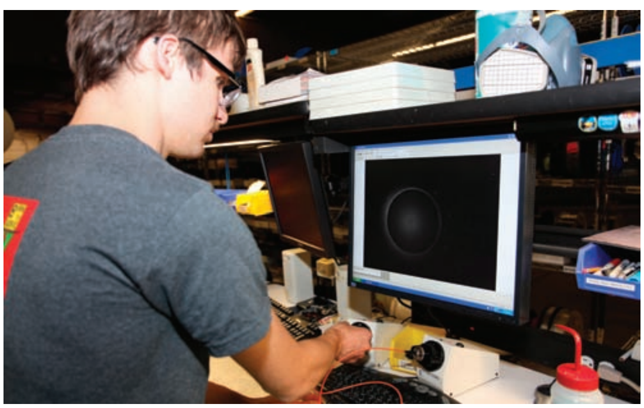
Fiber Manufacturing

Thorlabs' Bare Fiber on a Spool

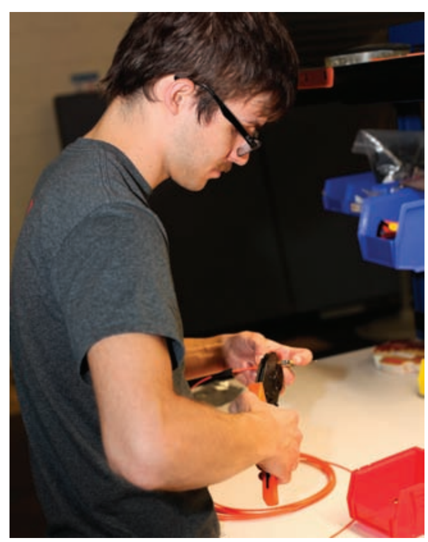
Thorlabs has extensive bare fiber, patch cable, and fiber optic component manufacturing capabilities. Using our fiber draw towers, we produce a range of fibers, which are a part of Thorlabs' industry-leading selection of bare fiber that is kept in stock. Our broad selection of fiber coupled with our efficient patch cable manufacturing process allows us to provide same-day service on most custom patch cables. In addition to bare fiber and patch cables, we manufacture fiber components including optical isolators, couplers, and over 150 collimators. We welcome the opportunity to create customized fiber optic solutions for customers through our broad manufacturing capabilities.


One of Thorlabs' Fiber Draw Towers

- Fiber Draw Towers for Bare Fiber Manufacturing
- Same-Day Turnaround on Most Custom Patch Cables
- Passive Fiber Components
- Largest Selection of Stocked Fibers in Industry


Inspecting a Fiber After Polishing

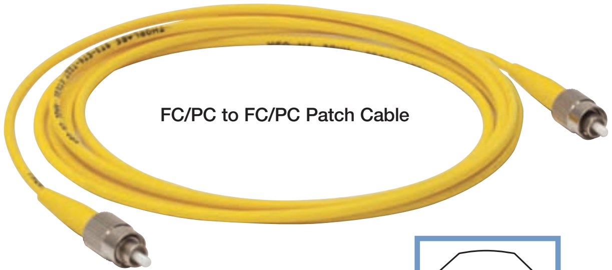

Spooling Fiber

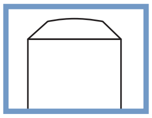

Connectorizing a Patch Cable Prior to Polishing

Fiber
Selection Guide

Fiber Patch Cables Selection Guide

Single Mode Patch Cables: FC/PC to FC/PC




FC/PC

Features

- FC/PC Connectors with 2 mm Narrow Keys on Both Ends
- Options for Transmission from 305 to 2100 nm
- Insertion Loss: 0.3 dB (Typical)
- Return Loss: 50 dB (Typical)
- Ø3 mm Yellow Furcation Tubing
- Length Tolerance
  - +7.5/-0 cm (1, 2, or 5 m)
  - +50/-0 cm (10 m)
- Custom Cables Available with Same-Day Turnaround


See pages 1138 - 1139

These are our stock single mode fiber patch cables with FC connectors and PC polishes on both ends. Each cable is manufactured at our facility on state-of-the-art equipment. We individually test each cable to ensure low back reflection (high return loss) at fiber-to-fiber junctions. All of the cables on this page feature Ø3 mm furcation tubing, which provides Kevlar threads within the tubing to protect the fiber optic.

If you do not see an FC/PC to FC/PC single mode patch cable suitable for your application here, please contact your local Thorlabs office or visit www.thorlabs.com/customcable.

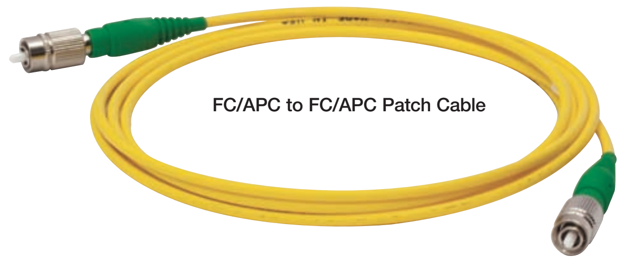
	ITEM #	OPERATING λ	CUTOFF λ	MFD[b]	CLAD	NA[c]	FIBER	L[d]	$	£	€	RMB
NEW	P1-305A-FC-1	305 – 450 nm	<300 nm	1.9 µm @ 305 nm 3.0 um @ 450 nm	Ø125 µm	0.13	SM300 (Page 1020)	1 m	$ 76.00	£ 54.72	€ 66,12	¥ 605.72
NEW	P1-305A-FC-2							2 m	$ 92.00	£ 66.24	€ 80,04	¥ 733.24
	P1-405A-FC-1	400 – 550 nm	350 – 390 nm	3.2 µm @ 460 nm	Ø125 µm	0.12	S405-HP (Page 1020)	1 m	$ 71.00	£ 51.12	€ 61,77	¥ 565.87
	P1-405A-FC-2							2 m	$ 80.00	£ 57.60	€ 69,60	¥ 637.60
	P1-405A-FC-5							5 m	$ 94.30	£ 67.90	€ 82,04	¥ 751.57
NEW	P1-460A-FC-1	450 – 600 nm	410 – 450 nm	3.5 µm @ 515 nm	Ø125 µm	0.13	460HP (Page 1020)	1 m	$ 70.00	£ 50.40	€ 60,90	¥ 557.90
	P1-460A-FC-2							2 m	$ 77.00	£ 55.44	€ 66,99	¥ 613.69
	P1-460A-FC-5							5 m	$ 94.30	£ 67.90	€ 82,04	¥ 751.57
NEW	P1-630A-FC-1	600 – 800 nm[a]	500 – 600 nm	4.3 µm @ 633 nm	Ø125 µm	0.12	SM600 (Page 1021)	1 m	$ 62.00	£ 44.64	€ 53,94	¥ 494.14
	P1-630A-FC-2							2 m	$ 67.00	£ 48.24	€ 58,29	¥ 533.99
	P1-630A-FC-5							5 m	$ 80.40	£ 57.89	€ 69,95	¥ 640.79
	P1-630A-FC-10							10 m	$ 108.50	£ 78.12	€ 94,40	¥ 864.75
NEW	P1-780A-FC-1	780 – 970 nm	700 – 760 nm	5.0 µm @ 850 nm	Ø125 µm	0.13	780HP (Page 1021)	1 m	$ 78.00	£ 56.16	€ 67,86	¥ 621.66
	P1-780A-FC-2							2 m	$ 88.00	£ 63.36	€ 76,56	¥ 701.36
	P1-780A-FC-5							5 m	$ 103.33	£ 74.40	€ 89,90	¥ 823.54
NEW	P1-830A-FC-1	800 – 1000 nm[a]	660 – 800 nm	5.6 µm @ 830 nm	Ø125 µm	0.12	SM800-5.6-125 (Page 1021)	1 m	$ 59.10	£ 42.55	€ 51,42	¥ 471.03
	P1-830A-FC-2							2 m	$ 64.10	£ 46.15	€ 55,77	¥ 510.88
	P1-830A-FC-5							5 m	$ 74.40	£ 53.57	€ 64,73	¥ 592.97
	P1-830A-FC-10							10 m	$ 97.70	£ 70.34	€ 85,00	¥ 778.67
NEW	P1-980A-FC-1	970 – 1650 nm[a]	870 – 970 nm	5.8 µm @ 980 nm 6.2 µm @ 1064 nm 10.4 µm @ 1550 nm	Ø125 µm	0.14	SM980-5.8-125 (Page 1022)	1 m	$ 60.10	£ 43.27	€ 52,29	¥ 479.00
	P1-980A-FC-2							2 m	$ 65.10	£ 46.87	€ 56,64	¥ 518.85
	P1-980A-FC-5							5 m	$ 76.50	£ 55.08	€ 66,56	¥ 609.71
NEW	P1-SMF28E-FC-1	1260 – 1625 nm	<1260 nm	9.2 µm @ 1310 nm	Ø125 µm	0.14	SMF-28e+ (Page 1023)	1 m	$ 38.90	£ 28.01	€ 33,84	¥ 310.03
	P1-SMF28E-FC-2							2 m	$ 39.60	£ 28.51	€ 34,45	¥ 315.61
	P1-SMF28E-FC-5							5 m	$ 40.80	£ 29.38	€ 35,50	¥ 325.18
	P1-SMF28E-FC-10							10 m	$ 52.50	£ 37.80	€ 45,68	¥ 418.43
NEW	P1-1550A-FC-1	1460 – 1620 nm	1350 – 1450 nm	9.5 µm @ 1550 nm	Ø125 µm	0.13	1550BHP (Page 1023)	1 m	$ 68.70	£ 49.46	€ 59,77	¥ 547.54
	P1-1550A-FC-2							2 m	$ 73.70	£ 53.06	€ 64,12	¥ 587.39
	P1-1550A-FC-5							5 m	$ 94.30	£ 67.90	€ 82,04	¥ 751.57
	P1-1550A-FC-10							10 m	$ 138.00	£ 99.36	€ 120,06	¥1,099.86
NEW	P1-2000-FC-1	1700 – 2100 nm	<1700 nm	13 µm @ 1996 nm	Ø125 µm	0.11	SM2000 (Page 1024)	1 m	$ 74.00	£ 53.28	€ 64,38	¥ 589.78
NEW	P1-2000-FC-2							2 m	$ 85.00	£ 61.20	€ 73,95	¥ 677.45

[a]The wavelength range given is an estimate and is not tested & guaranteed for the fiber. [b]Mode Field Diameter, Nominal [c]Numerical Aperture, Nominal [d]Length

Single Mode Patch Cables: FC/APC to FC/APC

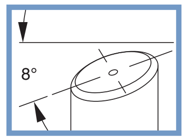
Features

- FC/APC Connectors with 2 mm Narrow Keys on Both Ends
- Options for Transmission from 305 to 2100 nm
- Insertion Loss
  - 0.2 dB (Typical)
- Ø3 mm Yellow Furcation Tubing
- Return Loss
  - 60 dB (Typical)
- Length Tolerance
  - +7.5/-0 cm
- Custom Cables Available with Same-Day Turnaround



FC/APC to FC/APC Patch Cable

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



FC/APC

These are our stock single mode fiber patch cables with FC connectors and APC polishes on both ends. Each cable is manufactured at our facility on state-of-the-art equipment. We individually test each cable to ensure low back reflection (high return loss) at fiber-to-fiber junctions. All of the cables on this page feature Ø3 mm furcation tubing, which provides Kevlar threads within the tubing to protect the fiber optic.

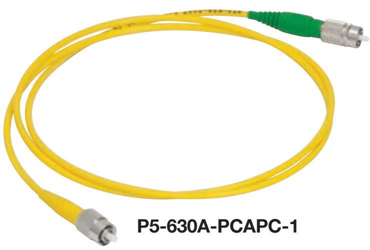
If you do not see an FC/APC to FC/APC single mode patch cable suitable for your application here, please contact your local Thorlabs office or visit www.thorlabs.com/customcable.

ITEM #	OPERATING λ	CUTOFF λ	MFD[b]	CLAD	NA[c]	FIBER	L[d]	$	£	€	RMB	
P3-305A-FC-1	305 – 450 nm	<300 nm	1.9 µm @ 305 nm 3.0 um @ 450 nm	Ø125 µm	0.13	SM300 (Page 1020)	1 m	$ 100.00	£ 72.00	€ 87,00	¥ 797.00	NEW
P3-405A-FC-1	400 – 550 nm	350 – 390 nm	3.2 µm @ 460 nm	Ø125 µm	0.12	S405-HP (Page 1020)	1 m	$ 93.70	£ 67.46	€ 81,52	¥ 746.79	NEW
P3-405A-FC-2							2 m	$ 100.00	£ 72.00	€ 87,00	¥ 797.00	NEW
P3-405A-FC-5							5 m	$ 114.00	£ 82.08	€ 99,18	¥ 908.58	NEW
P3-460A-FC-1	450 – 600 nm	410 – 450 nm	3.5 µm @ 515 nm	Ø125 µm	0.13	460HP (Page 1020)	1 m	$ 90.00	£ 64.80	€ 78,30	¥ 717.30	NEW
P3-460A-FC-2							2 m	$ 97.00	£ 69.84	€ 84,39	¥ 773.09	
P3-460A-FC-5							5 m	$ 114.00	£ 82.08	€ 99,18	¥ 908.58	
P3-630A-FC-1	600 – 800 nm[a]	500 – 600 nm	4.3 µm @ 633 nm	Ø125 µm	0.12	SM600 (Page 1021)	1 m	$ 82.00	£ 59.04	€ 71,34	¥ 653.54	NEW
P3-630A-FC-2							2 m	$ 87.00	£ 62.64	€ 75,69	¥ 693.39	
P3-630A-FC-5							5 m	$ 100.00	£ 72.00	€ 87,00	¥ 797.00	
P3-780A-FC-2	780 – 970 nm	700 – 760 nm	5.0 µm @ 850 nm	Ø125 µm	0.13	780HP (Page 1021)	2 m	$ 108.00	£ 77.76	€ 93,96	¥ 860.76	NEW
P3-780A-FC-5							5 m	$ 123.00	£ 88.56	€ 107,01	¥ 980.31	NEW
P3-830A-FC-1	800 – 1000 nm[a]	660 – 800 nm	5.6 µm @ 830 nm	Ø125 µm	0.12	SM800-5.6-125 (Page 1021)	1 m	$ 79.00	£ 56.88	€ 68,73	¥ 629.63	NEW
P3-830A-FC-2							2 m	$ 84.00	£ 60.48	€ 73,08	¥ 669.48	
P3-830A-FC-5							5 m	$ 94.00	£ 67.68	€ 81,78	¥ 749.18	
P3-980A-FC-1	970 – 1650 nm[a]	870 – 970 nm	5.8 µm @ 980 nm 6.2 µm @ 1064 nm 10.4 µm @ 1550 nm	Ø125 µm	0.14	SM980-5.8-125 (Page 1022)	1 m	$ 80.00	£ 57.60	€ 69,60	¥ 637.60	NEW
P3-980A-FC-2							2 m	$ 85.00	£ 61.20	€ 73,95	¥ 677.45	
P3-980A-FC-5							5 m	$ 96.00	£ 69.12	€ 83,52	¥ 765.12	NEW
P3-SMF28E-FC-1	1260 – 1625 nm	<1260 nm	9.2 µm @ 1310 nm	Ø125 µm	0.14	SMF-28e+ (Page 1023)	1 m	$ 58.90	£ 42.41	€ 51,24	¥ 469.43	NEW
P3-SMF28E-FC-2							2 m	$ 59.60	£ 42.91	€ 51,85	¥ 475.01	NEW
P3-SMF28E-FC-5							5 m	$ 60.80	£ 43.78	€ 52,90	¥ 484.58	NEW
P3-1550A-FC-1	1460 – 1620 nm	1350 – 1450 nm	9.5 µm @ 1550 nm	Ø125 µm	0.13	1550BHP (Page 1023)	1 m	$ 46.60	£ 33.55	€ 40,54	¥ 371.40	NEW
P3-1550A-FC-2							2 m	$ 93.00	£ 66.96	€ 80,91	¥ 741.21	
P3-1550A-FC-5							5 m	$ 114.00	£ 82.08	€ 99,18	¥ 908.58	
P3-2000-FC-2	1700 – 2100 nm	<1700 nm	13 µm @ 1996 nm	Ø125 µm	0.11	SM2000 (Page 1024)	2 m	$ 105.00	£ 75.60	€ 91,35	¥ 836.85	NEW

[a]The wavelength range given is an estimate and is not tested & guaranteed for the fiber. [b]Mode Field Diameter, Nominal [c]Numerical Aperture, Nominal [d]Length

Single Mode Patch Cables: FC/PC to FC/APC

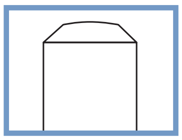
NEW products



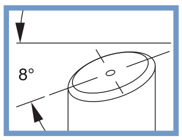
P5-630A-PCAPC-1

Features

- 2 mm Narrow Keys
- Options for Transmission from 305 – 2100 nm
- Ø3 mm Yellow Furcation Tubing
- Insertion Loss
  - FC/PC: 0.3 dB (Typical)
  - FC/APC: 0.2 dB (Typical)
- Return Loss
  - FC/PC: 50 dB (Typical)
  - FC/APC: 60 dB (Typical)
- Length Tolerance: +7.5/-0 cm
- Custom Cables Available with Same-Day Turnaround



FC/PC



FC/APC

These are our stock single mode fiber patch cables with an FC/PC connector on one end and an FC/APC connector on the other end. Each cable is manufactured at our facility on state-of-the-art equipment. We individually test each cable to ensure low back reflection (high return loss) at fiber-to-fiber junctions. All of the cables feature Ø3 mm furcation tubing with Kevlar threads within the tubing to protect the fiber optic.

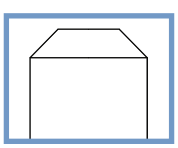
If you do not see a hybrid single mode patch cable suitable for your application here, please contact your local Thorlabs office or visit www.thorlabs.com/customcable.

FC/PC to FC/APC Hybrid Cables

ITEM #	OPERATING λ	CUTOFF λ	MFD[b]	CLAD	NA[c]	FIBER	L[d]	$	£	€	RMB
P5-305A-PCAPC-1	305 – 450 nm	<300 nm	1.9 µm @ 305 nm 3.0 um @ 450 nm	Ø125 µm	0.13	SM300 (Page 1020)	1 m	$ 90.00	£ 64.80	€ 78,30	¥ 717.30
P5-405A-PCAPC-1	400 – 550 nm	350 – 390 nm	3.2 µm @ 460 nm	Ø125 µm	0.12	S405-HP (Page 1020)	1 m	$ 83.70	£ 60.26	€ 72,82	¥ 667.09
P5-460A-PCAPC-1	450 – 600 nm	410 – 450 nm	3.5 µm @ 515 nm	Ø125 µm	0.13	460HP (Page 1020)	1 m	$ 80.70	£ 58.10	€ 70,21	¥ 643.18
P5-630A-PCAPC-1	600 – 800 nm[a]	500 – 600 nm	4.3 µm @ 633 nm	Ø125 µm	0.12	SM600 (Page 1021)	1 m	$ 72.00	£ 51.84	€ 62,64	¥ 573.84
P5-780A-PCAPC-1	780 – 970 nm	700 – 760 nm	5.0 µm @ 850 nm	Ø125 µm	0.13	780HP (Page 1021)	1 m	$ 88.00	£ 63.36	€ 76,56	¥ 701.36
P5-830A-PCAPC-1	800 – 1000 nm[a]	660 – 800 nm	5.6 µm @ 830 nm	Ø125 µm	0.12	SM800-5.6-125 (Page 1021)	1 m	$ 69.10	£ 49.75	€ 60,12	¥ 550.73
P5-980A-PCAPC-1	970 – 1650 nm[a]	870 – 970 nm	5.8 µm @ 980 nm 6.2 µm @ 1064 nm 10.4 µm @ 1550 nm	Ø125 µm	0.14	SM980-5.8-125 (Page 1022)	1 m	$ 70.10	£ 50.47	€ 60,99	¥ 558.70
P5-SMF28E-FC-1	1260 – 1625 nm	<1260 nm	9.2 µm @ 1310 nm	Ø125 µm	0.14	SMF-28e+ (Page 1023)	1 m	$ 48.90	£ 35.21	€ 42,54	¥ 389.73
P5-SMF28E-FC-2							2 m	$ 49.60	£ 35.71	€ 43,15	¥ 395.31
P5-SMF28E-FC-5							5 m	$ 50.80	£ 36.58	€ 44,20	¥ 404.88
P5-2000-PCAPC-1	1700 – 2100 nm	<1700 nm	13 µm @ 1996 nm	Ø125 µm	0.11	SM2000 (Page 1024)	1 m	$ 83.00	£ 59.76	€ 72,21	¥ 661.51

[a]The wavelength range given is an estimate and is not tested & guaranteed for the fiber. [b]Mode Field Diameter, Nominal [c]Numerical Aperture, Nominal [d]Length

Single Mode Patch Cables: FC/PC to SMA



SMA

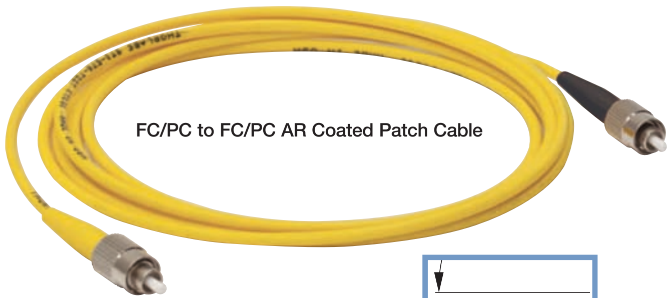
- 2 mm Narrow Keys
- Options for Transmission from 633 – 1650 nm
- Ø3 mm Yellow Furcation Tubing
- FC/PC Insertion Loss: 0.3 dB (Typical)
- FC/PC Return Loss: 50 dB (Typical)
- Length Tolerance: +7.5/-0 cm

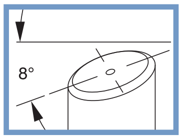
FC/PC to SMA Hybrid Cables

ITEM #	OPERATING λ	CUTOFF λ	MFD[b]	CLAD	NA[c]	FIBER	L[d]	$	£	€	RMB
NEW P2-630A-PCSMA-1	633 – 680 nm	550 ± 50 nm	4.3 µm @ 633 nm	Ø125 µm	0.10 - 0.14	SM600 (Page 1021)	1 m	$ 72.80	£ 52.42	€ 63,34	¥ 580.22
NEW P2-980A-PCSMA-1	970 – 1650 nm[a]	870 – 970 nm	5.8 µm @ 980 nm 6.2 µm @ 1064 nm 10.4 µm @ 1550 nm	Ø125 µm	0.13 - 0.15	SM980-5.8-125 (Page 1022)	1 m	$ 72.80	£ 52.42	€ 63,34	¥ 580.22

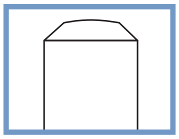
[a]The wavelength range given an is estimate and is not tested & guaranteed for the fiber. [b]Mode Field Diameter, Nominal [c]Numerical Aperture, Nominal [d]Length

Single Mode Patch Cables: AR Coated





FC/APC


FC/PC

NEW products

Features

- Ideal for Fiber to Free-Space Applications
- One AR-Coated FC/PC Connector Maximizes Return Loss
- One FC/PC or FC/APC Uncoated Connector
- Connectors Feature 2 mm Narrow Keys
- SMF-28e+ Fiber
- AR Coating: R < 0.5% at One of Two Wavelengths
  - 1310 ± 100 nm
  - 1550 ± 100 nm
- Ø3 mm Yellow Furcation Tubing
- Insertion Loss
  - FC/PC: 0.3 dB (Typical)
  - FC/APC: 0.2 dB (Typical)
- Return Loss (Fiber-to-Fiber Uncoated Connector)
  - FC/APC: 60 dB (Typical)
- Length Tolerance: +7.5/-0 cm

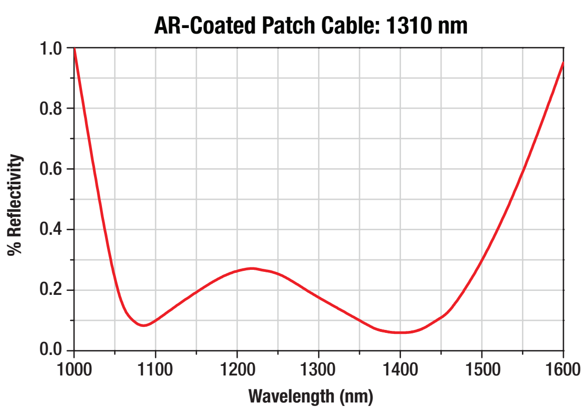
These are our stock AR-coated fiber patch cables with an AR coated FC/PC connector on one end and either an uncoated FC/PC or FC/APC connector on the other end. The FC/PC connector with the black boot is AR coated for either 1310 nm or 1550 nm, making these cables ideal for fiber to free-space applications. The other connector is uncoated. Note that the AR-coated end is meant for free-space applications (e.g., collimation) and will be damaged if it comes into contact with another connector tip. All of the cables on this page feature Ø3 mm furcation tubing, which provides Kevlar threads within the tubing to protect the fiber optic.

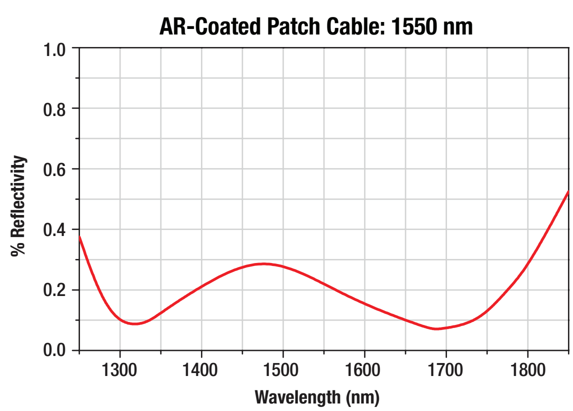
Fiber to Free-Space Return Loss Example

The P1-SMF28E-1-15 has an AR coating centered at 1550 nm. From the typical 1550 nm AR coating plot below, the reflectivity of the connectorized end at 1550 nm is 0.22%. Hence

Return Loss = 10log(1/0.0022)

This results in a return loss of 26.6 dB at 1550 nm. In comparison, an uncoated FC/PC fiber would have a return loss of approximately 14.0 dB.

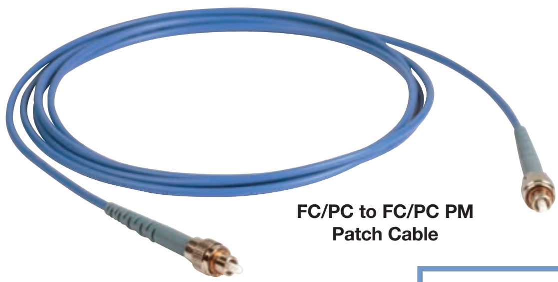




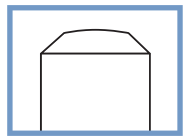
FIBER	OPERATING λ	CUTOFF λ	MFD	CLADDING	NA
SMF-28e+ (Page 1023)	1260 – 1620 nm	<1260 nm	9.2 ± 0.4 µm (@1310 nm) 10.4 ± 0.5 µm (@1550 nm)	125 ± 0.7 µm	0.14

ITEM #	AR COATING	AR-COATED CONNECTOR	CONNECTOR	UNCOATED LENGTH	$	£	€	RMB
P1-SMF28E-FC-1-13	1310 nm	FC/PC	FC/PC	1 m	$ 88.00	£ 63.36	€ 76,56	¥ 701.36
P1-SMF28E-FC-1-15	1550 nm	FC/PC	FC/PC	1 m	$ 88.00	£ 63.36	€ 76,56	¥ 701.36
P5-SMF28E-FC-1-13	1310 nm	FC/PC	FC/APC	1 m	$ 93.30	£ 67.18	€ 81,17	¥ 743.60
P5-SMF28E-FC-1-15	1550 nm	FC/PC	FC/APC	1 m	$ 93.30	£ 67.18	€ 81,17	¥ 743.60

Polarization-Maintaining Patch Cables: FC/PC to FC/PC



FC/PC to FC/PC PM Patch Cable



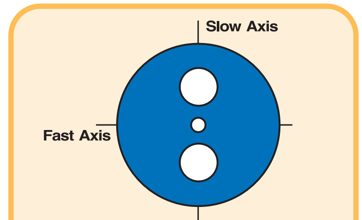
FC/PC

Features

- FC/PC Connectors with 2 mm Narrow Keys on Both Ends
- Options for Transmission from 460 to 1625 nm
- Panda Style Fibers with Connector Key Aligned to Slow Axis
- Ø3 mm Blue Furcation Tubing
- Return Loss: 50 dB (Typ.)
- Length Tolerance: ±0.1 m
- Polarization Axis to Key Tolerance: ±3º
- Cladding: Ø125 µm
- NA: 0.12

These are our stock polarization-maintaining (PM) fiber patch cables with FC connectors and PC polishes on both ends. Each cable is manufactured at our facility on state-of-the-art equipment and is individually tested to ensure its polarization extinction ratio and low back reflection (high return loss) at fiber-to-fiber junctions. All of the cables on this page feature Ø3 mm furcation tubing, which provides Kevlar threads within the tubing to protect the fiber optic.

If you do not see an FC/PC to FC/PC polarization-maintaining patch cable suitable for your application here, please contact your local Thorlabs office or visit www.thorlabs.com/customcable.



Panda PM Fiber Cross Section

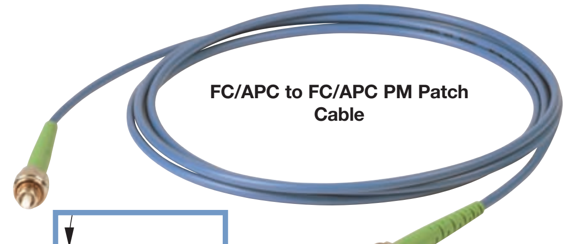
ITEM #	OPERATING λ	TEST λ	MFD[a]	FIBER	ER[b]	IL[c]	L[d]	$	£	€	RMB
P1-488PM-FC-2	460 – 700 nm	488 nm	3.3 µm @ 515 nm	PM460-HP (Page 1028)	18 dB	1.5 dB	2 m	$ 198.00	£ 142.56	€ 172,26	¥1,578.06
P1-488PM-FC-5							5 m	$ 292.00	£ 210.24	€ 254,04	¥2,327.24
P1-630PM-FC-2	620 – 820 nm	630 nm	4.5 µm @ 630 nm	PM630-HP (Page 1028)	20 dB	1.2 dB	2 m	$ 157.00	£ 113.04	€ 136,59	¥1,251.29
P1-630PM-FC-5							5 m	$ 221.00	£ 159.12	€ 192,27	¥1,761.37
P1-780PM-FC-2	770 – 1100 nm	780 nm	5.3 µm @ 850 nm	PM780-HP (Page 1028)	20 dB	1.0 dB	2 m	$ 138.00	£ 99.36	€ 120,06	¥1,099.86
P1-780PM-FC-5							5 m	$ 198.00	£ 142.56	€ 172,26	¥1,578.06
P1-980PM-FC-2	970 – 1550 nm	980 nm	6.6 µm @ 980 nm	PM980-XP (Page 1029)	22 dB	0.7 dB	2 m	$ 144.00	£ 103.68	€ 125,28	¥1,147.68
P1-980PM-FC-5							5 m	$ 213.00	£ 153.36	€ 185,31	¥1,697.61
P1-1064PM-FC-2	970 – 1550 nm	1064 nm	7.2 µm @ 1064 nm	PM980-XP (Page 1029)	22 dB	0.7 dB	2 m	$ 144.00	£ 103.68	€ 125,28	¥1,147.68
P1-1064PM-FC-5							5 m	$ 213.00	£ 153.36	€ 185,31	¥1,697.61
P1-1310PM-FC-2	1270 – 1625 nm	1310 nm	9.5 µm @ 1300 nm	PM1300-HP (Page 1029)	23 dB	0.5 dB	2 m	$ 144.00	£ 103.68	€ 125,28	¥1,147.68
P1-1310PM-FC-5							5 m	$ 213.00	£ 153.36	€ 185,31	¥1,697.61
P1-1550PM-FC-2	1440 – 1625 nm	1550 nm	10.5 µm @ 1550 nm	PM1550-HP (Page 1029)	23 dB	0.5 dB	2 m	$ 144.00	£ 103.68	€ 125,28	¥1,147.68
P1-1550PM-FC-5							5 m	$ 213.00	£ 153.36	€ 185,31	¥1,697.61

[a] Mode Field Diameter, Nominal [b] Minimum Extinction Ratio at Test Wavelength [c] Maximum Insertion Loss at Test Wavelength [d] Length

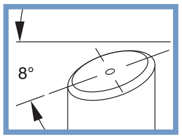
Polarization-Maintaining Patch Cables: FC/APC to FC/APC

Features

- FC/APC Connectors with 2 mm Narrow Keys on Both Ends
- Options for Transmission from 460 to 1625 nm
- Panda Style Fibers with Connector Key Aligned to Slow Axis
- Ø3 mm Blue Furcation Tubing
- Return Loss: 60 dB (Typ.)
- Length Tolerance: ±0.1 m
- Polarization Axis to Key Tolerance: ±3°
- Cladding: Ø125 µm
- NA: 0.12



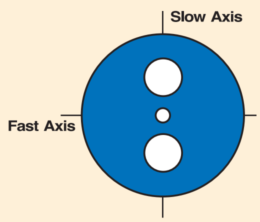
$$\text{Return Loss} = 10\,\text{Log}\left(\frac{P_{In}}{P_{Back}}\right)$$



FC/APC

These are our stock polarization-maintaining (PM) fiber patch cables with FC connectors and APC polishes on both ends. Each cable is manufactured at our facility on state-of-the-art equipment and is individually tested to ensure its polarization extinction ratio and low back reflection (high return loss) at fiber-to-fiber junctions. All of the cables on this page feature Ø3 mm furcation tubing, which provides Kevlar threads within the tubing to protect the fiber optic.

If you do not see an FC/APC to FC/APC polarization-maintaining patch cable suitable for your application here, please contact your local Thorlabs office or visit www.thorlabs.com/customcable.



Panda PM Fiber Cross Section

ITEM #	OPERATING λ	TEST λ	MFD[a]	FIBER	ER[b]	IL[c]	L[d]	$	£	€	RMB
P3-488PM-FC-2	460 – 700 nm	488 nm	3.3 µm @ 515 nm	PM460-HP (Page 1028)	18 dB	1.5 dB	2 m	$ 218.00	£ 156.96	€ 189,66	¥1,737.46
P3-488PM-FC-5							5 m	$ 310.00	£ 223.20	€ 269,70	¥2,470.70
P3-630PM-FC-2	620 – 820 nm	630 nm	4.5 µm @ 630 nm	PM630-HP (Page 1028)	20 dB	1.2 dB	2 m	$ 189.00	£ 136.08	€ 164,43	¥1,506.33
P3-630PM-FC-5							5 m	$ 253.00	£ 182.16	€ 220,11	¥2,016.41
P3-780PM-FC-2	770 – 1100 nm	780 nm	5.3 µm @ 850 nm	PM780-HP (Page 1028)	20 dB	1.0 dB	2 m	$ 169.00	£ 121.68	€ 147,03	¥1,346.93
P3-780PM-FC-5							5 m	$ 229.00	£ 164.88	€ 199,23	¥1,825.13
P3-980PM-FC-2	970 – 1550 nm	980 nm	6.6 µm @ 980 nm	PM980-XP (Page 1029)	22 dB	0.7 dB	2 m	$ 176.00	£ 126.72	€ 153,12	¥1,402.72
P3-980PM-FC-5							5 m	$ 244.00	£ 175.68	€ 212,28	¥1,944.68
P3-1064PM-FC-2	970 – 1550 nm	1064 nm	7.2 µm @ 1064 nm	PM980-XP (Page 1029)	22 dB	0.7 dB	2 m	$ 176.00	£ 126.72	€ 153,12	¥1,402.72
P3-1064PM-FC-5							5 m	$ 244.00	£ 175.68	€ 212,28	¥1,944.68
P3-1310PM-FC-2	1270 – 1625 nm	1310 nm	9.5 µm @ 1300 nm	PM1300-HP (Page 1029)	23 dB	0.5 dB	2 m	$ 166.00	£ 119.52	€ 144,42	¥1,323.02
P3-1310PM-FC-5							5 m	$ 220.00	£ 158.40	€ 191,40	¥1,753.40
P3-1550PM-FC-2	1440 – 1625 nm	1550 nm	10.5 µm @ 1550 nm	PM1550-HP (Page 1029)	23 dB	0.5 dB	2 m	$ 176.00	£ 126.72	€ 153,12	¥1,402.72
P3-1550PM-FC-5							5 m	$ 244.00	£ 175.68	€ 212,28	¥1,944.68

[a]Mode Field Diameter, Nominal [b]Minimum Extinction Ratio at Test Wavelength [c] Maximum Insertion Loss at Test Wavelength [d]Length

For more details, see pages 1120 - 1129

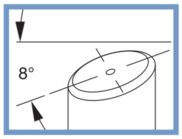
Polarization-Maintaining Patch Cables: FC/PC to FC/APC

FC/PC to FC/APC PM Patch Cable

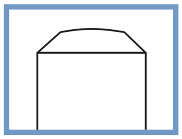
Features

- FC/PC to FC/APC Cables with 2 mm Narrow Key Connectors
- Options for Transmission from 460 to 1620 nm
- Panda Style Fibers with Connector Key Aligned to Slow Axis
- Ø3 mm Blue Furcation Tubing
- Return Loss: 60 dB (Typ.)
- Length Tolerance: ±0.1 m
- Polarization Axis to Key Tolerance: ±3º
- Cladding: Ø125 µm
- NA: 0.12

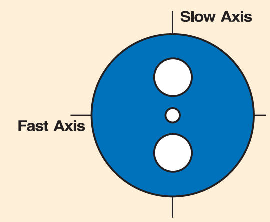
Return Loss = $10 \text{ Log}\left(\frac{P_{In}}{P_{Back}}\right)$



FC/APC



FC/PC



Panda PM Fiber Cross Section

These are our stock polarization-maintaining (PM) fiber patch cables with an FC/PC connector on one end and an FC/APC connector on the other end. Each cable is manufactured at our facility on state-of-the-art equipment and is individually tested to ensure its polarization extinction ratio and low back reflection (high return loss) at fiber-to-fiber junctions. All of the cables on this page feature Ø3 mm furcation tubing, which provides Kevlar threads within the tubing to protect the fiber optic.

If you do not see an FC/PC to FC/APC polarization-maintaining patch cable suitable for your application here, please contact your local Thorlabs office or visit www.thorlabs.com/customcable.

ITEM #	OPERATING λ	TEST λ	MFD[a]	FIBER	ER[b]	IL[c]	L[d]	$	£	€	RMB
P5-488PM-FC-2	460 – 700 nm	488 nm	3.3 µm @ 515 nm	PM460-HP (Page 1028)	18 dB	1.5 dB	2 m	$ 213.00	£ 153.36	€ 185,31	¥1,697.61
P5-630PM-FC-2	620 – 820 nm	630 nm	4.5 µm @ 630 nm	PM630-HP (Page 1028)	20 dB	1.2 dB	2 m	$ 173.00	£ 124.56	€ 150,51	¥1,378.81
P5-780PM-FC-2	770 – 1100 nm	780 nm	5.3 µm @ 850 nm	PM780-HP (Page 1028)	20 dB	1.0 dB	2 m	$ 154.00	£ 110.88	€ 133,98	¥1,227.38
P5-780PM-FC-5							5 m	$ 213.00	£ 153.36	€ 185,31	¥1,697.61
P5-980PM-FC-2	970 – 1550 nm	980 nm	6.6 µm @ 980 nm	PM980-XP (Page 1029)	22 dB	0.7 dB	2 m	$ 160.00	£ 115.20	€ 139,20	¥1,275.20
P5-1064PM-FC-2	970 – 1550 nm	1064 nm	7.2 µm @ 1064 nm	PM980-XP (Page 1029)	22 dB	0.7 dB	2 m	$ 160.00	£ 115.20	€ 139,20	¥1,275.20
P5-1310PM-FC-2	1270 – 1625 nm	1310 nm	9.5 µm @ 1300 nm	PM1300-HP (Page 1029)	23 dB	0.5 dB	2 m	$ 155.00	£ 111.60	€ 134,85	¥1,235.35
P5-1550PM-FC-2	1440 – 1625 nm	1550 nm	10.5 µm @ 1550 nm	PM1550-HP (Page 1029)	23 dB	0.5 dB	2 m	$ 160.00	£ 115.20	€ 139,20	¥1,275.20

[a]Mode Field Diameter, Nominal [b]Minimum Extinction Ratio at Test Wavelength [c] Maximum Insertion Loss at Test Wavelength [d]Length

High-Power Multimode Patch Cables: SMA to SMA

NEW products

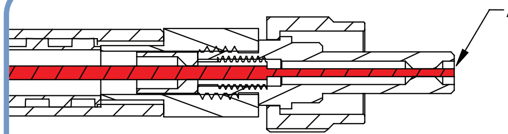
- Utilize Air-Gap-Ferrule Technology
- Damage Threshold for CW Application is up to 50 W or 50 kW/cm² @ 980 nm, Whichever is Less*
- Low OH Fiber with 0.22 NA
- Operating Wavelength Range: 350 - 2500 nm
- SMA 905 Style Connectors with Stainless Steel Ferrules
- Polished End Face
- Epoxy Free

*The damage threshold on these assemblies will vary based on launch conditions and operating wavelength.

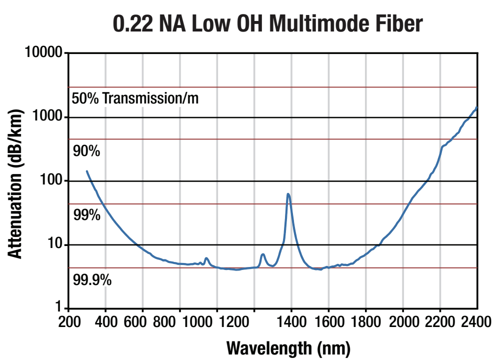
These High-Power SMA Patch Cables utilize air-gap-ferrule technology that eliminates energy-absorbing materials near the fiber end face such as epoxies, connector materials, and coatings, making them ideal for high-power applications. The connector ferrules, which are fabricated from stainless steel but can also be made from beryllium, copper, or a customer-specified material, are used as a heat sink, quickly pulling the heat away from the fiber. The damage threshold on these assemblies will vary with launch conditions and operating wavelength.

Each cable assembly goes through several inspections during the fabrication process, which include extensive material and optical inspection. The extensive inspections begin prior to production and continue throughout the entire production cycle, leading to an exceptional product.

There are some special considerations to keep in mind when handling high power cables. Please visit our website for specific handling guidelines.



The drawing above is a cross section of the SMA connector used with our high-power multimode patch cables. The air-gap ferrule avoids epoxy, which limits the power handling of the fiber.



NOTE: Before utilizing this product, the user should determine the suitability of the product for its intended use. The user assumes all risks and liability with such use. The proper operation and handling of these devices is imperative to prevent damage of the product and all related equipment. Thorlabs is not responsible for any damage incurred due to improper use.

ITEM #	CORE	CLADDING	BUFFER	COATING	NA	FIBER	L*	$	£	€	RMB
M200L02	Ø200 µm ± 2%	Ø240 µm ± 2%	Ø260 µm ± 3%	Ø400 µm ± 5%	0.22 ± 0.2	BFL22-200	2 m	$ 257.00	£ 185.04	€ 223,59	¥ 2,048.29
M365L02	Ø365 µm ± 2%	Ø400 µm ± 2%	Ø425µm ± 3%	Ø730 µm ± 5%	0.22 ± 0.2	BFL22-365	2 m	$ 273.00	£ 196.56	€ 237,51	¥ 2,175.81
M550L02	Ø550 µm ± 2%	Ø550 µm ± 2%	Ø630 µm ± 3%	Ø1040 µm ± 5%	0.22 ± 0.2	BFL22-550	2 m	$ 320.20	£ 230.54	€ 278,57	¥ 2,551.99

*Length

See page 1156

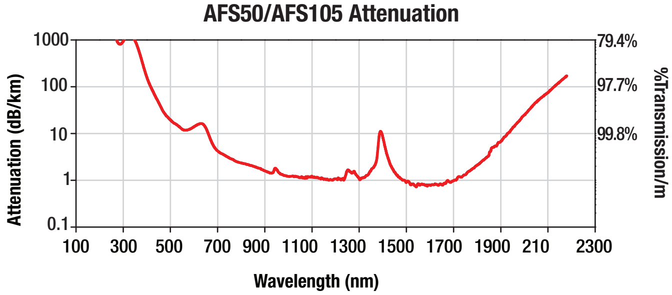
Multimode Patch Cables: SMA to SMA

M28L01

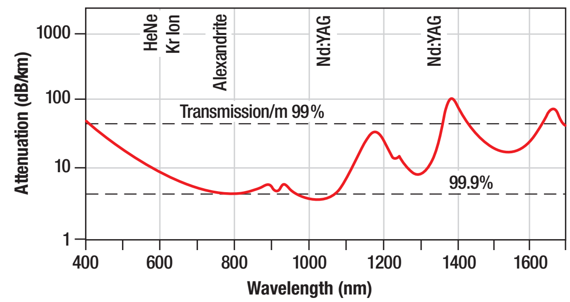
Features

- Shipped from Stock
- SMA 905 Connectors on Both Ends
- Step-Index Multimode Fiber
- Ø3 mm or Ø3.8 mm Reinforced Outer Jacket
- Custom Cables Available with Same-Day Turnaround

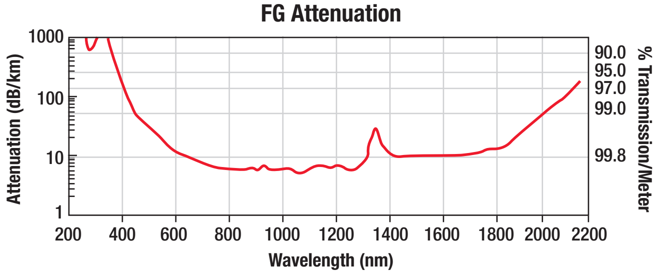
AFS50/AFS105 Attenuation



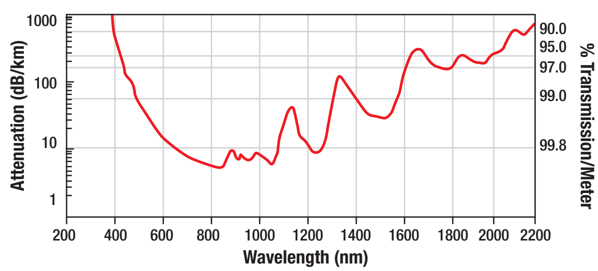
BFL48 Attenuation



FG Attenuation



FT Attenuation



ITEM #	CORE	NA	LENGTH	$	£	€	RMB	STBR[a]	LTBR[b]	FIBER	JACKET[c]
M14L01	Ø50 µm	0.22	1 m	$ 45.50	£ 32.76	€ 39,59	¥ 362.64	12 mm	24 mm	AFS50/125Y (Page 1057)	FT030
M14L02			2 m	$ 51.70	£ 37.22	€ 44,98	¥ 412.05				
M14L05			5 m	$ 70.10	£ 50.47	€ 60,99	¥ 558.70				
M15L01	Ø105 µm	0.22	1 m	$ 48.10	£ 34.63	€ 41,85	¥ 383.36	12 mm	24 mm	AFS105/125Y (Page 1057)	FT030
M15L02			2 m	$ 52.90	£ 38.09	€ 46,02	¥ 421.61				
M15L05			5 m	$ 67.80	£ 48.82	€ 58,99	¥ 540.37				
M25L01	Ø200 µm	0.22	1 m	$ 84.00	£ 60.48	€ 73,08	¥ 669.48	9 mm	18 mm	FG200LCC (Page 1058)	FT030
M25L02			2 m	$ 90.00	£ 64.80	€ 78,30	¥ 717.30				
M25L05			5 m	$ 108.00	£ 77.76	€ 93,96	¥ 860.76				
M38L01	Ø200 µm	0.39	1 m	$ 62.90	£ 45.29	€ 54,72	¥ 501.31	9 mm	18 mm	FT200EMT (Page 1061)	FT030
M38L02			2 m	$ 65.70	£ 47.30	€ 57,16	¥ 523.63				
M28L01	Ø400 µm	0.39	1 m	$ 80.00	£ 57.60	€ 69,60	¥ 637.60	20 mm	40 mm	FT400EMT (Page 1061)	FT030
M28L02			2 m	$ 85.00	£ 61.20	€ 73,95	¥ 677.45				
M28L05			5 m	$ 97.00	£ 69.84	€ 84,39	¥ 773.09				
M40L01	Ø400 µm	0.48	1 m	$ 64.90	£ 46.73	€ 56,46	¥ 517.25	22 mm	65 mm	BFL48-400 (Page 1062)	FT030
M40L02			2 m	$ 69.70	£ 50.18	€ 60,64	¥ 555.51				
NEW M37L01	Ø550 µm	0.39	1 m	$ 93.60	£ 67.39	€ 81,43	¥ 745.99	30 mm	60 mm	FG550LEC (Page 1058)	FT038
NEW M37L02			2 m	$ 136.00	£ 97.92	€ 118,32	¥1,083.92				
M29L01	Ø600 µm	0.39	1 m	$ 89.00	£ 64.08	€ 77,43	¥ 709.33	30 mm	60 mm	FT600EMT (Page 1061)	FT038
M29L02			2 m	$ 99.00	£ 71.28	€ 86,13	¥ 789.03				
M29L05			5 m	$ 108.00	£ 77.76	€ 93,96	¥ 860.76				
M41L01	Ø600 µm	0.48	1 m	$ 68.60	£ 49.39	€ 59,68	¥ 546.74	32 mm	95 mm	BFL48-600 (Page 1062)	FT038
M41L02			2 m	$ 77.10	£ 55.51	€ 67,08	¥ 614.49				
NEW M35L01	Ø1000 µm	0.39	1 m	$ 83.20	£ 59.90	€ 72,38	¥ 663.10	50 mm	100 mm	FT1000EMT (Page 1061)	FT038
NEW M35L02			2 m	$ 106.40	£ 76.61	€ 92,57	¥ 848.01				

[a]Short-Term Bend Radius [b]Long-Term Bend Radius [c]See Page 1151

Multimode Patch Cables: SMA to SMA Solarization-Resistant

NEW products

These patch cables are similar to our other multimode SMA to SMA patch cables but incorporate solarization-resistant fiber. Solarization refers to the formation of color centers within a fiber that lead to transmission degradation. These color centers form when exposed to light below 300 nm.

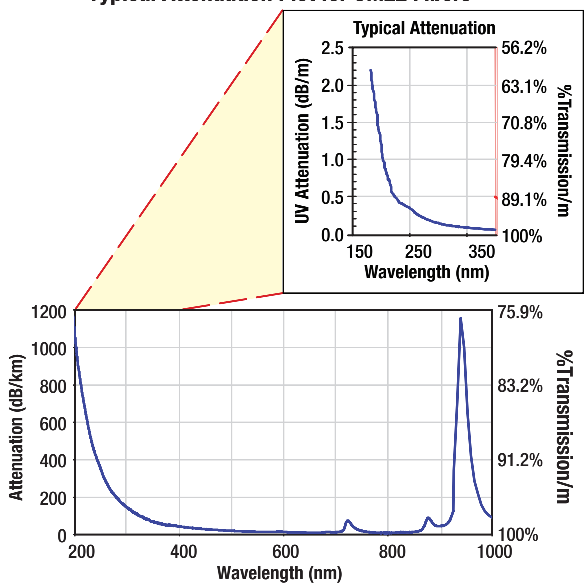
Solarization-Resistant fibers are thus desirable when working in the UV due to their superior transmission and prolonged performance. Typical applications for these fibers are spectroscopy, UV photolithography, and medical diagnostics. Please see page 1056 for more information on our solarization-resistant fibers.

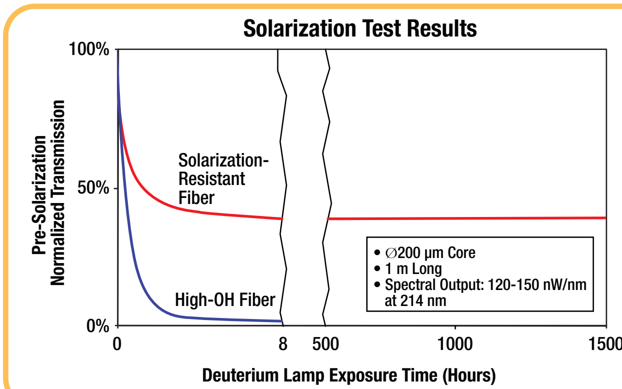
M19L01

Features

- UV Radiation Resistant Fibers
- Shipped from Stock
- SMA 905 Connectors on Both Ends
- Ø3 mm Orange Reinforced Outer Jacket
- Custom Cables Available with Same-Day Turnaround

Typical Attenuation Plot for UM22 Fibers*





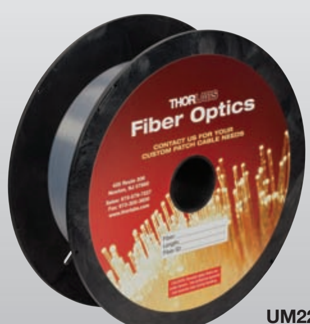
High-OH Fiber experiences significant transmission losses when exposed to UV radiation. In contrast, solarization-resistant fiber offers higher transmission. For optimal performance, expose the fiber to UV radiation for 5 minutes prior to use in your application to allow initial degradation. After this time, equilibrium is reached and the fiber can be used normally.

ITEM #	CORE	NA	LENGTH	$	£	€	RMB	STBR[a]	LTBR[b]	FIBER	JACKET[c]
M19L01	Ø200 µm	0.22	1 m	$ 131.35	£ 94.57	€ 114,27	¥ 1,046.86	22 mm	66 mm	UM22-200 (Page 1056)	FT030
M19L02			2 m	$ 140.35	£ 101.05	€ 122,10	¥ 1,118.59				
M22L01	Ø400 µm	0.22	1 m	$ 166.10	£ 119.59	€ 144,51	¥ 1,323.82	44 mm	132 mm	UM22-400 (Page 1056)	FT030
M22L02			2 m	$ 175.10	£ 126.07	€ 152,34	¥ 1,395.55				

[a]Short-Term Bend Radius [b]Long-Term Bend Radius [c]See Page 1151

Have you seen our...

Solarization-Resistant Bare Multimode Fiber



UM22-200

- Broad UV/NIR Spectral Range: 180 to 1150 nm
- Numerical Aperture: 0.22 ± 0.02
- Core Diameter Range: 100 to 600 µm
- Pure Silica Core, Doped-Silica Cladding, Polyimide Buffer

Our 0.22 NA solarization-resistant, multimode fiber exhibits impressive performance and transmission from the UV to the NIR (180 to 1150 nm). With exceptional UV radiation resistance compared to standard fibers, these multimode fibers are ideal for use in applications such as spectroscopy, UV photolithography, and medical diagnostics.

These fibers are used in our SMA-to-SMA Solarization-Resistant patch cables.

For more details, see page 1056

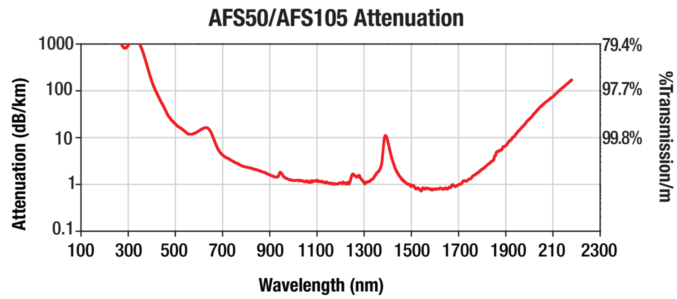
Multimode Patch Cables: FC/PC to SMA

Features

- FC/PC to SMA 905 Patch Cables
- FC/PC Connector has a 2 mm Width Key
- Step-Index Multimode Fiber
- Ø3 mm Orange Furcation Tubing
- 50 µm or 105 µm Core Diameter
- Custom Cables Available with Same-Day Turnaround

These multimode (MM) fiber patch cables have an FC/PC connector on one end and an SMA 905 connector on the other end. They utilize step-index multimode fiber and are available from stock in 1 m lengths.

If you do not see a hybrid multimode patch cable suitable for your application here, please contact your local Thorlabs office or visit www.thorlabs.com/customcable.



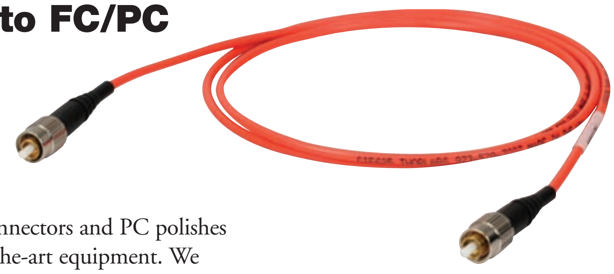
ITEM #	CORE	NA	LENGTH	STBR*	LTBR**	FIBER	JACKET	$	£	€	RMB
M16L01	Ø50 µm	0.22	1 m	12 mm	24 mm	AFS50/125Y (Page 1057)	FT030	$ 72.49	£ 52.19	€ 63,07	¥ 577.75
M18L01	Ø105 µm	0.22	1 m	12 mm	24 mm	AFS105/125Y (Page 1057)	FT030	$ 71.95	£ 51.80	€ 62,60	¥ 573.44

*Short-Term Bend Radius **Long-Term Bend Radius

Multimode Patch Cables: FC/PC to FC/PC

Features

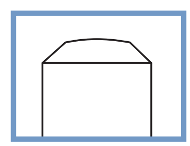
- FC/PC Connectors with 2 mm Narrow Keys on Both Ends
- Uses GIF625 Graded-Index Multimode Fiber
- Ø3 mm Orange Furcation Tubing
- Custom Cables Available with Same-Day Turnaround



These are our stock multimode (MM) fiber patch cables with FC connectors and PC polishes on both ends. Each cable is manufactured at our facility on state-of-the-art equipment. We individually test each cable to ensure its polarization extinction ratio and low back reflection (high return loss) at fiber-to-fiber junctions. All of the cables on this page feature Ø3 mm furcation tubing, which provides Kevlar threads within the tubing to protect the fiber optic.

If you do not see an FC/PC to FC/PC multimode patch cable suitable for your application here, please contact your local Thorlabs office or visit www.thorlabs.com/customcable.

Finish Polish Radius of Curvature Varies from 5 µm to 25 µm



FC/PC

ITEM #	CORE	CLADDING	COATING	NA	FIBER	LENGTH	$	£	€	RMB
M31L01	Ø62.5 ± 2.5 µm	Ø125 ± 1 µm	Ø245 ± 10 µm	0.275	GIF625 (Page 1055)	1 m	$ 47.00	£ 33.84	€ 40,89	¥ 374.59
M31L02						2 m	$ 50.70	£ 36.50	€ 44,11	¥ 404.08
M31L03						3 m	$ 52.20	£ 37.58	€ 45,41	¥ 416.03
M31L05						5 m	$ 57.20	£ 41.18	€ 49,76	¥ 455.88
M31L10						10 m	$ 69.80	£ 50.26	€ 60,73	¥ 556.31

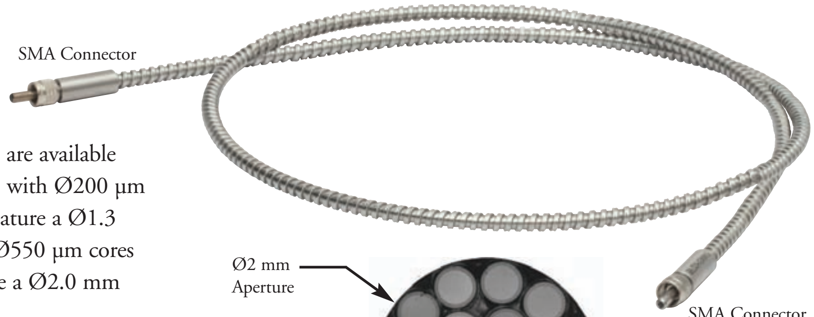
Need a Custom Patch Cable Quickly?

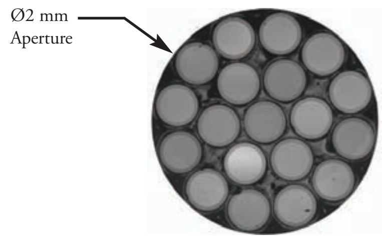
Thorlabs is pleased to offer same-day shipping service for small lots of custom patch cables assembled using our standard fibers. We stock many of our more popular fibers with protective jacketing in bulk, allowing us to assemble custom length patch cables the same day they are requested. Additionally, 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

Fiber Bundles: SMA to SMA

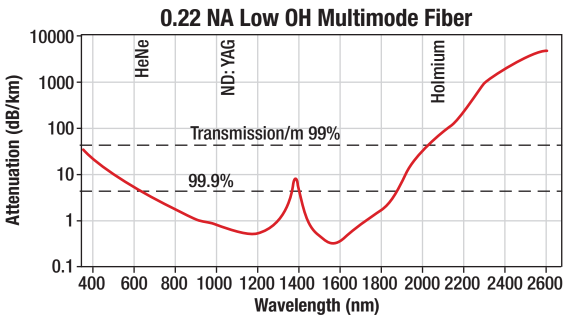
Thorlabs' line of high-quality fiber optical bundles consist of either 7 or 19 high-grade optical fibers in a round configuration combined in an SMA 905 connector. Versions are available with either low-OH or high-OH fibers. Fibers with Ø200 µm cores are used in the bundles of 7 fibers and feature a Ø1.3 mm bundle aperture. In contrast, fibers with Ø550 µm cores are used in the bundles of 19 fibers and feature a Ø2.0 mm bundle aperture.

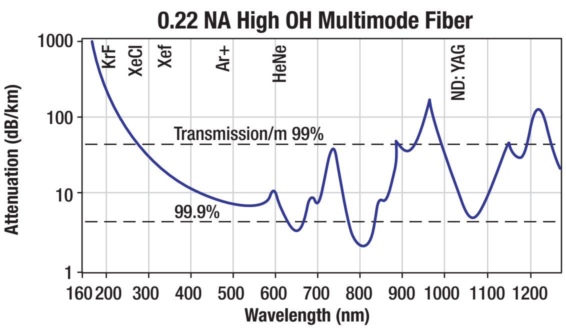




19 Fiber Bundle Connector Face

NEW products





Features

- 1 or 2 m Long Bundles of 7 or 19 Multimode Fibers
- SMA 905 Connectors on Both Ends
- Round-to-Round Configuration
- No Broken Fibers
- Incoherent – No Mapping
- Maximum Temperature: 140 °C

Applications

- Spectroscopy
- Fluorescence Microscopy Emission Collection
- Particle Detection Scanning
- Colorimetry

Have you seen our...

OSL1 Light Source

Couple light from our OSL1 lamp into a fiber bundle with the OSL1-SMA adapter.

See page 1366

Fiber Specifications

FIBER	CORE	CLADDING	NA	OH CONTENT
BFL22-200	Ø200 µm ± 2%	Ø240 µm ± 2%	0.22 ± 0.02	Low
BFH22-200	Ø200 µm ± 2%	Ø240 µm ± 2%	0.22 ± 0.02	High
BFL22-550	Ø550 µm ± 2%	Ø600 µm ± 2%	0.22 ± 0.02	Low
BFH22-550	Ø550 µm ± 2%	Ø600 µm ± 2%	0.22 ± 0.02	High

Fiber Bundles

ITEM #	APERTURE	BUNDLE # OF FIBERS	FIBER	LENGTH*	$	£	€	RMB
BF13LSMA1	Ø1.3 mm	7	BFL22-200	1 m	$ 222.80	£ 160.42	€ 193,84	¥ 1,775.72
BF13LSMA2				2 m	$ 334.49	£ 240.83	€ 291,01	¥ 2,665.89
BF13HSMA1			BFH22-200	1 m	$ 224.07	£ 161.33	€ 194,94	¥ 1,785.84
BF13HSMA2				2 m	$ 337.02	£ 242.65	€ 293,21	¥ 2,686.05
BF20LSMA1	Ø2.0 mm	19	BFL22-550	1 m	$ 347.00	£ 249.84	€ 301,89	¥ 2,765.59
BF20LSMA2				2 m	$ 525.07	£ 378.05	€ 456,81	¥ 4,184.81
BF20HSMA1			BFH22-550	1 m	$ 300.36	£ 216.26	€ 261,31	¥ 2,393.87
BF20HSMA2				2 m	$ 489.60	£ 352.51	€ 425,95	¥ 3,902.11

*Tolerance: ±10%/-0%

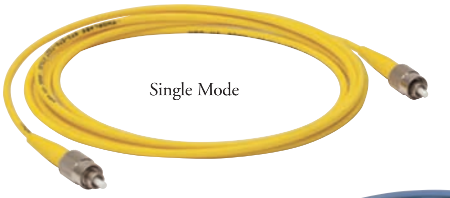
Lamp Adapter for OSL1 Light Source

ITEM #	$	£	€	RMB	DESCRIPTION
OSL1-SMA	$ 30.00	£ 21.60	€ 26,10	¥ 239.10	SMA Fiber Bundle Adapter for OSL1 Lamp

Custom Patch Cables

In addition to Thorlabs' wide range of stock patch cables, we also offer custom patch cables utilizing our bare fiber selection. Our inventory features the largest variety of bare optical fibers in the industry. To help expedite your research needs, we are able to ship many orders within the United States same day if the following criteria are met:

- Order Does Not Exceed 5 Cables
- Each Cable Does Not Exceed 20 m in Length
- The Order is Placed Before 12:00 PM EST
- The Request Does Not Include PM or Plastic Fibers


Single Mode


Polarization Maintaining

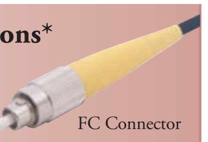
We offer a variety of options for custom patch cables including

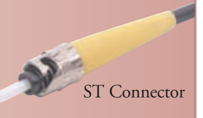
Protective Tubing Options*

- Ø900 µm Yellow (SM)
- Ø3 mm Yellow (SM)
- Ø3 mm Blue (PM)
- Ø3 mm Orange (MM)
- Ø3 mm Black
- Ø3.8 mm Red (MM)
- Ø3.8 mm Black
- Ø5.1 mm Stainless Steel
- None

Connector Options*

- FC/PC
- FC/APC
- SMA
- ST
- SC
- LC
- Flat Cleave
- None


FC Connector


ST Connector


LC Connector

*Please note that not all connectors and tubing types are compatible with all fibers. Please contact tech support to verify compatiblity.


Multimode

PM Alignment

- Slow Axis (Industry Standard)
- Fast Axis (Upon Request)

For customers outside of the United States, for larger quantities, or for PM and plastic fiber patch cables, please contact your local Thorlabs office for custom patch cable lead time information.


Stainless Steel Tubing

To request a quote, visit www.thorlabs.com/customcable

Did you know about our...

Fiber Production Facility

- 17,000 sq. ft. Production Facility
- Bare Fiber Production Capabilities
- Full Performance Testing
- Application of High-Performance TEQS Cladding

Thorlabs has a new production facility for bare fibers, which will further our ability to develop new fiber products and to create custom solutions for you. For more information on custom solutions or to suggest a new fiber product, please contact Tech Support.

Fiber Selection Guide

Fiber Selection Guide

Single Mode Fiber: 305 nm to 450 nm

SM300

NEW product

Features

- Single Mode Transmission from 305 to 450 nm
- Negligible Photodarkening
- Dual Acrylate Coating
- Recommended Stripping Tool: T06S13 (See Page 1154)
- Shipped from Stock, No Minimums

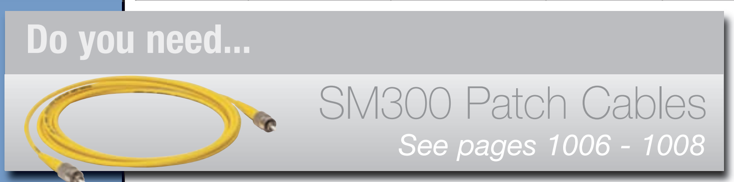
Thorlabs' SM300 fiber consists of an undoped, pure silica core surrounded by a depressed, fluorine-doped cladding. Since these fibers do not contain germania (GeO_2), which causes electronic defects and color centers, the primary cause of photodarkening is greatly reduced. The resulting power handling in the blue region of the spectrum is increased from several milliwatts to several watts. While this fiber will exhibit some photodarkening in the UV region, it has superior performance over conventional germano-silicate fibers.

Popular Compatible Connectors (See Page 1142)

CLADDING DIAMETER	FC/PC CONNECTOR	FC/APC CONNECTOR*
125 µm	30126D1	30126K1 (Ø900 µm) 30126F1 (Ø3 mm)

*Furcation Tubing Diameter is given in Parentheses

ITEM #	OPERATING WAVELENGTH	MODE FIELD DIAMETER	CLADDING DIAMETER	COATING DIAMETER	CUTOFF WAVELENGTH	SHORT- (LONG-) TERM BEND RADIUS	ATTENUATION MAXIMUM	NA
SM300	305 – 450 nm	1.9 µm @ 305 nm 3.0 µm @ 450 nm	125 ± 1 µm	245 µm ± 5%	<300 nm	≥10 mm (≥30 mm)	<70 dB/km @ 350 nm <100 dB/km @ 450 nm	0.12 - 0.14



ITEM #	PRICE/m*	$	£	€	RMB
SM300	1 to 9 m	$ 22.20	£ 15.99	€ 19,32	¥ 176.94
	10 to 49 m	$ 18.87	£ 13.59	€ 16,42	¥ 150.40
	50 to 249 m	$ 15.54	£ 11.19	€ 13,52	¥ 123.86

* Call for Quantities over 250 m

Single Mode Fiber: 400 nm to 600 nm

Features

- Shipped from Stock, No Minimums
- Acrylate Coating
- Recommended Stripping Tool: T06S13 (See Page 1154)

Pure Silica Core Fibers

- Resistance to Radiation-Induced Damage and Color Center Formation
- Low Attenuation

Specifications

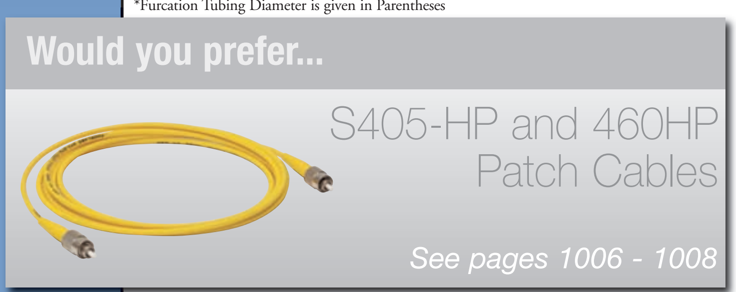
ITEM #	S405-HP[a]	SM450	460HP	S460-HP[a]
Operating Wavelength	400 - 550 nm	450 - 600 nm[b]	450 - 600 nm	460 - 600 nm
Mode Field Diameter[c]	2.9 µm @ 405 nm 3.2 µm @ 460 nm	3.3 µm @ 488 nm 3.4 µm @ 514 nm	3.5 ± 0.5 µm @ 515 nm	3.4 ± 0.5 µm @ 460 nm
Cladding Diameter	125 ± 1 µm	125 ± 1 µm	125 ± 1.5 µm	125 ± 1 µm
Coating Diameter	245 ± 15 µm	245 ± 15 µm	245 ± 15 µm	245 ± 15 µm
Cutoff Wavelength	370 ± 20 nm	400 ± 50 nm	430 ± 20 nm	425 ± 25 nm
Short- (Long-) Term Bend Radius	≥6 mm (≥13 mm)	≥5 mm (≥25 mm)	≥6 mm (≥13 mm)	≥6 mm (≥13 mm)
Attenuation (Maximum)	≤30 dB/km @ 460 nm	<50 dB/km @ 488 nm	≤30 dB/km @ 515 nm	≤30 dB/km @ 460 nm
Numerical Aperture	0.12[d]	0.12	0.13	0.12

[a] Pure Silica Core Fibers
[b] Wavelength range is illustrative and not guaranteed.
[c] MFD is a nominal, calculated value, estimated at the operating wavelength(s)
[d] 0.10 ≤ NA ≤ 0.14

Popular Compatible Connectors (See Page 1142)

CLADDING DIAMETER	FC/PC CONNECTOR	FC/APC CONNECTOR*
125 µm	30126D1	30126K1 (Ø900 µm) 30126F1 (Ø3 mm)

*Furcation Tubing Diameter is given in Parentheses



ITEM #	PRICE/m*	$	£	€	RMB
S405-HP	1 to 9 m	$ 13.70	£ 9.87	€ 11,92	¥ 109.19
	10 to 49 m	$ 11.65	£ 8.39	€ 10,14	¥ 92.82
	50 to 249 m	$ 9.59	£ 6.91	€ 8,35	¥ 76.44
SM450	1 to 9 m	$ 9.10	£ 6.56	€ 7,92	¥ 72.53
	10 to 49 m	$ 7.74	£ 5.57	€ 6,73	¥ 61.65
	50 to 249 m	$ 6.37	£ 4.59	€ 5,55	¥ 50.77
460HP	1 to 9 m	$ 10.10	£ 7.28	€ 8,79	¥ 80.50
	10 to 49 m	$ 8.59	£ 6.19	€ 7,47	¥ 68.43
	50 to 249 m	$ 7.07	£ 5.10	€ 6,16	¥ 56.35
S460-HP	1 to 9 m	$ 12.40	£ 8.93	€ 10,79	¥ 98.83
	10 to 49 m	$ 10.54	£ 7.59	€ 9,17	¥ 84.01
	50 to 249 m	$ 8.68	£ 6.25	€ 7,56	¥ 69.18

*Call for Quantities Over 250 m

Single Mode Fiber: 600 nm to 860 nm

Features

- Shipped from Stock, No Minimums
- True Single Mode Operation for HeNe and Red Laser Diodes
- Acrylate Coating
- Core-Clad Concentricity:
  - <1.0 µm for SM600
  - <0.5 µm for 630HP and S630-HP
- 630HP and S630-HP Offer a Tight Bend Radius for Applications in Miniaturized Fiber Optic Packages
- Recommended Stripping Tool: T06S13 (See Page 1154)

Specifications

ITEM #	SM600	630HP	S630-HP[a]
Operating Wavelength[b]	600 - 800 nm[c]	600 - 770 nm	630 - 860 nm
Mode Field Diameter[d]	4.3 µm @ 633 nm 4.6 µm @ 680 nm	4.0 ± 0.5 µm @ 630 nm	4.2 ± 0.5 µm @ 630 nm
Cladding Diameter	125 ± 1 µm	125 ± 1.5 µm	125 ± 1 µm
Coating Diameter	245 µm ± 5%	245 ± 15 µm	245 ± 15 µm
Cutoff Wavelength[b]	550 ± 50 nm	570 ± 30 nm	590 ± 30 nm
Short- (Long-) Term Bend Radius	≥5 mm (≥25 mm)	≥6 mm (≥13 mm)	≥6 mm (≥13 mm)
Attenuation (Maximum)	<15 dB/km @ 633 nm	≤12 dB/km @ 630 nm	≤10 dB/km @ 630 nm
Numerical Aperture	0.12[e]	0.13	0.12

[a] Pure Silica Core Fibers
[b] Operating wavelength range is typically 200 nm above the cutoff wavelength
[c] Wavelength range is illustrative and not guaranteed.
[d] MFD is a nominal, calculated value, estimated at the operating wavelength(s)
[e] $0.10 \leq NA \leq 0.14$

Popular Compatible Connectors (See Page 1142)

CLADDING DIAMETER	FC/PC CONNECTOR	FC/APC CONNECTOR*
125 µm	30126D1	30126K1 (Ø900 µm) 30126F1 (Ø3 mm)

*Furcation Tubing Diameter is given in Parentheses

ITEM #	PRICE/m*	$	£	€	RMB
SM600	1 to 9 m	$ 5.50	£ 3.96	€ 4,79	¥ 43.84
	10 to 49 m	$ 4.68	£ 3.37	€ 4,07	¥ 37.26
	50 to 249 m	$ 3.85	£ 2.78	€ 3,35	¥ 30.69
630HP	1 to 9 m	$ 5.40	£ 3.89	€ 4,70	¥ 43.04
	10 to 49 m	$ 4.59	£ 3.31	€ 4,00	¥ 36.59
	50 to 249 m	$ 3.78	£ 2.73	€ 3,29	¥ 30.13
S630-HP	1 to 9 m	$ 8.90	£ 6.41	€ 7,75	¥ 70.94
	10 to 49 m	$ 7.57	£ 5.45	€ 6,59	¥ 60.30
	50 to 249 m	$ 6.23	£ 4.49	€ 5,43	¥ 49.66

*Call for Quantities Over 250 m

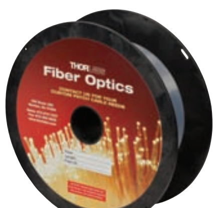
Do you need...

SM600
Patch Cables

See pages 1006 - 1008

Single Mode Fiber: 780 nm to 1000 nm

- Shipped from Stock, No Minimums
- Acrylate Coating
- Core-Clad Concentricity
  - <0.5 µm for 780HP
  - <1.0 µm for SM800-5.6-125
  - ≤0.75 µm for SM800G80
- 780HP Offers Tight Second Mode Cutoff Tolerances
- 780HP Offers a Tight Bend Radius for Applications in Miniaturized Fiber Optic Packages
- SM800G80 Offers Enhanced Bend Insensitivity
- Recommended Stripping Tools (See Page 1154):
  - T04S10 (Ø80 µm Cladding)
  - T06S13 (Ø125 µm Cladding)



SM300

Specifications

ITEM #	780HP	SM800-5.6-125	SM800G80
Operating Wavelength	780 - 970 nm	800 - 1000 nm[a]	820 - 1100 nm[a]
Mode Field Diameter[b]	5.0 ± 0.5 µm @ 850 nm	5.6 µm @ 830 nm	4.2 µm @ 830 nm
Cladding Diameter	125 ± 1.5 µm	125 ± 1 µm	80 ± 1 µm
Coating Diameter	245 ± 15 µm	245 µm ± 5%	175 µm ± 5%
Cutoff Wavelength	730 ± 30 nm	660 - 800 nm	600 - 800 nm
Short- (Long-) Term Bend Radius	≥6 mm (≥13 mm)	≥5 mm (≥25 mm)	≥5 mm (≥12 mm or 38 mm for 25 Year Life)
Attenuation (Maximum)	<3.5 dB/km @ 850 nm	<5 dB/km @ 830 nm	≤5 dB/km @ 830 nm
Numerical Aperture	0.13	0.12[c]	0.16[d]

[a] Wavelength range is illustrative and not guaranteed
[b] MFD is a nominal, calculated value, estimated at the operating wavelength(s)
[c] $0.10 \leq NA \leq 0.14$
[d] $0.14 \leq NA \leq 0.18$

Popular Compatible Connectors (See Page 1142)

CLADDING DIAMETER	FC/PC CONNECTOR	FC/APC CONNECTOR*
80 µm	30080D1	N/A
125 µm	30126D1	30126K1 (Ø900 µm) 30126F1 (Ø3 mm)

*Furcation Tubing Diameter is given in Parentheses

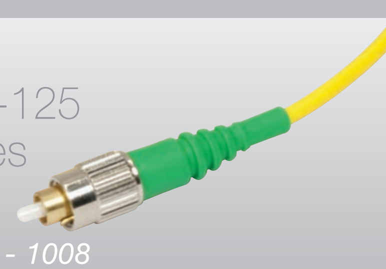
ITEM #	PRICE/m*	$	£	€	RMB
780HP	1 to 9 m	$ 5.40	£ 3.89	€ 4,70	¥ 43.04
	10 to 49 m	$ 4.59	£ 3.31	€ 4,00	¥ 36.59
	50 to 249 m	$ 3.78	£ 2.73	€ 3,29	¥ 30.13
SM800-5.6-125	1 to 9 m	$ 5.50	£ 3.96	€ 4,79	¥ 43.84
	10 to 49 m	$ 4.68	£ 3.37	€ 4,07	¥ 37.26
	50 to 249 m	$ 3.85	£ 2.78	€ 3,35	¥ 30.69
SM800G80	1 to 9 m	$ 4.60	£ 3.32	€ 4,01	¥ 36.67
	10 to 49 m	$ 3.91	£ 2.82	€ 3,41	¥ 31.17
	50 to 249 m	$ 3.22	£ 2.32	€ 2,81	¥ 25.67

NEW

*Call For Quantities Over 250 m

Would you prefer...

780HP and
SM800-5.6-125
Patch Cables



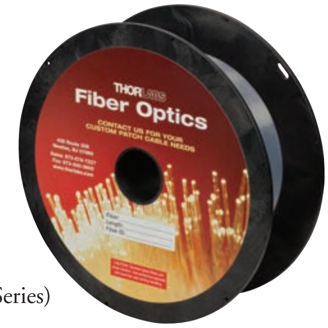
See pages 1006 - 1008

CHAPTERS
Fiber Patch Cables
Bare Fiber
Fiber Optomechanics
Fiber Components
Test and Measurement
SECTIONS
SM Fiber
PM Fiber
Doped Fiber
PCF
MM Fiber
Plastic Optical Fiber

Single Mode Fiber: 970 nm to 1650 nm

Features

- Shipped from Stock, No Minimums
- HI1060-J9 has Ø900 µm 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
- SM980G80 Offers Enhanced Bend Insensitivity
- Recommended Stripping Tools (See Page 1154):
  - T04S10 (Ø80 µm Cladding)
  - T06S13 (Ø125 µm Cladding, Use T08S40 for HI1060 Series)



ITEM #	OPERATING WAVELENGTH	MODE FIELD DIAMETER[b]	CLADDING DIAMETER	COATING DIAMETER	CUTOFF WAVELENGTH	SHORT- (LONG-) TERM BEND RADIUS	ATTENUATION MAXIMUM	NA
SM980-5.8-125	970 - 1650 nm	5.8 µm @ 980 nm 6.2 µm @ 1064 nm 10.4 µm @ 1550 nm	125 ± 1 µm	245 µm ± 5%	870 - 970 nm	≥5 mm (≥25 mm)	<3 dB/km @ 980 nm	0.14[c]
SM980G80	980 - 1650 nm[a]	4.5 µm @ 980 nm 7.5 µm @ 1550 nm	80 ± 1 µm	175 µm ± 5%	870 - 970 nm	≥5 mm (≥12 mm or 38 mm for 25 Year Life)	≤3 dB/km @ 980 nm and 1550 nm	0.18[d]
HI1060-J9	980 - 1180 nm	5.9 ± 0.3 µm @ 980 nm 6.2 ± 0.3 µm @ 1060 nm	125 ± 0.5 µm	245 ± 10 µm	920 ± 50 nm	–	≤2.1 dB/km @ 980 nm ≤1.5 dB/km @ 1060 nm	0.14
1060XP	980 - 1600 nm	5.9 ± 0.5 µm @ 980 nm 6.2 ± 0.5 µm @ 1060 nm 9.5 ± 0.5 µm @ 1550 nm	125 ± 0.5 µm	245 ± 10 µm	920 ± 30 nm	≥6 mm (≥13 mm)	≤2.1 dB/km @ 980 nm ≤1.5 dB/km @ 1060 nm	0.14
980HP	980 - 1600 nm	4.2 ± 0.5 µm @ 980 nm 6.8 ± 0.5 µm @ 1550 nm	125 ± 1.5 µm	245 ± 15 µm	920 ± 30 nm	≥6 mm (≥13 mm)	≤3.5 dB/km @ 980 nm	0.20

[a] Wavelength range is illustrative and not guaranteed.
[b] MFD is a nominal, calculated value, estimated at the operating wavelength(s)
[c] 0.13 ≤ NA ≤ 0.15
[d] 0.17 ≤ NA ≤ 0.19

ITEM #	PRICE/m*	$	£	€	RMB
SM980-5.8-125	1 to 9 m	$ 5.50	£ 3.96	€ 4,79	¥ 43.84
	10 to 49 m	$ 4.68	£ 3.37	€ 4,07	¥ 37.26
	50 to 249 m	$ 3.85	£ 2.78	€ 3,35	¥ 30.69
NEW SM980G80	1 to 9 m	$ 4.60	£ 3.32	€ 4,01	¥ 36.67
	10 to 49 m	$ 3.91	£ 2.82	€ 3,41	¥ 31.17
	50 to 249 m	$ 3.22	£ 2.32	€ 2,81	¥ 25.67
HI1060-J9	1 to 100 m	$ 7.90	£ 5.69	€ 6,88	¥ 62.97
NEW 1060XP	1 to 9 m	$ 4.85	£ 3.50	€ 4,22	¥ 38.66
	10 to 49 m	$ 4.12	£ 2.97	€ 3,59	¥ 32.86
	50 to 249 m	$ 3.40	£ 2.45	€ 2,96	¥ 27.06
980HP	1 to 9 m	$ 4.80	£ 3.46	€ 4,18	¥ 38.26
	10 to 49 m	$ 4.08	£ 2.94	€ 3,55	¥ 32.52
	50 to 249 m	$ 3.36	£ 2.42	€ 2,93	¥ 26.78

*Call for Quantities Over 250 m

Popular Compatible Connectors (See Page 1142)

CLADDING DIAMETER	FC/PC CONNECTOR	FC/APC CONNECTOR*
80 µm	30080D1	N/A
125 µm	30126D1	30126K1 (Ø900 µm) 30126F1 (Ø3 mm)

*Furcation Tubing Diameter is given in Parentheses

Standard Length Pricing

ITEM #	$	£	€	RMB	DESCRIPTION
HI1060-10	$ 68.20	£ 49.10	€ 59,33	¥ 543.55	10 m HI1060 w/ Ø900 µm Jacket
HI1060-100	$631.30	£ 454.54	€ 549,23	¥5,031.46	100 m HI1060 w/ Ø900 µm Jacket

Single Mode Fiber: 1260 nm to 1625 nm

Features

- Shipped from Stock, No Minimums
- Acrylate Coating
- SMF-28-J9 has a Ø900 µm Tight Buffer Outer Jacket
- Core-Clad Concentricity
  - <0.5 µm for SMF-28-J9, 1310BHP, and 1550BHP,
  - ≤0.75 µm for SM1250G80 and SM1500G80
- 1310BHP, and 1550BHP Offer Tight Second Mode Cutoff Tolerances
- SM1250G80 and SM1500G80 Offer Enhanced Bend Insensitivity
- Recommended Stripping Tools (See Page 1154):
  - T04S10 (Ø80 µm Cladding)
  - T06S13 (Ø125 µm Cladding, Use T08S40 for SMF-28 Series)

ITEM #	OPERATING WAVELENGTH	MODE FIELD DIAMETER	CLADDING DIAMETER	COATING DIAMETER	CUTOFF WAVELENGTH	SHORT- (LONG-) TERM BEND RADIUS	ATTENUATION MAXIMUM	NA
SMF-28-J9	1260 - 1620 nm	9.2 ± 0.4 µm @ 1310 nm 10.4 ± 0.5 µm @ 1550 nm	125 ± 0.7 µm	245 ± 5 µm	<1260 nm	–	<0.35 dB/km @ 1310 nm <0.20 dB/km @ 1550 nm	0.14
1310BHP	1300 - 1625 nm	8.6 ± 0.5 µm @ 1310 nm 9.7 ± 0.5 µm @ 1550 nm	125 ± 1.0 µm	245 ± 15 µm	1260 ± 30 nm	≥6 mm (≥13 mm)	0.5 dB/km @ 1310 nm 0.5 dB/km @ 1550 nm	0.13
SM1250G80	1260 - 1650 nm[a]	9.0 µm @ 1310 nm 10.5 µm @ 1550 nm	80 ± 1.0 µm	175 µm ± 5%	1150 - 1250 nm	≥5 mm (≥12 mm or 38 mm for 25 Year Life)	≤2 dB/km @ 1310 nm and 1550 nm	0.12[b]
1550BHP	1460 - 1620 nm	9.5 ± 0.5 µm @ 1550 nm	125 ± 1.0 µm	245 ± 15 µm	1400 ± 50 nm	≥6 mm (≥13 mm)	0.5 dB/km @ 1550 nm	0.13
SM1500G80	1550 - 1700 nm[a]	6.4 µm @ 1550 nm	80 ± 1.0 µm	175 µm ± 5%	1350 - 1500 nm	≥5 mm (≥12 mm or 38 mm for 25 Year Life)	≤2 dB/km @ 1550 nm	0.20[c]

[a] Wavelength range is illustrative and not guaranteed. [b] 0.11 ≤ NA ≤ 0.13 [c] 0.19 ≤ NA ≤ 0.21

Popular Compatible Connectors (See Page 1142)

CLADDING DIAMETER	FC/PC CONNECTOR	FC/APC CONNECTOR*
80 µm	30080D1	N/A
125 µm	30126D1	30126K1 (Ø900 µm) 30126F1 (Ø3 mm)

*Furcation Tubing Diameter is given in Parentheses

Standard Length Pricing (Longer Lengths Available)

ITEM #	$	£	€	RMB	DESCRIPTION
SMF-28-10	$ 8.06	£ 5.80	€ 7,01	¥ 64.24	10 m SMF-28-J9 w/ Ø900 µm Jacket
SMF-28-100	$ 51.51	£ 37.09	€ 44,81	¥410.53	100 m SMF-28-J9 w/ Ø900 µm Jacket
SMF-28-1000	$464.60	£334.51	€404,20	¥3,702.86	1000 m SMF-28-J9 w/ Ø900 µm Jacket

ITEM #	PRICE/m*	$	£	€	RMB
SMF-28-J9	1 to >100 m	$ 0.70	£ 0.50	€ 0,61	¥ 5.58
1310BHP	1 to 9 m	$ 4.80	£ 3.46	€ 4,18	¥ 38.26
	10 to 49 m	$ 4.08	£ 2.94	€ 3,55	¥ 32.52
	50 to 249 m	$ 3.36	£ 2.42	€ 2,93	¥ 26.78
SM1250G80 NEW	1 to 9 m	$ 4.60	£ 3.32	€ 4,01	¥ 36.67
	10 to 49 m	$ 3.91	£ 2.82	€ 3,41	¥ 31.17
	50 to 249 m	$ 3.22	£ 2.32	€ 2,81	¥ 25.67
1550BHP	1 to 9 m	$ 4.80	£ 3.46	€ 4,18	¥ 38.26
	10 to 49 m	$ 4.08	£ 2.94	€ 3,55	¥ 32.52
	50 to 249 m	$ 3.36	£ 2.42	€ 2,93	¥ 26.78
SM1500G80 NEW	1 to 9 m	$ 4.60	£ 3.32	€ 4,01	¥ 36.67
	10 to 49 m	$ 3.91	£ 2.82	€ 3,41	¥ 31.17
	50 to 249 m	$ 3.22	£ 2.32	€ 2,81	¥ 25.67

*Call for Quantities Over 250 m

Bend-Insensitive Single Mode Fiber: 1260 nm to 1625 nm

ITEM #	OPERATING WAVELENGTH	MODE FIELD DIAMETER	CLADDING DIAMETER	COATING DIAMETER	CUTOFF WAVELENGTH	SHORT- (LONG-) TERM BEND RADIUS	ATTENUATION MAXIMUM	NA
CCC1310-J9	1260 - 1625 nm	8.6 ± 0.4 µm @ 1310 nm 9.8 ± 0.5 µm @ 1550 nm	125.0 ± 0.7 µm	242.0 ± 5.0 µm	≤1260 nm	–	≤0.33 dB/km @ 1310 nm ≤0.21 dB/km @ 1550 nm	0.14

Features

- Microbend Loss 10.0 mm Radius, 1 Turn
  - 0.50 dB @ 1550 nm
  - 1.5 dB @ 1625 nm
- Dispersion [ps/(nm * km)]
  - ≤18.0 @ 1550 nm
  - ≤22.0 @ 1625 nm
- Polarization Mode Dispersion (ps/√km)
  - PMD Link Design Value ≤ 0.06
  - Maximum Individual Fiber PMD ≤ 0.1
- Ø900 µm Jacket
- Recommended Stripping Tool: T08S40 (Page 1154)

This bend-insensitive single mode fiber has enhanced macrobend features leading to superior performance when confined to a small radius compared to other single mode fibers. This fiber exceeds the ITU-T recommendation G.657.A1 in addition to remaining fully compliant with ITU-T Recommendation G.652.D. Our bend-insensitive optical fiber is also compatible with the installed base of SMF-28e and SMF-28e+ fiber.

Popular Compatible Connectors (See Page 1142)

CLADDING DIAMETER	FC/PC CONNECTOR	FC/APC CONNECTOR
125 µm	30126D1	30126K1

ITEM #	PRICE/m*	$	£	€	RMB
CCC1310-J9	1 to 9 m	$ 3.50	£ 2.52	€ 3,05	¥ 27.90
	10 to 49 m	$ 2.98	£ 2.15	€ 2,59	¥ 23.72
	50 to 249 m	$ 2.45	£ 1.77	€ 2,14	¥ 19.53

*Call for Quantities Over 250 m

Do you need...

SMF-28-J9 and 1550BHP Patch Cables

See pages 1006 - 1009

Single Mode Fiber: 1.7 to 2.1 µm

NEW product

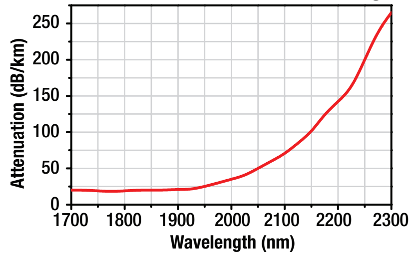
SM2000

Features

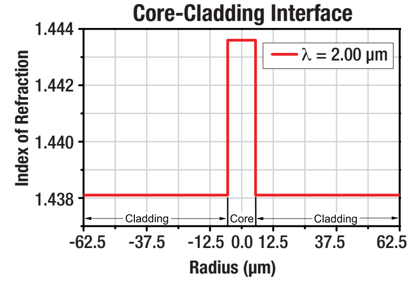
- Shipped from Stock, No Minimums
- Ge-Doped Silica Core
- Large Core for Coupling 2 µm Light
- NA Matched to SMF-28e+ Fiber
- Exceptional Core/Clad Concentricity Specifications
- Low Bend Loss
- Recommended Stripping Tool: T06S13 (See Page 1154)

The SM2000 was developed by Thorlabs for the growing market of 2 µm components. This fiber offers significantly lower bend loss than the SMF-28e+ fiber, as shown in the plot below, which makes it suitable for many demanding applications in the IR. While all silica-based fibers will suffer absorption in the IR, caused by vibration of the Si-O bonds, our SM2000 fiber features a Ge-doped core to increase the usable range further into the IR. Doping the silica with Ge lowers the resonant frequency of the vibrations, and therefore the wavelength where absorption becomes an issue is increased. The SM2000 has an NA matched to SMF-28e+ for excellent compatibility.

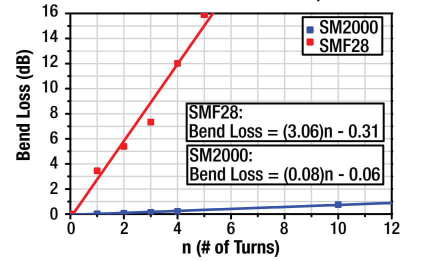
SM2000 Attenuation vs. Wavelength



Refractive Index Across the Core-Cladding Interface

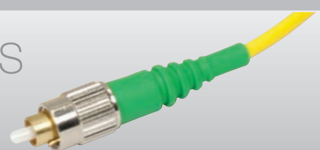


Bend Loss on Ø30 mm Mandrel, λ = 1996 nm



Would you prefer...

SM2000 Patch Cables



See pages 1006 - 1008

ITEM #	OPERATING WAVELENGTH	MODE FIELD DIAMETER	CORE DIAMETER	CLADDING DIAMETER	BUFFER DIAMETER	CLADDING NONCIRCULARITY	CORE/CLADDING CONCENTRICITY	INSERTION LOSS[a]	NA
SM2000	1700 – 2100 nm	13 µm @ 1996 nm	11 ± 1 µm	125 ± 1.0 µm	245 ± 10 µm	≤2%	≤0.8 µm	0.1 dB	0.11

a When mating with SMF-28e+

Popular Compatible Connectors (See Page 1142)

CLADDING DIAMETER	FC/PC CONNECTOR	FC/APC CONNECTOR*
80 µm	30080D1	N/A
125 µm	30126D1	30126K1 (Ø900 µm) 30126F1 (Ø3 mm)

*Furcation Tubing Diameter is given in Parentheses

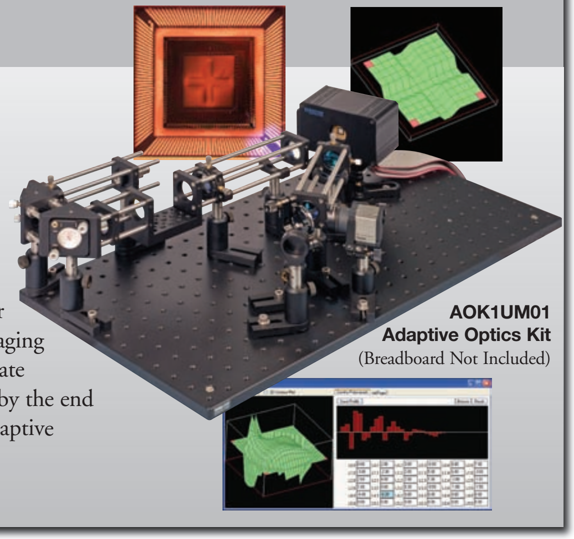
ITEM #	PRICE/m*	$	£	€	RMB
SM2000	1 to 9 m	$ 14.73	£ 10.61	€ 12,82	¥ 117.40
	10 to 49 m	$ 12.52	£ 9.02	€ 10,90	¥ 99.79
	50 to 249 m	$ 10.31	£ 7.43	€ 8,98	¥ 82.18

*Call for Quantities Over 250 m

Have you seen our...

Adaptive Optics Kits

- MEMS-Based Deformable Mirror Achieves High Spatial Resolution Due to High Actuator Count and Low Inter-Actuator Coupling
- Shack-Hartmann Wavefront Sensor
- Includes Light Source, Imaging Optics, and Associated Mounting Hardware



AOK1UM01
Adaptive Optics Kit
(Breadboard Not Included)

Thorlabs offers Adaptive Optics Kits that incorporate a MEMS-based deformable mirror (either gold or aluminum coated), a Shack-Hartmann wavefront sensor, all necessary imaging optics and mounting hardware, fully functional stand-alone control software for immediate control of the system, and a support library to assist with tailored applications authored by the end user. In addition, since the kit ships as three pre-aligned optomechanical sections, our adaptive optics kits provide a near out-of-the-box solution for real-time wavefront compensation.

For more details, see pages 1790 - 1795

Ultra-High NA Silica Fibers

ITEM #[a]	OPERATING WAVELENGTH	MODE FIELD DIAMETER[b]	CUTOFF WAVELENGTH	CORE COMPOSITION	ATTENUATION (TYPICAL)	NA	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL
UHNA3	960 - 1600 nm	2.6 µm @ 1100 nm 3.3 µm @ 1310 nm 4.1 µm @ 1550 nm	900 ± 50 nm	SiO_2/GeO_2	<20 dB/km[c]	0.35	125 ± 1.5 µm	250 ± 20 µm	T06S13
UHNA1	1100 - 1600 nm	3.3 µm @ 1100 nm 4.0 µm @ 1310 nm 4.8 µm @ 1550 nm	1000 ± 50 nm	SiO_2/GeO_2	<20 dB/km[c]	0.28	125 ± 1.5 µm	250 ± 20 µm	T06S13
UHNA4	1100 - 1600 nm	2.6 µm @ 1100 nm 3.3 µm @ 1310 nm 4.0 µm @ 1550 nm	1050 ± 50 nm	SiO_2/GeO_2	<20 dB/km[c]	0.35	125 ± 1.5 µm	250 ± 20 µm	T06S13

[a] The core can change up to 10 µm during the splicing process. It is increased with repeated arcing. [b] ± 0.3 µm [c] @ 1550 nm

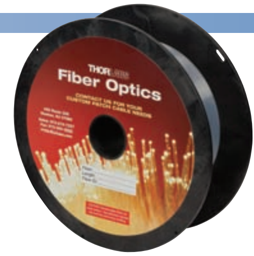
Fluoride optical fibers for amplifiers and lasers at 1300 nm and 1500 nm are important components for optical fiber communications systems. Efficient operation of fluoride fibers requires a very high numerical aperture (typically >0.3), which unfortunately leads to increased splice losses and low return 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.

ITEM #	PRICE/m*	$	£	€	RMB
UHNA3	1 to 9 m	$ 21.40	£ 15.41	€ 18,62	¥ 170.56
	10 to 49 m	$ 18.19	£ 13.10	€ 15,83	¥ 144.98
	50 to 249 m	$ 14.98	£ 10.79	€ 13,04	¥ 119.40
UHNA1	1 to 9 m	$ 21.40	£ 15.41	€ 18,62	¥ 170.56
	10 to 49 m	$ 18.19	£ 13.10	€ 15,83	¥ 144.98
	50 to 249 m	$ 14.98	£ 10.79	€ 13,04	¥ 119.40
UHNA4	1 to 9 m	$ 21.40	£ 15.41	€ 18,62	¥ 170.56
	10 to 49 m	$ 18.19	£ 13.10	€ 15,83	¥ 144.98
	50 to 249 m	$ 14.98	£ 10.79	€ 13,04	¥ 119.40

*Call for Quantities Over 250 m

See page 1148

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 (FBGs) used in pump stabilizers of diodes with wavelengths in the 980 to 1060 nm range. PS1060 may also be used in coupler applications.

ITEM #	OPERATING WAVELENGTH	MODE FIELD DIAMETER	CLADDING DIAMETER	COATING DIAMETER	CUTOFF WAVELENGTH	ATTENUATION	NA	STRIPPING TOOL
PS1060	980 - 1060 nm	6.2 ± 0.8 µm @ 1060 nm	125 ± 1.5 µm	245 ± 15 µm	920 ± 50 nm	20 dB/km @ 1060 nm	0.13	T06S13

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 to 9 m	$ 11.40	£ 8.21	€ 9,92	¥ 90.86
	10 to 49 m	$ 9.69	£ 6.98	€ 8,44	¥ 77.23
	50 to 249 m	$ 7.98	£ 5.75	€ 6,95	¥ 63.61

*Call for Quantities Over 250 m

Photosensitive Single Mode Fibers

These photosensitive fibers are highly sensitive to UV radiation, mode-matched to SMF-28e+ to reduce Fiber Bragg Grating (FBG) writing times associated with industry standard telecommunication fiber, and can be easily spliced to industry standard fibers. The low-loss GF1B fiber 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.

Applications
- Gain Flattening Filters
- Dispersion Compensators
- Pump Stabilizers
- Fiber Lasers

ITEM #	OPERATING WAVELENGTH	MODE FIELD DIAMETER	CUTOFF WAVELENGTH	CLADDING DIAMETER	COATING DIAMETER	NA	STRIPPING TOOL
GF1	1500 - 1600 nm	9.3 ± 0.5 µm @ 1310 nm 10.5 ± 1.0 µm @ 1550 nm	1260 ± 75 nm	125 ± 1.5 µm	250 ± 20 µm	0.13	T06S13
GF1B	1500 - 1600 nm	10.4 ± 0.8 µm @ 1550 nm	1260 ± 100 nm	125 ± 1.0 µm	245 ± 15 µm	0.13	T06S13
GF3	1500 - 1600 nm	7.5 ± 0.5 µm @ 1550 nm	1350 ± 50 nm	125 ± 1.5 µm	245 ± 1.5 µm	0.16	T06S13
GF4A	1450 - 1650 nm*	4.0 ± 0.3 µm @ 1550 nm	1350 ± 50 nm	125 ± 1.5 µm	250 ± 20 µm	0.30	T06S13

*Wavelength range is illustrative and not guaranteed.

Features
- Enhanced Photosensitivity
- Low Splice Loss to Transmission Fibers
- Tightly Controlled Uniformity
- >100 kpsi Proof Test Level
- >25 mm Long-Term Bend Radius
- >12 mm Short-Term Bend Radius
- GF4A: Cladding Mode Offset Fiber

ITEM #	PRICE/m*	$	£	€	RMB
GF1	1 to 9 m	$ 7.15	£ 5.15	€ 6,23	¥ 56.99
	10 to 49 m	$ 6.08	£ 4.38	€ 5,29	¥ 48.44
	50 to 249 m	$ 5.01	£ 3.61	€ 4,36	¥ 39.89
GF1B	1 to 9 m	$ 6.10	£ 4.40	€ 5,31	¥ 48.62
	10 to 49 m	$ 5.19	£ 3.74	€ 4,52	¥ 41.33
	50 to 249 m	$ 4.27	£ 3.08	€ 3,72	¥ 34.04
GF3	1 to 9 m	$ 30.00	£ 21.60	€ 26,10	¥ 239.10
	10 to 49 m	$ 25.50	£ 18.36	€ 22,19	¥ 203.24
	50 to 249 m	$ 21.00	£ 15.12	€ 18,27	¥ 167.37
GF4A	1 to 9 m	$ 19.60	£ 14.12	€ 17,06	¥ 156.22
	10 to 49 m	$ 16.66	£ 12.00	€ 14,50	¥ 132.79
	50 to 249 m	$ 13.72	£ 9.88	€ 11,94	¥ 109.35

*Call for Quantities Over 250 m

Have you seen our...

Solarization-Resistant Bare Multimode Fiber

UM22-200

- Broad UV/NIR Spectral Range: 180 to 1150 nm
- Numerical Aperture: 0.22 ± 0.02
- Core Diameter Range: 100 to 600 µm
- Pure Silica Core, Doped-Silica Cladding, Polyimide Buffer

Our 0.22 NA solarization-resistant, multimode fiber exhibits impressive performance and transmission from the UV to the NIR (180 to 1150 nm). With exceptional UV radiation resistance compared to standard fibers, these multimode fibers are ideal for use in applications such as spectroscopy, UV photolithography, and medical diagnostics.

These fibers are used in our SMA-to-SMA Solarization-Resistant patch cables.

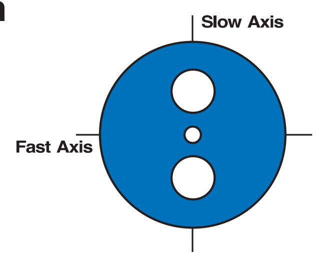
For more details, see page 1056

Fiber Selection Guide

PM Fiber Selection Guide

Pure-Silica Core PM Fiber, Panda: 350 – 500 nm

These pure-silica core polarization maintaining fibers are designed for either 350 - 460 nm or 400 - 500 nm operation. Their pure silica cores provide protection against radiation-induced damage and color center formation, making them ideal for use at shorter wavelengths. Both fibers are based on a panda stress rod design. If you wish to create your own patch cable using these fibers, we offer the 301255D1 adjustable key FC/PC connector on page 1142.



Panda PM Fiber Cross Section

ITEM #	OPERATING WAVELENGTH*	MODE FIELD DIAMETER**	CUTOFF WAVELENGTH	BEAT LENGTH	ATTENUATION	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL See Page 1154
PM-S350-HP	350 - 460 nm	2.3 µm @ 350 nm	≤340 nm	1.5 mm @ 350 nm	N/A	125 ± 1 µm	245 ± 15 µm	T06S13
PM-S405-HP	400 - 500 nm	3.2 µm @ 405 nm 3.5 ± 0.3 µm @ 460 nm	365 ± 25 nm	1.8 mm @ 405 nm	≤50 dB/km @ 405 nm	125 ± 1 µm	245 ± 15 µm	T06S13

*Nominal **1/e² fit - near field

Price Per Meter

Polarization-Maintaining Fiber, Panda by NUFERN

ITEM #*	$ 1-9 m	$ 10-49 m	$ 50-249 m	£ 1-9 m	£ 10-49 m	£ 50-249 m	€ 1-9 m	€ 10-49 m	€ 50-249 m	RMB 1-9 m	RMB 10-49 m	RMB 50-249 m
PM-S350-HP	$ 33.00	$ 28.05	$ 23.10	£ 23.76	£ 20.20	£ 16.64	€ 28,71	€ 24,41	€ 20,10	¥ 263.01	¥ 223.56	¥ 184.11
PM-S405-HP	$ 30.00	$ 25.50	$ 21.00	£ 21.60	£ 18.36	£ 15.12	€ 26,10	€ 22,19	€ 18,27	¥ 239.10	¥ 203.24	¥ 167.37

*Call for Quantities Over 250 m

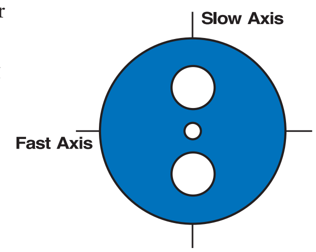
PM Fiber, Panda: 460 – 1100 nm

These polarization-maintaining fibers are designed for transmission of visible or NIR wavelengths. Their panda stress rod structure typically allows for tighter manufacturing tolerances than other PM fiber types. As a result, splicing and coupling can be done more reproducibly. Each of these fibers is available as a patch cable on pages 1010 - 1012. If you wish to create your own patch cable using these fibers, we offer the 301255D1 adjustable key FC/PC connector on page 1142.

Have you seen our...

PM460-HP, PM630-HP, and PM780-HP Patch Cables

See pages 1010 - 1012



Panda PM Fiber Cross Section

ITEM #	OPERATING WAVELENGTH*	MODE FIELD DIAMETER*	CUTOFF WAVELENGTH	BEAT LENGTH	ATTENUATION	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL See Page 1154
PM460-HP	460 - 700 nm	3.3 ± 0.5 µm @ 515 nm	410 ± 40 nm	1.3 mm @ 460 nm	<100 dB/km @ 488 nm	125 µm ± 1 µm	245 ± 15 µm	T06S13
PM630-HP	620 - 850 nm	4.5 ± 0.5 µm @ 630 nm	570 ± 50 nm	1.8 mm @ 630 nm	<15 dB/km @ 630 nm	125 µm ± 1 µm	245 ± 15 µm	T06S13
PM780-HP	770 - 1100 nm	5.3 ± 1.0 µm @ 850 nm	710 ± 60 nm	2.4 mm @ 850 nm	<4 dB/km @ 850 nm	125 µm ± 1 µm	245 ± 15 µm	T06S13

Price Per Meter

Polarization-Maintaining Fiber, Panda by NUFERN

ITEM #*	$ 1-9 m	$ 10-49 m	$ 50-249 m	£ 1-9 m	£ 10-49 m	£ 50-249 m	€ 1-9 m	€ 10-49 m	€ 50-249 m	RMB 1-9 m	RMB 10-49 m	RMB 50-249 m
PM460-HP	$ 27.30	$ 23.21	$ 19.11	£ 19.66	£ 16.71	£ 13.76	€ 23,76	€ 20,19	€ 16,63	¥ 217.59	¥ 184.95	¥ 152.31
PM630-HP	$ 19.60	$ 16.66	$ 13.72	£ 14.12	£ 12.00	£ 9.88	€ 17,06	€ 14,50	€ 11,94	¥ 156.22	¥ 132.79	¥ 109.35
PM780-HP	$ 19.60	$ 16.66	$ 13.72	£ 14.12	£ 12.00	£ 9.88	€ 17,06	€ 14,50	€ 11,94	¥ 156.22	¥ 132.79	¥ 109.35

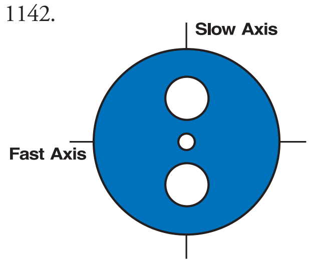
*Call for Quantities Over 250 m

PM Fiber, Panda: 970 - 1625 nm

Polarization-maintaining fibers with panda stress rods are most commonly used in telecom applications. The fibers here are designed for operation between 970 nm and 1625 nm. Each of these fibers is available as a patch cable on pages 1010 - 1012. If you wish to create your own patch cable using these fibers, we offer the 301255D1 adjustable key FC/PC connector on page 1142.

