SEMISHARE-X12

Semi Automatic Probe Station System Introduction

Advanced wafer prober testing technology

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SEMISHARE-**X12 X8 X6**
Semi Automatic Probe Station System Introduction

X12

Microscope

- Freely replaceable Mitutoyo objectives
- Built-in 3 zoom multi-view, triple-rate concentric focal path system (internal optical zoom: 0.6:1 ;2.5:1 ;9:1)
- Display multiple fields of views with different magnification simultaneously, provide a better view of probe contact.
- Dual Basler 2 megapixel high speed CCD and 23 " display for high-precision measurement and dynamic monitoring

Microscope Gantry Framework

- Gantry architecture, large stroke and high rigidity components
- Test instrument can be placed closer to DUT
- Guarantee minimμm test path and eliminate parasitic effects

Chuck Module

- High efficient motion system: speed ≥70mm/s, up to sub-rmicron level accuracy
- Temperature range from -60 to 300 ℃ and keep better surface flatness
- Temperature control accuracy and stability: better than 0.1 ℃
- Triaxial (signal, guard, ground) structure provides fA-level electrical test capability and extremely low parasitîc capacitance

Auxiliary Chuck Module

- Loaded with SUS316 probe card cleaning module
- Loaded with ceramic RF calibration module,flatness ≤ 5um

High security wafer loader

- Load wafers by fast rolling out stage
- Compatible with 300/200mm wafer
- Support both single wafer and fragment

Software Automation

- Automatic Wafer align , automatic die size measurement, automatic Wafer Map creation etc.
- One-button mechanical accuracy calibration , support micron-level pad probing
- Automatic temperature compensation
- Convenient system integration

Six Axis Positioner (Optional)

- Integrated scan routines for fiber optic alignment
- Ideal for applications in silicon photonics
- Extensive software package
- Direct detection of the optical signal
- Position sensors for high accuracy and operational reliability
- Automatic alignment of several fibers in <1s

Shielding

- Optimal EMI, Spectral noise and light shielding test environment
- Provides the best low noise and low leakage current capacity

Vibration Isolation Integration

- Built-in integrated high-performance vibration isolation platform, external isolation bar to avoid vibration caused by operators
- Fast vibration recovery time <1s for fast die to die testing
- Fully ergonomic design

Integrated Control System

- Provide faster, safer and more convenient prober control
- makes the prober and tester work more closely

X12

1.Equipment Principle

SEMISHARE X12(X series) semi-automated probe station is designed for testing 12 inch wafer under -60-300 ℃ environment. It connects wafer and tester through probe tip/probe card and cables. The input electrical signal is loaded on the chip and the output signal is measured. By calculating, analyzing and classifying, the testing result is fed back to the PC and inkjet system, then defective chips will be marked. The classifying and marking method can be set according to customer requirements. After a die's testing is completed, the chuck will move to the next die and the next test cycle is performed in sequence.

2.Equipment use & function

SEMISHARE X12 (X Series) is a semi-automated probe station that integrates electrical, light,microwave etc. test functions. It is specialized in 12-inch Si Wafer testing and also compatible with 8 inch, 6 inch GaN, SiC wafers. It can work 24X7 hours and can load different temperatures to meet customer' high and low temperature demand.

X12 can be equipped with different testers to meet l-V,C-V, optical signals, RF , and 1/F noise test. lt is a comprehensive multi-functional semi-automatic probe system and can be customized.

3.Application note

DUT classification	· Integrated Circuit test
	· LED test
	· High Power device test
	· MEMS test
	· PCB test
	· LCD Panel test
	· Solar Cell test
	· Material sheet resistivity test
Classified by test environment	· RF test
	· Testing in high and low temperature environments
	· Low current (<100fA level) test
	· IV/CV/P-IV test
	· High Voltage, High Current test
	· Testing under magnetic field
	· Testing under radiation environment test

4.Core advantages

The integration of patented mechanical design, superior components and advanced assembly technology ensures total system's state of the art performance.X12 can ensure high accuracy, fast and reliable testing results, and can improve the wafer process speed and product yield .
The X Series features with the industry's higher temperature range and test accuracy to match a wide range of test applications.

Note: The default environment is 24±2℃，relative hμmidity is 40%～60%. For other information, please refer to the product manual.

5.Feature description

Ultra-high test precision and efficiency	· Index time ≤500ms
High repeatability and low test cost	·Provide accurate test result, improve wafer processing speed and product yield ≤±1μm
Multi-view optical system	· 15:13-zoom microscope, can display low, medium and high magnification simultaneous, promote manual probing experience
Low noise	·＜50dB
Wide range of applications	·Support SiC/GaN wafer testing，high power wafer testing · Replaceable Chuck design for different wafer testing
Widest temperature range	· -60～200℃，can be customized on demand
Customized design	· Upgradable to high-power wafer test /RF test /fully automatic test / different testers integration
Mechanical system has the faster speed	· Maximum speed≥70mm/s

6.Equipment models

The X series is available in three models that match the 6/8/12 inch wafer testing .
Note: The prober size and weight will be different in the case of prober upgrades or partial customizations.

Model	Wafer size	X-Y axis stroke	Theta angular stroke	Theta Angle resolution	Dimension (mm)	Weight
X6	0-6″	350*365mm	±10°	0.0001°	1060*1610*1500	Approx.1500KG
X8	0-8″	350*365mm	±10°	0.0001°	1060*1610*1500	Approx.1500KG
X12	0-12″	350*365mm	±10°	0.0001°	1060*1610*1500	Approx.1500KG

