Integrated Motion and Machine Control Solutions
Aerotech’s Advanced Automation Technologies: 46 years in the making... and going strong...
Contents

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Configure Your Automation Solution with Aerotech

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

Aerotech
Integrated
Motion and
Machine
Control
• High performance
• Easy to use
• Flexible
• Scalable
• Networked
• Lowest cost of ownership
• Advanced control technology
• Controls servo, piezo, voice coil, and stepper motor
Develop your own applications with .NET, C#, VB.NET, C, LabVIEW®, Tango, AeroBasic™ or PLC languages

Award-Winning Controllers

**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 A)
- Scanner control for marking
- Tightly integrated laser functionality
- Retro-fit package for old controls
- Integrated PLC and Motion - MotionPAC

**Ensemble™**
- Stand-alone
- 1 to 10 axis controller
- Up to 4 tasks
- Versatile, cost-effective, coordinated motion
- PWM or linear drives (10-150 A peak)
- Drives brushless, linear, rotary, DC brush or stepper motors
- Desktop, rack mount or panel mount

**Soloist™**
- Stand-alone
- Network up to 1024 single axes
- Up to 4 tasks
- Elegant, economical, versatile controller
- PWM or linear drives (10-150 A peak)
- Drives brushless, linear, rotary, DC brush or stepper motors

**Piezo Controls**
- Network up to 32
- Coordinated motion with servo and stepper motor stages
- Available in desktop or rackmount configuration
- Powered by Automation 3200 motion controller
Linear and Rotary Servomotors/Accessories

Fieldbus and Network Connectivity
- EtherNet/IP™
- PROFINET
- Modbus®/TCP
- RS-232
- EtherCAT™
- Ethernet TCP/IP
- USB
- GPIB

Configure Your Automation Solution with Aerotech

Custom Controls, Drives and Motors
Integrated Configuration Manager for Easy Setup

- Compare parameter files
- Standard Windows® menus
- See all the controllers on the network
- Work with this controller
- Network Explorer for project management
- File space on the controller
- Tool tips
- Standard motion toolbars
- Configurable workspace with your preferences
- Extensive calculators for system setup
- Hyperlink to associated subjects
- Context sensitive integrated help

Motion Composer:
Use the same Aerotech software with the A3200, Ensemble, or Soloist

- Configuration Manager to organize your applications
- Calculators for quick and easy setup
- Extensive diagnostics for commissioning
- Integrated Development Environment for fast development
- Data Acquisition and Analysis Tools for increasing performance
- Fully compliant .NET 2.0 shortens the development cycle
Calculators for Quick and Easy Setup

- Easily switch axis to be configured
- Select your motor or add a custom motor
- System knows all parameters of Aerotech components
- Select amplifier type
- Directly enter any parameter values here
- Summary of default, current and new values for all parameters
- Configure feedback for user units
- Current loop calculator
- PID gain calculator
- Configure feedback for user units

Scalable Automation Control Software for Simple Applications and the Power User
Extensive Diagnostics for all System Signals and Variables Shorten Debug and Startup Time

- Control all axes at once
- Multiple tabs for organized programming
- View task status as needed
- Watch any variables as the program runs
- Pop-up error reporting
- Compiler output screen
- System toolbar for system control
- Axis toolbar for control of each axis
- Standard toolbar for program control
- Issue immediate commands without operator interface open
- Dockable windows for custom work environment
- Configurable to see only the information you want
- Real-time readout of system state variables
- Real-time access to system signals
- Real-time reporting of all faults
- Real-time system information
Advanced Diagnostic and Tuning Capabilities Minimize Startup Time and Allow Easy Optimization of Motion

Current and recommended gains pop up after each run

Save plots for future reference

Use sinusoidal sweep or white noise method

Input amplitude and frequency range for test

Select desired system bandwidth and phase margin

Scope, tuning and data collection fully integrated with controller

Automatic calculation of PID-FF gains
Use Encoder Tuning Tool to Increase System Accuracy

One click tuning

Fully integrated with controller

Graphical display of the Lissajous plot to optimize the encoder signal

Optimally calculates gain and phase of amplified sine encoder channels in seconds

Actual encoder performance

Use Encoder Tuning Tool to Increase System Accuracy

One click tuning

Fully integrated with controller

Graphical display of the Lissajous plot to optimize the encoder signal

Optimally calculates gain and phase of amplified sine encoder channels in seconds

Actual encoder performance
Loop Transmission is a Tuning and Diagnostic Utility that Greatly Enhances System Performance

Graphical loop shaping — add filters or change gain by dragging the gain curve, and the filter coefficients and PID gains are calculated automatically.

Open or closed loop response.

Analyze position loop, velocity loop or current loop.

Automatic calculation of gain margin.

Identify resonances and use filters.

Calculator and loop shaping to increase performance.

Automatic calculation of phase margin.

System frequency response or Bode plot.
Scalable Automation Control Software for Simple Applications and the Power User

Select your filter type: low pass, high pass, notch, resonant, lead/lag

Axis selection

Add up to eight filters per axis

Configure filters for your application by specifying frequency, depth and width

Discrete time gains are automatically calculated and stored in the parameter file

Cursor control to read out gain and phase

Composite frequency response of all filters

Store all parameters in the parameter file

Fully Integrated Digital Filter Calculator Makes Performance Enhancements Easy
Integrated I/O Panel for Debug, Commissioning or Operations

- Monitor digital I/O control
- Set digital I/O during test and commissioning
- View I/O axis information and program at the same time
- Monitor analog I/O
- Set analog I/O during commissioning for easy testing
- Use the I/O panel during programming to test as you go
- Tool tip provides physical connector and pin on the drive to easily associate electrical wiring with software variables

Scalable Automation Control Software for Simple Applications and the Power User
Integrated Development Environment Shortens Development Time

- Hide the axis manager while programming to see more code
- Visual Studio-like project management for advanced programming
- Powerful IntelliSense® capability
- Insert breakpoints to debug program
- Low learning curve with strict implementation of .NET naming conventions
- Detailed error explanation in error list
- Minimize development time with debug features, break point, step in and step over
- Full diagnostic instrumentation while debugging
- Watch window shows variable values for easy debugging
- Link to help file for description of error
Create Reusable Modules with AeroBasic™

- Create reusable code with libraries and `#include` files
- Write easy-to-read and maintainable code by using `#define` (rather than numeric constants)
- Real-time code environment
- Advanced programming techniques result in code that is easy to read, simple to maintain and reusable for other projects
- Protect intellectual property by using a library; permit or deny end users access to source code
- Built-in software security key for OEMs

Scalable Automation Control Software for Simple Applications and the Power User
Create Easy to Maintain Code with AeroBasic™

- User defined variable types allow an object-oriented approach to system design
- Use structures to define your own data types
- Advanced variable types such as arrays and strings allow for more advanced program design
- Memory management is done by the operating system
- Keeping all motion code in one function creates modularity, which brings products to market faster and reduces maintenance cost
- Variable initialization reduces code size and increases readability for multiple developers
- Standard program flow: while/wend, for/next, repeat, if/then/else
Program in IEC 61131-3: LD, FBD, ST

- 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

Online mode displays all Tag values
Axis manager
Tag database

Define hardware
Create libraries
Combine LD and FBD in the same program
Completely integrated motion blocks
Standard LD

LD, FBD or ST programs

Integrated Automation: MotionPAC

- 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 Automation: MotionPAC – PLC and Motion

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

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

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

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

Beckhoff Wago
- 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
Use Tags in Operator Interface by Name

View CNC code running at the same time as PLC code.

Use shared Tags defined in MotionPAC by name in a button action.