Features and Benefits

- Tighter Optical and Geometrical Tolerances
- Proof Tested at 200 kpsi



Panda PM Fiber

ITEM #	OPERATING WAVELENGTH*	MODE FIELD DIAMETER*	CUTOFF WAVELENGTH	BEAT LENGTH	ATTENUATION	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL See Page 1154
PM980-XP	970 - 1550 nm	6.6 µm @ 980 nm	920 ± 50 nm	≤2.7 mm @ 980 nm	≤2.5 dB/km @ 980 nm	125 µm ± 1 µm	245 µm ± 15 µm	T06S13
PM1300-HP	1270 - 1625 nm	9.5 µm @ 1300 nm	1200 ± 70 nm	≤4 mm @ 1300 nm	≤1.0 dB/km @ 1300 nm	125 µm ± 1 µm	245 µm ± 15 µm	T06S13
PM1550-HP	1440 - 1625 nm	10.5 µm @ 1550 nm	1370 ± 70 nm	≤5 mm @ 1550 nm	<1.0 dB/km @ 1550 nm	125 µm ± 1 µm	245 µm ± 15 µm	T06S13

*Mean value calculated from the relative specifications

Polarization-Maintaining Fiber, Panda by NUFERN

Price Per Meter

ITEM #*	$ 1-9 m	$ 10-49 m	$ 50-249 m	£ 1-9 m	£ 10-49 m	£ 50-249 m	€ 1-9 m	€ 10-49 m	€ 50-249 m	RMB 1-9 m	RMB 10-49 m	RMB 50-249 m
PM980-XP	$ 24.50	$ 20.83	$ 17.15	£ 17.64	£ 15.00	£ 12.35	€ 21,32	€ 18,12	€ 14,93	¥ 195.27	¥ 165.98	¥ 136.69
PM1300-HP	$ 24.50	$ 20.83	$ 17.15	£ 17.64	£ 15.00	£ 12.35	€ 21,32	€ 18,12	€ 14,93	¥ 195.27	¥ 165.98	¥ 136.69
PM1550-HP	$ 24.50	$ 20.83	$ 17.15	£ 17.64	£ 15.00	£ 12.35	€ 21,32	€ 18,12	€ 14,93	¥ 195.27	¥ 165.98	¥ 136.69

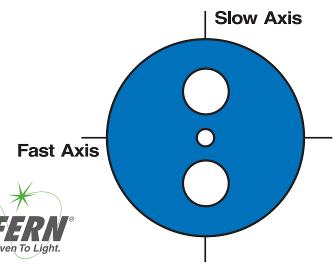
*Call for Quantities Over 250 m

Polarization-Maintaining Photosensitive Fiber: 970 - 1170 nm

- Low Attenuation
- All PM Attributes with Enhanced Photosensitivity
- High Lot-to-Lot Uniformity

This PM Photosensitive Fiber is designed for use in pump diodes, couplers, and multiplexers. Due to its photosensitive and polarization-maintaining attributes, writing time is substantially reduced.

Panda PM Fiber Cross Section



ITEM #	PRICE/m	$	£	€	RMB
PS-PM980	1 to 9 m	$ 30.70	£ 22.11	€ 26,71	¥ 244.68
	10 to 49 m	$ 26.10	£ 18.79	€ 22,71	¥ 207.98
	50 to 249 m	$ 21.49	£ 15.48	€ 18,70	¥ 171.28

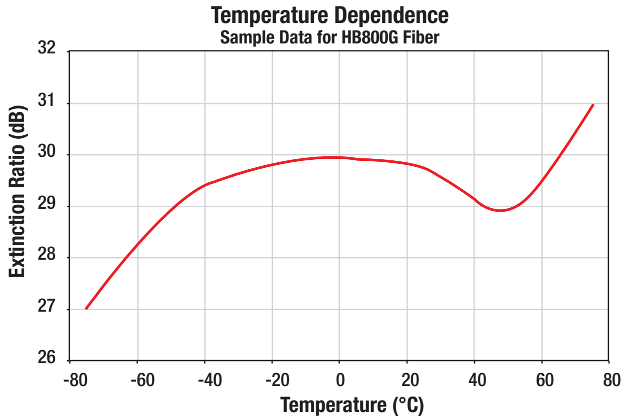
ITEM #	OPERATING WAVELENGTH*	MODE FIELD DIAMETER	CUTOFF WAVELENGTH	BEAT LENGTH	ATTENUATION	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL See Page 1154
PS-PM980	970 - 1170 nm	6.6 ± 1.0 µm @ 980 nm	900 ± 70 nm	≤3.3 mm @ 980 nm	≤3.0 dB/km @ 980 nm	125 µm	245 µm	T06S13

*Typically, the fiber will operate single mode for ~ 200 nm above the cutoff wavelength.

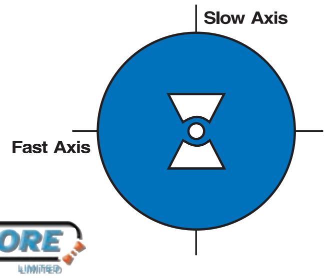
Bend-Insensitive PM Fiber, Bow Tie: 800 - 1000 nm

Bend-Insensitive Low-Temperature Fiber

Fibercore has designed polarization-maintaining fibers for fiber optic gyroscope (FOG) applications. This fiber has 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, this PM fiber integrates a dual-layer acrylic coating that increases the low-temperature performance. Extinction ratios of 29.5 dB at -40 °C and -28.5 dB at -60 °C are typical for this fiber.



Bow-Tie PM Fiber Cross Section



High-Performance, Low-Temperature, IR PM Fiber

ITEM #	PRICE/m	$	£	€	RMB
HB800G	1 to 9 m	$ 18.80	£ 13.54	€ 16,36	¥ 149.84
	10 to 49 m	$ 15.98	£ 11.51	€ 13,91	¥ 127.37
	50 to 249 m	$ 13.16	£ 9.48	€ 11,45	¥ 104.89

Polarization-Maintaining Fiber, High-Performance, Low-Temperature

ITEM #	OPERATING WAVELENGTH[a]	MODE FIELD DIAMETER[b]	CUTOFF WAVELENGTH	BEAT LENGTH[c]	ATTENUATION	NA	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL See Page 1154
HB800G	800 - 1000 nm	4.2 µm @ 830 nm	660 - 800 nm	<1.5 mm @ 633 nm	<5 dB/km @ 830 nm	0.14 - 0.18	80 µm ± 1 µm	170 µm ± 5%	T04S10

a Typical operating wavelengths - The single mode operating window is ~200 nm above the cutoff wavelength if dual mode effects are minimized near the cutoff wavelength and bend losses are minimized at long wavelengths.

b Mean value calculated from the relative specifications

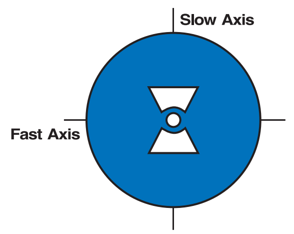
c Measured at 633 nm

PM Fiber, Bow Tie: 980 - 1750 nm

Polarization-maintaining fibers with bow-tie stress rods are commonly used in sensor applications. When mating a PM fiber to an existing fiber, it is desirable to match the stress rod structure of both fibers, thus choosing a bow-tie stress rod fiber is typically preferable.

The HB980T has been specifically designed for the polarization multiplexing of EDFA pump lasers. Alternatively, the HB1250T and HB1500T are well suited for laser pigtailing due to their large mode field diameters.

These fibers are designed for NIR applications. Each fiber here is compatible with our 301255D1 adjustable key FC/PC connector on page 1142.



Bow-Tie Fiber Cross Section

ITEM #	OPERATING WAVELENGTH	MODE FIELD DIAMETER	CUTOFF WAVELENGTH	BEAT LENGTH	ATTENUATION	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL See Page 1054
HB980T	980 - 1200 nm	6.0 µm @ 980 nm	870 - 970 nm	<2 mm @ 633 nm	<3 dB/km @ 980 nm	125 µm ± 1 µm	245 µm ± 5%	T06S13
HB1250T	1300 - 1650 nm	9.0 µm @ 1310 nm	1100 - 1290 nm	<2 mm @ 633 nm	<2 dB/km @ 1310 nm	125 µm ± 1 µm	400 µm ± 5%	T06S16
HB1500T	1550 - 1750 nm	10.5 µm @ 1550 nm	1290 - 1540 nm	<2 mm @ 633 nm	<2 dB/km @ 1550 nm	125 µm ± 1 µm	400 µm ± 5%	T06S16

Price Per Meter

Polarization-Maintaining Fiber, Bow-Tie by FIBERCORE

ITEM #*	$ 1-9 m	$ 10-49 m	$ 50-249 m	£ 1-9 m	£ 10-49 m	£ 50-249 m	€ 1-9 m	€ 10-49 m	€ 50-249 m	RMB 1-9 m	RMB 10-49 m	RMB 50-249 m
HB980T	$ 18.80	$ 15.98	$ 13.16	£ 13.54	£ 11.51	£ 9.48	€ 16,36	€ 13,91	€ 11,45	¥ 149.84	¥ 127.37	¥ 104.89
HB1250T	$ 18.80	$ 15.98	$ 13.16	£ 13.54	£ 11.51	£ 9.48	€ 16,36	€ 13,91	€ 11,45	¥ 149.84	¥ 127.37	¥ 104.89
HB1500T	$ 18.80	$ 15.98	$ 13.16	£ 13.54	£ 11.51	£ 9.48	€ 16,36	€ 13,91	€ 11,45	¥ 149.84	¥ 127.37	¥ 104.89

*Call for Quantities Over 250 m

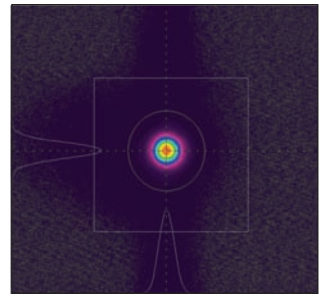
Fiber Selection Guide

Doped Fiber Selection Guide

Highly Doped Yb Fibers for Lasers and Amplifiers (Page 1 of 2)

Liekki DND Technology

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



TYPICAL BEAM QUALITY FOR YB1200-20/400DC (M^2 = 1.1)

The YB1200 and YB2000 families of highly doped ytterbium fibers are designed for fiber lasers and continuous wave (CW) and pulsed fiber amplifiers that operate in the 1 µm wavelength range with output powers from 1 mW to >100 W. These fibers feature high-pump absorption, good beam quality, high resistance to photodarkening, and excellent usability.

The double clad fibers feature a low-index fluoroacrylate coating with >0.46 NA. Fluorosilicate-coated all-glass variants are available for demanding high-power applications.

Liekki also manufactures matched passive fibers that are designed to match to the commercially available large-mode-area (LMA) active fibers presented here. They will maintain excellent beam quality when incorporated into fiber lasers or amplifiers. See page 1038 for more details.

Features and Benefits

- Match Industry Standard Active Fiber Geometries with Ø125, Ø250, or Ø400 µm Cladding
- 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
- Ideal for Use with LMA Fibers

Do you need an...

LMA-Matched Fiber

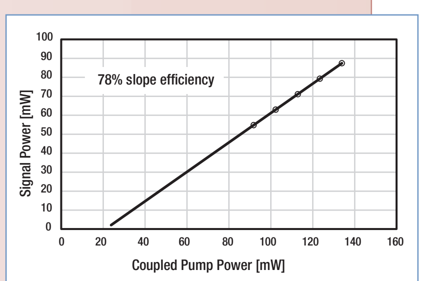
Core Size Options
- Ø10 µm
- Ø20 µm
- Ø25 µm

See page 1038

Core-Pumped Single Mode Fiber

YB1200-4/125

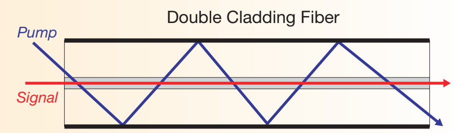
Liekki YB1200-4/125 is a highly doped ytterbium fiber for low noise, low nonlinearity preamplifiers and lasers. The fiber is compatible with low-cost pump diodes and standard single mode passive fibers.



Why Use Double Cladding Fiber?

- Low-Cost and High-Power Stripe and Bar Pump Lasers can be used to Reach Kilowatt-Level Pump Powers
- Diffraction-Limited Output with >80% Optical-to-Optical Efficiencies
- All Configurations Possible: CW Lasers, Pulsed Lasers, CW Amplifiers, Pulsed Amplifiers, and MOPAs

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

Core-Pumped SM Fiber

ITEM #	CLADDING GEOMETRY	ABSORPTION @ 920 nm*	MODE FIELD DIAMETER**	CLADDING DIAMETER	COATING DIAMETER	CUTOFF WAVELENGTH	CORE NA
YB1200-4/125	Round	280 dB/m	4.4 µm @ 1060 nm	125 ± 2 µm	245 ± 15 µm	1010 ± 70 nm	0.2

*Core Absorption, Core-Pumped Fiber **±0.8 µm

Double Cladding SM and MM Fibers

ITEM #	CLADDING GEOMETRY	ABSORPTION @ 920 nm*	CORE DIAMETER	CLADDING DIAMETER**	COATING DIAMETER (SECOND CLAD)	CLADDING NA	CORE NA
YB1200-6/125DC	Octagonal	0.6 ± 0.2 dB/m	5.5 ± 0.5 µm	125 ± 2 µm	245 ± 15 µm	>0.46	0.15 ± 0.01
YB1200-10/125DC		1.8 ± 0.4 dB/m	10 ± 1 µm	125 ± 2 µm	245 ± 15 µm		0.08 ± 0.01
YB1200-20/400DC		0.7 ± 0.2 dB/m	20 ± 2 µm	400 ± 15 µm	500 ± 15 µm		0.07 ± 0.01
YB1200-25/250DC		2.5 ± 0.7 dB/m	25 ± 2.5 µm	250 ± 15 µm	350 ± 15 µm		0.07 ± 0.01
YB2000-10/125DC		2.0 ± 0.4 dB/m	10 ± 1.0 µm	125 ± 2 µm	245 ± 15 µm		0.12 ± 0.02

*Cladding Absorption, Double Clad Fibers **Flat to Flat

Highly Doped Yb Fibers for Lasers and Amplifiers (Page 2 of 2)

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

YB1200-4/125
Liekki YB1200-4/125 is a highly doped, ytterbium fiber for low noise, low nonlinearity preamplifiers and lasers. Its telecom-like geometry makes the fiber compatible with low cost pump diodes and standard single mode passive fibers.

YB1200-6/125DC
Liekki YB1200-6/125DC is a highly doped, single mode, double-clad 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 pages 1034 - 1035 for the PM version (YB1200-6/125DC-PM).

YB1200-10/125DC
Liekki YB1200-10/125DC is a highly doped, double-clad fiber for medium to high-power fiber laser and amplifier applications. The combination of high cladding absorption and a single mode core make the fiber ideal for compact fiber-based power amplifiers. See pages 1034 - 1035 for the PM version (YB1200-10/125DC-PM).

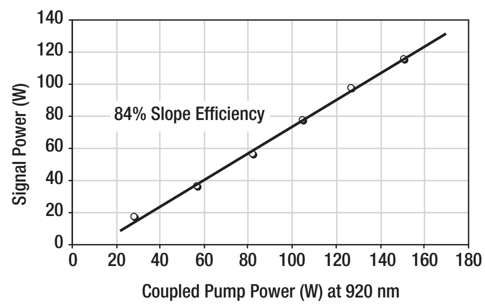
YB1200-20/400DC
Liekki YB1200-20/400DC is a highly doped, double-clad fiber for high-power fiber lasers and amplifiers. The fiber combines a large core with excellent beam quality and a Ø400 µm cladding that is compatible with industry-standard high-power pump lasers and delivery fibers.

YB1200-25/250DC
(30/250 Available Upon Request)

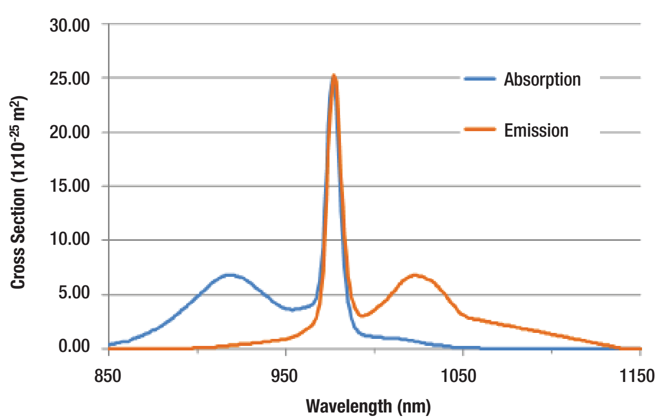
Liekki YB1200-25/250DC is a highly doped, double-clad fiber featuring very high cladding absorption, high efficiency per application length, and excellent beam quality. The fiber is ideal for high- average-power pulsed fiber amplifiers. See pages 1034 - 1035 for the PM version (YB1200-25/250DC-PM).

YB2000-10/125DC
Liekki YB2000-10/125DC is a highly doped, photodarkening-resistant fiber suitable for low-power laser or amplifier applications.

Typical Efficiency Plot (YB1200-10/125DC)



Liekki™ Fiber Yb Cross Section



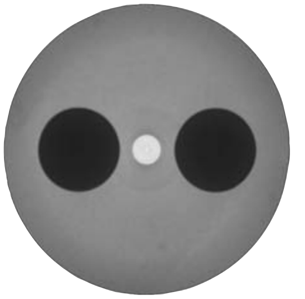
ITEM #	PRICE/m*	$	£	€	RMB
YB1200-4/125	1 to 9 m	$ 98.00	£ 70.56	€ 85,26	¥ 781.06
	10 to 49 m	$ 83.30	£ 59.98	€ 72,48	¥ 663.91
YB1200-6/125DC	1 to 9 m	$ 90.00	£ 64.80	€ 78,30	¥ 717.30
	10 to 49 m	$ 76.50	£ 55.08	€ 66,56	¥ 609.71
YB1200-10/125DC	1 to 9 m	$ 165.00	£ 118.80	€ 143,55	¥ 1,315.05
	10 to 49 m	$ 140.25	£ 100.98	€ 122,02	¥ 1,117.80
YB1200-20/400DC	1 to 9 m	$ 254.00	£ 182.88	€ 220,98	¥ 2,024.38
	10 to 49 m	$ 215.90	£ 155.45	€ 187,84	¥ 1,720.73
YB1200-25/250DC	1 to 9 m	$ 345.00	£ 248.40	€ 300,15	¥ 2,749.65
	10 to 49 m	$ 293.25	£ 211.14	€ 255,13	¥ 2,337.21
YB2000-10/125DC	1 to 9 m	$ 288.00	£ 207.36	€ 250,56	¥ 2,295.36
	10 to 49 m	$ 244.80	£ 176.26	€ 212,98	¥ 1,951.06

*Call for quantities over 250 m

Polarization-Maintaining Highly Doped Ytterbium Fibers (Page 1 of 2)

Liekki DND Technology

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



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

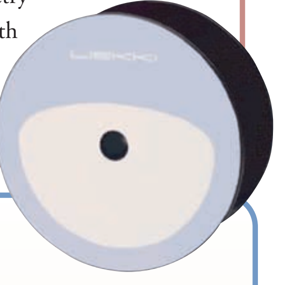
Liekki also manufactures matched passive fibers that are designed to match to commercially available large-mode-area (LMA) active fibers, such as the YB1200 product series featured here. They will maintain excellent beam quality when incorporated into fiber lasers or amplifiers. See page 1038 for details.

Features and Benefits

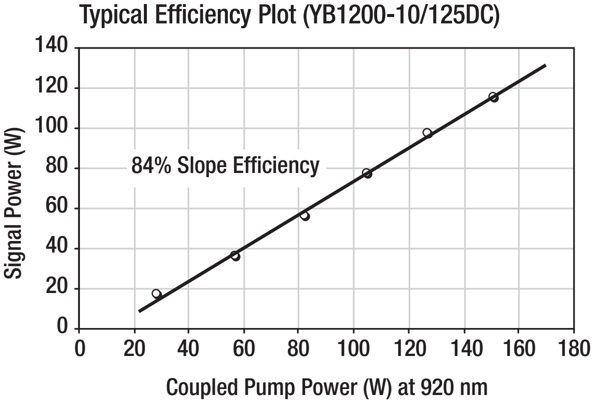
- Match Industry Standard Active Fiber Geometries with 125 and 250 µm Cladding Diameters
- Round Cladding for Easy Cleaving, Splicing, and Handling
- Low Signal and Pump Coupling Losses from Passive to Active Fiber
- Low-Index Fluoroacrylate Coating with >0.46 NA
- Excellent Beam Quality
- Ideal for Use with LMA Fibers

Features

- High Birefringence and Polarization Extinction Ratio
- Large Cores with Low NA
- High Pump Absorption
- Round Cladding Geometry
- High Mechanical Strength
- Low Nonlinear Effects
- Low Photodarkening



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



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.

YB1200-25/250DC-PM
(30/250 Available Upon Request)
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.

Polarization-Maintaining Highly Doped Ytterbium Fibers (Page 2 of 2)

Double Cladding SM and MM Fibers

ITEM #	CLADDING GEOMETRY	ABSORPTION @ 920 nm*	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER (SECOND CLAD)	CLADDING NA	CORE NA
YB1200-6/125DC-PM	Round	0.6 ± 0.2 dB/m	6 ± 2 µm	125 ± 2 µm	245 ± 15 µm	>0.46	0.15 ± 0.01
YB1200-10/125DC-PM		1.8 ± 0.4 dB/m	10 ± 1 µm	125 ± 2 µm	245 ± 15 µm		0.08 ± 0.01
YB1200-25/250DC-PM		2.6 ± 0.7 dB/m	25 ± 2.5 µm	250 ± 15 µm	350 ± 15 µm		0.07 ± 0.01

*Cladding Absorption, Double-Clad Fibers

ITEM #	PRICE/m*	$	£	€	RMB
YB1200-6/125DC-PM	1 to 9 m	$ 165.00	£ 118.80	€ 143,55	¥ 1,315.05
	10 to 49 m	$ 140.25	£ 100.98	€ 122,02	¥ 1,117.80
YB1200-10/125DC-PM	1 to 9 m	$ 295.50	£ 212.76	€ 257,09	¥ 2,355.14
	10 to 49 m	$ 251.18	£ 180.85	€ 218,53	¥ 2,001.87
YB1200-25/250DC-PM	1 to 9 m	$ 695.00	£ 500.40	€ 604,65	¥ 5,539.15
	10 to 49 m	$ 590.75	£ 425.34	€ 513,96	¥ 4,708.28

*Call for Quantities Over 50 m

Highly Doped Er Fibers, 1.53 - 1.61 µm (Page 1 of 2)

Features and Benefits

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

Thorlabs offers a wide range of highly doped erbium fibers suitable for fiber lasers and amplifiers operating in the 1.53 to 1.61 µm 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.

Structure of Octagonal Er-Doped Fibers

Highly Doped Er Fiber Specifications

ITEM #	RECOMMENDED OPERATING λ	PEAK CORE ABSORPTION*	MFD**	CLADDING DIAMETER	COATING DIAMETER	CUTOFF WAVELENGTH	NA
ER16-8/125	C-Band	16 ± 2 dB/m	9.5 ± 0.8 µm			1100 - 1400 nm	0.13
ER30-4/125		30 ± 3 dB/m	6.5 ± 0.5 µm			800 - 980 nm	0.2
ER80-4/125	C- and L-Bands	80 ± 8 dB/m	6.5 ± 0.5 µm	125 ± 2 µm	245 ± 15 µm	800 - 980 nm	0.2
ER80-8/125		80 ± 8 dB/m	9.5 ± 0.8 µm			1100 - 1400 nm	0.13
ER110-4/125		110 ± 10 dB/m	6.5 ± 0.5 µm			800 - 980 nm	0.2

* @ 1530 nm   ** Mode Field Diameter @ 1550 nm

Large-Mode-Area Erbium Doped Fiber

ER16-8/125

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

Optical Characteristics

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

ER30-4/125

Liekki ER30-4/125 is a highly doped single mode 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 20 m.

Optical Characteristics

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

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

Large-Mode-Area Erbium Doped Fiber

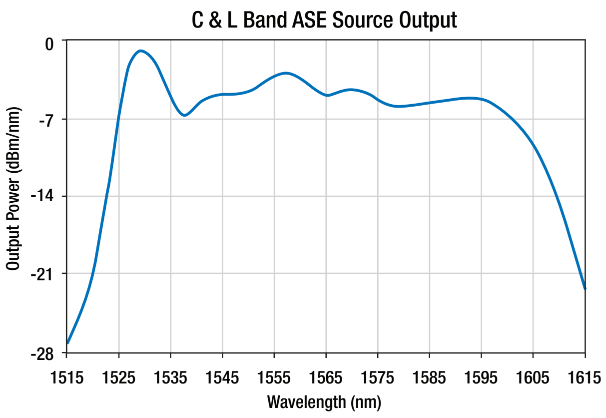
ER80-8/125

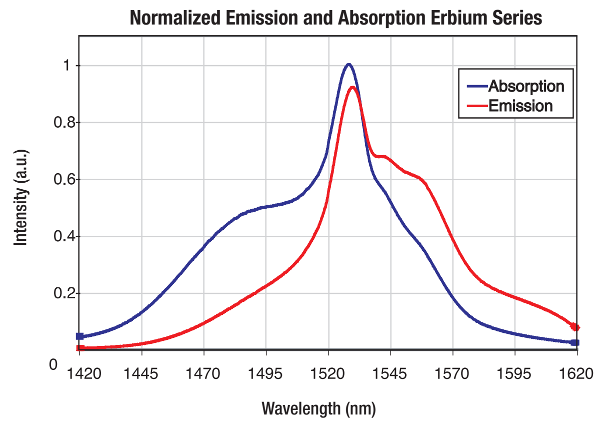
Liekki ER80-8/125 is a highly doped, single mode fiber suitable for high-power amplifiers and lasers (output power of 25 dBm or more). Good spliceability, high doping, and a large core make this fiber ideal for high-peak-power pulse amplification in the eye-safe 1.5 µm wavelength region.

Optical Characteristics

- **Peak Core Absorption at 1530 nm:** 80 ± 8 dB/m
- **Mode Field Diameter at 1550 nm:** 9.5 ± 0.8 µm
- **Core Numerical Aperture:** 0.13
- **Fiber Cutoff Wavelength:** 1100 - 1400 nm

Highly Doped Er Fibers, 1.53-1.61 µm (Page 2 of 2)





ER110-4/125

Liekki ER110-4/125 is a highly doped single mode fiber for ultra-short pulse amplifiers operating in the 1500 nm 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 Core Absorption at 1530 nm:** 110 ± 10 dB/m
- **Mode Field Diameter at 1550 nm:** 6.5 ± 0.5 µm
- **Core Numerical Aperture**: 0.2
- **Fiber Cutoff Wavelength:** 800 - 980 nm

ITEM #	PRICE/m*	$	£	€	RMB
ER16-8/125	1 to 9 m	$ 75.80	£ 54.58	€ 65,95	¥ 604.13
	10 to 49 m	$ 64.43	£ 46.39	€ 56,06	¥ 513.51
ER30-4/125	1 to 9 m	$ 22.30	£ 16.06	€ 19,41	¥ 177.74
	10 to 49 m	$ 18.96	£ 13.65	€ 16,50	¥ 151.08
ER80-4/125	1 to 9 m	$ 99.00	£ 71.28	€ 86,13	¥ 789.03
	10 to 49 m	$ 84.15	£ 60.59	€ 73,22	¥ 670.68
ER80-8/125	1 to 9 m	$ 99.00	£ 71.28	€ 86,13	¥ 789.03
	10 to 49 m	$ 84.15	£ 60.59	€ 73,22	¥ 670.68
ER110-4/125	1 to 9 m	$ 99.00	£ 71.28	€ 86,13	¥ 789.03
	10 to 49 m	$ 84.15	£ 60.59	€ 73,22	¥ 670.68

*Call for Quantities Over 50 m

Large-Mode-Area (LMA) Matching Passive Fibers

Thorlabs offers a range of passive large-mode-area (LMA) fibers matched with available active LMA fibers such as Liekki's YB1200 and YB2000 product families. 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.

Features

- Matching with Industry Standard Active Fiber Cladding Geometries of Ø125, Ø250, and Ø400 µm
- Low Signal and Pump Coupling Losses from Passive to Active Fiber
- Excellent Beam Quality

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	CORE NA	CLADDING NA	PROOF TEST	MATCHING ACTIVE FIBER	PAGE NUMBER
P-10/125DC	10 ± 1 µm	125 ± 2 µm	245 ± 15 µm	0.08 ± 0.01	>0.46	>100 kpsi	YB1200-10/125DC	1032
P-20/390DC	20 ± 2 µm	390 ± 8 µm	500 ± 15 µm	0.07 ± 0.01		>50 kpsi	YB1200-20/400DC	1032
P-25/240DC	25 ± 2.5 µm	240 ± 5 µm	350 ± 15 µm	0.07 ± 0.01		>100 kpsi	YB1200-25/250DC	1032

ITEM #	PRICE/m*	$	£	€	RMB
P-10/125DC	1 to 9 m	$ 10.70	£ 7.71	€ 9,31	¥ 85.28
	10 to 49 m	$ 9.10	£ 6.55	€ 7,92	¥ 72.49
P-20/390DC	1 to 9 m	$ 54.50	£ 39.24	€ 47,42	¥ 434.37
	10 to 49 m	$ 46.33	£ 33.36	€ 40,31	¥ 369.22
P-25/240DC	1 to 9 m	$ 46.50	£ 33.48	€ 40,46	¥ 370.61
	10 to 49 m	$ 39.53	£ 28.46	€ 34,39	¥ 315.02

* Call for quantities over 50 m.

Applications

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

Erbium-Doped C- and L-Band Fibers

Specialty Fiber Manufactured by FIBERCORE LIMITED

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 sections could be over 100 meters in length, leading to both fiber management and cost issues. MetroGain™ has a core composition with increased erbium concentration. At the pump wavelength of 980 nm, the absorption is about 12 dB/m. The co-dopants incorporated into the fiber core ensure that even with the relatively high levels of rare earth, negligible clustering occurs. The result is a high absorption, high efficiency, erbium-doped fiber with an intrinsically flat gain profile.

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

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

ITEM #	PRICE/m*	$	£	€	RMB
M5-980-125	1 to 9 m	$ 13.10	£ 9.44	€ 11,40	¥ 104.41
	10 to 49 m	$ 11.14	£ 8.02	€ 9,69	¥ 88.75
M12-980-125	1 to 9 m	$ 13.10	£ 9.44	€ 11,40	¥ 104.41
	10 to 49 m	$ 11.14	£ 8.02	€ 9,69	¥ 88.75

* Call for quantities over 50 m.

Features and Benefits

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

Fiber Selection Guide

Photonic Crystal Fiber Selection Guide

Photonic Crystal Fibers (PCF) (Page 1 of 3)

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 concept's inception, PCF is now a proven technology that is competing with conventional fibers in many applications and providing new possibilities for applications where all-glass fibers are not appropriate. In collaboration with NKT Photonics (formerly 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; typically, these differences are at most a few percent 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, even for large core diameters. However, they can be highly nonlinear, can possess unusual dispersion, or can be highly birefringent. Perhaps the most revolutionary type of PCFs are hollow-core fibers in which light is guided largely within an air core surrounded by photonic bandgap structure.

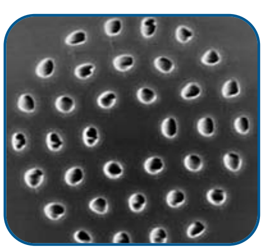
Two Types of Photonic Crystal Fiber

PCFs come in two basic varieties. While both types contain an arrangement of tens to 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 effect 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.

Solid Core Photonic Crystal Fiber



Early Large-Mode-Area Endlessly Single Mode Photonic Crystal Fiber[a]

- **Guidance Mechanism**
  Total Internal Reflection at Boundary Between High-Index Solid Core and Lower Average Index Between Air and Glass 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)

a) Birks, T. A., *et al.*, **31** 1941-1942 (1995)

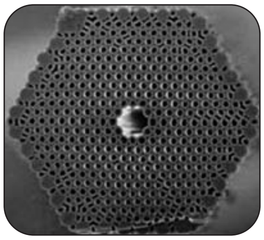
Photonic Crystal Fibers (PCF) (Page 2 of 3)

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 PCFs can 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.

Hollow Core Photonic Crystal Fiber

First air-guiding photonic bandgap hollow core fiber made by the founders of BlazePhotonics[b]

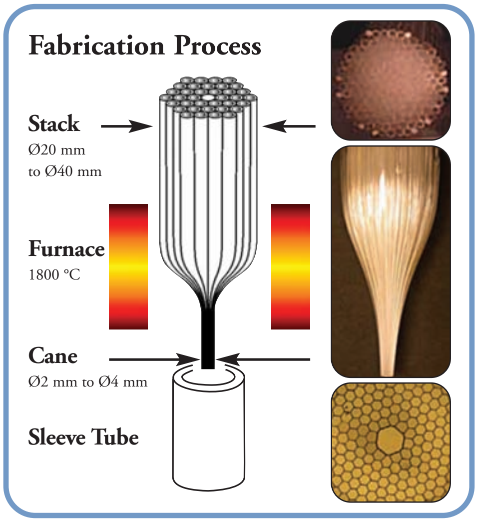


- **Guidance Mechanism**
  Photonic Bandgap Cladding Confines Light to an Evacuated or Gas-Filled Core
- **Key Optical Properties**
  - Operating Bandwidth: ±10% of Design Wavelength
  - Zero Dispersion Close to Design Wavelength
  - Near Gaussian-Shaped Fundamental Mode M^2 Value
  - Modal Index ≈1 (Virtually no Fresnel Reflection)
- **Applications**
  - Power Delivery (Short Pulses and CW)
  - Pulse Shaping and Compression

b) Cregan, R. F. *et al*, . Science **285** 1537-1539 (1999)

Fabrication

A core is embedded by replacing one or more of these capillaries with a solid rod or with a thin-walled tube in 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 arrangement 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 processed in-house from high-grade fused silica glass, giving NKT Photonics a high degree of design flexibility and control over material quality. Draw lengths of a few kilometers are typical, but there is no known limit to the length.



NKT Photonics' PCFs are fabricated by assembling fused silica capillaries into a preform stack.

Mechanical Properties and Handling

Remarkably, despite the presence of the holes, silica PCFs are mechanically robust. Winding them at a 2 - 3 mm radius, for example, does not damage the internal structure. All NKT Photonics fibers are proof tested. The fibers can be cleaved with conventional tools. 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, NKT Photonics now offers custom splicing, end face protection, and connectorization services (see page 1042).

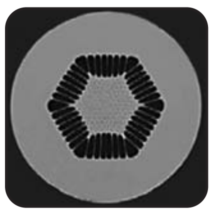
Photonic Crystal Fibers (PCF) (Page 3 of 3)

The Future

One key objective of research in this field 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 <2 dB/km loss are now a reality,* 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.

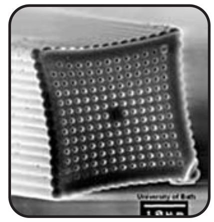
The large number of degrees of freedom in the design of PCFs, combined with the fact that small changes in the waveguide structure can sometimes have a surprisingly large effect on the optical properties of the fiber, suggest that the range of fiber designs and applications will continue to grow rapidly. Therefore, if none of our standard products are what you are looking for, NKT Photonics 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.

*B.J.Mangan. *et al.*, OFC2004, Post Deadline Paper

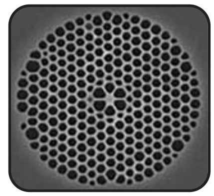


Doped, Double-Clad PCF for Lasers

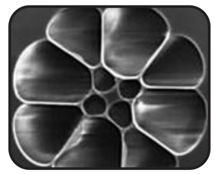
Early PCFs



Square Lattice Cladding



Dispersion-Compensating PCF



Non-Silica PCF (SF6)

Dual-Core PCF

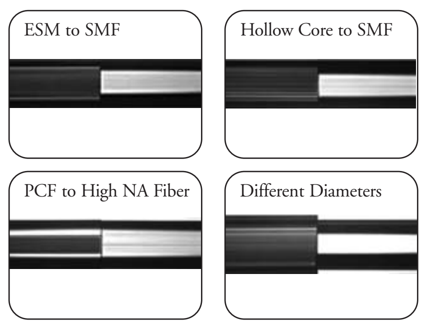
Splicing and Interfacing

NKT Photonics has optimized the process of splicing PCFs in order to maintain the integrity of the holey structure. As the fiber is heated to the splicing temperature, surface tension forces will collapse the holes in the fiber. Therefore, splicing time and temperature 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; for identical endlessly single mode fibers (e.g., ESB-12B), splices routinely yield a loss <0.15 dB. With 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, NKT Photonics offers a custom PCF-to-conventional fiber (using a range of standard fibers or customer-supplied fiber) splicing service.

Please contact us to discuss your requirement.

PCF Splicing

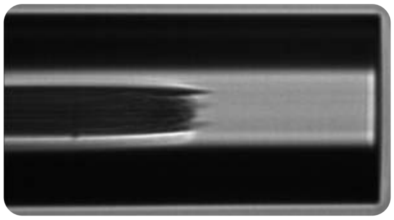


Photonic Crystal Fiber End-Sealing and Connectorization

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.

NKT Photonics 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, NKT Photonics obtains the advantageous features listed below.

Photograph of Collapsed Fiber End

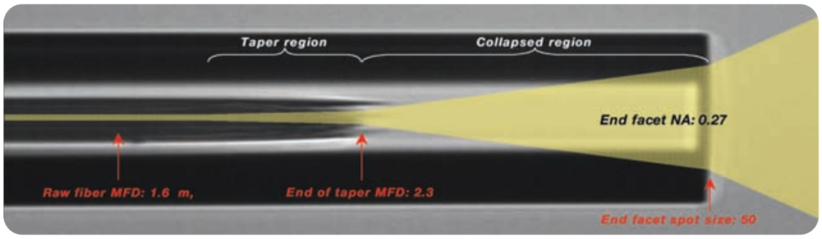


Features

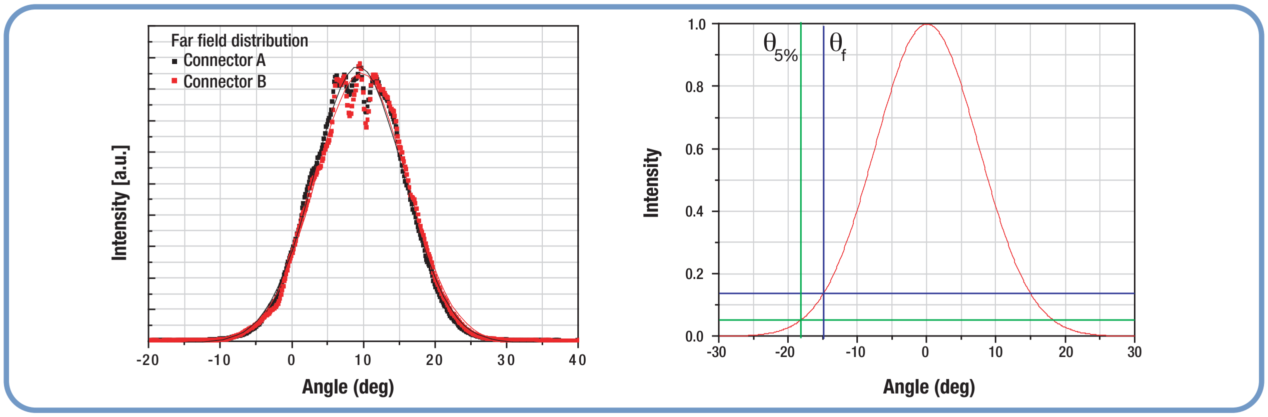
- Hermetically Sealed Fiber
- Very High Fiber End Damage Threshold due to Beam Expansion Such that the Spot Size at the End Face is ≥10X the Internal MFD
- Higher Coupling Efficiency and Stability due to Reduced NA and Increased MFD
- Can be Connectorized and Polished (FC/PC, FC/APC, and SMA905 for High Power)

Example of Nonlinear Fiber End Treatment

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 = 780 nm



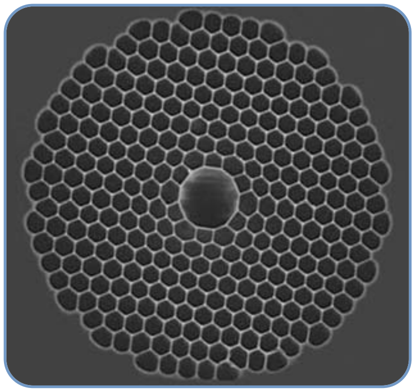
Definition of Far-Field Parameters:

Assuming a Gaussian far-field distribution, the following definitions are used:

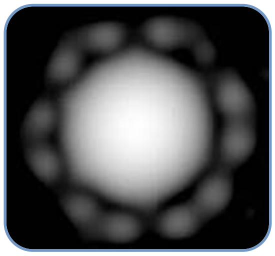
- θ_f is the angle where the peak intensity has decreased to $1/e^2$ (see figure)
- $\theta_{5\%}$ is the angle where the peak intensity has decreased to 5% (see figure)
- $\theta_{5\%} = (\ln(20)/2)^{0.5}\ \theta^*\ \theta_f = 1.2239 * \theta_f$
- $\theta_{5\%}$ NA = $\sin(\theta_{5\%})$
- $\theta_{5\%}$ MFD = $2\lambda / (\pi \sin(\theta_f))$ (Gaussian mode field diameter)

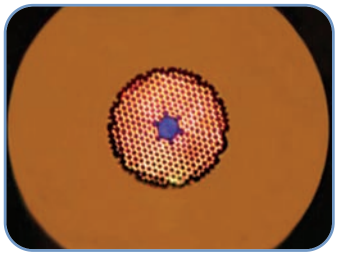
For more details, see pages 960 - 961

Hollow-Core, Photonic Crystal Fibers (Page 1 of 3)



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 in a Wide Range of Design Wavelengths
- Available with 7-Cell and 19-Cell Cores
- Operating Bandwidth is ±10% of Design Wavelength
- Attenuation from 20 dB/km (1550 nm) to 300 dB/km (830 nm)
- 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 PCF has a quasi-Gaussian intensity distribution. In the case of the 19-cell hollow-core fiber with a 1550 nm 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 PCF 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.

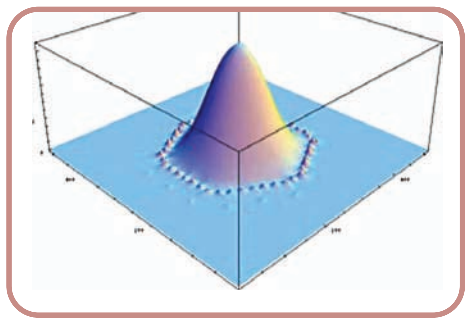
- **Chromatic Dispersion**

  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 page 1045).

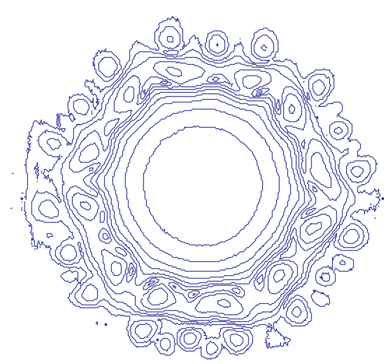
- **Attenuation**

  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, 3 dB/Contour

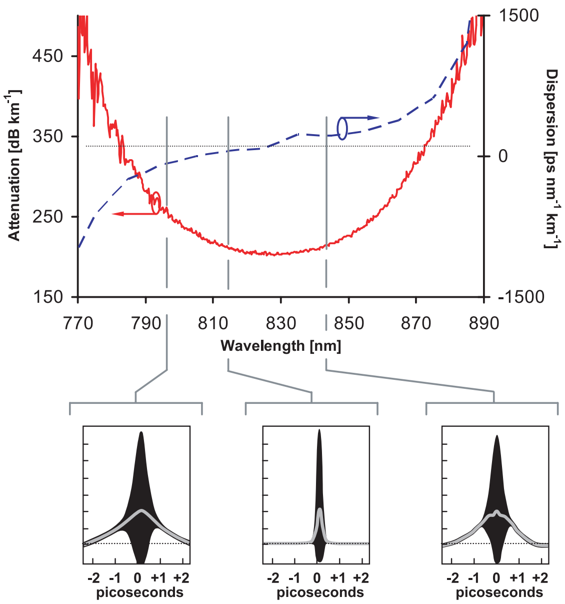


Applications

- Delivery of Ultra-Short High-Power Optical Pulses
- Pulse Compression and Pulse Shaping
- Sensors and Spectroscopy

Hollow-Core, Photonic Crystal Fibers (Page 2 of 3)

Application Example – Delivery of Femtosecond Pulses from a Ti:Sapphire Laser



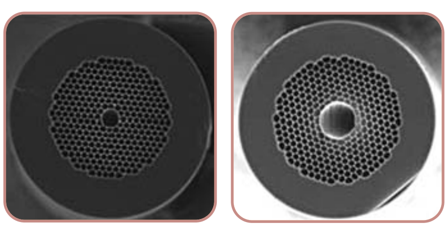
Since most of the optical power is located in the core and cladding holes and not in the glass, the nonlinearity of hollow-core fibers can be 2 to 3 orders of magnitude smaller than that of conventional fibers. These characteristics, along with the fact that dispersion crosses zero within the operating waveband, make these fibers ideally suited for the delivery of ultra-short, high-power optical pulses.

This is demonstrated here for the delivery of 150 fs, 8 nJ pulses from a Ti:Sapphire laser over a 1.5 m long fiber. Around the zero dispersion wavelength, the pulses leave the fiber virtually undistorted, despite the fact that the peak power exceeds 100 kW.

Low nonlinearity and anomalous dispersion at any wavelength also make it possible to transmit more powerful pulses in a soliton regime.[a,b] Peak powers of up to 2 MW have been transmitted without causing damage to the fiber.

[a] Ouzounov *et al.*, Science, **301**, 2003
[b] Luan *et al.*, Opt. Express, **12**, 2004

7- and 19-Cell Cores



Core Size

Hollow core fibers are available in two core sizes, which are optimized for different application requirements:

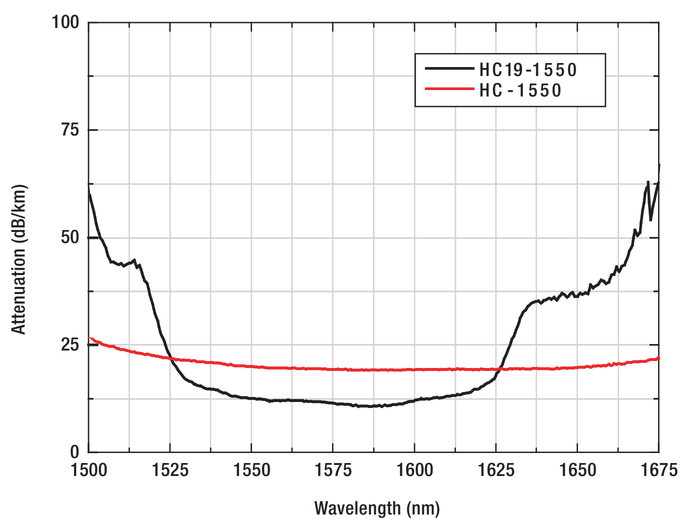
7-Cell Core

- 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

Transmission Spectra: 7-Cell and 19-Cell PCFs

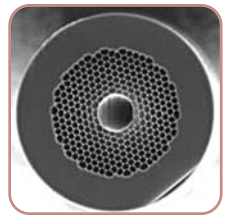


The graph above compares typical transmission spectra for a 7-cell (HC-1550) and a 19-cell core fiber (HC19-1550), both designed for operation at 1550 nm. The peaks in the transmission band of the 19-cell fiber are due to surface modes that have a propagation constant that is degenerate with the fundamental mode at certain wavelengths.

Hollow-Core Photonic Crystal Fibers (Page 3 of 3)

HC-1550
7-Cell Core

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.



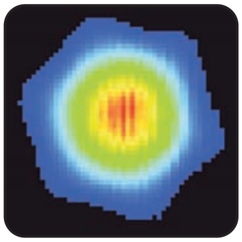
HC19-1550
19-Cell Core

ITEM #	CENTER λ	CORE DIAMETER*	MFD**	NUMERICAL APERTURE	EFFECTIVE MODE INDEX	ATTENUATION	BANDWIDTH	CLADDING DIAMETER	COATING DIAMETER
HC-800B	820 nm	7.5 µm	5.5 µm	~0.20	~0.99	<0.3 dB/km	770 - 870 nm	130 µm	220 µm
HC-1060	1060 nm	10 ± 1 µm	7.5 ± 1 µm	~0.20	~0.99	<0.1 dB/km	1015 - 1105 nm	123 ± 5 µm	220 ± 50 µm
HC-1550	1550 nm	10 ± 1 µm	7.5 µm	~0.20	~0.99	<0.03 dB/km	1450 - 1650 nm	120 µm	220 µm
HC19-1550	1570 nm	20 ± 2 µm	13 µm	~0.13 ± 0.03	~0.995	<0.02 dB/km	1530 - 1610 nm	115 µm	220 µm
HC-2000	2025 nm	14.5 ± 0.5 µm	12 ± 2 µm	~0.20	~0.99	<0.02 dB/m	1950 - 2100 nm	155 ± 5 µm	275 ± 50 µm

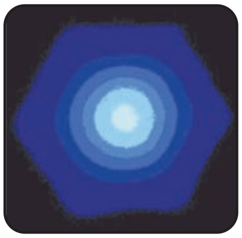
*Core formed by removing 7 (19 for HC19-1550) hexagonal unit cells of caldding.
**Full $1/e^2$ width of the near field intensity distribution.

ITEM #	PRICE/m	$	£	€	RMB	DESCRIPTION
HC-800B	1 to 9 m	$ 533.00	£ 383.76	€ 463,71	¥ 4,248.01	Hollow-Core PCF, 820 nm, 7-Cell Core
	10 to 49 m	$ 266.50	£ 191.88	€ 231,86	¥ 2,124.01	
HC-1060	1 to 9 m	$ 533.00	£ 383.76	€ 463,71	¥ 4,248.01	Hollow-Core PCF, 1060 nm, 7-Cell Core
	10 to 49 m	$ 266.50	£ 191.88	€ 231,86	¥ 2,124.01	
HC-1550	1 to 9 m	$ 533.00	£ 383.76	€ 463,71	¥ 4,248.01	Hollow-Core PCF, 1550 nm, 7-Cell Core
	10 to 49 m	$ 266.50	£ 191.88	€ 231,86	¥ 2,124.01	
HC19-1550	1 to 9 m	$ 898.00	£ 646.56	€ 781,26	¥ 7,157.06	Hollow-Core PCF, 1570 nm, 19-Cell Core
	10 to 49 m	$ 449.00	£ 323.28	€ 390,63	¥ 3,578.53	
NEW HC-2000	1 to 9 m	$ 532.00	£ 383.04	€ 462,84	¥ 4,240.04	Hollow-Core PCF, 2025 nm, 7-Cell Core
	10 to 49 m	$ 266.00	£ 191.52	€ 231,42	¥ 2,120.02	

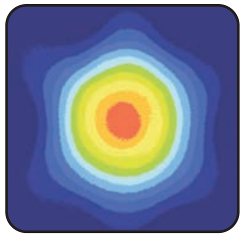
Single Mode, Large-Mode-Area, Photonic Crystal Fiber



LMA-20



LMA-25



LMA-35

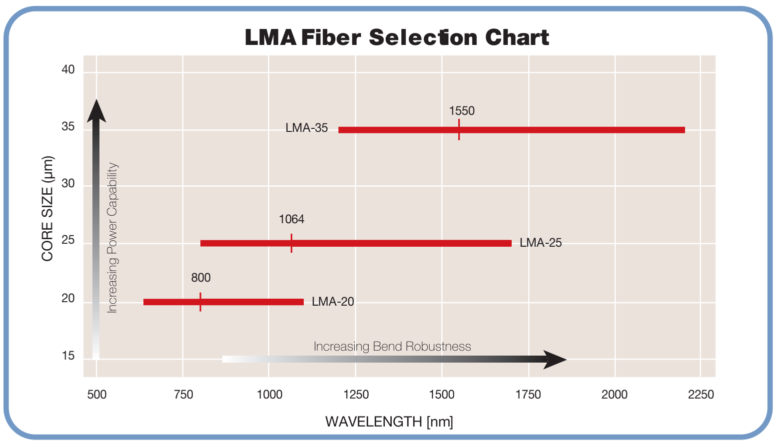
Near-Field Intensity Profiles

LMA-20: at 635 nm
LMA-25: with White Light
LMA-35: at 635 nm

Thorlabs offers a selection of Endlessly Single Mode (ESM), Large-Mode-Area (LMA) Photonic Crystal Fibers (PCFs), including Polarization-Maintaining (PM) versions (see page 1048). A conventional single mode fiber is actually multimode for wavelengths shorter than the second-mode cutoff wavelength, limiting the useful operating wavelength range in many applications. In contrast, NKT Photonics' endlessly single mode PCFs are truly single mode at all wavelengths for which fused silica is transparent.

In practice, the useful operating wavelength range is limited only by bend loss. Although the cladding possesses six-fold symmetry, the mode profile is very similar to the quasi-Gaussian fundamental mode of a conventional, axially symmetric, step-index fiber, resulting in a form overlap that is >90%. Unlike conventional fibers, these fibers are fabricated from a single material: undoped, high-purity, fused silica glass. The combination of material and very large mode area enables high power levels to be transmitted through the fiber without material damage or the adverse effects caused by the fiber's nonlinear properties.

The fibers can be spliced to standard single mode fibers or directly connectorized with standard FC/PC connectors or SMA 905 high power connectors. They can also be offered with end sealing or connectors as a custom item. Please contact your local Tech Support office for details or to receive a quotation.



Features

- Very High Average Power and Peak Power Handling Capability
- Low Nonlinearities
- Low Fiber Attenuation
- Endlessly Single Mode Operation – No Higher Order Mode Cutoff
- Mode Field Diameter is Wavelength Independent
- Available Optimized for 780, 1064, and 1550 nm (Core Sizes of 20, 25, and 35 µm, Respectively)

Optical and Mechanical Properties

PARAMETERS	LMA-20	LMA-25	LMA-35
MFD	15.0 ± 1.5 µm	19.8 ± 2.0 µm	26.0 ± 2.5 µm
Attenuation*	<7 dB/km @ 780 nm < 5 dB/km @ 1060 nm	<3.5 dB/km @ 1064 nm <1.5 dB/km @ 1550 nm	<10 dB/km @ 1550 nm
NA	0.04 ± 0.01 @ 780 nm 0.05 ± 0.01 @ 1060 nm	0.04 ± 0.01 @ 1064 nm 0.06 ± 0.01 @ 1550 nm	0.046 ± 0.01 @ 1550 nm
Core Diameter	20 ± 0.4 µm	25.2 ± 0.4 µm	35.0 ± 0.5 µm
Cladding Diameter	230 ± 5 µm	268 ± 5 µm	335 ± 5 µm
Coating Diameter	350 ± 10 µm	410 ± 10 µm	488 ± 10 µm
Coating Material	Acrylate	Acrylate	Acrylate

*Measured for bend radius of 16 cm.

Applications

- High-Power Delivery
- Short Pulse Delivery
- Mode Filtering
- Laser Pigtailing
- Multi-Wavelength Guidance
- Broadband Interferometry

ITEM #	PRICE/m	$	£	€	RMB
LMA-20	1 to 9 m	$ 128.00	£ 92.16	€ 111,36	¥ 1,020.16
	10 to 49 m	$ 79.36	£ 57.14	€ 69,05	¥ 632.50
LMA-25	1 to 9 m	$ 128.00	£ 92.16	€ 111,36	¥ 1,020.16
	10 to 49 m	$ 79.36	£ 57.14	€ 69,05	¥ 632.50
LMA-35	1 to 9 m	$ 128.00	£ 92.16	€ 111,36	¥ 1,020.16
	10 to 49 m	$ 79.36	£ 57.14	€ 69,05	¥ 632.50

NKT Photonics the power of light

Polarization-Maintaining, Large-Mode-Area Photonic Crystal Fibers

Thorlabs offers a selection of Endlessly Single Mode (ESM), Large-Mode-Area (LMA), Polarization-Maintaining (PM) Photonic Crystal Fibers (PCFs). A conventional single mode fiber is actually multimode for wavelengths shorter than the second-mode cutoff wavelength, limiting the useful operating wavelength range in many applications. In contrast, NKT Photonics' endlessly single mode, LMA, PM PCFs are truly single mode at all wavelengths for which fused silica is transparent.

In practice, the useful operating wavelength range is limited only by bend loss. Although the cladding possesses six-fold symmetry, the mode profile is very similar to the quasi-Gaussian fundamental mode of a conventional, axially symmetric, step-index fiber, resulting in a form overlap that is >90%. Unlike conventional fibers, these fibers are fabricated from a single material: undoped, high-purity, fused silica glass. The PM performance is achieved via stress-rod-applied birefringence. The combination of material and very large mode area enables high power levels to be transmitted through the fiber without material damage or the adverse effects caused by the fiber's nonlinear properties.

Features

NEW products

- Endlessly Single Mode
- Polarization Extinction Ratio >20 dB over 100 m
- Mode Field Diameter Independent of Wavelength

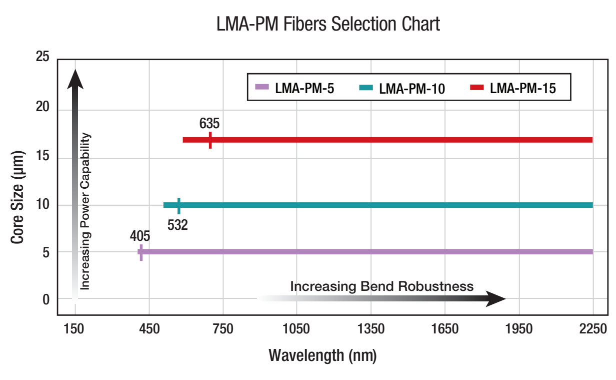
Applications

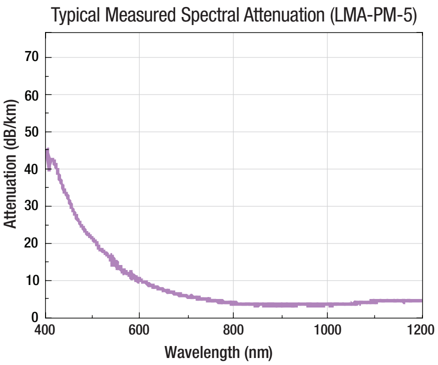
- Delivery of High-Power Broadband Radiation in a Single Spatial Mode
- Short Pulse Delivery
- Mode Filtering
- Laser Pigtailing
- Multi-Wavelength Guidance
- Sensors and Interferometers

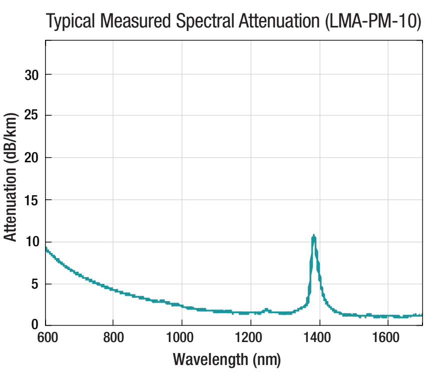
Optical and Mechanical Properties

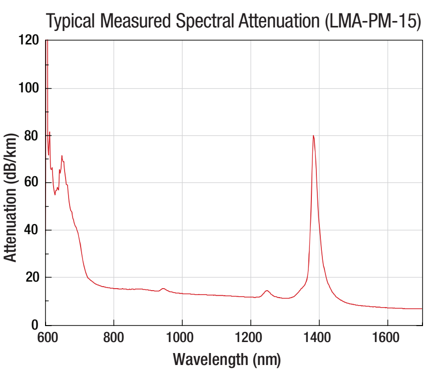
ITEM #	LMA-PM-5	LMA-PM-10	LMA-PM-15
MFD*	4.2 ± 0.5 µm	8.0 ± 0.8 µm	12.5 ± 0.5 µm
Attenuation**	<30 dB/km @ 470 nm <10 dB/km @ 800 nm	<30 dB/km @ 470 nm <5 dB/km @ 1060 nm <5 dB/km @ 1550 nm	<25 dB/km @ 800 nm <15 dB/km @ 1000 nm <10 dB/km @ 1550 nm
NA	0.09 ± 0.01 @ 470 nm	0.10 ± 0.05 @ 1060 nm	0.09 ± 0.02 @ 1060 nm
Core Diameter	5.0 ± 0.5 µm	10.0 ± 1.0 µm	15.0 ± 0.5 µm
Cladding Diameter	125 ± 3 µm	230 ± 5 µm	230 +1/-5 µm
Coating Diameter	245 ± 10 µm	350 ± 10 µm	350 ± 10 µm
Cladding Material	Pure Silica		
Coating Material	Acrylate, Single Layer		

*Full width at points in the near field where intensity has dropped to 1/e of the peak value.
**Measured for a bend radius of 16 cm.



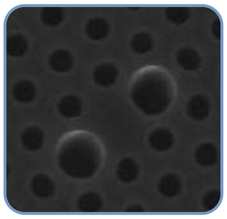






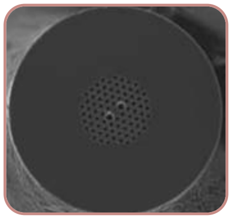
ITEM #	PRICE/m	$	£	€	RMB
LMA-PM-5	1 to 9 m	$ 130.00	£ 93.60	€ 113,10	¥ 1,036.10
	10 to 49 m	$ 80.60	£ 58.04	€ 70,13	¥ 642.39
LMA-PM-10	1 to 9 m	$ 130.00	£ 93.60	€ 113,10	¥ 1,036.10
	10 to 49 m	$ 80.60	£ 58.04	€ 70,13	¥ 642.39
LMA-PM-15	1 to 9 m	$ 234.00	£ 168.48	€ 203,58	¥ 1,864.98
	10 to 49 m	$ 145.08	£ 104.46	€ 126,22	¥ 1,156.29

Polarization-Maintaining Photonic Crystal Fiber



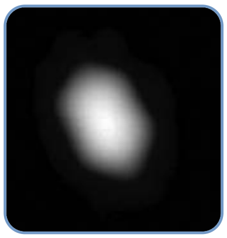
Birefringence in conventional polarization-maintaining (PM) fibers is created elasto-optically by incorporating materials with different thermal expansion properties close to the core, which generates stress when the fiber cools down in the drawing process. Strong form birefringence is caused by the noncircular core in combination with the large refractive index difference between air and glass. The result is a shorter beat length, which reduces the bend-induced coupling between polarization states and the birefringence sensitivity to temperature changes. The temperature coefficient of birefringence for these fibers is up to 30 times less than that of other leading stress-birefringent fibers.

Top & Bottom: SEM of PM-1550-01



Features

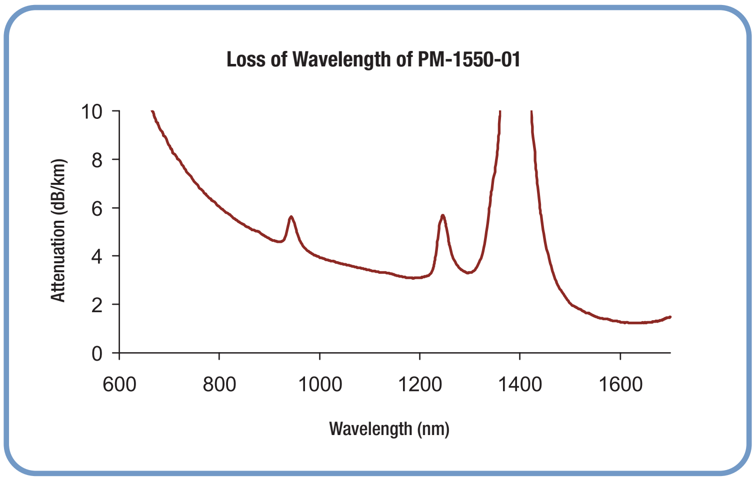
- Beat Length <4 mm (Beat Lengths of <1 mm Possible)
- Polarization Extinction Ratio (PER) >30 dB Over 100 m
- Temperature Sensitivity 30X Lower than that of Other Stress-Birefringent Fibers
- Near-Gaussian Mode Profile (Ellipticity of Approximately 1.5)



Measured Near Field Profile (Log Scale) of PM-1550-01

Applications

- Gyroscopes
- Sensors
- Interferometers



Specifications (@1550 nm)

- **Mode Field Diameter Long/Short Axis**
  - S-Polarization: 3.6/3.1 µm
  - P-Polarization: 3.6/3.1 µm
- **Attenuation:** <1 dB/km
- **Beatlength:** <4 mm (Typ.)
- **Differential Group Delay:** 2.25 ns/km
- **Polarization Extinction Ratio (PER):** >30 dB/100m (Ø155 mm Spool Typical)
- **Chromatic Dispersion**
  - S-Polarization: 54 ps/nm/km
  - P-Polarization: 59 ps/nm/km
- **Pitch, Λ (Spacing Between Holes):** 4.4 µm
- **Large Hole Diameter:** 4.5 µm
- **Small Hole Diameter:** 2.2 µm
- **Diameter of Holey Region:** 40 µm
- **Outside Diameter:** 125 µm
- **Coating Diameter (Single Layer Acrylate):** 230 µm

ITEM #	PRICE/m	$	£	€	RMB
PM-1550-01	1 to 9 m	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89
	10 to 49 m	$ 84.94	£ 61.16	€ 73,90	¥ 676.98

NKT Photonics the power of light

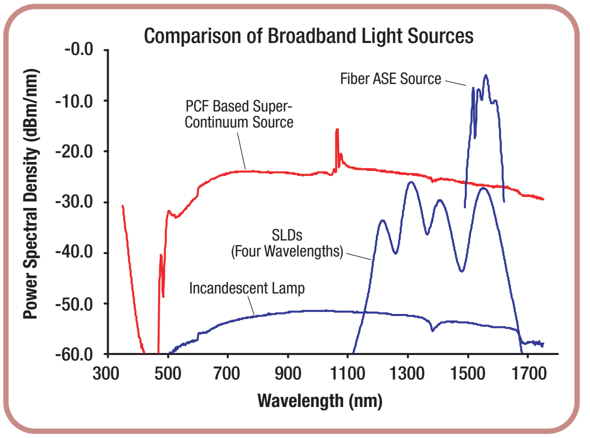
See pages 1065 - 1080

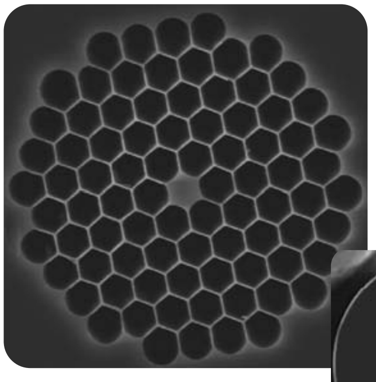
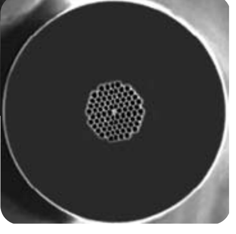
Highly Nonlinear Photonic Crystal Fiber (Page 1 of 2)

Nonlinear Fibers for Supercontinuum from Visible to NIR

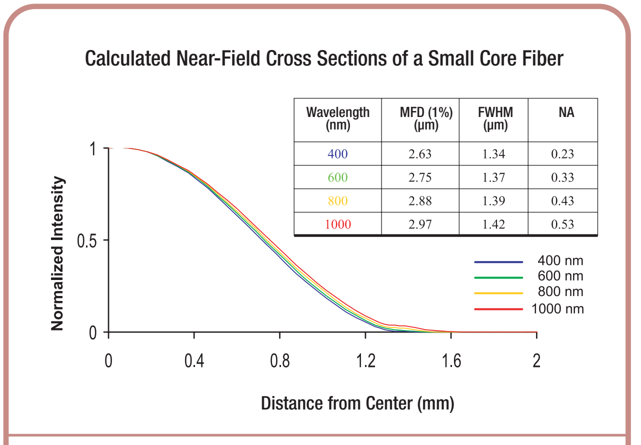
Supercontinuum (SC) sources are a new type of light source that combine the high brightness of a laser (output in a single transverse mode) with a spectral bandwidth usually associated with an incandescent source. This combination often drastically improves the signal-to-noise ratio, reduces the measurement time, or widens the spectral range in applications that require a broadband source, including high-resolution spectroscopy, the characterization of optical components, or optical coherence tomography.

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 laser and a nonlinear element with the right dispersion characteristics. The high concentration of power, long length at comparatively low loss, and ability to achieve zero dispersion at wavelengths shorter than 1,250 nm – something that is not achievable with conventional fibers – make small-core PCF (Photonic Crystal Fiber) ideally suited as the nonlinear element in an SC source. NKT Photonics offers a range of small-core fibers suitable for use with fs Ti:sapphire lasers (NL Series of fiber), 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). The graph above compares the time averaged power spectral density for supercontinuum sources to that of other typical broadband sources. Detailed application notes are available on our website.

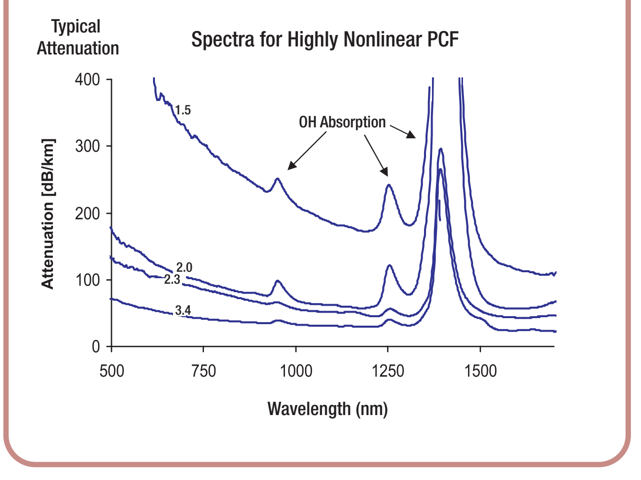


Scanning Electron Micrograph (SEM) of a Cross Section of a Highly Nonlinear Photonic Crystal Fiber



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



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

Highly Nonlinear Photonic Crystal Fiber (Page 2 of 2)

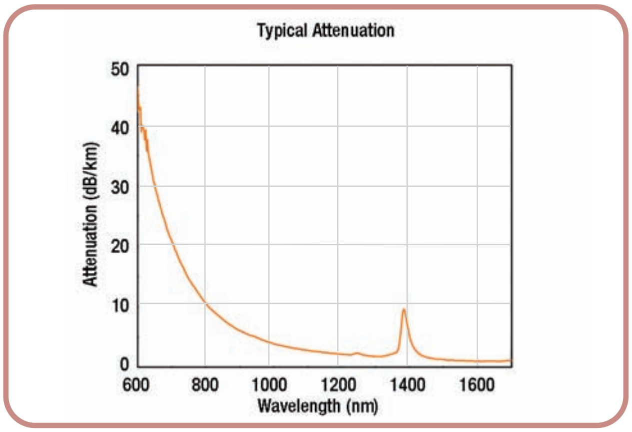
ITEM #	λ_0, ZERO DISPERSION WAVELENGTH	MFD @ λ_0	NUMERICAL APERTURE @ λ_0	EFFECTIVE NONLINEAR AREA	NONLINEAR COEFFICIENT @ λ_0	CORE DIAMETER (AVERAGE)	CLADDING DIAMETER	COATING DIAMETER
NL-1.5-670-02	670 ± 5 nm	1.1 ± .01 μm	0.5	1.23 μm^2	190 (W•km)$^{-1}$	1.5 ± 0.1 μm	106 ± 1 μm	220 μm
NL-1.7-700-02	700 ± 5 nm	1.2 ± 0.1 μm	0.45	1.51 μm^2	148 (W•km)$^{-1}$	1.7 ± 0.1 μm	116 μm	220 μm
NL-1.8-730-02	730 ± 5 nm	1.4 ± 0.1 μm	0.4	1.76 μm^2	122 (W•km)$^{-1}$	1.8 ± 0.1 μm	127 μm	220 μm
NL-2.0-745-02	745 ± 5 nm	1.4 ± 0.1 μm	0.42	2.0 μm^2	104 (W•km)$^{-1}$	2.0 ± 0.1 μm	127 μm	220 μm
NL-2.3-790-02	790 ± 5 nm	1.5 ± 0.1 μm	0.4	2.7 μm^2	75 (W•km)$^{-1}$	2.3 ± 0.1 μm	147 μm	220 μm
NL-2.4-800	800 ± 5 nm	1.5 ± 0.1 μm	0.19	2.8 μm^2	70 (W•km)$^{-1}$	2.4 ± 0.1 μm	105 ± 1 μm	230 ± 5 μm
NL-2.8-850-02	850 ± 5 nm	1.9 ± 0.1 μm	0.38	4.0 μm^2	47 (W•km)$^{-1}$	2.8 ± 0.1 μm	136 μm	220 μm
NL-3.3-890-02	890 ± 5 nm	2.1 ± 0.1 μm	0.35	4.8 μm^2	37 (W•km)$^{-1}$	3.2 ± 0.1 μm	154 μm	220 μm
NL-PM-750	Short: 750 ± 15 nm Long: 1260 ± 20 nm	1.6 ± 0.3 μm @ 780 nm	0.38 ± 0.05 @ 780 nm	–	~95 (W•km)$^{-1}$ @ 780 nm	1.8 ± 0.3 μm	120 ± 5 μm	240 ± 10 μm
SC-5.0-1040	1040 ± 10 nm	4.0 ± 0.2 μm	0.20 ± 0.05 @ 1060 nm	–	11 (W•km)$^{-1}$ @ 1060 nm	4.8 ± 0.2 μm	125 ± 3 μm	244 ± 10 μm

ITEM #	PRICE/m	$	£	€	RMB	DESCRIPTION
NL-1.5-670-02	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	1.5 μm Core Diameter, Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
NL-1.7-700-02	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	1.7 μm Core Diameter, Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
NL-1.8-730-02	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	1.8 μm Core Diameter, Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
NL-2.0-745-02	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	2.0 μm Core Diameter, Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
NL-2.3-790-02	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	2.3 μm Core Diameter, Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
NL-2.4-800	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	2.4 μm Core Diameter, Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
NL-2.8-850-02	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	2.8 μm Core Diameter, Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
NL-3.3-890-02	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	3.3 μm Core Diameter, Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
NL-PM-750	1 to 9 m	$ 1,495.00	£ 1,076.40	€ 1.300,65	¥ 11,915.15	1.8 μm Core Diameter, Polarization-Maintaining Nonlinear PCF
	10 to 49 m	$ 1,345.50	£ 968.76	€ 1.170,59	¥ 10,723.64	
SC-5.0-1040	1 to 9 m	$ 629.00	£ 452.88	€ 547,23	¥ 5,013.13	Nonlinear PCF for Supercontinuun Generation, with Nd^{3+} Laser
	10 to 49 m	$ 478.04	£ 344.19	€ 415,90	¥ 3,809.98	

See pages 1276 - 1279

Endlessly Single Mode Photonic Crystal Fiber

A conventional single mode fiber is actually multimode for wavelengths shorter than the second-mode cutoff wavelength, limiting the useful operating wavelength range in many applications. In contrast, NKT Photonics' endlessly single mode Photonic Crystal Fibers (PCFs) are truly single mode at all wavelengths for which fused silica is transparent, regardless of the core size. In practice, the useful operating wavelength range is limited only by bend loss. Although the cladding possesses six-fold symmetry, the mode profile is very similar to the quasi-Gaussian fundamental mode of a conventional axially symmetric step-index fiber resulting in a form overlap that is >90%. Unlike conventional fibers, these fibers are fabricated from a single material – undoped high-purity fused silica glass.

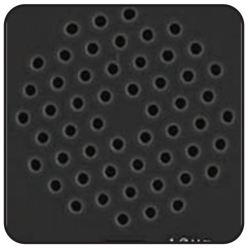


Features

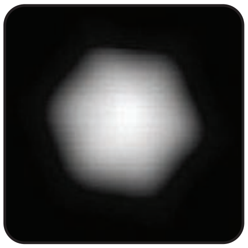
- Single Mode at All Wavelengths
- Operating Wavelength Range: 600 - 2000 nm
- Near-Gaussian Mode Profile
- Single Material
- Attenuation <0.8 dB/km for ESM-12B @ 1550 nm
- Low Bend Loss
- Standard Core Sizes: 12 µm (Other Sizes Available upon Request)
- Can be Provided with Connectors or Hermetically Sealed Ends

Applications

- Delivery of High-Power Broadband Radiation in a Single Spatial Mode
- Short Wavelength Applications (Visible and UV)
- Sensors and Interferometers



SEM of ESM-12B



Measured Near-Field Profile (log scale) of ESM-12B

Specifications

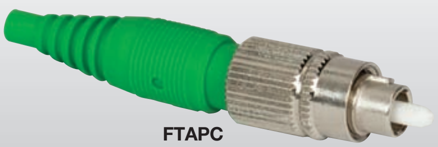
ITEM #	ESM-12B
MFD	10 ± 1 µm @ 1550 nm
Attenuation	<4 dB/km @ 1060 nm <15 dB/km @ 1384 nm <1 dB/km @ 1550 nm
NA	0.1 ± 0.05 @ 1550 nm
Core Diameter	12 ± 1 µm
Cladding Diameter	125 ± 3 µm
Coating Diameter	240 ± 15 µm
Cladding Material	Pure Silica
Coating Material	Acrylate

ITEM #	LENGTH	$	£	€	RMB
ESM-12B	1 to 9 m	$ 112.00	£ 80.64	€ 97,44	¥ 892.64
	10 to 49 m	$ 89.60	£ 64.52	€ 77,96	¥ 714.12

NKT Photonics the power of light

Have you seen our...

Light Trap Connectors



FTAPC
(FC/APC)

See page 1140

- Reduce Back Reflection of Unused Feed Through Ports
- Back Reflection Better than -50 dB
- FC/PC, FC/APC, or SMA Connector
- 1260 - 1620 nm Wavelength Range

Thorlabs' Terminating Connectors are designed to be used with feed through ports that do not have an output fiber connected to them. Light coupled into them is diffused rather than reflected back into the source, reducing the back reflection by roughly 20 dB.

Fiber Selection Guide

Multimode Fiber Selection Guide

0.19 NA Graded-Index MM Polymer Optical Fibers

Thorlabs 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 850 nm and 1300 nm. Please see pages 1063 - 1064 for detailed fiber specifications.

GIPOF50, Ø50 µm Core, No Jacket, Ø490 µm

PRICE/m	$	£	€	RMB
1 to 24 m	$ 1.27	£ 0.92	€ 1,11	¥ 10.13
25 to 99 m	$ 1.08	£ 0.78	€ 0,94	¥ 8.61
100 to 499 m	$ 0.89	£ 0.65	€ 0,78	¥ 7.09
500 to 999 m	$ 0.70	£ 0.51	€ 0,61	¥ 5.57
1000 to 1999 m	$ 0.64	£ 0.46	€ 0,56	¥ 5.07

GIPOF50-P, Ø50 µm Core, Jacketed, Ø2.9 mm

PRICE/m	$	£	€	RMB
1 to 24 m	$ 1.76	£ 1.27	€ 1,54	¥ 14.03
25 to 99 m	$ 1.50	£ 1.08	€ 1,31	¥ 11.93
100 to 499 m	$ 1.23	£ 0.89	€ 1,08	¥ 9.82
500 to 999 m	$ 0.97	£ 0.70	€ 0,85	¥ 7.72
1000 to 1999 m	$ 0.88	£ 0.64	€ 0,77	¥ 7.02

GIPOF62, Ø62.5 µm Core, No Jacket, Ø490 µm

PRICE/m	$	£	€	RMB
1 to 24 m	$ 1.49	£ 1.08	€ 1,30	¥ 11.88
25 to 99 m	$ 1.27	£ 0.92	€ 1,11	¥ 10.10
100 to 499 m	$ 1.04	£ 0.76	€ 0,91	¥ 8.32
500 to 999 m	$ 0.82	£ 0.60	€ 0,72	¥ 6.54
1000 to 1999 m	$ 0.75	£ 0.54	€ 0,65	¥ 5.94

GIPOF62-P, Ø62.5 µm Core, Jacketed, Ø2.9 mm

PRICE/m	$	£	€	RMB
1 to 24 m	$ 1.98	£ 1.43	€ 1,73	¥ 15.79
25 to 99 m	$ 1.68	£ 1.22	€ 1,47	¥ 13.42
100 to 499 m	$ 1.39	£ 1.00	€ 1,21	¥ 11.05
500 to 999 m	$ 1.09	£ 0.79	€ 0,95	¥ 8.68
1000 to 1999 m	$ 0.99	£ 0.72	€ 0,87	¥ 7.90

GIPOF120, Ø120 µm Core, No Jacket, Ø490 µm

PRICE/m	$	£	€	RMB
1 to 24 m	$ 1.84	£ 1.33	€ 1,61	¥ 14.67
25 to 99 m	$ 1.56	£ 1.13	€ 1,37	¥ 12.47
100 to 499 m	$ 1.29	£ 0.93	€ 1,13	¥ 10.27
500 to 999 m	$ 1.01	£ 0.73	€ 0,89	¥ 8.07
1000 to 1999 m	$ 0.92	£ 0.67	€ 0,81	¥ 7.34

GIPOF120-P, Ø120 µm Core, Jacketed, Ø2.9 mm

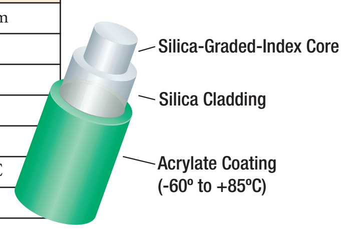
PRICE/m	$	£	€	RMB
1 to 24 m	$ 2.32	£ 1.68	€ 2,02	¥ 18.50
25 to 99 m	$ 1.97	£ 1.42	€ 1,72	¥ 15.72
100 to 499 m	$ 1.62	£ 1.17	€ 1,42	¥ 12.95
500 to 999 m	$ 1.28	£ 0.92	€ 1,12	¥ 10.17
1000 to 1999 m	$ 1.16	£ 0.84	€ 1,01	¥ 9.25

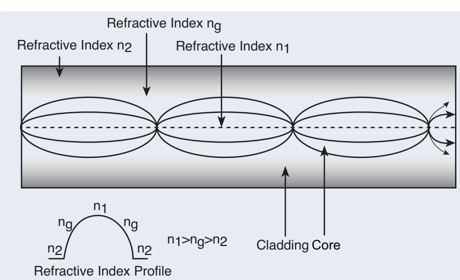
0.20 NA Graded-Index MM Fiber, 50 µm Core

PRODUCT SPECIFICATIONS	
Operating Wavelength	750 - 1450 nm
Numerical Aperture	0.200 ± 0.015
Attenuation	≤2.3 dB/km @ 850 nm 0.6 dB/km @ 1300 nm
Bandwidth*	≥850 MHz-km @ 850 nm
Key Geometric Specifications	
Core Diameter	50.0 ± 2.5 µm
Cladding Diameter	125 ± 1 µm
Coating Diameter	245 ± 5 µm
Core-Clad Concentricity	≤1.5 µm
Coating Material	Acrylate
Operating Temperature	-60 to 85 °C
Proof Test	≥100 kpsi

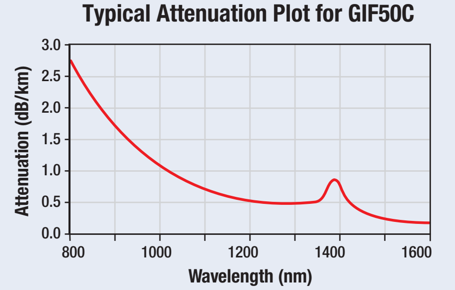
*Laser source (for LED sources at 850 nm, the overfilled bandwidth is ≥1500 MHz-km, while at 1300 nm, the overfilled bandwidth is ≥500 MHz-km).

Graded-index multimode fiber provides significantly less bend loss than traditional multimode fibers. The GIF50C graded-index multimode fiber has a Ø50 µm core with a mechanically strippable acrylate coating (245 µm outer diameter). GIF50C supports serial transmission rates of 10 Gb/s over distances of 300 m in the 850 nm window.





Typical Attenuation Plot for GIF50C



NEW version

Popular Compatible Connectors (See Pages 1142 - 1143)

SMA	FC/PC
10125A	30128E2

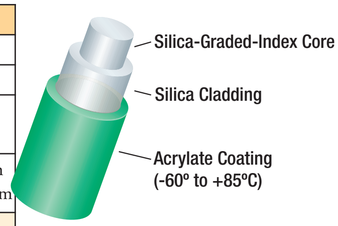
GIF50C, Ø50 µm Core*

PRICE/m	$	£	€	RMB
1 to 9 m	$ 2.45	£ 1.77	€ 2,14	¥ 19.53
10 to 49 m	$ 1.47	£ 1.06	€ 1,28	¥ 11.72
50 to 249 m	$ 0.74	£ 0.53	€ 0,64	¥ 5.86

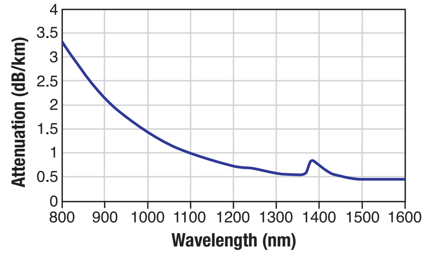
*Suggested Stripping Tool: T08S13 (See Page 1154)

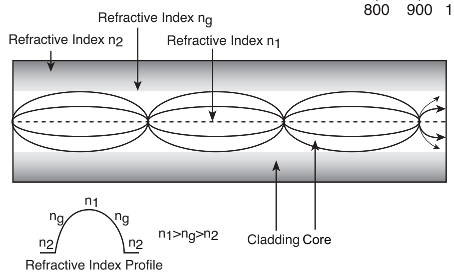
0.275 NA Graded-Index MM Fiber, 62.5 µm Core

PRODUCT SPECIFICATIONS	
Operating Wavelength	800 - 1350 nm
Numerical Aperture	0.275 ± 0.015
Attenuation	2.7 to 3.2 dB/km @ 850 nm 0.6 to 0.9 dB/km @ 1300 nm
Bandwidth	160 to 400 MHz-km @ 850 nm 300 to 1200 MHz-km @ 1300 nm
Key Geometric Specifications	**GIF625**
Core Diameter	62.5 ± 3 µm
Cladding Diameter	125 ± 2 µm
Coating Diameter	245 ± 10 µm
Core-Clad Offset	<3 µm
Coating Material	–
Operating Temperature	-60 to 85 °C



Typical Spectral Attenuation Plot for GIF625





Suggested Stripping Tool - T08S13
(See Page 1154)

Ø62.5 µm Core, Sold by the Meter

ITEM #	PRICE/m	$	£	€	RMB
GIF625	1 to 199 m	$ 2.15	£ 1.55	€ 1,88	¥ 17.14
	200 to 499 m	$ 1.08	£ 0.78	€ 0,94	¥ 8.57
	500 to 999 m	$ 0.54	£ 0.39	€ 0,47	¥ 4.29

Popular Compatible Connectors
(See Pages 1142 - 1143)

SMA	FC/PC
10125A	30128E2

Ø62.5 µm Core, Sold by the Spool

ITEM #	L	$	£	€	RMB	DESCRIPTION
GIF625-10	10 m	$ 12.32	£ 8.87	€ 10,72	¥ 98.19	62.5 µm Core, 0.275 NA, GI Fiber, 10 m Spool
GIF625-100	100 m	$ 72.11	£ 51.92	€ 62,74	¥ 574.72	62.5 µm Core, 0.275 NA, GI Fiber, 100 m Spool
GIF625-1000	1000 m	$ 381.17	£ 274.44	€ 331,62	¥ 3,037.92	62.5 µm Core, 0.275 NA, GI Fiber, 1000 m Spool

See page 1016

0.10 NA High-Power, Step-Index MM Fibers

Features

- Ideal for High-Power, High-Performance Laser Transmission up to 350 Watts CW
- Long Operation without Photodarkening in the UV Range
- Undoped, Pure Silica Core, Fluorine-Doped Cladding

HPSC fiber is specifically designed for high power applications such as laser-projection-based technologies as well as advanced sensing applications. These fibers provide ultra-high stability during high-power laser transmission.

The fiber is protected with an enhanced coating material that guarantees long-term performance and reliability. The dual-layer acrylate material is easy to use and easy to strip, thereby leaving no residue. This fiber is manufactured utilizing an MCVD process, which yields an ultra-pure core region. Due to this, impurities that cause photodarkening are not present. Structural defects can also cause photodarkening, but these are kept low through a high-quality manufacturing process.

PRODUCT SPECIFICATIONS		
Operating Wavelength	280 to 750 nm	
Numerical Aperture	0.100 ± 0.015	
Attenuation at 600 nm	≤20 dB/km	
CW Damage Threshold (@ 1064 nm)	350 W	
Pulsed Damage Threshold (10 ns Pulse @ 1064 nm)	2.3 kW Peak Pulsed Power (30 W/µm²)	
Core Index of Refraction (@ 633 nm)	1.4570	
Cladding Index of Refraction (@ 633 nm)	1.4537	
Time for Transmission to Drop 90%*	>5 hrs**	
Key Geometric Specifications	**HPSC10**	**HPSC25**
Core Diameter	10.0 ± 3.0 µm	25.0 ± 3.0 µm
Cladding Diameter	125.0 ± 2.0 µm	
Coating Diameter	245.0 ± 10 µm	
Core/Clad Concentricity	<1.0 µm	
Coating	Two-Layer Acrylate	
Operating Temperature	-60 to 85 °C	
Proof Test	100 kpsi	

* The amount of time it takes for the transmitted power to drop to 90% of the initial transmitted power if 1.0 W of input is used at 446 nm. Note: this drop is permanent.

** An ultra-high purity form of this fiber is available upon request that has a time for transmission of >40 hrs. (Please call our technical support staff to request this version of the multimode fiber).

Popular Compatible Connectors
(See Pages 1142 - 1143)

SMA	FC/PC
10125A	30128E2

HPSC10, Ø10 µm Core

PRICE/m	$	£	€	RMB
1 to 9 m	$ 21.50	£ 15.48	€ 18,71	¥ 171.36
10 to 49 m	$ 20.43	£ 14.71	€ 17,77	¥ 162.79
50 to 249 m	$ 18.71	£ 13.47	€ 16,28	¥ 149.08

HPSC25, Ø25 µm Core

PRICE/m	$	£	€	RMB
1 to 9 m	$ 33.74	£ 24.30	€ 29,36	¥ 268.91
10 to 49 m	$ 32.05	£ 23.08	€ 27,89	¥ 255.47
50 to 249 m	$ 29.35	£ 21.14	€ 25,54	¥ 233.95

0.22 NA Step-Index MM Fibers, Solarization-Resistant

NEW products

- Broad UV to NIR Spectral Range: 180 – 1150 nm
- Pure Silica Core, Doped-Silica Cladding, Polyimide Buffer
- Can be used at Temperatures up to 300 °C

Our 0.22 NA solarization-resistant, multimode fiber exhibits impressive performance and transmission from the UV to the NIR (180 to 1150 nm). With exceptional UV radiation resistance compared to standard fibers, these multimode fibers are ideal for use in applications such as spectroscopy for pollution analysis and chemical processing, UV photolithography, and medical diagnostics. The polyimide buffer allows this fiber to be used at temperatures up to 300 °C.

Because of the polyimide buffer, it is not possible to mechanically strip these fibers. Please contact tech support for assistance.

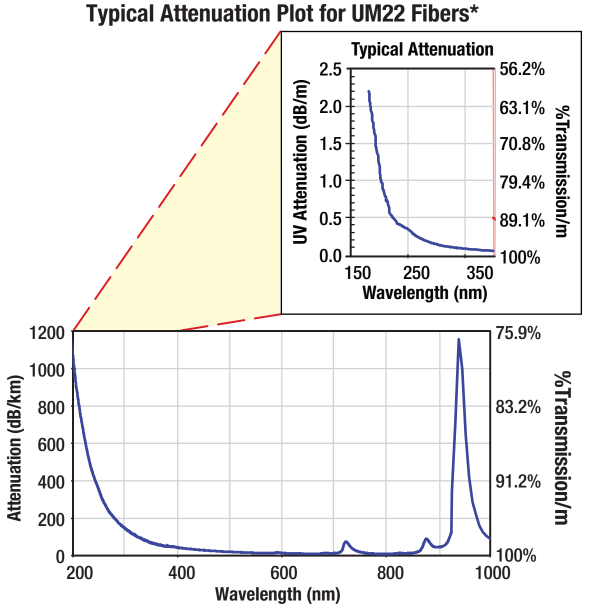
Solarization-Resistant Patch Cables

See page 1015

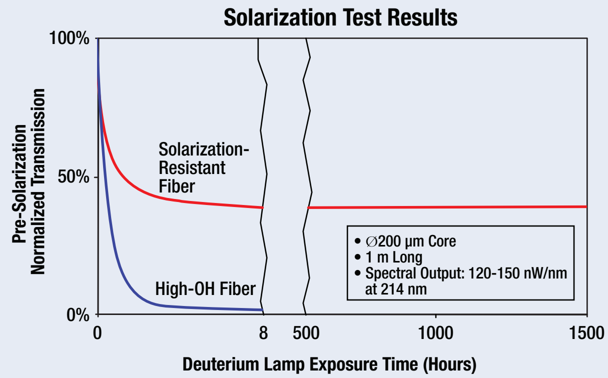
Popular Compatible Connectors (See Pages 1142 - 1143)

FIBER CLAD DIAMETER	SMA	FC/PC
110 µm	10125A	30128E2
220 µm	10230A	30126G2-230
330 µm	10340A	30126G2-340
440 µm	10450A	30126G2-450
660 µm	10670A	30126G2-670

Typical Attenuation Plot for UM22 Fibers*



*Attenuation was measured using new fiber. If your appreciation is in the UV spectral region see the Solarization Test Results to the right for information on the long-term transmission performance of the fiber.



In this plot the transmission through a standard High-OH MM fiber and a UM22-200 fiber are normalized to 100% at the beginning of the test. The output of a Deuterium lamp is coupled into both fibers and transmitted intensity is measured as a function of time. As the plot indicates, UM22 fibers are resistant to solarization and thus maintain a much higher level of transmission after prolonged exposure to UV light. Please note that any transmission loss due to solarization of the fiber is permanent.

UV to NIR, Solarization-Resistant, Multimode Fibers

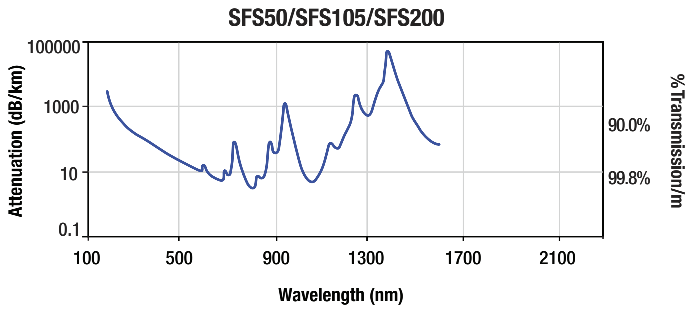
ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NUMERICAL APERTURE	PROOF TEST	BEND RADIUS SHORT TERM/LONG TERM
UM22-100	100 ± 3 µm	110 ± 3 µm	124 ± 3 µm	0.22 ± 0.02	>100 kpsi	100 / 300 x Cladding Diameter
UM22-200	200 ± 4 µm	220 ± 4 µm	239 ± 5 µm	0.22 ± 0.02	>100 kpsi	100 / 300 x Cladding Diameter
UM22-300	300 ± 6 µm	330 ± 7 µm	370 ± 10 µm	0.22 ± 0.02	>100 kpsi	100 / 300 x Cladding Diameter
UM22-400	400 ± 8 µm	440 ± 9 µm	480 ± 7 µm	0.22 ± 0.02	>100 kpsi	100 / 300 x Cladding Diameter
UM22-600	600 ± 10 µm	660 ± 10 µm	710 ± 10 µm	0.22 ± 0.02	<100 kpsi	300 / 300 x Cladding Diameter

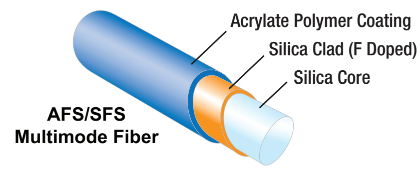
ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
UM22-100	$ 12.20	$ 10.37	$ 8.54	£ 8.79	£ 7.47	£ 6.15	€ 10,62	€ 9,03	€ 7,43	¥ 97.24	¥ 82.65	¥ 68.07
UM22-200	$ 13.40	$ 11.39	$ 9.38	£ 9.65	£ 8.21	£ 6.76	€ 11,66	€ 9,91	€ 8,17	¥ 106.80	¥ 90.78	¥ 74.76
UM22-300	$ 24.00	$ 20.40	$ 16.80	£ 17.28	£ 14.69	£ 12.10	€ 20,88	€ 17,75	€ 14,62	¥ 191.28	¥ 162.59	¥ 133.90
UM22-400	$ 39.80	$ 33.83	$ 27.86	£ 28.66	£ 24.36	£ 20.06	€ 34,63	€ 29,44	€ 24,24	¥ 317.21	¥ 269.63	¥ 222.05
UM22-600	$ 71.00	$ 60.35	$ 49.70	£ 51.12	£ 43.46	£ 35.79	€ 61,77	€ 52,51	€ 43,24	¥ 565.87	¥ 480.99	¥ 396.11

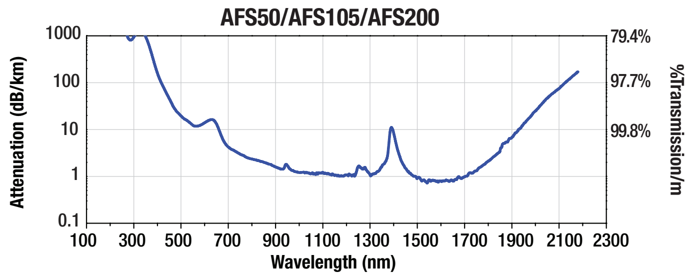
*Call for Quantities Over 250 m **Prices are given per meter

0.22 NA Step-Index MM Fibers

NEW products







Features

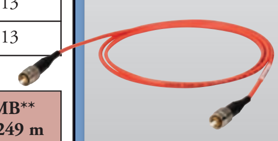
- Broad UV, VIS, and NIR Spectral Range
  - High OH: 250 - 1200 nm*
  - Low OH: 400 - 2400 nm
- Low OH Versions Ideal for Holmium and Erbium Laser Delivery

*Solarization may occur if used in the spectral region below 300 nm

Popular Compatible Connectors (See Pages 1142 - 1143)

FIBER CLAD DIAMETER	SMA	FC/PC
125 µm	10125A	30128E2
220 µm	10230A	30126G2-230

Multimode fiber with good transmission properties in the UV, VIS, and NIR spectral regions is used in a broad variety of applications including spectroscopy for pollution analysis and chemical processing, medical instrumentation, and fiber-coupled LEDs.



VIS-to-IR Transmission (Low OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NUMERICAL APERTURE	CORE/CLAD CONCENTRICITY	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
AFS50/125Y	50 µm ± 2%	125 µm*	250 µm ± 5%	0.22 ± 0.02	<1%	120/240 x Clad Diameter	T08S13
AFS105/125Y	105 µm ± 2%	125 µm*	250 µm ± 5%	0.22 ± 0.02	<1%	120/240 x Clad Diameter	T08S13
AFS200/220Y	200 µm ± 2%	220 µm ± 2%	320 µm ± 5%	0.22 ± 0.02	<1%	120/240 x Clad Diameter	T10S13

*+1 µm/-3 µm

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
AFS50/125Y	$ 4.50	$ 3.83	$ 3.15	£ 3.24	£ 2.76	£ 2.27	€ 3,92	€ 3,33	€ 2,75	¥ 35.87	¥ 30.49	¥ 25.11
AFS105/125Y	$ 2.90	$ 2.47	$ 2.03	£ 2.09	£ 1.78	£ 1.47	€ 2,53	€ 2,15	€ 1,77	¥ 23.12	¥ 19.65	¥ 16.18
AFS200/220Y	$ 7.60	$ 6.46	$ 5.32	£ 5.48	£ 4.66	£ 3.84	€ 6,62	€ 5,63	€ 4,63	¥ 60.58	¥ 51.49	¥ 42.41

*Call for Quantities Over 250 m **Prices are given per meter

UV-to-NIR Transmission (High OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NUMERICAL APERTURE	CORE/CLAD CONCENTRICITY	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
SFS50/125Y	50 µm ± 2%	125 µm*	250 µm ± 5%	0.22 ± 0.02	<1%	120/240 x Clad Diameter	T08S13
SFS105/125Y	105 µm ± 2%	125 µm*	250 µm ± 5%	0.22 ± 0.02	<1%	120/240 x Clad Diameter	T08S13
SFS200/220Y	200 µm ± 2%	220 µm ± 2%	320 µm ± 5%	0.22 ± 0.02	<1%	120/240 x Clad Diameter	T10S13

*+1 µm/-3 µm

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
SFS50/125Y	$ 4.50	$ 3.83	$ 3.15	£ 3.24	£ 2.76	£ 2.27	€ 3,92	€ 3,33	€ 2,75	¥ 35.87	¥ 30.49	¥ 25.11
SFS105/125Y	$ 2.90	$ 2.47	$ 2.03	£ 2.09	£ 1.78	£ 1.47	€ 2,53	€ 2,15	€ 1,77	¥ 23.12	¥ 19.65	¥ 16.18
SFS200/220Y	$ 7.60	$ 6.46	$ 5.32	£ 5.48	£ 4.66	£ 3.84	€ 6,62	€ 5,63	€ 4,63	¥ 60.58	¥ 51.49	¥ 42.41

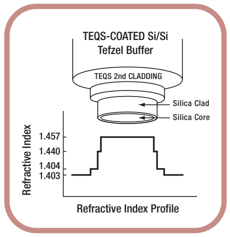
*Call for Quantities Over 250 m **Prices are given per meter

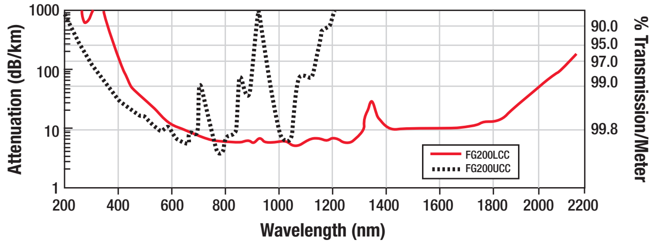
0.22 NA Step-Index MM Fibers, TEQS™ Coated Silica/Silica

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 NIR 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
- Shipped from Stock, No Minimum
- TEQS Cladding is Removable with Acetone

NEW versions





Popular Compatible Connectors (See Pages 1142 - 1143)

FIBER	SMA	FC/PC
FG200	10270A	30126G2-270
FG365	10440A	30126G2-440
FG550	10640A	30126G2-640
FG910	11050A	30126G2-1050

Visible-to-NIR Transmission (Low OH)

	ITEM #	CORE DIAMETER	CLADDING DIAMETER	BUFFER DIAMETER	COATING DIAMETER	NA	MAXIMUM POWER CAPABILITY		MAX CORE OFFSET	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
							PULSED[a]	CW[b]			
	FG200LCC	200 ± 8 µm	240 ± 5 µm	260 ± 6 µm	400 ± 30 µm	0.22 ± 0.02	1.0 MW	0.2 kW	5 µm	9 mm / 18 mm	T12S18
	FG365LEC	365 ± 14 µm	400 ± 8 µm	425 ± 10 µm	730 ± 30 µm	0.22 ± 0.02	3.4 MW	0.7 kW	7 µm	20 mm / 40 mm	T21S31
	FG550LEC	550 ± 19 µm	600 ± 10 µm	630 ± 10 µm	1040 ± 30 µm	0.22 ± 0.02	7.6 MW	1.5 kW	9 µm	30 mm / 60 mm	T28S46
NEW	FG910LEC	910 ± 30 µm	1000 ± 15 µm	1035 ± 15 µm	1400 ± 50 µm	0.22 ± 0.02	25.1 MW	5.0 kW	10 µm	50 mm / 100 mm	M44S67

[a]Based on 5 GW/cm² for 1064 nm Nd:YAG laser with 10 ns pulse length and input spot size equal to 80% of the core diameter
[b]Based on 1 MW/cm² for 1064 nm Nd:YAG laser and input spot size equal to 80% of the core diameter

	ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
	FG200LCC	$ 7.70	$ 6.55	$ 5.39	£ 5.55	£ 4.72	£ 3.89	€ 6,70	€ 5,70	€ 4,69	¥ 61.37	¥ 52.17	¥ 42.96
	FG365LEC	$ 16.05	$ 13.64	$ 11.24	£ 11.56	£ 9.83	£ 8.09	€ 13,97	€ 11,87	€ 9,78	¥ 127.92	¥ 108.74	¥ 89.55
	FG550LEC	$ 38.70	$ 32.90	$ 27.09	£ 27.87	£ 23.69	£ 19.51	€ 33,67	€ 28,62	€ 23,57	¥ 308.44	¥ 262.18	¥ 215.91
NEW	FG910LEC	$ 92.70	$ 78.80	$ 64.89	£ 66.75	£ 56.74	£ 46.73	€ 80,65	€ 68,56	€ 56,46	¥ 738.82	¥ 628.00	¥ 517.18

*Call for Quantities Over 250 m **Prices are given per meter

UV-to-Visible Transmission (High OH)

	ITEM #	CORE DIAMETER	CLADDING DIAMETER	BUFFER DIAMETER	COATING DIAMETER	NA	MAXIMUM POWER CAPABILITY		MAX CORE OFFSET	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
							PULSED	CW			
	FG200UCC	200 ± 8 µm	240 ± 5 µm	260 ± 6 µm	400 ± 30 µm	0.22 ± 0.02	1.0 MW	0.2 kW	5 µm	9 mm / 18 mm	T12S18
	FG365UEC	365 ± 14 µm	400 ± 8 µm	425 ± 10 µm	730 ± 30 µm	0.22 ± 0.02	3.4 MW	0.7 kW	7 µm	12 mm / 24 mm	T21S31
	FG550UEC	550 ± 19 µm	600 ± 10 µm	630 ± 10 µm	1040 ± 10 µm	0.22 ± 0.02	7.6 MW	1.5 kW	9 µm	25 mm / 50 mm	T28S46
NEW	FG910UEC	910 ± 30 µm	1000 ± 15 µm	1035 ± 15 µm	1400 ± 50 µm	0.22 ± 0.02	25.1 MW	5.0 kW	10 µm	50 mm / 100 mm	M44S67

	ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
	FG200UCC	$ 7.70	$ 6.55	$ 5.39	£ 5.55	£ 4.72	£ 3.89	€ 6,70	€ 5,70	€ 4,69	¥ 61.37	¥ 52.17	¥ 42.96
	FG365UEC	$ 14.70	$ 12.50	$ 10.29	£ 10.59	£ 9.00	£ 7.41	€ 12,79	€ 10,88	€ 8,96	¥ 117.16	¥ 99.59	¥ 82.02
	FG550UEC	$ 35.20	$ 29.92	$ 24.64	£ 25.35	£ 21.55	£ 17.75	€ 30,63	€ 26,04	€ 21,44	¥ 280.55	¥ 238.47	¥ 196.39
NEW	FG910UEC	$ 84.50	$ 71.83	$ 59.15	£ 60.84	£ 51.72	£ 42.59	€ 73,52	€ 62,49	€ 51,47	¥ 673.47	¥ 572.45	¥ 471.43

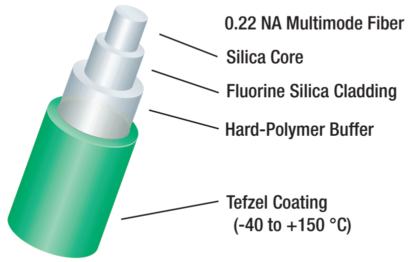
*Call for Quantities Over 250 m **Prices are given per meter

0.22 NA, Hard Polymer Buffer, Silica/Silica, Step-Index MM Fiber

- Broad UV, VIS, and NIR Spectral Range
  - High OH: 190 - 1200 nm
  - Low OH: 350 - 2500 nm
- High Laser Damage Resistance, High Core-to-Clad Ratio
- USP Class VI for Non-Toxicity and Biocompatibility
- Sterilizable by ETO and Other Methods

Popular Compatible Connectors
(See Pages 1142 - 1143)

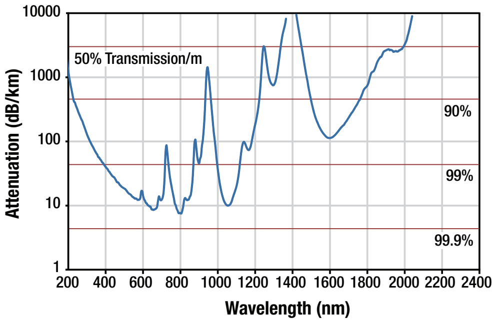
FIBER CLAD DIAMETER	SMA	FC/PC
240 µm	10270A	30126G2-270
400 µm	10440A	30126G2-440
600 µm	10640A	30126G2-640
1000 µm	11050A	30126G2-1050



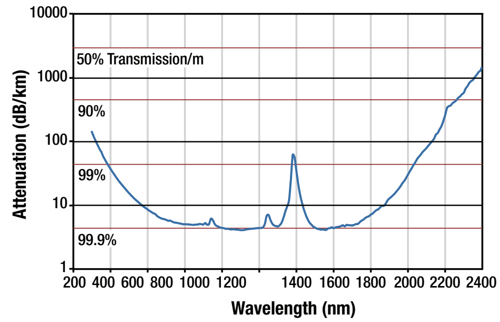
Our 0.22 NA multimode fiber exhibits impressive performance and transmission from the deep UV to the IR. With exceptional radiation resistance and broad temperature capabilities, these fibers are ideal for applications including spectroscopy, Thomson scattering, and medical diagnostics.

