FIBRAIN®
PASSIVE OPTICAL NETWORK

ELMAT
DOSTAWCA TELEINFORMATYKI

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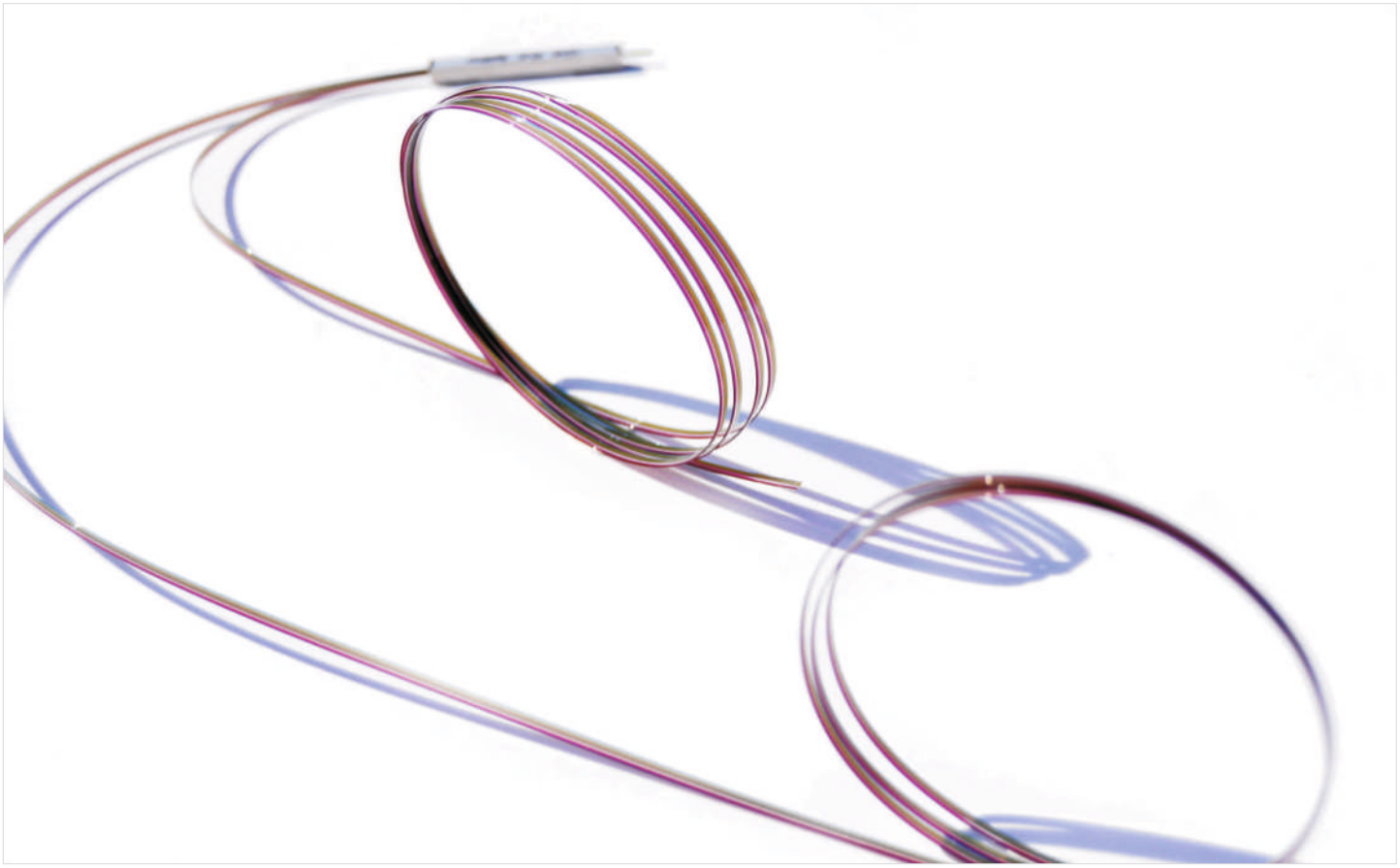


Passive Optical Network Products 2012/13

FIBRAIN.COM

version 1.4

02

Fiber Optical Cables

Optical Elements - PON

Contents

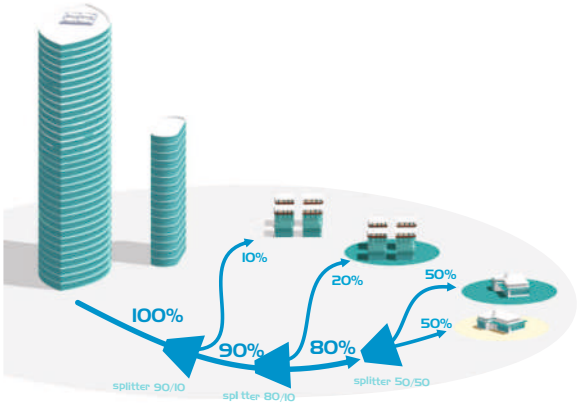
PON systems for FTTH Network - Fibrain PON

FTTH networks are typically based on the single-mode fiber optic cables. The aim is to connect a large number of users using a single fiber strand, so to a single fiber up to 128 subscribers can be connected (the current standard is 64 subscribers). To achieve this, optical signal is split onto a number of ports. Signal division can be done with the FBT or PLC splitters that can be located in different network points. Depending on the location of splitters, the network topology could be of the star type or bus type. Mixed topologies (the so called cascaded stars) are also possible.

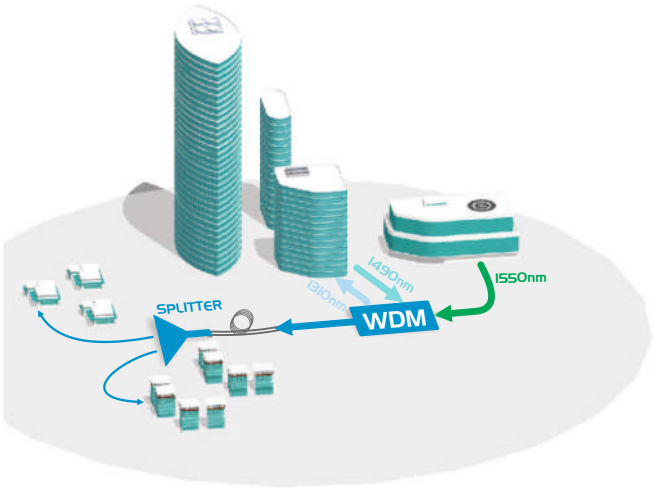
Additionally, different kind of WDM filters, which normally facilitate adding and transferring of the signals at different wavelength may be used in the network. Presently, the 1550 nm, 1490 nm and 1310 nm wavelengths are the most popular in modern FTTH networks.

PON networks main advantages are cost-effectiveness and available bandwidth per user. They efficiently solve the ever more pressing problem of the low transmission speed and low signal quality in the last mile of the network, which allows operators offering the triple play services (i.e. internet access, telephony and TV) using common infrastructure.

Scheme of power distribution in optical networks



FTTH network in bus topology – power splitting only.



FTTH with CATV overlay – transmission of 1310 nm, 1490 nm and 1550 nm signals.

Scheme of signal division in the FTTH networks with use of splitters

Attenuation (dB)	Range (%)	
	Transmission	Attenuation
1.0 dB	~79.40 %	~20.60 %
2.0 dB	~63.10 %	~36.90 %
3.0 dB	~50.10 %	~49.90 %
4.0 dB	~39.80 %	~60.20 %
5.0 dB	~31.60 %	~68.40 %
6.0 dB	~25.10 %	~74.90 %
7.0 dB	~19.90 %	~80.10 %
8.0 dB	~15.80 %	~84.20 %
9.0 dB	~12.60 %	~87.40 %
10.0 dB	~10.00 %	~90.00 %
11.0 dB	~7.90 %	~92.10 %
12.0 dB	~6.30 %	~93.70 %
13.0 dB	~5.00 %	~95.00 %
14.0 dB	~4.00 %	~96.00 %
15.0 dB	~3.20 %	~96.80 %
16.0 dB	~2.50 %	~97.50 %
17.0 dB	~2.00 %	~98.00 %
18.0 dB	~1.60 %	~98.40 %
19.0 dB	~1.30 %	~98.70 %
20.0 dB	~1.00 %	~99.00 %

Scheme of signal division in the FTTH networks with use of splitters

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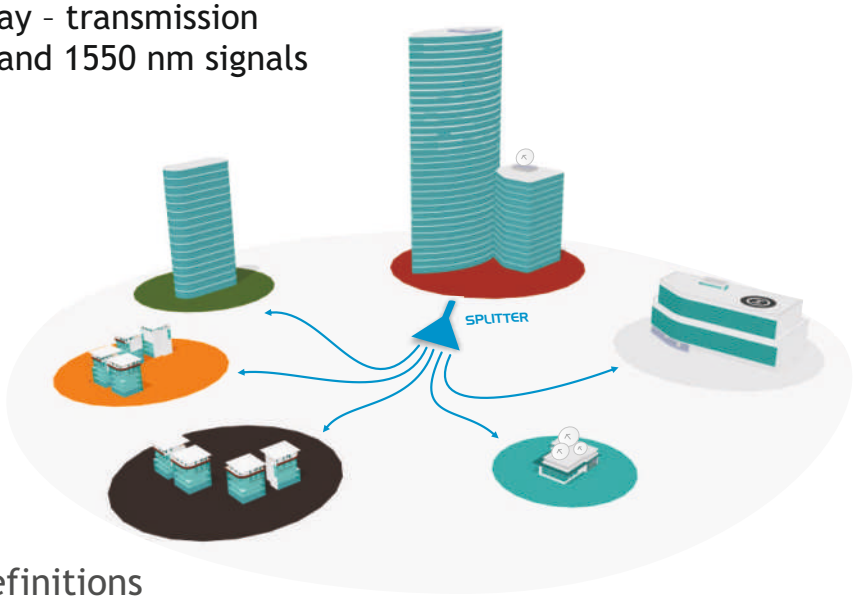
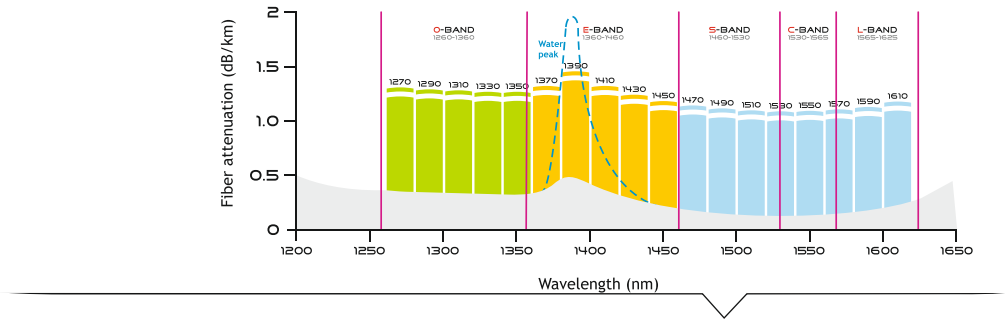
FTTH with CATV overlay – transmission of 1310 nm, 1490 nm and 1550 nm signals



Index of terms and definitions

Attenuation	- reduction of the signal magnitude or loss, caused by absorption and scattering. Values are normally expressed in decibels (dB).
Attenuator	- a passive device for reducing the amplitude of a signal without distorting the waveform.
Bidirectional	- a device, which operates in both directions.
Broadband Device	- optical broadband devices cover a wide range of wavelengths.
Center Wavelength	- the nominal operating wavelength of an optical device.
Coupler	- a bidirectional device with three or more fiber ends, combining the signals of two or more input ports into one output port. Also referred to as splitter.
Decibel (dB)	- a logarithmic unit of measurement for calculating the attenuation of an optical device or an optical system. A change of -3 dB equates to the halving of the optical power.
Demultiplexer	- a device that separates two or more multiplexed signals into its original single signals; the inverse of a multiplexer.
Directivity	- the amount of undesired optical signals observed at a given input port of a device. Also referred as near-end crosstalk (NEXT).
Dual Window	- a passive optical component that is optimised to operate at two different center wavelengths. For example at 1310 nm and 1550 nm.
Excess Loss	- attenuation or loss of the optical component itself, without including any attenuation effects of the device due to signal splitting.
Fused Biconical Tapering (FBT)	- a manufacturing process for passive optical network components. It consist of twisting bare fibers together, stretching and then fusing the fibers together
Insertion Loss (IL)	- a sum of excess loss, splitting loss and loss caused by other optical effects. Total loss experienced by signal traversing the device.
Isolation	- the amount of undesired optical signals observed at a given output port of a device. Also referred as far-end crosstalk (FEXT).
Multiplexer	- a device that combines two or more signals into a single output; the inverse of a demultiplexer.
Operating Wavelength	- the wavelength, or wavelength range, for which a passive optical component is optimised for operating.
Planar Lightwave Circuit (PLC)	- a manufacturing process for optical passive network components. Its main components is a waveguide array that is induced in a silica chip by using a photolithographic masking process.
Polarization Dependent Loss (PDL)	- changes in attenuation caused by the state of polarisation (SOP). This optical effect results in a deviation between the maximum and minimum loss on an optical device.
Return Loss (RL)	- the ratio of optical power reflected back along the path of transmission from a connector or any other optical device . Values are normally expressed in decibels (dB).
Single Window	- a passive optical component that is optimised to operate at a single specified center wavelength. For example at 1310 nm or 1550 nm.
Splitter	- a bidirectional device with three or more fiber ends, which divides the signal from one input port into two or more output ports. Also referred to as coupler.
Splitting Ratio	- the percentage of optical power transferred to an output port of an optical device, with respect to the total power at the input to the device.
Uniformity	- the maximum deviation of insertion loss between the different ports on a device within the operating wavelength range.
Wavelength Division Multiplexing (WDM)	- a technique of transmitting various signals at different wavelengths through the same fiber.



xWDM Technologies

Solution as:

- WDM (Wavelength Division Multiplexer),
- CWDM (Coarse Wavelength Division Multiplexer Device),
- DWDM (Dense Wavelength Division Multiplexer Device),

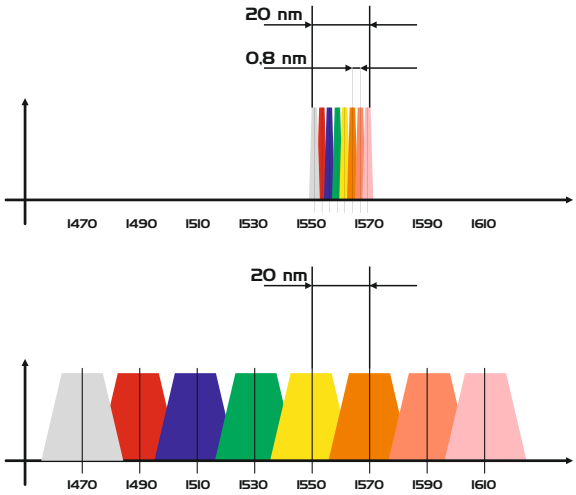
unlikely to splitters cause multiplication of optical signal transmitted in one optical fiber by simultaneous transmission of different wavelength signals. It facilitates dynamic and effective increase of transition possibilities of network based on these solutions. These technologies are “optically transparent” that allows to use them independently to protocol used.

Technology basis

The idea of xWDM systems is very simple and is based on basic electromagnetic waves features. These waves of different length do not interfere between each other and there is possible simultaneous transmission in one fiber. At transmission side each signal that is transmitted is to be modulated at strictly given wave length. Further are input into one optic fiber by optic multiplexer (MUX passive device). At the other optic fiber end is located demultiplexer (DEMUX passive device), that separates optical beam into waves of given length. Connection point-point is the simplest CWDM network topology. On its basis one may create networks where single wave (signals transmitted at single wave length) is isolated from transmission duct for instance by 20 km by use of ADD-DROP devices (passive device) at location that we are suppose to connect to our network.

Information worth remembering is specification of transmitting duct it is one directional. For bidirectional transmission it is necessary to use at each side pair of multiplexer and demultiplexer (MUX/DEMUX). In general CWDM system consists of active part that is responsible for transmission of wave at given length and signals received at the other end as well as passive part multiplexing and demultiplexing signals transmitted at different lambdas.

Whole transmission is performed in specific optic windows that are characterized by different attenuation at given wave length. The number of signals in one fiber depends on distance between wavelengths used. It is essential difference between Dense WDM and Coarse WDM systems. DWDM uses minimal distances between wavelengths (typical 0.8 nm) facilitating multiplexation of 128 channels in comparison to 18 channels for CWDM.



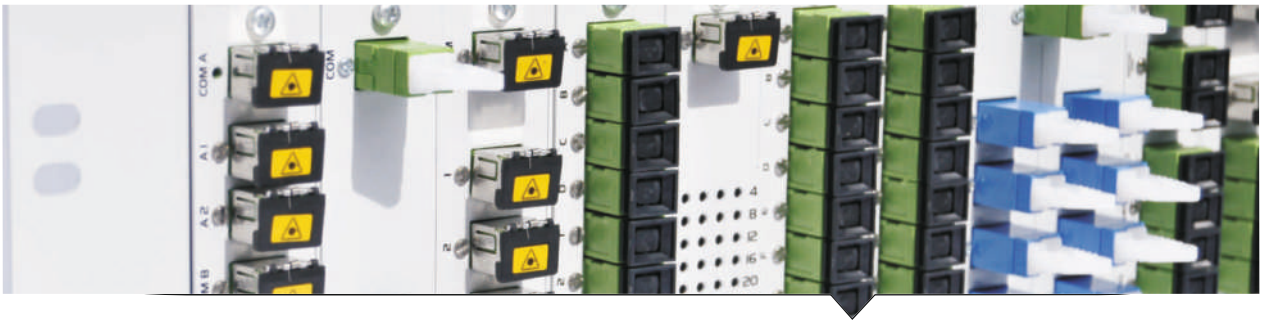
Overview of optical transmision bands:		
Band	Wavelength range	Description
O - Band	1260 nm - 1360 nm	Original band
E - Band	1360 nm - 1460 nm	Extended band
S - Band	1460 nm - 1530 nm	Short wavelength band
C - Band	1530 nm - 1565 nm	Conventional band
L - Band	1565 nm - 1625 nm	Long wavelength band
U - Band	1625 nm - 1675 nm	Ultra long wavelength band

Overview of optical bands.

