HOLO/OR

LASER COMPONENTS

Utilizing Diffractive Optics

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Diffractive Optics

Grating equation for normal incident beam: $m \cdot \lambda = \Lambda \sin \Phi_m$

Grating equation for non-normal incident beam: $m \cdot \lambda = \Lambda(\sin \Phi_m - \sin \Phi_i)$

Diffraction angle changes as a function of wavelength: $\sin(\alpha_2) = \frac{\lambda_2}{\lambda_1} \sin(\alpha_1)$

Diffraction limited spot size: $DL_{spot\_size} = \frac{4 \cdot EFL \cdot \lambda}{\pi \cdot D_{input}} \cdot M^2$

Holo/Or defines uniformity as contrast: $Uniformity = \frac{I_{max} - I_{min}}{I_{max} + I_{min}}$

- Our DOEs work best with collimated beam but uncollimated Beam can be handled as well.
- Our DOEs do not require polarized or coherent beam.
- DOEs do not affect polarization except sub-wavelength regime.

Beam Splitter (Multi-Spot)

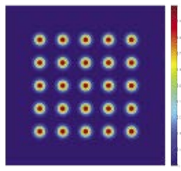
Our Multi-Spot elements are used to split a single beam into several beams, each with the characteristics of the original beam

Input Beam Mode: SM / MM

Average distance between neighboring spots: $d = EFL * \tan(\Phi_s)$

Size of each spot $= \frac{4 \cdot WD \cdot \lambda}{\pi \cdot D} M^2$ (at focal length)

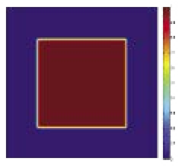
Tolerance: Not sensitive to X-Y-Z misalignment or beam size
Efficiency: 70-95%
Uniformity: Typically <5%



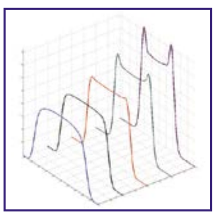
Multi-Spot/Beam Splitter

Top-Hat Beam Shaper

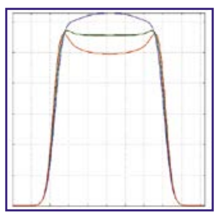
The Top-Hat Beam Shaper is used to transform a Gaussian incident laser beam into a uniform-intensity spot of various shapes with very sharp edges, in a specific work plane.
Characteristics - Image size from ~x1.5 DL size to over a hundred times DL size.
Input Beam Mode: SM TEM00 (recommended: M2<1.3)
Typical Efficiency: >93%
Typical Uniformity: <5%, speckles free
Tolerances – sensitive to X-Y misalignment, defocus & input beam size.



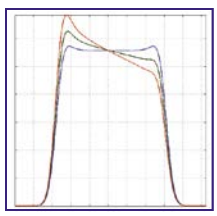
Top Hat/Flat Top



Defocus effect: blue line before nominal position (red) and violet after.



Beam size effect: blue line smaller input beam than nominal (green) and red is larger input beam than nominal



Decenter effect: nominal is the blue line.

01/20 / V02 / IF / holo-or/utilizing-diffractive-optics

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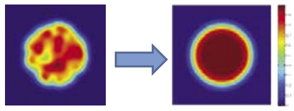
LASER COMPONENTS

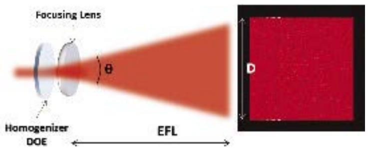
Diffractive Diffuser/Homogenizer

Generates a well-defined beam with homogenized intensity.
Shaping to any beam shape (round/square/line/arbitrary) is also possible.
Input Beam Mode: MM or SM (larger M^2 will give better homogeneity).



Diffuser/Homogenizer

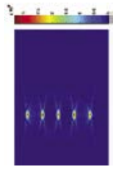
Spot Size $= 2 * EFL * \tan\left(\theta_{Diffuser}/2\right)$



Typical Efficiency: 70%-90%
Tolerance – Not sensitive to X-Y-Z misalignment or beam size

Diffractive Multi-Focal Lens

This solution allows a single incident beam to focus simultaneously at several focal points along the propagation axis.
Input Beam Mode: SM / MM



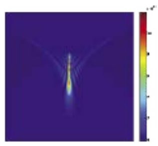
Multi-Focal
Propagation direction →

Multi-focal formula: $$\frac{1}{f_m} = \frac{1}{f_{\text{Refractive}}} + \frac{m}{f_{\text{Diffractive}}}, m = \pm 1,2,3...$$

Note: Distance between focii increases with higher refractive index.

Elongated Focus Lens

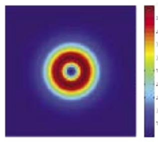
A new solution, achieving extended depth of focus as well as high lateral resolution (small beam waist).



Elongated Focus (along the propagation axis)

Vortex DOE

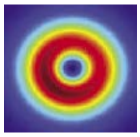
Converts a Gaussian input profile into a donut-shaped energy ring.
Ring diameter at focal plane $\cong DL * (m+1)$
where m is the topological charge.



Vortex

Input Beam Mode: SM TEM00 (Recomnded: M2<1.5)
Typical efficiency (>95%)
Tolerances – sensitive mostly to de-centration.
Not sensitive to input beam diameter.

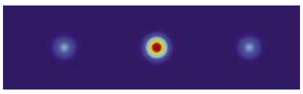
Beam de-centration effect:



Vortex (Beam decentered)

Beam Sampler

A Diffractive Beam Sampler allows real-time monitoring of high power laser by producing two sub beams with low energy without any other interruption or change of the main beam. The sub beam characteristics are identical to the main beam and can be measured easily (beam profile, power, spectrum, pulse width, etc.)
Beam sampling: 0.2% and up.



Beam Sampler

	Symbol Key
Wavelength(actual/ initial)	λ / λ_0
Diffraction Angle	α
Grating period	Λ
Diffraction Limit	DL
Diffraction order number	m
Separation angle	ϕ
Beam size	D
Working Distance	WD
Effective focal length	EFL
Effective focal length refractive/diffractive	$f_{refractive} / f_{diffractive}$
Focal length of order "m"	f_m
Focal length of focus lens	f_r
Beam quality parameter	M^2
Separation between foci (actual/ initial)	Δ / Δ_0
Single Mode/ Multi Mode	SM/MM
Uniformity	$Unif$
Clear Aperture	CA

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