SGD Series Micro-nano Optical Elements

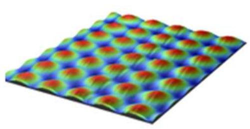
The research on micro-nano optical devices and their array modulation optical behavior can realize new functions such as miniaturization, array, integration and wavefront conversion and form a variety of new systems. It has made great achievements in micro-nano optical theory, system application, device design and fabrication. At present, a series of products mainly consisting of microlenses, phase plates and diffraction devices have been formed and customized by users.

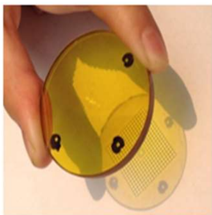
1. Microlens Array (MLA)

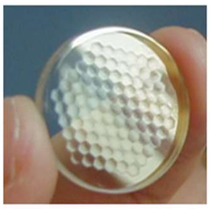
Microlens array is composed of lenses with aperture of micron-millimeter and relief depth of nano-micron. It has the basic functions of focusing and imaging. Its unit size is small and its integration is high. It can accomplish functions that traditional optical elements cannot accomplish. It can also form many new optical systems, such as scanning, display, optical fiber coupling, light focusing imaging and so on.

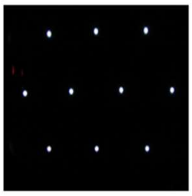
A high-precision continuous surface microlens array with non-diffraction chromatic aberration, which is suitable for wide-band imaging and focusing, is developed by using unique surface control technology.

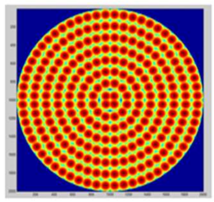
- Numerical aperture: 0.01-0.5
- Lens surface: spherical, parabolic, hyperboloid and other precise control
- Surface error: 3%
- Sub-aperture: 20 m-4 mm
- Filling factor: > 98%
- Integration degree :800-600/cm^2
- Sub-aperture shape: quadrilateral, hexagonal, circular, rectangular, etc.
- Lens Materials: Fused quartz, Silicon, Ge, Znse, K9, CaF_2, PMMA, PC, etc.


3D Profile of MLA


Znse Quadrilateral MLA

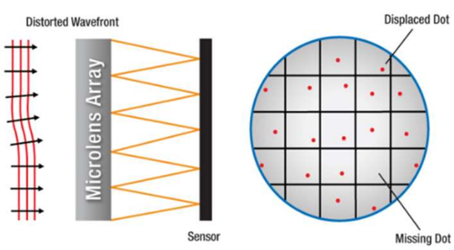

Quartz Quadrilateral MLA


Focused Spot Array

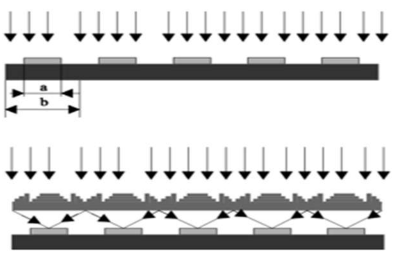

Ring-arranged MLA

1.1 Wavefront detection

The wavefront sensor system based on MLA wavefront segmentation is applied in aerospace, ophthalmology and other research fields to achieve high precision, non-destructive and on-line wavefront detection.



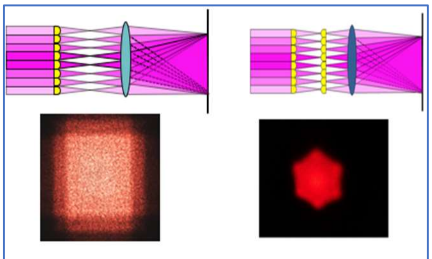
Wavefront Detection Principle



Light Concentration of MLA

1.2 Infrared Focal Plane Light Concentration

The MLA is used to collect and converge the light projected outside the photosensitive, so as to improve the efficiency of the detector.


Beam Homogenization of MLA

1.3 Beam collimation, shaping and 3D imaging

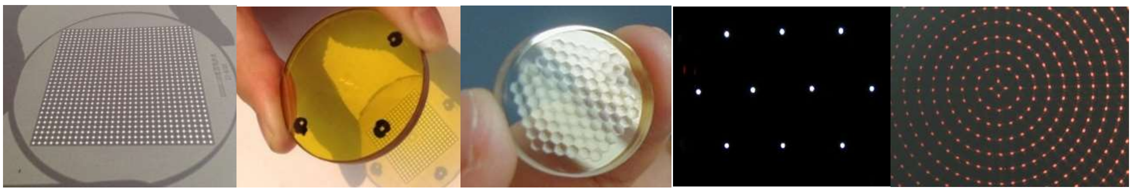
The MLA is used to collimate, shape, focus light and imaging, and the miniaturized optical coupling, scanning, anti-counterfeiting film, 3D display, integrated imaging, optical field camera and other systems are constructed.

Sub-aperture shape	**Pitch (µm)**									
Square	8	20	21	22	24	31	32.5	42	55	69
	93	96	97	100	110	120	130	144	149	150
	168	176	182	183	192	200	210	216	220	229
	240	243	245	250	252	270	275	280	300	320
	336	360	384	400	420	448	449	450	462	480
	500	528	533	545	600	680	700	720	800	833
	840	850	875	880	900	960	1000	1015	1067	1080
	1100	1120	1200	1333	1373	1380	1440	1625	1750	1915
	2000	2667	2800	3000	3556	5334				
Hexagon	57	130	192	200	207	259	260	300	336	331
	400	462	480	560	576	667	700	800	840	1000
	1360	2000								

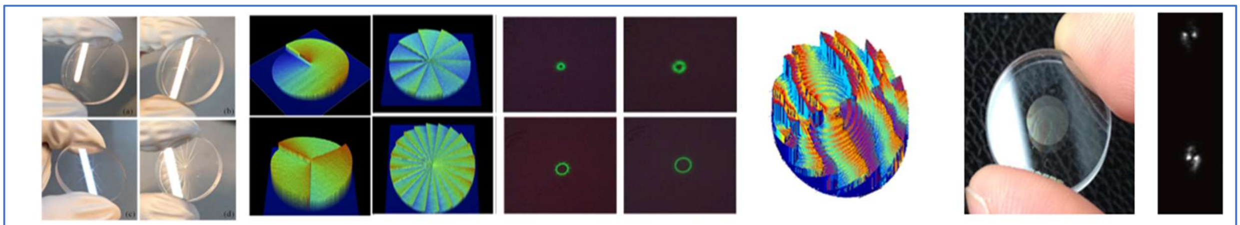
Part-numbering:

SGD-MLA	-XXXX	-XX
	Pitch (µm)	Sub aperture shape
	0008: 8µm 0093: 93µm 0400: 400µm 1360: 1360µm	SQ: Square HX: Hexagon

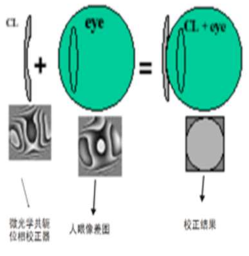
e.g.: SGD-MLA-0008SQ: Microlense array 8µm pitch square sub-aperture shape.
SGD-MLA-1360HX: Microlense array 1360µm pitch hexagon sub-aperture shape



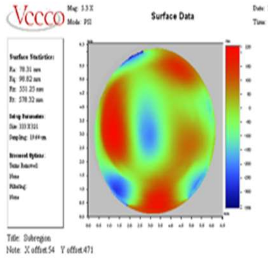
2. Phase Plate


Spiral Phase Plate Physical Chart
3D Profile
Vortex Light
Large Depth of Field and Large FOV Vortex Light of Composite Phase Plate

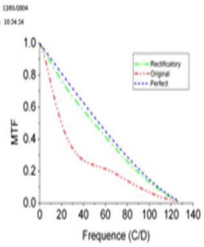
The micro-optical phase plate can accurately simulate, correct or modulate the phase of the system, which has the advantages of accurate, compact and convenient adjustment. Single-order and multi-order aberration phase devices can be generated for static aberration correction of various optical systems. Typical devices include random planar phase plate, spiral phase plate and composite phase plate, which are used in quantum communication, particle manipulation and free space optical communication.



Human Eye Aberration Compensation System



Phase Distribution



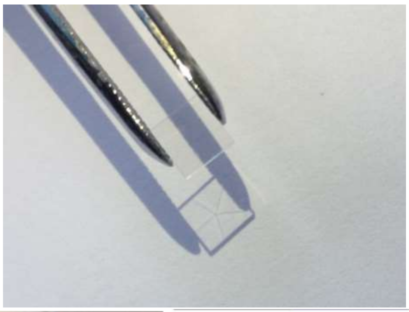
Experimental Result

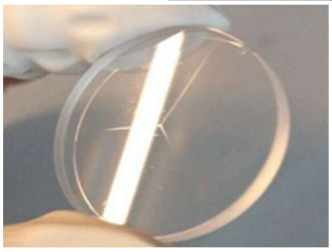
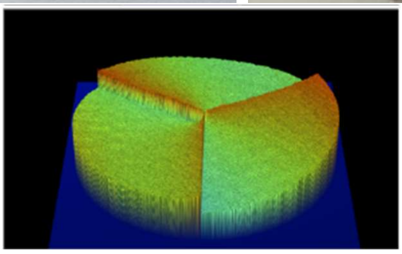
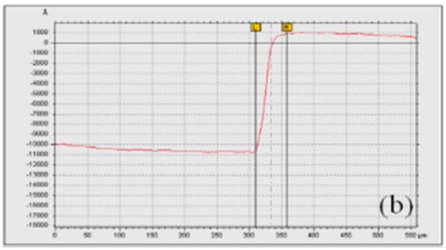

Visible Atmospheric Turbulence Simulator


Infrared Atmospheric Turbulence Simulator

Wavelength	Size	Part number
532nm L=1, 2	6mmx6mm	SGD-PP-532-6x6
	11mmx11mm	SGD-PP-532-11x11
	1 inch	SGD-PP-532-1
632.8nm L=1,2	6mmx6mm	SGD-PP-632-6x6
	11mmx11mm	SGD-PP-632-11x11
	1 inch	SGD-PP-632-1
808nm L=1, 2	6mmx6mm	SGD-PP-808-6x6
	11mmx11mm	SGD-PP-808-11x11
	1 inch	SGD-PP-808-1
1064nm L=1, 2	6mmx6mm	SGD-PP-1064-6x6
	11mmx11mm	SGD-PP-1064-11x11
	1 inch	SGD-PP-1064-1
1550nm L=1, 2	6mmx6mm	SGD-PP-1550-6x6
	11mmx11mm	SGD-PP-1550-11x11
	1 inch	SGD-PP-1550-1

Please call for other wavelengths.

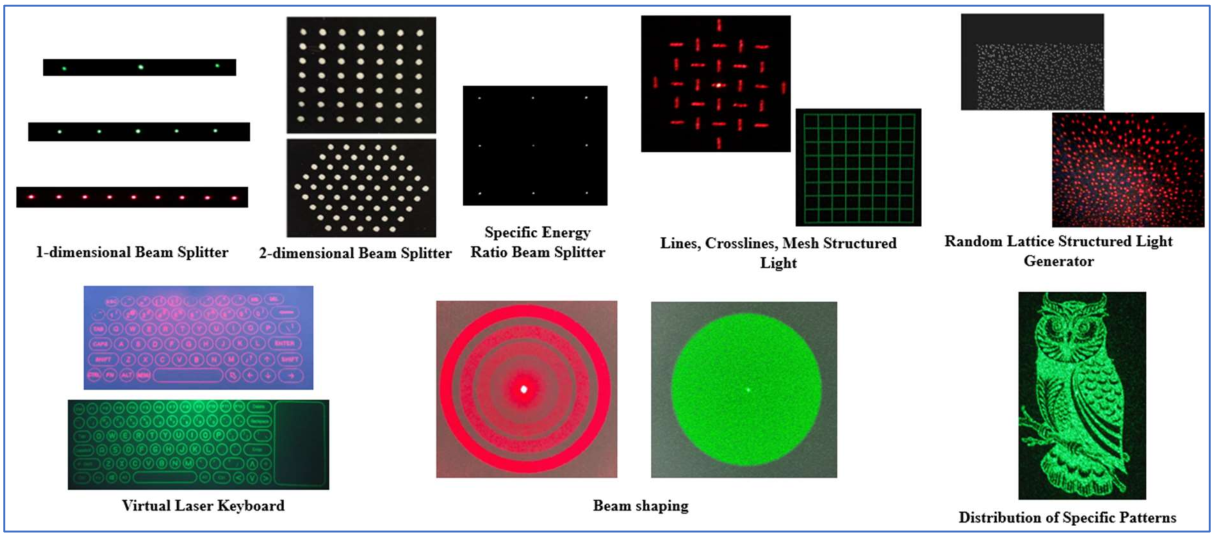


3. Diffractive Optical Element (DOE)

The research team can provide standard diffraction devices and accept customization to achieve high diffraction efficiency, high uniformity beam transformation, shaping, beam splitting and phase modulation. Applications: Laser processing, laser beam shaping, laser medical treatment, mobile intelligent equipment, human-computer natural interaction somatosensation, gesture control, three-dimensional measurement, face recognition system, etc.

