CHAPTER 9

FIBER-OPTICS

Fibers 9.2

Patchcables 9.4

Specialized Fibers 9.5

Passive Components 9.9

Active Components 9.14

Fiber Optic Tools 9.16

Fusion Splicer 9.18

Test and Measurement 9.19

Fiber Alignment Stages 9.21

Photonics Crystal Fibers 9.25

CHAPTER 9 FIBER OPTICS

SINGLE MODE FIBER

SM600

780HP

H1980-100

Single Mode Fiber: 400 to 600 nm

Item #	Operating Wavelength	Mode Field Diameter	Cladding	Coating	Cutoff Wavelength
S405-HP	400-525 nm	2.9 (norminal) @ 405 nm	125 ± 1.0 µm	245 ± 15 µm	370 ± 20 nm
SM450[a]	488/514 nm	3.3/3.4 µm[b]	125 ± 1 µm	245 ± 5%	400 ± 50 nm
460HP	460-600 nm	3.5 ± 0.5 µm @ 515 nm	125 ± 1.5 µm	245 ± 15 µm	430 ± 20 nm
S460-HP	450-600 nm	3.4 ± 0.5 µm @ 460 nm	125 ± 1.0 µm	245 ± 15 µm	425 ± 25 nm

a) Operating wavelength is typically 200 nm above the cutoff wavelength.
b) MFD is a nominal, calculated value, estimated at the operating wavelength(s) using a typical value of NA & cutoff wavelength.

Item #	Short Term Bend Radius	Long Term Bend Radius	Attenuation (Max)	NA	Manufacturer
S405-HP	≥6 mm	≥13 mm	≤30 dB/km @ 460 nm	0.12	Nufern
SM450	≥5 mm	≥25 mm	<50 dB/km @ 488 nm[c]	0.10 - 0.14	Fibercore
460HP	≥6 mm	≥13 mm	<30 dB/km @ 630 nm	0.13	Nufern
S460-HP	≥6 mm	≥13 mm	≤30 dB/km @ 460 nm	0.12	Nufern

Single Mode Fiber: 600 to 860 nm

Item #	Operating Wavelength	Mode Field Diameter	Cladding	Coating	Cut-Off Wavelength[c]
SM600	633 - 680 nm[a]	4.3 - 4.6 µm[b]	125 ± 1 µm	245 ± 5%	550 ± 50 nm
S630-HP	630 - 860 nm	4.2 ± 0.5 µm @ 630 nm	125 ± 1.0 µm	245 ± 15 µm	590 ± 30 nm
630HP	600 - 770 nm	4.0 ± 0.5 µm @ 630 nm	125 ± 1.5 µm	245 ± 15 µm	570 ± 30 nm

a) Operating wavelength is typically 200 nm above the cutoff wavelength.
b) MFD is a nominal, calculated value, estimated at the operating wavelength(s) using a typical value of NA & cutoff wavelength.
c) The wavelength at which the fiber only allows a single mode to propogate.

Item #	Short Term Bend Radius	Long Term Bend Radius	Max Attenuation	NA	Manufacturer
SM600	≥5 mm	≥25 mm	<15 dB/km[d]	0.10 - 0.14	Fibercore
S630-HP	≥6 mm	≥13 mm	≤10 dB/km @ 630 nm	0.12	Nufern
630HP	≥6 mm	≥13 mm	<12 dB/km @ 630 nm	0.13	Nufern

d) Attenuation is worst-case value, quoted for the shortest wavelength.

Single Mode Fiber: 780 to 970 nm

Item #	Operating Wavelength	Mode Field Diameter	Cladding	Coating	Cut-off Wavelength
780HP	780 - 970 nm	5.0 ± 0.5 µm @ 850 nm	125 ± 1.5 µm	245 ± 15 µm	730 ± 30 nm
SM800-5.6-125	830 nm[a]	5.6 µm[b]	125 ± 1 µm	245 ± 5%	660 - 800 nm

a) Operating wavelength is typically 200nm above the cutoff wavelength.
b) MFD is a nominal, calculated value, estimated at the operating wavelength(s) using a typical value of NA & cutoff wavelength.

Item #	Short-term Bend Radius	Long-term Bend Radius	Attenuation (Max)	NA	Manufacturer
780HP	≥6 mm	≥13 mm	<4 dB/km @ 780 nm	0.13	Nufern
SM800-5.6-125	≥5 mm	≥25 mm	<5 dB/km[c]	0.10 - 0.14	Fibercore

c) Attenuation is a worse-case value, quoted for the shortest design wavelength.

Single Mode Fiber: 980 to 1600 nm

Item #	Operating Wavelength	Mode Field Diameter	Cladding	Coating	Cut-off Wavelength
SM980-5.8-125	980 1064 1550 nm[a]	5.8 µm 6.2 µm 10.4 µm[b]	125 ± 1 µm	245 ± 5%	870-970 nm
HI1060-J9 HI1060-J9-PVC	980 - 1060 nm	5.9 µm @ 980 nm 6.2 µm @ 1060 nm	125 ± 0.5 µm	245 ± 10 µm	920 ± 50 nm
HI980-J9	980 - 1550 nm	4.2 ± 0.3 µm @ 980 nm	125 ± 0.5 µm	245 ± 10 µm	930 ± 50 nm
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
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

a) Operating wavelength is typically 200 nm above the cutoff wavelength.
b) MFD is a nominal, calculated value, estimated at the operating wavelength(s) using a typical value of NA & cutoff wavelength.

Item #	Short-term Bend Radius	Long-term Bend Radius	Attenuation (Max)	NA	Manufacturer
SM980-5.8-125	≥5 mm	≥25 mm	<3 dB/km[c]	0.13 - 0.15	Fibercore
HI1060-J9 HI1060-J9-PVC	—	—	2.1 dB/km @ 980 nm 1.5 dB/km @ 1060 nm	0.14	Corning
HI980-J9	—	—	<2.5 dB/km @ 980 nm	0.20	Corning
1060XP	≥6 mm	≥13 mm	≤2.1 dB/km @ 980 nm ≤1.5 dB/km @ 1060 nm	0.14	Nufern
980HP	≥6 mm	≥13 mm	<3.5 dB/km @ 980 nm	0.20	Nufern

Single Mode Fiber: 980 to 1620 nm

Item #	Operating Wavelength	Mode Field Diameter	Cladding	Coating	Cut-off Wavelength
SMF-28-J9	1260 - 1600 nm	9.2 ± 0.4 µm @ 1310 nm 10.5 ± 0.5 µm @ 1550 nm	125 ± 1.0 µm	900 µm	<1260 nm
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
1550BHP	1460 - 1620 nm	9.5 ± 0.5 µm @ 1550 nm	125 ± 1.0 µm	245 ± 15 µm	1400 ± 50 nm

Item #	Short-term Bend Radius	Long-term Bend Radius	Attenuation (Max)	NA	Manufacturer
SMF-28-J9	-	-	0.33-0.35 dB/km @ 1310 nm 0.19-0.20 dB/km @ 1550 nm	0.14	Corning
1310BHP	≥6 mm	≥13 mm	≤0.5 dB/km @ 1310 nm & 1550 nm	0.13	Nufern
1550BHP	≥6 mm	≥13 mm	≤0.5 dB/km @ 1550 nm	0.13	Nufern

CHAPTER 9 FIBER OPTICS

FIBER PATCHCABLE & CONNECTOR

P1-405A-FC-2

- Connectorized on Both Ends with Hight Quality Ceramic FC connectors
- Low Back-Reflection (Return Loss) at Fiber-to-Fiber Junctions
- Typical Return Loss 50 dB (40 dB min)

ADAFC3

ADAFC1

FCB1

ADAFCSMA1

Item #	Cutoff Wavelength	Fiber	MFD	Cladding Diameter	NA	Length
P1-405A-FC-2	300 - 400 nm	S405-HP	3.2 ± 0.5 µm	125 ± 1.0 µm	0.12	2 m
P1-405A-FC-5	300 - 400 nm	S405-HP	3.2 ± 0.5 µm	125 ± 1.0 µm	0.12	5 m
P1-460A-FC-2	410 - 450 nm	460HP	3.3 µm	125 µm	0.1	2 m
P1-460A-FC-5	410 - 450 nm	460HP	3.3 µm	125 µm	0.1	5 m
P1-630A-FC-2	500 - 600 nm	SM600	4.3 µm	125 µm	0.12	2 m
P1-630A-FC-5	500 - 600 nm	SM600	4.3 µm	125 µm	0.12	5 m
P1-630A-FC-10	500 - 600 nm	SM600	4.3 µm	125 µm	0.12	10 m
P1-830A-FC-2	660 - 800 nm	SM800-5.6-125	5.6 µm	125 µm	0.12	2 m
P1-830A-FC-5	660 - 800 nm	SM800-5.6-125	5.6 µm	125 µm	0.12	5 m
P1-830A-FC-10	660 - 800 nm	SM800-5.6-125	5.6 µm	125 µm	0.12	10 m
P1-980A-FC-2	870 - 970 nm	SM980-5.8-125	5.8 µm	125 µm	0.14	2 m
P1-980A-FC-5	870 - 970 nm	SM980-5.8-125	5.8 µm	125 µm	0.14	5 m
P1-1550A-FC-2	1350 - 1450 nm	1550BHP	9.5 µm	125 µm	0.13	2 m
P1-1550A-FC-5	1350 - 1450 nm	1550BHP	9.5 µm	125 µm	0.13	5 m
P1-1550A-FC-10	1350 - 1450 nm	1550BHP	9.5 µm	125 µm	0.13	10 m

