# Cisco Network Convergence System 2000 Series Passive Auxiliary Modules

Product Overview

The Cisco® Network Convergence System 2000 Series (NCS 2000 Series) features a suite of passive modules to accommodate network elements built on the Cisco nLight™ reconfigurable optical add-drop multiplexer (ROADM) node architecture (Figure 1).

Figure 1. Cisco nLight ROADM Architecture
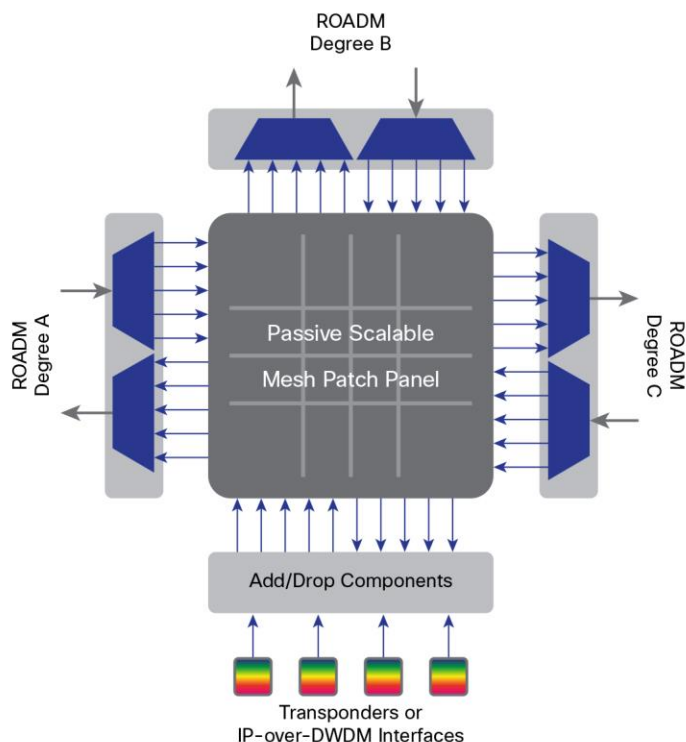
Features and Benefits

The Cisco nLight ROADM node architecture has been specifically defined and engineered to provide:

- High reliability: The modular architecture allows complete independence between specific direction-facing units with the ability to house units in physically separated shelves.
- Low insertion loss: Selected technology allows direct integration of different functions in the same optical module, reducing the number of optical connections.
- Reduced footprint: The auxiliary passive units integrate power monitoring with an exceptionally small footprint, reducing node power consumption and increasing system density.

Each module uses USB to connect with the external connection unit (ECU) of the NCS 2000 Series chassis. The USB communication channel is used to:

- Retrieve data stored in the nonvolatile memory of the module, specifically, inventory data and the insertion loss of the optical paths
- Retrieve the optical power levels monitored by the photodiode of the module
- Activate an LED indicator on the front panel of each module

Module Types

Three types of modules are available-patch - panel modules, add-drop modules, and adapter modules - all of which fit into the slots of a 1-rack-unit (1RU) mechanical frame chassis (MF 1RU) (Figure 2). Their passive nature helps ensure extremely high availability in a small, low-power footprint.

