Motion and Automation for Test, Measurement and Inspection

www.aerotech.com
Dedicated to the Science of Motion
Capabilities in Test, Measurement and Inspection

Since 1970, Aerotech has been dedicated to developing solutions for the test, measurement and inspection industry. Our expertise includes systems for shop floor, R&D, vacuum and cleanroom environments. Our ability to provide custom-engineered products and systems to end users, integrators and high-volume OEMs is unmatched, and our products deliver quality, performance, flexibility and the highest return on investment.

**Sensor Testing**
- Single- and multi-axis rate tables
- Motion simulator software
- Advanced control techniques
- Excellent rate and in-position stability

**Surface Profiling**
- Compact surface measurement platform (SMP)
- Linear amplifiers
- Integrated system support
- Measure wafers, optics and cylindrical shapes

**Nondestructive Test**
- X-ray inspection
- Ultrasonic testing
- Large selection of components
- Linear amplifiers
- Linear and rotary motors
Semiconductor Inspection and Metrology

- Ellipsometry, scanning white light interferometry, stylus measurements
- High performance linear motor stages
- Low profile direct-drive vertical and rotary stages
- Vacuum chuck options with integrated leveling mechanisms
- Linear and PWM digital controllers

Cleanroom and High Vacuum Systems

- Satellite inertial navigation system testing
- Scanning electron microscopy
- Optics polishing
- Vacuum option for $10^{-3}$ to $10^{-8}$
- Experience with vacuum applications

Integrated Automation and Data Acquisition

- Stand-alone and PC-based controllers
- PLC and motion integration with MotionPAC
- Operator interface
- Data acquisition - Sensor Fusion
- Advanced tuning and controls features
# Contents

**WORLD HEADQUARTERS**

Aerotech, Inc.
101 Zeta Drive
Pittsburgh, PA 15238
Ph: 412-963-7470
Fax: 412-963-7459
Email: sales@aerotech.com

**Aerotech United Kingdom**

Jupiter House, Calleva Park
Aldermaston, Berkshire
RG7 8NN, United Kingdom
Ph: +44-118-9409400
Fax: +44-118-9409401
Email: sales@aerotech.co.uk

**Aerotech Germany**

Südwestpark 90
90449 Nürnberg, Germany
Ph: +49-911-9679370
Fax: +49-911-96793720
Email: sales@aerotech.de

**Aerotech Japan**

17-25 1-chome
Kitahoncho Funabashi-shi
Chibaken, 273-0864, Japan
Ph: +81-47-489-1741
Email: sales@aerotechgmbh.de

**Aerotech China**

Unit 3328, 33/F,
China Merchants Tower,
168 - 200 Connaught Road Central,
Hong Kong
Ph: +852-3793-3488
Email: saleschina@aerotech.com

**Aerotech Taiwan**

1F No. 42 Lane 128
Jing Ye 1st Road
Zhongshan District, Taipei City,
Taiwan R.O.C. [104]
Ph: +886-2-8502-6651
Email: sales@taiwan.aerotech.com

**Aerotech France**

BP 70043
45702 Villemandeur Cedex
France
Ph: +33-238970830
Email: sales@aerotech.co.uk

---

## Awards and Recognition

---

## Sensor Testing

- Inertial Sensor Testing and Calibration ............................................. 6
- Motion Simulators ............................................................................. 8
- General Sensor Testing ................................................................. 12

## Surface Profiling

- Surface Measurement Motion Platform (SMP) .................................. 16
- Traditional Profiling and Measurement Solutions .......................... 18

## Nondestructive Test

- X-Ray Inspection ........................................................................... 20
- Ultrasonic Testing ........................................................................ 22

## Semiconductor Inspection and Metrology

- Thin Film Measurement ................................................................. 24
- Wafer Inspection ........................................................................... 26
- Atomic Force Microscopes............................................................ 28
- Defect Detection/Particle Scanning ................................................. 30
- Electrical and Magnetic Characterization .................................... 32
- Reticle Inspection ......................................................................... 33
- SEM, TEM, FIB ........................................................................... 34

## Cleanroom Systems

- Cleanroom Capabilities ............................................................... 36

## High-Vacuum Systems

- Vacuum Applications ................................................................... 38
- Rotary Test Platform ..................................................................... 40

## Integrated Automation and Data Acquisition

- Aerotech Integrated Automation Solutions ....................................... 42
- Standard Controls ......................................................................... 44
- Advanced Controls ....................................................................... 45
- Data Acquisition Solutions – Sensor Fusion .................................. 46
- MotionPAC .................................................................................. 48
- A Wide Variety of Amplifier Options ............................................. 50

## Rotary and Linear Motion

- Rotary Motion Solutions ............................................................... 52
- Linear Motion Solutions ............................................................... 56
- Planar Air-Bearing Stages ............................................................. 58
- Nanopositioners .......................................................................... 60
- Components to Integrated Solutions ............................................ 64

## Bringing Value and Convenience to our Customers .................... 65

## Engineered Systems .................................................................... 66

## Capabilities in Other Markets ..................................................... 68

## Worldwide Training and Support ................................................. 70

## Awards and Recognition .............................................................. 71
Sensor Testing
Inertial Sensor Testing and Calibration

Regardless of the size, composition, degrees of freedom or quantity of sensors, Aerotech has a solution for the testing and calibration of today’s inertial sensors. Our solutions are designed to induce sinusoidal excitations, accelerations and positions for the testing and calibration of accelerometers, gyroscopes, inertial navigation systems, fiber optic gyros, inertial measurement units and stabilized systems. When coupled with our state of the art controllers containing Harmonic Cancellation, Motion Simulator Software, Motion Designer Software, Command Shaping and various other advanced control techniques, precise and highly-repeatable testing and calibration are assured.

Applications

- Accelerometers
- Gyroscopes
- MEMS calibration
- Inertial measurement units

Features and Benefits

- High accuracy, direct-drive motion simulators
- No cogging
- High torque
- Mechanical or air bearings
- Real-time data collection
- Position, rate and oscillation modes
- User-profile importing
- Easy-to-use programming tools
- Slip-rings or twist cables feed UUT signals/power
- Solutions range from economical single-axis systems to high-performance three-axis systems
Challenge

Many times a sinusoidal excitation is needed in the testing or calibration procedure of an inertia device. The very nature of this test introduces errors in the motion at the excitation frequency and other higher order harmonics. Left uncorrected, these errors can skew test results, lead to poor calibration or trigger unnecessary failures in quality assurance.