Item #	Cutoff Wavelength	Fiber	Cladding Diameter	Coating Diameter	NA	Length
P1-SMF28-FC-1	<1260 nm	SMF-28e+	125 ± 1.0 µm	250 ± 5 µm	0.13	1 m
P1-SMF28-FC-2	<1260 nm	SMF-28e+	125 ± 1.0 µm	250 ± 5 µm	0.13	2 m
P1-SMF28-FC-5	<1260 nm	SMF-28e+	125 ± 1.0 µm	250 ± 5 µm	0.13	5 m
P1-SMF28-FC-10	<1260 nm	SMF-28e+	125 ± 1.0 µm	250 ± 5 µm	0.13	10 m

PHOTOSENSITIVE SINGLE MODE FIBER

GF1

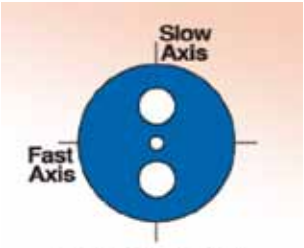
- Enhanced Photosensitivity
- Low Loss Photosensitive Fibers
- Ciadding Mods Suppressed Photosensitive Fibers
- Select Cut-Off Photosensitive Fibers

Thorlabs offers a range of photosensitive single mode fibers designed to provide high photosensitivity for UV radiation. These fibers offer low splice loss to transmission fiber and are suitable for a range of applications. Please see the table below for specifications regarding each product. We recommend T06S13 for use as a stripper tool when removing the buffer from these optical fibers in preparation for connectorization.

Item #	Description	Operating Wavelength	Mode Field Diameter	Cut-Off Wavelength
GF1	Standard	1500 - 1600 nm	10.5 ± 1.0 µm at 1550 nm 9.3 ± 0.5 µm at 1310 nm	1260 ± 75 nm
GF1AA	Standard	1500 - 1600 nm	10.5 ± 0.8 µm at 1550 nm	1350 ± 100 nm
GF3	Standard	1500 - 1600 nm	7.5 ± 0.5 µm at 1550 nm	1350 ± 50 nm
GF1B	Low Loss	1550 nm	10.4 ± 0.8 µm at 1550 nm	1260 ± 100 nm
GF4A	Cladding Mode Offset	1550 nm	4.4 ± 0.2 µm at 1550 nm	<1450 nm
PS1060	Select Cut-Off	1060 nm	6.2 ± 0.8 µm at 1060 nm	920 ± 50 nm
PS-PM980	Polarization Maintaining	980 nm	6.6 ± 1.0 µm at 1550 nm	900 ± 70 nm

SINGLE MODE POLARIZATION MAINTAINING FIBER

"Bow-Tie" Style PM Fiber



"PANDA" Style PM Fiber

- 350 nm to 1620 nm Operating Wavelenghts
- 80 µm & 125 µm Cladding Fibers
- "Bow-Tie" & "PANDA" Style Fibers

Item #	Wavelength Range	MFD*	NA	Cutoff	Attenuation	Beat Length
PM-S350-HP	350 - 460 nm	2.3 µm @ 350 nm	0.12	≤340 nm	N/A	1.5 mm @ 350 nm
PM-S405-HP	400 - 500 nm	3.2 µm @ 405 nm 3.5 ± 0.3 µm @ 460 nm	0.12	365 ± 25 nm	<30 dB/km @ 460 nm	2.0 mm @ 405 nm
PM460-HP	460 - 700 nm	3.3 ± 0.5 µm @ 515 nm	0.12	420 ± 30 nm	<100 dB/km @ 488 nm	1.3 mm @ 460 nm
PM-S630-HP	630 - 780 nm	4.2 ± 0.5 µm @ 630 nm	0.12	580 ± 40 nm	<12 dB/km @ 630 nm	4.7 mm @ 630 nm
PM630-HP	620 - 820 nm	4.5 ± 0.5 µm @ 630 nm	N/A	570 ± 50 nm	<12 dB/km @ 630 nm	1.8 mm @ 630 nm
PM780-HP	770 - 1100 nm	5.3 ± 1.0 µm @ 850 nm	N/A	710 ± 60 nm	<4 dB/km @ 850 nm	2.4 mm @ 850 nm
PM980-XP	970 - 1550 nm	6.6 ± 0.7 µm @ 980 nm	N/A	920 ± 50 nm	≤2.5 dB/km @ 980 nm	≤2.7 mm @ 980 nm
PM1300-HP	1280 - 1340 nm	9.5 ± 1.0 µm @ 1300 nm	N/A	1200 ± 70 nm	<1.0 dB/km @ 1300 nm	≤4.0 mm @ 1300 nm
PM14XX-HP	1400 - 1490 nm	9.8 ± 0.8 µm @ 1450 nm	N/A	1320 ± 60 nm	<1.0 dB/km @ 1450 nm	≤4.7 mm @ 1450 nm
PM1550-HP	1490 - 1620 nm	10.5 ± 0.8 µm @ 1550 nm	N/A	1370 ± 70 nm	<1.0 dB/km @ 1550 nm	≤5.0 mm @ 1550 nm

Item #	Design Wavelength*	MFD	Cutoff	Attenuation	Beat Length
FS-LS-4616	820 nm	5.3 ± 0.5 µm	<780 nm	<3-5 dB/km @ 820 nm	1.5-2.0 mm @ 633 nm

Item #	Design Wavelength(s)[a]	MFD[b]	NA	Cutoff	Attenuation	Beat Length[c]
HB450	488 and 514 nm	3.6 µm	0.10 - 0.13	350 - 470 nm	<100 dB/km	<2 mm
HB600	633 and 688 nm	3.2 µm	0.14 - 0.18	500 - 600 nm	<15 dB/km	<2 mm
HB750	780 nm	4.0 µm	0.14 - 0.18	610 - 750 nm	<8 dB/km	<2 mm
HB800G	830 nm	4.2 µm	0.14 - 0.18	680 - 780 nm	<5 dB/km	<1.5 mm
HB980T	980 nm	6.0 µm	0.13 - 0.15	870 - 970 nm	<3 dB/km	<2 mm
HB1250T	1310 nm	9.0 µm	0.11 - 0.13	1100 - 1290 nm	<2 dB/km	<2 mm
HB1480T	1480 nm	10.1 µm	0.11 - 0.13	1290 - 1450 nm	<2 dB/km	<2 mm
HB1500T	1550 nm	10.5 µm	0.11 - 0.13	1290 - 1540 nm	<2 dB/km	<2 mm

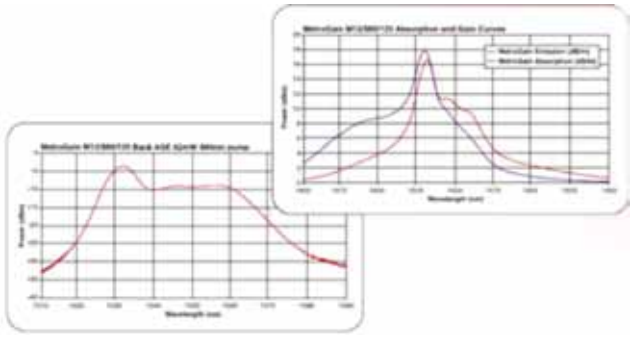
a The fiber will transmit the TEM00 mode at wavelengths up to approximately 200 nm longer than the cutoff wavelength.
b Mode Field Diameter (MFD) is a nominal, calculated value, estimated at the operating wavelength(s) using a typical value of numerical aperture and cut-off wavelength.
c The Beat Length is measured at 633 nm for all HB fiber types. To a first approximation, beat length scales directly with operating wavelength.

Item #	Design Wavelength(s)	MFD*	NA	Cutoff
HB450	488 and 514 nm	3.6 µm	0.10 - 0.13	350 - 470 nm
HB600	633 and 688 nm	3.2 µm	0.14 - 0.18	500 - 600 nm
HB750	780 nm	4.0 µm	0.14 - 0.18	610 - 750 nm
HB800G	830 nm	4.2 µm	0.14 - 0.18	680 - 780 nm
HB980T	980 nm	6.0 µm	0.13 - 0.15	870 - 970 nm
HB1250T	1310 nm	9.0 µm	0.11 - 0.13	1100 - 1290 nm
HB1480T	1480 nm	10.1 µm	0.11 - 0.13	1290 - 1450 nm
HB1500T	1550 nm	10.5 µm	0.11 - 0.13	1290 - 1540 nm

* Mode Field Diameter (MFD) is a nominal, calculated value, estimated at the operating wavelength(s) using a typical value of numerical aperture and cut-off wavelength.