Use shared Tags by name in program called by a button click.
Standard PLC Functions: IEC 61131-3

Ladder Diagram
- VALUE
- TRUE
- FALSE
- COMMENT
- CONNECTOR
- JUMP
- LABEL
- RETURN
- CONTACT (NO, NC)
- COIL
- LEFT POWERRAIL
- RIGHT POWERRAIL

Function Blocks
- CTD
- CTU
- CTUD
- F_TRIG
- R_TRIG
- RS
- SR
- TOF
- TOF_R
- TON
- TON_R
- TP
- TP_R

Motion Blocks (Partial List)
- MoveAbsolute
- MoveRelative
- MoveSuperimposed
- MoveVelocity
- Home
- Stop
- PositionProfile
- MoveContinuous
- Halt
- CamIn/CamOut
- CamTableSelect
- GearInPos
- GearIn/GearOut
- Phasing

Administrative Motion Blocks (Partial List)
- ReadStatus
- ReadAxisError
- ReadParameter
- WriteParameter
- ReadActualPosition
- AbortTrigger
- ReadDigitalInput
- ReadDigitalOutput
- WriteDigitalOutput
- SetPosition

Functions (Partial List)
- ABS
- ACOS
- B_BCD_TO_DINT
- B_BCD_TO_INT
- DELETE
- DINT_TO_BOOL
- EXP
- EXPT
- FIND
- GE
- GE_STRING
- INT_TO_BOOL
- INT_TO_BYTE
- INT_TO_DINT
- INT_TO_DWORD
- LE
- LE_STRING
- LEFT
- LEN
- MULTIME
- NE
- OR
- REAL_TO_BOOL
- SEL_TO_BOOL
- SEL_TO_BYTE
- TRUNC_SINT
- UDINT_TO_BOOL
One I/O and Data Dictionary for the Machine

Integrated Development Environment
Shortens Development Time

I/O available in all applications: scope, configurator, MotionPAC (PLC) and Motion Composer

Drive I/O connected to system
Fieldbus I/O connected to the system

I/O defined in one place
Easily map I/O to program Tags

Memory management automatically done by the MotionPAC
Use Scope to Plot Any Motion, PLC, I/O, Variable or Tag

All information in Global Tag database available for real time plotting and analysis with all motion variables.
Use the Aerotech standard GUI...
...or build a custom interface for your application

- Easy to use
- Faster development
- Lower maintenance cost

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

SDK: Software Development Kit
.NET Library

- High-end motion with a custom GUI
- Use the best language for the application
- Fully functional libraries for each language

All Aerotech applications are written using the .NET library. Aerotech provides customers with the same tools used at Aerotech.

TAKE ADVANTAGE OF:

.NET Framework 2.0

- Generics
- Enumerations
- Indexers
- Events
- Exceptions

Object Model

- Well-organized structure with two main classes: network and controllers
- Common features are higher in the hierarchy
- Minimal code required to accomplish the task at hand

Libraries Include:

- Initialization functions
- Global data functions
- Motion functions
- Error handling
- Status and position functions
- Analog and digital I/O functions
- Parameter functions
- Run CNC program functions
- Utility functions
- Get and set variable functions

OBJECT MODEL

[Diagram of object model with classes and methods]

Legend
- Class
- Collection
**Applications**

- Dynamic environment simulation
- Sensor or component testing
- Gyros or accelerometers; tracking or beam-steering gimbals
- Crash sensors and roll-over sensors

- Minimize programming time
- Import actual data
- Import from Excel or MATLAB®

Create and modify multi-axis trajectories using predefined building blocks to provide rapid motion prototyping.

Perform data analysis such as FFT, max, min, average, rms and standard deviation from an existing trajectory for diagnosing system performance.

Add standard filter types: notch, resonant, low pass and high pass.

Enter standard filter frequency parameters.

Digital filter coefficients are automatically calculated.

Applications:

- Dynamic environment simulation
- Sensor or component testing
- Gyros or accelerometers; tracking or beam-steering gimbals
- Crash sensors and roll-over sensors

- Minimize programming time
- Import actual data
- Import from Excel or MATLAB®
Automatic AeroBasic™ program generation for all controllers

Project tree for simple organization

Trajectory properties (e.g., user units)

Automatically calculates missing state information (e.g., acceleration, velocity or position)

Create periodic motion

Point-to-point moves

Overlay multiple trials for easy comparison

Easily modify an existing trajectory

Rapid motion programming

Trajectory properties

Automatic AeroBasic™

Program generation for all controllers

Project tree for simple organization

Trajectory properties (e.g., user units)

Automatically calculates missing state information (e.g., acceleration, velocity or position)
Aerotech’s Motion Simulator software is an easy-to-use Windows®-based program for creating simple and advanced motion stimuli for testing and calibrating inertial sensors and systems. The Aerotech Motion Simulator software includes all controls for manually or automatically running 1-3 axis motion simulations. The GUI provides a user interface and programming environment that requires no third-party development software.

**Key Features:**
- User-friendly Windows®-based graphical user interface
- Trajectory tracking from Ethernet, analog or Windows® program inputs
- Iterative Learning minimizes position error
- Overlap multiple runs of a trajectory to easily see how program changes modify the motion
- Perform data analysis such as FFT, max, min, average, rms and standard deviation from an existing trajectory for diagnosing system performance
- Data input file formats include Excel, CSV or MATLAB®; Motion Simulator can calculate the missing state variables
Main Screen

Motion Designer

Program

Frequency Response

Track screen allows external signal selection for tracking

Data Analysis
Generate Motion Programs Directly From Your CAD Drawing

- Easily imports vector-based drawing files and produces G-code motion programs
- Interactive canvas allows easy editing and creation of new shapes and text
- Automatic and manual shape re-ordering options allow for optimal tool and processing paths
- Export to RS-274D G-code format
- Allows user-defined initialization, process shutdown, and shuttering commands (tool on/off)
- Offers seamless use of Aerotech’s powerful controller features such as PSO (Position Synchronized Output)
Open Simulation Environment

- Support for Coppelia Robotics virtual robot experimentation platform (V-REP)
- Full system modeling capability
- Visualization and selection of coordinate systems for multi-DOF systems like hexapods
- Pre-configured models connect directly to Aerotech’s A3200 motion controller
- Import custom objects as 3D mesh files
- Supports collision detection between all elements in the environment
- Control grippers and vacuum pickup devices with Aerotech I/O
Operator Interface

- Use the Aerotech Operator Interface (OI) for fast deployment
- Customize the OI to suit the application
- User customizable buttons that can execute standard G-code and AeroBasic™

Configurable Operator Interface

- Issue immediate commands
- Configurable axis manager
- Configurable jog pad
- User customizable buttons
- Active program
- Standard machine controls
- Designed for touch screen
- Set up simple or complex action — user can attach a standard G-code program to a button
Advanced Software Architecture

Layered for flexibility • Customizable at many layers • Most cost-effective solution
Digital Automation Platform

- Higher throughput due to high performance control, network and high-power drives
- Higher accuracy and repeatability due to all digital drives and advanced servo algorithms
- Faster startup and changeover results from fully integrated motion platform, easy-to-use setup tools and extensive diagnostics
- Lower startup and life-cycle cost due to less components and reduced engineering
- Higher reliability due to fewer components
- Simplified integration

Distributed Motion Control
- Motion trajectory generation and synchronization are centralized at the PC
- Motion execution is decentralized at the drives
- A3200 operates on any standard desktop or industrial PC
- Servo loops are closed on the drive

Use Nservo to Retrofit Existing Motors & Drives or Drive Large Motors

Nstep

Any Stepper Drive

Any Stepper Motor

Any Servo Amplifier

AGV Galvo Control

Npaq® 6-Axis High Performance Drive Rack
The Intelligent 32-Axis Motion, Vision, PLC, Robotics and I/O Platform

