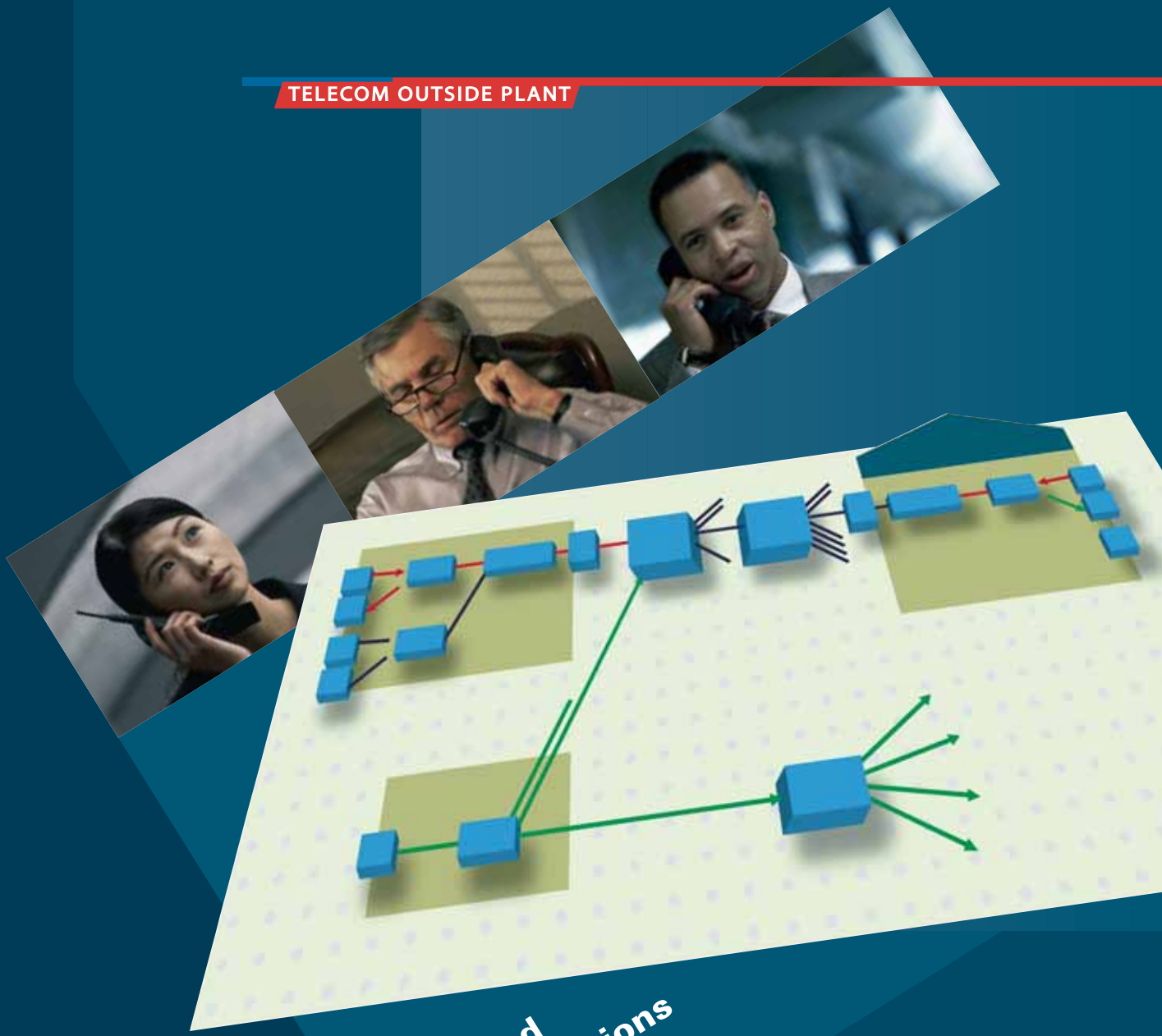
tyco Electronics

A World of Passive Components

TELECOM OUTSIDE PLANT

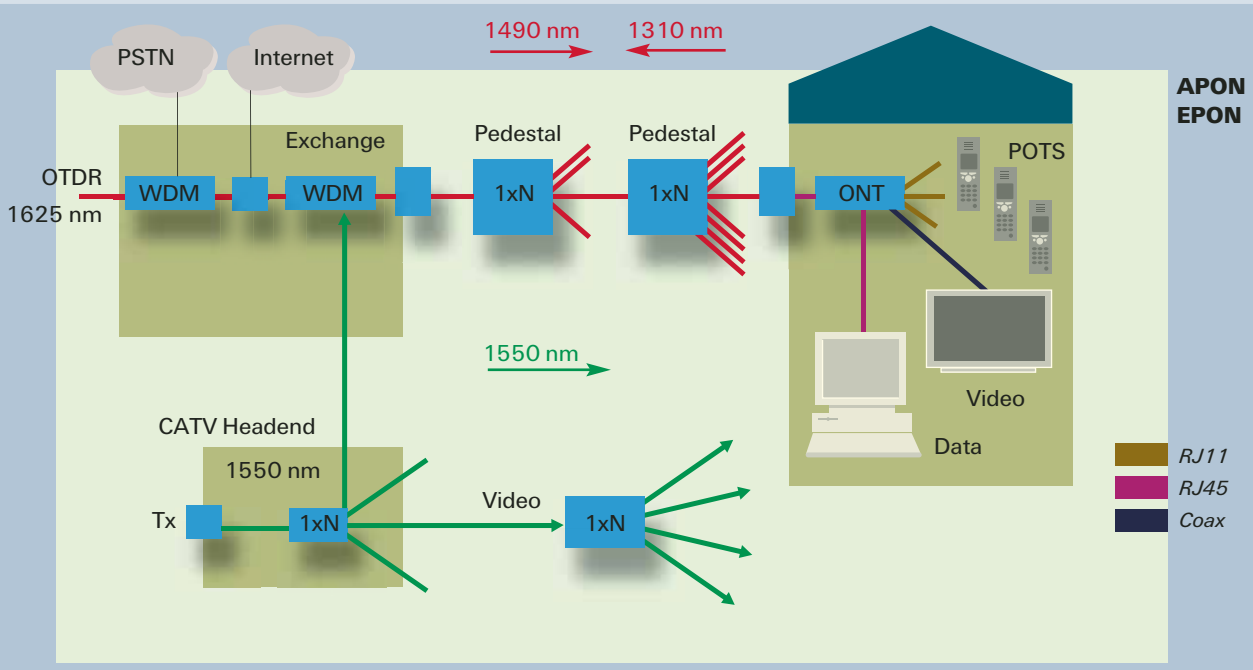


Integrated Optical Solutions within the Outside Plant Network


Introduction and applications

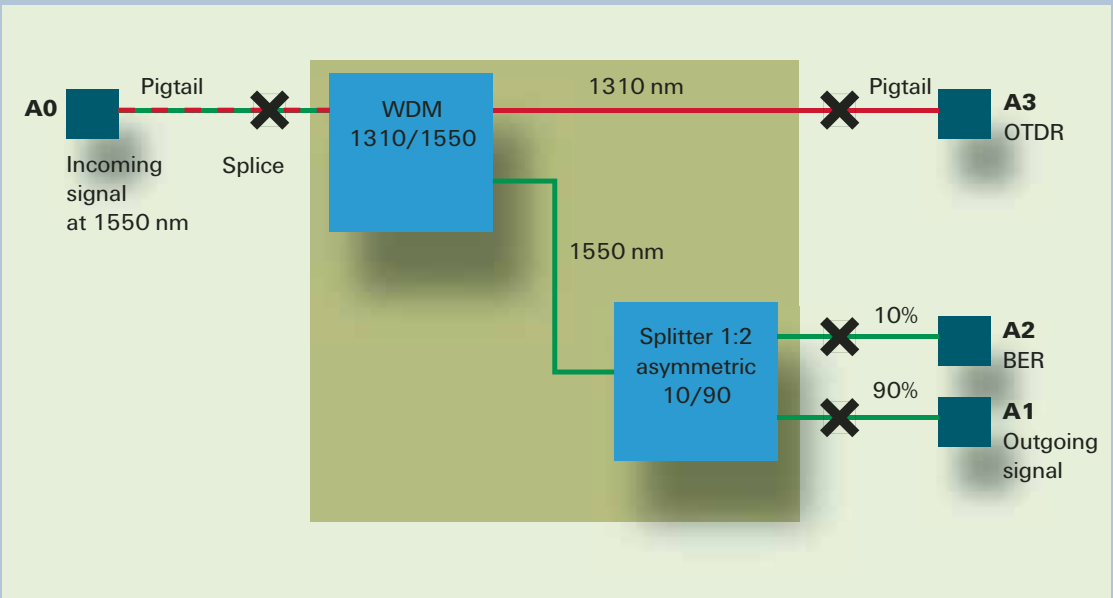
Passive optical components are becoming more and more significant in the communication networks of today. A modern long-haul, access, metro, CATV or mobile network can operate much more efficiently when optical splitters or wavelength division multiplexing components are incorporated. Here are some typical examples:

• Telephony, broadband, Passive Optical Network (TPON/BPON)



In an APON (ATM Passive Optical Network) and an EPON (Ethernet Passive Optical Network), every customer is connected to the central office via one fiber. This fiber carries traffic at 1310 nm (upstream data), 1490 nm (downstream data) and 1550 nm (video broadcast) using the wavelength division multiplexing technique.
Splitters are used in the outside plant (for example in a closure or cabinet) to split the fiber coming from the central office to for example 32 subscribers.
A WDM separates/combines the data traffic from the CATV signal.
The ONT unit separates the data, video and telephony signal at the subscriber's location.
Another WDM could add a 1625 nm signal for OTDR measurements.

