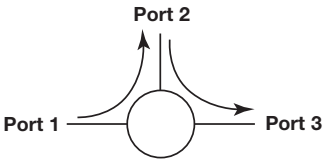
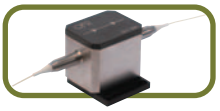
# Fiber Optics Selection Guide

Pages 995-1101





## Passive Components

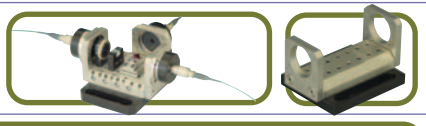
- Fiber Isolators
- WDMs and Couplers
- Circulators
- Optical Attenuator
- Faraday Rotator Mirror
- Polarization Controller
- In-Fiber Polarizers

**See Pages 996-1008**

## Fiber Collimation Packages

- Collimation and Coupling Packages
- Adjustable Collimators
- Pigtailed Ferrules & GRIN Lenses

**See Pages 1009-1019**



## Fiber Benches

- Fiber Collimation and Coupling
- Pigtailed Ferrules & GRIN

**See Pages 1020-1034**

## Optical Switches

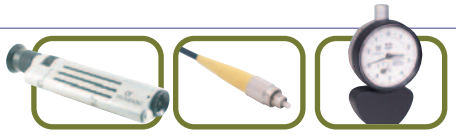
- HighSpeed Multi-channel Systems
- 1x2 Solid State Switches

**See Pages 1034-1041**

## Rackbox System

- Rackbox Chassis
- Fiber Feedthrough Subpanels
- Electronic Feedthrough Subpanels

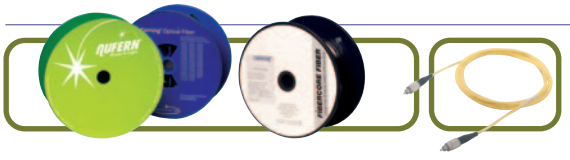
**See Pages 1042-1043**



## Connectors and Termination Tools

- SMA905, FC, ST, LC, & SC Connectors
- Fiber Termination & Inspector Supplies
- Bare Fiber Terminations
- UV-Curing System

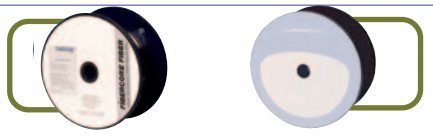
**See Pages 1044-1056**




## Single Mode Fiber

- FC/PC & FC/APC Patch Cables
- Nufern, Fibercore, and Corning Fiber
- Select Cut-off, High NA
- Photosensitive Fiber

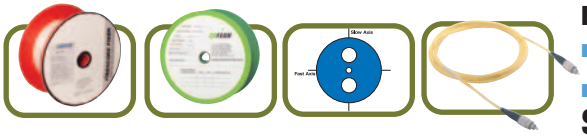
**See Pages 1057-1063**



## Rare Earth Doped

- Highly/Very Highly Doped Yb Fibers
- Highly/Very Highly Doped Er Fibers
- Single & Double Clad Fibers
- Standard & Large Core Fibers

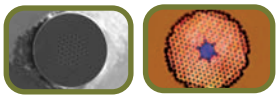
**See Pages 1064-1074**



## Polarization Maintaining Fiber

- Bend Insensitive & Low Temperature Fibers
- Operating Wavelengths From 488-1620nm
- Bow-Tie & Stress Rod Designs
- Patch Cables

**See Pages 1075-1078**



## Photonic Crystal Fiber

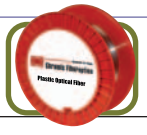
- Hollow Core Bandgap Fiber
- Highly Nonlinear Fiber
- Polarization Maintaining Fiber
- Patch Cables

**See Pages 1079-1090**


## Multimode Fiber

- 62.5µm Graded Index
- Low & High OH Fiber Step Index
- Stock Patch Cables
- Cores From 50µm to 1.5mm

**See Pages 1091-1099**



## Plastic Optical Fiber

- Graded-Index Polymer Optical Fiber
- Custom Patch Cables

**See Pages 1100-1101**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Inline Fiber Isolators

Fiber isolators like free-space isolators are used to protect sources from reflections and signals that can cause instabilities and damage. Fiber isolators are available in both polarization-dependent and polarization-independent models for wavelengths from 780 to 1550nm. Operating power and wavelength are the two most important factors in isolator design. Telecom isolators use a Bismuth Iron Garnet (BIG) rotator, which is very compact and inexpensive. Non-telecom isolators rely on bulk rotators, which have a much lower Verdet constant than BIG rotators, and require the use of magnets that are orders of magnitude larger and more expensive. For 1064nm fiber-laser applications, we use the same high-power isolator technology that is used in the free-space isolators and combine that with our fiber coupling experience to produce the highest power fiber isolators available.

## Low-Power, Polarization-Independent Fiber Isolator

IO-H-1550

IO-H-1064

To reduce cost and package size, BIG film rotators are used in the IO-H series of isolators. The IO-H is a polarization-independent isolator, which means that SM fiber is used on the input and output. The insertion loss and the isolation value will not change with respect to the input or return polarization state. Power is limited by absorption of the rotator material. BIG films are very transparent in the 1300 to 1550nm region and are almost opaque at 980nm. BIG films can be used at 1064nm, but absorption changes rapidly. Therefore, please contact Thorlabs if you would like to use these 1064nm isolators at wavelengths shorter than 1064nm.

| ITEM # | IO-H-1064 | IO-H-1310 | IO-H-1550 |
|---|---|---|---|
| Wavelength | 1064nm +20/-4nm | 1310nm ± 20nm | 1550nm ± 20nm |
| Max Power | 250mW | 300mW | 300mW |
| Isolation[1] | ≥33dB @ 1064nm | 38-44dB | 38-44dB |
| Insertion Loss | 1.4-2.0dB | 0.3-0.6dB | 0.3-0.6dB |
| PDL | ≤0.15dB | ≤0.1dB | ≤0.1dB |
| Return Loss | >50dB | >55dB | >55dB |
| Fiber | HI1060 | SMF-28e | SMF-28e |

(1) Isolation depends on wavelength and temperature, not for use with pulsed applications

### 300-500mW Polarization-Independent Fiber Isolator Single Mode Fiber

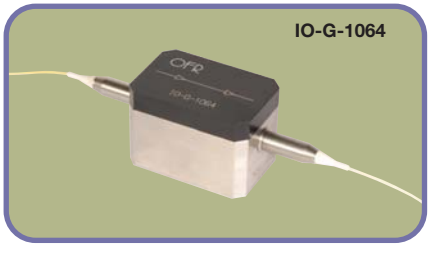
| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| IO-H-1064 | $ 1,450.00 | £ 913.50 | € 1.348,50 | ¥ 13,847.50 | Cleaved | Low-Power, SM, Inline Fiber Isolator, 1064nm |
| IO-H-1064APC | $ 1,490.00 | £ 938.70 | € 1.385,70 | ¥ 14,229.50 | FC/APC | Low-Power, SM, Inline Fiber Isolator, 1064nm |
| IO-H-1310 | $ 295.00 | £ 185.90 | € 274,40 | ¥ 2,817.30 | Cleaved | Low-Power, SM, Inline Fiber Isolator, 1310nm |
| IO-H-1310APC | $ 335.00 | £ 211.10 | € 311,60 | ¥ 3,199.30 | FC/APC | Low-Power, SM, Inline Fiber Isolator, 1310nm |
| IO-H-1550 | $ 295.00 | £ 185.90 | € 274,40 | ¥ 2,817.30 | Cleaved | Low-Power, SM, Inline Fiber Isolator, 1550nm |
| IO-H-1550APC | $ 335.00 | £ 211.10 | € 311,60 | ¥ 3,199.30 | FC/APC | Low-Power, SM, Inline Fiber Isolator, 1550nm |

## Low-Power, Polarization-Dependent Fiber Isolator

The IO-G series of isolators use BIG film rotators and absorptive thin film polarizers. PM fiber is used on the input and output with the device aligned for transmission along the slow axis of the fiber. Any signal not aligned to the input slow axis will be absorbed and measured as an increased insertion loss. BIG films are very transparent in the 1300 to 1550nm region and are almost opaque at 980nm. BIG films can be used at 1064nm, but absorption changes rapidly. Therefore, please contact Thorlabs if you would like to use these 1064nm isolators at wavelengths shorter than 1064nm. Also, due to the polarizer absorption, care should be taken to launch into the correct fiber axis.

| ITEM # | IO-G-1064 | IO-G-1310 | IO-G-1550 |
|---|---|---|---|
| Wavelength | 1064nm ± 10nm | 1310nm ± 10nm | 1550nm ± 10nm |
| Max Power | 300mW | 300mW | 300mW |
| Isolation[1] | 30-38dB @ 1064nm | 39-42dB | 39-42dB |
| Insertion Loss[2] | 0.7-1.5dB | 0.7-1.2dB | 0.7-1.2dB |
| ER[2] | 20dB | 24-30dB | 24-30dB |
| Return Loss | >50dB | ≤55dB | ≤55dB |
| Fiber | PM 980/1064 | PM 1300 | PM 1550 |

1) Isolation depends on wavelength and temperature; not for use in pulsed applications.
2) Device aligned for transmission along the slow axis; light launched into the fast axis is not transmitted.

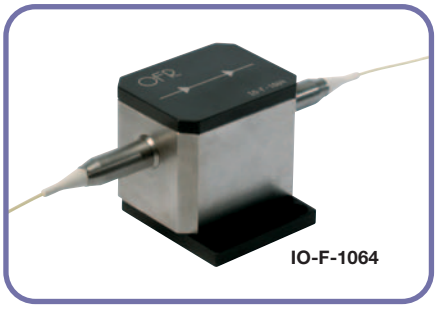



### 300mW Polarization-Dependent Fiber Isolator, PM Fiber

| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| IO-G-1064 | $ 2,200.00 | £ 1,386.00 | € 2.046,00 | ¥ 21,010.00 | Cleaved | Low-Power, PM, Inline Fiber Isolator, 1064nm |
| IO-G-1064APC | $ 2,240.00 | £ 1,411.20 | € 2.083,20 | ¥ 21,392.00 | FC/APC | Low-Power, PM, Inline Fiber Isolator, 1064nm |
| IO-G-1310 | $ 1,575.00 | £ 992.30 | € 1.464,80 | ¥ 15,041.30 | Cleaved | Low-Power, PM, Inline Fiber Isolator, 1310nm |
| IO-G-1310APC | $ 1,615.00 | £ 1,017.50 | € 1.502,00 | ¥ 15,423.30 | FC/APC | Low-Power, PM, Inline Fiber Isolator, 1310nm |
| IO-G-1550 | $ 1,575.00 | £ 992.30 | € 1.464,80 | ¥ 15,041.30 | Cleaved | Low-Power, PM, Inline Fiber Isolator, 1550nm |
| IO-G-1550APC | $ 1,615.00 | £ 1,017.50 | € 1.502,00 | ¥ 15,423.30 | FC/APC | Low-Power, PM, Inline Fiber Isolator, 1550nm |

# High-Power, Polarization-Independent Fiber Isolator

The IO-F is a high-power polarization-independent isolator, and thus, SM fiber is used on the input and output. The insertion loss and the isolation value will not change with respect to the input or return polarization state that is used. To increase the power handling of the isolator, non-absorptive crystal polarizers as well as crystal Faraday rotators are used. In the reverse direction (isolation), the polarizers displace rather than absorb the return beam so that it does not couple back into the incoming fiber.


| ITEM # | IO-F-780 | IO-F-850 | IO-F-980 | IO-F-1064 | IO-F-1310 | IO-F-1550 |
|---|---|---|---|---|---|---|
| Wavelength | 780nm ± 10nm | 850nm ± 10nm | 980nm ± 10nm | 1064nm ± 10nm | 1310nm ± 20nm | 1550nm ± 20nm |
| Max Power[2] | 2W (CW) | 2W (CW) | 2W (CW) | 3W (CW) | 5W (CW) | 5W (CW) |
| Isolation[1] | 30 -38dB | 30-38dB | 33-38dB | 33-38dB | 32-38dB | 32-38dB |
| Insertion Loss | 1.0-1.8dB | 1.0-1.8dB | 0.7-1.2dB | 0.7-1.3dB | 0.4-1.0dB | 0.4-1.0dB |
| PDL | ≤0.25dB | ≤0.25dB | ≤0.2dB | ≤0.15dB | ≤0.2dB | ≤0.2dB |
| Return Loss | >50dB | >50dB | >50dB | >50dB | >55dB | >55dB |
| Fiber | HI1060 | SMF-28e | PM 980/1060 | HI1060 | SMF-28e | SMF-28e |

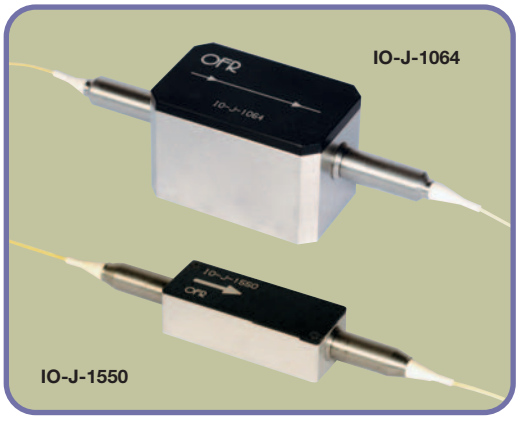
(1) Isolation depends on wavelength and temperature, not for use with pulsed applications

(2) Power rating is specified only for cleaved fiber

### High-Power, 2 to 5W, Polarization-Independent Fiber Isolator, Polarization Maintaining Fiber

| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| IO-F-780 | $ 2,150.00 | £ 1,354.50 | € 1.999,50 | ¥ 20,532.50 | Cleaved | High-Power, SM, Inline Fiber Isolator, 780nm |
| IO-F-780APC | $ 2,190.00 | £ 1,379.70 | € 2.036,70 | ¥ 20,914.50 | FC/APC | High-Power, SM, Inline Fiber Isolator, 780nm |
| IO-F-850 | $ 2,150.00 | £ 1,354.50 | € 1.999,50 | ¥ 20,532.50 | Cleaved | High-Power, SM, Inline Fiber Isolator, 850nm |
| IO-F-850APC | $ 2,190.00 | £ 1,379.70 | € 2.036,70 | ¥ 20,914.50 | FC/APC | High-Power, SM, Inline Fiber Isolator, 850nm |
| IO-F-980 | $ 2,000.00 | £ 1,260.00 | € 1.860,00 | ¥ 19,100.00 | Cleaved | High-Power, SM, Inline Fiber Isolator, 980nm |
| IO-F-980APC | $ 2,040.00 | £ 1,285.20 | € 1.897,20 | ¥ 19,482.00 | FC/APC | High-Power, SM, Inline Fiber Isolator, 980nm |
| IO-F-1064 | $ 1,625.00 | £ 1,023.80 | € 1.511,30 | ¥ 15,518.80 | Cleaved | High-Power, SM, Inline Fiber Isolator, 1064nm |
| IO-F-1064APC | $ 1,665.00 | £ 1,049.00 | € 1.548,50 | ¥ 15,900.80 | FC/APC | High-Power, SM, Inline Fiber Isolator, 1064nm |
| IO-F-1310 | $ 1,550.00 | £ 976.50 | € 1.441,50 | ¥ 14,802.50 | Cleaved | High-Power, SM, Inline Fiber Isolator, 1310nm |
| IO-F-1310APC | $ 1,590.00 | £ 1,001.70 | € 1.478,70 | ¥ 15,184.50 | FC/APC | High-Power, SM, Inline Fiber Isolator, 1310nm |
| IO-F-1550 | $ 1,550.00 | £ 976.50 | € 1.441,50 | ¥ 14,802.50 | Cleaved | High-Power, SM, Inline Fiber Isolator, 1550nm |
| IO-F-1550APC | $ 1,590.00 | £ 1,001.70 | € 1.478,70 | ¥ 15,184.50 | FC/APC | High-Power, SM, Inline Fiber Isolator, 1550nm |

# High-Power, Polarization Dependent, Fiber Isolator, PM Fiber




The IO-J is a high-power polarization-dependent isolator. PM fiber is used on the input and output with the device aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be displaced internally and measured as an increased insertion loss. In the reverse direction, any signal that travels backward will be displaced so that it does not couple back into the incoming fiber.

| ITEM # | IO-J-980 | IO-J-1064 | IO-J-1310 | IO-J-1550 |
|---|---|---|---|---|
| Wavelength | 980nm ± 10nm | 1064nm ± 10nm | 1310nm ± 10nm | 1550nm ± 10nm |
| Max Power[3] | 3W (CW) | 3W (CW) | 5W (CW) | 5W (CW) |
| Isolation[1] | 30 -38dB | 32-38dB | 32-38dB | 32-38dB |
| Insertion Loss[2] | 0.8-1.6dB | 0.6-1.3dB | 0.4-1.0dB | 0.4-1.0dB |
| ER[2] | >20dB | >20dB | >20dB | >20dB |
| Return Loss | >50dB | >50dB | >55dB | >55dB |
| Fiber | PM 980/1064 | PM 980/1064 | PM 1300 | PM 1500 |

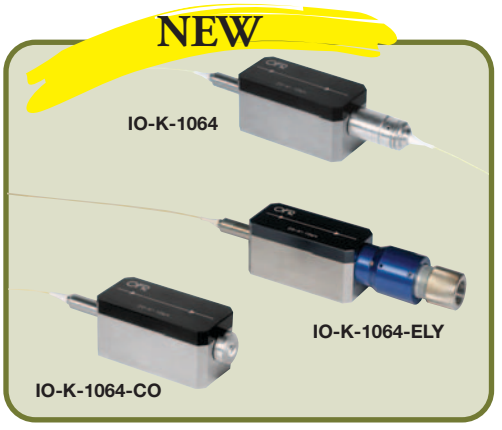
1) Isolation depends on wavelength and temperature, not for use with pulsed applications
2) Device aligned for transmission along the slow axis; light launched into the fast axis is not transmitted.
3) Power rating is specified only for cleaved fiber

### High-Power, 3 to 5W Polarization Dependent Fiber Isolator, Polarization Maintaining Fiber

| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| IO-J-980 | $ 2,500.00 | £ 1,575.00 | € 2.325,00 | ¥ 23,875.00 | Cleaved | High Power, PM, Inline Fiber Isolator, 980nm |
| IO-J-980APC | $ 2,540.00 | £ 1,600.20 | € 2.362,20 | ¥ 24,257.00 | FC/APC | High Power, PM, Inline Fiber Isolator, 980nm |
| IO-J-1064 | $ 2,500.00 | £ 1,575.00 | € 2.325,00 | ¥ 23,875.00 | Cleaved | High Power, PM, Inline Fiber Isolator, 1064nm |
| IO-J-1064APC | $ 2,540.00 | £ 1,600.20 | € 2.362,20 | ¥ 24,257.00 | FC/APC | High Power, PM, Inline Fiber Isolator, 1064nm |
| IO-J-1310 | $ 2,100.00 | £ 1,323.00 | € 1.953,00 | ¥ 20,055.00 | Cleaved | High Power, PM, Inline Fiber Isolator, 1310nm |
| IO-J-1310APC | $ 2,140.00 | £ 1,348.20 | € 1.990,20 | ¥ 20,437.00 | FC/APC | High Power, PM, Inline Fiber Isolator, 1310nm |
| IO-J-1550 | $ 1,685.00 | £ 1,061.60 | € 1.567,10 | ¥ 16,091.80 | Cleaved | High Power, PM, Inline Fiber Isolator, 1550nm |
| IO-J-1550APC | $ 1,725.00 | £ 1,086.80 | € 1.604,30 | ¥ 16,473.80 | FC/APC | High Power, PM, Inline Fiber Isolator, 1550nm |

# 10W Polarization Independent Fiber Isolator, Single Mode Fiber

The new IO-K model is the newest of the polarization-independent fiber isolators. It couples high-powered fiber coupling experience with all of OFR's high-power, free-space isolator experience to produce the highest power, fiber coupled isolators available. The fiber laser market is experiencing tremendous advances in power handling requirements, and we are continually working with new fibers and technologies to accommodate these new challenging power levels. The IO-K uses new fiber technologies and thermal management techniques to push the damage thresholds to new levels. See the website for models as they develop.




## Specifications

- **Wavelength:** 1064nm ± 10nm, 1550nm ± 10nm
- **Max Power:** 10W (CW)
- **Isolation:** 30-38dB
- **Insertion Loss:** 0.8-1.5dB
- **ER:** ≤0.25dB
- **Return Loss:** >50dB
- **Fiber:** HI1060

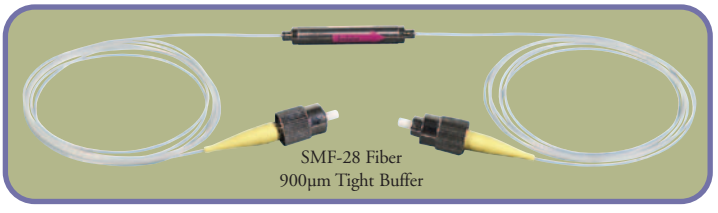
### Isolators – 1064nm

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| IO-K-1064 | $ 2,750.00 | £ 1,732.50 | € 2.557,50 | ¥ 26,262.50 | 10W Fiber Isolator, SMF, Fiber to Fiber (HI1060) |
| IO-K-1064-CO | $ 2,525.00 | £ 1,590.80 | € 2.348,30 | ¥ 24,113.80 | 10W Fiber Isolator, SMF, Fiber to Free Space, 1mm Collimated |
| IO-K-1064-ELY | $ 3,195.00 | £ 2,012.90 | € 2.971,40 | ¥ 30,512.30 | 10W Fiber Isolator, SMF, Fiber to Free Space, 3mm Collimated |

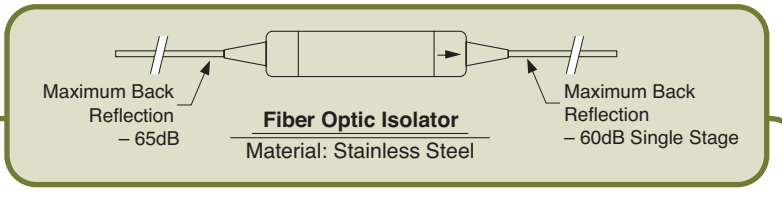
### Isolator – 1550nm

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| IO-K-1550 | $ 1,950.00 | £ 1,228.50 | € 1.813,50 | ¥ 18,622.50 | 10W Fiber Isolator, SMF, Fiber to Fiber (SMF28e) |

# Isolators




These polarization-insensitive, single-stage fiber optic isolators are passive, unidirectional, high-performance components for suppressing optical feedback in laser-based fiber optic systems. They provide very low insertion loss, high isolation, high return loss, and excellent environmental stability and reliability in a compact, rugged package.




## Specifications

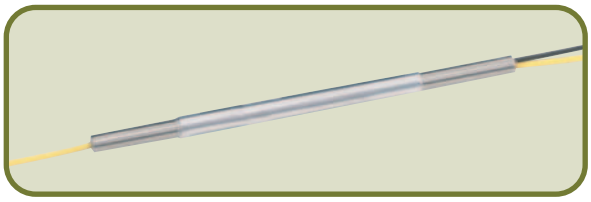
- **Center Wavelength (4013SA):** 1310nm
- **Center Wavelength (4015SA):** 1550nm
- **Typical Peak Isolation:** >40dB
- **Minimum Isolation:**[1] >30dB
- **Typical Insertion Loss:** 0.4dB
- **Maximum Insertion Loss:** <0.7dB
- **Return Loss (Input/Output):** ≥60/50dB
- **Polarization Dependent Loss:** <0.1dB
- **Polarization Mode Dispersion:** <0.25ps
- **Max Optical Power:** 300mW
- **Max Tensile:** 5N
- **Operating Temperature:** -20 to +60°C
- **Storage Temperature:** -40 to +85°C
- **Fiber Length:** 1m

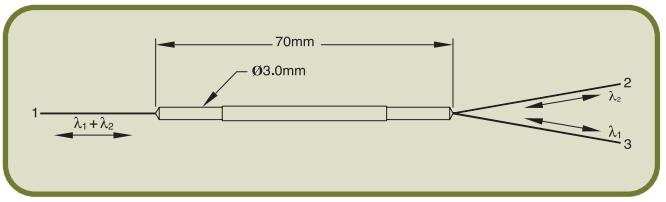
[1]Over center wavelength ±15nm, at 25°C, and all polarization states

### Isolators – FC/APC Connectors Available by Special Order

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 4013SA | $ 267.00 | £ 168.20 | € 248,30 | ¥ 2,549.90 | 1310nm Single Stage Isolator |
| 4015SA | $ 246.00 | £ 155.00 | € 228,80 | ¥ 2,349.30 | 1550nm Single Stage Isolator |
| 4013SAFC | $ 282.00 | £ 177.70 | € 262,30 | ¥ 2,693.10 | 1310nm Single Stage Isolator, FC/PC Connectors |
| 4015SAFC | $ 261.00 | £ 164.40 | € 242,70 | ¥ 2,492.60 | 1550nm Single Stage Isolator, FC/PC Connectors |

# WDMs: 980/1550nm, 1310/1550nm, and 1480/1550nm






### Features

- 300mW Maximum Power
- Operating Temp: -40 to 85°C
- Available With FC Connectors From Stock
- Custom Connector Options Available

### Performance Specifications

| PARAMETERS | WD202A | WD202B | WD202C |
|---|---|---|---|
| Operating Wavelength (nm) | 980/1550 | 1310/1550 | 1480/1550 |
| Max Insertion Loss (dB) | 0.55 | 0.5 | 0.95 |
| Min Isolation (dB) | 19 | 16 | 10 |
| Polarization Dependent Loss (dB) | <0.1 | <0.1 | <0.15 |
| Wavelength Bandwidth (nm) | ±10.0 | ±15.0 | ±15.0 |
| Directivity (dB) | < –50.0 | NA | < –50.0 |
| Operating Temperature (°C) | –40 to 85 | –40 to 85 | –40 to 85 |
| Storage Temperature (°C) | –50 to 85 | –50 to 85 | –50 to 85 |
| Fiber Type, 1m | Flexcor 1060 | SMF-28e | SMF-28e |
| Package | 900µm Loose Tube | 900µm Loose Tube | 900µm Loose Tube |

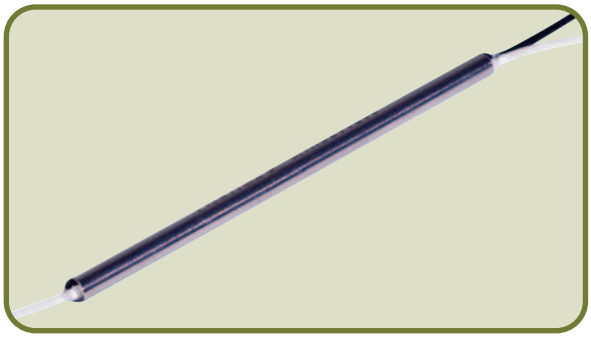
1) Insertion loss and return loss will change depending on connector type.

### Wavelength Division Multiplexers (WDM)

| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| WD202A | $ 192.80 | £ 121.50 | € 179,30 | ¥ 1,841.20 | None | 980/1550 Wavelength Division Multiplexer |
| WD202A-FC | $ 242.80 | £ 153.00 | € 225,80 | ¥ 2,318.70 | FC/PC | 980/1550 Wavelength Division Multiplexer |
| WD202B | $ 117.30 | £ 73.90 | € 109,10 | ¥ 1,120.20 | None | 1310/1550 Wavelength Division Multiplexer |
| WD202B-FC | $ 158.10 | £ 99.60 | € 147,00 | ¥ 1,509.90 | FC/PC | 1310/1550 Wavelength Division Multiplexer |
| WD202C | $ 206.00 | £ 129.80 | € 191,60 | ¥ 1,967.30 | None | 1480/1550 Wavelength Division Multiplexer |
| WD202C-FC | $ 234.60 | £ 147.80 | € 218,20 | ¥ 2,240.40 | FC/PC | 1480/1550 Wavelength Division Multiplexer |

# Couplers: 1x2 Multimode

Thorlabs now stocks 1x2 multimode (MM) fiber couplers, manufactured using industry standard 50/125µm graded-index and 62.5/125µm graded-index fibers. These couplers offer low insertion loss and excellent environmental and mechanical stability. They are stocked with and without FC connectors. Other connector styles are available as a custom request; please contact tech support for a quote.



| PARAMETER | FCMM625 | FCMM50 |
|---|---|---|
| Fiber | 62.5/125µm Graded Index | 50/125µm Graded Index |
| Center Wavelength | 850nm ± 40nm | 850nm ± 40nm |
| Coupling Ratio | 50/50<br>90/10<br>99/1 | 50/50<br>90/10<br>99/2 |
| Directivity | > 35dB | > 35dB |
| Ports | 1x2 | 1x2 |
| Operating Temperature | -40 to 85°C | -40 to 85°C |

### Multimode Couplers: 1x2

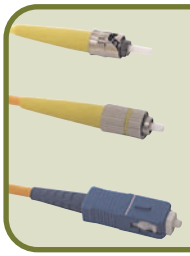
| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| FCMM625-50A | $ 103.00 | £ 64.90 | € 95,80 | ¥ 983.70 | None | 1x2 62.5/125µm MM Fiber Coupler, 50/50 |
| FCMM625-50A-FC | $ 128.80 | £ 81.10 | € 119,80 | ¥ 1,230.00 | FC/PC | 1x2 62.5/125µm MM Fiber Coupler, 50/50 |
| FCMM625-90A | $ 103.00 | £ 64.90 | € 95,80 | ¥ 983.70 | None | 1x2 62.5/125µm MM Fiber Coupler, 90/10 |
| FCMM625-90A-FC | $ 128.80 | £ 81.10 | € 119,80 | ¥ 1,230.00 | FC/PC | 1x2 62.5/125µm MM Fiber Coupler, 90/10 |
| FCMM625-99A | $ 103.00 | £ 64.90 | € 95,80 | ¥ 983.70 | None | 1x2 62.5/125µm MM Fiber Coupler, 99/1 |
| FCMM625-99A-FC | $ 128.80 | £ 81.10 | € 119,80 | ¥ 1,230.00 | FC/PC | 1x2 62.5/125µm MM Fiber Coupler, 99/1 |
| FCMM50-50A | $ 103.00 | £ 64.90 | € 95,80 | ¥ 983.70 | None | 1x2 50/125µm MM Fiber Coupler, 50/50 |
| FCMM50-50A-FC | $ 128.80 | £ 81.10 | € 119,80 | ¥ 1,230.00 | FC/PC | 1x2 50/125µm MM Fiber Coupler, 50/50 |
| FCMM50-90A | $ 103.00 | £ 64.90 | € 95,80 | ¥ 983.70 | None | 1x2 50/125µm MM Fiber Coupler, 90/10 |
| FCMM50-90A-FC | $ 128.80 | £ 81.10 | € 119,80 | ¥ 1,230.00 | FC/PC | 1x2 50/125µm MM Fiber Coupler, 90/10 |
| FCMM50-99A | $ 103.00 | £ 64.90 | € 95,80 | ¥ 983.70 | None | 1x2 50/125µm MM Fiber Coupler, 99/1 |
| FCMM50-99A-FC | $ 128.80 | £ 81.10 | € 119,80 | ¥ 1,230.00 | FC/PC | 1x2 50/125µm MM Fiber Coupler, 99/1 |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Couplers: 2x2 Single Mode


Thorlabs offers an array of single mode 2x2 fiber couplers operating at wavelengths from 635nm to 1550nm. These couplers are available with 50:50, 90:10, or 99:1 split ratios with FC terminations, as bare fibers, or with custom connector options. All fibers have a 900µm diameter tight outer jacket that provides better protection for the optical fiber than a loose jacket. Additionally, these couplers are fully bidirectional, allowing any one of the ports to be used as an input port.

- Stocked With and Without FC Connectors
- Polarization Insensitive
- High Directivity
- Optically Reversible
- Dual Wavelength Model for 1310 and 1550nm
- Custom Connector Option Available



**Thorlabs offers custom patch cable and termination services. If you wish to have any of the fiber optic components from our catalog, or components supplied by you, terminated with any of the standard connectors on pages 1044-1056, please contact technical support for a quotation.**

## Single Mode Couplers: 2x2

| PARAMETER | 10202A | FC1064 | FC980 | FC830 | FC632 |
|---|---|---|---|---|---|
| Center Wavelength | 1310nm and 1550nm | 1064nm | 980nm | 830nm | 633nm |
| Bandwidth | ±40nm | ±15nm | ±15nm | ±15nm | ±15nm |
| Coupling Ratio | 50/50<br>90/10<br>99/1 | 50/50<br>90/10<br>99/1 | 50/50<br>90/10<br>99/1 | 50/50<br>90/10<br>99/1 | 50/50<br>90/10<br>99/1 |
| Insertion Loss (Coupling Ratio + Excess Loss) | 3.8/3.8dB<br>12.7/0.8dB<br>21.6/0.4dB | 3.1-3.5 / 3.1-3.5dB<br>9.5-10.5 / 0.7-0.4dB<br>20-22 / 0.35-0.15dB | 3.1-3.5 / 3.1-3.5dB<br>9.5-10.5 / 0.7-0.4dB<br>20-22 / 0.35-0.15dB | 3.1-3.5 / 3.1-3.5dB<br>9.5-10.5 / 0.7-0.4dB<br>20-22 / 0.35-0.15dB | 3.1-3.5 / 3.1-3.5dB<br>9.5-10.5 / 0.7-0.4dB<br>20-22 / 0.35-0.15dB |
| Excess Loss | 0.2dB | 0.12dB | 0.12dB | 0.15dB | 0.3dB |
| PDL | < 0.15dB | < 0.2dB | < 0.15dB | < 0.2dB | < 0.2dB |
| Directivity | > 60dB | > 55dB | > 55dB | > 55dB | > 55dB |
| Operating Temperature | −40 ~ +85°C | −40 ~ +85°C | −40 ~ +85°C | −40 ~ +85°C | −40 ~ +85°C |
| Fiber Type[1] | SMF-28E | Flexcor 1060 | Flexcor 980 | SM-800 | SM-600 |

1) Equivalent fiber types may be substituted

## Single Mode Couplers: 2x2

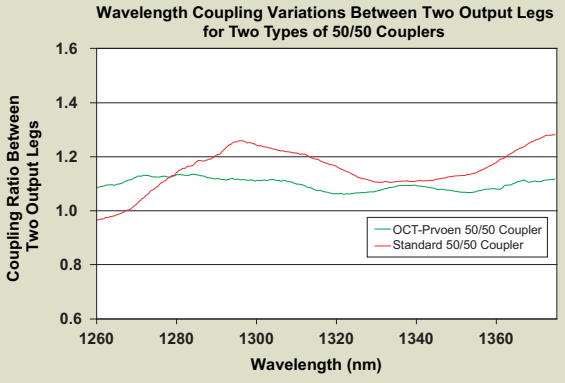
| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 10202A-50 | $ 96.80 | £ 61.00 | € 90,00 | ¥ 924.40 | None | 2x2 Single Mode Fiber Coupler, 1310 & 1550nm, 50/50 |
| 10202A-50-FC | $ 153.00 | £ 96.40 | € 142,30 | ¥ 1,461.20 | FC/PC | 2x2 Single Mode Fiber Coupler, 1310 & 1550nm, 50/50 |
| 10202A-90 | $ 80.50 | £ 50.70 | € 74,90 | ¥ 768.80 | None | 2x2 Single Mode Fiber Coupler, 1310 & 1550nm, 90/10 |
| 10202A-90-FC | $ 145.70 | £ 91.80 | € 135,50 | ¥ 1,391.40 | FC/PC | 2x2 Single Mode Fiber Coupler, 1310 & 1550nm, 90/10 |
| 10202A-99 | $ 100.90 | £ 63.60 | € 93,80 | ¥ 963.60 | None | 2x2 Single Mode Fiber Coupler, 1310 & 1550nm, 99/1 |
| 10202A-99-FC | $ 147.80 | £ 93.10 | € 137,50 | ¥ 1,411.50 | FC/PC | 2x2 Single Mode Fiber Coupler, 1310 & 1550nm, 99/1 |
| FC1064-50B | $ 128.80 | £ 81.10 | € 119,80 | ¥ 1,230.00 | None | 2x2 Single Mode Fiber Coupler, 1060nm, 50/50 |
| FC1064-50B-FC | $ 161.50 | £ 101.70 | € 150,20 | ¥ 1,542.30 | FC/PC | 2x2 Single Mode Fiber Coupler, 1060nm, 50/50 |
| FC1064-90B | $ 133.90 | £ 84.40 | € 124,50 | ¥ 1,278.70 | None | 2x2 Single Mode Fiber Coupler, 1060nm, 90/10 |
| FC1064-90B-FC | $ 167.10 | £ 105.30 | € 155,40 | ¥ 1,595.80 | FC/PC | 2x2 Single Mode Fiber Coupler, 1060nm, 90/10 |
| FC1064-99B | $ 139.10 | £ 87.60 | € 129,40 | ¥ 1,328.40 | None | 2x2 Single Mode Fiber Coupler, 1060nm, 99/1 |
| FC1064-99B-FC | $ 172.60 | £ 108.70 | € 160,50 | ¥ 1,648.30 | FC/PC | 2x2 Single Mode Fiber Coupler, 1060nm, 99/1 |
| FC980-50B | $ 115.90 | £ 73.00 | € 107,80 | ¥ 1,106.80 | None | 2x2 Single Mode Fiber Coupler, 980nm, 50/50 |
| FC980-50B-FC | $ 147.50 | £ 92.90 | € 137,20 | ¥ 1,408.60 | FC/PC | 2x2 Single Mode Fiber Coupler, 980nm, 50/50 |
| FC980-90B | $ 123.60 | £ 77.90 | € 114,90 | ¥ 1,180.40 | None | 2x2 Single Mode Fiber Coupler, 980nm, 90/10 |
| FC980-90B-FC | $ 155.90 | £ 98.20 | € 145,00 | ¥ 1,488.80 | FC/PC | 2x2 Single Mode Fiber Coupler, 980nm, 90/10 |
| FC980-99B | $ 128.80 | £ 81.10 | € 119,80 | ¥ 1,230.00 | None | 2x2 Single Mode Fiber Coupler, 980nm, 99/1 |
| FC980-99B-FC | $ 161.50 | £ 101.70 | € 150,20 | ¥ 1,542.30 | FC/PC | 2x2 Single Mode Fiber Coupler, 980nm, 99/1 |
| FC830-50B | $ 144.20 | £ 90.80 | € 134,10 | ¥ 1,377.10 | None | 2x2 Single Mode Fiber Coupler, 830nm, 50/50 |
| FC830-50B-FC | $ 178.20 | £ 112.30 | € 165,70 | ¥ 1,701.80 | FC/PC | 2x2 Single Mode Fiber Coupler, 830nm, 50/50 |
| FC830-90B | $ 149.40 | £ 94.10 | € 138,90 | ¥ 1,426.80 | None | 2x2 Single Mode Fiber Coupler, 830nm, 90/10 |
| FC830-90B-FC | $ 183.80 | £ 115.80 | € 170,90 | ¥ 1,755.30 | FC/PC | 2x2 Single Mode Fiber Coupler, 830nm, 90/10 |
| FC830-99B | $ 139.10 | £ 87.60 | € 129,40 | ¥ 1,328.40 | None | 2x2 Single Mode Fiber Coupler, 830nm, 99/1 |
| FC830-99B-FC | $ 172.60 | £ 108.70 | € 160,50 | ¥ 1,648.30 | FC/PC | 2x2 Single Mode Fiber Coupler, 830nm, 99/1 |
| FC632-50B | $ 167.40 | £ 105.50 | € 155,70 | ¥ 1,598.70 | None | 2x2 Single Mode Fiber Coupler, 632nm, 50/50 |
| FC632-50B-FC | $ 195.70 | £ 123.30 | € 182,00 | ¥ 1,868.90 | FC/PC | 2x2 Single Mode Fiber Coupler, 632nm, 50/50 |
| FC632-90B | $ 175.10 | £ 110.30 | € 162,80 | ¥ 1,672.20 | None | 2x2 Single Mode Fiber Coupler, 632nm, 90/10 |
| FC632-90B-FC | $ 200.90 | £ 126.60 | € 186,80 | ¥ 1,918.60 | FC/PC | 2x2 Single Mode Fiber Coupler, 632nm, 90/10 |
| FC632-99B | $ 180.30 | £ 113.60 | € 167,70 | ¥ 1,721.90 | None | 2x2 Single Mode Fiber Coupler, 632nm, 99/1 |
| FC632-99B-FC | $ 200.90 | £ 126.60 | € 186,80 | ¥ 1,918.60 | FC/PC | 2x2 Single Mode Fiber Coupler, 632nm, 99/1 |

# Broadband Fiber-Optic Couplers for OCT

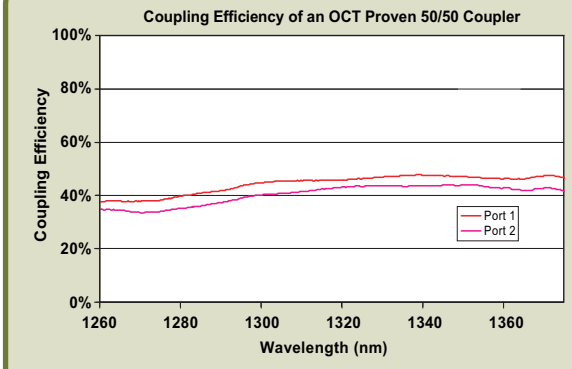

Optical Coherence Tomography (OCT) systems require components that operate over a broad spectral range, with minimal spectral dependency. Thorlabs' OCT-proven couplers are tested to ensure minimal wavelength dependent insertion loss variations, making them an ideal choice for integrating into many OCT systems.

## Features

- **Operating Wavelengths:** 1310 ± 70nm, 850 ± 40nm
- Broadband Wavelength Flattened Coupling
- Low Insertion Loss
- **Different Coupling Ratios:** 1:99, 10:90, and 50:50
- FC/APC Connectors
- Customized Fiber Lengths Available




**The plot above shows the ratio of transmitted intensity between the two output ports versus wavelength for a standard and an OCT-proven 50/50 coupler. The standard coupler shows a ratio of 1.14 and a standard deviation of 12.6%, while the OCT-proven coupler shows a ratio of 1.10 and a standard deviation of 5.0%. Therefore the OCT-proven coupler exhibits a split ratio performance that is ~2.5x better.**




**The plot above shows the coupling efficiency for each of the two output ports of a typical OCT-proven 50/50 coupler versus wavelength. Port 1 shows a mean coupling efficiency of 39% and a standard deviation of 5%. Port 2 shows a mean coupling efficiency of 43% and a standard deviation of 5%.**

### FC850-40-XX-APC Series

| PARAMETERS | 850 +/-40nm | | |
|---|---|---|---|
| Fiber Type (nm) | SM-800, 900µm Hytel Tubing | | |
| Coupling Ratio | 1/99 | 10/99 | 50/50 |
| Insertion Loss (dB) | 0.25/20 | 0.75/10 | 3.7/3.7 |
| Polarization-Dependent Loss (dB) | ≤0.2 | | |
| Excess Loss (dB) | ≥0.5 | | |
| Directivity (dB) | ≥55 | | |
| Port Configuration | 2 x 2 | | |
| Operating Temperature Range (°C) | 0 ~ +70° | | |
| Storage Temperature Range (°C) | -40 ~ +85° | | |
| Lead Length and Tolerance (cm) | 100 +/- 10 | | |
| Connectors | FC/APC | | |

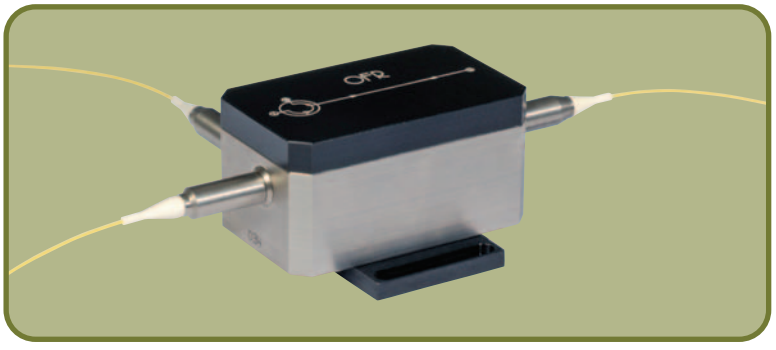
### FC1310-70-XX-APC Series

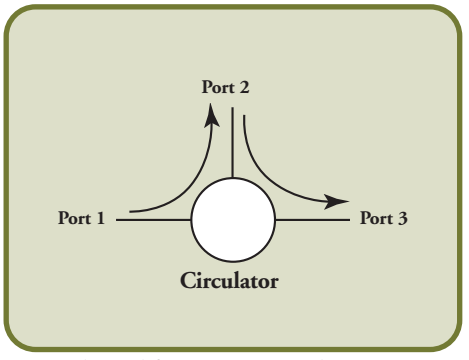
| PARAMETERS | 1310 +/-40nm | | |
|---|---|---|---|
| Fiber Type (nm) | Corning SMF-28e, 900µm Hytel Tubing | | |
| Coupling Ratio | 1/99 | 10/90 | 50/50 |
| Insertion Loss (dB) | 0.4/21.6 | 0.8/12.7 | 3.8/3.8 |
| Polarization-Dependent Loss (dB) | <0.15 | | |
| Excess Loss (dB) | 0.2 | | |
| Directivity (dB) | >60 | | |
| Port Configuration | 2 x 2 | | |
| Connectors | FC/APC | | |

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FC1310-70-01-APC | $ 250.00 | £ 157.50 | € 232,50 | ¥ 2,387.50 | Broadband Fiber Optic Coupler, 1310nm ± 70nm, 1:99 |
| FC1310-70-10-APC | $ 250.00 | £ 157.50 | € 232,50 | ¥ 2,387.50 | Broadband Fiber Optic Coupler, 1310nm ± 70nm, 10:90 |
| FC1310-70-50-APC | $ 250.00 | £ 157.50 | € 232,50 | ¥ 2,387.50 | Broadband Fiber Optic Coupler, 1310nm ± 70nm, 50:50 |
| FC850-40-01-APC | $ 250.00 | £ 157.50 | € 232,50 | ¥ 2,387.50 | Broadband Fiber Optic Coupler, 850nm ± 40nm, 1:99 |
| FC850-40-10-APC | $ 250.00 | £ 157.50 | € 232,50 | ¥ 2,387.50 | Broadband Fiber Optic Coupler, 850nm ± 40nm, 10:90 |
| FC850-40-50-APC | $ 250.00 | £ 157.50 | € 232,50 | ¥ 2,387.50 | Broadband Fiber Optic Coupler, 850nm ± 40nm, 50:50 |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# High-Power PM Circulators






This high-power PM fiber optic circulator is a non-reciprocating device that transports an optical signal from one port to the next port, but only in one direction (i.e. 1 to 2 or 2 to 3). They may be used to separate forward and backward propagating signals, typically with 45dB of isolation and a directivity (crosstalk) figure of better than 40dB.

### Specifications

| PARAMETERS | OC-L-1064 | OC-L-1550 |
|---|---|---|
| Max. Optical Power | 3W | 5W |
| Wavelength Range | 1053 - 1075nm | 1530-1570nm |
| Isolation | 30dB | 32dB |
| Insertion Loss | 1.3-1.9dB | 0.9-1.3dB |
| Directivity | 40dB | 50dB |
| Return Loss | 50dB | 55dB |

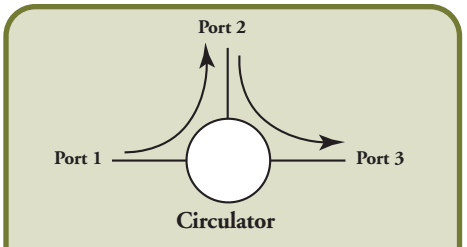
### Applications

- High-Power Fiber Laser
- Fiber Sensors
- Bidirectional Pumping

### High-Power Optical Circulators

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| OC-L-1064 | $ 5,700.00 | £ 3,591.00 | € 5.301,00 | ¥ 54,435.00 | 3 Port, High-Power PM Fiber Circulator, 1064nm, 3W |
| OC-L-1550 | $ 3,100.00 | £ 1,953.00 | € 2.883,00 | ¥ 29,605.00 | 3 Port, High-Power PM Fiber Circulator, 1550nm, 5W |

# Telecom Circulators


Insertion Loss (1➛2, 2➛3) 0.8 Typical
Isolation (2➛1, 3➛2) 40dB Minimum
Directivity (1➛3) ≥50dB

This fiber optic circulator is a non-reciprocating device that transports an optical signal from one port to the next port, only in one direction (i.e. 1 to 2, or 2 to 3). They may be used to separate forward and backward propagating signals, typically with 45dB of isolation and a directivity (crosstalk) figure of better than 50dB.

### Specifications

- **Wavelength Range:** 1525-1565nm
- **Isolation, Max/Min:** 50dB/40dB
- **Insertion Loss, Typical/Max:** 0.8/1.0dB
- **Directivity:** ≥50dB
- **Return Loss:** ≥50dB
- **Polarization Dependent Loss:** ≤0.1dB
- **Polarization Mode Dispersion:** ≤0.1ps
- **Max. Optical Power:** 500mW
- **Operating Temperature:** 0 to 65°C
- **Storage Temperature:** –40 to 85°C

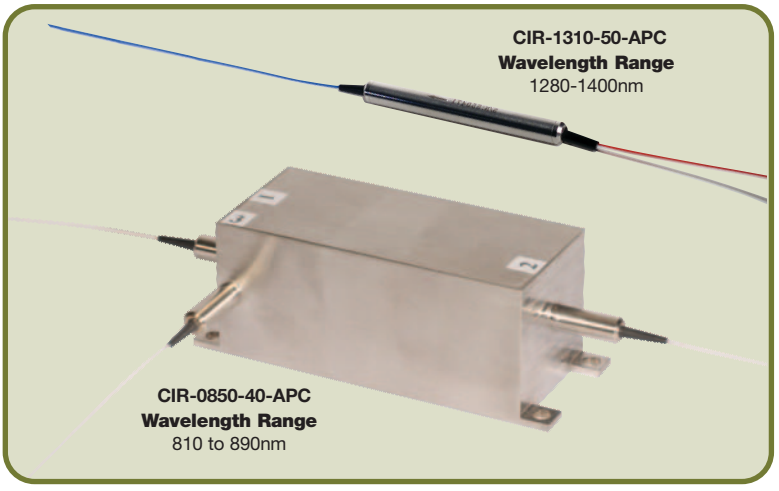
### Applications Features

- Add-Drop
- Fiber Sensors
- Bidirectional Pumping
- Exceptional Environmental Stability

### Optical Circulators

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 6015-3 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | 3 Port Fiber Circulator, 1550nm |
| 6015-3-FC | $ 605.00 | £ 381.20 | € 562,70 | ¥ 5,777.80 | 3 Port Fiber Circulator, 1550nm With FC Connectors |
| 6015-3-APC | $ 625.00 | £ 393.80 | € 581,30 | ¥ 5,968.80 | 3 Port Fiber Circulator With FC/APC Connectors |

# OCT Proven Broadband Circulators




Optical Coherence Tomography (OCT) systems require components that operate over a broad spectral range, with minimal spectral dependency. Thorlabs OCT proven circulators are tested to ensure minimal wavelength dependent insertion loss variations, making them an ideal choice for integrating in many OCT systems.

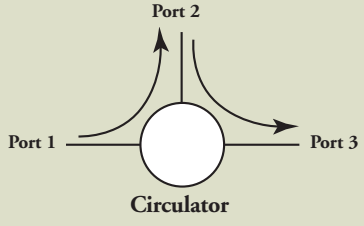
Other wavelength ranges are available; please call for more information and pricing.

## Features

- Wide Operating Wavelength Range
- Low Insertion Loss

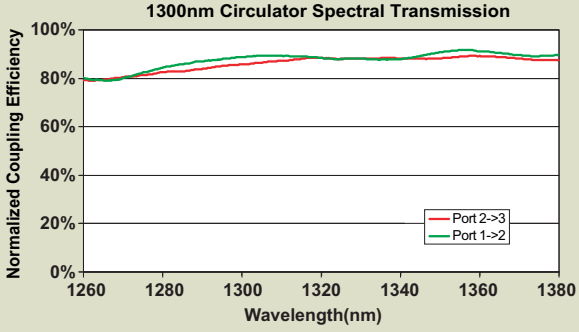
## Specifications

| PARAMETERS | CIR-0850-40-APC | CIR-1310-50-APC |
|---|---|---|
| Wavelength Range | 810-890nm | 1280-1400nm |
| Isolation | ≥15dB | 28dB |
| Insertion Loss | 1.5dB | 1.6dB |
| Directivity | ≥40dB | 50dB |
| Return Loss | ≥45dB | 45dB |
| Polarization-Dependent Loss | 0.5dB Max / 0.25dB Typ. | 0.2dB |
| Polarization Mode Dispersion | – | 0.05ps |
| Max. Optical Power | 500mW | 500mW |
| Operating Temperature | 10 to 50°C | 0 to 70°C |
| Storage Temperature | -40° to 85°C | -40 to 85°C |

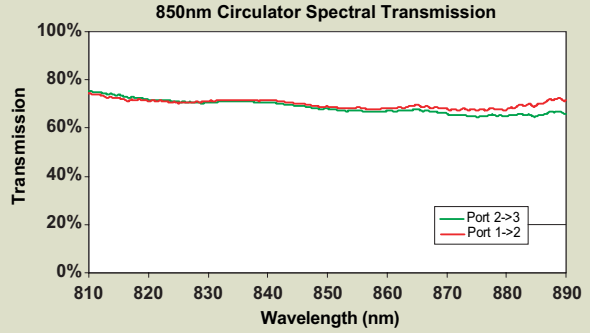



Circulator

Insertion Loss (1➛2, 2➛3)
Isolation (2➛1, 3➛2)
Directivity (1➛3)




**The plot above shows the normalized coupling efficiency for the two beam propagation paths of a typical OCT-proven 1310nm circulator (CIR-1310-50-APC) versus wavelength. Port 1-to-2 shows a mean coupling efficiency of 88% with a standard deviation of 10%. Port 2-to-3 shows a mean coupling efficiency of 86% with a standard deviation of 12%.**




**The plot above shows the normalized coupling efficiency for the two beam propagation paths of a typical OCT-proven 850nm circulator (CIR-0850-40-APC) versus wavelength. Port 1-to2 shows a mean coupling efficiency of 70% with a standard deviation of 4%. Port 2-to-3 shows a mean coupling efficiency of 70% with a standard deviation of 4%.**

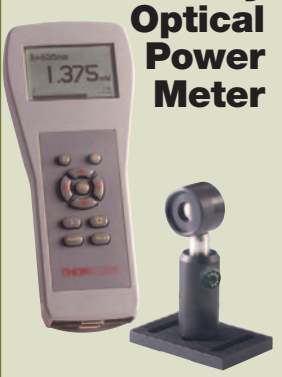
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| CIR-0850-40-APC | CALL | CALL | CALL | CALL | Broadband Fiber Circulator, 810-890nm |
| CIR-1310-50-APC | $ 700.00 | £ 441.00 | € 651,00 | ¥ 6,685.00 | Broadband Fiber Circulator, 1280-1400nm |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Optical Attenuator: Single Mode, Fiber Connector

These fiber connector style terminators allow one to attenuate an optical signal easily by plugging an FC/PC terminated fiber directly into the attenuator. The front of the attenuator is a male FC/PC connector, allowing the attenuators to be plugged directly into FC receptacles or adapters. These single mode attenuators use polarization-insensitive, doped fiber to achieve the specified attenuation.

**High-Sensitivity Optical Power Meter**



**See Page 946**

### Features

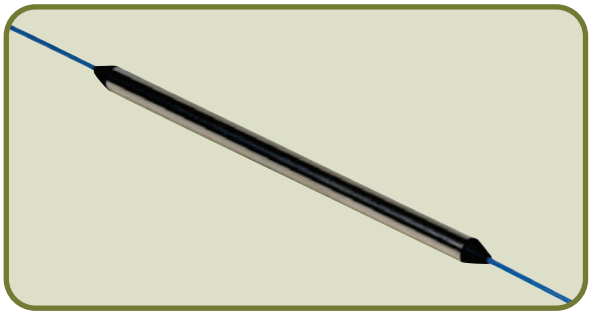
- **Operating Wavelength:** 1240-1620nm
- **Return Loss:** >55dB
- **Max. Power Capability:** 1W
- **Operating Temperature:** –40 to 75°C
- **PDL:** <0.1dB

### Fiber Connector Optical Attenuators

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FA05T | $ 20.30 | £ 12.80 | € 18,90 | ¥ 193.90 | Fixed Optical Attenuator, 5dB (31.6%T) |
| FA10T | $ 20.30 | £ 12.80 | € 18,90 | ¥ 193.90 | Fixed Optical Attenuator, 10dB (10% T) |
| FA15T | $ 20.30 | £ 12.80 | € 18,90 | ¥ 193.90 | Fixed Optical Attenuator, 15dB (3.2% T) |
| FA25T | $ 20.30 | £ 12.80 | € 18,90 | ¥ 193.90 | Fixed Optical Attenuator, 25dB (0.35% T) |

# Optical Attenuators: Inline

Inline optical isolators are ideal for balancing signal strengths in fiber circuits and for attenuating an optical signal to test the dynamic range of a measurement system. These inline isolators include SMF-28 fiber with a loose 900µm jacket, and they are offered with and without FC/PC connectors. These isolators are available with FC/APC connectors; please contact your local Thorlabs office for a quotation.



### Specifications

- **Operating Wavelength:** 1310nm ± 40nm and 1550 ± 40nm
- **Attenuation:** 3dB ± 0.3dB Typical
  5dB ± 0.3dB Typical
  10dB ± 0.5dB Typical
  20dB ± 0.5dB Typical
- **Back Reflection:** <–50dB
- **Operating Temperature:** –40 to 85°C
- **Storage Temperature:** –55 to 85°C

### Features

- Low Insertion Loss
- Low Return Loss
- Compact Design
- Environmentally Stable

### Applications

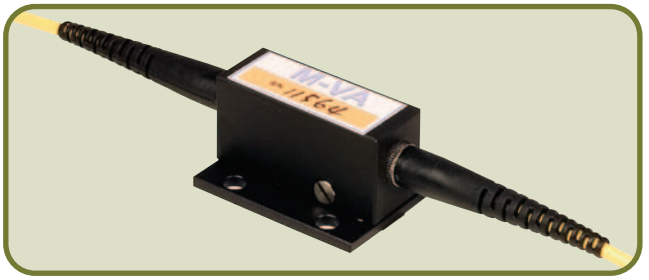
- Fiber Optic Sensors
- Instrumentation Testing
- Telecommunications

### Inline Fiber Optic Attenuators

| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION | %T |
|---|---|---|---|---|---|---|---|
| FOA03 | $ 75.00 | £ 47.30 | € 69,80 | ¥ 716.30 | None | Fiber Optic Inline Isolator, 3dB | 50% |
| FOA03-FC | $ 91.90 | £ 57.90 | € 85,50 | ¥ 877.60 | FC/PC | Fiber Optic Inline Isolator, 3dB | 50% |
| FOA05 | $ 75.00 | £ 47.30 | € 69,80 | ¥ 716.30 | None | Fiber Optic Inline Isolator, 5dB | 31.6% |
| FOA05-FC | $ 91.90 | £ 57.90 | € 85,50 | ¥ 877.60 | FC/PC | Fiber Optic Inline Isolator, 5dB | 31.6% |
| FOA10 | $ 75.00 | £ 47.30 | € 69,80 | ¥ 716.30 | None | Fiber Optic Inline Isolator, 10dB | 10% |
| FOA10-FC | $ 91.90 | £ 57.90 | € 85,50 | ¥ 877.60 | FC/PC | Fiber Optic Inline Isolator, 10dB | 10% |
| FOA20 | $ 75.00 | £ 47.30 | € 69,80 | ¥ 716.30 | None | Fiber Optic Inline Isolator, 20dB | 1% |
| FOA20-FC | $ 91.90 | £ 57.90 | € 85,50 | ¥ 877.60 | FC/PC | Fiber Optic Inline Isolator, 20dB | 1% |

# Optical Attenuator: Inline Variable (VOA)

This manually-adjusted, inline, variable optical attenuator (VOA) is used for precisely balancing the signal strengths in fiber circuits and also for balancing an optical signal when evaluating the dynamic range of the measurement system. These in-line VOAs include SMF-28e fiber with a 3mm jacket, and they are offered either terminated with FC/APC connectors or non-terminated. These attenuators are available with other connector styles; please contact your local Thorlabs office for a quotation.




## Specifications

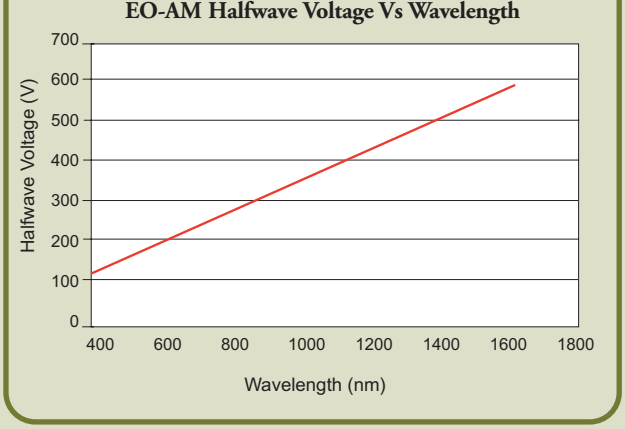
- **Operating Wavelength:** 1200 to 1600nm
- **Fiber:** SMF-28e or Equivalent
- **Residual Attenuation:** ≤1.5dB
- **Attenuation Range:** ≥50dB
- **Attenuation Resolution:** ≤0.1dB
- **Back Reflection (Return Loss):** <–55dB
- **Polarization Sensitivity:** ≤0.2dB
- **Optical Power:** ≤300mW
- **Thermal Stability:** ≤0.03dB/°C
- **Operating Temperature:** 0 to 60°C
- **Storage Temperature:** –40 to 75°C
- **Dimension:** 38 x 30 x 19mm

### Inline Variable Optic Attenuators

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| VOA50 | $ 221.45 | £ 139.50 | € 205,90 | ¥ 2,114.80 | Inline Variable Optical Attenuator, 50dB |
| VOA50-APC | $ 264.85 | £ 166.90 | € 246,30 | ¥ 2,529.30 | Inline Variable Optical Attenuator, 50dB, FC/APC |

TOOLS OF THE TRADE

## New Electro-Optic Modulators


### Highlights

- High Performance in a Compact Package
- Broadband DC Coupled and High Q Resonant Models for Low RF Drive
- Standard Broadband AR and Custom Coatings
- 2mm Diameter Clear Aperture
- SMA Female Modulation Input Connector
- MgO-Doped Versions for High Power
- DC to 100MHz
- Custom OEM Versions Available

See Page 684-685

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Faraday Rotator Mirror

Thermal and mechanical perturbations introduced to a standard, single mode fiber often cause variations in the state of polarization (SOP) of the guided light. These changes can adversely affect the performance of many different types of systems. Retaining the SOP using polarization-maintaining (PM) fiber can reduce or eliminate these adverse effects, but PM fiber is costly and often difficult to incorporate effectively.

The Faraday Rotator Mirror (FRM) is a low-cost, passive device that correctly compensates for such SOP variations. This simple, easily installed component works to neutralize the effects caused by changes in the SOP, allowing engineers greater control over the design of systems such as fiber sensors, erbium-doped fiber amplifiers, and tunable fiber lasers.

**Principle**

The Faraday Effect describes the non-reciprocal rotation of a signal's polarization as it passes through an optical medium within a magnetic field. Situated at the end of an optical fiber, the FRM is designed to rotate a signal's SOP by 45° for each pass through the optical medium. Since the Faraday Effect is non-reciprocal, the resultant SOP is rotated by 90° with respect to the original signal.

A Faraday rotator is situated in front of the mirror. It is this element that provides the non-reciprocal 45° rotation of the state of polarization each time the light passes through it. These rotations, applied in combination with a reversal of the polarization state's handedness upon reflection at the mirror interface, yield a state that is perpendicular to the original signal.

In this way, any SOP fluctuations that occur anywhere along the fiber are exactly compensated for, and their unwanted effects are neutralized.

**Design**

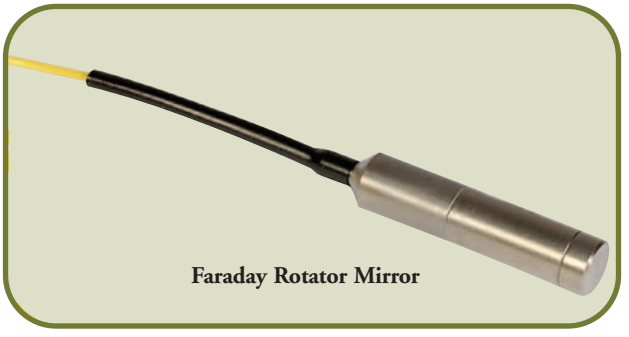
Using a micro aspheric glass lens, light exiting the fiber is properly collimated through a Bismuth Iron Garnet (BIG) Faraday rotating element that is accurately positioned in the field of a permanent magnet. The beam, reflected at normal incidence by a dielectric coated mirror, retraces its original path and re-enters the fiber.

These Faraday Rotator Mirrors are available off-the-shelf pigtailed with standard single mode fiber, Corning SMF 28e or equivalent. The fiber is mounted in a standard 900mm tight tube buffer with proper strain relief.

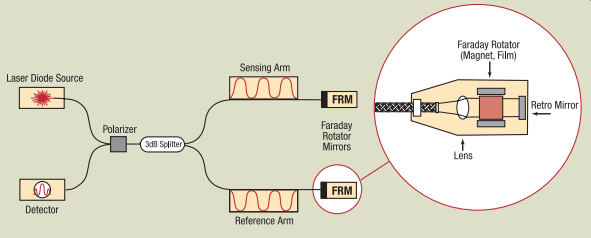
Custom models are available upon special request.

### Features

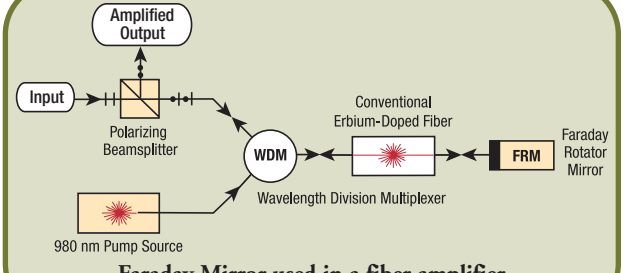
- Low Insertion Loss
- High-Power Handling 2-3Watts
- Epoxy-Free Optical Path
- SMF 28e Fiber or Equivalent



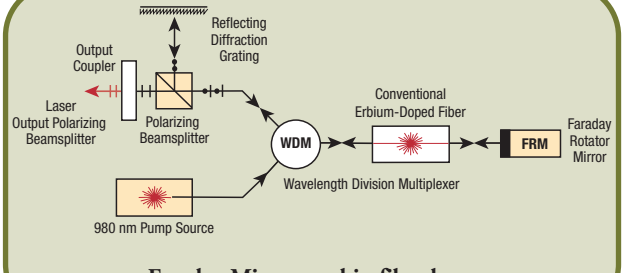
Faraday Rotator Mirror




Faraday Mirror used in a interferometer based fiber sensor.




Faraday Mirror used in a fiber amplifier.




Faraday Mirror used in fiber laser.

## Faraday Rotator Mirror Specifications

| ITEM# | CENTER WAVELENGTH | BANDWIDTH | INSERTION LOSS | RETURN LOSS | FARADAY ROTATION |
|---|---|---|---|---|---|
| MFI-1310 | 1310nm | 13nm | 0.5dB Typ/ 0.8dB Max | >55dB | 45° ± 1° |
| MFI-1550 | 1550nm | 15nm | 0.5dB Typ/ 0.8dB Max | >55dB | 45° ± 1° |

## Faraday Rotator Mirror

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| MFI-1310 | $ 490.00 | £ 308.70 | € 455,70 | ¥ 4,679.50 | Inline Faraday Rotator Mirror for 1310nm |
| MFI-1550 | $ 490.00 | £ 308.70 | € 455,70 | ¥ 4,679.50 | Inline Faraday Rotator Mirror for 1550nm |

# Fiber Polarization Controller

D5 Fiber is Compatible With SMF-28

FPC031

FPC560
For Bend Sensitive Fibers

The FPC family of Polarization Controllers are easily used to convert elliptically polarized light from single mode fiber into linearly polarized light. It is as simple as coiling a prescribed number of fiber loops into each paddle and adjusting the three paddle positions.

Stress-induced birefringence in the fiber creates three independent fractional "wave plates" to alter the polarization of the transmitted light in single mode fiber by looping the fiber into three independent spools. The amount of birefringence induced in the fiber is a function of the fiber cladding diameter, the spool diameter (fixed), the number of fiber loops per spool, and the wavelength of the light. (Note: the desired birefringence is induced by the loop in the fiber and not by twisting of the fiber paddles.)

| ITEM# | $ | £ | € | RMB | FIBER | OPERATING RANGE | CONNECTORS | BEND LOSS |
|---|---|---|---|---|---|---|---|---|
| FPC030 | $ 186.20 | £ 117.30 | € 173,20 | ¥ 1,778.20 | None | N/A | N/A | N/A |
| FPC031 | $ 227.80 | £ 143.50 | € 211,90 | ¥ 2,175.50 | D5[1] | 1310-1550nm | FC/PC | ≤ 0.1dB |
| FPC032 | $ 286.00 | £ 180.20 | € 266,00 | ¥ 2,731.30 | D5[1] | 1310-1550nm | FC/APC | ≤ 0.1dB |
| FPC560 | $ 207.00 | £ 130.40 | € 192,50 | ¥ 1,976.90 | None | N/A | N/A | N/A |
| FPC561 | $ 248.60 | £ 156.60 | € 231,20 | ¥ 2,374.10 | SMF-28 | 1310-1550nm | FC/PC | ≤ 0.1dB |
| FPC562 | $ 306.80 | £ 193.30 | € 285,30 | ¥ 2,929.90 | SMF-28 | 1310-1550nm | FC/APC | ≤ 0.1dB |

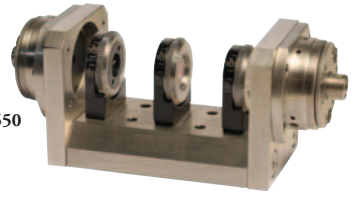
NOTE: The FPC030 works well with all of our single mode fiber. For fibers with relatively higher bend loss (e.g. Corning's SMF-28), use model FPC560.

