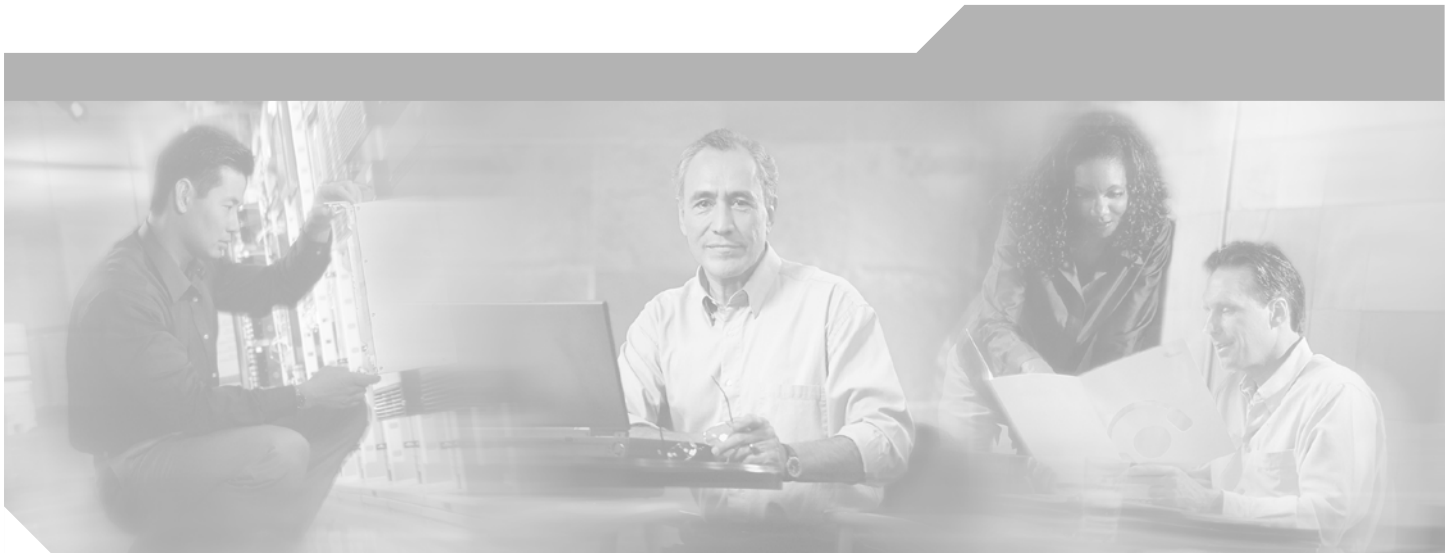

Cisco ONS 15216 FlexLayer User Guide

Release 2.0
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Cisco ONS 15216 FlexLayer User Guide

CONTENTS

About This Guide

This section explains the objectives, intended audience, and organization of the *Cisco ONS 15216 FlexLayer User Guide* and describes the conventions that convey instructions and other information.

This section provides the following information:

Document Objectives

This guide provides procedures for the network design, installation, and connection for the Cisco ONS 15216 FlexLayer products. Network architecture examples, product descriptions, product part numbers, and optical performance specifications are included.

Audience

To use this guide you should be familiar with Cisco or equivalent optical transmission hardware and cabling, optical network architecture, and have experience as a telecommunications technician.

Document Organization

Chapter	Description
Chapter 1, “Introduction”	Provides summary and description of the various pieces of the Cisco ONS 15216 product.
Chapter 2, “Installation”	Explains how to install the Cisco ONS 15216 FlexLayer product.
Chapter 3, “Applications”	Provides network configuration examples for the Cisco ONS 15216 FlexLayer product.
Chapter 4, “Hardware”	Provides Cisco ONS 15216 FlexLayer part numbers, functional descriptions ,and block diagrams.
Appendix A, “Specifications”	Provides technical specifications for the various modules in the Cisco ONS 15216 FlexLayer product.

Document Conventions

This publication uses the following conventions:

Convention	Application
boldface	Commands and keywords in body text.
italic	Command input that is supplied by the user.
[ ]	Keywords or arguments that appear within square brackets are optional.
{ x | x | x }	A choice of keywords (represented by x) appears in braces separated by vertical bars. The user must select one.
Ctrl	The control key. For example, where Ctrl + D is written, hold down the Control key while pressing the D key.
`screen font`	Examples of information displayed on the screen.
`boldface screen font`	Examples of information that the user must enter.
< >	Command parameters that must be replaced by module-specific codes.

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the document.

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the document.

Caution Means *reader be careful*. In this situation, the user might do something that could result in equipment damage or loss of data.

Warning

IMPORTANT SAFETY INSTRUCTIONS

This warning symbol means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device. Statement 1071

SAVE THESE INSTRUCTIONS

Where to Find Safety and Warning Information

For safety and warning information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document that accompanied the product. This publication describes the international agency compliance and safety information for the Cisco ONS 15xxx systems. It also includes translations of the safety warnings that appear in the ONS 15xxx system documentation.

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Submitting a Service Request

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Introduction

This document describes the Cisco ONS 15216 FlexLayer Asymmetric DWDM network equipment and provides a detailed overview of the new features that are either directly visible to the end user or are important to understanding the equipment operation.

All components are optically passive and require no electrical connections.

The Cisco ONS 15216 FlexLayer Asymmetric DWDM release includes the following components:

- Eight channel add or drop flex module
- Two channel add or drop flex module
- Optical splitter or combiner flex module (2, 3, and 4 channels)
- Four channel VOA flex module
- FlexLayer shelf assembly.

The FlexLayer modules use Y-cable protection modules. These modules are:

- Multimode Y cable protection module
- Single mode Y cable protection module

The FlexLayer features include:

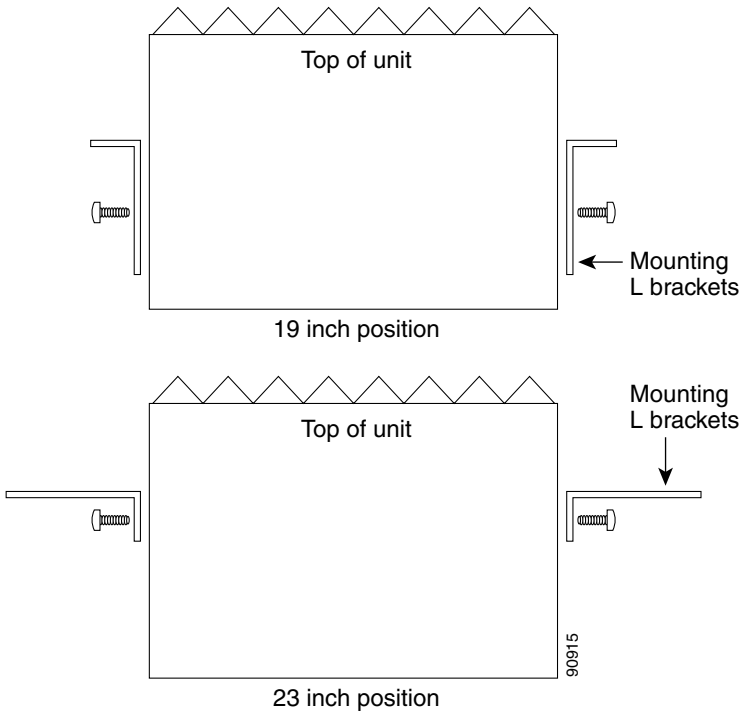
- 200km of total fiber length or 3600 ps/nm of total fiber dispersion
- 82 dB (20+2x22+18) maximum point to point loss with optical amplification and no regeneration
- 25 dB maximum point to point loss without optical amplification and no regeneration.
- Unidirectional TX only
- Protected pt-pt application
- Protected hubbed rings, 16 Nodes, 2 32 Channel per Node
- Unprotected pt-pt application
- 32 channels + 1 OSC channel
- OSC support for management connectivity
- Optical drop with 2 channel granularity
- NEBS 3E
- Compatible to operate on ITU-T G652 Single Mode Fiber (SMF28 or equivalent)

Installation

2.1 Overview

The ONS 15216 can be installed in a standard 19- or 23-inch equipment rack. Each assembly includes reversible mounting brackets that you can rotate to fit either rack size. The unit ships with the mounting brackets in the 19-inch position. Figure 2-1 shows the top view of a unit with the mounting brackets in both positions.

Figure 2-1 ONS 15216 Reversible Mounting Brackets

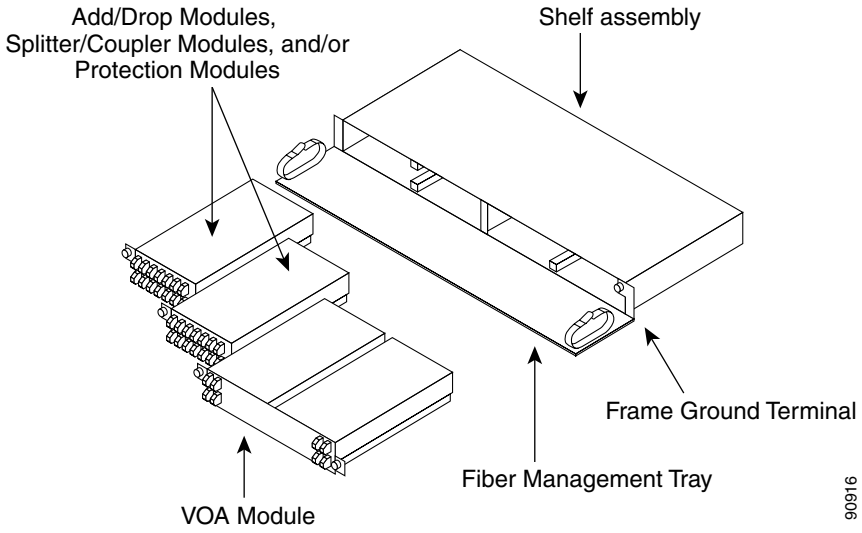


Four rack-mounting screws are included with each ONS 15216. Because the ONS 15216 is a passive device, no power cabling or connections are necessary. The unit can be installed anywhere in the rack (in other words, above or below the DWDM generating equipment), according to local site practice.

2.2 Install the ONS 15216

The FlexLayer shelf assembly is 1 RU high and can be mounted in a 19- or 23-inch rack (2-way mounting brackets). The shelf assembly is made to house four Add/Drop or Splitter/Combiner FlexLayer modules or two VOA FlexLayer modules. Frame grounding terminals and a fiber management tray are also provided. Figure 2-2 shows the FlexLayer shelf assembly and how it supports FlexLayer modules.

Figure 2-2 ONS 15216 FlexLayer Shelf Assembly



Step 1 Set the mounting brackets to the 19- or 23-inch position, depending on the rack you are using.

Note Remember that the units are shipped with the mounting brackets in the 19-inch position. See Figure 2-1 on page 2-1 for mounting bracket positioning.

Step 2 Secure the unit to the rack using the three mounting screws provided.

Step 3 As appropriate, connect the fibers according to the fiber connection drawings referenced in the port layouts shown in Figure 4-4 on page 4-4, Figure 4-7 on page 4-6, Figure 4-8 on page 4-6, Figure 4-17 on page 4-10, Figure 4-18 on page 4-11, Figure 4-20 on page 4-12, Figure 4-21 on page 4-12, Figure 4-23 on page 4-13, Figure 4-24 on page 4-14, Figure 4-29 on page 4-16 and Figure 4-32 on page 4-18.

2.3 Fiber Optic Connector Cleaning and Maintenance

Connector cleaning is required to maintain the performance of fiber-optic circuits. It is important that both the LC/UPC connector at the end of the fiber-optic cable and the mating bulkhead adapter on the front panel of the ONS 15216 are clean before the connection is made.

Warning **To prevent serious eye damage, never look directly into a fiber optic cable connector or mating adapter. Never assume laser power is turned off or the fiber is disconnected at the other end.**

Warning **Always handle, use, and dispose of chemicals and other cleaning materials in accordance with manufacturer's instructions.**

Note Before installing the fiber-optic cable, always perform the cleaning procedure for cable connectors described in the following section. Whenever possible, inspect each connector before connecting it to the mating bulkhead adapter on the ONS 15216 front panel.

Note The LC bulkhead adapters on the ONS 15216 front panel are less likely to get dirty if they are capped when not in use. Because the procedure for a thorough cleaning of these adapters is complicated and involves opening the ONS 15216 unit, Cisco recommends that you use a commercially available cleaning kit and closely follow the instructions included with the kit. Only a simple, routine cleaning procedure for these adapters that can be easily performed by the customer is described here.

2.3.1 Customer Supplied Cleaning Materials

The following cleaning materials are recommended but are not supplied with the ONS 15216 unit:

- Reagent grade ethyl alcohol in an alcohol dispenser
- Lint free laboratory wipes
- Clean, dry, oil-free compressed air

When cleaning a paired cable connector (bulkhead mating adapter), always clean the mating adapter first.

