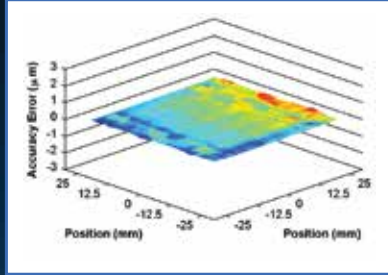
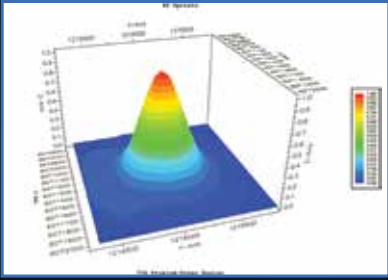
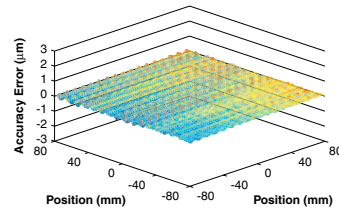


Precision Motion Control for Fiber Optics and Silicon Photonics



Aerotech Overview

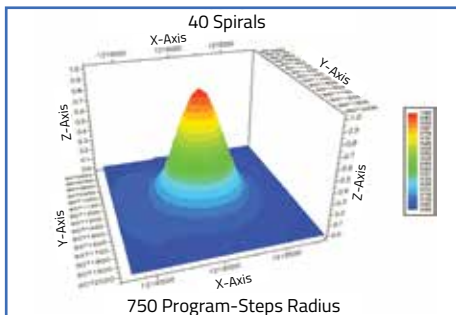
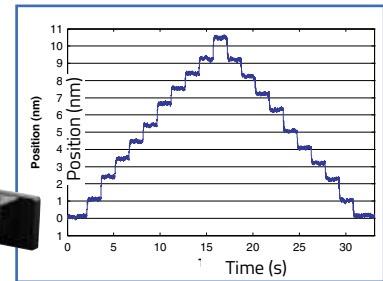


Single-source supplier for precision mechanics, controls and drives, advanced software, and complete motion subsystems for precision manufacturing.

Solutions for the Fiber-Optics Industry

Best-In-Class Mechanics

Our precision mechanics offer hundreds of millimeters of travel with SINGLE NANOMETER linear steps and SUB-ARC-SECOND rotary steps for unmatched alignment capabilities.



State-of-the-Art Controllers

Maximize your return on investment with Aerotech's industry leading controllers. Utilize our suite of fiber-optic manufacturing control features and seamlessly interface with Aerotech mechanics.

Customized Motion Subsystems

Aerotech's engineers ensure that your motion subsystem is tailored to fit your application. In addition to our extensive standard product offering, we also can customize motion control solutions to optimize your process.



Unparalleled Start-Up and Support

Aerotech motion products come to you as a fully functional system so you can focus on the process. Enjoy the convenience of a single-source, global support team.



Fiber-Optic Motion Solutions at Every Step

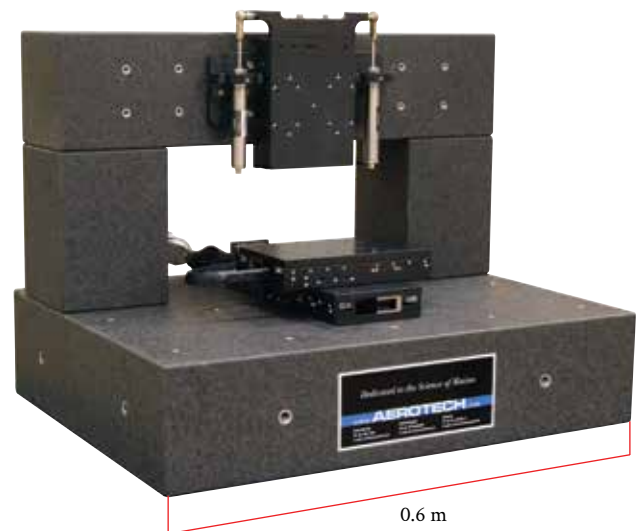
Fiber-Optic Alignment

- Flexible design for fiber-to-fiber and fiber-to-chip alignment.
- Utilize our fiber-optic controller routines to quickly deploy active alignment processes.
- Easily incorporate vision and leverage single nanometer step sizes.
- Our unparalleled precision provides the most repeatable, reliable device assembly.



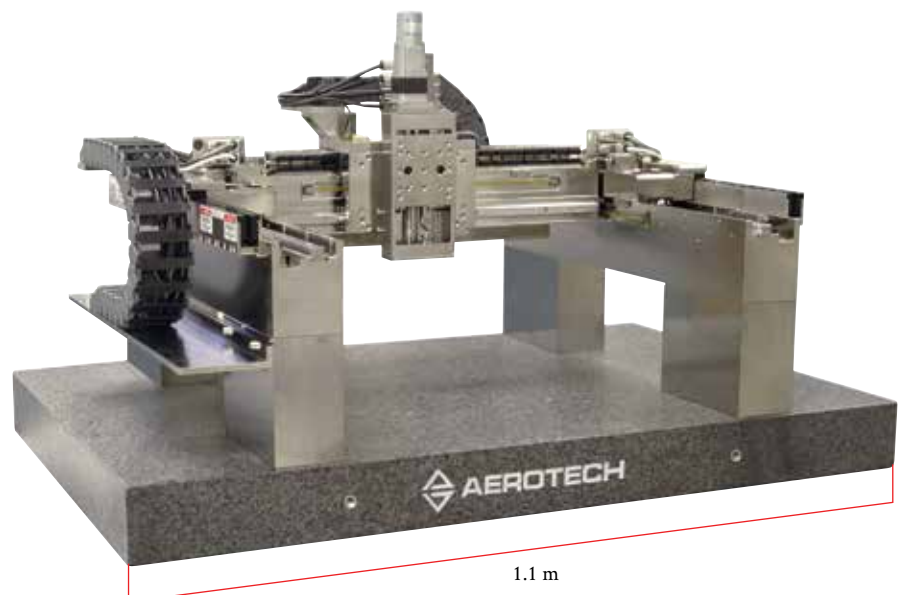
Bonding and Laser Welding

We understand the challenges involved with welding and bonding processes. Aerotech's nanopositioner family is the ideal modular solution to fit any welding or bonding process.



