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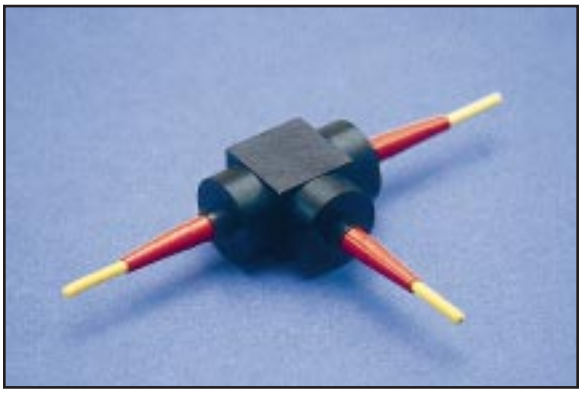
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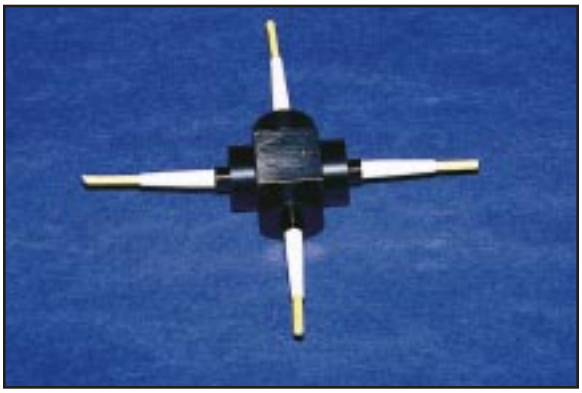
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FIBER OPTIC BEAM SPLITTERS/COMBINERS





OZ Optics beam splitters are used to divide and couple light into two or more fibers. Light from one or two input fibers is first collimated, then sent through a beamsplitting surface to divide it in two. The resultant output beams are then focused back into the output fibers. By utilizing Oz Optics' patented tilt alignment technique, both one-by-two and two-by-two splitters can be constructed with both low insertion losses and low backreflection levels. Furthermore, because the light is first collimated, then focused into a second fiber, splitters can be built with different types of fiber on the input and output sides. For example, a polarizing splitter could be built using a normal singlemode fiber as an input, and two polarization preserving fibers as outputs. Source to fiber splitters are also available, where either a collimated source, such as an HeNe laser or Argon-Ion laser, or a laser diode is used as an input.

OZ Optics splitters come in small, rugged packages and are available either with female receptacles to accept different connectors (NTT-FC, AT&T ST, etc.), or pigtail style, with the fibers directly attached. Pigtail style splitters and combiners are recommended for optimum stability, minimum insertion losses, and low backreflection. Receptacle style splitters are best suited for applications where one or more of the fiber ends are used with multimode fibers, and for collimated source to fiber splitters. They are also recommended for extremely high power applications.

One unique property of OZ Optics two-by-two splitters is their directionality. Normally OZ Optics splitters are designed to be bi-directional. The coupling efficiencies from ports 1 and 2 into port R are similar to those from port T into ports 1 and 2. In some cases however, it is desirable to couple light from only one port into port R. An example would be a backreflection monitoring system. Light is coupled from port T into ports 1 and 2. Port 1 is used as a sensor, while port 2 is used to monitor the source power. The splitter can be factory adjusted so that only light from port 1 is reflected back into port R, not port 2.

A variety of beam splitting surfaces are available for dividing the beam. The two most common types are polarizing beam splitters and polarization independent splitters, otherwise known as non-polarizing splitters.

Polarizing beam splitters take an input beam of light and divide it into two orthogonal polarizations. The output is typically polarized to greater than 20 dB extinction ratio from the splitter outputs. Broadband polarizing splitters are also available, operating at both 1300nm and 1550nm, with only a 0.3dB variation in the insertion losses over the wavelength range. Versions are also available for 400 to 700nm, and for 700 to 1100nm wavelengths

A polarizing beam splitter can also be used in the reverse direction to combine two polarized beams into a single output fiber. They are ideal for polarization analyzers, one-by-two polarizing splitters, fiber optic combiners, and one-by-two variable splitters where the input source is polarized.

