SÜSS MicroTec

MA/BA6+

HIGH-PRECISION MASK AND BOND ALIGNER

UNIVERSAL FULL-FIELD EXPOSURE TOOL
MAXIMUM FLEXIBILITY FOR VARIOUS APPLICATIONS

The SUSS MA/BA6 mask aligner is widely recognized as a benchmark in semiconductor submicron research and microsystems production. With its innovative design the platform meets customer needs for precision, flexibility and low cost of ownership. Processes designed on the MA/BA6 in a laboratory environment are easily transferred to volume production on automated SUSS mask aligners.

The MA/BA6 is designed for all standard lithography applications and wafer sizes of up to 150 mm. For thick-resist MEMS applications, the MA/BA6 offers high resolution and optimum edge quality. The bottom side alignment option allows for pattern printing on both sides of the substrate. The MA/BA6 additionally provides tailored features for fragile III-V compounds, thinned or warped wafers, transparent substrates and pieces or single dies.

HIGHLIGHTS

+ Top side / bottom side / infrared alignment
+ Customized illumination and diffraction-reducing exposure optics
+ Manual or motorized stage
+ Processing of wafers or squares from 2" to 150 mm
+ Processing of fragile, warped or uneven wafers and pieces
+ Pieces down to a few millimeters in top side or bottom side alignment mode

OPTIONS

+ High accuracy bond alignment
+ Imprint lithography for full wafer and small area printing of geometries in nanometer range
+ Lithography simulation software

APPLICATIONS
IN RESEARCH AND PRODUCTION

MEMS
With its high intensity exposure optics, the MA/BA6 offers efficient support for thick-resist MEMS applications. Features like back side or infrared alignment (transmission or reflective illumination), bond alignment and the capability to process any type of substrates make the MA/BA6 an enabling lithography tool for the development and for low volume production of MEMS devices.

ACADEMIA
The MA/BA6 stands for versatility and ease of use, which makes it the tool of choice for research applications. Whether deployed for nanoimprint lithography, bond alignment or thick-resist lithography applications, change-over to a different process is quickly executed, guaranteeing full flexibility. Equipment options range from a low-cost manual set-up for basic studies to a fully motorized system.

3D STRUCTURING
The MA/BA6 covers all aspects of nanoimprint lithography solutions from low to high resolution and from small to large area. The UV-NIL option is aimed at high resolution prints on small substrates. For full wafer imprint up to 150 mm, SUSS MicroTec's unique SCIL nano-imprint technology is the optimal choice.

ALIGNMENT
PRECISION - RELIABILITY - EASE OF USE

TOP SIDE ALIGNMENT (TSA)
The MA/BA6 is equipped with a motorized top side alignment system which can reach an alignment accuracy of ± 0.5 µm. Using the optional turrets enables the operator to easily switch between different magnifications.

BOTTOM SIDE ALIGNMENT (BSA)
In addition to top side alignment, many applications such as MEMS require precise bottom side alignment. The MA/BA6 can optionally be equipped with bright-field bottom side microscopes. They include an optical magnification switch and facilitate 1 µm alignment accuracy. The BSA microscope with single- and splitfield features uses high resolution CCD cameras. The unique image storage and realtime image processing is more precise and faster than common crosshair alignment.

INFRARED ALIGNMENT (IR)
Infrared alignment allows for processing opaque, yet IR-transparent materials such as GaAs, InP, silicon or adhesives, as used for thin wafer handling or encapsulation applications. The MA/BA6 is optionally equipped with either a transmissive or reflective IR toolset attached to the standard BSA microscopes.