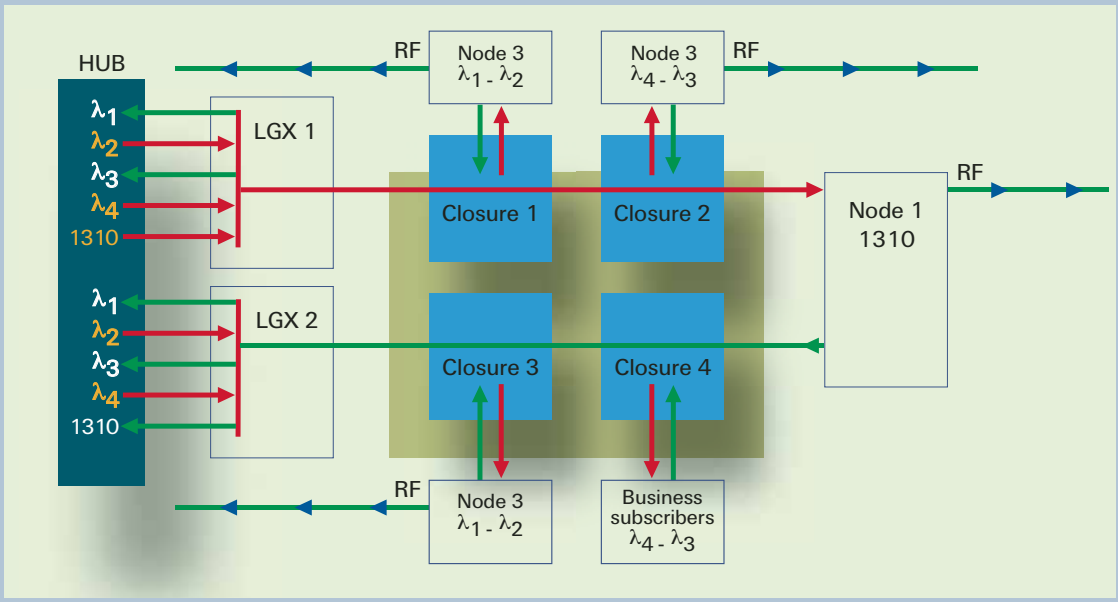
Network monitoring system



This application allows the operator to monitor the signals without disconnecting the link. There is one connection point for OTDR measurements on the line. OTDR measurements are performed at 1310 nm. The 1550 nm signal is split asymmetrically. The bulk of the signal (90%) goes to the electronics; the 10% leg of the splitter can be used to connect BER (Bit- Error-Rate) test equipment. In normal operation, ports A0 and A1 are connected while ports A2 and A3 are the test ports.

These components can be built into a standard patching tray, integrating with the network without losing any of the features of the FIST system.

CWDM upgrade between Hub and Node in a CATV infrastructure



Due to increased data traffic, the fiber link between a Hub and a CATV node can get saturated. A CWDM upgrade can increase this capacity drastically.

In this topology, two closures can be placed on both the upstream and downstream fiber.

This closure offers the possibility to splice the in- and outgoing fibers onto the CWDM add/drops. Each closure taps-off two wavelengths (one for upstream and one for downstream traffic). All CWDM wavelengths are situated in the 1550 nm window; the original node (node1) continues to operate in the 1310 nm window without any modification.This topology can also be used to address 2 or more wavelengths to for example a business subscriber. The CWDM add/drops are placed in the outside plant.

Integrating these fragile components with the network should not be a complex procedure. That is why Tyco Electronics focuses on the design of passive optical building blocks that readily integrate with existing systems and provide the required flexibility. This level of flexibility also means that the building blocks can be placed anywhere in the network and not only in controlled areas such as Central Offices. This is not always so with the more complex technologies.

Tyco Electronics modules are designed and tested for operation in outside plant conditions.

The TOAST concept

The performance of some passive optical components is influenced by the fluctuations of humidity and temperature that are typical for outside plant conditions. However, for most passive optical components (e.g. planar splitters) the drift due to temperature fluctuations under controlled humidity is limited.

