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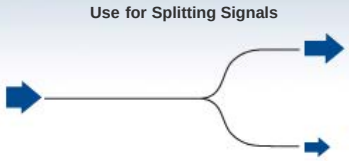
THORLABS

PMC1060-50B-APC - September 2. 2016

Item # PMC1060-50B-APC was discontinued on September 2, 2016. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

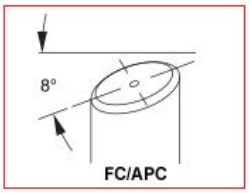
1064 NM 1X2 POLARIZATION-MAINTAINING FIBER OPTIC COUPLERS / TAPS

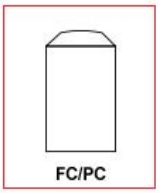
- **Narrowband PM Couplers for 1064 nm**
- **Available with 50:50, 75:25, 90:10, or 99:1 Coupling Ratio**
- **Standard and Premium Versions Available**



PMC1060-90B-APC
90:10 PM Coupler with FC/APC Connectors

PN1064R5F1
50:50 PM Coupler with FC/PC Connectors





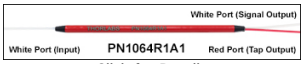
Hide Overview

OVERVIEW

Features

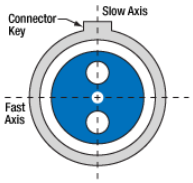
- Polarization-Maintaining Fiber Optic Couplers for Use at 1064 nm
- Two Versions Available
  - Standard: 1060 nm ± 15 nm and ≥18 dB PER Excluding Connectors
  - Premium: 1064 nm ± 15 nm and ≥20 dB PER Including Connectors
- 50:50, 75:25, 90:10, or 99:1 Split Ratios
- 2.0 mm Narrow Key FC/PC or FC/APC Connectors
- Individual Test Report Included with Each Premium Coupler (See the *PER Measurement* Tab; Click Here for a Sample Data Sheet)
- Contact Us for Custom Wavelength, Coupling Ratio and Connector Options

1x2 PM Coupler Selection Guide	
Center Wavelength	**Bandwidth**
630 nm	±15 nm
780 nm	±15 nm
1064 nm	±15 nm
1310 nm	±15 nm
1550 nm	±15 nm



Click for Details
Each premium coupler is engraved with the Item #, serial number, and key specifications for easy identification. When the white port on the left is used as the input, the coupling ratios listed below correspond to the ratio of the measured output power from the white (signal output) port to the red (tap output) port.

Panda PM Fiber Cross Section



The connector key is aligned to the slow axis of the fiber.

These 1x2 Polarization-Maintaining (PM) Fiber Couplers are designed for operation at 1064 nm and are available with 50:50, 75:25, 90:10, or 99:1 coupling ratios. 1x2 couplers have only one input port for simplified use and cable management. These couplers are ideal for applications where light is split from the input port into two output ports at the specified coupling ratio; unlike WDMs, they are generally not recommended for beam combining applications. The unused port is internally terminated within the coupler housing in a manner that minimizes back reflections (please see the *1x2 Coupler Tutorial* tab for details).

PM couplers are manufactured using panda-style PM fiber which allows them to maintain a high polarization extinction ratio (PER) when light is launched along the slow axis of the fiber. As seen in the diagram to the right, stress rods run parallel to the fiber's core and apply stress that creates birefringence in the fiber's core, allowing polarization-maintaining operation. Typical applications for PM couplers include optical sensors, optical amplifiers, and fiber gyroscopes.

Thorlabs' Premium PM Couplers (indicated by Item #'s starting with PN) provide an improved PER (≥20 dB including connectors) and a wide -40 °C to 85 °C operating range. These couplers undergo extensive testing and verification of the PER; details of our testing procedures are provided on the *PER Measurement* tab. Testing results are included with a data sheet that is shipped with premium couplers. A sample data sheet for the 1064 nm PM couplers can be viewed here.