Solution

Using Harmonic Cancellation, which is part of our Dynamic Controls Toolbox, you can easily cancel out any disturbances caused by the excitation frequency or an imbalanced load. This feature adapts to magnitude and frequency of error source. An easy-to-use setup wizard is provided through the Digital Scope and the Motion Simulator. Aerotech understands that disturbances are unacceptable and has developed Harmonic Cancellation for all of our controller lines to eliminate these errors, resulting in the most accurate testing and calibration results available.
Motion Simulators – GUI

Key Features:

• Operate 1, 2, 3 axis motion simulators
• User-friendly graphical user interface
• Graphical motion profile PVAT (Position, Velocity, Acceleration, Time) importing
• Position Synchronized Output for real-time event triggering
• Trajectory tracking from Ethernet, analog or program inputs
• Frequency response mode allows input sine sweep and UUT performance tests on customer device
• Iterative Learning minimizes position error
• GUI remote client-server mode allows parallel processing capabilities and control via Ethernet network
• Harmonic Cancellation optimizes motion position errors generated by sinusoidal motion
Motion Simulators – Single Axis

Single-Axis ARMS Series Rate Tables

- Single-axis configurations include optional free standing, high stiffness post with leveling feet
- Reconfigurable for continuous or limited travel
- Custom slip-ring options available
- Vertical or horizontal orientation options
- Different tabletop size options

ARMS-260

- 500 lb (227 kg) payload capacity
- Unloaded acceleration >20,000°/s²
- Minimum rate 0.001°/s

High Speed Rotation or Oscillation

Tilt Motion

Area for mounting multiple UUTs (Unit Under Test) on our large tabletops for simultaneous testing

UUT power and signals route through slip rings

PC and Npaq or HLe rack-mount control operation via Aerotech Motion Simulation package

High Accuracy Single-Axis Rate Table with Tilt Table

- Allows rate table performance at multiple inclination angles
- Mounted to a gear-drive rotary table for tilt motion
Motion Simulators – Two Axis

Two-axis motion simulators are useful for simultaneous axis testing of position, rate and acceleration sensors.

Two-Axis Rate Table with Integrated Electronics

- Continuous rotation of both axes
- Smooth motion from non-cogging brushless, slotless motors
- Power and signal slip rings
- Two rotating gas/liquid ports
- Machine base includes motion controller, linear digital amps and ESTOP safety controls

Accuracy plot showing better than \( \pm 1 \) arc-sec accuracy (\( \pm 4.85 \) \( \mu \)rad)

www.aerotech.com
Three-axis motion simulators provide roll, pitch and yaw simultaneous motion for real-world angular velocity profiles.

- Smaller than traditional three-axis simulators to accommodate today’s miniature MEMS gyros in a much smaller footprint
- Modular design based on the ARMS rate tables
- Continuous or limited travel options
- Pedestal options

Each motion simulator is tested for accuracy and tilt errors. Typical tilt error is below 10 μrad. Typical accuracy is ±5-10 μrad.

- Single-axis rate tables integrated with a heat chamber
- Vertical and horizontal mount available
- Low cycle times for temperature tests
General Sensor Testing

Sensors of all shapes and sizes can be found in virtually every product that is manufactured. Sensors allow the products we use to work smarter and safer. The testing of these devices is critical to ensure safe and accurate operation. Regardless of the sensor type, Aerotech has a solution to meet your testing needs.

Applications

- Position sensors
- Infrared detectors
- Automotive sensors
- Pressure sensors

Products

- APR
- ADRT/ADRS
- PRO series (ball screw and linear motor)
- AGC
- ACS
- AGS1500
- Custom solutions

Features and Benefits

- Superior velocity stability
- Low settling time
- High throughput
- High accuracy
- Component level to turnkey system capabilities
- Numerous stage offerings
- Customizable user interface
- Integrated Development Environment (IDE)
- Advanced controls techniques
Variety of Linear Motion Stages for Every Application

**ANT130-L:** High resolution linear motor stage

**ACT15:** Low cost, low-lead-time actuators

**PRO165LM-XY:** Standard XY, XYZ, XYθ combinations

**ANT130-L:** High resolution linear motor stage

**PRO165LM-XY:** Standard XY, XYZ, XYθ combinations

**MPS75SL:** Miniature gear-driven linear stage

**Broad Selection of Integrated Controllers**

**Ensemble Series**

**Soloist Series**
Challenge

Today’s sensors can come in many different shapes and sizes with even more variations in functionality. Developing and manufacturing devices is your area of expertise, and testing and inspecting those devices is very important. Aerotech understands that many times these highly specific devices require customized testing and calibration solutions.

Solution

Our highly skilled Mechanical, Electrical and System engineers will work with you to design a custom solution to meet your specific testing needs. We are capable of providing customization on all levels. From special motors to custom stages to complete machines with enclosures, safety and consoles, Aerotech is your one stop shop for all of your custom automation needs.
Surface Profiling
Surface Measurement Motion Platform (SMP)

Aerotech’s Surface Measurement Motion Platform (SMP) is a unique solution for surface profiling needs. The SMP is particularly effective when measuring or testing rotation symmetric objects but smaller non-rotation symmetric objects can also be measured. With the small mechanical footprint, integrated controls and flexible sensor options, the SMP can be easily added to any laboratory, testing facility or manufacturing floor. With the R and Theta axes available as air bearings or mechanical bearings there is a solution for every budget.

Features and Benefits

• Ideal for rotationally symmetric objects
• Includes up to four axes of motion in a compact package
  - Available as a mechanical bearing or air bearing solution
• Flexibility to measure top and side surfaces as well as flat or spherical parts
• Mechanical design allows for various sensor options
  - White Light Interferometer
  - Multi-Wavelength Interferometer
  - Vision System
  - Touch Probes
• Compact design is 60% smaller than traditional Cartesian systems
• High-speed design is 40% faster than traditional Cartesian systems
• Superior position repeatability in the nm range
• Linear amplifier technology
• Versatile software architecture allows for easy integration
• Advanced control techniques to eliminate environmental disturbances
• Available operator interface allows for a shorter time to market
Challenge

The mechanics and controls are only part of a complete profiling or inspection machine. Sensor integration, process development and data acquisition are many times a much larger part of the overall machine. Many times, coordinating the mechanical system position with the sensor values can be difficult and time consuming. Incorporating the results into a polished user interface is also necessary in order to bring the final product to market.

Solution

Aerotech offers a suite of powerful software tools that allow for fast development of a custom interface.

- C#
- VB.NET®
- Managed C++
- LabVIEW® (VIs provided)
- C Library
- EPICS
- IEC61131-3

Increase rate stability and decrease settle times in the presence of vibration with Aerotech's Enhanced Throughput Module (ETM)
Traditional Profiling and Measurement Solutions

Surface profiling applications challenge current motion control technology on a number of fronts. Extremely high probe sensitivity is required for state-of-the-art systems, mandating the smallest possible parasitic motion (such as flatness), while high-speed data collection must not be hampered by the automation controller. Aerotech’s integrated scanning platforms offer key features to increase both throughput and performance.