Dense insertion of channels is basic requirement at Telecom market, it requires use of high-precision optic elements (it specially concerns transmitting lasers demanding voltage and temperature stabilization) and that is reflected in price of DWDM solutions.

Optical Elements- PON

xWDM Technologies



On the other hand metro networks demands multiplexation of the comparatively small channels number. There it is area for CWDM technology using wider spaces between wavelengths (typically 8 channels, every 20 nm in whole bandwidth there are 18 channels). Above products specification and it's requirements regarding precision of their components decrease costs of CWDM solutions that makes them very accessible at MAN network operators and enterprises requiring linking several independent systems located at distance of several dozen kilometers.

Differences between CWDM vs DWDM

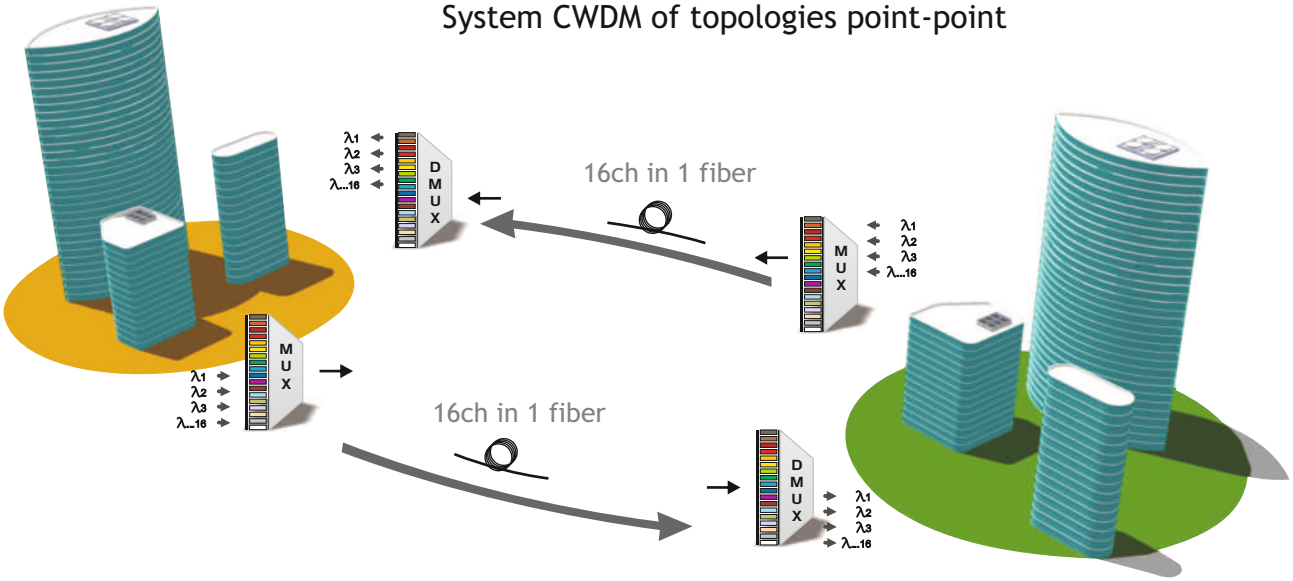
Basic difference between these technologies is distance between multiplexed wavelengths that considerable reflects the price. However very important factor influencing their usage is range. With DWDM technology is possible regeneration of signal and though extension of signal even up to 1000 km thanks to optical amplifiers placed every several dozen kilometers. In case of CWDM lack of a such possibility is result of use of wider spectrum of wavelengths existing optical amplifiers are not able to amplify signal of such a wide band of frequencies. Regarding above within CWDM technology only one way of signal range extension is use of more sophisticated electric method (optical demultiplexation, electric regeneration/retiming of each channel separately in one optic fiber link).

Topologies

Point - Point

The simplest and very popular topology in CWDM system is point-point. It facilitates transmission up to 18 channels between two localizations in one fiber optic link.

System CWDM of topologies point-point

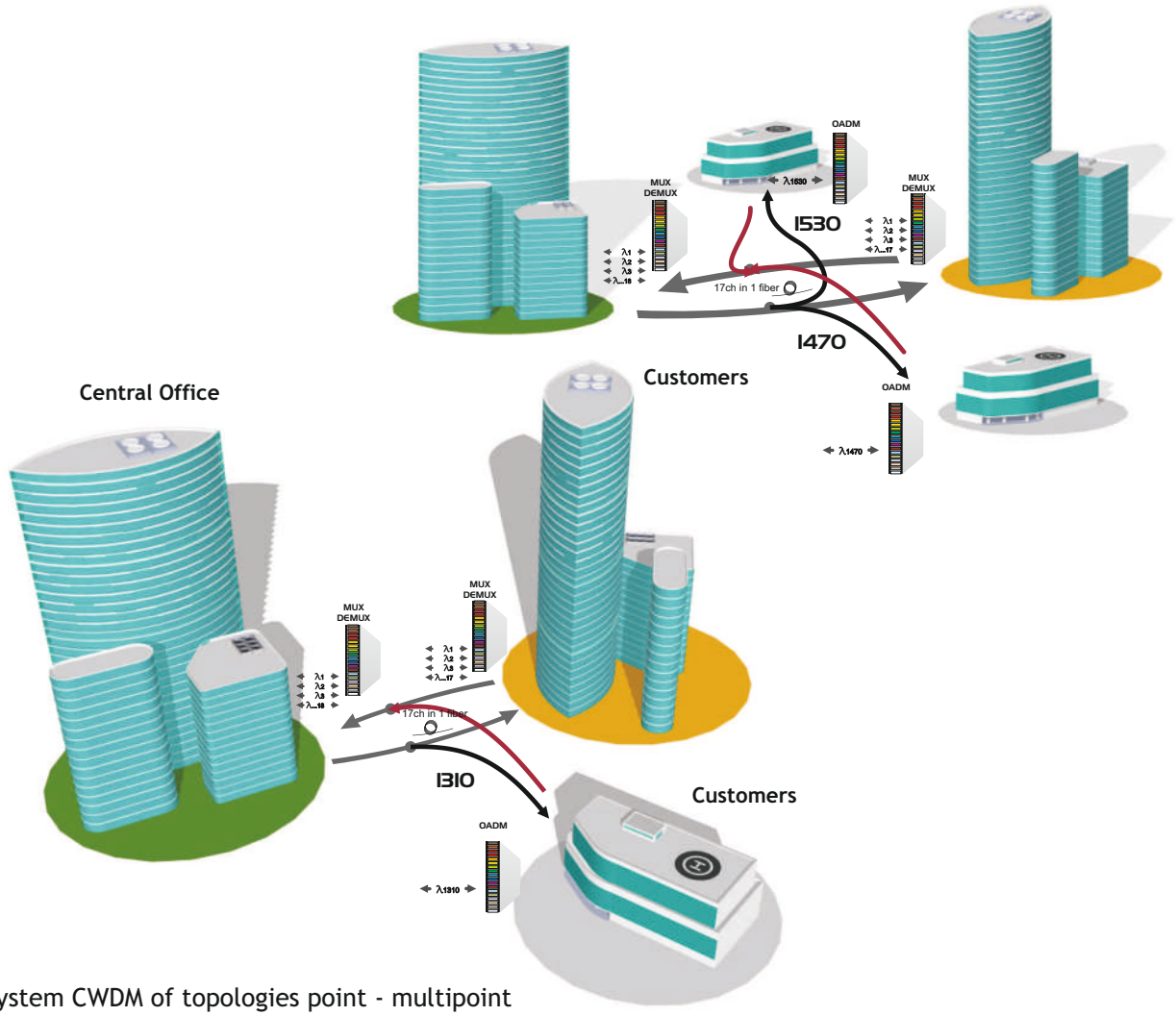


Interesting feature of CDWM systems is possibility of bidirectional transmission in one optic fiber. However in this solution we use different wavelengths for transmission and receive that decreases by half the number of channels available. Another solution is transmission and receive at the same wavelength (lambda) with use of optical circulator that results in duplication of system capacity based on pair of fibers.

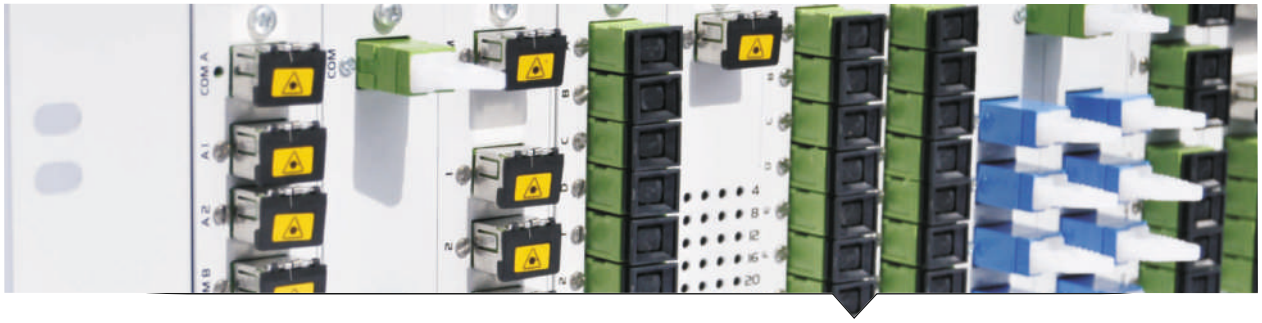
Point - Multipoint

More sophisticated topologies may be constructed by use of add/drop multiplexers (Optical Add/drop Multiplexer AODM) that are to distinguish one, two or four lambdas and transparent transmission of waves of different lengths. Unlikely to classic MUX/DEMUS module OADM has a two line interfaces (often marked as a east and west) and from two up to eight local interfaces (two interfaces for each lambda separately for directions east and west). With use of OADM modules one may connect CWDM systems into topology point multipoint or ring.

System CWDM of topologies point - multipoint



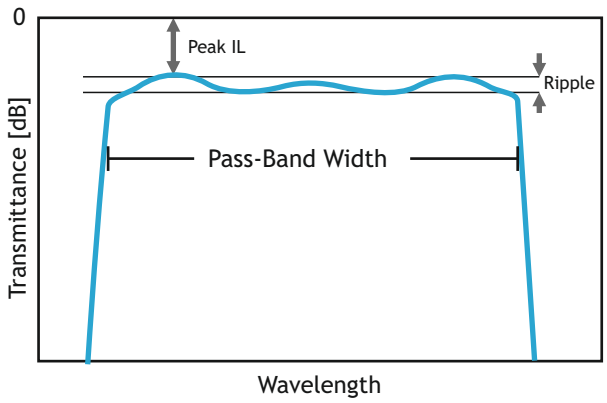
System CWDM of topologies point - multipoint

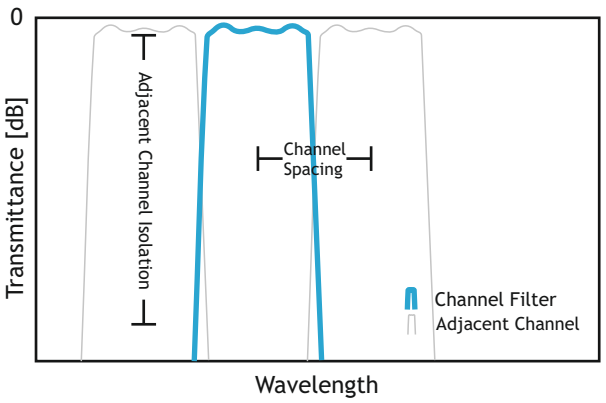


Basic parameters of xWDM devices – measurement definitions

CDWM filter is a device that separates signal of single lambda (wavelength) from many signals transmitted at different wavelengths. Optical signals are input into Common port, separation is made by passing specified wavelength (dedicated lambda) to pass port and the rest of spectrum transferred is reflected to reflect port. In the same way one may add signals to transmission.

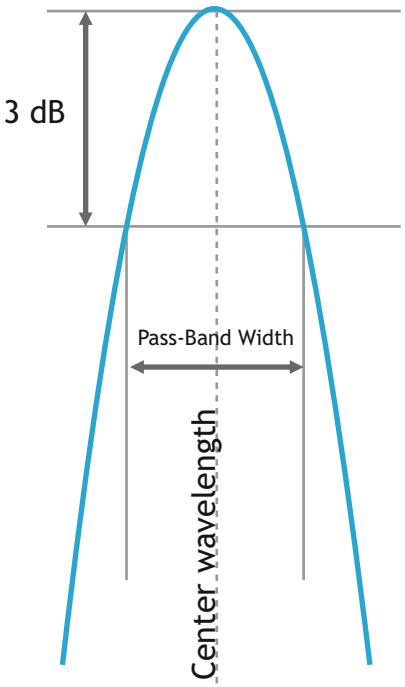
Pass Band Width and Isolation must be harmonious for specific interchannel space in CWDM and DWDM system.



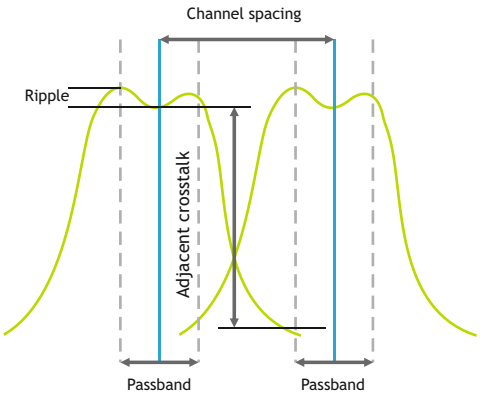


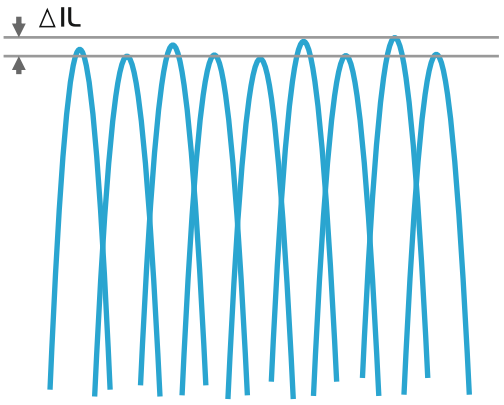
Center Wavelength [nm]
It is an average wavelength basing on 2 points of signal transmittance curve of the same level. Typical level is FWFM (Full Width Half Maximum) or -3 dB. At this level transmittance ripple and other pass-band defects do not influence.

Pass-band (PB) [nm]
Width of pass-band given in nm where transmittance is the highest. Usually is defined for given transmittance threshold (-0.5, -3, -20 dB). Pass band width is specified as a certain transmittance in relation to maximum level in given bandwidth.
For example: Pass-band @ - 0.3 dB: 1530-1570 nm also Pass-band can be specified as a center wavelength and bandwith around it.
For example: Center wavelength @ -0.3 dB: 1550+/-0.5 nm.
Bandwidth @ -0.3 dB > 40 nm.



Isolation
Difference between transmittance minimum T within pass band and maximum T of the same filter in pass band of other channel. Typically directly adjacent channels have lower isolation in comparison to non-adjacent channels.





Polarization Dependent Loss (PDL) [dB]
Maximum change of observed transmittance difference T for given λ towards SOP change.
Transmittance PDL(λ) [dB] = Ts(λ) [dB] - Tp(λ) [dB].
Peak Insertion Loss (IL) [dB].
It is maximum transmittance T within pass-band.
Peak IL = T(λPeak) [dB].
For example: Peak IL,0,1 dB inside pass-band.

Uniformity of insertion loss △IL
It is difference of maximum and minimum attenuation among all channels.

Pass Band Ripple [dB]
Usually one specifies it as difference of maximum and minimum transmittance within pass-band.

Directivity
It is a measure of transmitted signals penetration and undesired dispersion that increases attenuation between ports pass and reflect.

Polarization Mode Dispersion
It is a measure of optic signals dispersion caused by different polarizations of different speeds optic singals transmitted.

Optical Elements - PON

CPL FBT (Fused Biconical Tapering) Splitters/Couplers

FBT Splitters/Couplers

Fibrain optical splitters of the CPL family are used for splitting of optical power irrespective of the signal wavelength (within the operating region). They are available in different production variants. The CPL series couplers are made in the FBT (Fused Biconical Tapering) process. The advantages of this technology include very small excess loss, low reflectance, low PDL and small size. For 1x2 couplers, any custom split ratio is available.

