蔚華科技
SPIROX

Revolutionary Breakthrough! Industry-first

Non-Destructive TGV Laser Modification Inspection System

SP8000G

SPIROX LTS®

Spirox *L*aser *T*omography *S*can

Tomogram of Laser Modification for Superior Pre-Etching Quality Assessment & Precision Control for Success!

- Exclusive Patented SpiroxLTS® Technology!
  Advanced non-linear optical measurement with SpiroxLTS® Technology for the improvement of the laser modification to best match the glass processing.
- No Destruction on Sample!
  Non-destructive inspection with SpiroxLTS® enables precise control of laser modification performance, significantly reducing process costs and optimizing production conditions!

Non-Destructive Laser Modification Inspection System – *SP8000G*

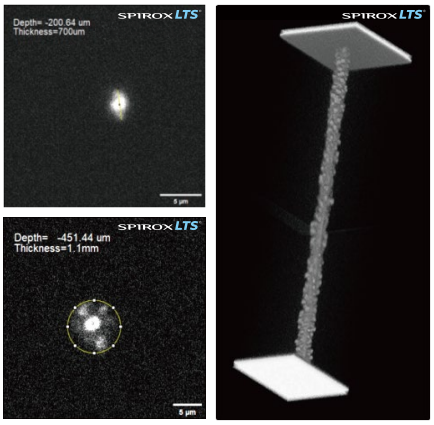
- Multi-Mode Automatic Inspection with Flexibility
  - ROI (Region of Interest) Inspection modes
  - Script scanning workflow
  - Coordinate-based inspection mode
  - Random inspection mode
- Dynamic Tomogram of Laser Modification (DTLM)
- Intuitive User Interface
- Manual Loading and Unloading
  - Standard Supported Substrate Size: 310 × 310 mm
  - Maximum Supported Substrate Size: 510 × 515 mm

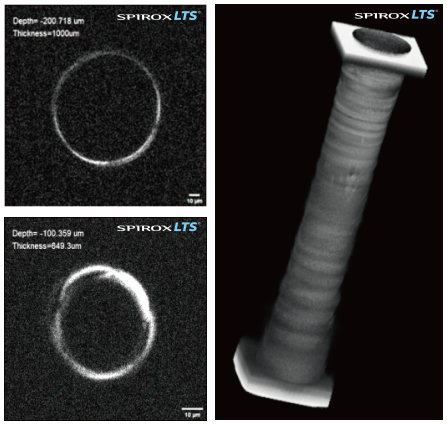
Laser Modification → **TGV Etching** → **Metallization**

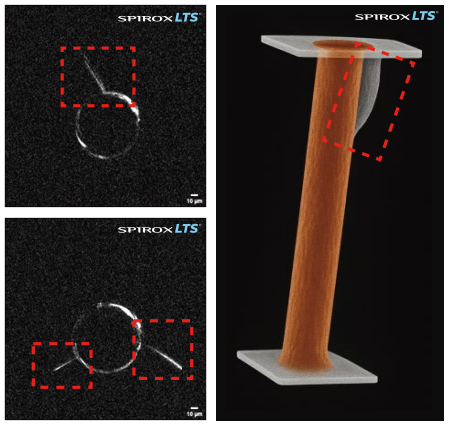
Modified Beam Profile and Uniformity Inspection