7.Equipment structure

The equipment consists of software system, chuck system, probing system, visual/optical system, shielding and vibration isolation system.
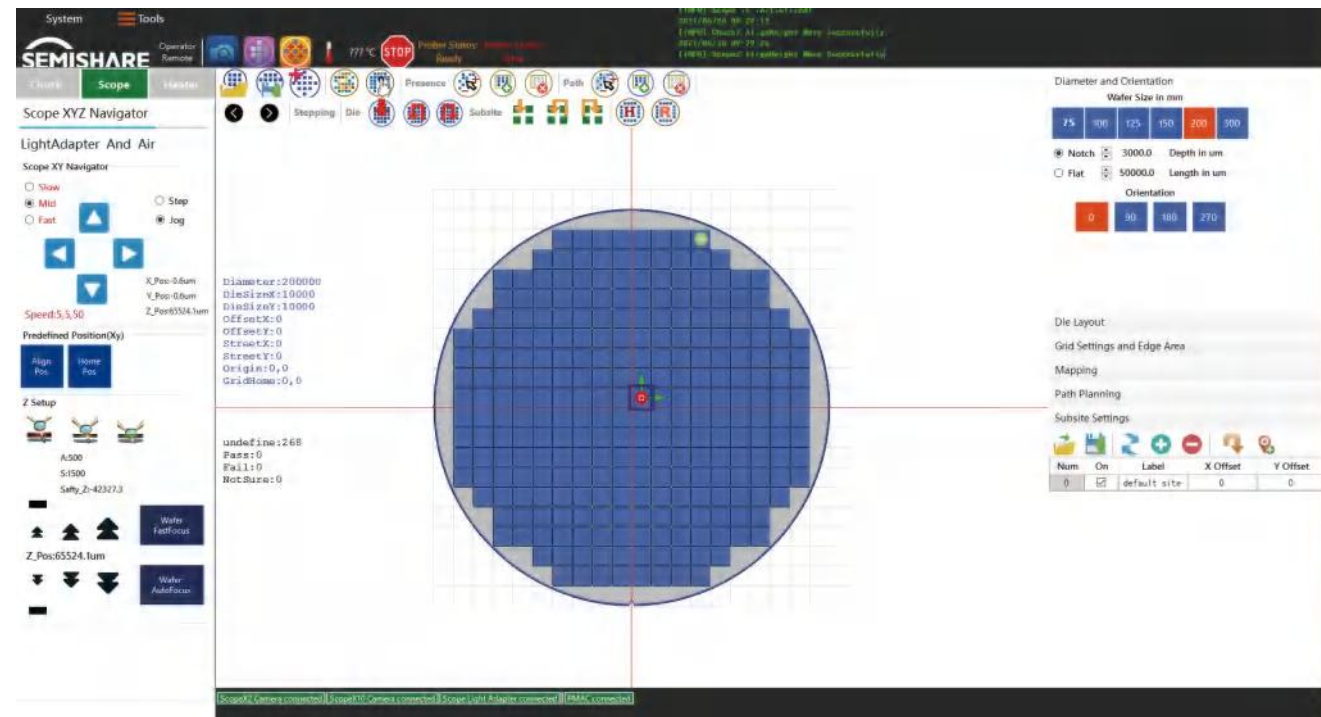
8.Software system

8.1.Wafer test software

Wafer test software is communicating with testers and controlling the testing process according to testers.

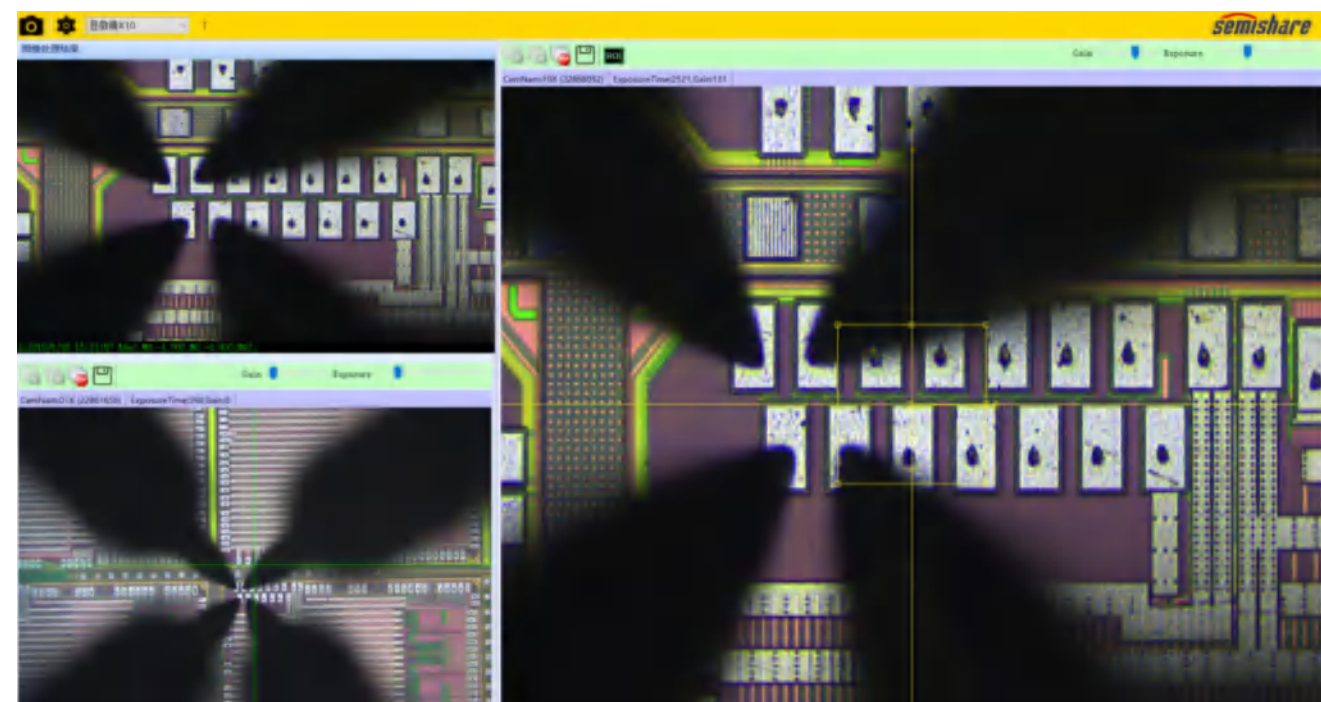# X12

8.1.1.Software Interface 1

8.1.2.Software Interface 2

8.1.3.Software Function

①	Support semi-automatic control (available in manual test or upgrade to automatic test)
②	Automatic wafer alignment
③	Automatic die size measurement
④	Automatic wafer mapping and remote access of data
⑤	Managing and programming of input and output parameters freely
⑥	Fast multi-testers integration
⑦	One-button automatic RF calibration , automatic needle cleaning function
⑧	Operation system and applications are completely separated; operation system, application system and device test system can be upgraded independently
⑨	Can support single point test and continuous test
⑩	Automatically store data and curves, synchronously process data
⑪	Classifying test results by different bin values and display different color in wafer map
⑫	Speed limit control and safety interlock

9.Chuck System

9.1.Chuck and four-axis motion control

The XYZ-theta four-axis motion control feedback the tester's results to PC and the inkjet system.

