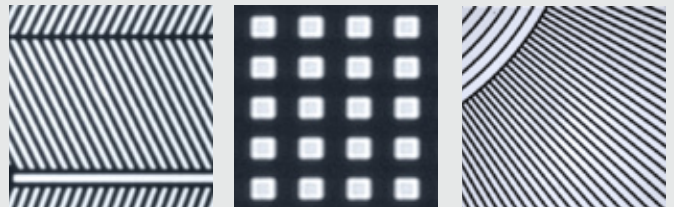


# VPG<sup>+</sup> 200 / VPG<sup>+</sup> 400 / VPG<sup>+</sup> 800

THE SMALL- AND MEDIUM-AREA VOLUME PATTERN GENERATORS  
FOR PHOTOMASK PRODUCTION



# VPG<sup>+</sup> 200 / VPG<sup>+</sup> 400 / VPG<sup>+</sup> 800

## THE SMALL- AND MEDIUM-AREA VOLUME PATTERN GENERATORS FOR PHOTOMASK PRODUCTION

Our small- and medium-area Volume Pattern Generators VPG<sup>+</sup> 200, VPG<sup>+</sup> 400, and VPG<sup>+</sup> 800 are a family of flexible multi-purpose photomask writers that fulfill the stringent requirements associated with the production of demanding binary photomasks in fields such as high-resolution electronic packaging, touch panels, or in general binary templating. The three systems are designed to handle different sizes of photomasks from 9" x 9" to 32" x 32", and all feature the same ultra-high-speed exposure engine and automated alignment capabilities, as well as exchangeable write modes.

### PRODUCTIVITY: THE HIGH-SPEED EXPOSURE SYSTEM

The light engine of our VPG<sup>+</sup> systems is based on a high-speed 1D optical modulator, the grating light valve (GLV). In combination with a high-power DPSS laser (355 nm) this forms an ultra-high-speed exposure engine that enables significantly reduced write times.

This means high throughput (more than 7800 mm<sup>2</sup> / min) and maximization of production output. In a 24/7 production environment, the VPG<sup>+</sup> can achieve a volume of over 1000 packaging masks per month. It also delivers speed in the context of higher precision production: a 14" mask with 1 μm resolution can be written in under 40 minutes.