These couplers are available with 2.0 mm narrow key FC/PC and FC/APC connectors, as outlined in the tables below. Fiber leads are jacketed in Ø900 µm Hytrel® tubing and the leads are 0.8 m long. Custom coupler configurations with other wavelengths, fiber types, coupling ratios, alignment axes, or port configurations are also available. Please contact Tech Support with inquiries.

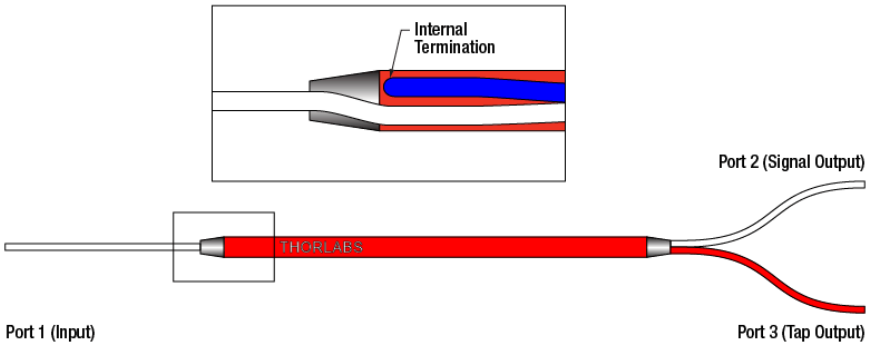
Alternative Fiber Coupler Options				
Double-Clad Couplers	**Single Mode Couplers**	**Multimode Couplers**	**Polarization-Maintaining Couplers**	**Wavelength Division**

2x2	1x2	2x2	1x4	Graded-Index 1x2	Step-Index 2x2	1x2	2x2	**Multiplexers (WDM)**

1X2 COUPLER TUTORIAL

Definition of 1x2 Fused Fiber Optic Coupler Specifications

This tab provides a brief explanation of how we determine several key specifications for our 1x2 couplers. 1x2 couplers are manufactured using the same process as our 2x2 fiber optic couplers, except the second input port is internally terminated using a proprietary method that minimizes back reflections. 1x2 couplers are not recommended for light combining applications and should only be used to split light. For combining light of different wavelengths, Thorlabs offers a line of wavelength division multiplexers (WDMs). The ports on our 1x2 couplers are configured as shown in the schematic below.



Excess Loss

Excess loss in dB is determined by the ratio of the total input power to the total output power:

$$\text{Excess Loss}(dB) = 10\log\frac{P_{port1}(mW)}{P_{port2}(mW) + P_{port3}(mW)}$$

P_{port1} is the input power at port 1 and P_{port2}+P_{port3} is the total output power from Ports 2 and 3. All powers are expressed in mW.

Optical Return Loss (ORL) / Directivity

The directivity refers to the fraction of input light that is lost in the internally terminated fiber end within the coupler housing when port 1 is used as the input. It can be calculated in units of dB using the following equation:

$$\text{Directivity}(dB) = 10\log\frac{P_{port1b}(mW)}{P_{port1}(mW)}$$

where P_{port1} and P_{port1b} are the optical powers (in mW) in port 1 and the internally terminated fiber, respectively. This output is the result of back reflection at the junction of the legs of the coupler and represents a loss in the total light output at ports 2 and 3. For a 50:50 coupler, the directivity is equal to the optical return loss (ORL).

Insertion Loss

The insertion loss is defined as the ratio of the input power to the output power at one of the output legs of the coupler (signal or tap). Insertion loss is always specified in decibels (dB). It is generally defined using the equation below:

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

where P_{in} and P_{out} are the input and output powers (in mW). For our 1x2 couplers, the insertion loss specification is provided for both signal and tap outputs; our specifications always list insertion loss for the signal output first. To define the insertion loss for a specific output (port 2 or port 3), the equation is rewritten as:

$$\text{Insertion Loss}_{port1\rightarrow port2}(dB) = 10\log\frac{P_{port1}(mW)}{P_{port2}(mW)}$$

$$\text{Insertion Loss}_{port1\rightarrow port3}(dB) = 10\log\frac{P_{port1}(mW)}{P_{port3}(mW)}$$