Morphology and Dimensional Inspection

Crack Inspection after Metallization and CMP

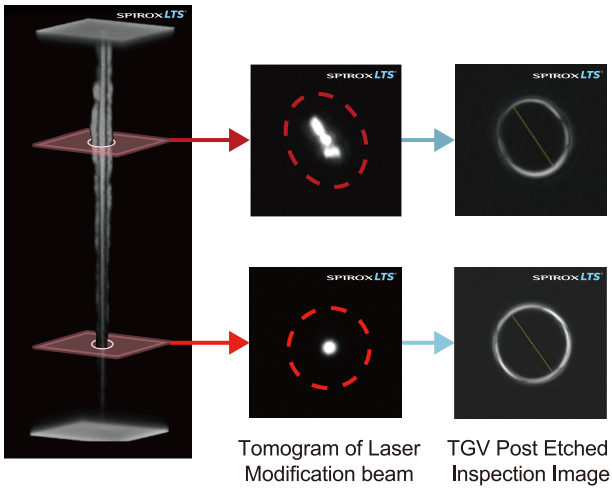




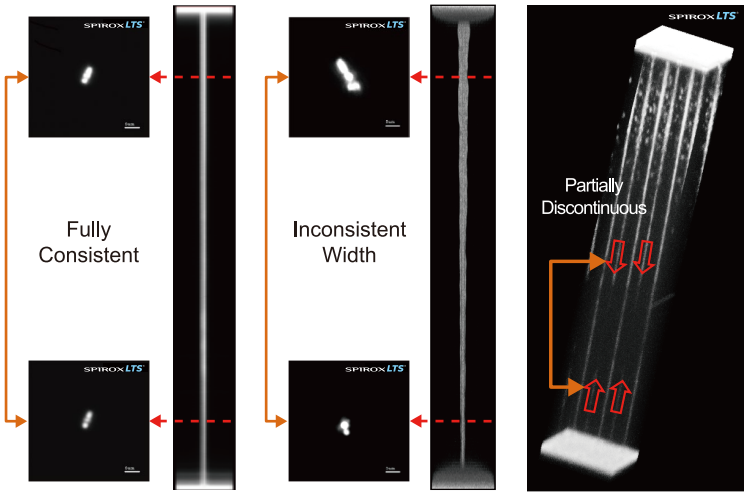


Laser Modification Inspection

Laser Modification Impact on Post Etched TGV

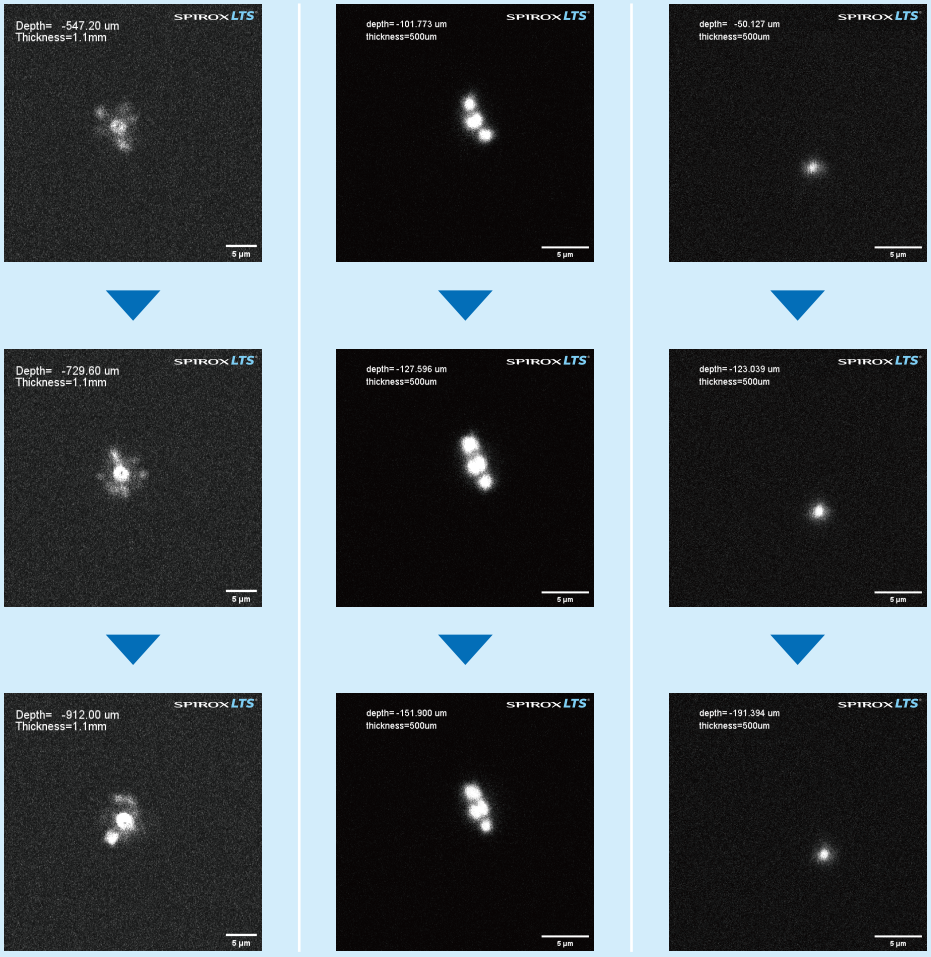


3D Tomogram: Uniformity and Continuity of Laser Modification



Dynamic Tomogram of Laser Modification

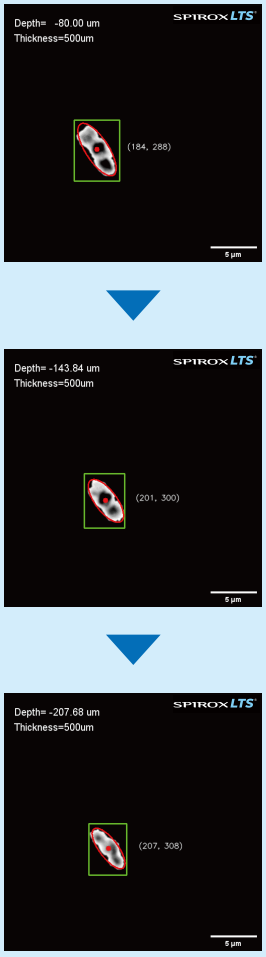
It's able to observe laser modification variations along the vertical depth changes.



Tracking Function of DTLM

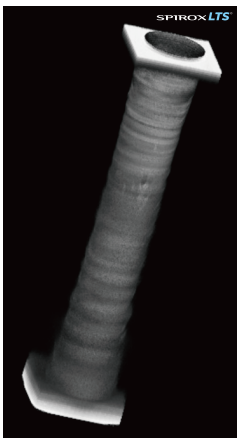
Inspection Area Criteria Mask

- Observation Center

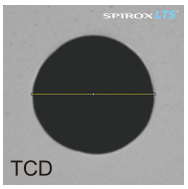


TGV Etching

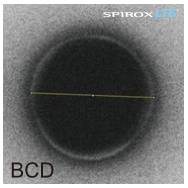
