

OEM WAFER HANDLING SOLUTIONS

ADVANCED CONTROL HARDWARE AND
SOFTWARE FOR BETTER PERFORMANCE
AND RELIABILITY IN WAFER HANDLING

A WHOLE NEW LEVEL OF PERFORMANCE IN WAFER HANDLING HARDWARE AND SOFTWARE.



CHALLENGES

Semiconductor equipment OEMs are burdened by equipment front-end module (EFEM) designs that limit tool productivity. Lacking pre-integrated components, designs are stitched together with complex and costly custom software—that ultimately limits EFEM capabilities. Unnecessary design complexity reduces EFEM reliability and cost-effectivity.

These OEMs are also burdened with the complexities of new wafer-handling robot integration and related tool customization. World-class throughput, capabilities, maintainability and reliability are required. Development schedules and costs are serious challenges.

SOLUTION

BX-300™ controller and Semiconductor Toolkit™ provide a superior wafer handling solution.

BX-300™ Controller

High performance wafer handling solutions providing:

- Fully pre-integrated OEM robot and aligner controller
- Equipment front-end module (EFEM) and wafer-handling controller

Semiconductor Toolkit™

Software tools that dramatically simplify and speed integration of atmospheric and vacuum robots into tool design as well as EFEM and wafer handlers.

Key features include:

- Host command interpretation for transparent, drop-in system compatibility
- Advanced path planning to maximize throughput, and smooth wafer handling
- Autocalibration® technology to fully automate robot teaching, and ensure precise wafer placement
- Dynamic Wafer Calibration™ for on-the-fly detection and correction of wafer centering

BX-300™ CONTROLLER

COMPACT POWERHOUSE

The BX-300™ controller with Semiconductor Toolkit™ accelerates development of robust wafer-handling solutions—including complete equipment front-ends modules (EFEMs). Optionally available integration services can guarantee success in time-bound or difficult projects.

In the BX-300™ with Toolkit™, needed control elements—motion, I/O, communications, and advanced performance and reliability enhancing tools—have been combined in a single hardware and software platform that greatly simplifies, and reduces the cost of tool development.

In one compact package, the BX-300™ controller combines exceptionally high-performance motion control with six built-in servo drives, fast internal I/O, and Ethernet networking.

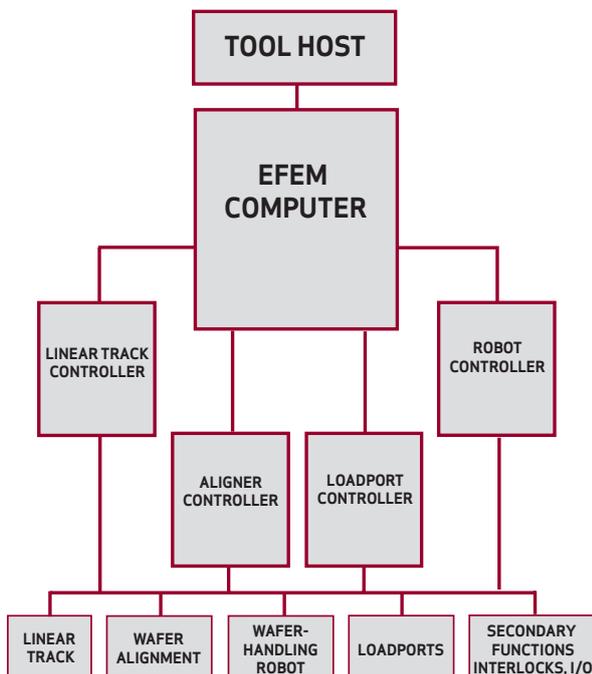
This single part number controller replaces what are commonly multiple interconnected modules. Space requirements are reduced, wiring is simplified, and reliability enhanced.

BX-300™ with Toolkit™ enable you to deliver the most productive, technologically advanced solutions to your customers' wafer-handling requirements.