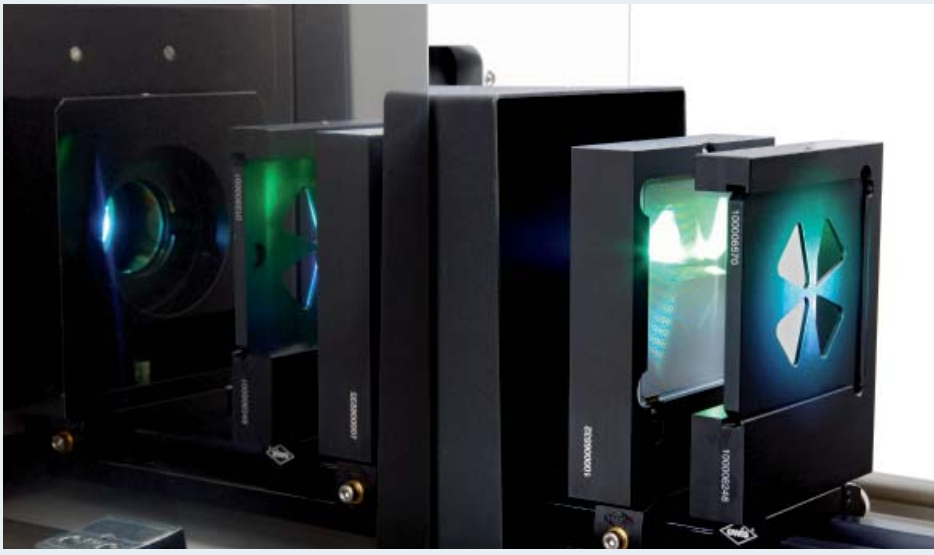
ENHANCED IMAGE STORAGE SYSTEM (EISS)
SUSS MicroTec's enhanced image storage system meets highest alignment demands. Features range from SVGA resolutions and contrast enhancement to electronic brightness and contrast adjustment, as well as brightness-ratio adjustment between stored and live image.

LARGE-GAP ALIGNMENT

The MA/BA6 is equipped with the AL400, a large-gap alignment option, that ensures high accuracy alignment even in applications that require large alignment gaps between mask and wafer.

EXPOSURE OPTICS
TAILORED SOLUTIONS FOR ANY REQUIREMENT

Available Optics Systems in the MA/BA6
- High-Resolution Optics (HR Optics)
- Large-Gap Optics (LGO)
- MO Exposure Optics® (MOEO)

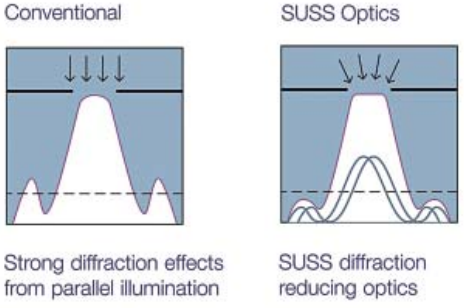


HIGH-RESOLUTION OPTICS
The special HR Optics have been optimized for highest optical performance in small exposur gaps or in contact exposure mode.
The high resolution optics achieve resolution down to 2.5 µm at 20 µm exposure gap and submicron resolution in contact.

LARGE-GAP OPTICS
SUSS MicroTecs Large-Gap Optics are tailored to achieve high resolution when exposing in large mask-to-wafer distances through a dedicated illumination angle setting. This optics are typically used for applications with high topography substrates or thick resist applications.