Non-polarizing splitters will split an input beam of light at a fixed splitting ratio independent of the input polarization state, and without modifying the light's polarization. These splitters are polarization insensitive over a wavelength range of ±30nm from the specified central wavelength. One-by-two and two-by-two polarization maintaining splitters are made in this fashion. All input and output ports will maintain polarization to greater than 20dB with this technique. Splitters that maintain 30dB extinction ratios are available on request.

09/99 OZ Optics reserves the right to change any specifications without prior notice.

SPECIFICATIONS

Splitting ratio:	50/50 to 95/5 splitting ratios are available for polarization independent splitters. The splitting ratio for polarizing splitters depends upon the input polarization.
Insertion loss:	Typically 0.7dB for pigtail style splitters, 2dB for receptacle style versions. Lower losses are available on special request.
Backreflection levels:	Typically -15dB for receptacle style versions, and either -25dB, -40dB, -50dB, or -60dB for pigtail style versions. -60dB versions are available only for 1300nm and 1550nm wavelengths.
Cross talk:	Typically less than -40dB. Lower cross talk levels are available on request.
Wavelength range:	Splitters are available for wavelengths from 300nm to 2000nm
Maximum power rating:	Up to 2W CW. High power splitters able to handle up to 100W CW are available on request.
Operating temperature:	-20°C to +60°C.
Output extinction ratios:	Typically greater than 20dB. 25dB and 30dB versions are available for 1x2 splitters at 1300 - 1550nm broadband wavelengths.

ORDERING INFORMATION:

When ordering source to fiber splitters, please specify the source laser beam characteristics (beam diameter, divergence angle, laser power, and wavelength) or laser diode specifications (diode type, angular beam profile, housing dimensions). In addition please indicate how you wish to align the polarization axis of each PM fiber. The OZ Optics standard is to align all PM fibers such that output light is transmitted along the slow axis of the fiber.

Part Number	Description
FOBS-12-*XYZ*-*ABC*-*W*-*S/R*	One-by-two fiber to fiber splitter with connector receptacles.
FOBS-22-*XYZT*-*ABCD*-*W*-*S/R*	Two-by-two fiber to fiber splitter with connector receptacles.
ULBS-1*XY*-*AB*-*W*-*S/R*-*f*-*LH*	Laser to fiber splitter with connector receptacles.
LDBS-1*XY*-*AB*-*W*-*S/R*	Laser diode to fiber splitter with connector receptacles.
FOBS-12P-111-*a/b*-*ABC*-*W*-*S/R*-*LB*-*XYZ*-*JD*-*L*	One-by-two pigtail style splitter.
FOBS-22P-1111-*a/b*-*ABCD*-*W*-*S/R*-*LB*-*XYZT*-*JD*-*L*	Two-by-two pigtail style splitter.
ULBS-12P-*a/b*-*AB*-*W*-*S/R*-*f*-*LB*-*XY*-*JD*-*L*	Pigtail style laser to fiber splitter.
LDBS-12P-*a/b*-*AB*-*W*-*S/R*-*LB*-*XY*-*JD*-*L*	Pigtail style laser diode to fiber splitter.

