LASER 2000
HighWave Optical Technologies

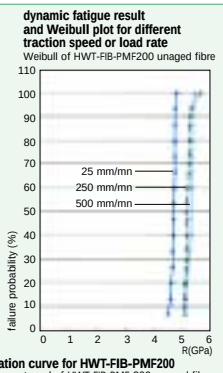
Highwave Optical Technologies, based in Lannion the heartland of French telecommunications, develops and manufactures new generation optical components for the DWDM telecom market. Manufacturing facilities include; fibre preform manufacture, fibre drawing and Bragg grating writing facilities in Lannion; EDFA mass production in Rennes, and DWDM mux/demux production in Paris, bringing the total production capacities to over 110,000 sq.ft.

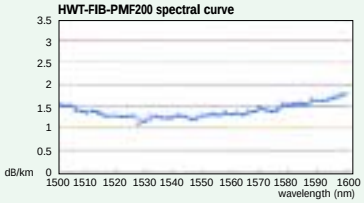
HIGHWAVE OPTICAL TECHNOLOGIES **Fibres**

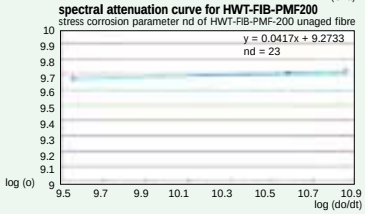
Polarisation Maintaining Fibre

- *HWT-FIB-PMF100 980 µm wavelength stabiliser*
- *HWT-FIB-PMF200 1480 µm wavelength stabiliser*
- *GR-20 and GR-1209 qualification report available*
- *Highly compatible with other manufacturers' PM fibre*

PM fibre designed specifically to laser pigtailing and bragg grating laser diode stabiliser application for the multiplexing of EDFA pump diodes.





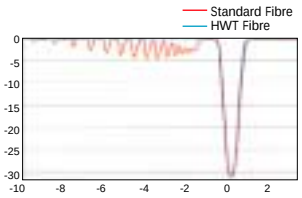


Parameters		HWT-FIB-PMF100	HWT-FIB-PMF200
Fibre cut-off wavelength λc	nm	<950 nm	<1420nm
Numerical aperture		0.13 ± 0.01	0.13 ± 0.01
Mode field diameter	µm	8 ± 1 @ 1310nm	10.5 ± 1 @ 1550nm
Attenuation	dB/km	<5 @ 980nm	<3 @ 1480nm
Outside cladding diameter	µm	125 ± 3	125 ± 3
Coating diameter	µm	245 ± 10	245 ± 10
Cladding non - cicularity		<3%	<3%
Cladding / coating concentricity error	µm	<15	<15
Proof test level	kPsi	150	150
Static fatigue corrosion parameter		n > 20	n > 20
Tensile strength	Gpa	>3.5	> 3.5
Coating stripping force (dual acrylate layer)		1 to 3.5 N	1 to 3.5 N
Cross talk		< -25dB	< -25 dB
Birefringence		2.10-4 < B < 3.10-4	2.10-4 < B < 3.10-4
Beat wavelength		3.3<Lb<4.9mm@980nm	4.9<Lb<7.4mm@1480nm
Holding parameter m-1		h < 5.10-5	h < 5.10-5
Macrobending loss		<0.5dB @ 980 nm	<0.5dB @ 1550nm
Splice loss to standard SMF		<0.15 dB	<0.15dB
Splice loss to PANDA SM 98		< 0.15 dB	<0.15dB

UV Sensitive Fibre

- *Fibre for Bragg grating application*
- *Low cladding mode losses*
- *Low splice loss*

This fibre is specially designed to be sensitive to UV radiation used for the writing of fibre Bragg gratings. New SMG 110 soon available with cladding modes reduced to less than 0.2dB.



Comparison between standard and specially designed HighWave Technologies photosensitive fibre (type SMG).

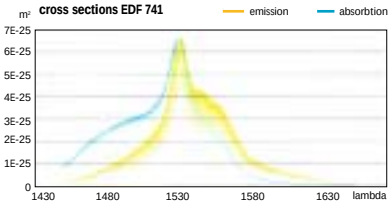
Parameters		SMG fibre	HNA fibre
Attenuation coefficient at 1550nm	dB/km	<0.6	<10
Cut - off wavelength	µm	<1.45	<1.3
Mode field diameter at 1550nm	µm	10.5 ± 1	3.6 ± 0.5
Outside cladding diameter	µm	125 ± 1	125 ± 1
Mode field concentricity error	µm	<0.8	<1
Proof test level	kPsi	100	100
Static fatigue corrosion parameter		n > 20	n > 20
Tensile strength	GPa	>3.5	>3.5
Splice loss to standard telecom fibre	dB	<0.1	<0.2
Core diameter	µm	8.3 ± 0.5	2.8 ± 0.2
Numerical aperture		0.13 ± 0.01	0.35 ± 0.02
Displacement of cladding mode losses	nm	1.5	>10

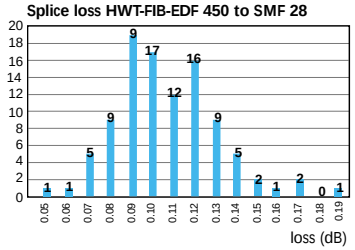
Erbium Doped Fibre

- *C & L band application*
- *Optimised for 980 / 1480nm pumping*
- *Low splice loss*
- *Low noise figure and flat gain EDFA shape*

Highwave manufactures a wide range of Erbium doped silica fibres for EDFA and fibre laser application.As HWT draws its own fibre, unique advantages in flatness, gain and noise figures are achieved. Standard modules are detailed in the datafile below, whereas custom builds are also routinely undertaken.

For further information on the HWT range of products, ask for the HWT catalogue.





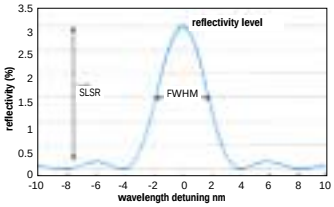
Parameters		HWT-FIB-EDF-510	HWT-FIB-EDF-341	HWT-FIB-EDF-741	HWT-FIB-EDF-741a	HWT-FIB-EDF-450	HWT-FIB-EDF-742	HWT-FIB-EDF-750
Absorption coefficient at 1530nm	dB/m	4 ± 1	3.5 ± 1	7 ± 1	9.5 ± 1	4.5 ± 1	14 ± 2	17.5 ± 2.5
Absorption coefficient at 1480nm	dB/m	1.3 ± 0.5	1.5 ± 0.5	3 ± 0.5	4 ± 0.75	2 ± 0.5	6 ± 1	7 ± 1.5
Cut - off wavelength	nm	850 ± 50	1000 ± 100	1000 ± 50	1000 ± 50	875 ± 75	1000 ± 50	1000 ± 100
Background loss at 1200nm	dB/km	<10	<10	<10	<10	<3	<10	<10
Mode field diameter at 1550nm	µm	5.5 ± 1	5 ± 1	5 ± 1	5 ± 1	7.5 ± 1.5	5 ± 1	7.0 ± 1
Mode field diameter at 980nm	µm	2.7 ± 0.5	3.2 ± 0.5	3.2 ± 0.5	3.2 ± 0.5	3.2 ± 0.2	3.2 ± 0.5	3.2 ± 0.5
Core diameter	µm	3 ± 0.2	3 ± 0.2	3 ± 0.2	3 ± 0.2	4 ± 0.2	3 ± 0.2	4 ± 0.2
Cladding diameter	µm	125 ± 1	125 ± 1	125 ± 1	125 ± 1	125 ± 2	125 ± 1	125 ± 2
Coating diameter	µm	245 ± 10	245 ± 10	245 ± 10	245 ± 10	245 ± 10	245 ± 10	245 ± 10
Core / cladding excentricity	%	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Back scattering capture constant	% (typical)	0.30	0.20	0.25	0.25	0.1	0.30	0.15
Proof test level	kPsi	140	140	140	140	140	140	140
Numerical aperture		0.27 ± 0.03	0.26 ± 0.03	0.26 ± 0.03	0.26 ± 0.03	0.17 ± 0.03	0.26 ± 0.03	0.19 ± 0.02
Splice loss to standard single mode fibre	dB	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Bragg Gratings

Wavelength Stabilizers

- ***Option available - special ferrule assembly, pigtail AR coating at 980 / 14xxnm***

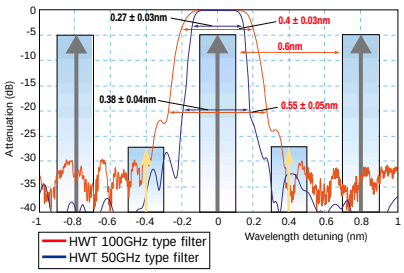
To meet the need for more output power in the new generation of EDFAs, pump laser manufacturers need to select specific wavelengths in the 980 and 1480nm bandwidths. The use of low reflectance gratings to pigtail the laser pumps enables wavelength stabilization of the laser diodes by optical feedback. Highwave Optical Technologies proposes a full range of laser diode stabilizers to achieve this functionality. These components are fully Bellcore tested.



Parameters for Laser Diode Stabilizer		
Optical parameters		
Wavelength range (@ T =25°C)	nm	980 or 14xx
Wavelength accuracy (@ T=25°C)	nm	± 0.2 (min.) or ± 0.5 (typ.)
FWHM	nm	0.2 to 4
FWHM accuracy	nm	± 0.05 (min.) or ± 0.2 (typ.)
Reflectivity	%	1 to 10
Reflectivity accuracy	%	± 0.5 (R< 5%) or ± 1 (R>5%)
SLSR	dB	>10
Mechanical parameters		
Reinstated recoat type	N/A	acrylate or sleeve (patented tech.)
Reinstated coating length	mm	>10
Bent radius	mm	>20
Operating conditions	°C	-20 to +80
Shift of central wavelength with T°	pm/°C	<12 (depending on fibre type)
Fibre type	N/A	PM or SM
Fibre strength	KPSI	>100

DWDM Filters

- ***Bandwidth @ - 30dB in transmission adapted for small wavelength deviation***
- ***Filter design close to a rectangular shape to guarantee good isolation for adjacent channels in the full temperature range***
- ***Reduced inband ripple***



Parameters		50GHz	100GHz
Inband Crosstalk	dB	>30	>30
FWHM	nm	0.27 ±0.03	0.4 ±0.03
Transmission BW @-30dB	nm	>0.07	>0.1
Outband Crosstalk @±ITUgrid	dB	>28	>28
Reflection BW @-25dB	nm	<0.7	<0.8
Reflection BW @-0.5dB	nm	>0.2	>0.3
Central wavelength accuracy (with package)		±0.05	±0.05
PDL	dB	<0.1	<0.1
PMD	ps	<0.1	<0.1

Insertion Loss

The insertion loss seen in the Bragg grating is due to the coupling between the fundamental mode and the cladding modes of the fibre. Existing fibres used for photoinscription produce losses at short wavelengths up to 5dB for saturated gratings. With the HWT photosensitive fibres, these losses are reduced to 0.25dB over the entire bandwidth in the short wavelength range.

By precisely controlling the manufacturing process of optical fibres, HighWave Technologies offers specific index profiles allowing the location of cladding mode losses to be changed based on the customer's requirements.

Chirped Gain Flattening Filters

- ***C & L band working filter***
- ***Low ripple***
- ***Low insertion loss***
- ***Athermal patented package***

Highwave Optical Technologies has specially developed a photoinscription set-up allowing any filter shape to be precisely traced by manufacturing only one grating.

Parameters		Specifications
Filter centre wavelength @ 25°C	nm	1500 to 1600
Accuracy @ 25°C	nm	± 0.2
Filter attenuation @ 25°C	dB	-2 to -15
Input and output fibre		Corning SMF 28
Typical flatness (depends on the EDFA shape)	dB	<0.5
Insertion loss	dB	<0.3
PDL	dB	<0.1
PMD (ps) @ 25°C		<0.1
Maximum optical power	mW	300
Thermal stability (pm) -10°C to +70°C		<150
Ripple (peak to peak)	dB	<0.25

HWT gain flattening filters are supplied in an athermal patented package (size: 5.5 x 5.5 x 55mm).

