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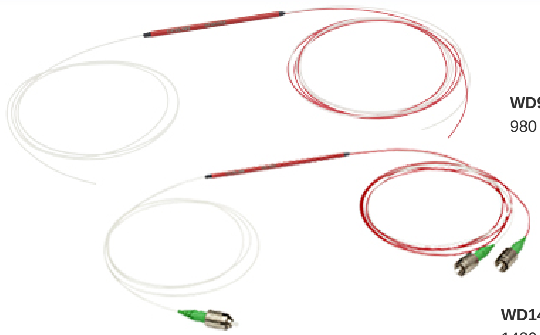
WD202F - MAR 08, 2018

Item # WD202F was discontinued on MAR 08, 2018. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

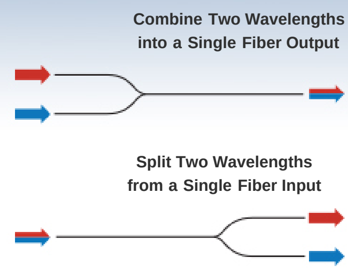
IR, 2-WAVELENGTH, SINGLE MODE WDMS (980 NM AND UP)

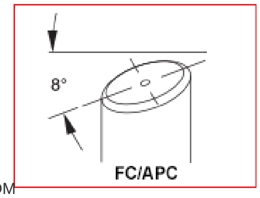
- Combine or Split Single Mode Signals by Wavelength
- Designed for Common NIR or Telecom Wavelengths
- 11 Wavelength Combinations Available
- Unterminated, FC/PC, or FC/APC Outputs

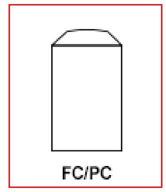


WD9850BB
980 nm / 1550 nm WDM

WD1450A
1480 nm / 1550 nm WDM







OVERVIEW

Features

- Wavelength Division Multiplexers (WDMs) for Infrared Signals (≥980 nm)
- Combine or Split Two Wavelengths (See Table to the Right for Wavelength Combinations)
- Ideal for Fiber Lasers, Fiber Amplifiers, or Other Telecom Applications
- Combine 1050 nm or 1300 nm Signals with a Visible Alignment Beam
- Available with Bare Fiber Ends, FC/PC, or FC/APC Connectors (Other Connectors Upon Request)

Webpage Features
Clicking an info icon below will open a window that contains detailed specifications.

Quick Links
980 nm / 1030 nm
980 nm / 1053 nm
980 nm / 1060 nm
980 nm / 1310 nm
980 nm / 1550 nm
1050 nm / 635 nm[a]
1064 nm / 1310 nm
1300 nm / 650 nm[a]
1310 nm / 1550 nm
1480 nm / 1550 nm
1550 nm / 1625 nm

- These WDMs are designed to be used with a visible alignment beam. As these WDMs are multimode at the lower wavelength, they should not be used to split input light.

Wavelength Division Multiplexers (WDMs) are used to combine or split two different single mode signals with low insertion loss. Thorlabs' WDMs featured on this page are manufactured using Fused Biconic Taper (FBT) technology and are designed for common NIR and telecom wavelengths (see the table to the right for options). They are an ideal solution for combining pump and signal wavelengths in fiber lasers and amplifiers or for combining telecom signals.

Because most WDMs are bidirectional, they can also be used to split two wavelengths entering the common port into two separate output ports. Thorlabs also offers 1050 nm / 635 nm and 1300 nm / 650 nm WDMs that allow the IR signal to be combined with a visible alignment beam. However, since visible light is below the cut-off wavelength of the fiber in these WDMs, they are not bidirectional, and should not be used to split light. Thorlabs also offers single mode WDMs designed for 488 nm - 785 nm and polarization-maintaining WDMs.

Our WDMs are offered from stock with 2.0 mm narrow key FC/PC or FC/APC connectors or with unterminated leads. Other fiber types and select wavelength combinations are available upon request. Please contact Technical Support with inquiries. Thorlabs also offers a wide range of single mode fiber connectors and a fiber termination kit.

Other Wavelength Division Multiplexers (WDMs)				
2-Wavelength WDMs		3-Wavelength WDMs	Polarization Maintaining WDMs	Fused Fiber Couplers
Visible/NIR (λ ≤ 785 nm)	Infrared (λ ≥ 980 nm)	Visible/NIR	Infrared	

WDM DESIGN

Wavelength Division Multiplexer Design

Thorlabs' Wavelength Division Multiplexers (WDMs) are designed to combine or split light at two different wavelengths. Thorlabs offers a variety of multiplexers with wavelength combinations spanning the visible, near-IR, and IR regions of the spectrum. Our visible wavelength division multiplexers are also known as "wavelength combiners" as they are commonly used in microscopy applications to generate multi-color composite images.

The animation to the right illustrates the basic operating principles of a 1x2 WDM. When combining light, the wavelength-specific ports will transmit light within a specified bandwidth region and combine them into a multi-wavelength signal output at the common port, with minimal loss in signal.

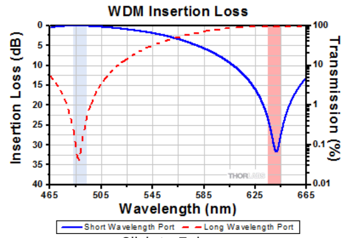
Except where indicated, our WDMs are bidirectional; they can also split a two-wavelength signal that is inserted into the common port into the component wavelengths. For optimal combining/splitting performance, the input signal(s) should contain only the wavelengths specified for the WDM. An insertion loss graph can help determine the transmission and coupling performance within and outside the specified bandwidth. For our WDMs that have red, engraved housings, this data is included with the item-specific datasheet that ships with each coupler.

Insertion Loss and Isolation

WDM performance is typically quantified using insertion loss. As seen in the definition below, insertion loss (measured in dB) is the ratio of the input power to the output power from each leg of the WDM. For optical systems, the definition of insertion loss is given as:

$$\text{Insertion Loss}(dB) = 10 \log \frac{P_{in}(mW)}{P_{out}(mW)}$$

where P_{in} and P_{out} are the input and output powers (in mW).



Click to Enlarge
The shaded regions in the plot indicate the bandwidth where each port meets the specified performance.

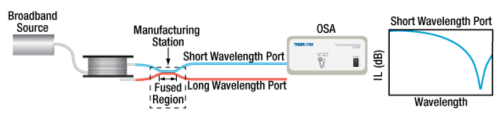
Each port of the coupler is designed to have low insertion loss (i.e., high transmission) at the desired wavelength while suppressing the signal at the specified wavelength of the other port, which minimizes cross talk between the ports. Therefore, isolation is specified as the insertion loss of these undesired wavelengths. High dB values of isolation are ideal for signal separation applications using a WDM. For example, in the graph shown to the right, the long wavelength port (shown using a red dashed line) has a low insertion loss around 640 nm (indicated by the red shaded region), but exhibits high isolation (>25 dB) in the region specified for the short wavelength port (indicated by the light blue shaded region).