[1]We use Lucent D5 fiber for 1310 and 1550nm applications due to its low bend losses. It is compatible with SMF-28 for most applications.

# Polarization Controller Kit for 1550nm

This polarization controller kit is assembled from a FiberBench, FiberPorts, and other component modules, all of which are included. The bench controller has the same functionality as a paddle controller, but offers a more deterministic and more stable polarization control. The kit contains three rotating zero-order wave plates (1/4, 1/2, and 1/4). The retarders have precise continuous rotation through 360° and can produce any possible polarization state.

Polarization Contoller



PC-FFB-1550

**Features**
- Mechanical and Thermal Stability
- Deterministic Polarization Control

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| PC-FFB-1550 | $ 2,320.00 | £ 1,461.60 | € 2.157,60 | ¥ 22,156.00 |

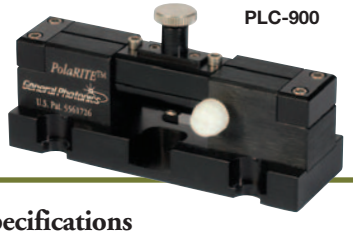
The kit is supplied assembled but not aligned. Fiber cables are not included. They can be purchased seperately, see page 1058.

**Includes:**
- 1 FiberBench
- 2 FiberPorts
- 1 Half Wave Retarder
- 2 Quarter Wave Retarder

# Inline Fiber Polarization Controllers

The PLC-900 polarization controller is ideal for applications that require a stable, compact, manual controller. It is designed to be used with 900µm jacketed single mode fiber. The fiber is simply placed in a channel, and end-clamps hold it in place. One knob is adjusted to squeeze the fiber and rotate it, allowing one to convert an arbitrary input state of polarization into any other state of polarization; any point on the Poincare sphere may be set. A separate knob is used to lock the controller into position.

PLC-900




**Features**
- For 900µm Jacketed Fiber
- Compact
- Insensitive to Wavelength Variations

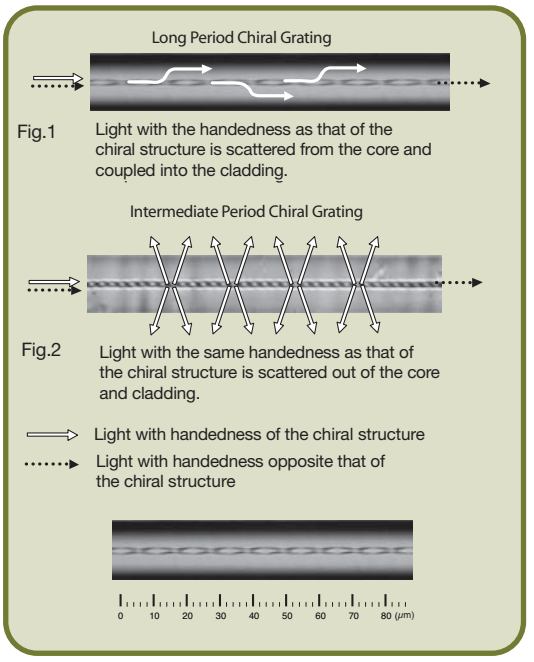
**Specifications**
- **Operating Wavelength:** 780-1550nm
- **Insertion Loss:** 0.05dB
- **Return Loss:** 65dB
- **Extinction Ratio:** >40dB

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| PLC-900 | $ 500.00 | £ 315.00 | € 465,00 | ¥ 4,775.00 | Inline Fiber Polarization Controller for 900µm Fiber Jacket |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

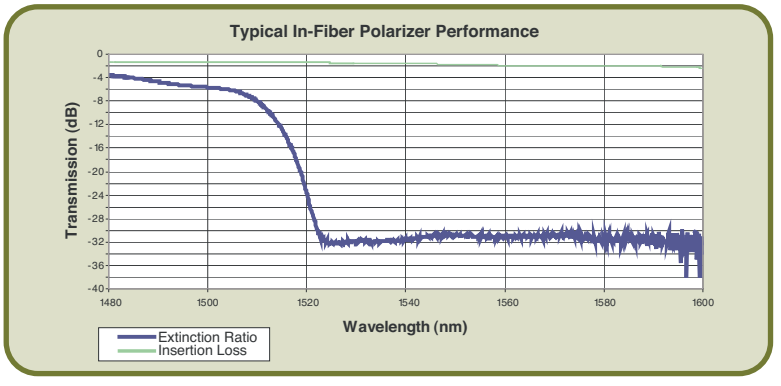
# Infiber Linear Polarizers

Thorlabs offers a unique infiber, linear polarizer manufactured by Chiral Photonics using their proprietary chiral technology. The all glass infiber polarizer provides a high extinction ratio over a broad spectral range. Unlike conventional single mode optical fibers that guide light using a concentric circular core and cladding, Chiral Photonics manufactures the chiral fibers by twisting rectangular core fibers, which creates a double-helical core. This double-helical structure causes light with the same handedness as the fiber to be scattered out of the core while light with opposite handedness continues within the core. The twist length determines the performance of the device. A chiral structure with a relatively loose twist and ~100µm period. scatters light into the cladding, where it is coupled into the cladding modes (Fig.1). These types of structures are beneficial to a multitude of sensor applications, such as pressure, temperature, and torque sensors. In gratings with a reduced twist period, the photons are scattered out of the core at larger angles, and the photons are no longer guided in the cladding (Fig. 2). These moderately twisted structures are the basis for polarizers that are advantageous for fiber optic gyroscopes and current meters. As the period of the twist is further reduced, say to ~1µm, the photons with the handedness of the chiral core are back-reflected within the fiber core. The wavelength and polarization of the reflected photons are controlled by the pitch and handedness of the twist. These tightly twisted chiral fibers are a promising replacement for fiber Bragg gratings (FBGs) as well as the basis for highly efficient fiber lasers.




## Applications Features

- Polarization Measurement and Control
- Coherent Transmission
- Optical Sensors
- Test and Measurement Instrumentation
- Navigation Instrumentation
- R & D Optical System

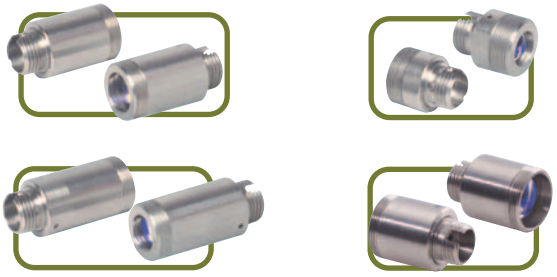

| PROPERTIES | |
|---|---|
| Center Wavelength | 980nm, 1310nm, 1550nm |
| Bandwidth | >50nm |
| Extinction Ratio (ER) | >30dB |
| Intrinsic ER | >50dB |
| Insertion Loss | <2dB |
| Polarizer Length | 42 ± 2mm |
| Package Style | Flexible Stainless Steel Microtubing (28cm Long) Under 900µm Furcation Tubing |
| Pigtails | PM or SM, 1m |
| Operating Temperature | –50 to +50°C |
| Storage Temperature | –70 to +85°C |

| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| IFP1550PM | $ 185.00 | £ 116.60 | € 172,10 | ¥ 1,766.80 | None | Infiber Polarizer, 1550nm, PM/PM Pigtails |
| IFP1550PM-FC | $ 315.00 | £ 198.50 | € 293,00 | ¥ 3,008.30 | FC/PC | Infiber Polarizer, 1550nm, PM/PM Pigtails, FC/PC |
| IFP1310PM | $ 185.00 | £ 116.60 | € 172,10 | ¥ 1,766.80 | None | Infiber Polarizer, 1310nm, PM/PM Pigtails |
| IFP1310PM-FC | $ 315.00 | £ 198.50 | € 293,00 | ¥ 3,008.30 | FC/PC | Infiber Polarizer, 1310nm, PM/PM Pigtails, FC/PC |
| IFP980PM | $ 191.00 | £ 120.30 | € 177,60 | ¥ 1,824.10 | None | Infiber Polarizer, 980nm, PM/PM Pigtails |
| IFP980PM-FC | $ 325.00 | £ 204.80 | € 302,30 | ¥ 3,103.80 | FC/PC | Infiber Polarizer, 980nm, PM/PM Pigtails, FC/PC |
| IFP1550SM | $ 175.00 | £ 110.30 | € 162,80 | ¥ 1,671.30 | None | Infiber Polarizer, 1550nm, SM/SM Pigtails |
| IFP1550SM-FC | $ 205.00 | £ 129.20 | € 190,70 | ¥ 1,957.80 | FC/PC | Infiber Polarizer, 1550nm, SM/SM Pigtails, FC/PC |
| IFP1310SM | $ 175.00 | £ 110.30 | € 162,80 | ¥ 1,671.30 | None | Infiber Polarizer, 1310nm, SM/SM Pigtails |
| IFP1310SM-FC | $ 205.00 | £ 129.20 | € 190,70 | ¥ 1,957.80 | FC/PC | Infiber Polarizer, 1310nm, SM/SM Pigtails, FC/PC |
| IFP980SM | $ 175.00 | £ 110.30 | € 162,80 | ¥ 1,671.30 | None | Infiber Polarizer, 980nm, SM/SM Pigtails |
| IFP980SM-FC | $ 205.00 | £ 129.20 | € 190,70 | ¥ 1,957.80 | FC/PC | Infiber Polarizer, 980nm, SM/SM Pigtails, FC/PC |

*Slow axis aligned to key

# Fiber Optics Selection Guide

Pages 1010-1019



## Fixed FC Fiber Collimators

- Effective Focal Lengths From 4.5 to 15.3mm
- Easily Integrated Into Optical Systems
- Molded Aspheric Lenses
- FC/PC & FC/APC Models

**See Page 1010**

## Fixed SMA Fiber Collimators

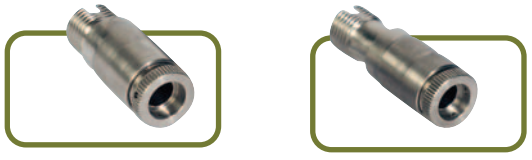
- Effective Focal Lengths From 4.5 to 15.3mm
- Molded Aspheric Lenses
- Standard SMA Interface

**See Page 1011**

## Low Divergence Collimators

- Multi-Element Lens Design
- Models Aligned at Six Wavelengths From 543 to 1550nm
- SMA, FC/PC, and FC/APC

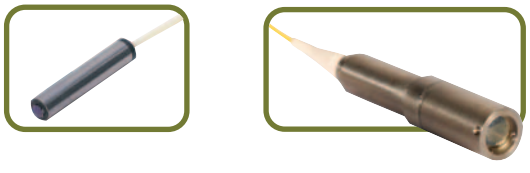
**See Page 1012**



## Adjustable Fiber Collimators

- Compact Adjustable Design
- Effective Focal Lengths From 2.0mm to 11.0mm
- Molded Aspheric Lenses
- Standard FC/PC & FC/APC Interfaces

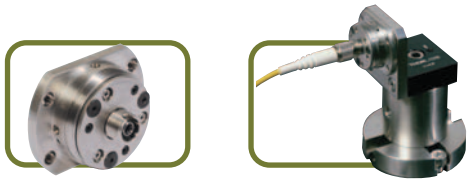
**See Page 1013**



## Pigtailed Collimators

- Aspheric & GRIN Lens Collimators
- Effective Focal Lengths From 1.9mm to 11.0mm
- GRIN Collimators Components
- AR-Coated Pigtails

**See Pages 1014-1016**



## Fiber Ports

- Adjustable Collimators/Couplers, 5 Degrees of Freedom
- Molded Aspheric Lenses
- Intergrates With Fiber Benches, Fiber Tables, and Cage Systems

**See Pages 1017-1019**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# FC/PC Fixed Fiber Collimation Packages

Thorlabs' Fiber Collimation Packages are designed to collimate a laser beam propagating out of an optical fiber. Each collimation package is factory aligned so that the lens is one focal length away from the output end of the fiber. These packages can also be used to couple a free-space laser beam into an optical fiber.

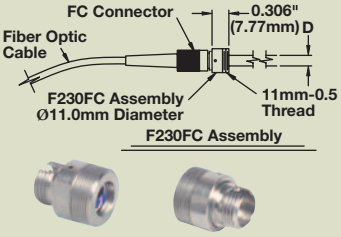
- Fiber Collimation
- Popular SMA and FC Connectors
- Simplifies Free-Space Laser to Fiber Coupling
- Simplifies Fiber Coupled Detection Systems

| P/N SUFFIX | ALIGNMENT WAVELENGTH | ALIGMENT FIBER[1] |
|---|---|---|
| -A | 543nm | 460HP |
| -B | 633nm | SM600 |
| -C | 1310nm | SMF-28e |
| -1550 | 1550nm | SMF-28e |

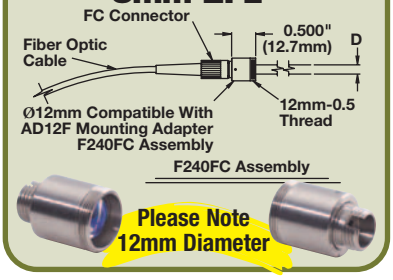
1) Fiber not included

**Call for Alignment at Custom Wavelengths**

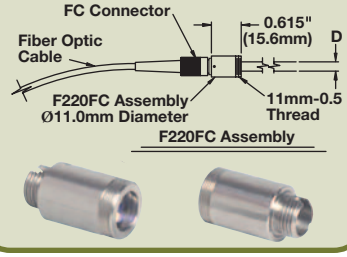
## Aspheric Collimator 4.5mm EFL



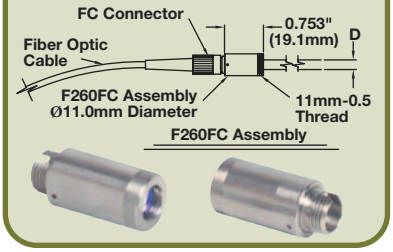

## Aspheric Collimator 8mm EFL




## Aspheric Collimator 11mm EFL




## Aspheric Collimator 15.3mm EFL




### FC/PC Connectorized Collimation Packages

| ITEM# | $ | £ | € | RMB | AR COATING[1] | D[2] | Θ[3] | $NA_{LENS}$ | F (mm) |
|---|---|---|---|---|---|---|---|---|---|
| F230FC-A | $ 137.00 | £ 86.30 | € 127,40 | ¥ 1,308.40 | 400-600nm | 0.9mm | 0.045° | 0.55 | 4.5 |
| F230FC-B | $ 137.00 | £ 86.30 | € 127,40 | ¥ 1,308.40 | 600-1050nm | 0.9mm | 0.051° | 0.55 | 4.5 |
| F230FC-C | $ 137.00 | £ 86.30 | € 127,40 | ¥ 1,308.40 | 1050-1600nm | 0.8mm | 0.118° | 0.55 | 4.5 |
| F230FC-1550 | $ 137.00 | £ 86.30 | € 127,40 | ¥ 1,308.40 | 1050-1600nm | 0.8mm | 0.134° | 0.55 | 4.5 |
| F240FC-A | $ 146.30 | £ 92.20 | € 136,10 | ¥ 1,397.20 | 400-600nm | 1.6mm | 0.025° | 0.50 | 8.0 |
| F240FC-B | $ 146.30 | £ 92.20 | € 136,10 | ¥ 1,397.20 | 600-1050nm | 1.6mm | 0.029° | 0.50 | 8.0 |
| F240FC-C | $ 146.30 | £ 92.20 | € 136,10 | ¥ 1,397.20 | 1050-1600nm | 1.4mm | 0.067° | 0.50 | 8.0 |
| F240FC-1550 | $ 146.30 | £ 92.20 | € 136,10 | ¥ 1,397.20 | 1050-1600nm | 1.5mm | 0.075° | 0.50 | 8.0 |
| F220FC-A | $ 127.70 | £ 80.50 | € 118,80 | ¥ 1,219.50 | 400-600nm | 2.2mm | 0.018° | 0.25 | 11.0 |
| F220FC-B | $ 127.70 | £ 80.50 | € 118,80 | ¥ 1,219.50 | 600-1050nm | 2.2mm | 0.021° | 0.25 | 11.0 |
| F220FC-C | $ 127.70 | £ 80.50 | € 118,80 | ¥ 1,219.50 | 1050-1600nm | 2.0mm | 0.048° | 0.25 | 11.0 |
| F220FC-1550 | $ 127.70 | £ 80.50 | € 118,80 | ¥ 1,219.50 | 1050-1600nm | 2.1mm | 0.055° | 0.25 | 11.0 |
| F260FC-A | $ 136.00 | £ 85.70 | € 126,50 | ¥ 1,298.80 | 400-600nm | 3.0mm | 0.013° | 0.16 | 15.3 |
| F260FC-B | $ 136.00 | £ 85.70 | € 126,50 | ¥ 1,298.80 | 600-1050nm | 3.1mm | 0.015° | 0.16 | 15.3 |
| F260FC-C | $ 136.00 | £ 85.70 | € 126,50 | ¥ 1,298.80 | 1050-1600nm | 2.7mm | 0.035° | 0.16 | 15.3 |
| F260FC-1550 | $ 136.00 | £ 85.70 | € 126,50 | ¥ 1,298.80 | 1050-1600nm | 2.9mm | 0.039° | 0.16 | 15.3 |

1) See data on AR Coatings on www.thorlabs.com
2) Measured $1/e^2$ diameter at 1 focal length from lens; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C and -1550)
3) Calculated full angle of divergence; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C and -1550)

## SM1 Mounting Adapters

- Adapters for GRIN and Aspheric Fiber Collimators
- External SM1 Threads (1.035"-40)

**AD11F**
(For F220, F230, and F260 Collimators)

**AD12F**
(For F240 Collimators)

**SM1PT**
(For GRIN Fiber Collimator)

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| AD11F | $27.80 | £ 17.50 | € 25,90 | ¥ 265.50 |
| AD12F | $28.80 | £ 18.15 | € 26,80 | ¥ 275.00 |
| SM1PT | $29.60 | £ 18.60 | € 27,50 | ¥ 282.70 |

# FC/APC Fixed Fiber Collimation Packages

These FC/APC connectorized fiber collimation packages are ideal for systems that are sensitive to back reflections. APC connectors utilize a ferrule that has an 8° end face with an ultra PC polish, thus leading to a return loss greater then 60dB.

| P/N SUFFIX | ALIGNMENT WAVELENGTH | ALIGMENT FIBER[1] |
|---|---|---|
| -A | 543nm | 460HP |
| -B | 670nm | SM600 |
| -C | 1310nm | SMF-28e |
| - 1550 | 1550nm | SMF-28e |

1) Fiber not included

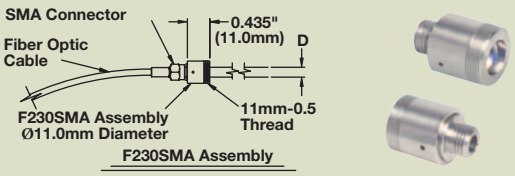
### FC/APC Connectorized Collimation Packages

| ITEM# | $ | £ | € | RMB | AR COATING[1] | D[2] | Θ[3] | $NA_{LENS}$ | F (mm) |
|---|---|---|---|---|---|---|---|---|---|
| F240APC-A | $ 187.50 | £ 118.10 | € 174,40 | ¥ 1,790.60 | 400-600nm | 1.5mm | 0.025° | 0.50 | 8.0 |
| F240APC-B | $ 187.50 | £ 118.10 | € 174,40 | ¥ 1,790.60 | 600-1050nm | 1.4mm | 0.032° | 0.50 | 8.0 |
| F240APC-C | $ 187.50 | £ 118.10 | € 174,40 | ¥ 1,790.60 | 1050-1600nm | 1.4mm | 0.067° | 0.50 | 8.0 |
| F240APC-1550 | $ 187.50 | £ 118.10 | € 174,40 | ¥ 1,790.60 | 1050-1600nm | 1.5mm | 0.075° | 0.50 | 8.0 |

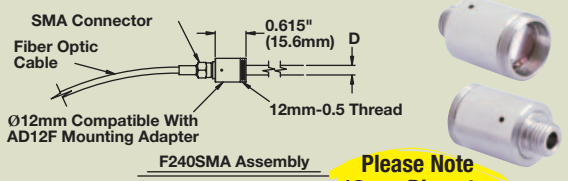
1) See data on AR Coatings on www.thorlabs.com
2) Measured $1/e^2$ diameter at 1 focal length from lens; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C and -1550)
3) Calculated full angle of divergence; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C and -1550)

# SMA Fixed Fiber Collimation Packages

## Aspheric Collimator 4.5mm EFL

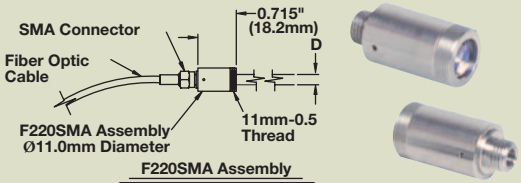



## Aspheric Collimator 8mm EFL

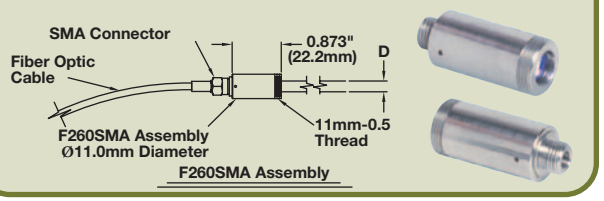



Please Note 12mm Diameter

## Aspheric Collimator 11mm EFL




## Aspheric Collimator 15.29mm EFL




### SMA Connectorized Collimation Packages

| ITEM# | $ | £ | € | RMB | AR COATING[1] | D[2] | Θ[3] | $NA_{LENS}$ | F (mm) |
|---|---|---|---|---|---|---|---|---|---|
| F230SMA-A | $ 137.00 | £ 86.30 | € 127,40 | ¥ 1,308.40 | 400-600nm | 0.9mm | 0.045° | 0.55 | 4.5 |
| F230SMA-B | $ 137.00 | £ 86.30 | € 127,40 | ¥ 1,308.40 | 600-1050nm | 0.9mm | 0.051° | 0.55 | 4.5 |
| F230SMA-C | $ 137.00 | £ 86.30 | € 127,40 | ¥ 1,308.40 | 1050-1600nm | 0.8mm | 0.118° | 0.55 | 4.5 |
| F240SMA-A | $ 144.20 | £ 90.80 | € 134,10 | ¥ 1,377.10 | 400-600nm | 1.6mm | 0.025° | 0.50 | 8.0 |
| F240SMA-B | $ 144.20 | £ 90.80 | € 134,10 | ¥ 1,377.10 | 600-1050nm | 1.6mm | 0.029° | 0.50 | 8.0 |
| F240SMA-C | $ 144.20 | £ 90.80 | € 134,10 | ¥ 1,377.10 | 1050-1600nm | 1.4mm | 0.067° | 0.50 | 8.0 |
| F220SMA-A | $ 130.80 | £ 82.40 | € 121,60 | ¥ 1,249.10 | 400-600nm | 2.2mm | 0.018° | 0.25 | 11.0 |
| F220SMA-B | $ 130.80 | £ 82.40 | € 121,60 | ¥ 1,249.10 | 600-1050nm | 2.2mm | 0.021° | 0.25 | 11.0 |
| F220SMA-C | $ 130.80 | £ 82.40 | € 121,60 | ¥ 1,249.10 | 1050-1600nm | 2.0mm | 0.048° | 0.25 | 11.0 |
| F260SMA-A | $ 126.70 | £ 79.80 | € 117,80 | ¥ 1,210.00 | 400-600nm | 3.0mm | 0.013° | 0.16 | 15.3 |
| F260SMA-B | $ 126.70 | £ 79.80 | € 117,80 | ¥ 1,210.00 | 600-1050nm | 3.1mm | 0.015° | 0.16 | 15.3 |
| F260SMA-C | $ 126.70 | £ 79.80 | € 117,80 | ¥ 1,210.00 | 1050-1600nm | 2.7mm | 0.035° | 0.16 | 15.3 |

1) See data on AR Coatings at www.thorlabs.com
2) Measured $1/e^2$ diameter at 1 focal length from lens; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C and -1550)
3) Calculated full angle of divergence; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C and -1550)

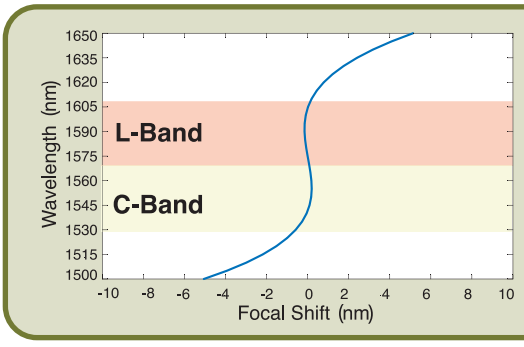
| P/N SUFFIX | ALIGNMENT WAVELENGTH | ALIGMENT FIBER[1] |
|---|---|---|
| -A | 543nm | 460HP |
| -B | 633nm | SM600 |
| -C | 1310nm | SMF-28e |

1) Fiber not included

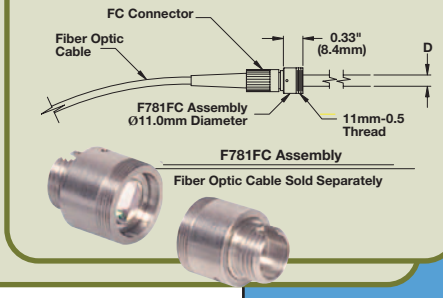
# Diffractive-Aspheric Fixed Fiber Collimator

This collimator uses an achromatic lens that is custom designed by Thorlabs to incorporate diffractive components along with the refractive, aspheric properties to keep the chromatic aberrations minimized over the entire C- and L-bands (ie. 1500-1650nm). It is diffraction limited and the focal shift is 10nm over the whole range.

- Diffraction-Limited Achromatic Collimating Lens
- Wide Wavelength Band 1500–1650nm with Extremely Low Focal Shift <0.010µm
- One Single Element Design
- Popular FC/PC Connector Interface




## Diffractive-Aspheric Collimator



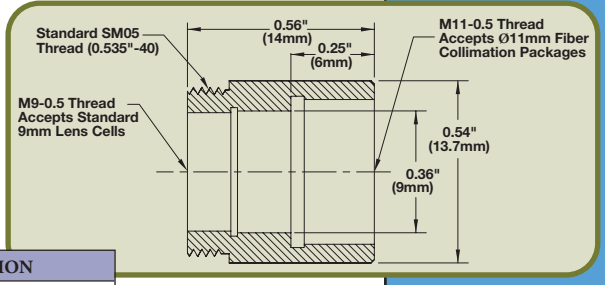

| ITEM# | $ | £ | € | RMB | AR COATING[1] | D[2] | θ[3] | $NA_{LENS}$ | F (mm) |
|---|---|---|---|---|---|---|---|---|---|
| F781FC-1550 | $ 197.80 | £ 124.60 | € 184,00 | ¥ 1,889.00 | 1500-1650nm | 0.86mm | 0.13° | 0.55 | 4.55 |

1) See data on AR Coatings at www.thorlabs.com
2) Calculated $1/e^2$ diameter at 1 focal length from lens; fiber: SMF-28e
3) Calculated beam full angle of divergence; fiber: SMF-28e

# Fixed Focus Lens Adapter

Fiber Collimator and Aspheric Lens Sold Separately

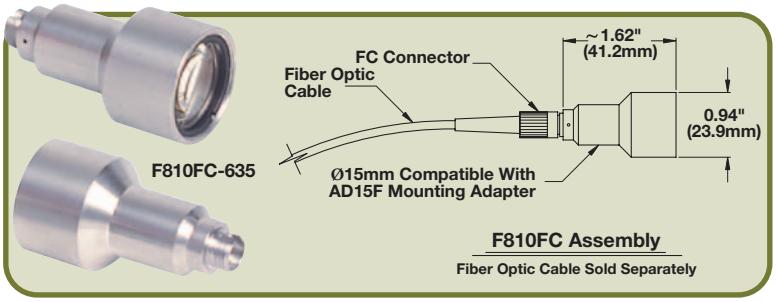
- Allows Aspheric Cells (Ø9mm) to be Mounted With Collimation Packages (Ø11mm)
- Allows Collimation Packages to be Integrated With SM05 Threaded Components (With or Without an Aspheric Lens)
- Mounted Aspheric Lens Oriented to Minimize Aberrations

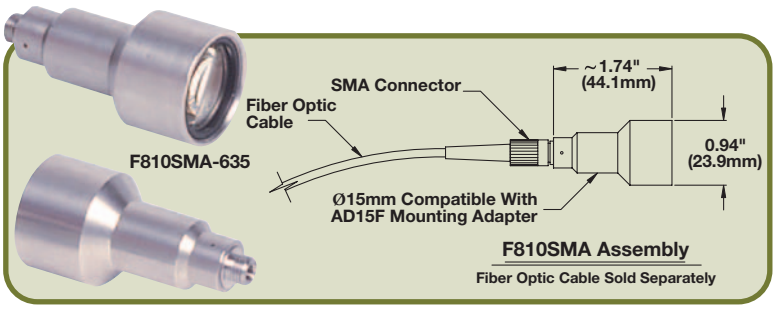



| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| AD1109F | $ 29.00 | £ 18.25 | € 27,00 | ¥ 277.00 | Focus Lens Adapter |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# FC and SMA Low Divergence, Large Beam Fixed Collimators




- Multi-Element Lens Design for Diffraction-Limited Performance
- Popular SMA and FC Connector Options
- Simplifies Fiber-Coupled Detection Systems

Our fiber collimation packages are designed to collimate a laser beam propagating out of the end of an optical fiber. Each fiber collimator package is factory aligned for a lens that is one focal length away from the output end of the fiber. These packages can also be used to couple a free-space laser beam into an optical fiber.

| P/N SUFFIX | ALIGNMENT WAVELENGTH | ALIGMENT FIBER[1] |
|---|---|---|
| -543 | 543nm | 460HP |
| - 635 | 635nm | SM600 |
| - 780 | 780nm | 780HP |
| - 1064 | 1064nm | SM940 |
| - 1310 | 1310nm | SMF-28E |
| - 1550 | 1550nm | SMF-28E |

**See Page 190 for AD15F Mounting Adapter**

### FC/PC Air-Spaced Doublet Collimators

| ITEM# | $ | £ | € | RMB | AR COATING | D[2] | θ[3] | NA$_{LENS}$ | F (mm) |
|---|---|---|---|---|---|---|---|---|---|
| F810FC-543 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 420-650nm | 6.8mm | 0.006° | 0.26 | 34.7 |
| F810FC-635 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 420-650nm | 6.6mm | 0.007° | 0.25 | 35.3 |
| F810FC-780 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 650-1050nm | 7.1mm | 0.008° | 0.25 | 35.9 |
| F810FC-1064 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 1050-1620nm | 8.5mm | 0.009° | 0.25 | 36.5 |
| F810FC-1310 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 1050-1620nm | 6.6mm | 0.014° | 0.24 | 36.8 |
| F810FC-1550 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 1050-1620nm | 7.0mm | 0.016° | 0.24 | 37.0 |

### SMA Air-Spaced Doublet Collimators

| ITEM# | $ | £ | € | RMB | AR COATING | D[2] | θ[3] | NA$_{LENS}$ | F (mm) |
|---|---|---|---|---|---|---|---|---|---|
| F810SMA-543 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 420-650nm | 6.8mm | 0.006° | 0.26 | 34.7 |
| F810SMA-635 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 420-650nm | 6.6mm | 0.007° | 0.25 | 35.3 |
| F810SMA-780 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 650-1050nm | 7.1mm | 0.008° | 0.25 | 35.9 |
| F810SMA-1064 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 1050-1620nm | 8.5mm | 0.009° | 0.25 | 36.5 |
| F810SMA-1310 | $ 201.90 | £ 127.20 | € 187,80 | ¥ 1,928.10 | 1050-1620nm | 6.6mm | 0.014° | 0.24 | 36.8 |

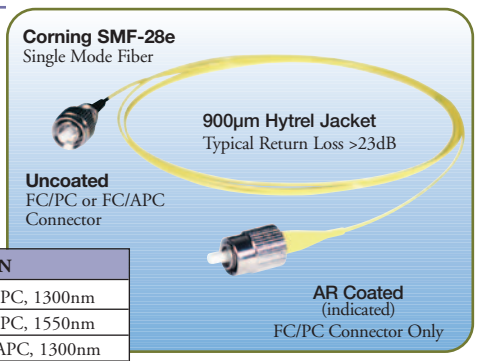
### FC/APC Air-Spaced Doublet Collimators

| ITEM# | $ | £ | € | RMB | AR COATING | D[2] | θ[3] | NA$_{LENS}$ | F (mm) |
|---|---|---|---|---|---|---|---|---|---|
| F810APC-780 | $ 232.80 | £ 146.70 | € 216,50 | ¥ 2,223.20 | 650-1050nm | 7.1mm | 0.008° | 0.25 | 35.9 |
| F810APC-842 | $ 232.80 | £ 146.70 | € 216,50 | ¥ 2,223.20 | 650-1050nm | 7.0mm | 0.008° | 0.25 | 35.9 |
| F810APC-1310 | $ 232.80 | £ 146.70 | € 216,50 | ¥ 2,223.20 | 1050-1620nm | 6.6mm | 0.014° | 0.24 | 36.8 |
| F810APC-1550 | $ 232.80 | £ 146.70 | € 216,50 | ¥ 2,223.20 | 1050-1620nm | 7.0mm | 0.016° | 0.24 | 37.0 |

1) See data on AR Coatings at www.thorlabs.com
2) Measured 1/e² diameter at 1 focal length from lens; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C and -1550)
3) Calculated full angle of divergence; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C and -1550)

# AR Coated (One End) Fiber Patch Cables

- Ideal for use With Our Collimation Packages to Minimize Fresnel Losses
- SMF-28e Fiber, 1m Length (Cutoff Wavelength <1260nm)
- AR Coated FC/PC Connector (One End):
  R <0.5%, 1300nm ± 100nm or 1550nm ± 100nm
- Uncoated FC/PC or FC/APC Input Connector




| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| P1-SMF28-FC-1-13 | $ 82.40 | £ 51.90 | € 76,60 | ¥ 786.90 | FC/PC AR Coated to FC/PC, 1300nm |
| P1-SMF28-FC-1-15 | $ 82.40 | £ 51.90 | € 76,60 | ¥ 786.90 | FC/PC AR Coated to FC/PC, 1550nm |
| P5-SMF28-FC-1-13 | $ 94.40 | £ 59.50 | € 87,80 | ¥ 901.50 | FC/PC AR Coated to FC/APC, 1300nm |
| P5-SMF28-FC-1-15 | $ 94.40 | £ 59.50 | € 87,80 | ¥ 901.50 | FC/PC AR Coated to FC/APC, 1350nm |

# Adjustable FC Collimators

OFR, a division of THORLABS

These snap-on collimators are made of stainless steel and are designed to connect onto the end of a FC/PC or FC/APC connector. These collimators contain a double-aspheric lens, which is designed for diffreaction-limited performance. The lenses are coated with our standard -A, -B, and -C coating options.

All of our snap-on collimators feature our VeriFocus focusing system. The mounted aspheric lens is spring-loaded into the adjustment barrel, which is rotated to adjust the focal distance to the fiber. This feature allows small movements of the barrel to adjust for any focal length changes or re-collimation of the beam over the operating wavelength of the lens.

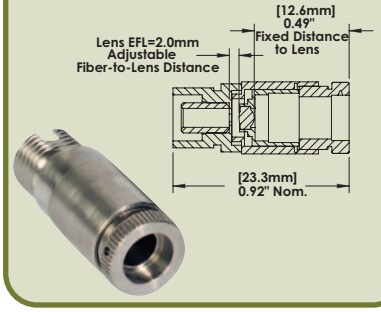
Our snap-on collimators can be used unmounted or mounted; our HCF-N mounting adapter allows the collimator to be post mounted into a Ø1" mount using an M6, 1/4"-20, #8-32, or M4 threaded hole.

## Snap-On Collimator Mount

- Mounting Holes for #8-32 and M4
- Fits in Ø1" Mounts

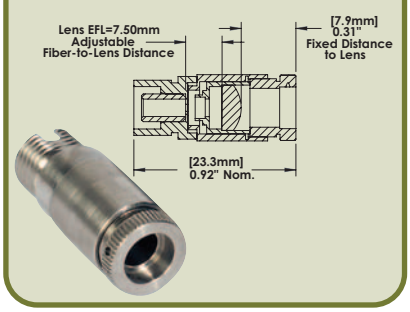

| ITEM # | $ | £ | € | RMB |
|---|---|---|---|---|
| HCFN | $ 60.00 | £ 37.80 | €55.80 | ¥ 573.00 |

## Aspheric Collimator 2mm EFL



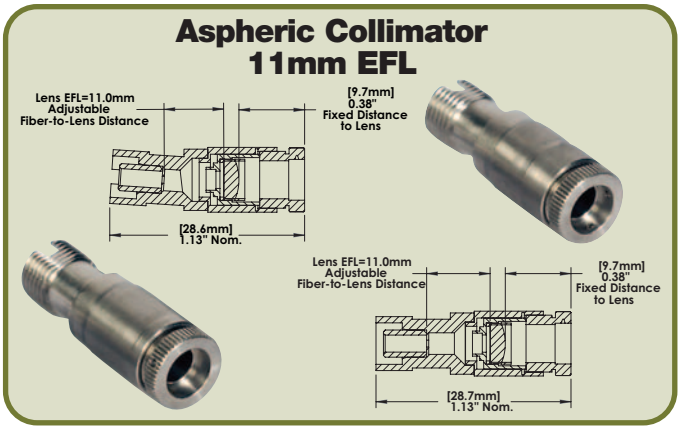

## Aspheric Collimator 5mm EFL


## Aspheric Collimator 8mm EFL




| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| CFC-2-A | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-2-B | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-2-C | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-5-A | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-5-B | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-5-C | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-8-A | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-8-B | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-8-C | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 |
| CFC-11-A | $ 240.00 | £ 151.20 | € 223,20 | ¥ 2,292.00 |
| CFC-11-B | $ 240.00 | £ 151.20 | € 223,20 | ¥ 2,292.00 |
| CFC-11-C | $ 240.00 | £ 151.20 | € 223,20 | ¥ 2,292.00 |
| CFC-11-A-APC | $ 290.00 | £ 182.70 | € 269,70 | ¥ 2,769.50 |
| CFC-11-B-APC | $ 290.00 | £ 182.70 | € 269,70 | ¥ 2,769.50 |
| CFC-11-C-APC | $ 290.00 | £ 182.70 | € 269,70 | ¥ 2,769.50 |

## Aspheric Collimator 11mm EFL




| ITEM# | EFL (mm) | INPUT MFD[4] (µm) | OUTPUT WAIST DIA. (mm) | MAX WAIST[3] DIST. (mm) | DIVERGENCE (mrad) | LENS CHARACTERISTICS | | | CONNECTOR |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CA[1](mm) | NA | AR λ (nm)[2] | |
| CFC-2-A | 2.0 | 3.5 | 0.33 | 96 | 1.75 | 2.0 | 0.50 | 400-600 | FC/PC or APC |
| CFC-2-B | 2.0 | 4.3 | 0.38 | 89 | 2.15 | 2.0 | 0.50 | 600-1050 | FC/PC or APC |
| CFC-2-C | 2.0 | 10.4 | 0.38 | 38 | 5.20 | 2.0 | 0.50 | 1050-1600 | FC/PC or APC |
| CFC-5-A | 4.6 | 3.5 | 0.75 | 500 | 0.76 | 4.9 | 0.53 | 400-600 | FC/PC or APC |
| CFC-5-B | 4.6 | 4.3 | 0.86 | 467 | 0.93 | 4.9 | 0.53 | 600-1050 | FC/PC or APC |
| CFC-5-C | 4.6 | 10.4 | 0.87 | 200 | 2.26 | 4.9 | 0.53 | 1050-1600 | FC/PC or APC |
| CFC-8-A | 7.5 | 3.5 | 1.2 | 1300 | 0.47 | 4.4 | 0.29 | 400-600 | FC/PC or APC |
| CFC-8-B | 7.5 | 4.3 | 1.4 | 1200 | 0.57 | 4.4 | 0.29 | 600-1050 | FC/PC or APC |
| CFC-8-C | 7.5 | 10.4 | 1.4 | 500 | 1.39 | 4.4 | 0.29 | 1050-1600 | FC/PC or APC |
| CFC-11-A | 11.0 | 3.5 | 1.8 | 2800 | 0.32 | 4.4 | 0.20 | 400-600 | FC/PC |
| CFC-11-B | 11.0 | 4.3 | 2.1 | 2700 | 0.39 | 4.4 | 0.20 | 600-1050 | FC/PC |
| CFC-11-C | 11.0 | 10.4 | 2.1 | 1100 | 0.95 | 4.4 | 0.20 | 1050-1600 | FC/PC |
| CFC-11-A-APC | 11.0 | 3.5 | 1.8 | 2800 | 0.32 | 4.4 | 0.20 | 400-600 | FC/APC |
| CFC-11-B-APC | 11.0 | 4.3 | 2.1 | 2700 | 0.39 | 4.4 | 0.20 | 600-1050 | FC/APC |
| CFC-11-C-APC | 11.0 | 10.4 | 2.1 | 1100 | 0.95 | 4.4 | 0.20 | 1050-1600 | FC/APC |

1) Clear Aperture
2) Wavelength of the Antireflection Coating
3) Defile
4) Mode Filed Diameter

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

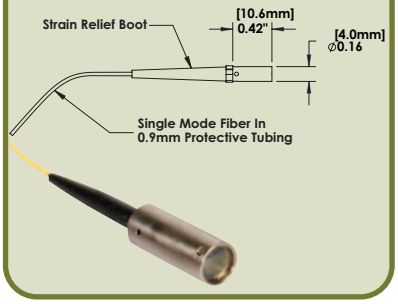
# FC and FC/APC Pigtailed Collimators for SM and PM Fibers

Our line of pigtailed collimators has the fiber and AR-coated aspheric lens rigidly potted inside a stainless steel housing. Each collimator comes with one meter of single mode or multimode fiber and is collimated to the specified wavelength. Since the AR coating encompasses a broad spectral range, it is possible to use this collimator at any wavelength within the coating range; however, the coupling loss will increase as the wavelength is detuned from the design wavelength. Custom wavelengths are available upon request.

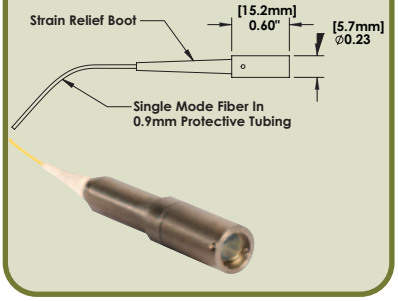
**Specifications**
- **Insertion Loss:** <0.2dB
- **Return Loss:** >-55dB
- **Fiber Length:** 1m

| ITEM# | FIBER | ALIGNMENT | AR λ (nm) |
|---|---|---|---|
| CFSXX-532-FC | 460HP | 532mm | 400-600 |
| CFSXX-1030-FC | HI1060 | 1030mm | 600-1050 |
| CFSXX-1064-FC | 1060XP | 1064mm | 1050-1600 |
| CFSXX-1310-APC | SMF28e | 1310mm | 1050-1600 |
| CFSXX-1550-APC | SMF28e | 1550mm | 1050-1600 |

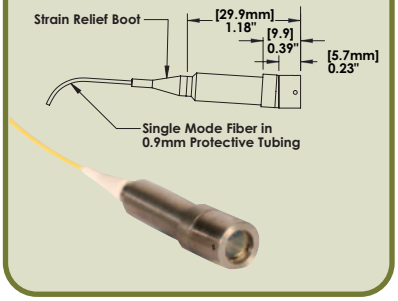
## Aspheric Collimator 2.0mm EFL



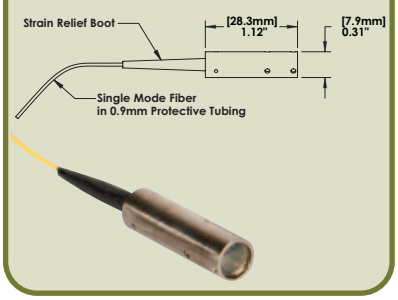

## Aspheric Collimator 4.6mm EFL




## Aspheric Collimator 11.0mm EFL




## Aspheric Collimator 18.0mm EFL




| ITEM# | EFL (mm) | INPUT MFD[3] (µm) | OUTPUT WAIST DIA. (mm) | MAX WAIST DIST. (mm)[2] | DIVERGENCE (mrad) | LENS CHAR CA[1] (mm) | LENS CHAR NA | ALIGNMENT (nm) | CONNECTOR |
|---|---|---|---|---|---|---|---|---|---|
| CFS2-532-FC | 2.0 | 3.5 | 0.39 | 110 | 1.75 | 2.0 | 0.50 | 532 | FC/PC |
| CFS2-1030-FC | 2.0 | 6.0 | 0.44 | 75 | 3.00 | 2.0 | 0.50 | 1030 | FC/PC |
| CFS2-1064-FC | 2.0 | 6.2 | 0.44 | 72 | 3.10 | 2.0 | 0.50 | 1064 | FC/PC |
| CFS2-1310-APC | 2.0 | 9.2 | 0.54 | 89 | 3.10 | 2.0 | 0.50 | 1310 | FC/APC |
| CFS2-1550-APC | 2.0 | 10.4 | 0.38 | 38 | 5.20 | 2.0 | 0.50 | 1550 | FC/APC |
| CFS5-532-FC | 4.6 | 3.5 | 0.89 | 590 | 0.76 | 4.9 | 0.53 | 532 | FC/PC |
| CFS5-1030-FC | 4.6 | 6.0 | 1.0 | 390 | 1.30 | 4.9 | 0.53 | 1030 | FC/PC |
| CFS5-1064-FC | 4.6 | 6.2 | 1.0 | 380 | 1.35 | 4.9 | 0.53 | 1064 | FC/PC |
| CFS5-1310-APC | 4.6 | 9.2 | 0.83 | 210 | 2.00 | 4.9 | 0.53 | 1310 | FC/APC |
| CFS5-1550-APC | 4.6 | 10.4 | 0.87 | 200 | 2.26 | 4.9 | 0.53 | 1550 | FC/APC |
| CFS11-532-FC | 11.0 | 3.5 | 2.1 | 3400 | 0.32 | 4.4 | 0.20 | 532 | FC/PC |
| CFS11-1030-FC | 11.0 | 6.0 | 2.4 | 2200 | 0.55 | 4.4 | 0.20 | 1030 | FC/PC |
| CFS11-1064-FC | 11.0 | 6.2 | 2.4 | 2100 | 0.56 | 4.4 | 0.20 | 1064 | FC/PC |
| CFS11-1310-APC | 11.0 | 9.2 | 2.0 | 1200 | 0.84 | 4.4 | 0.20 | 1310 | FC/APC |
| CFS11-1550-APC | 11.0 | 10.4 | 2.1 | 1100 | 0.95 | 4.4 | 0.20 | 1550 | FC/APC |
| CFS18-532-FC | 18.4 | 3.5 | 3.6 | 9400 | 0.19 | 5.5 | 0.15 | 532 | FC/PC |
| CFS18-1030-FC | 18.4 | 6.0 | 4.0 | 6200 | 0.33 | 5.5 | 0.15 | 1030 | FC/PC |
| CFS18-1064-FC | 18.4 | 6.2 | 4.0 | 6000 | 0.34 | 5.5 | 0.15 | 1064 | FC/PC |
| CFS18-1310-APC | 18.4 | 9.2 | 3.3 | 3400 | 0.50 | 5.5 | 0.15 | 1310 | FC/APC |
| CFS18-1550-APC | 18.4 | 10.4 | 3.5 | 3100 | 0.57 | 5.5 | 0.15 | 1550 | FC/APC |

1) Clear Aperture
2) Defined Max Waist Distance
3) Mode-Filed Diameter

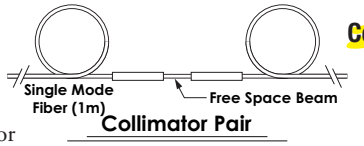
| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| CFS2-532-FC | $ 230.00 | £ 144.90 | € 213,90 | ¥ 2,196.50 |
| CFS2-1030-FC | $ 230.00 | £ 144.90 | € 213,90 | ¥ 2,196.50 |
| CFS2-1064-FC | $ 230.00 | £ 144.90 | € 213,90 | ¥ 2,196.50 |
| CFS2-1310-APC | $ 230.00 | £ 144.90 | € 213,90 | ¥ 2,196.50 |
| CFS2-1550-APC | $ 230.00 | £ 144.90 | € 213,90 | ¥ 2,196.50 |
| CFS5-532-FC | $ 210.00 | £ 132.30 | € 195,30 | ¥ 2,005.50 |
| CFS5-1030-FC | $ 210.00 | £ 132.30 | € 195,30 | ¥ 2,005.50 |
| CFS5-1064-FC | $ 210.00 | £ 132.30 | € 195,30 | ¥ 2,005.50 |
| CFS5-1310-APC | $ 210.00 | £ 132.30 | € 195,30 | ¥ 2,005.50 |
| CFS5-1550-APC | $ 210.00 | £ 132.30 | € 195,30 | ¥ 2,005.50 |

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| CFS11-532-FC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS11-1030-FC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS11-1064-FC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS11-1310-APC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS11-1550-APC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS18-532-FC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS18-1030-FC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS18-1064-FC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS18-1310-APC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |
| CFS18-1550-APC | $ 310.00 | £ 195.30 | € 288,30 | ¥ 2,960.50 |

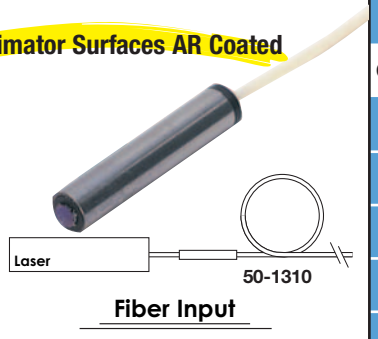
# GRIN Fiber Collimators

## Maximum Power 300mW

- Ø1.8mm Clear Aperture
- AR Coated on all Surfaces
- Input Coupler
- Output Collimator



Collimator Pair



Fiber Input

| ITEM# | $ | £ | € | RMB | OPERATING WAVELENGTH | FIBER | END PREPARATION |
|---|---|---|---|---|---|---|---|
| 50-1310 | $ 82.00 | £ 51.70 | € 76,30 | ¥ 783.10 | 1310nm | SMF-28e | None |
| 50-1310-FC | $ 110.00 | £ 69.30 | € 102,30 | ¥ 1,050.50 | 1310nm | SMF-28e | FC Connector |
| 50-1550 | $ 58.00 | £ 36.50 | € 53,90 | ¥ 553.90 | 1550nm | SMF-28e | None |
| 50-1550-FC | $ 84.00 | £ 52.90 | € 78,10 | ¥ 802.20 | 1550nm | SMF-28e | FC Connector |

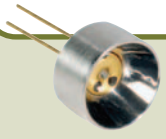
# NEW Light Emitting Diodes (LEDs)

### Features

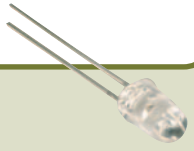
- More Than 80 LED Products
- Wavelengths From 340nm to 4.5µm
- Optical Power up to 700mW
- Bare LEDs, Collimated LEDs, LED Arrays, and Mounted LEDs
- LED Drivers


S1LEDM
(SM1 Threaded Mount for LEDs)


LEDD1
(LED Drivers)


LED312P


LED341W


LED521E

See Pages 504-523

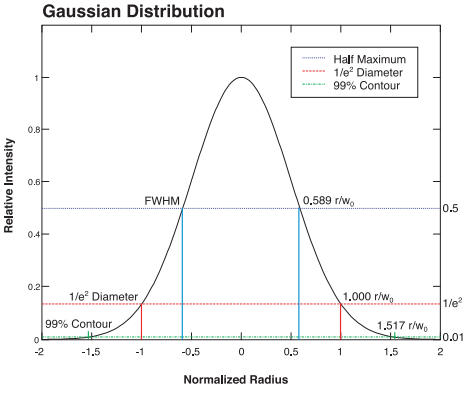
# Large Aperture Aspheric Glass Lenses

- Large Diameters Aspheres
- Low Dispersion Materials
- Focal Lengths From 8–100mm
- Diameters From 10–100mm

**Variable Definitions**

| | |
|---|---|
| z: | SAG as a function of Y |
| R: | Radius of curvature |
| k: | Conic constant |
| A4: | 4th order aspheric coefficient |
| A6: | 6th order aspheric coefficient |
| A8: | 8th order aspheric coefficient |
| A10: | 10th order aspheric coefficient |
| A12: | 12th order aspheric coefficient |

$$z = \frac{Y^2}{R\left(1+\sqrt{1-(1+k)Y^2/R^2}\right)} + A_4Y^4 + A_6Y^6 + A_8Y^8 + A_{10}Y^{10} + A_{12}Y^{12}$$




# NEW Molded Glass Aspheric Lenses


### Features

- Fully RoHS Compliant
- Drop-In Replacements for Existing Molded Aspheric Lenses
- Diffraction-Limited Performance

See Pages 738-757

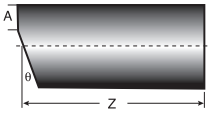
Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# GRIN Lenses

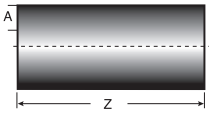
Thorlabs offers a selection of graded-index lenses for applications at 1300nm and 1560nm. GRIN lenses are typically used in fiber-based, passive and active components to couple laser light from one fiber through a free-space optical system (such as an optical isolator) and back into another fiber to propagate through the rest of the system. GRIN lenses can also be used for coupling the output of laser diodes into fibers, coupling laser light onto a detector, and collimating laser light.


## Specifications

- **Pitch:** 0.23 and 0.29
- **Lens Diameter:** 1.8mm
- **Operating Wavelength Windows:** 1.30µm and 1.56µm
- **On-Axis NA:** 0.46
- **Transmittance:** >89%, 380-2000nm
- **Polarization Preservation:** 99%
- **Material:** Oxide Glass
- **Operating Temperature:** <350°C




**The 0.23 pitch lenses include an 8° angled facet to minimize back reflection and compensate for the angular beam deviation from angled fiber ferrules.**




**The 0.29 pitch lenses include 0° end faces with AR coatings to minimize back reflection.**

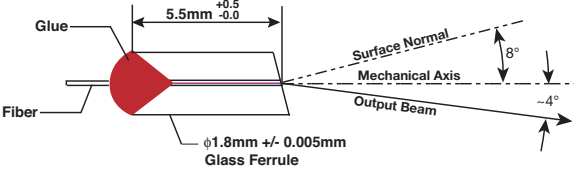
| ITEM# | PITCH | NA | DIAMETER | DESIGN WAVELENGTH | INDEX ($n_0$) | LENGTH (Z) | EFFECTIVE FOCAL LENGTH | GLASS MATERIAL |
|---|---|---|---|---|---|---|---|---|
| GRIN2313A | 0.23 | 0.46 | Ø1.8mm | 1300nm | 1.5916 | 4.42mm | 1.94mm | Oxide Glass |
| GRIN2315A | 0.23 | 0.46 | Ø1.8mm | 1560nm | 1.5901 | 4.43mm | 1.94mm | Oxide Glass |
| GRIN2913 | 0.29 | 0.46 | Ø1.8mm | 1300nm | 1.5916 | 5.57mm | 1.98mm | Oxide Glass |
| GRIN2915 | 0.29 | 0.46 | Ø1.8mm | 1560nm | 1.5906 | 5.59mm | 1.99mm | Oxide Glass |

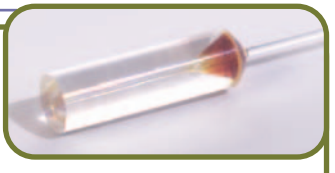
### GRIN Lenses

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| GRIN2313A | $ 28.00 | £ 17.60 | € 26,00 | ¥ 267.40 | GRIN Lens, Ø1.8mm, 0.23 Pitch, 1300nm, AR Coated |
| GRIN2315A | $ 28.00 | £ 17.60 | € 26,00 | ¥ 267.40 | GRIN Lens, Ø1.8mm, 0.23 Pitch, 1560nm, AR Coated |
| GRIN2913 | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 | GRIN Lens, Ø1.8mm, 0.29 Pitch, 1300nm, AR Coated |
| GRIN2915 | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 | GRIN Lens, Ø1.8mm, 0.29 Pitch, 1560nm, AR Coated |

# Pigtailed Ferrules

These pigtailed glass ferrules include 1.5 meters of SMF-28e fiber and a 0° or 8° angled face, which is AR coated to minimize back-reflection (return-loss). These features make them ideal for numerous applications.



## Pigtail Specifications

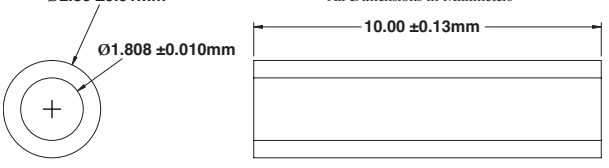
- **Ferrule Diameter:** 1.800mm ±5µm
- **Ferrule Length:** 5.5mm +0.5/-0.0mm
- **Wedge Angles:** 0.0°, 8.0°
- **Wedge Tolerance:** ±0.2°
- **Fiber Type:** SMF-28e
- **AR Coating:** R<0.25%, 1310nm ±40nm or 1550nm ±40nm
- **Fiber Length:** 1.5m

### Pigtailed Ferrules

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| SMPF0213 | $ 14.80 | £ 9.30 | € 13,80 | ¥ 141.30 | Pigtailed Ferrule, Ø1.8mm, 0°, 1310nm, AR Coated |
| SMPF0215 | $ 14.80 | £ 9.30 | € 13,80 | ¥ 141.30 | Pigtailed Ferrule, Ø1.8mm, 0°, 1550nm, AR Coated |
| SMPF0113 | $ 14.80 | £ 9.30 | € 13,80 | ¥ 141.30 | Pigtailed Ferrule, Ø1.8mm, 8°, 1310nm, AR Coated |
| SMPF0115 | $ 14.80 | £ 9.30 | € 13,80 | ¥ 141.30 | Pigtailed Ferrule, Ø1.8mm, 8°, 1550nm, AR Coated |

# GRIN to Ferrule Sleeves

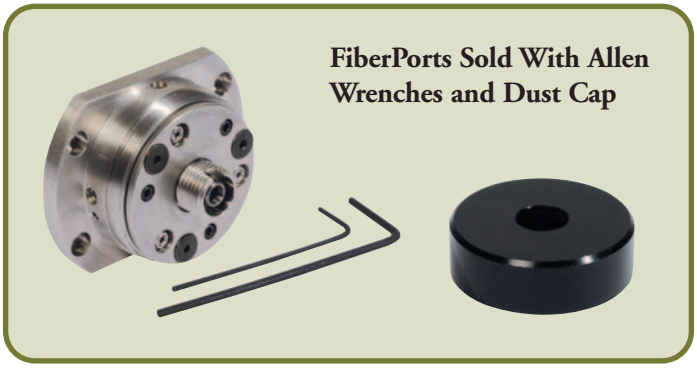
The 51-2800-1800 sleeve allows a GRIN lens to be integrated easily with one of the pigtailed ferrules above. The glass material is transparent in the UV region for curing UV adhesives.




### GRIN to Ferrule Sleeve

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 51-2800-1800 | $ 4.75 | £ 2.99 | € 4,40 | ¥ 45.40 | Sleeve for GRIN Lens & Ferrules, 1.8mm I.D., 10mm Long, Borosilicate Glass |

# FiberPort Collimators Overview




**FiberPort** Thorlabs' new compact, ultra-stable FiberPort micro-positioners provide an easy to use, stable platform for coupling light into and out of optical fibers. The FiberPort devices utilize an AR coated aspheric lens, which is available in three wavelength ranges and several focal lengths. This device enables alignment to an FC/PC, FC/APC, or SMA terminated fiber with five or six directional adjustments. The compact size and the ultra-stable alignment maintained over time make the FiberPort an ideal solution for fiber coupling, collimation, or incorporation into OEM systems.

While holding the connector and fiber stationary, the built-in aspheric lens can be aligned with five degrees of freedom (3 transitional and 2 rotational): linear alignment of the lens on the x, y, and z-axes and angular alignment around three fixed axes. In addition, the locking screws on the front plate can be loosened to enable rotation for PM fiber alignment. The lens adjustment and front plate adjustment provide a total of six degrees of freedom. After alignment is complete, a locking setscrew can be tightened to secure the settings.

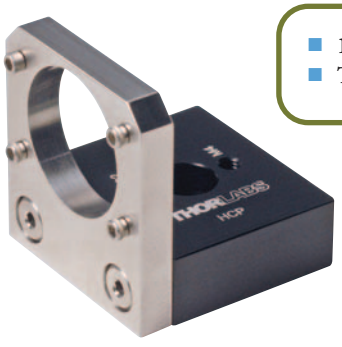
Each FiberPort is shipped complete with all needed screws, cover, alignment tools, and instructions on assembly and operation.

Thorlabs offers models with our -A, -B, or -C coating. These models may be used with single mode, multimode, and PM fibers terminated with FC/PC, FC/APC, or SMA connectors.

Our FiberPort collimators can be mounted in several configurations with various available mounting accessories. A mounting plate CP02FP, is available, which allows the FiberPort to be mounted in our 30mm Cage System. The base of the V-HCP, an L-shaped mounting bracket, includes an #8-32 and M4 tapped hole and a 1/4"-20 (M6) counterbored hole. This allows the collimator to be mounted onto a post, stage, or platform. The FiberPort can also be mounted onto a laser; there is an industry standard 4-hole pattern that is compatible with lasers such as our HeNe Lasers. Finally, Thorlabs offers Benchtop Alignment Stages, which provide full fiber coupling flexibility in a wide range of configurations for various applications.

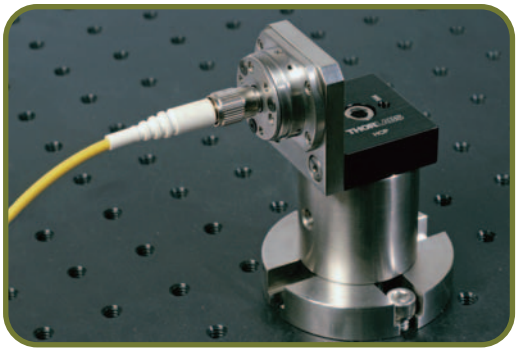

**See following pages for product offerings.**

# FiberPort Mount




- **1/4"-20 (M6) Counterbore**
- **Tapped #8-32 and M4 Holes**

HCP



The L-shaped FiberPort mount can be easily attached to an optical table or to a post since it has threaded 8-32 and M4 holes, as well as a counterbored through-hole for a 1/4"-20 or M6 screw.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| HCP | $ 99.00 | £ 62.40 | € 92,10 | ¥ 945.50 | Fiberport Mount |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# FiberPort for Single Mode and PM Fibers – Page 1 of 2

The three FC body styles of the FiberPort allow them to be used with FC/PC and FC/APC connectors. The PAFX2, PAFX-5, and PAFX7 have the same housing and FC interface. The NA of the lenses used in these FiberPorts is large enough to work with FC/PC and FC/APC connetors. The PAFX11-PC, PAFX15-PC, and V-PAFX18-PC have the same main housing and a straight FC interface. These are for use with FC/PC connectors. The PAFX11, PAFX15, and PAFX18 models have the same main housing and an angled FC interface. The FC bulkhead is at 3.7° to accommodate the beam angle from an FC/APC connector.