TGV Dimension Measurement

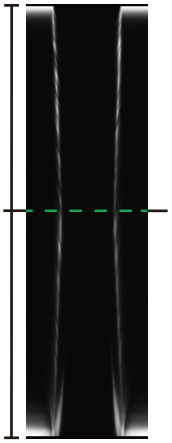


3D Imaging to TGV Profile



Vertical Depth of Aperture Changes and Waist Depth Positioning

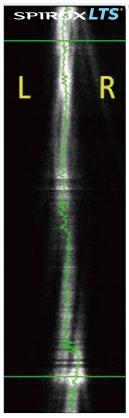




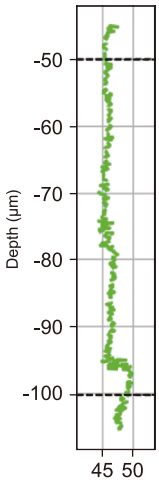
Offering Vertical Cross-Section Imaging without Sample Destruction

Sidewall Roughness: Critical Pre-Plating Check

Slicing View

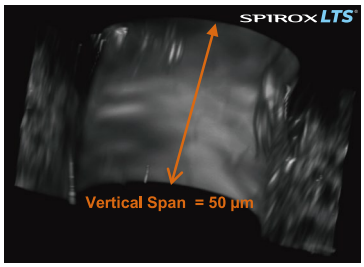


Live Profile

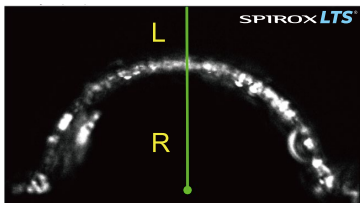


Distance from Center (µm)

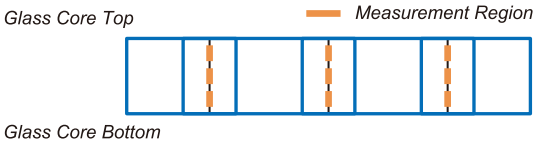
3D View



Tomograph – Top View



TGV Side View



	Ra Results by SP8000G		
	Via 1	Via 2	Via 3
Upper	0.21 µm	0.18 µm	0.15 µm
Middle	0.13 µm	0.12 µm	0.09 µm
Lower	0.20 µm	0.19 µm	0.18 µm