If properly maintained (only used with clean, defect-free fiber connectors and capped when not in use), the mating adapter should not require cleaning. However, if you suspect the adapter is dirty, clean it by blowing with clean, dry, oil-free compressed air.

2.3.2 Clean the Bulkhead Mating Adapters

Step 1 Read the manufacturer instructions to properly use the compressed air can.

Note Improper use of the compressed air may cause more contamination to the part being cleaned and defeat the purpose of cleaning the bulkhead mating adapters.

Step 2 Before blowing the adapter clean, release a short blast of compressed air to remove any dust inside the nozzle of the compressed air can.

Step 3 Blow three to four short blasts of air into the adapter housing to remove any dust.

Note Always keep unused adapter ports and fiber connectors capped with a clean dust cap.

2.3.3 Clean Fiber-Optic Cable Connectors

Step 1 Fold a clean wipe several times to get a pad of 6 to 8 layers of material.

Step 2 Remove the protective cap on the LC/UPC optical fiber cable connector.

Step 3 Dampen (but do not soak) a corner of the pad with alcohol using the alcohol dispenser.

Step 4 Firmly press the tip of the ferrule into the alcohol-moistened area of the wipe. Pinch the wipe firmly with your fingers against the ferrule and twist the ferrule to firmly wipe the ferrule. Repeat this step three times, using a clean alcohol-moistened area each time.

Note The design of the LC connector makes it difficult to clean the entire perimeter of the ferrule, because only a small portion close to the ferrule tip is accessible. Clean the tip of the ferrule and the entire accessible perimeter. Keep the fiber connector capped at all times when not in use.

Step 5 Press the ferrule tip into a clean, dry spot on the wipe and perform the pinch-and-twist procedure described in Step 4 once.

Step 6 Discard the used wipe.

Step 7 (Optional) A couple of short blasts of clean, dry oil-free compressed air should remove any tissue fragments that may have been deposited on the ferrule during cleaning.

Step 8 Whenever possible, inspect the ferrule end-face to ensure that the cleaning procedure effectively removed the dust/dirt from the ferrule and that no cleaning-induced damages are present.

Step 9 If the ferrule end-face is still dirty, repeat Steps 1 through 8.

Step 10 If the ferrule shows damages (for example, scratches or pits across the fiber core), replace the fiber patch cord with a new one equipped with a defect-free connector.

Defects on the fiber cable connector are likely to damage the mating connector inside the ONS 15216, which results in more costly repairs.

Step 11 If the ferrule end-face is clean and damage-free, place the connector into the corresponding clean mating adapter on the ONS 15216 front panel following the instructions in the next section.

2.4 Install and Route Fiber-Optic Cables

Warning **Follow all directions and warning labels when working with optical fiber cables and adapters. To prevent serious eye damage, never look directly into an optical fiber cable connector or mating adapter.**

Warning **When connecting an optical fiber patch cord between the ONS 15216 and the optical card ports in the ONS 15454, use the electrostatic discharge wristband supplied with the ONS 15454. Plug the wristband into the ESD jack on the lower right front side of the ONS 15454.**

Note Always clean all fiber connectors thoroughly before making the connection with the mating adapter. Very small particles can permanently damage the end of the mating fiber inside the ONS 15216 unit, which makes regular cleaning imperative. See the "2.3 Fiber Optic Connector Cleaning and Maintenance" section on page 2-3 for cleaning instructions.

Note The ONS 15216 front panel features LC/UPC bulkhead adapters. Always use fiber optic cables equipped with the corresponding (LC/UPC) connector type. Using any other type of connector results in damaging the connector and/or adapter.

Step 1 Place the LC/UPC cable connector in front of the corresponding bulkhead adapter on the front panel of the ONS 15216.

Step 2 Align the keyed ridge of the cable connector with the slot in the receiving adapter.

Step 3 Gently push the cable connector into the adapter until you hear a click, indicating the latching system is engaged.

Step 4 Open the fiber guide by pulling the fiber guide locker on the appropriate side of the front panel.

Step 5 A spring-ball screw that allows the fiber guide locker to be easily opened or closed secures the top.

Step 6 Route fiber cables through the fiber guide and lock them into place using the fiber guide locker.

Applications

3.1 Application Overview

The purpose of the FlexLayer Asymmetric DWDM component system is unidirectional Video on Demand (VoD) applications. These applications require only one channel, the OSC (if used), to be bidirectional. The other channels are unidirectional. The ONS 15216 R2.1 channel plan (32 channels, 100 GHz spacing) is used in this release. Table 3-1 shows how the FlexLayer A/D modules are grouped in relation to the supported channels.

Table 3-1 ONS15216 r2.1 100 GHz Channel Plan

ITU	Channel ID	Frequency (THz)	Wavelength (nm)	2 Ch A/D Flex Module	8 Ch A/D Flex Module
59	30.3	195.9	1530.33		
58	31.1	195.8	1531.12		
57	31.9	195.7	1531.90		
56	32.6	195.6	1532.68		
54	34.2	195.4	1534.25		
53	35.0	195.3	1535.04		
52	35.8	195.2	1535.82		
51	36.6	195.1	1536.61		
49	38.1	194.9	1538.19		
48	38.9	194.8	1538.98		
47	39.7	194.7	1539.77		
46	40.5	194.6	1540.56		
44	42.1	194.4	1542.14		
43	42.9	194.3	1542.94		
42	43.7	194.2	1543.73		
41	44.5	194.1	1544.53		

Table 3-1 ONS15216 r2.1 100 GHz Channel Plan (continued)

ITU	Channel ID	Frequency (THz)	Wavelength (nm)	2 Ch A/D Flex Module	8 Ch A/D Flex Module
39	46.1	193.9	1546.12		
38	46.9	193.8	1546.92		
37	47.7	193.7	1547.72		
36	48.5	193.6	1548.51		
34	50.1	193.4	1550.12		
33	50.9	193.3	1550.92		
32	51.7	193.2	1551.72		
31	52.5	193.1	1552.52		
29	54.1	192.9	1554.13		
28	54.9	192.8	1554.94		
27	55.7	192.7	1555.75		
26	56.5	192.6	1556.55		
24	58.1	192.4	1558.17		
23	58.9	192.3	1558.98		
22	59.7	192.2	1559.79		
21	60.6	192.1	1560.61		

The ONS 15216 FlexLayer system is designed to support the DWDM transmission of 1.25 gigabit interface converter (GBIC) interfaces. The reference performance of these interfaces is reported in Table 3-2. The ONS 15216 FlexLayer system deploys the ONS 15216 EDFA2 for optical amplification of the signal.

Note The ONS 15216 FlexLayer system can also support 2.5G and 10G transmissions; contact your sales representative for information.

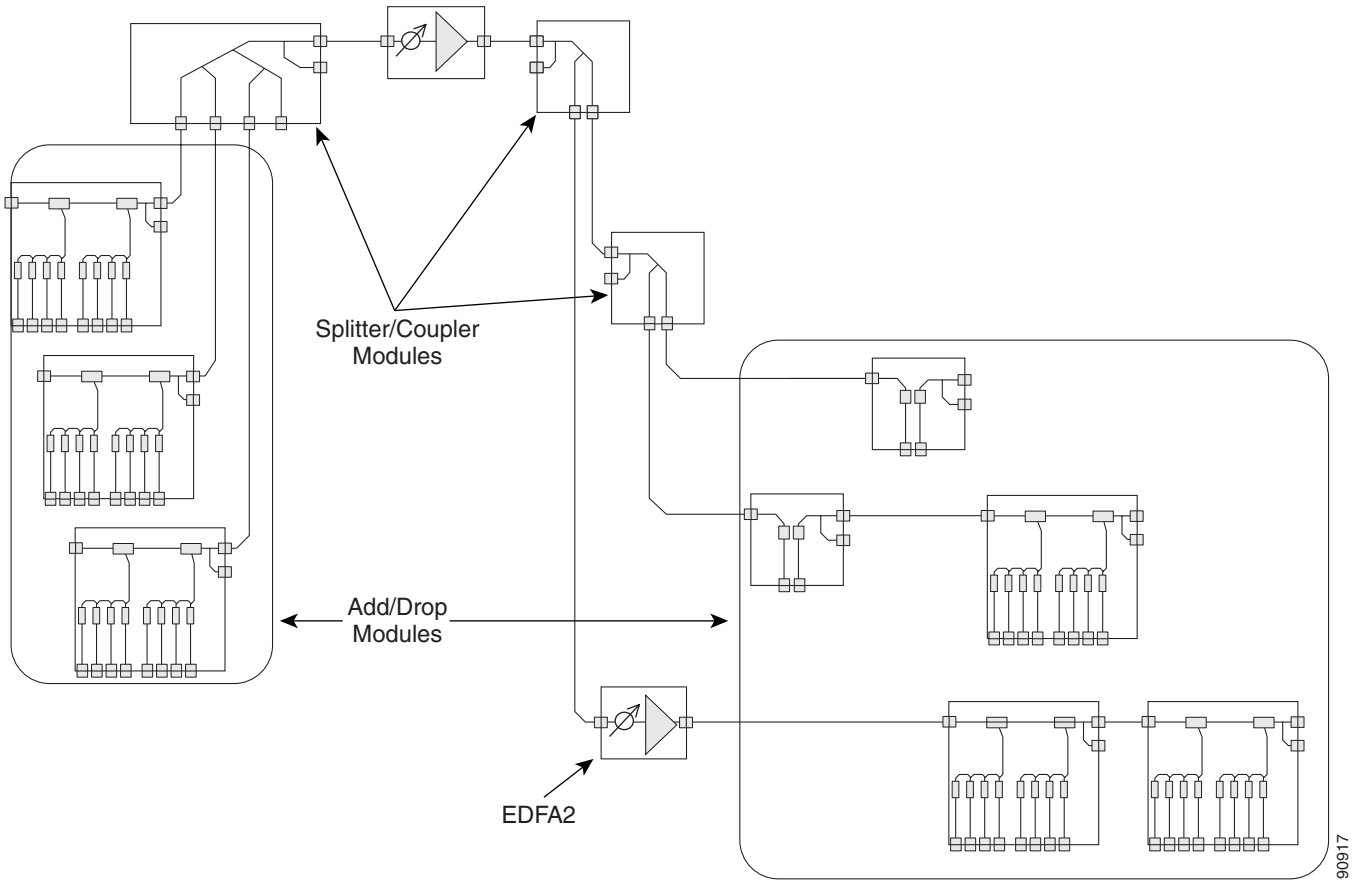
Table 3-2 Reference Optical Performance of 1.25 GBIC Interfaces

Max Bit Rate	Regen	FEC	Threshold	Max BER	Min Required OSNR[1]	Received Power Range	Transmitted Power Range
1.25 Gb/s	N/A	No	Average	10^{-12}	20 dB	-28 to -7 dBm	0 to +4 dBm

1. Measured on 0.1 nm Resolution Bandwidth.

Figure 3-1 illustrates a typical ONS 15216 FlexLayer architecture.

Figure 3-1 A Typical ONS 15216 FlexLayer Architecture

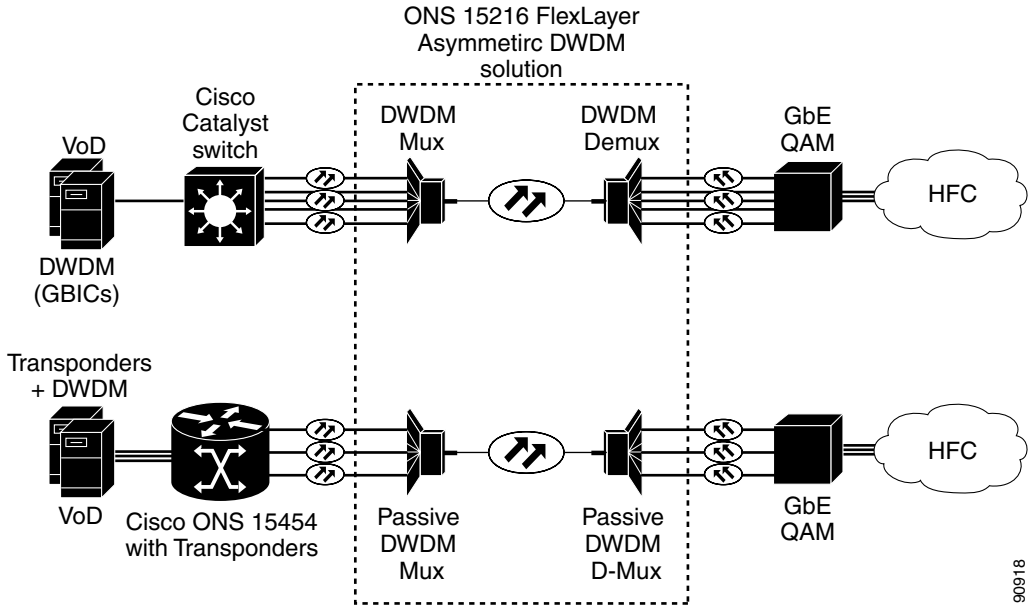


These unidirectional channels are transported from one side and available at every remote site. The channel requirements at that site can be de-multiplexed as necessary. In the ONS 15216 FlexLayer architectures, nodes are designed for specific roles. These roles include:

- Head-End Node
- Broadcast Node
- In-Line Drop Node
- Drop-and-Broadcast Node
- Line-Amplifier Node

Figure 3-2 on page 3-4 shows the required Cisco VoD GigE transport solutions. In Figure 3-2 on page 3-4, the top solution uses the Cisco Catalyst 45XX w/ITU GBICs. The bottom solution uses the Cisco ONS 15454 w/GE transponders.