## FiberPort Body Styles


| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| PAF-X-2-A | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-2-B | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-2-C | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-5-A | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |
| PAF-X-5-B | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |
| PAF-X-5-C | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |
| PAF-X-7-A | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |
| PAF-X-7-B | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |
| PAF-X-7-C | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| PAF-X-11-A | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-11-B | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-11-C | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-11-PC-A | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-11-PC-B | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-11-PC-C | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-15-A | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-15-B | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-15-C | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-15-PC-A | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-15-PC-B | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-15-PC-C | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-18-A | $ 500.00 | £ 315.00 | € 465,00 | ¥ 4,775.00 |
| PAF-X-18-B | $ 500.00 | £ 315.00 | € 465,00 | ¥ 4,775.00 |
| PAF-X-18-C | $ 500.00 | £ 315.00 | € 465,00 | ¥ 4,775.00 |
| PAF-X-18-PC-A | $ 500.00 | £ 315.00 | € 465,00 | ¥ 4,775.00 |
| PAF-X-18-PC-B | $ 500.00 | £ 315.00 | € 465,00 | ¥ 4,775.00 |
| PAF-X-18-PC-C | $ 500.00 | £ 315.00 | € 465,00 | ¥ 4,775.00 |

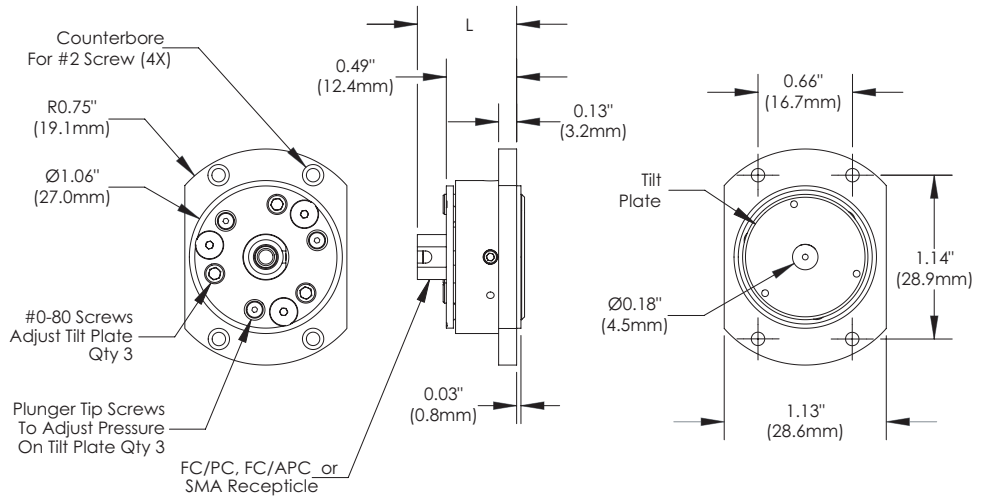
## Specifications

| ITEM# | EFL (mm) | INPUT MFD[4] (µm) | OUTPUT WAIST DIA. (mm) | MAX WAIST DIST. (mm)[3] | DIVERGENCE (mrad) | LENS CHARACTERISTICS | | | BULKHEAD TYPE | LENGTH L (in/mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CA[1](mm) | NA | ARλ(nm)[2] | | |
| PAF-X-2-A | 2.0 | 3.5 | 0.33 | 96 | 1.75 | 2.0 | 0.50 | 400-600 | FC/PC or APC | 0.69"/17.5mm |
| PAF-X-2-B | 2.0 | 4.3 | 0.38 | 89 | 2.20 | 2.0 | 0.50 | 600-1050 | FC/PC or APC | 0.69"/17.5mm |
| PAF-X-2-C | 2.0 | 10.4 | 0.38 | 38 | 5.20 | 2.0 | 0.50 | 1050-1600 | FC/PC or APC | 0.69"/17.5mm |
| PAF-X-5-A | 4.6 | 3.5 | 0.75 | 500 | 0.76 | 4.9 | 0.53 | 400-600 | FC/PC or APC | 0.69"/17.5mm |
| PAF-X-5-B | 4.6 | 4.3 | 0.86 | 470 | 0.93 | 4.9 | 0.53 | 600-1050 | FC/PC or APC | 0.69"/17.5mm |
| PAF-X-5-C | 4.6 | 10.4 | 0.87 | 200 | 2.30 | 4.9 | 0.53 | 1050-1600 | FC/PC or APC | 0.69"/17.5mm |
| PAF-X-7-A | 7.5 | 3.5 | 1.2 | 1300 | 0.47 | 4.4 | 0.29 | 400-600 | FC/PC or APC | 0.69"/17.5mm |
| PAF-X-7-B | 7.5 | 4.3 | 1.4 | 1200 | 0.57 | 4.4 | 0.29 | 600-1050 | FC/PC or APC | 0.69"/17.5mm |
| PAF-X-7-C | 7.5 | 10.4 | 1.4 | 520 | 1.40 | 4.4 | 0.29 | 1050-1600 | FC/PC or APC | 0.69"/17.5mm |

| ITEM# | EFL (mm) | INPUT MFD[4] (µm) | OUTPUT WAIST DIA. (mm) | MAX WAIST DIST. (mm)[3] | DIVERGENCE (mrad) | LENS CHARACTERISTICS | | | BULKHEAD TYPE | LENGTH L (in/mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CA[1](mm) | NA | AR λ(nm)[2] | | |
| PAF-X-11-A | 11.0 | 3.5 | 1.8 | 2800 | 0.32 | 4.4 | 0.20 | 400-600 | FC/APC | 0.87"/22.8mm |
| PAF-X-11-B | 11.0 | 4.3 | 2.1 | 2700 | 0.39 | 4.4 | 0.20 | 600-1050 | FC/APC | 0.87"/22.8mm |
| PAF-X-11-C | 11.0 | 10.4 | 2.1 | 1100 | 0.95 | 4.4 | 0.20 | 1050-1600 | FC/APC | 0.87"/22.8mm |
| PAF-X-11-PC-A | 11.0 | 3.5 | 1.8 | 2800 | 0.32 | 4.4 | 0.20 | 400-600 | FC/PC | 0.87"/22.8mm |
| PAF-X-11-PC-B | 11.0 | 4.3 | 2.1 | 2700 | 0.39 | 4.4 | 0.20 | 600-1050 | FC/PC | 0.87"/22.8mm |
| PAF-X-11-PC-C | 11.0 | 10.4 | 2.1 | 1100 | 0.95 | 4.4 | 0.20 | 1050-1600 | FC/PC | 0.87"/22.8mm |
| PAF-X-15-A | 15.4 | 3.5 | 2.5 | 5600 | 0.23 | 5.0 | 0.16 | 400-600 | FC/APC | 0.87"/22.8mm |
| PAF-X-15-B | 15.4 | 4.3 | 2.9 | 5200 | 0.28 | 5.0 | 0.16 | 600-1050 | FC/APC | 0.87"/22.8mm |
| PAF-X-15-C | 15.4 | 10.4 | 2.9 | 2200 | 0.68 | 5.0 | 0.16 | 1050-1600 | FC/APC | 0.87"/22.8mm |
| PAF-X-15-PC-A | 15.4 | 3.5 | 2.5 | 5600 | 0.23 | 5.0 | 0.16 | 400-600 | FC/PC | 0.87"/22.8mm |
| PAF-X-15-PC-B | 15.4 | 4.3 | 2.9 | 5200 | 0.28 | 5.0 | 0.16 | 600-1050 | FC/PC | 0.87"/22.8mm |
| PAF-X-15-PC-C | 15.4 | 10.4 | 2.9 | 2200 | 0.68 | 5.0 | 0.16 | 1050-1600 | FC/PC | 0.87"/22.8mm |
| PAF-X-18-A | 18.4 | 3.5 | 3.0 | 8000 | 0.19 | 5.5 | 0.15 | 400-600 | FC/APC | 0.87"/22.8mm |
| PAF-X-18-B | 18.4 | 4.3 | 3.5 | 7400 | 0.23 | 5.5 | 0.15 | 600-1050 | FC/APC | 0.87"/22.8mm |
| PAF-X-18-C | 18.4 | 10.4 | 3.5 | 3100 | 0.57 | 5.5 | 0.15 | 1050-1600 | FC/APC | 0.87"/22.8mm |
| PAF-X-18-PC-A | 18.4 | 3.5 | 3.0 | 8000 | 0.19 | 5.5 | 0.15 | 400-600 | FC/PC | 0.87"/22.8mm |
| PAF-X-18-PC-B | 18.4 | 4.3 | 3.5 | 7400 | 0.23 | 5.5 | 0.15 | 600-1050 | FC/PC | 0.87"/22.8mm |
| PAF-X-18-PC-C | 18.4 | 10.4 | 3.5 | 3100 | 0.57 | 5.5 | 0.15 | 1050-1600 | FC/PC | 0.87"/22.8mm |

1) Clear Aperture
2) Wavelength of the Antireflection Coating
3) Define Maximum Waist Distant
4) Mode-Field Diameter

# FiberPort for Single Mode and PM Fibers – Page 2 of 2




## High Sensitivity Optical Power Meter

See Page 946

## FiberPort Cage Plate

The CP02FP allows the integration of any FiberPort into our 30mm Cage System. See pages 227 to 246 for our full cage system product offering.

| ITEM# | METRIC | $ | £ | € | RMB |
|---|---|---|---|---|---|
| CP02FP | CP02FP/M | $ 20.50 | £ 12.90 | € 19,10 | ¥ 195.80 |

# FiberPorts with SMA Interface

PAF-SMA-5
PAF-SMA-7

PAF-SMA-11

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| PAF-SMA-5-A | $ 360.00 | £ 226.80 | € 334,80 | ¥ 3,438.00 |
| PAF-SMA-5-B | $ 360.00 | £ 226.80 | € 334,80 | ¥ 3,438.00 |
| PAF-SMA-5-C | $ 360.00 | £ 226.80 | € 334,80 | ¥ 3,438.00 |
| PAF-SMA-7-A | $ 360.00 | £ 226.80 | € 334,80 | ¥ 3,438.00 |
| PAF-SMA-7-B | $ 360.00 | £ 226.80 | € 334,80 | ¥ 3,438.00 |
| PAF-SMA-7-C | $ 360.00 | £ 226.80 | € 334,80 | ¥ 3,438.00 |
| PAF-SMA-11-A | $ 375.00 | £ 236.30 | € 348,80 | ¥ 3,581.30 |
| PAF-SMA-11-B | $ 375.00 | £ 236.30 | € 348,80 | ¥ 3,581.30 |
| PAF-SMA-11-C | $ 375.00 | £ 236.30 | € 348,80 | ¥ 3,581.30 |

| ITEM# | EFL (mm) | INPUT MFD[4] (µm) | OUTPUT WAIST DIA. (mm) | MAX WAIST DIST. (mm)[3] | DIVERGENCE (mrad) | LENS CHARACTERISTICS | | | BULKHEAD TYPE | LENGTH L (in/mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CA[1](mm) | NA | ARλ(nm)[2] | | |
| PAF-SMA-5-A | 4.6 | 2.12 | 1.2 | 1400 | 0.46 | 4.9 | 0.53 | 400-600 | SMA | 0.85"/21.7mm |
| PAFS-MA-5-B | 4.6 | 2.12 | 1.8 | 1900 | 0.46 | 4.9 | 0.53 | 600-1050 | SMA | 0.85"/21.7mm |
| PAF-SMA-5-C | 4.6 | 2.12 | 4.3 | 4700 | 0.46 | 4.9 | 0.53 | 1050-1600 | SMA | 0.85"/21.7mm |
| PAF-SMA-7-A | 7.5 | 3.43 | 1.3 | 1400 | 0.46 | 4.4 | 0.29 | 400-600 | SMA | 0.85"/21.7mm |
| PAF-SMA-7-B | 7.5 | 3.43 | 1.8 | 1900 | 0.46 | 4.4 | 0.29 | 600-1050 | SMA | 0.85"/21.7mm |
| PAF-SMA-7-C | 7.5 | 3.43 | 4.3 | 4700 | 0.46 | 4.4 | 0.29 | 1050-1600 | SMA | 0.85"/21.7mm |
| PAF-SMA-11-A | 11.0 | 5.01 | 1.3 | 1400 | 0.46 | 4.4 | 0.20 | 400-600 | SMA | 1.04"/26.3mm |
| PAF-SMA-11-B | 11.0 | 5.01 | 1.8 | 2000 | 0.46 | 4.4 | 0.20 | 600-1050 | SMA | 1.04"/26.3mm |
| PAF-SMA-11-C | 11.0 | 5.01 | 4.3 | 4800 | 0.46 | 4.4 | 0.20 | 1050-1600 | SMA | 1.04"/26.3mm |

1) Clear Aperture
2) Wavelength of the Antireflection Coating
3) Define Max. Waist Distant
4) Mode-Field Diameter

# Thorlabs welcomes OFR

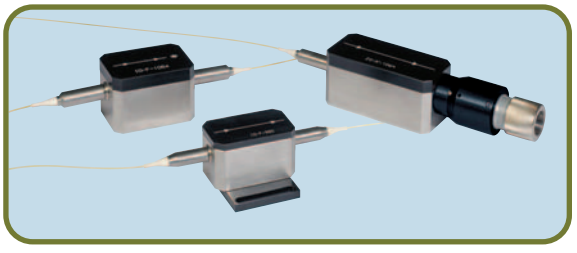
Thorlabs, Inc., announced in January the acquisition of OFR, Inc., of Caldwell, New Jersey. OFR has a 30-year history as an important supplier of critical optical components, subsystems, and systems to the photonics market.

"I am thrilled to welcome OFR into the Thorlabs family of companies, which now includes seven entities, all with substantial manufacturing and design capabilities," said Alex Cable, President and Founder of Thorlabs, Inc. "OFR has a stellar reputation and an extensive history of providing important products to our industry. I used OFR-produced products before founding Thorlabs, and have always been impressed with the OFR business model as well as their approach to the world. I believe that the combination of OFR and Thorlabs will be quite powerful and will be highly beneficial to the customers we serve."

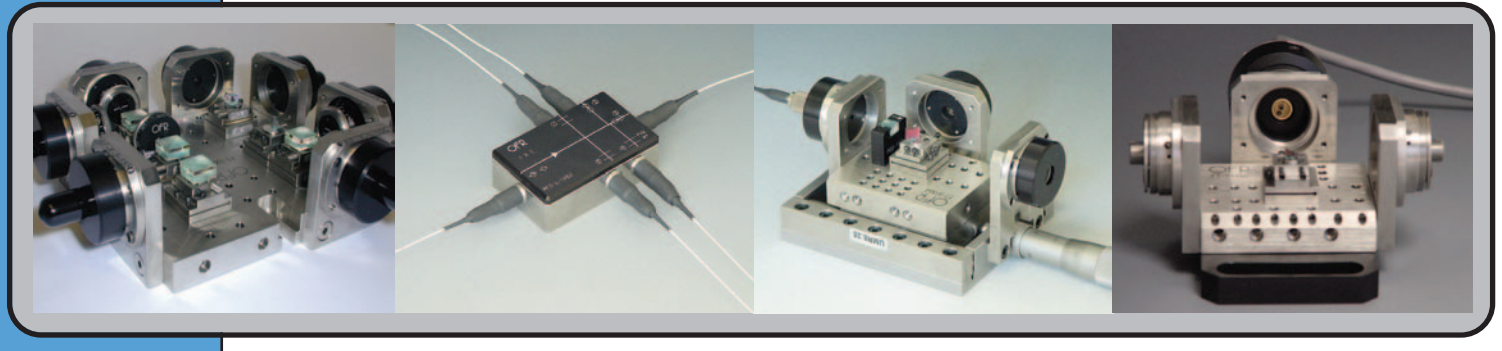
OFR brings to Thorlabs a broad array of products that include free-space and fiber-based optical isolators and circulators; high-performance objective lenses for laser machining and marking; and the "Fiber Bench" series, which is a novel set of optomechanical building blocks used to rapidly prototype complex optical systems. OFR's products have been adopted by a number of key market segments identified as critical to Thorlabs' future, including the rapidly growing high-power fiber laser and advanced imaging markets.

"The union of OFR and Thorlabs makes good sense," said Donald Wilson, President and Founder of OFR. "Both companies manufacture and supply highest-quality products into the world's photonics markets, from the laboratory to product development to OEM supply. Thorlabs' outstanding manufacturing capacity will significantly increase OFR's ability to meet our OEM customers' delivery requirements, something we critically need. At the same time, we will continue doing what we do best here at OFR, fiber-optic product and isolator innovation and product development, thereby adding to the expanding product lines of both companies. Alex Cable and I have a longtime professional relationship built on mutual respect, and I think the fit is an excellent one."

OFR was established in 1976 to manufacture and market precision optical components and instruments for use in university, government and medical research, the military, research and development, and other industrial applications. In 1985, OFR developed the first optical isolator in the United States. OFR manufactures more isolator models than any other producer in the world, and is a major supplier of specialized fiber-optic devices and components for the R&D and OEM markets.



The FiberBench, FiberTable, Optics, and MicroSpot product lines are all represented in the new Thorlabs catalog. These OFR product lines are very complementary to the Thorlabs products, and the union will create a stronger user experience than either piece alone. Customers are the source of many product innovations, and they are often the ones that drive the development of a product line. The ever-changing needs of our customers as well as our own internal use of our own products constantly pushes and challenges us to provide new and useful components. Projects typically start out on breadboards and throughout their lifecycle migrate to enclosed miniaturized products. The pictures below represent a small number of the custom designs and devices that have been built.



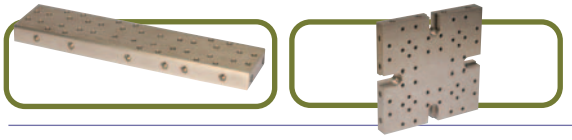
# Fiber Optics Selection Guide



### FiberBench

- FiberBenches
- FiberBench Couplers
- Polarization Controllers

**See Pages 1022-1023**



### FiberTable

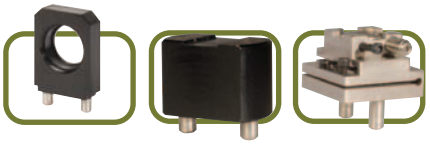
- FiberTable Models
- 5-8 Port Models

**See Pages 1024-1025**

### FiberBench / FiberTable Modules

- Wall Plates
- Retarders and Polarizers
- Polarization Reference
- Beamsplitters and Mirrors
- ND Attenuators
- Beam Aligner

**See Pages 1026-1032**



### FiberBench / FiberTable Optical Mounts

- 1/2" Optic Mount
- Rotation Mount
- Flexure Base
- Aperture Plates
- Static Mounting Platform
- Universal Base

**See Pages 1033-1034**

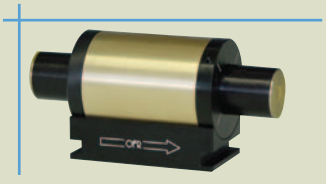
### Aligned FiberBench

- Prealigned @ 1310 or 1550nm
- Use With FiberBench Modules
- Stable
- Low Insertion Loss

**See Page 1034**

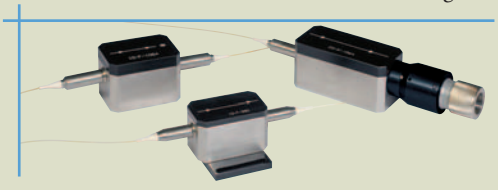
## OFR, a Division of Thorlabs

With the purchase of OFR by Thorlabs, the OFR products are now available through the Thorlabs' catalog or directly from OFR. Complete contact information for all Thorlabs and OFR offices can be found on the back cover of this catalog.



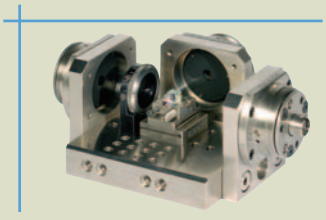
**Free-Space Isolators (Pages 671-682)**

- Polarization Dependent and Independent
- Wavelengths: 405-2100nm



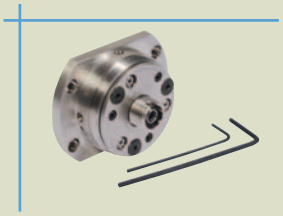
**Fiber Isolators (Pages 996-998)**

- Polarization Dependent and Independent
- High Power to 10W



**FiberBench (Pages 1026-1032)**

- Compact, Stable Mounting
- Modular Component



**FiberPort (Pages 1016-1019)**

- Compact 5-Axis Adjustment
- Stable Fiber and Free-Space Coupling

**MicroSpot (Page 659)**

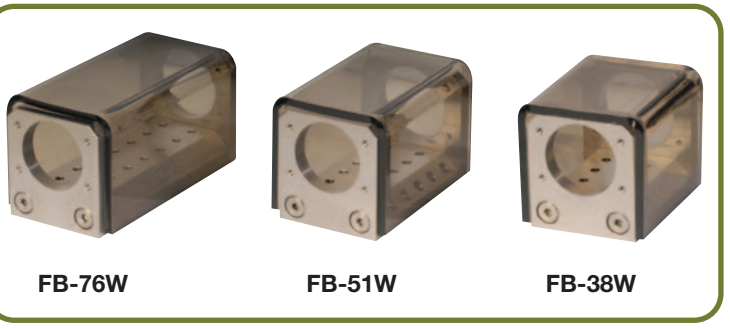
- UV Achromatic and HP YAG
- Air-Spaced Infinite Conjugate Design

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Single-Mode: PM
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# FiberBench

OFR, a division of THORLABS

The FiberBench and FiberTable subassemblies form the foundation of the nearly infinite array of miniature fiber optic systems that OFR customers have been building for the last decade. When used with the PAF Series Fiber Collimators/Couplers (see pages 1016-1019), a complete optical circuit can be constructed. For basic systems that require only one input and one output path, the FiberBench is ideal; for more complex systems that require multiple inputs and outputs, we recommend the use of the FiberTable products that are shown on pages 1024-1025.

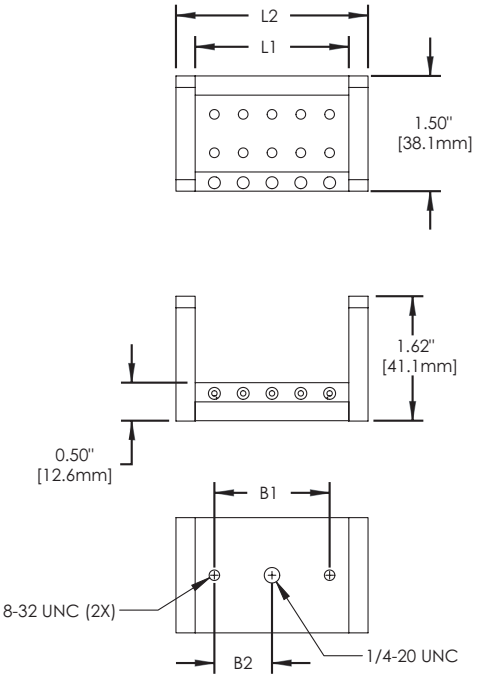


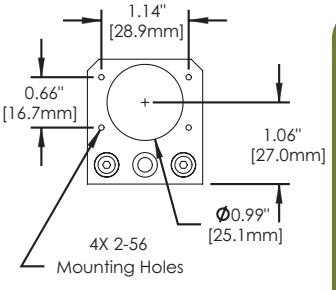
FB-76W FB-51W FB-38W

The FiberBenches and FiberTables are inherently versatile, and their all-stainless steel construction offers the stability required when building fiber optic systems. All benches, tables and couplers are made from non-magnetic 303 stainless steel, which ensures both mechanical rigidity as well as thermal stability. Our design approach has been validated by temperature cycling aligned systems from -20°C to +20°C; only 0.1dB change in insertion loss was detected during these tests. The FiberBenches and FiberTables are intended to be used with the PAF Series Fiber Couplers (FiberPorts), two of which are shown on the next page. The two FiberPorts shown are offered with three different AR coatings, and are designed to collimate the output of an optical fiber or to re-couple a free space beam back into an optical fiber. Both Fiber Ports offer excellent optical coupling. Please see the table below for details.

- Mounting Sub-Base Included
- FiberBenches Include Two Wall Plates and a Dust Cover
- Beam Height is 14.3mm
- 303 Non-Magnetic Stainless Steel

Visit www.thorlabs.com For Mechnical Drawings and Our New Solid Models




### FiberBench Dimensions

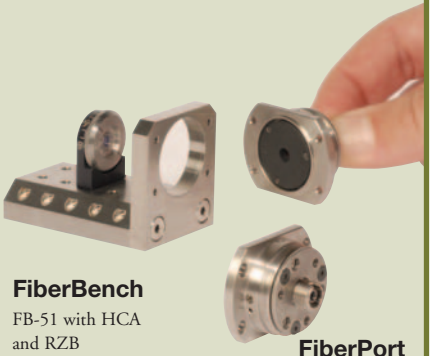
| ITEM# | L1 | L2 | B1 | B2 |
|---|---|---|---|---|
| FB-38W | 1.5" | 2.0" | 0.175" | 1.15" |
| FB-51W | 2.0" | 2.5" | 0.250" | 1.50" |
| FB-76W | 3.0" | 3.5" | 0.375" | 2.25" |

**Notes:**

- Beam Height is 14.3mm Off the Deck
- FiberBenches Include Two Wall Plates and a Dust Cover

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FB-38W | $ 205.00 | £ 129.20 | € 190,70 | ¥ 1,957.80 | FiberBench 38mm, 3 Position |
| FB-51W | $ 215.00 | £ 135.50 | € 200,00 | ¥ 2,053.30 | FiberBench 51mm, 5 Position |
| FB-76W | $ 225.00 | £ 141.80 | € 209,30 | ¥ 2,148.80 | FiberBench 76mm, 7 Position |

## Building A FiberBench System



FiberBench
FB-51 with HCA and RZB

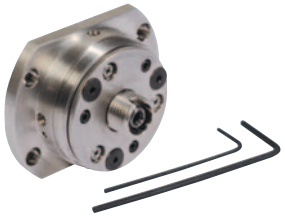
FiberPort

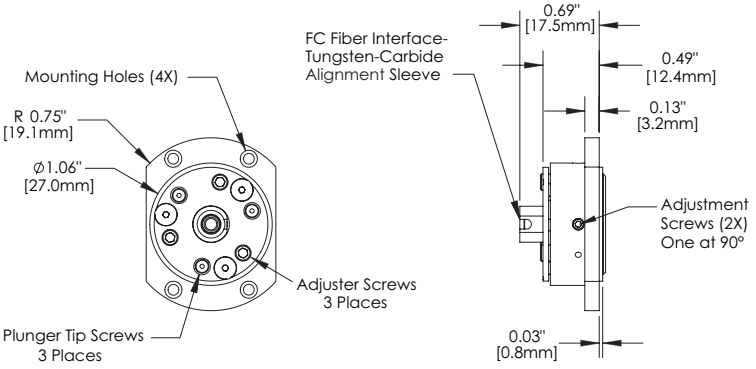
- Select a Bench Based on the Air Gap or Number of Optical Modules Needed.
- Choose a PAF FiberPort (Next Page)
- Select Mounted Optical Modules (Pages 1027-1033), Empty Modules (Page 1034).

# FiberBench Couplers

OFR, a division of THORLABS

The OFR FiberBenches and FiberTables are designed to be used with the PAF Series Couplers / Collimators. Common models are listed below.






| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| PAF-X-2-A | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-2-B | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-2-C | $ 460.00 | £ 289.80 | € 427,80 | ¥ 4,393.00 |
| PAF-X-5-A | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |
| PAF-X-5-B | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |
| PAF-X-5-C | $ 420.00 | £ 264.60 | € 390,60 | ¥ 4,011.00 |

- FC/PC and FC/APC Compatible
- 303 Non-Magnetic Stainless Steel
- Mounts to Wall Plates (HCA)
- Locking Mechanism
- See Pages 1016-1019 for the Full FiberPort Offering

| ITEM# | EFL (mm) | INPUT MFD (µm) | OUTPUT WAIST DIA. (mm) | MAX WAIST DIST. (mm) | DIVERGENCE (mrad) | LENS CHARACTERISTICS | | | SPAN |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CA (mm) | NA | AR λ (nm) | |
| PAF-X-2-A | 2.0 | 3.5 | 0.33 | 96 | 1.75 | 2.0 | 0.50 | 400-600 | < 76mm |
| PAF-X-2-B | 2.0 | 4.3 | 0.38 | 89 | 2.20 | 2.0 | 0.50 | 600-1050 | < 76mm |
| PAF-X-2-C | 2.0 | 10.4 | 0.38 | 38 | 5.20 | 2.0 | 0.50 | 1050-1600 | < 76mm |
| PAF-X-5-A | 4.6 | 3.5 | 0.75 | 500 | 0.76 | 4.9 | 0.53 | 400-600 | ≥ 76mm |
| PAF-X-5-B | 4.6 | 4.3 | 0.86 | 470 | 0.93 | 4.9 | 0.53 | 600-1050 | ≥ 76mm |
| PAF-X-5-C | 4.6 | 10.4 | 0.87 | 200 | 2.30 | 4.9 | 0.53 | 1050-1600 | ≥ 76mm |

# Polarization Controller Kit for 1550nm

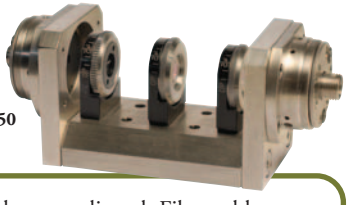
A polarization controller can be assembled from the FiberBench, FiberPort, and component modules. A bench controller has the same function as a paddle controller, but offers a more deterministic and more stable polarization manipulation. The kit contains three rotating zero-order wave plates (1/4, 1/2, 1/4). The retarders have precise continuous rotation through 360° and the combination can produce any possible polarization state.

**Features**

- Mechanical and Thermal Stability
- Deterministic Polarization Control

POLARIZATION CONTROLLER

PC-FFB-1550



The kit is supplied assembled but not aligned. Fiber cables can be purchased separately, see page 1058.

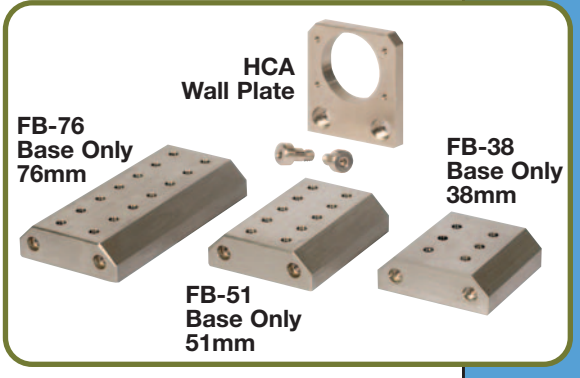
**Includes:**

- x1 FiberBench
- x2 FiberPort
- x1 Half-Wave Retarder
- x2 Quarter-Wave Retarder

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| PC-FFB-1550 | $ 2,320.00 | £ 1,461.60 | € 2.157,60 | ¥ 22,156.00 |

# FiberBench Spare Parts

FiberBenches can be ordered without the HCA wall plates. For free-space to fiber coupling applications, it is common to use a bench with only one wall plate.




### FiberBench Base and Wall Plate

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FB-38 | $ 115.00 | £ 72.50 | € 107,00 | ¥ 1,098.30 | FiberBench Base, 38mm Length |
| FB-51 | $ 125.00 | £ 78.80 | € 116,30 | ¥ 1,193.80 | FiberBench Base, 51mm Length |
| FB-76 | $ 135.00 | £ 85.10 | € 125,60 | ¥ 1,289.30 | FiberBench Base, 76mm Length |
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 | FiberBench Wall Plate |

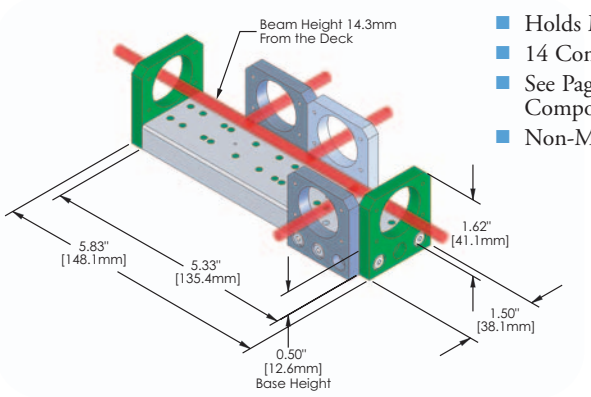
Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Single-Mode: PM
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# FiberTable

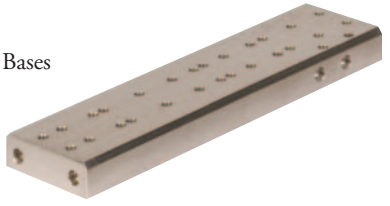
The FiberTable product selection offers platforms with support for three or more wall plates, which are sold separately. Each table is designed so that multiple PAF series fiber couplers/collimators (see pages 1016-1019) can be used to assemble complex systems. An array of holes are positioned on the top surface to allow for the mounting of wave plates, polarizers, beamsplitters, and other optical components. The tables provide a common, compact, and stable platform for optical system designs with parallel and perpendicular beam propagation paths.

NOTE: The FiberTables do not include HCA wall plates that are used to mount the PAF series fiber coupler. An HCA wall plate should be ordered for each input and output; see the previous page for PAF information.

## FiberTable - 38mm x 135mm, 5-Port



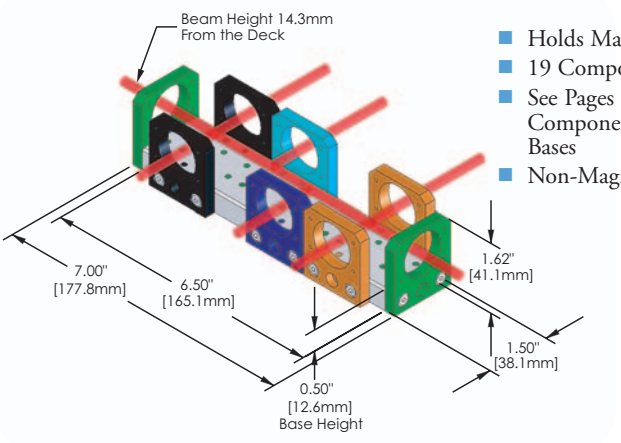

- Holds Maximum of 5 Wall Plates
- 14 Component Mounting Positions
- See Pages 1027-1034 for Optical Component Modules and Mounting Bases
- Non-Magnetic Stainless Steel



**Wall Plates (HCA) Sold Separately**

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| FT-38X135 | $ 240.00 | £ 151.20 | €223,20 | ¥ 2,292.00 |
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 |

## FiberTable - 38mm x 165mm, 8-Port

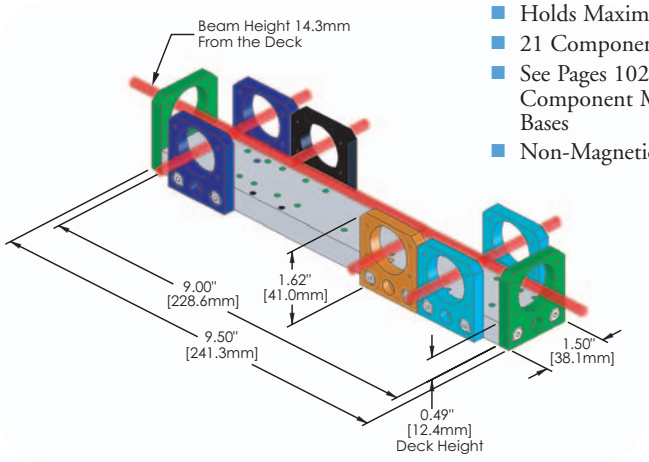



- Holds Maximum of 8 Wall Plates
- 19 Component Mounting Positions
- See Pages 1027-1034 for Optical Component Modules and Mounting Bases
- Non-Magnetic Stainless Steel

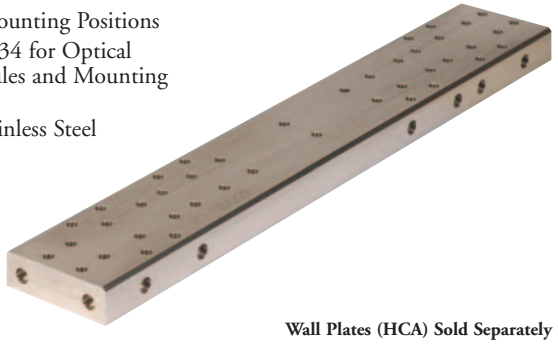
**Wall Plates (HCA) Sold Separately**

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| FT-38X165 | $ 260.00 | £ 163.80 | € 241,80 | ¥ 2,483.00 |
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 |

## FiberTable - 38mm x 229mm, 8-Port




- Holds Maximum of 8 Wall Plates
- 21 Component Mounting Positions
- See Pages 1027-1034 for Optical Component Modules and Mounting Bases
- Non-Magnetic Stainless Steel



**Wall Plates (HCA) Sold Separately**

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| FT-38X229 | $ 315.00 | £ 198.50 | €239,00 | ¥ 3,008.30 |
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 |

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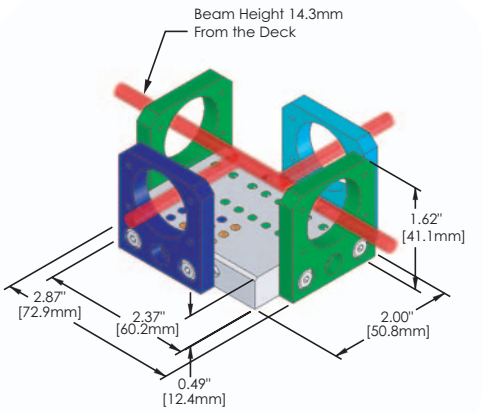
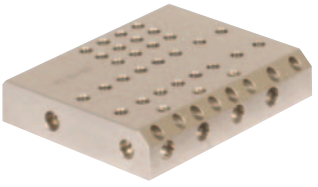
## FiberTable - 51mm x 60mm, 4-Port



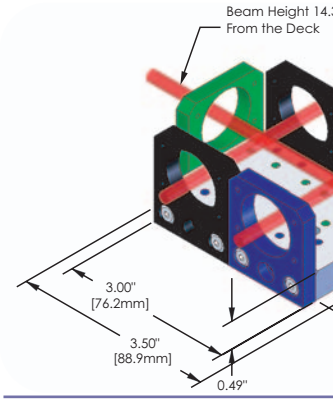



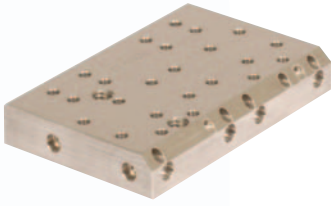
- Holds Maximum of 4 Wall Plates
- 16 Component Mounting Positions
- See Pages 1027-1034 for Optical Component Modules and Mounting Bases
- Non-Magnetic Stainless Steel

**Wall Plates (HCA) Sold Separately**

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| FT-51X60 | $ 195.00 | £ 122.90 | € 181,40 | ¥ 1,862.30 |
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 |

## FiberTable - 51mm x 76mm, 6-Port



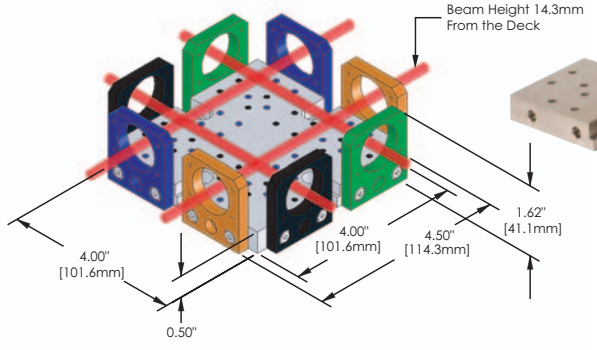



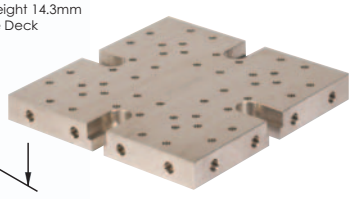
- Holds Maximum of 6 Wall Plates
- 12 Component Mounting Positions
- See Pages 1027-1034 for Optical Component Modules and Mounting Bases
- Non-Magnetic Stainless Steel

**Wall Plates (HCA) Sold Separately**

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| FT-51X76 | $ 345.00 | £ 217.40 | € 320,90 | ¥ 3,294.80 |
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 |

## FiberTable - 100mm x 100mm, 8-Port



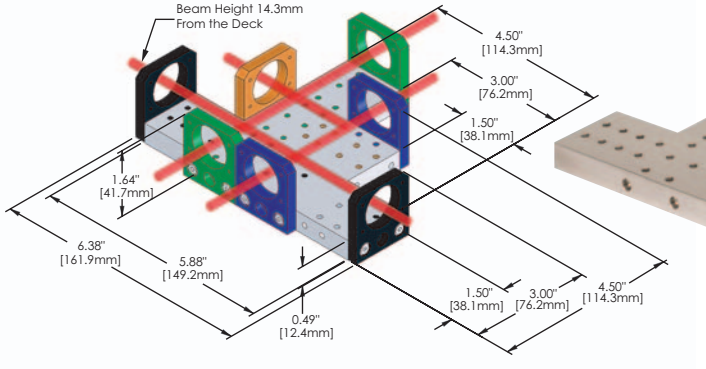



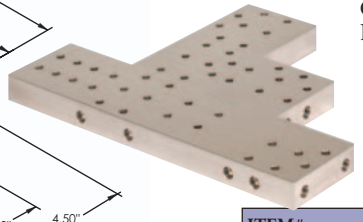
- Holds Maximum of 8 Wall Plates
- 24 Component Mounting Positions
- See Pages 1027-1034 for Optical Component Modules and Mounting Bases
- Non-Magnetic Stainless Steel

**Wall Plates (HCA) Sold Separately**

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| FT-100X100 | $ 670.00 | £ 422.10 | € 623,10 | ¥ 6,398.50 |
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 |

## FiberTable - 114mm x 149mm, 8-Port



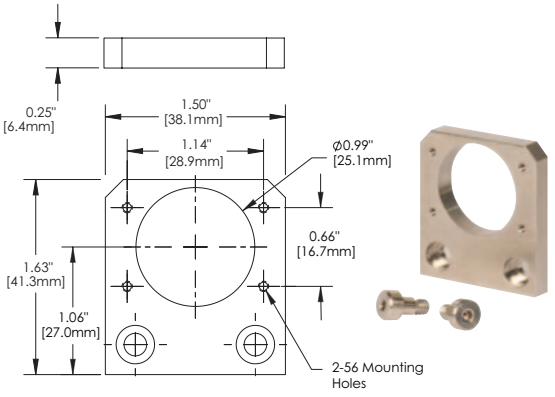
- Holds Maximum of 8 Wall Plates
- 24 Component Mounting Positions
- See Pages 1027-1034 for Optical Component Modules and Mounting Bases

**Wall Plates (HCA) Sold Separately**

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| FT-114X149 | $ 670.00 | £ 422.10 | € 623,10 | ¥ 6,398.50 |
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Single-Mode: PM
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Wall Plates




- For Mounting PAF Fiber Coupler to FiberBenches and FiberTables
- Mounting Screws Included

**FiberBench**
The basic building blocks of any FiberBench system are a FiberBench or FiberTable, a Wall Plate, and a FiberPort.

**FiberBench**
FB-51 FiberBench with HCA Wall Plate and RZB Rotating Zero-Order Retarder

**FiberPort**
PAF Fiber Coupler and Collimator for FC Patch Cables

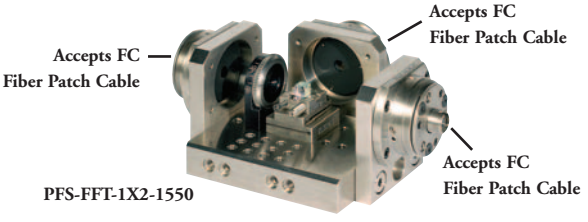
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| HCA | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 | FiberBench Wall Plate |

# Variable Polarization Splitter Kit

A half-wave retarder will rotate the input polarization orientation from a PM fiber. By changing the orientation, the ratio of the vertical to horizontal state of polarization (SOP) is changed, which will then affect how much signal is transmitted and reflected. The split ratio is continously variable from 0 to 40dB.*

*Dependent on Polarization Extinction Ratio from the input PM fiber.

**VARIABLE POLARIZATION SPLITTER**




### Features
- Mechanical and Thermal Stability
- Continuously Variable Split Ratio

| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| PFS-FFT-1X2-1550 | $ 2,650.00 | £ 1,669.50 | € 2.464,50 | ¥ 25,307.50 |

The kit is supplied assembled but not aligned. It is intended for use with either our broad sellection of patch cables (see pages 1058-1060) or customer supplied patch cables.

**Includes:**
- x1 FiberBench
- x2 FiberPort
- x1 Half Wave Retarder
- x2 Quarter Wave Retarder

Visit www.thorlabs.com For Mechnical Drawings and Our New Solid Models

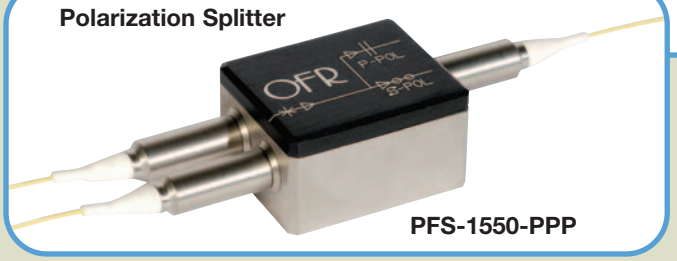
# OEM Fiber Components Production Services

The FiberBench product line is an excellent system for product prototyping and development. As the product design matures, we can further develop the product into a finshed, packaged, commercial component. Contact tech support for information.

**Polarization Neutral Splitter**

**PSP-S3-1x2-800**

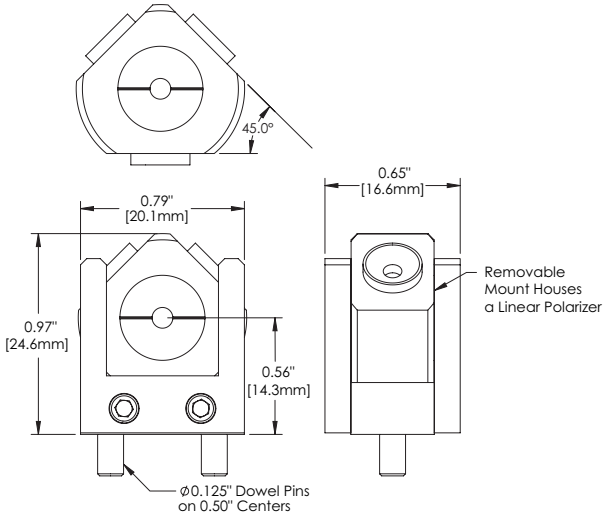
**Polarization Splitter**



**PFS-1550-PPP**

### Example Custom Systems
- Polarization Splitters
- Polarization Neutral Splitters
- Polarization Extinction Measurment Splitters
- PM, SM, and Multimode Fiber Models

# Linear Polarization Reference Module




## Features

- Precision Linear Polarization Reference
- 0°, 45°, 90°, and 135° Orientation
- Angle Tolerance <1°
- Highly Repeatable Positioning

## Applications

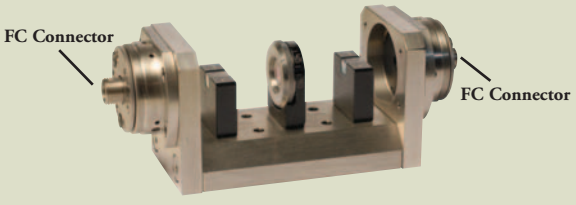
- Polarization Extinction Ratio Measurements
- Polarimetry
- PM Fiber Alignment

LPR-633

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| LPR-633 | $600.00 | £378.00 | € 558,00 | ¥ 5,730.00 | Linear Polarization Reference Module, 633nm |
| LPR-780 | $600.00 | £378.00 | € 558,00 | ¥ 5,730.00 | Linear Polarization Reference Module, 780nm |
| LPR-850 | $600.00 | £378.00 | € 558,00 | ¥ 5,730.00 | Linear Polarization Reference Module, 850nm |
| LPR-1310 | $825.00 | £519.80 | € 767,30 | ¥ 7,878.80 | Linear Polarization Reference Module, 1310nm |
| LPR-1550 | $825.00 | £519.80 | € 767,30 | ¥ 7,878.80 | Linear Polarization Reference Module, 1550nm |

Other wavelengths and units with an integrated quarter-wave retarder to function as a manual polarimeter are available by request.

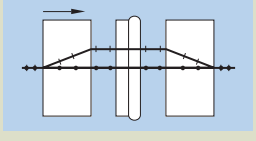
## Application: Variable Optical Attenuator




### Parts List

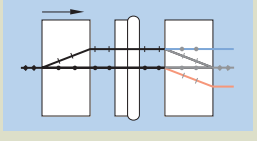
| QUANTITY | ITEM | DESCRIPTION | PAGE |
|---|---|---|---|
| 2 | PAF-X-2-C | Fiber Collimator/Coupler | 1023 |
| 1 | FB-51W | FiberBench | 1022 |
| 1 | RZBH-1550 | Rotating Half-Wave Plate | 1029 |
| 1 | PBB-1R-10-L | Calcite Walk-Off Polarizer | 1028 |
| 1 | PBB-1R-10-R | Calcite Walk-Off Polarizer | 1028 |
| 2 | Fiber Patchcord Required | | 1058 |

A continuously variable attenuator can be assembled using the following FiberBench parts: PAF collimator FiberPort (pages 1016-1019), FB-51W FiberBench, PBB calcite polarizers, and RZB rotating half-wave retarder. The PAF Series FiberPort collimates the beam from a SM or PM fiber, and the collimated beam then goes through a calcite walk-off polarizer where it is split into its respective horizontal (P) and vertical (S) components. The light then travels through a rotating half-wave retarder where the relative S and P orientations can be changed. Next, the signal enters another reversed calcite walk-off polarizer where it will be recombined or further separated. The only energy that will couple back into the output fiber is the signal on the central axis. The central beam will then be focused into the output fiber by the output PAF FiberPort.



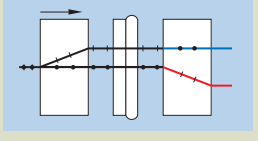
**Zero Attenuation:**

The RZBH Zero-Order Retarder Module is rotated so that there is only one output beam; this also means that the input and output polarizations are the same.



**Partial Attenuation:**

The RZBH Zero-Order Retarder Module is rotated so that there are three output beams. The RZB orientation will control how much energy is in each beam. The only energy that will couple into the fiber is the energy in the central beam. The attenuation range is 0-40dB with any value in between.

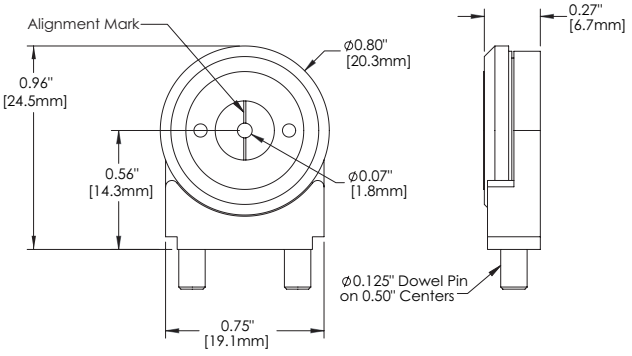


**Full Attenuation:**

The RZBH Zero-Order Retarder Module is rotated so that there are only two output beams, which will be displaced to the left and to the right of the center. In this position, there will be zero coupling, and the polarization has been rotated by 90°.

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Single-Mode: PM
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Linear Polarizer Modules




PCB-2.5-VIS

## Specifications

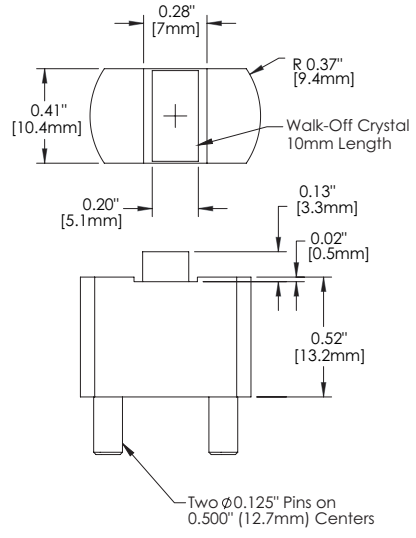
- Thin Film Linear Polarizer
- AR Coated Film Between Glass Plates
- 10,000:1 Extinction
- Wavefront Error < λ/10
- 1.5 and 2.5mm Apertures
- 360° Rotation
- 1.5° Measurement Precision
- Magnetic Mount for Smooth Continuous Rotation

This series of polarizer modules utilizes dichroic film polarizers that absorb the light not aligned to the transmission axis of the polarizer. While these polarizers provide excellent extinction their absorptive nature limits their power handling capability to 500mW spread over the aperture.

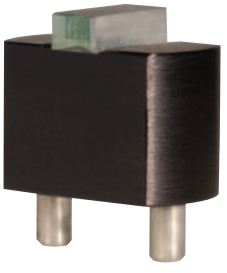
### Rotating Linear Polarizer Modules

| ITEM# | $ | £ | € | RMB | APERTURE | WAVELENGTH | TRANSMISSION | EXTINCTION |
|---|---|---|---|---|---|---|---|---|
| PCB-2.5-VIS | $ 265.00 | £ 167.00 | € 246,50 | ¥ 2,530.80 | 2.5mm | 630-690nm | >80% | >40dB |
| PCB-2.5-NIR | $ 265.00 | £ 167.00 | € 246,50 | ¥ 2,530.80 | 2.5mm | 750-870nm | >90% | >40dB |
| PCB-2.5-YAG | $ 265.00 | £ 167.00 | € 246,50 | ¥ 2,530.80 | 2.5mm | 970-1100nm | >95% | >40dB |
| PCB-1.5-1310 | $ 265.00 | £ 167.00 | € 246,50 | ¥ 2,530.80 | 1.5mm | 1270-1350nm | >97% | >40dB |
| PCB-1.5-1550 | $ 265.00 | £ 167.00 | € 246,50 | ¥ 2,530.80 | 1.5mm | 1500-1600nm | >98% | >40dB |
| PCB-2.5-1310 | $ 434.00 | £ 273.40 | € 403,60 | ¥ 4,144.70 | 2.5mm | 1270-1350nm | >97% | >40dB |
| PCB-2.5-1550 | $ 434.00 | £ 273.40 | € 403,60 | ¥ 4,144.70 | 2.5mm | 1500-1600nm | >98% | >40dB |

# Walk-Off Polarizer Module



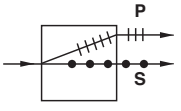

PBB-VIS-10-L



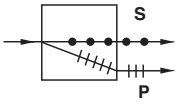
## Specifications

- AR Coated Calcite Polarizer
- 100,000:1 Extinction
- Beam Displacement 1mm
- Maximum Beam Input 1mm
- 500W/cm² Power Handling
- Broadband Operation

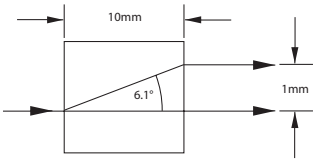
### Right-Handed Walk-Off Polarizer




### Left-Handed Walk-Off Polarizer




### Internal Separation Angle




### Calcite Walk-Off Polarizer Modules

| ITEM# | $ | £ | € | RMB | APERTURE | WAVELENGTH | TRANSMISSION | EXTINCTION |
|---|---|---|---|---|---|---|---|---|
| PBB-VIS-10-L | $ 270.00 | £ 170.10 | € 251,10 | ¥ 2,578.50 | 1.0mm | 620-690nm | >96% | >50dB |
| PBB-VIS-10-R | $ 270.00 | £ 170.10 | € 251,10 | ¥ 2,578.50 | 1.0mm | 620-690nm | >96% | >50dB |
| PBB-NIR-10-L | $ 270.00 | £ 170.10 | € 251,10 | ¥ 2,578.50 | 1.0mm | 770-870nm | >97% | >50dB |
| PBB-NIR-10-R | $ 270.00 | £ 170.10 | € 251,10 | ¥ 2,578.50 | 1.0mm | 770-870nm | >97% | >50dB |
| PBB-YAG-10-L | $ 270.00 | £ 170.10 | € 251,10 | ¥ 2,578.50 | 1.0mm | 970-1080nm | >97% | >50dB |
| PBB-YAG-10-R | $ 270.00 | £ 170.10 | € 251,10 | ¥ 2,578.50 | 1.0mm | 970-1080nm | >97% | >50dB |
| PBB-IR-10-L | $ 270.00 | £ 170.10 | € 251,10 | ¥ 2,578.50 | 1.0mm | 1280-1625nm | >97% | >50dB |
| PBB-IR-10-R | $ 270.00 | £ 170.10 | € 251,10 | ¥ 2,578.50 | 1.0mm | 1280-1625nm | >97% | >50dB |

# Rotating Retarder Modules

Retarders are mounted on a precision 360 degree rotation fixture. The mount has degree marks and a recordable scale with 1.5 degree precision. The modules are AR coated and fit so that they only contribute 0.1dB additional IL per component. Modules can be removed and replaced with no change in IL. Quarter- and half-wave modules can be added to create polarization controllers, PM fiber launch systems, and other devices.

## Zero-Order

The Zero-Order retarder module is a compound plate design with an epoxy-free beam path. The plates are air-spaced to provide a high-power beam path that has excellent wavefront and minimum beam deviation.

**Features**

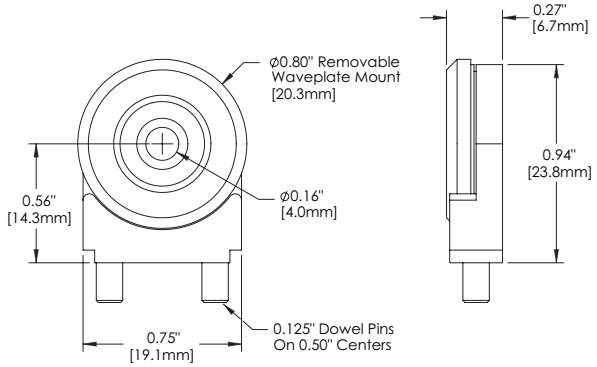
- Compound Plate Design
- Crystal Quart
- Epoxy-Free Beam Path
- Air-Spaced Construction
- High-Power Applications
- Engraved Angle Index

## Achromatic

The Achromatic retarder module is a compound plate design using Crystal Quartz and $MgF_2$. The plates are air-spaced to provide a high-power beam path that has excellent wavefront and minimum beam deviation. Acromatic retarders are best for applications that have greater than 20nm bandwidths.

**Features**

- Compound Plate Design
- Crystal Quart and $MgF_2$
- Epoxy-Free Beam Path
- Flat Spectral Response
- Air-Spaced Construction
- High-Power Applications
- Engraved Angle Index




### Specifications

- **Aperture:** 4mm
- **Beam Deviation:** < 1 arcmin
- **Wavefront Error:** < λ/10
- **Scratch Dig:** 20-10
- 360° Rotation
- 1.5° Measurement Precision

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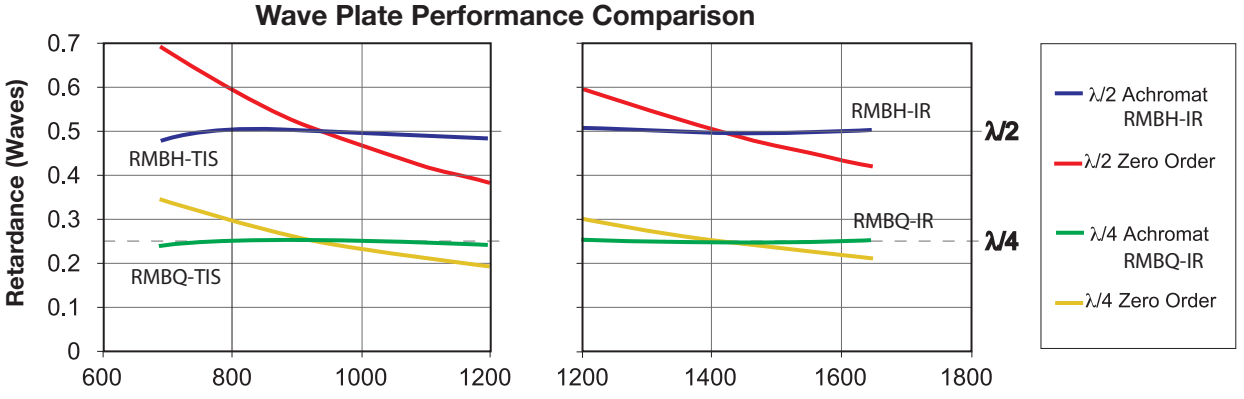



### Rotating Zero-Order Retarder Modules

| ITEM# λ/4 | ITEM# λ/2 | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|---|
| RZBQ-633 | RZBH-633 | $ 395.00 | £ 248.90 | €367,40 | ¥ 3,772.30 | Rotating Zero-Order Wave Plate for 633nm |
| RZBQ-780 | RZBH-780 | $ 395.00 | £ 248.90 | €367,40 | ¥ 3,772.30 | Rotating Zero-Order Wave Plate for 780nm |
| RZBQ-800 | RZBH-800 | $ 395.00 | £ 248.90 | €367,40 | ¥ 3,772.30 | Rotating Zero-Order Wave Plate for 800nm |
| RZBQ-850 | RZBH-850 | $ 395.00 | £ 248.90 | €367,40 | ¥ 3,772.30 | Rotating Zero-Order Wave Plate for 850nm |
| RZBQ-1064 | RZBH-1064 | $ 395.00 | £ 248.90 | €367,40 | ¥ 3,772.30 | Rotating Zero-Order Wave Plate for 1064nm |
| RZBQ-1550 | RZBH-1550 | $ 395.00 | £ 248.90 | €367,40 | ¥ 3,772.30 | Rotating Zero-Order Wave Plate for 1550nm |

### Rotating Achromatic Retarder Modules

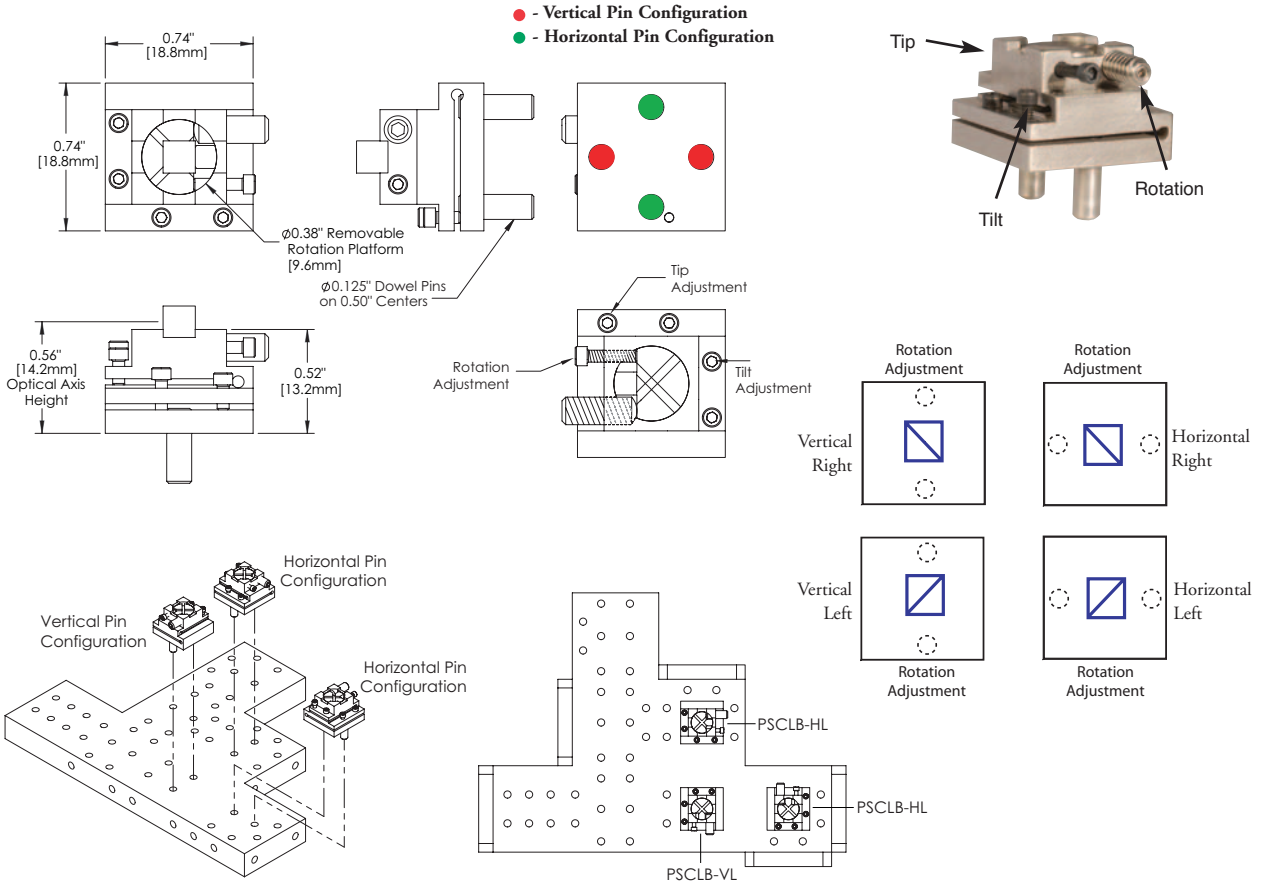
| ITEM# λ/4 | ITEM# λ/2 | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|---|
| RMBQ-TIS | RMBH-TIS | $ 500.00 | £315.00 | €465,20 | ¥ 4,775.00 | Rotating Achromatic Wave Plate, Spectral Range 780-1170nm |
| RMBQ-IR | RMBH-IR | $ 500.00 | £315.00 | €465,20 | ¥ 4,775.00 | Rotating Achromatic Wave Plate, Spectral Range 1200-1700nm |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Single-Mode: PM
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

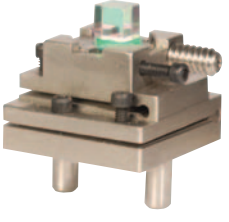
# Adjustable Polarizing Cube, Plate, and Mirror Tutorial

For applications that require a beam to be split or reflected, we offer polarizing cubes, beamsplitter plates, and mirrors mounted to a multiaxis flexure base. The base allows for tip, tilt, and rotational adjustment for precision beam alignment and steering control. The modules are mounted to provide easy access to the adjustment mechanism without interfering with the beam path. Mount that directs the beam to the correct ports without placing the adjusting screws in an inconvenient postion should be chosen carefully. The flexure base has two basic pin mounting orientations; vertical and horizontal. The vertical pin configuration is the most common and is used on all FiberTables, except the FT-100X100 and FT-1X6.

A vertical pin configuration is defined as having the pins mounted parallel to the rotation adjustment screw. In the horizontal configuration, the pins will be mounted perpendicular to the rotation adjustment screw. The next designation is handled as a Right or Left turn. The Right or Left designation will determine the orientation of the Cube, Plate, or Mirror with respect to the rotation adjustment screw. See the sketches and diagrams below for help in selecting a component.




# Adjustable Polarizing Cube Module



The PSCLB Series module uses a polarizing beamsplitter cube mounted on the ACB flexure base. The module provides a polarization-dependent split with better than a 1000:1 extinction ratio and is useful for polarization dependent measurements and applications that require a spatial beam overlap.

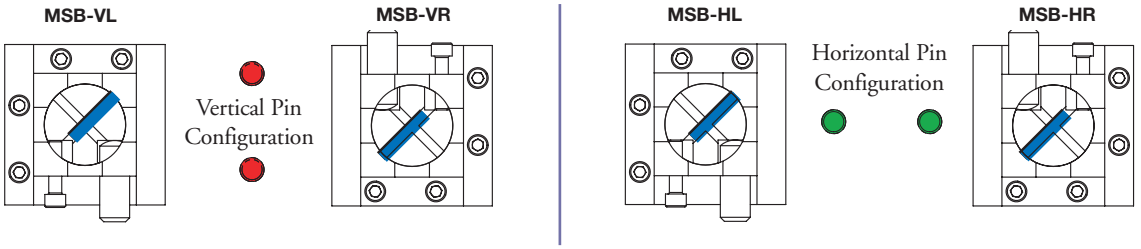
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| PSCLB-VL-780 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Vertical Left, 780nm |
| PSCLB-HL-780 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Horizontal Left, 780nm |
| PSCLB-VR-780 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Vertical Right, 780nm |
| PSCLB-HR-780 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Horizontal Right, 780nm |
| PSCLB-VL-1064 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Vertical Left, 1064nm |
| PSCLB-HL-1064 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Horizontal Left, 1064nm |
| PSCLB-VR-1064 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Vertical Right, 1064nm |
| PSCLB-HR-1064 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Horizontal Right, 1064nm |
| PSCLB-VL-1550 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Vertical Left, 1550nm |
| PSCLB-HL-1550 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Horizontal Left, 1550nm |
| PSCLB-VR-1550 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Vertical Right, 1550nm |
| PSCLB-HR-1550 | $ 550.00 | £ 346.50 | € 511,50 | ¥ 5,252.50 | FiberBench Beamsplitter, Horizontal Right, 1550nm |

## Specifications

- **Clear Aperture:** 1.5mm
- **Beam Deviation:** 90 ± 5arcmin
- **Wavefront Distortion:** ≤λ/4

# Adjustable Plate Beamsplitter Module

The MSB Series module uses a plate beamsplitter mounted on the ACB flexure base. The module provides a 4/96 or 50/50 split. The plate beamsplitter is useful for beam sampling applications or applications that require a relatively flat and neutral 50/50 split.




| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| MSB-VL-780-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Left, 780nm-50/50 |
| MSB-HL-780-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Left, 780nm-50/50 |
| MSB-VR-780-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Right, 780nm-50/50 |
| MSB-HR-780-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Right, 780nm-50/50 |
| MSB-VL-780-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Left, 780nm-4/96 |
| MSB-HL-780-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Left, 780nm-4/96 |
| MSB-VR-780-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Right, 780nm-4/96 |
| MSB-HR-780-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Right, 780nm-4/96 |
| MSB-VL-1064-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Left, 1064nm-50/50 |
| MSB-HL-1064-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Left, 1064nm-50/50 |
| MSB-VR-1064-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Right, 1064nm-50/50 |
| MSB-HR-1064-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Right, 1064nm-50/50 |
| MSB-VL-1064-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Left, 1064nm-4/96 |
| MSB-HL-1064-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Left, 1064nm-4/96 |
| MSB-VR-1064-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Right, 1064nm-4/96 |
| MSB-HR-1064-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Right, 1064nm-4/96 |
| MSB-VL-1550-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Left, 1550nm-50/50 |
| MSB-HL-1550-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Left, 1550nm-50/50 |
| MSB-VR-1550-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Right, 1550nm-50/50 |
| MSB-HR-1550-50/50 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Right, 1550nm-50/50 |
| MSB-VL-1550-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Left, 1550nm-4/96 |
| MSB-HL-1550-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Left, 1550nm-4/96 |
| MSB-VR-1550-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Vertical Right, 1550nm-4/96 |
| MSB-HR-1550-4/96 | $ 510.00 | £ 321.30 | € 474,30 | ¥ 4,870.50 | Beamsplitter, Horizontal Right, 1550nm-4/96 |

**MSB Plate Beamsplitter**

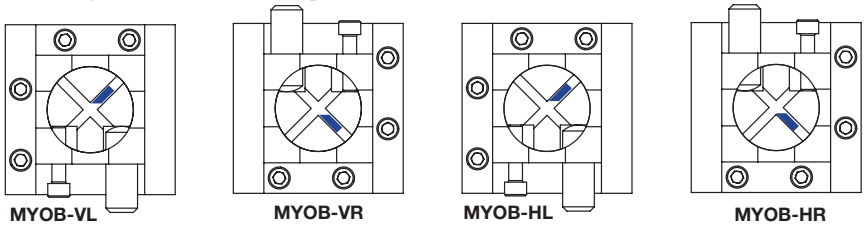
The black surface denotes the reflective surface of the beamsplitter. The back side is AR coated.

### Specifications

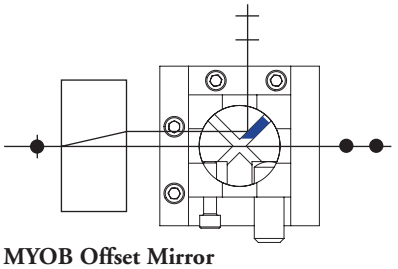
- **Clear Aperture:** 1.5mm
- **Wavefront Distortion:** ≤λ/4
- **Plate Thickness:** 1.5mm
- **Beam Displacement:** ~0.5mm

# Adjustable Offset Mirror Module

The MYOB series module uses an enchanced gold mirror that is positioned off axis from the center beam path. The mirror is positioned such that it will intersect the displaced beam from a preceding PBB polarizer to reflect it 90°. The PBB and MYOB combination simplifies the alignment of complex systems by de-coupling the transmitted and reflected beams, allowing for the independent adjustment of each beam path.




| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| MYOB-VL-780 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Vertical Left, 780nm |
| MYOB-HL-780 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Horizontal Left, 780nm |
| MYOB-VR-780 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Vertical Right, 780nm |
| MYOB-HR-780 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Horizontal Right, 780nm |
| MYOB-VL-1064 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Vertical Left, 1064nm |
| MYOB-HL-1064 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Horizontal Left, 1064nm |
| MYOB-VR-1064 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Vertical Right, 1064nm |
| MYOB-HR-1064 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Horizontal Right, 1064nm |
| MYOB-VL-1550 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Vertical Left, 1550nm |
| MYOB-HL-1550 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Horizontal Left, 1550nm |
| MYOB-VR-1550 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Vertical Right, 1550nm |
| MYOB-HR-1550 | $ 400.00 | £ 252.00 | € 372,20 | ¥ 3,820.00 | Gold Mirror, Horizontal Right, 1550nm |



**MYOB Offset Mirror**

Alignment is critical when aligning systems with a PBB/MYOB combination. Clipping can occur if the beam is too large or not centered.

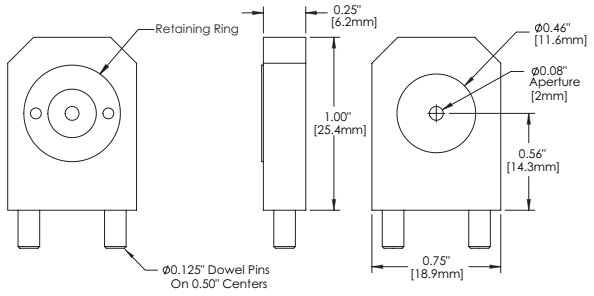
### Specifications

- **Clear Aperture:** 1.0mm
- **Wavefront Distortion:** ≤λ/4
- **Reflectivity:** > 95%

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Single-Mode: PM
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Attenuator Module

Our two most common neutral density filters, which have attenuations of 3 and 10dB, are available mounted in a 1/2" Optics Mount (HOM, see page 1033). Filters can be added in series to achieve higher attenuation levels.