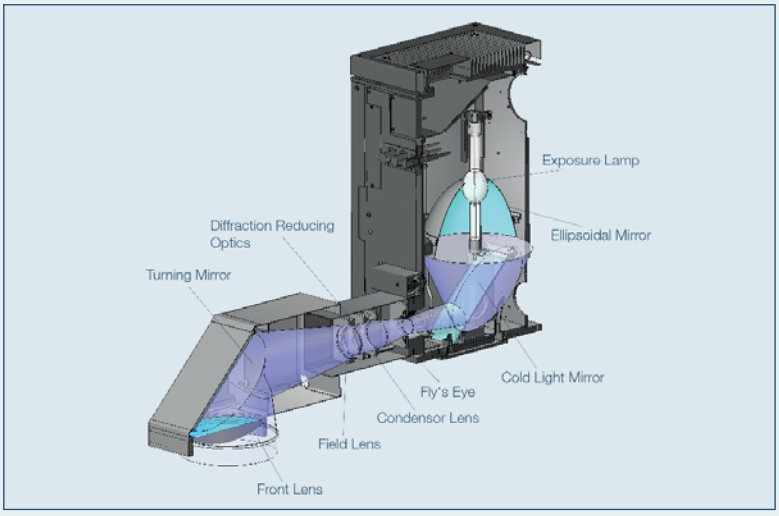
MO EXPOSURE OPTICS®
MO Exposure Optics are based on unique high-quality microlens arrays that are combined with an exchangeable Illumination Filter Plate (IFP). They provide outstanding light uniformity and allow quick and easy changeover between both classical SUSS exposure optics, HR- and Large-Gap Optics. MO Exposure Optics additionally allow customized illumination through modification of the IFP and enable use of enhanced lithography techniques such as source-mask optimization (SMO) or Optical Proximity Correction (OPC).

DIFFRACTION REDUCING SYSTEM
SUSS MicroTec's unique exposure system minimizes resolution-limiting diffraction effects at feature edges. The system allows simultaneous exposure with a certain number of illumination angles to smooth out the printed features - a technology that results in significant improvement of resolution and yield.



Strong diffraction effects from parallel illumination (graphics left) vs. SUSS diffraction-reducing optics (graphics right). SUSS MicroTec is the only semiconductor equipment supplier offering diffraction reducing optical setups.

EXPOSURE
INTENSITY ADAPTED TO APPLICATION NEEDS



Optical System of a SUSS MA/BA6 Mask Aligner

EXPOSURE MODES

The MA/BA6 offers various exposure modes to meet any requirements for a broad range of applications. Soft, hard and vacuum contact printing is used to achieve highest resolution down to submicron range. Proximity printing is applied to avoid any mask/wafer contact. The prevention of mask contamination directly translates into higher yield.

MA/BA6 RESOLUTION

EXPOSURE MODE	UV400	UV300	UV250
Vacuum Contact	< 0.8 µm	< 0.7 µm	< 0.6 µm
Hard Contact	< 1.5 µm	< 1.0 µm	-
Soft Contact	< 2.5 µm	< 2.0 µm	-
Proximity (20 µm)	< 3.0 µm	< 2.5 µm	-

Line, Space resolution achieved on 150 mm Si-wafer in 1.2 µm thick resist AZ 4110 (UV400, UV300) and 0.8 µm thick resist (UV6, UV250) respectively.

Achievable resolution depends on wafer size, wafer flatness, resist type, clean room condition, and therefore, might vary for different processes.

WAFER LEVELING AND EXPOSURE GAP CONTROL
PRECISION FOR HIGHEST RESOLUTION

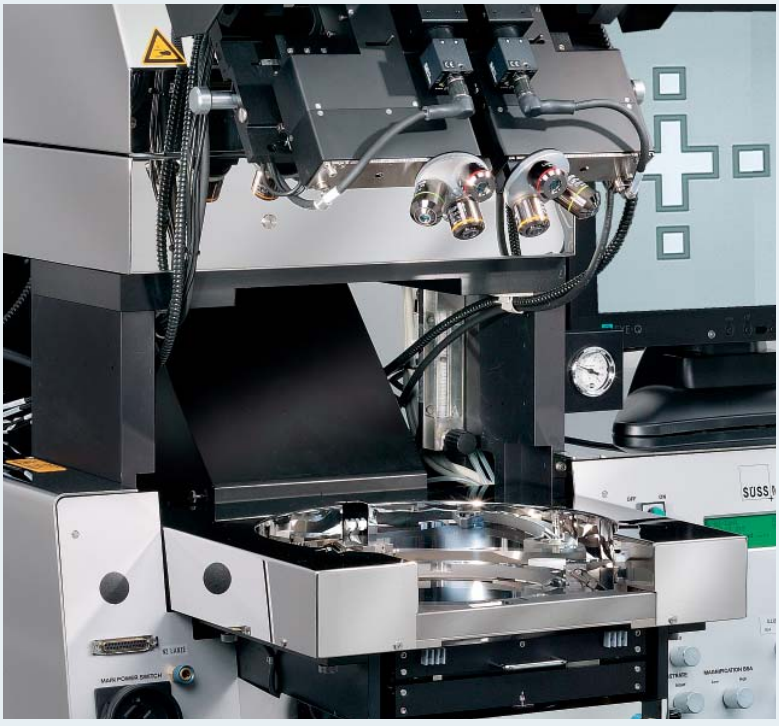
Accurate leveling and gap control of mask and wafer is essential for optimum CD-control. It ensures the parallelism of mask and substrate during alignment and exposure as well as precise gap control, to avoid parallax errors and to achieve higher resolution. The leveling and gap calibration system of the MA/BA6 is designed to fulfill highest demands with regards to accuracy and reliability.

