56 Sparta Avenue • Newton, New Jersey 07860
(973) 300-3000 Sales • (973) 300-3600 Fax
www.thorlabs.com

THORLABS

Part FCMH2-SMA - JUN 13 2019

Item # FCMH2-SMA was discontinued on JUN 13, 2019. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

2X2 STEP-INDEX MULTIMODE FIBER OPTIC COUPLERS, Ø200 MM CORE, 0.39 NA

- 0.39 NA, Ø200 µm Core Multimode Fiber
- 400 - 900 nm Operating Wavelength Range
- FC/PC or SMA Connectors
- Versions Available with Ø1.25 mm or Ø2.5 mm Ferrules Terminating Two Legs

Hide Overview

OVERVIEW

Features

2x2 MM Coupler Selection Guide
Step-Index Fiber
Ø105 µm Core, 0.22 NA, 400 - 900 nm (High OH) Ø105 µm Core, 0.22 NA, 400 - 2200 nm (Low OH)
Ø200 µm Core, 0.22 NA, 400 - 900 nm (High OH) Ø200 µm Core, 0.22 NA, 400 - 2200 nm (Low OH)
Ø200 µm Core, 0.39 NA, 400 - 900 nm (High OH)

- 50:50 Coupling Ratio
- Operating Wavelength Range: 400 - 900 nm
- 0.39 NA, Ø200 µm Core Step-Index Multimode Fiber
- Maximum Power Level: 300 mW (CW)

These 2x2 Multimode Fiber Optic Couplers/Splitters are built with FT200UMT 0.39 NA, Ø200 µm core fiber. They offer low insertion loss and excellent environmental and mechanical stability, making them ideal solutions for combining and splitting signals in multimode fiber systems. Additionally, the step-index fiber utilized in the design is well suited for use in Optogenetics applications.

These couplers have either FC/PC or SMA connectors on two of the ports. We offer models with FC/PC connectors, SMA connectors, or Ø1.25 mm or Ø2.5 mm ferrule-terminated ends on the other two ports. These couplers are also available with custom connector options. Contact techsupport@thorlabs.com to order.

Common Specifications[a]	
Operating Wavelength Range	400 - 900 nm[b]
Coupling Ratio	50:50 ± 3.5%
Insertion Loss	4 dB Typical from 400 to 900 nm 5.5 dB Max @ 455 nm
Excess Loss	1 dB Typical from 400 to 900 nm 2.5 dB Max @ 455 nm
Directivity	≥40 dB
Max Power Level	300 mW (CW)
Fiber Type	FT200UMT, 0.39 NA, Ø200 µm Core, High-OH
Fiber Length	1.0 +0.075/-0.0 m
Coupler Body Dimensions	2.36" x Ø0.16" (60 mm x Ø4 mm)
Operating Temperature	-40 to 85 °C
Storage Temperature	-50 to 85 °C

- All specifications are measured without connectors during the manufacturing process.
- All other specifications are guaranteed within the 400 - 900 nm operating wavelength range. However, the couplers perform well outside of this range, as shown on the *Graphs* tab.

Launch Conditions and Coupler Performance

When launching light from a source such as a fiber-coupled LED into a multimode fiber using a butt-coupling setup, it is common for some of the light to be coupled into the fiber's cladding instead of the core. Please note that light coupled into the cladding will not be transmitted through these couplers. All specifications apply to light in the fiber's core only.

Click to Enlarge

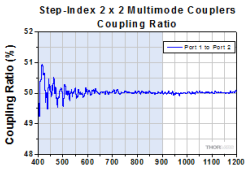
The couplers' ports are clearly labeled for easy identification. Ports 1 and 4 are on one side of the coupler, while 2 and 3 are on the other side.

Alternative Fiber Coupler & Splitter Options											
Double-Clad Couplers	Single Mode Couplers			Single Mode PLC Splitters		Multimode Couplers		Polarization-Maintaining Couplers			Wavelength Division Multiplexers (WDM)
2x2	1x2	2x2	1x4	1x8	1x16	1x2	2x2	1x2	2x2	1x4	

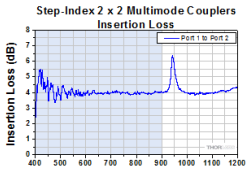
Hide Graphs

GRAPHS

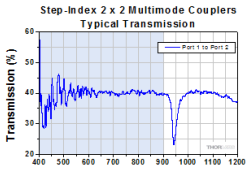
Thorlabs' multimode 2x2 couplers have a specified operating wavelength range of 400 - 900 nm. However, their performance remains nearly constant over a much greater wavelength range, as shown in the graphs below. Please note that these test data represent one individual coupler. The exact splitting ratio, insertion loss, and transmission will vary from unit to unit. The 400 - 900 nm wavelength range is indicated by the shaded region. Data from Port 1 to Port 2 is representative of performance from any leg on one side of the coupler to any leg on the other side.



