AEROTECH

Dedicated to the Science of Motion

AUTOMATION SOLUTIONS for the FIBEROPTICS INDUSTRY

www.aerotech.com

AEROTECH *Advantages*

Shorter Time to Market

Fast Prototype Development

Technologically Superior Components and Systems

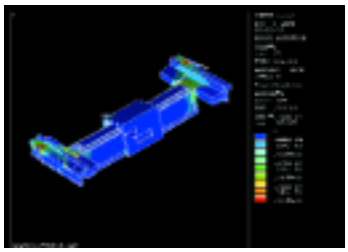
Direct-Drive Linear Motor Technology

Turnkey System Solutions Designed for Full-Scale Production

Precision Mechanics with Cutting-Edge Performance

State-of-the-Art Controllers with Advanced Capabilities

Comprehensive Technical Support Services



Advanced Design and Analysis Capability

Worldwide Start-up and Service

Fully Equipped Training Facilities

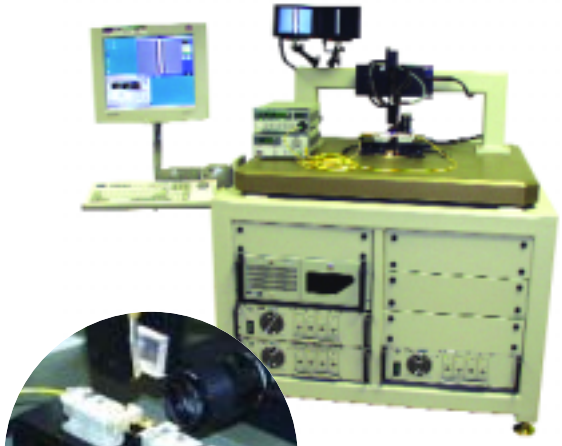
Proof of Concept Laboratory

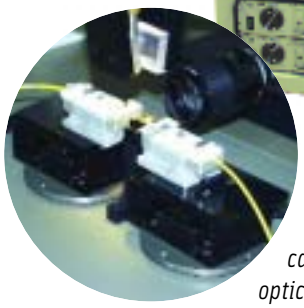
Purpose

To assist our customers in the selection and optimization of their system for highest throughput and yield, Aerotech has developed a *Proof of Concept Laboratory*. This laboratory has state-of-the-art optical component positioning, transport equipment, vision systems, and is supported by engineers with expertise in mechanics, electronic control, software, and vision systems.

We invite you to take advantage of our expertise and let us assist you with a comprehensive system specification and process review to ensure your project's success.

Members of Aerotech's Fiberoptics Systems Group are experts in mechanics, electronics, software, and vision.





This is one of Aerotech's fiber alignment systems with vision. Note how our Zero Z option can be used to position the optical axis at any height above (or below) the work surface.

Custom Systems

Aerotech's comprehensive engineering capability, sophisticated manufacturing and testing, all in one facility, create advanced, high-performance, customized, fully-integrated systems for leaders in the semiconductor, medical, optical fabrication, laser processing, and other industries.

This custom seven-camera vision inspection system was built to inspect television screens.

This turnkey fully integrated machine was built to fabricate intra-ocular lenses.

This fully integrated system is used in disk-drive inspection and assembly.

WORLD HEADQUARTERS: Aerotech, Inc., 101 Zeta Drive, Pittsburgh, PA 15238, USA 412- 963-7470 Fax:412-963-7459
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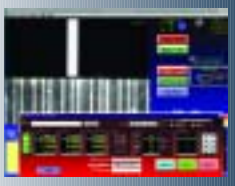

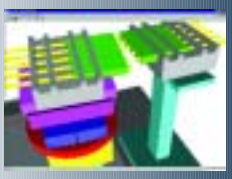

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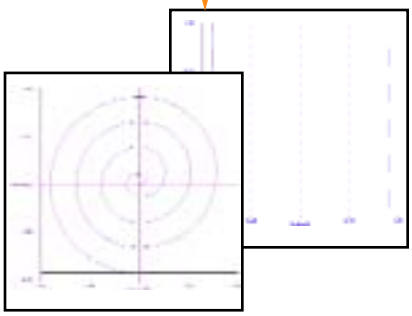
Optical Components Alignment System Diagram

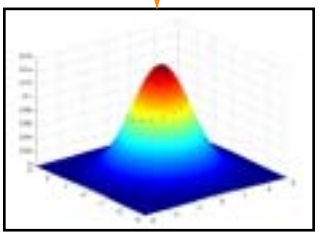
6-axis FiberMax™



High-speed scan routines include: 2D and 3D, hill climb, spiral, and raster.

High-resolution imaging hardware is combined with two five-axis FiberMax nano-positioning systems utilizing the ZeroZ™ option – providing a complete alignment solution.

NPaq, 6-axis drive rack.



Fast power peaking.

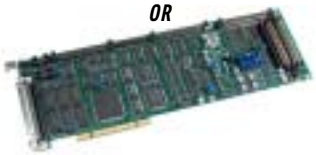
Aerotech's powerful and flexible machine vision software assists in parts loading, characterization, alignment, and provides powerful analysis functions.

DR300, 4-axis drive rack.

Power meter.

Automation 3200 software motion controller.

OR



U500FM PC-card motion controller.

VCSELs
DWDM
Fiber-to-Fiber
Fiber-to-Waveguide
Fiber-to-Laser Diode
Fiber-to-Optics

Bragg Gratings
Collimators
Fiber Array Alignment
MEMS Assembly and Testing
Pig-Tailing
Photonics Packaging

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FiberMax™ SERIES

4- to 6-Axis Fiber Nano-Positioner

- Up to six axes of precise motion
- Noncontact direct-drive for all axes
- 10 nm resolution X-Z axis
- 2 nm resolution Y axis
- 300 picometer resolution with Automation 3200
- Direct-drive rotary axes, T-P-R
- 0.027 to 0.058 arc second resolution on all rotary axes
- 32-axis turnkey drive and control electronics
- Integrated vision systems options
- Raster, spiral, or power peaking algorithms
- Interface to industry-standard power meters
- Zero Z™ low-profile option

6-Axis FiberMax

4-Axis | *Zero-Z Option* | *5-Axis*

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Introduction

Aerotech's FiberMax™ represents a significant breakthrough in the high-volume manufacturing and testing of fiber-optic components. The FiberMax reflects more than 30 years of experience in designing advanced positioning systems for OEMs and end-users in the high-technology industries. FiberMax is a second-generation precision positioning system incorporating the most advanced mechanical design and drive control technologies. Simply stated, FiberMax is the highest performance, smallest volume fiber-alignment system in the world today. It is designed to meet the demanding needs of critical fiberoptic alignment in a highly automated, 24/7 production environment with no compromise in speed, accuracy, and resolution.

Automated Production

A highly repeatable, precise, and industrial-grade positioning system is the foundation for high-volume manufacturing and testing of fiberoptic components. FiberMax's highly reliable, unique drive and control technologies assure many years of maintenance-free service in a high throughput, 24/7 manufacturing environment. When configured with the Zero Z™ option, FiberMax's compact size and design features permit positioning the optical axis to virtually any height above the tabletop, providing easy access to components by the operator or other devices.

Noncontact Direct-Drive

Only noncontact direct-drive technology offers the robust, accurate, and high-speed positioning necessary for mass production of precision devices. FiberMax utilizes advanced direct-drive technology pioneered by Aerotech (patent pending) to achieve the highest level of positioning performance. These high-performance, non-cogging, noncontact, high-speed, high-resolution, and high-accuracy drives are employed to position all of the axes (linear and rotary) in FiberMax. This unique drive technology offers a significant (several times higher) throughput advantage over conventional screw and piezo-drive-based systems.

Fast Vision Alignment and Power Scanning Algorithms

To further automate the manufacturing process, we provide a flexible machine vision toolkit for quick and accurate alignment of components for first light. Our machine vision system is employed as a position encoder to resolve the location of parts. Our easy-to-use graphical user interface lets customers quickly determine necessary inspection processing for part location detection. The inspection results can then be used directly for incremental moves to align the components. Once the components are aligned, our power servo scanning algorithms can be called to optimize power coupled through the devices. Standard scanning routines include 2D, 3D, 4D, and fast align, hill climb, spiral, and raster searches.

Virtual Pivot Point

Our Virtual Pivot Point software can rotate parts at a location in space other than the physical rotation point of the FiberMax. This assists the speed and accuracy of active alignment.

Users have great latitude to customize the software for their specific needs. We have an extensive range of software and hardware options to suit our customers' needs.

6-Axis Detached

FiberMax XRT Extended Travel

FiberMax AXR Air Bearing Extended Travel

FiberMax™ 4-Axis Nano-Positioner

FiberMax™ Z-X-Y-T	
Optical Axis Height	130 mm
Length x Width x Height	224 mm x 150 mm x 130 mm
Travel	25 mm (X) x 25 mm (Z) x 4 mm (Y) x 20° (T)
Resolution	10 nm ZX (300 pm)[1]; 2 nm Y (60 pm)[1]; 0.045 arc-sec T (0.0014 arc-sec)[1]
Accuracy[2]	±0.3 µm per axis[2]
Repeatability	±50 nm[2]; ±100 nm
Velocity	100-250 mm/s XZ; 50 mm/s Y; 150°/s yaw
Load	2 kg

Notes: 1. With Aerotech Automation 3200 controller.
2. Values with Aerotech controls and HAL option.

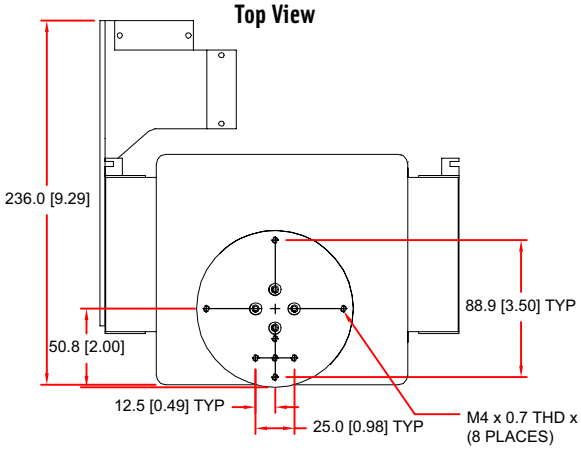
T=Rotation about Y axis (yaw)
P=Rotation about X axis (pitch)
R=Rotation about Z axis (roll)

All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.
Tolerance on mounting holes is ± 0.005 in (0.13 mm)

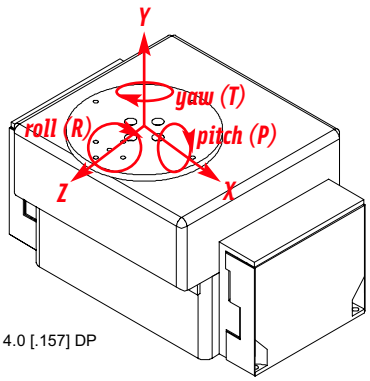
System Characteristics

Outstanding accuracy, position repeatability, and in-position stability requires high system resolution. FiberMax's industry-leading 10 nanometer closed-loop resolution provides this high level of performance. Advanced, patent pending, real-time axis calibration systems for all axes allow the highest level of system accuracy. High-speed 32 megahertz electronic circuitry enables extremely fast positioning even at 10 nanometer resolution. Excellent in-position stability, assisted by high-quality, no-creep linear bearings, enables virtually maintenance-free operation over the life of the product.

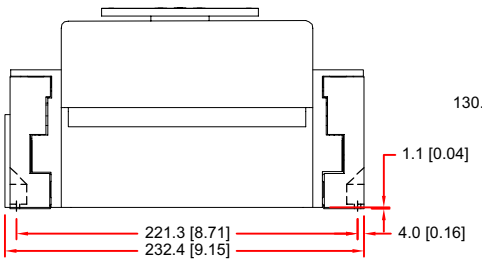
Top View



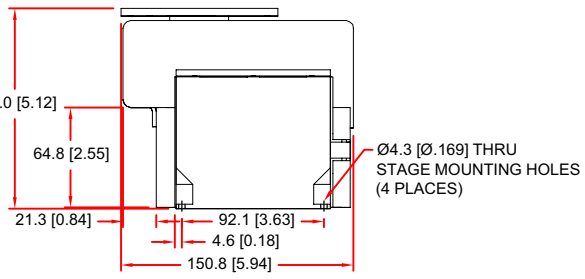
Axis Designation



DIMENSIONS - MILLIMETERS [INCHES]



Front View



Side View

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System Characteristics

By incorporating Aerotech's advanced direct-drive, noncontact, high-resolution goniometer (ANT-20G), further improvements or flexibility in optical component adjustment can be achieved.

The ANT-20G can be field or factory mounted to the tabletop in either of two directions, enabling the component to be rotated either about the Z optical axis (roll) or the X linear axis (pitch). This versatile, low-profile device offers high resolution (0.058 with the ANT-20G-50 or 0.027 with the ANT-20G-90), high positioning speed (150° per second), excellent in-position stability, and a large 20° angular range to facilitate high throughput 24/7 manufacturing.

FiberMax™ 5-Axis Nano-Positioner

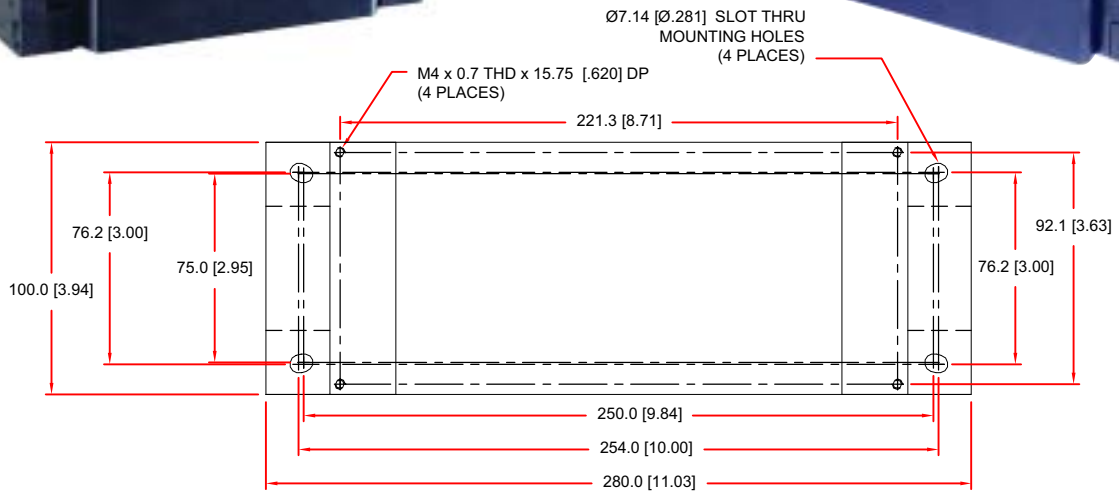
FiberMax™ Z-X-Y-T-P or R	
Optical Axis Height	168 mm
Length x Width x Height	224 mm x 150 mm x 168 mm
Travel	25 mm x 25 mm x 4 mm x 20° x 20°
Resolution	10 nm ZX (300 pm)[1]; 2 nm Y (60 pm)[1]; 0.045 arc-sec T (0.0014 arc-sec)[1]; 0.058 arc sec (0.0018 arc sec)[1] ANT-20G-50 or 0.027 arc sec (0.00082 arc sec)[1] ANT-20G-90 P,R
Accuracy[2]	±0.3 µm per axis[2]
Repeatability	±50 nm[2]; ±100 nm
Velocity	100-250 mm/s XZ; 50 mm/s Y; 150°/s T, P, or R
Load	2 kg

Notes: 1. With Aerotech Automation 3200 controller.
2. Values with Aerotech controls and HAL option.

T=Rotation about Y axis (yaw)
P=Rotation about X axis (pitch)
R=Rotation about Z axis (roll)

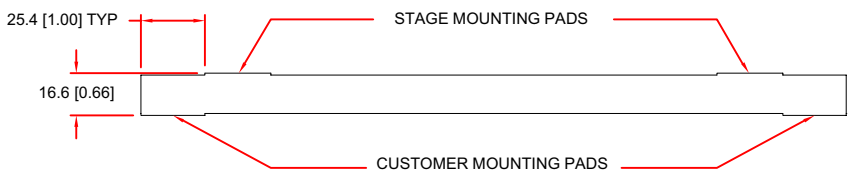
FiberMax™ ZXYTR

FiberMax™ ZXYTP



DIMENSIONS - MILLIMETERS [INCHES]

Optional Breadboard Mounting Plate is available for all FiberMax models.



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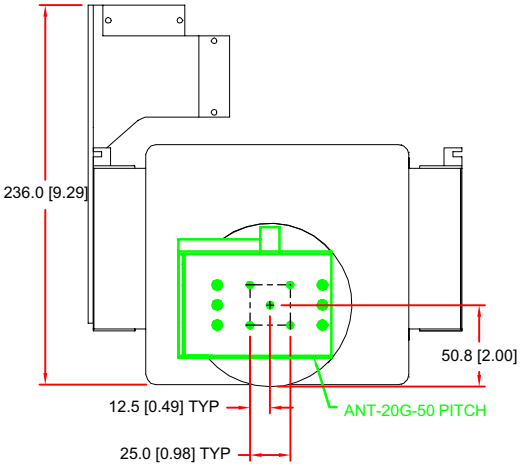
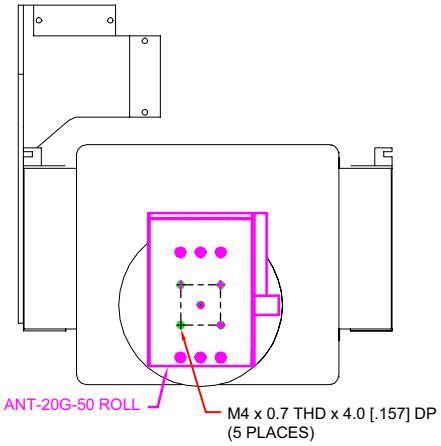
Top View
FiberMax™ ZXYTP



Top View
FiberMax™ ZXYTR



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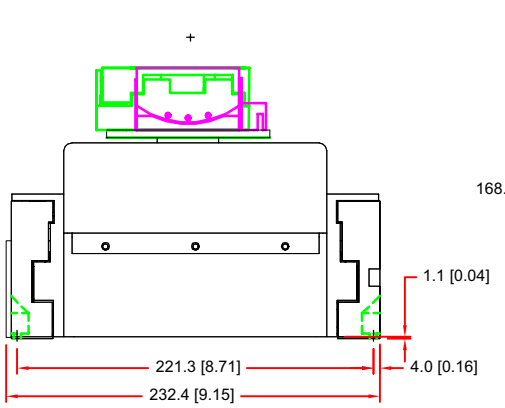
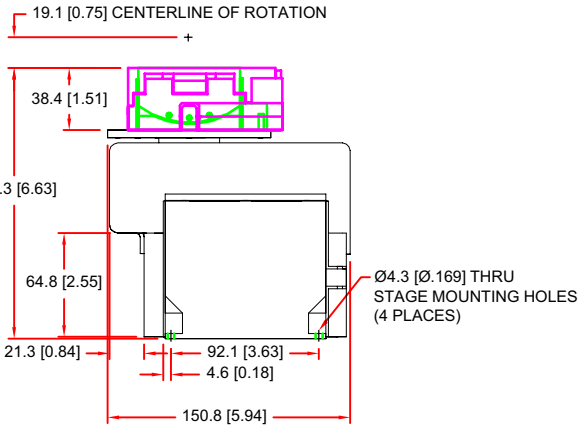


Front View
FiberMax™ ZXYTP
FiberMax™ ZXYTR



Side View
FiberMax™ ZXYTP
FiberMax™ ZXYTR

All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.
Tolerance on mounting holes is ± 0.005 in (0.13 mm)

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System Characteristics

In those cases where a sixth axis is required, the versatile FiberMax™ construction permits two different approaches. In one configuration, stacked ANT-20G goniometers can easily be mounted to the horizontally rotating tabletop, thus creating three rotating axes (T, P, and R). Alternately, one goniometer can be separately mounted on an adjacent stand or shuttle, lowering overall height. When the FiberMax™ is purchased with the Zero-Z option, the optical axis height can be set virtually any distance above or at the same height as the general mounting surface. This unique feature significantly lowers the complexity of optical component mounting and accessibility.

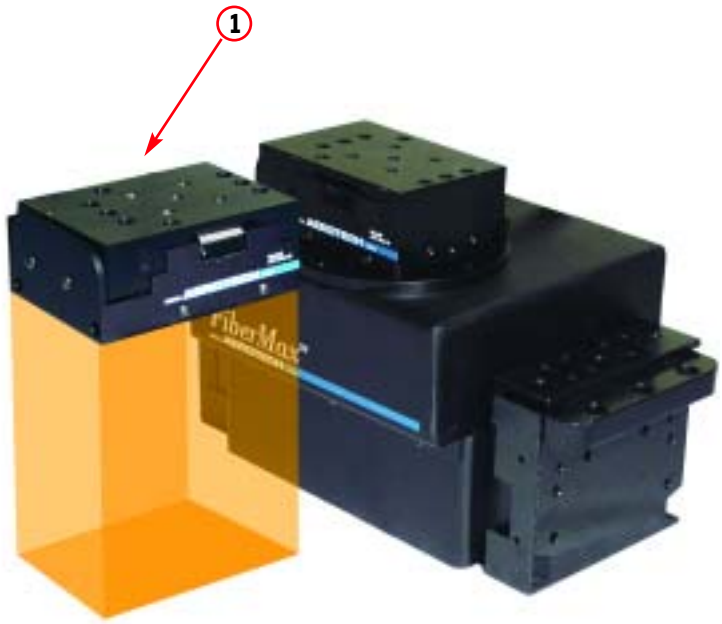
FiberMax™ 6-Axis Nano-Positioner

FiberMax™ Z-X-Y-T-P or R	
Optical Axis Height	206 mm or 168 mm
Length x Width x Height	224 mm x 150 mm x 206 mm or 168 mm
Travel	25 mm x 25 mm x 4 mm x 20° x 20° x 20°
Resolution	10 nm ZX (300 pm)[1]; 2 nm Y (60 pm)[1]; 0.045 arc-sec T (0.0014 arc-sec)[1]; 0.058 arc sec (0.0018 arc sec)[1] ANT-20G-50 or 0.027 arc sec (0.00082 arc sec)[1] ANT-20G-90 P,R
Accuracy[2]	±0.3 µm per axis[2]
Repeatability	±50 nm[2]; ±100 nm
Velocity	100-250 mm/s XZ; 50 mm/s Y; 150°/s T, P, or R
Load	2 kg

Notes: 1. With Aerotech Automation 3200 controller.
2. Values with Aerotech controls and HAL option.

T=Rotation about Y axis (yaw)
P=Rotation about X axis (pitch)
R=Rotation about Z axis (roll)

FiberMax™ ZXYTPR



FiberMax™ ZXYTP and R with detached 6th axis and Zero-Z option

1 *Detached 6th axis R (ANT-20G-50)*

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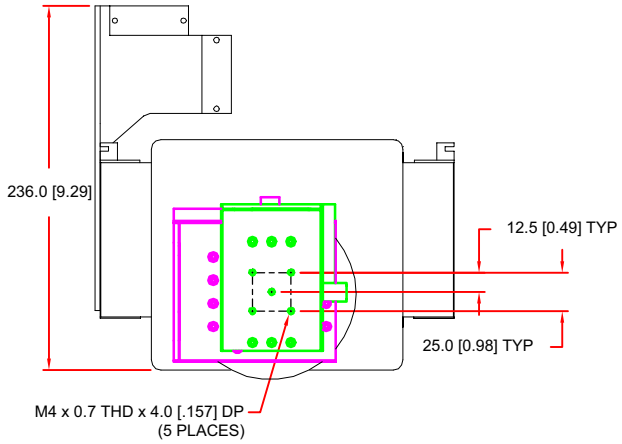
Top View



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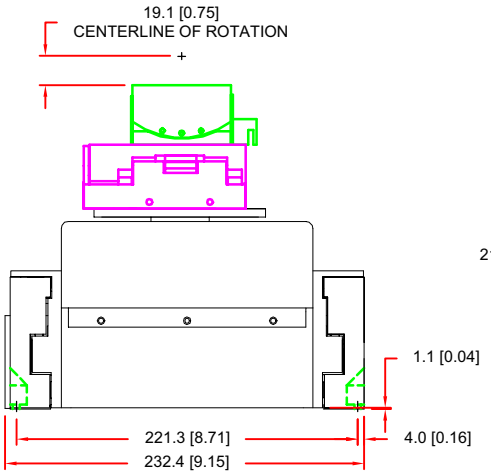
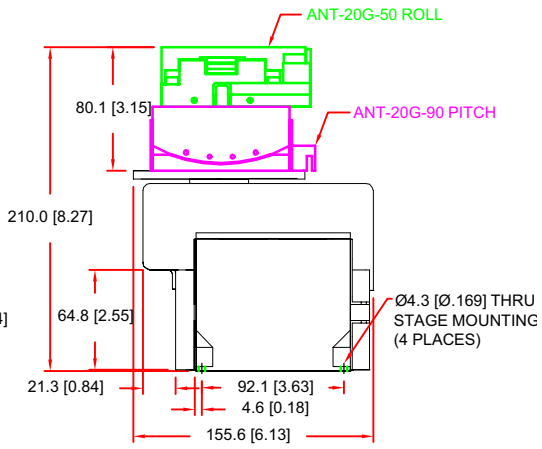


Front View



Side View

All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.
Tolerance on mounting holes is ± 0.005 in (0.13 mm)

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Introduction

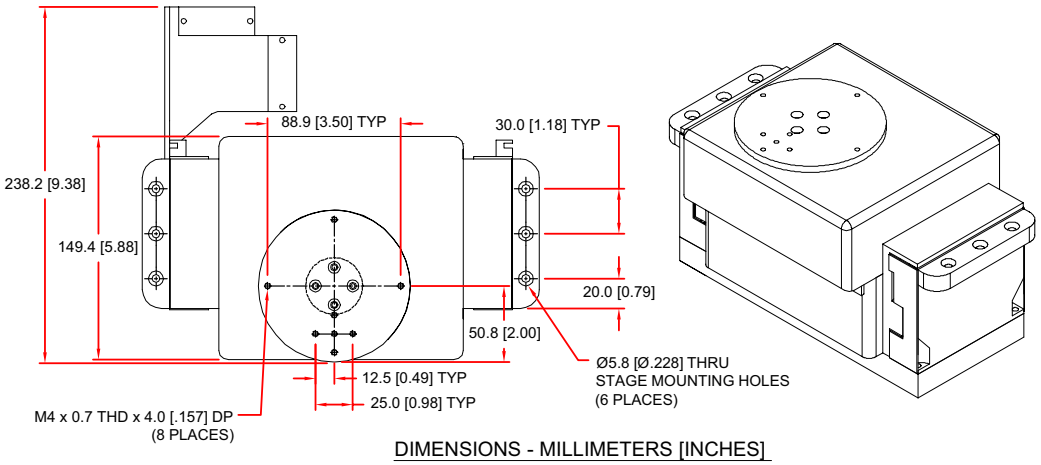
A significant challenge in optical component manufacturing is to optimize light transfer through many different devices. To achieve that goal, components must sometimes be positioned in six degrees of freedom with high accuracy, high resolution, and held in position during the process.

Aerotech's FiberMax™ optical component nano-positioner meets that challenge better than any other system on the market. To further improve in-position stability, facilitate access to the devices, simplify and lower the cost of the support structure, and permit rapid change-over to different devices, Aerotech offers the Zero Z™ option. When ordered with the Zero Z option, FiberMax can be lowered into a pre-cut recess in the machine's surface and the optical axis height can be set at any desired distance above or below the machine surface. This approach can significantly lower the work height of all machine positioning systems and tooling, thus improving overall stability and accuracy.

FiberMax™ ZXYT
With Zero Z™ Option

To cover the recess and provide easy access to FiberMax's top axis, a removeable tooling mounting plate can be utilized. This tooling plate can be removed by dismounting the FiberMax's top axis only, without disturbing any of the other axes or support structure.

The Zero Z feature makes the changeover to manufacture different devices very convenient and cost-effective. Multiple tooling plates with preset elements will further speed the changeover process.



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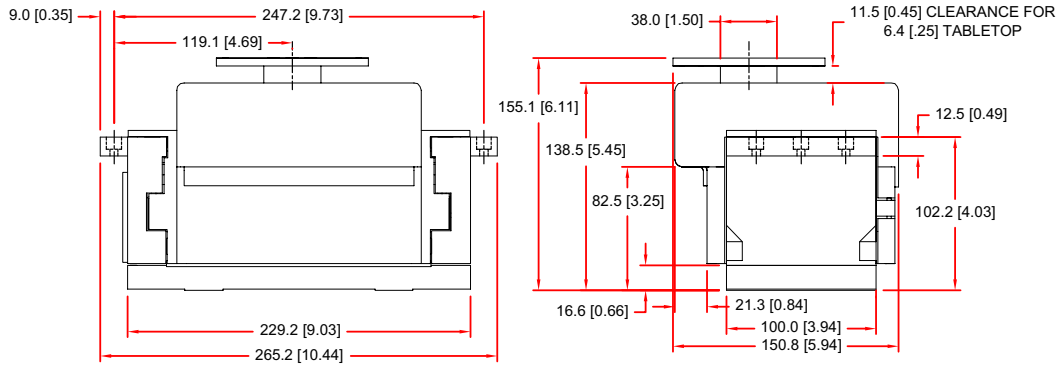

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Ordering Example	FiberMax FiberMax Series Stage	-ZXYTPR Axis Configuration	-90 Pitch/Roll	-50 Roll/Pitch	-MP-FM Breadboard Mounting Option
	FiberMax FiberMax-ZZ	-ZXYT -ZXYTP -ZXYTR -ZXYTPR -ZXYTRP	-50 -90	-50	English Metric

FiberMax Series Stage

FiberMax		Four- to six-axis fiber nano-positioner with noncontact direct-drive.
FiberMax-ZZ		Four- to six-axis fiber nano-positioner with noncontact direct-drive that includes mounting flanges on the dual Z-axis for variable optical height setting.
	-ZXYT	Cartesian with yaw (rotation about Y axis)
	-ZXYTP	Cartesian with yaw and pitch (rotation about Y and X axis)
	-ZXYTR	Cartesian with yaw and roll (rotation about Y and Z axis)
	-ZXYTPR	Cartesian with yaw, pitch, and roll (rotation about Y, X, and Z axis)
	-ZXYTRP	Cartesian with yaw, pitch, and roll (rotation about Y, X, and Z axis)

Options

5th Axis

-50	ANT-20G-50 goniometer with 50 mm radius
-90	ANT-20G-90 goniometer with 90 mm radius

6th Axis

-50	ANT-20G-50 goniometer with 50 mm radius

Mounting

-MP-FM	FiberMax English/metric breadboard mounting plate

Controllers

-U500FM	Includes the required PCI-bus controller and expansion cards, DR300 drive rack(s) with cables, MMI and multidimensional alignment software to support up to sixteen axes of motion
-U511	Stand-alone controller with RS-232, IEEE-488 or front panel interface and integral amplifiers. Can only be used with -ZXYT axis configuration option
-A3200	Automation 3200 software-only controller

See *Motion Controllers* section for specifications.

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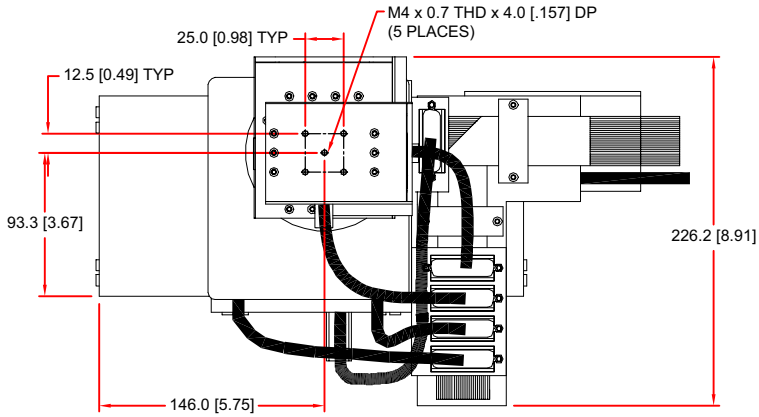
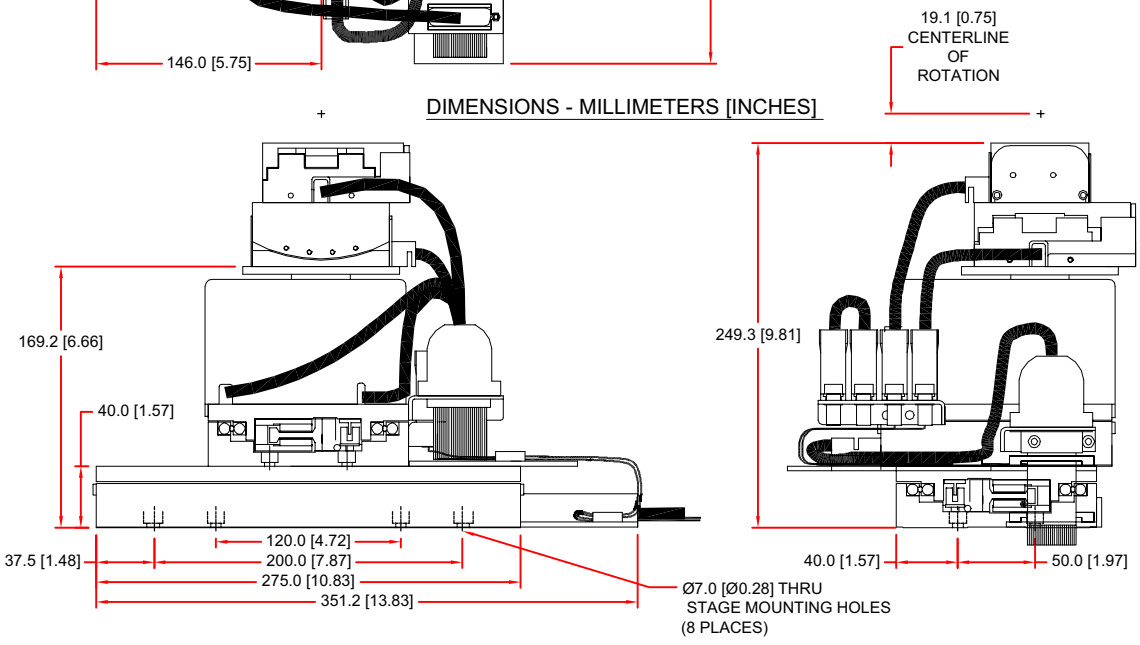
FiberMax XR (left to right) 4-axis, 5-axis with ANT-20G-50, and 6-axis with an ANT-20G-50 and -90.

FiberMax XR

Designed for large DWDMs, VCSEL and fiber arrays, and multiple device testing, the FiberMax XR is Aerotech's innovative system for ultra-resolution positioning where accuracy over long travel is important. Based on our industry-leading FiberMax, the XR combines our miniature nano-positioning ANT series stages with our ALS130 cross-roller bearing stages. As device density, size, and required accuracy outgrow the limits of piezo and screw stages, FiberMax XR is there to provide the travel and accuracy needed. The same nano-positioning and sub-arc-second resolution of the FiberMax is now available in numerous configurations from 25 to 150 mm in the horizontal axes. Let Aerotech solve your long-travel application problems with a high-speed, direct-drive FiberMax XR.