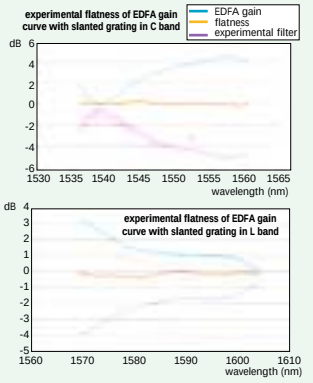
Slanted Gain Flattening Filters

- ***Flat spectral response***
- ***Low back reflection (no isolator is needed)***
- ***Large volume capacities***

Highwave Optical Technologies has specially developed a photosensitive fibre for the manufacturing of slanted Bragg gratings (HighWave patented). This allows very symmetrical filters to be obtained with a varying width and low back reflection, making redundant the use of an isolator in the EDFA.

Parameters		Specifications
Filter centre wavelength @ 25°C	nm	1500 to 1600
Accuracy @ 25°C	nm	± 0.2
Filter attenuation @ 25°C	dB	-2 to -15
Input and output fibre		Corning SMF 28
Return loss 1530 - 1562nm	dB	-30 to -10
Typical flatness (depends on the EDFA shape)	dB	<1
Insertion loss	dB	<0.6
PDL	dB	<0.1
PMD (ps) @ 25°C		<0.1
Maximum optical power	mW	300
Thermal stability (pm) -10°C to +70°C		<150
Ripple (peak to peak)	dB	<0.25

Highwave Optical Technologies gain flattening filters are supplied in an athermal patented package (size: 5.5 x 5.5 x 55mm).

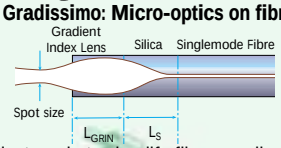


Gradissimo - Fibre Pigtailing Lens Assembly

- ***Spot diameters from 5 to 45µm***
- ***High coupling efficiency and alignment tolerance***
- ***Long working distances 0 to 1.5mm***
- ***Cladding diameter 125 ± 3µm***
- ***Return loss -15 to -30 dB without AR coating***

Pigtail / Collimator

Gradissimo: Micro-optics on fibre



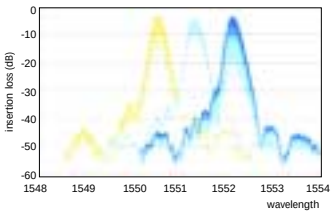
The Gradissimo fibre pigtailing lens assembly is a revolutionary product made to simplify fibre coupling. Essentially a GRIN lens in a fibre, the Gradissimo reduces the requirements for lateral alignment and improved coupling efficiency.

Stimax

- *Can be used in both multiplexing and demultiplexing operations*
- *Very low insertion loss*
- *Up to 64 channels*

Options available:

- *Thermal regulation: ± 1°C (wavelength drift < ± 14pm)*
- *Rack*

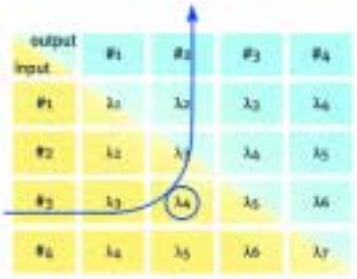


Highwave Technologies offers Dense Wavelength Division Multiplexers (DWDM) with up to 64 channels for use in the 1550nm communication band (Cand L). These components can be integrated into DWDM systems used in fibre optic communications networks to increase the capacity of existing fibre.

Parameters			Stimax Specifications	
Channel number			Standard: 32 to 64.	
Spacing	GHz		100	200
Insertion loss	dB	<32 channels	<5	<4
		>48 channels	<5.5	
Channel FWHM	nm		>0.18	>0.37
Isolation	dB	Adjacent crosstalk	<-28	<-28
		Non-adjacent crosstalk	<-35	<-35
		Cumulative crosstalk	<-25	<-25
PDL	dB		<0.5	<0.5
Frequency position accuracy @25°C	GHz		< ± 4	< ± 4
Directivity	dB		<-45	<-45
Return loss	dB		<-45	<-45
Thermal drift	nm/°C		<0.014	<0.014
Temperature range	°C		-20 to +70	
Package size	mm		204 x 35 x 35	
Fibre			Corning SMF 28	

Dense Wavelength Routers

NEW



Highwave Technologies now offers Dense Wavelength fully bidirectional routers with up to 40 x 40 entrance x output ports for use in the 1550nm communication band.

These components, based on Stimax and Minilat WDM technology, can be integrated into DWDM systems used in fibre optic communications for optical signal routing of existing networks.

Parameters		Specifications	
Port number (standard)		4 x 4 to 40 x 40	
Technology		Stimax	Minilat
Channel Spacing	GHz	200, 100	100, 50
Adjacent channel crosstalk	dB	<-28	<-33
Insertion loss	dB	<5	<8
PDL	dB	<0.5	<0.5
Thermal drift	nm/°C	<0.014	<0.001
Channel FWHM	nm	0.2, 0.37	0.1, 0.2

Other configurations (wavelength ranges, number of channels, channel spacing, etc.) are also available including components for the 1310nm band. Each component can be interleaved with one another to double the port number and reduce the channel spacing.

Minilat DWDM

- *Up to 96 channels*
- *Athermal*
- *Fully bidirectional*
- *Flat top option available*

Highwave Technologies now offers Minilat athermal Wavelength Division Multiplexer with up to 96 channels, which places Highwave as the unchallenged leader of high channel count DWDM multiplexers.

Mux / Demux and λ Routing

HIGHWAVE OPTICAL TECHNOLOGIES

Parameters		Minilat Specifications								
Channel shape		Standard Gaussian			Enlarged Gaussian			Flat Top		
Number of channels			32 to 96	32 to 48		32 to 96	32 to 48		32 to 96	32 to 48
Spacing	GHz		50	100		50	100		50	100
Insertion loss	dB	<48 channels	<5	<5	<48 channels	<7	<7	48 channels	<8	<8
		>96 channels	<5.5		>48 channels	<8		96 channels	<9	
Channel FW @ -1dB	nm		>0.05	>0.1		>0.1	>0.2		>0.1	>0.2
Channel FW @ -3dB	nm		>0.09	>0.18		>0.2	>0.4		>0.15	>0.3
Isolation	dB	Adjacent crosstalk	<-28	<-28	Adjacent crosstalk	<-25	<-25	Adjacent crosstalk	<-25	<-25
		Non-adjacent crosstalk	<-35	<-35	Non-adjacent crosstalk	<-32	<-32	Non-adjacent crosstalk	<-32	<-32
		Cumulative crosstalk	<-25	<-25	Cumulative crosstalk	<-22	<-22	Cumulative crosstalk	<-22	<-22
PDL	dB		<0.5	<0.5		<0.5	<0.5		<0.5	<0.5
Frequency position accuracy	GHz		<±4	<±4		<±4	<±4		<±4	<±4
Directivity	dB		<-45	<-45		<-45	<-45		<-45	<-45
Return loss	dB		<-45	<-45		<-45	<-45		<-45	<-45
Package size	mm		160 x 30 x 30	Ø25 x 130		Ø30 x 160	Ø18 x 120		Ø30 x 160	Ø18 x 120
Thermal drift	nm/°C		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001
Temperature range	°C		-20 to +70			-20 to + 70			-20 to +70	

C-Band EDFAs

Features:
- Broad range of gain and output power available • Flat gain across bandwidth
- Input/output monitoring • High input/output isolation • Optimised package size
- High reliability • Operating windows: 1528-1562nm (full C-band) • Low NF
- Wide operating temperature range: -5°C to 70°C • Wide variety of options (see below)
- Designed to meet Telcordia GR-1312 standards • 980nm and 1480nm pumps

Applications:
- Suitable for data rate from 2.5 Gb/s to 40Gb/s
- Short-haul to long-haul DWDM transmission system
- Compatible with and without distributed Raman pre-amplification
- Booster, pre-amplifier, in-line amplifiers with and without mid-stage access

Using its optimised Erbium-doped fibres and gain flattening filters (GFFs), HighWave proposes a wide variety of high-performance EDFA products for C-band WDM advanced networks.

The broad range of gain and output power and the different product options available are suitable for boosters, pre-amplifiers, and in-line amplifiers for short-haul and long / ultra-long haul applications. HighWave proposes off-the-shelf products as well as short lead delivery time custom made solutions. All HighWave modules use Bellcore qualified optical components.

C-Band EDFA Specifications

Parameters		Typical Value
Wavelength range	nm	1528-1562
Nominal saturated output power range	dBm	from 14 to 23
Nominal gain range	dB	from 13 to 23
Nominal gain flatness	dB	<1.0
Nominal noise figure	dB	<6.0
PMD	ps	<0.5
PDL	dB	<0.3
Input / output tap responsivity	µA/mW	from 10 to 80
Input / output return loss	dB	>40.0
Operating temperature range	°C	-5 to 70
Package dimensions	mm^3	depends on options available on demand

EDFAs

HIGHWAVE OPTICAL TECHNOLOGIES

Options	Characteristics
VOA	from 0 to 10dB
Mid-stage access	from 0 to 12dB
Coil heaters	power consumption <10W
On-board Control Electronics	**Serial Interface:** RS232 at 0 to 5V for external control and monitor data rate: 9600 bauds input signal and pump power loss alarms
	Control modes: constant output power constant gain constant pump current/power VOA setting coil temperature

L-Band EDFAs

Features:
- Broad range of gain and output power available
- Flat gain across bandwidth • Input/output monitoring
- High input/output isolation • Optimised package size
- High reliability • From 1 to 4 1480nm pumps
- Operating windows: 1570-1605nm (full L-band)
- Wide operating temperature range: -5°C to 70°C
- Designed to meet Telcordia GR-1312 standards
- Low NF • Wide variety of options (see below)

Applications:
- Suitable for data rate from 2.5 Gb/s to 40Gb/s
- Short-haul to long-haul DWDM transmission system
- Compatible with and without distributed Raman pre-amplification
- Network upgrade
- Booster, pre-amplifier, in-line amplifiers with and without mid-stage access

To meet the growing demand for larger transmission bandwidth of long-haul WDM systems, HighWave has designed a wide variety of L-band EDFAs. Using our optimised L-band erbium-doped fibre and GFFs, our products offer excellent performance over a broad range of gain and output power, suitable for booster, pre-amplifier, and in-line amplifier applications. HighWave develop tailored solutions for your specific needs in a very short lead-time as well as off-the shelf products. All HighWave modules are designed to comply with the Telcordia GR132 standards.

L-Band EDFA Specifications

Parameters		Typical Value
Wavelength range	nm	1570-1605
Nominal saturated output power range	dBm	from 14 to 23
Nominal gain range	dB	from 13 to 28
Nominal gain flatness	dB	<1.0
Nominal noise figure	dB	<6.5
PMD	ps	<0.5
PDL	dB	<0.3
Input / output tap responsivity	µA/mW	from 10 to 80
Input / output return loss	dB	>40.0
Operating temperature range	°C	-5 to 70
Package dimensions	mm^3	depends on options available on demand

Compact Metro EDFAs

Features:
- Compact size • Low cost • High reiability • Single 980nm pump
- Designed to meet TelcordiaGR-1312 standards
- Operating windows: 1546-1560nm (red-band) and 1532-2562nm (full C-band)
- Input / output monitoring and isolation
- Low NF • Wide operating temperature range: -5°C to 70°C
- Pump power consumption <5W EOL

Applications:
- Suitable for single wavelength and DWDM applications
  - metro and local access WDM systems
  - short-haul and long-haul networks

Created for cost-effective OEM integration, the compact metro EDFAs are ideal for metropolitan and local access network applications. Using HighWave technology and knowhow, these amplifiers have been designed to be compact and to offer the best performance / cost trade-off. Currently available in two different versions (red-band and full C-Band),these modules can be used either for single wavelength or WDM operation. Because of its reactivity and flexibility, HighWave can also develop custom-made solutions optimised for your system needs.