Figure 3-2 Cisco GigE VoD Transport Solutions



3.2 Optical Performance of 1.25 GBIC Interfaces

The head-end node is a terminal node that transmits all the channels passing through it. This node performs a complete multiplexing of the channels. Typical equipment layouts include the linear and parallel configurations.

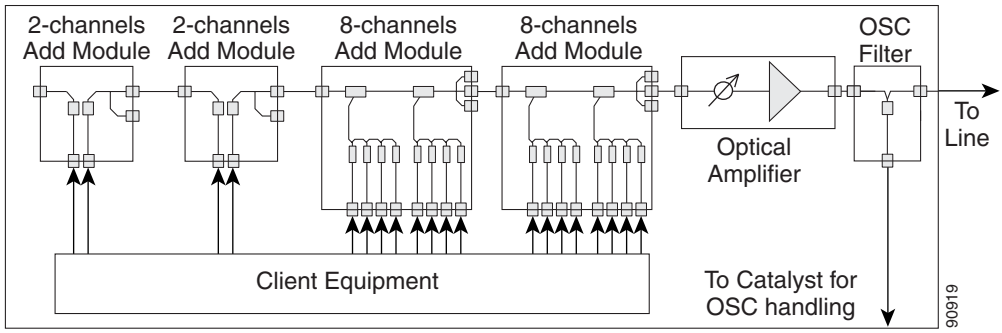
3.2.1 Linear Layout

The basic elements of the node are the n-channel add/drop modules used in the add arrangement. They collect traffic from the client equipment and aggregate it in a DWDM composite signal on a single fiber. Modules are connected in series (that is, the output of a card to the input of another one) to build a linear configuration. A linear configuration allows the highest degree of flexibility for a future non-service -affecting upgrade of the terminal site channel capacity.

When new channels are added to the multiplexing capacity, the output port of the new module is connected to the input port of the first module of the chain. An optical amplifier can be inserted at the output of the last card to recover for the node losses. The OSC filter can be inserted at the node output to allow OSC capabilities in conjunction with the client equipment.

Figure 3-3 shows a FlexLayer linear head-end configuration.

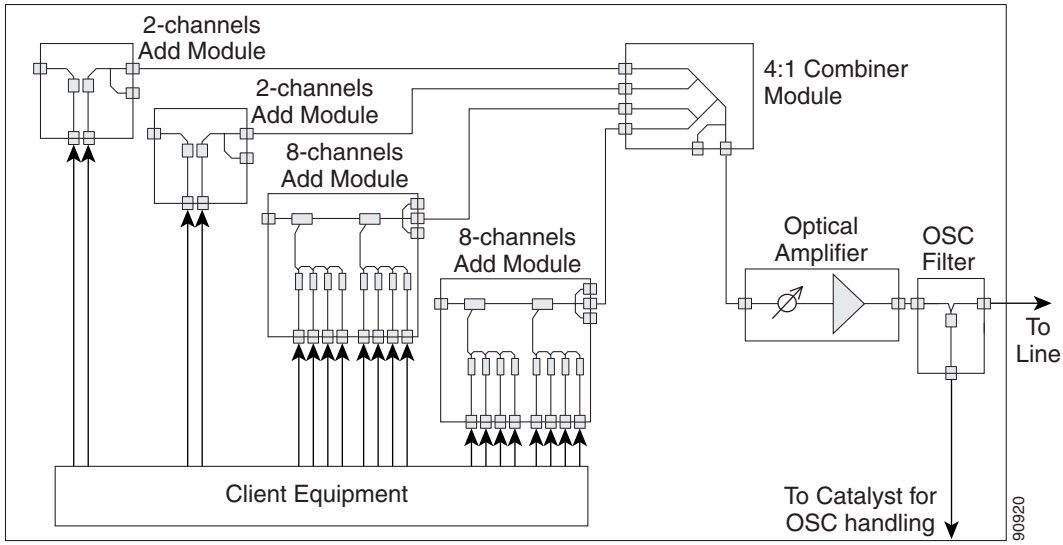
Figure 3-3 A FlexLayer Linear Head-End Configuration



3.2.2 Parallel Layout

The parallel layout uses a x:1 combiner module to collect output signals from add modules. The combiner limits the maximum number of add modules that can be deployed in the node, but achieves a better channel power equalization when compared to the linear layout. The VOA module is added to fine tune the channel sub-band equalization. An optical amplifier can be introduced at the output of the combiner to recover for the network element insertion loss. The OSC filter can be inserted at the node output to allow OSC capabilities in conjunction with the client equipment. Figure 3-4 shows a FlexLayer parallel head-end configuration.

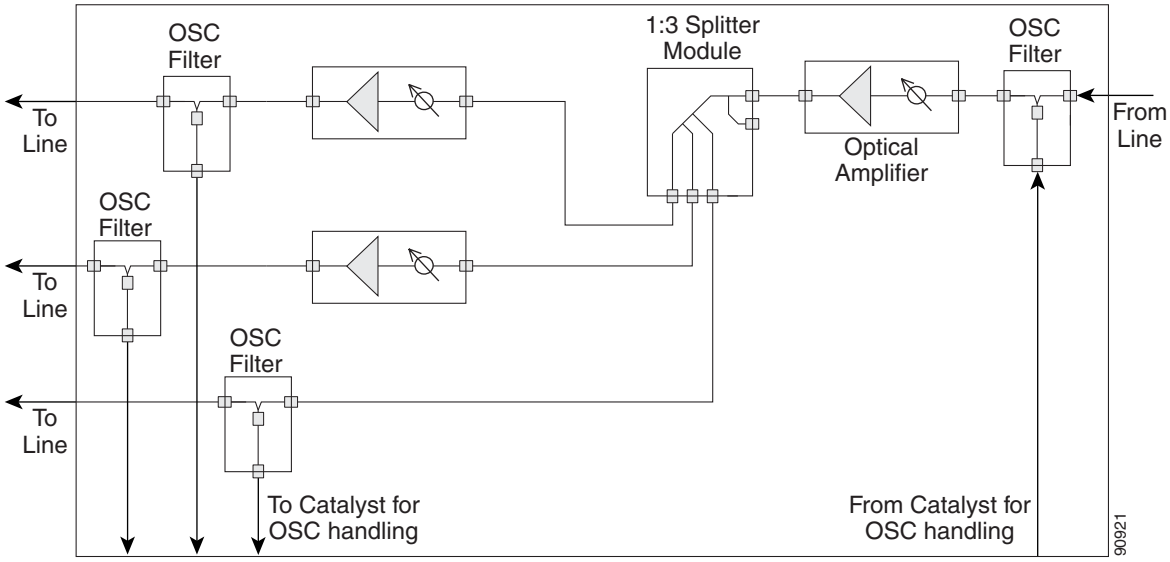
Figure 3-4 FlexLayer Parallel Head-End Configuration



3.3 Broadcast Node FlexLayer Configuration

The broadcast node has one input optical port and two or more optical output ports. The node replicates the input signal spectrum at the output ports, thus allowing a wider distribution of the data traffic. Optical amplifiers can be connected to the input or to one or more of the output ports to recover for node insertion losses or to allow further propagation. It must be noted that the optical amplifiers are both optional, and their presence depends on the network. The OSC filters can be inserted at the node input and at the node output ports to allow OSC capabilities in conjunction with the client equipment. Figure 3-5 shows how a FlexLayer broadcast node could be set up.

Figure 3-5 FlexLayer Broadcast Node Configuration



3.4 In-Line Drop Node FlexLayer Configuration

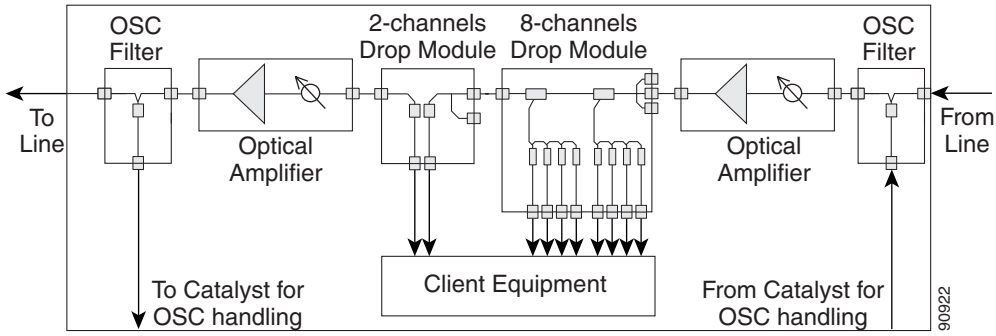
The drop node performs the extraction of some channels from the composite signal leaving remnant channels available on the output port. The client equipment is connected to the drop ports of the drop modules. Each module output port is connected to the input port of another module in a chain arrangement. The channel power and the receiver define the order of the modules. The input port of the first module is the input port of the node. An optical amplifier can be inserted here to recover for insertion losses. The output port of the last drop module is the output port of the network element. An optical amplifier can be inserted here to recover for insertion losses.

Note The optical amplifiers are both optional, and their presence depends on the network.

If at least one amplifier is present, the OADM node is called an “active drop node,” otherwise the node is called a “passive node.”

If an optical amplifier is inserted at the input port of the node, the VOA module must be used between some of the drop modules and the client equipment to avoid damage of the client equipment. The OSC filters can be further inserted at the node input and at the node output to allow OSC capabilities in conjunction with the client equipment. If the output port is unconnected the node acts as a terminal node. Figure 3-6 shows how a typical FlexLayer in-line drop node configuration can be organized.

Figure 3-6 FlexLayer In-Line Drop Node Configuration



3.5 Drop-and-Broadcast Node FlexLayer Configuration

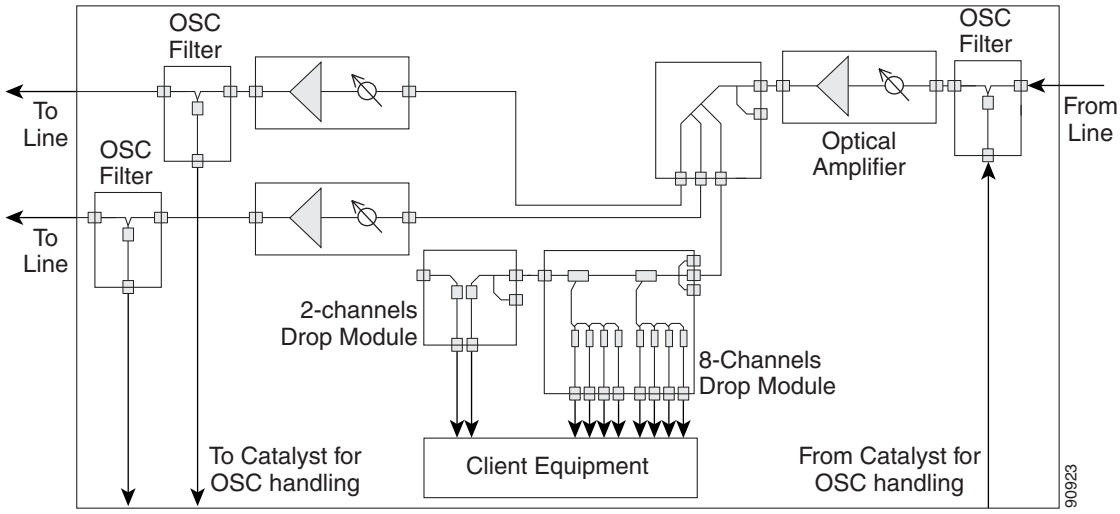
The drop-and-broadcast node extracts some channels from the composite DWDM signal and replicates (regenerates) all the channels on the output ports. The client equipment is connected to the drop ports of the drop modules. Each FlexLayer module output port is connected to the input port of another FlexLayer module in a chain arrangement. The input port of the first FlexLayer module is the input port of the node. An optical amplifier can be inserted here to recover for insertion losses. The output port of the last FlexLayer module is the output port of the network element. An optical amplifier can be inserted here to recover for insertion losses.

Note The optical amplifiers are all optional, and their presence depends on the network.

If at least one amplifier is present the OADM node is called an “active drop node,” otherwise the node is called a “passive node”.