All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.
Tolerance on mounting holes is ± 0.005 in (0.13 mm)



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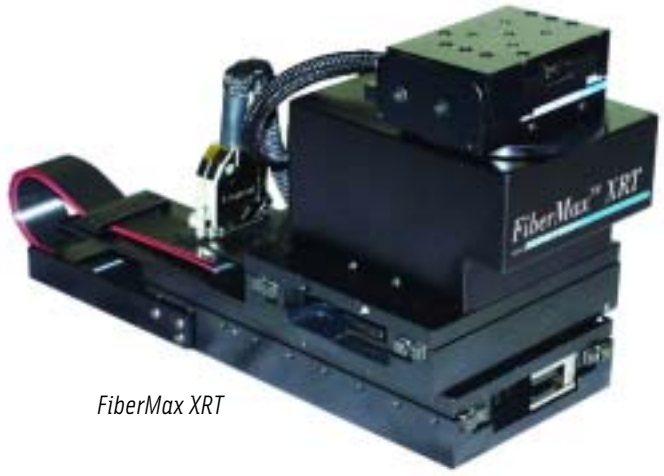
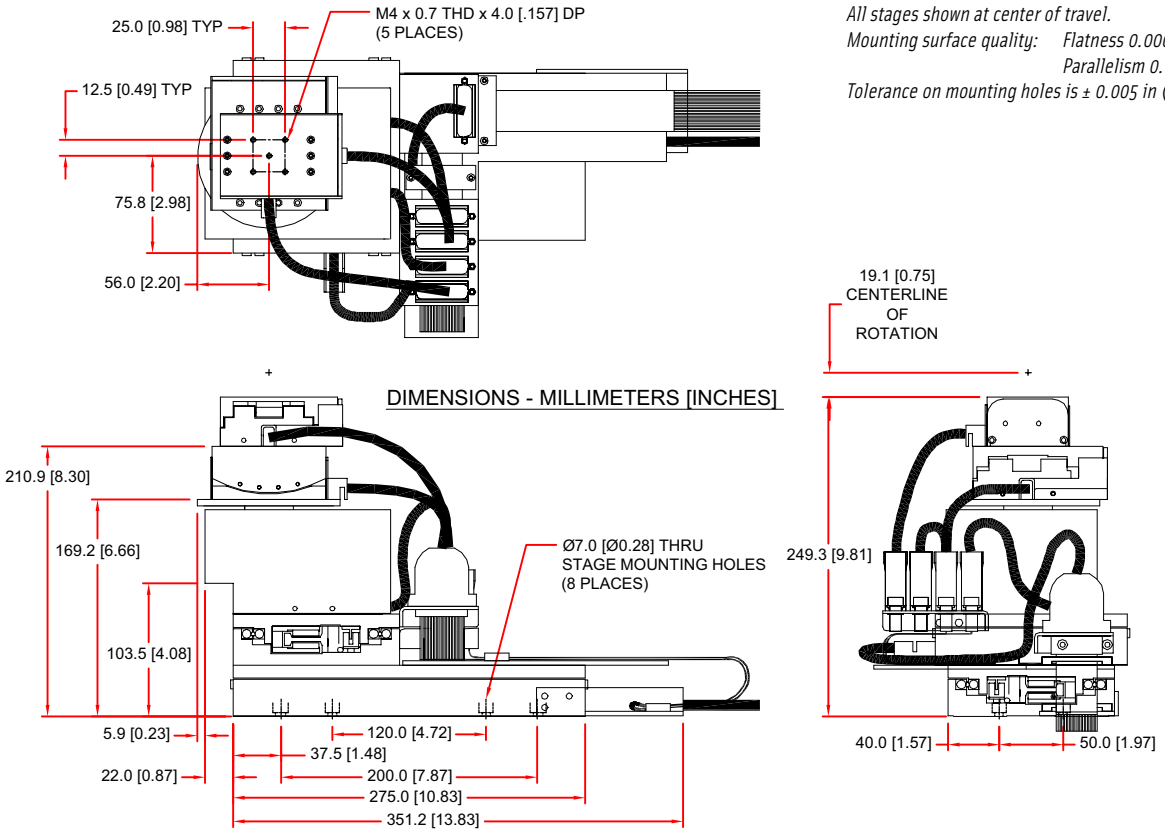


FiberMax XRT

FiberMax XRT

The FiberMax XRT is Aerotech's industry-leading long travel photonics alignment system designed for 24/7 operation. The FiberMax XRT is designed as a "T" ALS130 stack that offsets the rotary center closer to the device under test. It is ideal for *n* x *n* MEMs, DWDM, arrays, collimators, filter test and manufacturing. The XRT's small size allows multiple systems to be configured to align 2, 3, and 4-sided devices. The long travel options provide maximum flexibility for testing different size parts. Cable management is at the rear of the stack to maximize alignment work space. Easily configured as 3-6 axes, the XRT can meet the most demanding high-accuracy applications. Horizontal travel options range from 25 to 150 mm. Please consult the factory for other custom configurations available.



All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.
Tolerance on mounting holes is ± 0.005 in (0.13 mm)

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Ordering Example	FiberMax XRT	-ZXYTPR Axis Configuration	-90 Pitch/Roll	-50 Roll/Pitch
	FiberMax XR FiberMax XRT	-ZXYT -ZXYTP -ZXYTR -ZXYTPR -ZXYTRP	-50 -90	-50

FiberMax XR and XRT Series Fiber Translator

FiberMax XR		Proprietary direct-drive motor technology, linear encoder, integrated 4- to 6-axis fiber nano-translator, with 10 nm resolution X and Z axes, 2nm resolution Y axis, sub-arc second rotary axis resolution and extended travel X and Z axes.
FiberMax XRT		Proprietary direct-drive motor technology, linear encoder, integrated 4- to 6-axis fiber nano-translator, with 10 nm resolution X and Z axes, 2nm resolution Y axis, sub-arc second rotary axis resolution and extended travel X and Z axes.
	-ZXYT	Cartesian with yaw (rotation about Y axis)
	-ZXYTP	Cartesian with yaw and pitch (rotation about Y and X axis)
	-ZXYTR	Cartesian with yaw and roll (rotation about Y and Z axis)
	-ZXYTPR	Cartesian with yaw, pitch, and roll (rotation about Y, X, and Z axis)
	-ZXYTRP	Cartesian with yaw, pitch, and roll (rotation about Y, X, and Z axis)

Options

5th Axis

-50	ANT-20G-50 goniometer with 50 mm radius
-90	ANT-20G-90 goniometer with 90 mm radius

6th Axis

-50	ANT-20G-50 goniometer with 50 mm radius

Controllers

-U500FM	Includes the required PCI-bus controller and expansion cards, DR300 drive rack(s) with cables, MMI and multidimensional alignment software to support up to sixteen axes of motion.
-U511	Stand-alone controller with RS-232, IEEE-488 or front panel interface and integral amplifiers. Can only be used with -ZXYT axis configuration option.
-A3200	Automation 3200 software-only controller

See *Motion Controllers* section for specifications.

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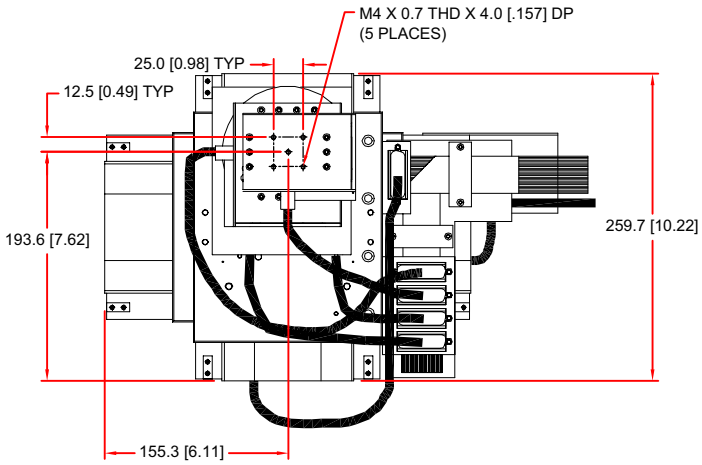
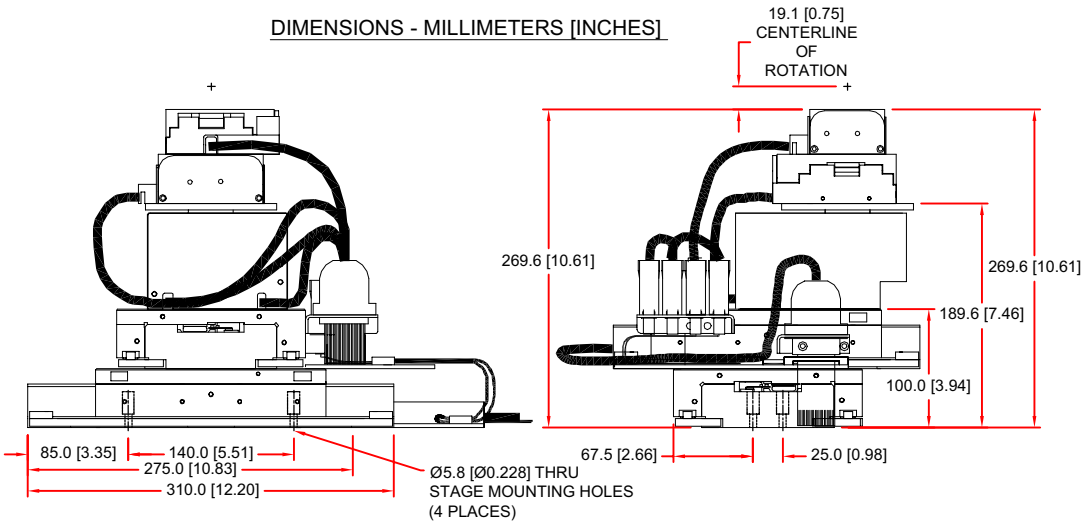
- Air bearing horizontal linear stages
- 4 to 6-axis extended range FiberMax
- 50 and 100 mm horizontal travel
- 2 nm XZ resolution
- 62 picometer XZ resolution with Automation 3200
- Superior flatness and straightness
- Ultra-smooth velocity control



All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.
Tolerance on mounting holes is ± 0.005 in (0.13 mm)

DIMENSIONS - MILLIMETERS [INCHES]



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FiberMax AXR

For extended range systems requiring the most demanding position and velocity control, Aerotech has developed a new small footprint air-bearing stage package that is combined with the ANT lift and rotary stages, and goniometers, to provide superior linear motion. Developed for fiberoptic bonding and welding applications, we leveraged our 30 years of air-bearing experience to provide the most reliable, robust system available in its class.

The FiberMax AXR is Aerotech's innovative air-bearing design for unsurpassed motion performance where accuracy over long travel lengths is important. Based on our industry leading FiberMax, the AXR combines our miniature nano-positioning ANT series stages with our FiberGlide 1000 air bearing stages. The same nano-positioning and sub-arc-second resolution of the FiberMax is now available in multiple configurations with 25 mm, 50 mm, and 100 mm travel in the horizontal axes.

Ordering Example	FiberMax AXR	-ZXYTR Axis Configuration	-90 Pitch/Roll	-50 Roll/Pitch
	Fiber Positioning System	-ZXYT -ZXYTP -ZXYTR -ZXYTPR -ZXYTRP	-50 -90	-50

FiberMax AXR Series Fiber Translator

FiberMax AXR	Proprietary direct drive motor technology, linear encoder, integrated 4 to 6 axis fiber nano-translator, with 2 nm resolution X and Z axes, 2 nm resolution Y axis, sub-arc second rotary axis resolution and extended travel X and Z axes.
-ZXYT	Cartesian with yaw (rotation about Y axis)
-ZXYTP	Cartesian with yaw and pitch (rotation about Y and X axis)
-ZXYTR	Cartesian with yaw and roll (rotation about Y and Z axis)
-ZXYTPR	Cartesian with yaw, pitch, and roll (rotation about Y, X, and Z axis)
-ZXYTRP	Cartesian with yaw, pitch, and roll (rotation about Y, X, and Z axis)

Options

5th Axis

-50	ANT-20G-50 goniometer with 50 mm radius
-90	ANT-20G-90 goniometer with 90 mm radius

6th Axis

-50	ANT-20G-50 goniometer with 50 mm radius

Controllers

-U500FM	Includes the required PCI-bus controller and expansion cards, DR300 drive rack(s) with cables, MMI and multidimensional alignment software to support up to sixteen axes of motion
-U511	Stand-alone controller with RS-232, IEEE-488 or front panel interface and integral amplifiers. Can only be used with -ZXYT axis configuration option
-A3200	Automation 3200 software-only controller

See *Motion Controllers* section for specifications.

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FiberGlide™ 3D

- **Designed for high-performance photonics alignment and assembly**
- **Linear encoder feedback provides up to 2 nm resolution**
- **62 picometer resolution available with the Automation 3200**
- **Fully preloaded air bearing**
- **Complete noncontact design**
- **Ultra-smooth velocity control**

The FiberGlide 3D series represents the highest performance miniature three axis air-bearing stages available. Aerotech has combined over 30 years of precision motion control and positioning system experience with the latest technologies to produce a truly outstanding miniature, linear air-bearing stage.

Linear Stage

The linear positioner is a fully preloaded, noncontact design. Inherently frictionless, air bearings have proven to be the standard in precision applications, and Aerotech has now produced a miniature version that is well-suited for the fiberoptics industry.

Driven by a noncontact linear brushless servomotor, this stage proves the ultimate solution whether the application requires small, accurate steps or constant smooth velocity. Years of research have resulted in a robust and perturbation-free cable management system.

Feedback and Control System

Directly coupled, noncontact linear encoder position feedback is available with different options. A wide selection of state-of-the-art controllers is available, including the Automation 3200 software controller with digital drives, our PCI-bus-based U500, or the stand-alone U511.

Options

Convenient rack or panel-mount amplifiers are included with all systems. Aerotech's expert technical staff is experienced in custom system designs and will work with you to generate a system to meet the unique needs of your application.

Clean Room Compatibility

The air-bearing design is inherently clean-room compatible. A high quality cable management system, together with low particulate generation materials, provides compliance to Class 1 with proper integration.

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Basic Model		FiberGlide 3D		
Total Travel		25 mm (1 in)	50 mm (2 in)	100 mm (4 in)
Drive System		Linear Brushless Servomotor		
Feedback		Noncontact Linear Encoder (LN or LT)		
Resolution	**LN**	2 nm (0.08 µin) (60 picometers with Automation 3200)		
	LT	10 nm (0.4 µin) (300 picometers with Automation 3200)		
Maximum Travel Speed[1]		200 mm/s (8 in/s)		
Maximum Load		5.0 kg (11.0 lb)		
Overall Accuracy	**LN**[2]	±0.2 µm (±8 µin) per axis[2]; ±1 µm (±40 µin)	±0.2 µm (±8 µin) per axis[2]; ±1.5 µm (±60 µin)	±0.2 µm (±8 µin) per axis[2]; ±2 µm (±80 µin)
	LT[2]	±0.3 µm (±12 µin) per axis[2]; ±2 µm (±80 µin)	±0.3 µm (±12 µin) per axis[2]; ±3 µm (±120 µin)	±0.3 µm (±12 µin) per axis[2]; ±5 µm (±200 µin)
Repeatability	**LN**	±50 nm (±2 µin) per axis[2]		
	LT	±50 nm (±2 µin) per axis[2]; ±100 nm (±4 µin)		
Straightness and Flatness	**Differential**	0.25 µm/ 25 mm (10 µin/in)		
	Maximum Deviation	±0.25 µm (±10 µin)	±0.25 µm (±10 µin)	±0.4 µm (±16 µin)
Pitch / Roll / Yaw		±0.25 arc sec/25 mm		
Operating Pressure[3]		80 psi ±5 psi		
Air Consumption[4]		<0.3 cfm @ 80 psi		

Notes: 1. Maximum speed based on stage capability; maximum application velocity may be limited by system data rate and system resolution.
2. Values with Aerotech controls and HAL option.
3. To protect air bearing against under-pressure, an in-line pressure switch is required and tied to the controller E-stop input.
4. Air supply must be clean, dry to 0° F dew point, and filtered to 0.25 µm or better; recommend nitrogen at 99.99% purity.

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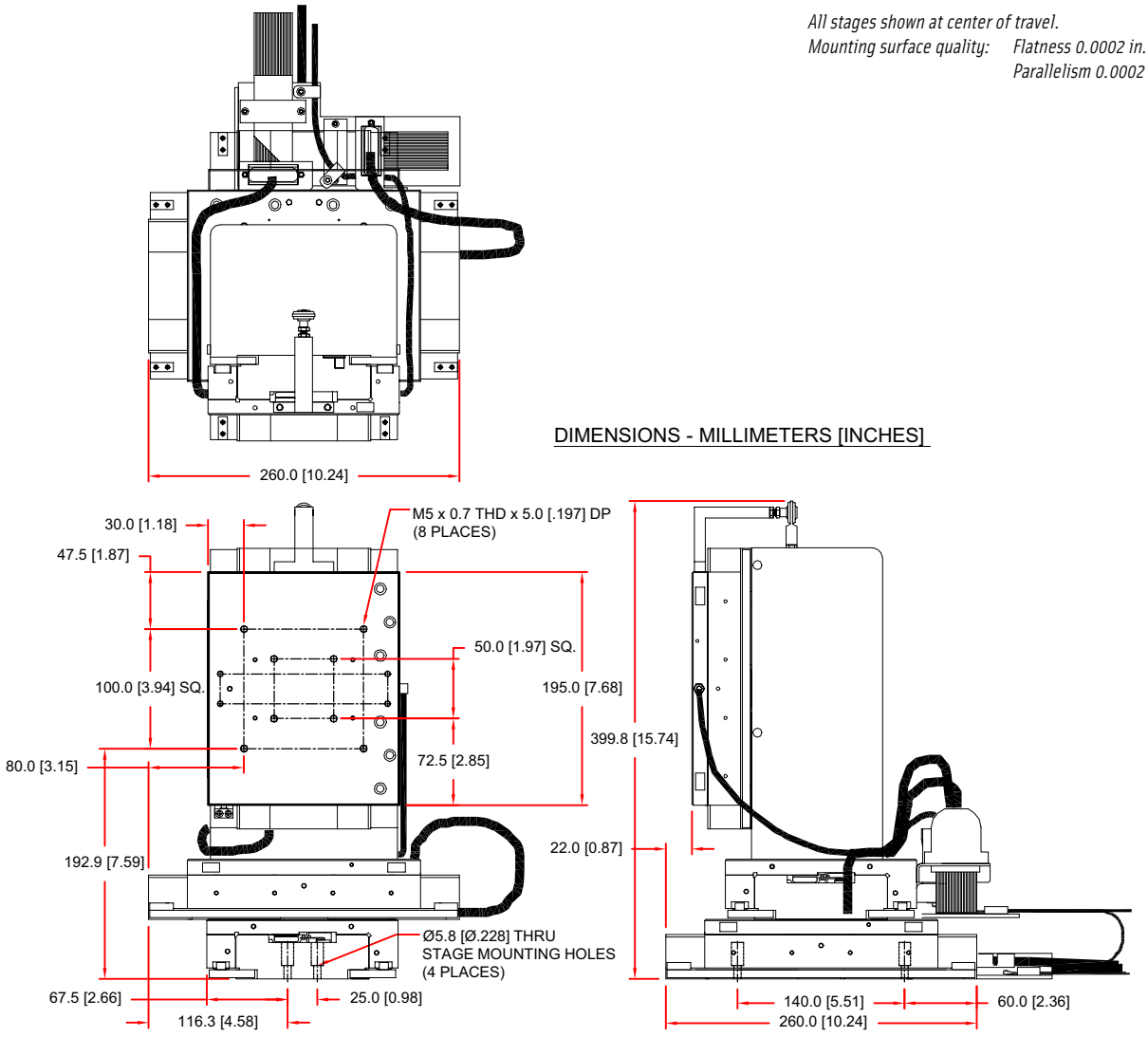
All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.

DIMENSIONS - MILLIMETERS [INCHES]



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Ordering Example	FG1000-3D Series	-100 Travel (mm)	-LT Feedback
		-25 -50 -100	-LT -LN -LT/lower -LN/lower -LT/upper -LN/upper -LT/vertical -LN/vertical

FiberGlide 1000 Series Photonics Alignment and Assembly System

FG1000-3D	Linear air bearing positioner.

Linear Stage Travel (Z, X, Y)

-25	25 mm (1 in) travel stage with linear motor
-50	50 mm (2 in) travel stage with linear motor
-100	100 mm (4 in) travel stage with linear motor

Feedback

-LT	Linear encoder feedback (10 nm resolution), amplified sine output
-LN	High-accuracy linear encoder feedback (2 nm resolution), amplified sine output
-LT/lower	LT option with lower axis cable management
-LN/lower	LN option with lower axis cable management
-LT/upper	LT option with upper axis cable management
-LN/upper	LN option with upper axis cable management
-LT/vertical	LT option with vertical axis cable management
-LN/vertical	LN option with vertical axis cable management

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FiberAlign™ 90 and 130 SERIES

- 3- to 6-axis fiberoptic alignment
- Noncontact linear motor drive
- 10 nm resolution linear motion
- 300 picometer resolution with Automation 3200
- 0.027 to 0.058 arc-second angular resolution
- 0.001 to 0.002 arc-second resolution with Automation 3200
- Turnkey drive and control electronics
- Direct-drive rotary axes
- Raster, spiral, or power peaking algorithms
- Interface to industry-standard power meters
- Integrated vision systems options

FA90 X-Y-Z volume is 729,000 mm³ (90 x 90 x 90 mm).

FA130 X-Y-Z volume is 2,197,000 mm³ (130 x 130 x 130 mm).

Introduction

Aerotech's FiberAlign series is a high-performance fiberoptic aligning system incorporating best-in-class drive and state-of-the-art axis control technology. Its modular design permits the selection of the number of axes, the distance to be travelled, and the amount of payload, all at high speed, resolution, and accuracy.

Automated Production

As alignment accuracies, the quest for higher yields, and device volumes increase, the need for a precise, reliable, and repeatable motion system becomes increasingly important. Due to the rapidly changing nature of components and manufacturing processes, flexibility in system configuration becomes a must. Aerotech's FiberAlign product offering responds to and satisfies all of these requirements. More than thirty years of experience serving the high-technology OEM marketplace are reflected in these systems. With the selection of robust system components, high-volume production in a 24/7 manufacturing environment has become a reality.

Advanced Drive Technology

Only noncontact direct-drive technology offers the robust, accurate, high-speed and high-resolution positioning necessary for mass production of precision devices. Aerotech's state-of-the-art patent-pending drive technology offers industry - leading resolution of 10 nanometers combined with high positioning speed of greater than 250 mm/s. Utilizing ultra-quiet linear drives and advanced control technology, coupled with high-performance, best-in-class signal multipliers, Aerotech's FiberAlign series offers the best position repeatability, accuracy, and in-position stability to meet the motion system requirements of higher yields.

Fast Vision Alignment and Power Scanning Algorithms

A comprehensive software toolkit provides easy access to commonly used functions. Alignment functions such as hill climbing from a power meter input, and raster, square, or circular spiral scans, are easily implemented via standard functions. In addition to the automated tools, both joystick and on-screen jog control are available for manual operations.

FiberAlign 90 or 130

To satisfy the ongoing positioning and processing needs of the fiberoptic manufacturing industry, Aerotech offers the FiberAlign 90 and 130 series. Both series' basic three-axis model can be extended with additional axes to satisfy the requirement to control motion in six axes: X, Y, Z, T (yaw), P (pitch), R (roll).

FiberAlign 90 represents the more compact version (1/3 the volume of FiberAlign 130) and is ideal where space is limited and travels need not exceed 25 millimeters in the primary axis. Due to its smaller size, the effective payload is also less than its larger version, the FiberAlign 130. By attaching the Universal Mounting Post to the Z axis, additional axes can be attached to provide high-resolution, high-accuracy rotary motion. This flexible arrangement permits the user to purchase only the number of axes needed to perform the task, yet assures further expansion if needed.

Yaw rotary motion is provided by Aerotech's ANT-20RA, a direct-drive high-resolution rotary actuator, while pitch and roll motion are provided by Aerotech's advanced ANT-20G patent pending, direct-drive, high-resolution goniometer. The rotary devices offer a 20 degree angular range with industry-leading resolution of up to 0.027 arc second.

The FiberAlign 130 is similar in construction to the 90 but offers a larger travel and

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larger load carrying capability in a slightly larger envelope. Travel for the X and Y axis is selectable up to 150 millimeters.

The FiberAlign 130 also accepts the ANT-20RA rotary actuator and the ANT-20G goniometers, providing six axes of motion control. Due to its larger size, the FiberAlign 130 also can accept the ADR-75 direct-drive rotary table offering 360 degrees of continuous rotary motion.

Basic Model	FiberAlign 90	FiberAlign 130
Total Travel	25 mm (1 in) x 25 mm (1 in) x 25 mm (1 in)	150 mm (6 in) x 150 mm (6 in) x 25 mm (1 in)
Drive System	Linear Brushless Servomotor	
Feedback	Noncontact Linear Encoder	
Resolution	10 nm (0.4 µin) (300 picometers with Automation 3200)	
Maximum Travel Speed	100 - 250 mm/s (4 - 10 in/s)	150 mm/s (6 in/s)
Maximum Load[1]	5.0 kg (11.0 lb)	10.0 kg (22 lb)
Accuracy[2]	±0.3 µm (±12 µin) per axis[2]; ±3 µm (±120 µin)	
Bidirectional Repeatability	±50 nm (±2 µin) per axis[2]; ±100 nm (±4 µin)	
Orthogonality	10 arc sec	5 arc sec
Material	Aluminum	
Finish	Black Anodize	

Notes: 1. Three-axis configuration.
2. Values with Aerotech controls and HAL option.

FA90 with the ANT-20G-50 goniometer.

FA130 with the ANT-20G-50 goniometer mounted using the Aerotech Universal Mounting Post.

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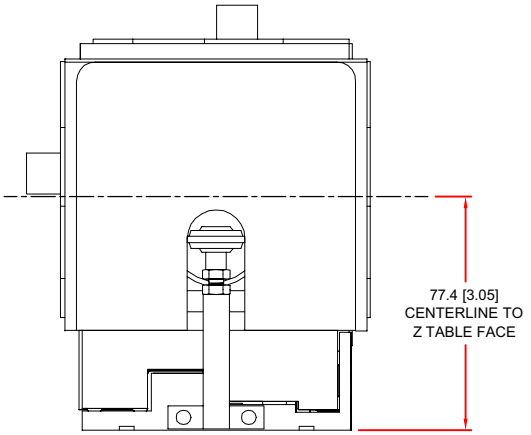
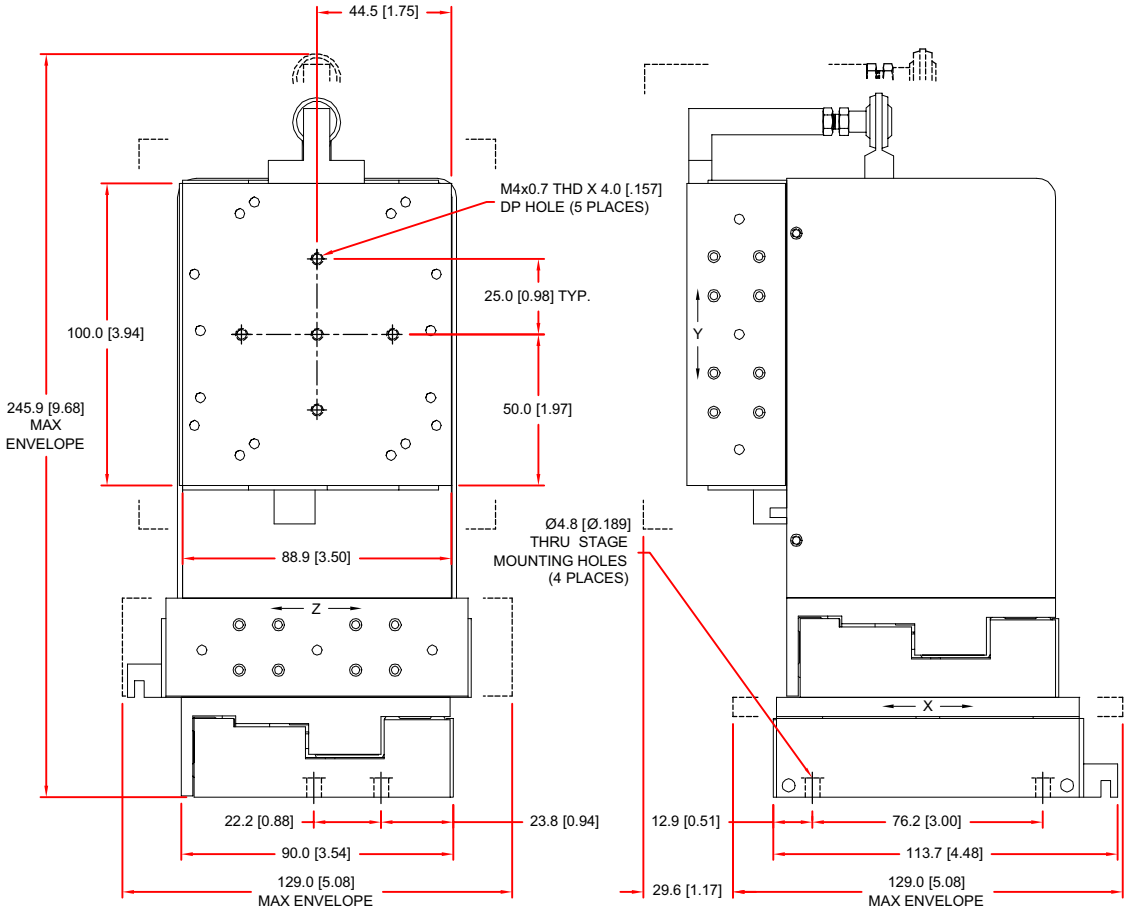
FiberAlign 90

All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.



DIMENSIONS - MILLIMETERS [INCHES]



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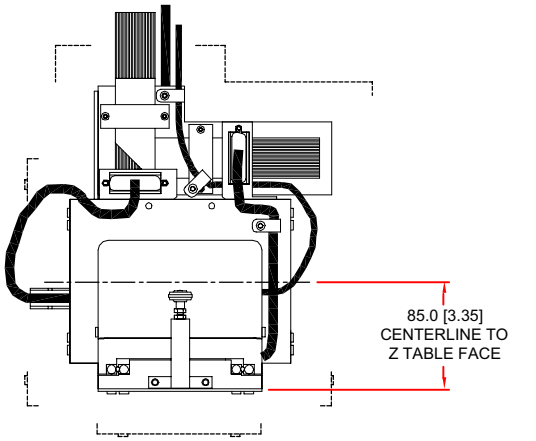
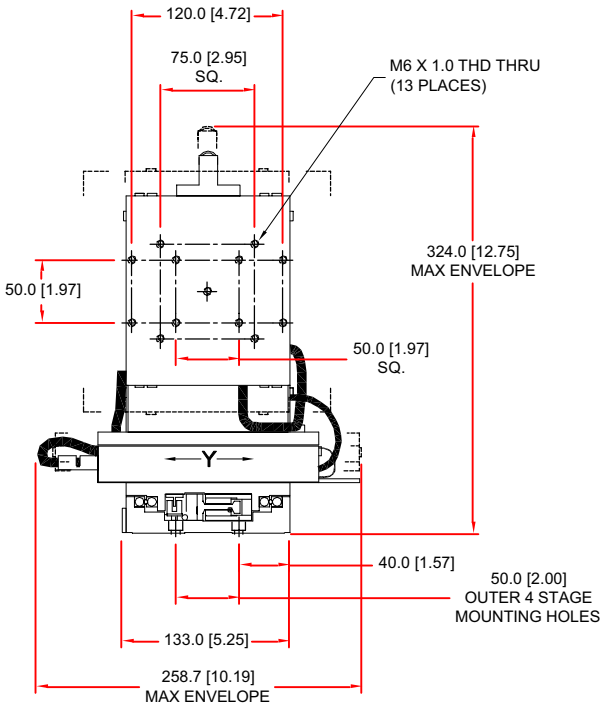
FiberAlign 130

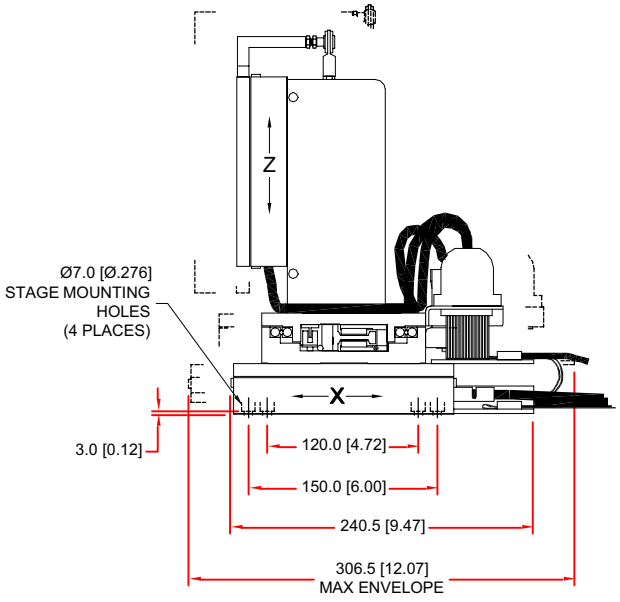
All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.



TRAVELS:
X AXIS ALS130-050: 50mm
Y AXIS ALS130-050: 50mm
Z AXIS ALS130-025: 25mm

DIMENSIONS - MILLIMETERS [INCHES]





WORLD HEADQUARTERS: Aerotech, Inc., 101 Zeta Drive, Pittsburgh, PA 15238, USA 412- 963-7470 Fax:412-963-7459
Aerotech Ltd., Jupiter House, Calleva Park, Aldermaston, Berkshire RG7 8NN, UK 44-118-9409400 Fax:44-118-9815022
Aerotech GmbH, Südwestpark 90, 90449 Nürnberg, Germany +49-911-9679370 Fax:+49-911-96793720

Ordering Example	FA90	-25 Lower Axis Travel (mm)	-25 Middle Axis Travel (mm)	-25 Vertical Axis Travel (mm)	-R Opt Rotary Axis 1	-AA Orientation
		-25 -50	-25 -50	-4 -25	-T -P -R	-AA -AB -BB -BC

FA90 Series Fiber Translator

FA90 Proprietary direct-drive motor technology, linear encoder based fiber translator. XYZ axes aligned to 10 arc sec orthogonal.

Note: Requires clean, dry air supply for pneumatic counterbalance when a vertical axis is specified.

Linear Stage Travel

-4 4 mm (.16 in) travel stage (vertical only)
-25 25 mm (1 in) travel stage (vertical or horizontal axis)

Optional Rotary Axes (OptRotaryAxis 1-3)

For reference purposes the Z axis is considered to be the middle axis of a three-axis stack, X is the bottom axis, and Y is the vertical axis.

-T Single "planar" rotary axis oriented as yaw, rotation about Y axis (ANT-20RA)
-P Single "goniometer" rotary axis oriented as pitch, rotation about X axis (ANT-20G)
-R Single "goniometer" rotary axis oriented as roll, rotation about Z axis (ANT-20G)

*For 5 and 6-axis configurations, please consult the factory.
*The above sequences represent the only valid rotary axis combinations.

Controller Platform

-U500 Includes the required PCI-bus controller and expansion cards, DR300 drive rack(s) with cables, MMI, and multidimensional alignment software to support up to sixteen axes of motion.
-U511-x Stand-alone controller with RS-232, IEEE-488, or front panel interface and integral amplifiers.
-A3200 Automation 3200 software-only controller

Note: The U511 option is only valid for systems with up to 4 axes. Cannot be used when 2 or 3 rotary axes are selected.

See *Motion Controllers* section for specifications.

Orientation (-AA, -AB, -BB, -BC)

The letters in the orientation correspond to the standard X/Y/Z configurations detailed in Aerotech's PA5 specification. The first letter indicates the orientation of the two horizontal axes and the second letter indicates the orientation of the vertical axes. These four combinations represent the only four standard configurations. Combinations AA-BC, AB-BB can be considered as left- and righthand orientations of the same stack, or mirror images of each other.

-AA Bottom axis cable exit rear, middle axis cable exit left, vertical tabletop parallel to middle axis travel and facing the front.
-AB Bottom axis cable exit rear, middle axis cable exit left, vertical axis tabletop parallel to bottom axis facing to the right.
-BB Bottom axis cable exit rear, middle axis cable exit right, vertical axis tabletop parallel to bottom axis facing to the left.
-BC Bottom axis cable exit rear, middle axis cable exit right, vertical tabletop parallel to middle axis travel and facing the front.

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Ordering Example	FA130	-50	-50	-25	-T	-P	-R	-AA
		Lower Axis Travel (mm)	Middle Axis Travel (mm)	Vertical Axis Travel (mm)	Opt Rotary Axis 1	Opt Rotary Axis 2	Opt Rotary Axis 3	Orientation
		-25 -50 -100 -150	-25 -50 -100 -150	-25	-T -P -R	-P -R	-R	-AA -AB -BB -BC

FiberAlign 130 Series Fiber Translator

FA130 Direct-drive linear motor, linear-encoder-based fiber translator. XYZ axes aligned to 5 arc sec orthogonal.

Note: Requires clean, dry air supply for pneumatic counterbalance for vertical axis.

Linear Stage Travel

-25 25 mm (1 in) travel stage (vertical axis only)
-50 50 mm (2 in) travel stage (horizontal axes only)
-100 100 mm (4 in) travel stage (horizontal axes only)
-150 150 mm (6 in) travel stage (horizontal axes only)

Optional Rotary Axes (Opt Rotary Axis 1-3)

For reference purposes the "Z" axis is considered to be the middle axis of a three-axis stack, X is the bottom axis, and Y is the vertical axis.

-T Single "planar" rotary axis oriented as yaw, rotation about Y axis (ANT-20RA)
-P Single "goniometer" rotary axis oriented as pitch, rotation about X axis (ANT-20G)
-R Single "goniometer" rotary axis oriented as roll, rotation about Z axis (ANT-20G)
-T-P Dual rotary axis, one planar and one goniometer (50 mm radius), yaw and pitch
-T-R Dual rotary axis, one planar and one goniometer (50 mm radius), yaw and roll
-P-R Dual rotary axis, two goniometers (50 mm and 90 mm), pitch and roll
-T-P-R Triple rotary axis, one planar and two goniometers (50 mm and 90 mm), yaw, pitch, and roll

*The above sequences represent the only valid rotary axis combinations.

Controller Platform

-U500 Includes the required PCI-bus controller and expansion cards, DR300 driverack(s) with cables, MMI, and multidimensional alignment software to support up to sixteen axes of motion.
-U511 Stand-alone controller with RS-232, IEEE-488, or front panel interface and integral amplifiers.
-A3200 Automation 3200 software-only controller

NOTE: The -U511 option is only valid for systems with up to 4 axes. Cannot be used when 2 or 3 rotary axes are selected.

See *Motion Controllers* section for specifications.

