Motion Control for Precision Manufacturing

AEROTECH

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Aerotech Overview

Single-source supplier for motion components, drive electronics, controls, and complete motion subsystems for precision manufacturing.

Micromachining Applications

Motor Components for Machine Builds and Upgrades

- Linear and rotary motors offered in a full range of sizes and torques
- Brush, brushless, and slotless motors
- High coil-density for maximum torque in a small package
- Vacuum compatible motors

Rotary Applications

- Precision rotary axes for moving workpieces and tools
- Combine with linear stages to reach 4, 5, or 6 degrees of freedom
- Axis of intersection alignment and multi-axis orthogonality alignment reduce offset-induced errors at the work point
- Integral rotary union for vacuum or air-activated tooling

AXR two-axis rotary assembly

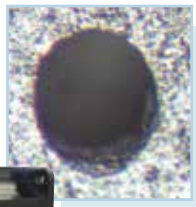
Lathe-Style Part Holding and Tube Cutting Applications

- Integrated pneumatic chucks and collets for ideal runout properties
- Low profile and high-performance designs meet various application requirements
- Combine with linear stages and coordinated motion for dynamic tube-cutting applications

CCS and ACS integrated pneumatic chuck and captive collet direct-drive rotary stages

Manufacturing Solutions for Drilling

- Complex hole geometries are achievable with multi-axis motion systems
- High-resolution direct-drive axes allow micron-level dynamic tolerances for drilling deep aspect-ratio holes with complex contours
- Engineered counterbalances enable arc-sec precision positioning of the part in 3D space
- Motion coordinate transformations allow the user to specify the programming coordinates while the axis commands run based on the positions or velocities of other axes

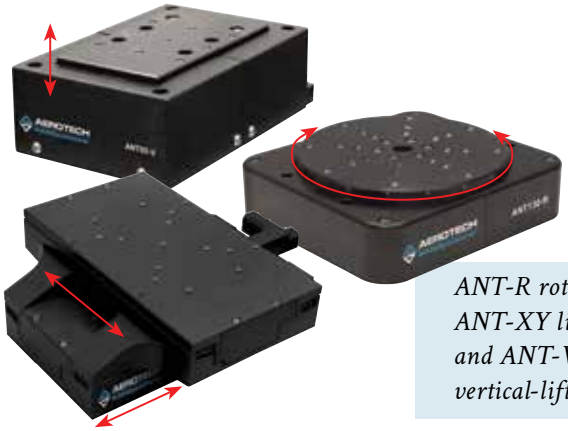


Small 0.100 mm hole features made possible by high-resolution motion

Nanomanufacturing Applications

Direct-Drive Servo Stages

- Excellent accuracy and in-position stability achievable with direct-drive linear and rotary motors
- Linear, rotary, lift, and goniometer configurations provide solutions for all degrees of freedom necessary for complex part geometries
- Mechanical- and air-bearing options for a variety of part tolerance and surface finish requirements



ANT-R rotary, ANT-XY linear, and ANT-V vertical-lift stages

Piezo Nanopositioners

- Sub-nanometer positioning resolution and nanometer-level accuracies (linearity)
- High stiffness and large resonant frequencies for higher throughput and faster closed-loop response
- Ideal for diamond turning, high-dynamic tool movements, and precision alignment routines
- Offered in various configurations including X, XY, and Z with a powerful networkable controller

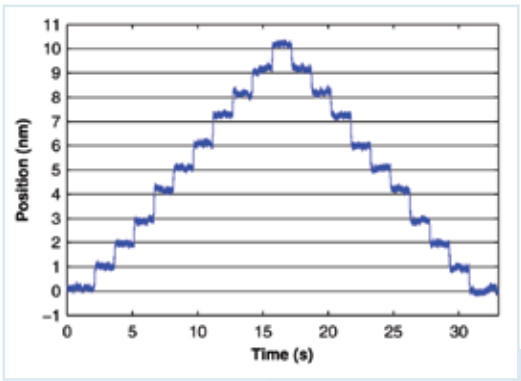
QNP™ series linear, XY, and Z axis piezo stages