If an optical amplifier is inserted at the input port of the node, the VOA module must be used between some of the drop modules and the client equipment to avoid damage to the client equipment. The OSC filters can be inserted at the node input and at the node output ports to allow OSC capabilities in conjunction with the client equipment. Figure 3-7 on page 3-8 shows how a typical FlexLayer drop-and-broadcast node configuration can be organized.

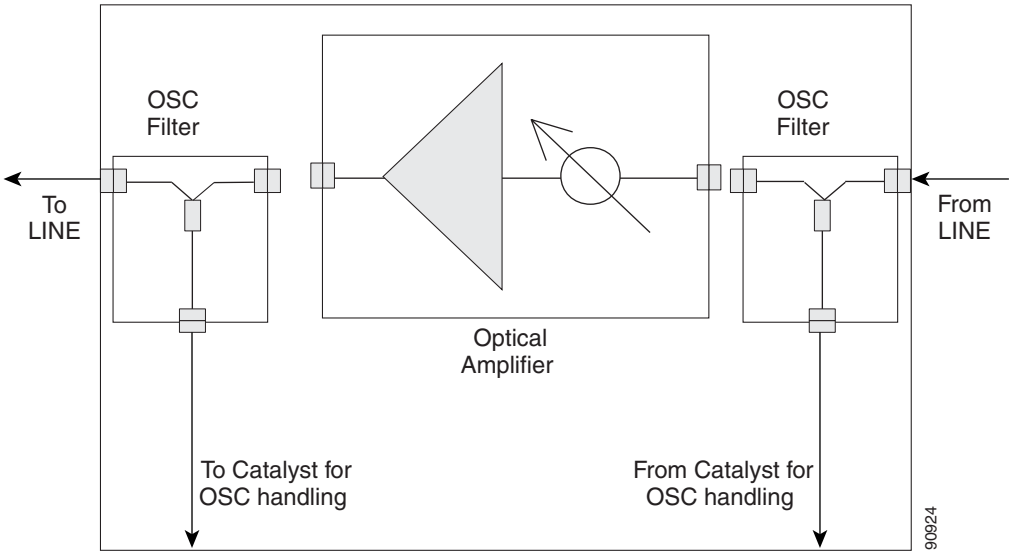
Figure 3-7 FlexLayer Drop-and-Broadcast Node Configuration



3.6 Line-Amplifier Node FlexLayer Configuration

The line amplifier node performs signal power recovery to achieve a longer transmission distance. It is composed of optical amplifiers only. The OSC filters can be inserted at the node input and at the node output ports to allow OSC capabilities in conjunction with the client equipment. Figure 3-8 shows a FlexLayer line-amplifier node configuration.

Figure 3-8 FlexLayer Line-Amplifier Node Configuration



Hardware

4.1 Hardware Overview

This release introduces several modules that can be used to support the ONS 15216 FlexLayer Asymmetric DWDM solution. The part numbers are listed in Table 4-1.

Table 4-1 ONS15216 FlexLayer Hardware Part Numbers

Part Number	Description
8 Channel Add/Drop FlexLayer Modules	
15216-FLA-8-36.6=	ITU-100 GHz 8 Ch, FlexMod - 1530.33, 1531.12, 1531.90, 1532.68, 1534.25, 1535.04, 1535.82, and 1536.61
15216-FLA-8-44.5=	ITU-100 GHz 8 Ch, FlexMod - 1538.19, 1538.98, 1539.77, 1540.56, 1542.14, 1542.94, 1543.73, and 1544.53
15216-FLA-8-52.5=	ITU-100 GHz 8 Ch, FlexMod - 1546.12, 1546.92, 1547.72, 1548.51, 1550.12, 1550.92, 1551.72, and 1552.52
15216-FLA-8-60.6=	ITU-100 GHz 8 Ch, FlexMod - 1554.13, 1554.94, 1555.75, 1556.55, 1558.17, 1558.98, 1559.79, and 1560.61
2 Channel Add/Drop FlexLayer Modules	
15216-FLB-2-31.1=	ITU-100 GHz 2 Ch, FlexMod - 1530.33 and 1531.12
15216-FLB-2-32.6=	ITU-100 GHz 2 Ch, FlexMod - 1531.90 and 1532.68
15216-FLB-2-35.0=	ITU-100 GHz 2 Ch, FlexMod - 1534.25 and 1535.04
15216-FLB-2-36.6=	ITU-100 GHz 2 Ch, FlexMod - 1535.82 and 1536.61
15216-FLB-2-38.9=	ITU-100 GHz 2 Ch, FlexMod - 1538.19 and 1538.98
15216-FLB-2-40.5=	ITU-100 GHz 2 Ch, FlexMod - 1539.77 and 1540.56
15216-FLB-2-42.9=	ITU-100 GHz 2 Ch, FlexMod - 1542.14 and 1542.94
15216-FLB-2-44.5=	ITU-100 GHz 2 Ch, FlexMod - 1543.73 and 1544.53
15216-FLB-2-46.9=	ITU-100 GHz 2 Ch, FlexMod - 1546.12 and 1546.92
15216-FLB-2-48.5=	ITU-100 GHz 2 Ch, FlexMod - 1547.72 and 1548.51
15216-FLB-2-50.9=	ITU-100 GHz 2 Ch, FlexMod - 1550.12 and 1550.92
15216-FLB-2-52.5=	ITU-100 GHz 2 Ch, FlexMod - 1551.72 and 1552.52
15216-FLB-2-54.9=	ITU-100 GHz 2 Ch, FlexMod - 1554.13 and 1554.94

Table 4-1 ONS15216 FlexLayer Hardware Part Numbers (continued)

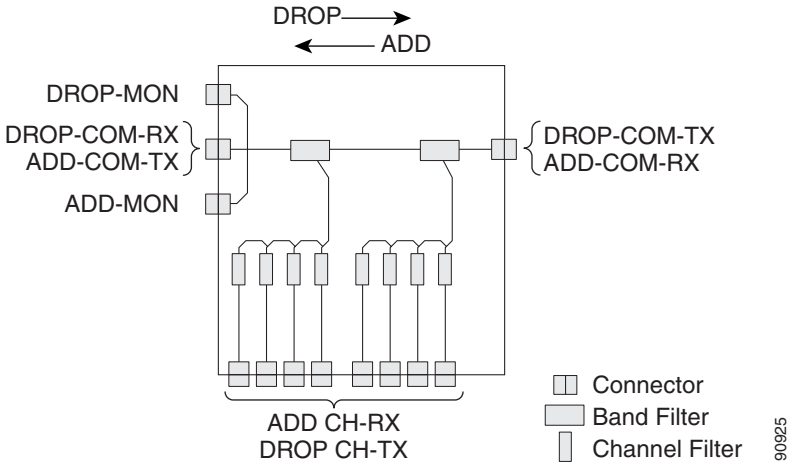
Part Number	Description
15216-FLB-2-56.5=	ITU-100 GHz 2 Ch, FlexMod - 1555.75 and 1556.55
15216-FLB-2-58.9=	ITU-100 GHz 2 Ch, FlexMod - 1558.17 and 1558.98
15216-FLB-2-60.6=	ITU-100 GHz 2 Ch, FlexMod - 1559.79 and 1560.61
Optical Splitter/Combiner FlexLayer Modules	
15216-CS-4=	4 Channel Optical Splitter or Combiner FlexMod
15216-CS-3=	3 Channel Optical Splitter or Combiner FlexMod
15216-CS-2=	2 Channel Optical Splitter or Combiner FlexMod
15216-SC-4B=	4 Band Optical Splitter/Combiner
Y-Cable Modules	
15216-CS-MM-Y=	Multi-Mode Y Cable Protection FlexMod
15216-CS-SM-Y=	Single-Mode Y Cable Protection FlexMod
Variable Attenuator FlexLayer Module	
15216-V-4=	4 Channel VOA FlexMod
FlexLayer Shelf	
15216-FL-SA=	FlexLayer 4 Slot Shelf Assembly

4.2 Eight-Channel Optical Add or Drop FlexLayer Module

The Eight-Channel Add/Drop FlexLayer module is a completely passive unidirectional component that allows the insertion or the extraction of eight channels within the ONS 15216 channel plan. Four specific modules are available to cover the whole 32-channel bandwidth (see Figure 3-1 on page 3-3).

Figure 4-1 shows the unit functional block diagram. In reference to Figure 4-1, the signal flows from left to right when the unit is used as a drop site and from right to left when the unit is used as an add site.

Figure 4-1 Eight Channel Add or Drop FlexLayer Module Block Diagram



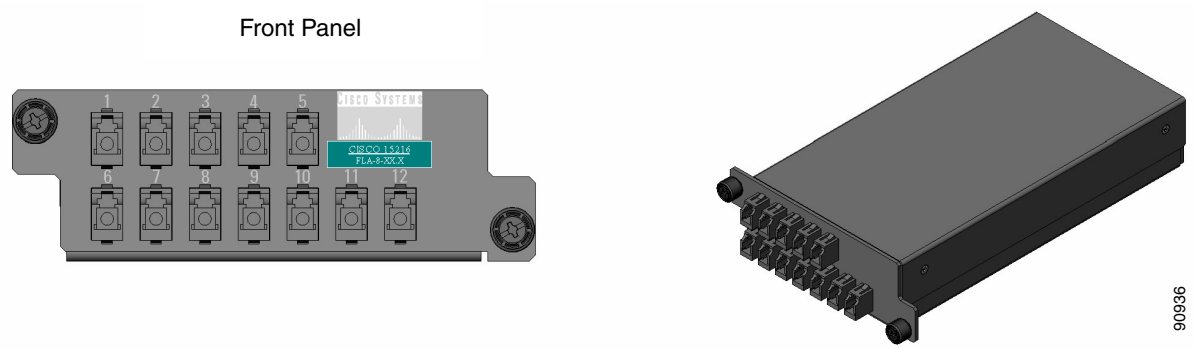
When the unit is used as a drop component, the WDM composite signal coming from the DROP-COM-RX port is filtered sequentially by a band and a channel filter and the filtered channels are dropped at the eight DROP-CH-TX ports. The remainder of the WDM composite signal is sent to the DROP-COM-TX port. A 2% tap coupler, DROP-MON, is used to monitor the input WDM composite signal.

Note Throughout this document the following convention is used for port labeling: any input port is labeled "RX" and all the output ports are labeled "TX."

When the unit is used as an add component, the eight channels coming from the eight ADD-CH-RX parts are added to the WDM composite signal coming from the ADD-COM-RX ports. The muxed WDM composite signal is sent to the ADD-COM-TX port. A 2% tap coupler, ADD-MON, is used to monitor the muxed WDM composite signal.

Figure 4-2 shows the physical appearance of the ONS 15216 Eight-Channel Add/Drop FlexLayer Module.

Figure 4-2 The ONS15216 Eight-Channel Add/Drop FlexLayer Module.



Labels are provided to show how the unit ports are mapped. It is the end user responsibility to label the unit for its intended use (drop or add component). Figure 4-3 shows how the connectors are mapped and labeled in the front panel when the component is used as a drop. The COM-RX is mapped to Port 1, the COM-TX is mapped to Port 12, and the eight dropped channel TX ports are mapped to Ports 2 to 5 and 8 to 11. The 2% tap MON port is mapped to Port 6. Port 7 is not active.

Figure 4-3 Eight Channel Drop Component Connector Mapping and Labeling

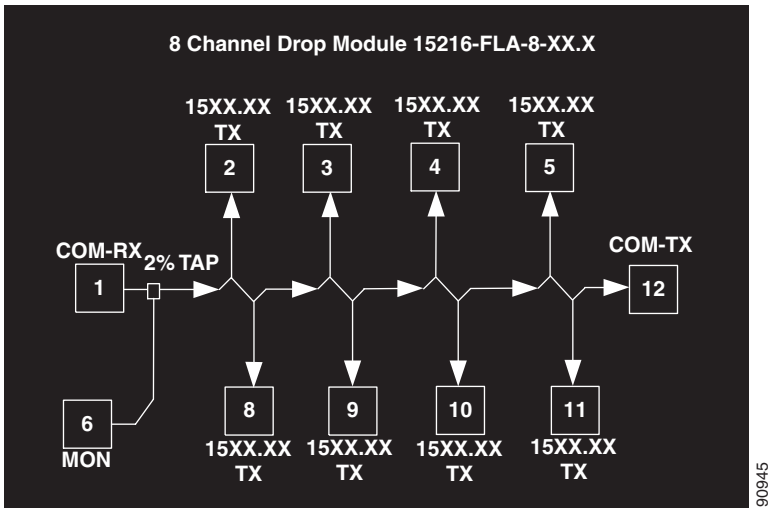
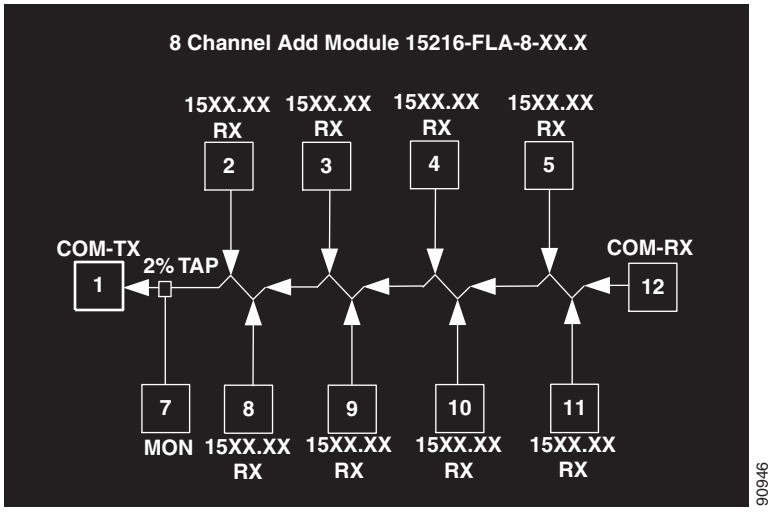


Figure 4-4 shows how the connectors are mapped and labeled in the front panel when the component is used as an add. The COM-TX is mapped to Port 1, the COM-RX is mapped to Port 12, and the added channels are mapped to the eight RX Ports 2 to 5 and 8 to 11. The 2% tap MON port is mapped to Port 7. Port 6 is not active.