Figure 2.   Mechanical Frame Chassis
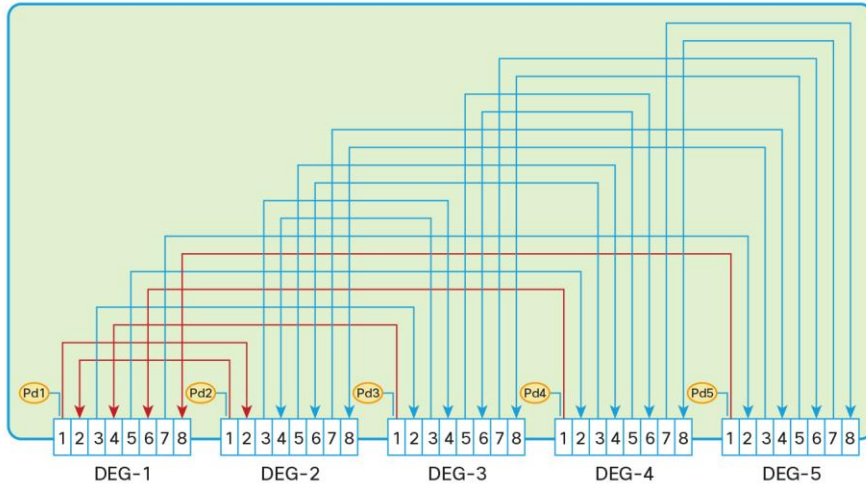

Modular Patch Panel Modules

ROADM node architectures built with Cisco nLight ROADM feature a modular approach to degree interconnection, offering an incremental payment model combining just two units: a 5-Degree Patch Panel Module (product number: NCS2K-MF-DEG-5=) and a 4-Degree Upgrade Patch Panel Module (product number: NCS2K-MF-UPG-4=) (Figure 3).

Figure 3.   Cisco 5-Degree Patch Panel and 4-Degree Upgrade Patch Panel Modules


The 5-Degree Patch Panel Module provides interconnections between five 8-port multifiber push-on (MPO) connectors. It is used to connect any combination of up to five ROADM line degrees (express connections) and add-drop components (add-drop connections). The 40 optical paths are interconnected as shown in Figure 4. Five photodiodes provide power monitoring of fiber 1 of each MPO connector. Power values, as well as the manufacturing data stored in the flash memory, are provided to a Cisco Transport Controller through the USB connection. This module is single-slot height in the mechanical frame chassis.

Figure 4.   Cisco 5-Degree Patch Panel Module Optical Diagram

The Cisco 4-Degree Upgrade Modular Patch Panel Module provides interconnections among eight 8-fiber MPO connectors. It is used to expand the number of degrees and the number of add-drop ports supported by the node. The 64 optical paths are interconnected as shown in Figure 5. A total of eight photodiodes provide power monitoring of fiber 1 of each MPO connector. Power values, as well as the manufacturing data stored in the flash memory, are provided to Cisco Transport Controller through the USB connection. This module is single-slot height in the mechanical frame chassis.

Figure 5.   Cisco 4-Degree Upgrade Modular Patch Panel Module
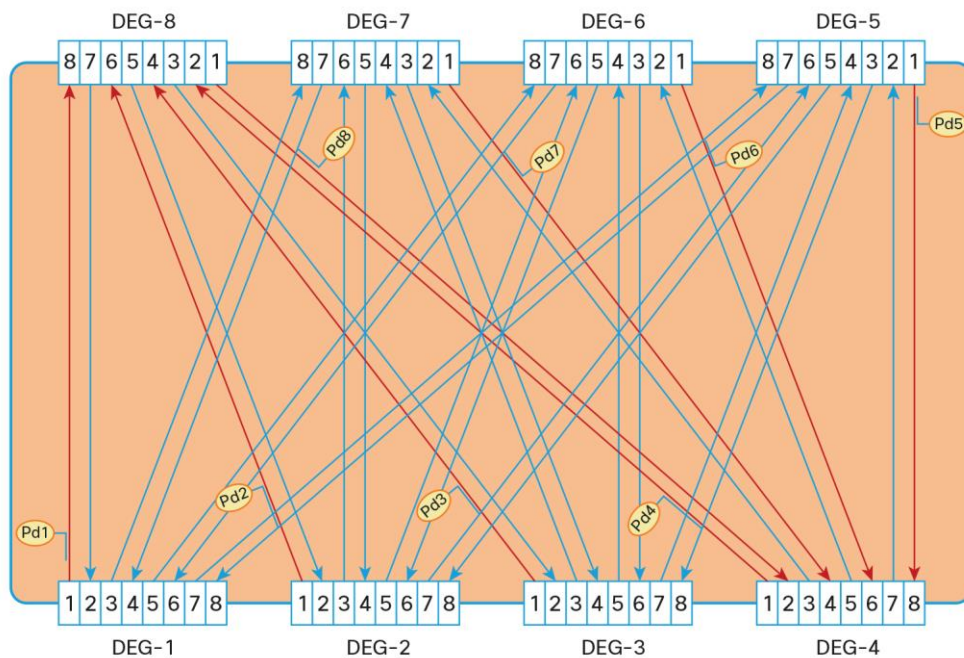
Add-Drop Modules