**Specifications**
- **Clear Aperture:** 2mm
- **Surface Flatness:** λ/4
- Inconel ND Filter

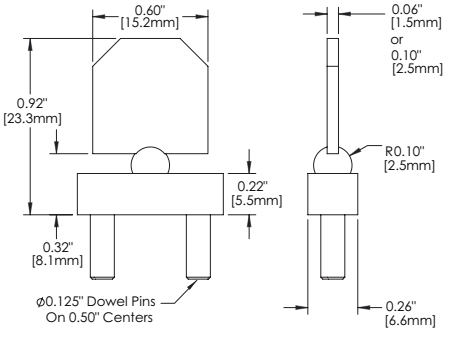
Other attenuation values available by request

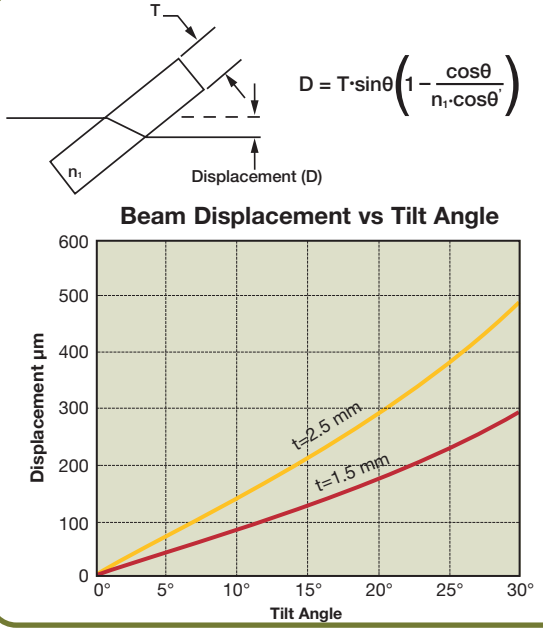
**FDB-03**

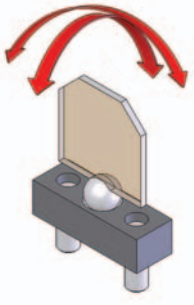
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FDB-03 | $ 200.00 | £ 126.00 | € 186,00 | ¥ 1,910.00 | FiberBench Attenuator, ND 0.3 |
| FDB-10 | $ 200.00 | £ 126.00 | € 186,00 | ¥ 1,910.00 | FiberBench Attenuator, ND 1.0 |

# X-Y Tweaker Module

The X-Y Tweaker Module consists of a precision-polished, AR-coated, plane-parallel plate mounted on a magnetic ball and socket. The plates are offered with a thickness of 1.5mm and 2.5mm and can be rotated and tilted in nearly any orientation. The beam is consequently displaced parallel to the optical axis by as much as ±500µm. Tilting beyond 30° can cause insertion loss because of the angular dependence of the AR coating. If source wanders or drifts are inputted the Tweaker module offers very quick, precise adjustment. Adjustments of a few microns are made easily.



**Adjustable**

- Use for Precise Beam Steering With Micron-Level Precision
- Vertical and Horizontal Beam Displacement
- Inquire About Using With Special Filters

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| HWXY-A | $ 180.00 | £ 113.40 | € 167,40 | ¥ 1,719.00 | Tweaker Module 1.5mm Thick, 350-650nm |
| HWXY-B | $ 180.00 | £ 113.40 | € 167,40 | ¥ 1,719.00 | Tweaker Module 1.5mm Thick, 650-1050nm |
| HWXY-C | $ 180.00 | £ 113.40 | € 167,40 | ¥ 1,719.00 | Tweaker Module 1.5mm Thick, 1050-1620nm |
| HWXYT-A | $ 180.00 | £ 113.40 | € 167,40 | ¥ 1,719.00 | Tweaker Module 2.5mm Thick, 350-650nm |
| HWXYT-B | $ 180.00 | £ 113.40 | € 167,40 | ¥ 1,719.00 | Tweaker Module 2.5mm Thick, 650-1050nm |
| HWXYT-C | $ 180.00 | £ 113.40 | € 167,40 | ¥ 1,719.00 | Tweaker Module 2.5mm Thick, 1050-1620nm |

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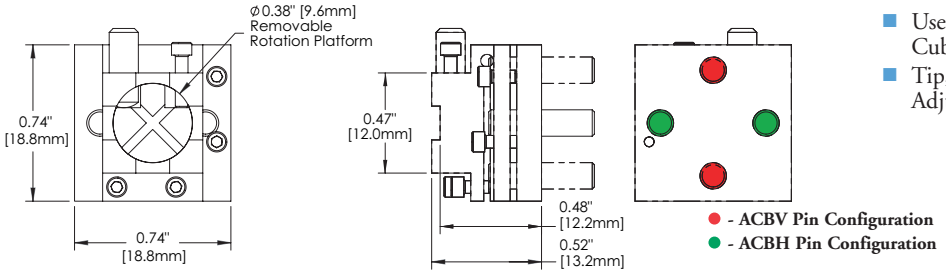
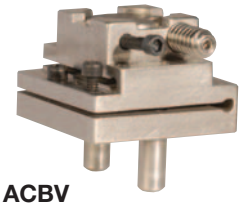
# Flexure Bases

There are several general optics mounts that can be used to attach customer-supplied optical components to the FiberBench and FiberTable. All modules are designed to put the optic at the appropriate beam height through the system. Modules are available for fixed static mounting, flexure, and rotational mounting. See page 1030 for tutorial.




- Use for Beamsplitter Plates and Cubes
- Tip, Tilt, and Rotation Stage Adjustment



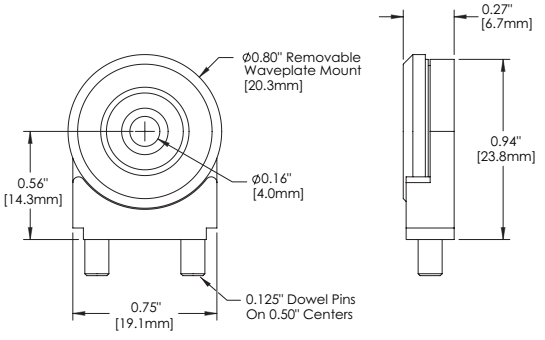
ACBV

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| ACBV | $ 290.00 | £ 182.70 | € 269,70 | ¥ 2,769.50 | FiberBench Flexure Base, Vertical Pins |
| ACBH | $ 290.00 | £ 182.70 | € 269,70 | ¥ 2,769.50 | FiberBench Flexure Base, Horizontal Pins |

# Rotation Mount

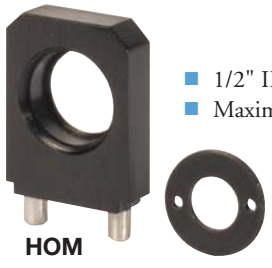
RCB

- Use for Rotating Filters or Polarizers
- Magnetic Mount for Smooth Continuous Rotation
- 360° Rotation
- 1.5° Measurement Precision



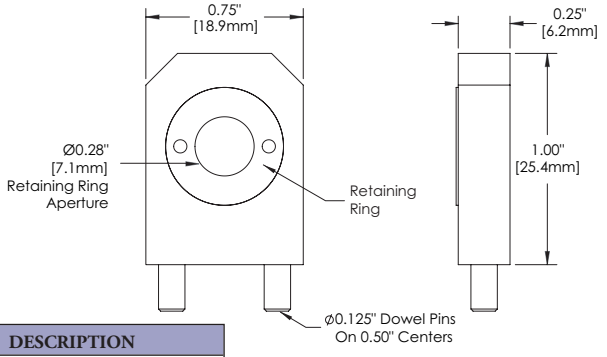

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| RCB | $ 95.00 | £ 59.90 | € 88,40 | ¥ 907.30 | FiberBench Rotation Mount |

# 1/2" Optics Mount



HOM

- 1/2" ID Holder With Retaining Ring
- Maximum Optical Thickness 1.5mm




| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| HOM | $ 55.00 | £ 34.70 | € 51,20 | ¥ 525.30 | FiberBench 1/2" Optics Mount |

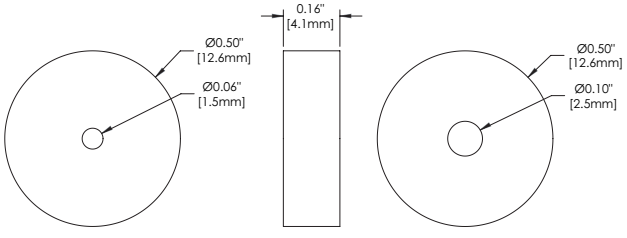
# Aperture Plates

Aperture plates are a useful tool for system alignment. The aperture plate is mounted into the above HOM mount and is then used to establish an optical center line in a FiberBench/FiberTable system. It is also useful for blocking stray light or other unwanted light in an optical system.

AP1.5

AP2.5

- Mounts in HOM 1/2" Optic Mount
- 1.5 and 2.5mm Apertures




AP1.5 AP2.5

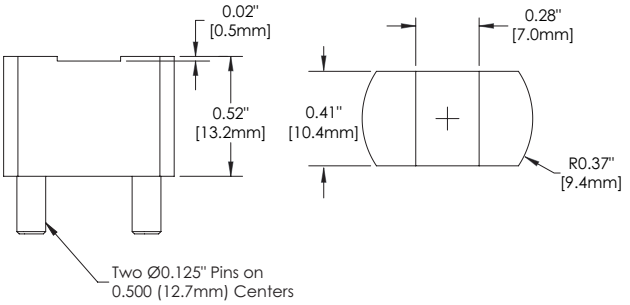
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| AP1.5 | $ 20.00 | £ 12.60 | € 18,60 | ¥ 191.00 | HOM Aperture Plate 1.5mm |
| AP2.5 | $ 20.00 | £ 12.60 | € 18,60 | ¥ 191.00 | HOM Aperture Plate 2.5mm |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Single-Mode: PM
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Static Mounting Platform

HCB

- Use for Static Mounting of Filters, Prisms, Polarizers
- Approximately 1.5mm from Beam Centerline to Top Surface

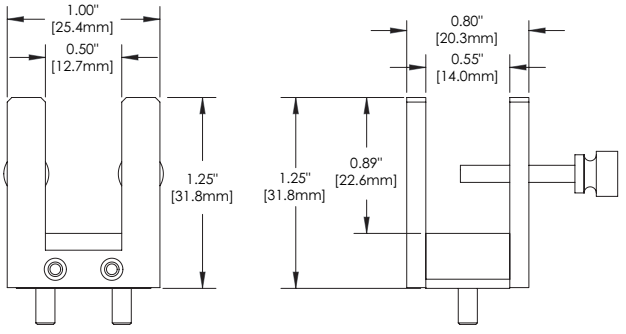



| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| HCB | $ 55.00 | £ 34.70 | € 51,20 | ¥ 525.30 | Static Mount Platform |

# Universal Component Base

UCB

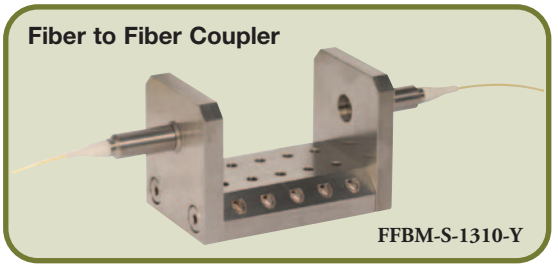
- Used for Mounting Filters and Windows
- Non-Marring Delrin Construction
- Maximum Thickness is 15mm



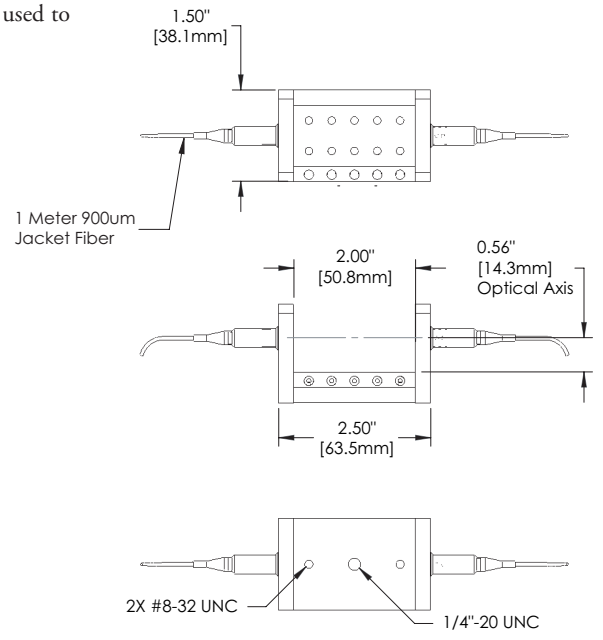

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| UCB | $125.00 | £ 78.80 | € 116,30 | ¥ 1,193.80 | Universal Mounting Base |

# Permanent Pigtailed Fiber-Fiber Coupler

For systems that require the utmost in stability in the field, factory locked fiber-fiber couplers can be ordered. Aligned systems do not drift and cannot be adjusted. Modules can be inserted into the bench with only 0.1dB* insertion loss per component. When inserting thick optical components into the beam path, lateral offset can occur, leading to additional insertion loss. The HWXY tweaker module can be used to compensate for up to 500µm of beam displacement.




- Locked Coupling
- Thermally and Mechanically Stable
- Five Module Mounting Positions




| ITEM # | FFBM-S-1310-Y | FFBM-S-1550-Y |
|---|---|---|
| Wavelength | 1310nm ± 20nm | 1550nm ± 20nm |
| Max Power | 3W | 3W |
| Insertion Loss | 0.6 ± 0.3dB* | 0.6 ± 0.3dB* |
| Return Loss | >55dB | >55dB |
| Fiber | SMF-28e | SMF-28e |

* Insertion Loss does not include connector losses

| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| FFBM-S-1310-Y | $ 975.00 | £ 614.30 | € 906,80 | ¥ 9,311.30 | Cleaved | SM Fiber-Fiber Coupler, 1310nm |
| FFBM-S-1310-Y-PC | $ 1,075.00 | £ 677.30 | € 999,80 | ¥ 10,266.30 | FC/PC | SM Fiber-Fiber Coupler, 1310nm |
| FFBM-S-1550-Y | $ 975.00 | £ 614.30 | € 906,80 | ¥ 9,311.30 | Cleaved | SM Fiber-Fiber Coupler, 1550nm |
| FFBM-S-1550-Y-PC | $ 1,075.00 | £ 677.30 | € 999,80 | ¥ 10,266.30 | FC/PC | SM Fiber-Fiber Coupler, 1550nm |

# 1x2 Solid-State Fiber Optic Switch

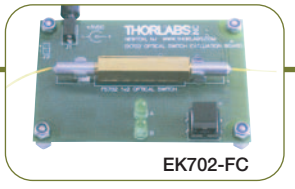
The FS Series switch connects optical channels by redirecting an incoming optical signal into a selected output fiber. This is achieved using non-mechanical proprietary configurations and activated via an electrical control signal. Latching operation preserves the selected optical path after the drive signal has been removed.

- Ultra-High Reliability & Repeatability
- Latching, Bidirectional Operation and Fast Switching Speed
- Ideal for Building Test and Measurement Setups


## Specifications

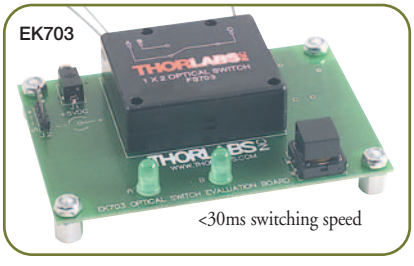
- **Operating Wavelength:** 1520-1610nm
- **Insertion Loss:** <1dB
- **Crosstalk:** -50dB
- **Polarization Dependent Loss:** ≤0.2dB
- **Polarization Mode Dispersion:** 0.1ps Typical
- **Return Loss:** ≥55dB Typical
- **Switching Speed:** <200µs
- **Drive Voltage:** 5V
- **Operating Temperature:**
  **EK702-FC:** 10 to 40°C
  **FS702:** -5 to 70°C

The FS702 is available in a convenient evaluation kit, which includes all necessary drive circuitry to actuate the fiber switch. Fully compatible with our LDS1 power supplies, the EK702-FC also includes FC/PC connectors on all three optical fibers.




| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FS702 | $ 1,640.00 | £ 1,033.20 | € 1.525,20 | ¥ 15,662.00 | 1x2 Bidirectional High-Speed Switch Kit, FC/PC Connectors |
| EK702-FC | $ 1,780.00 | £ 1,121.40 | € 1.655,40 | ¥ 16,999.00 | 1x2 Solid State Fiber Optic Switch |
| LDS1 | $ 81.40 | £ 51.30 | € 75,70 | ¥ 777.40 | 5VDC Regulated Power Supply |

1) Evaluation Kit, Power Supply sold separately 2) Switch only




# 1x2 Bidirectional Optical Switch Modules

The EK703-FC evaluation kit contains a 1x2 bidirectional optical switch module and all of the necessary electronics to drive the switch. This MEMS type switch comes complete with FC/PC terminations.

- High Reliability due to MEMS Technology
- Switching Speed (<30ms)
- Excellent Repeatability (0.01dB Max.)

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| EK703-FC | $ 575.00 | £ 362.30 | € 534,80 | ¥ 5,491.30 | 1x2 Bidirectional Switch Kit, FC\PC Connectors |

TOOLS OF THE TRADE

# Polarization Measurement Platform


The PAX5710 consists of a TXP compatible card and an external polarization measurement sensor. The PAN5710 external measurement sensor facilitates polarization analysis in free-space setups. It can be easily mounted to optical benches and is also compatible with our extensive line of 30mm cage system components. All sensors are supplied with a fiber collimator for FC/PC optical cables to allow polarization measurements on fiber based systems, or you may choose to use the PAX5720, which is dedicated to fiber based measurements.

**See Page 976**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# 1x2 and 2x2 MEMS Optical Switch Kits

The OSWxx Series Switch Kits include a MEMS optical switch with an integrated control circuit that includes a USB 2.0 interface for easy integration into your optical system. It is available as 1x2 or 2x2 MEMS modules with an operating wavelength of 488, 633, 780, 830, 980, or 1310nm. These bidirectional switches have low insertion loss and excellent repeatability. The switching mechanism is based on silicon MEMS technology, which ensures high reliability, provides exceptionally low crosstalk between channels, and is inherently very fast (switching time <1ms). The OSWxx switches are designed for the distribution and routing of signals at the indicated visible or near infrared wavelengths. The switches are controlled via an on-board pushbutton switch, a TTL toggle input signal, or digitally via the USB 2.0 port. A seven segment LED displays the active channel.

By default, all switches are shipped without fiber connectors. Termination of the fibers is available upon request; please contact your local Thorlabs office or distributor for pricing. Additionally, 1x4 and 1x8 MEMS switch modules are available upon request.

The OSWxx Series requires a +5V DC supply voltage. The Thorlabs LDS1 power supply is an ideal choice and is listed in the tables below.

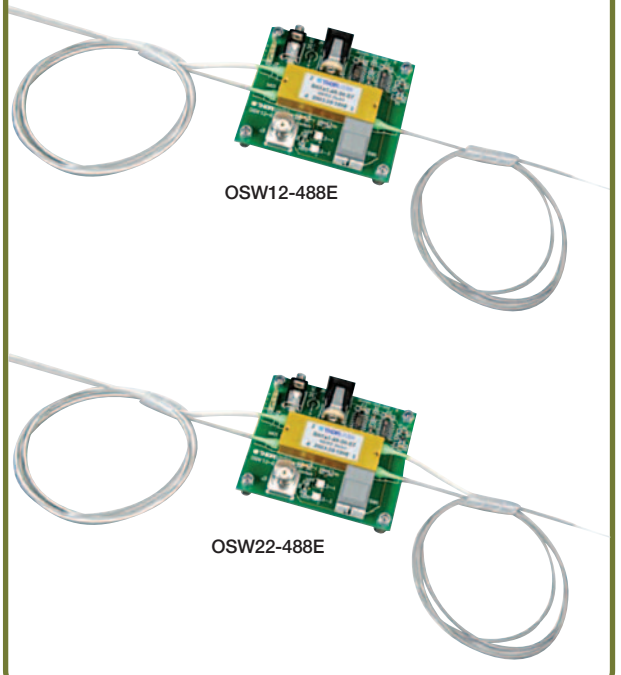
## Specifications

- **Operating Wavelengths:** 488&514, 633&680, 780, 830, 980&1064, and 1310&1550nm
- **Switching Time:** 1ms, Max
- **Repeatability:** 0.001dB Max
- **Insertion Loss:** 0.7dB Typical
- **Crosstalk:** 75dB Typical
- **Back Reflection:** 55dB Typical
- **Polarization Dependent Loss:** 0.02dB Typical

## Features

- **Switch Types:** 1x2, 2x2 (Optional: 1x4, 1x8)
- **USB Remote Control**
- Pushbutton Toggle Switch on Board
- TTL Input
- **Channel:** Indication by 7 Segment LED Display
- TTL Status Signals
- **Euro Size Card:** (100mm x 160mm) With Standard DIN 41612 Connector for Easy Integration Into 19" Systems
- **Power Supply:** 5VDC by Wall Adapter or via DIN 41612 Connector

RoHS COMPLIANT




### VIS/NIR MEMS 1x2 Switch Kits – FC/PC and FC/APC Connectors Available, Please Call

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| OSW12-488E | $ 1,068.00 | £ 672.80 | € 993,20 | ¥ 10,199.40 | Electronic Controlled 1x2 Switch Module 488nm & 514nm |
| OSW12-633E | $ 1,068.00 | £ 672.80 | € 993,20 | ¥ 10,199.40 | Electronic Controlled 1x2 Switch Module 633nm & 680nm |
| OSW12-780E | $ 1,068.00 | £ 672.80 | € 993,20 | ¥ 10,199.40 | Electronic Controlled 1x2 Switch Module 780nm |
| OSW12-830E | $ 1,068.00 | £ 672.80 | € 993,20 | ¥ 10,199.40 | Electronic Controlled 1x2 Switch Module 830nm |
| OSW12-980E | $ 1,068.00 | £ 672.80 | € 993,20 | ¥ 10,199.40 | Electronic Controlled 1x2 Switch Module 980nm & 1064nm |
| OSW12-1310E | $ 1,068.00 | £ 672.80 | € 993,20 | ¥ 10,199.40 | Electronic Controlled 1x2 Switch Module 1310nm & 1550nm |
| LDS1 | $ 81.40 | £ 51.30 | € 75,70 | ¥ 777.40 | 5V Regulated Power Supply |

### VIS/NIR MEMS 2x2 Switch Kits – FC/PC and FC/APC Connectors Available, Please Call

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| OSW22-488E | $ 1,188.00 | £ 748.40 | € 1.104,80 | ¥ 11,345.40 | Electronic Controlled 2x2 Switch Module 488nm & 514nm |
| OSW22-633E | $ 1,188.00 | £ 748.40 | € 1.104,80 | ¥ 11,345.40 | Electronic Controlled 2x2 Switch Module 633nm & 680nm |
| OSW22-780E | $ 1,188.00 | £ 748.40 | € 1.104,80 | ¥ 11,345.40 | Electronic Controlled 2x2 Switch Module 780nm |
| OSW22-830E | $ 1,188.00 | £ 748.40 | € 1.104,80 | ¥ 11,345.40 | Electronic Controlled 2x2 Switch Module 830nm |
| OSW22-980E | $ 1,188.00 | £ 748.40 | € 1.104,80 | ¥ 11,345.40 | Electronic Controlled 2x2 Switch Module 980nm & 1064nm |
| OSW22-1310E | $ 1,188.00 | £ 748.40 | € 1.104,80 | ¥ 11,345.40 | Electronic Controlled 2x2 Switch Module 1310nm & 1550nm |
| LDS1 | $ 81.40 | £ 51.30 | € 75,70 | ¥ 777.40 | 5V Regulated Power Supply |

# PDA8000 Photocurrent Measurement Module


**Modules for Optical Power Measurement**

The PDA8000 is designed as a plug-in module for the PRO8000 chassis detailed on page 432. The module is recognized by the chassis when powered. All of the control functions of the photocurrent amplifier can be used in manual or remote modes.

The PDA8000 series single- or dual-channel photocurrent measurement modules enables high-precision measurement of photocurrents with 16-bit resolution. Seven measurement ranges are available; on the most sensitive 10nA full scale setting, the resolution is 0.1pA.

If your photodiode is calibrated, the photocurrent module can be used as a precise optical power meter with high resolution and a large dynamic range.

PRO800 With PDA8000-2 and ITC8022 Module


**Introduction – Photocurrent Measurement Module**

The PDA8000 photocurrent measurement module is an ideal companion for our other PRO8000 series plug-in modules. It provides precise photocurrent measurements from a few pA to 10mA. An over-sampled 16-bit A/D converter is used to ensure a measurement resolution of ±0.001% of the full scale reading. These features, combined with the built-in, low noise photodiode bias, make this instrument an ideal photodiode current amplifier.

**Calibrated Optical Power Measurements**

Using the PDA8000 a photodiode can be calibrated to read out directly in optical power. Through the input screen of the PRO8000, a photodiode responsivity value can be entered. This allows the direct entry of standard calibration data provided by photodiode manufacturers when a calibrated diode is purchased.

**Computer Control IEEE-488.2**

As with all of our PRO8000 compatible modules, all of the PDA8000 module commands can be accessed via the IEEE-488 interface. This includes access to the calibration factor, the photodiode bias voltage, all of the measurement control parameters, and the measurement results.

## Features

- Seven Current Measurement Ranges From 10nA to 10mA, With 16 Bit Resolution
- Resolution 0.1pA on the 10nA scale
- Accuracy ±0.025% of Full Scale Reading
- Single & Dual Channel Modules

## Photocurrent Module Specification

- **Photodiode Current Range:** 10nA to 10mA
- **Photodiode Polarity:** Freely Selectable
- **Setting Range of Bias Voltage (Can be Switched Off):** 0.1V to 10V
- **Setting Range of Sensitivity for Power Display:** Freely Programmable
- **Input Resistance:** Virtual Ground
- **Temperature Coefficient:** 50ppm / °C

## General Data

- **Module Width:** 1 Slot
- **Photodiode Connectors:**
  PDA8000-1 1xBNC
  PDA8000-2 2xBNC

All data are valid at 23 ± 5°C and 45 ± 15% relative humidity.

## PDA8000 Measurement Range

| Measurement Range | Resolution | Accuracy |
|---|---|---|
| 10mA | 0.1µA | ± 0.025% Full Scale |
| 1mA | 10nA | ± 0.025% Full Scale |
| 100µA | 1nA | ± 0.025% Full Scale |
| 10µA | 0.1nA | ± 0.025% Full Scale |
| 1µA | 10pA | ± 0.025% Full Scale |
| 100nA | 1pA | ± 0.25% Full Scale |
| 10nA | 0.1pA | ± 0.8% Full Scale |

**Precision Optical measurements**

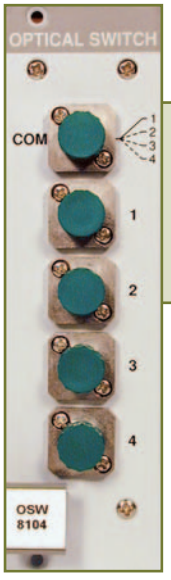
The variable photodiode bias allows for operating in either a photovoltaic or photoconductive mode. The bias also reduces the junction capacitance of the diode, thus improving the linearity of the detector when making long-term measurements. Additionally, there is a front panel trim-pot that is used to null out the photodiode dark currents that are found in semiconductor optical sensors.

**The PDA8000 is designed as a plug-in module for the PRO8000 chassis detailed on page 432. The module is recognized by the chassis when powered. All of the control functions of the photocurrent amplifier can be used in manual or remote modes.**

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| PDA8000-1 | $ 900.00 | £ 567.00 | € 837,00 | ¥ 8,595.00 | Photocurrent Measurement Module, 1 Channel |
| PDA8000-2 | $ 1,020.00 | £ 642.60 | € 948,60 | ¥ 9,741.00 | Photocurrent Measurement Module, 2 Channels |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Optical Switch Modules





**PRO8000 Optical Switch Modules:** The OSW8000 optical switch modules facilitate distribution of test signals in complex test setups. The modularity of 1x2, 1x4, 1x8, and 2x2 switches allows flexible routing paths. The bidirectional, ultra-fast, and highly reliable switch modules are designed for low insertion loss with excellent repeatability. The exceptionally low crosstalk between switch channels ensures the integrity of high precision optical measurements.

**Introduction - Optical Switch Modules**
This family of optical switching modules provides additional building blocks when constructing automated optical test networks. Four different bidirectional switching modules are available, providing highly flexible routing of optical signals.

The PRO8000 series bidirectional Optical Switches with their fast switching time (typically, rise times are better than 0.5ms with a maximum of 1ms), and broad wavelength range (1240nm to 1610nm) are ideal companions to our extensive line of DWDM and CWDM laser diode sources shown on pages 558 through 563. The four different modules offered are 1x2, 1x4, 1x8, and 2x2 switches, each of which features low insertion loss and excellent repeatability.

Utilizing the IEEE-488.2 interface facilitates complete control of the multiple functions of each module, thus supporting the configuration of complex test routines that utilize different types of modules.

## Switch Modules Highlights

- Very Fast Response Time, 0.5ms Typical, 1ms Max
- Low Insertion Loss, Typical 0.7dB (1x2), Max 1.5dB (1x4)
- Excellent Repeatability of ±0.01dB
- MEMS Technology for Long Life (>$10^9$ Cycles)
- Four Modules: 1x2, 1x4, 1x8, and 2x2
- Up to Eight Switch Modules per Chassis
- LabVIEW™ and LabWindows™/CVI Drivers Included
- Efficient Test Signal Routing in Branching Test Beds

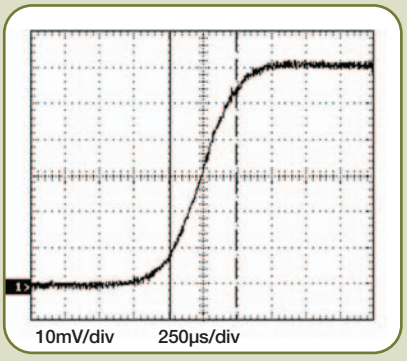




**Figure 1**
Rise time measurement of the MEMS based optical switch; the rise time measured between the 10% and 90% points is 480µs.

**MEMS Technology:**
**Provides Billions of Switch Cycles**
The switching mechanism is based on silicon MEMS (Micro-Electro-Mechanical Systems) technology which ensures very long lifetime and fast operation (see Figure 1). This technology also provides very low crosstalk between channels; the 1x4 and 1x8 switches have a maximum crosstalk specification of -60dB, and the 1x2 and 2x2 are both rated at -50dB.

**IEEE-488 Computer Control of Multiple PRO8000's**
The PRO8000 chassis (2 slot and 8 slot models) are both equipped with a fast IEEE-488.2 interface supported by a number of free LabVIEW™ and LabWindows™ drivers. The PRO8000 can accept an assortment of different modules allowing the OSW8000 switches to be combined with our high-performance laser sources. All PRO8000 series chassis are also equipped with an RS-232C interface.

**User Friendly Operation**
The PRO8000 series chassis offer a user friendly, menu-driven platform from which a selection of various modules can be operated.

Configuring a system is as simple as inserting the modules; each of the plug-in modules automatically identify themselves to the chassis processor. A brightly lit, 4x20 fluorescence display allows the user to scroll through and select any installed module. When selected on the display, all of the control parameters for the individual module are accessible – all functionality is controllable via the front panel. Additional higher level commands are available for operating the system via the IEEE-488 interface, facilitating changing switch settings to automate multi-path testing.

# Optical Switch Modules – Continued



The OSW8000 series of modules requires one of our two PRO8000 series chassis to operate. We offer a two bay chassis that is useful where space is limited and an eight bay system. The eight bay PRO8000 chassis is ideal for use in building larger test systems. A large number of the mainframes can be controlled simultaneously via the IEEE-488.2 interface. Details on both of these PRO8000 chassis can be found on page 432.

## OSW8000 Series DWDM modules

| | OSW8102 | OSW8104 | OSW8108 | OSW8202 |
|---|---|---|---|---|
| Switching Configuration | 1x2 | 1x4 | 1x8 | 2x2 |
| Switching Time Typical | 0.5ms Typical (1ms Max) | | | |
| Wavelength Ranges | 1240 to 1610nm | | | |
| Maximum Input Power | 17dBm | | | |
| Insertion Loss (Typical/Max)[1] | 0.7dB/<1.5dB | 1.2dB/<2.1dB | 1.6dB/<2.6dB | 0.7dB/<1.5dB |
| PDL[2] | <0.1dB | 0.15dB | <0.2dB | <0.15dB |
| Crosstalk, Max | -50dB | -60dB | -60dB | -50dB |
| Repeatability | ±0.01dB | | | |
| Return Loss | -50dB | -50dB | -45dB | -50dB |
| Connectors[3] | FC/APC | | | |
| **General Data** | | | | |
| Operating Temperature | 0 to 35°C | | | |
| Storing Temperature | -10°C to +60°C | | | |
| Width | 1 Slot | | | |

1) Including connectors.
2) Measured at 1550nm.
3) Other connectors on request.

**Other Connectors Available**

## We Help You

For customers who need to drive and monitor multiple devices simultaneously, or for those who would like all of their instrumentation controlled from one convenient location, Thorlabs offers the PRO8 and TXP families of host frames and a suite of modules to customize your instrumentation needs.

**Modular WDM Laser Systems**
**DWDM Laser Modules**
**CWDM Laser Modules**

**See Pages 430-448**

**Put it all Together**

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| OSW8102 | $ 3,120.00 | £ 1,965.60 | € 2.901,60 | ¥ 29,796.00 | 1x2 Optical Switch, FC/APC |
| OSW8104 | $ 4,080.00 | £ 2,570.40 | € 3.794,40 | ¥ 38,964.00 | 1x4 Optical Switch, FC/APC |
| OSW8108 | $ 7,920.00 | £ 4,989.60 | € 7.365,60 | ¥ 75,636.00 | 1x8 Optical Switch, FC/APC |
| OSW8202 | $ 3,840.00 | £ 2,419.20 | € 3.571,20 | ¥ 36,672.00 | 2x2 Optical Switch, FC/APC |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

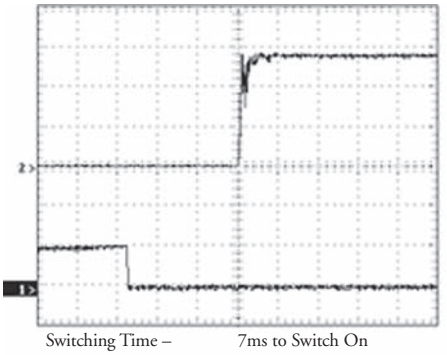
# Multichannel Optical Switch


MCS412

The MCS412 consists of four individual 1x2 optical switches that can be used separately as four bidirectional 1x2 switches or in conjunction with each other to form a bidirectional 1x5 optical switch.

Channel selection can be performed manually from the front panel simply by pressing one of four control switches or remotely by applying a TTL signal to the DB9 connector located on the rear panel.

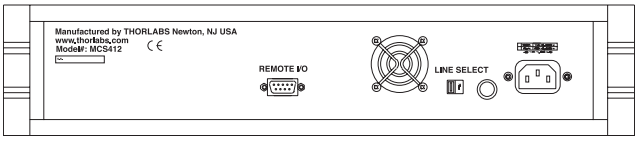
The active output fiber is indicated on an array of eight LEDs on the front panel and TTL signals are available on the rear panel DB9 connector.

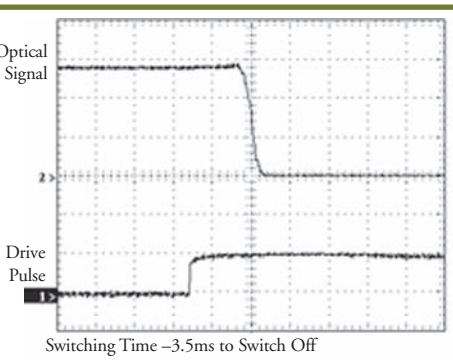


Switching Time – 7ms to Switch On
2.5 ms/div

## Features

- Bidirectional MEMS Switch Architecture
- Four 1x2 Optical Switches
- Configurable to a 5:1 Optical Multiplexer
- Remote Controlled Using Standard TTL Signals
- Simple Front Panel and Remote Control



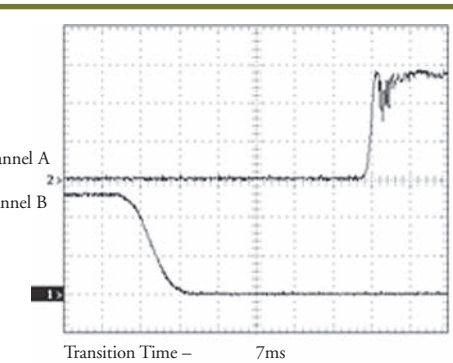

Switching Time –3.5ms to Switch Off
2.5 ms/div

## General Specifications

Number of Switches . . . . . Four
Switch Types . . . . . Bidirectional MEMS
Fiber Type . . . . . Corning SMF-28 or Equivalent
Fiber Connection . . . . . FC/PC Style Fiber Optic Connector
External Interface . . . . . DB9 (TTL Logic)
Line Voltage . . . . . 115/230VAC @ 50-60Hz (Switch Selectable)

## Performance Specifications

| Parameter | Minimum | Typical | Maximum | Unit |
|---|---|---|---|---|
| Wavelength | 1520 | 1550 | 1610 | nm |
| Insertion Loss @ 1550nm | | 0.4 | 0.7 | 1 | dB |
| Cross Talk | -40 | -50 | -70 | dB |
| Switching Speed | — | 7 | 30 | ms |
| Return Loss | -55 | -65 | | dB |
| Maximum Optical Power | — | — | 24.8 | dBm |
| Operating Temperature | 0 | — | 70 | °C |
| Repeatability | — | — | 0.01 | dB |




Transition Time – 7ms
1 ms/div

| ITEM# | $ | £ | € | RMB | DESCRIPTION | CONNECTORS |
|---|---|---|---|---|---|---|
| MCS412 | $ 3,995.00 | £ 2,516.90 | € 3.715,40 | ¥ 38,152.30 | Multichannel Optic Switch | FC/PC |

# Multichannel Laser Source Module

The MCLS Multichannel Laser Source consists of four individual single mode fiber coupled laser diodes. The output of each laser is accessible through FC/PC terminations on the front panel.

The lasers are operated in a constant power mode and are controlled through a front panel power adjust knob. Each output may also be individually controlled via a rear panel interface by applying an analog voltage (0-5V).

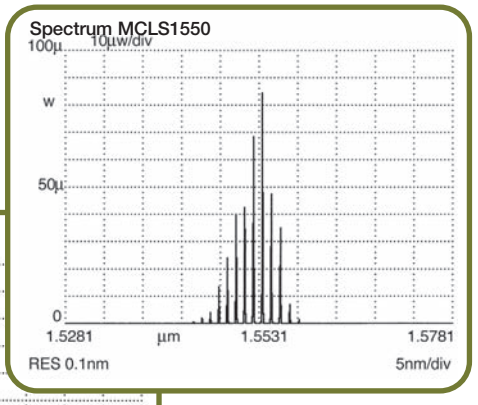

MCLS1550
19" Rack Mount Package

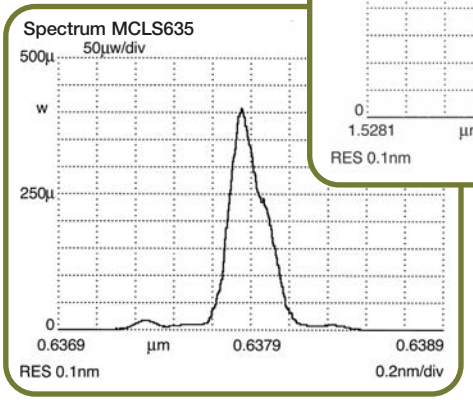
**Analog Modulation Mode**

BNC analog modulation connections are available for each channel on the rear panel. Applying a 0 to 5V signal allows remote adjustment of each channel. The signal input may be modulated as high as 30kHz.

**Master or Individual Channel Enable**

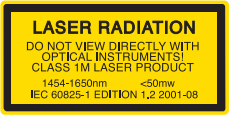
All channels can be enabled either simultaneously (via the master enable) or individually (via dedicated enable controls for each channel). Front panel LEDs indicate active channels.



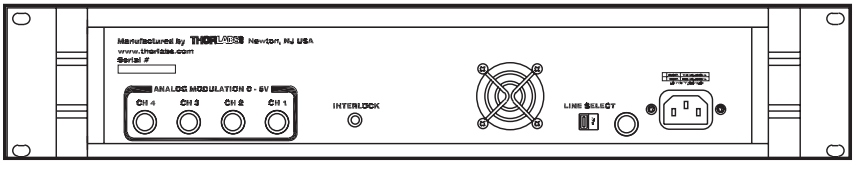




## Features

- Four FC/PC Laser Outputs
- Multiple Control Options
- Available in Two Models: 635nm and 1550nm (Other Wavelengths Available)
- Analog Modulation to 30kHz
- Master and Individual Laser Enable
- Safety Features Include Output Caps, a Keylock Master Power Control, Remote Interlock Capability, and a Master Enable Control


**MCLS Rear Panel**




## Specifications

| Analog Input | 0 to 5V Provides 0 to Full Power | | | |
|---|---|---|---|---|
| **Performance Specifications Parameter** | **Minimum** | **Typical** | **Maximum** | **Unit** |
| **Wavelength** | | | | |
| MCLS635 | 625 | 635 | 640 | nm |
| MCLS1550 | 1530 | 1550 | 1570 | nm |
| **Power per Channel*** | | | | |
| MCLS635 | | 2.5 | | mW |
| MCLS1550 | | 1.5 | | mW |
| Stability: 15min | | ±0.05 | | dB |
| Long-Term | | ±0.1 | | dB |
| Modulation Bandwidth | | 30 | | kHz |
| Operating Temp | 10 | | 40 | °C |

*Minimum Power available at the output connector, the actual power may be greater

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| MCLS635 | $ 2,500.00 | £ 1,575.00 | € 2.325,00 | ¥ 23,875.00 | Multichannel Laser Source Module 635nm |
| MCLS1550 | $ 2,900.00 | £ 1,827.00 | € 2.697,00 | ¥ 27,695.00 | Multichannel Laser Source Module 1550nm |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

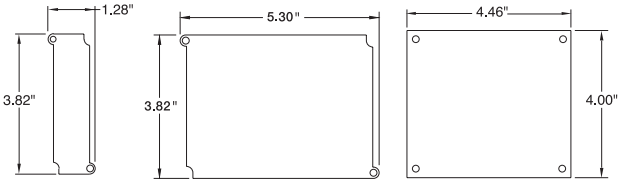
# Rackbox

- Optical Breadboard in an Easy Slide Chassis Box
- 1/4"-20 (M6) Mounting Holes on 1" (25mm) Centers
- Large Working Surface 15.5" x 16" is Accessible When Rackbox is Extended
- Quick Release Subpanels: FC, SMA, BNC, and DB9
- Blank Front and Back Panels Available for Customization

RBX32

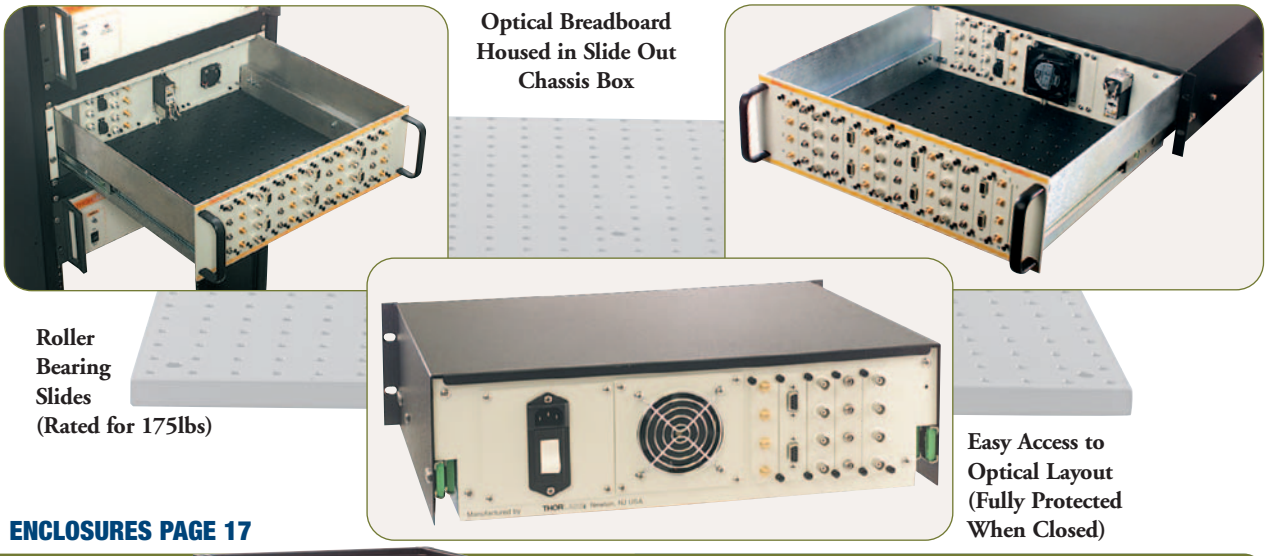
RBX32-BFP

**Please order subpanel accessories individually; Rackbox Chassis are sold without subpanels to allow you to configure application-specific systems.**




| Small Panel | Large Panel | Large Panel |
|---|---|---|
| 14 Front, 5 Back | 5 Slot Panel, Back or Front | 2 Large Panels, Backside Only |

This versatile proto-typing Rackbox System™ is ideal for building custom fiber-based assemblies. An extensive series of quick connect subpanels provides support for both fiber optic as well as electrical systems. Thorlabs is committed to making this product family as functional as possible; if you have any suggestions for additional features or components, please email us at techsupport@thorlabs.com.



**Optical Breadboard Housed in Slide Out Chassis Box**

**Roller Bearing Slides (Rated for 175lbs)**

**Easy Access to Optical Layout (Fully Protected When Closed)**

ENCLOSURES PAGE 17

# Rackbox

## Purchase Subpanels Separately

| ITEM# | METRIC ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|---|
| RBX32 | RBX32/M | $ 560.00 | £ 352.80 | € 520,80 | ¥ 5,348.00 | Rackbox Chassis With Slide Out Rails |
| RBX32-BFP | RBX32-BFP/M | $ 540.00 | £ 340.20 | € 502,20 | ¥ 5,157.00 | Rackbox Chassis With Blank Front Panel |
| RBX-FC | — | $ 59.00 | £ 37.20 | € 54,90 | ¥ 563.50 | FC/FC Optical Fiber Subpanel |
| RBX-SMA | — | $ 78.50 | £ 49.50 | € 73,00 | ¥ 749.70 | SMA Electrical Feed-Through Subpanel |
| RBX-DB9 | — | $ 9.75 | £ 6.10 | € 9,10 | ¥ 93.10 | DB9 Electrical Feed-Through Subpanel |
| RBX-BNC | — | $ 26.75 | £ 16.90 | € 24,90 | ¥ 255.50 | BNC Electrical Feed-Through Subpanel |
| RBX-AC | — | $ 58.00 | £ 36.50 | € 53,90 | ¥ 553.90 | AC Power Entry Module Subpanel |
| RBX-FAN | — | $ 48.00 | £ 30.20 | € 44,60 | ¥ 458.40 | Cooling Fan Subpanel |
| RBX-BLK1F | — | $ 7.10 | £ 4.50 | € 6,60 | ¥ 67.80 | Small Format Blank Subpanel, Front |
| RBX-BLK1B | — | $ 16.50 | £ 10.40 | € 15,30 | ¥ 157.60 | Large Format Blank Subpanel, Back |
| RBX-BLK5F | — | $ 22.00 | £ 13.90 | € 20,50 | ¥ 210.10 | Blank Panel, 5 Slot, Front |

## Subpanel Selection Guide

**RBX-FC**
FC/PC Optical Subpanel

**RBX-BNC**
BNC Electrical Subpanel

**RBX-SMA**
SMA RF Electrical Subpanel

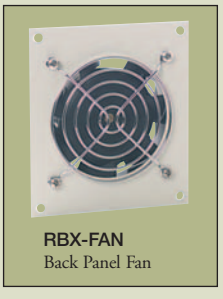
**RBX-DB9**
DB9 Electrical Subpanel

**RBX-BLK1F**
Blank Subpanel

**RBX-BLK5F**
Blank Panel

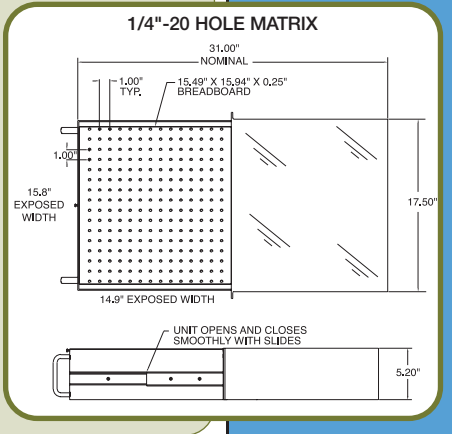
The RBX Rackbox System™ provides a flexible platform for building complex fiber optic and electro-optic instruments. All of the accessories shown feature a quick release mechanism for rapid prototyping of your optical designs. Our customers have responded with enthusiasm to this product line, and Thorlabs is committed to expanding rapidly the accessories it offers for the RBX Series. New products will be posted on our website www.thorlabs.com; if you have specific suggestions for additional features, please email us at techsupport@thorlabs.com.

**RBX-BLK1B**
Back Panel Blank



**RBX-FAN**
Back Panel Fan

**RBX-AC AC POWER**
Back Panel




SEE PAGE XXX FOR RACKS & ACCESSORIES

## 19" Rack Boards

- Mount Optomechanics in 19" Racks
- Low Profile Optical Breadboard Shelf
- Mounts to Both Front & Back Rack Channels for Extra Rigidity
- Ball Bearing Slides Allow Rack Board to Extend Out of the Rack for Easy Access
- 1/4"-20 (M6)Hole Matrix

These slide out rack boards allow optical systems to be built within a standard 19" instrumentation rack. This new combination allows you to integrate plug and play instruments using the full array of Thorlabs' optical bench components.

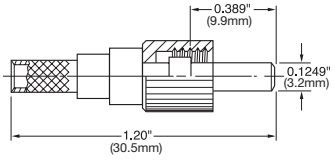
| ITEM# | METRIC# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|---|
| RK5006 | RK5006/M | $ 299.00 | £ 188.40 | € 278,10 | ¥ 2,855.50 | 19" Slide Out Rack Board |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# SMA 905 Fiber Connectors


**Custom Drilled Connectors Available**
**Call Tech Support**

Crimp Tool CT042 Required for 3mm Tubing



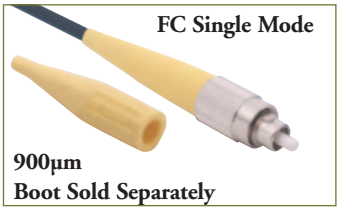

| ITEM# | $ | £ | € | RMB | FIBER SIZE |
|---|---|---|---|---|---|
| 10125A | $ 8.99 | £ 5.65 | € 8,35 | ¥ 85.90 | 125µm |
| 10140A | $ 9.45 | £ 5.95 | € 8,80 | ¥ 90.20 | 140µm |
| 10230A | $ 9.45 | £ 5.95 | € 8,80 | ¥ 90.20 | 230µm |
| 10250A | $ 9.45 | £ 5.95 | € 8,80 | ¥ 90.20 | 250µm |
| 10260A | $ 9.45 | £ 5.95 | € 8,80 | ¥ 90.20 | 260µm |
| 10270A | $ 9.45 | £ 5.95 | € 8,80 | ¥ 90.20 | 270µm |
| 10340A | $ 9.45 | £ 5.95 | € 8,80 | ¥ 90.20 | 340µm |
| 10410A | $ 9.45 | £ 5.95 | € 8,80 | ¥ 90.20 | 400µm |
| 10440A | $ 9.45 | £ 5.95 | € 8,80 | ¥ 90.20 | 445µm |
| 10510A | $ 9.55 | £ 6.00 | € 8,90 | ¥ 91.20 | 500µm |
| 10610A | $ 9.55 | £ 6.00 | € 8,90 | ¥ 91.20 | 600µm |
| 10640A | $ 9.55 | £ 6.00 | € 8,90 | ¥ 91.20 | 630µm |
| 10770A | $ 9.55 | £ 6.00 | € 8,90 | ¥ 91.20 | 750µm |
| 10850A | $ 9.55 | £ 6.00 | € 8,90 | ¥ 91.20 | 830µm |
| 11040A | $ 9.98 | £ 6.30 | € 9,30 | ¥ 95.30 | 1030µm |
| 11050A | $10.25 | £ 6.45 | € 9,55 | ¥ 97.90 | 1050µm |
| 11275A | $10.25 | £ 6.45 | € 9,55 | ¥ 97.90 | 1250µm |

[1]Ferrule hole size is +10µm over fiber size.
[2]Ferrule hole size is +20µm over fiber size.

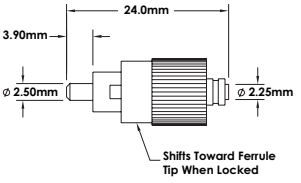
### SMA Main Body

SMA style connectors are most commonly used with multimode fibers. The ferrule design on the SMA connector makes it an ideal choice for large core fibers. Thorlabs stocks a complete selection of SMA connector sizes to accommodate our full line of large core fibers (see pages 1093-1099).

# FC Ceramic Fiber Connectors




Crimp Tool CT042 Required for 3mm Tubing

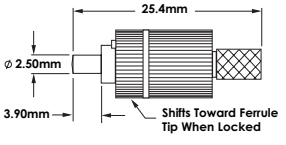



FC/PC Connector
Concentricity 1µm Maximum
Hole Size Tolerance +1µm/-0µm

This FC single mode connector features a pre-radiused (R20mm) ceramic ferrule; the pre-radiused tip minimizes back reflections. It is packaged with a strain relief boot for Ø3mm tubing.

| ITEM# | $ | £ | € | RMB | DECRIPTION |
|---|---|---|---|---|---|
| 30126D1 | $ 8.00 | £ 5.05 | € 7,45 | ¥ 76.40 | FC, Single Mode, 125µm |
| 30080D1 | $ 19.95 | £ 12.55 | € 18,55 | ¥ 190.50 | FC, Single Mode, 80µm |
| 190044-50 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Black |
| 190044-55 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Yellow |

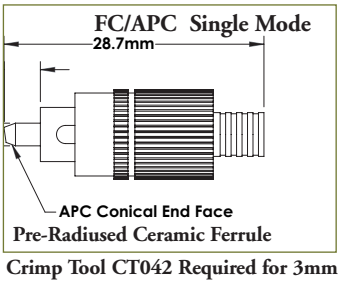

Crimp Tool CT042 Required for 3mm Tubing



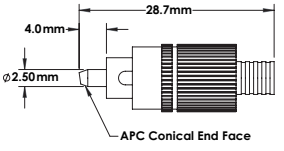

FC Multimode Connector
Concentricity 3µm Maximum
Hole Size Tolerance +2µm/-0µm

This FC multimode connector features a ceramic ferrule and a pre-radiused tip to minimize back reflections.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 30140E1 | $ 8.95 | £ 5.65 | € 8,30 | ¥ 85.50 | FC, Multimode, 140µm |
| 190044-50 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Black |
| 190044-55 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Yellow |

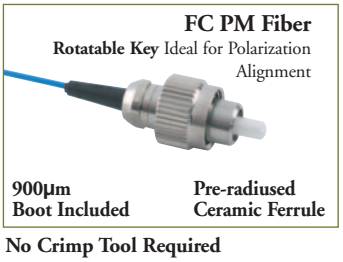



Crimp Tool CT042 Required for 3mm Tubing

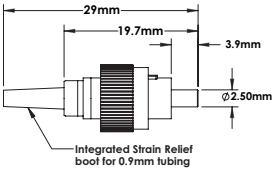



The FC/APC connector has an 8° pre-angled ceramic ferrule that simplifies the production of angled polishes. This typically results in a <60dB return loss. This connector has a low 0.25dB connector-to-connector loss.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 30126F1 | $ 11.50 | £ 7.25 | € 10,70 | ¥ 109.80 | FC/APC, 125µm, 3mm Boot |
| 30126K1 | $ 11.50 | £ 7.25 | € 10,70 | ¥ 109.80 | FC/APC, 125µm, 900µm Boot |




No Crimp Tool Required

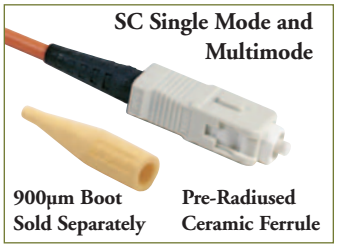



<1µm Concentricity Hole Size Tolerance +1/-0µm

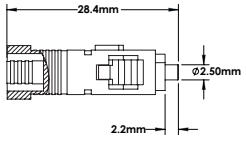
These FC connectors are designed for Polarization Maintaining (PM) Fibers. The key is continuously adjustable, allowing precise alignment with the axis of the PM fiber. (No crimp tool required)

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 30127D2 | $ 10.75 | £ 6.75 | € 10,00 | ¥ 102.70 | FC, PM, 125µm, 900µm Boot |

# SC Ceramic Fiber Connectors



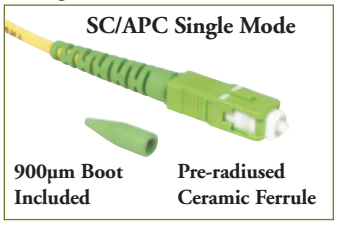

Crimp Tool CT042 Required for 3mm Tubing



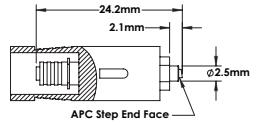

Side View

These SC connectors feature a pre-radiused (R20mm) ceramic ferrule; the pre-radiused tip minimizes back reflections.

| ITEM# | $ | £ | € | RMB | DECRIPTION |
|---|---|---|---|---|---|
| 30126G1 | $ 10.25 | £ 6.45 | € 9,55 | ¥ 97.90 | SC, Single Mode, 125µm |
| 30126H1 | $ 8.50 | £ 5.35 | € 7,90 | ¥ 81.20 | SC, Multimode, 125µm |
| 190044-50 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Boot |
| 190044-55 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Boot |




Crimp Tool CT042 Required for 3mm Tubing



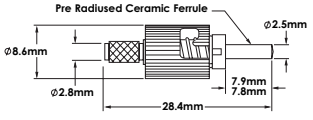

Top View

These SC/APC connectors offer a radiused, pre-angled (8-degree), conical Zerconica ferrule, which simplifies the production of polishes. They provide a return loss of >60dB and an insertion loss of <0.25dB for a 9/125µm fiber at 1310nm.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 30126J1 | 7.00 | £ 4.40 | € 6,50 | ¥ 66.90 | SC/APC, Single Mode, 126µm |

# ST Ceramic and Stainless Steel Fiber Connector


Crimp Tool CT042 Required for 3mm Tubing

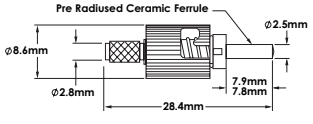



ST Connector
Concentricity 1µm Maximum
Hole Size Tolerance +1µm/-0µm

This ST single mode connector features a ceramic ferrule with a pre-radiused tip (R20mm) to minimize back reflections\ and is packaged with a strain relief boot for Ø3mm tubing.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 30126B1 | $ 8.50 | £ 5.35 | € 7,90 | ¥ 81.20 | Ceramic, PC 125µm |
| 190044-50 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Black |
| 190044-55 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Yellow |


Crimp Tool CT042 Required for 3mm Tubing

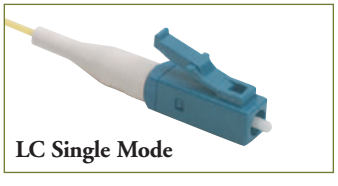


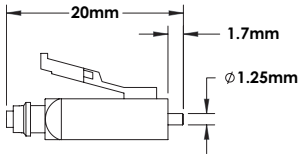

ST Connector
Concentricity 1µm Maximum
Hole Size Tolerance +1µm/-0µm

These ST connectors are designed for multimode applications. The stainless ferrule connectors can be customized to accept fiber diameters up to Ø1mm.

| ITEM# | $ | £ | € | RMB | DECRIPTION |
|---|---|---|---|---|---|
| 30140C1 | $ 4.25 | £ 2.70 | € 3,95 | ¥ 40.60 | Ceramic, PC 140µm |
| 10140G1 | $ 10.99 | £ 6.90 | € 10,20 | ¥ 105.00 | Stainless 140µm |
| 190044-50 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Black |
| 190044-55 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Yellow |

# LC Fiber Connector




The LC connector was developed to meet the need for small and easier to use fiber optic connectors. The LC connector reduces space required on panels by 50%.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 86024-5500 | $ 9.95 | £ 6.25 | € 9,30 | ¥ 95.00 | LC, 900µm Tubing, 125µm |

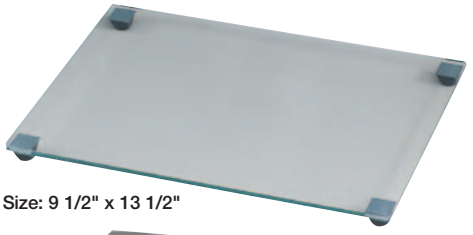
# Connector Crimp Tool

One tool can be used for crimping SMA, FC, SC, and ST connectors. Connectors with 3mm or greater tubing require the crimping tool. The 900µm tubing or smaller does not need to be crimped.

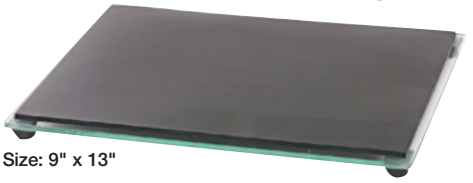
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| CT042 | $ 97.00 | £ 61.10 | € 90,20 | ¥ 926.40 | Crimp Tool |

CT042

# Polishing Plate and Polishing Pad



Size: 9 1/2" x 13 1/2"



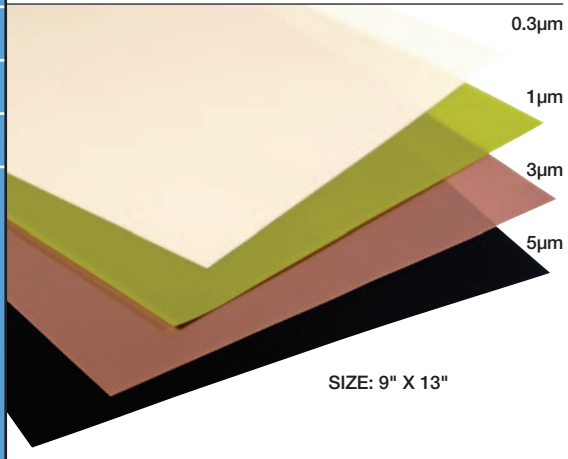
Size: 9" x 13"

Our glass polishing plate provides the hard, flat surface required for polishing fiber optic connectors. The plate is produced from safety glass with all of the edges and corners rounded.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| CTG913 | $ 23.75 | £ 15.00 | € 22,10 | ¥ 226.80 | Glass Polishing Plate 9-1/2" x 13-1/2" |
| NRS913 | $ 19.90 | £ 12.50 | € 18,50 | ¥ 190.00 | Polishing Pad 9" x 13" |

The rubber polishing pad is required when polishing PC style pre-radiused connectors. When used with our glass polishing plate, the pad helps to maintain the pre-radiused connector tip geometry during polishing. We recommend purchasing a copy of our *Guide to Connectorization and Polishing Optical Fibers* (p/n FN96A) for complete details.

# Polishing/Lapping Film, Aluminum Oxide

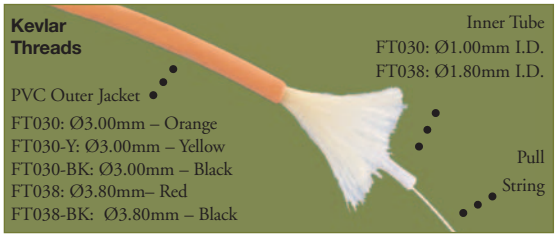



Thorlabs recommends using a four step polishing process when connectorizing fibers. Our 9" x 13" sheets fit onto our glass polishing plates (CTG913) and rubber polishing pads (NRS913). We offer four different levels of lapping sheets: 5, 3, 1, and 0.3µm. Each package comes with 10 sheets.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| LFG03P | $ 13.10 | £ 8.30 | € 12,20 | ¥ 125.10 | 0.3µm Lapping Film, 10 Sheets |
| LFG1P | $ 13.10 | £ 8.30 | € 12,20 | ¥ 125.10 | 1.0µm Lapping Film, 10 Sheets |
| LFG3P | $ 13.10 | £ 8.30 | € 12,20 | ¥ 125.10 | 3.0µm Lapping Film, 10 Sheets |
| LFG5P | $ 13.10 | £ 8.30 | € 12,20 | ¥ 125.10 | 5.0µm Lapping Film, 10 Sheets |
| FN96A | $ 6.50 | £ 4.10 | € 6,00 | ¥ 62.10 | Fiber Polishing Notes |

- Large 9" x 13" Sheets
- Prices Shown are for Packages of 10 Sheets
- 4 Grades of Lapping Film

# Ø3.00mm and Ø3.80mm Furcation Reinforced Tubing




| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FT030 | $ 1.30 | £ 0.80 | € 1,20 | ¥ 12.40 | Orange 3mm Furcation Tubing |
| FT030-Y | $ 1.30 | £ 0.80 | € 1,20 | ¥ 12.40 | Yellow 3mm Furcation Tubing |
| FT030-BK | $ 1.30 | £ 0.80 | € 1,20 | ¥ 12.40 | Black 3mm Furcation Tubing |
| FT038 | $ 1.80 | £ 1.10 | € 1,70 | ¥ 17.20 | Red 3.8mm Furcation Tubing |
| FT038-BK | $ 1.80 | £ 1.10 | € 1,70 | ¥ 17.20 | Black 3.8mm Furcation Tubing |

# Stainless Steel Tubing

- 5.1mm O.D. x 3.5mm I.D.
- Best Protection for Fibers

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FT051SS | $ 5.80 | £ 3.70 | € 5,40 | ¥ 55.40 | Stainless Steel Furcation Tubing |

# Ø900µm Furcation Tubing

FT900SM

- Hytrel Tubing
- 500µm I.D.
- 900µm O.D.

This 900µm furcation tubing is convenient for protecting short sections of bare optical fiber. The hytrel tubing is well suited for allowing the user to insert up to 10m of bare fiber.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FT900SM | $ 2.00 | £ 1.30 | € 1,90 | ¥ 19.10 | 900µm Hytrel Tubing |

# Epoxy for Fiber Optic Connectors

- Easy-to-Use 2g BI PAX®
- 25-30 Connectors per Pack
- Prices Shown are for Packs of 10

These pre-measured 2g packets of two-part epoxy are specifically formulated to produce low stress fiber optic terminations.

**F112* – Long Pot Life, Room Temperature Cure**
The F112 epoxy is an ideal epoxy for making room temperature terminations. The long 40 minute pot life allows more connectors to be produced from one mix.

**F120* – Fast Room Temperature Cure**
The F120 epoxy provides a combination of fast cures and low shrinkage for quick high performance fiber optic connections. At room temperature, the connectors are ready for polishing within 30 minutes; however, fully matured bonds require up to 48 hours.

**F123 – Color-Keyed High Temperature Cure**
The F123 has a unique three-step color change formulation: unmixed components are light yellow, the mixed color is green, and after the required 100°C high-temperature cure, the color is a deep reddish-amber.

| ITEM# | $/PKG. | £ | € | RMB | POT LIFE | CURE TIME 25°C | TYPICAL CURE SCHEDULE | OPERATING TEMPERATURE | CURED COLOR |
|---|---|---|---|---|---|---|---|---|---|
| F112 | $ 72.50 | £ 45.70 | € 67,40 | ¥ 692.40 | 40 Minutes | 18 Hours | 15 Minutes @65°C | -60 to 110°C | Blue |
| F120 | $ 36.80 | £ 23.20 | € 34,20 | ¥ 351.40 | 5 Minutes | 18 Hours | 1 Hour @25°C | -60 to 115°C | Straw |
| F123 | $ 72.50 | £ 45.70 | € 67,40 | ¥ 692.40 | 4 Hours | No Cure@Room Temp. | 5 Minutes @100°C | -60 to 175°C | Reddish-Amber |

*Not recommended for hard polymer clad fiber.

# High-Temperature and Low CTE Epoxies

EPO-TEK 353ND is known industry wide as a high-temperature epoxy. This two part, 100% solids, heat curing epoxy can be used in applications requiring constant performance at 200°C, and it can handle 300 to 400°C for brief periods. Thorlabs offers 353ND in pre-measured 4-gram packs, eliminating the need for measuring while providing repeatable performance.

