	$ 550.00	£ 381.30	€ 488,30	¥ 4,644.30	XY Linear Translation Stage with Z-Axis Rotation

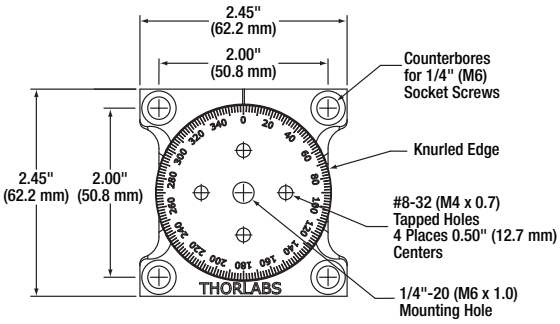
Rotation Platform

The RP01 Rotation Platform provides a solution for applications requiring smooth, backlash-free rotation. This platform can be fastened to an optical table or breadboard using the four corner-located 1/4" (M6) counterbored holes, provides continuous 360° rotation, has a radial scale with markings every 2°, and is capable of accepting vertical loads as heavy as 110 lbs (50 kg). Once the desired position is achieved, a balldriver-actuated setscrew locks the platform into place.

- Continuous 360° Rotation
- Accepts Heavy Loads up to 110 lbs (50 kg)
- Lockable
- 2° Increments
- Horizontal or Vertical Mounting
- Double Thrust Bearing Design

RP01





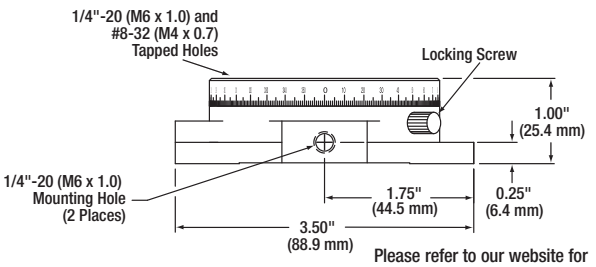
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
RP01	RP01/M	$ 91.00	£ 63.10	€ 80,80	¥ 768.50	Rotation Platform

Precision Rotation Plaform

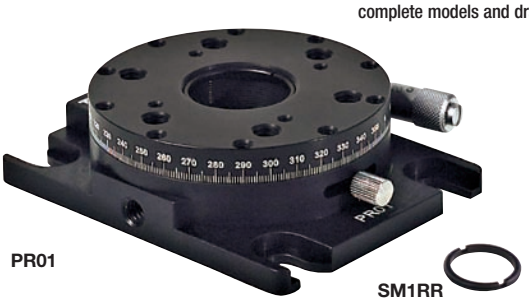
Mechanical Drawings Available on the WEB

The PR01 Precision Rotation Platform combines easy-to-use manual rotation with high-precision, backlash-free micrometer adjustment. While the platform dial is in an unlocked state, continuous smooth rotation can be measured with the 1° graduation marks. When locked, the dial is adjusted by the ±7° micrometer drive system, offering 5 arcmin resolution from the side vernier. For even higher angular resolution, the vernier can be used to calibrate the micrometer head graduations to as low as 1 arcmin across a ±5° range with an accuracy of better than 1%.

- 360° Coarse Rotation
- 1° Graduations on Main Dial
- Vernier Scale Provides 5 arcmin Resolution
- When Locked, Micrometer-Driven ±7° of Fine Rotation (~2.4 arcmin per Micrometer Division)
- Directly Accepts Ø1" Optics up to 0.70" (17.5 mm) Thick
- Compatible with Our SM1 Series of Lens Tubes and Accessories (See Pages 123-135)
- Mounts Horizontally or Vertically
- Compatible with PM1/PM2 Prism Mounting Hardware (Not Included)

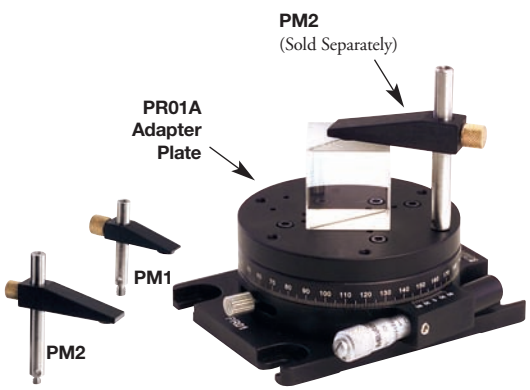


Please refer to our website for complete models and drawings.



PR01

SM1RR



ITEM#*	METRIC ITEM#*	$	£	€	RMB
PM1*	PM1/M	$ 9.50	£ 6.60	€ 8,50	¥ 80.30
PM2*	PM2/M	$ 14.70	£10.20	€ 13,10	¥ 124.20

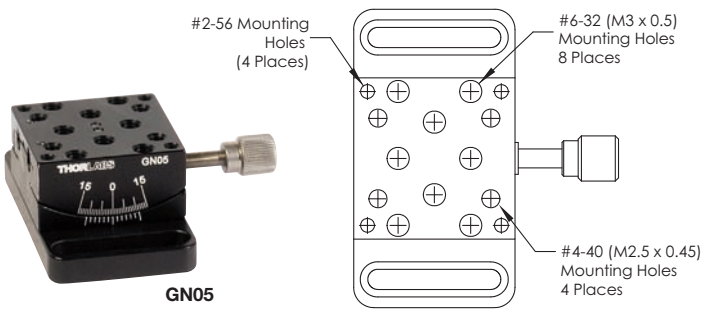
*Description: Prism Mounting Hardware

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
PR01*	PR01/M*	$ 318.00	£ 220.50	€ 282,40	¥ 2,685.20	Precision Rotation Platform
PR01A	PR01A/M	$ 18.90	£ 13.20	€ 16,80	¥ 159.60	PR01 Solid Adapter Plate
SM1RR	SM1RR	$ 4.50	£ 3.10	€ 4,00	¥ 38.00	Additional Ø1" Retaining Ring

*One SM1RR Included with Each Rotation Mount

Goniometers

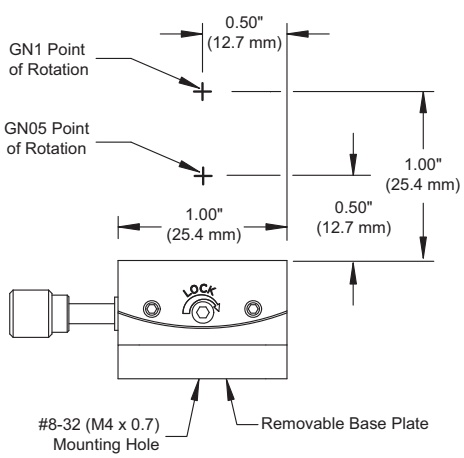
Goniometers are similar to linear stages, but, rather than providing linear movement, the stage partially rotates about a fixed point above the mounting surface of the stage. In our two product lines, the distance from the point of rotation to the mounting surface was designed so that two different goniometer models may be stacked in an X-Y configuration and both stages will rotate about the same point. Our GN series of goniometers use a backlash-free leadscrew, whereas the larger GNL series uses a precision micrometer for enhanced angular positioning of the top plate.

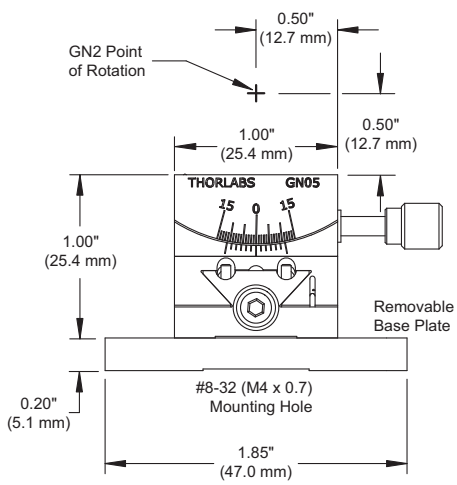


Please refer to our website for complete models and drawings.

Small (GN Series) Goniometer Specifications

- **Distance to Point of Rotation from Top Surface**
  - 0.50" (12.7 mm) for GN05 and GN2
  - 1.00" (25.4 mm) for GN1
- **Rotation:**
  - ±15° for GN05 and GN2
  - ±10° for GN1
- **Accuracy:** 10 arcmin
- **Load Capacity:** 0.25 lbs (0.11 kg)





Mechanical Drawings Available on the WEB

ITEM#*	METRIC ITEM#*	$	£	€	RMB	DESCRIPTION
GN05	GN05/M	$ 99.00	£ 68.70	€ 87,90	¥ 836.00	Goniometer with 1/2" Virtual Point
GN1	GN1/M	$ 103.00	£ 71.50	€ 91,50	¥ 869.80	Goniometer with 1" Virtual Point
GN2	GN2/M	$ 194.00	£ 134.50	€ 172,30	¥ 1,638.20	Goniometer Pair

*Each unit ships complete with mounting base plate

Manual, Large-Platform Goniometers

A goniometer stage is a device used to rotate an object precisely, within a small angular range, about a fixed point in space.

Our goniometers offer unobstructed, pure rotational motion about their point of rotation over the angle of rotation. The compact, stackable design allows one model to be fastened to the top plate of another aligning their points of rotation. In the GNL series, the GNL10 can be mounted on top of the GNL18. This combination can be purchased preassembled on a single base (Item# GNL20). The precision dovetail design, accompanied by a backlash-free micrometer and a vernier scale, provides accurate and repeatable positioning. A side-mounted setscrew can be used to lock the platform in position.

GNL10

Large (GNL Series) Goniometer Specifications

- **Distance to Point of Rotation from Top Surface**
  - GNL10: 1.00" (25.4 mm)
  - GNL20: 1.00" (25.4 mm)
  - GN18: 1.75" (44.5 mm)
- **Stackable Design:** Easily Assembles into 2-Axis System
- **Rotation:**
  - GNL10: ±10°
  - GNL20: ±10°
  - GNL18: ±5°
- **Accuracy:** 10 arcmin
- **Load Capacity:** 0.50 lbs (0.23 kg)

Manual Goniometers
See Our Motorized Stages Chapter for Details on these Specialized Products
Motorized Goniometers
See Page 464

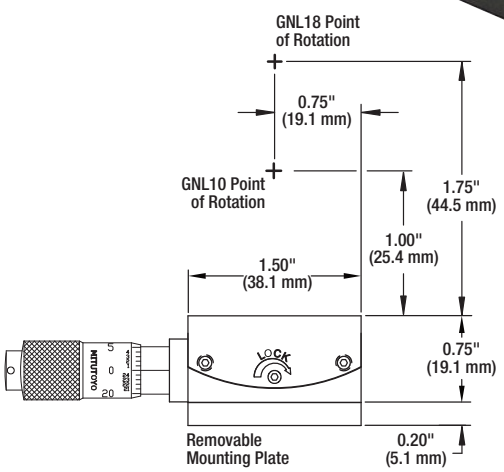
Motorized Goniometers

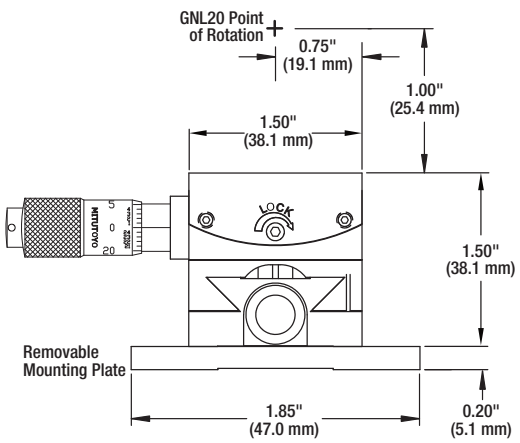
Thorlabs offers an extensive selection of motorized stages, as well as the manual stages shown in this section. Please see our Motorized Stages chapter, Goniometer tab for our complete line of motorized goniometers.

Mechanical Drawings Available on the WEB

GNL18

GNL20





ITEM#*	METRIC ITEM#*	$	£	€	RMB	DESCRIPTION
GNL10	GNL10/M	$ 183.00	£ 126.90	€ 162,50	¥ 1,545.30	Large Goniometer with 1" Virtual Point
GNL18	GNL18/M	$ 196.00	£ 135.90	€ 174,10	¥ 1,655.10	Large Goniometer with 1.75" Virtual Point
GNL20	GNL20/M	$ 356.00	£ 246.80	€ 316,10	¥ 3,006.10	Large Goniometer 2-Axis Stage, 1" Virtual Point

*Each unit ships complete with mounting base plate

Motorized Linear Stages – Comparison Table

ITEM#	PAGE	TRAVEL RANGE	MAX VELOCITY	BIDIRECTIONAL REPEATABILITY	BACKLASH	MIN INCREMENTAL MOVEMENT	HOME LOCATION ACCURACY
MT1-Z8	444	13 mm	3 mm/s	1.5 µm	<6 µm	100 nm	<2 µm
PT1-Z8	445	25 mm	3 mm/s	1.5 µm	<12 µm	100 nm	<2 µm
MTS25X-Z8	446	25 mm	3 mm/s	1.6 µm	<6 µm	50 nm	<8 µm
MTS50X-Z8	446	50 mm	3 mm/s	1.6 µm	<6 µm	50 nm	<8 µm
LNR50V	452	50 mm	50 mm/s	5 µm	<11 µm	200 nm	<10 µm
LNR50S	448	50 mm	8 mm/s	0.5 µm	<6 µm	50 nm	<2 µm
LNR50SE	450	50 mm	8 mm/s	0.2 µm	<6 µm	100 nm	<0.5 µm
NRT100	454	100 mm	10 mm/s	1 µm	<3 µm	100 nm	<1.2 µm
NRT150	454	150 mm	10 mm/s	1 µm	<3 µm	100 nm	<1.2 µm
LTS150	456	150 mm	15 mm/s	2 µm	<5 µm	100 nm	<6 µm
LTS300	456	300 mm	15 mm/s	2 µm	<5 µm	100 nm	<6 µm

ITEM#	PAGE	MAX ON AXIS LOAD CAPACITY		ABSOLUTE ON AXIS ACCURACY	MAX PERCENT ACCURACY	PITCH	YAW
		VERTICAL	HORIZONTAL				
MT1-Z8	444	4.5 kg	9 kg	95 µm	0.70%	0.006°	0.013°
PT1-Z8	445	4.5 kg	9 kg	130 µm	0.52%	0.006°	0.013°
MTS25X-Z8	446	4.5 kg	12 kg	145 µm	0.60%	0.04°	0.05°
MTS50X-Z8	446	4.5 kg	12 kg	290 µm	0.70%	0.05°	0.06°
LNR50V	452	10 kg	30 kg	83 µm	0.37%	0.03°	0.015°
LNR50S	448	10 kg	30 kg	10 µm	0.02%	0.03°	0.015°
LNR50SE	450	10 kg	30 kg	±3 µm	0.02%	0.03°	0.015°
NRT100	454	5 kg	20 kg	16 µm	0.09%	0.008°	0.05°
NRT150	454	5 kg	20 kg	20 µm	0.09%	0.008°	0.05°
LTS150	456	5 kg	15 kg	50 µm	0.18%	0.016°	0.05°
LTS300	456	5 kg	15 kg	50 µm	0.20%	0.022°	0.06°

Definition of Characteristics

- **Maximum Velocity**
  Specifications for the maximum velocity are stated for the stages without load.
- **Bidirectional Repeatability**
  Repeatability is a measure of the ability of a stage to return to an exact commanded position. Bidirectional repeatability is an average of the repeatability when the commanded position is approached from both directions. In the above table, the bidirectional repeatability is measured with the backlash correction feature in the control software enabled.
- **Backlash**
  Backlash is a mechanical phenomenon caused by the lead screw mechanism. When the direction of travel of a lead screw is reversed it will take up some slack in the system before actually moving the stage, however the encoder in the system will observe the screw to have rotated, leading to a discrepancy between commanded position and absolute position. All Thorlabs controllers can compensate for backlash.
- **Minimum Incremental Movement**
  This is the actual minimum incremental motion that a stage can make, otherwise known as the minimum step size.
- **Maximum On-Axis Load Capacity**
  The maximum weight that can be mounted on the center of the stage and be actuated repeatedly without damage to the stage or it's actuators.
- **Absolute On-Axis Accuracy**
  This is defined as the maximum discrepancy between the command position and the absolute position over the full travel of the stage. Absolute on-axis accuracy is measured over the full travel range of the un-calibrated stage using an interferometer. Note that all NRT and LTS stages are calibrated, and a calibration file sent with the unit. Calibrated accuracy is provided for these stages.
- **Maximum Accuracy**
  This is the maximum discrepancy between command position and absolute position expressed as a percentage of the commanded position. The advantage of expressing this as a percentage is that the performance of the stage can be compared to stages with different maximum travel ranges.
- **Home Location Accuracy**
  Measurement of how accurately the stage returns to home after power cycling the controller.

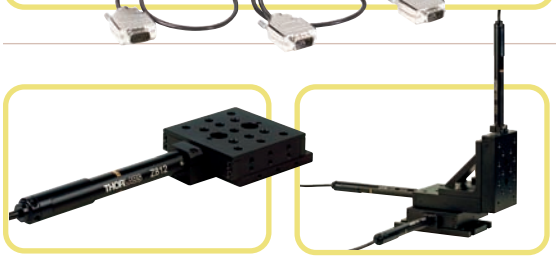
Motorized Stage Selection Guide

Pages 442-459

Motorized Multi-Axis Platforms

- 3- and 6-Axis Models
- 4 mm of Travel per Axis

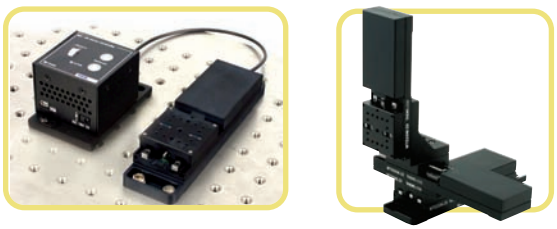
See Pages 442-443



0.5" and 1" Large Platform Translation Stages

- DC Servo Driven
- Aluminum Construction
- XYZ Configurable

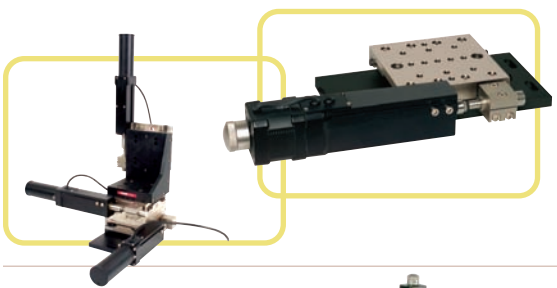
See Pages 444-445



1" and 2" Compact Translation Stages

- DC Servo Driven
- Small Compact Package
- Recirculating Ball Bearing
- XYZ Configurable

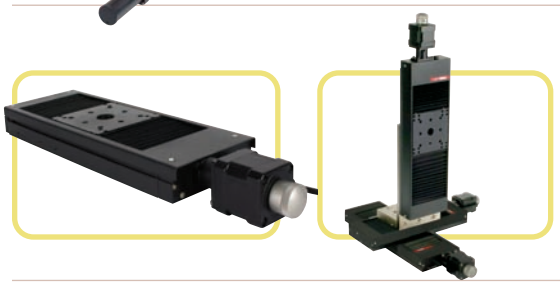
See Pages 446-447



2" TravelMax™ Translation Stages

- DC Servo and Stepper Motor Options
- Heavy Duty Stainless Steel Design
- Crossed Roller Bearings
- XYZ Configurable

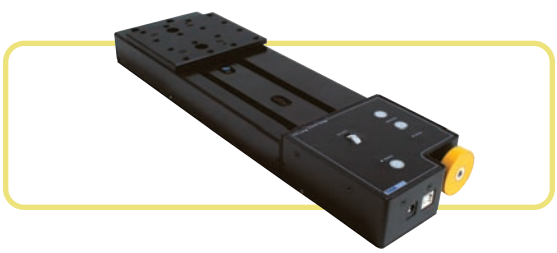
See Pages 448-453



4" and 6" Long Travel Translation Stages

- 4" (100 mm) and 6" (150 mm) Travel
- Stepper Motor Driven
- Recirculating Ball Bearings
- XYZ Configurable

See Pages 454-455



Long-Travel Translation Stages with Integrated Controllers

- 6" (150 mm) and 12" (300 mm) Travel
- Stepper Motor Driven
- Integrated Controller for Remote or Stand Alone Operation
- Low Profile Design

See Pages 456-458

Motorized Lab Jack

- 2" (50 mm) Vertical Travel
- Integrated Controller for Remote or Stand Alone Operation

See Page 459

4 mm Travel, NanoMax™ with Stepper Motors and Piezos

MAX341
Patented 6,467,762

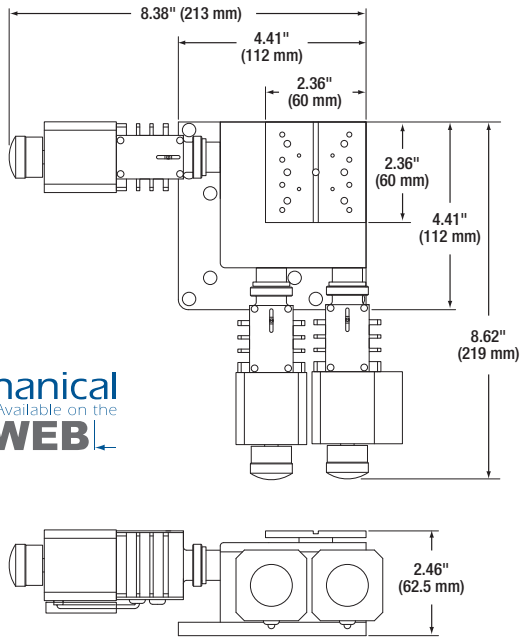
The MAX341 features internal piezoelectric actuators built directly into the body of the platform, providing a 20 µm travel range with a positional resolution of 20 nm. The MAX341 has three strain gauge displacement sensors, providing a voltage signal that is linearly proportional to the displacement of the piezoelectric element. This signal is used to compensate for the hysteresis, creep, and thermal drift that is inherent in all piezoelectric elements. If used with a BPC203, the piezoelectric actuator can be controlled in a closed-loop feedback mode that results in a resolution of 5 nm.

See the Full NanoMax™ 300 Range Starting on Page 470

Manual Stages
See Our Multi-Axis Platforms Chapter for Details on these Specialized Products
Motorized Stages
See Page 472-473

Multi-Axis Platforms

These flexure-based 3-axis precision stages are shown in more detail in the chapter on Multi-Axis Platforms. In the Multi-Axis Platforms section, you will find manual and motorized versions of both the 3-axis as well as the 6-axis stage. Complete pre-configured, fiber launch systems are also featured.



Mechanical Drawings Available on the WEB

Note: All measurements related to the performance of the piezoelectric actuators are made with the Thorlabs model BPC203 piezo driver, which can be found on page 569

General Specifications

- **XYZ Travel:** 0.16" (4 mm)
- **Max Velocity:** 2.5 mm/s
- **Max Acceleration:** 4 mm/s²
- **Backlash:** <7.0 µm
- **Min Achievable Incremental Movement:** 0.06 µm
- **Absolute On-Axis Accuracy:**
  X-Axis: 43 µm
  Y-Axis: 66 µm
  Z-Axis: 278 µm
- **Max Percentage Accuracy:**
  X-Axis: 4.2%
  Y-Axis: 4.35%
  Z-Axis: 10.4%
- **Bidirectional Repeatability:** 0.5 µm
- **Home Location Accuracy:** ±1.5 µm
- **Thermal Stability:** 1 µm/°C
- **On-Axis Load Capacity:** 2.2 lbs (1 kg)
- **Resonant Frequency (±10%):**
  375 Hz (No Load), 200 Hz (275 g Load), 150 Hz (575 g Load)
- **Weight:** 2.2 lbs (1 kg)
- **Deck Height:** 2.46" (62.5 mm) from the Bottom Surface of the Moving Platform. The Accessory Beam Height is 2.95" (75 mm) from the Bottom Surface of the Stage

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX343	MAX343/M	$ 2,345.00	£ 1,625.50	€ 2.082,00	¥ 19,802.00	NanoMax™ Stage with Stepper Motor Drives
MAX341	MAX341/M	$ 3,530.00	£ 2,447.00	€ 3.134,00	¥ 29,808.00	NanoMax™ Stage; Stepper, Piezoeletric Actuator, & Sensor

4 mm Travel, NanoMax™ with Stepper Motor 6-Axis Flexure Stage

Specifications

- **Stepper Motor Range:** 4 mm (0.16") (x, y, z), 6° (θx, θy, θz)
- **Optional Piezo Actuators:** 30 µm (x, y, z), 1.8 arcmin (θx, θy, θz)
- **Stepper Motor Resolution:** 20 nm (x, y, z), 0.1 arcsec (θx, θy, θz), Tested with Model BSC103 Stepper Motor Driver
- **Optional Piezoelectric Actuator:** 30 nm (x, y, z), 0.1 arcsec (θx, θy, θz)
- **Optional Piezoelectric Actuator with Feedback:** 7 nm (x, y, z), 0.03 arcsec (θx, θy, θz), The Strain Gauge Sensors Improve the Resolution by Ensuring Deterministic Control of the Piezo Movement
- **Deck Height:**
  - 112.5 mm (4.43") for Mounting Surfaces of the Moving Platform.
  - Add an Additional 12.5 mm (0.5") for the Accessory Beam Height 125 mm (4.92")*
- **Modular Stepper Motor Drives:** Hybrid Stepper Motor with 1.8° Step Angle and 23 N·cm of Holding Torque

*Measured from the bottom surface of the stage

Patented 6,467,762

See the Full NanoMax™ 600 Range Starting on Page 475

NanoMax™ Outfitted with Stepper Motors

- **Step Angle:** 1.8°
- **Step Accuracy:** 5%
- **Rated Phase Current:** 1 A
- **Phase Resistance:** 4.6 Ω
- **Phase Inductance:** 10.6 mH
- **Holding Torque:** 23.1 N·cm
- **Detent Torque:** 1.7 N·cm

These motorized NanoMax™ 6-axis stages combine the high thermal and mechanical stability of our NanoMax™ 600 series stage with the automated control offered by outfitting the system with micro-stepping stepper motors. When controlled by the apt™-Series Stepper Motor System Controllers, they provide fast, automated positioning.

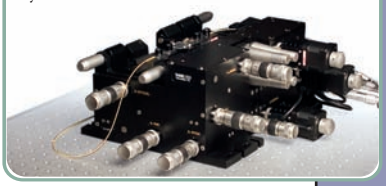
The NanoMax™ TS series offers inherently low kinematic static friction and virtually zero backlash except for that associated with the leadscrew of the stepper motors. These features combine to produce an automation tool that is capable of 24/7 operation with a positional resolution of 20 nm that will not degrade in industrial applications. Compared to traditional flexure designs, the mechanical stiffness is an order of magnitude higher, providing additional resistance against the external forces often encountered in the assembly process. Therefore, this stage is ideal for fiber alignment and positioning tasks, particularly those involving multi-channel optical waveguides and complex optical circuits.

For an increased level of automation, we offer two models with internal piezoelectric actuators. One of these two is also offered with displacement sensors that attach directly to the piezoelectric stacks. This added feature increases the resolution by a factor of two and enables closed-loop operation.

Manual Stages
See Our Multi-Axis Platforms Chapter for Details on these Specialized Products
Motorized Stages
See Page 488

Multi-Axis Platforms

These flexure-based 6-axis precision stages are shown in more detail in the chapter on Multi-Axis Platforms. In the Multi-Axis Platforms section, you will find manual and motorized versions of both the 3-axis as well as the 6-axis stage. Complete pre-configured, fiber launch systems are also featured.



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX604	MAX604/M	$ 7,175.00	£ 4,974.00	€ 6.371,00	¥ 60,586.00	NanoMax 6-Axis Positioning Stage with Stepper Motors

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX605	MAX605/M	$ 11,035.00	£ 7,650.00	€ 9.797,00	¥ 93,180.00	NanoMax 6-Axis Positioning Stage, Stepper Motors, & Piezos

NanoMax™ 606: Stepper Motors, Piezoelectric Actuators, & Displacement Sensors

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX606	MAX606/M	$ 13,210.00	£ 9,158.00	€ 11.728,00	¥ 111,546.00	NanoMax 6-Axis Stage, Stepper Motors, Piezos, & Sensors

All models are available in a left handed configuration, please call for details.

0.5" Travel Motorized Translation Stages

Features

- DC Servo Motor with an Optical Encoder
- High-Torque Gear Head
- Built-In Mechanical Limit Switches
- Right- or Left-Handed Configuration

The MT1-Z8 provides 0.5" (13 mm) of motorized motion in a single axis, whereas the MT3-Z8 provides 0.5" (13 mm) of travel in the X, Y, and Z axes. The MT1-Z8 is assembled from three single axis stages using the MT402 bracket. Each stage comes with two mounting dowels to ensure orthogonality when stacking multiple stages. The 12 VDC servo motor actuators use a 1.0 mm pitch leadscrew, a 67:1 gear head, and a built-in optical encoder that provides 34,304 counts per revolution to ensure sub-micron positioning. See pages 534-539 for more information on our DC servo motors.

T-Cube DC Servo Motor Driver

For More Details, See Pages 542

Specifications

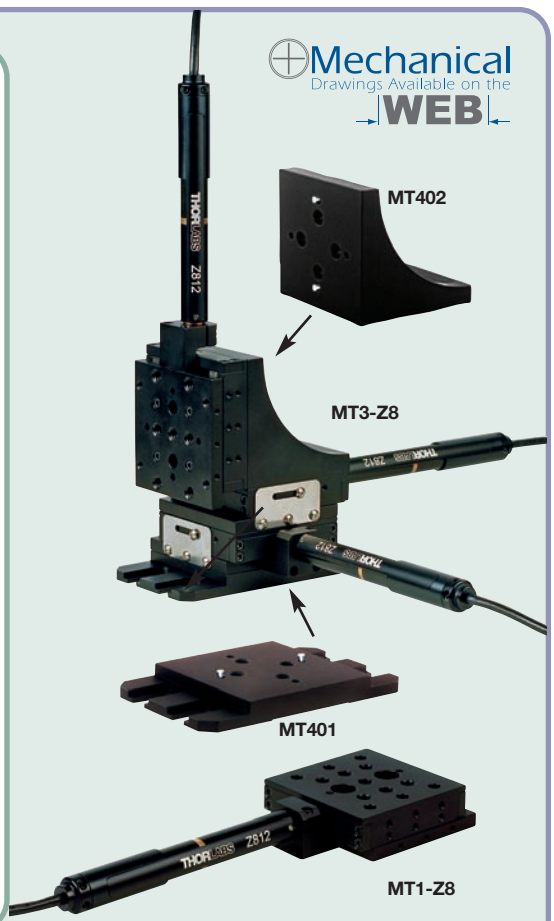
NEW design

- **Travel Range:** 0.5" (13 mm)
- **Recommended Controller:** TDC001
- **Max Velocity:** 3 mm/sec
- **Stage/Bearing Construction:** Aluminum/Ball Bearing
- **Bidirectional Repeatability:** 1.5 µm
- **Backlash:** <6 µm
- **Min Achievable Incremental Movement:** 100 nm
- **Max On-Axis Load Capacity (Vertical):** 10 lbs (4.5 kg)
- **Max On-Axis Load Capacity (Horizontal):** 20 lbs (9 kg)
- **Absolute On-Axis Acurracy:** 95 µm
- **Max Percentage Accuracy:** 0.7%
- **Home Location Accuracy:** <2 µm
- **Pitch:** 0.006°
- **Yaw:** 0.013°
- **Weight:** 0.88 lbs (0.4 kg)
- **Platform**
  - 2.40" x 2.40" (61 mm x 61 mm)
  - 1/4" - 20 (M6 x 1.0) Tapped Holes, 7 Places
  - #8-32 (M4 x 0.7) Tapped Holes, 4 Places

Linear Displacement per Encoder Count: There are 512 encoder counts per revolution of the motor. The output shaft of the motor goes into a 67:1 planetary gear head. This requires the motor to rotate 67 times in order to rotate the 1.0 mm pitch leadscrew one revolution. The end result advances the stage by 1.0 mm. To calculate the linear displacement of the actuator per encoder count:

- 512 x 67 = 34,304 encoder counts per revolution of the leadscrew
- 1.0 mm/34,304 counts = 2.915 x 10^{-5} mm (29 nm) linear displacement of the leadscrew per encoder count.

Mechanical Drawings Available on the WEB



Save 10% When Purchasing Complete Package Stage Plus Motorized Actuators

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MT1-Z8	MT1/M-Z8	$ 681.30	£ 472.30	€ 604,90	¥ 5,753.00	Motorized Translation Stage, 0.5" (13 mm of Travel)
MT3-Z8	MT3/M-Z8	$ 2,045.00	£ 1,417.50	€ 1.815,50	¥ 17,269.00	XYZ Motorized Tranlslation Stage, 0.5" (13 mm of Travel)
MT401	MT401	$ 19.30	£ 13.40	€ 17,20	¥ 163.00	Base Plate
MT402	MT402	$ 36.50	£ 25.40	€ 32,50	¥ 308.30	Angle Mounting Bracket

Manual Stages — See Our Manual Stages Chapter for Details on the MT3 w/Manual Drives — Motorized Stages

See Page 428

Manual Stages

Manual versions of the MT-Series stage can be found back in the Manual Stages chapter of this section. Many applicaitons require a combination of motorized and manually-driven stages,. The MT3 platform supports the easy mixing-and-matching of various drive optisons.

1" Travel Motorized Translation Stages

Features

- Optical Encoder with 34,304 Pulses/Rev
- 67:1 Gear Head for High Torque
- Built-In Limit Switches
- Right-Handed Configuration, User Changeable to Left Handed

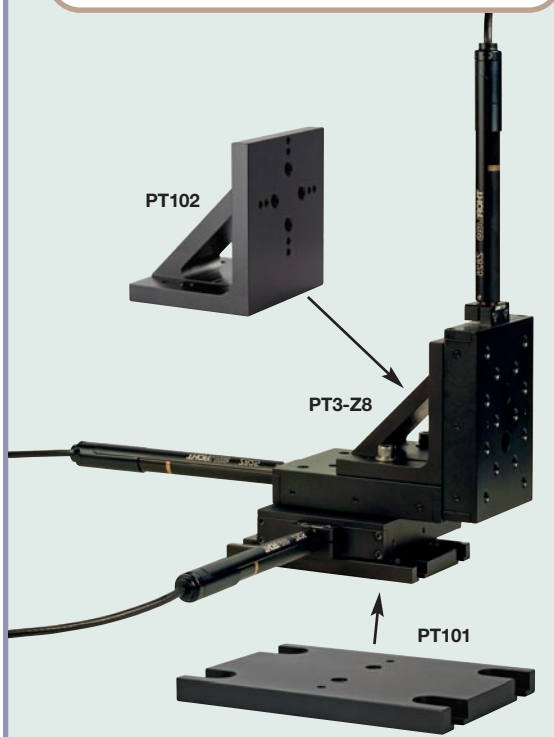
The PT1-Z8 and the PT3-Z8 motorized stages provide a 1" (25 mm) total travel range for each axis. The PT3-Z8 is assembled from three single axis stages using the PT102 (/M) bracket. Each stage comes with two mounting dowels to ensure orthogonality when stacking multiple stages. The motorized actuators allow sub-micron control and provide position feedback via an optical encoder. A 12 VDC servo motor and gear head rotate the 1.0 mm pitch leadscrew that drives the stage; built-in limit switches provide overdrive protection.

Thorlabs' motorized actuators are some of the smallest that are commercially available. Combining these actuators with our compact high-precision translation stages results in an extremely compact sub-micron translator.

Manual Stages
See Our Manual Stages Chapter for Details on the PT3 w/Manual Drives
Motorized Stages
See Page 429

Manual Stages

This motorized translation stage is based on our popular PT-Series manually-driven stages. The manually-driven version of this stage utilizes micrometer drives; this product is featured in our Manual Stages chapter.



Specifications

NEW design

- **Travel Range:** 1" (25 mm)
- **Recommended Controller:** TDC001
- **Max Velocity:** 3 mm/sec
- **Stage Bearing Construction:** Aluminum/Ball Bearing
- **Bidirectional Repeatability:** 1.5 µm
- **Backlash:** < 12 µm
- **Min Achievable Incremental Movement:** 100 nm
- **Max On-Axis Load Capacity (vertical):** 10 lbs (4.5 kg)
- **Max On-Axis Load Capacity (horizontal):** 20 lbs (9 kg)
- **Absolute On-Axis Acurracy:** 130 µm
- **Max Percentage Accuracy:** 0.52%
- **Home Location Accuracy:** <2 µm
- **Pitch:** 0.006°
- **Yaw:** 0.013°
- **Platform**
  - 3.00" x 4.00" (76.2 mm x 101.6 mm)
  - 1/4" - 20 (M6 x 1.0) Tapped Holes, 16 Places

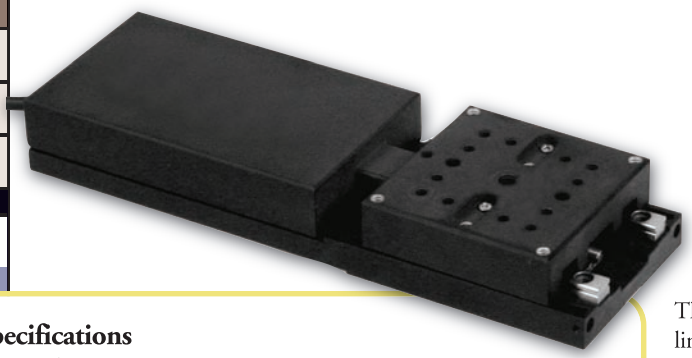
Linear Displacement per Encoder Count: There are 512 encoder counts per revolution of the motor. The output shaft of the motor goes into a 67:1 planetary gear head. This requires the motor to rotate 67 times in order to rotate the 1.0 mm pitch leadscrew one revolution. The end result advances the stage by 1.0 mm. To calculate the linear displacement of the actuator per encoder count:

- 512 x 67 = 34,304 encoder counts per revolution of the leadscrew
- 1.0 mm/34,304 counts = 2.915 x 10^{-5} mm (29 nm) linear displacement of the leadscrew per encoder count.

Save 10% When Purchasing Complete Package Stage Plus Motorized Actuators

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
PT1-Z8	PT1/M-Z8	$ 680.00	£ 471.40	€ 603,80	¥ 5,742.00	Single-Axis Motorized Translation Stage, 1" (25 mm) Travel
PT3-Z8	PT3/M-Z8	$ 2,085.00	£ 1,445.50	€ 1.851,00	¥ 17,606.00	Three-Axis Motorized Translation Stage, 1" (25 mm) Travel
PT101	PT101	$ 15.60	£ 10.80	€ 13,90	¥ 131.80	Base Plate
PT102	PT102/M	$ 68.60	£ 47.60	€ 61,00	¥ 579.30	Angle Mounting Bracket

25 and 50 mm Travel Motorized Translation Stages



Features

- Compact Modular Design
- Bundle Offer Includes TDC001 T-Cube Driver and Power Supply
- High-Load Linear Guide Rails
- Modular Design Allows Multi-Axis Configurations
- Built-In Limit Switches on the Stage
- Hall Effect Encoded DC Servo Motors

Specifications

- **Travel Range**
  - **MTS25:** 25 mm
  - **MTS50:** 50 mm
- **Recommended Controller:** TDC001
- **Max Velocity:** 3 mm/sec
- **Stage/Bearing Construction:** Aluminum/Recirculating Ball Bearing
- **Bidirectional Repeatability:** 1.6 µm
- **Backlash:** <6 µm
- **Min Achievable Incremental Movement:** 50 nm
- **Max On-Axis Load Capacity (Vertical):** 10 lbs (4.5 kg)
- **Max On-Axis Load Capacity (Horizontal):** 26.4 lbs (12 kg)
- **Absolute On-Axis Acurracy**
  - **MTS25:** 145 µm
  - **MTS50:** 290 µm
- **Max Percentage Accuracy**
  - **MTS25:** 0.6%
  - **MTS50:** 0.7%
- **Home Location Accuracy:** <8 µm
- **Pitch**
  - **MTS25:** 0.04°
  - **MTS50:** 0.05°
- **Yaw**
  - **MTS25:** 0.05°
  - **MTS50:** 0.06°
- **Weight:** 0.7 lbs (0.31 kg)
- **Platform**
  - 1.50" x 1.69" (38.1 mm x 43.0 mm)
  - #4-40 (M3 x 0.5) Tapped Holes, 18 Places
  - #8-32 (M4 x 0.7) Tapped Holes, 1 Place

Linear Displacement per Encoder Count: There are 512 encoder counts per revolution of the motor. The output shaft of the motor goes into a 67:1 planetary gear head. This requires the motor to rotate 67 times in order to rotate the 1.0 mm pitch leadscrew one revolution. The end result advances the stage by 1.0 mm. To calculate the linear displacement of the actuator per encoder count:

- 512 x 67 = 34,304 encoder counts per revolution of the leadscrew
- 1.0 mm/34,304 counts = 2.915 x 10^{-5} mm (29 nm) linear displacement of the leadscrew per encoder count.

NEW design

The compact, motorized MTS Series stages feature a dual set of linear rails with a continuously recirculating ball bearing on a moveable carriage. This mechanism provides smooth, low-friction movement. The minimum achievable movement is 50 nm.

Limit switches on the stage ensures controlled motion within the parameters of the unit and prevents overdriving in both directions.

Two travel ranges are available: 25 mm and 50 mm.
The stages are configurable in XY, XZ, and XYZ in both left- and right-handed configurations using the Angle Brackets and Spacer Plates. Base plates are also available allowing them to be bolted directly to an optical table. The MTS25-Z8 and MTS50A-Z8 stages can be attached to a MTS25A-Z8 or MTS50A-Z8 base, respectively, using the four included M3 x 1.0 caphead screws and dowel pins. For added flexibility, multi-axis configuration can be made using a mixture of 25 mm and 50 mm stages.

The MTS bundles include a TDC001 Controller, power supply, and necessary cables for fast out-of-the-box setup and operation.

For a complete technical description of the TDC001 T-Cube™ servo driver is found on pages 552-553, in the Controllers chapter.

Mechanical Drawings Available on the WEB

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MTS25-Z8	MTS25/M-Z8	$ 809.00	£ 560.90	€ 718,30	¥ 6,831.30	Compact Motorized 25 mm Travel Translation Stage
MTS25-Z8E	MTS25/M-Z8E	$ 1,390.00	£ 963.60	€ 1.234,00	¥ 11,738.00	MTS25 Translation Stage Plus TDC001 Controller
MTS50-Z8	MTS50/M-Z8	$ 899.00	£ 623.30	€ 798,20	¥ 7,591.20	Compact Motorized 50 mm Travel Translation Stage
MTS50-Z8E	MTS50/M-Z8E	$ 1,490.00	£ 1,033.00	€ 1.323,00	¥ 12,582.00	MTS50 Translation Stage Plus TDC001 Controller
PAA632	PAA632/M	$ 52.80	£ 36.70	€ 46,90	¥ 445.90	Hi Density D-Type Extender Cable, 2.5 m
TPS001	TPS001*	$ 25.00	£ 17.40	€ 22,20	¥ 211.20	±15 V Power Supply for Single T-Cube
TPS008	TPS008*	$ 175.00	£ 121.40	€ 155,40	¥ 1,477.80	±15 V Power Supply for up to 8 T-Cubes

*Imperial and Metric parts are equivalent.

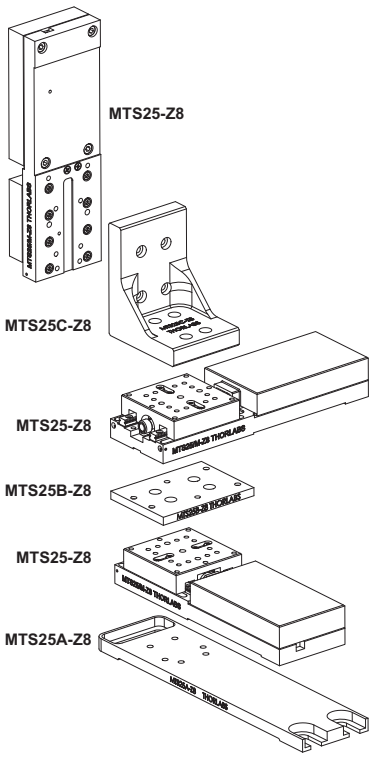
…Continued on Next Page

MTS Series Adapter Plates

Mechanical Drawings Available on the WEB

NEW design

XYZ Configuration Built with MTS25A-Z8, MTS25B-Z8, and MTS25C-Z8



Each adapter plate comes with the required dowel pins to ensure orthogonality as the system is reconfigured. The base plates are designed to allow the stages to be easily secured to an optical table with 1/4"-20 (M6 x 1.0) tapped holes on 1" (25 mm) centers.

MTS Series Mounting Adapters

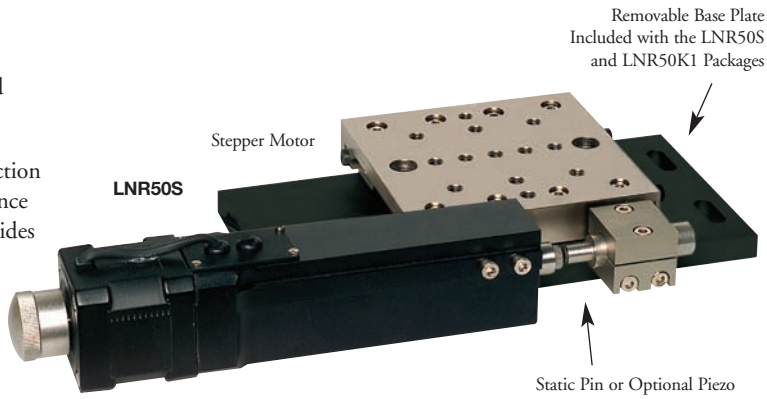
ITEM#	$	£	€	RMB	STAGE SERIES	DESCRIPTION
MTS25A-Z8*	$ 41.00	£ 28.50	€ 36,50	¥ 346.30	MTS25	Base Adapter Plate
MTS25B-Z8*	$ 29.00	£ 20.20	€ 25,80	¥ 244.90	MTS25	XY Adapter Plate
MTS25C-Z8*	$ 62.00	£ 43.00	€ 55,10	¥ 523.60	MTS25	Right-Angle Bracket
MTS25CSA*	$ 40.00	£ 27.80	€ 35,60	¥ 337.80	MTS25	60 mm Cage System Adapter Plate
MTS50A-Z8*	$ 51.00	£ 35.40	€ 45,30	¥ 430.70	MTS50	Base Adapter Plate
MTS50B-Z8*	$ 39.00	£ 27.10	€ 34,70	¥ 329.40	MTS50	XY Adapter Plate
MTS50C-Z8*	$ 72.00	£ 50.00	€ 64,00	¥ 608.00	MTS50	Right-Angle Bracket
MTS50CSA*	$ 48.00	£ 33.30	€ 42,70	¥ 405.40	MTS50	60 mm Cage System Adapter Plate

*Imperial and metric compatible

2" TravelMax™ Stage with Stepper Motor

Features

- Solid Stainless Steel Construction
- Stepper Motor Drive with Precision Ground Trapezoidal Leadscrew
- Heavy-Duty Cross Roller Bearings
- Thermally-Matched Stainless Steel Construction
- Offers Excellent Dynamic-Torque Performance
- High-Precision, Home-Position Sensor Provides Excellent Repeatability
- Optional Piezo Actuators (see pages 530-532)



Motorized TravelMax™ Cross-Roller-Bearing Stage

Combining the TravelMax™ stage with our DRV014 high-performance stepper motor based actuator provides true nanopositioning capability. The stepper motor actuator uses a trapezoidal-shaped 1 mm/rev pitch leadscrew that provides a high load carrying capability. When used with the BSC101 stepper motor driver a step size of 50 nm is achievable.

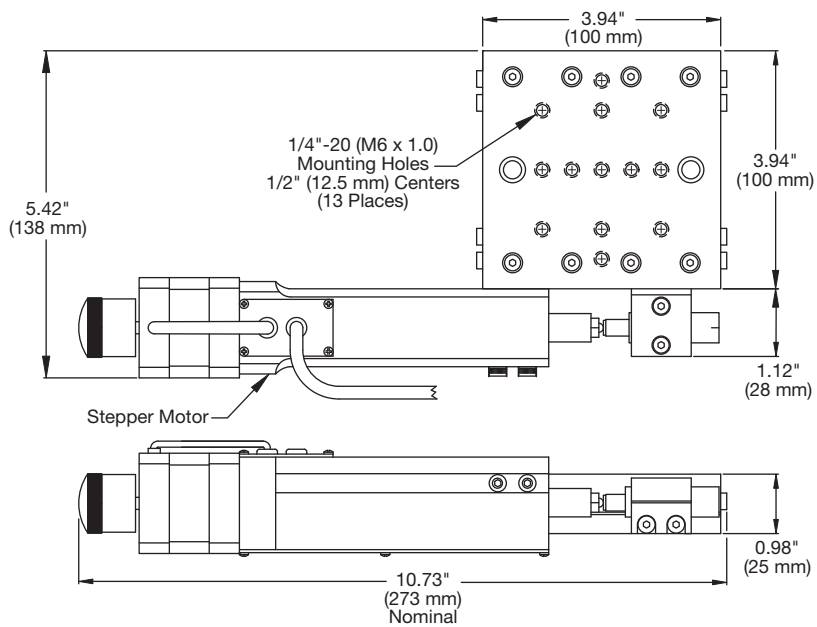
The exceptional performance of the LNR50S is a result of the rigid all stainless steel construction of the stage combined with the sophisticated design of the DRV014 actuator. The high-quality, cross-roller-bearing rails can carry loads up to 10 times larger than equivalent-sized ball slides. The precision-ground shafts provide excellent straight line accuracy and the alternately crossed rollers can handle force in any direction. The performance is further enhanced by using thermally matched materials that ensure stability and uniform performance over the entire 2" (50 mm) range of motion.

The modular design of the LNR50 family of stages allows optional elements (such as piezo actuators – see pages 530-532) to be added to the platform within minutes. The top and bottom surfaces of the LNR series stages are equipped with an array of 1/4"-20 (M6 x 1.0) tapped holes to maximize the mounting flexibility of components. The LNR50P1 baseplate and LNR50P2 angle bracket allow the LNR series of stages to be configured in left- or right-handed orientations in XY, XZ, or XYZ systems – see pages 432-433.

Mechanical Drawings Available on the WEB

LNR50S (LNR50S/M) Specifications

- **Travel Range:** 2" (50 mm)
- **Recommended Controller:** BSC101
- **Max Velocity:** 8 mm/sec
- **Stage/Bearing Construction:** Stainless Steal/Crossed Roller Bearing
- **Bidirectional Repeatability:** 0.5 µm
- **Backlash:** <6 µm
- **Min Achievable Incremental Movement:** 50 nm
- **Max On-Axis Load Capacity (Vertical):** 22 lbs (10 kg)
- **Max On-Axis Load Capacity (Horizontal):** 66 lbs (30 kg)
- **Absolute On-Axis Acurracy:** 10 µm
- **Max Percentage Accuracy:** 0.02%
- **Home Location Accuracy:** <2 µm
- **Pitch:** 0.03°
- **Yaw:** 0.015°
- **Weight:** 6.2 lbs (2.82 kg)



2" (50 mm) TravelMax™ Stage with Stepper Motor Actuator

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50S	LNR50S/M	$ 1,690.00	£ 1,171.50	€ 1.500,50	¥ 14,271.00	2" (50 mm) TravelMax™, Stepper Motor Drive

2" TravelMax™ Stage Bundle

LNR50K1

Save 10% with this Complete Package
Includes LNR50S, BSC101 Controller, Cables, and Software

apt™ System: Stepper Motor Controller

The BSC series apt™ stepper-motor controllers (see pages 558-559) are designed to drive larger framed 2-phase bipolar stepper motors, with and without encoder feedback. The BSC101 is capable of delivering powers up to 48 V/50 W peak (25 W average).

The controller combines high-speed digital signal processors (DSP) with low-noise analog electronics and ActiveX® software technology for effortless one, two, or three-axis motion. Additional axes can be driven by connecting one or more benchtop units via a standard USB hub. The controller is supplied with a full suite of software support tools. An intuitive graphical instrument panel allows immediate control and visualization of the operation of the stepper controllers, and any other apt™ controllers that are installed. See pages 580-582 for a full description of the apt™ system software.

Features

- Single-Channel (Other Multi-Channel Models Available)
- Supports 2-Phase Bipolar Steppers up to 50 W
- Differential Encoder Feedback Support Closed-Loop Positioning
- Auto-Configure Function for ll Thorlabs Stages
- USB Plug and Play Plus Multi-Axis Expansion
- Motor Control I/O Port (Jogging, Interlocks)
- Full Software GUI Control Suite
- High-Resolution Micro Stepping Control
- Stable and Predictable Low-Speed Operation
- ActiveX® Software Graphical Panels
- ActiveX® Programming Interfaces
- Seamless Software Integration With apt™ Family

Motor Drive Specifications

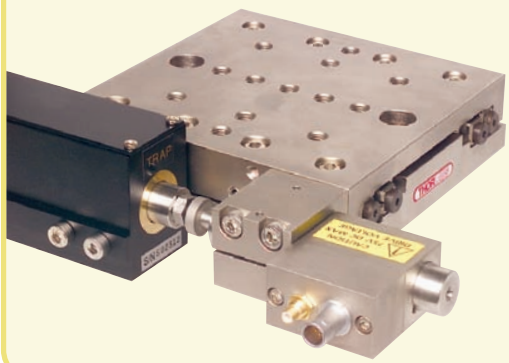
- **Leadscrew Pitch:** 1 mm
- **Limit Switches:** Ceramic Tipped Electro-Mechanical Switches
- **MicroStepping Resolution:** <50 nm (25,600 Microsteps Per 1 mm of Translation)
- **Speed Range:** 200 nm/s to 8 mm/s
- **Controller Interface:** USB

Mechanical and Electrical Data

- **Step Angle:** 1.8° (50 poles and 2 Phases Results in 360° Divided by 200)
- **Step Accuracy:** 10% (Nominal)
- **Rated Phase Current:** 1 A
- **Phase Resistance:** 4.6 Ω
- **Phase Inductance:** 10.6 mH
- **Holding Torque:** 23.1 N-cm
- **Operating Temperature:** -20 to 40° C (Motor Specification)

Upgradeable to Piezoelectric-Assisted Drives

Referring to the photograph at the top of the page, the LNR50S stage includes a static pin that provides a stop for the motor drive. This pin is easily removable and can be replaced with a piezoelectric transducer to complement the manual drive, as shown on the left. Details of complete piezo actuators can be found starting on page 530.

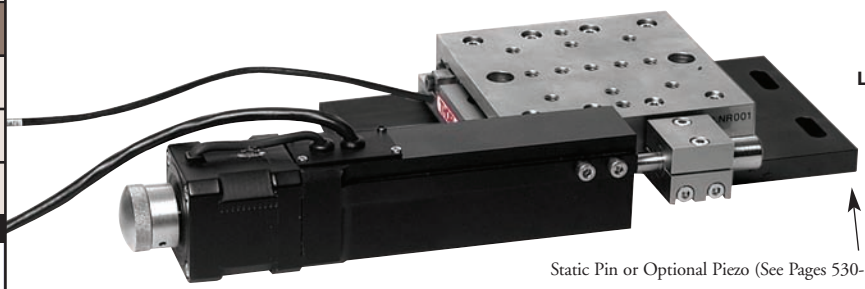


2" (50 mm) TravelMax™ Stage and apt™ Controller Package

Save 10% on the Complete Package: Includes Stage, Actuator, Controller, Cables, and Software

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50K1	LNR50K1/M	$ 2,677.50	£ 1,856.00	€ 2.377,00	¥ 22,609.000	2" (50 mm) Stage, Stepper Motor Drive, and BSC101 Controller

2" TravelMax™ Stage Encoded Stepper Motor



LNR50SE

Static Pin or Optional Piezo (See Pages 530-532)

Mechanical Drawings Available on the WEB

Overview Motorized TravelMax™ Stage

The LNR50SE is a 2" (50 mm) TravelMax™ Stage with an optical linear encoder and Stepper Motor. The actuator uses a trapezoidal-shaped leadscrew with 1 mm/rev pitch that provides a high load carrying capability.

The exceptionally high performance of the LNR50SE is a result of the combination of rigid all-steel construction, optical linear encoder, and the sophisticated design of the DRV014 actuator. When driven with a BSC series stepper motor controller (see pages 558-559) a true micro-stepping resolution of 50 nm and position accuracy of 10 µm can be achieved.

Accuracy and Repeatability

Furthermore the ability to automatically control and set the absolute position of the stage with accuracies and repeatabilities in the range of 10 µm means that the LNR50SE stage can be used in a wide variety of automated analytical scanning characterization and test applications.

The optically encoded stage comes with a control unit that can be connected directly to a BSC series stepper motor controller, which then allows the fast development of sophisticated automated routines via the comprehensive ActiveX programming environment. See pages 558-559 for more details on the BSC series controllers.

Linear Position Encoder

Combining the TravelMax™ all-stainless steel stage with an integrated linear optical encoder provides the ideal solution for when stability, long travel, and high load capacity also need to be coupled to absolute position accuracy. When combined with the Thorlabs BSC series stepper motor controller, the high resolution encoder helps ensure a fully operational solution out of the box.

The LNR50SE features a high, sub-micron resolution linear scale that is directly attached to the moving platform of the stage. This linear optical encoder provides the necessary feedback to the drive electronics to ensure true nanopositioning capabilities. This means that mechanical positioning errors associated with backlash can be removed as the encoder provides a direct readout of the absolute position.

The glass scale encoder system has a resolution of 100 nm and provides absolute position accuracies on the order of ±3 µm over the full 2" (50 mm) of travel. The bidirectional repeatability is on the order of 0.2 µm.

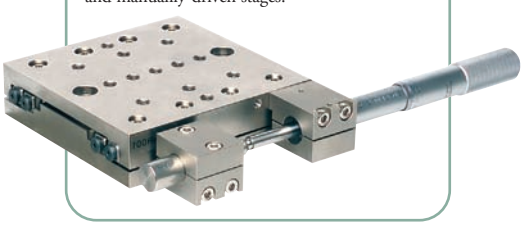
LNR50SE (LNR50SE/M) Specifications

- **Travel Range:** 2" (50 mm)
- **Recommended Controller:** BSC101
- **Max Velocity:** 8 mm/s
- **Stage/Bearing Construction:** Stainless Steal/Crossed Roller Bearing
- **Bidirectional Repeatability:** 0.2 µm
- **Backlash:** <6 µm
- **Max On-Axis Load Capacity (Vertical):** 22 lbs (10 kg)
- **Max On-Axis Load Capacity (Horizontal):** 66 lbs (30 kg)
- **Absolute On-Axis Acurracy:** ±3 µm
- **Encoder Resolution:** 100 nm
- **Grating Pitch:** 20 µm
- **Max Percentage Accuracy:** 0.02%
- **Home Location Accuracy:** <0.5 µm
- **Pitch:** 0.03°
- **Yaw:** 0.015°
- **Weight:** 6.2 lbs (2.82 kg)

Manual Stages
See Our Manual Stages Chapter for Details on the LNR w/manual drives
Motorized Stages
See Page 432-433

Manual Stages

Our popular LNR series motorized stages are also available in manually-driven versions. Many applications require multiple axes of translation, however some of these multi-axis systems will not require motorized drives. The modularity of this family of products allows the user to easily configure a mixture of motorized and manuallly-driven stages.



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50SE	LNR50SE/M	$ 3,495.00	£ 2,423.00	€ 3.103,00	¥ 29,512.00	2" (50 mm) Linear Encoded TravelMax™ Stage, Stepper Motor Drive

2" TravelMax™ Stage Encoded Stepper Motor Bundle

BSC101
Controller Details,
See Pages 558-559

LNR50SEK1

Save 10% with this Complete Package
Includes All Drives, Controller, Cables, and Software

Mechanical Drawings Available on the WEB

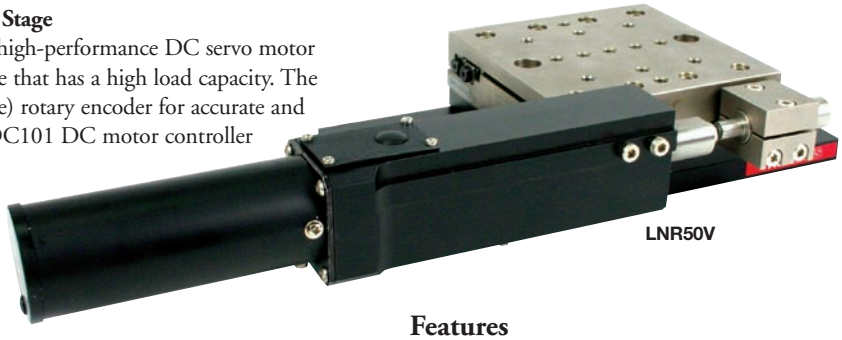
LNR50SEK1 – This fully configured single-axis system incorporates the LNR50SE TravelMax™ all-steel stage with the DRV014 trapezoidal stepper motor actuator and the powerful BSC101 single-channel benchtop stepper motor controller.

2" (50 mm) Travel Linear Position Encoder and Stepper Motor Drives

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50SEK1	LNR50SEK1/M	$ 4,300.00	£ 2,981.00	€ 3.818,00	¥ 36,310.00	2" (50 mm) Linear Encoded TravelMax™ Stage, Stepper Motor Drive, and BSC101 Controller

2" TravelMax™ Stage with DC Servo Motor

Motorized TravelMax™ Cross Roller Bearing Stage
The combination of a TravelMax™ stage and a high-performance DC servo motor actuator provides the user with a high speed stage that has a high load capacity. The actuator incorporates a 1024-lines (4096 effective) rotary encoder for accurate and repeatable positioning, when driven with the BDC101 DC motor controller (pages 548-549).


LNR50V

The exceptional performance of the LNR50V is a result of the rigid all stainless steel construction of the stage combined with the rugged design of the DRV414 actuator (page 536).

When stability, long travel, and high load capacity need to be combined with automated control at high speeds, the DC servo-driven TravelMax™ stage is the perfect solution. The high-quality, cross roller bearing rails can carry loads up to 10 times larger than equivalent sized ball slides. The precision-ground shafts provide excellent straight line accuracy and the alternately crossed rollers can handle force in any direction. The performance is further enhanced by using thermally matched materials that ensure stability and uniform performance over the entire 2" (50 mm) range of motion.

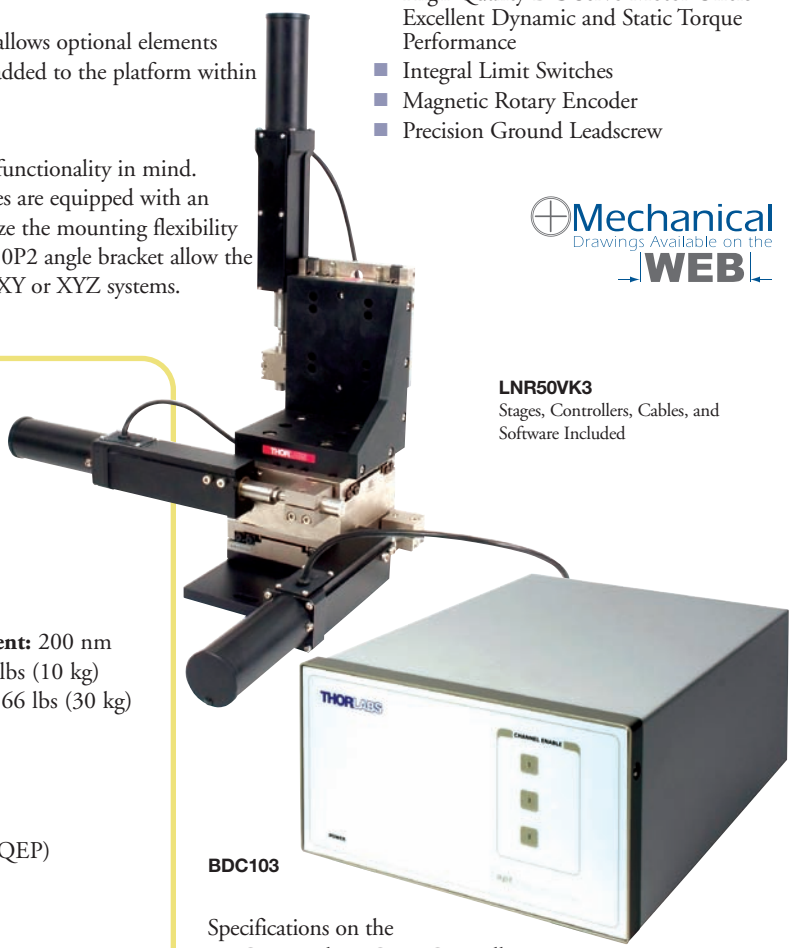
The modular design of the LNR50 family of stages allows optional elements (such as piezo actuators – see pages 530-532) to be added to the platform within minutes.

Left- or Right-Handed and XYZ Configurable
The TravelMax™ was designed with flexibility and functionality in mind. The top and bottom surfaces of the LNR series stages are equipped with an array of 1/4"-20 (M6 x 1.0) tapped holes to maximize the mounting flexibility of components. The LNR50P1 baseplate and LNR50P2 angle bracket allow the LNR series to be configured in left-or right-handed XY or XYZ systems.

Features
- High-Speed Operation
- Solid Stainless Steel Construction
- Heavy-Duty Cross Roller Bearings
- Thermally Matched Stainless Steel Construction
- Right- or Left-Handed XYZ Configurable
- High-Quality DC Servo Motor Offers Excellent Dynamic and Static Torque Performance
- Integral Limit Switches
- Magnetic Rotary Encoder
- Precision Ground Leadscrew

Mechanical Drawings Available on the WEB

Specifications
- **Travel Range:** 2" (50 mm)
- **Recommended Controller:** BDC101
- **Max Velocity:** 50 mm/s
- **Stage/Bearing Construction:** Stainless Steal/Crossed Roller Bearing
- **Bidirectional Repeatability:** 5 µm
- **Backlash:** <11 µm
- **Minimum Achievable Incremental Movement:** 200 nm
- **Max On-Axis Load Capacity (Vertical):** 22 lbs (10 kg)
- **Max On-Axis Load Capacity (Horizontal):** 66 lbs (30 kg)
- **Absolute On-Axis Acurracy:** 83 µm
- **Max Percentage Accuracy:** 0.37%
- **Home Location Accuracy:** <10 µm
- **Lead Screw Pitch:** 1 mm
- **Rotary Encoder:** 1024 Line (4096 Effective QEP)
- **Pitch:** 0.03°
- **Yaw:** 0.015°
- **Weight:** 5.0 lbs (2.2 kg)



LNR50VK3
Stages, Controllers, Cables, and Software Included

BDC103

Specifications on the BDC101 and BDC103 Controllers can be found on pages 548-549.

2" (50 mm) Travel DC Servo Motor Actuator

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50V	LNR50V/M	$ 2,190.00	£ 1,518.00	€ 1.944,50	¥ 18,493.00	2" (50 mm) TravelMax Stage, DC Servo Motor Drive
LNR50VK1	LNR50VK1/M	$ 3,475.00	£ 2,409.00	€ 3.085,00	¥ 29,343.00	2" (50 mm) TravelMax Stage, DC Motor Drive, BDC101 Controller
LNR50VK3	LNR50VK3/M	$ 9,240.00	£ 6,406.00	€ 8.204,00	¥ 78,023.00	3-axis 2" (50 mm) TravelMax Stage, DC Motor Drive, BDC103 Controller

TravelMax™ Series Base Plate

Features

- This Mounting Plate is Included with all LNR50 Stages that Come Equipped with Stepper Motors
- Mounting Slots Allow Coarse XY Positioning of the System
- Assortment of Mounting Screws Included

LNR50P1

LNR50 TravelMax™ Mounting Plate

The LNR50P1 provides additional mounting options for the TravelMax™ series stages. The plate is 0.39" (10 mm) thick by 3.94" (100 mm) wide by 7.68" (195.1 mm) long. Tapped holes match up to the two mounting counterbored clearance holes of the LNR50 stage. The set of four slots located in the middle of the plate allow the angle bracket shown below to be directly attached to this plate; these four slots are counterbored for either 1/4" or M6 socket head screws.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50P1	LNR50P1/M	$ 56.50	£ 39.20	€ 50,20	¥ 477.10	2.54" (10 mm) Thick TravelMax™ Series Adapter Plate

Right-Angle Bracket, TravelMax™ Series


LNR50P2

This right angle mounting bracket allows the TravelMax™ family of stages to be mounted vertically. This right angle bracket is useful for building XYZ stage assemblies; it can also be used to build an XZ configuration.

Mechanical Drawings Available on the WEB

Features

- Designed to Support the Construction of XYZ Stage Assemblies
- Attaches Directly to an Optical Table for Applications Requiring One Axis of Vertical Translation
- Reconfigurable for Right- or Left-Handed Applications
- Assortment of Mounting Screws Included

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50P2	LNR50P2/M	$ 88.80	£ 61.60	€ 78,90	¥ 749.90	TravelMax™ Series Right-Angle Bracket

Spacer Block for Stacking Motor Driven TravelMax™ Stages

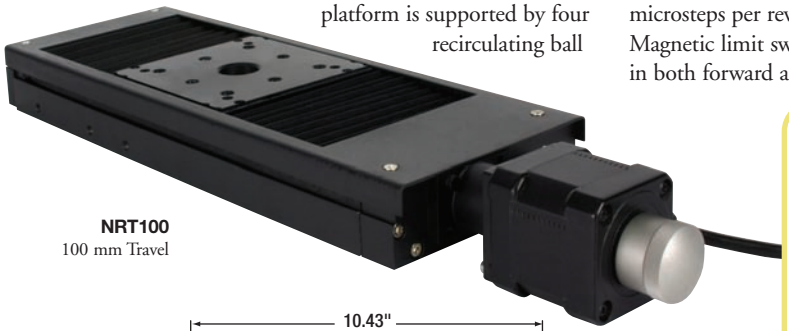
LNR50P3

The LNR50P3 is specifically designed to allow the TravelMax™ stages outfitted with motor drives to be stacked into an XY orientation, assuming Z to be the vertical dimension. The plate is 0.94" (24 mm) thick and comes complete with all the mounting hardware required to attach two LNR50 stages to its top and bottom surfaces.

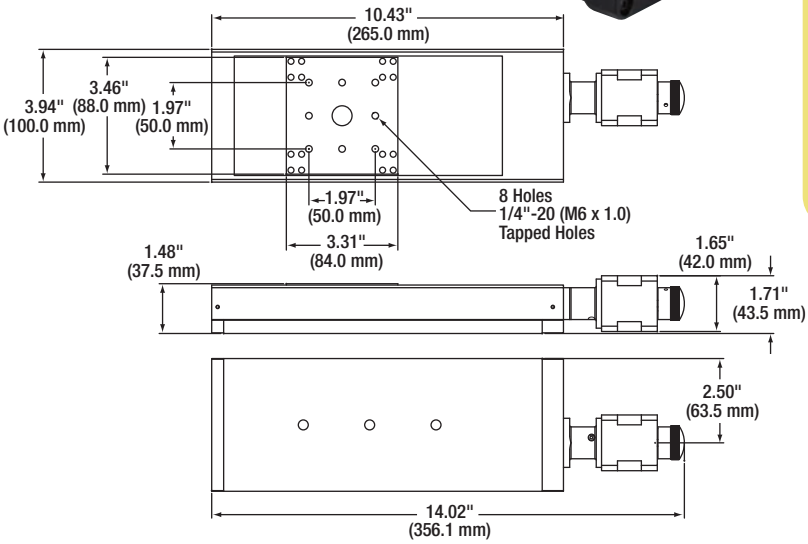
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LNR50P3	LNR50P3/M	$ 45.30	£ 31.50	€ 40,30	¥ 382.60	Motor-Driven TravelMax™ Stages

NRT 100 mm (4") and 150 mm (6") Long-Travel Stages (Page 1 of 2)

The NRT positioning stages are ideally suited for applications that require long travel, high precision, and high-load capacity such as measurement and inspection. The main platform is supported by four recirculating ball carrier bearings mounted to precisely aligned linear guide rails. A minimal backlash leadscrew produces smooth translation. It is directly driven with a two-phase stepper motor capable of 25,600 microsteps per revolution (minimum step size of 100 nm). Magnetic limit switches allow homing and overdriving protection in both forward and reverse directions.



NRT100
100 mm Travel



Mechanical and Electrical Data

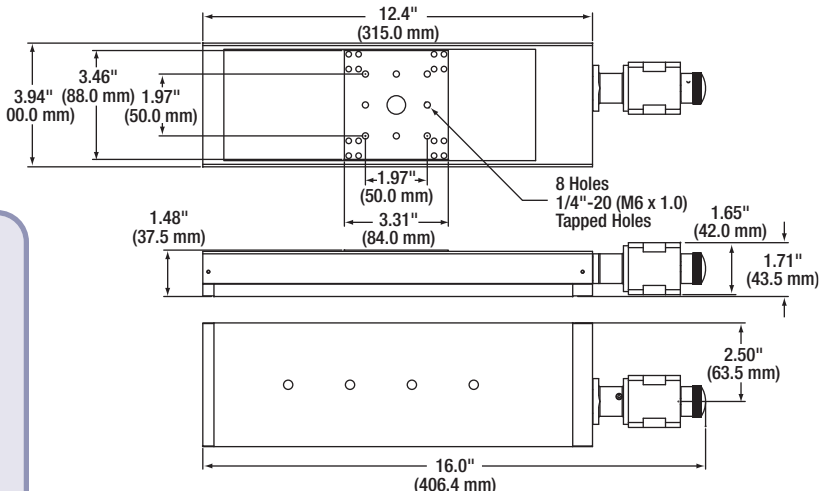
Stepper Motor-Based Actuator

- **Step Angle:** 1.8° (50 poles and ±2 Phases for 360° Divided by 200)
- **Step Accuracy:** 5%
- **Rated Phase Current:** 1 A
- **Phase Resistance:** 4.6 Ω
- **Phase Inductance:** 10.6 mH
- **Holding Torque:** 23.1 N·cm
- **Detent Torque:** 1.7 N·cm
- **Operating Temperature:** -20 °C to +40 °C (Motor Specification Only)

Features

- Low Profile
- Lightweight Aluminum Body
- Microstepping Resolution
- XYZ Configurable

Mechanical Drawings Available on the WEB



The stepper motor used in the NRT stage has 50 individual magnetic teeth and is ideally suited for microstepping applications. Aside from the obvious increase in resolution provided by increasing the steps per revolution from 200 to 25,600, microstepping ensures smoother low-speed motion by allowing the discrete 1.8° step size, which produces vibrational noise, to be reduced to much smaller steps, resulting in lower vibrational noise.

