PART # 8J06012. REV 01

User Notes

FOCAL SPOT ANALYZER (FSA)

BEAM SAMPLER

CAMERA MODEL SP932U

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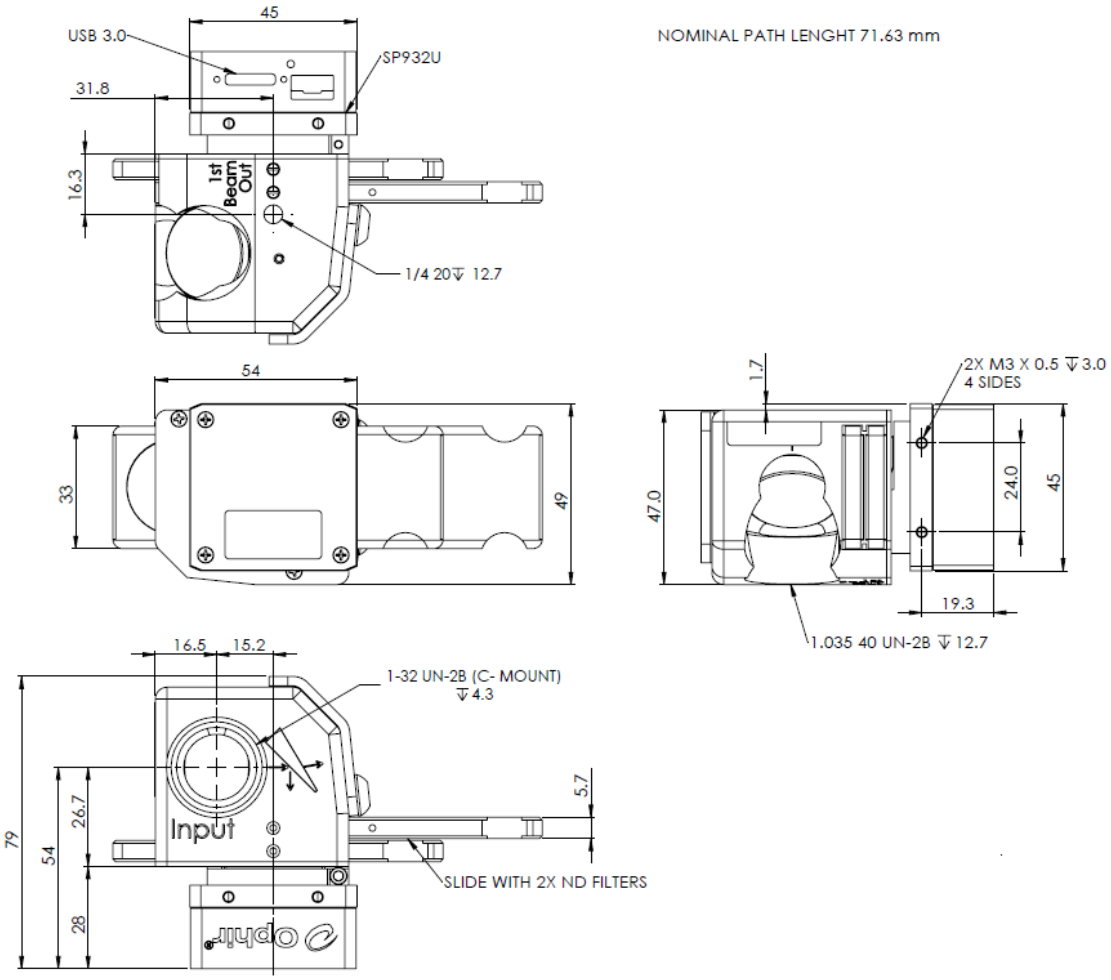
Focal Spot Analyzer (FSA) Beam Sampler User Notes

DIMENSIONS

FSA with SP932U Camera



INSTRUCTION

The Focal Spot Analyzer allows measuring laser beams with diameters up to 17.5 mm and minimal focal spot of 34.5 µm and powers ranging from 10mW to ~400W[1].

The design of the beam sampler maintains the original polarization of the beam. The front surface reflection from two beam splitters directs the beam through the filter slides and then on to the camera sensor. Approximately 97-99% of the beam is transmitted through the beam sampler with ≥ 0.01% passed on to the camera[2].