Compact metro EDFA Specifications

Parameters		Typical Value
Wavelength range	nm	1532-1562
Saturation output power	dBm	>10.0
Gain value	dB	15.0
Gain flatness	dB	<2.0
Noise figure	dB	<6.0
PMD	ps	<0.5
PDL	dB	<0.5
Input / output photodetector	µA/mW	40
Input / output return loss	dB	>30.0
Operating temperature	°C	-5 to 70
Power consumption EOL	W	<5
Package dimensions*	mm^3	70 x 102 x 11
*available soon	mm^3	70 x 90 x11

Broadband ASE Sources

C-Band ASE Sources (single or double output)

Parameters		min	typ	max
Wavelength bandwidth	nm	1525		1575
Total output power[1]	dBm	14 (25mW)		
Flatness within the 1528-1565nm wavelength bandwidth	dB		7	8
Spectrum stability	dB/h			±0.03
Output isolation	dB	40		
Optical connectors		FC/APC		
Power supply		110-240V, 50-60Hz		
Alarms		laser current limit		
Dimensions (HxWxD)		132.5 x 233.6 x 280mm		

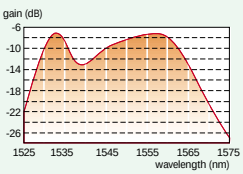
[1]optional second output channel, minimum output power per channel of 10dBm

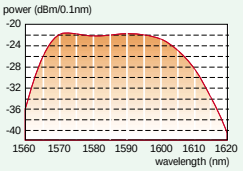
L-Band ASE Sources (single or double output)

Parameters		min	typ	max
Wavelength bandwidth	nm	1560		1620
Total output power[2]	dBm	10 (10mW)		
Flatness within the 1570-1595nm wavelength bandwidth	dB		0.5	1
Spectrum stability	dB/h			±0.03
Output isolation	dB	40		
Optical connectors		FC/APC		
Power supply		110-240V, 50-60Hz		
Alarms		laser current limit		
Dimensions (HxWxD)		132.5 x 233.6 x 280mm		

[2]optional second output channel, minimum output power per channel of 5dBm

HWT optical broadband Erbium-doped fibre sources are designed to offer a continuous stable emission in the 1530 to 1610nm wavelength bandwidth. All ASE sources are optimised to minimise the spectrum flatness value.

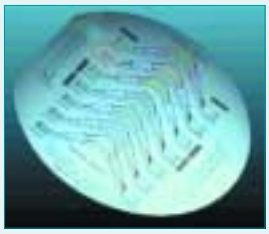




WAVESPLITTER™
TECHNOLOGIES. INC.

WaveArray High Channel AWG

- *High channel count*
- *Dense channel spacing*
- *Low insertion loss*
- *Excellent loss uniformity*
- *Scalable*
- *High level of integration*
- *Easily customised*
- *Economical*



Building on established technical expertise, WaveSplitter is currently developing its latest addition to an expanding portfolio of fiber optic products, the Planar Lightguide Circuit (PLC) platform. The WaveArrayTM High-Channel Count Arrayed Waveguide Grating is designed to meet the needs of DWDM system designers by offering a range of channel count products with narrow channel spacings. The WaveArray allows multiplexing and demultiplexing of densely packed wavelength channels on a very large scale in a cost efficient manner.

WaveSplitter's first introduction from the WaveArray product line are 100 GHz Arrayed WaveGuide Grating products with a combination of low and uniform insertion loss, low polarization dependent loss and low channel cross-talk. Additionally, the WaveArray maintains a compact foot-print for ease of system integration.

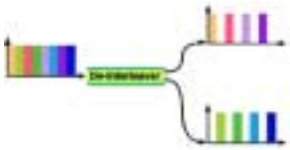
The WaveArray product portfolio is based on mature silica-on-silicon wafer technology utilizing highly scalable manufacturing processes. The platform technology consists of light-guiding structures and channels that exhibit high wavelength resolution which allow narrow-channel-spacing, high-channel-count devices in a small package. Silica based integrated waveguides provide the ideal match with standard single mode optical fiber, creating low insertion loss for the device.

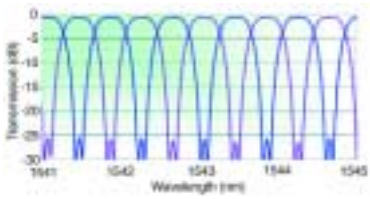
Preliminary Performance Specifications for WaveArray™ High Channel AWG

Parameters		Gaussian Profile	Flat-Top
Channel count		16, 32, 40	
Channel spacing	GHz	100	
Wavelength range	Band	C or L band	
Channel wavelength	nm	1530 to 1562	1575 to 1608
Frequency range	THz	186.4 to 190.4	191.4 to 195.5
Pass band: (ITU grid, pm)		+ 50	+ 100
1dB Band width	nm	> 0.2	> 0.25
3dB Band width	nm	> 0.35	> 0.45
Ripple	dB	< 0.8	< 0.5
Insertion loss	dB	< 4.8	< 7.5
Insertion loss uniformity	dB	< 1.7	
Polarization dependent loss	dB	< 0.35	
Adjacent channel crossTalk	dB	< -25	
Total optical crossTalk	dB	< -22	
Return loss	dB	> 40	
Optical input power range	mW	100	
Electrical Characteristics			
Power consumption	Watts	< 4.5	
Resistance	ohms	< 3.1@25°C	
Thermister resistance	K ohms	10 +2%@25°C	
Thermister B value	k	3450 +2%	
Module Size			
Foot print (WxLxH)	mm	65 x 94 x 16	52 x 88 x 8.5
Optical Fiber Characteristics			
Fiber type		SMF	
Fiber length	mm	1300 ± 100	
Optical fiber termination		SC connectors	
Fiber tensile strain	N	> 5	
Fiber bead radius	mm	> 30	
Operating Conditions			
Temperature	°C	0 to 65	
Relative humidity	% RH	85	
Storage Conditions			
Temperature	°C	-40 to 85	
Relative humidity	% RH	< 90	
Vibration	Hz	10 to 55, amplified 1.5 mm	
Mechanical shock		100G	

WaveProcessor™ F3T Interleaver

- *Low insertion loss*
- *Wide, flat-top passband*
- *Low dispersion*
- *Dense channel spacing*
- *All-fibre technology*
- *Future proof solution*
- *Scalable*
- *Wide wavelength range*
- *Cost Effective*





Performance Specifications for WaveProcessor F3T Interleaver

Parameters		Multiplexer	Demultiplexer
Channel spacing		50 GHz	50 GHz
Maximum channel count		80 channels	80 channels
Wavelength range	nm	1500-1610	1500-1610
Insertion loss	dB	1.0	2.0
Insertion loss uniformity	dB	< + 0.25	< + 0.50
Ripple	dB	0.5	0.5
0.5 dB bandwidth	GHz	+ 13	+ 11
1.0 dB bandwidth	GHz	+ 16	+ 13
3.0 dB bandwidth	GHz	+ 22	+ 18
Optical return loss	dB	> 45	> 45
PDL	dB	< 0.3	< 0.3
Dispersion	ps/nm	< 10 (at ± 10 GHz)	< 10 (at ± 10 GHz)
Channel crosstalk	dB	≥12 (at ± 10 GHz)	≥22 (at ± 10 GHz)
Storage temperature	°C	-40 to 85	-40 to 85
Operating temperature	°C	0 to 65	0 to 65
Module warm-up time (at 23° C)		10 minutes	10 minutes
Heater power consumption (steady state)		~6W @ 0° C	~6W @ 0° C
Heater power consumption (Max)		~9W	~9W
Package size	cm	15.0 x 7.7 x 2.9	15.0 x 7.7 x 2.9

With the need for bandwidth growing explosively, system designers are packing as many channels as possible into their DWDM systems. Their design goals place increasingly stringent demands on all the filtering components used in the system, demands such as wide channel passband, good crosstalk performance, low insertion loss and minimal dispersion. Wavesplitter is continuing with its ground-breaking developments by introducing state-of-the-art interleaver products.

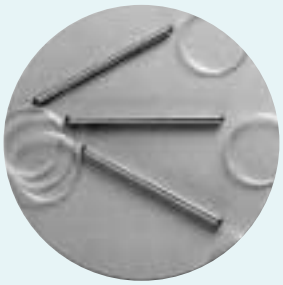
Wavesplitter Technologies has developed all-fibre, 50 and 100GHz Flat-Top Interleaver products with channel counts of up to 80 channels. This entirely new design offers a flat-top passband with best-in-class specifications for the key parameters such as passband width, insertion loss and dispersion.

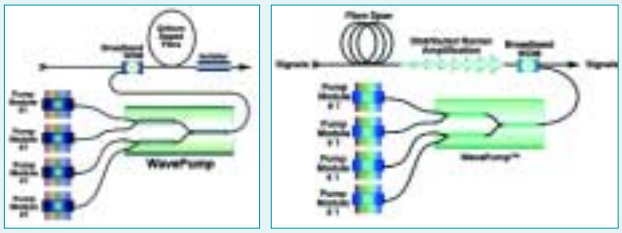
The all-fibre interleaver construction maintains and offers absolute compatibility with existing and new network infrastructure. It offers solutions for today's growing capacity demands while future proofing for upgrading networks to 40Gb/s for tomorrow and beyond. The flat-top design offers an intrinsically wide passband with extremely low insertion loss and excellent crosstalk that fills up to 55% of the channel spacing with <1 dB of insertion loss. An all-fibre construction provides enhanced environmental and reliability performance over a wide range of operating environments.
An optimised small footprint enables easy integration at the system board level and offers a range of fibre and electrical terminations to suit system connectivity needs.

The F3T is insensitive to environmental conditions, unlike passive interleaver designs which are limited by high temperature coefficients (typically 350/ °C). With active temperature control, the F3T offers enhanced centre wavelength accuracy and tuning for a very modest power rating. This enables the systems designer to specify a wider range of lasers and offers a cost effective network solution.

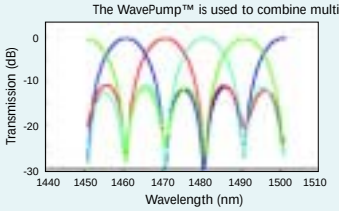
WavePump™ 1480 & 980nm Pump Laser Combiner

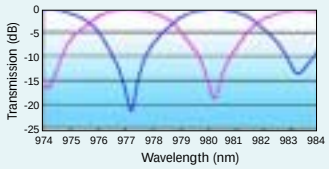
- *High optical power handling*
- *Very low insertion loss*
- *Multi-channel pumping*
- *Telcordia reliability*
- *Flexible wavelength and channel spacing*
- *Increased amplifier power*
- *Enhanced amplifier reliability*
- *Higher amplifier efficiency*
- *Raman or EDFA design*
- *Economical*





The WavePump™ is used to combine multiple pump lasers at different wavelengths in an EDFA.





Higher power amplifiers are needed in order to handle the ever-increasing channel counts and bit rates of DWDM telecommunication systems. This requires combining multiple pump lasers in the amplifier in the most efficient, economical way possible.

The WavePump is a reliable, low-loss, all-fibre pump laser combiner for use in EDFA and Raman amplifier designs. The Fused Cascader Fibre (FCF) approach offers an intrinsically low loss design while allowing many pump lasers to be combined to achieve high amplification. High pump power levels are easily handled with the all-fibre design, and the available wavelengths cover 980nm, 1480nm, or Raman pump lasers. The WavePump can accomodate your design needs with its range of centre wavelength and channel spacing options.

WaveSplitter understands that excellent performance is just one of the many selection criteria for choosing a pump laser combiner, and the WavePump has been designed to meet the highest reliability standards. The WavePump meets or exceeds all of the Telcordia™ reliability requirements.

Finally, WavePump offers a low-cost alternative to expensive polarisation beam combiners and other methods of combining pump lasers. When you combine the technical benefits of low-cost, multiple channels, and high power handling capability with the Telcordia™ reliability and value, he WavePump makes an excellent choice to meet your amplifier design goals.