The use of a trapezoidal leadscrew in the NRT series also provides a number of benefits over the more common Acme-style thread. The benefits include improved durability, lower friction due to improved surface quality, and very little backdrive, which eliminates the need for a braking mechanism commonly required with ball screws.

NRT150
150 mm Travel

NRT 100 mm (4") and 150 mm (6") Long-Travel Stages (Page 2 of 2)

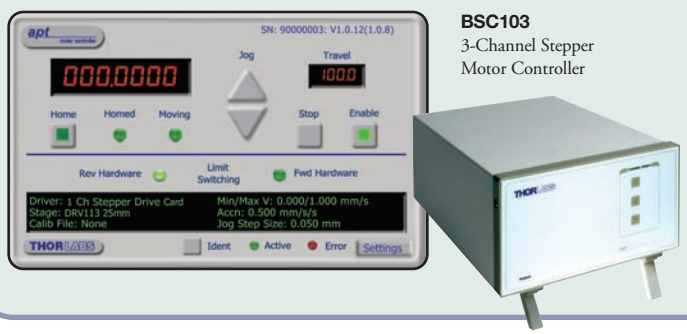
Specifications

- **Travel Range**
  - NRT100: 4" (100 mm)
  - NRT150: 6" (150 mm)
- **Recommended Controller:** BSC101
- **Max Velocity:** 10 mm/s
- **Stage Bearing Construction:** Aluminum Recirculating Ball Bearing
- **Bidirectional Repeatability:** 1 µm
- **Backlash:** <3 µm
- **Min Achievable Incremental Movement:** 100 nm
- **Max On-Axis Load Capacity (Vertical):** 11 lbs (5 kg)
- **Max On-Axis Load Capacity (Horizontal):** 44 lbs (20 kg)
- **Absolute On-Axis Acurracy**
  - NRT100: 16 µm
  - NRT150: 20 µm
- **Calibrated Accuracy:** 2 µm
- **Max Percentage Accuracy:** 0.09%
- **Home Location Accuracy:** <1.2 µm
- **Pitch:** 0.008°
- **Yaw:** 0.05°
- **Weight**
  - NRT100: 4.5 lbs (2.0 kg)
  - NRT100: 5.5 lbs (2.5 kg)

NRT100 and NRT150 Stages Stacked in an XYZ Configuration

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NRT100	NRT100/M	$ 1,920.00	£ 1,331.00	€ 1.704,50	¥ 16,213.00	4" (100 mm) Travel Motorized Linear Stage
NRT150	NRT150/M	$ 2,135.00	£ 1,480.00	€ 1.895,50	¥ 18,028.00	6" (150 mm) Travel Motorized Linear Stage
NRT150P1	NRT150P1/M	$ 113.00	£ 78.40	€ 100,40	¥ 954.20	Vertical Mounting Bracket For NRT Series Stages

apt™ System: Multi-Channel Stepper Motor Controllers



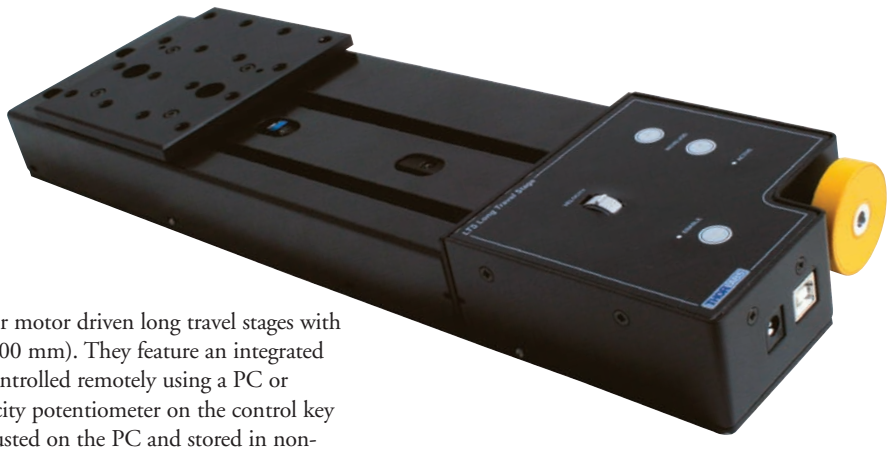
BSC103
3-Channel Stepper Motor Controller

The BSC103 benchtop 3-axis stepper motor controller combines high-speed digital signal processor, low-noise analog electronics, and ActiveX® software technology to provide effortless one- or three-axis control. Additional axes can be controlled by connecting one or more benchtop units via a standard USB hub or by utilizing the new midi-rack controller.

See Pages 558-559 for Details

150 mm (6") and 300 mm (12") Travel: LTS Series (Page 1 of 2)

NEW products

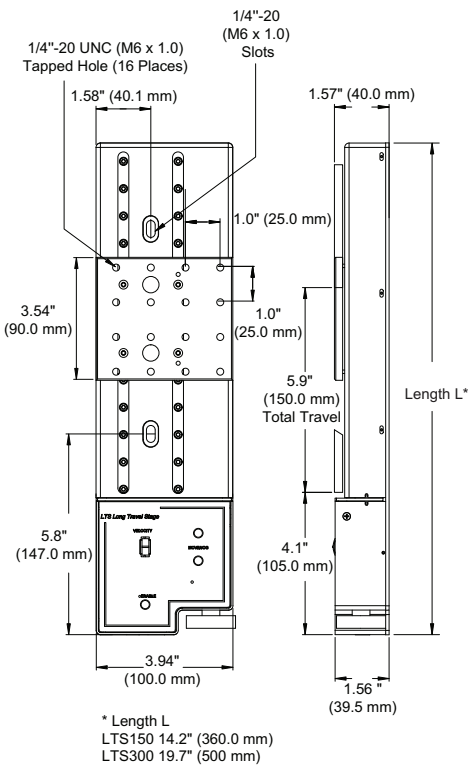


The LTS Series of stages are stepper motor driven long travel stages with ranges of 6" (150 mm) and 12" (300 mm). They feature an integrated electronic controller that can be controlled remotely using a PC or manually via the buttons and velocity potentiometer on the control key pad. Parameter settings can be adjusted on the PC and stored in non-volatile memory within the unit itself. When the unit is next powered up these settings are applied automatically. This is particularly useful when the stage is being used in the absence of a PC and USB link.

The stages are lightweight, compact, and robust with excellent performance characteristics over the full travel range. The long travel range makes them ideal for applications such as interferometry and M^2 measurements, while the 33 lbs (15 kg) load capacity make the stage practical for most applications that fit on the large 3.54" x 3.54" platform. They are compatible with our range of optomechanical and translation stages. The aluminum construction and low profile design make these stages ideal for applications where space is limited. Integrated magnetic limit switches allow homing and provide overdriving protection in both directions. A precision ball screw delivers smooth virtually noise free movement.

Features

- Low-Profile, Long Travel Stages
- Stepper Motor Driven
- Integrated APT Controller with USB Interface
- 6" (150 mm) and 12" (300 mm) Travel Ranges



Specifications

- **Travel Range:**
  - **LTS150:** 6" (150 mm)
  - **LTS300:** 12" (300 mm)
- **Maximum Velocity:** 15 mm/s
- **Stage/Bearing Construction:** Aluminum/Recirculating Ball Bearing
- **Bidirectional Repeatability:** 2 µm
- **Backlash:** <5 µm
- **Min Achievable Incremental Movement:** 100 nm
- **Max On-Axis Load Capacity (Vertical):** 11 lbs (5 kg)
- **Max On-Axis Load Capacity (Horizontal):** 33 lbs (15 kg)
- **Absolute On-Axis Acurracy:** 50 µm
- **Max Percentage Accuracy LTS150:** 0.18 %
- **Max Percentage Accuracy LTS300:** 0.20%
- **Home Location Accuracy:** <6 µm
- **Pitch:**
  - **LTS150:** 0.016°
  - **LTS300:** 0.022°
- **Yaw:**
  - **LTS150:** 0.05°
  - **LTS300:** 0.06°
- **Weight:**
  - **LTS150:** 4.2 lbs (1.9 kg)
  - **LTS300:** 5.5 lbs (2.5 kg)

Mechanical Drawings Available on the WEB

150 mm (6") and 300 mm (12") Travel: LTS Series (Page 2 of 2)

NEW products

Driver Flexibility

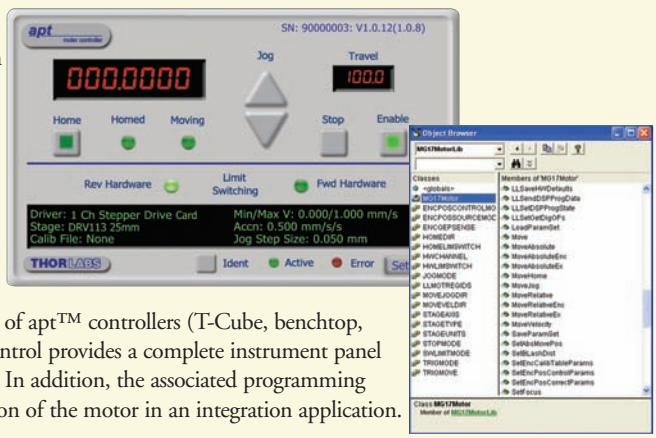
The LTS series of stages feature an integrated apt™ compatible controller, that is fully configurable (parameterized) with key settings that can be made by using the included software. Jog step sizes can be selected, phase currents can be limited to suitable peak powers as required, and limit switch configuration is accommodated through flexible logic settings. Moreover, relative and absolute moves can be initiated with move profiles set using velocity profile parameters (including acceleration and deceleration). Similarly, homing (zero position datum) sequences have a full set of associated parameters that can be adjusted for a particular application. For simplicity of operation, the apt™ software incorporates pre-configured settings for the LTS series stages. For convenience and ease of use, adjustment of all key parameters is possible through direct interaction with intuitive software graphical panels. For example, a move to the next position can be initiated by clicking directly on the position display and entering a new value. Note that all such settings and parameters are also accessible through the ActiveX® programmable interfaces for automated alignment sequences.

Full Software GUI Control Suite and ActiveX® Controls Included

A full and sophisticated software support suite is supplied with the LTS series stages. The suite includes a number of out-of-the-box user utilities to allow immediate operation of the unit without any detailed pre-configuration. All operating modes can be accessed manually, and all operating parameters may be changed and saved for future use. For more advanced custom motion control applications, a fully featured ActiveX® programming environment is also included to facilitate custom application development in a wide range of programming environments. Note that all such settings and parameters described above are also accessible through these ActiveX® programmable interfaces.

The ActiveX® apt™ system software shipped with the LTS stages is also compatible with other apt™ family controllers including our multi-channel rack-based system and smaller optical table mountable T-Cube controllers. This unified software package allows seamless mixing of the LTS stages with any apt™ benchtop, table top, and rack based controllers so that the user can build a single software interface for an application utilizing multiple stages of different types.

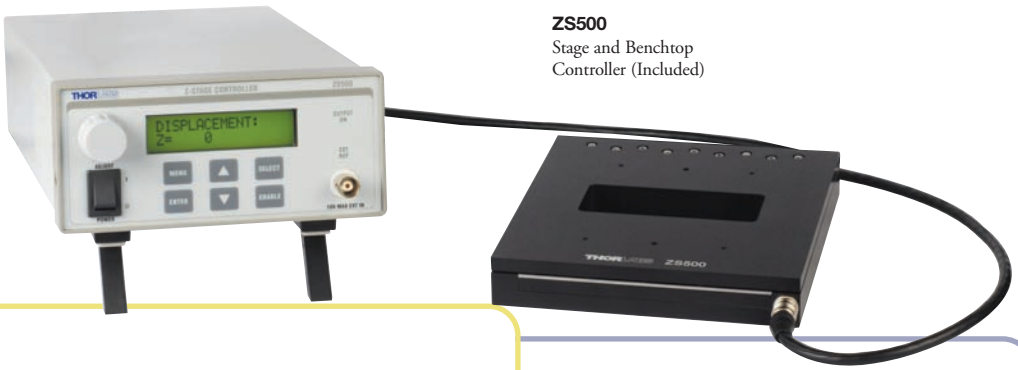
ActiveX® Controls allow apt™ motion control and alignment functionality to be incorporated quickly and easily into custom applications. ActiveX® Controls are pre-compiled software functional blocks (or components) that typically include both a graphical user interface (GUI) and programming (software function) interface. There are many such ActiveX® Controls available to the Windows software developer providing an enormous range of pre-compiled functionality for use in their own custom (or client) applications. The ActiveX® Controls supplied with the apt™ system provide all of the GUI and programmability required to operate and control the full range of apt™ controllers (T-Cube, benchtop, and rack-based variants). For example, the Motor ActiveX® Control provides a complete instrument panel allowing full manual control of our stepper motor driver units. In addition, the associated programming interface allows the software developer to automate the operation of the motor in an integration application.



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
LTS150	LTS150/M	$ 2,600.00	£ 1,802.50	€ 2.308,50	¥ 21,955.00	Integrated Long Travel Stage 6" (150 mm) Travel
LTS300	LTS300/M	$ 2,950.00	£ 2,045.00	€ 2.619,00	¥ 24,910.00	Integrated Long Travel Stage 12" (300 mm) Travel

Voice Coil Z-Translation Stage and Controller

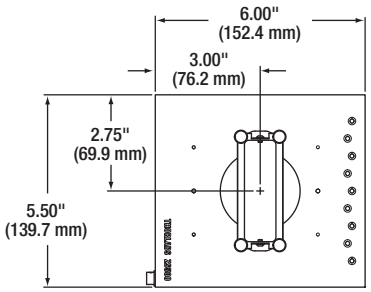
NEW product

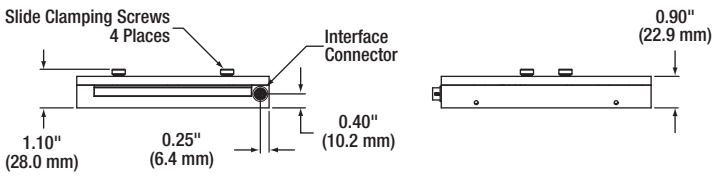


ZS500
Stage and Benchtop Controller (Included)

Features

- Motorized Z-Translation Stage Ideal for Microscopy Applications
- 2.0 mm Travel with Better Than 200 nm Resolution
- Compact Footprint (L x W x H): 6.0" x 5.5" x 0.9" (152.4 x 139.7 x 22.9 mm)
- Closed-Loop Feedback System
- Clear Aperture to Accommodate Standard Microscopy Specimen Slides





Please refer to our website for complete models and drawings.

Laser Microscopy Z-Stage

The ZS500 is a voice coil actuator stage that is capable of 2.0 mm travel with better than 200 nm resolultion and offers a minimum step size of less than 50 nm. The frictionless voice-coil and flexure stage are ideal for rapid movement of relatively heavy loads where speed, precision, and short settling times are required (i.e., microtitre plates). Our unique flexure design ensures repeatable linear movement. Stage motion is monitored in real time through a closed-loop feedback system based on an optical position sensor that allows for a high degree of accuracy.

The benchtop controller is included with the ZS500 stage. Through the controller, users can enable/disable the stage, translate the stage along the z-axis, and set step size and height limits for automated scanning. An analog input is included on the front panel of the controller so users can implement their own automation. The ZS500 is used in the new Thorlabs multi-channel video rate Confocal Microscope. The Confocal Microscope is featured in our Imaging section of this catalog.

The exceptionally long travel and high precision of the stage make it useful in fluorescence applications involving deconvolution, confocal, or multiphoton microscopy. When used in deconvolution applications, the superior speed of the voice coil stage in comparison to conventional stepper motor driven stages fascilitates high speed z-stepping. With today's high-speed digital cameras, this additional speed is useful in capturing rapid 3D images of live samples. The ZS500 offers an ideal combination of speed, travel, and precision, rivaling many piezo-driven focusing stages.

Coming Soon

Z-Translation Stages to Accomodate Ø35 mm Petri Dishes and Multi-Well Plates. Please see our website for details on this rapidly growing product line; search on ZS500 for the latest details on this product.

Specifications*	ZS500
Travel Range	2.0 mm
Step Resolution	<200 nm
Tilt/Yaw	<2 µrad
Max. Load Capacity	1.1 lbs (0.5 kg)
Stage Control Input	Analog via BNC
Input Signal	0 - 10.0 V
Operating Temperature	0 - 40 °C
Stage Housing	
Dimensions (L x W x H)	6.0" x 5.5" x 0.9"
Weight (Mass)	0.935 lbs (0.425 kg)
Material	Anodized Aluminum

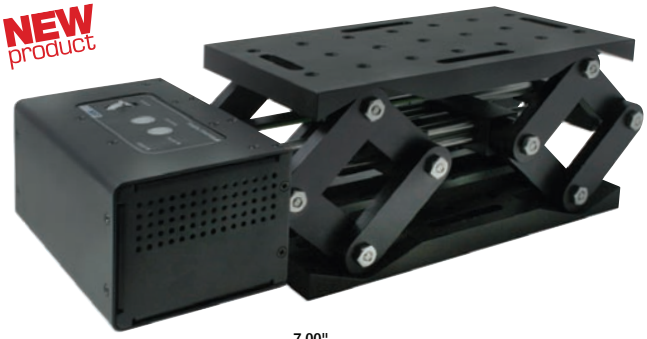
* All specifications are subject to change. Please refer to our website, www.thorlabs.com, or call for up-to-date details on this product.

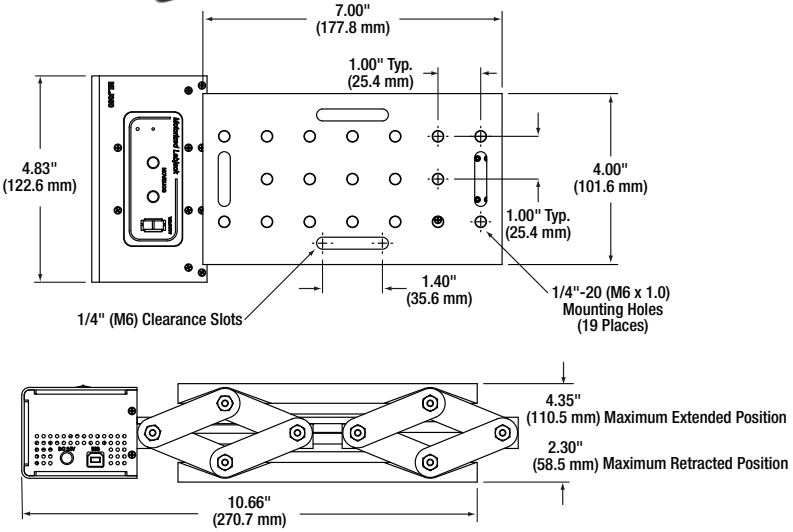
ITEM#	$	£	€	RMB	DESCRIPTION
ZS500*	$ 5,000.00	£ 3,467.00	€ 4.440,00	¥ 42,221.00	Z-Translation Stage with Benchtop Controller

*Universal Design

Motorized Lab Jack, 2" (50 mm) Vertical Travel

NEW product





Features

- Integral apt Controller with USB Interface
- Rugged, Dual Pantograph
- Large Array of Mounting Holes
- Power Supply Included

Specifications

- **Maximum Velocity:**
  - 1 mm/s at Loads <5.5 lbs (2.5 kg)
  - 0.5 mm/s at Loads <33 lbs (15 kg)
- **Max Load Capacity:** 33 lbs (15 kg)
- **Repeatability:** 5 µm
- **Travel Range:** 2.04" (52 mm)
- **Deck Parallelism:** <250 µm Over Full Range of Travel
- **Deck Pitch:** 0.04°

Controller Specifications

- **Voltage:** 24 VDC
- **Power:** 30 W (Peak)

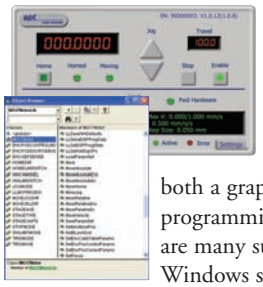
Mechanical Drawings Available on the WEB

The L490MZ is a stepper motor driven lab jack. It features an integrated electronic controller that can be controlled remotely using a PC with apt software suite (included) or manually via the buttons and velocity potentiometer on the control key pad. Parameter settings can be adjusted on the PC and stored in non-volatile memory within the unit itself. The next time the unit is powered up these settings are applied automatically. This is particularly useful when the unit is being used manually in the absence of a PC and USB link.

These motorized lab jacks provide a rugged, height adjustable platform ideal for mounting optomechanical sub-assemblies requiring height adjustment. Based upon the dual pantograph design of the manual L490, the L490MZ Motorized Lab Jack offers excellent rigidity and platform parallelism. The large 7" x 4" (180 mm x 100 mm) mounting platform supports up to 33 lbs (15 kg) with a smooth vertical adjustment range of 2" (50 mm). Both the top and bottom plates offer a generous array of 1/4"-20 (M6 x 1.0) tapped holes and clearance slots for general mounting requirements.

Integrated Controller for Remote and Local Control

The L490MZ features an integrated controller based on the TST001 (pages 556-557), which alllows for remote operation via USB and stand alone local conrol using easily accessible push button controls. All units are shipped with apt™ control software.



ActiveX® Controls allow the apt™ software suite to be incorporated quickly and easily into custom applications. ActiveX® Controls are pre-compiled software functional blocks (or components) that typically include both a graphical user interface (GUI) and programming (software function) interface. There are many such ActiveX® Controls available to the Windows software developer providing a large range of pre-compiled functionality for use in their own custom (or client) applications. The ActiveX® Controls supplied with the apt™ software suite provide all of the GUI and programmability required to operate and control the full range of apt™ controllers including the L490MZ.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
L490MZ	L490MZ	$1,950.00	£1,352.00	€ 1.731,00	¥ 16,466.00	Motorized Labjack 2" (50 mm) Travel

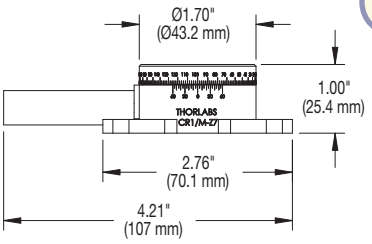
Motorized Rotation Stage

Receive a 10% Discount on the TDC001 When Ordering Both the CR1-Z7 and TDC001 Together (ITEM# CR1-7E)

- Continuous 360° Rotation with Low Backlash Design
- High-Torque, DC Servo Motor with Gear Head and Optical Encoder
- High-Count Optical Encoder (12,288 pulses/rev)
- Angular Readout in 2° Increments Plus a Vernier Scale Provides 10 arcmin Precision
- Application Tested to 25 lbs Vertical Load

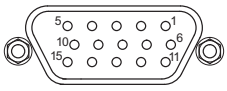
TDC001
DC Motor Controller
See Page 552

CR1-Z7E
Complete system rotation stage & DC Servo driver. See price box.



CR1-Z7
Motorized rotation stage only. See price box. Also available with a manual drive. See page 436.

Mechanical Drawings Available on the WEB



Pin	Description	Pin	Description
1	Ground	9	Not Connected
2	Forward Limit Switch	10	5 V Encoder Supply
3	Reverse Limit Switch	11	Encoder Channel A
4	Not Connected	12	Not Connected
5	Motor -	13	Encoder Channel B
6	Not Connected	14	Not Connected
7	Motor +	15	Not Connected
8	Not Connected		Not Connected

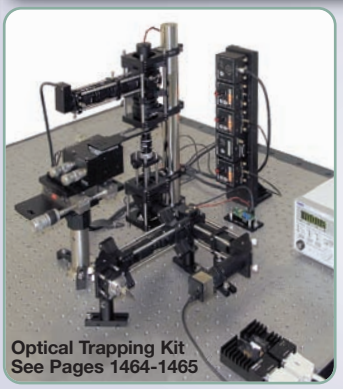
Motor Connector Pin Out

The CR1-Z7 motorized rotation stage offers high-precision, continuous motion in a sturdy, compact package. The backlash-free worm-gear design, coupled with a high-resolution optical encoder, provides the rotational precision required in optical laboratories. The high-torque 12 VDC Servo Motor supplies ample power for rotating vertical loads of up to 25 lbs.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
CR1-Z7	CR1/M-Z7	$ 813.60	£ 564.10	€ 722,40	¥ 6,870.10	Motorized Rotation Stage
CR1-Z7E	CR1/M-Z7E*	$ 1349.10	£ 935.30	€ 1.197,80	¥ 11,392.00	Rotation Stage with DC Servo Motor Controller
CR1A	CR1A/M	$ 19.30	£ 13.40	€ 17,20	¥ 163.00	Rotation Stage Adapter
TPS001**	TPS001**	$ 25.00	£ 17.40	€ 22,20	¥ 211.20	15 V Power Supply Unit for a Single T-Cube

*Price includes a 10% discount on the drive module, TDC001 Power Supply Included. **Universal Design, Imperial and Metric Compatible

Lab Automation Made Simple



Optical Trapping Kit
See Pages 1464-1465

T-Cube Automation Options

A compact and complete suite of instruments ideally suited to bring automation wherever it is needed.

- Laser Diode Controller
- TEC Controller
- Stepper Motor Driver
- DC Servo Motor
- Strain Gauge Reader
- Solenoid Controller
- Position Sensing Reader
- Fiber-Coupled Laser Sources
- NanoTrak Auto-Alignment Controller

APT Software

USB 2.0 Controller Hub

T-Cube: Automation Building Blocks Pages 542-547

Motorized High-Precision Rotation Mount for Ø1" Optics

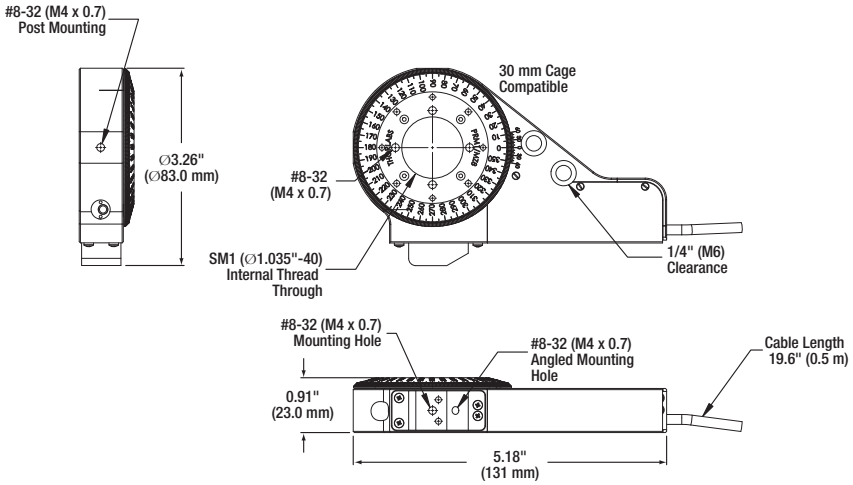
The PRM1-Z8 is a small, compact, motorized rotation stage that accepts Ø1" optics and is based on our popular PRM1 rotation mount (see page 260).

Rotation is driven via a DC servo motor that is equipped with a 67:1 gearbox and a rotary encoder for accurate closed-loop position control. The TDC001 DC Servo Controller is the ideal companion for achieving smooth, continuous motion, which can be automated via the software interface. The user can measure the angular displacement by using either the software interface or the Vernier dial in conjunction with the graduation marks that are etched on the rotating plate in 1° increments. The precision DC motor actuator provides 25 arcsec incrimental motion over the entire 360° of rotation. This rotation stage is also equipped with a precision home limit switch to facilitate automated rotation to the zero position, thus ensuring absolute angular positioning thereafter. The limit switch is designed to allow continuous rotation of the stage over multiple 360° cycles.

For complete flexibility, the stage can be mounted either vertically on a post or horizontally using an adapter plate (PRM1SP2).

Features

- 360° Coarse Rotation
- 1° Graduations on Main Dial
- Compact Design
- High Load Capabilities
- Precision Home Limit Switch
- Can be Used as a Stage or Rotation Mount
- Directly Accepts Ø1" Optics up to 0.50" (12.7 mm) Thick
- Fully Compatible with Our SM1 Lens Tubes Accessories (See Pages 123-135)



Specifications

- **Range:** 360° Continuous Rotation
- **Bidirectional Repeatability:** ±0.1°
- **Backlash:** ±0.3°
- **Rotational Velocity (Max):** 25°/s
- **On-Axis Load Capacity (Horizontal):** 1.5 kg
- **On-Axis Load Capacity (Vertical):** 0.5 kg*
- **Min Achievable Incremental Motion:** 25 arcsec
- **Absolute On-Axis Accuracy:** 0.1%
- **Percent Accuracy (Max):** 0.08%
- **Home Location Accuracy:** ±0.2°

** Measured centrally on axis, 50 mm off the platform*

Mechanical Drawings Available on the WEB

PRM1Z8E

Compact Motorized Rotation Stage with Servo Motor Controller and Power Supply

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
PRM1Z8*	PRM1/MZ8*	$ 820.00	£ 568.50	€ 728,10	¥ 6,924.10	Compact Motorized Rotation Stage
PRM1Z8E*	PRM1/MZ8E*	$ 1,355.00	£ 939.40	€ 1.203,00	¥ 11,442.00	Compact Motorized Rotation Stage w/ Servo Motor Controller
PRM1SP1	PRM1SP1/M	$ 40.00	£ 27.80	€ 35,60	¥ 337.80	Solid Adapter Plate
PRM1SP2**	PRM1SP2**	$ 40.00	£ 27.80	€ 35,60	¥ 337.80	Horizontal Mounting Plate
PRM1SP3**	PRM1SP3**	$ 40.00	£ 27.80	€ 35,60	¥ 337.80	Horizontal Mounting Riser Plate
SM1RR	SM1RR	$ 4.50	£ 3.10	€ 4,00	¥ 38.00	Additional Ø1" Retaining Ring

*One SM1RR retaining ring included with each unit.
** Imperial and Metric Compatible

NanoRotator™ 360° Stage

The NanoRotator™ rotation stage provides arcsecond resolution when driven from a microstepping stepper motor control. The low-profile design, just 2.17" (55 mm) high, is made possible by the use of two compact precision bearings. The rotating carriage of the stage provides continuous rotation of on-axis loads up to 110 lbs (50 kg) and has a Ø2" (Ø50 mm) clear aperture to allow a light source to pass directly through the stage.

The main body of the stage is made from an aluminum alloy and can attach directly to an optical table. Alternatively, it can be mounted at any orientation via the nine mounting holes provided along four surfaces of the device. A worm gear assembly is used to transfer the rotary motion of the stepper motor into rotary motion of the carriage. There is a mechanical reduction in this gear assembly that causes one revolution of the carriage for every 66 turns of the stepper motor.

The hybrid stepper motor used in the NR360S actuator is ideally suited for microstepping applications that require high resolution. The rotor, with 50 individual magnetic teeth, ensures smoother low-speed motion by allowing the discrete 1.8° step size associated with vibrational noise to be reduced to much smaller steps with inherently lower resultant vibrational noise.

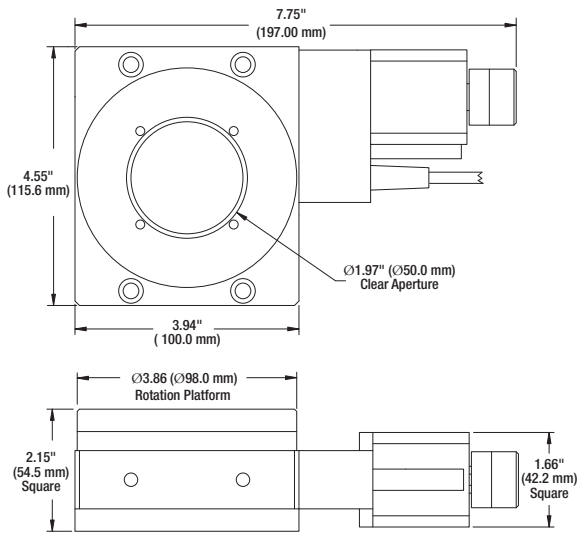
When used with the apt™ Series BSC101 Stepper Motor Controller (see page 559), the stepper motor provides 25,600 microsteps per revolution, resulting in a platform rotation of 0.213° x 10^{-3} (3.7 µrad) per microstep.

Features

- High Load Capacity
- Manual Control of the Rotating Carriage
- Preloaded Worm Gear Drive Mechanism with Minimal Backlash
- Origin Indicating Switch Every 360°

Specifications

- **Travel:** 360° of Continuous Rotation
- **On-Axis Load Capacity:** 110 lbs (50 kg)
- **Bidirectional Repeatability:** 10 arcsec
- **Min Achievable Incremental Motion:** <1 arcsec
- **Max Accuracy (over 10° Range)** 5 arcmin
- **Eccentricity (Run-Out) of Top Plate:** <50 µm
- **Max Speed:** 15°/sec
- **Max Torque:** 0.9 Nm
- **Construction:** Aluminum Body and Platform with Black Finish
- **Weight:** 3.1 lbs (1.4 kg)
- **Recommended Controller:** BSC101



Mechanical Drawings Available on the WEB

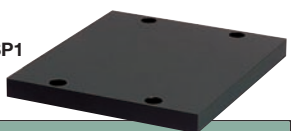
Rotation Stage with Stepper Motor Drive

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NR360S	NR360S/M	$ 2,425.00	£ 1,681.00	€ 2.153,00	¥ 20,477.00	Rotation Stage with Stepper Motor, Ø50 mm Center Hole

Table Spacer Plate for NR Series Rotation Stage

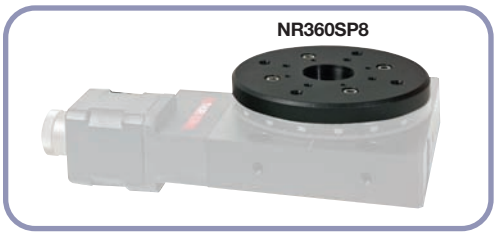
This adapter plate is used to mount the NR360S rotation stage to a large flat surface. The 10 mm thickness ensures that the stage sits flat to the mounting surface, providing clearance for the stepper motor that extends below the bottom surface of the stage.

NR360SP1



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NR360SP1	NR360SP1/M	$ 71.00	£ 49.30	€ 63,10	¥ 599.60	Adapter Plate for the NR360S

NR Series SM1-Compatible Adapter Plate



This adapter plate bolts to the top of the NR360S NanoRotator™ Stage. An SM1-threaded through hole allows Ø1" optics and Thorlabs' SM1 family of products to be mounted to the stage. Thorlabs' standard 30 mm cage assemblies can be attached via #4-40 taps.

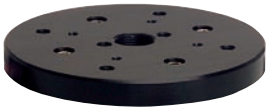
- SM1-Threaded Through Hole
- Four Each of #4-40 Taps, #8-32 Taps, 1/4"-20 Taps, and #8 (M4) Counterbores


NR360SP8

ITEM#	$	£	€	RMB	DESCRIPTION
NR360SP8	$ 48.00	£ 33.30	€€ 42,70	¥ 405.40	SM1-Compatible Adapter Plate for the NR360S Stage

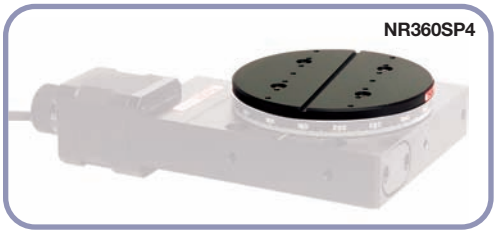
NR Series M16 Adapter Plate

This adapter plate is used to provide a number of different mounting options when attaching devices to our NR360S rotation stage. The mounting holes on the carriage consist of six 1/4"-20 (M6 x 1.0) through holes and four counterbores for #8-32 (M4 x 0.6) cap screws, all centered about a central M16 x 1.0 through hole.


NR360SP3

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NR360SP3	NR360SP3/M	$ 112.00	£ 77.70	€ 99,50	¥ 945.80	M16 Adapter Plate for the NR360S Stage

NR Series Grooved Adapter Plate



This adapter plate provides an easy means to integrate all of the miscellaneous accessories from our fiber launch product line, including optical mounts, tip-tilt mounts, and fiber holders. Please refer to page 496 for the complete selection of products.

Adapter Plate Shown with Waveguide and Fiber Accessories (See Pages 501-506)

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NR360SP4	NR360SP4/M	$ 112.00	£ 77.70	€ 99,50	¥ 945.80	Grooved Adapter Plate for the NR360S Stage

Vertical Mounting Bracket

The NR360SP2 Vertical Mounting Bracket allows the NR360S NanoRotator™ Stage to be mounted in a vertical orientation. The bracket can be attached to an optical table or breadboard using the seven 1/4"-20 (M6 x 1.0) mounting holes.

The photograph to the right shows the NR360SP2 with a NanoRotator NR360S.

Mechanical Drawings Available on the WEB


NR360SP2

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NR360SP2	NR360SP2/M	$226.00	£156.70	€ 200,70	¥ 1,908.40	Verticle Mounting Bracket

NR Series Adapter Plates

NR360SP5
Bottom Mounting Adapter

The NR360SP5 allows the NR360S NanoRotator™ to be mounted directly to any LNR or NRT stage. The LNR stage is found on pages 432-433, while the NRT stage is found on pages 454-455.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NR360SP5	NR360SP5/M	$ 89.00	£ 61.70	€ 79,10	¥ 751.60	Mounting Adapter Plate

Motorized, Large-Platform Goniometers

Goniometers are similar to linear stages, but, rather than providing linear movement, the stage partially rotates about a fixed point above the mounting surface of the stage. The distance from the point of rotation to the mounting surface was designed so that two different goniometer models may be stacked in an X-Y configuration and both stages will rotate about the same point.

Our motorized goniometers feature the same specifications as the manual GNL series featured on page 439, but the micrometers have been replaced with the Z812 DC Servo Motor Actuators, giving the user an automated solution. Our Z8 Series Motorized Actuators offer high resolution in a lightweight, compact package, which makes them ideally suited for demanding optical laboratory automation applications. The Z812 delivers 12 mm of travel, and commercial limit switches have been added to provide overdrive protection and accurate home positioning. The motor in the Z8 provides higher torque than the old Z7 models, allowing the gearbox ratio to be reduced and increasing the motion velocity to 3 mm/s compared to 0.4 mm/s for the Z7. The precision of the encoder is also higher (512 counts/rev instead of 48), which compensates for the gearbox reduction. For more information about our Z8 Series of Actuators, please see page 534.

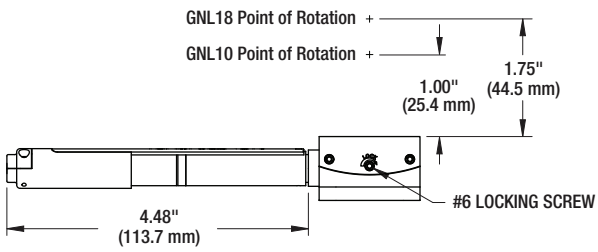
Actuator Specifications

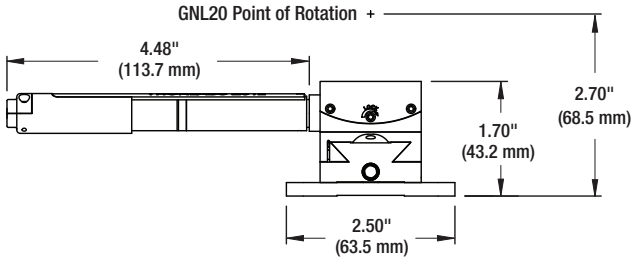
- **Travel Range of Z812:** 0.5" (12 mm)
- **Maximum Velocity:** 3 mm/sec
- **Bidirectional Repeatability:** <1.5 µm
- **Backlash (with Preload) of Z812:** <6 µm
- **Min Achievable Movement:** 0.05 µm
- **Max On-Axis Load (Vertical):** 10 lbs (4.5 kg)
- **Max On-Axis Load (Horizontal):** 20 lbs (9 kg)
- **Home Location Accuracy:** <2 µm
- **Leadscrew Pitch:** 1 mm
- **Encoder Lines:** 512
- **Planetary Gear Head Ratio:** 67:1
- **Recommended Controller:** TDC001, See Pages 552-553

Goniometer Specifications

- **Distance to Point of Rotation from Top Surface**
  - 1.00" (25.4 mm) for GNL10-Z8 and GNL20-Z8
  - 1.75" (44 mm) for GNL18-Z8
- **Rotation:**
  - GNL10-Z8: ±8°
  - GNL18-Z8: ±5°
  - GNL20-Z8: ±8° & ±5° for Top & Bottom Stages Respectively
- **Accuracy:** 10 arcmin
- **Load Capacity:** 0.50 lbs (0.23 kg)

Mechanical Drawings Available on the WEB





Please refer to our website for complete models and drawings.

Manual Goniometers
See Our Manual Stages Chapter for Details on these Specialized Products
Motorized Goniometers
See Page 439

Manual Goniometers

These motorized goniometers are also available with manual drives, please see our complete selection of manual goniometers in the goniometers section of the manual stages chapter.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
GNL10-Z8	GNL10/M-Z8	$ 601.20	£ 416.80	€ 533,80	¥ 5,076.60	Large, Motorized Goniometer - 1" Virtual Point
GNL18-Z8	GNL18/M-Z8	$ 612.90	£ 424.90	€ 544,20	¥ 5,175.40	Large, Motorized Goniometer - 1.75" Virtual Point
GNL20-Z8	GNL20/M-Z8	$ 1,193.40	£ 827.30	€ 1.059,60	¥ 10,078.00	Large, Dual-Axis Motorized Goniometer Pair

Multi-Axis Platforms

Three-Axis Roller Bearing Platforms

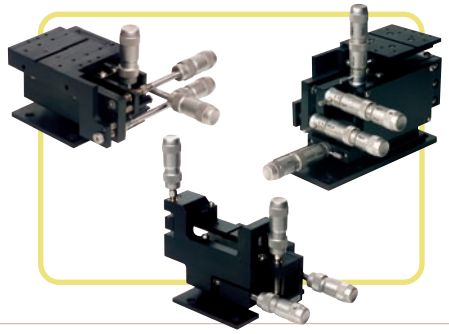
- X, Y, and Z Translation
- RollerBlock™ 0.5" (13 mm) Travel Stage

See Pages 466-467

Three-Axis Flexure Platforms

- X, Y, and Z Translation
- PiezoBlock 90 µm Travel XYZ Translator
- MicroBlock™ 0.16" (4 mm) Travel Stage with Manual Actuators
- NanoMax™ 0.16" (4 mm) Travel Stage with Manual, Stepper Motor, or Piezo Actuators

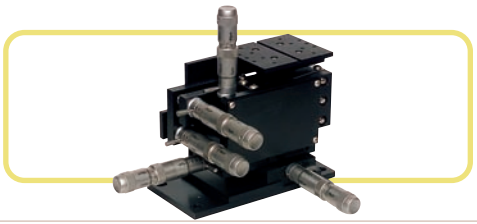
See Pages 468-483



Four-Axis Flexure Platforms

- Two Translational, Two Rotational Degrees of Freedom
- MicroBlock™ 4-Axis Low Profile Stage, 2.46" (62.5 mm) Deck Height
- MicroBlock™ 4-Axis Stage, 2.46" (62.5 mm) Deck Height
- NanoBlock™ 4-Axis Stage, 4.43" (112.5 mm) Deck Height

See Pages 484-486



Five-Axis Flexure Platforms

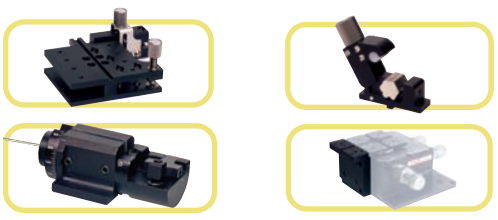
- Three Translational, Two Rotational Degrees of Freedom
- NanoBlock™ 5-Axis Stage, 4.43" (112.5 mm) Deck Height

See Page 487

Six-Axis Flexure Platforms

- Three Translational, Three Rotational Degrees of Freedom
- NanoMax™ 0.16" (4 mm) Travel Stage with Manual, Stepper Motor, or Piezo Actuators

See Pages 488-495



Flexure Stage Accessories

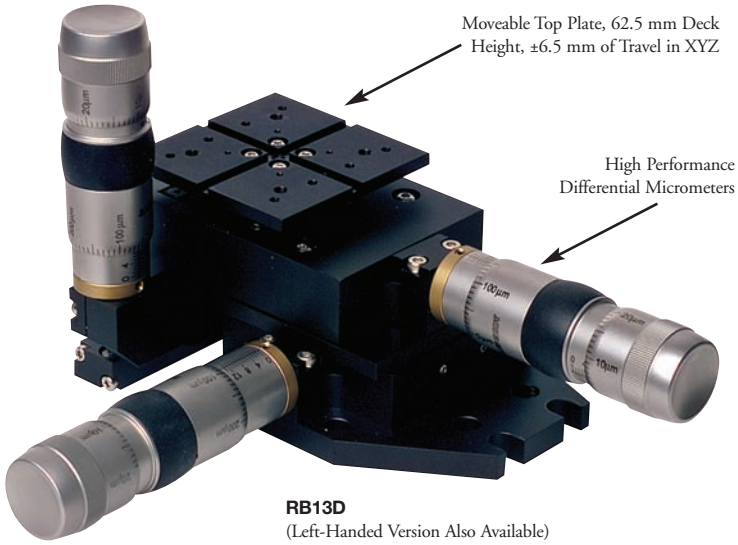
- Bare Fiber Holders and Rotators
- Adapter Plates
- Optic Mounts
- Kinematic Platforms

See Pages 496-512

1/2" (13 mm) Travel Three-Axis RollerBlock™ Platforms (Page 1 of 2)

The combination steel and aluminum construction of the RollerBlock™ translator is ideally suited for a broad range of photonics applications. The cross-roller-bearing design provides a vertical load capacity of 9.7 lbs (4.4 kg) while maintaining the submicron resolution provided by the high-precision actuators. The integrated XYZ design, compared with other modular approaches, provides a more compact stage, which enables this three-axis translator to meet the performance demands of many positioning applications over the entire 0.5" (13 mm) translation range. Compared to translation stages constructed from stacking single axis stages, the unibody approach with steel construction provides improved product lifetime as well as enhanced thermal stability.

The moveable deck has a full 0.5" (13 mm) of travel in three orthogonal directions and includes mounting features that allow our full line of optical mounting accessories (see page 496) to be directly attached to its surface. The deck height of this compact stage matches the 2.46" (62.5 mm) deck height of our flexure-based translation stages featured on page 468. Utilizing this standard deck height allows this longer travel stage to be incorporated into complex optical systems built around our popular flexure based stages that comprise our PiezoBlock™, MicroBlock™, and NanoMax™ series. One simple example of this cross-series compatibility is shown in the photograph on the bottom of the next page.

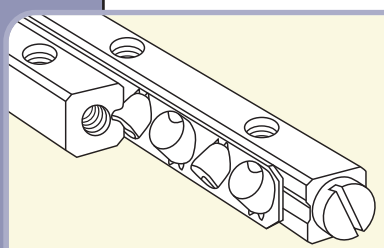


RB13D
(Left-Handed Version Also Available)

Features

- Cross-Roller-Bearing Design
- High-Load Capacity
- Hardened Steel Construction on all Wear Surfaces for Excellent Long Term Stability
- Extensive Line of Accessories Available
- Compact, Modular Design
- Available in Left- or Right-Handed Versions
- Bearing Surfaces Protected to Reduce Wear

Mechanical Drawings Available on the WEB

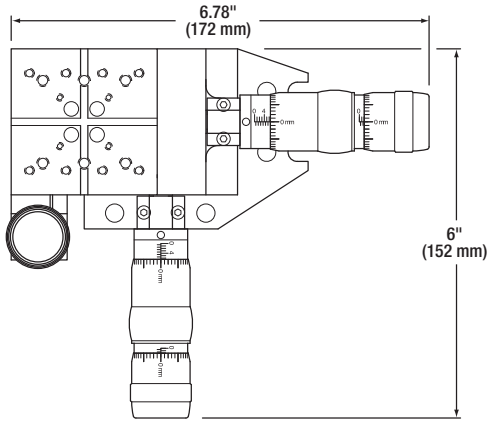


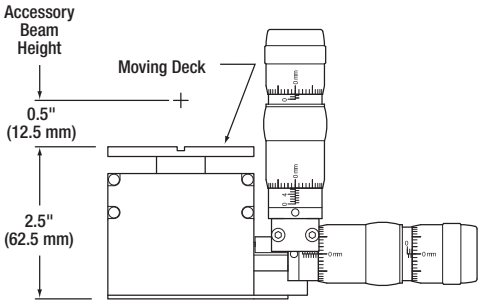
The RollerBlock™ XYZ translation stage features cross-roller-bearing assemblies that ensure low stiction for true submicron resolution. An adjustable preload virtually eliminates all unwanted side play.

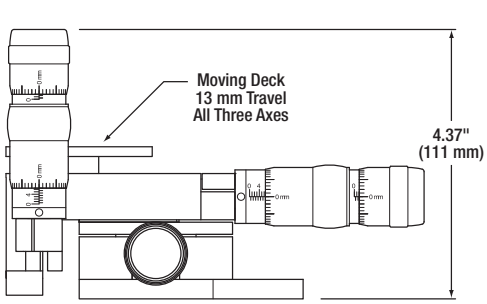
Differential Drive RollerBlock™

- **Manual Travel:** 0.5" (13 mm) in XYZ Directions
- **Coarse Adjustment Range:** 0.5" (13 mm)
- **Coarse Adjustment Pitch:** 0.5 mm (0.02")
- **Fine Adjustment Range:** 300 µm
- **Fine Adjustment Pitch:** 0.05 µm
- **Deck Height:** 2.46" (62.5 mm)
- **Load Capacity:** 9.7 lbs (4.4 kg)

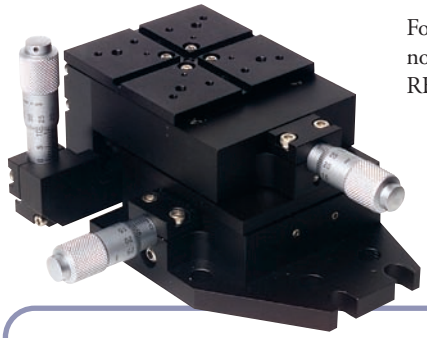
Please refer to our website for complete models and drawings.







1/2" (13 mm) Travel Three-Axis RollerBlock™ Platforms (Page 2 of 2)

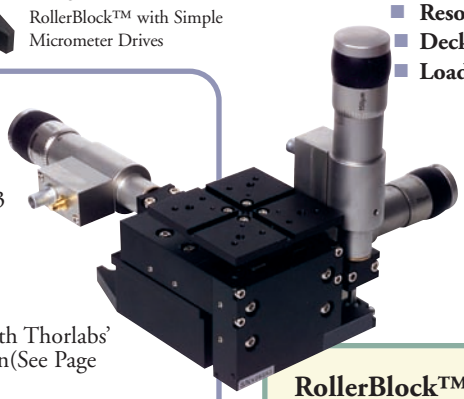


RB13M
RollerBlock™ with Simple Micrometer Drives

For applications that require high stability and high load capacity but do not require the high resolution of our performance actuators, the model RB13M is an ideal choice.

Micrometer Drive RollerBlock™

- **Manual Travel:** 0.5" (13 mm) in XYZ Directions
- **Resolution:** 10 µm/graduation
- **Deck Height:** 2.46" (62.5 mm)
- **Load Capacity:** 9.7 lbs (4.4 kg)



RollerBlock™ with Piezo Assisted Micrometers

30 µm Piezoelectric Assisted RollerBlock™

- **Manual Micrometer Drive:** 0.5" (13 mm) Travel, 5 µm/graduation
- **Piezoelectric Range:** 30 µm @ 75 V
- **Piezoelectric Resolution:** 10 nm with Thorlabs' Controller in Closed-Loop Operation(See Page 568)

For applications requiring very precise positional control, the manual drives can be replaced with piezo-adjusted differential micrometers (DRV517, see page 529). With these drives, the stage provides submicron manual resolution that is supplemented with 10 nm piezoelectric resolution. Our high-performance piezoelectric controllers are an ideal companion product for this stage (see pages 568 for details).

RollerBlock™ Adapter Plate, 1/4"-20 (M6 x 1.0) and #8-32 (M4 x 0.7)

RB13P1

- Convert the RollerBlock into a General Purpose Optical Table Translator
- Easily Replaces Slotted Top Plate via Four Mounting Screws.

This optional mounting plate has a generous array of mounting holes to adapt the RollerBlock to general purpose optical table applications.

13 mm Travel RollerBlock™ Stages Available with Micrometers, Differential Adjusters and 30 µm Piezos

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
RB13D	RB13D/M	$ 2,610.00	£ 1,809.50	€ 2.317,00	¥ 22,039.00	3-Axis RollerBlock™ with Differential Micrometers
RB13M	RB13M/M	$ 1,325.00	£ 918.60	€ 1.176,40	¥ 11,189.00	3-Axis RollerBlock™ with Micrometers
RB13P1	RB13P1/M	$ 48.40	£ 33.60	€ 43,00	¥ 408.70	1/4"-20 (M6 x 1.0) and #8-32 (M4 x 0.7) Adapter Plate

Question

Can I build a complete fiber launch system using the RollerBlock™ translator?

Answer

Yes! As shown in the picture to the left, you can build a complete fiber launch system using the RollerBock™ translator. You will need the parts from the list below.

Parts List

Item#	Description/Function	Page #
RB13D	13 mm Translation Stage	467
HFV001	Optical Fiber Clamp	501
HCS013	Microscope Objective Holder	499
AMA025	Fixed Height Platform	498
RMS10X	Microscope Objective	804

90 µm Travel Three-Axis PiezoBlock™ Platforms

APB301

The PiezoBlock™ 3-axis flexure platform provides a compact solution to 3-axis piezo driven nanopositioning. It measures just 2.36" (60 mm) on each side and offers 90 µm of piezoelectric controlled displacement in three orthogonal directions.

The relatively long piezoelectric controlled travel is engineered using a large displacement piezo stack that is mechanically multiplied to provide 90 µm of travel. This internal flexure-based mechanism intrinsically possesses very low friction and high stiffness, allowing the PiezoBlock™ to be positioned with low settling time and high repeatability.

The drive voltage required for the full range of travel is 75 V, while the displacement resolution is typically limited by the piezoelectric driver that is used to power the actuators. The PiezoBlock™ has been tested interferometrically with our BPC203 piezoelectric driver (see page 568) to verify the 25 nm resolution specification. We offer a number of other drive options, from simple open-loop drivers to closed-loop auto-alignment systems that allow automated control for a nanopositioning applications. All of these options are featured in the Drive Electronics section that begins on page 541.

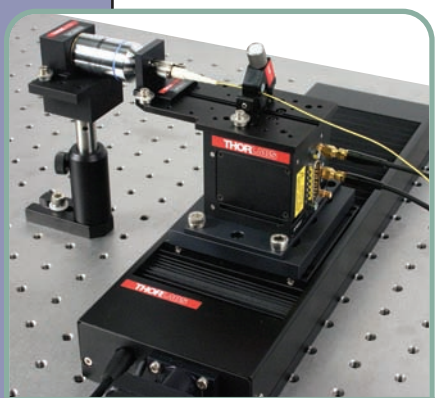
The stage is fitted with the same grooved top plate as our MicroBlock™ and NanoMax™ platforms, to allow for rapid system reconfiguration. An extensive selection of accessories for the PiezoBlock™ can be found starting on page 496.

Features

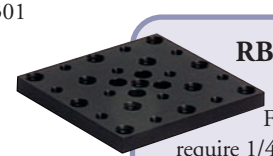
- Three Mounting Surfaces, Top Plate and Two Sides (Not Shown)
- Grooved Top Plate for Full Range of Mounting Accessories
- Small, Compact Package
- Flexure-Based Design Offers Smooth Continuous Motion and High Stiffness
- High Resonant Frequency Provides Immunity to External Vibrations
- Optional Strain Gauge Displacement Sensor

Specifications

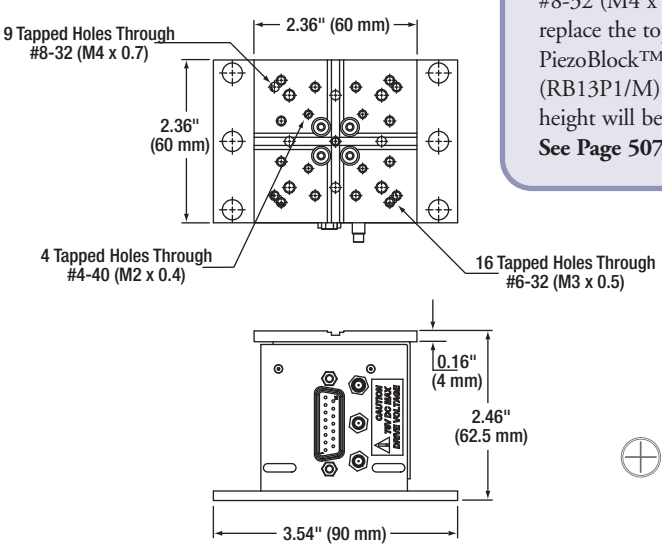
- **XYZ Travel Range:** 90 µm
- **Deck Height:** 2.46" (62.5 mm)
- **Optical Height:** 2.95" (75 mm)
- **Load Capacity:** 2.2 lbs (1 kg) Centered on Top Surface in Horizontal Orientation
- **Resolution:** 25 nm (with Displacement Sensors)
- **Resonant Frequency:** >150 Hz
- **Repeatability:** 50 nm (APB301 Closed-Loop)
- **Stiffness:** 0.3 N/µm
- **Thermal Stability:** 1 µm/°C
- **Electrical Connectors:** 3 SMC
- **Piezo Drive Voltage:** 0 - 75 V
- **Weight:** 0.7 lb (0.3 kg)
- **Dimensions:** 2.2" x 2.2" x 2.2" (55 mm x 55 mm x 55 mm) Excluding Adapter Plate
- **Transfer Function:** 1.33 µm/V

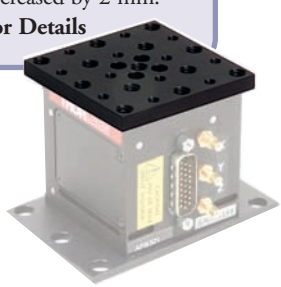


The fiber launch application photo above shows an APB301 PiezoBlock™ mounted on an NR150 150 mm travel stage (using an APBP2 adapter plate). The top plate of the PiezoBlock™ can be replaced with one of our platform extension plates (AMA005 shown, see page 497). This extended mounting surface is convenient for attaching extra components and allows easier access into smaller spaces.



RB13P1 (RB13P1/M) Adapter Plate:
For applications that require 1/4"-20 (M6 x 1.0) and #8-32 (M4 x 0.7) mounting holes replace the top plate of the PiezoBlock™ with an RB13P1 (RB13P1/M) top plate. The deck height will be increased by 2 mm.
See Page 507 for Details





Mechanical Drawings Available on the WEB

Please refer to our website for complete models and drawings.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
APB302	APB302/M	$ 1,995.00	£ 1,383.00	€ 1.771,00	¥ 16,846.00	PiezoBlock™ 3-Axis Translator without Feedback
APB301	APB301/M	$ 3,250.00	£ 2,253.00	€ 2.885,50	¥ 27,444.00	PiezoBlock™ 3-Axis Translator with Feedback
APBP2*	APBP2*	$ 56.60	£ 39.30	€ 50,30	¥ 478.00	Adapter Plate for Mounting to NRT Linear Stages

*Compatible with Metric and Imperial

4 mm Travel, Three-Axis MicroBlock™ Flexure Platform

The smooth, continuous motion provided by the MicroBlock™ 3-axis platform makes this device ideally suited for almost any micropositioning application. An innovative flexure design provides three orthogonal directions of linear travel without the severe limitations of kinetic or static friction that are found in traditional bearing based stages.

The use of nested flexure plates allows the platform to operate indefinitely without needing any lubricant, which is one of the primary sources of drift within positioning devices. In addition, the flexure spring design allows considerable tolerance to shock and vibration, even when fully loaded.

The central keyway that extends across the surface of the moving top plate allows rapid system reconfiguration while maintaining alignment. An extensive selection of accessories for the MicroBlock™ system can be found on pages 496-512.

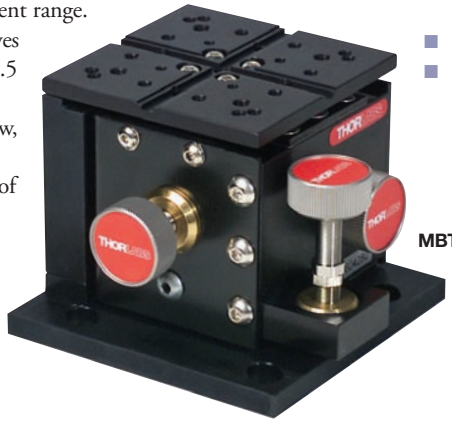
The platform is offered preconfigured with a choice of two actuator options. The differential adjusters (MBT616) provide 50 nm resolution over the 300 µm fine adjustment range. The thumbscrew drives (MBT602) provide 0.5 mm of travel per revolution of the screw, giving a calculated positional resolution of around 0.5 µm.

MBT616
Patent 6,186,016

75 mm x 75 mm x 62.5 mm

Features

- Flexure Design Ensures Smooth, Continuous Motion
- Compact Design: 62.5 mm from the Table to the Moving Platform, and 75 mm from the Table to the Optical Axis of the Accessories
- No Sliding Parts to Minimize Friction
- Flexure Design Enhances Long-Term Stability



MBT602

Specifications

- **XYZ Travel:** 4 mm
- **Deck Height:** 62.5 mm
- **Optical Height:** 75 mm
- **Crosstalk:** <20 µm/mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters:**
  - Coarse Adjust 0.5 mm/rev
  - Fine Adjust 50 µm/rev
- **High Resolution Actuators:** 50 nm Over the 300 µm Fine Adjustment Range – Provided by Our Patented Concentric Conical Drive Design
- **Thumbscrew Drives:** 0.5 mm/rev
- **Mechanical Stability:** Flexure Design Utilizes Nested Flexure Plates to Minimize Mechanical Drift
- **Load Capacity:** 2.2 lbs (1 kg)

RB13P1 Adapter Plate: This replacement top plate has an array of both 1/4"-20 (M6 x 1.0) and #8-32 (M4 x 0.7) mounting holes to adapt the stage for general purpose optical table applications.

See Page 507 for Details

MBT616 Shown with RB13P1 Adaptor Plate

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MBT602	MBT602/M	$ 745.00	£ 508.40	€ 661,50	¥ 6,290.80	MicroBlock™ 3-Axis Positioner with Fine Thread Thumbscrew
MBT616	MBT616/M	$ 1,025.00	£ 699.50	€ 910,10	¥ 8,655.20	MicroBlock™ 3-Axis Stage with High Resolution Drives

Preconfigured Fiber Launch System

We offer numerous free-space to fiber launch systems which use bare fiber clamps, FC connector adapters, GRIN lens holders, and mircoscope objective holders.

See Page 910

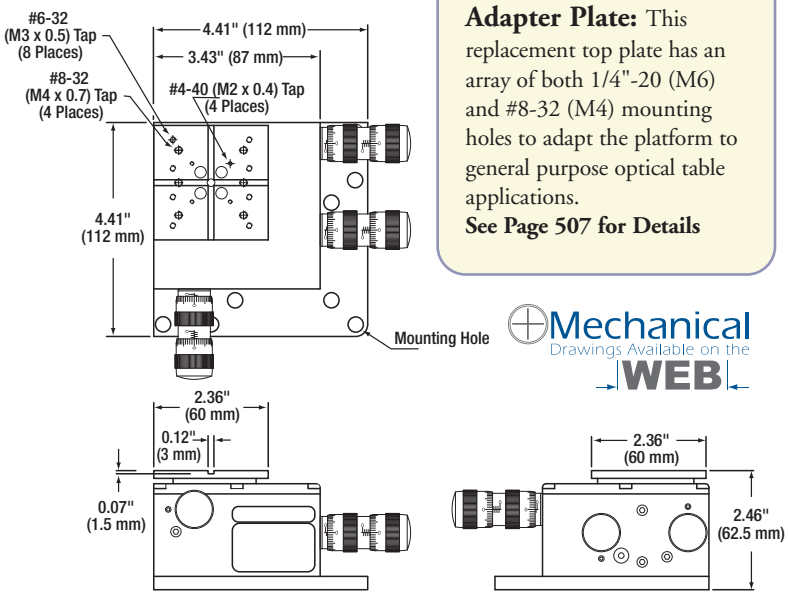
4 mm Travel, NanoMax™ with Micrometers

Moving Top Plate Provides 4 mm of Travel in XYZ directions.

All 3 actuators are directly attached to the base (fixed portion of the stage body).

MAX313
Patents 6,186,016 and 6,467,762

RB13P1
Adapter Plate: This replacement top plate has an array of both 1/4"-20 (M6) and #8-32 (M4) mounting holes to adapt the platform to general purpose optical table applications.
See Page 507 for Details



Mechanical Drawings Available on the WEB

Please refer to our website for complete models and drawings.

The MAX313 is the manual version of our NanoMax™ series three-axis platform. It provides an unmatched combination of high stability and high resolution. Major improvements in performance, functionality, and robustness have been achieved by the patented parallel flexure design. This design has the unique feature that all three actuators are connected directly to the base, thus providing a degree of rigidity unachievable in multi-axis systems built from a series of stacked single axis stages.

The advantages of the MAX300 Series parallel flexure design are readily apparent when implemented in alignment applications requiring submicron resolution. With a multi-axis stacked stage, touching one of the two drives that are not referenced to the base will result in unwanted motion within the assembly. With each of the drives coupled directly to the base of the NanoMax™ series platforms, these adverse effects are eliminated.

See Page 496

The NanoMax™ series 3-axis platforms can be easily configured to meet the ever changing requirements of both research and manufacturing. We offer a series of different actuator options such as manual drives, stepper motors, and piezo-electric actuators with internal strain gauge displacement sensors. Additionally, we offer over 50 different component devices that are designed to interface with the 3 mm wide keyway that is machined into the top deck of the stage (see page 496).

Specifications

- **XYZ Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters:**
  - Coarse Adjust: 0.5 mm/rev
  - Fine Adjust: 50 µm/rev
- **High Resolution Manual Drives:** Patented Drive Design Provides 50 nm of Fine Control Resolution Over a Total Range of 300 µm
- **Crosstalk:** Maximum 20 µm/mm of Travel
- **Repeatability:** 500 nm RMS Bidirectional
- **Load Capacity:** 2.2 lbs (1kg)
- **Resonant Frequency (±10%):** 375 Hz, with No Load on the Stage; 200 Hz with a 275 g Load, and 150 Hz with a 575 g Load
- **Weight:** 2.2 lbs (1 kg)
- **Deck Height:** 62.5 mm From the Bottom Surface of the Stage to the Moving Platform. The Accessory Beam Height is 75 mm from the Bottom of the Stage

Preconfigured Fiber Launch Systems

The 3 Axis NanoMax™ stages are ideal for fiber coupling applications, to save time, we have assembled complete launch systems that are configured to meet many of the most common laboratory applications

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX313	MAX313/M	$ 1,535.00	£ 1,064.00	€ 1.363,00	¥ 12,962.00	NanoMax™ Stage with Differential Micrometer Drives

4 mm Travel, NanoMax™ with Piezos

The MAX311 and MAX312 platforms have all the same features as the MAX313 with the added benefit of internal piezoelectric actuators. Additionally, the MAX311 has a strain gauge based displacement sensor incorporated into the piezoelectric actuator.

The internal actuators are built directly into the base and provide a 20 µm travel range in three directions. The MAX312 has a positional resolution of 20 nm, while the resolution of MAX311 is 5 nm due to the feedback from the strain gauge sensors. These resolutions were calculated based on using our BPC203 Piezo Controller. The resolution is limited by the noise characteristics of the controller, therefore use of a third party controller may result in a degradation in the positional resolution.

The strain gauge sensors improve the resolution by providing a voltage signal that is linearly proportional to the displacement of the piezoelectric element. When used with a closed-loop controller, like the BPC203, it is possible to compensate for hysteresis, creep, and thermal drift and improve the resolution.

Mechanical Drawings Available on the WEB

Displacement Sensor

The strain gauge displacement sensor, directly attached to the body of the piezoelectric element, provides an analog signal that is proportional to its displacement. When combined with low-noise electronics, the resolution obtained is better than 5 nm.

All 3 actuators are directly attached to the base (fixed portion of the stage body).

SMC Piezo Connector Cables Included

MAX311
Patents 6,186,016 and 6,467,762

Specifications

- **Manual Travel:** 0.16" (4 mm) in XYZ Direction
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters:**
  - Coarse Adjust: 0.5 mm/rev
  - Fine Adjust: 50 µm/rev
- **Piezoelectric Travel:** 20 µm in XYZ Directions
- **Manual Drive Resolution (Calculated):** 50 nm Resolution over a 300 µm Travel Range
- **Piezo Resolution (Calculated):** 5 nm (with Internal Piezo Displacement Sensors), 20 nm (without Sensors)
- **Max Piezoelectric Drive Voltage:** 75 VDC
- **Crosstalk:** Maximum 20 µm/mm of Travel
- **Repeatability:** 500 nm RMS Bidirectional
- **Load Capacity:** 2.2 lbs (1kg)
- **Resonant Frequency (±10%):** 375 Hz (No Load), 200 Hz (275 g Load), 150 Hz (575 g Load)
- **Weight:** 2.2 lbs (1 kg)
- **Deck Height:** 2.46" (62.5 mm) from the Bottom Surface of the Moving Platform. The Accessory Beam Height is 2.95" (75 mm) from the Bottom Surface of the Stage

Note: All measurements related to the performance of the piezoelectric actuators are made with the Thorlabs model BPC203 Piezo Driver, which can be found on page 568.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX312	MAX312/M	$ 2,020.00	£ 1,400.50	€ 1.793,50	¥ 17,057.00	NanoMax™ Stage with Piezoeletric Actuator
MAX311	MAX311/M	$ 2,785.00	£ 1,930.50	€ 2.472,50	¥ 23,517.00	NanoMax™ Stage with Piezoeletric Actuator and Sensor

4 mm Travel, NanoMax™ with Stepper Motors (Page 1 of 2)

Features

- Submicron Resolution Stepper Motor Drives
- Optional Piezo Drives
- Flexure Design Ensures Smooth, Continuous Motion
- Compact Design – 62.5 mm (2.46") from the Table to the Moving Deck, and 75 mm (2.95") from the Table to the Optical Axis of the Accessories
- No Kinetic or Static Friction
- Enhanced Long-Term Stability
- Unparalleled Stability

Specifications

- **XYZ Travel:** 0.16" (4 mm)
- **Max Velocity:** 2.5 mm/sec
- **Max Acceleration:** 4 mm/sec^2
- **Backlash:** <7.0 µm
- **Min Achievable Incremental Movement:** 0.06 µm
- **Absolute On-Axis Accuracy:**
  X-Axis: 43 µm
  Y-Axis: 66 µm
  Z-Axis: 278 µm
- **Max Percentage Accuracy:**
  X-Axis: 4.2%
  Y-Axis: 4.35%
  Z-Axis: 10.4%
- **Bidirectional Repeatability:** 0.5 µm
- **Home Location Accuracy:** ±1.5 µm
- **Thermal Stability:** 1 µm/°C
- **On-Axis Load Capacity:** 2.2 lbs (1 kg)
- **Resonant Frequency (±10%):**
  375 Hz (No Load), 200 Hz (275 g Load), 150 Hz (575 g Load)
- **Weight:** 2.2 lbs (1 kg)
- **Deck Height:** 2.46" (62.5 mm) from the Bottom Surface of the Moving Platform. The Accessory Beam Height is 2.95" (75 mm) from the Bottom Surface of the Stage

Stepper Motor Specification

- **Step Angle:** 1.8°
  (50 poles and ±2 phases for 360° Divided by 200, or 1.8°)
- **Step Accuracy:** 5%
- **Rated Phase Current:** 1 A
- **Phase Resistance:** 4.6 Ω
- **Phase Inductance:** 10.6 mH
- **Holding Torque:** 23.1 N·cm
- **Detent Torque:** 1.7 N·cm
- **Operating Temperature:** -20 to 40 °C
  (Motor Specification Only)

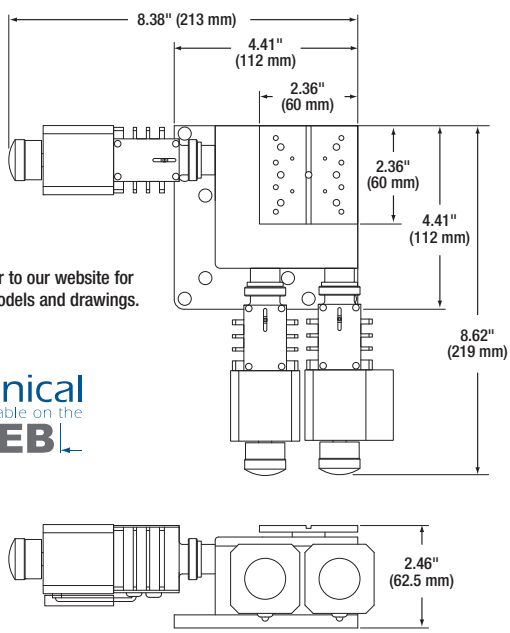
For applications requiring fast precision positioning, the NanoMax™ platforms described on the previous pages are offered here with stepper motor drives. These platforms offer
all of the advantages of the patented parallel flexure design, coupled with improved positioning resolution and repeatability, as well as increased speed. A piezo drive option is also available, either with or without strain gauge feedback.

The DRV001 Stepper Motors used in the MAX343 stage have a rotor that consists of 50 individual magnetic teeth that are ideally suited for micro-stepping applications. Aside from the increase in resolution provided by increasing the steps per revolution from the standard 200 to 25,600 with BSC series controllers, microstepping also ensures smoother low-speed motion by producing 128 steps per standard 1.8° step, which significantly reduces the vibrational noise inherent when using the 1.8° steps. Together this gives the stage a minimum step size of 0.06 µm.

The use of a trapezoidal leadscrew in the stepper motor drive assembly provides a number of benefits over the more common Acme style thread. The benefits include improved durability, lower friction due to improved surface quality, and nearly no backdrive, thus eliminating the need for a braking mechanism.

Please refer to our website for complete models and drawings.

Mechanical Drawings Available on the WEB



4 mm Travel, NanoMax™ with Stepper Motors (Page 2 of 2)

The MAX341 features internal piezoelectric actuators built directly into the body of the platform, providing a 20 µm travel range with a positional resolution of 20 nm. The MAX341 has three strain gauge displacement sensors, providing a voltage signal that is linearly proportional to the displacement of the piezoelectric element. This signal is used to compensate for the hysteresis, creep, and thermal drift that is inherent in all piezoelectric elements. If used with a BPC203, the piezoelectric actuator can be controlled in a closed-loop feedback mode that results in a resolution of 5 nm.

