Automation 3200
Software-Based 32-Axis Motion, Vision, PLC, Robotics, and I/O Platform

Complete motion capabilities include: point-to-point; linear, circular, helical, and spherical interpolation; velocity profiling; electronic gearing; on-the-fly trajectory modification; high speed I/O; camming

1 to 32 axes of scalable, synchronized motion

Utilizes the power of the PC to eliminate the motion control card

Uses commercially available IEEE-1394’s (FireWire®) determinism for communications between drives and controller

Programmable in native RS-274 G-code, AeroBasic™ command set, C, C++/CLI, .NET, MATLAB®, or LabVIEW® for flexibility

20 kHz servo update rate for 1 to 32 axes provides consistent performance regardless of axis count

Digital current loops for improved control and stability

Integrated high-speed Position Synchronized Output (PSO) for laser firing or position latching

Integrated I/O

Kinematics task for robot control

Fiberoptic interface expandable up to 1000 meters

High Performance, 32-Axis Motion, Vision, Robotics, and I/O Platform

Aerotech’s ground-breaking, motion, vision, robotics, and I/O platform, the Automation 3200, is used in many applications in semi, data storage, medical laser processing, automotive, and machine tool industries. The system features a high-performance, software-only controller (Motion Composer) that offers 32 axes of synchronized motion control. It is the successor to Aerotech’s performance-leading and widely utilized UNIDEX 500 and 600 PC-based motion controllers. Motion Composer retains the best features of these previous controllers and combines them with an advanced, high-performance distributed control architecture to produce a truly state-of-the-art motion, vision, robotics, and I/O platform.

The Digital Automation Platform: Automation 3200

The Automation 3200 digital automation platform represents a revolutionary advancement over traditional PC-bus-based motion controllers. The A3200 is software-based (no PC slots required) and marries a robust, high performance motion engine with vision, robotics, and I/O in one unified programming environment. The A3200 utilizes the industry standard super high performance FireWire® (IEEE-1394) network to provide from 1 to 32 axes of synchronized control with no degradation in performance as the axis count increases.
Automation 3200 DESCRIPTION

The integration of multiple common automation tools into a single platform provides users the ability to integrate, develop, and maintain the system faster, with lower cost than ever before. For instance, coupling a vision module with the motion system that coordinates a cutting process (laser, drill, mill, etc.) provides the ability to identify the workpiece and its position, and to adjust the position and signal to the cutter all within one system. This integration dramatically reduces wiring and the necessary components, which not only lowers integration and setup cost but also increases reliability.

No Degradation of Performance as Axis Count Increases

The Automation 3200 addresses a major shortcoming of today’s multi-axis controllers: as axes are added, performance markedly degrades as either the servo update time or program execution time increases. The Automation 3200 utilizes a distributed control architecture that enables it to maintain performance independent of the number of axes being controlled. It accomplishes this by avoiding the processing bottleneck caused by today’s common single processor control architecture. Position, velocity, and current loop closure are handled by Aerotech’s Intelligent Network Drive (Ndrive). Trajectory generation is done on the PC using a real-time operating system that runs with higher priority than Windows®. The PC executes programs and sends the position commands to the Ndrive via the IEEE-1394 (FireWire®) high-speed serial bus.

Greatly Simplified System Wiring

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

The Advantages of FireWire™ (IEEE-1394)

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

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

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

- **Deterministic**
  Complex motion such as contouring requires that all axes receive their data at exactly the same interval of time each time.

- **Capable of greater than 100 Mbps**
  A faster network reduces the latency between transmitting and receiving data. Also, this allows the user to view real-time data on the PC.

- **Standard on PCs**
  As the Automation 3200 does not require a motion card, having the network standard on PCs eliminates the cost of additional hardware.

- **Supported by Windows® operating systems**
  Windows® support ensures that the software will work on the PC with the network.

- **Have continued R&D effort by the chip manufacturers**
  A strong R&D effort by manufacturers allows the performance to increase and cost of the chips to decrease.

- **Tree topology**
  Unlike a ring topology, a tree topology does not require a link back to the originating PC, which reduces the cabling effort.

