Welcome to Advanced Nanolithography
Beyond Speed Limits ...

XENOS Semiconductor Technologies GmbH

Product Sheet

# XENOS XPG2 WRITER


The **XENOS XPG2 Writer** is a system that designs pattern data and produces the respective deflection signals for beam steering of charged particle beams such as electron beams for semiconductor lithography applications or focussed ion beam systems.

When attached to a conventional scanning electron microscope, it upgrades the system to perform advanced electron beam nanolithography on semiconductor materials.

The **XPG2 Writer** consists of a fast pattern generator in order to produce the deflection signal data for the patterns which are then written by the SEM, e-beam or FIB system, implementing intelligent writing schemes and shape primitives so as to take full benefit of limited deflection chain bandwidths. The system is supplied with user-friendly and application-based *ECP* design and control software. Firmware boot from PC and configurable programmable logic allow easy firmware updates as well as the implementation of new features without actual hardware changes.

## KEY HARDWARE SPECIFICATIONS:

- **Writing Speed:** up to 40 MPixels/s digital scan generation
- **Resolution:** 16 Bit with ultra low noise analog outputs
- **Implemented Shapes:** dot, single pixel line, rectangular primitives (spiral or meander fill), trapezoidals, triangles, parallelograms, arrays of any single shape, 3rd order polynomials, circles, rings or segments, import of image files (*.bmp, *.jpg ...) and AutoCad/ Autosketch *.dxf
- **Writing Clock:** 10 kHz up to 40 MHz in 1 kHz increments
- **Digital Full Bandwidth Field Correction:** shift, size, rotation and orthogonality
- **Mark Detection Input:** analog input for electron detector output (adjustable gain and offset) with 12 Bit sampling, 2048k FIFO, single line scan, selected area or full frame
- **Deflection Outputs:** analog outputs: up to +/- 10V (terminated and galvanically isolated, adjustable)
- **Blanker Output:** fibre optics blanker driver 820 nm ST connector on 62,5 µm multimode fibre
- **PC Interface:** USB for pattern data, mark detection video data transmission, system control and firmware boot

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## KEY *ECP* SOFTWARE SPECIFICATIONS:

- **Exposure Patterns:** design of shapes (with hierarchical structures), dose clock and field size within the writing field
- **Batch Processing Files:** design of size and position of multiple writing fields for larger areas (with stitching between fields), controls for writing scheme (calibration, alignment, current steering, user breaks...), automated cutting of shapes
- **Control of SEM Exposures and Pattern Generator:** control of single field or batch exposure, statical focus over the exposure specimen
- **Stage Control:** mapping of user coordinates, homing, absolute and relative positioning, predefined positions
- **Focus, Field and Stage Calibration:** calibration of deflection and stage coordinates (relative to laser interferometer coordinates if installed), statical feedback of the mechanical stage misalignment, correction of the electron beam's focus after stage positioning
- **Mark Detection and Alignment:** calculation of field correction parameters, scan control of the alignment marks

*The XPG2 offers 4 essential advantages:*

**High Writing Speed**
Pixelrates up to 40 MHz can be realised with the **XPG2** system. Due to intelligent writing algorithms, the limited deflection bandwidth of current SEMs is taken into account. Optimized data transmission and settling time calculation are matched to the high writing speed in order to provide all of the advantages of fast writing.

**Intelligent and Versatile Writing Primitives**
In competing systems, curved structures like circles, rings or ellipsoids will be written by a polygonial approximation of the structures. Arising problems are due either to poor approximation or huge amounts of data that have to be processed and that often results in undesirable blanking between the polygonial parts of the structures.

The XPG2 implements a polynomial scan logic of 3rd order that can generate and write those polynomials at maximum speed solely based on hardware and thus improved in comparison with our competitors. Circles, rings or ellipsoids can therefore be written by concentrical single pixel rings, usually without blanking during the exposure. Thus, maximum writing speed and approximation quality can be achieved with minimum data overhead and transmission time.

Moreover, the sinusoidal shape of the deflection signals consumes much less deflection bandwidth than raster scanning of polygonial parts of the structures.