Technical specification:

Standard single window			
Type	**1x2; 2x2**	**1x3**	**1x4**
Power split	1-50%	33.3/33.3/33.3*	25/25/25/25*
Wavelength	1310 / 1550 nm /other		
Bandwidth	+/-40 nm		
Uniformity	<=0.5 dB	<=1.1 dB	<=1.4 dB
PDL max.	<=0.15 dB		
Max. Attenuation	<=3.4 dB 50/50	<=5.6 dB	<=7.2 dB
Directivity	>=55 dB		
Temperature stability	0.002 dB/°C		
Operating temperature	-40°C to +85°C		

*other split ratios available per individual order

Example of power split/attenuation:			
Type	**1x2; 2x2**	**1x3**	**1x4**
	1/99 21 dB / 0.2 dB		
	10/90 10.8 dB / 0.6 dB		
	20/80 7.60 dB / 1.2 dB		
	30/70 5.80 dB / 1.9 dB		
	40/60 4.40 dB / 2.5 dB		

Dual window 1310&1550 nm			
Type	**1x2; 2x2**	**1x3**	**1x4**
Power split	1-50%	33.3/33.3/33.3*	25/25/25/25*
Wavelength	1310 / 1550 nm /other		
Bandwidth	+/-40 nm		
Uniformity	<=0.6 dB	<=1.1 dB	<=1.4 dB
PDL max.	<=0.15 dB		
Max. Attenuation	<=3.6 dB 50/50	<=5.8 dB	<=7.6 dB
Directivity	>=55 dB		
Temperature stability	0.002 dB/°C		
Operating temperature	-40°C to +85°C		

*other split ratios available per individual order

Example of power split/attenuation:			
Type	**1x2; 2x2**	**1x3**	**1x4**
	1/99 23.5 dB / 0.3 dB		
	10/90 11.3 dB / 0.6 dB		
	20/80 7.85 dB / 1.4 dB		
	30/70 6.00 dB / 1.9 dB		
	40/60 4.70 dB / 2.7 dB		

Applications:

- passive optical networks B-PON, G-PON, E-PON,
- telecommunication networks,
- CATV networks,
- measuring devices.

Features:

- custom split ratios available,
- non-standard operating windows possible,
- full spectral loss profiles available on request.

Splitters 1x2 & 2x2 type:

1x2 2x2 - standard single window 1310 nm+/- 40 nm lub 1550 nm+/-40 nm
1x2 2x2 - dual window 1310/1550 nm +/-40 nm
1x2 2x2 - wide band 1310/1550 nm +/-40 nm 1490 nm+/-10 nm
1x2 2x2 - all band wideband - 1260 -1620 nm

Splitters 1x3 & 1x4 - monolithic type:

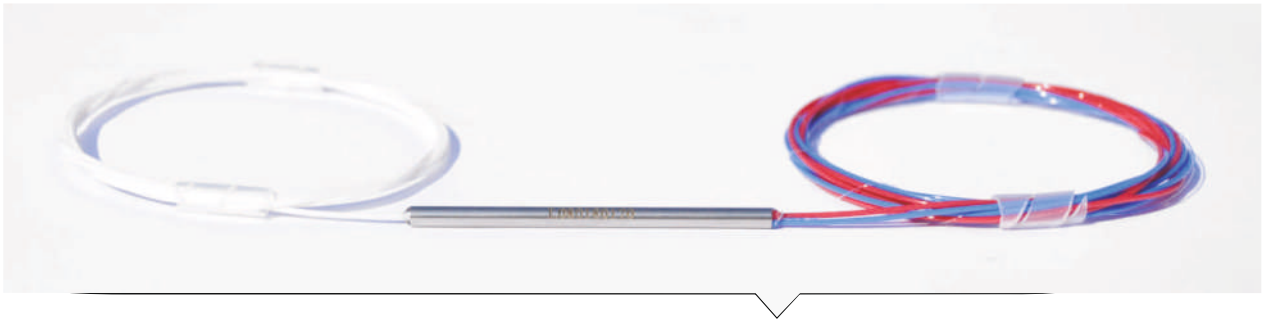
1x3 1x4 - standard single window 1310 nm+/- 40 nm lub 1550 nm+/-40 nm
1x3 1x4 - dual window 1310/1550 nm +/-40 nm
1x3 1x4 - wide band 1310/1550 nm +/-40 nm 1490 nm+/-10 nm

Casing:

3x55 mm: 1x2 and 2x2; 250 µm or 900 µm,
3x60 mm: 1x3 and 1x4; 250 µm or 900 µm,
Blackbox 90x20x10 mm: 1x2; 2x2; 2.0 mm or 3.0 mm,
Blackbox 100x80x12 mm: 1x3 1x4; 2.0 mm or 3.0 mm,
19" 1U and 2U patchpanels,
LGX module or modular patchpanel.

Optical Elements - PON

CPL FBT (Fused Biconical Tapering) Splitters/Couplers

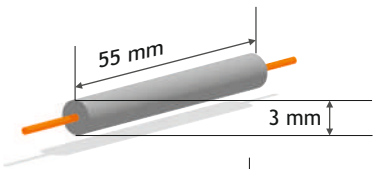


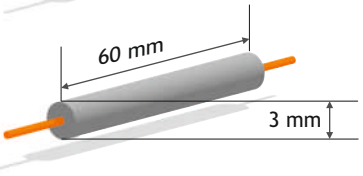
Three window 1310 & 1550 & 1490 nm			
Type	**1x2; 2x2**	**1x3**	**1x4**
Power split	1-50%	33.3/33.3/33.3*	25/25/25/25*
Wavelenght	1310 / 1550 / 1490 nm /other		
Bandwidth	+/-40 nm		+/-40 nm/+10 nm
Uniformity	<=0.7 dB	<=1.4 dB	<=1.7 dB
PDL max.	<=0.20 dB	<=0.30 dB	<=0.30 dB
Max. Attenuation	<=3.7 dB 50/50	<=6.0 dB	<=7.8 dB
Directivity	>=55 dB		
Temperature stability	0.002 dB/°C		
Operating temperature	-40°C to +85°C		

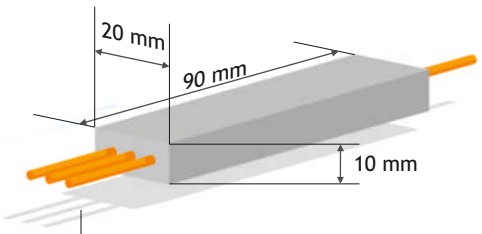
*Another split available per individual order

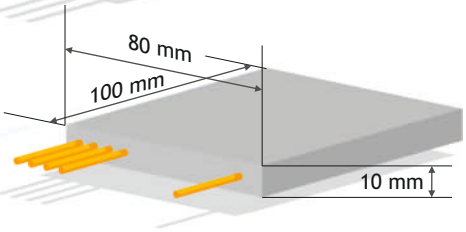
Example of power split/attenuation:			
Type	**1x2; 2x2**	**1x3**	**1x4**
	1/99 23.5 dB / 0.30 dB		
	10/90 11.5 dB / 0.75 dB		
	20/80 7.95 dB / 1.50 dB		
	30/70 6.20 dB / 2.10 dB		
	40/60 4.90 dB / 2.80 dB		

All band 1260-1620 nm	
Type	**1x2; 2x2**
Power split	1-50%
Wavelenght	1260-1620 nm
Uniformity	<=0.9 dB
PDL max.	<=0.20 dB
Max. Attenuation	<=3.9 dB 50/50
Directivity	>=55 dB
Temperature stability	0.002 dB/°C
Operating temperature	-40°C to +85°C









Fiber:
1-G652D
2-G657A
3-G657B
4-MM50
5-OM3
6-M62.5

Lenght:
0 - 0.5 MB
1 - 1.0 MB
2 - 2.0 MB

Fiber type:
25 - 250 µm
90 - 900 µm
20 - 2.0 mm
30 - 3.0 mm

Casing type:
1 - 3x55 mm pipe
2 - 3x60 mm pipe
3 - 3.5x40 mm pipe
4 - 90x20x10 mm blackbox
5 - 100x80x10 mm blackbox
6 - 125x95x16 mm blackbox
7 - 10x60 mm Y patchcord

Window type:
S - single window
D - dual windows
T - three windows
F - full band
M - multimode

CPL - G0 - 1 - 22 - 0 - 15 - 25 - 50 - 4 - S - SC - SC

Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Split:
12 - 1X2
22 - 2X2
13 - 1X3
14 - 1X4
18 - 1X8
116 - 1X16
132 - 1X32
164 - 1X64
... etc.

Wavelenght:
85 - 850 nm
98 - 980 nm
10 - 1060 nm
13 - 1310 nm
15 - 1550 nm
35 - 1310/1550 nm
345 - 1310/ 1490/ 1550 nm
XX - other

Power split:
50 -50/50
70 -70/30
3333 -33/33/33
2525- 25/25/25/25
... etc.

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

CPL-G0-1-22-0-15-25-50-4-S-SC-SC

Example: CPL series splitter, 2x2, 50% split ratio, single window 1550 nm, 0.5 m pigtails, 250 mm, SC PC connectors

Optical Elements - PON

FPLC PLC (Planar Waveguide Circuits) splitters

PLC Splitters

Fibrain PLC splitters series are used for splitting of optical power. Thanks to planar technology, very high port count devices are available and the number of output ports varies from 2 up to 128. At the same time, the technology guarantees small dimensions and small loss variations in the full bandwidth 1260-1650 nm. FPLC splitters exhibit also low PDL, very good channel uniformity and excellent thermal stability. Most often, PLC splitters have nominally symmetrical split, however there are also available asymmetrical FPLC 1x5 splitters, with a single high power express output port and 4 local ports (lower power) which are dedicated for FTTH networks in rural areas.

Applications:

- telecommunication networks,
- CATV networks,
- Fiber to the Home (FTTH) networks.

Features:

- low insertion loss,
- good uniformity,
- very wide spectrum,
- compact casings,
- low macrobending losses due to G.657A fiber,
- low PDL,
- suitable for uncontrolled environment.

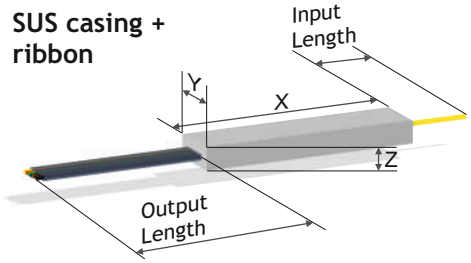
Technical Parameters:

Characteristics of Spliters with Bare Fibers

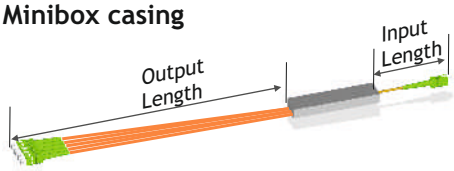
Parameter	Unit	Specification				
		1x2	1x3	1x4	1x6	1x8
Insertion Loss (Max. S/P)	dB	4.0/3.7	6.3/6.0	7.3/7.1	9.5/9.1	10.7/10.5
Uniformity (Max. S/P)	dB	0.8/0.6	0.6/0.1	0.6/0.5	0.8/0.7	1.0/0.8
PLD (Max. S/P)	dB	0.2/0.15	0.2/0.2	0.2/0.2	0.2/0.2	0.3/0.3
Return loss/Directivity	dB	>=55				
Operating Wavelength	nm	1260 ~1650				
Operating Temperature	°C	-40 to +85				
Optical Fiber	-	Bend Insensitive Fiber				

Parameter	Unit	Specification					
		1x12	1x16	1x24	1x32	1x64	1x128
Insertion Loss (Max. S/P)	dB	12.5/12.4	13.8/13.7	-	17.0/17.0	20.5	-
Uniformity (Max. S/P)	dB	1.1/1.0	1.2/1.0	-	1.3/1.1	2.0	-
PLD (Max. S/P)	dB	0.3/0.3	0.3/0.3	-	0.3/0.25	0.3	-
Return loss/Directivity	dB	>=55					
Operating Wavelength	nm	1260 ~ 1650					
Operating Temperature	°C	-40 to +85					
Optical Fiber	-	Bend Insensitive Fiber					

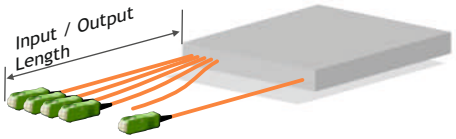
SUS casing + ribbon



Minibox casing



Blackbox casing



Casing:

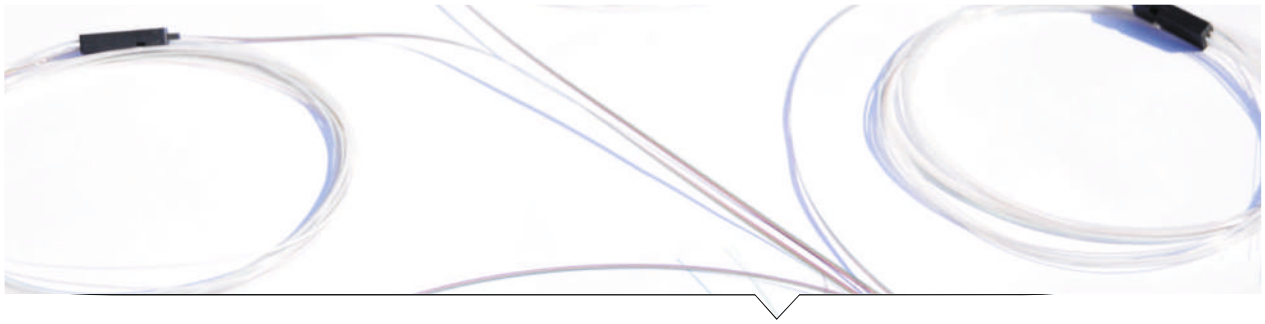
SUS stainless steel box. Output - ribbon 250 µm						
Type	**1x2, 1x3, 1x4, 1x5, 1x6, 1x8, 1x12, 1x16, 2x2**	**2x4, 2x8**	**1x32**	**1x64**	**2x16**	**2x32**
Material	Stainless steel (SUS)					
Dimensions (mm)	40x4x4	50x7x4	55x7x4	58x12x4	60x5x4	60x7x4

SUS minibox. Output - loose tube 900 µm					
Type	**1x2, 1x3, 1x4 1x5, 1x6, 1x8**	**2x2**	**1x16**	**1x32**	**1x64**
Material	Stainless steel (SUS)				
Dimensions (mm)	55x7x4	60x7x4	60x12x4	80x23x4.5	100x48x4.5
Fibers & tubes	Output fibers in 900 µm Hytrel, white, loose tube.				

ABS blackbox. Output - cable 2.0 mm or 3.0 mm	
Type	**1x2, 1x3, 1x4, 1x6, 1x8, 1x12, 1x16, 1x32, 1x64, 2x2, 2x4, 2x8, 2x16, 2x32**
Material	ABS
Dimensions (mm)	100x75x20
Fibers & tubes	Output fibers in 2.0 mm or 3.0 mm, PVC, yellow cable.

Optical Elements - PON

FPLC Splitters PLC (Planar Wave Circuit)



Color of Fiber:

Ribbon Fiber can be distinguished each fiber by using method of coloring

Channel (Output)	Fiber Number							
	1	2	3	4	5	6	7	8
4ch Ribbon Fiber	Blue	Yel.	Gre.	Red	-	-	-	-
8ch Ribbon Fiber	Blue	Yel.	Gre.	Red	Oran.	Viol.	Bro.	Bla.

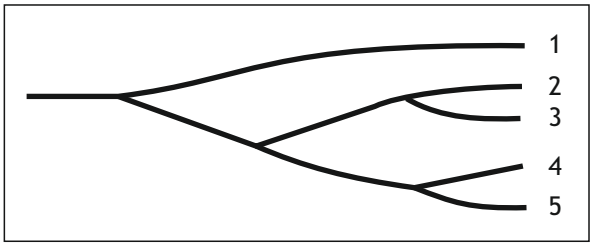
Channel (Input)	Fiber Number	
	1	2
1ch	Clear	None
2ch	Blue	Clear

Output ribbon fiber Configuration:

Splitter Type				
1x2/2x2	1x3	1x4/2x4	1x6	1x8/2x8
1ea - 4ch Ribbon	1ea - 4ch Ribbon	1ea - 4ch Ribbon	2ea - 4ch Ribbon	1ea - 8ch Ribbon & 2ea - 4ch Ribbon
1x12	1x16/2x16		1x32/2x32	1x64
2ea - 8ch Ribbon	2ea - 8ch Ribbon		4ea - 8ch Ribbon	8ea - 8ch Ribbon

Splitter FPLC 1x5

Fibrain FPLC 1x5 splitters are dedicated for FTTH networks in rural areas. In contrast to standard symmetrical PLC splitters, the 1x5 splitters are asymmetrical, and have a high power (low loss) express port and 4 local (higher loss) ports. The 1x5 splitters are available in four different versions, with the express port carrying 75%, 67%, 50% or 5% of the total input power.