9.2.Characteristics

■ The bottom plate uses castings through long-time treatment as the basic parts. This thick bottom plate enhances the isolation performance. In the same time, the compact structure with low center of gravity ensures the acceleration stability during motion.
■ High-precision stepper actuator + linear sliding mechanism; crossed roller bearing + zero bask lash design; Superior precision grinding ball screw + high-rigidity guide, ensuring total mechanical system micron-accuracy and excellent rigidity.
■ Each part is treated with a conductive surface to ensure good grounding .
■ Chuck is electrical floating (can be used as backside electrode during wafer testing)

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Appliable wafer	Wafer size	0-12"
	Wafer thickness	0mm~2.0mm
XY axis	XY motion resolution	0.1μm
	XY positioning repeatability	≤±1μm
	XY positioning accuracy	≤±2μm
	XY travel speed	≥70mm/s
	X stroke	350mm
	Y stroke	365mm
	Feedback system	0.1μm grating feedback

Z axis	Z motion resolution	0.1μm
	Z repeatability	≤±1μm
	Z positioning accuracy	≤±2μm
	Z travel speed	≥20mm/s
	Z-stroke	20mm
Theta axis	Travel range	±10°
	Edge shift resolution	0.175μm(0.0001°)
	Motion resolution	0.0001°
	Repeatability	≤±1μm(on 300mm Chuck edge)
	Positioning accuracy	≤±2μm(on 300mm Chuck edge)
	Rate	≤10°/s

9.4.Chuck temperature control system (optional configuration)

Basic parameters	Type	6"~12"
	Temperature control range	-60℃ -300
	Temperature control stability	±0.1℃
	Minimμm setting of temperature control	0.1℃
	Temperature display resolution	0.01℃
	Noise	＜50dB
	Heating mode	Low pressure direct current heating / PID control
	Cooling mode	Compressor refrigeration

Timetable	From	To	Time (min)
Heating Rate	+25℃	+150℃/+200℃/+300℃	20/25/30
	0℃	+25℃	5
	-20℃	+25℃	8
	-40℃	+25℃	10
	-55℃	+25℃	12
	-60℃	+25℃	15
Cooling Rate	+150℃/＋200℃/+300℃	+25℃	25/30/35
	+25℃	0℃	15
	+25℃	-20℃	25
	+25℃	-40℃	35
	+25℃	-55℃	40
	+25℃	-60℃	50

9.5.Manual Loading, Auxiliary Chuck Module

Structure Description

- ■ a. The wafer is fixed by a central vacuum adsorption hole and multiple vacuum adsorption rings. Each vacuμm channel is independently controlled.
- ■ b. Needle cleaning module can clean the foreign matter attached to the needle tip during probe card test.
- ■ c. RF Calibration module has independent vacuμm adsorption control,perform RF calibration before test.
- ■ d.Fast roll-out stage, with a large stroke of 370mm, can roll the chuck out of the chamber more than 3/4 which is convenient for wafer loading.

10.Probe System

10.1.Probe holder

X12 can integrate light wave, microwave, electricity, RF, and high-power test functions. By equipping with corresponding probe holder and tips, X12 can cary out characteristic analysis of -V, C-V , optical signal,RF , 1/F noise on vorious devices and wafers, O-type platform can hold up to 12 probe micro-positioners and tip holders.

10.2.Micro-positioner

SS-100

| Parameter	· Weight	Around 1000 g
	· Dimensions	115L*100W*112H(mm)
	· XYZ Axis stroke	12*12*12(mm)
	· XYZ Motion resolution	0.7μm
	· Base	Magnetic absorption
		with magnetic switch

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10.3.Test Module (Optional)

Optical fiber fixture, RF fixture, and high-power fixture can be selected acording to the test application, and probe card test module is optional.
Optional 1: Fiber test module----PI six-axis motion positioner
Alignment of optical components, automatic wafer tests, assembling technology in silicon photonics
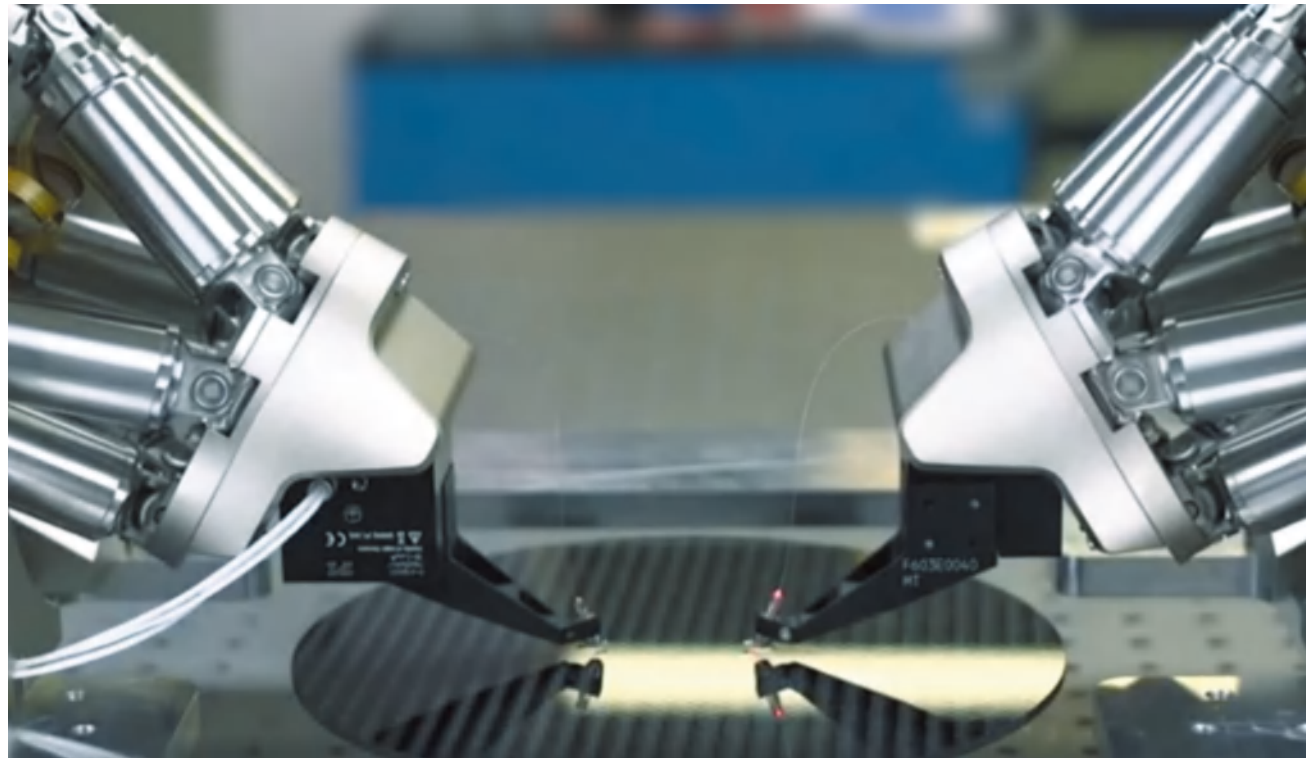

■ a. LWP fiber probe and fiber fixture, adjustable incident angle
■ b. PI six-axis positioner

Features and Applications	Integrated scan routines for fiber optic alignment
	Extensive software package
	Position sensors for high accuracy and operational reliability
	Ideal for applications in silicon photonics
	Direct detection of the optical signal
	Automatic alignment of several fibers in <1s

Precision Parameter	Active axes	X, Y, Z, θx, θy, θz
	Travel range in X, Y, Z	±6.5, ±16, ±8.5*)(mm)
	Travel range in θX, θY, θZ	±14.5, ±10, ±10*(°)
	XYZ repeatability	±0.15, ±0.15, ±0.06
	Repeatability in θX, θY, θZ	±2, ±2, ±3

Application Function

| Probe	■ Correct coupling is difficult and time-consuming.and manual methods cannot meet the capacity expansion requirements required by silicon photonic devices. Even if an automated solution is used, a lengthy iterative cycle is still required, which greatly reduces the economics of testing and packaging. ■ PI's alignment automation solution uses an in-depth toolkit based on firmware algorithms to provide precise optimization. PI's unique full parallel technology can optimize multiple degrees of freedom, multiple inputs and outputs across channels, and even optimize multiple devices at the same time. PI's hexapod-based solution provides freely selectable pivots to ensure that you can optimize by rotating around the beam waist, focus, or optical axis to further improve efficiency.
Chip inspection	■ PI can greatly improve the processing speed of chip inspection, while ensuring that the product will not be damaged in each packaging step and lead to packaging waste.Support customized and embeddable configuration.
Wafer inspection	■ The structure of silicon photonic components is highly complex, with multiple interacting input and output, component alignment, and multiple channels, all of which need to be optimized in multiple degrees of freedom to ensure detection. PI can detect the photonic components on the wafer, improve the yield rate, and effectively reduce the cost.