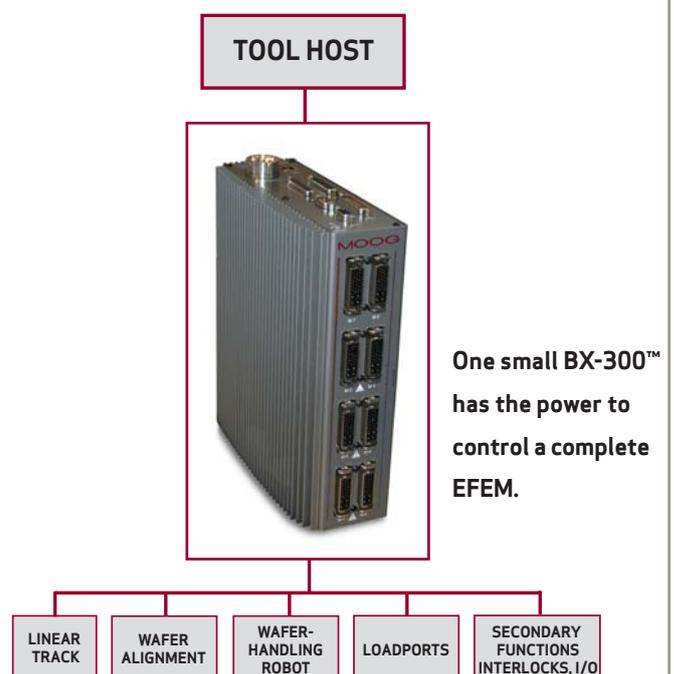
INTEGRATED CONTROL

- Processing power to do it all
- 8 axes of coordinated motion control
- 6 built-in servo drives
- 46 points of fast I/O
- Ethernet networking
- Comprehensive configurable software integration environment eliminates coding, and supports:
 - Host command interpretation
 - Advanced path planning
 - Autocalibration® technology
 - Dynamic Wafer Calibration™

TRADITIONAL METHOD



THE BX-300™ SOLUTION



SEMICONDUCTOR TOOLKIT™

CONFIGURATION - instead of writing new software code

Moog's Semiconductor Toolkit™ is a unique and powerful configurable software environment for EFEM and wafer handling integration and control. Its foremost virtue is that it eliminates the need for costly and time consuming software programming.

High-performance wafer handling solutions are implemented by simply configuring BX-300™ and/or Toolkit™ capabilities. Integration is fast, and robust. Wafer handler maintenance is eased, reliability improved, and downtime reduced.

In addition, Toolkit™ enables four especially unique and valuable capabilities: Host command interpretation, advanced path planning, Autocalibration® technology, and Dynamic Wafer Calibration™.

HOST COMMAND INTERPRETATION

Semiconductor Toolkit's agile command interpretation and emulation capabilities make robot and other EFEM hardware changes completely transparent to the host. Toolkit™ seamlessly interprets and emulates the host command protocol.

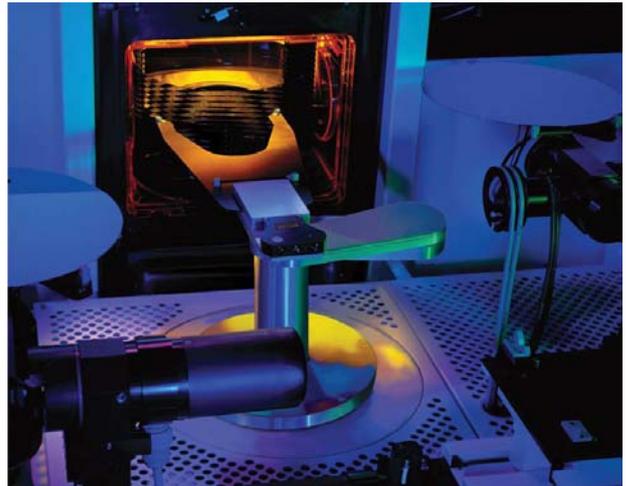
Previously closed system architectures are opened up. It is practical to host connect one brand of robot via another brand's command protocol. This capability significantly eases a change of robot vendors, and support of multiple vendors' robots—to meet your business needs, or customers' demands.

ADVANCED PATH PLANNING

Wafer path planning is intended to extract maximum system throughput by moving wafers along the shortest possible paths—safely.

Moog's Semiconductor Toolkit™ implements an advanced, patented, path planning system that substantially improves on prior approaches. Wafers are transferred faster, smoother, and with significantly reduced risk of wafer slippage or damage.