A set of add-drop modules provides colorless, omnidirectional, and flex spectrum add-drop functions to Cisco nLight ROADM nodes. Four different add-drop modules are available (Figure 6):
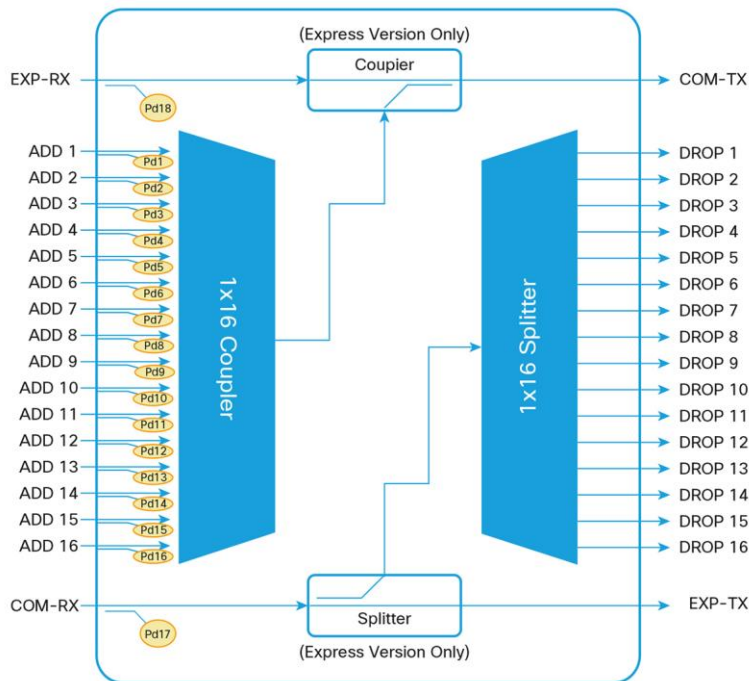
- 1 x 16 colorless flex spectrum (CFS) add-drop module
- 1 x 16 colorless flex spectrum add-drop plus express module
- 1 x 10 colorless flex spectrum add-drop module
- 4 x 4 colorless 0mnidirectional flex spectrum (COFS) add-drop module

Figure 6. Cisco Passive Auxiliary Add-Drop Units (from top to bottom, 1 x 16 CFS Add/Drop Module, 1 x 16 CFS Add/Drop plus Express Module, 1 x 10 CFS Add/Drop Module, 4 x 4 COFS Add/Drop Module)
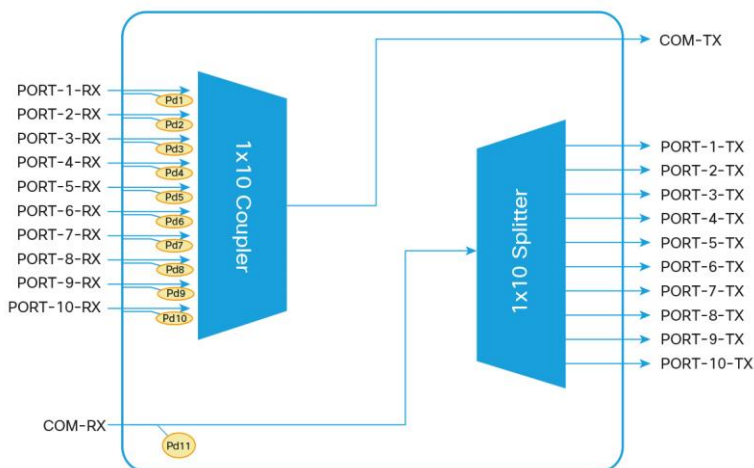

The 1 x 16 colorless flex spectrum (CFS) add-drop module (product number: NCS2K-MF-16AD-CFS=) is a passive unit comprising one 1 x 16 splitter and one 16 x 1 combiner, plus 17 photodiodes arranged as shown in Figure 7. This module is double-slot height (full height) in the mechanical frame chassis. Its primary function is to provide optical multiplexing and demultiplexing for up to 16 optical signals. Because it is based on optical splitter and combiner technology, only transceivers employing coherent detection can be directly connected to the 16 client ports of the unit. Integrated photodiodes provide connectivity check and monitoring functions. Virtual photodiodes are implemented on the drop ports by subtracting the insertion losses from the photodiode reading on the COM-RX port. Power values, as well as the manufacturing data stored in the flash memory, are provided to Cisco Transport Controller through the USB connection. A second variant of the 1 x 16 colorless flex spectrum (CFS) add-drop (product number: NCS2K-MF-16AE-CFS) includes an express path, which allows wavelengths that do not add and drop to optically bypass the device, which allows the construction of passive add-drop network architectures.