PI Software interface
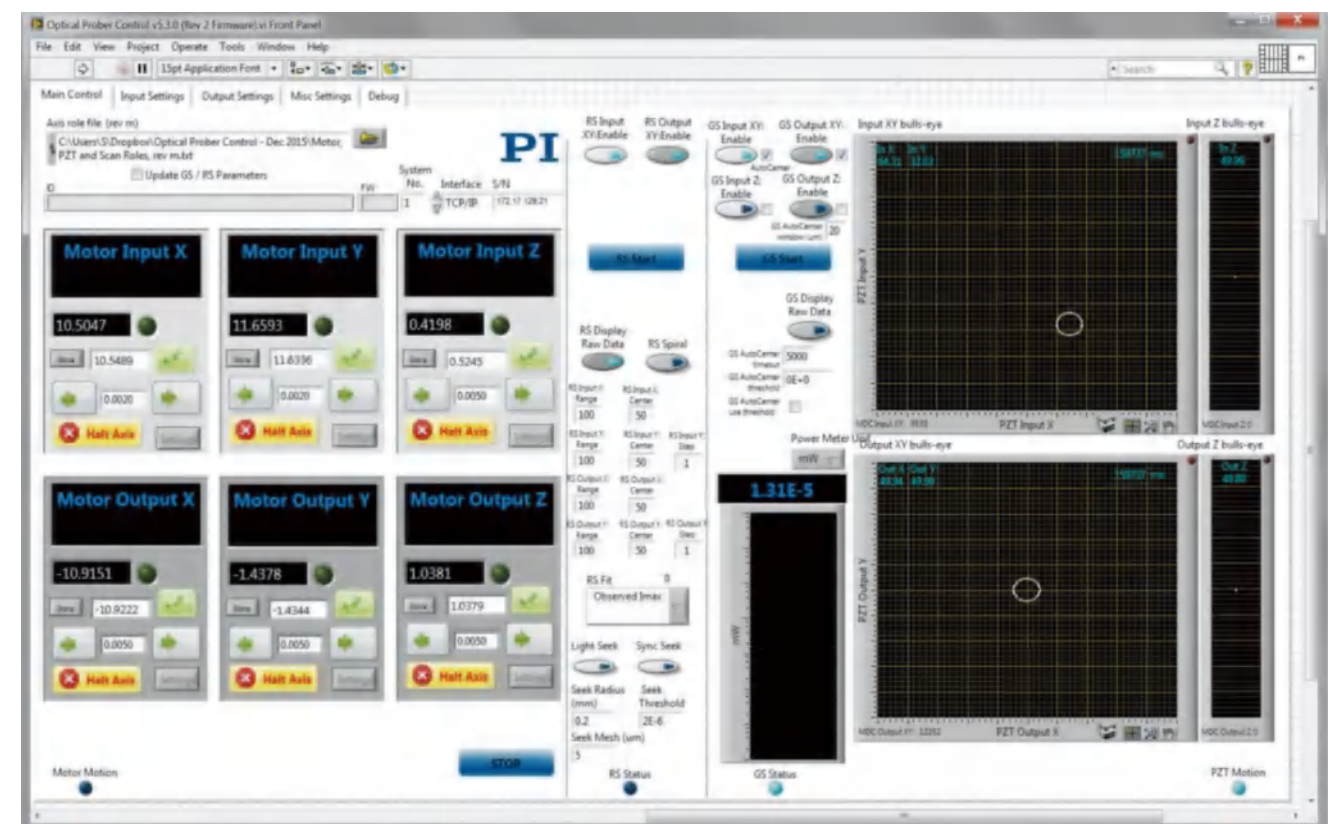
X12
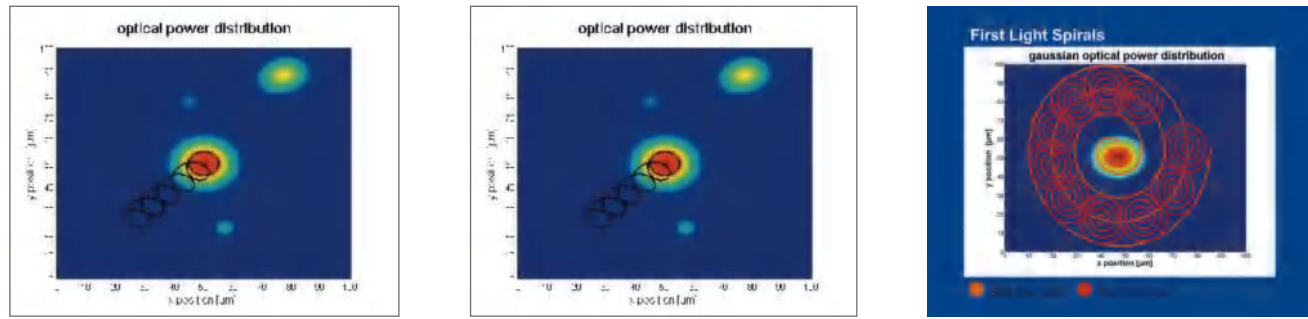
## Groundbreaking Built-in-Routines for faster Peak Finding