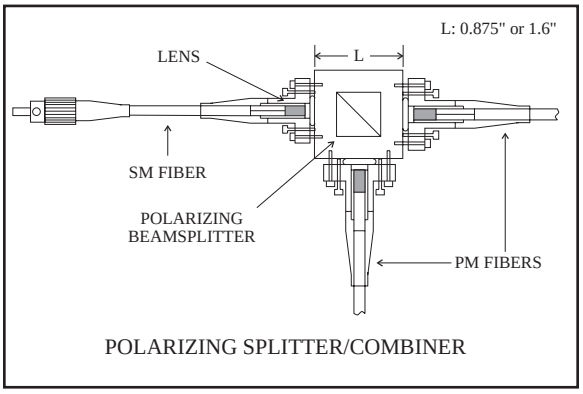
Where: ***X,Y,Z,T*** are the input and output connector receptacle types for connector style splitters. For pigtail style splitters they refer to the male connectors on the fiber ends (3 for FC, 5 for SMA 905, 8 for ST connectors, X for unterminated fibers on pigtail style splitters, etc..),
A,B,C,D are the fiber types used at the input and output ends (S for singlemode, M for multimode, P for polarization maintaining fiber),
W is the operating wavelength in nm.. For broadband splitters, specify the wavelength range (Example: 400/700, 700/1100, or 1300/1550),
a,b are the fiber core and cladding sizes, respectively, in microns,
S/R is the desired splitting ratio (Use PBS to indicate a polarizing beam splitter),
LB is the desired backreflection level (25dB, 40dB,50dB, or 60dB for pigtail style systems),
JD is the fiber jacket type (1 for 1mm OD jacketed fiber, 3 for 3mm OD loose tube Kevlar,
3A for 3mm OD armored cable, and 5A for 5mm armored cable.),
L is the fiber length, in meters.
f is the focal length of the lens and lens type. See Tables 9 to 12 of the Standard Tables data sheet.
LH is the laser head adaptor. See Table 8 of the Standard Tables data sheet.

Note: For extinction ratios higher than 30dB, add the term **"-ER=30"** to the end of the part number for 1300nm and 1550nm 1x2 splitter only. For other wavelengths, 2x2 splitters, and 1300nm - 1550nm broadband splitters, add "-ER=25" to the end of the part number for extinction ratios higher than 25dB.

APPLICATIONS

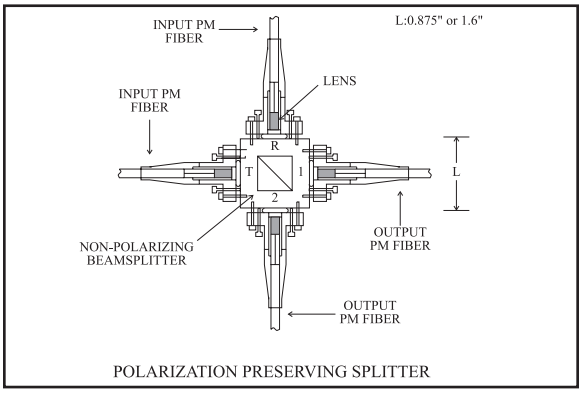
Because of the inherent flexibility of the OZ Optics splitter design, an almost limitless set of configurations are possible. The following set of examples show only a few of the possible applications.

1. Polarizing splitter / polarization combiner: A 1×2 splitter is required to split the light from a 1300nm singlemode fiber into two orthogonal polarizations, and then transmit the two signals along two PM fibers. This splitter could also be used in the reverse direction to combine the light from two PM fibers into one singlemode fiber. The two PM fibers are aligned such that for either output port the light is transmitted along the slow axis of the fiber. The output extinction ratios from the PM fibers must be at least 30dB, while the typical backreflection will be 25dB. The singlemode input fiber is terminated with a male FC connector, while the two output fibers are unterminated. All three fibers are cabled using 3mm O.D. kevlar cabling, and are one meter long. OZ Optics' part number:**FOBS-12P-111-9/125-SPP-1300-PBS-25-3XX-3-1-ER=30**