Performance Specifications for 1480 and 980nm WavePump Pump Laser Combiner

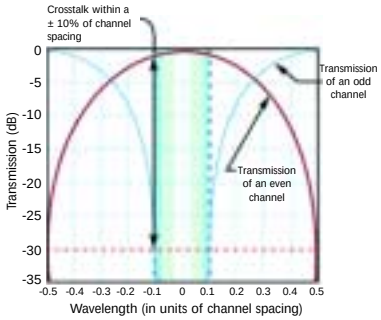
Parameters		1480 (& Raman)	980
Available channel wavelength range	nm	1420 to 1495	970 to 990
Available number of channels		2, 3 and 4	
Available channel spacing range 2 Channels	nm	7 to 60	5 to 10
3 & 4 Channels	nm	7 to 25	5 to 10
0.5 dB Bandwidth		35% of Channel Spacing	
Insertion loss 2 Channel	dB	< 0.3	< 0.4
3 & 4 Channels	dB	< 0.6	< 0.8
PDL	dB	< 0.1	
Isolation	dB	> 15	> 14
Directivity	dB	< -60	
Return loss	dB	> 55	
Typical thermal wavelength drift	pm/°C	5 to 7	3 to 5
Operating temperature	°C	-20 to 70	
Storage temperature	°C	-40 to 85	
Fiber type		SMF 28	Flexcor™ 1060
Optical power	W	> 5	

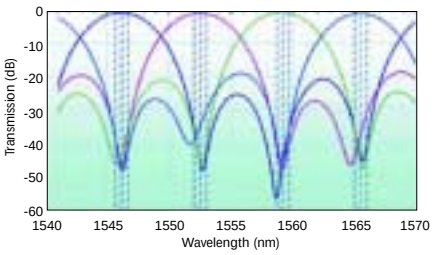
WaveMetro Narrow WDM

- *Very low insertion loss*
- *Flexible channel plan*
- *TelcordiaTM reliability*
- *Extended link lengths*
- *Narrow WDM Metro and Access systems*

E-commerce and new Internet-based multimedia are creating a need for more bandwidth, not just in the long-haul backbone, but also in the metro and access networks. These new systems need more than two channels used in original coarse-WDM designs (1310 and 1550 nm), but do not need the dense channel spacings of newer DWDM systems. In the metro environment, WDM systems must also compete with other bandwidth solutions such as deploying new fiber or increasing bit-rates. Amplifiers are avoided whenever possible to reduce the cost, placing a premium on component insertion loss in addition to component cost.

The WaveMetro is a low-loss, economical alternative to thin-film filters for use in narrow-WDM metro systems. The Fused Cascaded Fiber (FCF) approach offers an intrinsically low loss design while allowing multiple wavelengths to be combined or filtered. The WaveMetro is available with a choice of channel spacings and wavelength range, giving you flexibility in your design for a metro WDM system.





Performance Specifications for WaveMetro Narrow WDM1-3

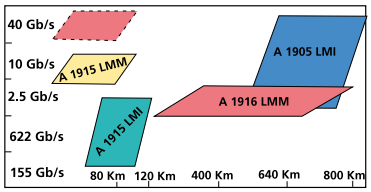
Parameters		Multiplexer					
Available channel wavelength range	nm	1500 to 1610					
Available channel spacing	nm	6		10		20	
Available number of channels		2	4	2	4	2	4
Effective passband window	nm	+ 0.6		+ 1.0		+ 2.0	
Insertion loss	dB	< 0.6	< 1.0	< 0.5	< 0.9	< 0.4	< 0.8
Crosstalk	dB	> 10	> 11	> 12	> 13	> 13	> 14
PDL	dB	< 0.1					
Typical thermal wavelength drift	pm/°C	5 to 7					
Operating temperature	°C	-20 to 70					
Storage temperature	°C	-40 to 85					
Fiber type		SMF 28					
Optical power	W	> 5					

ALCATEL

Alcatel Optronics based in Nozay, France, is the world's leading manufacturer of active discrete devices for long haul and high data-rate DWDM transmission systems, with over 175,000 sq. ft of manufacturing capacity worldwide.

Alcatel CW Lasers

The A1905 LMI range of lasers are InGaAsP, DFB, SLMQW narrow linewidth lasers complete with isolator, TEC, monitor and provided in an industry standard, 14 pin butterfly package. They are designed for extra-long haul 10 and 40 Gbit/s DWDM synchronous digital transmission systems, submarine terminal digital transmission systems and instrumentation. They feature upto 30mW output power, wavelength selection to ITU-T G.692, are optimised for use with LiNbO3 external modulators and include a polarisation maintaining fiber pigtail.



Product Family		A1905LMI	A1905LMI	A1905LMI	A1905LMI	A1905LMI
Code		3CN00386xx	3CN00410xx	3CN00302xx	3CN00386xx	3CN00410xx
Wavelength	nm	1530/1570 (WDM 200, 100, 50GHz)	1530/1570 (WDM 200GHz)	1530/1570 (WDM 200GHz)	1570/1610 (WDM 200, 100, 50GHz)	1570/1610 (WDM 200, 100, 50GHz)
Peak output power	mW	10	20	30	10	20
Modulation rate	Gb/s	CW	CW	CW	CW	CW
RIN	dB/Hz	-140	-140	-140	-140	-140
Temperature	°C	-10,+70	-10,+70	-10,+70	-10,+70	-10,+70

Alcatel Modulated Lasers

L-Band Available

The A1915 LMI range of lasers are InGaAsP, DFB, SLMQW narrow linewidth lasers complete with isolator, TEC, monitor and provided in an industry standard, 14 pin butterfly package. They are designed for STM-16 and OC-48 high speed WDM transmission systems, submarine terminal transmission systems and instrumentation. They feature upto 10mW output power, wavelength selection to ITU-T G.692, and are optimised for direct modulation at 2.5Gbit/s. In addition they deliver low dispersion penalty and chirp making them ideally suited for high speed use.

The A1916 LMM range is designed for STM-16 and OV-48 extra-long haul transmission systems and high speed metropolitan area networks. It features very low dispersion penalty enabling reaches of 7540km to be achieved at 2.5Gbit.s operation.
The A1915LMM range is designed for STM-64 and OC192 short and long haul transmission systems. These lasers feature very low dispersion penalty for over 90km for 10Gbit/sec operation on singlemode fibre. Both the 1915LMM and 1916LMM have a monolithically integrated DFB laser and modulator chip design for the highest performance.

Product Family		A1915 LMI	A1915 LMI	A1916LMM	A1916LMM	A1915LMM	A1915LMM	A1915LMM
Code		3CN00154xx	3CN00347xx	3CN00149xx	3CN00397xx	3CN00317xx	3CN00315xx	3CN00316xx
Wavelength	nm	1530/1570 (WDM 200GHz)	1530/1570 (WDM 200GHz)	1530/1570 (WDM 200,100GHz)	1530/1570 (WDM 200,100GHz)	1530/1570 (WDM 200,100GHz)	1530/1570 (WDM 200,100GHz)	1530/1570 (WDM 200,100GHz)
Peak output power	dBm	3	10	0	0	-3	0	3
Modulation rate	Gb/s	2.5 (Direct modulation)	2.5 (Direct modulation)	2.5 (EA modulation)	2.5 (EA modulation)	10 (EA modulation)	10 (EA modulation)	10 (EA modulation)
Dispersion	ps/nm	1900	1800	7200	12800	50	800	1600
Temperature	°C	-10,+70	-10,+70	0, +65	0, +65	-5, +70	-5, +70	-5, +70

Alcatel Pump Lasers

The Alcatel range of 980nm and 1480nm pump lasers are high reliability, high output power MQW lasers suitable for terrestrial and submarine applications. With their high output powers and optional wavelength range of 1400-1500nm, they are ideally suited for Raman pumping as well as EDFA pumping. Additional options include PM fibre and Bragg Grating Wavelength stabilisers for multiple pumping configurations. Furthermore, low profile packages are also available for those applications where compact amplifier configurations are critical.

Product Family		A1998 PLM	A1992 SGP	A1948 PLO	A1948PLI	A1948 FBG
Wavelength	nm	980	972/984	1460/1490	1460/1490	1460/1490
Output power options	mW	60-150	130-150	140-180	120-200	140-180
Temperature	°C	0, +70	0, +43	-5,+70	-5, +70	-5, +70
Bragg grating stabilised	Yes/no	Yes	Yes	No	No	Yes
Optical isolator	Yes/no	No	No	No	Yes	No

Multi Pump Module

Multi Pump Module

The A1948 MPM is specifically designed for high power OFA pumping and Raman pumping. It is provided as a complete module including drive electronics in a variety of wavelength/output power configurations. By adjusting the dopant profiles of individual laser chips, high output powers can be reached at any wavelength in the 1400nm-1500nm region. As a result, the desired Raman wavelength and spectrum can be obtained by combining several pumps (by PM, WDM, or both) to deliver high power (400-800mW) and with the pumping spectrum optimised for the transmission line fiber and amplified bandwidth.

Product Family		A1948 MPM	A1948MPM	A1948MPM	A1948MPM
Product code		3CN00395AA	3CN00395AB	3CN00395AC	3CN00455AA
Application		OFA pumping	OFA pumping	OFA pumping	RAMAN
Wavelength	nm	1480	1480	1480	1400-1500 (choose)
Output power options	mW	350	350	500	800
Temperature	°C	-5, +70	-5, +70	-5, +70	0, +60

Active Discrete Components

Semi-Conductor Optical Amplifiers

The Alcatel semiconductor optical amplifier is based on a state of the art InGaAsP buried ridge stripe heterostructure. Utilising highly efficient fibre to chip coupling ensures very high fibre gain. The strained structure reduces polarisation dependence and an adiabatic taper reduces far field divergence. The amplifier stripe is angled to the output facets to minimize gain ripple.

The A1901 SOA features high fibre to fibre gain, low gain ripple, low polarisation sensitivity, high saturation output power and low noise figure. It is specifically designed for use in those applications requiring optical in-line amplification, gating for high speed switching, four wave mixing, wavelength conversion for optical routing, as a high power non-coherent source.

Typical values		A1901 SOA
Wavelength of maximum gain	nm	1540
Fibre to fibre gain at Pin = -25dBm	dB	25
Gain ripple at 20dB	dB	0.2
TE/TM differential gain	dB	0.5
Noise figure	dB	7
3dB bandwidth	nm	40
Switching time	nsec	<1
Drive current	mA	150

Alcatel 1901 ICM All-Optical Interferometric Wavelength Converter.

The Alcatel A1901ICM is an all-optical wavelength converter based on SOA technology. The ICM exploits cross-phase modulation in an integrated Mach Zehnder interferometer (MZI) based on an all-active structure. An input modulated signal at wavelength 1 modulates the carrier density inside the interferometer producing a modulation of its refractive index. This in turn leads to a phase modulation of an injected CW beam at the desired output wavelength, which is converted to amplitude modulation via the MZI.

The A1901 ICM features bit rate transparency, digital amplitude modulation format transparency, large optical bandwidth, high extinction ratio, and small chirp. It is specifically designed for applications such as wavelength conversion, optical regeneration, WDM routing, and amplitude regeneration.

Typical Specifications		A1901 ICM
Operation bit rate	Gb/s	2.5
Modulated optical signal power	dBm	5
Optical CW carrier power	dBm	3
Optical output converted signal power	dBm	>-5
Peak output gain wavelength	nm	In the range 1520-1570
Optical bandwidth	nm	35
Extinction ratio	dB	10

Optical Interface Sub-Systems

SDH Modules

Used in transmission systems from medium to high speed for intra-office, intermediate reach and long reach applications, the Alcatel 1900SDH family operates at SONET OC-3, OC-12 and OC-48 rates as well as at ITU-T SDH rates of STM-1, STM-4 and STM-16. Covering all types of SONET/SDH optical interfaces (tributary and aggregate functions), the Alcatel 1900 SDH modules are suitable for line systems, add and drop multiplexers, digital cross connects and ATM switches.

The A1900SDH family feature 1310 and 1550nm sources, low dispersion, ultra low jitter, monitoring capability, data reshaping, clock recovery, data retiming and high reliability. They are suitable for reaches of up to 320km (1916 + preamp).