Built-in routines enable extremely high alignment speed.The algorithms for first light, area scan,and gradient search routines are extraordinarily fast and reliable for all kind of couplings. They offer process time of less than 1 second for aligning input and output simultaneously. PI algorithms even include automatic modeling of scan data to accurately localize the optimμm even in fast, coarse scans. This includes the ability to rapidly localize the centroid of top-hat couplings – another PI world exclusive.
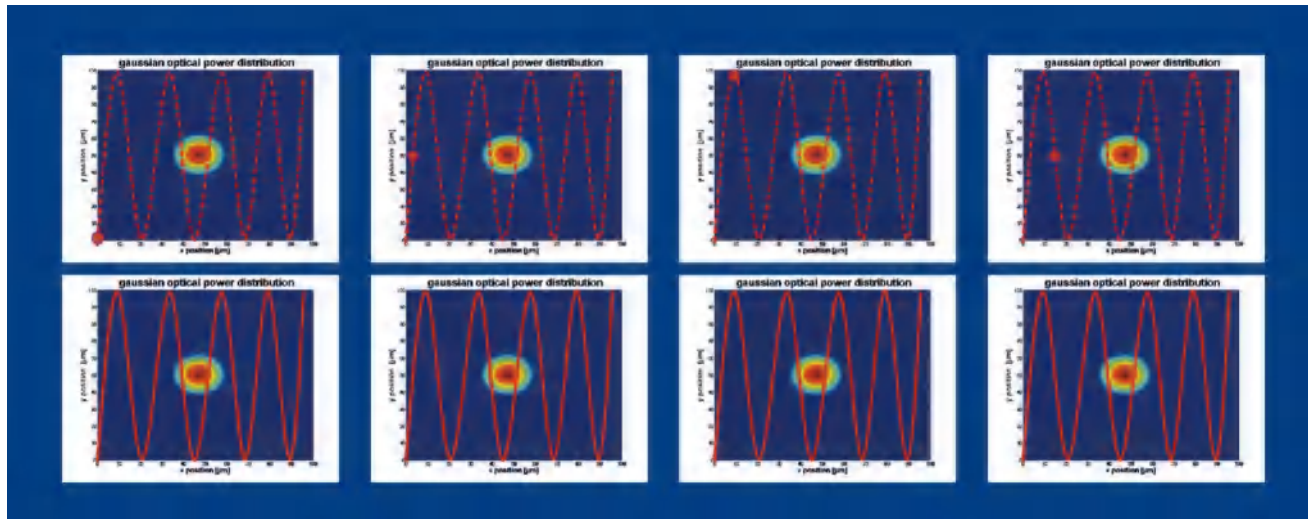
First Light Scan

In order to determine the global maximμm of a signal, it is necessary to make an intensity signal available to the controller that can be optimized. The bult-in frmware algorithms provide all convenient and fast searching for hirt light'. To ensure extremely foast success for firt light searching it is possible to combine several area scan routines for this scan, which can be performed simultaneously.

This can be performed quickly and reliably even for doublesided tasks, where both sides need to be coupled at the same time; the firmware-based algorithms run fully automatically and simultaneously until the predefined threshold value has been reached or the entire area has been scanned. All axes, irrespective of whether they are coarse or fine axes, can be used and configured according to their dynamics. For example, the transmitter side can perform highly dynamic area scans, during which,the receiver side moves slowly but continuously. Therefore, the entire transmitter side is scanned for each and every position on the receiver side. It is also possible to set whether scanning stops as soon as the defined threshold value has been reached or whether the entire area of both sides should be examined.
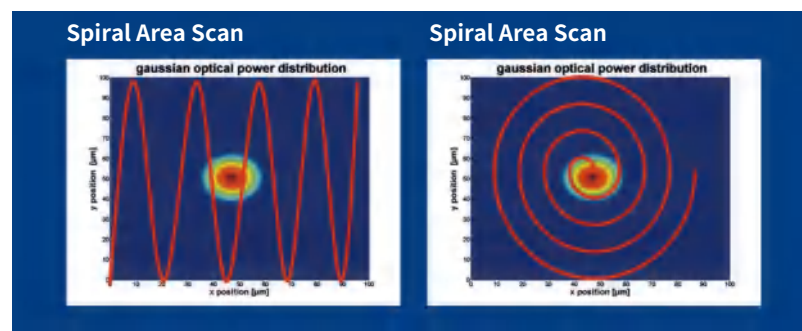

Area Scan Routines

The FMPA system offers 3 different routines for an area scan. The spiral scan with constant angular velocity, the spiral scan with constant path velocity, and the sinusoidal area scan.All routines can be configured individually and therefore optimized for the respective application case. Several scan routines can also be started simultaneously with a single command. It is possible to calculate the approximate maximμm using a Gauss function or by determining the centroid.

In the case of the sinusoidal scan routine the defined surface is scanned continuously without strong acceleration or deceleration phases. Surface, starting point, line distance, and success criteria can be defined by the user.

In the case of the spiral scan routine, a defined area is scanned helically, whereby either a constont angle or a constant path velocity is maintained. The advantage of spiral scanning at a constant frequency is the ability to avoid system resonance. This ensures successful scanning. The advantage of spiral scanning at a constant path velocity is the ablity to reduce the scanning duration inthe case of lower system dynamics. Application-specific configuration of the routine is also possible here.

Gradient Search Routines

Ground-breaking results can be achieved with the unique implementation of this algorithm. If the light signal is present, this gradient search makes it possible to find the signal maximpm in less than 1 second even in the case of double-sided tasks. It is also possible to run several searches at the same time and therefore optimize the signal simultaneously in several degrees of freedom. The routine allows excellent "tracking" and therefore it is possible to compensate any drift effects. Several parameters are also available here for optimizing the search for the respective application case.
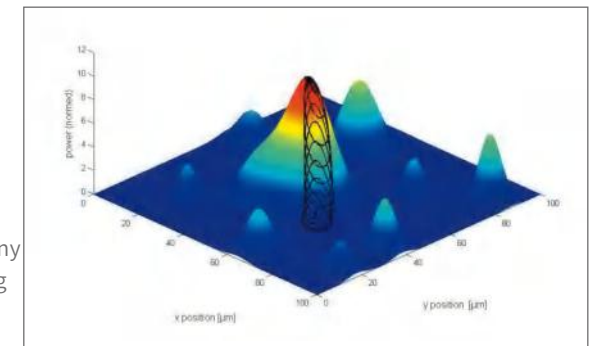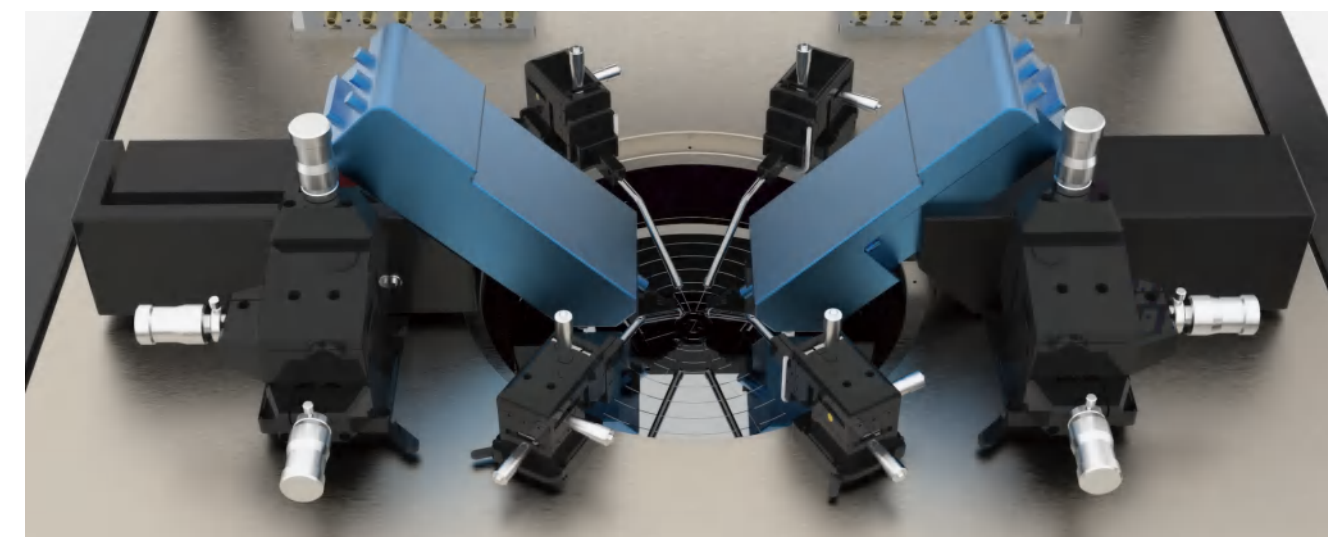