- Easily installed digital drives
- FireWire® (IEEE-1394) industry standard, high-performance motion bus

Any Brush, Brushless or Stepper Motor with any Drive

Digital Drive Features

- PWM or linear (10 A to 150 A peak)
- Integrated 10/100 Base-T Ethernet
- Encoder, resolver or inductosyn feedback
- Onboard x65536 encoder multiplication
- 20 kHz position, velocity and current-loop sample rate
- Integral power supply
- Sinusoidal commutation
- Local I/O ports

Easily integrates with Keyence LK-G Series Laser Displacement Sensors

Fieldbus Interface
Smart Camera
FireWire®
Ethernet
Stand-Alone Multi-Axis Automation Controller

- Easy to use
- Powerful architecture
- Distributed control
- Network ready

6-Axis Stand-Alone, Rack Mount or Desktop Plus Three Axes
Stand-Alone Single-Axis Automation Controller

- Easy to use
- Scalable
- Ethernet/USB connectivity

Soloist®

Integrated Motion and Machine Control Solutions
Software, Controls, Drives and I/O in One Compact Package

from 10 to 150 A peak

Soloist HPe 150
Soloist HPe
Soloist CP
Soloist MP
Soloist ML
Soloist HLe

Brushless Linear Motors
Stepper Motors
Slotless Motors
Brushless Servomotors
ASR2000 Spindle

Easily integrates with Keyence LK-G Series Laser Displacement Sensors

LAN/WAN/Internet up to 1024 on one network

Connect, program or monitor locally or remotely

Easily integrates with Keyence LK-G Series Laser Displacement Sensors

Connect, program or monitor locally or remotely
Controller and Drive Technology

MP for OEMs lowers costs • CP solutions for less integration work • HPe for the highest performance solution

Ndrive® MP
Ensemble® MP
Soloist® MP
Width: 41.1 mm
Height: 141.2 mm

Ndrive® CP
Ensemble® CP
Soloist® CP
Width: 63.5 mm
Height: 198.2 mm

FireWire®
(IEEE-1394)
(J101, J102)

LED Status
Indicators

Motor Feedback
Connector (J103)

10-80 VDC
Bus Voltage
Input

Motor Output
10-80 VDC, 10 Apk

24-80 VDC, 2 A
Max Logic Power
Input (TB103, Bottom)

Emergency Stop
Sense Input (TB101, Top)

Second Encoder
Interface (J201)

Brake Relay (TB201)

One 12-Bit Analog
Input and One 16-Bit Analog Output (TB202)

Eight Opto-Isolated Inputs, Common Sink or Common Source (User Defined) (TB203)

Eight Opto-Isolated Outputs, Common Sink or Common Source (User Defined) (TB204)

Control Supply
(Bottom)

Two 16-Bit Analog Inputs, One Analog Output (TB201)

Eight Opto-Isolated Outputs, Common Sink or Common Source (User Defined) (TB202)

Eight Opto-Isolated Outputs, Common Sink or Common Source (User Defined) (TB203)

Eight Opto-Isolated Inputs, Common Sink or Common Source (User Defined) (TB205)

Eight Opto-Isolated Inputs, Common Sink or Common Source (User Defined) (TB204)

Motor Output
10-320 VDC, 10-30 Apk

7-240 VAC
Single-Phase
Input

Brake Relay (TB206)
Ndrive® HPe
Ensemble® HPe
Soloist® HPe

Model shown is 10 to 30 amps peak with I/O expansion

Width: 99.1 mm
Height: 232.5 mm

Control
Supply
1-3 Phase
7-240 VAC
50/60 Hz
3 Phase
10-320 VDC
Motor Output
10-30 Apk

Auxiliary I/O
(J205)
RS-232 (J206)
Emergency
Stop Sense
Input (TB201)
Power LED

Model shown is 10 to 30 amps peak with I/O expansion

Ndrive® HPe
Ensemble® HPe
Soloist® HPe

Width: 212.6 mm
Height: 234.8 mm

Control
Supply
1-3 Phase
7-240 VAC
50/60 Hz
3 Phase
10-320 VDC
Motor Output
50-100 Apk

User Power
(TB303)
Eight Opto-Isolated
Inputs, Common Sink or Common Source (User-Defined) (TB304)
Eight Opto-Isolated
Outputs, Common Sink or Common Source (User-Defined) (TB305)
Motor Feedback Connector (J207)

Model shown is 50 to 100 amps peak with I/O expansion

Ethernet (J204)
FireWire®
(IEEE-1394)
(J201, J202,
J203)
PSO/Absolute
Encoder Interface (J301)
Two Channels SSINet
for Buffered RS-422
(Multiplied) Encoder
IN/OUT (J302, J303)
LED Status Indicators
Two 18-Bit Analog
Outputs and Brake Relay
(TB301)
Two 16-Bit Analog
Inputs (TB302)
User Power
(TB303)
Eight Opto-Isolated
Outputs, Common Sink or Common Source (User-Defined) (TB304)
Eight Opto-Isolated
Inputs, Common Sink or Common Source (User-Defined) (TB305)

Communication
Channel (Device #)
Settings
Resolver Interface
(Opt) (J401, J402)
IEEE-1397
FireWire® (J201,
J202, J203)
PSO/Absolute
Encoder Interface
(J301)
Two Channels
SSINet for Buffered
RS-422 (Multiplied)
Encoder IN/OUT
(J302, J303)
Two 18-Bit Analog
Outputs and Brake Relay
(TB301)
Two 16-Bit Analog
Inputs (TB302)
User Power
(TB303)
Eight Opto-Isolated
Outputs, Common Sink or Common Source (User-Defined) (TB304)
Eight Opto-Isolated
Inputs, Common Sink or Common Source (User-Defined) (TB305)
Motor Feedback
Connector (J207)

Model shown is 50 to 100 amps peak with I/O expansion

Ethernet (J204)
FireWire®
(IEEE-1394)
(J201, J202,
J203)
PSO/Absolute
Encoder Interface (J301)
Two Channels SSINet
for Buffered RS-422
(Multiplied) Encoder
IN/OUT (J302, J303)
LED Status Indicators
Two 18-Bit Analog
Outputs and Brake Relay
(TB301)
Two 16-Bit Analog
Inputs (TB302)
User Power
(TB303)
Eight Opto-Isolated
Outputs, Common Sink or Common Source (User-Defined) (TB304)
Eight Opto-Isolated
Inputs, Common Sink or Common Source (User-Defined) (TB305)

Communication
Channel (Device #)
Settings
Resolver Interface
(Opt) (J401, J402)
**Linear Drive Advantages**

- Ultra-smooth motion during reversals
- Superior in-position stability
- Integrated with controls
- No switching noise
- No dead band
- Low EMI

**Applications**

- Nondestructive testing
- Stencil cutting
- Any small move, or sinusoidal movements
- Very slow velocity applications
- Stent manufacturing
- Target tracking
- Piezo stages

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**Ndrive® HPe150**

- Ensemble® HPe150
- Soloist® HPe150

Width: 229.7 mm  
Height: 406.1 mm

**Ndrive® ML**

- Ensemble® ML
- Soloist® ML

Width: 41.1 mm  
Height: 141.2 mm

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Controller and Drive Technology

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**Controller and Drive Technology**

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**Linear Drive Advantages**

- Ultra-smooth motion during reversals
- Superior in-position stability
- Integrated with controls
- No switching noise
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**Applications**

- Nondestructive testing
- Stencil cutting
- Any small move, or sinusoidal movements
- Very slow velocity applications
- Stent manufacturing
- Target tracking
- Piezo stages

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Controller and Drive Technology
Ndrive® HLe
Ensemble® HLe
Soloist® HLe