Component Assembly and Alignment

Precision Positioning

- Hold nanometer-level in-position stability over long periods of time
- High mechanical-resolution stages capable of producing nanometer and sub-arc-sec step sizes
- Anti-creep crossed-roller bearings and direct-drive servo motors enable smooth velocity regulation and negligible hysteresis or backlash

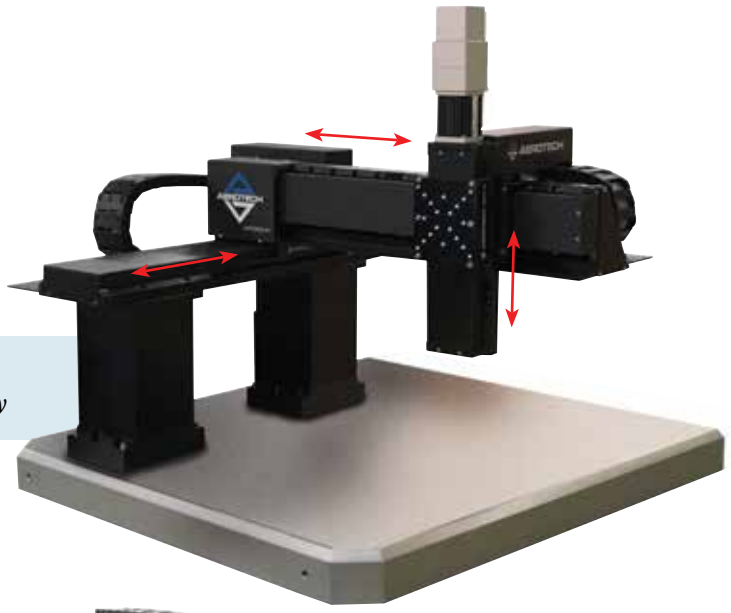
ANT130 XYZ direct-drive counterbalanced stage system



ANT95 linear stage showing a 1 nm step plot tested using advanced metrology methods

Cartesian Gantry Systems

- High-performance gantries available in both H- and T-style configurations
- Aerotech gantries allow for 5g accelerations and 3 m/s velocities that are ideal for increasing throughput without sacrificing precision
- Customized cable management provisions for customer process components
- Ideal for electronics manufacturing, high-speed pick-and-place, assembly, part processing, component inspection, and alignment applications



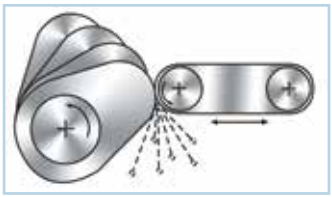
Cartesius-HD T-style gantry

AGS15000 H-style gantry

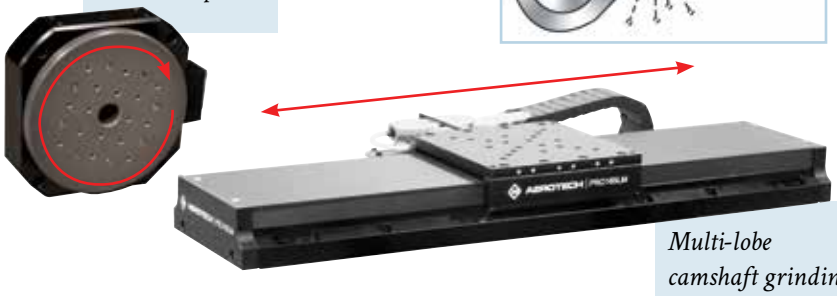
Precision Grinding Applications

Cam Grinding

- Easily defined cam tables provide slave positions as a function of master position with as many or as few points as the part profile requires
- High coil-density allows rotary and linear motors to provide the highest output in the smallest space



Main spindle



Multi-lobe camshaft grinding

Optic Grinding

- Direct-drive motors allow for high dynamics and minimum velocity errors for a high-quality surface finish
- Stainless steel and sealed rotary stages ideal for optical grinding and polishing in a variety of environments