Figure 7.   1 x 16 Colorless Flex Spectrum (CFS) Add-Drop Functional Diagram


The 1 x 10 colorless flex spectrum (CFS) add-drop module (product number: NCS2K-MF-10AD-CFS) is a passive unit with one 1 x 10 splitter and one 10 x 1 combiner, plus 11 photodiodes arranged as shown in Figure 8. This module is double-slot height (full height) in the mechanical frame chassis. Its primary function is to provide optical multiplexing and demultiplexing for up to 10 optical signals. Because it is based on optical splitter and combiner technology, only transceivers employing coherent detection can be directly connected to the 10 client ports of the unit. Integrated photodiodes provide connectivity check and monitoring functions. Virtual photodiodes are implemented on the drop ports by subtracting the insertion losses from the photodiode reading on the COM-RX port. Power values, as well as the manufacturing data stored in the flash memory, are provided to Cisco Transport Controller through the USB connection.

Figure 8.   1 x 10 Colorless Flex Spectrum (CFS) Add-Drop Module Functional Diagram

The 4x4 colorless omnidirectional flex spectrum (COFS) add-drop module (product number: NCS2K-MF-4X4-COFS-AD) is a passive unit consisting of eight 2 x 2 optical couplers and eight photodiodes, arranged as shown in Figure 9. This module is single-slot height in the mechanical frame chassis. Power monitoring is present at each channel input port and at each common input port. Virtual photodiodes are implemented on the channel drop ports by subtracting the insertion losses from the photodiode reading on the COM-RX ports. Power values, as well as the manufacturing data stored in the flash memory, are provided to Cisco Transport Controller through the USB connection. The module's primary function is to provide optical multiplexing and demultiplexing for up to four optical signals. Because it is based on optical splitter and combiner technology, only transceivers employing coherent detection can be directly connected to four client ports of this unit.

Figure 9. 4 x 4 Colorless Omnidirectional Flex Spectrum (COFS) Add-Drop Module
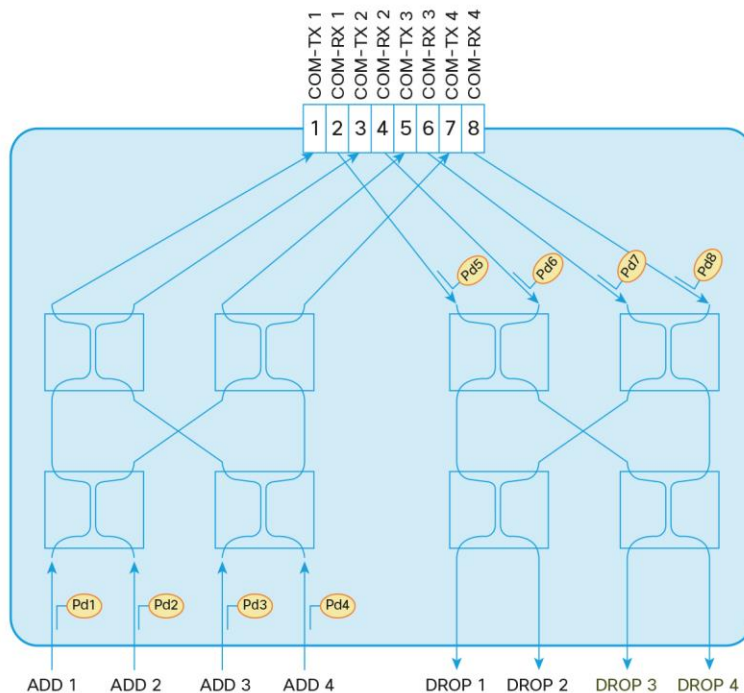
Adapter Modules