Width: 206.9 mm
Height: 234.3 mm

Motor Output (TB101)

Ethernet (J204)

LED Status Indicators

Auxiliary I/O (J205)

RS-232 (J206)

Emergency Stop Sense Input (TB201)

Power/Enabled LED

Motor Feedback Connector (J207)

PSO/Absolute Encoder Interface (J301)

FireWire® (IEEE-1394) (J201, J202, J203)

Resolver Interface (Opt) (J401, J402)

Main Supply AC1, AC2, Ground

Two Channels SSINet for Buffered RS-422 (Multiplied) Encoder IN/OUT (J302, J303)

Control Supply

Two 18-Bit Analog Outputs/Brake Relay (TB301)

Two 16-Bit Analog Inputs (TB302)

User Power (TB303)

Eight Opto-Isolated Outputs, Common Sink or Common Source (User-Defined) (TB304)

Eight Opto-Isolated Inputs, Common Sink or Common Source (User-Defined) (TB305)

Nstep

Width: 49.2 mm
Height: 161.8 mm

One Input and Output per Axis and Sixteen Additional I/O Points

Reset LED

Power LED

Amplifier Interface Axis 3

Amplifier Interface Axis 4

Encoder Input Axis 1

Encoder Input Axis 2

Enable LEDs Axis 1 and 2

FireWire®

Amplifier Interface Axis 3

Amplifier Interface Axis 4

Encoder Input Axis 3

Encoder Input Axis 4

Enable LEDs Axis 3 and 4

Amplifier Interface Axis 3

Amplifier Interface Axis 4

Encoder Input Axis 3

Encoder Input Axis 4

Enable LEDs Axis 3 and 4

Amplifier Interface Axis 3

Amplifier Interface Axis 4

Encoder Input Axis 3

Encoder Input Axis 4

Enable LEDs Axis 3 and 4

Amplifier Interface Axis 3

Amplifier Interface Axis 4

Encoder Input Axis 3

Encoder Input Axis 4

Enable LEDs Axis 3 and 4

Amplifier Interface Axis 3

Amplifier Interface Axis 4

Encoder Input Axis 3

Encoder Input Axis 4
Controller and Drive Technology

**Nmark® GCL**
Width: 121.5 mm  
Height: 219 mm

**Nmark® SSaM**
Width: 63.7 mm  
Height: 199.0 mm

- **FireWire®**
- **Laser Output**
- **Encoder Input**
- **Encoder Output**
- **Motor Supply**
- **2-Axis Galvo Motor and Feedback**
- **Opto-Isolated I/O**
- **Laser Interface**
- **Analog I/O**
Nservo
Width: 87.6 mm
Height: 230.4 mm

- Analog I/O
- ESTOP and Extra Encoder Channel
- Eight Opto-Outputs
- Eight Opto-Inputs
- PSO and Brake
- Eight Opto-Outputs
- Eight Opto-Inputs
- PSO and Brake

Nservo – OEM
4 Axis or Less
Width: 284.5 mm
Height: 276.9 mm

- General Purpose 48 Bit I/O
- Optional Power Supply
- Encoder Limits and Motor Power
- FireWire®
Controller and Drive Technology

Npaq® and Epaq Rack Mount or Desktop Solutions in One Box Minimize Wiring

Npaq®
6 Axis or Less
Width: 436.7 mm
Height: 132.0 mm

- Laser Feedback (Optional)
- Power Switch/Circuit Breaker
- Resolver Inputs (Optional)
- Analog I/O (Optional)
- Emergency Stop (Optional)
- AC Power Input
- Motor Output
- Encoder Feedback
- Communication Channel Numbers
- FireWire®
- Ethernet (Optional)
- User I/O

Npaq® MR/Epaq MR
8 Axis or Less
Width: 436.7 mm
Height: 132.0 mm

- Power Switch
- FireWire®
- Joystick
- ESTOP
- Analog Connection
- I/O
- Encoder
- Motor
- 115 VAC or 220 VAC
**Ensemble® Epaq**

5 Axis or Less  
Width: 431.8 mm  
Height: 177.8 mm

- LCD Screen
- Directional Keypad
- ESTOP Button (Optional)
- Power Switch
- Axes 2 through 6 (Optional)
- AC Power Input
- Options
- Control Board
- Axis 1

**Ensemble® LAB**

4 Axis or Less  
Width: 370.2 mm  
Height: 98.4 mm

- Touch Screen Interface
- Numeric Keypad
- Directional Keypad
- Power Switch
- Jog Buttons
- Axes 1 through 4
- USB Port
- AC Power Input
- I/O
- Joystick
- USB
- ESTOP
- Ethernet
Standard Control Capabilities

Aerotech controllers offer the broadest array of programming interfaces and core motion capabilities of any automation system available today. Aerotech controllers have the programming flexibility and capability to meet the requirements of the most demanding motion applications of OEMs and end-users alike.

**Point-to-Point Motion**
Basic independent axis positioning with programmable accel/decel and feedrate.

**Acceleration Limiting**
Anticipate sharp corners and small radius arcs and automatically decelerate as needed.

**Coordinated Motion**
Linear and circular motions are supported in all languages.

**Arbitrary Path Generation (PVT)**
Specify discrete position, velocity and time and the controller will interpolate to create a smooth, contiguous path.

**Electronic Gearing**
Electronically control one axis as a simple ratio or as a complex function of another axis; fire I/O in real time during a move.

**On the Fly End-Point Modification**
Modify the endpoint during execution of the motion profile.

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

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

**Velocity Profiling**
Maintains a constant vector velocity along the programmed path.
Kinematics

Execute complex inverse kinematic equations within the flow of the trajectory generation.

Analog Power Control

Adjust the setting of an analog output in relationship to the vector speed of two axes to permit the automatic regulation of laser power or material dispensing processes.

Gantry Mode

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

Retrace

Retrace a path block by block.

Intra-Block Retrace

Retrace a path inside a block.

Fast Position Capture

Store positions based on the transition of a digital input, allowing close correlation of axis positions to external events.

Retrace

High-Speed Registration

High-speed registration to trigger motion is useful in packaging and labeling.

Velocity Blending

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

Seven Segment Acceleration

Specify the acceleration profile in seven segments, providing precise control over system motion.

Velocity Blending

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Standard Control Capabilities

Motor Control
All controllers operate brush, brushless or stepper motors in any combination.

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

Axis Calibration
Compensate for repeatable mechanical errors in a positioning system.

Sinusoidal Commutation
Brushless motors produce smoothest motion when sinusoidally commutated, eliminating the need for multiple transducers and reducing cabling.

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.

Quadrature Encoder
Use a standard A, B quadrature encoder, incremental or absolute.

Analog Feedback
For high resolution, short travel applications, linear drives accept analog inputs from analog sensors.

Resolver/Inductosyn
Programmable carrier frequencies make resolvers/inductosyns easy to integrate.
Laser Interferometer

Systems requiring ultra-high resolution and feedback stability use interferometer feedback.

Encoder

Systems requiring high resolution use a 1 Vpp encoder with Aerotech multiplier, up to 65,536 and 2 MHz input frequency.

Tachometer

For dual feedback systems use tach for velocity control and encoder for position control.

PIDFF

PID digital control loop with feedforward for velocity, acceleration and friction.

Safe Zones

Safe zones can be set up on multi-axis systems to protect against crashes.

Slice Move

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

Limits

Set up hard limits and soft limits for maximum safety and flexibility.

Spindle Control

Spindle commands use standard m-codes.