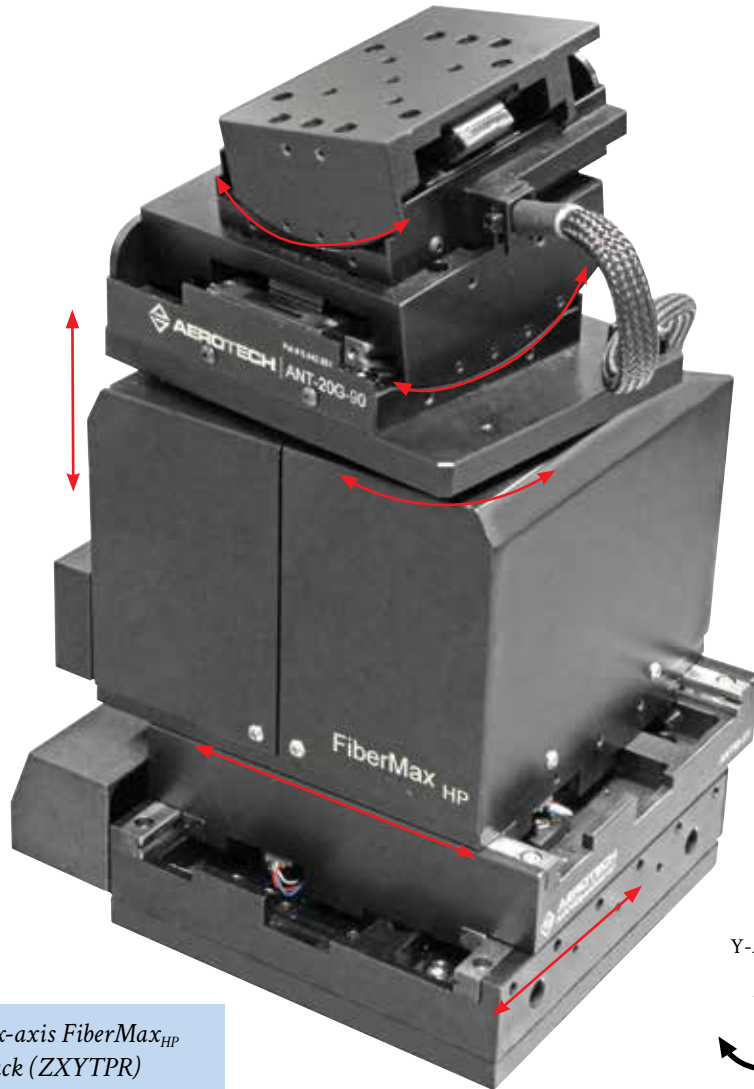
Pick-and-Place Assembly with up to 32 Coordinated Axes of Motion

Aerotech has the optimal motion solution for your assembly processes. We will tailor your motion subsystem to your process with the perfect drive technology, degrees of freedom, and controls integration.



FiberMax_{HP} Photonics Alignment Platform

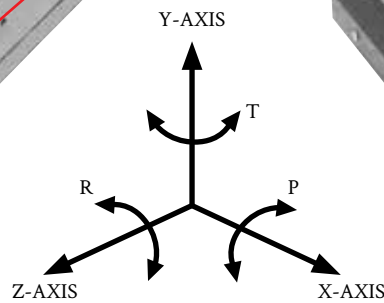
- Configurable virtual pivot point allows for easy component manipulation
- Next generation photonics alignment platform built on high-performance ANT nanopositioners
- Precision motion for up to six degrees of freedom
- Noncontact, direct-drive for all axes enabling high-throughput alignment
- Minimum incremental motion to 2 nm linear and 0.05 μ rad rotary motion



Six-axis FiberMax_{HP} stack (ZXYTPR)

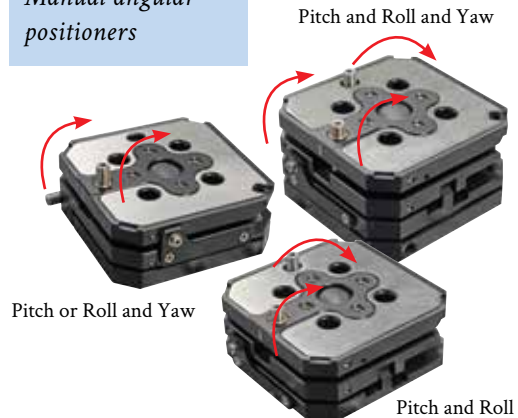


Six-axis FiberMax_{HP} stack (ZXYTPR)

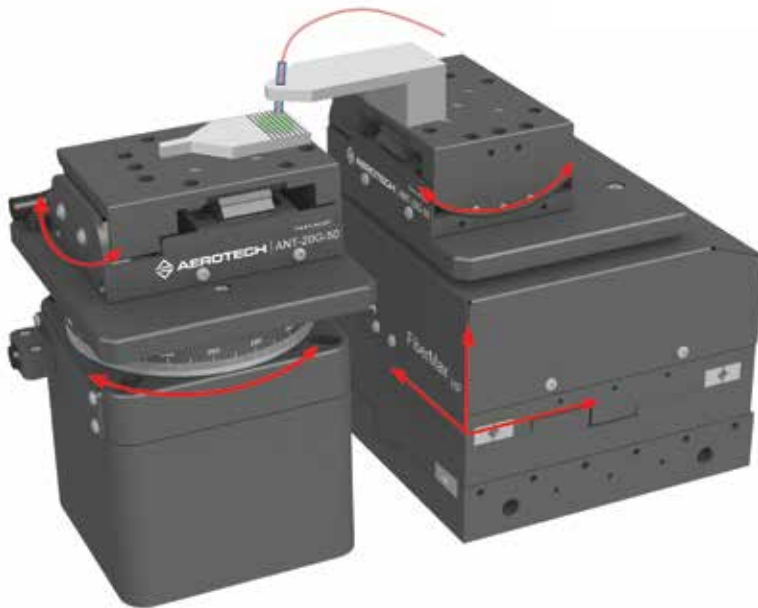
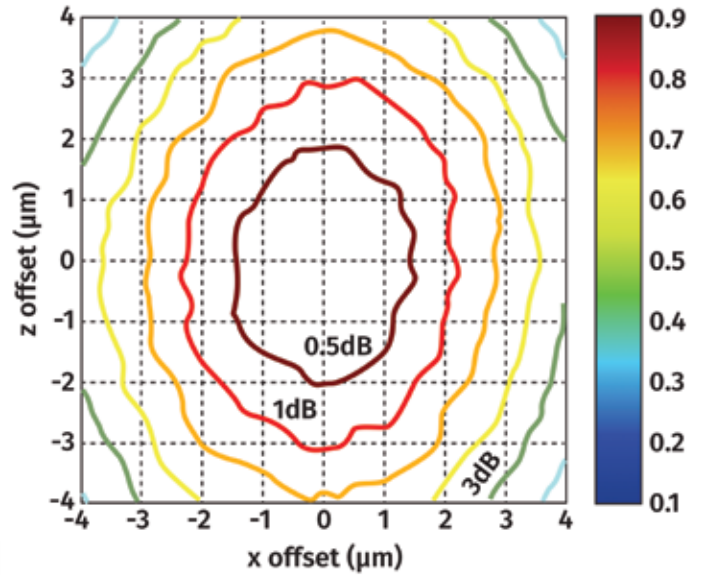


