



OZ Optics

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RGB (RED/GREEN/BLUE) COMBINER AND DELIVERY SYSTEMS

Features:

- Modular design for easy installation and maintenance
- Two, three, and up to 6 wavelength versions
- Singlemode, multimode and polarization maintaining fiber versions.
- High power versions
- A variety of wavelengths available
- Low noise, stable output.
- High power handling

Applications:

- White light displays
- Confocal microscopy
- Laser spectroscopy
- Fluorescence microscopy
- Color Holography

Product Description:

A common application today is the combination of visible laser light of different wavelengths into a single fiber. Such systems are used in a variety of applications where one wants to produce full color images. By combining red, green and blue light and varying the intensities of the signals, one can reproduce practically any color desired.

In order to achieve this, wavelength division multiplexers (WDMs) are used to combine light of different wavelengths into a single fiber. The light from each fiber is first collimated. The collimated beams are then combined using a dichroic filter, with typically the longer wavelength transmitted from port T, the shorter wavelength reflected from port R. The combined beams are then focused into the output fiber at Port 1. OZ Optics uses this technique to build WDMs for combining visible wavelengths. Our RGB multiplexers combine light at red, green and blue wavelengths into singlemode or polarization maintaining fiber. OZ Optics also offers source to fiber wavelength division multiplexers, where the sources are mounted directly onto the device. This improves the overall system efficiency, and reduces costs.

Complementing our line of RGB WDM's are our OZ-1000 and OZ-2000 Turnkey OEM sources. They are temperature stabilized fiber coupled, laser diode sources. The compact housings contain both the laser diode and the temperature control, and are powered by a single 5 volt DC supply. The sources have an operating temperature range of 15 - 45°C, and hold the temperature variation of the laser diode to within 0.1°C. This maintains the wavelength variation to better than 0.1nm and also reduces the tendency of the laser diode to mode hop.

The output power from each source can be adjusted using a 0 to 5 volt control voltage. Standard sources can be modulated at low frequencies (a few kHz), and devices can be configured at the factory for modulation capability up to 100 kHz, if requested. This is ideal for generating full color displays. Special versions are available from OZ Optics to cover even higher modulation frequencies, up to 50 MHz. Contact OZ Optics with your requirements.

Used together, the OZ sources and RGB multiplexors provide a complete method to deliver full color output from a singlemode or polarization maintaining fiber. The light from the output fiber can be collimated using an optional achromatic collimator to give near ideal Gaussian beams ranging from 0.6mm to 10mm in diameter. Alternatively the achromatic focusers can be supplied to focus the light to spots only a few microns in diameter.

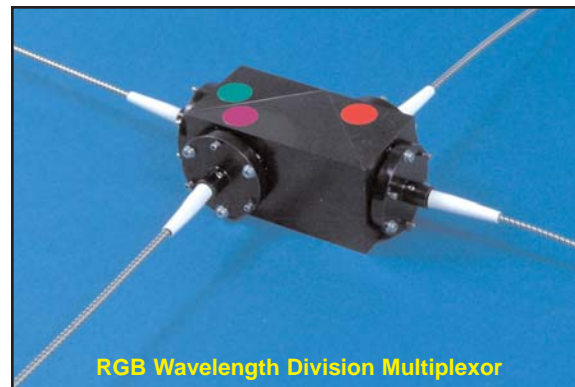
Sources and combiners can be provided either as individual components or as complete integrated systems. See the figure on page 2 showing the layout for such