Calculating Insertion Loss using Power Expressed in dBm

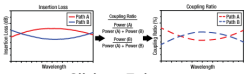
Insertion loss can also be easily calculated with the power expressed in units of dBm. The equation below shows the relationship between power expressed in mW and dBm:

$$P(dBm) = 10\log P(mW)$$

Then, the insertion loss in dB can be calculated as follows:

$$\text{Insertion Loss}(dB) = P_{in}(dBm) - P_{out}(dBm)$$

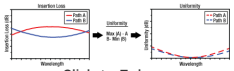
Coupling Ratio



Click to Enlarge
A graphical representation of the coupling ratio calculation.

Insertion loss (in dB) is the ratio of the input power to the output power from each leg of the coupler as a function of wavelength. It captures both the coupling ratio and the excess loss. The coupling ratio is calculated from the measured insertion loss. Coupling ratio (in %) is the ratio of the optical power from each output port (ports 2 and 3) to the sum of the total power of both output ports as a function of wavelength. Path A represents light traveling from port 1 to port 2 while Path B represents light traveling from port 1 to port 3. It is not impacted by spectral features such as the water absorption region because both output legs are affected equally. Persistence plots showing the coupling ratio of our wideband couplers can be viewed by clicking on the blue info icons below.

Uniformity



Click to Enlarge
A graphical representation of the Uniformity calculation.

The uniformity is also calculated from the measured insertion loss. Uniformity is the variation (in dB) of the insertion loss over the bandwidth. It is a measure of how evenly the insertion loss is distributed over the spectral range. The uniformity of Path A is the difference between the value of highest insertion loss and the solid red insertion loss curve (in the Insertion Plot above). The uniformity of Path B is the difference between the solid blue insertion loss curve and the value of lowest insertion loss. Persistence plots showing the uniformity of our wideband couplers can be viewed by clicking on the blue info icons below.

PER MEASUREMENT

Measurement of Polarization Extinction Ratio (PER)

The polarization extinction ratio (PER) is a measure of how well a polarization-maintaining (PM) fiber or device can prevent cross coupling between the different polarization axes of the fiber. External stress on a fiber from sources such as heating, bending, or pulling can all cause the PER to change.

Click to Enlarge
Setup to Measure Extinction Ratio of a 1550 nm
PM Coupler

There are two accepted techniques for measuring PER in a fiber coupler. The most common method uses a low-coherence (unpolarized or circularly polarized) broadband light source and measures the extinction ratio with a linear polarizer and power meter. An alternative method uses a narrowband, high-coherence light source and measures the PER with a polarimeter.

Thorlabs uses the power meter method to characterize the extinction ratio performance of the premium PM fiber couplers sold on this page. An example of the power meter setup is shown in the image and table to the right. A broadband light source is input into the linear polarizer module, which sets the polarization of light input into the coupler. The output from one of the legs is sent to the analyzer module, which contains another polarizer and the power meter for measuring the output. Alternatively, the analyzer module can be replaced with an extinction ratio meter (Item # ERM100).

The PER is measured using the test procedure below.

Testing Procedure

- Prepare the fiber end faces of the PM coupler to connect to the measurement setup.
  - For bare fiber ends, strip and cleave the fibers. Use a bare fiber terminator, such as the BFT1, to create a temporary fiber termination.

