

Park NX-TSH400TF

Industry's Leading Automated AFM
for 300 mm Tape Frame Advanced Packaging



Park
SYSTEMS

Park NX-TSH400TF is a state-of-the-art automated AFM developed to measure 300 mm tape frame samples used in the semiconductor Wafer Level Packaging (WLP) process with sub-nanometer-level precision. Tape frame samples are typically larger and heavier than standard wafers, making their measurement more challenging. To address this, the system adopts a Tip Scanning Head (TSH), enabling fast and precise measurements. A porous sample chuck further ensures stable measurement on film-based samples. The NX-TSH400TF is already in use at major semiconductor manufacturers involved in WLP production.

Park NX-TSH400TF

Key Features

Semiconductor Fab Integrability

- Fully automated operation through XEA software with an intuitive UI
- SECS/GEM communication for fab host integration
- Automated wafer handling and probe exchange
- Full compatibility according to SEMI standards

Engineered for 300 mm Tape Frames

- Capable of handling film samples using a porous sample chuck
- Alignment procedure for dies on tape frame
- Electrostatic neutralization using dual ionizers

High-Precision AFM Technology

- Minimized out-of-plane motion through a decoupled XY and Z scanner architecture
- True Non-contact™ mode preserves tip shape and extends tip lifetime

Versatile Applications

- Comprehensive 3D nanometrology
- Nanomanipulation mode for defect removal

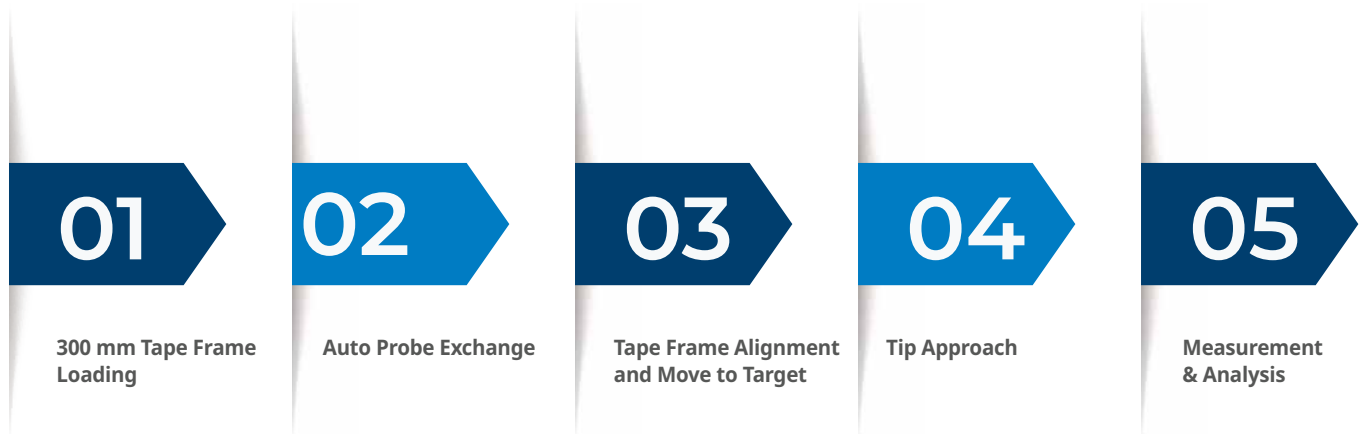


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Semiconductor Fab Integrability