RGB Delivery System



OZ Sources for UV Blue, Green, Red and IR



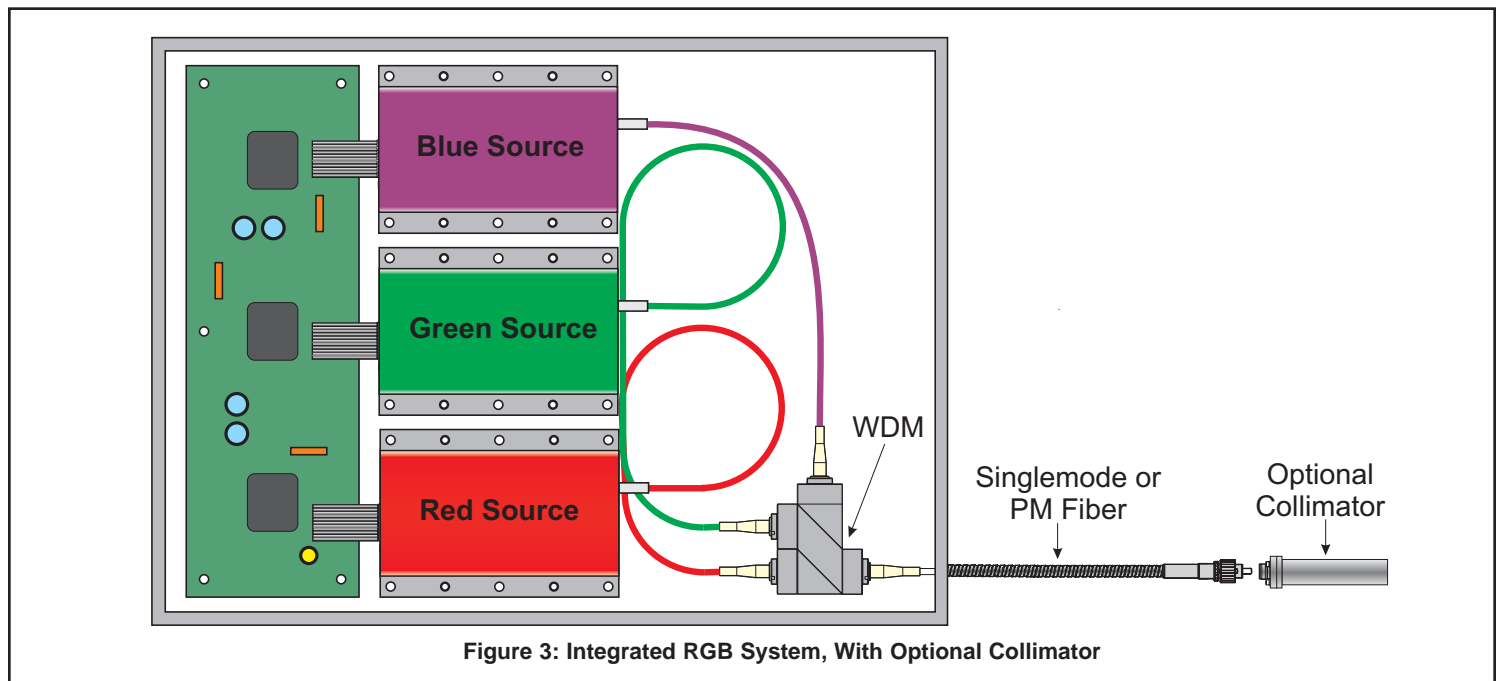
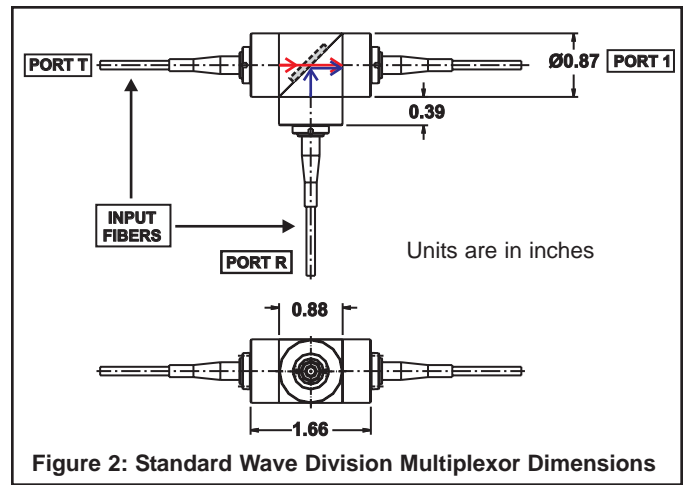
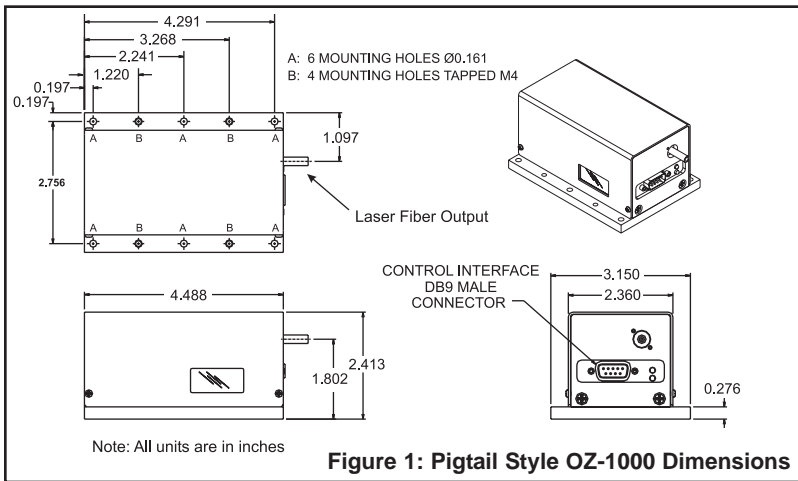
RGB Wavelength Division Multiplexor