Products

- AGS10000 and AGS15000 linear motor gantries
- ANT130-XY multi-axis nanopositioner
- ANT130-LZ vertical nanopositioner
- Components for custom solutions

Features and Benefits

- In-position stability
- High accuracy
- Low total cost of ownership
- Component-to-turnkey system capabilities
- Solutions for all levels of accuracy
  - Ball-screw stages
  - Linear motor stages
  - Air-bearing stages
Nondestructive Test
X-Ray Inspection

Aerotech understands the challenges behind today’s X-ray technology and has the components and stages to support all areas of X-ray inspection. As the tolerances for inspection get better and better, then so must the precision of the axes involved in the test procedure. This is why it is important to choose your products from a vendor that can supply not only what you need today, but also what you will need in the future.

Products

- PRO115 and PRO165 ball-screw stages
- AGR gear-drive rotary stage
- ADRS mechanical bearing, direct-drive rotary stage
- ABRS and ABRT air-bearing, direct-drive rotary stages
- Custom solutions

Features and Benefits

- Accurate low-speed operation
- High velocity stability
- Controls solutions for all axes
- Large selection of components
Solution

At Aerotech we have a wide range of stages and components to meet all of the needs of X-ray inspection machines. At the component level we have our linear motors, rotary motors and control solutions. Our PRO Series ball-screw stages and AGR Series gear-driven rotaries are the perfect choices for those non-testing axes. For test axes we have a large selection of direct drive and air-bearing options to meet any requirement.

Challenge

X-ray inspection machines require different axes of varying degrees of precision. Many times the axes not used during testing only require ball screw or gear-driven technology, while the test axes can require direct-drive motion or even air-bearing-level precision.
Ultrasonic Testing

Whether you are in search of a complete ultrasonic testing machine or just the components to build your own system, Aerotech has a solution. Our large selection of ball-screw stages, gear-driven rotaries and linear motor actuators are complemented nicely by our extensive controls in order to provide you with the best solution, all from a single vendor.

Products

• PRO115 ball-screw linear stage
• ACT linear actuator
• Linear amplifiers
• Rack-mounted amplifiers
• Linear motors
• Rotary motors
• Full inspection machines

Features and Benefits

• Cost effective
• No radiated electrical noise
• Flexible solutions
• Components to complete systems

Custom XYZ gantry system built from PRO series linear stages

Complete line of linear amplifiers and motors
Semiconductor Inspection and Metrology
Thin Film Measurement

Aerotech has a multitude of linear, rotary and Z stage options for two-, three- and four-axis thin film thickness and profile measurement tools. Each system has been designed to optimize throughput while minimizing thickness/profile direction geometric errors. All mechanics are designed to be fully cleanroom compatible by utilizing strict manufacturing methods, careful material selection and thoughtful cable management designs. Aerotech’s Ensemble controller, utilizing the ultra-compact Ensemble MP drive, provides a high-performance motion platform that requires minimal space.

Applications

- Ellipsometry
- Reflectometry
- Scanning White Light Interferometry (SWLI)
- Stylus measurements

Products

- Ensemble MP PWM controller/drive
- High performance linear motor stages (ALS20000, PRO22SLM)
- Low profile direct-drive Z and rotary stages (WaferMax Z, WaferMax T, ADRS)

Features and Benefits

- Highly accurate closed-loop control
- Digital output encoder options
- Brushless, slotless motor for smooth motion with no cogging
- Low profile Z and theta stage options
- Rotary stage options with integral rotary union for vacuum chuck operation
- Vacuum chuck options with integral leveling mechanism

300 mm wafer chuck with integral 3-point leveling mount

350 mm travel ALS20000 XY stage with WaferMax theta stage

Ensemble MP PWM drives

www.aerotech.com
Challenge

Fab floor-space is at a premium, which forces tool manufacturers to provide the smallest machine footprint possible. In addition, a variety of machine safety standards must be satisfied. Compact drive electronics that can run on non-lethal voltages (48 VDC and below) and can be mounted just about anywhere in the tool are highly valuable when attempting to pass regulatory standards like Semi S2.

Solution

Aerotech’s MP and ML drive options are compact, DC input compatible drives that provide nearly all of the control functionality of other drives but take up less than one-fourth the volume. Their compact size allows them to be mounted just about anywhere and they are compatible with readily available 24 and 48 VDC supplies.
Wafer Inspection

An integral element of every wafer fabrication facility is its optical (lightfield and darkfield) inspection systems. These surface characterization tools detect a wide variety of defects including voids, pits and scratches in the wafer surface. Smooth, high-speed raster scanning is required to meet the needs of today’s fabrication facility. Aerotech’s ABL9000 has long been the standard for this type of inspection by providing superior dynamic performance characteristics.

Products

- High dynamic stages (PlanarHD, ABL9000, ABL1500, ALS3600)
- Direct-drive rotary and Z-axis stages (WaferMax Z and T)
- High performance A3200 control platform

Features and Benefits

- Aerotech direct-drive linear motors allow for high-speed scanning and fast turnaround, thus maximizing inspection tool throughput
- Aerotech offers a wide variety of axes that can be mounted on an XY stage, including theta axes for pattern alignment and Z axes for focus adjustment
- Open-frame stage for microscope applications
- Aerotech-supplied machine base and isolation system minimize integration time
- Aerotech’s experienced engineering group can assist in developing a custom system to meet your specific needs
Challenge

The key to optical wafer measurement systems is their ability to accurately identify and measure defects while running at production line rates. This requires exceptionally stiff mechanical structures, motion profile generation and responsive isolation systems. The system’s ability to settle to a target scan velocity is key to meeting wafer per hour (wph) throughput requirements.

Solution

Both Aerotech’s air and mechanical bearing stages are developed to be the highest stiffness structures possible. This design philosophy forces throughput reducing natural frequencies as high as possible. In addition, Aerotech has developed move profile optimization routines that allow for faster settling after acceleration. The Slice command smooths the stage turnaround during raster scanning, and Directional Gain Scheduling reduces settling time by automatically adjusting gains based on error motions.

This system features air-bearing stages and two-axis laser interferometer feedback to provide sub-nanometer resolution.

Automation 3200 (A3200) multi-axis machine controller

Aerotech has multiple open frame stage configurations including air and mechanical bearing systems ideally suited to optical wafer inspection applications.

High throughput custom ALS3600 open frame stage
Atomic Force Microscopes

Many inspection applications require tight positional stability, but few are as stringent as that for Atomic Force Microscopes (AFMs). Aerotech has multiple motion platform solutions that directly address the needs of Atomic Force Microscopy by providing nanometer step sizes to single-digit nanometer positional stability. The recommended platforms are all direct-drive, direct-feedback devices that undergo extensive testing to ensure top-notch accuracy and stability performance.