RARE EARTH DOPED FIBERS

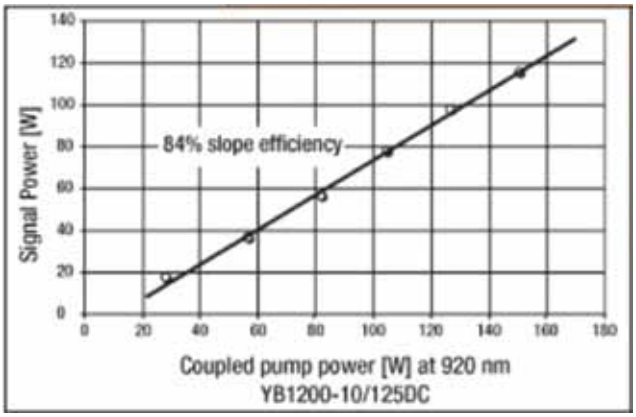
Highly Doped Erbium Fibers



- Minimize Required Fiber Lengths
- Reduced Nonlinear Effects
- Provides Strong Amplification, High Efficiency, Broad & Flat Gain Profile

Item #	Mode Field Diameter	Peak Core Absorption	Numerical Aperture	Cut-off Wavelength	Cladding Diameter	Coating Diameter
Er16-8/125	9.5 ± 0.8 μm[a]	16 ± 2 dB/m[c]	0.13 (Nom)	1100 - 1400 nm	125 ± 2 μm	245 ± 15 μm
Er30-4/125	6.5 ± 0.5 μm[a]	30 ± 3 dB/m[c]	0.2 (Nom)	800 - 980 nm	125 ± 2 μm	245 ± 15 μm
Er60-40/140DC	NA	4.6 ± 1.0 dB/m[c,e]	0.09 ± 0.01	NA	140 ± 5 μm	245 ± 15 μm
Er80-4/125	6.5 ± 0.5 μm[a]	80 ± 8 dB/m[c]	0.2 ± 0.02 (Nom)	800 - 980 nm	125 ± 2 μm	245 ± 15 μm
Er80-8/125	9.5 ± 0.8 μm[a]	80 ± 8 dB/m[c]	0.13 ± 0.02 (Nom)	1100 - 1400 nm	125 ± 2 μm	245 ± 15 μm
Er110-4/125	6.5 ± 0.5 μm[a]	110 ± 10 dB/m[c]	0.2 ± 0.02 (Nom)	800 - 980 nm	125 ± 2 μm	245 ± 15 μm
M5-980-125	3.5 μm[b,d] 5.9 μm[a]	4.5 - 5.5dB/m[b]	0.22 - 0.24	900 - 970 nm	125 ± 1 μm	245 μm (Nom)
M12-980-125	3.7 μm[b,d] 6.2 μm[a]	11 - 13 dB/m[b]	0.21 - 0.23	900 - 970 nm	125 ± 1 μm	245 μm (Nom)

Ytterbium Doped Optical Fiber



Item#	YB1200-4/125
MFD	4.4 ± 0.8 µm
Peak Core Abs @ 976 nm (Nominal)	1200 dB/m
Core Abs @ 920 nm	280 ± 50 dB/m
Core NA (Nominal)	0.2
Cladding NA	>0.46
Cutoff Wavelength	1010 ± 70 nm
Cladding Dia.	125 ± 2 µm
Cladding Geometry	Round
Coating Diameter	245 ± 15 µm
Coating Material	High Index Acrylate
Core Diameter	–
Core Concentricity Error	<0.7 µm
Proof Test	>100 kpsi

Item #	YB1200-6/125DC	YB1200-10/125DC	YB1200-25/250DC
MFD	6.0 ± 0.8 µm	–	–
Peak Cladding Abs @ 976 nm	2.6 dB/m Nom	6.5 dB/m Nom	10.8 dB/m Nom
Cladding Abs @ 920 nm	0.6 ± 0.2 dB/m	1.8 ± 0.4 dB/m	2.5 ± 0.7 dB/m
Core NA	0.15 ± 0.01	0.08 ± 0.01	0.07 ± 0.01
Cladding NA	>0.46	>0.46	>0.46
Cutoff Wavelength	n/a	n/a	n/a
Cladding Diameter*	125 ± 2 µm	125 ± 2 µm	250 ± 15 µm
Cladding Geometry	Octagonal	Octagonal	Octagonal
Coating Dia.	245 ± 15 µm	245 ± 15 µm	350 ± 15 µm
Coating Material	Low Index Acrylate	Low Index Acrylate	Low Index Acrylate
Core Diameter	5.5 ± 0.5 µm	10 ± 1 µm	25 ± 2.5 µm
Core Concentricity Error	<1.0 µm	<1.5 µm	<1.5 µm
Proof Test	>100 kpsi	>100 kpsi	>100 kpsi

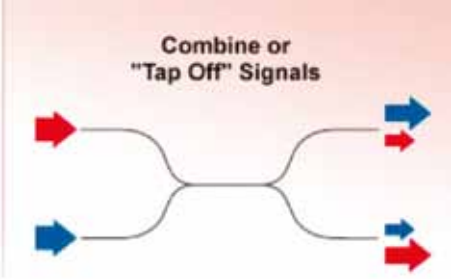
*) Flat to flat

Item#	YB1200-20/400DC	YB2000-7/125DC	YB2000-10/125DC
MFD	–	–	–
Peak Cladding Abs @ 976 nm	3.0 dB/m	–	–
Cladding Abs @ 920 nm	0.7 ± 0.2 dB/m	1.0 ± 0.2 dB/m	2.0 ± 0.4 dB/m
Core NA	0.07 ± 0.01	0.19 ± 0.02	0.12 ± 0.02
Cladding NA	>0.46	>0.46	>0.46
Cutoff Wavelength	n/a	n/a	n/a
Cladding Diameter*	400 ± 15 µm	125 ± 2 µm	125 ± 2 µm
Cladding Geometry	Octagonal	Octagonal	Octagonal
Coating Dia.	500 ± 15 µm	245 ± 15 µm	245 ± 15 µm
Coating Material	Low Index Acrylate	Low Index Acrylate	Low Index Acrylate
Core Diameter	20 ± 2 µm	7 ± 0.5 µm	10 ± 1.0 µm
Core Concentricity Error	<1.5 µm	<1.5 µm	<1.5 µm
Proof Test	>50 kpsi	>100 kpsi	>100 kpsi

*) Flat to flat

FIBER OPTIC COUPLERS

- Center Wavelengths from 632 nm to 1550 nm
- 50:90, 91:10, and 99:1 Coupling Ratios
- OCT Proven Couplers at 850 nm and 1310 nm