a system. Integrated systems provide the greatest throughput and final output power possible. This is because it eliminates the fiber-to-fiber connections normally present when connecting sources and combiners together. Such connections introduce as much as 1.5dB additional losses at 405nm wavelengths, because the fiber core sizes are so small (as small as 3 microns at 405nm). At this size even a one micron offset will cause significant losses. Thus an integrated system can deliver 25% more power than connected components.

For those who wish to use their own laser sources, OZ Optics also provides a full line of laser to fiber couplers and laser diode to fiber couplers. Systems can be custom built to provide optimum coupling to your source. We work extensively with various laser manufacturers, designing optics and adaptors to fit their lasers.

OZ Optics also offers a complete line of fiber optic collimators and focusers, to take the output from a fiber and deliver it precisely to where it is required. We stock a broad array of achromat lenses, perfect for RGB applications. Further details on these products can be found in our catalog and on our website under *Laser To Fiber Delivery Systems*. Contact a sales representative for additional details.

For more detailed information on both wavelength division multiplexers and sources, please refer to our detailed product data sheets *Wavelength Division Multiplexers*, and *Turnkey, Ultra Stable, OEM Laser Diode Sources - OZ-1000 & OZ-2000 Series*.



Wave Division Multiplexer Specifications:

Parameter	Units	Condition	Value
WDM Type			WDM-12P, WDM-13P or WDM-14P
Available Wavelengths	nm		400-1650
Return Losses	dB	400-1200 nm	40 or 60
Insertion Losses (Typical) ^{1,2}	dB	400-1200 nm	1.1
Insertion Losses (Maximum) ^{1,2}	dB	400-1200 nm	1.4
Insertion Losses ⁴ (60dB Return Loss Option)	dB	400-1200 nm	1.2 max
Polarization Extinction Ratio ⁴	dB	400-600 nm	18
		600-1150 nm	20
Power Handling	mW	SM or PM fiber, 633nm	250 ³
Operating Temperature	°C		-20 to +60

¹For components whose wavelengths are separated by more than 20nm and less than 200nm

²Does not include connector losses

³Higher power versions (up to 5 watts into singlemode fiber, higher into multimode fiber), are available on request.

⁴For One by two wave division multiplexers.

Standard Source Specifications (1):

Wavelength (nm)	375, 405, 440,532, 635, 650, 670, 685, 750, 780, 810, 830, 850, 980, 1064, 1310, 1480, 1550, or 1625
Output Power	Up to >100mW ²
Output Power Stability	Typically < ± 0.025dB ³
Output Wavelength Stability	Typically < ± 0.1nm ³
Operating Temperature	15 – 45°C
Operating Humidity	0–95% Non-condensing
Power	5V @ 1A (typical)
Storage temperature	0-50°C
Analog power control	0-5VDC, 100% to 0% output respectively
Warranty	18 months or 5000 hours ⁴
Size	114 x 80 x 61mm (L x W x H)

¹ Product specifications are for standard laser diode wavelengths (1550, 1310, 850 and 635nm)

² Depending upon wavelength and fiber type.

³ Output power stability and wavelength stability depend upon the source wavelength, power level and choice of options.
Contact OZ Optics for specific needs.

⁴ Whichever comes first. Not applicable for wavelengths less than 600nm. Instead, the manufacturers warranty for the laser diode will apply.