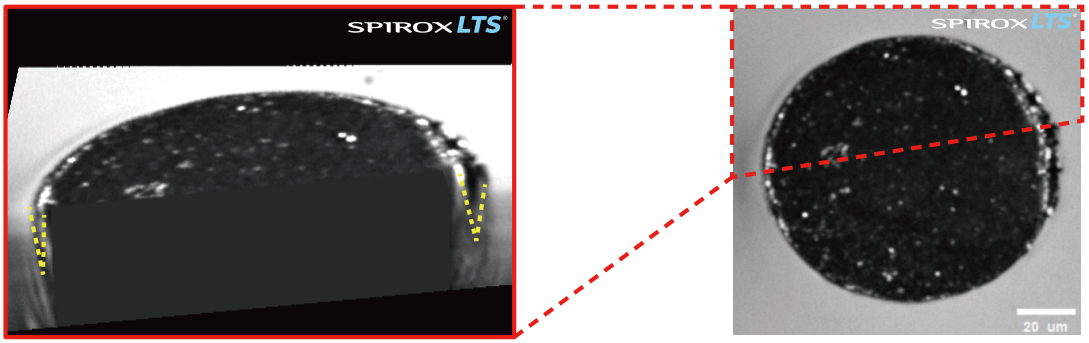
Roughness Calculation after Via Etching

Sidewall Roughness: Critical Pre-Plating Check

The Ra measurement starts from the surface and proceeds downward, covering three regions in total — upper, middle, and lower. Each region spans a depth range of 50 µm as the measurement coverage.

Sidewall roughness is a critical pre-plating inspection item. Verifying it in advance provides immediate feedback on upstream process conditions, helps avoid ineffective plating, improves yield, and reduces cost.

Post-CMP Delamination Inspection for TGV Metallization

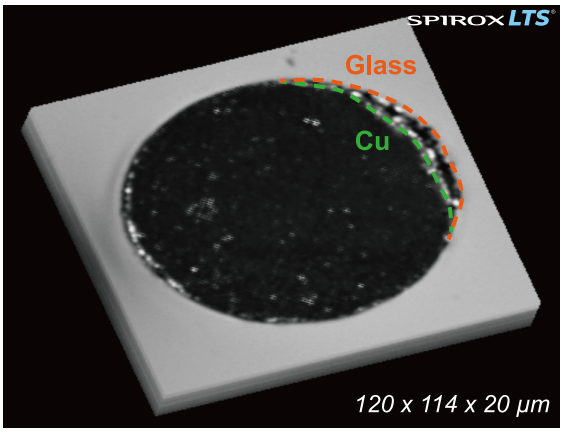


3D Cross-Section:

- Right (yellow dashed marker):
  A prominent delamination trench is observed, approximately 5 µm (width) × 8 µm (depth).
- Left (yellow dashed marker):
  A secondary, narrower trench is identified, measuring roughly 2 µm (width) × 8 µm (depth).

Surface Tomograph:

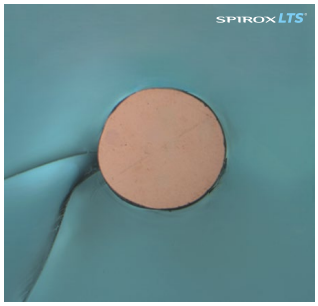
The red dashed box highlights the Region of Interest (ROI) selected for 3D cross-sectional analysis.



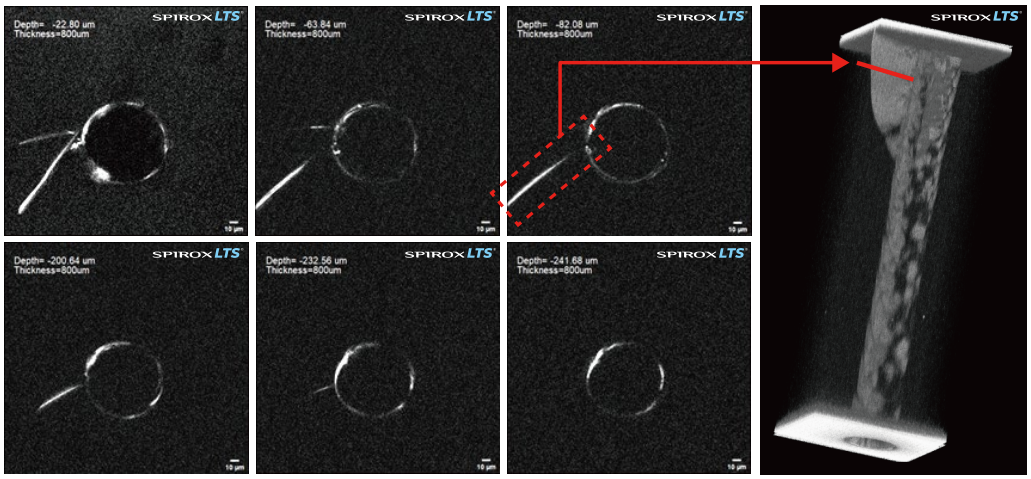
3D View (Volume: 120 × 114 × 20 µm):

This view provides a spatial visualization of the interface, clearly capturing the delamination trench between the copper (Cu) pillar boundary (green dashed line) and the glass via wall (orange dashed line).