BFL22 and BFH22 Patch Cables
See pages 1013 & 1017

0.22 NA High OH Multimode Fiber



0.22 NA Low OH Multimode Fiber



Visible-to-NIR Transmission (Low OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NA	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
BFL22-200	200 µm ± 2%	240 µm ± 2%	400 µm ± 5%	0.22 ± 0.02	50/150 x Clad Diameter	T12S18
BFL22-365	365 µm ± 2%	400 µm ± 2%	730 µm ± 5%	0.22 ± 0.02	50/150 x Clad Diameter	T21S31
BFL22-550	550 µm ± 2%	600 µm ± 2%	1040 µm ± 5%	0.22 ± 0.02	50/150 x Clad Diameter	T28S46
BFL22-910	910 µm ± 2%	1000 µm ± 2%	1400 µm ± 5%	0.22 ± 0.02	50/150 x Clad Diameter	M44S63

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
BFL22-200	$ 8.10	$ 6.89	$ 5.67	£ 5.84	£ 4.96	£ 4.09	€ 7,05	€ 5,99	€ 4,94	¥ 64.56	¥ 54.88	¥ 45.19
BFL22-365	$ 16.90	$ 14.37	$ 11.83	£ 12.17	£ 10.35	£ 8.52	€ 14,71	€ 12,50	€ 10,30	¥ 134.70	¥ 114.49	¥ 94.29
BFL22-550	$ 40.70	$ 34.60	$ 28.49	£ 29.31	£ 24.91	£ 20.52	€ 35,41	€ 30,10	€ 24,79	¥ 324.38	¥ 275.73	¥ 227.07
BFL22-910	$ 97.60	$ 82.96	$ 68.32	£ 70.28	£ 59.74	£ 49.20	€ 84,92	€ 72,18	€ 59,44	¥ 777.88	¥ 661.20	¥ 544.52

*Call for Quantities Over 250 m   **Prices are given per meter

UV-to-Visible Transmission (High OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NA	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
BFH22-200	200 µm ± 2%	240 µm ± 2%	400 µm ± 5%	0.22 ± 0.02	50/150 x Clad Diameter	T12S18
BFH22-365	365 µm ± 2%	400 µm ± 2%	730 µm ± 5%	0.22 ± 0.02	50/150 x Clad Diameter	T21S31
BFH22-550	550 µm ± 2%	600 µm ± 2%	1040 µm ± 5%	0.22 ± 0.02	50/150 x Clad Diameter	T28S46
BFH22-910	910 µm ± 2%	1000 µm ± 2%	1400 µm ± 5%	0.22 ± 0.02	50/150 x Clad Diameter	M44S63

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
BFH22-200	$ 8.10	$ 6.89	$ 5.67	£ 5.84	£ 4.96	£ 4.09	€ 7,05	€ 5,99	€ 4,94	¥ 64.56	¥ 54.88	¥ 45.19
BFH22-365	$ 15.50	$ 13.18	$ 10.85	£ 11.16	£ 9.49	£ 7.82	€ 13,49	€ 11,47	€ 9,44	¥ 123.54	¥ 105.01	¥ 86.48
BFH22-550	$ 37.10	$ 31.54	$ 25.97	£ 26.72	£ 22.71	£ 18.70	€ 32,28	€ 27,44	€ 22,60	¥ 295.69	¥ 251.34	¥ 206.99
BFH22-910	$ 89.00	$ 75.65	$ 62.30	£ 64.08	£ 54.47	£ 44.86	€ 77,43	€ 65,82	€ 54,21	¥ 709.33	¥ 602.94	¥ 496.54

*Call for Quantities Over 250 m   **Prices are given per meter

0.37 NA, Hard Polymer Clad, Step-Index Multimode Fiber

See Website for Attenuation Plots
www.thorlabs.com

- Broad UV, VIS, and NIR Spectral Range
  - High OH: 300 - 1200 nm
  - Low OH: 400 - 2200 nm
- Reduced Static Fatigue, Lower Microbend Losses
- USP Class VI for Non-Toxicity and Biocompatibility

Popular Compatible Connectors (See Pages 1142 - 1143)

FIBER CLAD DIAMETER	SMA	FC/PC
230 µm	10230A	30126G2-230
330 µm	10340A	30126G2-340
430 µm	10440A	30126G2-440
630 µm	10640A	30126G2-640
830 µm	10850A	30126G2-840
1035 µm	11050A	30126G2-1050
1240 µm	11275A	30126G2-1270
1550 µm	11580A	30126G2-1580

Visible-to-NIR Transmission (Low OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NA	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
BFL37-200	200 µm ± 2%	230 µm ± 2%	500 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	T12S21
BFL37-300	300 µm ± 2%	330 µm ± 2%	650 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	T16S31
BFL37-400	400 µm ± 2%	430 µm ± 2%	730 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	T21S31
BFL37-600	600 µm ± 2%	630 µm ± 2%	1040 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	T28S46
BFL37-800	800 µm ± 2%	830 µm ± 2%	1400 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	M37S63
BFL37-1000	1000 µm ± 2%	1035 µm ± 2%	1400 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	M44S63
BFL37-1200	1200 µm ± 2%	1240 µm ± 2%	1650 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	M54S76
BFL37-1500	1500 µm ± 2%	1550 µm ± 2%	2000 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	M63S86

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
BFL37-200	$ 1.60	$ 1.36	$ 1.12	£ 1.16	£ 0.98	£ 0.81	€ 1,40	€ 1,19	€ 0,98	¥ 12.76	¥ 10.84	¥ 8.93
BFL37-300	$ 2.50	$ 2.13	$ 1.75	£ 1.80	£ 1.53	£ 1.26	€ 2,18	€ 1,85	€ 1,53	¥ 19.93	¥ 16.94	¥ 13.95
BFL37-400	$ 4.00	$ 3.40	$ 2.80	£ 2.88	£ 2.45	£ 2.02	€ 3,48	€ 2,96	€ 2,44	¥ 31.88	¥ 27.10	¥ 22.32
BFL37-600	$ 8.30	$ 7.06	$ 5.81	£ 5.98	£ 5.08	£ 4.19	€ 7,23	€ 6,14	€ 5,06	¥ 66.16	¥ 56.23	¥ 46.31
BFL37-800	$ 15.70	$ 13.35	$ 10.99	£ 11.31	£ 9.61	£ 7.92	€ 13,66	€ 11,62	€ 9,57	¥ 125.13	¥ 106.36	¥ 87.60
BFL37-1000	$ 26.60	$ 22.61	$ 18.62	£ 19.16	£ 16.28	£ 13.41	€ 23,15	€ 19,68	€ 16,20	¥ 212.01	¥ 180.21	¥ 148.41
BFL37-1200	$ 62.30	$ 52.96	$ 43.61	£ 44.86	£ 38.13	£ 31.40	€ 54,21	€ 46,08	€ 37,95	¥ 496.54	¥ 422.06	¥ 347.58
BFL37-1500	$ 106.10	$ 90.19	$ 74.27	£ 76.40	£ 64.94	£ 53.48	€ 92,31	€ 78,47	€ 64,62	¥ 845.62	¥ 718.78	¥ 591.94

*Call for Quantities Over 250 m **Prices are given per meter

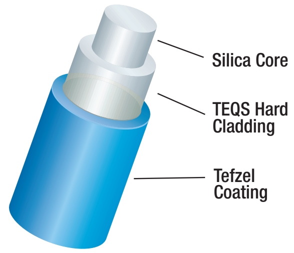
UV-to-Visible Transmission (High OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NA	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
BFH37-200	200 µm ± 2%	230 µm ± 2%	500 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	T12S21
BFH37-300	300 µm ± 2%	330 µm ± 2%	650 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	T16S31
BFH37-400	400 µm ± 2%	430 µm ± 2%	730 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	T21S31
BFH37-600	600 µm ± 2%	630 µm ± 2%	1040 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	T28S46
BFH37-800	800 µm ± 2%	830 µm ± 2%	1400 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	M37S63
BFH37-1000	1000 µm ± 2%	1035 µm ± 2%	1400 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	M44S63
BFH37-1200	1200 µm ± 2%	1240 µm ± 2%	1650 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	M54S76
BFH37-1500	1500 µm ± 2%	1550 µm ± 2%	2000 µm ± 5%	0.37 ± 0.02	50/150 x Clad Diameter	M63S86

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
BFH37-200	$ 1.50	$ 1.28	$ 1.05	£ 1.08	£ 0.92	£ 0.76	€ 1,31	€ 1,11	€ 0,92	¥ 11.96	¥ 10.17	¥ 8.37
BFH37-300	$ 2.40	$ 2.04	$ 1.68	£ 1.73	£ 1.47	£ 1.21	€ 2,09	€ 1,78	€ 1,47	¥ 19.13	¥ 16.26	¥ 13.39
BFH37-400	$ 3.60	$ 3.06	$ 2.52	£ 2.60	£ 2.21	£ 1.82	€ 3,14	€ 2,67	€ 2,20	¥ 28.70	¥ 24.39	¥ 20.09
BFH37-600	$ 7.50	$ 6.38	$ 5.25	£ 5.40	£ 4.59	£ 3.78	€ 6,53	€ 5,55	€ 4,57	¥ 59.78	¥ 50.81	¥ 41.85
BFH37-800	$ 13.30	$ 11.31	$ 9.31	£ 9.58	£ 8.14	£ 6.71	€ 11,58	€ 9,84	€ 8,10	¥ 106.01	¥ 90.11	¥ 74.21
BFH37-1000	$ 22.70	$ 19.30	$ 15.89	£ 16.35	£ 13.90	£ 11.45	€ 19,75	€ 16,79	€ 13,83	¥ 180.92	¥ 153.79	¥ 126.65
BFH37-1200	$ 68.60	$ 58.31	$ 48.02	£ 49.40	£ 41.99	£ 34.58	€ 59,69	€ 50,73	€ 41,78	¥ 546.75	¥ 464.74	¥ 382.72
BFH37-1500	$ 81.10	$ 68.94	$ 56.77	£ 58.40	£ 49.64	£ 40.88	€ 70,56	€ 59,98	€ 49,39	¥ 646.37	¥ 549.42	¥ 452.46

*Call for Quantities Over 250 m **Prices are given per meter

0.39 NA Step-Index MM Fibers, TEQS™ Clad

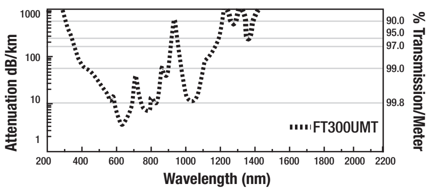


Features

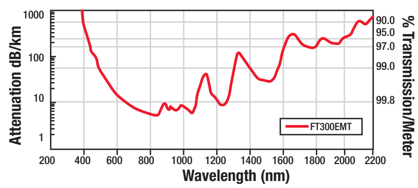
- Hard Cladding Increases Fiber Strength, Reduces Static Fatigue in Humid Environments, and Protects the Fiber During Buffer Stripping to Prevent Fiber Breakage
- High Core-to-Clad Bonding Prevents Pistoning and Provides More Stable Crimp-and-Cleave or Epoxy Terminations
- Shipped from Stock, No Minimum
- TEQS Cladding is Removable with Acetone

NEW versions

TEQS™ Clad High OH



TEQS™ Clad Low OH



Popular Compatible Connectors (See Pages 1142 - 1143)

FIBER	SMA	FC/PC
FT200	10230A	30126G2-230
FT300	10340A	30126G2-340
FT400	10440A	30126G2-440
FT600	10640A	30126G2-640
FT800	10850A	30126G2-850
FT1000	11050A	30126G2-1050
FT1500	11580A	30126G2-1580

Visible-to-NIR Transmission (Low OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NA	MAXIMUM POWER CAPABILITY PULSED	MAXIMUM POWER CAPABILITY CW	MAXIMUM ATTEN. @850 nm	MAX CORE OFFSET	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
FT200EMT	200 ± 5 µm	225 ± 5 µm	500 ± 30 µm	0.39 ± 0.02	1.0 MW	0.2 kW	10 dB/km	5 µm	9 mm / 18 mm	T12S21
FT300EMT	300 ± 6 µm	325 ± 10 µm	650 ± 30 µm	0.39 ± 0.02	2.3 MW	0.5 kW	10 dB/km	5 µm	11 mm / 22 mm	T16S31
FT400EMT	400 ± 8 µm	425 ± 10 µm	730 ± 30 µm	0.39 ± 0.02	4.0 MW	0.8 kW	10 dB/km	7 µm	20 mm / 40 mm	T21S31
FT600EMT	600 ± 10 µm	630 ± 10 µm	1040 ± 30 µm	0.39 ± 0.02	9.0 MW	1.8 kW	10 dB/km	9 µm	30 mm / 60 mm	T28S46
FT800EMT	800 ± 10 µm	830 ± 10 µm	1040 ± 30 µm	0.39 ± 0.02	16 MW	3.2 kW	10 dB/km	9 µm	40 mm / 80 mm	M37S46
FT1000EMT	1000 ±15 µm	1035 ± 15 µm	1400 ± 50 µm	0.39 ± 0.02	25.1 MW	5.0 kW	10 dB/km	10 µm	50 mm / 100 mm	M44563
FT1500EMT	1500 ± 30 µm	1550 ± 31 µm	2000 ± 100 µm	0.39 ± 0.02	56.6 MW	11.3 kW	18 dB/km	15 µm	75 mm / 150 mm	M63S86

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
FT200EMT	$ 1.50	$ 1.28	$ 1.05	£ 1.08	£ 0.92	£ 0.76	€ 1,31	€ 1,11	€ 0,92	¥ 11.96	¥ 10.17	¥ 8.37
FT300EMT	$ 2.30	$ 1.96	$ 1.61	£ 1.66	£ 1.41	£ 1.16	€ 2,01	€ 1,71	€ 1,41	¥ 18.34	¥ 15.59	¥ 12.84
FT400EMT	$ 3.80	$ 3.23	$ 2.66	£ 2.74	£ 2.33	£ 1.92	€ 3,31	€ 2,82	€ 2,32	¥ 30.29	¥ 25.75	¥ 21.21
FT600EMT	$ 7.90	$ 6.72	$ 5.53	£ 5.69	£ 4.84	£ 3.99	€ 6,88	€ 5,85	€ 4,82	¥ 62.97	¥ 53.52	¥ 44.08
FT800EMT	$ 14.90	$ 12.67	$ 10.43	£ 10.73	£ 9.12	£ 7.51	€ 12,97	€ 11,02	€ 9,08	¥ 118.76	¥ 100.95	¥ 83.13
FT1000EMT	$ 25.20	$ 21.42	$ 17.64	£ 18.15	£ 15.43	£ 12.71	€ 21,93	€ 18,64	€ 15,35	¥ 200.85	¥ 170.72	¥ 140.60 NEW
FT1500EMT	$100.80	$ 85.68	$ 70.56	£ 72.58	£ 61.69	£ 50.81	€ 87,70	€ 74,55	€ 61,39	¥ 803.38	¥ 682.87	¥ 562.37 NEW

*Call for Quantities Over 250 m **Prices are given per meter

UV-to-Visible Transmission (High OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	NA	MAXIMUM POWER CAPABILITY PULSED	MAXIMUM POWER CAPABILITY CW	MAXIMUM ATTEN. @850 nm	MAX CORE OFFSET	BEND RADIUS SHORT-TERM/ LONG-TERM	STRIPPING TOOL See Page 1154
FT200UMT	200 ± 5 µm	225 ± 5 µm	500 ± 30 µm	0.39 ± 0.02	1.0 MW	0.2 kW	12 dB/km	5 µm	9 mm / 18 mm	T12S21
FT300UMT	300 ± 6 µm	325 ± 10 µm	650 ± 30 µm	0.39 ± 0.02	2.3 MW	0.5 kW	12 dB/km	5 µm	11 mm / 22 mm	T16S31
FT400UMT	400 ± 8 µm	425 ± 10 µm	730 ± 30 µm	0.39 ± 0.02	4.0 MW	0.8 kW	12 dB/km	7 µm	20 mm / 40 mm	T21S31
FT600UMT	600 ± 10 µm	630 ± 10 µm	1040 ± 30 µm	0.39 ± 0.02	9.0 MW	1.8 kW	12 dB/km	9 µm	30 mm / 60 mm	T28S46
FT800UMT	800 ± 10 µm	830 ± 10 µm	1040 ± 30 µm	0.39 ± 0.02	16 MW	3.2 kW	12 dB/km	9 µm	40 mm / 80 mm	M37S46
FT1000UMT	1000 ± 15 µm	1035 ± 15 µm	1400 ± 50 µm	0.39 ± 0.02	25.1 MW	5.0 kW	12 dB/km	10 µm	50 mm / 100 mm	M44S63
FT1500UMT	1500 ± 30 µm	1550 ± 31 µm	2000 ± 100 µm	0.39 ± 0.02	56.6 MW	11.3 kW	18 dB/km	15 µm	75 mm / 150 mm	M63S86

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
FT200UMT	$ 1.40	$ 1.19	$ 0.98	£ 1.01	£ 0.86	£ 0.71	€ 1,22	€ 1,04	€ 0,86	¥ 11.16	¥ 9.49	¥ 7.82 NEW
FT300UMT	$ 2.30	$ 1.96	$ 1.61	£ 1.66	£ 1.41	£ 1.16	€ 2,01	€ 1,71	€ 1,41	¥ 18.34	¥ 15.59	¥ 12.84
FT400UMT	$ 3.40	$ 2.89	$ 2.38	£ 2.45	£ 2.09	£ 1.72	€ 2,96	€ 2,52	€ 2,08	¥ 27.10	¥ 23.04	¥ 18.97
FT600UMT	$ 7.10	$ 6.04	$ 4.97	£ 5.12	£ 4.35	£ 3.58	€ 6,18	€ 5,26	€ 4,33	¥ 56.59	¥ 48.10	¥ 39.62
FT800UMT	$ 12.60	$10.71	$ 8.82	£ 9.08	£ 7.72	£ 6.36	€ 10,97	€ 9,32	€ 7,68	¥ 100.43	¥ 85.36	¥ 70.30 NEW
FT1000UMT	$ 21.50	$18.28	$ 15.05	£ 15.48	£ 13.16	£ 10.84	€ 18,71	€ 15,90	€ 13,10	¥ 171.36	¥ 145.66	¥ 119.95 NEW
FT1500UMT	$ 77.00	$65.45	$ 53.90	£ 55.44	£ 47.13	£ 38.81	€ 66,99	€ 56,95	€ 46,90	¥ 613.69	¥ 521.64	¥ 429.59 NEW

*Call for Quantities Over 250 m **Prices are given per meter

CHAPTERS
Fiber Patch Cables
Bare Fiber
Fiber Optomechanics
Fiber Components
Test and Measurement
SECTIONS
SM Fiber
PM Fiber
Doped Fiber
PCF
MM Fiber
Plastic Optical Fiber

0.48 NA Step-Index MM Fibers, Hard Polymer Clad

- Broad UV, VIS, and NIR Spectral Ranges
  - High OH: 300 - 1200 nm
  - Low OH: 400 - 2200 nm
- Reduced Static Fatigue, Lower Microbend Losses
- USP Class VI for Non-Toxicity and Biocompatibility
- 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

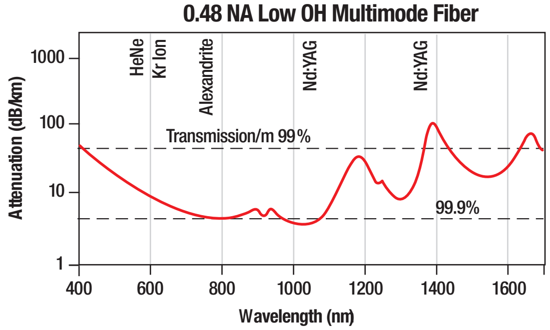
- **Step-Index Profile**
- **Core:** Pure Silica
- **Cladding:** Hard-Polymer Cladding
- **Coating:** Tefzel
- **Numerical Aperture (NA):** 0.48 ± 0.02
- **Standard Proof Test:** 70 kpsi
- **Minimum Bend Radius:**
  - 100X Clad Radius (Momentary)
  - 300X Clad Radius (Long-Term)
- **Operating Temperature, Tefzel Coating:** -40 to 150 °C

BFL48-400 and BFL48-600 Patch Cables
See page 1014

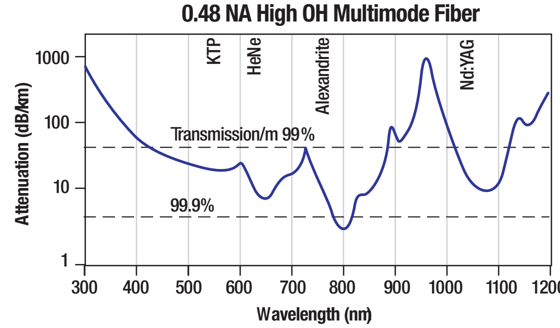
Popular Compatible Connectors (See Pages 1142 - 1143)

FIBER CLAD DIAMETER	SMA	FC/PC
230 µm	10230A	30126G2-230
430 µm	10440A	30126G2-440
630 µm	10640A	30126G2-640
1035 µm	11050A	30126G2-1050

0.48 NA Low OH Multimode Fiber



0.48 NA High OH Multimode Fiber



Visible-to-NIR Transmission (Low OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL See Page 1155
BFL48-200	200 µm ± 2%	230 µm ± 2%	500 µm ± 5%	T12S21
BFL48-400	400 µm ± 2%	430 µm ± 2%	730 µm ± 5%	T21S31
BFL48-600	600 µm ± 2%	630 µm ± 2%	1040 µm ± 5%	T28S46
BFL48-1000	1000 µm ± 2%	1035 µm ± 2%	1400 µm ± 5%	M44S63

UV-to-Visible Transmission (High OH)

ITEM #	CORE DIAMETER	CLADDING DIAMETER	COATING DIAMETER	STRIPPING TOOL See Page 1154
BFH48-200	200 µm ± 2%	230 µm ± 2%	500 µm ± 5%	T12S21
BFH48-400	400 µm ± 2%	430 µm ± 2%	730 µm ± 5%	T21S31
BFH48-600	600 µm ± 2%	630 µm ± 2%	1040 µm ± 5%	T28S46
BFH48-1000	1000 µm ± 2%	1035 µm ± 2%	1400 µm ± 5%	M44S63

ITEM #*	$** 1-9 m	$** 10-49 m	$** 50-249 m	£** 1-9 m	£** 10-49 m	£** 50-249 m	€** 1-9 m	€** 10-49 m	€** 50-249 m	RMB** 1-9 m	RMB** 10-49 m	RMB** 50-249 m
BFL48-200	$ 2.00	$ 1.70	$ 1.40	£ 1.44	£ 1.23	£ 1.01	€ 1,74	€ 1,48	€ 1,22	¥ 15.94	¥ 13.55	¥ 11.16
BFL48-400	$ 5.60	$ 4.76	$ 3.92	£ 4.04	£ 3.43	£ 2.83	€ 4,88	€ 4,15	€ 3,42	¥ 44.64	¥ 37.94	¥ 31.25
BFL48-600	$ 10.80	$ 9.18	$ 7.56	£ 7.78	£ 6.61	£ 5.45	€ 9,40	€ 7,99	€ 6,58	¥ 86.08	¥ 73.17	¥ 60.26
BFL48-1000	$ 29.10	$ 24.74	$ 20.37	£ 20.96	£ 17.81	£ 14.67	€ 25,32	€ 21,52	€ 17,73	¥ 231.93	¥ 197.14	¥ 162.35
BFH48-200	$ 1.80	$ 1.53	$ 1.26	£ 1.30	£ 1.11	£ 0.91	€ 1,57	€ 1,34	€ 1,10	¥ 14.35	¥ 12.20	¥ 10.05
BFH48-400	$ 3.80	$ 3.23	$ 2.66	£ 2.74	£ 2.33	£ 1.92	€ 3,31	€ 2,82	€ 2,32	¥ 30.29	¥ 25.75	¥ 21.21
BFH48-600	$ 8.30	$ 7.06	$ 5.81	£ 5.98	£ 5.08	£ 4.19	€ 7,23	€ 6,14	€ 5,06	¥ 66.16	¥ 56.23	¥ 46.31
BFH48-1000	$ 26.10	$ 22.19	$ 18.27	£ 18.80	£ 15.98	£ 13.16	€ 22,71	€ 19,31	€ 15,90	¥ 208.02	¥ 176.82	¥ 145.62

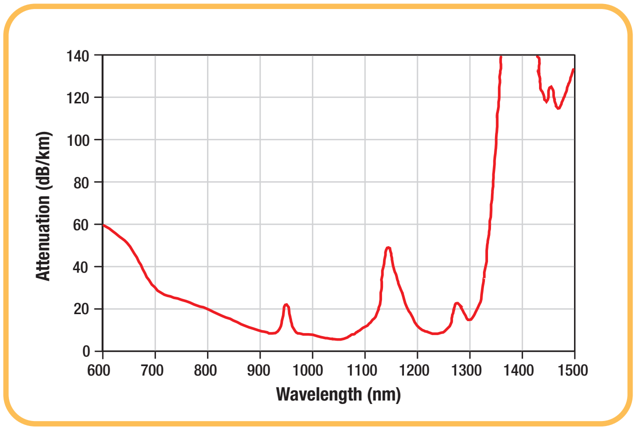
*Call for Quantities Over 250 m **Prices are given per meter

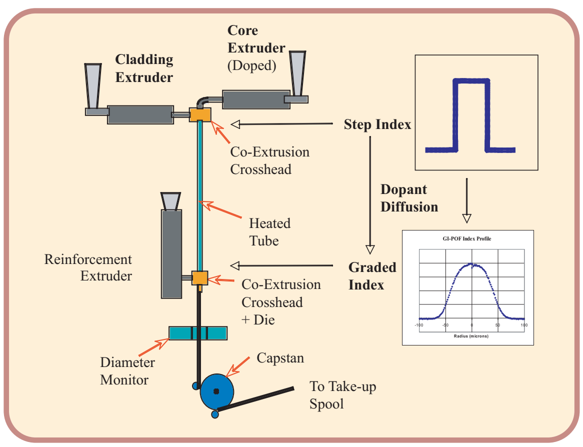
Graded-Index Polymer Optical Fiber (Page 1 of 2)

Perfluorinated graded-index polymer optical fibers (GI-POFs) combine high data transmission rates and low attenuation in the commercially desirable 850 - 1300 nm 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 530 nm or 650 nm, which is well outside of standard communication wavelengths (850 nm or 1300 nm) where high-speed transceivers are readily available. Due to the high attenuation in the near infrared, these fibers are restricted to low performance (<100 Mb/s), short range (<50 m) 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 (~10 dB/km) as shown in the graph above right and can support transmission rates up to 10 Gb/s for distances up to 100 m. 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.



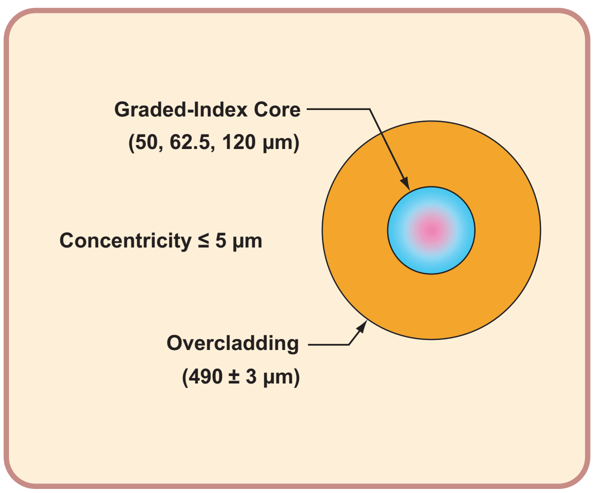


Unlike conventional glass fibers, which suffer from high interconnection and receiver costs, perfluorinated GI-POFs are easy to install. To add a connector to a glass fiber, the fiber needs to be cleaved using an expensive, specialized tool. Then, epoxy is used to attach the fiber to the connector hardware. 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.

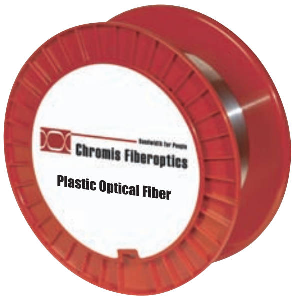
In order to produce GI-POFs with the properties necessary to meet the demands of high-performance applications, two major hurdles needed to be overcome. First, a technique needed to be developed to produce a high-quality, graded-index structure consistently. Second, the high purity of the perfluorinated material needed to be maintained during the extrusion process so that attenuation levels below 30 dB/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.



Graded-Index Polymer Optical Fiber (Page 2 of 2)

Thorlabs 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.



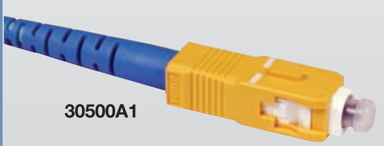
These fibers feature the ease of use associated with plastic fibers while providing the low loss, low dispersion, and good transmission characteristics typical of glass fibers at 850 nm and 1300 nm. In addition, these fibers can sustain long-term bend radii as small as 5 mm, which is much better than 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.

Specifications

- **Attenuation at 850 nm:** <60 dB/km
- **Attenuation at 1300 nm:** <60 dB/km
- **Bandwidth at 850 nm:** >300 MHz-km
- **Zero Dispersion Wavelength:** 1200 - 1650 nm
- **Dispersion Slope:** ≤0.06 ps/nm^2-km
- **Cladding Diameter:** 490 ± 5 µm
- **Tensile Load (Max):** 7.0 N
- **Temperature-Induced Attenuation at 850 nm (-20 to +70 °C):** ≤5 dB/km
- **Temperature-Induced Attenuation at 850 nm (75 °C, 85% RH, 30 Day Cycle):** ≤10 dB/km

ITEM #	NUMERICAL APERTURE*	MACROBEND LOSS**	CORE DIAMETER	CORE-CLADDING CONCENTRICITY	LONG-TERM BEND RADIUS
GIPOF50	0.190	<0.25 dB	50 ± 5 µm	≤4 µm	5 mm
GIPOF62	0.190	<0.35 dB	62.5 ± 5 µm	≤5 µm	5 mm
GIPOF120	0.185	<0.60 dB	120 ± 10 µm	≤5 µm	10 mm

*±0.015 ** for 10 turns on a 25 mm radius quarter circle



See page 1144

Polymer Optical Fiber, Ø490 µm

ITEM #	PRICE/m	$	£	€	RMB
GIPOF50	1 to 24 m	$ 1.27	£ 0.92	€ 1,11	¥ 10.13
	25 to 99 m	$ 1.08	£ 0.78	€ 0,94	¥ 8.61
	100 to 499 m	$ 0.89	£ 0.65	€ 0,78	¥ 7.09
	500 to 999 m	$ 0.70	£ 0.51	€ 0,61	¥ 5.57
	1000 to 1999 m	$ 0.64	£ 0.46	€ 0,56	¥ 5.07
GIPOF62	1 to 24 m	$ 1.49	£ 1.08	€ 1,30	¥ 11.88
	25 to 99 m	$ 1.27	£ 0.92	€ 1,11	¥ 10.10
	100 to 499 m	$ 1.04	£ 0.76	€ 0,91	¥ 8.32
	500 to 999 m	$ 0.82	£ 0.60	€ 0,72	¥ 6.54
	1000 to 1999 m	$ 0.75	£ 0.54	€ 0,65	¥ 5.94
GIPOF120	1 to 24 m	$ 1.84	£ 1.33	€ 1,61	¥ 14.67
	25 to 99 m	$ 1.56	£ 1.13	€ 1,37	¥ 12.47
	100 to 499 m	$ 1.29	£ 0.93	€ 1,13	¥ 10.27
	500 to 999 m	$ 1.01	£ 0.73	€ 0,89	¥ 8.07
	1000 to 1999 m	$ 0.92	£ 0.67	€ 0,81	¥ 7.34

Jacketed Polymer Optical Fiber, Ø2.9 mm

ITEM #	PRICE/m	$	£	€	RMB
GIPOF50-P	1 to 24 m	$ 1.76	£ 1.27	€ 1,54	¥ 14.03
	25 to 99 m	$ 1.50	£ 1.08	€ 1,31	¥ 11.93
	100 to 499 m	$ 1.23	£ 0.89	€ 1,08	¥ 9.82
	500 to 999 m	$ 0.97	£ 0.70	€ 0,85	¥ 7.72
	1000 to 1999 m	$ 0.88	£ 0.64	€ 0,77	¥ 7.02
GIPOF62-P	1 to 24 m	$ 1.98	£ 1.43	€ 1,73	¥ 15.79
	25 to 99 m	$ 1.68	£ 1.22	€ 1,47	¥ 13.42
	100 to 499 m	$ 1.39	£ 1.00	€ 1,21	¥ 11.05
	500 to 999 m	$ 1.09	£ 0.79	€ 0,95	¥ 8.68
	1000 to 1999 m	$ 0.99	£ 0.72	€ 0,87	¥ 7.90
GIPOF120-P	1 to 24 m	$ 2.32	£ 1.68	€ 2,02	¥ 18.50
	25 to 99 m	$ 1.97	£ 1.42	€ 1,72	¥ 15.72
	100 to 499 m	$ 1.62	£ 1.17	€ 1,42	¥ 12.95
	500 to 999 m	$ 1.28	£ 0.92	€ 1,12	¥ 10.17
	1000 to 1999 m	$ 1.16	£ 0.84	€ 1,01	¥ 9.25

Fiber Selection Guide

FiberBench Selection Guide

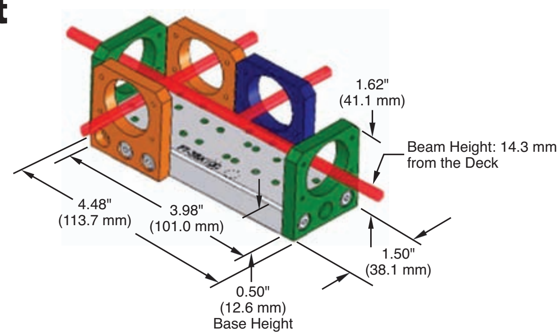
FiberTable

The FiberTable series offers a versatile platform on which free-space and fiber to free-space optical setups can be built. The tables come in eight sizes, and each offers a different number of available wall plate locations and mounting hole configurations for optical components. The hole arrays on the top surface allow for the mounting of wave plates, polarizers, beamsplitters, and other optical components. The FiberTables and components are designed to ensure all components are aligned along common beam paths that are parallel to the base.

NOTE: FiberTables do not include wall plates (see page 1069) that are used to mount the FiberPort fiber couplers.

FiberTable, 38 mm x 100 mm, 5-Port

- Holds a Maximum of 5 Wall Plates
- 12 Component Mounting Positions
- 303 Nonmagnetic Stainless Steel

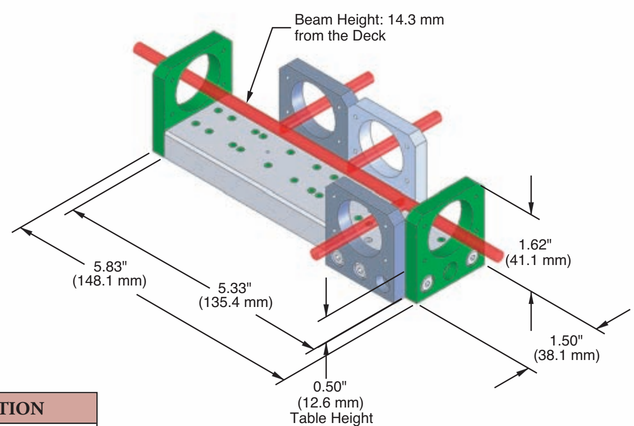


Wall Plates Sold Separately

ITEM #	$	£	€	RMB	DESCRIPTION
FT-38X100	$ 195.00	£ 140.40	€ 169,65	¥ 1,554.15	38 mm x 100 mm FiberTable

FiberTable, 38 mm x 135 mm, 5-Port

- Holds a Maximum of 5 Wall Plates
- 14 Component Mounting Positions
- 303 Nonmagnetic Stainless Steel

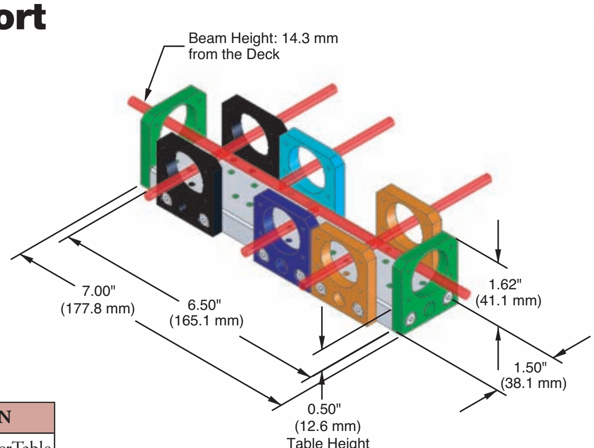


Wall Plates Sold Separately

ITEM #	$	£	€	RMB	DESCRIPTION
FT-38X135	$ 240.00	£ 172.80	€ 208,80	¥ 1,912.80	38 mm x 135 mm FiberTable

FiberTable, 38 mm x 165 mm, 8-Port

- Holds a Maximum of 8 Wall Plates
- 19 Component Mounting Positions
- 303 Nonmagnetic Stainless Steel

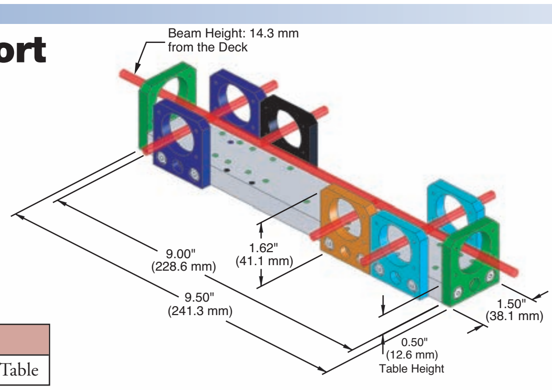


Wall Plates Sold Separately

ITEM #	$	£	€	RMB	DESCRIPTION
FT-38X165	$ 275.00	£ 198.00	€ 239,25	¥ 2,191.75	38 mm x 165 mm FiberTable

FiberTable, 38 mm x 229 mm, 8-Port

- Holds a Maximum of 8 Wall Plates
- 21 Component Mounting Positions
- 303 Nonmagnetic Stainless Steel

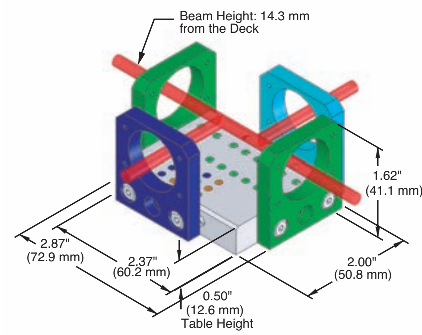


Wall Plates Sold Separately

ITEM #	$	£	€	RMB	DESCRIPTION
FT-38X229	$ 325.00	£ 234.00	€ 282,75	¥ 2,590.25	38 mm x 229 mm FiberTable

FiberTable, 51 mm x 60 mm, 4-Port

- Holds a Maximum of 4 Wall Plates
- 16 Component Mounting Positions
- 303 Non-Magnetic Stainless Steel
- Sidewalls can be Centered or Skewed for Dual Beamsplitter Systems

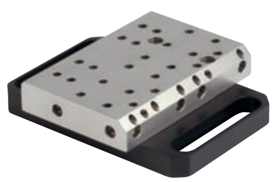


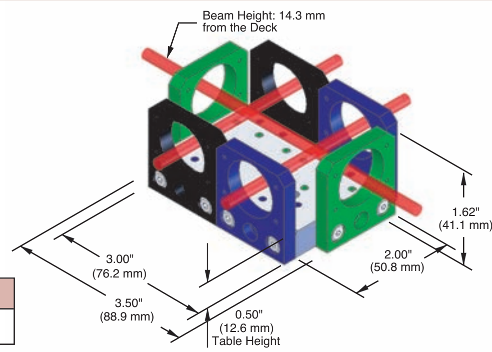
Wall Plates Sold Separately

ITEM #	$	£	€	RMB	DESCRIPTION
FT-51X60	$ 205.00	£ 147.60	€ 178,35	¥ 1,633.85	51 mm x 60 mm FiberTable

FiberTable, 51 mm x 76 mm, 6-Port

- Holds a Maximum of 6 Wall Plates
- 12 Component Mounting Positions
- 303 Non-Magnetic Stainless Steel



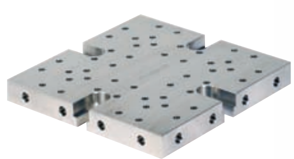


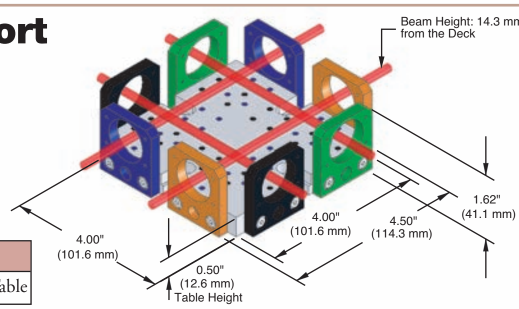
Wall Plates Sold Separately

ITEM #	$	£	€	RMB	DESCRIPTION
FT-51X76	$ 250.00	£ 180.00	€ 217,50	¥ 1,992.50	51 mm x 76 mm FiberTable

FiberTable, 102 mm x 102 mm, 8-Port

- Holds a Maximum of 8 Wall Plates
- 24 Component Mounting Positions
- 303 Non-Magnetic Stainless Steel
- 1/4" (M6) Mounting Slots



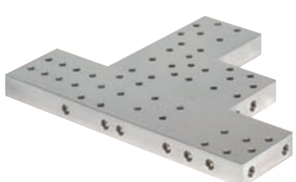


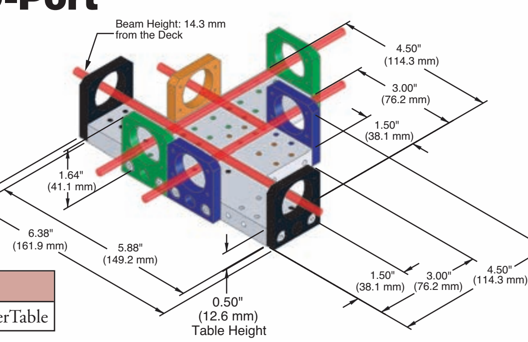
Wall Plates Sold Separately

ITEM #	$	£	€	RMB	DESCRIPTION
FT-100X100	$ 300.00	£ 216.00	€ 261,00	¥ 2,391.00	102 mm x 102 mm FiberTable

FiberTable, 114 mm x 149 mm, 10-Port

- Holds a Maximum of 8 Wall Plates
- 24 Component Mounting Positions
- 303 Non-Magnetic Stainless Steel
- For 1 x 6 Systems with Equal Path





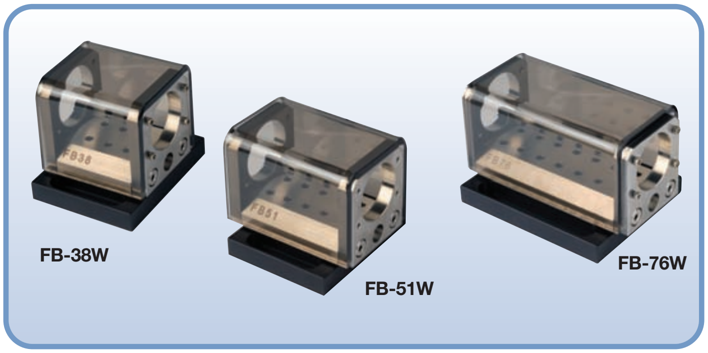
Wall Plates Sold Separately

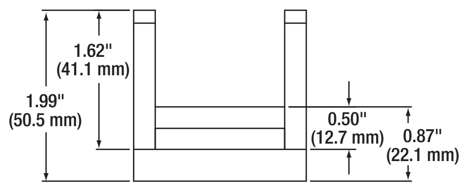
ITEM #	$	£	€	RMB	DESCRIPTION
FT-114X149	$ 350.00	£ 252.00	€ 304,50	¥ 2,789.50	114 mm x 149 mm FiberTable

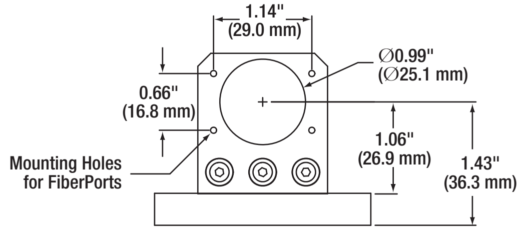
FiberBench

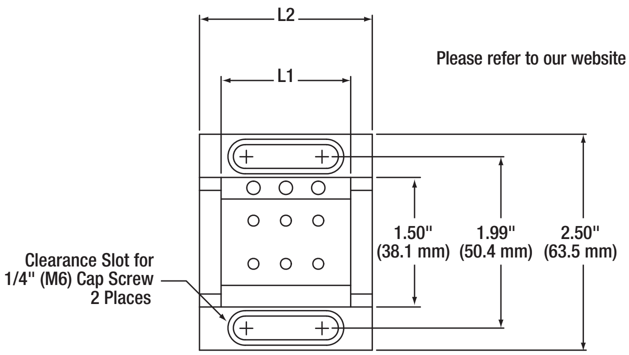
The FiberBench subassemblies can form the foundation of the nearly infinite array of miniature fiber optic systems that can be constructed. When used with the PAF Series Fiber Collimators/Couplers (see pages 1081 - 1085), a complete optical circuit can be constructed. For basic systems that require only one input and one output path, the FiberBench is ideal; for more complex systems that require multiple inputs and outputs, we recommend using one of our FiberTable products that are shown on pages 1066 - 1067.

The versatile FiberBenches are made of nonmagnetic 303 stainless steel, which offers the rigidity and stability required when building fiber optic systems. Design validation tests showed a variation of only 0.1 dB in insertion loss when the temperature was cycled from 0 to 40 °C.









Please refer to our website for complete models and drawings.

The black anodized aluminum mounting plate is a convenient way to secure a FiberBench to an optical table with 1/4"-20 (M6) tapped holes on 1" (25 mm) centers. If the mounting plate is not needed it can be easily removed.

FiberBench Dimensions

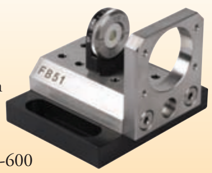
ITEM #	L1	L2
FB-38W	1.5" (38.1 mm)	2.0" (50.8 mm)
FB-51W	2.0" (50.8 mm)	2.5" (63.5 mm)
FB-76W	3.0" (76.2 mm)	3.5" (88.9 mm)

Notes:

- FiberBench Includes Base, Mounting Plate, Two HCA3 Wall Plates and a Dust Cover
- Beam Height is 14.3 mm (9/16") Above the Deck
- 303 Non-Magnetic Stainless Steel Base and Wall Plates

ITEM #	$	£	€	RMB	DESCRIPTION
FB-38W	$ 209.10	£ 150.55	€ 181,92	¥ 1,666.53	FiberBench 38 mm, 3 Position
FB-51W	$ 219.30	£ 157.90	€ 190,79	¥ 1,747.82	FiberBench 51 mm, 5 Position
FB-76W	$ 229.50	£ 165.24	€ 199,67	¥ 1,829.12	FiberBench 76 mm, 7 Position

Building A FiberBench System



FiberBench

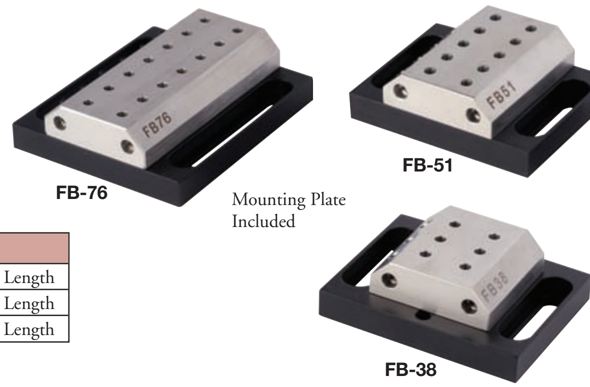
FB-51 with HCA3 and RABH-600

FiberPort

- Select a Bench Based on the Air Gap Distance or Number of Optical Modules Needed
- Choose a PAF FiberPort (Pages 1081 - 1085)
- Select Mounted Optical Modules (Pages 1070 - 1074), or Empty Modules (Pages 1075 - 1076)

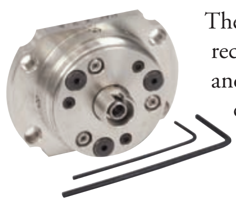
FiberBench Base

FiberBenches can be ordered without the HCA3 wall plates.
For free-space to fiber coupling applications, it is common to use a bench with only one wall plate.



ITEM #	$	£	€	RMB	DESCRIPTION
FB-38	$ 117.30	£ 84.46	€ 102,05	¥ 934.88	FiberBench Base, 38 mm Length
FB-51	$ 127.50	£ 91.80	€ 110,93	¥ 1,016.18	FiberBench Base, 51 mm Length
FB-76	$ 137.70	£ 99.14	€ 119,80	¥ 1,097.47	FiberBench Base, 76 mm Length

FiberPort Fiber Couplers for FiberBench



The FiberPorts listed below are recommended for use with FiberBenches and FiberTables. Additional specifications can be found on Pages 1081 - 1085.

- FC/PC and FC/APC Compatible
- 303 Non-Magnetic Stainless Steel
- Mounts to HCA3 Wall Plates
- Models Optimal for Short Air Gaps
- PAF-X Designs use Molded Aspheric Lenses
- PAFA Designs use Achromatic Doublets
- See Pages 1081 - 1085 for the Full Line of FiberPorts

ITEM #	EFL[a] (mm)	OUTPUT WAIST DIA.[b] (mm)	LENS CHARACTERISTICS			FIBER-to-FIBER SPAN
			CA[c] (mm)	NA	AR λ[d] (nm)	
PAF-X-2-A	2.0	0.33	2.0	0.50	350 - 700	<76 mm
PAF-X-2-B	2.0	0.38	2.0	0.50	650 - 1050	<76 mm
PAF-X-2-C	2.0	0.38	2.0	0.50	1050 - 1620	<76 mm
PAFA-X-4-A	4.0	0.86	1.8	0.22	400 - 700	≥76 mm
PAFA-X-4-B	4.0	0.87	1.8	0.22	650 - 1050	≥76 mm
PAFA-X-4-C	4.0	0.73	1.8	0.22	1050 - 1620	≥76 mm
PAF-X-5-A	4.6	0.75	4.9	0.53	350 - 700	≥76 mm
PAF-X-5-B	4.6	0.86	4.9	0.53	650 - 1050	≥76 mm
PAF-X-5-C	4.6	0.87	4.9	0.53	1050 - 1620	≥76 mm

[a]Effective Focal Length [b]Optimal Input Beam Diameter is equal to Output Waist Diameter [c]Clear Aperture
[d]AR Coating Wavelength Range

ITEM #	$	£	€	RMB	
PAF-X-2-A	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52	
PAF-X-2-B	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52	
PAF-X-2-C	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52	
PAFA-X-4-A	$ 500.00	£ 360.00	€ 435,00	¥ 3,985.00	
PAFA-X-4-B	$ 500.00	£ 360.00	€ 435,00	¥ 3,985.00	NEW
PAFA-X-4-C	$ 500.00	£ 360.00	€ 435,00	¥ 3,985.00	NEW
PAF-X-5-A	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35	
PAF-X-5-B	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35	
PAF-X-5-C	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35	

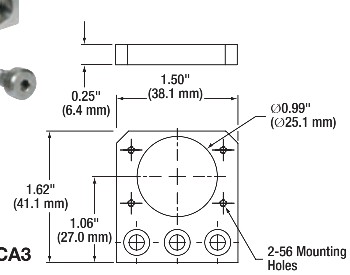
FiberBench Wall Plates

HCA3

Please refer to our website for complete models and drawings.

HCA3-SM05

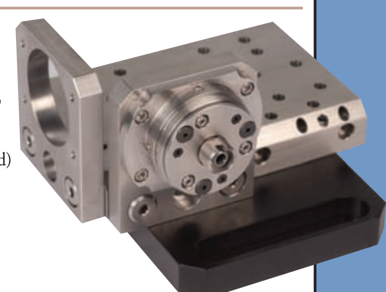
HCA3-SM1



HCA3

- Mount a PAF Fiber Coupler to a FiberBench or FiberTable
- Mounting Screws Included
- SM-Threaded Versions with Included Retaining Rings

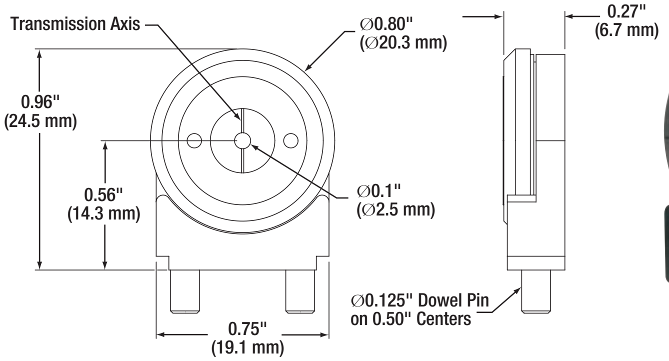
(Hex Keys Included)



The HCA3 series of wall plates are one of three basic building blocks for any FiberTable or FiberBench system. The wall plates are attached to the sides of a FiberBench or FiberTable using the two included 8-32 mounting screws. A FiberPort is then attached to either an HCA3 or an HCA3-SM1 wall plate using the four included 2-56 screws.

ITEM #	$	£	€	RMB	DESCRIPTION
HCA3	$ 52.00	£ 37.44	€ 45,24	¥ 414.44	3-Hole FiberBench Wall Plate
HCA3-SM05	$ 58.00	£ 41.76	€ 50,46	¥ 462.26	3-Hole FiberBench Wall Plate with SM05 Thread (Ø0.535"-40)
HCA3-SM1	$ 58.00	£ 41.76	€ 50,46	¥ 462.26	3-Hole FiberBench Wall Plate with SM1 Thread (Ø1.035"-40)

Rotating Linear Polarizer Modules



Please refer to our website for complete models and drawings.

PCB-2.5-1310

Specifications

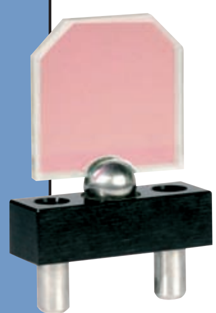
- Thin Film Linear Polarizer
- AR Coated
- 10,000:1 Extinction Ratio
- Wavefront Error < λ/10
- Ø2.5 mm Apertures
- 360° Continuous Rotation
- 1.5° Measurement Precision
- Magnetic Mount for Smooth Rotation

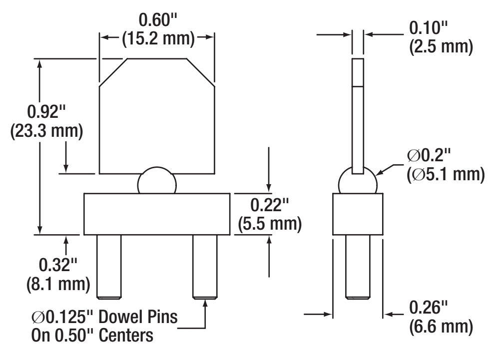
These polarizer modules use dichroic film polarizers that absorb light not aligned to the transmission axis of the polarizer. They provide an excellent extinction ratio, and have a power handling capability of 500 mW spread over the aperture.

ITEM #	$	£	€	RMB	APERTURE	WAVELENGTH	TRANSMISSION	EXTINCTION RATIO
PCB-2.5-VIS	$ 175.00	£ 126.00	€ 152,25	¥ 1,394.75	Ø2.5 mm	440 - 650 nm	>80%	>40 dB
PCB-2.5-NIR	$ 175.00	£ 126.00	€ 152,25	¥ 1,394.75	Ø2.5 mm	750 - 870 nm	>93%	>40 dB
PCB-2.5-YAG	$ 175.00	£ 126.00	€ 152,25	¥ 1,394.75	Ø2.5 mm	970 - 1100 nm	>96%	>45 dB
PCB-2.5-1310	$ 175.00	£ 126.00	€ 152,25	¥ 1,394.75	Ø2.5 mm	1270 - 1350 nm	>97%	>45 dB
PCB-2.5-1550	$ 175.00	£ 126.00	€ 152,25	¥ 1,394.75	Ø2.5 mm	1500 - 1600 nm	>98%	>45 dB

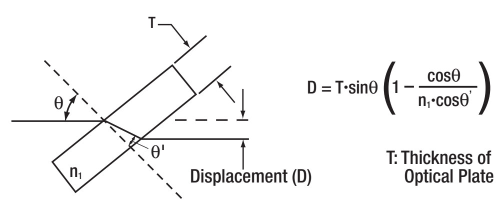
X-Y Tweaker Module

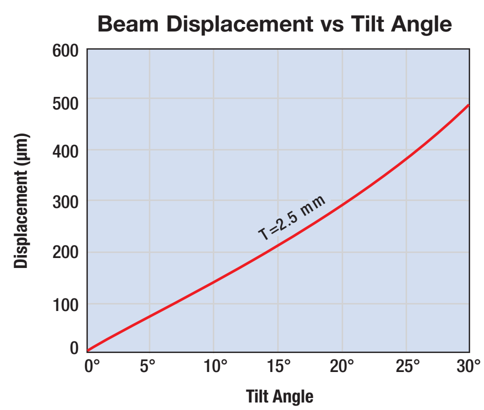
The XY Tweaker Module consists of a precision-polished, AR-coated, plane-parallel plate mounted on a magnetic ball and socket. The plates are offered with a thickness of 2.5 mm and can be rotated and tilted in nearly any orientation. The beam is consequently displaced parallel to the optical axis by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



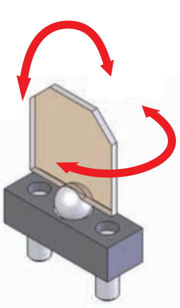


Please refer to our website for complete models and drawings.





- Use for Beam Steering with Micron-Level Precision
- Vertical and Horizontal Beam Displacement
- Inquire About Using with Special Filters
- Use as Attenuator (0 - 20 dB)
- Use to Correct Known Offsets of System Optics
- AR Coating: R_{avg} <0.5% over Wavelength Range



Adjustable

ITEM #	$	£	€	RMB	DESCRIPTION
HWXYT-A	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50	Tweaker Module 2.5 mm Thick, 350 - 650 nm
HWXYT-B	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50	Tweaker Module 2.5 mm Thick, 650 - 1050 nm
HWXYT-C	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50	Tweaker Module 2.5 mm Thick, 1050 - 1620 nm

Rotating Achromatic Wave Plate Modules

FiberBench retarders are mounted in a precision 360° rotation fixture. The mount has engraved degree marks and a knurled outer edge that allows for an alignment precision of 1.5°. The AR-coated retarders only contribute 0.1 dB of additional insertion loss and are easily removed and replaced. The rotating plate holding the retarder can be removed from the magnetic mount, which simplifies optics changes. Quarter- and half-wave modules can be used to create polarization controllers, PM fiber launch systems, and other devices.

NEW versions

The achromatic wave plate module is a compound plate design using Crystal Quartz and MgF_2. The plates are air-spaced to provide a high-power beam path. The beam deviation and transmitted wavefront error are both minimal. Zero-order wave plates are available upon request. Please contact Tech Support.

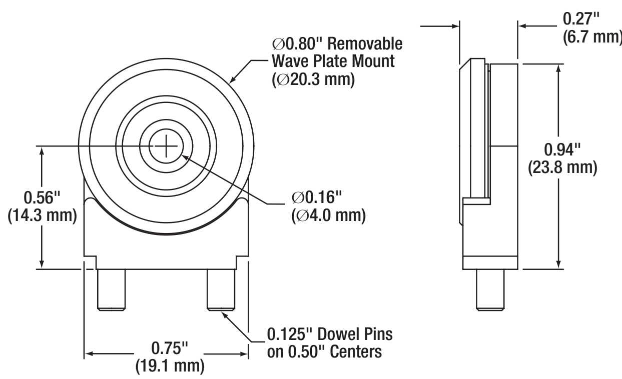
Features

- Compound Plate Design
- Crystal Quartz and MgF_2
- Epoxy-Free Beam Path
- Flat Spectral Response
- Air-Spaced Construction
- High-Power Handling ($2\ MW/cm^2$ CW, $2\ J/cm^2$ @ 10 ns Pulse)
- Engraved Angle Index

RABQ-600

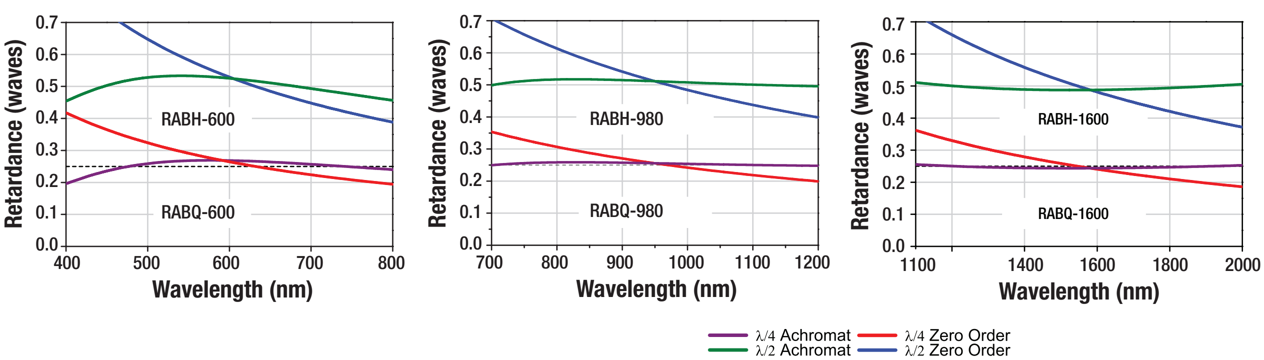
Specifications

- **Aperture:** Ø4 mm
- **Beam Deviation:** ≤10 arcsec
- **Wavefront Error:** <λ/4
- **Scratch Dig:** 40-20
- 360° Rotation
- 1.5° Measurement Precision



Please refer to our website for complete models and drawings.

Retardance Performance Comparison: Achromatic vs. Zero Order



λ/4 Rotating Achromatic Wave Plate Modules

ITEM #	$	£	€	RMB	DESCRIPTION
RABQ-600	$ 300.00	£ 216.00	€ 261,00	¥ 2,391.00	Rotating Achromatic λ/4 Wave Plate, Wavelength Range: 400 - 800 nm
RABQ-980	$ 300.00	£ 216.00	€ 261,00	¥ 2,391.00	Rotating Achromatic λ/4 Wave Plate, Wavelength Range: 700 - 1200 nm
RABQ-1600	$ 300.00	£ 216.00	€ 261,00	¥ 2,391.00	Rotating Achromatic λ/4 Wave Plate, Wavelength Range: 1100 - 2000 nm

NEW

λ/2 Rotating Achromatic Wave Plate Modules

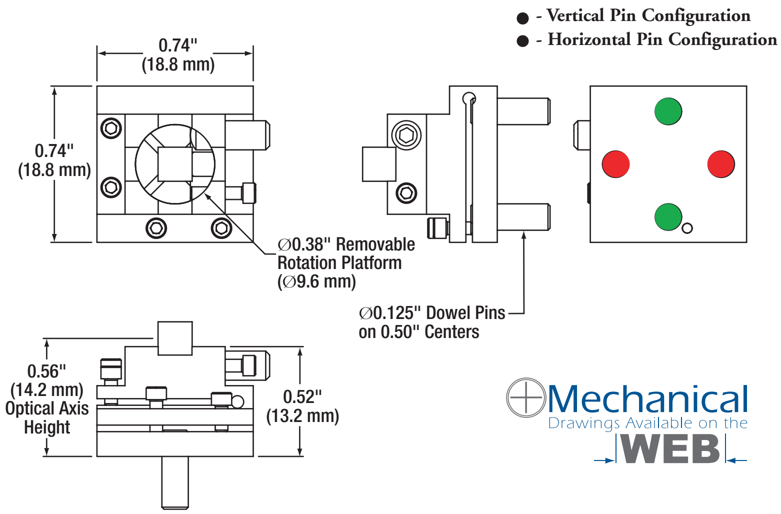
ITEM #	$	£	€	RMB	DESCRIPTION
RABH-600	$ 300.00	£ 216.00	€ 261,00	¥ 2,391.00	Rotating Achromatic λ/2 Wave Plate, Wavelength Range: 400 - 800 nm
RABH-980	$ 300.00	£ 216.00	€ 261,00	¥ 2,391.00	Rotating Achromatic λ/2 Wave Plate, Wavelength Range: 700 - 1200 nm
RABH-1600	$ 300.00	£ 216.00	€ 261,00	¥ 2,391.00	Rotating Achromatic λ/2 Wave Plate, Wavelength Range: 1100 - 2000 nm

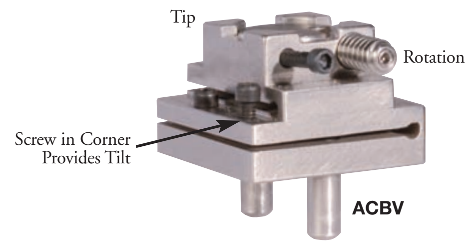
NEW

Adjustable Polarizing Cube, Plate, and Mirror Tutorial

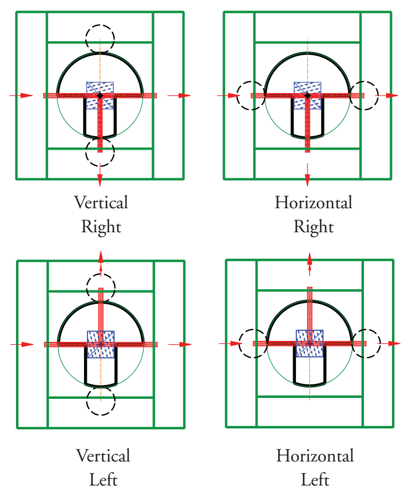
For applications that require a beam to be split or reflected, we offer polarizing cubes, beamsplitter plates, and mirrors mounted to a multi-axis flexure base. The base allows for tip, tilt, and rotational adjustment for precise beam alignment and steering control. The modules provide easy adjustment to the mechanism without interfering with the beam path. You can choose the mount that directs the beam to the correct port's path so that the adjusting screws are in a convenient position for your setup. The flexure base has vertical and horizontal pin mounting orientations. The vertical pin configuration is the most common and is used on all FiberTables, except the FT-100X100 and FT-114X149. Please contact tech support, and a FiberBench expert will help you.

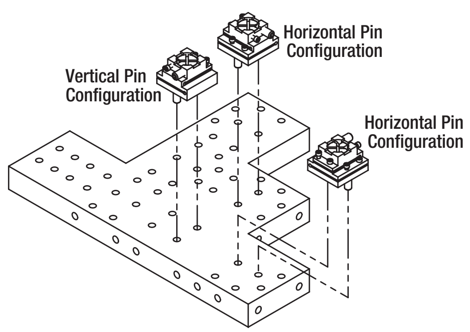
A vertical pin configuration is defined as having the pins mounted parallel to the rotation adjustment screw. In the horizontal configuration, the pins will be mounted perpendicular to the rotation adjustment screw. The next designation is handled as a right or left turn of the incoming beam. The right 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.

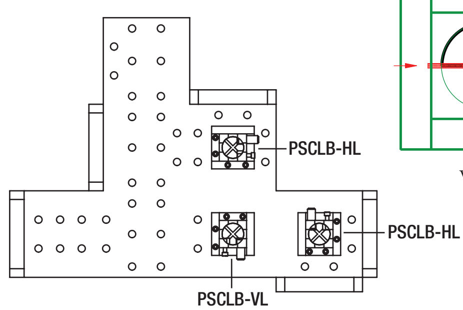




Mechanical Drawings Available on the WEB

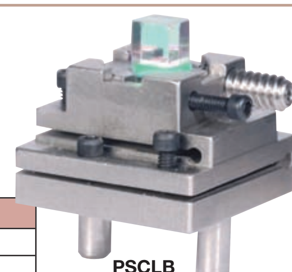






Adjustable Polarizing Cube Beamsplitter Modules

The PSCLB Series of modules uses a polarizing beamsplitter cube mounted on the ACBH or ACBV flexure base. Each module provides a polarization-dependent split with an extinction ratio that is better than a 1000:1. Other wavelengths are available. Please contact Tech Support for a quotation.



Cube Beamsplitter

Specifications

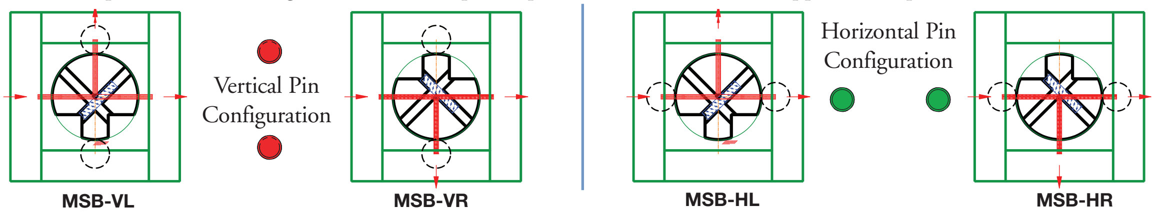
- **Clear Aperture:** Ø1.5 mm
- **Beam Deviation:** ±5 arcmin
- **Wavefront Distortion:** ≤λ/4

ITEM #	$	£	€	RMB	DESCRIPTION
PSCLB-VL-780	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Vertical Left, 780 nm
PSCLB-HL-780	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Horizontal Left, 780 nm
PSCLB-VR-780	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Vertical Right, 780 nm
PSCLB-HR-780	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Horizontal Right, 780 nm
PSCLB-VL-1064	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Vertical Left, 1064 nm
PSCLB-HL-1064	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Horizontal Left, 1064 nm
PSCLB-VR-1064	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Vertical Right, 1064 nm
PSCLB-HR-1064	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Horizontal Right, 1064 nm
PSCLB-VL-1550	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Vertical Left, 1550 nm
PSCLB-HL-1550	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Horizontal Left, 1550 nm
PSCLB-VR-1550	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Vertical Right, 1550 nm
PSCLB-HR-1550	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FiberBench Beamsplitter, Horizontal Right, 1550 nm

See page 1074

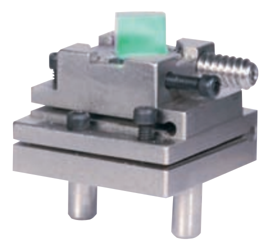
Adjustable Non-Polarizing Plate Beamsplitter Modules

The MSB series of beamsplitter modules 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. Other wavelengths are available upon request. Please contact Tech Support for a quotation.



50:50 Split

ITEM #	$	£	€	RMB	DESCRIPTION
MSB-VL-780-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Left, 780 nm, 50:50
MSB-HL-780-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Left, 780 nm, 50:50
MSB-VR-780-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Right, 780 nm, 50:50
MSB-HR-780-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Right, 780 nm, 50:50
MSB-VL-1064-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Left, 1064 nm, 50:50
MSB-HL-1064-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Left, 1064 nm, 50:50
MSB-VR-1064-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Right, 1064 nm, 50:50
MSB-HR-1064-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Right, 1064 nm, 50:50
MSB-VL-1550-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Left, 1550 nm, 50:50
MSB-HL-1550-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Left, 1550 nm, 50:50
MSB-VR-1550-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Right, 1550 nm, 50:50
MSB-HR-1550-50/50	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Right, 1550 nm, 50:50



MSB Plate Beamsplitter

4:96 Split

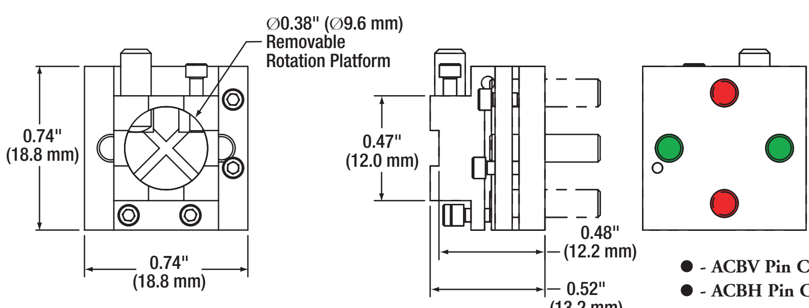
ITEM #	$	£	€	RMB	DESCRIPTION
MSB-VL-780-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Left, 780 nm, 4:96
MSB-HL-780-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Left, 780 nm, 4:96
MSB-VR-780-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Right, 780 nm, 4:96
MSB-HR-780-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Right, 780 nm, 4:96
MSB-VL-1064-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Left, 1064 nm, 4:96
MSB-HL-1064-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Left, 1064 nm, 4:96
MSB-VR-1064-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Right, 1064 nm, 4:96
MSB-HR-1064-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Right, 1064 nm, 4:96
MSB-VL-1550-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Left, 1550 nm, 4:96
MSB-HL-1550-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Left, 1550 nm, 4:96
MSB-VR-1550-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Vertical Right, 1550 nm, 4:96
MSB-HR-1550-4/96	$ 375.00	£ 270.00	€ 326,25	¥ 2,988.75	Beamsplitter, Horizontal Right, 1550 nm, 4:96

Specifications

- **Clear Aperture:** Ø1.5 mm
- **Wavefront Distortion:** λ/4
- **Plate Thickness:** 1.5 mm
- **Beam Displacement:** ~0.5 mm
- **Split Ratios for Unpolarized Signals:** 50:50 and 4:96

Flexure Bases

These flexure bases are designed to mount customer-supplied optics on a FiberBench or FiberTable. The base allows for tip, tilt, and rotational adjustment for precise beam alignment and steering control. It is available with either a vertical or horizontal pin orientation so that the adjustment screws do not interfere with the beam path.

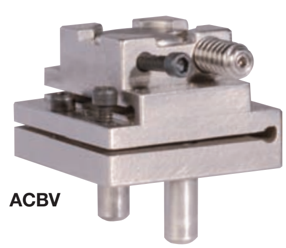


Please refer to our website for complete models and drawings.

● - ACBV Pin Configuration

● - ACBH Pin Configuration

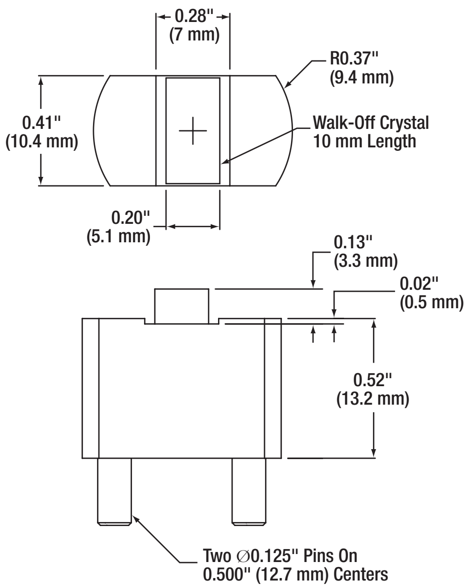
- Use with Beamsplitter Plates up to 1 mm Thick and 6 mm Cubes (Larger Cubes Can be Held, but it May be More Difficult to Align)
- 6° Tip/Tilt Adjustment
- ±5° Rotation Alignment

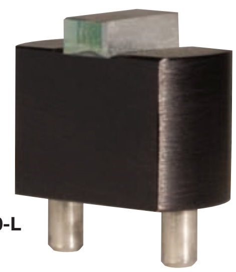


ACBV

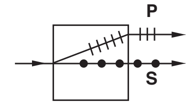
ITEM #	$	£	€	RMB	DESCRIPTION
ACBV	$ 295.80	£ 212.98	€ 257,35	¥ 2,357.53	FiberBench Flexure Base, Vertical Pins
ACBH	$ 295.80	£ 212.98	€ 257,35	¥ 2,357.53	FiberBench Flexure Base, Horizontal Pins

Walk-Off Polarizer Module

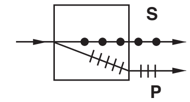



PBB-VIS-10-L

Left-Handed Walk-Off Polarizer



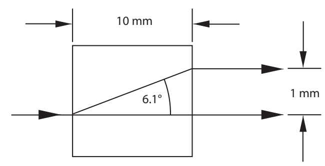
Right-Handed Walk-Off Polarizer



Specifications

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

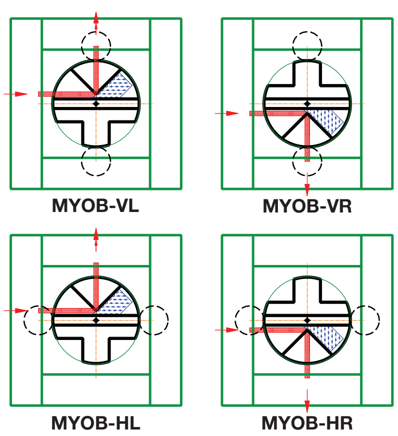
Internal Separation Angle

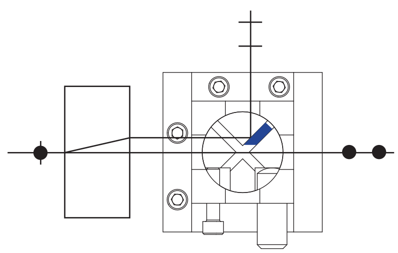


ITEM #	$	£	€	RMB	APERTURE	WAVELENGTH	TRANSMISSION	EXTINCTION
PBB-VIS-10-L	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	Ø1.0 mm	620 - 690 nm	>96%	>50 dB
PBB-VIS-10-R	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	Ø1.0 mm	620 - 690 nm	>96%	>50 dB
PBB-NIR-10-L	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	Ø1.0 mm	770 - 870 nm	>97%	>50 dB
PBB-NIR-10-R	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	Ø1.0 mm	770 - 870 nm	>97%	>50 dB
PBB-YAG-10-L	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	Ø1.0 mm	970 - 1080 nm	>97%	>50 dB
PBB-YAG-10-R	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	Ø1.0 mm	970 - 1080 nm	>97%	>50 dB
PBB-IR-10-L	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	Ø1.0 mm	1280 - 1625 nm	>97%	>50 dB
PBB-IR-10-R	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	Ø1.0 mm	1280 - 1625 nm	>97%	>50 dB

Adjustable Offset Mirror Modules

The MYOB series of modules uses an enhanced 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.



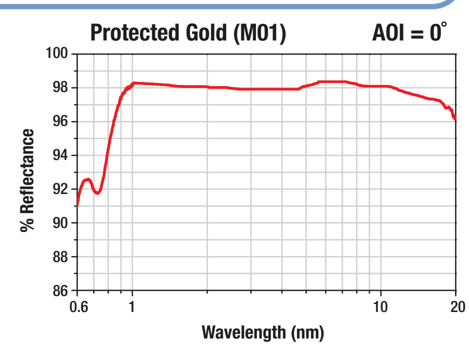


Specifications

- **Clear Aperture:** Ø1.0 mm
- **Wavefront Distortion:** ≤λ/4
- **Reflectivity:** >95% (800 nm - 10 µm)

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.



ITEM #	$	£	€	RMB	DESCRIPTION
MYOB-VL-M01	$ 350.00	£ 252.00	€ 304,50	¥ 2,789.50	Gold Mirror, Vertical Left
MYOB-HL-M01	$ 350.00	£ 252.00	€ 304,50	¥ 2,789.50	Gold Mirror, Horizontal Left
MYOB-VR-M01	$ 350.00	£ 252.00	€ 304,50	¥ 2,789.50	Gold Mirror, Vertical Right
MYOB-HR-M01	$ 350.00	£ 252.00	€ 304,50	¥ 2,789.50	Gold Mirror, Horizontal Right

FiberTable Adapter for Mirror Mounts

FT-MMAC

- For Mounting a Mirror Mount to FiberBenches or FiberTables
- Mounting Screws Included

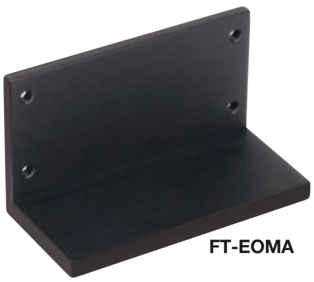
The FT-MMAC is ideal for mounting one of our mirror mounts to a FiberTable or FiberBench, such as our KS05 (as shown in the picture to the right), KM05, KMS, or KMSS (see pages 247, 249 and 250). Additionally, users can use one of our VH1 V-clamps (see page 319) with this versatile adapter.

The FT-MMAC comes with all the screws necessary to mount it to the table (two 8-32 shoulder screws) and to the mirror mount (one 8-32 and one M4 cap screw).

The image shows an FT-MMAC being used to mount a KS05 to a FiberTable in an interferometer application.

ITEM #	$	£	€	RMB	DESCRIPTION
FT-MMAC	$ 29.00	£ 20.88	€ 25,23	¥ 231.13	FiberTable Adapter for Mirror Mounts

FiberTable Adapter for EO Modulators



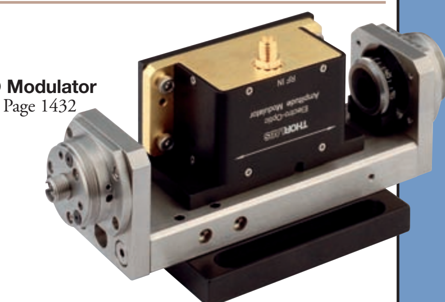
FT-EOMA

- Adapter Plate Aligns an EO Modulator in the Beam Path
- 4 Tapped 6-32 Holes for Mounting the Modulator, Screws Included
- Alignment Pins for Mounting to any FiberTable or FiberBench Over 70 mm Long

The FT-EOMA is a mounting bracket used to mount an EO modulator onto a FiberTable or FiberBench. The length of the table needs to be at least 70 mm along the axis you wish to mount the modulator. As an accessory we offer the EO-GTH5M mount and polarizer (see page 1434), but we recommend using the FiberTable Linear Polarizer Modules (see page 1070) with an EO Modulator FiberTable setup as shown.

EO Modulator

See Page 1432



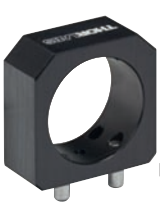
The setup picture above shows an EO Modulator with an FT-38X100 FiberTable, one PCB Linear Polarizer, and two PAF FiberPorts

ITEM #	$	£	€	RMB	DESCRIPTION
FT-EOMA	$ 45.00	£ 32.40	€ 39,15	¥ 358.65	FiberTable Adapter for EO Modulators

FiberBench Adapter for Free-Space Isolators

This adapter mounts our free-space isolators (see pages 927 - 946) with an outer diameter of 0.87" (22.1 mm) to our FiberBench series and aligns the optical axis with the isolator. The mount is compatible with all FiberBench and FiberTable products.

Mechanical Drawings Available on the WEB



H1C

Compatible Isolators

- IO-2D-633-VLP
- IO-3D-633-VLP
- IO-3D-633-PBS
- IO-3D-780-VLP
- IO-3D-830-VLP
- IO-3D-850-VLP
- IO-2.5E-1064-VLP

The image above shows a free-space isolator mounted in an H1C, on an FB-76 FiberBench, with a FiberPort fiber collimator.

ITEM #	$	£	€	RMB	DESCRIPTION
H1C	$ 66.30	£ 47.74	€ 57,68	¥ 528.41	FiberBench Adapter for Free-Space Isolators

Rotation Mount


RCB

- Mount Filters or Polarizers up to 1 mm Thick and 14 mm in Diameter
- Ø4 mm Clear Aperture
- Optic Secured with Retaining Ring
- Magnetic Mount for Smooth, Continuous Rotation
- 360° Rotation
- 1.5° Measurement Precision

ITEM #	$	£	€	RMB	DESCRIPTION
RCB	$ 65.00	£ 46.80	€ 56,55	¥ 518.05	FiberBench Rotation Mount

FiberBench Mounting Adapter

The FT-SM05 optics mount is designed to hold Ø1/2" optics while also maintaining the appropriate beam height when placed on a FiberBench or FiberTable. It features our standard SM05 thread (Ø0.535"-40).

- Holds Ø1/2" Optics up to 2.5 mm Thick
- Retaining Ring Included
- Ø11 mm Clear Aperture


SM05RR Retaining Ring Included


FT-SM05

ITEM #	$	£	€	RMB	DESCRIPTION
FT-SM05	$ 40.00	£ 28.80	€ 34,80	¥ 318.80	FiberBench Mounting Adapter for Ø1/2" Optics, Internal SM05 Threading

Aperture Plates

- Mounts in FT-SM05 Ø1/2" Optic Mount
- Ø1.5 and Ø2.5 mm Apertures


AP1.5


AP2.5

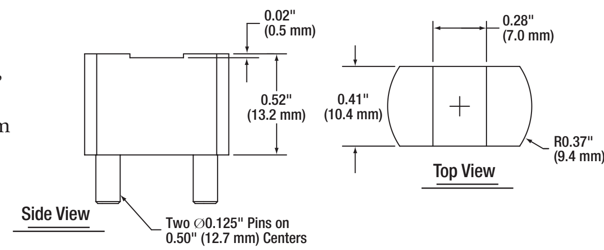
Aperture plates are a useful tool for system alignment or to measure beam size. When the aperture plate is mounted into the above FT-SM05 mount, it can be used to establish an optical center line in a FiberBench/FiberTable system. It is also useful for blocking stray light or other unwanted light in an optical system.

ITEM #	$	£	€	RMB	DESCRIPTION
AP1.5	$ 10.00	£ 7.20	€ 8,70	¥ 79.70	Ø1.5 mm Alignment Aperture Plate
AP2.5	$ 10.00	£ 7.20	€ 8,70	¥ 79.70	Ø2.5 mm Alignment Aperture Plate

Static Mounting Platform


HCB

- Use for Static Mounting of Filters, Prisms, and Polarizers
- Approximately 1.5 mm from Beam Center Line to Top Surface
- Epoxy Optic to Mount

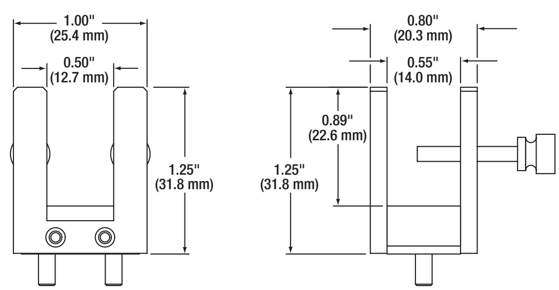


ITEM #	$	£	€	RMB	DESCRIPTION
HCB	$ 40.00	£ 28.80	€ 34,80	¥ 318.80	Static Mounting Platform for FiberBench

Universal Mounting Base


UCB

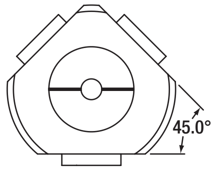
- Used for Mounting Filters and Windows
- Non-Marring Delrin® Construction
- 14 mm Maximum Optic Thickness



Please refer to our website for complete models and drawings.

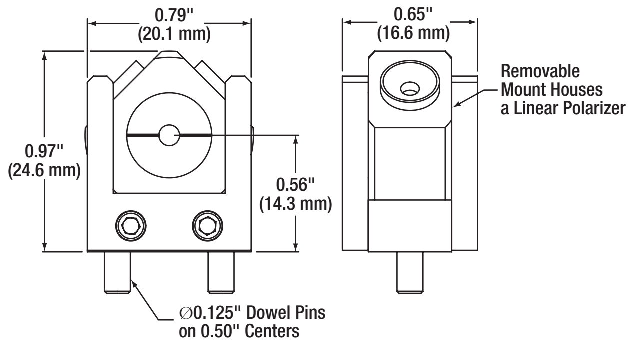
ITEM #	$	£	€	RMB	DESCRIPTION
UCB	$ 60.00	£ 43.20	€ 52,20	¥ 478.20	Universal Mounting Base for FiberBench

Linear Polarization Reference Module



The Linear Polarization Reference Module consists of a PCB Linear Polarizer held in a Capture Cage. The LPR module establishes a reference plane, starting at 0°, and then at every 45°. It is ideal for polarization extinction ratio measurements, polarimetry, and PM fiber alignment. Other wavelengths and units with an integrated quarter-wave retarder, to function as a manual polarimeter, are available by request. Please contact Tech Support for details.


LPR-1550



Please refer to our website for complete models and drawings.

Features

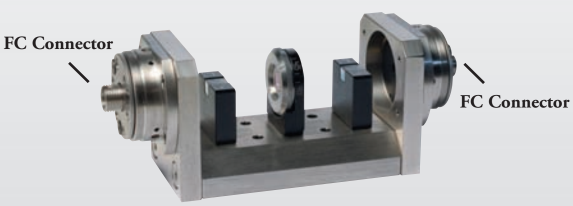
- Precision Linear Polarization Reference
- 0°, 45°, 90°, and 135° Orientations
- Angle Tolerance <30 arcmin
- Highly Repeatable Positioning by Magnetic Contact

Applications

- Polarization Extinction Ratio Measurements
- Polarimetry
- PM Fiber Alignment

ITEM #	$	£	€	RMB	DESCRIPTION
LPR-1550	$ 825.00	£ 594.00	€ 717,75	¥ 6,575.25	Linear Polarization Reference Module, 1500 – 1600 nm

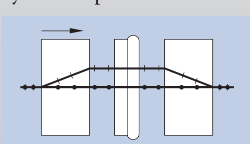
Variable Optical Attenuator Application



Parts List

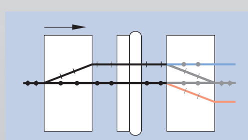
QUANTITY	ITEM #	DESCRIPTION	PAGE
2	PAF-X-2-C	Fiber Collimator/Coupler	1082
1	FB-51W	FiberBench	1068
1	RABH-1600	Rotating Half-Wave Plate	1071
1	PBB-IR-10-L	Calcite Walk-Off Polarizer	1074
1	PBB-IR-10-R	Calcite Walk-Off Polarizer	1074
2	SM or PM Fiber Patchcord Required		1005 - 1012

A continuously variable attenuator can be assembled using the following FiberBench parts: two PAF collimator FiberPorts (pages 1081 - 1085), a FB-51W FiberBench (page 1068), PBB calcite polarizers (page 1074), and RABH rotating half-wave retarder (page 1071). 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 a 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.



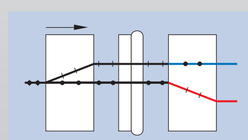
Zero Attenuation:

The RABH 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 RABH Zero-Order Retarder Module is rotated so that there are three output beams. The RABH 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 to 40 dB with any value in between.



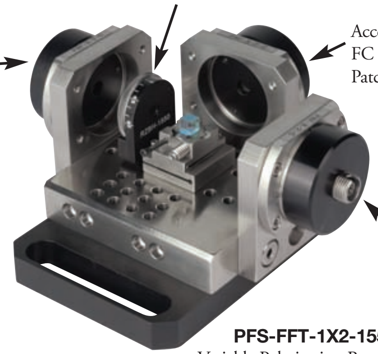
Full Attenuation:

The RABH 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 minimal coupling efficiency, resulting in a maximum attenuation of 40 dB.

1550 nm Variable Polarization Beamsplitter Kit

Features

- Power is Fiber Limited to 10 W (CW, Typical)
- Mechanical and Thermal Stability
- Continuously Variable Split Ratio
- Special Wavelengths Available upon Request
- FC/PC, FC/APC Compatible
- Also Useful As a Variable 1 x 2 Coupler



PFS-FFT-1X2-1550
Variable Polarization Beamsplitter

The kit is supplied assembled but not aligned.

Includes

- 1 FiberTable (FT-51X60)
- 3 FiberPorts (PAF-X-2-C)
- 3 Wall Plates (HCA3)
- 1 Polarization Beamsplitter (PSCLB-VL-1550)
- 1 Zero Order 1/2 Wave Plate Module (RABH-1600)

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 continuously variable from 0 to 30 dB.* Please contact Tech Support to discuss custom configurations.

*Dependent on polarization extinction ratio from the input PM fiber and the spectral line width when $\Delta\lambda \leq 3$ nm

ITEM #	$	£	€	RMB	DESCRIPTION
PFS-FFT-1X2-1550	$ 2,650.00	£ 1,908.00	€ 2.305,50	¥ 21,120.50	Variable Polarization Beamsplitter Kit, 1550 nm

1550 nm Polarization Controller Kit

Features

- Mechanical and Thermal Stability
- Deterministic Polarization Control
- Special Wavelengths Available upon Request

PC-FFB-1550
Polarization Controller

We offer a polarization controller assembled from a FiberBench, FiberPorts, and component modules. A bench controller has the same function as a paddle controller, but offers a more deterministic and stable polarization manipulation.

The FiberBench polarization controller PC-FFB-1550 is a deterministic system with no hysteresis, thus it is possible to predict the controller's output SOP at any instant in time given only its input SOP. In any system with hysteresis, like a fiber paddle controller, there is no way to predict the output. Hysteresis describes the lag that exists between the responding parameter and the changing parameter or in this case the time lag between the SOP change and the moving of the fiber paddles. When a paddle controller is adjusted, the SOP takes time to stabilize and may not stabilize at the intended value. Furthermore, without a polarimeter, the SOP from the paddle controller cannot be determined directly. With a FiberBench polarization controller, any known input polarization state can be deterministically rotated into a known output polarization state using the quarter-wave plate, half-wave plate, and quarter-wave plate. Each wave plate can be precisely and continuously rotated through 360°.

The kit is supplied assembled but not aligned.

Includes

- 1 FiberBench (FB-51W)
- 2 FiberPorts (PAF-X-2-C)
- 2 Quarter-Wave Retarders
- 1 Half-Wave Retarder

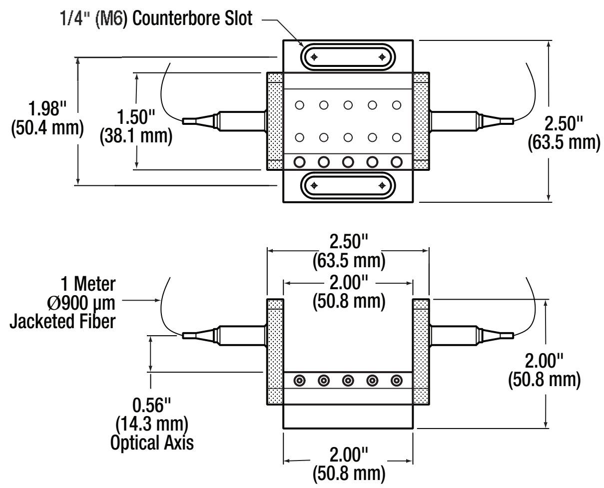
ITEM #	$	£	€	RMB	DESCRIPTION
PC-FFB-1550	$ 2,320.00	£ 1,670.40	€ 2.018,40	¥ 18,490.40	Polarization Controller Kit with Zero Order Waveplates, 1550 nm

Fiber-to-Fiber U-Bench: Fixed

NEW products

FBC-1550-APC
Fiber-to-Fiber Coupler
(Dust Cover Not Shown)

- Fixed Coupling for 780 nm, 1064 nm, 1310 nm, or 1550 nm
- Bandwidth: ±15 nm
- Return Loss: >55 dB
- Fiber Length: 1 m
- Max Power: 3 W CW
- Based on Configurable FiberBench Platform
- Thermally and Mechanically Stable
- Fibers Feature Either FC/PC or FC/APC Connectors
- Custom Versions Available Upon Request



Thorlabs' high performance fixed fiber-to-fiber U-benches allow easy access to the optical beam in a fiber-based application. They facilitate optical chopping and the insertion of plano/plano optical elements such as filters, polarizers, and attenuators as they are fully compatible with our wide offering of FiberBench accessories (pages 1070 - 1077). These devices are bidirectional with the input optics, output optics, and fiber end faces coated with narrowband anti-reflection coatings (R < 0.25%) for minimized insertion and return losses.

ITEM #	$	£	€	RMB	FIBER TYPE	IL*	BEAM DIAMETER (TYPICAL)	WAVELENGTH	CONNECTORS
FBC-780-FC	$ 620.00	£ 446.40	€ 539,40	¥ 4,941.40	780HP (Page 1021)	0.85 ± 0.3 dB	0.5 mm	780 nm	FC/PC
FBC-780-APC	$ 640.00	£ 460.80	€ 556,80	¥ 5,100.80				780 nm	FC/APC
FBC-1064-FC	$ 595.00	£ 428.40	€ 517,65	¥ 4,742.15	1060XP (Page 1022)		2.0 mm	1064 nm	FC/PC
FBC-1064-APC	$ 615.00	£ 442.80	€ 535,05	¥ 4,901.55				1064 nm	FC/APC
FBC-1310-FC	$ 595.00	£ 428.40	€ 517,65	¥ 4,742.15	SMF-28e+ (Page 1023)	0.6 ± 0.3 dB	2.8 mm	1310 nm	FC/PC
FBC-1310-APC	$ 615.00	£ 442.80	€ 535,05	¥ 4,901.55				1310 nm	FC/APC
FBC-1550-FC	$ 595.00	£ 428.40	€ 517,65	¥ 4,742.15			3.1 mm	1550 nm	FC/PC
FBC-1550-APC	$ 615.00	£ 442.80	€ 535,05	¥ 4,901.55				1550 nm	FC/APC

*Insertion Loss

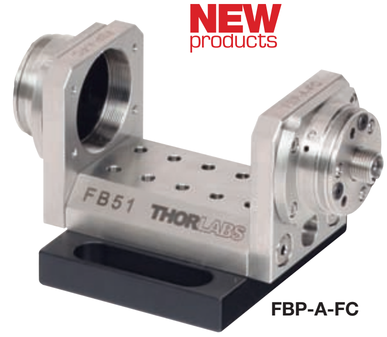
For more details, see page 1097

Fiber to Fiber U-Bench: Adjustable

Features

- Adjustable Collimation/Coupling for Applications Requiring Flexibility
- Three Wavelength Ranges
  - 350 – 700 nm
  - 650 – 1050 nm
  - 1050 – 1620 nm
- Coating Performance: $R_{avg} < 0.5\%$
- Five Axes of Adjustment on Each FiberPort
- Rough Aligned at 633 nm (-A), 780 nm (-B), and 1310 nm (-C)
- Factory-Aligned Versions Available Upon Request

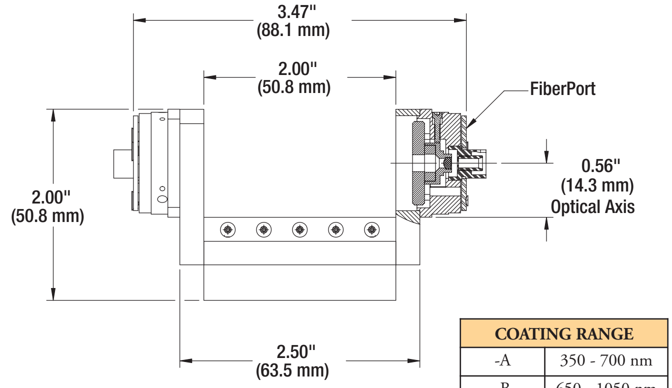
NEW products



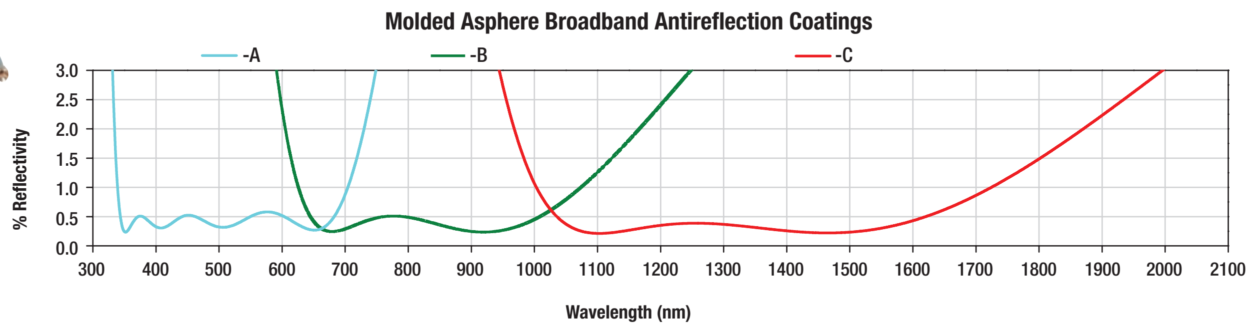
FBP-A-FC

Dust Cover and FiberPort Caps Not Shown

Thorlabs' Adjustable Fiber-to-Fiber U-Benches provide the same benefits as our Fixed U-Benches (see page 1079) with the added flexibility of using any desired fiber with FC/PC or SMA connectors. Based on the stable FiberBench platform, these devices are easily configured and aligned for any potential application. For minimal insertion and return losses, we recommend using antireflection coated patch cables. For fiber with core size >Ø62.5 µm, there will be high insertion loss.



COATING RANGE	
-A	350 - 700 nm
-B	650 - 1050 nm
-C	1050 - 1620 nm



ITEM #	EFL	INPUT MFD[a]	OUTPUT WAIST DIA.	MAX WAIST DIST.[b]	DIVERGENCE	LENS CHARACTERISTICS CA[c]	NA	AR λ[d]	BULKHEAD TYPE
FBP-A-FC	2.0 mm	3.5 µm	0.33 mm	96 mm	1.75 mrad	2.0 mm	0.50	350 - 700 nm	FC/PC or APC
FBP-B-FC	2.0 mm	4.3 µm	0.38 mm	89 mm	2.20 mrad	2.0 mm	0.50	650 - 1050 nm	FC/PC or APC
FBP-C-FC	2.0 mm	10.4 µm	0.38 mm	38 mm	5.20 mrad	2.0 mm	0.50	1050 - 1620 nm	FC/PC or APC
FBP-A-SMA	2.0 mm	3.5 µm	0.33 mm	96 mm	1.75 mrad	2.0 mm	0.50	350 - 700 nm	SMA
FBP-B-SMA	2.0 mm	4.3 µm	0.38 mm	89 mm	2.20 mrad	2.0 mm	0.50	650 - 1050 nm	SMA
FBP-C-SMA	2.0 mm	10.4 µm	0.38 mm	38 mm	5.20 mrad	2.0 mm	0.50	1050 - 1620 nm	SMA

[a]Mode Field Diameter
[b]Maximum distance that the beam waist can be from the lens while still remaining collimated
[c]Clear Aperture
[d]Wavelength range of the antireflection coating

ITEM #	$	£	€	RMB	WAVELENGTH RANGE	CONNECTORS
FBP-A-FC	$ 1,000.00	£ 720.00	€ 870,00	¥ 7,970.00	350 - 700 nm	FC/PC
FBP-A-SMA	$ 830.00	£ 597.60	€ 722,10	¥ 6,615.10	350 - 700 nm	SMA
FBP-B-FC	$ 1,000.00	£ 720.00	€ 870,00	¥ 7,970.00	650 - 1050 nm	FC/PC
FBP-B-SMA	$ 830.00	£ 597.60	€ 722,10	¥ 6,615.10	650 - 1050 nm	SMA
FBP-C-FC	$ 1,000.00	£ 720.00	€ 870,00	¥ 7,970.00	1050 - 1620 nm	FC/PC
FBP-C-SMA	$ 830.00	£ 597.60	€ 722,10	¥ 6,615.10	1050 - 1620 nm	SMA

FiberPort Overview

Thorlabs' FiberPorts are adjustable fiber coupling and collimation devices. They feature either an aspheric or an achromatic doublet lens, which is positioned with respect to an optical fiber with an FC/PC, FC/APC, or SMA connector. The FiberPort offers 5 axes of adjustment of the collimating/coupling lens: X, Y, Z, pitch (θ_x), and yaw (θ_y). Rotation about the optical axis (θ_z) axis is achieved by rotating the fiber receptacle on the FiberPort, which is particularly useful when working with polarization-sensitive applications. Each FiberPort's lens has an anti-reflection coating to minimize back reflections.

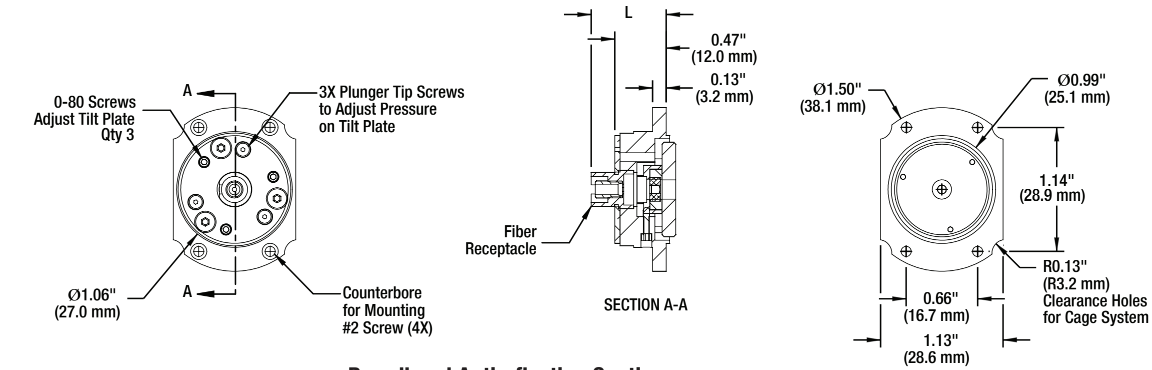
We now offer FiberPorts for collimation and coupling between 350 nm and 2400 nm. Versions with aspheric lenses are available with focal lengths ranging from 2.0 mm to 18.4 mm, allowing customers to choose a FiberPort based on their desired output beam diameter or spot size.

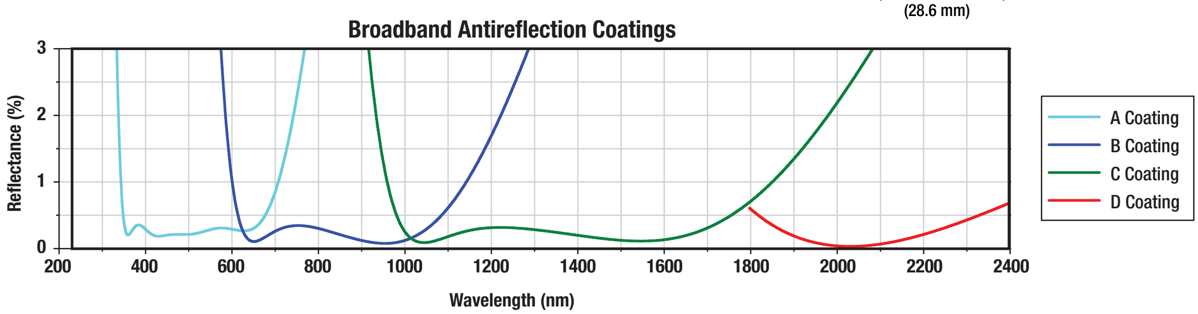
FiberPorts with achromatic doublets are new for our V21 catalog. These versions are desirable when working with polychromatic light or with a system where multiple light sources are used. As achromatic doublets feature a minimal focal shift over their specified wavelength range, few adjustments will need to be made to the FiberPort for optimum coupling or collimation.

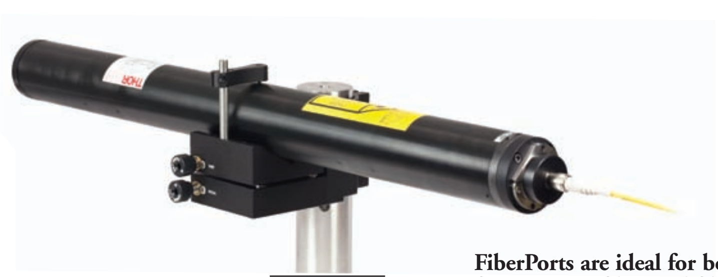
Our FiberPorts are designed for compatibility with our FiberBench and FiberTable systems (see pages 1066 - 1080). Additionally, FiberPorts can be mated to HeNe lasers (see pages 1276 - 1280) or integrated into our 30 mm cage system (see pages 176 - 201) using available adapters (see page 1085).

PAFA-X-4-A

- FC/PC and FC/APC, and SMA Connectors
- Aspheric or Achromatic Collimation Lenses
- Ideal for Single Mode, Polarization-Maintaining, and Multimode Fiber
- Stable and Compact Fiber Coupling and Collimation Package







FiberPorts are ideal for both free-space to fiber and fiber to free-space applications.

FiberPort Couplers: Aspheric (Page 1 of 2)

Thorlabs' compact, ultra-stable FiberPort micropositioners provide an easy-to-use platform for coupling light into and out of optical fibers. This device enables alignment to an FC/PC-, FC/APC-, or SMA-terminated fiber with six directional adjustments. The compact size combined with the ultra-stable alignment, which is maintained over time, makes the FiberPort an ideal solution for fiber coupling or collimation.

Lens Selection

Most FiberPorts incorporate an AR-coated aspheric lens, which allows them to couple monochromatic light. These lenses have different focal lengths and antireflection coatings specifically designed for use within a particular wavelength range. For applications requiring coupling of multiple visible wavelengths, the Achromatic FiberPorts are ideal. These use achromatic doublets designed for three wavelengths within the lens' operating range. See page 1084 for a comparison between FiberPorts with aspheric and achromatic lenses.

Thorlabs offers aspheric FiberPort models utilizing our -A, -B, -C, or -D AR coating, which are designed for 350 - 700 nm,* 600 - 1050 nm, 1050 - 1600 nm, or 1800 - 2400 nm, respectively. These models may be used with single mode, multimode, and PM fibers and accommodate various connectors. Care should be taken in selecting a FiberPort to make sure the correct fiber/connector/FiberPort combination is selected. If you need assistance, please contact tech support at your local office.

*For certain models only, please see Specifications below for details.