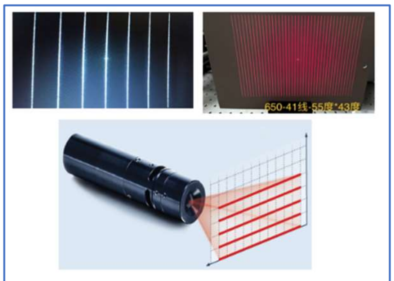
- Element Aperture: < 100mm
- Element Materials: fused quartz, BK7, silicon, Ge, Znse, K9, CaF2, sapphire, etc
- Feature Size: 100 Nanometer to micron
- Quantization Step: Multi-step
- Diffraction Angle: 100 degrees.



1-dimensional Beam Splitter
2-dimensional Beam Splitter
Specific Energy Ratio Beam Splitter
Lines, Crosslines, Mesh Structured Light
Random Lattice Structured Light Generator
Virtual Laser Keyboard
Beam shaping
Distribution of Specific Patterns

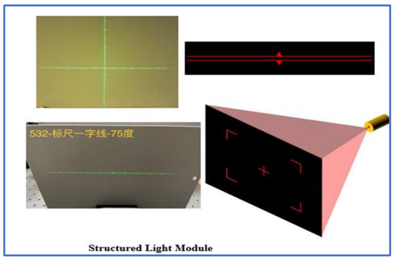
3.1 Multi-line structured light module

Diversification of wavelength, line number, angle and high uniformity, high light efficiency, compact structure, used for high-precision 3D measurement.



Structural Light for 3D Measurement

3.2 Human-computer interaction structured light



Structured Light Module

High uniformity random lattices satisfying human eye safety are used for security access control system, somatosensory equipment, identification and unlocking, etc.

3.3 Location frame module

Large angle, various complex patterns, small stray light, used for positioning, indication, calibration, etc.

1. Beam splitter

1-dimensional beam splitter

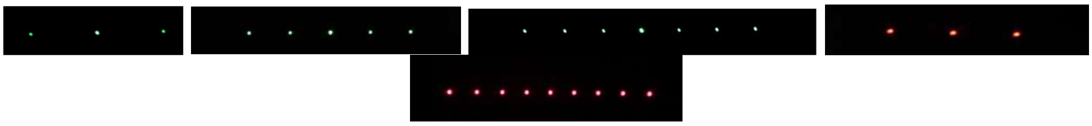
Part number	Wavelength	Splitting number	Angle
SGD-BS1-450-03-02	450	1x3	2.3
SGD-BS1-450-03-09	450	1x3	9
SGD-BS1-450-03-15	450	1x3	15
SGD-BS1-450-05-10	450	1x5	10.5
SGD-BS1-450-05-14	450	1x5	14
SGD-BS1-450-07-20	450	1x7	20
SGD-BS1-450-09-25	450	1x9	25
SGD-BS1-450-11-12	450	1x11	12
SGD-BS1-450-11-30	450	1x11	30
SGD-BS1-450-11-35	450	1x11	35
SGD-BS1-450-13-34	450	1x13	34
SGD-BS1-450-13-38	450	1x13	38
SGD-BS1-450-15-36	450	1x15	36
SGD-BS1-450-17-25	450	1x17	25.4
SGD-BS1-450-17-30	450	1x17	30
SGD-BS1-450-17-40	450	1x17	40
SGD-BS1-450-21-35	450	1x21	35
SGD-BS1-450-25-18	450	1x25	18
SGD-BS1-450-25-35	450	1x25	35
SGD-BS1-450-49-23	450	1x49	23
SGD-BS1-450-99-45	450	1x99	45
SGD-BS1-450-101-15	450	1x101	15
SGD-BS1-638-11-30	638	1x11	30
SGD-BS1-650-03-01	650	1x3	1.27
SGD-BS1-650-03-09	650	1x3	9
SGD-BS1-650-03-15	650	1x3	15
SGD-BS1-650-05-19	650	1x5	19
SGD-BS1-650-07-23	650	1x7	23
SGD-BS1-650-07-28	650	1x7	28
SGD-BS1-650-07-50	650	1x7	50
SGD-BS1-650-09-30	650	1x9	30
SGD-BS1-650-09-37	650	1x9	37
SGD-BS1-650-11-30	650	1x11	30
SGD-BS1-650-13-38	650	1x13	38
SGD-BS1-650-15-36	650	1x15	36
SGD-BS1-650-17-40	650	1x17	40

SGD-BS1-650-25-36	650	1x25	36
SGD-BS1-780-11-32	780	1x11	32
SGD-BS1-780-49-30	780	1x49	30
SGD-BS1-800-07-03	800	1x7	3
SGD-BS1-850-07-18	850	1x7	18
SGD-BS1-850-11-30	850	1x11	30
SGD-BS1-905-05-12	905	1x5	12
SGD-BS1-905-32-25	905	1x32	25
SGD-BS1-1064-03-03	1064	1x3	0.32
SGD-BS1-1064-04-04	1064	1x4	0.43
SGD-BS1-1064-04-05	1064	1x4	5.39
SGD-BS1-1064-04-10	1064	1x4	10.8
SGD-BS1-1064-14-41	1064	1x14	41
SGD-BS1-1064-23-03	1064	1x23	3.23
SGD-BS1-1550-04-01	1550	1x4	1.5
SGD-BS1-1550-04-02	1550	1x4	2.85
SGD-BS1-1550-19-18	1550	1x19	18
SGD-BS1-1550-32-02	1550	1x32	2.5
SGD-BS1-1550-32-05	1550	1x32	5
SGD-BS1-1550-32-40	1550	1x32	40
SGD-BS1-1550-33-03	1550	1x33	3.2
SGD-BS1-1550-33-16	1550	1x33	16
SGD-BS1-1550-41-40	1550	1x41	40
SGD-BS1-1550-65-32	1550	1x65	32
SGD-BS1-10600-10-10	10600	1x10	10.2

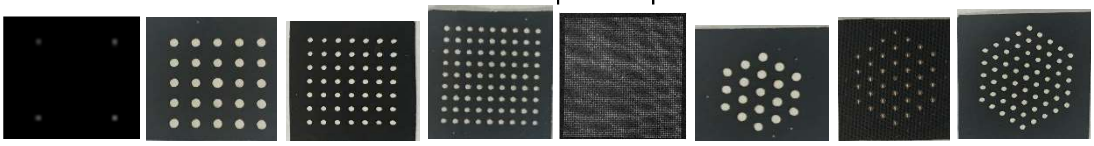
2-dimensional beam splitter

Part number	Wavelength	Splitting number	Angle
SGD-BS2-405-03-02	405	3x3	0.229
SGD-BS2-450-11-53	450	11x11	53
SGD-BS2-525-05-07	525	5x5	7.5
SGD-BS2-532-04-03	532	4x4	3.51
SGD-BS2-532-05-60	532	5x5	60
SGD-BS2-532-07-06	532	7x7	6.8
SGD-BS2-532-07-11	532	7x7	11
SGD-BS2-532-08-03	532	8x8	3.51
SGD-BS2-532-09-50	532	9x9	50
SGD-BS2-532-11-50	532	11x11	50
SGD-BS2-532-11-64	532	11x11	64
SGD-BS2-532-17-60	532	17x17	60
SGD-BS2-532-19-11	532	19	11
SGD-BS2-532-61-11	532	61	11
SGD-BS2-565-02-05	565	2x2	5.4
SGD-BS2-650-15-08	650	15x15	8
SGD-BS2-650-17-60	650	17x17	60
SGD-BS2-650-21-30	650	21x21	30
SGD-BS2-694-15-07	694	15x15	7.5
SGD-BS2-850-65-10	850	65x65	10
SGD-BS2-780-02-02	780	2x2	2
SGD-BS2-800-05-03	800	3x5	1.5x3
SGD-BS2-830-05-02	830	5x5	0.28
SGD-BS2-850-65-10	850	65x65	10
SGD-BS2-850-47-49	850	151x47	70x49
SGD-BS2-980-09-11	980	9x9	11
SGD-BS2-1064-05-16	1064	3x5	8x16
SGD-BS2-1064-05-11	1064	5x5	11
SGD-BS2-1064-07-05	1064	7x7	5.7
SGD-BS2-1064-07-11	1064	7x7	11

SGD-BS2-1064-08-03	1064	8x8	3.51
SGD-BS2-1064-08-07	1064	8x8	7
SGD-BS2-1064-08-11	1064	8x8	11
SGD-BS2-1064-09-05	1064	9x9	5.6
SGD-BS2-1064-09-08	1064	9x9	8
SGD-BS2-1064-09-11	1064	9x9	11
SGD-BS2-1064-32-01	1064	32x32	1.59
SGD-BS2-1064-07-11	1064	7	11
SGD-BS2-1064-19-11	1064	19	11
SGD-BS2-1064-37-11	1064	37	11
SGD-BS2-1064-61-11	1064	61	11
SGD-BS2-1064-61-16	1064	61	16
SGD-BS2-1535-61-05	1535	61	5
SGD-BS2-1550-16-32	1550	16x2	32x2
SGD-BS2-2940-09-11	2940	9x9	11
SGD-BS2-9600-09-11	9600	9x9	11
SGD-BS2-10600-05-05	10600	5x5	5.7
SGD-BS2-10600-07-11	10600	7x7	11
SGD-BS2-10600-09-11	10600	9x9	11



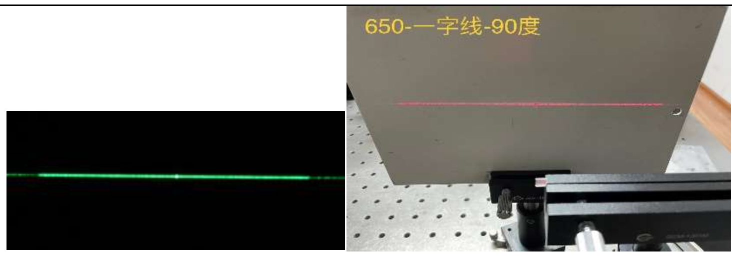
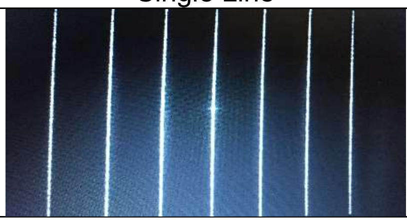
1-dimensional Beam Splitter Spot Distribution



2-dimensional Beam Splitter Spot Distribution

2. Structured Light for Tools

1）Single Line, Multiline, Grid and Random Speckle

Item-Wavelength-Angle	Illustration
SGD-SL- L1-650-43	 Single Line
SGD-SL- L1-650- 60	
SGD-SL-L1-650 -90	
SGD-SL-L1-905-60	
SGD-SL-L1-905-100	
SGD-SL-L3-650-67×17	
SGD-SL-L7-650-23×50	
SGD-SL-L7-808-33	
SGD-SL-L11-650-30	
SGD-SL-L41-650-55×43	
SGD-SL-L25-808-33	

