

FBS®-L Top Hat Line Shaper

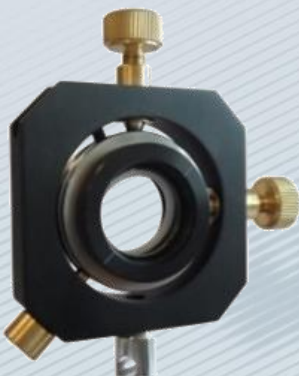
PRODUCT FEATURES

- ▲ Generation of 1 dim. Top Hat spots
- ▲ Homogeneous shape along the line and Gaussian shape across the line
- ▲ Smallest achievable line length
- ▲ Thin single optical element
- ▲ Easy integration in existing beam paths

APPLICATIONS

- ▲ Line scribing
- ▲ Wafer dicing
- ▲ Micromachining

RELATED PRODUCT

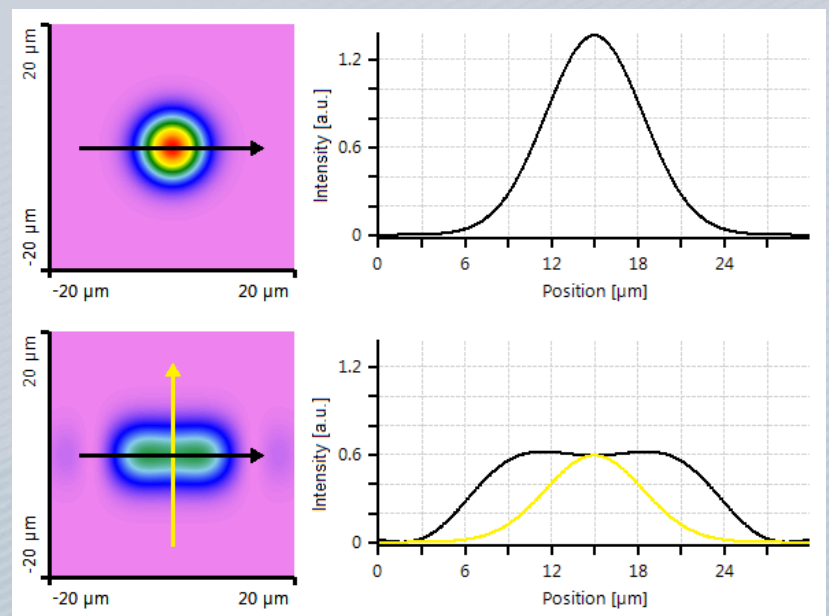


Translation mount HSF02 for the alignment of the FBS-L in lateral (x, y) directions. It also allows rotating the Top Hat line (orientation) in the working plane.

FBS-L is a Top Hat beam shaper especially designed to generate short, narrow and homogeneous line spots in the focal plane. It combines the well-tried Top Hat shape of the FBS-2 shaper with the smallest possible spot size of Gaussian spots.

Along the line FBS-L generates a Top Hat profile. Thereby, pulse-to-pulse overlap can be reduced and processing speed increased. The Top Hat profile also leads to more homogeneous ablation and can avoid damage of subjacent layers of layer systems. Across the line the shape is Gaussian to allow the smallest line width. The ratio between length and width is about 1.6:1 @1/e² and 2.2:1 @FWHM.