Four-axis FiberMax_{HP} stack (ZXY+T)

Manual angular positioners



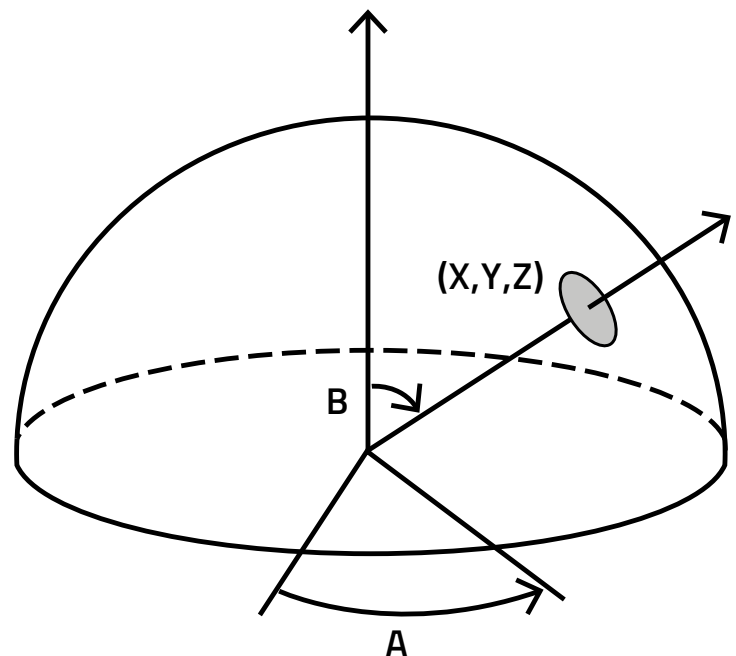
- Direct-drive motion platform allows for better incremental positioning than parallel kinematic solutions
- Global accuracy to ± 200 nm, repeatability to ± 150 nm
- Powerful controls with automated scanning algorithms and virtual pivot-point kinematics
- Interface to industry-standard power meters
- Flexible design with many standard configurations and options
- Manual stages for angular positioning



Six-axis
FiberMax_{HP}
Alignment System
(ZXYP+TR)

Virtual Pivot Point

- A3200 can automatically implement virtual pivot point (VPP) kinematics using the **ROTATION** command
- **ROTATION** allows the user to program axis pairings and virtual axes configurations
- When using the **ROTATION** command, reference frames that are dependent on the positioning of specific axes can be programmed so that motion can be commanded in virtual space
- Allows user to easily adjust the positioning angle of a tool or work-point without affecting its position in XYZ space



Fiber Alignment Systems

Aerotech's FAe series high-performance photonics aligning systems incorporate best-in-class direct-drive and state-of-the-art axis control technology. Their 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.

- Three- to six-axis fiber and photonics alignment
- Raster, spiral, or power-peaking algorithms
- 1 nm resolution linear motion
- Turnkey drive and control electronics
- Noncontact direct-drive linear and rotary axes
- Interface to industry-standard power meters
- Crossed-roller mechanical or air-bearing solutions

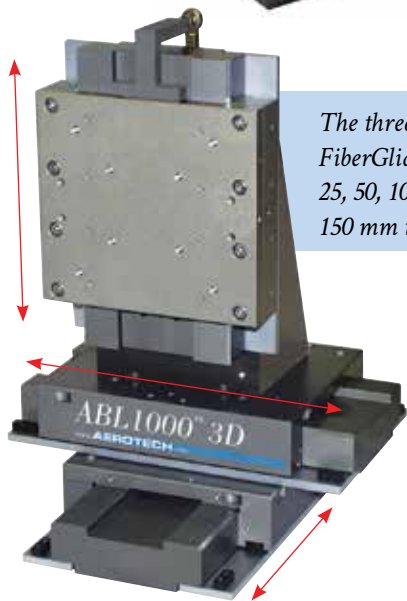
Six-axis FA130e fiber alignment system



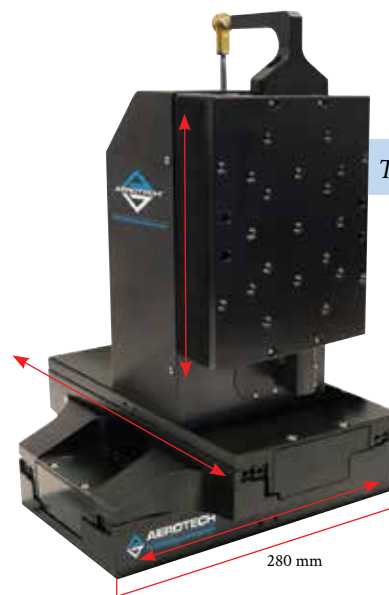
Three-axis FA95e



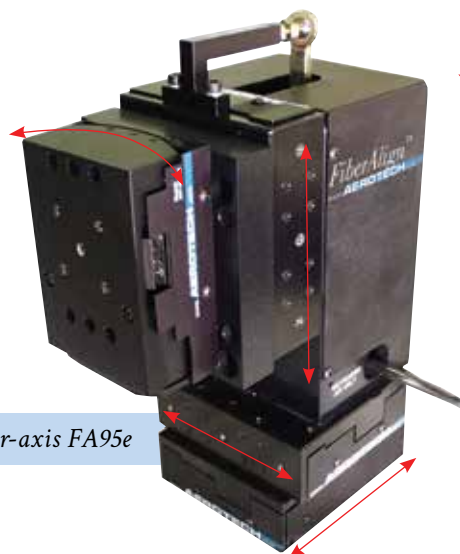
The three-axis air-bearing FiberGlide 3D offers 25, 50, 100, and 150 mm travels