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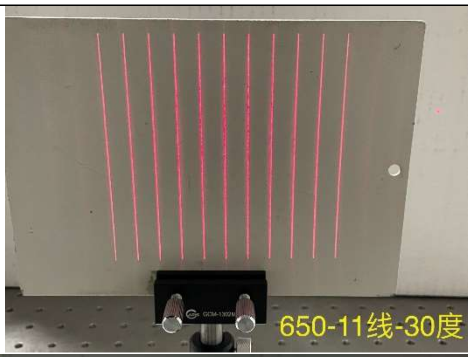
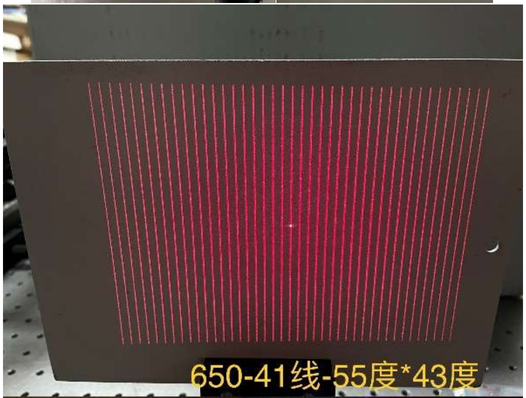
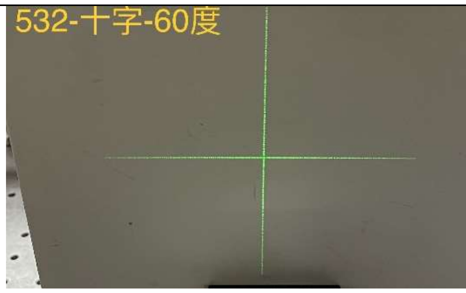
<tr><td></td><td>



Multiline</td></tr>
<tr><td>SGD-SL-C-532-15</td><td rowspan="3">

Cross</td></tr>
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Sintec Optronics

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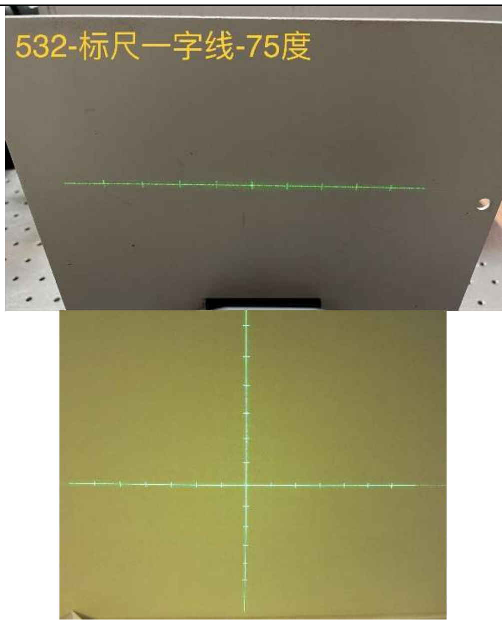
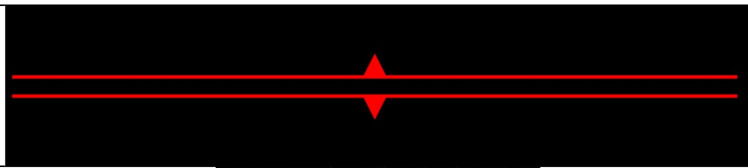
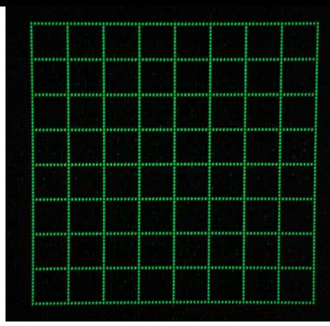
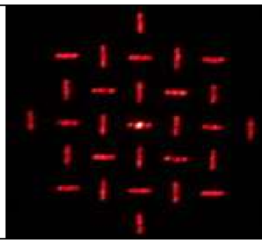
<tr><td></td><td>

Cross with scale</td></tr>
<tr><td>SGD-SL-A-635-47×4.6</td><td></td></tr>
<tr><td>SGD-SL-G-532-8×8-8</td><td rowspan="4">
Grid</td></tr>
<tr><td>SGD-SL-G-532-8×8-36</td></tr>
<tr><td>SGD-SL-G-450 -10×10-53</td></tr>
<tr><td>SGD-SL-G-650 -10×10-2.9</td></tr>
<tr><td>SGD-DWX-650-10</td><td rowspan="2"></td></tr>
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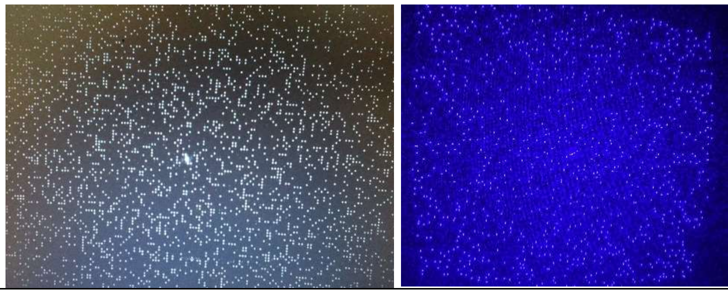
<tr><td>SGD-SL-830-NJ-63×51</td><td rowspan="9"></td></tr>
<tr><td>SGD-SL-532-962-30</td></tr>
<tr><td>SGD-SL-532-35000-30×40</td></tr>
<tr><td>SGD-SL-830-35000-63×51</td></tr>
<tr><td>SGD-SL-830-53×0.36</td></tr>
<tr><td>SGD-SL-830-4800-40</td></tr>
<tr><td>SGD-SL-830-900-38</td></tr>
<tr><td>SGD-SL-940-4800-42</td></tr>
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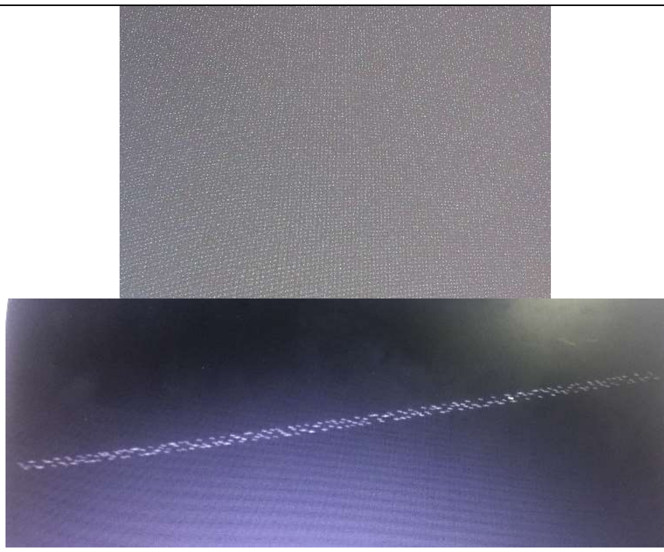
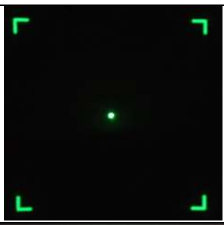
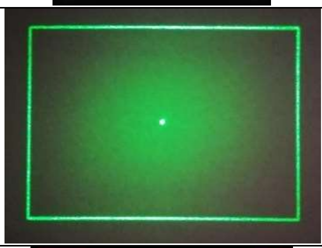
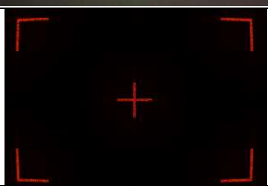
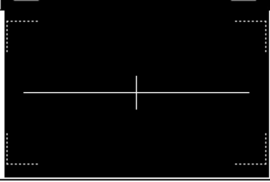
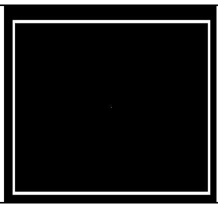
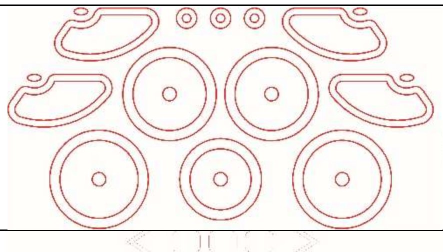
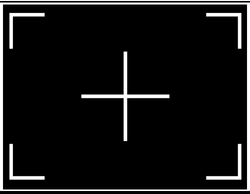
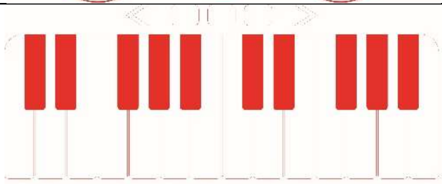
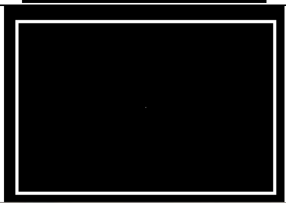
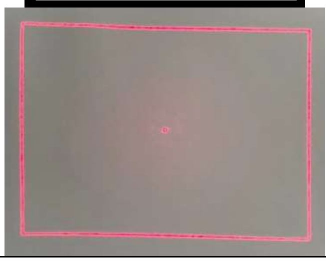
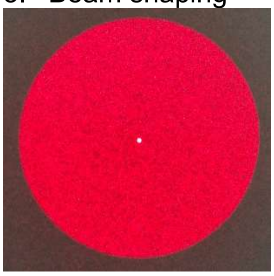
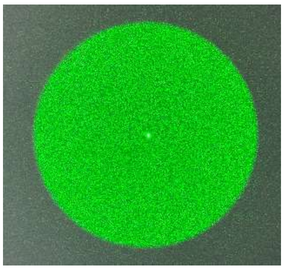
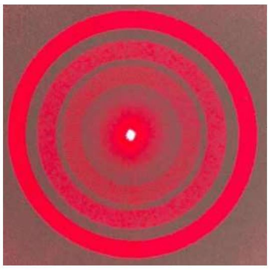
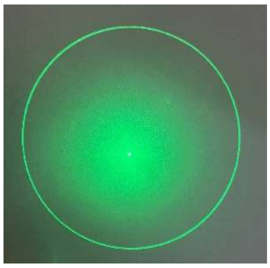
	 Random Speckle

2）Positioning and Human-computer Interaction Structure

Item-Wavelength-Angle	Pattern	Item	Pattern
SGD-DWK-520-21		SGD-PT-JP-F	
SGD-DWK-520-50.8×39		SGD-PT-JP-I	
SGD-DWK-520-60×45			
SGD-DWK-650-30×21		SGD-PT-JP-I	
SGD-DWK-650-40×31		SGD-PT-JP-SB	
SGD-DWK-650-42×24		SGD-PT-TY-WY	

SGD-DWK-650-45×45		SGD-PT-TY-DT	
SGD-DWK-635-47×35		SGD-PT-G	
SGD-DWK-650-53×39		SGD-PT-Q	
SGD-DWK-650-45		SGD-PT-S	
SGD-DWK-650-60×45			
SGD-DWK-650-70×50			

3. Beam shaping

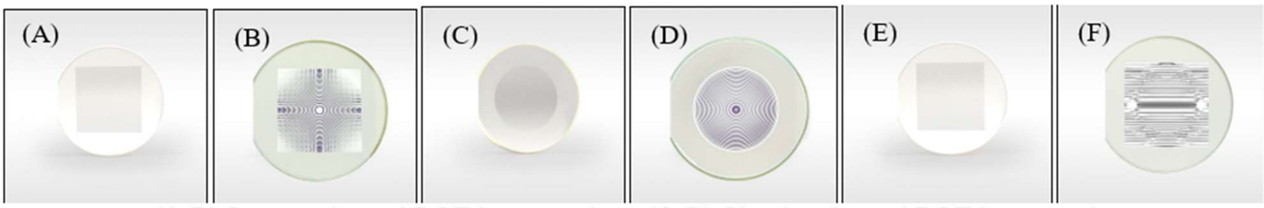





SLB Series Micro-nano Optics

1. SLB Series DOE Beam Shapers

1.1 DOE Homogenizers

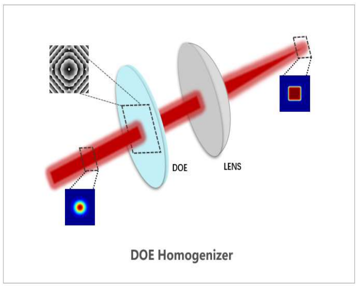
DOE homogenizer is a flat optical element designed based on the principle of diffraction optics, consisting of liquid crystal polymer (LCP) thin films and two N-BK7 window sheets. According to the known incident light parameters, lens focal length and expected outgoing light parameters, the design phase is calculated by point-to-point mapping. Finally, the designed geometric phase distribution is introduced into LCP film to shape and homogenize the Gaussian (TEM00, M2<1.3) incident light. The DOE homogenizer can achieve non collimated homogenization effects of any geometric shape such as square, circular, and linear for single mode lasers. Because of its advantages such as high uniformity, high transmittance, high damage threshold, and sharp boundary, it has great application prospects in laser medical beauty, laser processing, surface treatment and other scenarios, such as laser welding, laser marking, laser cutting, skin beauty, and laser treatment. It can bring higher energy utilization, better machining quality, higher machining accuracy, and more flexible and controllable machining scale adjustment. In addition to standard products, we also provide flexible customization of parameter specifications. If you need UV/high-power homogenization DOE, please contact us.