Item #	Center Wavelength	Δλ	Coupling Ratio	Insertion Loss (dB)	Excess Loss	PDL	Directivity	Termination
FC632-50B	632 nm	±15 nm	50:50	3.1-3.5 / 3.1-3.5	0.3 dB	<0.2 dB	>55 dB	Bare Fiber
FC632-50B-FC		±15 nm	50:50	3.1-3.5 / 3.1-3.5	0.3 dB	<0.2 dB	>55 dB	FC/PC
FC632-90B		±15 nm	90:10	9.5-10.5 / 0.7-0.4	0.3 dB	<0.2 dB	>55 dB	Bare Fiber
FC632-90B-FC		±15 nm	90:10	9.5-10.5 / 0.7-0.4	0.3 dB	<0.2 dB	>55 dB	FC/PC
FC632-99B		±15 nm	99:1	20-22 / 0.35-0.15	0.3 dB	<0.2 dB	>55 dB	Bare Fiber
FC632-99B-FC		±15 nm	99:1	20-22 / 0.35-0.15	0.3 dB	<0.2 dB	>55 dB	FC/PC
FC830-50B	830 nm	±15 nm	50:50	3.1-3.5 / 3.1-3.5	0.15 dB	<0.2 dB	>55 dB	Bare Fiber
FC830-50B-FC		±15 nm	50:50	3.1-3.5 / 3.1-3.5	0.15 dB	<0.2 dB	>55 dB	FC/PC
FC830-90B		±15 nm	90:10	9.5-10.5 / 0.7-0.4	0.15 dB	<0.2 dB	>55 dB	Bare Fiber
FC830-90B-FC		±15 nm	90:10	9.5-10.5 / 0.7-0.4	0.15 dB	<0.2 dB	>55 dB	FC/PC
FC830-99B		±15 nm	99:1	20-22 / 0.35-0.15	0.15 dB	<0.2 dB	>55 dB	Bare Fiber
FC830-99B-FC		±15 nm	99:1	20-22 / 0.35-0.15	0.15 dB	<0.2 dB	>55 dB	FC/PC
FC850-40-50-APC	850 nm	±40 nm	50:50	3.7 / 3.7	≤0.5 dB	<0.2 dB	>55 dB	FC/APC
FC850-40-10-APC		±40 nm	90:10	0.75 / 10	≤0.5 dB	<0.2 dB	>55 dB	FC/APC
FC850-40-01-APC		±40 nm	99:1	0.25 / 20	≤0.5 dB	<0.2 dB	>55 dB	FC/APC
FC980-50B	980 nm	±15 nm	50:50	3.1-3.5 / 3.1-3.5	0.12 dB	<0.15 dB	>55 dB	Bare Fiber
FC980-50B-FC		±15 nm	50:50	3.1-3.5 / 3.1-3.5	0.12 dB	<0.15 dB	>55 dB	FC/PC
FC980-90B		±15 nm	90:10	9.5-10.5 / 0.7-0.4	0.12 dB	<0.15 dB	>55 dB	Bare Fiber
FC980-90B-FC		±15 nm	90:10	9.5-10.5 / 0.7-0.4	0.12 dB	<0.15 dB	>55 dB	FC/PC
FC980-99B		±15 nm	99:1	20-22 / 0.35-0.15	0.12 dB	<0.15 dB	>55 dB	Bare Fiber
FC980-99B-FC		±15 nm	99:1	20-22 / 0.35-0.15	0.12 dB	<0.15 dB	>55 dB	FC/PC
FC1064-50B	1064 nm	±15 nm	50:50	3.1-3.5 / 3.1-3.5	0.12 dB	<0.2 dB	>55 dB	Bare Fiber
FC1064-50B-FC		±15 nm	50:50	3.1-3.5 / 3.1-3.5	0.12 dB	<0.2 dB	>55 dB	FC/PC
FC1064-90B		±15 nm	90:10	9.5-10.5 / 0.7-0.4	0.12 dB	<0.2 dB	>55 dB	Bare Fiber
FC1064-90B-FC		±15 nm	90:10	9.5-10.5 / 0.7-0.4	0.12 dB	<0.2 dB	>55 dB	FC/PC
FC1064-99B		±15 nm	99:1	20-22 / 0.35-0.15	0.12 dB	<0.2 dB	>55 dB	Bare Fiber
FC1064-99B-FC		±15 nm	99:1	20-22 / 0.35-0.15	0.12 dB	<0.2 dB	>55 dB	FC/PC
FC1310-70-01-APC	1310 nm	±70 nm	50:50	3.8 / 3.8	<0.5 dB	<0.15	>60 dB	FC/APC
FC1310-70-10-APC		±70 nm	90:10	0.8 / 12.7	<0.5 dB	<0.15	>60 dB	FC/APC
FC1310-70-50-APC		±70 nm	99:1	0.4 / 21.6	<0.5 dB	<0.15	>60 dB	FC/APC
10202A-50	1310 nm / 1550 nm	±40 nm	50:50	3.8 / 3.8	0.2 dB	<0.15 dB	>60 dB	Bare Fiber
10202A-50-FC		±40 nm	50:50	3.8 / 3.8	0.2 dB	<0.15 dB	>60 dB	FC/PC
10202A-50-APC		±40 nm	50:50	3.8 / 3.8	0.2 dB	<0.15 dB	>60 dB	FC/APC
10202A-90		±40 nm	90:10	12.7 / 0.8	0.2 dB	<0.15 dB	>60 dB	Bare Fiber
10202A-90-FC		±40 nm	90:10	12.7 / 0.8	0.2 dB	<0.15 dB	>60 dB	FC/PC
10202A-90-APC		±40 nm	90:10	12.7 / 0.8	0.2 dB	<0.15 dB	>60 dB	FC/APC
10202A-99		±40 nm	99:1	21.6 / 0.4	0.2 dB	<0.15 dB	>60 dB	Bare Fiber
10202A-99-FC		±40 nm	99:1	21.6 / 0.4	0.2 dB	<0.15 dB	>60 dB	FC/PC
10202A-99-APC		±40 nm	99:1	21.6 / 0.4	0.2 dB	<0.15 dB	>60 dB	FC/APC

CHAPTER 9 FIBER OPTICS

FIBER U-BENCH

FB-21x

FB-22x

Fiber U-benches allow access to the optical beam in a fiber-based application. They facilitate optical chopping and the insertion of plano/plano optical instruments such as polarizers, isolators, attenuators and filters while maintaining high return loss low insertion loss.

6.8mm Gap

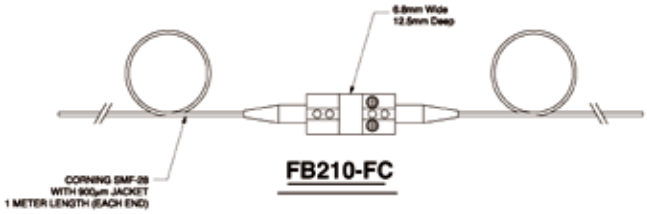
MODEL No.	DESCRIPTION
FB-210-FC	1310nm Fiber U-Bench, FC / PC Connectors
FB-211-FC	1550nm Fiber U-Bench, FC / PC Connectors

30mm Gap

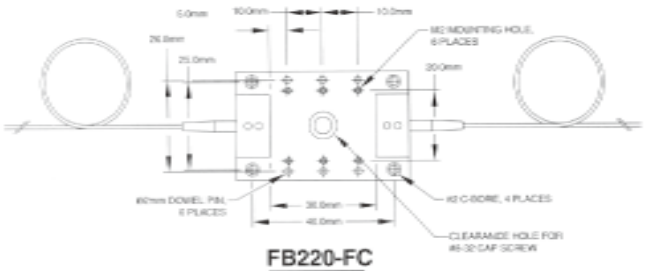
MODEL No.	DESCRIPTION
FB-220-FC	1310nm Fiber U-Bench, FC / PC Connectors
FB-221-FC	1550nm Fiber U-Bench, FC / PC Connectors

SPECIFICATIONS: 6.80mm Gap	
Return Loss	50dB
Insertion Loss, Typical/Max	0.2/0.5dB
Bandwidth	<40nm
Beam Diameter	0.5mm
Operating Temperature	-20 to 60oC

SPECIFICATIONS: 30.00mm Gap	
Return Loss	50dB
Insertion Loss, Typical/Max	0.5/1.0dB
Bandwidth	<40nm
Beam Diameter	0.50mm
Operating Temperature	-20 to 60oC



FB210-FC



FB220-FC

FB-22X u-bench accessories

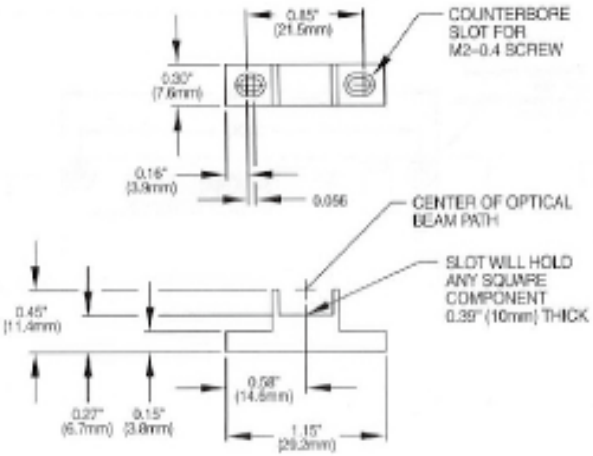
FBA1

FBA2

- Provides ± 0.03" (0.84mm) translation from center
- Compatible with FB220-series 30mm gap fiber u-benches
- FBA1 securely holds 10mm beam splitting cube or 10 mm square components(Includes GL5 glan laser polarizer)
- FBA2 securely holds 2mm filters
- Includes two M2-0.4 socket head screws

RT1

Rotator for fiber U-bench
(Sold without wavelplate)



ITEM#	DESCRIPTION
FBA1	GL5 Mount for U-Bench
FBA2	2mm Filter Mount for U-Bench
RT1	Individual Rotator for U-Bench

FIBER POLARIZATION CONTROLLER

These polarization controllers utilize stress-induced birefringence to create three independent fractional `wave plates' to alter the polarization of the transmitted light on single mode fiber. The fiber is looped into three independent spools, creating three independent fractional `wave plates' (fiber retarders). 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.

In general, the FPC030 may be configured to convert an arbitrary state of polarization by loading the three paddles with a prescribed number of fiber loops (to represent a nominal `quarter wave retarder', a `half wave retarder', and a `quarter wave retarder').

Adjusting each of the three paddles (fiber retarders) allows complete control of the output polarization state; the full poincare sphere may be circumscribed. This may be achieved over a broad range of wavelengths (500-1660nm).

FPC030

FPC-560 For bend sensitive fibers

FPC031

MODEL No.	FIBER	OPERATING RANGE	CONNECTORS	BEND LOSS
FPC030	None	N/A	N/A	N/A
FPC031*	D5	1310-1550nm	FC/PC	≤0.1dB
FPC032*	D5	1310-1550nm	FC/APC	≤0.1dB
FPC560	None	N/A	N/A	N/A
FPC561	SMF-28	1310-1550nm	FC/PC	≤0.1dB
FPC562	SMF-28	1310-1550nm	FC/APC	≤0.1dB

*: We use Lucent D5 fiber for 1310 & 1550 nm applications due to its low bend losses. It is compatible with SMF-28™ for most applications.

Fiber U-Bench Polarization Controller

- Extremely stable, insensitive to both temperature variations & mechanical disturbances
- 1/4-wave:1/2-wave:1/4-wave configuration for total polarization control
- Waveplates not included

The U-bench fiber polarization controller utilizes three miniature waveplates placed between two prealigned fiber collimators. Using this approach to polarization control with fiber optic systems is significantly more stable than the looped fiber (paddle) controllers.

