4PICO Litho

PicoMaster 200

UV direct laser writer for maskless lithography

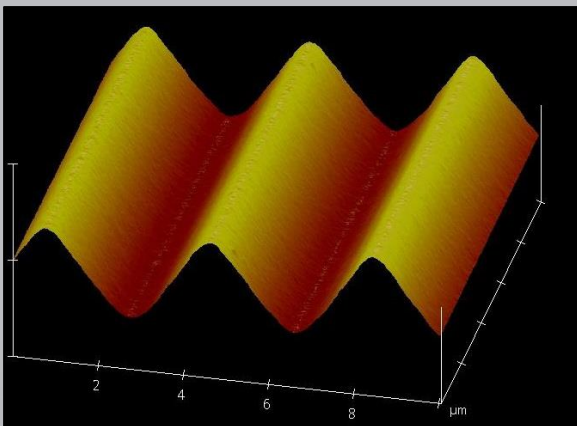**Excellent performance** in creating 3D micro structures

- Highest resolution in the market utilizing a 405 nm diode laser

- High quality tool & high quality output

- Minimal maintenance costs

- Compact optical module: use a spare optical module for revolutionary machine downtime reduction
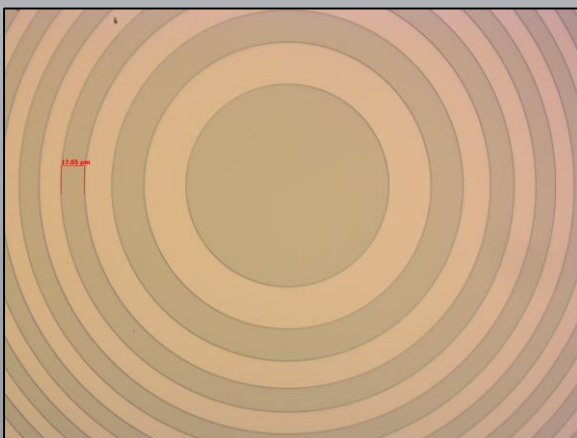
- User-friendly operation

Stand alone

Contents

Unique opportunity for R&D

The 375 nm optical module will allow the system to write lines down to 250 nm

Introducing the ideal litho tool for R&D

■ **Meet the smallest high quality laser beam spot available in the market**

The PicoMaster is a versatile UV laser writer with ultra-high precision components, specifically designed to give the user the highest degree of freedom to create micro structures in photo sensitive layers. The PicoMaster 200 is a stand alone system. All components are enclosed, including control rack, vacuum pump and control PC. This allows for quick and easy installation. A touch screen for operating the machine is attached to the frame. The system includes a 405 nm optical module capable of writing structures as small as 300 nm in photo resist layers. This user friendly tool supports up to 4095 levels of grayscale or pure binary mode and allows for 3D optical structures, surface structures as well as mask projects. Real time laser controlled auto focus and laser intensity control ensure high quality imaging during the entire exposure process.

The PicoMaster Project Manager software is included in the package and can be freely installed on any Windows based PC.

When connected to an air conditioning unit to supply conditioned air, a built-in Hepa filter creates a clean cross flow.

The massive base frame supported by isolation mounts filters out ground frequencies to ensure minimum vibrations in the system.

■ **Applications**

- Research / Semiconductor
- Photonic devices
- Mask making
- 3D Lithography
- Diffractive optical elements
- Microfluidics
- Security / Holographics
- Other

Sample of grayscale mode image

Sample of binary mode image

Ultra high precision

Excellent performance in creating 3D micro structures

Benefits

■ **Capabilities**

- Highest resolution in the market utilizing a long life time 405 nm diode laser.

- Critical dimension of 300 nm.

- Up to 4095 levels of grayscale or pure binary mode.

- 375 nm source available for more demanding applications.

- Raster mode as well as vector mode available.

- High degree of freedom to create micro structures in photo sensitive layers.

- Software controllable selection of write resolutions.

- 4PICO Litho's proprietary light weight objective lens makes real time auto focus possible.