Click to Enlarge



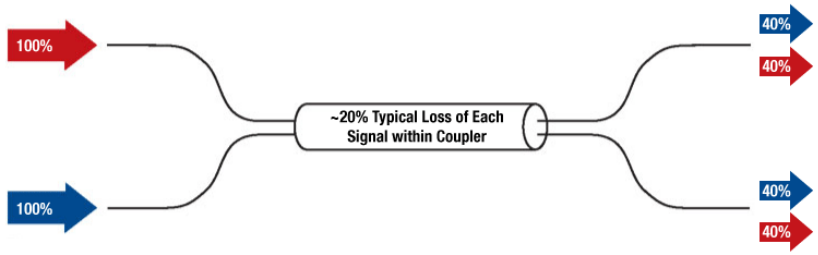
Click to Enlarge



Click to Enlarge

Click to Download Raw Data for All Graphs

Signal Paths and Strength



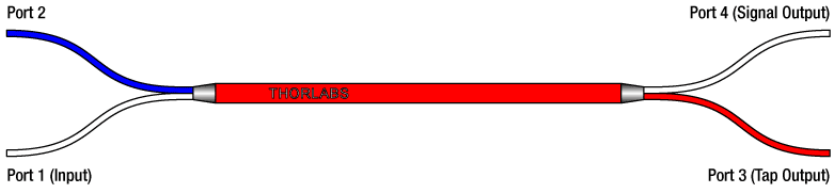
The signal strength percentages given in the diagram above are typical, and performance will vary slightly at different wavelengths and between individual couplers.

Hide 2x2 Coupler Tutorial

2X2 COUPLER TUTORIAL

Definition of 2x2 Fused Fiber Optic Coupler Specifications

This tab provides a brief explanation of how we determine several key specifications for our 2x2 couplers. The ports of the coupler are defined as shown in the coupler schematic below. In the sections below, the light is input into port 1. Port 3 and port 4 would then be considered the signal and tap outputs, respectively.



Excess Loss

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

$$\text{Excess Loss}(dB) = 10\log\frac{P_{port1}(mW)}{P_{port3}(mW) + P_{port4}(mW)}$$

P_{port1} is the input power at port 1 and P_{port3}+P_{port4} is the total output power from ports 3 and 4, assuming no input power at port 2. All powers are expressed in mW.

Polarization Dependent Loss (PDL)

The polarization dependent loss is defined as the ratio of the maximum and minimum transmissions due to polarization states in couplers. This specification pertains only to couplers not designed for maintaining polarization. PDL is always specified in decibels (dB), and can be calculated with the following equation:

$$\text{Polarization Dependent Loss}(dB) = 10\log\frac{P_{max}(mW)}{P_{min}(mW)}$$

where P_{max} is the maximum power able to be transmitted through the coupler when scanning across all possible polarization states. P_{min} is the minimum transmission across those same states.

Optical Return Loss (ORL) / Directivity

The directivity refers to the fraction of input light that exits the coupler through an input port (i.e., light exiting at port 2) instead of the intended output port. It can be calculated in units of dB using the following equation:

$$\text{Directivity}(dB) = 10\log\frac{P_{port1}(mW)}{P_{port2}(mW)}$$

where P_{port1} and P_{port2} are the optical powers (in mW) in port 1 and port 2, 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 3 and 4. 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 2x2 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 3 or port 4), the equation is rewritten as:

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

$$\text{Insertion Loss}_{port1\rightarrow port4}(dB) = 10\log\frac{P_{port1}(mW)}{P_{port4}(mW)}$$

A similar equation can be used to define the insertion loss at port 2 for input at port 1. However, as seen above, this is already defined as the directivity of the coupler.

Insertion loss inherently includes both coupling (e.g., light transferred to the other output leg) and excess loss (e.g., light lost from the coupler) effects.
The maximum allowed insertion loss for each output, signal and tap, are both specified. Because the insertion loss in each output is correlated to light coupled to the other output, no coupler will ever have the maximum insertion loss in both outputs simultaneously.

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:

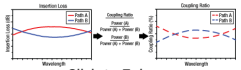
$$P(dBm) = 10\log P(mW)$$

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

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

Coupling Ratio

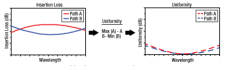
Insertion loss (in dB) is the ratio of the input power to the output power from each leg of the coupler as a function of wavelength. It captures both the coupling ratio and the excess loss. The coupling ratio is calculated from the measured insertion loss. Coupling ratio (in %) is the ratio of the optical power from each output port (A and B) to the sum of the total power of both output ports as a function of wavelength. It is not impacted by spectral features such as the water absorption region because both output legs are affected equally.



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

Uniformity

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.



Click to Enlarge
A graphical representation of the Uniformity calculation.