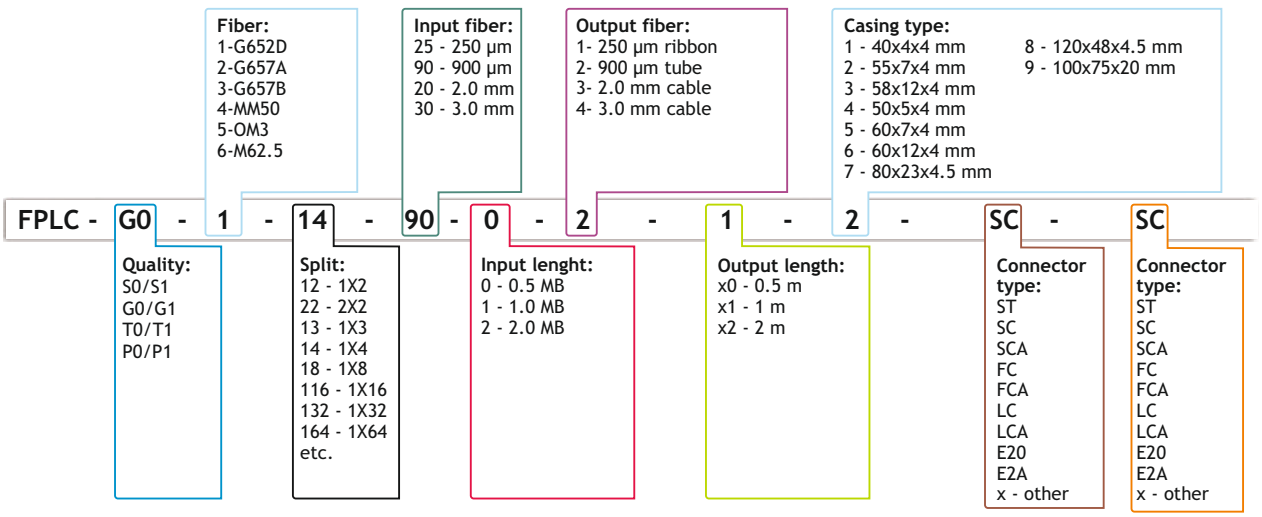


Technical data

Parameter / Type	Max IL (port 1) [dB]	Max IL (ports 2-5) [dB]	Uniformity (ports 2-5) [dB]	Max PDL [dB]
75%/(4x6%)	2.0	15.3	0.8	0.25
67%/(4x8%)	2.7	13.6	0.8	0.25
50%/(4x12%)	4.0	10.8	0.8	0.25
5%/(4x24%)	16.6	8.0	0.8	0.25

Fibrain FPLC 1x5 asymmetric splitters, available versions:

Port 1: 75%, 67%, 50%, 5%
Ports 2-5: 6%, 8%, 12%, 24%

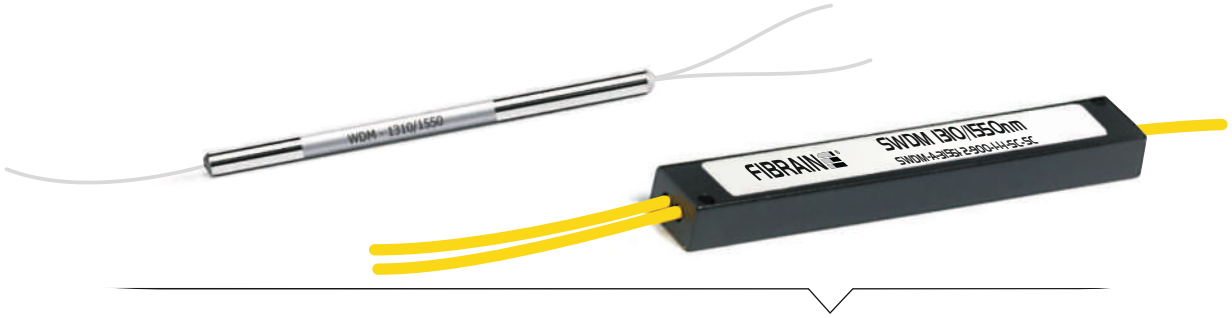


FPLC-G0-1-14-90-0-2-1-11-SC-SC

Example: FPLC series splitter, G.652D fiber, 1x4 split, 900 µm tube, 0.5 m input pigtail, 1.0 m output pigtails, 55x7x4 mm minibox, SC PC connectors.

Optical Elements - WDM

SWDM multiplexers WDM (Fused Biconical Tapering)



SWDM multiplexers WDM

Fibrain SWDM series multiplexers are manufactured in the FBT technology (Fused Biconical Tapering). These devices are characterized by low insertion loss, high reflection loss and small sensitivity to external conditions. They are the enablers to build networks utilizing the wide WDM technology, where different signals are transferred over the same fiber at different wavelengths.

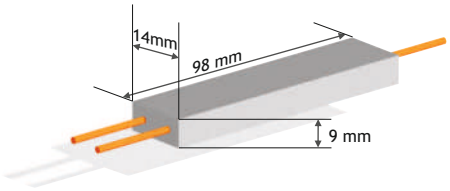
Applications:
- WDM systems,
- telecommunication networks,
- CATV networks,
- optical amplifiers,
- measuring equipment.

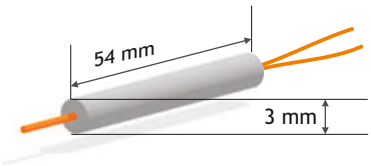
Features:
- high thermal stability of parameters,
- low insertion loss and polarization loss,
- high channel isolation.

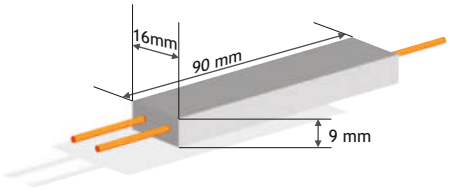
Technical specification:

Type	1310/1550		980/1550		
Wavelength	1310 nm & 1550 nm		980 nm & 1550 nm		
Bandwidth	+/-15nm		970-990 nm / 1530-1570 nm		
Type	A	P	A	P	U
Attenuation [dB]	0.3	0.2	0.05	0.15	0.25
Isolation [dB]	>=16	>=17	>=18	>=20	>=20
PDL [dB]	0.1	0.05	0.1	0.05	0.05
Directivity	>=55 dB				
Temperature stability	0.002 dB/°C				
Operating temperature	-40°C to +85°C				
Fiber type	SM 09/125 G.652D		Corning HI 1060 Flex or OFS BF05635-02		

Casing:			
Fiber	250 µm	900 µm	900 µm, 2.0 mm or 3.0 mm
Dimensions	Ø 54*3 mm	Ø 54*3 mm	98x14x9 mm lub 90x16x9 mm







Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Split:
12 - 1x2

Wavelength:
3155 - 1310/1550
9855 - 980/1550
4855 - 1480/1550
xxxx - other

Casing type:
1 - 3x54 mm pipe
2 - 3x60 mm pipe
3 - 98x14x9 mm minibox
4 - 90x19x9 mm minibox
5 - patchcord Y, 10x60 mm
x - other

SWDM - G0 - 1 - 12 - 1 - 3155 - 90 - 1 - SC - SC

Fiber:
1 - G652D
2 - G657A
7 - HI 1060

Length:
0 - 0.5 m
1 - 1 m
2 - 2 m

Fiber type:
25 - 250 µm
90 - 900 µm
20 - 2.0 mm
30 - 3.0 mm

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

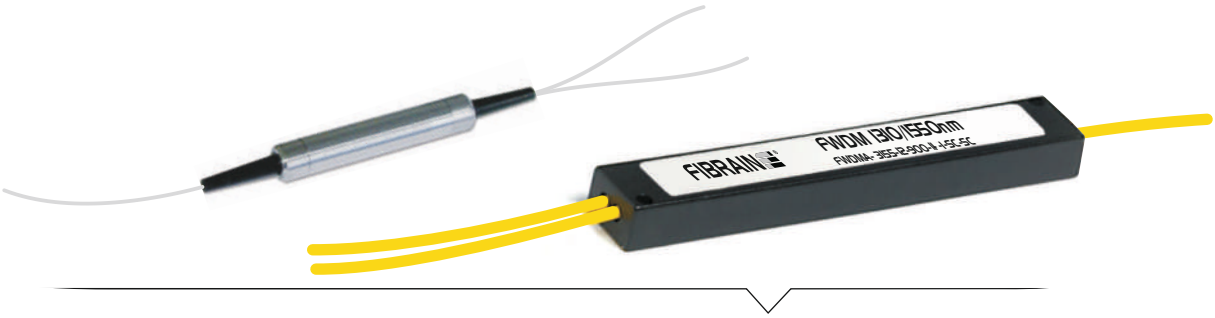
Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

SWDM-G0-1-12-1-3155-25-1-SC-SC

Example: Fibrain SWDM series multiplexer, 1310/1550 output ports, 1x2 port configuration, 900 µm pigtails, Ø 54x3 mm pipe packaging, SC/SC connectors.

Optical elements - WDM

FWDM passive solutions - multiplexers



FWDM passive solutions - multiplexers

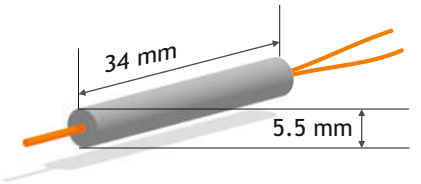
Fibrain FWDM (Filter Wavelength Division Multiplexer) series multiplexers utilize the TFF (Thin Film Filter) technology. The TFF technology allows obtaining low insertion loss and flat loss spectral profile, high interchannel isolation and very good temperature stability. Thanks to the flexibility, filters with different characteristics are available.

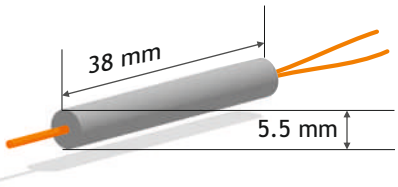
Applications:
- bidirectional WDM systems,
- telecommunication networks,
- CATV networks.

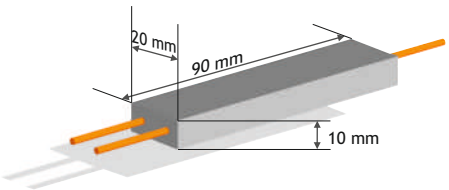
Features:
- high thermal stability of parameters,
- low insertion loss and polarization loss,
- high channel isolation.

Examples of technical specification for typical FWDM filters			
Type	**1310/1550 nm**	**1480/1550 nm**	**1550/1310 & 1490 nm**
Transmission port bandwidth	1260-1360 nm (1520-1600 nm)	1440-1490 nm (1530-1580 nm)	1550-1600 nm
Reflection port bandwidth	1520 nm-1600 nm (1260-1360 nm)	1530-1580 nm (1440-1490 nm)	1260-1360 nm & 1460-1500 nm
Transmission port IL [dB]	<=0.6	<=0.6	<=0.6
Reflection port IL [dB]	<=0.5	<=0.5	<=0.5
Transmission port isol. [dB]	>30		
Reflection port isol. [dB]	>15	>15	>20
PDL [dB]	0.1		0.15
PMD [ps]	0.1		
Directivity [dB]	>=50		
RL [dB]	>= 50		
Thermal stability	0.005 dB/°C		
Storage temperature	-40°C to +85°C		
Operating temperature	-20°C to +70°C		
Fiber type	SM 09/125 G.652D		
Max. optical power [mW]	300		
Casing:			
Fiber type	**250 µm**	**900 µm**	**900 µm, 2.0 mm or 3.0 mm**
Dimensions	Ø 34*5.5 mm	Ø 38*5.5 mm	90x20x10 mm

Other filter types (for example MM850/1300, 980/1550, 310/1480, 1510/1550, FTTH/OTDR and FTTH/CATV triplexers, other special CATV filters) also available. High isolation version (isolation >45 dB for both channels) on request.







Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Split:
12 - 1x2

Wavelength:
3155 - 1310/1550
9855 - 980/1550
4855 - 1480/1550
5538 - 1550/1310 &1480
xxxx - other

Casing type:
1 - 5.5x34 mm pipe
2 - 5.5x38 mm pipe
3 - 5.5x40 mm pipe
4 - 90x20x10 mm minibox
5 - 100x12x8 mm minibox

FWDM - G0 - 1 - 12 - 0 - 3155 - 90 - 1 - SC - SC

Fiber:
1 - G652D
2 - G657A
7 - HI 1060

Length:
0 - 0.5 m
1 - 1 m
2 - 2 m

Fiber type:
25 - 250 µm
90 - 900 µm
20 - 2.0 mm
30 - 3.0 mm

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

FWDM-G0-1-12-0-3155-25-1-SC-SC

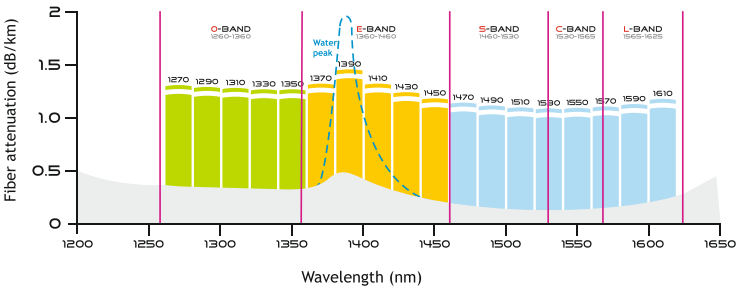
Example: Fibrain FWDM mulitplexer, 1310/1550 channels, 1x2 port configuration, 900 µm pigtails, pigtail length 1 m, Ø 34x5.5 mm pipe packaging, SC/SC connectors.

Optical Elements - WDM

CWDM multiplexers WDM (Coarse Wavelength Division Multiplexer)

CWDM passive solutions - add/drop filters, multi-and-demultiplexers

Fibrain CWDM series devices utilize the TFF technology. They are characterized by high interchannel isolation, low insertion loss and flat passband profile (low ripple). Outdoor versions (for -40°C to +85°C temperature range, also in water-tight packaging) are also available. These devices are use to multiply the transmission capacity of the existing fiber links. Any number of channels from 2 up to 18 is possible. Customized and hybrid solutions (CWDM+DWDM+special channels) are also available. For applications with very tight loss budget Compact CWDM products (with ultra-low insertion losses) are recommended.



Technical data of CWDM filters ADD or DROP, for 1271-1451 nm half band:	
Type	1271,1291,..1451nm or 1270, 1290,..1450
Interchannel space [nm]	20
Channel width [nm]	λc+/-6.5
Reflection bandwidth [nm]	1260-1610
Pass bandwidth @ -0.5dB	>=14
Pass Channel flatness [dB]	<=0.3
Pass insertion loss [dB]	<=0.8
Reflection insertion loss [dB]	<=0.6
Adjacent channel isolation [dB]	>=30
Non-adjacent channel isolation [dB]	>=40
Reflection Channel Isolation [dB]	>=15
Directivity [dB]	>55
Return loss [dB]	>50
PDL [dB]	0.1
Bandwidth temerature stability	0.003 nm/°C
Attenuation temperature stability	0.005 dB/°C
Power handling [mW]	<500 mW
Operating temperature	-5°C to +70°C
Storage temerature	-40°C to +85°C

Casing:			
Fiber	250 µm	900 µm	900 µm, 2.0 mm or 3.0 mm
Dimensions	Ø 34*5.5 mm	Ø 38*5.5 mm	90x20x10 mm

Applications:

- CWDM systems,
- ADD/DROP solutions,
- telecommunication networks,
- optical amplifiers,
- CATV networks.

Features:

- high thermal stability of parameters,
- low insertion loss and polarization loss,
- high channel isolation.

Device types:

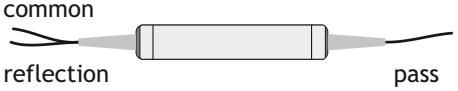
· **CWDM filters** - used to separate single CWDM from the incoming multiplex. Characterized by significantly better interchannel isolation than FBT-based products. Can be cascaded to obtain more advanced functionalities.

· **OADM (add/drop optical multiplexers)** - used to drop and add selected channels, whereas the remaining (express) channels are transmitted without change

· **MUX/DMUX modules** - installed in terminals, used to multiply the capacity of the existing fiber links, without the need to lay more cables. Most often used as 4-, 8-, and 16-channel devices, other functionalities like upgrade port, grey 1310 nm port, monitor port or OTDR 1650 nm port are also available.

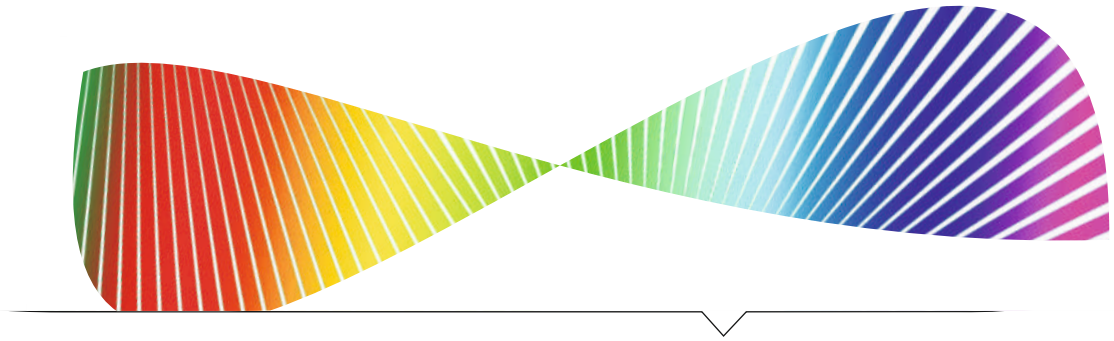
· **CCWDM (Compact CWDM)** - thanks to free space technology, these devices have smaller size and smaller insertion losses than traditional CWDM filters.