MAX341
Patented 6,467,762

Piezo Specifications on MAX341

- **Piezoelectric XYZ Travel:** 20 µm
- **Piezoelectric Actuator Resolution:** 5 nm
- **Bidirectional Repeatability:** 0.05 µm
- **Absolute On-Axis Accuracy:** 1.0 µm
- **Max Piezoelectric Drive Voltage:** 75 VDC

Note: All measurement related to the performance of the piezoelectric actuators are made with the Thorlabs BPC203 Piezo Driver, which can be found on page 568.

Mix-and-Match Drives

Does your application require two stepper motors and one manual drive or some other combination of options? Please see page 482 to configure a stage to your specific needs.

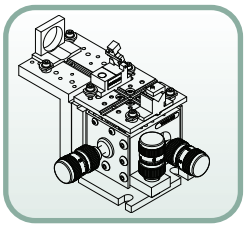
Displacement Sensor

PIN 1: +15V
PIN 2: OSCILLATOR+
PIN 3: 0V
PIN 4: SIG OUT-
PIN 5: SIG OUT+
PIN 6: -15V
PIN 7: TRAVEL

The strain gauge displacement sensor, directly attached to the body of the piezoelectric element, provides an analog signal that is proportional to its displacement. When combined with low-noise electronics, the resolution obtained is better than 5 nm.

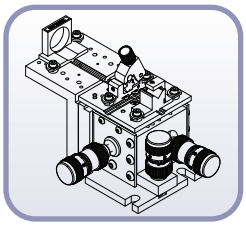
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX343	MAX343/M	$ 2,345.00	£ 1,625.50	€ 2.082,00	¥ 19,802.00	NanoMax™ Stage with Stepper Motor Drives
MAX341	MAX341/M	$ 3,530.00	£ 2,447.00	€ 3.134,00	¥ 29,808.00	NanoMax™ Stage; Stepper, Piezoeletric Actuator, & Sensor

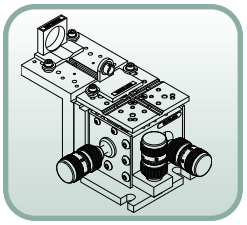
Fiber Launch Systems



SM Fiber Launch with Quick Release Clamp, See Page 475

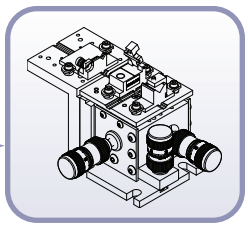
SM Fiber Launch with Variable V-Groove Clamp, See Page 475

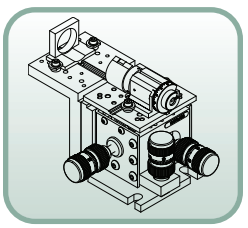




SM Fiber Launch with FC Connector, See Page 476

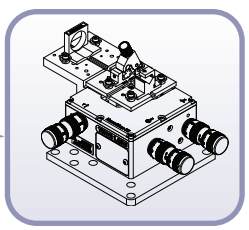
SM Fiber Launch with GRIN Lens Holder, See Page 476

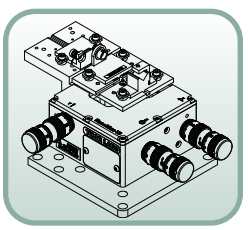




PM Fiber Launch with Microscope Objective Holder, See Page 477

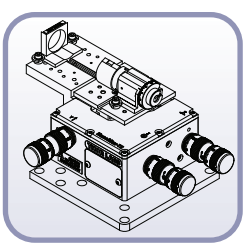
Free-Space to SM Fiber Launch System with Microscope Objective, See Page 477

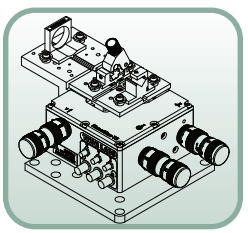




Free-Space to FC Launch System with GRIN Lens Holder, See Page 478

Free-Space to PM Launch System with Variable Force Rotator, See Page 478

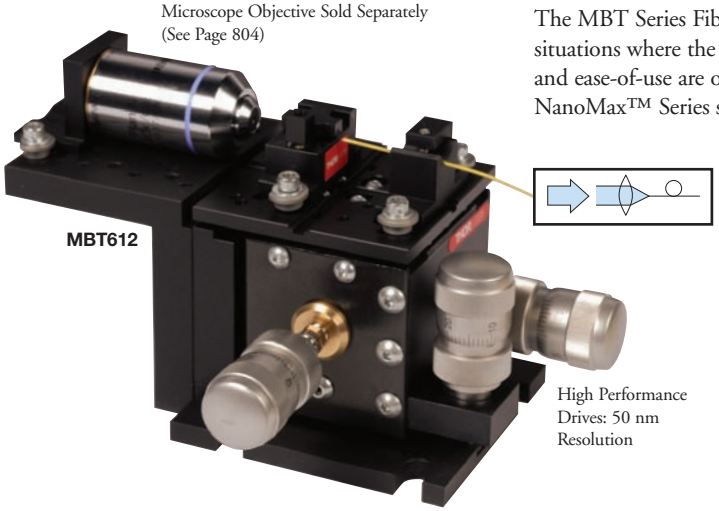




Free-Space to SM Fiber Launch System with Piezo Actuators and Sensors, See Page 479

MicroBlock™ SM Fiber Launch with Quick-Release Clamp

Microscope Objective Sold Separately (See Page 804)



The MBT Series Fiber Launches are recommended for less-demanding situations where the cost of the system is a concern. When long-term stability and ease-of-use are of paramount importance, we recommend the NanoMax™ Series shown on page 477.

System Includes

- MBT616 High-Resolution Flexure Stage with 4 mm of Travel, See Page 469
- Three High Performance Adjusters Provide 300 µm of Fine Travel with 50 nm Resolution
- HFF003 Fiber Clamp, See Page 501
- AMA009 Large Fixed Platform, See Page 497
- HCS013 Microscope Objective Mount, See Page 499
- HFS001 Cable Strain Relief, See Page 501

This MicroBlock™ launch system features our high-resolution differential adjusters that are ideal for optimizing the coupling of a free-space laser into a single mode fiber, even at visible wavelengths where the mode field diameter of the fibers are as small as 3 µm. The addition of a cable strain relief helps to prevent inadvertent disruption of the system, which can be a great time saver.

This preconfigured fiber launch is an ideal starter system that can be quickly adapted to many uses. Additional accessories are available that enhance the flexibility of this platform. Please see pages 496-512 for details.

Specifications

- **Travel:** 4 mm
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev

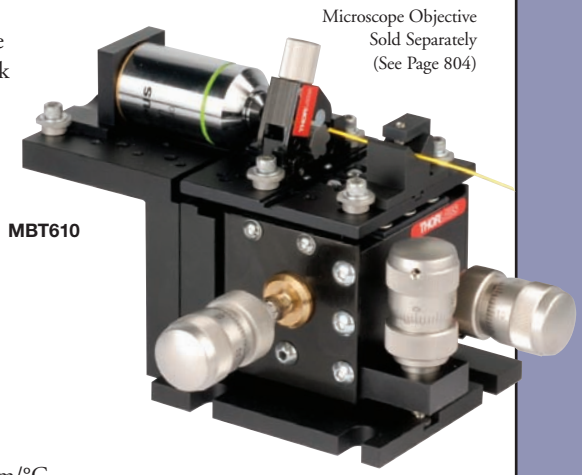
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MBT612	MBT612/M	$ 1,425.00	£ 972.50	€ 1.265,00	¥ 12,033.00	MicroBlock™ Fiber Launch System w/ Quick Release Clamp

MicroBlock™ SM Fiber Launch with Variable V-Groove Clamp

The MBT610 launch system features our high resolution drives which are ideal for optimizing the coupling of a free-space laser into a single mode fiber, even the visible spectrum where the mode field diameter of the fibers are as small as 3 µm. The quick release fiber holder provides six mounting surfaces, each one designed to accept a different size fiber. The addition of a cable strain relief helps to prevent inadvertant disruption of the system, which can be a great time saver.

This preconfigured system is an ideal starter system and can be quickly adapted to other applications using our extensive line of accessories.
Please see pages 496-512 for details.

Microscope Objective Sold Separately (See Page 804)

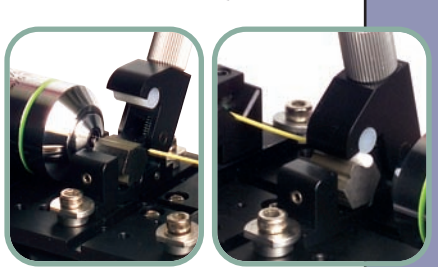


System Includes:

- MBT616 High Resolution Flexure Stage with 4 mm of Travel, See Page 469
- Three High Performance Drives Provide 300 µm of Fine Travel with 50 nm Resolution
- HFF001 V-Groove Fiber Holder with Adjustable Force (25 to 200 g), See Page 501
- AMA009 Large Fixed Platform, See Page 497
- HCS013 Microscope Objective Mount with RMS Threads, See Page 499
- HFS001 Cable Strain Relief, See Page 501

Specifications

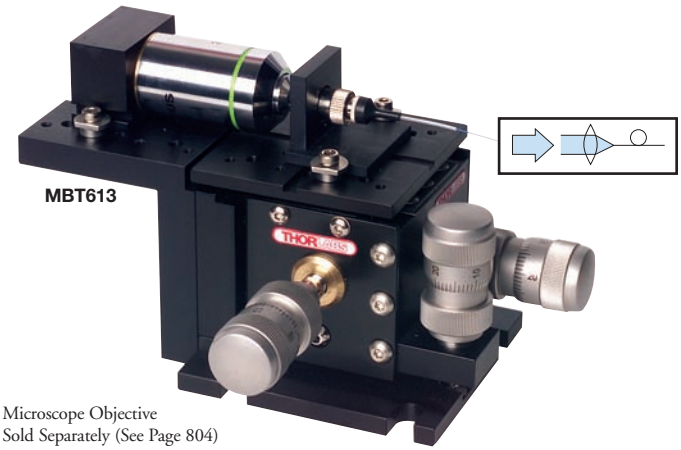
- **Travel**: 4 mm
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** = 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev



Fiber V-Groove Adapts to Various Fiber Diameters From 125 µm to 2 mm

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MBT610	MBT610/M	$ 1,660.00	£ 1,132.90	€ 1.474,00	¥ 14,018.00	MicroBlock™ Fiber Launch System with Variable Clamp

MicroBlock™ SM Fiber Launch with FC Connectorized Fiber Holder



Microscope Objective
Sold Separately (See Page 804)

The MBT Series Fiber Launches are recommended for less-demanding situations where the cost of the system is a concern. This entry into the MBT Fiber Launch Series features the MBT flexure stage with a HCS013 Microscope Objective Mount and HFB004 FC Fiber Holder. This combination of accessories, along with a microscope objective (not included, see Page 804), launches light directly into an FC/PC connector.

System Includes

- MBT616 High Resolution Flexure Stage with 4 mm Travel, See Page 469
- Three High Performance Drives Provide 300 µm of Fine Travel
- HFB004 FC Fiber Holder, See Page 504
- AMA009 Large Fixed Platform, See Page 497
- HCS013, Microscope Objective Mount with RMS Threads, See Page 499

Specifications

- **Travel:** 0.16" (4 mm)
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters:**
  - Coarse Adjustment 0.5 mm/rev
  - Fine Adjustment 50 µm/rev

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MBT613	MBT613/M	$ 1,255.00	£ 856.50	€ 1.114,20	¥ 10,598.00	MicroBlock™ Free-Space to FC Fiber Launch System

MicroBlock™ SM Fiber Launch with GRIN Lens Holder

Close-Up View
The GRIN lens holder provides easy access to the optic during loading. The spring clamp allows easy, fast exchange of optics.

System Includes:

- MBT616 High-Resolution Flexure Stage with 4 mm of Travel, See Page 469
- HGI003 GRIN Lens Holder, See Page 499
- AMA009 Large Fixed Platform, See Page 497
- GRIN Lenses Sold Separately, See Page 648
- HFF003 Fiber Clamp, See Page 501
- HFS001 Cable Strain Relief, See Page 501

Specifications

- **Travel**: 4 mm
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev

The MBT614 fiber launch system is built around our MBT616 3-axis flexure stage, which has been specifically designed to meet the challenging requirements associated with alignment of single mode fibers. The system features our high resolution differential drives that are ideal for coupling of a free-space laser into a single mode fiber, even at visible wavelengths where the mode field diameter of single mode fibers can be as small as 3 µm. The GRIN lens holder accommodates lenses with diameters from 1 to 3 mm and lengths as short as 2 mm. To view the complete line of flexure accessories, please refer to pages 496-512.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MBT614	MBT614/M	$ 1,365.00	£ 931.50	€ 1.211,90	¥ 11,527.00	MicroBlock™ Free-Space to Fiber GRIN Launch System

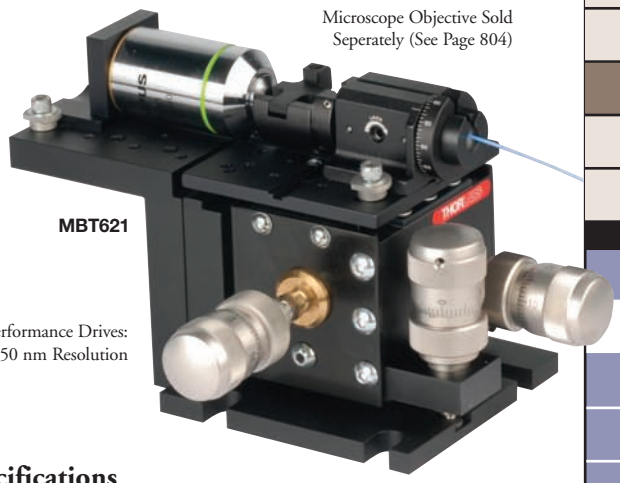
MicroBlock™ PM Fiber Launch with Fiber Rotator

System Includes:

- MBT616 High-Resolution Flexure Stage with 4 mm of Travel, See Page 469
- Three High-Performance Drives Provide 4 mm of Coarse Travel and 300 µm of Fine Travel
- HFR007 Fiber Rotator with Adjustable Force Magnetic Clamping Mechanism, See Page 503
- AMA009 Large Fixed Platform, See Page 497
- HCS013 Microscope Objective Mount, See Page 499

The MBT621 launch system features our high resolution drives that are ideal for coupling a free-space laser into a single mode fiber, even at visible wavelengths where the mode field diameter of the fibers are as small as 3 µm. The rotary fiber holder provides smooth rotation with negligible run-out. When using polarization maintaining fibers, this system provides an easy means of optimizing the extinction ratio of the signal being coupled through the PM fiber. Thorlabs offers a number of five- and six-axis systems for applications that require more advanced capabilities. Please see page 487-495.

Microscope Objective Sold Seperately (See Page 804)



MBT621

High Performance Drives: 50 nm Resolution

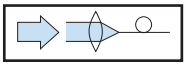
Specifications

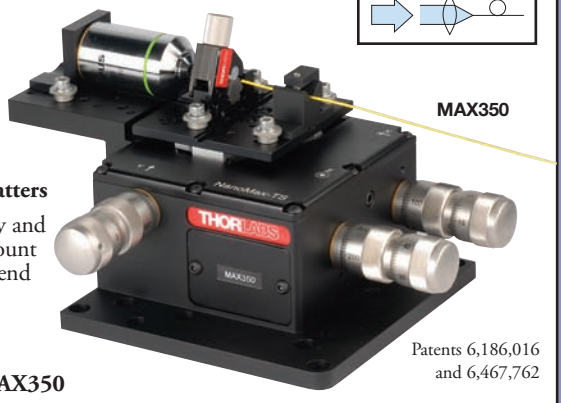
- **Travel:** 0.16" (4 mm)
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MBT621	MBT621/M	$ 1,355.00	£ 924.70	€ 1.203,00	¥11,442.00	MicroBlock™ Free-Space to PM Fiber Launch System

NanoMax™ SM Fiber Launch for Bare Fiber

Microscope Objective Sold Separately (See Page 804)





MAX350

Patents 6,186,016 and 6,467,762

Specifications

- **Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev
- **High-Resolution Manual Drives:** Provides 50 nm of Fine Control Resolution Over a Total Range of 300 µm
- **Parallel 3-Axis Flexure Mechanism:** Allows all Three Drives to be Rigidly Attached to the Main Body of the Stage
- **Crosstalk:** 20 µm/mm of Travel (Max)
- **Repeatability:** 500 nm RMS Bidirectional
- **Load Capacity:** 2.2 lbs (1 kg)
- **Resonant Frequency (±10% Hz):** 375 Hz (No Load), 200 Hz (275 g Load), 150 Hz (575 g Load)
- **Accessories:** Mounted on the Top Deck of the Stage:
  Large Fixed Bracket (AMA009)
  Microscope Objective Mount (HCS013)
  Adjustable Force Fiber Clamp (HFF001)
  Cable Strain Relief (HFS001)

When Performance Matters

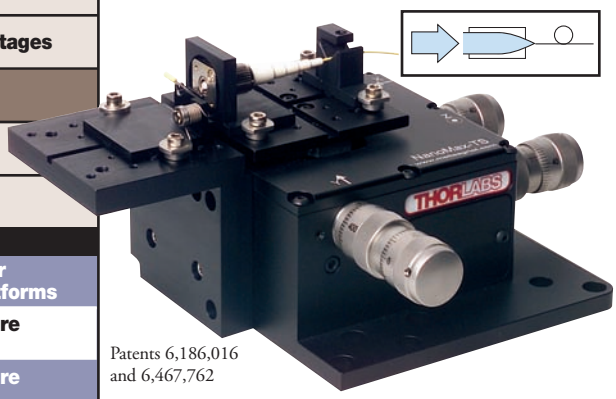
When long-term stability and ease-of-use are of paramount importance, we recommend this series of NanoMax launch systems.

NanoMax™ Model MAX350

The MAX350 series represents the latest generation of single mode fiber launch systems. Utilizing our patented highly stable flexure design with our patented dual-stage high resolution micrometers, we create a fiber launch system that ensures the very best performance of all our platforms. When coupling a free-space beam into a single mode fiber, the critical performance factors are the resolution and stability of the system. The intrinsic stiffness and resultant stability of our flexure system, as compared to a linear bearing design, provides superior performance during the initial alignment of the system as well as its long term operation. The resolution is ensured through the unique combination of our high performance dual stage micrometers and the parallel flexure mechanism that provides a true nanopositioning capability.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX350	MAX350/M	$ 1,930.00	£ 1,338.00	€ 1.713,50	¥16,297.00	NanoMax™ Fiber Launch System

NanoMax™ SM Launch for GRIN Lenses and FC Connectors



Patents 6,186,016 and 6,467,762

When Performance Matters

When long-term stability and ease-of-use are of paramount importance, we recommend this series of NanoMax launch systems.

NanoMax™ Model MAX355

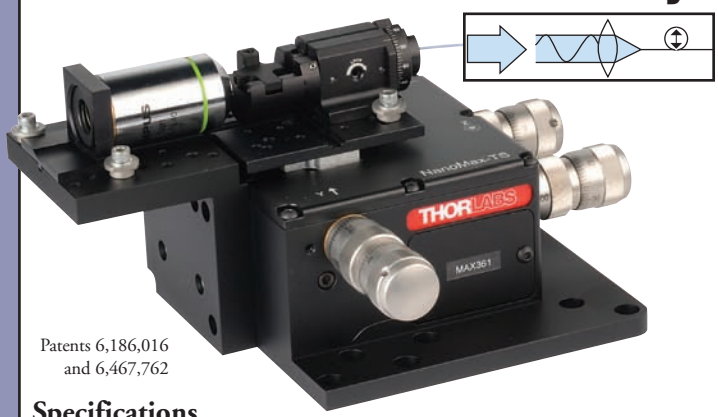
One of the most challenging alignment tasks in a photonics laboratory is the launching of light from a free-space laser into a single mode optical device or fiber, especially when the laser is operating in the visible range and the mode field diameter of the device is less than 4 µm. This MAX350 series of fiber launch systems have been redesigned to perform this task with ease. From the patented high-resolution, dual-stage adjusters (coarse range of 4 mm with <1 µm resolution, and fine range of 300 µm with <50 nm resolution) to the patented flexure design that forms the foundation of the system, this three-axis translator provides both the stability and the resolution required to hit submicron targets.

Specifications

- **Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev
- **High Resolution Manual Drives:** Provides 50 nm of Fine Control Resolution Over a Total Range of 300 µm
- **Repeatability:** 500 nm RMS Bidirectional
- **Load Capacity:** 2.2 lbs (1 kg)
- **Resonant Frequency (±10% Hz):** 375 Hz (No Load), 200 Hz (275 g Load), 150 Hz (575 g Load)
- **Accessories:** Mounted on the Top Deck of the Stage:
  Large Fixed Bracket (AMA009)
  Grin Lens Mount (HGI003)
  FC Optical Fiber Cable Holder (HFB004)
  Cable Strain Relief (HFS001)

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX355	MAX355/M	$ 1,850.00	£ 1,282.50	€ 1.642,50	¥ 15,622.00	NanoMax™ Fiber Launch System for FC Cables

NanoMax™ PM Fiber Launch: Easy Load



Patents 6,186,016 and 6,467,762

When Performance Matters

When long-term stability and ease-of-use are of paramount importance, we recommend this series of NanoMax™ launch systems.

NanoMax™ Model MAX361

The MAX361 fiber launch system is configured from our highest-performing flexure stage and three of our high-resolution, dual stage micrometers. This combination provides both the resolution and the stability required to achieve true submicron positional control. The system features the HFR007 fiber rotator which provides the added degree of rotational freedom that is required to optimize the extinction ratio of a PM fiber. The MAX361 PM Fiber Launch System provides a substantial improvement over linear bearing based designs or other less advanced three-axis flexure stages. The base translator utilizes our patented, highly stable, flexure design, which has the unique feature that all three adjusters are rigidly connected to the fixed portion of the main structure of the stage. Competing products either utilize three stacked individual stages, or at best are designed as one integrated system with two of the three actuators moving along with the moving portion of the stage. This causes unwanted motion in the form of cross-talk when the actuators are touched by the operators hand, thus impeding true nanopositioning.

Specifications

- **Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse: 0.5 mm/rev
  - Fine: 50 µm/rev
- **Rotation:** Continuous
- **High Resolution Manual**
- **Drives:** 50 nm Fine Control Over Range of 300 µm
- **Parallel 3-Axis Flexure:** Allows All Three Drives to be Rigidly Attached to Ground
- **Load Capacity:** 2.2 lbs
- **Resonant Frequency (±10% Hz):**
  - 375 Hz (No Load)
  - 200 Hz (275 g Load)
  - 150 Hz (575 g Load)
- **Top Deck Acessories:**
  - Large Fixed Bracket (AMA009)
  - Microscope Objective Mount (HCS013)
  - Adjustable Force Fiber Clamp (HFF001)
  - Fiber Clamp with Rotation (HFR007)

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX361	MAX361/M	$ 1,860.00	£ 1,289.50	€ 1.651,50	¥ 15,706.00	NanoMax PM Fiber Launch System with Fast Loading Rotator

NanoMax™ SM Fiber Launch with 20 µm Piezos and Sensors

Specifications

- **Manual Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev
- **Piezoelectric Travel:** 20 µm
- **Manual Drive Resolution:** Provides 50 nm Resolution Over a 300 µm Travel Range
- **Piezoelectric Actuator Resolution:** 5 nm When Operating with Internal Piezo Displacement Sensors.
- **Max Piezoelectric Drive Voltage:** 75 VDC
- **Crosstalk:** 20 µm/mm of Travel (Max)
- **Resonant Frequency (±10%):** 375 Hz (No Load) 200 Hz (275 g Load) 150 Hz (575 g Load)
- **Load Capacity:** 2.2 lbs (1 kg)
- **Deck Height:** 62.5 mm from the Base of the Stage to the Mounting Surfaces of the Moving Platform, the Accessory Beam Height is 75 mm from the Bottom Surface of the Stage
- **Accessories:** Mounted on the Top Deck of the Stage:
  Large Fixed Bracket (AMA009)
  Microscope Objective Mount (HCS013)
  Adjustable Force Fiber Clamp (HFF001)
  Cable Strain Relief (HFS001)

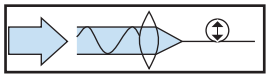
Note: All measurements related to the performance of the piezoelectric actuators are made with Thorlabs' model BPC203 piezo driver, which can be found on page 568.

Displacement Sensor

The strain gauge displacement sensor, directly attached to the body of the piezoelectric element, provides an analog signal that is proportional to its displacement. When combined with low noise electronics, the resolution obtained is better than 5 nm.

Microscope Objective Sold Separately (See Page 804)

Patents 6,186,016 and 6,467,762



When Performance Matters

When long-term stability and ease-of-use are of paramount importance, we recommend this series of NanoMax launch systems.

NanoMax™ Stage with High Resolution Manual Adjusters and Piezoelectric Actuators

The MAX373 Fiber Launch System is built from our MAX311 three-axis translation stage; for details on this stage, please see page 471. This stage and accessory package are ideally suited for use with our NanoTrak™ auto-alignment system (see page 572 for details). The 20 µm of piezoelectric travel provides sufficient electrical control of the position of the optical fiber to ensure rapid 'first-light' detection as well as automatic optimization of the coupling efficiency.

The MAX373 utilizes three strain gauge displacement sensors to provide a voltage signal that is linearly proportional to the displacement of the piezoelectric element. Using this signal, it is possible to compensate for hysteresis, creep, or thermal drift that is inherent to all piezoelectric elements. Additionally, the use of the displacement sensor in combination with our NanoTrak™ auto-alignment system allows one to precisely optimize the coupling efficiency of an optical system; then, once aligned, the displacement sensors can be used to stabilize the position of the system while subsequent operations are performed.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX373	MAX373/M	$ 3,185.00	£ 2,208.00	€ 2.827,50	¥26,895.00	NanoMax™ SM Fiber Launch System with Piezos and Sensors

SM Fiber Launch Systems with Auto-Alignment Controller (Page 1 of 2)

NEW products

Fiber Launch System with NanoTrak™, Controller, 3-Axis Flexure Stage, and Accessories (Microscope Objective Not Included)

10% Discount for Complete Package

Features

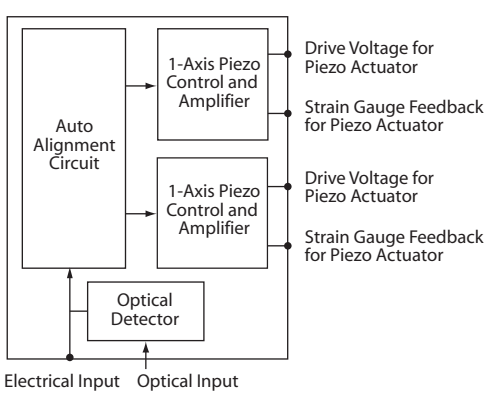
- 3-Axis Flexure Stage
  - Manual Differential Adjusters
  - Internal Piezo Actuators with Strain Gauge Sensors
- NanoTrak™ Auto-Alignment Controller
  - Integrated InGaAs or Si Detector
  - Two Inputs for Strain Gauge Feedback
  - Two Outputs to Drive Piezo Actuators
  - Advanced Alignment Optimization Algorithms
  - USB Interface

Introduction

The MAX371K1 and MAX371K2 are automated fiber launch systems that reduce the time it takes to optimize the coupling of light into a bare single mode fiber. The kits package a nanopositioning 3-axis flexure stage with a NanoTrak™ controller that optimizes the position of the fiber perpendicular to the optical axis using the internal piezo actuators in the stage. Also included are three stage accessories: an RMS-threaded optical mount (HCS013), a bare fiber clamp (HFF001), and a cable strain relief clamp (HFS001). Other accessories can be purchased separately (see page 496) in order to expand the system's capabilities for use with other optical elements like waveguides or connectorized fibers.

NanoTrak™ Controller

When activated, the NanoTrak™ controller (see schematic below) generates drive voltages for two piezo actuators based on the optical (electrical) feedback signal. In the MAX373 kits, the piezo actuators will control the position of the fiber along the two axes perpendicular to the optical axis, and the feedback signal will be proportional to how much light is coupled into the optical fiber. By letting the NanoTrak™ controller position the fiber tip on the optical axis, optimizing the coupling simply requires the user to manually align the fiber along the optical axis. After the coupling of light into the fiber has been optimized, the tracking mode can be turned off without affecting the coupling, or the tracking mode can be left on in order to ensure that the coupling remains optimized even if external effects, like changes in temperature, cause small changes in the beam position. See page 583 for information on how the Auto Alignment Circuit in the NanoTrak™ controller functions.

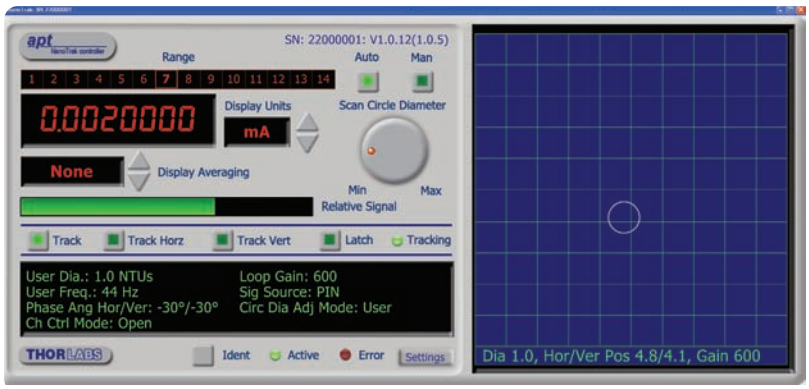


10 Minute Alignment Procedure

By using Thorlabs' MAX311 (see page 471) flexure stage as the base for this fiber launch system, first light detection, even with single mode fiber, is straightforward. Before starting this procedure use two steering mirrors to steer the beam so that it is roughly propagating 12.5 mm above the channel on the empty stage, which is locked down on an optical table. Also have the NanoTrak™ controller connected to the stage and to a computer with the software loaded and operational.

- Mount your coupling optic on the provided RMS threaded mount (HCS013) and place the mount in the channel on the fixed large angle bracket (AMA009) attached to the stage.
- Adjust the stage using the manual differential adjusters so that the HCS013 can be slid easily from the AMA009 to the stage platform (keep the HCS013 tight against one side of the channel).
- Steer your free-space beam so that the beam position does not wander as the coupling optic is slid from the large angle bracket to the stage platform.
- While keeping the mount pressed against one side of the channel, lock down the HCS013 on the AMA009 such that the light is focused at a point near the edge but still over the adjustable platform on the stage.
- Lock down the fiber clamp and the strain relief cable on the stage platform so that the tip of the fiber will be further away from the coupling optic than the point at which the light is focused. (Make sure the stage platform can be translated forward far enough to move the fiber tip through the focal point.)
- Load the fiber and if the other end of the fiber has an FC connector attach it to the NanoTrak™ detector. Otherwise, use a suitable detector to measure the light coupled into the fiber and use the electrical input on the NanoTrak™ controller to provide the feedback it requires.
- Use the manual actuator to move the fiber tip toward or away from the lens untill first light is detected.
- Coarsely maximize the signal using all three manual adjusters.
- Activate the NanoTrak™. It will immediately maximize the position of the fiber tip perpendicular to the beam propagation direction.
- Use the manual actuator to move the fiber tip toward or away from the lens while watching the power monitor. If the piezo actuators near the limit of their range use one of the other manual actuators to put them back toward the middle.
- Stop once the coupled power has been maximized.

SM Fiber Launch System with Auto-Alignment Controller (Page 2 of 2)



The apt™ NanoTrak™ controller is supplied with a full suite of software support tools. Once the software and associated USB drivers are installed, the aptUser utility provides a full featured intuitive graphical instrument panel allowing full control and visualization of the NanoTrak™ operation. Additionally, ActiveX® components are included to speed user developed routines in the user's programming environment of choice (e.g., LabVIEW™, Visual Basic, or C++).

NanoTrak™ Controller Specifications

- **Optical Power Measurement**
  - PIN Photodiode: FC/PC Fiber Input
  - Si or InGaAs Detector: 1 nA to 10 mA Photocurrent
  - Optical Power Monitor (BNC): Multiple Ranges
  - Signal Phase Compensation: -180° to 180°
- **Principle NanoTrak Parameters**
  - Circle Scanning Frequency: 1-300 Hz
  - Circle Dia Adjustment Modes: Automatic and Manual
- **Piezoelectric Input/Output**
  - Two Output Connectors (SMC Male):
    - Voltage Output: 0-75 VDC/Channel
    - Voltage Stability: 100 ppm Over 24 Hours
    - Noise: <3 mV_{rms}
    - Output Current: 500 mA/Channel
  - Output Monitors (BNC): 0-10 VDC
  - Analog Inputs (BNC): 0-10 VDC (Used in Piezo Amp Mode)
  - Strain Gauge Position Feedback: (Two 9-Pin D-Type Female)
- **Other Input/Output**
  - Optical Power Monitor (BNC): 0-10 VDC
  - User Control (37-Pin D-Type Female)
    - Isolated Digital I/O
  - Trigger In/Out (BNC): 0-10 DC
  - USB Port
- **Power Requirements**
  - Voltage: 85-64 VAC
  - Frequency: 47-63 Hz
  - Power: 200 W
  - Fuse: 3 A
- **General**
  - Dimensions (W x D x H): 245 mm x 330 mm x 130 mm (9.65" x 13" x 5.12")
  - Weight: 6 kg (13 lbs)

See page 471 for a complete presentation of the NanoTrak controller used in the MAX373K1 and MAX373K2 kits.

Flexure Stage Specifications

- **Manual Travel:** 0.16" (4 mm)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev
- **Piezoelectric Travel:** 20 µm
- **Manual Drive Resolution:** Provides 50 nm Resolution Over a 300 µm Travel Range
- **Piezoelectric Actuator Resolution:** 5 nm When Operating with Internal Piezo Displacement Sensors.
- **Max Piezoelectric Drive Voltage:** 75 VDC
- **Crosstalk:** 20 µm/mm of Travel (Max)
- **Resonant Frequency (±10%):** 375 Hz (No Load), 200 Hz (275 g Load), 150 Hz (575 g Load)
- **Load Capacity:** 2.2 lbs (1 kg)
- **Deck Height:** 62.5 mm from the Base of the Stage to the Mounting Surfaces of the Moving Platform, the Accessory Beam Height is 75 mm from the Bottom Surface of the Stage
- **Accessories:** Mounted on the Top Deck of the Stage:
  - Large Fixed Bracket (AMA009)
  - Microscope Objective Mount (HCS013)
  - Adjustable Force Fiber Clamp (HFF001)
  - Cable Strain Relief (HFS001)

See page 479 for a complete presentation of the MAX311 flexure stage used in the MAX373K1 and MAX373K2 kits.

ITEM#	$	£	€	RMB	DESCRIPTION
MAX373K1	$ 8,950.50	£ 6,205.00	€ 7.947,00	¥ 75,579.00	apt™ NanoTrak™ Fiber Launch System with InGaAs Detector
MAX373K2	$ 8,950.50	£ 6,205.00	€ 7.947,00	¥ 75,579.00	apt™ NanoTrak™ Fiber Launch System with Silicon Detector

Customer Configured NanoMax™ Stages (Page 1 of 2)

In the event that you need a configuration other than our standard preconfigured options, Thorlabs offers custom configured NanoMax™ platforms. These units typically ship within 24 hours.

To achieve this degree of configurability, Thorlabs has designed a complete set of actuators that are modular and can be fitted within seconds without needing any tools.

Simply choose the base platform from the models below and add the required actuators from the facing page.

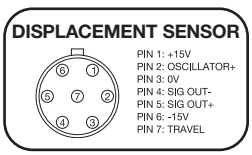
Patents 6,186,016 and 6,467,762

NanoMax™ Platform, Piezoelectric Actuators, and Sensors

MAX301

LEMO Connector

Adding strain gauge displacement sensors to the internal piezoelectric elements of the NanoMax™ platform enhances the resolution performance of the system by a factor of four. Additionally, it improves the linearity and drift performance of the stage while allowing the system to be operated in a closed- loop system. For complete details on the performance of the NanoMax™ platform with internal piezos and strain gauge displacement sensors please, refer to the MAX311 on page 471.



LEMO Connector

ITEM#	METRIC ITEM#	$	£	€	RMB
MAX301	MAX301/M	$ 2,075.00	£ 1,438.50	€ 1.842,00	¥ 17,522.00

NanoMax™ Platform, Piezoelectric Actuators

MAX302

SMC Piezo Connector

Adding internal piezoelectric elements to the basic NanoMax™ platform provides 20 µm of high-resolution electrical control (0 to 75 V). The typical piezo resolution is 20 nm. For complete details on the performance of the NanoMax™ platform with internal piezoelectric actuators, please refer to the MAX312 on page 471.

ITEM#	METRIC ITEM#	$	£	€	RMB
MAX302	MAX302/M	$ 1,210.00	£ 838.80	€ 1.074,30	¥ 10,218.00

Mechanical Drawings Available on the WEB

NanoMax™ Platform, No Actuators

MAX303

Use this base unit if your application does not require piezoelectric actuators. Please note that while the external drives can be easily changed in the field, internal piezoelectric actuators are incorporated directly into the platform and cannot be added later. If your needs change and you subsequently require piezoelectric actuators, the piezo extenders shown on the next page can be used along with our other drive options.

ITEM#	METRIC ITEM#	$	£	€	RMB
MAX303	MAX303/M	$ 875.00	£ 606.60	€ 776,90	¥ 7,388.60

Customer Configured NanoMax™ Stages (Page 2 of 2)

High-Resolution Differential Micrometer

NEW product

DRV003

This high-resolution micrometer drive with 50 nm positional resolution is matched in performance to the capabilities of the NanoMax™ series platforms. Full details on this drive can be found on page 528.

Specifications in Stage

- **Travel:**
  - Coarse: 0.16" (4 mm)
  - Fine: 250 µm
- **Resolution:**
  - Coarse: 1.0 µm
  - Fine: 50 nm

ITEM#	$	£	€	RMB
DRV003	$ 195.00	£ 135.20	€ 173,20	¥ 1,646.60

Mechanical Drawings Available on the WEB

Stepper Motor

DRV001

This stepper motor drive is fully detailed on page 536. When used with an apt™ series stepper motor driver, it provides 25,600 microsteps per revolution.

Specifications in Stage

- **Travel:** 0.16" (4 mm)
- **Resolution:** 25 nm
- **Holding Torque:** 23.1 N·cm

ITEM#	$	£	€	RMB
DRV001	$ 585.00	£ 405.60	€ 519,40	¥ 4,939.80

Thumbscrew

DRV004

This thumbscrew drive is often used in applications or positioning tasks that require a high degree of stability, yet have lower resolution requirements.

Specifications in Stage

- **Travel:** 0.16" (4 mm)
- **Resolution:** 1 µm (500 µm Thread Pitch)

ITEM#	$	£	€	RMB
DRV004	$ 96.50	£ 66.90	€ 85,70	¥ 814.90

Piezoelectric Extenders

These piezoelectric extenders provide 20 µm or 80 µm of high-resolution travel to any of the modular drives shown above. The modular design allows these extenders to be attached in series with any of Thorlabs' modular drives. These extenders are ideal for applications that require high-resolution movements over a small range. Coarse adjustments are made using any one of our modular drives shown above.

Specifications

- **Travel:** 20 µm
- **Closed-Loop Resolution:** 5 nm
- Displacement Sensor

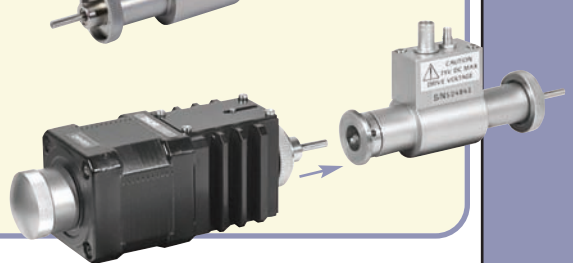
DRV120

Specifications

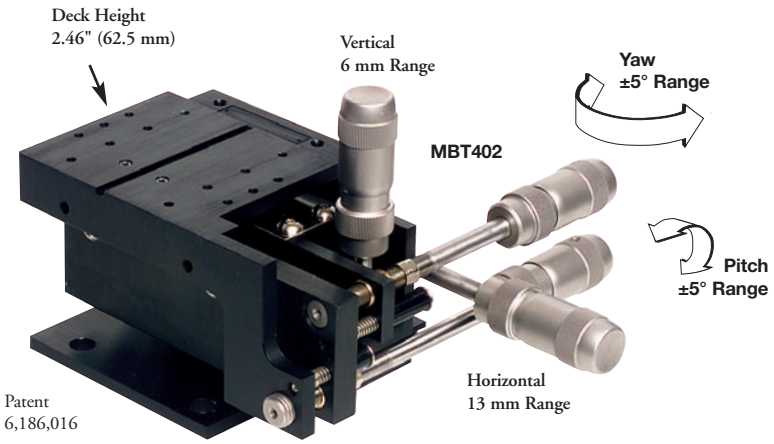
- **Travel:** 80 µm
- **Resolution:** 20 nm

DRV181

ITEM#	$	£	€	RMB
DRV120	$ 995.00	£ 689.80	€ 883,40	¥ 8,401.90
DRV181	$ 995.00	£ 689.80	€ 883,40	¥ 8,401.90



Low-Profile, Four-Axis MicroBlock™ Positioner

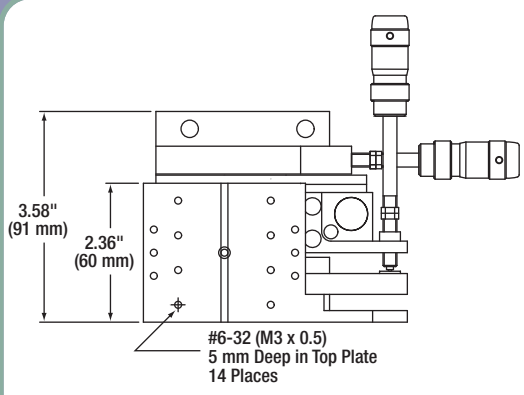


This low-profile MicroBlock™ Device Platform is a compact, cost-effective, four-axis positioner designed for precise orientation of photonics components and other planar devices. This device is intended to allow a complex optical element that either has multiple single mode ports or has angled output surfaces to be properly positioned with respect to one of our high-performance stages. The four independent degrees of freedom provide 0.5" (13 mm) of horizontal translation, 0.24" (6 mm) of vertical translation, 10° of pitch, and 10° of yaw.

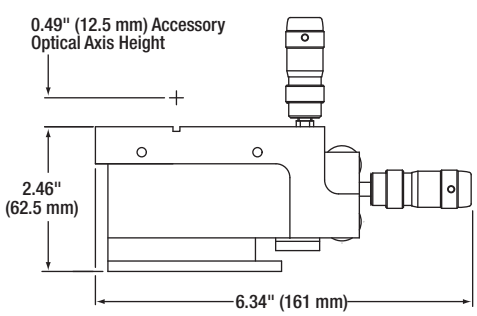
This stage, when combined with any of our three-axis stages (MicroBlock™, NanoMax™, PiezoBlock™, or RollerBlock™ on pages 466-483), is ideal for building high-performance fiber launch or single-mode-waveguide couplers (see photograph below). The 0.5" (13 mm) of horizontial travel allows the individual channels of a multichannel waveguide to be readily accessed.

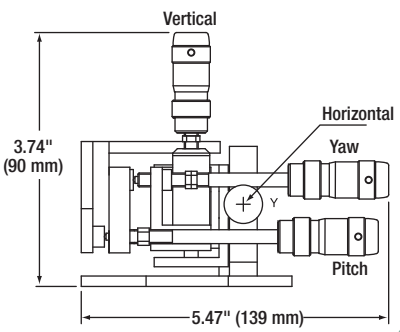
Specifications

- **Coarse Travel**
  - Horizontal Axis (X): 0.5" (13 mm)
  - Vertical Axis (Y): 0.24" (6 mm)
  - Pitch Axis (θy): 10°
  - Yaw Axis (θz): 10°
- **Fine Travel**
  - Horizontal Axis: 300 µm
  - Vertical Axis: 300 µm
  - Pitch Axis: 12 arcmin
  - Yaw Axis: 30 arcmin
- **Coarse Travel Resolution**
  - Horizontal Axis: 1 µm
  - Vertical Axis: 1 µm
  - Pitch Axis: 10 arcsec
  - Yaw Axis: 10 arcsec
- **Fine Travel Resolution**
  - Horizontal Axis: 50 nm
  - Vertical Axis: 50 nm
  - Pitch Axis: 1 arcsec
  - Yaw Axis: 1 arcsec
- **Deck Height:** 2.46" (62.5 mm) to the Mounting Surface of the Moving Platform, Accessory Beam Height is 75 mm Measured from the Bottom Surface of the Stage
- **Load Capacity:** 1.1 lbs (500 g)
- **Weight:** 1.7 lbs (750 g)



An example showing fiber to fiber alignment with a MAX303 platform and MBT402.





Please refer to our website for complete models and drawings.

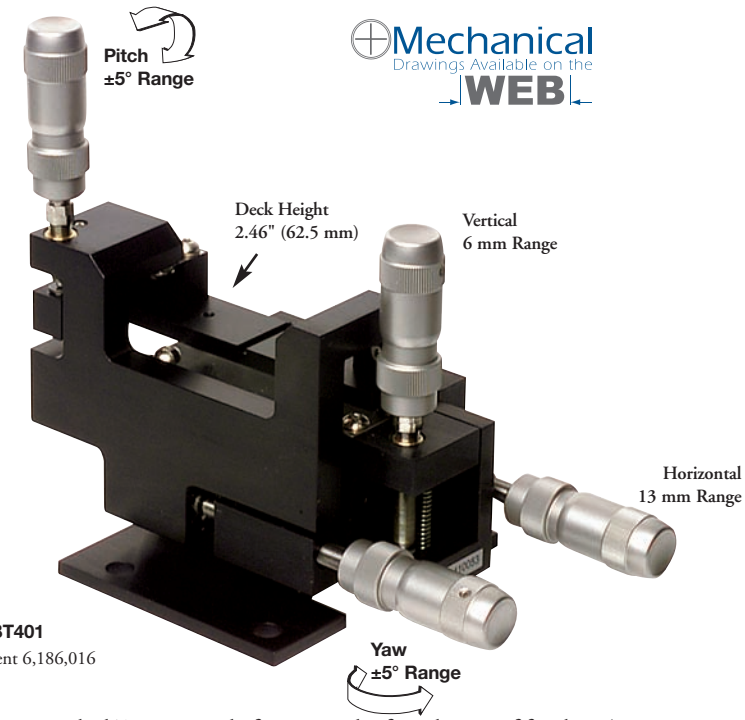
The use of nested flexure elements ensures smooth, continuous motion over all three rotational axes, making this device ideally suited for high resolution optical applications. Aside from its low profile, the key feature that this particular stage offers is the easy accessibility of the moving platform. As can be seen from the photograph above, the moving platform is accessible from three of the four sides; this feature maximizes the free space available for additional equipment that your setup may require.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MBT402	MBT402/M	$ 1,940.00	£ 1,345.00	€ 1.722,50	¥ 16,382.00	MicroBlock™ 4-Axis, Low-Profile Positioner

Four-Axis MicroBlock™ Positioner

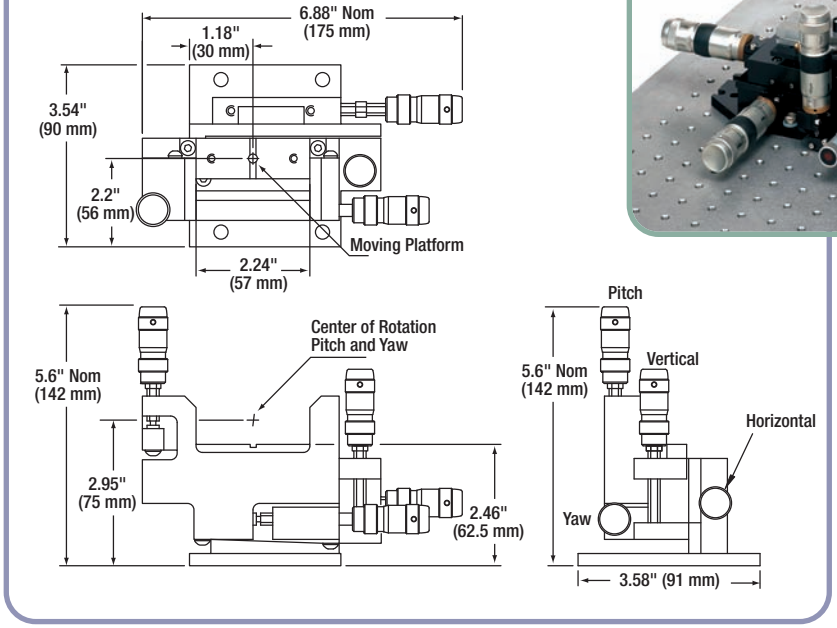
Specifications

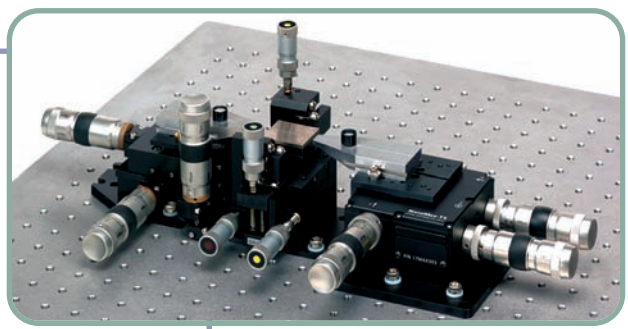
- **Coarse Travel**
  - Horizontal Axis (X): 0.5" (13 mm)
  - Vertical Axis (Y): 0.24" (6 mm)
  - Pitch Axis (θy): 10°
  - Yaw Axis (θz): 10°
- **Fine Travel**
  - Horizontal Axis: 300 µm
  - Vertical Axis: 300 µm
  - Pitch Axis: 30 arcmin
  - Yaw Axis: 30 arcmin
- **Coarse Travel Resolution**
  - Horizontal Axis: 1 µm
  - Vertical Axis: 1 µm
  - Pitch Axis: 10 arcsec
  - Yaw Axis: 10 arcsec
- **Fine Travel Resolution**
  - Horizontal Axis: 50 nm
  - Vertical Axis: 50 nm
  - Pitch Axis: 1 arcsec
  - Yaw Axis: 1 arcsec
- **Deck Height:** 2.46" (62.5 mm) to the Mounting Surface of the Moving Platform, Accessory Beam Height is 75 mm Measured from the Bottom Surface of the Stage
- **Load Capacity:** 1.1 lbs (500 g)
- **Weight:** 2.2 lbs (1 kg)



Mechanical Drawings Available on the WEB

This MicroBlock™ Device Platform provides four degrees of freedom (i.e., two translation and two rotation). The 2.46" (62.5) mm deck height is compatible with our 3-Axis MicroBlock™, NanoMax™, PiezoBlock™, and RollerBlock™ families of stages. The photograph below shows the MBT401 4-axis system integrated into a larger setup that contains both a long-travel RollerBlock stage, as well as a 4 mm travel NanoMax 3-Axis flexure platform.





We recommend this narrow platform positioning system for applications that require a device to be positioned between two coupling stages. The extensive selection of accessories presented at the end of this section (see page 496) are all compatible with our 4-axis platform stages.

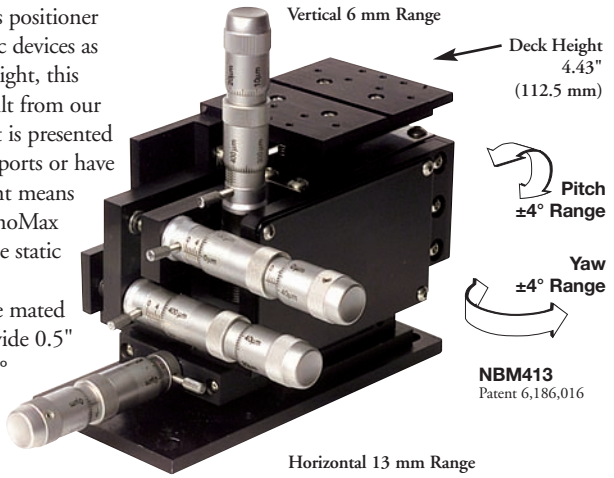
Given the large array of possible solutions to any particular alignment challenge, Thorlabs recommends that you contact one of our regional offices for expert technical assistance in configuring a system that is ideally suited to your specific needs.

Please refer to our website for complete models and drawings.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MBT401	MBT401/M	$ 1,775.00	£ 1,230.50	€ 1.576,00	¥ 14,989.00	MicroBlock™ 4-Axis, Narrow Platform Positioner

Four-Axis, NanoBlock™ Positioner

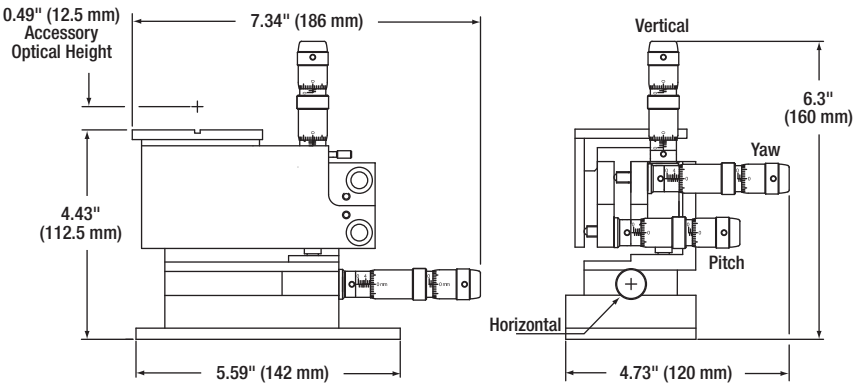
This NanoBlock™ device platform is offered as a cost-effective, four-axis positioner designed for the precise orientation of integrated optical or optoelectronic devices as well as general photonic components. With a 4.43" (112.5 mm) deck height, this system is intended to allow advanced optical alignment stations to be built from our high-performance NanoMax™ six-axis waveguide alignment system that is presented on page 489. For optical elements that have either multiple single mode ports or have angled input and output facets, this device platform provides a convenient means for properly positioning them with respect to our high-performance NanoMax six-axis platforms. Please note that we only recommend this device for the static positioning of the optical element or device; for the best results, any optimization of the coupling efficiency should be accomplished using the mated 6-axis positioning system. The four independent degrees of freedom provide 0.5" (13 mm) of horizontal translation, 0.24"(6 mm) of vertical translation, 8° of pitch, and 8° of yaw. The 0.5" (13 mm) of horizontal travel allows the individual channels of a multichannel waveguide to be readily accessed.



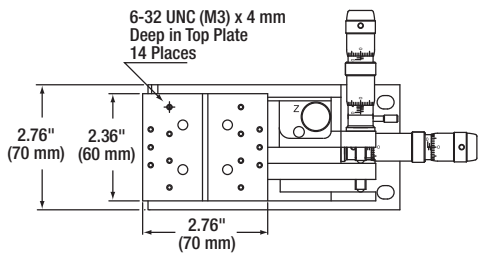
Specifications

- **Coarse Travel**
  - Horizontal Axis (X): 0.5" (13 mm)
  - Vertical Axis (Y): 0.24" (6 mm)
  - Pitch Axis (θy): 8°
  - Yaw Axis (θz): 8°
- **Fine Travel**
  - Horizontal Axis: 300 µm
  - Vertical Axis: 300 µm
  - Pitch Axis: 30 arcmin
  - Yaw Axis: 10 arcmin
- **Coarse Travel Resolution**
  - Horizontal Axis: 1 µm
  - Vertical Axis: 1 µm
  - Pitch Axis: 10 arcsec
  - Yaw Axis: 10 arcsec
- **Fine Travel Resolution**
  - Horizontal Axis: 50 nm
  - Vertical Axis: 50 nm
  - Pitch Axis: 1 arcsec
  - Yaw Axis: 1 arcsec
- **Deck Height:** 4.43" (112.5 mm) to the Mounting Surfaces of the Moving Platform, Accessory Beam Height is 4.93" (125 mm) from the Bottom Surface of the Stage
- **Load Capacity:** 1.1 lbs (500 g)

Mechanical Drawings Available on the WEB



Please refer to our website for complete models and drawings.



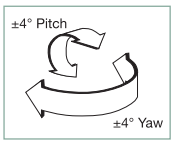
This multi-axis positioning device incorporates flexure hinges, making it appropriate for the ultra-precise, backlash-free orientation of any integrated optical or optoelectronic device. This system has flexure hinges for the rotational degrees of freedom. Both of the linear degrees of freedom are achieved using traditional bearing stages to obtain longer travel. For device characterization or industrial pigtailing applications, it is recommended that a NanoTrak™ control unit be used to servo-control the vertical and horizontal axes of the NanoMax platform that positions the input/output fibers.

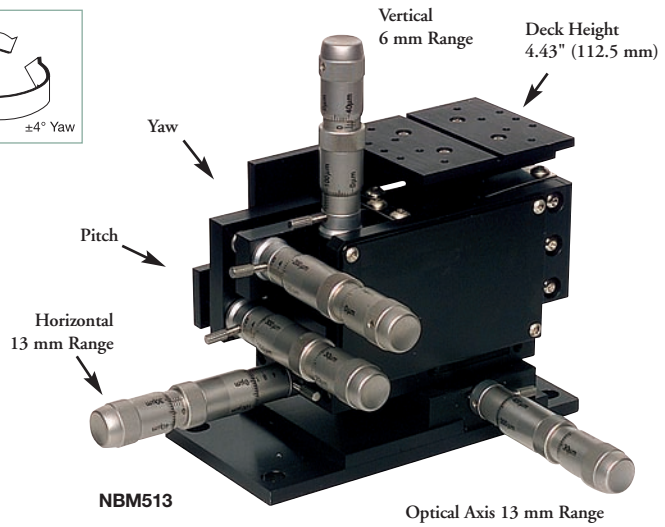
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NBM413	NBM413/M	$ 3,635.00	£ 2,520.00	€ 3.227,00	¥ 30,695.00	NanoBlock™ 4-Axis Device Platform, 112.5 mm Deck Height

Five-Axis NanoBlock™ Positioner 4.43"

This 5-Axis Device Platform is designed to be used in conjunction with the NanoMax™ 600 six-axis waveguide manipulator. It is well suited for applications that require an optical element or assembly to be held at a fixed position in front of a high-performance, multi-axis alignment system. The five degrees of freedom that this device offers, allow the fixed portion of the optical assembly to be positioned such that it has the proper orientation with respect to another positioning stage. Figure 1 below shows the NBM513, five-axis device positioner, mounted next to our high-performance NanoMax™ 300 (MAX313), which is an excellent choice for applications requiring complex optical alignment routines at the nanometer level (see page 470 for details).

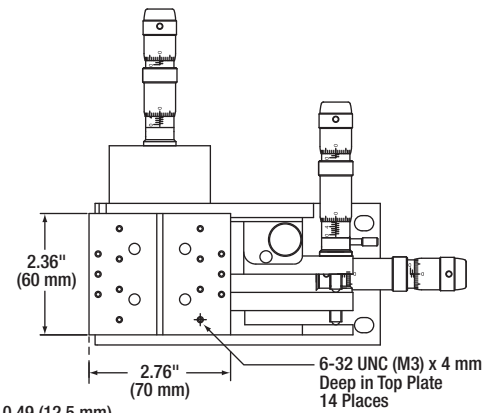
The NBM513, Five-axis Device Platform has flexure hinges for all of the rotational degrees of freedom; both the X and Y linear axes utilize traditional bearing stages to provide for longer travel. The top deck of the NBM513 is located 4.43" (112.5 mm) above the bottom mounting surface of the device and is designed to accept any of the accessories that are featured on pages 496-512.

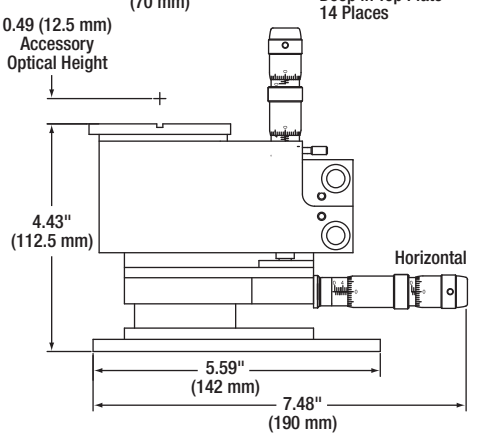


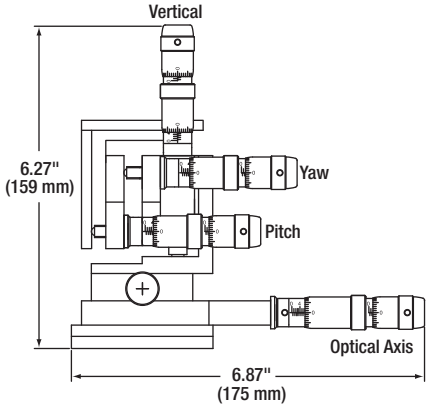


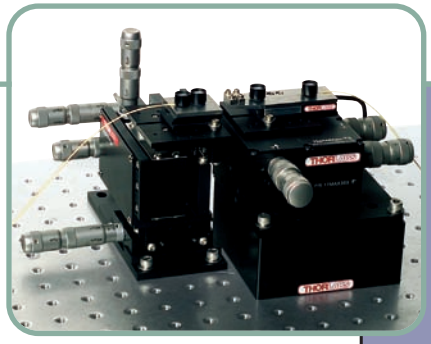
Specifications

- **Travel**
  - Coarse Travel:
    - Optical Axis (X): 0.5" (13 mm)
    - Horizontal Axis (Y): 0.5" (13 mm)
    - Vertical Axis (Z): 6 mm
    - Pitch Axis (θy): 8°
    - Yaw Axis (θz): 8°
  - Fine Travel:
    - Optical Axis: 300 µm
    - Horizontal: 300 µm
    - Vertical: 300 µm
    - Pitch: 30 arcmin
    - Yaw: 10 arcmin
- **Resolution**
  - Coarse Travel:
    - Optical Axis: 1 µm
    - Vertical Axis: 1 µm
    - Horizontal Axis: 1 µm
    - Pitch Axis: 10 arcsec
    - Yaw Axis: 10 arcsec
  - Fine Travel:
    - Optical Axis: 50 nm
    - Vertical: 50 nm
    - Horizontal: 50 nm
    - Pitch: 1 arcsec
    - Yaw: 1 arcsec
- **Deck Height:** 4.43" (112.5 mm)to the Mounting Surface of the Moving Platform, Accessory Beam Height is 4.93" (125 mm) Measured from the Bottom Surface of the Stage
- **Load Capacity:** 1.1 lbs (500 g)









Mechanical Drawings Available on the WEB

Please refer to our website for complete models and drawings.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
NBM513	NBM513/M	$ 5,615.00	£ 3,893.00	€ 4.986,00	¥ 47,414.00	NanoBlock™ 5-Axis Device Platform, 112.5 mm Deck Height

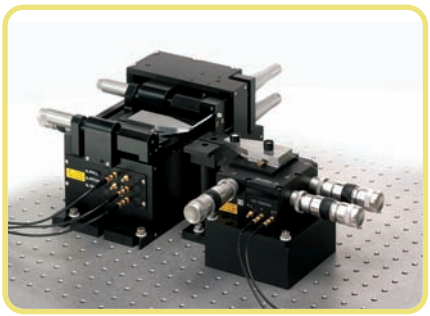
6-Axis Flexure Platform Selection Guide

Pages 489-495

NanoMax™ 600 Tutorial

- Overview of NanoMax™ 600 Parallel Flexure Platform

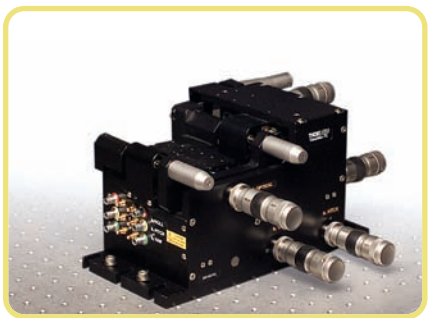
See Pages 489-491



NanoMax™ 600 with Manual Actuators

- Six-Axis Platform with Manual Actuators
- Six-Axis Platform with Manual Actuators and Piezos
- Six-Axis Platform with Manual Actuators, Piezos, and Sensors

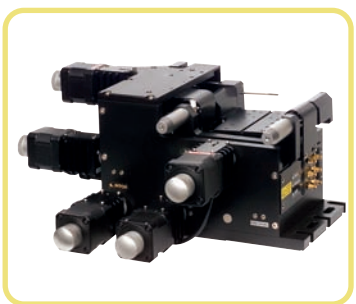
See Page 492



NanoMax™ 600 with Stepper Motor Actuators

- Six-Axis Platform with Stepper Motor Actuators
- Six-Axis Platform with Stepper Motor Actuators and Piezos
- Six-Axis Platform with Stepper Motor Actuators, Piezos, and Sensors

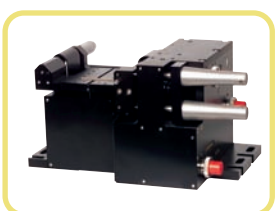
See Page 493



Custom Configured NanoMax™ 600

- Customer Configurable Platform with Choice of Actuators
- Manual: Thumbscrew and Micrometer
- Motorized: Stepper Motor
- Internal Piezoelectric Actuators
- Internal Strain Gauge Sensors
- Piezoelectric Extenders

See Pages 494-495

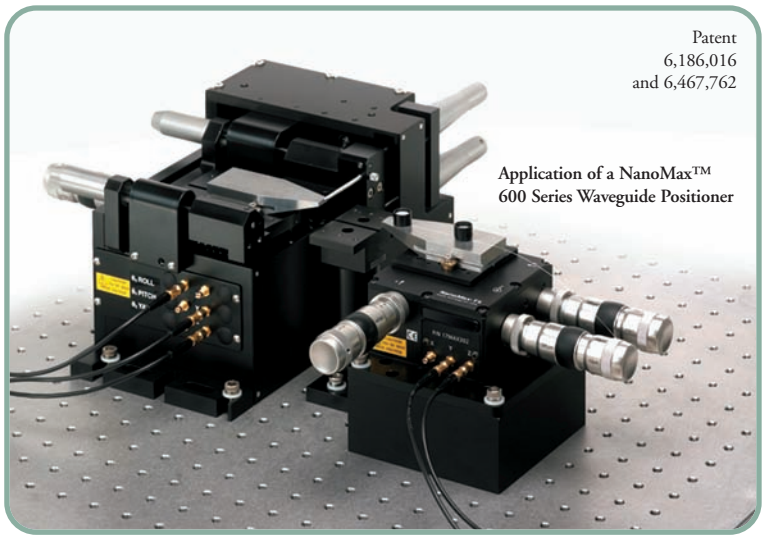


NanoMax™ 600 6-Axis Waveguide Positioner

A powerful tool for nanopositioning, the NanoMax™ 600 Series offers two innovative features: a common point of rotation and a patented design that fixes all actuators to the base assembly.

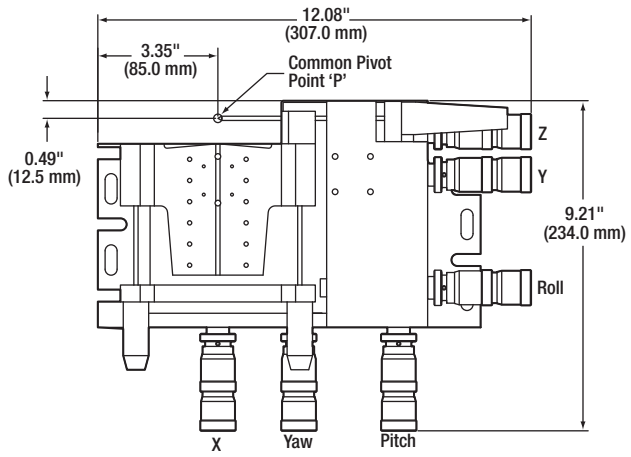
Six Models

- **Six-Axis Manual Positioning Platform**
  - MAX601 – Differential Micrometers (see page 492)
  - MAX602 – Internal Piezos and Differential Micrometers (see page 492)
  - MAX603 – Internal Closed-Loop Piezos and Differential Micrometers (see page 492)
- **Six-Axis Motorized Positioning Platform**
  - MAX604 – Stepper Motors (see page 493)
  - MAX605 – Internal Piezos and Stepper Motors (see page 493)
  - MAX606 – Internal Closed-Loop Piezos and Stepper Motors (see page 493)

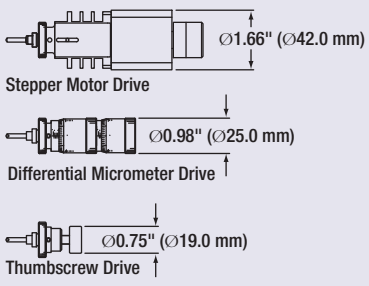


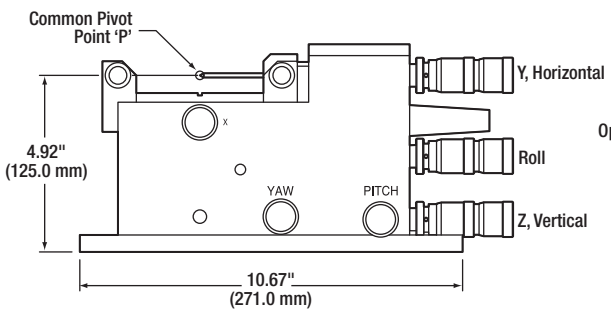
Patent 6,186,016 and 6,467,762

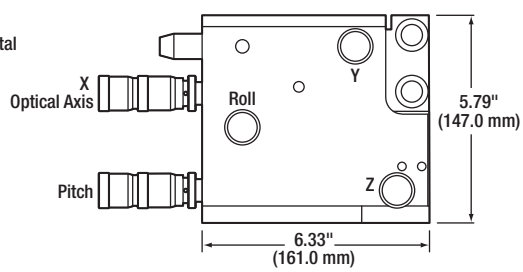
Application of a NanoMax™ 600 Series Waveguide Positioner



Drive Options







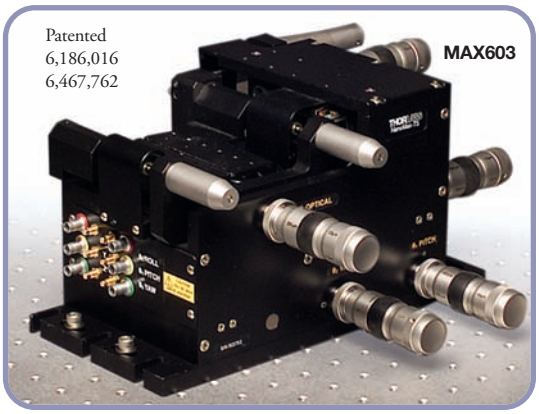
Please refer to our website for complete models and drawings.

Need a custom-configured stage with a unique set of options? See page 482, or call Thorlabs to speak with a technical support expert.

NanoMax™ 600 Six-Axis Parallel Flexure Platform (Page 1 of 2)

Features

- 0.16" (4 mm) of X, Y, Z Translational Motion and 6° (θx, θy, θz) of Rotational Motion
- Optional Piezoelectric Actuators for Closed-Loop Operation
- High Resolution (up to 10 nm)
- Thermal Stability <100 nm/°C from 15-30 °C
- High Resonant Frequency
- Active Thermal Compensation
- Patented Parallel Flexure Mechanism with Fixed Drives
- Common Pivot Point for All Degrees of Freedom Simplifies Alignment
- Low-Maintenance Design



What Makes the NanoMax™ 600 Better?
For complex, multi-axis positioning, parallel flexure platforms 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, thereby fully constraining the body with six actuators. This contrasts with serial designs that use a stack of single-degree-of-freedom mechanisms to achieve the same result.

Reduced Part Count Improves Performance
The beauty of our parallel flexure approach is its simplicity. Designers and users of nanopositioning equipment know that to transmit motion accurately it is preferable to have as few moving parts acting in series as possible. At each interface between parts, microscopic friction can occur. 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 root-mean-squared bi-directional repeatability of 30 nm, or 0.1% of full range for the NanoMax 600 series of stages. These results are made possible by the inherent superior performance of the parallel flexure mechanism that eliminates static and kinematic friction within the platform.

Specifications

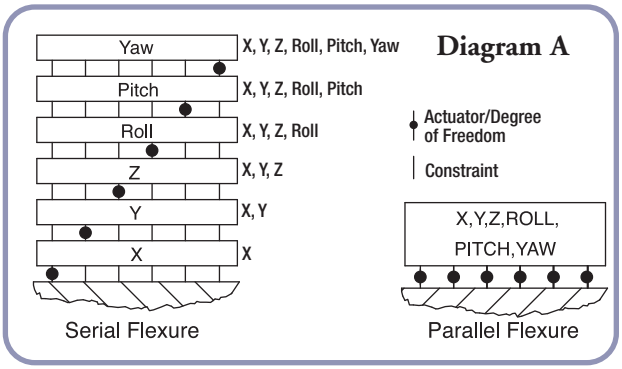
- **Stiffness Flexure Design:** 1 N/µm in X and Z, 0.5 N/µm in Y
- **Optical Axis Height:** 4.92" (125 mm)
- **Deck Height:** 4.43" (112.5 mm)

Stacked Systems Versus Inherently Parallel Multi-Axis Platform Design
Multi-axis systems are traditionally built by connecting together a series of single-axis mechanisms, as shown in the Diagram A to the right. 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 errors. The cosine error arises when the axes of two stages are not aligned orthogonal 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.

Our Superior Patented Parallel Flexure Design
The NanoMax 600 series has been at the forefront of nanopositioning technology for a number of years. The parallel flexure design of the 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, leading to excellent dynamic performance, making this product ideal for fast, automated alignment.

A parallel platform design solves the problem of error buildup. The enabling design step 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.



NanoMax™ 600 Six-Axis Parallel Flexure Platform (Page 2 of 2)

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.

All Actuators are Attached to the Base
This six-axis parallel flexure design has all of the benefits of a high-performance flexure stage with the added benefit of improved volumetric accuracy. This accuracy is better than traditional designs. As a secondary advantage, the actuators are connected to the base rather than the moving top plate. Consequently, during manual operation, operators can achieve a higher resolution with less skill. In motorized and automated applications, actuator vibration and shocks have little affect on the moving top plate.

A Common Pivot Point Simplifies any Alignment Challenge
A unique mechanical feature of the NanoMax 600 Series is that there is a single common pivot point for all three of the rotation axes. In practical terms this means that the need for compensating lateral movement is nearly eliminated when making rotational alignment movements. For complex alignments of planar optical devices this can vastly reduce the time required for optimizing a system.

