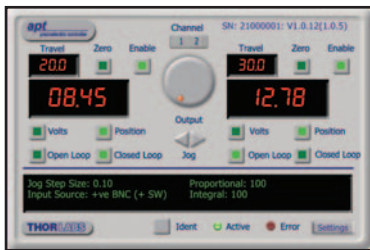
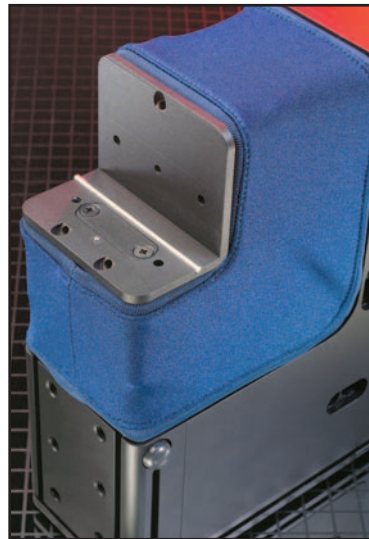
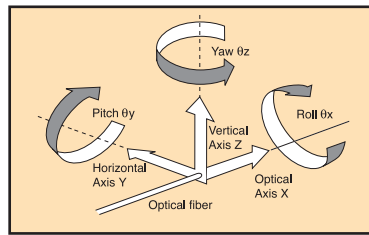
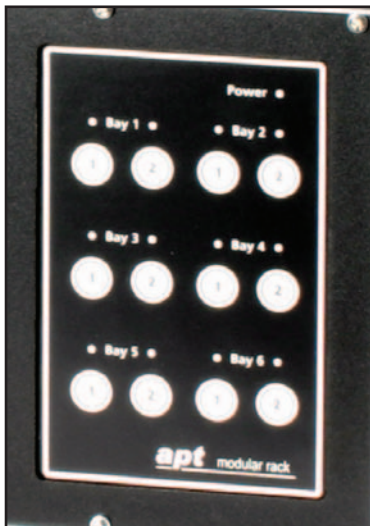


apt™ 600 SERIES 6-AXIS ADVANCE POSITIONING TECHNOLOGY STAGE

The apt™ 600 Series offers a patented design that fixes all actuators to the fixed world.

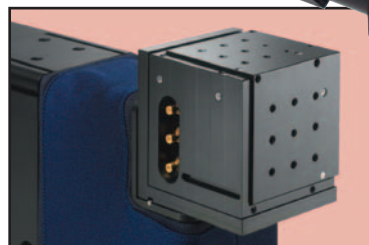
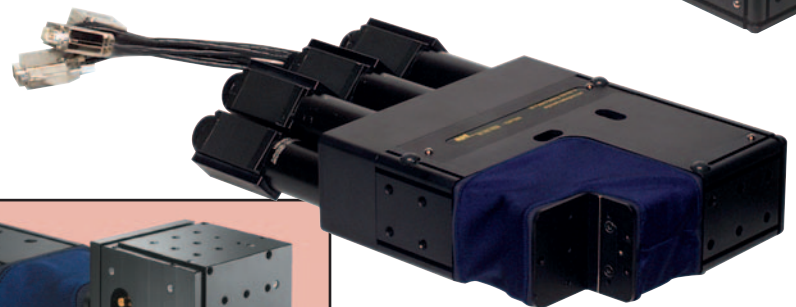


SIX MODELS

- APT601: 6-Axis Manual Positioning Stage with a High Resolution Mechanical Drive.
- APT602: 6-Axis Manual Positioning Stage with Internal Piezos and High Resolution Mechanical Drives.
- APT603: 6-Axis Manual Positioning Stage with High Resolution Mechanical Drive and Internal Closed-Loop Piezos and Feedback.
- APT604: 6-Axis Motorized Positioning Stage with a High Resolution Stepper Motor Drive.
- APT605: 6-Axis Motorized Positioning Stage with Stepper Motors & Internal Piezos.
- APT606: 6-Axis Motorized Positioning Stage with Internal Closed-Loop Piezos and Feedback.



Designed to Operate in Any Orientation



Introducing: apt™ System 6-Axis Positioning Stage

A New Class of Positioning Systems: The APT600 Family of 6-Axis Nanopositioning Stages

The APT600 series is based on a novel mechanism for multi-axis positioning. This new apt (Advanced Positioning Technology) system provides superior performance with six axes of motion, modular and interchangeable actuators, small footprint, and multiple mounting surfaces.

Novel Patented Design

All apt system stages incorporate the patented guided alignment system using linkage pins in a parallel configuration with a single moving platform. This technology provides for a substantially longer travel range as compared to other six-axis positioners.