A set of interchangeable ND filters is provided to make final intensity adjustments to the beam before it reaches the camera imager.

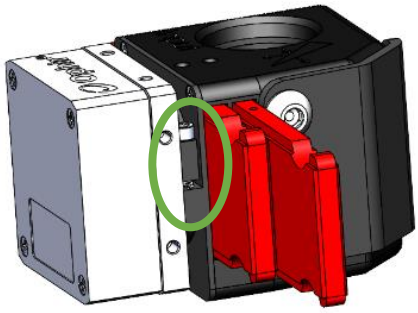
Notes: 1. 0.5mW to ~400W for SP90601. For Gaussian beam diameter <1/2 the clear aperture and depending on ND filter and camera saturation limits the maximum power may be as high as 1000W.

2. The SP90601 passes 0.16% to the camera.

FACTORY CALIBRATION

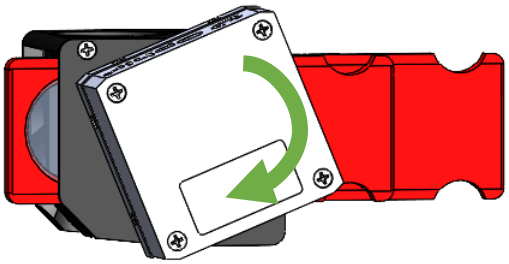
Focal Spot Analyzer is pre-calibrated in the factory. A detailed explanation about optical path length measurement is provided in section **Optical path calculation**

The camera orientation can be easily rotated to fit the needs of your beam.



1. Use the provided hex key to loosen the screw securing the camera.

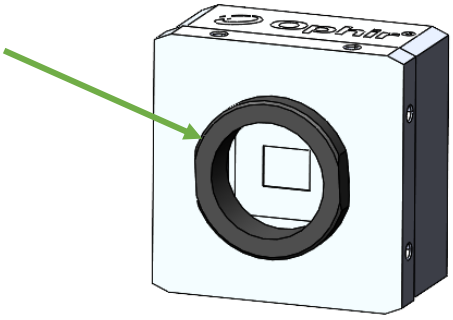
2. Rotate the camera as needed.



3. Make sure that the camera is flush with the beam splitter housing before tightening the screw to maintain the calibration distance.

4. Re-secure the screw to tighten the camera in place.

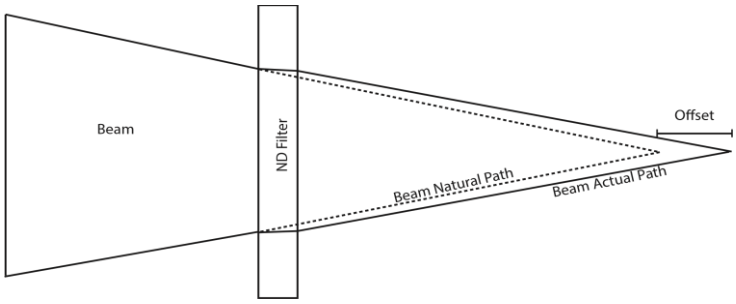
Warning: Do not remove the ring from the camera. Doing so will interfere with the calibration of the system



Warning *:* We do not recommend removing the camera when rotating. There is no window protecting the camera sensor and removing it will make it more susceptible to damage or dust contamination

LENGTH CALCULATION

With the beam traveling through the ND filters, there is an inherent offset that occurs. This offset must be considered when determining the actual beam path distance.



Each beam splitter housing and ND Filter holder has its own calibrated dimensions printed and placed on the unit. To calculate the total path length, we need to look at all the variables.

Total path length = [calibrated path] + [Filter offset$_a$] + [Filter offset$_b$]

Note:The calibrated path is the internal distance from the top surface (Datum reference) of the FSA to the camera sensor and is found on the FSA label with the serial number.

The total path length then needs to be added to the distance the beam travels from the source where it enters the FSA to give the actual travel length of the beam.

Example:
In this example we are using FSA with ND 3.0 and 0.8 for attenuation. To fill out the equation we will need to look at the Path Length Offset found on the labels for ND filter 3.0 and ND filter 0.8 as shown below.