A set of adapter modules converts between MPO-8, MPO-16, and LC fiber connectors. The following adapter modules are available:
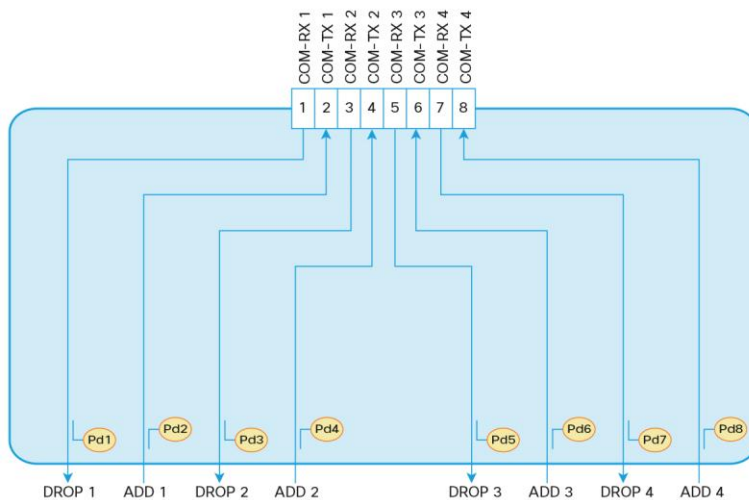
- MPO-8 to 16 x LC fan-out module
- MPO-16 to 16 x LC fan-out module
- MPO-16 to 2 x MPO-8 adapter (two adapters in one module)

Figure 10. Cisco Adapter Modules, from top to bottom, MPO-8 to 8 x LC Fan-Out Module, MPO-16 to 16 x LC Fan-Out Module, MPO-16 to 2 x MPO-8 Adapter
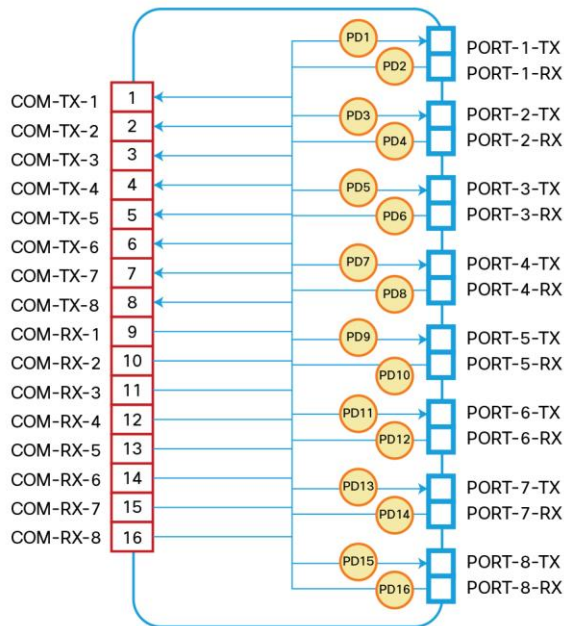

The MPO-8 to 8 x LC fan-out module provides mechanical adaptation from units offering LC connectors to those with MPO-8 connectors. A total of eight photodiodes provide power monitoring of input and output ports, as shown in Figure 11.

**Figure 11.** MPO-8 to 8 x LC Fan-Out Module Functional Diagram

The MPO-16 to 16 x LC Fan-Out Module provides mechanical adaptation from units offering LC connectors to those with MPO-16 connectors. A total of sixteen photodiodes provide power monitoring of input and output ports, as shown in Figure 12.

Figure 12. MPO-16 to 16 x LC Fan-Out Module Functional Diagram

The MPO-16 to 2 x MPO-8 adapter module provides mechanical adaptation from units offering MPO-8 connectors to those with MPO-16 connectors. Two adaptations are provided per module. Three photodiodes provide power monitoring of input and output ports, as shown in Figure 13.

Figure 13. MPO-16 to 2 x MPO-8 Adapter Functional Diagram
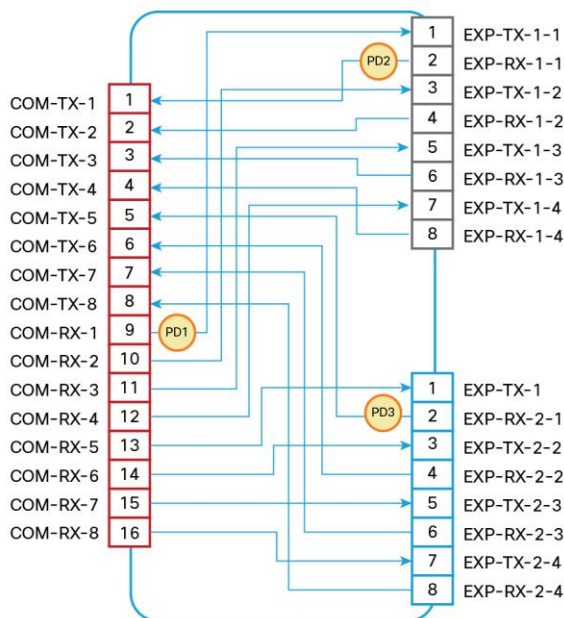
Combination Mesh Patch Panel Plus Add-Drop Module