ITEM No.	CONNECTOR	DESCRIPTION
FBR05	FC	Fiber U-Bench Polarization Controller

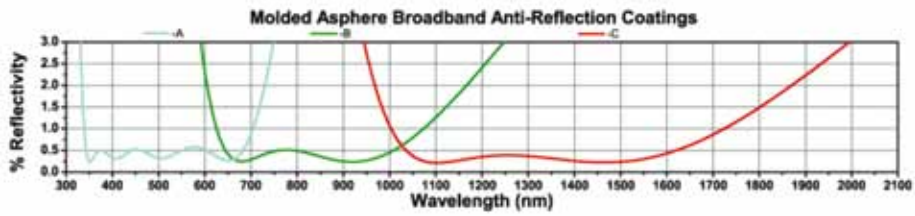
FIBER COLLIMATOIES

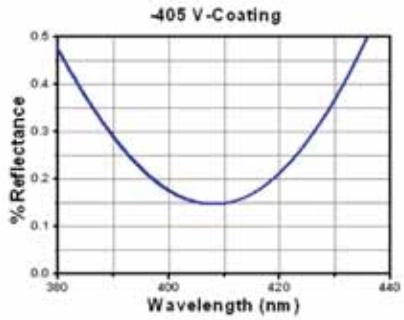
F230FC-1550
Shown with patch cable

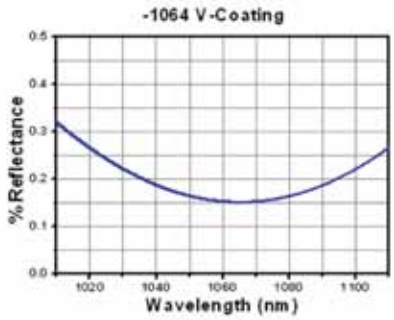
F240FC-A

- Mates with Popular SMA, FC, or APC Connectors
- Simplifies Collimation of Output of Single Mode Fiber
- Collimated Beam Diameters Range from 0.7-3.51 mm
- Models Aligned at 405 nm, 543 nm, 633 nm, 1064 nm, 1310 nm, & 1550 nm

Coating Informationv						
Coating Designation	A	B	C	405	1064	1550
Coating Range	400-600 nm	600-1050 nm	1050-1600 nm	395-415 nm	1050-1075 nm	1050-1600 nm (Same Coating Curve as -C)



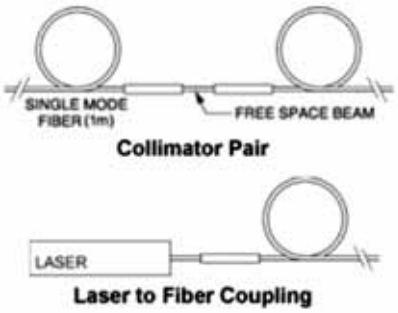




Item #	Alignment† Wavelength	AR Coating (nm)	Material	D* (mm)	Θ**	Lens NA	f (mm)	Suggested Adapter
F671FC-405	405 nm	395-415	ECO-550	0.7	0.041°	0.60	4.02	AD11F
F230FC-A	543 nm	400 - 600	S-NPH1	0.89	0.045°	0.55	4.50	AD11F
F240FC-A	543 nm	400 - 600	S-LAL13	1.58	0.025°	0.50	8.00	AD12F
F220FC-A	543 nm	400 - 600	D-K59	2.17	0.018°	0.25	11.00	AD11F
F260FC-A	543 nm	400 - 600	ECO-550	3.02	0.013°	0.16	15.29	AD11F
F280FC-A	543 nm	400 - 600	ECO-550	3.51	0.011°	0.15	18.40	AD11F
F230FC-B	633 nm	600 - 1050	S-NPH1	0.91	0.051°	0.55	4.50	AD11F
F240FC-B	633 nm	600 - 1050	S-LAL13	1.62	0.029°	0.50	8.00	AD12F
F220FC-B	633 nm	600 - 1050	D-K59	2.22	0.021°	0.25	11.00	AD11F
F260FC-B	633 nm	600 - 1050	ECO-550	3.08	0.015°	0.16	15.29	AD11F
F280FC-B	633 nm	600 - 1050	ECO-550	3.45	0.013°	0.15	18.40	AD11F
F220FC-1064	1064 nm	1050-1075	ECO-550	2.45	0.016°	0.25	11.00	AD11F
F230FC-C	1310 nm	1050 - 1600	S-NPH1	0.81	0.118°	0.55	4.50	AD11F
F240FC-C	1310 nm	1050 - 1600	S-LAL13	1.43	0.067°	0.50	8.00	AD12F
F220FC-C	1310 nm	1050 - 1600	D-K59	1.97	0.048°	0.25	11.00	AD11F
F260FC-C	1310 nm	1050 - 1600	ECO-550	2.74	0.035°	0.16	15.29	AD11F
F280FC-C	1310 nm	1050 - 1600	ECO-550	3.27	0.029°	0.15	18.40	AD11F
F230FC-1550	1550 nm	1050 - 1600	S-NPH1	0.85	0.134°	0.55	4.50	AD11F
F240FC-1550	1550 nm	1050 - 1600	S-LAL13	1.50	0.075°	0.50	8.00	AD12F
F220FC-1550	1550 nm	1050 - 1600	D-K59	2.07	0.055°	0.25	11.00	AD11F
F260FC-1550	1550 nm	1050 - 1600	ECO-550	2.87	0.039°	0.16	15.29	AD11F
F280FC-1550	1550 nm	1050 - 1600	ECO-550	3.55	0.032°	0.15	18.40	AD11F

For optimal collimation these packages should be used at the alignment wavelength. For some applications they may also be used within the AR coating range. Contact your local Tech Support for custom alignment packages.
*Collimated Beam Diameter: Measured 1/(e2) diameter @ 1 focal length from lens; fibers: 460HP (-A), SM600 (-B), SMF-28e (-C & -1550)
**Measured beam full angle of divergence; fibers: 460HP (-A), SM600 (-B), SMF-28e+ (-C & -1550), S405 (-405)

- Industry Standard SMF-28e Fiber
- AR Coated all Surfaces
- Input Coupler
  Output Collimator



Item #	50-1310	50-1310-FC	50-1310-APC	50-1550	50-1550-FC	50-1550-APC
Operating Wavelength	1280-1340 nm			1520-1580 nm		
Material	Oxide Glass					
Insertion Loss	<0.2 dB					
Return Loss	-	>45 dB	>65 dB	-	>65 dB	>65 dB
Clear Aperture	Ø1.8 mm					
Beam Diameter	0.5 mm FWHM					
Optimized Working Distance	20 mm					
Acceptance Angle	0.15°					
Beam Divergence	0.25°					
Max Optical Power	300 mW					
Tensile Load	5 N					
Fiber	2m SMF-28e	2m SMF-28e with FC/PC Connector	2m SMF-28e with FC/APC Connector	2m SMF-28e	2m SMF-28e w/ FC/PC Connector	2m SMF-28e w/ FC/APC Connector
Operating Temperature	-20 to 60 °C					
Storage Temperature	-40 to 85 °C					

INTUN™ SERIES TUNABLE LASERS

- Wavelength Ranges from 770 nm to 1650 nm
- Collimated Free Space Ouptut Beam
- Instantaneous Linewidth of 120 kHz (Typical)
- USB 2.0 Interface
- SM1 and 30 mm Cage System Compatible
- Suitable for Spectroscopy and Interferometry

Thorlabs' INTUN Series of Tunable Lasers are designed for demanding applications such as spectroscopy. With four models spanning the wavelength range from 770 - 1650 nm, this family covers the widest spectral range of any of our tunable products. These truly continuously tunable lasers are optimized for step and measurement applications, offer mode-hop-free operation, and have a convenient USB 2.0 interface.

Item #	TL780-B	TL980-B	TL1300-B	TL1550-B
Wavelength	780 nm	980 nm	1320 nm	1550 nm
Optical Power	>5 mW	>20 mW	>20 mW	>20 mW
Tuning Range	15 nm	25 nm	>110 nm	>150 nm
Tuning Speed Continuous	0 - 15 nm/s	0 - 15 nm/s	0 - 50 nm/s	0 - 50 nm/s
Wavelength Resolution	0.1 pm			
Wavelength Repeatability	1 pm			
Absolute Wavelength Accuracy	± 50 pm			
Wavelength Stability (1h/24hr)	± 2 pm / ± 10 pm			
Power Resolution	25 µW			
Spectral Linewidth	150 kHz Max*			
Effective Linewidth	1.5 MHz			
Coherence Control	1 GHz or 2 GHz			
Side Mode Suppression Ratio (SMSR)	45 dBc min			
Signal To Source Spontaneous Emission Ratio (SSE)	70 dB/nm**			
Signal To Source Spontaneous Emission Ratio (STSSER)	65 dB			
Relative Intensity Noise (RIN)	-140 (dB/Hz)			
Optical Output	Free-Spcace Collimated Beam			

* Measurement Time <1 ms. ** Appication Dependent

Electrical and Interface Specifications

Parameter	INTUN-B
DC Input	+48 V/20 W
Analog Modulation Input	2 Vp-p
Analog Wavelength Output	0 - 4 V
Electrical Connectors	
DC Input Voltage	Rear Panel Socket
Digital Status	0 - 5 V
Interlock	DB9
Communications	USB 2.0
Analog Inputs	BNC
General	
Operating Temperature Range	15 to 30 °C
Dimensions	242 mm x 87 mm x 142 mm