Wavelength Division Multiplexer Manufacturing Process

This section details the steps used in manufacturing and verifying the performance of our wavelength division multiplexers.

Step 1

At the first stage, two fibers are fused on a manufacturing station so that the two fiber cores are in close proximity. This allows light to propagate between the two fiber cores over the fused region in a process known as evanescent coupling. The fusing process is stopped once the desired insertion loss and isolation specifications are achieved.

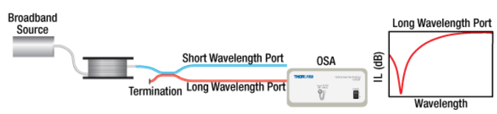


Click to Enlarge
In the diagram, the fibers are color-coded; blue for the short wavelength port and red for the long wavelength port.

The output from the short wavelength port is monitored during the fusing process using a broadband source on one side and an optical spectrum analyzer (OSA) on the other. The insertion loss as a function of wavelength is calculated from the spectrum obtained from the OSA.

Step 2

To verify the WDM performance, the output is measured in the long wavelength port using a broadband source and OSA. By combining the plots obtained in steps 1 and 2, the insertion loss and isolation in each channel can be calculated.



Click to Enlarge
In the diagram, the fibers are color-coded; blue for the short wavelength port and red for the long wavelength port.

DAMAGE THRESHOLD

Laser-Induced Damage in Silica Optical Fibers

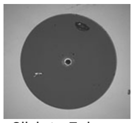
Quick Links
Damage at the Air / Glass Interface
Intrinsic Damage Threshold
Preparation and Handling of Optical Fibers

The following tutorial details damage mechanisms relevant to unterminated (bare) fiber, terminated optical fiber, and other fiber components from laser light sources. These mechanisms include damage that occurs at the air / glass interface (when free-space coupling or when using connectors) and in the optical fiber itself. A fiber component, such as a bare fiber, patch cable, or fused coupler, may have multiple potential avenues for damage (e.g., connectors, fiber end faces, and the device itself). The maximum power that a fiber can handle will always be limited by the lowest limit of any of these damage mechanisms.

While the damage threshold can be estimated using scaling relations and general rules, absolute damage thresholds in optical fibers are very application dependent and user specific. Users can use this guide to estimate a safe power level that minimizes the risk of damage. Following all appropriate preparation and handling guidelines, users should be able to operate a fiber component up to the specified maximum power level; if no maximum is specified for a component, users should abide by the "practical safe level" described below for safe operation of the component. Factors that can reduce power handling and cause damage to a fiber component include, but are not limited to, misalignment during fiber coupling, contamination of the fiber end face, or imperfections in the fiber itself. For further discussion about an optical fiber's power handling abilities for a specific application, please contact Thorlabs' Tech Support.

Damage at the Air / Glass Interface

There are several potential damage mechanisms that can occur at the air / glass interface. Light is incident on this interface when free-space coupling or when two fibers are mated using optical connectors. High-intensity light can damage the end face leading to reduced power handling and permanent damage to the fiber. For fibers terminated with optical connectors where the connectors are fixed to the fiber ends using epoxy, the heat generated by high-intensity light can burn the epoxy and leave residues on the fiber facet directly in the beam path.



Click to Enlarge
Damaged Fiber End

Click to Enlarge
Undamaged Fiber End

Damage Mechanisms on the Bare Fiber End Face

Damage mechanisms on a fiber end face can be modeled similarly to bulk optics, and industry-standard damage thresholds for UV Fused Silica substrates can be applied to silica-based fiber. However, unlike bulk optics, the relevant surface areas and beam diameters involved at the air / glass interface of an optical fiber are very small, particularly for coupling into single mode (SM) fiber. therefore, for a given power density, the power incident on the fiber needs to be lower for a smaller beam diameter.

The table to the right lists two thresholds for optical power densities: a theoretical damage threshold and a "practical safe level". In general, the theoretical damage threshold represents the estimated maximum power density that can be incident on the fiber end face without risking damage with very good fiber end face and coupling conditions. The "practical safe level" power density represents minimal risk of fiber damage. Operating a fiber or component beyond the practical safe level is possible, but users must follow the appropriate handling instructions and verify performance at low powers prior to use.

Estimated Optical Power Densities on Air / Glass Interface[a]		
Type	**Theoretical Damage Threshold[b]**	**Practical Safe Level[c]**
CW (Average Power)	~1 MW/cm^2	~250 kW/cm^2
10 ns Pulsed (Peak Power)	~5 GW/cm^2	~1 GW/cm^2

- All values are specified for unterminated (bare) silica fiber and apply for free space coupling into a clean fiber end face.
- This is an estimated maximum power density that can be incident on a fiber end face without risking damage. Verification of the performance and reliability of fiber components in the system before operating at high power must be done by the user, as it is highly system dependent.
- This is the estimated safe optical power density that can be incident on a fiber end face without damaging the fiber under most operating conditions.

Calculating the Effective Area for Single Mode and Multimode Fibers

The effective area for single mode (SM) fiber is defined by the mode field diameter (MFD), which is the cross-sectional area through which light propagates in the fiber; this area includes the fiber core and also a portion of the cladding. To achieve good efficiency when coupling into a single mode fiber, the diameter of the input beam must match the MFD of the fiber.

As an example, SM400 single mode fiber has a mode field diameter (MFD) of ~Ø3 µm operating at 400 nm, while the MFD for SMF-28 Ultra single mode fiber operating at 1550 nm is Ø10.5 µm. The effective area for these fibers can be calculated as follows:

SM400 Fiber: Area = Pi x $(\text{MFD}/2)^2$ = Pi x $(1.5\ \mu\text{m})^2$ = 7.07 µm^2 = 7.07 x 10^{-8} cm^2

SMF-28 Ultra Fiber: Area = Pi x $(\text{MFD}/2)^2$ = Pi x $(5.25\ \mu\text{m})^2$ = 86.6 µm^2 = 8.66 x 10^{-7} cm^2

To estimate the power level that a fiber facet can handle, the power density is multiplied by the effective area. Please note that this calculation assumes a uniform intensity profile, but most laser beams exhibit a Gaussian-like shape within single mode fiber, resulting in a higher power density at the center of the beam compared to the edges. Therefore, these calculations will slightly overestimate the power corresponding to the damage threshold or the practical safe level. Using the estimated power densities assuming a CW light source, we can determine the corresponding power levels as:

SM400 Fiber: 7.07 x 10^{-8} cm^2 x 1 MW/cm^2 = 7.1 x 10^{-8} MW = 71 mW (Theoretical Damage Threshold)
7.07 x 10^{-8} cm^2 x 250 kW/cm^2 = 1.8 x 10^{-5} kW = 18 mW (Practical Safe Level)

SMF-28 Ultra Fiber: 8.66 x 10^{-7} cm^2 x 1 MW/cm^2 = 8.7 x 10^{-7} MW = 870 mW (Theoretical Damage Threshold)
8.66 x 10^{-7} cm^2 x 250 kW/cm^2 = 2.1 x 10^{-4} kW = 210 mW (Practical Safe Level)

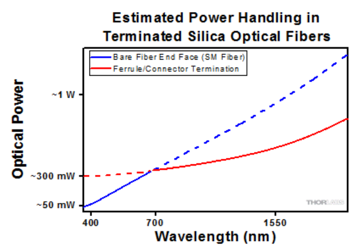
The effective area of a multimode (MM) fiber is defined by the core diameter, which is typically far larger than the MFD of an SM fiber. For optimal coupling, Thorlabs recommends focusing a beam to a spot roughly 70 - 80% of the core diameter. The larger effective area of MM fibers lowers the power density on the fiber end face, allowing higher optical powers (typically on the order of kilowatts) to be coupled into multimode fiber without damage.

Damage Mechanisms Related to Ferrule / Connector Termination

Fibers terminated with optical connectors have additional power handling considerations. Fiber is typically terminated using epoxy to bond the fiber to a ceramic or steel ferrule. When light is coupled into the fiber through a connector, light that does not enter the core and propagate down the fiber is scattered into the outer layers of the fiber, into the ferrule, and the epoxy used to hold the fiber in the ferrule. If the light is intense enough, it can burn the epoxy, causing it to vaporize and deposit a residue on the face of the connector. This results in localized absorption sites on the fiber end face that reduce coupling efficiency and increase scattering, causing further damage.

For several reasons, epoxy-related damage is dependent on the wavelength. In general, light scatters more strongly at short wavelengths than at longer wavelengths. Misalignment when coupling is also more likely due to the small MFD of short-wavelength SM fiber that also produces more scattered light.

To minimize the risk of burning the epoxy, fiber connectors can be constructed to have an epoxy-free air gap between the optical fiber and ferrule near the fiber end face. Our high-power multimode fiber patch cables use connectors with this design feature.



Click to Enlarge
Plot showing approximate power handling levels for single mode silica optical fiber with a termination. Each line shows the estimated power level due to a specific damage mechanism. The maximum power handling is limited by the lowest power level from all relevant damage mechanisms (indicated by a solid line).

Determining Power Handling with Multiple Damage Mechanisms

When fiber cables or components have multiple avenues for damage (e.g., fiber patch cables), the maximum power handling is always limited by the lowest damage threshold that is relevant to the fiber component.

As an illustrative example, the graph to the right shows an estimate of the power handling limitations of a single mode fiber patch cable due to damage to the fiber end face and damage via an optical connector. The total power handling of a terminated fiber at a given wavelength is limited by the lower of the two limitations at any given wavelength (indicated by the solid lines). A single mode fiber operating at around 488 nm is primarily limited by damage to the fiber end face (blue solid line), but fibers operating at 1550 nm are limited by damage to the optical connector (red solid line).

In the case of a multimode fiber, the effective mode area is defined by the core diameter, which is larger than the effective mode area for SM fiber. This results in a lower power density on the fiber end face and allows higher optical powers (on the order of kilowatts) to be coupled into the fiber without damage (not shown in graph). However, the damage limit of the ferrule / connector termination remains unchanged and as a result, the maximum power handling for a multimode fiber is limited by the ferrule and connector termination.

Please note that these are rough estimates of power levels where damage is very unlikely with proper handling and alignment procedures. It is worth noting that optical fibers are frequently used at power levels above those described here. However, these applications typically require expert users and testing at lower powers first to minimize risk of damage. Even still, optical fiber components should be considered a consumable lab supply if used at high power levels.

Intrinsic Damage Threshold

In addition to damage mechanisms at the air / glass interface, optical fibers also display power handling limitations due to damage mechanisms within the optical fiber itself. These limitations will affect all fiber components as they are intrinsic to the fiber itself. Two categories of damage within the fiber are damage from bend losses and damage from photodarkening.

Bend Losses

Bend losses occur when a fiber is bent to a point where light traveling in the core is incident on the core/cladding interface at an angle higher than the critical angle, making total internal reflection impossible. Under these circumstances, light escapes the fiber, often in a localized area. The light escaping the fiber typically has a high power density, which burns the fiber coating as well as any surrounding furcation tubing.

A special category of optical fiber, called double-clad fiber, can reduce the risk of bend-loss damage by allowing the fiber's cladding (2nd layer) to also function as a waveguide in addition to the core. By making the critical angle of the cladding/coating interface higher than the critical angle of the core/clad interface, light that escapes the core is loosely confined within the cladding. It will then leak out over a distance of centimeters or meters instead of at one localized spot within the fiber, minimizing the risk of damage. Thorlabs manufactures and sells 0.22 NA double-clad multimode fiber, which boasts very high, megawatt range power handling.

Photodarkening

A second damage mechanism, called photodarkening or solarization, can occur in fibers used with ultraviolet or short-wavelength visible light, particularly those with germanium-doped cores. Fibers used at these wavelengths will experience increased attenuation over time. The mechanism that causes photodarkening is largely unknown, but several fiber designs have been developed to mitigate it. For example, fibers with a very low hydroxyl ion (OH) content have been found to resist photodarkening and using other dopants, such as fluorine, can also reduce photodarkening.

Even with the above strategies in place, all fibers eventually experience photodarkening when used with UV or short-wavelength light, and thus, fibers used at these wavelengths should be considered consumables.

Preparation and Handling of Optical Fibers

General Cleaning and Operation Guidelines

These general cleaning and operation guidelines are recommended for all fiber optic products. Users should still follow specific guidelines for an individual product as outlined in the support documentation or manual. Damage threshold calculations only apply when all appropriate cleaning and handling procedures are followed.

1. All light sources should be turned off prior to installing or integrating optical fibers (terminated or bare). This ensures that focused beams of light are not incident on fragile parts of the connector or fiber, which can possibly cause damage.

2. The power-handling capability of an optical fiber is directly linked to the quality of the fiber/connector end face. Always inspect the fiber end prior to connecting the fiber to an optical system. The fiber end face should be clean and clear of dirt and other contaminants that can cause scattering of coupled light. Bare fiber should be cleaved prior to use and users should inspect the fiber end to ensure a good quality cleave is achieved.