- **Peer-to-peer transmissions**
  Peer-to-peer transmissions allow the transfer of data between two drives without going through the root node. This allows quick transmission of encoder or I/O or any other type of information between drives.

The following table shows a comparison between the different networks. Based on this information, the IEEE-1394 network was chosen by Aerotech.
## Automation 3200 SPECIFICATIONS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>FireWire® (IEEE-1394)</th>
<th>SynqNet™</th>
<th>Ethernet</th>
<th>USB</th>
<th>SERCOS</th>
<th>CAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deterministic</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Data Rate</td>
<td>3.2 Gbps</td>
<td>200 Mbps</td>
<td>1 Gbps</td>
<td>480 Mbps</td>
<td>16 Mbps</td>
<td>1 Mbps</td>
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<tr>
<td>Standard on PCs</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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<td>Windows Support</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<td>Self ID</td>
<td>Yes</td>
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<td>Topology</td>
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<td>Ring</td>
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<td>Tree</td>
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<tr>
<td>Peer-to-Peer</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Driver Type Compatibility
- Brushless (linear or rotary) servo with on-board commutation
- DC brush servo
- Stepper

Position Feedback
- 5 V TTL quadrature encoders; max 40 MHz input
- 1 Vp-p sine wave encoders; max 250 kHz input; requires MXH, MXR, MXU multiplier
- Resolver, Inductosyn®
- Absolute encoder

Position Modes
- Absolute, incremental, dynamic trajectory correction

Motion Types
- Independent Motions: Point-to-point incremental; target position or velocity; velocity profiles; time based; free run
- Coordinated Motions: RS-274 standard G-code motion including linear, circular, helical and spherical interpolation, cutter compensation, normalcy, parts rotation, mirroring, path retrace, polar transformations and cylindrical transformations, scaling
- Electronic Gearing: Electronic master/slave gearing, cam profiling with cubic splining
- Advanced Features: High-speed registration, multi-dimensional error mapping and orthogonality correction, autotuning, backlash compensation, gantry algorithms

Range Limits
- Position: ±2⁰²⁴ cnt
- Velocity: 8 x 10⁵ cnt/second

Acceleration Profiles
- Linear and modified sine

Programmable Multitasking
- 4 tasks standard; 32 tasks available with Professional Edition

Programming
- Native G-code programming with AeroBasic extensions, .NET, C#, C, LabVIEW®, MATLAB®

Advanced Functionality
- Three-dimensional Position Synchronized Output, kinematics, Dynamic Controls Toolbox, Enhanced Throughput Module (ETM), Galvo API, Motion Designer

Minimum PC Requirements
- The Automation 3200 platform works with most modern Windows/Intel-based desktop PCs. Please refer to the Aerotech website for complete specifications.

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**SynqNet™** is a registered trademark of Motion Engineering.

**FireWire®** is a registered trademark of Apple Computer.
## Automation 3200 Ordering Information

<table>
<thead>
<tr>
<th>Software</th>
<th>License</th>
<th>Number of Axes</th>
<th>Controller Options</th>
<th>Motion Composer (MX) Options</th>
<th>FireWire Cable</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A3200-IA</td>
<td>-MACHINE</td>
<td>-2 AXES</td>
<td>-PROFINET</td>
<td>-MOTION SIMULATOR</td>
<td>-NCONNECT-900-66</td>
<td>-MAINTENANCE-y-mm</td>
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<tr>
<td></td>
<td>-MACHINE UPGRADE</td>
<td>-4 AXES</td>
<td>-ETHERCAT</td>
<td>-MOTION DESIGNER</td>
<td>-NCONNECT-1800-66</td>
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<td></td>
<td>-LICENSE EXTENSION</td>
<td>-6 AXES</td>
<td>-FIVE AXIS</td>
<td>-CNC OPERATOR INTERFACE</td>
<td>-NCONNECT-3300-66</td>
<td></td>
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<td></td>
<td>-MACHINE MIGRATION</td>
<td>-8 AXES</td>
<td>-CONTROUING</td>
<td>-LABVIEW</td>
<td>-NCONNECT-4500-66</td>
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<td></td>
<td>-MACHINE ADDITION</td>
<td>-10 AXES</td>
<td>-FIBER OPTIC</td>
<td>-MATLAB</td>
<td>-NO CABLE</td>
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<td></td>
<td>-MEDIA ONLY</td>
<td>-12 AXES</td>
<td>-DYNAMIC CONTROLS TOOLBOX</td>
<td>-REMOTE</td>
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<td></td>
<td>-REFERENCE</td>
<td>-14 AXES</td>
<td>-ENHANCED THROUGHPUT MODULE</td>
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<td>-16 AXES</td>
<td>-ENHANCED TRACKING CONTROL</td>
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<td>-32 AXES</td>
<td>-CNC</td>
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<td>-MC PROFESSIONAL</td>
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<td></td>
<td></td>
<td></td>
<td>-VERSION</td>
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</tr>
</tbody>
</table>