Filters ADD or DROP CWDM - scheme of ports



Optical Elements - WDM

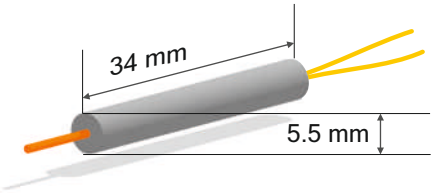
CWDM multiplexers WDM (Coarse Wavelength Division Multiplexer)

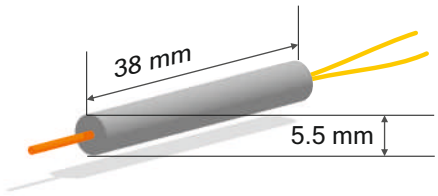


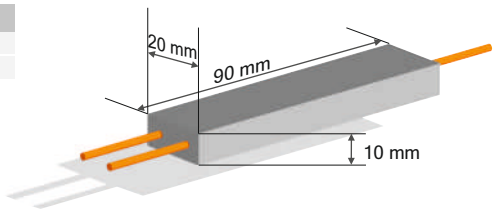
Technical data of CWDM filters ADD or DROP, for 1471-1611 nm half band:	
Type	1471,1491,..1611nm or 1470, 1490,..1610 nm
Interchannel space [nm]	20
Channel width [nm]	λc+/-6.5
Channel flatness [dB]	<=0.4
Pass insertion loss [dB]	<=0.6
Reflection insertion loss [dB]	<=0.4
Adjacent channel isolation [dB]	>=30
Non-adjacent channel isolation [dB]	>=40
Directivity [dB]	>55
Return loss [dB]	>50
PDL [dB]	0.1
Bandwidth temperature stability	0.003 nm/°C
Attenuation temperature stability	0.005 dB/°C
Power handling [mW]	<500 mW
Operating temperature	-5°C to +70°C
Storage temperature	-40°C to +85°C

Casing:			
Fiber	250 µm	900 µm	900 µm, 2.0 mm or 3.0 mm
Dimensions	Ø 34*5.5 mm	Ø 38*5.5 mm	98x20x10 mm

CWDM examples - add / drop

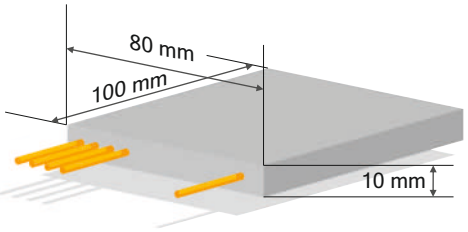






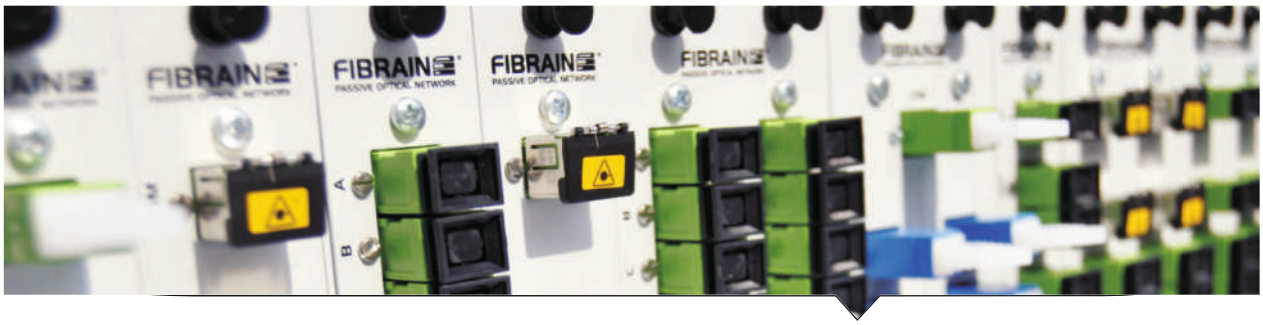
Technical data of OADM modules add/drop:				
Type		1270, 1290,1310,…. 1610 or 1271, 1291, 1311….1611		
Number of channel		1ch	2ch	4ch
Interchannel space [nm]		20		
Channel width [nm]		λc+/-6.5		
Channel flatness [dB]		<=0.4		
Insertion loss [dB]	Add/Drop Ch.	<=0.6	<=1.0	<=1.7
	Express Ch.	<=0.6	<=1.2	<=2.0
Isolation Add/Drop Channel [dB]	Adjacent channel	>=30		
	Non-adjacent	>=40		
Express Channel Isolation [dB]		>=25		
Directivity [dB]		>55		
Return loss [dB]		>50		
PDL [dB]		<=0.1		
Bandwidth temperature stability		0.003 nm/°C		
Attenuation temperature stability		0.005 dB/°C		
Power handling [mW]		<=500 mW		
Operating temperature		0°C to 70°C		
Storage temperature		-40°C to 85°C		
Casing:				
		100x80x10 mm or LGX or 19” rack 1U		

OADM example - ADD/DROP



Optical Elements - WDM

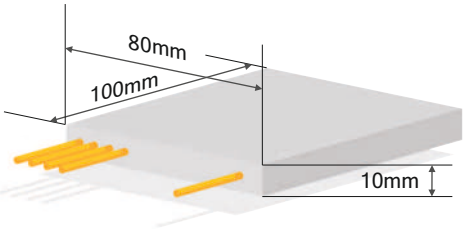
CWDM multiplexers WDM (Coarse Wavelength Division Multiplexer)

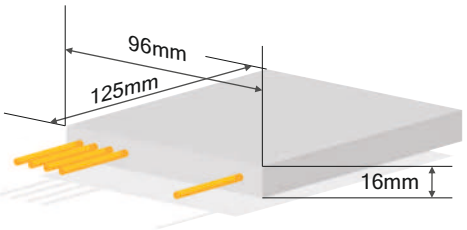


MUX and DMUX technical data:

Type	4 channels	8 channels	16 channels
Attenuation [dB]	<=2.0	<=3.5	<=4.5
Wavelength [nm]	1270, 1290,1310,..1610 or 1271, 1291, 1311..1611		
Interchannel space [nm]	20		
Channel width [nm]	λc+/-6.5		
Channel flatness [dB]	<=0.4		
Channel uniformity [dB]	<=1.0		
Adjacent channel isolation [dB]	>=30		
Non-adjacent ch. isolation [dB]	>=40		
Directivity [dB]	>55		
Return loss [dB]	>50		
PDL [dB]	0.15		0.20
PMD [ps]	0.10		0.15
Bandwidth temperature stability	0.003 nm/°C		
Attenuation temp. stability	0.005 dB/°C		
Power handling [mW]	<500 mW		
Operating temperature	-5°C to +70°C		
Storage temperature	-40°C to +85°C		
Casing:			
	100x80x10	100x80x10	125×96×16
Additional ports:			
	Port test 1310 +/- 50 nm Port monitor 1/99% Port upgrade 1260-1457 nm Port upgrade 1460-1610 nm		Port monitor 1/99% Port test 1310 nm +/-50 nm

Examples MUX and DEMUX

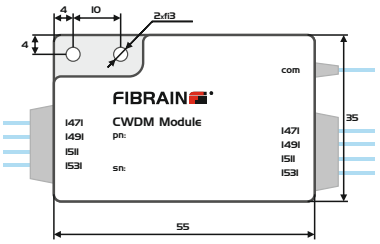




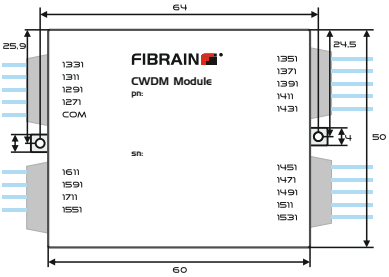
Compact MUX and DMUX technical data:

Type		4 channels	8 channels	18 channels
Attenuation [dB]		<=1.6	<=1.8	<=1.8 type (2.5 max)
Wavelength [nm]		1270, 1290,1310,..1610 or 1271, 1291, 1311..1611		
Interchannel space [nm]		20		
Channel width [nm]		λc+/-6.5		
Test port		1310 µm +/-50 nm		
Monitor port		1/99%		
Channel flatness [dB]		<=0.4		
Upgrade port		1260-1457 nm or 1460-1610 nm IL<=1.2 dB		
Isolation	MUX Adjacent Channel [dB]	>30		
	MUX Non-adjacent Channel [dB]	>40		
	DMUX Adjacent Channel [dB]	>30		
	DMUX Non-adjacent Channel [dB]	>40		
	Upgrade port [dB]	>15		
Ripple in Passband [dB]		<=0.3		<=0.5
Directivity [dB]		>55		
Return loss [dB]		>45		
PDL [dB]		<0.15		<0.20
PMD [ps]		0.10		
Bandwidth temperature stability		0.003 nm/°C		
Attenuation temperature stability		0.005 dB/°C		
Power handling [mW]		<500 mW		<300 mW
Operating temperature		-10°C to +70°C		0°C to +70°C
Storage temerature		-40°C to +85°C		
Fiber type		250 µm or 900 µm SM G.652D		
Casing:				
		55x35x8		60x50x7
Additional ports:				
		Port test 1310 +/- 50 nm Port monitor 1/99% Port upgrade 1260-1457 nm Port upgrade 1460-1610 nm		

Example CCWDM 8 channels

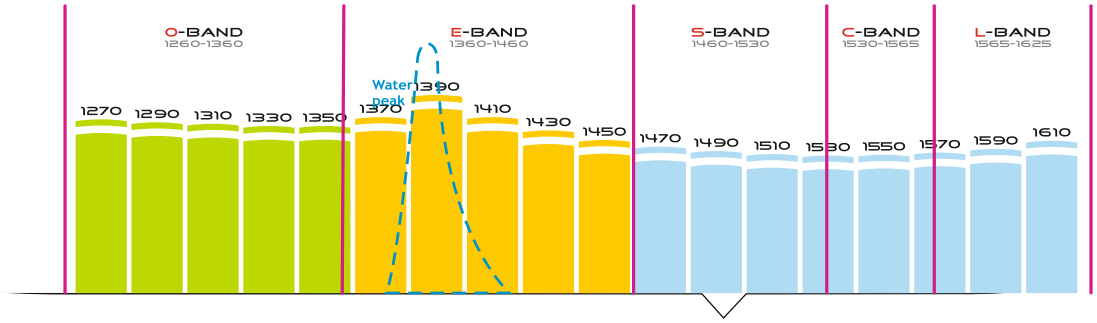


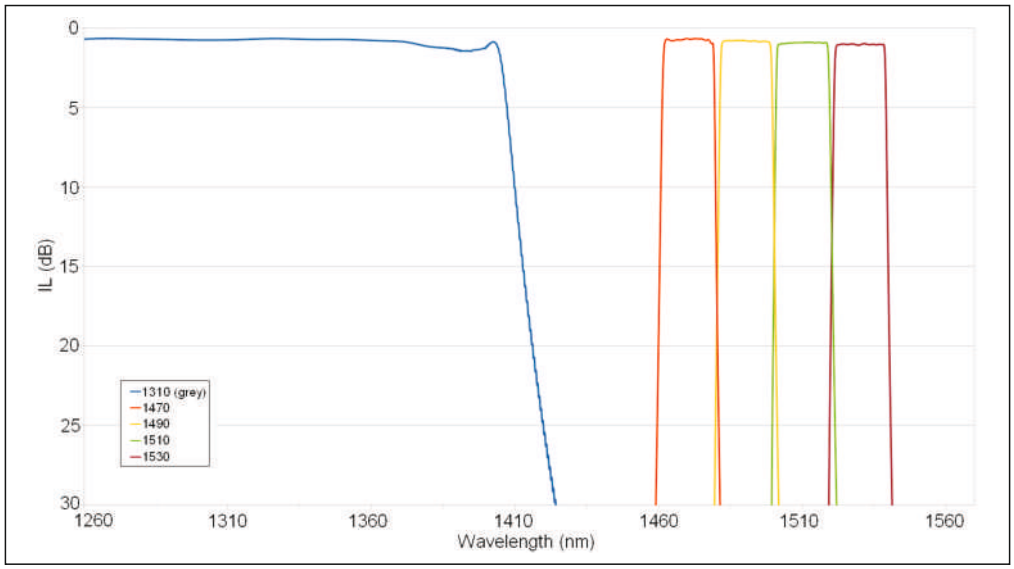
Example CCWDM 18 channels



Optical Elements - WDM

CWDM multiplexers WDM (Coarse Wavelength Division Multiplexer)





Spectral loss profile of a 4 CWDM channels + grey 1310 channel multiplexer

CWDM transmission is very often utilized in metro links, where signal quality is very important and operators cannot accept the risk of reducing this quality, as often high priority and sensitive data is sent. To provide the max information about our products, Fibrain CWDM devices are always measured in the whole spectral range and delivered with test reports showing the full loss spectral profile. Thanks to this rigorous quality control, all IL and isolation values quoted in test reports are always worst case values.

Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Split:
0004 - 4CH
0008 - 8CH
0016 - 16H
1004 - 4CH 1310MM
1104 - 4CH 1310
1/99 MONITOR
1114 - 4CH 1310
1/99 UPGRADE
1260-1557
1124 - 4CH 1310
1/99 UPGRADE
1460-1610

Wavelength:
MUX - MUX
DUX - DMUX
MDUX - MUX/DMUX
CMUX - COMPACT MUX
DDUX - COMPACT DMUX
ADD
DROP
OADM

Casing type:
1 - 5.5x34 mm pipe
2 - 5.5x38 mm pipe
3 - 90x20x10 mm
4 - 100x80x10 mm
5 - 120x80x15 mm
5 - 125x96x16 mm
6 - 140x115x18 mm
A - 55x35x8 mm
B - 60x50x7 mm

CWDM - G0 - 1 - 0003 - 1 - MUX - 90 - 47 - 51 - 4 - SC - SC

Fiber:
1 - G652CD
2 - G657A
3 - G657B
4 - MM50
5 - OM3
6 - M62.5

Length:
0 - 0.5 m
1 - 1 m
2 - 2 m

Fiber type:
25 - 250 µm
90 - 900 µm
20 - 2.0 mm
30 - 3.0 mm

Starting channel:
47-1470 nm
49-1490 nm
51-1510 nm

End chanel:
47-1470 nm
49-1490 nm
51-1510 nm

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

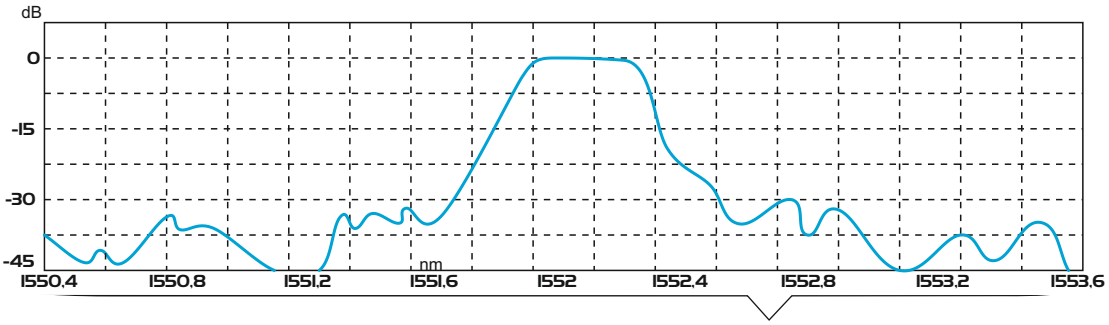
Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

CWDM-G0-1-0008-1-MUX-25-47-51-1-SC-SC

Example: Fibrain CWDM multiplexer, 3 channels, starting channel 1470, end channel 1510 nm, 900 µm pigtails, pigtail length 1 m, 100x80x10 mm packaging, SC PC connectors.

Optical Elements - WDM

DWDM add or drop multiplexers (Dense WDM)

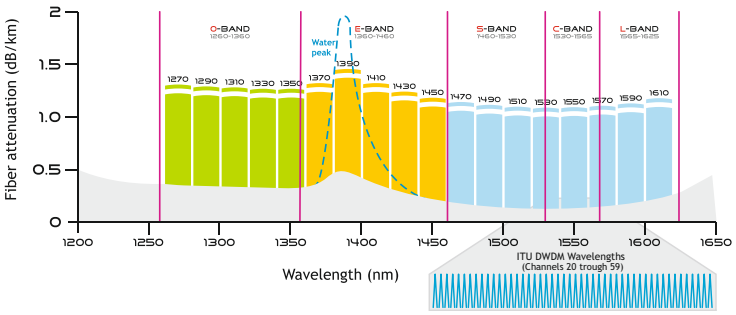


DWDM passive solutions - add/drop filters, multi-and-demultiplexers

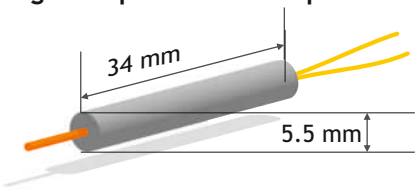
Fibrain DWDM series multiplexers are characterized by small sensitivity to external conditions, low insertion loss and high reflection losses. DWDM multiplexing allows transmitting up to 44 channels (on 100 GHz grid) in one fiber. Thanks to the availability of EDFA optical amplifiers, very long reaches are attainable.

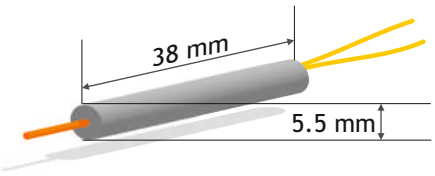
Applications:
- WDM systems,
- telecommunication networks,
- CATV networks,
- measuring equipment.

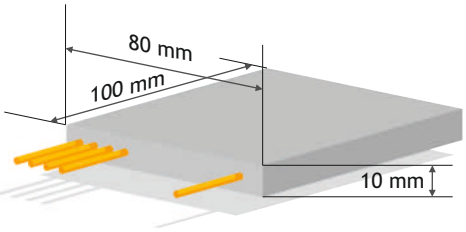
Features:
- high thermal stability of parameters,
- low insertion loss and polarization loss,
- high channel isolation.