CAM Profiling

Electronically command one axis position as a function of another axis with a CAM table and fire I/O during the move.
Harmonic Cancellation

- Reduce position error on periodic trajectories
- Reject periodic disturbances
- Built-in setup wizards
- Adapts to magnitude and frequency of error source

Reduce Position Error

Continuously adapts and tracks sinusoids

Applications

- Machining
- Spindle Control
- Cogging Reduction
- EDM/ECM
- MEMS Sensor Testing
- R0 Wafer Inspection

10 Hz Command; ± 1 mm
Iterative Learning Control

- Repeating move sequences can be learned and optimized
- Reduce following error
- Increase dynamic accuracy
- Increase production rates

Applications

- Stencil Cutting
- Stent Cutting
- Sensor Testing
- Micromachining
Enhanced Throughput Module (ETM)

- Multi-axis feedforward capability
- Faster settling time
- Increase rate stability

Improved Settling Time

Applications

- Pick and Place Machines
- Semiconductor Inspection
- Genome Sequencing
Directional Gain Scheduling

- Decrease settle time
- Increase in-position stability

System automatically adjusts gain based on error motion during settling
**Advanced Control**

**EasyTune®/EasySetup**
- Automatically tune servo and piezo axes
- Hands-off! EasyTune requires no user input or controls knowledge
- Set a custom performance target – improves throughput and system stability

---

*Catalog Manager*

*Motor Phasing Calculator*
Reduce cross-axis position error during acceleration

Cross-Axis Feedforward

- Reduce position error on an axis due to acceleration of another axis
Reduce Vibration at the Work Point

Command Shaping

- Increase throughput
- Faster settle time at the work point
- No additional sensors required
- Reduced vibration in point-to-point moves
- Easy tuning

Applications

- Pick and Place Machines
- Semiconductor Inspection
- Genome Sequencing

Position error at work point to 30 mm step move
High Accuracy Firing Based on Actual Calibrated Encoder Counts

Array-Based Firing
- PSO fire points are defined in an array based on calibrated position
- Pulse train specified with absolute or incremental positions
- Variable pulse width
- Specify pulse lead, pulse and pulse tail for precise energy delivery

Windowing
- Output pulses are constrained inside a user-defined window with the first pulse relative to the edge of the window
- Excellent when the processing of a part requires the axes to move beyond the part for settling or direction reversal in applications such as flat-panel manufacturing or fuel-injector drilling

Fixed Distance Firing
- Single- or multiple-pulse output as a function of up to 3 axes’ position feedback
- Minimizes heat-affected zone in welding, cutting and drilling
- Outstanding for stent manufacturing, hermetic welding and drilling holes in turbine blades

Position Synchronized Output (PSO)
- Increase throughput
- Higher accuracy
- 1-, 2- or 3-axis PSO
- Configurable command pulse train

- Use to trigger
  - Laser firing
  - Camera capture
  - Data acquisition
  - Nondestructive test triggering
Gantry Control

- Both spars are programmed and commanded as a single axis
- Easy homing
- Marker offset for high accuracy
- Orthogonality correction

Gantry Modes

- Current Synchronization
- Position Synchronization

Gantry Configuration

- 2 Motors, 2 Encoders
- 2 Motors, 1 Encoder
- 1 Motor, 1 Encoder
Open architecture, PC-based robot controller for three-axis (X/Y/Z) Delta robots. Includes a pre-configured installation of Aerotech’s A3200 automation platform with robot specific programming extensions, NEMA 32 frame size motors, drives, and cables. Key system features include:

Delta Robot Control
- Industrial panel-mount PC with solid-state disk drive
- Teach mode with user defined number of points
- Synchronization with moving material
- Target position command queue of user defined depth
- Real-time simultaneous display of tool and work-point coordinates
- G code and AeroBasic™ motion command syntax
- Control up to 20 additional axes
- Optional IEC 61131-3 PLC interface with support for PLCopen and .NET
- Servomotor with absolute feedback device and brake
- Ndrive CP10 drives
- 5 meter long motor power and feedback cables
Directly Synchronize Scanhead and Servo Motion for Ultimate Flexibility in Marking Applications

Laser Marking—Nmark® CLS (Closed-Loop Scanner)

- Expand scanner field-of-view without sacrificing effective pixel resolution
- Mark long vectors with one continuous pass
- Draw large-scale graphics without stitching multiple exposures
- Mark on a tube or other irregularly shaped object without manually repositioning
- Single programming environment for both scanner and servo axes minimizes application complexity
- Eliminate angular errors
- Scanner programmed with standard RS-274 G code
- Laser firing based on real-time scanner position
**Nmark AGV-HP**
- Highest accuracy scanner available attains single-digit, micron-level accuracy over the field of view
- Optical feedback technology significantly improves thermal stability
- Industry-best resolution of >24 bits when used with Aerotech’s Nmark GCL controller
- Wide range of apertures and focal lengths

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- Highest accuracy scanner available attains single-digit, micron-level accuracy over the field of view
- Optical feedback technology significantly improves thermal stability
- Industry-best resolution of >24 bits when used with Aerotech’s Nmark GCL controller
- Wide range of apertures and focal lengths, and many choices of mirror surface treatments for a variety of laser wavelengths

**Nmark GCL**
- Closed-loop, two-axis servo drive for Aerotech’s AGV series scanners
- Infinite Field of View (IFOV) seamlessly combines AGV and servo motion to expand the scanner work area
- Full servo state control with “zero-tracking error” eliminates speed-related part distortion such as necking on circles and rounding of corners
- Position-based laser firing (PSO) with windowing maintains consistent spot spacing over a wide range of operating speeds

---

**High-Performance Galvanometer Scanners**

**Vector Applications**
- Cutting
- Welding
- Sealing
- Ablation
- Marking

**Graphic Applications**
- Bar Code
- Serialization
- Engraving
- Character Scribing
Friction Compensation

- Reduced settle time
- Reduced error at direction reversals

Advanced Friction Model

Friction Compensation Results

High speed, high accelerations and minimal position error achieved with feedforward additive force
Aerotech controllers support a multitude of industry-standard communication protocols to facilitate easy component networking, device connectivity and superior motion system performance.

<table>
<thead>
<tr>
<th>Networking Type</th>
<th>Plant</th>
<th>Fieldbus</th>
<th>Motion</th>
<th>Drive I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3200</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ensemble</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Soloist</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Summary**

- **Aerotech controllers** connect seamlessly to your existing corporate network or PC via these standard protocols.
- **Aerotech controllers** support a variety of fieldbus communication protocols to fit your application.
- Aerotech controllers use state-of-the-art communication standards for motion network communication to ensure a robust, high-performance system.
- Aerotech drives include a standard complement of on-board analog and digital I/O, with an option for an expanded I/O board.

*Coming Soon

Fieldbus I/O with Hilscher NetX technology

Corporate networking protocols allow remote control and monitoring of your motion system.

Fieldbus communication protocols provide extensive options for communicating with PLCs and other components in your system.

Aerotech's motion networking architectures are truly plug-and-play, making setup quick and easy.
**Aerotech’s HEX RC**

Aerotech’s HEX RC is a high-performance, 6-axis motion controller ideal for controlling robotic systems like hexapods. The HEX RC is 4U high, rack-mountable, and compatible with the Automation 3200 (A3200) motion platform. A high-performance processor provides the intense computing power needed to run up to 32 axes, perform complex, synchronized motion trajectories, manipulate I/O, and collect data at high speeds.