ADRT and ADRS rotary stage families in stainless steel

Environmentally Sealed Applications

- Components for environments that are harmful to precision mechanics
- Ideal for micromachining and diamond turning applications that produce debris
- Sealing options for both air-bearing and mechanical-bearing stages

ABL1500 with bellows

Welding Applications

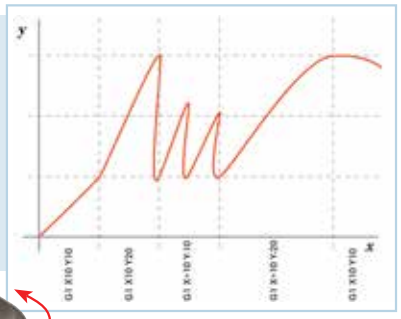
- Gantry design optimized for minimal tracking error and high-positional accuracy along weld paths
- Position Synchronized Output (PSO) allows for a welding head to be fired based on the calibrated feedback of the stage for ultimate geometric control

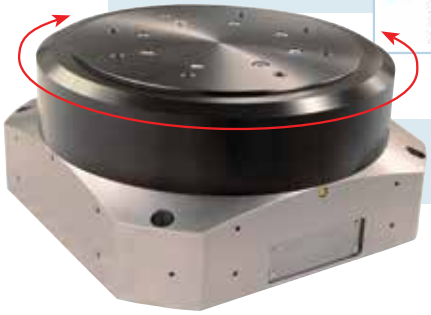
Sealed AGS series gantries for harsh environments

Electrical-Discharge Machining (EDM) Applications

- Negative MFO (Manual Feedrate Override) allows an EDM generator to command the axis to reverse direction depending on burn characteristics
- Multiple gains for the negative MFO allow the axis to retract and advance at different rates
- Intra-block retrace eliminates the need to break motion programs into multiple small modules for retrace capabilities
- IP66-sealed direct-drive rotary stages optimized for wet environments while providing high accuracy at high speeds for high-quality parts and throughput

For more detailed control, intra-block retrace allows for a path inside of a block of code to be retraced

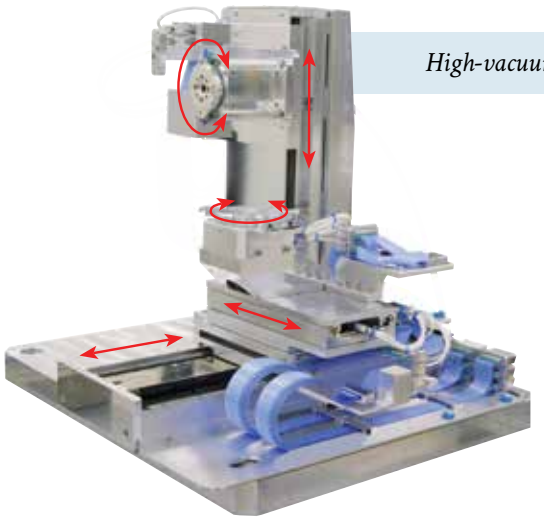




ASRT-245

Electron-Beam Manufacturing

- High-vacuum motion systems capable of 10^{-8} Torr built to minimize outgassing while maintaining performance
- Custom cable management solutions for vacuum compatibility
- Liquid-cooled linear motors for high dynamics and improved thermal management
- Custom stage configurations to fit into existing chambers



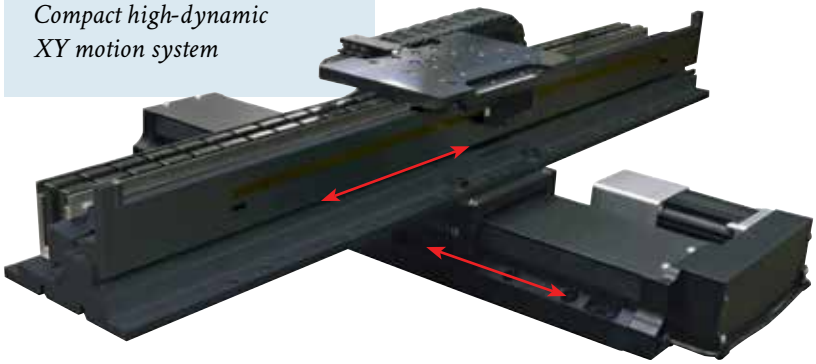
High-vacuum system

Printing and Holography Applications

Industrial Printing

- High-speed printing axis with low-speed step axis provide a cost-effective solution for ink-jet printing processes
- Excellent velocity stability and small minimum step sizes accommodate the most demanding printheads
- Compact stage designs minimize machine footprint