C&L BAND HIGH POWER WHITE LIGHT SOURCE

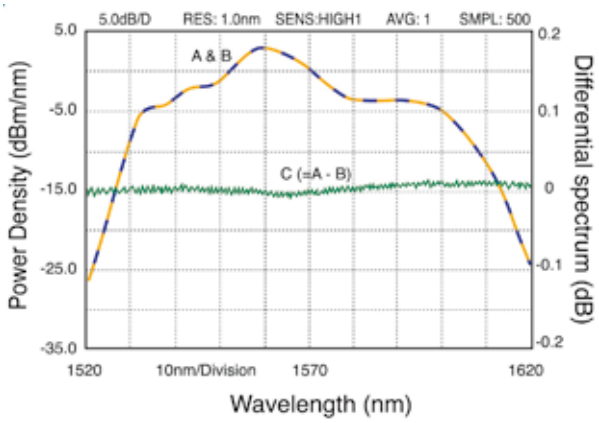
- Additional L-Band power
- High power (30mW)
- Low noise

The ASE 730 White Light Test Source delivers more than +15dBm of output power across the C & L Band wavelngths (1530nm to 1610nm). The source satisfies the demand for higher power, longer wavelngth test equipment for the growing L-Band market while also supporting the existing C-Band test instrumentation. The ASE730 is the lowest noise, high power C & L Band test source available today. Key features of all our ASE modules include low intensity noise, broadband output, and exceptional wavelength stability.

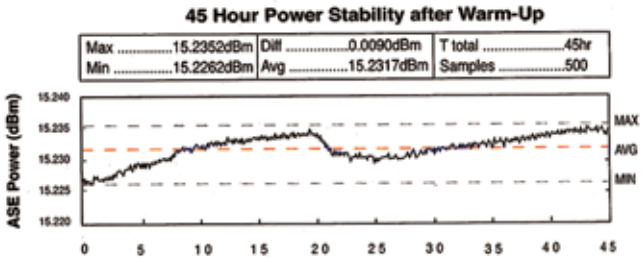
ASE730 OPTICAL SPECIFICATIONS	
Total Output Power	>+15dBm(30mW)
Spectral Power Density(typical)	>-18dBm/nm@1530nm >-11dBm/nm@1540-1600nm >-18dBm/nm@1610nm
Output Power Stability (typical)	±0.001dB(15min.after 1 hour warmup) ±0.005dB Maximum

GENERAL SPECIFICATIONS	
Output Fiber	SMF-28
Size(mm)	88(H)x230(W)x352(D)
Operation Temperature	0°C to 40°C
Storage Temperature	-10°C to 45°C

Output spectrum

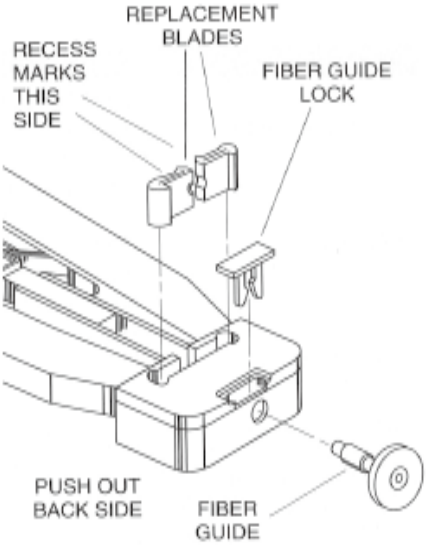


Differential spectrum showing power stability over a 15 minute time interval



Power stability plots,15 minute and 45 hour time intervals

FIBER OPTIC STRIPPER



MODEL No.	TYPICAL FIBER CLADDING/ COATING	CLADDING RANGE	COATING RANGE
T06S13	125 µm / 250 µm	125 - 135 µm	250 - 343 µm
T08S13	125 µm / 250 µm	125 - 175 µm	250 - 343 µm
T08S40	125 µm /900 µm	125 - 175 µm	889 - 1016 µm
T10S13	200 µm / 300 µm	180 - 230 µm	250 - 343 µm
T12S16	250 µm / 400 µm	235 - 280 µm	343 - 407 µm
T12S18	250 µm / 430 µm	235 - 280 µm	407 - 457 µm
T12S21	250 µm / 500µm	235 - 280 µm	457 - 533 µm
T12S25	250 µm / 580 µm	235 - 280 µm	533 - 635 µm
T16S31	360 µm / 650 µm	335 - 380 µm	635 - 787 µm
T18S31	400 µm / 730 µm	385 - 430 µm	635 - 787 µm
T21S31	460 µm / 730 µm	435 - 500 µm	635 - 787 µm
T23S46	500 µm / 1000 µm	505 - 550 µm	1016 - 1168 µm
T28S46	630 µm / 1040 µm	605 - 680 µm	1016 - 1168 µm
M34S52	770 µm / 1250 µm	755 - 830 µm	1168 - 1321 µm
M37S46	860 µm / 1080 µm	835 - 900 µm	1016 - 1168 µm
M37S63	860 µm / 1400 µm	835 - 900 µm	1397 - 1600 µm
M44S63	1035 µm / 1400 µm	905 - 1050 µm	1397 - 1600 µm
M44S67	1035 µm / 1600 µm	905 - 1050 µm	1600 - 1702 µm
M54S76	1250 µm / 1850 µm	1055 - 1350 µm	1778 - 1930 µm
M63S86	1550 µm / 2000 µm	1390 - 1600 µm	2057-2184 µm

- Automatic cleaving(one action)
- Low cleaving angle: 0.5o
- Long Life Time
- For both single and ribbon fibers
- High degree of hardness
- 80 angled cleaver is available

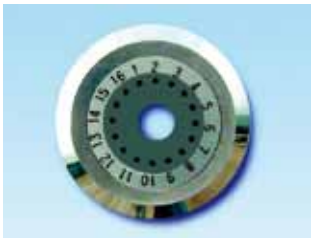
CI01

CI02

CI03

	CI01	CI02	CI03
Fiber Diameter	125 µm	125 µm	125 µm
Coating Diameter	0.25 - 0.9mm	0.25 - 0.9mm	0.25 - 0.9mm
Cleave Length	5 ~ 20mm(Single, Ribbon)	5 ~ 20mm(Single)** 10 ~ 25mm(Ribbon)	10 ~ 25mm(Single, Ribbon)
Blade Life Time	48000 cleaves	60000 cleaves	60000 cleaves
Cleaving Angle*	90+/-0.50(Single Fiber)	90+/-40(Single Fiber)	90+/-0.40(Single Fiber)
Dimension	58mmx55mmx48mm	84mmx65mmx54mm	58mmx66mmx48mm
Weight	360g	420g	400g
Distinction	Manual(six action)	Automatic(one action), wastebasket	Automatic(one action)

*8^0 angled cleaver is available.(custom-made for other angles)
**CI-02 Cleave length 9mm~50mm Custom-made available.

	BI-04 CI-01 Blade	Blade Life	36,000 Times (Minimum)
		Blade Position	3 Position heights 12 Cutting spot positions
	**BI-05** CI-02 or CI-03 Blade	Blade Life	48,000 Times (Minimum)
		Blade Position	3 Position heights 12 Cutting spot positions)

FUSION SPLICER

SPECIFICATIONS

Subject	Description
Alignment	Core to Core Alignment
Applicable fibers	SMF(ITU-T G.652), MMF(ITU-T G.651), DSF(ITU-T G.653), NZDSF(ITU-T G.655)
Fiber Diameter	cladding : 80μm ~ 150μm, coating : 100μm ~ 1000μm (Single)
Fiber cleave length	250μm (Coat) : 8 ~ 16mm, 250μm ~ 1000μm : 16mm
Typical splice loss	SMF : 0.02μm, MMF : 0.01μm, DSF : 0.04μm, NZDSF : 0.04μm
Return loss	>-60dB
SPLICE Time	SPLICE : Typical 9sec, Tube Heat : Typical 26sec with S-160(60mm) Tube
Program	SPLICE Mode : 40,Heat Mode : 13
Storage of splice result	the last 2,000 results
Operating altitude	0 ~5000m above sea level
Operating temperature	-10°C to 50°C, humidity : 95%, non-Condensing
Storage temperature	-40°C to 80°C
Wind protection	$15^{m}/_{s}$
SIZE, Weight	150W×190D×120H (include Monitor), 2.6kg (include Battery)
Terminal	USB 2.0, RCA, External Power
Power	DC 14.8V Battery (5600mAh), 100 ~ 240V AC Charger
Additional power	DC 12V automobile cigar jack avaliable
No, of splice/Heating with battery	typical 200cycle with S-1B, Typical 400cycle with S-SB
Electrode	more than 3,000 times splicing without exchange
Mechanical proof test	2N / 4.4N (OPTION)

STANDARD PACKAGE

Description	Model	Q'ty
Arc Fusion Splicer	S1	1
AC Charger	S-11	1
Sleeve Loader	S-12	1
Spare Electrodes	S-1E	1
Battery Pack	S-1B	1
Carrying Case		1
User Manual		1

OPTION

Description	Model
Battery Pack	S-SB (Super Battery)
Fiber Cleaver (Auto)	CI-01, CI-02,CI-03
Heating Stripper	Auto Stripper(ATS)
Fiber Solution	Multipack(MP-S)
Tube	S-160(60mm), S-140(40mm)
Alcohol dispenser	ad

HANDHELD INSPECTION MICROSCOPE WITH COAXIAL ILLUMINATOR

These handheld inspection microscopes with coaxial illumination send light down the optical path (axis) so that it comes out the tip of the objective and strikes the sample perpendicular to the fiber end face. This process produces excellent detail of scratches and contamination on the fiber ferrule, but requires backlight to examine core condition. Excellent for inspecting a connector ferrule for polish quality, cleave quality, and cleanliness. A universal connector is included with each microscope that accepts any 2.5mm diameter ferrule. Specific connector adapters sold separately.