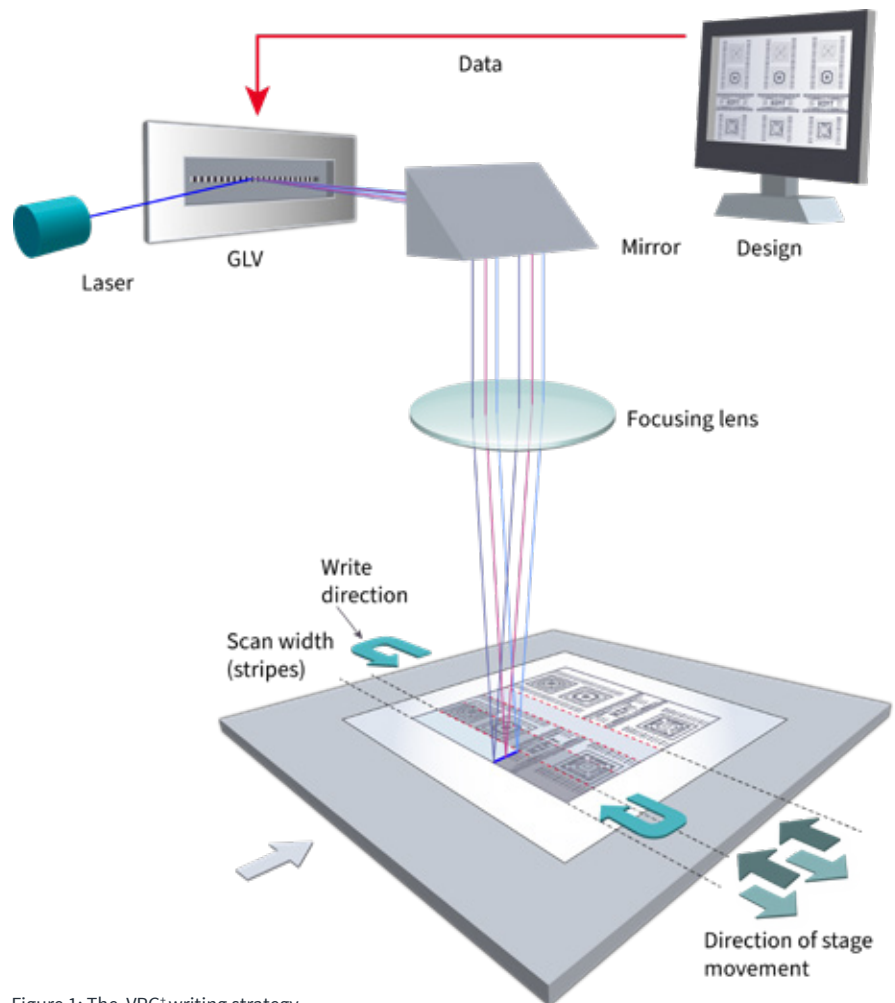


Figure 1: The VPG<sup>+</sup> writing strategy

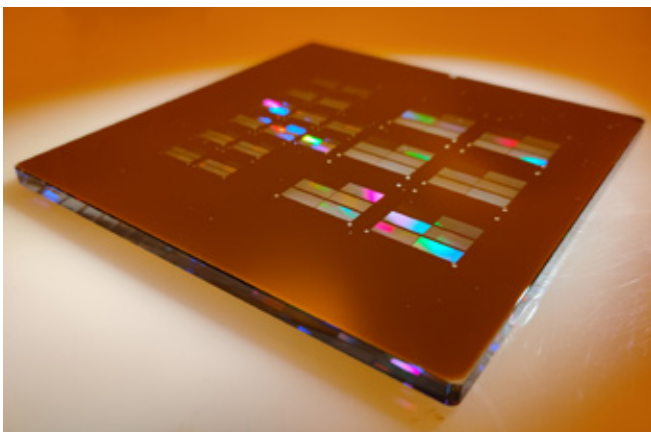


Figure 2: 6" reticle with demo pattern

### APPLICATIONS: PHOTOMASK PRODUCTION

A photomask serves as a master template for photolithographic manufacturing and as such has to fulfill highest requirements with regards to line-width uniformity, pattern position accuracy, edge roughness, and minimum feature size.

Our VPG<sup>+</sup> systems have been designed to be the ideal tools for the production of demanding photomasks – particularly for applications like MEMs, sensors, through-glass via (TGV), 3D-integration, and other advanced packaging technologies – and are found in mask shops around the world.

## FLEXIBILITY

In this family of photomask writers, the powerful optical engine and exposure strategy has been adapted to serve different photomask sizes, along with different handling requirements. Each system can be further configured to specific applications.

All systems offer a selection of write modes, allowing prioritization of either high resolution or high speed, plus the most advanced I-QX mode that features high resolution at enhanced structure quality and specifications.

In addition to the features shared by all three systems, the VPG<sup>+</sup> 200 and VPG<sup>+</sup> 400 offer a number of options that further allow to address specific requirements, like customized chucks made of granite or Zerodur™ and full automatic mask loading up to 14".

The VPG<sup>+</sup> 800 is equipped with a semi-automatic substrate loading system as standard, and includes automatic write mode exchange.

## HIGH PRECISION

Advanced packaging masks can consist of sets of masks which need to fit consistently. Especially for medium sized (9", 14") packaging masks, requirements are getting tighter. With a VPG<sup>+</sup> system, a production line is well prepared for production below 2 μm target. CDs with layer-to-layer overlay precision below 200 nm and even below 100 nm layer precision are possible with the optional Zerodur™ stage.

## THE SMALL- AND MEDIUM-AREA VPG<sup>+</sup> SYSTEMS IN A NUTSHELL

- Light source and stages: the VPG<sup>+</sup> small- und medium-area systems operate with a high-power pulsed UV laser source with a wavelength of 355 nm. The systems are equipped with a full air-bearing stage designed to accommodate substrates of up to 9" (VPG<sup>+</sup> 200), 17" (VPG<sup>+</sup> 400), and 32" (VPG<sup>+</sup> 800) respectively.
- Ultra-high-speed exposure engine
- Real-time pneumatic autofocus system
- Additional optical autofocus system
- Camera system for metrology and alignment
- Closed-loop environmental chamber

## POWERFUL METROLOGY FUNCTIONS

Our VPG<sup>+</sup> systems include a high-resolution metrology and alignment package with precision of several 10th of nanometers. The camera system captures images through the same objective lens that the writing beam is focused through. This setup therefore provides a true position reference as well as a fixed dependency of metrology and exposure.