(A-B) Square shaped DOE homogenizer; (C-D) Circular shaped DOE homogenizer;
(E-F) Straight horizontal DOE homogenizer

Product features

- Flat structure, small size, easy to assemble
- Transmission type homogenization with high energy utilization rate
- Continuous phase, high diffraction efficiency, and good homogenization effect
- Customization flexibility, uniform spot size adjustable
- Non collimation homogenization suitable for high-quality single mode lasers



Standard product model

Product model	Homogenization type	Working wavelength nm	Incident spot diameter mm	Effective lens focal length mm	Exit spot size µm
SLB-DOE25-532-6-FTS50	Square flat roof	532	6	100	50x50
SLB-DOE25-532-6-FTS200	Square flat roof	532	6	100	200x200
SLB-DOE25-532-7-FTS30	Square flat roof	532	7	100	30.3x30.3
SLB-DOE25-532-7-FTS76	Square flat roof	532	7	100	75.76x75.76
SLB-DOE25-1064-6-FTS80	Square flat roof	1064	6	100	80x80
SLB-DOE25-1064-6-FTS200	Square flat roof	1064	6	100	200x200
SLB-DOE25-1064-7-FTS30	Square flat roof	1064	7	100	30.3x30.3
SLB-DOE25-1064-7-FTS76	Square flat roof	1064	7	100	75.76x75.76
SLB-DOE25-532-6-FTC50	Circular flat roof	532	6	100	Ø 50
SLB-DOE25-532-6-FTC200	Circular flat roof	532	6	100	Ø 200
SLB-DOE25-1064-6-FTC80	Circular flat roof	1064	6	100	Ø 80
SLB-DOE25-1064-6-FTC200	Circular flat roof	1064	6	100	Ø 200
SLB-DOE25-532-6-FTL250	Linear flat roof	532	6	100	250
SLB-DOE25-532-6-FTL1000	Linear flat roof	532	6	100	1000
SLB-DOE25-1064-6-FTL250	Linear flat roof	1064	6	100	250
SLB-DOE25-1064-6-FTL1000	Linear flat roof	1064	6	100	1000

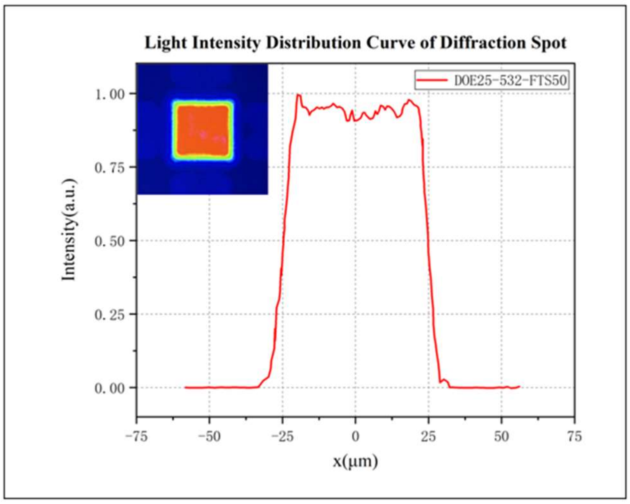
Sintec Optronics

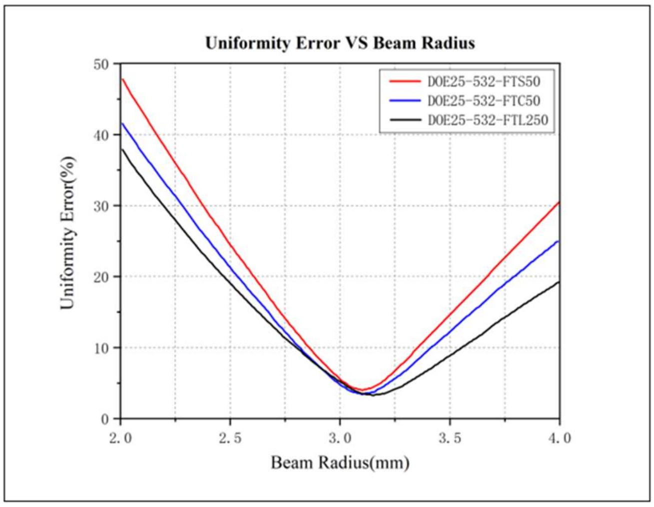
Working parameter

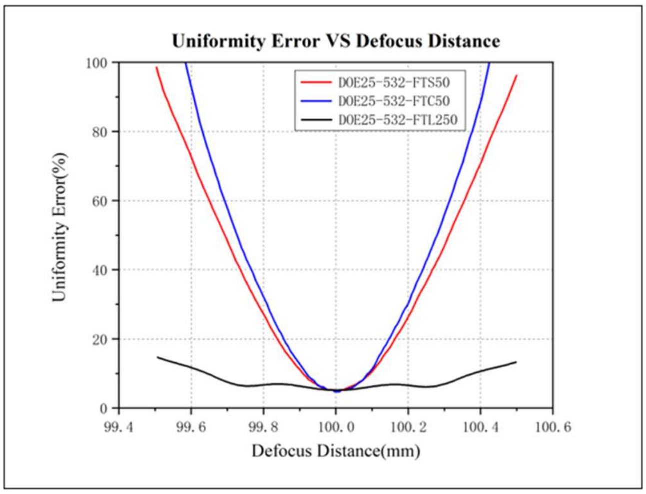
Product type	Standard products	Customization
Working wavelength	532 nm, 1064 nm	400-1700 nm
Component size and installation method	Ø 25.4x3.2mm, single side trimming, compatible with 1-inch optical component mounting bracket	
Incident beam quality	TEM00, M ²< 1.3	
Polarization state of incident beam	Uniform polarization state	
Incident beam size	Ø 6 mm, Ø 7 mm	Suggest less than half of the optical aperture
Optical aperture	15×15 mm, Ø 15 mm	
Shape of outgoing beam	Square, circular, linear	Any geometric shape
Exit spot size	>1.5 DL (diffraction limit), adjustable with matching focusing lens	
Non-uniform exit spot	<5%	<10%, minimum achievable<5%
Transmission area width	>0.5 DL (diffraction limit)	
Transmittance	>98%	>85% @ 400-450 nm >96% @ 450-1700 nm
Reflectivity	Ravg<0.5% (0 ° incidence angle)	
Diffraction efficiency	>95%	Customization

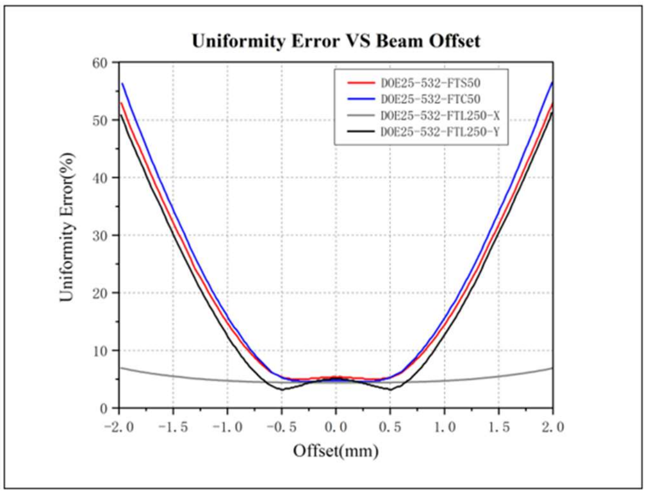
- Exit spot size: The full-wave half maximum size of the normalized energy distribution of the spot
- Non-uniform of exit light spot: Root-mean-square deviation of energy in the area where the normalized energy distribution of light spot is more than 90%
- Transmission area width: The width of the edge area corresponding to the normalized energy range of 13.5% -90%
- Diffraction efficiency: The ratio of normalized energy distribution of above 90% of the light spot to all outgoing light energy

Performance curve

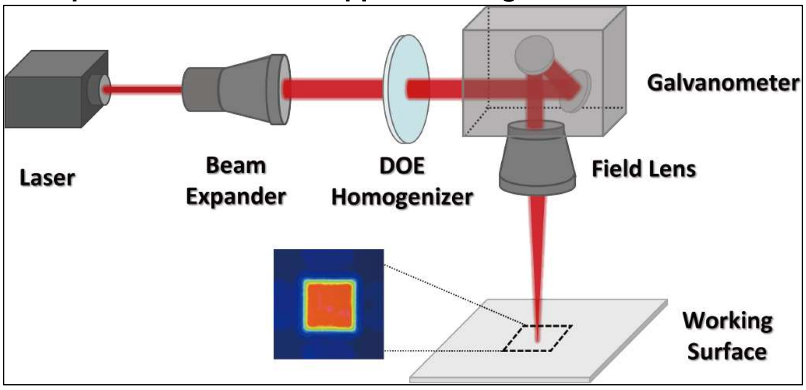








Example of Uniform DOE Application Light Path



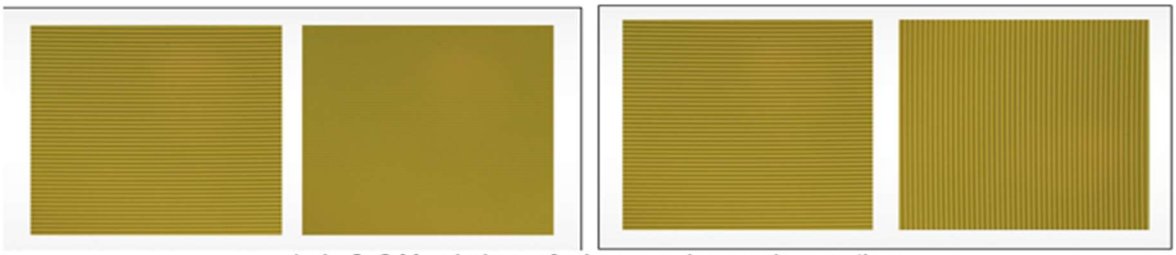
1.2 DOE Beam Splitter

Beam splitting DOE often implement the use of either a periodic phase design based on pixel points or a combination of grating cascades to achieve one-dimensional or two-dimensional, odd or even beam splitting effects. The beam splitting DOE we provide is divided into multilayer grating beam splitters and liquid crystal beam splitters. The multilayer grating beam splitter (MLGS) is made of N-BK7 glass substrate and Liquid Crystal Polymers (LCP) material, consisting of three 1-inch double cut edge substrates coated with LCP layers with grating and wave plate structures, and is a single wavelength device. When the incident light is linearly polarized, the multilayer grating beam splitter can achieve one-dimensional or two-dimensional of four splitting based on the relative position relationship of the grating lines at all levels, which is parallel or vertical. The resulting beams are circularly polarized with different rotations, and their beam splitting angle is related to the period of each level of grating. Cascaded gratings have high transmittance, and through better phase design and precise delay control, they have higher beam splitting efficiency and uniformity than typical Dammam grating beam splitters, and can ensure high beam splitting angle accuracy. Our Liquid Crystal Beam Splitter (LCBS) DOE is made of N-BK7 glass substrate and Liquid Crystal Polymers (LCP) material, presenting a typical sandwich flat structure as a single wavelength device. The phase structure of liquid crystal beam splitting DOE is designed based on the principles of diffraction optics, according to the expected beam splitting mode, beam splitting spot spacing, or beam separation angle. The expected beam splitting effect is achieved by allocating the energy of the corresponding diffraction order. Compared with cascaded grating beam splitters, beam splitting DOE has no requirement for the polarization state of the incident light and can achieve odd number beam splitting; Compared with the Dammam grating beam splitter, the beam splitting DOE diffraction efficiency and beam splitting spot uniformity are better; Compared with traditional etching DOE, liquid crystal beam splitting DOE is easier to achieve multi order phase changes, resulting in higher diffraction efficiency and significantly reduced process difficulty. Therefore, based on the advantages of liquid crystal beam splitting DOE, such as high diffraction efficiency, high beam splitting uniformity, high separation angle accuracy, low ineffective diffraction level noise impact, and simple process, it can be used in many application directions, such as parallel laser processing, optical sensor detection, optical aesthetic medicine, to improve processing efficiency and consistency.