Products

- Ultra-stable multi-axis motion platforms (ABL9000, ANT95-XY, ANT130-XY)
- Low noise, high resolution control electronics (Ndrive HLe, Npaq/DL4010, Ndrive ML)
- Alternative construction materials to minimize thermal issues

Features and Benefits

- A3200 motion controller with rack mount or discrete linear amplifiers
- High performance integrated XY linear motor stages – air bearing and mechanical bearing
- Ultra-stable motion platform provides very tight in-position stability and minimal drift

300 mm wafer class ABL9000 planar air-bearing
Solution

Aerotech’s ABL9000 can be “locked” in both X and Y to dramatically increase positional stability over time. Specially designed methods are used to control the locking procedure while maintaining positional information. This ensures that the user always knows where the sample is positioned regardless of the locking condition.

Special calibration methods can be used to increase both the unlocked and locked accuracy at the workplane of an XY stage system. These methods are designed to not only reduce the positional errors but also X and Y direction errors caused by rotations in theta X, theta Y and theta Z directions.

Challenge

AFMs produce exceptionally high-resolution images of very complex geometric features. The challenge is finding a motion platform that provides very accurate positioning as well as no motion when settling in position. Positional instability is a parasitic motion that AFMs cannot tolerate.

1 nm step plot for ANT95-XY-ULTRA

Invar ALS130-XY with pneumatically counterbalanced Z axis is specifically designed to dramatically increase thermal stability.
Defect Detection/Particle Scanning

Aerotech’s ultra-smooth linear air-bearing motion systems and high performance rotary stages are an excellent choice for macro-defect, particle contamination and general defect measurements. High speed linear and matched rotary stages coupled with a state-of-the-art motion controller provide accurate, high-throughput measurements. Whether it is simple “spokes-of-the-wheel” motions or tightly controlled helical inspection profiles, Aerotech has the optimum stage combination.

Products

• A3200 motion controller with rack-mount or discrete linear amplifiers
• Harmonic Cancellation advanced controls minimize parasitic coupling between rotary and linear axes
• High performance air-bearing, linear motor stages (ABL1500/ABL2000)
• Direct-drive high-speed spindle or traditional rotary stages (ABS2000/ASR2000/ABRS/ADRS)
Challenge
When incorporating high-speed rotary axes into a multi-axis motion platform, chuck balancing becomes an important concern. Proper balancing of the payload increases accuracy by reducing machine vibration and increases throughput by allowing for higher spindle speeds.

Solution
For applications utilizing a high-speed spindle, Aerotech can perform chuck centering/balancing to reduce integration time. In addition, Aerotech’s advanced control suite incorporates "Harmonic Cancellation," a control method specifically designed to dramatically reduce cross-talk between rotary axes with residual imbalance and linear axes.

Features and Benefits
• Aerotech advanced controls – Harmonic Cancellation
• Reduce position error on periodic trajectories
• Reject periodic disturbances
• Adapts to magnitude and frequency of error source
• Built-in setup wizards
Electrical and Magnetic Characterization

From traditional four-axis stage stacks to small footprint gantry systems, Aerotech has a multitude of options for electrical and magnetic measurements. For magnetic measurements, Aerotech can also supply custom structures that increase the distance between magnetic materials and the work area or can provide specially designed shielding solutions.

Products

- Epaq rack mount or Ensemble CP/MP discrete drives
- PRO series, AGS1000, side-drive XY
- AVS/AVSI series, ATS100 for focusing
- AGR series

AGS1000 Cartesian gantry

Features and Benefits

- Traditional XY or gantry configurations
- Rotary encoder, linear encoder or “dual-loop” feedback
- High accuracy and tight in-position stability
- Custom designs available

Ensemble multi-axis stand-alone controller

Custom XY crossed-roller stage
Reticle Inspection

Reticle inspection requires a unique combination of mechanics that provides both ultra-high accuracy and a large clear aperture. The combination of high stiffness air bearings and dual linear-motor-driven axes provides an XY open-frame stage with exceptional performance characteristics. The ABL3600 represents a major upgrade in performance over traditional mechanical-bearing open-frame stages.

Features and Benefits

- Large clear aperture provides complete access for inspection and illumination
- Dual linear-motor-driven X and Y axes provide excellent yaw performance (0.5 arc sec)
- All air bearings are fully preloaded to provide exceptional system stiffness
- Brushless, slotless motor for smooth motion with no cogging
- Linear encoder or laser interferometer feedback provides highly accurate positioning

Products

- ABL3600
- ALS3600
- Custom tip-tilt
- A3200 controller
- Npaq drive chassis

Automation 3200 (A3200) multi-axis machine controller

ABL3600 open-frame air-bearing with 250 mm XY travel
SEM, TEM, FIB

Electron/ion microscopy including transmission electron, scanning electron and focused ion beam microscopes provide exceptionally high resolution images with large depths of field and have many other advantages over traditional microscopy. Strikingly clear images are obtained from samples ranging from biological samples to semiconductor wafers. Regardless of the component under test, Aerotech has a variety of high vacuum, low magnetic field electromechanical solutions.

Applications

Today’s electron- and ion-beam microscopes require very high throughput motion systems that utilize high vacuum compatible materials and incorporate careful magnetic field management. All of these features ensure fast, accurate measurements with little contamination.

• BGA components
• Biological samples
• Materials qualification
• Semiconductor wafers

Solution

Aerotech has a long history of supplying vacuum compatible motion systems for a variety of applications including semiconductor inspection, satellite testing and ion beam profiling. Our application, engineering and production staff are highly skilled and experienced with custom vacuum system solutions designed to meet specific testing needs of vacuum inspection systems.

Features and Benefits

• Custom solutions
• High throughput
• Low settling time
• High accuracy
• Component turnkey system capabilities
• Integrated Development Environment
• Advanced control techniques

XY vacuum stage with special shielded magnets
Cleanroom Systems
Cleanroom Capabilities

Aerotech manufactures the widest variety of cleanroom compatible motion solutions for high performance applications such as wafer inspection and metrology.

Aerotech Cleanroom-Ready Motion Systems Feature:

- Low particulate generating cable management systems
- Cleanroom compatible, hydrocarbon-free lubricants
- Special material surface treatments
- Manufacturing processes that are specifically designed to maximize system-level cleanliness
- Cleanroom packaging

Cleanroom Facility

- ISO Class 6
- Cell specific ISO class 5 areas
- Temperature control to ±0.1 degree C
- Dedicated product transfer and large main product assembly areas
- Actively-isolated granite surface plates for testing purposes

ALS2000XY linear motor stage

ABL9000 planar air-bearing with custom isolation system

High-throughput open-frame system
High-Vacuum Systems
Vacuum Applications

Aerotech’s vast application experience, unmatched product scope, and extensive engineering capabilities make us the partner of choice for vacuum compatible motion systems. Since our inception, Aerotech has designed and manufactured the highest-performance motion control and positioning systems available, and our vacuum-compatible platforms are no exception. Aerotech’s precision motion control products provide the critical performance for today’s demanding vacuum applications in markets such as semiconductor manufacturing and inspection, optics fabrication and military/aerospace. Always guiding our vacuum system development effort is Aerotech’s motto: “Dedicated to the Science of Motion.”