- Supports substrates from $5x5mm^2$ up to 8"x8".
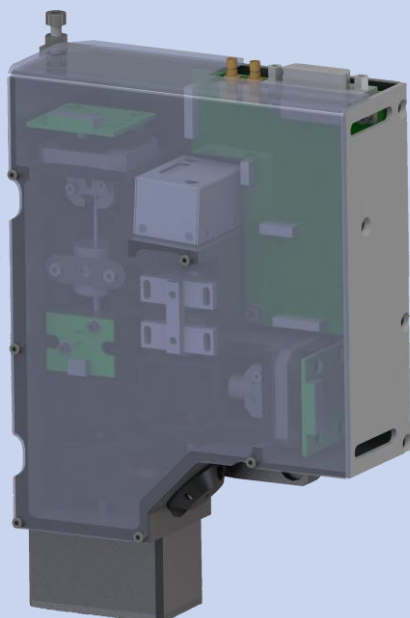
■ **Operation**

- A modern Microsoft Windows based user interface allows for user-friendly operation.

- Highly automated processing, one button operation.

- Short preparation time required using PicoMaster Project Manager and PicoMaster Machine
  Controller applications. On the fly processing of jobs, minimum pre-processing required.

- Up-to-date online manuals.

- Remote internet support.

■ **Installation and maintenance**

- The PicoMaster 200 is a stand alone system which allows for quick and easy installation.

- Compact optical module: use a spare optical module for revolutionary machine downtime reduction.

- Minimal maintenance costs, no regular maintenance required.

PicoMaster 200: the ideal Litho tool for R&D.

Optics

■   **Compact optical module for excellent stability & revolutionary short machine downtime**

The full optical path is contained in a small easily changeable module (optical module). By keeping the optical path as short as possible, the pointing stability is greatly increased compared to traditional optical setups. The optical module contains a long lifetime 405 nm GaN laser diode and beam shaping optics for the best spot shape. Together with 4PICO's proprietary high NA objective lens this results in the smallest high quality laser beam spot available on the market.

Features:
- Smallest high quality laser beam spot available in the market.
- The integrated 650 nm red laser controlled autofocus system automatically corrects for height variations.
- Intergrated Dose control.
- Option: a 375 nm wavelength optical module can be supplied on request.
- Option: for less demanding tasks a larger spot size can be selected by using a fully automated NA switch. This switch allows the system to use a larger spot for increased speed.
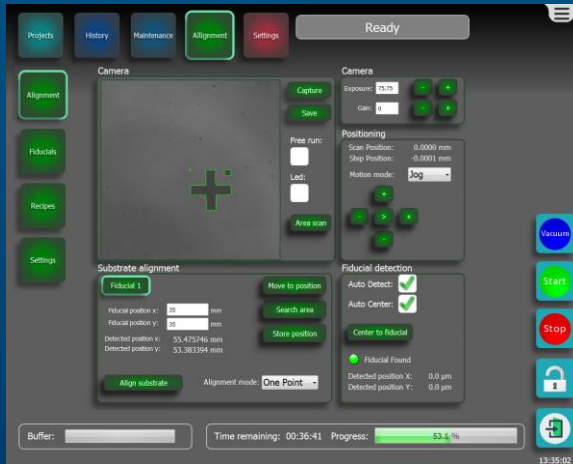
Optical properties	
Laser source	405 nm, GaN laser diode.
Lifetime	>10.000 hours
Write modes	0.3 µm, optional 0.6 µm and 0.9 µm FWHM.
NA	0.85
Working distance	0.6mm
Intensity	Max. 3 mW in the spot. Software controllable.
Grayscale control	4095 levels
Autofocus	800 Hz bandwidth, 650 nm red laser controlled -0.3…x…+0.3 mm height variation with auto height tracking. Fast voice coil actuator for accurate real-time Z correction.
Focus offset	Adjustable by software control.