Furthermore, the **XPG2** writing algorithm symmetrically uses the bandwidth of X- and Y- axis.

**Extreme Flexibility**
The modular system can be configured to suit your needs perfectly. Logic configuration and DSP kernel can be updated within only a few minutes in order to supply new features.

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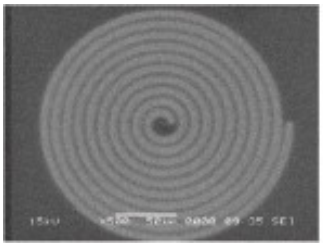
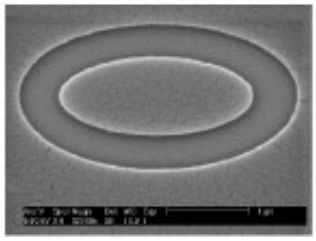
**Latest Digital Electronics, User Friendly Software and First Class Accessories**
The complete deflection signal generation is implemented in a programmable logic device with 16/32 bit per axis. The field correction does not use bandwidth limiting multiplying analog DACs, but is fully digitally built, therefore writing at maximum speed without any distortions in the resulting deflection signal.

The exposure dwell time is generated linearily with sub nanosecond resolution. Our CAD and control software ECP has been written by experienced lithography users. This makes ECP a user friendly and lithography user specific system. ECP is available for Linux or Windows, whilst the CAD part can be used at liberty within the workgroup. The system can be completed by a range of specimen stages, from ultra compact piezo stage with 100 nm resolution that can be easily fitted into the chamber of any popular SEM up to fully featured laser interferometer stages.

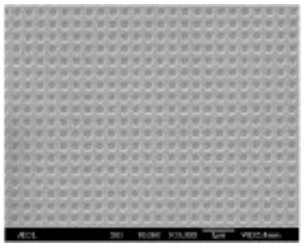
## Intelligent and Versatile Writing Primitives



Spiral structure exposed with XPG2 and JEOL JSM-6480 into PMMA (70 nm) on Si

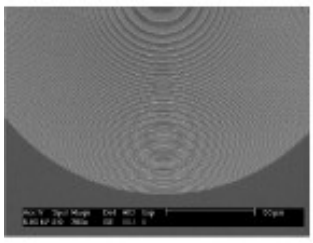


Elliptic ring, exposed with XPG2 connected to FEI XL30 FEG SEM into PMMA (100 nm) on Si

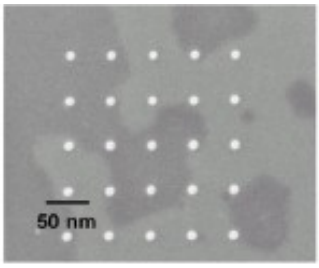


Array of 200 nm dots exposed with JEOL JSM-7000F Beam Draw into PMMA (80 nm) on Si

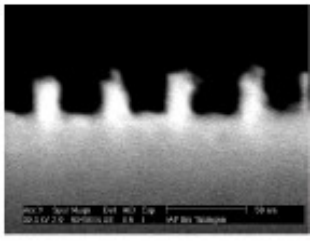
## High Resolution and High Writing Speed



Fresnel lens exposed with XPG2 and FEI XL30 FEG SEM at **12.5 MHz** into PMMA (100 nm) on Si, overall exposure time 80 seconds




**Sub 10 nm** dots exposed with XPG2 connected to ZEISS 1530 (*University of Pittsburgh*)



**Sub 20 nm** lines patterned with HSQ resist on Si (*courtesy Institute of Applied Physics , University of Tübingen*)

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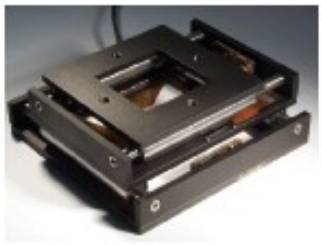
**Latest Digital Electronics, User Friendly Software and First Class Accessories**

High-end electronics
DSP and Gate Arrays



Ultra compact piezo stage,
100 nm resolution,
20 or 30 mm travel

ECP CAD and control program

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