Vacuum Options Available from Aerotech

- Low vacuum option (10⁻³ torr)
- Standard vacuum option (10⁻⁶ torr)
- High vacuum option (10⁻⁸ torr)

Aerotech Has Specific Experience with Vacuum-Compatible Motion Platforms

- Material selection
- Surface preparation
- Hardware venting and elimination of trapped volumes
- Lubricant selection
- Thermal management
- Magnetic field control
- Cleaning
- Bake-out
- Handling and packaging

Aerotech’s Vacuum Experience Includes a Wide Variety of Applications

- Satellite component testing
- Scanning electron microscopy (SEM)
- E-beam inspection
- EUV lithography
- Ion-beam profiling
- Ion implantation
- Deposition
- Optics polishing
A wide variety of standard Aerotech motion products are available in vacuum-prepared versions. In addition to standard platforms, Aerotech routinely manufactures custom systems designed to meet application-specific needs. All of Aerotech’s vacuum compatible motion platforms minimize pump down time, chamber contamination and thermal issues. In addition, these systems can incorporate key application considerations like reduction of magnetic fields.
The Aerotech Rotary Calibrator (ARC) sets a new industry standard of performance for angle and rotary table calibrations. At the heart of the Calibrator is a large rotary air-bearing axis with nanometer-level error motion performance. This high-accuracy air-bearing master axis is constructed of steel to closely match the CTE of the surrounding granite structure. The air-bearing acts as the master angle generator to generate angles as small as 0.015 arc-seconds to over 360° (continuous rotation).

The Calibrator is equipped with a high-resolution, high-accuracy electronic autocollimator for measurement feedback on optical surfaces. The entire instrument is built on a precision granite machine structure that is isolated from the machine base and floor through passive air isolation. A custom enclosure isolates the system from air turbulence, high-frequency thermal fluctuations and ambient light. System electronics are housed in a separate enclosure from the instrument to isolate any electrical noise and heat from the instrument. Custom calibration software provides the operator with easy control of the angular step, test procedure (such as circle closure) and plot/report generation.

Specifications

- Master-axis accuracy: <0.15 arc-seconds (<727 nano-radians)
- Minimum incremental step (min. angle): 0.015 arc-seconds (73 nano-radians)
- Electronic system resolution: 0.0069 arc-seconds (34 nano-radians)
- Angular measurement uncertainty: <0.2 arc-seconds expanded uncertainty, k=2 (<970 nano-radians, k=2)1.

1. Angular measurement uncertainty analysis performed according to ANSI/NCSL Z540.2-1997: Guide to the Expression of Uncertainty in Measurement while calibration of a rotary table over 360° with 10° steps using a modified circle closure technique. The temperature of the lab was controlled to 20°C +/- 0.25°C.

www.aerotech.com
Integrated Automation and Data Acquisition
Aerotech Integrated Automation Solutions

- Common Software Platform: Tools, Powerful Programming Environment, Calculators, Diagnostics

Programming Interface

Autonome

Loop Transmission

Automation 3200

- PC-based
- 1 to 32 axes of coordinated motion
- Up to 32 tasks
- RS-274 (G-code)
- Advanced features for demanding applications

- PWM or linear drives (up to 150 amp)
- Scanner control for marking
- Tightly integrated laser functionality
- Retrofit package for old controls
- Integrated PLC – MotionPAC

Configure Your Automation Solution with Aerotech

- High performance
- Easy to use
- Flexible
- Scalable
- Networked
- Lowest cost of ownership
- Advanced control technology

Linear and Rotary Servomotors

- EtherCAT

Network and Fieldbus Connectivity

- Modbus®/TCP
- DeviceNET
- Ethernet TCP/IP
- USB
- RS-232
- GPIB

www.aerotech.com
**Soloist**

- Stand-alone
- Network up to 1,024 single axes
- Up to 4 tasks
- Elegant, economical, versatile controller

- PWM or linear drives (10-150 amp peak)
- Drives brushless, linear, rotary, DC brush or stepper motors
- Desktop, rack mount or panel mount

**Accessories**

- Linear amps
- ESTOP
- Rack-mount configuration
- Rack-mount PCs

**Data Acquisition**

- PWM or linear drives (10-150 amp peak)
- Drives brushless, linear, rotary, DC brush or stepper motors

**Use the libraries and SDK to develop your own applications with .NET, C#, VB.NET, C, or LabVIEW®**
Standard Controls

Aerotech controllers offer the broadest array of programming interfaces and core motion capabilities of any automation system available today for both OEMs and end-users alike.

Slice Move
Increase scanning throughput by blending step and scan into a contoured move

Axis Calibration
Compensate for repeatable mechanical errors in a positioning system

Gantry Mode
Complex gantry control is reduced to a few simple commands to handle dual motor and/or dual feedback configurations

Parts Rotation
Use when a two-dimensional part must be repeated in different orientations without translating the part program many times over

3D Error Correction
Measure XYZ errors and the controller can correct the commanded position to accurately move to all locations in the 3D space

Dual-Loop Control
Dual-loop control is used to eliminate the effects of backlash and other sources of error

Laser Interferometer
Systems requiring ultra-high resolution and feedback stability use interferometer feedback

Velocity Blending
The velocity changes to the next velocity command, acceleration limited, without stopping

Orthogonality Correction
Improve X-Y planar accuracy by simply entering the known orthogonality error and the controller will compensate
Advanced Controls

Harmonic Cancellation
Reduce position error on periodic trajectories and reject periodic disturbances

Directional Gain Scheduling
Decrease settle-time and increase in-position stability

Iterative Learning Control
Reduce following error on repeated move sequences that can be learned and optimized

Friction Compensation
Reduce settle time and reduce error at direction reversals

Enhanced Throughput Module (ETM)
Increase rate stability and decrease settle times in the presence of vibration

Position Synchronized Output (PSO)
Trigger external events precisely at desired position while in motion

Command Shaping
Reduce vibration at the work point

Motion Designer
Graphical trajectory generation and data analysis

Loop Transmission
Tuning and diagnostic utility that greatly enhances system performance

Enhanced Throughput Module (ETM)
Data Acquisition Solutions – Sensor Fusion

The Sensor Fusion desktop, rack mount or panel mount system allows you to record sensor I/O precisely aligned with encoder positions, and to retrieve the results through one easy to use software interface. The Sensor Fusion, when used with PSO and the Digital Scope, is Aerotech’s answer for all of your data acquisition needs. The Sensor Fusion can have up to four of the following card options:

- Analog Input
- Digital Input
- Encoder Input and PSO Output
- Analog Output
- Digital Output

With a variety of analog, digital, encoder and PSO cards available, the Sensor Fusion allows you to record sensor data and position data in ways that have never been possible. Its modular design allows for additional cards such as vision and serial data acquisition. With desktop, rack mount and panel mount options available, there is a Sensor Fusion for every application. As an integrated member of the A3200 motion controller family, the Sensor Fusion allows you to collect position data as well as sensor data in concert with one another.