3. If an optical fiber is to be spliced into the optical system, users should first verify that the splice is of good quality at a low optical power prior to high-power use. Poor splice quality may increase light scattering at the splice interface, which can be a source of fiber damage.

4. Users should use low power when aligning the system and optimizing coupling; this minimizes exposure of other parts of the fiber (other than the core) to light. Damage from scattered light can occur if a high power beam is focused on the cladding, coating, or connector.

Tips for Using Fiber at Higher Optical Power

Optical fibers and fiber components should generally be operated within safe power level limits, but under ideal conditions (very good optical alignment and very clean optical end faces), the power handling of a fiber component may be increased. Users must verify the performance and stability of a fiber component within their system prior to increasing input or output power and follow all necessary safety and operation instructions. The tips below are useful suggestions when considering increasing optical power in an optical fiber or component.

1. Splicing a fiber component into a system using a fiber splicer can increase power handling as it minimizes possibility of air/fiber interface damage. Users should follow all appropriate guidelines to prepare and make a high-quality fiber splice. Poor splices can lead to scattering or regions of highly localized heat at the splice interface that can damage the fiber.

2. After connecting the fiber or component, the system should be tested and aligned using a light source at low power. The system power can be ramped up slowly to the desired output power while periodically verifying all components are properly aligned and that coupling efficiency is not changing with respect to optical launch power.

3. Bend losses that result from sharply bending a fiber can cause light to leak from the fiber in the stressed area. When operating at high power, the localized heating that can occur when a large amount of light escapes a small localized area (the stressed region) can damage the fiber. Avoid disturbing or accidently bending fibers during operation to minimize bend losses.

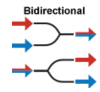
4. Users should always choose the appropriate optical fiber for a given application. For example, large-mode-area fibers are a good alternative to

standard single mode fibers in high-power applications as they provide good beam quality with a larger MFD, decreasing the power density on the air/fiber interface.

5. Step-index silica single mode fibers are normally not used for ultraviolet light or high-peak-power pulsed applications due to the high spatial power densities associated with these applications.

Wavelength Division Multiplexers: 980 nm / 1053 nm

- Combine or Split 980 nm and 1053 nm Signals
- ±5.0 nm Bandwidth
- Available with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



These items will be retired without replacement when stock is depleted. If you require one of these parts for line production, please contact our OEM Team.

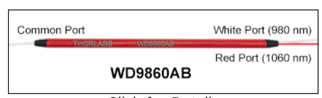
The WD202G WDMs are designed for combining or splitting two signals at 980 nm and 1053 nm and feature a ±5.0 nm bandwidth around the center wavelength of each channel. They are available with 2.0 mm narrow key FC/PC or FC/APC connectors.

Item #	Info[a]	Operating Wavelengths	Bandwidth	Insertion Loss[b]	Isolation[b]	Polarization-Dependent Loss[b]	Directivity[b]	Fiber Type	Termination
WD202G-FC		980 nm / 1053 nm	±5.0 nm	≤0.3 dB (Click for Plot)	≥15 dB	≤0.1 dB	>50 dB	OFS 980	FC/PC
WD202G-APC									FC/APC

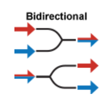
- Please click on the blue icon for complete specifications.
- These specifications were measured without connectors.

Part Number	Description	Price	Availability
WD202G-FC	**Customer Inspired!980 nm / 1053 nm Wavelength Division Multiplexer, FC/PC Connectors**	**$236.64**	**Today**
WD202G-APC	**Customer Inspired!980 nm / 1053 nm Wavelength Division Multiplexer, FC/APC Connectors**	**$267.24**	**Today**

- Combine or Split 980 nm and 1060 nm Signals
- ±5 nm Bandwidth
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- HI1060 and HI1060 FLEX Fiber Options
- Available with Unterminated Fiber Leads or with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



These WDMs are designed for combining or splitting two signals at 980 nm and 1060 nm and feature a ±5 nm bandwidth around the center wavelength of each channel. They can handle a maximum power of 1 W with connectors or bare fiber and a maximum power of 5 W when spliced (see the *Damage Threshold* tab for more details). As seen in the image to the right, the red housing of these multiplexers is engraved with the Item # and the port wavelengths. A detailed test report is included with each WDM; click here for a sample data sheet. They are available with no connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors.

These WDMs are available with HI1060 or HI1060 FLEX fiber. HI1060 fiber offers a Ø5.3 µm core size and a 0.14 NA, while HI1060 FLEX fiber offers a Ø3.4 µm core size, a 0.22 NA, and reduced bending loss relative to HI1060.

Item #	Info[a]	Operating Wavelengths	Bandwidth	Insertion Loss[b]	Isolation[b]	Polarization-Dependent Loss[b]	Directivity[b]	Fiber Type	Termination
WD9860BA		980 nm / 1060 nm	±5 nm	≤0.3 dB (Click for Plot)	≥15 dB	≤0.2 dB	≥60 dB	HI1060 (0.14 NA)	No Connectors Scissor Cut
WD9860FA									FC/PC
WD9860AA									FC/APC
WD9860BB		980 nm / 1060 nm	±5 nm	≤0.3 dB (Click for Plot)	≥15 dB	≤0.2 dB	≥60 dB	HI1060 FLEX (0.22 NA)	No Connectors Scissor Cut
WD9860FB									FC/PC
WD9860AB									FC/APC

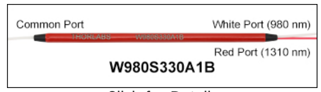
- Please click on the blue icon for complete specifications.
- These specifications were measured without connectors.

Part Number	Description	Price	Availability
WD9860BA	**980 nm / 1060 nm Wavelength Division Multiplexer, HI1060 Fiber, No Connectors**	**$214.20**	**Today**
WD9860FA	**980 nm / 1060 nm Wavelength Division Multiplexer, HI1060 Fiber, FC/PC Connectors**	**$244.80**	**Today**
WD9860AA	**980 nm / 1060 nm Wavelength Division Multiplexer, HI1060 Fiber, FC/APC Connectors**	**$275.40**	**Today**
WD9860BB	**980 nm / 1060 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, No Connectors**	**$214.20**	**Today**
WD9860FB	**980 nm / 1060 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, FC/PC Connectors**	**$244.80**	**Today**

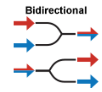
WD9860AB	**980 nm / 1060 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, FC/APC Connectors**	**$275.40**	**Today**

Wavelength Division Multiplexers: 980 nm / 1310 nm

- Combine or Split 980 nm and 1310 nm Signals
- ±15.0 nm Bandwidth
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- HI1060 and HI1060 FLEX Fiber Options
- Available with Unterminated Fiber Leads or with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



The W980S330 WDMs are designed for combining or splitting two signals at 980 nm and 1310 nm and feature a ±15.0 nm bandwidth around the center wavelength of each channel. They can handle a maximum power of 1 W with connectors or bare fiber and a maximum power of 5 W when spliced (see *Damage Threshold* tab for more details). As seen in the image to the right, the red housing of these multiplexers is engraved with the Item # and the port wavelengths. A detailed test report is included with each WDM; click here for a sample data sheet. They are available with no connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors.