Item #[a]	Description	Qty.
Light Source (Not Shown)		
S5FC1005P	PM Benchtop SLD Source, 1550 nm	1
P1-1550PM-FC-1	Patch Cable, FC/PC, 1550 nm, PM Panda Style, 1 m	1
Linear Polarizer Module		
PAF-X-11-PC-C	FiberPort, FC/PC, 1050 nm - 1620 nm	2
CP08FP	Cage Plates for Mounting FiberPorts	2
LPNIR050-MP2	Linear Polarizer	1
CRM1P	Cage Rotation Mount	1
SM1A6T	Adapter with External SM1 Threads and Internal SM05 Threads	1
ER2-P4	2" (50.8 mm) Long Cage Rods, 4 Pack	1
Analyzer Module		
PAF-X-11-PC-C	FiberPort, FC/PC, 1050 nm - 1620 nm	1
CP08FP	Cage Plates for Mounting FiberPorts	1
LPNIR050-MP2	Linear Polarizer	1
CRM1P	Cage Rotation Mount	1
SM1A6T	Adapter with External SM1 Threads and Internal SM05 Threads	1
CP02	SM1-Threaded (1.035"-40) Cage Plate	1
PM122D	Digital Power Meter, 700 - 1800 nm	1
ER2-P4	2" (50.8 mm) Long Cage Rods, 4 Pack	1

- Item list does not include the posts, post holders, clamps, breadboard, or fiber component tray shown in the photo to the left.

For terminated fiber ends, clean and inspect the connector end faces.
- Attach a fiber optic light trap to any fiber leads not being measured.

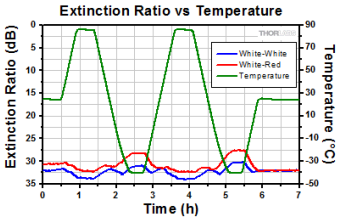
- Adjust the polarizers in the linear polarizer and analyzer modules sequentially until a minimum power value is measured by the power meter. Record the measured value as P_{min}.
- Rotate the analyzer rotation mount by 90°. Then record the measured value as P_{max}.

After P_{min} and P_{max} are measured, the extinction ratio can be calculated using the equation:

$$PER(dB) = -10\log\left(\frac{P_{min}}{P_{max}}\right)$$

Temperature Cycling Tests

PM couplers typically exhibit diminished PER performance when used at sub-zero temperatures due to the contraction of the adhesives that are used in the coupler package. This effect disrupts the polarization state of light within the coupler that leads to a decrease in PER. Soft adhesives can be used to mitigate the impact of cold-temperature operation, but can create reliability issues at higher temperatures. At high temperatures, adhesives can soften permanently, which changes the optical properties of the coupler.



Click to Enlarge
PER measured using the white-white path and white-red path through a PN1550R5A1 PM coupler.

Thorlabs' Premium PM Couplers use a proprietary packaging process and design as well as careful selection of adhesives to enable operation over a very wide temperature range (from -40 °C to 85 °C) without significant changes to PER and other optical specifications. The graph to the right illustrates a 7-hour temperature cycling test performed on a PN1550R5A1 PM fiber coupler showing that the PER remains stable over a wide temperature range.

50:50 Fiber Couplers

Premium Item #	Info	Center Wavelength	Bandwidth[a]	Coupling Ratio[a] (%)	Extinction Ratio[b]	Insertion Loss[a]	Excess Loss[a]	Fiber Type[c]	Termination[d]
PN1064R5F1		1064 nm	±15 nm	50:50	≥20.0 dB / ≥20.0 dB (Including Connectors)	≤3.4 dB / ≤3.4 dB	≤0.3 dB (Typ.)	PM 98-U25D	FC/PC
PN1064R5A1									FC/APC

- Values are specified with a slow axis launch at room temperature without connectors and measured at the center wavelength through the white input port, as indicated in the diagram above.
- Extinction ratio is specified with a slow axis launch at room temperature with connectors and measured at the center wavelength through the white input port, as indicated in the diagram above. See the *PER Measurement* tab for more information on how extinction ratio is measured.
- The fiber used in this coupler is compatible with PM980-XP fiber. Other fiber types may be available upon request. Please contact Tech Support with inquiries.
- The connector key is aligned to the slow axis of the fiber.

