

Inspection and Metrology for Semiconductor Manufacturing

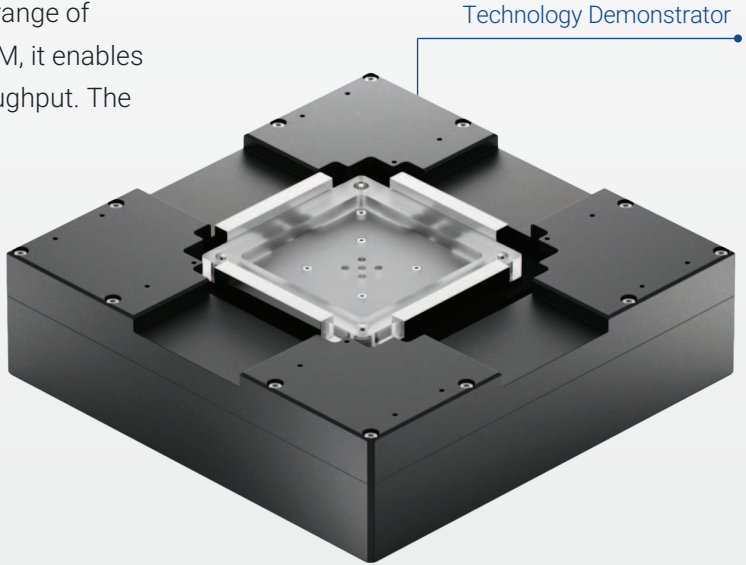


Subnanometer Precision Across Millimeter Scan Ranges for High-Throughput Inspection and Metrology

Shrinking nodes, features, and pitches demand higher resolution and accuracy, while high throughput and inline process control favor scanning larger fields of view at high speed. This MagLev demonstrator combines a millimeter range of motion, picometer-class resolution, high dynamics, and active 6DoF control in one contact-free stage. For AFM, it enables high-resolution scanning and long-range profiling at die level without stitching, increasing measurement throughput. The range of motion can be scaled up or down to fit the application, up to wafer-level scanning and profiling.

Key MagLev Advantages

- ✓ **Accuracy** — Piezo-level performance in mm travel
- ✓ **Scan Fidelity** — Low tracking error
- ✓ **High Dynamics** — Fast turnarounds, short settling
- ✓ **Contact-Free Operation** — No lubricants, wear, or particle generation



Range of Motion	Dynamics	Resolution	In-Position Stability	Repeatability	Accuracy
X/Y: 12.1* ... 50 mm Z: 50 μ m* Θ XYZ: 2 mrad*	Acceleration: 0.15* ... 1g Velocity: 15* ... 100 mm/s	X/Y: $\leq$ 50 pm* Z: $\leq$ 100 pm* Θ XY: $\leq$ 1.5 nrad* Θ Z: $\leq$ 0.5 nrad*	X/Y: $<$ 70 pm* Z: $<$ 110 pm*	$<$ 3 nm*	$<$ 10* nm with calibration

* Asterisked values represent the performance of the demonstrator shown; additional values indicate achievable performance with different system configurations.

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CHALLENGE

Small Features Across Larger Scan Areas

Shrinking features and advanced packaging, such as hybrid bonding, require subnanometer height measurements.

Scan Fidelity and Stable Measurements

Tracking, pitch/roll errors, and stage jitter can distort surface profiles or mask shallow dishing.

Throughput and Cleanliness

Move-and-settle overhead limits sampling. Guide wear and lubricants pose risk to surface contamination.

SOLUTION

Accuracy: Fine Motion Over Millimeters

One contact-free stage combines fine scans and millimeter travel with fewer XY interfaces.

Scan Fidelity: Active Control in 6DoF

6DoF control and ILC (iterative learning control) feed-forward reduce motion errors.

Fast, Frictionless Motion

Direct actuation enables dynamic scanning and fast site changes without bearing wear or lubrication.

RESULT

Precision Over 5 mm

2.8 nm repeatability and <10 nm accuracy with calibration.

Low Noise During Scanning

130 pm RMS Z-jitter with ILC at 20 mm/s over 8 mm.

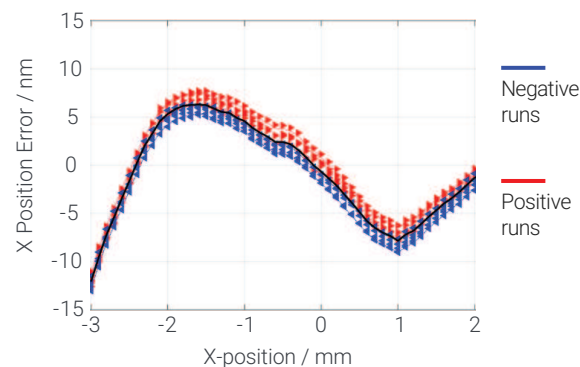
One Clean Motion Platform

Fine scans and millimeter travel with no bearing wear or lubricant sources.

Positioning Accuracy and Repeatability, X-Axis

2.8 nm repeatability

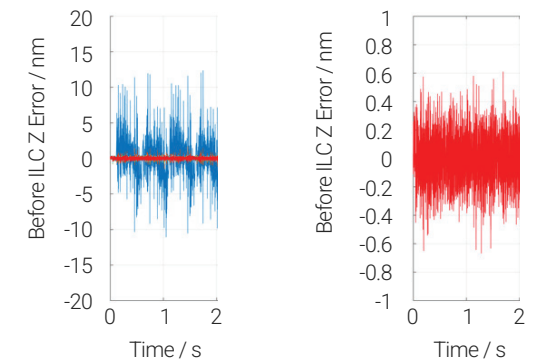
22.3 nm accuracy over 5 mm without calibration



Z-Error Before and After ILC Correction

130 pm RMS while scanning

Z-jitter with ILC 20 mm/s scan speed over 8 mm



LET'S TALK ABOUT YOUR APPLICATION

Discuss your process requirements and the right approach with our experts.

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