Figure 4-4 Eight Channel Add Component Connector Mapping and Labeling



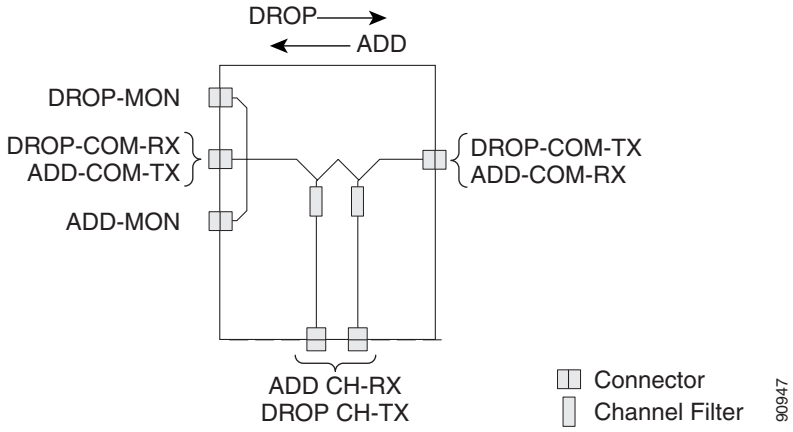
See Appendix A, "Specifications" for unit specifications.

4.3 Two-Channel Optical Add or Drop FlexLayer Module

The Two-Channel Add/Drop FlexLayer module is a completely passive unidirectional component that allows the insertion or the extraction of two channels within the ONS 15216 channel plan. Sixteen specific modules are available to cover the whole 32-channel bandwidth (see Table 3-1 on page 3-1).

Figure 4-5 shows the unit functional block diagram. In reference to Figure 4-5, the signal flows from left to right when the card is used as a drop and from right to left when the card is used as an add.

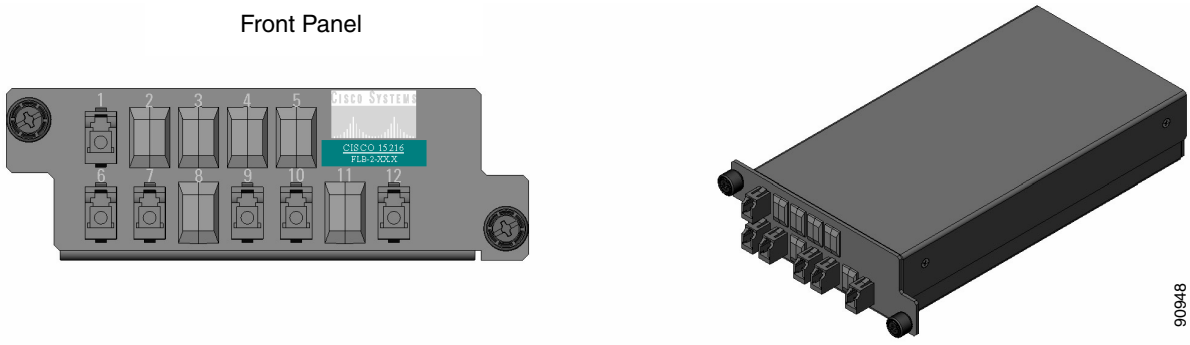
Figure 4-5 Two-Channel Add or Drop FlexLayer Module Block Diagram



When the unit is used as a drop component, the WDM composite signal coming from the DROP-COM-RX port is filtered sequentially by two filters and the filtered channels are dropped at the two DROP-CH-TX ports. The remainder of the WDM composite signal is sent to the DROP-COM-TX port. A 2% tap coupler, DROP-MON, is used to monitor the input WDM composite signal.

When the unit is used as an add component, the added channels coming from the two ADD-CH-RX ports are combined with the WDM composite signal coming from the ADD-COM-RX port. The muxed WDM composite signal is sent to the ADD-COM-TX port. A 2% tap coupler, ADD-MON, is used to monitor the muxed WDM composite signal. Figure 4-6 shows the physical appearance of the ONS15216 Two-Channel Add/Drop FlexLayer Module.

Figure 4-6 ONS15216 Two-Channel Optical Add/Drop FlexLayer Module



Labels are provided to show how the unit ports are mapped. It is the end user responsibility to label the unit for its intended use (drop or add component). Figure 4-7 on page 4-6 shows how the connectors are mapped and labeled on the front panel when the component is used as a drop. The COM-RX is mapped to Port 1, the COM-TX is mapped to Port 12, and the two dropped channel TX ports are mapped to ports 9 and 10. The 2% tap MON port is mapped to Port 6. Port 7 is not active.

Figure 4-7 Two Channel Drop Component Connector Mapping and Labeling

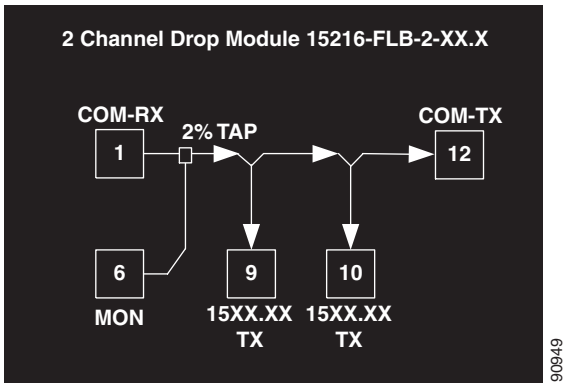
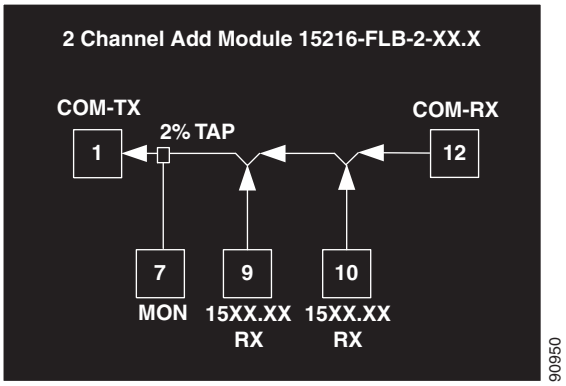


Figure 4-8 shows how the connectors are mapped and labeled in the front panel when the component is used as an add. The COM-TX is mapped to Port 1, the COM-RX is mapped to Port 12, and the added channels are mapped to the two RX Ports 9 and 10. The 2% tap MON port is mapped to Port 7. Port 6 is not active.

Figure 4-8 Two Channel Add Component Connectors' Mapping and Labeling



See Appendix A, "Specifications" for unit specifications.

4.4 Four-Band Splitter/Combiner FlexLayer Module

The Four-Band Splitter/Combiner (15216-SC-4B) FlexLayer module is a completely passive four band mux/demux (wavelength sensitive) module that can be used as a splitter or coupler. This card is an add-on to the Splitters/Combiner (15216-CS-x) cards of the FlexLayer product line. The functionality of the Four-Band Splitter/Combiner card is similar to the 1:4 Splitter/4:1 Combiner card (15216-CS-4), but the 15216-SC-4B client ports are wavelength selective and therefore cannot be interchanged. The advantage of this card with respect to the 15216-SC-4 is its lower insertion loss.

Figure 4-9 shows the Four-Band Splitter/Combiner (15216-CB-46) module.

Figure 4-9 SC-4B Front Panel Layout

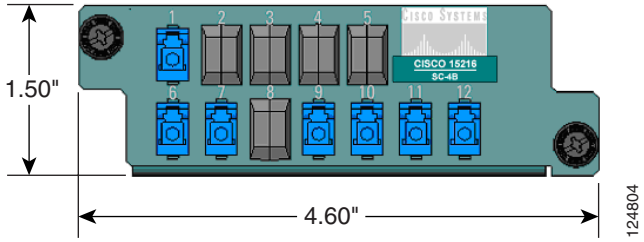
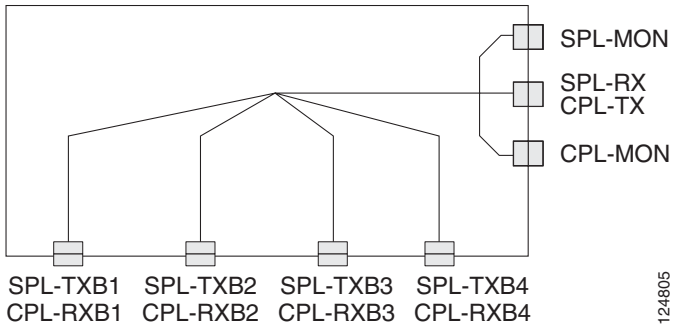


Figure 4-10 shows the schematic block diagram of the 4-Band Splitter/Coupler FlexLayer module. In the figures below, the signal flows from bottom to right when the card is used as a coupler and from right to bottom when the card is used as splitter. When the card is used as a coupler, the individual signals enter the card from the CPL-RXBn1 ports that are coupled together through a passive star coupler to the CPL-TX port. All ports are not wavelength selective.

When the card is used as a splitter, the composite signal enters the card from the SPL-RX port and is split through a passive star coupler to the SPL-TXBn ports. All "Bn" ports are wavelength selective and show the port mapping with the bands.

Figure 4-10 4B Splitter/Coupler (15216-SC-4B) Block Diagram



Because the same card will be used as a splitter or a coupler card, different port-mapping and labeling is used for the two instances. Only one monitor is used in each of the two configurations. The different labeling is indicated with a sticker.

When the card is used as a splitter (see Figure 4-11), the composite RX port is mapped to Port 1, the TXB1, TXB2, TXB3, and TXB4 ports are mapped to Ports 9, 10, 11, and 12 respectively, and the monitor port is mapped to Port 6. Port 7 is not active.

When the card is used as a coupler (see Figure 4-12), the RXB1, RXB2, RXB3, RXB4 ports are mapped to Ports 9, 10, 11, and 12 respectively, the composite TX port is mapped to Port 1, and the monitor port is mapped to Port 7. Port 6 is not active.

Figure 4-11 SC-4B Splitter Port Mapping and Labeling

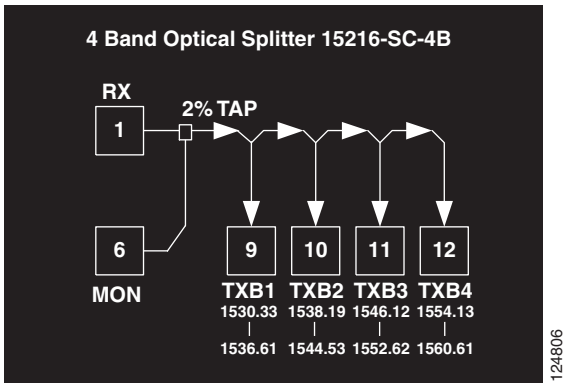
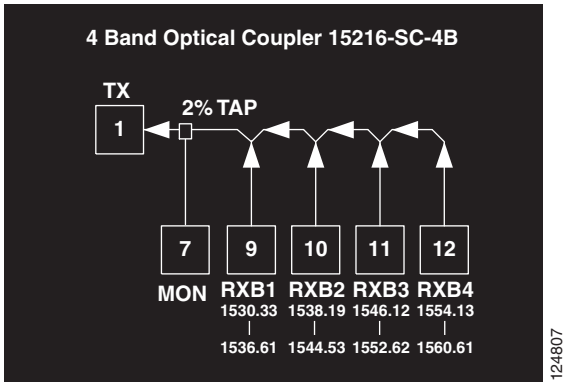


Figure 4-12 SC-4B Coupler Port Mapping and Labeling



4.5 Optical Splitter or Coupler FlexLayer Modules

The 1:x Splitter/x:1 Combiner (x being 2, 3, or 4) modules are completely passive star coupler components (wavelength insensitive) that can be used as splitters or couplers. These modules can be used to couple the composite outputs (ADD-COM-TX ports) of the Optical Add/Drop FlexLayer modules or split their input signal to the composite input (DROP-COM-RX) of the Optical Add/Drop FlexLayer modules.