OPTIONS

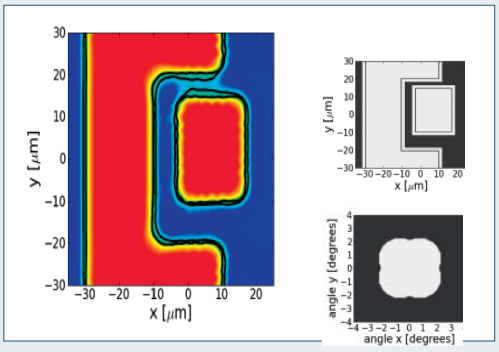
OPTIONAL ENHANCEMENTS
BEYOND STANDARD LITHOGRAPHY

BOND ALIGNMENT
The MA/BA6 offers a highly precise alignment function for wafer-to-wafer bonding. Based on SUSS MicroTec´s enhanced image storage system (EISS), the bond alignment system achieves alignment accuracy of 0.5 µm. The SUSS bond fixture maintains the alignment precision of the wafer stack during manual transfer from the aligner to a SUSS bonder and ensures a controlled gap between the substrates. The bond alignment functionality is either integrated in the MA/BA6 or available as a stand-alone bond aligner, SUSS BA6/8.

FUSION BONDING
The MA/BA6 supports fusion bonding processes in the tool itself. After precise alignment, the two wafers are brought into direct contact, thus initiating the fusion pre-bond process in the bond aligner.



LAB® SIMULATION SOFTWARE
The SUSS version of the LAB lithography simulation software incorporates all SUSS MicroTec optics solutions, such as HR-, LGO and MO Exposure Optics including their individual characteristics. The software reduces the need for experimental layout optimization and simplifies process development. Together with MO Exposure Optics, LAB simulation software is the enabling technology for mask aligner source-mask optimization.



Software simulation of critical features and shortenings, optimized with customized illumination and OPC

Courtesy: FhG IISB

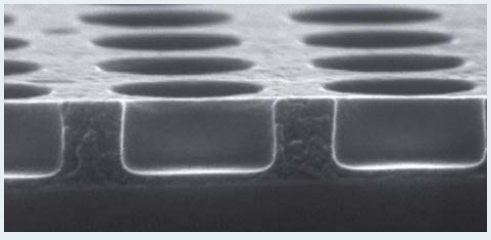
OPTIONAL ENHANCEMENTS
BEYOND STANDARD LITHOGRAPHY

IMPRINT LITHOGRAPHY

UV-NIL
Low-cost production UV-NIL solutions for nano-structures today may be the enabling technique for next-generation semiconductor, MEMS and optoelectronic technology.
UV-NIL uses small (1"x1") rigid or softstamps and UV curing inside the MA/BA6 Mask Aligner. UV-NIL can be used to reach sub-50nm resolution, thus forming a cost-effective alternative to e-beam lithography. It can be attached to the mask aligner as a tool set and also be upgraded in the field.