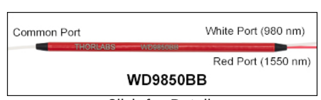
These WDMs are available with HI1060 or HI1060 FLEX fiber. HI1060 fiber offers a Ø5.3 µm core size and a 0.14 NA, while HI1060 FLEX fiber offers a Ø3.4 µm core size, a 0.22 NA, and reduced bending loss relative to HI1060.

Item #	Info[a]	Operating Wavelengths	Bandwidth	Insertion Loss[b]	Isolation[b]	Polarization-Dependent Loss[b]	Directivity[b]	Fiber Type	Termination
W980S330B1A		980 nm / 1310 nm	±15.0 nm	≤0.4 dB (Click for Plot)	≥15 dB	≤0.2 dB	≥60 dB	HI1060 (0.14 NA)	No Connectors Scissor Cut
W980S330F1A									FC/PC
W980S330A1A									FC/APC
W980S330B1B		980 nm / 1310 nm	±15.0 nm	≤0.3 dB (Click for Plot)	≥15 dB	≤0.2 dB	≥60 dB	HI1060 FLEX (0.22 NA)	No Connectors Scissor Cut
W980S330F1B									FC/PC
W980S330A1B									FC/APC

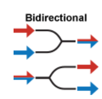
- Please click on the blue icon for complete specifications.
- These specifications were measured without connectors.

Part Number	Description	Price	Availability
W980S330B1A	**980 nm / 1310 nm Wavelength Division Multiplexer, HI1060 Fiber, No Connectors**	**$229.50**	**Today**
W980S330F1A	**980 nm / 1310 nm Wavelength Division Multiplexer, HI1060 Fiber, FC/PC Connectors**	**$271.32**	**Today**
W980S330A1A	**980 nm / 1310 nm Wavelength Division Multiplexer, HI1060 Fiber, FC/APC Connectors**	**$271.32**	**Today**
W980S330B1B	**980 nm / 1310 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, No Connectors**	**$229.50**	**Today**
W980S330F1B	**980 nm / 1310 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, FC/PC Connectors**	**$271.32**	**Today**
W980S330A1B	**980 nm / 1310 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, FC/APC Connectors**	**$271.32**	**Today**

- Combine or Split 980 nm and 1550 nm Signals
- ±10.0 nm Bandwidth
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- Available with Unterminated Fiber Leads or with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



These WDMs are designed for combining or splitting two signals at 980 nm and 1550 nm and feature a ±10.0 nm bandwidth around the center wavelength of each channel. Each WDM can handle a maximum power of 1 W with connectors or unterminated (bare) fiber and a maximum power of 5 W when spliced (see the *Damage Threshold* tab for details). They are available without connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors. A detailed test report is included with each WDM; click here for a sample data sheet.

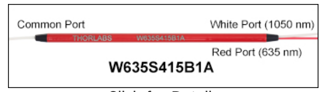
Item #	Info[a]	Operating Wavelengths	Bandwidth	Insertion Loss[b]	Isolation[b]	Polarization-Dependent Loss[b]	Directivity[b]	Fiber Type	Termination
WD9850BB		980 nm / 1550 nm	±10.0 nm	≤0.3 dB (Click for Plot)	≥19 dB	≤0.2 dB	≥60.0 dB	HI1060 FLEX (0.22 NA)	No Connectors Scissor Cut
WD9850FB									FC/PC
WD9850AB									FC/APC

- Please click on the blue icon for complete specifications.
- These specifications were measured without connectors.

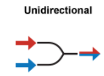
Part Number	Description	Price	Availability
WD9850BB	**980 nm / 1550 nm Wavelength Division Multiplexer, No Connectors**	**$205.02**	**Today**
WD9850FB	**980 nm / 1550 nm Wavelength Division Multiplexer, FC/PC Connectors**	**$236.64**	**Today**
WD9850AB	**980 nm / 1550 nm Wavelength Division Multiplexer, FC/APC Connectors**	**$267.24**	**Today**

Wavelength Division Multiplexers: 1050 nm / 635 nm

- Combine a 1050 nm Signal with a 635 nm Alignment Beam
- ±50 nm Bandwidth at 1550 nm
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- HI1060 and HI1060 FLEX Fiber Options
- Available with Unterminated Fiber Leads or with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



The W635S415 WDMs are designed for combining an alignment beam at around 635 nm with a 1050 nm signal. They can handle a maximum power of 300 mW with connectors or bare fiber and a maximum power of 500 mW when spliced (see the *Damage Threshold* tab for more details). Because of the large ±50 nm bandwidth at 1050 nm, this multiplexer is ideal for applications in life science imaging. Unlike other WDMs on this page, these WDMs are unidirectional because light at 635 nm will be multimode. They should not be used to split light. They are available with no connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors.

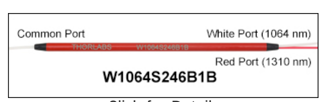
These WDMs are available with HI1060 or HI1060 FLEX fiber. HI1060 fiber offers a Ø5.3 µm core size and a 0.14 NA, while HI1060 FLEX fiber offers a Ø3.4 µm core size, a 0.22 NA, and reduced bending loss relative to HI1060.

Item #	Info[a]	Operating Wavelengths[b]	Bandwidth	Insertion Loss[c]	Isolation[c]	Polarization-Dependent Loss[c]	Directivity[c]	Fiber Type	Termination
W635S415B1A		1050 nm / 635 nm	±50 nm @ 1050 nm +45 / -5 nm @ 635 nm	≤0.3 dB @ 1050 nm (Click for Plot)	≥13 dB @ 1050 nm	≤0.2 dB	≥60 dB	HI1060 (0.14 NA)	No Connectors Scissor Cut
W635S415F1A									FC/PC
W635S415A1A									FC/APC
W635S415B1B				≤0.3 dB @ 1050 nm (Click for Plot)				HI1060 FLEX (0.22 NA)	No Connectors Scissor Cut
W635S415F1B									FC/PC
W635S415A1B									FC/APC

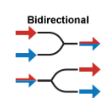
- Please click on the blue icon for complete specifications.
- These couplers are designed for single mode operation at 1050 nm and multimode operation at 635 nm, and are intended for alignment applications. They should not be used to split light.
- These specifications were measured without connectors.

