

3.3.6 Focal Spot Analyzer

Captures the beam size, shape and profile at focus

- Image focal spots down to $34.5\mu\text{m}$ in size
- For laser powers up to 400W ⁽¹⁾ (additional external ND filters required) and up to 5kW for FSA- HP version
- Can measure systems with focal length as short as 73mm ⁽²⁾ (exact path length distance within the assembly will be NIST/National Lab calibrated and includes a calibration certificate $\pm 50\mu\text{m}$)
- Produces undistorted sample of laser under test
- Adjustable attenuation maximizes system dynamic range
- Up to 1×10^{-10} attenuation available (without external filters)
- Analyzer includes camera, attenuator, BeamGage software and calibration certificate



Measure your laser beam power distribution and focal spot size of wavelengths from 300 – 1100nm.

The average power can be from <1 to 400 Watts and up to 5 kW for FSA-HP, the focal spot can be as small as $34.5\mu\text{m}$.

The FSA can also be used to measure how the focal spot shifts with power during its critical start-up phase.

The FSA is a combination of a camera, Beam Splitter, natural density filters and a BeamGage software.

FSA-HP

For measurement of focal position and profile of high power lasers above 1kW at NIR ($\sim 1064\text{nm}$) region FSA-HP version can be used. It allows same operation as standard FSA but operates up to 5kW or $15\text{MW}/\text{cm}^2$ without significant heating.

Only 0.0001% ($1/10^6$) of the incident beam is reflected towards Ophir Beam Profiler enabling beam sampling of extremely high powers and power densities.

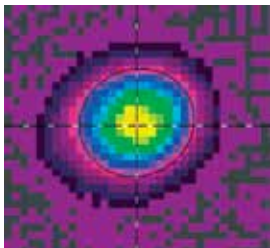
Operation

The assembly is placed below the final focusing lens of the laser at a distance equal to the expected focal length less the $\sim 73\text{mm}$ of the calibrated distance, so the beam will be focused on the camera layer. The focal spot is found by moving the assembly closer and farther from the beam until the smallest spot size is seen. The distance between the focusing lens and the datum point on the FSA assembly is added to the distance from the datum to the camera array (each FSA assembly will be factory calibrated to within $\pm 50\mu\text{m}$). These two measurements will give you the exact distance of your lasers focal spot.

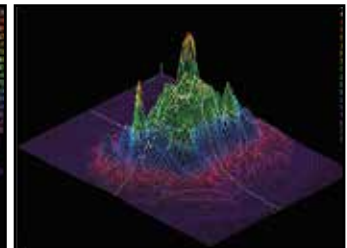
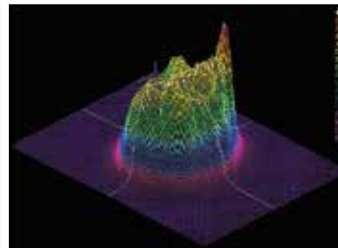
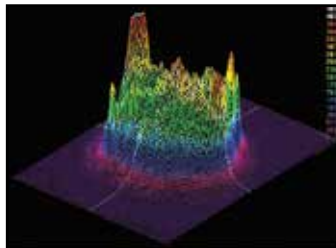
(1) For Gaussian beam diameter $< 1/2$ the clear aperture and depending on ND filter and camera saturation limits the maximum power may be as high as 1000W.

(2) Using beam expanders, focal spots as small as $10\mu\text{m}$ can be measured and calibrated. Ask your Ophir representative about special calibrated focal spot analyzers.

Examples of Usage



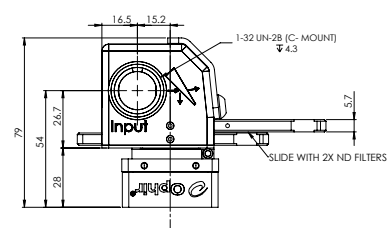
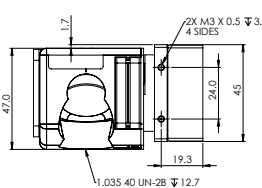
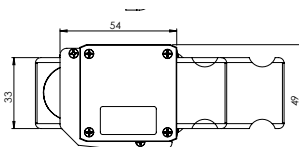
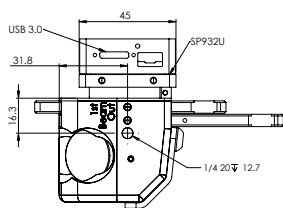
65µm diameter focal spot