### Automation 3200 Software

**A3200:**
Full installation of Automation 3200 controller and selected software components on a new system. Full part number includes options listed below. Pricing is summation of selected products. Maintenance (software update) included in price for one year from date of purchase.

A3200 is intended for deployment on desktop or industrial PCs. See website for PC specifications.

The CNC-OI option must be used for applications that require a native language user interface.

**-IA:** INTEGRATED AUTOMATION STANDARD
Includes the Integrated Development Environment, Parameter Editor, Tuning Scope, System Diagnostics, and System Maintenance.

Includes the following software options:
## A3200 ORDERING INFORMATION

### License

**-MACHINE**
- Provides the ability to:
  - Write, compile, execute, debug programs in AeroBasic or G-code
  - Full access to .NET 2.0, C
  - Access full diagnostics, fault, and status information
  - Access and set I/O, registers, and variables
  - Collect, analyze, and save data
  - View files from machine for analysis and record keeping
  - Connect PC to machine directly with FireWire card
  - Connect PC to machine remotely through Ethernet TCP/IP
  - Upgrades can be installed (firmware or controller) using Loader
  - Two axes of software motion engine
  - Simulate trajectory on PC
  - Installs Intime on the PC

**-MACHINE UPGRADE**
- Use to change the AXES, CONTROLLER, or MC options on an existing Machine License.
- Requires the current License ID from Customer. License ID should be entered in the extended attributes. Do not use to extend Maintenance. Price is based on the new options added.

**-LICENSE EXTENSION**
- Extends the maintenance period on an existing license. Can be purchased in yearly increments.

**-MACHINE MIGRATION**
- Use this license to migrate a MACHINE license prior to 2.53 to 2.53 or later. Also used to create installation keys for versions older than 2.53.

**-MACHINE ADDITION**
- Use this to increase the number of licenses associated with an existing Key.

**-MEDIA ONLY**
- License ID distributed on the specified media.

**-REFERENCE**
- No software provided.

### Axes

**-2 AXES**
- Software only motion, robotics, and I/O controller; provides 2 axes coordinated motion and 4.5 m FireWire® cable

**-4 AXES**
- Software only motion, robotics, and I/O controller; provides 4 axes coordinated motion and 4.5 m FireWire® cable

**-6 AXES**
- Software only motion, robotics, and I/O controller; provides 6 axes coordinated motion and 4.5 m FireWire® cable

**-8 AXES**
- Software only motion, robotics, and I/O controller; provides 8 axes coordinated motion and 4.5 m FireWire® cable

**-10 AXES**
- Software only motion, robotics, and I/O controller; provides 10 axes coordinated motion and 4.5 m FireWire® cable

**-12 AXES**
- Software only motion, robotics, and I/O controller; provides 12 axes coordinated motion and 4.5 m FireWire® cable

**-14 AXES**
- Software only motion, robotics, and I/O controller; provides 14 axes coordinated motion and 4.5 m FireWire® cable

**-16 AXES**
- Software only motion, robotics, and I/O controller; provides 16 axes coordinated motion and 4.5 m FireWire® cable

**-32 AXES**
- Software only motion, robotics, and I/O controller; provides 32 axes coordinated motion and 4.5 m FireWire® cable