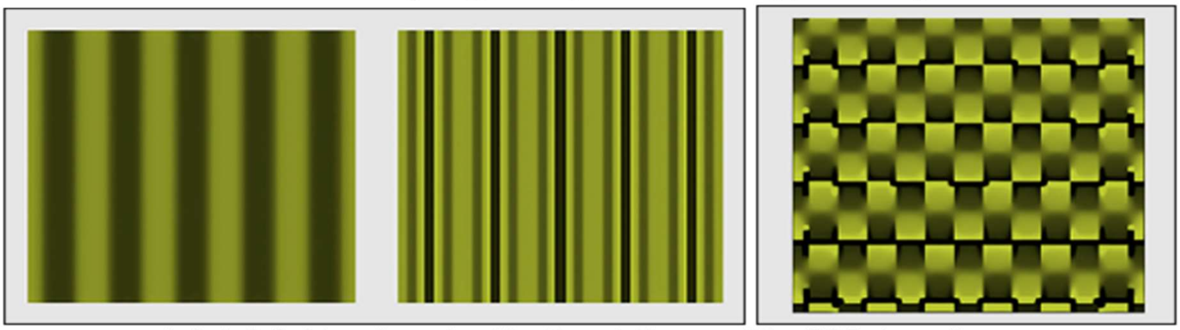
The standard beam splitting DOE working wavelength λ we provide are 532nm and 1064nm, with cascaded grating beam splitter beam splitting mode of 1×4 and 2×2 options, LCP beam splitting DOE beam splitting mode has 1×3, 1×9 and 2×3 options. In addition to existing standard products, we also provide flexible customization of various parameter specifications to facilitate users' diverse needs in different application.

Cascaded grating beam splitter DOE

liquid crystal beam splitter DOE



1×4, 2×2 Morphology of primary and secondary gratings in a cascaded grating beam splitter under linearly polarized light



1×3, 1×9, 2×3 two dimensional liquid crystal beam splitting DOE phase diagram

Product features

- Flat structure, small size, easy to integrate
- Transmitting element with high energy utilization rate
- Continuous phase, high diffraction efficiency, and good beam splitting uniformity
- Flexible customization, high accuracy of beam splitting angle, and adjustable beam splitting angle
- Suitable for beam splitting of various types of light sources

Standard product model

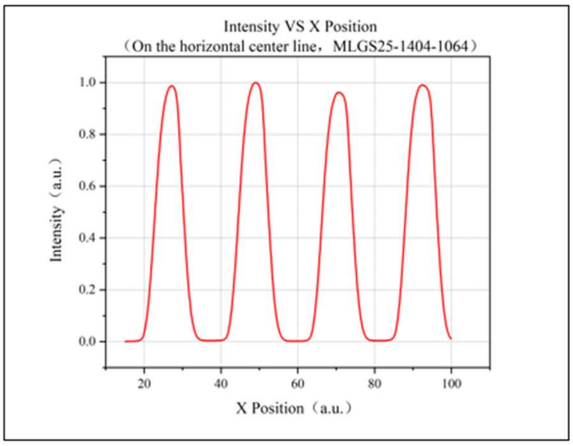
Product model	Beam splitting mode	Working wavelength/nm	Optical aperture/mm	Beam splitting angle/°
SLB-MLGS25-1402-532	1x4	532	Ø 20	2
SLB-MLGS25-1404-1064	1x4	1064	Ø 20	4
SLB-MLGS25-2202-532	2x2	532	Ø 20	2
SLB-MLGS25-2204-1064	2x2	1064	Ø 20	4
SLB-LCBS25-532-0109-000015	1×3	532	Ø 21.5	0.5
SLB-LCBS25-532-0109-000015	1x9	532	Ø 21.5	0.15
SLB-LCBS25-1064-0103-000100	1×3	1064	Ø 21.5	1
SLB-LCBS25-1064-0109-000030	1x9	1064	Ø 21.5	0.3
SLB-LCBS25-532-0203-025015	2x3	532	Ø 21.5	0.25x0.15
SLB-LCBS25-1064-0203-050030	2x3	1064	Ø 21.5	0.5x0.3

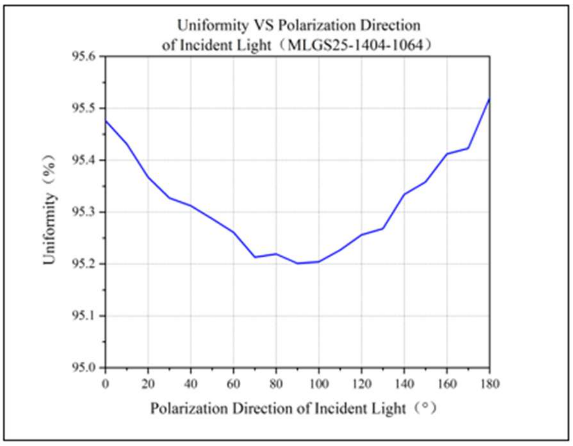
Working parameter

Product type	Standard products	Customization
Working wavelength	532 nm, 1064 nm	400-1700 nm
Component size and installation method	Ø 25.4x2.7 mm, no trimming/dual trimming compatible with 1-inch optical component mounting bracket	
Incident beam quality	none	
Polarization state of incident beam	Depend on the specific application of the product	
Incident beam size	Less than half of the aperture (recommended)	
Optical aperture	Ø 20 mm, Ø 21.5 mm	
Beam splitting mode	Please refer to the table above for details	1xm, mxn
Beam splitting uniformity	>90%	>90%, maximum achievable>97%
Beam splitting angle	Please refer to the table above for details	Adjustable with matching focusing lens
Transmittance	>96%	>85% @ 400-450nm, >96% @ 450-1700 nm
Reflectivity	Ravg<0.5% (0 ° incidence angle)	
Diffraction efficiency	>97%	

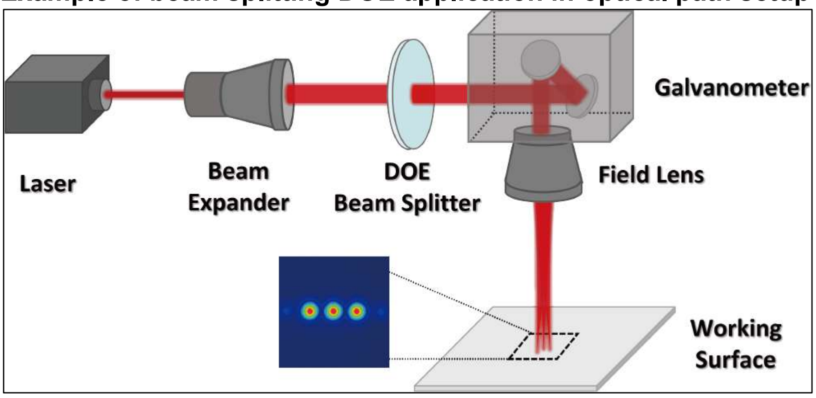
- Beam splitting uniformity: For the energy of each beam spot obtained by beam splitting, uniformity is defined as (1-range/sum) × 100%
- Diffraction efficiency: the ratio of the effective order energy obtained by beam splitting to the energy of all emitted light
- Beam splitting angle: There are different definitions for different beam splitting method

Performance curve





Example of beam splitting DOE application in optical path setup



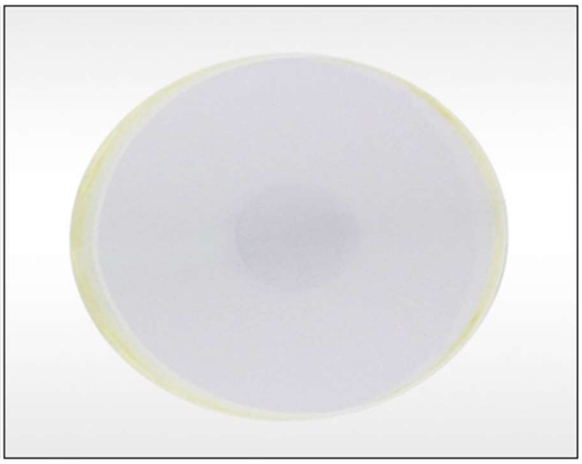
1.3 DOE Focus Shaping

The focus shaping DOE can modulate the energy distribution of the beam in the z-direction, which can be divided into two effects: long focus depth shaping and multi focus shaping. Commonly used in cutting applications in laser processing to obtain smoother cutting sections and better cutting quality. We provide two types of focal shaping DOEs, namely long focal depth and multi focal depth. The long focal depth DOE is a flat cone lens (PB Axicon, PBA) based on N-BK7 glass substrate and Liquid Crystal Polymers (LCP) material, presenting a sandwich structure of "front and rear are glass substrates, middle is LCP functional film layer. In the LCP layer, the fast axis orientation of liquid crystal molecules shows an equiperiodic gradient distribution along the radial direction of the substrate, and it has the same orientation on the entire device plane λ/ 2 phase delay, for single wavelength devices. Flat cone lenses have polarization related optical properties, and can be used to achieve circular convergence or divergence of light beams depending on the polarization state of the incident beam; When the incident light is left circularly polarized, it can also be used to generate Bessel beams with non diffraction and self recovery characteristics. Compared to traditional conical lenses, our flat conical lenses have a flat structure without a three-dimensional cone tip and are easier to integrate. At the same time, the structural formation of its cone tip depends on the orientation change of liquid crystal molecules, which can achieve processing accuracy at the micrometer level. In addition, it also has the characteristic of large dispersion.

The Multi Focal (MF) DOE is also made of N-BK7 glass substrate and liquid crystal polymer material, consisting of two 1-inch glass substrates and a single layer of LCP layer with design phase, making it a single wavelength device. Multi focal DOE is a diffractive optical element used for focus shaping, which can achieve the axial focusing of incident light into a fixed number, equally spaced, and energy uniform focal points. It uses the diffraction principle of light to design the phase, and through optical orientation, forms a designed phase structure in the liquid crystal polymer film, thereby achieving phase modulation of incident light and dispersing it at different diffraction levels, Finally, use a focusing lens to focus each level to form multiple focal points. Therefore, multifocal DOEs are generally used in conjunction with objective lenses to facilitate the implementation of multifocal requirements in general application scenarios. Multi focus DOE is mainly used for laser depth cutting, such as cutting of transparent glass, sapphire, etc. Compared with traditional laser cutting, it can use a number of uniformly arranged axial focuses to perform depth cutting of materials, so as to achieve an ideal flat section.