**Cure Schedule**
150°C . . . . . 1 minute
120°C . . . . . 2-5 minutes
100°C . . . . . 5-10 minutes
80°C . . . . . 15-30 minutes

**353NDPK**
Sold 10 per Pack

| ITEM# | $* | £* | €* | RMB* | POT LIFE | OP. TEMP RANGE | CURED COLOR | DESCRIPTION |
|---|---|---|---|---|---|---|---|---|
| 353NDPK | $ 67.00 | £ 42.20 | € 62,30 | ¥ 639.90 | 4 Hours | -50 to +200°C | Dark Red | 353ND, 4g Bi-Pack, 10 per Pack |

*Price is per package of 10

# Syringes for Epoxy Application

**Syringe**
10 Per Pack

The syringe is used to inject epoxy through the back of the connector. Each pack contains 10 syringes.

| ITEM# | $/PKG. | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| MS403-10 | $10.00 | £ 6.30 | € 9,30 | ¥ 95.50 | Disposable Syringe |

## *Epoxy Mixing Kit, 5-Minute Epoxy, and Vacuum Epoxy*

The EMK100 epoxy mixing kit includes 100 disposable round aluminum mixing trays, 100 mixing sticks, and 250 toothpicks. This kit has been put together based on common items used to keep epoxies as clean as possible when mixing. The trays have no oil residue and no vinyl coating, which can cause contamination problems.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| EMK100 | $ 17.95 | £ 11.30 | € 16,70 | ¥ 171.40 | Epoxy Mixing Kit |
| TS10 | $ 83.00 | £ 52.30 | € 77,20 | ¥ 792.70 | Vacuum Epoxy |
| G14250 | $ 8.30 | £ 5.20 | € 7,70 | ¥ 79.30 | 5-Minute Epoxy, 1 ounce |

*Epoxy Mixing Kit*
**See Page 888**


TS10

G14250

**See Page 887 for Details**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Fiber Inspection Scope




**CL-200-SMA**
SMA Adapter

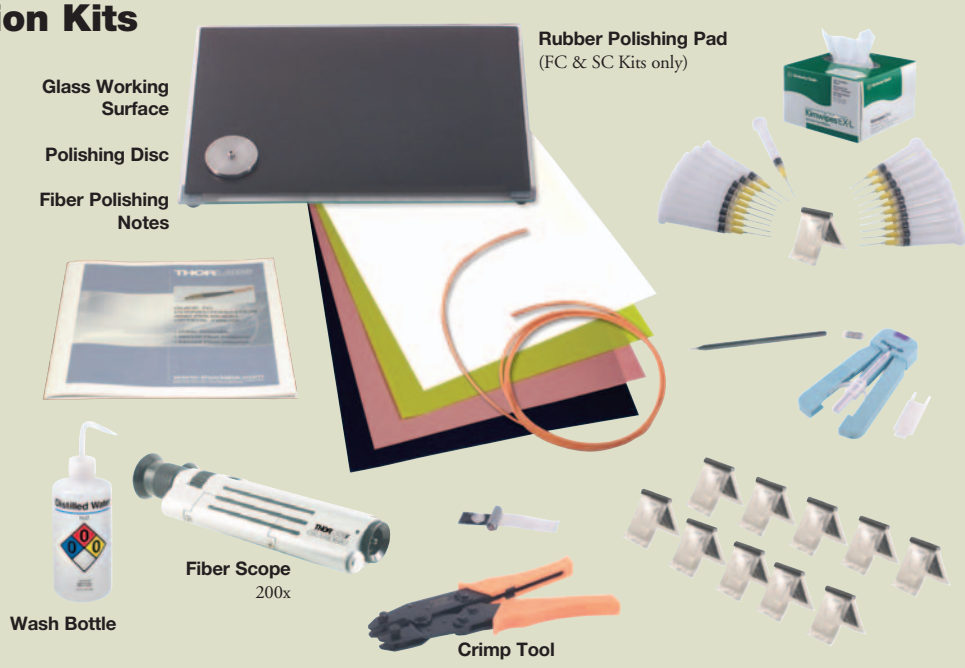
- Optical Magnification of 200x
- LED Rated Life of 100,000 Hours
- 225mm (8.76") Long x Ø32mm (1.25")
- Momentary On/Off Switch and Fine Focus Control
- Built-In Safety Filter

The CL-200 fiber microscope utilizes a white LED for coaxial illumination. Light is introduced into the optical path (axis) so that it comes out of the tip of the objective and strikes the sample perpendicular to the fiber end-face. It produces excellent detail of scratches and contamination. For critical examination of polish quality, we strongly recommend this fiber microscope. The inspection scope comes with an adapter for FC and ST terminated fibers.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| CL-200 | $ 198.00 | £ 124.70 | € 184,10 | ¥ 1,890.90 | Fiber Microscope |
| CL-200-SMA | $ 20.00 | £ 12.60 | € 18,60 | ¥ 191.00 | SMA Fiber Microscope Adapter |

# Connectorization Kits

- Complete Kit
- Step-by-Step Instructions
- All Connectorization Kits Include:
  - Glass Polishing Plate
  - 40 Sheets of Polishing Film
  - Polishing Disc
  - 200x Fiber Scope
  - Diamond Scribe
  - 20 Syringes
  - 2m Furcation Tubing
  - Epoxy
  - Fiber Stripper
  - Kim Wipes
  - Wash Bottle
- The CK03 & CK05 Kits Include an Additional Rubber Polishing Pad That is Used to Produce PC (radiused) Polishes.




**Kim Wipes**

**20 Syringes**
Syringe for inserting the epoxy into the connector

**S90W Diamond Scribe**
Diamond Wedge Scribe for Fiber Cleaving

**Stripping Tool**
Stripper 125/250 Fiber
(See page 1050 for other models)

**F112 Epoxy**
Ideal for making room temperature terminations

**Items Not Included:**
- Connectors, See Pages 1044-1045
- Fiber, See Page 1057-1101

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| CK01 | $ 542.00 | £ 341.50 | € 504,10 | ¥ 5,176.10 | SMA Connectorization Tool Kit |
| CK03 | $ 544.00 | £ 342.70 | € 505,90 | ¥ 5,195.20 | FC Connectorization Tool Kit |
| CK05 | $ 587.00 | £ 369.80 | € 545,90 | ¥ 5,605.90 | FC/APC Connectorization Tool Kit |

# Guide to Connectorization and Polishing Optical Fibers

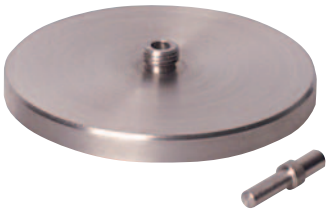
**Easy to Follow Step-by-Step Instructions**

- Connectorization
- Cleaving
- Polishing

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FN96A | $ 6.50 | £ 4.10 | € 6,00 | ¥ 62.10 | Guide to Connectorization, Polishing, and Cleaving of Fibers |

# Polishing Discs

SMA



### SMA Polishing Disc

This screw mount SMA polishing/lapping disc will accommodate both SMA type 905 and SMA type 906 connectors. Each disc is factory set to produce the correct ferrule length after polishing is complete. The D50-SMA polishing disc can be recalibrated using our D50-A calibration pin, which is included with the purchase of the D50-SMA polishing disc.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| D50-SMA | $ 62.00 | £ 39.10 | € 57,70 | ¥ 592.10 | SMA Polishing Disc |
| D50-A | $ 19.00 | £ 12.00 | € 17,70 | ¥ 181.50 | Calibration Pin for D50-SMA |

FC AND SC

### FC and SC Polishing Disc

This FC polishing/lapping disc will accommodate both flat and pre-radiused (PC style) connectors.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| D50-FC | $ 62.00 | £ 39.10 | € 57,70 | ¥ 592.10 | FC & SC Polishing Disc |

ST

### ST Polishing Disc

The ST polishing disc is designed to allow the connector to float. This design allows the polishing of both flat and pre-radiused (PC style) connectors.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| D50-ST | $ 80.00 | £ 50.40 | € 74,40 | ¥ 764.00 | ST Polishing Disc |

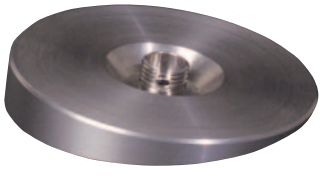
LC

### LC Polishing Disc

The LC polishing disc is designed to allow the connector to float. This design allows the polishing of both flat and pre-radiused (PC style) connectors.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| D50-LC | $ 80.00 | £ 50.40 | € 74,40 | ¥ 764.00 | LC Polishing Disc |

FC/APC



### FC/APC Polishing Disc

This FC/APC polishing disc will accommodate standard angled FC connectors. Each disc is set to produce the correct angle after polishing is complete.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| D50-FC/APC | $ 97.00 | £ 61.10 | € 90,20 | ¥ 926.40 | FC/APC Polishing Disc |

# SMA Height Gauge


The 10125HG SMA height gauge is ideal for accurately measuring the height of a polished fiber optic SMA connector. SMA-to-SMA couplers are designed to have a non-contact interface. Since the insertion loss of an SMA-SMA junction is dependent on the distance between the two SMA connector end faces, the height of the polished SMA connector is important. Individually calibrated gauge pins are included with each 10125HG gauge to ensure proper height measurements.

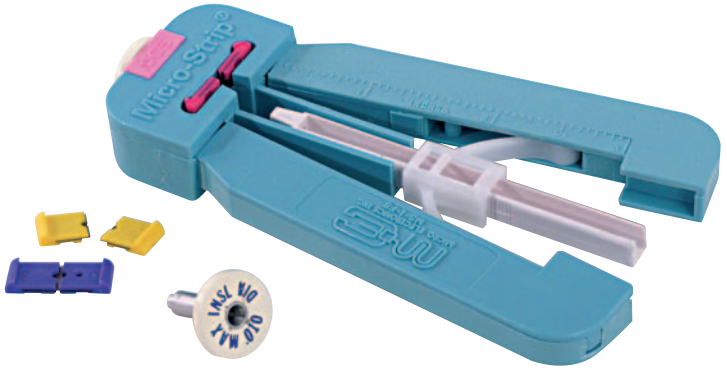
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| 10125HG | $ 295.00 | £ 185.90 | € 274,40 | ¥ 2,817.30 | Fiber Optic SMA Connector Height Gauge |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

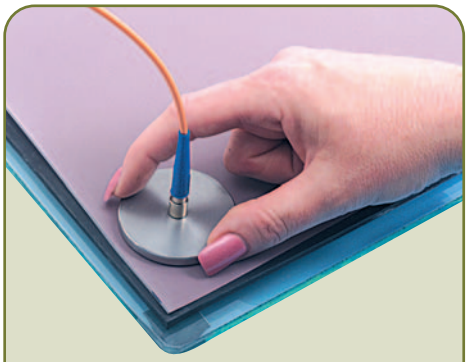
# Fiber Optic Stripping Tool

**STRONGLY RECOMMENDED**
"Best Choice" **Stripping Tool**

**Single Mode, Multimode, and Polarization Maintaining Fibers**




- Foolproof, No-Nick Design
- Fast, Reliable Fiber Stripping
- Self-Aligning Blade Set Assures Concentric Scoring of Buffer or Coating



## Fiber Polishing Kits

Complete set of accessories
for polishing and connectorizing fibers.

**See Page 1048**

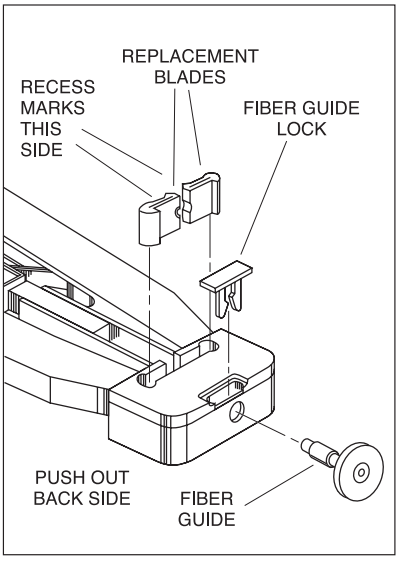
### Tool Selection

A. Note your CLADDING and COATING* diameters along with their respective high side tolerances.
B. Look down the sixth column of the table below for your fiber size.
C. With your fiber size identified in the chart below, scan across to the corresponding CLADDING RANGE & COATING* RANGE columns. Ensure that your fiber dimensions plus the high side tolerances fall within the range listed; if they do, then refer to the corresponding ITEM# to place your order. If the maximum fiber dimensions fall outside the range shown, order the next larger tool.

### Standard Tool Selection

| ITEM# | $ | £ | € | RMB | TYPICAL FIBER CLADDING/COATING | CLADDING RANGE | COATING* RANGE |
|---|---|---|---|---|---|---|---|
| T04S10 | $ 66.60 | £ 42.00 | € 61,90 | ¥ 636.00 | 80µm / 200µm | 65 - 80µm | 150 - 250µm |
| T05S10 | $ 66.60 | £ 42.00 | € 61,90 | ¥ 636.00 | 100µm / 200µm | 85 - 120µm | 150 - 250µm |
| T06S13 | $ 66.60 | £ 42.00 | € 61,90 | ¥ 636.00 | 125µm / 250µm | 125 - 135µm | 250 - 343µm |
| T08S13 | $ 66.60 | £ 42.00 | € 61,90 | ¥ 636.00 | 140µm / 250µm | 125 - 175µm | 250 - 343µm |
| T08S40 | $ 66.60 | £ 42.00 | € 61,90 | ¥ 636.00 | 125µm /900µm | 125 - 175µm | 889 - 1016µm |
| T12S16 | $ 64.00 | £ 40.30 | € 59,50 | ¥ 611.20 | 240µm / 400µm | 235 - 280µm | 343 - 407µm |
| T12S18 | $ 64.00 | £ 40.30 | € 59,50 | ¥ 611.20 | 240µm / 400µm | 235 - 280µm | 407 - 457µm |
| T12S21 | $ 64.00 | £ 40.30 | € 59,50 | ¥ 611.20 | 230µm / 500µm | 235 - 280µm | 457 - 533µm |
| T12S25 | $ 64.00 | £ 40.30 | € 59,50 | ¥ 611.20 | 250µm / 600µm | 235 - 280µm | 533 - 635µm |
| T16S31 | $ 64.00 | £ 40.30 | € 59,50 | ¥ 611.20 | 325µm / 650µm | 335 - 380µm | 635 - 787µm |
| T18S31 | $ 64.00 | £ 40.30 | € 59,50 | ¥ 611.20 | 400µm / 730µm | 385 - 430µm | 635 - 787µm |
| T21S31 | $ 64.00 | £ 40.30 | € 59,50 | ¥ 611.20 | 430µm / 730µm | 435 - 500µm | 635 - 787µm |
| T23S46 | $ 64.00 | £ 40.30 | € 59,50 | ¥ 611.20 | 500µm / 1000µm | 505 - 550µm | 1016 - 1168µm |
| T28S46 | $ 65.90 | £ 41.50 | € 61,30 | ¥ 629.30 | 630µm / 1040µm | 605 - 680µm | 1016 - 1168µm |
| M34S52 | $ 65.10 | £ 41.00 | € 60,50 | ¥ 621.70 | 750µm / 1250µm | 755 - 830µm | 1168 - 1321µm |
| M37S46 | $ 65.10 | £ 41.00 | € 60,50 | ¥ 621.70 | 860µm / 1080µm | 835 - 900µm | 1016 - 1168µm |
| M44S63 | $ 65.10 | £ 41.00 | € 60,50 | ¥ 621.70 | 1035µm / 1400µm | 905 - 1050µm | 1397 - 1600µm |
| M44S67 | $ 65.10 | £ 41.00 | € 60,50 | ¥ 621.70 | 1400µm / 1600µm | 905 - 1050µm | 1600 - 1702µm |
| M54S76 | $ 65.10 | £ 41.00 | € 60,50 | ¥ 621.70 | 1250µm / 1850µm | 1055 - 1350µm | 1778 - 1930µm |
| M63S86 | $ 77.70 | £ 49.00 | € 72,30 | ¥ 742.00 | 1550µm / 2000µm | 1390 - 1600µm | 2057 - 2184µm |

*Coating refers to the jacket, buffer, or coating that is being removed.

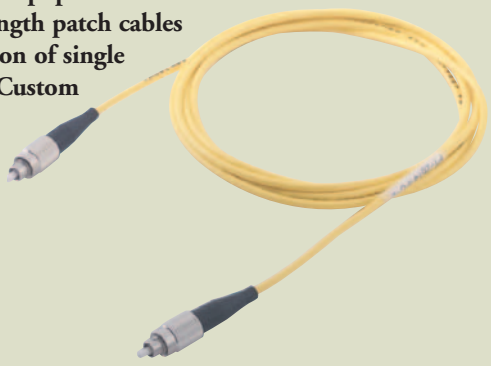


# Custom Patch Cables

## Next-Day Shipping Available Upon Request

**Thorlabs is pleased to offer next-day shipping service for small lots of custom patch cables assembled using our standard fibers. We stock many of our more popular fibers with protective jacketing in bulk, allowing us to assemble custom length patch cables within one day. Additionally, Thorlabs stocks the largest selection of single mode and multimode optical fibers in the photonics industry. Custom patch cable lengths are only limited by the draw length of the particular fiber. Please see pages 1057-1063 for available single mode fibers, pages 1091-1099 for available multimode fibers, and pages 1044-1045 for our wide selection of fiber optic connectors.**

Due to the special requirements of photonic crystal fibers, please contact technical support for custom patch cables assembled using these fibers.



TOOLS OF THE TRADE

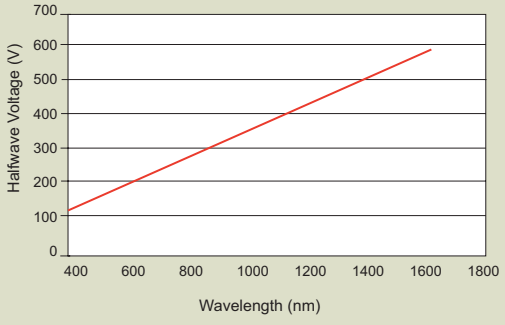
## New Electro-Optic Modulators


EO-PM-NR-C1

EO-HVA

EO-AM-NR-C2

EO-AM Halfwave Voltage Vs Wavelength




### Highlights

- High Performance in a Compact Package
- Broadband DC Coupled and High Q Resonant Models for Low RF Drive
- Standard Broadband AR and Custom Coatings
- 2mm Diameter Clear Aperture
- SMA Female Modulation Input Connector
- MgO-Doped Versions for High Power
- DC to 100MHz
- Custom OEM Versions Available

**See Pages 683-696**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

## Diamond Wedge Scribe

- Cleave Bare Fiber to Produce Optical Quality Surfaces
- Scribe Excess Fiber From the Connector Ferrule in Preparation for Polishing
- 90° Wedge-Shaped Diamond Tip Preferred by Most Optical Technicians

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| S90W | $ 60.20 | £ 37.90 | € 56,00 | ¥ 574.90 | 90° Wedge-Shaped Diamond Scribe |

## Fiber Cleaver

1 SIMPLE
2 3-STEP
3 PROCESS

Innovative Suspension Cleave Design:
See Page 1056

## Wash and Dropper Bottles


Plastic wash bottles are made for specific liquids. The name of the liquid is silk-screened on the bottle with color-coded caps.

The small eye dropper bottles are recommended for dispensing cleaning fluids for laser grade optics. Both the bottles and droppers are glass.

**Special Note:**
Wash and dropper bottles sold empty; please contact your local chemical supplier for solvents.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| B2939 | $ 62.00 | £ 39.10 | € 57,70 | ¥ 592.10 | Kit: 4 Wash Bottles & 3 Glass Dropper Bottles |

## Kevlar Cutters

These cutters are designed for cutting the Kevlar threads that are used in the protective jackets of some tubings.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| T865 | $33.60 | £ 21.20 | € 31,20 | ¥ 320.90 | Kevlar Cutter |

## Lint-Free Kimwipes


These wipes are ideal for cleaning connectors between polishing steps and are sold in cases of 12 boxes per case. Sorry, no partial cases.

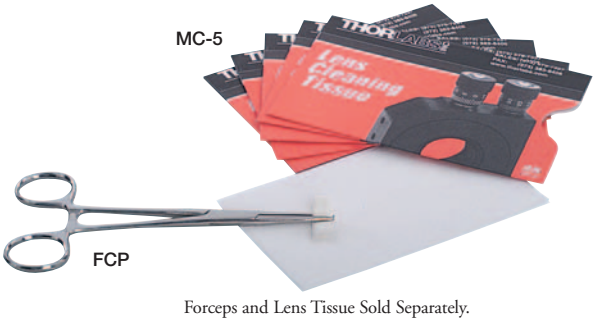
| ITEM# | $/CASE | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| KW32 | $ 43.70 | £ 27.50 | € 40,60 | ¥ 417.30 | Kimwipes 12 Boxes |

## Lens Tissues And Forceps

**Lens Tissues (MC-5)**
These extremely soft, premium grade tissues are packaged in a protective booklet with 25 sheets per booklet, 5 booklets per pack.

**Forceps (FCP)**
Solid stainless steel.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| MC-5 | $ 8.70 | £ 5.50 | € 8,10 | ¥ 83.10 | Lens Tissues, 5 Booklets |
| FCP | $ 18.30 | £ 11.50 | € 17,00 | ¥ 174.80 | Forceps, Solid Stainless Steel |




Forceps and Lens Tissue Sold Separately.

# Dusting Kit


**Dusting Kit Refill Can (CA1)**
10oz can of tetrafluoroethane (ozone safe)

**Trigger Valve Metal Nozzle (CA2)**
For 10oz can of tetrafluoroethane (ozone safe)

**Complete Duster (CA3)**
10oz can of tetrafluoroethane with built-in plastic nozzle, Not Compatible with CA2

Requires Ground Shipment

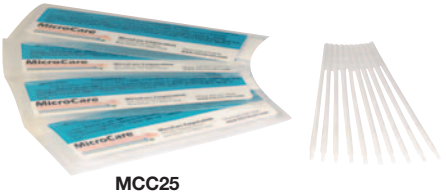

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| CA1 | $ 11.60 | £ 7.30 | € 10,80 | ¥ 110.80 | Refill Can |
| CA2 | $ 33.80 | £ 21.30 | € 31,40 | ¥ 322.80 | Metal Nozzle for CA1 |
| CA3 | $ 9.90 | £ 6.20 | € 9,20 | ¥ 94.50 | Can w/ Plastic Nozzle |

# Precision Fiber and Optical Cleaning Products


- Non-Pressurized TravelSAFE™
- U.S. D.O.T. Classified "Nonhazardous, Nonregulated"
- Doubled-Filtered to 0.2µm


LFW90

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FCS1 | $ 13.00 | £ 8.20 | € 12,10 | ¥ 124.20 | Fiber Preparation Fluid |
| FCS2 | $ 12.00 | £ 7.60 | € 11,20 | ¥ 114.60 | Fiber Connector Cleaner |
| FCS3 | $ 16.00 | £ 10.10 | € 14,90 | ¥ 152.80 | Precision Optical Cleaner |
| LFW90 | $ 7.00 | £ 4.40 | € 6,50 | ¥ 66.90 | Lint-Free Wipes |
| MCC25 | $ 24.50 | £ 15.40 | € 22,80 | ¥ 234.00 | Connector Cleaning Sticks |




MCC25

# UV Curing System

- Intensity >90mW/cm² Over 300-400nm Range Delivered Out the Fiber Optic Tip
- 600mW/cm² Visible Lamp Output
- Complete System Includes 8mm Tip, Safety Goggles, and Free Replacement Bulb
- Continuous Operation With Audible Tone at 10-Second Intervals
- Long Bulb Life >100,000 Hours (20 Second Exposure Cycles)
- Ideal for All Our UV Curable Adhesives
- Lightweight, 10oz Hand-Piece, With 360° Swiveling Light Guide

### UV Curing System

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| CS410 | $1,318.90 | £ 830.90 | € 1.226,60 | ¥12,595.50 | Complete UV Curing System* 100-120 VAC |
| CS410-EC | $1,318.90 | £ 830.90 | € 1.226,60 | ¥12,595.50 | Complete UV Curing System* 230 VAC |

*Includes UV Light Source, 8mm Tip, Safety Goggles, and Replacement Bulb


This easy-to-use, high intensity, UV light source is designed to provide a high intensity source of UV light for curing 350 to 380nm. This is the range where the photo-initiators for most UV curable adhesives are most sensitive. With this system, you are in control of exactly when your adhesive cures which allows precise alignment of your optical or mechanical system prior to rapid curing.

# UV Curing System Accessories

**CS410B**
Replacement Bulb

**CS420**
Ø3mm x 7mm Curved Tip

**CS421**
Ø13mm x 38mm
Straight Tip

**CS300**
UV Protective Glasses

### Accessories

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| CS410B | $ 68.20 | £ 43.00 | € 63,40 | ¥ 651.30 | Replacement Bulbs |
| CS420 | $ 125.00 | £ 78.80 | € 116,30 | ¥ 1,193.80 | Ø3mm x 7mm Curved Tip |
| CS421 | $ 125.00 | £ 78.80 | € 116,30 | ¥ 1,193.80 | Ø13mm x 38mm Straight Tip |
| CS300 | $ 20.50 | £ 12.90 | € 19,10 | ¥ 195.80 | UV Protective Goggles |

**UV Curing Epoxy**

See Page 885

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Index-Matching Gel


- Minimizes Back Reflections in Fiber to Fiber Splices
- Can be Used as a Mode Stripping Gel
- Temperature Stable From Freezing to Boiling
- Stays a Gel (Does Not Cure)

| λ (nm) | n |
|---|---|
| 632.8 | 1.456 |
| 840.0 | 1.451 |
| 1064.8 | 1.449 |
| 1300.0 | 1.448 |
| 1550.0 | 1.447 |

This high-quality, index-matching gel may be used to couple optical signals into or out of optical fibers. It may also be used as a mode stripping gel. When coated onto the fiber cladding, it will strip out the signal carried in the cladding. The gel is stable over a wide temperature range, with a freezing point of -67°C and a boiling point >416°C. Note that this gel does not cure or harden and always remains a gel.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| G608N | $ 30.20 | £ 19.00 | € 28,10 | ¥ 288.40 | 1cc Syringe of Index-Matching Gel |

# Reusable Fiber-to-Fiber Splice

View Port Allows Clear View of Fiber Ends

Collet Clamps Accept 250-900µm Jackets

Index-Matching Gel Pre-Loaded

These easy-to-use fiber-to-fiber splices offer high performance (~0.2dB average splice loss) in a reusable package. The glass capillary alignment tube comes pre-loaded with our index-matching gel shown above. The fiber location within the glass capillary can be monitored through a central viewport.

**Specifications**

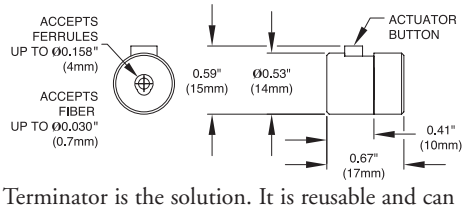
- **Average Splice Loss:** 0.2dB
- **Fiber Jacket Size Range:** 250-900µm (All Models)
- **Fiber Retention:** >1250gm
- **Installation Time:** <60sec.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| TS125 | $ 18.10 | £ 11.40 | € 16,80 | ¥ 172.90 | Single Mode Fiber-to-Fiber Splice, 125µm |
| TS128 | $ 18.10 | £ 11.40 | € 16,80 | ¥ 172.90 | Multimode Fiber-to-Fiber Splice, 128µm |

# Bare Fiber Terminator


- For Temporary Connection of Fiber to a Connector
- Compatible With FC, ST, and SMA Connectors

Connectors are Sold Separately (See Pages 1044-1045)

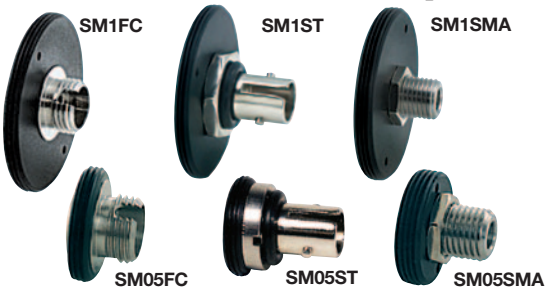



For applications where a temporary fiber termination is desired, Thorlabs' Bare Fiber Terminator is the solution. It is reusable and can be easily cleaned out if the fiber breaks inside the connector by using our cleaning wires (WC100). This terminator is designed to hold fibers mechanically in standard connectors, which are sold separately.

**Fits all Thorlabs Connectors on Pages 1044-1045, Except: 30080D1, 30126F1, 30127D2, 30126D3, 30126D4, 30126K1, 30140E1, and 86024-5500**

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| BFTU | $ 75.20 | £ 47.40 | € 69,90 | ¥ 718.20 | Universal Terminator for FC, ST, and SMA Connectors |
| WC100 | $ 12.30 | £ 7.70 | € 11,40 | ¥ 117.50 | Clean Out Wires (8 Pieces per Vial) |
| 190044-50 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Boot, Black |
| 190044-55 | $ 0.41 | £ 0.26 | € 0,40 | ¥ 3.90 | 900µm Strain Relief Boot, Yellow |

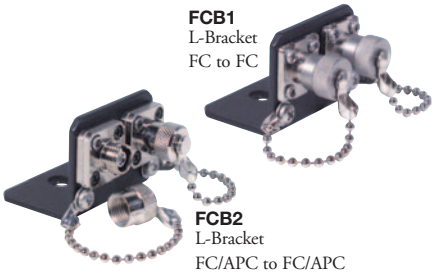
# SM1 Series Fiber Adapters




Allows connectorized fibers to be integrated into the SM1 series or SM05 series of lens tubes. Common applications include building fiber to free-space collimators and light-tight coupling to our DET and PDA detector series (see pages 928-934).

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| SM1FC | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 | SM1 to FC Adapter |
| SM1SMA | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 | SM1 to SMA Adapter |
| SM1ST | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 | SM1 to ST Adapter |
| SM05FC | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 | SM05 to FC Adapter |
| SM05SMA | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 | SM05 to SMA Adapter |
| SM05ST | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 | SM05 to ST Adapter |

# FC to FC Mating Sleeves



**FCB1**
L-Bracket
FC to FC

**FCB2**
L-Bracket
FC/APC to FC/APC

**ADAFC1**
Panel Mount
FC to FC

**ADAFC2**
Four Hole Pattern
FC to FC

**ADAFC3**
Panel Mount
FC/APC to FC/APC

- Superior Performance Over Beryllium Copper Sleeves, Which Flake and May Damage Connectors

**ADAFC1:** Use this as a panel mount (D hole) or as a floating style adapter to connect two single mode or multimode cables.

**ADAFC2:** This FC to FC adapter has a square flange and is intended for panel mounting. The flange has two clearance holes located diagonally on a 9.50mm square.

**ADAFC3:** For use with angle-polished FC cables. This adapter can be used as a floating style or as a panel mount (D hole) to connect two single mode APC cables.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| ADAFC1 | $ 9.40 | £ 5.90 | € 8,70 | ¥ 89.80 | Single Mode FC to FC Mating Sleeve (D Hole) |
| ADAFC2 | $ 10.40 | £ 6.55 | € 9,70 | ¥ 99.30 | Single Mode FC to FC Square Mating Sleeve |
| ADAFC3 | $ 20.30 | £ 12.80 | € 18,90 | ¥ 193.90 | FC/APC to FC/APC Single Mode Mating Sleeve |
| FCB1 | $ 53.60 | £ 33.80 | € 49,80 | ¥ 511.90 | FC to FC Dual Mating Sleeve Dual L-Bracket |
| FCB2 | $ 73.40 | £ 46.20 | € 68,30 | ¥ 701.00 | FC/APC to FC/APC Mating Sleeve Dual-Bracket |

# PM FC to FC Mating Sleeves

**FCA-N2.0-PM**
Panel Mount
PM FC to PM FC
2.0mm Key Slot

**FCA-W2.1-PM**
Panel Mount
PM FC to PM FC
2.1mm Key Slot

- Monolithic Design Ensures Optimal Performance for PM-PM Interfaces
- Wide Key and Narrow Key Versions

**FCA-N2.0-PM:** Use this as a panel mount adapter to connect two PM cables that have connectors with narrow (2.0mm) keys.

**FCA-W2.1-PM:** Use this as a panel mount adapter to connect two PM cables that have connectors with wide (2.1mm) keys.

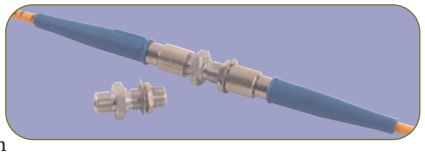
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| FCA-N2.0-PM | $ 47.00 | £ 29.60 | € 43,70 | ¥ 448.90 | PMFC Adapter Narrow (2mm) Key |
| FCA-W2.1-PM | $ 47.00 | £ 29.60 | € 43,70 | ¥ 448.90 | PMFC Adapter Wide (2.1mm) Key |

# SMA to SMA Mating Sleeves

**ADASMA**
Panel Mount
SMA to SMA

**SMAB1**
L-Bracket
SMA to SMA

- Durable All-Metal Design



The ADASMA is a panel mount style stainless steel mating sleeve that is used to connect two SMA905 fiber optic cables. The SMA906 can be used with an adapter sleeve that comes with the SMA906 connector (not sold by Thorlabs).

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| ADASMA | $ 16.95 | £ 10.70 | € 15,80 | ¥ 161.90 | SMA to SMA Mating Sleeve |
| SMAB1 | $ 39.50 | £ 24.90 | € 36,70 | ¥ 377.20 | SMA to SMA Dual L-Bracket |

# ST to ST Mating Sleeves

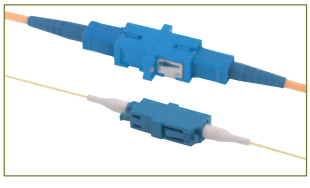
**ADAST**

**ST Single Mode Adapter**
(Also Compatible With Multimode Fibers)

The ADAST is a panel mount style adapter that is used to connect two ST connectors. The metal housing and precision alignment sleeve ensures proper alignment of the mating ferrules and allows the two fiber cores to contact for minimal back reflections.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| ADAST | $ 5.75 | £ 3.60 | € 5,30 | ¥ 54.90 | ST to ST Mating Sleeve |

# LC & SC Mating Sleeves



**ADASC1**
SC to SC
Panel Mount

**ADALC1**
LC to LC

**ADASC1:** This SC/PC to SC/PC adapter is designed to connect two SC/PC terminated fiber optic cables.

**ADALC1:** This LC to LC adapter is designed to connect two LC terminated fiber optic cables.

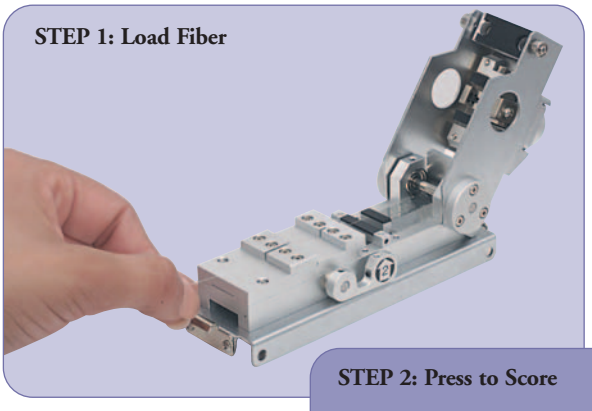
| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| ADASC1 | $ 17.20 | £ 10.85 | € 16,00 | ¥ 164.30 | SC/PC to SC/PC Mating Sleeve |
| ADALC1 | $ 17.20 | £ 10.85 | € 16,00 | ¥ 164.30 | LC to LC Mating Sleeve |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# "Suspension" Cleaver Design

The XL410 high-precision fiber cleaver's unique design ensures cleave angles <0.5°. Its simple three step operation significantly improves productivity by delivering perpendicular, chip-free cleaves that are a must for low loss fusion splicing.

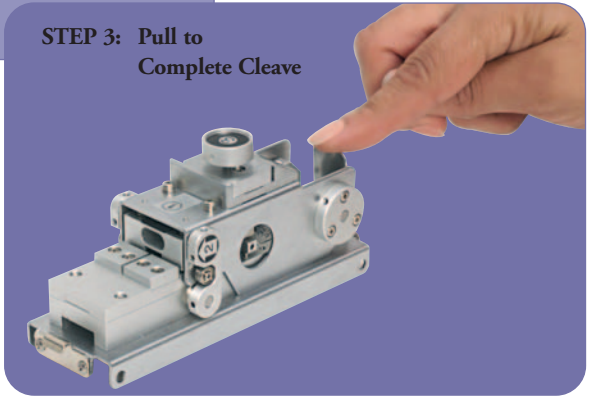
**The XL410's superior performance is a result of its unique design!**



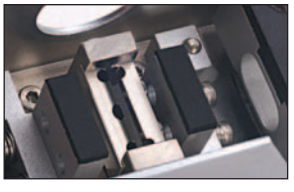

1
2
3

**SIMPLE 3-STEP PROCESS**


**Each step is clearly labeled.**


- Precision Engineered
- Highly Repeatable Cleaves in Less Than 30 Seconds
- Precise Mechanical Design Allows Field Replacement of Blades
- Standard 125/250µm and 125/900µm Fibers
- Ribbon Fiber Option (Requires Adapter Plate Sold by Alcoa Fujikura)
- Cutter Blades Will Last at Least 1000 Operations Under Normal Use



This suspension cleaver design follows a simple 3-step cleave sequence. The design ensures consistent 0.5° cleaves. For ease of use, the 3-step sequence is clearly indicated on the tool, making this an ideal instrument for any application or environment.

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| XL410 | $ 1,360.00 | £ 856.80 | € 1.264,80 | ¥ 12,988.00 | Precision Fiber Cleaver |
| XL410B | $ 84.00 | £ 52.90 | € 78,10 | ¥ 802.20 | Replacement Blade |

# Single Mode Fiber Selection Guide

Pages 1058-1088

### Single Mode Patch Cables

- 400nm-1550nm Patch Cables
- FC/PC and FC/APC
- Call for Custom Lengths and Fibers

**See Pages 1058-1059**


### 400nm-1550nm Single Mode Fibers

- Corning
- Nufern Select Cutoff
- Fibercore

**See Pages 1060-1061**


### Ultra-High NA Fibers

- High Coupling Efficiency to Planar Waveguides
- Low Splice Loss to Flouride Fibers
- Low Splice Loss to Standard Silica Fibers

**See Page 1062**


### Photosensitive

- Low Loss
- Enhanced Photosensitivity
- Cladding Mode Suppressed

**See Page 1063**

### Rare Earth Doped

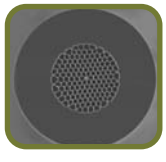
- Highly and Very Highly Doped Yb Fibers
- Highly and Very Highly Doped Er Fibers
- Single and Double Clad Fibers
- Standard and Large Core Fibers

**See Pages 1064-1073**

### Polarization Maintaining

- Bend Insensitive and Low Temperature Fibers
- Operating Wavelengths from 488-1620nm
- Bow-Tie and Stress Rod Designs

**See Pages 1075-1078**



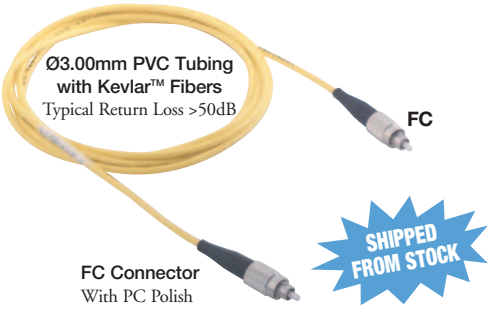
### Photonic Crystal Fibers

- Highly Nonlinear
- Polarization Maintaining Fiber
- Hollow Core Bandgap Fiber
- Patch Cables

**See Pages 1079-1088**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crustal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Fiber Patch Cables: Single Mode FC/PC




## Custom Patch Cables

**Thorlabs is pleased to offer next-day shipping service for small lots of custom patch cables assembled using our standard fibers. We stock many of our more popular fibers with protective jacketing in bulk, allowing us to assemble custom length patch cables within one day when requested. Additionally, we stock the largest selection of single mode and multimode optical fibers in the photonics industry.**

For Details Contact Technical Support at: techsupport@thorlabs.com

### Features

- Connectorized on Both Ends
- Typical Return Loss of 50dB (40dB min.)
- Ceramic Radiused Ferrules (PC)
- 2, 5, and 10 Meter Lengths
- Ø3mm Protective Outer Jacket

These fiber patch cables are connectorized on both ends with high quality ceramic FC connectors. Manufactured in our facility, each cable is individually tested to ensure low back-reflection (return loss) at fiber-to-fiber junctions. Available from stock, these cables feature a high quality polish, which yields typical return losses of over 50dB.

### 405nm FC Single Mode Patch Cables[1]

| ITEM# | $ | £ | € | RMB | CUTOFF WAVELENGTH | L | FIBER (see page 1060) | MFD[2]/CLAD | NA[3] |
|---|---|---|---|---|---|---|---|---|---|
| P1-405A-FC-2 | $ 72.90 | £ 45.90 | € 67,80 | ¥ 696.20 | 300-400nm[1] | 2m | S405 | 3.2/125µm | 0.12 |
| P1-405A-FC-5 | $ 93.30 | £ 58.80 | € 86,80 | ¥ 891.00 | 300-400nm[1] | 5m | S405 | 3.2/125µm | 0.12 |

1) Operating wavelength: 400-525nm.
2) MFD: mode field diameter (@ 460nm)
3) Nominal NA

### 488/514nm FC Single Mode Patch Cables[1]

| ITEM# | $ | £ | € | RMB | CUTOFF WAVELENGTH | L | FIBER (see page 1060) | MFD[2]/CLAD | NA[3] |
|---|---|---|---|---|---|---|---|---|---|
| P1-460A-FC-2 | $ 72.90 | £ 45.90 | € 67,80 | ¥ 696.20 | 410-450nm[1] | 2m | 460HP | 3.3/125µm | 0.13 |
| P1-460A-FC-5 | $ 93.30 | £ 58.80 | € 86,80 | ¥ 891.00 | 410-450nm[1] | 5m | 460HP | 3.3/125µm | 0.13 |

1) Operating wavelength: 450-600nm.
2) MFD: mode field diameter (@ 515nm)
3) Nominal NA

### 630nm FC Single Mode Patch Cables[1]

| ITEM# | $ | £ | € | RMB | CUTOFF WAVELENGTH | L | FIBER (see page 1060) | MFD[2]/CLAD | NA[3] |
|---|---|---|---|---|---|---|---|---|---|
| P1-630A-FC-2 | $ 66.30 | £ 41.80 | € 61,70 | ¥ 633.20 | 500-600nm[1] | 2m | SM600 | 4.3/125µm | 0.12 |
| P1-630A-FC-5 | $ 79.60 | £ 50.10 | € 74,00 | ¥ 760.20 | 500-600nm[1] | 5m | SM600 | 4.3/125µm | 0.12 |
| P1-630A-FC-10 | $ 107.40 | £ 67.70 | € 99,90 | ¥ 1,025.70 | 500-600nm[1] | 10m | SM600 | 4.3/125µm | 0.12 |

1) Typically these fibers can be operated 200nm above their cutoff wavelengths
2) MFD: mode field diameter (4.3µm @ 633nm and 4.6µm @ 680nm)
3) Mean NA: 0.10 ≤ NA ≤ 0.14

### 830nm FC Single Mode Patch Cables[1]

| ITEM# | $ | £ | € | RMB | CUTOFF WAVELENGTH | L | FIBER (see page 1060) | MFD[2]/CLAD | NA[3] |
|---|---|---|---|---|---|---|---|---|---|
| P1-830A-FC-2 | $ 63.40 | £ 39.90 | € 59,00 | ¥ 605.50 | 660-800nm[1] | 2m | SM800-5.6-125 | 5.6/125µm | 0.12 |
| P1-830A-FC-5 | $ 73.60 | £ 46.40 | € 68,40 | ¥ 702.90 | 660-800nm[1] | 5m | SM800-5.6-125 | 5.6/125µm | 0.12 |
| P1-830A-FC-10 | $ 96.70 | £ 60.90 | € 89,90 | ¥ 923.50 | 660-800nm[1] | 10m | SM800-5.6-125 | 5.6/125µm | 0.12 |

1) Typically these fibers can be operated 200nm above their cutoff wavelengths
2) MFD: mode field diameter (@ 830nm)
3) Mean NA: 0.10 ≤ NA ≤ 0.14

### 980/1064/1550nm FC Single Mode Patch Cables[1]

| ITEM# | $ | £ | € | RMB | CUTOFF WAVELENGTH | L | FIBER (see page 1061) | MFD[2]/CLAD | NA[3] |
|---|---|---|---|---|---|---|---|---|---|
| P1-980A-FC-2 | $ 64.40 | £ 40.60 | € 59,90 | ¥ 615.00 | 870-970nm[1] | 2m | SM980-5.8-125 | 5.8/125µm | 0.14 |
| P1-980A-FC-5 | $ 75.70 | £ 47.70 | € 70,40 | ¥ 722.90 | 870-970nm[1] | 5m | SM980-5.8-125 | 5.8/125µm | 0.14 |

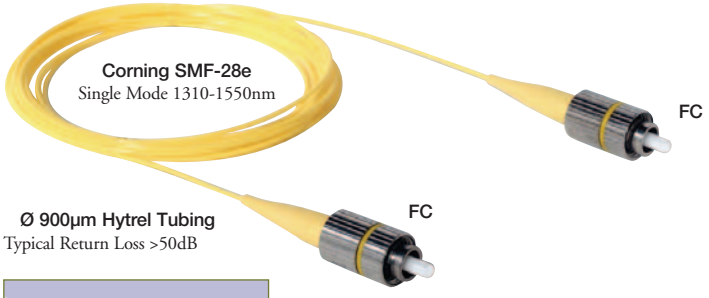
1) The design wavelengths are 980nm, 1064nm, and 1550nm. This fiber can typically be operated 200nm above their cutoff wavelengths.
2) MFD: mode field diameter (5.8µm @ 980nm, 6.2µm @ 1064nm and 10.4µm @ 1550nm)
3) Mean NA: 0.13 ≤ NA ≤ 0.15

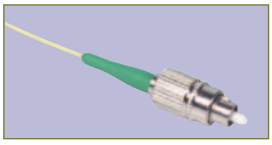
### 1550nm FC Single Mode Patch Cables[1]

| ITEM# | $ | £ | € | RMB | CUTOFF WAVELENGTH | L | FIBER (see page 1061) | MFD[2]/CLAD | NA |
|---|---|---|---|---|---|---|---|---|---|
| P1-1550A-FC-2 | $ 72.90 | £ 45.90 | € 67,80 | ¥ 696.20 | 1350-1450nm[1] | 2m | 1550BHP | 9.5/125µm | 0.13 |
| P1-1550A-FC-5 | $ 93.30 | £ 58.80 | € 86,80 | ¥ 891.00 | 1350-1450nm[1] | 5m | 1550BHP | 9.5/125µm | 0.13 |
| P1-1550A-FC-10 | $ 132.00 | £ 83.20 | € 122,80 | ¥ 1,260.60 | 1350-1450nm[1] | 10m | 1550BHP | 9.5/125µm | 0.13 |

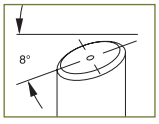
1) Typically these fibers can be operated 50nm below and 200nm above their design wavelengths
2) MFD: mode field diameter

# Fiber Patch Cables: Single Mode Corning® SMF-28e



900µm Protective Jacket
APC Return Loss >60dB **FC/APC**




Return Loss = $10 \text{ Log}\left(\frac{P_{In}}{P_{Back}}\right)$

## Features

- Cutoff Wavelength of <1260nm
- <0.3dB Loss Connector to Connector
- Low Back Reflections (High Return Loss)
- Ø900µm Protective Jacket
- Each Cable Individually Tested
- Longer Length Cables Available

Connectorized on both ends, these Fiber Patch Cables feature high-quality ceramic connectors. Manufactured in our facility, each cable is individually tested to ensure low back-reflection (high return loss) at fiber-to-fiber junctions. Available from stock, these cables feature a high-quality polish, which is achieved on state-of-the-art equipment to yield typical return losses of 50dB or greater.

### SMF-28e Stock Cable FC/PC

| ITEM# | $ | £ | € | RMB | L[1] | DESCRIPTION |
|---|---|---|---|---|---|---|
| P1-SMF28-FC-1 | $ 38.50 | £ 24.30 | € 35,80 | ¥ 367.70 | 1m | SMF-28e Patch Cable with FC/PC Connectors |
| P1-SMF28-FC-2 | $ 39.20 | £ 24.70 | € 36,50 | ¥ 374.40 | 2m | SMF-28e Patch Cable with FC/PC Connectors |
| P1-SMF28-FC-5 | $ 40.30 | £ 25.40 | € 37,50 | ¥ 384.90 | 5m | SMF-28e Patch Cable with FC/PC Connectors |
| P1-SMF28-FC-10 | $ 51.90 | £ 32.70 | € 48,30 | ¥ 495.60 | 10m | SMF-28e Patch Cable with FC/PC Connectors |

1) Length

### SMF-28e Stock Cables: FC/APC

| ITEM# | $ | £ | € | RMB | L[1] | DESCRIPTION |
|---|---|---|---|---|---|---|
| P3-SMF28-FC-2 | $ 59.30 | £ 37.40 | € 55,10 | ¥ 566.30 | 2m | SMF-28e Patch Cable with FC/APC Connectors |
| P3-SMF28-FC-5 | $ 68.90 | £ 43.40 | € 64,10 | ¥ 658.00 | 5m | SMF-28e Patch Cable with FC/APC Connectors |

1) Length

### SMF-28e Stock Cables: FC/PC to FC/APC

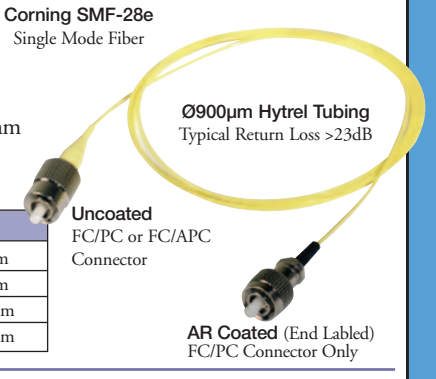
| ITEM# | $ | £ | € | RMB | L[1] | DESCRIPTION |
|---|---|---|---|---|---|---|
| P5-SMF28-FC-2 | $ 59.30 | £ 37.40 | € 55,10 | ¥ 566.30 | 2m | SMF-28e Patch Cable, FC/PC to FC/APC Connectors |
| P5-SMF28-FC-5 | $ 68.90 | £ 43.40 | € 64,10 | ¥ 658.00 | 5m | SMF-28e Patch Cable, FC/PC to FC/APC Connectors |

1) Length



# AR Coated (One End) Fiber Patch Cables

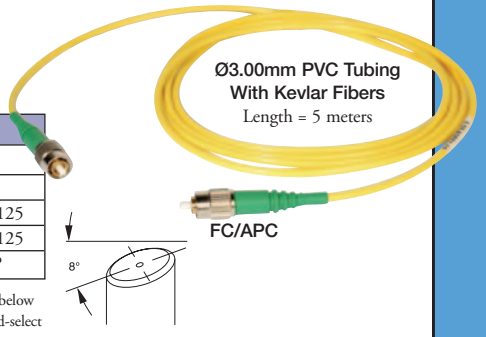
- Ideal for Use With Our Collimation Packages to Minimize Fresnel Losses
- SMF-28e Fiber, 1m Length (Cutoff Wavelength <1260nm)
- AR Coated FC/PC Connector (One End): R < 0.5%, 1300nm ± 100nm or 1550nm ± 100nm
- Uncoated FC/PC or FC/APC Input Connector




| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| P1-SMF28-FC-1-13 | $ 82.40 | £ 51.90 | € 76,60 | ¥ 786.90 | FC/PC AR Coated - FC/PC, 1300nm |
| P1-SMF28-FC-1-15 | $ 82.40 | £ 51.90 | € 76,60 | ¥ 786.90 | FC/PC AR Coated - FC/PC, 1550nm |
| P5-SMF28-FC-1-13 | $ 94.40 | £ 59.50 | € 87,80 | ¥ 901.50 | FC/PC AR Coated - FC/APC, 1300nm |
| P5-SMF28-FC-1-15 | $ 94.40 | £ 59.50 | € 87,80 | ¥ 901.50 | FC/PC AR Coated - FC/APC, 1550nm |

# Fiber Patch Cables: Single Mode FC/APC

These FC/APC patch cables are ideal for systems that are sensitive to back reflections. The APC connector utilizes a ferrule that has an 8° end and an ultra PC polish, thus ensuring that the return losses are greater than 60dB.




| ITEM# | $ | £ | € | RMB | λ* | FIBERS |
|---|---|---|---|---|---|---|
| P3-460A-FC-5 | $ 124.10 | £ 78.20 | € 115,40 | ¥ 1,185.20 | 488/514nm | 460HP |
| P3-630A-FC-5 | $ 108.50 | £ 68.40 | € 100,90 | ¥ 1,036.20 | 630nm | SM600 |
| P3-830A-FC-5 | $ 101.60 | £ 64.00 | € 94,50 | ¥ 970.30 | 830nm | SM800-5.6-125 |
| P3-980A-FC-5 | $ 104.10 | £ 65.60 | € 96,80 | ¥ 994.20 | 980/1064/1550nm | SM980-5.8-125 |
| P3-1550A-FC-5 | $ 124.10 | £ 78.20 | € 115,40 | ¥ 1,185.20 | 1550nm | 1550BHP |

*) λ is the operating wavelength of the fiber. The typical wavelength range over which these fibers are single mode is approximately 50nm below to 200nm above the specified operating wavelength. If you need to operate near the lower end of this range, please call so that we can hand-select the fiber to ensure single mode operation.

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crustal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Single Mode Fiber, 400nm to 600nm

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| S405 | 1 to 9m | $ 13.50 | £ 8.50 | € 12,55 | ¥ 128.95 |
| | 10 to 49m | $ 11.20 | £ 7.05 | € 10,40 | ¥ 106.95 |
| | 50 to 249m | $ 8.65 | £ 5.45 | € 8,05 | ¥ 82.60 |
| SM450 | 1 to 9m | $ 9.00 | £ 5.65 | € 8,35 | ¥ 85.95 |
| | 10 to 49m | $ 6.70 | £ 4.20 | € 6,25 | ¥ 64.00 |
| | 50 to 249m | $ 5.65 | £ 3.55 | € 5,25 | ¥ 53.95 |
| 460HP | 1 to 9m | $ 9.95 | £ 6.25 | € 9,25 | ¥ 95.00 |
| | 10 to 49m | $ 8.50 | £ 5.35 | € 7,90 | ¥ 81.20 |
| | 50 to 249m | $ 6.50 | £ 4.10 | € 6,05 | ¥ 62.10 |
| S460 | 1 to 9m | $ 12.20 | £ 7.70 | € 11,35 | ¥ 116.50 |
| | 10 to 49m | $ 9.60 | £ 6.05 | € 8,95 | ¥ 91.70 |
| | 50 to 249m | $ 8.15 | £ 5.15 | € 7,60 | ¥ 77.85 |

Call For Quantities Over 250m


**NEW** Pure Silica Core Fibers

- Resistance to Radiation-Induced Damage and Color Center Formation
- Low Attenuation
- Available P/Ns: S405, S460, and S630

### Features

- Shipped From Stock, No Minimums
- Acrylate Jacket

| ITEM# | OPERATING WAVELENGTH | MODE FIELD DIAMETER | CLADDING | COATING | CUTOFF WAVELENGTH | ATTENUATION MAXIMUM | NA | VENDOR |
|---|---|---|---|---|---|---|---|---|
| S405[4,5] | 400-550nm | 2.9µm @ 405nm | 125 ± 1.0µm | 245 ± 15µm | 370 ± 20nm | ≤30dB/km @ 460nm | 0.12 | Nufern |
| SM450 | 488/514nm[1] | 3.3/3.4µm[2] | 125 ± 1µm | 245 ± 5% | 400 ± 50nm | <50dB/km @ 488nm[5] | 0.13[3] | Fibercore |
| 460HP[5] | 450-600nm | 3.5 ± 0.5µm @ 515nm | 125 ± 1.5µm | 245 ± 15µm | 430 ± 20nm | <30dB/km @ 630nm | 0.13 | Nufern |
| S460[4,5] | 450-600nm | 3.4 ± 0.5µm @ 460nm | 125 ± 1.0µm | 245 ± 15µm | 425 ± 25nm | <30dB/km @ 460nm | 0.13 | Nufern |

1) Operating wavelength range is typically 200nm above the cutoff wavelength.
2) MFD is a nominal, calculated value, estimated at the operating wavelength(s)
3) 0.10 ≤ NA ≤ 0.14
4) Pure Silica Core Fibers
5) Short term bend radius ≥6mm

# Single Mode Fiber, 633nm to 770nm

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| SM600 | 1 to 9m | $ 5.40 | £ 3.40 | € 5,00 | ¥ 51.55 |
| | 10 to 49m | $ 3.85 | £ 2.45 | € 3,60 | ¥ 36.75 |
| | 50 to 249m | $ 3.35 | £ 2.10 | € 3,10 | ¥ 32.00 |
| 630HP | 1 to 9m | $ 5.25 | £ 3.30 | € 4,90 | ¥ 50.15 |
| | 10 to 49m | $ 4.25 | £ 2.70 | € 3,95 | ¥ 40.60 |
| | 50 to 249m | $ 3.25 | £ 2.05 | € 3,00 | ¥ 31.05 |
| S630 | 1 to 9m | $ 8.50 | £ 5.35 | € 7,90 | ¥ 81.20 |
| | 10 to 49m | $ 7.30 | £ 4.60 | € 6,80 | ¥ 69.70 |
| | 50 to 249m | $ 5.30 | £ 3.35 | € 4,95 | ¥ 50.60 |

Call For Quantities Over 250m

### Features

- Shipped From Stock, No Minimums
- True Single Mode Operation for HeNe and All Visible Laser Diodes
- Acrylate Coating
- Exceptional Core/Clad Concentricity Specifications
- 630HP and S630 Offer a Tight Bend Radius for Applications in Miniaturized Fiber Optic Packages

| ITEM# | OPERATING WAVELENGTH | MODE FIELD DIAMETER | CLADDING | COATING | CUTOFF WAVELENGTH | ATTENUATION MAXIMUM | NA | VENDOR |
|---|---|---|---|---|---|---|---|---|
| SM600 | 633/680nm[1] | 4.3/4.6µm[2] | 125 ± 1µm | 245 ± 5% | 550 ± 50nm | <15dB/km @ 633nm | 0.12[3] | Fibercore |
| 630HP[5] | 610-770nm | 4.0 ± 0.5µm @ 630nm | 125 ± 1.5µm | 245 ± 15µm | 570 ± 30nm | <12dB/km @ 630nm | 0.13 | Nufern |
| S630[4,5] | 600-860nm | 4.2 ± 0.5µm @ 630nm | 125 ± 1.0µm | 245 ± 15µm | 590 ± 30nm | <10dB/km @ 630nm | 0.12 | Nufern |

1) Operating wavelength range is typically 200nm above the cutoff wavelength.
2) MFD is a nominal, calculated value, estimated at the operating wavelength(s)
3) 0.10 ≤ NA ≤ 0.14
4) Pure Silica Core Fibers
5) Short term bend radius ≥6mm

# Single Mode Fiber, 780nm to 970nm

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| 780HP | 1 to 9m | $ 5.25 | £ 3.30 | € 4,90 | ¥ 50.15 |
| | 10 to 49m | $ 4.25 | £ 2.70 | € 3,95 | ¥ 40.60 |
| | 50 to 249m | $ 3.25 | £ 2.05 | € 3,00 | ¥ 31.05 |
| SM800-5.6-125 | 1 to 9m | $ 5.40 | £ 3.40 | € 5,00 | ¥ 51.55 |
| | 10 to 49m | $ 3.85 | £ 2.45 | € 3,60 | ¥ 36.75 |
| | 50 to 249m | $ 3.35 | £ 2.10 | € 3,10 | ¥ 32.00 |

Call For Quantities Over 250m

### Features

- Shipped From Stock, No Minimums
- Acrylate Jacket
- Exceptional Core/Clad Concentricity Specifications
- 780HP Offers Tight Second Mode Cutoff Tolerances
- 780HP Offers a Tight Bend Radius for Applications in Miniaturized Fiber Optic Packages

| ITEM# | OPERATING WAVELENGTH | MODE FIELD DIAMETER | CLADDING | COATING | CUTOFF WAVELENGTH | ATTENUATION MAXIMUM | NA | VENDOR |
|---|---|---|---|---|---|---|---|---|
| 780HP[4] | 780-970nm | 5.0 ± 0.5µm @ 850nm | 125 ± 1.5µm | 245 ± 15µm | 730 ± 30nm | <3.5dB/km @ 850nm | 0.13 | Nufern |
| SM800-5.6-125 | 830nm[1] | 5.6µm[2] | 125 ± 1µm | 245 ± 5% | 730 ± 70nm | <5dB/km @ 830nm | 0.12[3] | Fibercore |

1) Operating wavelength range is typically 200nm above the cutoff wavelength.
2) MFD is a nominal, calculated value, estimated at the operating wavelength(s)
3) 0.10 ≤ NA ≤ 0.14
4) Short term bend radius ≥6mm

# Single Mode Fiber, 980nm

### Features
- Shipped From Stock, No Minimums
- HI1060-J9 and HI980-J9 Have 900µm Tight Buffer Outer Jacket
- SM980-5.8-125 has a MFD Matched to Other Fibers Used in EDFA Pump Laser Pigtails
- 980HP Offers a Tight Second Mode Cutoff Tolerance


| ITEM# | OPERATING WAVELENGTH | MODE FIELD DIAMETER | CLADDING | COATING | CUTOFF WAVELENGTH | ATTENUATION MAXIMUM | NA | VENDOR |
|---|---|---|---|---|---|---|---|---|
| SM980-5.8-125 | 980/1064/1550nm[1] | 5.8µm | 125 ± 1µm | 245 ± 5% | 870-970nm[1] | 3dB/km @ 980nm | 0.14 | Fibercore |
| HI1060-J9 | 980-1060nm | 5.9 ± 0.3µm @ 980nm | 125 ± 0.5µm | 245 ± 10µm | 920 ± 50nm | 1.5dB/km @ 1060nm[2] | 0.14 | Corning |
| HI980-J9 | 980-1550nm | 4.2 ± 0.3µm @ 980nm | 125 ± 0.5µm | 245 ± 10µm | 930 ± 50nm | ≤2.5dB/km @ 980nm | 0.20 | Corning |
| 980HP[3] | 980-1600nm | 4.2 ± 0.5µm @ 980nm | 125 ± 1.5µm | 245 ± 15µm | 920 ± 30nm | <3.5dB/km @ 980nm | 0.20 | Nufern |

1) Operating wavelength range is typically 200nm above the cutoff wavelength.
2) Attenuation 2.1dB/km @ 980nm
3) Short term bend radius ≥6mm

### Standard Lengths

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| HI1060-10 | $ 67.50 | £ 42.50 | € 62,80 | ¥ 644.60 | 10m HI1060 with 900µm Jacket |
| HI1060-100 | $ 625.00 | £ 393.75 | € 581,25 | ¥ 5,968.80 | 100m HI1060 with 900µm Jacket |

### Standard Lengths

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| HI980-10 | $ 101.00 | £ 63.60 | € 93,90 | ¥ 964.55 | 10m HI980 with 900µm Jacket |
| HI980-100 | $ 900.00 | £ 567.00 | € 837,00 | ¥ 8,595.00 | 100m HI980 with 900µm Jacket |

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| SM980-5.8-125 | 1 to 9m | $ 5.40 | £ 3.40 | € 5,00 | ¥ 51.55 |
| | 10 to 49m | $ 3.85 | £ 2.45 | € 3,60 | ¥ 36.75 |
| | 50 to 249m | $ 3.35 | £ 2.10 | € 3,10 | ¥ 32.00 |
| HI1060-J9 | >100m | $ 6.50 | £ 4.10 | € 6,05 | ¥ 62.10 |
| HI980-J9 | >100m | $ 9.25 | £ 5.85 | € 8,60 | ¥ 88.35 |
| 980HP | 1 to 9m | $ 4.75 | £ 3.00 | € 4,40 | ¥ 45.35 |
| | 10 to 49m | $ 3.75 | £ 2.35 | € 3,50 | ¥ 35.80 |
| | 50 to 249m | $ 2.95 | £ 1.85 | € 2,75 | ¥ 28.15 |

Call For Quantities Over 250m



# Single Mode Fiber, 1060nm to 1620nm

### Features
- Shipped From Stock, No Minimums
- Fibers Have Acrylate Coatings
- SMF-28-J9 has a 900µm Tight Buffer Outer Jacket
- Exceptional Core/Clad Concentricity Specifications
- 1060XP, 1310BHP, and 1550BHP Offer Tight Second Mode Cutoff Tolerances

### Standard Lengths (Longer Lengths Available)

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| SMF-28-10 | $ 5.90 | £ 3.70 | € 5,50 | ¥ 56.30 | 10m SMF-28-J9 w/ 900µm Jacket |
| SMF-28-100 | $ 51.00 | £ 32.10 | € 47,40 | ¥ 487.10 | 100m SMF-28-J9 w/ 900µm Jacket |
| SMF-28-1000 | $460.00 | £ 289.80 | €427,80 | ¥ 4,393.00 | 1000m SMF-28-J9 w/ 900µm Jacket |

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| 1060XP | 1 to 9m | $ 4.75 | £ 3.00 | € 4,40 | ¥ 45.40 |
| | 10 to 49m | $ 3.75 | £ 2.35 | € 3,50 | ¥ 35.80 |
| | 50 to 249m | $ 2.95 | £ 1.85 | € 2,75 | ¥ 28.20 |
| SMF-28-J9 | >100m | $ 0.50 | £ 0.32 | € 0,47 | ¥ 4.78 |
| 1310BHP | 1 to 9m | $ 4.75 | £ 3.00 | € 4,40 | ¥ 45.40 |
| | 10 to 49m | $ 3.75 | £ 2.35 | € 3,50 | ¥ 35.80 |
| | 50 to 249m | $ 2.95 | £ 1.85 | € 2,75 | ¥ 28.20 |
| 1550BHP | 1 to 9m | $ 4.75 | £ 3.00 | € 4,40 | ¥ 45.40 |
| | 10 to 49m | $ 3.75 | £ 2.35 | € 3,50 | ¥ 35.80 |
| | 50 to 249m | $ 2.95 | £ 1.85 | € 2,75 | ¥ 28.20 |

Call For Quantities Over 250m

| ITEM# | OPERATING WAVELENGTH | MODE FIELD DIAMETER | CLADDING | COATING | CUTOFF WAVELENGTH | ATTENUATION MAXIMUM | NA | VENDOR |
|---|---|---|---|---|---|---|---|---|
| 1060XP[4] | 1060-1600nm | 6.2 ± 0.5µm @ 1060nm | 125 ± 0.5µm | 245 ± 15µm | 920 ± 30nm | <1.5dB/km[1] | 0.14 | Nufern |
| SMF-28-J9 | 1260-1600nm | 9.2µm/10.4µm | 125 ± 0.7µm | 245 ± 5µm | <1260nm | ≤0.35dB/km[2] | 0.13 | Corning |
| 1310BHP[4] | 1300-1625nm | 8.6µm[2]/9.7µm[3] | 125 ± 1.0µm | 245 ± 15µm | 1260 ± 30nm | ≤0.5dB/km[2, 3] | 0.13 | Nufern |
| 1550BHP[4] | 1460-1620nm | 9.5 ± 0.5µm @ 1550nm | 125 ± 1.0µm | 245 ± 15µm | 1400 ± 50nm | <0.5dB/km @ 1550nm | 0.13 | Nufern |

1) Attenuation 2.1dB/km @ 980nm and1.5dB/km @ 1060nm
2) @1310nm
3) @1550nm
4) Short term bend radius ≥6nm

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crustal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Ultra-High NA Silica Fibers

**For Fluoride and Tellurite Fiber Splicing**

Fluoride optical fibers for amplifiers and lasers at 1300 and 1500nm are becoming important components for optical fiber communications systems. Efficient operation of fluoride fibers requires a very high numerical aperture (typically >0.3), which unfortunately leads to increased splice losses and low return loss when connected to standard silica fibers. This splice loss decreases the overall gain and seriously degrades the noise figure. By splicing UHNA series fibers between the fluoride and standard silica fibers, these losses can be dramatically reduced.

### Price Schedule

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| UHNA1 | 1 to9m | $ 21.10 | £ 13.30 | € 19,60 | ¥ 201.50 |
| | 10 to49m | $ 16.40 | £ 10.35 | € 15,25 | ¥ 156.60 |
| | 50 to249m | $ 13.45 | £ 8.45 | € 12,50 | ¥ 128.45 |
| UHNA3 | 1 to9m | $ 21.10 | £ 13.30 | € 19,60 | ¥ 201.50 |
| | 10 to49m | $ 16.40 | £ 10.35 | € 15,25 | ¥ 156.60 |
| | 50 to249m | $ 13.45 | £ 8.45 | € 12,50 | ¥ 128.45 |
| UHNA4 | 1 to9m | $ 21.10 | £ 13.30 | € 19,60 | ¥ 201.50 |
| | 10 to49m | $ 16.40 | £ 10.35 | € 15,25 | ¥ 156.60 |
| | 50 to249m | $ 13.45 | £ 8.45 | € 12,50 | ¥ 128.45 |

Call For Quantities Over 250m

### Ultra-High NA Silica Fibers by Nufern

| ITEM# | OPERATING WAVELENGTH | MODE FIELD DIAMETER | CUTOFF WAVELENGTH | CORE COMPOSITION | ATTENUATION TYPICAL@1550nm | NA | CLADDING | JACKET | STRIPPING TOOL |
|---|---|---|---|---|---|---|---|---|---|
| UHNA1 | 1100-1600nm | 4.0µm @ 1310nm | 1000 ± 50nm | $SiO_2/GeO_2$ | <20dB/km | 0.28 | 125 ± 1.5µm | 250 ± 20µm | T06S13 |
| UHNA3 | 960-1600nm | 3.3µm @ 1310nm | 850 ± 50nm | $SiO_2/GeO_2$ | <20dB/km | 0.35 | 125 ± 1.5µm | 250 ± 20µm | T06S13 |
| UHNA4 | 1100-1600nm | 4.0µm @ 1550nm | 1050 ± 50nm | $SiO_2/GeO_2$ | <20dB/km | 0.35 | 125 ± 1.5µm | 250 ± 20µm | T06S13 |

1) The core can change up to 10µm during the splicing process. It is increased with repeated arcing.

# Photosensitive Select Cutoff Fiber


The PS1060 photosensitive fiber is designed to provide high photosensitivity for UV radiation. It is designed for writing fiber Bragg gratings for pump stabilizers of diodes with wavelengths in the 980 to 1060nm range. PS1060 may also be used in coupler applications.

**Features**
- High Photosensitivity
- Low Splice Loss to Transmission Fiber
- Low Cost, High Yield Grating Fabrication

**Applications**
- Gain Flattening Filters
- Dispersion Compensators
- Pump Stabilizers

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| PS1060 | 1-9m | $11.40 | £7.20 | € 10,60 | ¥ 108.90 |
| | 10-49m | $ 8.90 | £5.60 | € 8,30 | ¥ 85.00 |
| | 50-249m | $ 7.25 | £4.60 | € 6,75 | ¥ 69.20 |

### Photosensitive Select Cutoff Fiber by Nufern

| ITEM# | OPERATING WAVELENGTH | MODE FIELD DIAMETER | CLADDING | COATING | CUTOFF WAVELENGTH | ATTENUATION | NA | STRIPPING TOOL |
|---|---|---|---|---|---|---|---|---|
| PS1060 | 1060nm | 6.2 ± 0.8µm @ 1060nm | 125 ± 1.5µm | 245 ± 15µm | 920 ± 50µm | 20dB/km @ 1060nm | 0.13 | T06S13 |

# Photosensitive Optical Fiber

These photosensitive fibers are highly sensitive to UV radiation and are mode-matched to SMF-28e GF1 fibers are designed to reduce FBG writing times associated with industry standard telecommunication fiber can be easily spliced to industry standard fibers. The low-loss GF1B provides much higher photosensitivity than standard transmission fibers for UV radiation. The reduced attenuation allows longer length fibers to be used and reduces the insertion loss.