Unique
Smallest high quality focused laser beam spot available in the market

Close to perfection
Automated marker recognition reduces operator errors

# Top Side Alignment

■ **Top side alignment**

The optical module is equipped with a high resolution camera for applications which require multiple layers. The camera images are processed by advanced imaging software. Automatic marker recognition makes it easy for the user to locate the markers. The user can teach any shape to be used as marker. When the marker cannot be found in the camera's field of view the software supports area scan to automatically search the marker in a larger area. Alignment and image compensation can be based on one, two or three markers.

| Specifications Top side alignment	
Alignment camera	Monochrome 5.2 Mpixel.
Pixel resolution	1 µm
Final alignment accuracy	< 0.5 µm
Correction algorithmes	Position, Scale (max 5%), Skew, Rotation (Max +/-5 degrees) Rotation correction is performed by interpolated motion between scan and step axis.
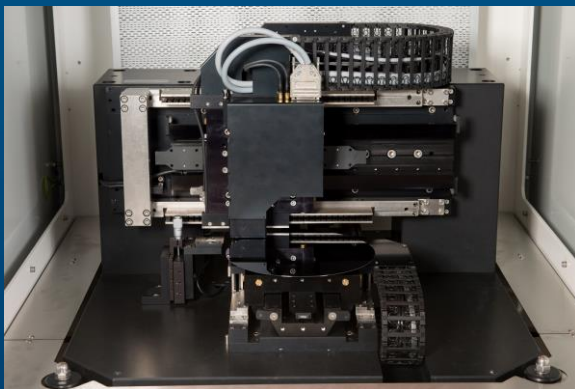
Benefit

Maintenance free axes

Mechanics

The PicoMaster 200 is equipped with high precision axes for X and Y motion and one optional axis for Z motion. Both the scan axis (Y) and step axis (X) incorporate high precision dove tail air bearings which are driven by linear motors with nanometer resolution encoders. This system allows for extreme low mechanical errors and fast scan movements. The optional motorized controlled Z-axis has a 12 mm stroke to support various substrate thicknesses.

Substrates are clamped down by using a vacuum chuck. Vacuum chucks are easily exchangeable to support different substrate sizes.

Mechanical properties	
Stroke Scan and Step	Max. 250 mm
Repeatability	< 20 nm RMS
Resolution	2 nm
Scan speed	Max 400 mm/s
Straightness axis	< 1 μm over 230 mm
Substrate thickness	0 - 4 mm manual adjustment. 12 mm with the optional motorized Z-axis installed.
Substrate thickness variation	Max +/- 0.15mm
Substrate size	Min. 5 x 5 mm, max. 220 x 220 mm.
Exposable area	Max. 215 x 215 mm (speed dependent).
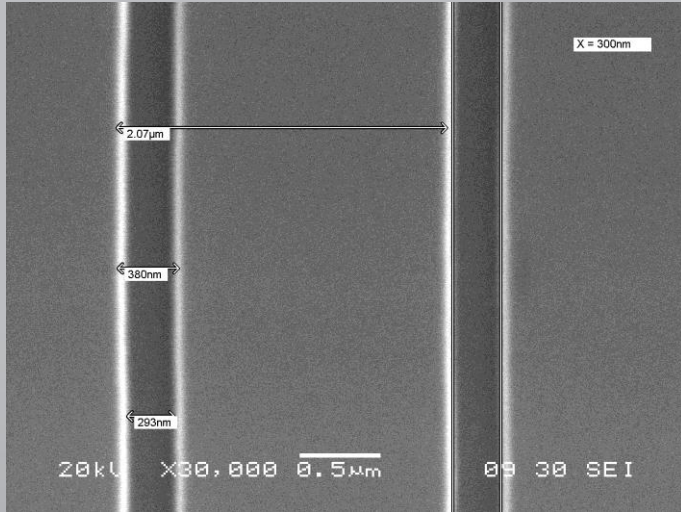
Performance

300nm lines

Performance specifications	
CD[1]	Min. 300 nm
Line width uniformity	< 50 nm
Address grid	Selectable. Standard: 20 nm in scan direction and 100 nm in step direction.
Data rate	10Mhz

[1]*Critical Dimension of the PicoMaster strongly depends on process parameters, such as resist types and layer thickness.*

Writing speeds	Resolution (µm)	Normal Quality (mm²/min)	Reduced Quality[2] (mm²/min)
High resolution	0.3	1.7	2.6
Mid resolution	0.6	3.4	5.3
Low resolution	0.9	5.2	7.7
Extra low resolution	5 (example)	29	43

[2]*When exposing with reduced quality the line edge roughness will increase.*

Screenshot of the visual Project Manager software.