Part Number	Description	Price	Availability
W635S415B1A	**1050 nm / 635 nm Wavelength Division Multiplexer, HI1060 Fiber, No Connectors**	**$318.24**	**Today**
W635S415F1A	**1050 nm / 635 nm Wavelength Division Multiplexer, HI1060 Fiber, FC/PC Connectors**	**$359.04**	**Today**
W635S415A1A	**1050 nm / 635 nm Wavelength Division Multiplexer, HI1060 Fiber, FC/APC Connectors**	**$359.04**	**Today**
W635S415B1B	**1050 nm / 635 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, No Connectors**	**$359.04**	**Today**
W635S415F1B	**1050 nm / 635 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, FC/PC Connectors**	**$359.04**	**Today**
W635S415A1B	**1050 nm / 635 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, FC/APC Connectors**	**$359.04**	**Today**

- Combine or Split 1064 nm and 1310 nm Signals
- ±15.0 nm Bandwidth
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- HI1060 and HI1060 FLEX Fiber Options
- Available with Unterminated Fiber Leads or with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



The W1064S246 WDMs are designed for combining or splitting two signals at 1064 nm and 1310 nm and feature a ±15.0 nm bandwidth around the center wavelength of each channel. They can handle a maximum power of 1 W with connectors or bare fiber and a maximum power of 5 W when spliced (see the *Damage Threshold* tab for more details). As seen in the image to the right, the red housing of these multiplexers is engraved with the Item # and the port wavelengths. A detailed test report is included with each WDM; click here for a sample data sheet. They are available with no connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors.

These WDMs are available with HI1060 or HI1060 FLEX fiber. HI1060 fiber offers a Ø5.3 µm core size and a 0.14 NA, while HI1060 FLEX fiber offers a Ø3.4 µm core size, a 0.22 NA, and reduced bending loss relative to HI1060.

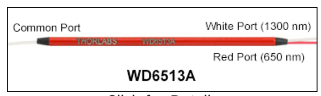
Item #	Info[a]	Operating Wavelengths	Bandwidth	Insertion Loss[b]	Isolation[b]	Polarization-Dependent Loss[b]	Directivity[b]	Fiber Type	Termination

W1064S246B1A	i	1064 nm / 1310 nm	±15 nm	≤0.4 dB (Click for Plot)	≥15 dB	≤0.2 dB	≥60 dB	HI1060 (0.14 NA)	No Connectors Scissor Cut
W1064S246F1A	i								FC/PC
W1064S246A1A	i								FC/APC
W1064S246B1B	i	1064 nm / 1310 nm	±15 nm	≤0.3 dB (Click for Plot)	≥15 dB	≤0.2 dB	≥60 dB	HI1060 FLEX (0.22 NA)	No Connectors Scissor Cut
W1064S246F1B	i								FC/PC
W1064S246A1B	i								FC/APC

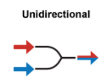
- Please click on the blue icon for complete specifications.
- These specifications were measured without connectors.

Part Number	Description	Price	Availability
W1064S246B1A	1064 nm / 1310 nm Wavelength Division Multiplexer, HI1060 Fiber, No Connectors	$229.50	Today
W1064S246F1A	1064 nm / 1310 nm Wavelength Division Multiplexer, HI1060 Fiber, FC/PC Connectors	$271.32	Today
W1064S246A1A	1064 nm / 1310 nm Wavelength Division Multiplexer, HI1060 Fiber, FC/APC Connectors	$271.32	Today
W1064S246B1B	1064 nm / 1310 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, No Connectors	$229.50	Today
W1064S246F1B	1064 nm / 1310 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, FC/PC Connectors	$271.32	Today
W1064S246A1B	1064 nm / 1310 nm Wavelength Division Multiplexer, HI1060 FLEX Fiber, FC/APC Connectors	$271.32	Today

- Combine a 1300 nm Signal with a 650 nm Alignment Beam
- ±80 nm Bandwidth at 1300 nm
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- Available with Unterminated Fiber Leads or with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



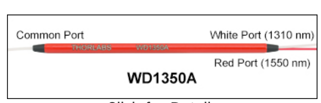
The WD6513 WDMs are designed for combining an alignment beam at around 650 nm with a 1300 nm signal. They can handle a maximum power of 300 mW with connectors or bare fiber and a maximum power of 500 mW when spliced (see the *Damage Threshold* tab for more details). Because of the large ±80 nm bandwidth at 1300 nm, this multiplexer is ideal for applications in life science imaging. Unlike other WDMs on this page, these WDMs are unidirectional because light at 635 nm will be multimode. They should not be used to split light. They are available with no connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors.

Item #	Info[a]	Operating Wavelengths[b]	Bandwidth	Insertion Loss[c]	Isolation[c]	Polarization-Dependent Loss[c]	Directivity[c]	Fiber Type	Termination
WD6513B	i	1300 nm / 650 nm	±80 nm @ 1300 nm +30 / -20 nm @ 650 nm	≤0.5 dB @ 1300 nm (Click for Plot)	≥13 dB @ 1300 nm	≤0.2 dB	≥60 dB	SMF-28e+ (0.14 NA)	No Connectors Scissor Cut
WD6513F	i								FC/PC
WD6513A	i								FC/APC

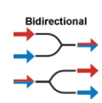
- Please click on the blue icon for complete specifications.
- These couplers are designed for single mode operation at 1300 nm and multimode operation at 650 nm, and are intended for alignment applications. They should not be used to split light.
- These specifications were measured without connectors.

Part Number	Description	Price	Availability
WD6513B	1300 nm / 650 nm Wavelength Division Multiplexer, No Connectors	$287.64	Today
WD6513F	1300 nm / 650 nm Wavelength Division Multiplexer, FC/PC Connectors	$318.24	Today
WD6513A	1300 nm / 650 nm Wavelength Division Multiplexer, FC/APC Connectors	$359.04	Today

- Combine or Split 1310 nm and 1550 nm Signals
- ±15.0 nm Bandwidth
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- Available with Unterminated Fiber Leads or with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



These WDMs are designed for combining or splitting two signals at 1310 nm and 1550 nm and feature a ±15.0 nm bandwidth around the center wavelength of each channel. Each WDM can handle a maximum power of 1 W with connectors or unterminated (bare) fiber and a maximum power of 5 W when spliced (see the *Damage Threshold* tab for details). They are available without connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors. A detailed test report is included with each WDM; click here for a sample data sheet.