### Features

- Enhanced Photosensitivity
- Low Splice Loss to Transmission Fibers
- Tightly Controlled Uniformity
- >25mm Long-Term Bend Radius
- >12mm Short-Term Bend Radius
- >100kpsi Proof Test Level

### Applications

- Gain Flattening Filters
- Dispersion Compensators
- Pump Stabilizers
- Fiber lasers

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| GF1 | 1 to9m | $ 7.15 | £ 4.50 | € 6,65 | ¥ 68.30 |
| | 10 to49m | $ 5.95 | £ 3.75 | € 5,55 | ¥ 56.80 |
| | 50 to249m | $ 4.70 | £ 2.95 | € 4,35 | ¥ 44.90 |
| GF1B | 1 to9m | $ 5.70 | £ 3.60 | € 5,30 | ¥ 54.45 |
| | 10 to49m | $ 4.90 | £ 3.10 | € 4,55 | ¥ 46.80 |
| | 50 to249m | $ 4.25 | £ 2.70 | € 3,95 | ¥ 40.60 |

Call For Quantities Over 250m

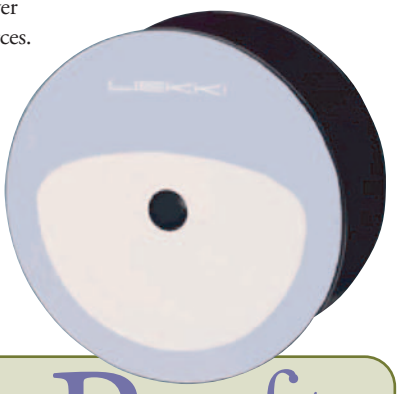
### Photosensitive Optical Fiber by Nufern

| ITEM# | OPERATING WAVELENGTH | MODE FIELD DIAMETER | CUTOFF WAVELENGTH | CLADDING | JACKET | NA | ATTENUATION | STRIPPING TOOL |
|---|---|---|---|---|---|---|---|---|
| GF1 | 1500-1600nm | 9.3 ± 0.5µm @ 1310nm<br>10.5 ± 1.0µm @ 1550nm | 1260 ± 75nm | 125 ± 1.5µm | 250 ± 20µm | 0.13 | - | T06S13 |
| GF1B | 1550nm | 10.4 ± 0.8µm @ 1550nm | 1260 ± 100nm | 125 ± 1.0µm | 245 ± 15µm | 0.13 | 0.5dB/km @ 1550nm | T06S13 |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# HIGHLY DOPED RARE EARTH FIBERS

Thorlabs offers state-of-the-art, highly doped erbium and ytterbium optical fibers for high-power pulsed and continuous wave fiber lasers and amplifier applications, EDFAs, and ASE light sources. These fibers, manufactured by Liekki Corporation in Finland, are fabricated using the latest doped fiber production technology – Liekki Direct Nanoparticle Deposition (DND). The DND technology directly and simultaneously deposits all of the elements (wave-guiding and dopant) in nanoparticle size to create preforms efficiently. This process eliminates the need to solution dope, which is a time-consuming, inaccurate, and performance-limiting process. Applications in the fast growing fiber laser and high-power amplifier segments require short fiber lengths (high doping), specialized refractive index, specialized doping profiles, and large core-to-cladding ratios (large-mode-area double cladding fibers). Liekki DND technology was designed with the requirements of these advanced fiber applications in mind.



## Highly Doped Fiber Benefits

**Precise doping control via the Direct Nanoparticle Deposition (DND) process gives the fiber excellent doping uniformity, peak absorption consistency, spectral shape reproducibility, and excellent beam quality.**

**Highly Doped Fiber**
- Minimize Required Fiber Lengths
- Reduced Nonlinear Effects
- Provides Strong Amplification, High Efficiency, and a Broad and Flat Gain Profile

**Matching Passive Fibers Available**
- Provides Ultimate Performance for Demanding Laser Applications

**Liekki Application Designer (LAD)**
- Simulation Software for Fiber Lasers and Amplifiers

Good fiber applications also require good design. Thorlabs makes the design process easy by offering the Liekki Application Designer software – a simulation tool designed for EDFAs, ASE light sources, and high-power fiber amplifiers and lasers. This software models highly doped large-mode-area fibers accurately. Using fibers should also be easy; Liekki EasySplice software provides splicing parameters. Design guidelines, technical support documents, and other supportive material are also available.


*In Addition to the Products Presented in Our Catalog, Liekki Also Offers Complementary Products & Services.*

### Liekki Fiber Bragg Grating (FBG) Large-Mode-Area (LMA) Fibers

Fiber Bragg grating (FBG) written in passive large-mode-area (LMA) fibers and matched with Yb1200 active LMA fibers. FBG fibers are available for different wavelengths and grating reflectances. The FBG fibers are coated with low-index fluoroacrylate, enabling active fibers to be pumped through them. High-index acrylate coated and all-glass passive fibers are available upon request.

### Liekki Combiners for Large-Mode-Area (LMA) Fibers

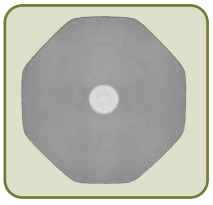
Combiners made with Liekki's passive large-mode-area fibers, matching with Yb1200 active LMA fibers.

### Splicing, Recoating, Endcapping and Other Fiber Services

Splicing, recoating, and endcapping services are offered to fiber laser developers. In addition, precoiling and packaging of fibers is offered.

# Rare Earth Fibers Selection Guide

Pages 1065-1074



### Highly Doped Yb-Fibers for 1.04-1.1µm Lasers and Amplifiers

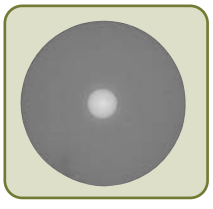
- Doping Levels Provide Peak Absorptions From 2.6 to 1200dB/m (@976nm)
- Doping Levels Minimize Required Fiber Lengths & Reduce Nonlinear Effects
- Strong Amplification, High Efficiency, and a Broad, Flat Gain Profile
- Core-Pumped Single Mode Fiber
- Single Mode and Multimode Double Cladding Fiber

**See Pages 1066-1067**

### Polarization-Maintaining, Highly Doped Yb-Fibers

- Birefringence >2.00 x $10^{-4}$
- Doping Levels Provide Peak Absorptions From 2.6 to 11.2dB/m (@976nm)
- Doping Levels Minimize Required Fiber Lengths & Reduce Nonlinear Effects
- Strong Amplification, High Efficiency, and a Broad, Flat Gain Profile
- Single Mode and Multimode Double Cladding Fiber

**See Pages 1068-1069**



### Highly Doped Er-Fibers for 1.53-1.61µm Lasers & Amplifiers

- Doping Levels Provide Peak Absorptions From 16 to 110dB/m (@1530nm)
- Doping Levels Minimize Required Fiber Lengths & Reduce Nonlinear Effects
- Strong Amplification, High Efficiency, and a Broad, Flat Gain Profile
- Single Mode

**See Pages 1070-1071**

### Large-Mode-Area Matching Passive Fibers

- Matched With Commercially Available Large-Mode-Area Active Fibers
- Low/High Index Coating
- For Octagonal Non-PM and Round PM Geometries
- Low Signal and Pump Coupling Losses From Passive to Active Fiber

**See Page 1072**


### Erbium-Doped C- and L-Band Fibers

- Single Mode Fibers With Dual Acrylate Coatings
- Peak Absorption of ~5.0dB/m (C-Band) and ~12dB/m (L-Band) @ 980nm
- Splice Loss to SMF-28e fiber <0.15dB
- Low Birefringence

**See Page 1073**


### Fiber Laser, Amplifier, and ASE Simulation Software

- Professional Version Simulates Liekki's and Custom Er- and Yb-Doped Fibers
- Supports Single Mode, Multimode, and Large-Mode-Area Fibers, Low/High Doping Levels, Clustering Effects

**See Page 1074**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Ytterbium Doped Fibers for 1.04-1.1µm Lasers and Amplifiers

The YB1200 family of highly doped ytterbium fibers is designed for fiber lasers and continuous wave (CW) and pulsed fiber amplifiers that operate in the 1µm wavelength range with output powers from mW to >100W. These fibers feature high pump absorption, good beam quality, high resistance to photodarkening and excellent usability. The double cladding fibers feature low-index fluoroacrylate coating with >0.46 NA. Fluorosilicate coated all-glass variants are available for demanding high-power applications.

## Passive Double Cladding Fibers

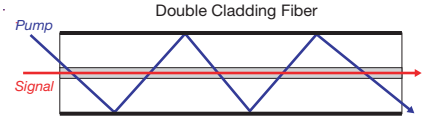
Liekki's matched passive fibers are designed and manufactured to match to commercially available large-mode-area (LMA) active fibers, such as Liekki's YB1200 family of LMA fibers. They will maintain excellent beam quality when incorported into fiber lasers or amplifiers.

### Features and Benefits

- Matching With Industry Standard Active Fiber Geometries 125, 250, and 400µm
- Designed to "Fit-in" Octagonal Active Fibers
- Low Signal and Pump Coupling Losses From Passive to Active Fiber
- Low-Index Fluoroacrylate Coating With >0.46 NA
- Excellent Beam Quality and Matching to LMA Fibers

**See Page 1072**

## The Working Principle of Double Cladding Fiber




– High numerical aperture pump propagates in the cladding and is absorbed by the core
– Low numerical aperture signal propagates in the core and is amplified

## Why double cladding fiber?

- Low-Cost and High-Power Stripe and Bar Pump Lasers can be Used to Reach kW Level Pump Powers
- Operates as Brightness Converter - Diffraction-Limited Output With >80% Optical-to-Optical Efficiencies
- All Configurations Possible: CW Lasers, Pulsed Lasers, CW Amplifiers, Pulsed Amplifiers, and MOPAs.

### Optical and Mechanical Parameters

| | PARAMETERS | CORE PUMPED SM FIBER | DOUBLE CLADDING SM & MM FIBERS | | | | |
|---|---|---|---|---|---|---|---|
| | | YB1200-4/125 | YB1200-6/125DC | YB1200-10/125DC | YB1200-20/125DC | YB1200-20/400DC | YB1200-25/250DC |
| Optical | MFD | 4.4 ± 0.8µm | 6.0 ± 0.8µm | — | — | — | |
| | Peak Absorption @ 976nm[1] | 1200dB/m Nom | 2.6dB/m Nom. | 6.5dB/m Nom | 29dB/m Nom | 3.0dB/m Nom | 10.8dB/m Nom |
| | Absorption @ 920nm[2] | 280 ± 50dB/m | 0.6 ± 0.2dB/m | 1.5 ± 0.4dB/m | 6.8 ± 1.7dB/m | 0.7 ± 0.2dB/m | 2.5 ± 0.7dB/m |
| | Core NA | 0.2 Nom | 0.15 ± 0.01 | 0.08 ± 0.01 | 0.07 ± 0.01 | 0.07 ± 0.01 | 0.07 ± 0.01 |
| | Cladding NA | — | >0.46 | >0.46 | >0.46 | >0.46 | >0.46 |
| | Cutoff Wavelength | 1010 ± 70nm | — | — | — | — | — |
| Mechanical | Cladding Dia. | 125 ± 2µm | 125 ± 2µm[3] | 125 ± 2µm[3] | 125 ± 2µm[3] | 400 ± 15µm | 250 ± 15µm[3] |
| | Cladding Geometry | Round | Octagonal | Octagonal | Octagonal | Octagonal | Octagonal |
| | Coating Dia. | 245 ± 15µm | 245 ± 15µm | 245 ± 15µm | 245 ± 15µm | 500 ± 15µm | 350 ± 15µm |
| | Coating Material | High Index Acrylate | Low Index Acrylate | Low Index Acrylate | Low Index Acrylate | Low Index Acrylate | Low Index Acrylate |
| | Core Dia. | — | 5.5 ± 0.5µm | 10 ± 1µm | 20 ± 2µm | 20 ± 2µm | 25 ± 2.5µm |
| | Core Concentricity Error | <0.7µm | <1.5µm | <1.5µm | <1.5µm | <1.5µm | < 1.5µm |
| | Proof Test | >100kpsi | >100kpsi | >100kpsi | >100kpsi | >50kpsi | >50kpsi |

1) Peak Core Absorption for core-pumped fibers; Peak Cladding Absorption for double cladding fibers
2) Core Absorption for core-pumped fibers; Cladding Absorption for double cladding fibers
3) Flat to flat

### Ytterbium Doped Fibers – Call For Quantities Over 250m

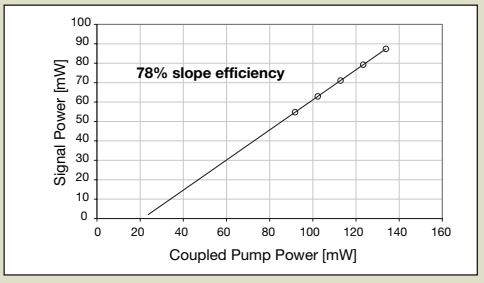
| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| YB1200-4/125 | 1 to 9m | $ 98.00 | £ 61.75 | € 91,15 | ¥ 935.90 |
| | 10 to 49m | $ 76.10 | £ 47.95 | € 70,75 | ¥ 726.75 |
| | 50 to 249m | $ 63.40 | £ 39.95 | € 58,95 | ¥ 605.45 |
| YB1200-6/125DC | 1 to 9m | $ 90.00 | £ 56.70 | € 83,70 | ¥ 859.50 |
| | 10 to 49m | $ 71.10 | £ 44.80 | € 66,10 | ¥ 679.00 |
| | 50 to 249m | $ 59.10 | £ 37.25 | € 54,95 | ¥ 564.40 |
| YB1200-10/125DC | 1 to 9m | $ 158.75 | £ 100.00 | € 147,65 | ¥ 1,516.05 |
| | 10 to 49m | $ 126.50 | £ 79.70 | € 117,65 | ¥ 1,208.05 |
| | 50 to 249m | $ 105.41 | £ 66.40 | € 98,05 | ¥ 1,006.70 |
| YB1200-20/125DC | 1 to 9m | $ 694.00 | £ 437.20 | € 645,40 | ¥ 6,627.70 |
| | 10 to 49m | $ 554.95 | £ 349.60 | € 516,10 | ¥ 5,299.75 |
| | 50 to 249m | $ 462.40 | £ 291.30 | € 430,05 | ¥ 4,415.90 |
| YB1200-20/400DC | 1 to 9m | $ 242.00 | £ 152.45 | € 225,05 | ¥ 2,311.10 |
| | 10 to 49m | $ 193.95 | £ 122.20 | € 180,35 | ¥ 1,852.20 |
| | 50 to 249m | $ 161.50 | £ 101.75 | € 150,20 | ¥ 1,542.35 |
| YB1200-25/250DC | 1 to 9m | $ 285.00 | £ 179.55 | € 265,05 | ¥ 2,721.75 |
| | 10 to 49m | $ 227.35 | £ 143.25 | € 211,45 | ¥ 2,171.20 |
| | 50 to 249m | $ 181.90 | £ 114.60 | € 169,15 | ¥ 1,737.15 |

# Ytterbium Doped Fibers for 1.04-1.1µm Lasers and Amplifiers

## Core-Pumped Single Mode Fiber

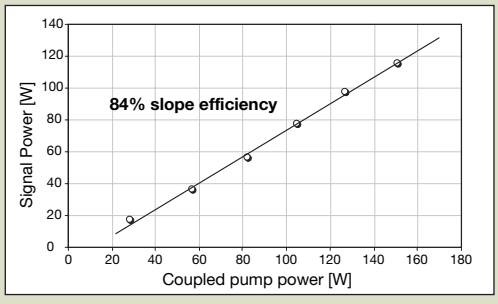
**YB1200-4/125**
Liekki YB1200-4/125 is a highly doped ytterbium fiber for low noise, low nonlinearity preamplifiers and lasers. The fiber is compatible with low-cost pump diodes and standard single mode passive fibers.

**Typical Efficiency Plot**




## Double Cladding, Single Mode, and Multimode Large-Mode-Area (LMA) Fibers

**Typical Efficiency Plot**

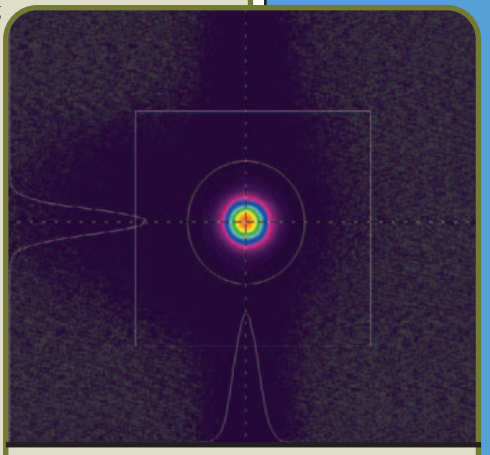



**YB1200-6/125DC**
Liekki YB1200-6/125DC is a highly doped, single mode, double cladding fiber for medium-power fiber laser and amplifier applications. The fiber is compatible with many fiber-based components such as fiber gratings and combiners. See page 1068 for the PM version (YB1200-6/125DC-PM).

**YB1200-10/125DC**
Liekki YB1200-10/125DC is a highly doped, double cladding fiber for medium-to-high-power fiber laser and amplifier applications. The combination of high cladding absorption with a single mode core makes the fiber ideal for compact fiber-based power amplifiers. See page 1068 for the PM version (YB1200-10/125DC-PM).

**YB1200-20/125DC**
Liekki YB1200-20/125DC is a highly doped, double cladding fiber ideally suited for compact, high-average-power, pulsed amplifier applications where large-mode-area and short fiber length are critical for suppression of nonlinear effects. The combination of a highly doped core, a large core-to-cladding ratio, and an efficient octagonal cladding shape provide very high cladding absorption.

**YB1200-20/400DC**
Liekki YB1200-20/400DC is a highly doped, double cladding fiber for high-power fiber lasers and amplifiers. The fiber combines a large core with excellent beam quality and a 400µm cladding that is compatible with industry standard high-power pump lasers and delivery fibers. See page 1068 for the PM version (YB1200-20/400DC-PM).



Typical Beam Quality for YB1200-20/400DC ($M^2 = 1.1$)

**YB1200-25/250DC**
**(30/250 Available Upon Request)**
Liekki YB1200-25/250DC is a highly doped, double cladding fiber featuring very high cladding absorption, high efficiency per application length, and excellent beam quality. The fiber is ideal for high-average-power pulsed fiber amplifiers. See page 1068 for the PM version (YB1200-25/250DC-PM).

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Polarization Maintaining Highly Doped Ytterbium Fibers

**Liekki DND Technology**

Liekki uses its proprietary Direct Nanoparticle Deposition (DND) technology and long-term experience of conventional fiber manufacturing technologies to provide customers with high-quality, state-of-the-art fibers. Highly doped Liekki fibers minimize required application fiber length while providing strong amplification, high efficiency, a broad and flat gain profile, excellent beam quality, and reduced nonlinear effects.

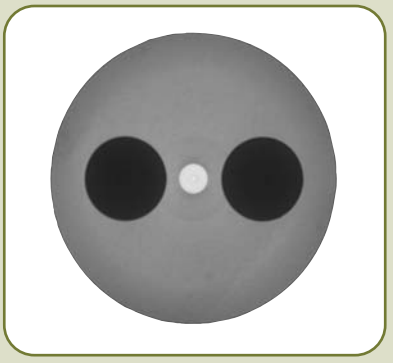
## PM Passive Double Cladding Fibers

Liekki's matched passive fibers are designed and manufactured to match to commercially available large-mode-area active fibers, such as Liekki's YB1200 product series of LMA fibers. They will maintain excellent beam quality when incorporated into fiber lasers or amplifiers.

### Features and Benefits

- Matching With Industry Standard Active Fiber Geometries 125, 250, and 400µm
- Round Cladding for Easy Cleaving, Splicing, and Handling
- Low Signal and Pump Coupling Losses From Passive to Active Fiber
- Low Index Fluoroacrylate Coating With >0.46 NA
- Excellent Beam Quality and Matching to LMA Fibers

**See Page 1072**



**These fibers are based on a PANDA design with two round stress elements, one on each side of the core.**

### Features

- High Birefringence and PER
- Large Cores With Low NA
- High Pump Absorption
- Round Cladding Geometry
- High Mechanical Strength
- Low Nonlinear Effects
- Low Photodarkening

### Optical, Geometrical, and Mechanical Parameters

| | PARAMETERS | Double Cladding SM & MM Fibers | | | |
|---|---|---|---|---|---|
| | | YB1200-6/125DC-PM | YB1200-10/125DC-PM | YB1200-20/400DC-PM | YB1200-25/250DC-PM |
| Optical | MFD | 6.0 ± 0.8µm | — | — | — |
| | Peak Absorption @ 976nm[1] | 2.6dB/m Nom | 6.9dB/m Nom | 3.0dB/m Nom | 11.2dB/m Nom |
| | Absorption @ 920nm[2] | 0.6 ± 0.2dB/m | 1.6 ± 0.4dB/m | 0.7 ± 0.2dB/m | 2.6 ± 0.7dB/m |
| | Core NA | 0.15 ± 0.01 | 0.08 ± 0.01 | 0.07 ± 0.01 | 0.07 ± 0.01 |
| | Cladding NA | >0.46 | >0.46 | >0.46 | >0.46 |
| | Cutoff Wavelength | — | — | — | — |
| | Birefringence | >1.7E-04 | >1.4E-04 | >1.4E-04 | >0.2E-04 |
| Mechanical | Core Diameter | 5.5 ± 0.5µm | 10 ± 1µm | 20 ± 2µm | 25 ± 2.5µm |
| | Core Concentricity Error | <1.5µm | <1.5µm | <1.5µm | <1.5µm |
| | Cladding Dia. | 125 ± 2µm | 125 ± 2µm | 400 ± 15µm | 250 ± 15µm |
| | Cladding Geometry | Round | Round | Round | Round |
| | Coating Dia. | 245 ± 15µm | 245 ± 15µm | 500 ± 15µm | 350 ± 15µm |
| | Coating Material | Low Index Acrylate | Low Index Acrylate | Low Index Acrylate | Low Index Acrylate |
| | Proof Test | >100kpsi | >100kpsi | >50kpsi | >100kpsi |

1) Peak Core Absorption for "core-pumped" fibers; Peak Cladding Absorption for "double cladding" fibers
2) Core Absorption for "core-pumped" fibers; Cladding Absorption for "double cladding" fibers

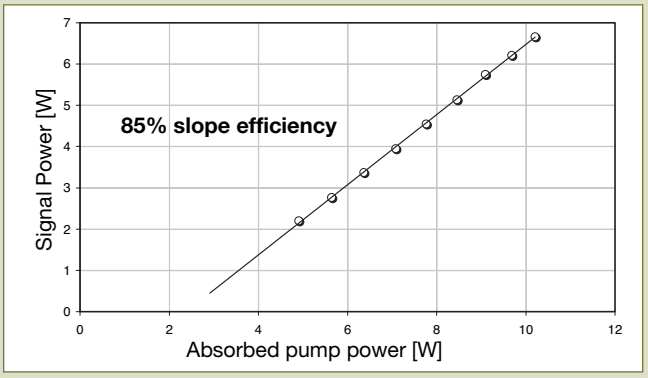
### PRICE SCHEDULE - Call For Quantities Over 250m

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| YB1200-6/125DC-PM | 1 to 9m | $ 145.00 | £ 91.35 | € 134,85 | ¥ 1,384.75 |
| | 10 to 49m | $ 112.90 | £ 71.15 | € 105,00 | ¥ 1,078.20 |
| | 50 to 249m | $ 94.05 | £ 59.25 | € 87,45 | ¥ 898.20 |
| YB1200-10/125DC-PM | 1 to 9m | $ 295.00 | £ 185.85 | € 274,35 | ¥ 2,817.25 |
| | 10 to 49m | $ 236.00 | £ 148.70 | € 219,50 | ¥ 2,253.80 |
| | 50 to 249m | $ 196.60 | £ 123.85 | € 182,85 | ¥ 1,877.55 |
| YB1200-20/400DC-PM | 1 to 9m | $ 485.00 | £ 305.55 | € 451,05 | ¥ 4,631.75 |
| | 10 to 49m | $ 387.85 | £ 244.35 | € 360,70 | ¥ 3,703.95 |
| | 50 to 249m | $ 323.05 | £ 203.50 | € 300,45 | ¥ 3,085.15 |
| YB1200-25/250DC-PM | 1 to 9m | $ 631.00 | £ 397.55 | € 586,85 | ¥ 6,026.05 |
| | 10 to 49m | $ 559.50 | £ 352.50 | € 520,35 | ¥ 5,343.25 |
| | 50 to 249m | $ 419.65 | £ 264.40 | € 390,25 | ¥ 4,007.65 |

# Polarization-Maintaining Highly Doped Ytterbium Fibers

## Double Cladding, Single Mode, and Multimode PM Yb-Doped Fibers

### Typical Efficiency Plot




**YB1200-6/125DC-PM**
Liekki YB1200-6/125DC-PM is a highly doped, polarization-maintaining, single mode, double cladding fiber for medium-power fiber laser and amplifier applications. The fiber is compatible with many fiber-based components such as fiber gratings and combiners.

**YB1200-10/125DC-PM**
Liekki YB1200-10/125DC-PM is a highly doped, polarization maintaining, double cladding fiber for medium-power fiber laser and amplifier applications. The combination of a high cladding absorption and a single mode core makes the fiber ideal for compact fiber-based power amplifiers.

**YB1200-20/400DC-PM**
Liekki YB1200-20/400DC-PM is a highly doped, polarization maintaining, double cladding fiber for high-power fiber lasers and amplifiers. The fiber combines a large core with excellent beam quality and a 400µm cladding that is compatible with industry standard high-power pump lasers and delivery fibers.

**YB1200-25/250DC-PM (Optionally 30/250 Available)**
Liekki YB1200-25/250DC-PM is a highly doped, polarization maintaining, double cladding fiber featuring very high cladding absorption, high efficiency per application length, and excellent beam quality. The fiber is ideal for high-average-power pulsed fiber amplifiers.

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Highly Doped Erbium Fibers for 1.53-1.61µm Lasers & Amplifiers

Thorlabs offers a wide range of highly doped erbium fibers suitable for fiber lasers and amplifiers operating in the 1.53-1.61µm wavelength region. These fibers are utilized in a broad range of applications including telecommunication amplifiers (EDFAs), high-power PON/CATV boosters, and ultra-short pulse amplifiers used in instrumentation, industrial, and medical applications.

Large-Mode-Area (LMA) Double Cladding Erbium fibers are also available upon request. These highly doped fibers have core sizes from 20 to 30µm with a 125µm cladding. **Please contact us for pricing and delivery information.**

**ER16-8/125**
Liekki ER16-8/125 is a large-mode-area (LMA) fiber suitable for high-power output amplifiers (output power of 25dBm or more). Good spliceability, excellent power conversion efficiency, and excellent spectral reproducibility and consistency make this fiber the choice for today's high-power output amplifiers for CATV and PON applications.

**Optical Characteristics**
- **Peak Absorption at 1530nm:** 16 ± 2dB/m
- **Mode Field Diameter at 1550nm:** 9.5 ± 0.8µm
- **Core Numerical Aperture:** 0.13 ± 0.02
- **Fiber Cutoff Wavelength:** 1100-1400nm

**ER20-4/125**
Liekki ER20-4/125 is a highly doped fiber designed for C- and L-Band Metro, CATV, and DWDM amplifiers and ASE sources. High erbium concentration reduces required application fiber length and reduces nonlinear effects, making the fiber ideal for small-size or high-bit-rate applications.

**Optical Characteristics**
- **Peak Absorption at 1530nm:** 20 ± 2dB/m
- **Mode Field Diameter at 1550nm:** 6.5 ± 0.5µm
- **Core Numerical Aperture:** 0.2 ± 0.02
- **Fiber Cutoff Wavelength:** 800-980nm

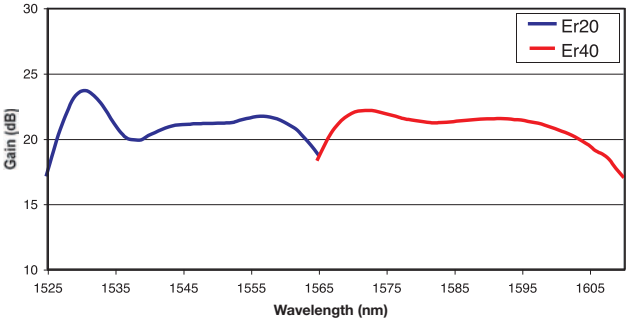
**ER30-4/125**
Liekki ER30-4/125 is a highly doped fiber designed for C- and L-Band amplifiers and ASE sources. This fiber has demonstrated the highest power conversion efficiency available in the L-Band, achieving more than 50% for a typical fiber length of 20m.

**Optical Characteristics**
- **Peak Absorption at 1530nm:** 30 ± 3dB/m
- **Mode Field Diameter at 1550nm:** 6.5 ± 0.5µm
- **Core Numerical Aperture:** 0.2 ± 0.02
- **Fiber Cutoff Wavelength:** 800-980nm

## Price Schedule – Call For Quantities > 250m

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| ER16-8/125 | 1 to 9m | $ 75.00 | £ 47.25 | € 69,75 | ¥ 716.25 |
| | 10 to 49m | $ 58.35 | £ 36.75 | € 54,25 | ¥ 557.25 |
| | 50 to 249m | $ 43.75 | £ 27.55 | € 40,70 | ¥ 417.80 |
| ER20-4/125 | 1 to 9m | $ 17.00 | £ 10.70 | € 15,80 | ¥ 162.35 |
| | 10 to 49m | $ 13.10 | £ 8.25 | € 12,20 | ¥ 125.10 |
| | 50 to 249m | $ 9.80 | £ 6.15 | € 9,10 | ¥ 93.60 |
| ER30-4/125 | 1 to 9m | $ 22.00 | £ 13.85 | € 20,45 | ¥ 210.10 |
| | 10 to 49m | $ 16.65 | £ 10.50 | € 15,50 | ¥ 159.00 |
| | 50 to 249m | $ 12.50 | £ 7.90 | € 11,65 | ¥ 119.40 |

Gain Spectrum of Er20 and Er40 (C & L Bands)




## Single Mode Highly Er-Doped Fiber Specifications

| ITEM# | RECOMMENDED OPERATING λ | PEAK ABSORPTION | MFD | CLADDING DIAMETER | COATING DIAMETER | CUTOFF WAVELENGTH | NA |
|---|---|---|---|---|---|---|---|
| ER16-8/125 | C-Band | 16 ± 2dB/m | 9.5 ± 0.8µm | 125 ± 2µm | 245 ± 15µm | 1100-1400nm | 0.13 ± 0.02 |
| ER20-4/125 | C- and L-Bands | 20 ± 2dB/m | 6.5 ± 0.5µm | 125 ± 2µm | 245 ± 15µm | 800-980nm | 0.2 ± 0.02 |
| ER30-4/125 | C- and L-Bands | 30 ± 3dB/m | 6.5 ± 0.5µm | 125 ± 2µm | 245 ± 15µm | 800-980nm | 0.2 ± 0.02 |

# Highly Doped Erbium Fibers for 1.53-1.61µm Lasers & Amplifiers

**ER40-4/125**
Liekki ER40-4/125 is a highly doped fiber for L-band amplifiers exhibiting a very low level of Polarization Mode Dispersion (PMD) and reduced nonlinear effects. This fiber is available in a low cutoff or a high cutoff version. The typical fiber length per application is about 15m.

**Optical Characteristics**
- **Peak Absorption at 1530nm:** 40 ± 4dB/m
- **Mode Field Diameter at 1550nm:** 6.5 ± 0.5µm
- **Core Numerical Aperture:** 0.2
- **Fiber Cutoff Wavelength:** 800-980nm

**ER80-4/125**
Liekki ER80-4/125 is a highly doped fiber for fiber lasers and amplifiers. It has a very high erbium concentration that minimizes the required application fiber length while providing strong gain and reduced nonlinear effects.

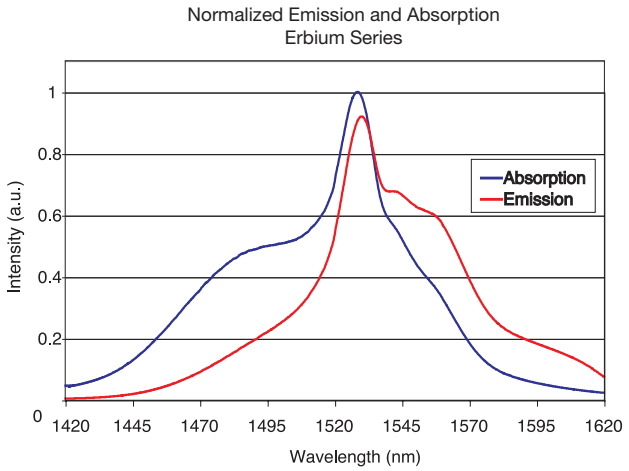
**Optical Characteristics**
- **Peak Absorption at 1530nm:** 80 ± 8dB/m
- **Mode Field Diameter at 1550nm:** 6.5 ± 0.5µm
- **Core Numerical Aperture:** 0.2
- **Fiber Cutoff Wavelength:** 800-980nm

**ER80-8/125**
Liekki ER80-8/125 is a large-mode-area, single mode fiber suitable for high-power amplifiers and lasers (output power of 25dBm or more). Good spliceability, high doping, and large core make this fiber ideal for high-peak-power pulse amplification in the eye-safe 1.5µm wavelength region.

**Optical Characteristics**
- **Peak Absorption at 1530nm:** 80 ± 8dB/m
- **Mode Field Diameter at 1550nm:** 9.5 ± 0.5µm
- **Core Numerical Aperture:** 0.13
- **Fiber Cutoff Wavelength:** 1100-1400nm

**ER110-4/125**
Liekki ER110-4/125 is a highly doped fiber for ultra-short pulse amplifiers operating in the 1.5µm wavelength region. It has a very high erbium concentration that minimizes the required application fiber length while providing strong gain and reduced nonlinear effects.

**Optical Characteristics**
- **Peak Absorption at 1530nm:** 110 ± 10dB/m
- **Mode Field Diameter at 1550nm:** 6.5 ± 0.5µm
- **Core Numerical Aperture:** 0.2
- **Fiber Cutoff Wavelength:** 800-980nm




## Price Schedule – Call For Quantities > 250m

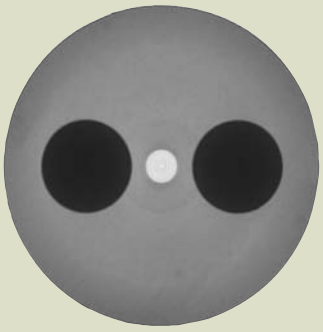
| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| ER40-4/125 | 1 to 9m | $ 24.00 | £ 15.10 | € 22,30 | ¥ 229.20 |
| | 10 to 49m | $ 19.05 | £ 12.00 | € 17,70 | ¥ 181.95 |
| | 50 to 249m | $ 14.30 | £ 9.00 | € 13,30 | ¥ 136.55 |
| ER80-4/125 | 1 to 9m | $ 98.00 | £ 61.75 | € 91,15 | ¥ 935.90 |
| | 10 to 49m | $ 75.00 | £ 47.25 | € 69,75 | ¥ 716.25 |
| | 50 to 249m | $ 56.25 | £ 35.45 | € 52,30 | ¥ 537.20 |
| ER80-8/125 | 1 to 9m | $ 98.00 | £ 61.75 | € 91,15 | ¥ 935.90 |
| | 10 to 49m | $ 75.00 | £ 47.25 | € 69,75 | ¥ 716.25 |
| | 50 to 249m | $ 56.25 | £ 35.45 | € 52,30 | ¥ 537.20 |
| ER110-4/125 | 1 to 9m | $ 98.00 | £ 61.75 | € 91,15 | ¥ 935.90 |
| | 10 to 49m | $ 75.00 | £ 47.25 | € 69,75 | ¥ 716.25 |
| | 50 to 249m | $ 56.25 | £ 35.45 | € 52,30 | ¥ 537.20 |

## Single Mode Very Highly Er-doped Fiber Specifications

| ITEM# | RECOMMENDED OPERATING λ | PEAK ABSORPTION | MFD | CLADDING DIAMETER | COATING DIAMETER | CUTOFF WAVELENGTH | NA |
|---|---|---|---|---|---|---|---|
| ER40-4/125 | L-Band | 40 ± 4dB/m | 6.5 ± 0.5µm | 125 ± 2µm | 245 ± 15µm | 800-980nm | 0.2 |
| ER80-4/125 | C-, L-Band | 80 ± 8dB/m | 6.5 ± 0.5µm | 125 ± 2µm | 245 ± 15µm | 800-980nm | 0.2 |
| ER80-8/125 | C-, L-Band | 80 ± 8dB/m | 9.5 ± 0.5µm | 125 ± 2µm | 245 ± 15µm | 1100-1400nm | 0.13 |
| ER110-4/125 | C-, L-Band | 110 ± 10dB/m | 6.5 ± 0.5µm | 125 ± 2µm | 245 ± 15µm | 800-980nm | 0.2 |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Large-Mode-Area (LMA) Matching Passive Fibers



**PM passive fibers are matched to the core size and NA of their matching active fibers.**

Thorlabs offers a range of passive large-mode-area (LMA) fibers matched with available active LMA fibers such as Liekki's YB1200 product family. These passive fibers are matched to the core diameters and numerical apertures of their active counterparts to maintain excellent beam quality throughout fiber laser or amplifier systems. The outer cladding diameter is designed to "round" the shaped active fibers in order to achieve a low coupling loss when matching passive to active fibers. The passive fibers are coated with low-index fluoroacrylate, enabling active fibers to be pumped through them. High-index acrylate coated fibers are available by special request; please contact us for details.

**Non-PM passive fibers are matched to the core size and NA of their matching active fibers and fit within their octagonal cladding.**

## Price Schedule – Matching Passive Fiber

| ITEM# | PRICE/m[1] | $ | £ | € | RMB |
|---|---|---|---|---|---|
| P-10/123DC | 1 to 9m | $ 10.70 | £ 6.75 | € 9,95 | ¥ 102.20 |
| | 10 to 49m | $ 8.35 | £ 5.25 | € 7,75 | ¥ 79.75 |
| | 50+m | $ 6.75 | £ 4.25 | € 6,30 | ¥ 64.45 |
| P-20/123DC | 1 to 9m | $ 15.75 | £ 9.90 | € 14,65 | ¥ 150.40 |
| | 10 to 49m | $ 11.95 | £ 7.55 | € 11,10 | ¥ 114.10 |
| | 50+m | $ 9.55 | £ 6.00 | € 8,90 | ¥ 91.20 |
| P-20/390DC | 1 to 9m | $ 54.50 | £ 34.35 | € 50,70 | ¥ 520.50 |
| | 10 to 49m | $ 41.35 | £ 26.05 | € 38,45 | ¥ 394.90 |
| | 50+m | $ 33.10 | £ 20.85 | € 30,80 | ¥ 316.10 |
| P-25/240DC | 1 to 9m | $ 46.50 | £ 29.30 | € 43,25 | ¥ 444.10 |
| | 10 to 49m | $ 35.45 | £ 22.35 | € 32,95 | ¥ 338.55 |
| | 50+m | $ 28.35 | £ 17.85 | € 26,35 | ¥ 270.75 |

1) Call for quantities over 250m.

## Price Schedule – Matching Passive PM-Fiber

| ITEM# | PRICE/m[1] | $ | £ | € | RMB |
|---|---|---|---|---|---|
| P-10/123DC-PM | 1 to 9m | $ 50.90 | £ 32.05 | € 47,35 | ¥ 486.10 |
| | 10 to 49m | $ 41.65 | £ 26.25 | € 38,75 | ¥ 397.75 |
| | 50+m | $ 33.10 | £ 20.85 | € 30,80 | ¥ 316.10 |
| P-20/390DC-PM | 1 to 9m | $ 250.00 | £ 157.50 | € 232,50 | ¥ 2,387.50 |
| | 10 to 49m | $ 190.05 | £ 119.75 | € 176,75 | ¥ 1,815.00 |
| | 50+m | $ 152.05 | £ 95.80 | € 141,40 | ¥ 1,452.10 |
| P-25/240DC-PM | 1 to 9m | $ 225.00 | £ 141.75 | € 209,25 | ¥ 2,148.75 |
| | 10 to 49m | $ 170.95 | £ 107.70 | € 159,00 | ¥ 1,632.55 |
| | 50+m | $ 136.80 | £ 86.20 | € 127,20 | ¥ 1,306.45 |

1) Call for quantities over 250m.

## Applications

- Pigtails for Fiber Lasers and Amplifiers
- All-Fiber Subassemblies
- High-Brightness Power Delivery
- Fiber Based Components for Fiber Lasers (e.g. Pump Combiners)

## Features

- Matching With Industry Standard Active Fiber Geometries 125, 250, and 400µm
- Designed to "Fit-in" Octagonal Active Fibers
- Low Signal And Pump Coupling Losses From Passive to Active Fiber
- Round Cladding for Easy Cleaving, Splicing, and Handling
- Low-Index Fluoroacrylate Coating With >0.46 NA
- Excellent Beam Quality and Matching to LMA Fibers

## Matching Fiber

| ITEM# | CORE | CLADDING | COATING | CORE NA | CLADDING NA | PROOF TEST | MATCHING ACTIVE FIBER | PAGE NUMBER |
|---|---|---|---|---|---|---|---|---|
| P-10/123DC | 10 ± 1µm | 123 ± 2µm | 245 ± 15µm | 0.07 ± 0.01 | >0.46 | >100 kpsi | YB1200-10/125DC | 1066 |
| P-20/123DC | 20 ± 2µm | 123 ± 2µm | 245 ± 15µm | 0.07 ± 0.01 | >0.46 | >100 kpsi | YB1200-20/125DC | 1066 |
| P-20/390DC | 20 ± 2µm | 390 ± 8µm | 500 ± 15µm | 0.07 ± 0.01 | >0.46 | >50 kpsi | YB1200-20/400DC | 1066 |
| P-25/240DC | 25 ± 2.5µm | 240 ± 5µm | 350 ± 15µm | 0.07 ± 0.01 | >0.46 | >100 kpsi | YB1200-25/250DC | 1066 |

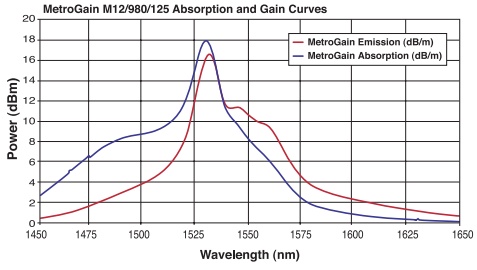
## Matching PM-Fiber

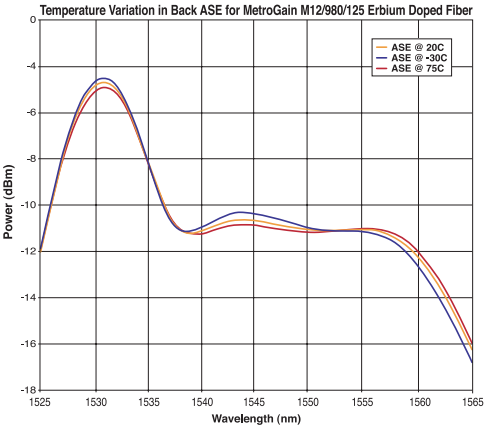
| ITEM# | CORE | CLADDING | COATING | CORE NA | CLADDING NA | BIREFRINGENCE | PROOF TEST | MATCHING ACTIVE FIBER | PAGE NUMBER |
|---|---|---|---|---|---|---|---|---|---|
| P-10/123DC-PM | 10 ± 1µm | 123 ± 2µm | 245 ± 15µm | 0.08 ± 0.01 | >0.46 | $1.4 \times 10^{-4}$ | >100 kpsi | YB1200-10/125DC-PM | 1068 |
| P-20/390DC-PM | 20 ± 2µm | 390 ± 8µm | 500 ± 15µm | 0.07 ± 0.01 | >0.46 | $1.4 \times 10^{-4}$ | >50 kpsi | YB1200-20/400DC-PM | 1068 |
| P-25/240DC-PM | 25 ± 2.5µm | 240 ± 5µm | 350 ± 15µm | 0.07 ± 0.01 | >0.46 | $1.2 \times 10^{-4}$ | >100 kpsi | YB1200-25/250DC-PM | 1068 |

# Erbium Doped C- & L- Band Fibers


Specialty Fiber Manufactured by

FIBERCORE LIMITED




Erbium-doped fiber amplifier technology continues to progress at an astonishing rate with commercial systems now in routine service around the globe. With the ever increasing demand for extra bandwidth, the development and deployment of amplifiers operating in the L-band have been rapid and extensive.

**MetroGain™ – A Fiber Optimized For Use In The L-Band**

To shift the gain curve into the L-band, long gain sections have conventionally been required. These could be over 100 meters in length, providing both fiber management and cost issues. MetroGain™ has a new core composition with increased erbium concentration. At the pump wavelength of 980nm, the absorption is about 12dB/m. The co-dopants incorporated in the fiber core ensure that with the relatively high levels of rare earth, negligible clustering occurs. The result is a high absorption, high efficiency, erbium-doped fiber. The gain profile is intrinsically flat.

The NA for this fiber is in the range of 0.21 to 0.23. This has been found to give good modal overlap of the pump with the doped region of the fiber while still maintaining excellent splice characteristics.

**High Power Short 'C-Band' Amplifiers**

The fiber has been evaluated in an amplifier incorporating a very high power, nominally 1480nm pump source. The pump input into the gain section was in excess of 1.5W. An output of 28.5dB/m was achieved using an input comprised from four signals, thus loading the amplifier with a total of 11.5dB/m. The inputs were between 1545 and 1560nm. The length of the gain fiber required to achieve this result was less than 5 meters.

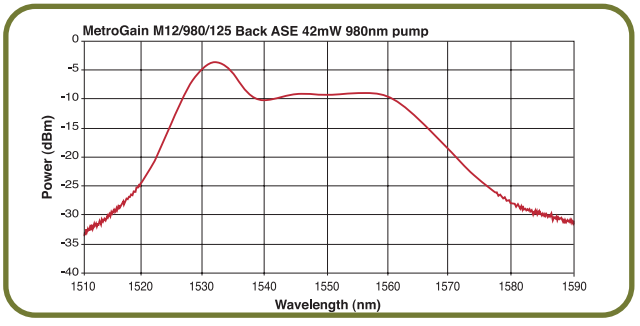
**Fiber Lasers And ASE Sources.**

The high absorption of the MetroGain™ makes it an ideal choice for fiber lasers and ASE sources. Very short cavity lengths for fiber lasers can be realized, and consequently, pulse distortion is minimized.

## Features and Benefits

- Excellent Geometric Properties Provide Very Low Birefringence and Excellent Splice Characteristics
- Splice Loss to SM Fiber of Pump Lasers ≤0.1dB
- Splice Loss to SMF-28e Fiber ≤0.15dB
- Core/Cladding Concentricity ≤0.5µm
- Dual Acrylate Coating

Since erbium-doped fiber is an intrinsically stable source, it is hard to beat the stability of a source based on this fiber. To the left are the results of the variation in ASE at temperature extremes of –30°C and +75°C. The result at 25°C is also shown. As expected, at increasing temperature, there is some energy shift towards the longer wavelength regime.




### PRICE SCHEDULE-Call for quantities over 250m

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| M5-980-125 | 1 to 9m | $ 12.90 | £ 8.15 | € 12,00 | ¥ 123.20 |
| | 10 to 49m | $ 9.65 | £ 6.10 | € 8,95 | ¥ 92.15 |
| | 50 to 249m | $ 7.75 | £ 4.90 | € 7,20 | ¥ 74.00 |
| M12-980-125 | 1 to 9m | $ 12.90 | £ 8.15 | € 12,00 | ¥ 123.20 |
| | 10 to 49m | $ 9.65 | £ 6.10 | € 8,95 | ¥ 92.15 |
| | 50 to 249m | $ 7.75 | £ 4.90 | € 7,20 | ¥ 74.00 |

| ITEM# | OPERATING WAVELENGTH | MFD @908/1550nm | CLADDING ±1µm | JACKET | CUTOFF WAVELENGTH | PEAK ABSORPTION | CORE/CLADDING CONCENTRICITY | NA | STRIPPER TOOL |
|---|---|---|---|---|---|---|---|---|---|
| M5-980-125 | C-Band | 3.5µm/5.9µm | 125µm | 245µm | 900-970nm | 4.5-5.5dB/m @ 980nm | ≤0.5µm | 0.22-0.24 | T06S13 |
| M12-980-125 | L-Band | 3.7µm/6.2µm | 125µm | 245µm | 900-970nm | 11-13dB/m @ 980nm | ≤0.5µm | 0.21-0.23 | T06S13 |

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

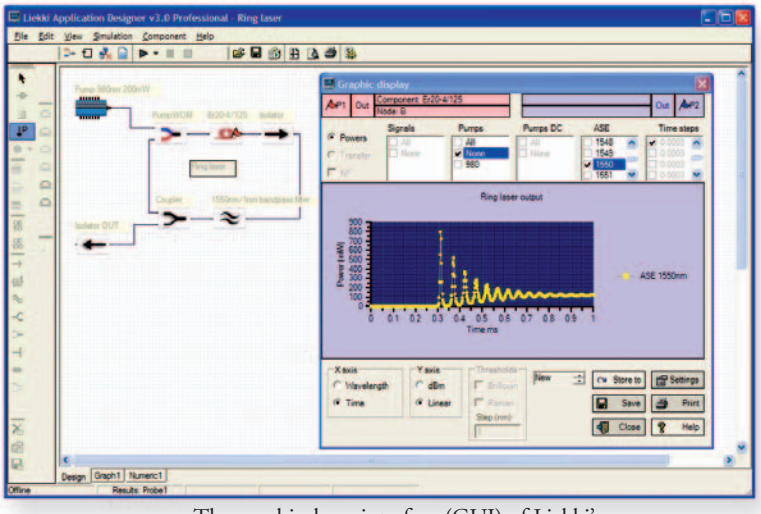
# Fiber Laser, Amplifier & ASE Simulation Software


**Liekki Application Designer (LAD)** is a versatile design tool for fiber applications providing a strong platform for simulating and optimizing fiber amplifiers, fiber laser systems, and ASE sources. This software is based on precise algorithms that account for all the reflections in the system, which are especially crucial for accurate laser and ASE light source simulations. The simulation engine also accurately accounts for large-mode-area and highly doped fibers, providing a robust design by allowing rapid exploration of multiple alternative designs.

The **Liekki Application Designer** is a very powerful tool for simulating high-power, continuous wave (CW) or pulsed lasers; it includes transient analysis, SBS and SRS threshold estimations, inversion level calculation, and radial doping. In addition. Monte Carlo simulation, which is very important when analyzing the manufacturability and tolerance sensitivity of a design, is included. Thus, Liekki Application Designer supports the full application design and analysis process from the early research, prototype, and pilot stages to full volume production. As a result, the Designer shortens the design cycle, saves on development expense, and improves time-to-market. The user of Liekki Application Designer could be a product designer, an optical engineer, a research scientist, or a student.

## Features

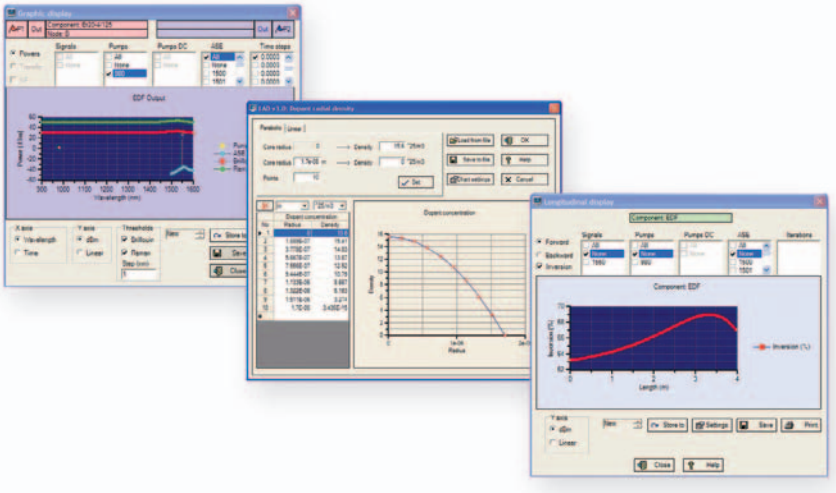
- Simulates Erbium-and Ytterbium-Doped Fibers:
  - Single Mode and Double Cladding Fibers
  - Small Core and Large-Mode-Area Fibers
  - Low and High Dopant Concentration
  - Clustering Effects
- CW and Transient Analysis Down to Picoseconds
- Monte Carlo Analysis
- SBS and SRS Threshold Estimations
- Inversion Level Calculation
- Distributed Computing
- User Defined Model




The graphical use interface (GUI) of Liekki's *Application Designer* simulation software.

## System Requirements

- Operating System: Windows XP/2000/NT/98
- Processor: Pentium 1GHz or Faster
- 256MB of RAM or Higher
- 100MB Free Hard Disk Space



- Functionality is Added Regularly to Follow the Evolutions of the Fiber Lasers and Amplifiers Industry
- LAD is Delivered With a 1-Year Maintenance Plan That Includes Upgrades and Full Support From Liekki Corporation
- User Developed Components are Easily Integrated

### Fiber Amplifier, ASE, & Laser Simulation Software

| ITEM # | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| LAD-PRO | $ 8,900.00 | £ 5,607.00 | € 8,277.00 | ¥ 84,995.00 | *Application Designer:* Fiber Amplifier, ASE, and Laser Simulator, Professional Version 3.3 |

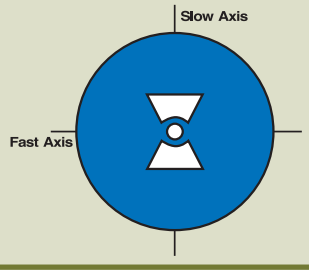
# Fiber Patch Cables: Polarization Maintaining FC/PC


**Features**

- Key Aligned to Slow Axis
- Typical Return Loss of 50dB (40dB Min)
- Ceramic Radiused Ferrules (PC)
- 2 and 5 Meter Lengths
- Ø3mm Yellow Protective Outer Jacket

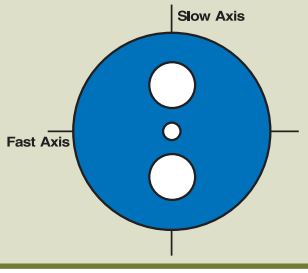
| ITEM# | $ | £ | € | RMB |
|---|---|---|---|---|
| P1-780PM-FC-2 | $ 101.40 | £ 63.90 | € 94,30 | ¥ 968.40 |
| P1-780PM-FC-5 | $ 145.35 | £ 91.60 | € 135,20 | ¥1,388.10 |
| P1-980PM-FC-2 | $ 105.95 | £ 66.70 | € 98,50 | ¥1,011.80 |
| P1-980PM-FC-5 | $ 156.50 | £ 98.60 | € 145,50 | ¥1,494.60 |
| P1-1310PM-FC-2 | $ 98.50 | £ 62.10 | € 91,60 | ¥ 940.70 |
| P1-1310PM-FC-5 | $ 138.40 | £ 87.20 | € 128,70 | ¥1,321.70 |
| P1-1550PM-FC-2 | $ 105.95 | £ 66.70 | € 98,50 | ¥1,011.80 |
| P1-1550PM-FC-5 | $ 156.50 | £ 98.60 | € 145,50 | ¥1,494.60 |

**Bow-Tie PM Fiber Cross Section**




**Contact Technical Support at techsupport@thorlabs.com to discuss your custom PM patch cable needs**

**Panda PM Fiber Cross Section**




These fiber patch cables are connectorized on both ends with high-quality, ceramic FC connectors. Manufactured in our facility, each cable is individually tested to ensure their extinction ratio and low back-reflection (return loss) at fiber-to-fiber junctions. Available from stock, these cables feature a high quality polish, which leads to a typical return loss of over 50dB.

### 780nm FC PM Fiber Patch Cables:[1] Panda Style

| ITEM# | MIN ER | MAX IL | TYP IL | CUTOFF WAVELENGTH | L | FIBER (see page 1076) | MFD[2,3]/CLAD[4] | NA |
|---|---|---|---|---|---|---|---|---|
| P1-780PM-FC-2 | 20dB | 1.5dB | 1.0dB | 710 ± 60nm | 2m | PM780-HP | 5.3/125µm | — |
| P1-780PM-FC-5 | 20dB | 1.5dB | 1.0dB | 710 ± 60nm | 5m | PM780-HP | 5.3/125µm | — |

1) Operating wavelength: 780-980nm
2) MFD: mode field diameter @ 850nm
3) ±1.0µm
4) ±1.0µm

### 980nm FC PM Fiber Patch Cables:[1] Panda Style

| ITEM# | MIN ER | MAX IL | TYP IL | CUTOFF WAVELENGTH | L | FIBER (see page 1077) | MFD[2,3]/CLAD[4] | NA |
|---|---|---|---|---|---|---|---|---|
| P1-980PM-FC-2 | 22dB | 0.7dB | 0.4dB | 900 ± 70nm | 2m | PM980-HP | 6.6/125µm | — |
| P1-980PM-FC-5 | 22dB | 0.7dB | 0.4dB | 900 ± 70nm | 5m | PM980-HP | 6.6/125µm | — |

1) Operating wavelength: 980nm
2) MFD: mode field diameter @ 980nm
3) ±1.0µm
4) ±1.0µm

### 1310nm FC PM Fiber Patch Cables:[1] Bow-Tie Style

| ITEM# | MIN ER | MAX IL | TYP IL | CUTOFF WAVELENGTH | L | FIBER (see page 1078) | MFD[2]/CLAD[3] | NA |
|---|---|---|---|---|---|---|---|---|
| P1-1310PM-FC-2 | 23dB | 0.5dB | 0.3dB | 1100-1290nm | 2m | HB1250T | 9.0/125µm | 0.12 |
| P1-1310PM-FC-5 | 23dB | 0.5dB | 0.3dB | 1100-1290nm | 5m | HB1250T | 9.0/125µm | 0.12 |

1) Operating wavelength: 1310nm
2) MFD: mode field diameter @ 1310nm
3) ±1.0µm

### 1550nm FC PM Fiber Patch Cables:[1] Panda Style

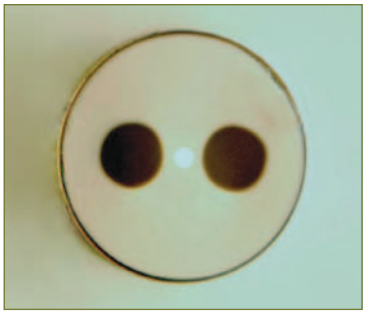
| ITEM# | MIN ER | MAX IL | TYP IL | CUTOFF WAVELENGTH | L | FIBER (see page 1077) | MFD[2,3]/CLAD[4] | NA |
|---|---|---|---|---|---|---|---|---|
| P1-1550PM-FC-2 | 23dB | 0.5dB | 0.3dB | 1370 ± 70nm | 2m | PM1550-HP | 10.5/125µm | — |
| P1-1550PM-FC-5 | 23dB | 0.5dB | 0.3dB | 1370 ± 70nm | 5m | PM1550-HP | 10.5/125µm | — |

1) Operating wavelength: 1490-1620nm
2) MFD: mode field diameter @ 1550nm
3) ±0.8µm
4) ±1.0µm

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Polarization Maintaining Fiber, 460nm to 980nm

Thorlabs offers "bow-tie" and "panda" style polarization maintaining fibers for laser pigtails, sensors, spectroscopy, biomedical, and many other research applications. They have very high birefringence to ensure that the linear polarization state is maintained over the entire length of the fiber, even with environmentally induced stresses on the fiber. These fibers minimize bend-induced losses that typically occur when the fiber is bent or coiled tightly.



Panda PM Fiber

Bow-Tie PM Fiber

## Polarization Maintaining Fiber, Panda

| ITEM# | OPERATING WAVELENGTH[1] | MODE FIELD DIAMETER[2] | CUT-OFF WAVELENGTH | BEAT LENGTH[3] | ATTENUATION | CLADDING ±1µm | COATING ±15µm | STRIPPING TOOL |
|---|---|---|---|---|---|---|---|---|
| PM630-HP | 630-780nm | 4.0 ± 0.5µm | 570 ± 50nm | 1.8mm @ 630nm | <12dB/km @ 630nm | 125µm | 245µm | T06S13 |
| PM780-HP | 780-980nm | 5.3 ± 1.0µm | 710 ± 60nm | 2.4mm @ 850nm | <4dB/km @ 780nm | 125µm | 245µm | T06S13 |

## Polarization Maintaining Fiber, Bow-Tie

| ITEM# | OPERATING WAVELENGTH[1] | MODE FIELD DIAMETER[2] | CUT-OFF WAVELENGTH | BEAT LENGTH[3] | ATTENUATION | CLADDING ±1µm | COATING ±12µm | STRIPPING TOOL |
|---|---|---|---|---|---|---|---|---|
| HB450 | 488/514nm | 3.6µm | 350-470nm | <2.0mm | <100dB/km | 125µm | 245µm | T06S13 |
| HB600 | 633/688nm | 3.2µm | 500-600nm | <2.0mm | <15dB/km | 125µm | 245µm | T06S13 |
| HB750 | 780nm | 4.0µm | 610-750nm | <2.0mm | <8dB/km | 125µm | 245µm | T06S13 |

1) Typical operating wavelengths - The single mode operating window is ~200nm above the cutoff wavelength if dual mode effects are minimized near the cutoff wavelength and bend losses are minimized at long wavelengths.
2) Mean value calculated from the relative specifications
3) Measured at 633nm

## Polarization Maintaining Fiber, Panda by NUFERN

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| PM630-HP | 1 to 9m | $ 19.40 | £ 12.20 | € 18,00 | ¥ 185.25 |
| | 10 to 49m | $ 16.35 | £ 10.30 | € 15,20 | ¥ 156.15 |
| | 50 to 249m | $ 14.30 | £ 9.00 | € 13,30 | ¥ 136.55 |
| | 250 to 999m | CALL | CALL | CALL | CALL |
| PM780-HP | 1 to 9m | $ 19.40 | £ 12.20 | € 18,00 | ¥ 185.25 |
| | 10 to 49m | $ 16.35 | £ 10.30 | € 15,20 | ¥ 156.15 |
| | 50 to 249m | $ 14.30 | £ 9.00 | € 13,30 | ¥ 136.55 |
| | 250 to 999m | CALL | CALL | CALL | CALL |

## Polarization Maintaining Fiber, Bow-Tie by FIBERCORE

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| HB450 | 1 to 9m | $ 18.40 | £ 11.60 | € 17,10 | ¥ 175.70 |
| | 10 to 49m | $ 16.05 | £ 10.10 | € 14,95 | ¥ 153.30 |
| | 50 to 249m | $ 13.10 | £ 8.25 | € 12,20 | ¥ 125.10 |
| | 250 to 999m | CALL | CALL | CALL | CALL |
| HB600 | 1 to 9m | $ 18.40 | £ 11.60 | € 17,10 | ¥ 175.70 |
| | 10 to 49m | $ 16.05 | £ 10.10 | € 14,95 | ¥ 153.30 |
| | 50 to 249m | $ 13.10 | £ 8.25 | € 12,20 | ¥ 125.10 |
| | 250 to 999m | CALL | CALL | CALL | CALL |
| HB750 | 1 to 9m | $ 18.40 | £ 11.60 | € 17,10 | ¥ 175.70 |
| | 10 to 49m | $ 16.05 | £ 10.10 | € 14,95 | ¥ 153.30 |
| | 50 to 249m | $ 13.10 | £ 8.25 | € 12,20 | ¥ 125.10 |
| | 250 to 999m | CALL | CALL | CALL | CALL |

# Pure Silice Core Polarization Maintaining Fiber, 350nm to 780nm

These PM fibers have all the benefits of the PM fibers above but with a pure silica core, which provides protection from radiation-induced damage and color center formation.

| ITEM# | OPERATING WAVELENGTH[1] | MODE FIELD DIAMETER[2] | CUT-OFF WAVELENGTH | BEAT LENGTH[1] | ATTENUATION | CLADDING ±1µm | COATING ±15µm | STRIPPING TOOL |
|---|---|---|---|---|---|---|---|---|
| PM-S350-HP | 350-460nm | 2.3µm @ 350nm | <340nm | 1.5mm @ 350nm | n/a | 125 | 245 | T06S13 |
| PM-S405-HP | 400-500nm | 2.5µm @ 405nm<br>2.8 ± 0.3µm @ 460nm | 365 ± 25nm | 2.0mm @ 405nm | <30dB/km @ 460nm | 125 | 245 | T06S13 |
| PM-S460-HP | 460-550nm | 3.5 ± 0.3µm @ 460nm | 420 ± 30nm | 2.3mm @ 460nm | <30dB/km @ 460nm | 125 | 245 | T06S13 |
| PM-S630-HP | 630-780nm | 4.2 ± 0.5µm @ 630nm | 580 ± 40nm | 4.7mm @ 630nm | <12dB/km @ 630nm | 125 | 245 | T06S13 |

1) Nominal
2) $1/e^2$ fit - near field

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| PM-S350-HP | 1 to 9m | $ 33.00 | £ 20.80 | € 30,70 | ¥ 315.20 |
| | 10 to 49m | $ 26.00 | £ 16.40 | € 24,20 | ¥ 248.30 |
| | 50 to 249m | $ 22.35 | £ 14.10 | € 20,80 | ¥ 213.40 |
| | 250 to 999m | CALL | CALL | CALL | CALL |
| PM-S405-HP | 1 to 9m | $ 30.00 | £ 18.90 | € 27,90 | ¥ 286.50 |
| | 10 to 49m | $ 23.70 | £ 14.95 | € 22,00 | ¥ 226.30 |
| | 50 to 249m | $ 20.35 | £ 12.80 | € 18,95 | ¥ 194.30 |
| | 250 to 999m | CALL | CALL | CALL | CALL |

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| PM-S460-HP | 1 to 9m | $ 30.00 | £ 18.90 | € 27,90 | ¥ 286.50 |
| | 10 to 49m | $ 23.70 | £ 14.95 | € 22,00 | ¥ 226.30 |
| | 50 to 249m | $ 20.35 | £ 12.80 | € 18,95 | ¥ 194.30 |
| | 250 to 999m | CALL | CALL | CALL | CALL |
| PM-S630-HP | 1 to 9m | $ 27.00 | £ 17.00 | € 25,10 | ¥ 257.90 |
| | 10 to 49m | $ 21.25 | £ 13.40 | € 19,75 | ¥ 202.90 |
| | 50 to 249m | $ 18.20 | £ 11.50 | € 16,95 | ¥ 173.80 |
| | 250 to 999m | CALL | CALL | CALL | CALL |

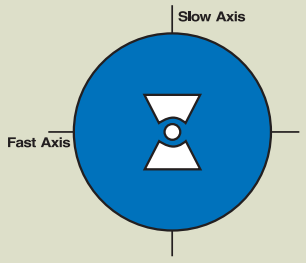
# Polarization Maintaining Fiber, 830nm to 1.6µm

**Bend Insensitive Low-Temp Fibers**

Fibercore has designed a series of polarization maintaining fibersfor fiber optic gyro (FOG) applications. These fibers have been designed for optimal performance over a wide temperature range and small coil radius. As opposed to conventional PM fibers that use a polymer coating that stiffens and degrades performance at lower temperatures, these PM fibers integrate a dual-layer acrylic coating that increases the low temperature performance. Extinction ratios of -30dB at -40°C and -27dB at -60°C are typical for these fibers.

