



# Beam Tap I & II

## Features

- Dual surface reflector for equalizing S & P polarization
- The two planes of reflection are orthogonal

### Single Surface Polarization Problems

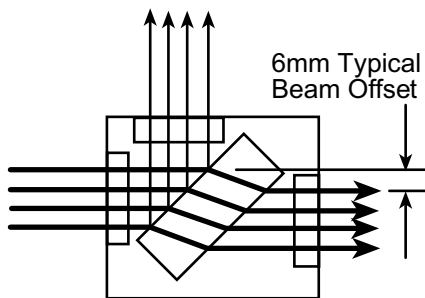
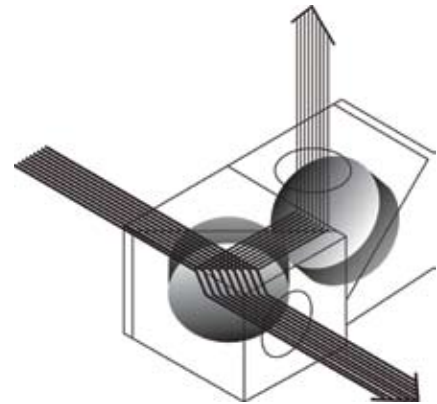
A single surface reflection at 45° is often used to sample a laser beam for profile measurements or for monitoring power or energy. However, as shown, at 45° a single surface reflects the S polarization component at more than 10 times the reflection of the P component. Depending on the laser polarization content, or stability, this sampling can provide very misleading and unreliable measurements. (The BT-I-YAG has both surfaces A/R coated for 1064nm so the reflection for both polarizations is equal at 0.5%. At other wavelengths far from 1064nm the above discussion applies.)

### Equalizing S & P reflected polarization

Any arbitrary polarization component can be broken into equivalent S & P components. With complimentary sampling surfaces any given component gets reflected once as the S polarization, and the second time as the P polarization. Thus using 2 surfaces, the total reflected energy for all polarization components is the sum of the S reflectance and the P reflectance. This causes the sampled beam to have S & P components that are identical to the original beam.

### Beam path through beam tap

The Beam Tap II uses two reflecting surfaces such that the two planes of reflection are orthogonal. With attenuation of  $2.5 \times 10^{-5}$  from the Beam Tap II, YAG lasers with CW power of up to  $10^4$  Watts/cm<sup>2</sup>, or pulsed lasers of up to  $5 \times 10^5$  joules/cm<sup>2</sup>, can be monitored without damage to the ND filters placed after the Beam Tap optics.



This diagram shows the 6mm offset of the through beam that is created by the reflecting optic. The deflection angle of the output beam is less than 0.007 degrees. The rear surface of the flat is AR coated to maximize the throughput of the main beam. The standard Beam Tap rear surface is AR coated for 400nm-700nm. The YAG version is AR coated for 1064nm on both surfaces.

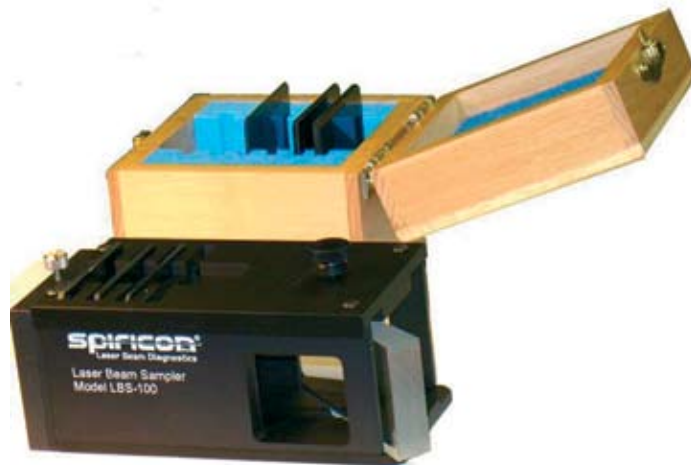
### Beam tap reflection vs wavelength

Shown is the Beam Tap II final sampled reflection vs. wavelength. As shown both the S & P reflection are nearly constant at 0.05% from the UV to the infrared.

Model	Surface	Wavelength range	Optical Material	Reflection
BT-I	Single surface, 1 cube	250-2000nm	UVFS	4% Ravg
BT-II	Dual surface, 2 cubes	250-2000nm	UVFS	0.16% Ravg
BT-I-YAG	Single surface, 1 cube	1064nm	BK7	0.5% Ravg
BT-II-YAG	Dual surface, 2 cubes	1064nm	BK7	0.0025% Ravg

## LBS-100 Attenuator – Beam Splitter System

In addition to the stackable filters and beam splitters described above, one can purchase the LBS-100 system that is not as compact as the stackable system above but has larger aperture, can be changed without disassembly and has versions for longer wavelengths. The system contains the mounting frame, 1 wedge beam splitter and several attenuators. The exit end of the LBS-100 is standard C mount thread so all our cameras can be mounted to the frame. The wedge angle is 6.5 degrees to insure that the reflection from the rear side will not enter the camera. The optical elements are flat to 1/4 wave in the visible to insure no distortion of the beam.