TOAST technology offers the possibility of using sensitive components in all outside plant conditions, even with free-breathing enclosures. The concept creates a conditioned environment for environmentally sensitive components, as it ensures relative humidity below 20% for a period of 25 years. These conditions exceed the Telcordia GR 1221 endurance specifications.

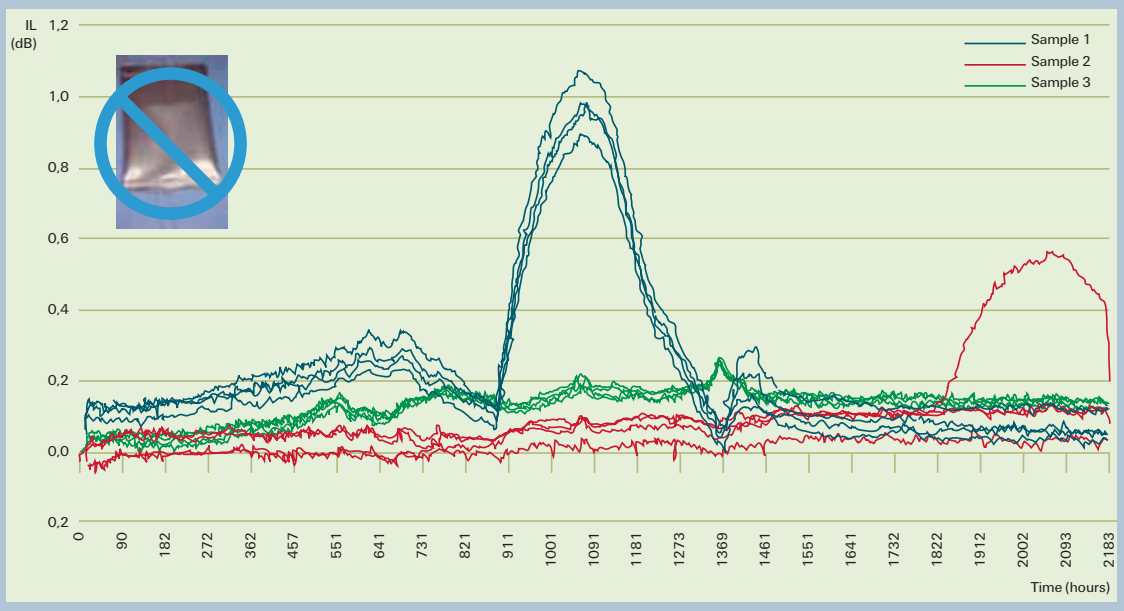
TOAST technology is compatible with the FIST and FOSC range in optical distribution frames, closures, street cabinets and customer termination points.

TOAST technology comprises an aluminium laminated bag which:

- acts as a moisture barrier
- seals the fiber inlet and outlet
- uses a special moisture regulating desiccant to control the humidity.

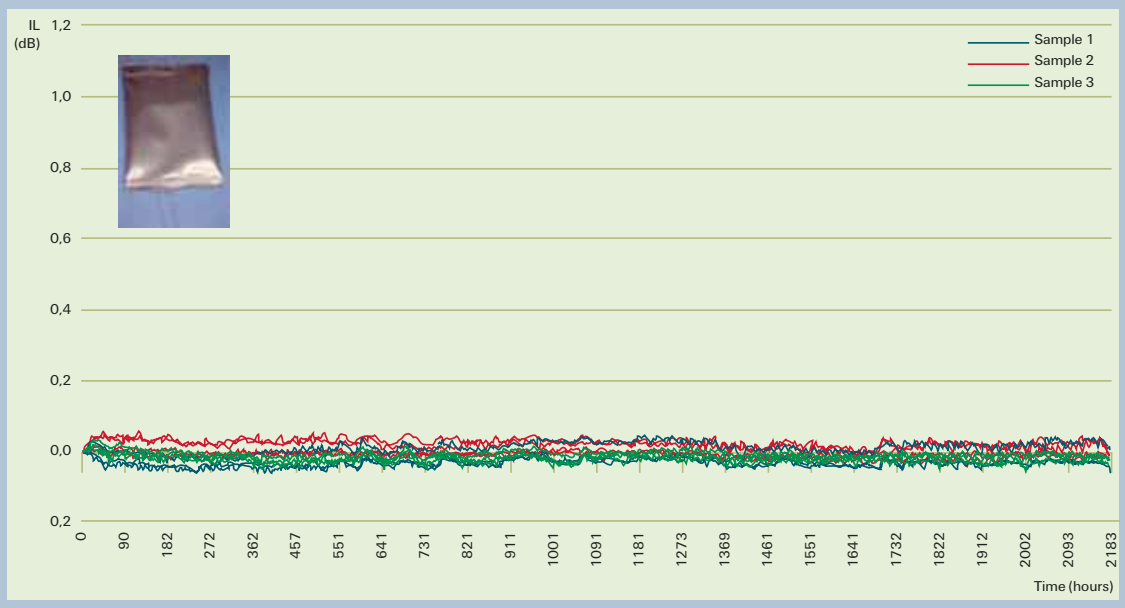
An example of the performance of such a sensitive component is shown below.