STM - 16 / OC-48 Interface Sub - Systems

A1916SDH SONET / SDH high performance receiver integrated modules
STM-16 / OC-48 for DWDM applications

A1926SDH DWDM SONET / SDH integrated modules
Multi-source compact STM-16 / OC-48

STM - 64 / OC-192 Interface Sub - Systems

A1964TRX SONET / SDH integrated modules -
SERDES Transceiver STM-64 / OC-192

Product Code	Temp. (°C)	Power Level min	Power Level max	Wavelength (nm)	λ Spacing (GHz)	Type	Dispersion (ps/nm)	Connector
Alcatel 1916 SDH								
3CN00217KA	0 +70	-31	-8	1530 / 1560	-	Rx Y-16.2 (WDM 2.7 Gb/s)	6400	FC/PC
3CN00217HA	0 +70	-31	-8	1530 / 1560	-	Rx Z-16.2 (WDM 2.5 Gb/s)	12800-	FC/PC
3CN00217JA	0 +70	-31	-8	1530 / 1560	-	Rx Z-16.2 (WDM 2.7 Gb/s)	12800	FC/PC
Alcatel 1926 SDH								
3CN00443##	0 +70	10		1528.7 / 1563.8	100	L-16.2	1800	-
3CN00326##	-5 +75	-9.5	-3	1266 / 1360	-	Tx I-16/SR-1	12	-
3CN00336##	-5 +75	-18	-3	1266 / 1360	-	Rx I-16/SR-1	-	-
3CN00327##	-40 +85	-9.5	-3	1266 / 1360	-	TX I-16/SR1	12	-
3CN00337##	-40 +85	-18	-3	1266 / 1360	-	Rx I-16/SR-1	-	-
3CN00328##	-5 +75	-4.5	0	1266 / 1360	-	Tx S-16.1/IR-1	100	-
3CN00336##	-5 +75	-18	0	1266 / 1360	-	Rx S-16.1/IR-1	-	-
3CN00329##	-40 +85	-4.5	0	1266 / 1360	-	Tx S-16.1/IR-1	100	-
3CN00337##	-40 +85	-18	0	1266 / 1360	-	Rx S-16.1/IR-1	-	-
3CN00330##	-5 +75	-1.5	+3	1280 / 1335	-	Tx L-16.1/IR-1	250	-
3CN00338##	-5 +75	-27.5	-8	1280 / 1335	-	Rx L-16.1/LR-1	-	-
3CN00331##	-40 +85	-1.5	+3	1280 / 1335	-	Tx L-16.1/LR-1	250	-
3CN00339##	-40 +85	-27.5	-8	1280 / 1335	-	Rx L-16.1/LR-1	-	-
Alcatel 1964 TRX								
3CN00468AA	-5 +65	-2		1530 / 1565	-	I-64.2/SR-2	400	FC/PC
3CN00434AA	-5 +65	0		1530 / 1565	-	S-64.2/IR-2	800	FC/PC

Luminent (formerly MRV Communications) is a vertically integrated manufacturer of optical transceivers, transmitters, receivers and passive devices for telecommunications and datacommunications applications.

All aspects of production and fabrication, from wafer growth through to device packaging and laser pigtailing, are conducted at the Luminent factory sites in Chatsworth, California, where rigorous control of these critical production steps ensures that highly reliable product is delivered to specification, on time.

As Luminent focuses 100% on singlemode data and telecommunications products, you can be confident of the knowledge that its products are of the highest quality and performance, ready to meet the toughest demands of the most critical installation requirements.

Transceivers

SONET and SDH Transceivers

Luminent provides off the shelf solutions for SONET OC1, OC3, OC12, OC48 and OC192 (SDH STM1, STM4, STM16 & STM64) telecommunications protocols.

Industry standard packages are available in high efficiency, low power-consumption formats suitable for straightforward incorporation into SONET and SDH standard applications.

Simplex (single fibre) and Duplex (separate Tx & Rx fibres) formats are available as are high temperature versions guaranteed to meet wide temperature range operation (-40°C to +80°C).

To find out more about the range of Luminent transceivers contact Laser 2000 today and ask for your free catalogue.

CWDM SONET OC192/SDH STM-16 Transceiver Module

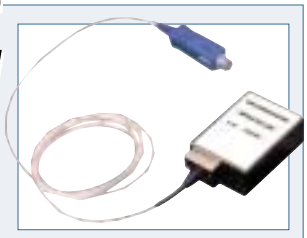
A new coarse wavelength division-multiplexing module from Luminent releases bandwidth in low cost high-speed datacoms and telecommunications.

The CWDM module delivers 4x-OC48 (4 x 2.5Gb/sec equating to 1 x OC192) channels over 4 wavelengths between 1495nm and 1567nm and is totally compatible with existing fibre installations. Each of the 4 wavelengths is optically mixed within the module and presented already multiplexed at a single fibre connector interface. Power budgets allow for the wavelength mixing by accounting for any losses in the multiplexer and final output powers after the multiplexer are guaranteed. As a result, transmission distances of up to as far as 50km are catered for.

Features of the CWDM transceiver include compatibility with standard optical connector types and a clock recovery option. Both a high temperature and a low voltage version are available.

For further information on this or similar devices, please request the CWDM data sheet.

Single Fibre SONET/SDH Solutions



In the case of most transceiver package types, the transmit and the receive paths propagate on different fibres.

However, in those cases where only a single fibre is available, these duplex packages clearly cannot provide the best solution. In addition to the numerous duplex packages that are available, Luminent also manufactures single fibre transceivers where both the transmit and receive path share the same input on the module.

For a small increase in cross talk, these packages provide practically the same performance as duplex packages.

To find out more contact Laser 2000.

Luminent Transceiver Range

	Min power (dBm)	Wavelength (nm)	Datarate (Mb/sec)	Min Rx Sensitivity (dBm)	Package Types Available
FDDI	-10.0 to 0.0	1310	140	-33	2x11
ATM/OC3	-15.0 to -3.0	1310/1550	155	-34	1x9, 2x9, 2x5
ATM/OC12	-15.0 to -3.0	1310/1550	622	-28	1x9, 2x9, 2x5
Gigabit ethernet	-10.0 to -5.0	1310/1550	1000	-24	1x9, 2x5, GBIC
OC48	-10.0 to -5.0	1310/1550	2488	-20	1x9, 2x9, 2x5

Laser Diodes, Photodiodes and Modules

Luminent

1310nm laser diode, pigtailed module, receptacle, dual In-line and butterfly packages

The Luminent range of discrete lasers and photodetectors is designed for non-DWDM telecom and datacoms applications where low cost but high specification and reliability are still of the utmost importance. These devices are ideally suited to CWDM and grey applications where wavelength stability is important but wavelength selection tolerances are less demanding.

Luminent manufactures laser devices at 1310nm for short-reach datacoms, telecoms and CATV applications. Based around their proprietary 1310nm-chip design, these devices deliver excellent thermal properties showing only small variation in quantum efficiency for wide temperature ranges.

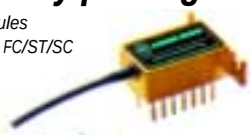
- *Uncooled laser diode with MQW structure*
- *5mW CW operation at -40°C to 85°C*
- *High temperature operation without active cooling*
- *Hermetically sealed active component*
- *Built-in InGaAs monitor photodiode*
- *Comply with Bellcore TA-NWT-000983*

		C-13-001-E-A	C-13-001-P-SSTL	C-13-001-R-SFCM	MRLD-14CD-020I	MRLD-14BD-020I
Physical format		TO-18 window	FC/PC SM pigtail	FC/PC receptacle	14 pin DIL	14 pin BFY
Laser type		high temperature Fabry-Perot	high temperature Fabry-Perot	high temperature Fabry-Perot	Fabry-Perot	Fabry-Perot
Optical output power	mW	5	1.5	0.8	3	3
LD reverse voltage	V	2	2	2	2	2
PD reverse voltage	V	10	10	10	15	15
PD forward voltage	mA	1	1	1.0	1	1
Operating temperature	°C	-45, +85	-45, +85	-45, +85	-20, +60	-20, +60
Storage temperature	°C	-40, +85	-40, +85	-40, +85	-30, +80	-30, +80

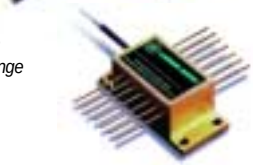
1550nm laser diode, pigtailed module, receptacle, dual In-line and butterfly packages

For those telecoms and datacoms applications requiring longer reach, the lower loss of standard telecomms fibres at 1550nm, make the transmission distances achievable by 1550nm devices, significantly greater than that achieved by 1310nm devices. In addition, 1550nm and 1310nm lasers can be multiplexed onto the same fibre by means of the Mux Demux components also available. See the index for further details of these components.

- *Pigtailed modules with SM fibre FC/ST/SC connector*



- *SM receptacle with 2-hole flange and optical connector*



- *Uncooled laser diode with MQW structure*
- *5mW CW operation at -40°C to 85°C*
- *High temperature operation without TE cooler*
- *Hermetically sealed active component*
- *Built-in InGaAs monitor photodiode*

		C-15-001-E-A	C-15-001-P-SSTL	C-15-001-R-SFCM	MRLD-14CD5-020I	MRLD-14BD5-020I
Physical format		TO-18 window	FC/PC SM pigtail	FC/PC receptacle	14 pin DIL	14 pin BFY
Laser type		high temperature Fabry-Perot	high temperature Fabry-Perot	high temperature Fabry-Perot	DFB	DFB
Optical output power	mW	6	1.5	0.8	3	3
LD reverse voltage	V	2	2	2	2	2
PD reverse voltage	V	10	10	10	15	15
PD forward voltage	mA	1	1	1.0	1	1
Operating temperature	°C	-45, +85	-45, +85	-45, +85	-20, +60	-20, +60
Storage temperature	°C	-40, +85	-40, +85	-40, +85	-30, +80	-30, +80

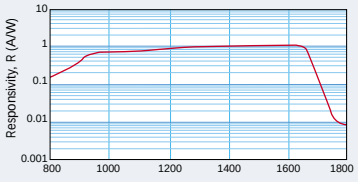
InGaAs PIN photodiode, pigtailed module and receptacle

- *InGaAs/InP PIN photodiode*
- *High responsivity at 1310nm and 1550nm*
- *Low dark current*
- *Fast pulse response*
- *-40 to 85°C operating temperature*
- *Hermetically sealed 3-pin metal case*
- *75µm or 300µm active diameter*

The high efficiency of InGaAs detectors coupled with their wide operating range, bandwidth, relative temperature insensitivity and low cost make these devices excellently suited to the demands of optical communications systems.

Luminent manufacture their own proprietary wafer design and provide numerous different package styles to suit most configurations. In addition, devices are available with built in calibrated attenuators.

Applications: *Connectorised receptacle module, coaxial pigtailed module, data and telecommunication*



		R-11-075-G-B	R-11-300-G-B	R-11-075-P-SFC	R-11-075-R-SFC
Physical format		TO-46 ball lens cap	TO-46 ball lens cap	FC/PC SM pigtail	FC/PC receptacle
Active area	µm	75	300	75	75
Detection range	nm	1100-1650	1100-1650	1100-1650	1100-1650
Responsivity	A/W	0.85	0.85	0.85	0.85
Dark current	NA	0.5	2	0.5	0.5
Capacitance	PF	0.8	6	0.8	0.8
Rise/fall time	ns	0.3	1	0.3	0.3

Luminent

Fibre Pigtails / Patchcords

The Luminent range of fibre patchcords comprehensively covers both singlemode and multimode transmission applications. Singlemode patchcords are available in 250µm, 900µm, and 3mm jacketed. Patchcords are available in either standard singlemode or polarisation-maintaining fibre (Fujikura Panda Fibre) for use at most infrared and visible wavelengths. All standard telecom connectors are provided as standard including the new LC and MU format connector types. As an additional option, polarisation maintaining pigtails and patchcords can be provided with the connector keyway referenced to the fibre slow axis. All patchcords are manufactured to stringent quality standards and are available in large volumes with only minor variation in specification between batches.