Three-axis FA130e



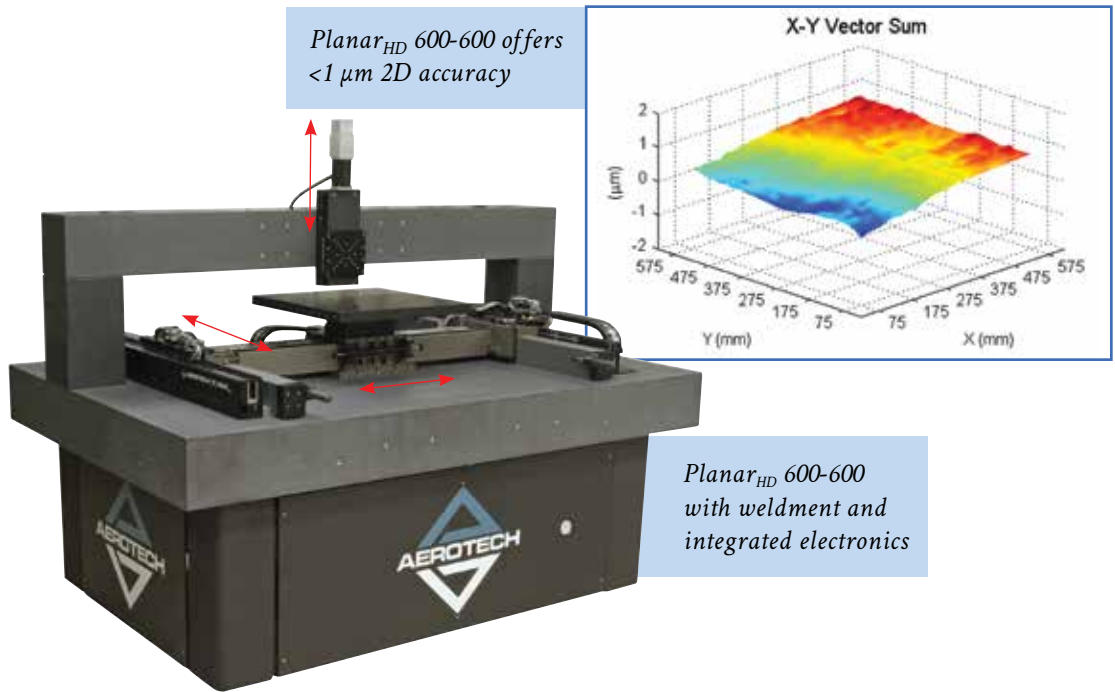
Four-axis FA95e



Direct-Writing of Waveguides

Waveguides are structures that guide optical, electromagnetic, or sound waves. Manufacturing of waveguides often involves using a laser to micromachine the surface and bulk of transparent materials. Since absorption of the laser energy is often nonlinear, structural changes can be localized in the bulk of the material, enabling the creation of 3D microstructures. These 3D structures permit fabrication of a wide range of passive and active optical devices for the telecommunications industry. Aerotech's motion platforms are ideally suited to provide exceptional 2D accuracy and minimal following error while processing at high speeds to reduce cycle time.

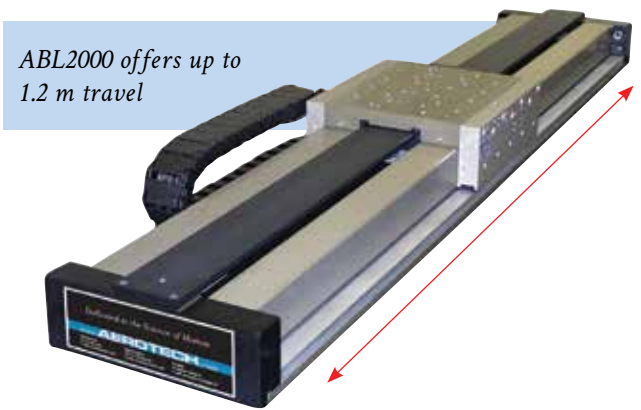
- Maximize throughput with 2 m/s scan velocity and 5 g acceleration
- <1 micron 2D accuracy capable
- Faster turnaround and minimized settling times
- Active yaw control
- Travel to 1.2 m x 1.2 m



Fiber Bragg Grating Solutions

Aerotech's ABL2000 air-bearing linear stage is specifically optimized for the manufacture of fiber Bragg gratings. A flexible workspace allows the system to be optimized for the unique needs of each manufacturer.

- Linear encoder with optional laser interferometer feedback
- Fully preloaded air-bearing with travels up to 1200 mm
- Excellent pitch, roll, and yaw characteristics and unsurpassed velocity control provide the precise positioning required to ensure wavelength filtering consistency
- Complete noncontact design
- Ultra-precise velocity control



Position Synchronized Output

- Aerotech's Position Synchronized Output (PSO) function triggers the laser in real time as a function of the encoder position, further enhancing the accuracy of the Bragg grating.
- Multiple operation modes allow the user to easily configure laser firing windows and number of laser pulses, simplifying process development.