• IL variations of 3 samples of a 1x4 planar splitter during damp heat testing (85°C/85% RH) (Telcordia 1221 reliability testing)



The variation during the test is within specification as long as the IL variation < 0.3 dB and the residual loss (after the test) < 0.3 dB. Some samples clearly exceed these limits.

• IL variations of 3 samples of a 1x4 planar splitter during damp heat testing (85°C/85% RH)



When the same sensitive component has been integrated in the TOAST package, the graph looks quite different. TOAST protected splitters avoid increasing insertion losses.

Similar results have been recorded during other tests (e.g. temperature cycle testing) and on other components.

Solutions - not just components

All Tyco passive components (packaged in Toast or not), are available as plug-and-play **building blocks**. These components are compatible with the Tyco FIST and FOSC systems, ensuring flexibility and installation friendliness for the installer or network planner. Here are a few examples:

CSX-2
Centralized splitter cabinet

GMS-2
Shelf with integrated WDMs and splitters

FOSC-400B
Splice closure with integrated 1x8 splitter

OC-FPS
1RU splitter shelf

· The FIST-FWASA2, a WDM assembly, can be integrated with any FIST splicing shelf, closure or box. The WDMs are spliced into the network using standard FIST input and output trays. No special training is required.

· The FOSC-OC range of splitter trays makes the integration of splitters with a FOSC closure or splitter cabinet extremely simple.

· When splitters need to be connectorized, the FIST-OCG patching tray is used. The inputs and outputs of the components are connectorized for additional flexibility.

· For front-patching solutions, standard LGX compatible units are available.

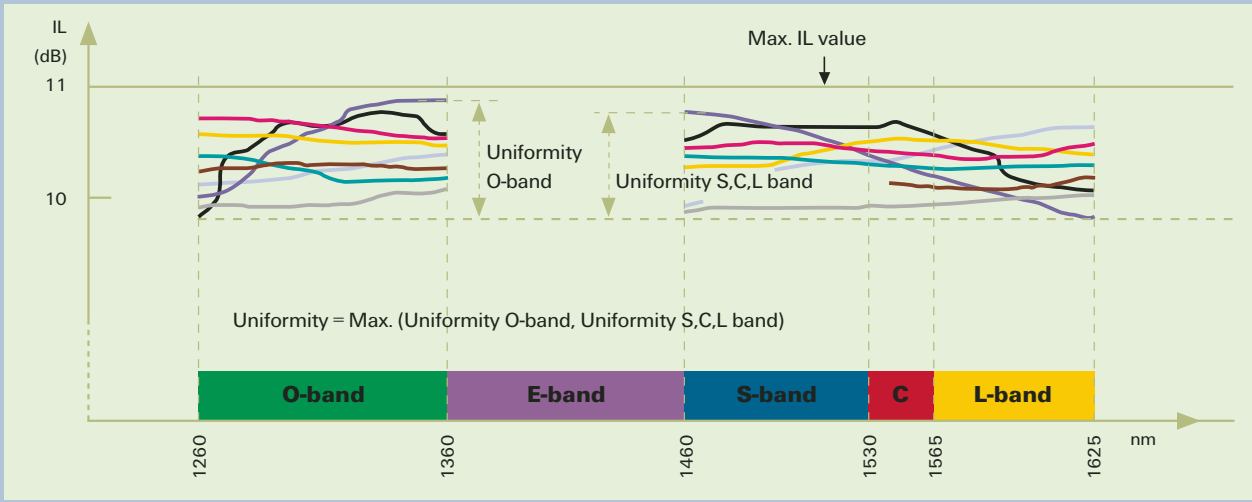
· Passive components can also be integrated with customer-specific housings.

· **Integrated solutions** (e.g. to pre-fiber complete patching shelves, closures or racks) are also available.

1 Splitters

Single mode wideband couplers/splitters are branching devices designed to split and combine light paths.

• Typical Insertion loss and uniformity of a 1 x 8 planar device



Tyco Electronics ensures a correct operation of the splitters in the O-, S-, C- and L-band.