Orientation (-AA, -AB, -BB, -BC)

The letters in the orientation correspond to the standard X/Y/Z configurations detailed in Aerotech's PA5 specification. The first letter indicates the orientation of the two horizontal axes and the second letter indicates the orientation of the vertical axes. These four combinations represent the only four standard configurations. Combinations AA-BC, AB-BB can be considered as left- and righthand orientations of the same stack, or mirror images of each other.

-AA Bottom axis cable exit rear, middle axis cable exit left, vertical tabletop parallel to middle axis travel and facing the front.
-AB Bottom axis cable exit rear, middle axis cable exit left, vertical axis tabletop parallel to bottom axis facing to the right.
-BB Bottom axis cable exit rear, middle axis cable exit right, vertical axis tabletop parallel to bottom axis facing to the left.
-BC Bottom axis cable exit rear, middle axis cable exit right, vertical tabletop parallel to middle axis travel and facing the front.

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FiberAlign 130 Ultra-Stable SERIES

- 3-axis fiberoptic alignment
- Noncontact linear motor drive
- 10 nm resolution linear motion
- 300 picometer resolution with Automation 3200
- Low C.T.E. construction
- Insensitive to environmental changes

Introduction

Aerotech's FiberAlign series is a high-performance fiberoptic aligning system incorporating best-in-class drive and state-of-the-art axis control technology. Its modular design permits the selection of the number of axes, the distance to be travelled, and the amount of payload, all at high speed, resolution, and accuracy.

Ultra-Stable Design

In addition to the performance features of the standard FA-130, the Ultra-Stable version is manufactured from low coefficient of thermal expansion materials to provide unparalleled thermal stability in the manufacturing and test environment. The expansion coefficient of these stages is ten times less than those of aluminum construction. The linear encoder is secured to the stage to take advantage of the stability of the base metal. The results are shown in the plots on page 31.

Automated Production

As alignment accuracies, the quest for higher yields, and device volumes increase, the need for a precise, reliable, and repeatable motion system becomes increasingly important. Due to the rapidly changing nature of components and manufacturing processes, flexibility in system configuration becomes a must. Aerotech's FiberAlign product offering responds to and satisfies all of these requirements. More than thirty years of experience serving the high-technology OEM marketplace are reflected in these systems. With the selection of robust system components, high-volume production in a 24/7 manufacturing environment has become a reality.

Advanced Drive Technology

Only noncontact direct-drive technology offers the robust, accurate, high-speed and high-resolution positioning necessary for mass production of precision devices. Aerotech's state-of-the-art patent-pending drive technology offers industry-leading resolution of 10 nanometers. Utilizing ultra-quiet drives and advanced control technology, coupled with high-performance, best-in-class signal multipliers, Aerotech's FiberAlign series offers the best position repeatability, accuracy, and in-position stability to meet the motion system requirements of higher yields.

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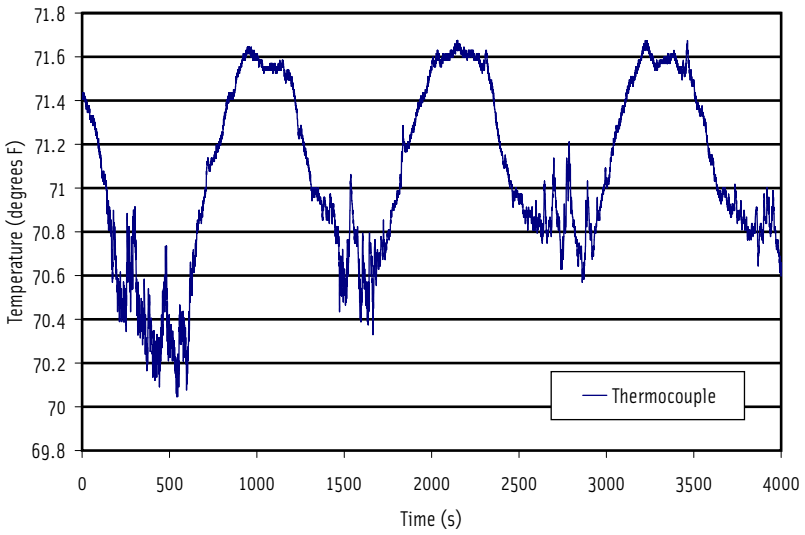
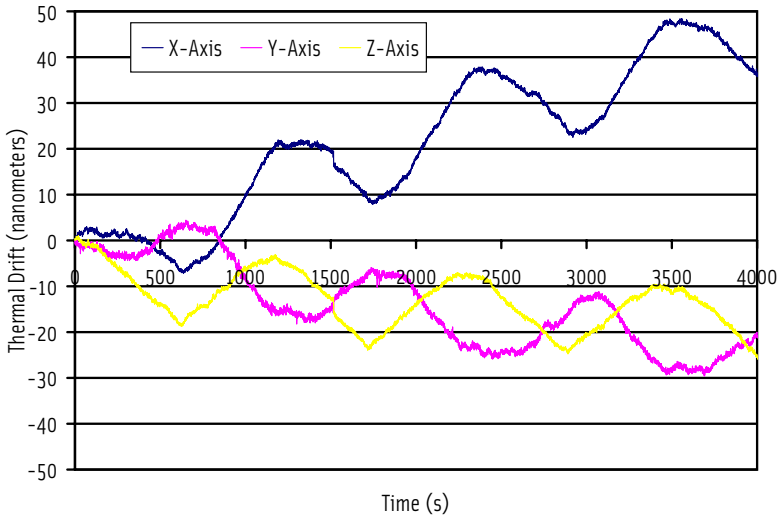
Basic Model	FiberAlign 130US
Total Travel	150 mm (6 in) x 150 mm (6 in) x 25 mm (1 in)
Drive System	Linear Brushless Servomotor
Feedback	Noncontact Linear Encoder
Resolution	10 nm (0.4 µin) (300 picometers with Automation 3200)
Maximum Travel Speed	100 mm/s (4 in/s)
Maximum Load[1]	10 kg (22 lb)
Accuracy[2]	±0.3 µm (±12 µin) per axis[2]; ±3 µm (±120 µin)
Bidirectional Repeatability	±50 nm (±2 µin) per axis[2]; ±100 nm (±4 µin)
Orthogonality	5 arc sec
Finish	Electroless Nickel

Notes: 1. Three-axis configuration.
2. Values with Aerotech controls and HAL option.
3. See drawing on page 27 for outline dimensions.





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Ordering Example	FA130US	-50	-50	-25	-T	-P	-R	-AA
		Lower Axis Travel (mm)	Middle Axis Travel (mm)	Vertical Axis Travel (mm)	Opt Rotary Axis 1	Opt Rotary Axis 2	Opt Rotary Axis 3	Orientation
		-25 -50 -100 -150	-25 -50 -100 -150	-25	-T -P -R	-P -R	-R	-AA -AB -BB -BC

FiberAlign 130 Ultra-Stable Series Fiber Translator

FA130US Direct-drive linear motor, linear-encoder-based fiber translator. XYZ axes aligned to 5 arc sec orthogonal.

Note: Requires clean, dry air supply for pneumatic counterbalance for vertical axis.

Linear Stage Travel

-25 25 mm (1 in) travel stage (vertical axis only)
-50 50 mm (2 in) travel stage (horizontal axes only)
-100 100 mm (4 in) travel stage (horizontal axes only)
-150 150 mm (6 in) travel stage (horizontal axes only)

Optional Rotary Axes (Opt Rotary Axis 1-3)

For reference purposes the "Z" axis is considered to be the middle axis of a three-axis stack, X is the bottom axis, and Y is the vertical axis.

-T Single "planar" rotary axis oriented as yaw, rotation about Y axis (ANT-20RA)
-P Single "goniometer" rotary axis oriented as pitch, rotation about X axis (ANT-20G)
-R Single "goniometer" rotary axis oriented as roll, rotation about Z axis (ANT-20G)
-T-P Dual rotary axis, one planar and one goniometer (50 mm radius), yaw and pitch
-T-R Dual rotary axis, one planar and one goniometer (50 mm radius), yaw and roll
-P-R Dual rotary axis, two goniometers (50 mm and 90 mm), pitch and roll
-T-P-R Triple rotary axis, one planar and two goniometers (50 mm and 90 mm), yaw, pitch, and roll

*The above sequences represent the only valid rotary axis combinations.

Controller Platform

-U500 Includes the required PCI-bus controller and expansion cards, DR300 driverack(s) with cables, MMI, and multidimensional alignment software to support up to sixteen axes of motion.
-U511 Stand-alone controller with RS-232, IEEE-488, or front panel interface and integral amplifiers.
-A3200 Automation 3200 software-only controller

NOTE: The -U511 option is only valid for systems with up to 4 axes. Cannot be used when 2 or 3 rotary axes are selected.

See *Motion Controllers* section for specifications.

Orientation (-AA, -AB, -BB, -BC)

The letters in the orientation correspond to the standard X/Y/Z configurations detailed in Aerotech's PA5 specification. The first letter indicates the orientation of the two horizontal axes and the second letter indicates the orientation of the vertical axes. These four combinations represent the only four standard configurations. Combinations AA-BC, AB-BB can be considered as left- and righthand orientations of the same stack, or mirror images of each other.

-AA Bottom axis cable exit rear, middle axis cable exit left, vertical tabletop parallel to middle axis travel and facing the front.
-AB Bottom axis cable exit rear, middle axis cable exit left, vertical axis tabletop parallel to bottom axis facing to the right.
-BB Bottom axis cable exit rear, middle axis cable exit right, vertical axis tabletop parallel to bottom axis facing to the left.
-BC Bottom axis cable exit rear, middle axis cable exit right, vertical tabletop parallel to middle axis travel and facing the front.

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FiberCouple™ 130 STAGE

- Dual carriage on common bearing
- Independent or coordinated motion
- 10 nm resolution
- 300 picometer with Automation 3200
- Noncontact linear motor drive
- Turnkey drive and control electronics
- Auxiliary Axes Available

Aerotech's FiberCouple 130 is the first system designed to meet the unique demands associated with fiber coupling. Accurately coupling a fiber requires a stage system that is capable of opposing motion, is very accurate in the axial direction, and offers outstanding velocity stability. The FiberCouple 130 optimizes all of these requirements in a compact, precision package.

Dual Carriage Design

A single set of linear bearings ensures that axial motion is true. This approach eliminates the need for cumbersome and time-consuming stage alignments typical of traditional approaches. This compact design also offers greater range of motion for each carriage by allowing each carriage access to the entire range of travel.

Linear Motor Drive

Years of experience serving the OEM marketplace are reflected in this system, which has been designed for 24/7 operation. The linear motor drive of the FiberCouple 130 is a noncontact device, which means there is no maintenance or parts to wear. And unlike a screw-based system, the performance of the stage doesn't change over time, making it the ideal solution for low-maintenance, full-scale production.

Since the linear motor is a direct-drive device, there is no backlash, windup, or friction normally associated with a lead screw or ball-screw drive. The resulting velocity stability is far superior to alternate technologies.

Synchronized Control

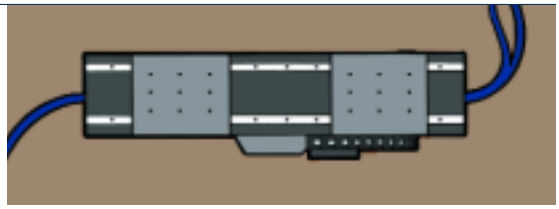
Axes can be operated in a synchronized mode or independently. When synchronized, the position and velocity of each axis is precisely coordinated. They can be commanded to operate in the same or opposite directions with a constant, synchronous velocity. Axes may also be controlled independently, which is useful for setup and load/unload operations. Since both modes are software enabled, users may alternate between them during a single process.

Control Platforms

All of Aerotech's industry leading motion controllers are available to drive a FiberCouple 130 system. Available platforms include the UNIDEX® 500 PCI-bus-based controller with rack-mount or panel-mount amplifiers, or the UNIDEX 511 stand-alone controller with integral amplifiers and front-panel, RS-232 or IEEE-488 interface. All Aerotech controllers come with a range of flexible software packages. These include easy-to-use Windows®-based user interface software, LabVIEW® drivers, and C and Visual Basic® libraries.

AEROTECH ADVANTAGE

By utilizing common bearing rails, both carriages have superior axial alignment.



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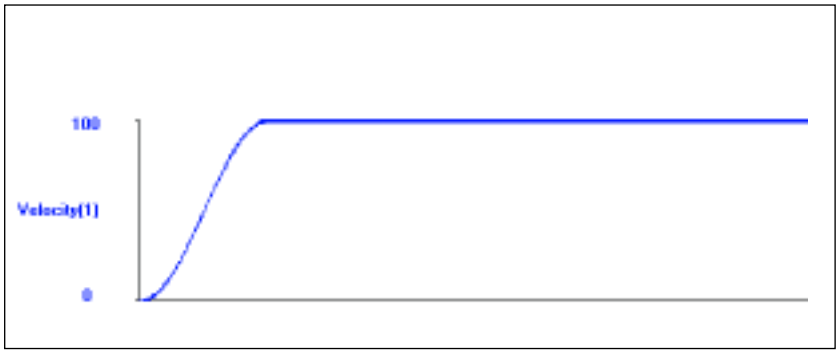
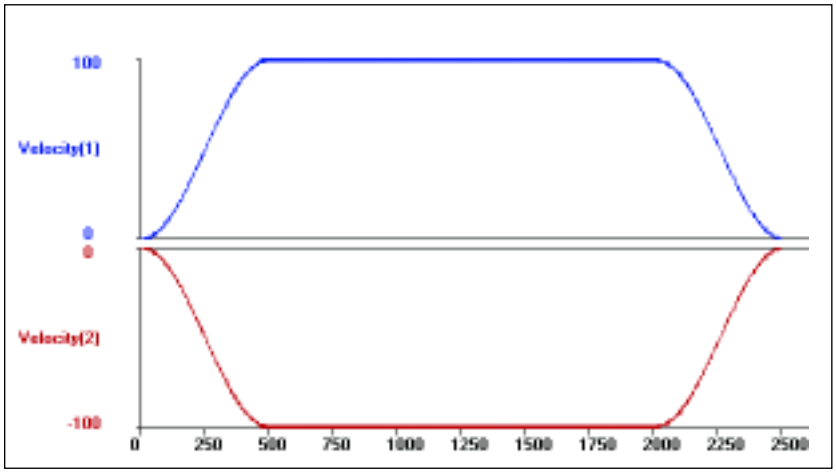
Basic Model	FiberCouple 130
Total Travel	140 mm (5.5 in) travel available to either carriage
Drive System	Dual Linear Brushless Servomotors - BLMUC-95-A
Feedback	Noncontact Linear Encoders
Resolution	10 nm (0.4 µin) (300 picometers with Automation 3200)
Maximum Travel Speed	300 mm/s (12 in/s)
Maximum Load	12.0 kg (26.4 lb)
Accuracy[1]	±0.3 µm (±12 µin) per axis[1]; ±3 µm (±120 µin)
Bidirectional Repeatability	±50 nm (±2 µin) per axis[1]; ±100 nm (±4 µin)
Straightness and Flatness	±2.0 µm (±80 µin)
Material	Aluminum
Finish	Black Anodize

Note: 1. Values with Aerotech controls and HAL option.



Constant Velocity
FiberCouple's linear motor drive yields unparalleled velocity control.



Synchronous Motion
State-of-the-art control algorithms ensure fully coordinated motion.

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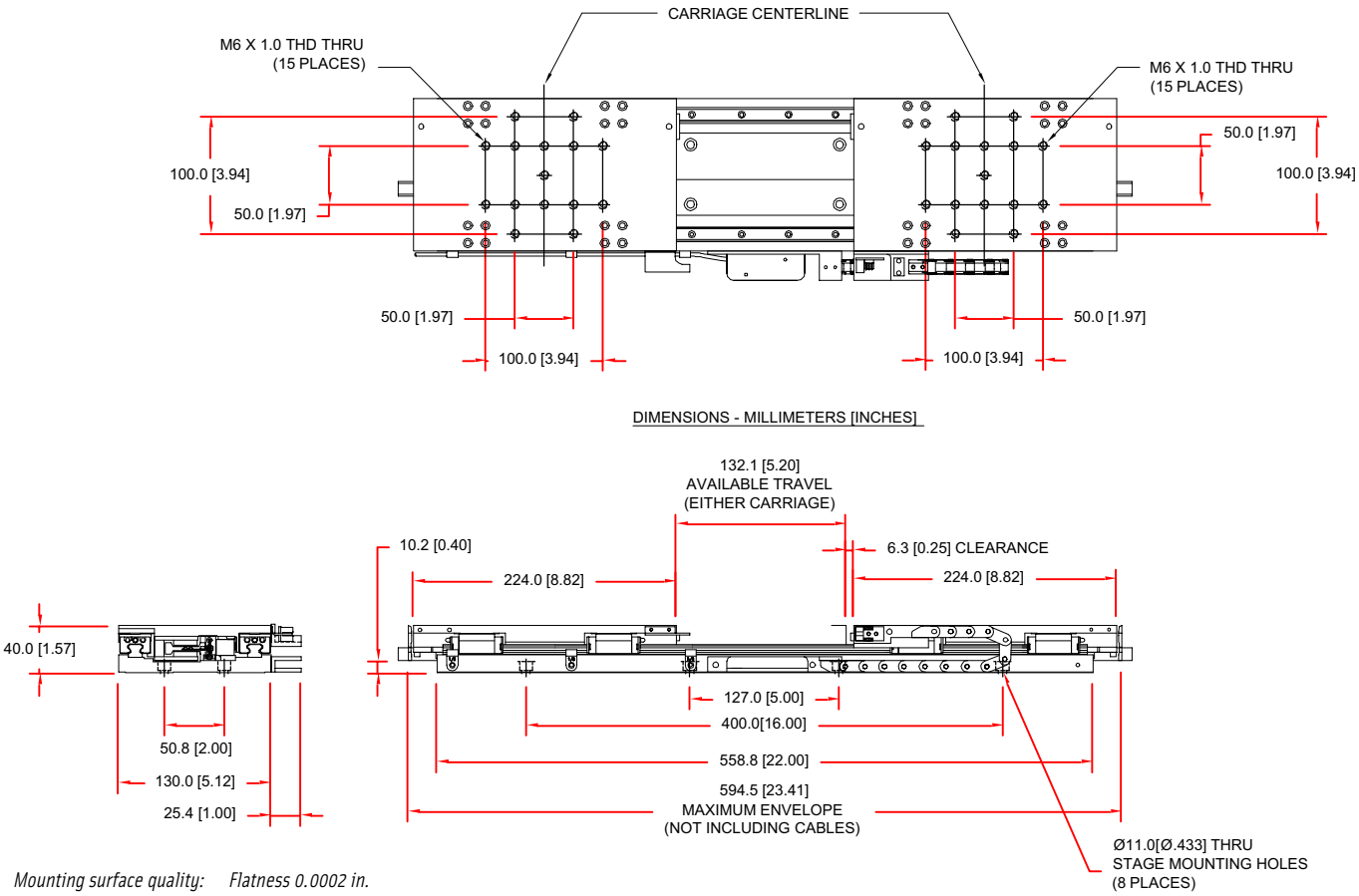

Mounting surface quality: *Flatness 0.0002 in.*
Parallelism 0.0002 in.

Ordering Example	FC130	-140 Travel (mm)
		-140

FiberCouple 130 Series Fiber Positioner

FC130	Linear motor, linear-encoder-based fiber coupling positioner. Independent dual carriages.

Linear Stage Travel

-140	140 mm (5.5 in) total travel. Available to either carriage.

Controller Platform

-U500	PC-bus based controller with DR300 series drive chassis and integral amplifier (AS3005)
-U511	Stand-alone controller with RS-232, IEEE-488, or front-panel interface and integral amplifier (AS3005)
-A3200	Automation 3200 software-only controller

See *Motion Controllers* section for specifications.

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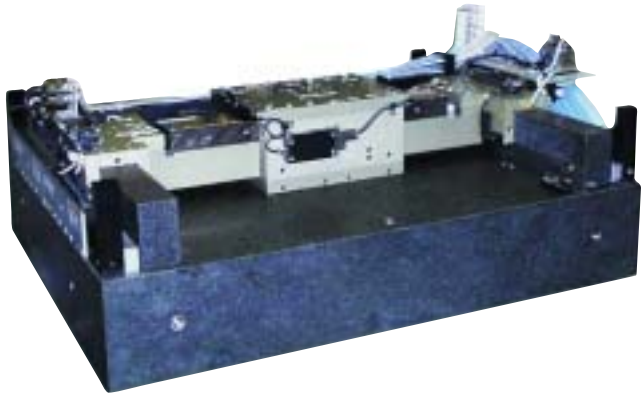
FiberPlane™ 9000 SERIES

- **Frictionless planar air bearing**
- **Turnkey drive and control electronics**
- **Noncontact linear motor drive**
- **Ultra-quiet linear servo drive**
- **Linear encoder or laser interferometer feedback**
- **10 nm to 2 nm resolution linear encoder**
- **0.3 nm resolution laser interferometer**
- **62 picometer resolution with the Automation 3200**
- **Configurations for alignment or waveguide fabrication**



Aerotech's FiberPlane 9000 is the world's highest performance motion system. Designed to meet the exacting requirements of advanced fiberoptics fabrication, FiberPlane 9000 has been successfully deployed in applications ranging from precision fiber alignment to planar waveguide fabrication.

Air Bearing Design

The FiberPlane 9000 incorporates an active preload on both vertical and horizontal surfaces for high mechanical stiffness, servo bandwidth, and repeatability. Proprietary manufacturing techniques result in a stage with unsurpassed geometrical characteristics. In addition, the air-bearing averaging effect further maximizes geometrical performance. This characteristic yields superior pitch, roll, yaw, straightness, and flatness specifications.

Direct Drive

The driving force behind this stage is Aerotech's BLM series brushless linear servomotors. Aerotech's long history and experience as a motor manufacturer are reflected in this latest design. BLM motors utilize ironless forcers, which means there is zero cogging and no attractive forces, resulting in unsurpassed smoothness of motion. Capable of generating high force and velocity, BLM motors represent the ultimate combination of power and performance.

Since the linear motor is a direct-drive device, there is no backlash, windup, or friction normally associated with a lead screw or ball-screw drive. The result is a stage system that is capable of making smaller and more repeatable steps than competing technologies.

Precision Positioning

With resolution options ranging from 10 nm to 0.3 nm per step, FiberPlane 9000 can meet the needs of even the most demanding applications. The planar design has an inherent advantage over stacked systems. Since the overall height is reduced, so are the effects of Abbe error. Unlike complex flexure systems where travel is limited and the motion in one axis introduces unwanted parasitic motion in other axes, all FiberPlane 9000 series are referenced to a common granite surface, eliminating any multi-axis errors.

AEROTECH ADVANTAGE

Laser interferometer feedback is available for maximum accuracy.

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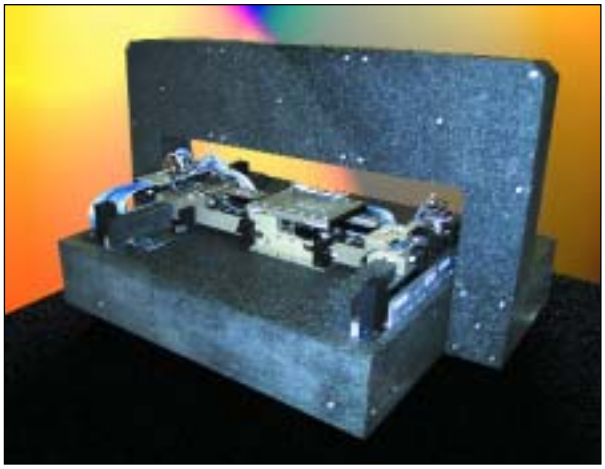
Basic Model		FiberPlane 9000
Total Travel		50 mm x 50 mm (2 in x 2 in) to 350 mm x 350 mm (14 in x 14 in)
Drive System		Linear Brushless Servomotor
Feedback		Noncontact linear encoder or laser interferometer
Resolution		10 nm to 0.3 nm (0.4 µin to 0.01 µin) (300 picometers to 9 picometers with Automation 3200)
Maximum Travel Speed[1]		300 mm/s (12 in/s)
Maximum Load		25.0 kg (55.1 lb)
Overall Accuracy (Travel Dependent)		50 nm/25 mm (2 µin/1 in) of travel with laser interferometer
Repeatability		±5 nm (± 0.2 µin) with laser interferometer
Straightness	**Differential**	±0.25 µm/25 mm (±10 µin/1 in)
and Flatness	**Maximum Deviation**	±0.5 µm (±20 µin)
Pitch / Roll		2 arc sec
Yaw		2 arc sec
Orthogonality		2 arc sec
Operating Pressure[2]		80 psi ±5 psi
Air Consumption[3]		< 2 cfm @ 80 psi (total for all axes)

Notes: 1. Maximum speed based on stage capability; maximum application velocity may be limited by system data rate and system resolution.
2. To protect air bearing against under-pressure, an in-line pressure switch is required and tied to the controller E-stop input.
3. Air supply must be clean, dry to 0° F dew point, and filtered to 0.25 µm or better; recommend nitrogen at 99.99% purity.



Custom stage configurations including granite bases, granite bridges, and machine bases are readily available.

Aerotech has extensive in-house design and manufacturing capabilities. Custom configurations are available for all products.

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FiberGrate™ 2000 SERIES

- **Closed-loop laser interferometer or linear encoder feedback**
- **Fully preloaded air bearing**
- **Advanced PCI-bus-based or Automation 3200 software-only controller**
- **62 picometer resolution with Automation 3200**
- **Low-noise linear amplifiers**
- **Complete noncontact design**
- **Includes granite base and optional vibration isolation system**
- **Ultra-precise velocity control**

FiberGrate is the world's first complete turnkey motion sub-system specifically designed for the manufacture of fiber Bragg gratings. A flexible workspace allows the system to be optimized for the unique needs of each manufacturer.

FiberGrate represents a major evolution as only Aerotech has the breadth of product line to offer a single-source solution that requires no integration by the end-user. All components are designed and manufactured by Aerotech's motion control experts, ensuring a turnkey, fully optimized solution.

Linear Stage

The linear positioner is based on Aerotech's ABL2000 series linear air bearing, and is a fully preloaded, noncontact design. Inherently frictionless, air bearings have proven to be the standard in precision applications. Driven by a noncontact linear brushless servomotor, this stage proves the ultimate solution whether the application requires small, accurate steps or constant smooth velocity. Years of research have resulted in a robust and perturbation-free cable management system. High-flex ribbon cable ensures years of maintenance-free operation.

Feedback and Control System

Aerotech's LZR series laser interferometers provide high stability, high resolution (0.3 nm) feedback. Designed for use with Aerotech's UNIDEX® and Automation 3200 series controllers, the interface between the interferometer and control systems is seamless. The laser is positioned at the height of the fiber and mask to eliminate Abbe error, resulting in exceptional accuracy. For less stringent applications, two different noncontact linear encoders (2 nm or 10 nm resolution) are offered. A wide selection of state-of-the-art UNIDEX-series controllers are available. Options range from single-axis, stand-alone controllers to 16-axis, PC-bus-based control. The Automation 3200 is a software-only controller capable of 32 axes of synchronized control. All of Aerotech's controllers offer position synchronized output pulses to control the laser. In addition, real-time position information may be logged on-board the controller, or read over high-speed parallel or serial interfaces.

Options

The FiberGrate may be configured with standard or custom granite, as well as vibration isolation systems. Additional indexing axes are available and are readily interfaced with the control and drive system. Convenient rack or panel-mount amplifiers are included with all systems. All systems have provisions for customer cabling.

Aerotech's expert technical staff is experienced in custom system designs and will work with you to generate a system to meet the unique needs of your application.

AEROTECH ADVANTAGE

A wide range of feedback options is available to meet the needs of any application.

0.3 nm resolution (5 pm with A3200)

2 nm resolution (62 pm with A3200)

10 nm resolution (300 pm with A3200)

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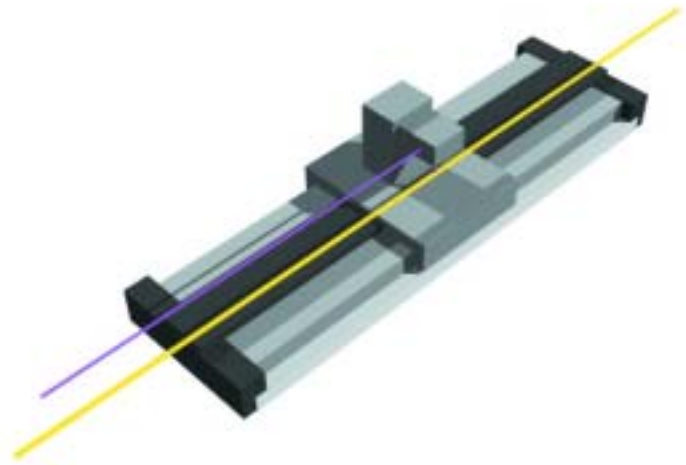
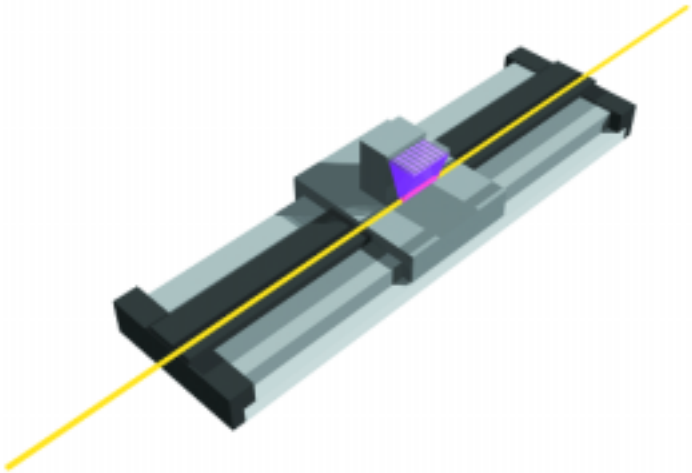


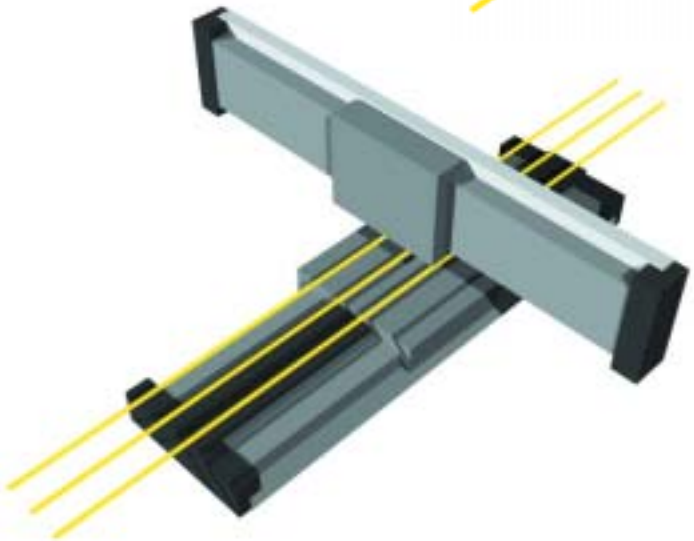
Direct Writing with PSO

Aerotech's Position Synchronized Output (PSO) function triggers laser firing as a function of position, making accurate direct writing possible.



Writing with Mask

Accurate positioning and unparalleled velocity control make FiberGrate the ideal solution for writing with a mask.



Secondary Axes

Aerotech has a wide range of positioning stages. Alternate and custom configurations are readily available.

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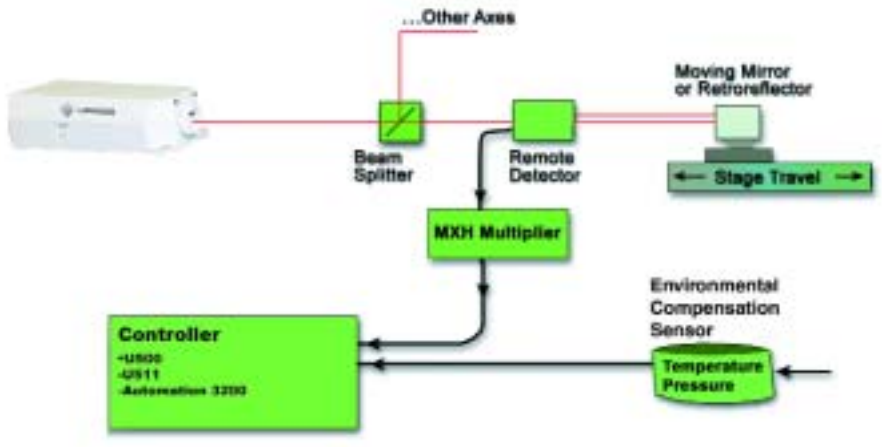
Basic Model		FiberGrate 2000
Total Travel		100 mm to 1.2 m (4 in to 48 in)
Drive System		Linear Brushless Servomotor - BLMC-192-A
Feedback		Laser Interferometer (LZR) or Noncontact Linear Encoder (LN or LT)
Resolution	**LZR**	0.3 nm - 79 nm (0.012 µin - 3.2 µin) (9 picometers with Automation 3200)
	LN	2 nm (0.08 µin) (60 picometers with Automation 3200)
	LT	10 nm (0.4 µin) (300 picometers with Automation 3200)
Maximum Travel Speed[1]		500 mm/s (20 in/s)
Maximum Load		40.0 kg (90.0 lb)
Overall Accuracy	**LZR**	±1.5 ppm
	LN[2]	±0.5 µm (±20 µin) to ±1.0 µm (±40 µin)
	LT[2]	±1 µm (±40 µin) to ±2 µm (±80 µin)
Repeatability	**LZR**	±5 nm (±0.2 µin)
	LN	±0.05 µm (±2 µin) to ±0.2 µm (±8 µin)
	LT	±0.1 µm (±4 µin) to ±0.4 µm (±16 µin)
Straightness and Flatness	**Differential**	±0.25 µm/25 mm (10 µin/1 in)
	Maximum Deviation	±0.25 µm (±10 µin) to ±5.0 µm (±200 µin)
Pitch / Roll / Yaw		±0.25 arc sec/25 mm
Operating Pressure[3]		80 psi ±5 psi
Air Consumption[4]		<1 cfm @ 80 psi
Granite		150 mm to 200 mm thickness laboratory grade
Isolation System		Air Isolation System

Notes: 1. Maximum speed based on stage capability; maximum application velocity may be limited by system data rate and system resolution.
2. With Aerotech controller.
3. To protect air bearing against under-pressure, an in-line pressure switch is required and tied to the controller E-stop input.
4. Air supply must be clean, dry to 0° F dew point, and filtered to 0.25 µm or better; recommend nitrogen at 99.99% purity.



Typical Laser Interferometer Interconnect
Use of a high-speed in-line multiplier eliminates the need for a PC card. The compact remote detector not only improves overall system stability, but enables a more flexible and efficient system layout.

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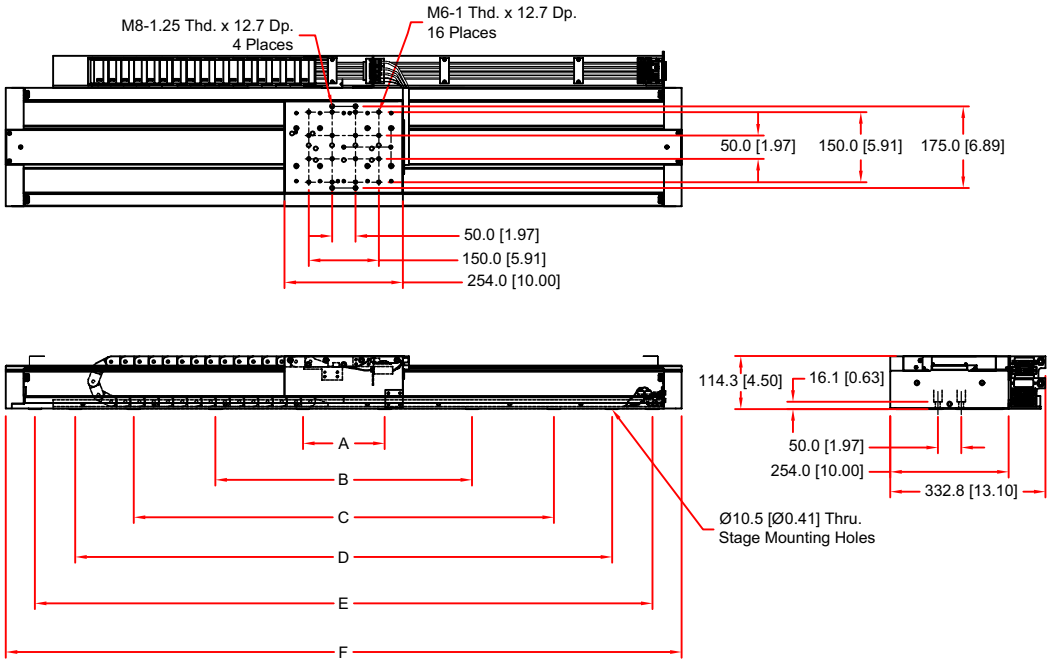

Basic Model	Total Travel	Dimensions -Millimeters [Inches]					
		A	B	C	D	E	F
ABL20010	100.0 [4.00]	175.0 [6.89]	350.0 [13.78]	-	-	-	457.2 [18.00]
ABL20020	200.0 [8.00]	175.0 [6.89]	450.0 [17.72]	-	-	-	558.8 [22.00]
ABL20030	300.0 [12.00]	175.0 [6.89]	550.0 [21.65]	-	-	-	660.4 [26.00]
ABL20040	400.0 [16.00]	175.0 [6.89]	450.0 [17.72]	650.0 [25.59]	-	-	762.0 [30.00]
ABL20050	500.0 [20.00]	175.0 [6.89]	450.0 [17.72]	750.0 [29.53]	-	-	863.6 [34.00]
ABL20075	750.0 [30.00]	175.0 [6.89]	450.0 [17.72]	750.0 [29.53]	1000.0 [39.37]	-	1117.6 [44.00]
ABL20100	1000.0 [40.00]	175.0 [6.89]	550.0 [21.65]	900.0 [35.53]	1250.0 [49.21]	-	1371.6 [54.00]
ABL20120	1200.0 [48.00]	175.0 [6.89]	550.0 [21.65]	900.0 [35.53]	1150.0 [45.76]	1450.0 [57.09]	1574.8 [62.00]

FiberGrate 2000 (ABL 2000 air bearing shown).