Our equation becomes:

Total path length = 72.32mm + 0.64mm + 0.76mm = 73.72mm

Note: filter offset values are wavelength dependent. A color code system for the filter holders notes which application it should be used in; blue is measured at 308nm, green 532nm, and red 1064nm. For help in getting more accurate measurements contact Customer Service.

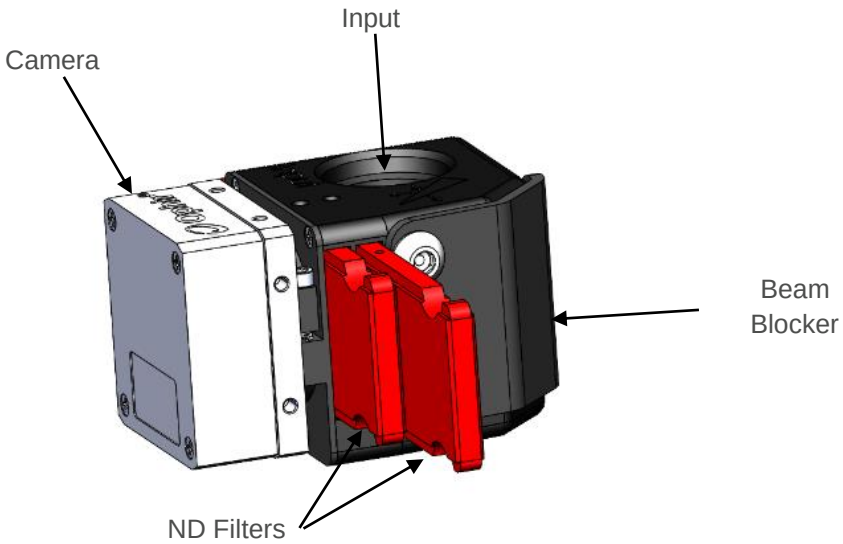
INSTALLATION AND SETUP

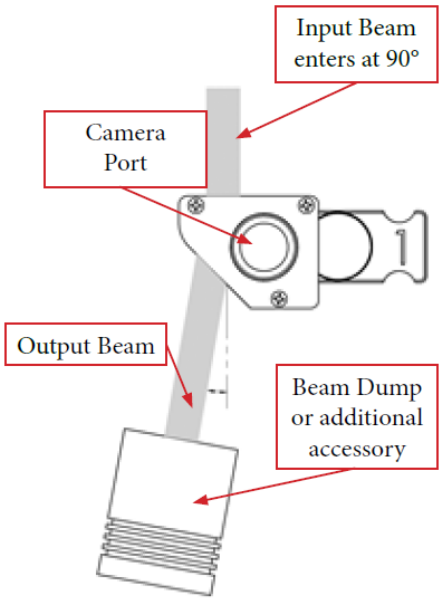
1. The FSA contains of beam splitter attached to the camera as shown above. Camera can be rotated at any required orientation as descried in **Factory Calibration.**

2. Position the FSA so the laser beam enters the center of the input port at a 90° incidence.

3. Removable beam blocker. The beam blocker is designated to keep the wedge surface protected during handling operation. It can be left attached or removed, in order to have additional beam sampling for power measurement. The resulting beam intensity is estimated ~1% of incident beam power/ energy.

A 1.035-40 thread is provided behind each wedge along the axis of the output beam that can be used to directly mount accessories with 1” lens tubes such as beam dumps or even power and energy sensors to the FSA.





4. The main beam will exit the FSA turned approximately 6 degrees as demonstrated:

Provision must be made to safely contain the transmitted beam. An optional beam dump is available to contain the beam if required.

Warning: You must provide a beam stop for the laser beam that passes through the beam sampler.
The beam stop must be able to withstand the continuous power/energy of the input beam.

OPERATION

1. Start the beam profiler software and adjust the ND filter holders until the maximum beam intensity is approximately 80% of saturation. See **Appendix A** for ND filter details.
If there are interference effects seen, slight angling of the setup to the beam path may eliminate this.

2. If no picture is seen, check again that the beam is aligned into the sampler. If the image is saturated when the maximum ND filters are in place, lower the camera signal below saturation by reducing the camera exposure setting.

> ***Note:*** ND filters may start to thermal lens and deform the observed beam profile above 5W/cm² for beam size 5mm, 10W/cm² for 2mm beam and >30W/cm² for 1mm beam.