Crack Inspection after TGV Metallization and CMP



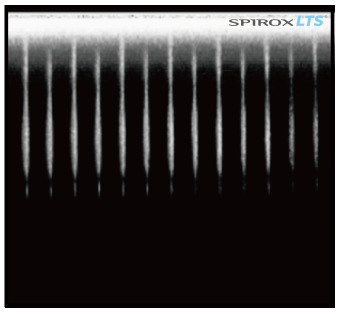
OM imaging only observe the surface.



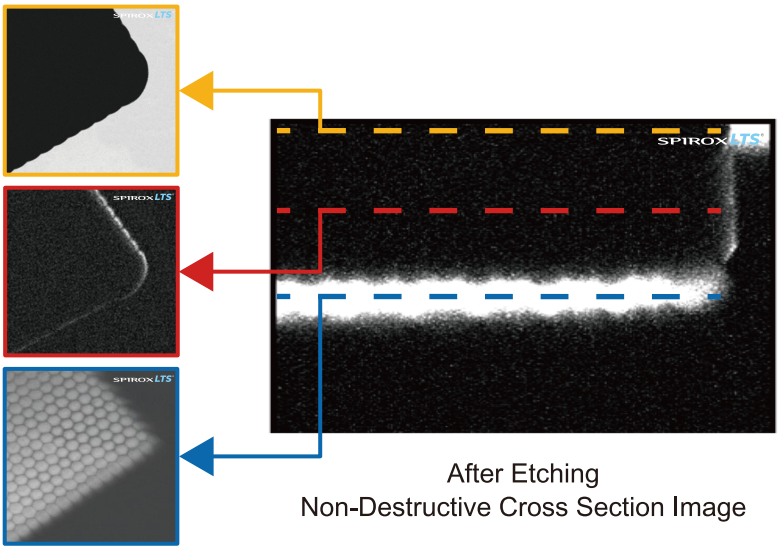
Tomogram allows observation of crack length variations along the vertical depth changes.

Co-Packaged Optics (CPO) Applications

Cavity in CPO Applications



Before Etching
Laser Modification Treatment

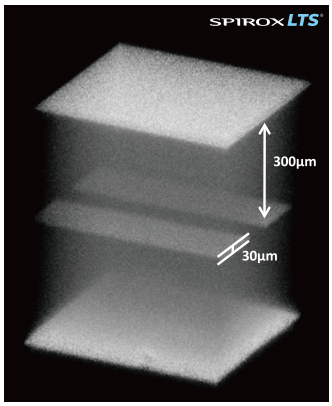


Tomogram

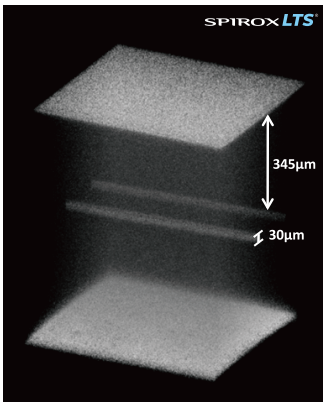
After Etching
Non-Destructive Cross Section Image

Glass Optical Waveguide in CPO Applications

It's able to inspect the waveguide structure made by laser modification in the glass, and observe its profile with 3D image!