Casing example - fiber 250 µm

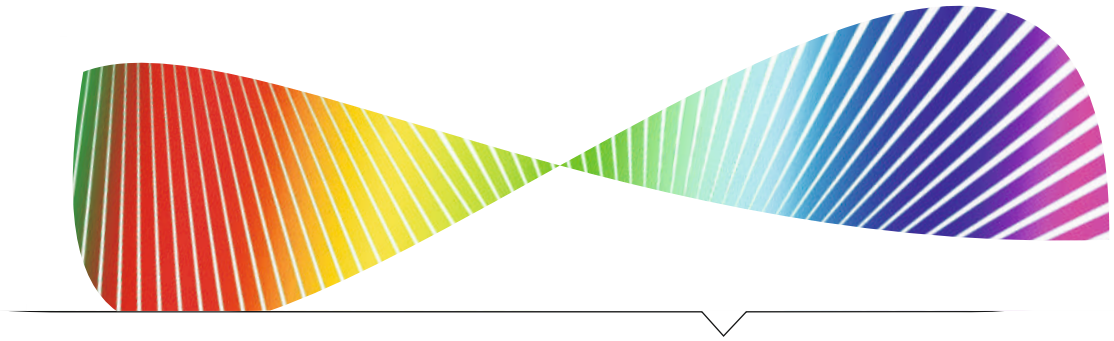






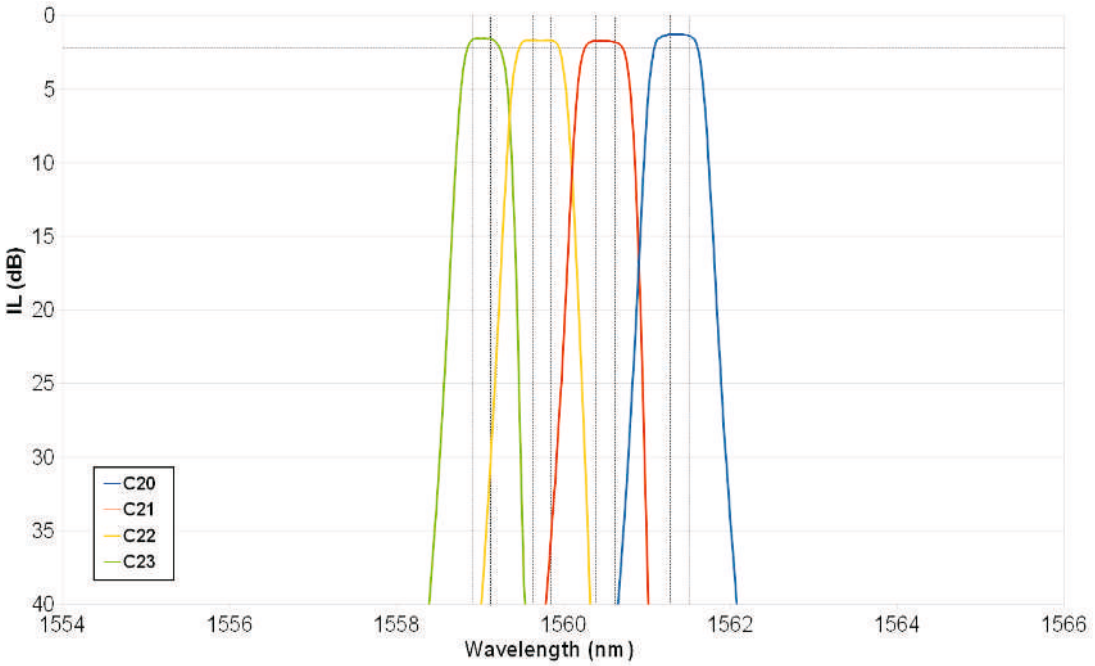
Technical data DWDM add or drop multiplexers:			
Type		100 GHz	200 GHz
Central Wavelength (λc)		ITU Grid	ITU Grid
Passband		ITU+/-0.11	ITU+/-0.25
Isolation	Adjacent Channel	>28 dB	30 dB
	Non-adjacent Channel	>40 dB	40 dB
	Express Channel	>12 dB	
Insertion Loss [dB]		<1.0 dB	<0.8 dB
Insertion Loss Express Chann. [dB]		<0.4 dB	
Ripple in Passband [dB]		<0.5	<0.3
Directivity		>=45 dB	>=50 dB
PDL [dB]		<0.15	<0.10
PMD [ps]		<0.20	<0.10
Return loss [dB]		>45	
Fiber Type		09/125 G.652D	
Power Handling		<=500 mW	
Operating temperature		0°C to +70°C	
Storage temperature		-40°C to +85°C	
Casing:			
Type	100 GHz	200 GHz	
Dimensions	32x5.5 mm **250 µm**, 34x3.6 mm **250 µm**, 39x5.5 mm **900 µm**		

Technical data DWDM add or drop multiplexers:							
Typ		100 GHz				200 GHz	
Kanały		4ch	8ch	16ch	32ch	4ch	8ch	16ch
Central Wavelength (λc)		1529.55~1560.61 ITU Grid						
Passband		ITU+/-0.11				ITU+/-0.25		
Isolation	Adjacent Channel	>28 dB				30 dB		
	Non-adjacent Channel	>40 dB				40 dB		
Insertion Loss [dB]		<2.0	<2.8	<4.0	<5.0	<2.0	<2.8	<4.0
Ripple in Passband [dB]		<0.5				<0.3		
Directivity		>=50 dB						
PDL [dB]		<0.15	<0.15	<0.20	<0.30	<0.15	<0.15	<0.20
PMD [ps]		<0.20				<0.10		
Return loss [dB]		>45						
Fiber Type		09/125 G.652D						
Power Handling		<=500 mW						
Operating temperature		0°C to +70°C						
Storage temperature		-40°C to +85°C						
Casing:								
Dimensions [mm]		120x80x9		120x80x15	150x110x23	120x80x9		120x80x15

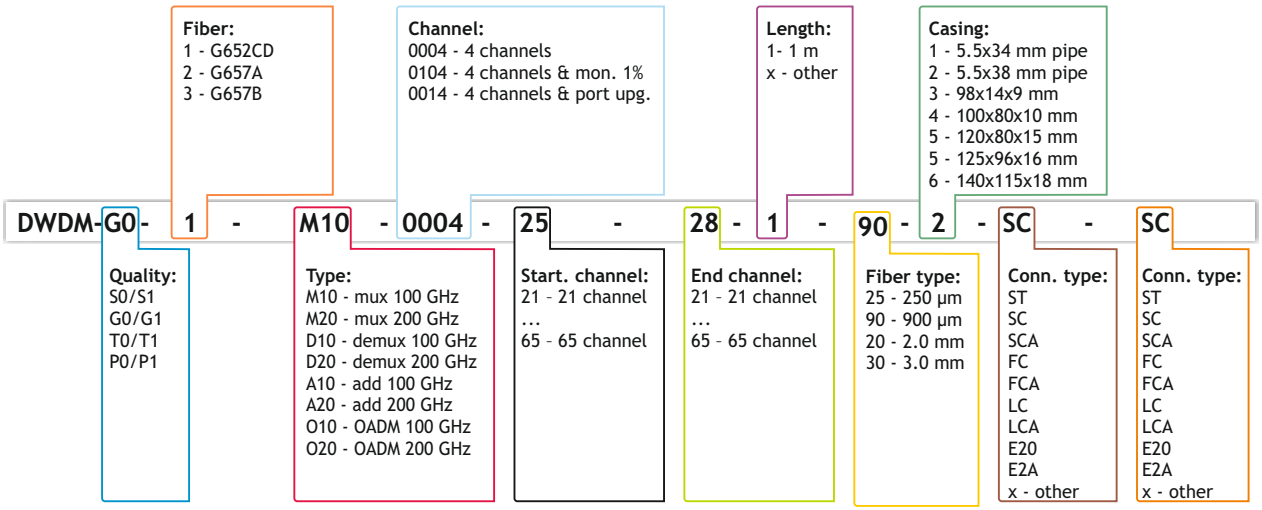


DWDM multiplexers (Dense WDM)

Customized non-standard solutions are available. Examples of non-standard functionalities include hybrid CWDM/DWDM devices, monitor port or integrated circulator. Other DWDM passive optics, like interleavers and dispersion compensators also available.



DWDM technology presents significant challenges in terms of technology and quality. That is why all Fibrain DWDM multiplexers are measured in the full spectral range and delivered with test reports showing the whole loss spectral profile.



DWDM-G0-1-M10-0004-25-28-1-90-4-SC-SC

Example: Fibrain DWDM multiplexer, 100 GHz grid, 4 channels, starting channel 25, end channel 28, 100x80x10 packaging, SC PC connectors.

Optical Elements - PON

19” integrated patch panels

PON-PZSP 19” integrated patch panels

Integrated patch panels Fibrain PON facilitate easy management of passive elements installed in telecommunication and providers networks. Variety of products available and tailored solutions additional effects flexibility of PON systems and provides future extension of systems.

Available casing of standard 19" and 21" dedicated for:
- integrated splitters shelves for CATV operator,
- integrated splitters shelves FTTH,
- hybrid solutions.

Applications:
- WDM systems,
- telecommunication networks,
- CATV networks,
- optic amplifiers,
- measuring equipment.

Features:
- easy management of PON elements,
- clear description of PON elements installed,
- possible installation of 1U and 2U in 19" and 21",
- dedicated and hybrid solutions.

Casings dimensions:

Type	PZPON-1U	PZPON-2U
Height	1U	2U
Depth [mm]	280	
Width [mm]	436	
Mounting	19” lub 21”	
Color	RAL7035*	

*Other colors available on request

**Technical data of splitters FBT and PLC see products cards.

Examples of execution:

Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Height:
1- 1U
2- 2U

Type:
S - single window
D - dual windows
T - three windows
F - full band
M - multimode
P - PLC

PZSP-G0-1-1-1612-D-35-50-SC-SC

Fiber:
1 - G.652D
2 - G.657A

Qty / type:
0812 - 8x1/2
1612 - 16x1/2
0414 - 4x1/4
0814 - 8x1/4
02116 - 2x1/16
xxxx - other

Wavelength:
85 - 850 nm
98 - 980 nm
10 - 1060 nm
13 - 1310 nm
15 - 1550 nm
35 - 1310/1550 nm
345 - 1310/1490/1550 nm
xx - other

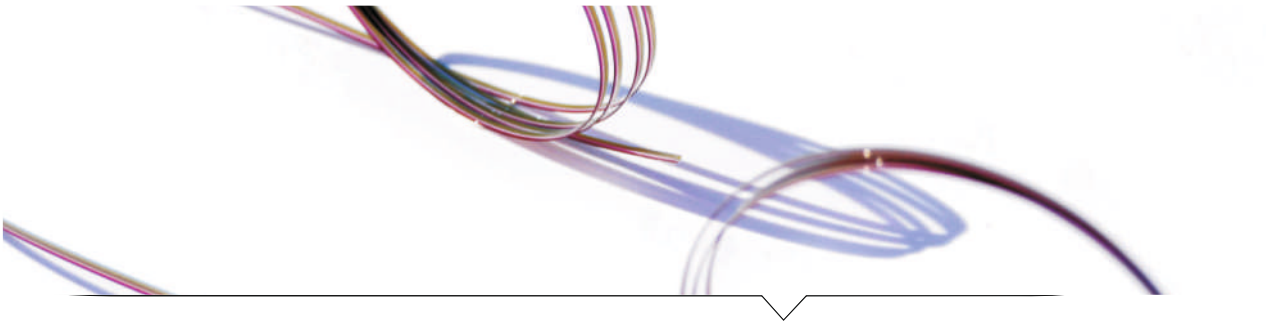
Power split:
50 - 50/50
70 - 70/30
3333 - 33/33/33 for 1x3
2525 - 25/25/25/25 for 1x4

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

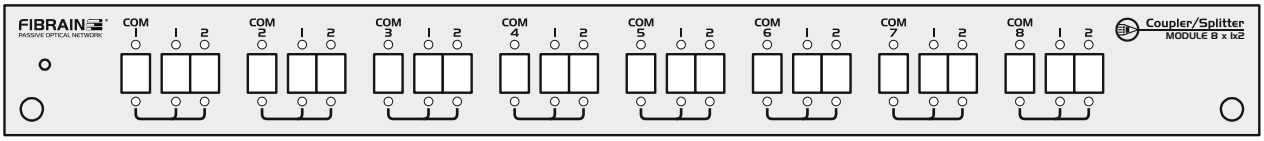
Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

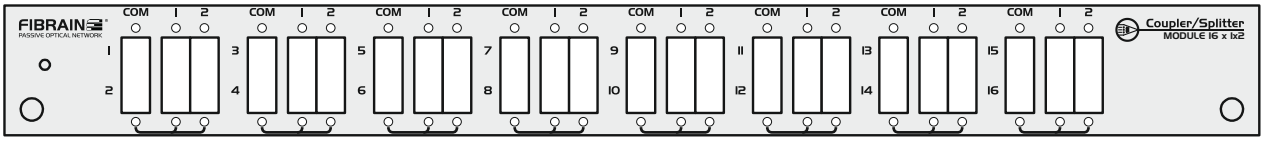
PZSP-G0-1-1-1612-D-35-50-SC-SC

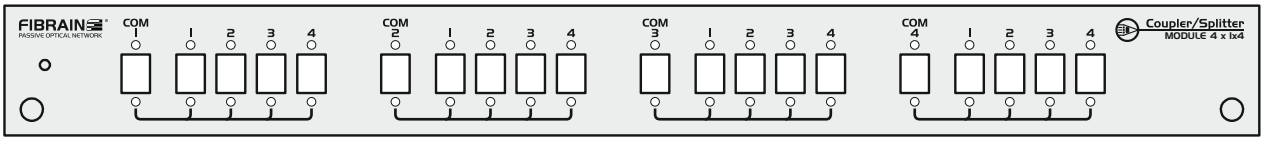
Example: integrated patch panel 19" 1U, 16x1/2 splitters, dual window, 1310/1550 nm 50/50% 48*SC/UPC.

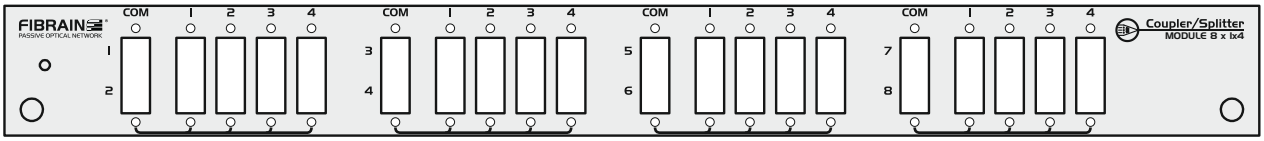


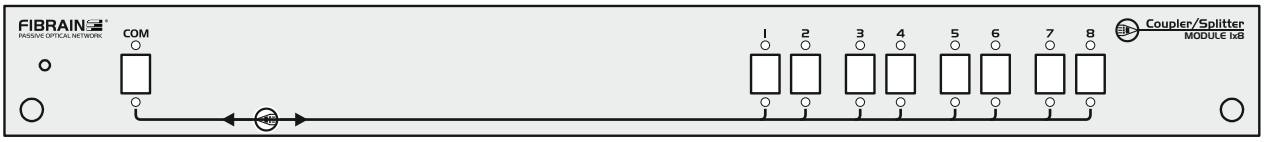
PZSP Solutions examples

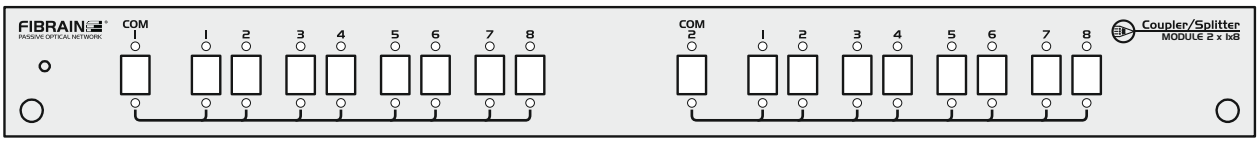


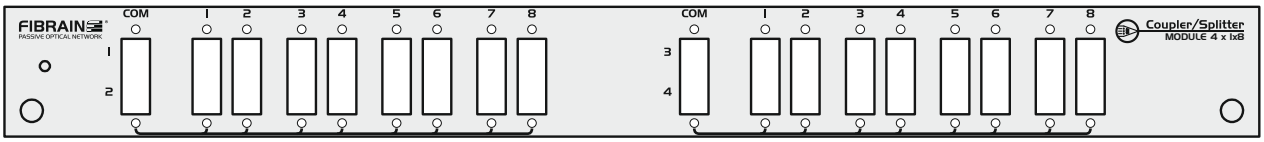


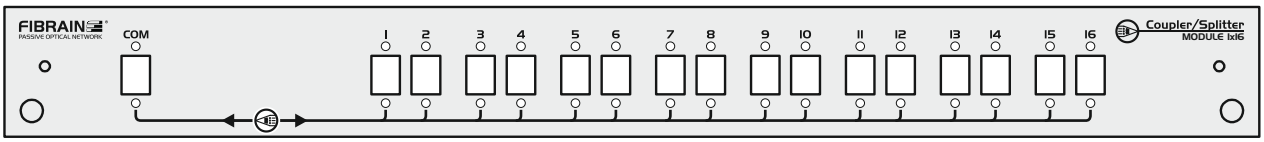


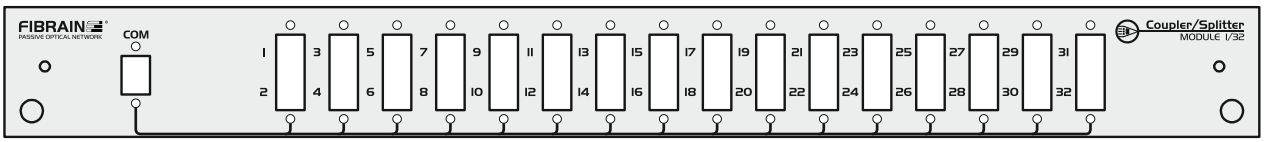






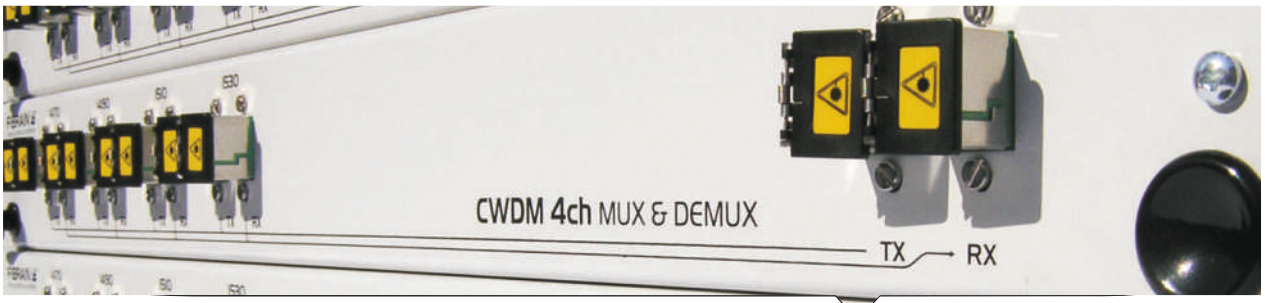






Optical Elements - PON

19” integrated patch panels PON



PON PZCW and PZDW 19” integrated patch panels

Fibrain integrated patch panels facilitate easy management of passive elements installed in telecommunication and providers networks. Variety of products available and customized solutions result in flexibility of the Fibrain PON systems and guarantee ease of future network upgrades.