User friendly

Minimum preparation time required using PicoMaster Project Manager and PicoMaster Machine Controller

Software

■ **PicoMaster Machine Controller and PicoMaster Project Manager**

The Picomaster comes with two Windows based applications: PicoMaster Machine Controller and Project Manager. Project Manager allows the user to select features and combine images while PicoMaster Machine Controller processes these jobs and control the machine. Jobs are processed on the fly, reducing preparation time to the minimum.

PicoMaster Machine Controller allows the operator to queue jobs, monitor progress and gives a high level of manual control features.
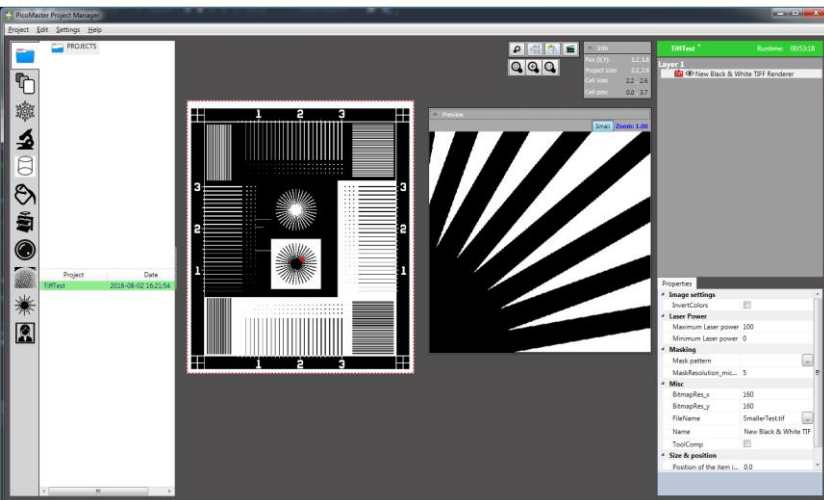
Features of PicoMaster Machine Controller:

- On the fly processing of jobs.
- Job queuing.
- Freely definable process and substrate recipes.
- Extended history database.
- Remote support.
- User access control through login credentials or smart card.

Supported formats	
Standard binary sources	Bitmaps, TIFF, GDSII
Offline conversion required	CIF, DXF
Parameterization	Basic shapes can be configured without source files.
3D sources	Grayscale bitmaps, Parametric.

■ **User Algorithms**

PicoMaster software supports user libraries. These libraries can be written in C# or VB.net. With these user libraries the user can create his own algorithm to calculate the laser intensity at each grid point.

Benefit

*PicoMaster 200:
a stand alone system
that allow for quick
and easy installation*

Options

■ **Additional write modes**

The optical module can be fitted with an automatic Numerical Aperture switch. Standard the PicoMaster 200 is fitted with a single spot for resolutions as small as 300 nm. For some applications this resolution is not required. The NA switch allows the user to select a lower resolution. This will enable increased writing speeds at lower resolutions.

Additional write modes	
Standard included: high resolution	0.3 µm
Mid resolution	0.6 µm
Low resolution	0.9 µm

■ **Extra-low resolution**

Standard the PicoMaster 200 comes with the highest resolution available in combination with a 405 nm laser source. Sometimes this is too small for the desired application. A second optical path with a low NA focus lens can be fitted to increase the spot size. Please contact us to discuss the required application.

■ **375 nm Optical module instead of 405 nm**

The system can be equipped with a 375 nm optical module. This allows the user to use resists only suitable for I-line light sources. Additional the spot size is reduced to 270 nm. This will allow the system to write lines at even higher resolutions.

■ **Holographics software libraries**

The high resolution optics and mechanics make the PicoMaster 200 a suitable platform for creating diffractive images. The holographics software libraries allow the user to create and design stunning security and decorative images. The software libraries consist of over 20 different features from basic blends to Fresnel lenses.

Convenient

A standard 12-month warranty and an optional extended warranty

■ **Motorized Z stage**

Some applications require thick substrates. The motorized Z stage will allow the system to detect the surface of a wafer fully automatically. Operator interference for height adjustment based on the used substrate is not required.

| Mechanical properties motorized Z stage	
Stroke	Max. 12 mm
Resolution	1 µm
Wafer thickness	0 - 10 mm

■ **Extra optical module**

The compact optical module is mounted to the step axis by just 3 bolts and a few electrical connections. Within 5 minutes the entire optical module can be swapped for a different module. When uptime is of critical importance, a spare optical module can be added. There is no need for optical alignment after an exchange. This unique feature introduces a revolutionary reduction of machine downtime!
The extra optical module can be fitted with either a 405 nm or a 375 nm laser diode.