FIBERCORE LIMITED

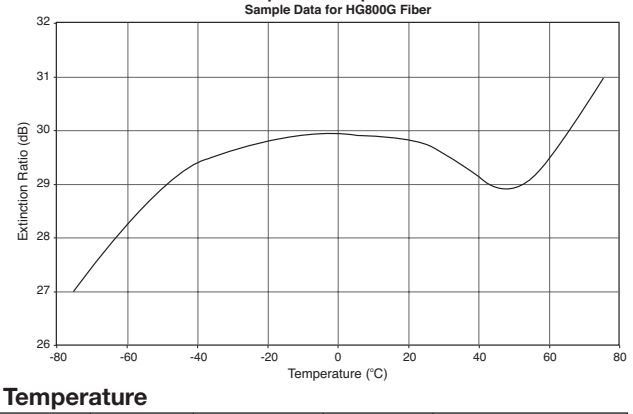
**Bow-Tie PM Fiber Cross Section**




### High Performance, Low Temperature, IR PM Fiber

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| HB800G | 1 to 9m | $ 18.40 | £ 11.60 | €17,10 | ¥ 175.70 |
| | 10 to 49m | $ 16.05 | £ 10.10 | €14,95 | ¥ 153.30 |
| | 50 to 249m | $ 13.10 | £ 8.25 | €12,20 | ¥ 125.10 |
| | 250 to 999m | CALL | CALL | CALL | CALL |
| HB1250G | 1 to 9m | $ 18.40 | £ 11.60 | €17,10 | ¥ 175.70 |
| | 10 to 49m | $ 16.05 | £ 10.10 | €14,95 | ¥ 153.30 |
| | 50 to 249m | $ 13.10 | £ 8.25 | €12,20 | ¥ 125.10 |
| | 250 to 999m | CALL | CALL | CALL | CALL |
| HB1500G | 1 to 9m | $ 18.40 | £ 11.60 | €17,10 | ¥ 175.70 |
| | 10 to 49m | $ 16.05 | £ 10.10 | €14,95 | ¥ 153.30 |
| | 50 to 249m | $ 13.10 | £ 8.25 | €12,20 | ¥ 125.10 |
| | 250 to 999m | CALL | CALL | CALL | CALL |

**Temperature Dependance**
Sample Data for HG800G Fiber




### Polarization Maintaining Fiber; High Performance, Low Temperature

| ITEM# | OPERATING WAVELENGTH[1] | MODE FIELD DIAMETER[2] | CUT-OFF WAVELENGTH | BEAT LENGTH[3] | ATTENUATION | NA | CLADDING ±1µm | COATING ±9µm | STRIPPER TOOL |
|---|---|---|---|---|---|---|---|---|---|
| HB800G | 830nm | 4.2µm | 680-780nm | <1.5mm | <5dB/km | 0.14-0.18 | 80µm | 175µm | T04S10 |
| HB1250G | 1300nm | 6.6µm | 1030-1270nm | <1.5mm | <2dB/km | 0.14-0.18 | 80µm | 175µm | T04S10 |
| HB1500G | 1550nm | 7.9µm | 1230-1520nm | <1.5mm | <2dB/km | 0.14-0.18 | 80µm | 175µm | T04S10 |

1) Typical operating wavelengths - The single mode operating window is ~200nm above the cutoff wavelength if dual mode effects are minimized near the cutoff wavelength and bend losses are minimized at long wavelengths.
2) Mean value calculated from the relative specifications
3) Measured at 633nm

# Polarization Maintaining Fiber: 980nm, 1450nm, and 1550nm

## Applications

- PMD Compensators, External Modulators
- Raman Gain Modules

## Features and Benefits

- Tighter Optical and Geometrical Tolerances
- Proof Tested at 200kpsi

**Price Schedule**

| PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|
| 1 to 9m | $ 24.00 | £ 15.10 | € 22,30 | ¥ 229.20 |
| 10 to 49m | $ 19.00 | £ 11.95 | € 17,65 | ¥ 181.45 |
| 50 to 249m | $ 17.40 | £ 10.95 | € 16,20 | ¥ 166.15 |

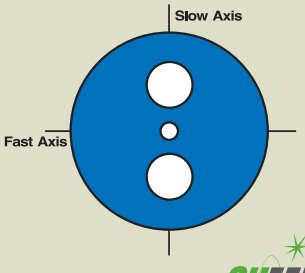
*Call For Quantities Over 250m*

This line of polarization maintaining fibers meets the optical performance specifications necessary for current industry standard PM fibers. Designed for use at 980nm, 1450nm, and 1550nm, these fibers are typically used in telecom applications that require PM Fibers.

| SPECIFICATIONS | | | |
|---|---|---|---|
| | PM980-HP | PM14XX-HP | PM1550-HP |
| Operating Wavelength | 980nm | 1400-1490nm | 1490-1620nm |
| 2nd Cutoff Wavelength | 900 ± 70nm | 1320 ± 60nm | 1370 ± 7nm |
| MFD @λ-operating | 6.6 ± 1.0µm[1] | 9.8 ± 0.8µm[2] | 10.5 ± 0.8µm[3] |
| Attenuation @λ-operating | <3.0dB/km[1] | <1.0dB/km[2] | <0.5dB/km[3] |
| Beat Length @λ-operating | ≤3.3mm[1] | ≤4.7mm[2] | ≤5.0mm[3] |
| Normalized Crosstalk | ≤–40dB (4m) | ≤–40dB (4 m) | ≤–40dB (4m) |
| Normalized Crosstalk (Nom.) | ≤–30dB (100m) | ≤–30dB (100m) | ≤–30dB (100m) |
| Cladding Diameter | 125 ± 1.0µm | 125 ± 1.0µm | 125 ± 1.0µm |
| Core-Cladding Concentricity | <0.5µm | <0.5µm | <0.5µm |
| Core-Cladding Offset | ≤5µm | ≤5µm | ≤5µm |
| Coating Style | Dual Acrylate UV Cured | Dual Coating (Acrylate/Acrylate) | Dual Coating (Acrylate/Acrylate) |
| Coating Diameter | 250 ± 20µm | 245 ± 15µm | 245 ± 15µm |
| Proof Testing | ≥200kpsi | ≥200kpsi | ≥200kpsi |
| Operating Temperature Range | –40 to 85°C | –40 to 85°C | –40 to 85°C |

1) @ 980nm 2) @ 1450nm 3) @ 1550nm

**Panda PM Fiber Cross Section**




NUFERN Driven To Light.

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Telecom Compatible Polarization Maintaining Fiber

The continued use of EDFAs and high cost of pump pasers has created a demand for a PM fiber that combines telecommunication compatibility with low cost. The HB-T series PM fiber offers circularized modes that are matched to standard telecommunication fibers.

The HB980T and HB1480T fibers have been specifically designed for the polarization multiplexing of EDFA pump lasers. The HB1250T and HB1500T offer nominal MFDs of 9.0µm and 10.5µm, respectively, and together with a 400µm dual-layer buffer, are ideally suited to both laser and integrated optic chip pigtailing.

| SPECIFICATIONS | | | | |
|---|---|---|---|---|
| | HB980T | HB1250T | HB1480T | HB1500T |
| Design Wavelength[1] | 980nm | 1310nm | 1480nm | 1550nm |
| Cutoff Wavelength | 870-970nm | 1100-1290nm | 1290-1450nm | 1290-1540nm |
| MFD @ λ-operating | 6.0µm @ 980nm<br>9.8µm @ 1550nm | 9.0µm @ 1310nm | 10.1µm @ 1480nm<br>10.5µm @ 1550nm | 10.5µm @ 1550nm |
| Numerical Aperture | 0.13-0.15 | 0.11-0.13 | | |
| Attenuation[2] | <3dB/km | <2dB/km | | |
| Beat Length[3] | <2mm | | | |
| Cladding Diameter | 125 ± 1.0µm | | | |
| Core-Cladding Offset | ≤0.75µm | | | |
| Coating Style | Dual UV Cure Acrylate | | | |
| Buffer Coating Diameter | 245µm ± 5% | 400µm ± 5% | | |
| Proof Test | 1% @ 100kpsi or 2% @ 200kpsi | | | |

1) Typically, the fiber will operate single mode for ~200nm above the cut-off wavelength.
2) Measured over nominal operating wavelength of 870-1600nm for HB980T, 1100-1600nm for HB1250T, and 1290-1600nm for HB1480T and HB1500T
3) Measured at 633nm4) Worse case value at the shortest design wavelength

- Low-Stress Bow-Tie Geometry Gives Improved Cleave Quality and Better Than -32dB Splice Extinction Ratio With Panda Fibers
- Dual-Layer Acrylate Coating Provides Enhanced Ruggedness
- <0.1dB Splice Loss Achievable
- Low NA Reduces Results in Bend-Induced Packaging Loss
- Optional 0.5µm Concentricity High Fusion Splice Yield

**Specialty Fiber Manufactured by**

FIBERCORE LIMITED

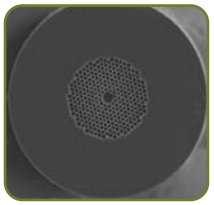
**PRICE SCHEDULE**

| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| HB980T | 1-9m | $ 18.40 | £ 11.60 | € 17,10 | ¥ 175.70 |
| | 10-99m | $ 16.05 | £ 10.10 | € 14,95 | ¥ 153.30 |
| | 100-499m | CALL | CALL | CALL | CALL |
| HB1250T | 1-9m | $ 18.40 | £ 11.60 | € 17,10 | ¥ 175.70 |
| | 10-99m | $ 16.05 | £ 10.10 | € 14,95 | ¥ 153.30 |
| | 100-499m | CALL | CALL | CALL | CALL |
| HB1480T | 1-9m | $ 18.40 | £ 11.60 | € 17,10 | ¥ 175.70 |
| | 10-99m | $ 16.05 | £ 10.10 | € 14,95 | ¥ 153.30 |
| | 100-499m | CALL | CALL | CALL | CALL |
| HB1500T | 1-9m | $ 18.40 | £ 11.60 | € 17,10 | ¥ 175.70 |
| | 10-99m | $ 16.05 | £ 10.10 | € 14,95 | ¥ 153.30 |
| | 100-499m | CALL | CALL | CALL | CALL |

*Call For Quantities Over 500m*

# Photonic Crystal Fiber Selection Guide

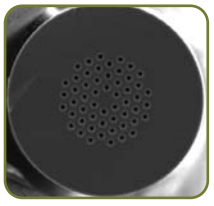
Pages 1080-1090



### Hollow Core Air-Guiding PCF

- True Hollow Core Waveguide
- Up to 99% of Optical Power Guided in Air
- Quasi-Gaussian Fundamental Mode Facilitating Coupling to Lasers and Conventional Fibers
- Low Bend Loss and Fresnel Reflections From the End Faces
- Radiation Insensitive
- Available for Operating Wavelengths Ranging From 440 to 1550nm
- Applications: Power Delivery, Pulse Compression, Spectroscopy, Sensors, Gyroscopes, and Communication

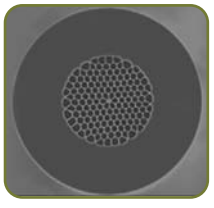
**See Pages 1080-1084**



### Large-Mode-Area PCF

- Diffraction Limited, High-Power Delivery (High Average as Well as Peak Power)
- Endlessly Single Mode Operation - No Higher Order Mode Cut-Off
- Mode Field Diameter is Wavelength Independent
- Low Nonlinearities
- Low Fiber Loss
- Pure Silica Fiber

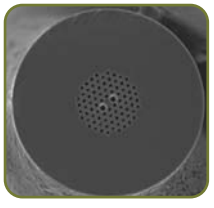
**See Page 1085**



### Highly Nonlinearity PCF

- Nonlinearity up to $104 W^{-1} km^{-1}$
- Core Sizes From 1.4 to 1.6µm
- Zero Dispersion Wavelengths From 745 to 800nm
- PM Version With Zero Dispersion at 750nm
- Applications: Supercontinuum Generation, Optical Switching, and Data Processing

**See Pages 1086-1087**



### Polarization Maintaining PCF

- Highly Polarization Maintaining (PER >30dB/100m Typical at 1550nm)
- Beatlength <4mm; Sub-Millimeter Beatlength Demonstrated for Similar Design
- Low Temperature Coefficient of Birefringence
- Single Material System (Pure Fused Silica)
- Applications: Sensors, Gyroscopes, and Interferometers

**See Page 1088**

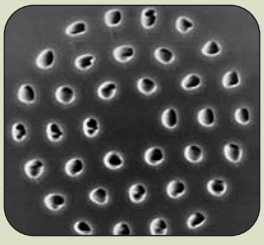
Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# PHOTONIC CRYSTAL FIBERS (PCF)

Photonic crystal fibers (PCFs) – optical fibers that contain an array of roughly wavelength-sized holes running along the fiber axis – vastly extend the possibilities of fiber optic technology. More than a decade after the inception of the concept, PCF is now a proven technology, which is competing with conventional fibers in many applications and is opening others that are not accessible to all-glass fibers. In collaboration with Crystal Fibre, Thorlabs offers a range of off-the-shelf PCF products, as well as custom design, splicing, and connectorization services.

Conventional optical fibers are limited to rather small differences in refractive index between core and cladding – a few percent at most for fibers made from doped silica. The comparatively large index contrast between air and glass in PCFs, combined with the ability to vary the sizes and positions of the air holes means that a much broader range of index profiles becomes possible, resulting in fibers with highly unusual optical characteristics. PCFs can be single mode at all wavelengths or at any given wavelength, up to large core diameters. However, they can be highly nonlinear, can possess unusual dispersion, or can be highly birefringent. Perhaps the most revolutionary type of PCF are hollow-core fibers in which light is guided largely outside of a solid core material.

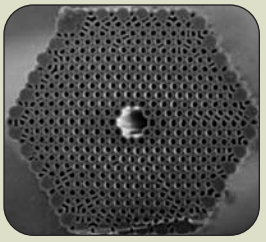
## SOLID CORE Photonic Crystal Fiber



**Early Large-Mode-Area Endlessly Single Mode Photonic Crystal Fiber**
Knight, Birks & Russell, OFC postdeadline, February 1996

- **Guidance Mechanism**
  Total Internal Reflection at Boundary Between High Index Solid Core and Lower "average" Index Between Air and Glass Index Photonic Crystal Cladding
- **Possible Design Features**
  - Endlessly Single Mode at All Wavelengths
  - Large-Mode-Area at Short Wavelengths
  - High Nonlinearity Multiple Cores in One Fiber
- **Applications**
  - Supercontinuum Generation
  - Power Delivery (Endlessly Single Mode Fiber)
  - Sensors (PM Fiber)

## HOLLOW CORE Photonic Crystal Fiber



**First air-guiding photonic bandgap hollow core fiber made by the founders of BlazePhotonics**
Cregan et al, Science 285 (1537-1539) 1999

- **Guidance Mechanism**
  Photonic bandgap cladding confines light to an evacuated or gas-filled core
- **Key Optical Properties**
  - Operating Bandwidth ±10% of Design Wavelength
  - Zero Dispersion Close to Design Wavelength
  - Near Gaussian-Shaped Fundamental Mode $M^2$ Value
  - Modal Index ≈1. Virtually no Fresnel Reflection
- **Applications**
  - Power Delivery (Short Pulses and CW)
  - Pulse Shaping and Compression

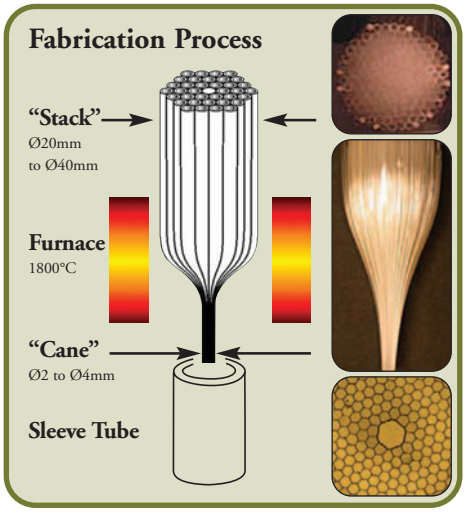
### Two types of Photonic Crystal Fiber

PCFs come in two basic varieties. While both types contain an arrangement of tens to several hundreds of air holes in an otherwise usually uniform material, operating principles, geometry, and optical properties of these fibers are quite different.

**Solid-Core PCFs:** Like conventional fibers, solid-core PCFs guide light by Total Internal Reflection (TIR) at the boundary between a low index cladding and a high index core. In most all-solid fibers, the required index difference is created by doping either the core or the cladding glass. In a PCF the same is achieved by incorporating holes into the cladding, causing the weighted average refractive index "seen" by the mode to be lower than that of the core. By altering the arrangement of holes or the shape of the core, optical properties such as mode shape, nonlinearity, dispersion, and birefringence can be varied over a range, often well exceeding what is possible with conventional fiber technology. As the distribution of light between air and glass changes with wavelength, so does the average index. This can be exploited to create fibers with very large amounts of dispersion of both signs or, alternatively, fibers with very low dispersion can be created by using the wavelength dependence of the effective index to compensate for material and waveguide dispersion. Similarly, it is easy to incorporate more than one core into the photonic crystal cladding, allowing one to form arrays of coupled or independent waveguides. In solid core PCFs, as in all TIR fibers, the vast majority of light propagates in the glass.

**Hollow Core Fibers:** Hollow core fibers employ a fundamentally different guiding mechanism. A photonic bandgap in the cladding acts as a virtually loss-free mirror confining light to a core that does not necessarily have to consist of solid material. This makes it possible to create low-loss waveguides with gas-filled or even evacuated cores at optical wavelengths, similar to the familiar hollow waveguides from microwave technology. Photonic bandgaps can form in materials with a periodically structured refractive index. In PCF, this is achieved by incorporating holes into a glass matrix. What makes this concept so interesting is

that the interaction between light and glass can be surprisingly small. In some types of PCFs, <1% of the optical power propagates in the glass, greatly reducing the extent to which the bulk properties of the glass determine the properties of the fiber. Hollow core PCF scan therefore have




extremely low nonlinearity, high breakdown threshold, zero dispersion at any design wavelength, and negligible interface reflection. Furthermore, it becomes possible to fabricate low-loss fibers from comparatively high-loss materials, extending the range of materials that can be considered for fiber fabrication.

## Fabrication

Crystal Fibre's PCFs are fabricated by assembling fused silica capillaries into a preform "stack." A core is embedded by replacing one or more of these capillaries with a solid rod or with a thin-walled tube into the case of hollow core PCFs. The resulting preform is then inserted into a sleeve tube and drawn to fiber. Careful control of the process conditions ensures that the capillaries are transformed into the desired arrangements of holes, despite the fact that the diameter of each hole is reduced several hundred-fold from stack to fiber. During the draw process, the holes are filled with dry inert gas to minimize the effects of gaseous contaminants. Capillaries and other key components are manufactured in-house from high-grade fused silica glass, giving Crystal Fibre a high degree of design flexibility and control over material quality. Draw lengths of a few kilometers are typical, but there ais no known limit to the length.

## Mechanical Properties and Handling

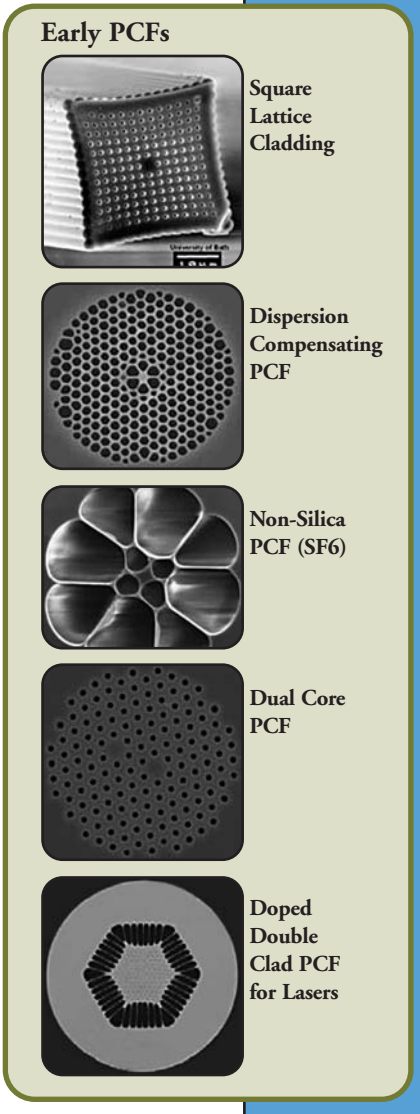
Remarkably, despite the presence of the holes, silica PCFs are mechanically robust. Winding them at a 2-3mm radius, for example, does not damage the internal structure. All Crystal Fibre fibers are proof tested at a strain of 0.25%. The fibers can be cleaved with conventional tools and fusion splicing of PCF to PCF and PCF to solid fiber is possible; however, splicing processes developed for conventional fibers need to be modified to achieve optimal results. To facilitate the integration of PCFs into optical systems, Crystal Fibre now offers custom splicing, end face protection, and connectorization services (see page 1089).

## The Future

One key objective of research is the reduction of attenuation for both solid and hollow core fibers. While the attenuation of some types of solid core fiber already approaches the theoretical limit set by Rayleigh scattering, the principle limits to loss of hollow core PCFs are still largely unexplored. However, hollow core fibers with <2dB/km loss are now a reality,[3] and it is possible that PCFs will ultimately achieve a loss well below that of the best conventional fibers. This, in combination with the virtual absence of nonlinearity, may enable PCFs to be the fiber of choice for long-haul transmission in the future.

Another interesting area of development are PCFs for short wavelengths, which promise to improve the level of power that can be delivered and to extend the application of fiber optics further into the ultraviolet. The potential in the UV is still unproven; but, Crystal Fibre offers hollow core fibers covering the entire visible spectrum, including fibers optimized for 532nm. Other wavelengths are available upon request. Hollow core technology also holds promise for the mid-infrared range by extending the wavelength range that can be covered with silica fibers to beyond 2µm. In the future, longer wavelengths may be obtainable using non-silica glasses.

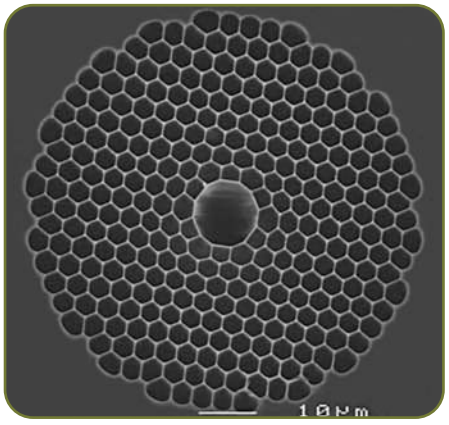
The large number of degrees of freedom in the design of PCFs, combined with the fact that small changes in the waveguide structure can sometimes have a surprisingly large effect on the optical properties of the fiber, suggest that the range of fiber designs and applications will continue to grow rapidly. Therefore, if none of our standard products are what you are looking for, Crystal Fibre welcomes requests for custom designed products. Our team of experienced application engineers are happy to explore solutions that meet your particular application requirements. Please contact us to discuss any questions that you may have about Photonic Crystal Fiber. ■



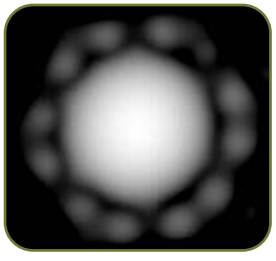

1) Birks, T. A., et al., 31 1941-1942 (1995)
2) Cregan, R. F. et al, . Science 285 1537-1539 (1999)
3) B.J.Mangan. et al., OFC2004, Post Deadline Paper

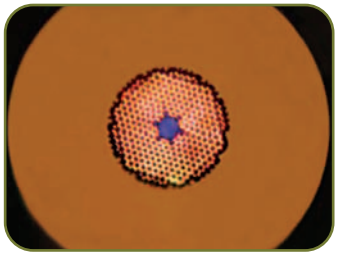
Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Hollow Core Photonic Crystal Fibers




**SEM cross section of a hollow core photonic crystal fiber (left). Typical output intensity profile measured in the near field (bottom left). Close up photograph of the fiber while under illumination makes the structure of the fiber clearly visible (below).**





The operating principle behind hollow core photonic bandgap fibers is very different from that of conventional fibers that guide light by total internal reflection; they are related more to that of a multi-layer mirror. For certain incident angles and optical frequencies, the reflection from each layer of holes can add up coherently, transforming the dielectric cladding into an almost perfect two dimensional mirror, which keeps the light in the core of the fiber.

## Key Properties

- Available With Design Wavelengths From 440-1550nm
- Available With 7-Cell and 19-Cell Cores
- Operating Bandwidth ±10% of Design Wavelength
- Attenuation From 20dB/km (1550nm) to 2dB/m (440nm)
- Zero Dispersion Occurs at a Wavelength in the Operating Band
- Near-Gaussian Fundamental Mode
- Virtually Free of Optical Nonlinearity
- Virtually Immune to Bend Loss
- No Fresnel Reflection From the Endfaces (Modal Index=1)

## Optical Properties

- **Modal Properties**

  As with conventional single mode fibers, the favored mode in hollow core PFC has a quasi-Gaussian intensity distribution. In the case of the 19 cell hollow core fiber with a 1550nm operating wavelength (HC19-1550), the measured shape overlap with the fundamental mode of an all-solid step index fiber is >97%, facilitating coupling to high mode quality lasers or conventional fiber. Even though hollow core PCFs are intended to be used like other single mode fibers, no low-loss hollow core PCFs demonstrated to date is a true single mode waveguide; typically, they support several higher order core modes, and in some cases, they support additional "surface" modes located at the core cladding boundary. All of these modes have higher loss than the fundamental mode and generally decay rapidly, but their presence needs to be taken into account when designing input and output coupling optics.

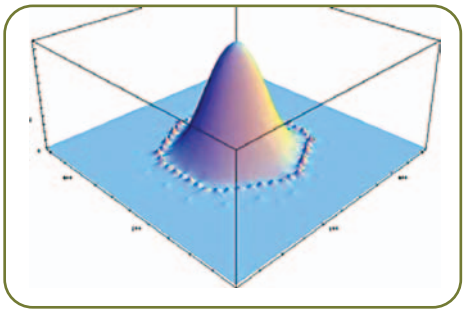
- **Chromatic Dispersion**

  Unlike in conventional fiber where material dispersion plays a major role, Group-Velocity Dispersion (GVD) in hollow-core PCF is dominated by waveguide dispersion. For any design wavelength, including those where the dispersion of silica makes it impossible to achieve zero dispersion in conventional fiber, dispersion is upward sloping and crosses zero at a wavelength close to the center of the operating wavelength band (see box on the next page).

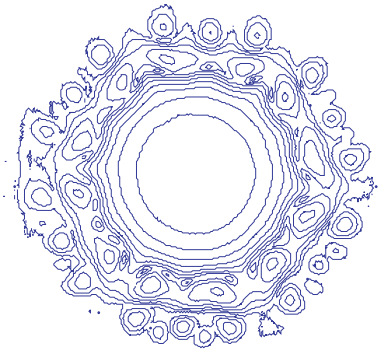
- **Attenuation**

  Hollow core fibers only guide over a wavelength range covered by the photonic bandgap in the cladding. Outside this range – typically about ±10% of the design wavelength – loss increases sharply.

**Measured Near-Field Intensity Profile**



**19 Cell Core, 3dB/Contour**



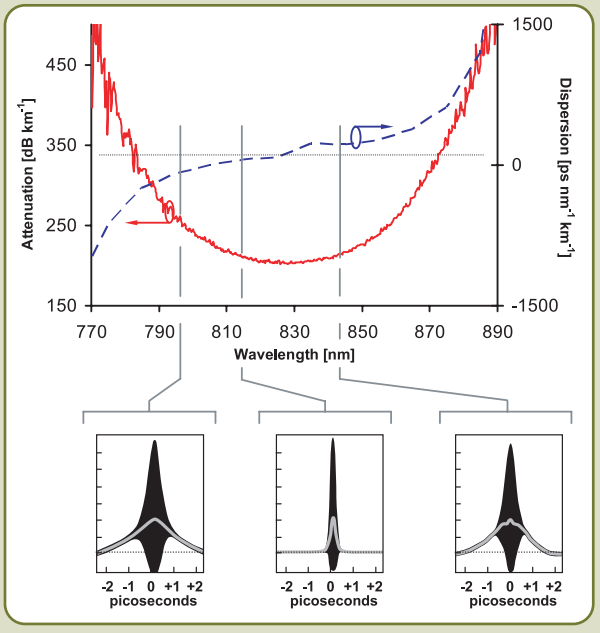
## Applications

- Delivery of Ultra-Short High-Power Optical Pulses
- Pulse Compression and Pulse Shaping
- Sensors and Spectroscopy

# Hollow Core Photonic Crystal Fibers



## Application Example – Delivery of Femtosecond Pulses From a Ti:Sapphire Laser



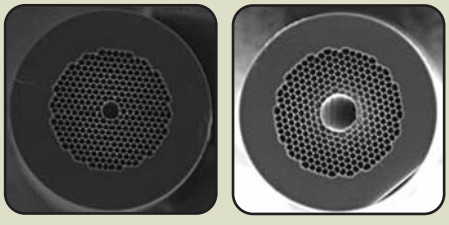

Since most of the optical power is located in the core and cladding holes and not in the glass, the nonlinearity of hollow core fibers can be 2-3 orders of magnitude smaller than that of conventional fibers. This characteristics, along with the fact that dispersion crosses zero within the operating waveband, makes these fibers ideally suited for the delivery of ultra-short, high-power optical pulses.

This is demonstrated here for the delivery of 150fs, 8nJ pulses from a Ti:Sapphire laser over a 1.5m long fiber. Around the zero dispersion wavelength, the pulses leave the fiber virtually undistorted, despite the fact that the peak power exceeds 100kW.

Low nonlinearity and anomalous dispersion at any wavelength also makes it possible to transmit more powerful pulses in a soliton regime.[2,3] Peak powers of up to 2MW have been transmitted without causing damage to the fiber.

1) Göbel *et al.*, June 1, Opt. Lett., Vol. 29, (11), 07/2004
2) Ouzounov *et al.*, Science, Vol. 301, 09/2003
3) Luan *et al.*, Opt. Express, Vol. 12, 03/2004

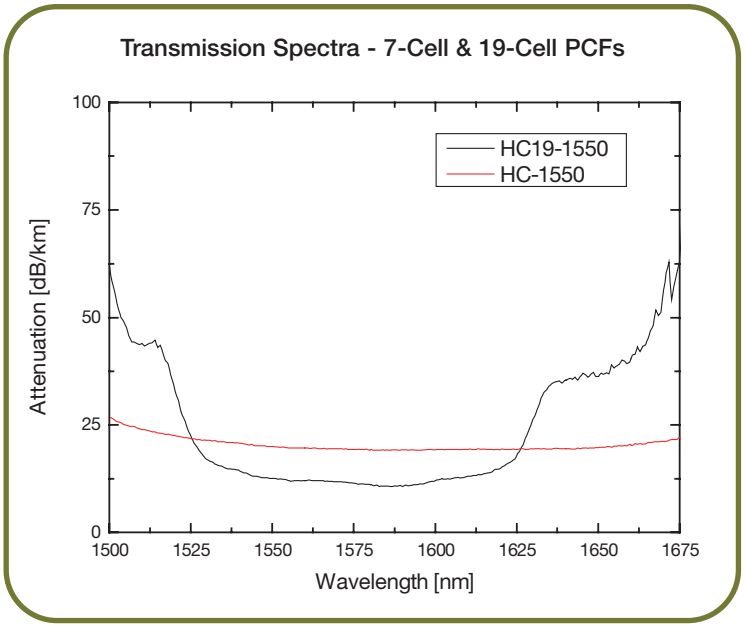
## 7 & 19 Cell Cores



**Core Size:**
Hollow core fibers are available in two core sizes, which are optimized for different application requirements.

**7-Cell Core**
- Larger Continuous Operating Bandwidth
- Smaller Number of Core Modes and Parasitic Surface Modes

**19-Cell Core**
- Larger Mode Field Diameter
- Lower $M^2$ of Fundamental Mode (More Gaussian-Like) Resulting in Increased Coupling Efficiency to High-Mode Quality Lasers and Conventional Fibers
- Lower Attenuation
- Lower Dispersion and Dispersion Slope
- Lower Optical Nonlinearity
- Higher Breakdown Power Threshold

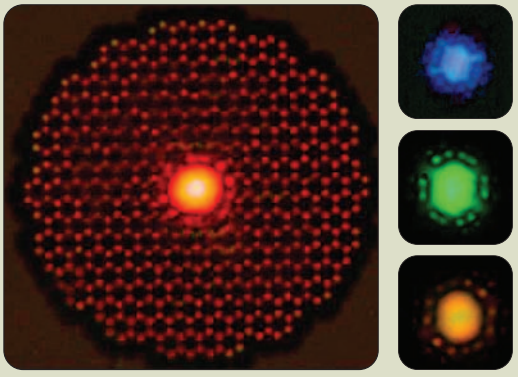



**The graph compares typical transmission spectra for a 7-cell (HC-1550) and a 19-cell core fiber (HC19- 1550), both designed for operation at 1550nm. The peaks in the transmission band of the 19-cell fiber are due to surface modes (i.e. modes at the boundary between core and cladding) that become degenerate in its propagation constant with the fundamental mode at certain wavelengths.**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Hollow Core Photonic Crystal Fibers

## Hollow Core Fibers for Visible Light



The operating wavelength of a hollow core fiber scales in direct proportion with the fiber dimensions. Employing a unique new process for fabricating the required small scale fiber structures, BlazePhotonics is now able to offer hollow core fibers that cover the visible and near infrared part of the spectrum. These fibers are particularly interesting for applications in RGB projection or printing, micromachining (532nm), or spectroscopy.

Standard products are available for wavelengths from 440 to 1550nm, although fibers for any wavelength in the range from 350 to 2500nm can be provided as a custom product.

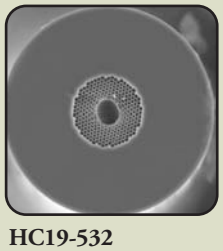
**Red-guiding hollow core fiber HC-633 back illuminated with white light**

| ITEM# | CENTER λ (nm) | CORE DIA. (µm) | MFD* (µm) | NUMEICAL APERTURE | EFFECTIVE MODE INDEX | ATTENUATION (dB/km) | BANDWIDTH (nm) | CLADDING DIA. (µm) | COATING DIA. (µm) |
|---|---|---|---|---|---|---|---|---|---|
| HC-1550 | 1550 | 10.9 | 7.5 | ~0.2 | ~0.99 | <30 | 1450-1650 | 120 | 220 |
| HC-1060 | 1060 | 9.7 | 6.5 | ~0.2 | ~0.99 | <100 | 1015-1105 | 123 | 220 |
| HC-800 | 840 | 6.8 | 5.0 | ~0.2 | ~0.99 | <250 | 795-885 | 130 | 220 |
| HC-633 | 630 | 5.1 | 4.7 | ~0.12 | ~0.99 | <1000 | 570-690 | 101 | 220 |
| HC-580 | 555 | 4.9 | 4.2 | ~0.12 | ~0.99 | <1000 | 515-595 | 89 | 220 |
| HC-440 | 440 | 4.9 | 4.2 | ~0.12 | ~0.99 | <2000 | 410-470 | 84 | 220 |
| HC19-1550 | 1570 | 20±2 | 13 | ~0.13±0.03 | ~0.995 | <20 | 1530-1610 | 115 | 220 |
| HC19-532 | 535 | 9.5/8.6 | 7.0/6.4 | ~0.12 | ~0.99 | <400 | 520-550 | 84 | 220 |

* Full 1/e-width of the near field intensity distribution.

## Hollow Cores

HC-633



HC19-532

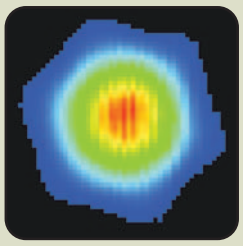
HC-1550

Photonic bandgap (hollow core) fibers guide light in a hollow core that is surrounded by a microstructured cladding formed by a periodic arrangement of air holes in silica. Since only a small fraction of the light propagates in glass, the effect of material nonlinearities is significantly reduced, and the fibers do not suffer from the same loss limitations as conventional fibers made from solid material alone. The fiber is protected by a single layer acrylate coating and can be stripped and cleaved like ordinary solid fibers.

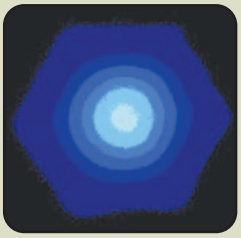
| ITEM# | PRICE/m* | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|---|
| HC-1550 | 1 to 9 | $ 533.00 | £ 335.80 | € 495,70 | ¥ 3,206.90 | Hollow Core PCF, Center Wavelength 1550nm, 7-Cell |
| | 10 to 49 | $ 224.00 | £ 141.10 | € 208,30 | ¥ 1,347.50 | |
| | 50+ | $ 122.00 | £ 76.90 | € 113,50 | ¥ 734.40 | |
| HC-1060 | 1 to | $ 533.00 | £ 335.80 | € 495,70 | ¥ 3,206.90 | Hollow Core PCF, Center Wavelength 1060nm, 7-Cell |
| | 10 to 49 | $ 224.00 | £ 141.10 | € 208,30 | ¥ 1,347.50 | |
| | 50+ | $ 122.00 | £ 76.90 | € 113,50 | ¥ 734.40 | |
| HC-800 | 1 to 9 | $ 533.00 | £ 335.80 | € 495,70 | ¥ 3,206.90 | Hollow Core PCF, Center Wavelength 840nm, 7-Cell |
| | 10 to 49 | $ 224.00 | £ 141.70 | € 208,30 | ¥ 1,347.50 | |
| | 50+ | $ 122.00 | £ 76.90 | € 113,50 | ¥ 734.40 | |
| HC-633 | 1 to 9 | $ 898.00 | £ 565.70 | € 835,10 | ¥ 5,402.40 | Hollow Core PCF, Center Wavelength 630nm, 7-Cell |
| | 10 to 49 | $ 525.00 | £ 330.80 | € 488,30 | ¥ 3,159.10 | |
| | 50+ | $ 364.00 | £ 229.30 | € 338,50 | ¥ 2,189.80 | |
| HC-580 | 1 to 9 | $ 898.00 | £ 565.70 | € 835,10 | ¥ 5,402.40 | Hollow Core PCF, Center Wavelength 555nm, 7-Cell |
| | 10 to 49 | $ 525.00 | £ 330.80 | € 488,30 | ¥ 3,159.10 | |
| | 50+ | $ 364.00 | £ 229.30 | € 338,50 | ¥ 2,189.80 | |
| HC-440 | 1 to 9 | $ 898.00 | £ 565.70 | € 835,10 | ¥ 5,402.40 | Hollow Core PCF, Center Wavelength 440nn, 7-Cell |
| | 10 to 49 | $ 525.00 | £ 330.80 | € 488,30 | ¥ 3,159.10 | |
| | 50+ | $ 364.00 | £ 229.30 | € 338,50 | ¥ 2,189.80 | |
| HC19-1550 | 1 to 9 | $ 898.00 | £ 565.70 | € 835,10 | ¥ 5,402.40 | Hollow Core PCF, Center Wavelength 1570nm, 19-Cell |
| | 10 to 49 | $ 525.00 | £ 330.80 | € 488,30 | ¥ 3,159.10 | |
| | 50+ | $ 364.00 | £ 229.30 | € 338,50 | ¥ 2,189.80 | |
| HC19-532 | 1 to 9 | $ 898.00 | £ 565.70 | € 835,10 | ¥ 5,402.40 | Hollow Core PCF, Center Wavelength 535nm, 19-Cell |
| | 10 to 49 | $ 525.00 | £ 330.80 | € 488,30 | ¥ 3,159.10 | |
| | 50+ | $ 364.00 | £ 229.30 | € 338,50 | ¥ 2,189.80 | |

*Prices for longer lengths upon request

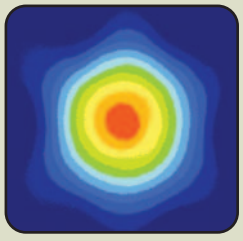
# Large-Mode-Area Photonic Crystal Fiber



LMA-20



LMA-25



LMA-35

### Near Field Intensity Profiles

**LMA-20:** @ 635 nm
**LMA-25:** w/white light
**LMA-35:** @ 635 nm

Thorlabs offers a selection of Large-Mode-Area (LMA) photonic crystal fibers that offer diffraction limited, high-power delivery. The very large mode area enables high power levels to be transmitted through the fiber without the effects caused by the fiber's nonlinear properties or material damage. With standard fiber technology large mode areas are not usually available with single mode operation, but Crystal Fibre's Large-Mode-Area fibers provide "endlessly single mode operation" (i.e. single mode operation over a large wavelength range).

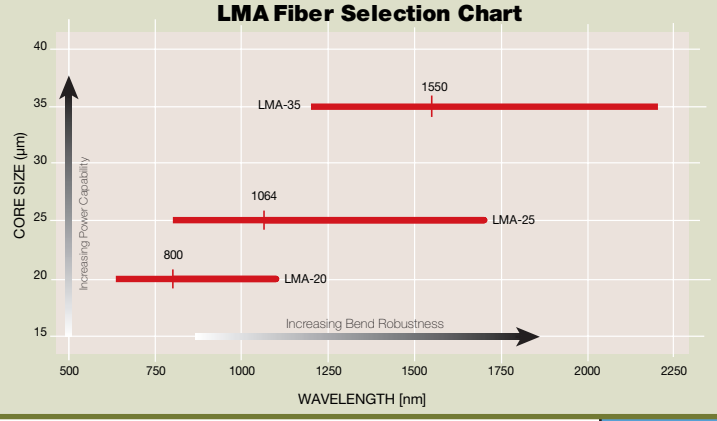
### Applications

- High-Power Delivery
- Short Pulse Delivery
- Mode Filtering
- Laser Pigtailing
- Multiwavelength Guidance
- Broadband Interferometry

### Features

- Very High Average Power and Peak Power Handling Capability
- Low Nonlinearities
- Low Fiber Attenuation
- Endlessly Single Mode Operation – No Higher Order Mode Cut-Off
- Mode Field Diameter is Wavelength Independent
- Available in 800nm, 1064nm, and 1550nm Optimized Version (Core Sizes of 20, 25, and 35µm, Respectively)

### LMA Fiber Selection Chart




| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| LMA-20 | 1 to 9 | $112.00 | £ 70.60 | € 104,20 | ¥ 1,069.60 |
| | 10 to 49 | $ 70.00 | £ 44.10 | € 65,10 | ¥ 668.50 |
| | 50+ | $ 60.00 | £ 37.80 | € 55,80 | ¥ 573.00 |
| LMA-25 | 1 to 9 | $112.00 | £ 70.60 | € 104,20 | ¥ 674.20 |
| | 10 to 49 | $ 70.00 | £ 44.10 | € 65,10 | ¥ 421.20 |
| | 50+ | $ 60.00 | £ 37.80 | € 55,80 | ¥ 361.00 |
| LMA-35 | 1 to 9 | $112.00 | £ 70.60 | € 104,20 | ¥ 674.20 |
| | 10 to 49 | $ 70.00 | £ 44.10 | € 65,10 | ¥ 421.20 |
| | 50+ | $ 60.00 | £ 37.80 | € 55,80 | ¥ 361.00 |

These fibers are experimental and may be subject to modification, production limitations or cancellation

### Optical & Mechanical Properties

| Parameters | LMA-20 | LMA-25 | LMA-35 |
|---|---|---|---|
| Attenuation* | <7dB/km @ 780 nm | <3.5dB/km @ 1064nm*<br><1.5dB/km @ 1550nm* | <10dB/km @ 1550nm* |
| Cut-Off Wavelength | None | None | None |
| MFD | 15.0 ± 1.5µm | 19.8 ± 2.0µm | 26.0 ± 2.5µm |
| NA | 0.041 ± 0.01 @ 780nm<br>0.055 ± 0.01 @ 1064nm | 0.04 ± 0.01 @ 1064nm<br>0.06 ± 0.01 @ 1550nm | 0.046 ± 0.01 @ 1550nm |
| Cladding Dia. | 229.5 ± 5µm | 268 ± 5µm | 283 ± 5µm |
| Coating Dia. | 340 ± 10µm | 410 ± 5µm | 426 ± 10µm |
| Coating Material | Acrylate | Acrylate | Acrylate |
| Core Dia. | 20.0 ± 0.4µm | 25.2 ± 0.4µm | 35.0 ± 0.5µm |

* Measured for bend radius of 16 cm.

## LMA Patch Cable: LMA-25 Fiber, 5m Length

These fibers are constructed using Crystal Fibre's end sealing process, which increases spot size at end face and improves coupling efficiency. Details on page 1089.

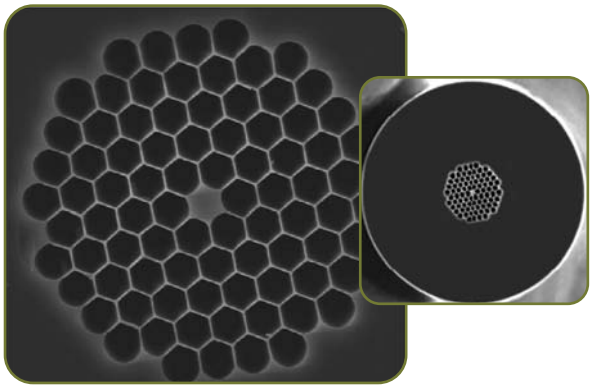
- High Damage Threshold
- Hermetical Sealed Fiber End Faces
- Rugged Stainless Steel Protective Jacketing
- FC/PC to FC/APC

| ITEM # | $ | £ | € | RMB |
|---|---|---|---|---|
| P1-LMA25-FC-5 | $ 1,946.00 | £ 1,226.00 | € 1.809,80 | ¥ 18,584.30 |

*Photonic Crystal Fiber Manufactured by*
CRYSTAL FIBRE

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Highly Nonlinear Photonic Crystal Fiber



**SEM of a cross-section of a highly nonlinear photonic crystal fiber**

## Features

- Zero Dispersion Wavelengths From 745 to 800nm
- PM Version With Zero Dispersion at 750nm Wavelength
- Core Diameter from 1.4-1.6µm
- Nonlinear Coefficients from 70 - 104 $W^{-1}km^{-1}$
- Near-Gaussian Mode Profile
- Pure Silica Core and Cladding

These highly nonlinear photonic crystal fibers guide light in a small solid silica core surrounded by large air holes. The optical properties of these structures closely resemble those of a rod of glass suspended in air, resulting in strong confinement of the light and, correspondingly, a large nonlinear coefficient. By selecting the appropriate core diameter, the zero-dispersion wavelength can be chosen over a wide range in the visible and near infrared spectra, making these fibers particularly suited to the generation of supercontinuum radiation with Ti:Sapphire or diode-pumped $Nd^{3+}$-lasers or for optical switching and signal processing applications.

## Specifications for NL-PM-750

*Best Choice for General Ti:Sapphire Pumping to Produce Broadest Supercontinuum*

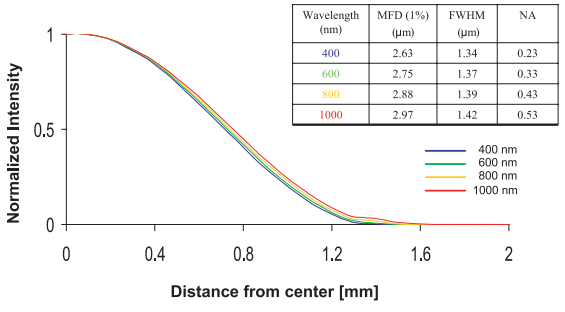
- **Core Diameter:** 1.8 ± 0.3µm
- **Mode Field Diameter:**[1] 1.6 ± 0.3µm
- **Zero Dispersion Wavelength $\lambda_0$:** 750 ± 15nm
- **Dispersion Slope at $\lambda_0$:** 0.23ps/nm²/km
- **Nonlinear Coefficient:**[1] ~95$W^{-1}km^{-1}$
- **Birefringence:** >3x$10^{-4}$
- **Cut Off Wavelength:**[1] <650nm
- **Numerical Aperture:**[1] 0.38 ± 0.05
- **Cladding Diameter:** 120 ± 5µm
- **Coating Diameter (Single Layer Acrylate):** 240 ± 10µm

1) at 780nm

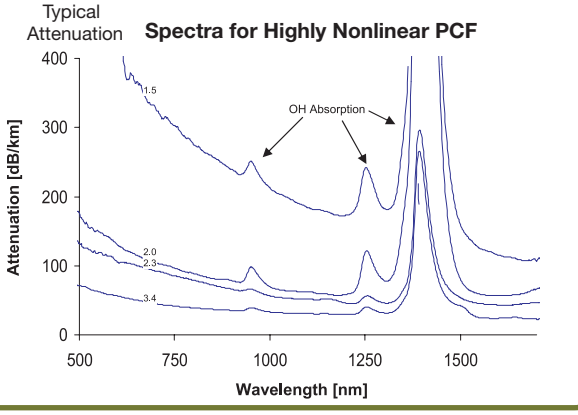
## Applications

- Supercontinuum Generation for Frequency Metrology, Spectroscopy, or Optical Coherence Tomography Using Ti:Sapphire, $Nd^{3+}$-Microchip, or $Nd^{3+}$ Fiber Laser Pumps
- Four-Wave Mixing and Self-Phase Modulation for Switching, Pulse-Forming, and Wavelength Conversion Applications
- Raman Amplification

**Calculated near field cross sections of a small core fiber**




| Wavelength (nm) | MFD (1%) (µm) | FWHM (µm) | NA |
|---|---|---|---|
| 400 | 2.63 | 1.34 | 0.23 |
| 600 | 2.75 | 1.37 | 0.33 |
| 800 | 2.88 | 1.39 | 0.43 |
| 1000 | 2.97 | 1.42 | 0.53 |




### Highly Nonlinear Photonic Crystal Fiber for Supercontinuum Generation

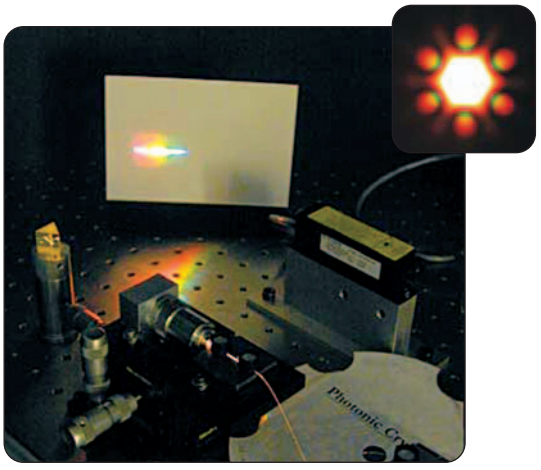
| ITEM# | ZERO DISPERSION $\lambda_0$ | DISPERSION SLOPE | NONLINEAR COEFFICIENT @ $\lambda_0$ | MFD @ $\lambda_0$ | PRICE/m* | $ | £ | € | RMB |
|---|---|---|---|---|---|---|---|---|---|
| NL-2.0-745-02 | 745 ± 5nm | 0.85 ps·nm$^{-2}$·km$^{-1}$ | 104 W$^{-1}$·km$^{-1}$ | 1.4 ± 0.1µm | 1 to 9 | $1,495.00 | £ 941.90 | € 1.390,40 | ¥ 8,995.10 |
| | | | | | 10 to 49 | $1,395.00 | £ 878.90 | € 1.297,40 | ¥ 8,393.50 |
| | | | | | 50+ | $1,345.00 | £ 847.40 | € 1.250,90 | ¥ 8,092.70 |
| NL-2.4-800 | 800 ± 5nm | 0.55 ps·nm$^{-2}$·km$^{-1}$ | 70 W$^{-1}$·km$^{-1}$ | 1.5 ± 0.1µm | 1 to 9 | $1,495.00 | £ 941.90 | € 1.390,40 | ¥ 8,995.10 |
| | | | | | 10 to 49 | $1,395.00 | £ 878.90 | € 1.297,40 | ¥ 8,393.50 |
| | | | | | 50+ | $1,345.00 | £ 847.40 | € 1.250,90 | ¥ 8,092.70 |
| NL-PM-750 | 750 ± 15nm | 0.23 ps·nm$^{-2}$·km$^{-1}$ | ~95 W$^{-1}$·km$^{-1}$** | 1.6 ± 0.3µm** | 1 to 9 | $1,495.00 | £ 941.90 | € 1.390,40 | ¥ 8,995.10 |
| | | | | | 10 to 49 | $1,395.00 | £ 878.90 | € 1.297,40 | ¥ 8,393.50 |
| | | | | | 50+ | $1,345.00 | £ 847.40 | € 1.250,90 | ¥ 8,092.70 |

* Call for Pricing on longer lengths  ** @ 780nm

# Highly Nonlinear Photonic Crystal Fiber

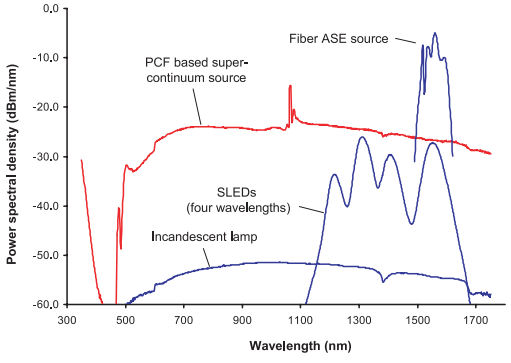


## Nonlinear Fibers for Visible Light



Red-guiding hollow core fiber HC-633-01 back illuminated with white light

### Broadband light sources




Red: supercontinuum generation with 75mW average power $Nd^{3+}$ microchip laser and 20m of fiber SC 5.0-1040
Blue: comparison of broadband light sources

Supercontinuum (SC) sources are a new type of light source that combine the high radiant power and high degree of spatial coherence of a laser with the spectral bandwidth usually associated with an incandescent source. Supercontinuum sources can often drastically improve the signal-to-noise ratio, reduce the measurement time, or widen the spectral range in applications that require a broadband source, including high-resolution spectroscopy, the characterization of optical components, or optical coherence tomography (OCT).

Despite the complex nature of the nonlinear optical processes that convert the narrowband output of a laser into a supercontinuum, the practical realization can be surprisingly straightforward. All that is required is a high peak power pulsed laser and a nonlinear element with the right dispersion characteristics. The high power density, long length at comparatively low loss and the ability to achieve zero dispersion at wavelengths shorter than 1250nm – something that is not achievable with conventional fibers – makes small-core PCF ideally suited as the nonlinear element in a SC source. Crystal Fibre offers small-core fibers (NL Series) suitable for use with femtosecond Ti:Sapphire lasers, as well as a fiber specifically designed to generate SC radiation from the output of a compact, low-cost, $Nd^{3+}$-YAG microchip laser (SC-5.0-1040). Additionally, Crystal Fibre offers a nonlinear pre fiber for SC qualification with Ti:Sapphire lasers. The graph shows the time averaged power spectral density supercontinuum sources realized with these fibers in comparison to the spectrum of other typical broadband sources. Detailed application notes are available at www.thorlabs.com.

### Specifications for SC-5.0-1040

- **Core Diameter:** 4.8 ± 0.2µm
- **Mode Field Diameter:** 4.0 ± 0.2µm
- **Zero Dispersion Wavelength $\lambda_0$:** 1040 ± 10nm
- **Dispersion Slope at $\lambda_0$:** 0.24ps/nm²/km
- **Nonlinear Coefficient:** $11 W^{-1}km^{-1}$
- **Cut Off Wavelength:** <1000nm
- **Cladding Diameter:** 125 ± 3µm
- **Coating Diameter (Single Layer Acrylate):** 244 ± 10µm

**†These fibers are experimental and may be subject to modification, production limitations, or cancellations.**

### Highly Nonlinear Photonic Crystal Fiber for Supercontinuum Generation

Typically 20m is required for supercontinuum generation; length is dependent on pump laser pulse properties.

| ITEM# | ZERO DISPERSION $\lambda_0$ | DISPERSION SLOPE | NONLINEAR COEFFICIENT | MFD @ $\lambda_0$ | PRICE/m* | $ | £ | € | RMB |
|---|---|---|---|---|---|---|---|---|---|
| SC-5.0-1040 | 1040 ± 10nm | 0.24 ps·nm$^{-2}$·km$^{-1}$ | 11 W$^{-1}$·km$^{-1}$ (@ 1060 nm) | 4.0 ± 0.2µm | 1 to 9 | $ 495.00 | £ 311.90 | € 460,40 | ¥ 2,978.60 |
| | | | | | 10 to 49 | $ 265.00 | £ 167.00 | € 246,50 | ¥ 1,594.90 |
| | | | | | 50+ | $ 255.00 | £ 160.70 | € 237,20 | ¥ 1,534.70 |

### Crystal Fibre's Popular SC-5.0-1040 Fiber Built Into a Convenient Patch Cable

- High Damage Threshold due to MFD at End Faces >10X Larger Than Internal MFD
- Improved Coupling Efficiency and Stability due to Increased MFD
- Hermetically Sealed Fiber End Faces
- End Faces can be Easily Cleaned
- Rugged Stainless Steel Protective Jacketing

### Call for Lead Time

| ITEM# | LENGTH | CONNECTORS | PROTECTIVE JACKET | $ | £ | € | RMB |
|---|---|---|---|---|---|---|---|
| P1-SC-5.0-FC-20 | 20m | FC/PC - FC/APC | Flexible Stainless Steel | $ 6,850.00 | £ 4,315.50 | € 6.370,50 | ¥ 65,417.50 |

Passive Components
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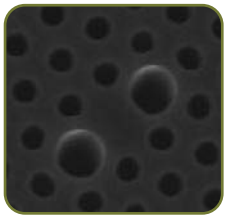
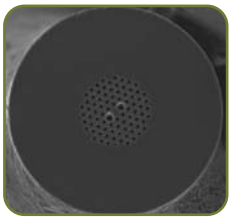
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Polarization Maintaining Photonic Crystal Fiber



Birefringence in conventional polarization maintaining (PM) fibers is created elastooptically by incorporating materials with different thermal expansion close to the core, which generate stress when the fiber cools down in the drawing process. In contrast, the noncircular core in combination with the large refractive index step between air and glass creates strong form birefringence. The result can be a shorter beatlength, which reduces the bend-induced coupling between polarization states, and a much reduced sensitivity of birefringence to temperature changes. The temperature coefficient of birefringence of these fibers is up to 30 times less than that of other leading stress-birefringent fibers.

**Top & Bottom:** SEM of PM-1550-01



Measured Near Field Profile (log scale) of PM-1550-01

## Features

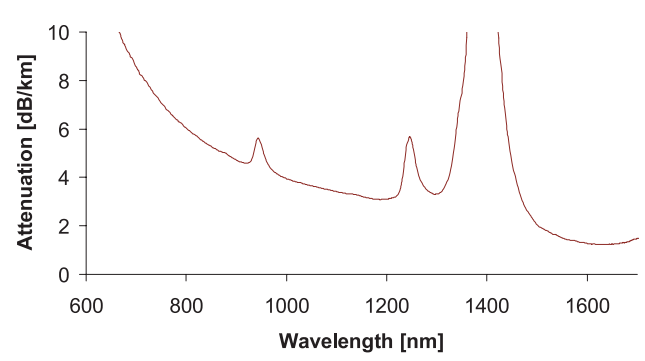
- Beatlength <4mm (Beatlengths of <1mm Possible)
- Polarization Extinction Ratio (PER) >30dB Over 100m
- Temperature Sensitivity 30x Lower Than That of Other Leading Stress-Birefringent Fibers
- Undoped Pure Silica Core and Cladding
- Near-Gaussian Mode Profile, (Ellipticity ≈1.5)

## Applications

- Gyroscopes
- Sensors
- Interferometers

## Specifications (@1550nm)

- **Mode Field Diameter Long/Short Axis:**
  - s-Polarization: 3.6/3.1µm
  - p-Polarization: 3.6/3.1µm
- **Attenuation:** <1dB/km
- **Beatlength:** <4mm
- **Differential Group Delay:** 2.25ns/km
- **Polarization Extinction Ratio (PER):** >30dB/100m (Ø155mm spool)
- **Chromatic Dispersion:**
  - s-Polarization: 54ps/nm/km
  - p-Polarization: 59ps/nm/km
- **Pitch, Λ (Spacing Between Holes):** 4.4µm
- **Large Hole Diameter:** 4.5µm
- **Small Hole Diameter:** 2.2µm
- **Diameter of Holey Region:** 40µm
- **Outside Diameter:** 125µm
- **Coating Diameter (Single Layer Acrylate):** 230µm




| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| PM-1550-01 | 1 to 9m | $ 137.00 | £ 86.30 | € 127,40 | ¥ 824.20 |
| | 10 to 49m | $ 86.00 | £ 54.20 | € 80,00 | ¥ 517.60 |
| | 50+m | $ 73.00 | £ 46.00 | € 67,90 | ¥ 439.30 |

These fibers are experimental and may be subject to modification, production limitations, or cancellation

*Photonic Crystal Fiber Manufactured by* CRYSTAL FIBRE

# Splicing and Interfacing

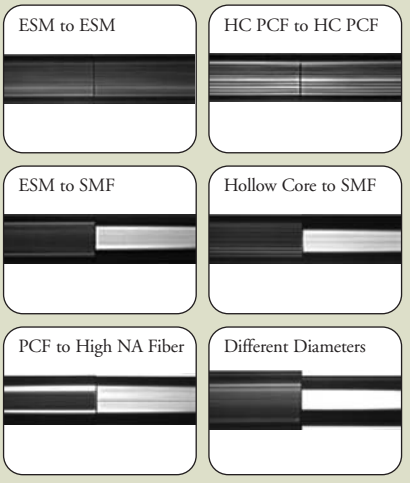
Crystal Fibre has optimized the process of splicing PCFs in order to maintain the integrity of the holey structure. Surface tension forces act to collapse the holes in the fiber while it is heated to the splicing temperature. Splicing time and temperature, therefore, need to be optimized to achieve the best compromise between retaining the structure and making a mechanically strong splice. As a general rule, PCF needs to be spliced "colder and faster" than conventional fibers. Low-loss, high-quality splices have been demonstrated; splices between identical endlessly single mode fibers (e.g. ESM-12-01) routinely yield a loss <0.15dB. With a superior control over temperature and timing, resistively heated splicers routinely make lower loss and more reproducible splices than fusion splicers.

To facilitate the integration of PCFs into your application, Crystal Fibre now offers a custom splicing service, including the following:

- PCF to PCF (Hollow Core and Solid Core)
- PCF to Conventional Fibers (Using a Range of Standard Fibers, or Customer Supplied Fiber)
- Mode Field Tapers Using Diffusible Core Fibers to Reduce Transition Losses Between Fibers of Different Mode Field Diameters

**Please contact us to discuss your requirement.**

## PCF Splicing




# Photonic Crystal Fiber End-Sealing

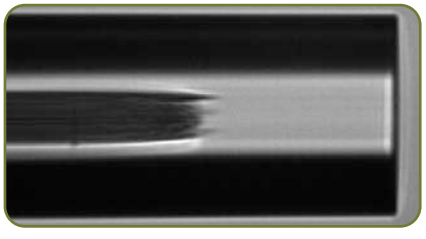
Long-term use of solid core fibers is often limited by end face damage due to the high intensity in the fiber core. This is especially the case when small core nonlinear fibers are pumped by high peak power femtosecond pulses.

Crystal Fibre has developed an elegant fiber end treatment to increase the fiber end damage threshold and generally ease the coupling into the fiber. By collapsing/tapering the fiber end, Crystal Fibre obtains the advantageous features listed to the right.

### Features

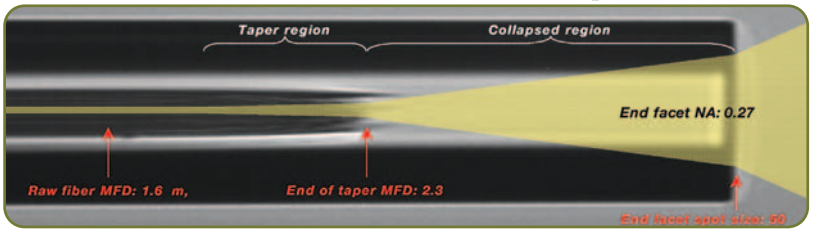
- Hermetically Sealed Fiber
- Very High Fiber End Damage Threshold due to Beam Expansion Such That the Spot Size at the End Face ≥10X the Internal MFD
- Higher Coupling Efficiency and Stability due to Reduced NA and Increased MFD
- Can be Connectorized and Polished

**Photo of Collapsed Fiber End**

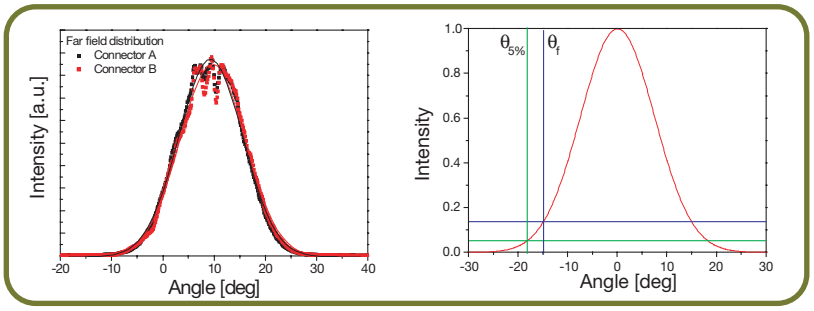


**Example of Nonlinear Fiber End Treatment, λ = 780nm**

**The end of the Photonic Crystal Fiber is heat treated to collapse the airholes.**




**Example of Far Field Distribution for Collapsed and FC/PC Connectorized Nonlinear Fiber, λ = 780nm**




**Definition of Far Field Parameters:**

Assuming a Gaussian far field distribution, the following definitions are used:

- $\theta_f$ is the angle where the peak intensity has decreased to $1/e^2$ (see figure)
- $\theta_{5\%}$ is the angle where the peak intensity has decreased to 5% (see figure)
- $\theta_{5\%} = (\ln(20)/2)^{0.5} \theta^* \theta_f = 1.2239 * \theta_f$
- $\theta_{5\%}$ NA = $\sin(\theta_{5\%})$
- $\theta_{5\%}$ MFD = $2\lambda / (\pi \sin(\theta_f))$ (Gaussian mode field diameter)

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Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# CONTINUOUSLY TUNABLE LASERS

**See Our Expanded Laser & ASE Sources Section Page 534**
Benchtop Systems • TXP Modules • OEM Modules

Thorlabs' tunable lasers are based on external cavity tunable laser technology with tuning ranges of up to 150nm. With products able to both continuously tune or step between ITU grid wavelengths, Thorlabs' tunable lasers are ideal for both test and measurement as well as research and development. Using our proprietary technology, most models exhibit mode-hop free tuning with wavelength resolution of 0.1pm and absolute wavelength accuracy within ±10pm. The highly stable output and quick tuning speed of our continuous tuning models allow the units to tune over their entire range in less than a second. The low SSE makes them an ideal source for testing fiber-optic components, spectroscopy, and basic research applications. Our tunable lasers cover wavelengths ranging from 770nm to 1650nm and are available with fiber output or with free-space collimated beams. The various models offer different features from benchtop units to OEM modules for integrating into larger applications; see pages 535-541.

## ECL Technology

Thorlabs' models are based on External Cavity Lasers (ECL), which are capable of delivering very high output powers in combination with a wide tuning range.

In addition, the ECL technology also has the advantage of continuous, mode-hop free tuning. ECL lasers are based on a high gain laser diode and a separate grating mounted on a pivoting arm to form the cavity (see Figure 1). To tune the laser's wavelength, the angle of the grating is changed by turning the arm with an actuator. The positioning and alignment of the grating assembly and the actuator design are critical for scanning performance.

## Scanning Capabilities

The patented inductive motor design of our continuously tunable models enables a smooth and quick sweep over the full wavelength range in both directions, with perfect repeatability. True continuous linear tuning without any ripple and optional step mode operation are results of this unique design.

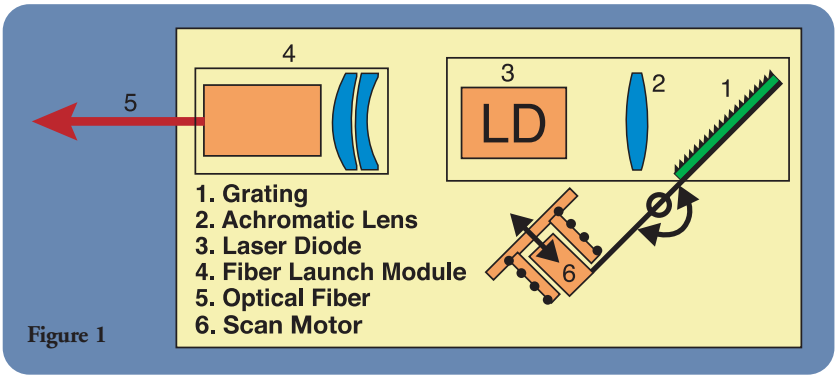
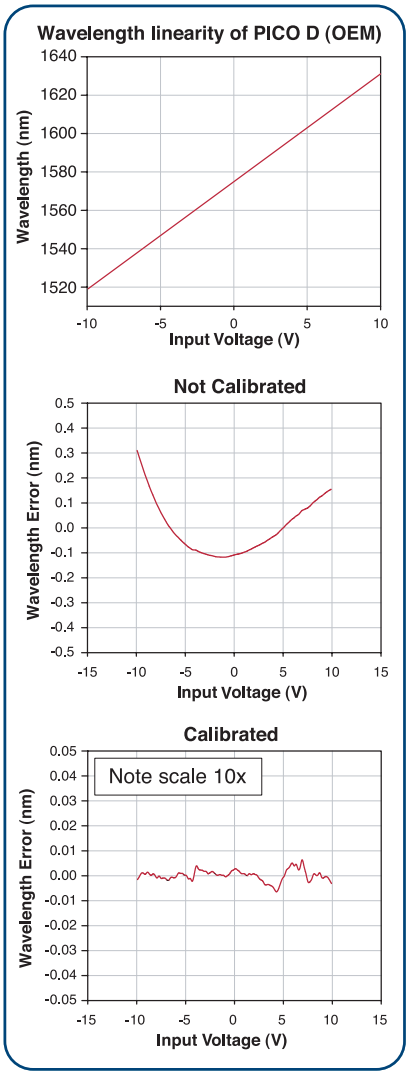



Figure 1

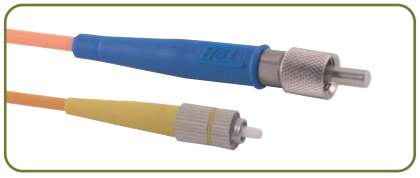
These lasers possess an excellent sweep performance while being robust and reliable at the same time.

The waveforms below show the excellent linearity of the ECL across the entire tuning range.