Specifications		
Models	HIM200	HIM400
Magnification	200X	400X
Optical Connection	2.5mm universal adapter included; specific adapters available separately	
Features	Fine-Focus control	
Illumination	White LED, Rated Life: 100,000 hrs.	
Power Requirements	3 AAA alkaline batteries	
Dimensions	8.75" L x 1.25" Dia	
Weight	1.2 lbs. (0.5 kg)	

Model	Connector adapter
HIM01C	Univerdal adapter for APC type (8°) 2.5-mm ferrules with `slip grip' mechanism. Compatible with APC versions of ST, SC, FC, and SMA
HIM02C	Universal adaptor for 1.25mm ferrules with `slip grip' mechanism. Compatible with LC or MU.
HIM03C	ST Adaptor
HIM04C	SC Adaptor
HIM05C	FC/PC Adaptor

FIBER OPTIC MICRO-INTERFEROMETER

- Lightweight, Fully Portable, Rugged Design for Field Use
- 0.12 Micron Vertical Resolution, the Best in the Industry
- Connects to ST, FC and SC Fibers
- View and Measure the PC and APC Polish Radius of Curvature
- View and Measure Apex Offset and Fiber Undercut or Protrusion
- Inspect Surface Finish for Scratch es and Defects

Each connector within a fiber optic system should be checked for radius of curvature, fiber undercut and fiber protrusion to ensure a proper polish for the lowest possible dB and return loss (lowest back reflection). Our new Fiber Optic Micro-Interferometer can be used to view and measure the polish and surface finish on FC, ST and SC fibers. Just insert fiber cable into connector mount, align with adjustment screws and view the interference fringes through included 10-20X zoom DIN standard eyepiece or optional video adapter. If protruding fiber breaks off it can potentially damage other fiber optic components. Both of these conditions result in high back reflections and an increase in dB loss and signal noise. Excess loss can also occur if the center of the fiber does not coincide with the highest point on the ferrule; this is known as apex offset. Our Fiber Optic Micro-Interferometer comes complete with a carbide connector mount for FC, ST, or SC connectors that will never wear out or damage the ceramic ferrule. Interferometer also includes a 110-120V AC wall adapter, glass reference flats, hydrophobic solution, carrying case, manual and 9V DC battery adapter. It's low weight, low cost, and portability make it ideal for field or laboratory inspection.

Specifications	
Optical Connection	Single Port FC, ST, or SC (2.5mm)
System Magnification	200X to 400X
Eyepiece	10X to 20X Zoom, 23mm Barrel
Input Voltage Options	110 to 120V AC, wall transformer 9V DC battery adapter
Dimensions (W x H x D)	4.25" x 2" x 6"
Weight	2 lbs.

Model No.	Description
FOI01	Fiber Optic Micro-Interferometer
FOI01-A	C-mount Video Adaptor for CCD Cameras

XYZ FLEXURE STAGE

MDT630A
COMPLETE SYSTEM
INCLUDES DRIVE
ELECTRONICS.

SPECIFICATIONS

- **Total Travel Manual Drives:**4mm
- **Total Travel Piezo Drives:**40 gm
- **Piezo-Electric Driver:** 0-150V
- **Output Noise:** 1.5mV RMS
- **Output Stability:** <0.01% over 16 hours

XYZ FLEXURE STAGE & PIEZOELECTRIC CONTROLLER

- The MDT630A is offered as a complete three axis flexured stage that features 4mm of manual travel as well as piezo-electric actuators that provide 20 gm of high resolution displacement.
- Our parallel flexure design does not require any lubrication within the mechanism that provides the 3-axis movement, this pro vides a significant advantage over crossed roller bearings which require lubrication that traps particles causing the sensitivity to degrade.
- Flexure design offers virtually infinite resolution thus complementing the high sensitivity Piezoelectric Actuators.

DISPLACEMENT SENSOR

PIN 1:+15V
PIN 2:OSCILLATOR+
PIN 3:OV
PIN 4:SIG OUT-
PIN 5:SIG OUT+
PIN 6:-15
PIN 7:TRAVEL

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

All 3 actuators are directly attached to the fixed portion of thestage body.

SMC Piezo Connector

STAGE SPECIFICATIONS

Manual Travel: 4mm in each x-y-z direction.
PZT Travel: 20 gm in each x-y-z direction.
Manual Drive Resolution: Patented drive design provides 50nm resolution over a 300µm travel range
PZT Actuator Resolution: 20nm
Piezoelectric Drive Voltage: Maximum piezoelectric drive voltage is 75 VDC.
Cross-Talk: Maximum 20µm per millimeter of travel.
Repeatability: 500nm RMS Bi-Directional
Load Capacity: 1 kg (2.2 lb)
Resonant Frequency (±10%): 375Hz,with no load on the stage; 200Hz, with a 275g load; and 150Hz, with a 575g load.
Weight: 1kg (2.2lbs), Total package weight.
Deck Height: 62.5mm from the bottom surface of the moving platform. The accessory beam height is 75mm from the bottom surface of the stage.

XYZ PIEZOBLOCK TRANSLATOR

APB302/M

FEATURES:

- 90µm of piezoelectric motion in x-y-z directions with 75V drive electronics.
- Three mounting surfaces on moving world each with an array of 9 mount ing holes.
- Small & compact package measuring 55 mm on a side.
- Flexure-based design offers smooth continuous motion and high stiffness (0.3N/µm).
- Resonant frequency greater than 150 Hz provides immunity to external vibrations.
- Optional strain gauge displacement sensor offers a repeatability of better than 50 nm.

INTRODUCING: APB302/M PIEZOBLOCK 90MM X-Y-Z TRANSLATOR

The new PiezoBlock™ 3 axis translator (patent pending) provides a unique solution to 3 axis piezo driven nanopositioning. This compact translator measures just 55mm (2.2") on a side, and offers 90µm of piezoelectric controlled displacement in three orthogonal directions.

The relatively long piezoelectric controlled travel is accomplished using a large displacement piezo stack that is mechanically multiplied to provide a full 90µm of travel. This internal mechanism is flexurebased; it intrinsically possesses very low friction and high stiffness, allowing the PiezoBlock moving world to be positioned with low settling time and high repeatability.

25NM POSITIONING RESOLUTION

The drive voltage required for the full range of travel is 75V, while the displacement resolution is typically limited by the piezoelectric driver that is used to power the actuators. The PiezoBlock™ has been tested interferometrically to verify the 25nm resolution specification, the test was performed with Thorlabs Model BPC002 piezoelectric driver. Thorlabs offers a number of other drive options, from simple open loop drivers, to closed loop auto-alignment systems that allow automated control of a nano positioning application.

PIEZOBLOCK INNOVATION

Design innovation in the PiezoBlock has allowed a host of beneficial features. In addition to the large 1.33 µm/V transfer function of the system, the PiezoBlock™ offers a small physical footprint, a multitude of mounting surfaces and operating orientations, and a robust mechanism that provides a high load carrying capability. These features, along with the fact that the device is vacuum compatible, enable it to address a broad range of applications. A few examples include: semiconductor manufacturing, specialized microscopy studies, MEMs manufacturing and testing, as well as traditional optical component manufacturing. The versatility of the PiezoBlock also makes it an ideal R&D tool.

SPECIFICATIONS

Piezoelectric Travel: 90µm (xyz)
Load Capacity: 1kg centered on top surface in horizontal orientation.
Resonant Frequency: >150Hz
Repeatability: 50 nm Open Loop
Stiffness: 0.3N/µm
Thermal Stability: 1µm/°C
Electrical Connectors: 3 SMC
Weight: 0.3 kg nominal
Dimensions: 55 x 55 x 55 mm (2.2 x 2.2 x 2.2 in.)

APB302/M PiezoBlock™ & MDT693 Three Channel Driver(sold separately)

FIBER LAUNCH SYSTEM

MBT612/M SINGLE MODE FIBER LAUNCH W/QUICK RELEASE CLAMP

- Ideal for 125μm to 400μm bare fibers
- Variable pressure clamping arm
- 4mm travel adjustment range
- 50μm/rev(250μm Range)
- Suitable for any RMS threaded objective (sold seperatly)

The MBT612/M 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 gm. The addition of a cable strain relief helps to prevent inadvertent disruption of the system, a small feature that 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 greatly enhance the flexibility of this platform to perform multiple functions.