We provide 1-inch standard flat cone lenses with working wavelengths of 532nm, 633nm, 1064nm, and deflection angles (half angles) of 0.5°, 1°, 2.0°, 2.3°, and 4.7°. We also provide standard multifocal DOEs with working wavelengths of 1064nm with 3 and 5 focal points. In addition to standard products, we also support flexible customization of parameter specifications to facilitate users' diverse needs in different application scenarios.

Flat cone lens



Multifocal DOE

Product features

- Flat structure, small size, easy to integrate
- Transmitting element with high energy utilization rate
- The diffractive cone lens has high precision of “cone tip”, diffraction efficiency, and optional depth of focus
- Multi focal DOE customization is flexible, with adjustable number of focal points, spacing, and energy distribution
- Suitable for high-quality single mode lasers

Standard product model

Product model	Focus shaping type	Working wavelength Nm	Optical aperture Mm	Deflection angle °	Number of focal points	Focus spacing μm
SLB-PBA25-532-05	long focal depth	532	Ø 20	0.5	\	\
SLB-PBA25-532-10	Long focal depth	532	Ø 20	1	\	\
SLB-PBA25-532-23	Long focal depth	532	Ø 20	2.3	\	\
SLB-PBA25-532-47	Long focal depth	532	Ø 20	4.7	\	\
SLB-PBA25-633-05	Long focal depth	633	Ø 20	0.5	\	\
SLB-PBA25-633-10	Long focal depth	633	Ø 20	1	\	\
SLB-PBA25-633-23	Long focal depth	633	Ø 20	2.3	\	\
SLB-PBA25-633-47	Long focal depth	633	Ø 20	4.7	\	\
SLB-PBA25-1064-05	Long focal depth	1064	Ø 20	0.5	\	\
SLB-PBA25-1064-10	Long focal depth	1064	Ø 20	1	\	\
SLB-PBA25-1064-23	Long focal depth	1064	Ø 20	2.3	\	\
SLB-PBA25-1064-47	Long focal depth	1064	Ø 20	4.7	\	\
SLB-LCMF25-1064-F5-3-15	Multifocal	1064	Ø 7.5	\	3	15
SLB-LCMF25-1064-F4-3-4	Multifocal	1064	Ø 5.5	\	3	4
SLB-LCMF25-1064-F5-5-15	Multifocal	1064	Ø 7.5	\	5	15
SLB-LCMF25-1064-F4-5-24	Multifocal	1064	Ø 5.5	\	5	24

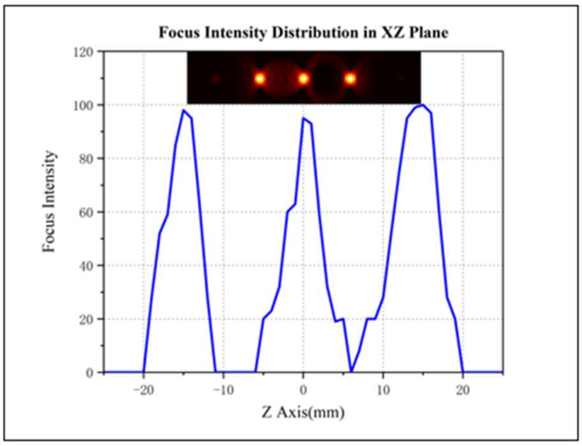
Performance parameter

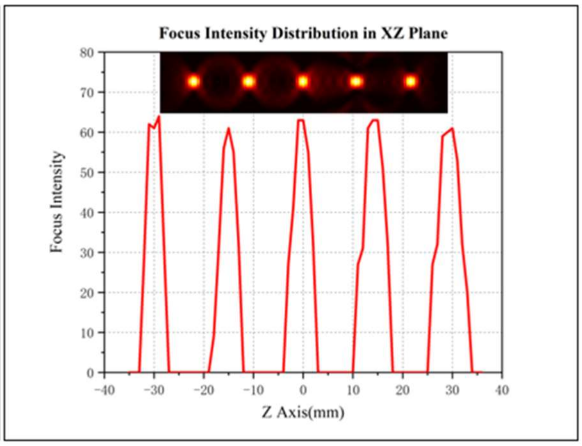
product type	Standard - Long focal depth	Customization - Long Focal Depth	Standard - Multi focus	Customization - Multi Focus
Working wavelength	532, 633, 1064nm	400-1700nm	1064nm	400-1700nm
Component size and installation method	Ø 25.4x3.2mm, compatible with 1-inch optical component mounting bracket	3-160 mm (Side length or diameter)	Ø 25.4x3.2 mm, compatible with 1-inch optical component mounting bracket	3-50.8 mm (Side length or diameter)
Requirements for quality of incident light spot	TEM00, $M^2 < 1.3$	Circular polarized light (recommended)		
Requirements for polarization state of incident light spot	Left circularly polarized light			
Incident spot size	Less than half of the aperture (recommended)			
Optical aperture	Ø 20mm	≤ substrate inner circle diameter x90%	Ø 5.5mm, Ø 7.5mm	≤ 10mm
Number of focal points	\	\	3 mm, 5 mm	
Focus spacing	\	\	4μm, 15μm, 24μm	
Energy distribution of focal point	\	\	Equal proportion	
Uniformity of focal energy	\	\	>95%	
Deflection angle	0.5 °, 1.0 °, 2.3 °, 4.7 °	0.2 ° -70 °	\	\
Transmittance	>97%	>85% @ 400-450nm >96% @ 450-1700nm	>98%	>85% @ 400-450nm >96% @ 450-1700nm
reflectivity	Ravg<0.5% (0 ° incidence angle)			
diffraction efficiency	\	\	>85%	
Zero order proportion	<4%		\	\

- Deflection angle: The half angle of the convergence or divergence angle of the outgoing beam obtained after the incoming collimated beam
- Uniformity of focal energy: For the energy of each focal point obtained by multifocal shaping, uniformity is defined as (1-range/sum) × 100%

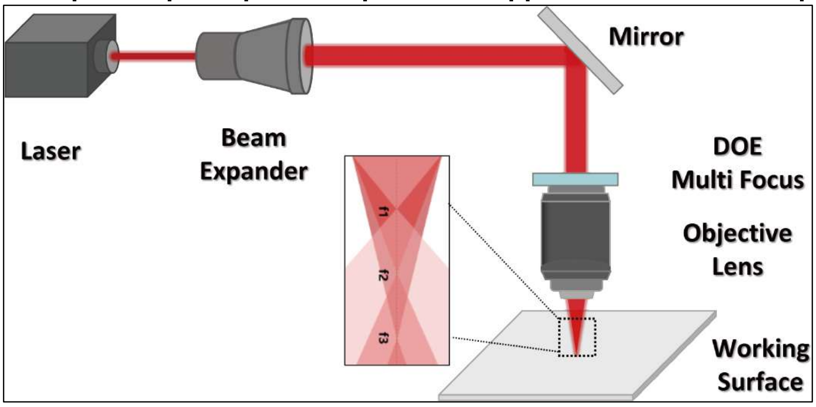
- Zero order proportion: The ratio of zero order spot energy obtained by long focal depth shaping to all outgoing light energy

Performance curve





Example of optical path setup for DOE application of focus shaping



1.4 Circular Shaping DOE

Circular shaping DOE can achieve different types of circular shaping effects based on its different phases, such as vortex light generated by vortex wave plates and far-field annular light generated by diffractive cone lens. Among them, vortex light is often used in various applications such as optical tweezers, super-resolution microscopy, lithography, etc; Far field annular light is commonly used in various applications such as atomic trapping, corneal surgery, and laser drilling.

Vortex Retarder (VR) is a sandwich structure based on N-BK7 glass substrate and Liquid Crystal Polymers (LCP) material, presented as a "front and rear glass substrate + middle LCP functional film layer", installed in a standard SM1 lens tube. In the LCP layer, the fast axis orientation of liquid crystal molecules has consistent radial along the substrate but gradually change along the substrate angle. It has the same $\lambda/2$ phase lag for single wavelength devices. Vortex wave plate has optical polarization properties. Depending on the polarization state of the incident beam, it can be used to generate vector polarized beam or vortex beam with spiral phase wavefront, and can convert TEM00 mode Gaussian beam to Laguerre Gaussian (LG) intensity distribution of "donut hole" (see the technical description for the above optical properties). Compared to traditional optical field control methods, vortex wave plates have the advantages of high efficiency, stability, easy operation, and specialized functionality; Its true zero order characteristics also help achieve lower wavelength sensitivity, higher temperature stability, and a larger incidence angle range.

PB Axicon (PBA) is a sandwich structure based on N-BK7 glass substrate and Liquid Crystal Polymers (LCP) material, presented as a "front and rear glass substrate, middle LCP functional film layer". In the LCP layer, the fast axis orientation of liquid crystal molecules shows an equiperiodic gradient distribution along the radial direction of the substrate. It has the same orientation on the entire device plane $\lambda/2$ phase delay for single wavelength devices. Flat cone lenses have polarization related optical properties, and can be used to achieve circular convergence or divergence of light beams depending on the polarization state of the incident beam. Compared to traditional conical lenses, our flat conical lenses have a flat structure without a three-dimensional cone tip and are easier to integrate; At the same time, the structural formation of its cone tip depends on the orientation change of liquid crystal molecules, which can achieve processing accuracy at the micrometer level; In addition, it also has the characteristic of large dispersion.

We provide standard vortex wave plates with working wavelengths ranging from 405 to 1550nm, orders m ranging from 1 to 128, and standard 1-inch flat cone lenses with working wavelengths of 532nm, 633nm, 1064nm, and deflection angles (half angles) of 0.5°, 1°, 2.0°, 2.3°, and 4.7 °. In addition to standard products, we also support flexible customization of parameter specifications to facilitate users' diverse needs in different application scenarios.

Vortex wave plate


Flat cone lens

Product features

- Flat structure, small size, easy to integrate
- Transmitting element with high energy utilization rate
- The control process of vortex optical field is easy to operate and has high conversion efficiency
- The diffractive cone lens has high precision of “cone tip”, high diffraction efficiency, and adjustable ring width and diameter
- Suitable for high-quality single mode lasers

Standard product model

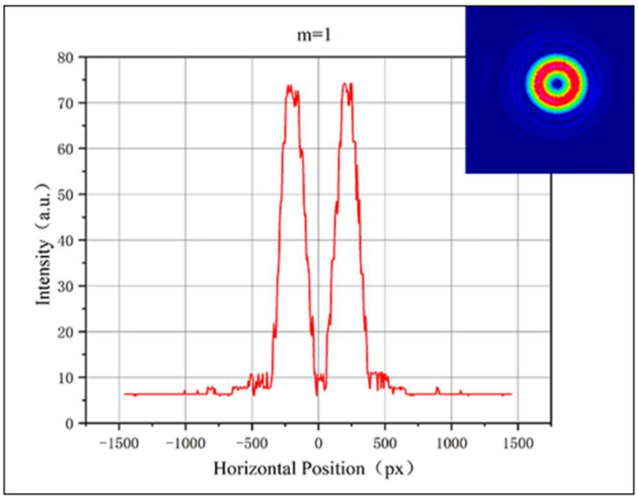
Product model	Circular shaping type	Working wavelength/nm	Optical aperture/mm	Deflection angle/°	Order m
SLB-VR1-532	Vortex optical field	532	Ø 21.5	\	1
SLB-VR1-633	Vortex optical field	633	Ø 21.5	\	1
SLB-VR1-1064	Vortex optical field	1064	Ø 21.5	\	1
SLB-VR2-532	Vortex optical field	532	Ø 21.5	\	2
SLB-VR2-633	Vortex optical field	633	Ø 21.5	\	2
SLB-VR2-1064	Vortex optical field	1064	Ø 21.5	\	2
SLB-VR4-532	Vortex optical field	532	Ø 21.5	\	4
SLB-VR8-532	Vortex optical field	532	Ø 21.5	\	8
SLB-VR16-532	Vortex optical field	532	Ø 21.5	\	16
SLB-VR32-532	Vortex optical field	532	Ø 21.5	\	32
SLB-VR64-532	Vortex optical field	532	Ø 21.5	\	64
SLB-VR128-532	Vortex optical field	532	Ø 21.5	\	128
SLB-PBA25-532-05	Far-field annular optical field	532	Ø 20	0.5	\
SLB-PBA25-532-10	Far-field annular optical field	532	Ø 20	1	\
SLB-PBA25-532-23	Far-field annular optical field	532	Ø 20	2.3	\
SLB-PBA25-532-47	Far-field annular optical field	532	Ø 20	4.7	\
SLB-PBA25-633-05	Far-field annular optical field	633	Ø 20	0.5	\
SLB-PBA25-633-10	Far-field annular optical field	633	Ø 20	1	\
SLB-PBA25-633-23	Far-field annular optical field	633	Ø 20	2.3	\
SLB-PBA25-633-47	Far-field annular optical field	633	Ø 20	4.7	\
SLB-PBA25-1064-05	Far-field annular optical field	1064	Ø 20	0.5	\
SLB-PBA25-1064-10	Far-field annular optical field	1064	Ø 20	1	\
SLB-PBA25-1064-23	Far-field annular optical field	1064	Ø 20	2.3	\
SLB-PBA25-1064-47	Far-field annular optical field	1064	Ø 20	4.7	\