Toolkit's advanced path planning employs a complex numerical method for calculating a path of wafer travel that controls wafer acceleration and jerk, and delivers the maximum safe speed of wafer movement from a first point to a second point. Wafer throughput is improved—risk of damage reduced.



Applications* CMP CVD Etch Ion implant Dry strip PVD Wet bench	Host Protocols* Asyst Brooks Hine isel Robotik PRI Customer unique
Robots* Asyst Brooks Equipe Hine isel Robotik PRI Yaskawa Custom	Host Protocols* Aligners Load points PDOs Process chambers Vacuum load locks Wafer cassettes

**To date (and not limited to)*

	All tools needed to set up a wafer-handling application, and verify its correct setup and configuration. User is guided through simple parameter-based configuration.
	Tools to set up, maintain, operate, and debug robots. Contains tools to manually operate robot. "Health checks" run robots through self-diagnostics routines.
	Setup, operation, and diagnostic panels for the system's stations. Contains common stations such as aligner, load port, wafer cassette, and process module.
	Tools to configure, operate, maintain, and diagnose system calibration using Autocalibration technology. Provides tools to update and verify calibration.
	Tools to configure wafer mapping, and perform qualitative testing of mapping quality. Mapping algorithms support a variety of mapping sensors.
	Enables configuration of the BX-300's command emulator for acceptance of the host's existing command set. Supports sequences. Also has host simulation tool.
	Logs selected data: I/O data, axis information, messages, alarms, events. Supports tracking historical data for diagnostic, statistical, or process analysis.

AUTOCALIBRATION® TECHNOLOGY

The Semiconductor Toolkit™ facilitates implementation of Moog's proven, and unparalleled, Autocalibration technology.

Autocalibration technology improves semiconductor fab equipment productivity by automating critical robot calibration processes that are conventionally performed by technicians using time-consuming and subjective manual methods. Calibration that previously required hours is decreased to minutes—reducing costly production downtime. Subjectivity is eliminated, resulting in highly repeatable calibration and improved tool reliability.

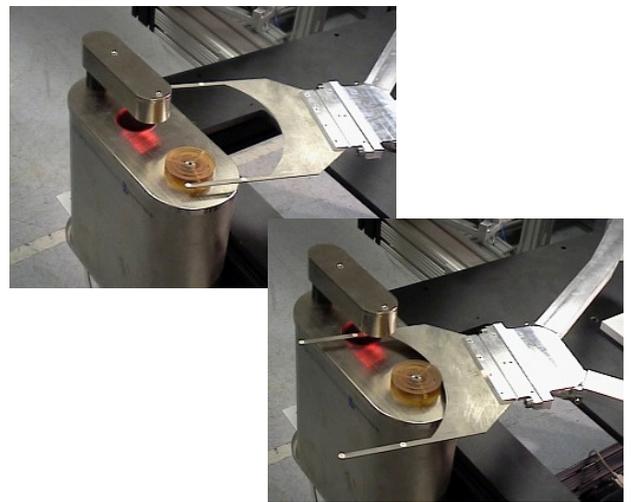
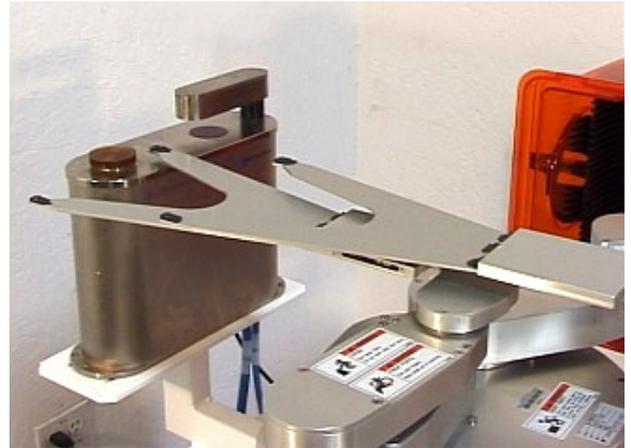
Autocalibration technology applies a mix of sensing techniques—including touch—to support diverse wafer station designs, in atmospheric and vacuum environments. It has been implemented with a broad spectrum of wafer-handling robots.

DYNAMIC WAFER CALIBRATION™

The precision calibration capabilities of Autocalibration technology enable Dynamic Wafer Calibration (DWC)—on-the-fly wafer center calculation and correction.