Caution: The damage threshold for the ND filters is 50 Watts/cm². Make sure the power density in the beam as it hits the ND filters does not exceed this amount. If the beam is converging (focusing) rather than collimated, be sure to take this effect into consideration as well.

PRODUCT INFORMATION

Check our website for latest version spec: www.ophiropt.com/laser-measurement

Focal Spot Analyzer				
Model	FSA-UV-SP932U	FSA-VIS-SP932U	FSA-NIR-SP932U	FSA-BB-SP932U
Part No.	**SP90614**	**SP90615**	**SP90616**	**SP90617**
Wavelength [a]	300-400nm	400-950nm	950-1100nm	300-1100nm
Wedge Material	UVFS	UVFS	UVFS	UVFS
Wedge Coating	A/R ≤1%	A/R ≤1%	A/R ≤1%	Uncoated: 4% reflection
Maximum Input to Wedge Surface	1 MW/cm², 5 J/cm²	1 MW/cm², 5 J/cm	1 MW/cm², 5 J/cm	10 MW/cm², 20 J/cm
Reflection [a] (Reflectance Spectra below)	0.01%	0.01% 400 – 700nm 0.16% 700 – 950nm	0.01% 1070nm 0.09% 1000-1050nm 0.16% 1100 – 1800nm 0.25% 950-1000nm	0.16%
Clear aperture	17.5mm	17.5mm	17.5mm	17.5mm
Wedge ND value, each	ND ≥2	ND ≥2	ND ≥2	ND ~1.3
ND Filters	Inconel	Bulk ND	Bulk ND	Combination of Inconel and Bulk ND
ND Values, nominal	0.3, 0.7, 1.0, 1.5, 2.5, 3.0 (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)	See Broad Band (BB) chart below
Filter Slides	3	3	3	5
Maximum allowable input to filter [b]	100 W/cm² CW 20mJ/cm², 10ns pulse	50 W/cm² 1J/cm², 10ns pulse	50 W/cm² 1J/cm², 10ns pulse	See UV, VIS and NIR specifications

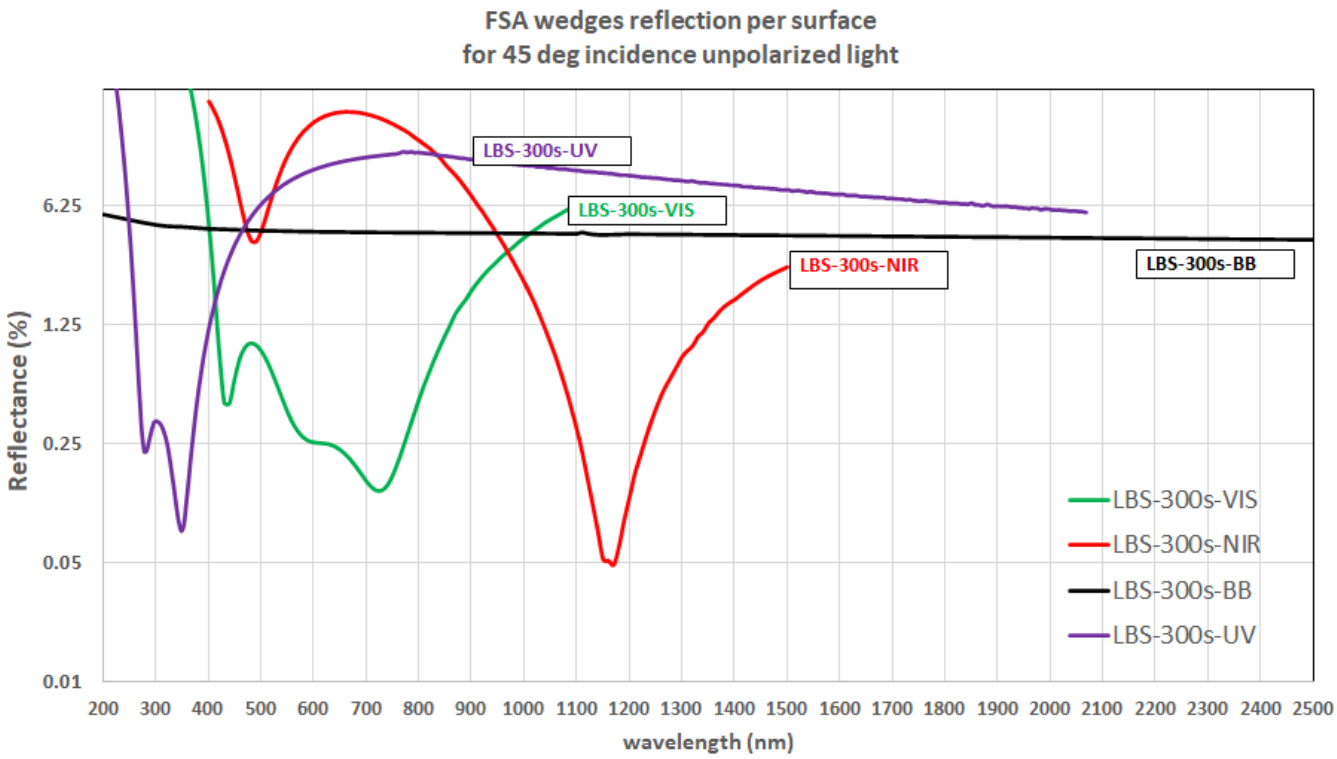
Note a: The AR coating used in FSA wedges has wider wavelength range but the FSA operating wavelengths is limited by SP932U camera to 300-1100nm. In case extending spectral region is required, contact your Ophir representative.