Standard Item #[a]	Info	Center Wavelength	Bandwidth	Coupling Ratio (%)	Extinction Ratio	Insertion Loss	Excess Loss	Fiber Type[b]	Termination[c]
PMC1060-50B-FC		1060 nm	±15 nm	50:50	≥18.0 dB / ≥18.0 dB (Excluding Connectors)	≤3.7 dB / ≤3.7 dB	≤0.4 dB (Typ.)	SM98-PR-U25D-H	FC/PC
PMC1060-50B-APC									FC/APC

- All specifications are measured without connectors during the manufacturing process.
- The fiber used in this coupler is compatible with PM980-XP fiber.
- The connector key is aligned to the slow axis of the fiber.

Part Number	Description	Price	Availability
PN1064R5F1	NEW! 1x2 PM Coupler, 1064 ± 15 nm, 50:50 Split, ≥20 dB PER, FC/PC Connectors	$485.00	Today
PN1064R5A1	NEW! 1x2 PM Coupler, 1064 ± 15 nm, 50:50 Split, ≥20 dB PER, FC/APC Connectors	$525.00	Lead Time
PMC1060-50B-FC	1x2 PM Coupler, 1060 ± 15 nm, 50:50 Split, ≥18 dB PER, FC/PC Connectors	$395.00	Today
PMC1060-50B-APC	Customer Inspired!1x2 PM Coupler, 1060 ± 15 nm, 50:50 Split, ≥18 dB PER, FC/APC Connectors	$395.00	Lead Time

75:25 Fiber Couplers

Premium Item #	Info	Center Wavelength	Bandwidth[a]	Coupling Ratio[a] (%)	Extinction Ratio[b]	Insertion Loss[a]	Excess Loss[a]	Fiber Type[c]	Termination[d]
PN1064R3F1		1064 nm	±15 nm	75:25	≥20.0 dB / ≥20.0 dB (Including Connectors)	≤1.6 dB / ≤6.5 dB	≤0.3 dB (Typ.)	PM 98-U25D	FC/PC
PN1064R3A1									FC/APC

- Values are specified with a slow axis launch at room temperature without connectors and measured at the center wavelength through the white input port, as indicated in the diagram above.
- Extinction ratio is specified with a slow axis launch at room temperature with connectors and measured at the center wavelength through the white input

port, as indicated in the diagram above. See the *PER Measurement* tab for more information on how extinction ratio is measured.
- The fiber used in this coupler is compatible with PM980-XP fiber. Other fiber types may be available upon request. Please contact Tech Support with inquiries.
- The connector key is aligned to the slow axis of the fiber.

Part Number	Description	Price	Availability
PN1064R3F1	NEW! 1x2 PM Coupler, 1064 ± 15 nm, 75:25 Split, ≥20 dB PER, FC/PC Connectors	$485.00	Today
PN1064R3A1	NEW! 1x2 PM Coupler, 1064 ± 15 nm, 75:25 Split, ≥20 dB PER, FC/APC Connectors	$525.00	Today

90:10 Fiber Couplers

Premium Item #	Info	Center Wavelength	Bandwidth[a]	Coupling Ratio[a] (%)	Extinction Ratio[b]	Insertion Loss[a]	Excess Loss[a]	Fiber Type[c]	Termination[d]
PN1064R2F1		1064 nm	±15 nm	90:10	≥20.0 dB / ≥20.0 dB (Including Connectors)	≤0.8 dB / ≤10.5 dB	≤0.3 dB (Typ.)	PM 98-U25D	FC/PC
PN1064R2A1									FC/APC

- Values are specified with a slow axis launch at room temperature without connectors and measured at the center wavelength through the white input port, as indicated in the diagram above.
- Extinction ratio is specified with a slow axis launch at room temperature with connectors and measured at the center wavelength through the white input port, as indicated in the diagram above. See the *PER Measurement* tab for more information on how extinction ratio is measured.
- The fiber used in this coupler is compatible with PM980-XP fiber. Other fiber types may be available upon request. Please contact Tech Support with inquiries.
- The connector key is aligned to the slow axis of the fiber.