Mounting surface quality: *Flatness 0.0002 in.*
Parallelism 0.0002 in.

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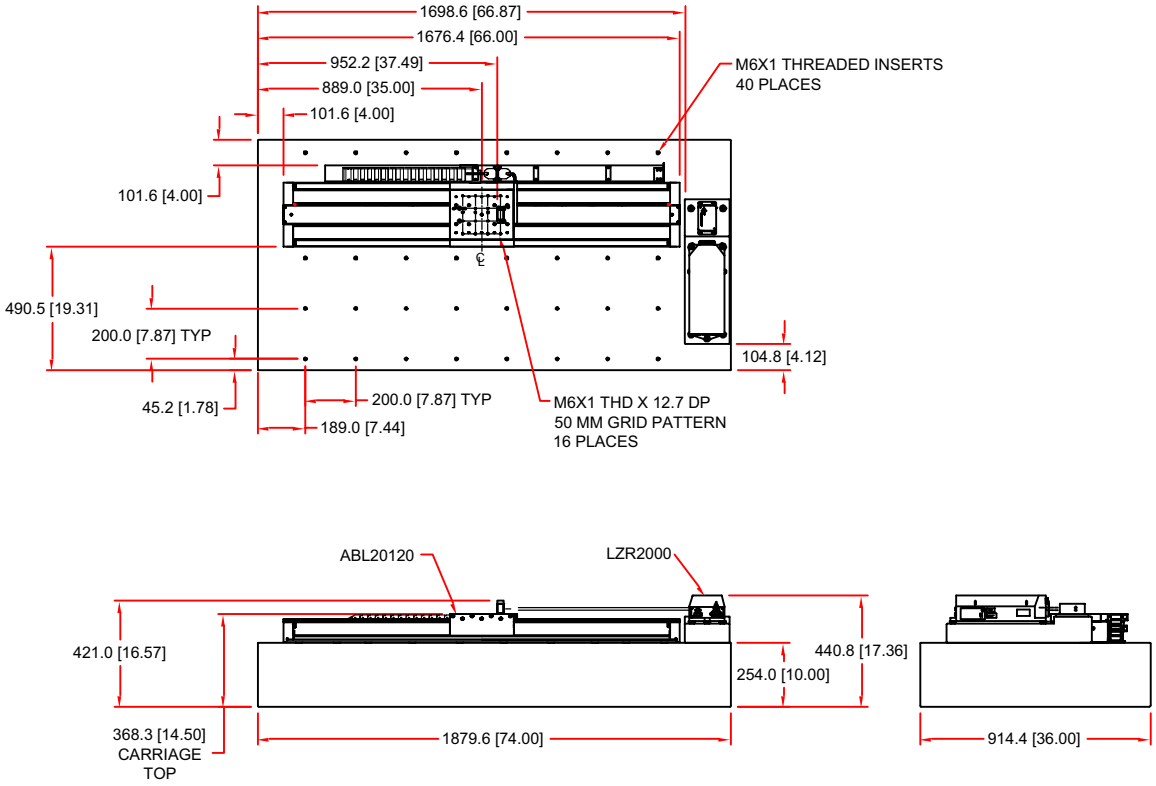

NOTES: 1. MUST BE MOUNTED ON AN AIR ISOLATION SYSTEM.
2. OTHER TRAVEL LENGTHS AVAILABLE. PLEASE CONSULT AEROTECH POSITIONING SYSTEMS CATALOG #6.

FiberGrate 2000 (1.2 m travel shown with typical granite configuration).

Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.

DIMENSIONS - MILLIMETERS [INCHES]

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Ordering Example	FG2000 Series	-1200 Travel (mm)	-LZR Feedback	-GRANITE Options
		-100 -200 -300 -400 -500 -750 -1000 -1200	-LZR -LN -LT	-GRANITE -ISOLATION

FiberGrate 2000 Series Fiber Bragg Grating Positioner

FG2000	Linear air bearing fiber/mask positioner.

Note: Requires clean, dry air supply. In-line under-pressure switch required.

Linear Stage Travel

-100	100 mm (4 in) travel stage with linear motor
-200	200 mm (8 in) travel stage with linear motor
-300	300 mm (12 in) travel stage with linear motor
-400	400 mm (16 in) travel stage with linear motor
-500	500 mm (20 in) travel stage with linear motor
-750	750 mm (30 in) travel stage with linear motor
-1000	1000 mm (40 in) travel stage with linear motor
-1200	1200 mm (48 in) travel stage with linear motor

Feedback

-LZR	Laser interferometer feedback (0.3 nm feedback); includes environmental compensation package
-LNxxAS	High-accuracy linear encoder feedback (2 nm resolution)
-LTxxAS	Linear encoder feedback (10 nm resolution)

Note: Specify travel length 'xx' in cm

Controller Platform

-U500	PC-bus based controller with DR300 series drive chassis and integral amplifier (AS3005)
-U511	Stand-alone controller with RS-232, IEEE-488, or front-panel interface and integral amplifier (AS3005)
-A3200	Automation 3200 software-only controller

See *Motion Controllers* section for specifications.

Options

-GRANITE	Granite to accommodate stage and customer fixturing. Requires user-approved drawing (ESxxxxx) to specify user-defined mounting holes.
-ISOLATION	Vibration isolation system. Requires GRANITE option.

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FiberGlide™ 1000 SERIES

- **Designed for high-performance photonics alignment and assembly**
- **Linear encoder feedback provides 2 nm resolution**
- **62 picometer resolution available with the Automation 3200**
- **Fully preloaded air bearing**
- **Advanced PCI-bus-based controller**
- **Low-noise linear amplifiers**
- **Complete noncontact design**

FiberGlide 1000 series stages are the highest performance miniature air-bearing stages available. Aerotech has combined over 30 years of precision motion control and positioning system experience with the latest technologies to produce a truly outstanding miniature, linear air-bearing stage.

Linear Stage

The linear positioner is a fully preloaded, noncontact design. Inherently frictionless, air bearings have proven to be the standard in precision applications, and Aerotech has now produced a miniature version that is well-suited for the fiberoptics industry. Driven by a noncontact linear brushless servomotor, this stage proves the ultimate solution whether the application requires small, accurate steps or constant smooth velocity. Superior magnetic field and motor coil design result in the highest force output of any miniature air-bearing stage. This stage offers superior servo performance. Years of research have resulted in a robust and perturbation-free cable management system.

Feedback and Control System

A wide selection of state-of-the-art controllers is available, including the Automation 3200 software controller with digital drives, our PCI-bus-based U500, or the stand-alone U511.

Options

Convenient rack or panel-mount amplifiers are included with all systems. Aerotech's expert technical staff is experienced in custom system designs and will work with you to generate a system to meet the unique needs of your application.

AEROTECH ADVANTAGE

A wide range of feedback options is available to meet the needs of any application.

LN – 2 nm resolution

LT – 10 nm resolution

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Basic Model		FiberGlide		
Total Travel		25 mm (1 in)	50 mm (2 in)	100 mm (4 in)
Drive System		Linear Brushless Servomotor		
Feedback		Noncontact Linear Encoder (LN or LT)		
Resolution	**LN**	2 nm (0.08 µin) (60 picometers with Automation 3200)		
	LT	10 nm (0.4 µin) (300 picometers with Automation 3200)		
Maximum Travel Speed[1]		300 mm/s (12 in/s)		
Maximum Load[2]		15.0 kg (33.0 lb)		
Overall Accuracy	**LN**[3]	±0.2 µm (±8 µin)[3]; ±1 µm (±40 µin)	±0.2 µm (±8 µin)[3]; ±1 µm (±40 µin)	±0.2 µm (±8 µin)[3]; ±2 µm (±80 µin)
	LT[3]	±0.3 µm (±12 µin)[3]; ±2 µm (±80 µin)	±0.3 µm (±12 µin)[3]; ±2 µm (±80 µin)	±0.3 µm (±12 µin)[3]; ±5 µm (±200 µin)
Repeatability	**LN**[3]		±50 nm (±2 µin)	
	LT[3]		±50 nm (±2 µin)[3]; ±100 nm (±4 µin)	
Straightness and Flatness	**Differential**		0.25 µm/25 mm (10 µin/in)	
	Maximum Deviation	±0.25 µm (±10 µin)	±0.25 µm (±10 µin)	±0.4 µm (±16 µin)
Pitch / Roll / Yaw		±0.25 arc sec/25 mm		
Operating Pressure[4]		80 psi ±5 psi		
Air Consumption[5]		<0.3 cfm @ 80 psi		

Notes: 1. Maximum speed based on stage capability; maximum application velocity may be limited by system data rate and system resolution.
2. Max load for XY configuration is 10.0 kg.
3. Values with Aerotech controls and HAL option.
4. To protect air bearing against under-pressure, an in-line pressure switch is required and tied to the controller E-stop input.
5. Air supply must be clean, dry to 0° F dew point, and filtered to 0.25 µm or better; recommend nitrogen at 99.99% purity.

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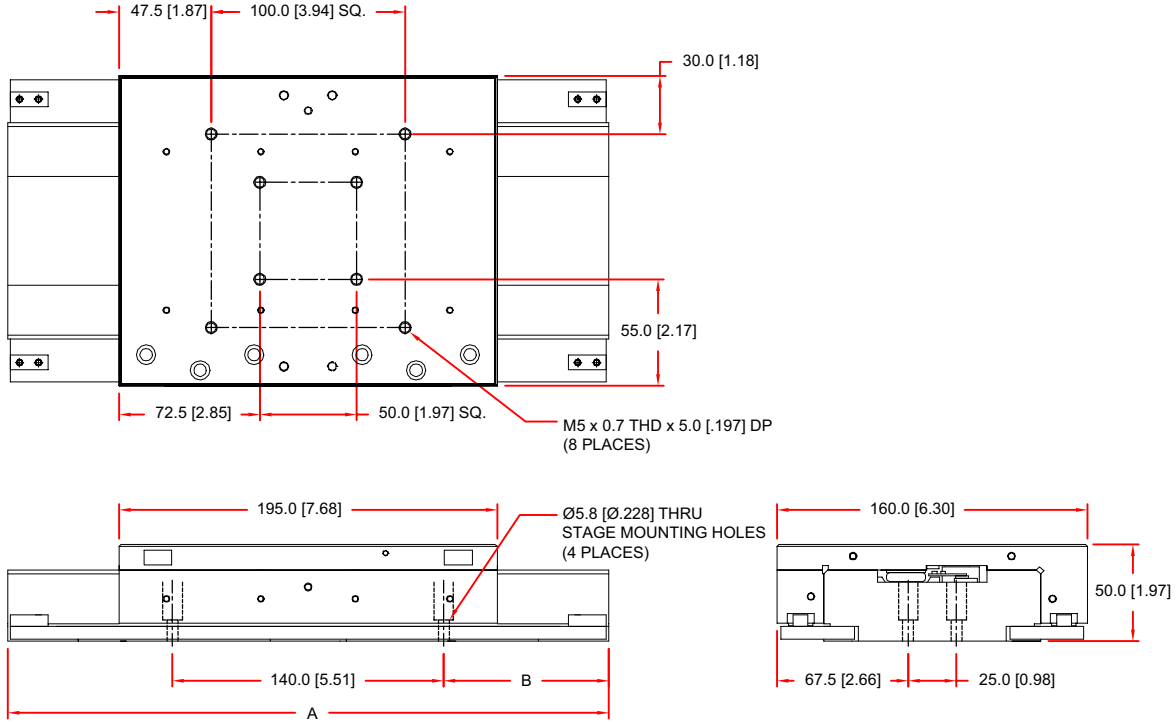

Basic Model	Total Travel	Dimensions - Millimeters [Inches]	
		A	B
FG-10025	25.0 [1.00]	235.0 [9.25]	47.5 [1.87]
FG-10050	50.0 [2.00]	260.0 [10.24]	60.0 [2.36]
FG-10100	100.0 [4.00]	310.0 [12.20]	85.0 [3.35]

All stages shown at center of travel.
Mounting surface quality: Flatness 0.0001 in.

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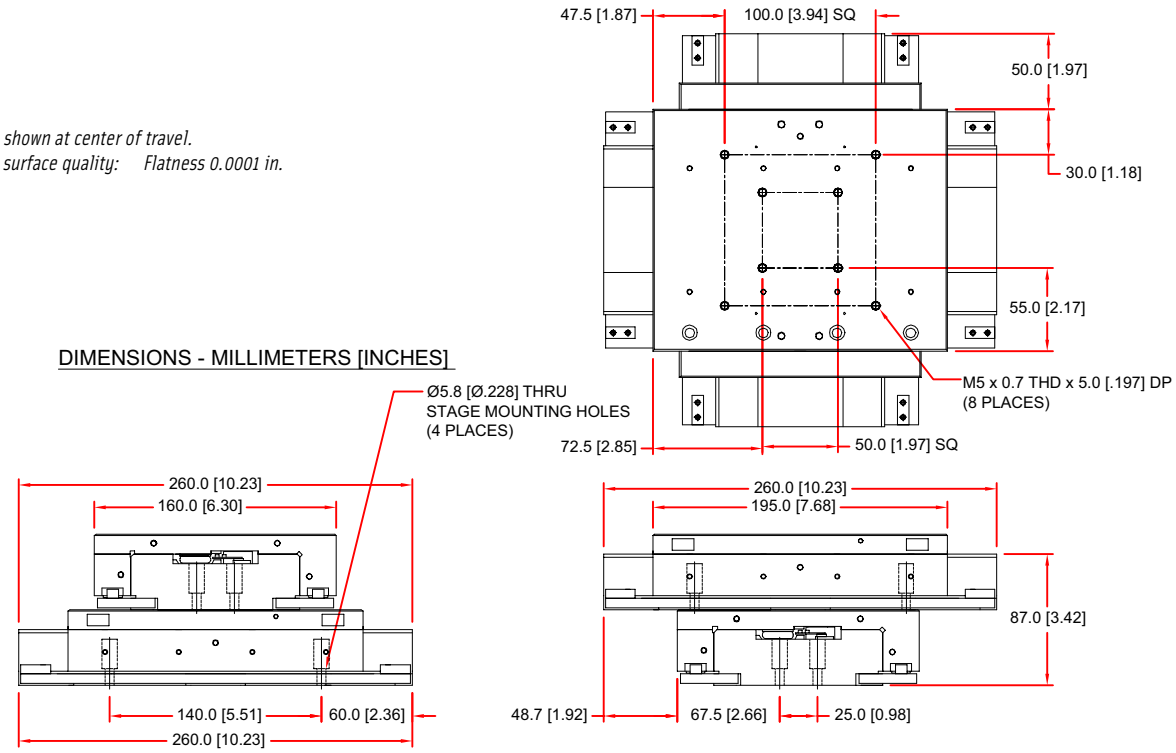
All stages shown at center of travel.
Mounting surface quality: Flatness 0.0001 in.

DIMENSIONS - MILLIMETERS [INCHES]



Ordering Example	FG1000 Series	-100 Travel	-LT Feedback
		-25 -50 -100	-LT -LN -LT/lower -LN/lower -LT/upper -LN/upper

FiberGlide 1000 Series Photonics Alignment and Assembly System

FG1000	Linear air bearing positioner

Note: Requires clean, dry air supply. In-line under-pressure switch provided.

Linear Stage Travel (X, Y)

-25	25 mm (1 in) travel stage with linear motor
-50	50 mm (2 in) travel stage with linear motor
-100	100 mm (4 in) travel stage with linear motor

Feedback

-LT	Linear encoder feedback (10 nm resolution), amplified sine output
-LN	High-accuracy linear encoder feedback (2 nm resolution), amplified sine output
-LT/lower	LT option with lower axis cable management
-LN/lower	LN option with lower axis cable management
-LT/upper	LT option with upper axis cable management
-LN/upper	LN option with upper axis cable management

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ANT™ STAGES | Aerotech Nano-Translators

- **Available in X, XY, XYZ, and many other combinations utilizing vertical lift and rotary stages, and goniometers**
- **10 nm linear resolution**
- **300 picometer with Automation 3200**
- **0.027 arc-sec angular resolution**
- **Turnkey drive and control electronics**
- **Noncontact, non-cogging, direct-drive (patent pending)**
- **Ultra-quiet linear servo drives**
- **High speed, real-time axis calibration**

ANT-25L and ANT-50L
Patents Pending

ANT-25LA
Patents Pending

ANT-20G-50 and ANT-20G-90
Patent Pending

ANT-4V
US Patent 5,731,641
Others Pending

ANT-20RA
Patent Pending

Introduction

Aerotech's Nano-Translation (ANT™) stages are clearly the best-in-class in combining speed, accuracy, resolution, repeatability, reliability, and size. No other automation tool manufacturer has successfully combined all of these features into a single product offering designed to meet the rigors of a 24/7 manufacturing environment. The Aerotech Nano-Translation stage series is ready to take your manufacturing alignment or test process to the next level.

Noncontact Direct Drive

Only noncontact direct-drive technology offers the robust, accurate, and high-speed positioning necessary for mass production of precision devices. ANT stages utilize advanced direct-drive technology pioneered by Aerotech (patent pending) to achieve the highest level of positioning performance. This direct-drive technology is high-performance, non-cogging, noncontact, high-speed, high-resolution, and high-accuracy. This unique drive technology offers a significant (several times higher) throughput advantage over conventional screw and piezo-drive-based systems.

Linear and Rotary Solutions

The ANT series consists of both linear and rotary components. The ANT-25L and ANT-50L stages can be mounted flat or on edge for maximum flexibility. Three vertical linear versions are available in travels of 4 mm (ANT-4V), 25 mm (ANT-25LV), and 50 mm (ANT-50LV). A planar rotary translator, the ANT-20RA, and two goniometric cradles, ANT-20G-50/90, also are available. In addition, Aerotech offers a rod-type linear actuator (ANT-25LA) with 25 mm of travel that can be used in place of micrometers to automate manual positioning elements. These components can be combined in numerous configurations to create motion platforms tailored to meet specific process requirements.

System Characteristics

Outstanding accuracy, position repeatability, and in-position stability require high system resolution. ANT's industry-leading resolution – 10 nanometer closed-loop resolution on linear stages, 2 nm resolution for ANT-4V, and 0.027 arc-sec resolution for rotary stages – provides this high level of performance. Advanced, patent-pending real-time axis calibration systems allow the highest level of system accuracy. High-speed, 32 megahertz electronic circuitry enables extremely fast positioning, over 250 mm per second, even at 10 nanometer resolution. Excellent in-position stability, assisted by high-quality, no-creep linear bearings, enable virtually maintenance-free operation over the life of the product. Aerotech's direct-drive technology has no hysteresis or backlash, enabling accurate and repeatable nanometer-scale motion.

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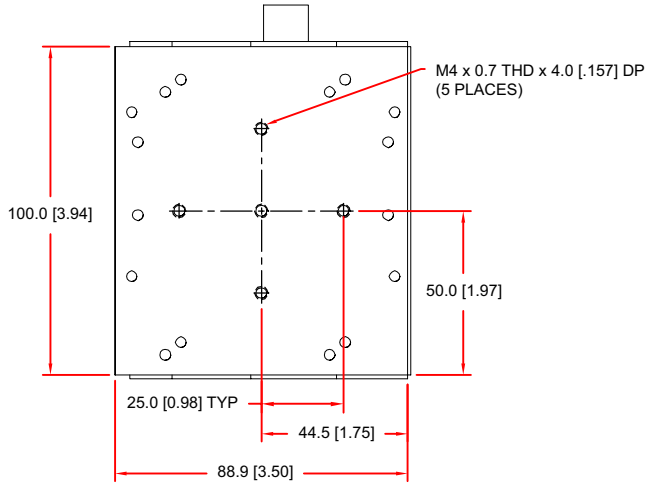
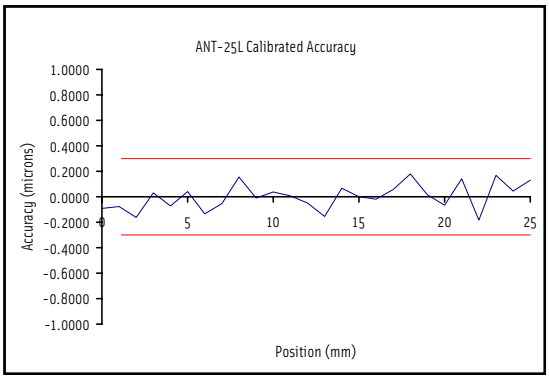
The ANT-25L and -50L can be used in side-mount configuration. Patents Pending

ANT-25L/-50L	25 mm	50 mm
Length x Width x Height	100 mm x 90 mm x 33 mm	141 mm x 90 mm x 33 mm
Travel	25 mm	50 mm
Resolution	10 nm (300 picometers with Automation 3200)	
Accuracy[1]	±0.3 µm per axis[1]; ±3 µm standard	±0.3 µm per axis[1]; ±5 µm standard
Repeatability	±50 nm (±2 µin) per axis[1]; ±100 nm (±4 µin)	
Max Load	5 kg	
Velocity	250 mm/s	
Nominal Stage Weight	0.8 kg (1.8 lb)	1.2 kg (2.7 lb)

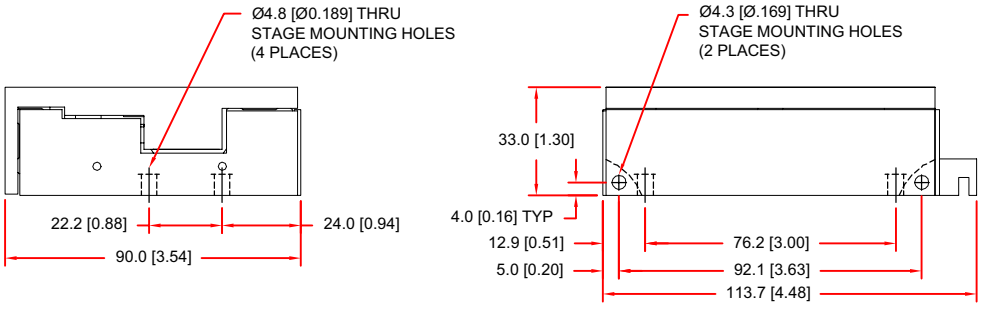
**Standard cable length is 1 meter.*

Note: 1. Values with Aerotech controls and HAL option.





DIMENSIONS - MILLIMETERS [INCHES]



All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.

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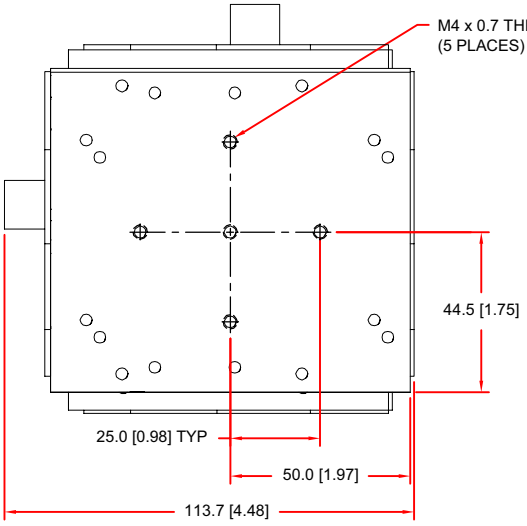
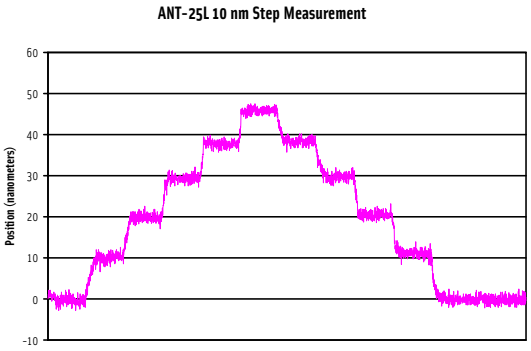
ANT-25L XY/-50L XY	25 mm	50 mm
Length x Width x Height	100 mm x 100 mm x 66 mm	141 mm x 141 mm x 66 mm
Travel	25 mm x 25 mm	50 mm x 50 mm
Resolution	10 nm (300 picometers with Automation 3200)	
Accuracy[1]	±0.3 µm per axis[1]; ±3 µm standard	±0.3 µm per axis[1]; ±5 µm standard
Repeatability	±50 nm (±2 µin) per axis[1]; ±100 nm (±4 µin)	
Velocity	250 mm/s	

Note: 1. Value with Aerotech controls and HAL option.

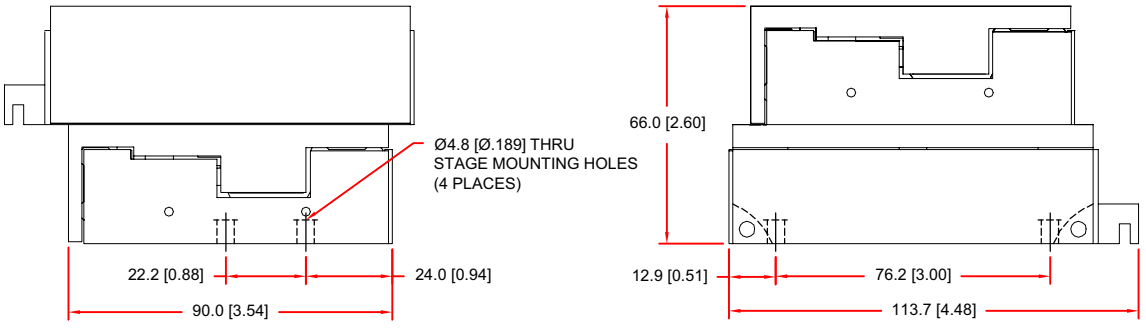
ANT-25L XY
Patents Pending





All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.

DIMENSIONS - MILLIMETERS [INCHES]



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- High-performance linear actuator
- Noncontact, noncogging direct-drive
- Glass scale encoder
- High speed (250 mm/s)
- 10 nm linear resolution
- Turnkey drive and control electronics
- Ultra-quiet servo drives

ANT-25LA

Introduction

Aerotech's ANT-25LA direct-drive linear actuator is designed and manufactured to overcome the inherent shortcomings of existing screw-based designs.

Noncontact Direct Drive

Only a noncontact linear motor drive with linear encoder feedback offers the high resolution, backlash- and windup-free drivetrain essential to meet the exacting positioning requirements of nano-positioners.

This robust, high-speed actuator employs linear motion guide bearings, and a glass linear encoder equipped with home marker and optical limits. These elements are connected directly to the output spindle assembly which is constrained in low-friction bearings.

This directly-coupled mechanical configuration allows backlash-free operation, very high industry-leading 10 nanometer resolution, excellent repeatability, in-position stability, and very high positioning speed exceeding 250 mm per second. The tip of the actuator output shaft is tapped with a standard 2 mm thread to facilitate the acceptance of threaded-ball or clip assemblies.

Maintenance-Free Operation

The ANT-25LA linear actuator is the result of more than thirty years of experience in designing high accuracy positioning components. It is designed to meet the rigors of a 24/7 manufacturing environment since the drivetrain of the actuator is a noncontact device requiring no maintenance. It is the ideal actuator for trouble-free full-scale production.

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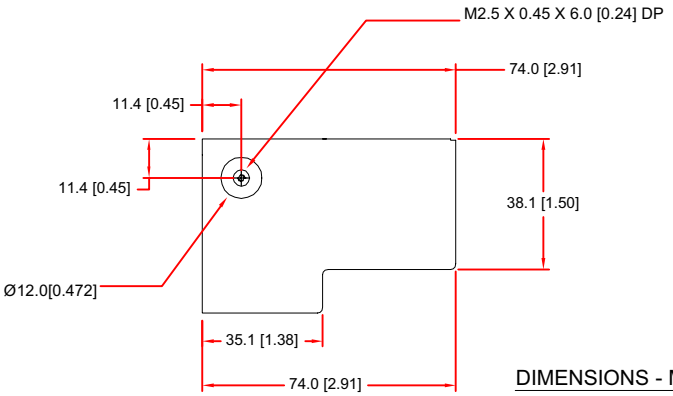
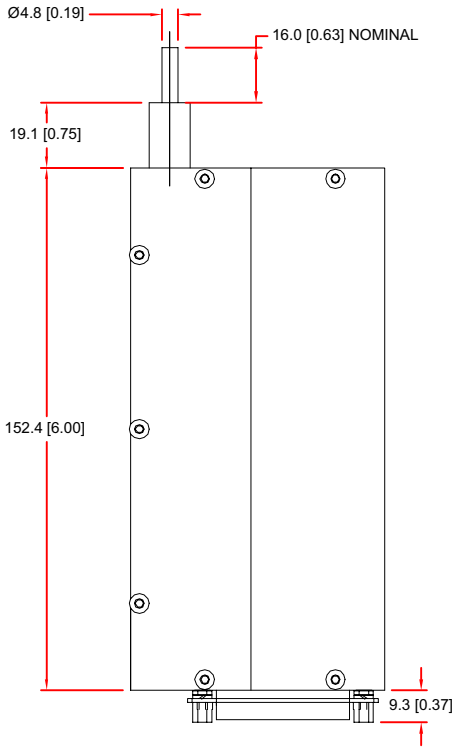
ANT-25LA (Linear Actuator)

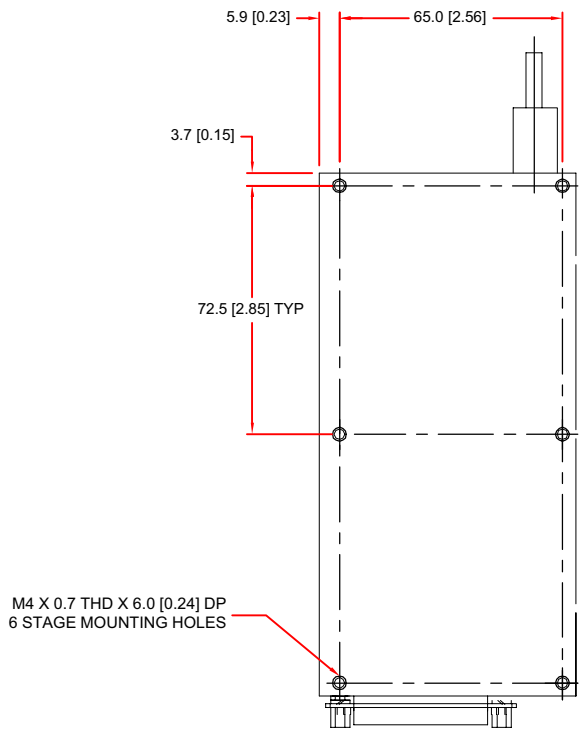
Travel	25 mm
Resolution	10 nm
Max Load	1 kg
Velocity	250 mm/s

**Standard cable length is 1 meter.*



DIMENSIONS - MILLIMETERS [INCHES]





BOTTOM VIEW

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ANT™ VERTICAL LIFT STAGE | ANT-4V

- **Compact construction**
- **Outstanding rigidity**
- **Noncontact direct drive**
- **2 nm resolution; 60 picometers with Automation 3200**
- **High repeatability**
- **Outstanding in-position stability**
- **No maintenance**

ANT-4V
US Patent 5,731,641
Others Pending

The ANT-4V represents a significant breakthrough in vertical alignment of high-precision components. This unique, patented device incorporates the best high-performance features: high speed (50 mm per second), high resolution (2 nm), superior in-position stability, and high accuracy (200 nm), in one compact package.

Its superior noncontact direct drive employs a high-accuracy glass encoder for direct position feedback. When combined with Aerotech's MXH multiplier, it offers an industry-leading 2 nm resolution in addition to high speed and accuracy.

All the critical elements of the ANT-4V were selected to operate in a 24/7 industrial environment and, unlike screw- or piezo-based vertical stages, the ANT-4V requires no maintenance and will assure years of trouble-free operation.

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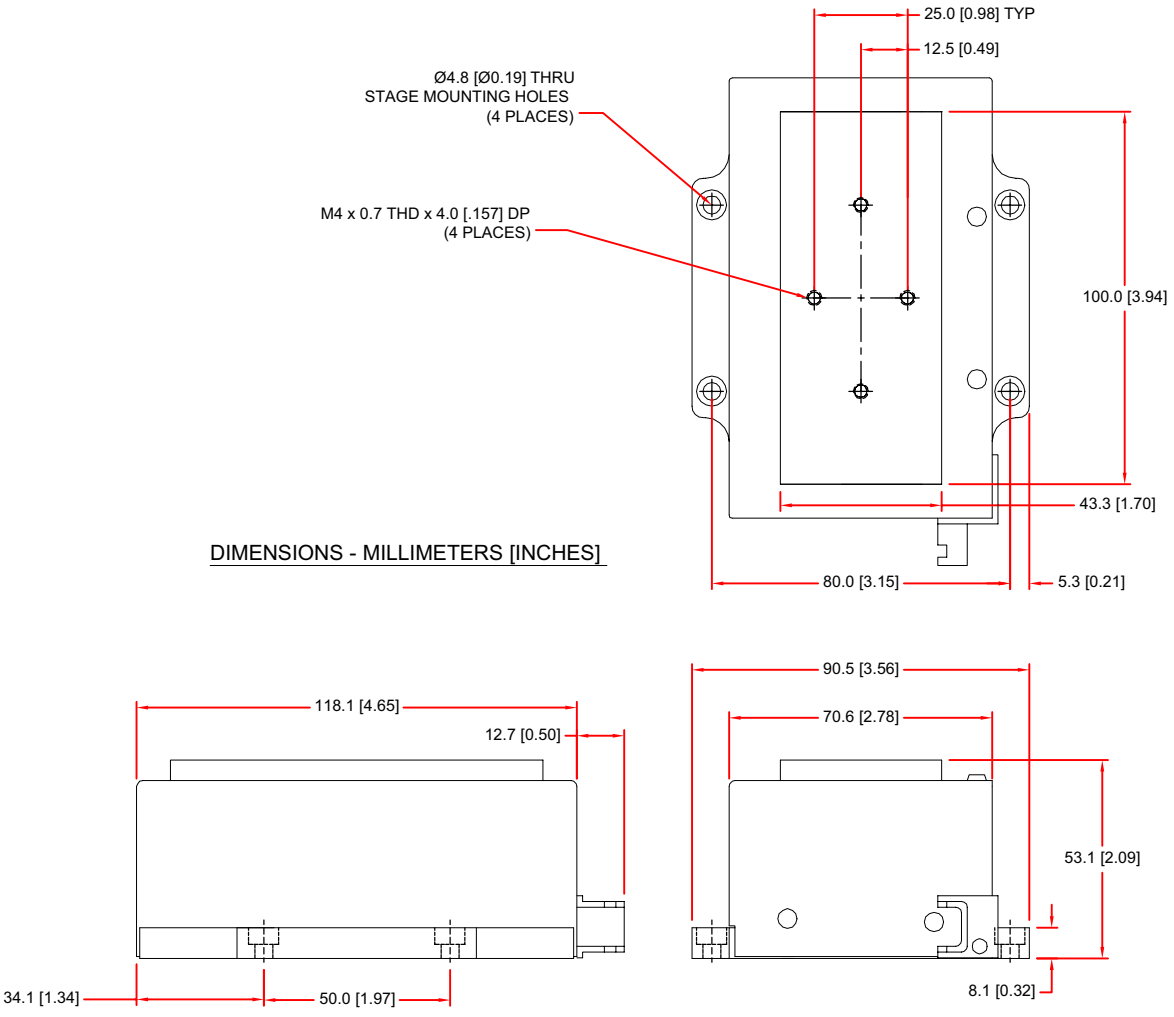
ANT-4V (Vertical Lift Stage)

Length x Width x Height	118 mm x 90 mm x 53 mm
Travel	4 mm
Resolution	2 nm (60 picometers with Automation 3200)
Repeatability[1]	±50 nm (±2 µin)[1]; ±100 nm (±4 µin)
Max Load	4 kg
Velocity	50 mm/s
Nominal Stage Weight	1.4 kg (3.1 lb)

**Standard cable length is 1 meter.*

Note: 1. Value with Aerotech controls and HAL option.



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- **Compact design**
- **Large angular range**
- **Easy fixturing**
- **Noncontact direct drive**
- **High speed and high resolution**
- **Excellent in-position stability**
- **No maintenance**
- **20 degrees travel**

ANT-20G-50 (left) and ANT-20G-90
Patent Pending

Aerotech's ANT-20G goniometers represent a significant breakthrough in high-accuracy angular alignment of optical components. This unique design utilizes Aerotech's best-in-class direct-drive noncontact motor technology. When used with Aerotech's MXH multiplier, the ANT-20G series provides an industry-leading positioning speed of 150 degrees per second.