Figure 4-13, Figure 4-14 and Figure 4-15 on page 4-9 show the unit block diagrams of the 1:2 Splitter/2:1 Coupler, 1:3 Splitter/3:1 Coupler, and the 1:4 Splitter/4:1 Coupler respectively. In Figure 4-13, Figure 4-14, and Figure 4-15 on page 4-9, the signal flows from bottom to right when the component is used as a coupler and from right to bottom when the component is used as splitter.

When the module is used as a coupler, the individual signals enter the card from the CPL-RX ports and are coupled together through a passive star coupler to the CPL-TX port. All ports are not wavelength selective (that is, in the operating wavelength range).

When the module is used as a splitter, the composite signal enters the card from the SPL-RX port and is split through a passive star coupler to the SPL-TXn ports. These modules (although designed to pass wavelengths associated with the ONS15216 32-channel plan) are not selective to specific wavelengths (that is, the units do not filter wavelengths).

Figure 4-13 1:2 Splitter or 2:1 Coupler FlexLayer Module Block Diagram

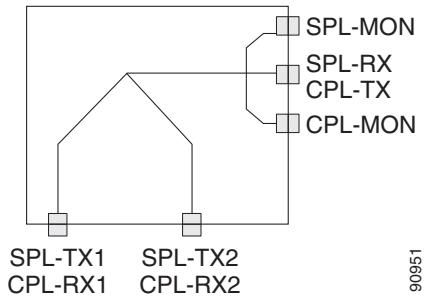


Figure 4-14 1:3 Splitter or 3:1 Coupler FlexLayer Module Block Diagram

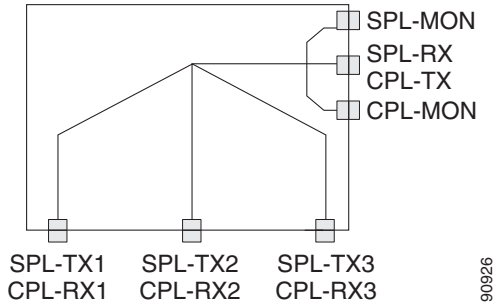
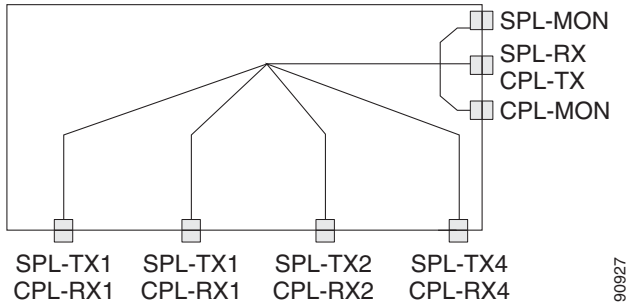


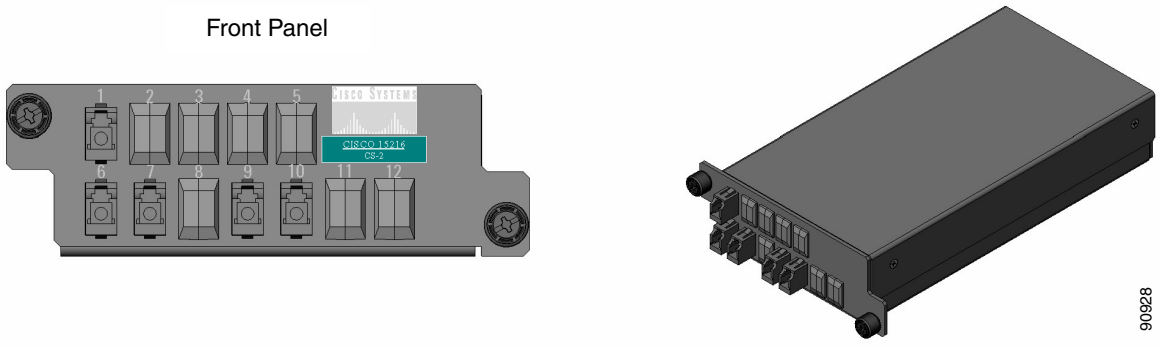
Figure 4-15 1:4 Splitter or 4:1 Coupler FlexLayer Module Block Diagram



4.5.1 1:2 Splitter or 2:1 Coupler

Figure 4-16 shows the ONS15216 1:2 Splitter/2:1 Coupler FlexLayer module.

Figure 4-16 ONS15216 1:2 Splitter or 2:1 Coupler FlexLayer Module



Labels are provided to show how the unit ports are mapped. It is the end user's responsibility to label the unit for its intended use (drop or add component).

Figure 4-17 shows how the module front panel ports are mapped and labeled when it is used as a splitter. The composite RX port is mapped to Port 1, the TX1 and TX2 ports are mapped to Ports 9 and 10 respectively, and the 2% tap monitor port is mapped to Port 6. Port 7 is not active.

Figure 4-17 1:2 Splitter Component Connectors' Mapping and Labeling

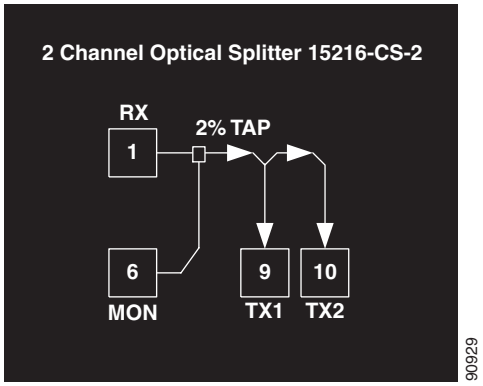
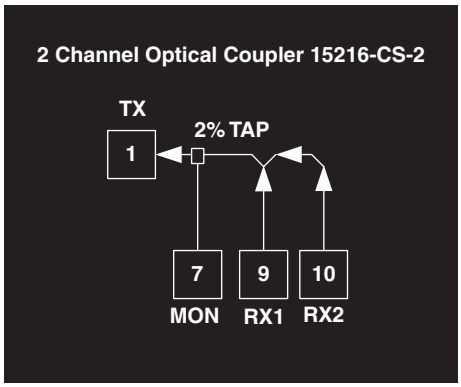


Figure 4-18 shows how the module front panel ports are mapped and labeled when the it is used as a coupler. The RX1 and RX2 ports are mapped to Ports 9 and 10 respectively, the composite TX port is mapped to Port 1, and the 2% tap monitor port is mapped to Port 7. Port 6 is not active.

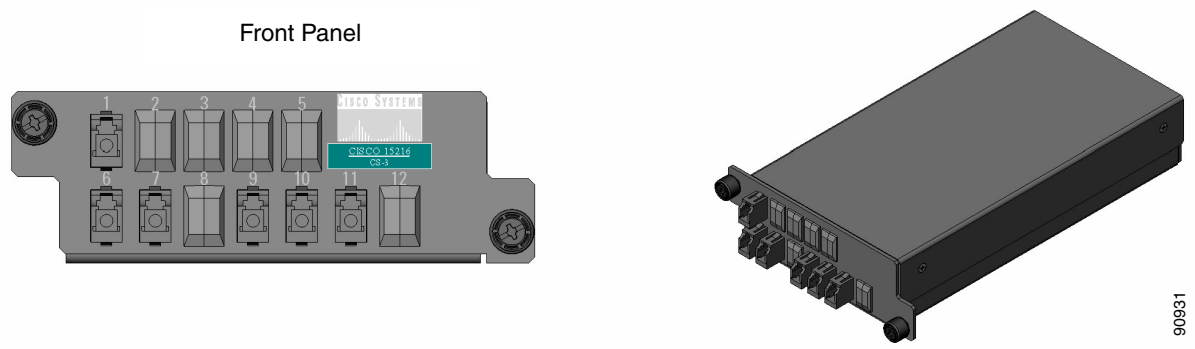
Figure 4-18 2:1 Coupler Component Connector Mapping and Labeling



4.5.2 1:3 Splitter or 3:1 Coupler

Figure 4-19 shows the ONS15216 1:3 Splitter/3:1 Coupler FlexLayer Module.

Figure 4-19 ONS15216 1:3 Splitter or 3:1 Coupler FlexLayer Module



Labels are provided to show how the unit ports are mapped. It is the end user's responsibility to label the unit for its intended use (drop or add component).

Figure 4-20 shows how the module front panel ports are mapped and labeled when it is used as a splitter. The composite RX port is mapped to Port 1, the TX1, TX2, and TX3 ports are mapped to Ports 9, 10, and 11 respectively, and the 2% tap monitor port is mapped to Port 6. Port 7 is not active.

Figure 4-20 1:3 Splitter Component Connectors' Mapping and Labeling

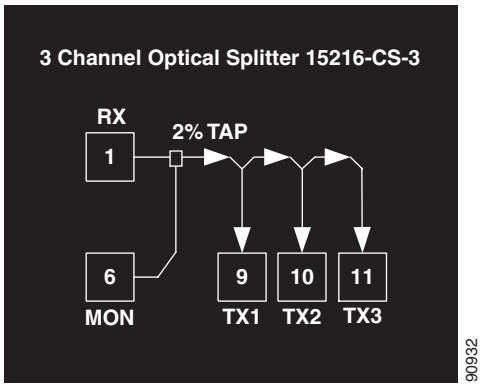
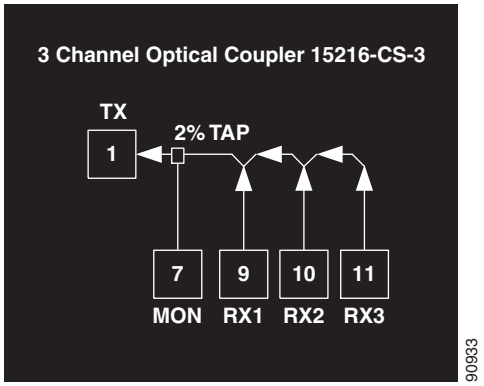


Figure 4-21 shows how the module front panel ports are mapped and labeled when it is used as a coupler. The RX1, RX2, RX3 ports are mapped to Ports 9, 10, and 11 respectively, the composite TX port is mapped to Port 1, and the 2% tap monitor port is mapped to Port 7. Port 6 is not active.

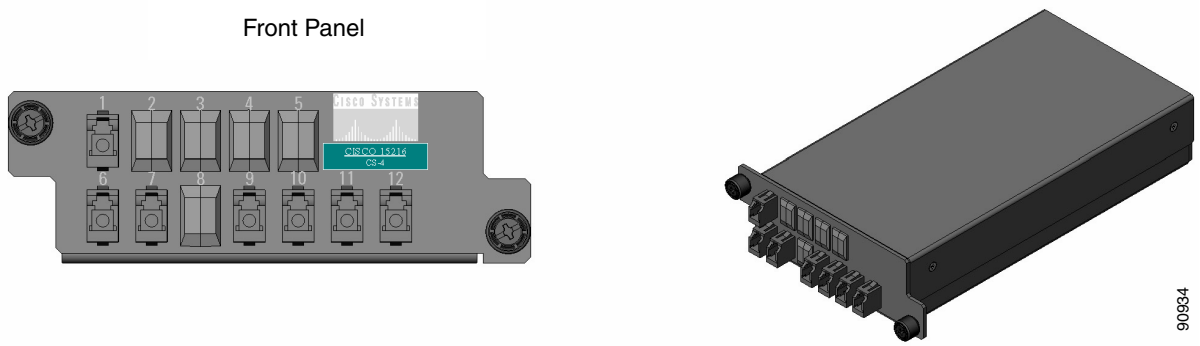
Figure 4-21 3:1 Coupler Component Connector Mapping and Labeling



4.5.3 1:4 Splitter or 4:1 Coupler

Figure 4-22 shows the ONS 15216 1:4 Splitter/4:1 Coupler FlexLayer Module.

Figure 4-22 ONS15216 1:4 Splitter or 4:1 Coupler FlexLayer Module



Labels are provided to show how the unit ports are mapped. It is the end user's responsibility to label the unit for its intended use (drop or add component).

Figure 4-23 shows how the module front panel ports are mapped and labeled when it is used as a splitter. The composite RX port is mapped to Port 1, the TX1, TX2, TX3, and TX4 ports are mapped to Ports 9, 10, 11, and 12 respectively, and the 2% tap monitor port is mapped to Port 6. Port 7 is not active.