The advanced metrology package includes tool-matching functions and provides precise write grid corrections. Linear and nonlinear global and local position correction of the writing grid are available. The alignment hardware and software comprise precise pattern recognition, linear (scaling, shear, trapezoid errors) and non-linear compensation methods for the second layer exposures. Individual measurement recipes can be created by the user according to the specific level of correction needed. The automated alignment capabilities allow multilayer exposures with excellent overlay accuracy and repeatability. Rigorous environmental monitoring and feedback control additionally ensure a stable overlay accuracy: software corrections based on precise measurements compensate for any variations in environmental parameters.

## CONVERSION: DATA PREPARATION

The systems include a high-end conversion station that translates the design information into machine data, including hierarchical operations and multiple pattern modification options. Advanced conversion functions like flexible write grid, pattern matching data optimization, biasing, and mask layout functions are included. Additional workstations can be added as required and can even be connected to form a cluster conversion for even faster conversion of larger and highly complex designs.

- Matrix correction software for calibration of stage position
- Edge detector system for precise pattern shift and angular correction
- Multiple data input formats
- Flexible stripe width and write grid
- User-programmable interface
- Mask labelling options
- Minimum structure size down to 0.75 μm
- Selection of exchangeable write modes, including advanced write mode
- Automatic or semi-automatic (VPG<sup>+</sup> 800) mask loading

# VPG<sup>+</sup> 200 / VPG<sup>+</sup> 400 / VPG<sup>+</sup> 800

## SYSTEM SPECIFICATIONS

Write mode	I-QX	WM I	WM II	WM III
<b>Writing performance</b>				
Physical grid [nm]	250	250	500	1000
Minimum feature [nm]	0.75	0.75	1	2
Edge roughness [3 $\sigma$ , nm]	30	40	50	70
CD uniformity [3 $\sigma$ , nm]	55	65	75	110
Stitching [3 $\sigma$ , nm]	30	60	70	100
Plate-to-plate overlay* [3 $\sigma$ , nm]	160	160	160	220
Throughput [mm <sup>2</sup> / min] (calculated on largest area)	552	1125	4125	8250
Exposure time for 100 x 100 mm <sup>2</sup> [min]	28	14	5.6	3.5
<b>System features</b>				
Light source	High-power DPSS laser with 355 nm			
Maximum substrate sizes VPG <sup>+</sup> 200 / VPG <sup>+</sup> 400 / VPG <sup>+</sup> 800	9" x 9" / 17" x 17" / 32" x 32"			
Substrate thickness	0 to 13 mm (other thicknesses on request)			
Maximum exposure area	205 x 205 mm <sup>2</sup> / 410 x 410 mm <sup>2</sup> / 800 x 800 mm <sup>2</sup>			
Autofocus	Real-time autofocus system (pneumatic; optical)			
Autofocus compensation range	Up to 150 $\mu$ m			
Flowbox	Closed-loop temperature controlled environmental chamber			
Alignment and metrology	Camera system and software package for metrology and alignment			
Other features	2D stage map correction, edge detector, multiple data input formats (DXF, CIF, GDSII, Gerber); exchangeable write modes (VPG <sup>+</sup> 800: automated), fully automatic or semi-automatic (VPG <sup>+</sup> 800) mask loading			
Options	Up to three write modes, optical autofocus, advanced write mode, and special chucks; VPG <sup>+</sup> 200 and VPG <sup>+</sup> 400: fully automatic mask loading up to 14", Zerodur <sup>®</sup> Stage, carriers for different mask sizes, automatic loading system			
<b>System dimensions</b>		<b>VPG<sup>+</sup> 200 / VPG<sup>+</sup> 400</b>		<b>VPG<sup>+</sup> 800</b>
Width [mm]	2605		3100	
Depth [mm]	1652		4250	
Height [mm]	2102		2700	
Weight [kg]	3550		10 000	
<b>Installation requirements</b>				
Electrical	400 VAC $\pm$ 5 %, 50/60 Hz, 16A, 3 phases		400 VAC $\pm$ 5 %, 50/60 Hz, 32 A	
Compressed air	8 - 10 bar		8 - 10 bar	

\*On standard granite stage

**Please note:** Specifications depend on individual process conditions and may vary according to equipment configuration. Write speed depends on exposure area. Design and specifications are subject to change without prior notice.

Visit product website for more information

To contact your local representative, please consult our website [heidelberg-instruments.com](http://heidelberg-instruments.com)