High-precision bearings, linear encoder feedback, and noncontact and noncogging direct-drive technology assure the highest level of performance and make excellent repeatability and in-position stability a reality.

The critical elements of the ANT-20G goniometers, as with all other ANT series nano-positioners, were selected to operate in a 24/7 manufacturing environment. Unlike worm- or piezo-driven goniometers, the ANT-20G series will not require periodic adjustment or maintenance. This will assure many years of trouble-free operation.

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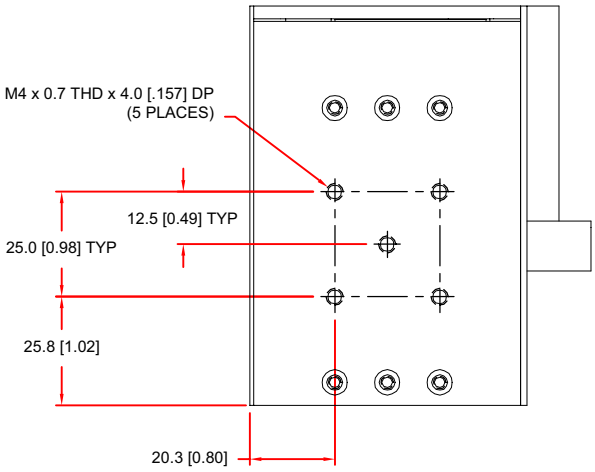
ANT-20G-50 (Goniometer)

Length x Width x Height	95 mm x 81 mm x 38 mm
Transverse Axis Radius	50 mm
Travel	20 degrees
Resolution	0.058 arc-second (0.0018 arc sec with Automation 3200)
Accuracy[1]	±10 arc-second
Repeatability	±0.5 arc-second
Max Load	1.5 kg
Velocity	150 degrees per second
Nominal Stage Weight	0.55 kg (1.2 lb)

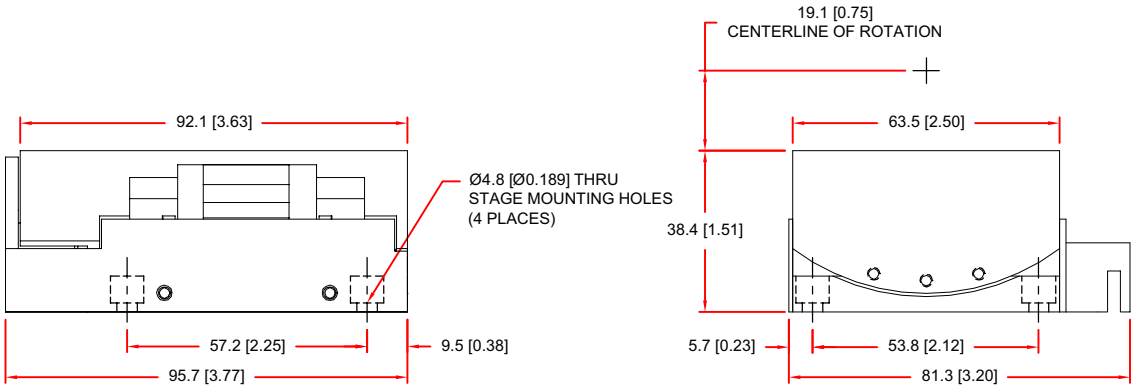
Notes: 1. Value with Aerotech controls and HAL option.
2. Standard cable length is 1 meter.

ANT-20G-50
Patent Pending

All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.



DIMENSIONS - MILLIMETERS [INCHES]



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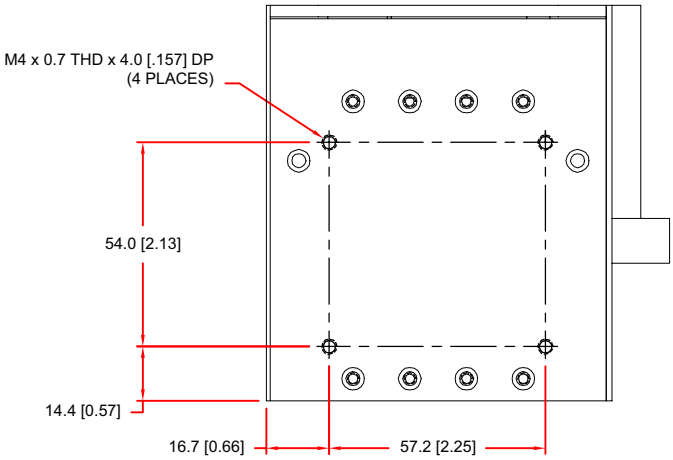
ANT-20G-90 (Goniometer)

Length x Width x Height	105 mm x 107 mm x 42 mm
Transverse Axis Radius	90 mm
Travel	20 degrees
Resolution	0.027 arc-second (0.00082 arc sec with Automation 3200)
Accuracy(1)	±10 arc-second
Repeatability	±0.5 arc-second
Max Load	2.0 kg
Velocity	150 degrees per second
Nominal Stage Weight	1.1 kg (2.4 lb)

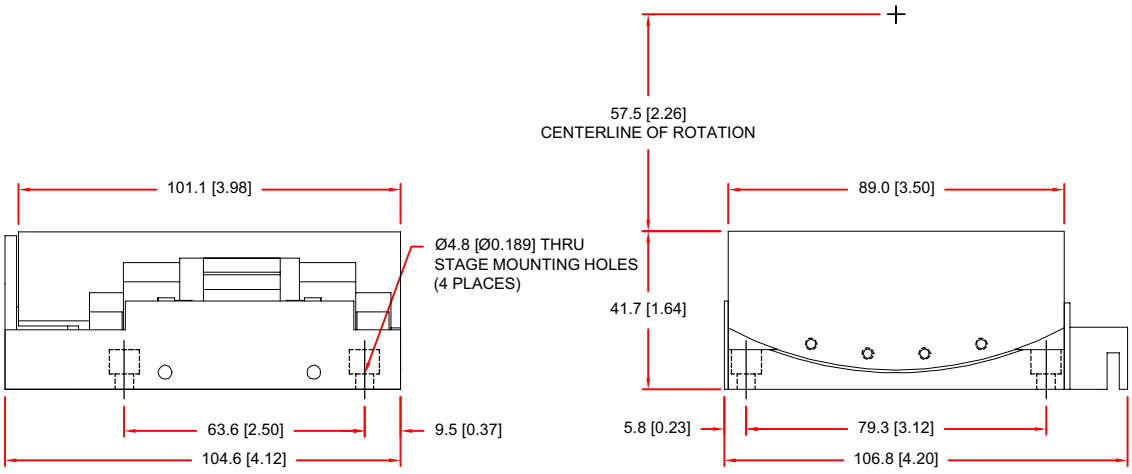
Notes: 1. Value with Aerotech controls and HAL option.
2. Standard cable length is 1 meter.

ANT-20G-90
Patent Pending

All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.



DIMENSIONS - MILLIMETERS [INCHES]



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ANT™ ROTARY ACTUATOR | ANT-20RA

- 0.045 arc-second resolution
- Compact design
- Large angular range
- Noncontact direct drive
- High speed and high resolution
- Excellent in-position stability
- No maintenance
- 20 degrees travel

ANT-20RA
Patents Pending

Aerotech's ANT-20RA is a high-performance rotary actuator specifically designed to be attached to ANT, FiberAlign 90 and 130 series nano-positioners. When combined with a universal base, the ANT-20RA can be easily mounted to any surface and perform rotation through a large angle in all three angular directions – roll, pitch, and yaw.

This unique design utilizes advanced patent-pending direct-drive technology combined with a high accuracy encoder and patent-pending high-resolution signal multiplier to offer both high speed and high resolution positioning. Angular positioning accuracy can be increased by the application of axis calibration.

Industry leading 0.045 arc-second resolution permits the finest alignment possible, assuring excellent in-position stability and repeatability throughout the manufacturing process.

All the critical elements of the ANT-20RA were carefully selected to enable optimized performance, to avoid any requirement for maintenance, and to permit robust operation in a 24/7 industrial environment for many years.

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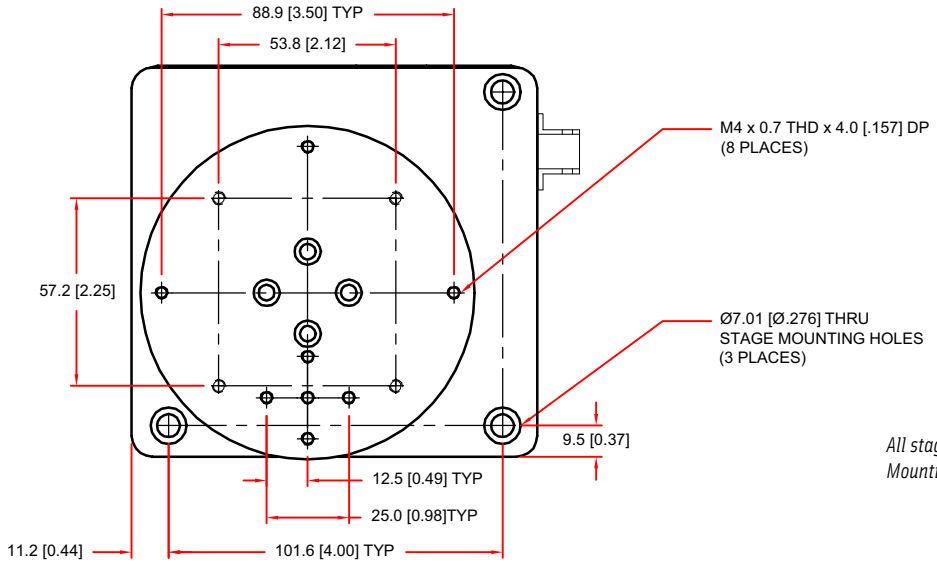
ANT-20RA (Rotary Actuator)	
Length x Width x Height	136 mm x 120 mm x 67 mm
– with ANT-4V	145 mm x 118 mm x 90 mm
Angular Range	20 degrees
Resolution	0.045 arc-second (0.0014 arc sec with Automation 3200)
Accuracy(1)	±10 arc-second
Repeatability	±0.5 arc-second
Max Load	2.5 kg
Velocity	150 degrees per second
Nominal Stage Weight	1.6 kg (3.6 lb)
-20RA/4V Combination	2.3 kg (5.0 lb)

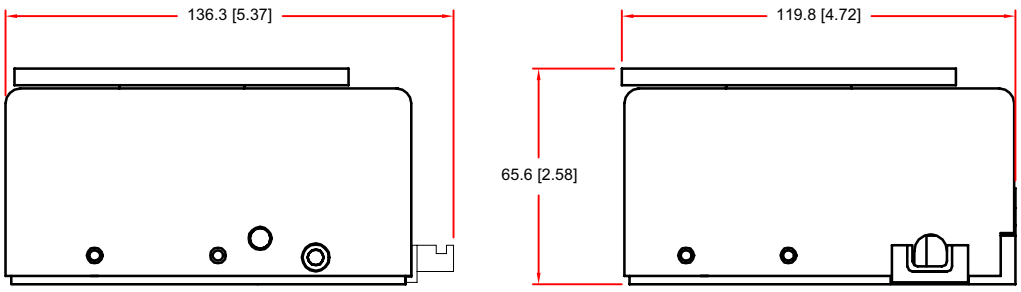
Notes: 1. Value with Aerotech controls and HAL option.
2. Standard cable length is 1 meter.

ANT-20RA



All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.

DIMENSIONS - MILLIMETERS [INCHES]



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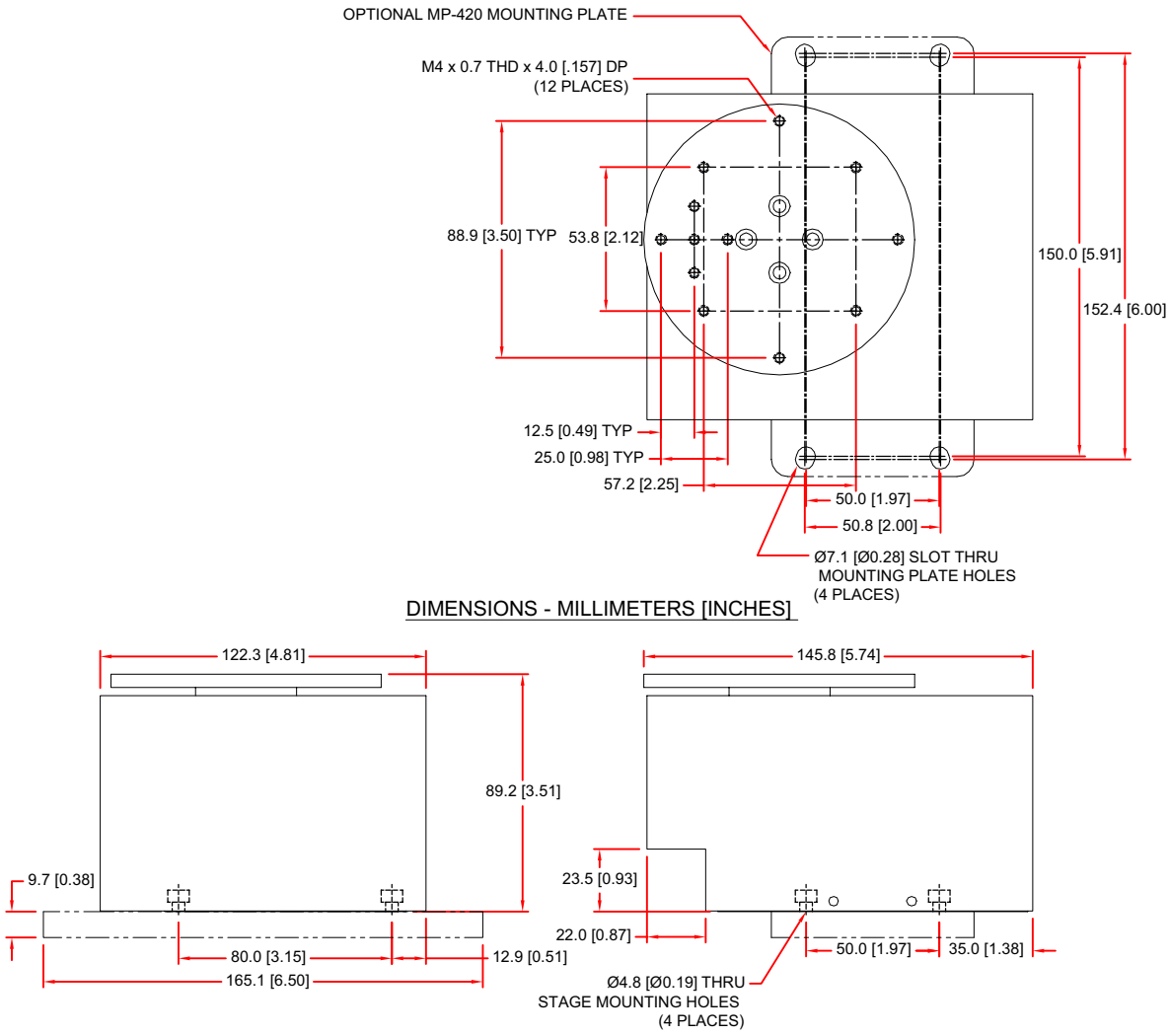
ANT-20RA with the ANT-4V Lift Stage



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Ordering Information

ANT-25L	25 mm (1 in) travel stage with proprietary direct-drive motor technology, 20 micron pitch sinusoidal output linear encoder and limits.
ANT-50L	50 mm (2 in) travel stage with proprietary direct-drive motor technology, 20 micron pitch sinusoidal output linear encoder and limits.
ANT-25LA	25 mm (1 in) travel linear rod actuator with proprietary direct-drive motor technology, 20 micron pitch sinusoidal output linear encoder and limits.
ANT-25LV	25 mm (1 in) vertical travel stage with proprietary direct-drive motor technology, 20 micron pitch sinusoidal output linear encoder and custom mounting bracket with integrated pneumatic counterbalance and limits.
ANT-4V	4 mm (0.157 in) vertical travel lift stage with proprietary direct-drive motor technology, effective 4 micron pitch sinusoidal output linear encoder and limits.
ANT-20RA	20 degree rotary travel stage with proprietary direct-drive motor technology, limits, and sinusoidal linear encoder with 85 arc-sec resolution (before multiplication). Includes fixture for stand-alone operation or mounting to ANT-25LV or ALS-130 series stages. Tabletop options include STD (standard) for four- and five-axis versions, and G90 for six-axis versions.
ANT-4V-20RA	20 degree rotary travel stage with proprietary direct-drive motor technology, limits, and sinusoidal linear encoder with 85 arc-sec resolution (before multiplication). Includes 4 mm (0.157 in) vertical travel lift stage with proprietary direct-drive motor technology, 4 micron pitch sinusoidal output linear encoder and limits. Tabletop options include STD (standard) for four- and five-axis versions, and G90 for six-axis versions. Also, the six-axis version is available with the MP-420 option, a breadboard mounting plate.
ANT-20G-50	20 degree travel goniometer with proprietary direct-drive motor technology, 50 mm radius, limits, and sinusoidal linear encoder with 85 arc-sec resolution (before multiplication).
ANT-20G-90	20 degree travel goniometer with proprietary direct-drive motor technology, 90 mm radius, limits, and sinusoidal linear encoder with 45 arc-sec resolution (before multiplication).
MX5-D-mm	20-times multiplier, 16 MHz max
MX10-D-mm	40-times multiplier, 16 MHz max
MX25-D-mm	100-times multiplier, 16 MHz max
MX50-D-mm	200-times multiplier, 16 MHz max
MXH50-D-mm	100-times multiplier, 32 MHz max
MXH100-D-mm	400-times multiplier, 32 MHz max
MXH200-D-mm	800-times multiplier, 32 MHz max
MXH250-D-mm	1000-times multiplier, 32 MHz max
MXH500-D-mm	2000-times multiplier, 32 MHz max
MXC-nn	Multiplier to controller cable; specify length '-nn' in feet
NOTE:	*Specify data rate "mm" 2 M=2 MHz, 4 M=4 MHz, 8 M=8 MHz, 16 M=16 MHz, 32 M=32 MHz (MXH only)*
HALAR	High accuracy system – linear error correction for accuracy and repeatability.
ALIGNMENT-NPA	Non-precision XY assembly
ALIGNMENT-PA10	XY assembly; 10 arc sec orthogonal
ALIGNMENT-PA5	XY assembly; 5 arc sec orthogonal

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AVL VERTICAL LIFT STAGE | AVL125

- **Compact construction**
- **Outstanding rigidity**
- **High repeatability**
- **Outstanding in-position stability**
- **Easily configurable with the ALS130 and other stages**
- **9 nm linear resolution**
- **0.25 nm resolution with Automation 3200**
- **Turnkey drive and control electronics**
- **Noncontact, non-cogging, direct-drive (patent pending)**

AVL125

The AVL125 represents a significant breakthrough in vertical alignment of high-precision components. This unique device incorporates the best high-performance features: high speed (>100 mm per second), high resolution (9 nm), superior in-position stability, and high accuracy in one compact package.

Its superior noncontact linear motor drive employs a high-accuracy encoder for direct position feedback. When combined with Aerotech's MXH multiplier, it offers an industry-leading 9 nm resolution in addition to high speed and accuracy.

Bearing elements are recirculating ball style for maximum stiffness and reliability. These are mounted on an optimized base and wedge assembly for stiffness and low mass/inertia, enhancing dynamic performance.

All the critical elements of the AVL125 were selected to operate in a 24/7 industrial environment and, unlike screw- or piezo-based vertical stages, the AVL125 requires no maintenance and will assure years of trouble-free operation.

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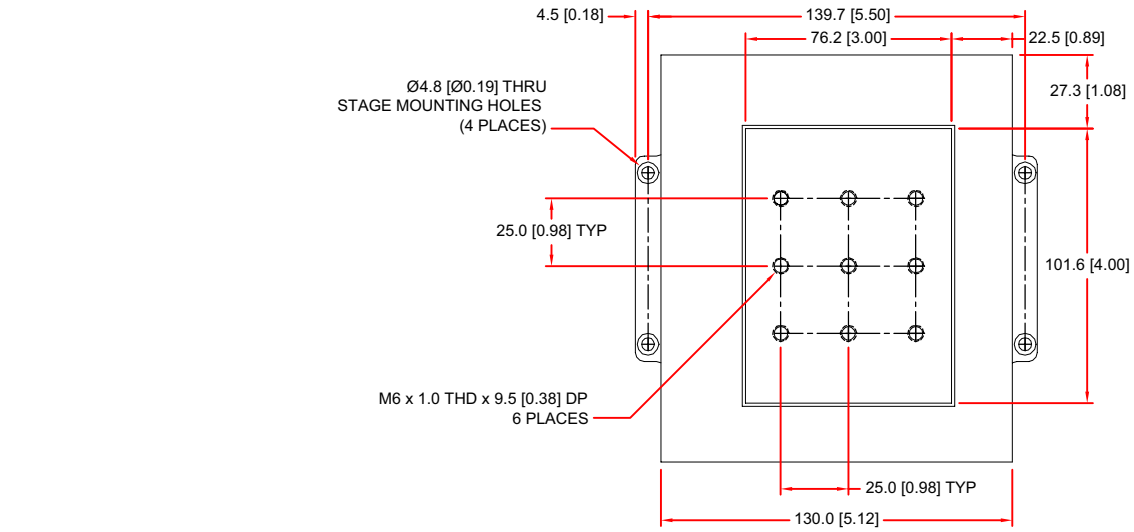
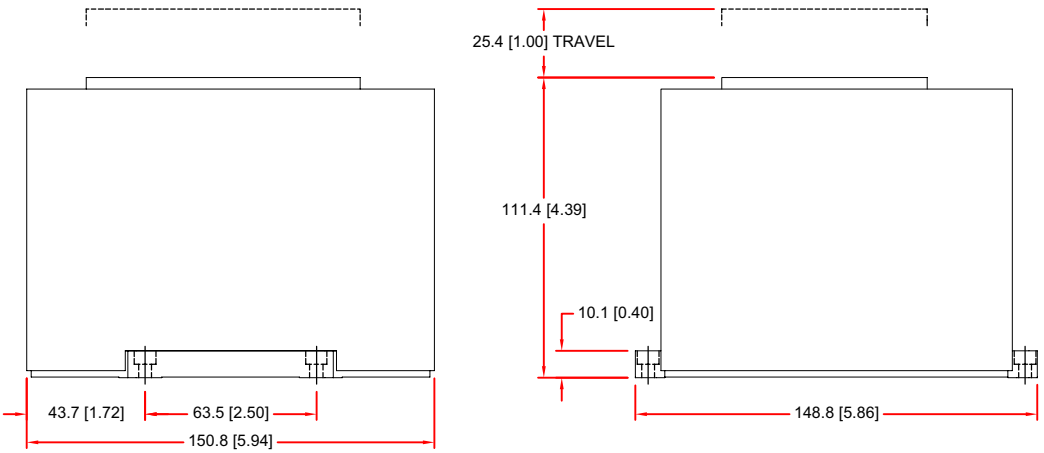
AVL125 (Vertical Lift Stage)	
Travel	25 mm
Resolution	9 nm (275 picometers with Automation 3200)
Repeatability	±100 nm
Max Load	7 kg
Velocity	100 mm/s
Nominal Stage Weight	4 kg (8.8 lb)



DIMENSIONS - MILLIMETERS [INCHES]



Ordering Information

AVL125	25 mm (1 in) travel stage with proprietary direct-drive motor technology, 20 micron pitch sinusoidal output linear encoder and limits.

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ADR75 ROTARY STAGE

- **Direct-drive brushless servomotor**
- **Cog-free design for outstanding velocity stability**
- **Outstanding wobble and runout**
- **Direct coupled, high-accuracy rotary encoder**
- **High-accuracy angular contact bearings**

Aerotech's ADR series direct-drive rotary stages provide superior angular positioning and velocity control. Applications include fiber alignment, high-speed laser machining, and precision wafer inspection.

Superior Mechanical Design

Angular contact bearings are used to maximize performance with respect to wobble, moment stiffness, and rotating friction. A thick-walled, precision-ground shaft further minimizes wobble.

Brushless Direct Drive

To maximize positioning performance, the ADR series utilizes Aerotech's S-series brushless, slotless motor. This motor has all the advantages of a brushless direct-drive motor – no brushes to wear, no gear trains to maintain, and high acceleration and high speeds. Since it is a slotless, ironless design, there is zero cogging, meaning that there is absolutely no torque ripple. This makes the ADR ideal for applications requiring outstanding contoured motion, smooth scan velocity, or precise incremental steps.

With its low inherent inertia and high power output, the ADR is capable of speeds and accelerations that are an order of magnitude greater than typical direct-drive devices or worm-driven stages.

The low inertia and zero backlash makes the ADR the ideal solution for applications requiring frequent directional changes.

Accurate Positioning

Performance is assured with an 11,800 lines per revolution encoder that results in 0.055 arc-sec resolution. The motor and high-performance rotary encoder are directly coupled to a common shaft. The absence of gear trains and mechanical couplings means no position errors caused by hysteresis, windup, or backlash. As a result, accuracy of ±5 arc sec is attainable.

Flexible Configurations

Options include thru-hole apertures and metric or English tabletops. Aerotech manufactures a wide range of servo amplifiers and advanced controllers to provide a complete, integrated package.

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Basic Model		ADR75
Table Diameter		75 mm (3 in)
Total Travel		±360° continuous
Drive System		Direct-Drive Brushless Servomotor
Feedback		11,800 line count/revolution
Resolution		0.055 - 5.5 arc sec (x500 - x5) (0.0017 arc sec with Automation 3200)
Accuracy[1]		±5 arc sec
Repeatability		±1 arc sec
Maximum Rotary Speed		200 rpm
Maximum Load	**Axial**	3 kg (6.6 lb)
	Radial	2 kg (4.4 lb)
Torque Output	**Peak**	1.12 N-m
	Continuous	0.28 N-m
Inertia (Unloaded)		0.0001 kg/m^2 (0.00007 lb-ft-s^2)
Acceleration (Unloaded)		530 rad/s^2
Axis Wobble		10 arc sec
Axis Runout	**Axial**	2.0 µm (80 µin)
	Radial	3.0 µm (120 µin)
Nominal Stage Weight		2.23 kg (4.9 lb)
Material	**Shaft**	Steel
	Body	Aluminum
Finish	**Stage**	Black Anodize
	Table	Black Anodize or Hardcoat

Notes: 1. Value with Aerotech controls and HAL option.

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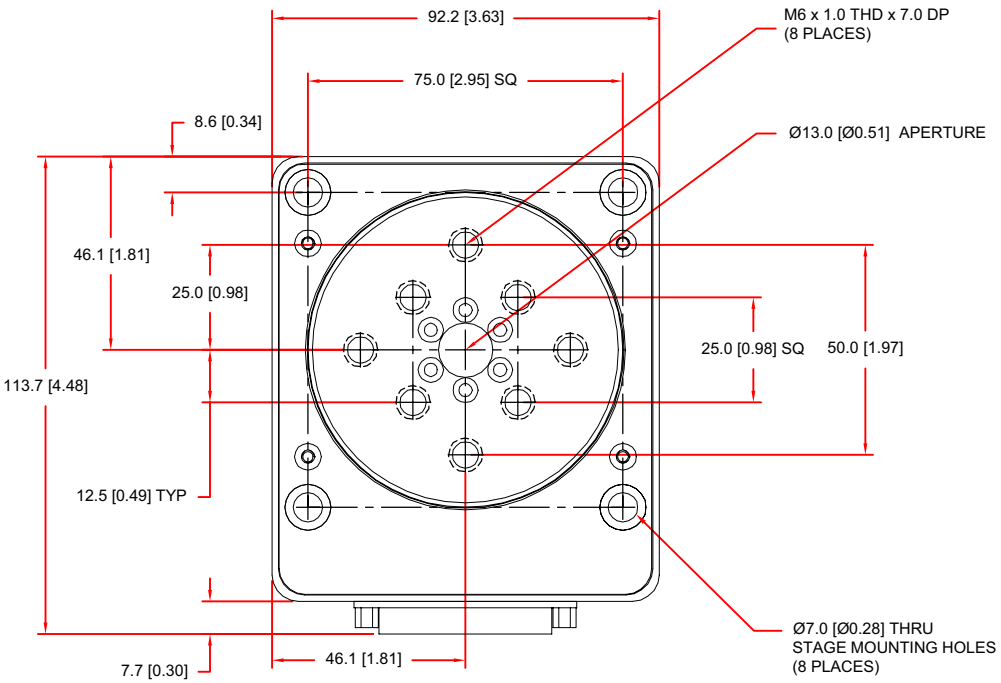
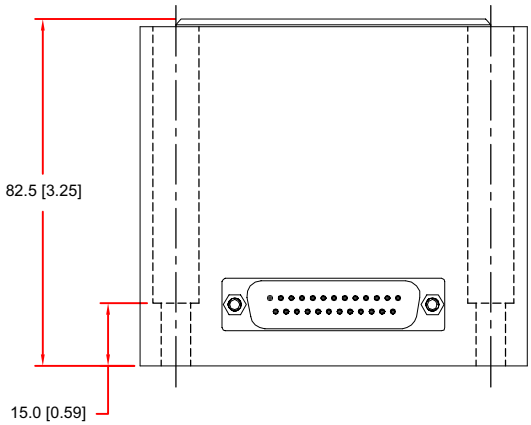


DIMENSIONS - MILLIMETERS [INCHES]



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Ordering Example	ADR Series	-75 Table Diameter (mm)	-MA Mounting and Grid Pattern
		-75 Consult factory for larger diameter	-MA

ADR Series Direct-Drive Rotary Stage

ADR75	75 mm (3 in) diameter rotary table

Mounting and Grid Pattern

-MA	Table Top with Aperature and Metric-dimension mounting pattern and holes

Accessories (to be ordered as separate line item)

MX5-D-mm	External 20-times multiplier, 16 MHz maximum output data rate; 5.5 arc sec resolution
MX10-D-mm	External 40-times multiplier, 16 MHz maximum output data rate; 2.75 arc sec resolution
MX25-D-mm	External 100-times multiplier, 16 MHz maximum output data rate; 1.098 arc sec resolution
MXH50-D-mm	External 200-times high resolution multiplier, 32 MHz maximum output data rate; 0.55 arc sec resolution
MXH100-D-mm	External 400-times high resolution multiplier, 32 MHz maximum output data rate; 0.275 arc sec resolution
MXH200-D-mm	External 800-times high resolution multiplier, 32 MHz maximum output data rate; 0.137 arc sec resolution
MXH250-D-mm	External 1000-times high resolution multiplier, 32 MHz maximum output data rate; 0.110 arc sec resolution
MXH500-D-mm	External 2000-times high resolution multiplier, 32 MHz maximum output data rate; 0.055 arc sec resolution
Note:	*Specify data rate "mm" 2M=2 MHz, 4M=4 MHz, 8M=8 MHz, 16M=16 MHz, 32M=32 MHz (MXH only)*

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ALS130 SERIES

- **Direct-drive linear motor for ultra-precise motion**
- **High-accuracy noncontact linear encoder**
- **Cross-roller bearings for smooth motion**
- **Outstanding performance in a small footprint**

The ALS130, with its low profile and outstanding performance characteristics, is the ultimate solution for high-accuracy alignment and inspection stations.

Linear Motor Drive

Unlike many stages that utilize a side-drive lead screw, the ALS130 employs a center-driven, non-cogging linear motor as the driving element. Since the linear motor is a direct drive device, there is no backlash, windup, or "stiction" that is normally associated with a lead screw or ball screw drive.

The linear motor drive also offers the advantage of higher speeds and accelerations. The compact yet powerful linear motor drives the ALS130 to a peak unloaded acceleration of 1g and a maximum velocity of 300 mm/s. The result is a high-accuracy device with outstanding throughput that significantly outperforms comparable high-accuracy screw-driven stages.

Outstanding Resolution

For alignment applications, outstanding step-to-step resolution is critical. The ALS130 meets this demand with a resolution of 20 nm when coupled with an MXH series multiplier box. The direct drive linear motor allows the ALS130 to make precise, small resolution steps. This is particularly important in alignment applications where step accuracy is critical.

Superior Geometry

Aerotech's ultra-stiff construction and compact two-piece design results in a stage with unmatched geometrical tolerances. As a result, straightness and flatness for the standard stage is < ±2 µm over the entire travel. Optional HALSF calibration improves that to ±1 µm. As a result, the effects of Abbe error are nearly eliminated, vastly improving overall system accuracy.

Smooth Travel

Designed for smooth, vibration-free motion, the ALS130 utilizes precision cross-roller bearings for outstanding smoothness of motion. Since neither the bearing system nor the drive system utilize any recirculating elements, the ALS130 exhibits the outstanding ripple-free motion required for scanning and inspection applications.

Designed for Long Life

Like all stages in the Aerotech product family, the ALS130 was designed for outstanding long-term performance. Both the linear motor and linear encoder are noncontact devices – they not only exhibit long-life, but are totally maintenance free. A moving magnet track design eliminates the need for cable management, further improving long-term reliability.

Precision Alignment

ALS130 series stages are easily configured as XY assemblies. Options include precision orthogonality alignment to 5 arc seconds and available vertical axis solutions.

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Basic Model		ALS130-25	ALS130-50	ALS130-100	ALS130-150
Total Travel		25 mm (1 in)	50 mm (2 in)	100 mm (4 in)	150 mm (6 in)
Drive System		Linear Brushless Servomotor			
Feedback		Noncontact Linear Encoder			
Resolution		0.01 µm - 1.0 µm (0.4 µin - 40 µin) (300 picometers with Automation 3200)			
Maximum Travel Speed[1]		300 mm/s (12 in/s)			
Maximum Linear Acceleration		1g - 10 m/s² (386 in/s²) (no load)			
Maximum Load[2]	**Horizontal**	12.0 kg (26.5 lb)			
	Side	10.0 kg (22.0 lb)			
Continuous Force	**Air Cooling (20 psi)**	43.3 N (9.7 lb)			
	No Air	31.5 N (7.35 lb)			
Peak Force[4]		173.0 N (38.9 lb)			
Accuracy	**HALAR**[5]	±0.3 µm (±12 µin)[5]			
	Standard	±2.0 µm (±80 µin)	±2.0 µm (±80 µin)	±4.0 µm (±160 µin)	±6.0 µm (±240 µin)
Straightness		±1 µm	±1.5 µm	±1.5 µm	±2 µm
Repeatability		±50 nm (±2 µin)[5]; ±100 nm (±4 µin)			
Flatness		±1 µm	±1.5 µm	±1.5 µm	±2 µm
Nominal Stage Weight		2.8 kg (6.2 lb)	3.0 kg (6.5 lb)	3.8 kg (8.4 lb)	4.6 kg (10.1 lb)
Material		Aluminum			
Finish		Black Anodize			

Notes: 1. Maximum speed based on stage capability; maximum application velocity may be limited by system data rate and system resolution.
2. Maximum load based on bearing capability; maximum application load may be limited by acceleration requirements.
3. Thermal limitations of positioning stage with respect to performance may limit continuous force output.
4. Force may be limited by amplifier output.
5. Value with Aerotech controls and HAL option.

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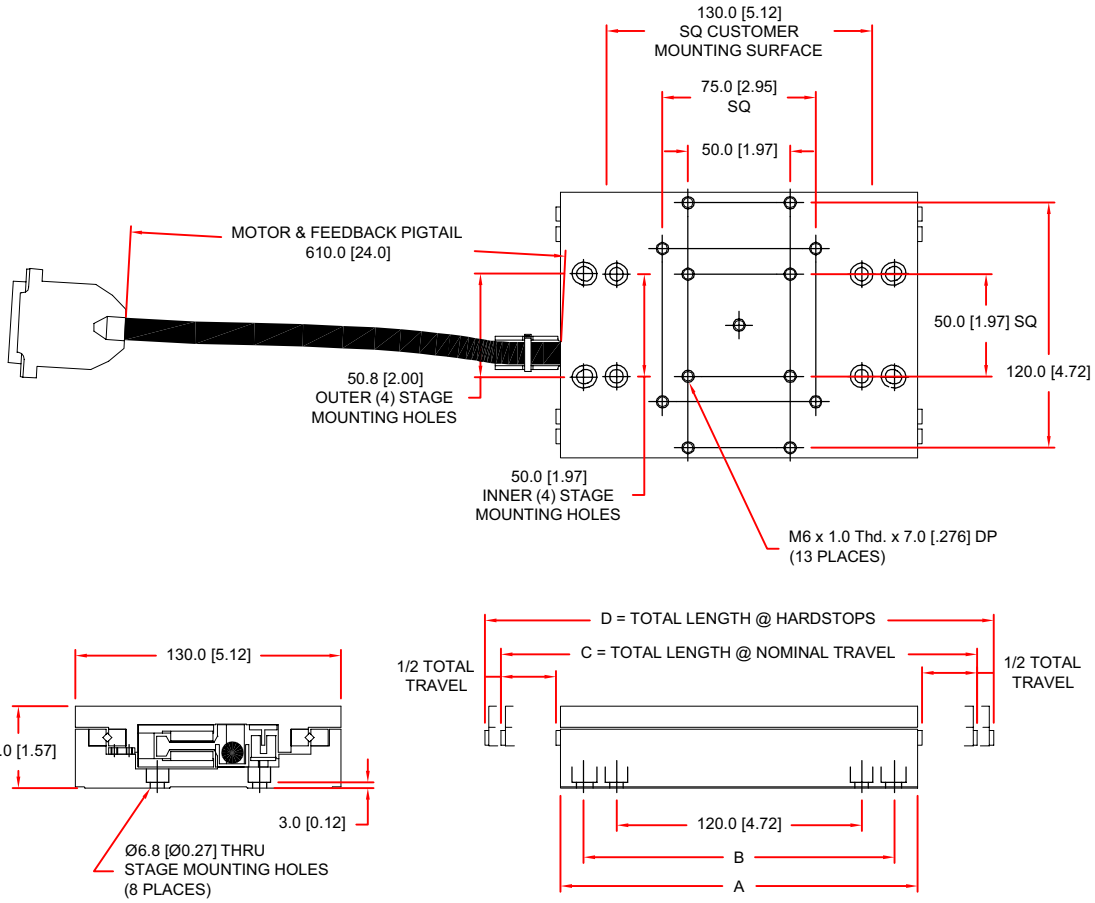

Basic Model	Total Travel	Dimensions - Millimeters [Inches]			
		A	B	C	D
ALS130-025	25.0 [1.00]	125.0 [4.92]	----------	179.0 [7.05]	195.0 [7.68]
ALS130-050	50.0 [2.00]	175.0 [6.89]	150.0 [5.91]	229.0 [9.02]	245.0 [9.65]
ALS130-100	100.0 [4.00]	225.0 [8.86]	150.0 [5.91]	329.0 [12.95]	345.0 [13.58]
ALS130-150	150.0 [6.00]	275.0 [10.83]	200.0 [7.87]	429.0 [16.89]	445.0 [17.52]

All stages shown at center of travel.
Mounting surface quality: Flatness 0.0002 in.
Parallelism 0.0002 in.