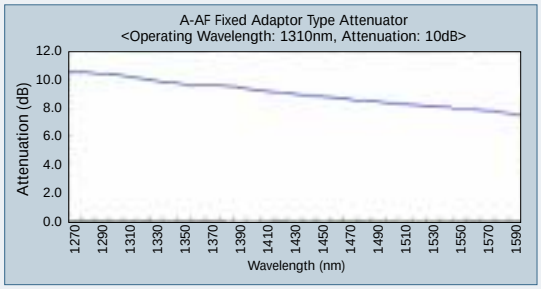
Product Code		J-xx-xx-xx-S	J-xx-xx-xx-A	J-xx-xx-AG-S	J-xx-xx-AG-H
Description		Singlemode	Singlemode	Angle polished	Angle polished
Typical insertion loss	dB	0.15	0.3	0.15	0.3
Maximum insertion loss	dB	0.25	0.4	0.3	0.5
Typical return loss	dB	50	40	67	62
Minimum return loss	dB	48	35	65	60
Operating temperature	°C	-40, +75	-40, +75	-40, +75	-40, +75
Storage temperature	°C	-55, +85	-55, +85	-55, +85	-55, +85

All Fibre Passive Devices

Attenuators

Attenuators are used in fibre optic transmission systems to reduce the optical power received by photo-detectors. The light intensity of lasers and LED's should be reduced to within the dynamic range of the photodetector in use. Reducing the emitter power electronically may do this. However a more simple method is to incorporate an attenuator in the transmission path.

Luminent attenuators are available for use at a variety of different centre wavelengths. They may be provided as in-line (fibre-type) or as in-line (connector type) packages. Both fixed attenuator and variable attenuators are available.



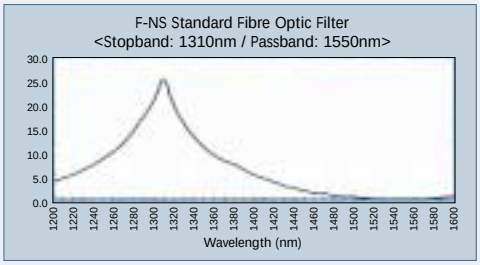
Product Code		A-AF-N	A-AF-W	A-IF-85 or 13 or 15	A-IF-3W or 5W	A-IF-35
Description		Standard fixed	Wideband fixed	Standard fixed	Wideband fixed	Dual window fixed
Physical format		Adaptor	Adaptor	In line	In line	In line
Operating wavelength	nm	850 or 1310 or 1550	1310 or 1550	850 or 1310 or 1550	1310 or 1550	1310 and 1550
Bandwidth	nm	±10	±40	±10	±40	±40
Attenuation	dB	1 - 30	1 - 30	1-30	1-30	1-30
Back reflection	dB	-40 (-60 for angled types)	-40 (-60 for angled types)	-60	-60	-60
Operating temp	°C	-40, +75	-40, +75	-40, +85	-40, +85	-40, +85
Storage temp	°C	-55, +85	-55, +85	-55, +85	-55, +85	-55, +85
Connector type		FC, SC, ST or other.	FC, SC, ST or other.	FC, SC, ST or other.	FC, SC, ST or other.	FC, SC, ST or other.

FBT Filters

High isolation filters are used to pass a broad wavelength range while isolating an adjacent wavelength range.

FBT filters are fully fused devices delivering moderate isolation for low cost. In addition, the manufacturing process introduces only a marginal increase in insertion loss. They are ideally suited to 1310/1550 WDM applications but are also available for 1625 and 1650nm pass/stop operation.

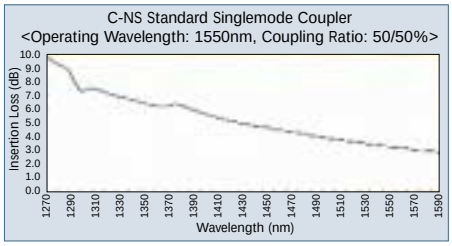
Automation of the Luminent FBT manufacturing process ensures that high product specification is achieved repeatably. In addition, high volumes are catered for with little batch to batch variation in specification.

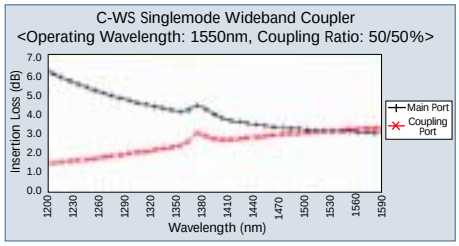


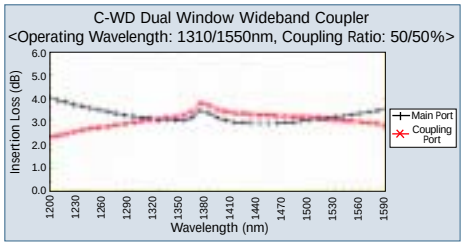
Product Code		H-NS-xx-xx-1-35	F-HI-xx-xx-2-35	F-HI-xx-xx-3-35
Type		Standard	High Isolation	High Isolation
# of stages		1	2 stage	3 stage
Description		1310 pass, 1550 stop	1310 pass, 1550 stop	1310 pass, 1550 stop
Insertion loss	dB	<0.4	<0.8	<1.2
Isolation	dB	>16	>30	>40
Stop band	nm	40	40	40

Also available at with pass/stop centre band wavelengths of 1550nm, 1625nm, and 1650nm.

FBT Single Mode Couplers







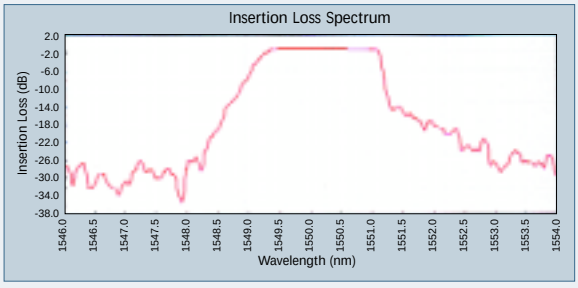
FBT couplers, like filters, offer superb performance versus cost. Couplers are available at a range of different centre wavelengths (visible, 850nm, 980nm, 1310nm, 1480nm, 550nm etc.) and in a variety of different fibres including multimode (50/125, 62.5/125) large core (100 - 500µm) and also in polarising maintaining fibre. Wideband couplers permit wavelength independent performance over a wide wavelength range for DWDM applications. Dual window couplers permit wavelength independent operation at two distinct wavelengths, such as 1310 and 1550nm for WDM applications. In addition to 1x2 couplers, mxN and 1xN couplers are available in fully fused or conjoined couplers, and for the highest port to port uniformity, Laser 2000 also offers Planar Lightwave Circuit products.

		Standard SM	Singlemode Wideband	Dual window Wideband
Product Code		C-NS	C-WS	C-WD
Operating wavelength	nm	1310 or 1550	1310±40 or 1550±40	1310±40 and 1550±40
Excess loss (typ)	dB	0.06	0.1	0.08
Uniformity	dB	0.5	0.6	0.8
Polarisation stability	dB	<0.1	<0.1	<0.1
	<0.1	<0.1	<0.1	<0.1
Port configuration		1x2 or 2x2	1x2 or 2x2	1x2 or 2x2
Coupling ratio		1:99 to 50:50	1:99 to 50:50	1:99 to 50:50
Directivity	dB	>50 (1x2), >60 (2x2)	>50 (1x2), >60 (2x2)	>50 (1x2), >60 (2x2)
Reflectance	dB	<-55	<-55	<-55
Operating temperature	°C	-40, +85	-40, +85	-40, +85
Storage temperature	°C	-55, +85	-55, +85	-55, +85

Also available: 1x3 unitary couplers, 1xN Tree couplers, MxN Star Couplers.

Chromatic Dispersion Compensation Gratings

Chromatic dispersion effects in fibre optic systems limit the transmission reach of high data-rate systems. The effect is proportional to data-rate, source linewidth and distance traveled. To compensate for this effect, fibre Bragg gratings are available to reverse the effects of dispersion at specific points in the network structure. These devices offer significant amounts of compensation whilst providing low loss and are only minimally invasive.

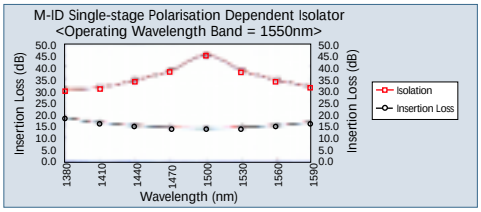


Product Code		F-DC		
		Typical	Min.	Max.
Centre wavelength			ITU Standard	
Wavelength accuracy at 20°C	nm		0.1-0.5	
Bandwidth (FWHM)	nm		0.5-10	
Reflectivity	dB		<=20	
Centre wavelength shift pm/°C (over operating temp range)	pm / °C	1.0 (compensated)	0.5 (compensated)	3.0 (compensated), 7.5 (uncompensated)
Insertion loss	dB	<=0.5	<=0.3	<=0.7
Dispersion compensation,	ps/km		200	1700

Micro-optical and Thin Film Passives

Isolators and Circulators

Isolators allow light to travel in one direction only. They prevent back-reflected signals from de-stabilizing a pump or emission source, a major factor in the cause of noise in transmission and amplification systems. Isolators are available in either single or double stage formats capable of delivering upto 70dB of isolation across a broad wavelength and temperature range. Circulators utilise the same principal but with either 3 or 4 ports. The primary application for circulators is in add-drop architectures for DWDM networks.

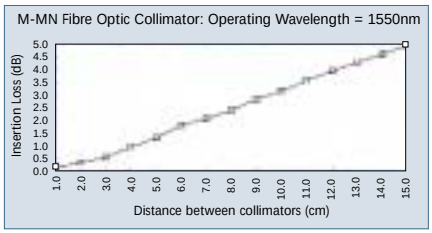


Product Code		M-CN-B	M-CN-C	M-FD-1-xx-S	M-FI-1-xx-L	M-ID-1-xx-S	M-II-1-xx-S	M-IS-2-xx-S
Description		3 port circulator	4 port circulator	Miniature free-space isolator	Miniature free-space isolator	In line isolator	In line isolator	In line isolator
Polarisation dependent / independent		Independent	Independent	Dependent	Independent	Dependent	Independent	Independent
Stages		2	2	1	1	1	1	2
Wavelength	nm	1310 or 1550	1310 or 1550	1310, 1480 or 1550	1310, 1480 or 1550	1310, 1480 or 1550	1310, 1480 or 1550	1310, 1480 or 1550
Peak isolation	dB	>70	>70	>42	>42	>40	>40	>70
Minimum isolation ±20nm at 25°C		>65	>65	>36	>30	>32	>32	>60
Minimum isolation over 0-60°C	dB	>60	>60	>35	>29	>31	>31	>60
Typical insertion loss ±20nm at 25°C	dB	1.0	1.0	0.15	0.2	0.6	0.4	0.7
Maximum insertion loss ±20nm, -20-+60°C	dB	1.3	1.3	0.2	0.3	1.0	0.5	1.0

Fibre Collimators

The output from a single mode fibre is highly divergent. These fibre collimators provide a simple way of collimating the output from any singlemode fibre for free-space applications such as short reach free-space communication or signal processing by subsequent modulation or filtering. They are highly efficient AR coated lenses introducing very low losses to the system and reducing back reflections significantly. In addition, they are very easy to incorporate as they can be spliced directly onto singlemode fibre or provided with an industry standard connectorised fibre.

Product Code		M-MN-xx-S
Wavelength	nm	850, 1310, or 1550.
Typical insertion loss	dB	0.15
Maximum insertion loss	dB	0.25
Return loss	dB	<-65
Beam Divergence	°	<0.25
Acceptance angle	°	<0.15
Beam diameter	mm	<0.5
Spectral width	nm	>±30
Operating temp	°C	-20, +60



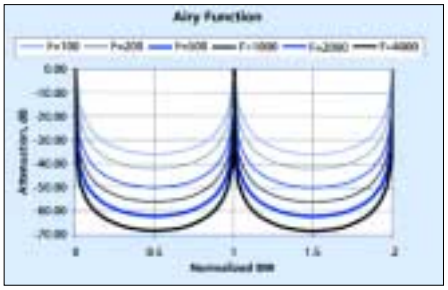
Dense Wavelength Division Multiplexers and Demultiplexers

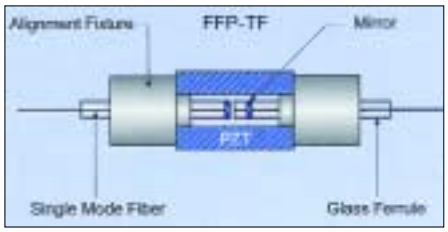
These DWDM filters are designed specifically for multiplexing and demultiplexing 200GHz+ spaced ITU-T GR.692 adjacent sources. The options detailed deliver low loss, high channel isolation for 4-8 channel mux/demux schemes. For higher channel count and smaller spaced channel architectures, AWG mux/demux and FBT interleavers are available (see index).