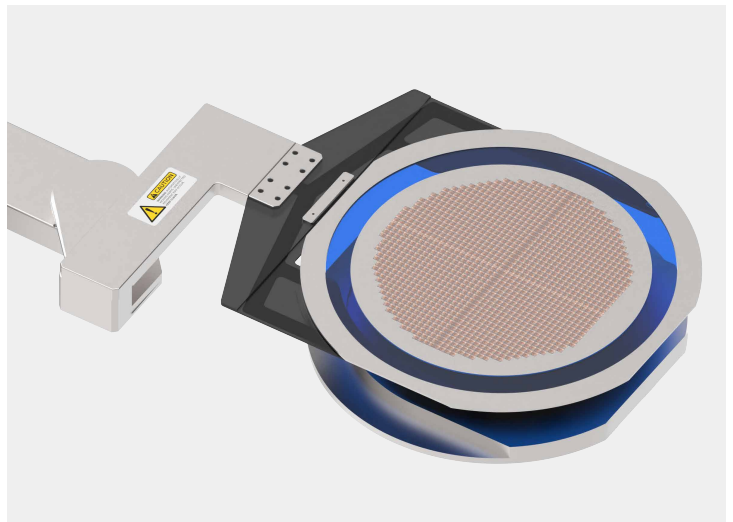
Fully Automated Operation

The NX-TSH400TF enables fully automated operation from 300 mm Tape Frame handling to measurement and analysis. The system automatically receives a recipe from the host, performs end-to-end automation, including selecting the appropriate probe, scanning multiple target areas, analyzing measurement data, and generating reports.



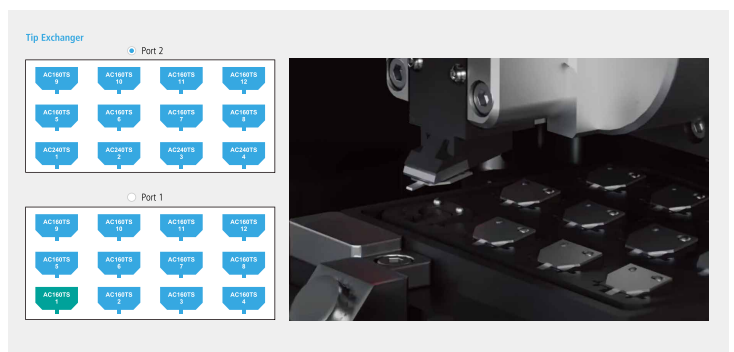
Automated 300 mm Tape Frame Handling Capability

300 mm tape frame transfer is performed automatically by an equipment front end module (EFEM). It uses robotic mechanisms, sensors, and algorithms to ensure precise alignment.



Automatic Probe Exchange

The automatic tip exchanger seamlessly replaces the probe when the threshold is exceeded. It can store up to 24 pre-mounted probes (12 probes per cassette).

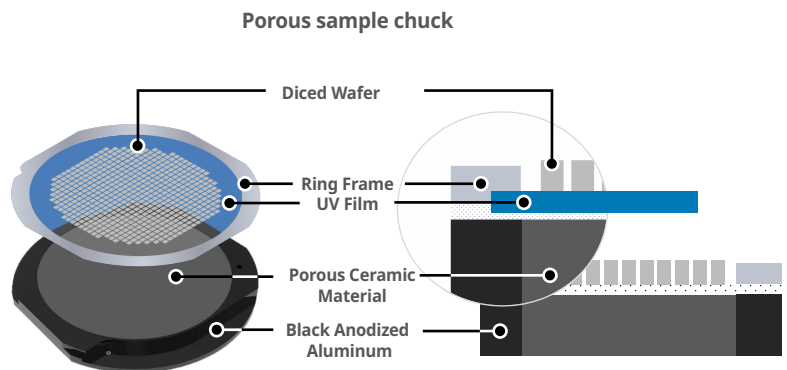


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Engineered for 300 mm Tape Frames