Compact Package

The APT600 six-axis stage is a long-travel, compact, modular, nanopositioning device. The highly reduced footprint compared to traditional designs facilitates adding multiple stages in a confined space; additionally, the actuators (differential drives, motors, piezos, and cables) are all on one side of the stage. These features are often critical when assembling complex multiple-operation automated assembly systems.

Multiple Functional Surfaces

A common weakness of many positioning system designs is that they do not, or cannot, utilize all of the available surface area. With a typical six-axis, stacked-bearing stage, the functional surface of each individual stage is required to mount the next stage in the series leaving only the topmost stage free to accommodate accessories and fixtures. Thorlabs' NanoMax™ stages were the first to break away from this constraint by providing fixed mounting surfaces in addition to the moving platform.

This capability has been further enhanced in the apt system. Now, in addition to attaching components to the moving platform, objects such as fixtures, cameras, holders, probes, and other devices can be mounted directly onto the fixed outer body of the stage via the mounting holes. This simplifies system setup, often eliminating the need for additional posts, pillars, and brackets, thus saving time, space, and money.

Full Range of Modular Drives & Supporting Drive/Control Electronics

The APT600 stage offers interchangeable manual or stepper-motor actuators for all six axes. These

modular drives can be field upgraded to ensure that this stage can meet the changing needs of present and future advanced nanopositioning applications. The system may also be equipped with internal piezoelectric actuators, with or without feedback capability. These drive options are all supported by a sophisticated library of software tools that allow the system designer to take full advantage of the advanced performance offered by the APT600 family of stages. The companion apt drive systems incorporate the latest high-speed digital signal processing (DSP), low-noise analog electronics, and ActiveX® software technology. Please see page 364 for details on the drive electronics.

Optional Internal Piezos & Closed-Loop Operation

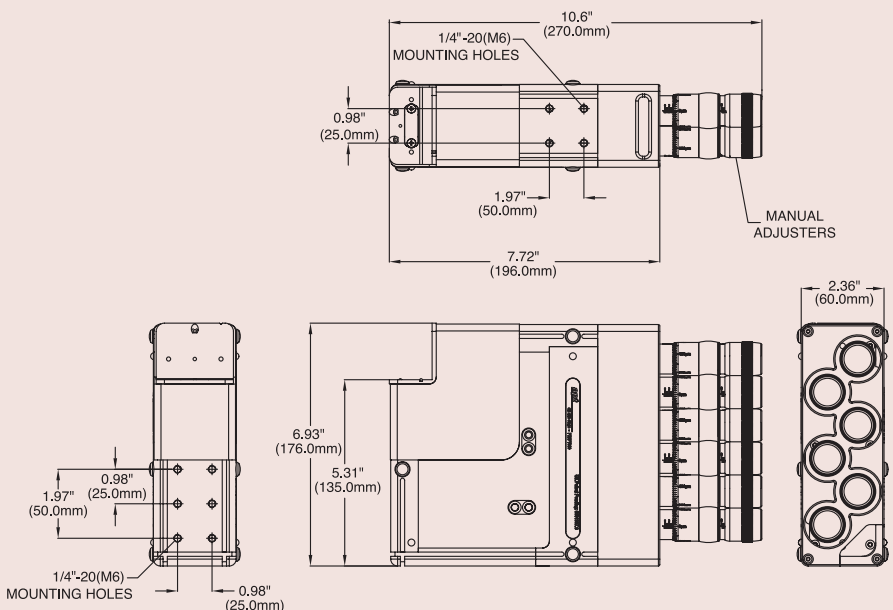
Several versions of the APT600 series 6-axis stage are offered with piezoelectric elements built directly into the stage. This option is part of the assembly and it must therefore be included at the time of purchase. The piezoelectric elements add a degree of flexibility that is critical when high resolution nanometer level positioning is required. Adding strain gauge displacement sensors directly to the piezoelectric stacks allows the drift and hysteresis, inherent in all piezo actuators, to be removed. Our apt family of piezo drive electronics (see page 367) utilize the strain gauge sensors to form a feedback loop. The sensors measure the position of the piezo and the driver circuitry subtracts the measured position from the required position to produce an error signal. A proportional-integral feedback loop then adjusts the voltage to the actuator until the error signal is driven to a minimum.

Mechanical/Thermal Performance

The impact on the system stability of external mechanical and thermal forces associated with common industrial applications are minimized by the mechanical stiffness and athermal design of the apt stage. Thermal stability is better than 1µm/°C around room temperature.

Mechanical Drawing: Manual Drives (No Piezos)

The drawing shows the model APT601, which features a full set of six differential micrometer drives. If your application requires a mixture of mechanical and motorized drives, please see our "customer configurable" series of APT600 products detailed on page 313.