Available are standard and tailor-made 19" and 21" patch panels dedicated for:
- integrated CWDM and DWDM multiplexers,
- hybrid solutions.

Applications:
- WDM systems,
- telecommunication networks,
- CATV networks,
- optic amplifiers,
- measuring equipment.

Features:
- easy management of PON elements,
- clear description of PON elements installed,
- possible installation of 1U and 2U in 19" and 21",
- dedicated and hybrid solutions.

Casings dimensions:		
Type	PZPON-1U	PZPON-2U
Height	1U	2U
Depth [mm]	280	
Width [mm]	436	
Mounting	19” or 21”	
Color	RAL7035*	

*Other colors available on request

**Technical data of multiplexers CWDM and DWDM see products cards

Examples of execution:

PZCW-G0-1-1-0004-MUX-47-53-SC-SC

Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Height:
1- 1U
2- 2U

Type:
MUX - mux
DUX - dmux
MDUX - mux/dmux
CMUX - compact mux
CDUX - comapct dmux
ADD
DROP
OADM

Starting channel:
47 - 1470 nm
49 - 1490 nm
51 - 1510 nm

Fiber:
1 - G.652D
2 - G.657A

Split:
0004 - 4ch
0008 - 8ch
0016 - 16ch
1004 - 4ch + 1310 nm
1104 - 4ch + 1310 + 1/99 monitor
1114 - 4ch + 1310 + 1/99 + upgrade 1260 - 1457 nm
1124 - 4ch + 1310 + 1/99 + upgrade 1460 - 1610 nm

End channel:
47 - 1470 nm
49 - 1490 nm
51 - 1510 nm

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

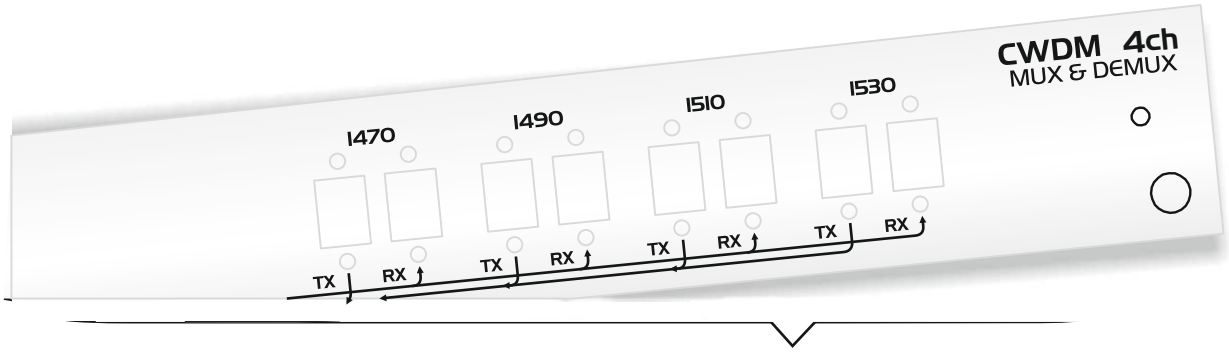
Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

PZCW-G0-1-1-0004-MUX-47-53-SC-SC

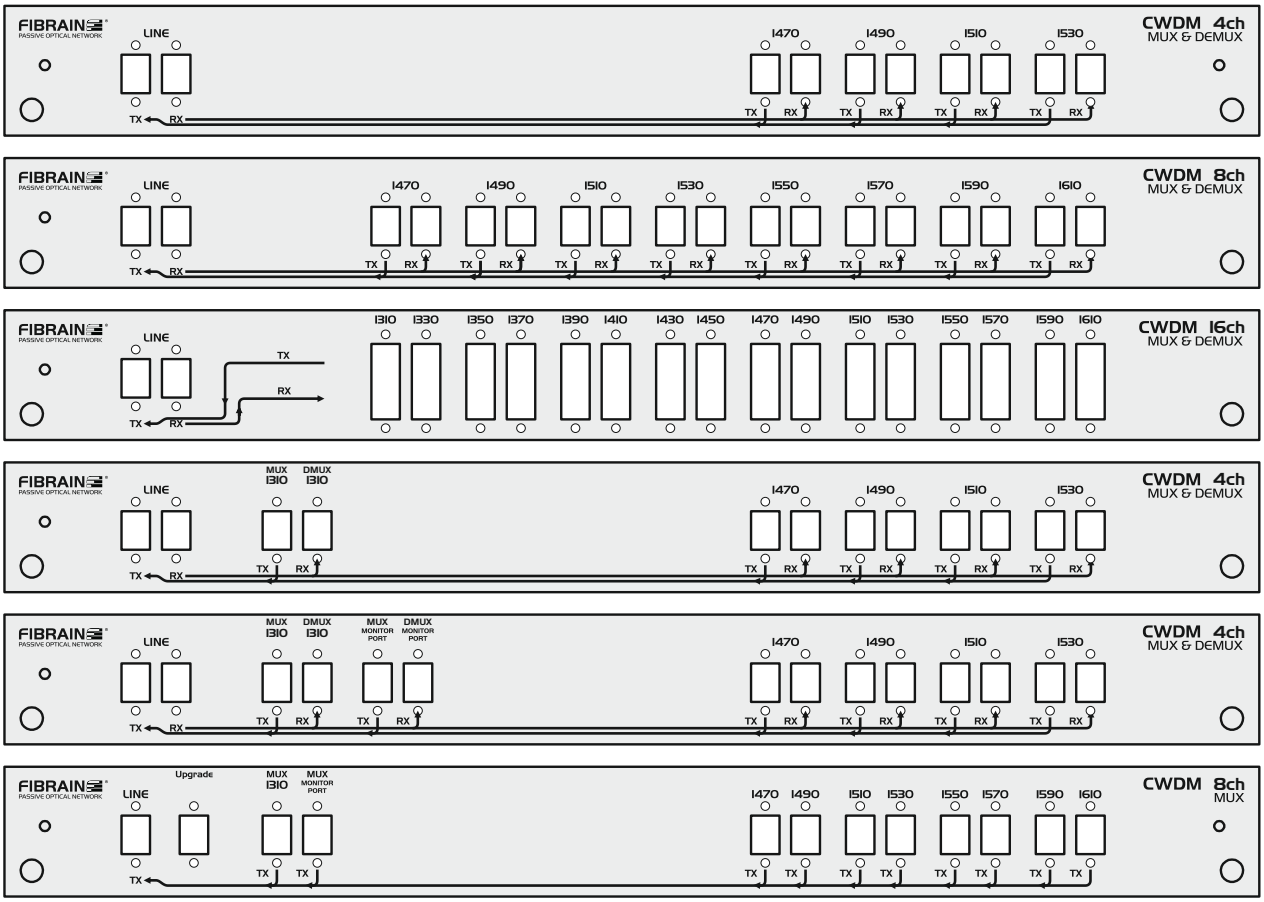
Example: Integrated patch panel 19" 1U, Multiplexer CWDM 4 channels, 1470 nm-1530 nm, connector type SC/UPC.

Optical Elements - PON

19” integrated patch panels PON



PZCW Solutions examples



Fiber:
1 - G.652D
2 - G.657A

Split:
0004 - 4ch
0008 - 8ch
0016 - 16ch
1004 - 4ch + 1310 nm
1104 - 4ch + 1310 + 1/99 monitor
1114 - 4ch + 1310 + 1/99 + upgrade 1260 - 1457 nm
1124 - 4ch + 1310 + 1/99 + upgrade 1460 - 1610 nm

PZDW -	G0	-	1	-	1	-	0004	-	M10	-	25	-	28	-	SC	-	SC

Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Height:
1 - 1U
2 - 2U

Type:
M10 - mux 100 GHz
M20 - mux 200 GHz
D10 - demux 100 GHz
D20 - demux 200 GHz
A10 - add 100 GHz
A20 - add 200 GHz
O10 - OADM 100 GHz
O20 - OADM 200 GHz

Starting channel:
C21 - 21 channel
...
C65 - 65 channel

End channel:
C21 - 21 channel
...
C65 - 65 channel

Conn. type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

Conn. type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

PZCW - G0- MUX- 004 - 29-32-1-1-SCA-SCA

Example: DWDM multiplexer, average, 100 GHz, 4 channels, starting channel 25, end channel 28, height 1 m, fiber 900 µm, casing 120x80x9 mm, connector type SCxSC.

Optical Elements- PON

Optical splitters in LGX casing

Optical splitters in LGX casing

Fibrain LGX solutions facilitate easy management of optical passive elements installed in telecommunication and providers networks. Additional chief asset is very easy extension as well as flexibility of demanded configuration adjustment.

LGX products offer possibility of mounting within one frame integrated FBT and PLC splitters, combiners.

Applications:

- WDM systems,
- telecommunication networks,
- CATV networks,
- optic amplifiers,
- measuring equipment,
- metropolitan networks.

Features:

- easy management of PON elements,
- clear description of PON elements installed,
- easy extension and development,
- dedicated and hybrid solutions.

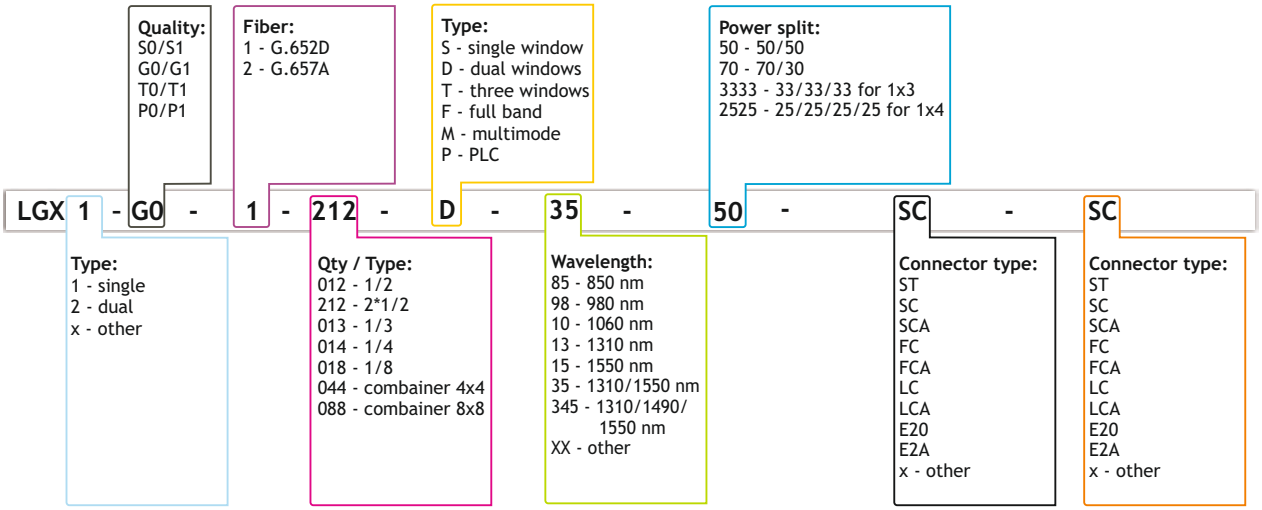
LGX casing:

Type	LGX1	LGX2
Height [mm]	100	
Depth [mm]	158.50	
Width [mm]	29	58
Mounting	19” lub 21”	
Color	RAL7035*	

*Other colors available on request

Shelves options for LGX modules:

Type	Height [mm]	Depth [mm]	Width [mm]	Color
LGX-1U-3-P	43.70	53.40	483	RAL7035*
LGX-2U-6-P	89	70	483	RAL7035*
LGX-3U-14-P	132	40	483	RAL7035*
LGX-4U-14-P	178	70	483	RAL7035*
LGX-1U-3-R	43.70	180	483	RAL7035*
LGX-2U-6-R	89	197	483	RAL7035*
LGX-3U-14-R	132	197	483	RAL7035*
LGX-4U-14-R	187	197	483	RAL7035*



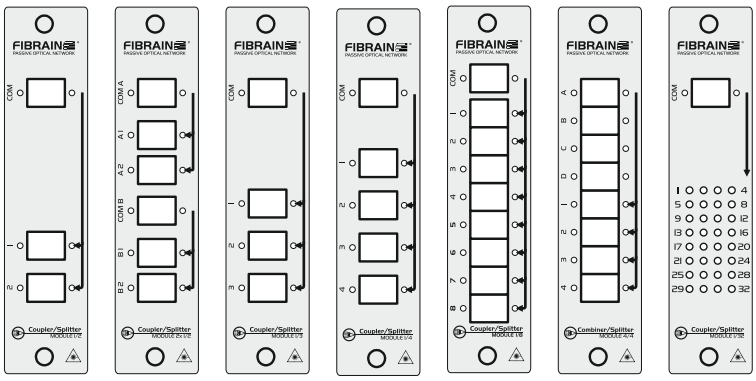
LGX1-G0-1-212-50-MUX-35-SC-SC

Example: Optical splitter in single width LGX, 2x1/2, dual window (1310/1550 nm), power split 50%, SC connectors.

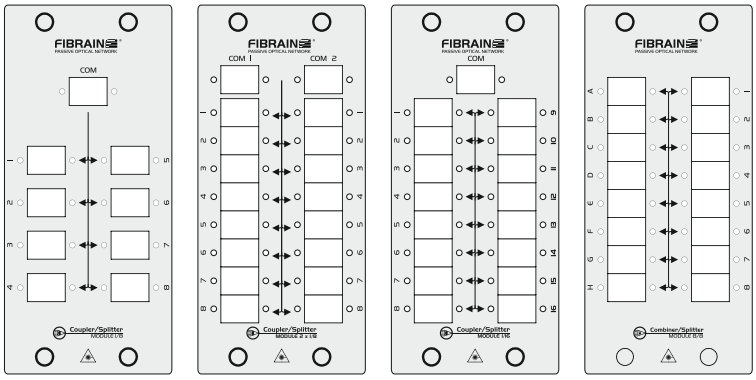
Optical Elements - PON

PON Solution in LGX casing

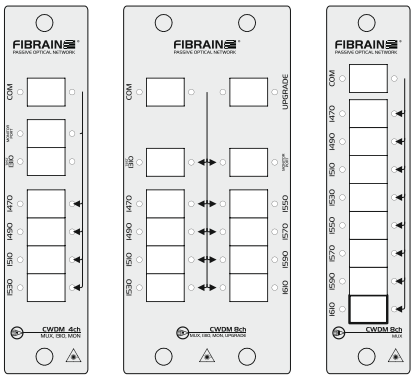
LGX Modules with installed splitters - examples



1 2 3 4 5 6 7



8 9 10 11



12 13 14

LGX1 Modules Examples:

1. Module LGX1 splitter 1/2
2. Module LGX1 splitter 2 x 1/2
3. Module LGX1 splitter 1/3
4. Module LGX1 splitter 1/4
5. Module LGX1 splitter 1/8
6. Module LGX1 combainer 4/4
7. Module LGX1 splitter 1/32

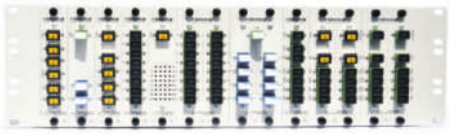
LGX2 Modules Examples:

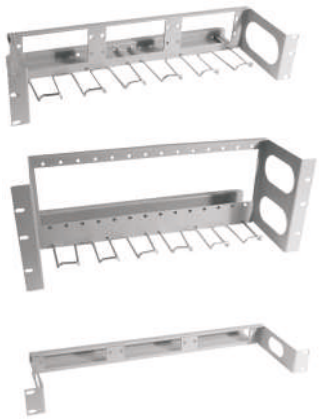
8. Module LGX2 splitter 1/8
9. Module LGX2 splitter 2 x 1/8
10. Module LGX2 splitter 1/16
11. Module LGX2 combainer 8/8

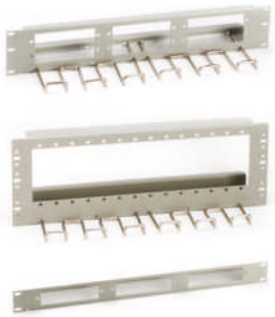
LGX2 Modules Examples:

12. Module LGX1 CWDM 4ch + 1310 nm + Port monitor
13. Module LGX2 CWDM 8ch + 1310 nm + Port monitor + Upgrade
14. Module LGX1 CWDM 8ch

* Available another solutions.