UV-NIL imprinted structures

SCIL
Substrate Conformal Imprint Lithography (SCIL) combines the advantages of a soft composite working stamp for large area patterning with a rigid glass carrier for low pattern deformation and best resolution. SCIL uses a sequential imprinting principle that applies capillary forces instead of backside pressure, minimizing air inclusions even on large areas, ensuring highest uniformity. Sequential separation of stamp and substrate prevents high forces and allows for clean and reliable separation without damage to patterned structures.



SCIL imprinted structures

TECHNICAL DATA

MASK AND WAFER / SUBSTRATE	
Wafer Size	up to 150 mm
Substrate Size	up to 6" x 6"
Pieces	down to 5 x 5 mm
Mask Size	SEMI spec, standard up to 7" x 7"
EXPOSURE MODES	
Contact	soft, hard, low vacuum, vacuum
Proximity	exposure gap 1-999 µm
Flood Exposure Mode	Yes
Gap Setting Accuracy	1 µm
Vacuum Contact	adjustable to 200 mbar abs
EXPOSURE OPTICS	
Resolution	see page 5 down to 0.5 µm
Wavelength Range	UV400 350 - 450 nm UV300 280 - 350 nm UV250 240 - 260 nm
Exposure Source	Hg lamps 200 - 1000 W HgXe lamp 500 W
Intensity Uniformity	± 5 % ± 2.5 % (MO Exposure Optics)
ALIGNMENT METHODS	
Top Side Alignment (TSA); Bottom Side Alignment (BSA); Infrared Alignment (IR), Large Gap Alignment (AL300)	
Dual Focus Alignment System AL400	
Enhanced Image Storage Alignment System	
Accuracy TSA	down to 0.5 µm
Accuracy BSA	down to 1 µm
Alignment Gap	1 - 999 µm 1 - 300 µm (with AL300)
ALIGNMENT STAGE	
Movement Range	X: ± 10 mm Y: ± 5 mm θ: ± 5°
Mechanical Accuracy	0.1 µm (step size)

Data, design and specification of custom built machines depend on individual process conditions and can vary according to equipment configurations. Not all specifications may be valid simultaneously. Illustrations in this brochure are not legally binding. SUSS MicroTec reserves the right to change machine specifications without prior notice.

TSA MICROSCOPE STAGE	
Single Field	X: ± 25 mm Y: ± 25/-75 mm
Split Field	X: ± 25 mm Y: ± 15/-75 mm; θ: ± 3° X: optional ± 50 mm
TOPSIDE MICROSCOPE TSA	
Single Field M500	up to 200 x
Split Field M306	up to 335 x
DVM6	up to 1045 x (17" screen)
IRDVM6	up to 1045 x (17" screen)
Objective Magnification	standard 2.5x, 5 x, 10 x, 20 x optional 5 x IR, 10 x IR
Split Field Objective Separation	with turret: 32-160 mm without turret: 27-160 mm
BOTTOMSIDE SPLITFIELD MICROSCOPE BSA	
Objective Separation	15 - 100 mm (62 - 148 mm optional)
Movement Range	Y: + 50/- 20 mm
Magnification	112/355 on 17" screen
Field of View	0.92 x 0.69 mm^2 (high magnification, full field)
UTILITIES	
Vacuum	<-0.8 bar, 200 mbar abs
Compressed Air	5 bar (75 psi)
Nitrogen	≥ 1 bar (15 psi)
With 350 W Lamp With 1000 W Lamp	0.3 m^3/h 0.9 m^3/h
POWER REQUIREMENTS	
Power	Voltage AC 230 V
	Frequency 50 - 60 Hz
Consumption with 350 W Lamp 500 W Lamp 1000 W Lamp	 1500 W 1700 W 2300 W
PHYSICAL DIMENSIONS	
H x W x D (LH1000)	1570 x 1214 x 1300 mm
H x W x D (LH350)	1535 x 1214 x 1300 mm
Weight	320 - 340 kg

