Enhanced C-Band Optical Amplifier for the Cisco ONS 15454 Multiservice Transport Platform

The Cisco® ONS 15454 Multiservice Transport Platform (MSTP) provides a comprehensive, intelligent dense wavelength-division multiplexing (DWDM) solution for expanding metropolitan (metro), regional, and long-haul bandwidth.

Product Overview

The Cisco ONS 15454 MSTP offers an enhanced optical amplifier card (Figure 1) operating in the C-band region of the optical spectrum to extend the reach and capacity of a metro, regional, or long-haul network. The optical amplifier cards are part of the Cisco ONS 15454 MSTP intelligent DWDM architecture engineered to reduce DWDM complexity and speed the deployment of next-generation networking solutions.

The Cisco ONS 15454 enhanced optical amplifier card is a plug-in module that takes advantage of the proven Cisco ONS 15454 carrier-class features. This card delivers the reach and optical performances to support a single DWDM channel all the way to 80 channels today, to meet the requirements of service provider and enterprise networks. Table 1 outlines the C-band optical amplifier plug-in card types available for the Cisco ONS 15454 MSTP with the applications they are designed to support.

Figure 1. Cisco ONS 15454 Enhanced C-Band Optical Amplifier (OPT-AMP-C)

Table 1. C-Band Optical Amplifier Cards with Applications

Component	Deployment Application
Enhanced optical amplifier (OPT-AMP-C)	This flexible amplifier can be used as a preamplifier or as a booster amplifier, providing a total output power of 20 dBm. It integrates an optical service channel splitter/combiner to allow the optical supervisory channel (OSC) to be sent to and received from the optical service channel module (OSCM) card. It employs a two-stage amplifier design to allow insertion of dispersion-management devices to compensate for pulse spreading at higher multiplexer speeds. Deployment locations include any site where high per-channel power or high optical gain is required.
Enhanced optical booster amplifier (OPT-BST-E)	This product amplifies the outgoing composite DWDM signal to overcome the attenuation of the fiber network, providing a total output power of 20 dBm. It integrates an optical service channel splitter/combiner to allow the OSC to be sent to and received from the OSCM card. Deployment locations include any site where high per-channel power is required to hit the fiber span.
Optical booster amplifier (OPT-BST)	This product amplifies the outgoing composite DWDM signal to overcome the attenuation of the fiber network, providing a total output power of 17 dBm. It integrates an optical service channel splitter/combiner to allow the OSC to be sent to and received from the OSCM card. Deployment locations include any site where amplification of the DWDM signals is required before hitting the fiber span.
17 dB gain optical amplifier (OPT-AMP-17C)	This flexible amplifier can be used as a preamplifier or as a booster amplifier, providing a total output power of 17 dBm. It integrates an optical service channel splitter/combiner to allow the OSC to be sent to and received from the OSCM card. It employs a single-stage amplifier design to optimize the noise figure and operates with a fixed gain of 17 dB. Deployment locations include any site where fixed gain amplification can be used to optimize node gain figure and dispersion-management devices are not needed.
Optical preamplifier (OPT-PRE)	This product amplifies the incoming composite DWDM signal to allow a sufficient optical power level to optical receivers on dropped wavelengths and to overcome the insertion losses of the reconfigurable or fixed optical filters in the node. It employs a two-stage amplifier design to allow insertion of dispersion-management devices to compensate for pulse spreading at higher multiplexer speeds, providing a total output power of 17 dBm. Deployment locations include any site where variable gain amplification and/or dispersion-management devices are required in the receive direction.