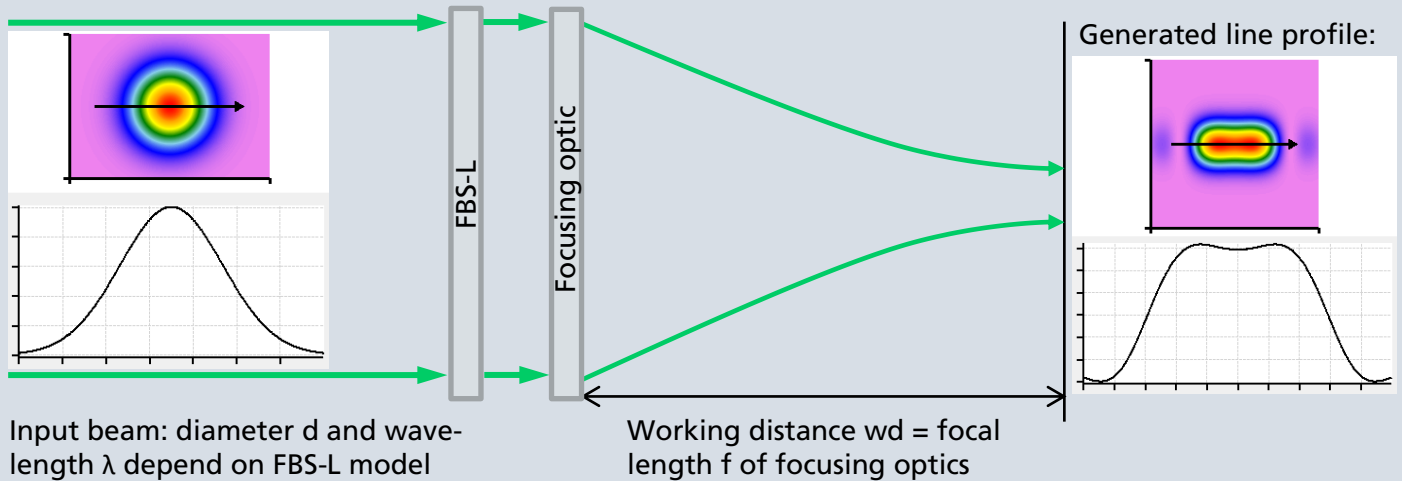
SPOT PROFILES: GAUSSIAN VS FBS-L



Above: Spot profile of a focused Gaussian beam in the focal plane (left) and the corresponding line scan (right).

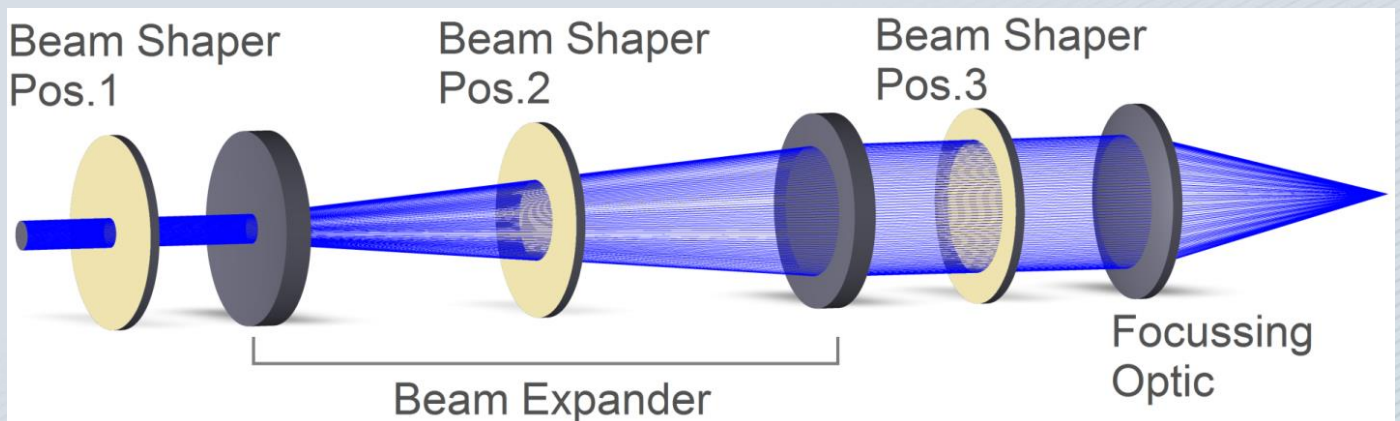
Below: Integration of FBS-L into the beam path leads to a line-shaped spot in focal plane (left). The shape along the line is homogeneous (black curve) and across the line Gaussian (yellow curve). Shown results are for $\lambda = 532 \text{ nm}$, 5.0 mm beam diameter @1/e² and 100 mm focal length.