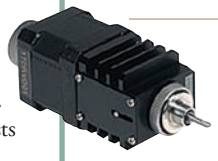
It is worth remembering that parallel flexures, like serial flexures, exhibit crosstalk or arcuate motion. As a stage is moved to either side of its central position, transverse arcuate displacements of approximately 10 µm per millimeter of travel occur. If several axes are moved at once, the combined 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 of 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 (see page 572), these effects are automatically compensated for by the controller itself. However, if arcuate motion is a defining parameter of a particular alignment or positioning application, its effects can also be compensated for with software.

Modular Actuators Allow a System to be Quickly Adapted
Designed for ease of use, the platform has a selection of modular actuators that may be used in any combination of stepper motor, external piezoelectric actuators, manual differential micrometers, and thumbscrew drives. However, the NanoMax 600 Series of nanopositioning platforms also includes a number of versions that have internal piezoelectric actuators giving 30 µm of ultrafine travel, either open-loop or with strain gauge position feedback. For increased performance and stability, the drive voltages are then also controlled by built-in circuitry to compensate for thermal variations.

The moving top plate of the NanoMax 600 stage offers a 125 mm optical axis height when used with any of the standard tongue and groove style accessories. Details of these optics and optical fiber holders can be found in the same accessory section as for the MicroBlock™, NanoMax™ 300, and RollerBlock™ on pages 496-512. Additionally, a range of accessory adapter plates and riser blocks allow the stage to be used together with all of the other nanopositioning stages.

Low Maintenance and Long Life
During operation, the NanoMax 600 series of 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 over, minimizing system down time and inconvenience.

Thumbscrew Drive
DRV004
See Page 528

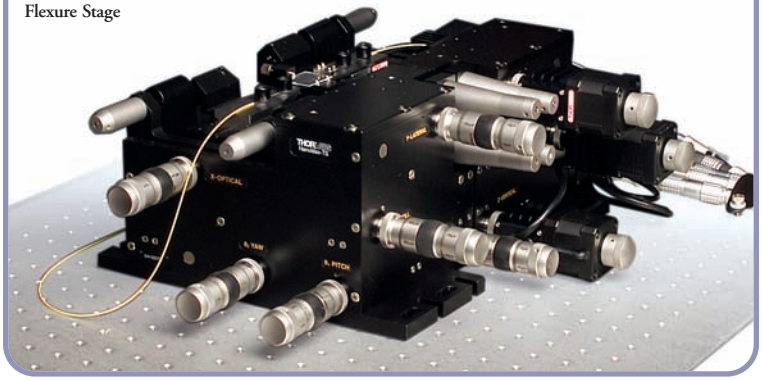


Stepper Motor Drive
DRV001
See Page 536

Differential Micrometer Drive
DRV002
See Page 528

Sophisticated Drive Electronics Ideally Suited for Automated Assembly Systems
Thorlabs offers a diverse selection of stepper motor, piezoelectric actuator, and auto-alignment systems supported with advanced software packages that significantly ease the task of building complete alignment systems. Please see our chapter on motion control drive electronics that starts on page 541.

Application of a Parallel Flexure Stage



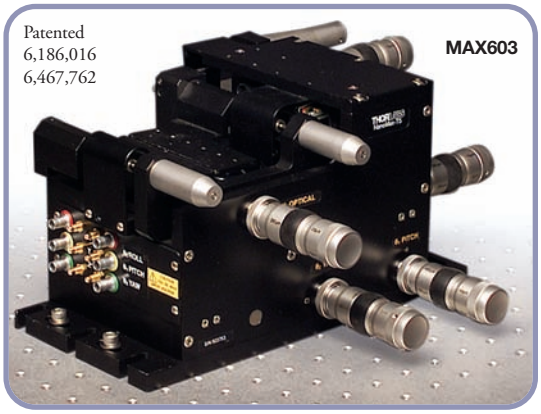
19" Rack System - See Page 407

NanoMax™ 600 Manual Six-Axis, Parallel Flexure Platform

These NanoMax™ six-axis platforms, fully detailed on the previous two pages, have all the high-stability features inherent in our patented parallel flexure design. The three most important practical results of this completely new design approach are the following:

- The common point of rotation is located on the optical axis defined by the accessory beam height; this feature simplifies, and consequently increases, the speed with which alignment tasks can be performed
- Increased stiffness of the backlash-free flexure mechanism that provides the stage's movement, a direct result of significantly fewer linkages being required to implement our parallel flexure design and thus providing greater stability and immunity to vibration as well as improved resistance to external forces that may arise in the assembly or bonding process
- All six actuators are stationary and held firmly to the base by the system's rigid frame. This ensures that the mass of the actuators does not add to the inertia of the moving platform and isolates the system from the disturbances induced by the operator using the touch controls.

Patented
6,186,016
6,467,762



These features, plus many more, make this stage ideal for fiber alignment and positioning tasks, particularly those involving multi-channel optical waveguides and complex optical circuits.

Specifications

- **Travel**
  - **Coarse Travel:** 0.16" (4 mm) (X, Y, Z), 6° (θx, θy, θz)
  - **Fine Travel:** 300 µm (X, Y, Z), 18 arcmin (θx, θy, θz)
  - **Optional Piezo Actuator Travel:** 30 µm (X, Y, Z), 1.8arcmin (θx, θy, θz)
- **Stiffness:** 1 N/µm in X and Z, 0.5 N/µm in Y
- **Resonant Frequency:** >130 Hz (to ±10%) Bidirectional
- **Resolution and Repeatability**
  - **Coarse Travel:** 1 µm (X, Y, Z), 4 arcsec (θx, θy, θz)
  - **Fine Travel:** 50 nm (X, Y, Z), 0.3 arcsec (θx, θy, θz)
  - **Optional Piezoelectric Actuators:** 30 nm (X, Y, Z), 0.1 arcsec (θx, θy, θz)
  - **Optional Piezoelectric Actuator with Feedback:** 10 nm Closed-Loop (X, Y, Z), 0.03 arcsec (θx, θy, θz)
- **RMS Repeatability:** 30 nm over 30 µm 0.1% Over full travel range

General Data

- **Load Capacity:** 2.2 lbs (1 kg)
- **Optional Piezoelectric Drive Voltage:** 0 - 75 VDC
- **Moving Top Plate Size:** 2.75" x 2.36" (70.0 mm x 60.0 mm)

Your Choice!

If you require two stepper motors and one manual drive for your application or any other combination, please see page 494 to configure a stage to your specific needs or speak to a member of our technical support staff.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX601	MAX601/M	$ 5,765.00	£ 3,997.00	€ 5.119,00	¥ 48,680.00	NanoMax™ 6-Axis Manual Positioning Stage

All models are available in a left-handed configuration; please call for details.

Two Models Offered with Piezoelectric Actuators

- **Piezoelectric Travel:** 30 µm Linear, 1.8 arcmin Angular in Each Direction
- **Displacement Sensor (MAX603):** Increases Resolution by a Factor of Four and Enables Closed-Loop Operation
- **Piezoelectric Drive Voltage:** Maximum Piezoelectric Drive Voltage is 75 VDC

Mechanical Drawings Available on the WEB

Piezoelectric Actuator and Optional Displacement Sensor

PIN 1: +15 V
PIN 2: OSCILLATOR+
PIN 3: 0 V
PIN 4: SIG OUT-
PIN 5: SIG OUT+
PIN 6: -15 V
PIN 7: TRAVEL

The strain gauge displacement sensor, directly attached to the body of the piezoelectric element, provides an analog signal that is proportional to its displacement. With low noise electronics, the resolution obtained is better than 10 nm over a 30 µm range.

NanoMax 602: Differential Manual Drives and Piezoelectric Actuators

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX602	MAX602/M	$ 9,625.00	£ 6,673.00	€ 8.546,00	¥ 81,274.00	NanoMax™ 6-Axis Manual Positioning Stage with Piezos

NanoMax 603: Differential Manual Drives, Piezoelectric Actuators, and Displacement Sensors

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX603	MAX603/M	$ 11,799.00	£ 8,180.00	€ 10.476,00	¥ 99,632.00	NanoMax™ 6-Axis Manual Stage with Piezos and Sensors

NanoMax™ 600 Stepper Motor Six-Axis, Parallel Flexure Platform

Specifications

- **Travel:**
  - Stepper Motor Range: 0.16" (4 mm) (X, Y, Z), 6° (θx, θy, θz)
  - Optional Piezo Actuators: 30 µm (X, Y, Z), 1.8 arcmin (θx, θy, θz)
- **Resolution:**
  - Stepper Motor Resolution: 20 nm (X, Y, Z), 0.1 arcsec (θx, θy, θz), Tested with Model BSC103 Stepper Motor Driver
  - Optional Piezoelectric Actuator: 30 nm (X, Y, Z), 0.1 arcsec (θx, θy, θz)
  - Optional Piezoelectric Actuator with Feedback: 10 nm (X, Y, Z), 0.03 arcsec (θx, θy, θz)

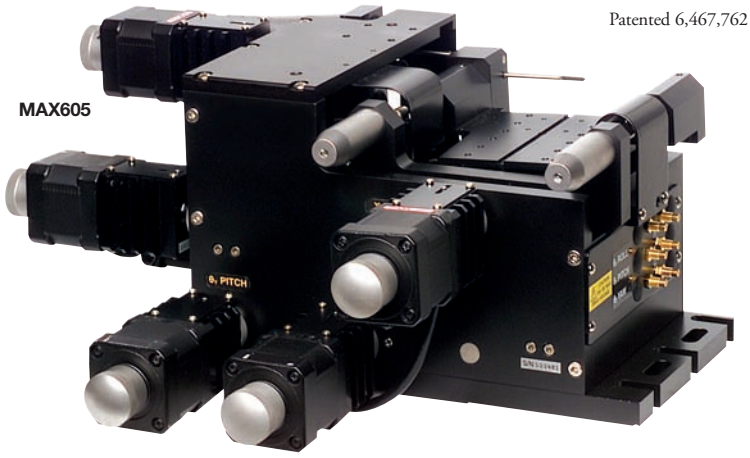
General Data

- **Deck Height**
  - Mounting Surface of the Moving Top Plate: 4.43" (112.5 mm)
  - Accessory Beam Height: 4.92" (125 mm)*
- **Resonant Frequency:** With no Load on the Stage >130 Hz (±10%)
- **Crosstalk:** Max 20 µm/mm of Travel (Also Known as Arcuate Motion)
- **Modular Stepper Motor Drives:** Hybrid Stepper Motor with 1.8° Step Angle and 23 N·cm of Holding Torque
- **Load Capacity:** 2.2 lbs (1 kg)

*Measured from the bottom surface of the stage

Customer Specific Configurations: As with all our products, we encourage you to call if you would like to have a system configured to your specific needs. Also, please refer to the next page for ordering custom stages.

Patented 6,467,762



These motorized NanoMax six-axis platforms combine the high thermal and mechanical stability of our other NanoMax™ 600 series platforms with the automated control offered by outfitting the system with microstepping stepper motors. When controlled by the apt™ Series Stepper Motor System Controllers, they provide fast, automated positioning.

The NanoMax TS series offers inherently low kinematic static friction and virtually zero backlash, except for that associated with the leadscrew of the stepper motors. These features combine to produce an automation tool that is capable of 24/7 operation with a positional resolution of 20 nm that will not degrade in industrial applications. Compared to traditional flexure designs, the mechanical stiffness is an order of magnitude higher. This offers additional resistance against the external forces often encountered in the assembly process. Hence, this stage is ideal for fiber alignment and positioning tasks, particularly those involving multi-channel optical waveguides and complex optical circuits.

For an increased level of automation, we offer two models with internal piezoelectric actuators. One of these two is also offered with displacement sensors that attach directly to the piezoelectric stacks. This added feature increases the resolution by a factor of two and enables closed-loop operation.

The hybrid stepper motors used in the NanoMax™ 600 series platforms have a rotor that consists of 50 individual magnetic teeth ideally suited for micro-stepping applications. Aside from the obvious increase in resolution provided by increasing the steps per revolution from the standard of 200 to 25,600, microstepping also ensures smoother low-speed motion by producing 128 steps per standard 1.8° step, significantly reducing the vibrational noise inherent with the 1.8° steps.

NanoMax™ Stepper-Motor-Based Actuators: Mechanical and Electrical Data

- **Step Angle:** 1.8°
- **Step Accuracy:** 5%
- **Rated Phase Current:** 1 A
- **Phase Resistance:** 4.6 Ω
- **Phase Inductance:** 10.6 mH
- **Holding Torque:** 23.1 N·cm
- **Detent Torque:** 1.7 N·cm

NanoMax 604: Stepper Motors, No Piezos

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX604	MAX604/M	$ 7,175.00	£ 4,974.00	€ 6.371,00	¥ 60,586.00	NanoMax™ 6-Axis Positioning Stage with Stepper Motors

NanoMax 605: Stepper Motors and Piezoelectric Actuators

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX605	MAX605/M	$ 11,035.00	£ 7,650.00	€ 9.797,00	¥ 93,180.00	NanoMax™ 6-Axis Positioning Stage, Stepper Motors, & Piezos

NanoMax 606: Stepper Motors, Piezoelectric Actuators, and Displacement Sensors

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MAX606	MAX606/M	$ 13,210.00	£ 9,158.00	€ 11.728,00	¥ 111,546.00	NanoMax™ 6-Axis Stage, Stepper Motors, Piezos, & Sensors

NanoMax™ 600, Customer-Configured, Six-Axis Platform (Page 1 of 2)

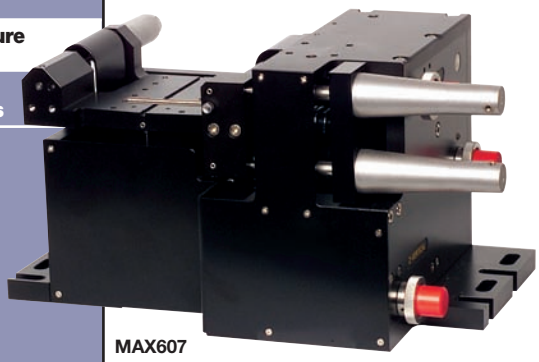
Patents
6,186,016 and 6,467,762

Thorlabs has designed a complete set of actuators that are modular and connect to the mating platform within seconds, without needing any tools.

To configure your own platform, simply choose the NanoMax™ bare unit from below and the number and type of actuators from the facing page.

MAX608

NanoMax™ Platform Only, No Piezos


MAX607

Use this base unit if your application does not require piezoelectric actuators. Please note that while the drives can be easily changed in the field, the piezoelectric actuators are built directly into the body of the stage. If your needs change and you later require piezoelectric actuators, they can be added using the modular piezoelectric extenders shown on the next page.

ITEM#	METRIC ITEM#	$	£	€	RMB
MAX607	MAX607/M	$ 4,055.00	£ 2,811.00	€ 3.600,00	¥ 34,241.00

NanoMax™ Platform, Piezoelectric Actuators

Mechanical Drawings Available on the WEB

Adding internal piezoelectric elements to the basic NanoMax™ 600 platform provides 30 µm of high- resolution motion control (0 to 75 V). The typical resolution of these piezo actuators is 30 nm.

ITEM#	METRIC ITEM#	$	£	€	RMB
MAX608	MAX608/M	$ 8,035.00	£ 5,571.00	€ 7.134,00	¥ 67,848.00

NanoMax™ Platform with Piezoelectric Actuators and Sensors

Adding strain gauge displacement sensors to the internal piezoelectric elements provides 30 µm of high-resolution motion control (0 to 75 V). However, including the strain gauge sensors improves the platform's resolution, linearity and drift performance. For more information on the performance of the NanoMax™ 600 platform with internal piezos and strain gauge displacement sensors, please refer to page 490.

Displacement Sensor

PIN 1: +15 V
PIN 2: OSCILLATOR+
PIN 3: 0 V
PIN 4: SIG OUT-
PIN 5: SIG OUT+
PIN 6: -15 V
PIN 7: TRAVEL

ITEM#	METRIC ITEM#	$	£	€	RMB
MAX609	MAX609/M	$ 10,275.00	£ 7,123.00	€ 9.123,00	¥ 86,763.00

NanoMax™ 600, Customer-Configured, Six-Axis Platform (Page 2 of 2)

High-Resolution Micrometer

Mechanical Drawings Available on the WEB

DRV002

This high-resolution micrometer drive with 50 nm positional resolution is matched in performance to the capabilities of the NanoMax™ series platforms. Full details on this drive can be found on page 528.

ITEM#	$	£	€	RMB
DRV002	$ 315.00	£ 218.40	€ 279,70	¥ 2,659.90

Specifications

- **Travel:**
  - Coarse: 0.16" (4 mm)
  - Fine: 300 µm
- **Resolution:**
  - Coarse: 0.5 µm
  - Fine: 50 nm

Stepper Motor

DRV001

This stepper motor drive is fully detailed on page 536. When used with our apt™ Series Stepper Motor Driver, it provides 25,600 microsteps per revolution.

ITEM#	$	£	€	RMB
DRV001	$ 585.00	£ 405.60	€ 519,40	¥ 4,939.80

Specifications

- **Travel:** 0.16" (4 mm)
- **Resolution:** 25 nm
- **Holding Torque:** 23.1 N·cm

Thumbscrew

DRV004

This Thumbscrew drive is often used in applications or positioning tasks that require a high degree of stability but have lower resolution requirements.

ITEM#	$	£	€	RMB
DRV004	$ 96.50	£ 66.90	€ 85,70	¥ 814.90

Specifications

- **Travel:** 0.16" (4 mm) (Overall)
- **Resolution:** 1 µm (500 µm Thread Pitch)

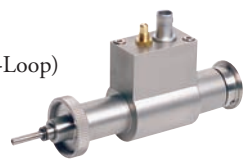
Piezoelectric Extenders

These piezoelectric extenders provide 20 µm or 80 µm of high-resolution travel to any of the modular drives shown above. The modular design allows these extenders to be attached in series with any of Thorlabs' modular drives. These extenders are ideal for applications that require high-resolution movements over a small range. Coarse adjustments are made using any one of our modular drives.

Specifications

- **Travel:** 20 µm
- **Resolution:** 5 nm (Closed-Loop)
- Displacement Sensor

DRV120

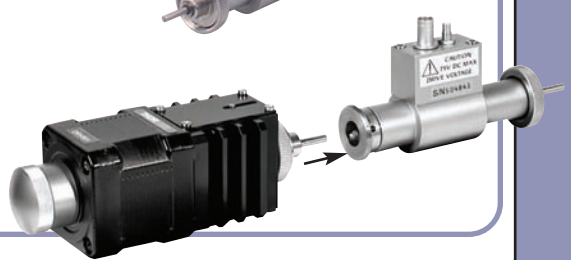


Specifications

- **Travel:** 80 µm
- **Resolution:** 80 nm

DRV181

ITEM#	$	£	€	RMB
DRV120	$ 995.00	£ 689.80	€ 883,40	¥ 8,401.90
DRV181	$ 995.00	£ 689.80	€ 883,40	¥ 8,401.90



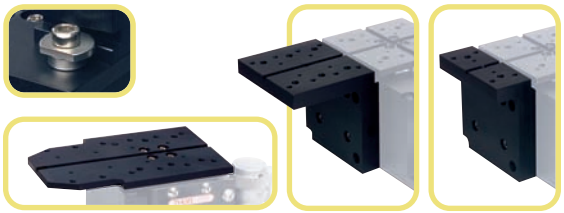
Flexure Accessories Selection Guide

Pages 496-512

Fixed Platforms

- Lock Down Clamps
- Angle Brackets
- Platform Extension Plates

See Pages 497-498



Fixed Optic Mounts

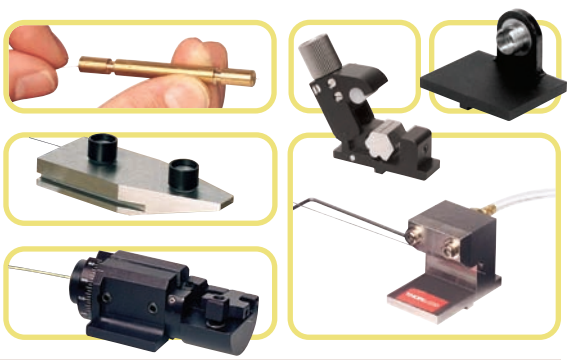
- SM05, RMS, or SM1 Threaded Mounts
- Mounts for GRIN Lenses and Fixed Collimation Packages
- Ø1" Optic Mount

See Pages 499-500

Fiber Mounts

- Holders for Bare Fibers from 125 µm to 2 mm
- Mount for Patch Cables with Either FC or SMA Connectors
- Fiber Chuck Pitch and Yaw Mount
- Fiber Rotators
- Fiber Array Holder

See Pages 501-505



Axial Force Sensors

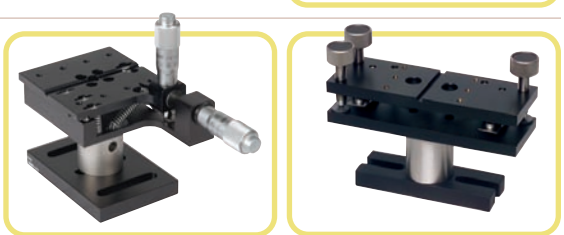
- Mounting Platform
- V-Groove Fiber Holder

See Page 506

Pitch, Roll and Yaw Platforms

- Pitch and Yaw or Pitch and Roll Platforms
- Thumbscrew or Micrometer Drives

See Pages 508-509

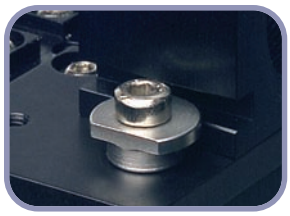


Adapters

- Mounting Adapter Plates
- Blank Mounting Bracket and Mounting Block
- Fixed Mounting Height Adapters
- Cross Platform Mounting Plate
- Height Risers for Raising 3-Axis Stages to 4-, 5-, and 6-Axis Platform Height

See Pages 507-512

Lock Down Clamp



These small clamps, which come in packages of 15, are used to attach accessories to the mounting surfaces of the NanoMax™, MicroBlock™, RollerBlock™, and PiezoBlock™ families of stages.

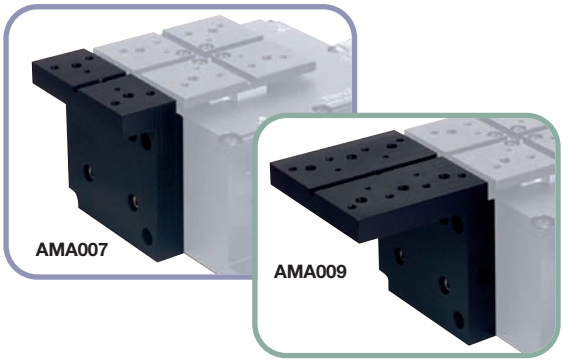
The flat that is milled along one side of the clamp allows it to be rotated such that when the flat is facing the center alignment groove, it is possible to drop an accessory into place between two clamps.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA010	AMA010/M	$ 35.60	£ 24.70	€ 31,70	¥ 300.70	Accessory Clamp, Package of 15 with Hex Wrench

Fixed Angle Brackets

These two angle brackets mount directly to the fixed portion of the NanoMax™ and MicroBlock™ stages. The smaller bracket is often used for fiber launch systems that utilize our aspheric lenses in place of much longer microscope objectives. The larger bracket is used in the Thorlabs' preconfigured fiber launch systems (see page 474). The larger mounting surface is generally useful when space permits.

- **AMA007 Mounting Surface:**
  1.02" (26 mm) Long
  2.46" (62.5 mm) Deck Height
- **AMA009 Mounting Surface:**
  2.2" (56 mm) Long
  2.46" (62.5 mm) Deck Height

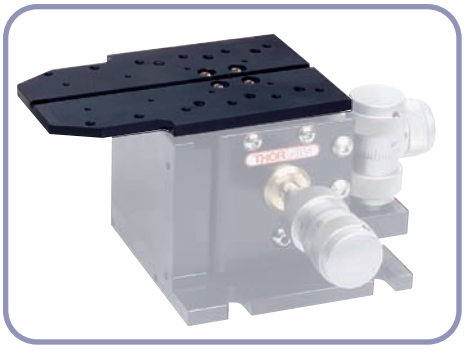


ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA007	AMA007/M	$ 64.60	£ 44.80	€ 57,40	¥ 545.50	Small Angle Bracket for 3-Axis Flexure Stage
AMA009	AMA009/M	$ 71.30	£ 49.50	€ 63,40	¥ 602.10	Large Angle Bracket for 3-Axis Flexure Stage

Platform Extension Plates

Mechanical Drawings Available on the WEB

These three extended platforms replace the top plate of any NanoMax™, MicroBlock™, RollerBlock™, or APB30X PiezoBlock™ stage. The extended mounting surface is convenient for attaching components or accessories that need to reach into smaller spaces.



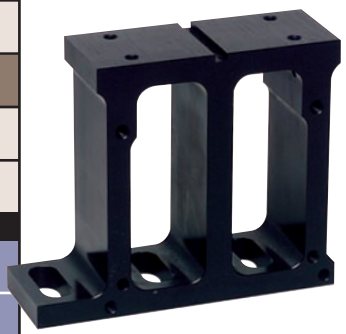
AMA001
3.35" (85 mm) Long

AMA003
3.74" (95 mm) Long

AMA005
4.13" (105 mm) Long

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA001	AMA001/M	$ 86.40	£ 59.90	€ 76,80	¥ 729.60	85 mm Extended Platform for NanoMax300 & MicroBlock
AMA003	AMA003/M	$ 86.40	£ 59.90	€ 76,80	¥ 729.60	95 mm Extended Platform for NanoMax300 & MicroBlock
AMA005	AMA005/M	$ 86.40	£ 59.90	€ 76,80	¥ 729.60	105 mm Extended Platform for NanoMax300 & MicroBlock

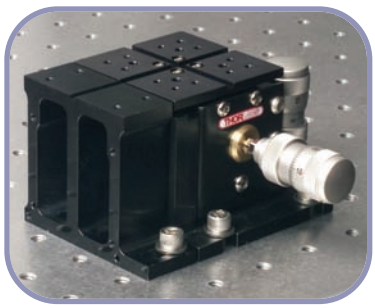
Free-Standing Table Platform



AMA025
2.46" (62.5 mm) Deck Height,
0.98" (25 mm) Wide

This free-standing, stationary table platform, which has a standard slotted top surface that attaches directly to the optical table, is designed to match the platform height of the NanoMax™, MicroBlock™, and PiezoBlock™ series of stages. In addition to the standard slot and tapped-hole pattern on the top surface, there are tapped holes on the sides, which can be used to mount other accessories or positioning stages.

Mechanical Drawings Available on the WEB



Front mounting holes on the table platform allow extended platforms to be built from the angle bracket (AMA007, AMA009, and AMA011) shown on the previous page.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA025	AMA025/M	$ 97.00	£ 67.30	€ 86,20	¥ 819.10	25 mm Wide Table Mounting Platform 62.5 mm Deck Height

Moving Angle Bracket

The AMA011 Angle Bracket can be used to replace the top plate of a three-axis nanopositioner (NanoMax™ or MicroBlock™) in order to provide a convenient vertical mounting surface. This allows for additional components or accessories to be attached to the stage.

Compatible with Both the NanoMax™ and MicroBlock™ Series of Three-Axis Stages

AMA011

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA011	AMA011/M	$ 71.30	£ 49.50	€ 63,40	¥ 602.10	Moving Angle Bracket for the Three-Axis NanoMax™ and MicroBlock™ Stages

Angle Bracket and Spacer Block Kits

NEW products

When a pitch/yaw or roll/pitch platform is removed from the post and fixed directly to the stage in place of the standard top plate, it raises the optical axis height of the stage by 15 mm (0.6").

These Angle Bracket and Spacer Block Kits can be fitted to the side of the stage to raise components on stages without an APR or APY series platform to the same height. The ABS001 is suitable for smaller components whereas the ABS002 is meant for larger devices such as stages with an APR or APY series platform.

NanoMax™ Stage with Pitch and Roll Stage Plus the Spacer Block ABS002

ABS001

ABS002

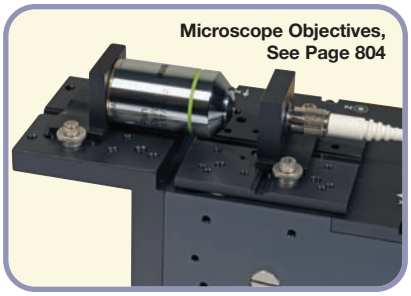
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
ABS001	ABS001/M	$ 106.60	£ 73.90	€ 94,70	¥ 900.20	Small Angle Bracket and Spacer Kit
ABS002	APY002/M	$ 124.50	£ 86.40	€ 110,60	¥ 1,051.30	Large Angle Bracket and Spacer Kit

Microscope Objective Holder

HCS013

The compact HCS013 flexure stage mount is internally threaded with the standard RMS microscope objective thread. This allows a microscope objective, or any component with external RMS thread, to be mounted with its optical axis 0.5" (12.5 mm) above any of our Multi-Axis Flexure Stages (NanoMax™, MicroBlock™, PiezoBlock™, or RollerBlock™ series).

Thorlabs also offers a complete selection of microscope objectives that are well suited to fiber coupling applications (see page 474).

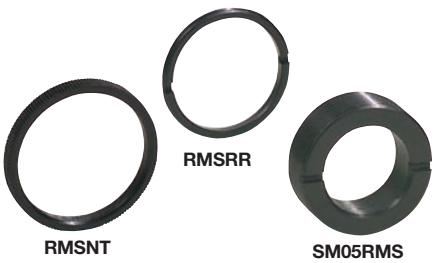


Microscope Objectives, See Page 804

ITEM#	$	£	€	RMB	DESCRIPTION
HCS013*	$ 63.00	£ 43.70	€ 56,00	¥ 532.00	Microscope Objective Holder

*Universal Design, Imperial and metric compatible.

RMS Retaining Rings and Adapter



The RMSNT locking nut has internal RMS threading and can be used to lock RMS-threaded components into place. The knurled external surface provides improved grip for tightening into position.

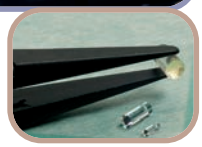
The RMSRR retaining ring has external RMS threading and can be used to lock RMS-threaded components into place.

This SM05RMS adapter allows any SM05-compatible products to be used in mounts with RMS threads. The adapter has an SM05 internal thread and an RMS external thread. (Use SPW603 spanner wrench).

ITEM#	$	£	€	RMB	DESCRIPTION
RMSRR	$ 10.20	£ 7.05	€ 9,10	¥ 86.20	RMS Retaining Ring
RMSNT	$ 10.20	£ 7.05	€ 9,10	¥ 86.20	RMS Locking Nut
SM05RMS	$ 14.30	£ 9.90	€ 12,70	¥ 120.80	SM05-to-RMS Adapter

GRIN Lens Holders

HGI003



GRIN Lenses See Page 648

The HGI003 lens holder secures gradient-index lenses with diameters ranging from 1 to 3 mm in a precision V-groove with a spring clamp. This easy-load holder fits into the locating keyway of our multi-axis flexure stages. The keyway allows the GRIN lens to be slid into its coarse position before tightening; final positioning is then accomplished using the precision control of the stage.

Gradient-index lenses are used to collect light from laser diodes and focus it into fibers (0.29 pitch), to collect and collimate light from laser diodes, or to focus collimated beams into fibers (0.23 pitch).

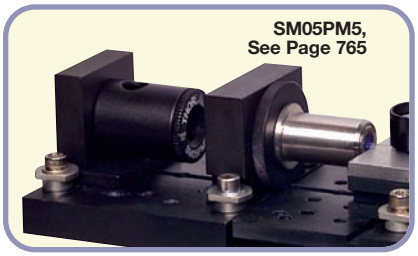
- Holds Ø1 to Ø3 mm GRIN Lenses
- Easy-to-Use, Simple, Spring-Clamping Action

ITEM#	$	£	€	RMB	DESCRIPTION
HGI003	$ 112.00	£ 77.70	€ 99,50	¥ 945.80	GRIN Lens Holder for Ø1 mm to Ø3 mm Optics

SM05-Threaded Adapter Mount

HCS020

The HCS020 mount allows our extensive line of SM05 (0.535"-40) threaded products to be integrated into any setup using Thorlabs' flexure stages. The most popular application of this mount is to enclose the light path using Ø1/2" lens tubes. Other applications include use with the SM05PM5 linear polarizer holder to align a PM fiber to a connector keyway.



SM05PM5, See Page 765

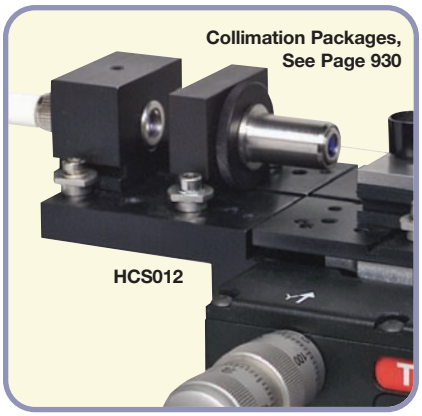
ITEM#	$	£	€	RMB	DESCRIPTION
HCS020*	$ 50.00	£ 34.70	€ 44,40	¥ 422.30	SM05-Threaded Adapter

*Uiversal Design, Imperial and Metric Compatible

Collimation Package Holders

Thorlabs' Ø11 mm, Ø12 mm, and Ø15 mm Collimation Packages can be integrated into a setup that uses a 3-axis translation stage by using a HCS011 (Ø11 mm Collimators), HCS012 (Ø12 mm Collimators), or HCS015 (Ø15 mm Collimators) mount.

Nylon-tipped setscrews secure the collimation package without marring the housing.



ITEM#	$	£	€	RMB	DESCRIPTION
HCS011*	$ 40.00	£ 27.80	€ 35,60	¥ 337.80	Ø11 mm Collimation Package Holder
HCS012*	$ 40.00	£ 27.80	€ 35,60	¥ 337.80	Ø12 mm Collimation Package Holder
HCS015*	$ 35.00	£ 24.30	€ 31,10	¥ 295.60	Ø15 mm Collimation Package Holder

*Universal Design, Imperial and Metric Compatible

Ø1" Optic Mount for Flexure Stages

HCS030

The HCS030 holds Ø1" (Ø25.4 mm) optics, keeping the center of the lens concentric with the 0.5" (12.7 mm) beam height standard for all flexure stage accessories with the exception of the HCS031. A non-marring delrin® pin is used to secure the optic. The HCS030 must be used with the updated (2006) alignment groove, which provides the required clearance for Ø1" optics.

- Allows Most Ø1" (Ø25.4 mm) Optics to be Mounted to any Thorlabs Flexure Stage
- Maintains 0.5" (12.7 mm) Optical Axis Height
- Must be used with Grooved Top Plates as Shown

MMP1
Detailed View Showing Updated Alignment Groove

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
HCS030*	HCS030*	$ 50.00	£ 34.70	€ 44,40	¥ 422.30	Ø1" Optic Mount for Flexure Stages
MMP1	MMP1/M	$ 68.00	£ 47.20	€ 60,40	¥ 574.20	Replacement Mounting Plate for Flexure Stages

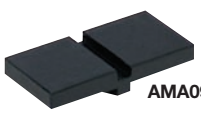
*Universal Design, Imperial and Metric Compatible

Ø1" SM1 Threaded Optic Mount for Flexure Stages

HCS031

The HCS031 mount has an internally SM1 (1.035"-40) threaded bore, which makes it compatible with Thorlabs' extensive line of SM1 threaded components. Due to the diameter of the SM1 threading, the optical axis of the HCS031 mount is 18 mm above the flexure stage platform instead of the standard 12.5 mm. As a result, a 5.5 mm riser plate (AMA093) is required for all mounts with an optical axis height of 12.5 mm when used with the HCS031.

- 18 mm Optical Axis Height (Caution Non-Standard Beam Height)



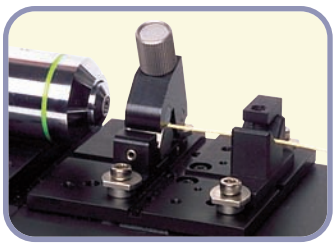
AMA093

Mechanical Drawings Available on the WEB

ITEM#	$	£	€	RMB	DESCRIPTION
HCS031*	$ 37.00	£ 25.70	€ 32,90	¥ 312.50	Ø1" SM1 Threaded Mount for Flexure Stages
AMA093*	$ 14.00	£ 9.70	€ 12,50	¥ 118.30	Riser Plate, 5.5 mm

*Universal Design, Imperial and Metric Compatible

Fiber Clamp: Multi-Fiber, Fast-Release, and Adjustable-Force



- Adjustable-Force Fiber Clamping Arm, 25 - 200 g
- Multi-Purpose V-Groove Insert Features 5 Different V-Grooves and 1 Flat Surface
- Accomodates Fibers or Cylindrical Optical Elements with Diameters Ranging from 125 µm to 2 mm

This fast-release, adjustable-force fiber clamp has several innovative features that make it our most versatile fiber clamp. The top knob is used to adjust the clamping force that the clamping arm exerts on the fiber. This feature is useful when working with speciality fibers such as highly birefringent fiber, photonic crystal fiber, or exotic glass fibers (for example, fluoride or tellurite fibers). The five-sided block has a different V-groove on each side that allows the user to mount a variety of photonic components, from bare optical fibers or optical fibers mounted in ceramic ferrules to multichannel waveguides.

ITEM#	$	£	€	RMB	DESCRIPTION
HFF001*	$ 455.00	£ 315.50	€ 404,00	¥ 3,842.10	Fiber Clamp for Ø125 µm to Ø2 mm Fibers

*Universal Design, Imperial and Metric Compatible

Simplified Ø250 µm Fiber Clamp

This fiber clamp is intended for those applications that do not require the extra features of the HFF001 fiber clamp. The clamping arm is designed to swing approximately 120° up from the clamping surface, allowing for easy loading of the fiber into the V-groove. A rare-earth magnet is used to hold the clamping arm in place once it is lowered onto the fiber. A setscrew in the arm provides a simple means of adjusting the clamping force by setting the gap between the two rare-earth magnets.

- Securely Clamps Ø250 µm Jacketed Optical Fiber
- Magnet Holds Clamping Arm in Place
- Simplified Mechanical Design Provides Economical Device

ITEM#	$	£	€	RMB	DESCRIPTION
HFF003*	$ 110.00	£ 76.30	€ 97,70	¥ 928.90	Fiber Clamp for 250 µm Diameter Fibers

*Universal Design, Imperial and Metric Compatible

Standard V-Groove Fiber Holder

- Precision V-Groove Designed to Hold Ø125 µm Fibers
- Nickel-Plated Steel Provides Robust, Wear-Resistant Surface
- Magnetic Clamps have a Soft Elastomer Pad to Protect the Fiber Cladding from Damage

For ease of mounting and experimental flexibility, the HFV001 Standard V-Groove Fiber Holder is an ideal solution for securing bare, single mode fibers. The fiber is held in the precision V-groove by two magnetic clamps. The clamps have a special elastomer pad that locally distorts around the fiber to provide a secure but delicate grip. The base of the holder is aluminum, but the top plate is made of nickel-plated magnetic steel.

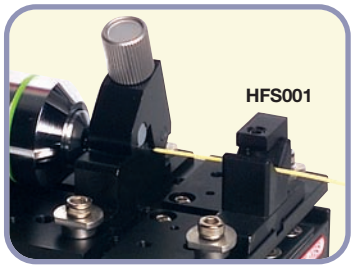
ITEM#	$	£	€	RMB	DESCRIPTION
HFV001*	$ 129.50	£ 89.80	€ 115,00	¥ 1,093.60	Standard V-Groove Fiber Holder

*Universal Design, Imperial and Metric Compatible

Cable Strain Relief

- Secures both Ø900 µm and Ø3 mm Cables
- Prevents Accidental Misalignment

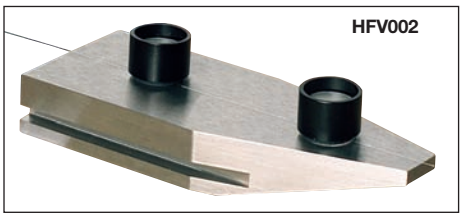
This strain relief accessory ensures that disturbances to the fiber optical cable do not cause unwanted movement of the fiber end face.



ITEM#	$	£	€	RMB	DESCRIPTION
HFS001*	$ 45.00	£ 31.20	€ 40,00	¥ 380.00	Cable Strain Relief

*Universal Design, Imperial and Metric Compatible

Tapered V-Groove Fiber Holder



- Precision V-Groove Designed to Hold Ø125 µm Fibers
- Nickel-Plated Steel Provides Robust, Wear-Resistant Surface
- Tapered End for Maximum Access in Industrial Coupling Applications

The longer HFV002 tapered V-groove fiber holder is designed to allow access to smaller devices. When butt-coupling single mode fibers to small waveguide devices (particularly when the device is mounted on a waveguide manipulator), users sometimes find it difficult to support and position the end of the fibers close enough to the input ports of the waveguide with the standard V-groove holder. The tapered top plate of this mount improves the visual observation of the fiber-waveguide interface. The fiber is secured with the two magnetic clamps, which are provided.

ITEM#	$	£	€	RMB	DESCRIPTION
HFV002*	$ 133.00	£ 92.20	€ 118,10	¥ 1,123.10	Tapered V-Groove Fiber Holder

*Universal Design, Imperial and Metric Compatible

Replacement Magnetic Clamps

- Soft Elastomer Bottom Surface Protects Exposed Fiber Cladding
- Sold in Packages of Six

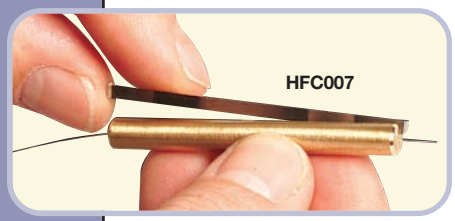
These magnet assemblies are used to securely hold the fiber on our V-groove fiber holders. Please note that two of these fiber clamps are included with each V-groove style fiber holder.

ITEM#	$	£	€	RMB	DESCRIPTION
HFM001*	$ 124.40	£ 86.30	€ 110,50	¥ 1,050.50	Package of 6 Magnetic Clamps

*Universal Design, Imperial and Metric Compatible

Classic Ø1/4" Fiber Chucks and Mounting Block

While Ø1/4" fiber chucks were popular a number of years ago, Thorlabs strongly recommends that users consider using one of the newer fiber clamp designs that utilize either a clamping arm or two magnetic caps to hold the fiber in place (see previous page).

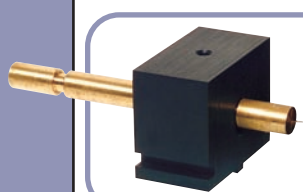


Side-Loading Fiber Chuck

The HFC007 industry-standard fiber chuck allows the fiber to be loaded from the side, making it possible to strip and cleave the fiber prior to loading. This chuck is designed to accept Ø250 µm fibers and secures the fiber in place with a spring clip that slips into place as shown in the photograph to the left. The dimensions of the chuck are 2.36" (60 mm) in length and 0.25" (6.35 mm) in diameter.

Back-Loading, Collet-Style Fiber Chuck

This traditional fiber chuck uses a collet mechanism to secure the fiber in place. The popular design requires that the fiber be fed through the length of the chuck. Therefore, the fiber needs to be fed through the holder prior to being cleaved in order to prevent the endface of the fiber from being damaged. The HFC005 has the same industry-standard dimensions as the HFC007 [i.e., Ø0.25" x 2.36" (Ø6.35 mm x 60 mm)].



Mounting Block Shown with the Collet-Style Fiber Chuck.

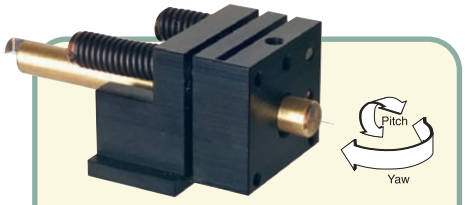
Fiber Chuck Mounting Block

The HFG001 mounting block is designed to accept the industry standard fiber chucks. The double bore ensures that two lines of contact are maintained along the length of the 1/4" diameter chuck. A nylon-tipped setscrew is used to apply the pressure required to hold the fiber chuck firmly in place.

ITEM#	$	£	€	RMB	DESCRIPTION
HFC005*	$ 130.90	£ 90.80	€ 116,30	¥1,105.40	Classic Ø1/4" Fiber Chuck with Collet Clamp
HFC007*	$ 72.70	£ 50.40	€ 64,60	¥ 613.90	Classic Ø1/4" Fiber Chuck with Side-Loading Fiber
HFG001*	$ 67.90	£ 47.10	€ 60,30	¥ 573.40	Mounting Block for Classic 1/4" Fiber Chucks

*Universal Design, Imperial and Metric Compatible

Fiber Chuck Pitch and Yaw Mount

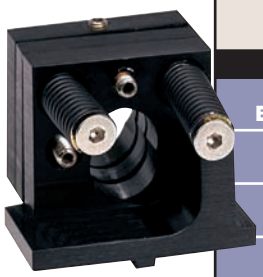


This photograph shows the HFG003 Fiber Chuck Pitch and Yaw Mount, along with our side-loading Ø1/4" fiber chuck. The flexure-based design of the HFG003 offers the stability that is required for a fiber coupling system.

- High-Stability Flexure Pitch and Yaw Fiber Chuck Holder
- Adjustment of Pitch and Yaw via Back Plate Adjuster Screws
- Adjustment Range of ±3°

The HFG003 flexure mount provides 2° of angular adjustment (pitch and yaw) and is designed to accept our Ø1/4" fiber chucks. When working with low-numerical-aperture optical fibers, the angular adjustment of the optical fiber with respect to the incoming laser beam can be a critical degree of freedom that may be required to optimize the coupling efficiency. Additionally, if small-core fibers are being used, the high divergence angle of tightly focused laser beams can also require careful alignment of the input angle to ensure that the input NA of the fiber is not exceeded.

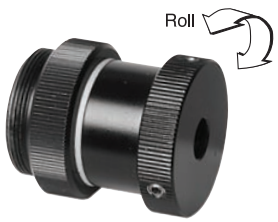
HFG003



ITEM#	$	£	€	RMB	DESCRIPTION
HFG003*	$ 142.00	£ 98.50	€ 126,10	¥ 1,199.10	Adjustable Flexure, Ø12.7 mm Optic Holder

*Universal Design, Imperial and Metric Compatible

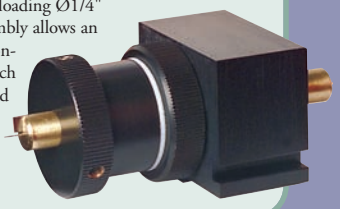
RMS Threaded Classic Fiber Chuck Rotator



HFR001

- Smooth, Low-Friction Fiber Rotator for Ø1/4" Fiber Chucks
- RMS-Threaded
- Three Nylon-Tipped Setscrews Secure the Fiber Chuck, Allowing the Lateral Offset to be Minimized when Operating the Rotation Stage

This photograph shows the HFR001 Fiber Chuck Rotator assembled with a side-loading Ø1/4" fiber chuck. This assembly allows an inexpensive polarization-maintaining fiber launch system to be configured from our multi-axis flexure stages featured on pages 468-495.

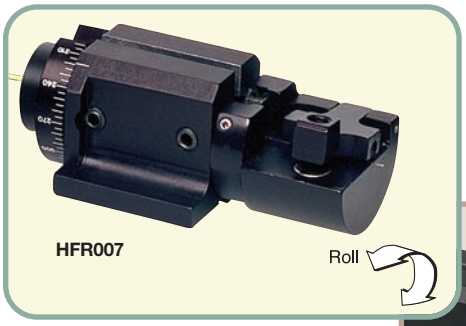


The HFR001 fiber chuck rotator is designed to hold and allow for the continuous rotation of a fiber chuck through 360°. It has a male RMS thread, which, when mounted in a microscope objective mount (HCS013, page 499), can be secured to the top plate of one of our multi-axis flexure stages or fixed brackets. The phosphor-bronze and Teflon bearing in the fiber chuck rotator provides smooth, low-friction rotation for precise angular orientation of a polarization-maintaining fiber. The lateral offset during rotation is typically less than 20 µm. This relatively small offset allows a Ø1.5 µm single mode fiber to be rotated by about 90° before compensating with Y and Z adjustments.

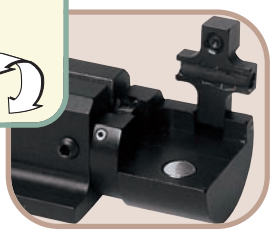
ITEM#	$	£	€	RMB	DESCRIPTION
HFR001*	$ 215.00	£ 149.10	€ 190,90	¥ 1,815.50	RMS Threaded Fiber Chuck Rotator

*Universal Design, Imperial and Metric Compatible

High-Precision Fiber Rotator: Quick-Load Bare Fiber



- 10 µm Maximum Eccentricity Over 360° Range
- Graduated Scale Provides ~2° Accuracy
- Easy-to-Load V-Groove Design uses a Swing Arm and Magnetic Force to Firmly Hold Optical Fiber
- Clamps on Fiber Cladding to Minimize Offset Errors
- Adjustable Holding Force Allows Control of the Stress-Induced Birefringence Caused by the Clamping Force Exerted on the Fiber



The HFR007 is intended for applications that require easy loading of the optical fiber. The swing arm lifts out of the way to expose a precision V-groove, which allows the fiber to be dropped down through the body of the rotator. An engraved dial, graduated in increments of 5°, is provided to allow measured angular changes in the orientation of the fiber.

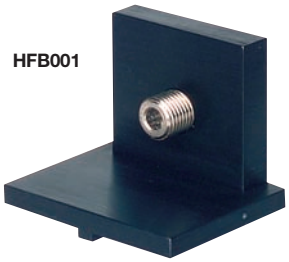
ITEM#	$	£	€	RMB	DESCRIPTION
HFR007*	$ 202.00	£ 140.10	€ 179,40	¥ 1,705.70	Precision Fiber Rotator for Bare Fiber

*Universal Design, Imperial and Metric Compatible

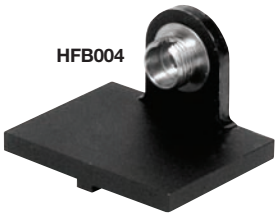
Connectorized Fiber Optic Cable Holders

The SMA-connectorized fiber holder HFB001 can be used to secure multimode fiber cables to our family of flexure-based nanopositioners and accessories. The SMA-style connector is almost exclusively used for multimode optical fibers.

HFB001



HFB004

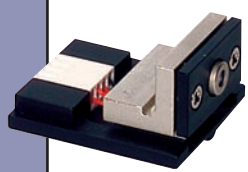


The FC-connectorized fiber holder HFB004 is a design that improves positional repeatability of the fiber through increased constraint of the fiber optic ferrule. It enables industry-standard FC/PC connectors to be secured to the mounting platforms of our multi-axis stages. The center of the connector is positioned 0.5" (12.5 mm) above the platform to provide the appropriate optical axis height.

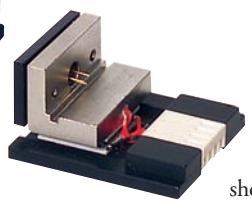
ITEM#	$	£	€	RMB	DESCRIPTION
HFB001*	$ 91.80	£ 63.70	€ 81,60	¥ 775.20	SMA Fiber Optic Cable Mount
HFB004*	$ 45.00	£ 31.20	€ 40,00	¥ 380.00	FC Fiber Optic Cable Mount

*Universal Design, Imperial and Metric Compatible

Diode Laser Mount with Thermoelectric Cooling



HLD001



- Laser Diode Mount with a Built-in TEC Element
- Mounts Directly onto the Deck of Our Multi-Axis Flexure Stages
- Supports the Mounting of Both Ø9 mm and Ø5.6 mm Laser Diode Packages
- Can be Driven by Our TTC001 T-Cube TEC Controller (See Page 1187)

In order to achieve the best possible performance from a laser diode, stability is often required. For applications that require power and/or wavelength stability, the laser diode should be operated utilizing a constant current driver as opposed to a constant power driver, which compensates for power flucuations by varying the drive current and often results in fluctuations of the output wavelength. To stabilize the output power and wavelength of a laser diode beam operated in the constant current mode, the temperature of the laser must also be held constant since a laser diode's output power and wavelength have a strong temperature dependence.

ITEM#	$	£	€	RMB	DESCRIPTION
HLD001*	$ 464.10	£ 321.80	€ 412,10	¥ 3,918.90	Diode Laser Mount with Thermoelectric Cooling

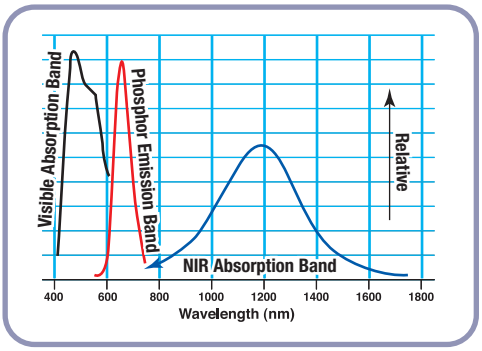
*Universal Design, Imperial and Metric Compatible

IR Viewing and Alignment Disk with RMS Thread

IR Viewing Surface

- Slow Fading, Constant Emission for Viewing CW Beams
- Ideal Alignment Aid for use with RMS-Threaded Mounts

The VRC2RMS is an excellent tool for aiding in IR fiber alignment. The thin, phosphorus-coated membrane fluoresces green, allowing the beam to be seen from either side of the active area. The front surface is etched with a crosshair to help gauge the position of the beam relative to the center of the target. The backside of the viewer is externally threaded for use with any internally RMS-threaded mount.



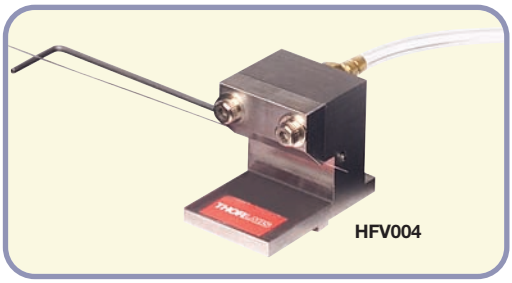
ITEM#	$	£	€	RMB	DESCRIPTION
VRC2RMS*	$ 80.00	£ 55.50	€ 71,10	¥ 675.60	IR Viewing Disk with RMS Thread, 800 - 1700 nm

*Universal Design, Imperial and Metric Compatible

Vacuum Fiber Holder

NanoMax™ 3-Axis Stage (MAX302) fitted with DRV002 Micrometer Drives (see Page 528), HFV004 Vacuum Fiber Holder, AMA009 Fixed Angle Bracket (see page 497), and HBB001 Blank Mounting Block (see page 507).

Mechanical Drawings Available on the WEB



The unique geometry of this fiber holder provides clearance around the side of the mount in order to allow the use of an optical inspection tool (video or conventional microscope) to monitor the alignment process. The vacuum holding force is exerted on the fiber jacket along the 20 mm length of the holder, thus ensuring that the fiber is well secured.

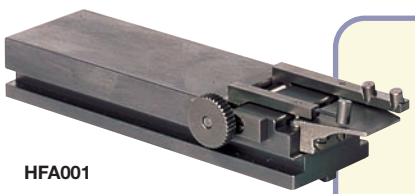
The main advantage of using a vacuum to secure the fiber is that it reduces the cycle time for the automated assembly of fiber pigtailing devices. The load/unload time is typically reduced because the vacuum action quickly and consistently pulls the fiber into place. In addition, the clamping and unclamping of the fiber can be automated. All of these factors lead to this device being an attractive alternative for manufacturing applications.

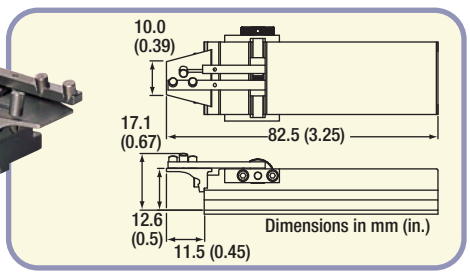
- Simple and Fast Vacuum Loading of Optical Fibers
- Inverted Design Provides Extra Clearance for Inspection Tools
- Ideal for Industrial Applications where Cycle Time is Critical
- Requires a Customer-Supplied Vacuum

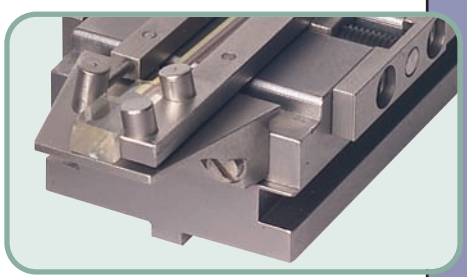
ITEM#	$	£	€	RMB	DESCRIPTION
HFV004*	$ 379.00	£ 262.80	€ 336,50	¥ 3,200.30	Inverted Vacuum Fiber Holder with Side Access

*Universal Design, Imperial and Metric Compatible

Adjustable Fiber Array Holder



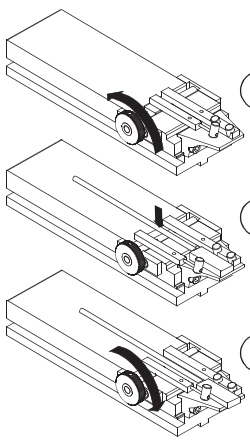




Please refer to our website for complete models and drawings.

- Accepts Rectangular Fiber Arrays up to 12 mm Wide
- Easy Loading with a Actuator Knob Controlling the Clamping Mechanism
- Angled Contact Pads Ensure that the Optical Element Sits Flat on the Support Surface
- Generally Useful for Mounting Rectangular Shaped Optics

The HFA001 fiber array holder is part of our extensive line of accessories that serve to enhance our multi-axis flexure stages. As can be seen from the drawing to the right, the operation of this device is achieved via a single actuator knob. This knob simultaneously moves both sides of the clamping mechanism to ensure that the device being mounted is centered on the support surface of the HFA001. The three angled clamping rods make contact and provide a slight downward pressure on the optical element; the three points of contact guarantee stability. The third clamping rod is mounted at the end of a flexure arm that provides for some spring loading of the element being clamped.

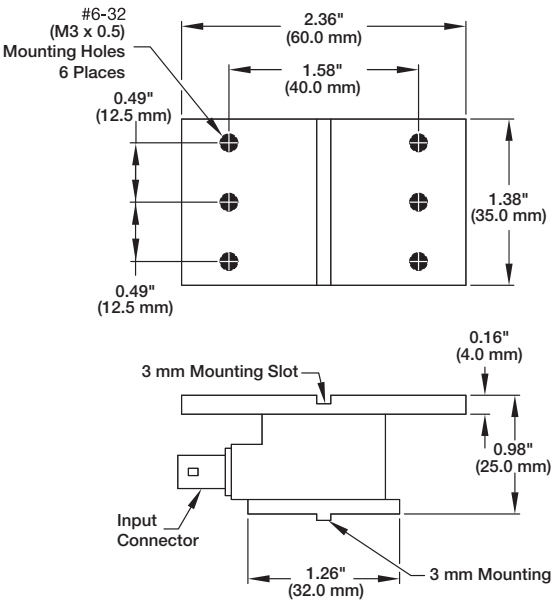


ITEM#	$	£	€	RMB	DESCRIPTION
HFA001*	$ 340.00	£ 235.70	€ 301,90	¥ 2,871.00	Adjustable Fiber Array Holder

*Universal Design, Imperial and Metric Compatible

Axial Force/Touch Sensor Mounting Platform

- **Load Capacity:** 30 N
- **Sensitivity:** 0.03 N
- Use AMA034 Support Post for 2.46" (62.5 mm) Deck Height



Please refer to our website for complete models and drawings.

FSC103

These force sensing cells can be used to position one device (e.g., a fiber) with respect to another in the direction of the optical axis. When the fiber makes contact with the device, a force arises that is detected by the cell, generating an electrical signal that is sent to the controller to indicate that the desired position has been reached. These cells mount in the tongue-in-groove assembly on the NanoMax™, MicroBlock™, PiezoBlock™, and RollerBlock™ systems. It accepts the full range of accessories described in this section. The TSG001 T-Cube Strain Gauge Reader (see page 564) is an ideal reader for this sensor.

AMA034

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
FSC103	FSC103/M	$ 675.00	£ 468.00	€ 599,30	¥ 5,699.80	Axial Force/Touch Sensor Grooved Mounting Platform
AMA034*	AMA034*	$ 57.30	£ 39.80	€ 50,90	¥ 483.90	Mounting Post for FSC103 Axial Force/Touch Sensor
TSG001*	TSG001*	$ 545.00	£ 377.90	€ 483,90	¥ 4,602.00	T-Cube Strain Gauge Reader
TPS002*	TPS002*	$ 105.00	£ 72.80	€ 93,30	¥ 886.70	±15 V/5 V Power Supply for Two T-Cubes

*Universal Design, Imperial and Metric Compatible

V-Grooved Fiber Holder Axial Force Sensor

- **Load Capacity:** 30 N
- **Sensitivity:** 0.03 N
- Clamps Ø250 µm Fiber Jacket
- Two Magnetic Fibers Holders

FSC102

This force sensing cell is used specifically to position a bare optical fiber with respect to another device in the direction of the optical axis. When the fiber makes contact with the device, a force arises that is detected by a strain gauge. An electrical signal is generated that enables the controller to indicate when the desired position has been reached. The TSG001 T-Cube Strain Gauge Reader (see page 564) is an ideal reader for this sensor.


TSG001

T-Cube apt™ USB Strain Gauge Reader
See Page 564

ITEM#	$	£	€	RMB	DESCRIPTION
FSC102*	$ 685.00	£ 474.90	€ 608,20	¥ 5,784.20	V-Grooved Fiber Holder Axial Force Sensor
TSG001*	$ 545.00	£ 377.90	€ 483,90	¥ 4,602.00	T-Cube Strain Gauge Reader
TPS002*	$ 105.00	£ 72.80	€ 93,30	¥ 886.70	±15 V/5 V Power Supply for Two T-Cubes

*Universal Design, Imperial and Metric Compatible

Kinematic Pitch/Yaw Mount: Microscope Objective Mount

HMM001
Mirror Sold Separately on Page 673

This kinematic flexure mount allows for fine angular control of Ø1/2" optics mounted on multi-axis flexure stages. A possible applicaiton for the HMM001 Flexure Stage Mount would be to use it in the construction of a fiber-based interferometer. The fine angular control of a mirror mounted in the HMM001 would allow the laser beam emerging from the fiber to be retro-reflected back to the fiber.

Externally RMS components can be mounted on the HMM001 by attaching the HMA001 adapter plate. With the HMA001 Adapter plate, the kiematic flexure mount is ideal for use as a fiber coupling objective mount when fine angular cotrol of the coupling objective is needed to maximize coupling efficiency. RMS adapter rings make it possible to mount components with alternative thread types.

Mechanical Drawings Available on the WEB

This Microscope Objective mount is comprised of the HMM001 Flexure Mount and a HMA001 Adapter Plate. The adapter plate is threaded with RMS threads, which accept standard microscope objectives.

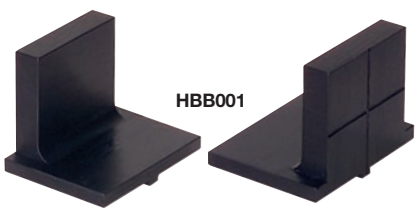
HMA001

HMM001 and HMA001
Microscope Objective
Sold Seperately

ITEM#	$	£	€	RMB	DESCRIPTION
HMM001*	$ 125.00	£ 86.70	€ 111,00	¥ 1,055.60	Pitch and Yaw Flexure Mount for Multi-Axis Stages
HMA001*	$ 27.90	£ 19.40	€ 24,80	¥ 235.60	RMS Adapter Plate for Pitch and Yaw Flexure Mount

*Universal Design, Imperial and Metric Compatible

Blank Mounting Bracket and Block



HBB001

While we offer the most extensive line of fiber launch and waveguide accessories available, it is difficult to anticipate all of the possible requirements that may arise for customers. Hence, we have added this simple component, which eases the production of one-of-a-kind mounting accessories. As can be seen in the photograph, the front surface is clearly marked with witness lines that are centered on the 12.5 mm high optical axis of our multi-axis flexure systems.

HBB002

ITEM#	$	£	€	RMB	DESCRIPTION
HBB001*	$ 70.30	£ 48.80	€ 62,50	¥ 593.70	Blank Mounting Bracket
HBB002*	$ 49.50	£ 34.40	€ 44,00	¥ 418.00	Blank Mounting Block

*Universal Design, Imperial and Metric Compatible

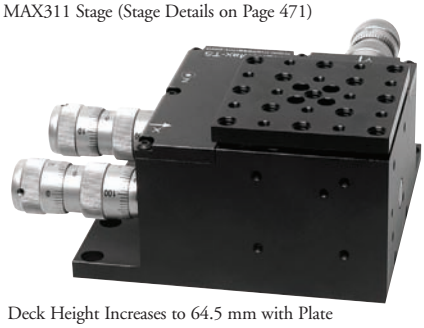
1/4"-20 (M6 x 1.0) and #8-32 (M4 x 0.7) Adapter Plate

RB13P1

- Converts the Three-Axis Stages into a General Purpose Optical Table Translator
- Easily Replaces Slotted Top Plate via Four Mounting Screws
- Adds 2 mm to the Deck Height

This optional replacement mounting plate has an array of both 1/4"-20 (M6 x 1.0) and #8-32 (M4 x 0.7) mounting holes to adapt the NanoMax™, MicroBlock™, PiezoBlock™, or RollerBlock™ stage into a general purpose optical table translation stage.

RB13P1 Adapter Plate Shown Mounted on a NanoMax™ MAX311 Stage (Stage Details on Page 471)



Deck Height Increases to 64.5 mm with Plate

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
RB13P1	RB13P1/M	$ 48.40	£ 33.60	€ 43,00	¥ 408.70	1/4"-20 (M6 x 1.0) #8-32 (M4 x 0.7) Adapter Plate

Pitch and Yaw Platforms, 0.75" (19 mm) Thick

NEW products

Specifications

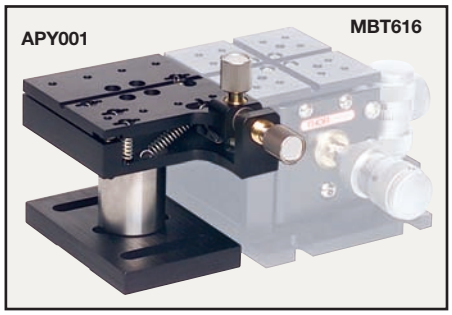
- **Travel:** ±4° per Axis
- **Resolution:** 10 arcsec
- **Micrometer Movement (APY002):**
  - Pitch: 1° = 0.86 mm
  - Yaw: 1° = 0.91 mm

APY001
Complete with Base and Post

APY002
Complete with Base and Post

The APY001 and APY002 platforms provide pitch and yaw adjustment about the optical axis. Designed for use with our NanoMax™, MicroBlock™, RollerBlock™, or PiezoBlock™ families of three-axis stages, they provide an upgrade path to five-axis positioning. The APY001 thumbscrew drives allow adjustment up to ±4° per axis with an accuracy of 10 arcsec. The APY002 micrometer drives offer precise control: 1° of pitch rotation corresponds to 0.03" (0.76 mm) micrometer movement (1 mm = 1.16°) while 1° of yaw rotation corresponds to 0.035" (0.89 mm) of micrometer movement (1 mm = 1.1°).

The mounting post produces an optical height of 75 mm (62.6 mm post plus 12.5 mm accessory height). The photo shows the APY001 mounted in front of our MicroBlock 3-axis flexure stage.



Alternatively, the pitch and yaw platform can be removed from the post and fixed directly to the stage in place of the standard top plate. This allows components mounted on the stage to be adjusted in roll and pitch and raises the optical axis height by 15 mm, from 75 mm to 90 mm.

Angle bracket and spacer block kits are available separately (see below), which raise components on stages without an APY series platform to the same height as stages with an APY series platform.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
APY001	APY001/M	$ 245.50	£ 170.20	€ 218,00	¥ 2,073.10	Pitch and Yaw Platform with Thumbscrew Drives
APY002	APY002/M	$ 536.20	£ 371.80	€ 476,10	¥ 4,527.70	Pitch and Yaw Platform with Micrometer Drives

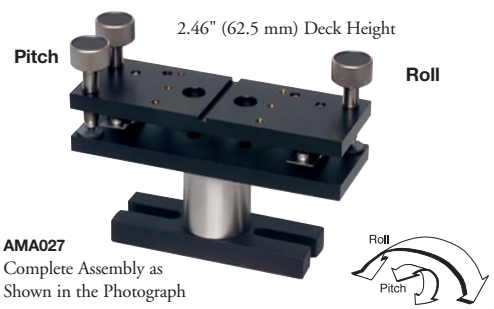
Pitch and Roll Platform with Adjustable Thickness

Specifications

- **Travel:** -8° to 4° per Axis
- **Resolution:** 10 arcsec
- **Deck Height:** 2.46" (62.5 mm)
- **Adjuster Travel:** 0.16" (±4 mm)
- **Platform Thickness:** 0.95" (24 mm) at the Center of Height Adjustment

Mechanical Drawings Available on the WEB

AMA027 Assembly
The AMA027 comes complete with the tilt platform as well as the support structure that is designed to position the platform at the proper height for use with our multi-axis flexure stages.



AMA027
Complete Assembly as Shown in the Photograph

The AMA027 is intended to allow an angled optical component to be positioned in front of one of our three-axis flexure stages. This add-on stage provides pitch and roll adjustment using the two labeled thumbscrews indicated in the photograph. Both the pitch and roll adjustment provide -8° to 4° of range; use of all three adjusters allows for the adjustment of the overall height of the platform. The amount of height adjustment ranges from -1 to 4 mm around the nominal 62.5 mm height of the entire assembly.

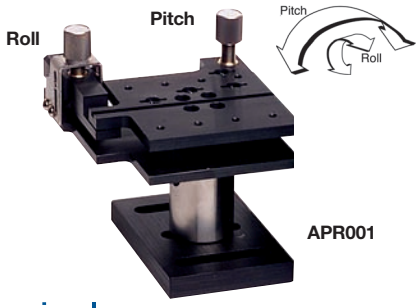
This platform is designed for use with our family of three-axis flexure stages, including the RollerBlock™, MicroBlock™, PiezoBlock™, and NanoMax™. This same pitch and roll device is available for use with our four-, five-, and six-axis stages; details for these products are can be found starting on page 484.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA027	AMA027/M	$ 290.80	£ 201.60	€ 258,20	¥ 2,455.60	Pitch and Roll Tilt Platform with Adjustable Thickness

Pitch and Roll Platform, 0.75" (19 mm) Thick

Specifications

- **Travel**: ±4° per Axis
- **Resolution**: 10 arcsec
- Effective Three-Axis to Five-Axis Stage Upgrade
- Tilt Platform 0.75" (19 mm) Thick

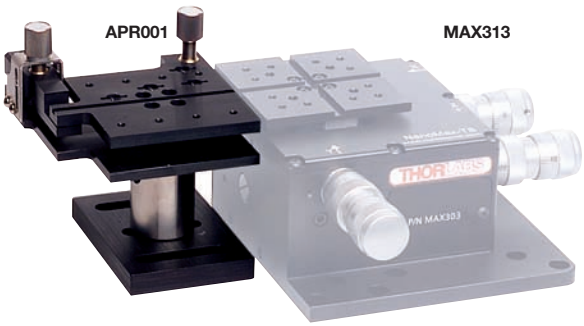


Mechanical Drawings Available on the WEB

The APR001 provides pitch and roll adjustment about the optical axis. It was designed for use with our NanoMax™, MicroBlock™, RollerBlock™, or PiezoBlock™ families of three-axis stages (see pages 466-483) and provides a cost efficient upgrade to five-axis positioning. The thumbscrew drives allow adjustment up to ±4° per axis with an accuracy of 10 arcsec.

The APR001 includes a pitch and roll platform, a mounting post, and base. When the stage is mounted on the post and base, the optical axis height is equivalent to the optical axis height of Thorlabs' NanoMax™, MicroBlock™, RollerBlock™, and PiezoBlock™ families of three-axis stages. Mounting components can then be attached to the platform and adjusted in pitch and roll.

The mounting post included produces an optical height of 75 mm (62.6 mm post plus 12.5 mm accessory height). The photo to the right shows the APR001 mounted in front of our NanoMax™ three-axis flexure stage.

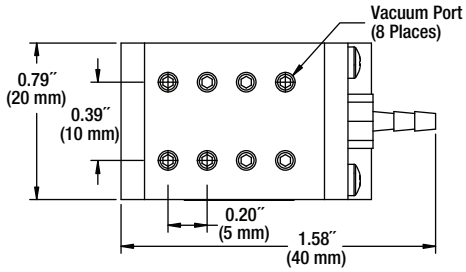


Alternatively, the pitch and roll platform can be removed from the post and fixed directly to the stage in place of the standard top plate. This allows components mounted on the stage to be adjusted in pitch and roll and raises the optical axis height by 15 mm (from 75 mm to 90 mm).

Angle bracket and spacer block kits are available separately (see page opposite), which raise components on stages without an APR001 to the same height.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
APR001	APR001/M	$ 521.00	£ 361.20	€ 462,60	¥ 4,399.40	Roll and Pitch Platform with Thumbscrew Drives

Vacuum Waveguide Mount



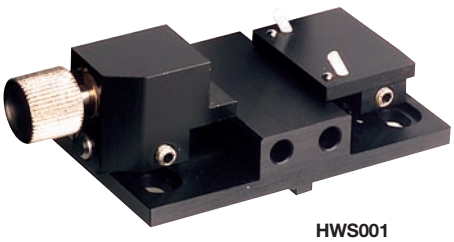
- Eight User-Selectable Vacuum Ports Provide Support for a Broad Range of Optic Sizes
- Small, Compact Design Allows Easy Access to Your Planar Optical Element

The HWV001 waveguide holder utilizes a vacuum to provide the holding force to secure planar waveguide devices. The mount consists of a platform with eight access ports to the internal vacuum chamber. By removing the conical-tipped setscrews that lie underneath the optical element, a vacuum-generated holding force appropriate for the size of the component can be obtained.