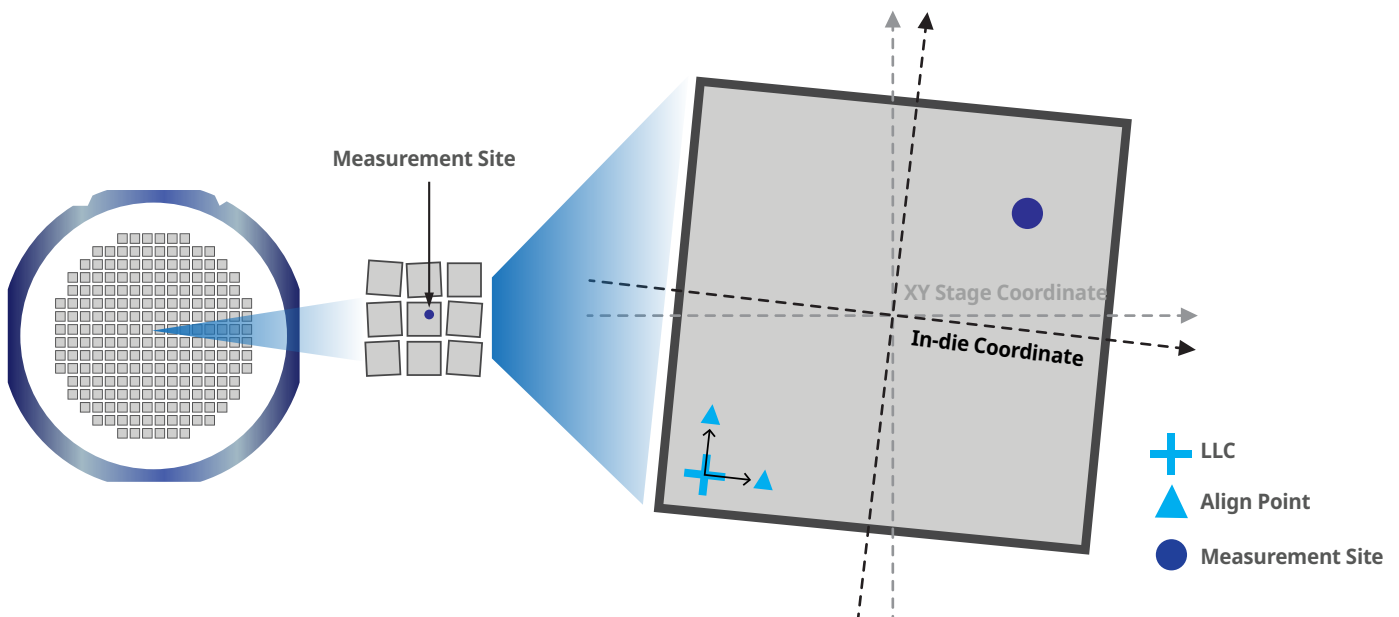
Support for Tape Frame Using a Porous Sample Chuck

The porous sample chuck is designed to accommodate standard tape frames with a diameter of up to 400 mm. The chuck provides uniform vacuum across the entire UV film surface, keeping all dies aligned and enabling precise and reliable AFM measurements. Electrostatic charge is minimized through a controlled surface resistivity of 10^6 – 10^9 Ω /sq at the contact area.



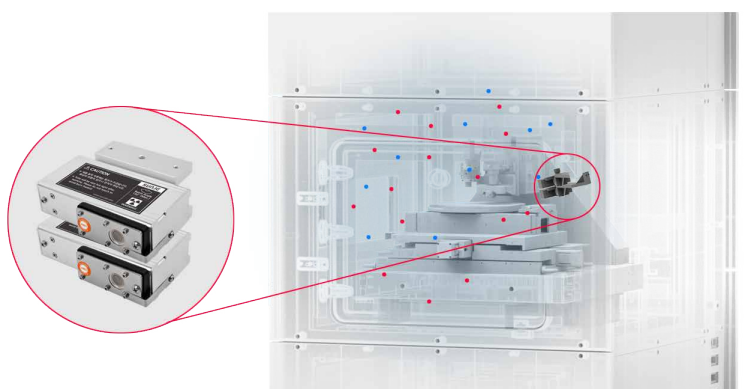
Die Alignment on Tape Frame

The NX-TSH400TF automatically compensates for the die's rotation angle using off-axis optics (0.8 $\times$) and maps the sample coordinates and XY stage coordinates of the lower-left corner (LLC) and two alignment points within the die, enabling accurate navigation to any desired measurement site.



Electrostatic Neutralization Using Dual Ionizers

Electrostatic charge on film samples is reduced using two 4.9 kV ionizers positioned in close proximity to the film surface, enhancing static removal performance.