The OPT-AMP-C takes advantage of the latest in amplifier technology, variable optical attenuators, photo diodes, and extensive software to facilitate a high degree of automation for simplified operations. The OPT-AMP-C features low-noise-gain blocks for C-band optical amplification requirements. For flexibility of application support, the amplifier can be used either as a pre-amplifier or as a booster amplifier. When used as a booster amplifier, the integrated OSC splitting and combining capability allows the OSCM unit to provide visibility and manageability of all the nodes of the network. The amplifier also provides fast-transient suppression to respond quickly to network changes without impairments and degradation of existing wavelengths. The amplifier integrates a software-controllable variable optical attenuator (VOA) to provide gain tilt control capabilities and to optimize the mid-access loss between the two amplification stages when different dispersion compensation units (DCUs) are used. The OPT-AMP-C provides optical safety functionality using the signal and OSC loss detection to help ensure user safety when operating the network, and complies with international standard requirements.

The flexibility provided by the OPT-AMP-C card and the possibility to configure it through software to operate as a preamplifier or as a booster amplifier greatly simplify the operation of the Cisco ONS 15454 MSTP and reduce the number of spare units to be kept by the users. Midstage access loss (MAL) provided by the OPT-AMP-C card can be used, when the card is used as a booster amplifier, to perform chromatic dispersion precompensation at the transmit location, improving overall system performances – especially with high (such as 10 Gbps) and very high (such as 40 Gbps) bit rates and services.

The optical amplifier card incorporates faceplate-mounted LEDs to provide a quick visual check of the operational status at the card. Printed on each of the faceplates is an icon, an orange circle, which is mapped to shelf-slot icons indicating the shelf slot where the card can be physically installed. The card is supported by the integrated Cisco Transport Controller craft manager on the Cisco ONS 15454, which provides the user access for operations, administration, maintenance, and provisioning (OAM&P) for the system.

Selection and deployment of the Cisco ONS 15454 Enhanced C-Band Optical Amplifier (OPT-AMP-C) depend on the requirements of the network. The Cisco Transport Planner optical design tool is available to assist in the engineering, bill-of-material development, and deployment of the DWDM network. Figure 2 shows the block diagram of the OPT-AMP-C. Figure 3 shows a sample signal-flow diagram for an Optical Line Amplifier (OLA) site using OPT-AMP-C units while Figure 4 shows a signal flow diagram for a Reconfigurable Optical Add/Drop Multiplexer (ROADM) site.