Aspheric FiberPort for FC/PC and FC/APC Connectors

ITEM #	$	£	€	RMB
PAF-X-2-A	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-2-B	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-2-C	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-5-A	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35
PAF-X-5-B	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35
PAF-X-5-C	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35
PAF-X-7-A	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35
PAF-X-7-B	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35
PAF-X-7-C	$ 428.40	£ 308.45	€ 372,71	¥ 3,414.35

Aspheric FiberPort for FC/PC Connectors

ITEM #	$	£	€	RMB
PAF-X-11-PC-A	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-11-PC-B	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-11-PC-C	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-15-PC-A	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-15-PC-B	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-15-PC-C	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-15-PC-D	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-18-PC-A	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70
PAF-X-18-PC-B	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70
PAF-X-18-PC-C	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70
PAF-X-18-PC-D	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70

Aspheric FiberPort for FC/PC and FC/APC Connectors

ITEM #	EFL	INPUT MFD[a]	OUTPUT WAIST DIA.	MAX WAIST DIST.[b]	DIVERGENCE	LENS CHARACTERISTICS			L[e]
						CA[c]	NA	AR λ[d]	
PAF-X-2-A	2.0 mm	3.5 µm	0.37 mm	109 mm	1.75 mrad	2.0 mm	0.50	400 - 600 nm	0.69" (17.5 mm)
PAF-X-2-B	2.0 mm	4.3 µm	0.37 mm	89 mm	2.15 mrad	2.0 mm	0.50	600 - 1050 nm	0.69" (17.5 mm)
PAF-X-2-C	2.0 mm	10.4 µm	0.38 mm	38 mm	5.20 mrad	2.0 mm	0.50	1050 - 1600 nm	0.69" (17.5 mm)
PAF-X-5-A	4.6 mm	3.5 µm	0.86 mm	571 mm	0.76 mrad	4.9 mm	0.53	350 - 700 nm	0.69" (17.5 mm)
PAF-X-5-B	4.6 mm	4.3 µm	0.86 mm	466 mm	0.93 mrad	4.9 mm	0.53	600 - 1050 nm	0.69" (17.5 mm)
PAF-X-5-C	4.6 mm	10.4 µm	0.87 mm	198 mm	2.26 mrad	4.9 mm	0.53	1050 - 1600 nm	0.69" (17.5 mm)
PAF-X-7-A	7.5 mm	3.5 µm	1.41 mm	1513 mm	0.47 mrad	4.4 mm	0.29	350 - 700 nm	0.69" (17.5 mm)
PAF-X-7-B	7.5 mm	4.3 µm	1.41 mm	1233 mm	0.57 mrad	4.4 mm	0.29	600 - 1050 nm	0.69" (17.5 mm)
PAF-X-7-C	7.5 mm	10.4 µm	1.42 mm	521 mm	1.39 mrad	4.4 mm	0.29	1050 - 1600 nm	0.69" (17.5 mm)

[a]Mode Field Diameter of input fiber used for calculations
[b]Maximum distance that the beam waist can be from the lens while still remaining collimated
[c]Clear Aperture
[d]Wavelength of the Antireflection Coating
[e]Length from tip of bulkhead to face of flange (see drawings on page 1081)

Aspheric FiberPort for FC/PC Connectors

ITEM #	EFL	INPUT MFD[a]	OUTPUT WAIST DIA.	MAX WAIST DIST.[b]	DIVERGENCE	LENS CHARACTERISTICS			L[e]
						CA[c]	NA	AR λ[d]	
PAF-X-11-PC-A	11.0 mm	3.5 µm	2.06 mm	3249 mm	0.32 mrad	4.4 mm	0.20	350 - 700 nm	0.87" (22.8 mm)
PAF-X-11-PC-B	11.0 mm	4.3 µm	2.06 mm	2648 mm	0.39 mrad	4.4 mm	0.20	600 - 1050 nm	0.87" (22.8 mm)
PAF-X-11-PC-C	11.0 mm	10.4 µm	2.09 mm	1115 mm	0.95 mrad	4.4 mm	0.20	1050 - 1600 nm	0.87" (22.8 mm)
PAF-X-15-PC-A	15.4 mm	3.5 µm	2.89 mm	6363 mm	0.23 mrad	5.0 mm	0.16	400 - 600 nm	0.87" (22.8 mm)
PAF-X-15-PC-B	15.4 mm	4.3 µm	2.89 mm	5184 mm	0.28 mrad	5.0 mm	0.16	600 - 1050 nm	0.87" (22.8 mm)
PAF-X-15-PC-C	15.4 mm	10.4 µm	2.92 mm	2179 mm	0.68 mrad	5.0 mm	0.16	1050 - 1600 nm	0.87" (22.8 mm)
PAF-X-15-PC-D	15.4 mm	13 µm	3.02 mm	1802 mm	0.84 mrad	5.0 mm	0.16	1800 - 2400 nm	0.87" (22.8 mm)
PAF-X-18-PC-A	18.4 mm	3.5 µm	3.45 mm	9080 mm	0.19 mrad	5.5 mm	0.15	400 - 600 nm	0.87" (22.8 mm)
PAF-X-18-PC-B	18.4 mm	4.3 µm	3.45 mm	7397 mm	0.23 mrad	5.5 mm	0.15	600 - 1050 nm	0.87" (22.8 mm)
PAF-X-18-PC-C	18.4 mm	10.4 µm	3.49 mm	3107 mm	0.57 mrad	5.5 mm	0.15	1050 - 1600 nm	0.87" (22.8 mm)
PAF-X-18-PC-D	18.4 mm	13 µm	3.60 mm	2569 mm	0.71 mrad	5.5 mm	0.15	1800 - 2400 nm	0.87" (22.8 mm)

[a]Mode Field Diameter of input fiber used for calculations
[b]Maximum distance that the beam waist can be from the lens while still remaining collimated
[c]Clear Aperture
[d]Wavelength of the Antireflection Coating
[e]Length from tip of bulkhead to face of flange (see drawings on page 1081)

Continued on page 1083

FiberPort Couplers: Aspheric (Page 2 of 2)

FiberPort Body Styles

PAF-X-2, PAF-X-5, PAF-X-7
Use with FC/PC or FC/APC

PAF-X-11, PAF-X-15
Use with FC/APC

PAF-X-18
Use with FC/APC

Mechanical Drawings Available on the WEB

PAF-X-11-PC, PAF-X-15-PC
PAF-X-18-PC
Use with FC/PC

PAF-SMA-5, PAF-SMA-7
Use with SMA

Aspheric FiberPort for FC/APC Connectors

ITEM #	$	£	€	RMB
PAF-X-11-A	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-11-B	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-11-C	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-15-A	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-15-B	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-15-C	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-15-D	$ 469.20	£ 337.82	€ 408,20	¥ 3,739.52
PAF-X-18-A	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70
PAF-X-18-B	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70
PAF-X-18-C	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70
PAF-X-18-D	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70

Aspheric FiberPort for SMA Connectors

ITEM #	$	£	€	RMB
PAF-SMA-5-A	$ 367.20	£ 264.38	€ 319,46	¥ 2,926.58
PAF-SMA-5-B	$ 367.20	£ 264.38	€ 319,46	¥ 2,926.58
PAF-SMA-5-C	$ 367.20	£ 264.38	€ 319,46	¥ 2,926.58
PAF-SMA-7-A	$ 367.20	£ 264.38	€ 319,46	¥ 2,926.58
PAF-SMA-7-B	$ 367.20	£ 264.38	€ 319,46	¥ 2,926.58
PAF-SMA-7-C	$ 367.20	£ 264.38	€ 319,46	¥ 2,926.58
PAF-SMA-11-A	$ 382.50	£ 275.40	€ 332,78	¥ 3,048.53
PAF-SMA-11-B	$ 382.50	£ 275.40	€ 332,78	¥ 3,048.53
PAF-SMA-11-C	$ 382.50	£ 275.40	€ 332,78	¥ 3,048.53

Aspheric FiberPort for FC/APC Connectors

ITEM #	EFL	INPUT MFD[a]	OUTPUT WAIST DIA.	MAX WAIST DIST.[b]	DIVERGENCE	LENS CHARACTERISTICS			L[e]
						CA[c]	NA	AR λ[d]	
PAF-X-11-A	11.0 mm	3.5 µm	2.06 mm	3249 mm	0.32 mrad	4.4 mm	0.20	350 - 700 nm	0.87" (22.8 mm)
PAF-X-11-B	11.0 mm	4.3 µm	2.06 mm	2648 mm	0.39 mrad	4.4 mm	0.20	600 - 1050 nm	0.87" (22.8 mm)
PAF-X-11-C	11.0 mm	10.4 µm	2.09 mm	1115 mm	0.95 mrad	4.4 mm	0.20	1050 - 1600 nm	0.87" (22.8 mm)
PAF-X-15-A	15.4 mm	3.5 µm	2.89 mm	6363 mm	0.23 mrad	5.0 mm	0.16	400 - 600 nm	0.87" (22.8 mm)
PAF-X-15-B	15.4 mm	4.3 µm	2.89 mm	5184 mm	0.28 mrad	5.0 mm	0.16	600 - 1050 nm	0.87" (22.8 mm)
PAF-X-15-C	15.4 mm	10.4 µm	2.92 mm	2179 mm	0.68 mrad	5.0 mm	0.16	1050 - 1600 nm	0.87" (22.8 mm)
PAF-X-15-D	15.4 mm	13 µm	3.02 mm	1802 mm	0.84 mrad	5.0 mm	0.16	1800 - 2400 nm	0.87" (22.8 mm)
PAF-X-18-A	18.4 mm	3.5 µm	3.45 mm	9080 mm	0.19 mrad	5.5 mm	0.15	400 - 600 nm	0.87" (22.8 mm)
PAF-X-18-B	18.4 mm	4.3 µm	3.45 mm	7397 mm	0.23 mrad	5.5 mm	0.15	600 - 1050 nm	0.87" (22.8 mm)
PAF-X-18-C	18.4 mm	10.4 µm	3.49 mm	3107 mm	0.57 mrad	5.5 mm	0.15	1050 - 1600 nm	0.87" (22.8 mm)
PAF-X-18-D	18.4 mm	13 µm	3.60 mm	2569 mm	0.71 mrad	5.5 mm	0.15	1800 - 2400 nm	0.87" (22.8 mm)

[a]Mode Field Diameter of input fiber used for calculations
[b]Maximum distance that the beam waist can be from the lens while still remaining collimated
[c]Clear Aperture
[d]Wavelength of the Antireflection Coating
[e]Length from tip of bulkhead to face of flange (see drawing on page 1081)

Aspheric FiberPort for SMA Connectors

ITEM #	EFL	INPUT MFD[a]	OUTPUT WAIST DIA.	MAX WAIST DIST.[b]	DIVERGENCE	LENS CHARACTERISTICS			L[e]
						CA[c]	NA	AR λ[d]	
PAF-SMA-5-A	4.6 mm	3.5 µm	0.86 mm	571 mm	0.76 mrad	4.9 mm	0.53	350 - 600 nm	0.85" (21.7 mm)
PAF-SMA-5-B	4.6 mm	4.3 µm	0.86 mm	466 mm	0.93 mrad	4.9 mm	0.53	600 - 1050 nm	0.85" (21.7 mm)
PAF-SMA-5-C	4.6 mm	10.4 µm	0.87 mm	198 mm	2.26 mrad	4.9 mm	0.53	1050 - 1600 nm	0.85" (21.7 mm)
PAF-SMA-7-A	7.5 mm	3.5 µm	1.41 mm	1513 mm	0.47 mrad	4.4 mm	0.29	400 - 600 nm	0.85" (21.7 mm)
PAF-SMA-7-B	7.5 mm	4.3 µm	1.41 mm	1233 mm	0.57 mrad	4.4 mm	0.29	600 - 1050 nm	0.85" (21.7 mm)
PAF-SMA-7-C	7.5 mm	10.4 µm	1.42 mm	521 mm	1.39 mrad	4.4 mm	0.29	1050 - 1600 nm	0.85" (21.7 mm)
PAF-SMA-11-A	11.0 mm	3.5 µm	2.06 mm	3249 mm	0.32 mrad	4.4 mm	0.20	350 - 600 nm	1.04" (26.3 mm)
PAF-SMA-11-B	11.0 mm	4.3 µm	2.06 mm	2648 mm	0.39 mrad	4.4 mm	0.20	600 - 1050 nm	1.04" (26.3 mm)
PAF-SMA-11-C	11.0 mm	10.4 µm	2.09 mm	1115 mm	0.95 mrad	4.4 mm	0.20	1050 - 1600 nm	1.04" (26.3 mm)

[a]Mode Field Diameter of input fiber used for calculations
[b]Maximum distance that the beam waist can be from the lens while still remaining collimated
[c]Clear Aperture
[d]Wavelength of the Antireflection Coating
[e]Length from tip of bulkhead to face of flange (see drawing on page 1081)

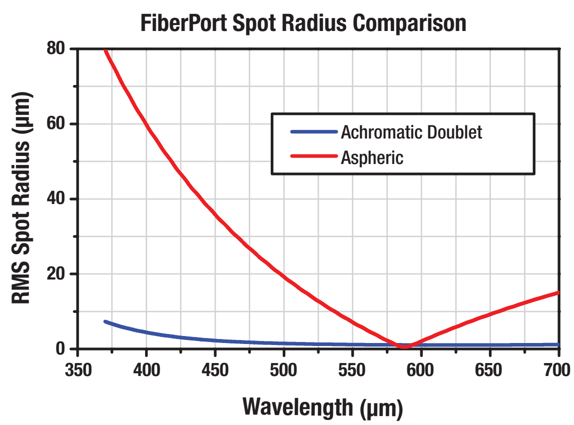
Achromatic FiberPorts

PAFA-X-4-A

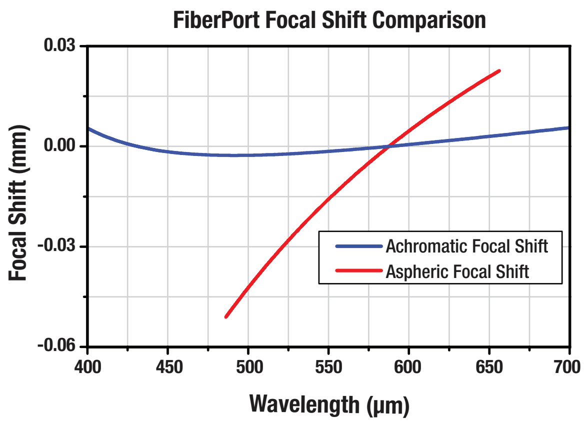
Features

- Achromatic Lens for Minimal Chromatic Focal Shift
- Minimizes Realignment with Wavelength Change
- Collimate Polychromatic Light
- AR Coated Lenses
- Optimized for Three Wavelengths
    - -A: 486.1, 587.6, and 656.3 nm
    - -B: 706.5, 855, and 1015 nm
    - -C: 1016, 1330, and 1550 nm
- Compatible with FC/PC and FC/APC Connectors

The achromatic design of the PAFA series of FiberPorts utilizes cemented doublets. These doublets minimize chromatic aberrations when coupling or collimating either a broadband light source or multiple wavelengths. The small focal length shifts experienced by an achromatic doublet allow the FiberPort to be used over a broad wavelength range without needing realignment (see below).



The plots to the left compare the performance of an achromatic doublet to an aspheric lens when a collimated beam is focused onto a fiber, such as the case with our FiberPort couplers. Without adjusting the Z-axis of the lens, the achromatic doublet provides a small spot size on the fiber, while the aspheric lens only offers a small spot size over a narrow wavelength range. Outside of this small range, a FiberPort with an aspheric lens would have to be reoptimized, while the achromatic FiberPort would still offer excellent coupling performance.



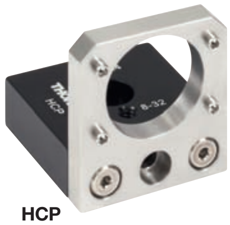
The graph to the left plot the focal length shift of an aspheric lens and a similar focal length achromatic doublet. This particular aspheric lens is used in our PAF-X-5-A FiberPort, while the achromatic doublet is used in the PAFA-X-4-A FiberPort. The focal shift experienced by the aspheric lens is an order of magnitude larger than that of the achromatic doublet. For more information on Aspheric FiberPorts, see pages 1082 - 1083 or our website.

ITEM #	EFL	INPUT MFD[a]	OUTPUT WAIST DIA.	MAX. WAIST DIST.[b]	DIVERGENCE	LENS CHARACTERISTICS CA[c]	NA	AR λ[d]	LENGTH[e]
PAFA-X-4-A	4.0 mm	3.5 µm	0.86 mm	571 mm	0.76 mrad	1.8 mm	0.22	400 - 700 nm	0.69" (17.5 mm)
PAFA-X-4-B	4.0 mm	5.0 µm	0.87 mm	350 mm	1.25 mrad	1.8 mm	0.22	650 - 1050 nm	0.69" (17.5 mm)
PAFA-X-4-C	4.0 mm	9.2 µm	0.73 mm	162 mm	2.30 mrad	1.8 mm	0.22	1050 - 1620 nm	0.69" (17.5 mm)

[a]Mode Field Diameter
[b]Maximum distance that the beam waist can be from the lens while still remaining collimated
[c]Clear Aperture
[d]Wavelength of the Antireflection Coating
[e]From tip of bulkhead to face of flange

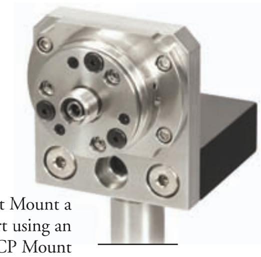
ITEM #	$	£	€	RMB	DESCRIPTION
PAFA-X-4-A	$ 500.00	£ 360.00	€ 435,00	¥ 3,985.00	Achromatic FiberPort, FC/PC & FC/APC, f = 4.0 mm, 400 – 700 nm
PAFA-X-4-B	$ 500.00	£ 360.00	€ 435,00	¥ 3,985.00	Achromatic FiberPort, FC/PC & FC/APC, f = 4.0 mm, 650 – 1050 nm
PAFA-X-4-C	$ 500.00	£ 360.00	€ 435,00	¥ 3,985.00	Achromatic FiberPort, FC/PC & FC/APC, f = 4.0 mm, 1050 – 1620 nm

FiberPort/LaserPort Mount



HCP

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



Post Mount a FiberPort using an HCP Mount

ITEM #	$	£	€	RMB	DESCRIPTION
HCP	$ 75.00	£ 54.00	€ 65,25	¥ 597.75	FiberPort/LaserPort Mount

FiberPort/LaserPort Cage Plate

NEW product

The CP08FP Cage Plate allows the integration of any FiberPort/LaserPort into our 30 mm Cage System and includes an 8-32 (M4) tap for post mounting. See pages 167 - 214 for our full cage system product offering.

CP08FP

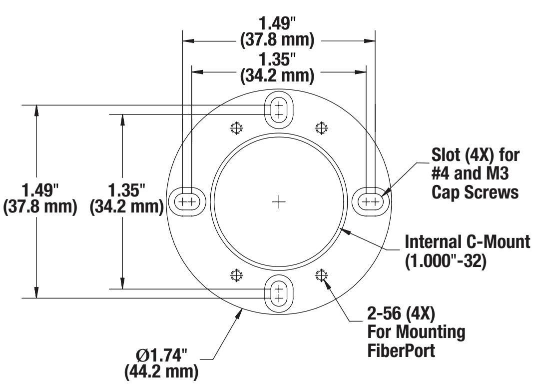
CP08FP
with FiberPort (see pages 1081 - 1084)

ITEM #	$	£	€	RMB	DESCRIPTION
CP08FP	$ 23.00	£ 16.56	€ 20,01	¥ 183.31	FiberPort/LaserPort Cage Plate, 8-32 Tap
CP08FP/M	$ 23.00	£ 16.56	€ 20,01	¥ 183.31	FiberPort/LaserPort Cage Plate, M4 Tap

FiberPort to HeNe Laser Adapter

HCL

The HCL allows a FiberPort to be mated to a HeNe laser (see pages 1276 - 1280) and fiber couple the laser's output. This adapter features four 2-56 threaded holes for attaching a FiberPort and a four slot pattern for #4 and M3 cap screws to mate the adapter to a HeNe. Additionally, the HCL features internal C-Mount (Ø1.00"-32) threading for alternate mounting options such as attaching filters and lens tubes. The HCL includes 2-56, 4-40, and M3 cap screws.



HCL FiberPort Adapter with HeNe Laser, Kinematic Mount, Clamp Arm, FiberPort Collimator, and Fiber Patch Cable
HCL, HNL100R, C1503, PAF-X-5-B, P1-630A-FC-2, and Post Sold Separately

Mechanical Drawings Available on the WEB

ITEM #	$	£	€	RMB	DESCRIPTION
HCL	$ 28.00	£ 20.16	€ 24,36	¥ 223.16	HeNe Laser Adapter, Internal C-Mount Threading

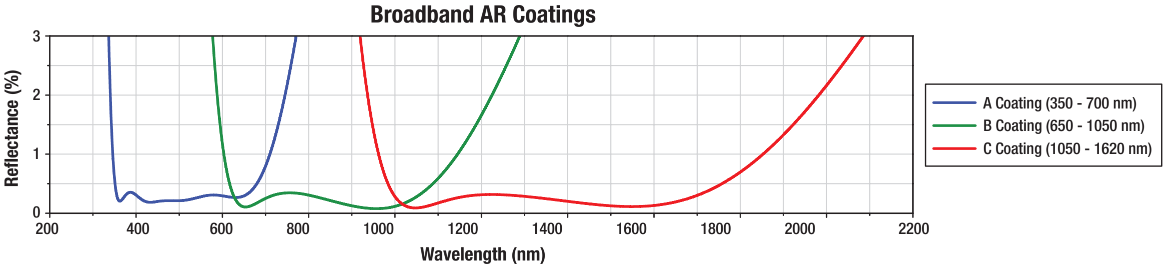
LaserPort Laser Diode Mount and Collimator

- Mount and Collimate a Ø5.6 mm or Ø9 mm Laser Diode
- AR-Coated Aspheric Lens with 5 Degrees of Freedom for Collimation
- Pair with a FiberPort on a FiberBench to Create a Temporary Fiber Pigtail
- Ideal for Low-Power Laser Diodes

Thorlabs' LaserPorts mount either Ø5.6 mm or Ø9 mm laser diodes and collimate the emitted light. Similar to our FiberPorts, the LaserPort uses 5-axis adjustment (X, Y, Z, pitch, yaw) of an AR-coated aspheric lens to collimate the laser diode. The diode is held in a ceramic seat to electrically isolate the laser diode from the mount. To connect a Thorlabs LD current controller to your laser diode, an SR9 cable (see page 1491) is needed, which provides a laser diode socket and a DB9 controller connection.

The LaserPort is an excellent choice when needing to create a temporary fiber pigtail based on our FiberBench system (see pages 1065 - 1080). A temporary pigtail can be made by mounting a LaserPort on one side of a FiberBench and a FiberPort coupler on the other end.

The LaserPorts offered here do not include a TEC element for temperature control. If a temperature-stabilized mount is needed, see our laser diode mount section on pages 1481 - 1492.



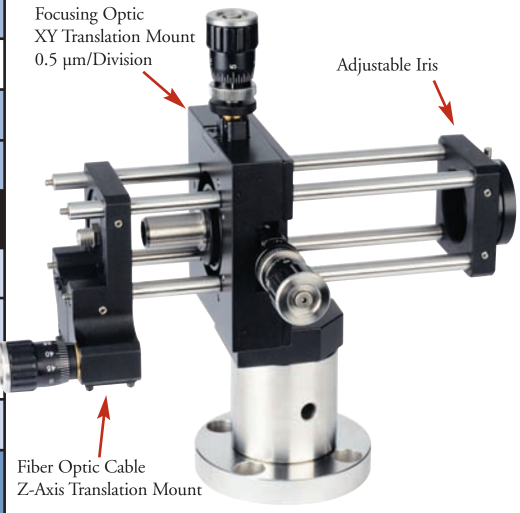
ITEM #	LENS EFL	COATING RANGE	LD MAX BEAM DIVERGENCE	COLLIMATED BEAM DIAMETER	LASER DIODE PACKAGE SIZE
PAL5-A	2.7 mm	350 - 700 nm	31°	0.5 - 2.7 mm	Ø5.6 mm
PAL5-B	2.7 mm	650 - 1050 nm	31°	0.5 - 2.7 mm	Ø5.6 mm
PAL5-C	2.7 mm	1050 - 1620 nm	31°	0.5 - 2.7 mm	Ø5.6 mm
PAL9-A	2.7 mm	350 - 700 nm	31°	0.5 - 2.7 mm	Ø9 mm
PAL9-B	2.7 mm	650 - 1050 nm	31°	0.5 - 2.7 mm	Ø9 mm
PAL9-C	2.7 mm	1050 - 1620 nm	31°	0.5 - 2.7 mm	Ø9 mm

ITEM #	$	£	€	RMB	DESCRIPTION
PAL5-A	$ 460.00	£ 331.20	€ 400,20	¥ 3,666.20	LaserPort, Ø5.6 mm Diodes, 350 - 700 nm
PAL5-B	$ 460.00	£ 331.20	€ 400,20	¥ 3,666.20	LaserPort, Ø5.6 mm Diodes, 650 - 1050 nm
PAL5-C	$ 460.00	£ 331.20	€ 400,20	¥ 3,666.20	LaserPort, Ø5.6 mm Diodes, 1050 - 1620 nm
PAL9-A	$ 460.00	£ 331.20	€ 400,20	¥ 3,666.20	LaserPort, Ø9 mm Diodes, 350 - 700 nm
PAL9-B	$ 460.00	£ 331.20	€ 400,20	¥ 3,666.20	LaserPort, Ø9 mm Diodes, 650 - 1050 nm
PAL9-C	$ 460.00	£ 331.20	€ 400,20	¥ 3,666.20	LaserPort, Ø9 mm Diodes, 1050 - 1620 nm

Fiber Selection Guide

Fiber Launch Platforms Selection Guide

Free-Space Fiber Coupler for Single Mode Fiber



- High-Precision Differential Adjusters Provide Submicron Translation
- Accepts Mounted Aspheres
- Easy-to-Follow Instructions and Alignment Tools

The KT110 Fiber Coupler is designed to couple free-space laser beams into fiber optic cables that are terminated with FC or SMA connectors. Fiber patch cables are available starting on page 1004, and other connector adapters are available on page 1096.

Many of our diffraction-limited aspheric lenses are compatible with the coupler. Due to their superior performance, these optics replace the microscope objectives that are traditionally used.

For most free-space coupling applications, we have found that the C230TME aspheric lens, which has an equivalent microscope magnification of 35X, is an ideal first choice. This lens, which is available with one of four antireflection coatings, is listed below for your ordering convenience. Complete optical specifications can be found on page 723.

Complete System Without Optics

ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
KT110	KT110/M	$ 1,041.75	£ 750.06	€ 906,32	¥ 8,302.75	Free-Space Single Mode Fiber Coupler

Recommended Coupling Optic*

ITEM #	$	£	€	RMB	DESCRIPTION
C230TME-A	$ 79.00	£ 56.88	€ 68,73	¥ 629.63	*f* = 4.5 mm Aspheric Lens, AR-Coated: 400 - 600 nm
C230TME-B	$ 79.00	£ 56.88	€ 68,73	¥ 629.63	*f* = 4.5 mm Aspheric Lens, AR-Coated: 600 - 1050 nm
C230TME-C	$ 79.00	£ 56.88	€ 68,73	¥ 629.63	*f* = 4.5 mm Aspheric Lens, AR-Coated: 1050 - 1620 nm
C230TME-1064	$ 83.00	£ 59.76	€ 72,21	¥ 661.51	*f* = 4.5 mm Aspheric Lens, AR-Coated: 1064 nm

*One Aspheric Optic Required. See Page 714 for Complete Optical Specifications.

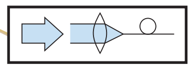
MicroBlock™ SM Fiber Launch with Quick-Release Clamp

Microscope Objective Sold Separately
(See Pages 960 - 963)

MBT612D

High Performance Drives: 50 nm Resolution

The MBT Series Fiber Launches are recommended for less-demanding situations where the cost of the system is a concern. When long-term stability and ease-of-use are of paramount importance, we recommend the NanoMax™ Series shown on page 1091.



System Includes

- MBT616D High-Resolution Flexure Stage with 4 mm of Travel, See Page 545
- Three High Performance Adjusters Provide 300 µm of Fine Travel with 50 nm Resolution
- HFF003 Fiber Clamp, See Page 580
- AMA009 Large Fixed Platform, See Page 573
- HCS013 Microscope Objective Mount, See Page 575
- HFS001 Cable Strain Relief, See Page 580

This MicroBlock™ launch system features our high-resolution differential adjusters that are ideal for optimizing the coupling of a free-space laser into a single mode fiber, even at visible wavelengths where the mode field diameter of the fibers are as small as 3 µm. The addition of a cable strain relief helps to prevent inadvertent disruption of the system, which can be a great time saver.

This preconfigured fiber launch is an ideal starter system that can be quickly adapted to many uses. Additional accessories are available that enhance the flexibility of this platform. Please see pages 572 - 588 for details.

Specifications

- **Travel:** 4 mm
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev

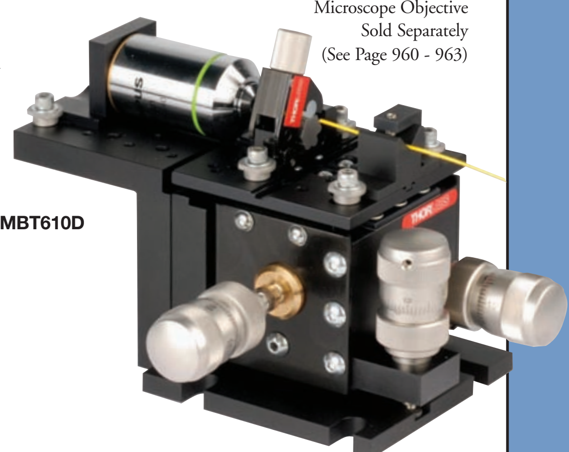
ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MBT612D	MBT612D/M	$ 1,182.87	£ 851.67	€ 1.029,10	¥ 9,427.47	MicroBlock™ Fiber Launch System w/ Quick-Release Clamp

MicroBlock™ SM Fiber Launch with Variable V-Groove Clamp

The MBT610D launch system features our high resolution drives which are ideal for optimizing the coupling of a free-space laser into a single mode fiber, even the visible spectrum where the mode field diameter of the fibers are as small as 3 µm. The quick release fiber holder provides six mounting surfaces, each one designed to accept a different size fiber. The addition of a cable strain relief helps to prevent inadvertent disruption of the system, which can be a great time saver.

This preconfigured system is an ideal starter system and can be quickly adapted to other applications using our extensive line of accessories.
Please see pages 572 - 588 for details.

Microscope Objective Sold Separately
(See Page 960 - 963)



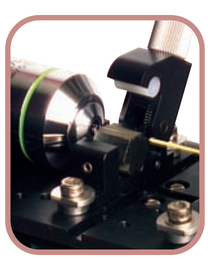
MBT610D

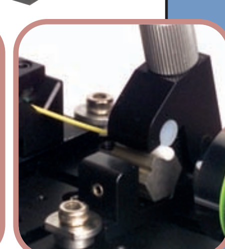
System Includes:

- MBT616D High Resolution Flexure Stage with 4 mm of Travel, See Page 545
- Three High Performance Drives Provide 300 µm of Fine Travel with 50 nm Resolution
- HFF001 V-Groove Fiber Holder with Adjustable Force (25 to 200 g), See Page 580
- AMA009 Large Fixed Platform, See Page 573
- HCS013 Microscope Objective Mount with RMS Threads, See Page 575
- HFS001 Cable Strain Relief, See Page 580

Specifications

- **Travel:** 4 mm
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev

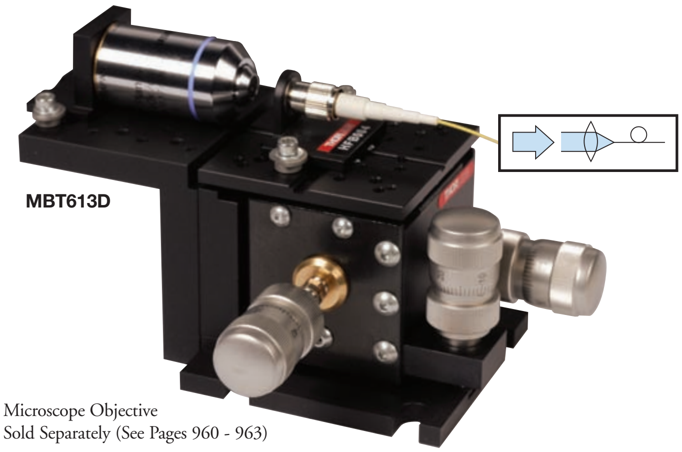




Fiber V-Groove Adapts to Various Fiber Diameters From 125 µm to 2 mm

ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MBT610D	MBT610D/M	$ 1,493.37	£ 1,075.23	€ 1.299,23	¥ 11,902.16	MicroBlock™ Fiber Launch System with Variable Clamp

MicroBlock™ SM Fiber Launch with FC Connectorized Fiber Holder



Microscope Objective
Sold Separately (See Pages 960 - 963)

System Includes

- MBT616D High Resolution Flexure Stage with 4 mm Travel, See Page 545
- Three High Performance Drives Provide 300 µm of Fine Travel
- HFB004 FC Fiber Holder, See Page 579
- AMA009 Large Fixed Platform, See Page 573
- HCS013, Microscope Objective Mount with RMS Threads, See Page 575

Specifications

- **Travel:** 0.16" (4 mm)
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters:**
  - Coarse Adjustment 0.5 mm/rev
  - Fine Adjustment 50 µm/rev

The MBT Series Fiber Launches are recommended for less-demanding situations where the cost of the system is a concern. This entry into the MBT Fiber Launch Series features the MBT flexure stage with a HCS013 Microscope Objective Mount and HFB004 FC Fiber Holder. This combination of accessories, along with a microscope objective (not included, see pages 960 - 963), launches light directly into an FC/PC connector.

ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MBT613D	MBT613D/M	$ 1,083.87	£ 780.39	€ 942,97	¥ 8,638.44	MicroBlock™ Free-Space to FC Fiber Launch System

Have you seen our...

Multichannel Fiber-Coupled Laser Source

- Ideal for Multichannel Fluorescence Imaging
- 4 Laser Output Channels
- Independent Temperature Control Gives High Temperature Stability
- USB Interface
- Choose Any Combination of Wavelengths

Thorlabs' 4-Channel, Fiber-Coupled Laser Source provides easy access to multiple wavelengths of single mode (SM) fiber-coupled light. The laser source is configured to accept any combination of four SM fiber-pigtailed laser diodes; choose from the following wavelengths: 405, 406, 473, 488, 635, 638, 642, 658, 670, 675, 785, 808, 850, 852, 904, 980, 1064, 1310, 1550 nm.

Each fiber-pigtailed laser diode is operated from an independent, high-precision, low-noise, constant-current source and temperature control unit. An intuitive front-panel interface allows the user to view and set operating parameters for each laser. The display indicates the selected channel number, output wavelength, operating power, and operating temperature of the laser diode.

This device includes a microcontroller to monitor the system for fault conditions and to fully control the laser's optical power and temperature. The laser source includes a USB connection that allows remote adjustment of power, temperature, and enabling. On the rear panel, analog inputs are available to modulate the lasers with an external signal.

See pages 1262 - 1263

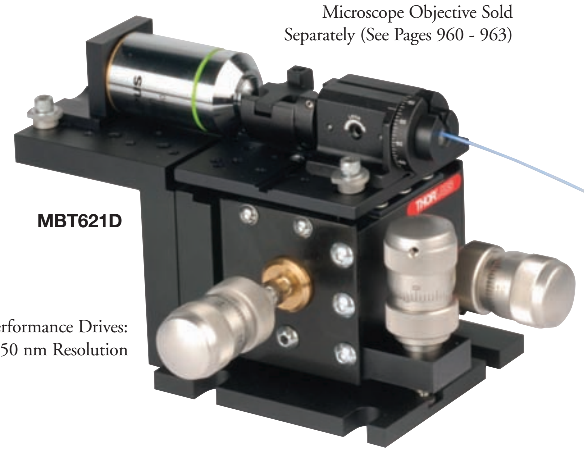
MicroBlock™ PM Fiber Launch with Fiber Rotator

System Includes:

- MBT616D High-Resolution Flexure Stage with 4 mm of Travel, See Page 545
- Three High-Performance Drives Provide 4 mm of Coarse Travel and 300 µm of Fine Travel
- HFR007 Fiber Rotator with Adjustable Force Magnetic Clamping Mechanism, See Page 582
- AMA009 Large Fixed Platform, See Page 573
- HCS013 Microscope Objective Mount, See Page 575

The MBT621D launch system features our high resolution drives that are ideal for coupling a free-space laser into a single mode fiber, even at visible wavelengths where the mode field diameter of the fibers are as small as 3 µm. The rotary fiber holder provides smooth rotation with negligible run-out. When using polarization maintaining fibers, this system provides an easy means of optimizing the extinction ratio of the signal being coupled through the PM fiber. Thorlabs offers a number of five- and six-axis systems for applications that require more advanced capabilities. Please see pages 563 - 571.

Microscope Objective Sold Separately (See Pages 960 - 963)



MBT621D

High Performance Drives: 50 nm Resolution

Specifications

- **Travel:** 0.16" (4 mm)
- **Crosstalk:** <20 µm/mm
- **Load Capacity:** 2.2 lbs (1 kg)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev

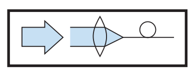
ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MBT621D	MBT621D/M	$ 1,225.17	£ 882.12	€ 1.065,90	¥ 9,764.60	MicroBlock™ Free-Space to PM Fiber Launch System

NanoMax™ SM Fiber Launch for Bare Fiber

Specifications

- **Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev
- **High-Resolution Manual Drives:** Provides 50 nm of Fine Control Resolution Over a Total Range of 300 µm
- **Parallel 3-Axis Flexure Mechanism:** Allows all Three Drives to be Rigidly Attached to the Main Body of the Stage
- **Crosstalk (Max):** 20 µm/mm of Travel
- **Repeatability (Bidirectional):** 500 nm RMS
- **Load Capacity:** 2.2 lbs (1 kg)
- **Accessories:** Mounted on the Top Deck of the Stage:
  Large Fixed Bracket (AMA009)
  Microscope Objective Mount (HCS013)
  Adjustable Force Fiber Clamp (HFF001)
  Cable Strain Relief (HFS001)

Microscope Objective Sold Separately (See Pages 960 - 963)



MAX350D

When Performance Matters

When long-term stability and ease-of-use are of paramount importance, we recommend this series of NanoMax launch systems.

Patents 6,186,016 and 6,467,762

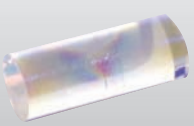
NanoMax™ Model MAX350D

The MAX350 series represents the latest generation of single mode fiber launch systems. Utilizing our patented highly stable flexure design with our patented dual-stage high resolution micrometers, we create a fiber launch system that ensures the very best performance of all our platforms. When coupling a free-space beam into a single mode fiber, the critical performance factors are the resolution and stability of the system. The intrinsic stiffness and resultant stability of our flexure system, as compared to a linear bearing design, provides superior performance during the initial alignment of the system as well as its long term operation. The resolution is ensured through the unique combination of our high performance dual stage micrometers and the parallel flexure mechanism that provides a true nanopositioning capability.

ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MAX350D	MAX350D/M	$ 1,958.70	£ 1,410.26	€ 1.704,07	¥ 15,610.84	NanoMax™ Fiber Launch System for Bare Fiber

Do You Need a...

GRIN Lens



See page 738

NanoMax™ SM Launch for GRIN Lenses and FC Connectors

Patents 6,186,016 and 6,467,762

When Performance Matters

When long-term stability and ease-of-use are of paramount importance, we recommend this series of NanoMax launch systems.

NanoMax™ Model MAX355D

One of the most challenging alignment tasks in a photonics laboratory is the launching of light from a free-space laser into a single mode optical device or fiber, especially when the laser is operating in the visible range and the mode field diameter of the device is less than 4 µm. This MAX350 series of fiber launch systems have been redesigned to perform this task with ease. From the patented high-resolution, dual-stage adjusters (coarse range of 4 mm with <1 µm resolution, and fine range of 300 µm with <50 nm resolution) to the patented flexure design that forms the foundation of the system, this three-axis translator provides both the stability and the resolution required to hit submicron targets.

Specifications

- **Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev
- **High Resolution Manual Drives:** Provides 50 nm of Fine Control Resolution Over a Total Range of 300 µm
- **Repeatability:** 500 nm RMS Bidirectional
- **Load Capacity:** 2.2 lbs (1 kg)
- **Accessories:** Mounted on the Top Deck of the Stage:
  - Large Fixed Bracket (AMA009)
  - Grin Lens Mount (HGI003)
  - FC Optical Fiber Cable Holder (HFB004)
  - Cable Strain Relief (HFS001)

ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MAX355D	MAX355D/M	$ 1,633.80	£ 1,176.34	€ 1.421,41	¥ 13,021.39	NanoMax™ Fiber Launch System for FC Cables

NanoMax™ PM Fiber Launch: Easy Load

Microscope Objective Sold Separately

Patents 6,186,016 and 6,467,762

When Performance Matters

When long-term stability and ease-of-use are of paramount importance, we recommend this series of NanoMax™ launch systems.

NanoMax™ Model MAX361D

The MAX361D fiber launch system is configured from our highest-performing flexure stage and three of our high-resolution, dual stage micrometers. This combination provides both the resolution and the stability required to achieve true submicron positional control. The system features the HFR007 fiber rotator which provides the added degree of rotational freedom that is required to optimize the extinction ratio of a PM fiber. The MAX361D PM Fiber Launch System provides a substantial improvement over linear bearing based designs or other less advanced three-axis flexure stages. The base translator utilizes our patented, highly stable, flexure design, which has the unique feature that all three adjusters are rigidly connected to the fixed portion of the main structure of the stage. Competing products either utilize three stacked individual stages, or at best are designed as one integrated system with two of the three actuators moving along with the moving portion of the stage. This causes unwanted motion in the form of cross-talk when the actuators are touched by the operators hand, thus impeding true nanopositioning.

Specifications

- **Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse: 0.5 mm/rev
  - Fine: 50 µm/rev
- **Rotation:** Continuous
- **High Resolution Manual**
- **Drives:** 50 nm Fine Control Over Range of 300 µm
- **Parallel 3-Axis Flexure:** Allows All Three Drives to be Rigidly Attached to Ground
- **Load Capacity:** 2.2 lbs (1 kg)
- **Top Deck Accessories:**
  - Large Fixed Bracket (AMA009)
  - Microscope Objective Mount (HCS013)
  - Fiber Clamp with Rotation (HFR007)

ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MAX361D	MAX361D/M	$ 1,690.50	£ 1,217.16	€ 1.470,74	¥ 13,473.29	NanoMax PM Fiber Launch System with Fast Loading Rotator

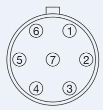
NanoMax™ SM Fiber Launch with 20 µm Piezos and Sensors

Specifications

- **Manual Travel:** 4 mm
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  • Coarse Adjustment: 0.5 mm/rev
  • Fine Adjustment: 50 µm/rev
- **Piezoelectric Travel:** 20 µm
- **Manual Drive Resolution:** Provides 50 nm Resolution Over a 300 µm Travel Range
- **Piezoelectric Actuator Resolution:** 5 nm When Operating with Internal Piezo Displacement Sensors.
- **Max Piezoelectric Drive Voltage:** 75 VDC
- **Crosstalk:** 20 µm/mm of Travel (Max)
- **Resonant Frequency (±10%):** 375 Hz (No Load) 200 Hz (275 g Load) 150 Hz (575 g Load)
- **Load Capacity:** 2.2 lbs (1 kg)
- **Deck Height:** 62.5 mm from the Base of the Stage to the Mounting Surfaces of the Moving Platform, the Accessory Beam Height is 75 mm from the Bottom Surface of the Stage
- **Accessories:** Mounted on the Top Deck of the Stage:
  Large Fixed Bracket (AMA009)
  Microscope Objective Mount (HCS013)
  Adjustable Force Fiber Clamp (HFF001)
  Cable Strain Relief (HFS001)
- **Recommended Controller:** BPC203 (See Page 642)

Note: All measurements related to the performance of the piezoelectric actuators are made with Thorlabs' model BPC203 piezo driver, which can be found on page 642.

Displacement Sensor



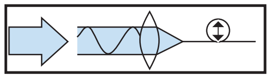
The strain gauge displacement sensor, directly attached to the body of the piezoelectric element, provides an analog signal that is proportional to its displacement. When combined with low noise electronics, the resolution obtained is better than 5 nm.

Microscope Objective Sold Separately (See Pages 960 - 963)

Patents 6,186,016 and 6,467,762

When Performance Matters

When long-term stability and ease-of-use are of paramount importance, we recommend this series of NanoMax launch systems.



NanoMax™ Stage with High Resolution Manual Adjusters and Piezoelectric Actuators

The MAX373D Fiber Launch System is built from our MAX311D three-axis translation stage; for details on this stage, please see page 547. This stage and accessory package are ideally suited for use with our NanoTrak™ auto-alignment system (see pages 646 - 651 for details). The 20 µm of piezoelectric travel provides sufficient electrical control of the position of the optical fiber to ensure rapid 'first-light' detection as well as automatic optimization of the coupling efficiency.

The MAX373D utilizes three strain gauge displacement sensors to provide a voltage signal that is linearly proportional to the displacement of the piezoelectric element. Using this signal, it is possible to compensate for hysteresis, creep, or thermal drift that is inherent to all piezoelectric elements. Additionally, the use of the displacement sensor in combination with our NanoTrak™ auto-alignment system allows one to precisely optimize the coupling efficiency of an optical system; then, once aligned, the displacement sensors can be used to stabilize the position of the system while subsequent operations are performed.

ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MAX373D	MAX373D/M	$ 3,088.93	£ 2,224.03	€ 2.687,37	¥ 24,618.77	NanoMax™ SM Fiber Launch System with Piezos and Sensors

SM Fiber Launch System with Auto-Alignment Controller (Page 1 of 2)

Fiber Launch System with NanoTrak™, Controller, 3-Axis Flexure Stage, and Accessories (Microscope Objective Not Included)

10% Discount for Complete Package

Features

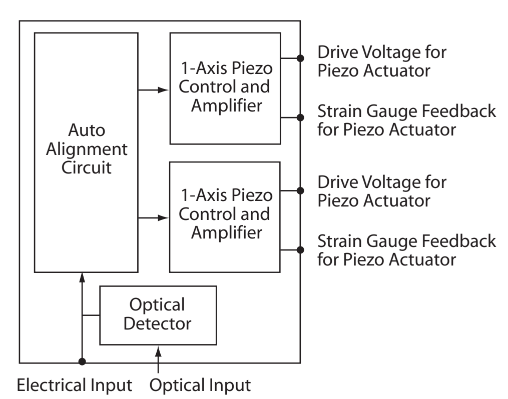
- 3-Axis Flexure Stage
  - Manual Differential Adjusters
  - Internal Piezo Actuators with Strain Gauge Sensors
- NanoTrak™ Auto-Alignment Controller
  - Integrated InGaAs Detector
  - Replacement Si Detector Available (NTA009)
  - Two Inputs for Strain Gauge Feedback
  - Two Outputs to Drive Piezo Actuators
  - Advanced Alignment Optimization Algorithms
  - USB Interface

Introduction

The MAX373DK1 is an automated fiber launch system that reduces the time it takes to optimize the coupling of light into a bare single mode fiber. This package includes a nanopositioning 3-axis flexure stage with a NanoTrak™ controller that optimizes the position of the fiber perpendicular to the optical axis using the internal piezo actuators in the stage. Also included are three stage accessories: an RMS-threaded optical mount (HCS013), a bare fiber clamp (HFF001), and a cable strain relief clamp (HFS001). Other accessories can be purchased separately (see pages 572 - 588) in order to expand the system's capabilities for use with other optical elements like waveguides or connectorized fibers.

NanoTrak™ Controller

When activated, the NanoTrak™ controller (see schematic below) generates drive voltages for two piezo actuators based on the optical (electrical) feedback signal. In the MAX373D kit, the piezo actuators will control the position of the fiber along the two axes perpendicular to the optical axis, and the feedback signal will be proportional to how much light is coupled into the optical fiber. By letting the NanoTrak™ controller position the fiber tip on the optical axis, optimizing the coupling simply requires the user to manually align the fiber along the optical axis. After the coupling of light into the fiber has been optimized, the tracking mode can be turned off without affecting the coupling, or the tracking mode can be left on in order to ensure that the coupling remains optimized even if external effects, like changes in temperature, cause small changes in the beam position. See pages 657 - 659 for information on how the Auto Alignment Circuit in the NanoTrak™ controller functions.



10 Minute Alignment Procedure

By using Thorlabs' MAX311D (see page 547) flexure stage as the base for this fiber launch system, first light detection, even with single mode fiber, is straightforward. Before starting this procedure use two steering mirrors to steer the beam so that it is roughly propagating 12.5 mm above the channel on the empty stage, which is locked down on an optical table. Also have the NanoTrak™ controller connected to the stage and to a computer with the software loaded and operational.

- Mount your coupling optic on the provided RMS threaded mount (HCS013) and place the mount in the channel on the fixed large angle bracket (AMA009) attached to the stage.
- Adjust the stage using the manual differential adjusters so that the HCS013 can be slid easily from the AMA009 to the stage platform (keep the HCS013 tight against one side of the channel).
- Steer your free-space beam so that the beam position does not wander as the coupling optic is slid from the large angle bracket to the stage platform.
- While keeping the mount pressed against one side of the channel, lock down the HCS013 on the AMA009 such that the light is focused at a point near the edge but still over the adjustable platform on the stage.
- Lock down the fiber clamp and the strain relief cable on the stage platform so that the tip of the fiber will be further away from the coupling optic than the point at which the light is focused. (Make sure the stage platform can be translated forward far enough to move the fiber tip through the focal point.)
- Load the fiber, and if the other end of the fiber has an FC connector attach it to the NanoTrak™ detector. Otherwise, use a suitable detector to measure the light coupled into the fiber and use the electrical input on the NanoTrak™ controller to provide the feedback it requires.
- Use the manual actuator to move the fiber tip toward or away from the lens until first light is detected.
- Coarsely maximize the signal using all three manual adjusters.
- Activate the NanoTrak™. It will immediately maximize the position of the fiber tip perpendicular to the beam propagation direction.
- Use the manual actuator to move the fiber tip toward or away from the lens while watching the power monitor. If the piezo actuators near the limit of their range use one of the other manual actuators to put them back toward the middle.
- Stop once the coupled power has been maximized.

SM Fiber Launch System with Auto-Alignment Controller (Page 2 of 2)

The apt™ NanoTrak™ controller is supplied with a full suite of software support tools. Once the software and associated USB drivers are installed, the aptUser utility provides a full featured intuitive graphical instrument panel allowing full control and visualization of the NanoTrak™ operation. Additionally, ActiveX® components are included to speed user developed routines in the user's programming environment of choice (e.g., LabVIEW™, Visual Basic, or C++).

NanoTrak™ Controller Specifications

- **Optical Power Measurement**
  - PIN Photodiode: FC/PC Fiber Input
  - InGaAs Detector: 1 nA to 10 mA Photocurrent
  - Optional Replacement Si Detector Available (NTA009) (Intended for use in the visible region of the spectrum)
  - Optical Power Monitor (BNC): Multiple Ranges
  - Signal Phase Compensation: -180° to 180°
- **Principle NanoTrak Parameters**
  - Circle Scanning Frequency: 1-300 Hz
  - Circle Diameter Adjustment Modes: Automatic and Manual
- **Piezoelectric Input/Output**
  - Two Output Connectors (SMC Male):
    - – Voltage Output: 0-75 VDC/Channel
    - – Voltage Stability: 100 ppm Over 24 Hours
    - – Noise: <3 mV_{rms}
    - – Output Current: 500 mA/Channel
  - Output Monitors (BNC): 0-10 VDC
  - Analog Inputs (BNC): 0-10 VDC (Used in Piezo Amp Mode)
  - Strain Gauge Position Feedback: (Two 9-Pin D-Type Female)
- **Other Input/Output**
  - Optical Power Monitor (BNC): 0-10 VDC
  - User Control (37-Pin D-Type Female)
    - – Isolated Digital I/O
  - Trigger In/Out (BNC): 0-10 VDC
  - USB Port
- **Power Requirements**
  - Voltage: 85-264 VAC
  - Frequency: 47-63 Hz
  - Power: 200 W
  - Fuse: 3 A
- **General**
  - Dimensions (W x D x H): 245 mm x 330 mm x 130 mm (9.65" x 13" x 5.12")
  - Weight: 6 kg (13 lbs)

NTA009

See page 648 for a complete presentation of the NanoTrak controller used in the MAX373DK1 kit.

Flexure Stage Specifications

- **Manual Travel:** 0.16" (4 mm)
- **Thermal Stability:** 1 µm/°C
- **Differential Adjusters**
  - Coarse Adjustment: 0.5 mm/rev
  - Fine Adjustment: 50 µm/rev
- **Piezoelectric Travel:** 20 µm
- **Manual Drive Resolution:** Provides 50 nm Resolution Over a 300 µm Travel Range
- **Piezoelectric Actuator Resolution:** 5 nm When Operating with Internal Piezo Displacement Sensors.
- **Max Piezoelectric Drive Voltage:** 75 VDC
- **Crosstalk:** 20 µm/mm of Travel (Max)
- **Resonant Frequency (±10%):** 375 Hz (No Load), 200 Hz (275 g Load), 150 Hz (575 g Load)
- **Load Capacity:** 2.2 lbs (1 kg)
- **Deck Height:** 62.5 mm from the Base of the Stage to the Mounting Surfaces of the Moving Platform, the Accessory Beam Height is 75 mm from the Bottom Surface of the Stage
- **Accessories:** Mounted on the Top Deck of the Stage:
  - Large Fixed Bracket (AMA009)
  - Microscope Objective Mount (HCS013)
  - Adjustable Force Fiber Clamp (HFF001)
  - Cable Strain Relief (HFS001)

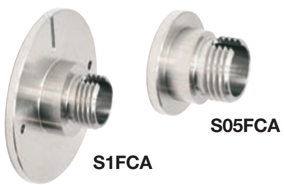
See page 547 for a complete presentation of the MAX311D flexure stage used in the MAX373DK1 kit.

ITEM #	METRIC ITEM #	$	£	€	RMB	DESCRIPTION
MAX373DK1	MAX373DK1/M	$ 9,172.90	£ 6,604.49	€ 7.980,42	¥ 73,108.01	apt™ NanoTrak™ Fiber Launch System with InGaAs Detector
NTA009	–	$ 295.00	£ 212.40	€ 256,65	¥ 2,351.15	apt™ NanoTrak™ Visible Light Detector Head

Bare Fiber Adapter

This adapter holds bare fibers between Ø250 µm and Ø450 µm and is typically used with our S140 series integrating spheres featured on page 1563. However, its two M2.5 countersunk counterbores allow it to be mounted in custom applications as well.

ITEM #	$	£	€	RMB	DESCRIPTION
S140-BFA	$ 120.00	£ 86.40	€ 104,40	¥ 956.40	Bare Fiber Adapter



Unthreaded Fiber Adapters

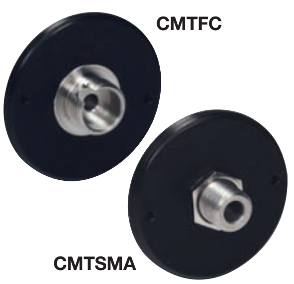
These fiber adapters have FC/APC connectors and smooth outer diameters, making them compatible with either Ø1/2" or Ø1" optomechanics. The S1FCA has two dimples for compatibility with the SPW801 adjustable spanner wrench (page 446).

ITEM #	$	£	€	RMB	DESCRIPTION
S05FCA	$ 32.00	£ 23.04	€ 27,84	¥ 255.04	1/2" Smooth O.D. to FC/APC
S1FCA	$ 32.00	£ 23.04	€ 27,84	¥ 255.04	1" Smooth O.D. to FC/APC

SM05-Threaded Fiber Adapters

Externally SM05-threaded (0.535"-40) fiber adapters are available for placing FC/PC, FC/APC, SMA, or ST connectorized fibers in SM05-threaded components. The SM05 threading is compatible with our Ø1/2" lens tubes (page 128) and many of our 16 mm mini-series cage plates (page 169).

ITEM #	$	£	€	RMB	DESCRIPTION
SM05FC	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External SM05 to FC/PC Adapter
SM05FCA	$ 32.00	£ 23.04	€ 27,84	¥ 255.04	External SM05 to FC/APC Adapter
SM05SMA	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External SM05 to SMA Adapter
SM05ST	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External SM05 to ST Adapter



C-Mount Threaded Fiber Adapters

NEW products

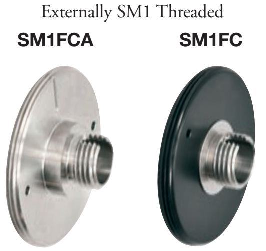
We have introduced this line of C-mount fiber adapters to provide compatibility with the C-mount threading (1.00"-32) commonly found on camera-based components. These externally threaded C-mount adapters have two dimples for compatibility with the SPW801 adjustable spanner wrench (page 446).

ITEM #	$	£	€	RMB	DESCRIPTION
CMTFC	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External C-Mount to FC/PC Adapter
CMTFCA	$ 42.00	£ 30.24	€ 36,54	¥ 334.74	External C-Mount to FC/APC Adapter
CMTSMA	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External C-Mount to SMA Adapter

SM1-Threaded Fiber Adapters

SM1-threaded (1.035"-40) fiber adapters are available either internally or externally threaded. The SM1 threading is compatible with our Ø1" lens tubes (page 134) and many of our 30 mm cage plates (page 177). Additionally, this threading is found on many of our detectors to simplify fiber measurements. These externally threaded adapters have two dimples for compatibility with the SPW801 adjustable spanner wrench (page 446).

Externally SM1 Threaded



Externally SM1-Threaded Fiber Adapters

ITEM #	$	£	€	RMB	DESCRIPTION
SM1FC	$ 27.00	£ 19.44	€ 23,49	¥ 215.19	External SM1 to FC/PC Adapter
SM1FCA	$ 30.00	£ 21.60	€ 26,10	¥ 239.10	External SM1 to FC/APC Adapter
SM1SMA	$ 27.00	£ 19.44	€ 23,49	¥ 215.19	External SM1 to SMA Adapter
SM1ST	$ 27.00	£ 19.44	€ 23,49	¥ 215.19	External SM1 to ST Adapter

Internally SM1 Threaded
S120-FC

Internally SM1-Threaded Fiber Adapters

ITEM #	$	£	€	RMB	DESCRIPTION
S120-FC	$ 38.00	£ 27.36	€ 33,06	¥ 302.86	Internal SM1 to FC/PC Adapter
S120-SC	$ 48.00	£ 34.56	€ 41,76	¥ 382.56	Internal SM1 to SC Adapter
S120-LC	$ 48.00	£ 34.56	€ 41,76	¥ 382.56	Internal SM1 to LC Adapter
S120-SMA	$ 38.00	£ 27.36	€ 33,06	¥ 302.86	Internal SM1 to SMA Adapter
S120-ST	$ 38.00	£ 27.36	€ 33,06	¥ 302.86	Internal SM1 to ST Adapter

Fiber Selection Guide

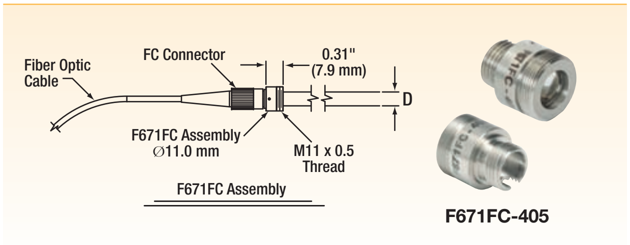
Fiber Collimators Selection Guide

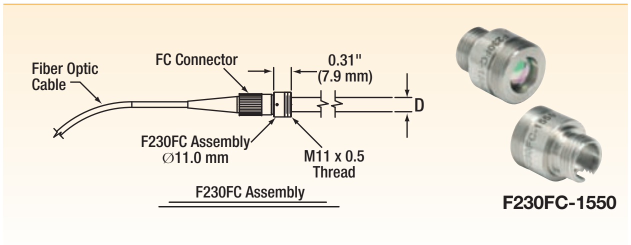
FC/PC Fixed Aspheric Lens Fiber Collimation Packages

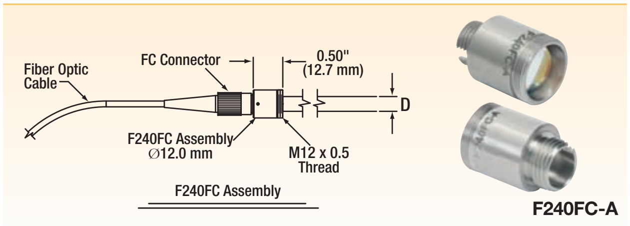
Thorlabs' Fixed Fiber Collimation Packages are designed to collimate a laser beam propagating out of an optical fiber. Each collimation package is factory aligned so that the lens and the output end of the fiber are separated by the wavelength-corrected focal length of the lens. These packages can also be used to couple a free-space laser beam into optical fiber provided that the collimation package is correctly aligned with respect to the input beam.

- Fiber Collimation
- Popular FC/PC Connectors, 2.1 mm Wide Key
- Free-Space Laser to Fiber Coupling
- Collect Light for Fiber Coupled Detection Systems

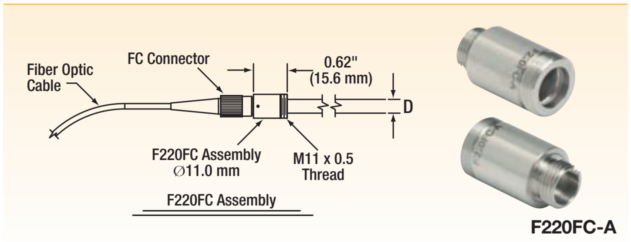
NEW versions

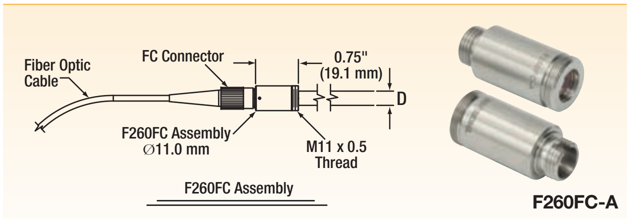


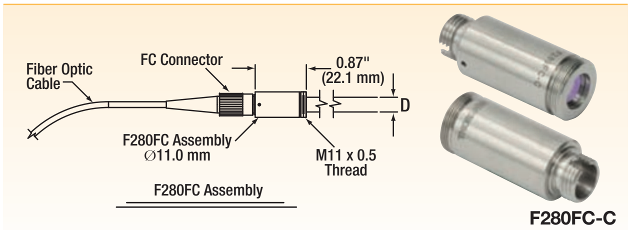




Please Note: 12 mm O.D.







Please refer to our website for complete models and drawings.

ITEM # SUFFIX	AR COATING	ALIGNMENT FIBER*
-405	395 - 415 nm	S405-HP
-A	350 - 700 nm	460HP
-B	650 - 1050 nm	SM600
-780	650 - 1050 nm	780HP
-C	1050 - 1620 nm	SMF-28e+
-1064	1050 - 1075 nm	SM980
-1550	1050 - 1620 nm	SMF-28e+

*Fiber not included with collimation package

Mechanical Drawings Available on the WEB

FC/PC Connectorized Collimation Packages

ITEM #	$	£	€	RMB	ALIGN λ	D[a]	Θ[b]	NA_{LENS}	f[c]
F671FC-405	$ 163.43	£117.67	€ 142,18	¥ 1,302.54	405 nm	0.7 mm	0.041°	0.60	4.02 mm
F230FC-A	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89	543 nm	0.8 mm	0.049°	0.57	4.34 mm
F230FC-B	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89	633 nm	0.8 mm	0.056°	0.56	4.43 mm
F230FC-C	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89	1310 nm	0.8 mm	0.114°	0.53	4.64 mm
F230FC-1550	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89	1550 nm	0.9 mm	0.128°	0.53	4.67 mm
F240FC-A	$ 146.30	£105.34	€ 127,28	¥ 1,166.01	543 nm	1.5 mm	0.027°	0.51	7.86 mm
F240FC-B	$ 146.30	£105.34	€ 127,28	¥ 1,166.01	633 nm	1.5 mm	0.031°	0.50	7.93 mm
NEW F240FC-780	$ 146.30	£105.34	€ 127,28	¥ 1,166.01	780 nm	1.5 mm	0.032°	0.50	8.00 mm
F240FC-C	$ 146.30	£105.34	€ 127,28	¥ 1,166.01	1310 nm	1.5 mm	0.065°	0.49	8.13 mm
F240FC-1550	$ 146.30	£105.34	€ 127,28	¥ 1,166.01	1550 nm	1.6 mm	0.073°	0.49	8.18 mm
F220FC-A	$ 127.70	£ 91.94	€ 111,10	¥ 1,017.77	543 nm	2.0 mm	0.020°	0.25	10.90 mm
F220FC-B	$ 127.70	£ 91.94	€ 111,10	¥ 1,017.77	633 nm	2.1 mm	0.022°	0.25	10.99 mm
NEW F220FC-780	$ 127.70	£ 91.94	€ 111,10	¥ 1,017.77	780 nm	2.3 mm	0.030°	0.25	11.07 mm
F220FC-1064	$ 127.70	£ 91.94	€ 111,10	¥ 1,017.77	1064 nm	2.4 mm	0.032°	0.25	11.17 mm
F220FC-C	$ 127.70	£ 91.94	€ 111,10	¥ 1,017.77	1310 nm	2.0 mm	0.047°	0.24	11.23 mm
F220FC-1550	$ 127.70	£ 91.94	€ 111,10	¥ 1,017.77	1550 nm	2.1 mm	0.053°	0.24	11.29 mm
F260FC-A	$ 136.00	£ 97.92	€ 118,32	¥ 1,083.92	543 nm	2.8 mm	0.014°	0.17	15.01 mm
F260FC-B	$ 136.00	£ 97.92	€ 118,32	¥ 1,083.92	633 nm	2.8 mm	0.016°	0.16	15.15 mm
F260FC-C	$ 136.00	£ 97.92	€ 118,32	¥ 1,083.92	1310 nm	2.8 mm	0.034°	0.16	15.52 mm
F260FC-1550	$ 136.00	£ 97.92	€ 118,32	¥ 1,083.92	1550 nm	3.0 mm	0.038°	0.16	15.58 mm
F280FC-A	$ 135.00	£ 97.20	€ 117,45	¥ 1,075.95	543 nm	3.3 mm	0.012°	0.15	18.07 mm
F280FC-B	$ 135.00	£ 97.20	€ 117,45	¥ 1,075.95	633 nm	3.4 mm	0.014°	0.15	18.24 mm
F280FC-C	$ 135.00	£ 97.20	€ 117,45	¥ 1,075.95	1310 nm	3.4 mm	0.028°	0.15	18.67 mm
F280FC-1550	$ 135.00	£ 97.20	€ 117,45	¥ 1,075.95	1550 nm	3.6 mm	0.032°	0.15	18.75 mm

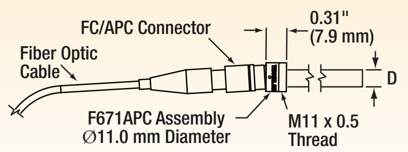
[a]Measured $1/e^2$ diameter at 1 focal length from lens at the alignment wavelength using the alignment fiber type
[b]Calculated full angle of divergence
[c]Effective focal length of the aspheric lens at the alignment wavelength

See page 1009

FC/APC Fixed Aspheric Lens Fiber Collimation Packages

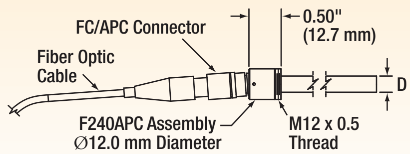
These FC/APC connectorized fiber collimation packages are ideal for systems that are sensitive to back reflections. APC connectors utilize a ferrule that has an 8° endface, typically leading to a return loss greater than 60 dB. Connectors have a 2.1 mm wide key.

NEW versions



F671APC Assembly

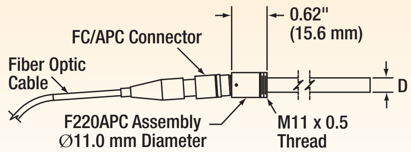
F671APC-405



F240APC Assembly

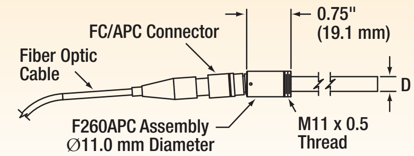
F240APC-1550

Please Note: 12 mm O.D.



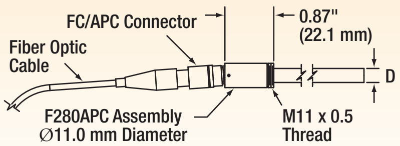
F220APC Assembly

F220APC-1064



F260APC Assembly

F260APC-A



F280APC Assembly

F280APC-1550

FC/APC Connectorized Collimation Packages

ITEM #	$	£	€	RMB	ALIGN λ	D[a]	Θ[b]	NA_{LENS}	f[c]
F671APC-405	$ 190.07	£ 136.85	€ 165,36	¥ 1,514.86	405 nm	0.7 mm	0.041°	0.60	4.02 mm
F240APC-A	$ 187.50	£ 135.00	€ 163,13	¥ 1,494.38	543 nm	1.5 mm	0.027°	0.51	7.86 mm
F240APC-B	$ 187.50	£ 135.00	€ 163,13	¥ 1,494.38	633 nm	1.5 mm	0.031°	0.50	7.93 mm
F240APC-780	$ 187.50	£ 135.00	€ 163,13	¥ 1,494.38	780 nm	1.5 mm	0.032°	0.50	8.00 mm NEW
F240APC-C	$ 187.50	£ 135.00	€ 163,13	¥ 1,494.38	1310 nm	1.5 mm	0.065°	0.49	8.13 mm
F240APC-1550	$ 187.50	£ 135.00	€ 163,13	¥ 1,494.38	1550 nm	1.6 mm	0.073°	0.49	8.18 mm
F220APC-780	$ 187.50	£ 135.00	€ 163,13	¥ 1,494.38	780 nm	2.3 mm	0.030°	0.25	11.07 mm NEW
F220APC-1064	$ 187.50	£ 135.00	€ 163,13	¥ 1,494.38	1064 nm	2.4 mm	0.032°	0.25	11.17 mm
F260APC-A	$ 185.00	£ 133.20	€ 160,95	¥ 1,474.45	543 nm	2.8 mm	0.014°	0.17	15.01 mm
F260APC-B	$ 185.00	£ 133.20	€ 160,95	¥ 1,474.45	633 nm	2.8 mm	0.016°	0.16	15.15 mm
F260APC-C	$ 185.00	£ 133.20	€ 160,95	¥ 1,474.45	1310 nm	2.8 mm	0.034°	0.16	15.52 mm
F260APC-1550	$ 185.00	£ 133.20	€ 160,95	¥ 1,474.45	1550 nm	3.0 mm	0.038°	0.16	15.58 mm
F280APC-A	$ 185.00	£ 133.20	€ 160,95	¥ 1,474.45	543 nm	3.3 mm	0.012°	0.15	18.07 mm
F280APC-B	$ 185.00	£ 133.20	€ 160,95	¥ 1,474.45	633 nm	3.4 mm	0.014°	0.15	18.24 mm
F280APC-C	$ 185.00	£ 133.20	€ 160,95	¥ 1,474.45	1310 nm	3.4 mm	0.028°	0.15	18.67 mm
F280APC-1550	$ 185.00	£ 133.20	€ 160,95	¥ 1,474.45	1550 nm	3.6 mm	0.032°	0.15	18.75 mm

[a]Measured $1/e^2$ diameter at 1 focal length from lens at the alignment wavelength using the alignment fiber type
[b]Calculated full angle of divergence
[c]Effective focal length of the aspheric lens at the alignment wavelength

Please refer to our website for complete models and drawings.

User-Defined Alignment Wavelengths Available

ITEM # SUFFIX	AR COATING	ALIGNMENT FIBER*
-405	395 - 415 nm	S405
-A	350 - 700 nm	460HP
-B	650 - 1050 nm	SM600
-780	650 - 1050 nm	780HP
-C	1050 - 1620 nm	SMF-28e+
-1064	1050 - 1075 nm	SM980
-1550	1050 - 1620 nm	SMF-28e+

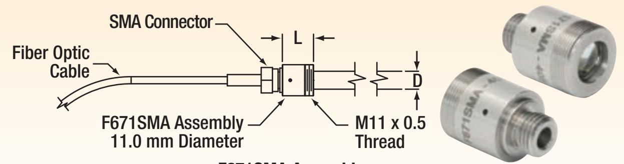
*Fiber not included

See page 1081

See page 350

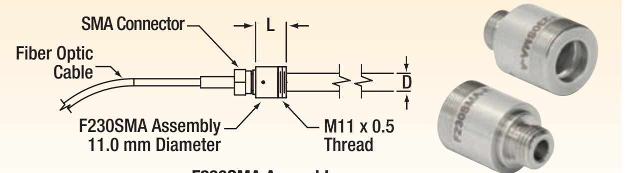
SMA Fixed Aspheric Lens Fiber Collimation Packages

NEW versions



F671SMA Assembly
Fiber Optic Cable Sold Separately

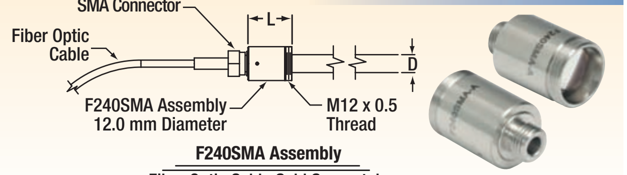
F671SMA-405
Suggested Adapter: AD11F



F230SMA Assembly
Fiber Optic Cable Sold Separately

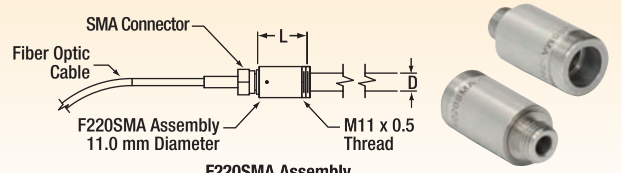
F230SMA-A
Suggested Adapter: AD11F

Please Note: 12 mm Outer Diameter



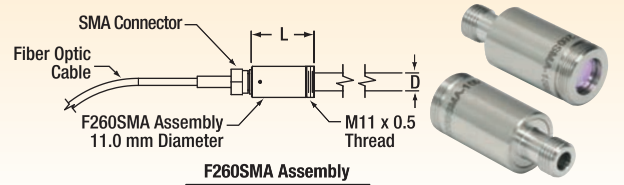
F240SMA Assembly
Fiber Optic Cable Sold Separately

F240SMA-A
Suggested Adapter: AD12F



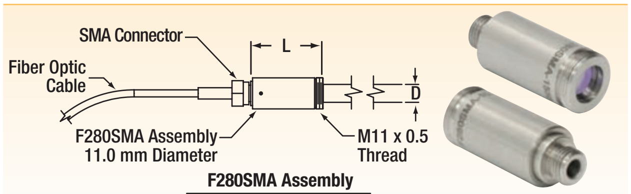
F220SMA Assembly
Fiber Optic Cable Sold Separately

F220SMA-780
Suggested Adapter: AD11F



F260SMA Assembly
Fiber Optic Cable Sold Separately

F260SMA-1550
Suggested Adapter: AD11F



F280SMA Assembly
Fiber Optic Cable Sold Separately

F280SMA-1550
Suggested Adapter: AD11F

Ideal for Coupling into Multimode Fiber

ITEM # SUFFIX	AR COATING	ALIGNMENT FIBER*
-405	395 - 415 nm	S405
-A	350 - 700 nm	460HP
-B	650 - 1050 nm	SM600
-780	650 - 1050 nm	780HP
-C	1050 - 1620 nm	SMF-28e+
-1064	1050 - 1075 nm	SM980
-1550	1050 - 1620 nm	SMF-28e+

* Fiber not included

SMA-Connectorized Collimation Packages

	ITEM #	$	£	€	RMB	ALIGN λ	D[a]	Θ[b]	NA_{LENS}	f[c]	L
	F671SMA-405	$ 158.10	£ 113.83	€ 137,55	¥ 1,260.06	405 nm	0.7 mm	0.041°	0.60	4.02 mm	11.0 mm
	F230SMA-A	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89	543 nm	0.8 mm	0.049°	0.57	4.34 mm	11.0 mm
	F230SMA-B	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89	633 nm	0.8 mm	0.056°	0.56	4.43 mm	11.0 mm
	F230SMA-C	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89	1310 nm	0.8 mm	0.114°	0.53	4.64 mm	11.0 mm
NEW	F230SMA-1550	$ 137.00	£ 98.64	€ 119,19	¥ 1,091.89	1550 nm	0.9 mm	0.128°	0.53	4.67 mm	7.9 mm
	F240SMA-A	$ 144.20	£ 103.82	€ 125,45	¥ 1,149.27	543 nm	1.5 mm	0.027°	0.51	7.86 mm	15.6 mm
	F240SMA-B	$ 144.20	£ 103.82	€ 125,45	¥ 1,149.27	633 nm	1.5 mm	0.031°	0.50	7.93 mm	15.6 mm
NEW	F240SMA-780	$ 144.20	£ 103.82	€ 125,45	¥ 1,149.27	780 nm	1.5 mm	0.032°	0.50	8.00 mm	15.6 mm
	F240SMA-C	$ 144.20	£ 103.82	€ 125,45	¥ 1,149.27	1310 nm	1.5 mm	0.065°	0.49	8.13 mm	15.6 mm
NEW	F240SMA-1550	$ 144.20	£ 103.82	€ 125,45	¥ 1,149.27	1550 nm	1.6 mm	0.073°	0.49	8.18 mm	12.7 mm
	F220SMA-A	$ 130.80	£ 94.18	€ 113,80	¥ 1,042.48	543 nm	2.0 mm	0.020°	0.25	10.90 mm	18.2 mm
	F220SMA-B	$ 130.80	£ 94.18	€ 113,80	¥ 1,042.48	633 nm	2.1 mm	0.022°	0.25	10.99 mm	18.2 mm
NEW	F220SMA-780	$ 130.80	£ 94.18	€ 113,80	¥ 1,042.48	780 nm	2.1 mm	0.030°	0.25	11.07 mm	18.2 mm
	F220SMA-1064	$ 130.80	£ 94.18	€ 113,80	¥ 1,042.48	1064 nm	2.4 mm	0.032°	0.25	11.17 mm	18.2 mm
	F220SMA-C	$ 130.80	£ 94.18	€ 113,80	¥ 1,042.48	1310 nm	2.0 mm	0.047°	0.24	11.23 mm	18.2 mm
NEW	F220SMA-1550	$ 130.80	£ 94.18	€ 113,80	¥ 1,042.48	1550 nm	2.1 mm	0.053°	0.24	11.29 mm	15.6 mm
	F260SMA-A	$ 126.70	£ 91.22	€ 110,23	¥ 1,009.80	543 nm	2.8 mm	0.014°	0.17	15.01 mm	22.2 mm
	F260SMA-B	$ 126.70	£ 91.22	€ 110,23	¥ 1,009.80	633nm	2.8 mm	0.016°	0.16	15.15 mm	22.2 mm
	F260SMA-C	$ 126.70	£ 91.22	€ 110,23	¥ 1,009.80	1310 nm	2.8 mm	0.034°	0.16	15.52 mm	22.2 mm
NEW	F260SMA-1550	$ 126.70	£ 91.22	€ 110,23	¥ 1,009.80	1550 nm	3.0 mm	0.038°	0.16	15.58 mm	19.1 mm
	F280SMA-A	$ 125.00	£ 90.00	€ 108,75	¥ 996.25	543 nm	3.3 mm	0.012°	0.15	18.07 mm	25.0 mm
	F280SMA-B	$ 125.00	£ 90.00	€ 108,75	¥ 996.25	633 nm	3.4 mm	0.014°	0.15	18.24 mm	25.0 mm
	F280SMA-C	$ 125.00	£ 90.00	€ 108,75	¥ 996.25	1310 nm	3.4 mm	0.028°	0.15	18.67 mm	25.0 mm
NEW	F280SMA-1550	$ 125.00	£ 90.00	€ 108,75	¥ 996.25	1550 nm	3.6 mm	0.032°	0.15	18.75 mm	22.1 mm

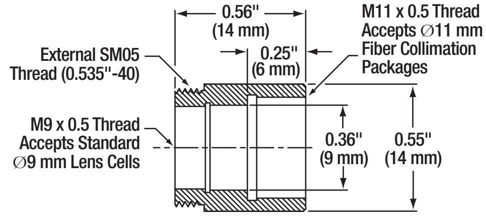
[a] Theoretical $1/e^2$ diameter at 1 focal length from lens at the alignment wavelength using the alignment fiber type
[b] Measured full beam angle of divergence
[c] Effective focal length of the aspheric lens at the alignment wavelength

Fixed Focus Lens Adapter

- Internal M11 Thread for Mounting Collimation Packages
- Internal M9 Thread for Mounting Aspheric Lens Cells (See Page 714)
- External SM05 Thread for Integration into SM05 Threaded Components

Fiber Collimator Sold Separately

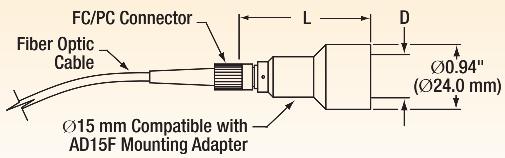
ITEM #	$	£	€	RMB	DESCRIPTION
AD1109F	$ 29.00	£ 20.88	€ 25,23	¥ 231.13	Fixed Focus Lens Adapter



Please refer to our website for complete models and drawings.

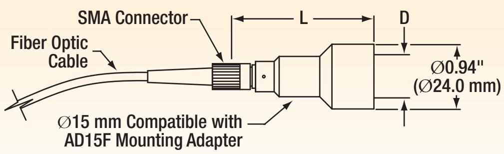
FC and SMA Doublet Collimators

F810FC-1310



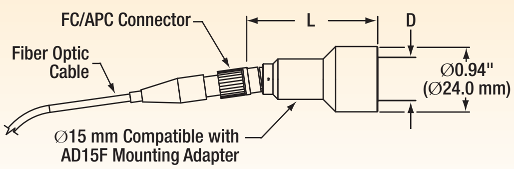
F810FC Assembly
Fiber Optic Cable Sold Separately

F810SMA-1310



F810SMA Assembly
Fiber Optic Cable Sold Separately

F810APC-1310



F810APC Assembly
Fiber Optic Cable Sold Separately

- Multi-Element Lens Design for Diffraction-Limited Performance
- Popular SMA and FC Connector Options
- Large Output Beam Diameters
- Collect Light for Fiber-Coupled Detection Systems

Our fiber collimation packages are designed to collimate a laser beam propagating out of the end of an optical fiber. These packages can also be used to couple a free-space laser beam into an optical fiber, provided that the collimation package is correctly aligned with respect to the input beam.

ITEM # SUFFIX	AR COATING	ALIGNMENT FIBER*
-543	420 - 650 nm	460HP
-635	420 - 650 nm	SM600
-780	650 - 1050 nm	780HP
-842	650 - 1050 nm	780HP
-1064	1050 - 1075 nm	SM980
-1310	1050 - 1620 nm	SMF-28e+
-1550	1050 - 1620 nm	SMF-28e+

* Fiber not included

See page 350

FC/PC Air-Spaced Doublet Collimators

Please refer to our website for complete models and drawings.

ITEM #	$	£	€	RMB	ALIGN λ[a]	D[b]	θ[c]	NA_{LENS}	f[d]	L[e]
F810FC-543	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	543 nm	6.4 mm	0.006°	0.26	34.74 mm	44.4 mm
F810FC-635	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	635 nm	6.7 mm	0.007°	0.25	35.41 mm	45.4 mm
F810FC-780	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	780 nm	7.5 mm	0.008°	0.25	36.01 mm	46.0 mm
F810FC-1064	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	1064 nm	8.0 mm	0.010°	0.25	36.60 mm	46.2 mm
F810FC-1310	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	1310 nm	6.7 mm	0.014°	0.24	36.90 mm	46.9 mm
F810FC-1550	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	1550 nm	7.0 mm	0.016°	0.24	37.13 mm	46.9 mm

SMA Air-Spaced Doublet Collimators

ITEM #	$	£	€	RMB	ALIGN λ[a]	D[b]	θ[c]	NA_{LENS}	f[d]	L[e]
F810SMA-543	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	543 nm	6.4 mm	0.006°	0.26	34.74 mm	47.3 mm
F810SMA-635	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	635 nm	6.7 mm	0.007°	0.25	35.41 mm	48.0 mm
F810SMA-780	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	780 nm	7.5 mm	0.008°	0.25	36.01 mm	48.6 mm
F810SMA-1064	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	1064 nm	8.0 mm	0.010°	0.25	36.60 mm	49.0 mm
F810SMA-1310	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	1310 nm	6.7 mm	0.014°	0.24	36.90 mm	49.6 mm
F810SMA-1550	$ 201.90	£ 145.37	€ 175,65	¥ 1,609.14	1550 nm	7.0 mm	0.016°	0.24	37.13 mm	49.8 mm

NEW

FC/APC Air-Spaced Doublet Collimators

ITEM #	$	£	€	RMB	ALIGN λ[a]	D[b]	θ[c]	NA_{LENS}	f[d]	L[e]
F810APC-780	$ 232.80	£ 167.62	€ 202,54	¥ 1,855.42	780 nm	7.5 mm	0.008°	0.25	36.01 mm	41.4 mm
F810APC-842	$ 232.80	£ 167.62	€ 202,54	¥ 1,855.42	842 nm	7.8 mm	0.008°	0.25	36.18 mm	41.4 mm
F810APC-1310	$ 232.80	£ 167.62	€ 202,54	¥ 1,855.42	1310 nm	6.7 mm	0.014°	0.24	36.90 mm	47.2 mm
F810APC-1550	$ 232.80	£ 167.62	€ 202,54	¥ 1,855.42	1550 nm	7.0 mm	0.016°	0.24	37.13 mm	46.9 mm

[a]Alignment wavelength
[b]Theoretical $1/e^2$ diameter at 1 focal length from lens at the alignment wavelength using the alignment fiber type
[c]Calculated full beam angle of divergence
[d]Effective focal length of the Collimation Package
[e]Length, includes receptacle for connector

See page 1081

Triplet Fiber Collimation Packages (Page 1 of 2)

NEW products

Features

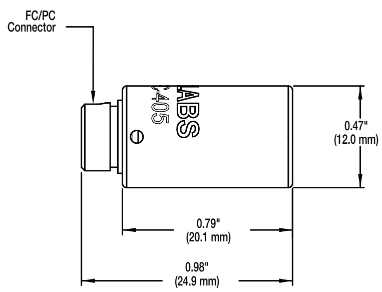
- Triplet Lens Design Provides Nearly Gaussian Output
- Stock Versions Available Aligned for 405, 543, 633, 780, 1064, 1310, or 1550 nm
- Low Divergence: 0.4 mrad Full Angle (Typical)
- Low Pointing Error:
  - FC/PC: 2 mrad (Max)
  - FC/APC: 3 mrad (Max)
- Low Wavefront Error: λ/8 (Typical)

TC12FC-405

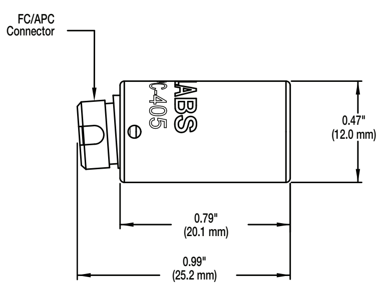
TC12APC-633

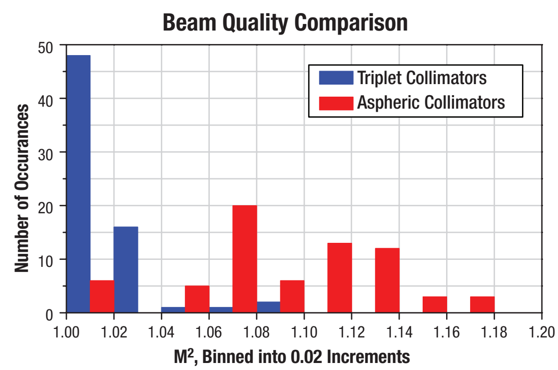
These collimators use air-spaced triplet lenses that offer superior beam quality performance when compared to aspheric lens collimators. The benefits of the low-aberration triplet design include an M^2 term closer to 1 (Gaussian), less divergence, and less wavefront error.

FC/PC Collimator

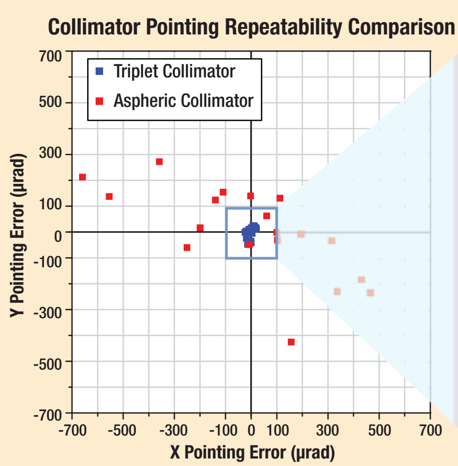


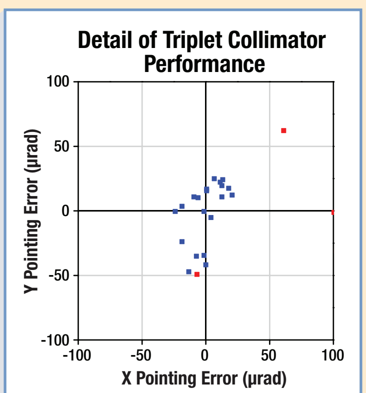
FC/APC Collimator





The graph above plots the beam quality, M^2, of 68 triplet collimators and 68 aspheric collimators. The measured beam qualities have been binned into increments of 0.02. This data shows that beam quality when using a triplet collimator is typically closer to 1 than when using an aspheric collimator. It also shows that beam quality achieved with a triplet collimator is more consistent from unit to unit.



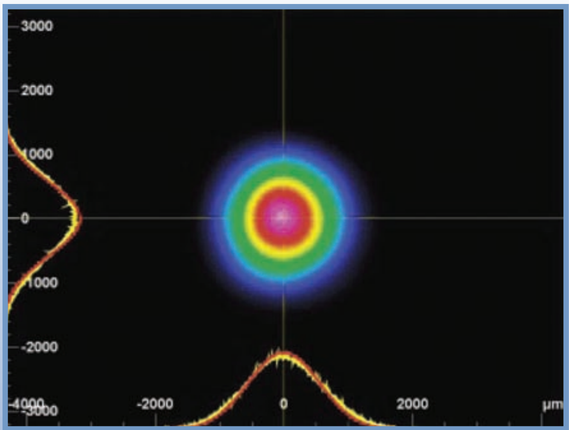


The graph to the left compares the pointing error of an aspheric lens collimator to that of a triplet collimator. Pointing error is graphed in X and Y components, each measured in microradians. Nineteen data points were taken with each collimator type and the beam's position was measured on a beam profiler.

Our triplet collimators use high-precision fiber receptacles, leading to a pointing accuracy an order of magnitude better than that of a similar aspheric lens collimator without a high-precision fiber receptacle.

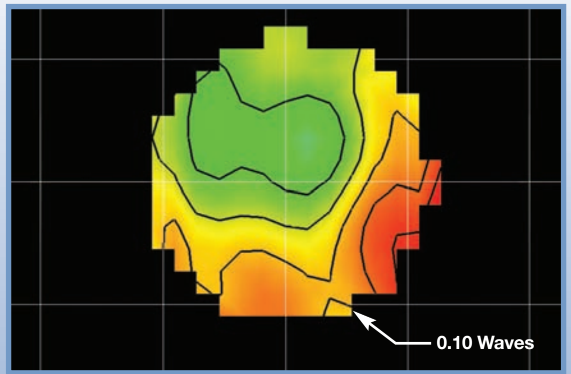
Features such as this make our triplet collimators an excellent choice for demanding applications.

Triplet Fiber Collimation Packages (Page 2 of 2)



The nearly Gaussian beam profile measured with our BC106-VIS (see page 1615) is of the beam created by collimating the output of a SM fiber coupled HeNe laser using a TC12FC-633 Triplet Collimation Package.

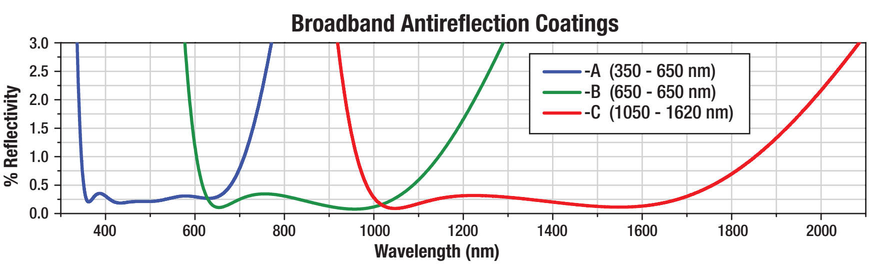
The graph represents the wavefront error of a collimated beam using our triplet collimators. Each contour line represents 0.02 waves of wavefront error.



Another measure of a beam's quality is the flatness of the wavefront at an image plane congugate to the fiber tip. Using our WFS150-5C wavefront sensor (see page 1610 - 1613) we measured the wavefront of a 633 mm beam collimated with a triplet collimator. The result was less than λ/8 deviation from a flat wavefront.

Our triplet fiber collimators are available from stock aligned for 405, 543, 633, 780, 1064, 1310, or 1550 nm. Each lens in the collimator has a broadband AR coating in order to minimize losses due to surface reflections. Collimation packages are offered for either FC/PC or FC/APC connectors. Our triplet fiber collimation packages use high-precision receptacles that provide excellent pointing repeatability. This allows the user to remove and replace the fiber without needing to realign the system. The collimator housing has an outer diameter of 12 mm, which makes them compatible with both the AD12NT and AD12F mounting adapters (see page 350).

For triplet collimators aligned to a wavelength other than what is available from stock, please contact your local Technical Support for additional information.



ITEM # SUFFIX	ALIGNMENT FIBER*
-405	S405-HP
-543	460HP
-633	SM600
-780	780HP
-1064	SM980
-1310	SMF-28e+
-1550	SMF-28e+

* Fiber not included

FC/PC Collimators

ITEM #	ALIGNMENT λ	AR COATING	D[a]	Θ[b]	f[c]	$	£	€	RMB
TC12FC-405	405 nm	350 - 650 nm	1.98 mm	0.015°	11.14 mm	$ 390.00	£ 280.80	€ 339,30	¥3,108.30
TC12FC-543	543 nm	350 - 650 nm	2.33 mm	0.017°	11.80 mm	$ 390.00	£ 280.80	€ 339,30	¥3,108.30
TC12FC-633	633 nm	350 - 650 nm	2.25 mm	0.021°	12.00 mm	$ 390.00	£ 280.80	€ 339,30	¥3,108.30
TC12FC-780	780 nm	650 - 1050 nm	2.42 mm	0.024°	12.19 mm	$ 390.00	£ 280.80	€ 339,30	¥3,108.30
TC12FC-1064	1064 nm	1050 - 1620 nm	3.73 mm	0.021°	12.38 mm	$ 390.00	£ 280.80	€ 339,30	¥3,108.30
TC12FC-1310	1310 nm	1050 - 1620 nm	2.24 mm	0.042°	12.48 mm	$ 390.00	£ 280.80	€ 339,30	¥3,108.30
TC12FC-1550	1550 nm	1050 - 1620 nm	2.38 mm	0.047°	12.56 mm	$ 390.00	£ 280.80	€ 339,30	¥3,108.30

[a]Beam Diameter at alignment wavelength using alignment fiber type [b]Full Angle Divergence [c]Wavelength-Adjusted Focal Length

FC/APC Collimators

ITEM #	ALIGNMENT λ	AR COATING	D[a]	Θ[b]	f[c]	$	£	€	RMB
TC12APC-405	405 nm	350 - 650 nm	1.98 mm	0.015°	11.14 mm	$ 450.00	£ 324.00	€ 391,50	¥3,586.50
TC12APC-543	543 nm	350 - 650 nm	2.33 mm	0.017°	11.80 mm	$ 450.00	£ 324.00	€ 391,50	¥3,586.50
TC12APC-633	633 nm	350 - 650 nm	2.25 mm	0.021°	12.00 mm	$ 450.00	£ 324.00	€ 391,50	¥3,586.50
TC12APC-780	780 nm	650 - 1050 nm	2.42 mm	0.024°	12.19 mm	$ 450.00	£ 324.00	€ 391,50	¥3,586.50
TC12APC-1064	1064 nm	1050 - 1620 nm	3.73 mm	0.021°	12.38 mm	$ 450.00	£ 324.00	€ 391,50	¥3,586.50
TC12APC-1310	1310 nm	1050 - 1620 nm	2.24 mm	0.042°	12.48 mm	$ 450.00	£ 324.00	€ 391,50	¥3,586.50
TC12APC-1550	1550 nm	1050 - 1620 nm	2.38 mm	0.047°	12.56 mm	$ 450.00	£ 324.00	€ 391,50	¥3,586.50

[a]Beam Diameter at alignment wavelength using alignment fiber type [b]Full Angle Divergence [c]Wavelength-Adjusted Focal Length

Adjustable Aspheric Collimators

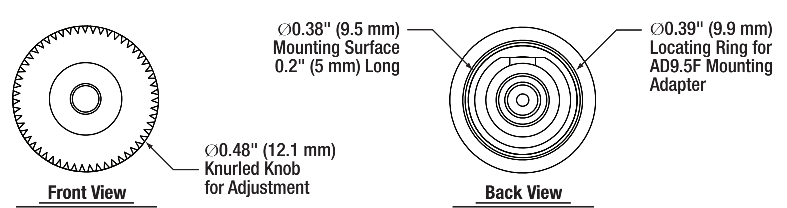
The design of our adjustable aspheric lens collimators translates, without rotating, the aspheric lens along the optical axis. Each FC/PC or FC/APC collimator contains a spring-loaded aspheric lens mounted in a cell. As the outer barrel of the collimator is rotated, the lens is translated along the optical axis. This mechanism, along with tight tolerances, minimizes deviations in the beam propagation direction as the user adjusts the distance between the lens and the tip of the fiber.

All of the CFC series adjustable FC collimators have an outside package diameter of 9.5 mm.

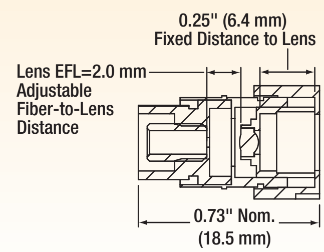
- Diffraction-Limited Performance
- Ø9.5 mm Mounting Surface
- AR Coated Aspheric Lenses
- Stainless Steel Construction
- FC/PC and FC/APC
- Collimate or Couple Light
- Locking Setscrew

*The Adjustment Barrel has a Larger Diameter

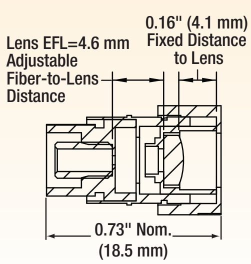
All Models



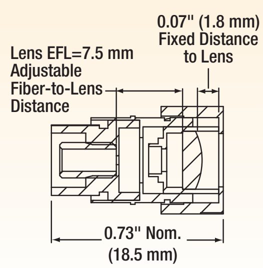
Aspheric Collimator 2.0 mm EFL



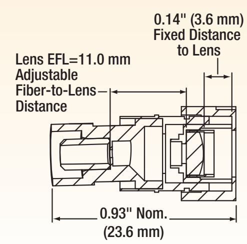
Aspheric Collimator 4.6 mm EFL



Aspheric Collimator 7.5 mm EFL



Aspheric Collimators 11.0 mm EFL



Please refer to our website for complete models and drawings.

Adjustable Collimators: FC/PC or FC/APC

ITEM #	$	£	€	RMB	D[a]	Θ[b]	NA_{LENS}	f[c]	AR λ[d]
CFC-2X-A	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	0.33 mm	0.10°	0.50	2.0 mm	400 - 600 nm
CFC-2X-B	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	0.38 mm	0.12°	0.50	2.0 mm	600 - 1050 nm
CFC-2X-C	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	0.38 mm	0.30°	0.50	2.0 mm	1050 - 1600 nm
CFC-5X-A	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	0.75 mm	0.04°	0.53	4.6 mm	350 - 700 nm
CFC-5X-B	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	0.86 mm	0.05°	0.53	4.6 mm	650 - 1050 nm
CFC-5X-C	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	0.87 mm	0.13°	0.53	4.6 mm	1050 - 1620 nm
CFC-8X-A	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	1.2 mm	0.03°	0.30	7.5 mm	350 - 700 nm
CFC-8X-B	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	1.4 mm	0.03°	0.30	7.5 mm	650 - 1050 nm
CFC-8X-C	$ 225.00	£162.00	€ 195,75	¥ 1,793.25	1.4 mm	0.08°	0.30	7.5 mm	1050 - 1620 nm

[a] Output waist diameter
[b] Full Beam Divergence
[c] Focal length of lens
[d] AR coating wavelength range
[a,b] Details of calculated specifications available online

Adjustable Collimators: FC/PC

ITEM #	$	£	€	RMB	D[a]	Θ[b]	NA_{LENS}	f[c]	AR λ[d]
CFC-11X-A	$ 240.00	£172.80	€ 208,80	¥ 1,912.80	1.8 mm	0.02°	0.30	11.0 mm	350 - 700 nm
CFC-11X-B	$ 240.00	£172.80	€ 208,80	¥ 1,912.80	2.1 mm	0.02°	0.30	11.0 mm	650 -1050 nm
CFC-11X-C	$ 240.00	£172.80	€ 208,80	¥ 1,912.80	2.1 mm	0.05°	0.30	11.0 mm	1050 - 1620 nm

[a] Output waist diameter
[b] Full Beam Divergence
[c] Focal length of lens
[d] AR coating wavelength range
[a,b] Details of calculated specifications available online

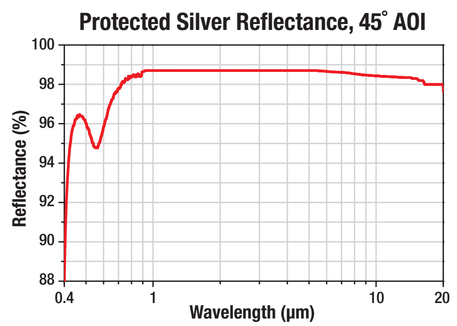
Reflective Collimators

- No Chromatic Aberration
- Nearly Gaussian Collimation Over Mirror's Reflection Band
- Protected Silver Coating Offers High Reflectance
- Great for Coupling Polychromatic Light into Multimode Fiber
- Externally Threaded Housings:
  - RC04/RC08: SM05 (0.535"-40)
  - RC12: SM1 (1.035"-40)
- FC/PC, FC/APC, or SMA Connectors
- Additional Metallic Coatings Available Soon

NEW products

RC08APC-P01
f = 33 mm

RC04APC-P01
f = 15 mm



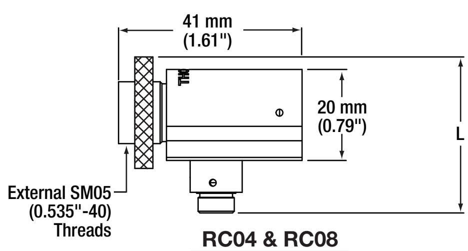
The RC Series of Reflective Collimators is based on 90° off-axis parabolic mirrors. A mirror, unlike a lens, does not suffer from dispersion and thus has a focal length that remains constant over a broad wavelength range. Due to this intrinsic property, parabolic mirror collimators do not need to be adjusted to accommodate various wavelengths of light, making them ideal for use with polychromatic light. By using protected silver mirrors, these collimators offer excellent performance in the 450 nm to 20 µm spectral range.

Common applications include systems that utilize multiple wavelengths that need to be collimated, collimation/coupling in the IR, and coupling polychromatic light into multimode fiber.

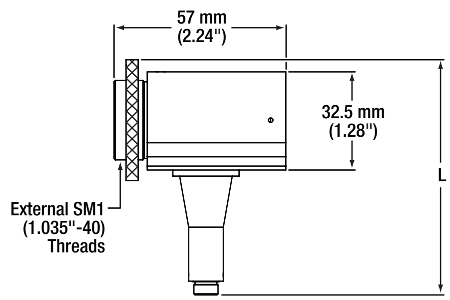
Common Specifications

- Mirror Surface Quality: 40-20 Scratch-Dig
- Approximate Full Angle Beam Divergence: 0.02°

Mechanical Drawings Available on the WEB



RC04 & RC08



RC12

ITEM #	FIBER CONNECTOR[a]	CLEAR APERTURE	BEAM DIAMETER[b]	MIRROR NA	EFL[c]	L[d]
RC04FC-P01	FC/PC	Ø11 mm	4 mm	0.36	15 mm	34.3 mm (1.4")
RC08FC-P01	FC/PC	Ø11 mm	8.5 mm	0.167	33 mm	52.3 mm (2.1")
RC12FC-P01	FC/PC	Ø22 mm	13 mm	0.216	50.8 mm	77.8 mm (3.1")
RC04APC-P01	FC/APC	Ø11 mm	4 mm	0.36	15 mm	34.5 mm (1.4")
RC08APC-P01	FC/APC	Ø11 mm	8.5 mm	0.167	33 mm	52.5 mm (2.1")
RC12APC-P01	FC/APC	Ø22 mm	13 mm	0.216	50.8 mm	78.0 mm (3.1")
RC04SMA-P01	SMA	Ø11 mm	4 mm	0.36	15 mm	37.9 mm (1.5")
RC08SMA-P01	SMA	Ø11 mm	8.5 mm	0.167	33 mm	55.9 mm (2.2")
RC12SMA-P01	SMA	Ø22 mm	13 mm	0.216	50.8 mm	81.4 mm (3.2")

[a]FC/PC and FC/APC versions use wide key connectors [b]Approximate, based on 0.13 NA fiber. Diameter = 2 x NA (Fiber) x f [c]Effective Focal Length [d]Length, See Drawing

Reflective Collimators, FC/PC Connector

ITEM #	$	£	€	RMB	DESCRIPTION
RC04FC-P01	$ 810.00	£ 583.20	€ 704,70	¥ 6,455.70	Reflective Collimator with Silver Mirror, f = 15 mm
RC08FC-P01	$ 525.00	£ 378.00	€ 456,75	¥ 4,184.25	Reflective Collimator with Silver Mirror, f = 33 mm
RC12FC-P01	$ 850.00	£ 612.00	€ 739,50	¥ 6,774.50	Reflective Collimator with Silver Mirror, f = 50.8 mm

Reflective Collimators, FC/APC Connector

ITEM #	$	£	€	RMB	DESCRIPTION
RC04APC-P01	$ 850.00	£ 612.00	€ 739,50	¥ 6,774.50	Reflective Collimator with Silver Mirror, f = 15 mm
RC08APC-P01	$ 575.00	£ 414.00	€ 500,25	¥ 4,582.75	Reflective Collimator with Silver Mirror, f = 33 mm
RC12APC-P01	$ 900.00	£ 648.00	€ 783,00	¥ 7,173.00	Reflective Collimator with Silver Mirror, f = 50.8 mm

Reflective Collimators, SMA Connector

ITEM #	$	£	€	RMB	DESCRIPTION
RC04SMA-P01	$ 850.00	£ 612.00	€ 739,50	¥ 6,774.50	Reflective Collimator with Silver Mirror, f = 15 mm
RC08SMA-P01	$ 575.00	£ 414.00	€ 500,25	¥ 4,582.75	Reflective Collimator with Silver Mirror, f = 33 mm
RC12SMA-P01	$ 900.00	£ 648.00	€ 783,00	¥ 7,173.00	Reflective Collimator with Silver Mirror, f = 50.8 mm

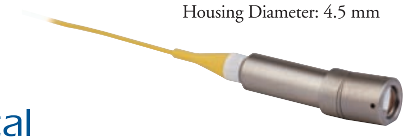
See page 1081

FC/PC and FC/APC Pigtailed Collimators with SM Fibers

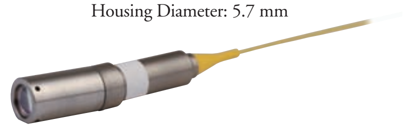
Our line of pigtailed collimators has a fiber and an AR-coated aspheric lens permanently glued inside a stainless steel housing. Each collimator comes with one meter of single mode fiber and is aligned to collimate/couple light at the specified wavelength. Since the AR coating encompasses a broad spectral range, it is possible to use this collimator at any wavelength within the coating range; however, the divergence angle/coupling loss will increase as the wavelength is detuned from the design wavelength. Custom alignment wavelengths are available upon request.

Aspheric Collimator 2.0 mm EFL
Housing Diameter: 4.5 mm

Aspheric Collimator 4.6 mm EFL
Housing Diameter: 5.7 mm



Aspheric Collimator 11.0 mm EFL
Housing Diameter: 9.0 mm



Aspheric Collimator 18.4 mm EFL
Housing Diameter: 9.0 mm

Mechanical Drawings Available on the WEB

Specifications

- **Insertion Loss:** <0.2 dB
- **Return Loss:** 40 dB (55 dB for CFS11-XXX-APC, CFS18-XXX-APC)
- **Fiber Length:** 1 m

ITEM #	FIBER*	ALIGNMENT	AR COATING (LENS)
CFSxx-532-FC	460HP	532 mm	350 - 700 nm
CFSxx-850-APC	SM800-5.6-125	850 mm	650 - 1050 nm
CFSxx-1030-FC	HI1060	1030 mm	650 - 1050 nm
CFSxx-1064-FC	HI1060	1064 mm	1050 - 1620 nm
CFSxx-1310-APC	SMF28e+	1310 mm	1050 - 1620 nm
CFSxx-1550-APC	SMF28e+	1550 mm	1050 - 1620 nm

*Fiber is AR Coated

ITEM #	EFL	INPUT MFD[a]	OUTPUT WAIST DIA.	DIVERGENCE[b]	LENS CHARACTERISTICS		ALIGNMENT	CONNECTOR
					CA[c]	NA		
CFS2-532-FC	1.97 mm	3.5 µm	0.39 mm	1.75 mrad	2.0 mm	0.51	532 nm	FC/PC
CFS2-1030-FC	2.01 mm	6.0 µm	0.44 mm	3.00 mrad	2.0 mm	0.50	1030 nm	FC/PC
CFS2-1064-FC	2.02 mm	6.2 µm	0.44 mm	3.10 mrad	2.0 mm	0.50	1064 nm	FC/PC
CFS5-1030-FC	4.67 mm	6.0 µm	1.0 mm	1.30 mrad	3.6 mm	0.39	1030 nm	FC/PC
CFS5-1064-FC	4.60 mm	6.2 µm	1.0 mm	1.35 mrad	3.6 mm	0.39	1064 nm	FC/PC
CFS11-1030-FC	11.16 mm	6.0 µm	2.4 mm	0.55 mrad	5.4 mm	0.24	1030 nm	FC/PC
CFS11-1064-FC	11.17 mm	6.2 µm	2.4 mm	0.56 mrad	5.4 mm	0.24	1064 nm	FC/PC
CFS18-532-FC	18.04 mm	3.5 µm	3.6 mm	0.19 mrad	5.5 mm	0.15	532 nm	FC/PC
CFS18-1030-FC	18.56 mm	6.0 µm	4.0 mm	0.33 mrad	5.5 mm	0.15	1030 nm	FC/PC
CFS18-1064-FC	18.57 mm	6.2 µm	4.0 mm	0.34 mrad	5.5 mm	0.15	1064 nm	FC/PC

[a] Mode Field Diameter [b] Full Angle in the Near-Field [c] Clear Aperture

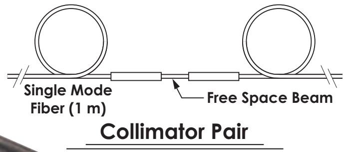
ITEM #	EFL	INPUT MFD[a]	OUTPUT WAIST DIA.	DIVERGENCE[b]	LENS CHARACTERISTICS		ALIGNMENT	CONNECTOR
					CA[c]	NA		
CFS2-1310-APC	2.03 mm	9.2 µm	0.54 mm	3.10 mrad	2.0 mm	0.49	1310 nm	FC/APC
CFS2-1550-APC	2.03 mm	10.4 µm	0.38 mm	5.20 mrad	2.0 mm	0.49	1550 nm	FC/APC
CFS5-1310-APC	4.70 mm	9.2 µm	0.83 mm	2.00 mrad	3.6 mm	0.38	1310 nm	FC/APC
CFS5-1550-APC	4.73 mm	10.4 µm	0.87 mm	2.26 mrad	3.6 mm	0.38	1550 nm	FC/APC
CFS11-850-APC	11.10 mm	5.6 µm	2.1 mm	0.50 mrad	5.4 mm	0.24	850 nm	FC/APC
CFS11-1310-APC	11.25 mm	9.2 µm	2.0 mm	0.84 mrad	5.4 mm	0.24	1310 nm	FC/APC
CFS11-1550-APC	11.31 mm	10.4 µm	2.1 mm	0.95 mrad	5.4 mm	0.24	1550 nm	FC/APC
CFS18-850-APC	18.45 mm	5.6 µm	4.0 mm	0.28 mrad	5.5 mm	0.15	850 nm	FC/APC
CFS18-1310-APC	18.67 mm	9.2 µm	3.3 mm	0.50 mrad	5.5 mm	0.15	1310 nm	FC/APC
CFS18-1550-APC	18.75 mm	10.4 µm	3.5 mm	0.57 mrad	5.5 mm	0.15	1550 nm	FC/APC

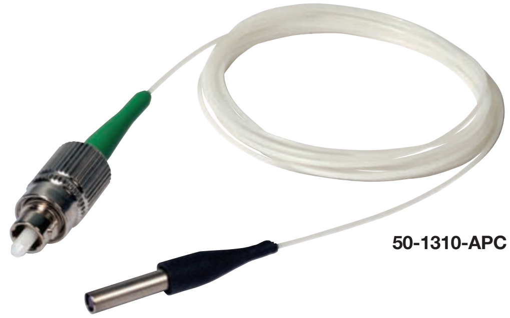
[a] Mode Field Diameter [b] Full Angle in the Near-Field [c] Clear Aperture

ITEM #	$	£	€	RMB
CFS2-532-FC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
CFS2-1030-FC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
CFS2-1064-FC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
CFS5-1030-FC	$ 210.00	£ 151.20	€ 182,70	¥ 1,673.70
CFS5-1064-FC	$ 210.00	£ 151.20	€ 182,70	¥ 1,673.70
CFS11-1030-FC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS11-1064-FC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS18-532-FC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS18-1030-FC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS18-1064-FC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70

ITEM #	$	£	€	RMB
CFS2-1310-APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
CFS2-1550-APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
CFS5-1310-APC	$ 210.00	£ 151.20	€ 182,70	¥ 1,673.70
CFS5-1550-APC	$ 210.00	£ 151.20	€ 182,70	¥ 1,673.70
CFS11-850-APC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS11-1310-APC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS11-1550-APC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS18-850-APC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS18-1310-APC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70
CFS18-1550-APC	$ 310.00	£ 223.20	€ 269,70	¥ 2,470.70

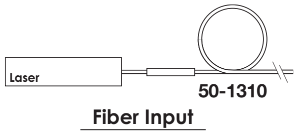
GRIN Fiber Collimators





50-1310-APC

Collimator Surfaces are AR Coated



Features

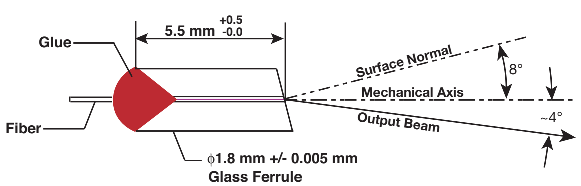
- Maximum Power 300 mW
- Ø1.8 mm Clear Aperture
- AR Coated on all Collimator Surfaces
- Input Coupler
- Output Collimator
- Fiber Length: 1 m

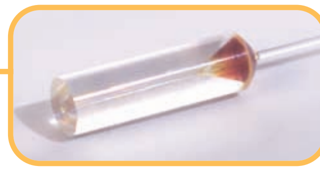
Please refer to our website for complete models and drawings.