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Ordering Example	ALS130 Series	-100 Travel (mm)	-M Mounting and Grid Pattern	-10 Motor	-NC Limits	-LT10X50 Linear Encoder
		-25 -50 -100 -150	-M	-10	-NC -NO	-LTnnAS -LTnnX50

ALS130 Series Linear Motor Stage

ALS130-25	25 mm (1 in) travel stage with linear motor and limits
ALS130-50	50 mm (2 in) travel stage with linear motor and limits
ALS130-100	100 mm (4 in) travel stage with linear motor and limits
ALS130-150	150 mm (6 in) travel stage with linear motor and limits

Mounting and Grid Pattern

-M	Metric dimension mounting pattern and holes

Motor

-10	Brushless linear motor (BLMUC-95-A)

Limits

-NC	Normally closed end of travel limit switches (STANDARD)
-NO	Normally open end of travel limit switches

Standard Linear Encoders

-LT02AS	Linear encoder for ALS130-25; Amplified Sine Output
-LT05AS	Linear encoder for ALS130-50; Amplified Sine Output
-LT10AS	Linear encoder for ALS130-100; Amplified Sine Output
-LT15AS	Linear encoder for ALS130-150; Amplified Sine Output
-LT02X50	Linear encoder for ALS130-25; 0.1 micron line driver output
-LT05X50	Linear encoder for ALS130-50; 0.1 micron line driver output
-LT10X50	Linear encoder for ALS130-100; 0.1 micron line driver output
-LT15X50	Linear encoder for ALS130-150; 0.1 micron line driver output

Accessories (to be ordered as separate line item)

MX5-D-mm	External 20-times multiplier, 16 MHz maximum data rate, 1.0 µm (LTAS)
MX10-D-mm	External 40-times multiplier, 16 MHz maximum data rate, 0.5 µm (LTAS)
MX25-D-mm	External 100-times multiplier, 16 MHz maximum data rate, 0.2 µm (LTAS)
MX50-D-mm	External 200-times multiplier, 16 MHz maximum data rate, 0.1 µm (LTAS)
MXH50-D-mm	External 200-times multiplier, 32 MHz maximum data rate, 0.1 µm (LTAS)
MXH100-D-mm	External 400-times multiplier, 32 MHz maximum data rate, 0.05 µm (LTAS)
MXH200-D-mm	External 800-times multiplier, 32 MHz maximum data rate, 0.025 µm (LTAS)
MXH250-D-mm	External 1000-times multiplier, 32 MHz maximum data rate, 0.02 µm (LTAS)
MXH500-D-mm	External 2000-times multiplier, 32 MHz maximum data rate, 0.01 µm (LTAS)
Specify data rate "mm" 2M=2 MHz, 4M=4 MHz, 8M=8 MHz, 16M=16 MHz, 32M=32 MHz (MXH only)	
MXC-nn	Multiplier to controller cable; specify length '-nn' in feet
HALAR	High-accuracy system - linear error correction for accuracy and repeatability.
HALSF	High-accuracy system - improved straightness and flatness.
ALIGNMENT-NPA	Non-precision XY assembly
ALIGNMENT-PA10	XY assembly; 10 arc sec orthogonal
ALIGNMENT-PA5	XY assembly; 5 arc sec orthogonal

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ALS135 SERIES

- **Direct-drive linear motor for ultra-precise motion**
- **High-accuracy noncontact linear encoder**
- **Outstanding performance in a small footprint**

The ALS135, with its low profile and outstanding performance characteristics, is the ultimate solution for high-accuracy alignment and inspection stations.

Linear Motor Drive

Unlike many stages that utilize a side-drive lead screw, the ALS135 employs a center-driven, non-cogging linear motor as the driving element. Since the linear motor is a direct-drive device, there is no backlash, windup, or "stiction" that is normally associated with a lead screw or ball screw drive.

The linear motor drive also offers the advantage of higher speeds and accelerations. The compact yet powerful linear motor drives the ALS135 to a peak unloaded acceleration of 1g and a maximum velocity of 300 mm/s. The result is a high-accuracy device with outstanding throughput that significantly outperforms comparable high-accuracy screw-driven stages.

Outstanding Resolution

For alignment applications, outstanding step-to-step resolution is critical. The ALS135 meets this demand with a resolution of 20 nm when coupled with an MXH series multiplier box. The direct-drive linear motor allows the ALS135 to make precise, small resolution steps. This is particularly important in alignment applications where step accuracy is critical.

Superior Geometry

Aerotech's ultra-stiff construction and compact two-piece design results in a stage with unmatched geometrical tolerances. As a result, straightness and flatness for the standard stage is < ±2 µm over the entire travel. As a result, the effects of Abbe error are nearly eliminated, vastly improving overall system accuracy.

Smooth Travel

Designed for smooth, vibration-free motion, the ALS135 exhibits the outstanding ripple-free motion required for scanning and inspection applications.

Designed for Long Life

Like all stages in the Aerotech product family, the ALS135 was designed for outstanding long-term performance. Both the linear motor and linear encoder are noncontact devices – they not only exhibit long-life, but are totally maintenance free. A moving magnet track design eliminates the need for cable management, further improving long-term reliability.

Precision Alignment

ALS135 series stages are easily configured as XY assemblies. Options include precision orthogonality alignment to 5 arc seconds and available vertical axis solutions.

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Basic Model		ALS135-25	ALS135-50	ALS135-100	ALS135-150	ALS135-200
Total Travel		25 mm (1 in)	50 mm (2 in)	100 mm (4 in)	150 mm (6 in)	200 mm (8 in)
Drive System		Linear Brushless Servomotor				
Feedback		Noncontact Linear Encoder				
Resolution		0.01 µm - 1.0 µm (0.4 µin - 40 µin) (300 picometer with Automation 3200)				
Maximum Travel Speed[1]		300 mm/s (12 in/s)				
Maximum Linear Acceleration		1g - 10 m/s^2 (384 in/s^2) (no load)				
Maximum Load[2]	**Horizontal**	12.0 kg (26.5 lb)				
	Side	10.0 kg (22.0 lb)				
Continuous Force	**Air Cooling (20 psi)**	43.3 N (9.7 lb)				
	No Air	31.5 N (7.35 lb)				
Peak Force[4]		173.0 N (38.9 lb)				
Accuracy	**HALAR**[5]	±0.3 µm (±12 µin)[5]				
	Standard	±2.0 µm (±80 µin)	±2.0 µm (±80 µin)	±4.0 µm (±160 µin)	±6.0 µm (±240 µin)	±8.0 µm (±320 µin)
Straightness		±1 µm	±1.5 µm	±1.5 µm	±2 µm	±2 µm
Repeatability		±50 nm (±2 µin)[5]; ±100 nm (±4 µin)				
Flatness		±1 µm	±1.5 µm	±1.5 µm	±2 µm	±2 µm
Nominal Stage Weight		2.8 kg (6.2 lb)	3.0 kg (6.5 lb)	3.8 kg (8.4 lb)	4.6 kg (10.1 lb)	5.4 kg (11.9 lb)
Material		Aluminum				
Finish		Black Anodize				

Notes: 1. Maximum speed based on stage capability; maximum application velocity may be limited by system data rate and system resolution.
2. Maximum load based on bearing capability; maximum application load may be limited by acceleration requirements.
3. Thermal limitations of positioning stage with respect to performance may limit continuous force output.
4. Force may be limited by amplifier output.
5. Value with Aerotech controls and HAL option.

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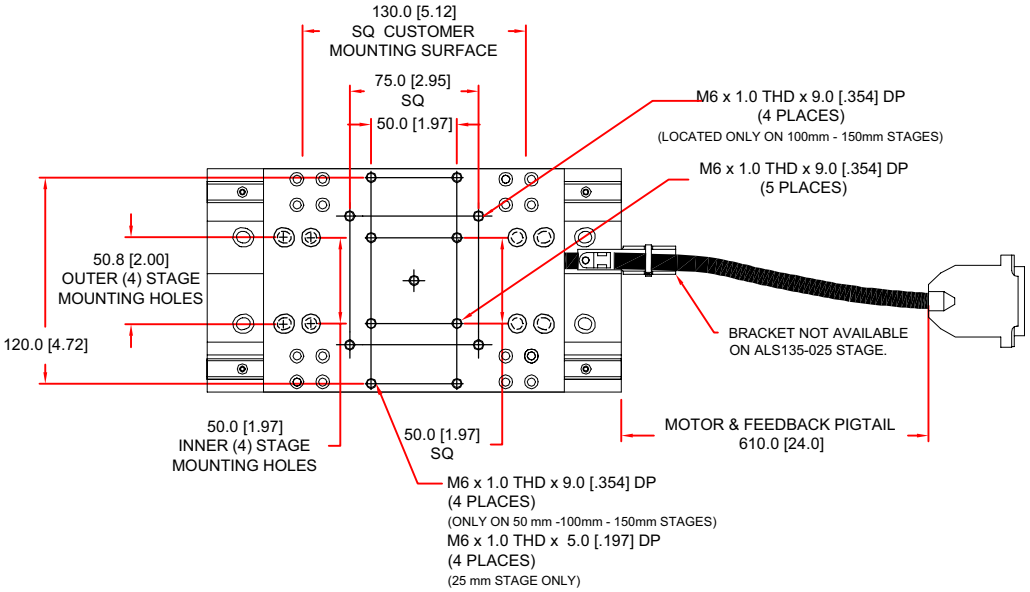

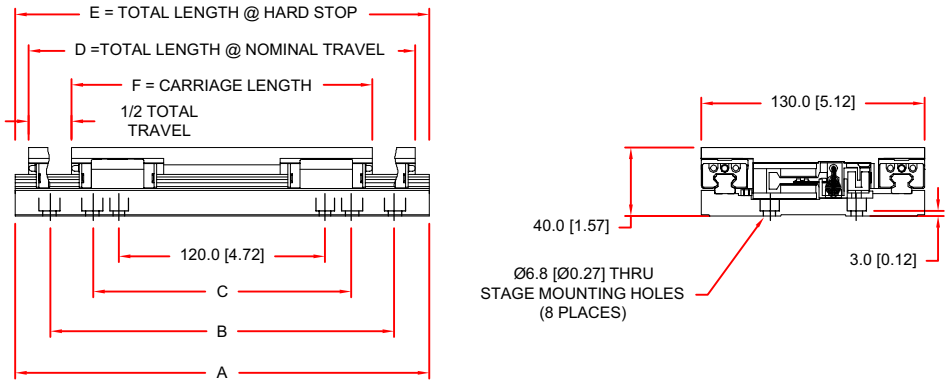

Basic Model	Total Travel	Dimensions - Millimeters [Inches]					
		A	B	C	D	E	F
ALS135-025	25.0 [1.00]	191.2 [7.53]	------	------	175.0 [6.89]	191.1 [7.53]	150.0 [5.91]
ALS135-050	50.0 [2.00]	241.0 [9.49]	------	150.0 [5.91]	225.0 [8.86]	241.0 [9.49]	175.0 [6.89]
ALS135-100	100.0 [4.00]	341.1 [13.43]	250.0 [9.84]	150.0 [5.91]	325.0 [12.80]	341.1 [13.43]	225.0 [8.86]
ALS135-150	150.0 [6.00]	442.7 [17.43]	400.0 [15.75]	200.0 [7.87]	425.0 [16.73]	442.7 [17.43]	275.0 [10.83]
ALS135-200	200.0 [8.00]	544.3 [21.43]	400.0 [15.75]	200.0 [7.87]	525.0 [20.67]	544.3 [21.43]	325.0 [12.80]

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Ordering Example	ALS135 Series	-100 Travel (mm)	-M Mounting and Grid Pattern	-10 Motor	-NC Limits	-LT10X50 Linear Encoder
		-25 -50 -100 -150 -200	-M	-10	-NC -NO	-LTnnAS -LTnnX50

ALS135 Series Linear Motor Stage

ALS135-25	25 mm (1 in) travel stage with linear motor and limits
ALS135-50	50 mm (2 in) travel stage with linear motor and limits
ALS135-100	100 mm (4 in) travel stage with linear motor and limits
ALS135-150	150 mm (6 in) travel stage with linear motor and limits
ALS135-200	200 mm (8 in) travel stage with linear motor and limits

Mounting and Grid Pattern

-M	Metric dimension mounting pattern and holes

Motor

-10	Brushless linear motor (BLMUC-95-A)

Limits

-NC	Normally closed end of travel limit switches (STANDARD)
-NO	Normally open end of travel limit switches

Standard Linear Encoders

-LT02AS	Linear encoder for ALS135-25; Amplified Sine Output
-LT05AS	Linear encoder for ALS135-50; Amplified Sine Output
-LT10AS	Linear encoder for ALS135-100; Amplified Sine Output
-LT15AS	Linear encoder for ALS135-150; Amplified Sine Output
-LT20AS	Linear encoder for ALS135-200; Amplified Sine Output
-LT02X50	Linear encoder for ALS135-25; 0.1 micron line driver output
-LT05X50	Linear encoder for ALS135-50; 0.1 micron line driver output
-LT10X50	Linear encoder for ALS135-100; 0.1 micron line driver output
-LT15X50	Linear encoder for ALS135-150; 0.1 micron line driver output
-LT20X50	Linear encoder for ALS135-200; 0.1 micron line driver output

Accessories (to be ordered as separate line item)

MX5-D-mm	External 20-times multiplier, 16 MHz maximum data rate, 1.0 µm (LTAS)
MX10-D-mm	External 40-times multiplier, 16 MHz maximum data rate, 0.5 µm (LTAS)
MX25-D-mm	External 100-times multiplier, 16 MHz maximum data rate, 0.2 µm (LTAS)
MX50-D-mm	External 200-times multiplier, 16 MHz maximum data rate, 0.1 µm (LTAS)
MXH50-D-mm	External 200-times multiplier, 32 MHz maximum data rate, 0.1 µm (LTAS)
MXH100-D-mm	External 400-times multiplier, 32 MHz maximum data rate, 0.05 µm (LTAS)
MXH200-D-mm	External 800-times multiplier, 32 MHz maximum data rate, 0.025 µm (LTAS)
MXH250-D-mm	External 1000-times multiplier, 32 MHz maximum data rate, 0.02 µm (LTAS)
MXH500-D-mm	External 2000-times multiplier, 32 MHz maximum data rate, 0.01 µm (LTAS)
Specify data rate "mm" 2M=2 MHz, 4M=4 MHz, 8M=8 MHz, 16M=16 MHz, 32M=32 MHz (MXH only)	
MXC-nn	Multiplier to controller cable; specify length '-nn' in feet
HALAR	High-accuracy system - linear error correction for accuracy and repeatability.
HALSF	High-accuracy system - improved straightness and flatness.
ALIGNMENT-NPA	Non-precision XY assembly
ALIGNMENT-PA10	XY assembly; 10 arc sec orthogonal
ALIGNMENT-PA5	XY assembly; 5 arc sec orthogonal

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Linear Motor Actuators | LMA and LMAC

- **Travels up to 1 m**
- **Velocity capability to 3 m/s**
- **Acceleration capability to 3 g**
- **Linear brushless servomotor and noncontact encoder eliminate typical ball screw or belt maintenance**
- **Force outputs from 32 N to 276 N are available**
- **Counterbalance is available for vertical applications**

Introduction

Faster than a ball screw, more accurate than a belt drive, the LMA and LMAC series actuators harness the speed, acceleration, and accuracy capability of a linear motor for the latest in high-throughput linear actuator technology.

This modular stage is ideal for pick-and-place machines, gantry axes, shuttle stages, assembly machines, or as a general-purpose positioner.

Since the LMA and LMAC series actuators integrate the mechanical and electrical components, they eliminate the guesswork involved with choosing bearings, motors, encoders, and the other components required for a linear motor system.

High Speed, High Acceleration

With a no-load acceleration of 3 g and a top speed of 3 m/s, the LMA and LMAC series actuators are the ideal solution to increasing throughput. A high-power brushless linear servomotor drives the LMA and LMAC actuators to speeds and resolutions that are impossible with a ball screw.

Excellent Accuracy and Repeatability

The feedback device is a directly coupled, high-accuracy linear encoder. Since the encoder is mounted in close proximity to the work surface, accuracy problems associated with pitch, roll, and yaw are greatly reduced. Repeatability is ±5 µm over the length of travel. The linear encoder is a robust, noncontacting scale with resolution options ranging from 0.1 µm to 1.0 µm.

OEM Version for Application Flexibility

For applications requiring integration into a custom machine, an OEM version is available. The OEM version offers all of the same performance characteristics as the standard actuator, but allows the user to eliminate or modify different characteristics of the actuator. For example, the user can provide their own cable management system, choose a different bearing system, or customize the mounting holes.

High Reliability

The LMA and LMAC linear motor drive system consists of two noncontacting parts, making the actuators virtually maintenance-free. As a result, there is no backlash, windup, wear, or maintenance that is normally associated with contacting-type systems such as ball screws or belts.

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Aerotech GmbH, Südwestpark 90, 90449 Nürnberg, Germany +49-911-9679370 Fax:+49-911-96793720

LMA										
Total Travel	100 mm	200 mm	300 mm	400 mm	500 mm	600 mm	700 mm	800 mm	900 mm	1000 mm
Drive System	Linear Brushless Servomotor									
Feedback	Noncontact Linear Encoder									
Resolution[5]	10 nm – 1.0 µm									
Max Travel Speed[1]	3 m/s									
Max Linear Acceleration	3 g (30 m/s² no load)									
Max Horizontal Load[2]	40 kg									
Max Side Load[2]	20 kg									
Continuous Force[3]	207 N									
Continuous Force (20 psi)[3]	276 N									
Peak Force[3]	1106 N									
Accuracy	±1 µm/25 mm									
Calibrated Accuracy[4]	±5 µm Over Entire Length of Travel									
Repeatability	± 0.5 µm									
Nominal Stage Weight	16.3 kg	18.5 kg	20.7 kg	22.8 kg	25.0 kg	27.2 kg	29.4 kg	31.6 kg	33.7 kg	35.9 kg
Moving Weight	142 Motor Option (3.28 kg)						264 Motor Option (5.18 kg)			
Material	Aluminum									
Finish	Electroless Nickel Base/Black Hardcoat Tabletop									

Notes: *1. Maximum speed based on stage capability; maximum application velocity may be limited by system data rate and resolution.*

2. Maximum load based on bearing capability; maximum application load may be limited by acceleration requirements.

3. Specifications based on BLM-264-A motor. Travel increases by 120 mm when using the BLM-142-A motor.

4. Available with Aerotech controller.

5. May require encoder multiplier.

Dual-carriage LMA gantry.

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LMAC										
Total Travel	100 mm	200 mm	300 mm	400 mm	500 mm	600 mm	700 mm	800 mm	900 mm	1000 mm
Drive System	Linear Brushless Servomotor									
Feedback	Noncontact Linear Encoder									
Resolution[5]	10 nm – 1.0 µm									
Max Travel Speed[1]	3 m/s									
Max Linear Acceleration	3 g (30 m/s² no load)									
Max Horizontal Load[2]	20 kg									
Max Side Load[2]	10 kg									
Continuous Force[3]	47.9 N									
Continuous Force (20 psi)[3]	73.1 N									
Peak Force[3]	292 N									
Accuracy	±1 µm/25 mm									
Calibrated Accuracy[4]	±5 µm Over Entire Length of Travel									
Repeatability	± 0.5 µm									
Nominal Stage Weight	4.5 kg	5.4 kg	6.3 kg	7.2 kg	8.1 kg	9.0 kg	9.9 kg	10.8 kg	11.7 kg	12.6 kg
Moving Weight	095 Motor Option (0.79 kg)						143 Motor Option (1.00 kg)			
Material	Aluminum									
Finish	Electroless Nickel Base/Black Hardcoat Tabletop									

Notes: 1. Maximum speed based on stage capability; maximum application velocity may be limited by system data rate and resolution.

2. Maximum load based on bearing capability; maximum application load may be limited by acceleration requirements.

3. Specifications based on BLMUC-143-A motor. Travel increases by 35 mm when using the 095 motor.

4. Available with Aerotech controller.

5. May require encoder multiplier.

Close-up of the dual carriages.

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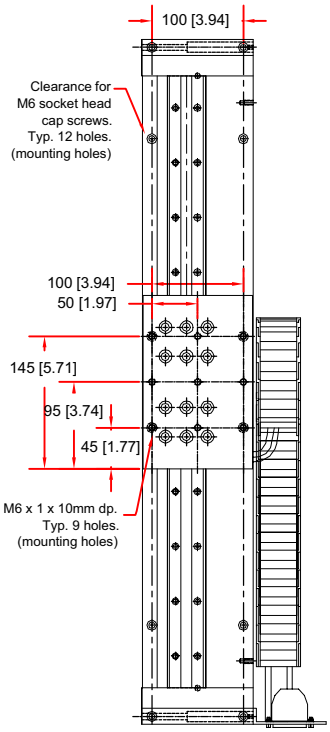
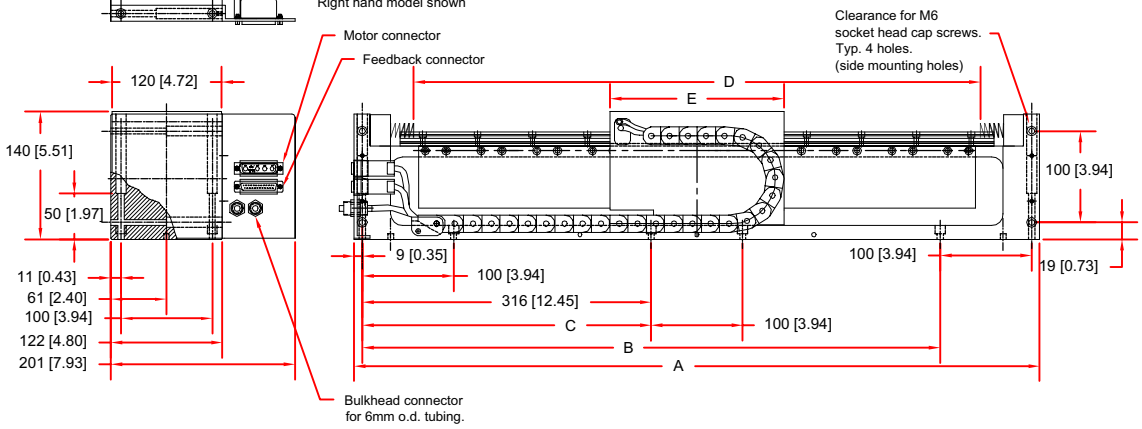


Basic Model	Total Travel	Dimensions - Millimeters [Inches]				
		A	B	C	D	E
LMA100	100[4.00]	550[21.65]	432[17.01]	216[8.50]	420[16.54]	310[12.20]
LMA200	200[7.88]	650[25.59]	532[20.94]	266[10.47]	520[20.47]	310[12.20]
LMA300	300[11.81]	750[29.53]	632[24.88]	316[12.44]	620[24.41]	310[12.20]
LMA400	400[15.75]	850[33.46]	732[28.82]	366[14.41]	720[28.35]	310[12.20]
LMA500	500[19.70]	950[37.40]	832[32.76]	416[16.38]	820[32.28]	310[12.20]
LMA600	600[23.63]	1050[41.34]	932[36.69]	466[18.35]	920[36.22]	310[12.20]
LMA700	700[27.55]	1150[45.28]	1032[40.63]	516[20.31]	1020[40.16]	310[12.20]
LMA800	800[31.50]	1250[49.21]	1132[44.57]	566[22.28]	1120[44.09]	310[12.20]
LMA900	900[35.43]	1350[53.15]	1232[48.50]	616[24.25]	1220[48.03]	310[12.20]
LMA1000	1000[39.37]	1450[57.10]	1332[52.44]	716[28.19]	1320[51.97]	310[12.20]

Basic Model	Total Travel	Dimensions - Millimeters [Inches]				
		A	B	C	D	E
LMA120	120[4.72]	450[17.72]	332[12.28]	166[6.54]	320[12.60]	190[7.48]
LMA220	220[8.66]	550[21.65]	432[17.01]	216[8.50]	420[16.54]	190[7.48]
LMA320	320[12.60]	650[25.59]	532[20.94]	266[10.47]	520[20.47]	190[7.48]
LMA420	420[16.54]	750[29.53]	632[24.88]	316[12.44]	620[24.41]	190[7.48]
LMA520	520[20.47]	850[33.46]	732[28.82]	366[14.41]	720[28.35]	190[7.48]
LMA620	620[24.41]	950[37.40]	832[32.76]	416[16.38]	820[32.28]	190[7.48]
LMA720	720[28.35]	1050[41.34]	932[36.69]	466[18.35]	920[36.22]	190[7.48]
LMA820	820[32.28]	1150[45.28]	1032[40.63]	516[20.31]	1020[40.16]	190[7.48]
LMA920	920[36.22]	1250[49.21]	1132[44.57]	566[22.28]	1120[44.09]	190[7.48]
LMA1020	1020[40.16]	1350[53.15]	1232[48.50]	616[24.25]	1220[48.03]	190[7.48]

Right hand model shown



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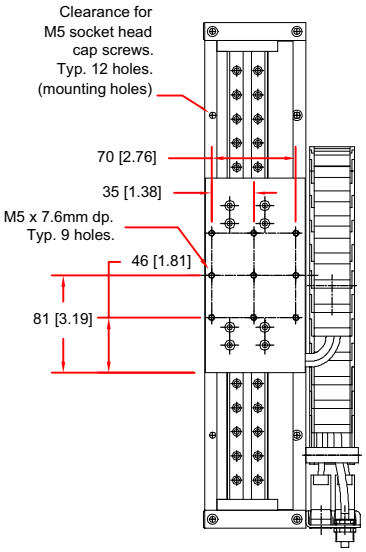
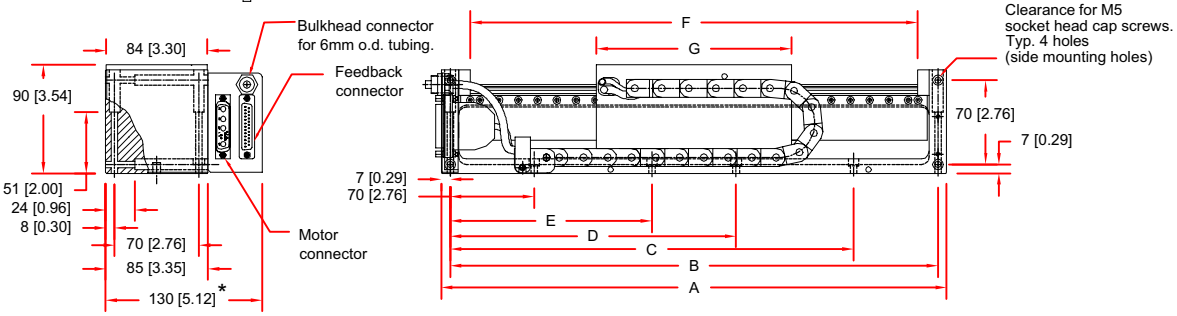


Basic Model	Total Travel	Dimensions - Millimeters [Inches]						
		A	B	C	D	E	F	G
LMAC100	100[4.00]	320[12.60]	305[12.02]	235[9.27]	188[7.39]	118[4.63]	272[10.70]	162 [6.38]
LMAC200	200[7.88]	420[16.54]	405[15.96]	335[13.20]	238[9.36]	168[6.60]	372[14.63]	162 [6.38]
LMAC300	300[11.81]	520[20.47]	505[19.90]	435[17.14]	288[11.33]	218[8.57]	472[18.58]	162 [6.38]
LMAC400	400[15.75]	620[24.41]	605[23.83]	535[21.08]	338[13.29]	268[10.54]	572[22.52]	162 [6.38]
LMAC500	500[19.70]	720[28.35]	705[27.77]	635[25.02]	388[15.26]	318[12.51]	672[26.45]	162 [6.38]
LMAC600	600[23.63]	820[32.28]	805[31.71]	735[28.95]	438[17.23]	368[14.48]	772[30.39]	162 [6.38]
LMAC700	700[27.55]	920[36.22]	905[35.64]	835[32.89]	488[19.20]	418[16.44]	872[34.32]	162 [6.38]
LMAC800	800[31.50]	1020[40.16]	1005[39.58]	935[36.83]	538[21.17]	468[18.41]	972[38.26]	162 [6.38]
LMAC900	900[35.43]	1120[44.09]	1105[43.52]	1035[40.76]	588[23.14]	518[20.38]	1072[42.19]	162 [6.38]
LMAC1000	1000[39.37]	1220[48.03]	1205[47.46]	1135[44.70]	638[25.11]	568[22.35]	1172[46.13]	162 [6.38]

Basic Model	Total Travel	Dimensions - Millimeters [Inches]						
		A	B	C	D	E	F	G
LMAC135	135[5.31]	320[12.60]	305[12.02]	235[9.27]	188[7.39]	118[4.63]	272[10.70]	127[5.00]
LMAC235	235[9.25]	420[16.54]	405[15.96]	335[13.20]	238[9.36]	168[6.60]	372[14.63]	127[5.00]
LMAC335	335[13.19]	520[20.47]	505[19.90]	435[17.14]	288[11.33]	218[8.57]	472[18.58]	127[5.00]
LMAC435	435[17.13]	620[24.41]	605[23.83]	535[21.08]	338[13.29]	268[10.54]	572[22.52]	127[5.00]
LMAC535	535[21.06]	720[28.35]	705[27.77]	635[25.02]	388[15.26]	318[12.51]	672[26.45]	127[5.00]
LMAC635	635[25.00]	820[32.28]	805[31.71]	735[28.95]	438[17.23]	368[14.48]	772[30.39]	127[5.00]
LMAC735	735[28.94]	920[36.22]	905[35.64]	835[32.89]	488[19.20]	418[16.44]	872[34.32]	127[5.00]
LMAC835	835[32.87]	1020[40.16]	1005[39.58]	935[36.83]	538[21.17]	468[18.41]	972[38.26]	127[5.00]
LMAC935	935[36.81]	1120[44.09]	1105[43.52]	1035[40.76]	588[23.14]	518[20.38]	1072[42.19]	127[5.00]
LMAC1035	1035[40.75]	1220[48.03]	1205[47.46]	1135[44.70]	638[25.11]	568[22.35]	1172[46.13]	127[5.00]

*Add 40[1.57] to width for B3/B4 connector options.

Right hand model shown.



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Ordering Example	LMA	-142	L	-520	-LT_0.1	-B2
		Motor	Left/Right Side	Travel (mm)	Encoder	Brackets
		-142	L R	-120, -220, -320, -420, -520, -620, -720, -820, -920, -1020	-LT-1.0 -LT-0.5 -LT-0.1	-B2 -B3 -B4
		-264	L R	-100, -200, -300, -400, -500, -600, -700, -800, -900, -1000	-LT-AS	

LMA Series Linear Motor Actuator

LMA-142L-xxx	168.0 N (20 psi), linear actuator with encoder (1 µm) and limits, left side
LMA-142R-xxx	168.0 N (20 psi), linear actuator with encoder (1 µm) and limits, right side
LMA-264L-yyy	276.0 N (20 psi), linear actuator with encoder (1 µm) and limits, left side
LMA-264R-yyy	276.0 N (20 psi), linear actuator with encoder (1 µm) and limits, right side

For 'xxx' substitute travel in mm. Available travels are 120, 220, 320, 420, 520, 620, 720, 820, 920, and 1020 mm.
For 'yyy' substitute travel in mm. Available travels are 100, 200, 300, 400, 500, 600, 700, 800, 900, and 1000 mm.

Encoder Options

LT-1.0	Linear encoder; 1.0 µm line-driver output
LT-0.5	Linear encoder; 0.5 µm line-driver output
LT-0.1	Linear encoder; 0.1 µm line-driver output
LT-AS	Linear encoder; 20 µm/V_{pp} output

Bracket Options

-B2	Standard connecter on LMA
-B3	Adds one additional 25-pin connector slot
-B4	Adds two additional 25-pin connector slots

Cover Options

Consult factory on cover options.

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Ordering Example	LMAC	-095	R	-335	-LT_0.5	-B3	-Z
		Motor	Left/Right Side	Travel (mm)	Encoder	Brackets	Z Axis Travel (mm)
		-095	L R	-135, -235, -335, -435, -535, -635, -735, -835, -935, -1035	-LT-1.0 -LT-0.5 -LT-0.1	-B2 -B3 -B4	-Z100 -Z200 -Z300
		-143	L R	-100, -200, -300, -400, -500, -600, -700, -800, -900, -1000	-LT-AS		-Z400

LMAC Series Linear Motor Actuator

LMAC-095L-xxx	43.3 N (20 psi), linear actuator with encoder (1 µm) and limits, left side
LMAC-095R-xxx	43.3 N (20 psi), linear actuator with encoder (1 µm) and limits, right side
LMAC-143L-yyy	73.1 N (20 psi), linear actuator with encoder (1 µm) and limits, left side
LMAC-143R-yyy	73.1 N (20 psi), linear actuator with encoder (1 µm) and limits, right side

For 'xxx' substitute travel in mm. Available travels are 135, 235, 335, 435, 535, 635, 735, 835, 935, and 1035 mm.
For 'yyy' substitute travel in mm. Available travels are 100, 200, 300, 400, 500, 600, 700, 800, 900, and 1000 mm.

Encoder Options

LT-1.0	Linear encoder; 1.0 µm line-driver output
LT-0.5	Linear encoder; 0.5 µm line-driver output
LT-0.1	Linear encoder; 0.1 µm line-driver output
LT-AS	Linear encoder; 20 µm/V_{pp} output

Bracket Options

-B2	Standard connecter on LMA
-B3	Adds one additional 25-pin connector slot
-B4	Adds two additional 25-pin connector slots

Cover Options

Consult factory on cover options.

Z-Axis

-Z100	For 100/135 mm travel
-Z200	For 200/235 mm travel
-Z300	For 300/335 mm travel
-Z400	For 400/435 mm travel

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3-Axis ANT-25L XY with ANT-4V.

4-Axis FiberAlign 130 with ANT-20G-50.

5-Axis FiberAlign 130 with ANT-20G-90 and ANT-20G-50.

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4-Axis FiberAlign 130 with ANT-20RA.

5-Axis FiberAlign 130 with ANT-20RA and ANT-20G-90.

6-Axis FiberAlign 130 with ANT-20RA and ANT-20G-90 and ANT-20G-50.

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3-Axis ALS130XY and ANT-20RA

4-Axis ALS130XY with ANT-20RA and ANT-20G-90

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MANUAL NANO-POSITIONERS

- **Linear resolution is 25 nm**
- **Linear digital readout resolution is 10 nm**
- **Rotary resolution is 0.1 arc-second**
- **Decoupled orthogonal movement**
- **360° rotation**
- **Cross-roller bearings**
- **Low profile**
- **Excellent thermal stability**

In those cases where a completely automated system is not required, or where one or more axes needs very infrequent adjustment, or perhaps in early stage proof-of-concept laboratory experiments, Aerotech's manual stages can do the job. Aerotech offers a line of nanometer resolution, large travel range, rotary and linear tables. These manual stages, which have been used extensively by the major research laboratories throughout the world over the past thirty years, offer excellent in-position stability, high positioning resolution, large adjustment range, and outstanding thermal stability.