Single Axis Stages

Multi-Axis Stages

Flexure Stage
AccessoriesMotorized
Mirror Mounts

Rotation Stages

Drive Electronics
& Auto-AlignmentActuators &
Adjusters

Brief Tutorials

Motion Control

Single Axis Stages

Multi-Axis Stages

Flexure Stage Accessories

Motorized Mirror Mounts

Rotation Stages

Drive Electronics & Auto-Alignment

Actuators & Adjusters

Brief Tutorials

Introducing: apt™ System 6-Axis Positioning Stage (cont.)

Reduced Footprint

Most six-axis stages, independent of their orientation, occupy a large volume, often dominating the available space within a workstation. The size, along with the associated equipment required to build a production system, results in large enclosures, which makes it difficult to locate tooling and work pieces are also limited access for the operator.

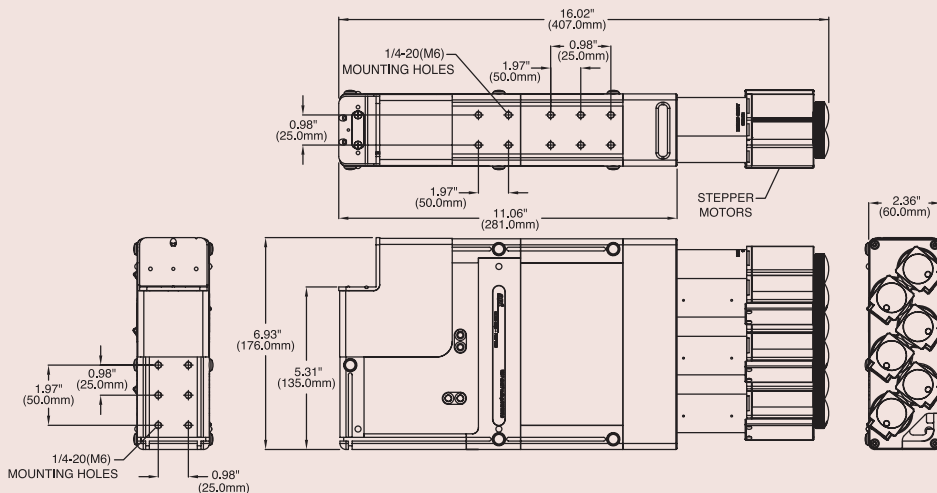
The APT600 stage has a narrow body that measures just 60mm (2.36") wide and a considerably smaller envelope than traditional six-axis stages. The fact that all the cables and actuators emerge from the back surface of the stage is a feature that further enhances the utility of the device. Additionally, the design of the moving platform provides easy access from all but one side. These features, taken together enable the apt stage to be utilized to build high density, specialized, automated assembly workstations.

Flexible Orientation

Virtually all other multi-axis stages are designed to be used in a single orientation. However, since the APT600 six-axis stage can be operated in any orientation, it can be mounted in places and positions impossible with any other stage design. With apt™ stages, designers can build a truly integrated system without working around the alignment system.

Mechanical Drawing: Stepper Motors & Piezos

The drawing shows the model APT606, which features a full set of six stepper motors as well as six piezos all with strain gauge displacement sensors. The piezoelectric elements and sensors are housed within the main body of the stage. Please note that the piezoelectric elements are incorporated into the system at the factory and are not a field upgradeable option. Comparing the two mechanical drawings shown on this page (one with the piezo option and one without) reveals that the overall package size grows by 85mm (3.35") when the piezos are added.



Features

- A Compact 6-Axis Positioner
- Multiple Mounting Surfaces
- Large Range of Motion
- Modular Interchangeable Actuators

Specifications

- **Travel:** 12mm (0.47") (x, y, z), 6° (θx, θy, θz)
- High Resolution (100nm) Mechanical Drives or Stepper Motors with 40nm Resolution
- Optional Piezos 20µm Range, 20nm Resolution
- **Load Capacity:** 1kg (2.2lbs)
- **Thermal Stability:** < 1µm/°C (15–30°C)