Hide 2x2 Multimode Couplers, Unjacketed Fiber Leads

2x2 Multimode Couplers, Unjacketed Fiber Leads

- FC/PC or SMA Connectors on All Legs
- Unjacketed Fiber with Ø500 µm Tefzel Tight Buffer

Item #	FCMH2-FC	FCMH2-SMA
	FC/PC	

These couplers have FC/PC or SMA905 connectors on all legs and are ideal for general use. They incorporate FT200UMT fiber with no jacket and blue Ø500 µm tefzel tight buffer

Connectors	2.0 mm Narrow Key	SMA905
Fiber Jacket	None (Ø500 µm Tefzel Tight Buffer)	

Part Number	Description	Price	Availability
FCMH2-FC	2x2 MM Coupler, 50:50 Split, Ø200 µm Core, 0.39 NA, FC/PC	$535.81	Today
FCMH2-SMA	2x2 MM Coupler, 50:50 Split, Ø200 µm Core, 0.39 NA, SMA	$535.81	Today

Hide 2x2 Multimode Couplers for Optogenetics, Ø1.25 mm Ferrule Ends and Black Tubing

2x2 Multimode Couplers for Optogenetics, Ø1.25 mm Ferrule Ends and Black Tubing

- FC/PC Connectors on Two Legs and Ø1.25 mm Ferrule Ends on Two Legs
- Ø1/16" (Ø1.6 mm) Black Heat-Shrink Tubing
- Optimized for Optogenetics Applications

Item #	FCMH2-FCL
Connectors (Side 1)	FC/PC 2.0 mm Narrow Key
Connectors (Side 2)	Ø1.25 mm Ceramic Ferrule
Fiber Jacket	Ø1/16" (Ø1.6 mm) Black Heat-Shrink Tubing

These couplers offer FC/PC or SMA905 connectors on two legs and Ø1.25 mm ferrule ends on the other two legs for applications, making them ideal for applications where a lightweight, slim connector is needed. They are built with FT200UMT fiber with Ø1/16" (Ø1.6 mm) heat-shrink tubing for protection and to block any light that may leak from the fiber.

Both couplers are optimized for optogenetics applications where one light source is used to illuminate two fiber optic implants. The smaller, Ø1.25 mm ferrules on these couplers connect to our Ø1.25 mm ferrule cannulae, which minimize stress on the specimen and offer the ability to implant several cannulae near the same location. For users of our Ø2.5 mm cannulae, we also offer these couplers with Ø2.5 mm ferrules (sold below).

Part Number	Description	Price	Availability
FCMH2-FCL	2x2 MM Coupler, 50:50 Split, Ø200 µm Core, 0.39 NA, FC/PC to Ø1.25 mm Ceramic Ferrules	$557.87	Today

Hide 2x2 Multimode Couplers for Optogenetics, Ø2.5 mm Ferrule Ends and Black Tubing

2x2 Multimode Couplers for Optogenetics, Ø2.5 mm Ferrule Ends and Black Tubing

- FC/PC or SMA Connectors on Two Legs and Ø2.5 mm Ferrule Ends on Two Legs
- Ø1/16" (Ø1.6 mm) Black Heat-Shrink Tubing
- Optimized for Optogenetics Applications

Item #	FCMH2-FCF	FCMH2-SMAF
Connectors (Side 1)	FC/PC 2.0 mm Narrow Key	SMA905
Connectors (Side 2)	Ø2.5 mm Ceramic Ferrule	
Fiber Jacket	Ø1/16" (Ø1.6 mm) Black Heat-Shrink Tubing	

These couplers offer FC/PC or SMA905 connectors on two legs and Ø2.5 mm ferrule ends on the other two legs for applications, making them ideal for applications where a lightweight, slim connector is needed. They are built with FT200UMT fiber with Ø1/16" (Ø1.6 mm) heat-shrink tubing for protection and to block any light that may leak from the fiber. To mount the ferrule ends of these couplers, we offer a post-mountable Ø2.5 mm ferrule clamp.

Both couplers are optimized for optogenetics applications where one light source is used to illuminate two fiber optic implants. The Ø2.5 mm ferrules on these couplers connect to our Ø2.5 mm ferrule cannulae, which provide easier handling and a more robust connection to the specimen. For users of our Ø1.25 mm cannulae, we also offer these couplers with Ø1.25 mm ferrules (sold above).

Part Number	Description	Price	Availability
FCMH2-FCF	2x2 MM Coupler, 50:50 Split, Ø200 µm Core, 0.39 NA, FC/PC to Ø2.5 mm Ceramic Ferrules	$557.87	Today
FCMH2-SMAF	2x2 MM Coupler, 50:50 Split, Ø200 µm Core, 0.39 NA, SMA905 to Ø2.5 mm Ceramic Ferrules	$557.87	Today