Product Code		W-DC	W-DF	W-DT	M-DT-2-M	M-DT-2-D	M-AD
Description		Circulator DWDM	Fused biconic tapered fibre DWDM	Thin film DWDM	Thin film DWD mux	Thin film DWD demux	Thin film add-drop mux.
Channel count		4 or 8	4 or 8	4 or 8	4 or 8	4 or 8	-NA-
Centre wavelength	nm	ITU	ITU	ITU	ITU	ITU	ITU
Channel spacing	GHz	1000, 500, 400 or 200	1000, 500, 400 or 200	1000, 500 or 400	200	200	200
Signal bandpass (FWHM)	nm	>0.5	>±1 (4), >±0.5 (8)	>0.8	>0.5	>0.5	>0.5
Insertion loss	dB	<=3.5 (4), <=4.5 (8)	<=2.5 (4), <=4 (8)	<=2.5(4), <=4 (8)	<3 (4), <5 (8)	<3.5 (4), <6 (8)	<1.5 (C-P1), <0.8 (C-P2)
Channel isolation	dB	>=30	>=30	>=30	>=15	>=30 >=40 (non adj)	>=30 (C-P1), >=10 (C-P2)
Uniformity	dB	<=1	<=0.5	<=0.5	<=1.0	<=1.0	-NA-
Directivity	dB	>60	>50	>50	<=50	<=50	>=45dB
Return loss	dB	=>60	>=45	>=50	>=45	>=45	>=45dB
PDL	dB	<0.15	<0.3	<=0.15	<=0.15	<=0.15	<=0.1

Fibre Fabry-Perot Tunable Filter

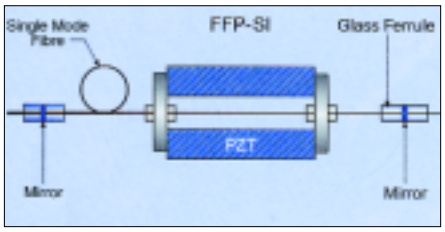
The Micron Optics, Inc. fibre Fabry - Perot tunable filter (FFP-TF), is an all-fibre device that consists of two mirrors deposited directly onto fibre ends, a single - mode fibre (SMF) waveguide (5µm to 10mm in length) bonded to one mirror within the cavity, and a 1-2µm air-gap also within the cavity for tuning. The entire optical configuration is aligned and secured within a piezoelectric actuator (PZT) to allow wavelength tuning and control with positioning accuracy of atomic dimensions.





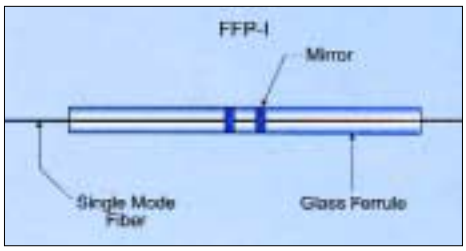
Fibre Fabry-Perot Scanning Interferometer

FFP-SIs are physically differentiated from FFP-TFs by their longer cavity lengths, generally >25mm, thus correspondingly narrow FSR and bandwidth. This configuration allows cavity tuning by directly stretching the fibre cavity via a PZT. In general, the maximum FSR of a FFP-SI is less than 4GHz, and a resolution in the MHz range. This high-resolution capability can enable direct optical investigation of fine optical frequency structure or content. Applications include measuring laser linewidths, mode structure, side-mode suppression, wavelength chirp and modulation content.



Fibre Fabry-Perot Interferometer

FFP-Is do not have tuning ability provided by the PZT actuators and thus are fixed filters. However, they can be packaged with a ther mo-electric control (TEC) to allow thermal tuning. FFP-Is can be fabricated with different FSR and finesse. As an application example, a 1mm-long FFP-I has a comb of resonance peaks spaced by 100GHz, and can be used as a multi-wavelength reference or an incoherent comb source by incorporating a broadband input source.



Wavelength Scanning

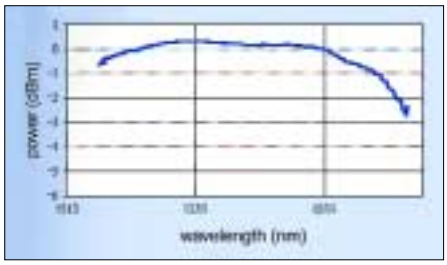
		FFP-TF	FFP-SI	FFP-I
		Fibre Fabry-Perot tunable filter	Fibre Fabry-Perot scanning interferometer	Fibre Fabry-Perot interferometer
Operating wavelength range, S-band	nm	1480-1520	1480-1520	1480-1520
Operating wavelength range, C-band	nm	1520-1570	1520-1570	1520-1570
Operating wavelength range, L-band	nm	1570-1620	1570-1620	1570-1620
Free spectral range (fixed but selectable within this range)	GHz	10-10,000	0.01-4	5-8000
Finesse (other options available)		10,40,100,150,200, 650,1000,2000	10,40,100,150,200, 650,1000,2000	10,40, 100
Insertion loss	dB	<2.5	3-6	3
Input power	mW	<200	<100	<200
Tuning voltage FSR/total	VDC	12/70	12/70	Fixed (thermal tuning only)

Please note that specifications are inter - dependent and may be mutually exclusive.

Swept Laser - Component Test System

- ***Fast spectral measurement***
- ***High optical resolution***
- ***Wide dynamic range***
- ***High accuracy***
- ***Expansion with 4 channel photodetector array***
- ***EDFA power boost***
- ***Rack mountable or stand alone Labview ™ software***

Micron Optics' SL-CTS allows for fast, accurate and continuous characterisation of DWDM components. The system includes a swept-laser source, an internal power monitor for normalisation, the patented picoWave™ multiwavelength reference, and a detector module for measuring devices in either transmission or reflection. The whole system is controlled via LabView™, which can be customised by the user.



Specifications		
Operating range	nm	1520 - 1570
Narrow linewidth	GHz	1
Rapid acquisition time	ms	<200
Wavelength accuracy	pm	±5
Total power	mW	1
Dynamic range	dB	60

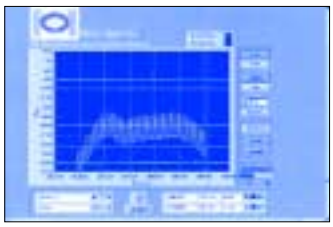
Instrumentation

Manufacturing Optical Spectrum Analyser

- ***Wavelength, power and OSNR measurements***
- ***High accuracy and reliability***
- ***More than 400 channel capacity***
- ***25 GHz channel spacing***
- ***10 GHz channel resolution***
- ***Compact and rugged***

Micron Optics, Inc. has combined the rugged, field proven Fibre Fabry - Perot Tunable Filter (FFP-TF) technology with high accuracy multi - wavelength referencing techniques to create an accurate and reliable, low - cost alternative to the bench top optical spectrum analyser (OSA) for the modules and systems level manufacturing floors. Micron Optics' Manufacturing Optical Spectrum Analyser (MOSA) performs all of the functions of the traditional bench top OSA on a significantly smaller footprint and at a much lower cost. Measuring only 298 x 18 x 48mm, the MOSA is encased in a rugged aluminium package, ready to withstand the occasional knocks and bumps of a manufacturing environment. In fact, the FFP-TF inside the MOSA has been measured to withstand over 26 Gs of lateral acceleration.

The MOSA is based around a PC processor, and can be driven as a stand alone instrument or under LabView by another PC controller.



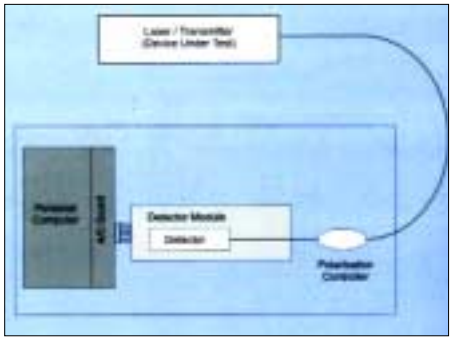
Specifications		
Wavelength		
Range	nm	1520 - 1570
Spectral resolution (FWHM)	pm	40
Channel resolution	GHz	10
Accuracy[1]	pm	± 30
Power		
Range	dBm	-70 to +10
Resolution	dB	0.01
Accuracy	dB	± 0.5
Temperature range	°C	0 - 65
OSNR[2]		
Range (peak power > -30 dBm, channel spacing = 100GHz)	dB	26
Range (peak power > -30 dBm, channel spacing = 50GHz)	dB	24

1. Accuracy specification applies over entire temperature range 0°C to 65°C. Based on the targeted application , a ± 0.7 dB version is also available.
2. ± 1dB OSNR accuracy

Optical Mode Analyser

- *High optical resolution*
- *Low insertion loss*
- *Wide dynamic range*
- *C & L-band operation (1520 - 1620nm)*
- *Rapid spectral acquisition*
- *LabView™ software*
- *Rack mountable or stand - alone*

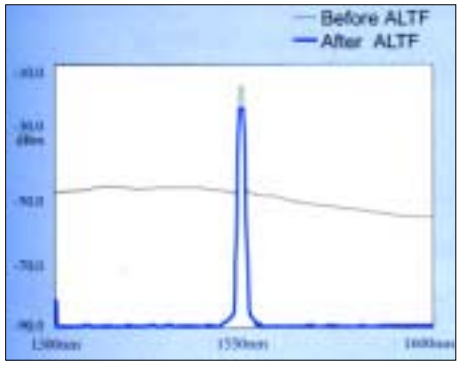
By incorporating the high - resolution capability of Micron Optics' Fibre Fabry - Perot Scanning Interferometer (FFP-SI), wide dynamic-range detection, and fast analogue - to - digital conversion onto a PC platform, the resulting OMA system can offer a very convenient tool for measuring laser linewidth, transmitter modulation sidebands, side-mode suppression levels, as well as polarisation side modes.



Specifications		
Operating range: C-Band	nm	1520 - 1570
L-Band	nm	1580 - 1620
FSR	GHz	1-4
Optical resolution	MHz	1-40
Rapid acquisition time	ms	<200
Dynamic range	dB	60

Automatic Laser Tracking Filter

- *Low insertion loss*
- *Automatic control circuitry*
- *Signal lock indicator*
- *Stand alone or daughter board*
- *Compact and rugged*
- *Turnkey operation*



The Micron Optics, Inc. Automatic Laser Tracking Filter (ALTF) provides automatic, effective suppression of stimulated spontaneous emission (SSE) noise on laser sources. The ALTF combines the high performance of the MOI Fibre Fabry - Perot Tunable Filters with automatic scan and lock circuitry to enable turnkey suppression of unwanted broadband noise.

Specifications		
Noise reduction	dB	21
Wavelength range	nm	1500 -1600
Input power range - option 010	dBm	+10 to -20
Input power range - option 020	dBm	+0 to -30
Tracking speed	nm/sec	100
Acquisition time	msec	400
Input & output isolation	dB	-30
Insertion loss	dB	4
Loss ripple	dB	0.5
Polarisation dependent loss	dB	0.1

Card Mounted Optical Channel Analyser

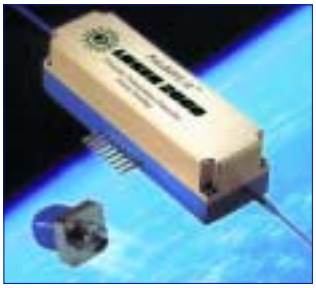
- *Wavelength, power and OSNR measurements*
- *High accuracy and reliability*
- *More than 400 channel capacity*
- *25 GHz channel spacing*
- *10 GHz channel resolution*
- *Compact and rugged*
- *Excellent thermal and long - term stability*

The Micron Optics, Inc. Card Mounted Optical Channel Analyser (CMOCA) is a fully functional optical spectrum analyser specially tailored to meet the stringent needs of today's DWDM and ultra - long - haul optical transmission systems.
The CMOCA utilises MOI's state of the art finesse 2000 Fibre Fabry - Perot Tuneable Filter to provide highly accurate and repeatable measurements of optical power, wavelength, and optical signal - to - noise ratio (OSNR) on more than 400 DWDM channels, simultaneously.