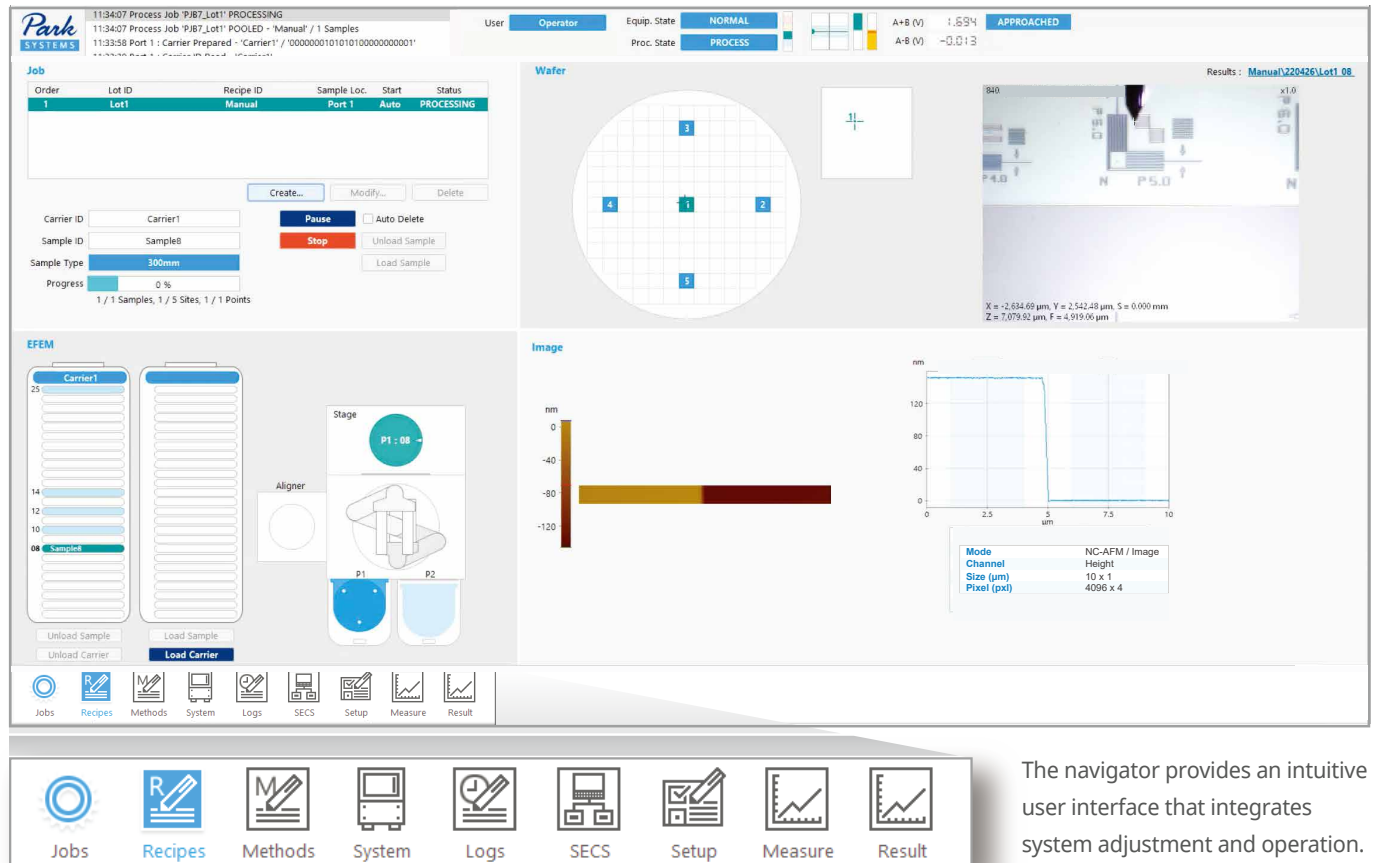


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Semiconductor Fab Integrability

Easy-to-Use Operation Software XEA

XEA offers practical features such as easy copy/paste of recipes, specialized editing modes, and real-time recipe updates. With built-in functions providing comprehensive system operation—including parameter adjustment, database management, and maintenance—the interface remains straightforward and user-friendly.



The navigator provides an intuitive user interface that integrates system adjustment and operation.

Fab Host

Tape Frame ID
Recipe ID

↕

Data
Event



Fab Host Communication via SECS/GEM Protocol

The system enables Fab host communication via the SECS/GEM protocol, ensuring full compliance with SEMI standards, including E30, E40, E87, E90, E94, and E84 PI/O for AMHS integration.