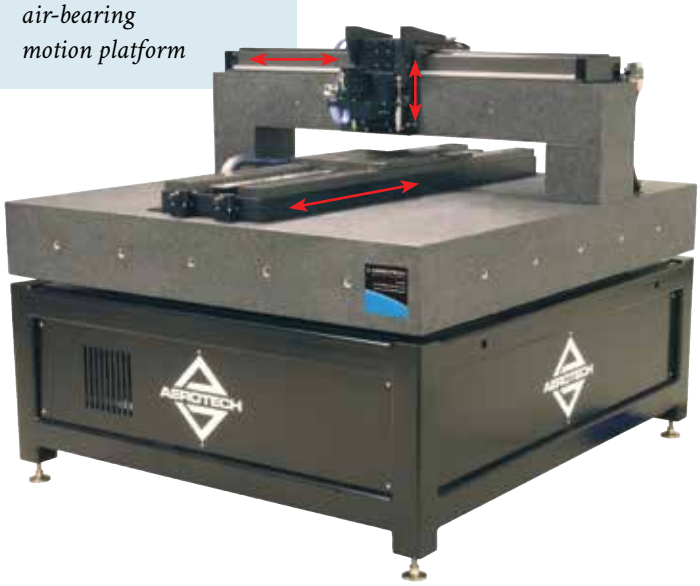
Compact high-dynamic XY motion system



Holographic Master Manufacturing

- Linear air-bearing options designed to optimize dynamic straightness, ensuring scan-line parallelism
- Scalable designs for masters of many sizes
- Industry-leading control system with real-time position-based laser firing output ensures laser pulses are fired at precise intervals, maximizing hologram quality
- Hold tolerances over long periods for consistent processing of large holograms

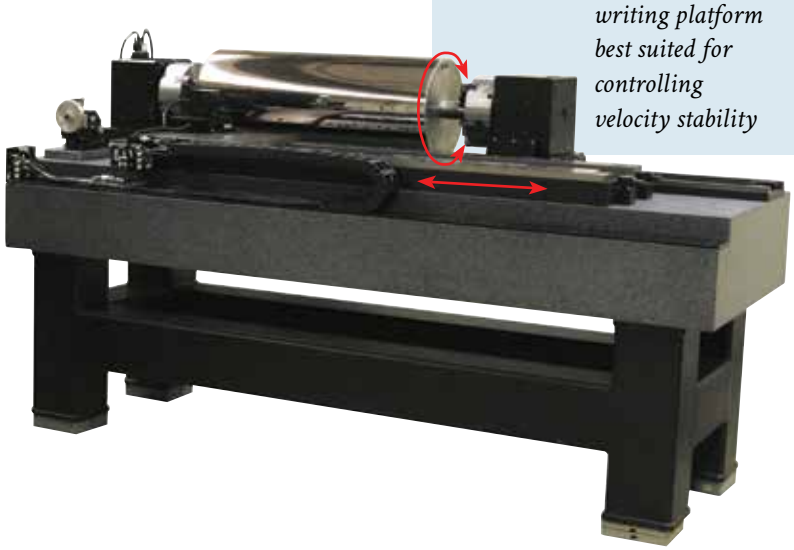
Highly repeatable air-bearing motion platform



Drum Writing

- High-accuracy linear air-bearing for excellent straightness and angular performance with tight line spacing with no overlap
- Large capacity mechanical or air-bearing rotary stages carry heavy loads while maintaining high positional accuracy and velocity stability
- Sliding tailstock accommodates multiple drum lengths
- Precision alignments minimize tool offset errors