Figure 4-23 1:4 Splitter Component Connector Mapping and Labeling

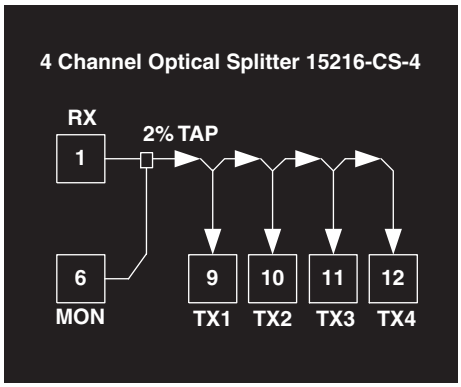
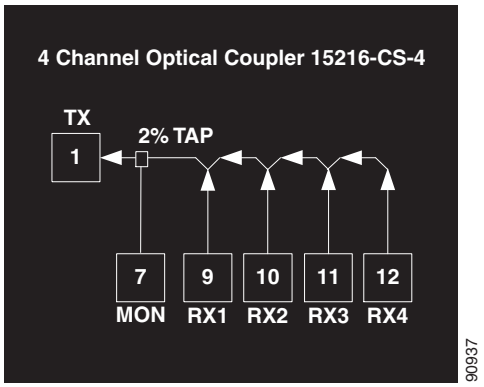


Figure 4-24 shows how the module front panel ports are mapped and labeled when it is used as a coupler. The RX1, RX2, RX3, RX4 ports are mapped to Ports 9, 10, 11, and 12 respectively, the composite TX port is mapped to Port 1, and the 2% tap monitor port is mapped to Port 7. Port 6 is not active.

Figure 4-24 4:1 Coupler Component Connector Mapping and Labeling



4.6 Y-Cable Protection Module

The Y-cable protection module is a bidirectional module. It is equipped with a passive star coupler that is used as a splitter and a passive star coupler that is used as a coupler.

The purpose of this module is to provide Y-Cable protection for transponder cards such as the ONS15454 multirate and 10G transponders (see Figure 4-25). There are two versions of this unit, one for multimode applications (CS-MM-Y) and one for single-mode applications (CS-SM-Y).

Figure 4-25 Typical Y-Cable Protection Module Configuration

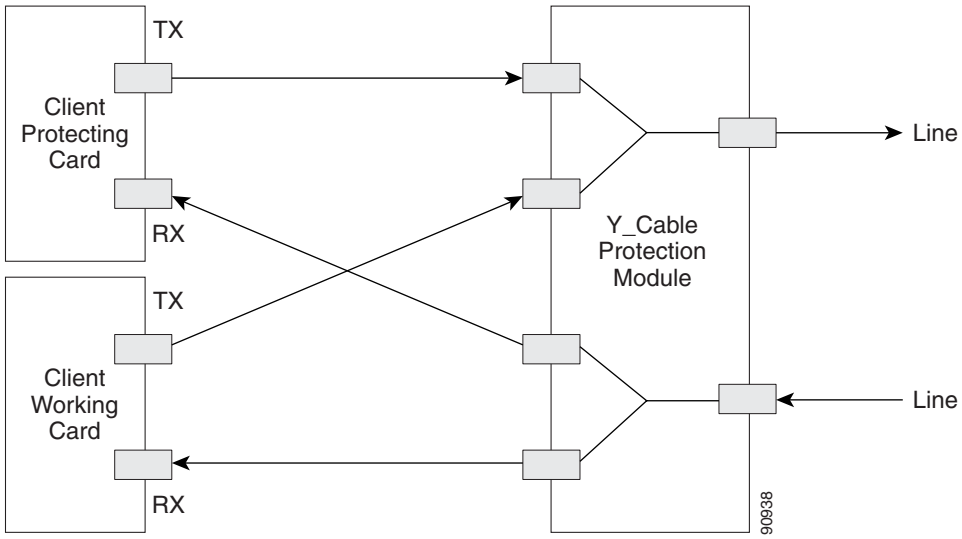


Figure 4-26 shows the unit block diagram of the Y-cable protection module. When the module is used in the coupler direction, the individual signals enter the module from the CPL-RXn ports and pass through a passive star coupler to the CPL-TX port.

It is important to note that the coupler is not meant to combine both the working and protect client card signals. The module allows a path for the working client transmit interface to connect to the network in the event the opposite interface in the protection pair should fail (the protecting interface switches to the working interface).

When the module is used in the splitter direction, the signal enters the module from the SPL-RX port and is split through a passive star coupler to the SPL-TXn ports. This module (although designed to pass wavelengths associated with the ONS 15216 32-channel plan) is not selective to specific wavelengths (units do not filter wavelengths).

Figure 4-26 1:2 Splitter and 2:1 Coupler (Y cable protection) Module Block Diagram

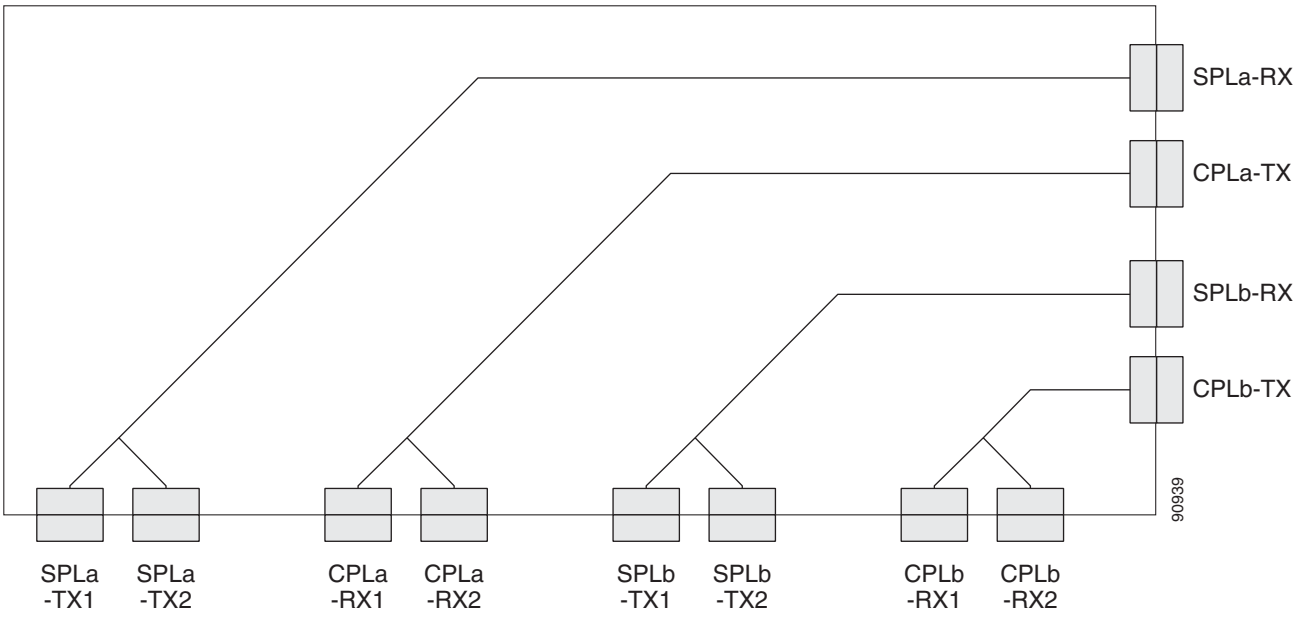


Figure 4-27 and Figure 4-28 on page 4-16 show the ONS 15216 Y-Cable Protection FlexLayer Module. This module has two versions, one for single-mode applications and the other for multimode applications.

Figure 4-27 ONS15216 Y-Cable Protection FlexLayer Module (Single-Mode)

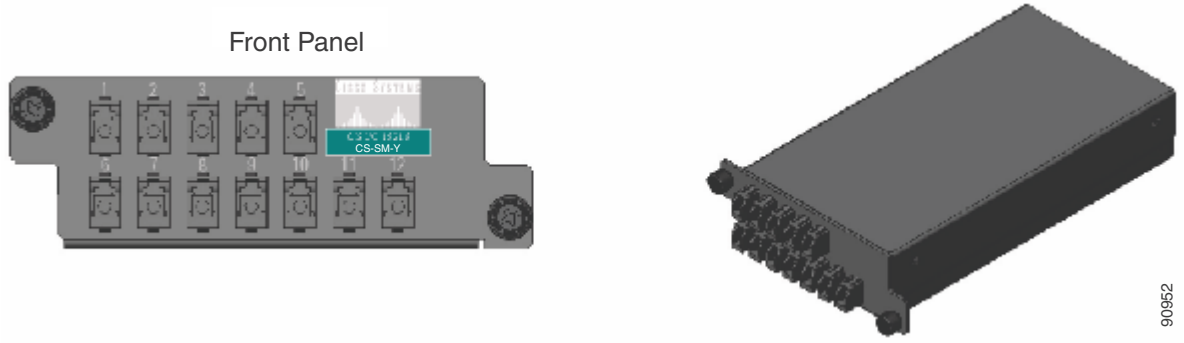


Figure 4-28 ONS15216 Y-Cable Protection FlexLayer Module (Multimode)

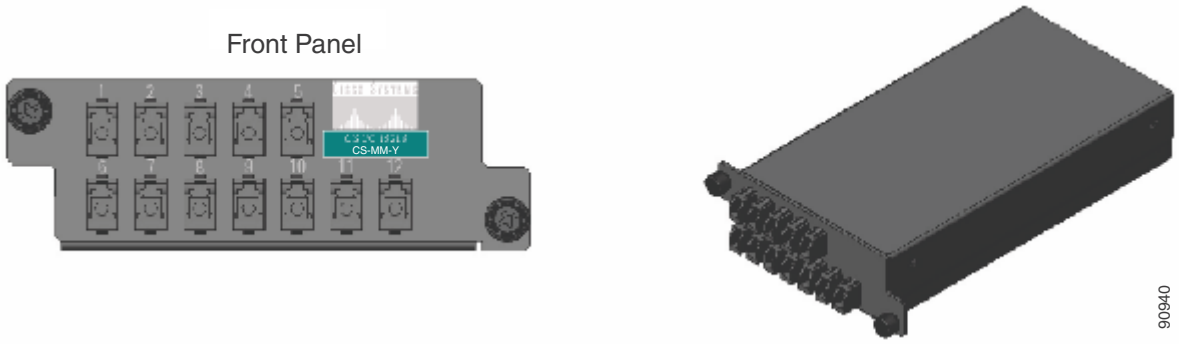
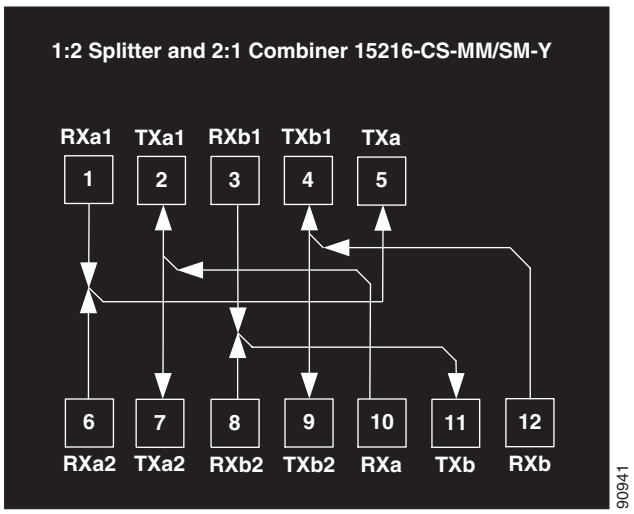


Figure 4-29 shows how the module front panel ports are mapped and labeled. The multimode unit is mapped and labeled the same as the single-mode unit.

Figure 4-29 Y-Cable Protection Component Connector Mapping and Labeling



See Appendix A, "Specifications"for unit specifications.

4.7 Four-Channel Variable Optical Attenuator (VOA) FlexLayer Module

The Four-Channel VOA module is a completely passive unidirectional component that allows equalizing the optical power of up to four channel groups. These modules are aimed to provide the ONS 15216 platform the capability of supporting VoD applications.

Figure 4-30 shows the unit functional block diagram. The input signals always flow from the VOA#-RX ports to the VOA#-TX ports. The pound (#) in the naming convention identifies the number ports and is limited from 1 to 4. The input signals are attenuated by the manual adjustment of the variable optical attenuators (VOAs) that are placed between the input and output ports.

Figure 4-30 Four-Channel VOA FlexLayer Module Block Diagram

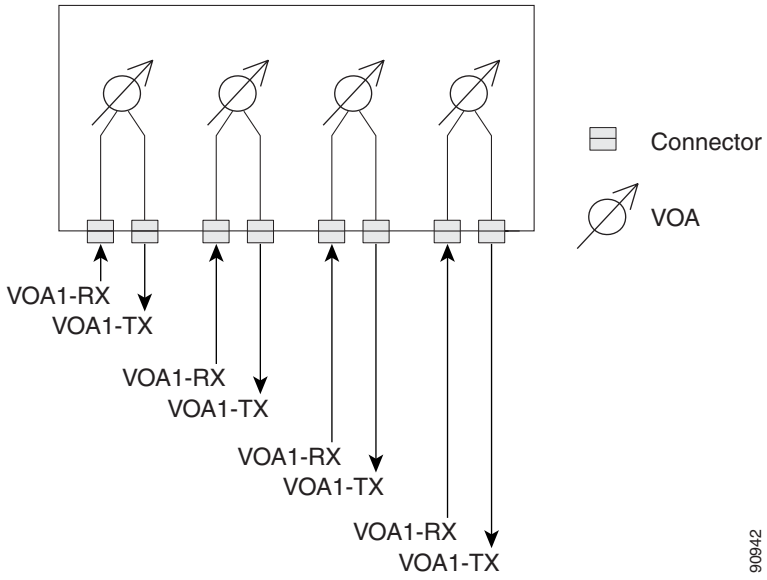


Figure 4-31 shows the ONS 15216 Four-Channel Variable Optical Attenuator FlexLayer Module.