Optional 2 RF Test Module

Microwave probe module can be selected according to Pad material and pitch etc.

◄ Structure Description

a. RF Probe
b.RF Probe fixture
c.SS-100 XYZ adjustment mechanism
d. Magnetic adsorption base

RF cable and positioner

X12

Test precision

Characteristic	■ <10fA very low electric current design
	■ Dual SSMC connection for quasi-Kelvin connection of SMU and LCR
	■ Replaceable coaxial probe design, easy to replace the damaged probe or change to a different radius size

Kelvin tips holder

Functional Application	■ Low current (SMU)(<10fA)
	■ LCR (<10fF)
	■ signal integrity
	■ Pulse source / sensing
	■ TLP(10ns rise, 76LWA ground loop)

Current Leakage: Leakage ≤±10fA or Leakage ≤±100fA @-60℃~+200℃ by using different tips holders and chuck .
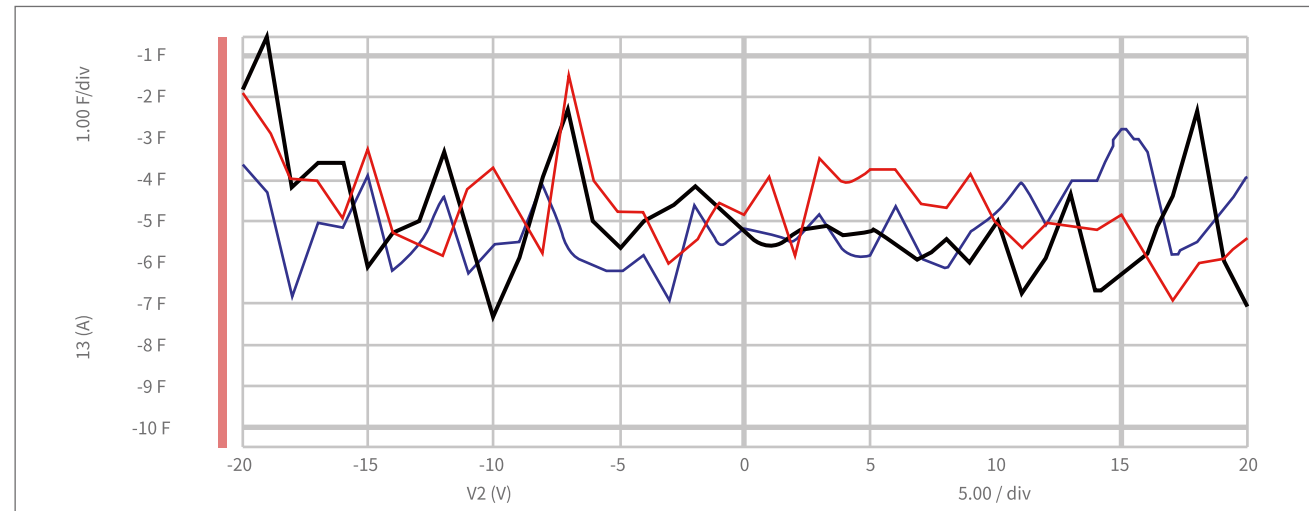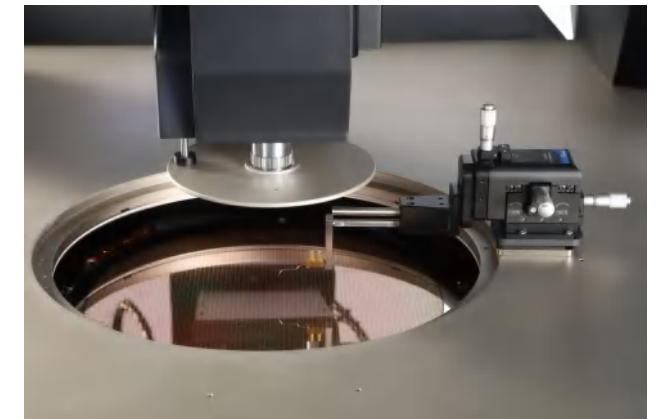
Other positioners and tip holder

Positioner specifications	SS-700 type	SS-100 type	SS-40 type
Dimensions(W*D*H)	148mm*120 mm*140mm	115mm*100mm*112mm	64mm*47mm*66mm
Weight	1500g	1000g	200g
Precision	0.1micron	0.7 micron	10 micron
Screw thread	700TPI	100TPI	40TPI
X-Y-Z linear stroke	12 mm*12 mm*12 mm	12mm*12mm*12mm	12mm*12mm*12mm

## Triaxial, Coaxial, Spring, Tubular Fixture

A mechanism mounted on the micro-positioner that hold the tip and transit signal from tip to tester through high shielding calbes . It moves together with micro-positioner's X-Y-Z .

Installation example

According To Mechanical Structure	■ Spring type: Fix the probe in the pinhole by spring elasticity (connect coaxial or triaxial cable at the backend). Easy to use, suitable for short-term high current (<1A), high stability coaxial cable, current leakage under 10PA , BNC male output connector.
	■ Tubular type: Fix the probe by the inner copper tube, and the outer copper tube shields the noise interference; there is insulation between the inner and outer copper tubes (can connect to ordinary cable, coaxial or triaxial cable at the backend.) current leakage <100fA, highest voltage is 1000V with shield box.
According To current leakage Accuracy	■ Coaxial tip holder : Connect to 1.2m BNC interface coaxial cable at back end. When using the standard shielding box, the electrical current leakage<10pA, the front end fixture is available in spring or tubular type.
	■ Triaxial tip holder : Connect to 2m triaxial interface cable at back end. When using the standard shielding box, the electrical current leakage<100fA, the frontend fixture is available in spring or tubular type. (Not recommended for SS-40 small micro-positioner)
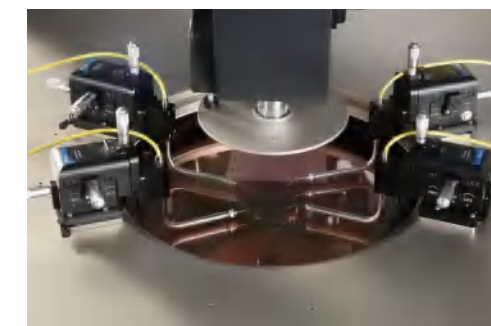
Tip holder selection procedure

Select a probe holder model according to the size of pad → select cable model according to the electrical test accuracy → select mechanical fixture model according to the mechanical precision and electrical test accuracy.