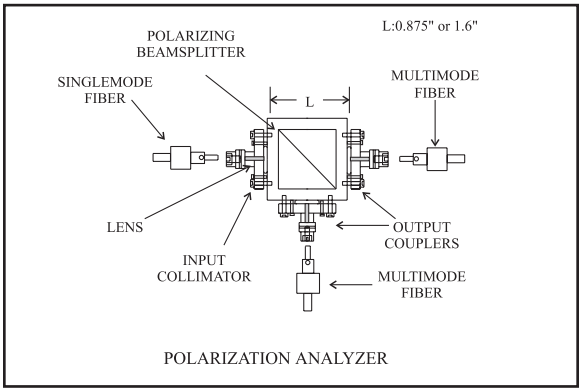
POLARIZING SPLITTER/COMBINER

2. Polarization preserving splitter: A two-by-two 50/50 splitter is required to combine the light from two 1550nm PM fibers and split the combined light into two other PM fibers. The input and output fibers must all maintain polarization to at least 20 dB, and the backreflection level should be around -60dB. All four fibers are one meter long, in 1mm O.D. tubing, and unterminated. OZ part number: **FOBS-22P-1111-10/125-PPPP-1550-50/50-60-XXXX-1-1**.



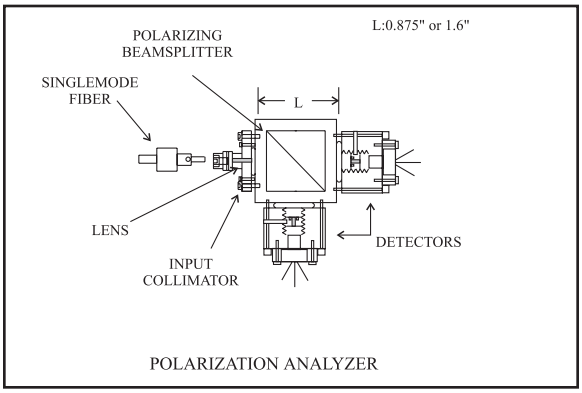
POLARIZATION PRESERVING SPLITTER

3. Polarization Analyzer: The output from a 1300nm singlemode fiber is connected to the input of a connector receptacle style one-by-two splitter. The analyzer consists of a polarizing splitter, an input collimator, and two focusing lenses. The output from each port of the splitter is then connected to a multimode fiber, and the resultant output powers monitored. In this manner one can study the output polarization of light from the fiber. For 1300nm fibers, terminated with ST connectors, the part number for the analyzer with corresponding receptacles is: **FOBS-12-888-SMM-1300-PBS**.



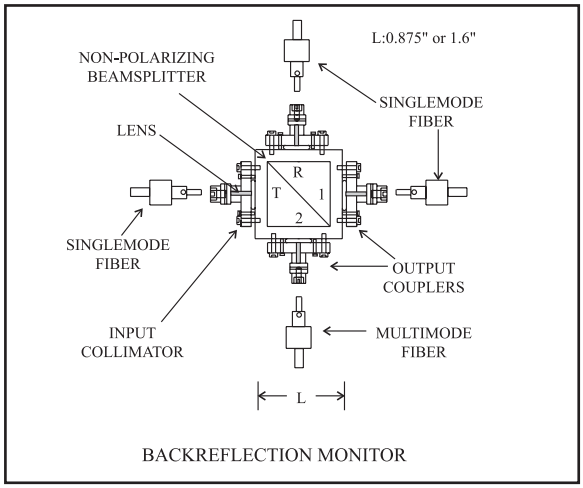
POLARIZATION ANALYZER

An alternative setup for an analyzer is available with photodiodes attached directly to the output ports rather than using focusing optics and multimode fibers. Such a system can reduce costs and improve coupling efficiency. OZ Optics' part number: **FOBS-12-8XX-SDD-1300-PBS**.