ITEM #	$	£	€	RMB	OPERATING WAVELENGTH	FIBER	CONNECTOR
50-1310	$ 83.70	£ 60.26	€ 72,82	¥ 667.09	1280 - 1340 nm	SMF-28e+	None
50-1310-FC	$ 113.70	£ 81.86	€ 98,92	¥ 906.19	1280 - 1340 nm	SMF-28e+	FC/PC
50-1310-APC	$ 133.70	£ 96.26	€ 116,32	¥ 1,065.59	1280 - 1340 nm	SMF-28e+	FC/APC
50-1550	$ 59.20	£ 42.62	€ 51,50	¥ 471.82	1520 - 1580 nm	SMF-28e+	None
50-1550-FC	$ 89.20	£ 64.22	€ 77,60	¥ 710.92	1520 - 1580 nm	SMF-28e+	FC/PC
50-1550-APC	$ 109.20	£ 78.62	€ 95,00	¥ 870.32	1520 - 1580 nm	SMF-28e+	FC/APC

Pigtailed Ferrules, AR Coated

Thorlabs' pigtailed glass ferrules feature 1.5 meters of single mode fiber and a 0° or 8° angled face, which is AR coated to minimize back reflection (return loss), as well as insertion loss. Pigtailed ferrules are ideal for numerous applications, including the manufacture of optical switches, isolators, circulators, and couplers.





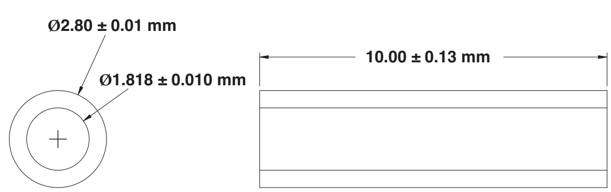
Pigtail Specifications

- **Ferrule Diameter:** 1.800 mm ± 5 µm
- **Ferrule Length:** 5.5 mm +0.5/-0.0 mm
- **Wedge Angles:** 0.0°, 8.0°
- **Wedge Tolerance:** ±0.2°
- **AR Coating:** R<0.25% @ 630, 830, 1060, 1310, or 1550 nm
- **Fiber Length:** 1.5 m

ITEM #	$	£	€	RMB	WEDGE ANGLE	AR COATING	FIBER PIGTAIL
SMPF0206	$ 26.83	£ 19.32	€ 23,34	¥ 213.84	0°	630 nm	SM600
SMPF0208	$ 26.83	£ 19.32	€ 23,34	¥ 213.84	0°	830 nm	SM800-5.6-125
SMPF0210	$ 26.83	£ 19.32	€ 23,34	¥ 213.84	0°	1060 nm	HI1060
SMPF0213	$ 18.00	£ 12.96	€ 15,66	¥ 143.46	0°	1300 nm	SMF-28e+
SMPF0215	$ 18.00	£ 12.96	€ 15,66	¥ 143.46	0°	1560 nm	SMF-28e+
SMPF0106	$ 26.83	£ 19.32	€ 23,34	¥ 213.84	8°	630 nm	SM600
SMPF0108	$ 26.83	£ 19.32	€ 23,34	¥ 213.84	8°	830 nm	SM800-5.6-125
SMPF0110	$ 26.83	£ 19.32	€ 23,34	¥ 213.84	8°	1060 nm	HI1060
SMPF0113	$ 18.00	£ 12.96	€ 15,66	¥ 143.46	8°	1300 nm	SMF-28e+
SMPF0115	$ 18.00	£ 12.96	€ 15,66	¥ 143.46	8°	1560 nm	SMF-28e+

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.



ITEM #	$	£	€	RMB	DESCRIPTION
51-2800-1800	$ 5.90	£ 4.25	€ 5,13	¥ 47.02	Sleeve for GRIN Lens and Ferrules, 1.8 mm I.D., 10 mm Long, Borosilicate Glass

GRIN Lenses, AR Coated

Thorlabs offers a selection of graded-index (GRIN) lenses for applications between 630 nm and 1560 nm. These lenses are particularly suited for such telecom applications due to their low cost, their ease of use with small beams, and their negligible chromatic aberration over telecom wavelengths. 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 and back into another fiber to propagate through the rest of the system. These lenses can also be used for coupling the output of laser diodes into fibers, focusing laser light onto a detector, or collimating laser light.

A GRIN lens' major advantages over an aspheric lens are cost, ease of handling due to our sleeve and ferrule (see previous page), and do not require an air gap to work since the operation of the lens is due to varying indices in the lens itself rather than the difference in indices between the air and the surrounding medium. Additionally, in a GRIN lens, all optical paths (index x distance) are the same length due to the varying index of refraction throughout the lens. This is in contrast with a traditional spherical or aspheric lens.

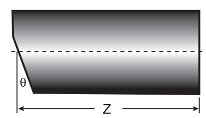
A ray incident on the front surface of a GRIN lens follows a sinusoidal path along the rod. The "pitch" of the lens is the fraction of a full sinusoidal period that the ray undergoes – Thorlabs' GRIN lenses are designed with pitches of 0.23 and 0.29, which are just short of focus, and just past focus, respectively.

To minimize back reflections, Thorlabs' GRIN lenses feature anti-reflection coatings providing an R_{avg} of <0.2%.

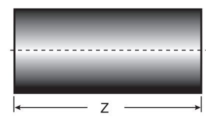
Build Your Own Collimator

Specifications

- **Pitch:** 0.23 or 0.29
- **Lens Diameter:** 1.8 mm
- **On-Axis NA:** 0.46
- **Transmittance:** >89%, 380 - 2000 nm
- **Polarization Preservation:** 99%
- **Material (SELFOC®):** Oxide Glass
- **Operating Temp:** <350 °C



The 0.23 pitch lenses are AR Coated and include an 8° angled facet which minimizes back reflection and compensates 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
GRIN2306A	0.23	0.46	Ø1.8 mm	630 nm	1.6073	4.26 mm	1.85 mm	Oxide Glass
GRIN2308A	0.23	0.46	Ø1.8 mm	830 nm	1.5986	4.35 mm	1.90 mm	Oxide Glass
GRIN2310A	0.23	0.46	Ø1.8 mm	1060 nm	1.594	4.40 mm	1.92 mm	Oxide Glass
GRIN2313A	0.23	0.46	Ø1.8 mm	1300 nm	1.5916	4.42 mm	1.94 mm	Oxide Glass
GRIN2315A	0.23	0.46	Ø1.8 mm	1560 nm	1.5901	4.43 mm	1.94 mm	Oxide Glass
GRIN2906	0.29	0.46	Ø1.8 mm	630 nm	1.6073	5.38 mm	1.90 mm	Oxide Glass
GRIN2908	0.29	0.46	Ø1.8 mm	830 nm	1.5986	5.49 mm	1.95 mm	Oxide Glass
GRIN2910	0.29	0.46	Ø1.8 mm	1060 nm	1.594	5.54 mm	1.97 mm	Oxide Glass
GRIN2913	0.29	0.46	Ø1.8 mm	1300 nm	1.5916	5.57 mm	1.98 mm	Oxide Glass
GRIN2915	0.29	0.46	Ø1.8 mm	1560 nm	1.5906	5.59 mm	1.99 mm	Oxide Glass

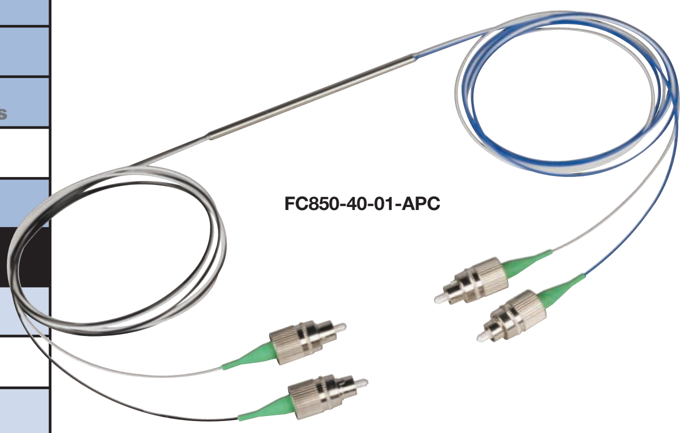
* Length measured at center of GRIN lenses

ITEM #	$	£	€	RMB	DESCRIPTION
GRIN2306A	$ 39.00	£ 28.08	€ 33,93	¥ 310.83	GRIN Lens, Ø1.8 mm, 0.23 Pitch, AR Coated for 630 nm
GRIN2308A	$ 39.00	£ 28.08	€ 33,93	¥ 310.83	GRIN Lens, Ø1.8 mm, 0.23 Pitch, AR Coated for 830 nm
GRIN2310A	$ 39.00	£ 28.08	€ 33,93	¥ 310.83	GRIN Lens, Ø1.8 mm, 0.23 Pitch, AR Coated for 1060 nm
GRIN2313A	$ 34.00	£ 24.48	€ 29,58	¥ 270.98	GRIN Lens, Ø1.8 mm, 0.23 Pitch, AR Coated for 1300 nm
GRIN2315A	$ 34.00	£ 24.48	€ 29,58	¥ 270.98	GRIN Lens, Ø1.8 mm, 0.23 Pitch, AR Coated for 1560 nm
GRIN2906	$ 35.00	£ 25.20	€ 30,45	¥ 278.95	GRIN Lens, Ø1.8 mm, 0.29 Pitch, AR Coated for 630 nm
GRIN2908	$ 35.00	£ 25.20	€ 30,45	¥ 278.95	GRIN Lens, Ø1.8 mm, 0.29 Pitch, AR Coated for 830 nm
GRIN2910	$ 35.00	£ 25.20	€ 30,45	¥ 278.95	GRIN Lens, Ø1.8 mm, 0.29 Pitch, AR Coated for 1060 nm
GRIN2913	$ 33.00	£ 23.76	€ 28,71	¥ 263.01	GRIN Lens, Ø1.8 mm, 0.29 Pitch, AR Coated for 1300 nm
GRIN2915	$ 33.00	£ 23.76	€ 28,71	¥ 263.01	GRIN Lens, Ø1.8 mm, 0.29 Pitch, AR Coated for 1560 nm

Fiber Selection Guide

Passive Fiber Components Selection Guide

2 x 2 OCT-Proven Broadband Fiber-Optic Couplers (Page 1 of 2)



Features

- Operating Wavelengths: 1310 ± 70 nm, 850 ± 40 nm
- Flat Spectral Response
- Low Insertion Loss
- Available Coupling Ratios: 1:99, 10:90, and 50:50
- 2.0 mm Narrow Key FC/APC Connectors
- Customized Fiber Lengths and Connectors Available

Note: Thorlabs uses both narrow (2.0 mm) and wide (2.14 mm) key FC connectors in its product line. Narrow key connectors are used on connectorized fiber, while wide key connectors are used on fiber bulkheads (with few exceptions). This ensures that our connectorized fibers are compatible with all of our mating components.

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 integration into many OCT systems.

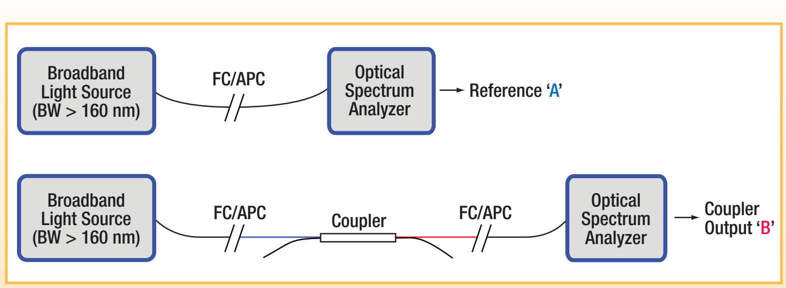
The FC850-40 and FC1310-70 series of OCT-proven broadband couplers are polarization-independent, passive, 2 x 2 single mode fiber optic components designed for use over larger bandwidths. An important consideration in the design of an OCT system is the flat spectral response of the components in the system. Shown on the next page are the spectral response curves for these couplers.

Specifications						
	FC850-40-XX-APC Series			FC1310-70-XX-APC Series		
Wavelength Range	850 ± 40 nm			1310 ± 70 nm		
Fiber Type	SM800-5.6-125 Ø900 µm Hytrel Tubing			Corning SMF-28e+, Ø900 µm Hytrel Tubing		
Coupling Ratio (%)	1/99	10/90	50/50	1/99	10/90	50/50
Insertion Loss	0.5/22 dB	0.9/13 dB	4.2/4.2 dB	0.4/21.6 dB	0.8/12.7 dB	3.8/3.8 dB
Polarization-Dependent Loss (PDL)	≤0.2 dB			≤0.15 dB		
Excess Loss	≤1.0 dB			≤0.5 dB		
Directivity	≥55 dB			≥60 dB		
Port Configuration	2 x 2					
Operating Temperature Range	-40 to +85 °C					
Storage Temperature Range	-40 to +85 °C					
Lead Length and Tolerance	100 ± 10 cm					
Connectors	FC/APC					

Experimental Test Procedure

A broadband light source is spectrally analyzed, and the trace is saved as Reference 'A'. Next, this reference light is sent to the coupler; the output of coupler is analyzed and saved as trace 'B' (Fig. 1). These two traces are normalized to 0 dB so that they share a common reference intensity (Fig. 2). The difference between these normalized curves is calculated and plotted (Difference = A – B) in Fig. 3. The result is the spectral uniformity curve for the fiber coupler, showing the variation in dB across the wavelength band of interest.

1300 nm Test Setup



2 x 2 OCT-Proven Broadband Fiber-Optic Couplers (Page 2 of 2)

Figure 1 - Raw Spectra

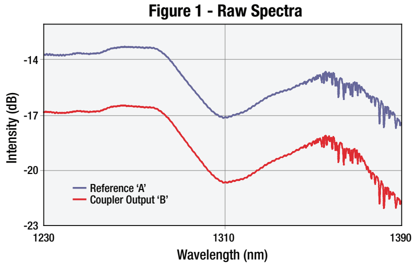


Figure 2 - Normalized Spectra

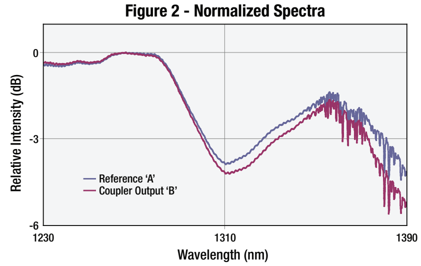
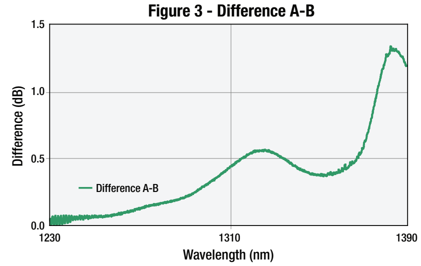
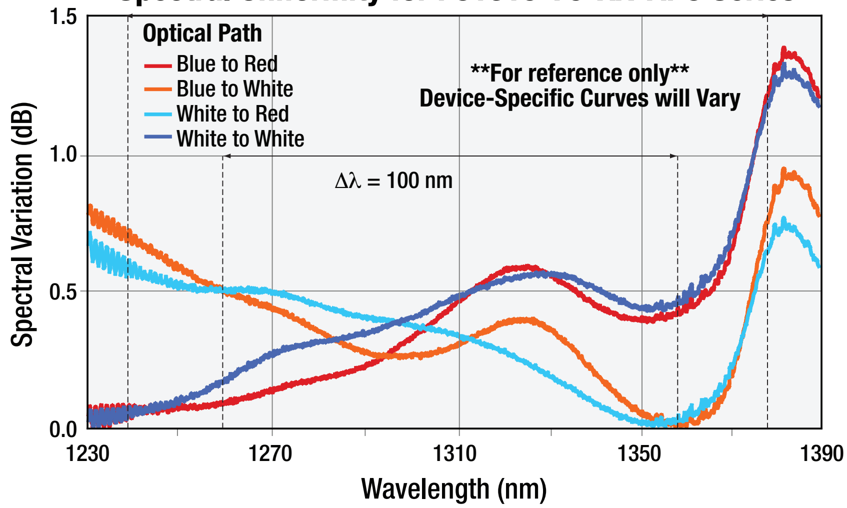


Figure 3 - Difference A-B



Each optical path is analyzed, yielding four traces for each coupler. For an operating bandwidth of 140 nm, the maximum variation of any optical path will not surpass 1.5 dB (2.0 dB @ 850 nm), and for an operating bandwidth of 100 nm, the maximum variation will not surpass 1.0 dB. This guarantees a flat response across a wide wavelength range, making these couplers perfect for broadband experiments and OCT imaging.

Spectral Uniformity for FC1310-70-XX-APC Series

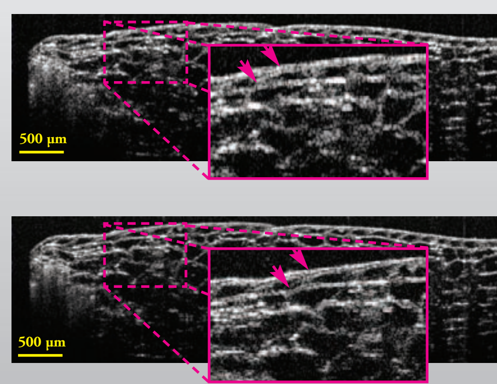


ITEM #	$	£	€	RMB	DESCRIPTION
FC850-40-01-APC	$ 255.00	£ 183.60	€ 221,85	¥ 2,032.35	Broadband Fiber Optic Coupler, 850 nm ± 40 nm, 1:99, FC/APC
FC850-40-10-APC	$ 255.00	£ 183.60	€ 221,85	¥ 2,032.35	Broadband Fiber Optic Coupler, 850 nm ± 40 nm, 10:90, FC/APC
FC850-40-50-APC	$ 255.00	£ 183.60	€ 221,85	¥ 2,032.35	Broadband Fiber Optic Coupler, 850 nm ± 40 nm, 50:50, FC/APC
FC1310-70-01-APC	$ 255.00	£ 183.60	€ 221,85	¥ 2,032.35	Broadband Fiber Optic Coupler, 1310 nm ± 70 nm, 1:99, FC/APC
FC1310-70-10-APC	$ 255.00	£ 183.60	€ 221,85	¥ 2,032.35	Broadband Fiber Optic Coupler, 1310 nm ± 70 nm, 10:90, FC/APC
FC1310-70-50-APC	$ 255.00	£ 183.60	€ 221,85	¥ 2,032.35	Broadband Fiber Optic Coupler, 1310 nm ± 70 nm, 50:50, FC/APC

Have you seen our...

Extended Broadband SLD Light Source

LS2000B

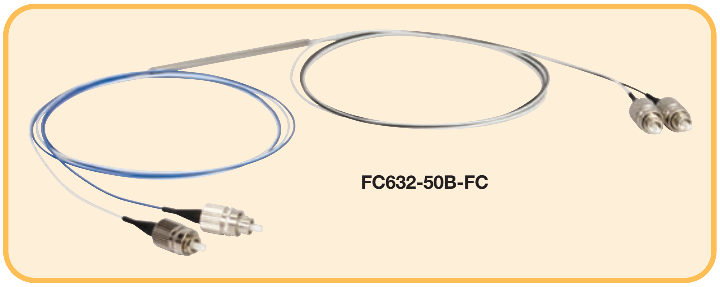


OCT Imaging with a 90 nm bandwidth (FWHM) source provides ~9 µm of axial resolution, as demonstrated in the top image of an onion skin. Incorporating an Extended Broadband SLD, based on matched-pair SLD light sources that together provide a bandwidth of >170 nm (FWHM), enables imaging at axial resolutions less than 4 µm, as demonstrated to the left. The higher resolution provided by the Extended Broadband SLD enables visualization of distinct layers in the onion skin (pink arrows).

For more details, see page 1765

2 x 2 Single Mode Fiber Couplers and Taps (Page 1 of 2)

NEW versions



Thorlabs offers single mode 2 x 2 fiber couplers with center wavelengths from 488 nm to 1550 nm. Split ratios of 50:50, 90:10, and 99:1 are available, with the 99:1 versions typically referred to as fiber optic taps. All fiber leads are 0.8 m long (1 m for 10202A) and have a Ø900 µm Hytrel jacket. All specifications below are valid for couplers without connectors.

Feature

- Three Split Ratios Offered
  - 50:50
  - 90:10
  - 99:1
- Center Wavelengths from 488 to 1550 nm
- Termination Options: FC/PC, FC/APC, or Unconnectorized
- FC Connectors Feature 2.0 mm Narrow Keys
- Polarization Insensitive
- High Directivity
- Bidirectional
- 0.8 m Fiber Leads (1 m for 10202A)
- Dual-Wavelength Model for 1310 & 1550 nm
- Custom Connectors Available

Specifications Provided for Unconnectorized Couplers

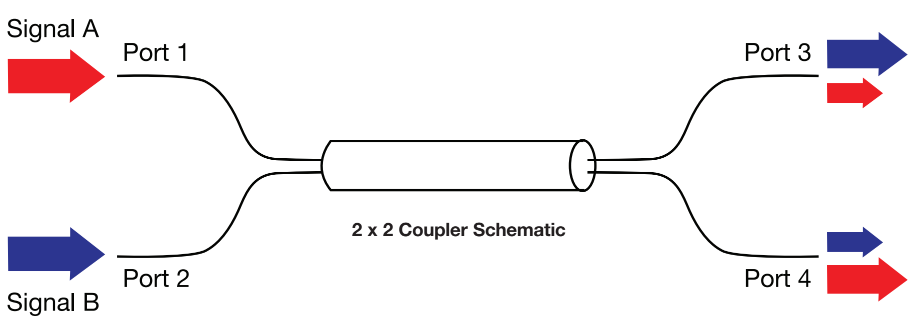
SERIES	FC488	FC532	FC632	FC780
Center Wavelength	488 nm	532 nm	632 nm	780 nm
Bandwidth	±15 nm	±15 nm	±15 nm	±15 nm
Coupling Ratio	50:50 90:10 99:1	50:50 90:10 99:1	50:50 90:10 99:1	50:50 90:10 99:1
Insertion Loss (Coupling Ratio + Excess Loss)	4.0/4.0 dB (50:50) 1.2/11 dB (90:10) 21/0.7 dB (99:1)	4.0/4.0 dB (50:50) 1.2/11 dB (90:10) 21/0.7 dB (99:1)	3.7/3.7 dB (50:50) 11/1.0 dB (90:10) 21/0.6 dB (99:1)	3.6/3.6 dB (50:50) 11/0.8 dB (90:10) 21/0.4 dB (99:1)
Excess Loss (Typical)	1.0 dB	1.0 dB	≤0.3 dB	0.3 dB
PDL	0.2/0.2 dB (50:50) 0.1/0.2 dB (90:10) 0.05/0.22 dB (99:1)	0.2/0.2 dB (50:50) 0.1/0.2 dB (90:10) 0.05/0.22 dB (99:1)	0.2/0.2 dB (50:50) 0.1/0.2 dB (90:10) 0.05/0.22 dB (99:1)	0.2/0.2 dB (50:50) 0.1/0.2 dB (90:10) 0.05/0.22 dB (99:1)
Directivity	≥50 dB	≥50 dB	>55 dB	≥50 dB
Operating Temperature	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C
Fiber Type*	460-HP or Equivalent	460-HP or Equivalent	SM600	HI780C

* Equivalent fiber types may be substituted.

SERIES	FC830	FC980	FC1064	10202A
Center Wavelength	830 nm	980 nm	1064 nm	1310 and 1550 nm
Bandwidth	±15 nm	±15 nm	±15 nm	±40 nm
Coupling Ratio	50:50 90:10 99:1	50:50 90:10 99:1	50:50 90:10 99:1	50:50 90:10 99:1
Insertion Loss (Coupling Ratio + Excess Loss)	3.1 - 3.5/3.1 - 3.5 dB (50:50) 9.5 - 10.5/0.4 - 0.7 dB (90:10) 20 - 22/0.15-0.35 dB (99:1)	3.1 - 3.5/3.1 - 3.5 dB (50:50) 9.5 - 10.5/0.4 - 0.7 dB (90:10) 20 - 22/0.15-0.35 dB (99:1)	3.1 - 3.5/3.1 - 3.5 dB (50:50) 9.5 - 10.5/0.4 - 0.7 dB (90:10) 20 - 22/0.15-0.35 dB (99:1)	3.8/3.8 dB (50:50) 12.7/0.8 dB (90:10) 21.6/0.4 dB (99:1)
Excess Loss (Typical)	0.15 dB	0.12 dB	0.12 dB	0.2 dB
PDL	<0.2 dB	<0.15 dB	<0.2 dB	<0.15 dB
Directivity	>55 dB	>55 dB	>55 dB	>60 dB
Operating Temperature	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C
Fiber Type*	SM800	HI1060FLEX	HI1060FLEX	SMF-28e+

* Equivalent fiber types may be substituted.

Note: Thorlabs uses both narrow (2.0 mm) and wide (2.14 mm) key FC connectors in its product line. Narrow key connectors are used on connectorized fiber, while wide key connectors are used on fiber bulkheads (with few exceptions). This ensures that our connectorized fibers are compatible with all of our mating components.



2 x 2 Coupler Schematic

2 x 2 Single Mode Fiber Couplers and Taps (Page 2 of 2)

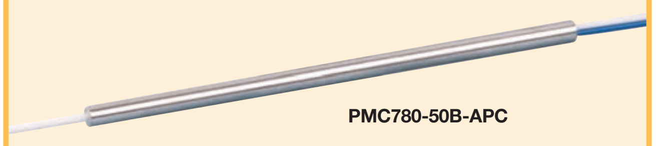
NEW versions

ITEM #	CENTER WAVELENGTH	COUPLING RATIO	CONNECTORS	$	£	€	RMB
FC488-50B-FC	488 nm	50:50	FC/PC	$ 360.00	£ 259.20	€ 313,20	¥ 2,869.20
FC488-50B-APC	488 nm	50:50	FC/APC	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00
FC488-90B-FC	488 nm	90:10	FC/PC	$ 360.00	£ 259.20	€ 313,20	¥ 2,869.20
FC488-90B-APC	488 nm	90:10	FC/APC	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00
FC488-99B-FC	488 nm	99:1	FC/PC	$ 360.00	£ 259.20	€ 313,20	¥ 2,869.20
FC488-99B-APC	488 nm	99:1	FC/APC	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00
FC532-50B-FC	532 nm	50:50	FC/PC	$ 330.00	£ 237.60	€ 287,10	¥ 2,630.10
FC532-50B-APC	532 nm	50:50	FC/APC	$ 370.00	£ 266.40	€ 321,90	¥ 2,948.90
FC532-90B-FC	532 nm	90:10	FC/PC	$ 330.00	£ 237.60	€ 287,10	¥ 2,630.10
FC532-90B-APC	532 nm	90:10	FC/APC	$ 370.00	£ 266.40	€ 321,90	¥ 2,948.90
FC532-99B-FC	532 nm	99:1	FC/PC	$ 330.00	£ 237.60	€ 287,10	¥ 2,630.10
FC532-99B-APC	532 nm	99:1	FC/APC	$ 370.00	£ 266.40	€ 321,90	¥ 2,948.90
FC632-50B	632 nm	50:50	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC632-50B-FC	632 nm	50:50	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC632-50B-APC	632 nm	50:50	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC632-90B	632 nm	90:10	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC632-90B-FC	632 nm	90:10	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC632-90B-APC	632 nm	90:10	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC632-99B	632 nm	99:1	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC632-99B-FC	632 nm	99:1	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC632-99B-APC	632 nm	99:1	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC780-50B-FC	780 nm	50:50	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC780-50B-APC	780 nm	50:50	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC780-90B-FC	780 nm	90:10	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC780-90B-APC	780 nm	90:10	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC780-99B-FC	780 nm	99:1	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC780-99B-APC	780 nm	99:1	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC830-50B	830 nm	50:50	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC830-50B-FC	830 nm	50:50	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC830-50B-APC	830 nm	50:50	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC830-90B	830 nm	90:10	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC830-90B-FC	830 nm	90:10	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC830-90B-APC	830 nm	90:10	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC830-99B	830 nm	99:1	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC830-99B-FC	830 nm	99:1	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC830-99B-APC	830 nm	99:1	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC980-50B	980 nm	50:50	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC980-50B-FC	980 nm	50:50	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC980-50B-APC	980 nm	50:50	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC980-90B	980 nm	90:10	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC980-90B-FC	980 nm	90:10	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC980-90B-APC	980 nm	90:10	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC980-99B	980 nm	99:1	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC980-99B-FC	980 nm	99:1	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC980-99B-APC	980 nm	99:1	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC1064-50B	1064 nm	50:50	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC1064-50B-FC	1064 nm	50:50	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC1064-50B-APC	1064 nm	50:50	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC1064-90B	1064 nm	90:10	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC1064-90B-FC	1064 nm	90:10	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC1064-90B-APC	1064 nm	90:10	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
FC1064-99B	1064 nm	99:1	None	$ 150.00	£ 108.00	€ 130,50	¥ 1,195.50
FC1064-99B-FC	1064 nm	99:1	FC/PC	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30
FC1064-99B-APC	1064 nm	99:1	FC/APC	$ 230.00	£ 165.60	€ 200,10	¥ 1,833.10
10202A-50	1310 nm & 1550 nm	50:50	None	$ 96.80	£ 69.70	€ 84,22	¥ 771.50
10202A-50-FC	1310 nm & 1550 nm	50:50	FC/PC	$ 136.80	£ 98.50	€ 119,02	¥ 1,090.30
10202A-50-APC	1310 nm & 1550 nm	50:50	FC/APC	$ 176.80	£ 127.30	€ 153,82	¥ 1,409.10
10202A-90	1310 nm & 1550 nm	90:10	None	$ 80.50	£ 57.96	€ 70,04	¥ 641.59
10202A-90-FC	1310 nm & 1550 nm	90:10	FC/PC	$ 120.50	£ 86.76	€ 104,84	¥ 960.39
10202A-90-APC	1310 nm & 1550 nm	90:10	FC/APC	$ 160.50	£ 115.56	€ 139,64	¥ 1,279.19
10202A-99	1310 nm & 1550 nm	99:1	None	$ 100.90	£ 72.65	€ 87,78	¥ 804.17
10202A-99-FC	1310 nm & 1550 nm	99:1	FC/PC	$ 140.90	£ 101.45	€ 122,58	¥ 1,122.97
10202A-99-APC	1310 nm & 1550 nm	99:1	FC/APC	$ 180.90	£ 130.25	€ 157,38	¥ 1,441.77

Have you seen our...
Broadband 2 x 2 Couplers
850 ± 40 nm
1310 ± 70 nm
See page 1110

1 x 2 Polarization-Maintaining Fiber Couplers

Thorlabs offers 1 x 2 high-performance polarization-maintaining fused fiber couplers. Thorlabs offers both 50:50 and 90:10 coupling ratios with either FC/PC or FC/APC connectors. Notable features include low excess loss, small package size, and high polarization extinction ratio. The PMC Series couplers are commonly used for optical sensors, optical amplifiers, and fiber gyroscopes.



PMC780-50B-APC

Features
- Low Loss
- High Polarization Extinction Ratio
- 50:50 or 90:10 Coupling Ratio
- FC/PC or FC/APC Connectors on Both Ends
- 2.0 mm Narrow Key Connectors
- Key Aligned to Slow Axis

Applications
- Optical Sensor
- Polarization-Maintaining Fiber Laser
- Power Monitoring
- Fiber Gyroscopes

Performance Specifications

SERIES	PMC780	PMC1060	PMC1310	PMC1550
Center Wavelength	780 nm	1060 nm	1310 nm	1550 nm
Bandwidth	±15 nm	±15 nm	±15 nm	±15 nm
Extinction Ratio	≥16.0 dB	≥18.0 dB	≥18.0 dB	≥18.0 dB
Coupling Ratio	50:50 90:10	50:50 90:10	50:50 90:10	50:50 90:10
Insertion Loss	≤4.1/4.1 dB (50:50) ≤1.6/12.0 dB (90:10)	≤3.7/3.7 dB (50:50) ≤1.2/11.6 dB (90:10)	≤3.6/3.6 dB (50:50) ≤0.95/11.3 dB (90:10)	≤3.6/3.6 dB (50:50) ≤0.95/11.3 dB (90:10)
Excess Loss (Typical)	≤0.6 dB	≤0.4 dB	≤0.3 dB	≤0.3 dB
Directivity	≥55 dB	≥55 dB	≥55 dB	≥55 dB
Operating Temperature	-20 to 70 °C	-20 to 70 °C	-20 to 70 °C	-20 to 70 °C
Fiber Length	0.8 m each leg	0.8 m each leg	0.8 m each leg	0.8 m each leg
Fiber Jacket	900 µm loose tubing	900 µm loose tubing	900 µm loose tubing	900 µm loose tubing
Dimension	Ø3 mm x 70 mm	Ø3 mm x 70 mm	Ø3 mm x 70 mm	Ø3 mm x 70 mm

Note: Thorlabs uses both narrow (2.0 mm) and wide (2.14 mm) key FC connectors in its product line. Narrow key connectors are used on connectorized fiber, while wide key connectors are used on fiber bulkheads (with few exceptions). This ensures that our connectorized fibers are compatible with all of our mating components.

NEW versions

FC/PC Polarization-Maintaining 1 x 2 Couplers

ITEM #	DESCRIPTION	$	£	€	RMB
PMC780-50B-FC	1 x 2 PM Coupler, 780 nm, 50:50, FC/PC, Aligned to Slow Axis	$ 1,287.10	£ 926.71	€ 1.119,78	¥ 10,258.19
PMC780-90B-FC	1 x 2 PM Coupler, 780 nm, 90:10, FC/PC, Aligned to Slow Axis	$ 1,287.10	£ 926.71	€ 1.119,78	¥ 10,258.19
PMC1060-50B-FC	1 x 2 PM Coupler, 1060 nm, 50:50, FC/PC, Aligned to Slow Axis	$ 1,121.40	£ 807.41	€ 975,62	¥ 8,937.56
PMC1060-90B-FC	1 x 2 PM Coupler, 1060 nm, 90:10, FC/PC, Aligned to Slow Axis	$ 1,121.40	£ 807.41	€ 975,62	¥ 8,937.56
PMC1310-50B-FC	1 x 2 PM Coupler, 1310 nm, 50:50, FC/PC, Aligned to Slow Axis	$ 855.70	£ 616.10	€ 744,46	¥ 6,819.93
PMC1310-90B-FC	1 x 2 PM Coupler, 1310 nm, 90:10, FC/PC, Aligned to Slow Axis	$ 855.70	£ 616.10	€ 744,46	¥ 6,819.93
PMC1550-50B-FC	1 x 2 PM Coupler, 1550 nm, 50:50, FC/PC, Aligned to Slow Axis	$ 855.70	£ 616.10	€ 744,46	¥ 6,819.93
PMC1550-90B-FC	1 x 2 PM Coupler, 1550 nm, 90:10, FC/PC, Aligned to Slow Axis	$ 855.70	£ 616.10	€ 744,46	¥ 6,819.93

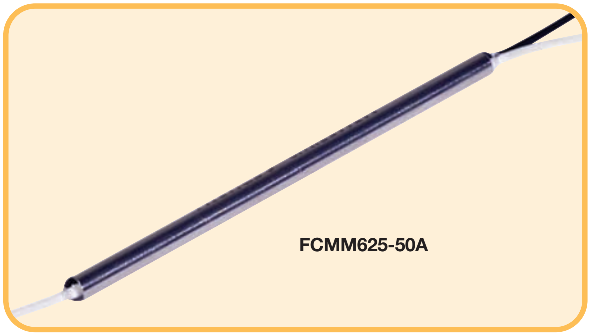
FC/APC Polarization-Maintaining 1 x 2 Couplers

ITEM #	DESCRIPTION	$	£	€	RMB
PMC780-50B-APC	1 x 2 PM Coupler, 780 nm, 50:50, FC/APC, Aligned to Slow Axis	$ 1,317.10	£ 948.31	€ 1.145,88	¥ 10,497.29
PMC780-90B-APC	1 x 2 PM Coupler, 780 nm, 90:10, FC/APC, Aligned to Slow Axis	$ 1,317.10	£ 948.31	€ 1.145,88	¥ 10,497.29
PMC1060-50B-APC	1 x 2 PM Coupler, 1060 nm, 50:50, FC/APC, Aligned to Slow Axis	$ 1,151.40	£ 829.01	€ 1.001,72	¥ 9,176.66
PMC1060-90B-APC	1 x 2 PM Coupler, 1060 nm, 90:10, FC/APC, Aligned to Slow Axis	$ 1,151.40	£ 829.01	€ 1.001,72	¥ 9,176.66
PMC1310-50B-APC	1 x 2 PM Coupler, 1310 nm, 50:50, FC/APC, Aligned to Slow Axis	$ 885.70	£ 637.70	€ 770,56	¥ 7,059.03
PMC1310-90B-APC	1 x 2 PM Coupler, 1310 nm, 90:10, FC/APC, Aligned to Slow Axis	$ 885.70	£ 637.70	€ 770,56	¥ 7,059.03
PMC1550-50B-APC	1 x 2 PM Coupler, 1550 nm, 50:50, FC/APC, Aligned to Slow Axis	$ 885.70	£ 637.70	€ 770,56	¥ 7,059.03
PMC1550-90B-APC	1 x 2 PM Coupler, 1550 nm, 90:10, FC/APC, Aligned to Slow Axis	$ 885.70	£ 637.70	€ 770,56	¥ 7,059.03

1 x 2 Multimode Couplers

Thorlabs offers a selection of 1 x 2 multimode (MM) fiber couplers, manufactured using industry standard 50/125 µm graded-index and 62.5/125 µm graded-index fibers. These couplers offer low insertion loss and excellent environmental and mechanical stability. They are stocked with and without 2.0 mm narrow key FC/PC connectors. Other connector styles are available as a custom request; please contact tech support for a quote. Each coupler is bidirectional.

PARAMETER	FCMM50	FCMM625
Fiber	50/125 µm Graded Index	62.5/125 µm Graded Index
Center Wavelength	850 ± 40 nm	
Coupling Ratio	50:50 90:10 99:1	
Insertion Loss	4.0/4.0 dB (50:50) 12.0/1.5 dB (90:10) 22.8/0.8 dB (99:1)	
Directivity	>35 dB	
Ports	1 x 2	
Operating Temperature	-40 to 85 °C 20 to 70 °C (with connectors)	


FCMM625-50A

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
FCMM50-50A	$ 82.00	£ 59.04	€ 71,34	¥ 653.54	None	1 x 2, 50/125 µm MM Fiber Coupler, 50:50
FCMM50-50A-FC	$ 122.00	£ 87.84	€ 106,14	¥ 972.34	FC/PC	1 x 2, 50/125 µm MM Fiber Coupler, 50:50, FC/PC
FCMM50-90A	$ 82.00	£ 59.04	€ 71,34	¥ 653.54	None	1 x 2, 50/125 µm MM Fiber Coupler, 90:10
FCMM50-90A-FC	$ 122.00	£ 87.84	€ 106,14	¥ 972.34	FC/PC	1 x 2, 50/125 µm MM Fiber Coupler, 90:10, FC/PC
FCMM50-99A	$ 82.00	£ 59.04	€ 71,34	¥ 653.54	None	1 x 2, 50/125 µm MM Fiber Coupler, 99:1
FCMM50-99A-FC	$ 122.00	£ 87.84	€ 106,14	¥ 972.34	FC/PC	1 x 2, 50/125 µm MM Fiber Coupler, 99:1, FC/PC
FCMM625-50A	$ 82.00	£ 59.04	€ 71,34	¥ 653.54	None	1 x 2, 62.5/125 µm MM Fiber Coupler, 50:50
FCMM625-50A-FC	$ 122.00	£ 87.84	€ 106,14	¥ 972.34	FC/PC	1 x 2, 62.5/125 µm MM Fiber Coupler, 50:50, FC/PC
FCMM625-90A	$ 82.00	£ 59.04	€ 71,34	¥ 653.54	None	1 x 2, 62.5/125 µm MM Fiber Coupler, 90:10
FCMM625-90A-FC	$ 122.00	£ 87.84	€ 106,14	¥ 972.34	FC/PC	1 x 2, 62.5/125 µm MM Fiber Coupler, 90:10, FC/PC
FCMM625-99A	$ 82.00	£ 59.04	€ 71,34	¥ 653.54	None	1 x 2, 62.5/125 µm MM Fiber Coupler, 99:1
FCMM625-99A-FC	$ 122.00	£ 87.84	€ 106,14	¥ 972.34	FC/PC	1 x 2, 62.5/125 µm MM Fiber Coupler, 99:1, FC/PC

1 x 4 Single Mode Fiber Couplers

NEW products

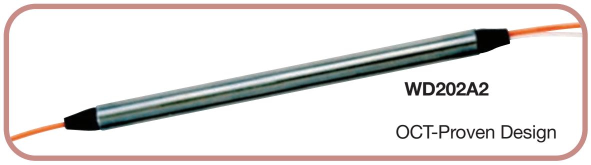
Thorlabs offers single mode 1 x 4 fiber couplers with center wavelengths of 632, 1064, and 1310/1550 nm. These couplers evenly split the input light, resulting in a 25:25:25:25 split ratio with a ±1.5% tolerance on each leg. Our advanced design allows the couplers to have low excess loss. Each coupler features 2.0 mm narrow key FC/PC or FC/APC connectors.

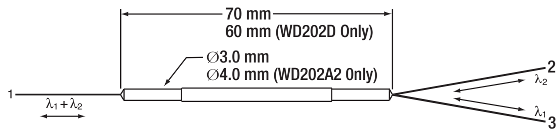
PARAMETER	FCQ632	FCQ1064	FCQ1315
Center Wavelength	632 nm	1064 nm	1310/1550 nm
Bandwidth	±15 nm	±15 nm	±40 nm
Coupling Ratio	25:25:25:25	25:25:25:25	25:25:25:25
Insertion Loss	8.5 dB	7.2 dB	6.2 dB
Excess Loss (Typical)	1.2 dB	0.35 dB	0.15 dB
PDL	<0.3 dB	<0.3 dB	<0.3 dB
Operating Temp.	-40 to 85 °C	-40 to 85 °C	-40 to 85 °C
Fiber Type	SM600 or Equivalent	HI1060 FLEX	SMF-28e+
Fiber Length	0.8 m		
Connectors	FC/PC or FC/APC		
Package Dimensions	100 mm x 80 mm x 10 mm		
Mounting	4x M2 (2.835" x 2.5")		

FCQ632-FC

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
FCQ632-FC	$ 490.00	£ 352.80	€ 426,30	¥ 3,905.30	FC/PC	1 x 4 Single Mode Fiber Coupler, 632 nm, FC/PC
FCQ632-APC	$ 540.00	£ 388.80	€ 469,80	¥ 4,303.80	FC/APC	1 x 4 Single Mode Fiber Coupler, 632 nm, FC/APC
FCQ1064-FC	$ 410.00	£ 295.20	€ 356,70	¥ 3,267.70	FC/PC	1 x 4 Single Mode Fiber Coupler, 1064 nm, FC/PC
FCQ1064-APC	$ 460.00	£ 331.20	€ 400,20	¥ 3,666.20	FC/APC	1 x 4 Single Mode Fiber Coupler, 1064 nm, FC/APC
FCQ1315-FC	$ 199.00	£ 143.28	€ 173,13	¥ 1,586.03	FC/PC	1 x 4 Single Mode Fiber Coupler, 1310/1550 nm, FC/PC
FCQ1315-APC	$ 249.00	£ 179.28	€ 216,63	¥ 1,984.53	FC/APC	1 x 4 Single Mode Fiber Coupler, 1310/1550 nm, FC/APC

Wavelength Division Multiplexers (WDM)





Please refer to our website for complete models and drawings.

Features

- 300 mW Maximum Power
- Available With or Without 2.0 mm Narrow Key FC/PC Connectors
- Custom Connector Options Available
- Bidirectional

Wavelength Division Multiplexers (WDMs) are used to combine or separate two different single mode signals. Available in versions capable of combining or separating five different wavelength combinations (660/1310 nm, 980/1550 nm, 1310/1550 nm, 1480/1550 nm, and 1600/1960 nm), these multiplexers are an ideal solution for combining pump and signal powers or for combining/separating telecom signals.

Based on the proven Fused Bionic Taper (FBT) technology, these multiplexers provide broad operating wavelengths and low insertion loss.

Performance Specifications

ITEM #	WD202A2	WD202A	WD202B	WD202C	WD202D
Operating Wavelength	660/1310 nm	980/1550 nm	1310/1550 nm	1480/1550 nm	1600/1960 nm
Insertion Loss (Max)*	0.5 dB	0.55 dB	0.5 dB	0.95 dB	0.80 dB
Isolation (Min)	19 dB		16 dB	10 dB	15 dB
Polarization-Dependent Loss	<0.1 dB			<0.3 dB	<0.2 dB
Wavelength Bandwidth	±40.0 nm @ 1310 nm	±10.0 nm	±20.0 nm	±5.0 nm	±20.0 nm
Directivity	36 dB	50 dB			45 dB
CW Power (Max)	300 mW				300 mW**
Operating Temperature	0 to 60 °C	–40 to 85 °C			-40 to 75 °C
Storage Temperature	–50 to 85 °C				-40 to 75 °C
Fiber Type	SMF-28e+	Flexcore 1060	SMF-28e+		SMF-DS
Fiber Lead Length	1 m				
Jacket	Ø900 µm Loose Tubing				None

*Insertion loss will change depending on connector type (specified without connectors) **WD202D can be used with higher powers under certain operating conditions.

WDMs Without Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
WD202A2	$ 272.90	£ 196.49	€ 237,42	¥ 2,175.01	OCT-Proven 660/1310 nm Wavelength Division Multiplexer
WD202A	$ 196.70	£ 141.62	€ 171,13	¥ 1,567.70	980/1550 nm Wavelength Division Multiplexer
WD202B	$ 119.70	£ 86.18	€ 104,14	¥ 954.01	1310/1550 nm Wavelength Division Multiplexer
WD202C	$ 210.20	£ 151.34	€ 182,87	¥ 1,675.29	1480/1550 nm Wavelength Division Multiplexer
WD202D	$ 1,100.00	£ 792.00	€ 957,00	¥ 8,767.00	1600/1960 nm Wavelength Division Multiplexer

WDMs With Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
WD202A2-FC	$ 350.90	£ 252.65	€ 305,28	¥ 2,796.67	OCT-Proven 660/1310 nm Wavelength Division Multiplexer, FC/PC
WD202A-FC	$ 226.70	£ 163.22	€ 197,23	¥ 1,806.80	980/1550 nm Wavelength Division Multiplexer, FC/PC
WD202B-FC	$ 149.70	£ 107.78	€ 130,24	¥ 1,193.11	1310/1550 nm Wavelength Division Multiplexer, FC/PC
WD202C-FC	$ 240.20	£ 172.94	€ 208,97	¥ 1,914.39	1480/1550 nm Wavelength Division Multiplexer, FC/PC
WD202D-FC	$ 1,150.00	£ 828.00	€ 1.000,50	¥ 9,165.50	1600/1960 nm Wavelength Division Multiplexer, FC/PC

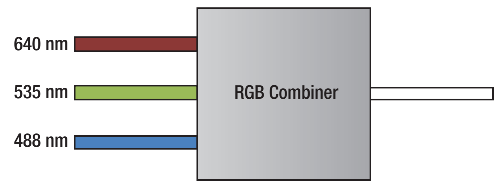
RGB Combiner: 488, 535, and 640 nm

NEW product

Other Wavelength Combinations Available

Features

- Combine 488 nm, 535 nm, and 640 nm Light
- Three FC/PC Input Bulkhead Connectors with 2.2 mm Wide Keys
- 1 m of Single Mode Fiber Output with FC/PC Connector and 2 mm Narrow Key



The RGB1-FC combines three fiber inputs into one output beam. The combiner has FC/PC inputs for red (640 ± 5 nm), green (535 ± 5 nm), and blue (488 ± 5 nm) lasers and couples the combined output into a Ø3 mm jacketed single mode fiber. RGB combiners are used often to illuminate multiple fluorophores in confocal microscopy.

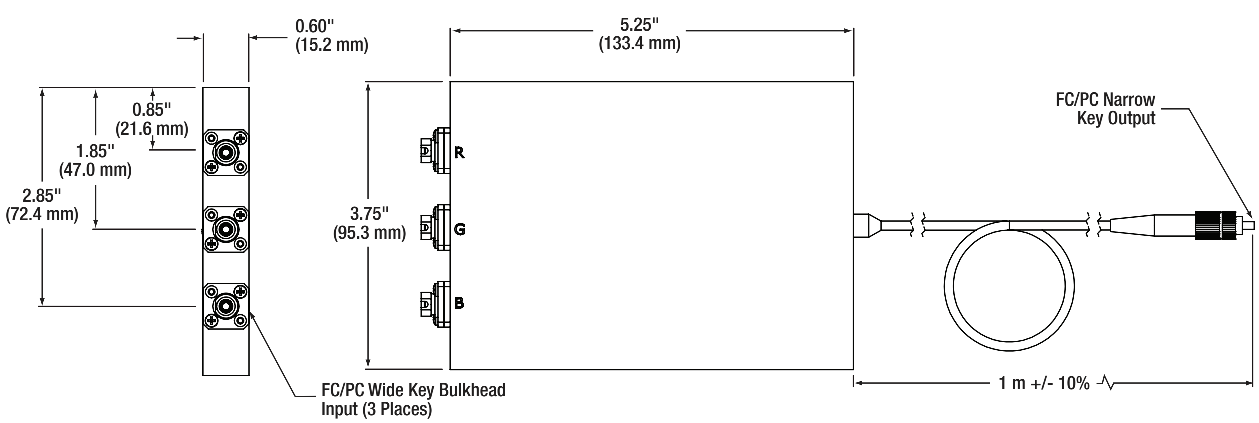
For other connector options, please contact your local Thorlabs Technical Support team. Other wavelength options are available on our website. Search on "Visible WDM."

SPECIFICATIONS	
Input Wavelengths	488 nm, 535 nm, and 640 nm
Bandwidth	±5 nm (at each input wavelength)
Insertion Loss (Max)*	3.6 dB
Max PDL	<0.2 dB
Damage Threshold*	500 mW (CW)
Operating Temperature	0 to 60 °C
Storage Temperature	-40 to 85 °C
Output Fiber Type	460HP
Output Fiber Length	1 m ± 10%
Output Fiber Connector	FC/PC, 2.0 mm Narrow Key
Fiber Inputs	FC/PC, 2.2 mm Wide Key

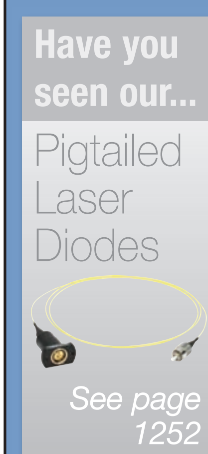
* For each leg.

Fiber Specifications (See Page 1020 for More Information)

FIBER TYPE	MODE FIELD DIAMETER	CLADDING	COATING	CUTOFF WAVELENGTH
460HP	3.5 ± 0.5 µm (@ 515 nm)	Ø125 ± 1.5 µm	Ø245 ± 15 µm	430 ± 20 nm



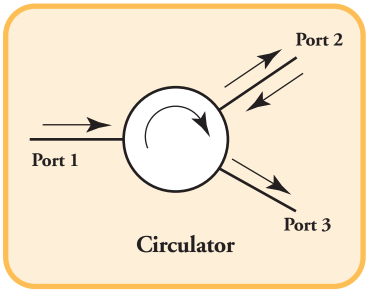
ITEM #	$	£	€	RMB	DESCRIPTION
RGB1-FC	$ 2,500.00	£ 1,800.00	€ 2.175,00	¥ 19,925.00	3-Channel (RGB) Visible Laser Combiner



OCT-Proven Broadband Circulator

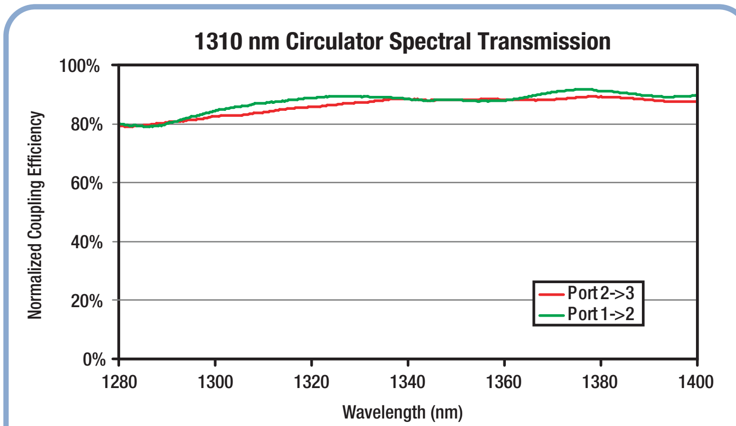
Features

- Polarization Independent
- 1280 - 1400 nm Wavelength Range
- <1.6 dB Insertion Loss
- 1 m Single Mode (SMF-28e) Fiber with FC/APC Connectors
- Ø900 µm Loose Protective Jacket
- Customized Fiber Length and Connectorization Available



Fiber Optic Circulators, such as the CIR-1310-50-APC, behave like isolators. Light from the input fiber (Port 1) is directed to the output fiber (Port 2), and light returning through the output fiber is redirected to a third fiber (Port 3) with virtually no loss.

Each OCT-Proven Broadband Circulator has been tested for optimal application in OCT imaging system designs. An important consideration in the design of an OCT system is the flat spectral response of the components in the system. The CIR-1310-APC was chosen as an OCT-proven broadband circulator because of its flat spectral response over its operating range.



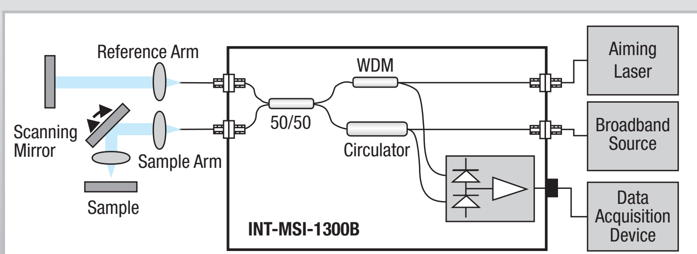
Normalized coupling efficiency versus wavelength for the two beam propagation paths of a typical OCT-proven 1310 nm circulator (CIR-1310-50-APC). Port 1 → 2 shows a mean coupling efficiency of 88%. Port 2 → 3 shows a mean coupling efficiency of 86% and a standard deviation of 12%.

SPECIFICATIONS	
Optical Power	500 mW (Max)
Wavelength Range	1280 - 1400 nm
Isolation	28 dB
Insertion Loss	<1.6 dB
Directivity (Port 1 → 3)	>50 dB
Return Loss	>45 dB
Polarization-Dependent Loss	<0.2 dB
Polarization Mode Dispersion	<0.05 ps
Operating Temperature	0 to 70 °C
Storage Temperature	-40 to 85 °C
Fiber Type	SMF-28e
Pigtail Type and Length	Ø900 µm Loose Tube, 1.0 ± 0.1 m
Connector	FC/APC for Each Port

ITEM #	$	£	€	RMB	DESCRIPTION
CIR-1310-50-APC	$ 700.00	£ 504.00	€ 609,00	¥ 5,579.00	Broadband SM Fiber Circulator, 1280 - 1400 nm with FC/APC Connectors

This Circulator is Integrated into Our...

Integrated Detection Modules

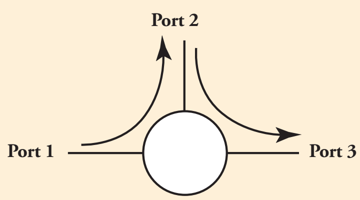


A schematic of a swept source OCT imaging system is shown to the left. A key component in the imaging system is the INT-MSI-1300 Michelson Type Interferometer (see page 1770), which utilizes a CIR-1310-50-APC. In the interferometer, the circulator guides the light emitted by the broadband light source into the sample and reference arms of the OCT system. The light returning from the sample and reference arms is then guided to the detector.

For more details, see page 1770

High-Power PM Circulators


OC-L-1064



These unconnectorized, high-power, PM fiber optic circulators are non-reciprocating devices that transport an optical signal from one port to the next port but only in one direction (i.e., 1 → 2 or 2 → 3). They may be used to separate forward and backward propagating signals, typically providing more than 30 dB of isolation and a directivity (crosstalk) figure of better than 40 dB.

Specifications

PARAMETERS	OC-L-1064	OC-L-1550
Optical Power	3 W (Max)	5 W (Max)
Wavelength Range	1053 - 1075 nm	1530 - 1570 nm
Isolation	30 dB	32 dB
Insertion Loss	1.3 - 1.9 dB	0.9 - 1.3 dB
Directivity (1 → 3)	40 dB	40 dB
Return Loss	50 dB	55 dB

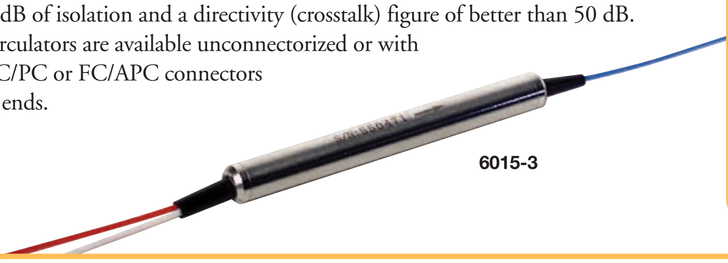
Applications
- High-Power Fiber Lasers
- Fiber Sensors
- Bidirectional Pumping

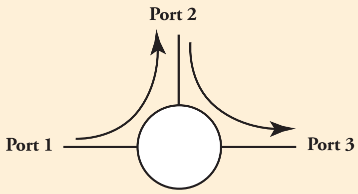
High-Power PM Optical Circulators

ITEM #	$	£	€	RMB	DESCRIPTION
OC-L-1064	$ 4,200.00	£ 3,024.00	€ 3.654,00	¥ 33,474.00	3-Port, High-Power PM Fiber Circulator without Connectors, 1064 nm, 3 W
OC-L-1550	$ 2,600.00	£ 1,872.00	€ 2.262,00	¥ 20,722.00	3-Port, High-Power PM Fiber Circulator without Connectors, 1550 nm, 5 W

Telecom Circulators

This 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 → 2 or 2 → 3). They may be used to separate forward and backward propagating signals, typically with 45 dB of isolation and a directivity (crosstalk) figure of better than 50 dB. These circulators are available unconnectorized or with either FC/PC or FC/APC connectors on both ends.


6015-3



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

Specifications
- Wavelength Range: 1525 - 1610 nm
- Isolation: >40 dB
- Insertion Loss: 0.8/1.0 dB (Typical/Max)
- Directivity: >50 dB
- Return Loss: ≥50 dB
- Polarization-Dependent Loss: ≤0.1 dB
- Polarization-Mode Dispersion: ≤0.05 ps
- Optical Power: 500 mW (Max)
- Operating Temperature: 0 to 70 °C
- Storage Temperature: -40 to 85 °C

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

Telecom Optical Circulators

ITEM #	$	£	€	RMB	DESCRIPTION
6015-3	$ 590.00	£ 424.80	€ 513,30	¥ 4,702.30	3-Port Fiber Circulator, 1550 nm without Connectors
6015-3-FC	$ 620.00	£ 446.40	€ 539,40	¥ 4,941.40	3-Port Fiber Circulator, 1550 nm with FC/PC Connectors
6015-3-APC	$ 650.00	£ 468.00	€ 565,50	¥ 5,180.50	3-Port Fiber Circulator, 1550 nm with FC/APC Connectors

Fiber Optic Isolators Selection Guide

Fiber isolators protect laser sources from back reflections and signals that can cause instabilities and damage. They are designed to block light traveling into the source while allowing light to exit the source with minimal loss. Available in both polarization-independent and polarization-dependent models, we have fiber isolator models designed for use with CW and pulsed lasers. Over thirty standard models are available; together they enable isolation in the 770 to 2010 nm spectral range (see the table below for details). If you do not find the perfect match for your application, please contact us to discuss your custom isolator needs.

When choosing an isolator, operating power and wavelength are the two most important factors. Isolators for use below 3 W and with wavelengths longer than 1250 nm use a Bismuth Iron Garnet (BIG) rotator, which leads to a compact design. For shorter wavelengths and the same power levels, Terbium-Gallium Garnet (TGG) rotators are typically employed. These rotators have a much lower Verdet constant than BIG rotators and require the use of magnets that are orders of magnitude stronger.

High-power isolators use non-absorptive crystal polarizers as well as crystal Faraday rotators. In the reverse direction, the polarizers displace rather than absorb the beam so that it does not couple back into the input fiber. These crystals require larger and more powerful magnets to achieve the desired level of isolation. In addition, a special fiber endface process is used that greatly reduces the risk of damage to the components.

ITEM #	CENTRAL WAVELENGTH	BANDWIDTH	POWER RATING	POLARIZATION DEPENDENCY	CONNECTORS	FIBER	PAGE
IO-F-780	780 nm	±10 nm	2 W CW	Independent	None	780HP	1121
IO-F-780APC	780 nm	±10 nm	2 W CW	Independent	FC/APC	780HP	1121
IO-F-SLD100-840	840 nm	±50 nm	2 W CW	Independent	None	780HP	1121
IO-F-850	850 nm	±10 nm	2 W CW	Independent	None	780HP	1121
IO-F-850APC	850 nm	±10 nm	2 W CW	Independent	FC/APC	780HP	1121
IO-F-SLD150-895	895 nm	±75 nm	2 W CW	Independent	None	780HP	1122
IO-F-980	980 nm	±10 nm	2 W CW	Independent	None	HI1060	1122
IO-F-980APC	980 nm	±10 nm	2 W CW	Independent	FC/APC	HI1060	1122
IO-J-980	980 nm	±10 nm	3 W CW	Dependent	None	PM 980	1122
IO-J-980APC	980 nm	±10 nm	3 W CW	Dependent	FC/APC	PM 980	1122
IO-H-1064	1064 nm	+20/-4 nm	0.25 W CW	Independent	None	HI1060	1123
IO-H-1064APC	1064 nm	+20/-4 nm	0.25 W CW	Independent	FC/APC	HI1060	1123
IO-G-1064	1064 nm	±5 nm	0.3 W CW	Dependent	None	PM980	1123
IO-J-1064	1064 nm	±10 nm	3 W CW	Dependent	None	PM 980/1064	1123
IO-J-1064APC	1064 nm	±10 nm	3 W CW	Dependent	FC/APC	PM 980/1064	1123
IO-F-1064	1064 nm	±10 nm	3 W CW	Independent	None	HI1060	1124
IO-F-1064APC	1064 nm	±10 nm	3 W CW	Independent	FC/APC	HI1060	1124
IO-K-1064	1064 nm	+11/-14 nm	10 W CW	Independent	None	HI1060	1124
IO-K-1064-ELY*	1064 nm	+16/-14 nm	30 W CW	Independent	None	HI1060	1124
IO-K-1064-LMA25-CRED*	1064 nm	±10 nm	50 W (10 kW Peak)	Independent	None	LMA25	1125
IO-H-1310	1310 nm	±20 nm	0.3 W CW	Independent	None	SMF-28e+	1125
IO-H-1310APC	1310 nm	±20 nm	0.3 W CW	Independent	FC/APC	SMF-28e+	1125
IO-H-1310FC	1310 nm	±20 nm	0.3 W CW	Independent	FC/PC	SMF-28e+	1125
IO-G-1310	1310 nm	±20 nm	0.3 W CW	Dependent	None	PM, Panda	1125
IO-H-1550	1550 nm	±20 nm	0.3 W CW	Independent	None	SMF-28e+	1126
IO-H-1550APC	1550 nm	±20 nm	0.3 W CW	Independent	FC/APC	SMF-28e+	1126
IO-H-1550FC	1550 nm	±20 nm	0.3 W CW	Independent	FC/PC	SMF-28e+	1126
IO-G-1550	1550 nm	±20 nm	0.3 W CW	Dependent	None	PM, Panda	1126
IO-J-1550	1550 nm	±10 nm	5 W CW	Dependent	None	PM1500	1126
IO-J-1550APC	1550 nm	±10 nm	5 W CW	Dependent	FC/APC	PM1500	1126
IO-F-1550	1550 nm	±20 nm	5 W CW	Independent	None	SMF-28e+	1127
IO-F-1550APC	1550 nm	±20 nm	5 W CW	Independent	FC/APC	SMF-28e+	1127
IO-K-1550	1550 nm	±20 nm	10 W CW	Independent	None	SMF-28e+	1127
IO-J-2000	2000 nm	±10 nm	3 W CW	Dependent	None	PM15-U40A	1128
IO-F-2000	2000 nm	±10 nm	3 W CW	Independent	None	SM2000	1128
IO-L-2000	2000 nm	±10 nm	10 W CW (<2 kW Peak)	Dependent	None	PM15-U40A	1128
IO-K-2000	2000 nm	±10 nm	10 W CW (<2 kW Peak)	Independent	None	SM2000	1129

*Fiber to Free-Space Isolator

780 nm, 2 W Polarization-Independent Fiber Isolators

Specifications

- **Wavelength:** 780 ± 10 nm
- **Power:*** 2 W CW (Max)
- **Isolation:**** 30 – 38 dB
- **Insertion Loss:** 1.0 – 1.6 dB
- **PDL:** ≤0.25 dB
- **Return Loss:** >50 dB
- **Fiber:** 780HP

*Specified power rating is for the isolator. Proper laser termination is critical.
**Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

The IO-F-780 and IO-F-780APC are CW polarization-independent fiber isolators. These isolators, which are designed for use in the 770 to 790 nm range, can be used with optical powers up to 2 W. Light returning is displaced from the optical axis, resulting in 30 to 38 dB of isolation. Due to the polarization-independent nature of these isolators, the insertion loss and the isolation value will not change with respect to the input or returning light's state of polarization.

Polarization Independent

IO-F-780

Mechanical Drawings Available on the WEB

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-F-780	$ 1,600.00	£ 1,152.00	€ 1.392,00	¥ 12,752.00	None	Low-Power, SM, Fiber Isolator, 780 nm
IO-F-780APC	$ 1,640.00	£ 1,180.80	€ 1.426,80	¥ 13,070.80	FC/APC	Low-Power, SM, Fiber Isolator, 780 nm

840 nm, 2 W Polarization-Independent Broadband Fiber Isolator

Polarization Independent

IO-F-SLD100-840

The IO-F-SLD100-840 polarization-independent broadband fiber isolator is specifically designed for use with superluminescent diodes (SLDs). This particular model offers high isolation in the 790 to 890 nm range. Although fiber isolators do exist with 30 to 33 dB of isolation at the 840 nm central wavelength, they suffer from large isolation drops (>10 dB) as the wavelength is detuned ±30 nm. In contrast, the isolation performance of the IO-F-SLD100-840 isolator is fairly flat for ±50 nm detunings, making it an ideal choice for use with SLDs.

Specifications

- **Wavelength:** 840 ± 50 nm
- **Power:*** 2 W CW (Max)
- **Isolation:**** 25 – 32 dB
- **Insertion Loss:** 1.0 – 1.6 dB
- **PDL:** ≤0.25 dB
- **Return Loss:** >52 dB
- **Fiber:** 780HP

*Specified power rating is for the isolator. Proper laser termination is critical.
**Isolation is both wavelength and temperature dependent (not for use with pulsed applications)

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-F-SLD100-840	$ 1,750.00	£ 1,260.00	€ 1.522,50	¥ 13,947.50	None	Fiber Isolator for SLD, 790 – 890 nm

850 nm, 2 W Polarization-Independent Fiber Isolators

Specifications

- **Wavelength:** 850 ± 10 nm
- **Power:*** 2 W CW (Max)
- **Isolation:**** 30 – 38 dB
- **Insertion Loss:** 1.0 – 1.6 dB
- **PDL:** ≤0.25 dB
- **Return Loss:** >50 dB
- **Fiber:** 780HP

*Specified power rating is for the isolator. Proper laser termination is critical.
**Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

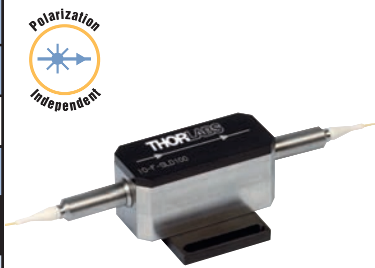
The IO-F-850 and IO-F-850APC are CW polarization-independent fiber isolators. These isolators, which are designed for use in the 840 to 860 nm range, can be used with optical powers up to 2 W. Single mode fiber is used on both the input and output. Light returning is displaced from the optical axis, resulting in 30 to 38 dB of isolation. Due to the polarization-independent nature of these isolators, the insertion loss and the isolation value will not change with respect to the input or returning light's state of polarization.

Polarization Independent

IO-F-850

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-F-850	$ 1,600.00	£ 1,152.00	€ 1.392,00	¥ 12,752.00	None	Low-Power, SM Fiber Isolator, 850 nm
IO-F-850APC	$ 1,640.00	£ 1,180.80	€ 1.426,80	¥ 13,070.80	FC/APC	Low-Power, SM Fiber Isolator, 850 nm

895 nm, 2 W Polarization-Independent Broadband Fiber Isolator



IO-F-SLD150-895
Broadband 150 nm

The IO-F-SLD150-895 polarization-independent broadband fiber isolator is specifically designed for use with superluminescent diodes (SLDs). This particular model offers high isolation in the 820 to 970 nm range. Although fiber isolators exist with higher isolation at this central wavelength, they suffer from large isolation drops (>10 dB) when operated outside the designed wavelength range. In contrast, the isolation performance of the IO-F-SLD150-895 isolator is fairly flat up to 75 nm from the center wavelength, making this isolator an ideal choice for use with SLDs.

Specifications

- **Wavelength:** 895 ± 75 nm
- **Power:*** 2 W CW (Max)
- **Isolation:**** 23 – 32 dB
- **Insertion Loss:** 1.4 – 2.1 dB
- **PDL:** ≤0.25 dB
- **Return Loss:** >52 dB
- **Fiber:** 780HP

*Specified power rating is for the isolator. Proper laser termination is critical.
**Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-F-SLD150-895	$ 1,975.00	£ 1,422.00	€ 1.718,25	¥ 15,740.75	None	Fiber Isolator for SLD, 820 – 970 nm

980 nm, 2 W Polarization-Independent Fiber Isolators

IO-F-980

Specifications

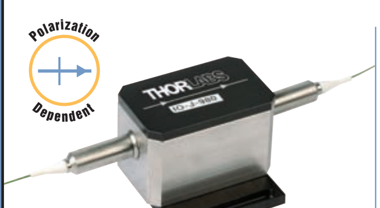
- **Wavelength:** 980 ± 10 nm
- **Power:*** 2 W CW (Max)
- **Isolation:**** 30 – 38 dB
- **Insertion Loss:** 0.7 – 1.2 dB
- **PDL:** ≤0.20 dB
- **Return Loss:** >50 dB
- **Fiber:** HI1060

*Specified power rating is for the isolator. Proper laser termination is critical.
**Isolation is both wavelength and temperature dependent (not for use with pulsed applications)

The IO-F-980 and IO-F-980APC are CW polarization-independent fiber isolators. These isolators are designed for use in the 970 to 990 nm range and can be used with optical powers up to 2 W. Returning light is displaced from the optical axis, resulting in 30 to 38 dB of isolation. Due to the polarization-independent nature of these isolators, the insertion loss and the isolation value will not change with respect to the input or returning light's state of polarization.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-F-980	$ 1,470.00	£ 1,058.40	€ 1.278,90	¥ 11,715.90	None	Low-Power, SM Fiber Isolator, 980 nm
IO-F-980APC	$ 1,510.00	£ 1,087.20	€ 1.313,70	¥ 12,034.70	FC/APC	Low-Power, SM Fiber Isolator, 980 nm

980 nm, 3 W Polarization-Dependent Fiber Isolators



IO-J-980

Mechanical Drawings Available on the WEB

The IO-J-980 and IO-J-980APC low-power, polarization-dependent fiber isolators utilize PM fiber on both the input and output of the isolator. Both isolators are aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be blocked. In the reverse direction, light with any state of polarization will be isolated. The IO-J-980 and IO-J-980APC fiber isolators are designed to provide 30 to 38 dB of isolation in the 970 to 990 nm range.

Specifications

- **Wavelength:** 980 ± 10 nm
- **Power:** 3 W CW (Max)
- **Isolation:**[a] 30 – 38 dB
- **Insertion Loss:**[b] 0.8 – 1.4 dB
- **Extinction Ratio:** >20 dB
- **Return Loss:** >50 dB
- **Fiber:**[c] PM 980

[a]Not for use with pulsed applications or feedback.
[b]Device aligned for transmission along the slow axis; light launched into the fast axis is not transmitted
[c]PM fiber 400 µm buffer with loose Hytrel tubing

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-J-980	$ 1,935.00	£ 1,393.20	€ 1.683,45	¥ 15,421.95	None	Low-Power, PM Fiber Isolator, 980 nm
IO-J-980APC	$ 2,035.00	£ 1,465.20	€ 1.770,45	¥ 16,218.95	FC/APC	Low-Power, PM Fiber Isolator, 980 nm

1064 nm, 250 mW Polarization-Independent Fiber Isolators

Specifications

- **Wavelength:** 1064 +20/-4 nm
- **Power:** 250 mW
- **Isolation:*** 33 dB @ 1064 nm
- **Insertion Loss:** 1.4 – 2.0 dB
- **PDL:** ≤0.15 dB
- **Return Loss:** >50 dB
- **Fiber:** HI1060

*Isolation is both wavelength and temperature dependent (not for use with pulsed applications)

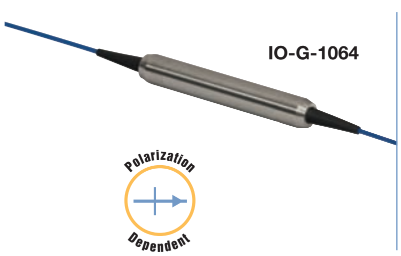
The IO-H-1064 and IO-H-1064APC narrowband, polarization-independent fiber isolators are designed for use in the 1060 to 1084 nm range.

To reduce package size, Bismuth Iron Garnet (BIG) film is used as the Faraday rotating material since it has a very high Verdet constant and is relatively inexpensive. However, absorption increases rapidly at wavelengths shorter than 1060 nm.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-H-1064	$ 1,450.00	£ 1,044.00	€ 1.261,50	¥ 11,556.50	None	Low-Power, SM Fiber Isolator, 1064 nm
IO-H-1064APC	$ 1,490.00	£ 1,072.80	€ 1.296,30	¥ 11,875.30	FC/APC	Low-Power, SM Fiber Isolator, 1064 nm

1064 nm, 300 mW Polarization-Dependent Fiber Isolator

NEW product



Specifications

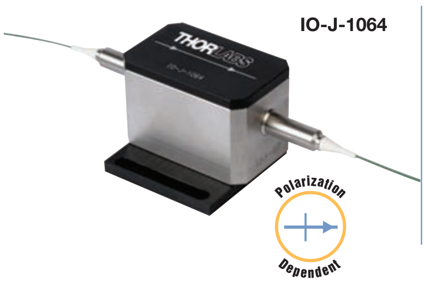
- **Wavelength:** 1064 +5 nm
- **Power:** 0.3 W CW (Max)
- **Isolation:*** ≥35 dB
- **Insertion Loss:** ≤1.8 dB
- **Extinction Ratio:** ≥20 dB
- **Return Loss:** ≥50 dB
- **Fiber:** PM980

*Within operating range at 23 °C. Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

The IO-G-1064 low-power, polarization-dependent fiber isolator utilizes PM fiber on both the input and the output of the isolator. It is aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be blocked. In the reverse direction, light with any state of polarization will be isolated. The IO-G-1064 fiber isolator is designed to provide 35 dB isolation in the 1059 to 1069 nm range.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-G-1064	$ 460.00	£ 331.20	€ 400,20	¥ 3,666.20	None	Low-Power, PM Fiber Isolator, 1064 nm

1064 nm, 3 W Polarization-Dependent Fiber Isolators



Specifications

- **Wavelength:** 1064 ± 10 nm (IO-J-1064)
- **Max Power:** 3W (CW)
- **Isolation:**[a] 32 – 38 dB (IO-J-1064)
- **Insertion Loss:**[b] 0.6 – 1.3 dB (IO-J-1064)
- **Extinction Ratio:** >20 dB
- **Return Loss:** >50 dB
- **Fiber:**[c] PM 980/1064 (IO-J-1064)

[a]Not for use with pulsed applications or feedback.
[b]Device aligned for transmission along the slow axis; light launched into the fast axis is not transmitted
[c]PM fiber 400 µm buffer with loose Hytrel tubing

These low-power polarization-dependent fiber isolators, which utilize PM fiber on both the input and output of the isolators, are designed for CW applications up to 3 W. The devices are aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be blocked. In the reverse direction, light with any state of polarization will be isolated.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-J-1064	$ 1,935.00	£ 1,393.20	€ 1.683,45	¥ 15,421.95	None	Low-Power, PM Fiber Isolator, 1064 nm
IO-J-1064APC	$ 2,035.00	£ 1,465.20	€ 1.770,45	¥ 16,218.95	FC/APC	Low-Power, PM Fiber Isolator, 1064 nm

1064 nm, 3 W Polarization-Independent Fiber Isolators

Polarization Independent

IO-F-1064

Specifications

- **Wavelength:** 1064 ± 10 nm
- **Power:** 3 W CW (Max)
- **Isolation:*** 33 – 38 dB
- **Insertion Loss:** 0.7 – 1.3 dB
- **PDL:** ≤0.15 dB
- **Return Loss:** >50 dB
- **Fiber:** HI1060

*Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

The IO-F-1064 and IO-F-1064APC narrowband, polarization-independent fiber isolators are designed for use in the 1054 to 1074 nm range. These fiber isolators utilize a TGG rotator so that they can be used with higher powers (3 W compared to 0.5 W) and at lower wavelengths (1054 nm instead of 1060 nm) than their BIG film rotator counterparts.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-F-1064	$ 1,470.00	£ 1,058.40	€ 1.278,90	¥ 11,715.90	None	Low-Power, SM Fiber Isolator, 1064 nm
IO-F-1064APC	$ 1,510.00	£ 1,087.20	€ 1.313,70	¥ 12,034.70	FC/APC	Low-Power, SM Fiber Isolator, 1064 nm

1064 nm, 10 W Polarization-Independent Fiber Isolator

Polarization Independent

IO-K-1064

Specifications

- **Wavelength:** 1064 +11/-14 nm
- **Power:** 10 W CW, 5 kW Peak
- **Isolation:** 30 – 36 dB
- **Insertion Loss:** 1.0 – 1.5 dB
- **PDL:** ≤0.25 dB
- **Return Loss:** >50 dB
- **Fiber:** HI1060

The IO-K-1064 fiber isolator is a high-power, polarization-independent fiber-to-fiber isolator designed for operation in the 1050 to 1075 nm range. Using our knowledge of high-power fiber coupling, we have been able to fabricate an isolator that is capable of handling CW powers up to 10 W and peak powers up to 5 kW. The IO-K-1064 isolator has HI1060 fiber coupled to both its input and output.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-K-1064	$ 1,925.00	£ 1,386.00	€ 1.674,75	¥ 15,342.25	None	10 W, Fiber Isolator, 1064 nm

1064 nm, 30 W Polarization-Independent Fiber to Free-Space Isolator

IO-K-1064-ELY

Polarization Independent

Mechanical Drawings Available on the WEB

The IO-K-1064-ELY is a fiber to free-space isolator for high-power applications in the 1050 to 1080 nm range. Utilizing our experience in high-power fiber coupling, we have been able to fabricate this isolator so that it can withstand CW laser powers up to 30 W. HI1060 single mode fiber has been used on the input end. Light exiting the isolator is collimated into a Ø3 mm beam by the attached beam expander.

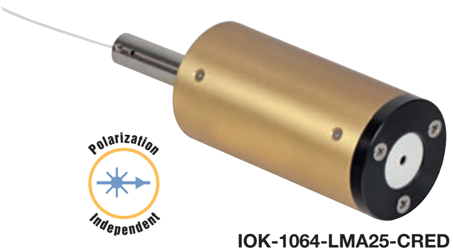
Specifications

- **Wavelength:** 1064 +16/-14 nm
- **Power:** 30 W CW*, 10 kW Peak
- **Isolation:** 30 – 38 dB
- **Insertion Loss:** <0.6 dB
- **Return Loss:** >50 dB
- **Fiber:** HI1060

*Average Power at 1064 nm

ITEM #	$	£	€	RMB	CONNECTOR	DESCRIPTION
IO-K-1064-ELY	$ 2,670.00	£ 1,922.40	€ 2.322,90	¥ 21,279.90	None	30 W Fiber to Free-Space Isolator, 1064 nm

1064 nm, 50 W Polarization-Independent Fiber to Free-Space Isolator



IOK-1064-LMA25-CRED

Specifications

- **Wavelength:** 1064 ± 10 nm
- **Power:** 50 W CW, 10 kW Peak, 25 W Average
- **Isolation:** >30 dB
- **Insertion Loss:** <0.45 dB
- **Return Loss:** >50 dB
- **Fiber:** LMA25

The IOK-1064-LMA25-CRED is a fiber to free-space isolator for high-power applications in the 1054 to 1074 nm range. Utilizing our experience in high-power fiber coupling, we have been able to fabricate this isolator so that it can withstand CW laser powers up to 50 W. This isolator has the added benefit that a red aiming laser with transmission in the 633 to 690 nm range can be coupled into the LMA25 fiber prior to entering the isolator. This aiming feature is extremely useful when working with a free-space IR beam. Mounting holes on the output facet allow components such as beam expanders to be attached. When no beam expander is attached, a Ø1 mm collimated beam exits the isolator centered on the body with a divergence that is less than 3 mrad.

ITEM #	$	£	€	RMB	CONNECTOR	DESCRIPTION
IOK-1064-LMA25-CRED	$ 1,850.00	£ 1,332.00	€ 1.609,50	¥ 14,744.50	None	50 W Fiber to Free-Space Isolator, 1064 nm

1310 nm, 300 mW Polarization-Independent Fiber Isolators

IO-H-1310

The IO-H-1310, IO-H-1310APC, and IO-H-1310FC polarization-independent fiber isolators are designed for use in the 1290 to 1330 nm range. The IO-H-1310APC and IO-H-1310FC have FC/APC- and FC/PC-connectorized endfaces, respectively. Due to the polarization-independent nature of these isolators, the insertion loss and the isolation value will not change with respect to the input or returning light's state of polarization.

Specifications

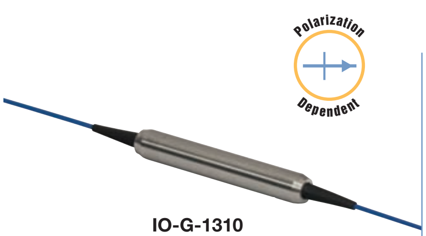
- **Wavelength:** 1310 ± 20 nm
- **Power:** 0.3 W CW
- **Isolation:*** 35 – 40 dB
- **Insertion Loss:** 0.3 – 0.7 dB
- **PDL:** ≤0.10 dB
- **Return Loss:** >55 dB
- **Fiber:** SMF-28e+

*Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-H-1310	$ 160.00	£ 115.20	€ 139,20	¥ 1,275.20	None	Low-Power, SM Fiber Isolator, 1310 nm
IO-H-1310APC	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	FC/APC	Low-Power, SM Fiber Isolator, 1310 nm
IO-H-1310FC	$ 180.00	£ 129.60	€ 156,60	¥ 1,434.60	FC/PC	Low-Power, SM Fiber Isolator, 1310 nm

1310 nm, 300 mW Polarization-Dependent Fiber Isolator

NEW product



IO-G-1310

Specifications

- **Wavelength:** 1310 +20 nm
- **Power:** 0.3 W CW (Max)
- **Isolation:*** 40 dB
- **Insertion Loss:** ≤0.6 dB
- **Extinction Ratio:** ≥20 dB
- **Return Loss:** ≥55 dB
- **Fiber:** PM, Panda

*Peak isolation. Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

The IO-G-1310 low-power, polarization-dependent fiber isolator utilizes PM fiber on both the input and the output of the isolator. It is aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be blocked. In the reverse direction, light with any state of polarization will be isolated. The IO-G-1310 fiber isolator is designed to provide up to 40 dB isolation in the 1290 to 1330 nm range.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-G-1310	$ 390.00	£ 280.80	€ 339,30	¥ 3,108.30	None	Low-Power, PM Fiber Isolator, 1310 nm

1550 nm, 300 mW Polarization-Independent Fiber Isolators

IO-H-1550

Mechanical Drawings Available on the WEB

The IO-H-1550, IO-H-1550APC, and IO-H-1550FC polarization-independent fiber isolators are designed for use in the 1530 to 1570 nm range. The IO-H-1550APC and IO-H-1550FC have FC/APC- and FC/PC-connectorized endfaces, respectively. Due to the polarization-independent nature of these isolators, the insertion loss and the isolation value will not change with respect to the input or returning light's state of polarization.

Specifications

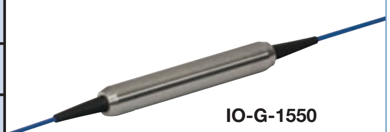
- **Wavelength:** 1550 ± 20 nm
- **Power:** 0.3 W CW
- **Isolation:*** 35 – 40 dB
- **Insertion Loss:** 0.3 – 0.7 dB
- **PDL:** ≤0.10 dB
- **Return Loss:** >55 dB
- **Fiber:** SMF-28e+

*Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-H-1550	$ 160.00	£ 115.20	€ 139,20	¥ 1,275.20	None	Low-Power, SM Fiber Isolator, 1550 nm
IO-H-1550APC	$ 200.00	£ 144.00	€ 174,00	¥ 1,594.00	FC/APC	Low-Power, SM Fiber Isolator, 1550 nm
IO-H-1550FC	$ 180.00	£ 129.60	€ 156,60	¥ 1,434.60	FC/PC	Low-Power, SM Fiber Isolator, 1550 nm

1550 nm, 300 mW Polarization-Dependent Fiber Isolator

NEW product



IO-G-1550

Specifications

- **Wavelength:** 1550 +20 nm
- **Power:** 0.3 W CW (Max)
- **Isolation:*** 40 dB
- **Insertion Loss:** ≤0.6 dB
- **Extinction Ratio:** ≥20 dB
- **Return Loss:** ≥55 dB
- **Fiber:** PM, Panda

*Peak isolation. Isolation is both wavelength and temperature dependent (not for use in pulsed laser applications)

The IO-G-1550 low-power, polarization-dependent fiber isolator utilizes PM fiber on both the input and the output of the isolator. It is aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be blocked. In the reverse direction, light with any state of polarization will be isolated. The IO-G-1550 fiber isolator is designed to provide up to 40 dB isolation in the 1530 to 1570 nm range.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-G-1550	$ 390.00	£ 280.80	€ 339,30	¥ 3,108.30	None	Low-Power, PM Fiber Isolator, 1550 nm

1550 nm, 5 W Polarization-Dependent Fiber Isolators

IO-J-1550

The IO-J-1550 and IO-J-1550APC are CW polarization-dependent isolators designed for use with laser powers up to 5 W. These isolators, which are equipped with PM fiber on both the input and output ends, are aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be blocked. In the reverse direction, light with any state of polarization will be isolated.

The IO-J-1550 and IO-J-1550APC fiber isolators are designed to provide 32 to 38 dB of isolation in the 1540 to 1560 nm range.

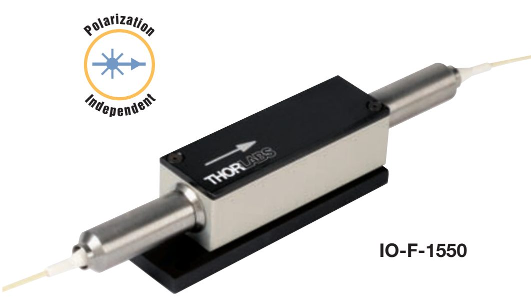
Specifications

- **Wavelength:** 1550 ± 10 nm
- **Power:** 5 W CW
- **Isolation:**[a] 32 – 38 dB
- **Insertion Loss:**[b] 0.4 – 1.0 dB
- **Extinction Ratio:**[b] >20 dB
- **Return Loss:** >55 dB
- **Fiber:**[c] PM1550

[a]Not for use in pulsed laser applications
[b]Device aligned for transmission along the slow axis; light launched into the fast axis is not transmitted
[c]PM fiber 400 µm buffer with loose Hytrel tubing

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-J-1550	$ 1,425.00	£ 1,026.00	€ 1.239,75	¥ 11,357.25	None	5 W, PM Fiber Isolator, 1550 nm
IO-J-1550APC	$ 1,525.00	£ 1,098.00	€ 1.326,75	¥ 12,154.25	FC/APC	5 W, PM Fiber Isolator, 1550 nm

1550 nm, 5 W Polarization-Independent Fiber Isolators



IO-F-1550

The IO-F-1550 and IO-F-1550APC are polarization-independent fiber isolators designed for use in the 1530 to 1570 nm range with powers up to 5 W. Returning light is displaced from the optical axis, resulting in 32 to 38 dB of isolation. Due to the polarization-independent nature of these isolators, the insertion loss and the isolation value will not change with respect to the input or returning light's state of polarization.

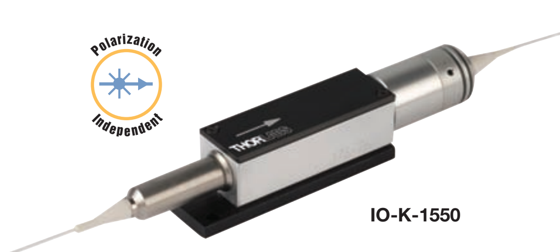
Specifications

- **Wavelength:** 1550 ± 20 nm
- **Power:*** 5 W CW (Max)
- **Isolation:** 32 – 38 dB
- **Insertion Loss:** 0.4 – 1.0 dB
- **PDL:** ≤0.15 dB
- **Return Loss:** >55 dB
- **Fiber:** SMF-28e+

*Power rating is specified only for the isolator. Proper laser termination is critical.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-F-1550	$ 1,250.00	£ 900.00	€ 1.087,50	¥ 9,962.50	None	5W, SM Fiber Isolator, 1550 nm
IO-F-1550APC	$ 1,290.00	£ 928.80	€ 1.122,30	¥ 10,281.30	FC/APC	5W, SM Fiber Isolator, 1550 nm

1550 nm, 10 W Polarization-Independent Fiber Isolator



IO-K-1550

Specifications

- **Wavelength:** 1550 ± 20 nm
- **Power:*** 10 W CW (Max)
- **Isolation:** 30 – 38 dB
- **Insertion Loss:** 0.8 – 1.5 dB
- **PDL:** ≤0.25 dB
- **Return Loss:** >55 dB
- **Fiber:** SMF-28e+

*Power rating is specified only for the isolator. Proper laser termination is critical.

The IO-K-1550 fiber isolator is a high-power, polarization-independent fiber isolator designed for operation in the 1530 to 1570 nm range. Using our high-power handling knowledge for free space and fiber-coupled isolators, we are able to produce the high power, fiber-coupled isolators. The IO-K-1550 employs fiber technologies and thermal management techniques to push the damage thresholds to higher levels. This particular fiber isolator, which utilizes SMF-28e+ on both the input and output of the isolator, is capable of handling CW powers up to 10 W and peak powers up to 2 kW.

ITEM #	$	£	€	RMB	CONNECTOR	DESCRIPTION
IO-K-1550	$ 1,950.00	£ 1,404.00	€ 1.696,50	¥ 15,541.50	None	10 W, SM Fiber Isolator, 1550 nm

See pages 1286 – 1299

2000 nm, 3 W Polarization-Dependent Fiber Isolator

NEW product

IO-J-2000

Specifications

- **Wavelength:** 2000 ± 10 nm
- **Power:*** 3 W CW
- **Isolation:** ≥25 dB
- **Insertion Loss:** 0.8 – 1.2 dB
- **PER:**** >18 dB
- **Return Loss:** >50 dB
- **Fiber:** PM15-U40A

*Power rating is specified only for the isolator. Proper laser termination is critical.
**Polarization Extinction Ratio

Thorlabs' IO-J-2000 is a low insertion loss, polarization-dependent fiber isolator designed for use at 2000 nm, a wavelength experiencing rapid advancements in fiber laser applications. This isolator, which utilizes PM15-U40A fiber on both the input and output, is aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be blocked. In the reverse direction, light with any state of polarization will be isolated. The IO-J-2000 has less insertion loss (0.8 - 1.2 dB) compared to its high-power IO-L-2000 counterpart and is capable of handling CW powers up to 3 W.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-J-2000	$ 3,500.00	£ 2,520.00	€ 3.045,00	¥ 27,895.00	None	3 W, PM Fiber Isolator, 2000 nm

2000 nm, 3 W Polarization-Independent Fiber Isolator

NEW product

IO-F-2000

Specifications

- **Wavelength:** 2000 ± 10 nm
- **Power:*** 3 W CW
- **Isolation:** >25 dB
- **Insertion Loss:** 0.8 – 1.2 dB
- **PDL:** ≤0.2 dB
- **Return Loss:** >50 dB
- **Fiber:** SM2000

*Power rating is specified only for the isolator. Proper laser termination is critical.

Thorlabs' IO-F-2000 is a low insertion loss, polarization-independent fiber isolator designed for the 2000 nm regime. Thorlabs' SM2000 single mode fiber is used on the input and output. The IO-F-2000 has less insertion loss (0.8 - 1.2 dB) compared to its high power counterpart (IO-K-2000) and is capable of handling CW powers up to 3 W.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-F-2000	$ 3,200.00	£ 2,304.00	€ 2.784,00	¥ 25,504.00	None	3 W, SM Fiber Isolator, 2000 nm

2000 nm, 10 W Polarization-Dependent Fiber Isolator

IO-L-2000

Specifications

- **Wavelength:** 2000 ± 10 nm
- **Power:*** 10 W CW, <2 kW Peak
- **Isolation:** ≥25 dB
- **Insertion Loss:** 1.4 – 1.6 dB
- **PER:**** >18 dB
- **Return Loss:** >50 dB
- **Fiber:** PM15-U40A

*Power rating is specified only for the isolator. Proper laser termination is critical.
**Polarization Extinction Ratio

The IO-L-2000 is a great example of our ability to fabricate isolators to meet the demands of various customers. This particular polarization-dependent fiber isolator is designed for use with CW or pulsed lasers at 2000 nm, a wavelength experiencing rapid advancements in fiber laser applications such as LIDAR and spectroscopy.

Fiber isolators for the 2000 nm region present many material and manufacturing design challenges. Our experience in supplying 2000 nm Ho:YAG isolators and optics was extremely useful when it came to producing a fiber isolator for this wavelength.

The IO-L-2000 uses polarization-maintaining fiber on both the input and output of the isolator. The device is aligned for transmission along the slow axis of the fiber. Any signal not aligned with the input slow axis will be blocked. In the reverse direction, light with any state of polarization will be isolated.

If your application could benefit from a custom isolator, please let us know. In the past, we have incorporated special fibers and free-space outputs for use with lasers outputting >20 W.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-L-2000	$ 4,500.00	£ 3,240.00	€ 3.915,00	¥ 35,865.00	None	10 W, PM Fiber Isolator, 2000 nm

2000 nm, 10 W Polarization-Independent Fiber Isolator

Specifications

- **Wavelength:** 2000 ± 10 nm
- **Power:*** 10 W CW, <2 kW Peak
- **Isolation:** ≥25 dB
- **Insertion Loss:** 1.4 - 1.6 dB
- **PDL:** ≤0.2 dB
- **Return Loss:** >50 dB
- **Fiber:** SM2000

*Power rating is specified only for the isolator. Proper laser termination is critical.

The IO-K-2000 is the polarization-independent version of the IO-L-2000 presented on page 1128. This fiber isolator utilizes Thorlabs' SM2000 single mode fiber for both the input and output and is designed for use at 2000 nm, a wavelength experiencing rapid advancements in fiber laser applications.

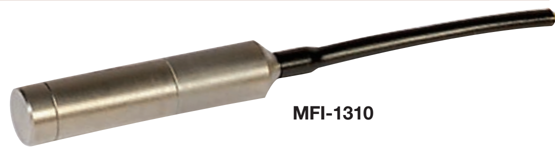
If your application could benefit from a custom isolator, please let us know. In the past, we have incorporated special fibers and free space outputs for use with lasers outputting >20 W.

ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IO-K-2000	$ 4,200.00	£ 3,024.00	€ 3.654,00	¥ 33,474.00	None	10 W, SM Fiber Isolator, 2000 nm

In-Line Faraday Rotator Mirrors

Features

- Low Insertion Loss (0.8 dB Max)
- High-Power Handling, up to 3 W
- Epoxy-Free Optical Path
- SMF-28e+ Fiber or Equivalent



Thermal and mechanical perturbations introduced to a standard, single mode fiber 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 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.

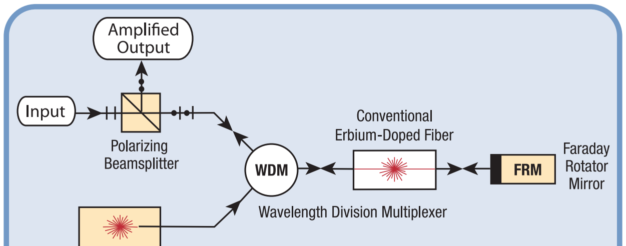
Principle

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.

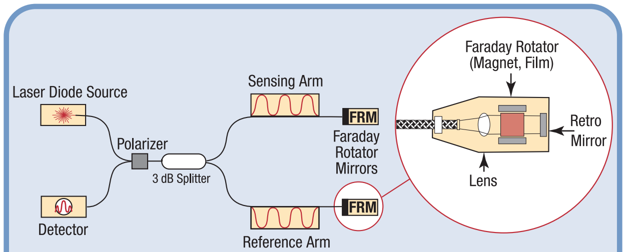
A Faraday rotator is situated in front of the mirror, which provides the non-reciprocal 45° rotation of the state of polarization each time the light passes through it. These rotations, applied in combination with a reversal of the polarization state's handedness upon reflection at the mirror interface,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

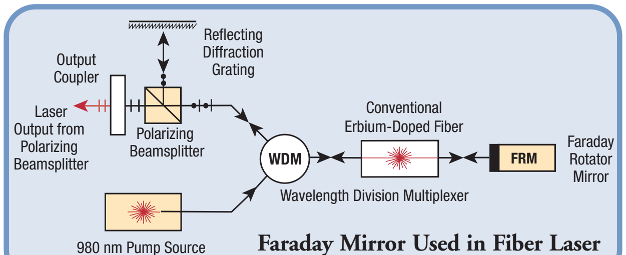
Custom models are available upon special request.



Faraday Mirror Used in a Fiber Amplifier



Faraday Mirror Used in an Interferometer-Based Fiber Sensor



Faraday Mirror Used in Fiber Laser

ITEM #	CENTER WAVELENGTH	BANDWIDTH	INSERTION LOSS	RETURN LOSS	FARADAY ROTATION
MFI-1310	1310 nm	12 nm	0.5 dB Typ/0.8 dB Max	>55 dB	45° ± 1°
MFI-1550	1550 nm	17 nm	0.5 dB Typ/0.8 dB Max	>55 dB	45° ± 1°

ITEM #	$	£	€	RMB	DESCRIPTION
MFI-1310	$ 499.80	£ 359.86	€ 434,83	¥ 3,983.41	In-Line Faraday Rotator Mirror for 1310 nm
MFI-1550	$ 499.80	£ 359.86	€ 434,83	¥ 3,983.41	In-Line Faraday Rotator Mirror for 1550 nm

FC/PC Single Mode Fiber Optical Attenuators: Fiber Connector

FA05T

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

Specifications

- **Operating Wavelength:** 1240 - 1620 nm
- **Return Loss:** >55 dB (FC/PC)
- **Maximum Power Capability:** 1 W
- **Polarization-Dependent Loss (PDL):** <0.1 dB (FC/PC)
- **Operating Temperature:** -40 to 85 °C
- **Key Size:** Universal (Wide-Key Input, Narrow-Key Output)

FC/PC Fiber Connector Optical Attenuators

ITEM #	$	£	€	RMB	DESCRIPTION
FA05T	$ 20.80	£ 14.98	€ 18,10	¥ 165.78	Fixed Optical Attenuator, 5 ± 0.5 dB, FC/PC Connector
FA10T	$ 21.00	£ 15.12	€ 18,27	¥ 167.37	Fixed Optical Attenuator, 10 ± 0.7 dB, FC/PC Connector
FA15T	$ 21.00	£ 15.12	€ 18,27	¥ 167.37	Fixed Optical Attenuator, 15 ± 1.0 dB, FC/PC Connector
FA25T	$ 21.00	£ 15.12	€ 18,27	¥ 167.37	Fixed Optical Attenuator, 25 ± 1.3 dB, FC/PC Connector

FC/APC Single Mode Fiber Optical Attenuators: Fiber Connector

FA05T-APC

NEW products

These terminators allow one to attenuate an optical signal easily by plugging an FC/APC-terminated fiber directly into the back end of the attenuator. The front of the attenuator is a male connector style and can be directly plugged into FC/APC receptacles or adapters. These single mode attenuators are made with polarization-insensitive doped fiber to achieve the specified attenuation.

Specifications

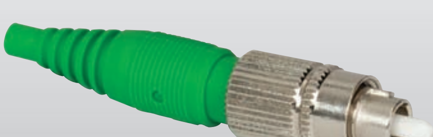
- **Operating Wavelength:** 1240 - 1620 nm
- **Return Loss:** >60 dB (FC/APC)
- **Maximum Power Capability:** 1 W
- **Polarization-Dependent Loss (PDL):** ≤0.1 dB (FC/APC)
- **Operating Temperature:** -40 to 85 °C
- **Key Size:** Universal (Wide-Key Input, Narrow-Key Output)

FC/APC Fiber Connector Optical Attenuators

ITEM #	$	£	€	RMB	DESCRIPTION
FA05T-APC	$ 24.00	£ 17.28	€ 20,88	¥ 191.28	Fixed Optical Attenuator, 5 ± 0.5 dB, FC/APC Connector
FA10T-APC	$ 24.00	£ 17.28	€ 20,88	¥ 191.28	Fixed Optical Attenuator, 10 ± 1.0 dB, FC/APC Connector
FA15T-APC	$ 24.00	£ 17.28	€ 20,88	¥ 191.28	Fixed Optical Attenuator, 15 ± 1.0 dB, FC/APC Connector
FA25T-APC	$ 24.00	£ 17.28	€ 20,88	¥ 191.28	Fixed Optical Attenuator, 25 ± 1.5 dB, FC/APC Connector

Have you seen our...

Light Trap Connectors



FTAPC

- Reduce Back Reflection of Unused Feed Through Ports
- Back Reflection Better than -50 dB
- FC/PC, FC/APC, or SMA Connector
- 1260 - 1620 nm Wavelength Range

Thorlabs' Terminating Connectors are designed to be used with feed through ports that do not have an output fiber connected to them. Light coupled into them is diffused, rather than reflected back into the source. This reduces the back reflection by roughly 20 dB.

For more details, see page 1140

Single Mode, Variable Fiber Optical Attenuators: Inline

This manually adjustable, inline variable optical attenuator (VOA) is used to precisely balance the signal strengths in fiber circuits or to balance an optical signal when evaluating the dynamic range of the measurement system. The attenuation is adjusted using a screw on the side of the attenuator housing. These in-line VOAs include SMF-28e+ single mode fiber with a Ø3 mm jacket, and they are offered unterminated or terminated with 2.0 mm narrow key FC/PC or FC/APC connectors. These attenuators are available with other connector styles; please contact your local Thorlabs office for a quotation.

VOA50

Specifications

- **Operating Wavelength:** 1200 to 1600 nm
- **Fiber:** SMF-28e+ or Equivalent, 1 m per Side
- **Attenuation Range:** 1.5 - 50 dB
- **Attenuation Resolution:** ≤0.1 dB
- **Back Reflection (Return Loss):** >55 dB
- **Polarization Sensitivity:** ≤0.2 dB
- **Optical Power:** ≤300 mW
- **Thermal Stability:** ≤0.03 dB/°C
- **Operating Temperature:** 0 to 60 °C
- **Dimensions:** 38 mm x 30 mm x 19 mm

Inline Variable Optic Attenuator: SM Fiber, No Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
VOA50	$ 225.90	£ 162.65	€ 196,53	¥ 1,800.42	Inline Variable Optical Attenuator, 50 dB, No Connectors

Inline Variable Optic Attenuator: SM Fiber, FC/PC Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
VOA50-FC	$ 245.90	£ 177.05	€ 213,93	¥ 1,959.82	Inline Variable Optical Attenuator, 50 dB, FC/PC Connectors

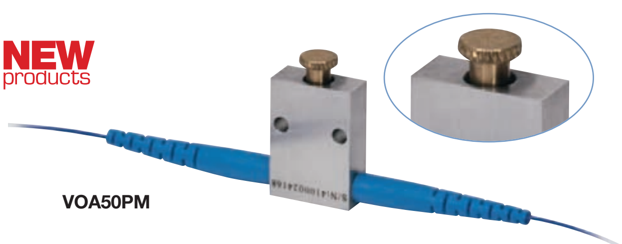
Inline Variable Optic Attenuator: SM Fiber, FC/APC Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
VOA50-APC	$ 265.90	£ 191.45	€ 231,33	¥ 2,119.22	Inline Variable Optical Attenuator, 50 dB, FC/APC Connectors

Polarization-Maintaining, Variable Fiber Optical Attenuators: Inline

Polarization-maintaining inline variable optical attenuators (VOAs) allow the user to manually vary the attenuation of a signal for precise power balancing in fiber circuits or evaluation of the dynamic range of measurement systems. A thumbscrew on the housing adjusts the amount of attenuation. All in-line PM VOAs have fiber pigtails with a Ø900 µm jacket. The VOA50PM has unconnectorized pigtails while the pigtails on the VOA50PM-FC and VOA50PM-APC have 2.0 mm narrow key FC/PC or FC/APC connectors, respectively. For other connector styles, please contact tech support for a quote.

NEW products



VOA50PM

Specifications

- **Operating Wavelength:** 1310/1550 nm ± 40 nm
- **Fiber:** SM15-PS-U25A, 1 m per side
- **Attenuation Range:**
  - Unconnectorized: 0.6 - 50 dB
  - Connectorized: 0.9 - 50 dB
- **Attenuation Resolution:** 0.15 dB
- **Back Reflection (Return Loss):** ≥50 dB
- **Polarization Sensitivity:** <0.15 dB
- **Extinction Ratio:**
  - Unconnectorized: ≥20 dB
  - Connectorized: ≥18 dB
- **Optical Power:** ≤500 mW
- **Operating Temperature:** -5 to 70 °C
- **Dimensions:** 26 mm x 18 mm x 8 mm

Inline Variable Optic Attenuator: PM Fiber, No Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
VOA50PM	$ 900.00	£ 648.00	€ 783,00	¥ 7,173.00	PM Variable Optical Attenuator, 50 dB, No Connectors

Inline Variable Optic Attenuator: PM Fiber, FC/PC Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
VOA50PM-FC	$ 940.00	£ 676.80	€ 817,80	¥ 7,491.80	PM Variable Optical Attenuator, 50 dB, FC/PC Connectors

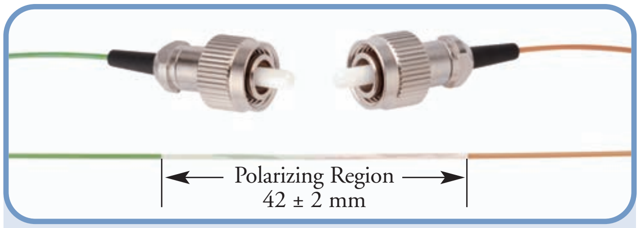
Inline Variable Optic Attenuator: PM Fiber, FC/APC Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
VOA50PM-APC	$ 960.00	£ 691.20	€ 835,20	¥ 7,651.20	PM Variable Optical Attenuator, 50 dB, FC/APC Connectors

CHAPTERS
Fiber Patch Cables
Bare Fiber
Fiber Optomechanics
Fiber Components
Test and Measurement
SECTIONS
Collimators
Couplers
WDMs
RGB Combiner
Circulators
Fiber Isolators
Faraday Mirrors
Fiber Attenuators
Polarization Controllers
Optical Switches
Mating Sleeves
Terminating Connectors
Termination

In-Fiber Linear Polarizers

Thorlabs offers these unique in-fiber, linear polarizers, which are manufactured by Chiral Photonics using their proprietary chiral technology. The all-glass in-fiber polarizer provides an extinction ratio in excess of 30 dB over broad spectral and operating temperature ranges. Chiral fibers are made by twisting rectangular core fibers in order to create a double-helical core structure. 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 propagates through the core in the twisted region of the fiber.