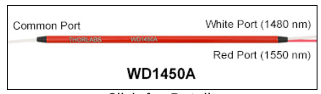
Item #	Info[a]	Operating Wavelengths	Bandwidth	Insertion Loss[b]	Isolation[b]	Polarization-Dependent Loss[b]	Directivity[b]	Fiber Type	Termination

WD1350B	i	1310 nm / 1550 nm	±15.0 nm	≤0.3 dB (Click for Plot)	≥17 dB	<0.3 dB	≥60 dB	SMF-28e+	No Connectors Scissor Cut
WD1350F	i								FC/PC
WD1350A	i								FC/APC

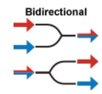
- Please click on the blue icon for complete specifications.
- These specifications were measured without connectors over the bandwidth.

Part Number	Description	Price	Availability
WD1350B	**1310 nm / 1550 nm Wavelength Division Multiplexer, No Connectors**	**$204.00**	**Today**
WD1350F	**1310 nm / 1550 nm Wavelength Division Multiplexer, FC/PC Connectors**	**$234.60**	**Today**
WD1350A	**1310 nm / 1550 nm Wavelength Division Multiplexer, FC/APC Connectors**	**$265.20**	**Today**

- Combine or Split 1480 nm and 1550 nm Signals
- ±5.0 nm Bandwidth
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- Available with Unterminated Fiber Leads or with 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



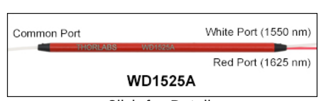
These WDMs are designed for combining or splitting two signals at 1480 nm and 1550 nm and feature a ±5.0 nm bandwidth around the center wavelength of each channel. Each WDM can handle a maximum power of 1 W with connectors or unterminated (bare) fiber and a maximum power of 5 W when spliced (see the *Damage Threshold* tab for details). They are available without connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors. A detailed test report is included with each WDM; click here for a sample data sheet.

Item #	Info[a]	Operating Wavelengths	Bandwidth	Insertion Loss[b]	Isolation[b]	Polarization-Dependent Loss[b]	Directivity[b]	Fiber Type	Termination
WD1450B	i	1480 nm / 1550 nm	±5.0 nm	≤0.3 dB (Click for Plot)	≥15 dB	≤0.2 dB	≥60 dB	SMF-28e+	No Connectors Scissor Cut
WD1450F	i								FC/PC
WD1450A	i								FC/APC

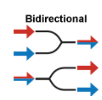
- Please click on the blue icon for complete specifications.
- These specifications were measured without connectors over the bandwidth.

Part Number	Description	Price	Availability
WD1450B	**1480 nm / 1550 nm Wavelength Division Multiplexer, No Connectors**	**$219.30**	**Today**
WD1450F	**1480 nm / 1550 nm Wavelength Division Multiplexer, FC/PC Connectors**	**$250.92**	**Today**
WD1450A	**1480 nm / 1550 nm Wavelength Division Multiplexer, FC/APC Connectors**	**$281.52**	**Today**

- Combine or Split 1550 nm and 1625 nm Signals
- ±5.0 nm Bandwidth
- Includes a Product-Specific Data Sheet (Click Here for a Sample)
- Available with Unterminated Fiber Leads or 2.0 mm Narrow Key FC/PC or FC/APC Connectors



Click for Details
The housings of these WDMs are engraved with the Item # and port wavelengths. The common port is located on the single fiber side and has a white jacket.



These WDMs are designed for combining or splitting two signals at 1550 nm and 1625 nm and feature a ±5.0 nm bandwidth around the center wavelength of each channel. Each WDM can handle a maximum power level of 1 W with connectors or bare fiber and a maximum power of 5 W when spliced (see the *Damage Threshold* tab for details). They are available without connectors or with 2.0 mm narrow key FC/PC or FC/APC connectors. A detailed test report is included with each WDM; click here for a sample data sheet.

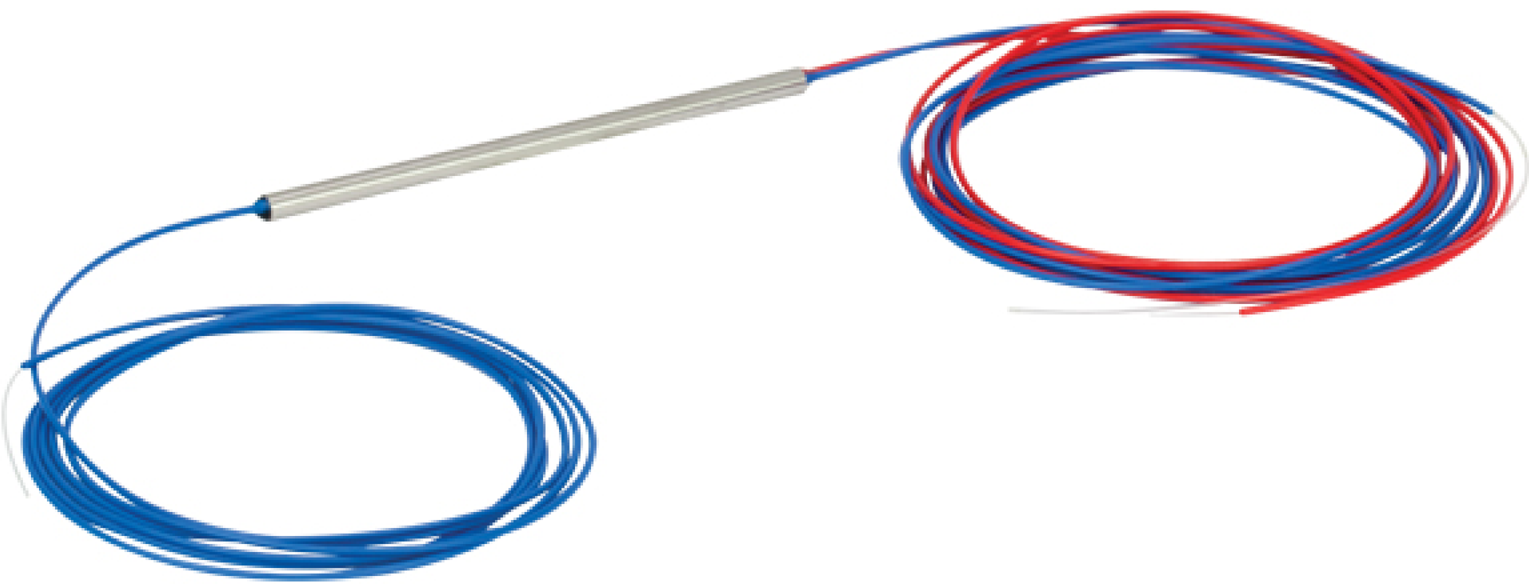
Item #	Info[a]	Operating Wavelengths	Bandwidth	Insertion Loss[b]	Isolation[b]	Polarization-Dependent Loss[b]	Directivity[b]	Fiber Type	Termination
WD1525B	i	1550 nm / 1625 nm	±5.0 nm	≤0.35 dB (Click for Plot)	≥14.5 dB	≤0.15 dB	≥60 dB	SMF-28e+	No Connectors
WD1525F	i								FC/PC
WD1525A	i								FC/APC

- Please click on the blue icon for complete specifications.
- These specifications were measured without connectors and over the bandwidth.