The following types are available:
Fused Biconic Tapered (FBT) couplers are relatively robust in Outside Plant environments. Consequently, no additional sealing (TOAST) is necessary. Higher split-ratios are offered by simply concatenating low split-ratio components.

Planar waveguide splitters are based on silica technology. These high split-ratio components are superior to FBT couplers in terms of sizing and optical performance. Because of their design, planar components are more sensitive to humidity. Tyco Electronics components are, therefore, protected in a TOAST package. Additional optical performance characteristics are given for E-band applications.

Tyco Electronics offers its splitter product range in different grades, allowing easy definition of the building block most suited to a specific application.

Grade A: low insertion loss, good uniformity value (FBT technology)
Grade P: specific grade for planar components (excellent uniformity over the widest wavelength range)
Grade O: 'low loss' grade for planar components.

Splitter overview

The table below shows the product codes for building blocks with a particular technology.

		FIST		FOSC	LGX Front patching	Non-integrated
Technology		Spliced-in	Connectorized	Spliced-in	Connectorized	Connectorized or spliced-in
1:2	FBT	FIST-FSASA2-XX-X**A**-X	FIST-OC-G**A**	FOSC-OC-X**A**	OCMX-S**A** OCFPSX-**A**	OCC1**A**
1:4						
1:8						
1:16	Planar (TOAST)	FIST-FSASA2-XX-X**P**-X	FIST-OC-G**P**	FOSC-OC-X**P**	OCMX-S**P** OCMX-S**O**	OCC1**P**
1:32		FIST-FSASA2-XX-X**O**-X	FIST-OC-G**O**	FOSC-OC-X**O**	OCFPSX-**P** OCFPSX-**O**	OCC1**O**

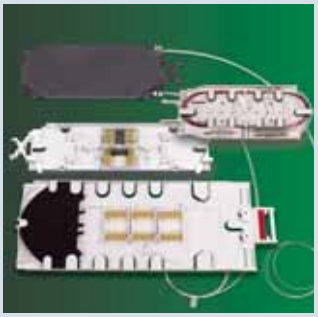
A, P or O (indicated in bold) refers to the grade of the splitter.

Integrated planar splitters are always packaged in TOAST protective sealing.

For more detailed technical information, please refer to Tyco specification RUD 5257 (FBT) and RUD 5330 (planar)

For more detailed ordering information, please refer to the corresponding product data sheet.

FIST-FSASA2



FOSC-OC

OCM5

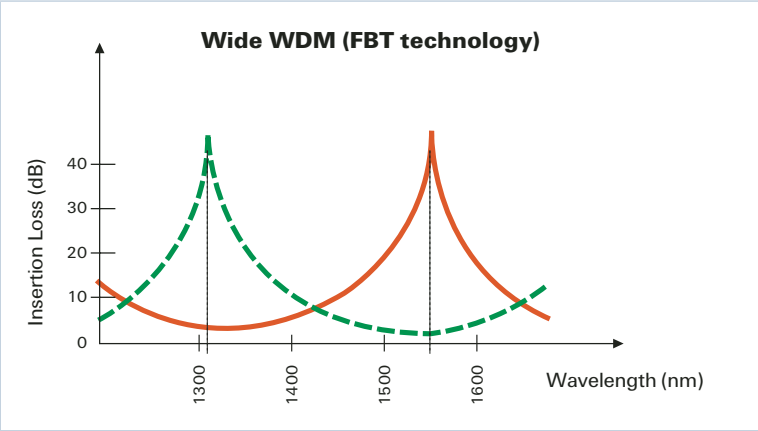
OCC1P

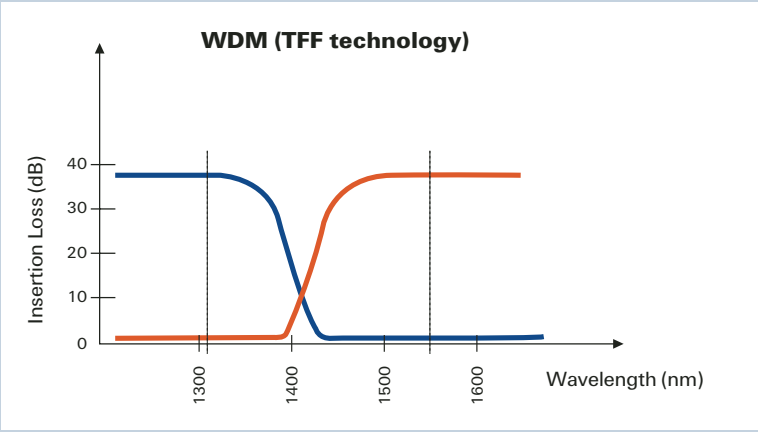
2 Wavelenght division multiplexing (WDM)