Figure 4-31 ONS 15216 Four-Channel Variable Optical Attenuator FlexLayer Module

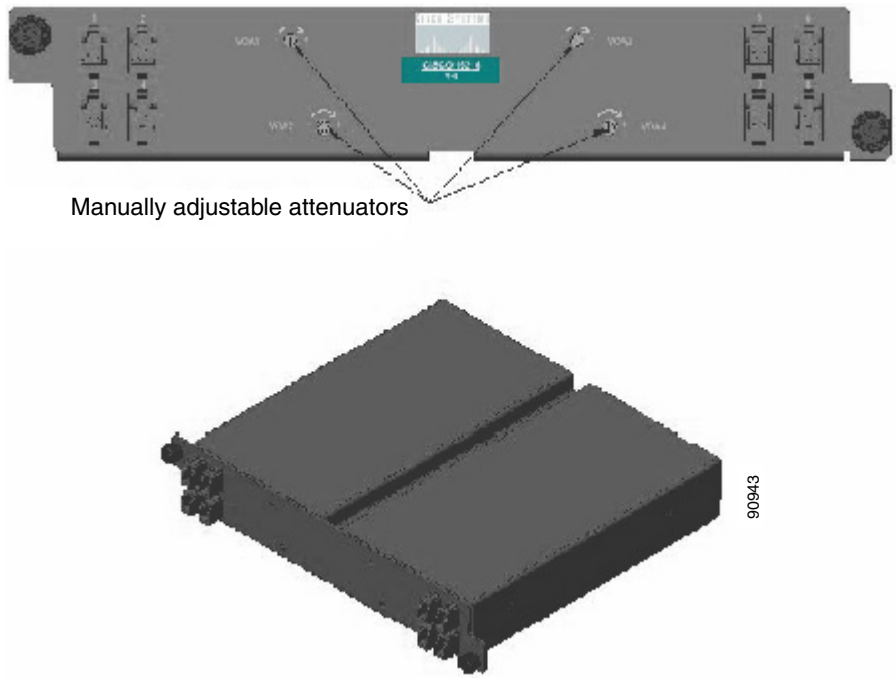
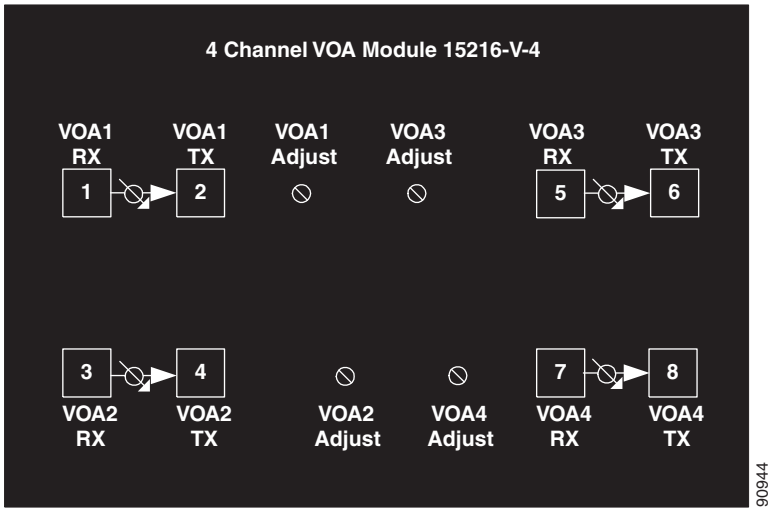


Figure 4-32 shows how the module front panel ports are mapped and labeled. The VOA#-TX ports are mapped with the even ports from 2 to 8 and the VOA#-RX ports are mapped with the odd ports from 1 to 7. VOA adjustment access is identified by VOA adjustment ports VOA 1 to 4.

Figure 4-32 4 Channel VOA Component Connectors' Mapping and Labeling



See Appendix A, "Specifications" for unit specifications.

Specifications

A.1 Eight Channel Optical Add/Drop FlexLayer Module Specifications

Table A-1 Eight Channel Optical Add/Drop FlexLayer Module Specifications

Parameter	Condition	Min	Max	Unit
Channel Plan		"4 skip 1": ITU 21-24, 26-29, 31-34, 36-39, 41-44, 46-49, 51-54, 56-59		ITU Ch
Channel spacing		100		GHz
Channel Groups	15216-FLA-8-36.6	59, 58, 57, 56, 54, 53, 52, 51		ITU Ch
	15216-FLA-8-44.5	49, 48, 47, 46, 44, 43, 42, 41		ITU Ch
	15216-FLA-8-52.5	39, 38, 37, 36, 34, 33, 32, 31		ITU Ch
	15216-FLA-8-60.6	29, 28, 27, 26, 24, 23, 22, 21		ITU Ch
Pass-Band	@ 0.5 dB	+/- 0.11		nm
Insertion Loss	DROP-COM-RX/ADD-COM-TX to DROP-CH-TX/ADD-CH-RX	2.4	3.5	dB
	DROP-COM-RX/ADD-COM-TX to DROP-COM-TX/ADD-COM-RX	0.6	1.7	dB
	DROP-COM-RX to DROP-MON	15.5	20.5	dB
	ADD-COM-TX to ADD-MON	15.5	20.5	dB

Table A-1 Eight Channel Optical Add/Drop FlexLayer Module Specifications (continued)

Parameter	Condition	Min	Max	Unit
Isolation	DROP-COM-RX/ADD-COM-TX to any DROP-CH-TX/ADD-CH-RX @ adjacent channels	25		dB
	DROP-COM-RX/ADD-COM-TX to DROP-COM-TX/ADD-COM-RX @ added/dropped channel wavelengths	14		dB
Ripple	Over Pass-Band		0.5	dB
Directivity	Any to any DROP-CH-TX/ADD-CH-RX	40		dB
Optical Return Loss	Any port	40		dB
Polarization Dependent Loss	Any path		0.2	dB
Max Optical Power	Any port		250	mW
Connector Type	LC			

A.2 Four Bands Splitter/Combiner FlexLayer Module Specifications

Table A-2 Four Bands Splitter/Combiner FlexLayer Module Optical Specifications

Parameter	Condition	Min	Max	Unit
Channel Plan		"4 skip 1": ITU 21-24, 26-29, 31-34, 36-39, 41-44, 46-49, 51-54, 56-59		
Channel Spacing		100		GHz
Channel Bands	B1	59, 58, 57, 56, 54, 53, 52, 51		
	B2	49, 48, 47, 46, 44, 43, 42, 41		
	B3	39, 38, 37, 36, 34, 33, 32, 31		
	B4	29, 28, 27, 26, 24, 23, 22, 21		
Pass-Band	@.5 dB	Bn +/- 0.12		nm
Insertion Loss	SPL-RX/CPL-TX to SPL-TXBn/CPL-RXBn	1.2	2.2	dB
	CPL-RX/CPL-MON	15.5	20.5	
	SPL-TX/SPL-MON	15.5	20.5	
Isolation	Any port	13		dB
Ripple	Any port		.5	dB
Directivity		40		dB

Table A-2 Four Bands Splitter/Combiner FlexLayer Module Optical Specifications (continued)

Parameter	Condition	Min	Max	Unit
Optical Return Loss	Any port	40		dB
Polarization Dependent Loss	Any path		.2	dB
Max Optical Power	Any port	250		mW
Connection Type	LC			

A.3 Two Channel Optical Add/Drop FlexLayer Module Specifications

Table A-3 Two Channel Optical Add/Drop FlexLayer Module Specifications

Parameter	Condition	Min	Max	Unit
Channel Plan		"4 skip 1": ITU 21-24, 26-29, 31-34, 36-39, 41-44, 46-49, 51-54, 56-59		ITU Ch
Channel spacing		100		GHz
Channel Groups	15216-FLB-2-31.1	59, 58		ITU Ch
	15216-FLB-2-32.6	57, 56		ITU Ch
	15216-FLB-2-35.0	54, 53		ITU Ch
	15216-FLB-2-36.6	52, 51		ITU Ch
	15216-FLB-2-38.9	49, 48		ITU Ch
	15216-FLB-2-40.5	47, 46		ITU Ch
	15216-FLB-2-42.9	44, 43		ITU Ch
	15216-FLB-2-44.5	42, 41		ITU Ch
Channel Groups (continued)	15216-FLB-2-46.9	39, 38		ITU Ch
	15216-FLB-2-48.5	37, 36		ITU Ch
	15216-FLB-2-50.9	34, 33		ITU Ch
	15216-FLB-2-52.5	32, 31		ITU Ch
	15216-FLB-2-54.9	29, 28		ITU Ch
	15216-FLB-2-56.5	27, 26		ITU Ch
	15216-FLB-2-58.9	24, 23		ITU Ch
	15216-FLB-2-60.6	22, 21		ITU Ch
Pass-Band	@ 0.5 dB	+/- 0.11		nm

Table A-3 Two Channel Optical Add/Drop FlexLayer Module Specifications (continued)

Parameter	Condition	Min	Max	Unit
Insertion Loss	DROP-COM-RX/ADD-COM-TX to DROP-CH-TX/ADD-CH-RX	.9	2.0	dB
	DROP-COM-RX/ADD-COM-TX to DROP-COM-TX/ADD-COM-RX	0.5	1.6	dB
	DROP-COM-RX to MON	15.5	20.5	dB
	ADD-COM-RX to MON	15.5	20.5	dB
Isolation	DROP-COM-RX/ADD-COM-TX to any DROP-CH-TX/ADD-COM-RX @ adjacent channels	25		dB
	DROP-COM-RX/ADD-COM-TX to DROP-COM-TX/ADD-COM-RX @ added/dropped channel wavelengths	14		dB
Ripple	Over Pass-Band		0.5	dB
Directivity	Any to any DROP-CH-TX/ADD-CH-RX	40		dB
Optical Return Loss	Any port	40		dB
Polarization Dependent Loss	Any path		0.2	dB
Max Optical Power	Any port		250	mW
Connector Type	LC			

A.4 Optical Splitter or Coupler FlexLayer Module Specifications

Table A-4 Optical Splitter or Coupler FlexLayer Module Specifications

Parameter	Condition		Min	Max	Unit
Operating Wavelength Range	CS-2, CS-3, CS-4		1529	1565	nm
	CS-SM-Y[1]		1260/1430	1360/1580	
	CS-MM-Y[1]		770/1260	860/1380	
Insertion Loss	SPL-RX/CPL-TX to any SPL-TXn/CPL-RXn	1:2/2:1	3.5	4.3	dB
		1:3/3:1	5.7	6.6	dB
		1:4/4:1	7.3	8.2	dB
		1:2&2:1SM	3.4	4.8	dB
		1:2&2:1MM	3.4	5.5	
	CPL-TX to CPL-MON		15.5	20.5	
	SPL-RX to SPL-MON		15.5	20.5	
Ripple[2]	Over Pass-Band			0.5	dB
Directivity	Any to any SPL-TXn/CPL-RXn		40		dB
Optical Return Loss[3]	Any port		40		dB
Polarization Dependent Loss	Any path	1:2/2:1		0.25	dB
		1:3/3:1		0.3	
		1:4/4:1		0.4	
		1:2&2:1		0.25	
Max Optical Power	Any port			250	mW
Connector Type	LC				

1. Dual Window
2. For CS-MM-Y: 0.7dB
3. For CS-MM-Y: 25dB

A.5 Four Channel Variable Optical Attenuator (VOA) FlexLayer Module Specifications

Table A-5 Four Channel Optical Variable Attenuator (VOA) FlexLayer Module Specifications

Parameter	Condition	Min	Max	Unit
Operating Wavelength Range		1529	1565	nm
Attenuation Tilt	Attenuation 0 dB		0.4	dB
	Attenuation: 15 dB		0.6	dB
	Attenuation: 30 dB		0.8	dB
Attenuation Ripples	Attenuation 0 dB		0.35	dB
	Attenuation 15 dB		0.45	dB
	Attenuation 30 dB		0.55	dB
Minimum Insertion loss			2.6	dB
Attenuation Range		30		dB
Number of Turns For 10 dB att	Typical 3 turns			dB
Optical Return Loss		45		dB
Polarization Dependent Loss	Attenuation < 0 dB		0.35	dB
	Attenuation < 15 dB		0.5	dB
	Attenuation < 30 dB		0.6	dB
Connector Type	LC			