Fiber Alignment Algorithms

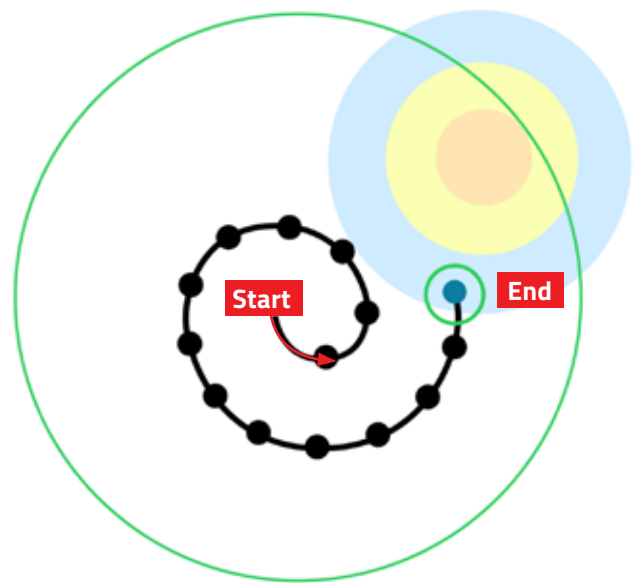
Aerotech's A3200 controller has built-in alignment algorithms that can be used out-of-the-box for a variety of fiber and silicon photonics alignment needs. Aerotech's fiber alignment routines are used in a variety of motion systems and for a variety of fiber aligning applications. Aerotech's fiber algorithms include dozens of configurable parameters to allow the user to define exactly how the algorithm should execute for a specific application, and can be used in conjunction with one another to optimize the photonics alignment.

First-Light Alignment Algorithms

Aerotech's first-light alignment algorithms are used to perform rough positioning before running a fine alignment algorithm to fully optimize the fiber alignment.

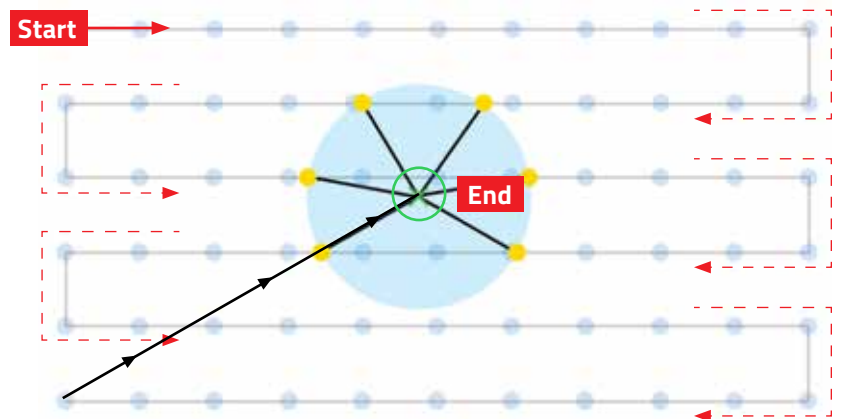
FIBER SPROUGH

The FIBER SPROUGH command, which stands for "Spiral Rough," executes a spiral motion pattern, sampling the power during the profile, with the origin of the spiral being the axes coordinates at the time the command is executed. The algorithm terminates when the power reading reaches a user-defined threshold.



FIBER GEOCENTER

FIBER GEOCENTER executes a raster scan pattern of user-defined size and records each time the pattern passes through a user-specified power threshold. Once the raster scan is completed, the algorithm calculates the geometric center of all the power distribution defined by the recorded threshold points.

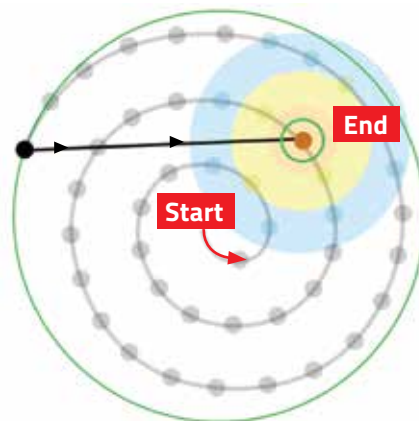


Power Optimization Alignment Algorithms

Aerotech's power optimization alignment algorithms are designed to fully optimize a fiber alignment to the maximum power position. Some of these require first light before they can operate, while others do not need first light.

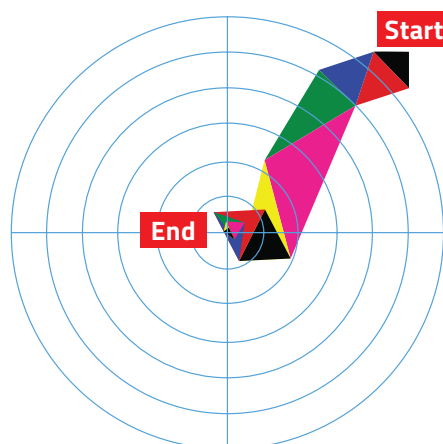
FIBER SPFINE

The FIBER SPFINE algorithm works in a very similar way to the FIBER SPROUGH algorithm, except that it includes a maximum radius parameter instead of a power threshold parameter. The algorithm terminates when this radius is reached, and then the axes return to the point of the highest power reading.



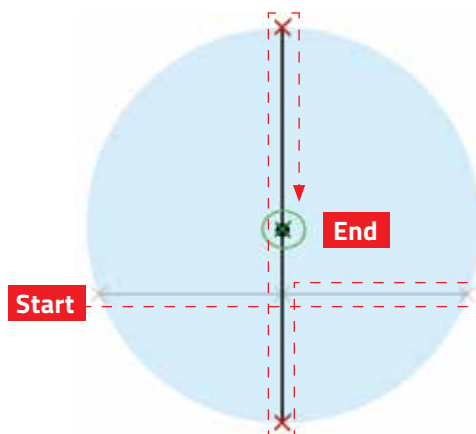
FIBER FASTALIGN (requires first light)

The FIBER FASTALIGN command uses an iterative process to explore an area and locate the optimized power location. FASTALIGN can be configured to use anywhere between two and six axes, and finds a point where the power reading exceeds a user-defined threshold.



FIBER CENTROID (requires first light)

The FIBER CENTROID algorithm is a fiber alignment method that is particularly useful when the power peak is a plateau or has multiple peaks. FIBER CENTROID will move to the edges of a power peak and then use this data to identify the center of the power peak.



FIBER HILLCLIMB

The FIBER HILLCLIMB routine is used to search in a positive or negative direction along one axis at a time for a local power peak. If the peak is not identified in the first direction, the direction is reversed and the rest of the axis is explored. Once a peak is found, the algorithm returns to this position.