■ **Extended warranty**

Standard the system comes with a 12-month warranty. The warranty can be extended on a yearly base. The extended warranty includes software updates, telephone and remote support and all non-wear and tear parts.

■ **Air-conditioning unit**

For best results the temperature inside the PicoMaster 200 should be maintained at constant environment conditions with a temperature range of +/- 0.5 ˚C and a humidity range of 45 - 70%. It is strongly recommended to use a dedicated air conditioning unit to supply conditioned air to the PicoMaster 200.
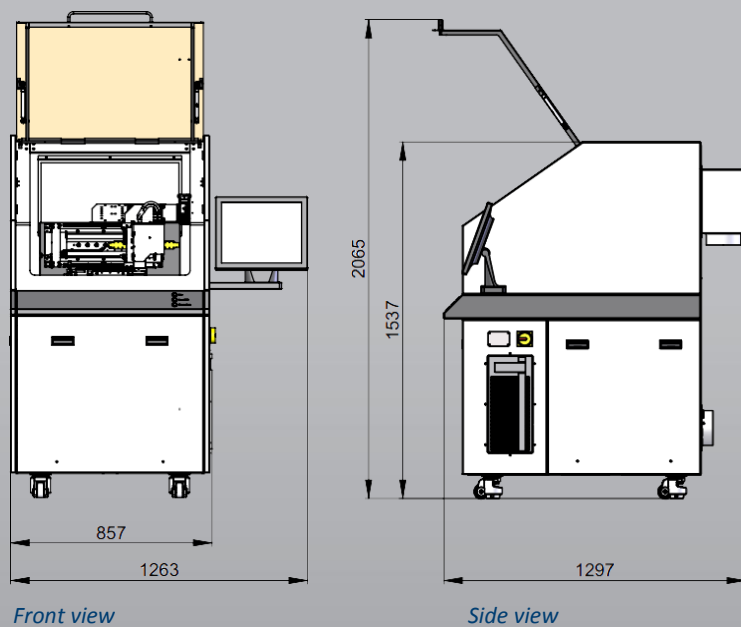
Installation requirements

Front view

Side view

Dimensions[1]	
Width	Width fixed screen: 1260 mm. Without screen 860 mm.
Height	To ceiling: 2065 mm
Depth	1297 mm
Weight	700 kg
Electrical connection	230V AC, max. 1 kW
Compressed air	5 - 7 Bar, Air quality according ISO8573-1:2010 class 3 or better.
Ethernet	For server connections and remote access.
Conditioned air piping[2]	Ø 150 mm in and out
Recommended environment	Clean room ISO class 5 or better.
	Room Temperature 21 °C +/- 1 °C
	Room Humidity 45 - 70% RH

[1] *Specifications may change without notification.*

[2] *It is strongly recommended to use an air conditioner with recirculation option to maintain optimal process conditions within the PicoMaster. A conditioner can be supplied as option.*

About 4PICO Litho

4PICO Litho is specialized in lithography equipment since 2004. The PicoMaster systems are a derivate of 4PICO's CD/DVD mastering system and built on 15 years of experience. The efficient multidisciplinary team of 4PICO Litho is based in Brainport Region and has access to high tech suppliers. All developments are done in-house.

Innovation

Brainport Region:

A perfect ecosystem

for innovation

Service and dealer information

■ **Samples**

Seeing is believing… 4PICO Litho's demo samples are state-of-the-art. Send in your requirements for a sample. At all times at least 1 demo system is operational.

4PICO Litho has in-house metrology tools such as Microscope, AFM and SEM for analyzing the samples.

■ **Service**

Local service engineers, remote support and minimum maintenance will guarantee a smooth and worry-free operation.

■ **Dealer**

Questions regarding the PicoMaster 200 and your application: please contact your local contact.

State-of-the-art

4PICO Litho's

demo samples are state-of-the-art

Your dealer

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