MICRONIC LASER SYSTEMS

Micronic Laser Pattern Generators

– Pattern Accuracy at the Speed of Light

Micronic Laser Systems provides laser pattern generators meeting the semiconductor industry requirements for state of the art photomasks with innovative technologies. Spatial light modulation (Sigma7000 Series) and acousto-optic raster scanning (Omega6000 Series) provide resolution and pattern accuracy for each technology node. Laser pattern generators continue to have short write times, good uptime and good yield.

The result - lower mask cost for every technology node.

Product Technology & Wavelength	Technology node 350 250 180 130 90 65
Omega6060 Raster scanning 413 nm	
Omega6600 Raster scanning 413 nm	
Sigma7100 SLM 248 nm	
Sigma7300 SLM 248 nm	

Sigma7300

The Sigma7300 is a DUV pattern generator based on spatial light modulation for image formation. The tool is targeted for manufacturing of photomasks at the 90 nm and 65 nm technology nodes. A high precision alignment system also enables production of phase shift masks.

Massively parallel printing limits write times to only a couple of hours. An easy to support modular platform with ultra-clean environment and SMIF ensures excellent uptime and production yield.

The Sigma7300 resembles a DUV micro-stepper where the spatial light modulator (SLM) is a computer-controlled reticle. It has the partial coherence and optimized illumination of the micro-stepper giving much better resolution than a raster scanner at the same wavelength, plus support for other stepper-type enhancement techniques.

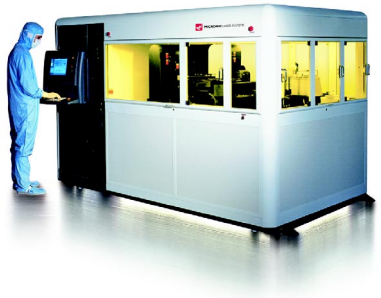
The Sigma7300 provides resolution and pattern accuracy earlier only expected from e-beam platforms, but with the short write time of a laser tool. In fact, with its enhancement techniques the Sigma7300 can be adjusted to meet design rules already set with other platforms in mind.



Omega6600

The Omega6600 is the latest laser raster scanner for standard i-line process building on the industry proven Omega6000 platform. A highly flexible architecture enables quality and throughput optimization for the maskshop. The tool uses digitally controlled acousto-optic modulation and acousto-optic deflection enabling extreme fine-tuning of CD control and placement. In high-quality mode the Omega6600 has the pattern accuracy to write most layers at the 130 nm node and in high-throughput mode at the 180 nm node.

As an option, Omega6600 can be equipped with a high precision alignment system for writing the second layer of phase shift masks.



Sigma7000 Series - Principle of Operation

The Sigma7000 light source is a pulsed excimer laser with 248 nm wavelength and high repetition rate. The light is focused on to the mask blank through a high NA reduction lens.

The pattern modulation is created by programming the spatial light modulator (SLM) between every laser flash. The SLM has a flat surface composed of a million mechanical micro-mirrors. The micro-mirrors can be slightly deflected with electrostatic forces by applying a voltage to them. Areas of the SLM with deflected mirrors scatter light outside of a Fourier aperture, in practice the aperture stop of the projection system. The scattered light is totally blocked by the Fourier aperture and will not reach the mask blank, or is attenuated, providing grayscale edge control. The SLM device works by diffraction and mirror deflections are very small.

The stage with the mask blank moves continuously and the interferometer commands the laser to flash when it reaches the position for the next field. Because of the short flash time, around 20 ns, the movement of the stage is frozen and a sharp contrast image of the SLM is produced in the photoresist. The SLM is reloaded with a new pattern in time for the next flash. The pattern is stitched together by overlapping fields.

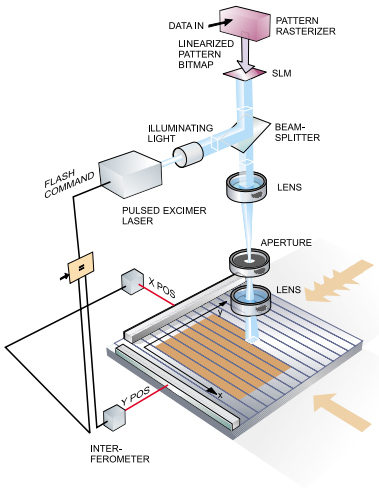
Omega6000 Series - Principle of Operation

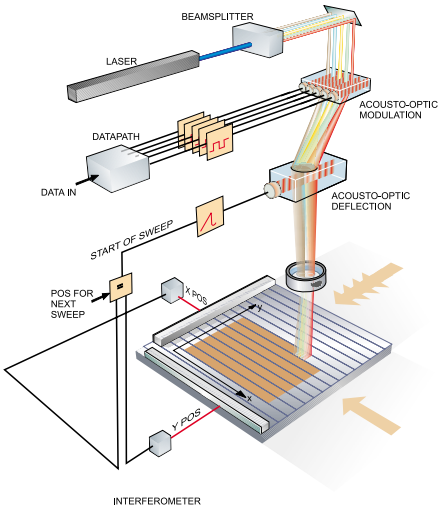
The Omega6000 raster scan pattern generator uses a 413 nm continuous laser, which is split into five beams for high throughput.

The five laser beams are individually modulated according to the pattern data in a five-channel acousto-optic modulator (AOM). The AOM combines digital and analog modulation, which creates an address grid much finer than the distance between adjacent sweeps, boosting the effective data rate.

The stage moves at a constant speed along the X axis and an acousto-optic deflector (AOD) deflects the five laser beams along the Y axis creating sweeps. This is repeated until the end of the pattern in the X direction, creating a scanstrip. After completing one scanstrip the stage retraces in X and moves in Y to the position of the next scanstrip. This process is repeated until the entire pattern area has been covered.

The sweeps created by the AOD are perpendicular to the sound wave in the AOM. This results in very good symmetry and pattern fidelity for contact holes and OPC features. Being an electronic device, the AOD allows a high degree of flexibility and calibration of the beam deflection to yield very accurate sweeps. Together with an advanced auto focus system, vibration-free linear motors and a stage with integrated air bearings, impressive linewidth control is achieved.





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