The 2RU 8-degree mesh patch panel 5-add-drop port module (Figure 14) is a standalone unit providing eight degrees of mesh connectivity and five add-drop ports. In contrast with the modular components described earlier, all express and add-drop connections are contained within the unit, simplifying node fibering. All connectors are either MPO-24 or MPO-8 for easy and direct interconnection to flex spectrum single-module ROADM or contentionless add-drop line cards (Figure 15).

Figure 14. 2RU 8-Degree Mesh Patch Panel 5-Add/Drop Port Module

Figure 15. 2RU 8-Degree Mesh Patch Panel - 5-Add-Drop Port Functional Diagram
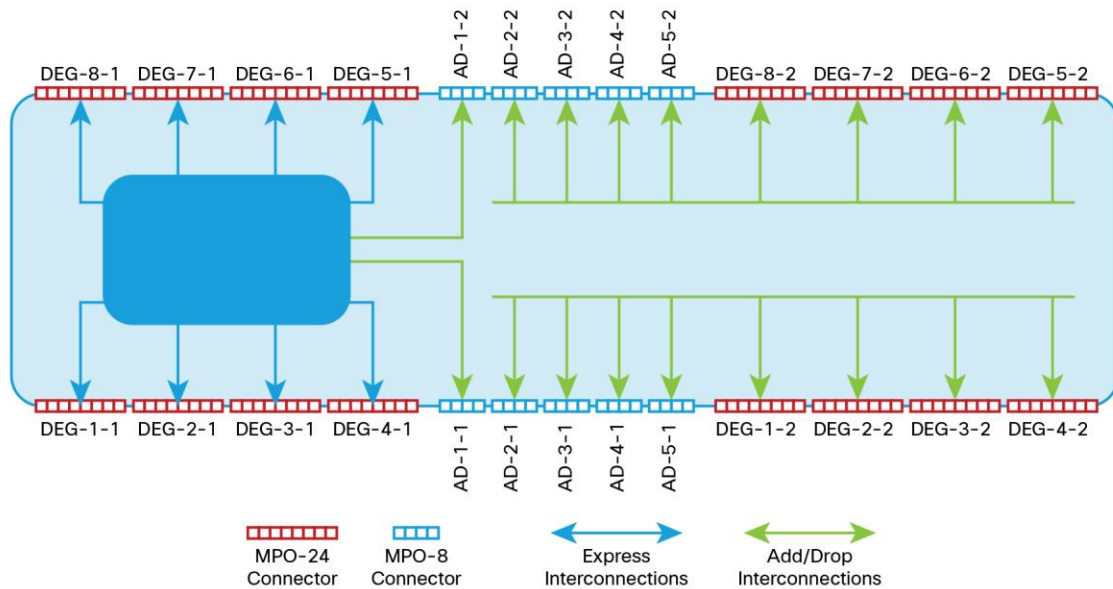
Passive Auxiliary Modules Product Specifications

Tables 1 through 11 list the specifications of the modules. Product numbers for ordering each module appear in Table 12.

Table 1. Optical Specifications for the 5-Degree Patch Panel Module

Parameter	Minimum	Maximum
Insertion loss	0 dB	1.5 dB
Insertion loss ripple (wavelength-dependent loss [WDL])		0.1 dB
Polarization Dependent Loss (PDL)		0.1 dB
Polarization mode dispersion (PMD)		0.05 ps
Return loss	40 dB	

Table 2. Optical Specifications for the 4-Degree Upgrade Patch Panel Modules

Parameter	Minimum	Maximum
Insertion loss	0 dB	1.5 dB
Insertion loss ripple (WDL)		0.1 dB
PDL		0.1 dB
PMD		0.05 ps
Return loss	40 dB	

Table 3. Optical Specifications for the 1 x 16 CFS Add-Drop Module

Parameter	Minimum	Maximum
Insertion loss	12 dB	14.5 dB
Insertion loss ripple (WDL)		0.3 dB
I.L. uniformity		1 dB
PDL		0.2 dB
PMD		0.05 ps
Chromatic dispersion		± 5 ps/nm
Group delay ripple		10 ps
Return loss	45 dB	