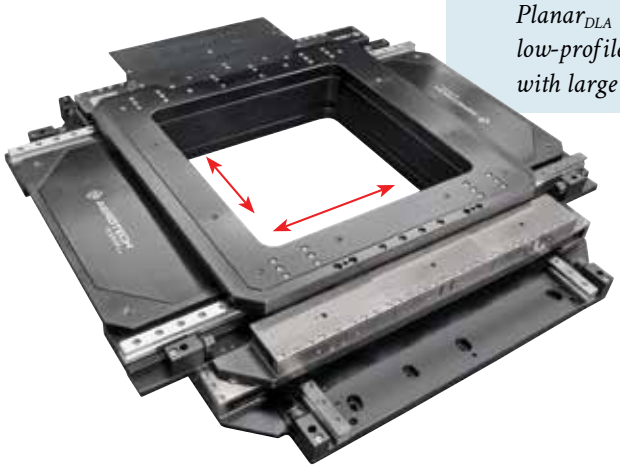
Air-bearing drum writing platform best suited for controlling velocity stability



Part Inspection Applications

Traditional Measurement Configurations

- Mechanics with excellent straightness and flatness specifications ideal for raster scan and Cartesian testing processes
- Crossed-roller and air-bearing stages for high dynamic accuracies
- Linear motor options for high-dynamics and throughput to decrease measurement time
- Screw-driven versions for a cost-effective solution

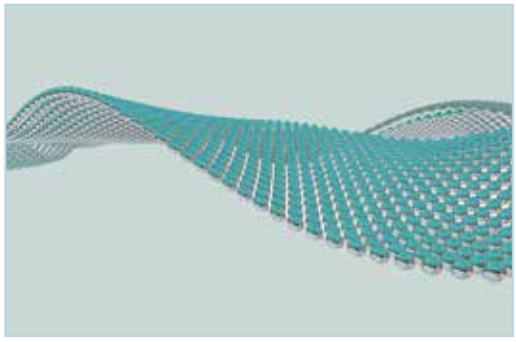


Planar$_{DLA}$ integrated, low-profile XY stage with large aperture

Planar$_{DL}$ integrated, low-profile XY stage

Surface Profiling

- Surface measurement platforms designed for various profiling applications
- Ideal for rotationally symmetric objects
- 60% smaller than traditional Cartesian systems while maintaining a 40% increase in scanning speed over traditional methods

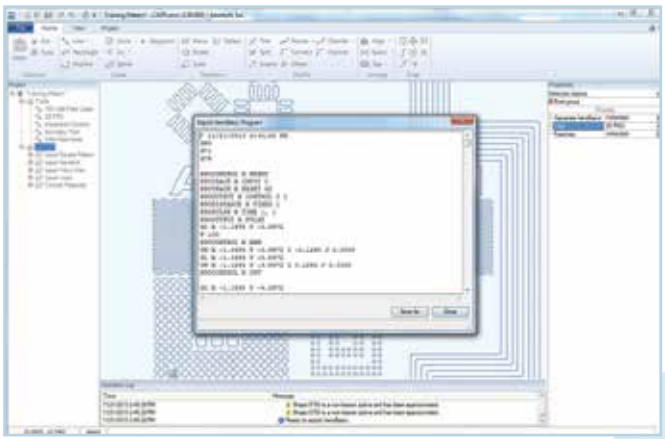


Ultra-high precision multi-axis motion platform

Aerotech's Software and Controls

CADFusion CAD to G-Code Software

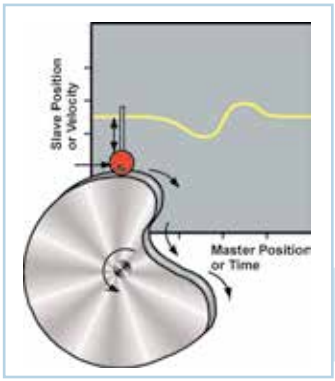
- Easily imports vector-based drawing files and produces Aerotech compatible motion programs
- Manually or automatically re-shapes tool paths for optimal processing routes
- Supports advanced Aerotech programming features such as Position Synchronized Output (PSO)
- Extensive drawing tools for part creation and transformation