LBS-100 System

Specifications LBS-100 system				
Item	LBS-100	LBS-100 YAG	LBS-100IR 0.5	LBS-100IR 5.0
Wavelength range	400 - 900nm recommended, functional to 2600nm	1064nm	10.6μm	10.6μm
Absorber material	Neutral density glass	Same	CaF2 flats, 3 -3mm and 1-1mm	Same
Optical Densities or transmission	0.3, 0.7, 1.0, 2.0, 3.0, 4.0 O.D. at 546nm	Same	30% T for 3mm flat, 60% T for 1mm flat at 10.6μm	Same
Wedge material and reflection	Fused Silica 4% in wavelength range 400 - 900nm	1% at 1064nm	ZnSe 0.5% at 10.6μm	ZnSe 5% at 10.6μm
Max power density on ND filters	5W/cm <sup>2</sup> for no distortion, 50W/cm <sup>2</sup> damage	Same	Same	Same
Clear aperture	19mm			
Dimensions	65mm W x 55mm H x 140mm D			



LBS-100 combined with 4X beam reducer

The LBS beam splitter/attenuator system can be combined with the 4X beam reducer as shown above to attenuate and view large beams

<b>Beam Splitters and Attenuators</b>		
<b>Stackable beam splitters and filters/attenuators</b>		
Beam splitter for mounting on cameras	45 degree angle wedge beam splitter which mounts onto camera. Reduces beam intensity by ~20 times. For spectral range 190 – 2500nm. Fits all cameras	SPZ17015
Additional beam splitters for mounting to previous beam splitter	Additional wedge beam splitter as above which mounts at right angles to previous beam splitter. As many as 3 beam splitters can be mounted in this fashion in series, each one reducing intensity by ~20 times.	SPZ17026
Large beam splitter	45 degree angle wedge beam splitter with large 30mm aperture. When stacked on top of smaller beam splitters especially useful for monitoring a converging beam.	SPZ17025
Stand alone large wedge beam splitter	Large size Wedge beam splitter which mounts to standard ¼" thread ½" laboratory rod. Reduces beam intensity by ~20 times. For spectral range 190 – 2500nm. Especially for 4X beam reducer.	SPZ17018
ND1 stackable filter (red housing)	4mm spacing screw on filter for camera with transmission of between 20% and 5% depending on spectral range Can be stacked and combined with other filters and beam splitters.. One filter is included with Spiricon cameras	SPZ08234
ND2 stackable filter (black housing)	4mm spacing screw on filter for camera with transmission of between 7% and 0.5% depending on spectral range. Can be stacked and combined with other filters and beam splitters. Two filters are included with Spiricon cameras	SPZ08235
ND3 stackable filter (green housing)	4mm spacing screw on filter for camera with transmission of between 2% and 0.05% depending on spectral range. Can be stacked and combined with other filters and beam splitters.	SPZ08253
4mm spacer	Blank stackable spacer / filter holder where 4mm spacing is needed but no attenuation is needed	SPG01698
5mm spacer	Spacer ring for adapting 12.5mm recess CS cameras to 17.5mm recess C mount lenses	SPG02106
8mm spacer	Spacer ring for adapting 4.5mm recess cameras to work with 12.5mm recess CS mount lenses	SPG02067
Filter holder and 50x50 filter set	Filter holder with set of 4 standard Schott 50X50mm neutral density filters. Useful to reduce intensity before inputting into 4X beam reducer. Mounts to standard ¼" thread, ½" diameter laboratory rod.	SPZ08240
LBF-50 filter set	Compact screw in filter holder with set of ND filters. Attenuations from low to 10 <sup>6</sup>	SP90081
Variable attenuator	Continuously variable attenuator for complete control over beam intensity. Especially useful for pulsed lasers. Varies the intensity over more than 4 orders of magnitude between wavelengths 350nm and 1100nm. Can be stacked and combined with other filters and beam splitters	SPZ17012
Filter for 355nm-V2	Silicon cameras can see the 355nm 3rd harmonic radiation of YAG. The YAG however usually emits some light at 532nm and 1064nm as well. This filter filters out the other 2 wavelengths to give an undistorted image of the 355nm light.	SPZ08246
Filter for 1300nm	For all cameras that can operate at 1300nm but are quite insensitive there. This filter filters out all light below 1200nm to allow viewing 1300nm radiation without background interference	SPZ08242
<b>LBS System Beam Splitters and attenuators</b>		
BA-NIR	Beam Attenuator calibrated at 1064nm	SP90159
BA-VIS	Beam Attenuator calibrated for the Visible region.	SP90158
BT-II	Beam Tap II (250nm-2000nm), UVFS, 0.16% R <sub>avg</sub>	SP90133
BT-II VIS	Beam Tap II-VIS (400nm-700nm)	SP90172
BT-I	Beam Tap I (250nm-700nm), Beam Tap-1 - YAG (1064nm)	SP90173
BT-I VIS	Beam Tap I-VIS (400nm-700nm)	SP90136
LBS-100-C	19mm clear aperture, recommended for 400nm to 900nm. Kit contains one uncoated fused silica beam splitter wedge and 6 ND filters	SP90061
LBS-100-YAG	As above but for YAG with beam splitter wedge AR coated to give a reflection of 1% for both S and P polarizations.	SP90057
LBS-100-IR-0.5	As above but for CO <sub>2</sub> . Contains 1 ZnSe wedge with 0.5% reflection and set of 4 CaF <sub>2</sub> flats.	SP90058
LBS-100-IR-5.0	As above but with 5% reflecting wedges	SP90059
LBS-100-UV	19mm clear aperture, recommended for 266nm to 355nm. Kit contains one uncoated fused silica beam splitter wedge and 6 ND filters	SP90171
LBS-100 to 4X beam reducer adapter	This adapter enables mounting of the LBS-100 beam splitter / attenuator assembly in front of the 4X beam reducer. The combined assembly can image large high power beams in one unit. See illustration on page 149.	SPZ17029