Figure 2. OPT-AMP-C Block Diagram

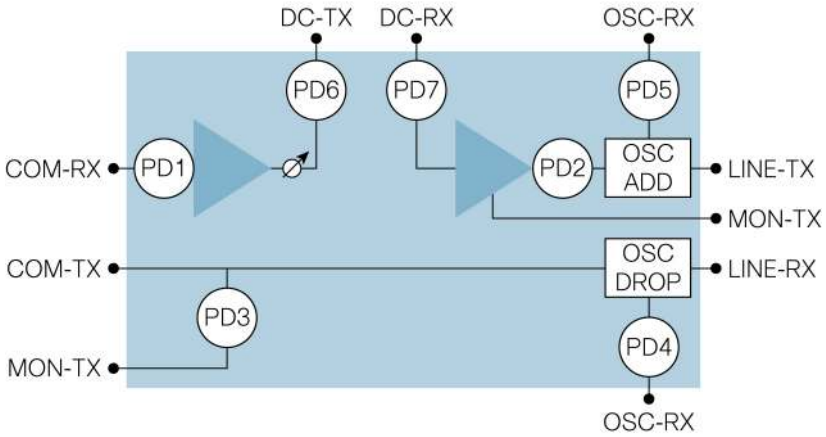


Figure 3. Cisco ONS 15454 MSTP OLA Site Signal Flow when OPT-AMP-C is Used

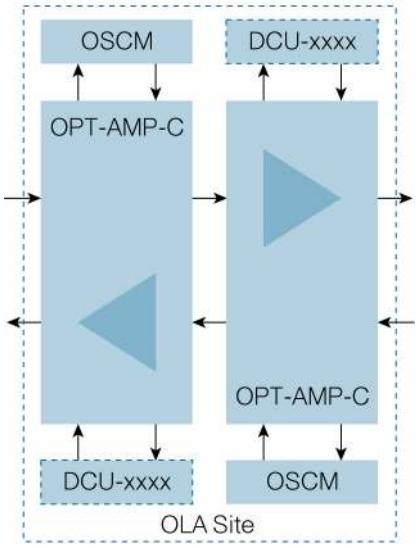
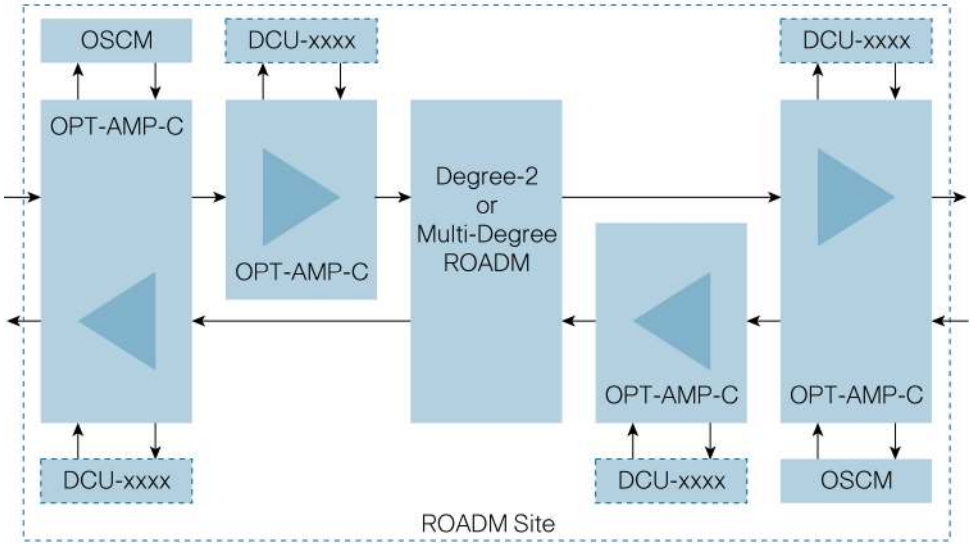


Figure 4. Cisco ONS 15454 MSTP ROADM Site Signal Flow when OPT-AMP-C is Used



Product Specifications

Table 2 gives regulatory compliance, Table 3 gives system requirements, and Tables 4 and 5 provide card and optical specifications for the Cisco ONS 15454 Enhanced C-Band Optical Amplifier.

Table 2. Regulatory Compliance[1]

ANSI (SONET) System	ETSI (SDH) System
Supported Countries	
• Canada • United States	• Europe • Latin America • Japan • Asia Pacific • Middle East and Africa
EMC (Class A)	
• ICES-003 Issue 3 (1997) • GR-1089-CORE, Issue 3 • FCC 47CFR15 subpart B (2004)	• EN 300 386 v1.3.3 (2005) • CISPR22 (2005), CISPR24 (+ Am 1, Am 2 2002) • EN55022 and EN55024
Safety	
• UL/CSA 60950 -1 First Edition (2003) • GR-1089-CORE , Issue 3	• UL/CSA 60950 -1 First Edition (2003) • IEC 60950 -1 (2001-01) First Edition/EN60950 -1 (2001), First Edition
Laser	
• UL/CSA 60950 -1 First Edition (2003) • IEC 60950 -1 (2001-01) First Edition/EN60950 -1 (2001), First Edition • IEC 60825-2 (2004-06) Third Edition • IEC 60825-1 +Am.1+ Am.2 (2001) • CDRH (Accession letter and report)	

[1] All compliance testing and documentation may not be completed at release of the product. Check with your sales representative for countries outside of Canada, the United States, and the European Union.