CADFusion user interface

CAM Profiling and Machine Moves

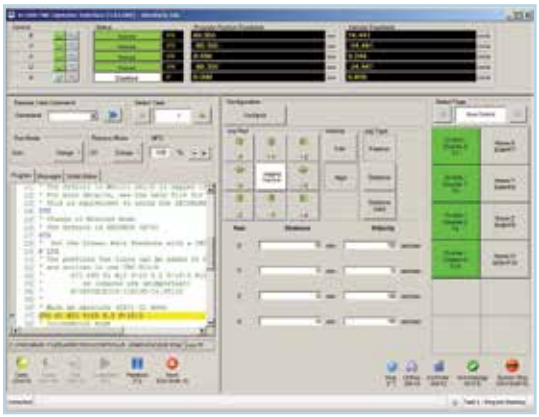
- Electronically command one axis position as a function of another axis with a CAM table and trigger I/O during the move
- Tool-path cutter compensation, arbitrary path generation, acceleration limiting, and coordinated motion are all standard control capabilities that make machine control effortless



CAM and follower

CNC Operator Interface

- Traditional CNC look and feel for operating a machine running G-code
- Customizable buttons that can execute simple or complex actions written in G-code and AeroBasic™
- Interface displays the actively running program and allows the user to issue immediate commands



Machine Retrofits

- Nservo and Nstep control third-party servo amplifiers with advanced A3200 Automation Controller allowing for powerful control upgrades while retaining the existing motors and drives
- Aerotech also offers a full line of amplifiers and motors for applications requiring complete controller/motor replacement

(l to r) Nservo, Nstep, A3200 Motion Server

Drive Electronics and Controls

Advanced System Controls

- A multitude of drive options increases flexibility
- Easily configured for brushless, brush, and stepper motors
- Capture all motion performance during testing for quality control

Machine Tool Specific Features

- 5-6 axis contouring capabilities
- Position Synchronized Output (PSO) trigger for laser sensor or camera control
- Calculators for quick and easy setup

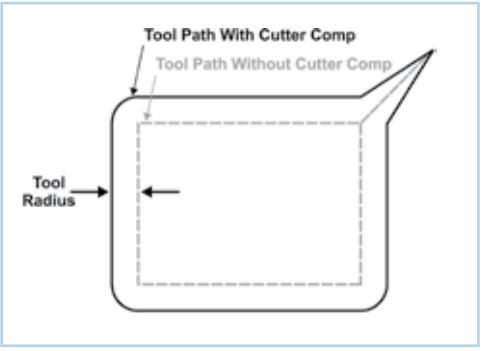
Software

- Easy setup with calculators and Autotune routine
- Use state-of-the-art IDE for developing your motion program
- Second-to-none diagnostics toolkit
- Conditional 2D error plotting

Automation 3200 Machine Controller

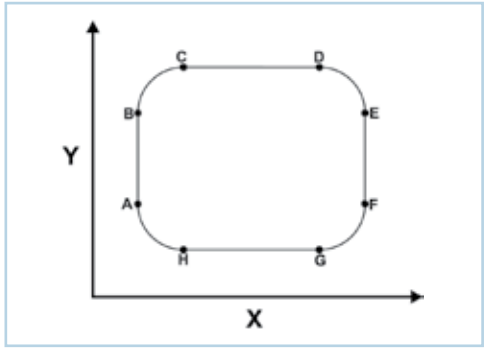
- Up to 32 tasks
- PC-based
- RS-274 G-code, .NET, LabVIEW®, AeroBasic™
- Advanced features for demanding applications
- PLC IEC 61131-3, PLCopen compliant
- 1 to 32 axes of coordinated motion
- Scanner control for marking
- Tightly integrated laser functionality
- Retrofit package
- Analog and digital I/O