Table 4. Optical Specifications for the 1 x 16 CFS Add-Drop Plus Express Module

Parameter	Optical Path	Minimum	Maximum
Insertion loss	COM-RX → EXP-TX EXP-RX → COM-TX	6 dB	7.5 dB
	ADD-i → COM-TX EXP-RX → DROP-i	13.5 dB	15 dB
Insertion loss ripple (WDL)			0.3 dB
I.L. uniformity			1 dB
PDL			0.2 dB
PMD			0.05 ps
Chromatic dispersion			± 5 ps/nm
Group delay ripple			10 ps
Return loss		45 dB	

Table 5.   Optical Specifications for the 1 x 10 CFS Add-Drop Module

Parameter	Minimum	Maximum
Insertion loss	10 dB	12 dB
Insertion loss ripple (WDL)		0.5 dB
I.L. uniformity		1 dB
PDL		0.2 dB
PMD		0.05 ps
Chromatic dispersion		± 5 ps/nm
Group delay ripple		10 ps
Return loss	40 dB	

Table 6.   Optical Specifications for the 4 x 4 Colorless Omnidirectional Flex Spectrum Add-Drop Module

Parameter	Minimum	Maximum
Insertion loss	6 dB	8 dB
Insertion loss ripple (WDL)		0.5 dB
I.L. uniformity		1 dB
PDL		0.1 dB
PMD		0.05 ps
Chromatic dispersion		± 5 ps/nm
Group delay ripple		10 ps
Return loss	40 dB	

Table 7.   Optical Specifications for the MPO-8xLC Adapter Module

Parameter	Minimum	Maximum
Insertion loss	0 dB	1.1 dB
Insertion loss ripple (WDL)		0.1 dB
PDL		0.1 dB
PMD		0.1 ps
Return loss	40 dB	

Table 8.   Optical Specifications for the MPO-16xLC Adapter Module

Parameter	Minimum	Maximum
Insertion loss	0 dB	1.1 dB
Insertion loss ripple (WDL)		0.1 dB
PDL		0.1 dB
PMD		0.1 ps
Return loss	40 dB	

Table 9. Optical Specifications for the MPO-16 to 2xMPO-8 Adapter Module

Parameter	Minimum	Maximum
Insertion loss	0 dB	1.5 dB
Insertion loss ripple (WDL)		0.1 dB
PDL		0.1 dB
PMD		0.05 ps
Return loss	40 dB	

Table 10. Optical Specifications for 8-Degree Mesh Patch Panel 5-Add-Drop Port Module

Parameter	Minimum	Maximum
Insertion loss	0 dB	1.5 dB
Insertion loss ripple (WDL)		0.1 dB
PDL		0.1 dB
PMD		0.05 ps
Return loss	40 dB	

Table 11. Passive Auxiliary Modules Physical Specifications

Parameter	Value
Power	500 mW maximum
Size (H x W x D)	0.67 x 7.05 x 6.5 in. (17 x 179 x 165 mm) for DEG-5, UPG-4, MPO-8LC, 4x4 COFS-AD, MPO-8LC, MPO-16LC, 2MPO-ADP, and 2LC-ADP 1.39 x 7.05 x 6.50 in. (35.2 x 179 x 165 mm) for 16AD-CFS, 16AE-CFS, and 10AD-CFS 3.45 x 17.21 x 10.89 in. (87.6 x 437.1 x 276.7 mm) for PPMESH8-5AD
Weight	1.28 lb (0.58 kg) for DEG-5, UPG-4, MPO-8LC, 4x4 COFS-AD, MPO-8LC, MPO-16LC, 2MPO-ADP, and 2LC-ADP 1.76 lb (0.8 kg) for 16AD-CFS, 16AE-CFS, and 10AD-CFS 10.36 lbs. (4.7 kg) for PPMESH8-5AD
Management	
Card LEDs	Each module has two LEDs at the front panel: one blue LED and one three-color LED (yellow, green, and red). Both LEDs can also blink at 0.5 Hz and 2.5 Hz on request. The LED is used to: ● Notify that the module is powered but not associated. LED not blinking, color yellow ● Notify that the module is powered and associated. LED not blinking, color green ● Help operator identify a specific module, light-up blue LED (blinking)
Operating Environment	
Temperature	23 to 131°F (-5 to 55°C)
Relative humidity	5 to 95%