Note b: ND filters may start to thermal lens and deform the observed beam profile above 5W/cm² for beam size 5mm, 10W/cm² for 2mm beam and >30W/cm² for 1mm beam

Features:

- C-mount stackable design compatible with most other C-mountable accessories
- Wedges removable for replacement and cleaning
- Multiple mounting points
- Marked for easy use
- Power/Energy meter at 1st exit port can measure ~99% (~95%-BB) of input beam

REFLECTANCE SPECTRA

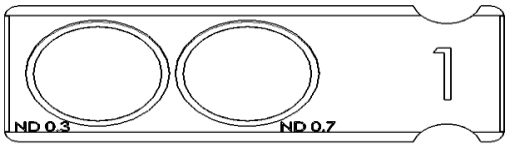


Reflectance Spectra demonstrates single surface reflection. The combined reflection of wedges is a multiplication of the percentage value of a single surface.

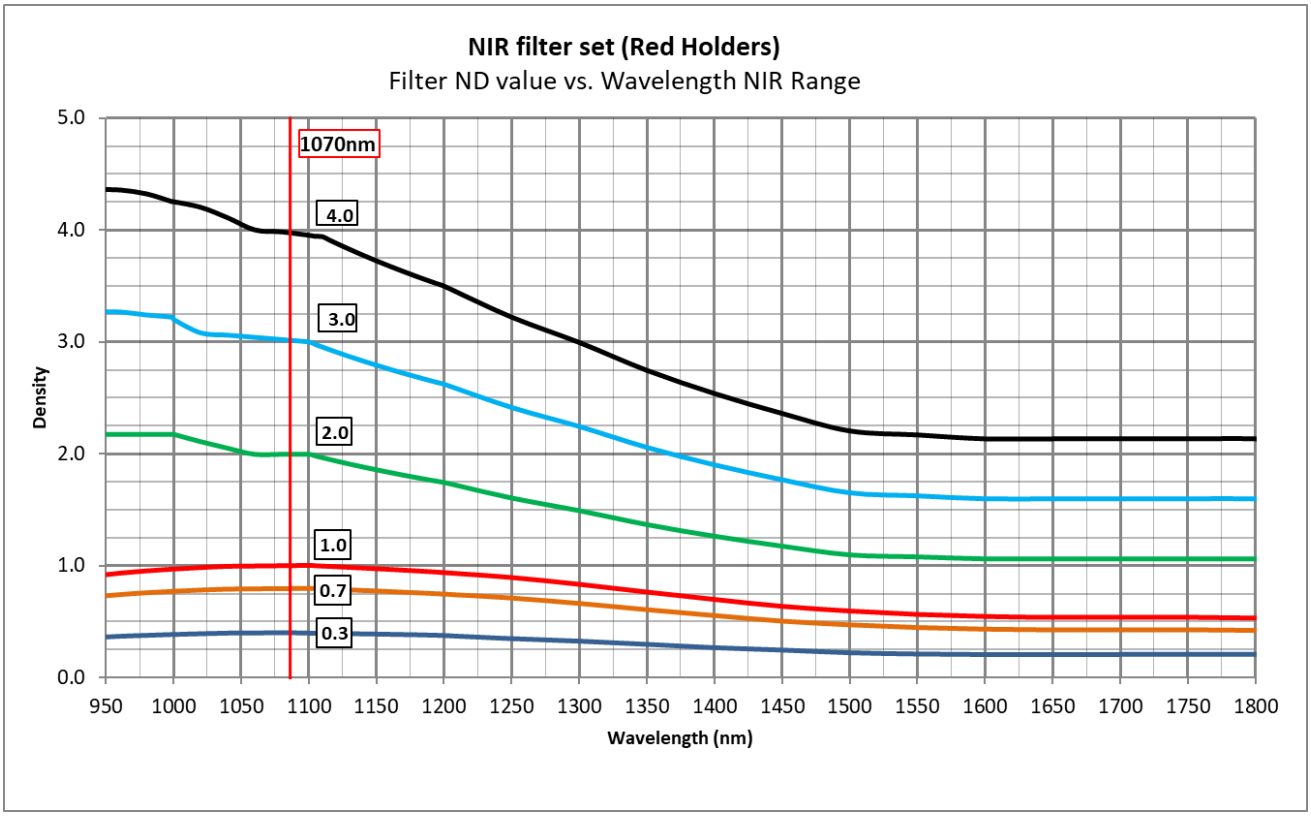
APPENDIX A: ND FILTERS

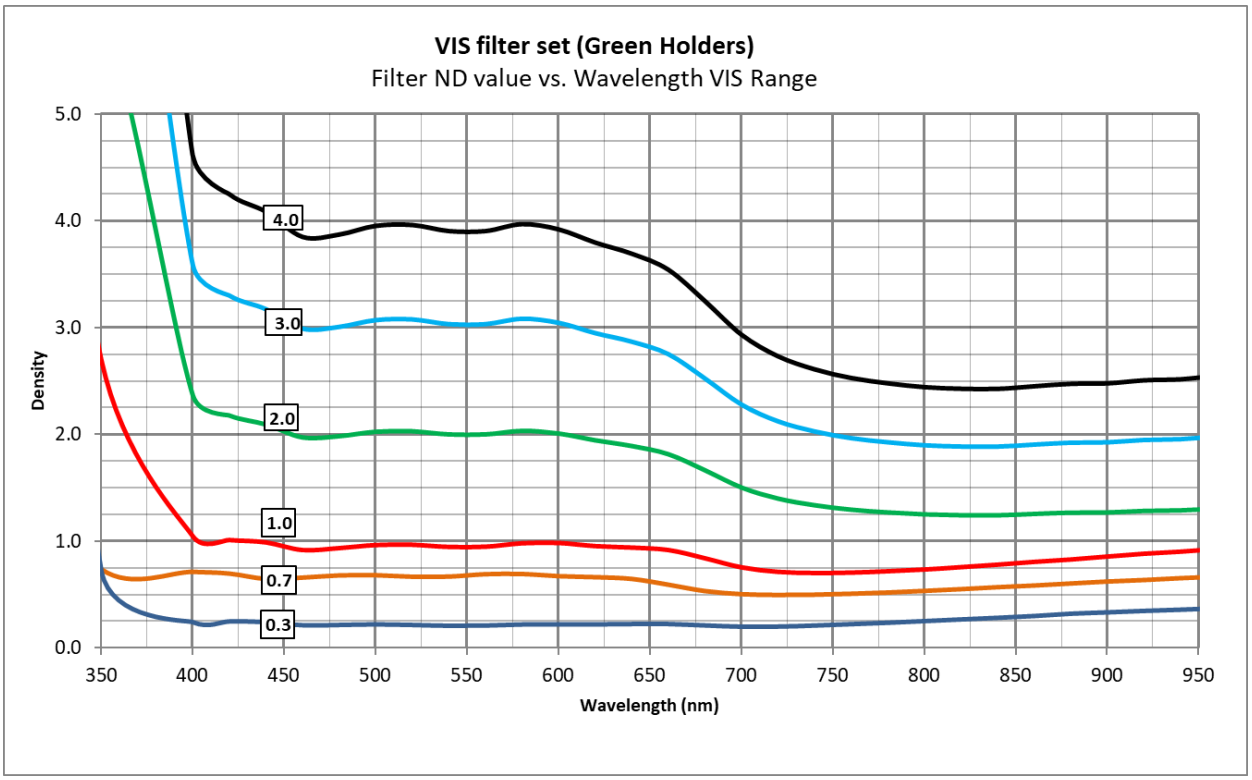
The ND filters provided with each FSA allow for final attenuation of the laser beam up to ND 6. Each filter in the holder provides for a different value of attenuation. To use, slide the desired holder into the slot in the FSA. A click is felt when the filter is properly aligned with the beam.