Ordering Information For Sources:

Bar Code	Part Number (Pigtail Style)	Description
17534	OZ-1000-405-3/125-P-40-3A-3-1-1	Pigtail style, self-contained OEM 405nm, 1mW fiber coupled source module. The output fiber is 3/125 micron PANDA style polarization maintaining fiber, 1 meter long, with 3mm Kevlar jacketed cable and terminated with an angled FC/APC connector. The output polarization is aligned parallel to the connector key.
19431	OZ-1000-405-3/125-S-40-3S-3A-1-1	Pigtail style, self-contained thermally stabilized OEM 405nm, 1mW fiber coupled source module. The output fiber is 3/125 micron SM, 1m long, with 3 mm armoured fiber terminated with a super FC/PC connector.
19424	OZ-2000-405-3/125-S-40-3S-3A-1-1	Pigtail style, self-contained thermally stabilized OEM 405nm, 1mW fiber coupled source module. The output fiber is 3/125 micron SM, 1m long, with 3 mm armoured fiber terminated with a super FC/PC connector. Electrical connections are located in rear panel
19426	OZ-1000-405-3/125-S-40-3S-3A-1-10	Pigtail style, self-contained thermally stabilized OEM 405nm, 8 - 10mW fiber coupled source module. The output fiber is 3/125 micron SM, 1m long, with 3 mm armoured fiber terminated with a super FC/PC connector.
20071	OZ-2000-405-3/125-S-40-3S-3A-1-10	Pigtail style, self-contained thermally stabilized OEM 405nm, 8 - 10mW fiber coupled source module. The output fiber is 3/125 micron SM, 1m long, with 3 mm armoured fiber terminated with a super FC/PC connector. Electrical connection in rear panel.
19430	OZ-1000-635-4/125-S-40-3S-3A-1-1	Pigtail style, self-contained thermally stabilized OEM 635nm, 1mW fiber coupled source module. The output fiber is 4/125 micron SM, 1m long, with 3 mm armoured fiber terminated with a super FC/PC connector.
19429	OZ-2000-635-4/125-S-40-3S-3A-1-1	Pigtail style, self-contained thermally stabilized OEM 635nm, 1mW fiber coupled source module. The output fiber is 4/125 micron SM, 1m long, with 3 mm armoured fiber terminated with a super FC/PC connector. Electrical connections are located in rear panel
19428	OZ-2000-635-4/125-S-40-3S-3A-1-10	Pigtail style, self-contained thermally stabilized OEM 635nm, 10mW fiber coupled source module. The output fiber is 4/125 micron SM, 1m long, with 3 mm armoured fiber terminated with a super FC/PC connector. Electrical connections are located in rear panel
19427	OZ-1000-635-4/125-S-40-3S-3A-1-10	Pigtail style, self-contained thermally stabilized OEM 635nm, 10mW fiber coupled source module. The output fiber is 4/125 micron SM, 1m long, with 3 mm armoured fiber terminated with a super FC/PC connector.
11147	AC-5VDC-NA	Universal 110/220 VAC to 5-volt DC power supply, 30 Watts, 4 Amps, w/ IEC power cord to North American Plug
12388	AC-5VDC-EU	Universal 110/220 VAC to 5-volt DC power supply, 30 Watts, 4 Amps, w/ IEC power cord to European Plug.
16885	AC-5VDC-UK	Universal 110/220 VAC to 5-volt DC power supply, 30 Watts, 4 Amps, w/ IEC power cord to United Kingdom Plug

Ordering Information For Standard Wave Division Multiplexors:

Note: The following parts are examples of configurations OZ Optics has made in the past, is is by no means a complete list. Instead, consider this a guide of typical products that OZ Optics can offer. Wavelengths, fiber types connector types and so on can be modified for your requirements.