- 4U high, rack-mount, six-axis controller for brush, brushless, and stepper motors
- Ideal for controlling six-axis robotic systems like hexapods
- Real-time A3200 distributed control architecture allows synchronized motion on up to 32 axes
- FireWire® or ASCII command interface via TCP/IP
- Optional integrated encoder multipliers for high resolution positioning and reduced integration complexity
- Optional six-axis jog pendant
- Program in native RS-274 G-code, AeroBasic™ command set, C, C++/CLI, .NET, MATLAB®, LabVIEW®, or IEC 61131-3 (LD, FBD, ST) for the ultimate in programming flexibility
**Ensemble QL/QLe™**

The Ensemble QL/QLe™ panel-mount nanopositioning piezo drive family is designed for seamless use with the Ensemble family of drives and controllers. The QL/QLe connects to any Ensemble controller network enabling coordinated motion between piezo stages and servo axes at much higher rates than other controller or drive products. This power, versatility, and affordability make the Ensemble QL/QLe drives ideal for applications ranging from the most demanding fundamental scientific research to advanced OEM machine systems.

**Ensemble QDe™**

The Ensemble QDe™ is a high-performance desktop nanopositioning piezo drive designed for seamless use with the Ensemble family of drives and controllers. The QDe connects to any Ensemble controller network enabling coordinated motion between piezo stages and servo axes at much higher rates than other controller or drive products. This power and versatility make the Ensemble QDe ideal for single or multi-axis applications ranging from fundamental scientific research to advanced OEM machine systems.

**Ensemble QLAB™**

The Ensemble QLAB™ is a high-performance nanopositioning piezo stage controller for 1 to 4 axes of motion. The flexible controller platform allows user-configurable open-loop and closed-loop operation on a per axis basis. Simple software commands allow the user to switch between open-loop and closed-loop if an axis is configured for closed-loop mode.
**Controller Comparison Chart**

<table>
<thead>
<tr>
<th>Basic Functions</th>
<th>A3200</th>
<th>Ensemble</th>
<th>Soloist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multi-Axis Architecture</strong></td>
<td>Up to 32 axes coordinated</td>
<td>Up to 10 axes coordinated</td>
<td>Single axis</td>
</tr>
<tr>
<td><strong>Number of Tasks</strong></td>
<td>32</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td><strong>CNC Functionality/RS-274</strong></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Coordinated Motion</strong></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Point-to-Point Motion</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Cutter Compensation</strong></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multi-Block Look-Ahead</strong></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acceleration Limiting/Look-Ahead</strong></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gantry Mode</strong></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Velocity Blending</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Electronic Gearing</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Electronic Cam Profiling</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Arbitrary Path Generation</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Jog and Offset, Jog and Return</strong></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Velocity Profiling</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Retrace (Block by Block)</strong></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Axis Calibration</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>3D Error Mapping</strong></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sinusoidal Commutation</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Analog Power Control</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Servo, Stepper or DC Motor Controller</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Expanded IO Available</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Encoder Tuning</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Dual Loop Control</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>PLC (IEC 61131-3)</strong></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unsure about which controller is right for your application? Consult the chart to see which controller fits your needs.
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<thead>
<tr>
<th>Advanced Functions</th>
<th>A3200</th>
<th>Ensemble</th>
<th>Soloist</th>
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<tbody>
<tr>
<td>IDE</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>.NET, AeroBasic™</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Fast Position Capture</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>High-Speed Registration</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>On the Fly End-Point Modification</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Orthogonality Correction</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Parts Rotation</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intra-Block Retrace</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iterative Learning Control</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>PSO Yes, up to 3 axes</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Harmonic Cancellation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Direction Gain Scheduling</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Inertial Damping</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Friction Compensation</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear Drive Amplifiers</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Machine Retrofit Hardware Available</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Galvo Integration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seven Segment Acceleration Profile</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Slice Move</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corner Rounding</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordinate Transformations</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kinematics</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loop Transmission</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Advanced Diagnostics and Tuning</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Auto Focus</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>MATLAB®</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Force Control</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Soft Landing</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Piezo Nanopositioners</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>HexGen Hexapod</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCP-DELTA Delta Robot</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use the Best Controller for Your Application
• Wired and tested consoles
• Wired panels and 19-inch racks
• Integrated subsystem with PC, controls, drives, cables, power supply or transformer, line filtering, PLC motion, I/O and customer I/O
• CE/UL standards
• Comply with NFPA79 wiring standard

Nsys Complete Consoles
Complete consoles are available that integrate all of the electronics for your system, including the controller, drives and/or drive racks, I/O and monitor.
## Aerotech Machine Safety Standards

<table>
<thead>
<tr>
<th>Safety Level</th>
<th>Fault Detection</th>
<th>Loss of Safety Function Probability</th>
<th>Single Fault Covered</th>
<th>Double Fault Covered</th>
<th>Input ESTOP Signal</th>
<th>Supply Power to Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category B</td>
<td>None</td>
<td>Very High</td>
<td>No</td>
<td>No</td>
<td>No specific design</td>
<td>No specific design</td>
</tr>
<tr>
<td>Category 1</td>
<td>None</td>
<td>Very High</td>
<td>No</td>
<td>No</td>
<td>Simple mushroom switch</td>
<td>One relay</td>
</tr>
<tr>
<td>Category 2</td>
<td>Low</td>
<td>High</td>
<td>No</td>
<td>No</td>
<td>Simple mushroom switch</td>
<td>One positive guided relay with auxiliary contact for checking</td>
</tr>
<tr>
<td>Category 3</td>
<td>Medium</td>
<td>Medium</td>
<td>Yes</td>
<td>No</td>
<td>Dual circuit mushroom with fault detection</td>
<td>Two positive guided relays with cross checking</td>
</tr>
<tr>
<td>Category 4</td>
<td>High</td>
<td>Low</td>
<td>Yes</td>
<td>Yes</td>
<td>Dual circuit mushroom with independent fault detection</td>
<td>Two positive guided relays with cross checking</td>
</tr>
</tbody>
</table>
## Hardware Options

### A3200 Drives

<table>
<thead>
<tr>
<th>MP</th>
<th>CP</th>
<th>HPe</th>
<th>HLe</th>
<th>ML</th>
<th>Integrated Drive Racks</th>
<th>Nservo</th>
<th>Netep</th>
<th>Nmark™</th>
<th>Console</th>
<th>QL/QLe</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="A3200 Drive" /></td>
<td><img src="image" alt="A3200 Drive" /></td>
<td><img src="image" alt="A3200 Drive" /></td>
<td><img src="image" alt="A3200 Drive" /></td>
<td><img src="image" alt="A3200 Drive" /></td>
<td><img src="image" alt="Integrated Drive Rack" /></td>
<td><img src="image" alt="Nservo" /></td>
<td><img src="image" alt="Netep" /></td>
<td><img src="image" alt="Nmark™" /></td>
<td><img src="image" alt="Console" /></td>
<td><img src="image" alt="QL/QLe" /></td>
</tr>
</tbody>
</table>

- **Npaq®**, **Npaq MR**, or **HEX RC** drive chassis

### Ensemble Controls

- **Ensemble Epaq**, **Epaq MR**, **LAB**, **QLAB**, or **QDe** drive chassis and motion controller

### Soloist Controls

- **Soloist Controls**

### Axes

<table>
<thead>
<tr>
<th>Axes</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1 to 8</th>
<th>1 to 8</th>
<th>2 or 4</th>
<th>2 or 4</th>
<th>3</th>
<th>1 to 12</th>
</tr>
</thead>
</table>

### Output Type

- **PWM**
- **PWM**
- **PWM**
- **Linear**
- **Linear**
- **PWM and Linear**
- **PWM and Linear**
- **Three-Phase ±10 V**
- **Clock and Direction**
- **Clock and Direction**
- **N/A**

### Peak Output Current

- **10 A**
- **10-30 A**
- **10-150 A**
- **10-20 A**
- **10 A**
- **Npaq**: 10-30 A
- **Npaq MR**: 10 A
- **Hex RC**: 10 A
- **Epaq/Epaq MR**: 10 A
- **Epaq**: 10 A
- **Ensemble LAB**: 5 A
- **Ensemble QLAB**: 300 mA
- **Ensemble QDe**: 250 mA
- **N/A**
- **N/A**
- **N/A**
- **N/A**
- **N/A**