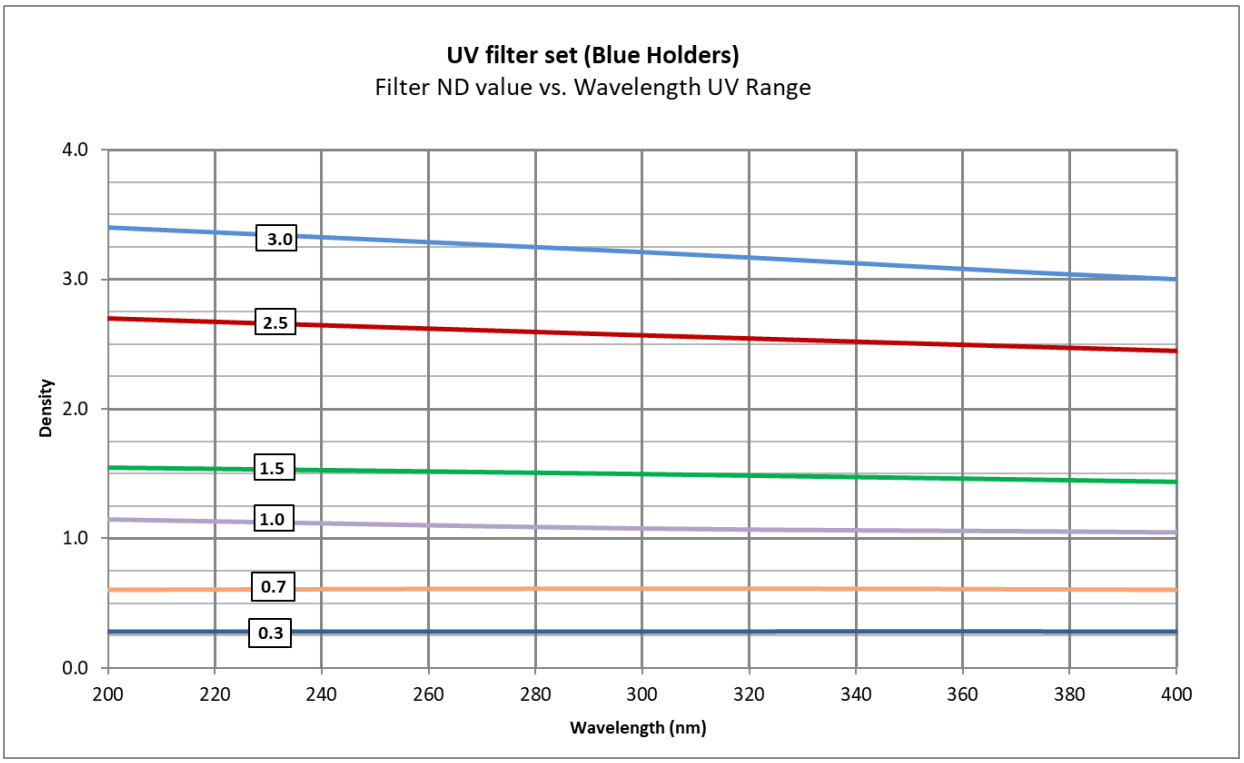
Holder Number	Filter A	Filter B
1	0.3	0.7
2	1	2
3	3	4



The attenuations at specified wavelengths are available in the charts below.