ANT-Series Nanopositioners

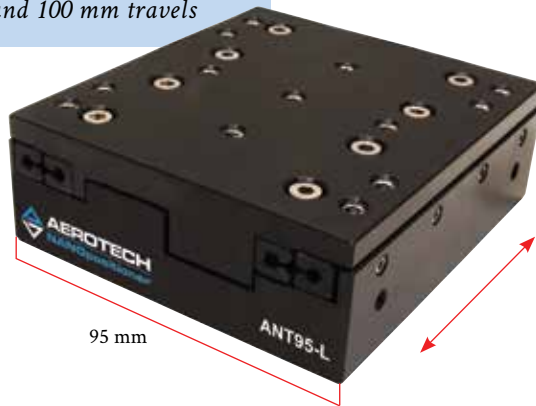
- Noncontact, non-cogging, frictionless direct-drive motion
- 1 nm resolution
- 250 nm accuracy

- 75 nm repeatability
- Sub-nanometer in-position stability
- High dynamic performance
- Low profile

Single-Axis Linear

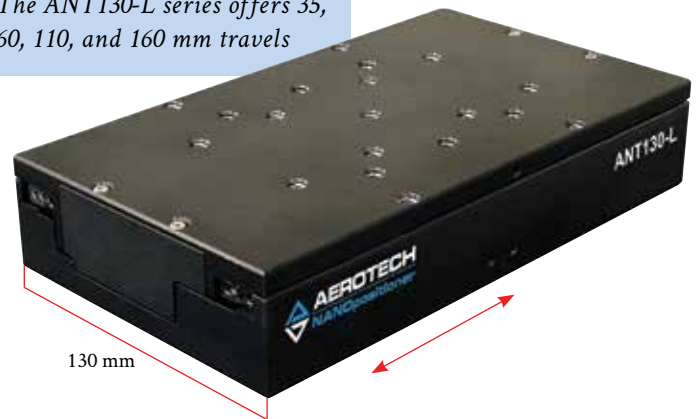
ANT95-L Single-Axis Linear Stage

The ANT95-L series offers 25, 50, 75, and 100 mm travels



ANT130-L Single-Axis Linear Stage

The ANT130-L series offers 35, 60, 110, and 160 mm travels



Integrated XY

ANT95-XY Dual-Axis Linear Stage

The ANT95-XY series offers 25 x 25 mm or 50 x 50 mm travels



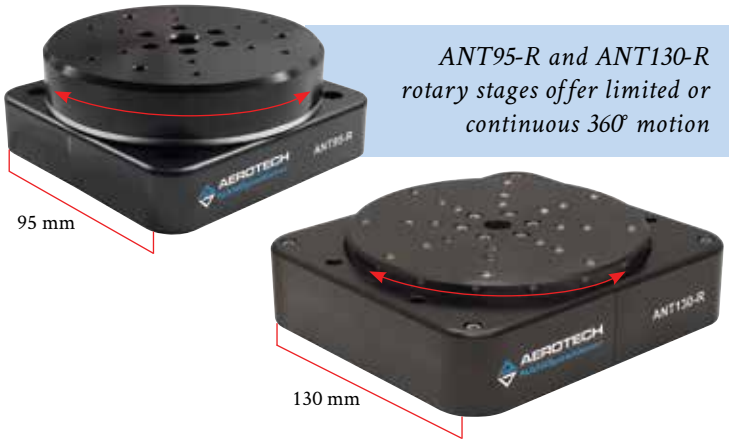
ANT130-XY Dual-Axis Linear Stage

The ANT130-XY series offers 60 x 60, 110 x 110, or 160 x 160 mm travels



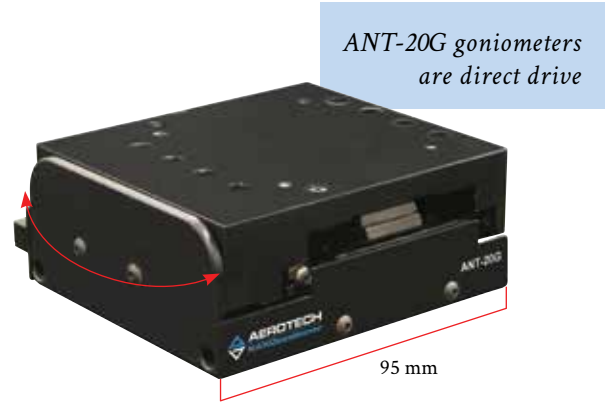
Rotary and Goniometers

ANT95-R and ANT130-R Rotary Stage



- 3 arc-second accuracy
- 1.5 arc-second bidirectional repeatability
- 0.005 arc-second in-position stability

ANT-20G Goniometers



- Large angular range up to 20 degrees of travel
- Multi-axis configurations
- Compact design

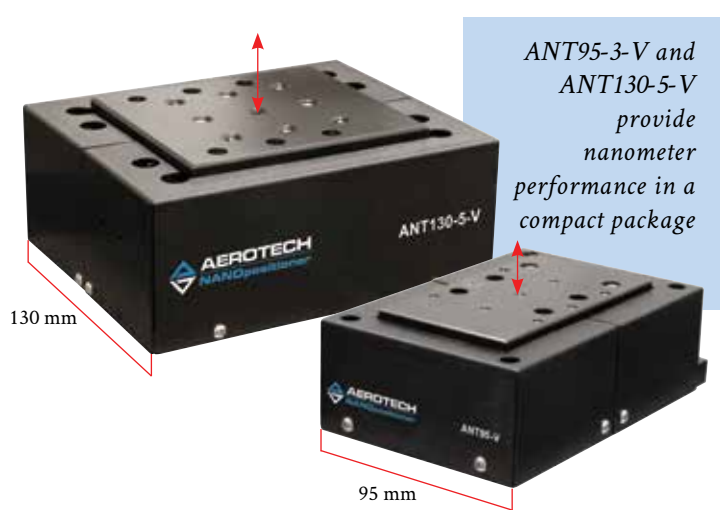
Vertical and Lift

ANT95-L-Z and ANT130-L-Z



- Nanometer performance in a large travel format
- High resolution (2 nm), repeatability (75 nm), and accuracy (300 nm)
- In-position stability of <2 nm

ANT95-3-V and ANT130-5-V



- Nanometer performance with either 3 or 5 mm travel
- In-position stability of <1 nm
- ±200 nm accuracy

Q-Series Piezo Nanopositioners

Aerotech's Q-series piezo stages offer sub-nanometer positioning resolution and nanometer-level accuracy (linearity). Open- and closed-loop feedback are available on all Q-series nanopositioners. The closed-loop capacitive sensor feedback allows for direct measurement of the positioning carriage. Also, the Q-series piezos can be effortlessly integrated into a system with servo axes to allow integrated coarse and fine motion control. Vacuum preparation is available.