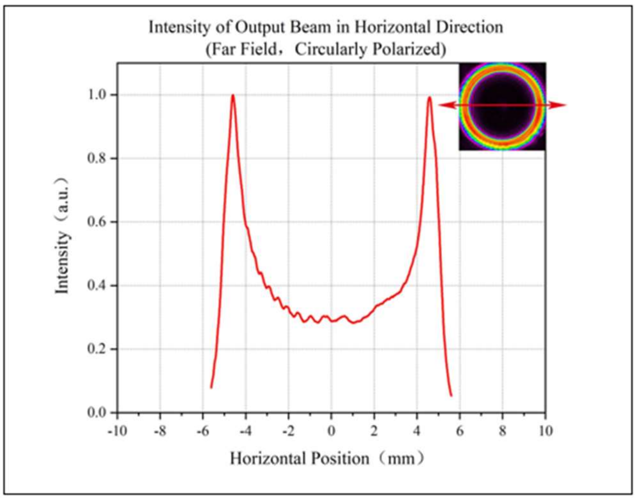
Working parameter

product type	Standard - Vortex Light Field	Customization - Vortex Light Field	Standard - Far Field Ring Light Field	Customization - Far Field Ring Light Field
Working wavelength	405-1550nm	400-1700nm	532, 633, 1064nm	400-1700nm
Component size and installation method	Ø 25.4x3.2mm, installed in SM1-8A mechanical housing	3-160mm (Side length or diameter)	Ø 25.4x3.2mm, compatible with 1-inch optical component mounting bracket	3-160mm (side length or diameter)
Order m	1-128 optional	1-128 optional	\	\
Requirements for quality of incident light spot	TEM00	TEM00	TEM00, M2<1.3	TEM00, M2<1.3
Requirements for polarization state of incident light spot	Linear polarized light/circularly polarized light	Linear polarized light/circularly polarized light	Circularly polarized light	Circularly polarized light
Incident spot size	Depends on the order m	≤ substrate inner circle diameter x90%	≤ Optical aperture	≤ Optical aperture
Optical aperture	Ø 21.5 mm		Ø 20 mm	≤ substrate inner circle diameter x90%
Deflection angle	\		0.5 °, 1.0 °, 2.3 °, 4.7 °	0.2 ° -7.0 °
Transmittance	>85% @ 400-450 nm,>96% @ 450-1700 nm	>85% @ 400-450 nm,>96% @ 450-1700 nm	>97%	>85% @ 400-450 nm, >96% @ 450-1700 nm
reflectivity	Ravg<0.5% (0 ° incidence angle)	Ravg<0.5% (0 ° incidence angle)	Ravg<0.5% (0 ° incidence angle)	Ravg<0.5% (0 ° incidence angle)
conversion efficiency	>99.5%	>97%, maximum achievable>99.5%	\	\
Zero order proportion	\		<4%	<4%

- Deflection angle: the half angle of the convergence or divergence angle of the outgoing beam obtained after the incident of a collimated beam
- Conversion efficiency: the ratio of first-order energy to all outgoing light energy in the Laguerre Gaussian energy distribution
- Zero order proportion: the ratio of zero order spot energy obtained by long focal depth shaping to all outgoing light energy

Performance curve



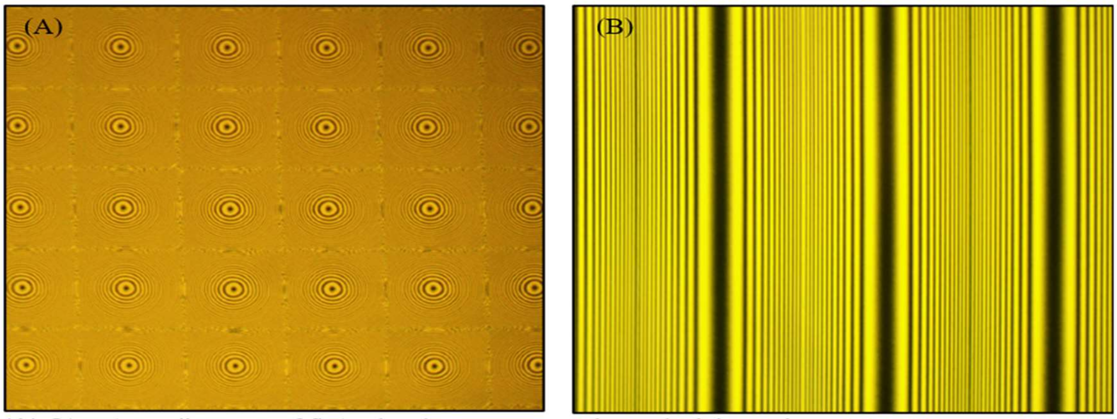


1.5 Lens Array Homogenizers

The lens array homogenizer can achieve non collimated homogenization effects of different shapes of multimode lasers. It can be used for beam homogenization in the direction of Aesthetic medicine, background light homogenization in the direction of machine vision and other scenario.

Our lens array homogenizer includes a flat plate microlens array and a flat plate cylindrical lens array. The flat plate microlens array is a flat plate optical element based on the optical diffraction principle of liquid crystal polymers to achieve laser beam homogenization and shaping. It is composed of a polymer film and a single N-BK7 window plate, and uses the array phase distribution on the liquid crystal polymer film to achieve the function of the microlens array. The shape of its outgoing beam is related to various parameters of the microlens unit. By adjusting the phase period and contour of the microlens unit, the divergence angle and spot shape of the outgoing beam can be flexibly controlled, achieving various laser uniform beam and beam shaping requirements of different shapes and sizes. This device is related to the polarization state of the incident light and controls whether the incident light is right or left circularly polarized, which can cause the beam to diverge or converge after passing through the lens. Based on the diffraction principle, the divergence or convergence angle of the lens follows $\sin \theta = \lambda / P$, in which λ is the design wavelength, p is the radial phase period of a single lens. At the same time, the microlens array is a single wavelength design, free of spherical aberration, and the incident surface is coated with Anti-reflective coating, which has a high transmittance and diffraction efficiency. It can be widely used in various systems such as wavefront sensing, optical energy gathering, and optical shaping. It has great development potential in the fields of optical information processing, optical interconnect, optical computing, image scanners, light field camera, medical devices, 3D imaging and display. Flat column lens array is a flat optical element based on the diffraction optics principle of liquid crystal polymers to achieve one-dimensional beam shaping and homogenization. It is composed of polymer thin films and dual N-BK7 window sheets, and the one-dimensional array phase distribution on the polymer thin film achieve the function of column lens array. Its modulation effect on the beam is related to the polarization characteristics of the incident beam and the parameters of the cylindrical lens unit: by adjusting the incident beam to left circularly polarized light (right circularly polarized light), a right circularly polarized outgoing beam (divergent left circularly polarized outgoing beam) that converges first and then diverges can be obtained, and the divergence or convergence angle follows $\sin \theta = \lambda / p$. Based on the formula, λ is the design wavelength, p is the phase period of the unit cylindrical lens. By adjusting the phase period of the cylindrical lens unit, the divergence angle of the outgoing beam can be flexibly controlled, achieving one-dimensional shaping and homogenization requirements for different specifications of beams. At the same time, the flat cylindrical lens array is designed with a single wavelength, no spherical aberration, and the incident surface is coated with anti-reflective coating, which has high transmittance and diffraction efficiency. The above characteristics make flat cylindrical lens arrays have great potential in scientific research fields such as imaging, machine vision, and semiconductor laser collimation.

We provide standard microlens arrays with a diameter size of 25.4 mm, microlens focal length of 5 mm and 50 mm, the shape of the outgoing beam is square, and the working wavelengths are 532 nm, 633 nm, 850 nm, 915 nm, and 976 nm. In addition, we also provide multi specification customization services, including special size, working wavelength, beam divergence angle, beam profile and other indicators.



(A) Structure diagram of flat microlens array under polarizing microscope
(B) Structure diagram of flat cylindrical lens array under polarizing microscope

Product features

- Flat structure, small size, easy to integrate
- Transmission type homogenization with high energy utilization rate
- Continuous phase, high duty cycle, high diffraction efficiency, and good homogenization effect
- Customization flexibility, uniform shape options, and adjustable divergence angle
- More suitable for non-collimation homogenization of multimode lasers

Standard product model

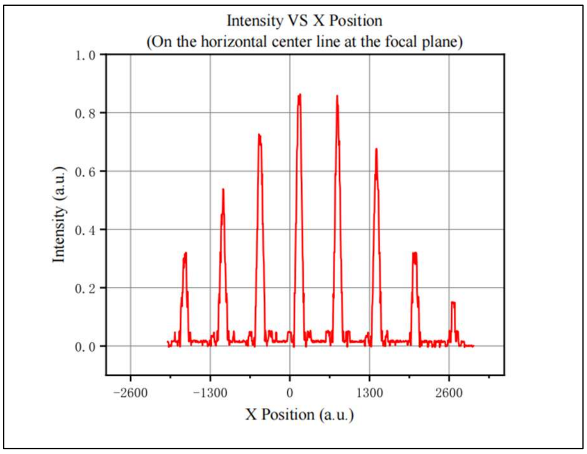
Product model	Uniform spot shape	Working wavelength/nm	Focal length/mm	Lens unit size	Optical aperture/mm
SLB-PBMLA25S-532-F5	square	532	5	300μmx300 μm	Ø 21.5
SLB-PBMLA25S-532-F50	square	532	50	300μmx300 μm	Ø 21.5
SLB-PBMLA25S-633-F5	square	633	5	300μmx300 μm	Ø 21.5
SLB-PBMLA25S-633-F50	square	633	50	300μmx300 μm	Ø 21.5
SLB-PBMLA25S-850-F5	square	850	5	300μmx300 μm	Ø 21.5
SLB-PBMLA25S-850-F50	square	850	50	300μmx300 μm	Ø 21.5
SLB-PBMLA25S-915-F5	square	915	5	1000μmx1000 μm	Ø 21.5
SLB-PBMLA25S-976-F5	square	976	5	1000μmx1000 μm	Ø 21.5
SLB-PBCLA25-520-8	linear	520	8	0.5mmx25.4mm	Ø 21.5
SLB-PBCLA25-650-8	linear	650	8	0.5mmx25.4mm	Ø 21.5
SLB-PBCLA25-915-5	linear	915	5	1mm x 25.4mm	Ø 21.5
SLB-PBCLA25-940-8	linear	940	8	0.5mmx25.4mm	Ø 21.5
SLB-PBCLA25-976-5	linear	976	5	1mm x 25.4mm	Ø 21.5