*Note: Old part number – NMotion SMC-nn*

### Controller Options

**-PROFINET**
- Provides PROFINET interface to fieldbus I/O directly into the realtime controller.

**-ETHERCAT**
- Provides EtherCAT interface to fieldbus I/O directly into the realtime controller.

**-FIVE AXIS CONTOURING**
- More than 4 axes of coordinated motion with a single motion command.
  - NOTE: Old part number - CNC-5

**-FIBER OPTIC**
- Fiber optic power scanning and virtual pivot point utilities
  - NOTE: Old part number - Nfiber

**-DYNAMIC CONTROLS TOOLBOX**
- Includes Harmonic Cancellation and Gain Scaling

**-ENHANCED THROUGHPUT MODULE**
- Includes setup and monitoring screens of the ETM module. Included in the price of the hardware modules sold separately.

**-ENHANCED TRACKING CONTROL**
- Enhanced tracking control for reduced dynamic following error and settling times
  - Includes all G and M code functionality as well as normalcy, cutter compensation, tool tables, polar/cylindrical coordinates, fixture offsets, inverse feedrate, spindles, reverse
circular interpolation, delete block mode, optional stop, MPF, part scaling, retrace, and rotations. This module is automatically included when ordering the CNC OPERATOR INTERFACE option.

**MC PROFESSIONAL**

Includes 31 user tasks that run programs, 1 dedicated library task, and 16 PC Modbus connections.

**VERSION**

X.XX = CURRENT will ship the most current release at the time of shipment. Previous release of A3200, where X.XX is the previous release number, can be selected. Releases prior to 2.53 should be ordered using US PRICELIST 08 09 REV.02 16 2009.XLS.

**Motion Composer (MC) Options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOTION SIMULATOR</strong></td>
<td>The Motion Simulator is a Man Machine Interface for simulating 1-3 axes of motion. Users can manually simulate motion with our advanced GUI and program simulation functions. With the included Motion Designer, rapid motion prototyping and learning simulation tools provide the ability to create, import, run, and evaluate motion profiles (trajectories). Analog inputs can be used for position or velocity tracking signals so customers may slave axes to their motion profiles with no programming. Infinite motion scope data collection, harmonic disturbance cancellation, and other advanced motion tools let users simulate their dynamic environments with little programming experience.</td>
</tr>
<tr>
<td><strong>MOTION DESIGNER</strong></td>
<td>The Motion Designer is an add-on software component that provides the ability to create, import, run, and evaluate motion profiles (trajectories). NOTE: Old part number - A3200-MD</td>
</tr>
<tr>
<td><strong>CNC OPERATOR INTERFACE</strong></td>
<td>Man-machine interface CNC software for Windows 7/8/8.1. This includes the CNC option. Includes user manuals, technical manuals, and cable drawings for all related equipment. NOTE: Old Part Number - Nview MMI</td>
</tr>
<tr>
<td><strong>LABVIEW</strong></td>
<td>Includes LABVIEW® 2010 VI samples</td>
</tr>
<tr>
<td><strong>MATLAB</strong></td>
<td>Includes MATLAB® library for motion, parameters, and data collection</td>
</tr>
<tr>
<td><strong>REMOTE</strong></td>
<td>Optional feature of the MACHINE license that provides full access to the controller from a separate PC over Ethernet</td>
</tr>
</tbody>
</table>

**FireWire Cable**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCONNECT-900-66</td>
<td>FireWire cable 900 mm (3 ft), 6P to 6P</td>
</tr>
<tr>
<td>NCONNECT-1800-66</td>
<td>FireWire cable 1.8 meter (6 ft), 6P to 6P</td>
</tr>
<tr>
<td>NCONNECT-3300-66</td>
<td>FireWire cable 3.3 meter (9.8 ft), 6P to 6P</td>
</tr>
<tr>
<td>NCONNECT-4500-66</td>
<td>FireWire cable 4.5 meter (15 ft), 6P to 6P</td>
</tr>
<tr>
<td>NO CABLE</td>
<td>No FireWire cable</td>
</tr>
</tbody>
</table>

**Maintenance**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAINTENANCE-y-mm</td>
<td>First year of maintenance is included with the initial purchase. Additional years can be purchased.</td>
</tr>
</tbody>
</table>

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