Table 12. ROADM Passive Auxiliary Modules Ordering Information

Product Name	Description
NCS2K-MF-1RU=	Mechanical Frame - 4 slots - 1 RU
NCS2K-MF-DEG-5=	Mesh Interconnection MF Unit - Up to 5 Degrees
NCS2K-MF-UPG-4=	Mesh Interconnection MF Unit - Upgrade - 4 Degrees
NCS2K-MF-16AD-CFS=	16-Ports Add/Drop MF Unit - Colorless and Flex Spectrum
NCS2K-MF-4X4-COFS=	4-Degree and 4-Ports Add/Drop MF Unit - CO and Flex Spectrum
NCS2K-MF-MPO-8LC=	MPO to 8x LC Fan-Out MF Unit - With Integrated Monitoring
NCS2K-MF-MPO-16LC=	MPO-16 to 16xLC Fan-Out MF Unit - With Integrated Monitoring
NCS2K-MF-2MPO-ADP=	Double MPO-16 to 2xMPO-8 Adapter MF Unit - Monitoring
NCS2K-PPMESH8-5AD=	2RU 8-Degree Mesh Patch Panel- 5-Add/Drop Port + Monitoring
NCS2K-MF-16AE-CFS=	16-Port Add/Drop + Express MF Unit - Colorless Flex Spectrum
NCS2K-MF-10AD-CFS=	10-Port Add/Drop MF Unit - Colorless Flex Spectrum
NCS2K-MF-COVER=	1 RU Cover for the Mechanical Frame
NCS2K-MF-2LC-ADP=	Double LC-LC Adapter MF Unit

Table 13 provides regulatory compliance information for all units included in this data sheet.

Table 13. Regulatory Compliance[1]

Countries Supported	
ANSI System	**ETSI System**
● Canada ● United States ● Korea ● Japan ● European Union	● European Union ● Africa ● CSI ● Australia ● New Zealand ● China ● Korea ● India ● Saudi Arabia ● South America
EMC (Class A)	
● ICES-003 (2004) ● GR-1089-CORE Issue 6, NEBS EMC and Safety (May 2011) ● 47 FCC part15 (2011)	● EN 300 386 Telecommunications Network Equipment (EMC): 2008 (Note: EMC-1) ● CISPR22 Ed.6 (2008) and CISPR24: Ed.2 (2010) ● EN55024 Ed.2 2010: Immunity levels: see EN61000-4-xx ● EN55022: 2007 Information Technology Equipment (Emissions)(2006) (EMC-2)
Safety	
● UL/CSA 60950-1,Second Ed 2011 ● GR-1089-CORE Issue 6, NEBS EMC and Safety (May 2011)	● UL/CSA 60950-1,Second Ed 2011 ● IEC 60950-1(2005/12), 2nd Edition and National Differences as per CB Bulletin 112A ● + Amendment 1: 2009
Laser	
● UL/CSA 60950-1,Second Ed 2011 ● IEC 60950-1(2005/12), 2nd Edition and National Differences as per CB Bulletin 112A ● +Amendment 1: 2009 ● IEC-60825-2 Edition 3.1, 2007/01	● CDRH (accession letter and report) ● IEC 60825-1 Ed. 2 2007-03

Countries Supported	
Environmental	
● GR-63-CORE Issue 4, NEBS Physical Protection (Apr 2012) ● ETS 300-019-2-1 V2.1.2 (2000-09) (Storage, Class 1.1)	● ETS 300-019-2-2 V2.2.1 (2011-11): Transportation, Class 2.3 ● ETS 300-019-2-3 V2.2.2 (2003-04): stationary use, Class 3.1E

Warranty

The following warranty terms apply to the Cisco NCS 2000 as well as services you may use during the warranty period. Your formal warranty statement appears in the Cisco Information Packet that accompanies your Cisco product.

- Hardware warranty duration: Five years.

- Software warranty duration: One year.

- Hardware replacement, repair, or refund procedure: Cisco or our service center will use commercially reasonable efforts to ship a replacement part for delivery within 15 working days after receipt of the defective product at the Cisco site. Actual delivery times of replacement products may vary depending on customer location.

Product warranty terms and other information applicable to Cisco products are available at: http://www.cisco.com/go/warranty.

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