ITEM#	$	£	€	RMB	DESCRIPTION
HWV001*	$ 195.00	£ 135.20	€ 173,20	¥ 1,646.60	Vacuum Waveguide Mount

*Universal Design, Imperial and Metric Compatible

Adjustable Waveguide Mount

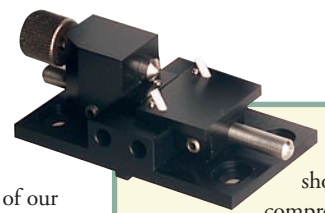


HWS001

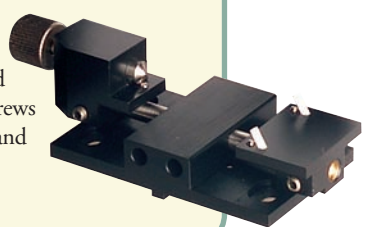
- Adjustable Optic Mount Accepts Thin Rectangular Elements from 0.16" (4 mm) to 1.50" (38 mm) in Width, up to 2 mm Thick
- Three Points of Contact Provided by Hardened, Precision-Ground Chromium Steel Balls
- An Adjustable Holding Force is Provided by a Spring-Loaded Plunger that is Beveled so that it Provides a Slight Downward Pressure on the Optical Element

Mechanical Drawings Available on the WEB

The HWS001 adjustable waveguide mount, while originally intended for use with planar waveguides, is useful for mounting a broad range of optical devices. Any thin [<0.08" (<2 mm) thick] rectangular device that needs to be integrated into an optical system built from one of our multi-axis flexure stages can be mounted in this holder provided the width of the device is less than 38 mm. The narrowest device that this mount is designed to accommodate is 0.16" (4 mm). This broad range of sizes is supported by moving the two sliding platforms (see photographs to the right) to within a few millimeters of the width of the device and then locking them into position with the setscrews; a gentle holding force is applied via a spring-loaded plunger that pushes the optical element against two angled white plastic pegs. A kinematic three-point contact is also achieved using three hardened chromium steal balls as optical support points.



These two photographs show the HWS001 fully compressed (above) so that it is ready to clamp a 0.16" (4 mm) wide optical element as well as fully open (below) so that it can accept a 1.5" (38 mm) optic. The two movable portions of the adjustable clamp are locked in place with the two setscrews that are visible on the left and right side of the device.



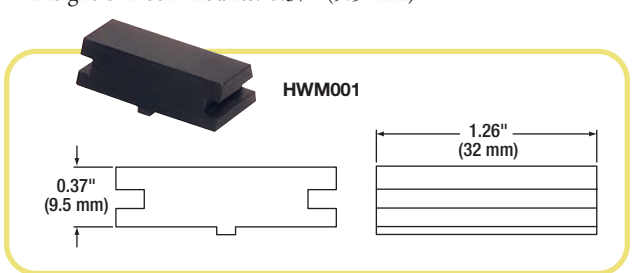
ITEM#	$	£	€	RMB	DESCRIPTION
HWS001*	$ 330.00	£ 228.80	€ 293,00	¥ 2,786.60	Adjustable Waveguide Mount

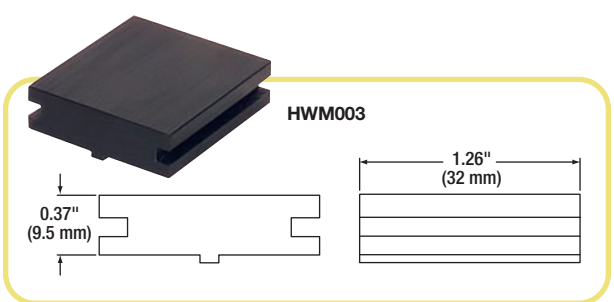
*Universal Design, Imperial and Metric Compatible

Waveguide Mounts

- Available in Two Lengths: 0.39" (10.0 mm) and 1.26" (32.0 mm)
- Width of Both Mounts: 1.26" (32.0 mm)
- Height of Both Mounts: 0.37" (9.5 mm)

The top surface of these waveguide mounts is 0.12" (3.0 mm) below the standard 0.5" (12.5 mm) optical axis height for flexure accessories. The smooth top surface is ideal for bonding waveguides to, via either tape or glue.

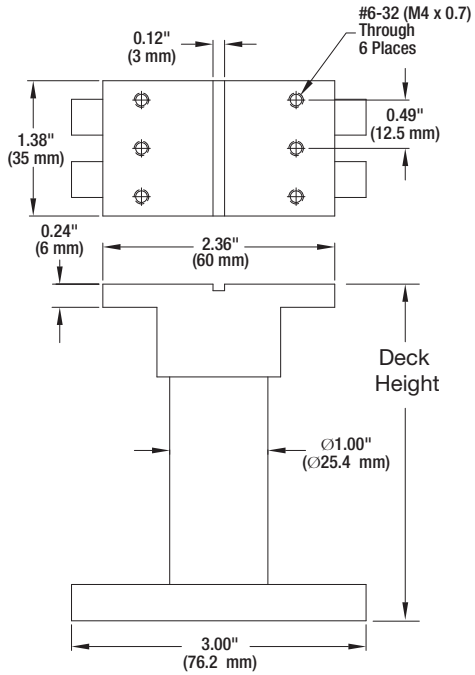




ITEM#	$	£	€	RMB	DESCRIPTION
HWM001*	$ 65.00	£ 45.10	€ 57,80	¥ 548.90	Standard Waveguide Mount, 10 mm Length
HWM003*	$ 60.00	£ 41.60	€ 53,30	¥ 506.70	Standard Waveguide Mount, 32 mm Length

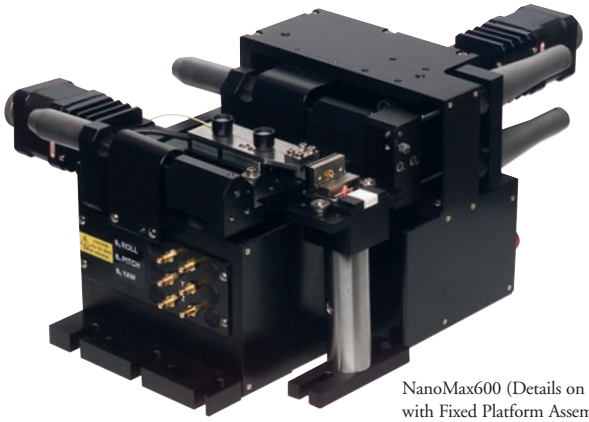
*Universal Design, Imperial and Metric Compatible

Fixed Platform Assemblies



Please refer to our website for complete models and drawings.

The AMA029 series of platform assemblies is intended to aid in the construction of complex optical systems that utilize multiple families of our motion control products. If a custom-height assembly is required, please contact your local Thorlabs office (see back cover for contact details).



NanoMax600 (Details on Page 489) with Fixed Platform Assemblies

AMA029A

AMA029C

AMA029B

AMA029D

ITEM#	DECK HEIGHT	USES
AMA029A	2.46" (62.5 mm)	Standard Deck Height for RollerBlock™, PiezoBlock™, MicroBlock™, and NanoMax™
AMA029B	4.17" (105.8 mm)	Platform for Moving Carriage of the NST Stage
AMA029C	3.21" (81.5 mm)	Matches 3-Axis Stage and 19 mm Tilt Stage
AMA029D	4.43" (112.5 mm)	NanoBlock™ and MAX600 4-, 5-, and 6-Axis Stages with 112.5 mm Deck Height

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA029A	AMA029A/M	$ 57.00	£ 39.60	€ 50,70	¥ 481.40	Platform, Matches 62.5 mm Standard Deck Height
AMA029B	AMA029B/M	$ 57.00	£ 39.60	€ 50,70	¥ 481.40	Platform for the Moving Carriage of the NST Stage
AMA029C	AMA029C/M	$ 57.00	£ 39.60	€ 50,70	¥ 481.40	Platform, Matches 3-Axis Stage and 19 mm Tilt Stage
AMA029D	AMA029D/M	$ 57.00	£ 39.60	€ 50,70	¥ 481.40	Platform, Matches 4-, 5-, or 6-Axis Stages with 112.5 mm Deck Height

Cross Platform Mounting Plate

AMA562

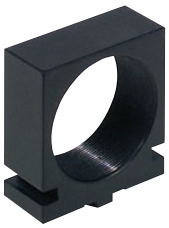
Mechanical Drawings Available on the WEB

This plate mounts the NanoMAX™ series of three-axis flexure stages to the 50 mm travel cross-roller bearing TravelMax™ series of stages. Please see page 432 for details on the LNR50 family of stages.

- **Deck Height:** 3.84" (97.5 mm)
- **Optical Axis:** 4.33" (110.0 mm)

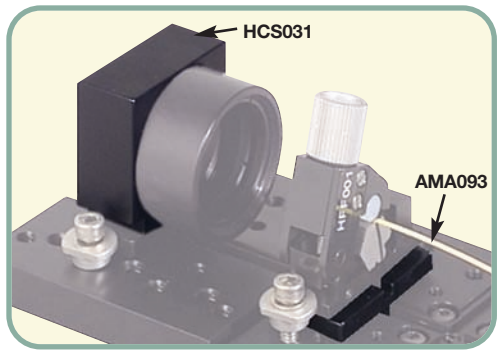
ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA562	AMA562/M	$ 79.20	£ 55.00	€ 70,40	¥ 668.80	Adapter Plate for NanoMax™ to LNR Series Stages

SM1 Mount and Height Adapters

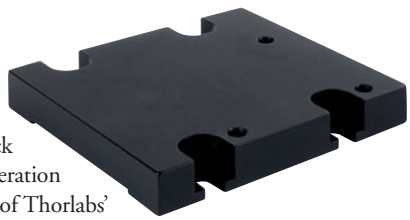


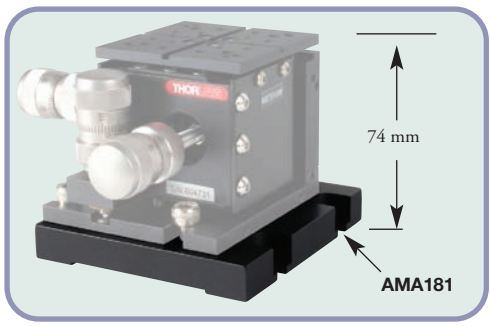
HCS031
The HCS031 SM1 Mount allows most of Thorlabs' SM1-based products to be mounted to any stage using the standard 3 mm wide alignment groove. The optical axis height of this mount is 0.7" (18 mm), which requires any accessories being used in the same system to be fitted with the AMA093 shim block shown below.

AMA093
The AMA093 Shim Block fits under any Thorlabs' accessories and increases the optical axis height to 0.7" (18 mm) to match the HCS031. The shim block includes two mounting cleats with extended screws to fasten accessories to the top deck of the stage.



AMA181
The AMA181 Height Adapter fits under the base of the MicroBlock™ and NanoMax™ stages. The riser block increases the height of any current generation flexure stage to match the deck height of Thorlabs' older generation stages.



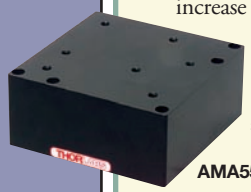


ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
HCS031	HCS031*	$ 37.00	£ 25.70	€ 32,90	¥ 312.50	SM1 Mount
AMA093	AMA093*	$ 14.00	£ 9.70	€ 12,50	¥ 118.30	Accessory Shim Block
AMA181	AMA181/M	$ 30.20	£ 21.00	€ 26,90	¥ 255.10	Stage Height Adapter

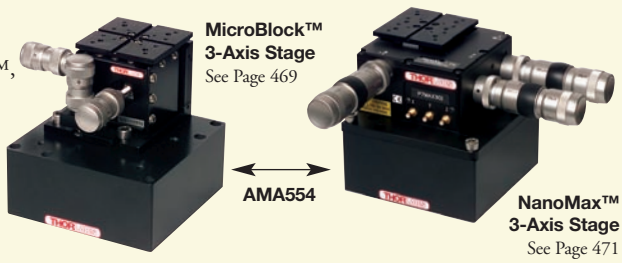
*Universal Design, Imperial and Metric Compatible

Adapting 3-Axis Systems to 4-, 5-, or 6-Axis Systems

The AMA554 Height Adapter Shown with Our 3-Axis Flexures. This simple height adapter accessory can be used to increase the working height of the NanoMax™, PiezoBlock™, and MircoBlock™ family of stages. The 1.96" (50.0 mm) thickness increases the deck height from 2.46" (62.5 mm) to 4.43" (112.5 mm), resulting in an increased optical axis height of 4.9" (125 mm).



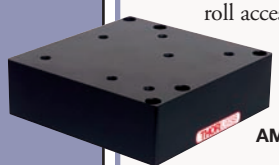
AMA554



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA554	AMA554/M	$ 98.80	£ 68.50	€ 87,80	¥ 834.30	NanoMax™ 300 and MicroBlock™ Riser Block for 125 mm Beam Height

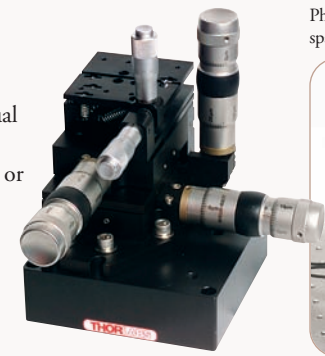
The AMA557 Height Adapter Shown with the RollerBlock™ Translator.

When using an AMA557 Adapter, the total deck height will be 4.43" (112.5 mm). This height is equal to the adapter height of 1.38" (35.0 mm) plus the stage height of 2.46" (62.5 mm) plus the pitch/yaw or roll accessory height of 0.59" (15.0 mm).

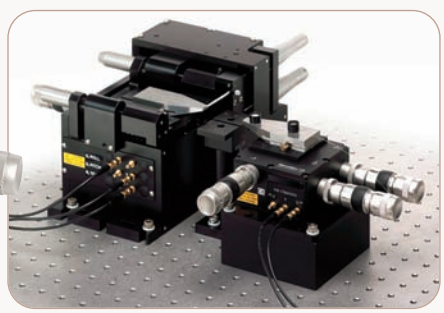


AMA557

RollerBlock™
3-Axis Stage
See Page 466



Photograph showing a typical application for the AMA554 spacer block. Please see page 488 for details on the 6-axis stage.



ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
AMA557	AMA557/M	$ 79.20	£ 55.00	€ 70,40	¥ 668.80	Three-Axis Stages plus Tip/Tilt Riser Block for 125 mm Beam Height

Actuator Selection Guide

Pages 514-540

Adjustment Screws

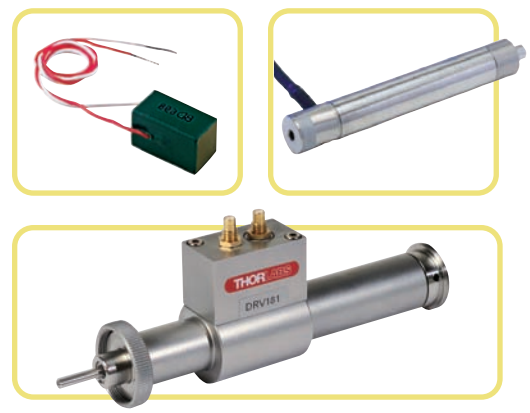
- Drill Kits and Specialty Taps
- Coarse Adjustment Screws
- Fine Adjustment Screws
- Ultrafine Adjustment Screws
- Differential Adjuster Screws

See Pages 514-522

Micrometers

- Standard Micrometer Heads
- Digital Micrometer Heads
- Differential Micrometers

See Pages 523-529



Piezoelectric Actuators

- Modular Piezo Actuators
- Piezo Actuators with Feedback
- Piezoelectric Stacks
- Piezoelectric Stacks with Strain Gauges

See Pages 530-533

Motorized Actuators

- DC Servo Actuators
- Vacuum-Compatible Actuators
- Stepper Motor Actuators
- High-Load Stepper Motor Actuators

See Pages 534-537

Drill Kits

DK2

Specifications

- 115-Piece Drill Bit Set
  - Steel Carrying Case
  - 60 Number-Sized Drill Bits
  - 26 Letter-Sized Drill Bits
  - 29 Fractional-Sized Drill Bits
- Durable Steel Carrying Case with Latch Provides Orderly Storage
- Numbered-Size Drill Bits Ranging from #1 Bit - #60 Bit
- Fractional-Size Drill Bits Ranging from 1/16" – 1/2"
- Covers Lettered-Size Drill Bits Ranging from Letter A Bit Through Letter Z Bit

This 115-piece drill set comes in a hinged steel carrying case with etched nameplates to denote the various drill sizes and decimal equivalents. These drill bits are constructed from the finest quality high-speed steel for long life.

ITEM#	$	£	€	RMB	DESCRIPTION
DK2	$ 63.30	£ 43.90	€ 56,20	¥ 534.60	115-Piece Drill Kit

Special Taps

Universal Tap Wrench

ITEM#	$	£	€	RMB	DESCRIPTION
TW25	$ 49.40	£ 34.30	€ 43,90	¥ 417.20	Tap Wrench - Fits up to 1/4" Taps
XE25TG	$ 66.30	£ 46.00	€ 58,90	¥ 559.90	Tap Guide for 1/4"-20 Tap (Item# 71598, see table below)

TW25
Tap Wrench

XE25TG
Tap Guide

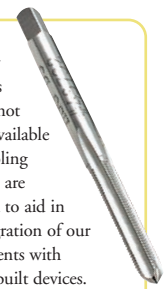
Imperial Taps

ITEM#	$	£	€	RMB	THREAD	TAP DRILL	USE
83373	$ 86.20	£ 59.80	€ 76,60	¥ 727.90	0.535"- 40	0.508"	SM05 Series Threads
97355	$ 86.20	£ 59.80	€ 76,60	¥ 727.90	1.035" - 40	1.008"	SM1 Series Threads
74580	$ 27.40	£ 19.00	€ 24,40	¥ 231.40	3/16" - 100	0.177"	F19SS, UFS, Ultra-Fine Adjustment Screws
60202	$ 28.40	£ 19.70	€ 25,30	¥ 239.90	5/16" - 32	0.281"	N100L5, UFS Nuts
71529	$ 27.40	£ 19.00	€ 24,40	¥ 231.40	1/4" - 80	0.238"	F25SS, FAS Fine Adjustment Screws
60242	$ 26.40	£ 18.40	€ 23,50	¥ 223.00	3/8" - 40	0.348"	FAS Nuts
99940	$ 35.70	£ 24.80	€ 31,70	¥ 301.50	1/4" - 100	0.240"	F25US, Ultrafine Adjustment Screws
99943	$ 30.50	£ 21.20	€ 27,10	¥ 257.60	#6-80	0.120"	F6SS, Fine Adjustment Screws
46720	$ 73.60	£ 51.10	€ 65,40	¥ 621.50	0.800" - 36	0.772"	RMS Microscope Threads
71598	$ 27.40	£ 19.00	€ 24,40	¥ 231.40	1/4" - 20	0.201"	1/4"-20 Mounting Holes

TW25
Tap Wrench

Metric Taps

ITEM#	$	£	€	RMB	THREAD	TAP DRILL	USE
99946	$ 35.70	£ 24.80	€ 31,70	¥ 301.50	3 mm - 0.25	0.107"	F3SS, MAS Screws
99833	$ 31.60	£ 22.00	€ 28,10	¥ 266.90	4.5 mm - 0.5	0.158"	N250L3, MAS Nuts
97368	$ 26.40	£ 18.40	€ 23,44	¥ 223.00	6 mm - 0.5	0.217"	6 mm-0.5 Threaded Aspheric Lens Housing
71498	$ 25.20	£ 17.50	€ 22,40	¥ 212.80	6 mm - 1.0	0.198"	M6-1.0 Mounting Holes
48443	$ 30.50	£ 21.20	€ 27,10	¥ 257.60	8 mm - 0.5	0.297"	8 mm-0.5 Threaded Aspheric Lens Housing
98109	$ 32.60	£ 22.60	€ 29,00	¥ 275.30	9 mm - 0.5	0.337"	9 mm-0.5 Threaded Aspheric Lens Housing
43122	$ 46.30	£ 32.10	€ 41,20	¥ 391.00	10 mm - 0.5	0.375"	10 mm-0.5 Threaded Aspheric Lens Housing
98110	$ 47.40	£ 32.90	€ 42,10	¥ 400.30	11 mm - 0.5	0.413"	11 mm-0.5 Threaded Aspheric Lens Housing
46152	$ 44.20	£ 30.70	€ 39,30	¥ 373.30	12 mm - 0.5	0.453"	12 mm-0.5 Threaded Aspheric Lens Housing
45283	$ 55.70	£ 38.70	€ 49,50	¥ 470.40	14 mm - 0.5	0.532"	E12RMS Tube External Thread



Specialty plug taps that are not readily available from tooling suppliers are provided to aid in the integration of our components with custom-built devices.

High-Precision Actuators

Imperial Coarse Adjusters

Page 516	1/4"-20	0.05"/Revolution	Lengths from 1" to 2"	5/64" Socket Hex

Metric Fine Adjusters

Page 517	M2.5-0.20 mm	200 µm/Revolution	Lengths from 8mm to 20 mm	1.5 mm Socket Hex
Page 518	M3-0.20 mm	200 µm/Revolution	Lengths from 8 mm to 25 mm	1.5 mm Socket Hex
Page 519	M3-0.25 mm	250 µm/Revolution	Lengths from 8 mm to 25 mm	1.5 mm Socket Hex

Imperial Fine Adjusters

Page 519	#6-80	0.0125"/Revolution	Lengths from 0.45" to 1.13"	5/64" Socket Hex
Page 520	3/16"-100	0.010"/Revolution	Lengths from 3/8" to 2"	5/64" Socket Hex
Page 521	1/4"-80	0.0125"/Revolution	Lengths from 3/8" to 4"	5/64" Socket Hex
Page 522	1/4"-100	0.010"/Revolution	Lengths from 3/8" to 2"	5/64" Socket Hex

All of our adjuster screws feature extremely tight tolerances; Thorlabs has developed a set of specifications that exceed the industry class 3 standard. Each screw is individually tested with a master gauge set that ensures the interchangeability of our adjuster screws and threaded sleeves. If you are incorporating any of these components into larger optomechanical systems, we recommend that you contact our technical support group to ensure that the specifications for any mating parts you are manufacturing have the appropriate tolerances.

Use these screws to build custom mounts or to replace existing adjusters with higher resolution screws. A series of matching brass bushings, removable knobs, and locking nuts for the adjusters provide a great deal of flexibility when building precision mechanical assemblies. All screws are made of 300 series stainless steel and have an exceptionally smooth feel when used with our corresponding brass bushings. All locking nuts (with the exception of LN2580) are made of 510 phosphor bronze, which is vacuum rated for 10^{-6} Torr. To support the production of custom mating parts, Thorlabs carries a line of specialty taps, which are available for all of our actuators except the 0.2 mm pitch screws (i.e., M2.5-0.2 mm and M3-0.2 mm). The 0.2 mm pitch internal threads must be machined on a high-precision CNC turning center to ensure adequate control of the tolerances.

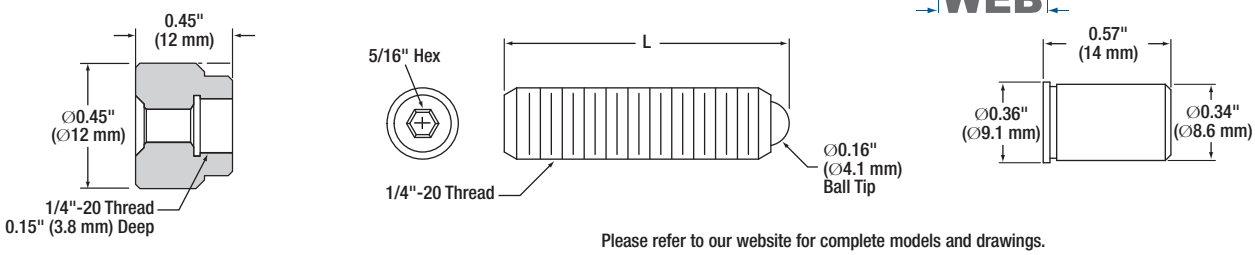
1/4"-20 Coarse Hex Adjusters

Features

- 1"and 2" Screw Lengths
- 0.57" Long Bushings
- Screws Have a Hex Head (5/64" Hex Key)
- Removable Knurled Knob for Easy Adjustment
- Vacuum-Compatible Lock Nut

These 1/4"-20 thread adjustment screws are for use in assemblies where fine adjustment is not necessary. They are supplied in 1" and 2" lengths. Bushings, lock nut, and a knurled adjustment knob are also available.

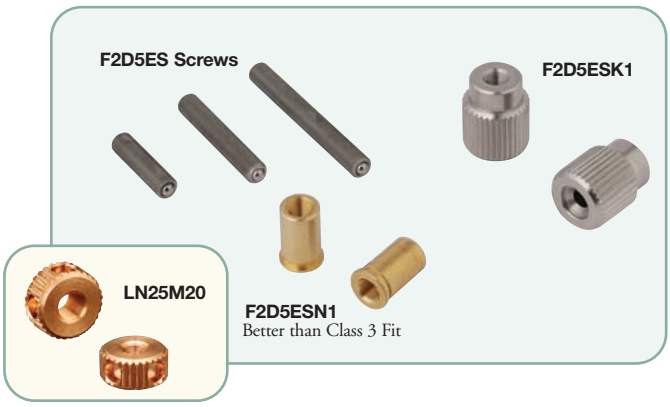
Mechanical Drawings Available on the WEB



Please refer to our website for complete models and drawings.

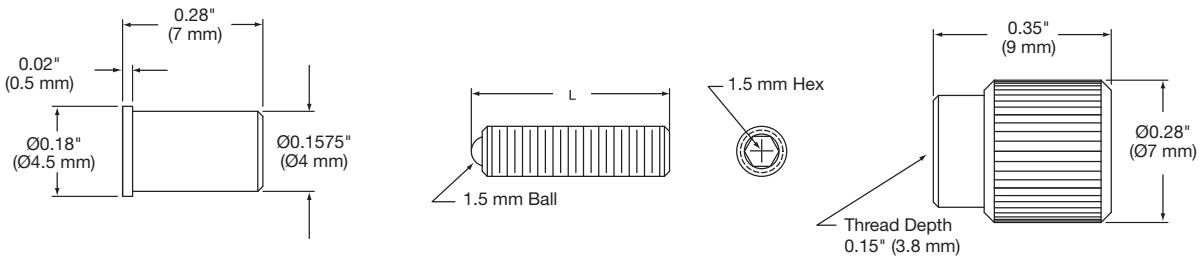
ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
CS25SS100	$ 6.20	£ 4.30	€ 5,60	¥ 52.40	1/4"-20 Coarse Adjustment Screw	1"
CS25SS200	$ 9.20	£ 6.40	€ 8,20	¥ 77.70	1/4"-20 Coarse Adjustment Screw	2"
CS25SSN1	$ 5.70	£ 3.95	€ 5,10	¥ 48.20	1/4"-20 Bushing	0.57"
CS25SSK1	$ 7.20	£ 5.00	€ 6,40	¥ 60.80	1/4"-20 Removable Adjustable Knob	0.47"
LN2520	$ 8.20	£ 5.70	€ 7,30	¥ 69.30	1/4"-20 Lock Nut	–

M2.5-0.20 mm Extremely Fine Hex Adjusters



The M2.5-0.20 mm Hex Adjusters are manufactured from 300 series stainless steel. The extremely fine (0.20 mm per revolution) thread precludes the use of taps to produce threaded mating parts for these adjusters. Instead, use the F2D5ESN1 threaded bushing, which is manufactured on a precision CNC turning center using a single-point threading tool. For custom bushings, please contact tech support. Also available are a removable knob and a vacuum-compatible lock nut.

Mechanical Drawings Available on the WEB



Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
F2D5ES8	$ 9.70	£ 6.70	€ 8,70	¥ 82.00	M2.5-0.20 mm Adjuster Screw	8 mm
F2D5ES10	$ 10.20	£ 7.05	€ 9,10	¥ 86.20	M2.5-0.20 mm Adjuster Screw	10 mm
F2D5ES12	$ 10.80	£ 7.50	€ 9,60	¥ 91.20	M2.5-0.20 mm Adjuster Screw	12 mm
F2D5ES15	$ 11.90	£ 8.25	€ 10,60	¥ 100.50	M2.5-0.20 mm Adjuster Screw	15 mm
F2D5ES20	$ 16.20	£ 11.30	€ 14,40	¥ 136.80	M2.5-0.20 mm Adjuster Screw	20 mm
F2D5ESN1	$ 7.60	£ 5.25	€ 6,80	¥ 64.20	M2.5-0.20 mm Threaded Bushing	7 mm
F2D5ESK1	$ 7.00	£ 4.85	€ 6,30	¥ 59.20	M2.5-0.20 mm Removable Adjuster Knob	9 mm
LN25M20	$ 8.20	£ 5.70	€ 7,30	¥ 69.30	M2.5-0.20 mm Lock Nut	–

Integrating Fine Adjustment Screws into Optomechanical Systems:

The assembly process begins by producing the appropriate-sized mating hole for the threaded bushing. Given the close fit between the threaded bushing and the mating adjuster screw, we caution against using a press fit to assemble these products.

Example Bushing

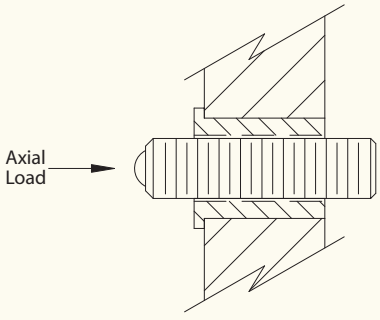


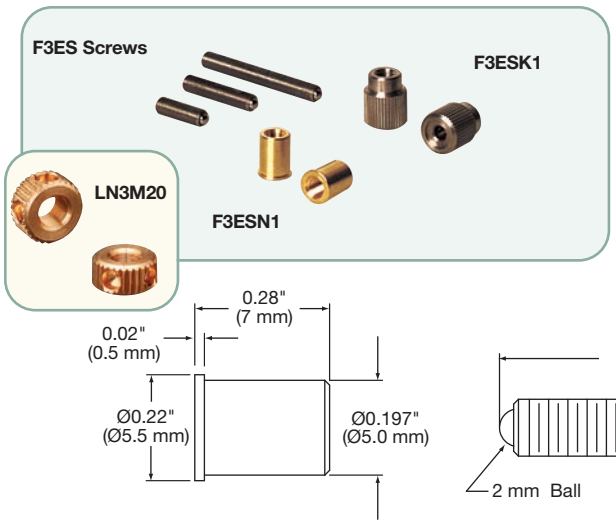
Figure 1

For our own production needs, we use a permanent anaerobic adhesive that provides excellent long-term performance. We recommend using Loctite™ Anaerobic Adhesive product number 680 or equivalent. In order to ensure maximum strength between the bonded parts, we strongly urge the user to follow carefully the instructions provided by Loctite, which specify the amount of clearance between the threaded bushing and the mounting plate. The most common source of failure is not allowing for the proper clearance between the parts being bonded since this clearance provides for the proper volume of adhesive.

As shown in Figure 1, the flange on the mating bushing is designed to support the axial load of the screw and bushing assembly.

When assembling, apply a small amount of the Loctite adhesive to both threaded bushings and the mounting plate and ensure a uniform distribution of the adhesive around the perimeter of the parts before assembly. After insertion, remove any excess adhesive from around the part.

M3-0.20 mm Extremely Fine Hex Adjusters



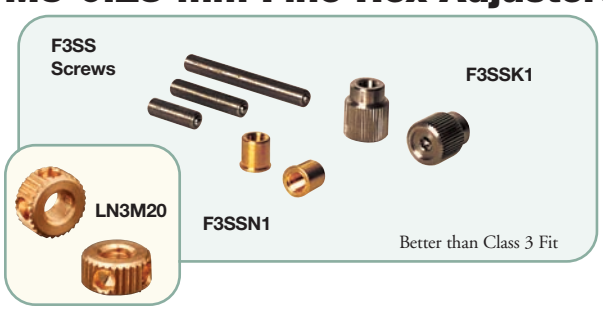
Fabricated from 300 series stainless steel, the M3-0.20 mm Hex Adjusters feature extremely fine (0.20 mm per revolution) threads that preclude the use of taps to produce threaded mating parts. Instead, use the F3ESN1 threaded bushing, which is manufactured on a precision CNC turning center using a single point threading tool. For custom bushings, please contact tech support. Also available are a removable knob and a vacuum-compatible lock nut.

Mechanical Drawings Available on the WEB

Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
F3ES8	$ 8.60	£ 5.95	€ 7,70	¥ 72.70	M3-0.20 mm Adjuster Screw	8 mm
F3ES10	$ 9.10	£ 6.30	€ 8,10	¥ 76.90	M3-0.20 mm Adjuster Screw	10 mm
F3ES12	$ 9.70	£ 6.70	€ 8,70	¥ 82.00	M3-0.20 mm Adjuster Screw	12 mm
F3ES15	$ 10.80	£ 7.50	€ 9,60	¥ 91.20	M3-0.20 mm Adjuster Screw	15 mm
F3ES20	$ 15.00	£ 10.40	€ 13,40	¥ 126.70	M3-0.20 mm Adjuster Screw	20 mm
F3ES25	$ 20.40	£ 14.20	€ 18,20	¥ 172.30	M3-0.20 mm Adjuster Screw	25 mm
F3ESN1	$ 7.60	£ 5.25	€ 6,80	¥ 64.20	M3-0.20 mm Threaded Bushing	7 mm
F3ESK1	$ 7.00	£ 4.85	€ 6,30	¥ 59.20	M3-0.20 mm Removable Adjuster Knob	9 mm
LN3M20	$ 8.20	£ 5.70	€ 7,30	¥ 69.30	M3-0.20 mm Lock Nut	–

M3-0.25 mm Fine Hex Adjusters



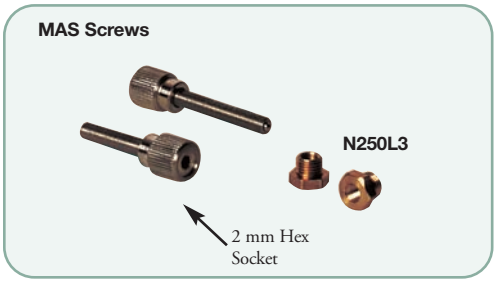
M3-0.5 mm hex adjusters are ideal for limited-space applications that require fine (0.25 mm/rev) resolution. The 125 µm thread depth, while shallow, does allow the use of a tap (ITEM# 99946 on page 514) to make mating parts. Alternatively, a F3SSN1 threaded bushing can be used. Also available for use with the M3-0.25 mm adjusters are removable knobs and vacuum-compatible lock nuts.

Mechanical Drawings Available on the WEB

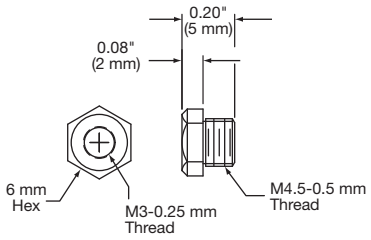
Please refer to our website for complete models and drawings.

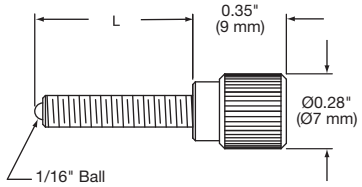
ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
F3SS8	$ 7.60	£ 5.25	€ 6,80	¥ 64.20	M3-0.25 mm Adjuster Screw	8 mm
F3SS10	$ 8.10	£ 5.60	€ 7,20	¥ 68.40	M3-0.25 mm Adjuster Screw	10 mm
F3SS12	$ 8.60	£ 5.95	€ 7,70	¥ 72.70	M3-0.25 mm Adjuster Screw	12 mm
F3SS15	$ 9.70	£ 6.70	€ 8,70	¥ 82.00	M3-0.25 mm Adjuster Screw	15 mm
F3SS20	$ 14.00	£ 9.70	€ 12,50	¥ 118.30	M3-0.25 mm Adjuster Screw	20 mm
F3SS25	$ 19.30	£ 13.40	€ 17,20	¥ 163.00	M3-0.25 mm Adjuster Screw	25 mm
F3SSN1	$ 6.50	£ 4.50	€ 5,80	¥ 54.90	M3-0.25 mm Threaded Bushing	5 mm
F3SSK1	$ 5.50	£ 3.80	€ 4,90	¥ 46.50	M3-0.25 mm Removable Adjuster Knob	9 mm
LN3M25	$ 8.20	£ 5.70	€ 7,30	¥ 69.30	M3-0.25 mm Lock Nut	–

M3-0.25 mm Ultrafine Adjustment Screws



- Stainless Steel Knob and Screw
- Brass Adjuster Nut





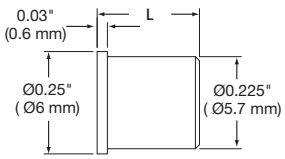
Please refer to our website for complete models and drawings.

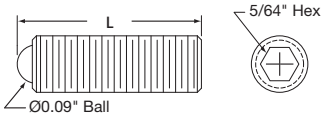
ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
N250L3	$ 9.70	£ 6.70	€ 8,70	¥ 82.00	M3-0.25 mm	5 mm
MAS15	$ 17.20	£ 12.00	€ 15,30	¥ 145.30	M3-0.25 mm	15 mm
MAS20	$ 18.30	£ 12.70	€ 16,30	¥ 154.60	M3-0.25 mm	20 mm

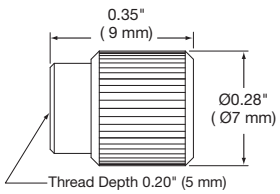
#6-80 Fine Hex Adjusters

#6-80 hex adjusters are great for miniature mounts that require fine (0.0125" per revolution) resolution. Mating parts can be made using a tap (ITEM# 99943 featured on page 514) or the F6SSN1 threaded bushing. Also available for use with the #6-80 hex adjusters are removable knobs and vacuum-compatible lock nuts.

Mechanical Drawings Available on the WEB





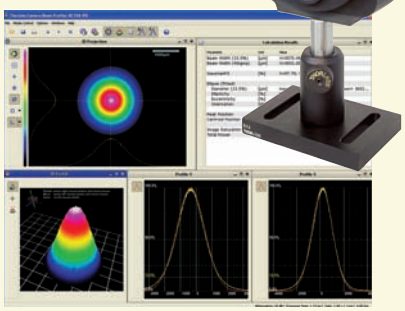


Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
F6SS045	$ 7.60	£ 5.25	€ 6,80	¥ 64.20	#6-80 Adjuster Screw	0.45"
F6SS058	$ 8.60	£ 5.95	€ 7,70	¥ 72.70	#6-80 Adjuster Screw	0.58"
F6SS088	$ 9.70	£ 6.70	€ 8,70	¥ 82.00	#6-80 Adjuster Screw	0.88"
F6SS113	$ 10.80	£ 7.50	€ 9,60	¥ 91.20	#6-80 Adjuster Screw	1.13"
F6SSN1	$ 6.80	£ 4.70	€ 6,10	¥ 57.50	#6-80 Threaded Bushing	0.250"
F6SSN2	$ 7.00	£ 4.85	€ 6,30	¥ 59.20	#6-80 Threaded Bushing	0.375"
F6SSK1	$ 6.20	£ 4.30	€ 5,60	¥ 52.40	#6-80 Removable Adjuster Knob	0.35"
LN680	$ 8.20	£ 5.70	€ 7,30	¥ 69.30	#6-80 Lock Nut	–

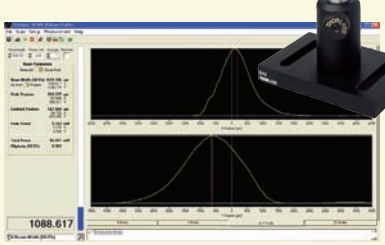
Beam Profilers: Scanning and CCD – See Pages 1318-1322

- Wavelength Range from 190 to 1100 nm
- CW and TTL-Triggered Single Pulse Detection
- High Dynamic Range CCD Camera with High Resolution and Low Noise



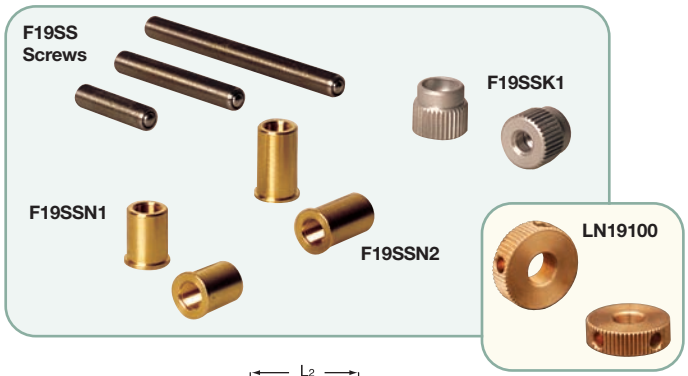
Compared to scanning slit profilers, Thorlabs' series of CCD camera-based beam profilers offers true 2D analysis of the beam's power density distribution. This greater detail allows complex mode patterns to be identified while optimizing a laser system.

- UV Through IR Detection with a Si or Ge Sensor
- CW and Pulsed Sources ≥10 Hz
- High Dynamic Range



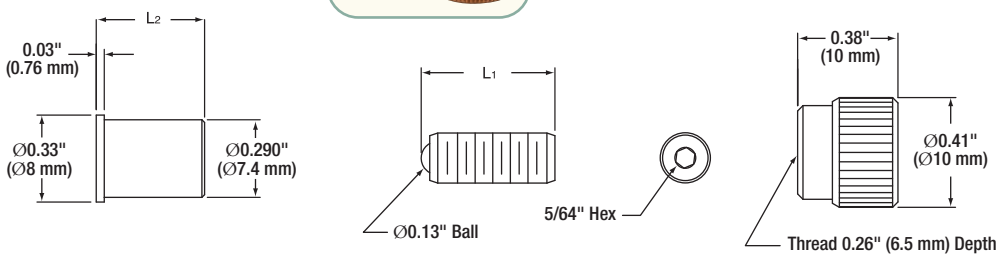
Thorlabs' Scanning Profiler is a high-precision instrument with a dynamic range of 72 dB that can analyze the power distribution of laser beams with diameters from 10 µm to 9 mm.

3/16"-100 Ultrafine Hex Adjusters



3/16"-100 TPI adjusters provide a resolution of 0.01" per revolution. The 0.006" thread depth, while shallow, does allow the use of a tap (ITEM# 74580 featured on page 514) to make mating parts. Alternatively, F19SSN1, F19SSN2 or N100B2 threaded bushings can be used. Also available for use with the 3/16"-100 TPI adjusters are removable knobs and vacuum-compatible lock nuts.

Mechanical Drawings Available on the WEB



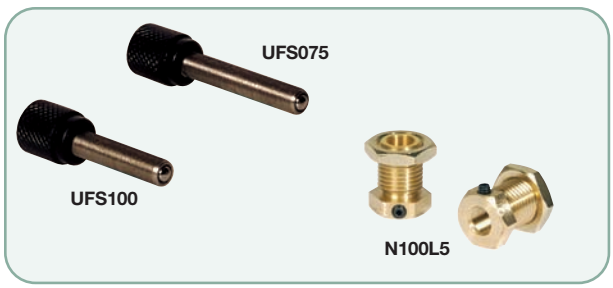
Please refer to our website for complete models and drawings.

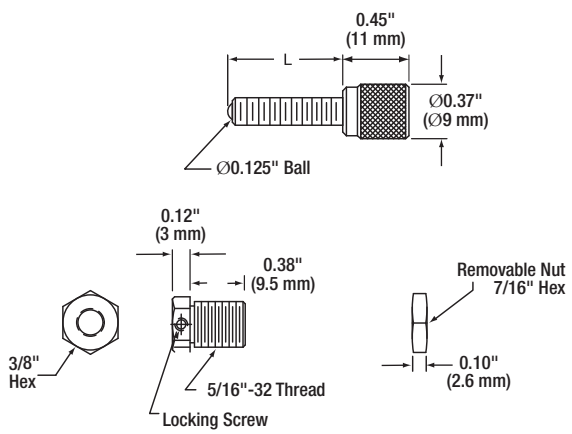
ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
F19SS038	$ 6.50	£ 4.50	€ 5,80	¥ 54.90	3/16"-100 Adjuster Screw	L_1 = 3/8"
F19SS050	$ 7.00	£ 4.85	€ 6,30	¥ 59.20	3/16"-100 Adjuster Screw	L_1 = 1/2"
F19SS075	$ 8.10	£ 5.60	€ 7,20	¥ 68.40	3/16"-100 Adjuster Screw	L_1 = 3/4"
F19SS100	$ 9.10	£ 6.30	€ 8,10	¥ 76.90	3/16"-100 Adjuster Screw	L_1 = 1"
F19SS125	$ 10.80	£ 7.50	€ 9,60	¥ 91.20	3/16"-100 Adjuster Screw	L_1 = 1-1/4"
F19SS150	$ 12.40	£ 8.60	€ 11,10	¥ 104.80	3/16"-100 Adjuster Screw	L_1 = 1-1/2"
F19SS200	$ 14.00	£ 9.70	€ 12,50	¥ 118.30	3/16"-100 Adjuster Screw	L_1 = 2"
F19SSN1	$ 6.50	£ 4.50	€ 5,80	¥ 54.90	3/16"-100 Threaded Bushing	L_2 = 0.40"
F19SSN2	$ 6.50	£ 4.50	€ 5,80	¥ 54.90	3/16"-100 Threaded Bushing	L_2 = 0.53"
F19SSK1	$ 4.80	£ 3.35	€ 4,30	¥ 40.60	3/16"-100 Removable Knob	0.38"
N100B2	$ 6.30	£ 4.35	€ 5,60	¥ 53.20	3/16"-100 Threaded Bushing	0.34"
LN19100	$ 8.20	£ 5.70	€ 7,30	¥ 69.30	3/16"-100 Lock Nut	–

3/16"-100 Ultrafine Adjustment Screws

Mechanical Drawings Available on the WEB

Our 3/16"-100 Ultrafine Adjustment Screws are a convenient drop-in replacement for our F19SS-eries hex adjusters. The non-slip knurled Delrin knob improves adjustment sensitivity. The convenient brass sleeve, complete with a removable nut, is precision-machined for a fit 30% better than the tightest industry standard (Class 3 Fit). The 3/8" hex head adjuster nut contains a nylon-tipped setscrew in the side of the head to lock the adjuster to the screw without causing damage to the threads.



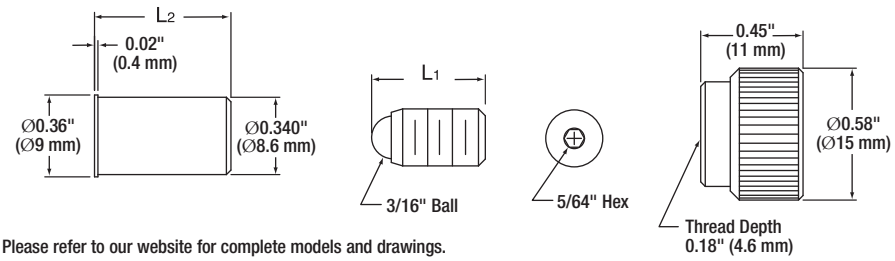


Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
UFS075	$ 12.90	£ 8.95	€ 11,50	¥ 109.00	3/16"-100 Threaded Screw, 3/4" Long
UFS100	$ 15.00	£ 10.40	€ 13,40	¥ 126.70	3/16"-100 Threaded Screw, 1" Long
N100L5	$ 10.70	£ 7.40	€ 9,50	¥ 90.40	3/16"-100 Adjuster Nut

1/4"-80 Fine Hex Adjusters

1/4"-80 hex adjusters are a popular choice for use in precision optomechanical mounts. Mating parts can be made using a tap (ITEM# 71529, see page 514) or with either the F25SSN1 or F25SSN2 threaded bushing. Also available for use with the 1/4"-280 hex adjusters are removable knobs and vacuum-compatible lock nuts.



Fine Hex Adjuster Locking Nut

- Compatible with Any Thorlabs 1/4"-80 Adjusters
- Make any Mount with 1/4"-80 Adjusters Lockable

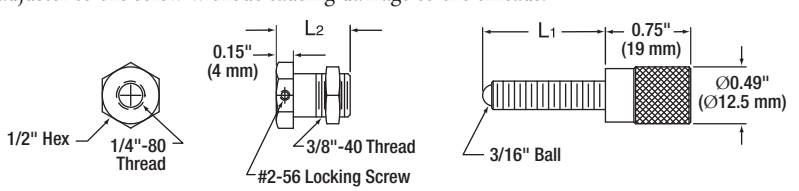
See Page 522

Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
F25SS038	$ 6.50	£ 4.50	€ 5,80	¥ 54.90	1/4"-80 Adjuster Screw	L_1 = 3/8"
F25SS050	$ 7.00	£ 4.85	€ 6,30	¥ 59.20	1/4"-80 Adjuster Screw	L_1 = 1/2"
F25SS075	$ 7.60	£ 5.25	€ 6,80	¥ 64.20	1/4"-80 Adjuster Screw	L_1 = 3/4"
F25SS085	$ 7.80	£ 5.40	€ 7,00	¥ 65.90	1/4"-80 Adjuster Screw	L_1 = 0.85"
F25SS100	$ 8.10	£ 5.60	€ 7,20	¥ 68.40	1/4"-80 Adjuster Screw	L_1 = 1"
F25SS116	$ 8.60	£ 5.95	€ 7,70	¥ 72.70	1/4"-80 Adjuster Screw	L_1 = 1.16"
F25SS150	$ 9.70	£ 6.70	€ 8,70	¥ 82.00	1/4"-80 Adjuster Screw	L_1 = 1.5"
F25SS200	$ 11.30	£ 7.85	€ 10,10	¥ 95.50	1/4"-80 Adjuster Screw	L_1 = 2"
F25SS250	$ 15.00	£ 10.40	€ 13,40	¥ 126.70	1/4"-80 Adjuster Screw	L_1 = 2.5"
F25SS300	$ 16.90	£ 11.80	€ 15,10	¥ 142.80	1/4"-80 Adjuster Screw	L_1 = 3"
F25SS400	$ 19.40	£ 13.50	€ 17,30	¥ 163.90	1/4"-80 Adjuster Screw	L_1 = 4"
F25SSN1	$ 8.60	£ 5.95	€ 7,70	¥ 72.70	1/4"-80 Threaded Bushing	L_2 = 0.63"
F25SSN2	$ 8.60	£ 5.95	€ 7,70	¥ 72.70	1/4"-80 Threaded Bushing	L_2 = 0.57"
F25SSK1	$ 6.50	£ 4.50	€ 5,80	¥ 54.90	1/4"-80 Removable Knob	0.45"
LN2580	$ 8.00	£ 5.55	€ 7,20	¥ 67.60	1/4"-80 Lock Nut	–

1/4"-80 Fine Adjustment Screws

Our high-precision 1/4"-80 Fine Adjustment Screws are a convenient drop-in replacement for our F25SS-series of hex adjusters. The knurled Delrin knob improves adjustment sensitivity. The convenient brass sleeve, complete with a removable nut, is precision-machined for a fit 30% better than the tightest industry standard (Class 3 Fit). The 1/2" hex head adjuster nut is equipped with a side-located nylon-tipped setscrew to lock the adjuster to the screw without causing damage to the threads.

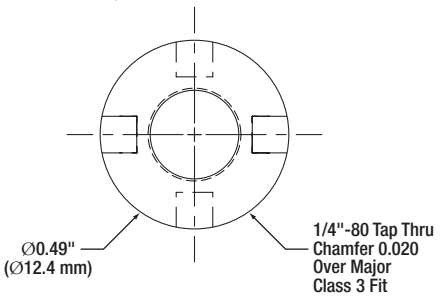


Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
FAS100	$ 7.80	£ 5.40	€ 7,00	¥ 65.90	1/4"-80 TPI Adjuster	L_1 = 1"
FAS125	$ 8.00	£ 5.55	€ 7,20	¥ 67.60	1/4"-80 TPI Adjuster	L_1 = 1 1/4"
FAS150	$ 8.30	£ 5.75	€ 7,40	¥ 70.10	1/4"-80 TPI Adjuster	L_1 = 1 1/2"
FAS200	$ 8.80	£ 6.10	€ 7,90	¥ 74.40	1/4"-80 TPI Adjuster	L_1 = 2"
FAS250	$ 9.90	£ 6.85	€ 8,80	¥ 83.60	1/4"-80 TPI Adjuster	L_1 = 2 1/2"
FAS300	$ 11.20	£ 7.75	€ 10,00	¥ 94.60	1/4"-80 TPI Adjuster	L_1 = 3"
N80L5	$ 7.60	£ 5.25	€ 6,80	¥ 64.20	1/4"-80 Locking Adjuster Nut	L_2 = 0.53"
N80L6	$ 8.40	£ 5.80	€ 7,50	¥ 71.00	1/4"-80 Locking Adjuster Nut	L_2 = 0.65"
N80L7	$ 9.50	£ 6.60	€ 8,50	¥ 80.30	1/4"-80 Locking Adjuster Nut	L_2 = 0.78"

1/4"-80 Fine Hex Adjuster Locking Nut

- Compatible with Any Thorlabs 1/4"-80 Adjuster
- Minimal Beam Shift When Locking Mirror Mount Actuator
- Make any Mount with 1/4"-80 Adjusters Lockable



KM100 with LN2580
KM100 Sold Separately

Please refer to our website for complete models and drawings.

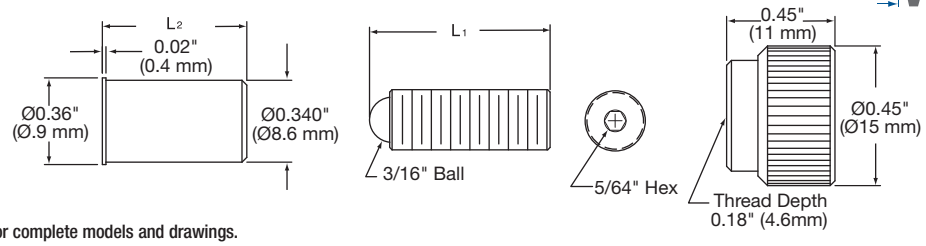
ITEM#	$	£	€	RMB	DESCRIPTION
LN2580	$ 8.00	£ 5.55	€ 7,20	¥ 67.60	1/4"-80 Lock Nut

Differential Adjuster Screw

The DAS110 is a standard 1/4"-80, 1.00" long adjuster screw with an internal differential adjustment mechanism. The fine adjustment is actuated by inserting a hex wrench through the clearance hole in the adjuster knob. Every rotation of the DAS110 fine adjustment mechanism yields a highly demagnified displacement of just 25 µm/rev. This adjuster is ideal as a drop-in replacement for increasing the resolution on most Thorlabs' mirror mounts.

ITEM#	$	£	€	RMB	DESCRIPTION
DAS110	$ 38.00	£ 26.40	€ 33,80	¥ 320.90	Miniature Differential Adjuster

1/4"-100 UltraFine Hex Adjusters



1/4"-100 hex adjusters are commonly used when making high-precision optomechanical mounts. Mating parts can be made using a tap (ITEM# 99940, see page 514) or either the F25USN1 or F25USN2 threaded bushing. Also available for use with the 1/4"-100 hex adjusters are removable knobs and vacuum-compatible lock nuts.

Mechanical Drawings Available on the WEB

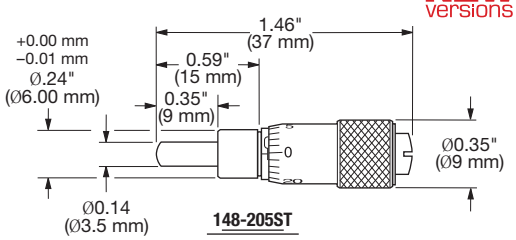
Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION	LENGTH
F25US050	$ 8.10	£ 5.60	€ 7,20	¥ 68.40	1/4"-100 Adjuster Screw	L_1 = 1/2"
F25US075	$ 8.60	£ 5.95	€ 7,70	¥ 72.70	1/4"-100 Adjuster Screw	L_1 = 3/4"
F25US100	$ 9.10	£ 6.30	€ 8,10	¥ 76.90	1/4"-100 Adjuster Screw	L_1 = 1"
F25US150	$ 10.80	£ 7.50	€ 9,60	¥ 91.20	1/4"-100 Adjuster Screw	L_1 = 1 1/2"
F25US200	$ 12.40	£ 8.60	€ 11,10	¥ 104.80	1/4"-100 Adjuster Screw	L_1 = 2"
F25USN1	$ 9.70	£ 6.70	€ 8,70	¥ 82.00	1/4"-100 Threaded Bushing	L_2 = 0.63"
F25USN2	$ 9.70	£ 6.70	€ 8,70	¥ 82.00	1/4"-100 Threaded Bushing	L_2 = 0.57"
F25USK1	$ 8.10	£ 5.60	€ 7,20	¥ 68.40	1/4"-100 Removable Knob	0.45"
LN25100	$ 8.20	£ 5.70	€ 7,30	¥ 69.30	1/4"-100 Locking Nut	–

6.5 mm Travel Micrometer Heads

NEW versions

148-208ST



Range: 0 to 6.50 mm (10 µm per Division)

These small micrometers are ideal for optical mounts. The spherical spindle tip provides a single point of contact, which eliminates alignment errors. The flat tip is ideal for measurement applications.

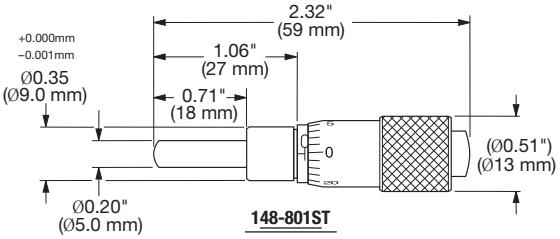
Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	RANGE	SPINDLE TIP
148-205ST	$ 44.90	£ 31.20	€ 39,90	¥ 379.20	0 - 6.50 mm	Spherical
148-201FT	$ 44.90	£ 31.20	€ 39,90	¥ 379.20	0 - 6.50 mm	Flat

13 mm Travel Micrometer Head

Mechanical Drawings Available on the WEB

148-801ST



Range: 0 to 13.00 mm (10 µm per Division)

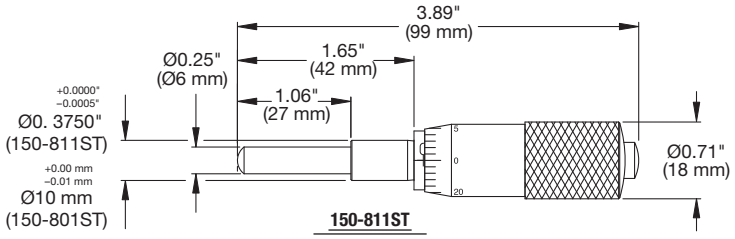
These micrometer heads offer 13 mm of travel and spherical spindle tips.

Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	RANGE
148-801ST	$ 45.90	£ 31.90	€ 40,80	¥ 387.60	0 - 13 mm

1.0" and 25 mm Travel Micrometer Heads

150-811ST



Range:

- 150-811ST: 0 to 1.000" (0.001" per Division)
- 150-801ST: 0 to 25 mm (10 µm per Division)

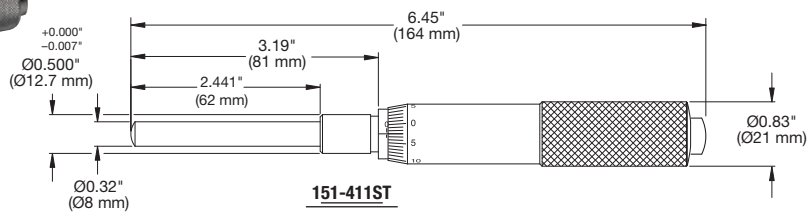
These micrometer heads offer 1" (25 mm) of travel and spherical spindle tips.

Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	RANGE
150-811ST	$ 51.00	£ 35.40	€ 45,30	¥ 430.70	0 - 1.000"
150-801ST	$ 51.00	£ 35.40	€ 45,30	¥ 430.70	0 - 25 mm

50 mm Travel Micrometer Head

151-411ST



Range: 0 to 50 mm (10 µm per Division)
These micrometer heads offer 50 mm of travel and spherical spindle tips.

Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	RANGE
151-411ST	$ 201.00	£ 139.40	€ 178,50	¥ 1,697.30	0 - 50 mm

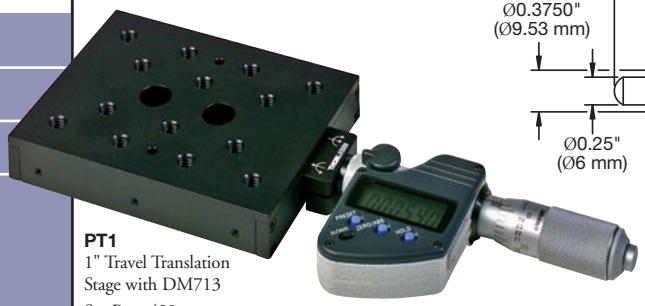
1" (25.4 mm) Travel, Digimatic Micrometer Head

1 µm LCD Readout

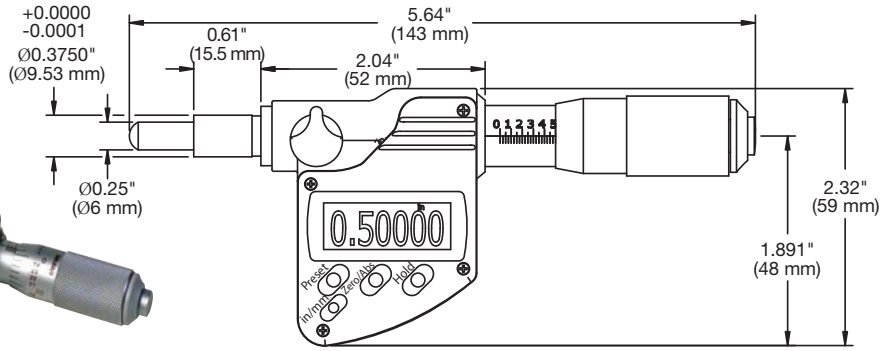
DM713

- Display Resolution of 1 µm (0.00005")
- Accuracy ±2 µm (0.0001")
- Instant Inch/Millimeter Conversion
- Measurement Hold Key
- Zero-Set Key Allows for Setting Zero at any Point
- Spherical Face Spindle
- Imperial and Metric User-Selectable Operating Modes
- Automatic Power-Off*

*Battery Life: 1 Year with Normal Use



PT1
1" Travel Translation Stage with DM713
See Page 429

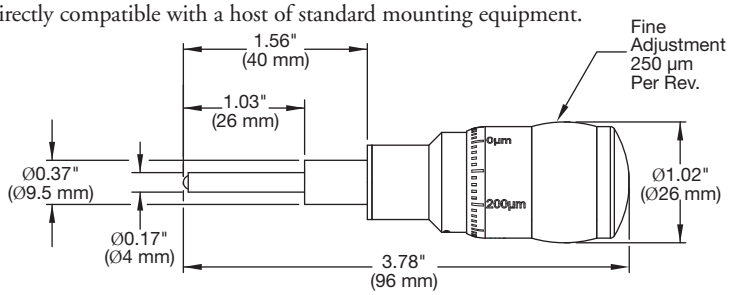


Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
DM713	$ 327.50	£ 227.10	€ 290,80	¥ 2,765.50	Imperial/Metric Digimatic Micrometer Head, Spherical Tip

0.5" (12.7 mm) Travel, Fine Drive Actuator

The DRV505 Fine Drive Actuator provides smooth, precision translation at 250 µm per revolution with 2 µm resolution. The large actuator knob with anti-slip padding provides increased sensitivity along with a laser-engraved scale marked with 5 µm graduations. The Ø3/8" mounting barrel is directly compatible with a host of standard mounting equipment.

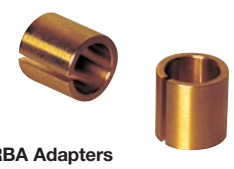


- 0.5" (12.7mm) of Travel
- 2 µm Resolution (Calculated)
- 250 µm Per Revolution

Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
DRV505	$ 274.60	£ 190.40	€ 243,80	¥ 2,318.80	1/2" (12.7 mm) Fine Drive Actuator

Micrometer Barrel Adapters



RBA Adapters

These slotted brass sleeves are an ideal solution for securing Ø3/8" and Ø10 mm mounting barrels into components designed for Ø1/2" and Ø0.47" barrels. The slotted sleeve allows an externally applied clamping force to be transferred to the mounting barrel.

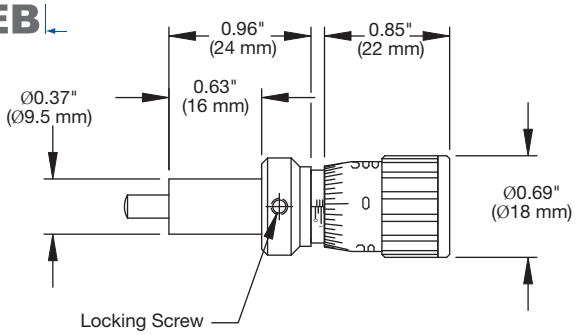
ITEM#	$	£	€	RMB	DESCRIPTION
RBA1	$ 6.85	£ 4.75	€ 6,10	¥ 57.90	Ø0.375" to Ø0.500" Adapter
RBA2	$ 6.85	£ 4.75	€ 6,10	¥ 57.90	Ø10 mm to Ø0.500" Adapter
RBA3	$ 6.85	£ 4.75	€ 6,10	¥ 57.90	Ø0.375" to Ø0.470" Adapter

10 mm Travel, High-Precision Micrometer Head

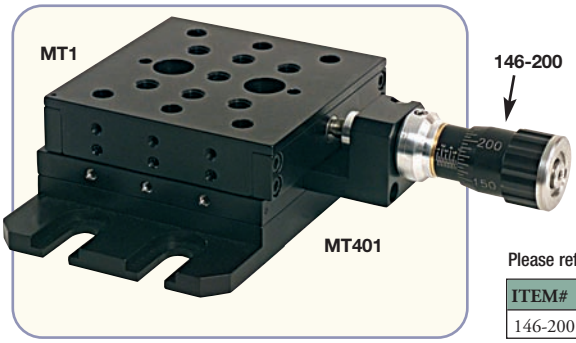
The 146-200 is a high-precision micrometer head with a 250 µm pitch leadscrew. The graduated dial and linear scale on the micrometer barrel provide a calibrated displacement readout. A spherical tip is provided to ensure a single point of contact between the adjuster and the mating surface.

- 0 - 2.54" (0 - 10 mm) Range
- 5 µm per Division
- Calculated Resolution Better than 1 µm
- Standard 3/8" Barrel Diameter
- 250 µm/rev

Mechanical Drawings Available on the WEB



Application Idea

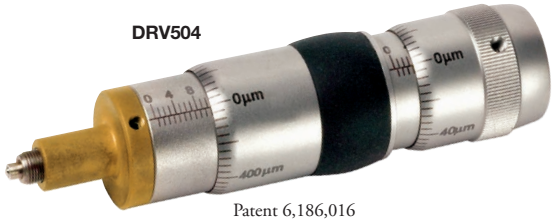


Please refer to our website for complete models and drawings.

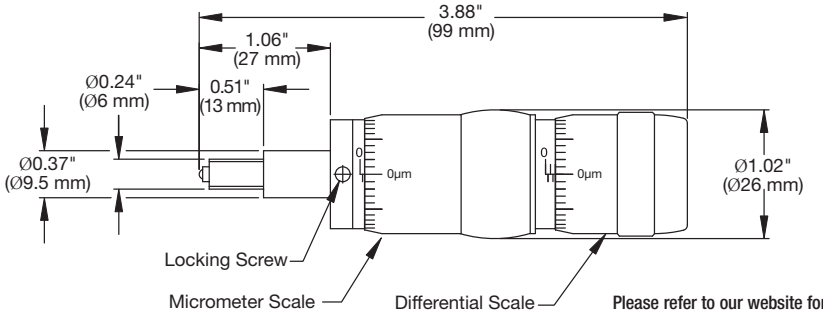
ITEM#	$	£	€	RMB	DESCRIPTION
146-200	$ 77.60	£ 53.80	€ 68,90	¥ 655.30	High-Precision Micrometer Head

0.5" (12.7 mm) Travel Differential Micrometer Head

- 0.5" (12.7 mm) of Coarse Travel
- 1 µm Coarse Resolution (Calculated)
- 300 µm High-Resolution Differential Travel
- 50 nm Differential Resolution (Calculated)
- Ø3/8" Mounting Barrel
- 500 µm/rev Coarse Adjustment
- 50 µm/rev Fine Adjustment



Patent 6,186,016



Please refer to our website for complete models and drawings.

The DRV504 Differential Micrometer has a unique mechanism that converts a relatively large displacement into a comparatively small displacement of the center fine adjustment spindle. The design has the additional benefit of providing a uniformly smooth feel that is largely independent of loading.

Two large knobs are provided for the coarse and differential adjustment, which adds to the overall sensitivity of the unit. The coarse adjustment knob provides 0.5" (12.7 mm) of total travel with 1 µm resolution, while the differential knob provides 300 µm of total travel with 50 nm resolution.

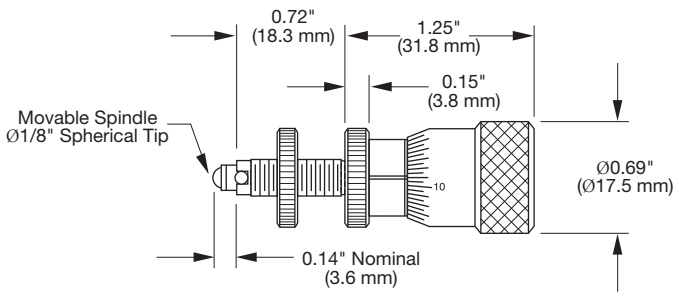
ITEM#	$	£	€	RMB	DESCRIPTION
DRV504	$ 395.00	£ 273.90	€ 350,70	¥ 3,335.40	Differential Micrometer, 0.5"(12.7 mm) Travel, Ø3/8" Mouting Barrel

Differential Adjuster for Optic Mounts

The DM22 differential adjuster uses two leadscrews; one pushes the center spindle forward at 400 µm per revolution while the other pulls it back at 375 µm per revolution. The resultant total forward motion of the center spindle is 25 µm per revolution of the graduated knob. Each small graduation of the fine control knob is 0.5 µm; the calculated resolution for the DM22 is approximately 50 nm.

Mechanical Drawings Available on the WEB

DM22
Submicron Adjuster



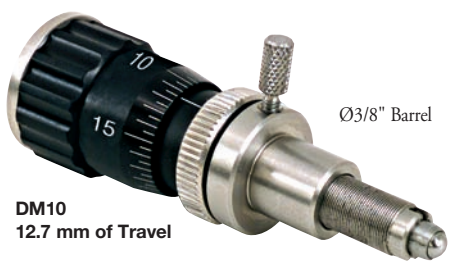
Fine Adjustment
- 250 µm Range
- 25 µm/rev

Coarse Adjustment
- 0.73" Long 1/4"-80 Threads
- 0.012"/rev (80 TPI)

Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
DM22	$ 95.90	£ 66.50	€ 85,20	¥ 809.80	Differential Adjuster 1/4"-80 External Thread

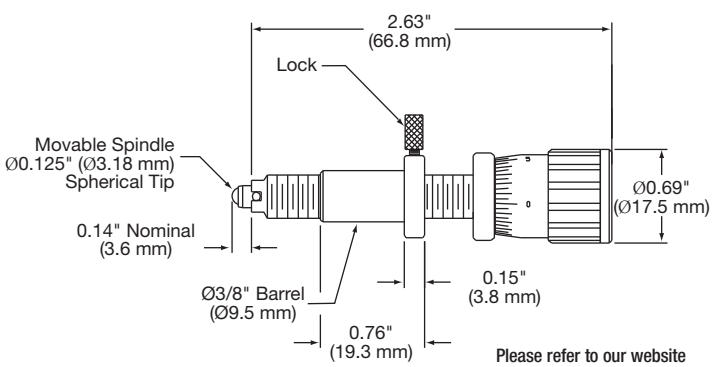
0.5" (12.7 mm) and 1.0" (25.4 mm) Travel Differential Adjusters for Translation Stages



DM10
12.7 mm of Travel

DM12
25.4 mm of Travel

The DM12 and DM10 use the same internal mechanism as the DM22 described above, but these models are designed specifically for use in our 1/2" (12.7 mm) and 1" (25.4 mm) translation stages (See pages 428-429).



Please refer to our website for complete models and drawings.

Fine Adjustment
- 250 µm Range
- 25 µm/rev

Coarse Adjustment
- 1.0" (25.4 mm) for DM12
- 0.5" (12.7 mm) for DM10

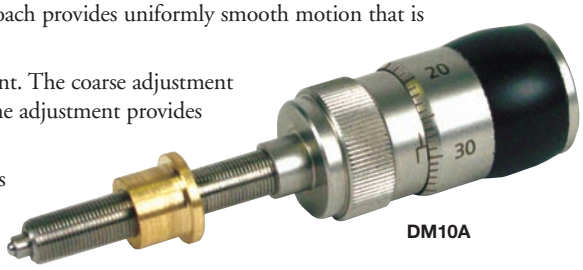
ITEM#	$	£	€	RMB	DESCRIPTION
DM10	$ 97.90	£ 67.90	€ 87,00	¥ 826.70	Differential Adjuster, 0.5" (12.7 mm) of Coarse Travel
DM12	$ 100.00	£ 69.40	€ 88,80	¥ 844.50	Differential Adjuster, 1.0" (25.4 mm) of Coarse Travel

8.0 mm Travel, High-Precision Differential Adjuster

The Thorlabs High-Precision Adjuster offers exceptional resolution and repeatability. The unique lever mechanism provides a precision mechanical advantage, which multiplies the resolution of its high-precision, fine- adjustment threads, resulting in a small displacement of the spindle. This approach provides uniformly smooth motion that is largely independent of loading.

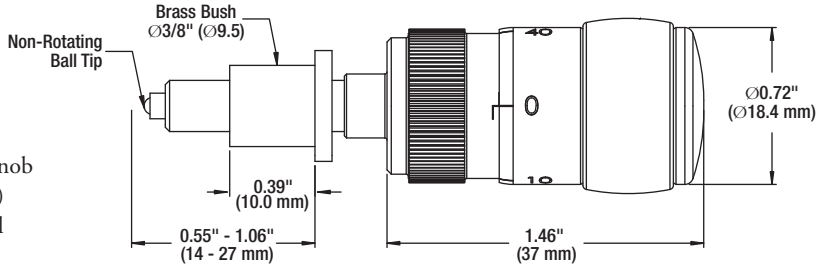
Two large knobs are provided for coarse and fine adjustment. The coarse adjustment provides 8.0 mm of travel at 1 µm resolution, while the fine adjustment provides 0.3 mm travel at 20 nm resolution (calculated).

The DM10A has a 0.5" (12.7 mm) mounting barrel and is compatible with our RollerBlock™ series of linear stages (see page 466).



DM10A

- Coarse Lead Screw with 500 µm/rev
- Fine Lead Screw with 65 µm/rev
- 8.0 mm of Travel
- 1 µm Resolution (Calculated)
- Negligible Backlash
- Soft Rubber Ring Reduces Heat Transfer
- Positive Travel Limit Stops on Control Knob
- Graduated Knob (50 Arbitrary Divisions)
- Output via Non-Rotating Hard Steel Ball



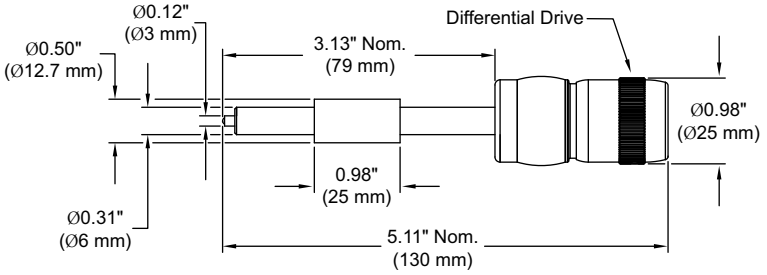
Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
DM10A	$ 195.00	£ 135.20	€ 173,20	¥ 1,646.60	Differential Adjuster, 8 mm of Travel

2" (50.8 mm) Travel, Differential Adjuster

This differential drive has been designed for use on single-axis stages equipped with a Ø1/2" (Ø12.7 mm) actuator mounting hole. The large-diameter differential drive actuator provides fine, ultra-smooth control over motion. The removable brass bushing allows this actuator to be used in any OEM application requiring 1" (25 mm) of overall travel.