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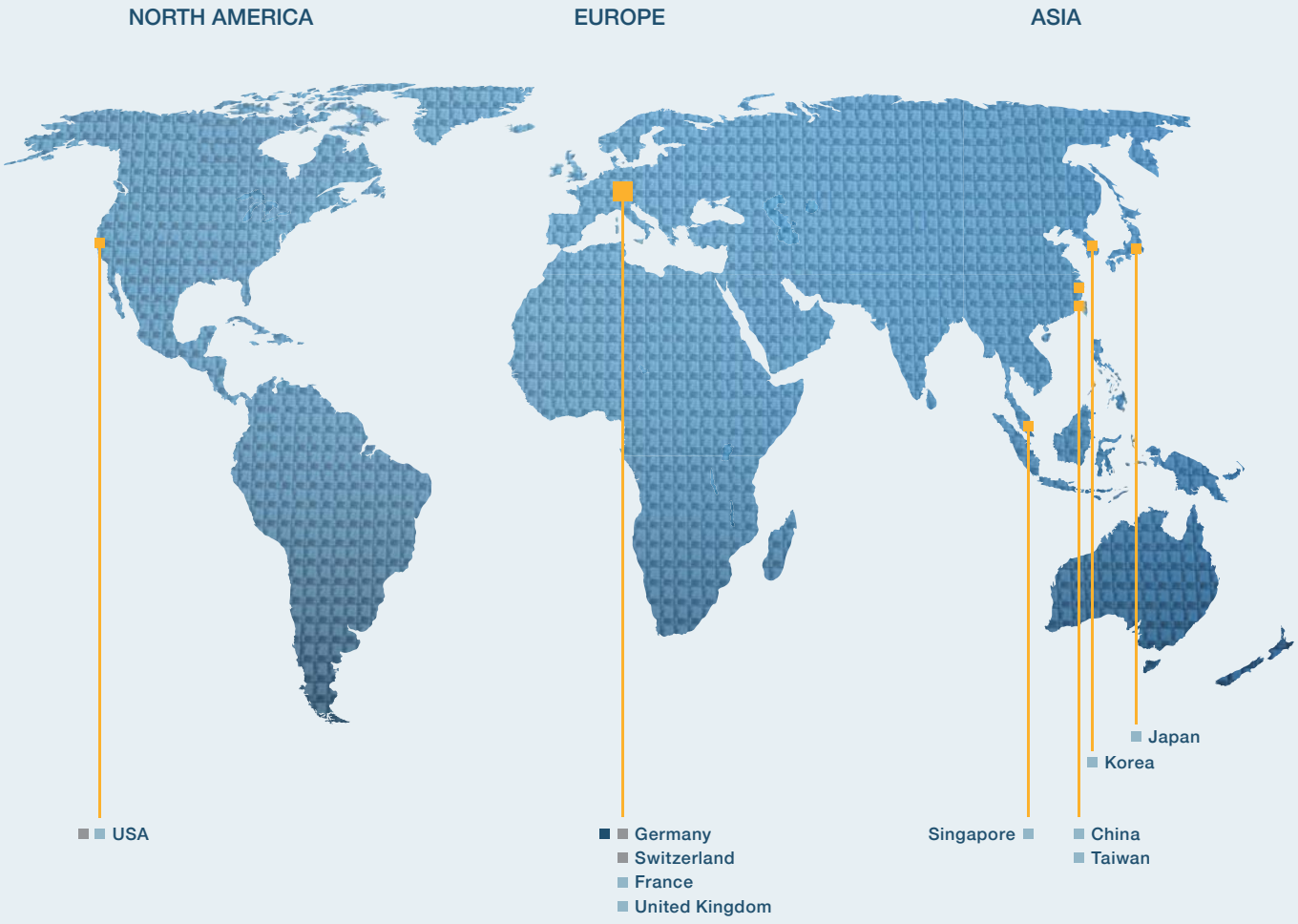

- Headquarters
- Production
- Sales

Visit **www.suss.com/locations** for your nearest SUSS representative or contact us:

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MA/BA6 · 09/2014 · BR_MABA6_2014 · V2