QNP-L, QNP-XY, and QNP-Z Medium Travel Linear Stages

- Travels include 100 μm , 250 μm , and 500 μm
- Linearity is to 0.007% of travel
- High stiffness permits the devices to achieve high throughput
- Large resonant frequencies, up to 1300 Hz for the 100 μm QNP-L, allow for fast closed-loop response
- Excellent geometric flexure performance allows for nanometer-level straightness/flatness
- Load capacity up to 1 kg
- Stages designed to easily mount together for various configurations



QNP_{HD} Series

- Closed-loop travels from 10 μm to 40 μm
- Direct-drive actuation enables fast response times and higher-throughput processes
- High-precision, frictionless flexure guidance
- Long device lifetime
- Superior positioning resolution (0.03 nm) and linearity (0.02%) with direct-metrology capacitive sensor option
- Open-loop and vacuum versions



QFOCUS QF-46 Single-Axis Piezo Microscope Objective

- Travels from 100 μm to 300 μm
- High-stiffness and dynamics resulting in outstanding step-and-settle and scanning performance
- Mounting flexibility with a variety of threaded adapters or mounting holes for custom mounting arrangements



Q-Series Piezo Controllers

The Q-series piezo controllers offer exceptional flexibility and performance. QLAB can control 1-4 axes of piezo nanopositioning stages in open or closed-loop operation. The QDe allows the piezo axes to be networked effortlessly with servo axes using Aerotech's powerful controller platform. This integrated programming environment and the ability to synchronize piezo and servo motion significantly reduces system and programming complexity. Additionally, advanced features are available for both piezo and servo axes, configurable with a simple and easy-to-use interface.



Ndrive QLe

- Real-time distributed control architecture allows synchronized motion control on up to 32 axes of piezo and/or servomotor stages
- Single- or multi-axis Position Synchronized Output (PSO) for real-time triggering of events
- Thermally-stable feedback circuit design option
- Advanced control features such as Learning Control, Harmonic Cancellation, and Command Shaping improve tracking error and overall process throughput

QLAB Controller

- Controls up to 4 axes
- -30 to +150 V semi-bipolar output
- 20-bit capacitive sensors for high resolution
- Ethernet and USB 2.0 communication
- Intuitive design and touch-screen panel for ease of use

Advanced Control Features

Position Synchronized Output (PSO)

- Prompt a tool to fire based on actual position feedback
- Uses the capacitive probe for direct measurement of the actual carriage position

Learning Control

- Allows for repeating move sequences to be learned and optimized
- Reduces following error
- Increases dynamic accuracy
- Increases throughput and production rates

Harmonic Cancellation

- Reduces position error in the presence of periodic disturbances
- Adapts to the magnitude and frequency of the error source

Command Shaping

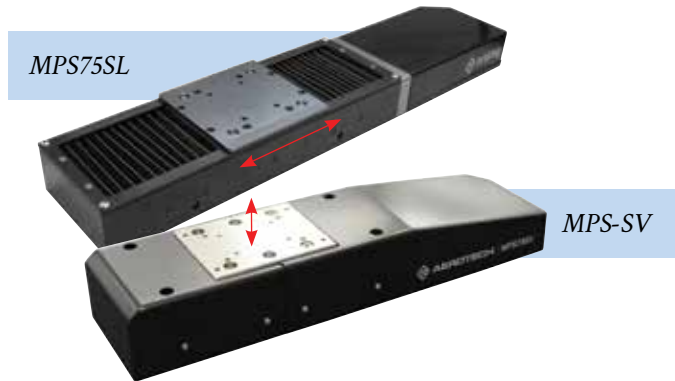
- Reduces vibration in point-to-point moves
- Allows for faster settling time at the work point

MPS - Micropositioning Stages

Aerotech's MPS linear, rotary, and lift stages offer a high-precision and cost-effective solution for single- and multi-axis motion. MPS stages are easily configured into multi-axis motion systems for assembly, alignment, and other processes. The precision ground ball-screw or lead-screw provides exceptional accuracy, repeatability, and ultra-fine positioning resolution capability to 0.1 micron. The DC servomotor is equipped with a rotary encoder. The crossed-roller linear bearings provide smooth travel and excellent payload characteristics.

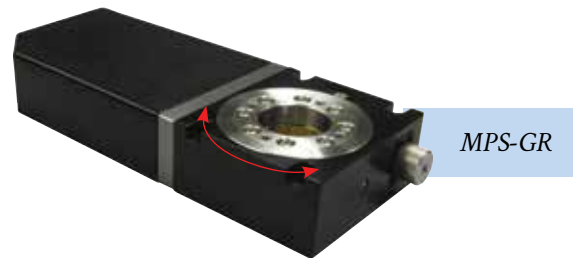
Linear and Lift

- Precision ground ball-screw or lead-screw drive
- DC servo or stepper motor
- Anti-creep, crossed-roller bearings
- High resolution (0.05 μm - 0.1 μm), repeatability ($\pm 0.75 \mu\text{m}$), and accuracy ($\pm 1.0 \mu\text{m}$)
- Available with direct encoder