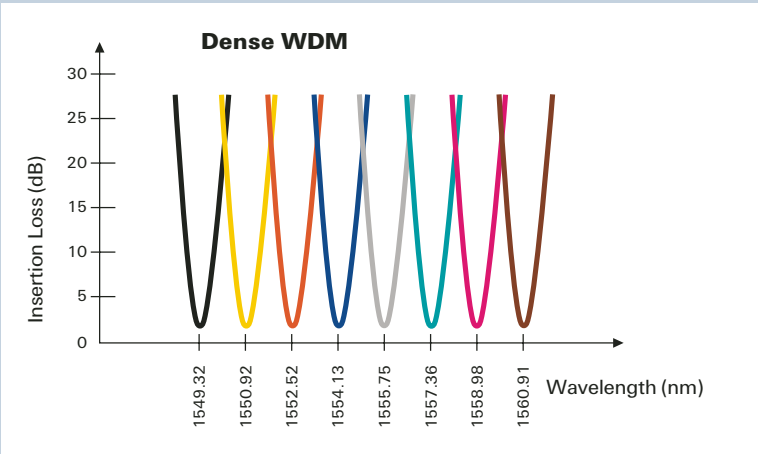
The wavelength division multiplexing technique combines (or multiplexes) two or more signals with different wavelengths in one common fiber. The same components can usually also be used to separate the wavelengths (de-multiplexing) at the remote location.

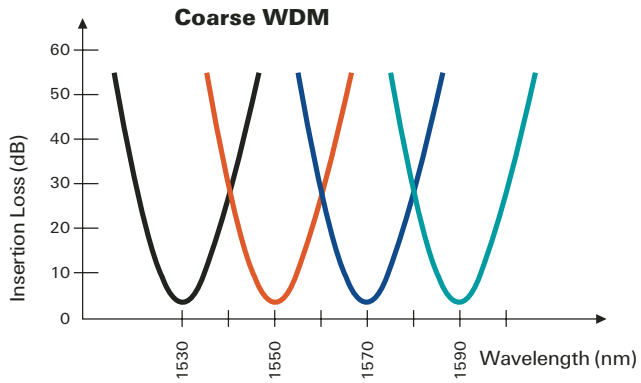
A wide wavelength division multiplexer (WWDM) separates or combines two wavelength ranges, such as 1310 nm or 1550 nm.
These components are available in different grades, based on FBT (fused biconic tapered) or TFF (thin-film filter) technology. This is an easy and cost-effective way to increase the capacity on existing fiber paths. The isolation value is important.

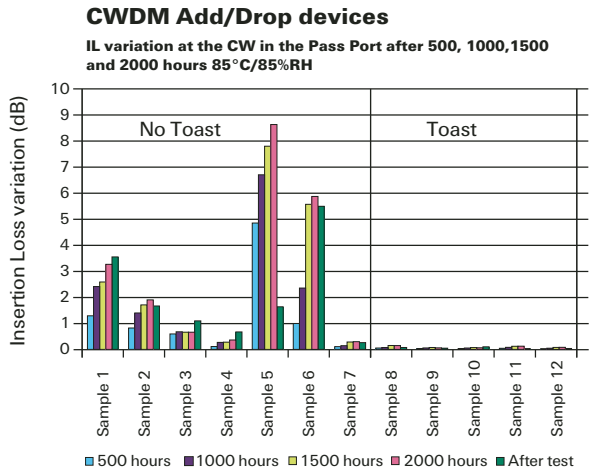
With DWDM (dense wavelength division multiplexing), several narrow-spaced channels are created. This technology allows for the cramming of a large number of densely packed wavelengths down a single fiber, resulting in heavy-duty bandwidth transport over long-haul and ultra-long-haul backbones. The typical channel spacing is 1,6 nm (200GHz) or 0,8 nm (100 GHz).