Features and Benefits

- Data acquisition precisely integrated with motion control
- Sensor I/O easily aligned with encoder position
- Data recording and playback
- Combine sensor inputs in real time
- 5 MHz collection rates
- One easy-to-use software interface
- No additional software required
- Desktop, rack mount and panel-mount options
**Analog Input**
- SF-AI-01
  - 16 analog inputs
  - Up to 400 kHz collection
  - 18-bit resolution
  - Selectable input range

- SF-AI-02

**Analog Output**
- SF-AO-01
  - 8 or 16 outputs
  - 500 kHz playback
  - 16-bit resolution
  - 5 V, 10 V or external reference voltage

- SF-AO-02

- SF-AO-03
  - 4 or 8 outputs
  - 750 kHz playback
  - 20-bit resolution
  - 5 V, 10 V or external reference voltage

- SF-AO-04

**Digital Input**
- Digital Input: SF-DI-01
  - 32 digital inputs
  - 5 MHz collection rate
  - 5 V or 24 V
  - Active high or active low

**Digital Output**
- SF-DO-01
  - 32 digital outputs
  - 5 MHz playback
  - 32 mA at 5 V
  - High power option: 325 mA at 5-24 V

- SF-DO-02

**Encoder Input and PSO Output**
- SF-ENC-01
  - 4 encoder inputs (TTL)
  - 1 PSO outputs
  - 1.0 MHz collection
MotionPAC – PLC Integrated With Motion

- 30% to 50% reduction in development time
- High-performance motion fully integrated with standard PLC environment
- Easy-to-use diagnostics and tools
- Standards & flexibility: IEC 61131-3, .NET, PLCopen, PC-based
- Integrated with the A3200 motion controller

Program in IEC6 1131-3: LD, FBD, ST

- Define hardware
- Online mode displays all Tag values
- Create libraries
- Axis manager
- Standard LD
- Combine LD and FD on same program
- Tag database
- LD, FBD or ST programs
- Completely integrated motion blocks
Integrated Automation: MotionPAC

HMI
- Program selection and run
- Jog panel
- Machine control
- Customizable buttons
- Axis manager

MotionPAC
- IEC 61131-3
- PLCopen
- Aerotech motion blocks
- Axis manager
- Extensive development & debug environment
- Simulate program

Motion Composer
- Axis manager
- Low-level motion diagnostics
- Motion programming
- Advanced control algorithms

Scope
- Signal capture & analysis
- Autotuning
- Loop transmission
- Encoder tuning
- Advanced controls

I/O & Data Acquisition
- High-speed data acquisition synchronized with motion & PLC
- High-speed registration
- Position Synchronized Output
- Machine interlocks
- Fieldbus I/O

Central Machine Tag Database
- Tags available in all applications by name
- Define both local or global machine Tags
- Define Tags in I/O definition, ST, LD, FBD or motion program
# A Wide Variety of Amplifier Options

<table>
<thead>
<tr>
<th>A3200 Drives</th>
<th>Ensemble Controls</th>
<th>Soloist Controls</th>
<th>Axes</th>
<th>Output Type</th>
<th>Peak Current Output</th>
<th>DC Bus Voltage</th>
<th>Standard I/O</th>
<th>Optional I/O</th>
<th>Incremental Encoder</th>
<th>Absolute Encoder</th>
<th>Resolver/Inductosyn</th>
<th>Capacitive Probes</th>
<th>Laser Interferometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP</td>
<td></td>
<td></td>
<td>1</td>
<td>PWM</td>
<td>10 A</td>
<td>10-80 VDC</td>
<td>1-AI</td>
<td>8-DI/8-DO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CP</td>
<td></td>
<td></td>
<td>1</td>
<td>PWM</td>
<td>10-30 A</td>
<td>10-320 VDC</td>
<td>6-DI/4-DO</td>
<td>16-DI/16-DO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>HPe</td>
<td></td>
<td></td>
<td>1</td>
<td>PWM</td>
<td>10-150 A</td>
<td>±40 VDC</td>
<td>6-DI/4-DO</td>
<td>16-DI/16-DO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CL</td>
<td></td>
<td></td>
<td>1</td>
<td>Linear</td>
<td>10 A</td>
<td>±40-80 VDC</td>
<td>6-DI/4-DO</td>
<td>16-DI/16-DO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>HLe</td>
<td></td>
<td></td>
<td>1</td>
<td>Linear</td>
<td>10-20 A</td>
<td>±40 VDC</td>
<td>6-DI/4-DO</td>
<td>16-DI/16-DO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ML</td>
<td></td>
<td></td>
<td>1</td>
<td>Linear</td>
<td>10 A</td>
<td>±40 VDC</td>
<td>6-DI/4-DO</td>
<td>16-DI/16-DO</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- All units capable of sinusoidal commutation, dual-loop control and drive brushless, brush or stepper motor

- Npaq® or Npaq® MR drive chassis
- Epaq or Epaq MR drive chassis and motion controller

- 1-AI per axis
- Multiple Configurations Available
Rotary and Linear Motion
Rotary Motion Solutions

ALAR

- 100 mm, 150 mm, 200 mm, 250 mm and 325 mm apertures
- Axial load capacity to 595 kg
- Excellent accuracy and repeatability
- Cog-free motor provides smooth motion
- No gear backlash
- No accuracy change over time from gear wear
- 45-300 rpm continuous rotation speed
- Vac 10⁻⁶ torr compatible versions
- High resolution gives excellent stepping and in-position stability

The ALAR-LP series is designed to be mounted with the vertical axis coincident with gravity. The LP is lower profile than the SP for applications that have less space available.

The ALAR-SP series is designed to be mounted in any configuration – vertical or horizontal.