Probe card holder

It is suitable for 4.5" standard pin card fixture, and can be customized design and production according to demand.

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10.4.Vision/Optical System

Visual System

The system composed of Basler 2-megapixel digital camera, Mitutoyo high resolution lens and SEMISHARE independently developed 3-zoom microscope for multi-view and high resolution image output.

Characteristic	■ Optical image identification, automatic wafer alignment
	■ SEMI digital computing model, precise positioning
	■ 32-bit color CMOS chips
	■ Gigabit network mode communication interface

Optical microscope

The microscope is configured as SEMISHARE 3-zoom concentric focal microscope and side-view microscope (optional for tip contact observation). Among them, the 3-zoom microscope is developed by SEMISHARE independently, which provides three different imaging magnifications without switching any lens. The three magnifications can meet most requirements of tested samples, with high compatibility and significantly improve the efficiency of test.

3-zoom concentric focal microscope
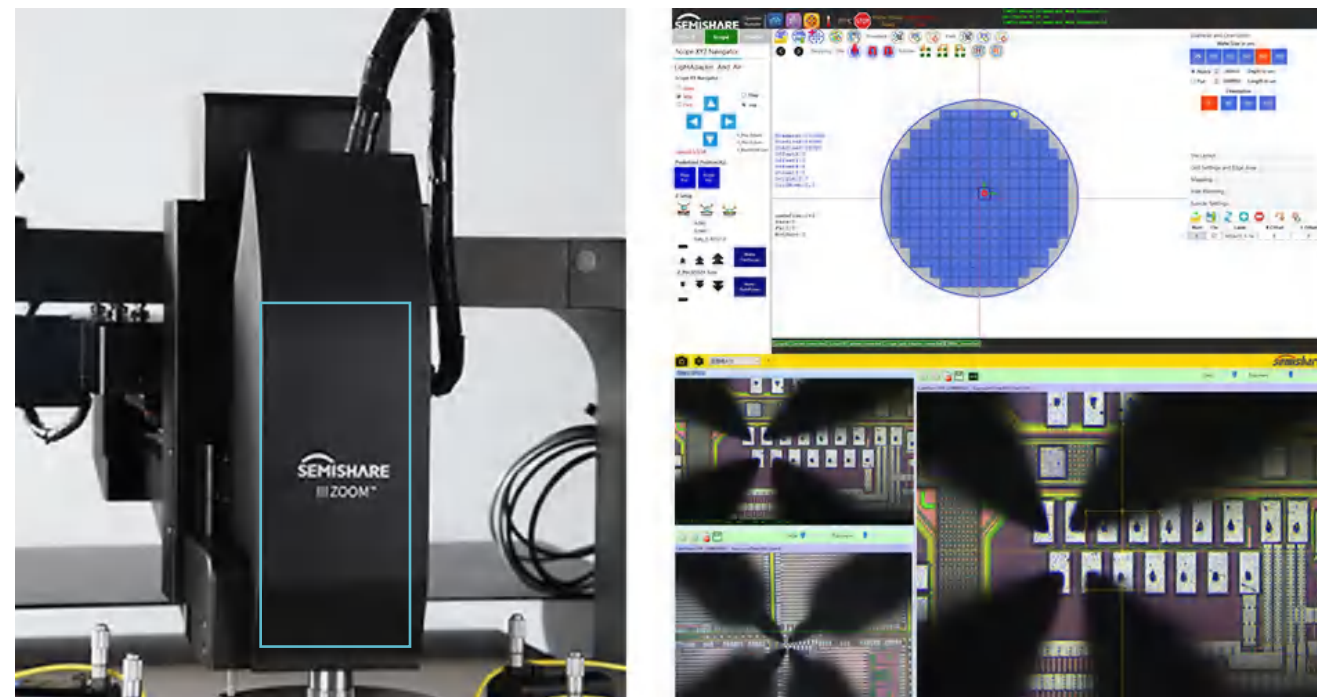
Configuration	■ Mitutoyo 5X (replaceable 2-50X) objectives	Magnification 0.6*5x/2.5*5x/9*5x
	■ Basler CMOS	2 Megapixel / high speed / 23" display
	■ Final imaging Magnification (use 5X objectives）	Magnification 100x/450x/1600x

Side-view microscope (Option)

It uses independent telecentric lens and coaxial illumination to observe real-time contact of probe tip to wafer in a long distance and wide range.
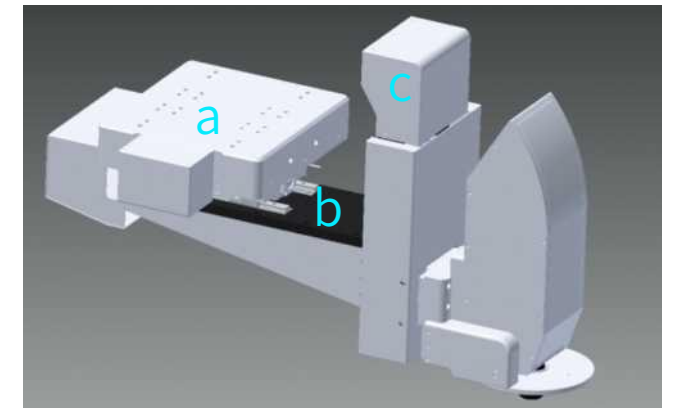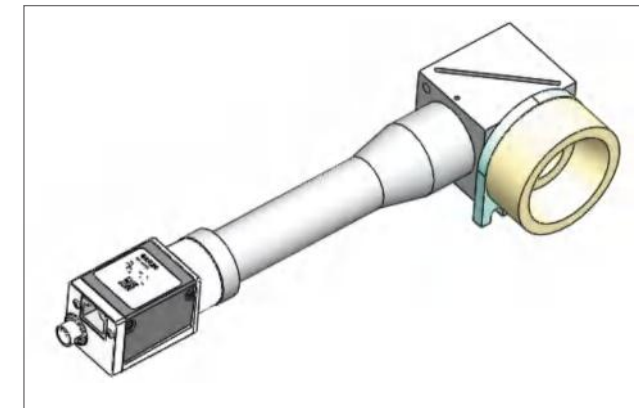
3 zoom Microscope motion system (triaxial control system)
Position Indication： a. is the X axis   b. is the Y axis   c. is the Z axis