Bar Code	Part Number	Description
19251	WDM-13P-1111-415/473/532-3.5/125-SSSS-40-3AF3AF3AF3-3-2	Pigtail Wavelength division multiplexer for 415, 473 & 532nm with 2 meter long, 3mm OD jacketed 3.5/125 SM fiber pigtails, 40dB return loss and terminated with angle flat FC/AFC connectors.
20462	WDM-13P-1111-460/532/635-3.5/125-PPPP-40-3A3A3A3A-3-1,1,1,10	Pigtail Wavelength division multiplexer for 460, 532 & 635nm with 1 meter long (inputs) and 10m long (output) , 3mm OD jacketed 3.5/125 PM fiber pigtails, 40dB return loss and terminated with angled FC/PCconnectors.
21061	WDM-13P-1111-473/532/638-3.5/125,4/125-PPPP-40-3AF3AF3AF3S-3-2,2,2,5-BL	Pigtail style wavelength division multiplexer for 473, 532 & 638nm with 2 meter long 3mm OD jacketed 3.5/125 PM fiber pigtail inputs for 473 and 532nm, 2 meter long 3mm OD jacketed 4/125 PM fiber pigtail input for 638nm, 5 meter long 3mm OD jacketed 3.5/125 PM fiber pigtail common output, 40dB return loss, terminated with angle flat FC/AFC connectors on inputs and a super FC/PC connector on output. BL: Blocking screws on all 3 input ports.
23482	WDM-13P-1111-410/532/633-3.5/125-PPPP-40-3S,3A,3A,A3A-3AS-1	Pigtail style wavelength division multiplexer for 410, 532 & 633 nm with 1 meter long, 3mm OD Stainless Steel jacketed 3.5/125 PM fiber at all ports, with <-40dB return loss, super FC/PC connector on the 410 nm port, angled FC/PC connectors on the 532nm and 633 nm ports and adjustable FC/APC connector on the common port.

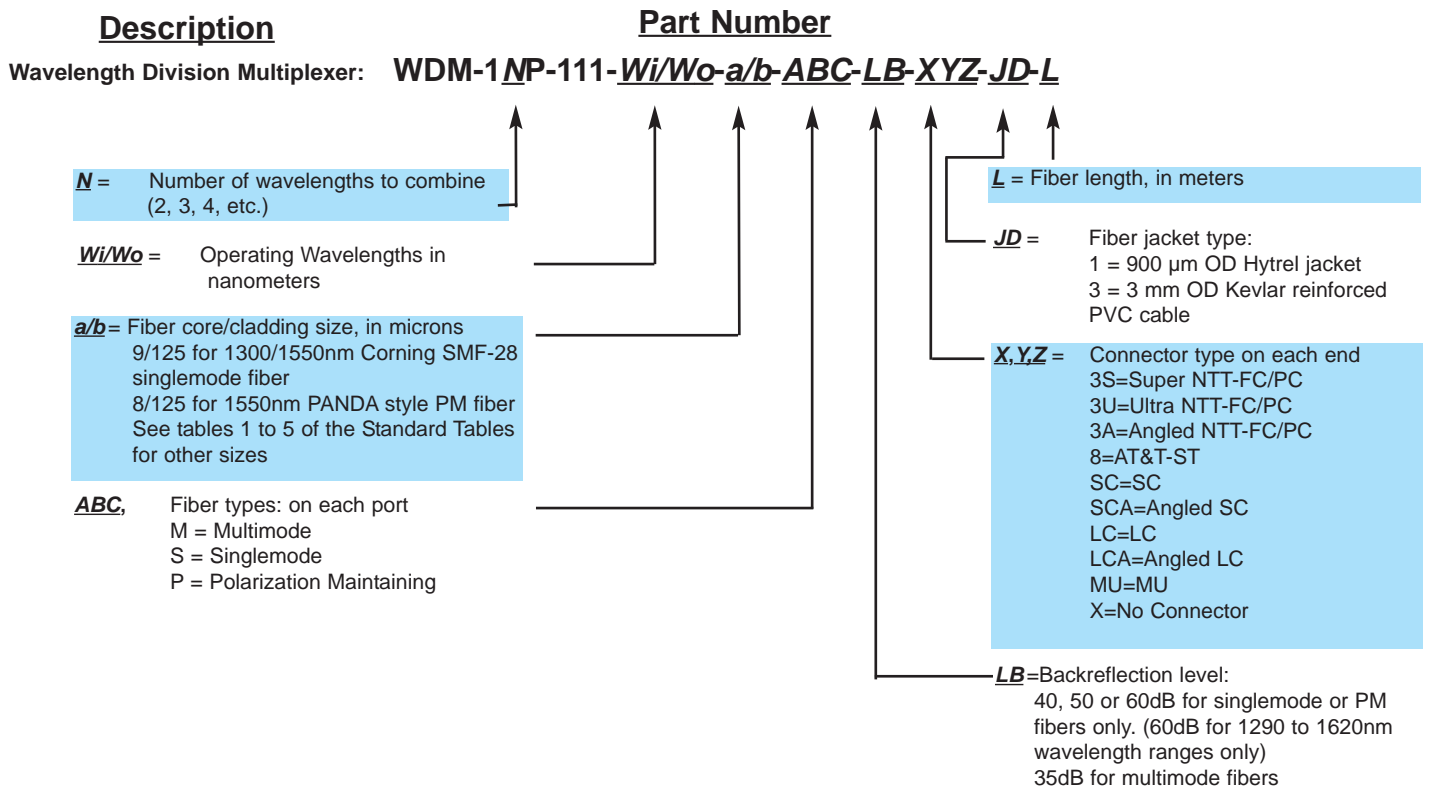
Ordering Information For Custom Parts:

OZ Optics welcomes the opportunity to provide custom designed products to meet your application needs. As with most manufacturers, customized products do take additional effort so please expect some differences in the pricing compared to our standard parts list. In particular, we will need additional time to prepare a comprehensive quotation, and lead times will be longer than normal. In most cases non-recurring engineering (NRE) charges, lot charges, and a 1 piece minimum order will be necessary. These points will be carefully explained in your quotation, so your decision will be as well informed as possible. We strongly recommend buying our standard products.

Questionnaire For Custom Parts:

- 1) What wavelengths are you interested in?
- 2) What type of fiber is being used? Singlemode, Multimode or PM?
- 3) What power levels are being used in your system?
- 4) What coupling efficiency do you require?
- 5) Are you using a polarized or randomly polarized light source?
- 6) What return losses are acceptable in your system?
- 7) What connector type are you using?
- 8) How do you intend to use this product?
- 9) How long should the fibers be?
- 10) Do you wish OZ Optics to provide the sources?
- 11) Do you need a collimated output beam?
- 12) If a collimated beam is required, what is the desired beam diameter?
- 13) If a focused spot is required, what is the desired spot size and working distance?

Note concerning part numbers: Depending on the configuration of the desired design, the fiber types, lengths, and connectors may be different on each channel. Therefore it is important to correctly identify each port in the proper order. When specifying wavelengths, list them from shortest to longest. When identifying fiber types, start from the shortest wavelength to the longest wavelength, and identify the combined port last. This rule is also used when specifying the connector types and fiber lengths.



Description:
Pigtail Style Source

Part Number
OZ-N000-W-a/b-F-LB-X-JD-L-P

N = 1000 for electrical & optical connections in same front panel
2000 for electrical connection on rear panel & optical connection on front panel

W = Wavelength ¹: 405, 440, 635, 650, 670, 685, 750, 780, 810, 830, 850, 980, 1064, 1310, 1480, 1550, 1625.

a/b = Fiber size: core/cladding diameters (in μm): (see tables 1 to 5 in the Standard Tables data sheet)

F = Fiber type: M = Multimode Fiber
S = Singlemode Fiber
P = Polarization Maintaining Fiber

LB = Backreflection level ²:
35 = 35dB return loss (MM only)
40 = 40dB return loss (SM & PM)
60 = 60dB return loss (SM & PM - 1300/1550nm only)

P = Output power available from the fiber end, in mW^3

L = Fiber length (in meters)

JD = Jacket Diameter:
1 = 900 μm jacketed fiber
3 = 3mm OD Kevlar jacketed fiber
3A = 3mm OD black armored cable
3AS = 3mm OD Stainless Steel armored cable
5A = 5mm OD black armored cable
5AS = 5mm OD Stainless Steel armored cable

X = Connector type: 3 = FC/PC
3S = Super FC/PC
3A = Angled FC/APC
5 = SMA905
8 = AT&T-ST
SC = SC or ultra SC
SCA = Angled SC

Description:
Receptacle Style Source

Part Number
OZ-N000-X-a/b-W-F-P

N = 1000 for electrical & optical connections in same front panel
2000 for electrical connection on rear panel & optical connection on front panel

X = Connector Receptacle:
2.5U = 2.5mm universal receptacle (for FC, ST, or SC).
3S = Super FC/PC
3A = Angled FC/APC
5 = SMA905
8 = AT&T-ST
SC = SC
SCA = Angled SC