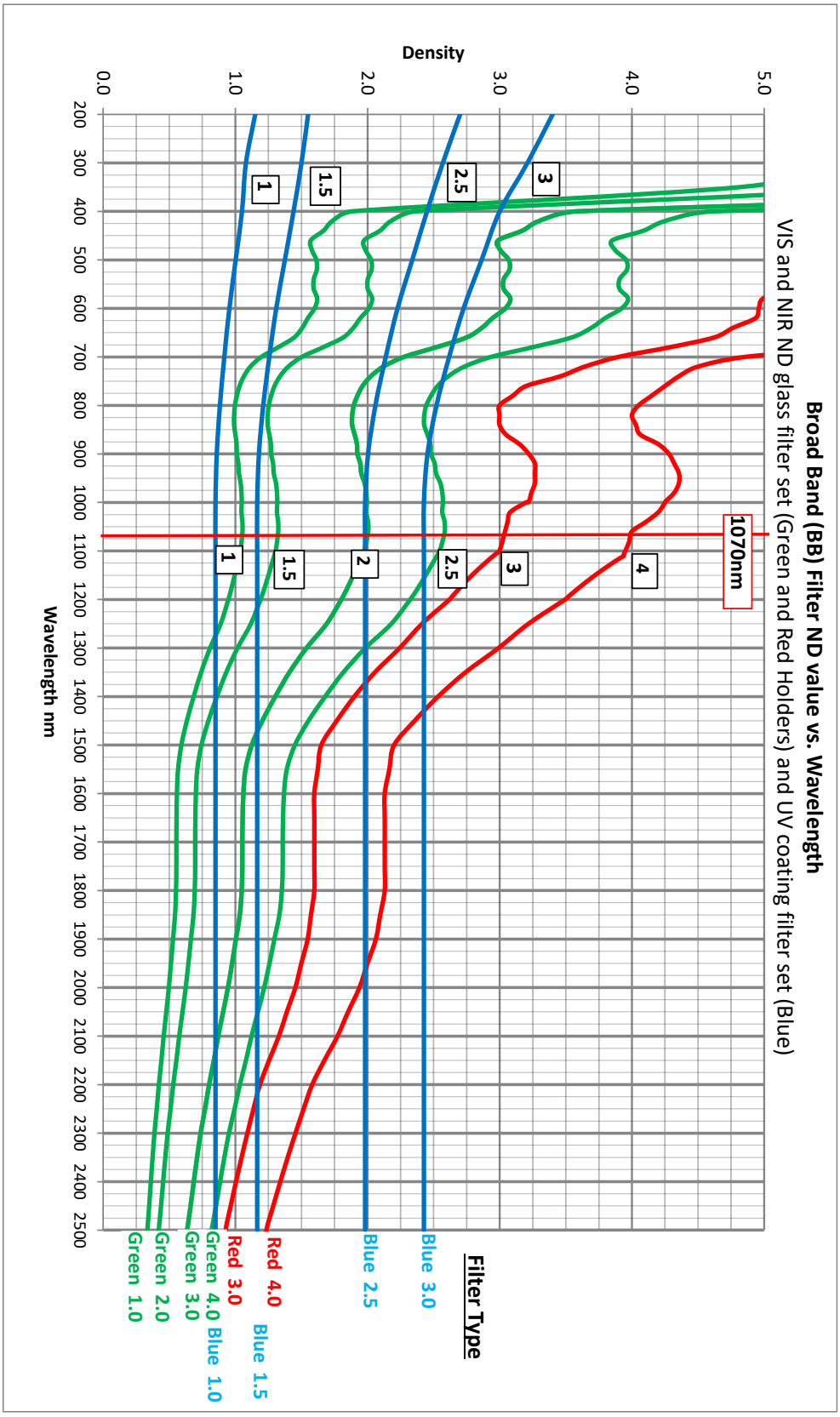



VIS filter set (Green Holders)
Filter ND value vs. Wavelength VIS Range
Density
Wavelength (nm)
4.0
3.0
2.0
1.0
0.7
0.3
5.0
4.0
3.0
2.0
1.0
0.0
350
400
450
500
550
600
650
700
750
800
850
900
950


UV filter set (Blue Holders)
Filter ND value vs. Wavelength UV Range
Density
Wavelength (nm)
3.0
2.5
1.5
1.0
0.7
0.3
4.0
3.0
2.0
1.0
0.0
200
220
240
260
280
300
320
340
360
380
400

BROAD BAND (BB) FILTER SET (RED, BLUE AND GREEN HOLDERS)

Filter ND value vs. Wavelength Visible Range



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