Controller Features



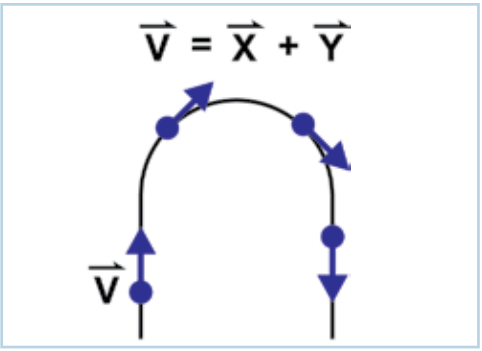
Cutter Compensation

Also known as tool radius compensation, this feature automatically adjusts the path to allow for the radius of a cutting tool



Coordinated Motion

Linear and circular motions are supported in all languages



Velocity Profiling

Maintains a constant vector velocity along the programmed path

Spindle Control

Commands for speed, direction, activation, behavior, and status

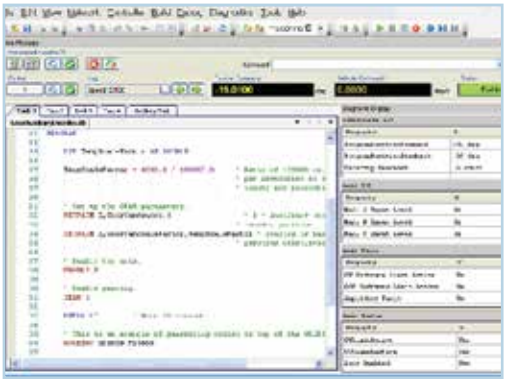
Interfaces

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

Accessories

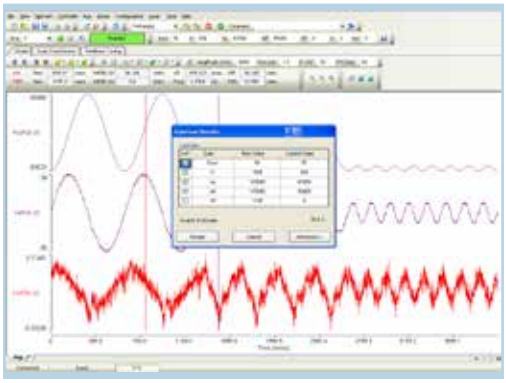
- Linear amplifiers
- ESTOP
- Rack-mount configuration
- Rack-mount PCs

Integrated Development Environment (IDE) Reduces Development Time



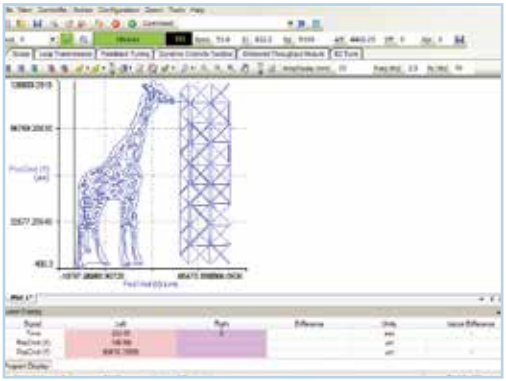
Programming Interface

- Integrated I/O panel
- Debugging features (breakpoint, step-in, etc.)



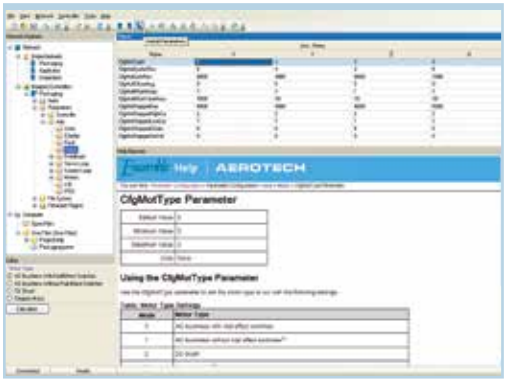
Autotune

- One click EasyTune™ to set gains and place filters
- Optimization and performance read-outs



Digital Scope

- 1D and 2D plot capability
- Plot move profiles, I/O, and commands for easy troubleshooting



Parameter Editor

- Easy-to-use calculators for system setup
- Integrated HELP files

Aerotech Global Technical Support

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