Features
- Non-Rotating Tip
- Ø1/2" (Ø12.7 mm) Interchangeable Brass Mounting Bushing



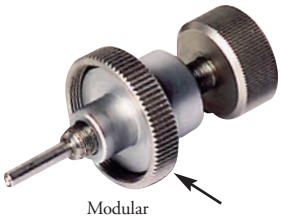
Please refer to our website for complete models and drawings.

Specifications
- **Coarse Adjustment**
  - **Leadscrew:** 500 µm/rev
  - **Range:** 2.0" (50 mm)
  - **Pitch:** 0.5 mm
- **Fine Adjustment**
  - **Leadscrew:** 50 µm
  - **Range:** 300 µm
  - **Pitch:** 0.05 µm

Mechanical Drawings Available on the WEB

ITEM#	$	£	€	RMB	DESCRIPTION
DRV008	$ 467.50	£ 324.10	€ 415,10	¥ 3,947.60	2" (50.8 mm) Travel Differential Adjuster, Ø12.7 mm Mounting Bush

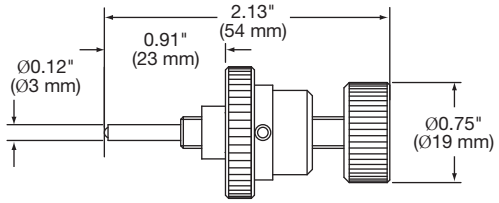
0.31" (8 mm) Travel Modular Thumbscrew Drive



Modular Quick Connect

This thumbscrew drive offers the modular quick-connect allowing it to be used in conjunction with other modular actuators in addition to the Modular Quick-Connect Adapter. The large-diameter knurled knob provides excellent sensitivity over a 0.31" (8 mm) adjustment range.

- 0.31" (8 mm) of Total Travel
- 500 µm per Revolution
- Compatible with Quick-Connect Adapters
- Ideal for Our Multi-Axis Stages (See Page 468)



Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
DRV004	$ 96.50	£ 66.90	€ 85,70	¥ 814.90	Modular Thumbscrew Drive

0.31" (8 mm) Travel Modular Differential Micrometer

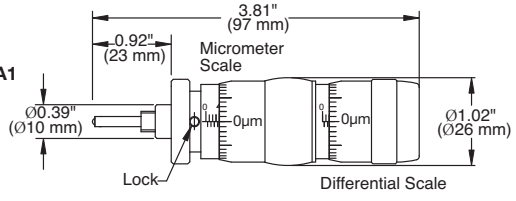
The DRV002 Modular Actuator offers 0.31" (8 mm) of coarse adjustment and 400 µm of differential adjustment with 50 nm resolution. Two large-diameter knobs are provided for increased sensitivity of the coarse and differential drives. The coarse adjuster provides 500 µm per revolution of travel with graduation marks every 10 µm while the differential adjuster provides 50 µm per revolution of travel with graduation marks every 1 µm.

DRV002

- 0.31" (8 mm) of Travel with 300 µm Fine Travel
- 50 nm Resolution (Calculated)
- 8 mm Coarse Adjustment
- Compatible with Quick-Connect Adapters
- 500 µm/rev Coarse Adjustment
- 50 µm/rev Fine Adjustment

MCA1

DRV002 Shown with MCA1 Creates Ø3/8" Mounting Barrel



Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
DRV002	$ 315.00	£ 218.40	€ 279,70	¥ 2,659.90	Modular Differential Adjuster with 0.31" (8 mm) of Travel
MCA1	$ 18.90	£ 13.20	€ 16,80	¥ 159.60	Modular Quick-Connect Adapter for Ø3/8" Mounting
MCA2	$ 18.90	£ 13.20	€ 16,80	¥ 159.60	Modular Quick-Connect Adapter for Ø10 mm Mounting

0.31" (8 mm) Travel, Differential Adjuster

The DRV003 offers increased linearity, in the fine adjustment and decreased drift over time compared to the DRV002. The DRV003 is directly compatible with our NanoMax MAX300 series stages. Two large knobs are provided for coarse and fine adjustment. The lockable coarse adjustment provides 8 mm of travel at 500 µm per revolution, while the fine adjustment provides 0.25 mm travel at 50 µm per revolution. These adjusters can be adapted to fit any stage accepting 0.375" and 10 mm mounting barrels using MCA1 or MCA2 adapters.

Application Showing DRV003 Installed in a MAX301

See Page 482

NEW product

DRV003

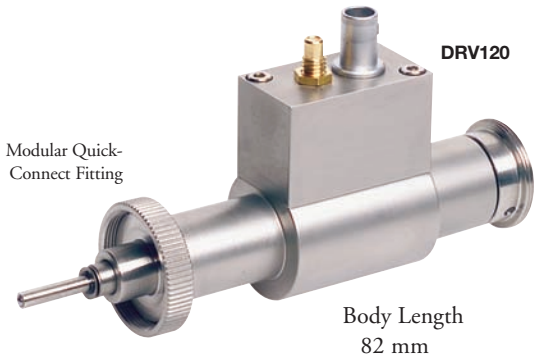
- 0.31" (8 mm) of Travel with 250 µm Fine Travel
- 1 µm Coarse, 20 nm Fine Resolution (Calculated)
- 500 µm/rev Coarse Adjustment
- 50 µm/rev Fine Adjustment
- Directly Compatible with MAX300 and MAX600 Series Stages

ITEM#	$	£	€	RMB	DESCRIPTION
DRV003	$ 195.00	£ 135.20	€ 173,20	¥ 1,646.60	Modular Differential Adjuster with 0.31" (8 mm) of Travel
MCA1	$ 18.90	£ 13.20	€ 16,80	¥ 159.60	Modular Quick-Connect Adapter for Ø3/8" Mounting
MCA2	$ 18.90	£ 13.20	€ 16,80	¥ 159.60	Modular Quick-Connect Adapter for Ø10 mm Mounting

Modular Piezoelectric Actuator with Position Feedback

Specifications

- **Piezo Voltage:** 0 - 75 VDC
- **Travel Range:** 20 µm
- **Resolution:** 5 nm
- **Mounting Connector:** Quick-Connect Fitting



The DRV120 Piezoelectric Actuator is designed to enhance the travel range and control of Thorlabs' NanoMax 300 and NanoMax 600 Series of flexure stages (see pages 470 and 492, respectively). This actuator, which is directly compatible with these stages, provides a travel range of 20 µm with 5 nm resolution. The positional feedback is provided by a strain gauge mounted directly to the piezo element. The strain gauge provides an analog signal that is proportional to its extension. The DRV120 has two connections, one for the piezo driver and another for a 7-pin LEMO connector.

By using our MCA1 or MCA2 Quick-Connect Adapter, respectively, the DRV120 piezoelectric actuator can be fitted to any stages accepting a Ø3/8" (Ø9.3 mm) or Ø0.39" (Ø10 mm) mounting barrel.

DRV120 Shown with MCA1

Strain Gauge Connector Pin Out

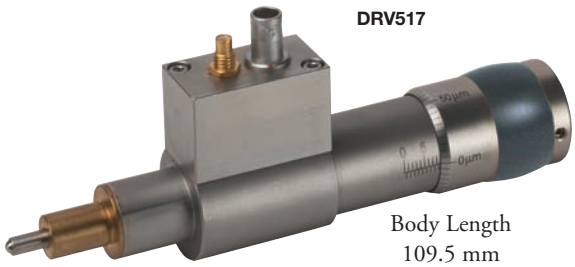
1 +15 V
2 Oscillator +
3 0 V
4 Sig Out -
5 Sig Out +
6 -15 V
7 Travel

ITEM#	$	£	€	RMB	DESCRIPTION
DRV120	$ 995.00	£ 689.80	€ 883,40	¥ 8,401.90	Piezoelectric Actuator with Feedback, 20 µm Travel
MCA1	$ 18.90	£ 13.20	€ 16,80	¥ 159.60	Modular Quick-Connect Adapter for Ø3/8" Mounting
MCA2	$ 18.90	£ 13.20	€ 16,80	¥ 159.60	Modular Quick-Connect Adapter for Ø10 mm Mounting

Feedback Piezo Element with Differential Micrometer

- **Piezo Voltage:** 0 - 75 VDC
- **Travel Range:**
  - Micrometer: 0.5" (12.7 mm)
  - Piezo: 30 µm
- **Resolution:**
  - Micrometer: 1 µm (Calculated)
  - Piezo: 10 nm (Calculated)

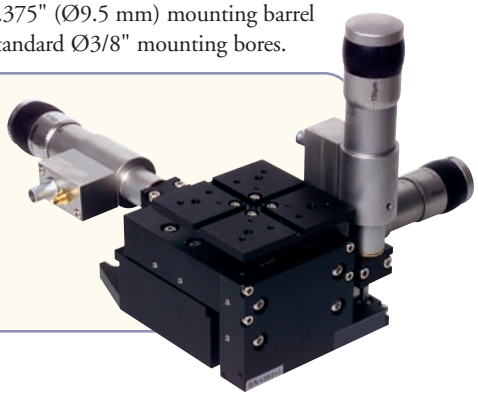
Mechanical Drawings Available on the WEB



Ø0.375" (Ø9.5 mm) Barrel

The DRV517 Combination Actuator provides 0.5" (12.7 mm) of differential adjustment with 1 µm resolution and 30 µm of piezoelectric adjustment with 10 nm resolution. Positional feedback is provided via a 7-pin LEMO connection that can be used in conjunction with our apt™ series of piezo controllers (see pages 580-582). The Ø0.375" (Ø9.5 mm) mounting barrel provides compatibility with standard Ø3/8" mounting bores.

Application Idea



RollerBlock™ with Piezo-Assisted Micrometer
(See Pages 466-467)

1 +15 V
2 Oscillator +
3 0 V
4 Sig Out -
5 Sig Out +
6 -15 V
7 Travel

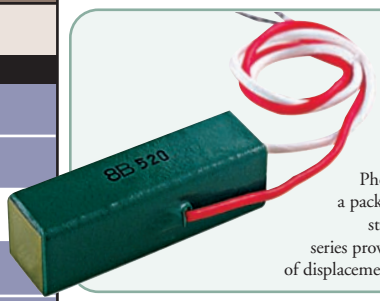
Strain Gauge Connector Pin Out

ITEM#	$	£	€	RMB	DESCRIPTION
DRV517	$ 1,195.00	£ 828.40	€ 1.061,00	¥ 10,091.00	Combo Piezoelectric Actuator/Micrometer with Piezo Feedback

The Piezoelectric Actuators – Tutorial

The Piezoelectric Effect

The Piezoelectric Effect is a basic material characteristic whereby certain types of crystalline materials expand reversibly when subjected to an electric field.



AE0505D08F

Photograph showing a packaged piezoelectric stack. This actuator series provides up to 18 µm of displacement (see page 532).

Although the amount of expansion is usually very small (corresponding to less than 1% strain in the material), it can be controlled extremely precisely by varying the strength of the electric field. Piezoelectric materials have, for many years, formed the basis of very high-precision actuators capable of atomic scale resolution. In fact, the resolution of these actuators is typically limited by the noise and stability of the drive electronics used to generate the electric fields, hence the noise specifications of any potential piezoelectric controller should be carefully evaluated against the requirements of the application. Moreover, the force generated by the expansion of a piezoelectric material is typically very large, often reaching into the range of hundreds of Newtons.

Perhaps the most useful property of these actuators is their ability to produce high speed repetitive motion, which is usually limited by the mechanical system that is being driven rather than by the piezoelectric material itself. This high-speed response of a piezoelectric actuator is used to considerable advantage in the NanoTrak™ control system (see page 572).

One of the drawbacks of piezoelectric materials is that the electric field gradient needed to produce a useful amount of expansion is quite large. To reduce the required drive voltage, the actuator can be constructed as a stack, consisting of many laminated layers of active material sandwiched between electrodes.

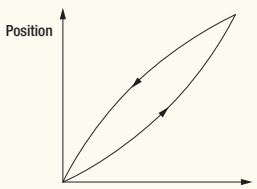
Using this stacked design, the distance from the positive to negative electrodes can be made very small, and a large field gradient can therefore be obtained. With this approach, maximum displacements in the range of 10 to 50 µm are possible, with drive voltages of around 100 V. As a comparison, using single layer bulk piezoelectric components often requires maximium drive voltages in the range of 1000 V. Even with these high voltages a bulk piezoelectric element would typically only provide sub-micron movement.

Hysteresis

Despite the very high resolution of piezoelectric actuators, an inherent problem is the significant amount of hysteresis they exhibit (i.e., the tendency of the actuator to reach a final position that lags behind the demand position).

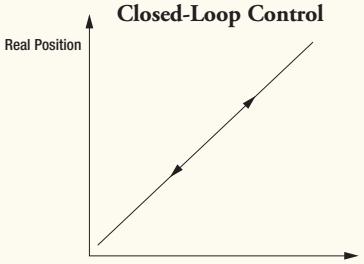
If a cyclical voltage is applied to the actuator, the positions reached on the upward sweep are smaller than those achieved on the downward sweep. If position is plotted against voltage, the graph exhibits a classic hysteresis loop as shown in the plot, above right.

Open-Loop Control



Piezoelectric Hysteresis

Closed-Loop Control



Position Sensing and Feedback

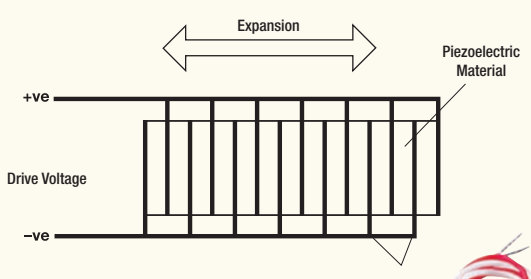
Hysteresis can be eliminated by using a position sensor and feedback loop; the sensor measures the position, the circuit subtracts the measured position from the demand position to obtain a measure of the error, and a feedback loop adjusts the voltage to the actuator until the error is driven to zero. This servo-loop feature is standard with all of our apt™ family of piezoelectric controllers.

Some piezoelectric nanopositioning actuators have position sensing, others do not. The apt™ piezoelectric controller fully supports both types, the photograph above shows one of our piezoelectric actuators that incorporates a strain gage displacement sensor.

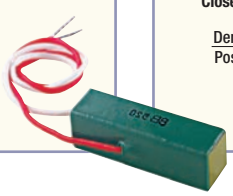
Open- and Closed-Loop Control

The result of using closed-loop control is a linear relationship between the requested position and the actual position (see the plot entitled Closed-Loop Control), in contrast to open loop control (see the plot entitled Open-Loop Control).

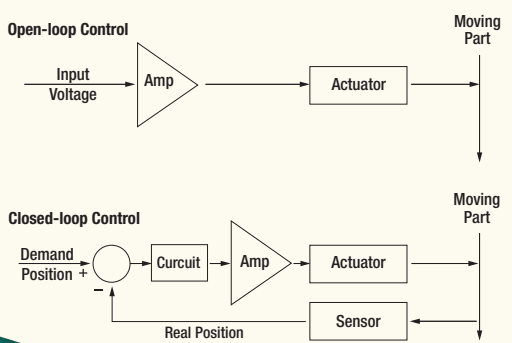
Piezoelectric Stack Diagram



Photograph of a Piezoelectric Stack (shown right): 20 mm long with 18 µm of displacement at 150 V. See our complete selection of piezoelectric stacks on page 532.

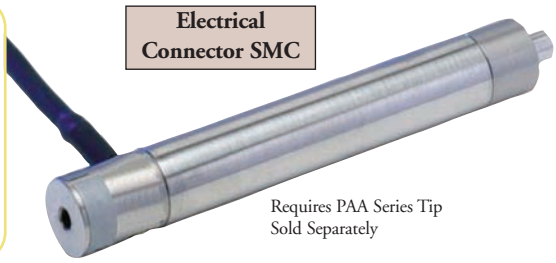


Piezoelectric System Schematic Diagram

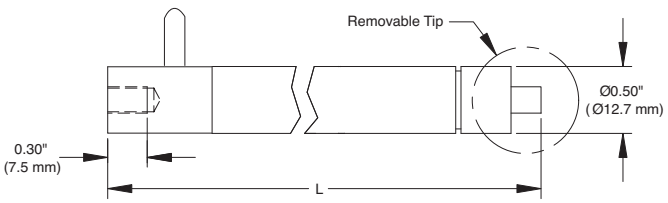


Piezoelectric Actuators without Feedback

Specifications
- Permanent Preload
- **Piezo Voltage:** 0 to 75 VDC
- **Drives:** Modular Drives
- **Opertating Temperature:** -20 to 80° C



Required, Interchangeable Tips Sold Separately (Shown Below)



The PAS Series of Piezoelectric Actuators provide a convenient mounting package with adjustment ranges of 20 mm, 40 mm, or 100 mm. The tip of the actuator is tapped to accept any of our PAA Series Actuator Tips featured below.

Please refer to our website for complete models and drawings.

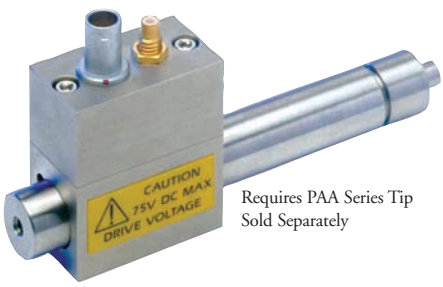
ITEM#	$	£	€	RMB	LENGTH L	TRAVEL	RESOLUTION
PAS020	$ 382.50	£ 265.20	€ 339,60	¥ 3,229.90	1.65" (42 mm)	20.0 µm	20.0 nm
PAS040	$ 565.00	£ 391.70	€ 501,70	¥ 4,770.90	2.36" (60 mm)	40.0 µm	40.0 nm
PAS100	$ 825.00	£ 572.00	€ 732,50	¥ 6,966.40	4.49" (114 mm)	100.0 µm	100.0 nm

End Tips for PAS/PAZ Series

The PAA series of actuator tips have been provided to enhance the mechanical interfacing of the PAS series of piezoelectric actuators featured above and the PAZ series featured below. These tips are precision-machined and feature a hardened steel insert for long life.

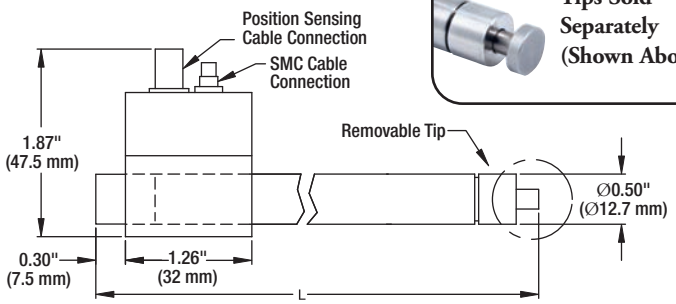
ITEM#	$	£	€	RMB	DESCRIPTION
PAA001	$ 21.00	£ 14.60	€ 18,70	¥ 177.40	Piezo Actuator Tip, Flat End
PAA005	$ 36.80	£ 25.60	€ 32,70	¥ 310.80	Piezo Actuator Tip, Ball End
PAA007	$ 24.30	£ 16.90	€ 21,60	¥ 205.20	Piezo Actuator Tip, M4 x 0.7 Threading
PAA013	$ 27.50	£ 19.10	€ 24,50	¥ 232.30	Piezo Actuator Tip, #8-32 UNC Threading

Piezo Actuators with Strain Gauge Feedback



Requires PAA Series Tip Sold Separately

Interchangeable Tips Sold Separately (Shown Above)



The PAZ series of piezoelectric actuators provides a wide selection of travel ranges (20 to 100 µm), the flexibility of replaceable tips, and feedback via a 7-pin LEMO connector that can be used in conjunction with our apt™ series of piezo controllers (see page 562). The Ø1/2" (Ø12.7 mm) mounting barrel provides compatibility with standard Ø1/2" (Ø12.7 mm) mounting bores.

Please refer to our website for complete models and drawings.

ITEM#	TRAVEL	LENGTH L	RESOLUTION
PAZ020	20 µm	2.36" (60 mm)	5.0 nm
PAZ040	40 µm	3.07" (78 mm)	10.0 nm
PAZ100	100 µm	5.20" (132 mm)	25.0 nm

Piezo Actuators

Please note that the actuators and tips are sold separately.

ITEM#	$	£	€	RMB	DESCRIPTION
PAZ020	$ 770.00	£ 533.80	€ 683,70	¥ 6,501.90	Piezoelectric Actuator with Feedback, 20 µm Travel
PAZ040	$ 915.00	£ 634.30	€ 812,40	¥ 7,726.30	Piezoelectric Actuator with Feedback, 40 µm Travel
PAZ100	$ 1,390.00	£ 963.60	€ 1.234,00	¥ 11,738.00	Piezoelectric Actuator with Feedback, 100 µm Travel

Piezoelectric Actuator

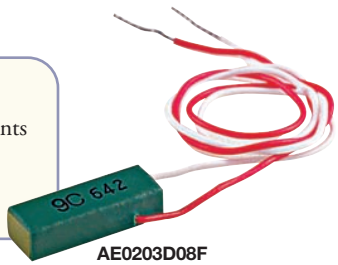
The PE4 incorporates one of our piezoelectric stacks (ITEM# AE0505D16F) and a manual 3/16" x 100 leadscrew. The manual adjuster has better than 1 µm resolution, which complements the 15 µm range of the piezo stack. When the PE4 is combined with our MDT694A driver (see page 566), translation on the order of 10 nm is achievable.

ITEM#	$	£	€	RMB	DESCRIPTION
PE4	$ 479.60	£ 332.50	€ 425,80	¥ 4,049.80	Piezoelectric Actuator, 4 mm of Coarse/15 µm of Fine Travel

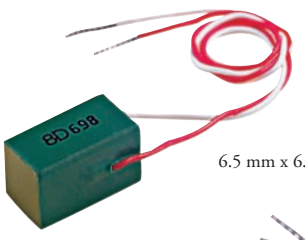
Piezoelectric Actuators

NEW versions

Operating Precautions
- Do Not Use in Highly Flammable Enviroments
- Always Ensure Proper Drive Polarity (Red +)
- Do Not Exceed 85 °C



AE0203D08F
3.5 mm x 4.5 mm x 10 mm



AE0505D08F
6.5 mm x 6.5 mm x 10 mm

These piezoelectric actuators transform electrical energy into precisely controlled mechanical displacements. They are ideal for applications requiring rapid, precise positional changes on the nanometer or micrometer scale. A room-temperature epoxy, such as F120 on page 367, is the recommended method for making connections to these piezoelectric stacks. When mounting, avoid bending forces and center the mechanical load on the piezoelectric end faces. If the actuator is incorporated into a design that calls for a preload, it is recommended that the preload not exceed 50% of the specified clamping force, which is 45 lbs for AE0203 models and 190 lbs for AE0505 models.

AE0203D04F
3.5 mm x 4.5 mm x 5 mm

AE0505D16F
6.5 mm x 6.5 mm x 20 mm

- **Fast Response Time:** 3x Resonant Frequency
- **Drive Voltage:** 0 - 150 VDC
- **Operating Temperature Range:** -25 to 85 °C
- **Recommended Drivers:** MDT693A, MDT694A, TPZ001, and BPC20X Series (See Page 562)

MDT693A

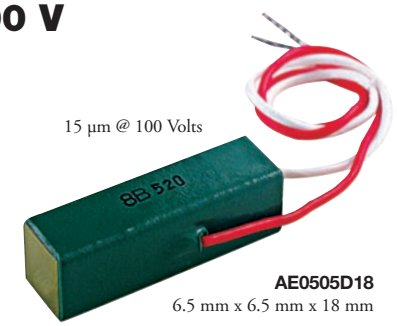
ITEM#	$	£	€	RMB	DISPLACEMENT @ 150 V	DISPLACEMENT @ 100 V	CAPACITANCE @ 1 kHz, 1 V RMS	RESONANT FREQUENCY
AE0203D04F	$ 72.80	£ 50.50	€ 64,70	¥ 614.80	4.6 ± 1.5 µm	3.0 ± 1.5 µm	0.09 µF	261 kHz
AE0203D08F	$ 79.80	£ 55.40	€ 70,90	¥ 673.90	9.1 ± 1.5 µm	6.1 ± 1.5 µm	0.18 µF	138 kHz
AE0505D08F	$ 130.80	£ 90.70	€ 116,20	¥ 1,104.50	9.1 ± 1.5 µm	6.1 ± 1.5 µm	0.75 µF	138 kHz
AE0505D16F	$ 153.30	£ 106.30	€ 136,20	¥ 1,294.50	17.4 ± 2.0 µm	11.6 ± 2.0 µm	1.40 µF	69 kHz

Low-Voltage Actuator, Full Displacement at 100 V

Operating Precautions
- Do Not Use in Highly Flammable Enviroments
- Always Ensure Proper Drive Polarity (Red +)
- Do Not Exceed 85 °C

This low-voltage actuator transforms electrical energy into precisely controlled mechanical displacements. The maximum displacement of 15 µm is achieved at the maximum input voltage (100 V).

When mounting, avoid bending forces by centering the mechanical load on the piezoelectric end faces. If the actuator is incorporated into a design that calls for a preload, it is recommended that the preload not exceed 95 lbs.

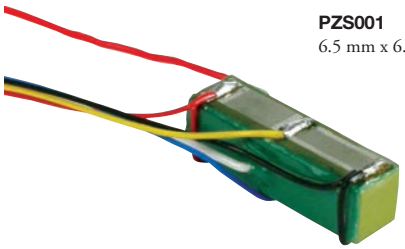


AE0505D18
6.5 mm x 6.5 mm x 18 mm

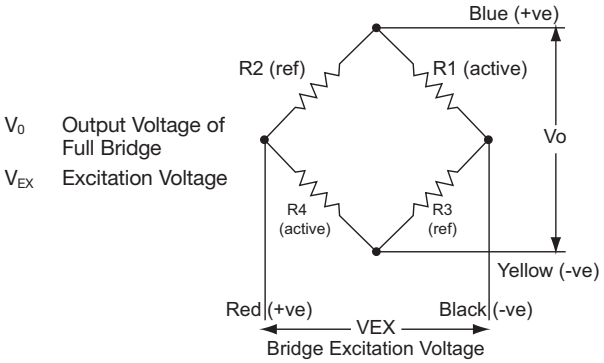
Applying a Drive Voltage in Excess of the 100 V can Cause the Actuator to Fail

ITEM#	$	£	€	RMB	DISPLACEMENT @ 100 V	CLAMPING FORCE	CAPACITANCE @ 1 kHz, 1 V RMS	RESONANT FREQUENCY
AE0505D18	$ 100.00	£ 69.40	€ 88,80	¥ 844.50	15 µm ± 10%	190 lbs	1.6 µF	69 kHz

Piezoelectric Actuator Fitted with a Strain Gauge



PZS001
6.5 mm x 6.5 mm x 20 mm



V_0 Output Voltage of Full Bridge
V_{EX} Excitation Voltage

The PZS001 is comprised from an AE0505D16F piezoelectric actuator with a built-in strain gauge bridge that is used to monitor the amount of piezo displacement. The strain gauge feedback and fast response time makes this actuator ideal for use in applications that require precise nanometer positioning. They are designed to be incorporated into OEM products to form a tightly controlled, high-speed, closed-loop actuator.

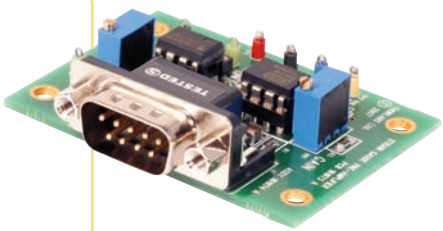
Note: If this product is to be used with a Thorlabs closed-loop piezo controller, a preamplification circuit is required between the bridge output and the controller. Please contact technical support for more information.

ITEM#	$	£	€	RMB	DISPLACEMENT @ 150 V	DISPLACEMENT @100 V	CAPACITANCE @1 kHz, 1 V RMS	RESONANT FREQUENCY
PZS001	$ 175.00	£ 121.40	€ 155,40	¥ 1,477.80	17.4 ± 2.0 µm	11.6 ± 2.0 µm	1.40 µF	69 kHz

Strain Gauge Preamp Circuits

Specifications

- **Drive Voltage:** 150 V
- **Displacement:** 17.4 ± 2 µm
- **Bridge Arm Resistance:** 350 Ω
- **Piezo Capacitance:** 1.4 µF
- **Resonant Frequency:** 69 kHz
- **Gauge Factor:** 2 ± 2%



AMP001

The AMP001 Preamp Circuit is required when using our wide range of closed-loop controllers with bare piezo stacks fitted with strain gauges. These circuits amplify the signal generated from the strain gauge by 500 times to generate a large enough signal to be interpreted by a controller such as the BPC201. (See page 569)

ITEM#	$	£	€	RMB	DESCRIPTION
AMP001	$ 89.50	£ 62.10	€ 79,50	¥ 755.80	Strain Gauge Preamp Board

DC Servo Motorized Actuators

NEW design

Our Z8 series of motorized actuators are engineered for use with optical positioning devices. The high-resolution design, which is incorporated into a compact, lightweight package, makes these actuators ideal for demanding optical laboratory automation applications. Additional features include an optical rotary encoder for closed-loop operation as well as improved commercial built-in limit switches that provide overdrive protection and precise homing accuracy.

The units are shipped with 1.6' (0.5 m) of cable. An 8' (2.5 m) extension cable (PAA632, see page 377) is available separately.

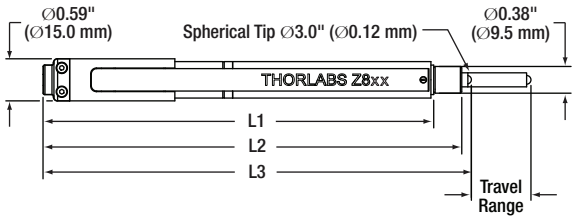
Specifications

- **Travel Range**
  - **Z806:** 0.24" (6 mm)
  - **Z812:** 0.47" (12 mm)
  - **Z825:** 0.98"(25 mm)
- **Recommended Controller:** TDC001
- **Max Velocity:** 3 mm/sec
- **Bidirectional Repeatability:** <1.5 µm
- **Backlash (with Preload):**
  - <6 µm (Z806 and Z812)
  - <12 µm (Z825)
- **Min Incremental Movement:** 0.05 µm
- **Max On-Axis Load Capacity (Vertical):** 10 lbs (4.5 kg)
- **Max On-Axis Load Capacity (Horizontal):** 20 lbs (9 kg)
- **Home Location Accuracy:** <2 µm
- **Leadscrew Pitch:** 1 mm
- **Encoder Lines:** 512
- **Planetary Gear Head Ratio:** 67:1

Features

- Compact 12 VDC Servo Actuator
- New High-Speed Design
- High Resolution via Precision Rotary Encoder
- Planetary Reduction Gearbox for High Loads
- Compatible with Thorlabs' Range of Positioning Stages
- Limit Switches for Zero Position and Actuator Protection
- Compatible with Thorlabs' TDC001 T-Cube Controller
- High-Precision Rotary Encoder (512 Encoder counts/rev and 67:1 Gear Head Yields 34,304 Encoder counts/rev of the Leadscrew)

Mechanical Drawings Available on the WEB



Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	L1 inch (mm)	L2 inch (mm)	L3 inch (mm)	DESCRIPTION
Z806	$ 475.00	£ 329.30	€ 421,80	¥ 4,011.00	4.05 (103.0)	4.45 (113.0)	4.59 (116.7)	6 mm Motorized Actuator with 1/4"-80 Threaded Barrel
Z812	$ 485.00	£ 336.30	€ 430,60	¥ 4,095.40	4.48 (113.9)	4.88 (123.9)	5.01 (127.3)	12 mm Motorized Actuator with 1/4"-80 Threaded Barrel
Z812B	$ 485.00	£ 336.30	€ 430,60	¥ 4,095.40	4.48 (113.9)	4.88 (123.9)	5.01 (127.3)	12 mm Motorized Actuator with Ø3/8" Barrel
Z825	$ 495.00	£ 343.20	€ 439,50	¥ 4,179.80	5.48 (139.3)	6.07 (154.3)	6.20 (157.6)	25 mm Motorized Actuator with 1/4"-80 Threaded Barrel
Z825B	$ 495.00	£ 343.20	€ 439,50	¥ 4,179.80	5.48 (139.3)	6.07 (154.3)	6.20 (157.6)	25 mm Motorized Actuator with Ø3/8" Barrel

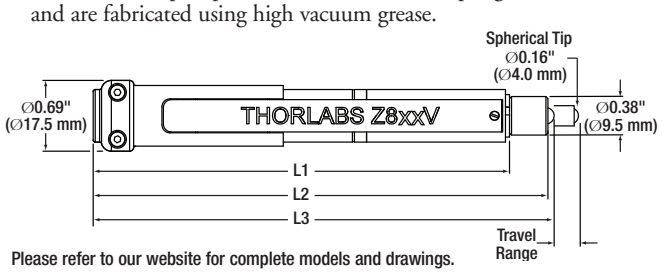
Vacuum-Rated DC Servo Motorized Actuators

NEW design

Our vacuum-compatible, motorized actuators offer the same great functionality as our standard Z8 Series actuators. The only difference is that they are equipped with vacuum-rated servo motors, have a phosphorus bronze internal coupling mechanism, and are fabricated using high vacuum grease.

Features

- Vacuum Rated to 10^{-6} Torr
- Ø3/8" or 1/4"-80 Mounting Barrel
- Same Specifications as the Z8 Series Above



Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	L1 inch (mm)	L2 inch (mm)	L3 inch (mm)	DESCRIPTION
Z806V	$ 675.00	£ 468.00	€ 599,30	¥ 5,699.80	4.05 (103.0)	4.45 (113.0)	4.59 (116.7)	6 mm Vacuum-Rated Actuator w/ 1/4"-80 Threaded Barrel
Z812V	$ 685.00	£ 474.90	€ 608,20	¥ 5,784.20	4.48 (113.9)	4.88 (123.9)	5.01 (127.3)	12 mm Vacuum-Rated Actuator w/ 1/4"-80 Threaded Barrel
Z812BV	$ 685.00	£ 474.90	€ 608,20	¥ 5,784.20	4.48 (113.9)	4.88 (123.9)	5.01 (127.3)	12 mm Vacuum-Rated Actuator w/ Ø3/8" Barrel
Z825V	$ 695.00	£ 481.80	€ 617,10	¥ 5,868.60	5.48 (139.3)	6.07 (154.3)	6.20 (157.6)	25 mm Vacuum-Rated Actuator w/ 1/4"-80 Threaded Barrel
Z825BV	$ 695.00	£ 481.80	€ 617,10	¥ 5,868.60	5.48 (139.3)	6.07 (154.3)	6.20 (157.6)	25 mm Vacuum-Rated Actuator w/ Ø3/8" Barrel

Stepper Motor Actuators

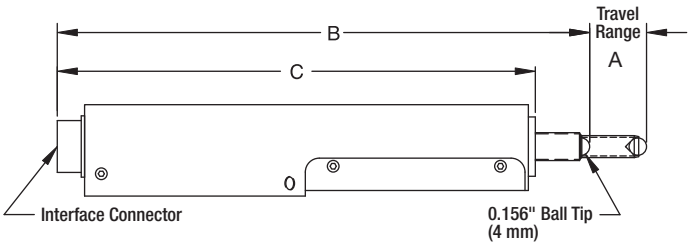
Our ZST actuators provide smooth, precise, linear motion control in a compact package. Powered by a small-diameter, dual-phase stepper motor, these actuators operate at speeds up to 0.5 mm/s and are capable of moving loads of up to 12 lbs. Mounting options include a high-tolerance Ø0.375" mounting barrel for fastening into any application compatible with our precision micrometer heads (see page 523), including our popular PT1 translation stages. A 1/4"-80 threaded barrel is also offered for use with any standard manual mirror mount using 1/4"-80 threaded adjusters.

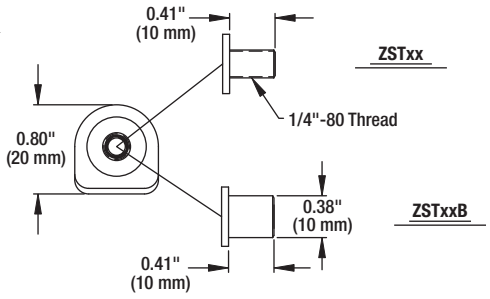
Electromechanical limit switches prevent the unit from being overdriven and provide homing capability with better than 10 µm accuracy. The rear-mounted, high-density push/pull connectors offer a durable, compact connectivity solution. For more information, including the most up-to-date specifications and support drawings, please visit our website.

Specifications

- **Nominal Supply Current (100% Duty Cycle):** 0.25 A
- **Phase Resistance (20 °C):** 12.5 Ω
- **Phase Inductance (1 kHz):** 5.5 mH
- **Holding Torque (with Nominal Current in Both Phases):** 65 oz·in
- **Operating Mode:** Current
- **Number of Phases:** 2
- **Max Speed:** 0.5 mm/s
- **Full Step Angle:** 15°
- **Steps/Rev:** 1,824 (25,600 µsteps/rev)*
- **Max Load:** 12 lbs (5.5 kg)
- **Gear Reduction:** 76:1
- **Leadscrew Pitch:** 0.5 mm
- **Limit Switch:** Mechanical
- **Max Winding Temp:** 266 °F (130 °C)

**Based on use with the TST001 series controller.*





ITEM#	A	B	C
ZST6B	0.26" (6 mm)	4.26" (108 mm)	3.78" (96 mm)
ZST13B	0.51" (13 mm)	4.77" (121 mm)	4.28" (109 mm)
ZST25B	1.00" (25 mm)	5.89" (150 mm)	5.40" (137 mm)

Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	TRAVEL	BUSHING
ZST6	$ 576.30	£ 399.60	€ 511,70	¥ 4,866.30	0.25" (6 mm)	1/4"-80 Threaded
ZST6B	$ 576.30	£ 399.60	€ 511,70	¥ 4,866.30	0.25" (6 mm)	3/8" Barrel
ZST13	$ 601.80	£ 417.20	€ 534,30	¥ 5,081.70	0.50" (13 mm)	1/4"-80 Threaded
ZST13B	$ 601.80	£ 417.20	€ 534,30	¥ 5,081.70	0.50" (13 mm)	3/8" Barrel
ZST25	$ 627.30	£ 434.90	€ 557,00	¥ 5,297.00	1.00" (25 mm)	1/4"-80 Threaded
ZST25B	$ 627.30	£ 434.90	€ 557,00	¥ 5,297.00	1.00" (25 mm)	3/8" Barrel

T-Cube Single-Channel DC Servo and Stepper Motor Controllers

These USB-interfaced, compact single-channel motor drivers are designed to operate with a variety of DC-brushed motors or stepper motors. They contain a full embedded controller and driver circuit and can be operated with or without a PC. These units offer fully featured motion control capabilities, including velocity profile settings, limit switch handling, and on-the-fly changes in motor speed and direction. For more advanced applications, the closed-loop PID parameters can be changed, and settings such as leadscrew pitch and gearbox ratio can be adjusted.

See Pages 552-561

USB Interface

DC Servo Motor Actuator

The DRV414 DC Servo Motor Actuator provides higher speed and torque capability compared to stepper motor actuators. The ball screw drive delivers highly reliable, low-friction operation. It has ceramic-tipped electromechanical limit switches and is ideally suited for applications that require high-speed precise motion control.

The design incorporates a rotary encoder with 1024 lines (4096 effective) for accurate, repeatable positioning when combined with the BDC101 DC motor controller.

The DRV414 actuator, which has been designed specifically for heavy loads, can handle a load capacity of 55 lbs (25 kg). It is also compatible with our TravelMax series of stages (see page 432).

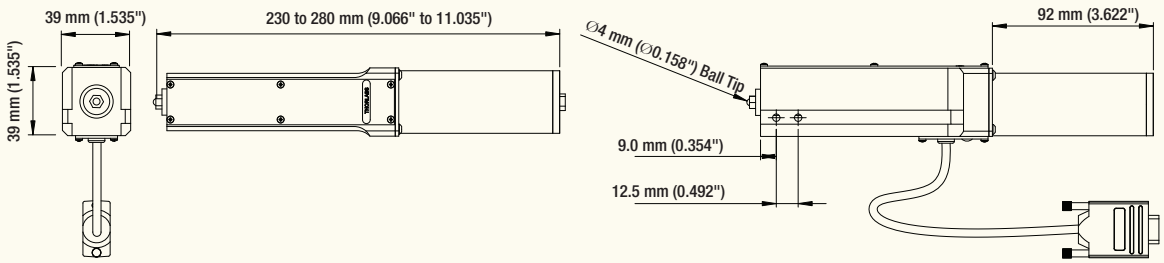
Specifications

- **Maximum Speed:** >50 mm/s
- **Travel:** 2" (50 mm)
- **Bidirectional Repeatability:** 5 µm
- **Leadscrew Pitch:** 1.25 mm
- **Minimum Incremental Movement:** 0.3 µm
- **Home Switch Accuracy:** <10 µm

Specifications measured on an LNR50 stage, using a BDC101 controller.

- High-Speed Operation
- High-Load Capacity
- Low-Friction Ball Screw Drives
- Preloaded to Minimize Backlash
- 1024 Line Rotary Encoder (4096 Effective QEP)
- Compatible with BDC101 DC Servo Driver (see page 555)

Our Full Line of Motor Controllers Starts on Page 541.

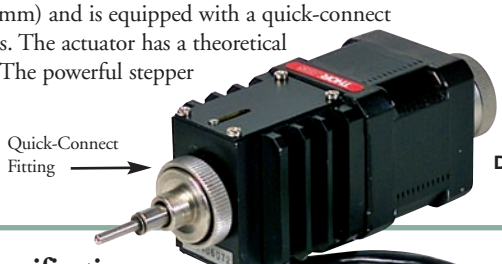


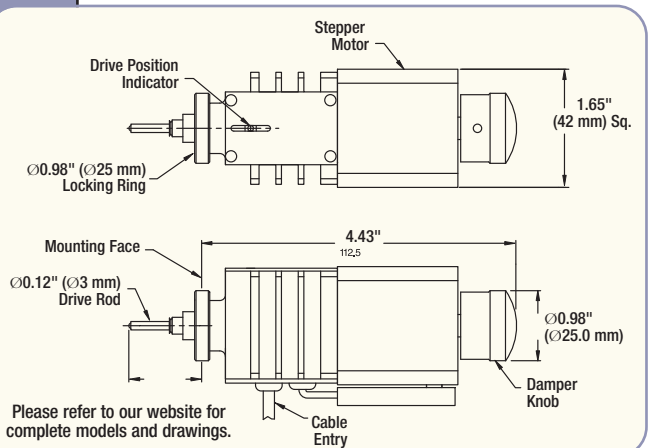
Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
DRV414	$ 1,495.00	£ 1,036.50	€ 1.327,50	¥ 12,624.00	2" (50 mm) of Travel, DC Servo Motor Actuator

Modular Stepper Motor Actuator, 0.31" (8 mm) Travel

The DRV001 Stepper Motor Actuator has a travel range of 0.31" (8 mm) and is equipped with a quick-connect fitting that ideal for use with our MAX300 and MAX600 series stages. The actuator has a theoretical minimum step size of 25 nm and is capable of speeds up to 4 mm/s. The powerful stepper motor is capable of handling a load capacity of up to 48 lbs (22 kg).





Please refer to our website for complete models and drawings.

Specifications

- **Maximum Speed:** 0.16 in/s (4 mm/s)
- **Travel:** 0.3" (8 mm)
- **Bidirectional Repeatability:** 0.5 µm
- **Minimum Incremental Movement:** 0.06 µm
- **Load Capacity:** 48 lb (22 kg)
- **Recommended Controllers:** BSC101 (Single Channel); BSC103 (3 Channels)
- Non-Rotating Tip
- Manual Adjuster Knob Provided

ITEM#	$	£	€	RMB	DESCRIPTION
DRV001	$ 585.00	£ 405.60	€ 519,40	¥ 4,939.80	0.31" (8 mm) of Travel, Stepper Motor Actuator

Stepper Motor with Trapezoidal Drives 1" (25 mm) or 2" (50 mm) Travel

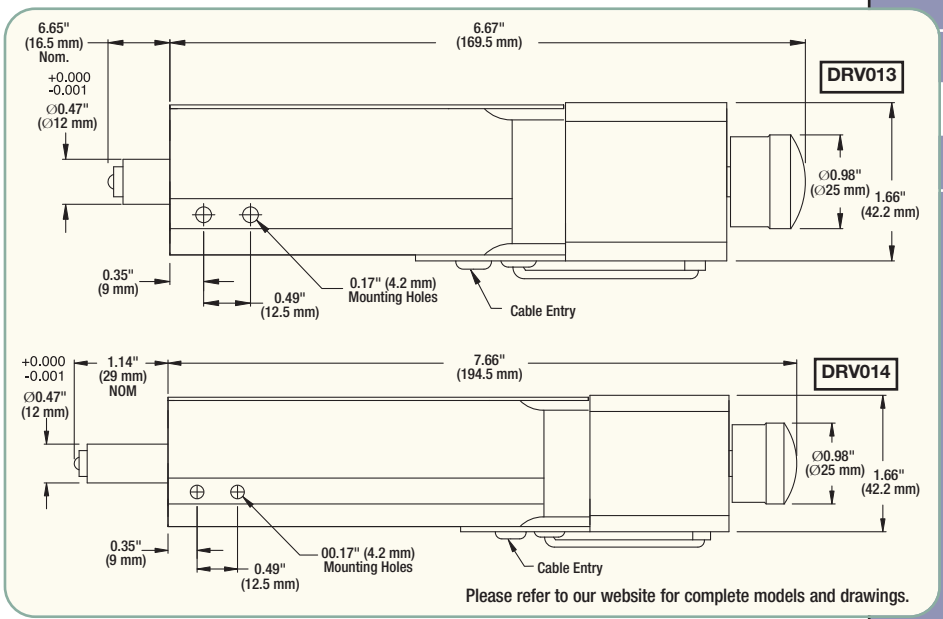
These stepper motor drives have a trapezoidal screw thread for clean, wear-resistant operation. The DRV013 drive offers 1" (25 mm) of travel while the DRV014 drive offers 2" (50 mm). Both units, which are compatible with our TravelMax series of stages (see page 432), have a maximum speed of 8 mm/sec and less than 1 µm bidirectional repeatability. They are capable of driving loads as high as 48 lbs (22 kg).

DRV013

Specifications

- **Travel Range:** 1" (25 mm) and 2" (50 mm)
- **Min Incremental Movement:** 0.05 µm
- **Max Speed:** 8 mm/s
- **Bidirectional Repeatability:** <1 µm
- **Load Capacity:** 48 lbs (22 kg) Load Capacity
- Manual Adjuster Knob Provided

Specifications measured on an LNR50 stage, using a BSC101 controller.



Please refer to our website for complete models and drawings.

See Our Single-Channel, Stepper Motor Controller

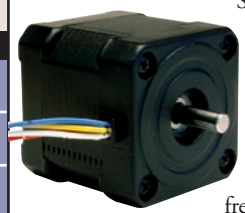
Page 558

ITEM#	$	£	€	RMB	DESCRIPTION
DRV013	$ 895.00	£ 620.50	€ 794,60	¥ 7,557.50	1" (25 mm) Trapezoidal Stepper Motor
DRV014	$ 995.00	£ 689.80	€ 883,40	¥ 8,401.90	2" (50 mm) Trapezoidal Stepper Motor

Stepper Motors and DC Servo Motors – Tutorial (Page 1 of 2)

Thorlabs offers a range of stepper and DC motor actuators and compatible controllers (page 555) for both low- and high-power applications. This section gives a short overview of how stepper and DC motors operate and some of their features.

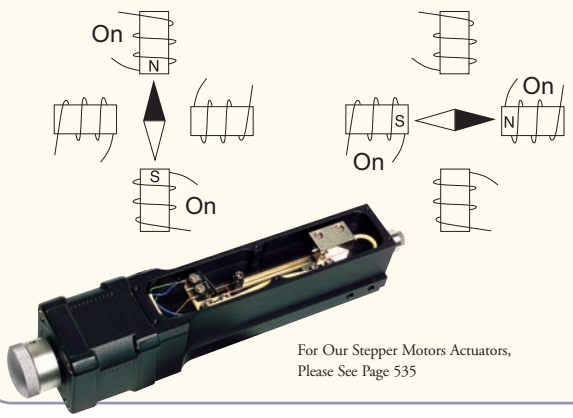
Stepper Motors



Stepper motors move in discrete steps. They operate on the principle of magnetic attraction and repulsion to convert digital pulses into mechanical shaft rotation. The amount of rotation achieved is directly proportional to the number of input pulses and the speed is proportional to the frequency of these pulses.

A basic stepper motor has a permanent magnet and/or an iron rotor, surrounded by a stator. The torque required to rotate the stepper motor is generated by switching the current in the stator coils as shown in the schematic.

Simplified Concept of Stepper Motor Operation



For Our Stepper Motors Actuators, Please See Page 535

Although the schematic only shows 4 stator coils, in reality a stepper motor will contain numerous tooth-like poles on both the rotator and the stator resulting in small positional increments (steps). For example, our ZST Series achieves incremental steps of 1.8° i.e. 200 steps/rev. If the current through one coil is increased as it is decreased in another, the new rotor position is somewhere between the two coils and the step size is a defined fraction of a full step (a microstep). When used with an apt™ benchtop or rack-based stepper motor controller, the smallest angular adjustment is 0.014°, resulting in a resolution of 25,600 microsteps per revolution for a 200 full step motor.

Advantages of Stepper Motors

- Operates in open loop with precise microstep positioning without an encoder.
- The motor does not contain brushes and hence does not suffer from wear like brushed DC motors do. This leads to a long operating lifetime.

Disadvantages of Stepper Motors

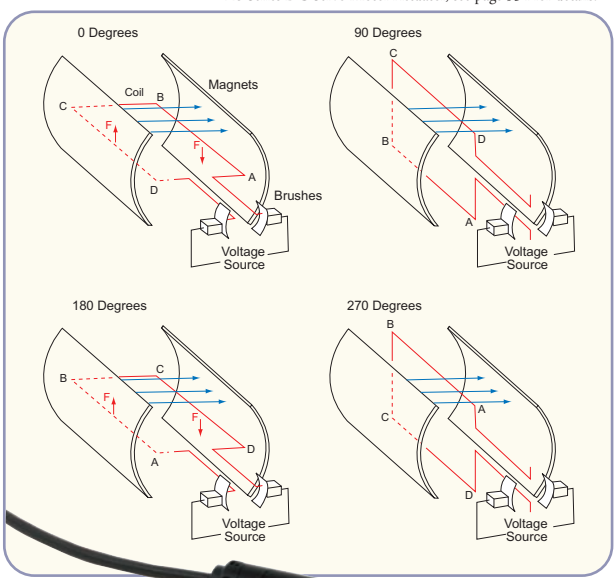
- A current is required to hold the position of the motor. When the controller is turned off the motor relaxes to the nearest full step.
- If the applied load is too high, the motor will not step and the actuator can lose position.

Brushed DC Servo Motors

A DC motor works by converting electric power into mechanical energy (movement). This is achieved by the interaction of a magnetic field with current carrying coils, which in turn, spins the motor. The Z8 and DRV414 actuators incorporate optical rotary encoders, fixed to the end of the motor for closed loop position control operation.

The diagram below of a single coil motor illustrates the operation of a DC motor.

Z8 Series DC Servo Motor Actuator, see page 534 for details.



Current flows through the coil via the sliding brushes, which are connected to the voltage source. The coil is positioned within a magnetic field, the direction of which is indicated by the blue arrows. At 0° rotation, the brushes are in contact with the voltage source and current is flowing. The current that flows through the wire from A to B interacts with the magnetic field and produces a downward force. The current that flows from C to D has a similar effect, but because the flow is in the opposite direction with respect to the magnetic field, the force is in the upward direction. Both forces are of equal magnitude. At 180°, the same phenomenon occurs, but segment A-B is forced up and C-D is down. In the 90° and 270° positions, the brushes are not in contact with the voltage source and no force is produced. In these two positions, the rotational kinetic energy of the motor keeps it spinning until the brushes regain contact. In reality, DC motors have several such coils, wound onto an armature, which produces a more even torque. The magnetic field is provided by an electromagnet.

Advantages of DC Servo Motors

- Encoder determines accuracy and resolution
- Optimized to run at high speeds

Disadvantages of DC Servo Motors

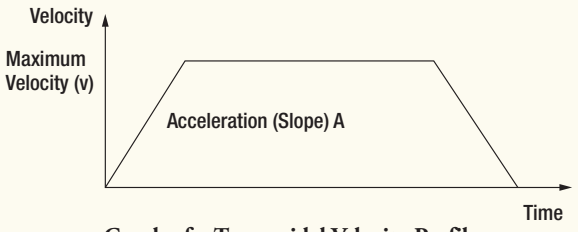
- Requires encoder and suitable controller for closed-loop positioning.
- Shorter lifetime due to wear on brushes
- Motor will stall and possibly burn out if the applied load is greater than the motor's capacity

Stepper Motors and DC Servo Motors – Tutorial (Page 2 of 2)

Features of Motorized Actuators

Velocity Profiles

To prevent the motorized actuator from stalling, it must be ramped up gradually to its maximum velocity. Certain limits to velocity and acceleration result from the torque and speed limits of the motor and the inertia and friction of the parts it drives. The motion employed is described by a trapezoidal velocity profile, reflecting the shape of the velocity vs. time graph (shown above). This drives the stage to its destination as quickly as possible without causing it to stall or lose steps. The stage is ramped at acceleration "A" to a maximum velocity "V." As the destination is approached, the stage is decelerated at "–A" so that the final position is approached slowly in a controlled manner.



Graph of a Trapezoidal Velocity Profile

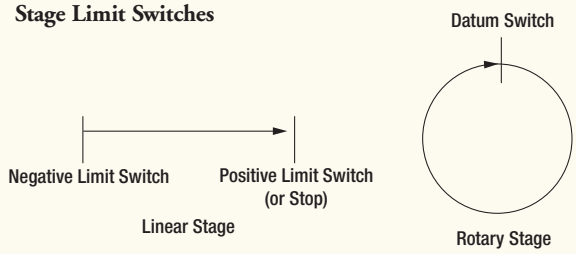
Home Position

Each motor in the system has an associated electronic counter, which keeps a record of the current position in microsteps (for stepper motors), or encoder counts (for brushed DC motors). If the control PC is requested to report the position, the value of this counter is converted back into motion units. When the system is powered up, the counters in the controller are all set to zero, and consequently, the system has no way of knowing the position of the stage in relation to any physical datum. A datum can be established by sending all the motors to their home positions which are set during manufacturing; the motor is initialized by driving the motor until the negative limit switch is reached and then driving positively a fixed distance (zero offset). When at the home position, the counters are reset to zero thereby establishing a fixed datum.

Note: During a manual move, (i.e. if the motor shaft is turned by hand) no signal is sent to the motor, the counter is not updated, and any subsequent position reporting will be false until the motor is returned to the home position vis the initialization procedure.

Limit Switches

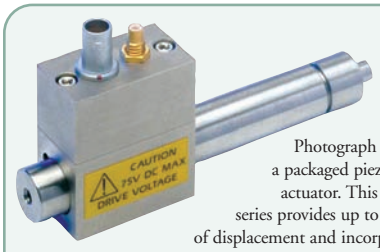
Linear and rotary stages can both contain microswitches that detect certain positions of the stage, but they typically differ in the way these switches are used. Most linear stages have limit switches to prevent the stage from accidentally being moved too far in either direction. Once this switch is activated, the movement of the stage should halt. A limit switch can also provide a physical datum used to define a home position. A rotary stage typically has only one switch, which is used to provide a reference point or home position in order to improve the accuracy of the stage. Movement is allowed right through the switch.



The Piezoelectric Actuators – Tutorial

The Piezoelectric Effect

The Piezoelectric effect is a basic material characteristic whereby certain types of crystalline materials expand reversibly when subjected to an electric field.



Photograph showing a packaged piezoelectric actuator. This actuator series provides up to 100 µm of displacement and incorporates a strain gauge displacement sensor (see page 531).

Although the amount of expansion is usually very small (corresponding to less than 1% strain in the material), it can be controlled extremely precisely by varying the strength of the electric field. Piezoelectric materials have, for many years, formed the basis of very high-precision actuators capable of atomic scale resolution. In fact, the resolution of these actuators is typically limited by the noise and stability of the drive electronics used to generate the electric fields, hence the noise specifications of any potential piezoelectric controller should be carefully evaluated against the requirements of the application. Moreover, the force generated by the expansion of a piezoelectric material is typically very large, often reaching into the range of hundreds of Newtons.

Perhaps the most useful property of these actuators is their ability to produce high speed repetitive motion, which is usually limited by the mechanical system that is being driven rather than by the piezoelectric material itself. This high-speed response of a piezoelectric actuator is used to considerable advantage in the NanoTrak™ control system (see page 572).

One of the drawbacks of piezoelectric materials is that the electric field gradient needed to produce a useful amount of expansion is quite large. To reduce the required drive voltage, the actuator can be constructed as a stack, consisting of many laminated layers of active material sandwiched between electrodes.

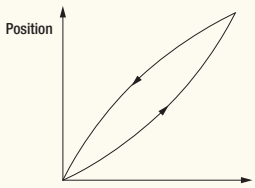
Using this stacked design, the distance from the positive to negative electrodes can be made very small, and a large field gradient can therefore be obtained. With this approach, maximum displacements in the range of 10 to 50 µm are possible, with drive voltages of around 100 V. As a comparison, using single layer bulk piezoelectric components often requires maximium drive voltages in the range of 1000 V. Even with these high voltages a bulk piezoelectric element would typically only provide sub-micron movement.

Hysteresis

Despite the very high resolution of piezoelectric actuators, an inherent problem is the significant amount of hysteresis they exhibit (i.e., the tendency of the actuator to reach a final position that lags behind the demand position).

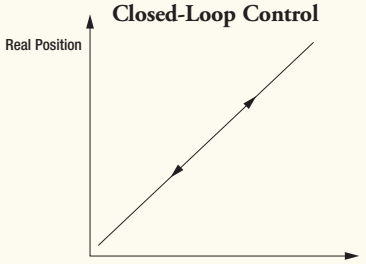
If a cyclical voltage is applied to the actuator, the positions reached on the upward sweep are smaller than those achieved on the downward sweep. If position is plotted against voltage, the graph exhibits a classic hysteresis loop as shown in the plot, above right.

Open-Loop Control



Piezoelectric Hysteresis

Closed-Loop Control



Position Sensing and Feedback

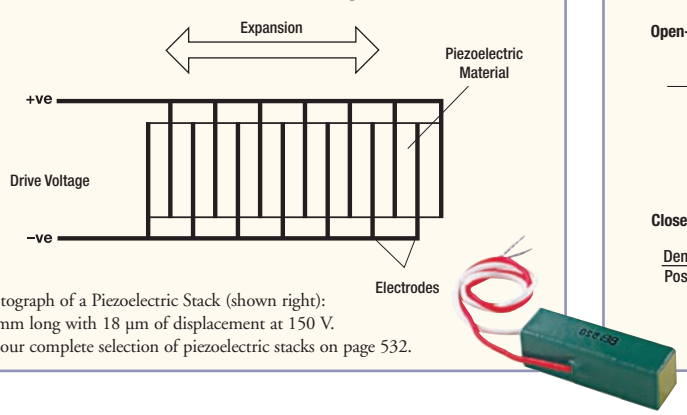
Hysteresis can be eliminated by using a position sensor and feedback loop; the sensor measures the position, the circuit subtracts the measured position from the demand position to obtain a measure of the error, and a feedback loop adjusts the voltage to the actuator until the error is driven to zero. This servo-loop feature is standard with all of our apt™ family of piezoelectric controllers.

Some piezoelectric nanopositioning actuators have position sensing, others do not. The apt™ piezoelectric controller fully supports both types, the photograph above shows one of our piezoelectric actuators that incorporates a strain gage displacement sensor.

Open- and Closed-Loop Control

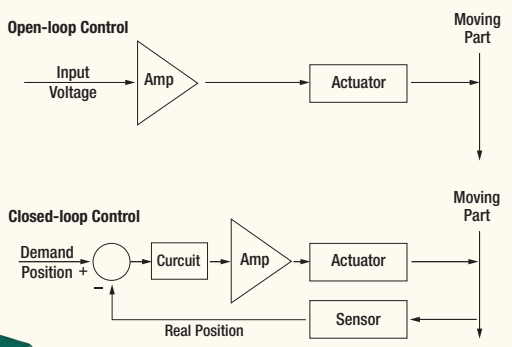
The result of using closed-loop control is a linear relationship between the requested position and the actual position (see the plot entitled Closed-Loop Control), in contrast to open loop control (see the plot entitled Open-Loop Control).

Piezoelectric Stack Diagram



Photograph of a Piezoelectric Stack (shown right):
20 mm long with 18 µm of displacement at 150 V.
See our complete selection of piezoelectric stacks on page 532.

Piezoelectric System Schematic Diagram



Controller Selection Guide

Pages 542-582

Overviews

- T-Cube™ System
- Benchtop System
- Rack System

See Pages 542-551

DC Servo Controllers

- T-Cube DC Servo Motor Controller
- Benchtop Single and Multichannel DC Servo Motor Controllers

See Pages 552-555

Stepper Motor Controllers

- T-Cube Stepper Motor Controller
- Benchtop Single and Multichannel Stepper Motor Controllers
- Modular Stepper Motor Controller for Rack System

See Pages 556-561

Piezo and Strain Gauge Controllers

- T-Cube Piezo Controller
- T-Cube Strain Gauge Reader
- Benchtop Single and Multichannel Piezo Controllers
- Modular Piezo Controller for Rack System

See Pages 562-571

NanoTrak Autoalignment Controller

- T-Cube Autoalignment Controller
- Benchtop Single and Multichannel Autoalignment Controller
- Modular Autoalignment Controller for Rack Systems

See Pages 572-577

Solenoid Controller

- T-Cube Solenoid Controller

See Pages 578-579

APT Control Software Overview

- apt™ Control Software

See Pages 580-582

T-Cube Controller Family Overview (Page 1 of 4)

Overview

The T-Cube product line provides a compact and scalable system of drivers that facilitate the automation of devices on optical table setups. Specifically, the T-Cubes address the space and cable management problems that come with device automation as well as the compatibility issues that often arise when dealing with the automation of multiple devices. All the T-Cube controllers have a manual interface and preprogrammed default settings that allow for immediate basic control of any compatible device upon connecting the controller. In addition, each controller has a USB interface through which the T-Cube can be operated remotely with a computer.

General Information

Each T-Cube is shipped attached to a removable base plate that can be easily secured to an optical table using a 1/4"-20 (M6 x 1.0) cap screw. One side of the T-Cube has the electrical and optical interfaces for the device it supports, while the opposite side has a Mini-B USB connector (USB A to Mini-B cable included) and a power jack.

The top surface of each T-Cube has manual interface controls and readouts. When used individually, each T-Cube requires its own power supply (not included with the T-Cube) and USB connection when remote operation is desired. However, the T-Cube Controller Hub provides power and USB connectivity for up to six standard footprint T-Cubes. A doublewide footprint T-Cube occupies two spots on the T-Cube controller hub.

Features

- Compact Size
  - Standard Footprint: 2.4" x 2.4" x 1.8" (60 mm x 60 mm x 47 mm)
  - Doublewide Footprint: 4.8" x 2.4" x 1.8" (120 mm x 60 mm x 47 mm)
- Manual Interface
- USB Connectivity
  - apt™ Software
  - Plug-and-Play
  - Intuitive Graphical Interface
- T-Cube Controller Hub
  - Holds up to Six Standard Footprint T-Cubes
  - Supports the Range of T-Cubes
  - Single Cable USB Connectivity
  - Single Power Cable
- ActiveX® Command Modules
  - Easily Create a Custom Interface
  - Supported by LabVIEW, Visual Basic, C++, and Many Other Programming Environments

T-Cube Power Supply Options

ITEM#	PRODUCT DESCRIPTION	TPS001 15 VDC PSU	TPS101 5 VDC PSU	TPS002 ±15 V/5 V x 2 PSU	TPS008 15 VDC x 8 PSU	TCH002 USB Hub
TLS001	Laser Source T-Cube		✔			✔
TTC001	TEC Controller T-Cube		✔			✔
TLD001	Laser Driver T-Cube			✔		✔
TQD001	Position Sensing T-Cube			✔		✔
TNA001	NanoTrak Auto-Alignment T-Cube			✔		✔
TPZ001	Piezo Driver T-Cube			✔		✔
TSG001	Strain Gauge Reader T-Cube			✔		✔
TST001	Stepper Motor Driver T-Cube	✔			✔	✔
TDC001	DC Servo Motor Driver T-Cube	✔			✔	✔
TSC001	Solenoid/Shutter Controller T-Cube	✔			✔	✔
LEDD1 and LEDD1A	LED Driver T-Cube	✔			✔	✔

T-Cube Controller Family Overview (Page 2 of 4)

DC Servo Motor Driver TDC001 – See Page 552

Features

- Supports DC Brushed Motors up to 12 V
- Encoder Feedback for Closed-Loop Positioning
- Auto-Configure Function for All Thorlabs' Z8-Equipped Stages/Actuators
- Easy-to-Use Manual Controls with Velocity Slider and Jog Buttons
- Fully Flexible Software Control Modes

The TDC001 T-Cube DC Driver is a compact, single-channel DC servo controller that provides manual and automated control of low-power (up to 15 V/2.5 W), DC-brushed servo motors equipped with encoder feedback. Although ideally suited to drive Thorlabs' family of Z8 DC motor-equipped optomechanical products, the TDC001 offers highly flexible software settings and closed-loop tuning, making it compatible with a wide range of third-party DC servo motor actuators.

Stepper Motor Driver TST001 – See Page 556

Features

- High-Resolution Microstepping
- Supports 2-Phase, Bipolar, Low-Power Stepper Motors
- Differential Encoder Feedback for Closed-Loop Positioning
- Compatible with Thorlabs' ZST Actuators
- Easy-to-Use Manual Controls with Velocity Slider and Jog Buttons

The TST001 T-Cube Stepper Driver is a compact, single-channel controller that provides manual and automated control of small, 2-phase, low-power (up to 15 V/5 W), bipolar stepper motors. The controller incorporates a powerful DSP controller, giving this compact unit high-resolution microstepping capability. Although ideally suited to drive Thorlabs' ZST stepper motor series, the TST001 is fully configurable, allowing it to support a wide range of third-party stepper motor actuators.

Piezo Driver TPZ001 – See Page 562

Features

- Drive Voltage Digital Display
- Low-Voltage Driver Input (SMA)
- Low-Voltage Monitor Output (SMA)
- Closed-Loop Operation with T-Cube Strain Gauge Reader Unit
- Voltage Ramp/Waveform Generation Capability

The TPZ001 T-Cube Piezo Driver is a very compact, single-channel controller that provides manual and automated nanometer-level motion control of Thorlabs' open-loop, piezo-actuated nanopositioning actuators and stages. The controller is capable of delivering up to 150 V of drive voltage at 7.5 mA, thereby allowing an operating bandwidth up to 1 kHz when using a piezo element with 1 µF of capacitance. When operated together with the T-Cube Strain Gauge Reader (TSG001), high-precision, closed-loop operation is possible using our line of feedback-equipped piezo actuators.

NanoTrak™ Auto-Alignment Controller TNA001 – See Page 572

Features

- Auto-Alignment for Optimum Coupling Efficiency
- Integrated Si or InGaAs Photodiode with FC/PC Fiber Connector
- Power Range and Signal Level LED Displays
- Operating Mode Select via Top Panel Buttons
- Operates with TPZ001 T-Cube Piezo Controllers

The TNA001 NanoTrak Auto-Alignment Controller generates the feedback required to position an optical element in two dimensions for the highest possible optical power throughput. The advanced algorithms used in this standard footprint T-Cube, make it ideal for low-volume assembly, characterization, and mapping applications. Since the TNA001 only provides the piezo position demand voltage outputs, the TPZ001 piezo controllers are required to drive the piezo actuators of the beam steering element or stage of the system being aligned.

T-Cube Controller Family Overview (Page 3 of 4)

Solenoid/Shutter Controller TSC001 – See Page 578

Features

- Operating Modes, Manually Selectable
  - Manual: User-Controlled On/Off
  - Single: DSP Programmed On/Off
  - Auto: DSP Programmed On/Off Cycle
  - Triggered: Externally Triggered On/Off
- Safety Interlock Input
- Removable On/Off Key
- Controlled Device State Indicator

The TSC001 T-Cube Solenoid Controller can be used to control 15 V solenoid-actuated devices like the SH05 shutter (see page 316). The solenoid controller applies a potential of 10 V across the solenoid to hold the solenoid-actuated device in place and provides a 15 V pulse to switch the state of the device.

Strain Gauge Reader TSG001 – See Page 564

Features

- Nanometer-Level Position Resolution with Thorlabs' Actuators
- Strain Gauge AC Bridge Signal Input
- Five-Digit Position Digital Display
- Closed-Loop Operation with T-Cube Piezo Driver
- Position, Force, or Voltage Readout

The TSG001 T-Cube Strain Gauge Reader is a single-channel reader designed to measure, condition (rectify and filter), and display the feedback signal derived from AC bridge strain gauge systems. The unit is compatible with Thorlabs' strain gauge-equipped piezo stacks, actuators, stages, and force sensors. In addition, closed-loop control of a piezo element with a strain gauge can be achieved using the TSG001 in combination with a TPZ001 T-Cube piezo controller.

Position Sensing Reader TQD001 – See Page 1297

Features

- Digital Position Reading System for our Quadrant and Lateral Effect Detectors
- Closed-Loop Mode for Auto Alignment
- Open-Loop Mode for Position Measurement
- Loop Mode Select Using Top Panel Button
- LED Cross Hairs Position Indication Display

The TQD001 T-Cube Postition Sensing Reader interfaces with PDQ80A and PDQ30C Quadrant Detector sensors or a PDP90A Lateral Effect Sensor. The TQD001 can either be used to measure the position of the beam on the sensor or to generate a signal that can be used as the feedback input for an automated beam steering element. The signal generated can be used to steer the beam to the center of the position sensor.

Laser Source Controller TLS001 – See Page 1059

Features

- FC/PC Optical Output
- 635 or 1550 nm Wavelenghs Available
- Five-Digit Digital Display
- Extended Modulation Input
- Interlock Safety Circuit
- Removeable On/Off Key

The TLS001 T-Cube laser sources are stand-alone modules that combine a pigtailed laser diode and laser diode driver into one compact package. The pigtail is a single mode fiber that is cleaved at an 8° angle on the laser diode end in order to minimize intensity noise. The other end of the pigtail connects to an FC/PC mating connector on the TLS001 housing. The T-Cube laser source is available in two versions: the TLS001-635 emits light at 635 nm and the TLS001-1550 emits light at 1550 nm. The TLS001 unit has a doublewide footprint and will take up two ports when used with the TCH002 T-Cube hub.

T-Cube Controller Family Overview (Page 4 of 4)

Laser Diode Controller TLD001 – See Page 1182

Features

- Constant Current and Constant Power Modes
- Enable Laser Button
- Five-Digit Digital Display
- Safety Interlock Input
- Removable On/Off Key
- External Modulation Input
- Compatible with TTC001 T-Cube TEC Controller

The TLD001 T-Cube is a full-featured, compact, stand-alone laser diode and LED controller for use with devices that have a compliance voltage of 10 V or less. The output connector is a 9-pin D-type connector that is compatible with Thorlabs' entire line of laser diode mounts (see page 1215). The TLD001 unit is double the width of the standard T-Cube footprint. As a result, the TLD001 will take up two ports when used with the T-Cube hub.

TEC Controller TTC001 – See Page 1187

Features

- Microcontroller-Based PID Temperature Control
- 4 W Output Drive Power
- Operates with Thermistor and IC Temperature Sensor
- Five-Digit Digital Display
- Temperature and Current Limit Setpoints
- Compatible with TLD001 T-Cube Laser Driver

The TTC001 T-Cube TEC Controller is designed to monitor and precisely control the temperature of small thermally sensitive components like laser diodes and CCD arrays. The unit is capable of supplying a maximum current of ±1 A (4 W max) to a Peltier effect thermoelectric heater/cooler or a resistive heating cartridge while simultaneously monitoring the signal from a standard thermistor or IC temperature sensor in order to provide closed-loop temperature regulation.

NEW versions

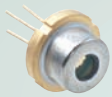
LED Controller LEDD1 and LEDD1A – See Page 1104

Features

- Operating Modes:
  - Constant Current
  - Pulsed
- Adjustable Output Intensity
- External Modulation Input

The LEDD1 and LEDD1A T-Cube Controller are compact, variable-output power supplies intended to power LEDs. The controllers have a standard T-Cube footprint and are shipped with a cable that has a connector compatible with the LEDD1 and the LEDD1A on one end and bare wires that can be attached to the LED or LED socket on the other end. In addition, all of the mounted LEDs sold by Thorlabs can be plugged directly into the LEDD1.

Laser Diodes
See Page 1032



For the convenience of our customers, Thorlabs offers an extensive collection of laser diodes from a number of manufacturers. We've recognized that discrete laser diodes in small volume are difficult to obtain; hence, we are committed to act as a stocking reseller of these devices.

- Ø5.6 mm and Ø9 mm Packages
- Wavelengths from 405 nm to 1550 nm
- Output Powers up to 1 W

Benchtop Current Controller
See Page 1178

Thorlabs offers a large number of laser diodes and TEC Controllers in an effort to meet nearly every requirement that might arrise as our customers work to integrate laser diode devices into their optical systems. From Benchtop Controllers to OEM Modules, you'll find driver designs to meet your needs. Please see the selection guide presented on page 1032 of our laser diodes section of the catalog

- Drive Currents from 20 mA to 4 A Available
- Compatible with All Laser Diode Polarities
- Constant Current and Constant Power Modes

T-Cube™ apt™ USB Controller Hub (Page 1 of 2)

TCH002
Shown with Five Standard Size T-Cubes
All T-Cubes Sold Separately

Do More in Less Space with the T-Cube™ Controller Hub
The TCH002 T-Cube Controller Hub is designed to significantly reduce the number of cables required to automate multiple devices and to support large scale implementation of the T-Cube family of device drivers. The power and USB connectivity for each T-Cube is provided by the hub, which eliminates the need for each T-Cube to have individual power and USB cables.