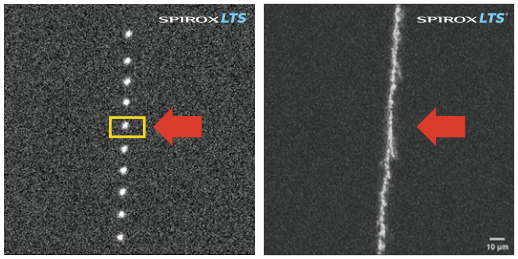
Planar Waveguide



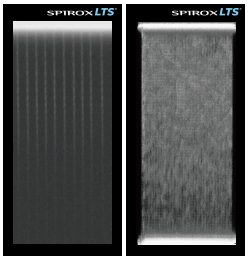
Channel Waveguide

Dicing Lane Inspection

Before Etching Laser Modification Treatment

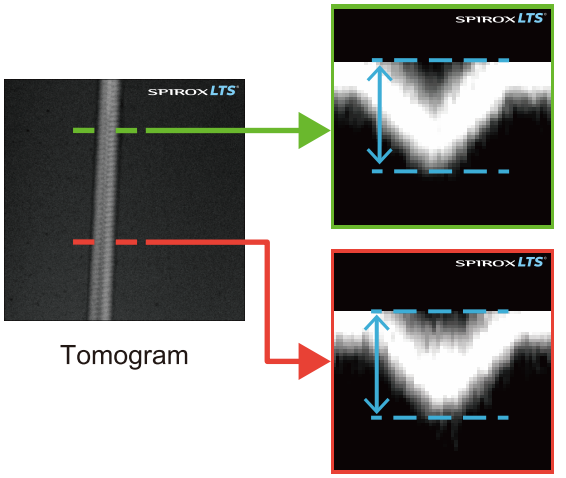


Tomogram



3D Side View Profile

After Etching



Tomogram

Non-Destructive
Cross Section Image

Features

- Patented SpiroxLTS® technology, precisely analyzing laser modification effectiveness.
- Non-destructive measurement. Comprehensive inspection of laser modification continuity and uniformity, ensuring that laser modification quality meets process design requirements.
- TGV profile inspections: TCD, Waist CD, BCD, depth, roundness, roughness.
- Crack inspection after TGV metallization and CMP: Accurately inspect the length and depth of crack-affected areas, and observe the crack conditions through 3D imaging.

Advantages

- **Industry-first direct identification:** The only technology for inspecting laser modification continuity and uniformity, providing early prediction of etched perforation outcomes after laser modification.
- **Process parameter optimization and calibration:** Tomogram of laser modification enables rapid adjustment of laser parameters and optimization of optical path design, significantly saving process development time.
- **TGV profile inspection:** Offering a more efficient, direct, and concrete inspection method without destruction.
- **Precise measurement of sample size and inspection of structural defects:** Identify the waist position, critical dimensions, roundness, roughness, and the impact area, length, and depth of cracks after metallization.

Benefits

- **Process development:** Significantly shortens development time and effectively reduces R&D costs. Precisely select laser source and glass material to ensure that TGV laser modification and through-via etching meet manufacturing quality specifications.
- **Process monitoring:** Monitor laser modification quality before etching, providing real-time prediction on whether etching is necessary, avoiding blind etching from past practices and preventing unnecessary cost waste.
- **TGV yield improvement:** Monitor TGV quality, reduce product defects, increase output, and prevent the batch costs associated with ineffective yield.

Specification

Model Number	SP8000G
Model Name	Non-Destructive Laser Modification Inspection System
Key Optical Technology	Patented SpiroxLTS® Non-linear Optical Inspection (Application wavelength 1200 - 1800 nm)
Applicable Substrate Size	Standard: 310 x 310 mm Maximum: 510 x 515 mm
Measurement Items	Tomogram of Laser Modification, 3D Tomogram of Laser Modification, Dynamic Tomogram of Laser Modification; TGV Aperture Size and Roundness Measurement, TGV Waist Depth Positioning, TGV 3D Profile Image, TGV Cross Section Analysis, TGV Roughness Calculation; Crack Inspection after TGV Metallization and CMP
FOV / Measurement Time	FOV 400 μm x 400 μm @20X objective magnification; 3.5 seconds / frame (Scanning resolution: 512 x 512 pixels); 100 frames ≒ 6 minutes
Inspection Modes	Micro-area imaging, sub-region automatic measurement, coordinate-based automatic measurement, random automatic measurement, script scanning process
Measurement Resolution	Image Minimum Resolution 0.5 μm
Motion Resolution	X-Y axis Motion Resolution 0.1 μm, Z axis Motion Resolution 0.1 μm
Load & Unload	Standard: Manual (Reserve space for EFEM upgrade) Maximum: Manual
Equipment Dimension / Weight	Standard: Length 2.375 m x Width 1.780 m x Height 1.900 m Weight 2700 kg (Tentative) Maximum: Length 2.600 m x Width 1.600 m x Height 1.900 m Weight 3500 kg (Tentative)
Electrical Specification	220 V 60 Hz AC 4400 W (Tentative)

Contact us

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