Optical Elements - PON

Optic multiplexers CWDM and DWDM in LGX casing

Optic multiplexers CWDM and DWDM in LGX casing

Fibrain LGX solutions facilitate easy management of optical passive elements installed in telecommunication and providers networks. Additional chief asset is very easy extension as well as flexibility of demanded configuration adjustment.

LGX products offer possibility of mounting within one frame integrated multiplexers CWDM and DWDM.

Applications:

- WDM systems,
- telecommunication networks,
- CATV networks,
- optic amplifiers,
- measuring equipment,
- metropolitan networks.

Features:

- easy management of PON elements,
- clear description of PON elements installed,
- easy extension and development,
- dedicated and hybrid solutions.

LGX casing:

Type	LGX1	LGX2
Height [mm]	100	
Depth [mm]	158.50	
Width [mm]	29	58
Mounting	19” or 21”	
Color	RAL7035*	

*Other colors available on request

Shelves options for LGX modules:

Type	Height [mm]	Depth [mm]	Width [mm]	Color
LGX-1U-3-P	43.70	53.40	483	RAL7035*
LGX-2U-6-P	89	70	483	RAL7035*
LGX-3U-14-P	132	40	483	RAL7035*
LGX-4U-14-P	178	70	483	RAL7035*
LGX-1U-3-R	43.70	180	483	RAL7035*
LGX-2U-6-R	89	197	483	RAL7035*
LGX-3U-14-R	132	197	483	RAL7035*
LGX-4U-14-R	187	197	483	RAL7035*

Casing:
LGX1
LGX2
LGX3

Device type:
CW - CWDM
DW - DWDM

CWDM split:
0004 - 4ch
0008 - 8ch
0016 - 16ch
1004 - 4ch + 1310 nm
1104 - 4ch + 1310 + 1/99 monitor
1114 - 4ch + 1310 + 1/99 + upgrade 1260 - 1457 nm
1124 - 4ch + 1310 + 1/99 + upgrade 1460 - 1610 nm

DWDM split:
0004 - 4ch
0008 - 8ch
0016 - 16ch
0032 - 32ch

LGX1 - G0 - CW - 1 - 0003 - MUX - 47 - 51 - SC - SC

Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Fiber:
0 - 250 µm
1 - 900 µm
2 - 2,0 mm
3 - 3,0 mm

Type CWDM:
MUX - mux
DUX - dmux
MDUX - mux/dmux
CMUX - compact mux
CDUX - comapct dmux
ADD
DROP
OADM

Type DWDM:
M10 - mux 100 GHz
M20 - mux 200 GHz
D10 - demux 100 GHz
D20 - demux 200 GHz
A10 - add 100 GHz
A20 - add 200 GHz
O10 - OADM 100 GHz
O20 - OADM 200 GHz

CWDM starting channel:
47 - 1470 nm
49 - 1490 nm
51 - 1510 nm
xx - other

DWDM starting channel:
21 - 21 channel
...
65 - 65 channel

CWDM end channel:
47 - 1470 nm
49 - 1490 nm
51 - 1510 nm
xx - other

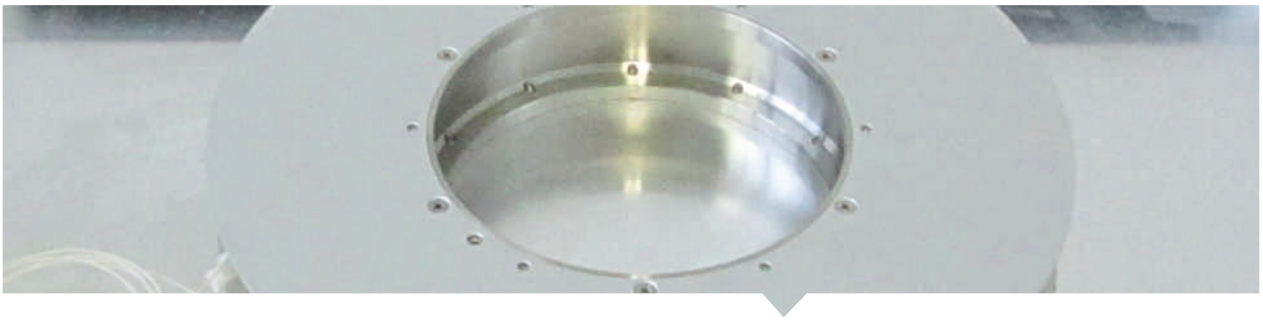
DWDM end channel:
21 - 21 channel
...
65 - 65 channel

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

LGX1-G0-CW-1-0008-MUX-47-51-SC-SC

Example: CWDM multiplexer in single width LGX, 3 channels, starting channel 1470, end channel 1510, SC PC connectors



Dispersion Compensating Modules (DCM)

Fibrain dispersion compensating modules (DCMs) are required in long-haul link to compensate for the degrading impact of chromatic dispersion on signal quality. Chromatic dispersion is an optical effect which considerably deteriorates the quality high speed optical signals (8 Gbps and faster) and, as a rule of thumb, links longer than 70 km long should be dispersion compensated. Fibrain DCM modules are characterized by low insertion loss, low polarization dependent loss and wide operating spectral range.

Technical specification

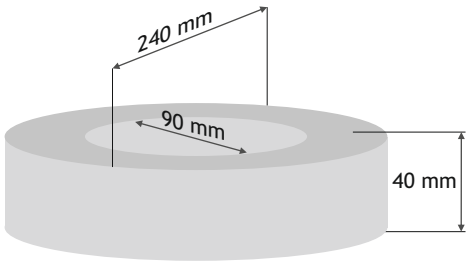
Compensated distance [km]	Dispersion @1550 nm +/-3%	Insertion loss [dB]	PMD [ps]	PDL [dB]
20	-340	≤ 2.9	≤ 0.1	≤ 0.5
40	-680	≤ 4.8	≤ 0.1	≤ 0.7
60	-1020	≤ 6.8	≤ 0.1	≤ 0.9
80	-1360	≤ 8.7	≤ 0.1	≤ 1.1
100	-1700	≤ 10.7	≤ 0.1	≤ 1.2
120	-2040	≤ 12.9	≤ 0.1	≤ 1.3
140	-2380	≤ 14.8	≤ 0.1	≤ 1.4
Min. spectral operating range: 1525-1565 nm				
Operating temperature range: -5°C to +70°C				

Applications:

- long haul networks,
- CWDM and DWDM transmission,
- CATV transmission.

Features:

- low insertion loss,
- low PDL loss,
- wide bandwidth,
- dispersion slope matched to transmission fiber.



Quality:
S0/S1
G0/G1
T0/T1
P0/P1

Compensated distance:
20 - 20 km
40 - 40 km
60 - 60 km
80 - 80 km

Pigtail length:
0 - 0.5 m
1 - 1 m
2 - 2 m

Casing type:
1 - 40x240 mm
2 - 19", 1U

DCM - G0 - 1 - 60 - C - 1 - 30 - 1 - SCA - SCA

Compensated fiber:
1 - G.652
2 - G.655 LEAF
3 - G.655TWRS

Operating window:
C - window C
L - window L

Pigtail type:
25 - 250 µm
90 - 900 µm
20 - 2.0 mm
30 - 3.0 mm

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

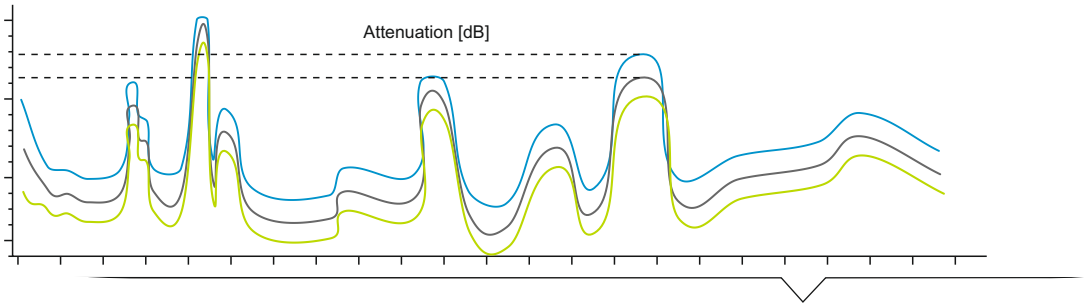
Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

DCM-G0-1-60-C-1-30-1-SCA-SCA

Example: DCM dispersion compensating module, for G.652 transmission fiber, 60 km compensated distance, C window, with 1 m 3.0 mm pigtails, SC APC connectors

Optical Elements - PON

Attenuators



Optical adapter attenuators AOA

Optical adapter attenuators AOA are characterized by high stability and low deviation from nominal attenuation. These are passive elements of optic duct used for limitation of transmitted signal optical power in order to adjust it to receiver bandwidth.

Optical attebuators technical data:

Type	Single mode 09/125	Multi mode
Wavelength	1260-1360 i 1460-1580	850/1300
Attenuation tolerance	1 - 9 dB +/-0.5 dB	1 - 5 dB +/-0.5 dB
	10-14 dB +/- 1 dB	6-14 dB +/- 1 dB
	15-19 dB +/-1.5 dB	15-19 dB +/-1.5 dB
	20-24 dB +/- 2.0 dB	20-24 dB +/- 2.0 dB
	25-30 dB +/- 2.5 dB	25-30 dB +/- 2.5 dB
Repetitiveness	<0.5 dB for 1000 cycles	<0.5 dB for 1000 cycles
Return loss RL [dB]	UPC > 50 dB	UPC > 50 dB
	APC > 65 dB	APC > 65 dB

Applications:
- WDM systems,
- telecommunication networks,
- CATV networks,
- optic amplifiers,
- measuring equipment.

Features:
- stability of parameters,
- wide attenuation band.

AOA - G0 - SC - 20 - SM - 15 - A

G0 – Quality:
S0/S1
G0/G1
T0/T1
P0/P1

SC – Connector type:
ST - ST/UPC
SC - SC/UPC
SCA - SC/APC
FC - FC/UPC
FCA - FC/APC
LC - LC/UPC
LCA - LC/APC
E20 - E2000/UPC
E2A - E2000/APC
x - other

20 – Attenuation:
xx - 01-30 dB

SM – Type:
SM - Single mode 09/125
M5 - Multi mode 50/125
M6 - Multi mode 62.5/125

15 – Wavelength:
85 - 850 nm
30 - 1300 nm
13 - 1310 nm
15 - 1550 nm
35 - 1310/1550
345 - 1310/1490 /1550
xx - other

A – Casing type:
A - metal
B - plastic

AOA-G0-SC-20-SM-15-A

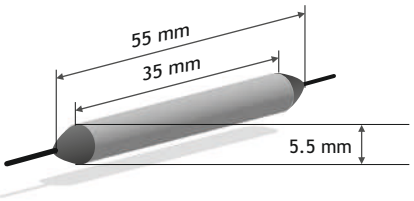
Example: Adapter attenuators, connector type SC, attenuation 20 dB, single mode, Wavelength 1310 & 1550, metal casing.

Fibrain Directivity

Products from the Fibrain Directivity family can be used to control the direction of optical propagation. As such, they can be used to set up single fiber bidirectional links, to build more complicated instruments with direction selectivity or in R&D. Fibrain Directivity products are characterized by high directional isolation, low insertion loss, wide spectral operating range and wide temperature operating range.

Fibrain optical isolators

Optical isolators are two-port devices, which block propagation of light in one direction, whereas in the other direction they exhibit very small insertion loss. Available in versions optimized for 1310, 1490, 1550 and 1590 nm windows.

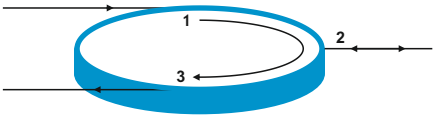


Features:

- Single stage and dual stage versions with higher directional isolation
- 1310, 1490, 1550 and 1590 nm operating windows
- Polarization insensitive
- Small size, typical pipe packaging 5.5x35 mm

Fibrain optical circulators

Optical circulators are most often used as 3-or 4-port devices, which can be used to switch incoming and outgoing signals between ports in a predetermined order. Often used as enablers to set up bidirectional transmission over single fiber strand. Available in versions optimized for 1310, 1490, 1550 and 1590 nm windows.



Bi-directional transsmision

Features:

- High directional isolation
- 1310, 1490, 1550 and 1590 nm operating windows
- Polarization insensitive
- Small size, typical pipe packaging 5.5x50 mm

DIR	-	C	-	S	-	1	-	1	-	55	-	25	-	1	-	LC	-	LC

Device type:
I - isolator
C - circulator

Isolation level:
S - single stage
D - dual stage

Fiber type:
1 - G.652
2 - G.655 LEAF
3 - G.655TWRS

Pigtail length:
0 - 0.5 m
1 - 1 m
2 - 2 m

Operating window:
31 - 1310
55 - 1550
35 - 1310/1550

Pigtail type:
25 - 250 µm
90 - 900 µm
20 - 2.0 mm
30 - 3.0 mm

Casing type:
1 - 5x50 mm
2 - 5.5x34 mm
3 - 5.5x38 mm
4 - 5.5x60 mm
5 - 98x24x9 mm

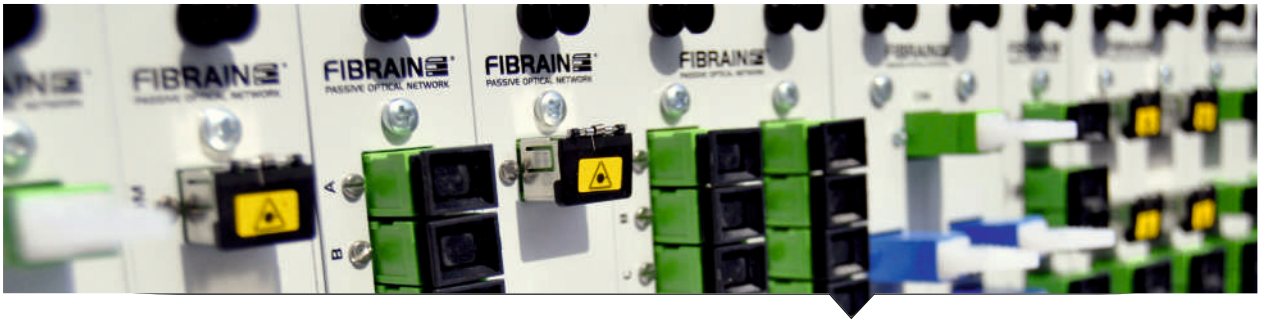
Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

Connector type:
ST
SC
SCA
FC
FCA
LC
LCA
E20
E2A
x - other

DCM-G0-1-60-C-1-30-1-SCA-SCA

Example: Fibrain directivity device, circulator, single stage, for 1550 nm window, in 5x50 mm pipe packaging, LC PC connectors

02



Fibrain PM elements

Fibrain PM elements are optical devices, which either polarize light or maintain polarization of the prepolarized light. They possess high polarization extinction ratio and high polarization isolation, low insertion loss, wide operating spectral range and broad operating temperature range.

Fibrain polarizers

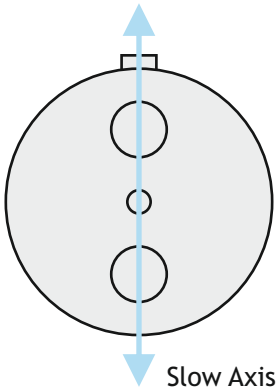
Optical polarizers are used to block one polarization of the incoming light, whereas, at the same time, they should introduce as small as possible insertion loss seen by the other polarization. Fibrain polarizers are also available connectorized, with PM pigtails and with connector key aligned either with the slow or fast axis.

Features:

- High polarization extinction
- Wide operating spectral range
- Low insertion loss
- Connector keying as requested by the customer
- Small size, typical packaging 5.5x30 mm pipe

Fibrain PM patchcords

The basis of polarization maintaining (PM) patchcords is the polarization maintaining fiber (Panda or Bow-tie). The standard connector keying is along the slow optical axis, however, on request other key alignments are available as well. All connector types are available.



Features:

- High polarization extinction
- Low insertion loss
- Wide operating spectral range (1310-1550 nm)
- Connector keying as requested by the customer
- All connector types

Fibrain polarization demultiplexers

Polarization demultiplexers are used to separate the two incoming orthogonal light polarizations and to split them between the two output ports. Available non-connectorized and connectorized, with keying as per customers request.

Features:

- High polarization extinction
- Low insertion loss
- Wide operating spectral range (1310-1550 nm)
- Connector keying as requested by the customer
- All connector types

Other PM elements

Most Fibrain passive optical devices are also available in polarization maintaining versions. Fibrain PM devices are always characterized by high quality, resulting in high polarization extinction ratio, low insertion loss, wide spectral and temperature working ranges.

Examples of available PM elements:

- PM FBT couplers
- PM SWDM couplers
- PM FWDM filters
- PM isolators
- PM circulators

Notes

01

FIBRAIN®
PASSIVE OPTICAL NETWORK

ELMAT
DOSTAWCA TELEINFORMATYKI

Passive Optical Network Products 2012/13

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