Focal spot spatial power density changing with laser power level

FSA-SP932U

NOMINAL PATH LENGTH 71.63 mm



Cameras Specifications

Model	SP932U	LT665
Format	1/1.8"	1"
Wavelengths ⁽¹⁾	190 - 1100nm	190 - 1100nm
Active Area	7.06mm x 5.3mm	12.5mm x 10mm
Beam sizes	34.5µm - 5.3mm	46µm - 9.9mm
Pixel spacing	3.45µm x 3.45µm	4.54µm x 4.54µm
Number of effective pixels	2048 x 1536	2752 x 2192
Dynamic range	72 dB	54 dB
Linearity with Power	±1%	±1%
Accuracy of beam width	±2%	±2%
Frame rates in 12 bit mode ⁽²⁾	24 fps at full resolution	27 fps at full resolution
Shutter duration	25µs to 2000ms	31µs to multiple frames
Gain control	1.46 dB to 256 dB	0.8 dB to 56 dB
Trigger	Hardware/Software trigger & strobe out	Hardware/Software trigger & strobe out
Photodiode trigger (Optional) ⁽³⁾	Si response: SP90408	Si response: SP90408
Saturation intensity ⁽⁴⁾	32µW/cm ² at 632nm, 500µW/cm ² at 1064nm	14µW/cm ²
Lowest measurable signal ⁽⁴⁾	0.2nW/cm ²	0.3nW/cm ²
Damage threshold ⁽⁵⁾	50W/cm ² / 1J/cm ² with all filters installed for < 100ns pulse width	50W/cm ² / 1J/cm ² with all filters installed for < 100ns pulse width
Dimensions	45mm x 45mm x 22.5mm	43mm x 43mm x 65mm
Imager recess	4.5mm	17.5mm
Image quality at 1064nm	Pulsed with trigger sync - excellent Pulsed with video trigger - good CW - good	Pulsed with trigger sync - excellent Pulsed with video trigger - good CW - good
Operation mode	CMOS, Global shutter	Quad Tap interline transfer CCD
PC interface	USB 3.0	USB 3.0
OS Supported	Windows 7 (64) and Windows 10	Windows 7 (64) and Windows 10
Compliance	CE, UKCA, China RoHS	CE, UKCA, China RoHS

Notes:

- (1) The camera's natural response is from 340nm through 1100nm. To measure effectively below 340nm, please make use of one of our UV converters. Otherwise the sensitivity is too low and the measurement accuracy may degrade.
- (2) Highly dependent on PC processor and graphics adapter performance.
- (3) For more information please see "Optical Camera Trigger" catalog page.
- (4) Camera set to full resolution at maximum frame rate at 633nm CW wavelength. Camera set to minimum useful gain and 1ms exposure time for saturation test and maximum useful gain and 35ms exposure time for lowest signal test.
- (5) This is the damage threshold of the filter glass of the filters. Assuming all filters mounted with ND1 (red housing) filter in the front. Distortion of the beam may occur with average power densities of 5W/cm² for beam size 5mm, 10W/cm² for 2mm beam and >30W/cm² for 1mm beam.

LBS -300s Specifications

Model	LBS-300s-UV	LBS-300s-VIS	LBS-300s-NIR	LBS-300HP-NIR	LBS-300s-BB
Wavelengths ⁽¹⁾	266-355nm	400-950nm	950-1800nm	1000-1100nm	190-2500nm
Wedge Material	UVFS	UVFS	UVFS	UVFS	UVFS
Wedge Coating	A/R ≤1%	AR ≤1%	AR ≤1%	AR ≤0.1% special surface	No coating, 4% reflection
Clear aperture	17.5mm	17.5mm	17.5mm	15mm	17.5mm
Reflection ⁽¹⁾⁽²⁾	0.01%	0.01%	0.01%	<0.0001% (1/10 ⁶)	0.16%
Wedge ND value, each	ND ≥2	ND ≥2	ND ≥2	ND ≥3	ND ~1.3
Maximum allowable input to wedge	10MW/cm ² 5 J/cm ²	10MW/cm ² 5 J/cm ²	10MW/cm ² 5 J/cm ²	15MW/cm ² , 10J/cm ² at beam splitter	10MW/cm ² 20 J/cm ²
ND Filters	Inconel	Bulk ND	Bulk ND	Bulk ND	Combination of Inconel and Bulk ND
ND Values, nominal	0.3, 0.7, 1.0, 2.0, 3.0, 4.0 (Blue holders)	0.3, 0.7, 1.0, 2.0, 3.0, 4.0 (Green holders)	0.4, 0.8, 1.0, 2.0, 3.0, 4.0 (Red holders)	0.4, 0.8, 1.0, 2.0, 3.0, 4.0 (Red holders)	10 filters UV, VIS and NIR
Filter Slides	3	3	3	3	5
Maximum allowable input to filter ⁽³⁾	100 W/cm ² CW 20mJ/cm ² , 10ns pulse	50 W/cm ² 1J/cm ² , 10ns pulse	50 W/cm ² 1J/cm ² , 10ns pulse	50 W/cm ² 1J/cm ² , 10ns pulse	See UV, VIS and NIR specifications

Notes:

- (1) The Wavelengths and Reflection refer to Wedges of LBS-300s Assembly used in FSA unit. The standard FSA operating wavelengths is limited by SP932U camera 300-1100nm, in case extending spectral region is required, contact your Ophir representative.
- (2) For reflectance Spectra see LBS-300 User Note.
- (3) This is the damage threshold of the filter glass of the filters. Distortion of the beam may occur with average power densities of 5W/cm² for beam size 5mm, 10W/cm² for 2mm beam and >30W/cm² for 1mm beam

Ordering Information

Model	SP932U	LT665
	Item	P/N
LBS-300s-UV	FSA-UV-SP932U	SP90614
LBS-300s-VIS	FSA-VIS-SP932U	SP90615
LBS-300s-NIR	FSA-NIR-SP932U	SP90616
LBS-300s-BB	FSA-BB-SP932U	SP90617
LBS-300HP-NIR	FSA-HP-NIR-SP932U	SP90603
	Item	P/N
	BGP-LBS-300s-UV-CAL-LT665	SP90481
	BGP-LBS-300s-VIS-CAL-LT665	SP90482
	BGP-LBS-300s-NIR-CAL-LT665	SP90483
	BGP-LBS-300s-BB-CAL-LT665	SP90484

Note:

Comes with BeamGage Professional software license, NIST/ National Lab traceable calibrated path length from top of unit to CCD array, USB cable and 3 ND filters.