ATT185-3

ATT185-5

ARS301

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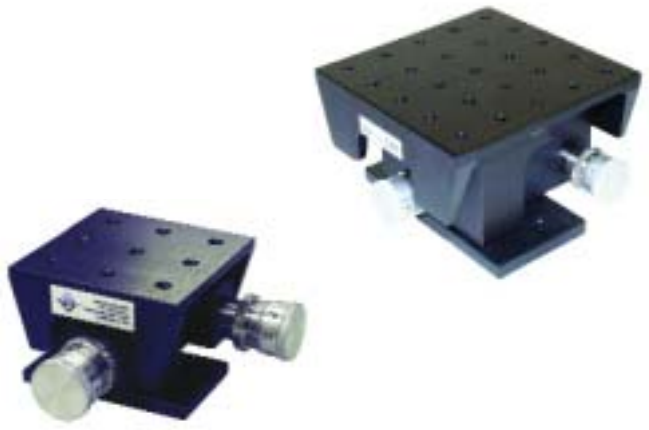
PRECISION TILT TABLES

- **Sub-arc-second resolution**
- **Decoupled, orthogonal tilting movement**
- **High thermal stability**



The ATT185 series precision tilt (pitch-roll) tables provide a means for leveling instruments or tilting components over a ±10° range. Aerotech's patented* sub-arc-second resolution drive allows the user to cover the total angular range quickly while maintaining a resolution of 0.2 arc-second for the ATT185-3, and 0.1 arc-second for the ATT185-5. With this unique drive, the tables exhibit virtually no creep or backlash and have excellent repeatability. These tables have a gimbal support with decoupled and orthogonal axial motion.

Both tilt table bases have clearance holes for M6 screws on 25 mm centers and are adaptable to Aerotech linear or rotary translation stages. The tables are constructed of aluminum with a black anodized finish.

*U.S. Patent #3,727,471

	ATT185-3	ATT185-5
Range	±10°	
Thimble Graduation	5.0 arc-second	2.5 arc-second
Resolution*	0.2 arc-second	0.1 arc-second
Max Load (Horizontal)**	4.54 kg (10 lb)	
Material	Aluminum	
Finish	Black Anodized	
Weight	0.5 kg (1.1 lb)	1.41 kg (3.1 lb)

**Per 0.5° movement of the fine adjustment.*

***Load should be centered or counterbalanced to provide accurate tilt.*

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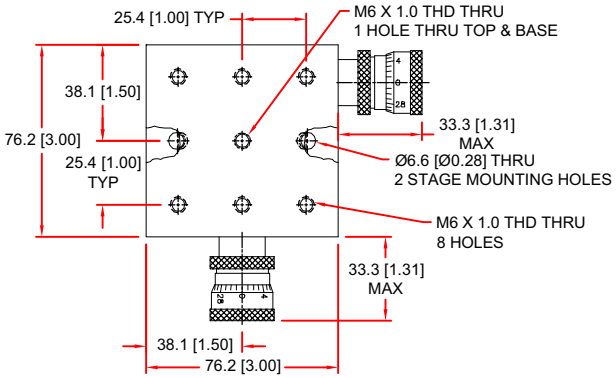
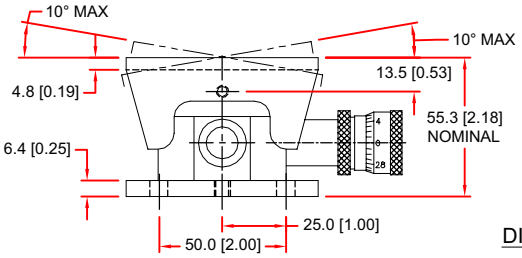
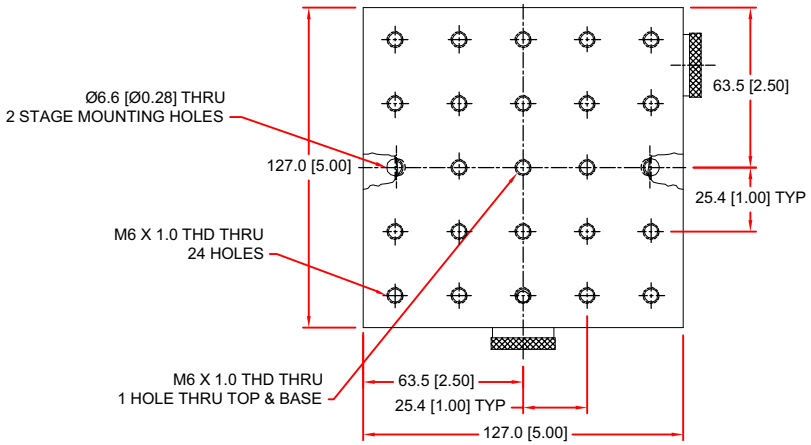


ATT185-3

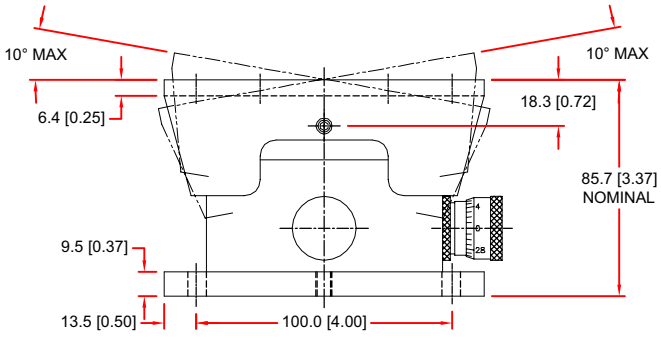


ATT185-3

DIMENSIONS - MILLIMETERS [INCHES]



ATT185-5



ATT185-5

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MANUAL ROTARY POSITIONING STAGE

- **360° rotation**
- **Excellent thermal stability**
- **Patented sub-arc-second resolution drive**

The ARS301 stage is a precise rotary positioner featuring Aerotech's patented sub-arc-second resolution drive mechanism. By depressing the release plunger, the rotary ring of the ARS301 can be quickly positioned to the approximate desired angle. It can then be fine-tuned with either the coarse or fine adjustment knob over a range of 10 degrees or 30 minutes, respectively. This stage achieves a 0.1 arc-second resolution. The fine thimble has a 32-division reference scale for convenience in positioning. An engraved dial with a six-minute vernier is standard on all tabletops. Due to the absence of any gearing in the ARS301's drive mechanism, the stage is backlash free.

The ARS301 has a 68 mm (2.68 in) clear aperture. If a solid mounting surface is required, the ARS301TT is available. The ARS301TT has a grid of M6 mounting holes on 25 mm centers. The ARS301 is made of aluminum with a black anodized finish and weighs 1.36 kg (3 lb).

ARS301

ARS301	
Thimble Graduation	2.54 arc-second
Resolution*	0.1 arc-second
Max Load (Horizontal)	11.36 kg (25 lb)
(Vertical)	6.82 kg (15 lb)
360° Dial and 6 Minute Vernier	Standard
Clear Aperture	68.07 mm (2.68 in)

**Per 0.5° movement of the fine adjustment.*

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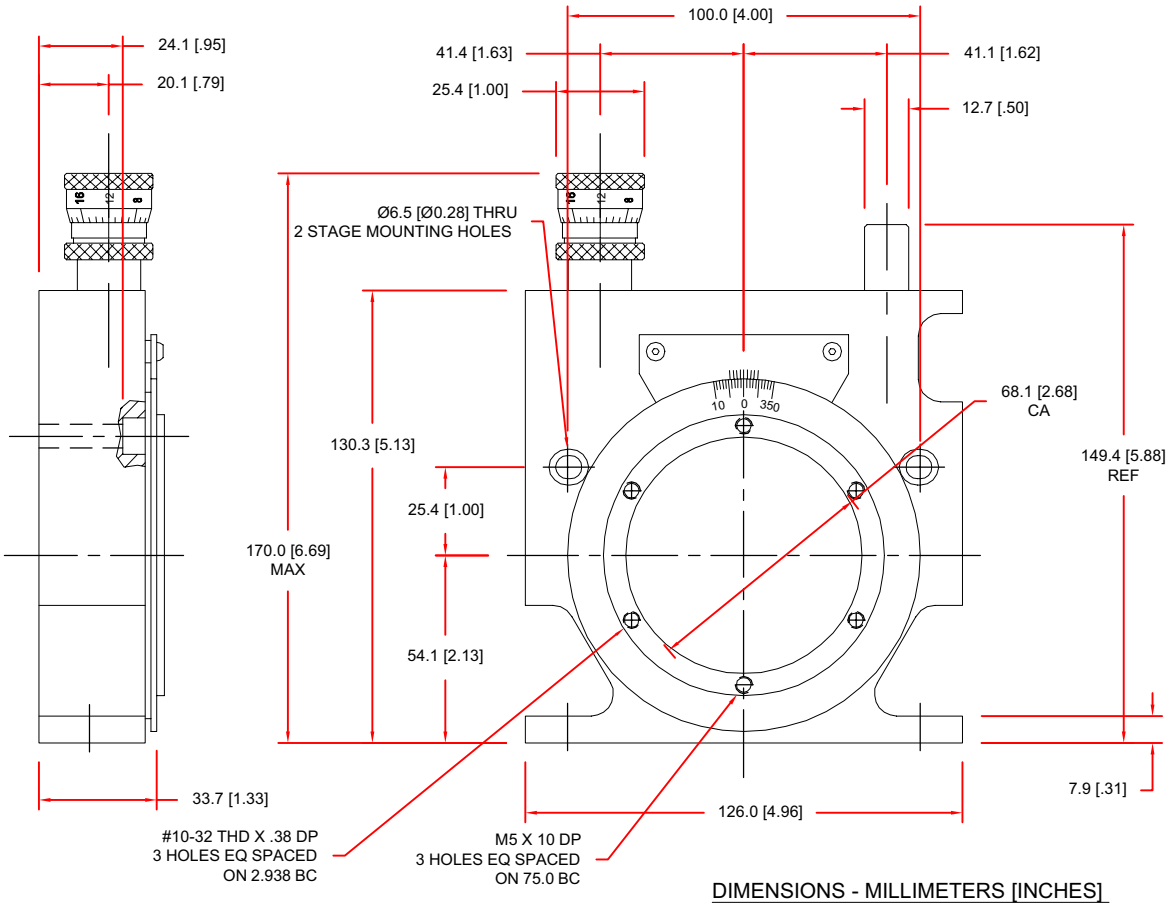
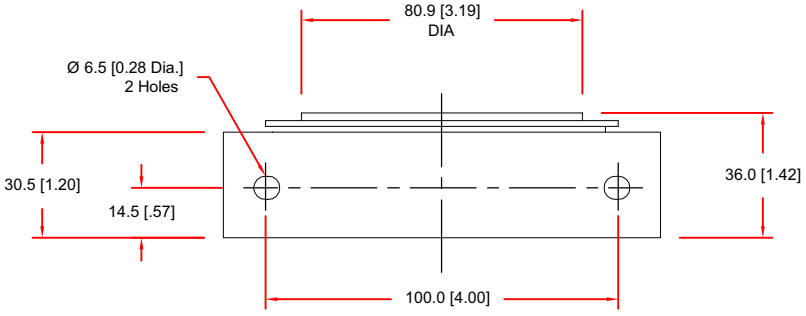
ARS301



DIMENSIONS - MILLIMETERS [INCHES]



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MANUAL LINEAR POSITIONING STAGES

- **Micrometer or patented* sub-micron-resolution drive**
- **12 mm and 25 mm travel**
- **Crossed-roller bearings for superior positioning performance**
- **Low profile**

ATS25-12

ATS25-25

Aerotech's low profile ATS25 series stages provide smooth and precision linear translation. The ATS25 series stages come with Aerotech's patented* sub-micron-resolution drive. This drive has both a coarse and fine adjustment. The coarse knob allows rapid translation, while the fine adjustment provides a 25 nm resolution.

Preloaded crossed-roller bearings provide better geometrical accuracies and larger load carrying capability than linear ball-bearing systems. These stages can be easily mounted in X-Y and X-Y-Z applications. An optional mounting bracket, HDZ3S, is available for applications that require a vertical mounting orientation.

*U.S. Patent # 3,727,471

	ATS25-12DM	ATS25-25DM
Range	12.5 mm (0.5 in)	25 mm (1 in)
Thimble Graduation		
-Micrometer Spindle	1 micron (40 µin)	
-Sub-Micron Drive	0.1 micron (4 µin)	
Resolution*	25 nm	25 nm
Max Load (Horizontal)	22.7 kg (50 lb)	
(Vertical)	9.09 kg (20 lb)	
Straightness and Flatness of Travel	0.5 micron (±20 µin)	
Repeatability (Unidirectional)	1 µm (20 nm)	
Material	Aluminum	
Finish	Black Anodize	
Weight	0.45 kg (1 lb)	0.9 kg (2 lb)

**Per 0.5° movement of the fine adjustment.*

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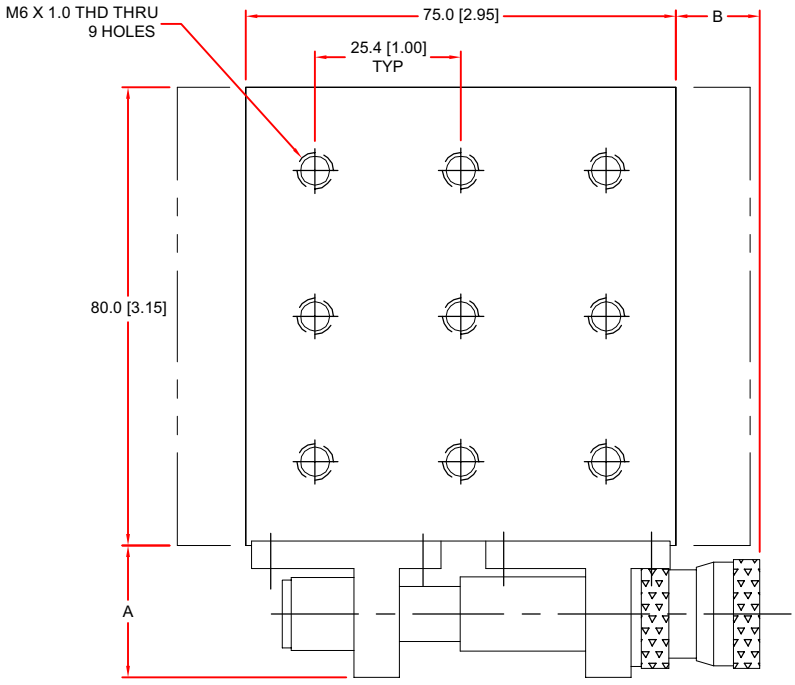
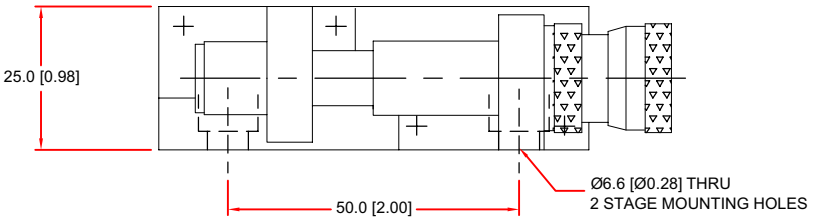


DIMENSIONS - MILLIMETERS [INCHES]



Dimensions - Millimeters [Inches]				
Basic Model	Total Travel	A	B	Weight kg [lb]
ATS25-12D (Differential)	12.0 [0.47]	23.1 [0.91]	14.5 [0.57]	0.45 [1.0]
ATS25-25D (Differential)	25.0 [0.98]	23.1 [0.91]	14.5 [0.57]	0.45 [1.0]

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ATS Series Linear

ATS25-12DM	12.5 mm (0.5 in) travel stage with Aerotech patented differential screw drive
ATS25-50DM	50 mm (2 in) travel stage with Aerotech patented differential screw drive

ARS Series Rotary

ARS301	Rotary positioning table with Aerotech patented differential screw drive and 68 mm (2.68 in) clear aperture
ARS301TT	Tabletop for ARS301 with metric hole pattern

ATT Series Tip and Tilt

ATT-185-3	Gimbal tilt table with +/-10 degree of travel in roll and pitch and 75mm x 75mm (3 in x 3 in) mounting surface

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Automation 3200

The Intelligent, 32-Axis Motion, Vision, and I/O System

- 1 to 32 axes of scalable, synchronized motion
- Utilizes the power of the PC to eliminate the motion control card
- Uses IEEE-1394's (Firewire) determinism for communications between drive and controller
- Programmable in native G-code or AeroBASIC™ command set, C, C++, VisualBASIC®, or LabVIEW™ from a soft MMI
- 20 kHz servo update rate for 1 to 32 axes
- Digital current loops for improved motion and stability
- Complete motion capabilities include: point-to-point; linear, circular, helical, and spherical interpolation; velocity profiling; electronic gearing; on-the-fly trajectory modification; on-the-fly I/O; camming
- Integrated high-speed Position Synchronized Output (PSO) for laser firing or position latching applications
- On-board encoder multiplier (x65536)

Automation 3200 Network Software:
N Motion SMC
N View MMI
N Control SDK
N Vision VCM
N Logic PLC

N Drive

Aerotech's N Paq

The World's First High Performance, 32-Axis Motion, Vision, and I/O System

Aerotech is pleased to announce the launch of its ground-breaking, next generation motion, vision, and I/O system, the Automation 3200. The system features the world's first high-performance software only controller (NMotion SMC) that offers 32 axes of synchronized motion control. It is the successor to Aerotech's performance-leading and widely utilized UNIDEX 500 and 600 PC-based motion controllers. The NMotion SMC retains the best features of our previous controllers and combines them with an advanced, high-performance control architecture to produce a truly state-of-the-art motion, vision, and I/O controller.

Industry-Leading 32 Axes of Synchronized Control

The Automation 3200 is capable of 32 axes of synchronized motion through one interface. Aerotech has designed the current platform to be expandable to 62 axes of synchronized control. Work done on the Automation 3200 platform will be portable to future releases so users can look forward to future advancements without having to worry about abandoning legacy programs.

No Degradation of Performance as Axis Count Increases

The Automation 3200 addresses a major shortcoming of today's multi-axis controllers: as axes are added, performance markedly degrades as either the servo update time or program execution time increases. The Automation 3200 utilizes a distributed control architecture that enables it to maintain performance independent of the number of axes being controlled.

It accomplishes this by avoiding the processing bottleneck caused by today's common single processor control architecture. Position and current loop closure is handled by Aerotech's Intelligent Network Drive (NDrive). Trajectory generation is done on the PC using the Windows® operating system. The PC executes programs and sends the incremental position commands to the NDrive via the high-speed serial bus IEEE-1394 (FireWire).

Greatly Simplified System Wiring

All of the external signals including encoder and I/O are fed directly into the drive, allowing one cable to be used between the PC and the drive.

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The Advantages of FireWire™ (IEEE-1394)

In designing the Automation 3200, Aerotech decided that its next generation controller had to overcome the shortcomings of the traditional ±10 V network interface. While still viable for many applications, ±10 V has shortcomings, particularly when complex motion control is involved such as is common in many Aerotech applications. For example, noise coupling onto the analog signals can cause instability in the servo loop that prevents high system bandwidth. Also, with the ±10 V command, the controller doesn't have knowledge of how well the current loops are tracking. With these and other shortcomings, it was decided that the next generation controller had to utilize a high-speed serial interface.

Digital networks, such as Ethernet and RS-232, are widely used in many different industries. Other newer networks such as FireWire™(IEEE-1394) and USB are becoming increasingly popular. For example, nearly all new computers now have these interfaces as standard.

With a variety of digital networks available, Aerotech developed a list of criteria that the Automation 3200 network interface had to possess. The following list details the key criteria we used to ultimately select FireWire (IEEE-1394), and why those criteria were considered important.

- **Deterministic**
  Complex motion such as contouring requires that all axes receive their data at exactly the same point in time each time.
- **Capable of greater than 100 Mbps**
  The faster the network, the lower the latency between transmitting and receiving data. Also, this allows the user to view real-time data on the PC.
- **Standard on PCs**
  As the Automation 3200 does not require a motion card, having the network standard on PCs eliminates the cost of additional hardware.
- **Supported by the Windows operating systems**
  Ensures that the software will work on the PC with the network.
- **Have continued R&D effort by the chip manufacturers**
  A strong R&D effort by manufacturers allows the performance to increase and cost of the chips to decrease.
- **Tree topology**
  Unlike a ring topology, a tree topology does not require a link back to the originating PC, which reduces the cabling effort.
- **Peer-to-peer transmissions**
  Peer-to-peer transmissions allow the transfer of data between two drives without going through the root node. This allows the transmission of encoder or I/O or any other type of information quickly between drives.

The following table shows the comparison between the different networks for some of the criteria. Based on this information, the IEEE-1394 network was chosen by Aerotech as being the future of distributed control.

Criteria	FireWire™ (IEEE-1394)	SynqNet™	Ethernet	USB	SERCOS	CAN
Deterministic	Yes	Yes	No	No	Yes	No
Data Rate	3.2 Gbps	200 Mbps	1 Gbps	480 Mbps	16 Mbps	1 Mbps
Standard on PCs	Yes	No	Yes	Yes	No	No
Windows Support	Yes	No	Yes	Yes	No	No
Self ID	Yes	Yes	Yes	Yes	No	No
Topology	Tree	Ring	Tree	Tree	Ring	Tree
Peer to Peer	Yes	NA	Yes	No	No	Yes

SynqNet™ is a registered trademark of Motion Engineering
FireWire™ is a registered trademark of Apple Computer

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Network Drive Specs – Power Stage Options

	PWM	Linear
Current Ratings (peak)	10, 20, 30, 50, 75, 100	10, 20
Current Ratings (peak-continuous)	5, 10, 15, 25, 37, 50	5, 10
Voltage Ratings	20-80, 100-340	0-160
Inrush Limiting	Yes	Yes
Shunt	Yes	NA
AC Input	1,3 phase	1 phase
Safety Ratings	IEC1010, UL3101	IEC1010, UL3101
EMC Compliance	Yes	Yes

Network Drive Specs – Control Hardware

Feature	
Communications Interfaces	IEEE-1394, Ethernet, RS-232, RS-485
On-Board I/O	8in/8out – high speed option available, common sink or common source
Expandable I/O	Limitless with Ethernet I/O
Dedicated Limits	Home, CW, CCW
Brake or General Purpose Relay	Yes
A/D	2 x 16 bit
D/A	2 x 16 bit
Option Cards	Half-slot PCI
Interpolator	Software selectable, up to x655360
Encoder Ports	2
Encoder types	Absolute or Incremental
PSO	1 or 2 axis
Servo Update	8 kHz
Current loop update	20 kHz

Software Only Controller Specs

Feature	
Positioning Capabilities	Incremental, Absolute, Homing, Registration, Gearing, CAM Tables, Clock/Dir
Position Capture	Yes
Trajectory Generation	1 ms
Programming Language	VisualBASIC™, Visual C/C++™, AeroBASIC, RS-274, or LabVIEW™
Digital Filters	Notch, low-pass, FIR

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U500 MOTION CONTROLLERS

U500 PCI Features:

- Sixteen-axis DSP-based motion controller for the PCI bus
- 240 MIPS DSP with single instruction per clock cycle execution
- 48 digital I/O points
- Up to eight 12-bit analog inputs
- Program in AeroBASIC™, C, C++, Visual Basic®, or LabVIEW®
- On-board high-speed Position Synchronized Output for laser firing or data acquisition
- Advanced active alignment routines
- Remote control via RS-232
- Multi-plane/multi-tasking

DR300/DR500 Features:

- Rack-mount designs
- Convenient modular drives
- Fully connectorized interface
- Linear or PWM servo drives
- Internal power supplies and cooling fans

U500PCI

The UNIDEX® 500 family of multi-axis motion controllers serves as a cornerstone for advanced PC-bus-based motion control. The UNIDEX 500 is built on the Motorola 56000 family of DSPs for fast servo loop and unparalleled motion control functionality. Providing up to sixteen axes of control, the UNIDEX 500 supports the motion requirements of today's most demanding machines.

In advanced automation, software requirements vary greatly by the application and user preferences. UNIDEX 500 controllers meet this challenge with a wide range of powerful programming interfaces and tools. All systems are provided with Aerotech's sophisticated Man-Machine-Interface software and comprehensive diagnostics suite. For users looking to create their own interface, software libraries are provided to program in C, C++, Visual Basic®, or LabVIEW®.

Aerotech designed the UNIDEX 500 with the needs of high-performance motion control users in mind. Containing a large feature set that includes functionality for both niche and general purpose machines, the UNIDEX 500 makes its home in any environment where performance and reliability are important. From hill-climbing algorithms to sophisticated image processing, the UNIDEX 500 contains all of the tools for advanced fiber production.

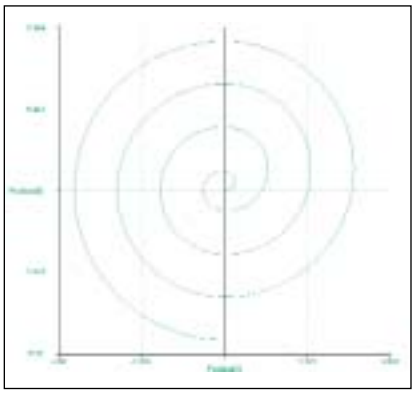
DR300/DR500 Drive Racks

For a convenient interface to drive amplifiers, Aerotech provides a drive rack system that supports up to four amplifiers. An interconnect panel is designed for quick assembly. Motor power is via quick-turn connectors, while system feedback is through standard D-connectors.

The DR300 is a 3U tall 19" rack chassis with internal power supplies and isolation transformers to accommodate a wide range of input power. All Aerotech drive racks have integral circuit breaker switches for over-current protection and convenient power disconnect. The DR500 is a 5U 19" rack chassis that has all the features of the DR300, with additional cooling and power capacity for higher-performance applications.

AEROTECH ADVANTAGE

The DR300's packaged design allows for simple system interconnect.

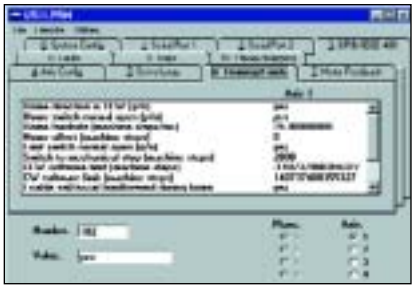


Logging Functions

Spiral and square scan routines, coupled with sophisticated logging functions, combine to make a powerful alignment station.

User Interface

The MMI500 software package is powerful, yet simple to use. Axis displays are easy to read and customizable. Both the status bar and function keys are quick ways to control system settings.



Parameter Editor

No controllers on the market are easier to configure than the UNIDEX 500 and 511. System parameters, which are factory preset, utilize text descriptions that are easy to understand.

UNIDEX 500 LabVIEW™ Drivers

Aerotech has developed a complete set of LabVIEW drivers for all UNIDEX 500 Series controllers. These drivers, which are included as part of the standard software set, access the DLL libraries. As a result, the UNIDEX 500's complete suite of motion capabilities is available through the LabVIEW interface.

Axis Tuning

One look at Aerotech's Axis Tuning utility and it is easy to see why it is regarded as the industry's best. Complete analysis of system performance and move profiles is simply a mouse click away. Left/right cursor utilities enable detailed data analysis.

System Analysis

Included as part of the Axis Tuning utility is a set of System Analysis Tools. Aerotech's years of experience have led to the development of this advanced toolset.

Sample of UNIDEX 500 Virtual Instrument Set

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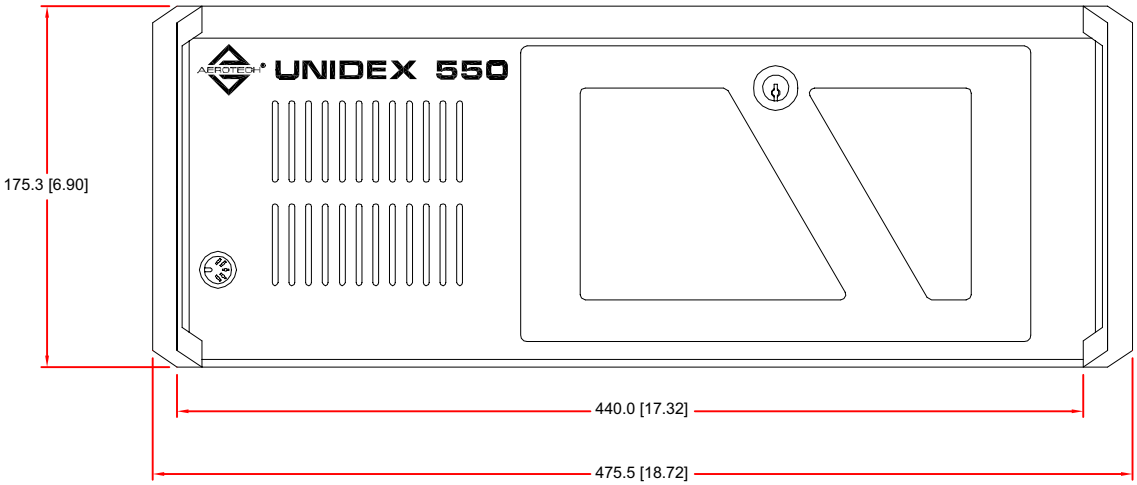
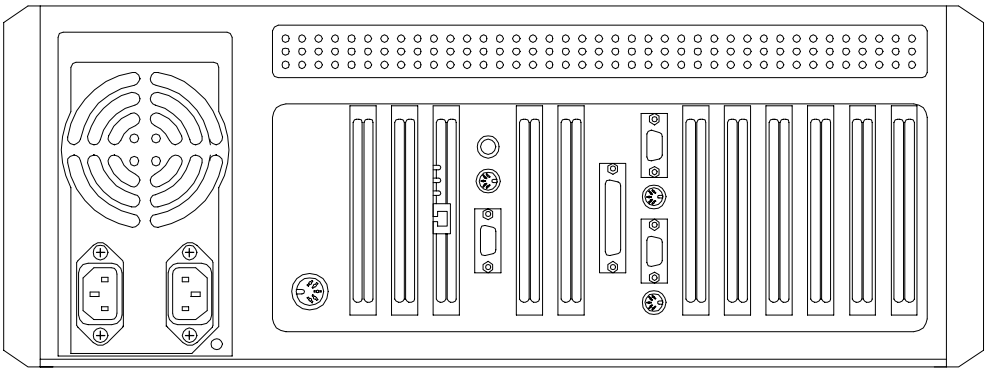
U550 MACHINE CONTROLLER

U550 Features:

- 19" rack mount
- Installed UNIDEX 500 motion controller
- Windows™ Operating System
- Includes pre-installed MMI software
- 14- slot backplane



Front Panel View



Note: DR550 Rack Depth Not Including Handles or Connectors is 450.8 [17.75]

Rear Panel View

Basic Model: U550 Series Drive Chassis

Dimensions - Millimeters [Inches]

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U511 Stand-Alone Motion Controller

U511 PCI Features:

- Enhanced four-axis, DSP-based motion engine
- Advanced multi-processor design
- 48 digital I/O points
- Program in AeroBASIC™, C, C++, Visual Basic® or LabVIEW®
- Optional high-speed Position Synchronized Output for laser firing or data acquisition
- Front panel displays and keypad for convenient menu-assisted programming
- Sophisticated interface via two standard RS-232 ports and optional IEEE-488
- Advanced Windows®-based remote diagnostic software
- Integral servo amplifiers
- Fully connectorized interface

UNIDEX® 511

The UNIDEX 511 is the latest in Aerotech's long line of stand-alone multi-axis motion controllers. State-of-the-art technology coupled with an intuitive interface make this an ideal controller for use in fiber-optic positioning applications.

By combining an advanced motion engine with the simplicity of a menu-driven interface, the UNIDEX 511 easily tackles the most complex motion applications. Unlike most controllers on the market today, there is no need to understand a cryptic command set to generate motion. The intuitive interface allows a user to begin programming with just a few presses of the keypad. And with on-line help, writing parts programs could not be easier.

System diagnostics are easily read from the built-in display, and an optional Windows®-based remote software package is included with each unit. This package allows the user to upload/download programs, modify parameter files, and analyze motion with Aerotech's advanced graphical tuning package, all from the convenience of a remote PC.

Whether operated in stand-alone mode via the front panel or by remote control with RS-232 / IEEE-488, the full functionality of the UNIDEX 511 is available. On-board configuration and monitoring utilities simplify remote communications. The UNIDEX 511 is populated with two RS-232 ports and an optional IEEE-488 port. The UNIDEX 511 can address all three ports simultaneously – a testament to the true power and flexibility of this controller.

As easy as the UNIDEX 511 is to operate, it is equally powerful for advanced applications. The DSP motion engine is capable of point-to-point motion, linear and circular interpolation, and multi-axis error correction. High-speed interrupts and data logging capabilities provide a real-time link to external systems. Whether the application requires simple point-to-point motion or complex power peaking algorithms, the UNIDEX 511 is capable of meeting the most advanced motion requirements.

Connections are made via standard connectors at the rear of the unit, so starting up a system is as simple as Plug-and-Go.

Designed as a complete motion controller, the UNIDEX 511 has 48 digital I/O, four 8-bit (12-bit optional) A/D inputs and dedicated home, over-travel, and E-Stop inputs.

AEROTECH ADVANTAGE

The UNIDEX 511 has an intuitive, menu-driven interface that simplifies motion control programming.

Diagnostics

As an aid to system setup, the UNIDEX 511 has a powerful diagnostic utility. System status is clearly displayed, simplifying system setup and debug.

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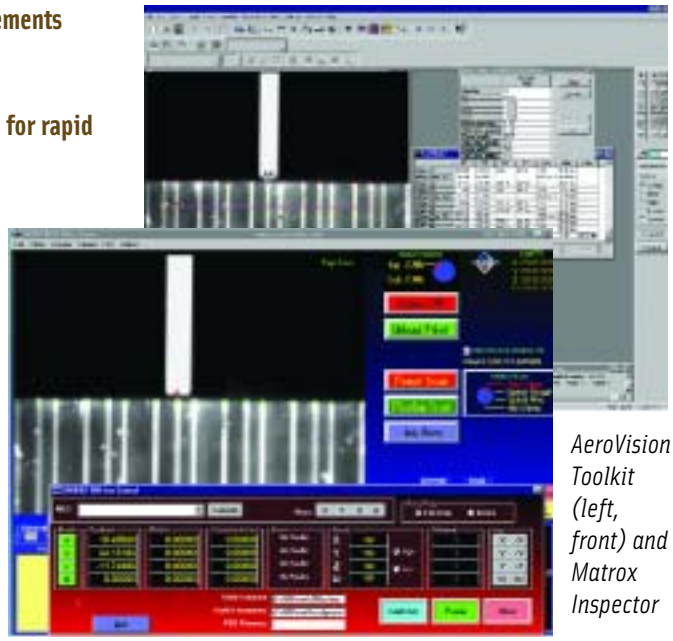
AeroVision Tools

- **Complete product offering for addressing the unique requirements associated with automating fiberoptic production processes**
- **Integrated motion, vision, and power-scanning capabilities for rapid application development**
- **Program in VB/C/C++ or use AeroBasic to quickly debug, prototype, and deploy vision-assisted applications**
- **Application-specific toolkits for various fiber alignment applications including cameras, lenses, and lighting**
- **Fast Object Position Tracking with upward scalable hardware options**
- **Standard and non-standard cameras can be interfaced with various hardware options**



AeroVision Toolkit (left, front) and Matrox Inspector

Aerotech's new vision and motion toolkit is designed for rapid prototyping with end users, systems integrators and OEMs in mind. Experienced vision and motion engineers, as well as first time users, can begin rapid prototyping immediately with AeroVision. AeroVision can be easily applied to any combined vision and motion application such as pick and place, part identification, measurements, etc., and also can be used to supplement or replace virtual toolpoint transforms.

Aerotech has developed a suite of vision tools enabling the rapid debug, prototyping, and deployment of vision-assisted fiberoptic or other automation applications. The tools are seamlessly integrated with Aerotech's motion development tools. Applications can be created in Visual Basic, C, and C++. Fibers, arrays, collimators, etc., are typically located and aligned using the included vision tools. Customers already using other machine vision libraries can quickly integrate our motion control code sections into their existing MMI to take advantage of our power scanning and nano-positioning

AeroVision's machine vision tools are based on the Matrox Imaging Library™ (MIL) and the Matrox Inspector interactive Windows™ imaging software. Both are industry-leading image processing packages with advanced high-level tools for determining an application's necessary inspection process and generating code necessary to perform the vision tasks. These are combined with an easy to use motion control Visual Basic toolkit for automating motion from the vision results. Users can customize the example code to their particular requirements via Visual Basic's development environment.