Characteristics	■ THK high rigidity and high precision guide and screw are used for linear motion
	■ Renishaw 0.1µm resolution grating is used, combined with high performance motion control card, and form closed-loop feedback system with the motor
	■ High stability and ultra-high precision motion control

Precision Parameter	XY motion resolution	0.1µm
	XYZ speed	≤15mm/s
	XY stroke range	50.8mm*50.8mm (2"*2")
	Z stroke range	125mm (5")
	Travel resolution	0.1µm

Objective

X12

| Characteristics	■ Long working distance for easy probing
	■ Additional installation of polarized light or multi-wavelength cutting lasers

Parameters	Objective magnification 2X	Working distance 34mm
	Objective magnification 10X	Working distance 33.5mm
	Objective magnification 20x	Working distance 20mm
	Objective magnification 50X	Working distance 20.5mm
	Objective magnification 100X	Working distance 13mm

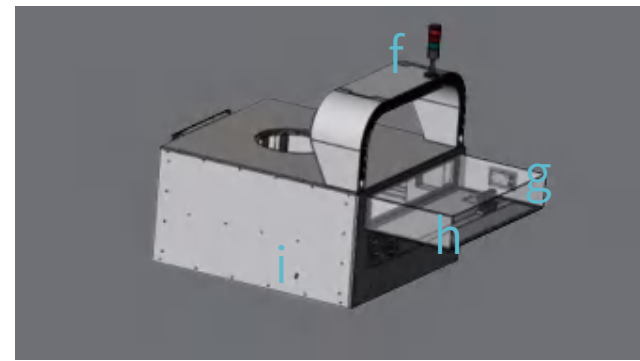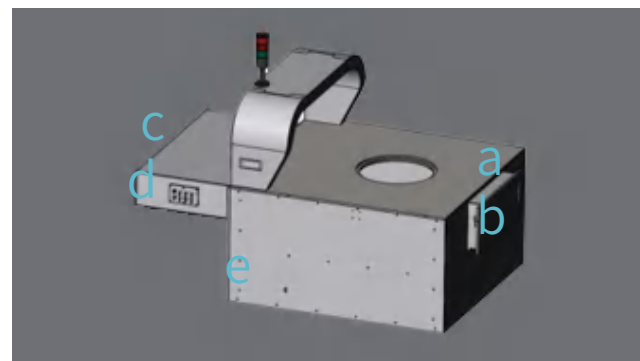## Shielding and vibration isolation system

Probe station shielding system

The shielding assembly is constituted of an octagonal box and chamber to shield internal and external noise for low current test , the chamber is almost a hermetic cavity filled dry air for high and low temperature wafer test .

Octagonal box
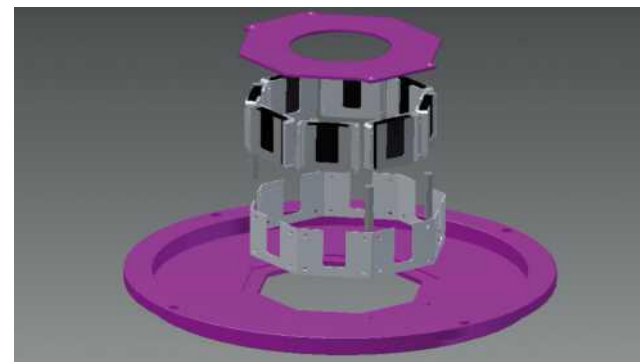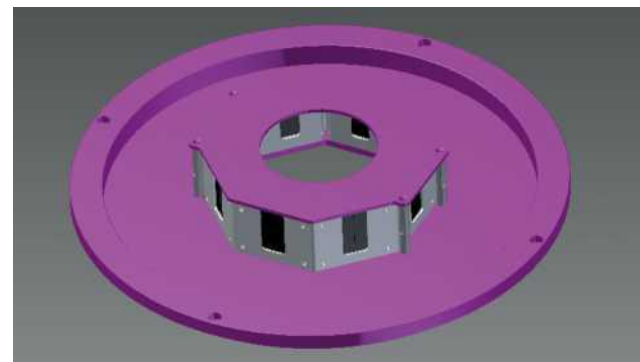
Chuck cavity

Structure Description	a. Shield cavity table	b. Shielded front door
	c. Back cover	d. Vacuμm transfer
	e. Shield cavity side	f. Gantry rack
	g. Refrigeration gas transfer	h. Dry air hμmidity sensor
	i. Hermitic communication adapter	

Shielding Parameter	EMI shield	>30 dB (typical)@ 1 kHz to 1 MHz
	Light attenuation	≥130 dB
	Spectral noise floor	≤-180 dB Vrms/rtHz(≤1 MHz)
	System AC noise	≤ 5 mVp-p (≤ 1 GHz)

| Characteristic	■ Conductive oxidation and nickel plating surface treatment to ensure the conduction state between the parts for the full shielding .
	■ High and low temperatures capability, dry air purge into the chamber during low temperature test process to prevent external vapor from entering the cavity and causing condensation/frost on the wafer .
	■ Light shielding .

Damping system

Passive air membrane isolation system and a casting is used as substrate to maintain the stability of the entire system during high speed motion.

Passive air membrane isolation airbag

Parameters	Vibration isolation mode	Air cushion film shock absorption ensures that the image is not shaken at 2000x magnification
	Inherent frequency	2.3~2.6Hz(verticalhorizontal)
	Roll-Roll Rate (10Hz)	Over 20-24dB
	Horizontal mode	Automatic leveling system with 3 balance valves
	Horizontal reset precision	±0.05/±0.1
	Working conditions	4~6Kg compressed air or liquid nitrogen
	Damping mode	air

High precision regulating valve
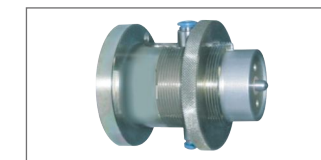
| Characteristics	Platform motion height error≤0.1mm
	High rigidity, vibration settling time ≤1S
	High test efficiency

Other Configuration

Safety system
Optional safety IR light curtain or safety sensor, real-time monitoring of operating status, and immediately stop the prober when an abnormal situation happens.

Operating System
· PC configurations 2 x 23' display, I7 CPU PC, 1TB hard drive, 8G memory, 1G discrete graphics, wireless mouse, GPIB communication interface
· Operation desk: It has independent flexible operation desk, manual control box (optional).

*Can increase depends on operator manual adjustment or interaction.
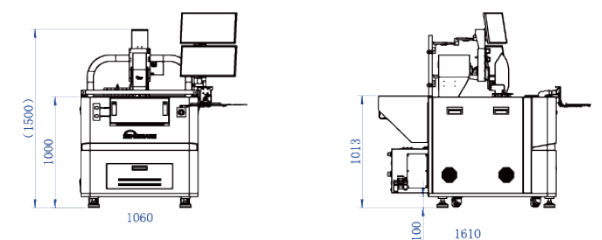
Physical parameter

X12
System dimensions (W x D x H)1060*1610*1500(mm)
Weight 1500KG