POLARIZATION ANALYZER

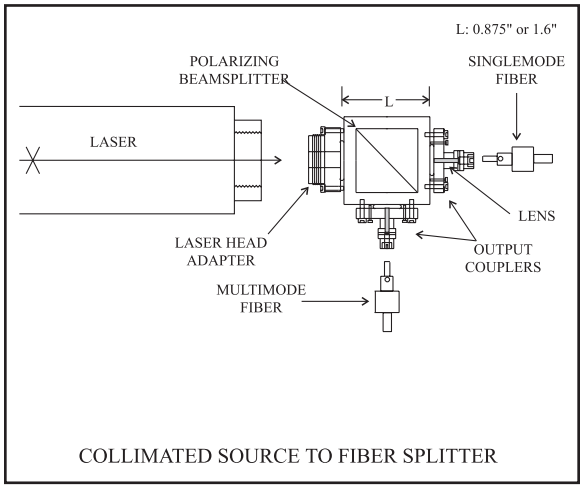
4. Backreflection Monitor: A customer wishes to monitor fluorescence from a sample by analyzing the signal being backreflected along a fiber. The input signal is 488nm light transmitted along a singlemode fiber. The input goes into port T of a receptacle style beam splitter, and goes out through port 1 into a second singlemode fiber. Half of the light is coupled into a multimode fiber at port 2 in order to monitor the source power. Port R is then aligned to couple as much of the backreflected signal from port 1 as possible into a singlemode fiber, while simultaneously rejecting any light reflected from port 2. Ports T, R, and 1 have FC receptacles, while port 2 has an AT&T--ST connector. OZ Optics part number: **FOBS-22-3338-SSSM-488-50/50**



BACKREFLECTION MONITOR

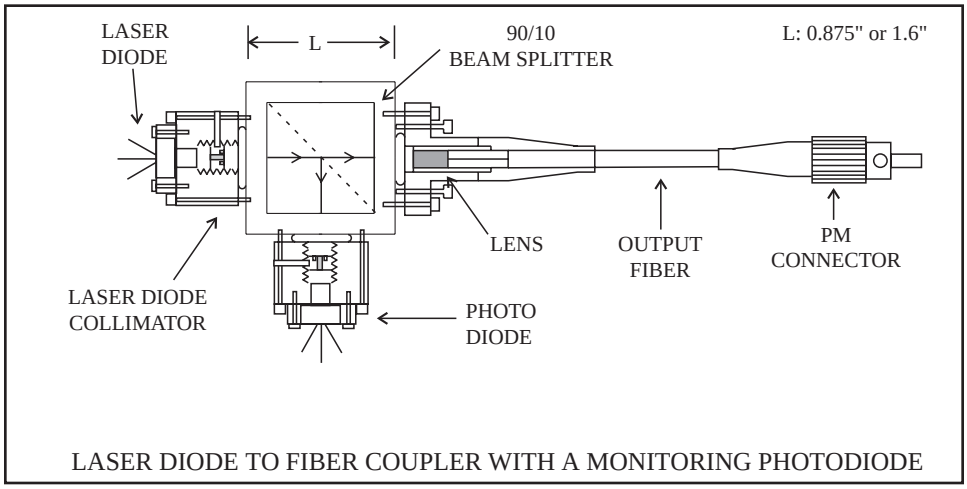
5. Collimated source to fiber splitter with variable splitting ratio: A customer wants to couple light from a polarized 488/514nm Ar-Ion laser with 1 - 32 TPI female receptacle into two PM fibers. Both fibers have FC connectors. By using a broadband polarizing splitter to divide the light from the laser, one can rotate the splitter to adjust the splitting ratio between the two fibers to any desired ratio. Achromat lenses are then used to couple the light with equal efficiency for the 488nm and 514nm Ar-Ion laser lines.

OZ Optics part number:**ULBS-133-PP-488/514-PBS-3.5AC-1.** A similar system is available for non-collimated sources, such as laser diodes. For these items a lens is used to initially collimate the source. Add BL to the part # if blocking attenuator is required for each output end.



COLLIMATED SOURCE TO FIBER SPLITTER

6. Laser diode to fiber coupler with monitoring photodiode: A 90/10 beam splitter is used to split the signal from an 830nm laser diode. Ninety percent of the light is coupled into a 2 meter long, 3.0mm O.D. cabled PM fiber, terminated with an FC connector. The remaining ten percent is reflected to a monitoring photodiode. The typical backreflection level is 25dB. In this manner, one can independently monitor the output power emitted by the laser diode before it enters the fiber. OZ Optics part number: **ULBS-12P-5/125-PD-830-90/10-25-3X-3-2**.



LASER DIODE TO FIBER COUPLER WITH A MONITORING PHOTODIODE

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