Matrox Meteor-II frame grabbers

MIL

The Matrox Imaging Library is a field-proven high level Windows™ software development toolkit available as DLL or OCX for machine vision and image analysis. MIL

Matrox Imaging Library

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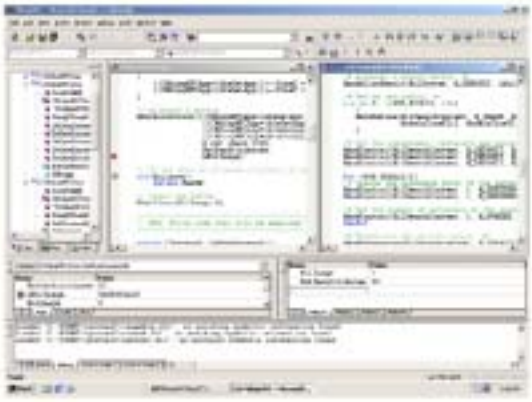
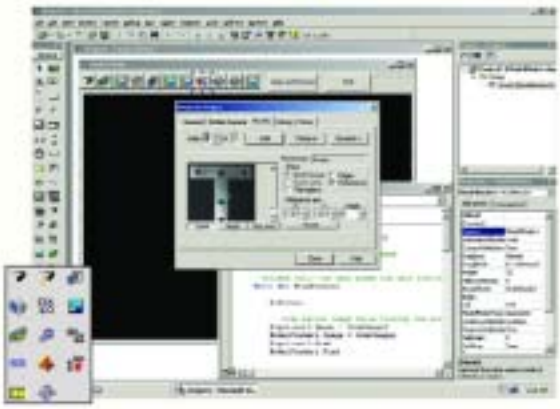


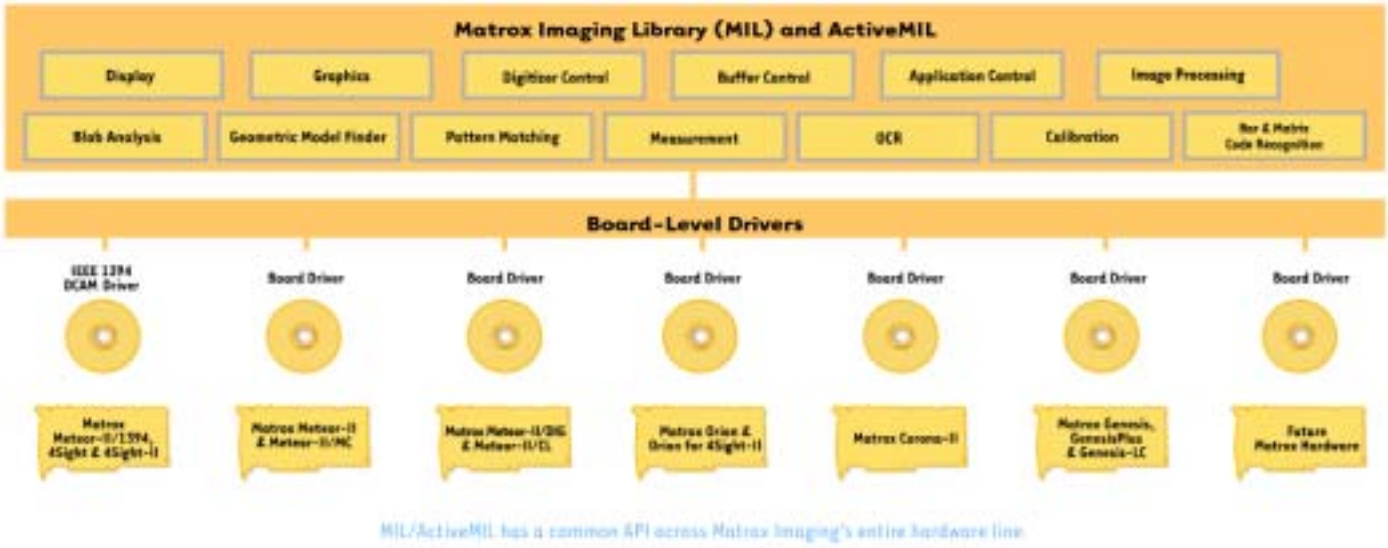
MIL's 'C' programming interface consists of descriptive command names and parameters. Commands are not only intuitive, but highly integrated, so applications are developed quickly with relatively few lines of code.



ActiveMIL (see enlarged controls on left) fully integrates into rapid application development (RAD) environments for Windows®, such as Microsoft® Visual Basic®. Application development consists of drag 'n' drop tool placement with point 'n' click configuration, resulting in substantially less coding than the classic 'C' method.

MIL provides a choice of programming environments for Windows application development: classic C/C++ or ActiveX (OCX).

has an extensive set of optimized functions for image capture, image processing (e.g., point-to-point, statistics, filtering, morphology, geometric transformations, FFT), pattern matching, blob analysis, measurement, OCR, bar and matrix code recognition, calibration, graphics, image compression, image display, and archiving. MIL now includes *Geometric Model Finder*, a unique pattern recognition tool that uses geometric features to quickly find patterns located at any position including angle, any scale from 50% to 200%, with occlusion, and under non-uniform changes in contrast including contrast reversal. MIL includes drivers for the Matrox line of frame grabbers and vision processors in one package. These various hardware options cover an immense range of processing solutions from low-end to ultra-high-end systems. MIL ties it all together so the user doesn't have to. MIL also includes ActiveMIL, an OCX interface to all MIL functions to ease programming.



MIL/ActiveMIL has a common API across Matrox Imaging's entire hardware line.

MIL software architecture

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Matrox Inspector

Matrox Inspector

Matrox Inspector is an interactive Windows™ application for image capture, processing, analysis, display and archiving. Based on the Matrox Imaging Library (MIL) software development toolkit, it provides point-and-click access to all of MIL's extensive library of optimized machine vision image processing functions. Inspector is designed as a companion tool to MIL to facilitate the development of machine vision and imaging applications.

Key additions to Inspector are ActiveMIL Builder, Model Finder, and Relative Region Tools. ActiveMIL Builder is a powerful code generation tool for creating stand-alone imaging applications using the Visual Basic™ development environment. Model Finder lets the user control the new Geometric Model Finder libraries of MIL.

Additional Programming Flexibility

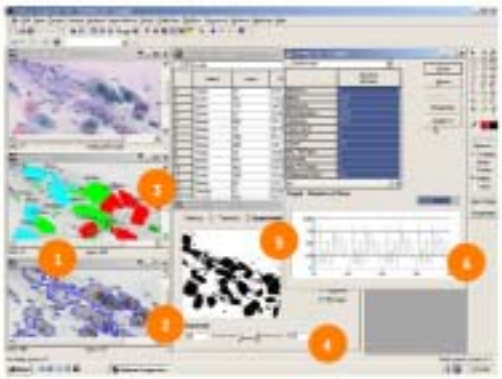
The standard AeroVision examples and tools are designed for Visual Basic, but the motion and vision libraries can also be called from C/C++. Aerotech's vision and motion tools are encapsulated in COM, DLL, and Active X formats enabling application implementation in various programming methods. This flexibility allows for the development of applications in familiar programming environments such as Microsoft's Visual Basic or Visual C, maximizing flexibility, code reusability, and reducing the learning curve associated with proprietary development environments.

Fast Tools + Fast Interfaces = Fast Object Tracking

Coupling PCI vision and motion hardware with fast inspection software allows the customer to implement fast, reliable systems with scalable performance. Vision hardware from analog video frame grabbers up to digital video vision processors are available. This, coupled with Aerotech's time-tested motion control solutions, gives customers the ability to build the system they need and easily upgrade later if their application requirements grow. A good example of fast processing would be active

1. Get an overview of open images, scripts and systems (digitizers) in the workspace pane
2. Toolbars provide easy access to operations
3. Define a model to be matched
4. Matches are highlighted directly on image
5. View features of graphical objects (e.g., average intensity, area, size, angle, etc.) in Quick View window
6. Results are displayed in a table and can be saved to a disk or transferred directly to Microsoft® Excel

1. Blobs individually labeled and identified on the image
2. Individual results reported by double-clicking a specific blob
3. Blobs can be classified based on user-selected criteria and displayed graphically on the image
4. Dual slider allows basic segmentation with a two-level threshold
5. Instant preview of resulting changes
6. View statistics for all blobs by feature



Inspector work environment

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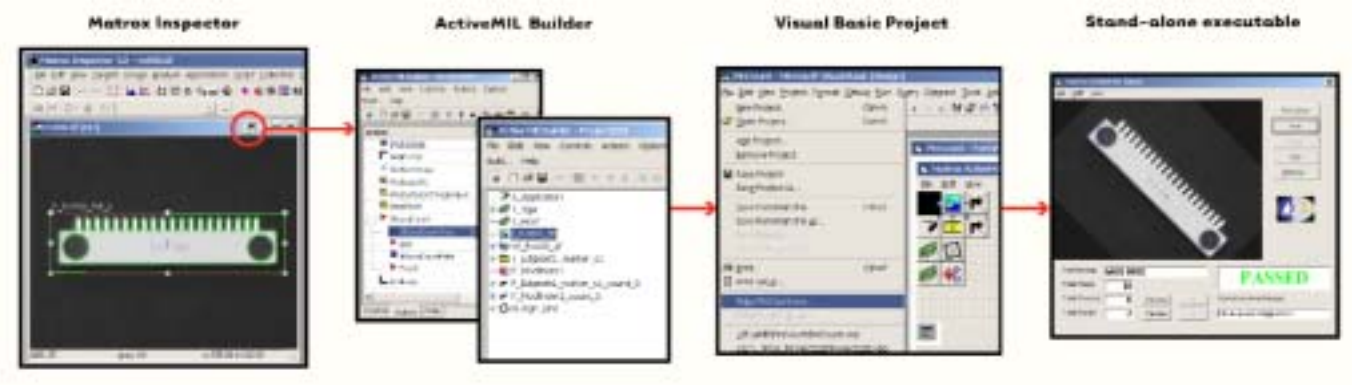


ActiveMIL Builder tool provides the shortest path from prototyping in Matrox Inspector to a stand-alone executable.

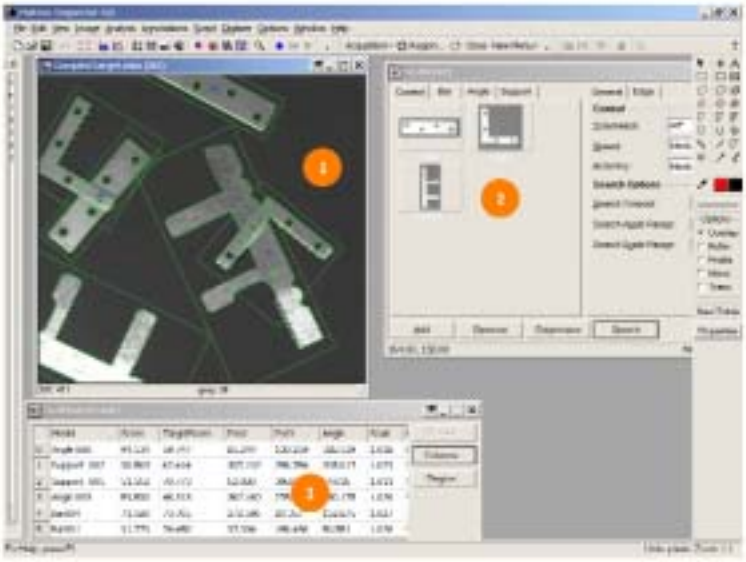
vision servoing by tracking an object and sending correction moves to the motion system at the camera frame rate.

Open Development Environment

Using industry standard development tools provides a completely open-architecture programming environment. Third-party network interfaces, I/O, and other peripherals can be seamlessly integrated at the application level. Other automation vendors claim open architecture by providing support for a limited number of third-party resources within their development environment. With Aerotech and the Windows VB/C/C++ programming environments, there are no such limitations. Developers are free to choose best-in-class peripherals to enhance and extend the capability of their systems.

High-Speed Communication

Interfacing to the Aerotech motion and vision subsystems occurs through the PCI bus, eliminating bottlenecks associated with RS-232 and IEEE-488 communication interfaces. RS-232 and IEEE-488 "legacy"-type interfaces have been well-suited for laboratory-type environments where speed and throughput are not an issue. Today's competitive optical component manufacturing environments require high speed, high throughput, and low downtime systems. Using the 32-bit parallel data PCI bus as the communication channel for image processing and motion control meets these requirements with throughput to spare. Programming support for "legacy"-type interfaces is available within the VB or



Geometric Model Finder tool uses geometric features to quickly find patterns at any angle, any scale from 50% to 200%, with occlusions, and under any non-uniform changes in contrast, including contrast reversal (1). One can add and adjust individually models and parameters, as well as save and load MIL MMF files (2). A user can view results in the target image and configure, sort and output results from result table (3).

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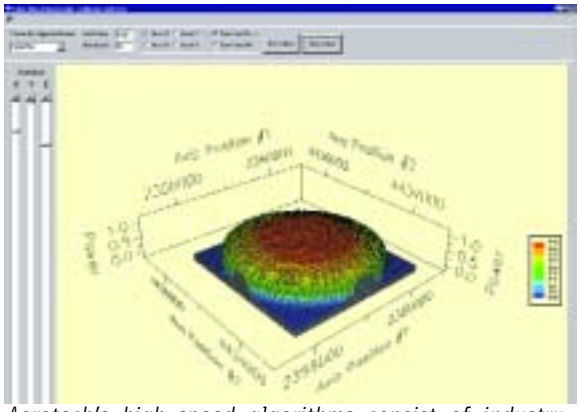
C/C++ programming environment for applications that must support communication with these devices.

Targeted Vision Solutions

These solutions are available with all required hardware such as frame grabber, cameras, lenses, lighting, and cables for a complete vision-enabled solution. Aerotech can provide a full line of analog, digital, IEEE-1394, or Camera-Link frame grabbers and image processors. Software-only solutions are available for customers familiar with the specification and application of vision-related hardware. The toolkit example code provided by Aerotech demonstrates how to identify the position and orientation of device-specific features and return this data to the program for subsequent processing. The toolkit provides customizable examples of the following necessary automation process steps:

- Customers can easily create an automated parts database for part selection and critical parameter setup.
- The machine vision and scan search limits can be used to provide collision avoidance.
- The high accuracy sub-micron vision capture rapidly ascertains part location and vision servo alignment.
- Aerotech's active alignment algorithms provide automatic nanometer positioning control.
- Standard interface I/O control or Pulse Synchronized Output provides coordinated triggering of epoxy dispense and cure or laser welding with post weld adjustments.
- Can communicate to the shop floor through standard Ethernet, USB, or Firewire protocols.



Aerotech's high-speed algorithms consist of industry-standard alignment functions as well as sophisticated proprietary multidimensional "fast" alignment routines.

Fast Power Scanning

Vision is well-suited for the initial alignment of optical components. Machine-vision-guided alignment can, in most cases, eliminate the need for manual operator intervention, resulting in lower production costs, more repeatable results, and higher yields. By locating the actual position and orientation of components with vision, the complexity and cost of fixtures also can be reduced. In most cases a properly configured vision system can align components with enough accuracy to attain a minimal amount of light coupling. The attainment of "first-light" using vision can lead to shorter manufacturing cycle times, further reducing the cost of optical components. However, finding "first-light" is only the initial step in the alignment process. The coupling of the light through the components must be optimized and this optimized orientation must be maintained throughout the remainder of the process. Aerotech has implemented a complete set of power coupling optimization tools that result in the fastest alignment times in the industry. These high-speed algorithms consist of industry-standard alignment functions such as spiral search and hill-climb routines, as well as sophisticated proprietary multi-dimensional "fast" alignment routines. These tools can be used individually or in combination to provide coupling efficiencies unattainable with a manual alignment station or competitive automated systems. Once the optimal alignment of the components has been achieved, Aerotech's nano-positioning tools have the required in-position stability to maintain the alignment throughout the rest of the manufacturing process.

Complete System Solution

Aerotech has all the key components from both a hardware and software perspective to meet the requirements of the most demanding fiberoptic component manufacturing applications. With high reliability, continuous-duty, 24/7-rated nano-translators, the fastest power alignment algorithms in the industry, integrated vision processing, and an open-architecture motion control platform, Aerotech truly represents the best-in-class fiber automation motion systems and tool provider.

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Virtual Pivot Point

Devices such as collimators, lensed fibers, AWGs, and arrays typically require angular as well as linear alignment for optimal power peaking. XYZ linear motion combined with pitch, yaw, and roll may be used for aligning these devices.

To facilitate part fixturing and loading configurations, there is often an associated moment arm located away from the stages' actual kinematic center. In addition, mechanical tolerances in the optical components, mechanics, and fixturing add to the coordinate reference system errors.

When the device and motion rotation points are not collocated, rotating a mechanical stage causes a linear translation of the DUT (Device Under Test) as well as a rotation. This translation can induce errors in an alignment algorithm process, increasing the amount of time to perform an alignment, reducing optimal power coupling efficiencies, and reducing component yields.

Aerotech's Virtual Pivot Point Software™ transforms in up to six dimensions the actual location of any region of interest on the DUT to compensate for misalignments. The "reverse kinematics" software calculates the translation error and a compensation move simultaneously during alignment. This permits the FiberMax system to seamlessly translate and rotate about the new Virtual Pivot Point in space.

The sophisticated Virtual Pivot Point software automatically removes the translation error produced by compensating with motion in the opposite direction and magnitude of the error. Aerotech's Virtual Pivot Point software is easy to set up and implement, so the user can quickly configure and run active power alignments. Single-channel power searches or dual-channel routines are available for array alignment. Virtual Pivot Point is available for the Automation 3200 and UNIDEX 500 motion controllers and includes support for LabVIEW®, DLL, and MMI interfaces. Please consult the factory for other controller compatibility.

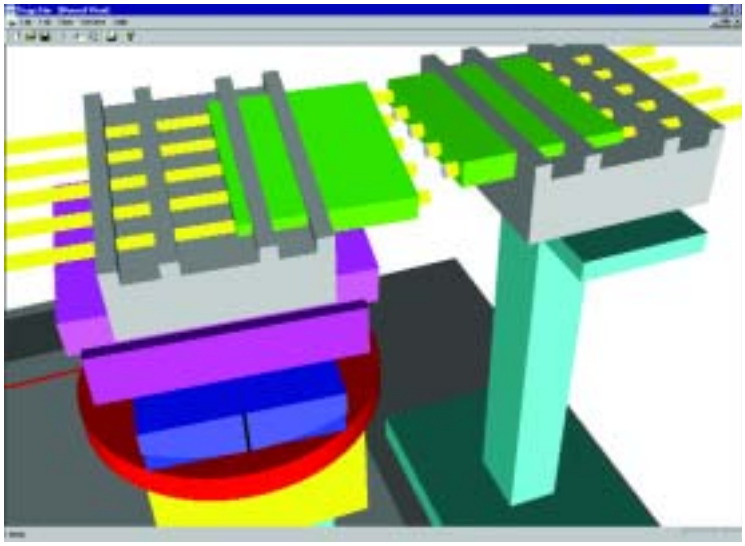

Figure 1. Screen shot of an arrayed simulation.

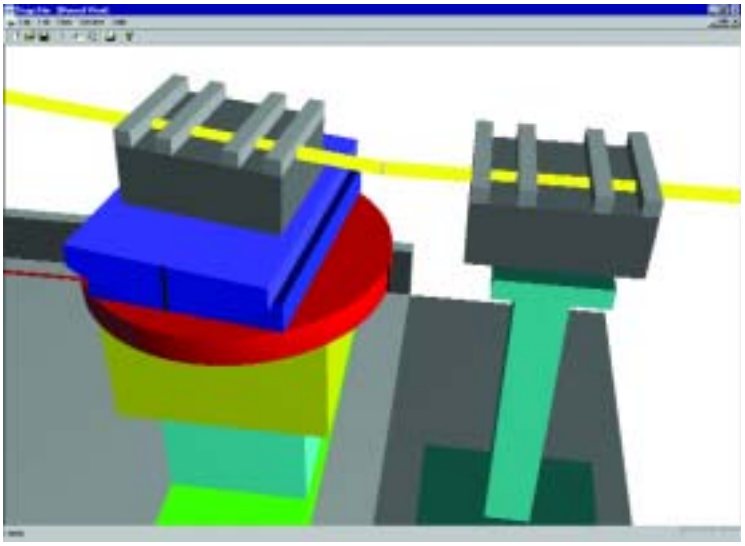

Figure 2. Screen shot of a single fiber simulation.

When coupled with Aerotech's power searching algorithms, AeroVision™ vision software, precision system electromechanics and motion controllers, it is easily the most powerful system solution on the market today.

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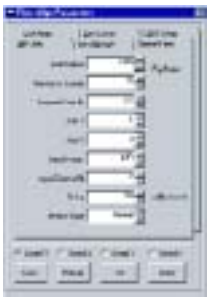
Power Scanning

- **First light alignment routines**
- **Power optimization alignment routines**
- **Scan simulator**

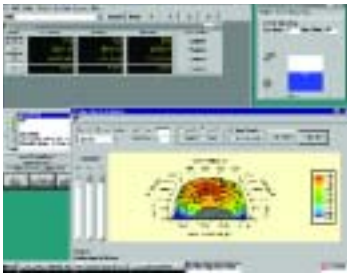
Aerotech has developed advanced user-friendly active alignment utilities for fast photonics component alignment. A scan simulator is included to quickly determine scan parameters based on device size and energy distribution.

Standard routines include:
- First Light Alignment Routines
- Spiral Rough, Step, or Continuous
- GeoCenter
- Power Optimization Alignment Routines
- Fast Align
- Spiral Fine
- Hill Climb
- Centroid

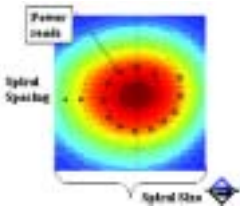
Each routine has setup parameters that can be quickly configured and saved. The standard MMI software has pull-down menus for user configuration, or parameters may be read, set, and saved directly in the user application program.



Scan routines can access power readings via GPIB or analog input. Users can also read and write directly to GPIB or RS-232 for meter control.



Spiral Rough can be run in step or continuous mode for fast first light detection. It stops at a user-programmed power threshold.



GeoCenter performs a raster scan to determine center of available energy over a programmed area and then moves to the center.

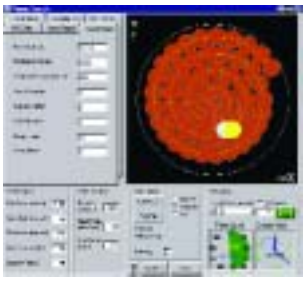
Fast Align is a 2D, 3D, 4D to ND rapid power peak alignment routine. It determines power direction and increases or decreases step size and direction as necessary.

Parameters include number and order of search axes, soft axis travel limits, power saturation threshold, convergence, and delay for meter settling.

Spiral Fine is similar to Spiral Rough except it completes the programmed spiral and then moves to the maximum energy found.

Hill Climb is a single axis peak or threshold search routine.

Centroid is a two-axis search that looks for a symmetrical drop in energy along two axes and then moves to center.



Scan Simulator is used to determine motion parameters. Users just enter beam and target size, and desired overlap and the system calculates the proper motion parameters for the power scanning. The scan simulator then simulates the power scan and time.

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Competing Technology Comparisons

There are various technologies that can be used to attain motion on a nanometer scale, and each of these technologies exhibits different optimal characteristics and performance limitations. Through a careful examination of the strengths and weaknesses of competing motion technologies, Aerotech's direct-drive noncontact technology demonstrates a superior combination of size, throughput, and reliability.

Piezo Actuators

Piezo actuators have been the predominant method of achieving nanometer-scale motion in telecommunications applications. The fundamental theory of operation is based on the "inverse" piezoelectric effect, where a voltage applied to a certain crystalline structure will cause the crystal to change shape or expand. This expansion is proportional to the applied voltage and the configuration of the piezo element. Typical motion for a stacked piezoelectric element is on the order of 100 microns.

Piezo Actuator Advantages

The proportional displacement-to-voltage characteristic permits an open-loop mode of operation that is one of the key advantages of the technology. This feature facilitates the implementation of a low-cost actuator, as no position feedback element is required for operation.

Piezo Actuator Disadvantages

There are several drawbacks to using piezo elements in an open-loop fashion. The voltage-to-displacement relationship is nonlinear and exhibits hysteresis (see Figure 1). The nonlinear relationship implies that for a given increase in voltage, the piezo will expand by a varying amount across its full range of extension. Hysteresis arises as the piezo element changes direction, where the expansion or retraction of the element traces a different path in the reverse direction as a function of the voltage. Furthermore, the degree of hysteresis varies depending on where in the expansion-versus-voltage curve the direction reversal occurs. And finally, the amount of expansion of a piezo element is proportional to the applied load. The load acts to compress the piezo effectively limiting its range of expansion. For different loads the piezo will exhibit different rates of expansion as a function of the applied voltage.

All of these effects limit the practical application of a piezo element in an open-loop mode for nano-positioning requirements. To overcome these problems, piezo manufacturers have integrated position feedback elements. While adding position feedback will address the aforementioned problems, it also adds cost and complexity to the system, thereby negating the cost advantage inherent with open-loop piezo operation.

There are several different implementations of piezo actuators, including stack-type actuators, flexure actuators, and friction drives.

Stack-Type Actuators

Stack-type actuators, as the name implies, consist of a stack of piezo elements enclosed in a cylinder. Attached to one end of the piezo stack is a moving contact element, while the other end of the stack expands against the end of the cylinder. These devices have been used primarily in conjunction with micrometer-driven manual stages to provide a limited degree of automation or a "fine" adjustment capability. Stack-type actuators are capable of full range motion on the order of 100 microns. A 100-micron travel actuator will be between 100 mm to 200 mm long (depending on the voltage range), giving a length-to-displacement ratio of 1000 to 1. The real limitation to increasing the range of stack-type actuators is related to the electrical characteristics of the device. However, if we were to assume the electrical issues could be overcome, a 1 mm travel piezo stack would be 1 meter long!

Hybrid approaches, which use a combination of traditional motor technologies such as stepper motors for coarse positioning, and piezo elements for fine positioning, have been implemented to provide a greater travel range. This method adds another layer of complexity in the form of additional drive electronics and feedback devices, increasing the footprint (see Figure 2) of the actuator and reducing overall system reliability.

Flexure Actuators

There are other approaches to increasing the range of travel of piezo elements that do not involve integrating a coarse positioning stage. Some vendors use flexure-driven stages where the piezo expands against a lever mechanism to increase the range of motion up to 400 microns. These designs have a side effect of off-axis motion where a movement along the primary axis is accompanied by motion in a perpendicular plane. These off-axis motions can be compounded when multiple flexure stages are coupled in a multi-axis

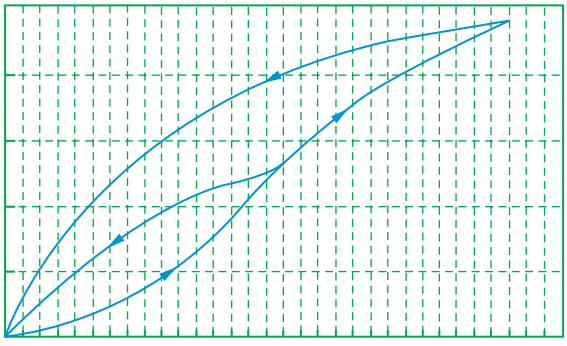

Figure 1. Typical hysteresis curve of a multilayer piezo stack.

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system. Complicated software correction algorithms must be used to compensate for this undesirable motion.

Friction Drives

A unique application of piezo technology that overcomes the travel limitations of stack or flexure designs utilizes a friction drive element. In this design, either an oscillating "finger"-type element pushes against a ceramic bar or an alternating clamping and expansion sequence on a ceramic cylinder induces linear motion. In both techniques the amount of travel is limited by maximum manufacturing length of the ceramic bar or cylinder. The drawback to this type of motor is that it relies on friction to create motion and the size of the resulting motor is much larger than a traditional piezo expansion-based stage. The friction induces wear in the drive element causing degradation of system performance over time, and limiting the life of the motor.

Both the clamping and oscillating technologies must strike a balance between force output and motor life. Higher force output of the motor requires greater preload between the drive elements, thus increasing friction and decreasing the life of the motor. The oscillating motor technology has a maximum speed of approximately 250 mm/s, although there is very little force available at this velocity, and a lifetime specification of 20,000 hours at 50% duty cycle. The clamping motor technique suffers from low top-speed (1.5 mm/s) and low life expectancy (200 to 2000 meters of travel). For example, if the clamping motor were to run at its maximum speed of 1.5 mm/s in a continuous fashion, the actuator would fail between 37 and 370 hours of operation!

Direct-Drive Technology

Aerotech uses a proprietary direct-drive, noncontact motor technology that is capable of unlimited travel, high acceleration, high velocity (250 mm/s), and due to its noncontact design, will never wear out. The only maintenance item on the stage is the mechanical bearings. The life expectancy of these bearings under medium-to-low duty cycle applications is on the order of 14,000,000 m. Under continuous operation where an ANT-25L is moving 25 mm once per second, the bearings would have a calculated lifetime of around 10 years (based on bearing manufacturer calculations and assuming recommended lubrication intervals).

All Aerotech's fiber related products rely on high-resolution linear encoder feedback with 10 nm linear resolution and 0.05 arc-sec angular resolution. Clearly the Aerotech ANT components, FA90, and FiberMax systems offer the best-in-class combination of speed, size, travel, lifetime, and lowest total cost-of-ownership available in the industry today. We invite you to take advantage of our expertise and let us assist you with a comprehensive system specification and process review to ensure your project's success.

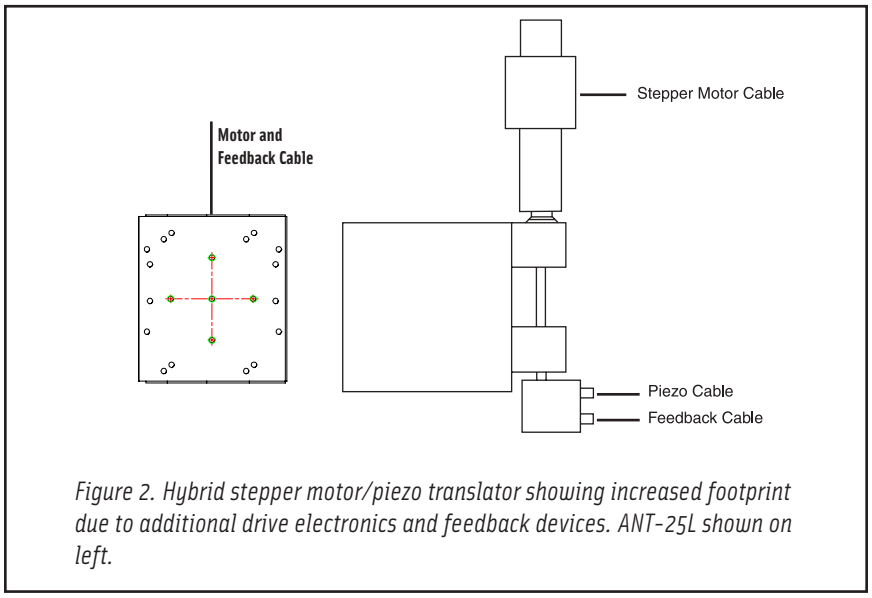


Figure 2. Hybrid stepper motor/piezo translator showing increased footprint due to additional drive electronics and feedback devices. ANT-25L shown on left.

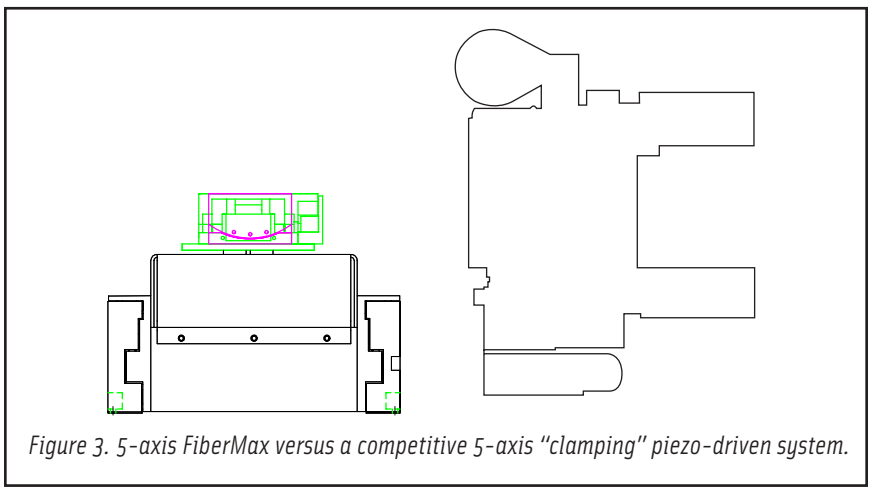
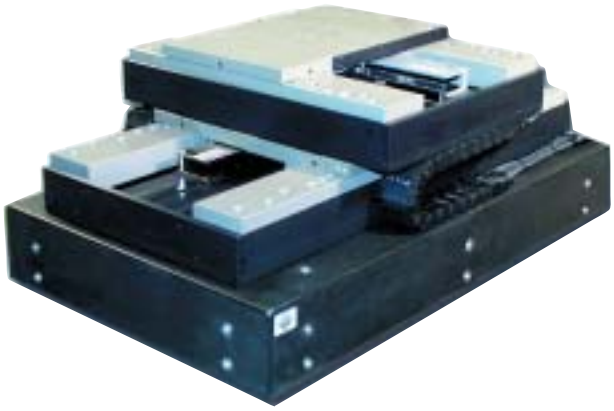


Figure 3. 5-axis FiberMax versus a competitive 5-axis "clamping" piezo-driven system.

Additional Aerotech Products

Aerotech manufactures a variety of positioning systems and motion control products to complement your application. These products include air bearings, gantries, linear and rotary stages, linear and rotary brush and brushless motors, amplifiers and drives, motion controllers, and custom positioning solutions. Some of our many products are shown on this and the following page.



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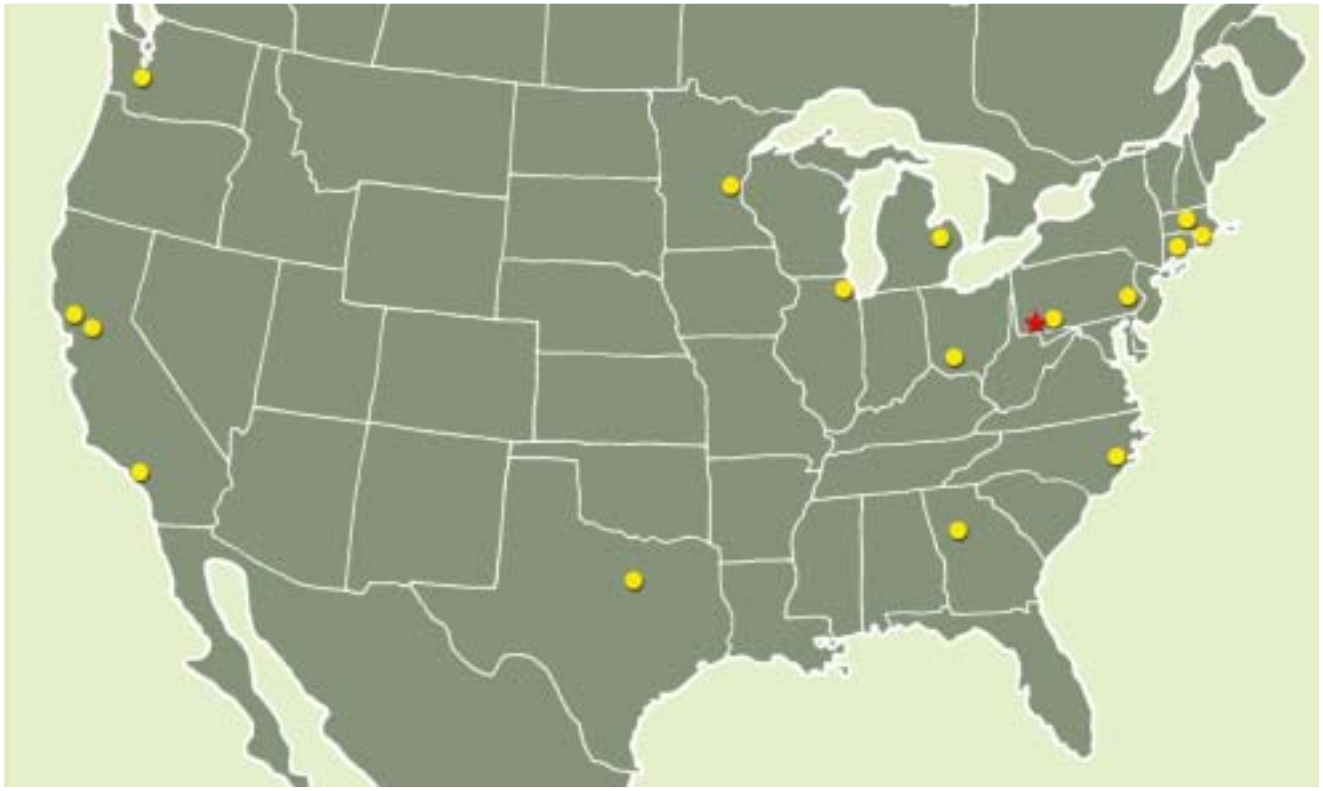

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Dedicated to the Science of Motion

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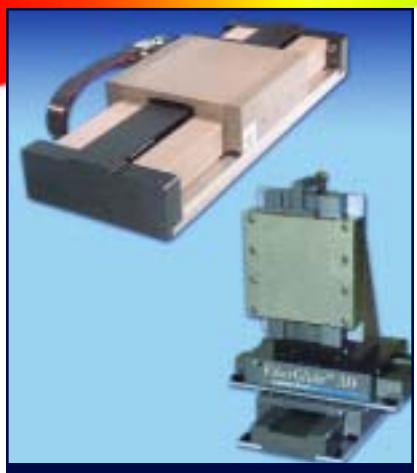

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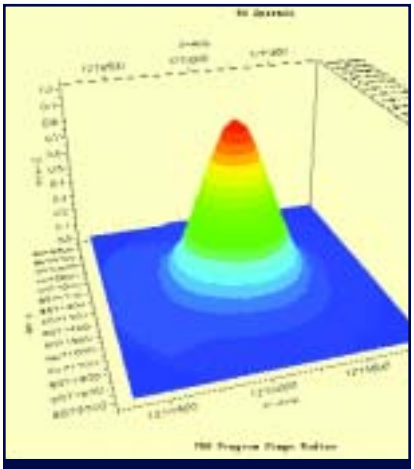

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