Part Number	Description	Price	Availability

WD1525B	**1550 nm / 1625 nm Wavelength Division Multiplexer, No Connectors**	**$219.30**	**Today**
WD1525F	**1550 nm / 1625 nm Wavelength Division Multiplexer, FC/PC Connectors**	**$250.92**	**Today**
WD1525A	**1550 nm / 1625 nm Wavelength Division Multiplexer, FC/APC Connectors**	**$281.52**	**Today**

Visit the *IR, 2-Wavelength, Single Mode WDMs (980 nm and Up)* page for pricing and availability information:
https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=375



WD202F

WD202F - 980 nm / 1030 nm Wavelength Division Multiplexer, No Connectors

Specifications | Insertion Loss

Specifications[a]	
Operating Wavelengths	980 nm / 1030 nm
Bandwidth	±5.0 nm
Insertion Loss (Max)	≤0.5 dB
Isolation (Min)	≥12 dB
Polarization-Dependent Loss (PDL)	≤0.1 dB
Directivity	>50 dB
CW Power (Max)	300 mW
Fiber Length	1 m
Jacket	Ø900 µm Loose Tube
Termination	No Connectors, Scissor Cut
Package Size	Ø3 mm x 65 mm
Operating Temperature	-40 to 85 °C
Storage Temperature	-50 to 85 °C

- **All specifications are measured without connectors.**

Fiber Specifications[a]	
Fiber Type	OFS 980
Mode Field Diameter	5.0 ± 0.3 µm @ 980 nm
Cladding	125 ± 2.0 µm
Coating	245 ± 15 µm
Attenuation (Max)	≤3.0 dB/km @ 980 nm
Numerical Aperture	0.16

- **All specifications are measured without connectors.**

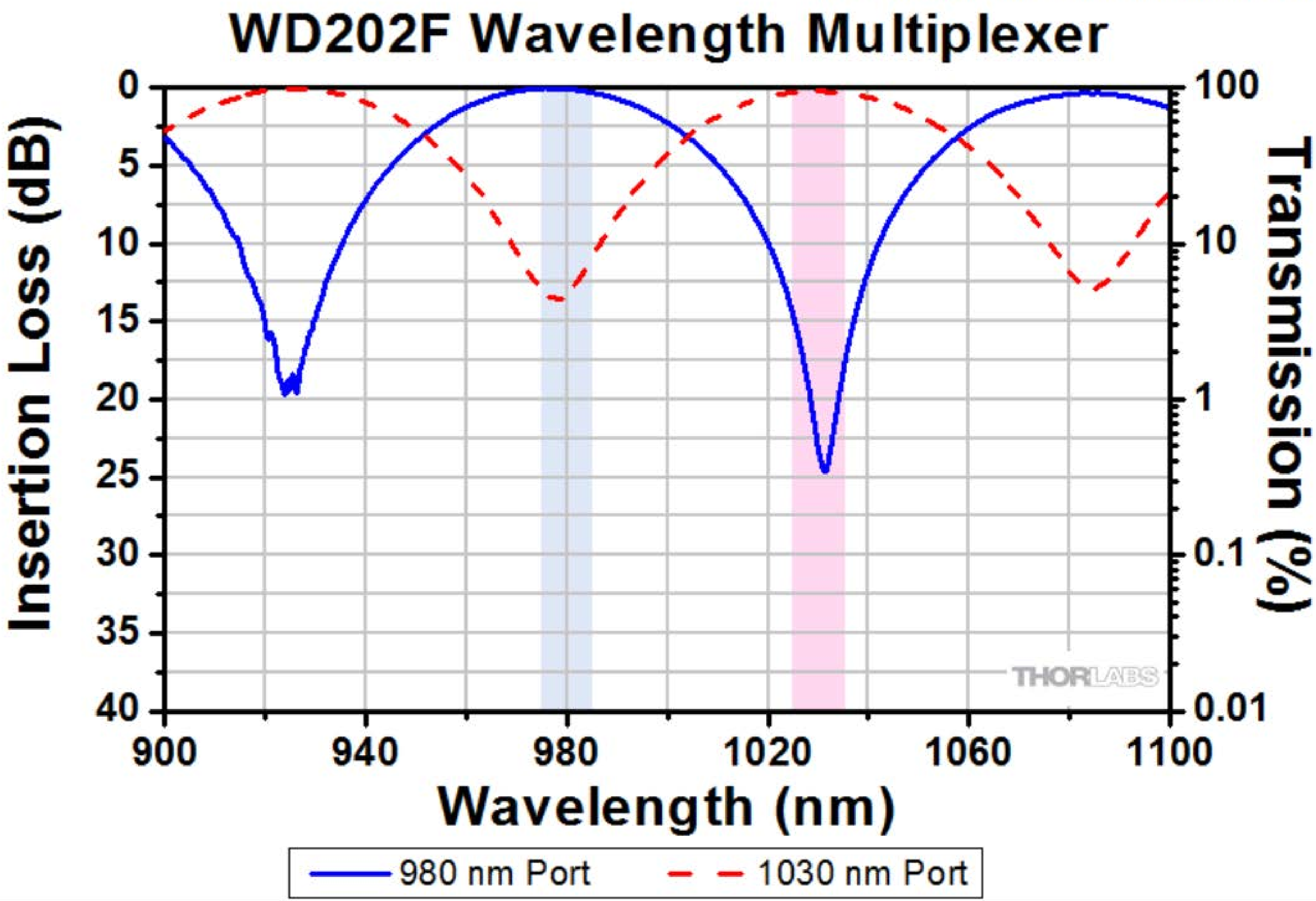
Auto CAD PDF | Auto CAD DXF | Solidworks | eDrawing | Step

WD202F - 980 nm / 1030 nm Wavelength Division Multiplexer, No Connectors

Specifications | Insertion Loss

This plot shows an example of the spectral performance of a 980 nm / 1030 nm WDM. The lines represent the spectral response of each channel, while the blue and red shaded regions denote the bandwidth around each channel. This data is typical; performance of each coupler may vary within the coupler specifications. Data was obtained without connectors.

Auto CAD PDF | Auto CAD DXF | Solidworks | eDrawing | Step



This plot shows an example of the spectral performance of a 980 nm / 1030 nm WDM. The lines represent the spectral response of each channel, while the blue and red shaded regions denote the bandwidth around each channel. This data is typical; performance of each coupler may vary within the coupler specifications. Data was obtained without connectors.