Suitably located optical sensors, precisely calibrated with Autocalibration technology, provide the calibrated location of the center of the end effector. Subsequent wafer passage through those optical sensors paths are processed by the DWC algorithm, which calculates the wafer center relative to the end effector center, and then seamlessly directs position correction before the wafer is placed.

Dynamic wafer calibration ensures correct wafer centering—without the throughput penalty of conventional wafer aligner use for this purpose. Autocalibration technology makes it precise and reliable.



	Teaching <small>(tech eyeballs position)</small>	Self-Teaching <small>(fixtures help technician)</small>	Autocalibration® Technology <small>(full automation of calibration)</small>
Ease	difficult	less difficult	push button
Skill Required	high	high	low
Contamination	high risk	high risk	low risk
Tools & Fixtures	yes	yes	no
Repeatability	variable	less variable	excellent
Time Required	hours	hours	minutes

In one critical Tier 1 evaluation, Autocalibration technology demonstrated repeatability of less than 50 microns standard deviation for each axis of motion – that's about the width of a human hair

Performance Monitoring & Diagnostics

The application of in situ tools to automate robot calibration and gather meaningful performance statistics enables improved wafer handler reliability and tool productivity.

BX-300 controller software monitors robot mechanism performance—indicating in advance when maintenance should be scheduled.

Extensive built-in diagnostics reduce the skill level required to diagnose faults. And e-Diagnostics enable remote monitoring, troubleshooting and data logging via the network connection.



WAFER HANDLING SOLUTIONS SPECIFICATIONS BX-300™ CONTROLLER

CONTROLLER HARDWARE

- Powerful 64-bit RISC processor manages all motion, sequencing, and I/O logic control
- Proven, multitasking, motion-control RTOS
- Substantial firmware-resident error handling provides increased state information and safety
- 8 coordinated motion control axes
- 6 built-in servo amplifiers—incorporate drive power interrupt and E-stop circuits; 24 to 160 VDC, 10A continuous; drive brushed, brushless, linear motors
- Built-in 100 Mbit/s Ethernet networking—supports host connection, multi-controller network, distributed I/O
- 46 points of fast digital I/O (32 inputs, 14 outputs)
- Fully connectorized to eliminate costly point-to-point wiring
- Drive Power: 24 to 120 VAC, 1ph/3ph, 50 or 60 Hz, 1600 W continuous
- Control Power: 24 VDC, 1.7 A plus requirements to power I/O points (10 A max)
- Physical: 290 mm x 219 mm x 86 mm (11.425 in x 8.6 in x 3.375 in); 5.2 kg (11.5 lbs); Panel mount to back, or side
- Environmental: 0 to 50 °C ambient operating; 0 to 95% relative humidity, non-condensing; with integral fan cooling
- Test Marks/Regulatory Compliance: TUV of North America: Certified to IEC61010-1. CE (EMC): EN61326; for Emissions. EN61326, EN61000-4-2, EN61000-4-3:2002, EN61000-4-5, EN61000-4-6, EN61000-4-11; for Immunity

SOFTWARE

- Software Toolkit™ configuration dramatically simplifies and speeds integrating EFEM and wafer-handling solutions for new or existing tool designs
- Software Toolkit™ enables a suite of unique capabilities that deliver superior wafer-handling performance and reliability
 - Host command interpretation and emulation—robot and other EFEM hardware changes are transparent to the host
 - Advanced path planning—not just coordinated and blended moves—shorter, faster, and smoother paths for superior wafer throughput, wafer safety, and tool reliability
 - Autocalibration® technology - fully automates robot calibration (teaching) for improved accuracy in wafer placement, reliability, and reduced tool downtime
 - Dynamic Wafer Calibration™ - an Autocalibration-enabled facility to do on-the-fly wafer center calculation and correction
- Integral control of Moog wafer pre-aligner hardware
- Integral support of many common wafer mappers, with sophisticated mapping routines
- Windows NT/2000/XP interface



The BX-300™ Controller provides coordinated motion control, six internal drives, and I/O in a single compact, connectorized module.

TAKE A CLOSER LOOK

Moog's OEM/EFEM Wafer Handling Solutions for high performance applications are readily available by calling or emailing us at sales.pps@moog.com

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