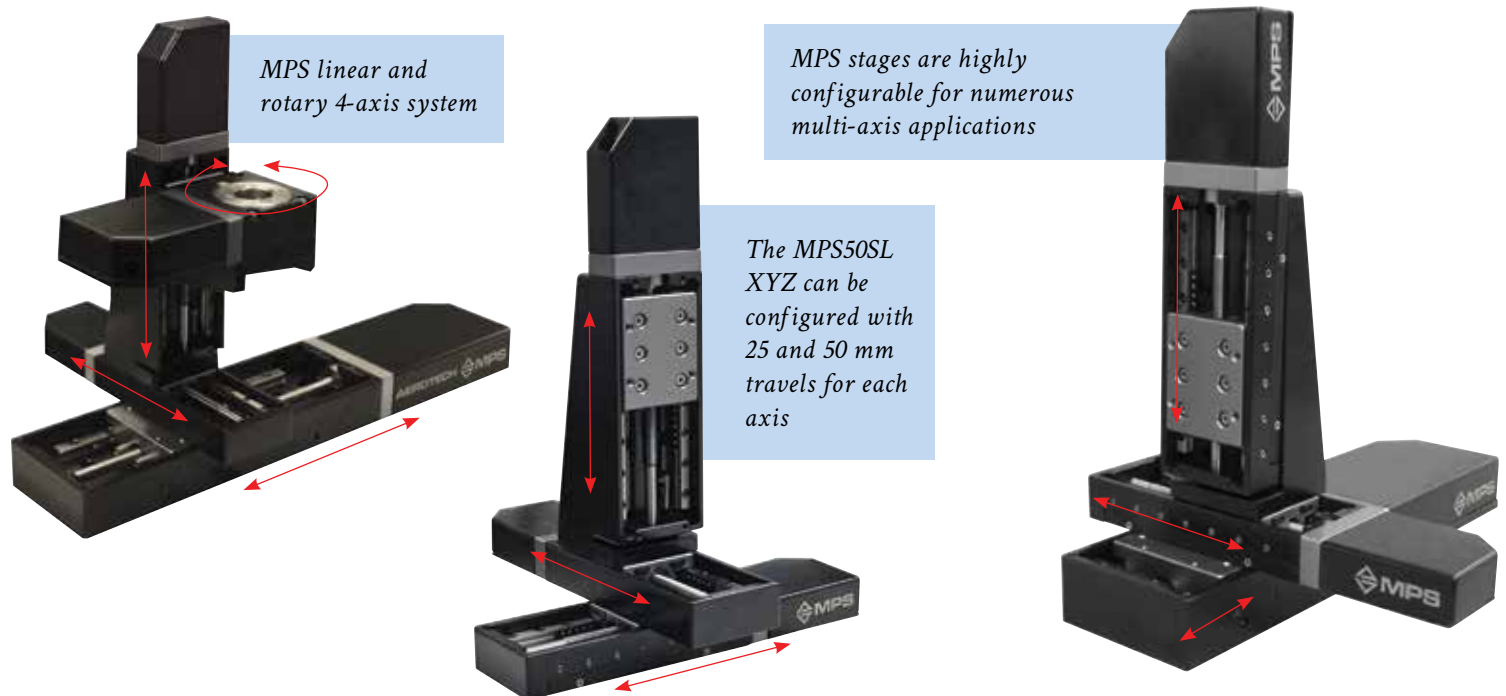


Rotary

- Precision worm-gear drive
- Low profile, compact design with aperture
- Continuous 360° rotary positioning
- High resolution (1 arc sec), repeatability (6 arc sec), and accuracy (80 arc sec)



MPS - Multi-Axis Configurations



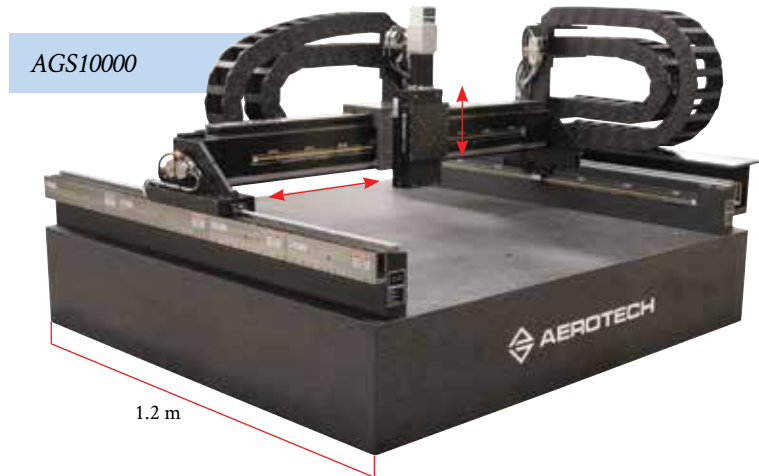
Cartesian Robots

Maximize Your Application Throughput

Minimal Tracking Error • Flexible Design • Lowest Cost of Ownership • Highly Configurable

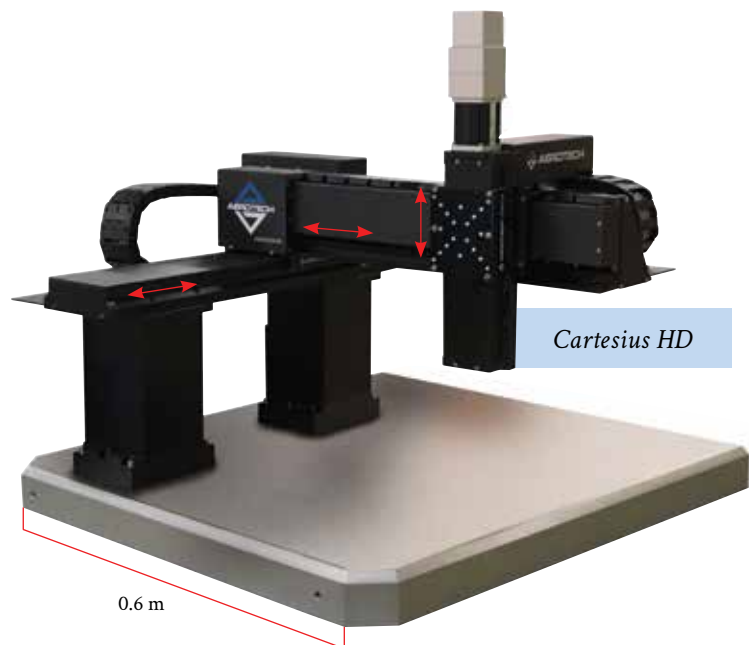
High-Performance Gantries

- Linear motors allow up to 3g acceleration and 3 m/s velocity, minimizing process time
- Components designed for minimal maintenance ensure reliable operation in 24/7 environments
- Cable management terminations provided at the workpiece simplify integration
- Applications for multi-axis alignment, high-speed component pick-and-place, component inspection and assembly



"T" Style Cartesian Robots

- High speed (up to 1.4 m/s with ball screw and 2 m/s with linear motor) ensures high throughput
- Multiple configurations maximize application flexibility (XY, XYZ, XYZ Θ)
- Economical T-style robot for most cost-effective performance
- Applications for component assembly and component inspection



Aerotech Worldwide

United States ■ France ■ Germany ■ Italy ■ United Kingdom
China ■ India ■ Japan ■ Taiwan ■ Thailand

