

## Diffraction Optical Elements (DOE) Flat Lenses and Lenslet Arrays

Finisar provides Diffraction Optical Elements (DOE) for demanding industrial and consumer applications. DOEs are lithographically patterned and offer complete phase control of transmitted light without limitations imposed by refractive optics. A micron-thick active phase-transforming layer is directly etched into chemically inert dielectrics on robust fused silica substrate. An organics-free material platform is characterized by excellent reliability and can withstand harsh environmental conditions, high optical power and temperatures up to 500°C. Finisar DOEs undergo extensive quality assurance, have a proven reliability track record and are competitively priced.

Fabrication is based on robust deep ultraviolet (DUV) photolithography and a reactive ion etch process. Wafer-scale DOE optics are mass-produced using robust volume fabrication methods of the electronic IC industry and is easily scalable to multiple millions of micro-optical devices per year.

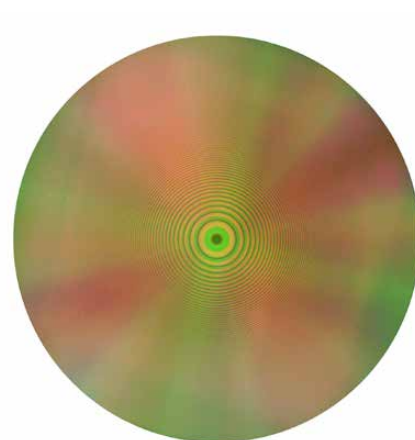
Flat lenses and lens arrays are designed to collimate, focus, or otherwise transform incoming wavefront. Complex aberration corrective aspheric focusing, off-axis or extended source collimation phase functions are rendered using a continuous phase rendition technique. Multiple phase transformation functions (such as focusing and Gaussian to flat hat conversion) may be combined in a single active layer

### Key Features:

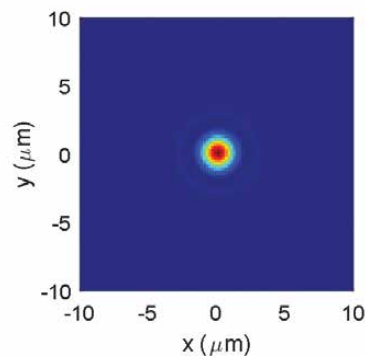
- Mapping of input beam to a desired output phase front using a designed phase transformation function
- Multiple phase transformation functions may be combined in a single surface
- Phase levels are rendered continuously from 0 to  $2\pi$
- Micron-thick active layer
- Etched directly into robust fused silica substrate and hard oxide films, no organics or polymers
- Wafer-scale mass production
- Withstand temperatures up to 500° C
- High power handling up to 125 GW/cm<sup>2</sup>
- Excellent long-term reliability

### Applications:

- Pattern generators and optical engines for 3D sensing (cell phones, consumer electronics, autonomous vehicles)
- Micro-optic lenses and arrays for transceivers



Flat Lens

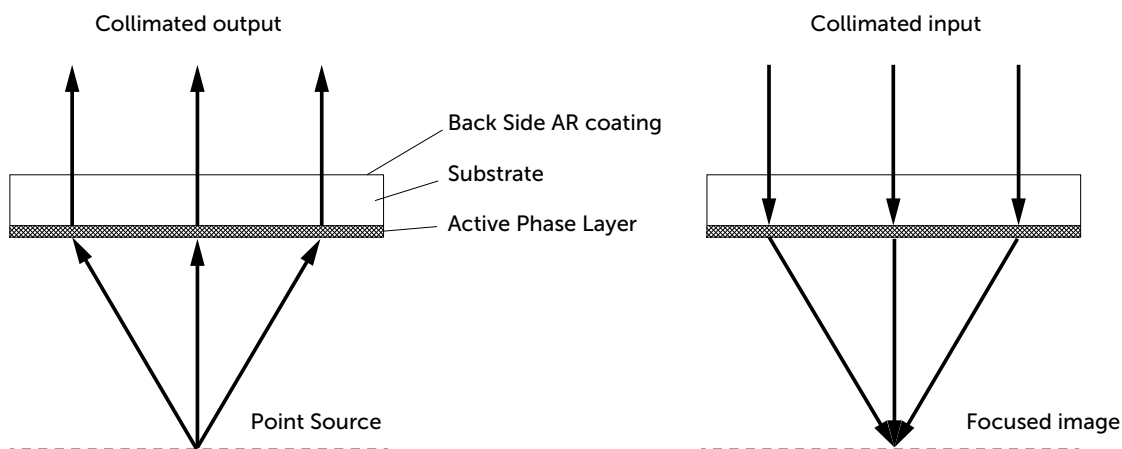


Diffraction Limited Focusing (test data)

# Diffraction Optical Elements (DOE)

## Flat Lenses and Lenslet Arrays

Flat lenses may be customized to a wide range of customer's optical and dimensional requirements. Two possible optical layouts implementing the flat lenses are shown below.



OEM-Customizable Specification			
Description	Value	Units	Comments
Focal Length	Custom		Arbitrary custom phase function
Numeric Aperture (NA)	0.3 max		Larger NA available upon request
Design Wavelength	850, 940	nm	Custom wavelengths available
Angle of incidence (AOI)	$0 \pm 10$	°	Custom AOI available
Absolute Efficiency, min	88	%	Higher efficiencies upon request
Number of Apertures	Custom		Single lens or lens array
Centration Accuracy	$\pm 10$	$\mu\text{m}$	To the substrate edges; 0.1 $\mu\text{m}$ to fiducials
Substrate (WxH)	Custom		$\pm 0.1$ mm dimension tolerance
Substrate thickness	$0.675 \pm 0.05$	mm	Down to 0.2 mm custom
Active layer thickness	$\sim 1$	$\mu\text{m}$	
Substrate Material	Fused Silica, hard dielectric oxides		
Back side AR coating	Yes		
Surface quality	40/20	Scratch/dig	20/10 upon request

**FINISAR**<sup>®</sup>

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