Fab Compatibility According to SEMI Standards

The NX-TSH400TF ensures optimal compatibility with cleanroom environments in semiconductor fabs. The system achieves ISO Cleanliness Class 1 (≤ 10 particles/ $\text{m}^3 \geq 0.1 \mu\text{m}$ and ≤ 2 particles/ $\text{m}^3 \geq 0.2 \mu\text{m}$) and minimizes particle contamination along the tape frame movement path through its engineered fan filter unit and ventilation system, while maintaining efficient noise shielding. Furthermore, the system is equipped with advanced monitoring capabilities that can detect and alert users to potential fire hazards or voltage sags.

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Park High-Precision AFM Technology

Tip Scanning Head (TSH) System

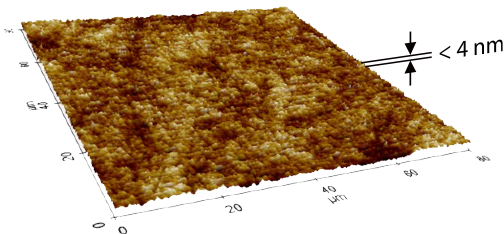
The sample is secured on the chuck while the gantry-mounted tip scanning head moves to desired measurement positions on the sample surface. This tip scanning approach eliminates sample size and weight limitations. The tip scanning head features fully decoupled XY and Z scanners, enabling precise control in each direction.



Optical Flat (80 μm × 80 μm)

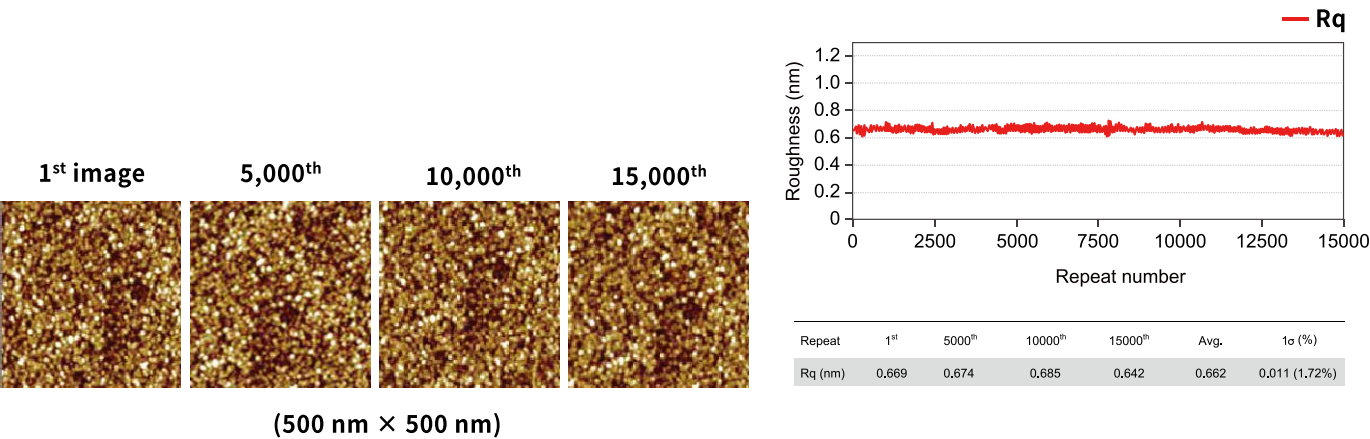
Decoupled XY and Z Scanner System

The separate flexure-guided 2D XY scanner and 1D Z scanner system minimizes out-of-plane motion by eliminating crosstalk between horizontal and vertical motion. The independent Z scanner enables precise, linear, and fast dynamic performance.



True Non-Contact™ Mode

True Non-contact™ mode, a proprietary technology offered by Park Systems, obtains topography by detecting the attractive van der Waals force between the tip and sample surface. The key advantage of True Non-contact mode is the prevention of tip wear and sample damage, ensuring consistent results with superior data reliability. This also reduces the total cost of ownership by extending tip life. The system also supports contact mode and tapping mode when required.