Working parameter

Product type	Standard - Microlens Array	Customization - Microlens Array	Standard - Column lens array	Customization - Column Lens Array
Working wavelength	532, 633, 850, 915, 976 nm	400-1700 nm	520, 650, 915, 940, 976 nm	400-1700 nm
Component size and installation method (Side length or diameter specifications)	Ø 25.4x1.6 mm, compatible with 1-inch optical component mounting bracket	3-160 mm (side length or diameter specifications)	Ø 25.4x3.2 mm, compatible with 1-inch optical component mounting bracket	3-160mm (Side length or diameter specifications)
Optical aperture	Ø 21.5 mm	≤ substrate inner circle diameter x90%	Ø 21.5 mm	≤ substrate inner circle diameter x90%
Requirements for quality of incident light spot	multimode			
Requirements for polarization state of incident light spot	nothing			
Incident spot size	Please consult us			
focal length	5 mm, 50 mm	Please consult us	5 mm, 50 mm	Please consult us
Shape of outgoing light spot	square	Any shape such as square, triangle, regular hexagon, etc., can achieve the best shape for dense splicing	linear	linear
non-uniform of outgoing light spot	<10%			
Transmittance	>85% @ 400-450 nm,>96% @ 450-1700 nm			
Reflectivity	Ravg<0.5% (0 ° incidence angle)			
Diffraction efficiency	>98%			

- Non-uniform of outgoing light spot: Root-mean-square deviation of energy in the area where the normalized energy distribution of light spot is more than 90%
- Diffraction efficiency: The ratio of energy in the region with a normalized energy distribution of over 90% of the light spot to all outgoing light energy

Performance curve



2. SLB Series Refractive Optical Modules

2.1 Bessel Processing Heads

The Bessel processing head is an optical module used for laser processing system terminals, composed of refractive and diffractive optical elements integrated into a metal mechanical sleeve. Through the light field control effect of the conical lens and the beam shaping effect of the double telecentric optical system, it can generate Bessel beams that meet the requirements of laser processing. Bessel processing head is suitable for single mode lasers. The optical components are made of high transmittance substrate, which has a high energy utilization rate. The compact modular structure is easy to integrate and has good adaptability to various laser processing systems. Through unique optical design, very small aberrations can be achieved. The size of the main lobe at the center of the outgoing light spot is <Ø 2μm. It can achieve small edge collapses, small heat affected areas, and non tapered cutting effects within a depth range of 0.2mm-12mm (including customization). At present, there are Bessel machining head standards designed with a working wavelength of 1064nm with an air focal depth of 0.5, 1, 2, 4, 6, and 8mm. They also support flexible customization of parameter specifications to facilitate users' diverse needs in different application scenarios.

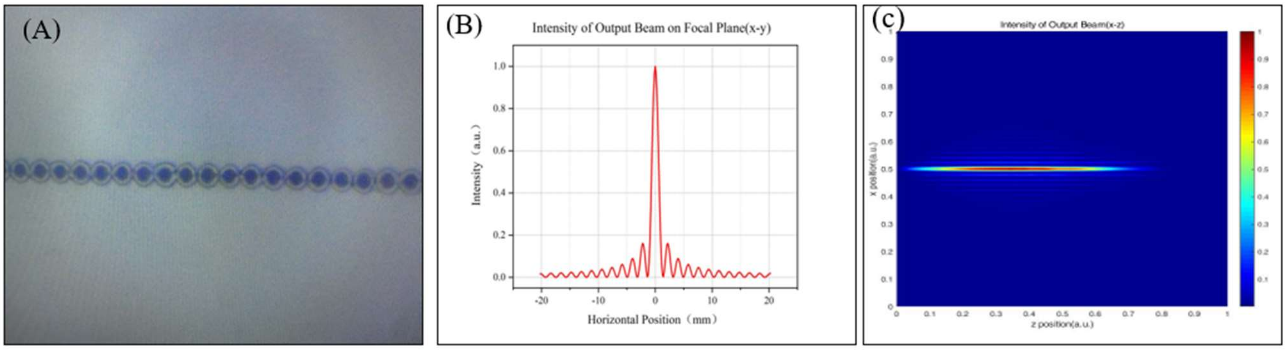
Product features

- Adopting high transmittance optical substrate, with high overall transmittance
- Unique optical design, small aberration, spot size< 2 μm
- Cutting depth 0.2-12mm, suitable for materials of different thicknesses
- Compact module, high adaptability, and easy integration
- Small edge breakage during cutting, no taper, and small heat affected area

Standard product model

Product model	Design wavelength/nm	Incident aperture/mm	Air focal depth/mm	Spot size/ μm
SLB-BPH-1064-6-05	1064	Ø 6	0.5	Ø 0.74
SLB-BPH-1064-6-1	1064	Ø 6	1.0	Ø1.28
SLB-BPH-1064-6-2	1064	Ø 6	2.0	Ø 1.2
SLB-BPH-1064-8-4	1064	Ø 8	4.0	Ø1.47
SLB-BPH-1064-10-6	1064	Ø 10	6.0	Ø 1.54
SLB-BPH-1064-10-8	1064	Ø 10	8.0	Ø 1.67

(C)



(A) The effect of Bessel processing head used for glass cutting
(B) The intensity of the output beam on the focal plane (x-y)
(C) The intensity of the output beam (x-z)

2.3 F-theta Field Lenses

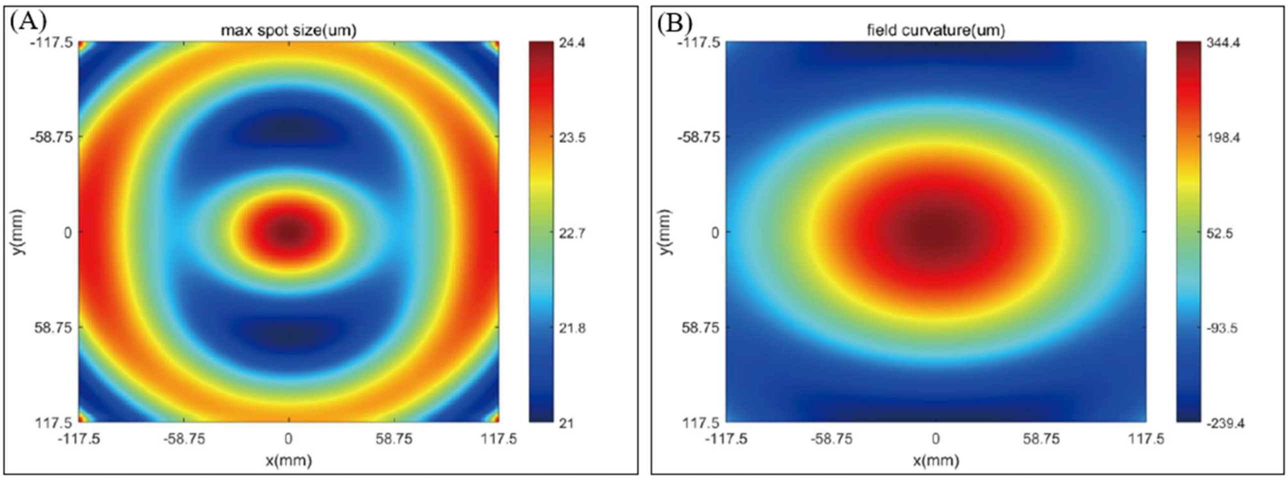
F-theta field lens is a flat field scanning lens that uses high transmittance optical glass as the substrate and is composed of a lens group integrated into a mechanical shell with a specific design scheme. The height of its focused beam is f ×θ (θ is the angle of incidence of the incident beam). Angular velocity of input beam is directly proportional to the angular velocity of the output beam, enabling the scanning mirror to operate at a constant angular velocity. It is commonly used to improve the ability of the edge beam to incident on the detector, homogenize the non-uniform light on the photosensitive surface of the detector, and compensate for the field curvature and distortion of the system. The F-theta field mirror can provide a flat field image plane when used, while greatly simplifying the control circuit. It has the characteristics of high transmittance, large scanning range, low aberration, and low F-theta distortion. It has great development potential in micro processing of medium and low laser power, such as marking machines, engraving machines, laser printers, fax machines, printing machines, laser pattern generators for semiconductor integrated circuits, and laser scanning precision equipment.

Product features

- Suitable for high-precision material processing and scanning applications
- Flat field image plane with large scanning range
- Air gap design, low aberration design
- Low F-theta distortion

Standard product model

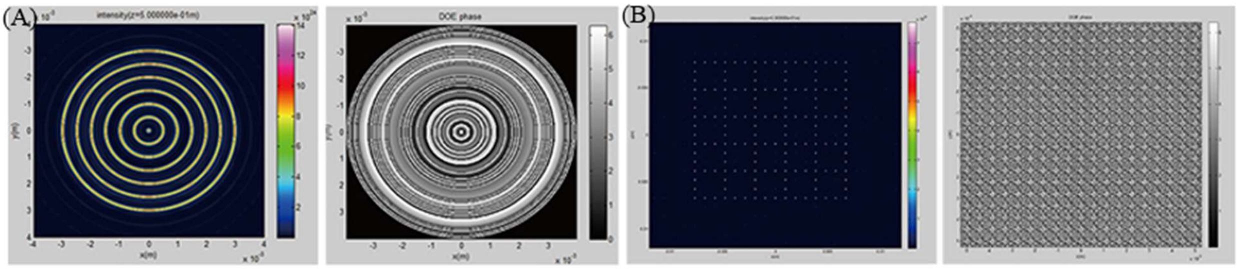
Product model	Design wavelength/nm	Incident aperture/mm	Focal length/mm	Scanning field/mm	Material quality
SLB-FT-532-16-330-347	532	Ø 16	330	245X245	optical glass
SLB-FT-1064-15-347-355	1064	Ø 15	347	253.4X253.4	optical glass
SLB-HPFT-532-14-330-230	532	Ø 14	330	110x110	optical glass
SLB-FT-1064-12-160-160	1064	Ø 12	160	160x160	Fused silica



(A) Focused spot size distribution map (using FT-532-16-330-347 as an example)
(B) Field curvature distribution map (using FT-532-16-330-347 as an example)

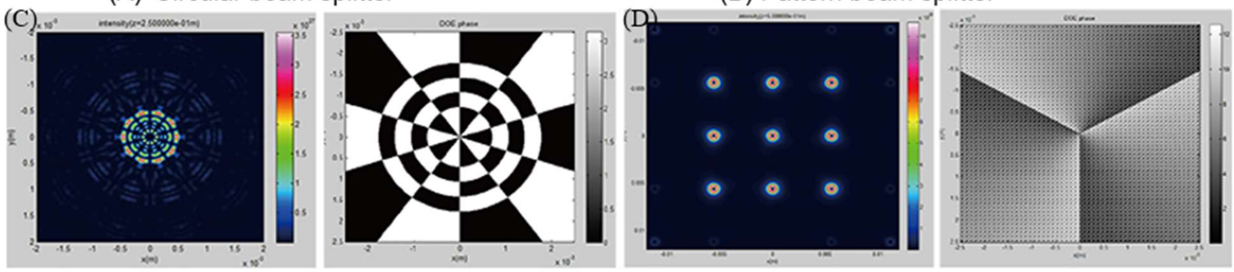
2.3 Customization of Micro/nano Optical Components

Micro nano optical elements, also known as diffractive optical elements, refer to optical elements that are fabricated in various ways on a flat substrate surface to produce two-dimensional structures at the micron and nanometer scales. Micro/nano optical elements transform the incident beam into any spot shape with the highest efficiency. According to different functions, micro/nano optical components can be basically divided into three categories: beam shaping devices, beam splitters, and homogenizers. Laser direct writing technology is one of the main technologies for producing micro/nano optical components. Various structures can be achieved by modulating the exposure beam power density, beam size, and polarization state. Based on the production process of liquid crystal micro/nano products, we can currently prepare various types of liquid crystal micro/nano optical components with working wavelengths in the range of 400-2000nm. Based on different structures, the minimum feature size can reach 5-0.2 μm. The phase structure can be flexibly processed, and can basically prepare either one-dimensional or two-dimensional phase structure. The device also supports multiple thicknesses and apertures in terms of external dimensions.



(A) Circular beam splitter

(B) Pattern beam splitter



(C) Special Gaussian mode converter

(D) Vortex beam splitter