Polarizers without connectors or with other connector styles are available upon request.

Region 1 Region 2 Region 3

Propagation Direction
(This choice is arbitrary as the device is bi-directional)

Chiral Photonics

Region 1
Light with vertical and horizontal states of polarization is transformed through states of elliptical polarization into orthogonal states of circular polarization.

- For the devices with PM Fiber, the light coupled into the slow axis of the fiber is transformed into a circularly polarized state that has a handedness opposite of the chiral structure so that it stays in the core.
- For the devices with PM fiber, the light coupled into the fast axis of the fiber is transformed into a circularly polarized state that has the same handedness as the chiral structure so that it is scattered from the core

Region 2
Light with the same handedness as the core is scattered out of the fiber, while light with the opposite handedness propagates through the core.

Region 3
The light emerging from Region 2 is transformed back into a linearly polarized state

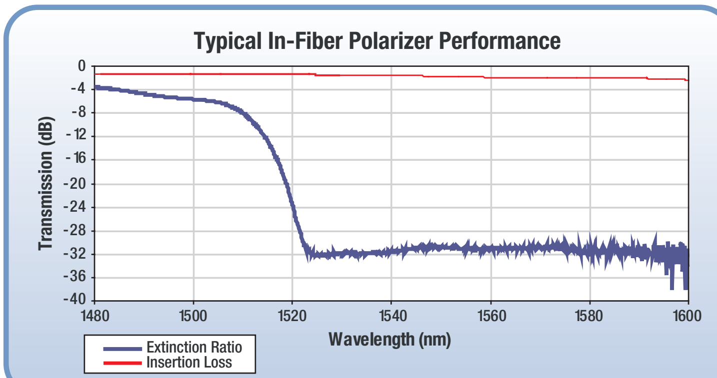
- For the devices with PM fiber, the linearly polarized state is coupled into the slow axis of the fiber.

Features
- Passive Fiber Component
- All-Fiber Technology
- Bi-Directional
- Low Loss (<2 dB)
- Wide Wavelength Range (>50 nm)
- Damage Threshold is Not Limited by Polarization Region

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

SPECIFICATIONS	
Center Wavelength	980 nm, 1064 nm, 1310 nm, 1550 nm
Bandwidth	>50 nm
Extinction Ratio (ER)	>20 dB
Intrinsic ER	>40 dB
Insertion Loss	<2 dB
Polarizer Length	42 ± 2 mm
Package Style	Stainless steel microtubing beneath 900 µm furcation tubing protects device over 280 mm central portion. Entire device is flexible/bendable to 1" radius.
Pigtails	Panda PM* or SM**, 1 m long
Operating Temperature	-40 to 85 °C
Storage Temperature	-70 to 85 °C

*Polarization-Maintaining Fiber **Single Mode Fiber



ITEM #	$	£	€	RMB	CONNECTORS	DESCRIPTION
IFP980PM-FC*	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FC/PC	In-Fiber Polarizer, 980 nm, PM/PM Pigtails, FC/PC Connectors
IFP1064PM-FC*	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FC/PC	In-Fiber Polarizer, 1064 nm, PM/PM Pigtails, FC/PC Connectors
IFP1310PM-FC*	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FC/PC	In-Fiber Polarizer, 1310 nm, PM/PM Pigtails, FC/PC Connectors
IFP1550PM-FC*	$ 400.00	£ 288.00	€ 348,00	¥ 3,188.00	FC/PC	In-Fiber Polarizer, 1550 nm, PM/PM Pigtails, FC/PC Connectors
IFP1550SM-FC*	$ 380.00	£ 273.60	€ 330,60	¥ 3,028.60	FC/PC	In-Fiber Polarizer, 1550 nm, SM/SM Pigtails, FC/PC Connectors

*Slow axis aligned to key

Fiber Polarization Controllers

CCC1310-J9
SM Fiber is Compatible
with SMF-28e

FPC030

FPC020

FPC560
For Bend-Sensitive Fibers

If your application includes single mode fiber and requires linearly polarized light, the FPC Series of Polarization Controllers can be easily implemented to convert elliptically polarized light in a single mode fiber into another state of polarization, including linearly polarized light. This polarization conversion is achieved by loading the paddles with a prescribed number of fiber loops and adjusting their positions to control the output polarization state.

These polarization controllers utilize stress-induced birefringence to create three independent fractional wave plates to alter the polarization of the transmitted light in the single mode fiber by looping the fiber into three independent spools. The miniature FPC020 Polarization Controller achieves the same results with just two paddles. Please check our website for detailed operating theory.

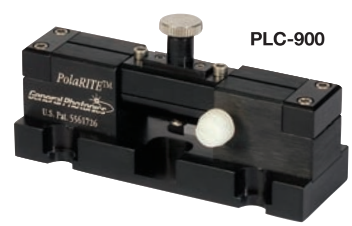
The amount of birefringence induced in the fiber is a function of the fiber cladding diameter, the spool diameter (fixed), the number of fiber loops per spool, and the wavelength of the light. The fast axis of the fiber, which is in the plane of the spool, is adjusted with respect to the transmitted polarization vector by manually rotating the paddles. The FPC031, FPC032, FPC561, and FPC562 fiber polarization controllers come preloaded with fiber.

NOTE: The FPC030 and FPC020 Controllers work well with most of our single mode fibers. For fibers with higher bend loss (e.g., SMF-28e+), we recommend FPC560, which has larger paddles.

ITEM #	LOOP DIAMETER	PADDLE ROTATION	FOOTPRINT	OPERATING WAVELENGTH	CONNECTORS	BEND LOSS
FPC020	0.71" (18 mm)	±286°	3.06" x 0.5" (77.7 mm x 12.7 mm)	N/A	N/A	N/A
FPC030	1.06" (27 mm)	±117.5°	8.5" x 1.0" (216 mm x 25 mm)	N/A	N/A	N/A
FPC031	1.06" (27 mm)	±117.5°	8.5" x 1.0" (216 mm x 25 mm)	1260 - 1625 nm	FC/PC	≤0.1 dB
FPC032	1.06" (27 mm)	±117.5°	8.5" x 1.0" (216 mm x 25 mm)	1260 - 1625 nm	FC/APC	≤0.1 dB
FPC560	2.2" (56 mm)	±117.5°	12.5" x 1.0" (317.5 mm x 25 mm)	N/A	N/A	N/A
FPC561	2.2" (56 mm)	±117.5°	12.5" x 1.0" (317.5 mm x 25 mm)	1260 - 1620 nm	FC/PC	≤0.1 dB
FPC562	2.2" (56 mm)	±117.5°	12.5" x 1.0" (317.5 mm x 25 mm)	1260 - 1620 nm	FC/APC	≤0.1 dB

ITEM #	$	£	€	RMB	DESCRIPTION
FPC020	$ 184.00	£ 132.48	€ 160,08	¥ 1,466.48	Miniature 2-Paddle Fiber Polarization Controller
FPC030	$ 190.00	£ 136.80	€ 165,30	¥ 1,514.30	3-Paddle Fiber Polarization Controller w/ Small Paddles, No Fiber
FPC031	$ 232.40	£ 167.33	€ 202,19	¥ 1,852.23	3-Paddle Fiber Polarization Controller w/ Small Paddles, FC/PC Connectors, CCC1310-J9 Fiber
FPC032	$ 252.40	£ 181.73	€ 219,59	¥ 2,011.63	3-Paddle Fiber Polarization Controller w/ Small Paddles, FC/APC Connectors, CCC1310-J9 Fiber
FPC560	$ 211.20	£ 152.06	€ 183,74	¥ 1,683.26	3-Paddle Fiber Polarization Controller w/ Large Paddles, No Fiber
FPC561	$ 253.60	£ 182.59	€ 220,63	¥ 2,021.19	3-Paddle Fiber Polarization Controller w/ Large Paddles, FC/PC Connectors, SMF-28e Fiber
FPC562	$ 273.60	£ 196.99	€ 238,03	¥ 2,180.59	3-Paddle Fiber Polarization Controller w/ Large Paddles, FC/APC Connectors, SMF-28e Fiber

Inline Fiber Polarization Controller



PLC-900

The PLC-900 polarization controller is ideal for applications that require a stable, compact, manual controller. It is designed to be used with Ø900 µm jacketed single mode fiber. Simply place the fiber in a channel and hold in place with end-clamps. An adjustable knob allows the fiber to be squeezed and rotated, providing the ability 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.

Features

- Insensitive to Wavelength Variations
- Compact
- For Ø900 µm Tight-Buffered Fiber

Specifications

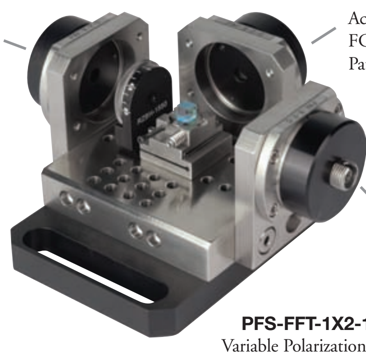
- **Insertion Loss:** <0.05 dB
- **Return Loss:** >65 dB
- **Extinction Ratio:** >40 dB

ITEM #	$	£	€	RMB	DESCRIPTION
PLC-900	$ 510.00	£ 367.20	€ 443,70	¥ 4,064.70	Inline Fiber Polarization Controller for Ø900 µm Tight-Buffered Fiber

1550 nm Variable Polarization Splitter Kit

A half-wave retarder is used to rotate the input linear state of polarization (SOP). By changing the orientation of the half-wave retarder, 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 continuously variable from 0 to 30 dB.*

*Dependent on polarization extinction ratio from the input PM fiber.



PFS-FFT-1X2-1550
Variable Polarization Splitter

The kit is supplied assembled but not aligned. It is intended for use with either our broad selection of patch cables (see pages 1004 - 1017) or customer supplied patch cables.

Includes

- 1 FiberTable (FT-51X60)
- 3 FiberPorts (PAF-X-2-C)
- 3 Wall Plates (HCA3)
- 1 Polarization Beamsplitter (PSCLB-VL-1550)
- 1 Zero-Order 1550 nm 1/2 Wave Plate Module (RABH-1600)

Features

- Power is Fiber Limited to 10 W (CW, Typical)
- Mechanical and Thermal Stability
- Continuously Variable Split Ratio
- Other Wavelengths Available upon Request
- FC/PC and FC/APC Compatible

ITEM #	$	£	€	RMB	DESCRIPTION
PFS-FFT-1X2-1550	$ 2,650.00	£ 1,908.00	€ 2.305,50	¥ 21,120.50	Variable Polarization Splitter Kit, 1550 nm

1550 nm Polarization Controller Kit

Thorlabs offers a polarization controller assembled from a FiberBench, FiberPorts, and component modules. A bench controller has the same function as a paddle controller but offers a more deterministic and stable polarization manipulation.

The PC-FFB-1550 FiberBench polarization controller is a deterministic system with no hysteresis. Hence, it is possible to predict the controller's output state of polarization (SOP) at any instant in time given only its input SOP. In any system with hysteresis, like a fiber paddle controller, there is no way to predict the output. Hysteresis describes the lag that exists between the responding parameter and the changing parameter, or in this case, the time lag between the SOP change and the moving of the fiber paddles. When a paddle controller is adjusted, the SOP takes time to stabilize and may not stabilize at the intended value. Furthermore, without a polarimeter, the SOP from the paddle controller cannot be determined directly.

With a FiberBench polarization controller, any known input polarization state can be deterministically rotated into a known output polarization state using the quarter-wave plate, half-wave plate, and quarter-wave plate. Each wave plate can be precisely and continuously rotated through 360°.

PC-FFB-1550
Polarization Controller

Features

- Mechanical and Thermal Stability
- Deterministic Polarization Control
- Other Wavelengths Available upon Request

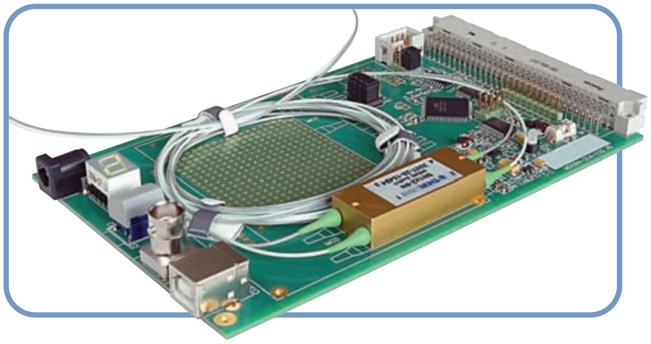
The kit is supplied assembled but not aligned. Fiber cables can be purchased separately (see pages 1004 - 1017).

Includes

- 1 FiberBench (FB-51W, Page 1068)
- 2 FiberPorts (PAF-X-2-C, Page 1082)
- 1 Half-Wave Retarder
- 2 1550 nm Quarter-Wave Retarders

ITEM #	$	£	€	RMB	DESCRIPTION
PC-FFB-1550	$ 2,320.00	£ 1,670.40	€ 2.018,40	¥ 18,490.40	Polarization Controller Kit with Zero-Order Wave Plates, 1550 nm

1 x 2 and 2 x 2 MEMS Optical Switch Kits



Features

- Switch Types: 1 x 2 or 2 x 2 (Optional: 1 x 4, 1 x 8)
- USB Remote Control
- Push Button Toggle Switch on Board
- BNC Input for Switching (TTL Signal)
- Channel: Indication by 7 Segment LED Display
- TTL Status Signals
- Euro Size Card: (100 mm x 160 mm) with Standard DIN 41612 Connector for Easy Integration Into 19" Rack Systems (See Page 473)
- Powered by Included 9 V Power Supply or via USB Port

The OSW series of switch kits consists of a MEMS optical switch with an integrated control circuit that includes a USB 2.0 interface for easy integration into your optical system. We offer 1 x 2 and 2 x 2 MEMS modules with operating wavelengths from 480 nm to 1575 nm. These bi-directional 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 <1 ms). The OSW switches are designed for the distribution and routing of signals at the indicated visible or near infrared wavelengths. The OSW series can be controlled via USB 2.0 by the included GUI and driver package, an onboard toggle switch, or via BNC input (TTL signal).

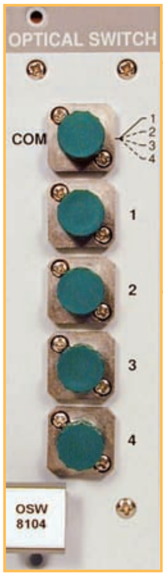
By default, all switches are shipped without fiber connectors. Termination of the fibers is available upon request; please contact your local technical support office for pricing. Additionally, 1 x 4 and 1 x 8 MEMS switch modules are available upon request.

The OSW series ships with a 9 V power supply, USB cable, and software package with GUI and LabVIEW™ driver set.

ITEM #	OSW12-488E OSW22-488E	OSW12-633E OSW22-633E	OSW12-780E OSW22-780E	OSW12-830E OSW22-830E	OSW12-980E OSW22-980E	OSW12-1310E OSW22-1310E
Operating Wavelength	480 - 650 nm	600 - 800 nm	750 - 950 nm	800 - 1000 nm	970 - 1170 nm	1285 - 1330 nm and 1525 - 1575 nm
Insertion Loss (Typical)	N/A	0.7 dB Over Wavelength Range				
Insertion Loss (Max)	4 dB at 488 nm	1.5 dB Over Wavelength Range				
Cross Talk	75 dB (Typical)/60 dB (Max)					
Polarization-Dependent Loss	0.02 dB (Typical)/ 0.05 dB (Max)					
Back Reflection	55 dB (Typical)/ 50 dB (Max)					
Switching Speed	0.5 ms (Typical)/ 1 ms (Max)					
Optical Power (Max)	30 mW	50 mW	75 mW	85 mW	105 mW	300 mW
Fiber Type (Single Mode)	SM450	CL 630 11	SM750	SM800-5.6-125	SM980-5.8-125	SMF-28e+
Mode-Field Diameter	3.3 µm @ 488 nm 3.4 µm @ 514 nm	4.3 µm @ 630 nm	5.3 µm @ 780 nm	5.6 µm @ 830 nm	5.8 µm @ 980 nm 6.2 µm @ 1064 nm	9.2 µm @ 1310 nm 10.4 µm @1550 nm
Lifetime (No Wear Out)	Proven up to 10^9 Switching Cycles					
Operating Voltage	4.75 - 5.25 VDC 300 mA (USB Connector) or 6 - 15 VDC 300 mA (DC Power Connector)					
Temperature	Operating: 0 to 40 °C, Storage: -40 to 70 °C					

ITEM #	$	£	€	RMB	DESCRIPTION
OSW12-488E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 480 - 650 nm
OSW12-633E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 600 - 800 nm
OSW12-780E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 750 - 950 nm
OSW12-830E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 800 - 1000 nm
OSW12-980E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 970 - 1170 nm
OSW12-1310E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 1285 - 1330 nm & 1525 - 1575 nm
OSW22-488E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 480 - 650 nm
OSW22-633E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 600 - 800 nm
OSW22-780E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 750 - 950 nm
OSW22-830E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 800 - 1000 nm
OSW22-980E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 970 - 1170 nm
OSW22-1310E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 1285 - 1330 nm & 1525 - 1575 nm

Optical Switch Modules for PRO8 (Page 1 of 2)



PRO8000 Optical Switch Modules: The OSW8000 optical switch modules facilitate distribution of test signals in complex test setups. The modularity of 1 x 2, 1 x 4, 1 x 8, and 2 x 2 switches allows for the flexible construction of routing paths. The bi-directional, 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 bi-directional switching modules are available, providing highly flexible routing of optical signals.

The OSW8000 series bi-directional optical switches offer a fast switching time (typically, rise times are better than 0.5 ms with a maximum of 1 ms), and a broad wavelength range (1240 nm to 1610 nm), making them ideal companions to our extensive line of DWDM laser diode sources shown on pages 1267 - 1275. The four different modules offered are 1 x 2, 1 x 4, 1 x 8, and 2 x 2 switches, each of which features low insertion loss and excellent repeatability.

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.

Features

- Wavelength Range: 1240 - 1610 nm
- Very Fast Response Time: 0.5 ms Typical, 1 ms Max
- Low Insertion Loss: 0.7 dB (1 x 2) Typical, 2.6 dB (1 x 8) Max
- Excellent Repeatability: ±0.01 dB
- MEMS Technology for Long Life: $>10^9$ Cycles
- Four Modules: 1 x 2, 1 x 4, 1 x 8, and 2 x 2
- Up to Eight Switch Modules per Chassis
- LabVIEW™ and LabWindows™/CVI Drivers Included
- Efficient Test Signal Routing in Branching Test Beds

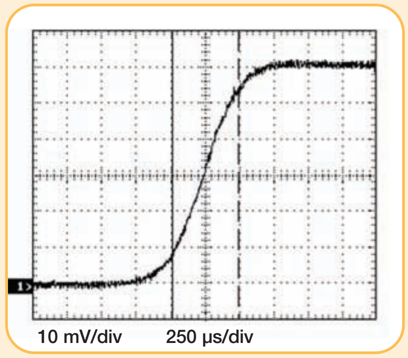


Figure 1
Rise time measurement of the MEMS based optical switch; the rise time measured between the 10% and 90% points is 480 µs.

MEMS Technology:
Provides Billions of Switch Cycles
The switching mechanism is based on silicon MEMS (Micro-Electro-Mechanical Systems) technology, which ensures a long lifetime and fast operation (see Figure 1). This technology also provides very low crosstalk between channels; the 1 x 4 and 1 x 8 switches have a maximum crosstalk specification of -60 dB, and the 1 x 2 and 2 x 2 are both rated at -50 dB.

IEEE-488 Computer Control of Multiple PRO8s
The PRO8 chassis (2 slot and 8 slot models) are both equipped with an IEEE-488.2 interface supported by a number of free LabVIEW™ and LabWindows™ drivers. The PRO8 can accept an assortment of different modules, allowing the OSW8000 switches to be combined with our high-performance laser sources. All PRO8 series chassis are also equipped with an RS-232C interface.

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

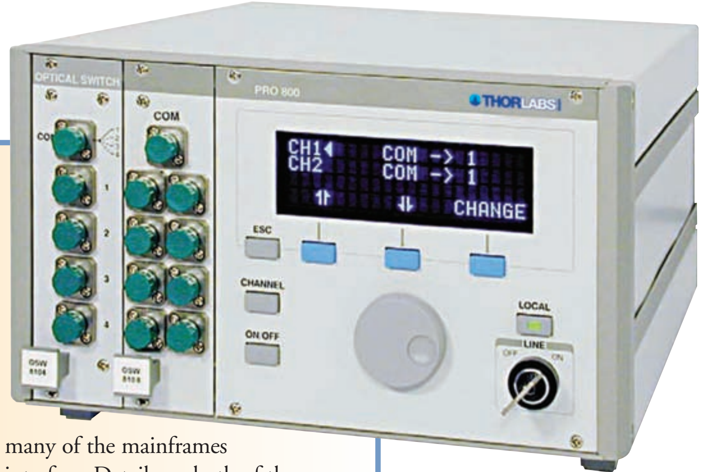
Configuring a system is as simple as inserting the modules; each of the plug-in modules automatically identifies itself to the chassis processor. A brightly lit, 4 x 20 fluorescence display allows the user to scroll through and select any installed module. When selected on the display, all of the control parameters for the individual module are accessible and all functionality is controllable via the front panel. Additional higher level commands are available for operating the system via the IEEE-488 interface (e.g., changing switch settings to automate multi-path testing).

Optical Switch Modules for PRO8 (Page 2 of 2)

OSW8202

Other Connectors Available upon Request.

The OSW8000 series of modules requires one of our two PRO8 series chassis. We offer two different chassis versions: the PRO800 two-slot chassis fits perfectly where space is limited, and the PRO8000 eight-slot chassis is ideal for use in building larger test systems. For even larger test systems it is possible to control many of the mainframes simultaneously via the IEEE-488.2 interface. Details on both of these PRO8 chassis can be found on page 1160.



PRO800 with Two OSW8000 Modules

ITEM #	OSW8102	OSW8104	OSW8108	OSW8202
Switching Configuration	1 x 2	1 x 4	1 x 8	2 x 2
Switching Time Typical	0.5 ms Typical (1 ms Max)			
Wavelength Ranges	1240 - 1610 nm			
Maximum Input Power	17 dBm (CW)			
Insertion Loss (Typical/Max)*	0.7 dB / < 1.5 dB	1.2 dB/<2.1 dB	1.6 dB/<2.6 dB	0.7 dB/<1.5 dB
PDL**	<0.1 dB	<0.15 dB	<0.2 dB	<0.15 dB
Crosstalk, Max	<-50 dB	<-60 dB	<-60 dB	<-50 dB
Repeatability	±0.01 dB			
Return Loss	-50 dB	-50 dB	-45 dB	-50 dB
Connectors	FC/APC			
General Data Operating Temperature	0 to +35 °C			
Storing Temperature	-10 to +60 °C			
Width	1 Slot			

* Including connectors ** Measured at 1550 nm

ITEM #	$	£	€	RMB	DESCRIPTION
OSW8102	$ 3,214.00	£ 2,314.08	€ 2.796,18	¥ 25,615.58	1 x 2 Optical Switch, FC/APC
OSW8104	$ 4,198.00	£ 3,022.56	€ 3.652,26	¥ 33,458.06	1 x 4 Optical Switch, FC/APC
OSW8108	$ 8,158.00	£ 5,873.76	€ 7.097,46	¥ 65,019.26	1 x 8 Optical Switch, FC/APC
OSW8202	$ 3,955.00	£ 2,847.60	€ 3.440,85	¥ 31,521.35	2 x 2 Optical Switch, FC/APC

FC/PC to FC/PC Mating Sleeves

FCB1
L-Bracket

ADAFC2
Square Flange

ADAFC1
Panel Mount

Mechanical Drawings Available on the WEB

- **FCB1:** Two FC/PC mating sleeves premounted on an L-bracket that can be easily mounted onto a TR series post. (Wide key: 2.2 mm)
- **ADAFC1:** Use this as a panel mount (D hole) or as a floating style adapter to connect two FC single or multimode cables. (Wide key: 2.2 mm)
- **ADAFC2:** This FC/PC to FC/PC adapter has a square flange and is intended for panel mounting. The flange has two clearance holes located diagonally on a 9.50 mm square, while two additional holes are M2 x 0.4 tapped. (Wide key: 2.2 mm)

ITEM #	$	£	€	RMB	DESCRIPTION
FCB1	$ 54.70	£39.38	€ 47,59	¥ 435.96	FC/PC to FC/PC Dual Mating Sleeve L-Bracket
ADAFC1	$ 9.60	£ 6.91	€ 8,35	¥ 76.51	FC/PC to FC/PC D Hole Mating Sleeve
ADAFC2	$ 10.70	£ 7.70	€ 9,31	¥ 85.28	FC/PC to FC/PC Square Mating Sleeve

FC/APC to FC/APC Mating Sleeves

FCB2
L-Bracket

ADAFC4
Panel Mount

ADAFC3
Square Flange

- **FCB2:** Two FC/APC mating sleeves premounted on an L-bracket that can be easily mounted onto a TR series post. (Narrow key: 2.0 mm)
- **ADAFC4:** Mount this mating sleeve in the D-hole of a standard rack mount panel or use it as a floating style adapter to connect two FC/APC single mode cables. (Narrow key: 2.0 mm)
- **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. (Narrow key: 2.0 mm)

ITEM #	$	£	€	RMB	DESCRIPTION
FCB2	$ 74.90	£ 53.93	€ 65,16	¥ 596.95	FC/APC to FC/APC Dual Mating Sleeve L-Bracket
NEW ADAFC4	$ 14.30	£ 10.30	€ 12,44	¥ 113.97	FC/APC to FC/APC D Hole Mating Sleeve
ADAFC3	$ 20.80	£ 14.98	€ 18,10	¥ 165.78	FC/APC to FC/APC Square Mating Sleeve

FC to FC PM Mating Sleeves

ADAFC2-PMW
Panel Mount
PM FC to PM FC
2.1 mm Key Slot

ADAFC2-PMN
Panel Mount
PM FC to PM FC
2.0 mm Key Slot

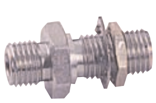
Features

- Compatible with FC/PC and FC/APC Connectors
- Monolithic Design Ensures Optimal Performance for PM-PM Interfaces
- Wide (2.09-2.14 mm) and Narrow (1.97-2.02 mm) Key Versions

The ADAFC2-PMN and ADAFC2-PMW mating sleeves have a monolithic construction and square flange that allows them to be attached to a panel. They are ideal for joining polarization-maintaining fibers with FC/PC or FC/APC connectors. ADAFC2-PMN has a 2.0 mm (narrow) keyway, while the ADAFC2-PMW has a 2.1 mm (wide) keyway.

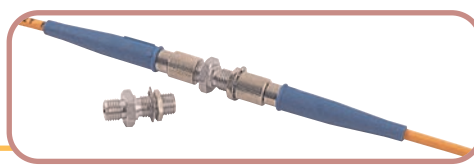
ITEM #	$	£	€	RMB	DESCRIPTION
ADAFC2-PMN	$ 48.00	£ 34.56	€ 41,76	¥ 382.56	PM FC Adapter Narrow (2.0 mm) Key
ADAFC2-PMW	$ 48.00	£ 34.56	€ 41,76	¥ 382.56	PM FC Adapter Wide (2.1 mm) Key

SMA to SMA Mating Sleeves



ADASMA
Panel Mount

SMAB1
L-Bracket



- The ADASMA Mating Sleeve and SMAB1 Dual L-Bracket are designed to connect SMA-terminated fibers. Although the ADASMA is compatible with SMA905-style connectors, an adapter is included that allows the mating sleeve to be used with SMA906-connectorized fibers.
- The SMAB1 Dual L-Bracket consists of two ADASMA mating sleeves that have been premounted on an L-bracket. The bracket can be mounted on a TR Series Post (See Page 93).

ITEM #	$	£	€	RMB	DESCRIPTION
ADASMA	$ 17.30	£ 12.46	€ 15,05	¥ 137.88	SMA to SMA Mating Sleeve
SMAB1	$ 39.50	£ 28.44	€ 34,37	¥ 314.82	SMA to SMA Dual L-Bracket Mating Sleeve

FC/PC to SMA Mating Sleeve

Mechanical Drawings Available on the WEB

The ADAFCSMA1 stainless steel mating sleeve is designed to join a single mode or multimode fiber that has an FC/PC connector with an SMA-connectorized multimode fiber. When joining two multimode fibers, the typical insertion loss is less than 1.4 dB.* On the other hand, if an FC/PC-terminated single mode fiber is mated with an SMA-terminated multimode fiber, the typical insertion loss is less than 0.2 dB.** It has a 2.14 mm (wide) keyway on the FC side of the mating adapter. Please note that the connector tips are brought into physical contact with each other when using this mating sleeve.

* During testing, an FC/PC-terminated MM fiber was mated to an SMA-terminated MM fiber; both fibers had Ø50 µm cores. The wavelength of the light was 633 nm with AFS50/125Y.

** During testing, an FC/PC-terminated SM fiber (SM600) with 0.12 NA was mated to an SMA-terminated MM fiber with a Ø50 µm core (AFS50/125Y). The wavelength of the light was 633 nm.

ADAFCSMA1

ITEM #	$	£	€	RMB	DESCRIPTION
ADAFCSMA1	$ 42.90	£ 30.89	€ 37,32	¥ 341.91	FC/PC to SMA Mating Sleeve

Please refer to our website for complete models and drawings.

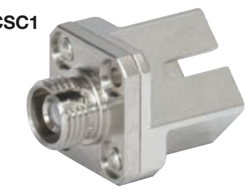
FC/PC to SC Mating Sleeve

NEW product

The ADAFCSC1 FC/PC to SC stainless steel mating sleeve is designed to allow an FC/PC-terminated single mode or multimode fiber to be mated with an SC-terminated single mode or multimode fiber. The typical insertion loss when connecting two SM fibers is less than 0.11 dB.* The connector tips are brought into physical contact with each other when using this mating sleeve. It has a 2.2 mm (wide) keyway and a square flange with two through holes for panel mounting.

* During testing, an FC/PC-terminated SM fiber with 0.14 NA was mated to an SC-terminated SM fiber; both fibers had Ø8.2 µm cores (SMF-28e+ fiber). The wavelength of the light was 633 nm.

ADAFCSC1



ITEM #	$	£	€	RMB	DESCRIPTION
ADAFCSC1	$ 12.00	£ 8.64	€ 10,44	¥ 95.64	FC/PC to SC Mating Sleeve

FC/PC to ST Mating Sleeve

NEW product

Thorlabs' ADAFCST1 FC/PC to ST stainless steel mating sleeve allows an FC/PC-terminated single mode or multimode fiber to be mated with an ST-terminated single mode or multimode fiber. The typical insertion when connecting these single mode fibers is less than 0.28 dB.* The connector tips are brought into physical contact with each other when using this mating sleeve. The ADAFCST1 features a 2.2 mm (wide) keyway and a square flange with two through holes that allow for panel mounting.

* During testing, an FC/PC-terminated SM fiber with 0.14 NA was mated to an ST-terminated SM fiber; both fibers had Ø8.2 µm cores (SMF-28e+ fiber). The wavelength of the light was 633 nm.

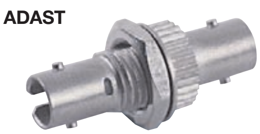
ADAFCST1

ITEM #	$	£	€	RMB	DESCRIPTION
ADAFCST1	$ 12.00	£ 8.64	€ 10,44	¥ 95.64	FC/PC to ST Mating Sleeve

ST to ST Mating Sleeve

The ADAST is a panel-mount-style adapter that is used to connect two ST connectors. The metal housing and precision alignment sleeve ensure proper alignment of the mating ferrules and allow the two fiber cores to be in contact, leading to minimal back reflections.

ADAST

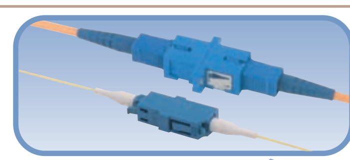


ST Single Mode Adapter
(Also Compatible with Multimode Fibers)

ITEM #	$	£	€	RMB	DESCRIPTION
ADAST	$ 5.90	£ 4.25	€ 5,13	¥ 47.02	ST to ST Mating Sleeve

LC and SC Mating Sleeves

The ADASC1 and ADALC1 are panel-mount-style mating sleeves that are used to connect two SC/PC- or LC-terminated fiber optic cables, respectively.



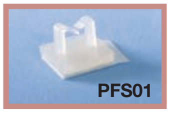
ADALC1
LC to LC

ADASC1
SC to SC Panel Mount

ITEM #	$	£	€	RMB	DESCRIPTION
ADASC1	$ 17.60	£ 12.67	€ 15,31	¥ 140.27	SC/PC to SC/PC Mating Sleeve
ADALC1	$ 17.60	£ 12.67	€ 15,31	¥ 140.27	LC to LC Mating Sleeve

Fiber Clips

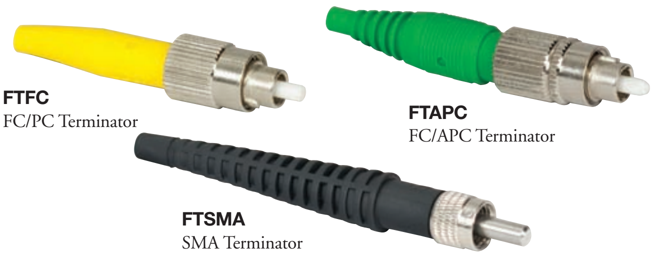
These Plastic Fiber Optic Clips are specifically designed to accept either Ø3 mm (PFS01) or Ø900 µm (PFS02) furcation tubes. The bottom surfaces of these clips have an adhesive that securely adheres them to clean, smooth surfaces.



ITEM #	$	£	€	RMB	DESCRIPTION
PFS01	$ 6.10	£ 4.39	€ 5,31	¥ 48.62	Ø3 mm Fiber Optics Cable Saddle, 10 per Pack
PFS02	$ 6.10	£ 4.39	€ 5,31	¥ 48.62	Ø900 µm Fiber Optic Cable Saddle, 10 per Pack

Light Trap Fiber Connectors

NEW products



Features

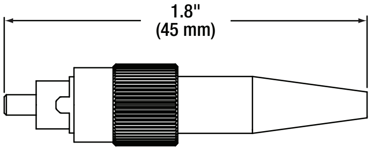
- Reduce Back Reflections of Unused Ports
- Back Reflection Better than -50 dB
- FC/PC, FC/APC, or SMA Connector
- Wavelength Range: 1260 – 1620 nm
- Fiber Type: SMF-28e+
- Other Connector Styles Available Upon Request

Thorlabs' Terminating Connectors are designed to be used with ports that do not have an output fiber connected to them. Terminating connectors reduce back reflections into the input fiber to ≤-50 dB by coupling emitted light into SMF-28e+ fiber and then diffusing the light within the terminator. In contrast, typical back reflections from an unused port can be as high as -30 dB.

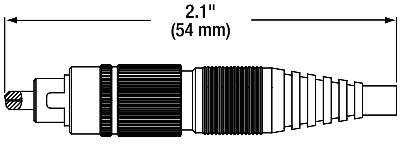
We offer terminating connectors with FC/PC, FC/APC, or SMA connectors. FC/PC and FC/APC versions use 2.0 mm narrow key connectors. For other connector styles, please contact your local Thorlabs office.

An FTFC terminating connector is used to reduce back reflections from Port A.

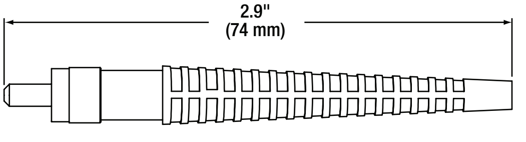
FTFC
FC/PC Terminator



FTAPC
FC/APC Terminator



FTSMA
SMA Terminator



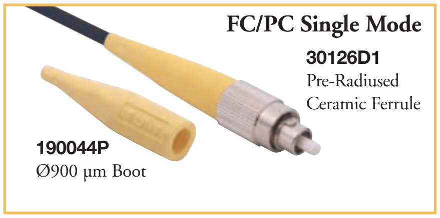
FTAPC
Back View

ITEM #	$	£	€	RMB	DESCRIPTION
FTFC	$ 17.00	£ 12.24	€ 14,79	¥ 135.49	FC/PC Light Trap Connector
FTAPC	$ 18.00	£ 12.96	€ 15,66	¥ 143.46	FC/APC Light Trap Connector
FTSMA	$ 12.50	£ 9.00	€ 10,88	¥ 99.63	SMA Light Trap Connector

Fiber
Selection Guide

Termination Selection Guide

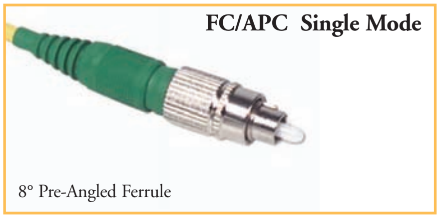
FC Fiber Connectors



CT042 Crimp Tool is Required for Ø3 mm Tubing

These FC/PC single mode connectors feature a pre-radiused (20 mm), ceramic ferrule that minimizes back reflections. These connectors, which have a narrow key width of 2.0 mm, come complete with a strain relief boot for either Ø3 mm or Ø900 µm tubing. Each connector package includes a fiber connector cap.

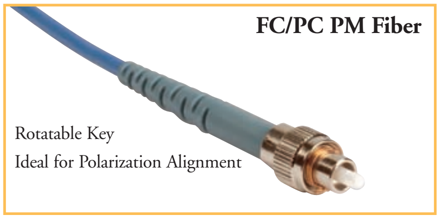
ITEM #	$	£	€	RMB	DESCRIPTION
30126D1	$ 8.16	£ 5.88	€ 7,10	¥ 65.04	FC/PC, SM, Ø125 µm Bore, Ø3 mm Boot
30080D1	$ 20.40	£ 14.69	€17,75	¥162.59	FC/PC, SM, Ø81 µm Bore, Ø900 µm Boot
190044P	$ 10.50	£ 7.56	€ 9,14	¥ 83.69	Ø900 µm Yellow Boots, 25/Pack



CT042 Crimp Tool is Required for Ø3 mm Tubing

These FC/APC connectors have an 8° pre-angled ceramic ferrule, which when properly polished, results in a typical return loss of 60 dB. These connectors, which have a 2.0 mm narrow key, have a low 0.25 dB connector-to-connector typical loss. Each connector package includes a fiber connector cap.

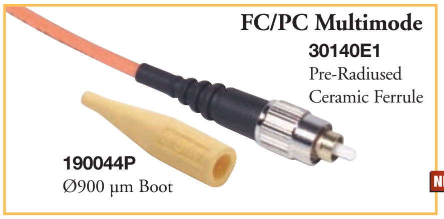
ITEM #	$	£	€	RMB	DESCRIPTION
30126F1	$14.00	£10.08	€12,18	¥111.58	FC/APC, Ø126 µm Bore, Ø3 mm Boot
30126K1	$11.73	£ 8.45	€10,21	¥ 93.49	FC/APC, Ø126 µm, Bore, Ø900 µm Boot



CT042 Crimp Tool is Required for Ø3 mm Tubing

Designed for polarization-maintaining fibers, these FC/PC connectors have a key that is continuously adjustable, allowing for precise alignment with either the slow or fast axis of the PM fiber. Once aligned, the key can then be glued into place for easy reference. These connectors also have a standard 2.0 mm narrow key.

ITEM #	$	£	€	RMB	DESCRIPTION
301255D1	$ 10.97	£ 7.90	€ 9,54	¥ 87.43	FC/PC, PM, Ø125.5 µm Bore, Ø3 mm/Ø900 µm Boots



CT042 Crimp Tool is Required for Ø3 mm Tubing

These FC/PC multimode connectors, which have a 2.0 mm narrow key, feature a stainless steel (30126G2 series) or ceramic (30128E2 and 30140E1) ferrule. Each connector includes a fiber connector cap.

NEW versions

Ceramic Ferrule Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
NEW 30128E2	$ 9.13	£ 6.57	€ 7,94	¥ 72.77	FC/PC, MM, Ø128 µm Bore, Ø900 µm and Ø3 mm Boot
30140E1	$ 9.13	£ 6.57	€ 7,94	¥ 72.77	FC/PC, MM, Ø140 µm Bore, Ø3 mm Boot
190044P	$10.50	£ 7.56	€ 9,14	¥ 83.69	Ø900 µm Yellow Boots, 25/Pack

Drilled Connector Features

- Stainless Steel Ferrules
- 2.0 mm Narrow Key
- For Connectorization of Our Large-Core Fibers
- Positive Contact
- Ø3 mm Boot Included

30126G2-230

Custom-Drilled Connectors Available
Call Tech Support

Drilled Stainless Steel Ferrule Connectors

ITEM #	$	£	€	RMB	DRILLED SIZE	DIAMETER TOLERANCE
NEW 30126G2	$ 9.13	£ 6.57	€ 7,94	¥ 72.77	Ø126 µm	+2/-0 µm
30126G2-230	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø230 µm	+10/-4 µm
30126G2-240	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø240 µm	+10/-4 µm
30126G2-250	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø250 µm	+10/-4 µm
30126G2-260	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø260 µm	+10/-4 µm
30126G2-270	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø270 µm	+10/-4 µm
30126G2-340	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø340 µm	+10/-4 µm
30126G2-440	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø440 µm	+10/-4 µm
NEW 30126G2-450	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø450 µm	+10/-4 µm
30126G2-500	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø500 µm	+20/-5 µm
30126G2-640	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø640 µm	+20/-5 µm
NEW 30126G2-670	$ 9.97	£ 7.18	€ 8,67	¥ 79.46	Ø670 µm	+20/-5 µm
NEW 30126G2-850	$ 12.50	£ 9.00	€ 10,88	¥ 99.63	Ø850 µm	+30/-10 µm
30126G2-1050	$ 12.50	£ 9.00	€ 10,88	¥ 99.63	Ø1050 µm	+30/-10 µm
NEW 30126G2-1270	$ 18.43	£ 13.27	€ 16,03	¥ 146.89	Ø1270 µm	+30/-10 µm
30126G2-1580	$ 18.43	£ 13.27	€ 16,03	¥ 146.89	Ø1580 µm	+30/-10 µm

SMA 905 Fiber Connectors

NEW versions

Custom-Drilled Connectors Available
Call Tech Support

CT042 Crimp Tool is Required for Ø3 mm Tubing

SMA Main Body

SMA-style connectors are most commonly used with multimode fibers since the ferrule is an ideal choice for large-core fibers (see pages 1053 - 1062 for our selection of these fibers). Thorlabs stocks a complete selection of SMA connectors with ferrule sizes to accommodate all of our fiber cladding sizes from Ø125 µm to Ø1250 µm. Each connector includes a fiber connector cap.

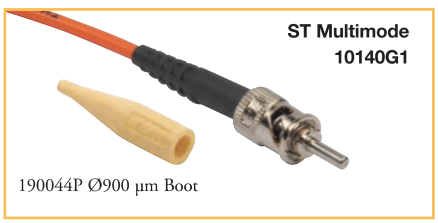
ITEM #	$	£	€	RMB	DRILLED SIZE	DIAMETER TOLERANCE
10125A	$ 9.20	£ 6.62	€ 8,00	¥ 73.32	Ø128 µm	+5/-0 µm
10140A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø144 µm	+5/-0 µm
10230A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø231 µm	+10/-0 µm
10250A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø250 µm	+15/-0 µm
10260A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø260 µm	+13/-0 µm
10270A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø270 µm	+15/-0 µm
10340A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø340 µm	+15/-0 µm
10410A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø410 µm	+15/-0 µm
10440A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø440 µm	+15/-0 µm
NEW 10450A	$ 9.65	£ 6.95	€ 8,40	¥ 76.91	Ø450 µm	+15/-0 µm
10510A	$ 9.76	£ 7.03	€ 8,49	¥ 77.79	Ø510 µm	+15/-0 µm
10610A	$ 9.76	£ 7.03	€ 8,49	¥ 77.79	Ø612 µm	+15/-0 µm
10640A	$ 9.76	£ 7.03	€ 8,49	¥ 77.79	Ø641 µm	+15/-0 µm
NEW 10670A	$ 9.76	£ 7.03	€ 8,49	¥ 77.79	Ø670 µm	+15/-0 µm
10770A	$ 9.76	£ 7.03	€ 8,49	¥ 77.79	Ø770 µm	+15/-0 µm
10850A	$ 9.76	£ 7.03	€ 8,49	¥ 77.79	Ø850 µm	+15/-0 µm
11040A	$ 10.20	£ 7.34	€ 8,87	¥ 81.29	Ø1040 µm	+15/-0 µm
11050A	$ 10.50	£ 7.56	€ 9,14	¥ 83.69	Ø1055 µm	+15/-0 µm
11275A	$ 10.50	£ 7.56	€ 9,14	¥ 83.69	Ø1275 µm	+15/-0 µm

ST Fiber Connectors

CT042 Crimp Tool is Required for Ø3 mm Tubing

This ST single mode connector features a ceramic ferrule with a pre-radiused tip (20 mm) to minimize back reflections and is packaged with a strain relief boot for Ø3 mm tubing.

ITEM #	$	£	€	RMB	DESCRIPTION
30126B1	$ 8.67	£ 6.24	€ 7,54	¥ 69.10	Ceramic Ferrule, ST/PC, Ø125 µm Cladding
190044P	$ 10.50	£ 7.56	€ 9,14	¥ 83.69	Ø900 µm Yellow Strain Relief Boots, 25/Pack

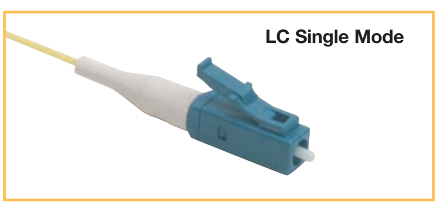


CT042 Crimp Tool is Required for Ø3 mm Tubing

This ST connector is designed for multimode applications. The stainless steel ferrule connector can be customized to accept fiber cladding diameters up to Ø1 mm, please contact Tech Support for details.

ITEM #	$	£	€	RMB	DESCRIPTION
10140G1	$ 11.20	£ 8.06	€ 9,74	¥ 89.26	Stainless Steel Ferrule, ST, Ø140 µm Cladding
190044P	$ 10.50	£ 7.56	€ 9,14	¥ 83.69	Ø900 µm Yellow Strain Relief Boots, 25/Pack

LC Fiber Connector



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

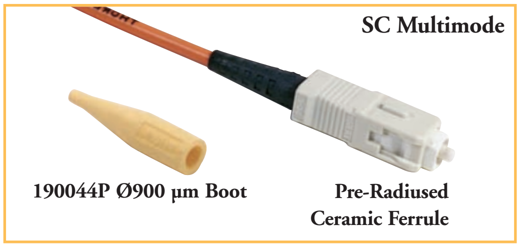
ITEM #	$	£	€	RMB	DESCRIPTION
86024-5500	$ 10.20	£ 7.34	€ 8,87	¥ 81.29	LC, Ø900 µm Tubing, Ø126 µm Cladding

Connector Crimp Tool

One tool can be used for crimping SMA, FC, SC, and ST connectors. Connectors with Ø3 mm or greater tubing require the use of a crimp tool, while Ø900 µm tubing or smaller does not need to be crimped.

ITEM #	$	£	€	RMB	DESCRIPTION
CT042	$ 99.00	£ 71.28	€ 86,13	¥ 789.03	Crimp Tool

SC Ceramic Fiber Connector



CT042 Crimp Tool is Required for Ø3 mm Tubing

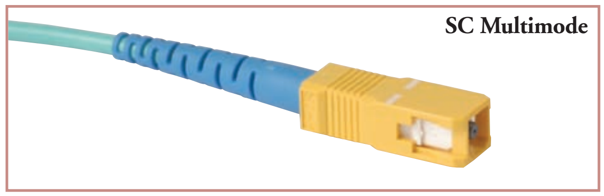
This SC-style connector features a pre-radiused (20 mm) ceramic ferrule that is packaged with a Ø3 mm boot and minimizes back reflections. The connector has a bore size of Ø125 µm. Each connector package includes a fiber connector cap and a Ø3 mm boot.

ITEM #	$	£	€	RMB	DESCRIPTION
30126H1	$ 8.67	£ 6.24	€ 7,54	¥ 69.10	SC, MM, Ø125 µm Bore
190044P	$ 10.50	£ 7.56	€ 9,14	¥ 83.69	Ø900 µm Yellow Boots, 25/Pack

SC Glue-On Connector for Plastic Optical Fiber

Features

- Standard SC Form Factor with Customized Ferrule
- All Material Complies with UL94 V0 and RoHS
- Internal Ferrule Dimension Allows for Direct Connection, No Buffer Removal Required
- F120 Fast Room Temperature Cure Epoxy Recommended for Termination
- LCP (Gray Plastic) Ferrule Material
- Compatible with Gradient-Index Plastic Optical Fiber (GIPOF), See Pages 1063 - 1064

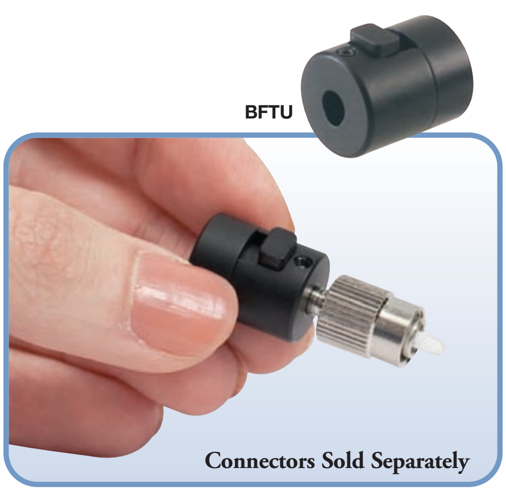


Crimp Tool CT042 Required for Ø3 mm Tubing

FERRULE DIMENSIONS	MIN	TYPICAL	MAX
Inner Diameter (ID)	0.493 mm	0.494 mm	0.496 mm

ITEM #	$	£	€	RMB	DESCRIPTION
30500A1	$ 6.85	£ 4.93	€ 5,96	¥ 54.59	SC Glue-On Connector

Bare Fiber Terminator



For applications where a temporary fiber termination is desired, our Bare Fiber Terminator is the solution. It is reusable and can be easily cleaned if the fiber breaks inside the connector by using the WC100 clean out wires (below). The bare fiber terminator is designed to mechanically hold fibers in standard connectors (sold separately). The BFTU accepts ferrules up to Ø0.158" (Ø4 mm) and fibers up to Ø0.03" (Ø0.7 mm).

The design is compatible with FC, ST, and SMA connectors, but is **not** compatible with the following connectors:

- SMA Connectors: 10850A, 11040A, 11050A, 11275A
- FC/PC Connectors: 30080D1, 301255D1
- FC/APC Connectors: 30126F1, 30126K1
- FC MM Connector: 30128E2, 30140E1, 30126G2 Series
- LC® SM Connector: 86024-5500

See Pages 1142 - 1143 for Compatible Connectors

ITEM #	$	£	€	RMB	DESCRIPTION
BFTU	$ 76.80	£ 55.30	€ 66,82	¥ 612.10	Terminator for FC, ST, and SMA Connectors
WC100	$ 12.60	£ 9.07	€ 10,96	¥ 100.42	Clean Out Wires (8 Pieces/Vial)

Dust Caps

Dirt on the fiber tip can result in permanent damage to the fiber connector, which can increase coupling losses or create undesirable mode structures in the output light. To prevent damaging the connectorized fiber, clean it before each use and use a fiber connector cap to protect the end face of the connectorized fiber when it is not in use. The CAPF is for use with fiber connector ferrules 2.5 mm in diameter while the CAPN is for use with SMA type connectors.

ITEM #	$	£	€	RMB	DESCRIPTION
CAPF	$ 6.60	£ 4.75	€ 5,74	¥ 52.60	Clear Dust Caps for Ø2.5 mm Ferrules (25/Pack)
CAPN	$ 6.60	£ 4.75	€ 5,74	¥ 52.60	Black Dust Caps for SMA Connectors (25/Pack)

Dust Remover

The CA3 is a pressurized 10 oz can of Tetrafluoroethane with built-in plastic nozzle, which is ideal for removing dust from optics and fiber.

Requires Ground Shipment

ITEM #	$	£	€	RMB	DESCRIPTION
CA3	$ 10.10	£ 7.27	€ 8,79	¥ 80.50	Canned Air with Plastic Nozzle

Fiber Inspection Scope

NEW product

- Optical Magnification of 200X
- White LED Illumination
- LED Lifetime: 100,000 Hours
- 190 mm (7.48") Long x Ø45 mm (1.77")
- Coaxial or Oblique Illumination Modes
- Fine Focus Control Wheel
- Built-In IR Filter
- Two AAA Batteries are Included

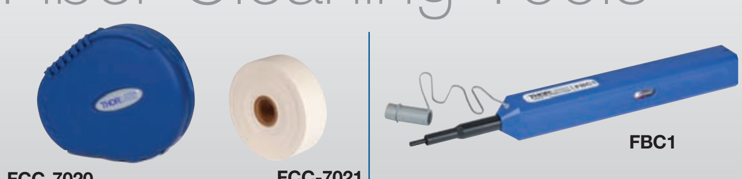
Universal Adapter for FC, ST, SC, and APC Connectors

The FS200 Fiber Inspection Scope, which comes with a universal adapter for FC-, ST-, SC-, and APC-terminated fibers, produces a high-quality, low-distortion image of both the connector end and the fiber. An adapter for SMA-terminated fibers is also included. With a high-intensity LED illumination system and 200X magnification, this microscope is powerful enough to offer a clear image of the fiber core as well as the surrounding cladding. In addition, there is the option to use an oblique illumination setting, which provides illumination at an off-center angle to the fiber endface. For critical examination of polish quality, we strongly recommend this fiber inspection scope.

ITEM #	$	£	€	RMB	DESCRIPTION
FS200	$ 202.00	£ 145.44	€ 175,74	¥ 1,609.94	Fiber Microscope

Have you seen our...

Fiber Cleaning Tools



- Universal Fiber Connector Cleaner and Refill
- Lint-Free Cleaning Cloth in Handheld Dispenser
- One-Step Fiber Bulkhead and Connector Cleaner
- Quickly Cleans FC/PC, ST, and SC Connectors and Bulkheads

See page 1156

Have you seen our...

Custom Patch Cables

- Same-Day Turnaround on Most Orders Before 12:00 pm Eastern, see website for details

See www.thorlabs.com/customcable

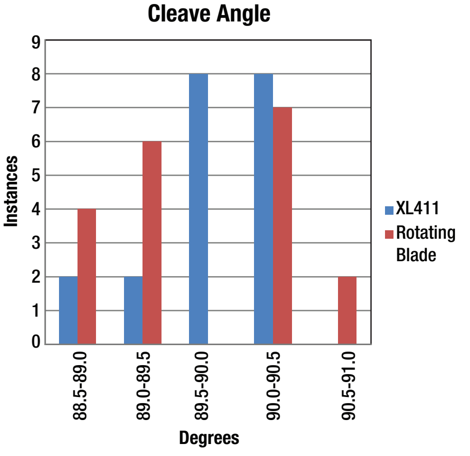
Precision Fiber Cleaver

Design and Cleave Quality

The XL411 is a high-precision fiber cleaver with a unique fixed blade design that consistently produces chip-free perpendicular cleaves. The flat blade is suspended above the fiber and, as a result, cleaves the fiber from the top. The result is a precision fiber cleaver that typically produces cleaves at 90° ± 1.0°, which is well within the ±3° tolerance needed for good fusion splicing. Many competing designs utilize a rotating blade that, while sufficient, does not produce cleaves with same consistency (see plot) because the rotating blade accesses the fiber from the side.

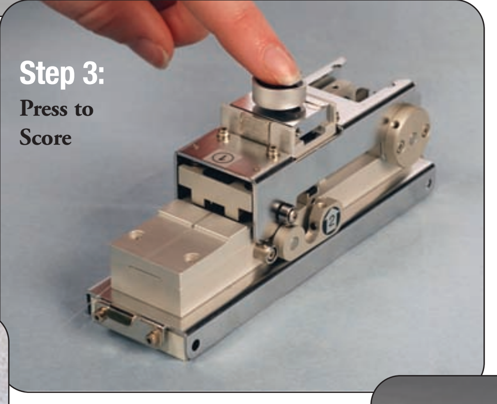
Blades

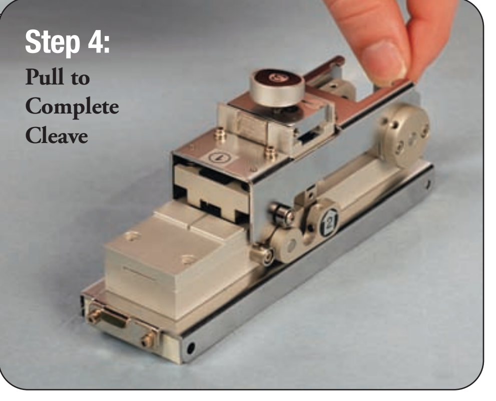
The blade used in the XL411 is flat, which has performance (see plot) and operational benefits. When the XL411 is used to cut single fibers, the lifetime of a single blade can be extended (up to 3 times) by repositioning the blade after the portion being used is dull so that a new portion of the blade is being used. After the entire blade has been used, the replacement of the blade is easily done in the field because of the easy to access blade location.



SIMPLE 4-STEP PROCESS

Each step is clearly labeled.





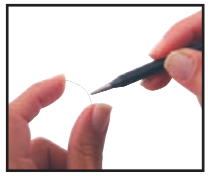
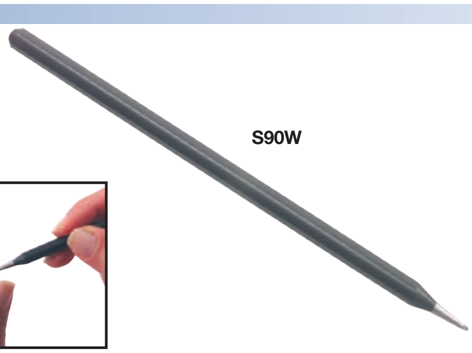
- Design Allows for a Switchable Blade Position
- Highly Repeatable Cleaves in Less than 30 Seconds
- Precise Mechanical Design Allows Field Replacement of Blades
- Standard Ø125/250 µm and Ø125/900 µm Fibers
- Cutter Blades Will Last at Least 3000 Operations Under Normal Use

ITEM #	$	£	€	RMB	DESCRIPTION
XL411	$ 1,360.00	£ 979.20	€ 1.183,20	¥ 10,839.20	Precision Fiber Cleaver, Switchable Blade Position
XL410B	$ 84.00	£ 60.48	€ 73,08	¥ 669.48	Replacement Blade

Diamond Wedge Scribe

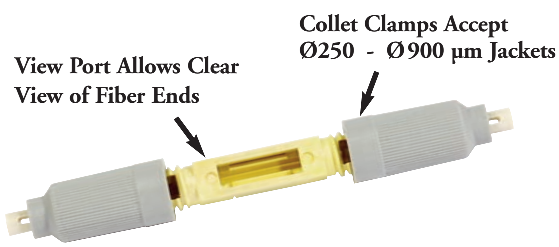
Features

- 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 Fiber Technicians
- Protective Cap Included

ITEM #	$	£	€	RMB	DESCRIPTION
S90W	$ 61.50	£ 44.28	€ 53,51	¥ 490.16	90° Wedge-Shaped Diamond Scribe

Reusable Fiber-to-Fiber Splice



Pre-Loaded Index-Matching Gel

Specifications

- **Average Splice Loss:** 0.2 dB
- **Fiber Jacket Size Range:** Ø250 - Ø900 µm (Both Models)
- **Fiber Retention:** >1250 g
- **Installation Time:*** <60 s

*See www.thorlabs.com for installation instructions.

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

ITEM #	$	£	€	RMB	DESCRIPTION
TS125	$ 18.50	£ 13.32	€ 16,10	¥ 147.45	Single Mode Fiber-to-Fiber Splice, Ø125 µm Cladding Size
TS128	$ 18.50	£ 13.32	€ 16,10	¥ 147.45	Multimode Fiber-to-Fiber Splice, Ø128 µm Cladding Size

Index-Matching Gel

- Minimizes Back Reflections in Fiber-to-Fiber Splices
- 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

*Index of Refraction @ 25° C

This index-matching gel may be used to couple optical signals into or out of optical fibers. When coated onto the fiber cladding for use as a mode stripper, 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 in excess of 416 °C. Note that this material will always remain a gel as it does not cure or harden.

ITEM #	$	£	€	RMB	DESCRIPTION
G608N	$ 30.90	£ 22.25	€ 26,88	¥ 246.27	1 mL Syringe of Index-Matching Gel

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.

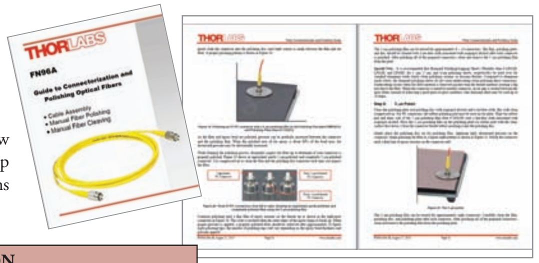
ITEM #	$	£	€	RMB	DESCRIPTION
B2939	$ 63.30	£ 45.58	€ 55,07	¥ 504.50	Kit: 4 Wash Bottles and 3 Glass Dropper Bottles

Guide to Connectorization and Polishing Optical Fibers

- Connectorization
- Cleaving
- Polishing

Free Download at www.thorlabs.com!

Easy-to-Follow Step-by-Step Instructions

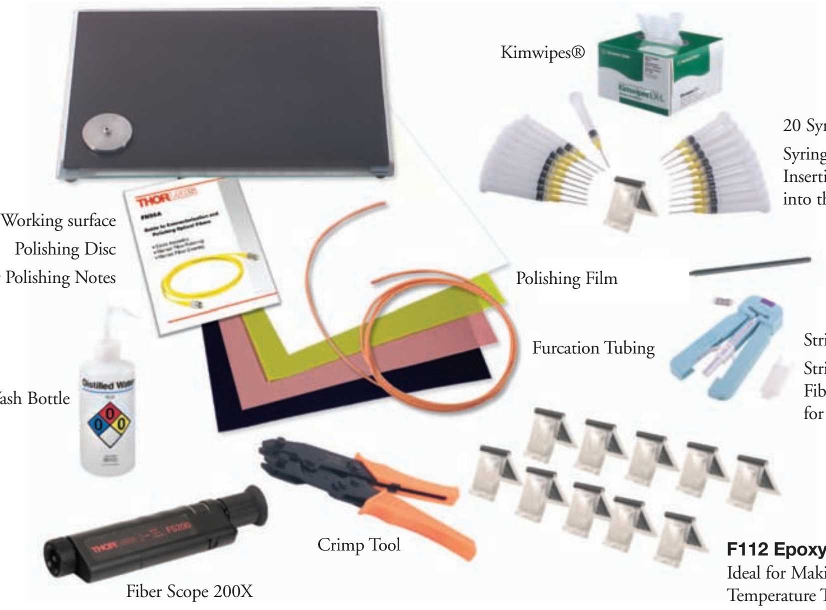


ITEM #	$	£	€	RMB	DESCRIPTION
FN96A	$ 6.90	£ 4.97	€ 6,00	¥ 54.99	Guide to Connectorization, Polishing, and Cleaving of Fibers

Connectorization Kits

- All Connectorization Kits Include
  - Glass Polishing Plate
  - 40 Sheets of Polishing Film
  - Polishing Disc
  - 200X Fiber Scope
  - Diamond Scribe
  - 20 Syringes
  - 2 m Furcation Tubing
  - Epoxy
  - Fiber Stripper
  - Kimwipes®
  - Wash Bottle
  - Crimp Tool
- The CK03 and CK05 Kits Include an Additional Rubber Polishing Pad that is Used to Produce PC (Radiused) Polishes.

Rubber Polishing Pad (FC and SC Kits only)



Items Not Included

- Connectors (See Pages 1142 - 1144)
- Fiber (See Pages 1019 - 1064)

ITEM #	$	£	€	RMB	DESCRIPTION
CK01	$ 715.12	£ 514.89	€ 622,15	¥ 5,699.51	SMA Connectorization Tool Kit
CK03	$ 735.42	£ 529.50	€ 639,82	¥ 5,861.30	FC/PC and SC Connectorization Tool Kit
CK05	$ 771.12	£ 555.21	€ 670,87	¥ 6,145.83	FC/APC Connectorization Tool Kit

Lens Tissues

MC-5 and MC-50E

These extremely soft, premium-grade, 4.9" x 2.9" (124 mm x 73 mm) tissues are shipped in packs of 5 or 50 protective booklets, with 25 sheets per booklet.

MC-5

MC-50E

ITEM #	$	£	€	RMB	DESCRIPTION
MC-5	$ 9.80	£ 7.06	€ 8,53	¥ 78.11	Lens Tissues (5 Booklets)
MC-50E	$ 78.00	£ 56.16	€ 67,86	¥ 621.66	Lens Tissues (50 Booklets)

Webril Lens Tissues

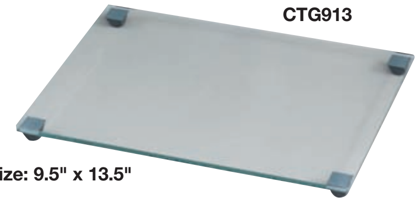
CP-100

These pure cotton, non-woven, lintless, absorbant cleaning pads are 4" x 8" (100 mm x 200 mm). 100 pads are included per package.

CP-100

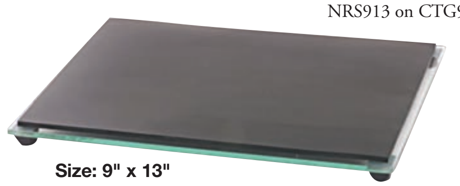
ITEM #	$	£	€	RMB	DESCRIPTION
CP-100	$ 11.40	£ 8.21	€ 9,92	¥ 90.86	Webril Pads (100/Pkg)

Polishing Plate and Polishing Pad



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

NRS913 on CTG913

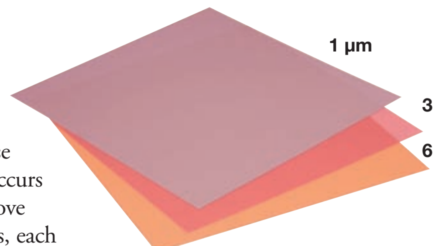


The rubber polishing pad is required when polishing PC-style pre-radiused connectors. When used with our glass polishing plate, the pad helps to maintain the pre-radiused connector tip geometry during polishing. We recommend using our *Guide to Connectorization and Polishing Optical Fibers* (FN96A on page 1148).

ITEM #	$	£	€	RMB	DESCRIPTION
CTG913	$ 33.00	£ 23.76	€ 28,71	¥ 263.01	Glass Polishing Plate, 9.5" x 13.5"
NRS913	$ 20.30	£ 14.62	€ 17,66	¥ 161.79	Polishing Pad, 9" x 13" for PC Finish

Polishing/Lapping Film, Diamond

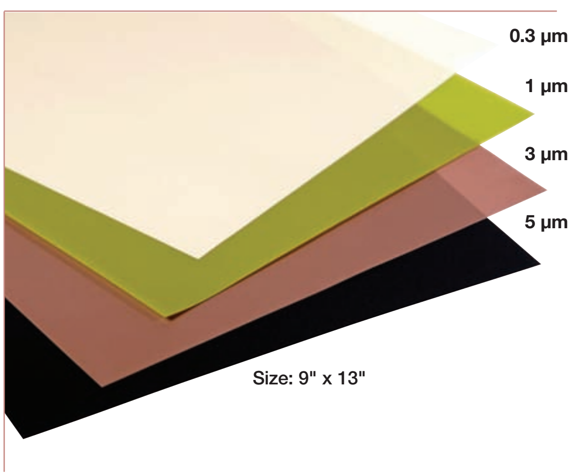
- 6" x 6" Sheets
- 3 Grades of Lapping Film



Thorlabs recommends using diamond sheets over the less expensive aluminum oxide sheets when polishing ceramic or zirconia ferrules because diamond sheets do not cause undercutting when polishing the connector like aluminum oxide can. Undercutting occurs when the fiber material is being removed faster than the ferrule, creating a gap just above the fiber. Even though the cost is higher per sheet compared to aluminum oxide sheets, each area of the sheet can be used up to 20 times, greatly increasing its value.We recommend using the 0.3 µm (LFG03P, below) finishing film to achieve the best possible polish.

ITEM #	$	£	€	RMB	DESCRIPTION
LFG1D	$ 46.00	£ 33.12	€ 40,02	¥ 366.62	1.0 µm Lapping Film, 5 Sheets
LFG3D	$ 46.00	£ 33.12	€ 40,02	¥ 366.62	3.0 µm Lapping Film, 5 Sheets
LFG6D	$ 46.00	£ 33.12	€ 40,02	¥ 366.62	6.0 µm Lapping Film, 5 Sheets

Polishing/Lapping Film, Aluminum Oxide/Silicon Carbide



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

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: 0.3, 1, 3, and 5 µm. Each package comes with 10 sheets. The 0.3, 1.0, and 3.0 µm films are aluminum oxide while the 5.0 µm film is silicon carbide.

ITEM #	$	£	€	RMB	DESCRIPTION
LFG03P	$ 15.07	£ 10.85	€ 13,11	¥ 120.11	0.3 µm Lapping Film, 10 Sheets
LFG1P	$ 13.40	£ 9.65	€ 11,66	¥ 106.80	1.0 µm Lapping Film, 10 Sheets
LFG3P	$ 13.40	£ 9.65	€ 11,66	¥ 106.80	3.0 µm Lapping Film, 10 Sheets
LFG5P	$ 13.40	£ 9.65	€ 11,66	¥ 106.80	5.0 µm Lapping Film, 10 Sheets

Polishing Discs

SMA

D50-A
Calibration Pin

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 SMA polishing disc.

ITEM #	$	£	€	RMB	DESCRIPTION
D50-SMA	$ 63.20	£ 45.50	€ 54,98	¥ 503.70	SMA Polishing Disc and Calibration Pin
D50-A	$ 19.40	£ 13.97	€ 16,88	¥ 154.62	Calibration Pin for D50-SMA

FC and SC

FC and SC Polishing Disc

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

ITEM #	$	£	€	RMB	DESCRIPTION
D50-FC	$ 63.20	£ 45.50	€ 54,98	¥ 503.70	FC and 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	$ 81.60	£ 58.75	€ 70,99	¥ 650.35	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	$ 81.60	£ 58.75	€ 70,99	¥ 650.35	LC Polishing Disc

FC/APC

FC/APC Polishing Disc

This FC/APC polishing disc is designed to polish ferrules at 8° while securing the connector key in the proper orientation with respect to the polish angle.

ITEM #	$	£	€	RMB	DESCRIPTION
D50-FC/APC	$ 98.90	£ 71.21	€ 86,04	¥ 788.23	FC/APC Polishing Disc

SMA Height Gauge

10125HG

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.

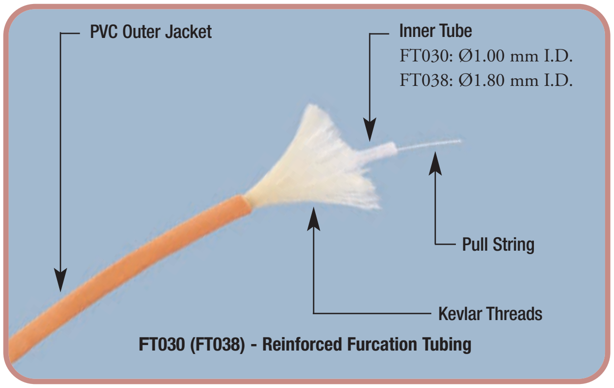
ITEM #	$	£	€	RMB	DESCRIPTION
10125HG	$ 300.90	£ 216.65	€ 261,78	¥ 2,398.17	Fiber Optic SMA Connector Height Gauge

Furcation Tubing

Furcation tubing, also commonly referred to as jacketing or buffer, is used to protect delicate fiber optic cables from being damaged. The tubing color is chosen to represent the type of fiber patch cable (e.g., single mode). Yellow tubing is industry standard for single mode fiber, orange for multimode fiber, and blue is typically reserved for polarization-maintaining fiber. Black jacketing is generally chosen for light-sensitive applications. When selecting furcation tubing, please note the inside diameter as this dimension must be larger than the outside diameter of the fiber you are using.

There are three main types of furcation tubing that are offered by Thorlabs. The first is the FT900SM, a 900 µm outside diameter Hytrel tube. Since this furcation tubing has an inside diameter of only 500 µm, it is only large enough to use with our single mode fibers. The FT030 and FT038 series of furcation tubings are very similar but differ in inside and outside diameter (see their composition at right). Feeding fiber through furcation tubing can be difficult, so the inner tubes of the FT030 and FT038 feature a pull string to help guide the fiber. The Kevlar threads that surround the inner tube protect the fiber from damage as they cushion impact that the PVC outer jacket incurs. These furcation tubes can be used with SM, PM, and MM fibers.

Finally, the FT051SS stainless steel tubing is available. A Ø3 mm Hytrel-jacketed fiber is typically fed through the steel tubing to provide substantial protection to the fiber.

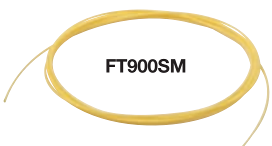


FT030 (FT038) - Reinforced Furcation Tubing

FT030 & FT038 series feature Thorlabs logo

Ø900 µm Hytrel Tubing

- 500 µm I.D.
- 900 µm O.D.



Ø3 mm PVC Outer Jacket

- 1.0 mm I.D.
- 3.0 mm O.D.

Features

- Protect Fiber Optic Cables
- Colored Tubing Denotes Fiber Type
- Four Types of Tubing Available

ITEM #	I.D.*	O.D.**	COLOR
FT900SM	500 µm	900 µm	Yellow
FT030	1.0 mm	3 mm	Orange
FT030-Y	1.0 mm	3 mm	Yellow
FT030-BK	1.0 mm	3 mm	Black
FT030-BLUE	1.0 mm	3 mm	Blue
FT038	1.8 mm	3.8 mm	Red
FT038-BK	1.8 mm	3.8 mm	Black
FT051SS	3.5 mm	5.1 mm	Stainless Steel

*Inner Diameter **Outer Diameter

ITEM #*	$ 1-9 m	$ 10-49 m	$ 50-249 m	£ 1-9 m	£ 10-49 m	£ 50-249 m	€ 1-9 m	€ 10-49 m	€ 50-249 m	RMB 1-9 m	RMB 10-49 m	RMB 50-249 m
FT900SM	$ 2.00	$ 1.90	$ 1.80	£ 1.44	£ 1.37	£ 1.30	€ 1,74	€ 1,66	€ 1,57	¥ 15.94	¥ 15.15	¥ 14.35
FT030	$ 1.30	$ 1.24	$ 1.17	£ 0.94	£ 0.89	£ 0.85	€ 1,14	€ 1,08	€ 1,02	¥ 10.37	¥ 9.85	¥ 9.33
FT030-Y	$ 1.30	$ 1.24	$ 1.17	£ 0.94	£ 0.89	£ 0.85	€ 1,14	€ 1,08	€ 1,02	¥ 10.37	¥ 9.85	¥ 9.33
FT030-BK	$ 1.30	$ 1.24	$ 1.17	£ 0.94	£ 0.89	£ 0.85	€ 1,14	€ 1,08	€ 1,02	¥ 10.37	¥ 9.85	¥ 9.33
FT030-BLUE	$ 1.30	$ 1.24	$ 1.17	£ 0.94	£ 0.89	£ 0.85	€ 1,14	€ 1,08	€ 1,02	¥ 10.37	¥ 9.85	¥ 9.33
FT038	$ 1.80	$ 1.71	$ 1.62	£ 1.30	£ 1.24	£ 1.17	€ 1,57	€ 1,49	€ 1,41	¥ 14.35	¥ 13.63	¥ 12.92
FT038-BK	$ 1.80	$ 1.71	$ 1.62	£ 1.30	£ 1.24	£ 1.17	€ 1,57	€ 1,49	€ 1,41	¥ 14.35	¥ 13.63	¥ 12.92
FT051SS	$ 5.80	$ 5.51	$ 5.22	£ 4.18	£ 3.97	£ 3.76	€ 5,05	€ 4,80	€ 4,55	¥ 46.23	¥ 43.92	¥ 41.61

*Call for Pricing on Quantities Over 250m

Have you seen our...
Furcation Tubing Stripper
See page 1155

Kevlar Cutters

These cutters are designed for cutting the Kevlar threads that are used in the protective jackets of some furcation tubings. The serrated carbon steel blades keep the Kevlar threads from sliding as they are being cut.


T865

ITEM #	$	£	€	RMB	DESCRIPTION
T865	$ 36.67	£ 26.40	€ 31,90	¥ 292.26	Kevlar Cutter

Connector Crimp Tool

The CT042 can be used for crimping SMA, FC, SC, and ST connectors. Connectors with Ø3 mm or greater tubing require the use of a crimp tool, while Ø900 µm tubing or smaller does not need to be crimped.


CT042

ITEM #	$	£	€	RMB	DESCRIPTION
CT042	$ 99.00	£ 71.28	€ 86,13	¥ 789.03	Crimp Tool

CHAPTERS
Fiber Patch Cables
Bare Fiber
Fiber Optomechanics
Fiber Components
Test and Measurement
SECTIONS
Collimators
Couplers
WDMs
RGB Combiner
Circulators
Fiber Isolators
Faraday Mirrors
Fiber Attenuators
Polarization Controllers
Optical Switches
Mating Sleeves
Terminating Connectors
Termination

Index-Matching Gel

- Minimizes Back Reflections in Fiber-to-Fiber Splices
- 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

* Index of Refraction @ 25 °C

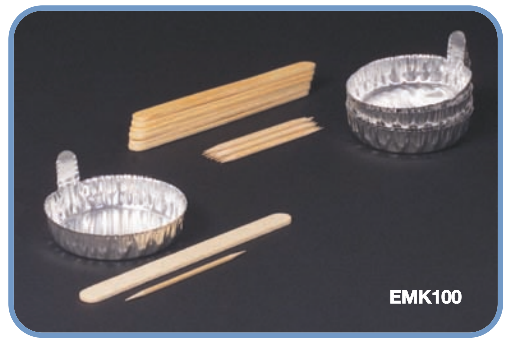
This index-matching gel may be used to couple optical signals into or out of optical fibers. When coated onto the fiber cladding, it will strip out the signal carried in the cladding. The gel is stable over a wide temperature range, with a freezing point of -67 °C and a boiling point in excess of 416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

ITEM #	$	£	€	RMB	DESCRIPTION
G608N	$ 30.90	£ 22.25	€ 26,88	¥ 246.27	1 mL Syringe of Index-Matching Gel

Epoxy Mixing Kit

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	$23.00	£ 16.56	€ 20,01	¥ 183.31	Epoxy Mixing Kit



5-Minute Epoxy

This is a general-purpose, 2-part epoxy that is packaged in an easy-to-use dispenser, thus ensuring a proper mix ratio every time. This epoxy is typically used for securing a boot to furcation tubing.

ITEM #	$	£	€	RMB	DESCRIPTION
G14250	$ 8.50	£ 6.12	€ 7,40	¥ 67.75	5-Minute Epoxy, 1 oz

Have you seen our...

UV Curing Epoxy and Tools

UV-Curing Epoxies

- Glass, Metal, or Plastic Adhesion
- Low Shrinkage and Low Stress
- Versions Available Individually or in a Kit Containing all 6 Adhesives
- Temporary Adhesive Available

UV-Curing System

- 27 W/cm² at 365 nm to Quickly Cure UV Adhesives
- Adjustable Beam Spots Through User-Replaceable Optics
- 5 Operation Modes Including 10 Configurable Profiles

For more details, see pages 408 - 409

Epoxy for Fiber Optic Connectors

- Easy-to-Use 2 g BI PAX®
- Enough Epoxy for 25 - 30 Connectors per Pack
- Sold in Packs of 10

These pre-measured 2 g 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 30 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.

*Not recommended for hard polymer clad fiber.

ITEM #	$/PKG.	£	€	RMB	POT LIFE	TYPICAL CURE SCHEDULE	OPERATING TEMPERATURE	CURED COLOR
F112*	$ 88.95	£ 64.04	€ 77,39	¥ 708.93	30 Minutes	15 Minutes @ 90 °C 1 Hour @ 65 °C 24 Hours @ 25 °C	-60 to 120 °C	Blue
F120*	$ 37.60	£ 27.07	€ 32,71	¥ 299.67	5 Minutes	1 Hour @ 65 °C 24 Hours @ 25 °C	-60 to 115 °C	Straw
F123	$ 85.98	£ 61.91	€ 74,80	¥ 685.26	4 Hours	5 Minutes @ 100 °C	-60 to 175 °C	Reddish-Amber

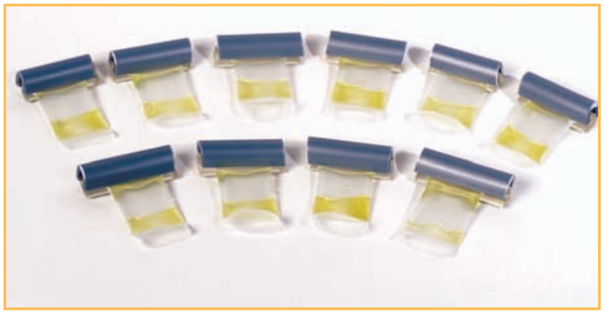
*Not recommended for hard polymer clad fiber.

High-Temperature and Low CTE Epoxies

- Packages of 10

EPO-TEK 353ND is known industry wide as a high-temperature epoxy. This two part, 100% solid, heat-curing epoxy can be used in applications requiring constant performance at 200 °C, and it can handle 300 - 400 °C for brief periods. Additionally, 353ND can be used in UHV environments. 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	$ 68.34	£ 49.20	€59,46	¥ 544.67	3 - 4 Hours	-50 to 200 °C	Dark Red	353ND, 4 g Bi-Pack, 10 per Pack

Syringes for Epoxy Application

- Package of 10 Syringes
- 3 cc Volume per Syringe

These syringes are used to inject epoxy through the back of the connector. Each pack contains 10 syringes.

ITEM #	$	£	€	RMB	DESCRIPTION
MS403-10	$ 10.20	£ 7.34	€ 8,87	¥ 81.29	Disposable Syringe, 10 per Pack

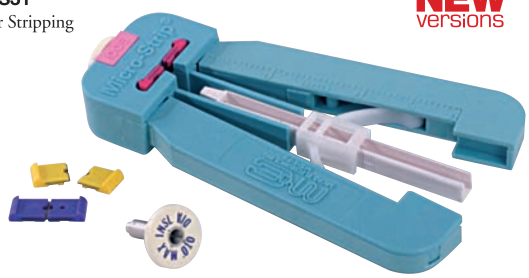
Fiber Optic Stripping Tools

- Foolproof, No-Nick Design
- Fast, Reliable Fiber Stripping
- Self-Aligning Blade Set Assures Concentric Scoring of Buffer or Coating
- Color-Coded Blades
- Long-Lasting, Swappable Blades

T12S16 Stripping Tool Shown with BFG1 Fiber Gripper

T16S31
Fiber Stripping Tool

NEW versions



Fiber Stripping Tools

These fiber buffer stripping tools provide a quick, easy, and reliable way to remove the buffer from an optical fiber in preparation for connectorization. A fiber guide and matched blades ensure that the optical fiber is correctly positioned and stripped each time. The blades are color coded to allow for fast identification of the proper fiber stripping tool. One BFG1 (below) is included with each stripper.

Tool Selection

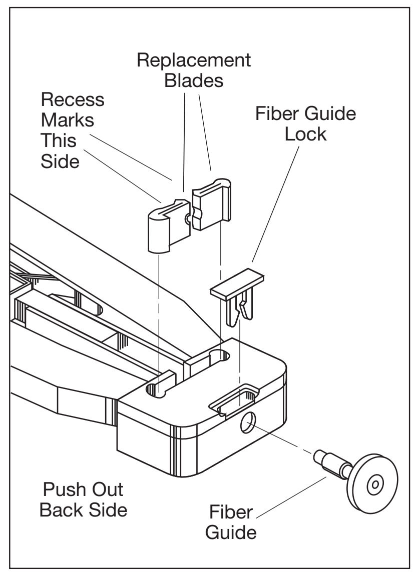
Step 1: Note your cladding and coating diameters, along with their respective tolerances.

Step 2: Refer to the column labeled 'Typical Fiber Cladding/Coating' in the table below for your fiber size.

Step 3: With your fiber size identified in the table below, scan across the corresponding 'Cladding Range' and 'Coating Range' columns. Ensure that your fiber dimension tolerances fall within the ranges listed. If they do, then refer to the corresponding item number to place your order. If the maximum fiber dimensions fall outside of the given range, order the next largest tool.

ITEM #	$	£	€	RMB	TYPICAL FIBER CLADDING/COATING	CLADDING RANGE	COATING* RANGE
NEW T04S10	$133.00	£ 95.76	€115,71	¥1,060.01	80 µm / 170 µm	65 - 80 µm	150 - 250 µm
T06S13	$ 68.00	£ 48.96	€ 59,16	¥ 541.96	125 µm / 250 µm	125 - 135 µm	250 - 343 µm
NEW T06S16	$ 68.00	£ 48.96	€ 59,16	¥ 541.96	125 µm / 400 µm	125 - 135 µm	343 - 407 µm
T08S13	$ 68.00	£ 48.96	€ 59,16	¥ 541.96	125 µm / 250 µm	125 - 175 µm	250 - 343 µm
T08S40	$ 68.00	£ 48.96	€ 59,16	¥ 541.96	125 µm / 900 µm	125 - 175 µm	889 - 1016 µm
T10S13	$ 68.00	£ 48.96	€ 59,16	¥ 541.96	200 µm / 300 µm	180 - 230 µm	250 - 343 µm
T12S16	$ 65.30	£ 47.02	€ 56,81	¥ 520.44	230 µm / 400 µm	235 - 280 µm	343 - 407 µm
T12S18	$ 65.30	£ 47.02	€ 56,81	¥ 520.44	230 µm / 430 µm	235 - 280 µm	407 - 457 µm
T12S21	$ 65.30	£ 47.02	€ 56,81	¥ 520.44	230 µm / 500 µm	235 - 280 µm	457 - 533 µm
T12S25	$ 65.30	£ 47.02	€ 56,81	¥ 520.44	230 µm / 600 µm	235 - 280 µm	533 - 635 µm
T16S31	$ 64.00	£ 46.08	€ 55,68	¥ 510.08	325 µm / 650 µm	335 - 380 µm	635 - 787 µm
T18S31	$ 64.00	£ 46.08	€ 55,68	¥ 510.08	400 µm / 730 µm	385 - 430 µm	635 - 787 µm
T21S31	$ 64.00	£ 46.08	€ 55,68	¥ 510.08	425 µm / 730 µm	435 - 500 µm	635 - 787 µm
NEW T23S31	$ 64.00	£ 46.08	€ 55,68	¥ 510.08	500 µm / 730 µm	505 - 550 µm	635 - 787 µm
T23S46	$ 64.00	£ 46.08	€ 55,68	¥ 510.08	500 µm / 1000 µm	505 - 550 µm	1016 - 1168 µm
T28S46	$ 65.90	£ 47.45	€ 57,33	¥ 525.22	630 µm / 1040 µm	605 - 680 µm	1016 - 1168 µm
M34S52	$ 66.50	£ 47.88	€ 57,86	¥ 530.01	770 µm / 1250 µm	755 - 830 µm	1168 - 1321 µm
M37S46	$ 66.50	£ 47.88	€ 57,86	¥ 530.01	830 µm / 1040 µm	835 - 900 µm	1016 - 1168 µm
M37S63	$ 66.50	£ 47.88	€ 57,86	¥ 530.01	830 µm / 1400 µm	835 - 900 µm	1397 - 1600 µm
M44S63	$ 66.50	£ 47.88	€ 57,86	¥ 530.01	1035 µm / 1400 µm	905 - 1050 µm	1397 - 1600 µm
M44S67	$ 66.50	£ 47.88	€ 57,86	¥ 530.01	1035 µm / 1600 µm	905 - 1050 µm	1600 - 1702 µm
M54S76	$ 66.50	£ 47.88	€ 57,86	¥ 530.01	1240 µm / 1650 µm	1055 - 1350 µm	1778 - 1930 µm
M63S86	$ 77.70	£ 55.94	€ 67,60	¥ 619.27	1550 µm / 2000 µm	1390 - 1600 µm	2057 - 2184 µm

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



One Fiber Gripper (BFG1) Included with Each Fiber Stripping Tool

Fiber Gripper

The BFG1 bare fiber gripper is an ideal aid when removing buffer material from an optical fiber. The textured rubber of this gripper provides a secure hold without damaging the fiber. This method of gripping is recommended over wrapping or clamping the loose end of the fiber, which can create microfractures.

NEW product

BFG1
Fiber Gripper
See Photo at Top of Page

ITEM #	$	£	€	RMB	DESCRIPTION
BFG1	$ 5.00	£ 3.60	€ 4,35	¥ 39.85	Rubber Gripper for Bare Optical Fiber

Adjustable Stripping Tool for Fiber Buffer and Fiber Jacket

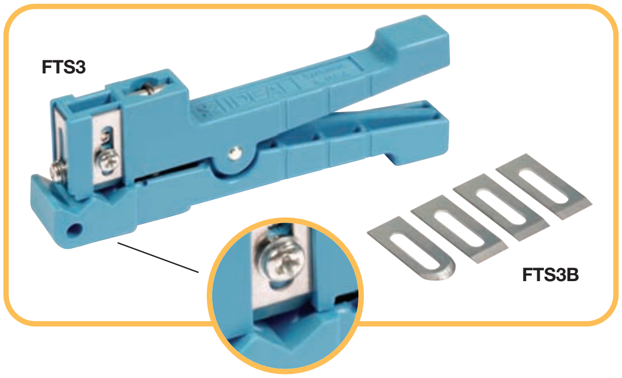
The AFS900 stripping tool is a versatile tool capable of stripping both the fiber jacket (furcation tubing) and fiber buffer. The blades have a V-groove slot to precisely hold the fiber in the proper position as the stripping tool is closed. The AFS900 has an adjustable blade stop that can be used to ensure that the optical fiber is not cut when stripping the jacket or buffer. This tool is often used when stripping a Ø900 µm fiber jacket (tight or loose) or a Ø250 µm buffer off of a Ø125 µm clad fiber. Because of the delicate nature of fiber, we recommend that the stop be properly set for a given fiber buffer and then the tool be dedicated for that use only. Also available are fiber buffer stripping tools with blades (see page 1154) that are dedicated for use with specific fiber cladding and buffer diameters.

AFS900

ITEM #	$	£	€	RMB	DESCRIPTION
AFS900	$ 16.90	£ 12.17	€ 14,70	¥ 134.69	Adjustable Fiber Buffer and Jacket Stripper

Stripping Tool for Ø3 mm and Ø3.8 mm Furcation Tubing

The FTS3 will provide precise cuts through Ø3 mm and Ø3.8 mm furcation tubing. Simply set the depth of the dual cutting blades before placing the cutting tool around the fiber. Then spin the tool around the fiber several times. This results in two precise cuts through the tubing. The furcation tubing between the two cuts can then be removed by using the blade at the end of the FTS3 to make a precise cut through the tubing along the length of the fiber. Each FTS3 also comes with a blade that has a rounded tip. Long cuts along the length of the fiber can be made through the furcation tubing by swapping the blade at the end of the FTS3 with the rounded blade. Simply place the fiber in the end V-grove, press the blade through the furcation tubing, and then draw the fiber through the tool. Replacement blades (FTS3B) are available for the FTS3 stripping tool. Each FTS3B contains three straight blades and one round tipped blade.



ITEM #	$		£		€		RMB		DESCRIPTION
FTS3	$	27.50	£	19.80	€	23,93	¥	219.18	Stripping Tool for Ø3 mm and Ø3.8 mm Furcation Tubing
FTS3B	$	8.25	£	5.94	€	7,18	¥	65.75	Replacement Blade Set (4 Blades) for FTS3

Kevlar Cutters

These cutters are designed for cutting the Kevlar threads that are used in the protective jackets of some furcation tubings. The serrated carbon steel blades keep the Kevlar threads from sliding as they are being cut.

ITEM #	$	£	€	RMB	DESCRIPTION
T865	$ 36.67	£ 26.40	€ 31,90	¥ 292.26	Kevlar Cutter

Connector Crimp Tool

The CT042 can be used for crimping SMA, FC, SC, and ST connectors. Connectors with Ø3 mm or greater tubing require the use of a crimp tool, while Ø900 µm tubing or smaller does not need to be crimped.

CT042

ITEM #	$	£	€	RMB	DESCRIPTION
CT042	$ 99.00	£ 71.28	€ 86,13	¥ 789.03	Crimp Tool

Fiber Bulkhead and Connector Cleaning

Thorlabs offers an assortment of fiber optic cleaning products for use with bare fiber, connectors, and bulkheads. Recommended cleaning procedures for many of these products may be found at www.thorlabs.com.

Cleaning Fiber Bulkheads and Fiber Connectors:
The FBC1 One-Step Bulkhead and Connector Cleaner contains a dry cleaning thread that eliminates the need for solvents. With over 525 cleanings per unit, it quickly cleans FC/PC, ST, and SC connectors and bulkheads by simply pushing the cleaner against the bulkhead or connector.

The FCS3 Precision Optic and Fiber Cleaning Solvent can be used with the MCC25 Connector Cleaning Sticks to clean any connectors or bulkheads, including FC/APC. The molded swabs conform to the shape of the connector to collect more particulates than fabric-style swabs.

For connectors, another option is to use the FCS3 solvent with the LFW90 Lint-Free Wipes. The 2" x 4" wipes come in a mini tub containing 90 wipes.

For fiber connectors, the FCC-7020 Universal Fiber Connector Cleaner is available. This cloth reel comes in a protective case and features a rubber pad under the cleaning surface to prevent scratching.

Cleaning Bare Fiber:
For cleaning bare fiber, the FCS3 Cleaning Solvent can be applied with LFW90 Lint-Free Wipes.

General Fiber Cleaning Supplies:
For customers who prefer to use their own solvents in the cleaning process, we offer the BD8 One-Touch Pump dispenser. The bottle is ideal for many solvents, including acetone, propanol, turpentine, and water. Eighteen pre-labeled and two blank self-adhesive labels are included.

Kimwipes are low-lint, 4.5" x 8.4" wipes ideal for many cleaning purposes, including cleaning connectors between polishing steps and bare fiber during preparation. CP-100 are 4" x 8" cotton, non-woven, lintless, absorbent pads.

FCS3
Fiber Cleaning Solvent, 3 oz

LFW90
2" x 4" Lint-Free Wipes, 90 Sheets per Tub

MCC25
Molded Connector Cleaning Sticks

FBC1
One-Step Fiber Connector and Bulkhead Cleaner

NEW product

FCC-7021
Replacement Reel for FCC-7020

FCC-7020
Universal Fiber Connector Cleaner

BD8
One-Touch Pump Dispenser for Solvents

KW32
Low-Lint Kimwipes

ITEM #	$	£	€	RMB	DESCRIPTION
FCS3	$ 16.40	£ 11.81	€ 14,27	¥ 130.71	Precision Optical and Fiber Cleaner, 3 oz Can
MCC25	$ 25.00	£ 18.00	€ 21,75	¥ 199.25	Connector Cleaning Sticks (50 per Pack)
LFW90	$ 9.90	£ 7.13	€ 8,61	¥ 78.90	Lint-Free Wipes (90 Sheets per Tub)
NEW FBC1	$ 83.00	£ 59.76	€ 72,21	¥ 661.51	One-Step Fiber Connector Cleaner, 525 Cleanings Per Unit
FCC-7020	$ 18.90	£ 13.61	€ 16,44	¥ 150.63	Universal Fiber Connector Cleaner, 20' Spool
FCC-7021	$ 6.20	£ 4.46	€ 5,39	¥ 49.41	Replacement Cleaning Reel for FCC-7020, 20' Spool
BD8	$ 19.80	£ 14.26	€ 17,23	¥ 157.81	8 oz One-Touch Pump Dispenser
KW32	$ 44.60	£ 32.11	€ 38,80	¥ 355.46	Kimwipes, 12 Boxes per Case, 280 Kimwipes per Box
CP-100	$ 11.40	£ 8.21	€ 9,92	¥ 90.86	Webril Handi Pads, 100 per Package

Complete Fiber Optic Cleaning Kit

This Kit includes everything needed to easily clean connectorized fiber without damaging the AR coating.

Contents

- 3 oz Can of Fiber Cleaner (FCS3)
- Connector Cleaning Sticks (MCC25)
- Tub of Lint-Free Wipes (LFW90)
- Handheld Connector Cleaner (FCC-7020)
- Replacement Reel for Handheld Connector Cleaner (FCC-7021)

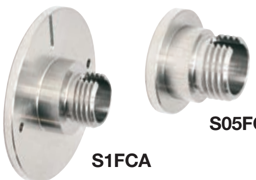
CKF
Kit Includes MCC25, FCS3, LFW90, FCC-7020, and FCC-7021

ITEM #	$	£	€	RMB	DESCRIPTION
CKF	$ 76.40	£ 55.01	€ 66,47	¥ 608.91	Fiber Optic Cleaning Kit

Bare Fiber Adapter

This adapter holds bare fibers between Ø250 µm and Ø450 µm and is typically used with our S140 series integrating spheres featured on page 1563. However, its two M2.5 countersunk counterbores allow it to be mounted in custom applications as well.

ITEM #	$	£	€	RMB	DESCRIPTION
S140-BFA	$ 120.00	£ 86.40	€ 104,40	¥ 956.40	Bare Fiber Adapter



S05FCA

S1FCA

Unthreaded Fiber Adapters

These fiber adapters have FC/APC connectors and smooth outer diameters, making them compatible with either Ø1/2" or Ø1" optomechanics. The S1FCA has two dimples for compatibility with the SPW801 adjustable spanner wrench (page 446).

ITEM #	$	£	€	RMB	DESCRIPTION
S05FCA	$ 32.00	£ 23.04	€ 27,84	¥ 255.04	1/2" Smooth O.D. to FC/APC
S1FCA	$ 32.00	£ 23.04	€ 27,84	¥ 255.04	1" Smooth O.D. to FC/APC

SM05FCA SM05FC

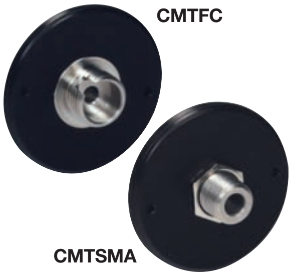
SM05SMA SM05ST

SM05-Threaded Fiber Adapters

Externally SM05-threaded (0.535"-40) fiber adapters are available for placing FC/PC, FC/APC, SMA, or ST connectorized fibers in SM05-threaded components. The SM05 threading is compatible with our Ø1/2" lens tubes (page 127) and many of our 16 mm mini-series cage plates (page 169).

ITEM #	$	£	€	RMB	DESCRIPTION
SM05FC	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External SM05 to FC/PC Adapter
SM05FCA	$ 32.00	£ 23.04	€ 27,84	¥ 255.04	External SM05 to FC/APC Adapter
SM05SMA	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External SM05 to SMA Adapter
SM05ST	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External SM05 to ST Adapter

CMTFC



CMTSMA

C-Mount Threaded Fiber Adapters

NEW products

We have introduced this line of C-mount fiber adapters to provide compatibility with the C-mount threading (1.00"-32) commonly found on camera-based components. These externally threaded C-mount adapters have two dimples for compatability with the SPW801 adjustable spanner wrench (page 446).

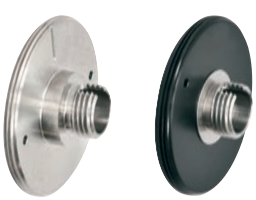
ITEM #	$	£	€	RMB	DESCRIPTION
CMTFC	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External C-Mount to FC/PC Adapter
CMTFCA	$ 42.00	£ 30.24	€ 36,54	¥ 334.74	External C-Mount to FC/APC Adapter
CMTSMA	$ 26.00	£ 18.72	€ 22,62	¥ 207.22	External C-Mount to SMA Adapter

SM1-Threaded Fiber Adapters

SM1-threaded (1.035"-40) fiber adapters are available either internally or externally threaded. The SM1 threading is compatible with our Ø1" lens tubes (page 134) and many of our 30 mm cage plates (page 177). Additionally, this threading is found on many of our detectors to simplify fiber measurements. These externally threaded adapters have two dimples for compatability with the SPW801 adjustable spanner wrench (page 446).

Externally SM1 Threaded

SM1FCA SM1FC



Externally SM1-Threaded Fiber Adapters

ITEM #	$	£	€	RMB	DESCRIPTION
SM1FC	$ 27.00	£ 19.44	€ 23,49	¥ 215.19	External SM1 to FC/PC Adapter
SM1FCA	$ 30.00	£ 21.60	€ 26,10	¥ 239.10	External SM1 to FC/APC Adapter
SM1SMA	$ 27.00	£ 19.44	€ 23,49	¥ 215.19	External SM1 to SMA Adapter
SM1ST	$ 27.00	£ 19.44	€ 23,49	¥ 215.19	External SM1 to ST Adapter

Internally SM1 Threaded

S120-FC

Internally SM1-Threaded Fiber Adapters

ITEM #	$	£	€	RMB	DESCRIPTION
S120-FC	$ 38.00	£ 27.36	€ 33,06	¥ 302.86	Internal SM1 to FC/PC Adapter
S120-SC	$ 48.00	£ 34.56	€ 41,76	¥ 382.56	Internal SM1 to SC Adapter
S120-LC	$ 48.00	£ 34.56	€ 41,76	¥ 382.56	Internal SM1 to LC Adapter
S120-SMA	$ 38.00	£ 27.36	€ 33,06	¥ 302.86	Internal SM1 to SMA Adapter
S120-ST	$ 38.00	£ 27.36	€ 33,06	¥ 302.86	Internal SM1 to ST Adapter

See page 580

Fiber Selection Guide

PRO8 Platform Selection Guide

Rack Systems: Laser Diode/TEC Controller Overview

Modular Platform Solutions

Thorlabs offers different platforms for modular, easy-to-customize instrumentation. The PRO8 and TXP series platforms are described in this section. For details about our compact T-Cube series platform, please see page 1442.

PRO8 Platform

The PRO8 platform has become a mainstay for many laser diode manufacturing and test facilities. It offers a selection of laser diode controller modules, WDM laser source modules, photodiode amplifiers, and a series of optical switch modules. The PRO8 platform is available as a rack version (PRO8000) for up to eight modules and a benchtop version (PRO800) for up to two modules, both of which can be operated as a stand-alone system without a PC or remotely controlled via IEEE 488.2 or RS-232.

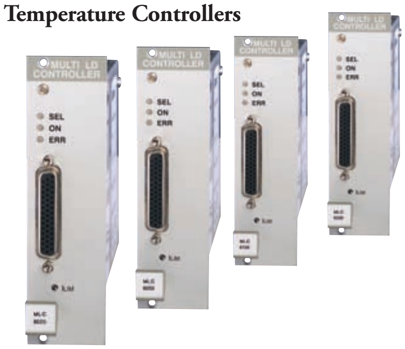
TXP Platform

The TXP platform is targeted at broader test and measurement applications. The system offers compatible WDM laser sources, laser diode modules, and high-performance polarization analysis and control modules. The TXP system is available as a rack-compatible version that mounts up to 16 modules or as a benchtop version that can mount up to 4 modules and a single module interface (TXP5001AD). The TXP series are remotely controlled by PC via a USB or TCP/IP interface.

PRO8 Modular Laser Diode Current Controllers

- The LDC8000 series modules offer laser diode drivers for almost any application from 100 mA up to 8 A. These drivers provide many of the same features and capabilities as our benchtop units.
- The MLC8000 series modules are high-density laser diode controller modules. Each can power up to eight laser diodes. This family of plug-ins are ideally suited for OEM applications that require testing and characterization of large volumes of laser diodes.

PRO8 Modular Laser Diode Temperature Controllers

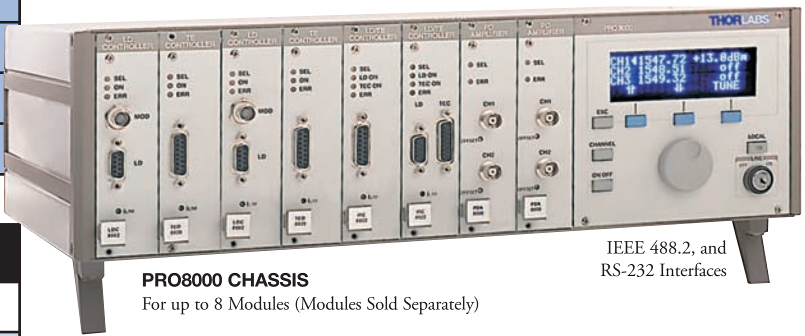


- The TED8000 series of temperature controllers provides excellent temperature stabilization of laser diodes as well as other temperature-sensitive devices. Typically, the temperature stability will be in the ±0.001 °C range. Three modules with up to 8 A/64 W of TEC power are offered.

PRO8 and TXP Modular Combined Laser Diode Current and Temperature Controllers

- The ITC8000 series of modules for the PRO8 platform is designed for applications that require temperature stabilization and laser diode control. The modules offer maximum laser drive currents from 200 mA to 1 A. All modules offer 2 A/16 W of TEC power.
- The ITC5000 for the TXP Platform allows space-saving simultaneous current and temperature control of a laser diode with a single module. This series offers three current ranges (±200 mA, ±500 mA, and ±1 A) and incorporates a TEC controller that provides up to 1.5 A/5.25 W. The modules can be modulated internally or externally.

PRO8 Modular Controller Systems (Page 1 of 2)



Stand-Alone Operation without PC

IEEE 488.2, and RS-232 Interfaces

PRO8000 CHASSIS
For up to 8 Modules (Modules Sold Separately)

Three Versions

- **PRO800:** 2-Slot Modular Benchtop Chassis
- **PRO8000:** 8-Slot Modular Rack Chassis
- **PRO8000-4:** 8-Slot Modular Rack Chassis, High Power

PRO8 Series Platform
Shown in Mounting Rack

Pictured System Powers 512 Lasers

Introduction

The PRO8 Series is a modular platform that provides a flexible solution to almost all laser diode control requirements. It is available in two versions: a compact benchtop unit for two modules (PRO800) or a 19" rack versions for up to eight modules (PRO8000). Together with an extensive range of modules (i.e., single or multi-channel current and temperature controllers, switches, photocurrent amplifiers, and laser sources), a PRO8 system can be configured for almost any application.

The PRO8 Series offers solutions to operate anywhere from one to hundreds of laser diodes. For example, a single PRO8000 19" rack with eight modules of our eight-channel drivers can drive 64 laser diodes. The PRO800 is an ideal choice for a flexible controller system for one or two lasers.

The standard PRO8000 can supply up to 16 A of total driving current for all installed modules; we also offer the PRO8000-4, which can supply up to 32 A of total driving current.

User-Friendly Controls

The PRO8 display menu allows easy configuration of any module in the chassis. Mnemonic symbols provide user-friendly access to all operational parameters. All settings are retained in memory and automatically recalled upon powering on the mainframe as long as modules are not moved to different slots during power down. Individual modules are automatically identified and, when selected, can be configured and controlled using the softkeys.

Interchangeable Modules

All modules can be driven in the compact PRO800, the 19" standard PRO8000, and the high-power PRO8000-4 mainframes. Aside from the size difference of the PRO800 and the heavy-duty power supply of the PRO8000-4, each chassis utilizes the same operating system and protocols. All chassis models can power any of the plug-in modules that are found in this section, as well as our selection of DFB laser modules (see pages 1170 - 1173).

Features

- Universal, Modular Platform
- Compact, 2-Slot Benchtop Version: PRO800, Ideal for Research
- Rack-Mountable, 8-Slot Version: PRO8000 /PRO8000-4 Chassis for Large Test and Manufacturing Environments
- PRO8000-4 Chassis for High-Power Applications
- Current and Temperature Controllers for Laser Diode Operation, Characterization, or Burn-In Applications
- Various Optical Modules Including WDM Laser Sources and Optical Switches for Component Testing in Production and Quality Control
- Remote Control via IEEE 488.2 and RS232 with Drivers for LabVIEW™ and LabWindows/CVI™

PRO8000-Compatible Modules

Laser Diode Controllers - See Page 1163
- 200 mA to 8 A

Multi-Channel Laser Diode Controllers See Pages 1164 - 1165
- 5 mA to 200 mA

Temperature Controllers - See Pages 1166 - 1167
- ±2 A or ±8 A

Combination LD and TEC Controllers See Pages 1168 - 1169
- ±200 mA or ±1 A Laser; 2 A TEC

DFB WDM Laser Sources See Pages 1170 - 1173
- C- and L- Band Precision Sources

Optical Switches - See Pages 1174 - 1175
- 1 x 2, 2 x 2, 1 x 4, and 1 x 8

Photodiode Measurement Module See Page 1176
- 10 nA to 10 mA

Each system is assembled and tested to your specific configuration. Contact our technical support team for expert advice on optimum solutions for your needs.

PRO8 Modular Controller Systems (Page 2 of 2)

All PRO8 series controllers are equipped with IEEE-488.2 and RS-232 interfaces. Each system is delivered with LabVIEW™ and LabWindows™/CVI drivers to support the individual modules, as well as their integration into a comprehensive test and measurement system.

Easy Operation

All modules are self-identifying and are operated via menu-driven softkeys; the analog values are set with a rotary knob on the front panel.

All values are displayed by a 4 x 20 character alphanumeric display. The functions of the softkeys change in accordance with the activated module. A key-operated power switch protects the PRO8000 series against unauthorized use.

PRO800 CHASSIS
Modules Sold Separately

PRO800 Benchtop Chassis

The smaller PRO800 is the benchtop version of the PRO8 system offering slots for two modules. It is menu driven, flexible, and supports a multitude of electrical and optical modules. The PRO800 is ideal for crowded lab environments and offers the same operating features as the larger eight-slot chasis PRO8000.