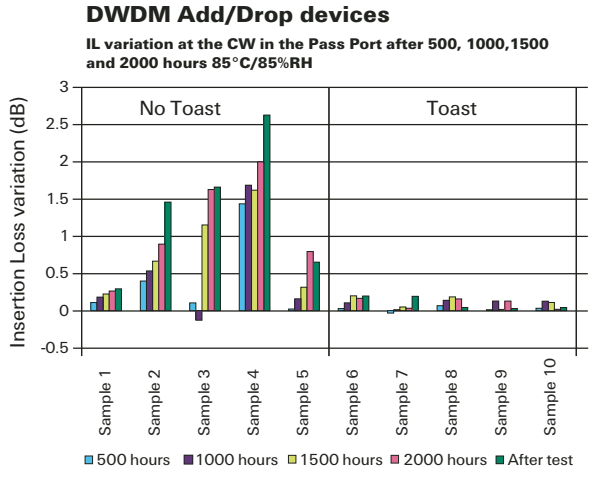












CWDM (coarse wavelength division multiplexing) systems are characterized by wider channel spacing than in traditional DWDM systems. These components are suitable for shorter transmission distances in metro networks. CWDM also reduces terminal costs (compared to DWDM systems) by eliminating the need for temperature control in the lasers, because a larger temperature drift is allowed.
Again, a CWDM can be built using FBT or TFF technology. The typical channel spacing is around 20 nm.

The above-mentioned components, based on filter technology, should be hermetically sealed when they are exposed to outside plant conditions.
Tyco Electronics can therefore offer these wide WDM, CWDM and DWDM components in TOAST packaging. These components will be further integrated with one of our building blocks to allow for easy implementation in the field.

WWDM overview

The table below shows the product codes for certain building blocks with a particular technology.

Product matrix			FIST		FOSC	LGX Front patching	Non-integrated
Technology	Passband	Typical Isolation	Connecto-rized	Spliced-in	Spliced-in	Connecto-rized	Connectorized or spliced-in
Standard FBT	1290 - 1330 nm and 1530 - 1570 nm (narrowband)	15 dB (grade B)	FIST-OC-G**W**	FIST-F**W**ASA2		OCMX-**W** OCFPSX-**W**	
High isolation Thin Film Filter	1260 - 1360 nm and 1480 - 1600 nm (wideband)	45 dB (grade A)	FIST-OC-G**T**	FIST-F**T**ASA2(*)		OCMX-**T** OCFPSX-**T**	OCC1T

Notes

- For other types of building blocks, contact your local sales engineer.
- The above mentioned standard WDM components separate the 1310 nm band from the 1550 nm + 1625 nm bands. For other passbands (such as blue-red filter WDM), please contact your local sales engineer.
- (*) Thin-Film-Filter-based components are packaged in "TOAST" protective sealing for outside plant applications.
- A special specification is available for PON video couplers (combining 1310 + 1490 [data] with 1550 [video]).
- For more detailed technical information, please consult the following technical specifications
  - RUD 5263: standard WWDM
  - RUD 5360: high isolation WWDM (indoor)
  - RUD 5335: high isolation WWDM (outdoor-TOAST)
  - RUD 5364: video coupler WDM for PON (indoor)
  - RUD 5339: video coupler WDM for PON (outdoor-PON)

CWDM overview

Coarse wavelength division multiplexing is characterized by a channel spacing of 20 nm.

Product matrix	**FIST**		**FOSC**	**LGX** **Front patching**	**Non-integrated**
Product matrix	Connectorized	Spliced-in	Spliced-in	Connectorized	Connectorized or spliced-in
Technology					
Thin film filter					
Center wavelengths					
1270-					
1290-...	FIST-OC-G**C**	FIST-F**C**ASA2 (*)	FOSC-OC-X**C** (*)	OCMX-**C**	
-1610 nm				OCFPSX-**C**	
Typical port allocation					
- 1, 2, 4 or 8 channels					
- 1310 nm feed-through					
- upgrade ports					

Notes

- Available types are MUX, DEMUX and MUX + DEMUX.
- For other types of building blocks, contact your local sales engineer.
- For more detailed technical information, please refer to the CWDM specification proposal nr. 5359 (indoor).
- (*) Thin film filter based components are packaged in “TOAST” protective sealing for outside plant applications (proposal 5336).

FOSC-OC-XC

DWDM overview

Dense wavelength division multiplexing is characterized by a channel spacing of 1.6 nm or 0.8 nm.

Product matrix	FIST		FOSC	LGX Front patching	Non-integrated
	Connectorized	Spliced-in	Spliced-in	Connectorized	Connectorized or spliced-in
Technology					
Thin film filter					
Center wavelength					
ITU grid	FIST-OC-G**D**		FOSC-OC-X**D** (*)	OCMX-**D** OCFPSX-**D**	
Typical nr. of channels					
4, 6 or 8 (more channels possible)					

Notes

- For other types of building blocks, contact your local sales engineer.
- For more detailed technical information, please refer to the DWDM specification proposal nr. 5362.
- The add-drop components for multiplexing and de-multiplexing have been put in a different sequence to balance the insertion loss.
- 100 GHz and 200 GHz DWDM modules use different components.
- (*) Thin film filter based components are packaged in 'TOAST' protective sealing for outside plant applications.

FIST-OC-GD

OCMX-D

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