### DC Bus Voltage

- **10-80 VDC** (Output)
- **10-320 VDC**
- **10-320 VDC**
- **±40-80 VDC**
- **±40 VDC**
- **Npaq**: 10-320 VDC
- **Npaq MR**: 10-80 VDC
- **Hex RC**: 80 VDC
- **Epaq**: 24-90 VDC, ±10-40 VDC
- **Epaq MR**: 10-80 VDC
- **Epaq**: 10-40 VDC
- **Ensemble LAB**: ±24 VDC
- **Ensemble QLAB**: -30 to +150 V
- **Ensemble QDe**: -30 to +150 V
- **N/A**
- **N/A**
- **N/A**
- **N/A**
- **N/A**

### Standard I/O

- **1-AI**
- **6-DI/4-DO 1-AI/1-AO**
- **6-DI/4-DO 1-AI/1-AO**
- **6-DI/4-DO 1-AI/1-AO**
- **6-DI/4-DO 1-AI/1-AO**
- **Multiple Configurations Available**
- **1-AI per axis**
- **11-DI/8-DO 4-AI/2-AO**
- **16 Assignable IO**
- **N/A**
- **N/A**
- **N/A**

### Optional I/O

- **8-DI/8-DO 1-AI/1-AO**
- **16-DI/16-DO 1-AI/1-AO**
- **16-DI/16-DO 4-AI/4-AO**
- **16-DI/16-DO 4-AI/4-AO**
- **16-DI/16-DO 1-AI/1-AO**
- **Multiple Configurations Available**
- **Multiple Configurations Available**
- **Via Optional Ethernet Port**
- **N/A**
- **N/A**
- **N/A**

### I/O Spec

- **12-bit differential AI 16-bit single-ended AO**
- **16-bit differential AI 16-bit single-ended AO**
- **Npaq or HEX RC**: Four 16-bit differential AI Two 16-bit single-ended AO
- **Npaq MR**: Same as ML or MP per axis
- **Epaq or Epaq MR**: Same as ML or MP per axis
- **Ensemble QLAB**: 4 AI, 4 AO
- **Ensemble QDe**: 1 16-bit, 1 18-bit
- **Two 16-bit differential AI Two 16-bit single-ended AO**
- **N/A**
- **N/A**
- **N/A**

### Incremental Encoder

- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes

### Absolute Encoder

- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes

### Resolver/Inductosyn

- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes

### Capacitive Probes

- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes

### Laser Interferometer

- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes
- Yes

All units capable of sinusoidal commutation, dual-loop control and drive brushless, brush, or stepper motor.
The BA series amplifiers are Aerotech’s stand-alone PWM drive for three-phase AC brushless and single-phase DC brush motors. BL series amplifiers are highly reliable linear brushless servo amplifiers.

**BA PWM Amplifiers**
- Wide output power range from 10 A peak to 100 A peak at 320 VDC
- No transformer required; direct connection to AC line
- Capable of running brushless or single-phase DC brush motors
- Velocity, torque and dual-phase mode input command
- Accepts both encoder or tachometer feedback for velocity control
- Can be externally commutated
- UL, CE and CSA approval

**BL Linear Amplifier**
- Non-switching, high-performance linear operation for ultra-smooth control of brushless motors
- Totally modular design accepts 110 VAC or 220 VAC input power
- Ideal for air-bearing systems and noise-sensitive applications
Rotary Motors

- Ironless/cogless design for superior motion
- Iron-core motors for high force output
- Frameless torque motors for custom machines
- Ultra-precision positioning
- Low heat generation
- Vacuum compatible options
- NEMA 17, 23, 34, 42 and IEC 142

Full line of DC brush, brushless, servo and stepper motors to fit almost any situation. Brushless motors feature neodymium iron boron magnets for maximum torque and acceleration in a small package.
Frameless Rotary Motors

**Torque**

<table>
<thead>
<tr>
<th>Type</th>
<th>Frameless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Torque</td>
<td>0.20 - 29.09 N·m</td>
</tr>
<tr>
<td>Peak Torque</td>
<td>0.82 - 116.37 N·m</td>
</tr>
<tr>
<td>Rated Speed</td>
<td>200 - 8000 rpm</td>
</tr>
</tbody>
</table>

Five frameless designs for easy integration into OEM machines.

Slotless stator and high-pole-count rotor provide zero cogging for exceptional velocity control.

**Force**

<table>
<thead>
<tr>
<th>Type</th>
<th>Flat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Force</td>
<td>19 - 697 N</td>
</tr>
<tr>
<td>Peak Force</td>
<td>75 - 1507 N</td>
</tr>
</tbody>
</table>

Aerotech’s proprietary coil winding technology produces the highest force to volume ratios available.

Direct drive, noncontacting forcer coil eliminates backlash, windup and wear for a maintenance-free system.

**Force**

<table>
<thead>
<tr>
<th>Type</th>
<th>U Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Force</td>
<td>14 - 1063 N</td>
</tr>
<tr>
<td>Peak Force</td>
<td>56 - 4252 N</td>
</tr>
</tbody>
</table>

Linear servomotors are ideal for:

- Robotics
- Packaging
- Actuators
- Tables/Stages
- Assembly
- Fiber Optics/Photonics
- Alignment and Positioning
- Machine Tools
- Semiconductor Equipment
- Electronic Manufacturing

Advanced magnetic field synthesis and analysis yields highest motor output power per unit volume.
We customize for you

- Change Coil Winding
- Change Thermistor
- Cable Exit on Side
- Change Port Interface
- Longer or Shorter Track
- Add Hole for Sensor
- Longer Stack
- Smaller OD
- Different Winding
- Higher Strength Magnet
- Larger ID
- Change Coil Winding Length
- Longer or Shorter Track
- New Mounting Interface
- New Winding
- Different Flange
- Change Shaft
- Shorter Housing
- Higher Load Bearings
**Connectivity**
- Ethernet
- Fieldbus
- Wireless
- USB

**Custom Automation**
- Coordinate motion, PLC, robotics, vision, and communications with one automation control
- Galvo control
- Piezo control
- Integration with process control
- HMI integration

**Custom Software**
- Custom operator interfaces
- Custom applications
- Custom software libraries
- Program in nearly any language

**Vision Integration**
- Interface with standard cameras and machine vision systems
- Registration marks or fiducials can be located and used as a home or reference position
- Vision can be coordinated with servo motion for vision guided robotics

**Custom Control Algorithms**
- Create algorithms at the application, motion engine, firmware, or hardware layer
- Flexible control architecture
- Custom kinematics

**Custom Drives**
- Plug-in architecture speeds development of custom algorithms – for example, 2D bar code, interfaces to non-standard sensors, and signal outputs synchronized to servo sample time
- Packaging can be customized for specific form factor and space constraints
- Custom algorithms can be developed at the firmware layer

**Custom Motor Design**
- Custom motors optimized for your specific application at a minimal price
- Customized motor mechanical characteristics including torque/force, length, width, height
- Customized motor electrical characteristics including bus voltage, resistance, inductance, pole pitch, and current
- Custom motors for low-volume projects
- Completely new motor design

**Custom Integration**
- Interface with standard cameras and machine vision systems
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**Connectivity**
- Ethernet
- Fieldbus
- Wireless
- USB

**Custom Software**
- Custom operator interfaces
- Custom applications
- Custom software libraries
- Program in nearly any language

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- Custom motors for low-volume projects
- Completely new motor design

**We customize for you...**

**Hardware • Software • Firmware • Packaging • Motors • HMI • Electronics • I/O**
We implement with you...

Tuning • Parameters • Optimize Performance • HMI • Write Software

We will work with you onsite or at our facility to meet your machine specifications.