Additional Modules for the PRO8 Series:

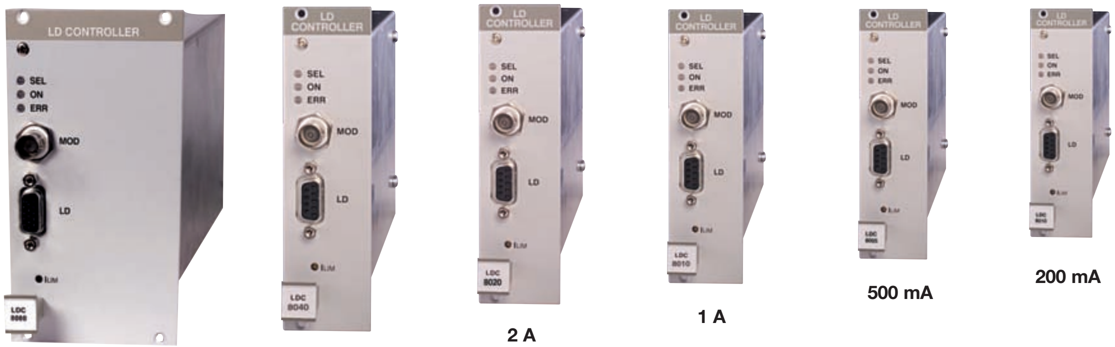
- DWDM Laser Sources in the C- and L-Band (See Pages 1170 - 1173)
- Optical Switch Modules (See Pages 1174 - 1175)

ITEM #	PRO800	PRO8000	PRO8000-4
Slots (Maximum Number of Modules)	2	8	8
Maximum Output Current for All Modules	8 A	16 A	32 A
Maximum Power Consumption	220 VA	500 VA	800 VA
Display	Alphanumeric Display with 4 x 20 Characters		
Operation	Menu Driven		
Setting	Function Keys and Rotary Knob		
Protection Features	Key-Operated Power Switch		
TTL Modulation Frequency Range*	DC to 10 kHz		
TTL Duty Cycle*	Selectable		
TTL Modulation Input (Max 5 V)	BNC		
TTL Trigger Output (Max 5 V)	BNC		
IEEE-488.2 Interface	24-Pin IEEE Jack (Rear Panel)		
RS-232 Interface	9-Pin D-sub Plug (Rear Panel)		
Chassis Ground	4 mm Banana Jack (Rear Panel)		
Line Voltage	100 V, 115 V and 230 V AC ± 10%		
Line Frequency	50 to 60 Hz		
Operating Temperature	0 to 40 °C		
Storage Temperature	-40 to 70 °C		
Relative Humidity	< 80% up to 31 °C, Decreasing to 50% @ 40 °C		
Dimensions (Chassis Only)	9.13" x 5.79" x 15.59" (232 mm x 147 mm x 396 mm)	17.68" x 5.79" x 15.59" (449 mm x 147 mm x 396 mm)	17.68" x 6.97" x 17.95" (449 mm x 177 mm x 456 mm)
Weight (Chassis Only)	<9 kg (<19.8 lbs)	<17 kg (<37.5 lbs)	<21 kg (<46.3 lbs)

*External synchronous current modulation for all cards in the chassis

ITEM #	$	£	€	RMB	DESCRIPTION
PRO800	$ 1,820.00	£ 1,310.40	€ 1.583,40	¥ 14,505.40	2-Slot Modular Benchtop Chassis, 8 A
PRO8000	$ 2,480.00	£ 1,785.60	€ 2.157,60	¥ 19,765.60	8-Slot Modular Rack Chassis, 16 A
PRO8000-4	$ 3,350.00	£ 2,412.00	€ 2.914,50	¥ 26,699.50	8-Slot High-Power Modular Rack Chassis, 32 A
PRO8000-R32	$ 66.00	£ 47.52	€ 57,42	¥ 526.02	19" Mounting Kit for PRO8000
PRO8000-R42	$ 89.00	£ 64.08	€ 77,43	¥ 709.33	19" Mounting Kit for PRO8000-4
PRO8000-C	$ 25.00	£ 18.00	€ 21,75	¥ 199.25	PRO800 / PRO8000 Front Cover Plate

PRO8 Laser Controller Modules (Page 1 of 2)



8 A   4 A   2 A   1 A   500 mA   200 mA

Introduction

The modular laser diode current controllers of the LDC8 series offer extremely low noise (<100 µA) and drift (<200 µA, 24 hrs), resulting in exceptional laser stability.

Six Current Ranges

Six different current controller modules are available, with maximum output currents ranging from 200 mA up to 8 A (10 A upon request). The drive current can be set precisely with 16-bit resolution (i.e., one part in 65,536). An analog control input allows all current modules to be operated in either constant current (CC) or constant power (CP) mode. The maximum modulation frequency is dependent on the type of LDC module used and its operating mode.

Features

- 200 mA, 500 mA, 1 A, 2 A, 4 A, and 8 A Modules
- Ultra-Stable Current Control with 16-Bit Resolution
- Extensive Laser Diode Protection Features
- Switchable Photodiode Bias for Improved Sensor Linearity
- Easily Configured Self-Identifying Modules
- External Modulation of Laser Output Current

User-Friendly Controls

After installing a new module into a PRO8 chassis, the front-panel control screen is used to configure the plug in. The softkeys or the rotary knob can be used to scroll through the slot location to access the basic settings. The operational settings are easily accessed; displayed mnemonic symbols and simple prompts enable user-friendly operation. All settings are retained in memory and automatically recalled upon powering the mainframe.

Laser Diode Protection Features

The LDC8000 Series current modules incorporate laser protection features to safeguard sensitive laser diodes. An advanced circuit design ensures that AC power line transients, power outages, and RF pickup cannot affect the laser diode.

For each current module, three independent limits can be set to safeguard the laser. Two of the limits are programmable, which prevent the laser current and the laser power from exceeding the user-defined maximum values. The third limit is set via a recessed front panel trim pot that sets a "hardware" current limit and protects against programming errors and accidental adjustment of the front panel knob. Even while externally modulating the laser, it is not possible to exceed the hard or soft limits.

After activating the laser diode, a soft-start function slowly increases the laser current without overshoots.

Even in the case of AC power fluctuation, the laser current remains transient free. Voltage peaks on the AC line are effectively suppressed by electronic filters, shielding of the transformer, and careful grounding of the modules and chassis. The LDC8000 series meets the international requirements regarding laser protection (e.g., CDRH US21, CFR 1040.10). Furthermore, the module's operation is protected by the PRO8 system's key-operated power switch, its interlock, a delay of the output current, and many additional features (see specs table on following page for details).

Protection Features

- Soft Start Slowly Increases Laser Drive Current
- Programmable Limits for Current and Optical Power
- Hardware Current Limit for Protection Against Errors Through Programming, Modulation, and Wrong Settings
- Extensive AC Power Filtering Eliminates Transients
- Temperature Window Protection in Combination with TED8000 Card
- Meets Applicable CDRH and CE Regulations

External Modulation of Laser Output

An analog control input enables the modulation of the laser diode in constant current or constant power mode. The maximum modulation frequency depends on the current module used and its operating mode. See the specifications table on the following page for details.

See pages 1168 - 1169

PRO8 Laser Controller Modules (Page 2 of 2)

LDC8000 Series LD Controllers Specifications

(All data valid at 23 ± 5 °C and 45 ±15% relative humidity)

ITEM #	LDC8002	LDC8005	LDC8010	LDC8020	LDC8040	LDC8080
Current Control						
Control Range (Continuous)	0 to ±200 mA	0 to ±500 mA	0 to ±1 A	0 to ±2 A	0 to ±4 A	0 to ±8 A[a]
Compliance Voltage	>5 V	>5 V	>5 V	>5 V	>5 V	>5 V
Resolution	3 µA	7.5 µA	15 µA	30 µA	70 µA	130 µA
Accuracy (Full Scale)	±0.05%	±0.05%	±0.1%	±0.1%	±0.1%	±0.3%
Noise Without Ripple (10 Hz to 10 MHz, RMS, Typical)	<3 µA	<5 µA	<10 µA	<20 µA	<50 µA	<100 µA
Ripple (50/60 Hz, RMS, Typical)	<1 µA	<1 µA	<1.5 µA	<3 µA	<4 µA	<8 µA
Transients (Processor, Typical)	<15 µA	<30 µA	<50 µA	<80 µA	<120 µA	<200 µA
Transients (Other, Typical)	<200 µA	<500 µA	<1 mA	<2 mA	<4 mA	<8 mA
Drift 60 min/24 hr (Typical, 0-10 Hz, at Constant Ambient Temperature)	<0.5 µA / <1.5 µA	<2 µA / <4 µA	<5 µA / <20 µA	<15 µA / <100 µA	<25 µA / <150 µA	<100 µA / <200 µA
Temperature Coefficient	<50 ppm/°C					
Power Control						
Control Range of Photocurrent	10 µA to 5 mA (Other Ranges Available upon Request)					
Reverse Bias Voltage	0 V / 5 V (Switchable)					
Resolution	100 nA					
Accuracy (Full Scale)	±0.05%					
Current Limit						
Setting Range (20-Turn Trim Pot)	0 to ≥200 mA	0 to ≥500 mA	0 to ≥1 A	0 to ≥2 A	0 to ≥4 A	0 to ≥8 A
Resolution	6 µA	15 µA	30 µA	60 µA	130 µA	250 µA
Accuracy	±200 µA	±500 µA	±2 mA	±4 mA	±8 mA	±50 mA
Power Limit						
Photocurrent Range	0 to 5 mA					
Resolution	1.25 µA					
Accuracy	±50 µA					
Laser Voltage Measurement						
Measurement Principle	4-Wire (Improves Accuracy by Compensating for Cable Resistance)					
Measurement Range	0 to 5 V					
Resolution	0.2 mV					
Accuracy	±5 mV					
Analog Modulation Input						
Input Resistance	10 kΩ					
3 dB-Bandwidth, CC[b]	DC to 200 kHz	DC to 100 kHz	DC to 50 kHz	DC to 30 kHz	DC to 20 kHz	DC to 10 kHz
Modulation Coefficient, CC	20 mA/V ± 5%	50 mA/V ± 5%	100 mA/V ± 5%	200 mA/V ± 5%	400 mA/V ± 5%	800 mA/V ± 5%
Modulation Coefficient, CP	0.5 mA/V ±5%					
Rise and Fall Time, Typical[c]	<2 µs	<4 µs	<5 µs	<6 µs	<9 µs	<15 µs
General Data						
Card Width	1 PRO8 Slot					2 Slots
Connector	9-Pin D-Sub (f)					15-Pin HD D-Sub (f)
Weight	< 300 g	< 500 g				< 750 g
Operating Temperature	0 to 40 °C					
Storage Temperature	-40 to 70 °C					

[a] 10 A Available upon request [b] Small Signal Bandwidth [c] External TTL Modulation, Synchronous for all LDC Modules

Drive up to 64 Lasers from 1 Chassis – See Next Page

ITEM #	$	£	€	RMB	DESCRIPTION
LDC8002	$ 1,050.00	£ 756.00	€ 913,50	¥ 8,368.50	PRO8000 LD Control Module, 200 mA
LDC8005	$ 1,074.00	£ 773.28	€ 934,38	¥ 8,559.78	PRO8000 LD Control Module, 500 mA
LDC8010	$ 1,086.00	£ 781.92	€ 944,82	¥ 8,655.42	PRO8000 LD Control Module, 1 A
LDC8020	$ 1,171.00	£ 843.12	€ 1.018,77	¥ 9,332.87	PRO8000 LD Control Module, 2 A
LDC8040	$ 1,181.00	£ 850.32	€ 1.027,47	¥ 9,412.57	PRO8000 LD Control Module, 4 A
LDC8080	$ 1,226.00	£ 882.72	€ 1.066,62	¥ 9,771.22	PRO8000 LD Control Module, 8 A, 2 Slots
CAB400	$ 66.00	£ 47.52	€ 57,42	¥ 526.02	DB9 Cable, LDC8000 Module to LD Mount*

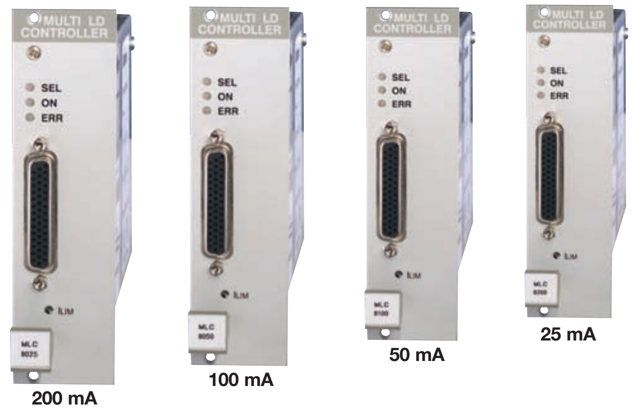
*Not for LDC8080

PRO8 High-Density Laser Controllers (Page 1 of 2)

Introduction

The MLC8000 Series laser diode controllers have been field proven in demanding applications for many years. They are designed to control up to eight lasers from a single module. When fully populated, a PRO8000 chassis can simultaneously power up to 64 laser diodes.

Designed to support high-density laser diode test and burn-in, this series provides eight different maximum drive current ranges. The PRO8000 chassis can support up to a total of 16 A of laser diode drive current (i.e., the sum of the output drive currents from all the installed cards) and therefore can easily support the demands of driving 64 lasers at 200 mA each.



Features

- Drives Eight Lasers from a Single Module and 64 Lasers from a Single MLC Chassis
- 5 mA, 10 mA, 25 mA, 50 mA, 100 mA, and 200 mA Ranges
- Ultra-Stable Current Control with 12-Bit Resolution
- Extensive Laser Diode Protection Features
- Easily Configured Self-Identifying Modules

Intuitive User-Friendly Controls

Each module provides eight independent outputs, all operating within the same set parameters (current range, current limit, and constant current or constant power operating mode). The laser drive current for each output, however, can be individually set. The various modules of the MLC8000 series can be used interchangeably, along with other PRO8 modules, in any of the three chassis to implement a large variety of systems.

After installing a new module into a PRO8 chassis, the front-panel control screen is used to configure the plug in. The softkeys or the rotary knob can be used to scroll through the slot locations to access the settings for the individual modules. The operational parameters are easily accessed using mnemonic symbols and simple prompts. All settings are retained in memory and automatically recalled upon powering on the mainframe.

The polarity of the laser diodes, either anode or cathode ground, is factory fixed. The eight outputs are switched on together, but the current control or power control is independent for each channel.

Laser Diode Protection

The MLC8000 Series of modules incorporate proven laser protection features to safeguard sensitive laser diodes. These features include a hardware current limit, a soft-start circuit, and an interrupt sensing circuit that shuts down the laser upon detecting a break in the electrical connection to the laser diode. Additionally, extensive precautions have been taken to protect the laser diodes during AC power fluctuation or outages.

The current limit is accessed only via a front-panel trim-pot to prevent the risk of accidental adjustment. All eight output channel current limits are identical for an individual card. After activating the laser power, a soft-start function slowly increases the laser current, preventing overshoots.

Even in the case of an AC power fluctuation, the laser current remains transient free. Voltage peaks on the AC line are effectively suppressed by electronic filters, shielding of the transformer, and careful grounding of the modules and chassis.

The MLC8000 Series meets the international requirements regarding laser protection (e.g., CDRH US21 CFR 1040.10). Furthermore, the modules' operation is protected by the PRO8 systems' key-operated power switch, its interlock, and a delay of the output current, in addition to many other features.

System Applications

The MLC8000 Series is an ideal choice for burn-in applications due to its high-density (64 lasers per PRO8000 chassis) drive capability coupled with the user-friendly advanced control features.

For technical support and advice about specific system configurations, please contact our Technical Support Team.

Easy User Interface

Each plug-in is automatically identified upon plugging in the module. A brightly lit 4 x 20 characters fluorescent display allows the user to select any of the installed modules. When selected, the control parameters can be changed quickly.

Laser Diode Grounding

The MLC8000 controllers are divided into two groups: one for grounded laser cathodes and one for grounded anodes. Each supports both PD polarities. Under all conditions, the laser diode is driven with respect to ground, ensuring maximum protection for the laser diode.

PRO8 High-Density Laser Controllers (Page 2 of 2)

Burn-In Station

The MLC8000 Series modules are designed to simultaneously supply drive current to eight laser diodes. Therefore, up to 64 laser diodes can be operated by a single PRO8000 chassis.

An automated test station for hundreds of laser diodes can be set up by connecting many PRO8000 systems via the IEEE-488 interface. High-level software macros speed the process of developing automated burn-in and final test routines.

Have you seen our...

LDC Series Interface Cable

CAB400

LDC modules ending in 8001 to 8040 with 9-pin D-Sub connectors can be connected directly to Thorlabs' laser diode mounts with DB9 interface using a shielded CAB400 cable (not included with the module). For additional or replacement cables, we have a full line from which to choose.

See page 437

MLC8000 Series-High Density Laser Diode Controllers Specifications

(All data valid at 23 ± 5 °C and 45 ±15% relative humidity)

ITEM # (8 CHANNELS PER MODULE)	MLC8025-8 SERIES	MLC8050-8 SERIES	MLC8100-8 SERIES	MLC8200-8 SERIES
Current Control				
Current Range (2 Switchable Ranges)	0 - 5 mA / 0 - 25 mA	0 - 10 mA / 0 - 50 mA	0 - 25 mA / 0 - 100 mA	0 - 50 mA / 0 - 200 mA
Laser Diode Polarity	Fixed, Either Anode Ground (AG) or Cathode Ground (CG)			
Compliance Voltage	>4 V			
Setting Accuracy	±15 µA / ±75 µA	±30 µA / ±150 µA	±75 µA / ±300 µA	±150 µA / ±600 µA
Resolution	1.2 µA / 6 µA	2.5 µA / 12 µA	6 µA / 25 µA	12 µA / 50 µA
Noise Without Ripple (10 Hz to 10 MHz), Typical	<0.5 µA / <0.5 µA		<0.5 µA / <1 µA	<0.5 µA / <1.5 µA
Ripple (50/60 Hz, rms), Typical	<0.5 µA / <0.5 µA		<0.5 µA / <1 µA	
Transients (Other, Typical)	<25 µA	<50 µA	<100 µA	<200 µA
Drift (60 min, 0 to 10 Hz), Typical	<0.3 µA / <1 µA	<0.5 µA / <1.5 µA	<1 µA / <3 µA	<1.5 µA / <5 µA
Temperature Coefficient	<50 ppm / °C			
Power Control				
Control Range of Photocurrent	5 µA to 2 mA			
Accuracy	±6 µA			
Resolution Photocurrent	0.5 µA			
Reverse Bias Voltage	0 V / 5 V (Wireable)			
Current Limit				
Setting Range (20-Turn Pot)	0 to 5 mA / 0 to 25 mA	0 to 10 mA / 0 to 50 mA	0 to 25 mA / 0 to 100 mA	0 to 50 mA / 0 to 200 mA
Resolution	1.2 µA / 6 µA	2.5 µA / 12 µA	6 µA / 25 µA	12 µA / 50 µA
Accuracy	±50 µA / ±125 µA	±100 µA / ±250 µA	±0.25 mA / ±0.5 mA	±0.5 mA / ±1 mA
General Data				
Connector	44-Pin HD D-Sub (F) (For Laser Diode, Photodiode and General Interlocks)			
Card Width	1 Slot			
Weight	<500 g (<1.1 lbs)			
Operating Temperature	0 to 40 °C			
Storage Temperature	-40 to 70 °C			

PRO8 High-Density Laser Controllers

ITEM #	$	£	€	RMB	DESCRIPTION
MLC8025-8AG	$ 1,198.80	£ 863.14	€ 1.042,96	¥ 9,554.44	PRO8 Multi-Channel LD Controller, ± 5 mA and ±25 mA, AG
MLC8025-8CG	$ 1,198.80	£ 863.14	€ 1.042,96	¥ 9,554.44	PRO8 Multi-Channel LD Controller, ±5 mA and ±25 mA, CG
MLC8050-8AG	$ 1,198.80	£ 863.14	€ 1.042,96	¥ 9,554.44	PRO8 Multi-Channel LD Controller, ±10 mA and ±50 mA, AG
MLC8050-8CG	$ 1,198.80	£ 863.14	€ 1.042,96	¥ 9,554.44	PRO8 Multi-Channel LD Controller, ±10 mA and ±50 mA, CG
MLC8100-8AG	$ 1,198.80	£ 863.14	€ 1.042,96	¥ 9,554.44	PRO8 Multi-Channel LD Controller, ±25 mA and ±100 mA, AG
MLC8100-8CG	$ 1,198.80	£ 863.14	€ 1.042,96	¥ 9,554.44	PRO8 Multi-Channel LD Controller, ±25 mA and ±100 mA, CG
MLC8200-8AG	$ 1,233.00	£ 887.76	€ 1.072,71	¥ 9,827.01	PRO8 Multi-Channel LD Controller, ±50 mA and ±200 mA, AG
MLC8200-8CG	$ 1,233.00	£ 887.76	€ 1.072,71	¥ 9,827.01	PRO8 Multi-Channel LD Controller, ±50 mA and ±200 mA, CG

PRO8 Temperature Control Modules (Page 1 of 2)

Introduction

Thorlabs offers range of thermoelectric temperature control modules from ±2 A/16 W to ±8 A/64 W with 16-bit resolution. For optimal laser operation in applications that require precise thermal control, the TED8000 Series of modules provide excellent temperature stabilization, (typically ±0.001 °C when using an AD590 thermal sensor), facilitating highly stable operation of temperature-sensitive components such as optical nonlinear birefringent crystal experiments.

Separate adjustment of the P, I, and D settings of the PID servo loop enable optimal settling times for different thermal loads.

The temperature controllers in the TED8000 series operate within our PRO8 series mainframe and are ideal companions to the LDC8000 laser diode current controller modules shown on pages 1162 - 1163.

TED8020 Module

TED8080 Module

High-Power/Channel Count Laser Systems

With up to 64 W of cooling power, the TED8080 is well matched to our LDC8080 laser diode control module, which provides 8 A of laser drive current (see page 1163). Laser diodes typically operate at approximately 2 to 3 V forward voltage. Operation at 8 A results in an overestimated thermal load of 16 to 24 W, assuming 0% lasing efficiency and that all the electrical energy is converted to thermal energy.

When using our eight-channel laser controller (MLC8000 series), the TED8080 is an ideal choice for stabilizing the temperature of a large number of lasers mounted on a common cooling plate.

Protection Features

Damage to the TE cooler is prevented by setting an adjustable TEC current limit. This can be set via a recessed potentiometer on the module front panel (hardware limit), the front panel softkeys, and one of the standard interfaces (software limit).

TED8000 Series Temperature Controller Specifications

ITEM #	TED8020	TED8040	TED8080
Type of Controller	Adjustable PID Share		
Setting Resolution	12-Bit Control Range		
Card Width	1 Slot	1 Slot	2 Slots
Connector	15-Pin D-Sub (F)		
Weight	<500 g (<1.1 lbs)	<600 g (<1.3 lbs)	<700 g (<1.5 lbs)
Operating Temperature	0 to 40 °C		
Storage Temperature	-40 to 70 °C		

When used with our laser diode current controllers (see pages 1162 - 1163), the temperature window protection safety feature can be enabled. If the laser temperature departs from the preset temperature window, the laser current will be switched off immediately. The temperature modules of the TED8000 series meet extremely high precision and drift performance standards and provide a low noise, bipolar output that enables extremely stable wavelength control and safe thermal load management.

Choice of Temperature Sensors

The temperature modules of the TED8000 series can be operated with thermistors, AD590/AD592 IC sensors, and LM135/LM335 transducers. When operated with a thermistor, the thermistor calibration constant can be set so that all applicable settings and displays are given directly in degrees Celsius rather than in ohms.

A Pt100 temperature sensing element can be operated with the modules of the TED8000PT series, replacing the IC sensors and transducers.

For extremely low temperature applications, such as the operation of lead-salt lasers, a cryogenic option is offered for all models. As a Pt1000 sensor is used for operating temperatures in the range of 20 to 310 K, the controller is modified to control a heating element.

PID Control System Functionality

The P, I, and D settings of the temperature control loop can be set via menu-driven softkeys or via the remote interface. Optimized adjustment ensures fast laser temperature settling times and long-term temperature stability of better than 1 mK.

A PID control system combines three different control strategies into one feedback loop. The PID refers to how the error signal (i.e., the difference between the actual temperature and the set current) is processed prior to being fed back to the driving element responsible for changing the system. The purely proportional controller simply scales the error signal by some number prior to feeding it back to the drive element.

PRO8 Temperature Control Modules (Page 2 of 2)

The PID control loop involves three separate parameters: the Proportional (P), the Integral (I), and the Derivative (D) parameter. The P value determines the reaction to the current temperature error, the I value determines the reaction based on the sum of recent temperature errors, and the D value determines the reaction based on the rate at which the temperature error has been changing. The weighted sum of these three terms is used to adjust the temperature via the current supply of a cooling/heating element (TEC element).

By "tuning" the values for these three parameters independently, the PID controller can be optimized to the setup and requirements of the application (e.g., minimizing temperature settling time for each specific thermal load and temperature level). The response of the PID controller can be described in terms of the responsiveness of the controller to an error, the degree to which the controller overshoots the setpoint, and the degree of system oscillation.

You can deactivate P, I, or D by setting it to zero (i.e., to use the controller only as a PI controller, just set the D value to zero). This may be useful in a noisy environment since derivative action is very sensitive to measurement noise. Deactivating the I value may prevent the system from reaching its target temperature and is therefore not recommended.

TED8000 Series Temperature Controllers Specifications

(All data valid at 23 ± 5 °C and 45 ±15% relative humidity)

ITEM #	TED8020	TED8040	TED8080
Control Range	-2 to 2 A	-4 to 4 A	-8 to 8 A
Compliance Voltage	>8 V		
Maximum Output Power	16 W	32 W	64 W
Measurement Resolution I_{TEC}	0.07 mA	0.15 mA	0.3 mA
Measurement Accuracy I_{TEC}	±10 mA	±20 mA	±50 mA
Measurement Resolution U_{TEC}	0.3 mV		
Measurement Accuracy U_{TEC}	± 20 mV		
Noise and Ripple (Typical)	<1 mA	<2 mA	<4 mA
Temperature Sensors: Thermistor (TED80x0 and TED80x0PT)			
Control Range	5 Ω to 20 kΩ / 50 Ω to 200 kΩ (Switchable)		
Calibration	Exponential Form, Steinhart-Hart		
Resolution	0.3 Ω / 3 Ω		
Accuracy	±2.5 Ω / ±25 Ω		
Stability (24 hrs, Typical)	<0.5 Ω / <5 Ω		
Temperature Sensor: IC-Sensors (AD590/AD592/LM135/LM335) (TED80x0)			
Control Range	-12.375 to 90 °C		
Calibration	2-Point Linearization		
Resolution	0.0015 °C		
Accuracy	±0.1 °C		
Stability (24 hrs, Typical)	<0.001 °C		
Temperature Sensor Pt100 Platinum: Optional Feature (PT) for TED80x0			
Control Range	-12.375 to 90 °C		
Resolution	0.0015 °C		
Accuracy	±0.3 °C		
Stability (24 hrs, Typical)	<0.005 °C		
Temperature Sensor Pt1000 KRYO: Optional Feature (KRYO) for TED8020			
Control Range	20 to 310 K		
Resolution	2 mK (Within 20 to 155 K)		
Accuracy	±2 K (Within 20 to 155 K)		
Stability (Typical)	0.005 K (Within 20 to 155 K)		
TEC Current Limit			
Setting Range (20-Turn Pot)	0 to ≥2 A	0 to ≥4 A	0 to ≥8 A
Resolution D/A Converter	0.5 mA	1 mA	2 mA
Accuracy	±20 mA	±40 mA	±80 mA

ITEM #	$	£	€	RMB	DESCRIPTION
TED8020	$ 621.00	£ 447.12	€ 540,27	¥ 4,949.37	PRO8 TEC Controller, ±2 A, 16 W
TED8040	$ 621.00	£ 447.12	€ 540,27	¥ 4,949.37	PRO8 TEC Controller, ±4 A, 32 W
TED8080	$ 743.00	£ 534.96	€ 646,41	¥ 5,921.71	PRO8 TEC Controller, ±8 A, 64 W

Laser Mount Connection Cable

All modules in the TED8000 Series except the TED8080, PT or KRYO options, can be connected to Thorlabs' laser diode mounts with a DB9 interface using a shielded CAB420-15 cable (not included with module). Thorlabs offers a full line of additional or replacement cables (see pages 433 - 437).

ITEM #	$	£	€	RMB	DESCRIPTION
CAB420-15	$ 72.00	£ 51.84	€ 62,64	¥ 573.84	DB9(F) to DB15(M) Cable

See Page 437

PRO8 Combination Laser Diode / TEC Controllers (Page 1 of 2)

3 Models

ITC8000
Combination Laser Diode and TEC Controllers

Laser Current: ±200 mA to ±1 A
TEC Current ±2 A / 16 W

Introduction

The ITC8000 series for the PRO8 platform incorporates a laser current controller combined with a TEC temperature controller in one space-saving module. Three models are available offering laser drive current ranges of 0 to ±200 mA, 0 to ±500 mA, or 0 to ±1 A. All three models incorporate a TEC controller that provides up to ±2 A/16 W.

Each module comes in two versions: the ITC8000 with a 9-pin connector for laser current output and a 15-pin connector for TEC current output. Alternatively, the ITC8000DS15 has a common 15-pin connector for both laser and TEC current output.

All of the ITC8000 modules offer the same exceptional performance as our separate laser controller and temperature controller modules. All laser diode and photodiode pin configurations are supported.

Extremely Low Noise

The ITC8000 Series modules feature exceptionally low laser current noise (from 2 - 10 µA depending on the model, see specs table on following page) and outstanding temperature stability of better than <0.001 °C when an AD590 temperature sensor is used. The performance of the ITC8000 modules is independent of the operation mode (constant current or constant power).

User-Friendly Controls

After installing a new module into a PRO8 chassis, the module can be configured via the front-panel softkey controls or via one of the remote computer interfaces. The softkeys or rotary knob on the PRO8 are used to scroll through the slot locations to access all the module settings. Alternatively, the IEEE-488.2 interface also provides convenient access to the controller settings. Once set, all the settings are retained in memory and automatically recalled upon powering up the mainframe.

Laser Diode Protection Features

The modules incorporate proven laser diode protection features. In addition to protection functions such as current limits, laser current soft start, and interrupt protection, an advanced circuit design ensures that AC power line transients, power outages, and RF pickup cannot affect the laser diode.

Additionally, a temperature window can be set that will shut the laser down in the event the high or low thresholds of the window are exceeded.

The ITC8000 Series meets the international requirements regarding laser protection (i.e., CDRHUS21 CFR 1040.10). Furthermore, the module's operation is protected by the PRO8 system's key-operated power switch, its interlock, and a delay of the output current.

Calibrating the Power Display

The display of the laser power can be easily calibrated with respect to the laser's monitor-photodiode current to provide a readout directly in milliwatts. This is accomplished by adjusting the "CALPD" calibration constant that is accessed via the front-panel softkeys or the computer interface. Please note that an optical power meter is required.

Setting the Temperature Control Loop

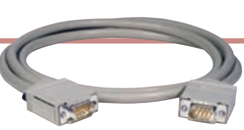
The P (gain), I, and D settings of the PID control loop can each be set independently to optimize the temperature response of the system to different thermal loads.

ITC8000 Series of Interface Cables

Thorlabs offers three cables that can be used to connect the ITC8000 combination modules to our laser diode mounts with DB9 interface: the CAB400 for all DB9 outputs of the LDC controllers, the CAB420-15 for all DB15 TEC controller outputs, and the CAB430 for all ITC8000DS15 modules. These cables are not included with the modules. For additional or replacement cables, we have a full line to choose from with same-day delivery.

ITEM #	$	£	€	RMB	DESCRIPTION
CAB400	$ 66.00	£ 47.52	€ 57,42	¥ 526.02	DB9(M) to DB9(M) Cable
CAB420-15	$ 72.00	£ 51.84	€ 62,64	¥ 573.84	DB9(F) to DB15(M) Cable
CAB430	$ 120.00	£ 86.40	€ 104,40	¥ 956.40	DB9(M) & DB9(F) to DB15(M) Cable

See Page 437



CAB400
For DB9 Outputs

CAB420-15
For DB15 Controller Ouptut

CAB430
For all ITC8000DS15 Modules

PRO8 Combination Laser Diode / TEC Controllers (Page 2 of 2)

ITC 8000 Series LD / TEC Controller Specifications

ITEM #	ITC8022	ITC8052	ITC8102
Laser Controller: Current Control			
Control Range of Injection Current	0 to ±200 mA	0 to ±500 mA	0 to ±1 A
Compliance Voltage	>5 V		
Resolution	3 µA	7.5 µA	15 µA
Accuracy (Full Scale)	±0.05%		±0.1%
Noise w/o Ripple (10 Hz to 10 MHz, RMS, Typical)	<2 µA	<5 µA	<10 µA
Ripple (50 Hz, RMS, Typical)	<1µA		<1.5 µA
Transients (Processor, Typical)	<15 µA	<30 µA	<50 µA
Transients (Other, Typical)	<200 µA	<500 µA	<1 mA
Drift (24 hrs, at Constant Ambient Temperature, Typical)	<3 µA	<10 µA	<25 µA
Temperature Coefficient	<50 ppm/°C		
Laser Controller: Power Control			
Control Range of Photocurrent	10 µA to 2 mA		
Reverse Bias Voltage	0 to 10 V (Adjustable)		
Resolution Photocurrent	30 nA		
Accuracy (Typical)	±0.1%		
Laser Controller: Current Limit			
Setting Range	0 to ≥200 mA	0 to ≥500 mA	0 to ≥ 1A
Resolution	6 µA	15 µA	30 µA
Accuracy	±200 µA	±500 µA	±2 mA
Laser Voltage Measurement			
Measurement Principle	4-wire (Improves Accuracy by Compensating for Cable Resistance)		
Measurement Range	0 to 10 V		
Resolution	0.3 mV		
Accuracy	±5 mV		
Temperature Controller: Output			
Control Range of TEC Current	-2 to +2 A		
Compliance Voltage	>8 V		
Maximum Output Power	16 W		
Measurement Resolution of TEC	0.07 mA (Current) / 0.3 mV (Voltage)		
Noise and Ripple (Typical)	<1 mA		
Temperature Controller: Current Limit			
Setting Range (20-Turn Pot)	0 to ≥ 2A		
Resolution	0.5 mA		
Setting Accuracy	±20 mA		
Temperature Controller: Sensor Data Thermistor:			
Control Range	200 Ω to 40 kΩ (10 kΩ Nominal Resistance @ 25 °C)		
Resolution	0.7 Ω		
Accuracy	±10 Ω		
Stability (24 hrs)	<1 Ω		
AD590, AD592, and LM335:			
Control Range	-12.375 to 90 °C		
Resolution	0.0015 °C		
Accuracy	±0.1 °C		
Temperature Stability (Typical)	<0.001 °C		
Connector: LD/TEC	9-Pin (LD)/15-Pin (TEC) D-Sub (ITC8000 Series); Common 15-Pin D-Sub (ITC8000DS15 Series)		

PRO8 Combined LD/TEC Controllers

ITEM #	$	£	€	RMB	DESCRIPTION
ITC8022	$ 1,724.00	£ 1,241.28	€ 1.499,88	¥ 13,740.28	PRO8 LD/TEC Controller, 200 mA/16 W, Dual Connector
ITC8022DS15	$ 1,680.00	£ 1,209.60	€ 1.461,60	¥ 13,389.60	PRO8 LD/TEC Controller, 200 mA/16 W, Single Connector
ITC8052	$ 1,864.00	£ 1,342.08	€ 1.621,68	¥ 14,856.08	PRO8 LD/TEC Controller, 500 mA/16 W, Dual Connector
ITC8052DS15	$ 1,800.00	£ 1,296.00	€ 1.566,00	¥ 14,346.00	PRO8 LD/TEC Controller, 500 mA/16 W, Single Connector
ITC8102	$ 2,091.00	£ 1,505.52	€ 1.819,17	¥ 16,665.27	PRO8 LD/TEC Controller, 1000 mA/16 W, Dual Connector
ITC8102DS15	$ 2,040.00	£ 1,468.80	€ 1.774,80	¥ 16,258.80	PRO8 LD/TEC Controller, 1000 mA/16 W, Single Connector

DWDM Laser Sources – PRO8 Series (Page 1 of 2)

ITU Coverage: We are committed to providing quick delivery of any of the 100 lasers (on a 100 GHz grid) that comprise the DWDM C- and L-bands.* When ordering, please refer to the tables presented on pages 1172 - 1173, which are organized based on 100 GHz channel spacings. Pricing and ordering codes can also be found there. Our order codes are a combination of the band designator (C or L), the 100 GHz channel number (01 through 50), and an additional character (A, B, C, or D) that indicates the frequency offset from the base channel.

*Subject to Laser Diode Availability, 50 GHz and 25 GHz grid upon request

Introduction – DWDM Laser Modules

The PRO8 DWDM laser modules offer precise tunability as well as long-term wavelength and power stability. Provided with adjustable coherence control, these laser modules are ideally suited for all DWDM applications, including test systems for fiber optic DWDM components, EDFA manufacturing, and multi-laser optical sources for DWDM transmission experiments.

Stability, Accuracy, and Dependability

This DWDM laser platform is the ideal choice for demanding DWDM test and measurement applications with laser linewidths of less than 10 MHz, center wavelength stability of better than 0.002 nm per 24 hours, and wavelength accuracy of better than ±0.025 nm.

We use only telecom-rated, butterfly packaged DFB lasers with integrated TEC elements, optical isolators, and low back-reflection fiber pigtails. When combined with our sophisticated drive circuits, the result is an extremely stable, low-noise laser source that exhibits optical power stability better than 0.005 dB per 15 minutes and a relative intensity noise (RIN) figure of -145 dB/Hz (Typical).

Our laser sources are supplied with a PM fiber and a non-orientated FC/APC connector. As a custom feature, Thorlabs also offers an option to align the slow axis to an orientated FC/APC connector (additional custom connector options available). Additionally, Thorlabs can incorporate user-supplied lasers into our modules. Please contact Technical Support for details.

Features

- Center Wavelengths on 100 GHz ITU-T Grid*
- Wavelengths in C- and L-Bands*
- Wavelength Stability of <0.002 nm (24 Hours)
- Extremely Stable Output Power of <0.01 dB (24 Hours)
- Precise Wavelength Tuning Over ±0.85 nm
- Direct Display of Wavelength During Tuning
- Precise Power Tunning Over >6 dB (Typical 10 dB)
- Variable Coherence Control; Linewidths up to 1 GHz
- Synchronous Modulation of All Laser Sources via Common External TTL Signal
- Instrument Drivers for LabVIEW™ and LabWindows™/CVI Included
- FC/APC Connector

*Subject to Laser Diode Availability, 50 GHz and 25 GHz grid upon request

DWDM Sources in PRO8000 Chassis

Have you seen our...

PRO8000 Optical Switch Modules

The OSW8000 optical switch modules facilitate distribution of test signals in complex test setups for cost-efficient use of laser sources. The modularity of 1 x 2, 1 x 4, 1 x 8, and 2 x 2 switches allows flexible routing paths.

See pages 1174 - 1175

DWDM Laser Sources – PRO8 Series (Page 2 of 2)

Coherence Control, Internal Modulation

For high-precision power measurements, the narrow linewidth of a DFB laser can lead to interference effects caused by reflections from the multiple surfaces that are present in most optical systems. These multiple reflections, while extremely small, can accumulate due to the long coherence length of the laser light. Brillouin scattering is another effect that can lead to significant errors when making optical power measurements in fiber-based systems.

Specifications

Wavelength

- **Options:** 100 Wavelengths on the 100 GHz ITU Grid, (C- and L-Band)*
- **Tuning Range:** ±0.85 nm
- **Accuracy:** ±0.025 nm, Typical< ±0.01 nm
- **Stability:** <0.002 nm over 24 Hours (Typ.)
- **Resolution:** 1 pm
- **Laser Linewidth:** <10 MHz

Output Power

- **Optical Power:** 20 mW
- **Accuracy (abs/rel):** 0.6 dB/0.4 dB
- **Stability:** <0.002 dB over 15 s, <0.005 dB Over 15 min, <0.01 dB Over 24 hrs
- **Attenuation:** >6 dB, 10 dB (Typ.)
- **Resolution:** 0.01 dB
- **Side Mode Suppression Ratio at Max Power:** >40 dB (Typ.), >36 dB (Min.)
- **Relative Intensity Noise (RIN):** -145 dB/Hz (Typ.)
- **Optical Isolation:** >35 dB

Coherence Control (Standard Feature, All Models)

- **Linewidth:** Up to 1 GHz (Adjustable)
- **Shape:** Noise, Sine, and Square (Triangle Upon Request)
- **Frequency:** 0.02 to up to 50 kHz
- **Modulation Depth:** 0.1 to 100%

Modulation

- **Synchronous TTL:** DC - 10 kHz (All Lasers via BNC Input)
- **Analog LF Modulation:** DC-50 kHz (Option via SMA Input)

General Data

- **Optical Output:** FC/APC Connector**
- **Fiber:** PMF (Connector Key Aligned to Slow Axis upon Request)
- **Operating Temperature:** 0 to 35 °C Non-Condensing
- **Storing Temperature:** -40 to 60 °C
- **Warm-Up Time:** 15 min for Rated Accuracy
- **Laser Module Width:** 1 Slot
- **Laser Safety Class:** 1 M

All Data Valid at 23 ± 5 °C and 45 ± 15% Relative Humidity

* Subject to Laser Diode Availability; 50 GHz and 25 Ghz Grid upon request

** Other Connector Styles, (i.e., SC, E2000) and Non-Angled (PC) Ferrule upon request

DWDM Sources

DWDM Sources in PRO800 Chassis

The magnitude of these effects can be significantly reduced by increasing the linewidth of the source. Therefore, all DWDM Series laser sources provide an adjustable coherence length control. Here a small signal modulation on the laser current is used to broaden the DFB laser linewidth from a few MHz up to 1 GHz. The PRO8 provides continuous adjustment of the linewidth over this entire range. An internal broadband noise source or an internal, freely running, sine wave/square wave generator is used to modulate the laser current. The modulation frequency range of the function generator is 20 Hz to 50 kHz with up to 100% modulation depths. Using these features, an ideal non-discrete Gaussian-shaped distribution or a discrete spectral distribution is generated.

External Digital Modulation, DC to 10 kHz

All laser modules within a chassis can be modulated synchronously by an external TTL signal. The modulation bandwidth ranges from DC to 10 kHz. The modulation signal input is on the back panel of the chassis and operates simultaneously on all laser modules of the chassis.

External Analog Low Frequency (LF) Modulation, DC to 50 kHz (Optional)

For applications where a precise LF modulation up to 50 kHz is required, the DWDM modules are available with an LF modulation option. With this option, the output power can be modulated via an optional SMA input. The laser remains fully protected due to a precise limit circuit located inside the module.

Precision Wavelength Tuning

The wavelength is displayed with a resolution of 0.001 nm on the PRO8000 front panel or can be read through the IEEE-488 interface with a resolution of 0.001 nm. By precisely controlling the temperature of the laser chip, the emitted wavelength can be tuned over a range of ±0.85 nm (approximately ±100 GHz). This range allows the central wavelength of the source to be shifted from one transmission channel to either of the adjacent channels for dense WDM systems with 100 GHz channel spacing or tuning over up to 8 channels for systems with 25 GHz channel spacing. This feature is useful for simulating crosstalk between channels. It can also be used to measure the profile of narrow band DWDM filters.

Manual polarization controllers can be supplied as accessories for laser modules. They can be used to adapt the state of polarization in the fiber to polarization-dependant external modulators. Please contact your local Tech Support for ordering information.

See pages 1172 - 1173 for pricing and order codes for laser modules.

DWDM Laser Sources Ordering Guide

The Thorlabs DWDM laser sources cover 100 lasers from the C-, and L-bands with a 100 GHz spacing. They are organized based on the ITU 100 GHz Grid in column A shown in the table on the page 1173. Sources from the 50 GHz and 25 GHz grid (i.e., sources from columns B, C, and D) are available upon request. For all sources the lead times are subject to laser diode availability.

To get the correct item name when ordering the sources, please read the appropriate codes for Band, Channel, and Column from the ITU Grid on the right and fill them into the item name template in the price box shown below.

Ordering Information for WDM8

BAND CODE (C or L)

ITU GRID COLUMN (A, B*, C*, or D*)

WDM8-☐-☐☐☐-20-NM

CHANNEL CODE

*Columns B (50 GHz Offset), C and D (25 GHz Offset) upon request; subject to laser diode availability.

Ordering Information for LS5

BAND CODE (C or L)

ITU GRID COLUMN (A, B*, C*, or D*)

LS5-☐-☐☐☐-20-NM

CHANNEL CODE

*Columns B (50 GHz Offset), C and D (25 GHz Offset) upon request; subject to laser diode availability.

Configuring a Laser Source

EXAMPLE If you want to order a laser source for 1561.42 nm (192.00 THz), which is from the C-Band, you'll find it on the facing page under C-Band, Column A, Channel 11. The item name therefore is: WDM8-C-11A-20-NM.

To order a source for 1590.20 nm (188.525 THz) the codes are L-Band, Column C, Channel 26, and the order code is WDM8-L-26C-20-NM.

Did You Know...

For Recalibration of WDM Sources

Contact Technical Support

Lead times depend on the wavelengths of our laser sources. Please contact our technical support team for more information.

ITEM #	$	£	€	RMB	DESCRIPTION
WDM8-X-XXX-20-NM	$ 2,856.00	£ 2,056.32	€ 2.484,72	¥ 22,762.32	Single PRO8 WDM Laser Source, 20 mW, No Direct Modulation
PRO800	$ 1,820.00	£ 1,310.40	€ 1.583,40	¥ 14,505.40	2-Slot Modular Benchtop Chassis
PRO8000	$ 2,480.00	£ 1,785.60	€ 2.157,60	¥ 19,765.60	8-Slot Modular Rack Chassis

Have you seen our...

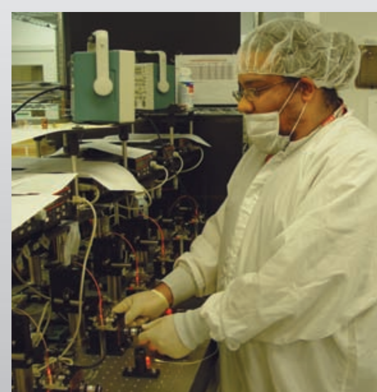
Pigtailed Laser Diodes

TO-Packaged Pigtail

- SM Pigtails from 405 to 2000 nm
- PM Pigtails from 635 to 1550 nm
- MM Pigtails with 635 m or 660 nm CWL
- Custom Pigtails Available Upon Request

Our high-quality pigtail alignment process for laser diodes includes multiple test and inspection points that ensure maximum coupling efficiency. In addition, the input end of the fiber is cleaved at an 8° angle in order to minimize back reflections that can cause the output intensity to fluctuate. Versions are offered based on TO-packaged diodes (Ø5.6 or Ø9 mm) or 14-pin butterfly packages.

See pages 1252 - 1260



Pigtailed Laser Diode Alignment

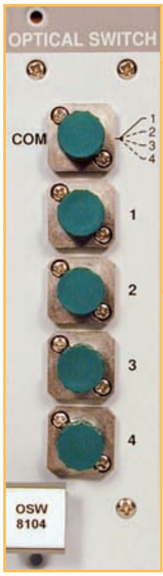
ITU Grid Ordering Guide

Channel	C-Band (1529.75 nm - 1569.59 nm)							
	100 GHz Grid 0.80 nm		50 GHz Offset 0.40 nm		-25 GHz Offset 0.20 nm		+25 GHz Offset 0.20 nm	
	THz	nm	THz	nm	THz	nm	THz	nm
	Column A		Column B*		Column C*		Column D*	
01	191.00	1569.59	191.05	1569.18	191.025	1569.39	191.075	1568.98
02	191.10	1568.77	191.15	1568.36	191.125	1568.57	191.175	1568.16
03	191.20	1567.95	191.25	1567.54	191.225	1567.75	191.275	1567.34
04	191.30	1567.13	191.35	1566.72	191.325	1566.93	191.375	1566.52
05	191.40	1566.31	191.45	1565.90	191.425	1566.11	191.475	1565.70
06	191.50	1565.50	191.55	1565.09	191.525	1565.29	191.575	1564.88
07	191.60	1564.68	191.65	1564.27	191.625	1564.47	191.675	1564.07
08	191.70	1563.86	191.75	1563.45	191.725	1563.66	191.775	1563.25
09	191.80	1563.05	191.85	1562.64	191.825	1562.84	191.875	1562.44
10	191.90	1562.23	191.95	1561.83	191.925	1562.03	191.975	1561.62
EXAMPLE 11	192.00	1561.42	192.05	1561.01	192.025	1561.22	192.075	1560.81
12	192.10	1560.61	192.15	1560.20	192.125	1560.40	192.175	1560.00
13	192.20	1559.79	192.25	1559.39	192.225	1559.59	192.275	1559.19
14	192.30	1558.98	192.35	1558.58	192.325	1558.78	192.375	1558.38
15	192.40	1558.17	192.45	1557.77	192.425	1557.97	192.475	1557.57
16	192.50	1557.36	192.55	1556.96	192.525	1557.16	192.575	1556.76
17	192.60	1556.55	192.65	1556.15	192.625	1556.35	192.675	1555.95
18	192.70	1555.75	192.75	1555.34	192.725	1555.55	192.775	1555.14
19	192.80	1554.94	192.85	1554.54	192.825	1554.74	192.875	1554.34
20	192.90	1554.13	192.95	1553.73	192.925	1553.93	192.975	1553.53
21	193.00	1553.33	193.05	1552.93	193.025	1553.13	193.075	1552.73
REF 22	193.10	1552.52	193.15	1552.12	193.125	1552.32	193.175	1551.92
23	193.20	1551.72	193.25	1551.32	193.225	1551.52	193.275	1551.12
24	193.30	1550.92	193.35	1550.52	193.325	1550.72	193.375	1550.32
25	193.40	1550.12	193.45	1549.72	193.425	1549.92	193.475	1549.52
26	193.50	1549.32	193.55	1548.91	193.525	1549.11	193.575	1548.71
27	193.60	1548.51	193.65	1548.11	193.625	1548.31	193.675	1547.92
28	193.70	1547.72	193.75	1547.32	193.725	1547.52	193.775	1547.12
29	193.80	1546.92	193.85	1546.52	193.825	1546.72	193.875	1546.32
30	193.90	1546.12	193.95	1545.72	193.925	1545.92	193.975	1545.52
31	194.00	1545.32	194.05	1544.92	194.025	1545.12	194.075	1544.72
32	194.10	1544.53	194.15	1544.13	194.125	1544.33	194.175	1543.93
33	194.20	1543.73	194.25	1543.33	194.225	1543.53	194.275	1543.13
34	194.30	1542.94	194.35	1542.54	194.325	1542.74	194.375	1542.34
35	194.40	1542.14	194.45	1541.75	194.425	1541.94	194.475	1541.55
36	194.50	1541.35	194.55	1540.95	194.525	1541.15	194.575	1540.76
37	194.60	1540.56	194.65	1540.16	194.625	1540.36	194.675	1539.96
38	194.70	1539.77	194.75	1539.37	194.725	1539.57	194.775	1539.17
39	194.80	1538.98	194.85	1538.58	194.825	1538.78	194.875	1538.38
40	194.90	1538.19	194.95	1537.79	194.925	1537.99	194.975	1537.59
41	195.00	1537.40	195.05	1537.00	195.025	1537.20	195.075	1536.81
42	195.10	1536.61	195.15	1536.22	195.125	1536.41	195.175	1536.02
43	195.20	1535.82	195.25	1535.43	195.225	1535.63	195.275	1535.23
44	195.30	1535.04	195.35	1534.64	195.325	1534.84	195.375	1534.45
45	195.40	1534.25	195.45	1533.86	195.425	1534.05	195.475	1533.66
46	195.50	1533.47	195.55	1533.07	195.525	1533.27	195.575	1532.88
47	195.60	1532.68	195.65	1532.29	195.625	1532.49	195.675	1532.09
48	195.70	1531.90	195.75	1531.51	195.725	1531.70	195.775	1531.31
49	195.80	1531.12	195.85	1530.72	195.825	1530.92	195.875	1530.53
50	195.90	1530.33	195.95	1529.94	195.925	1530.14	195.975	1529.75

Channel	L-Band (1569.80 nm - 1611.79 nm)							
	100 GHz Grid 0.80 nm		50 GHz Offset 0.40 nm		-25 GHz Offset 0.20 nm		+25 GHz Offset 0.20 nm	
	THz	nm	THz	nm	THz	nm	THz	nm
	Column A		Column B*		Column C*		Column D*	
01	186.00	1611.79	186.05	1611.35	186.025	1611.57	186.075	1611.14
02	186.10	1610.92	186.15	1610.49	186.125	1610.70	186.175	1610.27
03	186.20	1610.06	186.25	1609.62	186.225	1609.84	186.275	1609.41
04	186.30	1609.19	186.35	1608.76	186.325	1608.98	186.375	1608.54
05	186.40	1608.33	186.45	1607.90	186.425	1608.11	186.475	1607.68
06	186.50	1607.47	186.55	1607.04	186.525	1607.25	186.575	1606.820
07	186.60	1606.60	186.65	1606.17	186.625	1606.39	186.675	1605.96
08	186.70	1605.74	186.75	1605.31	186.725	1605.53	186.775	1605.10
09	186.80	1604.88	186.85	1604.46	186.825	1604.67	186.875	1604.24
10	186.90	1604.03	186.95	1603.60	186.925	1603.81	186.975	1603.38
11	187.00	1603.17	187.05	1602.74	187.025	1602.95	187.075	1602.53
12	187.10	1602.31	187.15	1601.88	187.125	1602.10	187.175	1601.67
13	187.20	1601.46	187.25	1601.03	187.225	1601.24	187.275	1600.81
14	187.30	1600.60	187.35	1600.17	187.325	1600.39	187.375	1599.96
15	187.40	1599.75	187.45	1599.32	187.425	1599.53	187.475	1599.11
16	187.50	1598.89	187.55	1598.47	187.525	1598.68	187.575	1598.25
17	187.60	1598.04	187.65	1597.62	187.625	1597.83	187.675	1597.40
18	187.70	1597.19	187.75	1596.76	187.725	1596.98	187.775	1596.55
19	187.80	1596.34	187.85	1595.91	187.825	1596.13	187.875	1595.70
20	187.90	1595.49	187.95	1595.06	187.925	1595.28	187.975	1594.85
21	188.00	1594.64	188.05	1594.22	188.025	1594.43	188.075	1594.00
22	188.10	1593.79	188.15	1593.37	188.125	1593.58	188.175	1593.16
23	188.20	1592.95	188.25	1592.52	188.225	1592.73	188.275	1592.31
24	188.30	1592.10	188.35	1591.68	188.325	1591.89	188.375	1591.47
25	188.40	1591.26	188.45	1590.83	188.425	1591.04	188.475	1590.62
26	188.50	1590.41	188.55	1589.99	188.525	1590.20	188.575	1589.78
27	188.60	1589.57	188.65	1589.15	188.625	1589.36	188.675	1588.94
28	188.70	1588.73	188.75	1588.30	188.725	1588.51	188.775	1588.09
29	188.80	1587.88	188.85	1587.46	188.825	1587.67	188.875	1587.25
30	188.90	1587.04	188.95	1586.62	188.925	1586.83	188.975	1586.41
31	189.00	1586.20	189.05	1585.78	189.025	1585.99	189.075	1585.57
32	189.10	1585.36	189.15	1584.95	189.125	1585.16	189.175	1584.74
33	189.20	1584.53	189.25	1584.11	189.225	1584.32	189.275	1583.90
34	189.30	1583.69	189.35	1583.27	189.325	1583.48	189.375	1583.06
35	189.40	1582.85	189.45	1582.44	189.425	1582.64	189.475	1582.23
36	189.50	1582.02	189.55	1581.60	189.525	1581.81	189.575	1581.39
37	189.60	1581.18	189.65	1580.77	189.625	1580.98	189.675	1580.56
38	189.70	1580.35	189.75	1579.93	189.725	1580.14	189.775	1579.73
39	189.80	1579.52	189.85	1579.10	189.825	1579.31	189.875	1578.89
40	189.90	1578.69	189.95	1578.27	189.925	1578.48	189.975	1578.06
41	190.00	1577.86	190.05	1577.44	190.025	1577.65	190.075	1577.23
42	190.10	1577.03	190.15	1576.61	190.125	1576.82	190.175	1576.40
43	190.20	1576.20	190.25	1575.78	190.225	1575.99	190.275	1575.57
44	190.30	1575.37	190.35	1574.95	190.325	1575.16	190.375	1574.75
45	190.40	1574.54	190.45	1574.13	190.425	1574.33	190.475	1573.92
46	190.50	1573.71	190.55	1573.30	190.525	1573.51	190.575	1573.09
47	190.60	1572.89	190.65	1572.48	190.625	1572.68	190.675	1572.27
48	190.70	1572.06	190.75	1571.65	190.725	1571.86	190.775	1571.45
49	190.80	1571.24	190.85	1570.83	190.825	1571.03	190.875	1570.62
50	190.90	1570.42	190.95	1570.01	190.925	1570.21	190.975	1569.80

*Columns B (50 GHz Offset), C and D (25 GHz Offset) upon request; subject to laser diode availability.

Optical Switch Modules for PRO8 (Page 1 of 2)



PRO8000 Optical Switch Modules: The OSW8000 optical switch modules facilitate distribution of test signals in complex test setups. The modularity of 1 x 2, 1 x 4, 1 x 8, and 2 x 2 switches allows for the flexible construction of routing paths. The bi-directional, 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 bi-directional switching modules are available, providing highly flexible routing of optical signals.

The OSW8000 series bi-directional optical switches offer a fast switching time (typically, rise times are better than 0.5 ms with a maximum of 1 ms), and a broad wavelength range (1240 nm to 1610 nm), making them ideal companions to our extensive line of DWDM laser diode sources shown on pages 1170 through 1173. The four different modules offered are 1 x 2, 1 x 4, 1 x 8, and 2 x 2 switches, each of which features low insertion loss and excellent repeatability.

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.

Features

- Wavelength Range: 1240 - 1610 nm
- Very Fast Response Time: 0.5 ms Typical, 1 ms Max
- Low Insertion Loss: 0.7 dB (1 x 2) Typical, 2.6 dB (1 x 8) Max
- Excellent Repeatability: ±0.01 dB
- MEMS Technology for Long Life: $>10^9$ Cycles
- Four Modules: 1 x 2, 1 x 4, 1 x 8, and 2 x 2
- Up to Eight Switch Modules per Chassis
- LabVIEW™ and LabWindows™/CVI Drivers Included
- Efficient Test Signal Routing in Branching Test Beds

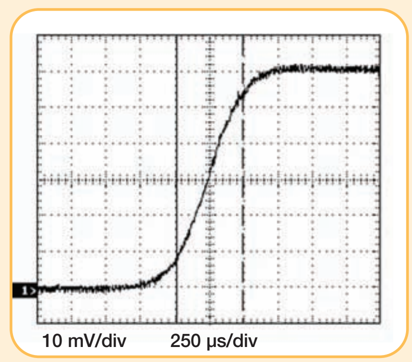


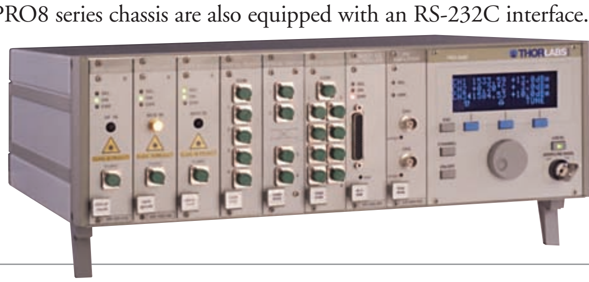
Figure 1
Rise time measurement of the MEMS based optical switch; the rise time measured between the 10% and 90% points is 480 µs.

MEMS Technology: Provides Billions of Switch Cycles

The switching mechanism is based on silicon MEMS (Micro-Electro-Mechanical Systems) technology, which ensures a long lifetime and fast operation (see Figure 1). This technology also provides very low crosstalk between channels; the 1 x 4 and 1 x 8 switches have a maximum crosstalk specification of -60 dB, and the 1 x 2 and 2 x 2 are both rated at -50 dB.

IEEE-488 Computer Control of Multiple PRO8s

The PRO8 chassis (2 slot and 8 slot models) are both equipped with a IEEE-488.2 interface supported by a number of free LabVIEW™ and LabWindows™ drivers. The PRO8 can accept an assortment of different modules, allowing the OSW8000 switches to be combined with our high-performance laser sources. All PRO8 series chassis are also equipped with an RS-232C interface.



User Friendly Operation

The PRO8000 series chassis offers a user friendly, menu-driven platform from which a selection of various modules can be operated.

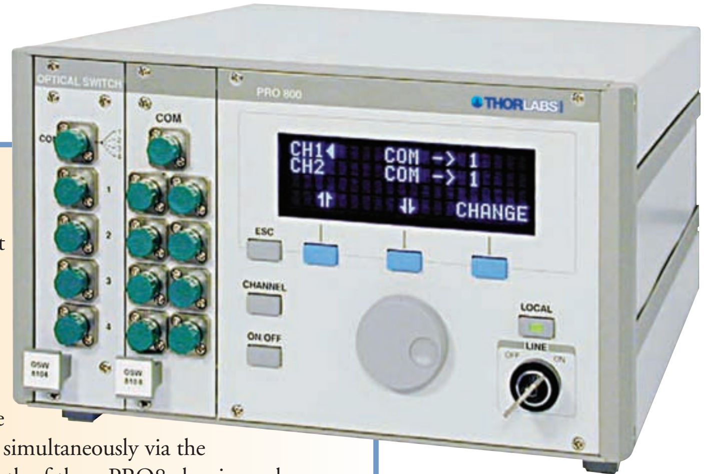
Configuring a system is as simple as inserting the modules; each of the plug-in modules automatically identifies itself to the chassis processor. A brightly lit, 4 x 20 fluorescence display allows the user to scroll through and select any installed module. When selected on the display, all of the control parameters for the individual module are accessible and all functionality is controllable via the front panel. Additional higher level commands are available for operating the system via the IEEE-488 interface (e.g., changing switch settings to automate multi-path testing).

Optical Switch Modules for PRO8 (Page 2 of 2)

OSW8202

Other Connectors Available upon Request.

The OSW8000 series of modules requires one of our two PRO8 series chassis. We offer two different chassis versions: the PRO800 two-slot chassis fits perfectly where space is limited, and the PRO8000 eight-slot chassis is ideal for use in building larger test systems. For even larger test systems it is possible to control many of the mainframes simultaneously via the IEEE-488.2 interface. Details on both of these PRO8 chassis can be found on pages 1160 - 1161.



PRO800 with Two OSW8000 Modules

ITEM #	OSW8102	OSW8104	OSW8108	OSW8202
Switching Configuration	1 x 2	1 x 4	1 x 8	2 x 2
Switching Time Typical	0.5 ms Typical (1 ms Max)			
Wavelength Ranges	1240 - 1610 nm			
Maximum Input Power	17 dBm (CW)			
Insertion Loss (Typical/Max)*	0.7 dB / < 1.5 dB	1.2 dB/<2.1 dB	1.6 dB/<2.6 dB	0.7 dB/<1.5 dB
PDL**	<0.1 dB	<0.15 dB	<0.2 dB	<0.15 dB
Crosstalk, Max	<-50 dB	<-60 dB	<-60 dB	<-50 dB
Repeatability	±0.01 dB			
Return Loss	-50 dB	-50 dB	-45 dB	-50 dB
Connectors	FC/APC			
General Data Operating Temperature	0 to +35 °C			
Storing Temperature	-10 to +60 °C			
Width	1 Slot			

* Including connectors. ** Measured at 1550 nm

ITEM #	$	£	€	RMB	DESCRIPTION
OSW8102	$ 3,214.00	£ 2,314.08	€ 2.796,18	¥ 25,615.58	1 x 2 Optical Switch, FC/APC
OSW8104	$ 4,198.00	£ 3,022.56	€ 3.652,26	¥ 33,458.06	1 x 4 Optical Switch, FC/APC
OSW8108	$ 8,158.00	£ 5,873.76	€ 7.097,46	¥ 65,019.26	1 x 8 Optical Switch, FC/APC
OSW8202	$ 3,955.00	£ 2,847.60	€ 3.440,85	¥ 31,521.35	2 x 2 Optical Switch, FC/APC

For more details, see pages 1548 - 1551

PDA8000 Photocurrent Measurement Module

Module for Optical Power Measurement

The PDA8000-2 is designed as a plug-in module for the PRO8000 chassis detailed on pages 1160 - 1161. 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 PDA8000-2 dual-channel photocurrent measurement module enables high-precision measurement of photocurrents with 16-bit resolution. Seven measurement ranges are available with the most sensitive 10 nA full scale setting providing a resolution of 0.1 pA.

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 Modules
(Sold Separately)

Introduction – Photocurrent Measurement Module

The PDA8000-2 photocurrent measurement module is an ideal companion for our other PRO8000 series plug-in modules. It provides precise photocurrent measurements from 10 nA to 10 mA. 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 calibrated photodiode can be used to accurately measure optical power. A photodiode responsivity value can be entered in the PRO8 channel menu. This allows the direct entry of standard calibration data provided by photodiode manufacturers when a calibrated photodiode is purchased.

Computer Control IEEE-488.2

As with all of our PRO8000 compatible modules, the PDA8000-2 dual-channel module commands can be accessed via an 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 10 nA to 10 mA with 16-Bit Resolution
- Resolution of 0.1 pA on the 10 nA scale
- Accuracy is ±0.025% of Full Scale Reading (1 mA to 10 mA)

PDA8000 Measurement Range

MEASUREMENT RANGE	RESOLUTION	ACCURACY
10 mA	0.1 µA	±0.025% Full Scale
1 mA	10 nA	±0.025% Full Scale
100 µA	1 nA	±0.025% Full Scale
10 µA	0.1 nA	±0.025% Full Scale
1 µA	10 pA	±0.025% Full Scale
100 nA	1 pA	±0.25% Full Scale
10 nA	0.1 pA	±0.8% Full Scale

Photocurrent Module Specifications

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

General Data

- **Module Width:** 1 Slot
- **Photodiode Connectors:** PDA8000-2 BNC (2x)

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

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 PDA8000-2 is designed as a plug-in module for the PRO8000 chassis detailed on pages 1160 - 1161. The module is recognized by the chassis when powered. All control functions of the photocurrent amplifier can be used in manual or remote modes.

ITEM #	$	£	€	RMB	DESCRIPTION
PDA8000-2	$ 1,041.00	£ 749.52	€ 905,67	¥ 8,296.77	Dual-Channel Photocurrent Measurement Module

Fiber Selection Guide

TXP5000 Selection Guide

Test and Measurement Platform (Page 1 of 2)

TXP5016 Chassis
Modules Sold Separately, Laptop not Included

Three Chassis Versions

- **TXP5004:** 4 Slots with USB Control
- **TXP5016:** 16 Slots with Ethernet Control
- **TXP5001AD:** Single Module Adapter with Desktop Power Supply and USB Control (See Next Page)

Available Modules

- **ITC5000:** Combination Laser Diode Current and TEC Temperature Control (See Pages 1186 - 1187)
- **LS5000:** Optical Sources from 1470 - 1620 nm (See Pages 1188 - 1191)
- **IPM5300:** High-Speed Inline Polarimeter (See Pages 1184 - 1185)
- **DPC5500:** Inline Deterministic Polarization Controller (See Page 1183)
- **PAX5710/5720:** Rotating Quarter-Wave Plate Polarimeter for VIS and NIR (See Pages 1180 - 1182)

Introduction

The TXP5000 Series is a powerful photonic test and measurement platform that bridges the gap between the research community and the industrial test and measurement market.

Benchtop and Rack Version

The three available TXP versions offer great flexibility regarding size, complexity, and connectivity of the system. The TXP5016 rack version for up to 16 modules includes a TCP/IP port and is optimized for large, complex systems in industrial environments. The TXP5004 benchtop version for up to four modules is controlled via a USB port and is targeted for R&D test and measurement applications in lab environments. The TXP5001AD single module interface offers economical evaluation with full functionality for a single module with USB connectivity.

The family of plug and play modules for a broad range of photonic applications include integrated laser drivers and TEC controllers, DWDM DFB laser sources, and advanced polarimetry control and measurement devices. All modules are interchangeable and can be integrated with LabVIEW™ and LabWindows™/CVI control. The TXP5000 platform incorporates an efficient architecture that shares common functionality within the mainframe. Only building blocks required for specific functionality or for real-time applications are implemented into the module itself.

TXP5004
4-Slot Chassis

Typical Applications

Typical applications of TXP systems span from qualification, test, and burn-in systems for optical equipment in manufacturing environments to PMD analysis in complex network architectures. The TXP system is especially well suited for high-performance polarization analysis and control.

User-Friendly Controls

The TXP5000 system utilizes USB and TCP/IP protocol for communication, which offers easy connection to PCs and integration into networks. The TXP5004 benchtop is controlled by a connected PC via USB, whereas the TXP5016 rack unit offers direct connection to Ethernet networks via an embedded server. The system is easily configured through the TXP Graphical User Interface (GUI). The TXP GUI makes local or remote administering very easy, and since it is completely network based, it enables worldwide access to the system.

Modularity, Interchangeability, and Flexibility

The "hot swap" feature of the TXP5000 system allows any module to be replaced without interrupting other modules in the same mainframe that are in operation. Arbitrary module assemblies can be pooled together into individual systems by specialized software modules, allowing them to perform new and more complex tasks through a single interface or GUI. This facilitates ever-changing requirements and the reuse of existing hardware for customized and more specialized applications. A customer who already owns the necessary modules needs only the software module to run that application. The internet-embedded architecture allows new or upgraded GUIs, software tools, and firmware to be easily downloaded and installed into the system.

Security Interlock

The TXP chassis provide global interlocks to secure TXP setups against external events such as opening of lab doors or pushing of emergency switches. The reaction of the TXP depends on the type of card inserted. In addition to the global interlock, some TXP cards have an individual interlock line.

Test and Measurement Platform (Page 2 of 2)

TXP5000 Series Chassis Specifications

ITEM #	TXP5016	TXP5004	TXP5001AD*
Maximum Power Delivery	320 W	100 W	36 W
Number of Slots	16 Slots	4 Slots	1 Slot
Operation	Graphical User Interface on PC		
Remote Interface	Ethernet 10BaseT	USB 2.0 (Full Speed)	
Remote Drivers	Driver DLL with Support for NI LabVIEW™, NI LabWindows/CVI™, MS Visual C++™, Borland C++™		
Chassis Ground	4 mm Banana		4.8 mm Fast-On
Line Voltage	100 to 240 VAC ±10%		
Line Frequency	50 to 60 Hz ± 5%		
Operating Temperature	0 to 40 °C		
Storage Temperature	-40 to 70 °C		
Dimensions	17.68" x 5.83" x 17.13" 449 mm x 148 mm x 435 mm	6.61" x 5.83" x 12.40" 168 mm x 148 mm x 315 mm	4.88" x 0.91" x 4.41" 124 mm x 23 mm x 112 mm
Weight (w/o Modules)	7 kg (15.4 lbs)	3 kg (6.6 lbs)	0.2 kg (0.4 lbs)

*Please see order information at the bottom of the page.

TXP5000 Series Chassis: 4-Slot and 16-Slot Systems

ITEM #	$	£	€	RMB	DESCRIPTION
TXP5004	$ 1,233.00	£ 887.76	€ 1.072,71	¥ 9,827.01	TXP5000 4 Slot Chassis with USB Control
TXP5016	$ 3,560.00	£ 2,563.20	€ 3.097,20	¥ 28,373.20	TXP5000 16 Slot Chassis with Ethernet Control

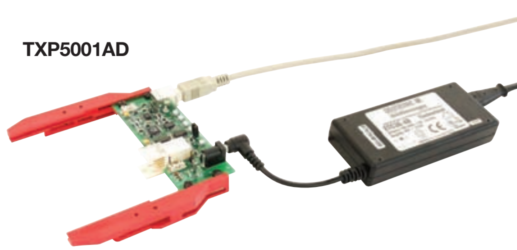
TXP Series Accessories and Replacement Items

ITEM #	$	£	€	RMB	DESCRIPTION
TXP5000C	$ 49.00	£ 35.28	€ 42,63	¥ 390.53	Front Cover Plate for TXP Chassis
TXP5000-R32	$ 72.00	£ 51.84	€ 62,64	¥ 573.84	Rack Mounting Kit, 19" for TXP5016
TXPCABCRO	$ 24.00	£ 17.28	€ 20,88	¥ 191.28	TXP5016 Crosslink Cable, 2 m Long
TXPCABETH	$ 24.00	£ 17.28	€ 20,88	¥ 191.28	TXP5016 Ethernet Cable, 2m Long
TXPCABSER	$ 31.00	£ 22.32	€ 26,97	¥ 247.07	TXP5016 Serial Service Cable for Software Upgrades
TXPCABUSB	$ 31.00	£ 22.32	€ 26,97	¥ 247.07	TXP5004 USB Cable, 2m Long

Single Module Interface

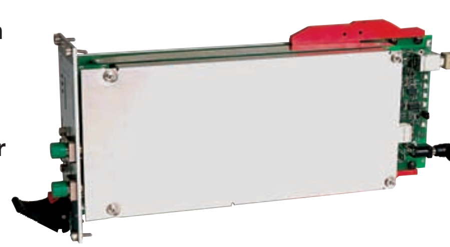
- Power/Control any Module for TXP5000 Series
- Ideal for Test Bench Operation of a Single Module
- USB Interface for Direct PC Connection and Control
- Also Available as an OEM Integration Tool for TXP5000 Technology
- USB Cable and External Power Supply Included

TXP5001AD



The TXP5001AD is a economical adapter for any TXP5000 Series module. It provides a USB interface and allows a single module to be operated without any additional equipment except a PC. The adapter comes with the TXP5000 software installation package including NI LabVIEW™, NI LabWindows/CVI™, MS Visual C++™, and Borland C++™ drivers. The connection to the user PC is accomplished via the included USB cable. The adapter offers the easiest and most cost-effective way to start using the modules of the TXP5000 series, such as laser diode controllers, optical signal sources/controllers, and polarimetric controllers and analyzers. A 48 V power supply is included that operates from 100 - 240 VAC, 50 - 60 Hz.

TXP5001AD shown with a TXP5000 Module (not included). See the following pages for details on TXP laser controllers, TEC controllers, and laser sources.



Single Module Test Bench Adapter

ITEM #	$	£	€	RMB	DESCRIPTION
TXP5001AD	$ 278.00	£ 200.16	€ 241,86	¥ 2,215.66	TXP5000 Single Module Interface with USB Control

PAX5710-T Series of Polarimeters (Page 1 of 3)

PAX5710VIS-T
(Cables and Laptop Included)

Applications

- Free-Space and In-Fiber Polarimetry
- ER Measurements on PMF
- DOP Measurements
- Polarimeter Unit for the PMD5000 System

Specifications

- **Input Power Range:**[a] -40 dBm to 0 dBm
- **Azimuth Angle Accuracy:**[b,c] ±0.25°
- **Ellipticity Angle Accuracy:**[b] ±0.25°
- **Degree of Polarization Accuracy:** ±0.5% Full Scale
- **Wavelength Range:**
  - VIS: 400 - 700 nm
  - IR1: 700 - 1000 nm
  - IR2: 1000 - 1350 nm
  - IR3: 1300 - 1700 nm
- **Maximum Measurement Rate:** 333 Samples/s
- **Fiber Input:** FC/PC (Others Available Upon Request)
- **Free-Space Input:** Ø3 mm, <3 mrad Beam Divergence
- **Analog Interface (Via Front Panel D-Sub):**
  - Outputs: S1, S2, S3, Power/dBm, and DOP (Complete Stokes Vector Plus DOP)
  - Inputs: Trigger
- **Digital Interface Outputs:** S1, S2, S3, Power, DOP, Azimuth, and Ellipticity
- **Warm-Up Time for Rated Accuracy:** <15 min
- **Operating Temperature:** 5 - 40 °C

a) Absolute power range depends on the current wavelength, which can be as large as -60 dBm to 10 dBm. Above specifications valid within the -40 dBm to 0 dBm range.

b) For any SOP with -30° < ellipticity < 30°

c) Azimuth angle is defined as the inclination angle of the major axis of the polarization ellipse to the horizontal axis. The ellipticity angle is given as arctan(b/a) where b is the length of the minor axis and a is the length of the major axis of the polarization ellipse.

Introduction - PAX5710-T Polarimeter

The PAX5710-T Series polarimeter system is a flexible and powerful polarization analysis system based on our modular TXP5000 platform (see pages 1178 - 1179). This polarimeter system is designed for different applications ranging from classic polarization measurements to complex tasks like evaluating optical components with the Jones matrix algorithm within the PMD5000 system. It is also well suited for determining the extinction ratio (ER) of polarization-maintaining fibers (PMF) and for alignment of PMF to laser modules. The PAX5710-T series is specifically engineered for accurate measurements of polarization-related effects for high dynamic ranges with wavelengths from 400 to 1700 nm. It consists of the analyzer with an external sensor head for free-space and fiber-based optical systems. In contrast to our IPM5000 Series, which allows transmission of the optical output, the PAX5710-T Series uses all incident light for the measurement without any optical output.

How it Works

The optical unit of a PAX5710-T measurement sensor consists of a rotating quarter-wave plate, a fixed polarizer, and a photodiode (see Figure 1). The wave plate transforms the input polarization depending on the actual rotating angle. Then, the polarizer only transmits the portion of light that has its polarization parallel to the transmission axis. As a result, the polarization modulation is converted into an amplitude modulation. The photodetector supplies a current that is proportional to the optical power. A Fourier transformation is used to accurately calculate all polarization-relevant parameters like SOP, DOP, azimuth, ellipticity, Stokes vectors, etc.

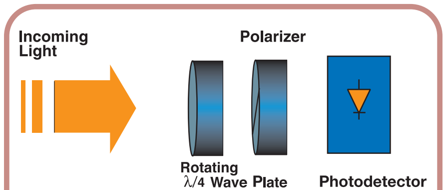


Figure 1 - Schematic of Rotating Wave Plate Technique

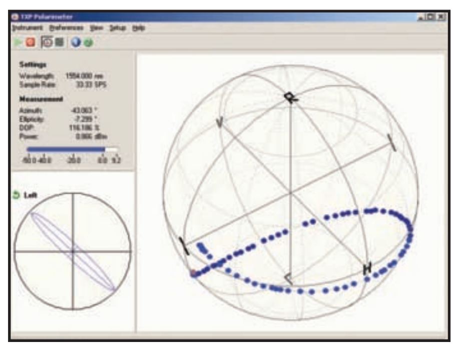


Figure 2 - Polarimeter GUI

SOP and DOP Measurements

The PAX5710-T analyzes the state of polarization and the degree of polarization of optical signals in either free-space or optical fibers. The resulting data can be viewed using the graphical user interface that is supplied with each PAX unit. The state of the input polarization is completely characterized by different representations. As can be seen in Figure 2, the polarization data is presented in a number of forms: on the Poincaré sphere, as numeric results, or as a polarization ellipse with the handedness noted. The degree of polarization and the total optical power are also provided.

PAX5710-T Series of Polarimeters (Page 2 of 3)

Long-Term Polarization Measurements

Another standard feature is the scope mode, which looks similar to an oscilloscope display. The polarization can be examined continuously over time or initiated with a software or hardware trigger signal. A maximum of 1024 data points can be collected. Another feature is the pre-trigger function, which can be activated in each trigger mode. A user-configurable number of samples are stored in a ring buffer until the trigger pulse is given. All acquired data before and after the trigger pulse are displayed in a diagram. Therefore, real-time monitoring of the system's polarization behavior can be realized with the PAX measurement system. The measured data can be stored in an ASCII format file (CSV). The data file contents can be viewed with any text editor and can be further processed using third-party software packages such as MathCAD, Mathematica, or Excel.

Software Features

The software for the PAX system includes drivers for LabVIEW™, LabWindows™/CVI™, MSVC, and Borland C. These drivers enable you to write your own applications to adapt the polarimeter into a complete optical setup. Included in the software are features specifically geared towards extinction ratio (ER) measurements (see below).

System Configurations

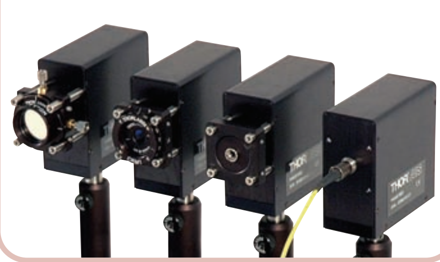
Due to its modular design and the various models available, the PAX system is an ideal tool for various types of polarization-related measurement tasks in research and development laboratories as well as for final inspection in manufacturing. The PAX5710-T series can be used for free-space and fiber-based applications in the 400 to 1700 nm wavelength range. See the following page 1182 for ordering information.

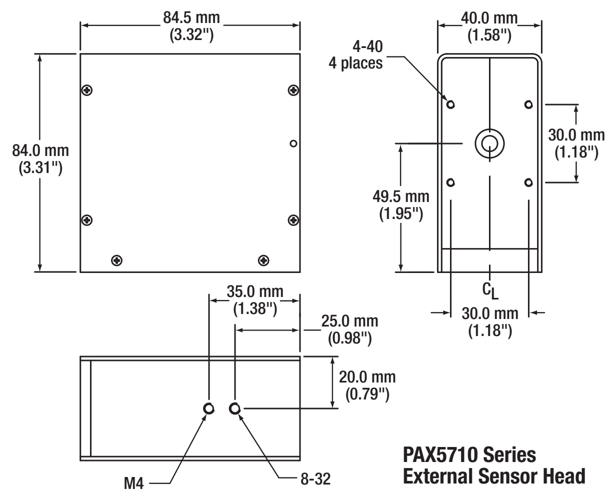
The PAX5710 consists of a TXP-compatible module and an external polarization measurement sensor. The PAN5710 external measurement sensor (see next page 1182) facilitates polarization analysis in free-space setups. It can be easily mounted to optical benches using the M4 x 0.7 or #8-32 mounting hole provided on the bottom surface of the head. It is also compatible with our extensive line of 30 mm cage system components. The optical light field to be measured should enter the aperture of the sensor nearly perpendicular to the front panel. The beam diameter should be less than 3 mm to guarantee that all of the light reaches the detector.

All sensors are supplied with a fiber collimator for FC/PC fiber connectors to allow polarization measurements on fiber-based systems.

Application Idea

External PAX Sensor Heads





PAX5710 Series External Sensor Head

Please refer to our website for complete models and drawings.

Extinction Ratio Measurement on Polarization-Maintaining Fibers

Extinction ratio (ER) is a key qualifier of polarization-maintaining fibers (PMF) and PM couplings. Using the standard features built into the PAX software, ER measurements can be made quickly and reliably in the 0 to 45 dB range.

The measured ER parameter refers to the PMF directly connected to the polarimeter input.

The easiest measurement technique is to find the maximum expansion of the polarization ellipse compared to the ideal linear state. Since this expansion is dependent on the fiber stress, a lot of values have to be recorded while the fiber is stressed, pulled, or a wavelength scan is performed.

This technique requires the highest accuracy in the measurement of the ellipticity angle. With a very high ER, the setup is prone to measurement inaccuracies. The PAX5710-T uses an optimized algorithm to mitigate this issue. The data collected from fiber stressing is used to fit a circle on the Poincaré sphere. The radius of the circle, expressed in degrees, is representative of the maximum expansion of the polarization ellipse.

Only the relative polarization measurement accuracy determines the ER measurement error, since the shift of the circle to any position on the Poincaré sphere is irrelevant as long as the size of the circle remains unchanged. Errors resulting from poorly or angle-polished fibers have no influence on the final value, only the ER of the stressed fiber segment measured.

The ER measurement on PMF is integrated in the PAX5710-T software, along with all polarimeter-related functions.

PAX5710-T Series of Polarimeters (Page 3 of 3)

PAX5710-T Series of Benchtop Free-Space Polarimeters

The PAX5710-T versions consist of a TXP5004 chassis with USB connection, a PAX5710 electronics card, one external polarimeter sensor, and pre-configured notebook computer, making this a complete free-space measurement system right out of the box. This package includes all of the necessary cables for connecting the sensor and computer.

The wavelength range can be easily changed by purchasing one of the sensor heads shown below.

PAX5710VIS-T
Cables, External Sensor Head, Chassis, and Laptop Included (All Sensor Heads are Factory Calibrated)

ITEM #	$	£	€	RMB	DESCRIPTION
PAX5710VIS-T	$ 7,991.00	£ 5,753.52	€ 6.952,17	¥ 63,688.27	TXP Polarimeter w/ External Sensor, 400 - 700 nm
PAX5710IR1-T	$ 7,991.00	£ 5,753.52	€ 6.952,17	¥ 63,688.27	TXP Polarimeter w/ External Sensor, 700 - 1000 nm
PAX5710IR2-T	$ 7,991.00	£ 5,753.52	€ 6.952,17	¥ 63,688.27	TXP Polarimeter w/ External Sensor, 1000 - 1350 nm
PAX5710IR3-T	$ 7,991.00	£ 5,753.52	€ 6.952,17	¥ 63,688.27	TXP Polarimeter w/ External Sensor, 1300 - 1700 nm

PAN5710IR2
External Sensor Head

External Measurement Heads for PAX5710-T Series

The External Measurement Heads of the PAX5710 Series of Polarimeters can be exchanged to switch to a different wavelength range without the need to purchase a complete new system. The external heads of the PAN5710 Series allow free-space and fiber-based measurements with easy integration in optical setups.

Features

- Extend the Wavelength Range Options of an existing PAX5710 System
- Free-Space and Fiber Input

ITEM #	$	£	€	RMB	DESCRIPTION
PAN5710VIS	$ 3,461.00	£ 2,491.92	€ 3.011,07	¥ 27,584.17	PAX External Sensor Head, 400 - 700 nm
PAN5710IR1	$ 3,461.00	£ 2,491.92	€ 3.011,07	¥ 27,584.17	PAX External Sensor Head, 700 - 1000 nm
PAN5710IR2	$ 3,461.00	£ 2,491.92	€ 3.011,07	¥ 27,584.17	PAX External Sensor Head, 1000 - 1350 nm
PAN5710IR3	$ 3,461.00	£ 2,491.92	€ 3.011,07	¥ 27,584.17	PAX External Sensor Head, 1300 - 1700 nm

Putting it all together

For more details, see pages 1192 - 1195

PMD5000 Series
Complete PMD Analysis System
(Laptop Included)

The PMD5000 Series combines our DPC5500 Series deterministic polarization controller, one of our IPM5300 Series or PAX5720IR3 Series polarimeters, and an external tunable laser source with a specialized software package. This combination creates a versatile polarization-mode dispersion (PMD) and a polarization-dependent loss (PDL) measurement system.

The PMD5000 series provides extensive measurement and analysis of PMD on both broadband and narrowband components, optical fibers, and installed optical systems. It is capable of determining polarization dependent loss (PDL) and polarization dependent gain (PDG). PMD measurements of complex optical networks can be performed as well as PMD monitoring of dark channels.

DPC5500-T Benchtop In-Line Deterministic Polarization Controller

Introduction

The DPC5500, an in-line deterministic polarization controller for the TXP5000 systems, combines deterministic state of polarization control, high-speed, low-loss, and high accuracy in a unique all-fiber-based solution. It is a versatile polarization control solution that may be utilized in many applications, ranging from research and development to industrial applications. The polarization controller is available as a complete benchtop unit including a preconfigured laptop, the DPC5500 module and TXP mainframe (DPC5500-T Series).

DPC5500-T
Benchtop Polarization Controller
(Includes Pre-Configured Laptop and TXP5000)

The DPC5500 is based on our high-speed, low-loss IPM5300 polarimeter technology and a non-deterministic state of polarization (SOP) controller. A digital signal processor (DSP) produces a feedback signal from the polarimeter to drive the fiber squeezer-based state of polarization controller. The DPC5500 is ideal for applications that require precise deterministic control or locking of an SOP. Software modules for electronic SOP control, SOP tracing on the Poincaré sphere, and SOP scrambling are available for specific applications.

How It Works

Central to the DPC5500 is a DSP, which enables high-speed control and locking of the SOP. The DSP monitors the polarization feedback signal from the polarimeter and drives the non-deterministic SOP controller, which is comprised of a multitude of piezoelectric-based fiber squeezers. A simple, yet robust, calibration algorithm accounts for the inherent nonlinearities in the piezoelectric elements and allows for accurate and stable deterministic SOP control. This facilitates SOP control at a user-defined location in the optical system such that the SOP can be varied to accurately and precisely follow a prescribed path on the Poincaré sphere (see Figure 1).

Comparison to Existing Systems

The DPC5500 eliminates the inadequacies of most commercially available SOP controllers whose output SOP depends on the input SOP. Any input SOP change will implicitly lead to a corresponding output SOP rotation. In addition, most commercial high-speed SOP controllers are trial and error controllers and suffer from drift and hysteresis effects. They are non-deterministic and are dependent on environmental and prior conditions. This all-fiber technology provides deterministic control with very low insertion loss. The desired SOP may either be defined via its azimuth/ellipticity parameters or its corresponding Stokes values, which are graphically defined by a point on the Poincaré sphere or electronically defined by supplying a feedback signal from a control loop.

Specifications

- **SOP Adjusting:** 150 µs (Typical)
- **Wavelength Range:**
  - 1510-1640 nm (Calibrated)
- **SOP Accuracy:** ±0.25° on Poincaré Sphere
- **DOP Accuracy:*** ±0.25%
- **Insertion Loss:**
  - <1.2 dB (Including Connectors)
- **PDL:** <0.05 dB
- **Dynamic Range:** 35 dB (-20 dBm to 15 dBm)
- **Operating Modes:** DPC, IPM Single-Mode, IPM Array Mode, Scrambler Mode (Optional)
- **Analog Interface:**
  - Outputs: S1, S2, S3, Power/dBm, DOP
  - Input: Trigger
- **Digital Interface Outputs:** S1, S2, S3, Power/dBm, DOP, Azimuth, and Ellipticity
- **Operating Temperature:** 5 - 40 °C

*At 1550 nm or user calibration wavelength and +3 dBm input power. DOP accuracy across entire specified wavelength range: ±0.5%.

Features

- Deterministic Polarization Control and Locking
- Generates Precise SOP Sequence for Jones and Mueller Matrix Characterization Methods
- Component for PDL/PMD Measurement
- External Trigger Allows Synchronized Measurement
- Monitoring the S Parameters by Analog Outputs
- High-Speed Feedback for Automatic Polarization Control

The DPC5500-T includes a TXP5000 series mainframe and a pre-configured laptop. See page 1179.

Figure 1
The degree to which we can deterministically control the state of polarization within an optical system is shown

SOP Scrambler

The system also includes an SOP Scrambler, which can be used to depolarize a source to minimize Polarization-Dependent Gain in fiber networks, to eliminate polarization dependencies of fiber optic sensors, or to perform PDL measurements.

The SOP Scrambler provides three modes of operation to adapt to the users application. These modes differ in the way the SOP values are generated and controlled (full deterministic SOP scanner, semi-deterministic SOP scanner, and deterministic randomizer). The options have different operation speeds depending on their involved complexity.

Please Call or Visit Our Website for Delivery Information

ITEM #	$	£	€	RMB	DESCRIPTION
DPC5500-T	$ 11,906.00	£ 8,572.30	€ 10.358,20	¥ 94,890.82	Benchtop In-Line Deterministic Polarimeter, Laptop Included

IPM5300-T Benchtop In-Line Polarimeter (Page 1 of 2)

Introduction - IPM5300 Fast In-Line Polarimeter

The IPM5300 fiber optic polarimeter module enables high-speed measurements of the state of polarization (SOP). The in-line fiber design has an insertion loss of less than 1.2 dB, a dynamic range of 45 dBm, and an accuracy of ±0.25° on the Poincaré sphere with a max sampling rate of 1 MHz. The IPM5300 series is available as a complete benchtop unit including preconfigured laptop and TXP Mainframe (IPM5300-T series, see pages 1184 - 1185).

This all-fiber polarimeter is based on patented FBG technology. It provides a novel combination of in-line polarimetric measurement, low insertion loss, high speed, and accuracy that enables unprecedented measurement control of the SOP in fiber optic applications.

IPM5300-T
Benchtop In-Line Polarimeter
Includes a Pre-Configured Laptop and TXP 5000

How it Works

The IPM5300 polarimeter is designed as an in-line polarimeter that utilizes a series of custom Fiber Bragg Gratings (FBGs). Figure 1 shows the optical schematic of the polarimeter module. The device uses two pairs of FBGs with polarization-dependent reflectivity to direct very small percentages of the transmitted optical power to four detectors. A λ/4 fiber wave plate is positioned between the two pairs of FBGs to produce the two additional elliptical states of polarization that are required for a full analysis of an arbitrary state of polarization.

The IPM5300 overcomes the limitations of other fiber-based in-line polarimeter designs by eliminating the need to use tap couplers, which exhibit temperature and wavelength sensitivity. The FBG approach offers superior performance; it provides a broad wavelength range (1510 - 1640 nm) as well as highly accurate SOP and DOP measurements.

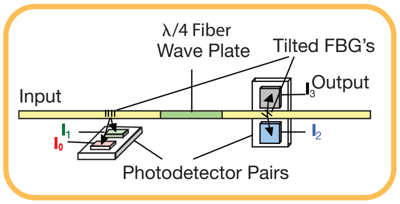


Figure 1
This figure shows the optical schematic of the IPM5300 polarimeter.

Polarimeter Functionality

All four Stokes values, which fully characterize a SOP, are provided either as analog output voltages or as digital values via USB port. The SOP measurement can be controlled via an external trigger function, thus allowing the synchronization of the IPM5300 with other devices. The 1 MHz update rate applies to the fully characterized SOP measurement. With its broad wavelength range, low-loss, high-speed, and accuracy, no other commercially available polarimeters can compare. Our polarization control capabilities are presented on the following page 1185.

No Moving Parts!

Applications

- High-Speed Polarization Measurement
- State of Polarization Measurements at 1 Million Samples per Second
- High-Speed DOP Measurements for Active Polarization Modal Dispersion Compensation
- High-Speed Feedback for Automatic Polarization Control

Specifications

- **Measurement Rate:** 3 to 10^6 samples/sec (1 Million Complete SOP Measurements per Second)
- **SOP Accuracy:** ±0.25° on Poincaré Sphere
- **DOP Accuracy:*** ±0.25%
- **Insertion Loss:** 1.2 dB
- **PDL:** <0.05 dB
- **Dynamic Range:** 45 dBm (-30 dBm to 15 dBm)
- **Wavelength Range:** 1510 - 1640 nm
- **Optical Input/Output Connectors:** FC/APC
- **Analog Interface (Via Front Panel D-Sub):**
  - Outputs: S1, S2, S3, Power/(dBm), and DOP; (Complete Stokes Vector Plus DOP)
  - Input: Trigger
- **Digital Interface Outputs:** S1, S2, S3, Power/dBm, DOP, Azimuth, and Ellipticity
- **Warm-Up Time for Rated Accuracy:** 10 min (No Moving Parts, Designed for 24/7 Operation)
- **Operating Temperature Range:** 5 - 40 °C

*At 1550 nm or user calibration wavelength and +3 dBm input power. DOP accuracy across entire specified wavelength range: ±0.5%.

The In-Line Polarimeter is available as a benchtop version (IPM5300-T) with a preconfigured Laptop and TXP Mainframe included.

IPM5300-T Benchtop In-Line Polarimeter (Page 2 of 2)

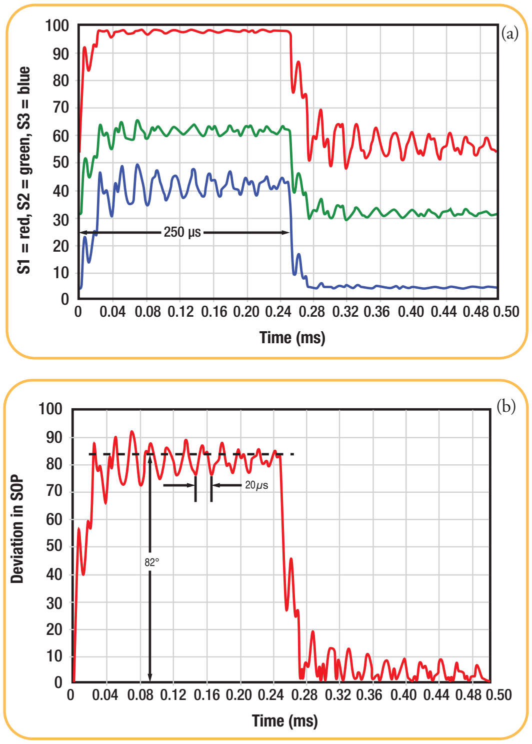


Figure 1

Test data was acquired using a standard piezoelectric polarization controller to change the input SOP being measured by the IPM5300 from one state to another. The ripple in the data is due to mechanical resonance in the piezo elements of the polarization controller.

a) Shows measured Stokes Vector Elements (S1, S2, and S3) versus time as the input SOP is changed from one state to another.

b) Shows the deviation in the SOP versus time as the polarization is changed from one state to another. This shows ~82° deviation on the Poincaré sphere.

An example of the measurement capability of the IPM5300 polarimeter is demonstrated in the data shown to the left. The experimental setup is depicted in Figure 3. A fiber-pigtailed laser was used as the input to the polarization controller. The signal from the controller was input to the IPM5300 and controlled via a local computer. The acquired data included the state of polarization (SOP), the change in the SOP, the power, and the degree of polarization (DOP). This data is shown in Figures 2 and 3.

The piezoelectric-based polarization controller was controlled with a square wave signal at 2 kHz to cause quick changes in the state of polarization into the polarimeter. The induced polarization change was 82° on the Poincaré sphere. Figure 1a shows the measured Stokes vector elements (S1, S2, and S3), while Figure 1b shows the angular deviation in the state of polarization on the Poincaré sphere.

Figure 2 shows the total measured power and the DOP versus time. One aspect of the data that is clearly evident in Figure 1 is the ripple. The polarimeter, with a data acquisition rate of 10^6 samples per second, accurately measures the SOP as the controller changes polarization (Figure 1a). The ripple in the data has a period of 20 µs (50 kHz), which is easily resolved by the polarimeter. This ripple displays true variation in the SOP caused by variations in the mechanical stress on the fiber due to a 50 kHz mechanical resonance in the piezo controller.

Despite the resonance, the measured optical power and the DOP were constant as the polarization was changed. The deviations in the data are at the measurement uncertainties of the polarimeter, <0.02 dB and <0.1%, respectively.

This example shows the precision and accuracy of the IPM5300 series even on fast changing states of polarization.

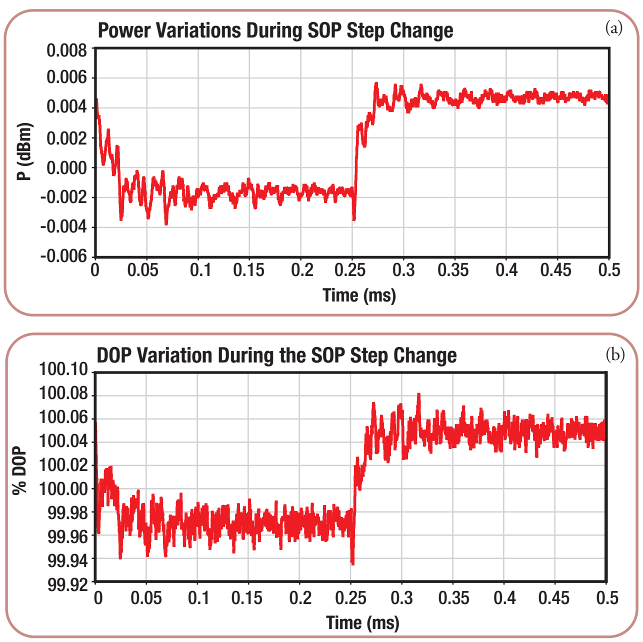


Figure 2

This data was taken at the same time as the data in Figure 1.

a) Shows measured optical power (dBm) versus time as the input SOP is changed from one state to another via a standard piezoelectric polarization controller.

b) Shows the DOP versus time as the polarization is changed from one state to another. This shows ~82° deviation on the Poincaré sphere.

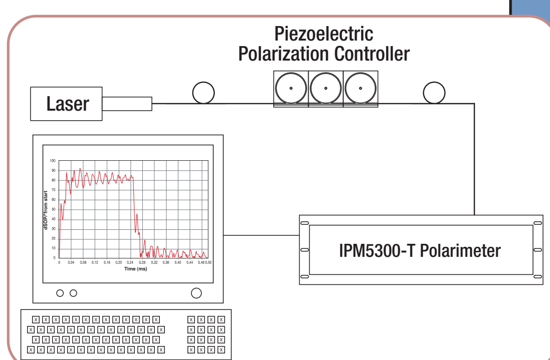


Figure 3

Experimental setup to measure polarimetric effects due to mechanical resonance in a piezoelectric-based polarization controller.

High-Speed In-Line Polarimeter Module and Chassis

ITEM #	$	£	€	RMB	DESCRIPTION
IPM5300-T	$ 10,457.00	£ 7,529.04	€ 9.097,59	¥ 83,342.29	Benchtop In-Line Polarimeter, Including Preconfigured PC

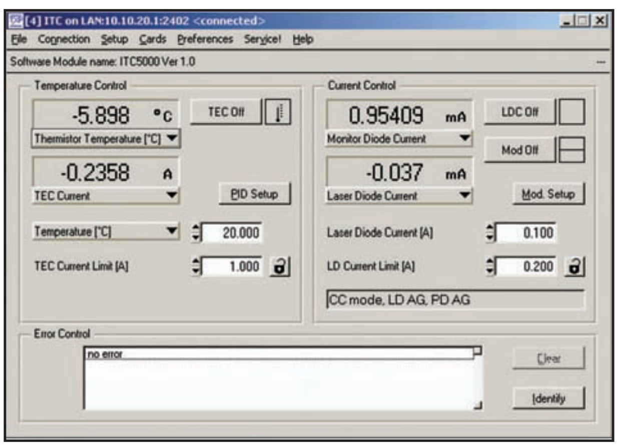
Combination Laser/TEC Controller (Page 1 of 2)

Features

- Simultaneous Current and Temperature Control
- Low Noise and Ultra-Stable Control of Injection Current
- Constant Current and Constant Power Operation
- Laser Driven with Respect to Ground
- Protected Analog Modulation of the Laser Diode
- Extensive Protection Features
- Safe and Ultra-Stable User Diode Operation

Introduction

The ITC5000 Series Controllers combine TXP5000 series current and temperature controller modules, enabling simultaneous current and temperature control of a laser diode via a single, compact module. The ITC5000 series offers three current ranges (±200 mA, ±500 mA, or ±1 A) that support all laser diode and photodiode polarities. These modules can be modulated externally or internally. All three models incorporate a TEC controller that provides up to ±1.5 A/5.25 W.



GUI for the ITC5000 Series Module

In addition to common protection functions such as interlock and soft start, an advanced circuit design ensures that transient spikes cannot affect the laser current.

The temperature controller, identical for all modules, is designed to keep the laser temperature constant for highly stable power and wavelength operation. Separate adjustment of the P, I, and D parameters of the integrated PID control loop minimize temperature settling times. An additional temperature window protection circuit switches the laser current off if the laser temperature leaves a preset temperature range.

The ITC5000 models offer exceptional noise and stability performance. All laser diode and photodiode pin configurations are supported.

Extremely Low Noise

The combination controller modules of the ITC5000 series all feature exceptionally low laser current noise (from 2 µA to 20 µA depending on the model, see table on next page) and exceptional temperature stability of better than 0.002 °C at 20 °C. The performance of the ITC5000 Series is independent of the operation mode (constant current or constant power).

User-Friendly Controls

After installing a new module into any TXP5000 chassis, the modules can be configured via remote computer interface. All settings can be stored on the computer and recalled the next time it is powered on.

Laser Diode Protection Features

The ITC5000 series modules incorporate proven laser protection features to safeguard sensitive laser diodes. Besides common protection functions, such as current limits, laser current soft start, and interrupt protection, an advanced circuit design ensures that AC power line transients or power outages, as well as RF pickup, will not affect the laser diode.

A laser current limit can be set to safeguard the laser diode. To protect the Peltier element, a TEC current limit is also provided. Additionally, a temperature window can be set that will shut the laser down in the event that the high or low thresholds of the window are exceeded. The limits and the window can be set independently for each installed module.

All ITC5000 modules also include an interlock and a delay of the output current.

For more details, see pages 1548 - 1551

Combination Laser/TEC Controller (Page 2 of 2)

ITC5000 Series Laser / TEC Controllers Specifications

(All data valid at 23 ± 5 °C and 45 ±15% relative humidity)

ITEM #	ITC5022	ITC5052	ITC5102
Laser Controller: Current Control			
Current Range	0 to ±200 mA	0 to ±500 mA	0 to ±1 A
Compliance Voltage	>2.5 V (Typical >3 V)		
Resolution	4 µA	10 µA	20 µA
Accuracy (Typical Full Scale)	±100 µA	±250 µA	±1 mA
Noise Without Ripple (10 Hz to 10 MHz, RMS, Typical)	<2 µA	<7 µA	<20 µA
Ripple (50 Hz, RMS, Typical)	<0.5 µA		
Transients (Processor, Typical)	<15 µA	<30 µA	<50 µA
Transients (Other, Typical)	200 µA	500 µA	1 mA
Drift (24 hrs, at Constant Ambient Temperature, Typical)	<2 µA	<5 µA	<20 µA
Temperature Coefficient	<50 ppm/°C		
Laser Controller: Power Control			
Control Range of Photocurrent	10 µA to 5 mA		
Reverse Bias Voltage	0 to 4 V (Adjustable)		
Resolution Photocurrent	0.1 µA		
Accuracy (Typical)	±5 µA		
Laser Controller: Current Limit			
Setting Range	0 to >200 mA	0 to >500 mA	0 to >1 A
Resolution	50 µA	125 µA	250 µA
Accuracy	±200 µA	±500 µA	±2 mA
Laser Voltage Measurement			
Measurement Principle	4-Wire (Improves Accuracy by Compensating for Cable Resistance)		
Measurement Range	0 to 4 V		
Resolution	0.15 mV		
Accuracy	±5 mV		
Analog Modulation			
Input Impedance	10 kΩ		
Modulation Coefficient CC	20 mA/V ±10%	50 mA/V ±10%	100 mA/V ±10%
Small Signal 3 dB-Bandwidth at CC	200 kHz		
Modulation Coefficient CP	0.5 mA/V ±10%		
Internal Modulation			
Form	Sinusoidal, Triangle, Square		
Frequency	0.02 kHz to 20 kHz		
Rise/Fall Time	4 µs		
Temperature Controller: Output			
Range of TEC Current	-1.5 to 1.5 A		
Compliance Voltage	>3.5 V		
Maximum Output Power	5.25 W		
Measurement Resolution of TEC Current	60 uA		
Measurement Range TEC Voltage	-4 to 4 V		
Measurement Resolution of TEC Voltage	0.2 mV		
Noise and Ripple (Typical)	<1 mA		
Temperature Sensors: Thermistor			
Control Range	0.2 to 40 kΩ		
Resolution	0.8 Ω		
Accuracy	±10 Ω		
Stability (24 hrs.)	1 Ω		
General Data			
Common LD/TEC Connector	15-Pin D-Sub		
LD MOD IN Connector	SMA		
Weight	675 g (1.5 lbs)		

ITEM #	$	£	€	RMB	DESCRIPTION
ITC5022	$ 2,091.00	£ 1,505.52	€ 1.819,17	¥ 16,665.27	TXP5000 Laser Diode Current/TEC Controller, ±200 mA/1.5 A
ITC5052	$ 2,091.00	£ 1,505.52	€ 1.819,17	¥ 16,665.27	TXP5000 Laser Diode Current/TEC Controller, ±500 mA/1.5 A
ITC5102	$ 2,091.00	£ 1,505.52	€ 1.819,17	¥ 16,665.27	TXP5000 Laser Diode Current/TEC Controller, ±1 A/1.5 A

DWDM Laser Sources for TXP5000 – LS5000 Series (Page 1 of 2)

ITU Coverage: We are committed to providing quick delivery of any of the 100 lasers (on a 100 GHz grid) that comprise the DWDM C- and L-bands*. When ordering, please refer to the tables presented on pages 1190 - 1191, which are organized based on 100 GHz channel spacings. Pricing and ordering codes can also be found there. Our order codes are a combination of the band designator (C or L), the 100 GHz channel number (01 through 50), and an additional character (A, B, C, or D) that indicates the frequency offset from the base channel.

*Subject to Laser Diode Availability, 50 GHz and 25 GHz grid upon request.

Introduction – LS5000 DWDM Laser Modules

The LS5000 DWDM laser modules for the TXP5000 Series Test and Measurement Platform offer precise tunability as well as long-term wavelength and power stability. Adjustable coherence control makes them ideal for both active and passive DWDM component testing as well as multi-wavelength transmission experiments.

The WDM laser modules are ideally suited for all DWDM applications, including test systems for fiber optic DWDM components, EDFA production, and multi-laser optical sources for DWDM transmission experiments.

Stability, Accuracy, and Dependability

This DWDM laser platform is the ideal choice for demanding DWDM test and measurement applications with laser linewidths of less than 10 MHz, center wavelength stability of better than 0.005 nm per 24 hours, and wavelength accuracy of better than ±0.025 nm. We use only telecom-rated, butterfly-packaged DFB lasers with integrated TEC elements, optical isolators, and low back-reflection fiber pigtails. When combined with our sophisticated drive circuits, the result is an extremely stable, low-noise laser source that exhibits optical power stability that is better than 0.005 dB per 60 minutes and a relative intensity noise RIN figure of 145 dB/Hz (Typical). All Thorlabs' instruments are backed by an extensive two-year warranty on materials and workmanship.

Extensive Inventories

Thorlabs' DWDM sources cover the ITU grid containing wavelengths (100 GHz channels) spanning the C- and L-Bands. Wavelengths on the 50 GHz and 25 GHz grid are available upon request.

For manufacturers of laser diodes, Thorlabs also offers the service of incorporating user-supplied lasers into our modules. Please contact technical support for details.

The LS5000 Sources for the TXP Test and Measurement Platform offer more general test and measurement applications than the WDM8 sources. The TXP platform consists of a combined laser diode current and TEC controller to drive the LS5000 sources and modules for polarization analysis and control (see pages 1186 - 1187). It offers TCP/IP or USB interfaces to allow for flexible setups.

Features

- 100 Wavelengths on 100 GHz ITU Grid*
- Wavelengths in C- and L-Bands*
- Wavelength Stability <0.005 nm (24 Hours)
- Output Power Stability <0.01 dB (24 Hours)
- Precise Wavelength Tuning Over ±0.85 nm
- Direct Display of Wavelength During Tuning
- Precise Power Tuning Over >6 dB (10 dB Typ.)
- Variable Coherence Control, Linewidths up to 1 GHz
- Instrument Drivers for LabVIEW™ and LabWindows™/CVI Included
- FC/APC Connector

* Subject to Laser Diode Availability, 50 GHz and 25 GHz grid upon request.