In-position stability of ±0.05 μrad
High resolution gives small step capability
Ultra-Precise, Low Profile, Direct-Drive Rotary Air-Bearings

- Excellent radial, axial and tilt error motions
- Direct coupled, high-accuracy rotary encoder
- Low profile, planar design
- Axial load capacity to 97 kg
- Magnetic preload

Ultra-Precise, High Accuracy, Direct-Drive Rotary Air-Bearings

- High torque output, direct-drive slotless, brushless servomotor
- Zero-cogging motor for outstanding velocity stability
- Excellent radial, axial and tilt error motions
- Direct coupled, high-accuracy rotary encoder
- Large-diameter clear aperture
- No mechanical contact
- Fully constrained air-bearing can be run upside down or on its side
- Axial load capacity to 69 kg
High Accuracy Rotary Stage

- Accuracies up to 1.1 arc second
- Axial load capacity up to 450 kg
- Incremental or absolute encoders
- Large bearings provide high payload and moment load capacity
- 375-800 rpm continuous rotation speed
- Seven models are available, each with either 50, 75 or 100 mm clear aperture

Low Profile, Direct-Drive Rotary Stages

- High torque output, direct-drive brushless servomotor
- Cog free, slotless motor design for superior velocity stability
- Direct coupled, high-accuracy rotary encoder
- Ultra-low-profile minimizes working height
High Torque Output, Direct-Drive Rotary Stages

- Cog-free brushless servomotor design for outstanding velocity stability
- Large-diameter clear aperture
- High load capacity and high speed
- 5-60 arc second accuracy

Large Aperture, Gear-Drive Rotary Stage

- Enhanced speed and load capacity
- Large aperture addresses a wide range of applications
- Useful for heavy and unbalanced loads
- Non-back-driving gear
- Vacuum rated options to $10^6$ torr
### Linear Motion Solutions

#### ALS Series
- Direct-drive linear motor stages
- Hard cover and side-seal design for years of maintenance-free operation
- High accuracy linear encoder option for applications that require excellent velocity regulation
- Multiple frame sizes and travel lengths provide system configuration flexibility
- Integrated cable management for XY, XYZ configurations and customer interfaces

#### AGS Series
- Optimized design for precise contouring
- Velocity to 3 m/s and acceleration to 5 g
- High power brushless linear servomotors for smooth motion
- Travels up to 1.5 m x 1.5 m
- Customizable Z and theta axes for flexible configurations
- Noncontact linear encoders
- Configurable cable management system allows for integration of fiber lasers, cameras, air lines, etc. for multiple applications

#### ABL Series
- Exceptional geometric air-bearing performance
- Travel to 1.2 meter
- Linear encoder or laser interferometer feedback
- Submicron accuracy
- Integrated XY and XYZ systems
- Non-cogging direct-drive motors
PRO Series

- Precision ground ball-screw drive
- Rugged construction
- Long-life linear motion bearing
- Side-seal design with hard cover protects from debris better than top-seal design
- Low cost, high performance
- 50 to 1500 mm travel

PRO LM Series

- Direct-drive linear motor for ultra-precise motion
- Long-life linear motion guide bearing system
- Travels from 100 mm to 1500 mm
- Low-cost, high-performance stage

MPS Series

- 50 and 75 mm widths
- Travel to 100 mm
- Precision ground ball-screw or lead-screw drive
- DC servo or stepper motor
- Crossed-roller bearings
- Compact multi-axis configurations

ATS Series

- Precision ground ball-screw drive
- Rugged construction
- High accuracy, noncontact linear encoder
- Long-life linear motion guide bearing system
- Travels from 25 mm to 1000 mm
- Heavy load options available
- $10^{-6}$ torr vacuum compatible
- Hard-coated tabletop and cover
- Low-bearing errors for excellent geometric performance
Planar Air-bearing Stages

ABL9000

- Full preload on all axes
- Dual linear-motor-driven Y axis
- Travel to 1.2 m x 1.2 m
- Linear encoder or laser interferometer feedback

PlanarHD

- Maximize throughput with 2 m/s scan velocity and 5 g acceleration
- Faster turnaround and minimized settling times
- Active yaw control
- Linear encoder or laser interferometer feedback
- Travel to 1.2 m x 1.2 m

Dynamic straightness, center 270 mm of travel at 500.0 mm/s max velocity
**AHL9000**

- Air-bearing scan axis; mechanical-bearing step axis
- Dual linear-motor-driven step axis
- Travel to 1.2 m x 1.2 m
- Linear encoder or laser interferometer feedback

**ABG10000**

- Air bearings for ultra-smooth motion
- All axes are fully preloaded
- Dual linear-motor-driven lower axis
- Travel to 1 m x 1 m
- Options include: Z axis, vibration isolation, machine base and control enclosure
Nanopositioners

ANT95-L Single-Axis Linear Stage
- Noncontact, non-cogging, frictionless direct-drive – zero backlash or hysteresis
- High resolution (1 nm), repeatability (75 nm) and accuracy (250 nm)
- In-position stability of <1 nm
- Anti-creep crossed-roller bearings
- High dynamic performance
- Available in X, XY, XYZ and many other combinations

ANT95-XY Dual-Axis Linear Stage
- Integrated low profile XY linear motor stage
- Noncontact, non-cogging, frictionless direct-drive – zero backlash or hysteresis
- High resolution (1 nm), repeatability (75 nm) and accuracy (250 nm) per axis
- In-position stability of <1 nm
- Anti-creep crossed-roller bearings
- High dynamic performance

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

The ANT95-XY series offers 25 x 25 mm or 50 x 50 mm travel
ANT130-L Single-Axis Linear Stage

• Noncontact, non-cogging, frictionless direct-drive – zero backlash or hysteresis
• High resolution (1 nm), repeatability (75 nm) and accuracy (250 nm)
• In-position stability of <1 nm
• Anti-creep crossed-roller bearings
• High dynamic performance
• Large selection – 4 different travel options

ANT130-XY Dual-Axis Linear Stage

• Integrated low profile XY linear motor stage
• Noncontact, non-cogging, frictionless direct-drive – zero backlash or hysteresis
• High resolution (1 nm), repeatability (75 nm) and accuracy (250 nm)
• In-position stability of <1 nm
• Anti-creep crossed-roller bearings
• High dynamic performance
ANT95-R and ANT130-R
Rotary Stages

- High resolution (0.01 arc sec)
- High performance in large travels
- Outstanding error motion specifications
- 0.005 arc-sec in-position stability
- 3 arc-sec accuracy
- 1.5 arc-sec bi-directional repeatability
- Multi-axis configurations

ANT-20G Goniometers

- Noncontact, non-cogging, frictionless direct-drive for zero backlash or hysteresis
- High speed (150 °/s)
- High resolution (0.05 arc second)
- Excellent in-position stability
- Large angular range; 20° of travel
- Orthogonal mounting of two cradles provides rotation about the same point
- No maintenance
- Compact design
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
- Anti-creep crossed-roller bearings
- High dynamic performance

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
Challenge
There can be drastic differences in requirements from one measurement system to the next depending on its intended use. As an integrator or OEM, this can be frustrating as it requires constant evaluation of new motion equipment to satisfy ever changing requirements. This can lead to inconsistent solutions and support challenges.

Solution
Aerotech offers solutions for all levels of performance and component needs. At the very simplest level we have controls and motors that users can buy to incorporate into their own designs. If more complete components are desired we offer a large selection of rotary and linear stages utilizing ball screw, gear drive, linear motor, mechanical bearing and air-bearing technology. If a complete system is needed Aerotech can provide a machine base, isolation systems, integrated controls, safety and enclosures. We can provide a solution that requires nothing more than adding a sensor and implementing the process.