Standard Item #[a]	Info	Center Wavelength	Bandwidth	Coupling Ratio (%)	Extinction Ratio	Insertion Loss	Excess Loss	Fiber Type[b]	Termination[c]
PMC1060-90B-FC		1060 nm	±15 nm	90:10	≥18.0 dB / ≥18.0 dB (Excluding Connectors)	≤1.2 dB / ≤11.6 dB	≤0.4 dB (Typ.)	SM98-PR-U25D-H	FC/PC
PMC1060-90B-APC									FC/APC

- All specifications are measured without connectors during the manufacturing process.
- The fiber used in this coupler is compatible with PM980-XP fiber.
- The connector key is aligned to the slow axis of the fiber.

Part Number	Description	Price	Availability
PN1064R2F1	NEW! 1x2 PM Coupler, 1064 ± 15 nm, 90:10 Split, ≥20 dB PER, FC/PC Connectors	$485.00	Today
PN1064R2A1	NEW! 1x2 PM Coupler, 1064 ± 15 nm, 90:10 Split, ≥20 dB PER, FC/APC Connectors	$525.00	Lead Time
PMC1060-90B-FC	1x2 PM Coupler, 1060 ± 15 nm, 90:10 Split, ≥18 dB PER, FC/PC Connectors	$395.00	Today
PMC1060-90B-APC	Customer Inspired!1x2 PM Coupler, 1060 ± 15 nm, 90:10 Split, ≥18 dB PER, FC/APC Connectors	$395.00	Today

99:1 Fiber Couplers

Premium Item #	Info	Center Wavelength	Bandwidth[a]	Coupling Ratio[a] (%)	Extinction Ratio[b]	Insertion Loss[a]	Excess Loss[a]	Fiber Type[c]	Termination[d]
PN1064R1F1		1064 nm	±15 nm	99:1	≥20.0 dB / ≥20.0 dB (Including Connectors)	≤0.4 dB / ≤21.5 dB	≤0.3 dB (Typ.)	PM 98-U25D	FC/PC
PN1064R1A1									FC/APC

- Values are specified with a slow axis launch at room temperature without connectors and measured at the center wavelength through the white input port, as indicated in the diagram above.
- Extinction ratio is specified with a slow axis launch at room temperature with connectors and measured at the center wavelength through the white input port, as indicated in the diagram above. See the *PER Measurement* tab for more information on how extinction ratio is measured.
- The fiber used in this coupler is compatible with PM980-XP fiber. Other fiber types may be available upon request. Please contact Tech Support with inquiries.
- The connector key is aligned to the slow axis of the fiber.

Part Number	Description	Price	Availability
PN1064R1F1	NEW! 1x2 PM Coupler, 1064 ± 15 nm, 99:1 Split, ≥20 dB PER, FC/PC Connectors	$485.00	Lead Time
PN1064R1A1	NEW! 1x2 PM Coupler, 1064 ± 15 nm, 99:1 Split, ≥20 dB PER, FC/APC Connectors	$525.00	Lead Time

Coupler Specifications[a]	
Coupling Ratio	50:50
Center Wavelength	1060 nm
Bandwidth	±15 nm
Extinction Ratio	≥18.0 dB / ≥18.0 dB
Insertion Loss	≤3.7 dB / ≤3.7 dB
Excess Loss	≤0.4 dB (Typical)
Optical Return Loss (ORL) / Directivity	≥55 dB
Max Power Level	1 W
Fiber Type	SM98-PR-U25D-H
Port Configuration	1x2
Fiber Lead Length and Tolerance	0.8 m +0.075 m / -0.0 m
Connectors[b]	2.0 mm Narrow Key FC/APC
Package Size	Ø0.12" x 2.76" (Ø3.0 mm x 70.1 mm)
Jacket	Ø900 µm Hytrel® Loose Tube
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C

a. All specifications are measured without connectors during the manufacturing process.
b. The connector key is aligned to the slow axis of the fiber.