In addition, the T-Cube controller hub provides a compact mounting surface for up to six standard or three doublewide footprint T-Cubes. The hub itself can be secured to an optical table either horizontally or vertically using the AP90 bracket (see page 111). Each hub must be connected to its own power supply (included). Furthermore, the fully compliant, powered USB 2.0 circuit in each hub allows multiple hubs to be connected in series so that only a single USB cable needs to be connected to the controlling PC when computer control of the T-Cubes is desired.

The T-Cube™ Controller Hub is contained in a slim base-plate type carrier with electrical connections located on the upper surface that accepts up to six T-Cubes.
The Controller Hub contains a fully USB 2.0 compliant hub and provides all communications and power distribution for up to six T-Cubes using only a single power connection.

Mix and match any combination of T-Cube™ Controllers to build your own custom, multichannel driver arrangement in an extremely compact footprint.

Features

- Compact USB 2.0 Platform
- Provides Power and USB Connectivity to T-Cubes
- Compatible with All T-Cubes
- Horizontal or Vertical Mounting to Optical Tables
- Reduced Cable Management – Single USB Communication and Power Cable
- USB Input/Output for Connecting Multiple Controller Hubs Together
- Six T-Cube Ports
- Standard Footprint T-Cubes Require One Port
- Doublewide Footprint T-Cubes Require Two Ports

Versatile Positioning Controller Hub

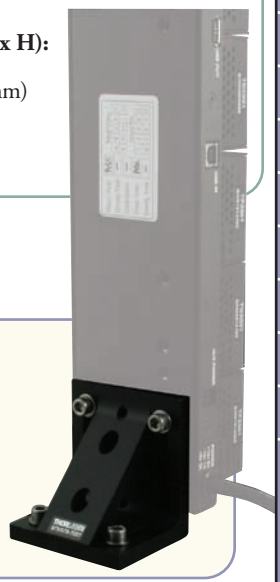
T-Cube™ apt™ USB Controller Hub (Page 2 of 2)

The controller hub circuitry provides a number of internal, flexible, digital and analog interconnect lines for deterministic multi-cube synchronized operation. This feature is particularly advantageous when operating the Piezo Controller (TPZ001 – page 562) and Strain Gauge Reader (TSG001 – page 564) T-Cubes together on a controller hub. Similarly, the NanoTrak™ controller (page 572) and piezo controllers (page 562) can be operated together in closed-loop mode on the hub to facilitate auto-alignment applications. They can be configured to operate as a coupled pair allowing closed-loop control of the wide number of piezo actuators available from Thorlabs. The controller hub also provides a rigid mechanical mounting platform for carrying the T-Cubes.

Imperial and metric mounting holes incorporated into the hub allow for a variety of mounting orientations. In this way, the controller hub can be mounted flat to the table surface (much like the individual T-Cubes), edge mounted, or vertically mounted to allow vertical stacking of up to 6 T-Cube™ controllers, thereby reducing the optical table footprint to an absolute minimum. One AP90 Right-Angle Bracket is needed to mount the hub vertically or two brackets are needed to edge mount.

Specifications

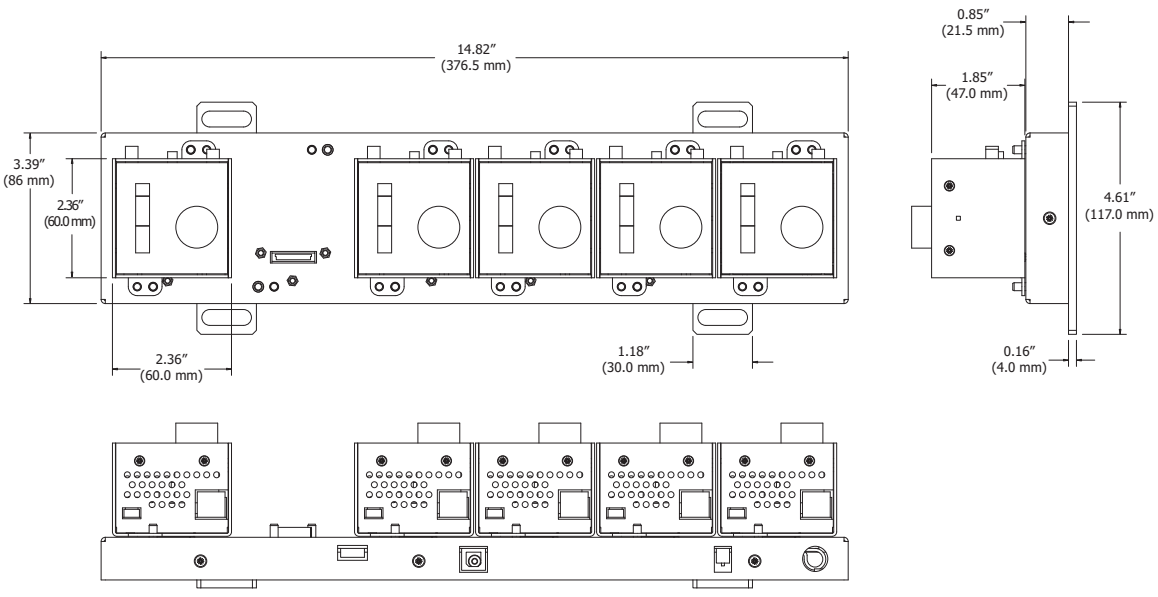
- **USB Hub:** Fully USB2.0 Compliant
- **Enclosure:** Rigid, Slim-Profile Baseplate Construction
- **T-Cube™ Bays:** Six
- **Table Mounting**
  - Orientation: Horizontal, Edge, or Vertical Using Thorlabs' AP90 Brackets
  - Universal Metric (M6 x 1.0) or Imperial (1/4"-20) Design
- **Input Power Requirements**
  - 100 - 250 VAC, 47 - 63 Hz
- **Housing Dimensions (W x D x H):** 14.82" x 3.39" x 0.85" (376.5 mm x 86 mm x 21.50 mm)
- **Weight:** 20 oz (575 g)



Vertical and Edge Mounting Brackets for the T-Cube Controller Hub

- Rigid One-Piece Construction
- Parallel and Perpendicular to within 0.002" (0.05 mm)

AP90
Right-Angle Mounting Brackets
Front and Back Shown
T-Cube Hub Sold Separately



Please refer to our website for complete models and drawings.

ITEM#	$	£	€	RMB	DESCRIPTION
TCH002	$ 726.90	£ 504.00	€ 645,40	¥ 6,138.00	T-Cube™ Controller Hub and Power Supply Unit
AP90	$ 74.20	£ 51.50	€ 65,90	¥ 626.60	Precision Right-Angle Plate
AP90/M	$ 74.20	£ 51.50	€ 65,90	¥ 626.60	Precision Right-Angle Plate, Metric

Benchtop Controller Family Overview (Page 1 of 2)

The apt™ benchtop series includes a Piezoelectric Controller, NanoTrak™ Auto-alignment Controller, DC Servo Motor Controller, and Stepper Motor Controller. Each of the electronic controllers is designed to be flexible and easy to use. Plug-and-play software and USB connections allow fast, out-of-the-box setup and configuration. The GUI is simple, intuitive, and easy to use; once the unit is connected and powered up, the operator will have immediate control of the equipment.

The apt benchtop motion control systems are designed to meet the performance requirements for a wide range of applications. The apt benchtop controller, together with Thorlabs' wide range of precision mechanical stages and actuators, is suitable for multi-axis positioning and alignment needs, inlcuding those frequently necessary when testing or processing semiconductors, operating micro-electrical mechanical systems, or working in the fiber optics, high-resolution microscopy, or nanotechnology fields.

The apt benchtop controllers have been designed around the latest digital and analog electronics technologies. Each controller combines high-speed, digital signal processors (DSP), with low noise analog electronics and ActiveX® software technology for flexible one-, two-, or three-channel control. In alignment applications, it is often crucial that timing of motion control is guaranteed (e.g., in scan and acquisition operations). The embedded DSP is responsible for ensuring this deterministic operation on a per channel basis.

Single and Three Channel Piezoelectric Controllers - See Page 566

- High Drive Power of 75 V, 500 mA Continuous
- Closed-Loop PID Position via Strain Gauge Feedback
- Quiet, High-Resolution Position Control
- Voltage Ramp/Waveform Generation Capability (for Scanning)
- High Bandwidth (10 kHz) Piezo Positioning (Open Loop)
- Optional Handset Controller (PHS101, See Page 659)

BPC201


BPC203

The apt™ system piezoelectric controller incorporates the latest high-speed digital signal processing technology and low-noise analog electronics to provide up to three high-voltage (0 - 75 V) output channels. It has been designed to drive a wide range of Thorlabs piezo-driven stages and actuators at high bandwidths.

The controller is available in one-channel (BPC201) and three-channel (BPC203) versions.

One-, Two-, and Three-Channel Stepper Motor Controllers - See Page 558

- Supports 2-Phase Bipolar Steppers up to 50 W
- Easy Software Configuration for all Thorlabs Stages
- Motor Control I/O Port (Jogging, Interlocks)
- High-Resolution Microstepping Control (For Very Fine Positioning Applications)
- Stable and Predictable Speed Control (for Velocity-Sensitive Applications)
- User I/O Port for External Equipment Control

BSC101

BSC103

The apt™ system stepper motor controllers use the latest high-speed digital signal processors (DSP) to ensure accurate positioning and velocity control of the connected stepper motor. It is compatible with the complete family of Thorlabs stepper-motor-equipped, high-precision motion control products (DVR Series, see page 527). It is available in one-channel (BSC101), two-channel (BSC102), and three-channel (BSC103) versions.

Benchtop Controller Family Overview (Page 2 of 2)

One-, Two-, and Three-Channel DC Servo Motor Controllers - See Page 554

- Supports Wide Range of Brushed DC Servo Motors up to 50 W
- High Motor Speeds and Torques
- Encoder Feedback for Closed-Loop Velocity and Position Control
- Motor Control I/O Port, Jogging, Interlocks, Safety Stop
- User I/O Port for Third-Party Equipment Control

BDC103

BDC101

The BDC series of DC Servo Motor Controllers are ideal for motion control applications requiring high-speed (up to 100 mm/s), high-load (>10 kg), and high resolution (<1 µm) capabilities. These controllers have been designed to operate optimally with the DRV414 DC servo actuator (page 536).

They are available in one-channel (BDC101), two-channel (BDC102), and three-channel (BDC103) versions.

NanoTrak™ Autoalignment Controller - See Page 574

- Tracking Feature Maintains Optimum Throughput Indefinitely
- Advanced Dark Search Algorithms for First-Light Detection with Motorized Fiber Launch, See Pages 576-577
- Two Piezo-Actuator Output Channels Provide Closed-Loop Feedback
- InGaAs or Si Detector, plus External Inputs (FC/PC for Optical and BNC for Voltage)

BNT001

The apt™ system NanoTrak™ controller combines an active-feedback optical alignment system and a two-channel piezoelectric controller within a single space-saving unit.

Although used primarily for aligning optical fibers and integrated optical devices, the enhanced NanoTrak can also be used for simplifying and automating tasks such as waveguide characterization and fiber pigtailing when combined with the range of piezo-actuated multi-axis flexure stages such as the MAX 300 series (see page 470).

TOOLS OF THE TRADE

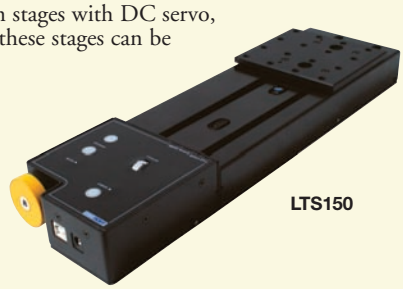
For More Details, See Pages 441-459

Motorized Linear Translation Stage

Thorlabs offers a large range of motorized translation stages with DC servo, stepper motor, and piezo actuator options. Many of these stages can be stacked to create two- and three-axis assemblies.

- Travel Ranges up to 12"
- One-, Two-, and Three-Axis Assemblies
- Small and Large Platforms Available

MT1-Z8



LTS150

apt™ Modular Rack System (Page 1 of 2)

The apt™ modular rack system is a sophisticated, self-contained, expandable, motion control platform for applications with a large number of channels. This new system deploys the same advanced high-speed, digital signal processing (DSP) technology and low-noise analog circuitry pioneered in the apt™ benchtop controllers. It also provides a highly functional 12-channel platform within the footprint of a 4U high, 19" wide enclosure. With a unified power supply and a single node USB communications interface, the apt™ rack system is easily incorporated into larger custom applications. Module functionallity is identical to the corresponding apt™ benchtop and T-Cube™ controllers, allowing a common software solution and learning curve for both benchtop and rack-based apt™ controllers. Multiple user development environments are supported (e.g., Visual Basic, LabVIEW™, HP VEE, C++, MATLAB, and .NET).

MMR601

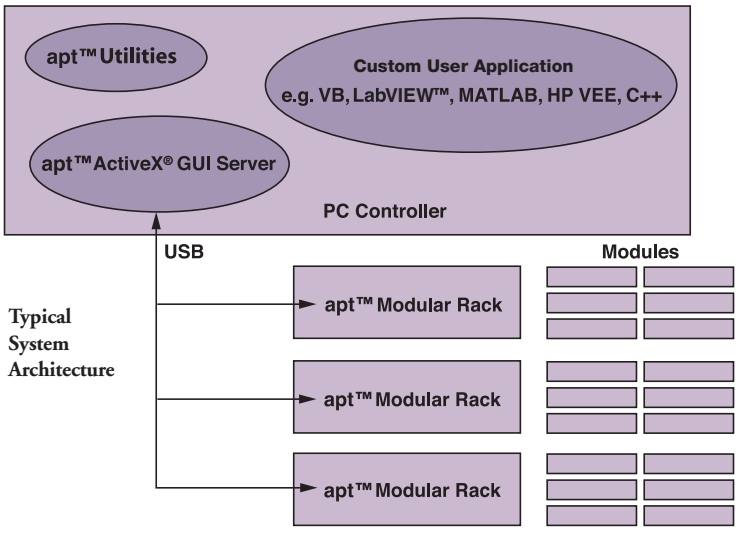
Building Larger Scale Systems

The two-channel apt™ stepper motor (see page 560), piezoelectric actuator driver (see page 570), and NanoTrak™ controllers (see page 576) all have functionally identical benchtop and rack-module equivalents. The unrestricted configuration flexibility offered by the apt™ rack-based products allows any combination of modules to be fitted for specific nanopositioning and alignment applications. For example, a system configured to operate our MAX606 (see page 443) nanopositioning stage that has six stepper motors and six piezoelectric actuators with displacement sensors, would require 12 channels of motion control. Using three stepper motor modules, each with two channels, the motor control necessary can be provided; using two piezoelectric controller modules and one NanoTrak™ controller module would power all 6 of the piezoelectric actuators while also taking advantage of the position sensors. Additionally, the NanoTrak™ module would provide the full range of features offered by a fully operational auto-alignment system. All this functionality fits into the rack chassis that measures just 4U in height.

Stepper Motor Driver
See Page 560

Two-Channel Piezo Driver
See Page 570

Auto-Alignment Module
See Page 576



Typical System Architecture

Engineered for Ease of Use

The rack system architecture, hardware, and software has been engineered to provide an efficient solution for complex, high-channel-count nanopositioning applications. Whether these applications are found in a modern high-volume optoelectronic component manufacturing facility or in a leading R&D facility, the MMR601 or MMR602 system is easy to implement and can be adapted to rapidly changing requirements.

apt™ Modular Rack System (Page 2 of 2)

The apt™ rack presents a clean, uncluttered front panel with six rear mounting bays for the plug-in modules. This arrangement greatly simplifies the cable management issues that arise as the number of channels expands.

Each module is equipped with an on-board digital signal processor (DSP), which allows processing power to be increased as modules (channels of operation) are added. Hence, the system is able to maintain maximum operating efficiency, even when fully loaded.

Furthermore, additional racks can be added to the USB bus as required, thus allowing multiple, fully automated, 6-axis positioning stages to be combined into a single unified motion control system.

The PC-based software that drives the rack system operates from the same kernel of ActiveX® multi-threaded server code used to drive the stand-alone benchtop controllers and includes the same collection of high-level user applications. All of our ActiveX® software is rigorously engineered using modern object-oriented techniques, which ensures independence of programming environment and compatibility with a large number of third-party development tools. See pages 580-582 for more details on the apt™ software suite.

The apt™ modular rack system provides unsurpassed ease of installation and use. In addition, it offers seamless third-party integration, scalability, flexibility, and reliability.

The MMR601 is designed to be mounted in a standard 19" instrument chassis. The MMR602 includes a cover and is intended for benchtop use.

Features

- Supports up to 12-Channels of Operation in a Single Chassis
- Three Plug-In Modules:
  - Dual-Channel Piezoelectric Controller with 75 V of Low-Noise Output (see page 570)
  - Dual-Channel Stepper Motor Controller with Peak Power of 50 W per Channel (see page 560)
  - Dual-Channel NanoTrak™ Auto-Alignment System (see page 576)
- 6 Module Slots per Chassis, Access from Rear Panel
- Advanced ActiveX® PC Control Software Suite
- USB Plug-and-Play
- USB Interface Allows Multiple Systems to be Connected and Controlled via One PC

MMR601
Rear Panel
Modules Sold Separately

Specifications

- **Standard 19" Rack, 4U High**
- **Power Input:**
  - **Voltage:** 85 - 264 VAC
  - **Frequency:** 47 - 63 Hz
  - **Power:** 800 W
  - **Fuse:** 15 A
- **Dimensions (W x D x H):** 19.0" x 17.6" x 7.0" (480 mm x 448 mm x 183 mm)
- **Weight:** 35.2 lbs (16 kg)

ITEM#	$	£	€	RMB	DESCRIPTION
MMR601	$ 3,579.00	£ 2,481.00	€ 3.177,50	¥ 30,222.00	apt™ Modular Rack for 19" Instrument Chassis
MMR602	$ 3,705.00	£ 2,568.50	€ 3.289,50	¥ 31,286.00	Benchtop apt™ Modular Rack with Cover

T-Cube™ DC Servo Motor Controller (Page 1 of 2)

TDC001
Compact Housing

Features

- USB Plug-and-Play Allows Easy Multi-Axis Expansion
- Full apt™ Software Control Suite Supplied
- Differential Encoder Feedback for Closed-Loop Positioning
- Auto-Configure Function for all Thorlabs Z8 DC Servo Motors
- Easy-to-Use Manual Controls with Velocity Slider and Jog Buttons
- Extensive ActiveX® Programming Interfaces
- Fully Software Integrated with Other apt™ Family Controllers

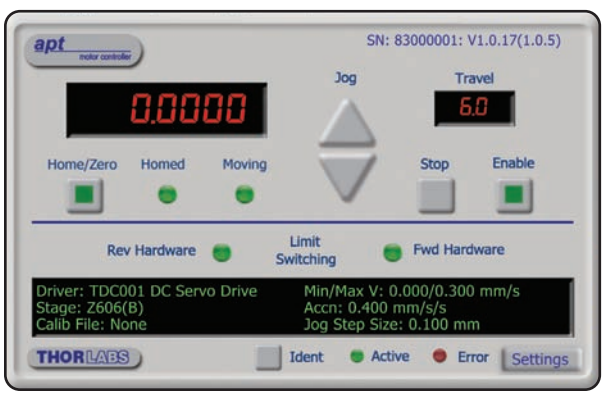
The TDC001 T-Cube™ USB DC Servo Motor Driver is a compact, single-channel controller for easy manual and automatic control of DC servo motors. This driver has been designed to operate with a variety of low-powered, DC-brushed motors (up to 15 V/2.5 W operation) equipped with encoder feedback. The TDC001 has been optimized for out-of-the-box operation with Thorlabs' range of Z8 DC motor-equipped optomechanical products (see page 534). The highly flexible software settings and closed-loop tuning also support operation with a wide range of third-party DC servo motors and associated stages and actuators.

USB connectivity provides easy plug-and-play, PC-controlled operation. The TDC001 also includes the user-friendly apt™ software, which allows the user to quickly set up complex moving sequences. For example, all relevant operating parameters are set automatically by the software for Thorlabs' stage and actuator products. Advanced custom motion control applications and sequences are also possible using the extensive ActiveX® programming environment.

For added convenience, multiple units can be connected to a single PC via standard USB hub technology or by using the T-Cube™ Controller Hub (TCH002) for multi-axis motion control applications (see page 547 for further details).

Specifications

- **Motor Drive Connector (15-Way D-Type):**
  - Motor Drive Outputs
  - Quadrature Encoder (QEP) Input (Single Ended)
  - Forward, Reverse Limit Switch Inputs (+ Common Return)
  - 5 V Encoder Supply
- **Front Panel Controls:**
  - Potentiometer Slider: 4-Speed Bidirectional Velocity Control
  - Dual Buttons Forward/Reverse Jogging or Position Presets
- **Motor Drive Voltage:** ±10 V to ±12 V Depending on Motor (Load)
- **Motor Drive Current:** 150 mA (Cont), >250 mA (peak)
- **Motor Drive Type:** 8-Bit Sign/Magnitude PWM
- **Control Algorithm:** Digital PID Filter (16-bit)
- **Position Feedback:** Quadrature Encoder (QEP) Input, 5 V Single Ended
- **Encoder Feedback Bandwidth:** 750 kHz
- **Position Counter:** 32-bit
- **Operating Modes:** Position, Velocity
- **Velocity Profile:** Trapezoidal
- **Input Power Requirements**: 15 V Regulated DC, 500 mA (Peak)
- **Dimensions (W x D x H):** 2.37" x 2.37" x 1.87" (60.3 mm x 60.3 mm x 47.5 mm)
- **Weight:** 5.5 oz (160 g)



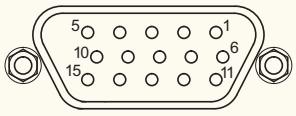
Compatible Motor Specifications

- **Motor Type:** Brushed DC Servo
- **Max Drive Voltage:** 12 V
- **Peak Power:** 2.5 W
- **Rated Current:** 10 - 200 mA (Nominal)
- **Coil Resistance:** 5 - 50 Ω (Nominal)
- **Coil Inductance:** 250 - 1500 µH
- **Position Control:** Incremental Encoder
- **Resolution:** Encoder Specific

T-Cube™ DC Servo Motor Controller (Page 2 of 2)

The TDC001 DC Servo Controller easily connects to one of our Z8 DC motor actuators. Motor operations are then controlled by the potentiometer slider and jog buttons located on the top face of the unit. Using the top panel slider the motor can be driven at predefined speeds in either forward or reverse directions for velocity control. Similarly, the jog buttons can be used to make discrete position increments in either direction enabling precise and repeatable positioning. For full flexibility, the supplied PC software can be used to fully control the TDC001 and alter both the speed response of the slider and the jogging modes for the buttons – saving any changes to the memory within the driver unit allowing the PC to be disconnected once changes have been made.

Motor Connector Pin Out



Pin	Description	Pin	Description
1	Ground	9	Not Connected
2	Forward Limit Switch	10	5 V Encoder Supply
3	Reverse Limit Switch	11	Encoder Channel A
4	Not Connected	12	Not Connected
5	Motor -	13	Encoder Channel B
6	Not Connected	14	Not Connected
7	Motor +	15	Not Connected
8	Not Connected		Not Connected

TDC001
Connector View

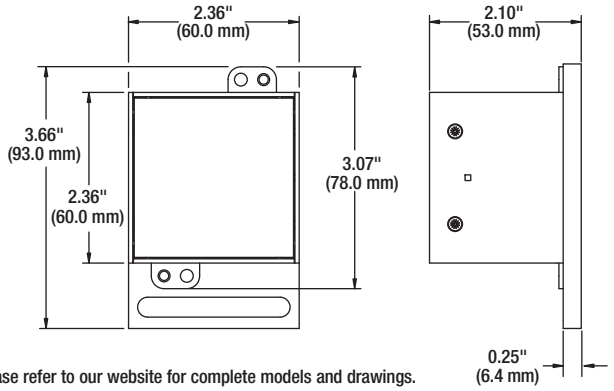
TDC001 DC Servo Driver Applications

The TDC001 DC Servo Driver T-Cube™ can be used to control our complete range of DC motor-driven, optomechanical products, such as the MT1-Z8 and MT3-Z8 translation stage and the PRM1Z8 rotation stages. For 3-axis control, three DC Driver T-cubes can be used, either on the TCH002 controller hub (see page 547) or bolted directly to the optical table.

Power Supply Options

Operation	Recommended Power Supply
Stand-Alone or Single-Channel Operation	TPS001 or TPS008
System or Multichannel Operation	TCH002

USB Interface



Please refer to our website for complete models and drawings.

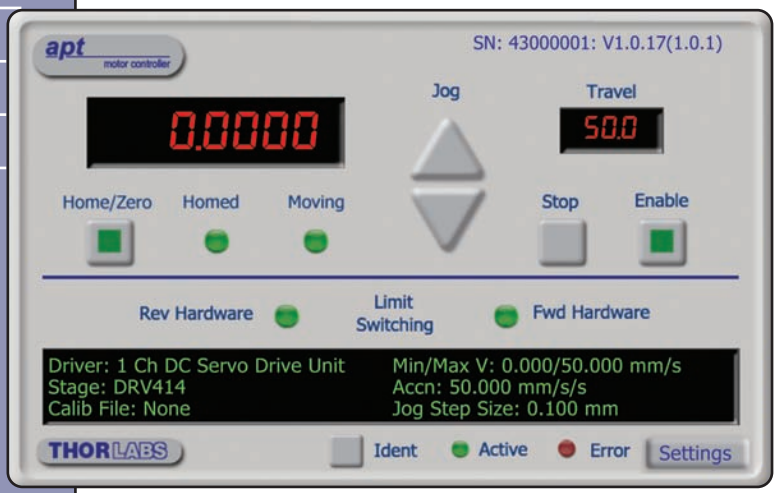
ITEM#	$	£	€	RMB	DESCRIPTION
TDC001	$ 595.00	£ 412.50	€ 528,30	¥ 5,024.20	T-Cube™ Single Channel USB DC Servo Controller/Driver
TPS001	$ 25.00	£ 17.40	€ 22,20	¥ 211.20	15 V Power Supply Unit for a Single T-Cube
TPS008	$ 175.00	£ 121.40	€ 155,40	¥ 1,477.80	15 V Power Supply Unit for up to 8 T-Cubes
TCH002	$ 726.90	£ 504.00	€ 645,40	¥ 6,138.00	T-Cube™ Controller Hub and Power Supply Unit

Benchtop DC Servo Motor Controllers

BDC101

Features

- Supports Wide Range of Brushed DC Servo Motors up to 50 W
- One-, Two-, or Three-Channel Models Available
- High Motor Speeds and Torques
- Encoder Feedback for Closed-Loop Velocity and Position Control
- Motor Control I/O Port, Jogging, Interlocks, Safety Stop
- User I/O Port
- ActiveX® Software Graphical Panels
- Fully Supported by the apt™ Software Control Suite
- Seamless Integration with all apt™ Family Controllers



See pages 580-582 for more information on the apt™ software included with the BDC Series Controllers.

Graphical Interface showing the current position of the motor connected to the controller.

The BDC Series DC Servo Motor Controllers are ideal for motion control applications requiring high-speed (up to 100 mm/s), high-load (>10 kg), and high-resolution (<1 µm) capability. One-, two-, and three-channel models are available, all capable of driving larger framed DC brushed motors up to 50 W and equipped with encoder feedback. The BDC servo controllers have been engineered to provide a seamless alternative to our BSC series stepper controllers particularly where high-speed, closed-loop operation is important. These DC drivers are especially suitable for use with our high-load and high-speed DRV414 50 mm actuator found on page 536.

We have ensured that the software interfaces to the BDC series are highly integrated with all other apt™ family controllers, providing easy system integration and reduced learning time. These units are backed up by the fully featured apt™ suite of PC software tools for immediate and easy out-of-the-box configuration and usage.

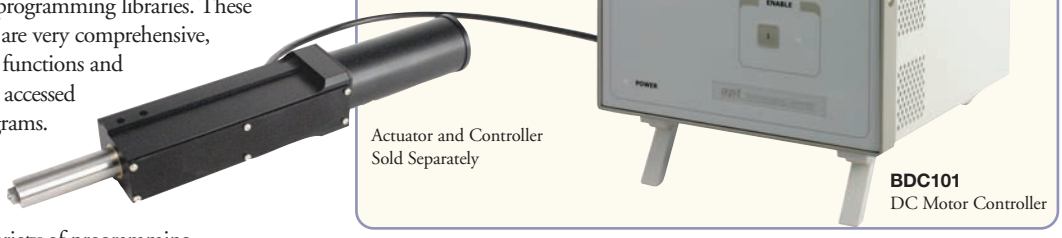
Compatible Motors

- DC Brushed Motors
- Max Drive Voltage: 48 V
- Peak Power: 50 W
- Average Power: 25 W Maximum
- Resolution: Encoder Specific, Nominal Encoder (500 - 2000 Line)
- Coil Resistance: 0.1 - 200 Ω
- Coil Inductance (Nominal): 1 - 15 mH
- Rated Phase Currents (Nominal): 100 mA to 1 A

A wide range of brushed DC servo motors and associated actuators are available, each with its own operational specifications. For this reason, the apt™ DC servo controllers are fully configurable (parameterized) to support different motor/actuator combinations. Key settings such as PID control loop values, minimum and maximum stage positions, leadscrew pitch, and limit switch configuration are exposed through the supplied apt™ software. Moreover, relative and absolute motion can be initiated with move profiles set using velocity profile parameters. Homing sequences for establishing a zero datum are also fully configurable for a particular stage or actuator. For simplicity of operation, the apt™ software incorporates pre-configured settings for each Thorlabs' stage and actuator including the DRV414 actuator.

Benchtop DC Servo Motor Controllers

All key parameters can be adjusted through direct interaction with the graphical software panels supplied. However, for custom motion control applications, all controller settings and commands are also accessible through the ActiveX® programming libraries. These programming libraries are very comprehensive, providing hundreds of functions and parameters that can be accessed from user-written programs. They are language independent in nature and consequently are supported by a large variety of programming environments that are ActiveX® compliant. These include LabVIEW™, Visual Basic, C++, Matlab, and HPVEE. See pages 580-582 for a full description of the apt™ system software.



DRV414
Motor Driven Actuators
See Page 536

Actuator and Controller Sold Separately

BDC101
DC Motor Controller

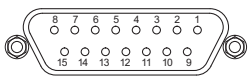
Specifications

- **Drive Connector:** 15-Pin D-Type Female (Drive Outputs, QEP Inputs, Limit Switch Input)
- **Motor Output Power:** Up to 48 V/50 W(Peak)
- **Output Type:** 10-bit Sign/Magnitude PWM
- **Operating Modes:** Position, Velocity
- **Control Algorithm:** Digital PID Filter, (16 Bit)
- **Velocity Profile:** Trapezoidal
- **Position Count:** 32-Bit
- **Position Feedback:** Incremental Encoder - Differential QEP Inputs
- **Encoder Feedback Bandwidth:** 500,000 Counts/Second
- **Motor Speeds:** Up to 6000 RPM (for 4096 Count Encoder)
- **Encoder Supply:** 5 V
- **User Control Connector:** 15-Pin D-Type Female (Jog Inputs, Enable Interlock, RS-232, Trigger In/Out (TTL), Brake Out, Safety Stop,User Digital I/O, 0 to 10 V Analog Input)

Input Power Requirements

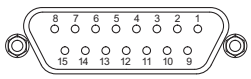
- **Volts:** 85 to 264 VAC
- **Power:**
  BDC102, BDC103: 200 W
  BDC101: 100 W
- **Fuse:** 3.15 A
- **Dimensions:**
  BDC101: 6.0" x 9.6" x 4.1"
  (152 mm x 244 mm x 104 mm)
  BDC102, BDC103: 9.5" x 14.2" x 5.2"
  (240 mm x 360 mm x 133 mm)
- **Weight:**
  BDC101: 7 lbs (3.18kg)
  BDC102, BDC103: 14.75 lbs (6.7 kg)

Motor Drive Connector Pin Out



Pin	Description
1	Encoder A +ve
2	Encoder A -ve
3	Encoder B +ve
4	Encoder B -ve
5	5 V User
6	Wall Sensor 2 (Future Use)
7	Power Ground/Earth
8	Motor Phase A
9	CW Limit Stwitch
10	CCW Limit Switch
11	0 V User
12	Wall Sensor 1 (Future Use)
13	Wall Sensor 3 (Future Use)
14	Motor Phase C
15	Motor Phase B

Control I/O Connector External Control Pin Out



Pin	Description	Return
1	User 5 V I/O	9
2	Jog Forwards*	9
3	Safety Stop	9
4	Tigger In (TTL)	–
5	Brake Out	–
6	RS232 TX (Future Use)	–
7	User In (TTL)	–
8	Keyed Pin	–
9	User 0 V	–
10	Jog Backwards*	9
11	Analog In (Future Use)**	9
12	Trigger Out (TTL)	4
13	Channel Enable	–
14	RS-232 RX (Future Use)	6
15	User Out (Open Collecter)	9

* Jog inputs must be short circuit to User 0 V (pin 9) in order to function.
** Analog In is 0 to 10 V wrt 0 V (pin 9) (For future use).

LNR50VK3
(3-Axis Stage with BDC103 Controller, See Page 452)

ITEM#	$	£	€	RMB	DESCRIPTION
BDC101	$ 1,285.00	£ 890.80	€ 1.140,90	¥ 10,851.00	Single-Channel DC Servo Motor Controller
BDC102	$ 2,095.00	£ 1,452.50	€ 1.860,00	¥ 17,691.00	Two-Channel DC Servo Motor Controller
BDC103	$ 2,670.00	£ 1,851.00	€ 2.370,50	¥ 22,546.00	Three-Channel DC Servo Motor Controller

T-Cube™ Stepper Motor Controller (Page 1 of 2)

TST001

Features

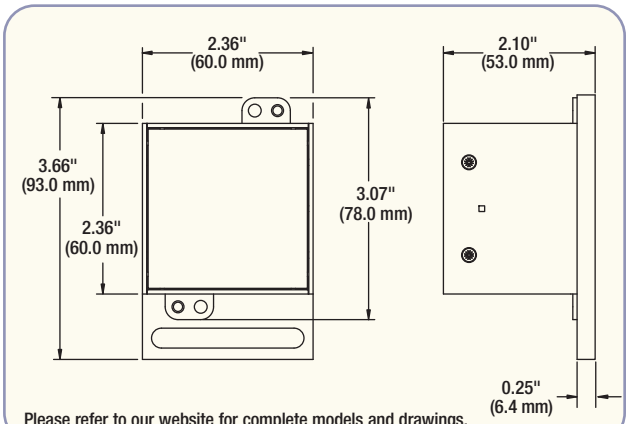
- High-Resolution Microstepping
- Supports 2-Phase, Bipolar, Low-Power Stepper Motors
- Compact Footprint
- Auto-Configure Function for Thorlabs' ZST Actuators
- USB Plug-and-Play PC-Controlled Operation
- Easy-to-Use Manual Controls with Velocity Slider and Jog Buttons
- Full Software Control Suite Supplied
- Extensive ActiveX® Programming Interfaces
- Software Integrated with Other apt™ Family Controllers

The T-Cube™ USB apt™ Stepper Motor Controller (TST001) is a very compact, single channel controller for easy manual and automated control of small, 2-phase, bipolar stepper motors. This driver has been designed to operate with a variety of low-power motors (up to 15 V/5 W operation). Although targeted at low-power operations, this product offers full control features with a highly flexible and powerful DSP controller providing a unique high resolution microstepping capability in a compact unit. The TST001 is optimized for out-of-the-box operation with the Thorlabs range of ZST mini stepper motor actuators (see page 535); however, its highly flexible parameterization also supports operation with a wide range of third party stepper motors and associated stages and actuators.

USB connectivity provides easy plug-and-play PC controlled operation. Multiple units can be connected to a single PC via standard USB technology or by using the T-Cube™ Controller Hub (TCH002) for multi-axis motion control applications (see page 547).

Specifications

- **Motor Drive Connector (15-Way, High-Density D-Type Female):**
  - Phase A and B Drive Outputs
  - Differential Quadrature Encoder (QEP) A and B Inputs
  - Forward, Reverse Limit Switch Inputs
  - 5 V Encoder Supply
- **Stepping:**
  - 128 Microsteps per Full Step
  - 3,072 Microsteps per Rev (for Our ZST Series)
- **Front Panel Controls:**
  - Potentiometer Slider
  - Bidirectional Velocity Control
  - Dual Buttons
  - Forward/Reverse Jogging or Position Presets
- **Motor Drive Voltage:** 15 V Max
- **Motor Drive Current:** 500 mA (Peak)
- **Motor Drive Type:** 10-Bit Sign/Magnitude PWM
- **Control Algorithm:** Open-Loop Microstepping
- **Position Counter:** 32-Bit
- **Operating Modes:** Position, Velocity
- **Velocity Profile:** Trapezoidal
- **Input Power Requirements:** 15 V Regulated DC, 500 mA (Peak)
- **Housing Dimensions (W x D x H):** 2.36" x 2.36" x 1.85" (60.3 mm x 60.3 mm x 47.5 mm)
- **Weight:** 3.5 oz (100 g)



Please refer to our website for complete models and drawings.

T-Cube™ Stepper Motor Controller (Page 2 of 2)

TST001 Stepper Motor Driver Applications

The TST001 Stepper Motor Driver T-Cube™ can be used to control our lower-power, stepper-motor-driven optomechanical products, such as the ZST series of actuators. For 3-axis control, three stepper motor driver T-cubes can be used, either with the TCH002 controller hub (see page 547) or simply bolted to the optical table.

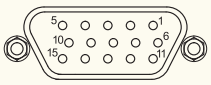
Power Supply Options

Operation	Recommended Power Supply
Stand-Alone or Single-Channel Operation	TPS001 or TPS008
System or Multichannel Operation	TCH002

Recommended Motor Requirements

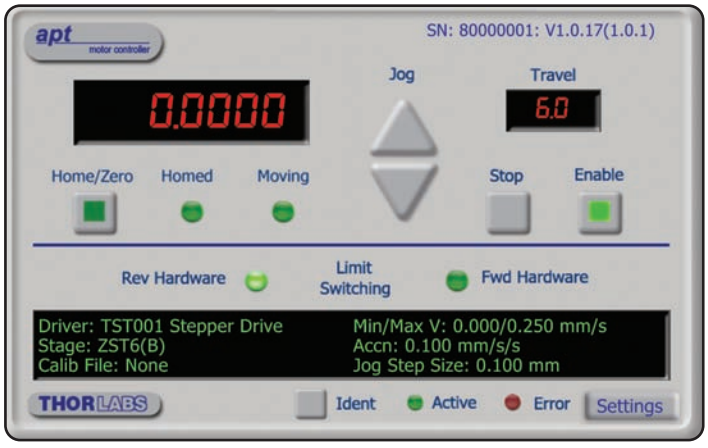
- **Motor Type:** 2-Phase Bipolar Stepper
- **Peak Power:** 5 W
- **Max Drive Voltage:** 15 V
- **Rated Phase Current:** 10 - 250 mA
- **Step Angles:** 1.8° to 20°
- **Motor Drive Mode:** Current
- **Coil Resistance (Nominal):** 5 - 20 Ω
- **Coil Inductance:** 2 – 5.5 mH
- **Position Control:** Open-Loop (Incremental Encoder Optional)

Motor Connector Pin Out



Pin	Description	Pin	Description
1	Ground	9	Ident In
2	CCW Limit Switch	10	+5V
3	CW Limit Switch	11	Enc A +ve
4	Phase B -ve	12	Enc A -ve
5	Phase B +ve	13	Enc B +ve
6	Phase A -ve	14	Enc B -ve
7	Phase A +ve	15	Trigger In/Chan Enable
8	Trigger Out		

TST001
Rear Connector View



See pages 580-582 for more information on the apt™ software included with the TST001 Stepper Controller.

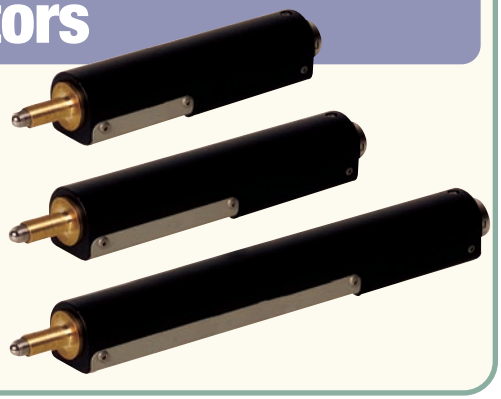
Power Supply not Inlcuded Please, See Page 542 for Power Supply Option Descriptions

ITEM#	$	£	€	RMB	DESCRIPTION
TST001	$ 595.00	£ 412.50	€ 528,30	¥ 5,024.20	T-Cube™ Single Channel USB Stepper Motor Controller/Driver
TPS001	$ 25.00	£ 17.40	€ 22,20	¥ 211.20	15 V Power Supply Unit for a Single T-Cube
TPS008	$ 175.00	£ 121.40	€ 155,40	¥ 1,477.80	15 V Power Supply Unit for up to 8 T-Cubes
TCH002	$ 726.90	£ 504.00	€ 645,40	¥ 6,138.00	T-Cube™ Controller Hub and Power Supply Unit

ZST Stepper Motor Actuators

Our ZST actuators provide smooth, precise, linear motion control in a compact package. Powered by a small-diameter, dual-phase stepper motor, these actuators operate at speeds up to 0.5 mm/s and are capable of moving loads of up to 12 lbs. Mounting options include a high-tolerance Ø0.375" mounting barrel for fastening into any application compatible with our precision micrometer heads, including our popular PT1 translation stages. A 1/4"-80 threaded barrel is also offered for use with any standard manual mirror mount using 1/4"-80 threads.

See Page 535



Benchtop Stepper Motor Controllers (Page 1 of 2)

BSC101
50W Drive Compatible
Single-Channel Model

Features

- One-, Two-, and Three-Channel Models Available
- Supports 2-Phase Bipolar Steppers up to 50 W
- Differential Encoder Feedback (QEP) Inputs for Closed-Loop Positioning
- USB Plug-and-Play Plus Multi-Axis Expansion
- Motor Control I/O Port (Jogging, Interlocks)
- Full Software GUI Control Suite
- High-Resolution Microstepping Control (For Very Fine Positioning Applications)
- Stable and Predictable Low-Speed Operation (For Velocity-Sensitive Applications)
- ActiveX® Programming Interfaces
- Seamless Software Integration with apt™ Family

The BSC series apt™ stepper motor controllers are designed to drive larger framed 2-phase bipolar stepper motors, with and without encoder feedback. One-, two-, and three-channel models are available. These units are capable of delivering powers up to 48 V/50 W peak (25 W average) and are compatible with all of our stepper-driven nanopositioning actuators and stages except the ZST Series.

The controllers combine the latest high-speed digital signal processors (DSP) with low-noise analog electronics and ActiveX® software technology for effortless one-, two-, or three-axis motion. Additional axes can be driven by connecting one or more benchtop units via a standard USB hub. The controllers are supplied with a full suite of software support tools.

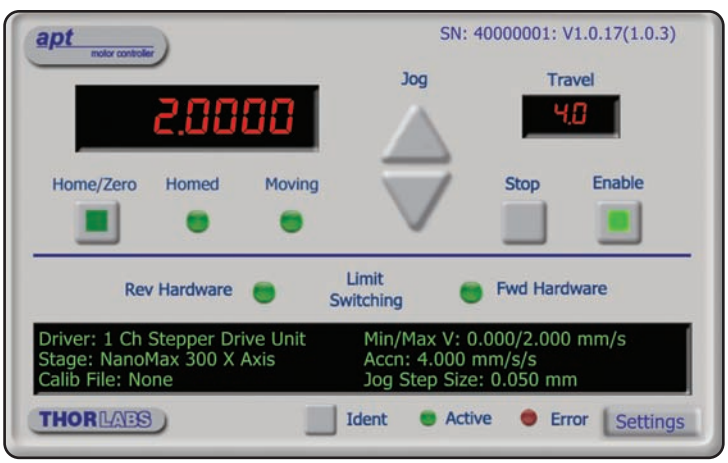
An intuitive graphical instrument panel allows immediate control and visualization of the operation of the controller. See page 580-582 for a full description of the apt™ system software.

Driver Functionality

Stepper motors give excellent low-speed performance and positioning stability. A wide range of 2-phase bipolar stepper motors and associated actuators are commercially available, each with its own characteristics such as step resolution, peak phase current or voltage, and leadscrew pitch. For this reason the apt™ stepper unit operation is fully configurable with key settings exposed through the associated graphical interface panels.

Motor step resolution and leadscrew pitch can be set for a particular motor/actuator combination, phase currents can be limited to suitable peak powers as required, and limit switch configuration is accommodated through a flexible set of limit switch logic settings.

Moreover, relative and absolute motion can be initiated with motion profiles that are set using velocity profile parameters. Similarly, home sequences have a full set of associated parameters that can be adjusted for a particular stage or actuator.



See pages 580-582 for more information on the apt™ software included with the BSC Series Controllers.

For simplicity of operation, the apt™ software incorporates preconfigured settings for each of our stages and actuators, while also allowing the user to enter each parameter for use with other stepper motor driven systems. For convenience and ease of use, adjustment of many key parameters is possible through direct interaction with the graphical panel. For example, movement to the next position can be initiated by clicking directly on the position display and entering a new value. Note that all such settings and parameters are also accessible through the ActiveX® programmable interfaces for automated motion control sequences.

Benchtop Stepper Motor Controllers (Page 2 of 2)

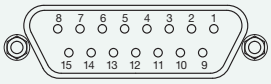
Specifications

- **Input/Output:**
  - **Motor Drive Channel (15-Pin D-Type Female)**
    - 2-Phase Bipolar Motor Drive Output
    - Differential Quadrature Encoder Interface
    - Forward, Reverse Limit Switch Inputs
  - **Motor Control (15-Pin D-Type Female)**
    - Jog Forward/Back
    - Enable/Disable Interlock
    - User Logic Outputs/Inputs
    - Single-Ended Analog Input (0 - 10 V)
    - Trigger In/Out
- **Resolution**
  - 128 Microsteps per Full Step
  - 200 Step Motor – 25,600 Microsteps per Revolution
- **Compatible Motors**
  - **Peak Powers:** 5 - 50 W
  - **Average Power:** 25 W Maximum
  - **Step Angle Range:** 20° - 1.8°
  - **Coil Resistance (Nominal):** 4 - 15 Ω
  - **Coil Inductance (Nominal):** 4 - 15 mH
  - **Rated Phase Currents (Nominal):** 100 mA - 1 A
- **Motor Power:** Up to 50 W (Peak)
- **Motor Max Drive Voltage:** 48 V
- **Motor Speeds:** Up to 600 RPM (for 200 Full Step Motor)
- **Encoder Feedback Bandwidth:** 500,000 Counts per Seconds
- **Housing Dimensions (W x D x H):**
  - **BSC101** 6" x 9.6" x 4.1" (152 mm x 244 mm x 104 mm)
  - **BSC102, BSC103** 9.5" x 14.2" x 5.2" (240 mm x 360 mm x 133 mm)
- **Input Power Requirements**
  - **Voltage:** 85 - 264 VAC
  - **Power:** BSC102 and BSC103: 200 W BSC101: 100 W
  - **Fuse:** 3.15 A
- **Weight:**
  - **BSC101** 7 lbs (3.18 kg)
  - **BSC102, BSC103** 14.75 lbs (6.7 kg)

BSC103
Three-Channel Model

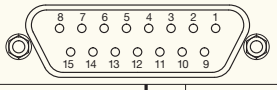
See our full line of motorized flexure stages starting on page 440.

Motor Drive Connector Pin Out



Pin	Description	Pin	Description
1	Encoder A +ve	9	CW Limit Stwitch
2	Encoder A -ve	10	CCW Limit Switch
3	Encoder B +ve	11	0 V User
4	Encoder B -ve	12	Not Used
5	5V User	13	Not Used
6	Not Used	14	Phase B +
7	Phase B -	15	Phase A +
8	Phase A -		

Control I/O Connector External Control Pin Out



Pin	Description	Pin	Description
1	5 V User	9	0 V User
2	Jog Fwd	10	Jog Back
3	Not Used	11	Analog In
4	Trig In	12	Trig Out
5	EN Return	13	Enable
6	RS-232TX	14	RS-232 RX
7	User In	15	User Out (o/c)
8	Keyed Pin		

Full Support for Encoder Feedback
The apt™ stepper unit also supports encoder feedback through dedicated quadrature encoded pulse (QEP) inputs, one for each channel of operation. A built-in algorithm can be enabled to allow the stepper system to reach and maintain an encoded position through an iterative move sequence. Please see page 448 for details on our linear-encoded LNR stage and apt™ stepper drive package.

Software Developers Support CD
A developers' kit ships with all of our apt™ series controllers. This additional software is intended for use by software developers working on large system integration projects which incorporate apt™ products. The kit contains an extensive selection of useful code samples as well as tutorial information.

See pages 580-582 for more information on the apt™ software included with the BSC Series Controllers.

ITEM#	$	£	€	RMB	DESCRIPTION
BSC101	$ 1,285.00	£ 890.80	€ 1.140,90	¥ 10,851.00	One-Channel apt™ Stepper Motor Controller
BSC102	$ 2,095.00	£ 1,452.50	€ 1.860,00	¥ 17,691.00	Two-Channel apt™ Stepper Motor Controller
BSC103	$ 2,670.00	£ 1,851.00	€ 2.370,50	¥ 22,546.00	Three-Channel apt™ Stepper Motor Controller

Modular Rack System Stepper Motor Controller

MST601

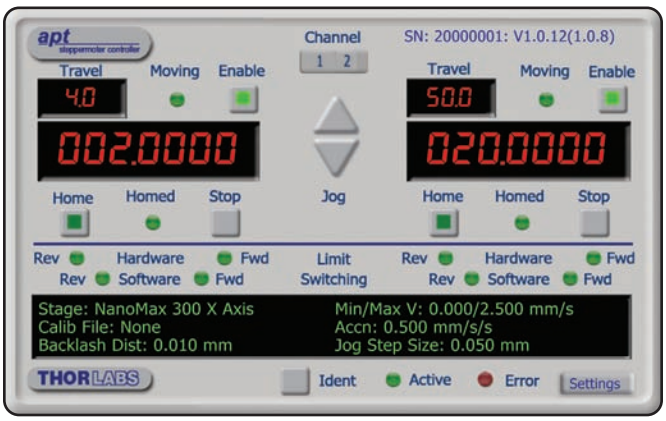
Our modular apt™ stepper motor driver provides a scalable motion control solution. Up to 12 stepper motors can be controlled by the 19" Rack Enclosure described on the next page, if it is loaded with six stepper motor modules. The USB interface and advanced application software allow multiple channel systems to be seamlessly integrated into a single, large-scale solution. The modular apt™ stepper motor controller is supplied with a full suite of software support tools. An intuitive graphical instrument panel allows immediate control and visualization of the operation of the stepper unit. See pages 580-582 for a full description of the apt™ system software.

Driver Functionality

A wide range of 2-phase bipolar stepper motors and associated actuators are available, each with its own characteristics, such as step resolution, peak phase current or voltage, and leadscrew pitch. Operation of the apt™ Stepper Motor Module is fully configurable. For example, the motor step resolution and leadscrew pitch can be set, phase currents can be adjusted, and the limit switch can be configured. Moreover, relative and absolute moves can be initiated with move profiles set using velocity profile parameters. All of our stepper motor actuators and stages are compatible with the module except the ZST Series.

Features

- Dual (Synchronized) Drive Channels
- Supports 2-Phase Bipolar Steppers up to 50 W
- Differential Encoder Feedback (QEP Inputs)
- Maximum 128 Microsteps per Full Step
- 25,600 Microsteps per Rev (200 Step Motor)
- User Controlled Digital I/O Port
- Motor Control I/O Port
- Full Software GUI Control Suite
- ActiveX® Graphical Panel Controls
- ActiveX® Programming Interfaces
- Seamless Software Integration with apt™ Family



MMR601
19" Rack Assembly Shown with Various Modules
All Sold Separately

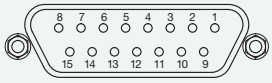
Full Support for Encoder Feedback

The modular apt™ stepper motor controller also supports encoder feedback through dedicated quadrature encoded pulse (QEP) inputs, one for each of the two channels of operation. A built-in algorithm can be enabled to allow the stepper system to reach and maintain an encoded position through an iterative move sequence.

Specifications

- **Input/Output:**
  - **Motor Drive Channel (25-Pin, D-Type Female for Each Channel)**
    - 2-Phase Bipolar Motor Drive Output
    - Differential Quadrature Encoder Interface
    - Forward, Reverse Limit Switch Inputs
  - **Motor Control (15-Pin, D-Type Female)**
    - Jog Forward
    - Jog Back
    - Enable/Disable Interlock
    - Jog Control Handset Available
  - **User I/O (26-Pin, D-Type Female)**
    - Logic Level Trigger Input/Output
- **Stepping** (Assumes 200 Step Motor)
  - 25,600 Microsteps per Revolution
  - Maximum 128 Microsteps per Full Step
- **Compatible Motors:**
  - **Peak Powers:** 5 - 50 W
  - **Average Power:** 25 W Maximum
  - **Max Drive Voltage:** 48 V
  - **Step Angle Range:** 20°-1.8°
  - **Coil Resistance (Nom):** 4 - 15 Ω
  - **Coil Inductance (Nom):** 4 - 15 mH
  - **Rated Phase Currents (Nom):** 100 mA to 1 A
- **General:**
  - **One Slot apt™ Rack**
  - **Dimensions (W x D x H):** 7.5" x 10.6" x 1.97" (190 mm x 270 mm x 50 mm)
  - **Weight:** 3.3 lbs (1.5 kg)

Motor Drive Connector Pin Out



Pin	Description	Pin	Description
1	Encoder A +ve	9	CW Limit Stwitch
2	Encoder A -ve	10	CCW Limit Switch
3	Encoder B +ve	11	0 V User
4	Encoder B -ve	12	Not Used
5	5V User	13	Not Used
6	Not Used	14	Phase B +
7	Phase B -	15	Phase A +
8	Phase A -		

ITEM#	$	£	€	RMB	DESCRIPTION
MST601	$ 1,210.00	£ 838.80	€ 1.074,30	¥ 10,218.00	apt™ 2-Channel Stepper Motor Controller Module

apt™ Modular Rack System

The apt™ modular rack system is a sophisticated, self-contained, expandable, motion control platform for applications with a large number of channels. This new system deploys the same advanced high-speed, digital signal processing (DSP) technology and low-noise analog circuitry pioneered in the apt™ benchtop controllers. It also provides a highly functional 12-channel platform within the footprint of a 4U high, 19" wide enclosure. With a unified power supply and a single node USB communications interface, the apt™ rack system is easily incorporated into larger custom applications. Module functionallity is identical to the corresponding apt™ benchtop and T-Cube™ controllers, allowing a common software solution and learning curve for both benchtop and rack-based apt™ controllers. Multiple user development environments are supported (e.g., Visual Basic, LabVIEW™, HP VEE, C++, MATLAB, and .NET).

The rack system architecture, hardware, and software has been engineered to provide an efficient solution for complex, high-channel-count nanopositioning applications. Whether these applications are found in a modern high-volume optoelectronic component manufacturing facility or in a leading R&D facility, the MMR601 or MMR602 system is easy to implement and can be adapted to rapidly changing requirements.

The rack presents a clean, uncluttered front panel with six rear mounting bays for the plug-in modules. This arrangement greatly simplifies the cable management issues that arise as the number of channels expands.

Each module is equipped with an on-board digital signal processor (DSP), which allows processing power to be increased as modules (channels of operation) are added. This way, the system is able to maintain maximum operating efficiency, even when fully loaded.

Furthermore, additional racks can be added to the USB bus as required, thus allowing multiple, fully automated, 6-axis positioning stages to be combined into a single unified motion control system.

The PC-based software that drives the rack system operates from the same kernel of ActiveX® multi-threaded server code used to drive the stand-alone benchtop controllers and includes the same collection of high-level user applications. All of our ActiveX® software is rigorously engineered using modern object-oriented techniques, which ensures independence of programming environment and compatibility with a large number of third-party development tools. See pages 580-582 for more details on the apt™ software suite.

Features

- Supports up to 12-Channels of Operation in a Single Chassis
- Three Plug-In Modules:
  - Dual-Channel Piezoelectric Controller with 75 V of Low-Noise Output (see page 570)
  - Dual-Channel Stepper Motor Controller with Peak Power of 50 W per Channel (see page 560)
  - Dual-Channel NanoTrak™ Auto-Alignment System (see page 576)
- 6 Module Slots per Chassis, Access from Rear Panel
- Advanced ActiveX® PC Control Software Suite
- USB Plug-and-Play
- USB Interface Allows Multiple Systems to be Connected and Controlled via One PC

Specifications

- **Standard 19" Rack, 4U High**
- **Power Input:**
  - **Voltage:** 85 - 264 VAC
  - **Frequency:** 47 - 63 Hz
  - **Power:** 800 W
  - **Fuse:** 15 A
- **Dimensions (W x D x H):** 19.0" x 17.6" x 7.0" (480 mm x 448 mm x 183 mm)
- **Weight:** 35.2 lbs (16 kg)

ITEM#	$	£	€	RMB	DESCRIPTION
MMR601	$ 3,579.00	£ 2,481.00	€ 3.177,50	¥ 30,222.00	apt™ Modular Rack for 19" Instrument Chassis
MMR602	$ 3,705.00	£ 2,568.50	€ 3.289,50	¥ 31,286.00	Benchtop apt™ Modular Rack with Cover

T-Cube™ Piezo Controller (Page 1 of 2)

TPZ001

Features

- Digital Potentiometer High-Voltage Control (Adjustable Resolution)
- Voltage Readout
- Compact Footprint
- Selectable High-Voltage Output Range of 75, 100, or 150 V
- Low-Voltage Driver Input (SMA)
- Low-Voltage Monitor Output (SMA)
- Closed-Loop Operation with T-Cube™ Strain Gauge Reader Unit (via Hub)
- Voltage Ramp/Waveform Generation Capability
- Stand-Alone or PC-Controlled Operation via USB
- Software Control Suite Included
- Extensive ActiveX® Programming Interfaces
- Software Compatible with Other apt™ Controllers

TPZ001
Input View

The T-Cube™ Piezo Controller, (TPZ001), is a compact single-channel controller/driver for manual and automatic control of a wide range of piezo stacks and actuators. This driver is capable of delivering up to 150 V of drive voltage at 7.5 mA. The TPZ001 can be used to operate the complete range of bare piezo stacks, piezo-equipped actuators, and piezo-driven mirror mounts supplied by Thorlabs. Furthermore, when operated together with the T-Cube™ Strain Gauge Reader unit (TSG001), high-precision, closed-loop operation is possible using a feedback-equipped piezo actuator. (See Pages 564-565)

All manual controls are located on the top face of the unit for manual adjustment of piezo position using the digitally encoded adjustment pot and easy-to-read (adjustable brightness) voltage display.

To support a wide variety of piezo devices, the output range can be user selected to 75, 100, or 150 V, and the resolution is easily altered to provide very accurate positioning control. Direct hardware control of the high voltage output can be facilitated using the low-voltage input connector.

A low-voltage output connector allows for monitoring of the HV output (for example, using an oscilloscope). As a useful feature, a programmable waveform generation capability makes this unit particularly well suited for use in piezo scanning applications.

USB connectivity provides easy PC-controlled operation. Advanced custom motion control applications and sequences are also possible using the extensive ActiveX® programming environments.

Specifications

- **Piezoelectric Output (SMC Male)**
  - Drive Voltage: 0 - 150 V (Selectable: 75, 100, or 150 V)
  - Drive Current: 7.5 mA Max Continuous
  - Stability: 100 ppm over 24 hours (After 30 Minutes Warm-up Time)
  - Noise: <2 mV RMS
  - Typical Piezo Capacitance: 1 - 10 µF
  - Bandwidth: 1 kHz (1 µF Load, 1 Vp-p)
- **External Input (SMA Male):** 0 to 10 V
- **Output Monitor (SMA Male):** 0 to 10 V
- **USB Port:** Version 1.1 mini
- **Power Requirements**
  - Voltage: 15 V @ 200 mA, -15 V @ 100 mA, 5 V @ 400 mA
- **Housing Dimensions (W x D x H):** Standard Width 2.4" x 2.4" x 1.8" (60.3 mm x 60.3 mm x 47.5 mm)
- **Weight:** 5.5 oz (160 g)

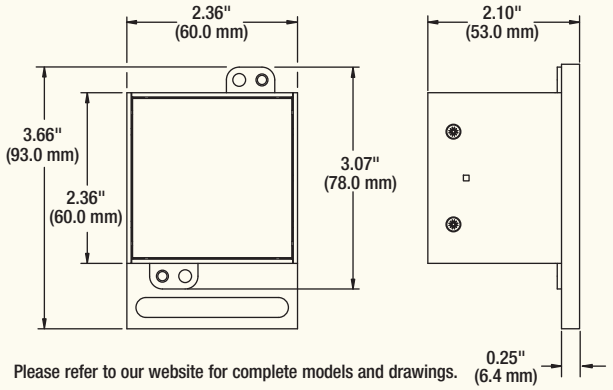
T-Cube™ Piezo Controller (Page 2 of 2)

The TPZ001 unit is equipped with SMA connectors for the EXT IN and MONITOR terminals. Thorlabs supplies a range of SMA to BNC converters for those applications where BNC connections are required (See page 373).

TPZ001 Piezo Driver Applications

The TPZ001 Piezo Driver T-Cube™ can be used to control our complete range of open-loop piezo products such as the KC1-PZ 3-axis mirror mount shown below. In this application, three piezo T-Cubes are required, one for each axis.

For closed-loop applications, the TPZ001 can be used in conjunction with the TSG001 strain gauge reader T-Cube™ (see page 564). This combination can be used to control a variety of closed-loop piezo products such as our PAZ series feedback piezo actuators (page 531).

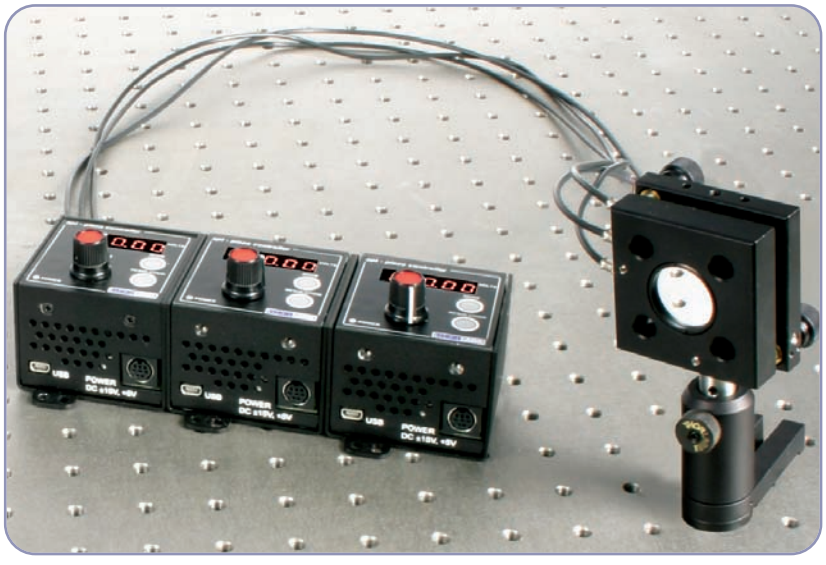


Please refer to our website for complete models and drawings.

Power Supply Options

The TPZ001 T-Cube™ requires a 5 V, 15 V, or -15 V power supply depending on the current. Thorlabs offers the TPS002, which is a compact, two-way power supply unit, allowing up to two T-Cubes to be powered from a single power outlet.

Alternatively, the TCH002 USB Controller Hub (see page 546) provides power for up to six T-Cubes. Furthermore, the controller hub contains a fully USB2.0 compliant hub to provide communications for up to six T-Cubes – a single USB connection to the Controller Hub is all that is required for PC control.



TPZ001 Piezo Controller T-Cubes with KC1-PZ Piezo-Driven Mirror Mount (See Page 165)

ITEM#	$	£	€	RMB	DESCRIPTION
TPZ001	$ 595.00	£ 412.50	€ 528,30	¥ 5,024.20	T-Cube™ 150 V Piezo Driver
TPS002	$ 105.00	£ 72.80	€ 93,30	¥ 886.70	±15 V/5 V Power Supply Unit for up to Two T-Cubes
TCH002	$ 726.90	£ 504.00	€ 645,40	¥ 6,138.00	T-Cube™ Controller Hub and Power Supply Unit

T-Cube™ Strain Gauge Reader (Page 1 of 2)

TSG001

Features

- Position, Force, or Voltage Reading
- Nanometer-Level Position Resolution with Thorlabs' Actuators
- Compact Footprint
- Strain Gauge AC Bridge Signal Input
- Clear Read Out with 5-Digit Display
- Low-Voltage Monitor Output (Supports Closed-Loop Applications)
- Zero Point Calibration
- Closed-Loop Operation with T-Cube™ Piezo Driver Simplified Using Controller Hub
- Software Control Suite Included
- Extensive ActiveX® Programming Interfaces
- Software Compatible with Other apt™ Controllers (Integrated Systems Development)

The TSG001 Strain Gauge Reader is a compact, single-channel reader designed to measure, condition (rectify and filter), and display the feedback signal derived from AC bridge strain gauge systems. The TSG001 provides complete operation with our range of strain gauge-equipped piezo stacks, actuators, stages, and force sensors.

This strain gauge reader can be used for reading position, force, or voltage. When used in isolation, the TSG001 can measure the deflection and extension in a strain gauge with nanometer-level resolution, or it may be used with our force sensor products (FSC102 and FSC103, page 506) for high-sensitivity force sensing down to mN levels.

For ease of use, all manual controls are located on the top face of the unit. A mode button allows the readout display mode to be changed between position, force, and voltage. Pressing and holding the mode button also initiates a self-calibration sequence, allowing the TSG001 unit to set a zero position point. The TSG001 is also equipped with a low-voltage monitor output (0 - 10 V) proportional to the strain gauge extension providing a conditioned feedback or monitoring signal for third-party systems. Setup is quick and easy using the standard apt™ software.

Multiple units can be connected to a single PC via standard USB hub technology or by using the new T-Cube™ Controller Hub (TCH002) for multi-axis applications (see page 546). When not used with the Hub Controller, this device may be powered by a T-Cube Dual-Channel Power Supply (TPS002), which is sold separately.

Note that the TSG001 unit is equipped with an SMA connector for the monitor output. Thorlabs supplies a range of SMA to BNC converters for those applications where BNC connections are required (see page 373).

TSG001 Strain Gauge Reader Applications
When the TSG001 is used in combination with the TPZ001 Piezo Driver, precise closed-loop piezo positioning control is possible. This T-Cube™ controller combination is then compatible with all of our closed-loop piezo solutions including the PAZ series actuators (page 531), 1-axis NanoFlex™ stages (page 420), APB301 3-axis PiezoBlock™ translator (page 468), and 3-axis NanoMax™ 300 stages (page 470).

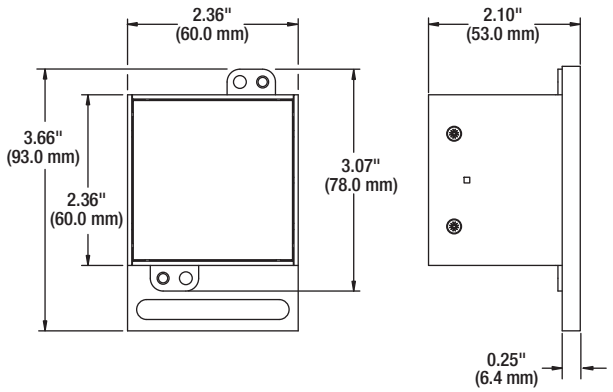
T-Cube™ Strain Gauge Reader (Page 2 of 2)

Power Supply Options

The TSG001 T-Cube™ requires a 5 V, 15 V, or -15 V power supply depending on the current. Thorlabs offers the TPS002, a compact, two-way power supply unit that allows up to two T-Cubes to be powered from a single outlet.

The TCH002 USB Controller Hub provides power distribution for up to six T-Cubes. The Controller Hub contains a fully USB 2.0 compliant hub to provide communications for all six T-Cubes – a single USB connection to the Controller Hub is all that is required for PC control.

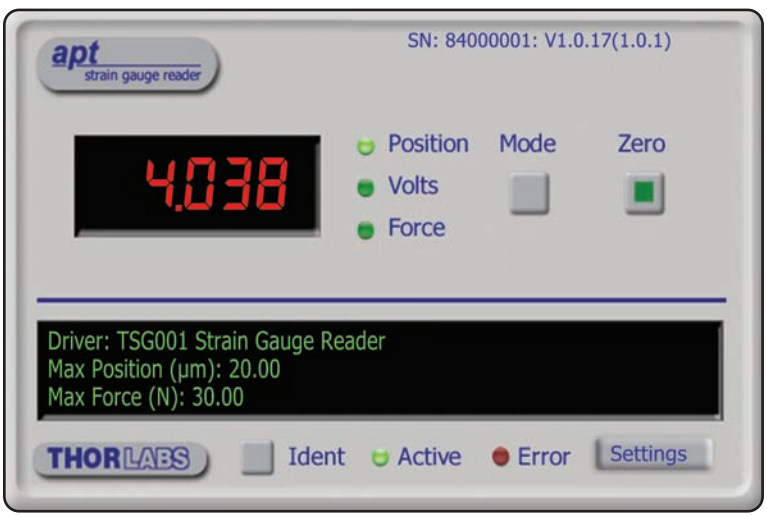
TSG001 Strain Gauge Reader T-Cubes with FSC102 Bare Fiber Force Sensor



Please refer to our website for complete models and drawings.

Specifications

- **Strain Gauge Input:** 9-Pin D-Type
- **Bridge Type:** AC
- **Excitation Frequency:** 18 kHz
- **Display Resolution**
  - Position Mode: 1 nm
  - Force Mode: 1 mN
  - Voltage Mode: 1 mV
- **Sampling Bandwidth:** 500 Hz
- **Position Output Monitor:** 0 - 10 V (SMA)
- **USB Port:** Version 1.1 mini
- **Reading Display:** 5 Digit, 7 Segment LED
- **Input Power Requirements:** 15 V (200 mA), -15 V (100 mA), or 5 V (400 mA)
- **Housing Dimensions (W x D x H):** 2.37" x 2.37" x 1.87" (60.3 mm x 60.3 mm x 47.5 mm)
- **Weight:** 5.5 oz (160 g)



Graphical Interface for Thorlabs' Strain Gauge Reader

ITEM#	$	£	€	RMB	DESCRIPTION
TSG001	$ 545.00	£ 377.90	€ 483,90	¥ 4,602.00	T-Cube™ Strain Gauge Reader
TPS002	$ 105.00	£ 72.80	€ 93,30	¥ 886.70	±15 V/5 V Power Supply Unit for up to Two T-Cubes
TCH002	$ 726.90	£ 504.00	€ 645,40	¥ 6,138.00	T-Cube™ Controller Hub and Power Supply Unit

Open-Loop Piezoelectric Controller: 1 and 3 Channels

MDT693A

Thorlabs' one-channel (MDT694A) and three-channel (MDT693A) Piezoelectric Controllers have been designed to take advantage of the very high resolution achievable with low-voltage piezo stacks (100 V compared to 1000 V). Both models combine precision control of the output voltage for maximum piezo resolution, along with a high output current capability to allow external modulation of the piezo. Computer control is available on both models via an RS-232 interface. For the added protection of your sensitive, low-voltage piezo devices, a selectable output voltage range switch has been added with three selectable ranges: 0-75 V, 0-100 V, and 0-150 V. Additionally, the three-channel MDT693A offers master scan controls that allow internal or external control of all three channels simultaneously.

Piezo control can be achieved manually using the front panel adjustment knob, electrically using a 0-10 V signal input into a front panel BNC connection, or remotely using the RS-232 interface and Graphical User Interface (GUI) provided with the unit.

The output is provided through a convenient BNC connector located on the rear panel. A BNC (male) to SMC (female) adapter is included for each output to provide compatibility between our various stages and piezo actuators.

MDT694A

The MDT694A is a single-channel, high-voltage amplifier designed to take advantage of the high resolution achievable with our line of piezoelectric stacks. The MDT694A combines precision high-voltage output capability with high-output current capability.

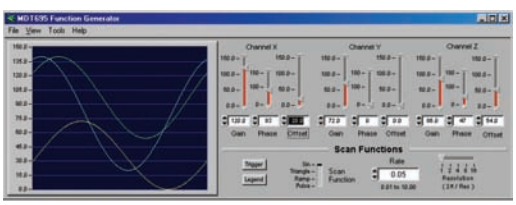
MDT693A and MDT694A Features

- Compatible with Our Full Line of Open-Loop Piezoelectric Actuators
- Precision, Low-Noise Outputs
- Internal/External Voltage Control
- Master Scan Controls
- RS-232 Interface
- 3 Channel Scan Balancing Compensates for Slightly Different Piezo Translation Factors (δL/δV)

MDT693A and MDT694A Specifications

- **Output Voltage:** 0 - 75 V, 0 - 100 V, 0 - 150 V Switchable Output Indicated on Front Panel
- **Output Current:** 60 mA/Channel
- **Output Noise:** 1.5 mV RMS
- **Output Stability:** 0.01% Over 5 hrs
- **Power Requirements:** 100 - 240 VAC, 50 - 60 Hz (Switch Selectable)

RS-232 Interface



LabWindows™ application programs are included for out of the box operation. MDT690 series Uses an RS-232 Interface.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MDT693A	MDT693A*	$ 1,580.00	£1,095.50	€ 1.402,50	¥ 13,342.00	3-Channel, Open-Loop Piezoelectric Controller
MDT694A	MDT694A*	$ 712.00	£ 493.60	€ 632,20	¥ 6,012.20	1-Channel, Open-Loop Piezoelectric Controller

*Power requirements 100 - 120 VAC, user switchable to 220 - 240 VAC 50 - 60 Hz operation.

3-Axis Flexure Stage with Controller Package

MDT630A
(Complete System)

Specifications

- **Total Travel Manual Drives:** 4 mm (See Page 471 for Details)
- **Total Travel Piezo Drives:** 20 µm
- **Piezoelectric Driver:** 0 - 150 V
- **Output Noise:** 1.5 mV RMS
- **Output Stability:** <0.01%, 5 hrs

Our MDT630A kit comes with our MAX312 flexure stage and MDT693A 3-channel piezoelectric controller. The NanoMax™ Flexure Stage has 4 mm of coarse travel and 300 µm of fine travel controlled by the differential drives. Additionally, the unit has three piezoelectric actuators built into the housing to give an additional 20 µm of travel and a resolution of 20 nm. The flexure design of the MAX312 ensures low crosstalk, high stability, and long-term reliability. The 3-channel controller offers a way to control the piezoelectric actuators with high stability and accuracy. The controller can be adjusted from the front panel or with the included, easy-to-use software through the RS-232 interface.