Components to Integrated Solutions...

www.aerotech.com
Bringing Value and Convenience to Our Customers

Aerotech offers its customers a number of important advantages as a single-source provider:

**Vertical Integration**
Our expertise in motors, amps, controls and stages enables us to provide a complete optimized solution.

**Interconnectability**
Aerotech systems are designed to work together. This allows you to spend time and resources on your process, not on system integration.

**System Checkout**
Prior to shipment, all systems are fully assembled and checked out. All system parameters are factory-set based on your specifications.

**Documentation**
All systems are fully documented. System interconnect-drawings, specification sheets and stage certification plots are included with every system.

**Support & Service**
Because all system elements are designed and manufactured by Aerotech, we provide the highest level of technical knowledge available. Unlike companies that only manufacture part of the system, Aerotech manufactures all of the system components, minimizing service time.

**Single-Source Solution**
Aerotech designs and manufactures precision stages, motors, drives and controllers giving you all of the components needed for a complete system.

**Application Experience**
Since 1970, Aerotech has completed thousands of motion control projects, spanning an extensive range of applications.

**R&D**
Our engineering teams are dedicated to product development and continuous improvement.

**Technology Leader**
Aerotech engineers are continuously updating existing products and introducing new products. We are truly “Dedicated to the Science of Motion.”

**Quality**
Aerotech is an ISO 9001 certified supplier with a rigorous quality program.

**Worldwide Presence**
Aerotech is committed to supporting customers worldwide. We operate full sales and service facilities in the United Kingdom, Germany, Japan, Taiwan and China. We also maintain a growing number of direct field sales and application engineering offices throughout North America, and work with representatives across the globe.

Corporate Headquarters • Pittsburgh, PA • USA

Aerotech United Kingdom  Aerotech Germany  Aerotech Japan  Aerotech China  Aerotech Taiwan
Engineered Systems

Aerotech engineers and manufactures specialty high-performance subsystems. Our highly-trained staff of experienced software and hardware engineers enables our customers to get to production readiness faster. Aerotech provides real-time collaborative support – either at your facility, at our facility or on the web.

Magnetic Characterization
Direct-Write Lithography
Rapid Prototyping
Advanced Pick-Place-Inspect Station

Ion Beam Profiling in Vacuum
Precision Optical Production
Two-Side Optical Inspection
Liquid-Cooled, Vacuum-Prepped System

High-Volume Production Inspection Station
4-Axis Coordinate Measuring Machine
Drum Writing
High-Speed Optical Indexer

Optical Inspection
Printhead Inspection Station
High-Accuracy Laser Machining
Experimental Lithography
Capabilities in Other Markets

**Photovoltaic, Fuel Cell and Alternative Energy**
Extensive application experience and a broad array of motion products make Aerotech the perfect partner for your photovoltaic (solar cell), fuel cell and other alternative energy manufacturing and testing platforms. Our worldwide operation has engineered and manufactured a multitude of motion platforms for these markets and we continue to provide innovative solutions.

**General Automation**
Since 1970 Aerotech has been a manufacturer of top-quality automation products. The breadth of our product line, including automated nanopositioners, planar air-bearing systems, high-speed gantries, linear and rotary and lift stages, brushless linear and rotary servomotors and drives, single- and multi-axis motion controllers, goniometers and gimbals/optical mounts makes Aerotech unique among motion control manufacturers. Aerotech is Dedicated to the Science of Motion.

**Control Systems**
Aerotech motion controllers, motors and drives are utilized in our own positioning systems and by end users and OEMs worldwide. From our Automation 3200 software-based motion controller that can control up to 32 axes, to the Soloist single-axis servo controller, to the Ensemble multi-axis stand-alone motion controller, we provide a variety of options to suit your application.

**Laser Processing**
Aerotech has extensive experience in providing motion components and subsystems for laser processes such as cutting, welding, marking, etching and micromachining. These processes are the key to advancing technology in markets such as photovoltaic manufacturing, aerospace and medical device manufacturing.
Defense and Aerospace

Aerotech has manufactured hundreds of high-accuracy systems including many for high vacuum ($10^{-6}$ torr) and cleanroom environments. Our equipment is used for testing electro-optic systems, high-performance laser processing, materials testing and manufacturing, target tracking, satellite sensor calibration and verification, inertial guidance testing, scanning, optical pointing, repeatability and life-cycle testing for quality control. Custom systems are available with minimal development time.

Government and Educational Research and Development

The breadth of Aerotech’s product line offers solutions for the wide-ranging requirements of academic and government R&D. Our nanopositioners provide the accuracy required not only for photonics experiments, but also for micro- and nano-machining workstations. Aerotech’s multi-axis rotary positioners and gimbals offer the high precision needed for defense, satellite and space science research. Unique applications call for unique solutions, and Aerotech can provide custom-engineered systems to meet your needs.

Electronics Manufacturing and Assembly

Speed, accuracy and reliability are the key requirements for pick-and-place machines, stencil cutting machines, printed circuit board assembly and other electronic manufacturing and assembly equipment. Since 1970 Aerotech has exceeded the most stringent criteria used to judge electronic manufacturing and assembly equipment, and we continue to raise the standard with our advanced motion technologies by addressing industry-specific challenges in pick-and-place machines, stencil cutting machines and printed circuit board assembly systems.

Medical Device Manufacturing and Life Sciences

Aerotech manufactures high-performance motion systems and components for medical and life sciences applications including stent cutting, medical laser welding systems for cardiac pacemakers and catheters, IOL and contact lens manufacturing, DNA sequencing, blood sequencing, haptic mills and drills, x-ray machines, magnetic resonance scanners and CAT scanners. We can customize a medical laser welding system for any need.
Worldwide Training and Support

Aerotech offers comprehensive worldwide training and customer service either at customer facilities or at one of our Aerotech training centers.

Our Training Program Features:
- Standard and customized courses
- Hands-on training with Aerotech positioning systems
- Interactive training with experienced instructors
- Comfortable, spacious facilities

Installation and Start up (Commissioning)

Startup and commissioning services minimize startup times, reduce cost and accelerate time-to-production. By combining our product knowledge with your process and application expertise, new systems and applications can be completed faster at a reduced overall cost.

Engineering Support

Aerotech provides complete engineering support for our products, including on-site support and maintenance, and remote support via phone, fax, website and/or WebEx® software. As a manufacturer staffed by engineers, we understand the unacceptability of downtime.

Training

Comprehensive training classes are designed to help our customers realize the full potential of our products. By demonstrating all of a product’s features and how to use them, customers have been able to reduce startup time and quickly optimize their applications. Our classes have been developed, and continually upgraded, using feedback from our customers.

Since 1970, Aerotech has designed motion control and positioning systems and components with an unsurpassed track record of reliability. When you make the choice to purchase from Aerotech, we urge you to learn how to get the most from your new products. We provides both on-site (your facility) and/or in-house (our facility) training for our customers’ convenience.
Aerotech’s Worldwide Sales and Service Locations

www.aerotech.com