# Multimode Fiber Selection Guide

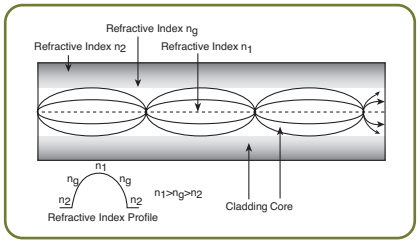




### Step- and Graded-Index Patch Cables

- SMA905 and FC Terminated Cables
- Standard Lengths
- Custom Cables Available

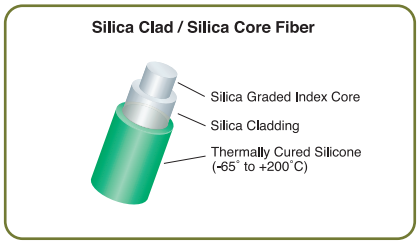
**See Page 1092**




### 62.5µm Core Graded-Index Fiber

- Attenuation: 2.7 to 3.2dB/km @ 850nm
  0.6 to 0.9dB/km @ 1300nm
- Bandwidth: 160 to 400MHz-km @ 850nm
  300 to 1200MHz-km @ 1300nm
- Numerical Aperture: 0.275 ± 0.015
- Zero Dispersion: 1320nm Min, 1365nm Max

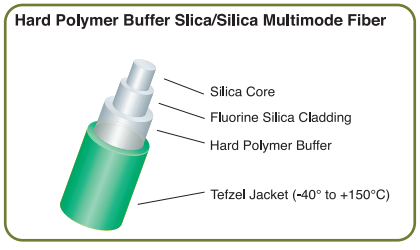
**See Page 1093**




### 62.5µm Core Graded-Index Fiber – High Temperature

- Operating Temperature: -65 to 200°C
- Operating Wavelength (Nominal): 800-1350nm
- Numerical Aperture: 0.275 ± 0.015
- Attenuation: 3.0dB/km @ 850nm
  0.9dB/km @ 1300nm
- Bandwidth: 160MHz-km @ 850nm
  500MHz-km @ 1300nm

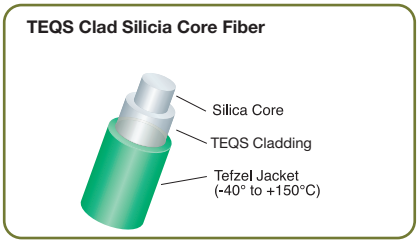
**See Page 1093**




### Hard Polymer Step-Index Multimode Fiber

- 0.22, 0.37, and 0.48 NA
- Broad UV, VIS, and NIR Spectral Range:
  High OH, 190 to 1200nm
  Low OH, 350 to 2500nm
- High Laser Damage Resistance, High Core to Clad Ratio
- Biocompatible Materials, Radiation Resistance: $10^9$rad Total
- Sterilizable by ETO and Other Methods

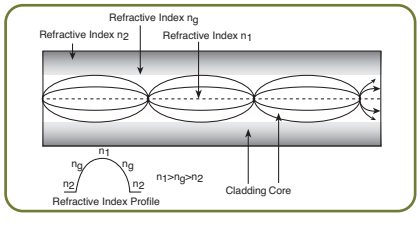
**See Pages 1094-1097**




### TEQS Step-Index Multimode Fiber

- 0.22 and 0.39 NA
- Broad UV, VIS, and NIR Spectral Range:
  High OH, 300 to 1200nm
  Low OH, 400 to 2200nm
- Reduced Static Fatigue, Lower Microbend Losses
- Biocompatible Materials, Radiation Resistance
- Sterilizable by ETO and Other Methods

**See Pages 1098-1099**




### Graded-Index Plastic Optical Fiber

- Perfluorinated Graded-Index Polymer Optical Fibers
- High Data Rates and Low Attenuation in the 850–1300nm Range
- Bare and Pre-jacketed Fibers with 50µm, 62.5µm, and 120µm Cores
- Custom Cables Available

**See Pages 1100-1101**

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Step-Index Patch Cable: SMA-SMA

- Our Most Popular Multimode Fibers
- Shipped From Stock
- Ø3mm Reinforced Outer Jacket
- Custom Cables Available


### 50µm/0.22 NA AFS50/125Y Fiber (See Page 1094)

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| M14L01 | $ 45.00 | £ 28.40 | € 41,90 | ¥ 429.80 | 1 Meter SMA Patch Cable |
| M14L02 | $ 51.10 | £ 32.20 | € 47,50 | ¥ 488.00 | 2 Meter SMA Patch Cable |
| M14L05 | $ 69.40 | £ 43.70 | € 64,50 | ¥ 662.80 | 5 Meter SMA Patch Cable |

### 100µm/0.22 NA AFS105/125Y Fiber (See Page 1094)

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| M15L01 | $ 47.60 | £ 30.00 | € 44,30 | ¥ 454.60 | 1 Meter SMA Patch Cable |
| M15L02 | $ 52.30 | £ 32.90 | € 48,60 | ¥ 499.50 | 2 Meter SMA Patch Cable |
| M15L05 | $ 67.10 | £ 42.30 | € 62,40 | ¥ 640.80 | 5 Meter SMA Patch Cable |

### 200µm/0.22 NA BFL22-200 Fiber (See Page 1095)

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| M25L01 | $ 54.00 | £ 34.00 | € 50,20 | ¥ 515.70 | 1 Meter SMA Patch Cable |
| M25L02 | $ 63.20 | £ 39.80 | € 58,80 | ¥ 603.60 | 2 Meter SMA Patch Cable |
| M25L05 | $ 91.10 | £ 57.40 | € 84,70 | ¥ 870.00 | 5 Meter SMA Patch Cable |

### 400µm/0.37 NA BFL37-400 Fiber (See Page 1096)

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| M28L01 | $56.40 | £ 35.50 | € 52,50 | ¥ 538.60 | 1 Meter SMA Patch Cable |
| M28L02 | $62.40 | £ 39.30 | € 58,00 | ¥ 595.90 | 2 Meter SMA Patch Cable |
| M28L05 | $71.10 | £ 44.80 | € 66,10 | ¥ 679.00 | 5 Meter SMA Patch Cable |

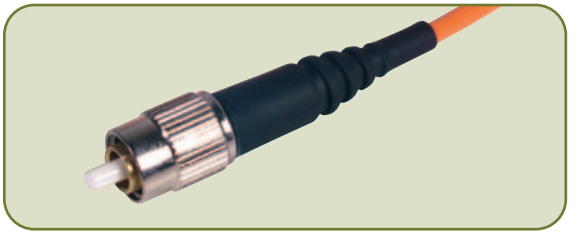
### 600µm/0.37 NA BFL37-600 Fiber (See Page 1096)

| ITEM# | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|
| M29L01 | $61.40 | £ 38.70 | € 57,10 | ¥ 586.40 | 1 Meter SMA Patch Cable |
| M29L02 | $72.60 | £ 45.70 | € 67,50 | ¥ 693.30 | 2 Meter SMA Patch Cable |
| M29L05 | $93.70 | £ 59.00 | € 87,10 | ¥ 894.80 | 5 Meter SMA Patch Cable |

# Graded-Index Patch Cables: FC-FC

- Shipped From Stock
- Ceramic Ferrules
- Individually Tested
- FC/PC on Both Ends

**Custom Lengths are Also Available Upon Request!**

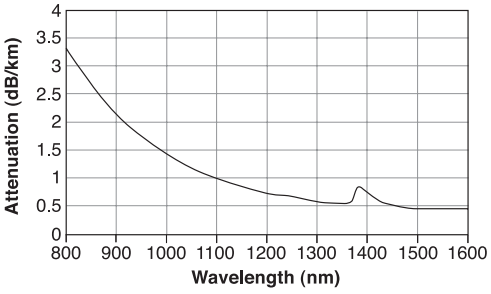


### 62.5µm/0.27 NA GIF625 Fiber (See page 1093)

| ITEM# | $ | £ | € | RMB | CONNECTORS | DESCRIPTION |
|---|---|---|---|---|---|---|
| M31L01 | $ 46.50 | £ 29.30 | € 43,20 | ¥ 444.10 | FC–FC | 1 meter FC Patch Cable |
| M31L02 | $ 50.10 | £ 31.60 | € 46,60 | ¥ 478.50 | FC–FC | 2 meter FC Patch Cable |
| M31L03 | $ 51.60 | £ 32.50 | € 48,00 | ¥ 492.80 | FC–FC | 3 meter FC Patch Cable |
| M31L05 | $ 56.60 | £ 35.70 | € 52,60 | ¥ 540.50 | FC–FC | 5 meter FC Patch Cable |
| M31L10 | $ 69.10 | £ 43.50 | € 64,30 | ¥ 659.90 | FC–FC | 10 meter FC Patch Cable |

# 0.27 NA Graded-Index 62.5µm Multimode Fiber

Typical Spectral Attenuation Plot for GIF625




## Mechanical Specifications

- **Core Diameter:** 62.5 ± 3µm
- **Cladding Diameter:** 125 ± 2µm
- **Coating Diameter:** 245 ± 10µm
- **Core-Clad Offset:** <3µm

Suggested Stripping Tool - T06S13 (See Page 1050)

## Optical Specifications

- **Numerical Aperture:** 0.275 ± 0.015
- **Attenuation:**
  2.7 to 3.2dB/km @ 850nm
  0.6 to 0.9dB/km @ 1300nm
- **Bandwidth:**
  160 to 400MHz-km @ 850nm
  300 to 1200MHz-km @ 1300nm
- **Zero Dispersion:**
  1320nm Min. 1365nm Max.
- **Operating Temperature:**
  -40°C to 85°C

| ITEM# | L | $ | £ | € | RMB | DESCRIPTION |
|---|---|---|---|---|---|---|
| GIF625* | <200m | $ 2.45 | £ 1.55 | € 2,30 | ¥ 23.40 | 62.5µm GI Fiber, 0.275NA (per meter) |
| GIF625-10 | 10m | $ 12.20 | £ 7.70 | € 11,35 | ¥ 116.50 | 10m Spool, 62.5µm GI Fiber, 0.275NA |
| GIF625-100 | 100m | $ 71.40 | £ 45.00 | € 66,40 | ¥ 681.90 | 100m Spool, 62.5µm GI Fiber, 0.275NA |
| GIF625-1000 | 1000m | $ 377.40 | £ 237.80 | € 351,00 | ¥ 3,604.20 | 1000m Spool, 62.5µm GI Fiber, 0.275NA |

*Order by length, minimum 200 meters

# 0.27 NA Graded-Index 62.5µm Multimode Fiber – High Temperature

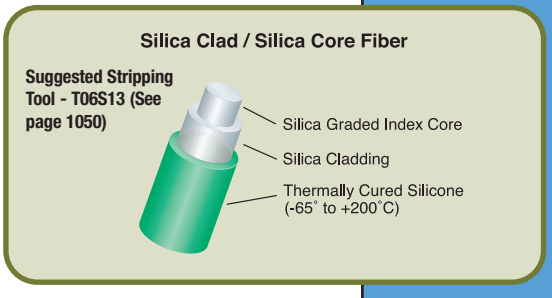
## Mechanical Specifications

- **Core Diameter:** 62.5 ± 3µm
- **Cladding Diameter:** 125 ± 2µm
- **Coating Diameter:** 250 ± 20µm
- **Core-Clad Offset:** <3µm
- **Coating Material:** Thermally Cured Silicone
- **Operating Temperature:** -65 to 200°C

**Designed for High Temperature and Harsh Environmental Applications**

## Optical Specifications

- **Operating Wavelength (nominal):**
  800-1350nm
- **Numerical Aperture:** 0.275 ± 0.015
- **Attenuation:**
  ≥ 3.0dB/km @ 850nm
  ≥ 0.9dB/km @ 1300nm
- **Bandwidth:**
  ≥ 160MHz-km @ 850nm
  ≥ 500MHz-km @ 1300nm

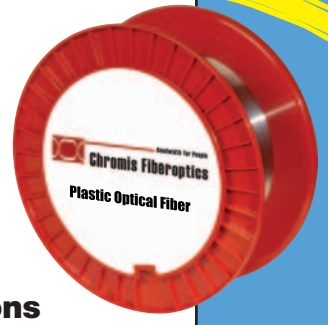



| ITEM# | PRICE/m | $ | £ | € | RMB |
|---|---|---|---|---|---|
| GIF625HT | 1 to 9m | $ 8.30 | £ 5.25 | € 7,70 | ¥ 79.30 |
| | 10 to 49m | $ 6.55 | £ 4.15 | € 6,10 | ¥ 62.60 |
| | 50 to 249m | $ 5.65 | £ 3.55 | € 5,25 | ¥ 54.00 |
| | 250 & up | Call | Call | Call | Call |

100/140µm Step Index version of this fiber available by special order

# 0.19 NA Graded-Index Plastic Optical Fiber

NEW




Thorlabs now offers a line of graded-index polymer optical fibers (GI- POFs) from Chromis Fiberoptics. These multimode fibers offer low attenuation and low material dispersion, thus allowing for high-speed Gigabit Ethernet and multi-gigabit applications at distances up to 100 meters or fast Ethernet up to 200 meters. These fibers feature the ease of use associated with plastic fibers while providing the low loss, low dispersion, and good transmission characteristics typical of glass fibers at 850nm and 1300nm.

These fibers can sustain long-term bending radii that are as small as 5mm, which is much better than glass fibers of the same core size. They are simple to terminate and polish quickly, leading to a low-loss end face. In addition no special connections are necessary to mate these fibers with like core sized glass equivalent devices. This feature allows for direct drop-in glass fiber replacement.

**See Page 1100 for Specifications**

### Plastic Optical Fiber

| ITEM# | $ | £ | € | RMB | CORE SIZE | DESCRIPTION |
|---|---|---|---|---|---|---|
| GIPOF50 | $ 1.26 | £ 0.79 | € 1,17 | ¥ 12.03 | 50µm | GI-POF, Price per Meter |
| GIPOF62 | $ 1.48 | £ 0.93 | € 1,38 | ¥ 14.13 | 62.5µm | GI-POF, Price per Meter |
| GIPOF120 | $ 1.82 | £ 1.15 | € 1,69 | ¥ 17.38 | 120µm | GI-POF, Price per Meter |

### Jacketed Plastic Optical Fiber

| ITEM# | $ | £ | € | RMB | CORE SIZE | DESCRIPTION |
|---|---|---|---|---|---|---|
| GIPOF50-P | $ 1.74 | £ 1.10 | € 1,62 | ¥ 16.62 | 50µm Core | GI-POF, Plenum Cable Jacket, Price per Meter |
| GIPOF62-P | $ 1.96 | £ 1.23 | € 1,82 | ¥ 18.72 | 62.5µm Core | GI-POF, Plenum Cable Jacket, Price per Meter |
| GIPOF120-P | $ 2.30 | £ 1.45 | € 2,14 | ¥ 21.97 | 120µm Core | GI-POF, Plenum Cable Jacket, Price per Meter |

*@1060nm

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Step-Index Multimode Fibers

Thorlabs has a long history of supplying multimode and single mode fibers for research and OEM applications. With the largest selection of single mode and multimode fibers in the photonics industry, in addition to supplying raw fiber, Thorlabs' Fiber Group offers many custom, value-added, fiber-based solutions to meet your needs.

In 2005 InnovaQuartz, Inc. began to bring 3M TEQS fibers to the market. Thorlabs is please to provide our customers with these fibers and other replacement fibers to 3M TEQS. The table below cross-references these fibers to the 3M TEQS fiber.

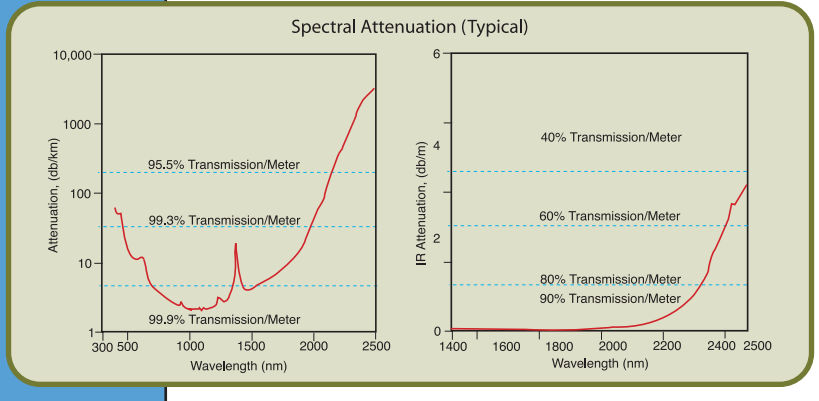
**See Pages 1098-1099**

Cross references for 3M fibers, Thorlabs fibers, and the IQ, Inc. TEQS fibers.

| 3M | | | | THORLABS | | | | INNOVAQUARTZ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ITEM# | OH | NA | CORE (µm) | ITEM# | OH | NA | CORE (µm) | ITEM# | OH | NA | CORE (µm) |
| FG-200-LCR | Low | 0.22 | 200 | BFL22-200 | Low | 0.22 | 200 | FG200LCC | Low | 0.22 | 200 |
| FG-365-LER | Low | 0.22 | 365 | BFL22-365 | Low | 0.22 | 365 | FG365LEC | Low | 0.22 | 365 |
| FG-550-LER | Low | 0.22 | 550 | BFL22-550 | Low | 0.22 | 550 | FG550LEC | Low | 0.22 | 550 |
| FG-910-LER | Low | 0.22 | 910 | BFL22-910 | Low | 0.22 | 910 | — | — | — | — |
| FG-200-UCR | High | 0.22 | 200 | BFH22-200 | High | 0.22 | 200 | FG200UCC | High | 0.22 | 200 |
| FG-365-UER | High | 0.22 | 365 | BFH22-365 | High | 0.22 | 365 | FG365UEC | High | 0.22 | 365 |
| FG-550-UER | High | 0.22 | 550 | BFH22-550 | High | 0.22 | 550 | FG550UEC | High | 0.22 | 550 |
| FG-910-UER | High | 0.22 | 910 | BFH22-910 | High | 0.22 | 910 | — | — | — | — |
| FT-200-EMT | Low | 0.39 | 200 | BFL37-200 | Low | 0.37 | 200 | FT200EMT | Low | 0.39 | 200 |
| FT-300-EMT | Low | 0.39 | 300 | BFL37-300 | Low | 0.37 | 300 | FT300EMT | Low | 0.39 | 300 |
| FT-400-EMT | Low | 0.39 | 400 | BFL37-400 | Low | 0.37 | 400 | FT400EMT | Low | 0.39 | 400 |
| FT-600-EMT | Low | 0.39 | 600 | BFL37-600 | Low | 0.37 | 600 | FT600EMT | Low | 0.39 | 600 |
| FT-800-EMT | Low | 0.39 | 800 | BFL37-800 | Low | 0.37 | 800 | FT800EMT | Low | 0.39 | 800 |
| FT-1.0-EMT | Low | 0.39 | 1000 | BFL37-1000 | Low | 0.37 | 1000 | FT1.0EMT | Low | 0.39 | 1000 |
| FT-1.5-EMT | Low | 0.39 | 1500 | BFL37-1500 | Low | 0.37 | 1500 | FT1.5EMT | Low | 0.39 | 1500 |
| FT-200-UMT | High | 0.39 | 200 | BFH37-200 | High | 0.37 | 200 | FT200UMT | High | 0.39 | 200 |
| FT-300-UMT | High | 0.39 | 300 | BFH37-300 | High | 0.37 | 300 | FT300UMT | High | 0.39 | 300 |
| FT-400-UMT | High | 0.39 | 400 | BFH37-400 | High | 0.37 | 400 | FT400UMT | High | 0.39 | 400 |
| FT-600-UMT | High | 0.39 | 600 | BFH37-600 | High | 0.37 | 600 | FT600UMT | High | 0.39 | 600 |
| FT-800-UMT | High | 0.39 | 800 | BFH37-800 | High | 0.37 | 800 | FT800UMT | High | 0.39 | 800 |
| FT-1.0-UMT | High | 0.39 | 1000 | BFH37-1000 | High | 0.37 | 1000 | FT1.0UMT | High | 0.39 | 1000 |
| FT-1.5-UMT | High | 0.39 | 1500 | BFH37-1500 | High | 0.37 | 1500 | FT1.5UMT | High | 0.39 | 1500 |
| FT-200-URT | High | 0.48 | 200 | BFH48-200 | High | 0.48 | 200 | — | — | — | — |
| FT-400-URT | High | 0.48 | 400 | BFH48-400 | High | 0.48 | 400 | — | — | — | — |
| FT-600-URT | High | 0.48 | 600 | BFH48-600 | High | 0.48 | 600 | — | — | — | — |
| FT-1.0-URT | High | 0.48 | 1000 | BFH48-1000 | High | 0.48 | 1000 | — | — | — | — |

## 0.22 NA Step-Index 50µm and 105µm Multimode Vis-IR Fiber

- Low Loss in the Near IR
- Excellent for Holmium and Erbium Laser Delivery
- Low Hydroxyl Ion Content Providing High Transmission Efficiency
- Useful Spectral Transmission Range From 400–2400nm




### 50µm/0.22 NA AFS50/125Y Fiber

| PRICE PER METER | $ | £ | € | RMB |
|---|---|---|---|---|
| 1 to 9m | $ 4.45 | £ 2.80 | € 4,15 | ¥ 42.50 |
| 10 to 49m | $ 3.20 | £ 2.00 | € 3,00 | ¥ 30.55 |
| 50 to 249m | $ 2.55 | £ 1.60 | € 2,35 | ¥ 24.35 |

### 105µm/0.22 NA AFS105/125Y Fiber

| PRICE PER METER | $ | £ | € | RMB |
|---|---|---|---|---|
| 1 to 9m | $ 2.85 | £ 1.80 | € 2,65 | ¥ 27.20 |
| 10 to 49m | $ 1.95 | £ 1.25 | € 1,80 | ¥ 18.60 |
| 50 to 249m | $ 1.65 | £ 1.05 | € 1,55 | ¥ 15.75 |

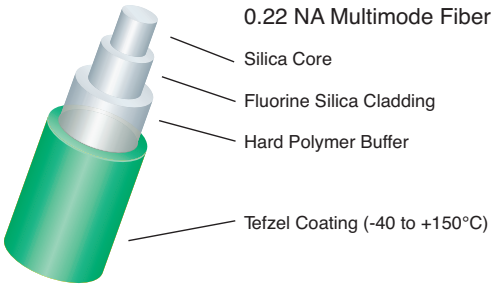
| ITEM# | CORE DIAMETER | CLAD DIAMETER | BUFFER DIAMETER | NUMERICAL APERTURE | MAXIMUM POWER CAPABILITY | | MAXIMUM CORE OFFSET | BEND RADIUS SHORT TERM/ LONG TERM | STRIPPING TOOL |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | PULSED | CW* | | | |
| AFS50/125Y | 50µm | 125µm | 250µm | 0.22 | 10.0J | 1.3kW | 0.4µm | 200x Fiber Radius/ 400x Fiber Radius | T06S13 |
| AFS105/125Y | 105µm | 125µm | 250µm | 0.22 | 10.0J | 1.3kW | 0.8µm | 200x Fiber Radius/ 400x Fiber Radius | T06S13 |

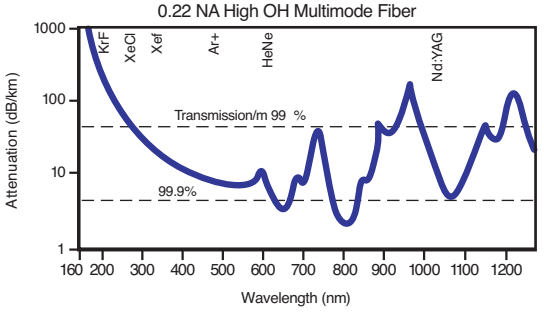
* @ 1060nm

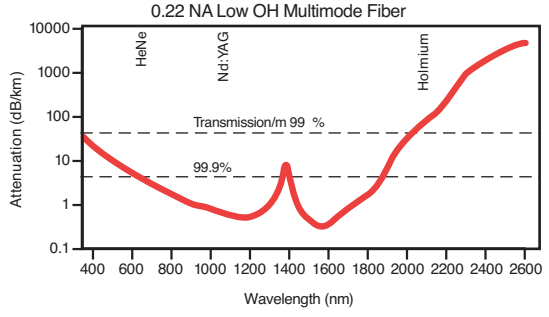
# 0.22 NA Hard Polymer Buffer, Silica/Silica Multimode Fiber

- Broad UV, VIS, and NIR Spectral Range:
  High OH, 190-1200nm
  Low OH, 350 to 2500nm
- High Laser Damage Resistance, High Core-to-Clad Ratio
- Biocompatible Materials, Radiation Resistance:
  $10^9$ Radians Total
- Sterilizable by ETO and Other Methods

Our 0.22 NA multimode fiber exhibits impressive performance and transmission from the deep UV to the IR. With exceptional radiation resistance and broad temperature capability, these fibers are ideal for applications including spectroscopy, Thomson scattering, and medical diagnostics.




## Specifications

### Step-Index Profile

- **Core/Cladding:** Pure Silica/Fluorine Silica Cladding
- **2nd Cladding (Buffer)/Coating:** Hard Polymer/Tefzel[1]
- **Numerical Aperture (NA):** 0.22 ± 0.02
- **Standard Proof Test:** 70kpsi
- **Minimum Bend Radius:**
  - 100x Clad Radius (Momentary)
  - 300x Clad Radius (Long Term)
- **Laser Damage Threshold:**
  - XeCl 18.0mJ/mm² (200ns pulse) at 308nm
  - XeCl 8.0mJ/mm² (20ns pulse) at 308nm
  - Nd:YAG 5.4J/mm² (1ms pulse) at 1060nm
  - Nd:YAG 1.3kW/mm² (CW) at 1060nm
- **Operating Temperature, Tefzel Coating:**
  -40 to +150°C

1) Polyimide Coated Version Available in Larger Quantities with Temperature Range of -190 to +400°C.

### UV to Visible Transmission (High OH)

| ITEM# | CORE DIAMETER | CLADDING DIAMETER | BUFFER DIAMETER | COATING DIAMETER | STRIPPING TOOL |
|---|---|---|---|---|---|
| BFH22-200 | 200µm±2% | 240µm±2% | 260µm±3% | 400µm±5% | T12S18 |
| BFH22-365 | 365µm±2% | 400µm±2% | 425µm±3% | 730µm±5% | T21S31 |
| BFH22-550 | 550µm±2% | 600µm±2% | 630µm±3% | 1040µm±5% | T28S46 |
| BFH22-910 | 910µm±2% | 1000µm±2% | 1035µm±3% | 1400µm±5% | M44S67 |

### Visible to Near-IR Transmission (Low OH)

| ITEM# | CORE DIAMETER | CLADDING DIAMETER | BUFFER DIAMETER | COATING DIAMETER | STRIPPING TOOL |
|---|---|---|---|---|---|
| BFL22-200 | 200µm±2% | 240µm±2% | 260µm±3% | 400µm±5% | T12S18 |
| BFL22-365 | 365µm±2% | 400µm±2% | 425µm±3% | 730µm±5% | T21S31 |
| BFL22-550 | 550µm±2% | 600µm±2% | 630µm±3% | 1040µm±5% | T28S46 |
| BFL22-910 | 910µm±2% | 1000µm±2% | 1035µm±3% | 1400µm±5% | M44S67 |

### Price Schedule

| ITEM# | $ 1-9m | $ 10-49m | $ 50-249m | £ 1-9m | £ 10-49m | £ 50-249m | € 1-9m | € 10-49m | € 50-249m | RMB 1-9m | RMB 10-49m | RMB 50-249m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BFH22-200 | $ 7.95 | $ 6.55 | $ 4.75 | £ 5.00 | £ 4.15 | £ 3.00 | € 7,40 | € 6,10 | € 4,40 | ¥ 75.90 | ¥ 62.55 | ¥ 45.35 |
| BFH22-365 | $ 15.25 | $ 12.60 | $ 9.15 | £ 9.60 | £ 7.95 | £ 5.75 | € 14,20 | € 11,70 | € 8,50 | ¥ 145.65 | ¥ 120.35 | ¥ 87.40 |
| BFH22-550 | $ 36.70 | $ 28.30 | $ 22.00 | £ 23.10 | £ 17.85 | £ 13.85 | € 34,15 | € 26,30 | € 20,45 | ¥ 350.50 | ¥ 270.25 | ¥ 210.10 |
| BFH22-910 | $ 88.10 | $ 67.85 | $ 52.85 | £ 55.50 | £ 42.75 | £ 33.30 | € 81,95 | € 63,10 | € 49,15 | ¥ 841.35 | ¥ 647.95 | ¥ 504.70 |
| BFL22-200 | $ 7.95 | $ 6.55 | $ 4.80 | £ 5.00 | £ 4.15 | £ 3.00 | € 7,40 | € 6,10 | € 4,45 | ¥ 75.90 | ¥ 62.55 | ¥ 45.85 |
| BFL22-365 | $ 16.70 | $ 13.90 | $ 10.00 | £ 10.50 | £ 8.75 | £ 6.30 | € 15,55 | € 12,95 | € 9,30 | ¥ 159.50 | ¥ 132.75 | ¥ 95.50 |
| BFL22-550 | $ 40.25 | $ 31.00 | $ 24.10 | £ 25.35 | £ 19.55 | £ 15.20 | € 37,45 | € 28,85 | € 22,40 | ¥ 384.40 | ¥ 296.05 | ¥ 230.15 |
| BFL22-910 | $ 96.60 | $ 74.40 | $ 57.90 | £ 60.85 | £ 46.85 | £ 36.50 | € 89,85 | € 69,20 | € 53,85 | ¥ 922.55 | ¥ 710.50 | ¥ 522.95 |

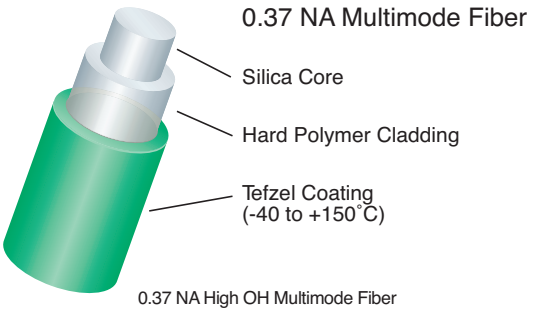
*Call For Quantities Over 250m*

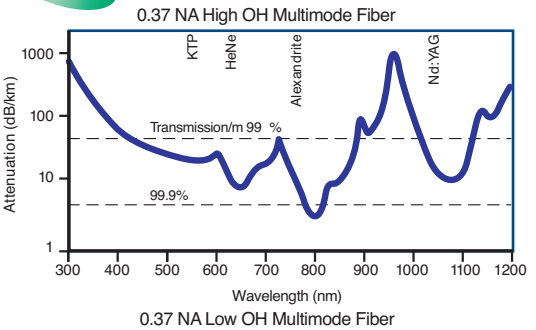
Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

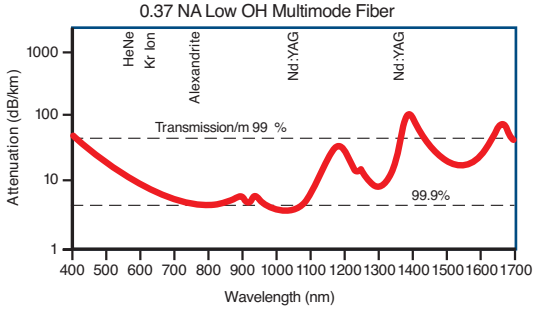
# 0.37 NA Hard Polymer Clad Multimode Fiber

- Broad UV, VIS, and NIR Spectral Range:
  High OH, 300-1200nm
  Low OH, 400-2200nm
- Reduced Static Fatigue, Lower Microbend Losses
- Biocompatible Materials, Radiation Resistance
- Sterilizable by ETO and Other Methods

Our 0.37 NA hard polymer-clad fibers offer high numerical apertures to suit a broad range of applications from remote illumination to photodynamic therapy. This high-quality fiber offers easy termination with no pistoning effect and is an alternative to silica/silica fiber.




## Specifications

**Step-Index Profile**

- **Core:** Pure Silica
- **Cladding:** Hard Polymer Cladding
- **Coating:** Tefzel
- **Numerical Aperture (NA):** 0.37 ± 0.02
- **Standard Proof Test:** 70kpsi
- **Minimum Bend Radius:**
  - 100x Clad Radius (Momentary)
  - 300x Clad Radius (Long Term)
- **Operating Temperature, Tefzel Coating:** -40 to +150°C

### UV to Visible Transmission (High OH)

| ITEM# | CORE DIAMETER | CLADDING DIAMETER | COATING DIAMETER | STRIPPING TOOL |
|---|---|---|---|---|
| BFH37-200 | 200µm±2% | 230µm±2% | 500µm±5% | T12S21 |
| BFH37-300 | 300µm±2% | 330µm±2% | 650µm±5% | T16S31 |
| BFH37-400 | 400µm±2% | 430µm±2% | 730µm±5% | T21S31 |
| BFH37-600 | 600µm±2% | 630µm±2% | 1040µm±5% | T28S46 |
| BFH37-800 | 800µm±2% | 830µm±2% | 1400µm±5% | M37S46 |
| BFH37-1000 | 1000µm±2% | 1035µm±2% | 1400µm±5% | M44S63 |
| BFH37-1200 | 1200µm±2% | 1240µm±2% | 1650µm±5% | M54S76 |
| BFH37-1500 | 1500µm±2% | 1550µm±2% | 2000µm±5% | M63S86 |

### Visible to Near-IR Transmission (Low OH)

| ITEM# | CORE DIAMETER | CLADDING DIAMETER | COATING DIAMETER | STRIPPING TOOL |
|---|---|---|---|---|
| BFL37-200 | 200µm±2% | 230µm±2% | 500µm±5% | T12S21 |
| BFL37-300 | 300µm±2% | 330µm±2% | 650µm±5% | T16S31 |
| BFL37-400 | 400µm±2% | 430µm±2% | 730µm±5% | T21S31 |
| BFL37-600 | 600µm±2% | 630µm±2% | 1040µm±5% | T28S46 |
| BFL37-800 | 800µm±2% | 830µm±2% | 1400µm±5% | M37S46 |
| BFL37-1000 | 1000µm±2% | 1035µm±2% | 1400µm±5% | M44S63 |
| BFL37-1200 | 1200µm±2% | 1240µm±2% | 1650µm±5% | M54S76 |
| BFL37-1500 | 1500µm±2% | 1550µm±2% | 2000µm±5% | M63S86 |

### Price Schedule

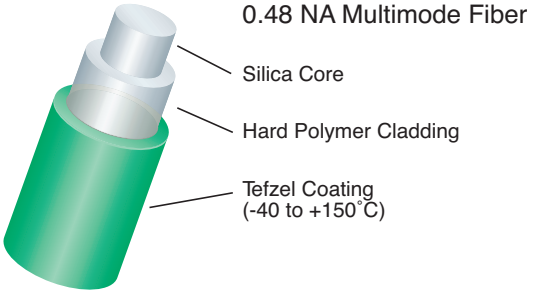
| ITEM# | $ 1-9m | $ 10-49m | $ 50-249m | £ 1-9m | £ 10-49m | £ 50-249m | € 1-9m | € 10-49m | € 50-249m | RMB 1-9m | RMB 10-49m | RMB 50-249m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BFH37-200 | $ 1.45 | $ 1.20 | $ 0.90 | £ 0.90 | £ 0.75 | £ 0.55 | € 1,35 | € 1,10 | € 0,85 | ¥ 13.85 | ¥ 11.45 | ¥ 8.60 |
| BFH37-300 | $ 2.30 | $ 1.95 | $ 1.50 | £ 1.45 | £ 1.25 | £ 0.95 | € 2,15 | € 1,80 | € 1,40 | ¥ 21.95 | ¥ 18.60 | ¥ 14.35 |
| BFH37-400 | $ 3.50 | $ 2.95 | $ 2.15 | £ 2.20 | £ 1.85 | £ 1.35 | € 3,25 | € 2,75 | € 2,00 | ¥ 33.45 | ¥ 28.15 | ¥ 20.55 |
| BFH37-600 | $ 7.40 | $ 6.15 | $ 4.50 | £ 4.65 | £ 3.85 | £ 2.85 | € 6,90 | € 5,70 | € 4,20 | ¥ 70.65 | ¥ 58.75 | ¥ 43.00 |
| BFH37-800 | $ 13.15 | $ 10.95 | $ 7.90 | £ 8.30 | £ 6.90 | £ 5.00 | € 12,25 | € 10,20 | € 7,35 | ¥ 125.60 | ¥ 104.55 | ¥ 75.45 |
| BFH37-1000 | $ 22.40 | $ 18.50 | $ 13.45 | £ 14.10 | £ 11.65 | £ 8.45 | € 20,85 | € 17,20 | € 12,50 | ¥ 213.90 | ¥ 176.70 | ¥ 128.45 |
| BFH37-1200 | $ 67.85 | $ 52.25 | $ 40.70 | £ 42.75 | £ 32.90 | £ 25.65 | € 63,10 | € 48,60 | € 37,85 | ¥ 647.95 | ¥ 499.00 | ¥ 388.70 |
| BFH37-1500 | $ 80.20 | $ 61.80 | $ 48.10 | £ 50.55 | £ 38.95 | £ 30.30 | € 74,60 | € 57,45 | € 44,75 | ¥ 765.90 | ¥ 590.20 | ¥ 459.35 |
| BFL37-200 | $ 1.58 | $ 1.20 | $ 0.90 | £ 1.00 | £ 0.75 | £ 0.55 | € 1,45 | € 1,10 | € 0,85 | ¥ 15.10 | ¥ 11.45 | ¥ 8.60 |
| BFL37-300 | $ 2.45 | $ 2.35 | $ 2.00 | £ 1.55 | £ 1.50 | £ 1.25 | € 2,30 | € 2,20 | € 1,85 | ¥ 23.40 | ¥ 22.45 | ¥ 19.10 |
| BFL37-400 | $ 3.88 | $ 3.25 | $ 2.45 | £ 2.45 | £ 2.05 | £ 1.55 | € 3,60 | € 3,00 | € 2,30 | ¥ 37.05 | ¥ 31.05 | ¥ 23.40 |
| BFL37-600 | $ 8.15 | $ 6.95 | $ 5.05 | £ 5.15 | £ 4.40 | £ 3.20 | € 7,60 | € 6,45 | € 4,70 | ¥ 77.85 | ¥ 66.35 | ¥ 48.25 |
| BFL37-800 | $ 15.45 | $ 12.75 | $ 9.30 | £ 9.75 | £ 8.05 | £ 5.85 | € 14,35 | € 11,85 | € 8,65 | ¥ 147.55 | ¥ 121.75 | ¥ 88.80 |
| BFL37-1000 | $ 26.30 | $ 21.70 | $ 15.80 | £ 16.55 | £ 13.65 | £ 9.95 | € 24,45 | € 20,20 | € 14,70 | ¥ 251.15 | ¥ 207.25 | ¥ 150.90 |
| BFL37-1200 | $ 61.65 | $ 52.25 | $ 39.20 | £ 38.85 | £ 32.90 | £ 24.70 | € 57,35 | € 48,60 | € 36,45 | ¥ 588.75 | ¥ 499.00 | ¥ 374.35 |
| BFL37-1500 | $ 105.00 | $ 80.85 | $ 63.00 | £ 66.15 | £ 50.95 | £ 39.70 | € 97,65 | € 75,20 | € 58,60 | ¥1,002.75 | ¥ 772.10 | ¥ 601.65 |

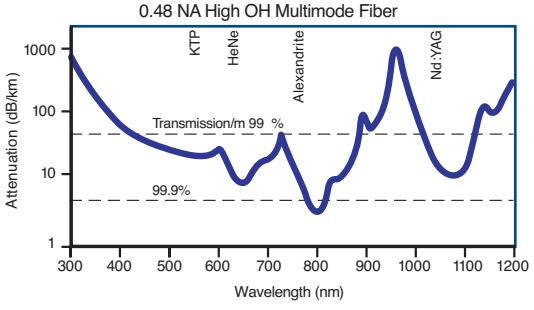
*Call For Quantities Over 250m*

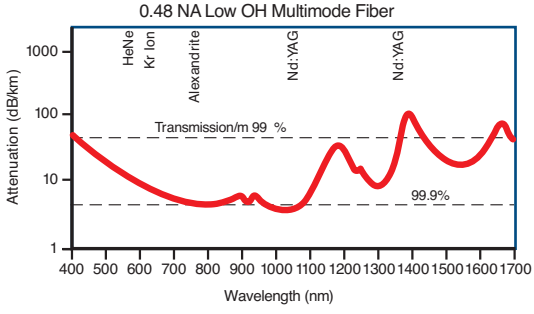
# 0.48 NA Hard Polymer Clad Multimode Fiber

- Broad UV, VIS, and NIR Spectral Range:
  High OH, 300-1200nm
  Low OH, 400-2200nm
- Reduced Static Fatigue, Lower Microbend Losses
- Biocompatible Materials, Radiation Resistance
- Sterilizable by ETO and Other Methods

Our 0.48 NA hard polymer-clad fibers offer high numerical apertures to suit a broad range of applications from remote illumination to photodynamic therapy. This high-quality fiber offers easy termination with no pistoning effect and is an alternative to silica/silica fiber.




## Specifications

**Step-Index Profile**

- **Core:** Pure Silica
- **Cladding:** Hard Polymer Cladding
- **Coating:** Tefzel
- **Numerical Aperture (NA):** 0.48 ± 0.02
- **Standard Proof Test:** 70kpsi
- **Minimum Bend Radius:**
  - 100x Clad Radius (Momentary)
  - 300x Clad Radius (Long Term)
- **Operating Temperature, Tefzel Coating:** -40 to +150°C



See Page 1048

### UV to Visible Transmission (High OH)

| ITEM # | CORE DIAMETER | CLADDING DIAMETER | COATING DIAMETER | STRIPPING TOOL |
|---|---|---|---|---|
| BFH48-200 | 200µm±2% | 230µm±2% | 500µm±5% | T12S21 |
| BFH48-400 | 400µm±2% | 430µm±2% | 730µm±5% | T21S31 |
| BFH48-600 | 600µm±2% | 630µm±2% | 1040µm±5% | T28S46 |
| BFH48-1000 | 1000µm±2% | 1035µm±2% | 1400µm±5% | M44S63 |

### Visible to Near-IR Transmission (Low OH)

| ITEM # | CORE DIAMETER | CLADDING DIAMETER | COATING DIAMETER | STRIPPING TOOL |
|---|---|---|---|---|
| BFL48-200 | 200µm±2% | 230µm±2% | 500µm±5% | T12S21 |
| BFL48-400 | 400µm±2% | 430µm±2% | 730µm±5% | T21S31 |
| BFL48-600 | 600µm±2% | 630µm±2% | 1040µm±5% | T28S46 |
| BFL48-1000 | 1000µm±2% | 1035µm±2% | 1400µm±5% | M44S63 |

### Price Schedule

| ITEM # | $ 1-9m | $ 10-49m | $ 50-249m | £ 1-9m | £ 10-49m | £ 50-249m | € 1-9m | € 10-49m | € 50-249m | RMB 1-9m | RMB 10-49m | RMB50-249m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BFH48-200 | $ 1.75 | $ 1.50 | $ 1.20 | £ 1.10 | £ 0.95 | £ 0.75 | € 1,65 | € 1,40 | € 1,10 | ¥ 16.70 | ¥ 14.35 | ¥ 11.45 |
| BFH48-400 | $ 3.70 | $ 3.05 | $ 2.25 | £ 2.35 | £ 1.90 | £ 1.40 | € 3,45 | € 2,85 | € 2,10 | ¥ 35.35 | ¥ 29.15 | ¥ 21.50 |
| BFH48-600 | $ 8.20 | $ 6.75 | $ 4.90 | £ 5.15 | £ 4.25 | £ 3.10 | € 7,65 | € 6,30 | € 4,55 | ¥ 78.30 | ¥ 64.45 | ¥ 46.80 |
| BFH48-1000 | $ 25.80 | $ 21.30 | $ 15.50 | £ 16.25 | £ 13.40 | £ 9.75 | € 24,00 | € 19,80 | € 14,40 | ¥ 246.40 | ¥ 203.40 | ¥ 148.05 |
| BFL48-200 | $ 1.94 | $ 1.65 | $ 1.20 | £ 1.20 | £ 1.05 | £ 0.75 | € 1,80 | € 1,55 | € 1,10 | ¥ 18.55 | ¥ 15.75 | ¥ 11.45 |
| BFL48-400 | $ 5.45 | $ 4.50 | $ 3.30 | £ 3.45 | £ 2.85 | £ 2.10 | € 5,05 | € 4,20 | € 3,05 | ¥ 52.05 | ¥ 43.00 | ¥ 31.50 |
| BFL48-600 | $ 10.60 | $ 8.80 | $ 6.40 | £ 6.70 | £ 5.55 | £ 4.05 | € 9,85 | € 8,20 | € 5,95 | ¥ 101.25 | ¥ 84.05 | ¥ 61.10 |
| BFL48-1000 | $ 28.80 | $ 23.75 | $ 17.25 | £ 18.50 | £ 14.95 | £ 10.85 | € 26,80 | € 22,10 | € 16,05 | ¥ 275.05 | ¥ 226.80 | ¥ 164.75 |

*Call For Quantities Over 250m*

Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

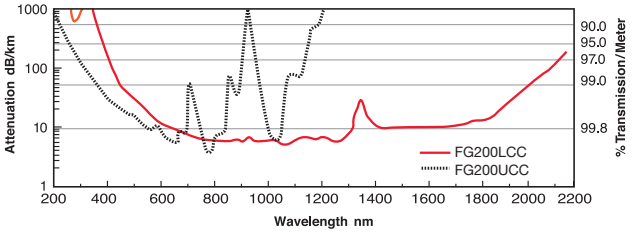
# 0.22 NA TEQS™ Coated Silica/Silica Multimode Fiber

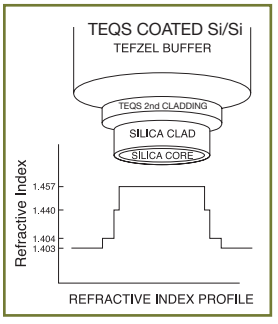
## FG Silica/Silica Multimode Fibers

### Features of Silica/Silica Fiber Construction

- Stability of Silica Cladding Allows for High-Power Handling Capability
- Low-Index Fluorine-Doped Silica Cladding Design Provides Superior UV and Near-IR Transmission
- Secondary Hard Cladding (TEQS) Provides a Dual-Waveguide Design, Resulting in Improved Bend Performance
- Strong Bonding of Silica to (TEQS) Cladding Prevents Pistoning and Provides More Stable Terminations


**No Minimums**




### Visible to Near-IR Transmission (Low OH)

| ITEM# | CORE DIAMETER | CLADDING DIAMETER | BUFFER DIAMETER | COATING DIAMETER | NUMERICAL APERATURE | MAXIMUM POWER CAPABILITY PULSED[1] | MAXIMUM POWER CAPABILITY CW[2] | MAXIMUM CORE OFFSET | BEND RADIUS SHORT TERM LONG TERM | STRIPPING TOOL SEE PAGE 1050 |
|---|---|---|---|---|---|---|---|---|---|---|
| FG200LCC | 200±8µm | 240±5µm | 260±6µm | 400±30µm | 0.22±0.02 | 1.0MW | 0.2kW | 5µm | 9mm/18mm | T12S18 |
| FG273LEC | 273±10µm | 300±6µm | 325±10µm | 430±30µm | 0.22±0.02 | 2.0MW | 0.4kW | 6µm | 12mm/24mm | T12S18 |
| FG365LEC | 365±14µm | 400±8µm | 425±10µm | 730±30µm | 0.22±0.02 | 3.4MW | 0.7kW | 7µm | 16mm/32mm | T21S31 |
| FG550LEC | 550±19µm | 600±15µm | 630±30µm | 1040±30µm | 0.22±0.02 | 7.6MW | 1.5kW | 9µm | 25mm/50mm | T28S46 |

1) Based on 5GW/cm² for 1064nm Nd:YAG laser with 10nsec pulse length and input spot size equal to 80% of the core diameter
2) Based on 1MW/cm² for 1064nm Nd:YAG laser and input spot size equal to 80% of the core diameter

### Price Schedule

| ITEM# | $ 1-9m | $ 10-49m | $ 50-249m | £ 1-9m | £ 10-49m | £ 50-249m | € 1-9m | € 10-49m | € 50-249m | RMB 1-9m | RMB 10-49m | RMB 50-249m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FG200LCC | $ 8.50 | $ 6.90 | $ 5.40 | £ 5.35 | £ 4.35 | £ 3.40 | € 7,90 | € 6,40 | € 5,00 | ¥ 81.20 | ¥ 65.90 | ¥ 51.55 |
| FG273LEC | $ 11.80 | $ 9.70 | $ 7.55 | £ 7.45 | £ 6.10 | £ 4.75 | € 10,95 | € 9,00 | € 7,00 | ¥ 112.70 | ¥ 92.65 | ¥ 72.10 |
| FG365LEC | $ 22.60 | $ 18.50 | $ 14.35 | £ 14.25 | £ 11.65 | £ 9.05 | € 21,00 | € 17,20 | € 13,35 | ¥ 215.35 | ¥ 176.70 | ¥ 137.05 |
| FG550LEC | $ 38.90 | $ 31.75 | $ 24.80 | £ 24.50 | £ 20.00 | £ 15.60 | € 36,20 | € 29,55 | € 23,05 | ¥ 371.50 | ¥ 303.20 | ¥ 236.85 |

*Call For Quantities Over 250m*

### UV to Visible Transmission (High OH)

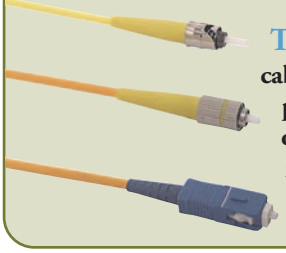
| ITEM# | CORE DIAMETER | CLADDING DIAMETER | BUFFER DIAMETER | COATING DIAMETER | NUMERICAL APERATURE | MAXIMUM POWER CAPABILITY PULSED | MAXIMUM POWER CAPABILITY CW | MAXIMUM CORE OFFSET | BEND RADIUS SHORT TERM/ LONG TERM | STRIPPING TOOL SEE PAGE 1050 |
|---|---|---|---|---|---|---|---|---|---|---|
| FG200UCC | 200±8µm | 240±5µm | 260±6µm | 400±30µm | 0.22±0.02 | 1.0MW | 0.2kW | 5µm | 9mm/18mm | T12S18 |
| FG365UEC | 365±14µm | 400±8µm | 425±10µm | 730±30µm | 0.22±0.02 | 3.4MW | 0.7kW | 7µm | 12mm/24mm | T21S31 |
| FG550UEC | 550±19µm | 600±15µm | 630±30µm | 1040±30µm | 0.22±0.02 | 7.6MW | 1.5kW | 9µm | 25mm/50mm | T28S46 |

### Price Schedule

| ITEM# | $ 1-9m | $ 10-49m | $ 50-249m | £ 1-9m | £ 10-49m | £ 50-249m | € 1-9m | € 10-49m | € 50-249m | RMB 1-9m | RMB 10-49m | RMB 50-249m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FG200UCC | $ 9.40 | $ 7.65 | $ 5.90 | £ 5.90 | £ 4.80 | £ 3.70 | € 8,75 | € 7,10 | € 5,50 | ¥ 89.75 | ¥ 73.05 | ¥ 56.35 |
| FG365UEC | $ 22.60 | $ 18.50 | $ 14.35 | £ 14.25 | £ 11.65 | £ 9.05 | € 21,00 | € 17,20 | € 13,35 | ¥ 215.85 | ¥ 176.70 | ¥ 137.05 |
| FG550UEC | $ 33.20 | $ 29.80 | $ 23.20 | £ 20.90 | £ 18.75 | £ 14.60 | € 30,90 | € 27,70 | € 21,60 | ¥ 317.05 | ¥ 284.60 | ¥ 221.55 |

*Call For Quantities Over 250m*

## Custom Patch Cables



**Thorlabs is pleased to offer next-day shipping service for small lots of custom patch cables assembled using our standard fibers. We stock many of our more popular fibers with protective jacketing in bulk, allowing us to assemble custom length patch cables within one day when requested. Additionally, we stock the largest selection of single mode and multimode optical fibers in the photonics industry.**

For details contact technical support at techsupport@thorlabs.com.

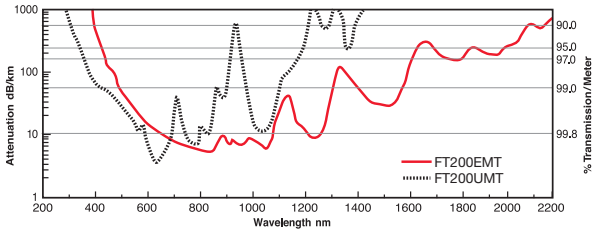
# 0.39 NA TEQS™ Clad Multimode Fiber

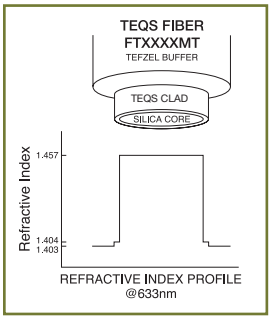
## FT Silica/TEQS™ Multimode Fibers

### Features

- Hard Cladding Increases Fiber Strength, Reduces Static Fatigue in Humid Environments, and Protects the Fiber During Buffer Stripping to Prevent Fiber Breakage
- Efficient Light Coupling and Superior Transmission in Tight Bends Due to High Numerical Aperture
- High Core-to-clad Bonding Prevents Pistoning and Provides More Stable Crimp-and-Cleave or Epoxy Terminations
- High Concentricity and Core-to-Clad Ratio for Excellent Connection Alignment, Fiber Core Positioning and High Transmission Bundles
- TEQS Cladding is Removable with Acetone


**No Minimums**




### Visible to Near-IR Transmission (Low OH)

| ITEM# | CORE DIAMETER | CLADDING DIAMETER | COATING DIAMETER | NUMERICAL APERATURE | MAXIMUM POWER CAPABILITY PULSED[1] | MAXIMUM POWER CAPABILITY CW[2] | MAXIMUM ATTENUATION @850nm[3] | MAXIMUM CORE OFFSET | BEND RADIUS SHORT TERM/ LONG TERM | STRIPPING TOOL SEE PAGE 1050 |
|---|---|---|---|---|---|---|---|---|---|---|
| FT200EMT | 200±5µm | 225±5µm | 500±30µm | 0.39±0.02 | 1.0MW | 0.2kW | 6dB/km | 5µm | 6mm/12mm | T12S21 |
| FT300EMT | 300±6µm | 325±10µm | 650±30µm | 0.39±0.02 | 2.3MW | 0.5kW | 10dB/km | 7µm | 12mm/24mm | T16S31 |
| FT400EMT | 400±8µm | 425±10µm | 730±30µm | 0.39±0.02 | 4.0MW | 0.8kW | 10dB/km | 7µm | 16mm/32mm | T21S31 |
| FT600EMT | 600±10µm | 630±10µm | 1040±30µm | 0.39±0.02 | 9.0MW | 1.8kW | 10dB/km | 9µm | 25mm/50mm | T28S46 |
| FT800EMT | 800±10µm | 830±10µm | 1040±30µm | 0.39±0.02 | 16MW | 3.2kW | 10dB/km | 10µm | 30mm/60mm | M37S46 |
| FT1.0EMT | 1000±15µm | 1035±15µm | 1400±50µm | 0.39±0.02 | 25MW | 5.0kW | 10dB/km | 10µm | 40mm/80mm | M44S63 |
| FT1.5EMT | 1500±30µm | 1550±31µm | 2000±100µm | 0.39±0.02 | 56MW | 11.0kW | 18dB/km | 15µm | 50mm/100mm | M63S86 |

### Price Schedule

| ITEM# | $ 1-9m | $ 10-49m | $ 50-249m | £ 1-9m | £ 10-49m | £ 50-249m | € 1-9m | € 10-49m | € 50-249m | ¥ 1-9m | ¥ 10-49m | ¥ 50-249m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FT200EMT | $ 1.60 | $ 1.35 | $ 1.05 | £ 1.00 | £ 0.85 | £ 0.65 | € 1,50 | € 1,25 | € 1,00 | ¥ 15.30 | ¥ 12.90 | ¥ 10.05 |
| FT300EMT | $ 1.80 | $ 1.85 | $ 1.40 | £ 1.15 | £ 1.15 | £ 0.90 | € 1,65 | € 1,70 | € 1,30 | ¥ 17.20 | ¥ 17.65 | ¥ 13.35 |
| FT400EMT | $ 3.20 | $ 2.55 | $ 1.90 | £ 2.00 | £ 1.60 | £ 1.20 | € 3,00 | € 2,35 | € 1,75 | ¥ 30.55 | ¥ 24.35 | ¥ 18.15 |
| FT600EMT | $ 6.50 | $ 5.35 | $ 4.15 | £ 4.10 | £ 3.35 | £ 2.60 | € 6,05 | € 5,00 | € 3,85 | ¥ 62.10 | ¥ 51.10 | ¥ 39.65 |
| FT800EMT | $ 13.40 | $ 10.55 | $ 8.50 | £ 8.45 | £ 6.65 | £ 5.35 | € 12,45 | € 9,80 | € 7,90 | ¥ 127.95 | ¥ 100.75 | ¥ 81.20 |
| FT1.0EMT | $ 23.70 | $ 25.50 | $ 19.15 | £ 14.95 | £ 16.05 | £ 12.05 | € 22,05 | € 23,70 | € 17,80 | ¥ 226.35 | ¥ 243.55 | ¥ 182.90 |
| FT1.5MT | $ 74.40 | $ 60.70 | $ 47.35 | £ 46.85 | £ 38.25 | £ 29.85 | € 69,20 | € 56,45 | € 44,05 | ¥ 710.50 | ¥ 579.70 | ¥ 452.20 |

*Call For Quantities Over 250m*

### UV to Visible Transmission (High OH)

| ITEM# | CORE DIAMETER | CLADDING DIAMETER | COATING DIAMETER | NUMERICAL APERATURE | MAXIMUM POWER CAPABILITY PULSED[1] | MAXIMUM POWER CAPABILITY CW[2] | MAXIMUM ATTENUATION @850nm[3] | MAXIMUM CORE OFFSET | BEND RADIUS SHORT TERM/ LONG TERM | STRIPPING TOOL SEE PAGE 1050 |
|---|---|---|---|---|---|---|---|---|---|---|
| FT200UMT | 200±5µm | 225±5µm | 500±30µm | 0.39±0.02 | 1.0MW | 0.2kW | 12dB/km | 5µm | 6mm/12mm | T12S21 |
| FT300UMT | 300±6µm | 325±10µm | 650±30µm | 0.39±0.02 | 2.3MW | 0.5kW | 12dB/km | 7µm | 12mm/24mm | T16S31 |
| FT400UMT | 400±8µm | 425±10µm | 730±30µm | 0.39±0.02 | 4.0MW | 0.8kW | 12dB/km | 7µm | 16mm/32mm | T21S31 |
| FT600UMT | 600±10µm | 630±10µm | 1040±30µm | 0.39±0.02 | 9.0MW | 1.8kW | 12dB/km | 9µm | 25mm/50mm | T28S52 |
| FT800UMT | 800±10µm | 830±10µm | 1040±30µm | 0.39±0.02 | 16MW | 3.2kW | 12dB/km | 10µm | 30mm/60mm | M37S46 |
| FT1.0UMT | 1000±15µm | 1035±15µm | 1400±50µm | 0.39±0.02 | 25MW | 5.0kW | 12dB/km | 10µm | 40mm/80mm | M44S63 |
| FT1.5UMT | 1500±30µm | 1550±31µm | 2000±100µm | 0.39±0.02 | 56MW | 11.3kW | 18dB/km | 15µm | 50mm/100mm | M63S86 |

### Price Schedule

| ITEM# | $ 1-9m | $ 10-49m | $ 50-249m | £ 1-9m | £ 10-49m | £ 50-249m | € 1-9m | € 10-49m | € 50-249m | ¥ 1-9m | ¥ 10-49m | ¥ 50-249m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FT200UMT | $ 1.60 | $ 1.35 | $ 1.05 | £ 1.00 | £ 0.85 | £ 0.65 | € 1,50 | € 1,25 | € 1,00 | ¥ 15.30 | ¥ 12.90 | ¥ 10.05 |
| FT300UMT | $ 2.10 | $ 1.75 | $ 1.30 | £ 1.30 | £ 1.10 | £ 0.80 | € 1,95 | € 1,65 | € 1,20 | ¥ 20.05 | ¥ 16.70 | ¥ 12.40 |
| FT400UMT | $ 3.50 | $ 2.85 | $ 2.25 | £ 2.20 | £ 1.80 | £ 1.40 | € 3,25 | € 2,65 | € 2,10 | ¥ 33.45 | ¥ 27.20 | ¥ 21.50 |
| FT600UMT | $ 7.40 | $ 6.05 | $ 4.65 | £ 4.65 | £ 3.80 | £ 2.95 | € 6,90 | € 5,65 | € 4,30 | ¥ 70.65 | ¥ 57.20 | ¥ 44.40 |
| FT800UMT | $ 13.60 | $ 11.10 | $ 8.70 | £ 8.55 | £ 7.00 | £ 5.50 | € 12,65 | € 10,30 | € 8,10 | ¥ 129.90 | ¥ 106.00 | ¥ 83.10 |
| FT1.0UMT | $ 24.00 | $ 19.60 | $ 15.30 | £ 15.10 | £ 12.35 | £ 9.65 | € 22,30 | € 18,25 | € 14,25 | ¥ 229.20 | ¥ 187.20 | ¥ 146.10 |
| FT1.5UMT | $ 81.70 | $ 66.80 | $ 52.00 | £ 51.45 | £ 42.10 | £ 32.75 | € 76,00 | € 62,10 | € 48,35 | ¥ 780.25 | ¥ 637.95 | ¥ 496.60 |

1) Based on 5GW/cm² for 1064nm Nd:YAG laser with 10nsec pulse length and input spot size equal to 80% of the core diameter

2) Based on 1MW/cm² for 1064nm Nd:YAG laser and input spot size equal to 80% of the core diameter

3) Typical attenuation at 850nm is 4 to 6dB/km, but may be as high as 10dB/km

*Call For Quantities Over 250m*

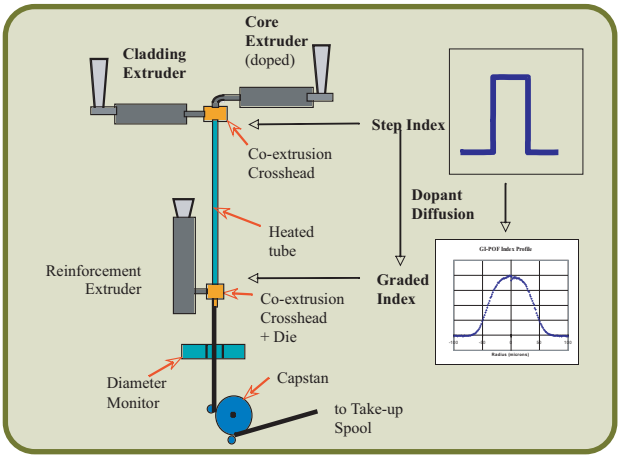
Passive Components
Collimation Packages
FiberBench
Optical Switches
Rackbox Systems
Connectors/ Termination Tools
Single-Mode Fiber
Rare Earth Doped
Polarization Maintaining Fiber
Photonic Crystal Fiber
Multimode Fiber: Graded Index
Multimode Fiber: Step Index
Plastic Optical Fiber

# Graded-Index Polymer Optical Fiber (GI-POF)

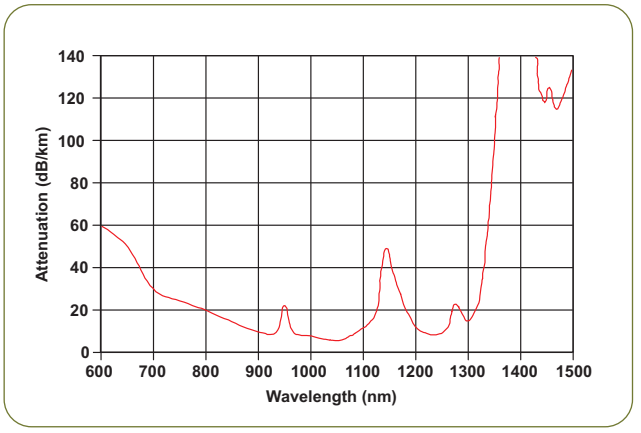
Perfluorinated graded-index polymer optical fibers (GI-POFs) combine high data transmission rates and low attenuation in the commercially desirable 850–1300nm range. GI-POFs offer a direct replacement and a low cost alternative to traditional glass. With ease of use and affordability, GI-POFs make an excellent choice for the installation of high performance fiber networks. In addition, GI-POFs provide a higher transmission bandwidth than any other type of plastic optical fiber.

Until recently, all commercially available POFs have been fabricated from non-fluorinated polymers such as polymethylmethacrylate (PMMA) and, as a result, have had a refractive index that changes in steps. Although inexpensive, these fibers are characterized by large modal dispersion and typically operate at 530nm or 650nm, which is well outside of standard communication wavelengths (850nm or 1300nm), which is where high-speed transceivers are readily available. Due to the high attenuation in the near infrared, these fibers are restricted to low performance (<100Mb/s), short range (<50m) applications in the visible region.

With the advent of an amorphous perfluorinated polymer, polyperfluoro-butenylvinylether (commercially known as CYTOP®), the limitations presented by step-index POFs have been overcome. Perfluorinated fiber exhibits very low attenuation in the near infrared (~10dB/km) as shown in the figure above and to the right and can support transmission rates up to 10Gb/s for distances up to 100m. Moreover, since the perfluorinated optical fiber can be constructed with a graded refractive index, it is capable of supporting bandwidths that are 100 times larger than those provided by conventional POFs. This is due to the interplay between high mode coupling, low material dispersion, and differential mode attenuation.




Unlike conventional glass fibers, which suffer from high interconnection and receiver costs, perfluorinated GI-POFs are easy to install. To add a connector to a glass fiber, the fiber needs to be cleaved using an expensive, specialized tool. Then, epoxy is used to attach the fiber to the connector hardware. Finally, the assembled connector must be polished. In contrast, the GI-POF can be terminated using simple and inexpensive tools, connectors are crimped on, and polishing occurs in mere seconds, leading to a high quality optical link in a fraction of the time. Moreover, GI-POFs are compatible with standard multimode glass fiber




transceivers.

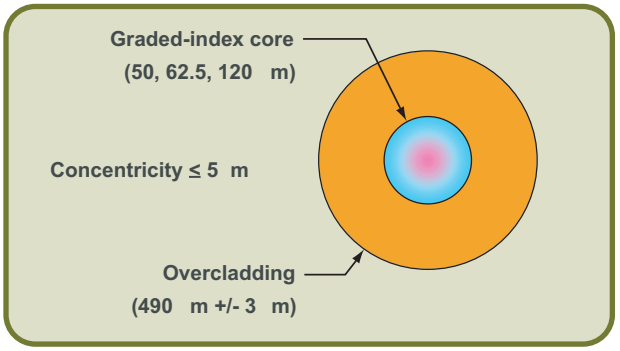
Next-Generation GI-POFs:

Thorlabs is pleased to offer a line of graded-index polymer optical fibers from Chromis Fiberoptics, a pioneer in plastic optical fiber technology and a world leader in perfluorinated GI-POFs. Unlike conventional preform-based manufacturing processes for GI-POFs, Chromis' patented manufacturing process extrudes fibers directly from bulk materials, resulting in high production rates at unmatched prices.

+ Cross-section of extruded perfluorinated GI-POF with an overclad (reinforcement) layer.

In order to produce GI-POFs with the properties necessary to meet the demands of high performance applications, two major hurdles needed to be overcome. First, a technique needed to be developed to produce a high-quality, graded-index structure consistently. Second, the high purity of the perfluorinated material needed to be maintained during the extrusion process so that attenuation levels below 30dB/m could be achieved.

Chromis' extrusion technology continuously converts high purity bulk materials into concentric layers of melt streams. As the melt streams are extruded into fiber, the concentric layers fuse to form the graded-index fiber. By controlling the temperature, residence times, and relative flow rates of the core and clad materials, fibers with a wide variety of dimensions and refractive index structures can be formed. By altering the polymer material used in the melt, specialty fibers, such as those used in high temperature or flame-retardant applications, can be produced using the same process.



# Plastic Optical Fibers

Thorlabs now offers a line of graded-index polymer optical fibers (GI-POFs) from Chromis Fiberoptics. These multimode fibers offer low attenuation and low material dispersion, thus allowing for high-speed Gigabit Ethernet and multi-gigabit applications at distances up to 100 meters or Fast Ethernet up to 200 meters. These fibers feature the ease of use associated with plastic fibers while providing the low loss, low dispersion, and good transmission characteristics typical of glass fibers at 850nm and 1300nm. In addition, these fibers can sustain long-term bending radii that are as small as 5mm, which is much better than glass fibers of the same core size. GI-POF fiber is simple to terminate and the end face can be polished quickly to produce a low-loss connection. The GI-POF fibers do not require special adapters in order to mate them with like core sized glass equivalent devices. As a result, GI-POF fibers are a direct drop-in glass fiber replacement alternative with a significant cost advantage.


## Product Specifications

| | 50SR | 62SR | 120SR |
|---|---|---|---|
| Transmission Characteristics | | | |
| Attenuation at 850nm | <60dB/km | | |
| Attenuation at 1300nm | <60dB/km | | |
| Bandwidth at 850nm | >300MHz-km | | |
| Numerical Aperture | 0.190 ± 0.015 | 0.190 ± 0.015 | 0.185 ± 0.015 |
| Macrobend Loss1 | <0.25dB | <0.35dB | <0.60dB |
| Zero Dispersion Wavelength | 1200-1650nm | | |
| Dispersion Slope | <0.06ps/nm2-km | | |
| Physical Characteristics | | | |
| Core Diameter | 50 ± 5µm | 62.5 ± 5µm | 120 ± 10µm |
| Cladding Diameter | 490 ± 5µm | | |
| Core-Cladding Concentricity | <4µm | <5µm | <5µm |
| Maximum Tensile Load | 7.0N | | |
| Bending Radius, Long Term | 5mm | 5mm | 10mm |
| Environmental Performance | | | |
| Temperature Induced Attenuation at 850nm (-20 to +70°C) | <5dB/km | | |
| Temperature Induced Attenuation at 850nm (75°C, 85% RH, 30 Day Cycle) | <10dB/km | | |

1) for 10 turns on a 25mm radius quarter circle

## Plastic Optical Fiber

| ITEM# | $ | £ | € | RMB | CORE SIZE | DESCRIPTION |
|---|---|---|---|---|---|---|
| GIPOF50 | $ 1.26 | £ 0.79 | € 1,17 | ¥ 12.03 | 50µm | GI-POF, Price per Meter |
| GIPOF62 | $ 1.48 | £ 0.93 | € 1,38 | ¥ 14.13 | 62.5µm | GI-POF, Price per Meter |
| GIPOF120 | $ 1.82 | £ 1.15 | € 1,69 | ¥ 17.38 | 120µm | GI-POF, Price per Meter |

## Jacketed Plastic Optical Fiber

| ITEM# | $ | £ | € | RMB | CORE SIZE | DESCRIPTION |
|---|---|---|---|---|---|---|
| GIPOF50-P | $ 1.74 | £ 1.10 | € 1,62 | ¥ 16.62 | 50µm Core | GI-POF, Plenum Cable Jacket, Price per Meter |
| GIPOF62-P | $ 1.96 | £ 1.23 | € 1,82 | ¥ 18.72 | 62.5µm Core | GI-POF, Plenum Cable Jacket, Price per Meter |
| GIPOF120-P | $ 2.30 | £ 1.45 | € 2,14 | ¥ 21.97 | 120µm Core | GI-POF, Plenum Cable Jacket, Price per Meter |