All the cables required to connect the stage to the controller are included in the kit. For more information on the MAX312, please see page 471.

ITEM#	METRIC ITEM#	$	£	€	RMB	DESCRIPTION
MDT630A*	MDT630A/M*	$ 3,600.00	£ 2,495.50	€ 3.196,00	¥ 30,399.00	Complete Piezoelectric Flexure Stage and Driver

*Power Requirements 100 - 120 VAC, 50 - 60 Hz; user switchable to 220 - 240 VAC, 50 - 60 Hz operation.

Piezoelectric Kinematic Mount with Controller Package

Piezoelectric Driver

- Output Current: 60 mA per Channel
- Frequency Response: DC - 10 kHz (1.4 µF Capacitance Load)
- 3 Independent Voltage Displays
- Very Low Noise Electronics
- Turnkey System Complete with All Cables

Mechanical

- 10 arcsec Angular Resolution
- ±4° Mechanical Angular Range
- 3 mm Translational Range

Electro-Mechanical

- 0.06 arcsec Angular Resolution
- 30 arcsec Angular Range
- 8 µm Translational Range

PZ630
Complete System Includes Drive Electronics
Base and Mirror Sold Separately
See Page 165

The PZ630 and PZ631 kits combine our KC1 Series 30 mm cage system kinematic mirror mount with piezoelectric stacks and our MDT693A 3-channel piezoelectric controller. This combination offers precise control of the angular orientation of the mirror. The manual thumb screws control the coarse angular adjustment while the piezoelectric stacks, mounted between the screw and the housing, allow for fine angular control. The combination allows for ±4° of motion with 0.06 arcsec of angular resolution. The controller can be adjusted from the front panel or with the included, easy-to-use software through the RS232 interface.

The mirror mount in both the PZ630 and PZ631 packages is compatible with Thorlabs' 30 mm cage system. The PZ630 is bundled with the KC1-PZ mirror mount, which has a Ø1.05" smooth bore hole to fit Ø1" optics and a nylon-tipped set screw to hold it securely in place. The PZ631 is sold with the KC1-T-PZ mirror mount, which has an SM1 (Ø1.035"- 40) threaded aperture for mounting Ø1" optics using the two included SM1RR retaining rings to hold the optic in place. The SM1 thread allows many of our mechanical parts to be easily attached to the the mount, such as our lens tubes (see page 117), cage system accessories (see page 147), and our laser diode mounts (see page 1216). Both kits come with all of the cables required to connect the mount to the controller.

ITEM#	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
PZ630	PZ630-EC	$2,178.60	£ 1,510.00	€ 1.934,00	¥ 18,397.00	Complete System: KC1-PZ Plus Controller
PZ631	PZ631-EC	$2,179.60	£ 1,511.00	€ 1.935,00	¥ 18,405.00	Complete System: KC1-T-PZ Plus Controller

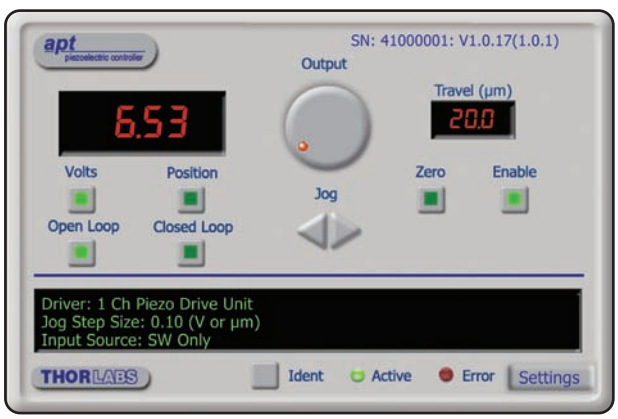
Benchtop Closed-Loop Piezo Controllers (Page 1 of 2)

BPC201

Features

- High-Resolution Position Control (for Very Fine Positioning)
- One-, Two-, and Three-Channel Models Available
- Front-Panel Controls
- High Power: 75 V, 500 mA Continuous
- Closed-Loop PID Position Via Strain Gauge Feedback Input
- Voltage Ramp/Waveform Generation Capability (for Scanning)
- High Bandwidth (10 kHz) Piezo Positioning (Open Loop)
- Auto-Configure Function for Thorlabs' Ident-Equipped Piezo Actuators
- Full Software Control Suite Supplied
- Extensive ActiveX® Programming Interfaces
- Software Integrated with Other apt™ Family Controllers
- Optional Handset Controller

The BPC apt™ high-power piezo controllers have been designed to drive the full range of open- and closed-loop piezo-equipped nanopositioning actuators and stages offered by Thorlabs. One-, two-, and three-channel models are available. Flexible software settings make these units highly configurable and therefore also suitable for driving a wide range of piezo elements in third-party products. A waveform generation capability combined with triggering outputs make this unit particularly well suited for piezo scanning applications.



See pages 580-582 for more information on the apt™ software included with the BPC Series Controllers.


PHS101

It is often convenient to make adjustments to the piezo output while closely watching the device being positioned, which can prove difficult when using the front panel keys or a remote PC.

To allow this kind of use, Thorlabs has developed the PHS101 handset, which enables the piezos to be positioned remotely from the controller and PC (i.e. without using the front panel buttons, GUI, or software method calls). It is supplied with a 9.75' (3 m) cable.

Modular High-Current Piezo Driver With Feedback

See Page 570

MPZ601

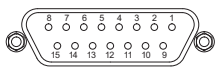
Benchtop Closed-Loop Piezo Controllers (Page 2 of 2)

BPC203

Controls are located on the front face of the unit to allow manual adjustment of the piezo position using the digitally encoded adjustment potentiometer. The display is easy to read and can be set to show either applied voltage or position in microns. Open or closed-loop control and zeroing of the voltage applied to the piezo can also be selected from the front panel.

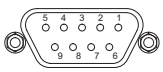
USB connectivity provides easy plug-and-play PC operation. Multiple units can be connected to a single PC via standard USB hub technology for multi-axis applications. Coupling this with the very user-friendly apt™ software allows it to quickly get running in a short time frame. For example, all relevant operating parameters are set automatically for Thorlabs' piezo actuator products. Advanced custom motion control applications and sequences are also possible using the extensive ActiveX® programming environment. The ActiveX® programming environment is described in more detail on pages 580-582.

User I/O Connector Pin Out



Pin	Description	Return
1	Digital O/P 1	5, 9, 10
2	Digital O/P 2	5, 9, 10
3	Digital O/P 3	5, 9, 10
4	Digital O/P 4	5, 9, 10
5	Digital Ground	
6	Digital I/P 1	5, 9, 10
7	Digital I/P 2	5, 9, 10
8	Digital I/P 2	5, 9, 10
9	Digital Ground	
10	Digital Ground	
11	For Future Use (Trigger Out)	5, 9, 10
12	For Future Use (Trigger IN)	5, 9, 10
13	Digital I/P 4	5, 9, 10
14	5 V Supply Output	5, 9, 10
15	5 V Supply Output	5, 9, 10

Strain Gauge Connector Pin Out



Pin	Description
1	Strain Gauge excitation
2	+15 V out*
3	-15 V out*
4	Ground
5	AC Feedback IN
6	Ground
7	Actuator ID signal**
8	Reserved for future use
9	Reserved for future use

Notes:
* Power supply for the piezo actuator feedback circuit. It must not be used to drive any other circuits or devices.
** This signal is applicable only to Thorlabs actuators. It enables the system to identify the piezo extension associated with the actuator.

Specifications (Per Channel)

- **Piezoelectric Output (SMC Male)**
  - **Voltage (Software Control):** 0 - 75 VDC
  - **Voltage (External Input):** ±10 VDC
  - **Current:** 500 mA Max Continuous
  - **Stability:** 100 ppm Over 24 Hours (After 30 min Warm-Up Time)
  - **Noise:** <3 mV RMS
  - **Typical Piezo Capacitance:** 1 - 10 µF
- **Bandwidth:** 10 kHz (1 µF Load, 1 V_{p-p})
- **Position Feedback (9-Pin D-Type Female)**
  - **Feedback Transducer Type:** Strain Gauge
  - **Detection Method:** AC Bridge (18 kHz Excitation)
  - **Typical Resolution:** 5 nm (For 20 µm Actuator; e.g., PAZ005)
  - **Auto-Configure:** Identification Resistance in Actuator
- **User Input/Output (15-Pin D-Type Female)**
  - **4 Digital Inputs:** TTL Levels
  - **4 Digital Outputs:** Open Collector
  - **Trigger Input/Output:** TTL
  - **Trigger Input Functionality:** Triggered Voltage Ramps/Waveforms
  - **Trigger Output Functionality:** Trigger Generation During Voltage Ramp Output
  - **User 5 V (with Ground):** 250 mA Max
- **USB Port:** Version 1.1
- **Power Input**
  - **Voltage:** 85 - 264 VAC
  - **Power:** BPC201: 100 W, BPC203: 200 W
  - **Fuse:** BPC201: 2 A, BPC203: 3 A
- **Housing Dimensions (W x D x H):**
  - **BPC201:** 6.0" x 9.6" x 4.1"(152 mm x 244 mm x 104 mm),
  - **BPC203:** 9.5" x 14.2" x 5.2" (240 mm x 360 mm x 133 mm)
- **Weight:**
  - **BPC201:** 7 lbs (3.18 kg)
  - **BPC203:** 14.75 lbs (6.7 kg)

ITEM#	$	£	€	RMB	DESCRIPTION
BPC201	$ 2,080.00	£ 1,442.00	€ 1.846,50	¥ 17,564.00	Single-Channel, Closed-Loop Piezo Controller/Driver
BPC203	$ 4,325.00	£ 2,998.00	€ 3.840,00	¥ 36,521.00	3-Channel, Benchtop Closed-Loop Piezo Controller/Driver
PHS101	$ 265.50	£ 184.10	€ 235,80	¥ 2,241.90	Remote Handset for BPC Series Benchtop Piezo Controllers

Modular Rack System Piezo Driver with Feedback

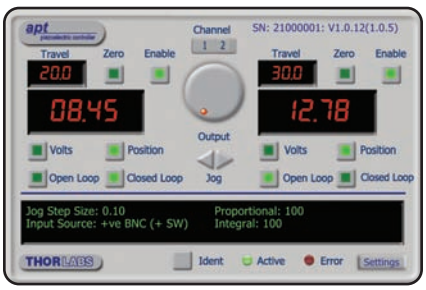
Features

- Two Piezo-Actuator Output Channels
- Open- and Closed-Loop Operation
- Strain Gauge Feedback Connections
- USB Plug-and-Play Connectivity
- User Controlled Digital I/O Port
- Full Software GUI Control Suite
- ActiveX® Graphical Panel Controls
- ActiveX® Programming Interfaces
- Seamless Software Integration with apt™ Family

MPZ601

Modular apt™ Piezoelectric Controller

This modular apt™ piezoelectric controller, compatible with the apt™ rack (page 408), incorporates the latest high-speed digital signal processing (DSP), low-noise analog electronics, and ActiveX® software technology to provide two low noise, fully software controlled, high-voltage (0-75 V) output channels. These modular controllers are designed for use in larger scale critical alignment applications where nanometer-level motion control is required. The modular apt™ piezo controller is supplied with a full suite of software support tools. An intuitive graphical instrument panel allows immediate control and visualization of the operation of the piezo controllers. See pages 580-582 for a full description of the apt™ system software, and the next page for details on the apt™ modular rack system that houses this module.



See pages 580-582 for more information on the included apt™ software.

Easily Configured Closed-Loop Operation

Module operation is fully configurable (parameterized) with key settings exposed through the associated graphical interface panel. Open-loop or closed-loop operating modes can be selected quickly. In both modes, the display can be changed to show drive voltage or position (in microns). In the closed-loop operation mode, both the P and I (proportional and integral) components of the feedback control loop can be altered to adjust the servo-loop response. Adjustment of all key parameters is possible through direct interaction with the graphical panel or through the ActiveX® programmable interfaces that are included with each instrument. This allows the user to build automated alignment routines in almost any programming language.

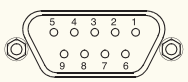
Software Developers Support CD

A developers' kit is shipped with all of our apt™ Series controllers. This additional software is intended for use by software developers working on large system integration projects that incorporate apt™ products. The kit contains an extensive selection of useful code samples as well as tutorial information.

Specifications

- **Piezoelectric Output:**
  - **Two Output Channels: SMC Male Connector**
    - **Voltage Output:** 0 - 75 VDC/Channel
    - **Voltage Stability:** 100 ppm Over 24 Hrs
    - **Noise:** <3 mV (RMS)
    - **Output Current:** 500 mA/Channel
  - **Differential Analog Inputs (BNC):** 0 - 10 VDC
  - **Position Feedback (9-Pin D-Type Connector)**
    - **Strain Gauge Feedback**
    - **Voltage Feedback:** 0 - 10 VDC
- **User Input/Output (26-Pin D-Type Connector):**
  - **Two Output Monitors:** 0 - 10 VDC
  - **Two Potentiometer Inputs:** 10-Turn Pots
  - **Trigger Input/Output:** TTL
  - **Digital I/O Lines:** Opto-Isolated
- **General:**
  - **One Slot apt™ Rack**
  - **Dimensions (W x D x H):** 7.5" x 10.6" x 1.97" (190 mm x 270 mm x 50 mm)
  - **Weight:** 3.3 lb (1.5 kg)

Displacement Sensor Input Connector Pin Out



Pin	Description	Return
1	Wheatstone bridge excitation	4 or 6
2	+15 V	4 or 6
3	-15 V	4 or 6
4	Equipment ground	
5	Feedback signal in	4 or 6
6	Equipment ground	
7	Actuator ID signal	4 or 6
8	RS485 NOT (0-5 V)	9
9	RS485 (0-5 V)	8

See pages 407-412 for more information on the apt™ rack enclosure.

ITEM#	$	£	€	RMB	DESCRIPTION
MPZ601	$ 2,180.00	£ 1,511.00	€ 1.935,50	¥ 18,408.00	apt™ 2-Channel Piezoelectric Drive Module with Feedback

apt™ Modular Rack System

The apt™ modular rack system is a sophisticated, self-contained, expandable, motion control platform for applications with a large number of channels. This new system deploys the same advanced high-speed, digital signal processing (DSP) technology and low-noise analog circuitry pioneered in the apt™ benchtop controllers. It also provides a highly functional 12-channel platform within the footprint of a 4U high, 19" wide enclosure. With a unified power supply and a single node USB communications interface, the apt™ rack system is easily incorporated into larger custom applications. Module functionallity is identical to the corresponding apt™ benchtop and T-Cube™ controllers, allowing a common software solution and learning curve for both benchtop and rack-based apt™ controllers. Multiple user development environments are supported (e.g., Visual Basic, LabVIEW™, HP VEE, C++, MATLAB, and .NET).

The rack system architecture, hardware, and software has been engineered to provide an efficient solution for complex, high-channel-count nanopositioning applications. Whether these applications are found in a modern high-volume optoelectronic component manufacturing facility or in a leading R&D facility, the MMR601 or MMR602 system is easy to implement and can be adapted to rapidly changing requirements.

The rack presents a clean, uncluttered front panel with six rear mounting bays for the plug-in modules. This arrangement greatly simplifies the cable management issues that arise as the number of channels expands.

Each module is equipped with an on-board digital signal processor (DSP), which allows processing power to be increased as modules (channels of operation) are added. This way, the system is able to maintain maximum operating efficiency, even when fully loaded.

Furthermore, additional racks can be added to the USB bus as required, thus allowing multiple, fully automated, 6-axis positioning stages to be combined into a single unified motion control system.

The PC-based software that drives the rack system operates from the same kernel of ActiveX® multi-threaded server code used to drive the stand-alone benchtop controllers and includes the same collection of high-level user applications. All of our ActiveX® software is rigorously engineered using modern object-oriented techniques, which ensures independence of programming environment and compatibility with a large number of third-party development tools. See pages 580-582 for more details on the apt™ software suite.

Features

- Supports up to 12-Channels of Operation in a Single Chassis
- Three Plug-In Modules:
  - Dual-Channel Piezoelectric Controller with 75 V of Low-Noise Output (see page 570)
  - Dual-Channel Stepper Motor Controller with Peak Power of 50 W per Channel (see page 560)
  - Dual-Channel NanoTrak™ Auto-Alignment System (see page 576)
- 6 Module Slots per Chassis, Access from Rear Panel
- Advanced ActiveX® PC Control Software Suite
- USB Plug-and-Play
- USB Interface Allows Multiple Systems to be Connected and Controlled via One PC

Specifications

- **Standard 19" Rack, 4U High**
- **Power Input:**
  - **Voltage:** 85 - 264 VAC
  - **Frequency:** 47 - 63 Hz
  - **Power:** 800 W
  - **Fuse:** 15 A
- **Dimensions (W x D x H):** 19.0" x 17.6" x 7.0" (480 mm x 448 mm x 183 mm)
- **Weight:** 35.2 lbs (16 kg)

ITEM#	$	£	€	RMB	DESCRIPTION
MMR601	$ 3,579.00	£ 2,481.00	€ 3.177,50	¥ 30,222.00	apt™ Modular Rack for 19" Instrument Chassis
MMR602	$ 3,705.00	£ 2,568.50	€ 3.289,50	¥ 31,286.00	Benchtop apt™ Modular Rack with Cover

T-Cube™ NanoTrak™ Auto-Alignment Controller (Page 1 of 2)

TNA001/VIS

The T-Cube™ NanoTrak™ Controller with USB computer interface represents the latest developments in automated optical alignment technology. It is designed for use in entry-level photonics devices and fiber alignment applications and is ideal for low-volume device assembly, characterization, and mapping.

This auto-alignment T-Cube™ unit is used together with a pair of external piezo amplifier channels (TPZ001 T-Cube™ Piezo Drivers, see page 562) to provide a complete solution for manipulating piezo-actuated nanopositioning stages. The complete system is capable of aligning the device position down to the 10 nm regime. Equipped with a direct FC/PC PIN photodiode input fed to a high-gain, multi-range, transimpedance amplifier, this unit uses the same advanced auto-alignment algorithms pioneered on our high-end, higher bandwidth, benchtop NanoTrak™ Controller (BNT001). For information on how the NanoTrak is used in auto-alignment applications, see the BNT001 on page 574. For an explanation of the NanoTrak™ theory of operation, please visit our website or see the tutorial on page 583.

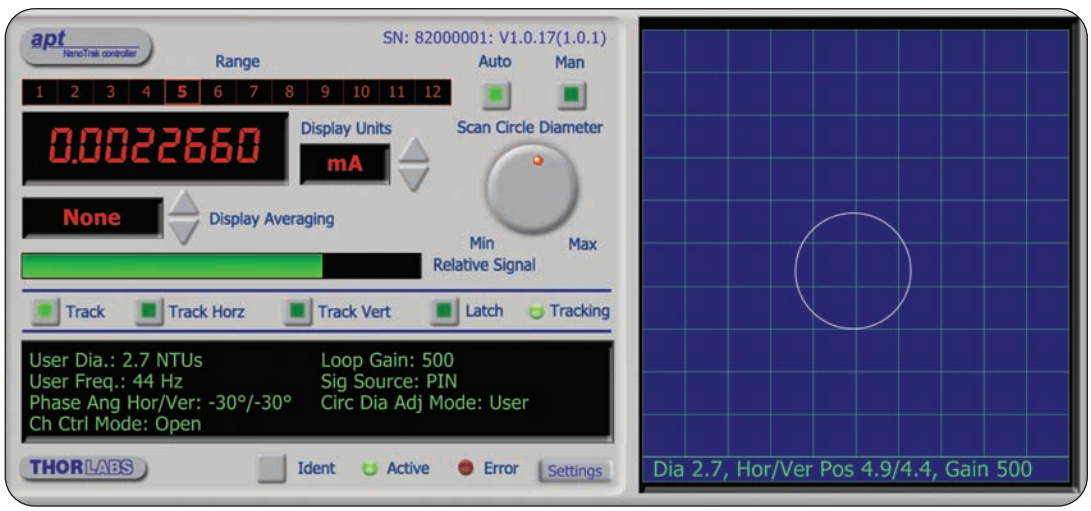
Features

- Compact Footprint
- Front Panel or PC Readout
- Active Fiber Alignment
- Maintain Optimum Power Throughput to Fiber
- InGaAs or Si Detectors and Pin Current Options
- USB Plug-and-Play Connectivity
- Full Software Control Suite Included
- Extensive ActiveX® Programming Interfaces

Operator interaction can be accomplished using either the manual control panel or via the intuitive apt™ software interface provided with the unit. This powerful controller in a miniature package can be mounted to an optical table directly with the included mounting plate so it is in close proximity to the device it controls. Tabletop operation also allows minimal drive cable lengths for easier cable management. All manual controls are located on the top face of the unit, making it convenient to adjust the piezo positions manually and to monitor the alignment via the easy-to-read target display.

Specifications

- **Optical Power Measurement:**
  - **PIN Photodiode:** 30 nA to 10 mA Photocurrent
  - **Si or InGaAs Detector:** FC/PC Fiber Input
  - **Signal Phase Compensation:** -180° to 180°
- **NanoTraking:**
  - **Circle Scanning Frequency:** 20 - 85 Hz
  - **Circle Diameter Makes Adjustment:** Automatic and Manual
- **Other Input/Output:**
  - **Feedback Signal In:** 0 - 10 V (SMA)
  - **Dual Piezo Position Demand Outputs:** 0 - 10 V (SMA)
  - **USB Port:** Version 1.1 Mini Connector
- **Input Power Requirements (DIN Connector):**
  - **Voltages:** 15 V (100 mA), -15 V (100 mA), or +5 V (400 mA)
- **Housing Dimensions (W x D x H):** 2.4" x 2.4" x 1.8" (60 mm x 60 mm x 47 mm)
- **Weight:** 5.5 oz (160 g)



Screenshot of the GUI that comes with the NanoTrak controller. Once in the tracking mode, the unit controls the piezo drivers, which adjust the stage's position in order to locate the position of maximum power.

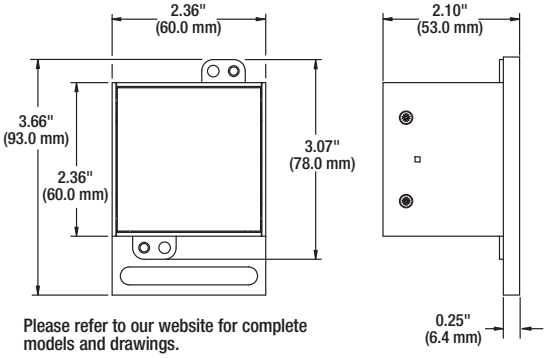
The diameter of the circle shown in the screen shot represents the amplitude of the fiber oscillation, while the center of the circle indicates the current horizontal and vertical position of the piezo actuators.

T-Cube™ NanoTrak™ Auto-Alignment Controller (Page 2 of 2)

Power Supply options

The TNA001 T-Cube™ requires a 5 V, 15 V, -15 V power supply. Thorlabs offers a compact, two-way power supply unit (TPS002), allowing up to two T-Cubes™ to be powered from a single main outlet.

Alternatively, the TCH002 USB Controller Hub (see page 546) provides power distribution for up to six T-Cubes. The Controller Hub contains a USB2.0 hub to provide communications for all six T-Cubes – a single USB connection to the Controller Hub is all that is required for PC control.



Please refer to our website for complete models and drawings.

apt™ NanoTrak™ Controller

For higher speed auto-alignment, please see our powerful benchtop NanoTrak™ unit. This controller combines an intelligent active feedback alignment control system and a two-channel, high-current piezoelectric controller into a single benchtop unit.

See Next Page

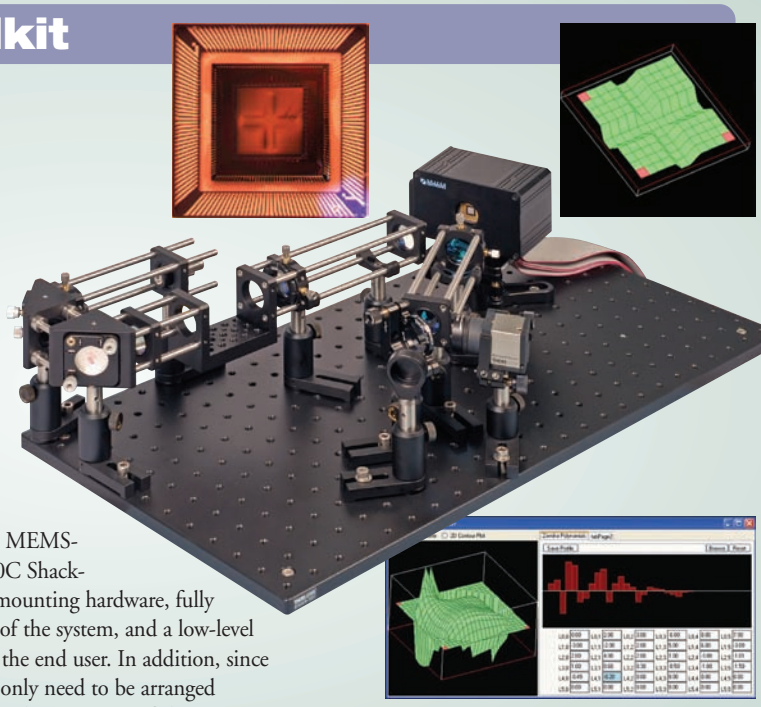
ITEM#	$	£	€	RMB	DESCRIPTION
TNA001/VIS*	$ 1,895.00	£ 1,313.50	€ 1.682,50	¥ 16,002.00	T-Cube™ NanoTrak™ Controller with Silicon Detector
TNA001/IR*	$ 1,895.00	£ 1,313.50	€ 1.682,50	¥ 16,002.00	T-Cube™ NanoTrak™ Controller with InGaAs Detector
NTA007	$ 295.00	£ 204.50	€ 262,00	¥ 2,491.00	InGaAs Detector for NanoTrak™
NTA009	$ 295.00	£ 204.50	€ 262,00	¥ 2,491.00	Silicon Detector for NanoTrak™
TPS002	$ 105.00	£ 72.80	€ 93,30	¥ 886.70	±15 V/5 V Power Supply Unit for up to 2 T-Cubes™
TCH002	$ 726.90	£ 504.00	€ 645,40	¥ 6,138.00	T-Cube™ Controller Hub and Power Supply Unit

*Power Supply not included

Adaptive Optics Toolkit

Features

- Out-of-the-Box Functionality for Real-Time, High-Precision Wavefront Control
- MEMS-Based DM Achieves High Spatial Resolution Due to High Actuator Count and Low Inter-Actuator Coupling
- Shack-Hartmann Wavefront Sensor with High Resolution CCD Camera and High-Quality Microlens Array
- Includes Light Source, Imaging Optics, and Associated Mounting Hardware



Thorlabs' new Adaptive Optics (AO) Toolkits remove the barrier for entry into adaptive optics, making this real-time wavefront-correcting technology accessible to researchers and OEM users alike. The kit includes Boston Micromachines Corporation's state of-the-art, 140-element, 3.5 micron stroke, MEMS-based deformable mirror. Also included is a Thorlabs' WFS150C Shack-Hartmann wavefront sensor, all necessary imaging optics and mounting hardware, fully functional stand-alone control software for immediate control of the system, and a low-level support library to assist with tailored applications authored by the end user. In addition, since the kit ships as three pre-aligned optomechanical sections that only need to be arranged on a user-supplied breadboard, our adaptive optics toolkits provide a near out-of-the-box solution for real-time wavefront compensation.

See Pages 1407-1411

Benchtop NanoTrak™ Controller (Page 1 of 2)

BNT001/IR

Features

- Tracking Feature Maintains Optimum Throughput Indefinitely
- Two Piezo-Actuator Output Channels Provide Closed-Loop Feedback
- InGaAS or Si Detector, or External Inputs (FC/PC for Optical and BNC for Voltage)
- USB Plug-and-Play Connectivity
- Full GUI Control Suite
- ActiveX® Graphical Panel Controls and Programming Interfaces
- Seamless Software Integration with Entire apt™ Family of Products

The benchtop NanoTrak™ auto-alignment controller combines an intelligent active feedback alignment control system and a two-channel piezoelectric controller into a single benchtop unit. As part of the apt™ series, this unit can be integrated with all of our apt™ controllers and drives. This system is a basic building block from which advanced alignment systems can be quickly configured. It can be fully integrated with our extensive selection of piezo-driven positioning systems (see page 471).

Although used primarily for aligning optical fibers and integrated optical devices, the NanoTrak™ is ideal for automating just about any labor-intensive alignment tasks such as waveguide characterization, fiber pigtailing of active and passive devices, as well as a multitude of other R&D applications.

Auto-Alignment

When combined with a positioning stage outfitted with at least two piezoelectric actuators, the NanoTrak™ auto-alignment system is designed to optimize the coupling through an optical assembly. Refer to the NanoTrak™ tutorial (page 583) for a more detailed explanation of the principle of operation of this unit.

In a typical, automated-alignment setup, it is common to align for initial first-light detection using motor control before allowing the NanoTrak™ to take over and achieve optimal alignment via piezo actuation. Many of our piezo-actuated stages can also be motorized to support this initial first alignment step (see our NanoMax™ stages starting on page 471).

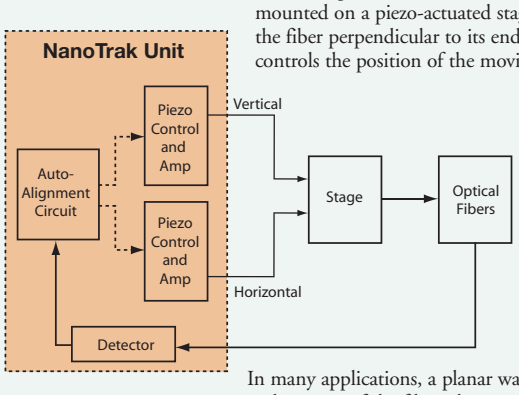
Once first-light detection is accomplished, the NanoTrak™ system begins its alignment process using advanced phase-sensitive detection and digital filtering techniques to generate correction voltages, which are then directly applied to the piezoelectric actuators in the stage.

Highly Adaptable Operation

There are an infinite variety of device alignment scenarios, each with potentially different optical and physical characteristics: half widths, coupled peak powers, misalignment sensitivity, and mechanical phase lags. Given the range of applications, it is important that NanoTrak™ be easily configured for a specific task.

To achieve this adaptability, NanoTrak's operation is fully configurable with many of the parameters of the system accessible through easy-to-use graphical software panels.

For example, when operating in tracking mode, the system applies a small sinusoidal dither to the piezoelectric actuators as part of the alignment process. To accommodate the specific optical characteristics of the elements in the system, the dithering amplitude and frequency can be adjusted via the Circle Diameter and Circle Frequency settings, respectively. Additionally, to deal with a potentially wide range of optical signal levels and sensitivities, the overall closed-loop gain can be adjusted via the Gain parameter.



Block Diagram: With one fiber fixed and the other mounted on a piezo-actuated stage capable of moving the fiber perpendicular to its endface, the NanoTrak™ controls the position of the moving fiber.

The NanoTrak's auto-alignment circuit controls the position of the fiber as it optimizes the efficiency of the butt-coupling.

In many applications, a planar waveguide or other device replaces one of the fibers; however, the basic principles remain the same.

Benchtop NanoTrak™ Controller (Page 2 of 2)

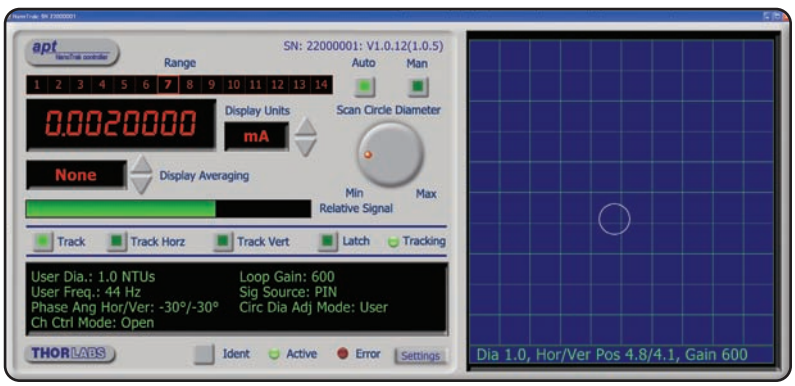
A few other important parameters are also worth covering in this brief summary of the NanoTrak™ system. The electromechanical phase lags associated with any moving device under piezoelectric control can be compensated by using phase correction parameters.
A wide range of feedback signal (coupled power) noise levels can be accommodated by altering the input amplifier gain and filtering parameters. There are many more settings and adjustments that can be made to fully optimize operation of the unit.

All such settings and parameters are also accessible through the ActiveX® programmable interfaces for automated alignment sequences. See pages 580-582 for a full description of the apt™ system software.

Specifications

- **Optical Power Measurement**
  - **PIN Photodiode:** 1 nA to 10 mA Photocurrent
  - **Si or InGaAs Detector:** FC/PC Fiber Input
  - **Optical Power Monitor (BNC):** Multiple Ranges
  - **Signal Phase Compensation:** -180° to 180°
- **NanoTraking**
  - **Circle Scanning Frequency:** 1 - 300 Hz
  - **Circle Diameter Adjustment Modes:** Automatic and Manual
- **Piezoelectric Input/Output**
  - **Two Output Connectors (SMC Male):**
    - **Voltage Output:** 0 - 75 VDC/Channel
    - **Voltage Stability:** 100 ppm Over 24 Hours
    - **Noise:** <3 mV RMS
    - **Output Current:** 500 mA/Channel
  - **Output Monitors (BNC):** 0 - 10 VDC
  - **Analog Inputs (BNC):** 0 - 10 VDC (Used in Piezo Amp Mode)
  - **Strain Gauge Position Feedback:** (Two 9-Pin, Female D-Type)
- **Other Input/Output**
  - **Optical Power Monitor (BNC):** 0 - 10 VDC
  - **User Control (37-Pin, D-Type)**
    – Isolated Digital I/O
  - **Trigger In/Out (BNC):** 0 - 10 VDC
  - **USB Port**
- **Power Requirements**
  - **Voltage:** 85 - 64 VAC
  - **Frequency:** 47 - 63 Hz
  - **Power:** 200 W
  - **Fuse:** 3 A
- **General**
  - **Dimensions (W x D x H):** Standard 9.67" x 13.0" x 5.1"

The apt™ NanoTrak™ controller is supplied with a full suite of software support tools. Once the software and associated USB drivers are installed, the aptUser utility provides a full-featured, intuitive graphical instrument panel, allowing full control and visualization of the NanoTrak™ operation. Additionally, ActiveX® components are included to speed user developed routines in the users programming environment of choice (e.g., LabVIEW™, Visual Basic, or C++).



ITEM#	$	£	€	RMB	DESCRIPTION
BNT001/IR	$ 6,760.00	£ 4,687.00	€ 6.002,00	¥ 57,082.00	apt™ NanoTrak™ Controller with InGaAs Detector
BNT001/VIS	$ 6,760.00	£ 4,687.00	€ 6.002,00	¥ 57,082.00	apt™ NanoTrak™ Controller with Silicon Detector
NTA007	$ 295.00	£ 204.50	€ 262,00	¥ 2,491.00	InGaAs Detector for NanoTrak™
NTA009	$ 295.00	£ 204.50	€ 262,00	¥ 2,491.00	Silicon Detector NanoTrak™

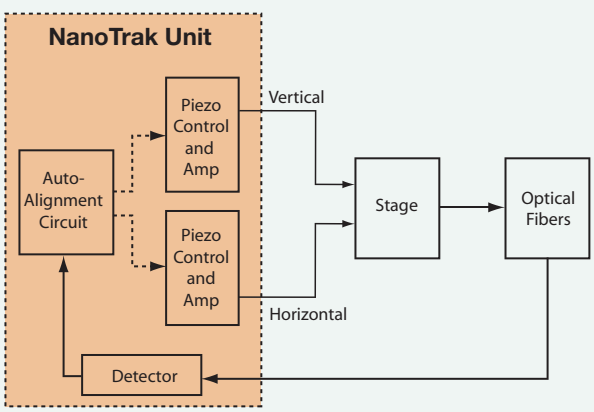
Modular Rack System NanoTrak™ Auto-Alignment Module (Page 1 of 2)

MNA601

The modular NanoTrak™ auto-alignment controller combines an intelligent active-feedback alignment control system and a two-channel piezoelectric controller into a single plug-in unit. As part of the apt™ series, this auto-alignment unit represents the latest developments in automated optical alignment technologies. This system is a basic building block from which advanced alignment systems can be quickly configured. It can be fully integrated into a rack mainframe system along with other plug-in modules (e.g., piezoelectric controllers (page 570), stepper motor controllers (page 560), and this NanoTrak™ auto-alignment module). Although used primarily for aligning optical fibers and integrated optical devices, the NanoTrak™ is ideal for automating just about any labor-intensive alignment tasks.

Features

- Tracking Feature Maintains Optimum Throughput Indefinitely
- Advanced Dark Search Algorithms for First-Light Detection with Motorized Fiber Launch
- Two Piezo Actuator Output Channels Provide Closed-Loop Feedback
- InGaAS or Si Detector or External Inputs (FC/PC for Optical and BNC Voltage for External Input)
- USB Plug-and-Play Connectivity
- Full GUI Control Suite
- ActiveX® Graphical Panel Controls and Programming Interfaces
- Seamless Software Integration with Entire apt™ Family of Products (Electronics and Mechanics)



With one fiber fixed and the other mounted on a piezo-actuated stage capable of moving the fiber perpendicular to its endface, the NanoTrak™ controls the position of the moving fiber. The NanoTrak's auto-alignment circuit controls the fiber's position as it optimizes the coupling efficiency through the two fibers. In many applications, a planar waveguide or other device replaces one of the fibers; however, the basic principles remain the same.

The modular NanoTrak™ plug-in is identical in functionality and associated user software to the benchtop NanoTrak™ system presented on page 568. The principles of operation are covered in detail in the NanoTrak™ tutorial (see page 583).

Auto-Alignment

When combined with a positioning stage that has at least two piezoelectric actuators, the NanoTrak™ auto-alignment system is designed to optimize the coupling through an optical assembly. The NanoTrak™ module is compatible with a wide range of Thorlabs' piezo-actuated stages and assemblies (see our NanoMax™ stages on pages 471 and 482, respectively).

In a typical automated alignment setup, it is common to align for initial first-light detection using motor control and then allow the NanoTrak™ to take over and achieve optimal alignment via piezo actuation. Many of Thorlabs' piezo-actuated stages can also be motorized to support this initial alignment step (see our NanoMax™ stages on pages 471-472); two-channel motor control modules (page 570) are available for use in the same rack mainframe as the NanoTrak™ module.

Once first-light detection is accomplished, the NanoTrak™ system begins its alignment process using advanced phase-sensitive detection and digital-filtering techniques to generate correction voltages. They are then directly applied to the piezoelectric actuators in order to achieve optimal alignment performance.

Modular Rack System NanoTrak™ Auto-Alignment Module (Page 2 of 2)

Highly Adaptable Operation

There are an infinite variety of alignment scenarios, each with potentially different optical and physical characteristics such as half widths, coupled peak powers, misalignment power response, and mechanical phase lags.

To deal with this range of applications, the NanoTrak's operation is fully configurable with many of the parameters of the system accessible through easy-to-use graphical software panels. For example, when operating in Tracking Mode, the system applies a small sinusoidal dither to the piezoelectric actuators as part of the alignment process (see the NanoTrak™ tutorial on page 583). To accommodate the specific optical characteristics of the elements in the system, the dithering amplitude and frequency can be adjusted via the Circle Diameter and Circle Frequency settings, respectively. Additionally, to deal with a potentially wide range of optical signal levels and sensitivities, the overall closed-loop gain can be adjusted via a gain parameter.

All such settings and parameters are also accessible through the ActiveX® programmable interfaces for automated alignment sequences. See pages 580-582 for a full description of the apt™ system software.

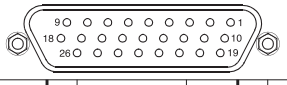
Extensive Software Support Tools

The apt™ software library contains a number of optional features, with many different graphical user interfaces, operational parameters, and programming functions. To assist in using the software, comprehensive, fully context-sensitive online help is provided.

Specifications

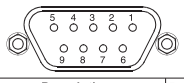
- **Optical Power Measurement:**
  - **PIN Photodiode:** 1 nA to 10 mA Photocurrent
  - **Si or InGaAs Detector:** FC/PC Fiber Input
  - **Ext. Power Meter Input (BNC):** Multiple Ranges
  - **Signal Phase Compensation:** -180° to 180°
- **NanoTraking:**
  - **Circle Scanning Frequency:** 1 - 300 Hz
  - **Circle Diameter Adjustment Modes:** Automatic and Manual
- **Piezoelectric Input/Output:**
  - **Two Output Connectors (SMC male):**
    - **Voltage Output:** 0 - 75 VDC per Channel
    - **Voltage Stability:** 100 ppm over 24 Hours
    - **Noise:** <3 mV RMS
    - **Output Current:** 500 mA/Channel
  - **Two Output Monitors (BNC):** 0 - 10 VDC
  - **Position Feedback (9-Pin, D-Type Female):**
    - **Strain Gauge Feedback**
    - **Voltage Feedback:** 0 - 10 VDC
- **User I/O Port (26-Pin D-Type Female):**
  - **Optical Power Monitors:** 0 - 10 VDC
  - **Two Differential Analog Inputs:** 0 - 10 VDC
  - **Trigger Input/Output:** TTL
  - **Digital I/O Lines:** Opto-Isolated
- **General:**
  - **One Slot apt™ Rack**
  - **Dimensions (W x D x H):** 7.5" x 10.6" x 2.0" (190 mm x 270 mm x 50 mm)
  - **Weight:** 3.3 lbs (1.5 kg)

User I/O



Pin	Description	Return	Pin	Description	Return	Pin	Description	Return
1	DIG IP 1	19	10	DIG OP 1	19	19	Isolated Dig Ground	
2	DIG IP 2	19	11	DIG OP 2	19			
3	DIG IP 3	19	12	DIG OP 3	19	20	Ext Trigger I/P	22
4	DIG IP 4	19	13	DIG OP 4	19	21	Ext Trigger O/P	22
5	Channel 1 RS485		14	Channel 2 RS485		22	Ground	
6	Channel 1 RS485 NOT		15	Channel 2 RS485 NOT		23	5 V User O/P (Isolated)	
7	Not Used		16	Not Used		24	Not Used	
8	Ext input (+) Channel 2	25	17	Analog I/P	25	25	Ground	
						26	TIA Sig O/P	25
9	Ext input (+) Channel 1	25	18	Analog I/P	25			

Piezo In



Pin	Description	Return
1	Wheatstone bridge excitation	4 or 6
2	+15 V	4 or 6
3	-15 V	4 or 6
4	Equipment ground	
5	Feedback signal in	4 or 6
6	Equipment ground	
7	Actuator ID signal	4 or 6
8	RS485 NOT (0-5 V)	9
9	RS485 (0-5 V)	8

ITEM#	$	£	€	RMB	DESCRIPTION
MNA601/IR	$ 5,620.00	£ 3,896.00	€ 4,990,00	¥ 47,456.00	apt™ NanoTrak™ Controller Module with InGaAs Detector
MNA601/VIS	$ 5,620.00	£ 3,896.00	€ 4,990,00	¥ 47,456.00	apt™ NanoTrak™ Controller Module with Silicon Detector
NTA007	$ 295.00	£ 204.50	€ 262,00	¥ 2,491.00	InGaAs Detector for NanoTrak™
NTA009	$ 295.00	£ 204.50	€ 262,00	¥ 2,491.00	Silicon Detector NanoTrak™

High-Density, Rack-Based Motion Controllers

Modular versions of the apt™ stepper motor and piezo controllers are also available for use with the apt™ rack system. The module versions are functionally identical to the benchtop units but provide a more compact implementation for multi-channel applications such as fully automated control of our range of three-to-six axis stages.

See Pages 560 and 570

T-Cube™ Solenoid/Shutter Controller (Page 1 of 2)

TSC001

Features

- Compact Footprint
- Full apt™ Software Control Suite Included
- Automatic, Single, Manual, and Triggered Operating Modes
- Operates Thorlabs' Solenoid-Actuated SH05 Shutter
- Manual- or PC-Controlled Operation via USB
- Input/Output Triggering (Daisy Chaining)
- Safety Enabled Key Switch
- Laser Safety Interlock Jack
- Extensive ActiveX® Programming Interfaces
- Software Compatible with Other apt™ Controllers

Specifications

- **Timing Resolution:** 250 µs
- **On/Off Times:** 100 ms to 10 s
- **Maximum Repetition Rate:** up to 10 Hz
- **Trigger In/Out (SMA Connected):** TTL
- **Output Enable:** Key Switch and Interlock Jack Plug
- **Operating Modes:**
  - Manual: User-Controlled On/Off
  - Single: DSP-Controlled Single On/Off Cycle
  - Auto: DSP-Controlled Multiple On/Off Cycles
  - Triggered: Externally Triggered On/Off
- **Output (6-Way Hirose Connectors):**
  - Solenoid Drive: 15 V Pulse (10 V Hold)
  - Position Sensor Feedback: Photodiode
- **Input Power Requirements:**
  - Voltage: 15 V Regulated DC
  - Current: 1 A Peak, 300 mA Steady State
- **Housing Dimensions (W x D x H):** 2.37" x 2.37" x 1.87" (60.3 mm x 60.3 mm x 47.5 mm)
- **Weight:** 5.5 oz (160 g)

The T-Cube™ Solenoid Controller (TSC001) is a compact, single-channel controller that provides easy manual and automated control of solenoid-operated shutters, flipper mounts, and other similar devices. Designed to operate 15 V solenoid-actuated devices, this miniature controller offers a complete set of control features via an embedded DSP processor, which provides a multitude of flexible operating modes. Embedded software functionality allows this unit to be used to control solenoid devices manually (using panel buttons), automatically with DSP-timed operation, or with external trigger signals for operation with third-party equipment. A trigger out connection allows multiple T-Cube™ controllers to be connected together for multichannel synchronized operation.

The TSC001 may be used as a stand-alone device or combined with the T-Cube™ Controller Hub (TCH002) for applications utilizing multiple T-Cubes. The manual controls for this unit are conveniently located on the upper surface. The mode button switches the unit between the various operating modes, while the enable button is used to initiate manual or automatic operation of the solenoid controller output. There is also a safety key switch and interlock plug fitted to this compact unit for use in laser safety applications. USB connectivity provides easy plug-and-play, PC-controlled operation.

Coupling the controller with the very user-friendly apt™ software (supplied) allows the user to get set up quickly. Advanced custom control sequences are also possible using the extensive ActiveX® programming environment.

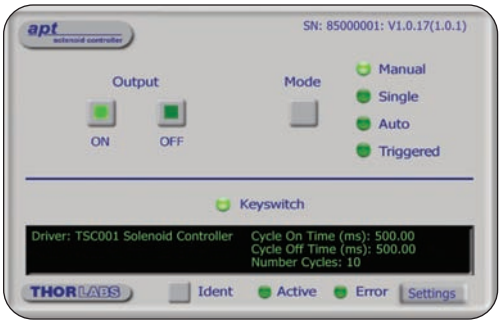
For multi-channel applications, the TCH002 USB Controller Hub contains a fully compliant USB2.0 hub circuit, providing power and communications for up to six T-Cubes – a single USB connection to the Controller Hub is all that is required for PC control. See page 546 for more details.

TSC001

T-Cube™ Solenoid/Shutter Controller (Page 2 of 2)

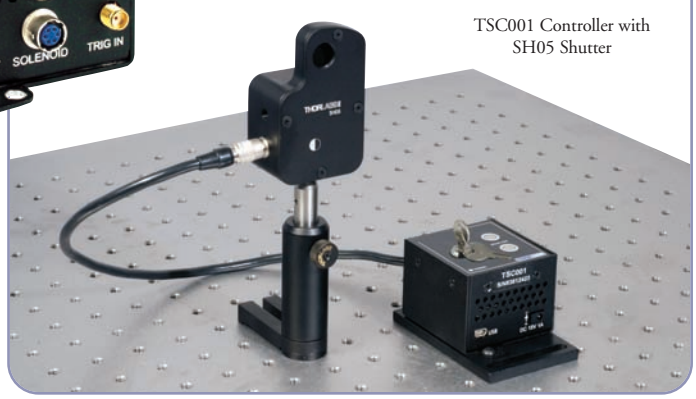
TSC001 Solenoid Controller Applications

The TSC001 Solenoid Controller has been designed to also control third-party, solenoid-operated devices with a maximum voltage of 15 V and a maximum current of 1 A. Thorlabs offers a solenoid-operated beam shutter (SH05, see page 316) and a motorized filter wheel with shutter (FWSH102, see page 317) that are compatible with the TSC001 Solenoid Controller.

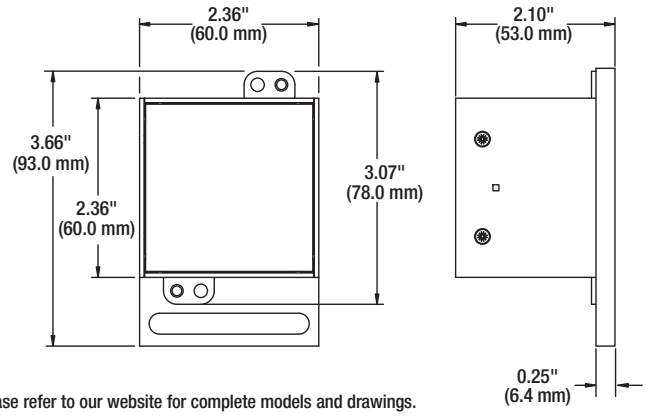


Power Supply Options

Operation	Recommended Power Supply
Stand-Alone or Single-Channel Operation	TPS001 or TPS008
System or Multichannel Operation	TCH002



TSC001 Controller with SH05 Shutter



Please refer to our website for complete models and drawings.

T-Cube™ Controller Hub TCH002

See Page 546

ITEM#	$	£	€	RMB	DESCRIPTION
TSC001	$ 545.00	£ 377.90	€ 483,90	¥ 4,602.00	T-Cube™ Flipper/Shutter Controller
SH05	$ 433.50	£ 300.60	€ 384,90	¥ 3,660.50	Beam Shutter with Ø1/2" Aperture
TPS001	$ 25.00	£ 17.40	€ 22,20	¥ 211.20	15 V Power Supply Unit for a Single T-Cube
TPS008	$ 175.00	£ 121.40	€ 155,40	¥ 1,477.80	15 V Power Supply Unit for up to 8 T-Cubes
TCH002	$ 726.90	£ 504.00	€ 645,40	¥ 6,138.00	T-Cube™ Controller Hub and Power Supply Unit

apt™ Control Software Overview (Page 1 of 3)

Constructing automated photonics or custom-alignment and positioning solutions in a speedy and efficient manner is becoming increasingly important in today's competitive environment. Timescales are often short; yet the nature of the solutions, particularly at the software level, are becoming more complex and demanding. We have worked very closely with a large number of system engineers and research specialists in order to gain a detailed understanding of the specific requirements for sophisticated, yet easy-to-use electronics and software controller products.

Out-of-the-Box Operation

When faced with an automated integration project, the system engineer or researcher will often face a steep learning curve, and when the end requirement involves programming automative alignment sequences, learning how to operate the equipment manually is an important first step. Every apt™ controller can be manually operated using the supplied APTUser utility. This utility gives access to all settings, parameters, and operating modes. With this, most automated sequences can be first tested and verified without writing a single line of custom software by first using APTUser.

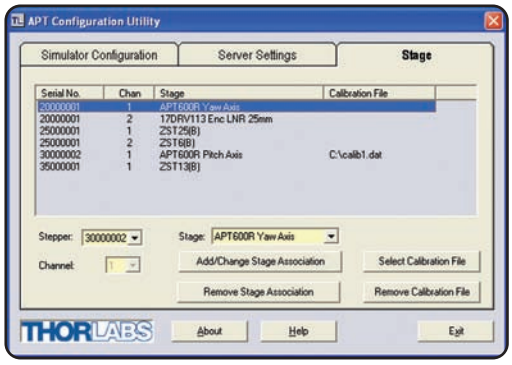
Time-Saving Pre-Configuration

In order to further reduce the time required to configure our range of apt™ controllers, an offline pre-configuration utility, APTConfig, is supplied with all units.

As an example, this utility can be used to associate Thorlabs' stages and actuators with individual motor drive channels, thus allowing the system to automatically set a large number of system parameter defaults. This offline configuration eliminates the need to write the large amounts of initialization code often required when using other control systems, greatly reducing the time taken when developing custom applications. Many other preconfigured settings can be made by using the APTConfig utility.

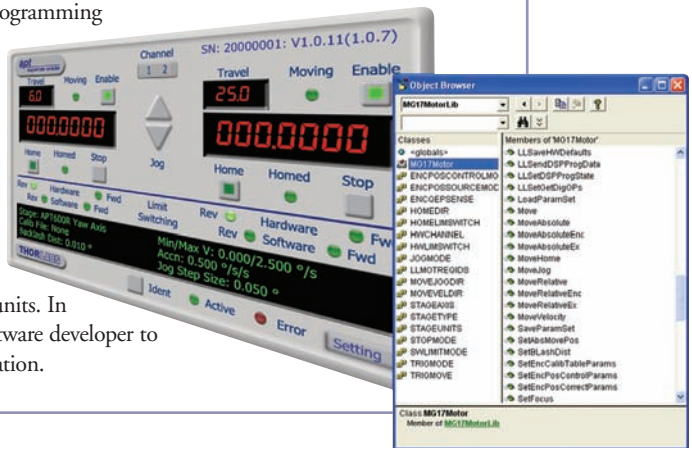
apt™ Server – The Engine for Integration Software Solutions

The apt™ Server lies at the heart of the apt™ system. This software engine sits underneath the operation of both APTUser and APTConfig and makes the functionality of both utilities easily accessible. The apt™ Server actually comprises a collection of cooperating ActiveX® Controls (see aside) and associated support libraries that provide a tool kit of graphical instrument panels and associated programming interfaces. It is this set of ActiveX® Controls that allow apt™ functionality to be incorporated quickly and easily into custom applications.



Full Version Available in the Download Section at www.thorlabs.com

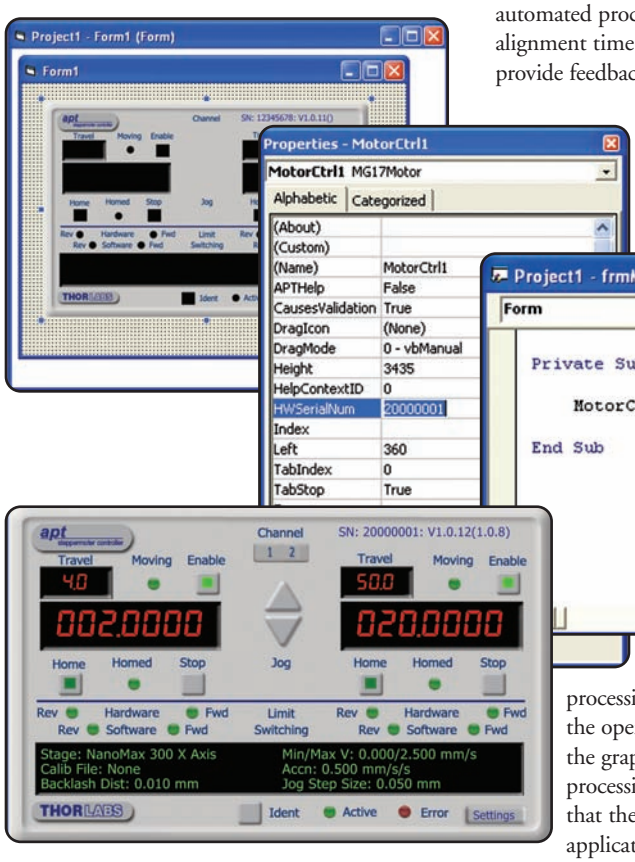
ActiveX® Controls allow apt™ motion control and alignment functionality to be incorporated quickly and easily into custom applications. ActiveX® Controls are pre-compiled software functional blocks (or components) that typically include both a graphical user interface (GUI) and programming (software function) interface. There are many such ActiveX® Controls available to the Windows software developer, providing an enormous range of pre-compiled functionality for use in their own custom (or client) applications. The ActiveX® Controls supplied with the apt™ system provide all of the GUI and programmability required to operate and control the full range of apt™ controllers (T-Cube, benchtop, and rack-based variants). For example, the Motor ActiveX® Control provides a complete instrument panel allowing for full manual control of our stepper motor driver units. In addition, the associated programming interface allows the software developer to automate the operation of the motor in an integration application.



apt™ Control Software Overview (Page 2 of 3)

Multiple Development Environment Support – Your Choice

Language compatibility is one of the first questions often posed by a system developer. Anticipating that our customers will want to use a wide variety of software development languages and tools when architecting their solutions, we have engineered the apt™ Server to be ActiveX® compliant. ActiveX® is a language independent interfacing technology supported by a large number of Windows-based software development environments. Using our apt™ controllers, it is possible to create custom alignment applications with environments such as LabVIEW™, Visual Basic, Visual C++, Borland C++, HP VEE, Matlab, and even Microsoft Office via VBA (Visual Basic for Applications). Certain .NET environments (e.g. VB.NET, C#.NET) will also support ActiveX® through Microsoft interop technology.



Rapid Application Development – Drag and Drop

One of the key benefits using the apt™ ActiveX® Controls is the speed with which the associated apt™ functionality can be incorporated into a custom alignment application.

Taking Visual Basic as an example, a fully functional apt™ motor control instrument panel can be incorporated into an end application literally within a minute with a single drag-and-drop operation, a single serial number setting, and a single line of code. Unlike many other motion control software libraries available, the apt™ system provides complete prewritten GUIs for use in custom applications. Consequently, a large amount of development time is saved by eliminating the need to write code to provide essential end user interface capability. These instrument panels can also be used during software development or when commissioning and configuring the system to alter essential settings. In the finished application, it is also very easy to hide these full parameter access graphical panels from the end user in order to prevent inadvertent changes to parameters.

Comprehensive Programming Interfaces

We recognize that it is crucially important that the apt™ Server makes available all required parameters and operating modes through its programming interfaces.

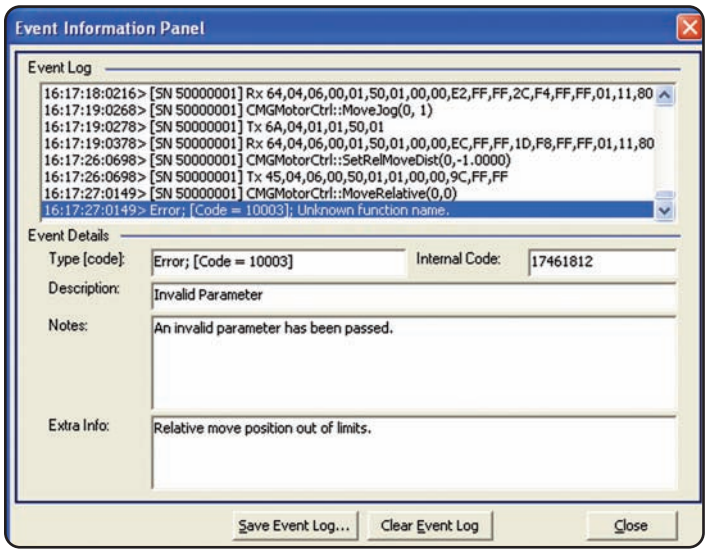
We have taken every available system setting and command and exposed them to support the vast range of integrated software applications that can be built around the apt™ system. Hundreds of software commands and settings exist to ensure full flexibility and adaptability when automating the operation of our controllers.

Multithreading

When developing custom applications on a PC, it is important to ensure that the automated process itself can execute without disruption (to maintain required alignment time for example). Additionally, a well-written client application will also provide feedback to the user via its GUI and allow operator intervention at any time should an error condition or other event occur. In many cases, a motion control application will also be required to interact with other system hardware such as device characterization and acquisition systems, laser sources, robotic units, and environment control units. The system engineer is faced with supporting all of the above within a single application while also overcoming the consequent issues of software latency from the end user's perspective (e.g. due to polling of equipment).

To address these fundamental application issues, we have built multithreading and event triggering capability into the apt™ Server. Multithreading is deployed to isolate operation of the apt™ hardware completely from that of the end application. In this way, an end client application can engage in intensive processing (such as data acquisition or number crunching) without affecting the operation of the apt™ controllers. Additionally, we have ensured that the graphical instrument panels are themselves executed in a separate processing thread. This unique approach taken in the apt™ Server ensures that the graphical panels remain fully responsive even when the end application is busy on some intensive processing activity. Always being able to access apt™ controller settings via their GUI panels is extremely useful when trying to optimize software routines, even if an automated sequence is running. Event triggering is the software mechanism by which an apt™ ActiveX® Control can inform the client application of some event or occurrence. In the apt™ system, this mechanism is effectively used to end motor movement and other lengthy operations. By responding to these events, a custom end application does not need to sit and poll for lengthy operations, which improves the overall system performance.

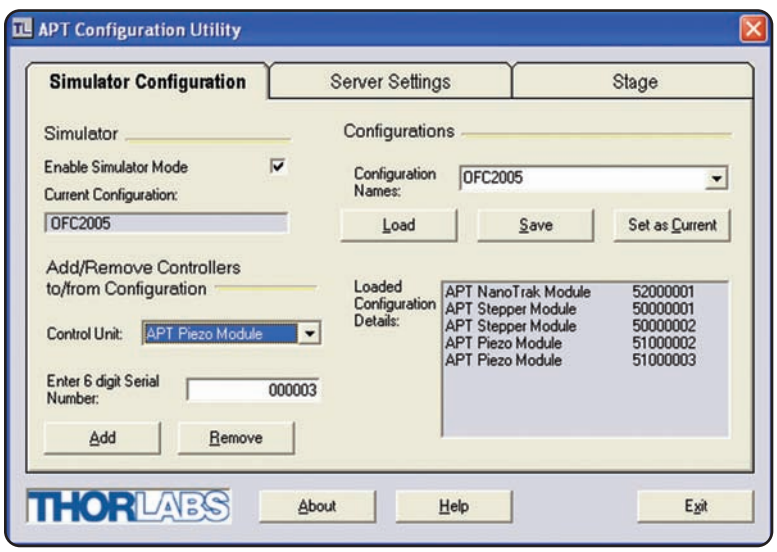
apt™ Control Software Overview (Page 3 of 3)



apt™ Hardware Emulator – Offline Application Development

For total convenience, the apt™ Server can be placed into a full hardware emulation mode (using the APTConfig utility), giving the freedom to run the software without connecting actual physical units.

This emulation support is useful for many reasons, including learning how to use and program the apt™ software without necessarily tying up real apt™ hardware, which is useful if multiple person teams are working on the same integration project.



It also gives the option of developing custom applications off-line if, for example, the apt™ hardware is unavailable or already being used. Moreover, after an apt™-based custom application has been developed and released, the actual physical apt™ hardware may no longer be accessible for software support and maintenance purposes, and so a simulator mode proves invaluable.

Debugging – apt™ System Logger

Software development, particularly of complex alignment and positioning systems, is a process that inevitably involves debugging and process optimization. Often errors that occur during actual execution of the associated software (e.g. incorrectly calculated position parameter passed to the apt™ Server) are difficult to analyze after the event (and may not even occur when interactively debugging because of the difference in execution dynamics). To solve this issue, the apt™ software has a built-in system-wide event logging capability that records all function calls (and associated parameters). This chronological record of client application activity is invaluable in monitoring the sequence of events that lead up to a process failure, thereby helping the software developer to find and debug problems.

Developer Support CD

It is inevitable, even for relatively simple applications, that software programming support will be needed. Having recognized this and the wide range of software end applications that can be built around the apt™ system, we have brought together a comprehensive collection of programmer information and reference material and made it available on CD. A full set of sample applications written in Visual Basic and LabVIEW™ is included, together with various hints and tips. The programming samples themselves cover a varying degree of complexity, from basic to advanced examples. The advanced examples are working programs that can be used with the apt™ motion controllers and Thorlabs' positioning stages and actuators to perform optical alignments of real world multi-axis photonics. They form an excellent starting point for the system development and in many cases will provide the functionality required with only minor coding enhancements/changes.

Try the apt™ Software for Yourself

In the end, the best way to appreciate the power and flexibility of the apt™ system software is to try it yourself. You can obtain the latest version of the apt™ software from the download section of the Thorlabs' website. After installation, it is possible to create a simulated configuration of apt™ controllers and then go on to explore all of the software commands and features described above, as well as experiment with writing custom motion control applications.

It is also useful to view the tutorial videos included. These cover all aspects of using the software, from overviews of the supplied user utilities to programming basics in Visual Basic, LabVIEW, and C++ environments.

NanoTrak™ Auto-Alignment Tutorial (Page 1 of 3)

Introduction
Active-feedback optical alignment systems are ideal for use with fiber optics and integrated optical systems. One such device, the Thorlabs NanoTrak™ (see page 481), can automatically align fibers to devices such as waveguides in less than one second. It can dramatically simplify characterization and pigtailing procedures and can ensure drift-free positioning and accurate data acquisition.

The NanoTrak™ can be used with any of the Thorlabs nanopositioners that incorporate piezoelectric actuators attached to two orthogonal translational axes, but it is particularly recommended for use with the NanoMax™ series of stages (see page 470).

How the NanoTrak™ Works
The NanoTrak™ performs three functions: searching, aligning, and maintaining optical coupling.

Searching
The gradient search algorithm allows the NanoTrak™ to operate similar to a compass finding the North Pole, pointing in the direction of peak power. The sensitivity of the search is such that even with small power gradients (far away from the peak power) the NanoTrak™ will decide in which direction the peak power is located. This information can then be used to make large movements in the correct direction without having to map or search a large area.

Aligning
In the proximity of the peak power, the gradient of the optical profile is much smaller, indicating that smaller corrective or compensating movement is required to align the components. NanoTrak™ automatically adjusts the magnitude of the movements. With the components aligned at the peak power position, the gradient changes to zero, indicating that optimum coupling is achieved.

Maintaining
The dynamic behavior of the NanoTrak™ allows it to continue the alignment process indefinitely. Should the components change position, the gradient search detects the change and makes a corrective move.

NanoTrak™ Operation Details Overview:
Optical power transmission through any system under alignment can be plotted as a function of any two axial positions of the moving component and shown as a series of concentric circles. These concentric circles represent the power contours and can be thought of as the contours of a hill on a map (see Figure 1). The NanoTrak™ must guide the component (e.g. fiber) to the summit.

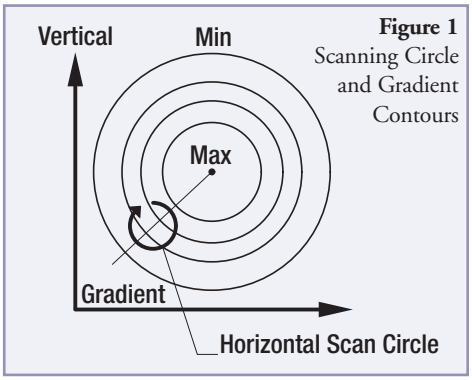


Figure 1
Scanning Circle and Gradient Contours

By detecting the gradient of the power at any given position, the NanoTrak™ can adjust that position until the power is maximized and the gradient becomes zero. This is achieved by scanning over the contours in a circular path to establish the position of the maximum signal on the circular trajectory. The origin of the scan circle is then moved in the direction of the maximum signal.

BNT001

Mechanical Drawings Available on the WEB

Patent 6,467,762

MAX605

NanoTrak™ Auto-Alignment System Tutorial (Page 2 of 3)

The basic building blocks of the system are shown in the block diagram below (illustrating specifically fiber to fiber alignment):

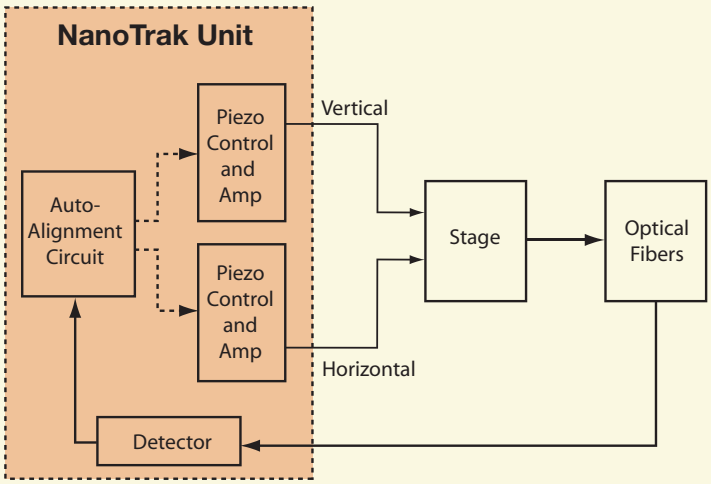


Figure 2

NanoTrak™ System Schematic Diagram

With one fiber fixed and the other mounted on a piezo actuated stage capable of moving the fiber perpendicular to its end face, the NanoTrak™ controls the position of the moving fiber. The NanoTrak's auto-alignment circuit controls the position of the fiber as it optimizes the efficiency of the coupling through the two fibers.

In many applications, a planar waveguide or other device replaces one of the fibers, however the basic principles remain the same.

The system is comprised of a PIN photodiode and transimpedance amplifier (detector block), an adjustable proportional and integral servo control loop (auto-alignment block), and a dual channel HV amplifier output circuit for driving two piezo actuators connected to a positioning stage (piezo amp block). The NanoTrak™ control loop maximizes the feedback signal by adjusting the HV amplifier outputs in order to physically move a portion of the optical assembly to its optimal position. It does this by superimposing a small user adjustable sinusoidal voltage on the HV amplifier outputs. The sinusoidal modulation is phase shifted by 90° between the two channels. If the two piezo actuators are orthogonal to each other, the resulting physical motion will be circular.

The radiation transmitted to the next optical component and on through the optical system is constantly monitored for changes in power, modulation intensity, and phase. By sampling the feedback signal around the circular trajectory, it is possible for the phase sensitive algorithms on the NanoTrak™ unit to determine a signal gradient. In this way the NanoTrak™ auto-alignment circuitry provides output DC correction voltages that are amplified by the piezoelectric amplifiers and applied to the device piezoelectric actuators to drive the component into alignment (in the direction of increasing signal).

When the device is centered on the signal peak, the

NanoTrak™ Auto-Alignment System Tutorial (Page 3 of 3)

signal gradient around the circle of motion is zero and the NanoTrak™ has achieved optimal coupling of the device under its control. At this point the NanoTrak™ dithering can be suspended (outputs latched) for static alignment requirements or dithering continued at smaller amplitudes for active continuous alignment in applications that suffer from drift.

The speeds of response of the control unit and the piezo-controlled nanopositioners are measured in milliseconds, and consequently, the time taken from signal acquisition (when the scanning covers the maximum area) to achieve alignment and maximum optical transmission is of the order of tens of milliseconds.

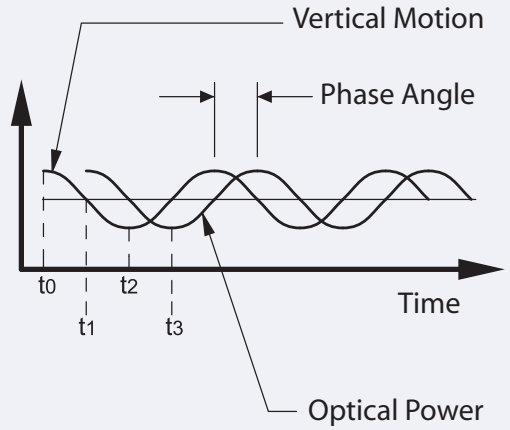
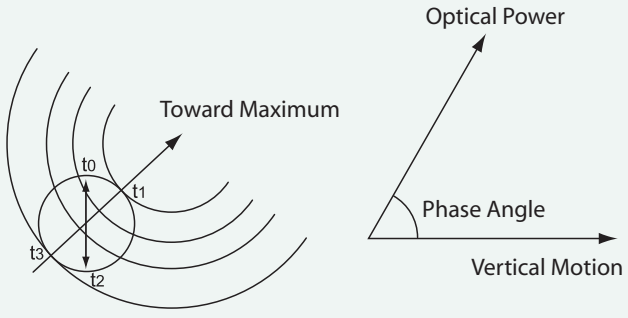


Figure 3
Optical Power and Vertical Motion as a Function of Time

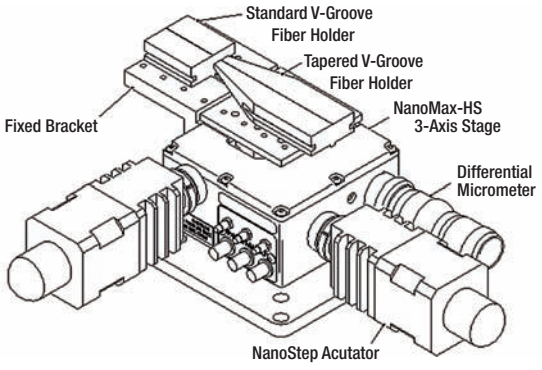
Figure 4
Phase Angle Between Optical Power and Vertical Motion



Phase Sensitive Detection

By considering only the vertical component of the motion and plotting the amplitude against time, this produces a sine wave, as shown above (Fig. 3). At t_0, the vertical motion is at the maximum, however, the power does not reach a maximum until t_1. Similarly, the motion is at a minimum at time t_2, whereas the minimum power is not reached until t_3. Therefore, the optical power lags the vertical motion by a phase angle (Fig. 4).

By detecting the phase of the optical power signal, the NanoTrak™ can automatically align two components. Once the NanoTrak™ has found the maximum signal, it locks on to it, and even if one of the components is moved slightly, the NanoTrak™ corrects for the movement to maintain the maximum power.



Summary

The NanoTrak™ from Thorlabs can automatically align fibers to devices such as waveguides in less than one second. It can dramatically simplify characterization and pigtailing procedures, and can ensure drift-free positioning and accurate data acquisition. By using the NanoTrak™ in auto-alignment systems there are significant advantages to be gained because of the improvement in the alignment process.

- Scanning and Searching to Find a Transmitted Optical Signal
- Rapidly Acquiring a Throughput Optical Signal
- Maximizing the Optical Signal Through Constant Adjustment of the Appropriate Position of the Piezo Actuators
- Active Real-Time Compensating of Mechanical Crosstalk on Multi-Axis Stage Mechanisms by Virtue of Optical Signal Feedback Loop
- Similarly Active Correction of Positional Changes Caused by Environmental Disturbances Such as Temperature Change and Vibration
- Countering Bonding Forces During Pigtailing Operation, Eliminating Erratic UV Curing and Other Undesirable Effects