P = Output power ³: Output power available from the receptacle, in mW

F = Fiber type: M = Multimode Fiber
S = Singlemode Fiber
P = Polarization Maintaining Fiber

W = Wavelength ¹: 405, 440, 635, 650, 670, 685, 750, 780, 810, 830, 850, 980, 1064, 1310, 1480, 1550, 1625

a/b = Fiber size: core/cladding diameters (in μm): (see tables 1 to 5 in the Standard Tables data sheet)

1 These are standard center wavelength values. The tolerance may vary depending on both wavelength and the laser diode manufacturers' tolerances. (Typical tolerances vary from $\pm 5\text{nm}$ to as high as $\pm 30\text{nm}$).

2 The backreflection specification refers to the reflected signal strength relative to the output power seen by the laser diode from internal reflections. It does not include external sources of reflection, including those from the connector at the end of the fiber. To minimize external reflections, OZ Optics recommends using angle polished FC/APC or SC/APC connectors. Backreflection values are limited by the wavelength and fiber type selected. Other backreflection levels may be possible. Please contact OZ for further information.

3 Note that due to variations in the optical characteristics of the laser diodes available, not all output powers are available at every wavelength for every fiber type. For wavelengths below 750nm, we recommend pigtail style to eliminate connection loss at the receptacle interface.

Options: Add "-ISOL" if an optical isolator is required (Please note that this option is only available for the 1300 to 1625nm wavelength range). Add "-BL" if OZ Optics is to provide a manual blocking screw to control the output power.

Frequently Asked Questions (FAQs):

Wavelength Division Multiplexor Questions

Q: What wavelength ranges are available?

A: OZ Optics offers a variety of WDMs working from 400nm to 1650nm. Custom designs are available for combining and splitting most combinations of wavelengths in this region.

Q: Can I use different fibers on each port?

A: Yes, OZ Optics' WDM design offers the flexibility of having different fiber types on each of the ports.

Q: Can I use high power with these WDMs?

A: Yes, OZ Optics' standard design can handle up to 250mW. For higher power applications a custom design can be done to handle up to 2W.

Q: What is the standard package size? Can I get a smaller package?

A: The standard packages for WDMs use a 0.8 or 1.6 inch cube design. These packages are ideal for low cost proto-type applications. For OEM applications OZ Optics will work with you to design a package that meets your size requirements.

Q: Do you offer WDMs that can combine more than two wavelengths?

A: Yes. Systems that combine 3 and 4 different wavelengths have also been made.

Source Questions

Q: What is the difference between the OZ-1000 and OZ-2000 systems?

A: The OZ-1000 has its electrical interface located on the front panel where the optical connector is located. The OZ-2000 has its electrical interface located on the rear panel opposite of where the optical connector is located. This is to best suit our customers' needs. In all other aspects, the units are identical.

Q: Since the interlock feature is TTL compatible, can I use it as a TTL input for modulation?

A: No, although the interlock is TTL compatible, it should only be used for turning the unit on or off through a computer interface or via a safety switch.

Q: Do the sources have a modulation function?

A: A standard OZ-1000 or OZ-2000 can be modulated at low frequencies by feeding the modulation signal to the power control input. The power control signal varies the output power from 100% to 0% as the voltage changes from 0 volts to 5 volts. Most applications using modulation would require a modulation signal with a DC offset. The standard units use filters to minimize noise in the drive circuitry so as to give the cleanest possible optical signal. However, these filters also limit the bandwidth of the output. For applications that require a higher modulation capability, the bandwidth limitation can be reduced at the factory, to allow modulation of over 100 kHz. Special versions can be built using dedicated circuitry to allow up to 50MHz. Contact OZ Optics if modulation above a few kHz is required.

Q: Can OZ Optics manufacture sources using a customer supplied laser diode and/or fiber?

A: Yes. Please provide OZ Optics with detailed information.

Q: Does OZ Optics offer higher power sources than what is standard on the data sheet?

A: Yes. Please provide OZ Optics with the requested fiber output power and fiber type and we'll work with you to find a solution.

Q: Why do you recommend integrated systems rather than individual sources and combiners for visible wavelengths?

A: For visible wavelengths the fiber core size is 4 microns or smaller. For such small sizes, mechanical tolerances may result in over 1dB (20%) losses at the receptacle interface. Using an integrated system avoids this issue.