ANSI (SONET) System	ETSI (SDH) System
Environmental	
• GR-63-CORE, Issue 2 and Issue 3	• ETS 300-019-2-1 V2.1.2 (Storage, Class 1.1) • ETS 300-019-2-2 V2.1.2 (Transportation, Class 2.3) • ETS 300-019-2-3 V2.1.2 (Operational, Class 3.1E)
Optical	
• GR-253-CORE • G.692	
Quality	
• TR-NWT-000332, Issue 4, Method 1 calculation for 20-year mean time between failure (MTBF)	
Miscellaneous	
• AT&T Network Equipment Development Standards (NEDS) Generic Requirements, AT&T 802-900-260 • SBC TP76200MP • Verizon SIT.NEBS.NPI.2002.010 • Worldcom ESD requirement	

Table 3. System Requirements

Component	Cisco ONS 15454 ANSI (SONET)	Cisco ONS 15454 ETSI (SDH)
Processor	TCC2P and TCC2	TCC2P and TCC2
Cross-connect	All (not required)	All (not required)
Shelf assembly	15454-SA-HD or 15454-SA-HD-DDR shelf assembly with CC-FTA version fan-tray assembly	15454E-SA-ETSI shelf assembly with CC-FTA version fan-tray assembly
System software	Release 8.5 ANSI or later	Release 8.5 ETSI or later
Slot compatibility	1 to 6 and 12 to 17	1 to 6 and 12 to 17

Table 4. Card Specifications

Specification	Value
Management	
Card LEDs Failure (FAIL) Active/standby (ACT/STBY) Signal fail (SF)	 Red Green/yellow Yellow
General Specifications	
Card power draw Typical Maximum	 45W 55W
Weight (not including clam shell)	1.4 kg / 3.08 lbs
Optical connectors	LC
Size	1 slot
Reliability	
Predicted MTBF	332,849 hrs
Operating Environment	
Temperature	23 to 131°F (–5 to 55°C)
Humidity	5 to 95% noncondensing
Storage Environment	
Temperature	–40 to 185°F (–40 to 85°C)
Humidity	5 to 95% noncondensing

Specification	Value
Transportation Environment	
Temperature	–40 to 158°F (–40 to 70°C)
Humidity	5 to 95% noncondensing

Table 5. Optical Specifications

Specification	Value
Channels allocation	1529.0 to 1562.5 nm
Input power range	–15 to 8 dBm (full channel load) –40 to –17 dBm (single channel)
Channel output power range	–5 to 20 dBm
Maximum total output power	20 dBm
Channel signal-spontaneous noise figure	5.5 dB with gain = 35 dB 6.5 dB with gain ≥ 24 dB
Input reflectance	40 dB
Output reflectance	40 dB
Pump leakage to input/output	–20 dBm
Maximum reflectance tolerable at input	14 dB
Maximum reflectance tolerable at output	14 dB
Channel addition/removal (steady-state) gain response	Between 5 ms and 1 second
Channel addition/removal (transient) gain response Maximum Typical	 0.5 ms (3 dB input power excursion, maximum undershoot and overshoot < 1.8 dB) 0.19 ms (3 dB input power excursion, maximum undershoot and overshoot < 1.8 dB)
Channel Gain	Between 12 dB and 35 dB
Multichannel gain variation (inter-channel gain difference) Maximum Typical	 1.2 dB 1.0 dB
Multichannel gain tilt	0 dB (gain ≤ 24 dB) Maximum 1 dB (gain ≥ 25dB)
Maximum Polarization Mode Dispersion (PMD)	0.15 ps

Ordering Information

Tables 6 gives ordering information for the Cisco ONS 15454 Enhanced C-Band Optical Amplifier card.

Table 6. Ordering Information

Part Number	Description
15454-OPT-AMP-C=	Enhanced optical amplifier, 20 dBm output power, can be configured as preamplifier or booster, C-band, 80 channel, 50-GHz compatible, LC connectors, midstage access, includes one 4-dB LC/LC attenuated loopback (to be used if DCU is not required) and two 2-meter LC/LC fiber-optic cables

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

Europe Headquarters
Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: +31 0 800 020 0791
Fax: +31 0 20 357 1100

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