Aerotech personnel will:
- Perform parameter setup and system tuning
- Setup of the Advanced Controls Toolbox to achieve the highest performance possible
- Write motion programs in AeroBasic™
- Write software (.NET, C) by applying our libraries

Benefits include:
- Maximize machine performance
- Minimize machine development time
- Minimize cost
- Write PLC programs using Ladder, Function Block, or Structured Text
- Product customization
- Product application
- Write/configure HMIs
- Integration with process controller
## Available Accessories:

<table>
<thead>
<tr>
<th>Maple Operator Interface</th>
<th>Joystick Handwheel/Pendant</th>
<th>Transformers Power Supplies</th>
<th>Cables Automation</th>
<th>Server MXH Multiplier Boxes</th>
<th>Line Filters Panel PC</th>
</tr>
</thead>
</table>

![Image of Maple Operator Interface](image1.png)

![Image of Joystick Handwheel/Pendant](image2.png)

![Image of Transformers Power Supplies](image3.png)

![Image of Cables Automation](image4.png)

![Image of Server MXH Multiplier Boxes](image5.png)

![Image of Line Filters Panel PC](image6.png)
Aerotech controls and components have become the preferred solution for a variety of applications in a host of industries around the world.

Markets and Industries

- Laser Processing
- Semiconductor Processing
- Military and Aerospace
- Electronics Manufacturing
- Medical Device Manufacturing
- Test and Inspection
- Machine Tools
- Automotive
- Packaging
- University Research
- Industrial R&D
- Photovoltaic Manufacturing
Aerotech Customer Applications

**A3200**
- Stencil Cutting
- Wire Bonding
- Die Bonding
- Optics Polishing
- Stent Manufacturing
- e-Beam Welding
- EDM
- Drilling and Milling
- Grinding and Polishing
- Waterjet Cutting
- Fuel Injector Drilling
- Fuel Cell Manufacturing
- Crystallography
- Target Tracking
- Beam Steering
- Pipe Thread Measurement

**A3200 or Ensemble**
- Dispensing (Printed Electronics, Material Dispensing)
- PCB Assembly (Pick and Place of SMT, Through-Hole)
- VIA Drilling
- Wafer Scribing and Singulation (Dicing)
- Die Bonding
- Resistor Trimming
- AOI/X-Ray Inspection
- Chip Testing
- Chip Packaging
- Crystallography
- Flat Panel
- Semiconductor Testing
- Semiconductor Manufacturing
- Photovoltaic Cell Manufacturing
- DNA Analysis
- Image Duplication
- Holographic Writing
- Sensor Testing
- Sensor Manufacturing

**Ensemble**
- Packaging Machines (Multi-Axis Applications)
- Web Applications
- Printing Applications
- Rollover Unit Testing
- IMU Testing
- ECM
- Marking
- Vertical Form, Fill, and Seal

**Soloist**
- EDM & ECM
- Packaging Machines (Case Erectors, Labeling Machines, Augers)
- Printing
- Gyro Testing
- Accelerometer Testing
- Optical Polishing (Spindle Axis)
- Beam Steering
Stent and Medical Device Manufacturing

Aerotech’s experience in market-specific solutions provides an edge in processes involving photonics, semiconductor processing, medical device manufacturing and laser processing. With a number of specially developed motion platforms for these industries, Aerotech provides a one-stop-shop for your motion requirements.

Controllers to Use:
• A3200

Solar Panel Scribing

Extensive application experience and a broad array of motion products make Aerotech the perfect partner for your photovoltaic (solar cell) manufacturing or testing platform. Our worldwide operation has engineered and manufactured a multitude of motion platforms for solar cell manufacturing and inspection. These platforms range from small format systems for R&D to full-size production panel processing systems.

Controllers to Use:
• A3200
• Ensemble

Aerotech’s highly successful VascuLathe® and LaserTurn® platforms deliver maximum productivity in a compact, easy to maintain package with the lowest cost of ownership in the industry. With the A3200’s PSO functionality, the throughput possible with the LaserTurn® and VascuLathe® series is unmatched.

• Laser Cutting
• Welding
• Wafer Dicing
• Solar Panel Scribing
• Fuel Injector Drilling
• Turbine Blade Inspection
Packaging
Line following applications including:
- Labeling, cut-to-length, fly cutting, lane diversion, rotary knife and many others.

Basic features for line following:
- Auxiliary encoder input for measuring line speed
- High-speed registration for measuring line position
- The relationship between line speed/position can be an arbitrary function or simply 1-to-1

Controllers to Use:
- Soloist
- Ensemble
- A3200

High Accuracy, Multi-Axis Inspection Systems

The A3200 controller is uniquely suited to complex inspection applications like turbine blade inspection that requires 5 axes or more of coordinated motion integrated with a sensor or camera.

Controllers to Use:
- A3200 with linear drives
Optical Mounts and Gimbals

• Directing optics, lasers or antennas
• LOS target tracking
• Precision pointing

Controllers to Use:
• A3200
• Ensemble

Fuel Cell Manufacturing Operations

• Laser machining the membranes (also referred to as MEAs)
• Welding the plates/membranes together
• Stacking the membranes into a cell
• Inspection of the MEAs, plates and cells

Controllers to Use:
• A3200

• Gyro Testing
• Reticle Inspection
• Lithography
• Wafer Defect Detection
• Thin Film Measurement
• Pick and Place
With 46 years in the business of designing and building motion systems, Aerotech has the experience and knowledge to understand the challenges and solutions of industrial and laboratory processes.
Aerotech has manufactured advanced motion controllers since 1970. From the industry workhorse PCI cards to state-of-the-art software-based control coupled with intelligent networked drives, the science of motion control has been our business for decades.
Aerotech offers comprehensive worldwide training and customer service at customer facilities or at one of our Aerotech training centers.

**Training Program:**
- Standard and customized courses
- Hands-on training with Aerotech controllers
- Interactive training with experienced instructors
- Comfortable, spacious facilities
- Online training modules
- Online FAQs
- At customer site or at Aerotech

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

**Engineering Support**
Aerotech provides complete engineering support for our products, including onsite 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.

**Join.Me.**
Aerotech can remotely support your startup, commissioning and debugging of systems over the internet.
Aerotech is an ISO 9001 Registered Company

Since 1995, Aerotech’s quality system has been certified to the ISO 9001 standard. The ISO 9001 standard encompasses the Aerotech organization through manufacturing.

As part of our commitment to the ISO standard, we formally survey our customers on a monthly basis which provides valuable feedback to continually improve our products and processes.
Aerotech at a Glance

**High-Volume Manufacturing**

Over 100,000 axes installed worldwide

**Worldwide Service and Support**

Worldwide startup service and on-site training

Fully equipped on-site training facilities

**Technically Superior Components**

Highest performance brushless linear and rotary motors

ADRT rotary stages

ALS1000 linear motor stage

A3200 Soloist®

Award-winning Automation 3200 1-32 axis motion, vision, PLC, robotics and I/O platform

Ensemble®
High Performance Sub-Assemblies

XYAB subsystem for high dynamic accuracy positioning in laser drilling and micromachining applications

HexGen high-load, ultra-precision hexapod provides unmatched performance

Highest throughput linear motor Cartesian gantry systems

Best-in-Class Subsystems

Highly integrated motion subsystems with machine frame, display and packaged electronics

Custom-engineered, vacuum and cleanroom compatible systems

RCP-Delta robot capable of 15g’s of acceleration and up to 200 pick and place operations per minute

Comprehensive Technical Support Services

Custom software application support

3D models to facilitate faster and more accurate system layout

Advanced analytical techniques for optimization of system geometry