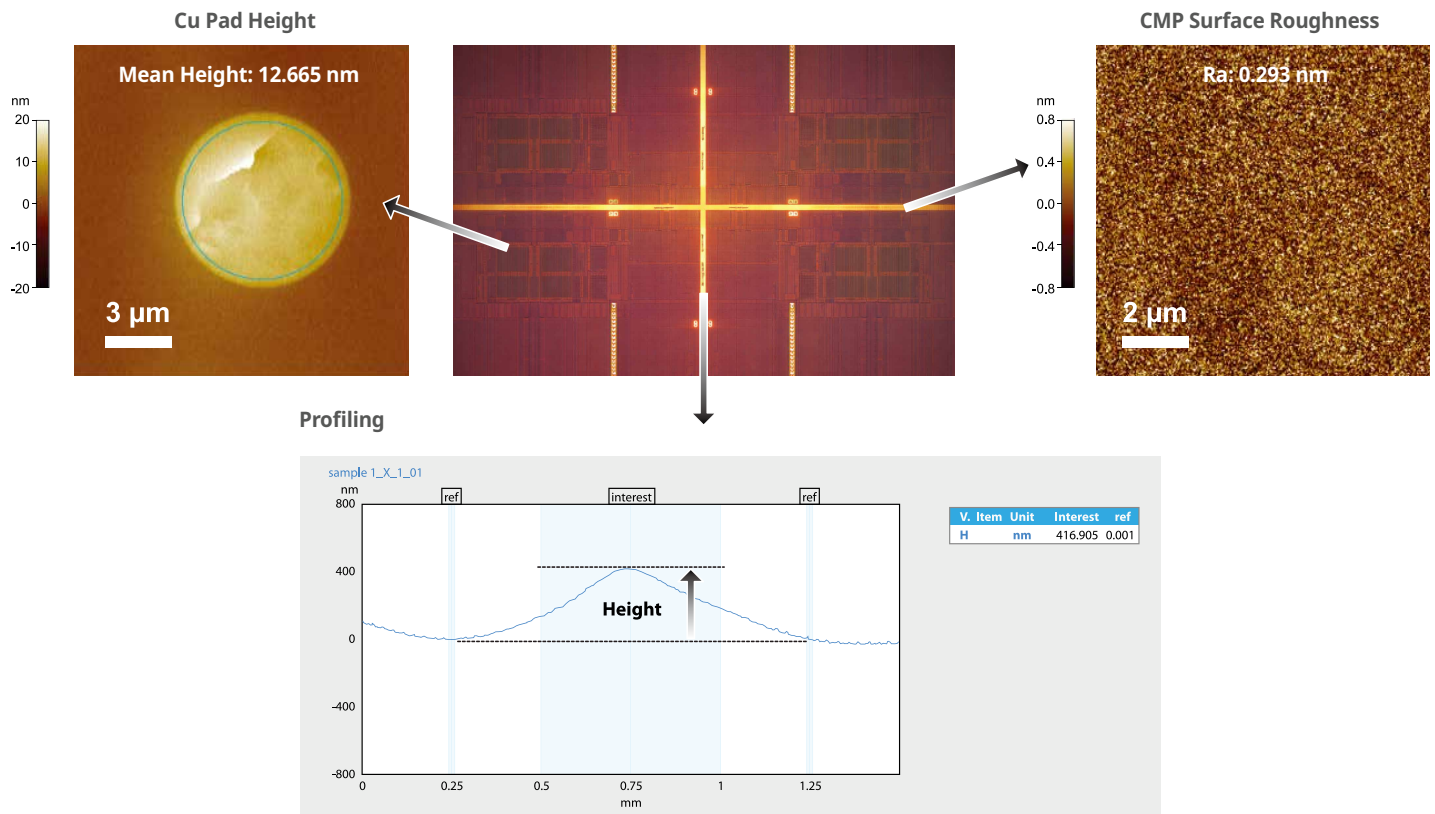


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Versatile Applications

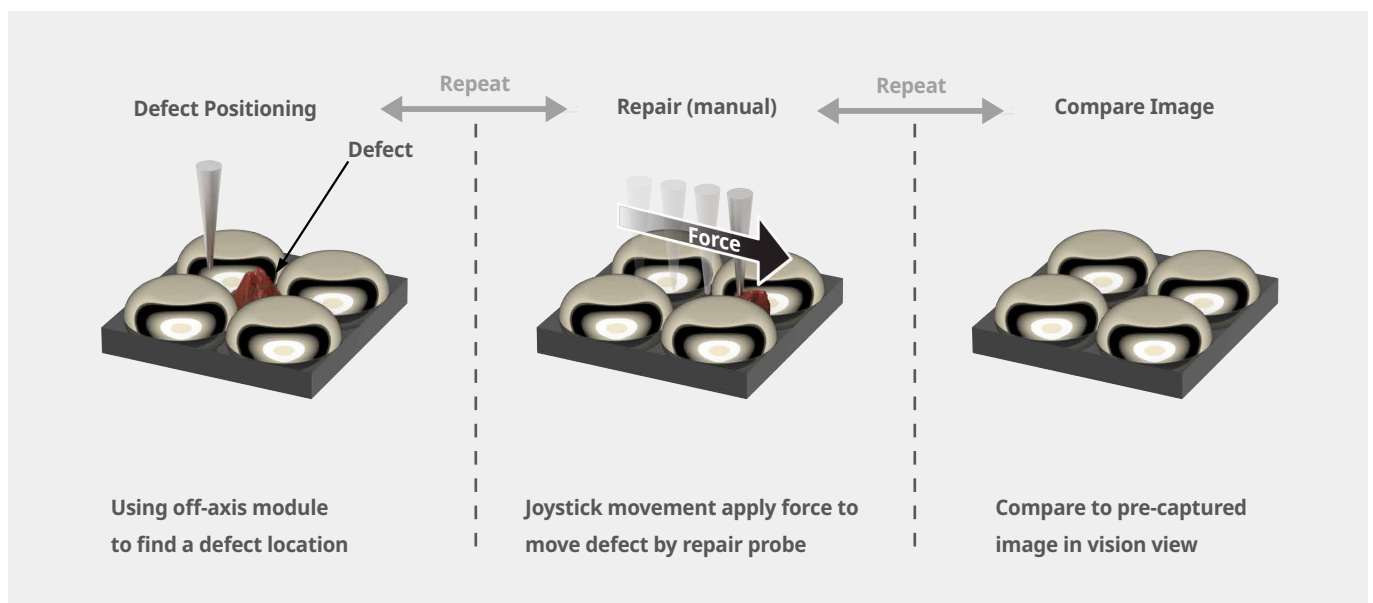
Comprehensive 3D Nano-Metrology

Provides AFM measurements for die on tape frame, primarily supporting Cu pad height, surface roughness, and profiling.



Nanomanipulation Mode for Defect Removal

Using the repair probe, defects such as tape residue located between C4 Cu bumps in the CoWoS structure can be removed.



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Technical Specifications

AFM Modes

- True Non-contact™ Mode
- Tapping Mode
- Contact Mode

Tip Scanning Head

- XY scan range (90 µm × 90 µm)
- Z scan range (15 µm)

Long Range Sliding Stage

- Up to 50 mm *

On-Axis Optics

- Direct on-axis vision of sample surface and cantilever
- Field of view: 840 µm × 630 µm (w/ 10× objective lens)
- CMOS: 5 M pixels

Off-Axis Optics

- Large field of view for easy sample navigation
- Field of view: 10.5 mm × 8.8 mm (w/ 0.8× objective lens)
- CMOS: 5 M pixels

Automatic Tip Exchanger

- 24 pre-mounted probes (12 probes per cassette)

Sample Handling Capability

- Standard 300 mm tape frame **

Dimension and Weight (Approx.)

- 3,989 mm × 2,418 mm × 2,535 mm (4,470 kg)

Required Environment

- Room temperature (stand by): 10 °C–40 °C
- Room temperature (operating): 18 °C–24 °C
- Humidity: 30%–60% (not condensing)
- Floor vibration level: VC-D (6.25 µm/sec)
- Acoustic noise: Below 65 dB
- Pneumatics
 - CDA 0.7 MPa
 - Vacuum -80 kPa
- Power supply rating: 208-240 V, single phase, 50/60 Hz
- Ground resistance: Below 1 Ω

* Requires additional options

** Consult with Park Systems