MBT610/M SINGLE MODE FIBER LAUNCH W/VARAIBLE V-GROOVE CLAMP

- Ideal for bare, lensed fiber or sleeved fibers
- Variable pressure clamping arm
- 4mm travel adjustment range
- 50μm/rev(250μm Range)
- Suitable for any RMS threaded objective (sold seperatly)

The MBT610/M 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 in the visible spectrum where the mode field diameter of the fibers are as small as 3 ggm. 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 inadvertant disruption of the system, a small feature that can be a great time saver. This preconfigured system is an ideal starter system, which can be quickly adapted to many uses. Additional accessories are available that greatly enhance the flexibility of this platform to perform multiple fuctions.

MBT613/M SINGLE MODE FIBER LAUNCH WITH FC CONNECTORIZED FIBER HOLDER

- For FC connectorized fiber SMF patch cords
- 4mm 3-axis travel adjustment range
- 50μm/rev(250μm Range)
- Suitable for any RMS threaded objective (sold seperatly)

The MBT613/M is configured three axis flexure stage. When considering a fiber launch system, the use of nested flexure plates in place of more traditional linear bearings provides a number of advantages. Firstly, the nearly perfect smooth continuous motion that is achievable with a flexure mechanism, and secondly, the elimination of all lubricants within the stage structure. With traditional bearings minor imperfections in the bearing or contaminates trapped in the lubricant create localized “rough spots” where the displacement resolution degrades significantly. The lack of lubricants also minimizes stage “creep”.

MBT614/M SINGLE MODE FIBER LAUNCH WITH GRIN LENS HOLDER

- Includes quick release fiber and GRIN lens holders
- Ideal for free space optical alignments
- 4mm travel adjustment range
- 50µm/rev(250µm Range)
- GRIN Lenses sold srparately

The MBT614/M fiber launch system is built around our 3-axis flexure stage, which has been specifically designed to meet the challenging requirements associated with alignment of single mode fibers. The system features our high resolution differential drives that are ideal for coupling of a free space laser into a single mode fiber, even at visible wavelengths where the mode field diameter of single mode fibers can be as small as 3µm. The GRIN lens holder accommodates lenses with diameters from 1mm to 3mm, and lengths as short as 2mm.

MBT611/M MULTI-MODE FIBER LAUNCH W/FAST RELEASE FIBER MOUNT

- Single groove multi-mode bare fiber holder
- 4mm 3-axis travel adjustment range with 1mm resolution
- Suitable for any RMS threaded objective (sold seperatly)

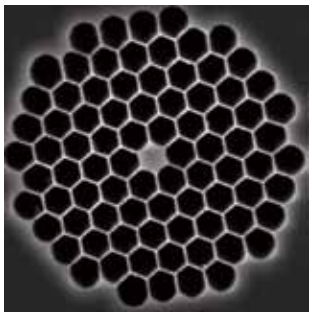
The MBT611 launch system features our high stabilty flexure stage outfitted with fine 0.5mm per revolution adjusters. Unlike conventional stages, our flexure based translation stages do not require the use of lubricants since there are no sliding parts, other than the adjusters. This yields a stage design that provides high stability, high repeatability, and no backlash and additionally, an athermalized stage design. This preconfigured package is an ideal starter system which can be quickly adapted to many other uses with any of our additional accessories.

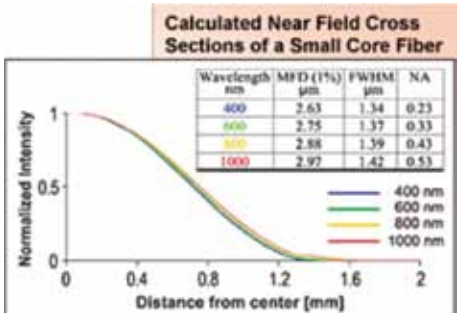
MBT621/M Polarization Maintaining Fiber Launch w/ Rotator

- Top loading fiber rotator with fast release clamp
- 360° rotation and 5° accuracy
- 4mm travel adjustment range
- 50µm/rev(250µm Range)
- Suitable for any RMS threaded objective (sold seperatly)

The MBT621 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 3µm. 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.

NONLINEAR PHOTONIC CRYSTAL FIBERS





- Zero Dispersion Wavelengths from 670-1040 nm
- PM Version with Zero Dispersion at 850 nm Wavelength
- core Diameter from 1.5-5.0 µm

Optical Properties							
Item #	λ_0	Dispersion Slope[a]	Attenuation	MFD[a,b]	NA[a,c]	Effective Nonlinear Area	Nonlinear Coefficienta
NL-1.5-670-02	670 ± 5 nm	1.4 ps/(nm^{2}km)	λ_0 < 90 dB/km 1550 nm < 25 dB/km 1380 nm < 300 dB/km 1000 nm < 60 dB/km 600 nm < 110 dB/km	1.1 ± 0.1 µm	0.5/0.55	1.23 µm^2	190 (W·km^{-1}
NL-1.7-700-02	700 ± 5 nm	1.0 ps/(nm^{2}km)	λ_0 < 50 dB/km 1550 nm < 20 dB/km 1380 nm < 300 dB/km 1000 nm < 40 dB/km 600 nm < 60 dB/km	1.2 ± 0.1 µm	0.45/0.52	1.51 µm^2	148 (W·km)$^{-1}$
NL-1.8-730-02	730 ± 5 nm	0.79 ps/(nm^{2}km)	λ_0 < 50 dB/km 1550 nm < 20 dB/km 1380 nm < 300 dB/km 1000 nm < 30 dB/km 600 nm < 50 dB/km	1.3 ± 0.1 µm	0.45/0.50	1.76 µm^2	122 (W·km)$^{-1}$
NL-2.0-745-02	745 ± 5 nm	0.85 ps/(nm^{2}km)	λ_0 < 30 dB/km 1550 nm < 20 dB/km 1380 nm < 200 dB/km 1000 nm < 20 dB/km 600 nm < 40 dB/km	1.4 ± 0.1 µm	0.42/0.47	2.03 µm^2	103.8 (W·km)$^{-1}$
NL-2.3-790-02	790 ± 5 nm	0.64 ps/(nm^{2}km)	λ_0 < 25 dB/km 1550 nm < 15 dB/km 1380 nm < 100 dB/km 1000 nm < 17 dB/km 600 nm < 40 dB/km	1.5 ± 0.1 µm	0.41/0.44	2.66 µm^2	75 (W·km)$^{-1}$
NL-2.4-800	800 ± 5 nm	0.55 ps/(nm^{2}km)	λ_0 < 80 dB/km 1550 nm < 50 dB/km 1380 nm < 420 dB/km 1000 nm < 60 dB/km 600 nm < 100 dB/km	1.5 ± 0.1 µm	0.19	2.8 µm^2	70 (W·km)$^{)-1}$
NL-2.8-850-02	850 ± 5 nm	0.48 ps/(nm^{2}km)	λ_0 < 10 dB/km 1550 nm < 6 dB/km 1380 nm < 40 dB/km 1000 nm < 10 dB/km 600 nm < 17 dB/km	2.0 ± 0.1 µm	0.38/0.39	3.97 µm^2	46.6 (W·km)$^{-1}$
NL-3.3-890-02	890 ± 5 nm	0.33 ps/(nm^{2}km)	λ_0 < 10 dB/km 1550 nm < 5 dB/km 1380 nm < 40 dB/km 1000 nm < 10 dB/km 600 nm < 20 dB/km	2.1 ± 0.1 µm	0.36/0.37	4.76 µm^2	37.52 (W·km)$^{-1}$
SC-5.0-1040	1040 ± 10 nm	-	λ_0 < 2 dB/km 1550 nm < 1.5 dB/km 600 nm < 15 dB/km	4.0 ± 0.2 µm	0.20±0.05	-	11 (W·km)$^{-1}$

Physical Properties						
Item #	Core Diameter	Pitch	Air Fill in Holey Region	Diameter of Holey Region	Diameter of Outer Silica Cladding	Fiber O.D.
NL-1.5-670-02	1.5 µm	1.9 µm	>90%	20 µm	106 µm	220 µm
NL-1.7-700-02	1.7 µm	1.8 µm	>85%	18.5 µm	116 µm	220 µm
NL-1.8-730-02	1.8 µm	2.0 µm	>88%	21 µm	127 µm	220 µm
NL-2.0-745-02	2.0 µm	2.0 µm	>90%	28 µm	127 µm	220 µm
NL-2.3-790-02	2.3 µm	1.6 µm	>94%	35 µm	147 µm	220 µm
NL-2.4-800	2.4 µm	2.9 µm	>90%	27 µm	105 µm	230 µm
NL-2.8-850-02	2.8 µm	2.7 µm	>88%	28 µm	136 µm	220 µm
NL-3.3-890-02	3.2 µm	3.1 µm	>88%	32 µm	154 µm	220 µm
SC-5.0-1040	4.8 µm	3.25 µm	-	-	125 µm	244 µm

a) Measured at λ0
b) Mode Field Diameter
c) Numerical Aperture