Specifications		
Wavelength		
Range	nm	1520 - 1570
Spectral resolution (FWHM)	pm	40
Channel resolution	GHz	10
Accuracy[1]	pm	± 30
Power		
Range	dBm	-70 to +10
Resolution	dB	0.01
Accuracy	dB	± 0.5
Temperature range	°C	0 - 65
OSNR[2]		
Range (peak power > -30 dBm, channel spacing = 100GHz)	dB	26
Range (peak power > -30 dBm, channel spacing = 50GHz)	dB	24

1. Accuracy specification applies over entire temperature range 0°C to 65°C. Based on the targeted application , a ± 0.7 dB version is also available.
2. ± 1dB OSNR accuracy

Dynamic Polarisation and Phase Controllers



Controller / Scrambler

- ***No intrinsic insertion loss***
- ***No intrinsic back reflection***
- ***No wavelength dependence***
- ***Compact, ideal for integration in modules***
- ***Fast response time***
- ***Endless polarisation control***

General Photonics' all fibre dynamic polarisation controller is specially designed for original equipment manufacturers (OEM) for integration into their fibre optic network modules and test equipment. The all fibre construction practically eliminates all insertion loss and back reflection. The device can be used as a fast electronic - driven polarisation controller to convert any input polarisation into any desired polarisation or as a polarisation scrambler to randomise the output polarisation state. The low insertion loss, low back reflection, low cost, compact size, and fast response time are the most desirable features of this device.

Product Code		PCS-xx	Phase Shifter
Description		Dynamic polarisation controller/scrambler	All fiber phase shifter
Wavelength	nm	1200-1620	1260-1650
Insertion Loss	dB	0.05	0.05
Return Loss	dB	69	69
Rise/fall time	µsec	30	-
3dB bandwidth	kHz	20	-
Scrambling frequencies	kHz	Ca. 60, 100, 130 (calibrate for individual units)	-
Vπ at DC	V	35 @1550nm	-
Vπ at scrambling frequencies	V	7 @60kHz, 6 @100kHz, 3.6 @130kHz (all at 1550nm)	-
Total phase shift at DC	π	-	3
Half wave voltage at DC	V	-	35 (@1550nm)
Total phase shift at 4kHz	π	-	20
PDL	dB	-	0.1
Residual amplitude modulation	dB	-	0.01
Maximum power	mW	-	300

All Fibre Phase Shifter

Applications:

- ***Fibre interferometer systems***
- ***Fibre laser systems***
- ***Fibre sensor systems***

General Photonics' all fibre phase shifter / modulator provides phase shifts up to 3π at DC and 20π at selected frequencies. The all fibre construction practically eliminates insertion loss and back reflection. This compact device is ideal for fibre laser systems, fibre resonators, and fibre interferometers for precision phase tuning or phase modulation.

Manually Variable Optical Delay Line-VariDelay™

Applications:

- ***Passive time division multiplexing***
- ***TDM bit alignment***
- ***Interferometers***

General Photonics' manual variable optical delay line provides precision optical path variation up to 20cm (660 ps). Driven by a DC motor with an integrated encoder, the device has a fine delay resolution of sub - micrometers. The compact and rugged design makes the device ideal for integration into network equipment and test instruments, or for use in the laboratory for precision optical path length or timing alignment.

Product Code		VariDelay	VariDelay
Description		Manually Variable Optical Delay Line	Motorised Variable Optical Delay Line
Operating wavelength	nm	1550±100	1550±100
Insertion loss	dB	1	1
Return Loss	dB	50	50
Delay range	cm (psec)	10 (330) or 20 (660)	10 (330) or 20 (660), speed 1mm/sec.max
Delay resolution	µm	0.1	0.5
PDL	dB	0.1	0.1
Maximum Power	mW	300	300

Differential Group Delay Lines

Dynamic Differential Group Delay Line - DynaDelay™

Applications:

- ***Polarisation mode dispersion compensation***
- ***TDM bit alignment***
- ***True-time delay for steering phased array antenna***

General Photonics' high speed variable differential group delay (DGD) line provides a varied amount of group delay difference between two linear orthogonal polarisation states. The amount of DGD can be digitally switched in just 35µs from 0ps to 43ps with a resolution of 0.7ps (6-bit resolution). It can include an integrated polarisation detector to facilitate polarisation alignment in PMDC modules. In addition to PMD compensation, this patented device can also be used for precision TDM bit alignment and as a true-time delay for steering phased array antennas.

Differential Group Delay Line - PolaDelay™

Applications:

- ***Polarisation mode dispersion compensation***
- ***Polarisation mode dispersion emulation***

General Photonics' differential group delay line provides a specific amount of group velocity difference between two linear orthogonal polarisation states. It includes an integrated polarisation detector to facilitate polarisation alignment in PMDC modules. It can be used to replace the bulky and expensive PM fibre spools to equalise the differential group delay accumulated in the transmission fibre links.

Product Code		PolaDelay	DynaDelay
Description		Differential group delay line	Dynamic differential group delay line
Wavelength	nm	1500±100nm	1500±100nm
Insertion loss	dB	0.8	1.5
Return Loss	dB	50	50
DGD	ps	86ps as standard (others available)	Variable from 0 to 43
Resolution	ps	-	0.7
Speed	µsec	-	35
PDL	dB	0.1	0.1
Maximum power	mW	500	300

High Speed In-Line Polarimeter - PolaDetect™

Applications:

- ***Simplify and speed up polarisation stabilisation and PMD compensation algorithms***

General Photonics' in-line polarimeter is specially designed for low cost and high-speed polarisation characterisation. It outputs three Stokes parameters of either the input or the output state of polarisation of the light passing through the device in sub-milliseconds, and is ideal for integating into PMD compensaton and polarisation stabilisation modules to increase their operation speeds. It can also be used in polarisation characterisation instruments. This unique device represents another major step forward for polarisation control.

Product Code		PolaDetect
Description		High speed in-line polarimeter
Wavelength range	nm	1500±100
Insertion loss	dB	1.5
Return loss	dB	50
PDL	dB	0.1
Measurement speed	µs per measurement	100
Measurement accuracy	±° on Poincare sphere	1
Maximum power.	mW	300

Planar Lightwave Circuits

Singlemode Splitter

High channel count FBT splitters can only be manufactured by cascading lower channel count splitters together. The effect of this is to introduce large variations in the uniformity across the output channels and ultimately leads to significant deviations from what should be an equal split ratio across each of the output ports.

The Laser 2000 range of PLC singlemode splitters delivers high uniformity across large channel counts with relatively low insertion loss. PLCs are particularly suited to those applications requiring a wide operating temperature (-40~85°C) or a wide operating spectra (1310+/-30nm and 1550+/-60nm).

Description		Singlemode PLC Splitter	Singlemode PLC Splitter	Singlemode PLC Splitter	Singlemode PLC Splitter
Product code		SP-SM-104	SP-SM-108	SP-SM-116	SP-SM-132
Wavelength range	nm	1310±30 or 1550±30	1310±30 or 1550±30	1310±30 or 1550±30	1310±30 or 1550±30
Number of ports		1x4	1x8	1x16	1x32
Insertion loss (Ave.)	dB	7	10.2	13.5	17.0
Insertion loss (Max.)	dB	7.5	11	14.5	18.0
Uniformity	dB	<=0.8	<=1.0	<=1.5	<=2.0
Return loss	dB	<=-50	<=-50	<=-50	<=-50
Directivity	dB	<=-50	<=-50	<=-50	<=-50

Polarisation Maintaining Splitter

PM PLC splitters offer an economic alternative to fully fused (FBT) PM splitters, whilst only showing a small increase in insertion loss. In addition, they are smaller and more compact than cascaded FBT splitters.

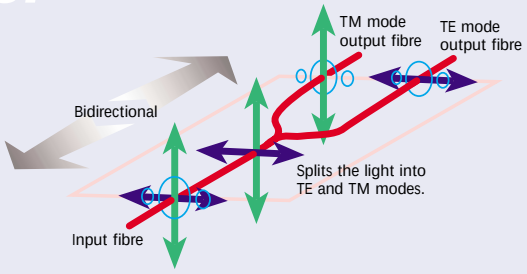
Polarization maintaining PLCs are particularly suited to those applications requiring a wide operating temperature (-40~85°C) or a wide operating spectra (1310+/-30nm and 1550+/-60nm).

Description		PM splitter
Product code		EOS-xx
Wavelength range	nm	1310±30 or 1550±30
Number of ports		1x2, 1x4, 1x8, 1x16
Excess insertion loss	dB	<3
Uniformity	dB	<0.5
Extinction ratio	dB	>20

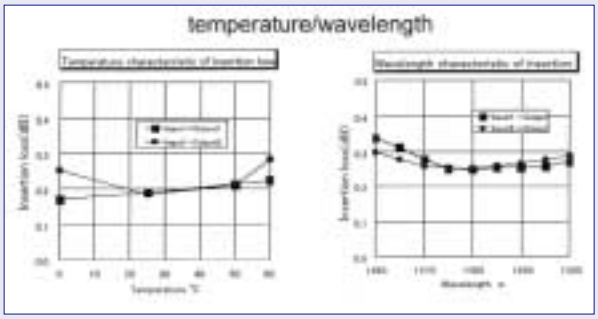
Polarisation Beam Combiner

Laser 2000 provides micro-optic thin film filter technology to combine beams of various different wavelengths, output powers or polarization states. In this case,the polarisation beam combiner allows two beams of orthogonal polarisation to be combined in a single fibre, whilst minimising losses.

They are especially useful in RAMAN and high power EDFA applications where multiple pumping architectures require the use of polarisation multiplexing in addition to WDM in order to increase the pump density on a single fibre. For details of high power WDMs, see "Wavesplitter Wavepump".

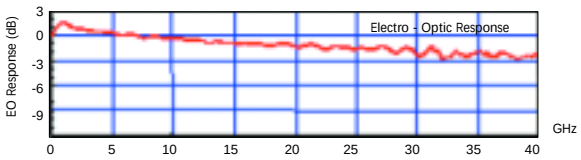


Specifications		Polarisation Mux / Demux
Wavelength	nm	1460 to 1490
Insertion loss	dB	0.5 max.
Return loss	dB	50 min.
Output fibre		Corning SMF28
Input 1 & 2 fibre		Fujikara polarisation maintain
Fibre length	m	1
Operation temperature	°C	0 to 50
Storage temperature	°C	-40 to 85
Maximum optical power	mW	300
Dimension	mm	34 x 12.8 x 6



Phase and Intensity Modulators

Laser 2000 Lithium Niobate intensity modulators are designed for use with PM pigtailed CW lasers for high bit rate, extra-long haul, synchronous digital transmission systems. They feature low insertion loss and low modulation voltages to enable highly efficient modulation at the fastest transmission data-rates. In addition to the products detailed here, custom MZI configurations are also available.



40 Gb/s Modulator

A low - loss and wideband intensity modulator for OC-768 applications.

Phase Modulator

A low-loss and wideband phase modulator for chirp control or coherent optical applications.

10 - 12.5 Gb/s Modulator

A low - loss extended bandwidth intensity modulator for OC-192 applications using Forward Error Connection (FEC).

Description		40Gb/s intensity modulator	10-12.5Gb/s intensity modulator	10-12.5Gb/sec phase modulator
Operating wavelength	nm	1310 or 1550	1310 or 1550	1550, 1310, 1064
Insertion loss	dB	<3	<3	<3
3dB bandwidth	GHz	>30	>12	>12
S11 (0.13-30GHz)	dB	<-10	<-10	<-10
Vπ (mod port @ 1GHz)	V	<6	<4.5	<6
Vπ (bias port)	V	<10	<10	-na-
Return loss	dB	>45	>45	>45
Crystal cut		Z-cut (negative chirp)	Z-cut (negative chirp) or X-cut optional	-na-
Input fibre		PM	PM	PM
Output fibre		SM or PM	SM or PM	SM or PM

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