See pages 1178 - 1179 for more details on the TXP5000 Series Test and Measurement Platform

TXP5000 SERIES SPECIFICATIONS			
	TXP5016	TXP5004	TXP5001AD
Number of Slots	16 Slots	4 Slots	1 Slot
Maximum Power Consumption Per Slot	40 W	25 W	36 W
Maximum Power Consumption	320 W	100 W	36 W
Operation	Graphical User Interface on Rem PC		
Remote Interface	Ethernet 10Base-T	USB 2.0	USB 2.0
Remote Drivers	Driver DLL with support for NI LabView™, NI LabWindows/CVI™, MS Visual C++™, Borland C++™		
Chassis	19", 3 U	1/3, 19", 3 U	No Chassis
Line Voltage	100 to 240 VAC ±10%		
Line Frequency	50 to 60 Hz ± 5%		
Operating Temperature	0 to 40 °C		
Storage Temperature	-40 to 70 °C		
Dimensions	449 mm x 148 mm x 435 mm	168 mm x 148 mm x 315 mm	124 mm x 23 mm x 112 mm
Weight (w/o Modules)	7 kg (15.41lbs)	3 kg (6.61lbs)	0.2 kg (0.44 lbs)

DWDM Laser Sources for TXP5000 – LS5000 Series (Page 2 of 2)

Coherence Control

All the DWDM series laser modules provide an adjustable coherence length control. For high-precision power measurement, the narrow linewidth of a DFB laser can lead to coherent interference effects due to reflections from the multiple surfaces that are present in most optical systems.

TXP5016 Chassis with LS5000 Modules

Specifications

Wavelength

- **Options:** 100 Wavelengths on the 100 GHz ITU Grid (C- and L-Bands)*
- **Tuning Range:** ±0.85 nm
- **Accuracy:** ± 0.025 nm, < ±0.01 nm (Typical)
- **Stability:** < 0.005 nm over 24 Hours (Typical)
- **Resolution:** 1 pm
- **Laser Linewidth:** < 10 MHz

Output Power

- **Optical Power:** 20 mW
- **Accuracy (Abs/Rel):** 0.6 dB/0.4 dB
- **Stability:** < 0.002 dB over 15 s, < 0.005 dB Over 1 hr, < 0.01 dB over 24 hrs
- **Attenuation:** >6 dB, 10 dB (Typical) (Continuously Variable)
- **Resolution:** 0.01 dB
- **Side Mode Suppression Ratio:** >40 dB (Typical), >36 dB Min (at Max Power)
- **Relative Intensity Noise (RIN):** -145 dB/Hz (Typical)
- **Optical Isolation:** >35 dB

Coherence Control (Standard Feature, All Models)

- **Linewidth:** up to 1 GHz (Adjustable)
- **Shape:** Sine, Square, and Triangle
- **Frequency:** 0.02 up to 20 kHz
- **Modulation Depth:** 0.1 to 100%

Modulation

- **Analog Modulation (Must order a -LF Source):** DC - 50 kHz (Optional via SMA Input)

General Data

- **Optical Output:** FC/APC Connector**
- **Fiber:** PMF (Connector Key Aligned to Slow Axis upon Request)
- **Operating temperature:** 0 to 35 °C Non Condensing
- **Storing temperature:** -40 to 60 °C
- **Warm-up Time:** 15 min for Rated Accuracy
- **Laser Module Width:** 1 Slot
- **Laser Safety Class:** 1M

*Subject to Laser Diode Availability, 50 GHz and 25 GHz grid upon request.

**Other Connector Styles, (i.e., SC, E2000) and Non-Angled (PC) Ferrule upon request.

Interference Effects

For high-precision power measurements, the narrow linewidth of a DFB laser can lead to interference effects caused by reflections from the multiple surfaces that are present in most optical systems. These multiple reflections, while extremely small, can accumulate due to the long coherence length. Brillouin scattering is another effect that can lead to significant errors when making optical power measurements in fiber-based systems. The magnitude of these effects can be significantly reduced by increasing the linewidths of the source. Therefore, all the LS5000 series laser sources provide a control to adjust the coherence length; a small signal modulation on the laser current is used to broaden the DFB laser linewidth from a few MHz up to more than 1 GHz. The LS5000 modules provide continuous adjustment of the linewidth over this entire range. An internal freely running sine/square/triangle wave generator is used to modulate the laser current. The modulation frequency range of the function generator is 20 Hz to 50 kHz with up to 100% modulation depths. Using these features, an ideal non-discrete, Gaussian or a discrete spectral distribution is generated.

External Analog Low Frequency (LF) Modulation DC to 50 kHz (Only Make-to-Order LS5 Sources with Item #s ending in -LF)

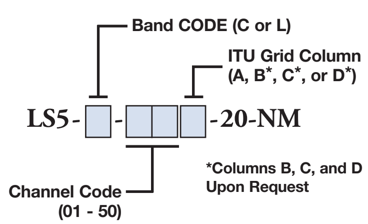
For applications where a precise LF modulation up to 50 kHz is required, the LS5000 modules are available with an LF modulation option. With this option, the output power can be modulated via an optional SMA input. The laser remains fully protected due to a precise limit circuit located inside the module.

Precision Wavelength Tuning

The wavelength is displayed with a resolution of 0.001 nm. By precisely controlling the temperature of the laser chip, the emitted wavelength can be tuned over a range of ±0.85 nm (approximately ±100 GHz). This range allows the central wavelength of the source to be shifted from one transmission channel to the adjacent channels in dense WDM systems with 100 GHz channel spacing and allows tuning over up to 8 channels in systems with 25 GHz channel spacing. This feature is useful for simulating crosstalk between channels and can also be used to measure the profile of narrow band DWDM filters.

Ordering Information

The item name for the order of your laser source can be obtained from the ITU Grid on page 1191 in the same way as for the WDM8 sources. Just replace WDM8 by LS5.



ITEM #	$	£	€	RMB	DESCRIPTION
LS5-X-XXX-20-NM*	$ 2,754.00	£ 1,982.88	€ 2.395,98	¥ 21,949.38	Single TXP WDM Laser Source, 20 mW, No LF Modulation
TXP5004	$ 1,233.00	£ 887.76	€ 1.072,71	¥ 9,827.01	TXP Test and Measurement, 4 Slot with USB Control
TXP5016	$ 3,560.00	£ 2,563.20	€ 3.097,20	¥ 28,373.20	TXP Test and Measurement, 16 Slot with Ethernet Control

*For a low frequency modulation input please contact Thorlabs to order a LS5-X-XXX-20-LF Laser Source

DWDM Laser Sources Ordering Guide

The Thorlabs DWDM laser sources cover 100 lasers from the C-, and L-bands with a 100 GHz spacing. They are organized based on the ITU 100 GHz Grid in column A shown in the table on the page 1191. Sources from the 50 GHz and 25 GHz grid (i.e., sources from columns B, C, and D) are available upon request. For all sources the lead times are subject to laser diode availability.

To get the correct item name when ordering the sources, please read the appropriate codes for Band, Channel, and Column from the ITU Grid on the right and fill them into the item name template in the price box shown below.

Ordering Information for WDM8

BAND CODE (C or L)

ITU GRID COLUMN (A, B*, C*, or D*)

WDM8-□-□□□-20-NM

CHANNEL CODE

*Columns B (50 GHz Offset), C and D (25 GHz Offset) upon request; subject to laser diode availability.

Ordering Information for LS5

BAND CODE (C or L)

ITU GRID COLUMN (A, B*, C*, or D*)

LS5-□-□□□-20-NM

CHANNEL CODE

*Columns B (50 GHz Offset), C and D (25 GHz Offset) upon request; subject to laser diode availability.

Configuring a Laser Source

EXAMPLE If you want to order a laser source for 1561.42 nm (192.00 THz), which is from the C-Band, you'll find it on the facing page under C-Band, Column A, Channel 11. The item name therefore is: WDM8-C-11A-20-NM.

To order a source for 1590.20 nm (188.525 THz) the codes are L-Band, Column C, Channel 26, and the order code is WDM8-L-26C-20-NM.

Lead times depend on the wavelengths of our laser sources. Please contact our technical support team for more information.

ITEM #	$	£	€	RMB	DESCRIPTION
WDM8-X-XXX-20-NM	$ 2,856.00	£ 2,056.32	€ 2.484,72	¥ 22,762.32	Single PRO8 WDM Laser Source, 20 mW, No Direct Modulation
PRO800	$ 1,820.00	£ 1,310.40	€ 1.583,40	¥ 14,505.40	2-Slot Modular Benchtop Chassis
PRO8000	$ 2,480.00	£ 1,785.60	€ 2.157,60	¥ 19,765.60	8-Slot Modular Rack Chassis

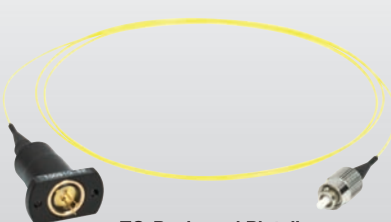
Did You Know...

For Recalibration of WDM Sources

Contact Technical Support

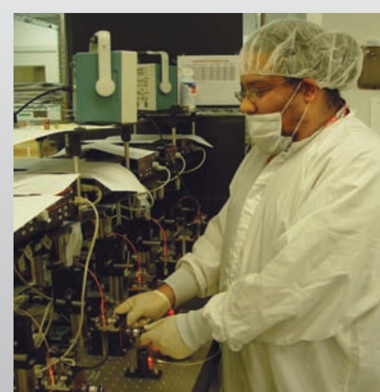
Have you seen our...

Pigtailed Laser Diodes



TO-Packaged Pigtail

- SM Pigtails from 405 to 2000 nm
- PM Pigtails from 635 to 1550 nm
- MM Pigtails with 635 m or 660 nm CWL
- Custom Pigtails Available Upon Request



Pigtailed Laser Diode Alignment

Our high-quality pigtail alignment process for laser diodes includes multiple test and inspection points that ensure maximum coupling efficiency. In addition, the input end of the fiber is cleaved at an 8° angle in order to minimize back reflections that can cause the output intensity to fluctuate. Versions are offered based on TO-packaged diodes (Ø5.6 or Ø9 mm) or 14-pin butterfly packages.

See pages 1252 - 1260

ITU Grid Ordering Guide

Channel	C-Band (1529.75 nm - 1569.59 nm)							
	100 GHz Grid 0.80 nm		50 GHz Offset 0.40 nm		-25 GHz Offset 0.20 nm		+25 GHz Offset 0.20 nm	
	THz	nm	THz	nm	THz	nm	THz	nm
	Column A		Column B*		Column C*		Column D*	
01	191.00	1569.59	191.05	1569.18	191.025	1569.39	191.075	1568.98
02	191.10	1568.77	191.15	1568.36	191.125	1568.57	191.175	1568.16
03	191.20	1567.95	191.25	1567.54	191.225	1567.75	191.275	1567.34
04	191.30	1567.13	191.35	1566.72	191.325	1566.93	191.375	1566.52
05	191.40	1566.31	191.45	1565.90	191.425	1566.11	191.475	1565.70
06	191.50	1565.50	191.55	1565.09	191.525	1565.29	191.575	1564.88
07	191.60	1564.68	191.65	1564.27	191.625	1564.47	191.675	1564.07
08	191.70	1563.86	191.75	1563.45	191.725	1563.66	191.775	1563.25
09	191.80	1563.05	191.85	1562.64	191.825	1562.84	191.875	1562.44
10	191.90	1562.23	191.95	1561.83	191.925	1562.03	191.975	1561.62
EXAMPLE 11	192.00	1561.42	192.05	1561.01	192.025	1561.22	192.075	1560.81
12	192.10	1560.61	192.15	1560.20	192.125	1560.40	192.175	1560.00
13	192.20	1559.79	192.25	1559.39	192.225	1559.59	192.275	1559.19
14	192.30	1558.98	192.35	1558.58	192.325	1558.78	192.375	1558.38
15	192.40	1558.17	192.45	1557.77	192.425	1557.97	192.475	1557.57
16	192.50	1557.36	192.55	1556.96	192.525	1557.16	192.575	1556.76
17	192.60	1556.55	192.65	1556.15	192.625	1556.35	192.675	1555.95
18	192.70	1555.75	192.75	1555.34	192.725	1555.55	192.775	1555.14
19	192.80	1554.94	192.85	1554.54	192.825	1554.74	192.875	1554.34
20	192.90	1554.13	192.95	1553.73	192.925	1553.93	192.975	1553.53
21	193.00	1553.33	193.05	1552.93	193.025	1553.13	193.075	1552.73
REF 22	193.10	1552.52	193.15	1552.12	193.125	1552.32	193.175	1551.92
23	193.20	1551.72	193.25	1551.32	193.225	1551.52	193.275	1551.12
24	193.30	1550.92	193.35	1550.52	193.325	1550.72	193.375	1550.32
25	193.40	1550.12	193.45	1549.72	193.425	1549.92	193.475	1549.52
26	193.50	1549.32	193.55	1548.91	193.525	1549.11	193.575	1548.71
27	193.60	1548.51	193.65	1548.11	193.625	1548.31	193.675	1547.92
28	193.70	1547.72	193.75	1547.32	193.725	1547.52	193.775	1547.12
29	193.80	1546.92	193.85	1546.52	193.825	1546.72	193.875	1546.32
30	193.90	1546.12	193.95	1545.72	193.925	1545.92	193.975	1545.52
31	194.00	1545.32	194.05	1544.92	194.025	1545.12	194.075	1544.72
32	194.10	1544.53	194.15	1544.13	194.125	1544.33	194.175	1543.93
33	194.20	1543.73	194.25	1543.33	194.225	1543.53	194.275	1543.13
34	194.30	1542.94	194.35	1542.54	194.325	1542.74	194.375	1542.34
35	194.40	1542.14	194.45	1541.75	194.425	1541.94	194.475	1541.55
36	194.50	1541.35	194.55	1540.95	194.525	1541.15	194.575	1540.76
37	194.60	1540.56	194.65	1540.16	194.625	1540.36	194.675	1539.96
38	194.70	1539.77	194.75	1539.37	194.725	1539.57	194.775	1539.17
39	194.80	1538.98	194.85	1538.58	194.825	1538.78	194.875	1538.38
40	194.90	1538.19	194.95	1537.79	194.925	1537.99	194.975	1537.59
41	195.00	1537.40	195.05	1537.00	195.025	1537.20	195.075	1536.81
42	195.10	1536.61	195.15	1536.22	195.125	1536.41	195.175	1536.02
43	195.20	1535.82	195.25	1535.43	195.225	1535.63	195.275	1535.23
44	195.30	1535.04	195.35	1534.64	195.325	1534.84	195.375	1534.45
45	195.40	1534.25	195.45	1533.86	195.425	1534.05	195.475	1533.66
46	195.50	1533.47	195.55	1533.07	195.525	1533.27	195.575	1532.88
47	195.60	1532.68	195.65	1532.29	195.625	1532.49	195.675	1532.09
48	195.70	1531.90	195.75	1531.51	195.725	1531.70	195.775	1531.31
49	195.80	1531.12	195.85	1530.72	195.825	1530.92	195.875	1530.53
50	195.90	1530.33	195.95	1529.94	195.925	1530.14	195.975	1529.75

Channel	L-Band (1569.80 nm - 1611.79 nm)							
	100 GHz Grid 0.80 nm		50 GHz Offset 0.40 nm		-25 GHz Offset 0.20 nm		+25 GHz Offset 0.20 nm	
	THz	nm	THz	nm	THz	nm	THz	nm
	Column A		Column B*		Column C*		Column D*	
01	186.00	1611.79	186.05	1611.35	186.025	1611.57	186.075	1611.14
02	186.10	1610.92	186.15	1610.49	186.125	1610.70	186.175	1610.27
03	186.20	1610.06	186.25	1609.62	186.225	1609.84	186.275	1609.41
04	186.30	1609.19	186.35	1608.76	186.325	1608.98	186.375	1608.54
05	186.40	1608.33	186.45	1607.90	186.425	1608.11	186.475	1607.68
06	186.50	1607.47	186.55	1607.04	186.525	1607.25	186.575	1606.820
07	186.60	1606.60	186.65	1606.17	186.625	1606.39	186.675	1605.96
08	186.70	1605.74	186.75	1605.31	186.725	1605.53	186.775	1605.10
09	186.80	1604.88	186.85	1604.46	186.825	1604.67	186.875	1604.24
10	186.90	1604.03	186.95	1603.60	186.925	1603.81	186.975	1603.38
11	187.00	1603.17	187.05	1602.74	187.025	1602.95	187.075	1602.53
12	187.10	1602.31	187.15	1601.88	187.125	1602.10	187.175	1601.67
13	187.20	1601.46	187.25	1601.03	187.225	1601.24	187.275	1600.81
14	187.30	1600.60	187.35	1600.17	187.325	1600.39	187.375	1599.96
15	187.40	1599.75	187.45	1599.32	187.425	1599.53	187.475	1599.11
16	187.50	1598.89	187.55	1598.47	187.525	1598.68	187.575	1598.25
17	187.60	1598.04	187.65	1597.62	187.625	1597.83	187.675	1597.40
18	187.70	1597.19	187.75	1596.76	187.725	1596.98	187.775	1596.55
19	187.80	1596.34	187.85	1595.91	187.825	1596.13	187.875	1595.70
20	187.90	1595.49	187.95	1595.06	187.925	1595.28	187.975	1594.85
21	188.00	1594.64	188.05	1594.22	188.025	1594.43	188.075	1594.00
22	188.10	1593.79	188.15	1593.37	188.125	1593.58	188.175	1593.16
23	188.20	1592.95	188.25	1592.52	188.225	1592.73	188.275	1592.31
24	188.30	1592.10	188.35	1591.68	188.325	1591.89	188.375	1591.47
25	188.40	1591.26	188.45	1590.83	188.425	1591.04	188.475	1590.62
26	188.50	1590.41	188.55	1589.99	188.525	1590.20	188.575	1589.78
27	188.60	1589.57	188.65	1589.15	188.625	1589.36	188.675	1588.94
28	188.70	1588.73	188.75	1588.30	188.725	1588.51	188.775	1588.09
29	188.80	1587.88	188.85	1587.46	188.825	1587.67	188.875	1587.25
30	188.90	1587.04	188.95	1586.62	188.925	1586.83	188.975	1586.41
31	189.00	1586.20	189.05	1585.78	189.025	1585.99	189.075	1585.57
32	189.10	1585.36	189.15	1584.95	189.125	1585.16	189.175	1584.74
33	189.20	1584.53	189.25	1584.11	189.225	1584.32	189.275	1583.90
34	189.30	1583.69	189.35	1583.27	189.325	1583.48	189.375	1583.06
35	189.40	1582.85	189.45	1582.44	189.425	1582.64	189.475	1582.23
36	189.50	1582.02	189.55	1581.60	189.525	1581.81	189.575	1581.39
37	189.60	1581.18	189.65	1580.77	189.625	1580.98	189.675	1580.56
38	189.70	1580.35	189.75	1579.93	189.725	1580.14	189.775	1579.73
39	189.80	1579.52	189.85	1579.10	189.825	1579.31	189.875	1578.89
40	189.90	1578.69	189.95	1578.27	189.925	1578.48	189.975	1578.06
41	190.00	1577.86	190.05	1577.44	190.025	1577.65	190.075	1577.23
42	190.10	1577.03	190.15	1576.61	190.125	1576.82	190.175	1576.40
43	190.20	1576.20	190.25	1575.78	190.225	1575.99	190.275	1575.57
44	190.30	1575.37	190.35	1574.95	190.325	1575.16	190.375	1574.75
45	190.40	1574.54	190.45	1574.13	190.425	1574.33	190.475	1573.92
46	190.50	1573.71	190.55	1573.30	190.525	1573.51	190.575	1573.09
47	190.60	1572.89	190.65	1572.48	190.625	1572.68	190.675	1572.27
48	190.70	1572.06	190.75	1571.65	190.725	1571.86	190.775	1571.45
49	190.80	1571.24	190.85	1570.83	190.825	1571.03	190.875	1570.62
50	190.90	1570.42	190.95	1570.01	190.925	1570.21	190.975	1569.80

*Columns B (50 GHz Offset), C and D (25 GHz Offset) upon request; subject to laser diode availability.

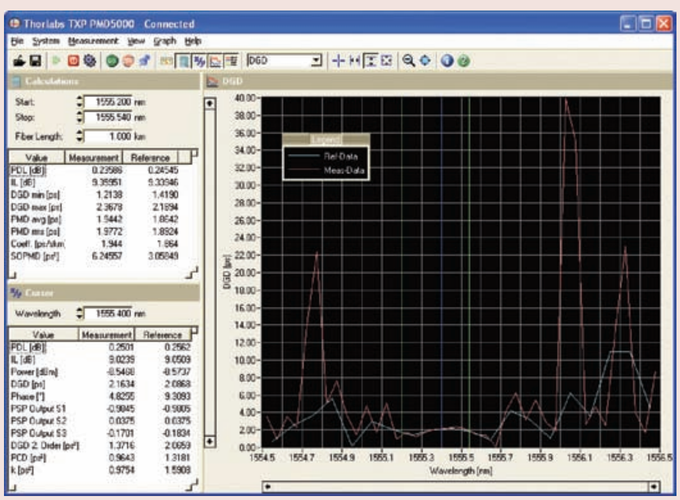
PMD/PDL Measurement Systems (Page 1 of 4)

PMD5000 SERIES

Complete PMD/PDL Analyzation System, Laptop Included

Introduction - PMD5000

The PMD5000 Series is a high-performance polarization mode dispersion (PMD) testing system based on the Jones Matrix Eigenanalysis. The modular design offers unique flexibility and adaptivity, making it ideal for all kinds of polarization-related measurements. It is especially useful for PMD analysis on broadband and narrowband components, optical fibers, and installed optical networks; these systems are capable of determining Differential Group Delay (DGD), Polarization Dependent Loss (PDL), and other parameters. Efficient PMD measurements of complex optical networks as well as PMD monitoring of dark channels are other applications that benefit from the ability to control a single transmitter unit and multiple receiver units at different locations via one remote computer.



A preconfigured laptop is included with the system. The software includes all features to analyze the PMD and PDL of fiber and optical components. It is intuitive and allows extensive analysis of the measured data set.

The transmitter parts of the PMD5000D consists of a polarization controller and external tunable laser source. For the analyzer, different high-performance polarimeter modules are available, which allow the system to be optimized for a particular application. If the system is being used with a split transmitter analyzer configuration, the unit can be controlled remotely via TCP/IP, Ethernet, or WLAN. The system is based on the TXP architecture and offers full compatibility. See pages 1178 - 1179 for an overview of the different configuration options. For more detailed information, please contact our tech support team.

Modularity

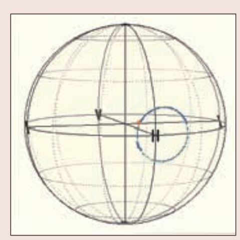
The PMD5000 measurement system includes the TXP5016 mainframe (see page 1179) and is controlled by an external computer via TCP/IP. The TXP architecture allows a separation of the transmitter and receiver units into two mainframes. The mainframes and control PC can be connected to the local area network (LAN) and are not necessarily tied to a single location.

The transmitter unit consists of the DPC5500 Series Deterministic Polarization Controller, which adjusts the necessary states of polarization. These modules are key components for the Jones Matrix Eigen analysis (JME). (Refer to the PMD application note on pages 1194 - 1195 for more information).

For the analyzer unit, either the IPM5300 Series High Speed In-Line Polarimeter or the PAX5720 Series High Dynamic Range Polarimeter may be selected, depending on the application requirements.

The fast IPM5300 is especially suited for PMD measurements on fibers with rapid changes in environmental conditions, which can affect the PMD, and therefore, faster measurement speeds (PMD5000FIN) are required. The high dynamic power range of the PAX5720 Series is required for differential group delay (DGD) measurements of components with bandpass characteristics.

For More Details on our Line of Polarimeter Tools, See Page 1180



PMD and PDL Measurement Systems (Page 2 of 4)

Features

- Jones Matrix PMD Measurement Method
- Ideal for PMD and PDL on Optical Fiber
- Includes a DPC5500 Deterministic Polarization Controller and an IPM5300 Fast In-Line Polarimeter
- DGD Meter with a 0.001-400 ps Range
- DGD Repeatability* of <0.01 ps
- 30 dB Maximum Insertion Loss of DUT**
- Typical Measurement Time for 1 (100) Data Point(s); 0.5 s (50 s)

** For PMD <0.3 ps*
*** At Input Power ≥1 mW*

General PMD Measurements

The PMD5000FIN is recommended for general polarization mode dispersion (PMD) measurements. PMD and PDL analysis of fibers and broadband components can be performed with this model, including the PMD measurement of passive components (couplers, isolators) and active components (EDFAs and PDFAs).

PMD Measurements on Narrow Bandwidth Components

Narrow bandwidth components (e.g., optical filters, Bragg gratings, and OADM) are considerably more challenging to characterize. In narrowband component manufacturing, it is important to assess the PDL in the “wings” of the pass band (typically around 20 dB) to determine if the component meets the isolation requirement for adjacent channels. The PMD5000 System with a PAX5720IR3 polarimeter as a receiver, which some non-standard systems include, facilitates this assessment and thereby increases production yield.

System Configurations - See Pages 1178 - 1179

Thorlabs is recognized throughout the photonics community for providing novel polarization measurement and control solutions. As can be seen from our selection of related products, our team of polarization experts has tackled many measurement and control problems in this specialized field. The selection guide shown on page 1195 describes the various systems offered for a broad array of PMD and PDL measurements.

System Capabilities

PMD Measurement

- PMD Measurements Based on the Jones Matrix Eigenanalysis
- PMD Monitoring of Dark Channels of an Optical Network
- PMD Measurement in Accordance with ITU-T G.650
- DGD Meter with a Range of 0.001 ps to 400 ps
- High Resolution PMD Measurement of Narrowband Components
- Mean and RMS Values of PMD, Plus 2nd Order PMD
- Long-Term PMD Measurement
- Measures the Principal States of Polarization as a Function of Wavelength
- Support of External Laser Sources (Agilent, Ando, etc.).

PDL Measurement

- PDL Measurements Based on Jones Matrix Eigenanalysis
- PDL Measurement in the Range of 0 to 50 dB with <0.02 dB Reproducibility
- Measurement of the Wavelength and Time Dependency of the PMD and PDL Changes

Polarization Analysis

- Dynamic Polarization Measurements in Real Time
- Fiber or Free-Space Input (Depending on Polarimeter Module)
- Long-Term Observation of Polarization Effects
- Polarimeter Measurements with Azimuth and Ellipticity Angle Accuracy <0.25°
- Large Dynamic Range: 60 dBm (PAX5720IR3)
- Fast Measurement Speed of 1 Msample/s (IPM5300)
- Operating Wavelength Range: 1510 - 1640 nm

Polarization Control

- Deterministic Polarization Control and Locking
- Accurate and Precise SOP Tracing
- SOP Scrambling
- Wavelength Range of 1510-1640 nm
- Dynamic Range of 35 dB (-20 to 15 dBm)
- Fast SOP Adjustments are <150 µs (Typ)

ER Measurement on PMF (only with PAX5710IR3)

- Extinction Ratio Measurement of PM Fiber
- Measurement Range of 0 to 50 dB

PMD and PDL Measurement Systems (Page 3 of 4)

Application Note: PMD Measurement

Polarization Mode Dispersion

Polarization Mode Dispersion (PMD) originates from the polarization dependency of an optical signal's propagation speed, which results in a delay in the arrival time of a bit stream for orthogonally launched polarization states and may lead to bit errors. For a given wavelength, the maximum delay between all pairs of orthogonal polarization states at a given time is called the differential group delay, DGD (see Figure 1). DGD is measured in picoseconds (ps). The polarization states associated with the fastest and slowest speeds are called principal states of polarization (PSP). In general, the PSPs are not associated with the fast and slow axes (the Eigen-Polarizations) of a birefringent component.

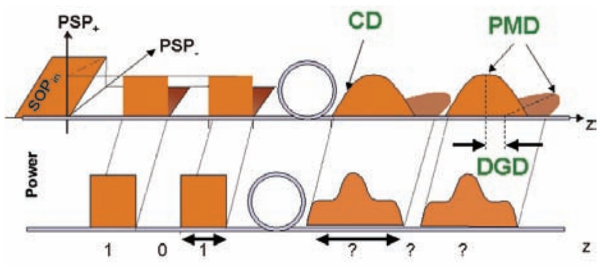


Figure 1 - Differential Group Delay

DGD is the primary measurement parameter for all PMD meters. The measurement of the DGD involves the determination of a phase change (arrival time difference) for a given frequency (wavelength) change. For a Jones Matrix Eigenanalysis, the polarization transformation function (the Jones Matrix) must be determined at two different wavelengths. The changes in the phases of the two Jones matrices divided by the wavelength difference (step size) yields the DGD value.

The PMD5000 is ideally suited for characterizing DGD and PMD in devices with random mode coupling, such as optical fibers, by using the Jones Matrix Eigenanalysis (JME) method. The JME method is the only technique providing wavelength-dependent information about the DGD and the PSP. It is also the only method that shows agreement between the measured DGD histogram and the theoretical Maxwell distribution.

Jones Matrix Eigenanalysis

The Jones Matrix Eigenanalysis (JME) provides the most comprehensive information about fiber links and active components. Besides the DGD over wavelength and the PMD value, the JME also returns the second order PMD as well as PDL and measures insertion loss versus wavelength. In general, monochromatic light with different input polarizations is fed into the optical device, and the resulting output SOP are measured. A convenient way to measure the Jones Matrix was presented by B.L. Heffner. Linearly polarized light enters the optical element parallel to the X-axis, parallel to the Y-axis, and parallel to the bisector of the angle between the positive X- and Y-axes. The three linear input states and the three corresponding polarization output states are used to calculate the 2 x 2 complex Jones matrix. In a pure mathematical sense, only two pairs of input and output states are needed to calculate a 2 x 2 matrix; however, since optical elements feature Eigen polarization states for which the input polarization is not transformed (i.e., the output polarization is equal to the input polarization), a third unique input polarization is needed.

PMD in Optical Fiber

Fibers may be modeled as a collection of many infinitesimally small fiber sections, each of which have a different birefringence and Eigen-polarization axes (see Figure 2). Thermal and mechanical stresses will change the polarization properties of these sections. The large number of sections, the randomness in the transformation properties, and environmental sensitivities require a statistical analysis to account for the DGD behavior fully. In a long length of fiber, the DGD (either as a function of time at fixed wavelength or as a function of wavelength at a fixed time) has a Maxwell distribution. The average of the DGD distribution is defined by the ITU standard bodies as the PMD value. Therefore, PMD is independent of the time and wavelength range.

Figure 2 - Model of a Long Fiber

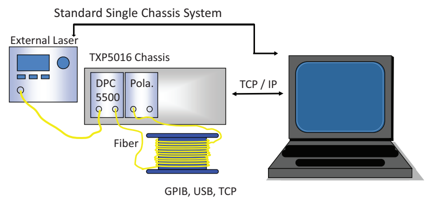
PMD in Fiber Components

Fiber optic components differ from long lengths of fiber in their thermal and mechanical sensitivity of DGD and PMD. The fixed optical elements integrated in the components are significantly less sensitive to environmental conditions. Fiber optic components have DGD values that are nearly fixed with respect to wavelength. A DGD measurement instrument would therefore produce a normal (Gaussian) distribution. Depending on the test instrument, the width of the distribution is determined by the instrument's performance and not the intrinsic randomness of the polarization modes throughout the component. As in the fiber PMD, the average value of the distribution is the PMD value that quantifies the amount of delay generated by the component. For some fiber optic components, DGD/PMD cannot be measured using the same procedure as those used for systems with random mode coupling. For example, DEMUX filters, with their narrow pass bands, do not allow relatively large frequency steps for high accuracy DGD measurements. Therefore, these filter components require special measurement attention. The PMD5000 Series Polarization Measurement System is designed for analyzing narrow bandwidth components and fiber networks (e.g., single components like Fiber Bragg Gratings (FBG) as well as single channels of a complex optical network with multiplexers and active components like EDFAs).

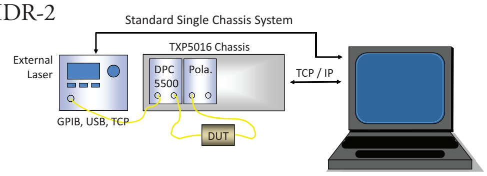
PMD and PDL Measurement Systems (Page 4 of 4)

Standard Systems

Application	Hardware Requirements
PMD and PDL Measurements of Fibers	**Preconfigured System:** PMD5000FIN-2 **Mainframe:** TXP5016 **Laser Source:** External Third-Party TLS **SOP Controller:** DPC5500 **Polarimeter:** IPM5300 (Fully Configured Laptop Included)



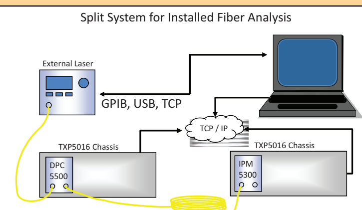
Application	Hardware Requirements
PMD and PDL Measurements of Narrow Bandwidth Devices	**Preconfigured System:** PMD5000HDR-2 **Mainframe:** TXP5016 **Laser Source:** Third-Party TLS **SOP Controller:** DPC5500 **Polarimeter:** PAX5720IR3 (Fully Configured Laptop Included)



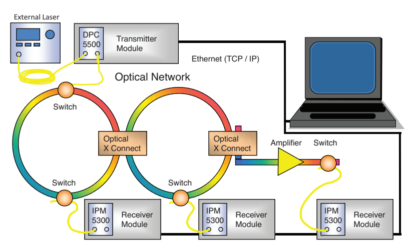
ITEM #	$	£	€	RMB	DESCRIPTION
PMD5000FIN-2	$ 34,260.00	£ 24,667.20	€ 29.806,20	¥ 273,052.20	PMD/PDL Analyzer for External Tunable Laser and IPM5300 Polarimeter
PMD5000HDR-2	$ 30,660.00	£ 22,075.20	€ 26.674,20	¥ 244,360.20	PMD/PDL Analyzer for External Tunable Laser and PAX5720IR3 Polarimeter

Non-Standard Systems

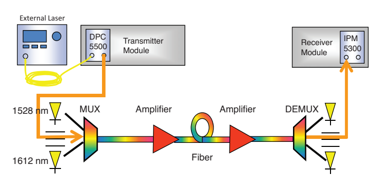
Application	Hardware Requirements
PMD and PDL Measurements on Installed Fibers with Split Transmitter and Receiver	**Non-Standard System:** **Mainframes:** TXP5016 **Laser Source:** Third-Party TLS **SOP Controller:** DPC5500 **Polarimeter:** IPM5300 (Fully Configured Laptop Included)



Application	Hardware Requirements
PMD and PDL Measurements on Optical Networks with a Single Transmitter and Several Receivers	**Non-Standard System:** **Mainframes:** TXP5016 **Laser Source:** Third-Party TLS **SOP Controller:** DPC5500 **Polarimeter:** IPM5300 (Fully Configured Laptop Included)



Application	Hardware Requirements
PMD and PDL Monitoring on a Live Fiber with Traffic	**Non-Standard System:** **Mainframes:** TXP5016 **Laser Source:** Third-Party TLS **SOP Controller:** DPC5500 **Polarimeter:** IPM5300 (Fully Configured Laptop Included)



Please contact *Europe@thorlabs.com* to order the non-standard systems mentioned above.

Extinction Ratio Meter

ERM100
with USB Interface

Applications

- Extinction Ratio (ER) Measurements of Polarization Maintaining (PM) Fibers
- Alignment of PM Fiber to Connector Key
- Alignment of PM Fiber to Laser Source

Specifications[a]

- **Fiber Connector:** FC/PC (Narrow Key)
- **Wavelength Range:** 800 - 1700 nm
- **Max ER[b]:** >40 dB
- **ER Accuracy[b]:** 0.5 dB
- **ER Resolution:** 0.1 dB
- **Angle Accuracy[b]:** 0.5°
- **Angle Resolution:** 0.1°
- **Dynamic Range[c]:** 50 dB (-40 to 10 dBm)
- **Operating Temperature:** 5 - 40 °C
- **Line Voltage:** 100, 115, 230 VAC

a All specifications are valid at 23 ± 5 °C and 45 ± 15% relative humidity.
b For input power > -30 dBm at 1550 nm.
c Dynamic Range depends on specific wavelength.

This benchtop device offers a fast and simple way to measure the Extinction Ratio (ER) of polarization-maintaining (PM) fibers. It is an easy-to-use device that may be utilized in many applications where the alignment of polarization-maintaining fibers is required.

How it Works

The ERM100 contains a rotating polarizer followed by a detector, which generates a photocurrent. In general, for an arbitrary elliptical input state, this photocurrent will be a sinusoidal function in time with a DC offset. By simultaneously analyzing the DC offset and the depth of modulation, the meter is able to determine the degree to which the light field is linearly polarized, thereby yielding the extinction ratio (ER).

PM Alignment Application

Thorlabs' Extinction Ratio Meter can be used to align the axis of a PM fiber with the polarization axis of the linearly polarized incident light. This process is not trivial because PM fiber exhibits stress-induced birefringence that affects the ellipticity of the polarization state outputted from the fiber. For proper alignment of the polarization axis, a time-varying stress needs to be applied to the PM fiber while maximizing the extinction ratio of the transmitted light (e.g., continuously change the bend of the fiber). Since the alignment between the fiber axis and the polarization axis of the incident light field is improved, the effect of the time-varying stress will be reduced, thereby stabilizing the ER. At this point, the axis of the PM fiber will be optimally aligned with the polarization axis of the linearly polarized incident light.

Benefits

This benchtop instrument is an easy-to-use measurement device for many PM fiber alignment applications. A set of controls and the liquid crystal display on the front panel allow a quick adjustment and measurement procedure. Any PM alignment task can be performed efficiently. The ERM100 is factory-calibrated and provides the ER, misalignment angle, and power. It can also be controlled via USB. Drivers for LabVIEW™ and LabWindows™/CVI™ are included.

ITEM #	$	£	€	RMB	DESCRIPTION
ERM100	$ 2,550.00	£ 1,836.00	€ 2.218,50	¥ 20,323.50	Extinction Ratio Meter, 800 - 1700 nm, FC/PC

For more details, see pages 244 - 246

State of Polarization Locker

PL100S

Applications

- Deterministic Polarization Control and Locking
- Replacement for the Looped Fiber (Paddle) Controllers
- SOP Scrambler

The PL100S State of Polarization (SOP) Locker is a stand-alone in-line deterministic polarization controller. This benchtop device offers accurate high-speed, low-loss control of the output polarization state, independent of the input SOP. The SOP locker can be used as a stand-alone device or it can be controlled by a computer through a USB port. A USB cable and software drivers are included. Drivers for LabVIEW™ and LabWindows/CVI™ programming environments are included. Similar to the DPC5500 Deterministic Polarization Controller (page 1183), the PL100S SOP Locker controls the output polarization using a closed-loop system consisting of several piezo-electric fiber squeezers, a fast in-line polarimeter, and a digital signal processor (DSP). For low-power signals, there is a precision mode that increases the averaging time, which allows the system to maintain precise control over the output SOP. Also, a button on the front panel toggles the active control of the output polarization on/off. Note that when the active control of the output SOP is off, the output polarization will be dependent on the input polarization. The PL100S has a built-in calibration routine that can be initiated via a button on the front panel.

The output polarization is set by using the up, down, right, and left buttons on the front panel. Pressing one of these buttons results in a 1° change in the output SOP along a longitudinal (up/down buttons) or latitudinal (right/left buttons) grid superimposed on the Poincaré Sphere. The SOP of the output light is stored in memory so that when the PL100S is turned off for some period of time and then turned back on the output SOP will not change. An additional operating mode on the PL100S produces a pseudo-depolarized output. In this mode, the polarization of the output light is rapidly changed such that all SOPs have an almost equal probability of occurring at any particular instant in time, thus scrambling the polarization.

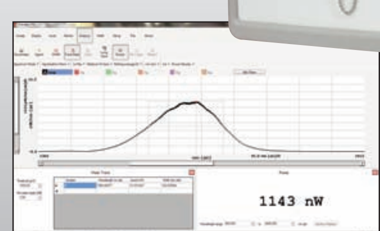
ITEM #	PL100S*
Output Fiber	Single Mode
Wavelength Range	1510 - 1640 nm
SOP Accuracy	±0.25° on Poincaré Sphere
DOP Accuracy**	±0.25%
Insertion Loss	<1.1 dB
PDL	<0.05 dB
Dynamic Range	35 dB (-20 to 15 dBm)
Accessible SOP's	Full Poincaré Sphere
SOP Setting Time in Normal Mode	150 µs for <10° Deviation 1 ms for <1° Deviation
Regulation Period Normal Mode	90 µs
Regulation Period Precision Mode	3 ms
SOP Repeatability	<0.1°
Input and Output Connectors	FC / APC
Power Supply	100 - 240 V ±10%, 50 - 60 Hz

*All specifications valid at 23 ± 5°C and 45 ± 15% relative humidity **Input Power: +3 dBm

ITEM #	$	£	€	RMB	DESCRIPTION
PL100S	$ 9,984.00	£ 7,188.48	€ 8.686,08	¥ 79,572.48	SOP Locker for SM Fiber, FC/APC Connectors*

*Other connectors available upon request.

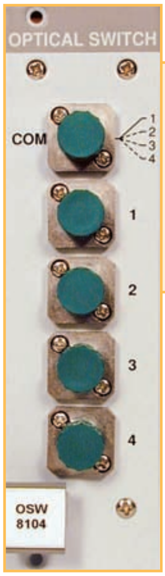
OSA201, OSA203



Spectrum of a 1550 nm Laser Diode

CHAPTERS
Fiber Patch Cables
Bare Fiber
Fiber Optomechanics
Fiber Components
Test and Measurement
SECTIONS
PRO8000 Platform
TXP5000 Platform
PMD/PDL System
Benchtop Systems
Optical Switches
Optical Modulators
Optical Spectrum Analyzers

Optical Switch Modules for PRO8 (Page 1 of 2)



PRO8000 Optical Switch Modules: The OSW8000 optical switch modules facilitate distribution of test signals in complex test setups. The modularity of 1 x 2, 1 x 4, 1 x 8, and 2 x 2 switches allows for the flexible construction of routing paths. The bi-directional, 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 bi-directional switching modules are available, providing highly flexible routing of optical signals.

The OSW8000 series bi-directional optical switches offer a fast switching time (typically, rise times are better than 0.5 ms with a maximum of 1 ms), and a broad wavelength range (1240 nm to 1610 nm), making them ideal companions to our extensive line of DWDM laser diode sources shown on page 1188 through 1191. The four different modules offered are 1 x 2, 1 x 4, 1 x 8, and 2 x 2 switches, each of which features low insertion loss and excellent repeatability.

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.

Features

- Wavelength Range: 1240 - 1610 nm
- Very Fast Response Time: 0.5 ms Typical, 1 ms Max
- Low Insertion Loss: 0.7 dB (1 x 2) Typical, 2.6 dB (1 x 8) Max
- Excellent Repeatability: ±0.01 dB
- MEMS Technology for Long Life: >10^9 Cycles
- Four Modules: 1 x 2, 1 x 4, 1 x 8, and 2 x 2
- Up to Eight Switch Modules per Chassis
- LabVIEW™ and LabWindows™/CVI Drivers Included
- Efficient Test Signal Routing in Branching Test Beds

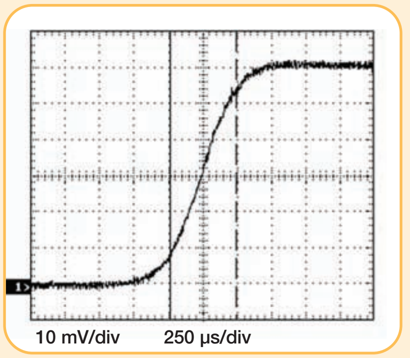


Figure 1
Rise time measurement of the MEMS based optical switch; the rise time measured between the 10% and 90% points is 480 µs.

MEMS Technology: Provides Billions of Switch Cycles

The switching mechanism is based on silicon MEMS (Micro-Electro-Mechanical Systems) technology, which ensures a long lifetime and fast operation (see Figure 1). This technology also provides very low crosstalk between channels; the 1 x 4 and 1 x 8 switches have a maximum crosstalk specification of -60 dB, and the 1 x 2 and 2 x 2 are both rated at -50 dB.

IEEE-488 Computer Control of Multiple PRO8s

The PRO8 chassis (2 slot and 8 slot models) are both equipped with an IEEE-488.2 interface supported by a number of free LabVIEW™ and LabWindows™ drivers. The PRO8 can accept an assortment of different modules, allowing the OSW8000 switches to be combined with our high-performance laser sources. All PRO8 series chassis are also equipped with an RS-232C interface.

User Friendly Operation

The PRO8000 series chassis offers a user friendly, menu-driven platform from which a selection of various modules can be operated.

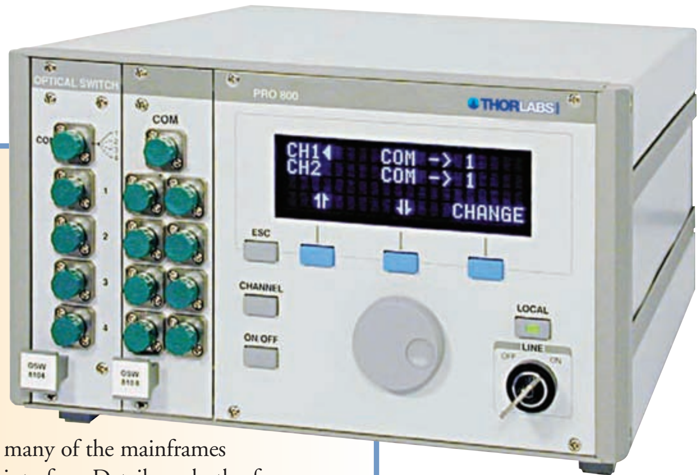
Configuring a system is as simple as inserting the modules; each of the plug-in modules automatically identifies itself to the chassis processor. A brightly lit, 4 x 20 fluorescence display allows the user to scroll through and select any installed module. When selected on the display, all of the control parameters for the individual module are accessible and all functionality is controllable via the front panel. Additional higher level commands are available for operating the system via the IEEE-488 interface (e.g., changing switch settings to automate multi-path testing).

Optical Switch Modules for PRO8 (Page 2 of 2)

OSW8202

Other Connectors Available upon Request.

The OSW8000 series of modules requires one of our two PRO8 series chassis. We offer two different chassis versions: the PRO800 two-slot chassis fits perfectly where space is limited, and the PRO8000 eight-slot chassis is ideal for use in building larger test systems. For even larger test systems it is possible to control many of the mainframes simultaneously via the IEEE-488.2 interface. Details on both of these PRO8 chassis can be found on page 1160.



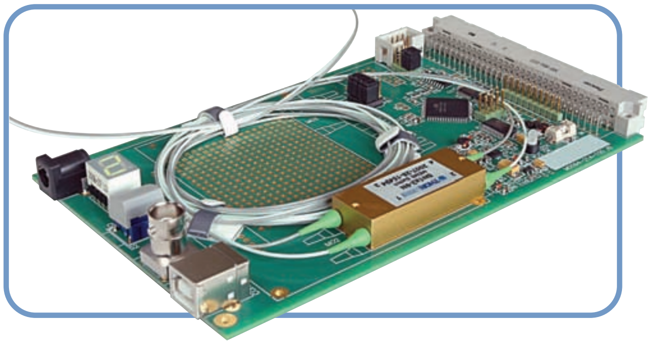
PRO800 with Two OSW8000 Modules

ITEM #	OSW8102	OSW8104	OSW8108	OSW8202
Switching Configuration	1 x 2	1 x 4	1 x 8	2 x 2
Switching Time Typical	0.5 ms Typical (1 ms Max)			
Wavelength Ranges	1240 - 1610 nm			
Maximum Input Power	17 dBm (CW)			
Insertion Loss (Typical/Max)*	0.7 dB/ < 1.5 dB	1.2 dB/<2.1 dB	1.6 dB/<2.6 dB	0.7 dB/<1.5 dB
PDL**	<0.1 dB	<0.15 dB	<0.2 dB	<0.15 dB
Crosstalk, Max	<-50 dB	<-60 dB	<-60 dB	<-50 dB
Repeatability	±0.01 dB			
Return Loss	-50 dB	-50 dB	-45 dB	-50 dB
Connectors	FC/APC			
General Data Operating Temperature	0 to +35 °C			
Storing Temperature	-10 to +60 °C			
Width	1 Slot			

* Including connectors ** Measured at 1550 nm

ITEM #	$	£	€	RMB	DESCRIPTION
OSW8102	$ 3,214.00	£ 2,314.08	€ 2.796,18	¥ 25,615.58	1 x 2 Optical Switch, FC/APC
OSW8104	$ 4,198.00	£ 3,022.56	€ 3.652,26	¥ 33,458.06	1 x 4 Optical Switch, FC/APC
OSW8108	$ 8,158.00	£ 5,873.76	€ 7.097,46	¥ 65,019.26	1 x 8 Optical Switch, FC/APC
OSW8202	$ 3,955.00	£ 2,847.60	€ 3.440,85	¥ 31,521.35	2 x 2 Optical Switch, FC/APC

1 x 2 and 2 x 2 MEMS Optical Switch Kits



The OSW series of switch kits consists of a MEMS optical switch with an integrated control circuit that includes a USB 2.0 interface for easy integration into your optical system. We offer 1 x 2 and 2 x 2 MEMS modules with operating wavelengths from 480 nm to 1575 nm. These bi-directional 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 <1 ms). The OSW switches are designed for the distribution and routing of signals at the indicated visible or near infrared wavelengths. The OSW series can be controlled via USB 2.0 by the included GUI and driver package, an onboard toggle switch, or via BNC input (TTL signal).

By default, all switches are shipped without fiber connectors. Termination of the fibers is available upon request; please contact your local technical support office for pricing. Additionally, 1 x 4 and 1 x 8 MEMS switch modules are available upon request.

The OSW series ships with a 9 V power supply, USB cable, and software package with GUI and LabVIEW™ driver set.

Features

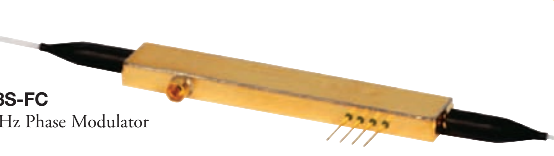
- Switch Types: 1 x 2 or 2 x 2 (Optional: 1 x 4, 1 x 8)
- USB Remote Control
- Push Button Toggle Switch on Board
- BNC Input for Switching (TTL Signal)
- Channel: Indication by 7 Segment LED Display
- TTL Status Signals
- Euro Size Card: (100 mm x 160 mm) with Standard DIN 41612 Connector for Easy Integration Into 19" Rack Systems (See Pages 473 - 475)
- Powered by Included 9 V Power Supply or via USB Port

ITEM #	OSW12-488E OSW22-488E	OSW12-633E OSW22-633E	OSW12-780E OSW22-780E	OSW12-830E OSW22-830E	OSW12-980E OSW22-980E	OSW12-1310E OSW22-1310E
Operating Wavelength	480 - 650 nm	600 - 800 nm	750 - 950 nm	800 - 1000 nm	970 - 1170 nm	1285 - 1330 nm and 1525 - 1575 nm
Insertion Loss (Typical)	N/A	0.7 dB Over Wavelength Range				
Insertion Loss (Max)	4 dB at 488 nm	1.5 dB Over Wavelength Range				
Cross Talk	75 dB (Typical)/60 dB (Max)					
Polarization-Dependent Loss	0.02 dB (Typical)/0.05 dB (Max)					
Back Reflection	55 dB (Typical)/50 dB (Max)					
Switching Speed	0.5 ms (Typical)/1 ms (Max)					
Max Optical Power	30 mW	50 mW	75 mW	85 mW	105 mW	300 mW
Fiber Type (Single Mode)	SM450	CL 630 11	SM750	SM800-5.6-125	SM980-5.8-125	SMF-28e+
Mode-Field Diameter	3.3 µm @ 488 nm 3.4 µm @ 514 nm	4.3 µm @ 630 nm	5.3 µm @ 780 nm	5.6 µm @ 830 nm	5.8 µm @ 980 nm 6.2 µm @ 1064 nm	9.2 µm @ 1310 nm 10.4 µm @1550 nm
Lifetime (No Wear Out)	Proven up to 10^9 Switching Cycles					
Operating Voltage	4.75 - 5.25 VDC 300 mA (USB Connector) or 6 - 15 VDC 300 mA (DC Power Connector)					
Temperature	Operating: 0 to 40 °C, Storage: -40 to 70 °C					

ITEM #	$	£	€	RMB	DESCRIPTION
OSW12-488E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 480 - 650 nm
OSW12-633E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 600 - 800 nm
OSW12-780E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 750 - 950 nm
OSW12-830E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 800 - 1000 nm
OSW12-980E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 970 - 1170 nm
OSW12-1310E	$ 1,084.00	£ 780.48	€ 943,08	¥ 8,639.48	Electronic Controlled 1 x 2 Switch Module 1285 - 1330 nm & 1525 - 1575 nm
OSW22-488E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 480 - 650 nm
OSW22-633E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 600 - 800 nm
OSW22-780E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 750 - 950 nm
OSW22-830E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 800 - 1000 nm
OSW22-980E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 970 - 1170 nm
OSW22-1310E	$ 1,188.00	£ 855.36	€ 1.033,56	¥ 9,468.36	Electronic Controlled 2 x 2 Switch Module 1285 - 1330 nm & 1525 - 1575 nm

10 GHz Phase Modulators

The LN53S and LN65S are Titanium-Indiffused Z-Cut $LiNbO_3$ Phase Modulators that are designed to be integrated into 300 pin MSA compatible transponders. Phase modulators provide chirp control in high-speed data communications. The $LiNbO_3$ design is also ideal for coherent communications, sensing, all-optical frequency-shifting, and data encryption applications.



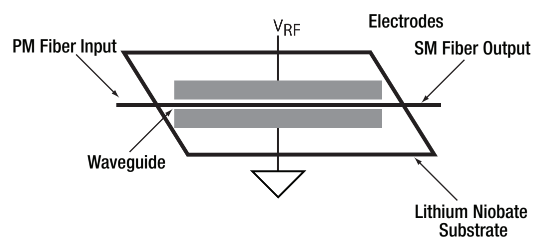
LN53S-FC
10 GHz Phase Modulator

The two Z-cut $LiNbO_3$ phase modulators presented here are 10 GHz devices with PM and SM fiber pigtails on the device input and output, respectively. The LN65S has an optional integrated optical polarizer positioned before the output port of the device. Both models are offered with FC/PC connectors. For more information on custom configurations (i.e., fiber type, connectorization, etc.) and quotes, please contact Technical Support.

ITEM #	LN53S / LN65S		
Parameter	**Min**	**Typical**	**Max**
Operating Wavelength[a]	1525 nm	–	1605 nm
Optical Insertion Loss (Connectorized)	–	3.5 dB	4.5 dB
E/O Bandwidth (-3 dB)	10.0 GHz	–	–
RF Drive Voltage (PRBS[b])	–	4.5 V	5.0 V
DC $V\pi$[c]	–	4.0 V	4.5 V
Optical Return Loss	40 dB	–	–
S11 (DC to 10 GHz)	–	-12 dB	-10 dB
Digital Comm. Bit Rate Frequency	9.953 Gb/s	–	–
Insertion Loss Variation (EOL[d])	-0.5 dB	–	0.5 dB
Operating Case Temperature	0 °C	–	70 °C

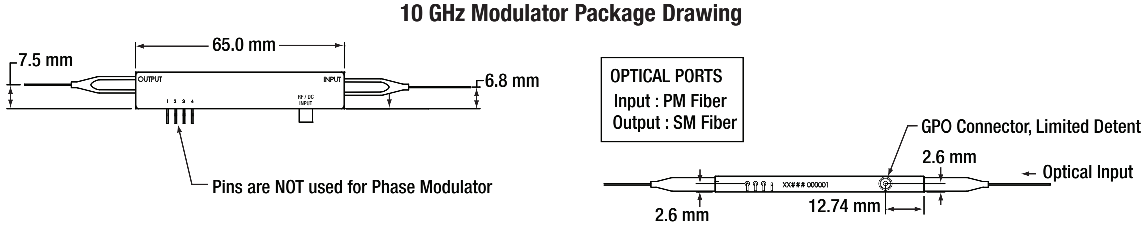
[a]The modulator is designed for use in the 1550 nm window. Using the modulator at another wavelength may cause a temporary increase in loss that is not covered under warranty.
[b]Pseudo Random Binary Sequence
[c]Half-Wave Retardation DC Voltage
[d]End of Life

Phase Modulator Waveguide



Mechanical Drawings Available on the WEB

10 GHz Modulator Package Drawing



ITEM #	$	£	€	RMB	DESCRIPTION
LN53S-FC	$ 1,550.00	£ 1,116.00	€ 1.348,50	¥ 12,353.50	10 GHz Phase Modulator, FC/PC Connectors
LN65S-FC	$ 1,550.00	£ 1,116.00	€ 1.348,50	¥ 12,353.50	10 GHz Phase Modulator with Polarizer, FC/PC Connector

Have you seen our...

Free-Space Modulators

- Operating Wavelengths from 400 to 1650 nm
- Amplitude or Phase Modulation
- Ø2 mm Clear Aperture

In addition to Thorlabs' fiber-based modulators, we also offer free-space designs for visible and NIR wavelengths. These compact $LiNbO_3$ devices can be driven by our HVA200 controller, or another voltage amplifier with an SMA connector.

For more details, see pages 1424 - 1434

10 GHz Intensity Modulators (Page 1 of 2)

Thorlabs' 10 GHz (10 Gb/s) Intensity Modulators are fabricated from titanium-indiffused lithium niobate (LiNbO3). All of these high-performance optical modulators are designed for simple system integration to benefit customers developing high-speed modulation systems. These 10 GHz (10 Gb/s) modulators have an extremely small profile (see drawing on following page) and feature a single-ended drive configuration with separate DC bias pins.

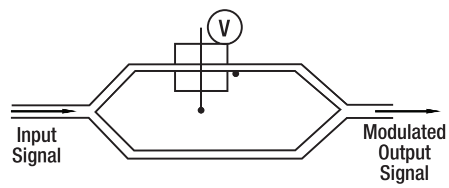
LN63S-FC
10 GHz Intensity Modulator

All modulators are based on a titanium-indiffused LiNbO3 structure and packaged in a hermetic housing with PM fiber and SM fiber pigtails on the device input and output, respectively. The pigtails are connectorized with FC/PC connectors. Polarization-maintaining fiber and a full range of connectorization options are also available for all lithium niobate Modulators. Please contact our Technical Support Team for customization assistance. Both fixed-chirp and zero-chirp intensity modulators are offered for dispersion control.

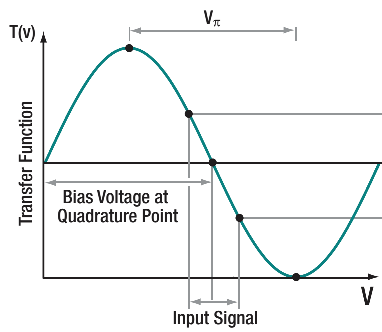
Mach-Zehnder Modulator Operation

Applying a voltage across one arm of the Mach-Zehnder modulator shifts the phase of the signal through that arm by an amount proportional to the voltage applied. If the phase shift equates to an integral number of wavelengths, the two beams will combine constructively, and the intensity of the output power will be at its maximum. If the phase shift is a half wavelength out of phase, the two beams will combine destructively and the output power will be at its minimum.

Schematic Diagram of a Mach-Zehnder Modulator



Transfer Function of a Mach-Zehnder Modulator



Fixed-Chirp Modulators

The LN63S, LN82S, and LN83S are 0.7 Fixed-Chirp $LiNbO_3$ Intensity Modulators that are designed to be integrated into 300 pin MSA compatible transponders. The LN63S and LN82S feature integrated photodiodes. Fixed-Chirp modulators are fabricated from Z-cut titanium-indiffused $LiNbO_3$, which creates in an inequality in the push-pull phase shift between the two arms of the Mach-Zehnder interferometer. This results in a phase/frequency shift (chirp) in the output in addition to the intensity modulation. These fixed chirp modulators down-chirp the pulse, which can be useful when the optical fiber in the network has a positive dispersion coefficient. The down-chirped pulse traveling through an optical fiber with a positive dispersion coefficient will be compressed until a minimum is reached. Beyond that point the dispersion term will dominate. Since chirping the pulse increases the spectral width of the pulse, the chirped pulse will eventually be broader than an unchirped pulse traveling through the same optical fiber.

These fixed chirp intensity modulators are ideal for applications requiring improved power penalty (less than two dB for +1600 ps/nm) performance over zero-chirp devices. The integrated photodiode can be used for optical power monitoring and modulator bias control, which eliminates the need for an external fiber tap.

The LN83S modulator also has an integrated variable optical attenuator that allows for active attenuation of the optical output power over a range greater than 15 dB. This optical attenuator enables efficient management of network imbalances in DWDM optical links. All three models are offered with PM and SM fiber pigtails on the device input and output, respectively, with FC/PC connectors. The LN82S also features a replaceable GPO connector.

ITEM #	LN63S / LN82S / LN83S		
Parameter	Min	Typical	Max
Operating Wavelength[a]	1525 nm	–	1605 nm
Optical Insertion Loss (Connectorized)	–	4.0 dB	5.0 dB
E/O Bandwidth (-3 dB)	10 GHz	–	–
RF Drive Voltage (PRBS[b])	–	3 V	8 V
$V\pi$ @ Bias Port[c]	–	–	–
Optical On/Off Extinction Ratio	20 dB	–	–
Optical Return Loss	40 dB	–	–
S11 (DC to 10 GHz)	–	-12 dB	-10 dB
Digital Comm. Bit Rate Frequency	9.953 Gb/s	5.5 V	6 V
Dynamic Extinction Ratio (PRBS[b])	13 dB	–	–
Chirp Parameter	0.6	–	0.8
Insertion Loss Variation (EOL[c])	-0.5 dB	–	0.5 dB
DC Bias Voltage Range (EOL[d])	-8 V	–	8 V
PD Responsivity	0.1 A/W	–	0.5 A/W
Output Optical Power Monitoring Range	-5 dBm	–	10 dBm
Output Monitor Variation	-0.5 dB	–	0.5 dB
Monitor Photodiode Reverse Bias Voltage	-5.5 V	–	-3.0 V
Operating Case Temperature	0 °C	–	70 °C

[a]The modulator is designed for use in the 1550 nm window. Using the modulator at another wavelength may cause a temporary increase in loss that is not covered under warranty.
[b]Pseudo Random Binary Sequence
[c]Half-Wave Retardation DC Voltage
[d]End of Life

10 GHz Intensity Modulators (Page 2 of 2)

Zero-Chirp Modulators

The LN56S and LN81S are Zero-Chirp $LiNbO_3$ Intensity Modulators with integrated photodiodes that are designed to be integrated into 300 pin MSA compatible transponders. Zero-Chirp modulators are fabricated from X-cut titanium-indiffused $LiNbO_3$, which allows for both arms of the Mach-Zehnder interferometer to be symmetric. This symmetry ensures that the modulated output of the intensity modulator is not also shifted in phase/frequency (chirped). A chirped signal will be spectrally broadened, which leads to greater chromatic dispersion and limits the WDM channel separation.

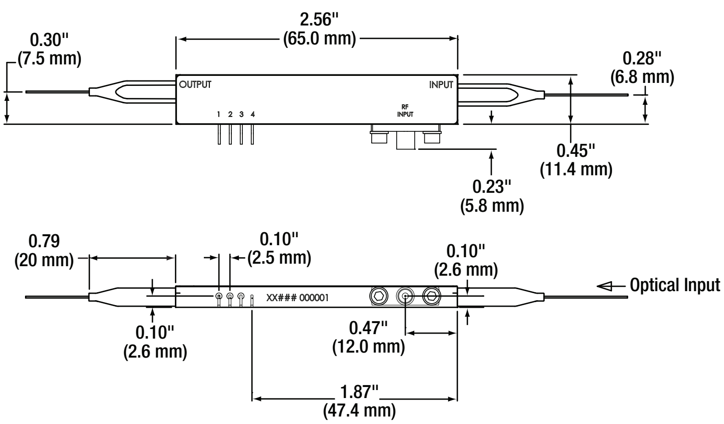
Zero-Chirp intensity modulators are ideal for use in metro and long-haul DWDM applications requiring less than a 2 dB power penalty for ±1,200 ps/nm dispersion. The integrated photodiode can be used for optical power monitoring and modulator bias control, which eliminates the need for an external fiber tap.

The LN81S and LN56S are offered with PM and SM fiber pigtails on the device input and output respectively, with FC/PC connectors. The LN81S also features a replaceable GPO connector.

ITEM #	LN56S / LN81S		
Parameter	Min	Typical	Max
Operating Wavelength[a]	1525 nm	–	1605 nm
Optical Insertion Loss (Connectorized)	–	4.0 dB	5.0 dB
E/O Bandwidth (-3 dB)	10.0 GHz	–	—
RF Drive Voltage (PRBS[b])	–	5.5 V	6 V
Vπ @ Bias Port[c]	–	–	8 V
Optical On/Off Extinction Ratio	20 dB	–	–
Optical Return Loss	40 dB	–	–
S11 (DC to 10 GHz)	–	-12 dB	-10 dB
Digital Comm. Bit Rate Frequency	9.953 Gb/s	–	–
Optical Extinction Ratio (PRBS[b])	13 dB	–	–
Chirp Parameter	-0.1 GHz	–	0.1 GHz
Insertion Loss Variation (EOL[c])	-0.5 dB	–	0.5 dB
DC Bias Voltage Range (EOL[d])	-8V	–	8 V
PD Responsitivity	0.1 A/W	–	0.5 A/W
Output Optical Power Monitoring Range	-5 dBm	–	10 dBm
Output Monitor Variation	-0.5 dB	–	0.5 dB
Monitor Photodiode Reverse Bias Voltage	-5.5 V	–	-3.0 V
Operating Case Temperature	0 °C	–	70 °C

[a]The modulator is designed for use in the 1550 nm window. Using the modulator at another wavelength may cause a temporary increase in loss that is not covered under warranty.
[b]Pseudo Random Binary Sequence
[c]Half-Wave Retardation DC Voltage
[d]End of Life

10 GHz Modulator Package Drawing



ITEM #	LN56S / LN63S LN83S	LN81S / LN82S
RF Input	SMP Connector	GPO Connector
Pin 1	Detector Cathode	Detector Cathode
Pin 2	Detector Anode	Detector Anode
Pin 3	DC Bias Voltage	DC Bias Voltage
Pin 4	Case Ground	Case Ground

OPTICAL PORTS

Input : PM Fiber
Output : SM FIber

Please refer to our website for complete models and drawings.

Other connector styles are available. Please contact technical support.

Mechanical Drawings Available on the WEB

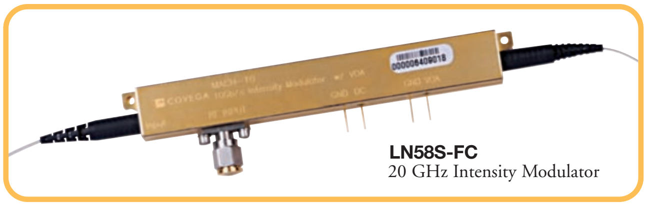
Fixed-Chirp Modulators

ITEM #	$	£	€	RMB	DESCRIPTION
LN63S-FC	$ 1,350.00	£ 972.00	€ 1.174,50	¥ 10,759.50	Fixed-Chirp, 10 GHz Intensity Modulator, Integrated PD, FC/PC Connectors
LN82S-FC	$ 1,350.00	£ 972.00	€ 1.174,50	¥ 10,759.50	Fixed-Chirp, 10 GHz Intensity Modulator, Integrated PD, Replaceable GPO Connector, FC/PC Connectors
LN83S-FC	$ 1,750.00	£ 1,260.00	€ 1.522,50	¥ 13,947.50	Fixed-Chirp, 10 GHz Intensity Modulator, Integrated PD, Integrated Variable Optical Attenuator, FC/PC Connectors

Zero-Chirp Modulators

ITEM #	$	£	€	RMB	DESCRIPTION
LN56S-FC	$ 1,275.00	£ 918.00	€ 1.109,25	¥ 10,161.75	Zero-Chirp, 10 GHz Intensity Modulator, Integrated PD, FC/PC Connectors
LN81S-FC	$ 1,275.00	£ 918.00	€ 1.109,25	¥ 10,161.75	Zero-Chirp, 10 GHz Intensity Modulator, Integrated PD, Replaceable GPO Connector, FC/PC Connectors

20 GHz Low V_π Analog Intensity Modulator

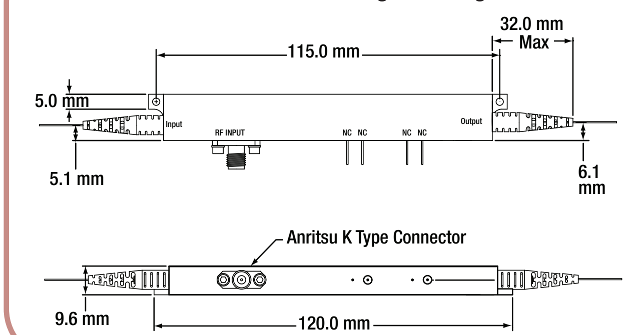

LN58S-FC
20 GHz Intensity Modulator

The LN58S Analog Intensity Modulator from Thorlabs Quantum Electronics (TQE) is a high-frequency, analog intensity modulator for use in the 1550 nm window. This innovative, single-ended drive modulator is based on Mach-Zehnder interferometric architecture, which uses Z-cut titanium-indiffused $LiNbO_3$. It is designed for ease of system integration to benefit customers developing high-speed analog modulation systems.

The LN58S offers a very low drive voltage (V_π < 3.9 V at 20 GHz) while supporting 20 GHz operating frequencies, making it well-suited for fiber optic antenna remoting and microwave photonics.

The LN58S is packaged in a hermetic housing with a K-connector RF input signal port and PM and SM fiber pigtails on the device input and output, respectively. This modulator is offered with FC/PC connectors. For more information on custom configurations (i.e., fiber type, connectorization, etc.) and quotes, please contact Technical Support.

20 GHz Modulator Package Drawing



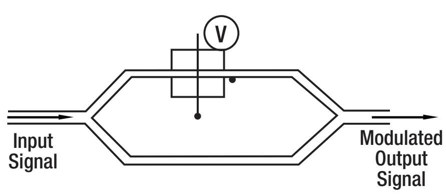
ITEM #	LN58S		
Parameter	Min	Typical	Max
Operating Wavelength*	1525 nm	–	1605 nm
Optical Insertion Loss (Connectorized)	–	–	5.5 dB
Vπ at 20 GHz	–	3.5 V	3.9 V
Vπ at DC	–	1.5 V	2.0 V
Optical On/Off Extinction Ratio	20 dB	–	–
Optical Return Loss	40 dB	–	–
S11 (DC to 20 GHz)	–	-12 dB	-10 dB
Insertion Loss Variation (EOL**)	-0.5 dB	–	–
Operating Case Temperature	0 °C	–	70 °C
Storage Temperature	-40 °C	–	85 °C

*The modulator is designed for use in the 1550 nm window. Using the modulator at another wavelength may cause a temporary increase in loss that is not covered under warranty.
** End of Life

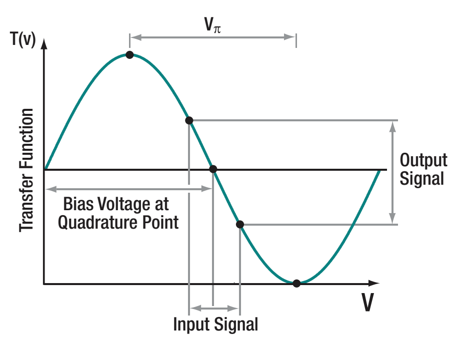
Mach-Zehnder Modulator Operation

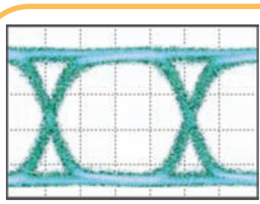
Applying a voltage across one arm of the Mach-Zehnder modulator shifts the phase of the signal through that arm by an amount proportional to the voltage applied. If the phase shift equates to an integral number of wavelengths, the two beams will combine constructively, and the intensity of the output power will be at its maximum. If the phase shift is a half wavelength out of phase, the two beams will combine destructively and the output power will be at its minimum.

Schematic Diagram of a Mach-Zehnder Modulator



Transfer Function of a Mach-Zehnder Modulator



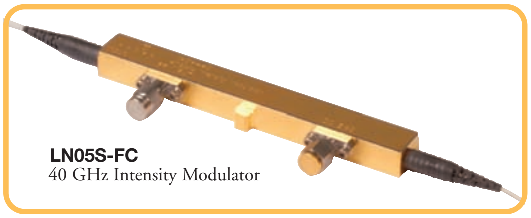


The display of a receiver "Eye Pattern" is a convenient graphical method to indicate the data signal quality produced by the communications channel. As one of the first elements in the communication channel, the modulators from Thorlabs Quantum Electronics (TQE), have been Telcordia GR-468-CORE qualified for use in communication systems.

The image is an example "Eye Pattern" produced by a TQE Modulator, showing the oscilloscope trace at the receiver of a two-level modulation scheme such as an "On-Off-Keying" (OOK) signal.

ITEM #	$	£	€	RMB	DESCRIPTION
LN58S-FC	$ 5,250.00	£ 3,780.00	€ 4.567,50	¥ 41,842.50	20 GHz Low V_π Intensity Modulator, FC/PC Connectors

40 GHz Phase and Intensity Modulators



LN05S-FC
40 GHz Intensity Modulator

The LN05S, LN27S, and the LN66S are 40 GHz Modulators manufactured by Thorlabs Quantum Electronics (TQE). These three revolutionary, titanium-indiffused Z-cut lithium niobate, high-performance optical modulators are designed for ease of system integration; they offer large bandwidths and are ideal for developing high-speed modulation systems.

The LN05S intensity modulator with external DC bias is a high-performance 40 GHz (40 Gb/s) modulator that has a single-ended drive configuration with a fixed chirp coefficient of ±0.7 and an industry-leading low RF drive voltage (5.5 V).

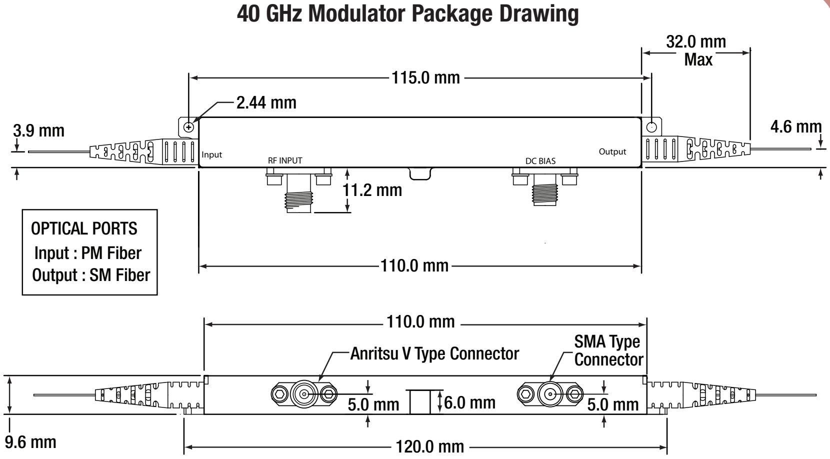
The LN27S and the LN66S phase modulators are high-performance, 40 GHz (40 Gb/s) modulators that enable chirp control in high-speed data communications. These modulators are also ideal for applications in coherent communications, sensing, all-optical frequency shifting, and data encryption. While the LN27S and LN66S modulators both offer internal RF terminations, the LN27S also offers an optical polarizer not included with the LN66S. With no polarizer, the LN66S is capable of supporting both optical modes, ordinary and extraordinary. Each mode will have a different modulation efficiency; the modulation efficiency ($V\pi$) of the extraordinary mode will be approximately a factor of three greater than the ordinary mode. The internal polarizer included with the LN27S is desirable for those interested in using only the extraordinary mode. Only performance specifications for the extraordinary mode are presented here.

All three modulators are based on Z-cut titanium-indiffused $LiNbO_3$ and are hermetically packaged in a dual-port housing with PM and SM fiber pigtails on the device input and output, respectively. The fiber pigtails are connectorized with FC/PC connectors. Please note that polarization-maintaining fiber and a full range of connectorization options are available for all lithium niobate modulators. Contact Technical Support for customization assistance.

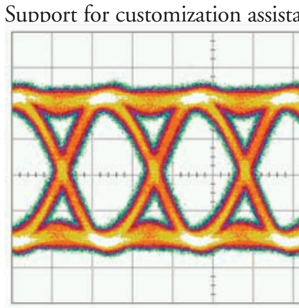
ITEM #	LN05S			LN27S / LN66S		
Parameter	**Min**	**Typical**	**Max**	**Min**	**Typical**	**Max**
Operating Wavelength[a]	1525 nm	–	1605 nm	1525 nm	–	1605 nm
Optical Insertion Loss (Connectorized)	–	4.0 dB	5.0 dB	–	4.0 dB	5.0 dB
E/O Bandwidth (-3 dB ref. 130 MHz)	30 GHz	35 GHz	–	30 GHz	35 GHz	–
RF Drive Voltage of RF Port (PRBS[b])	–	5.5 V	–	–	7.0 V	–
1 GHz V_π RF Port	–	5.0 V	5.5 V	–	–	7.0 V
Optical On/Off Extinction Ratio	–	20 dB	–	NA	NA	NA
Optical Return Loss	40 dB	–	–	40 dB	–	–
S11 (DC to 30 GHz)	–	-12 dB	-10 dB	–	-12 dB	-10 dB
S11 (30 GHz to 40 GHz)	–	-10 dB	-8 dB	–	-10 dB	-8 dB
Digital Comm. Bit Rate Frequency	–	40 Gb/s	–	–	40 Gb/s	–
Dynamic Extinction Ratio (PRBS[b])	–	13 dB	–	NA	NA	NA
Insertion Loss Variation (EOL[c])	-0.5 dB	–	0.5 dB	-0.5 dB	–	0.5 dB
Operating Case Temperature	0 °C	–	70 °C	0 °C	–	70 °C
Storage Temperature	-40 °C	–	85 °C	-40 °C	–	85 °C
V-Connector	RF Signal			RF Signal		
SMA Connector	DC Bias Voltage			Not Used / No Connect		

[a]The modulator is designed for use in the 1550 nm window. Using the modulator at another wavelength may cause a temporary increase in loss that is not covered under warranty.
[b]Pseudo Random Binary Sequence
[c]End of Life

40 GHz Modulator Package Drawing



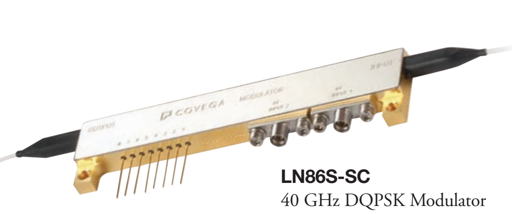
Please refer to our website for complete models and drawings.



The image above is an example "Eye Pattern" produced by a Thorlabs Modulator showing the oscilloscope trace of a two-level modulation scheme, such as an "On-Off-Keying" (OOK) signal. The modulators have been Telcordia GR-468-CORE qualified for use in communication systems.

ITEM #	$	£	€	RMB	DESCRIPTION
LN05S-FC	$ 4,850.00	£ 3,492.00	€ 4.219,50	¥ 38,654.50	40 GHz Intensity Modulator, FC/PC Connectors
LN66S-FC	$ 4,350.00	£ 3,132.00	€ 3.784,50	¥ 34,669.50	40 GHz Phase Modulator, FC/PC Connectors
LN27S-FC	$ 4,350.00	£ 3,132.00	€ 3.784,50	¥ 34,669.50	40 GHz Phase Modulator with Polarizer, FC/PC Connectors

40 GHz DQPSK/4QAM Modulator



LN86S-SC
40 GHz DQPSK Modulator

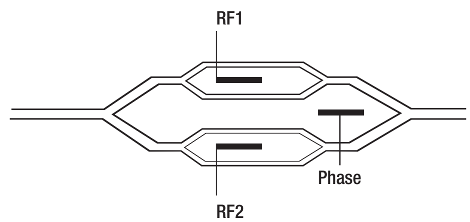
The LN86S is a Dual-Parallel, Titanium-Indiffused, X-Cut Lithium Niobate Modulator. It is capable of providing a 40 Gb/s signaling rate and offers a large bandwidth to benefit customers developing high-speed modulation systems. Each Mach-Zehnder Interferometer (MZI) has an independently-controlled bias section to achieve maximum performance. The front end of the modulator consists of two MZIs in parallel. Each MZI is an intensity modulator with separate external DC bias controls, giving the user the ability to perform multi-level signaling. The back end of the LN86S is a phase modulator which allows for the required phase control in the signal channel.

The LN86S is designed for quadrature modulation (QPSK or 4QAM) and single side-band suppressed carrier (SSB-SC) transmission. This modulator is part of a family of high-performance, Telcordia-compliant, external optical modulators with industry-leading long-term stability. It is hermetically packaged in a durable housing with PM and SM fiber pigtails on the device input and output, respectively. The standard device has fiber pigtails connectorized with FC/PC connectors. Please contact Technical Support for customization of these products.

Mach-Zehnder Modulator Operation

In this dual-parallel modulator, the incoming signal is equally split into two legs and sent through separate intensity modulators. Each intensity modulator can be modulated with a DPSK format. The outputs of each intensity modulator's legs are re-combined then sent through a low speed phase modulator. The phase modulator serves the purpose of applying a phase delay between the legs. The resultant output of the phase modulation section is then recombined and can form a DQPSK signal.

System Diagram of a Dual Parallel Modulator

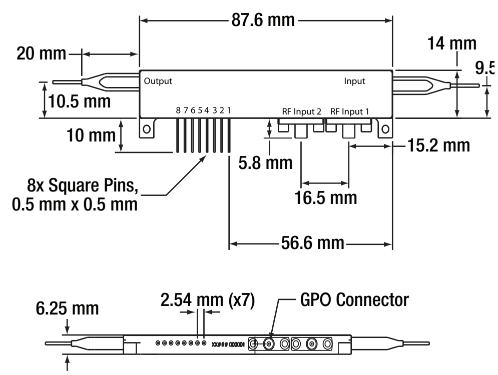


ITEM #	LN86S / LN86S		
Parameter	**Min**	**Typical**	**Max**
Operating Wavelength[a]	1525 nm	–	1575 nm
Optical Insertion Loss (Connectorized)	–	5.0 dB	6.0 dB
Optical Extinction Ratio[b] (@ DC)	20 dB	–	–
Optical Return Loss	40 dB	–	–
$V\pi$ RF Ports (@ DC)	–	3.5 V	4.5 V
$V\pi$ RF Ports (@ 1 GHz)	–	4.5 V	6 V
$V\pi$ Bias Ports (@ DC)	–	4.5 V	5.5 V
Insertion Loss Variation (EOL[c])	-0.5 dB	–	0.5 dB
Operating Case Temperature	0 °C	–	70 °C
Storage Temperature	-40 °C	–	85 °C
RF Parameters			
E/O Bandwidth (-3 dB)	14 GHz	–	–
S21 Amplitude Difference (50 MHz to 20 GHz)	-1.5 dB	–	1.5 dB
S21 Phase Difference (50 MHz to 14 GHz)	-10°	–	10°
S21 Phase Ripple (50 MHz to 10 GHz)	-10°	–	10°
Differential RF Delay	-5 ps	–	5 ps
RF Port S11 (50 MHz to 14 GHz)	–	-12 dB	-10 dB
Phase Modulator			
DC $V\pi$	–	–	6 V
E/O Bandwidth	1 MHz	–	–
RF Detectors			
Threshold	–	–	0.5 V
Slope (0.1 V/V_{pp} - 0.4 V/V_{pp})	0.1 V/V_{pp}	–	0.4 V/V_{pp}
Linearity	-5 %	–	5 %

[a]The modulator is designed for use in the 1550 nm window. Using the modulator at another wavelength may cause a temporary increase in loss that is not covered under warranty.
[b]Per MZI extinction ratio
[c]End of Life

40 GHz DQPSK Modulator Package Drawing

LN86S	
RF Input	GPO Connector
Pin 1	NC
Pin 2	RF2 Detector
Pin 3	NC
Pin 4	RF1 Detector
Pin 5	RF2 Bias
Pin 6	RF1 Bias
Pin 7	Phase Modulator
Pin 8	Ground



Please refer to our website for complete models and drawings.

ITEM #	$	£	€	RMB	DESCRIPTION
LN86S-FC	$ 4,850.00	£ 3,492.00	€ 4.219,50	¥ 38,654.50	40 GHz DQPSK Modulator, FC/PC Connectors

Fiber Polarization Controller

NEW product

Features

- High Bandwidth: >1 MHz
- Operation over C & L Bands (1525 - 1605 nm)
- Low Optical Insertion Loss: <4 dB
- Power: 100 mW (Max)
- Multiple Cascaded Stages for Flexible Control
- SC, FC/PC, FC/APC, and Bare Fiber Options
- Single Mode or PM Fiber

LNPC8S-FC

Thorlabs' LNPC8S series controller is a completely new polarization controller for C- and L-bands (1525 - 1605 nm) based on a planar lithium niobate circuit. Developed by the experts at Thorlabs Quantum Electronics, lithium niobate waveguides rotate the input light's polarization and phase through a cascade of eight stages. This allows the user to fully control the output polarization of light, regardless of the input polarization. Through the use of the electro-optic effect, this device is able to achieve >1 MHz bandwidth, making it our fastest polarization controller.

Each of the eight stages in the LNPC8S is identical and capable of controlling the phase or polarization rotation of light. To operate as a variable wave plate, a control voltage is applied, thereby creating a phase shift between the TE and TM modes. A separate control voltage can be applied to convert power from TE to TM modes without phase shift, or vice-versa. Complete polarization control is thus achievable with the LNPC8S.

Standard configurations include SM fiber connectorized with FC/PC connectors. Optional PM fiber pigtails are available on for the input and/or output ports. Please contact Technical Support for more information on customization.

Applications

- Test Instrumentation
- Polarization Mode Dispersion Control
- Polarization Scrambling

ITEM #	LNPC8S		
Parameter	Min	Typical	Max
Operating Wavelength	1525 nm	–	1605 nm
Optical Insertion Loss (Connectorized)	–	3 dB	4 dB
Input Power	–	–	100 mW
Number of Stages	–	8	–
TE to TM Conversion Voltage (per Stage)	–	120 V	–
TE/TM 180° Phase Shift Voltage (per Stage)	–	80 V	–
Zero Birefringence Bias Voltage (per Stage)	-35 V	–	35 V
Optical Return Loss	50 dB	–	–
Polarization-Dependent Loss	–	–	0.2 dB
Operating Case Temperature	0 °C	–	70 °C
Storage Temperature	-40 °C	–	85 °C

ITEM #	$	£	€	RMB	DESCRIPTION
LNPC8S-FC	$ 3,450.00	£ 2,484.00	€ 3.001,50	¥ 27,496.50	1 MHz Fiber Polarization Controller, FC/PC Connectors NEW

Have you seen our...

PAX Series Polarimeter: 1350 - 1700 nm

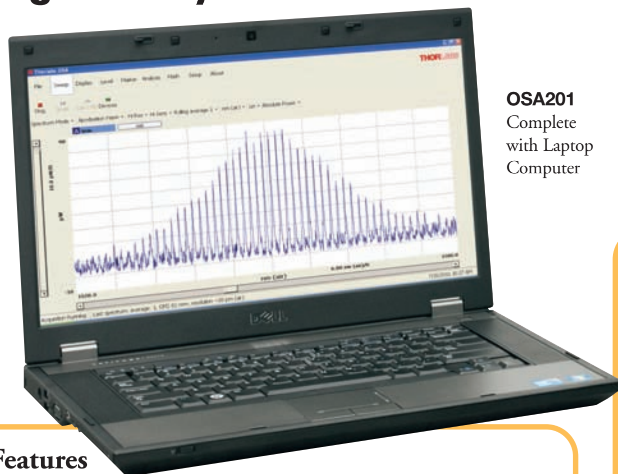
- Wavelength Range: 1350 – 1700 nm
- Internal Sensor Head
- Complete Benchtop Device Includes Preconfigured Notebook
- Sampling Rate up to 33 S/s
- Excellent Accuracy
- 7 Additional Models to Choose from with External or Internal Sensor Heads

The PAX720IR3-T PAX Series Polarimeter is a terminating rotating wave-plate-based polarimeter module with an internal sensor for free-space and fiber-based measurements of the state of polarization (SOP). This module features a high dynamic range of 70 dB and accuracy of ±0.25° on the Poincaré sphere.

PAX5720IR3-T
TXP Polarimeter Module with Internal Sensor

See pages 1180 - 1181

Optical Spectrum Analyzers (Page 1 of 4)



OSA201
Complete with Laptop Computer

Features

- Dual Function Broadband Spectrometer and Wavelength Meter
- Wavelength Ranges Available
  - OSA201: 350 - 1100 nm
  - OSA203: 1000 - 2500 nm*
- Resolution
  - Optical Spectrum Analyzer: 10 pm @ 633 nm
  - Wavelength Meter Mode: 0.1 ppm
- Update Rate as Fast as 2 Hz
- Includes Laptop with Pre-Installed Software

*Extended Wavelength ranges available, contact Thorlabs for details.

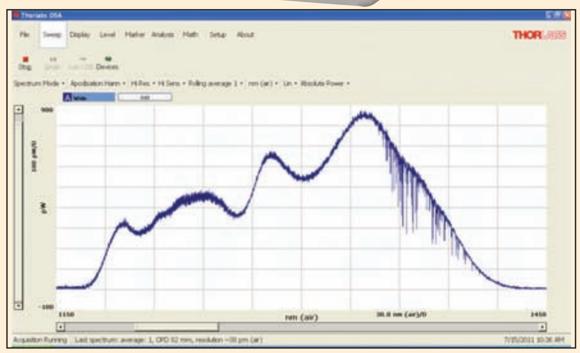


Figure 1a: Thorlabs' LS2000B broadband optical source, approximately 270 nm edge to edge, with approximately 5 µW of power delivered to the input of the FT-OSA. The fine structure visible across the spectrum is due to Fabry Perot modes of the semiconductor element, and the structure on the right are the expected water absorption lines that occur in the 1350 to 1400 nm range.

Introduction

Thorlabs' Optical Spectrum Analyzers (OSA201 and OSA203) are general-purpose instruments that measure optical power as a function of wavelength. These OSA instruments are versatile enough to analyze broadband optical signals as shown in Figures 1a and 1b, the Fabry Perot modes of a gain chip as shown in Figure 2, or a long-coherent-length, single mode external cavity laser as shown in Figure 4c.

SPECIFICATIONS	NOTES	OSA201	OSA203
Wavelength Range(1)	Detector Limited	350 - 1100 nm	1000 - 2500 nm
Spectral Resolution(2)	Broadband FT-OSA Mode	10 pm (0.25 cm^{-1}, 7.5 GHz)	60 pm (0.25 cm^{-1}, 7.5 GHz
Wavelength Meter Resolution(3) (6)	Wavelength Meter Mode Linewidth < 4 GHz	0.1pm	0.2 pm
Display Resolution(4)	Wavelength Meter Display Window	System Controlled with User Override, max 0.01 ppm	System with User Override, max 0.01 ppm
Spectral Accuracy(6)	Broadband FT-OSA Mode	±2 pm	±4 pm
Wavelength Meter Accuracy(6)	Wavelength Meter Mode	±1 pm	±2 pm
Spectral Precision(5) (6)	Broadband FT-OSA Mode	±1 pm	±1 pm
Wavelength Meter Precision(5) (6)	Wavelength Meter Mode	0.1 pm	0.2 pm
Measurement Rate	2 Hz		
Signal-to-Noise Ratio	>40 dB		
Level Sensitivity	-70 dB		
Input Power (Max)	10 dBm		
Dimensions	320 mm x 149 mm x 475 mm (12.6" x 5.9" x 18.7")		

1. Other detector options are available, please contact us for details.
2. Spectral Resolution is defined according to the Rayleigh Criterion as the wavelength separation required resolve two spectral lines.
3. Wavelength Meter Resolution is defined here as the smallest change the system can measure for an input with a FWHM linewidth of less than 4 GHz.
4. The Display Resolution is the number of digits shown on the Wavelength Meter Mode window, see Figure 4C.
5. Precision (Repeatability) is defined as the degree to which repeated measurements under unchanged conditions show the same results. The Spectral Precision was determined using an Acetylene cell absorption lines as shown in Figure 4D. Wavelength Meter Precision was determined using a 543 nm HeNe laser as well as an external cavity laser operating at 1550 nm.
6. Measurements for the OSA201 are made at 633 nm, and for the OSA203 are made at 1550 nm.

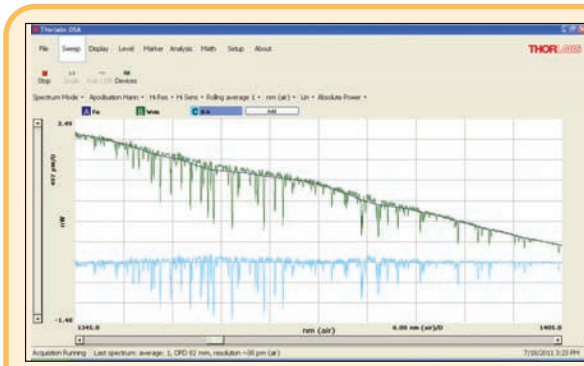


Figure 1b: Using the analysis features of the Optical Spectrum Analyzer, the absorption lines can be viewed by subtracting off the overall envelope of the source. As shown on page 1603 in Figure 4D, the absorption lines can be individually labeled and identified. Another function will automatically label any valley (or peak) that crosses a user-defined threshold.

Commonly available Optical Spectrum Analyzers are typically grating-based monochromators. While these devices offer broad wavelength coverage and good dynamic range, their resolution is usually limited to approximately 0.1 - 0.05 nm. The Thorlabs OSA is a Fourier Transform Optical Spectrum Analyzer (FT-OSA), which utilizes a scanning Michelson Interferometer in a push/pull configuration as shown in Figure 3. This approach allows for the design of a full-featured OSA with the additional benefit of a high precision Wavelength Meter (details are provided on page 1602).

Optical Spectrum Analyzers (Page 2 of 4)

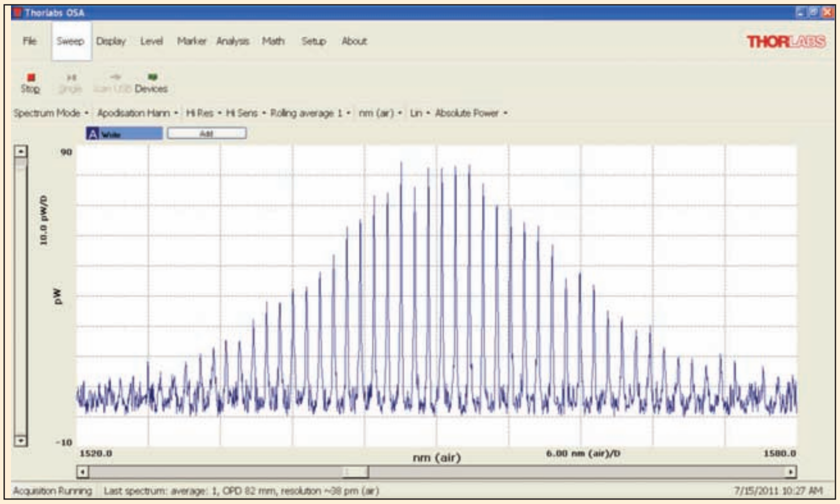


Figure 2: A 1550 nm laser diode operating below threshold, the overall gain curve of the device is evident, as well as the individual Fabry Perot modes of the semiconductor chip.

The Thorlabs FT-OSA has an FC-style optical fiber input (both single mode or multimode fibers up to Ø50 µm can be used), and after collimating the input, a beamsplitter divides the optical signal into two separate paths. The path length difference between the two paths is varied from zero to ± 40 mm. The collimated light fields then optically interfere as they recombine at the beamsplitter. The Detector Assembly shown in Figure 3 records the interference pattern, commonly referred to as an interferogram. This interferogram is the autocorrelation waveform of the input optical spectrum. By applying a Fourier Transform to the waveform, the optical spectrum is recovered.

The resulting spectrum offers both high resolution and very broad wavelength coverage with a spectral resolution that is related to the optical delay range. The wavelength range is limited by the bandwidth of the detectors and optical coatings. Furthermore, the accuracy of our system is ensured by including a frequency-stabilized HeNe reference laser, which acts to provide highly accurate measurements of beam path length changes, allowing the system to continuously self-calibrate. This process ensures accurate optical analysis well beyond what's possible with a grating-based OSA. More on these points will be presented below.

Interferometer Design

As mentioned, the instrument uses an arrangement with two retro-reflectors as shown in Figure 3. These retro-reflectors are mounted on a voice-coil-driven platform, which dynamically changes the optical path length of the two arms of the interferometer simultaneously and in opposite directions. The advantage of this layout is that it changes the optical path difference (OPD) of the interferometer by four times the mechanical movement of the platform. The longer the change in OPD, the finer the spectral detail that the FT-OSA can resolve. The OSA201 has a Spectral Resolution of 10 pm at 633 nm, while the OSA203 has a spectral resolution of 60 pm at 1550 nm. In this context, the Spectral Resolution is defined according to the Rayleigh Criterion (please see the manual for these systems available online at www.thorlabs.com; search on OSA201) and is the minimum separation required between two spectral features in order to resolve them as two separate lines. These spectral resolution numbers should not be confused with the resolution when operating in the Wavelength Meter Mode, which is considerably better.

The Thorlabs FT-OSA utilizes a built-in, actively stabilized HeNe Reference Laser to interferometrically record the variation of the optical path length. This Reference Laser is inserted into the interferometer and closely follows the same path traversed by the Unknown Input light field. The interferometer utilizes a dispersion compensation plate to nullify the wavelength-dependent optical path length differences for the two arms of the interferometer, which is mainly attributed to the beamsplitter.

Interferogram Data Acquisition

The interference pattern of the Reference Laser is used to clock a 16-bit ADC such that samples are taken at a fixed, equidistant optical path length interval. The HeNe reference fringe period is digitized and its frequency multiplied by a phase locked loop (PLL), leading to an extremely fine sampling resolution. Multiple PLL filters enable frequency multiplication settings of 16, 32, 64, or 128. At the128 multiplier setting, the data points are acquired approximately every 5 nm. The multiple PLL filters enable the user to choose system parameters optimized for measurements that range from high speed, reduced sensitivity, reduced resolution to lower speed, high sensitivity, high resolution.

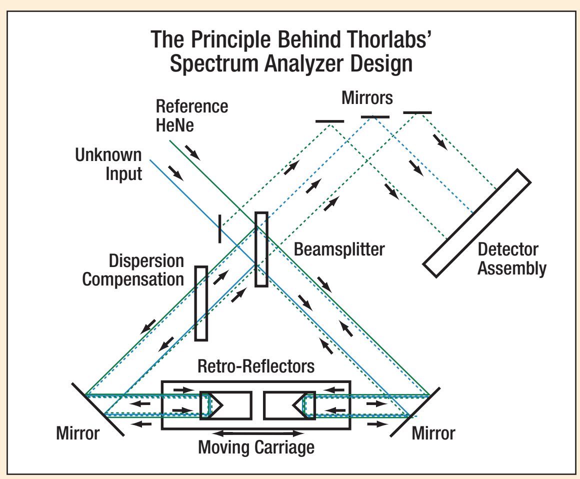


Figure 3: The optical schematic of the Thorlabs FT-OSA detailing the dual retro-reflector design. Note both retro-reflectors are attached to a common carriage that is moved via a voice coil motor. This configuration provides an optical delay that is four times the displacement of the carriage.

Optical Spectrum Analyzers (Page 3 of 4)

Interferogram Date Aquisition Continued…
A high-speed USB link transfers the interferogram for the device under test at 6 MBytes/s with a ping pong transfer scheme, enabling the streaming of very large data sets. Once the data is captured, the OSA software, which is highly optimized to take full advantage of modern multi-core processors, performs a number of calculations to analyze and condition the input waveform in order to obtain the highest possible resolution and signal-to-noise ratio (SNR) at the output of the Fast Fourier Transform (FFT).

A very low noise and low distortion detector amplifier with automatic gain control provides a large dynamic range, allows optimal use of the ADC, and ensures excellent SNR for up to 10 mW of input power. For low-power signals, the system can typically detect less than 100 pW from narrowband sources. The balanced detection architecture enhances the SNR of the system by enabling the Thorlabs FT-OSA to use all of the light that enters the interferometer, while also rejecting common mode noise.

Interferogram Data Processing
The interferograms generated by the instrument vary from 0.5 million to 16 million data points depending on the resolution and sensitivity mode settings employed. The FT-OSA software analyzes the input data and intelligently selects the optimal FFT algorithm from our internal library.

Additional software performance is realized by utilizing an asynchronous, multi-threaded approach to collecting and handling interferogram data through the multitude of processing stages required to yield spectrum information. The software's multi-threaded architecture manages several operational tasks in parallel by actively adapting to the PC's capabilities, thus ensuring maximum processor bandwidth utilization. Each of our FT-OSA instruments ships complete with a laptop computer that has been carefully selected to ensure both the data processing and user interface operate optimally.

Wavelength Meter Mode
When narrowband optical signals are analyzed, the FT-OSA automatically calculates the center wavelength of the input, which can be displayed in a window just below the main display that presents the overall spectrum. The central wavelength λ is calculated by counting interference fringes (periods in the interferogram) from both the Input and Reference Lasers according to the following formula:

$$\lambda = \frac{m_o}{m} \cdot \frac{n_\lambda}{n_o} \cdot \lambda_o$$

Here, m_o is the number of fringes for the HeNe Reference Laser, m is the number of fringes from the Unknown Input, n_o is the index of refraction of air at the Reference Laser wavelength, n_λ is the index of refraction for air at the wavelength λ, and λ_o is the vacuum wavelength of the HeNe Reference Laser.

The resolution of the FT-OSA operating as a Wavelength Meter is substantially higher than the system when it operates as a broadband spectrometer because the system can resolve a fraction of a fringe up to the limit set by the phase locked loop multiplier (see the section on Interferogram Data Acquisition). In practice, the resolution of the system is limited by the bandwidth and structure of the Unknown Input, noise in the detectors, drift in the Reference Laser, interferometer alignment, and other systematic errors. The system has been found to offer reliable results as low as ±0.1 pm in the visible spectrum and ±0.2 pm in the NIR/IR (see the Specification Table for details).

The software evaluates the spectrum of the Unknown Input in order to determine an appropriate display resolution. If the data is unreliable, as would be the case for a multiple peak spectrum, the software disables the Wavelength Meter Mode so as to not provide misleading results.

Wavelength Calibration and Accuracy
These FT-OSA Instruments incorporate a stabilized HeNe Reference Laser with a vacuum wavelength of 632.9913 nm. The use of a stabilized HeNe ensures long-term wavelength accuracy as the dynamics of the stabilized HeNe are well known and controlled.

The instrument is factory aligned so that the Reference and Unknown Input beams experience the same optical path length change as the interferometer is scanned. The effect of any residual alignment error on wavelength measurements is less than 0.5 ppm; the input beam pointing accuracy is ensured by a high-precision ceramic receptacle and a robust interferometer cavity design. No optical fibers are used within the scanning interferometer. The wavelength of the Reference Laser in air is actively calculated for each measurement using the Eldén formula with temperature and pressure data collected by sensors internal to the instrument.

For customers operating in the visible spectrum, the influence of relative humidity (RH) on the refractive index of air can affect the accuracy of the measurements. To compensate for this the software allows the RH to be set manually. The effect of the humidity is negligible in the infrared.

Dynamic Range
The Dynamic Range of an OSA can be defined as the noise floor, which is 500 GHz from the peak when measuring a narrowband laser source. Table 2 provides some example values for the Dynamic Range of the OSA203.

FROM PEAK	DYNAMIC RANGE
0.2 nm (25 GHz)	28 dB
0.4 nm (50 GHz)	30 dB
0.8 nm (100 GHz)	30 dB
4 nm (500 GHz)	40 dB
8 nm (1000 GHz)	45 dB

Table 2: Dynamic Range Measurement for an OSA203 at 1550 nm with the following settings: High Resolution, Low Sensitivity, Average 4, Apodization Hann.

Absolute Power and Power Density
The vertical axis of the spectrum can be displayed as Absolute Power or Absolute Power Density, both of which can be represented in either linear or logarithmic scale. In Absolute Power mode, the total power displayed is based on the actual instrument resolution for that specific wavelength; we recommend this setting only be used with narrow spectrum input light. For broadband devices, we recommend use of the Power Density mode. Here the vertical axis is displayed in units of power per unit wavelength where the unit wavelength is based upon a fixed wavelength band and is independent of the resolution setting of the instrument.

Optical Spectrum Analyzers (Page 4 of 4)

Operation

A GUI allows easy operation from a PC connected via USB port to the FT-OSA. The PC records the interferometric signal from the FT-OSA, which is then fast Fourier transformed (FFT) to yield the resulting spectra.

Monochromatic light may be viewed with sub-picometer resolution by utilizing the Wavelength Meter Mode of the FT-OSA. Broadband emission can also be viewed through the OSA's software, which has built-in zoom and peak analysis features. A peak discriminator can select bands that exceed a user-defined intensity and display them according to their wavelength (nm), wavenumber (cm^{-1}), or frequency (GHz). The instrument has a spectral resolution of 10 pm at 633 nm and 60 pm at 1550 nm and a wavelength accuracy better than 1 pm. In the Wavelength Meter Modes the resolution is 0.1 pm.

Software

The FT-OSA is shipped with the software package pre-installed on the laptop computer that is included with the purchase of this instrument.

The software has a customizable graphical user interface for acquiring, inspecting, manipulating, and analyzing spectra and interferograms. The software makes it easy to locate and track spectral peaks or valleys, measure the optical input power over any wavelength range, calculate an absorption spectrum in real-time, or track a large number of parameters over time.

A device interface library, containing a multitude of routines for data acquisition, instrument control, and spectral processing and manipulation, is also provided with the instrument. The library can be used to develop customized software for your own application using LabVIEW, C, C++, C#, Java, or another programming language. Each OSA ships with a set of LabVIEW routines to assist with writing your own applications.

The screen shots below were taken using the included software. Each trace utilized a 1550 nm laser diode and demonstrates some of the various measurements that are possible with the optical spectrum analyzer.

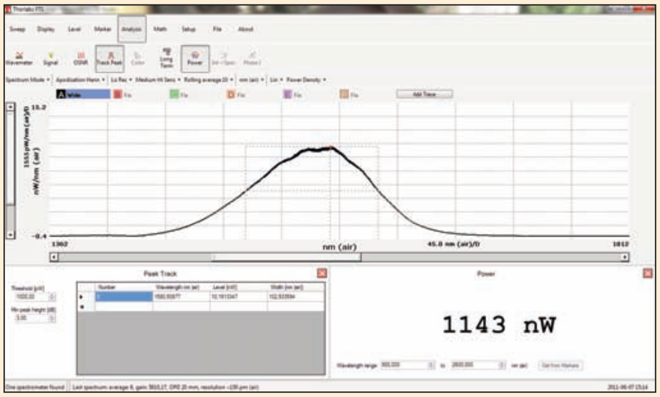


Figure 4a: The peak and total optical power of a 1550 nm gain chip operating well below threshold.

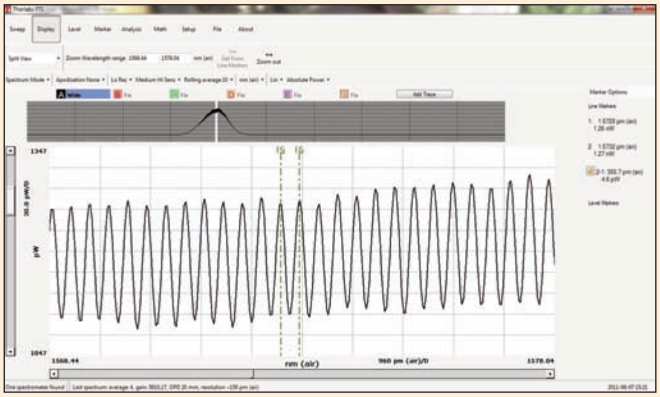


Figure 4b: The ASE spectrum of the same 1550 nm gain chip as in Figure 4a. The ripple is caused by Fabry Perot modes in the chip.

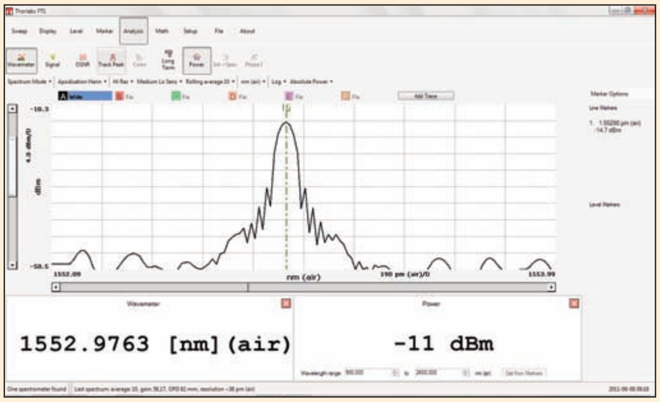


Figure 4c: 1550 nm gain chip in an external cavity laser. The software is set up to display the spectrum and the optical power. The Wavelength Meter Mode window is also activated.

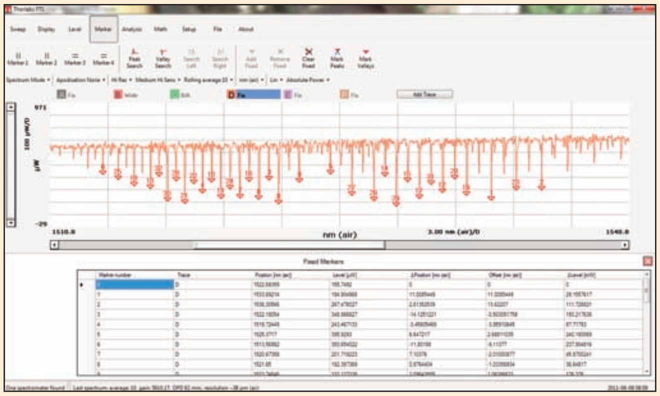


Figure 4d: A trace of the Acetylene absorption spectrum. The 1550 nm gain chip was used in ASE mode as the source, with the valley search function activated.

ITEM #	$	£	€	RMB	DESCRIPTION
OSA201	$ 23,000.00	£ 16,560.00	€ 20.010,00	¥ 183,310.00	Optical Spectrum Analyzer, 350 - 1100 nm
OSA203	$ 23,500.00	£ 16,920.00	€ 20.445,00	¥ 187,295.00	Optical Spectrum Analyzer, 1000 - 2500 nm