**TOOLS
OF THE
TRADE**

*Innovative products to help you
to get results.*

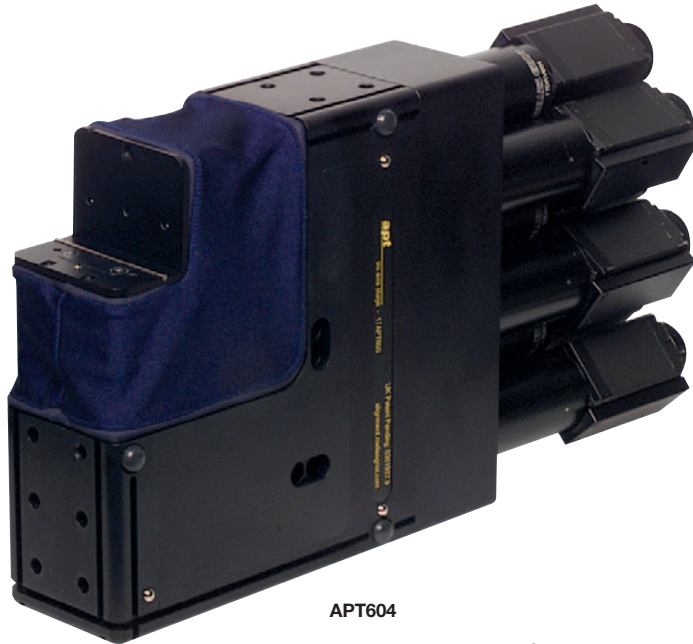
apt™ Series Control Electronics

See Pages 374-379

- Piezo Controller
- Stepper Motor Driver
- NanoTrak Auto-Alignment



apt™ System 6-Axis Stage, Stepper Motors, and Piezos



APT604

APT Stepper Motor

Specifications

- **Travel:** 12mm (0.47")
- **Resolution:** 40nm Based on 25,600 Microsteps/Rev
- **Maximum Velocity:** 6mm/s

The apt™ stepper motor actuator has been designed to be used under high work load conditions providing excellent stability when used on the APT600 series nanopositioning stage. The 25,600 microsteps per revolution can be achieved when using our apt™ stepper motor controllers, which are available in 1 to 12 channel systems. For complete details on all of our drive electronics, please see the Drive Electronics section that begins on page 374.

Specifications

Travel:

- **Stepper Motor Range:**
12mm (0.47") (x, y, z), 6° (θx, θy, θz)
- **Optional Piezo Actuators:**
20µm (x, y, z), 1.2arcmin (θx, θy, θz)

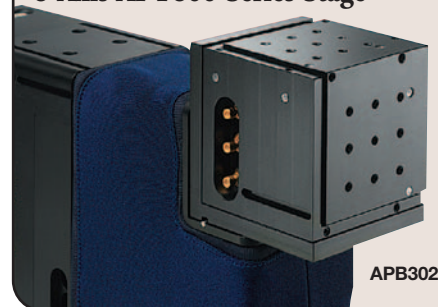
Resolution:

- **Stepper Motor Resolution:**
40nm (x, y, z), 0.14arcsec (θx, θy, θz), Tested with Model BPC001 Stepper Motor Driver Detailed on Page 370
- **Optional Piezoelectric Actuator:**
20nm (x, y, z), 0.07arcsec (θx, θy, θz)
- **Optional Piezoelectric Actuator with Feedback:**
5nm (x, y, z), 0.02arcsec (θx, θy, θz), the Strain Gauge Sensors Improve the Resolution By Ensuring Deterministic Control of the Piezo Movement
- **Repeatability:**
X, Y, and Z
– Unidirectional (Better than 1µm), Bidirectional (5µm)
ØX, ØY, and ØZ
– Unidirectional: Better than 3arcsec
Bidirectional: 16arcsec

General Data:

- **Total Weight:** 15kg (33lbs) (Including 6 Stepper Motors)
- **Load Capacity:** 1kg (2.2lbs)
- **Thermal Drift:** <1µm/°C (15 to 30°C)

PiezoBlock™ Mounted on the 6-Axis APT600 Series Stage



APB302

APT604: Stepper Motors, No Piezos

ITEM#	METRIC ITEM #	\$	£	€	RMB	DESCRIPTION
APT604	APT604/M	\$ 11,900.00	£ 7,497.00	€ 11,067.00	¥ 113,645.00	apt™ 6-Axis Stepper Motor Positioning Stage

APT605: Stepper Motors & Piezoelectric Actuators

ITEM#	METRIC ITEM #	\$	£	€	RMB	DESCRIPTION
APT605	APT605/M	\$ 16,830.00	£ 10,602.90	€ 15,651.90	¥ 160,726.50	apt™ 6-Axis Stepper Motor Positioning Stage with Piezos

APT606: Stepper Motors, Piezoelectric Actuators, & Displacement Sensors

ITEM#	METRIC ITEM #	\$	£	€	RMB	DESCRIPTION
APT606	APT606/M	\$ 19,550.00	£ 12,316.50	€ 18,181.50	¥ 186,702.50	apt™ 6-Axis Stepper Motor Stage with Piezos and Sensors