BASIC OPTICAL SETUP



FBS-L beam shaper in combination with any focusing optic and a single mode Gaussian beam (TEM_{00} with M^2 of 1.4 or better) delivers a homogeneous line profile. This line profile is generated in the focal plane of the focusing optic. The line length depends on the focal length f , the input beam diameter d ($@1/e^2$) and the wavelength λ . The line length ($@1/e^2$) is approximately $2 * \lambda * f / d$.

INTEGRATION



Pos. 1: FBS-L can be installed in front of a beam expander/telescope into the beam. Advantage of this option is scaling of spot size in the focal plane by changing the magnification of the beam expander.

Pos. 2: If the beam expander is not housed, it is also possible to place FBS-L between the telescope lenses. This position allows adjustment of the FBS-L position to match the effective beam diameter.

Pos. 3: FBS-L can be placed behind the beam expander into the increased beam diameter. Tolerances for the lateral displacement of the FBS-L and the input beam diameter are proportional to the input beam diameter. The advantage of this position is the larger lateral displacement tolerance for alignment.

Each beam shaper is designed for a fixed input beam diameter ($@1/e^2$). Therefore, it is not possible to use the same FBS-L in front, inside and behind a telescope.

SPECIFICATIONS

SPOT GEOMETRY

Line length (Top Hat)	approximately $2 * \lambda * f / d$, with f = focal length, d = beam diameter @ $1/e^2$
Line width (Gaussian)	similar to the dia. of the Gaussian spot in the same optical configuration
Efficiency	up to 92.5%
Homogeneity	ca. $\pm 2.5\%$ (rel. to average intensity along the line plateau)
Side modes (strongest)	~ 15x weaker than line plateau (< 1.7% of input energy)
Depth of focus (DOF)	~ 50% of the Rayleigh length

REQUIREMENTS FOR THE USE OF FBS-L

Input beam	Gaussian beam TEM ₀₀ , M ² of 1.4 or better
Input beam diameter ¹⁾	FBS-L models are designed for a fixed input beam dia., tolerance $\pm 5\%$. standard input beam diameters: 1.0 mm, 1.5 mm, ... or 10.0 mm @ $1/e^2$
Standard wavelengths ¹⁾	1064/1030 nm, 532/515 nm or 355/343 nm
Apertures within the optical setup	clear aperture along the whole beam path should be at least 2x larger than the beam diameter @ $1/e^2$

INTEGRATION OF FBS-L INTO THE BEAM PATH

Alignment	alignment in lateral direction is necessary (translation). Rotating the shaper around the optical axis is helpful to align the orientation of the Top Hat line. We recommend our mount HSF02.
Optical equipment	required: focusing optic to generate the Top Hat line in the focal plane of this focusing optic.
	useful: beam expander to firstly adjust the effective beam dia. to the design input beam dia. of the FBS-L and secondly adjust the beam dia. to the desired spot size.
	helpful: beam profiler to check profiles while aligning.

SUBSTRATE SPECIFICATIONS

Material ¹⁾	fused silica
Transmission	> 99%, with single line AR/AR coating
Damage threshold	@ 10 ns: 10 J/cm ² @ 1064 nm, 5 J/cm ² @ 532 nm, 3 J/cm ² @ 355 nm
Dimension ¹⁾	unmounted version: dia. 1 inch x 3 mm
	mounted version for beam dia. up to 6.0 mm: 16 x 16 x 3 mm ³ in dia. 1 inch x 5.5 mm holder

ORDER INFORMATION

Product code	FBSL - beam diameter - wavelength
Example	FBSL-50-532 → 5.0 mm input beam dia. @ $1/e^2$ and $\lambda = 532$ nm

¹⁾ Others on request