Provisioning Optical Amplifier Cards

This chapter describes the optical amplifier cards used in Cisco NCS networks and related procedures.

For card safety and compliance information, refer to the Regulatory Compliance and Safety Information for Cisco NCS Platforms document.

Optical amplifier card architecture includes an optical plug-in module with a controller that manages optical power, laser current, and temperature control loops. An amplifier also manages communication with the control card and operation, administration, maintenance, and provisioning (OAM&P) functions such as provisioning, controls, and alarms.

Applications of Amplifiers

The following amplifiers can be configured as booster or preamplifiers:

- OPT-AMP-C
- OPT-AMP-17C
- OPT-AMP-L
- OPT-BST-E
- OPT-BST

- OPT-EDFA-17
- OPT-EDFA-24

The amplifier functions as a booster amplifier by default. The amplifier role is automatically configured when the CTP NE update configuration file is loaded in CTC. The amplifier role can also be manually modified.

Note The OPT-BST and OPT-BST-E amplifiers are supported as preamplifiers in sites that are equipped with the OPT-RAMP-C card. In any other configuration, the OPT-BST and OPT-BST-E cards must be configured as a booster amplifier.

For more information about the supported configurations and network topologies, see and

Card Compatibility

The following table lists the Cisco Transport Controller (CTC) software compatibility for each optical amplifier card.

Table 1: Software Release Compatibility for Optical Amplifier Cards

Card Name	R10.0	R10.1	R10.3	R10.5	R10.5.2/R10.6.1
OPT-PRE	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015
OPT-BST	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015
OPT-BST-E	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015
OPT-AMP-17C	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015
OPT-AMP-C	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015
OPT-RAMP-C	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006
OPT-RAMP-CE	NCS 2006	NCS 2006	NCS 2006	NCS 2006	NCS 2006
RAMAN-CTP	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015	NCS 2002, NCS 2006, NCS 2015
RAMAN-COP	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015	NCS 2002, NCS 2006, NCS 2015

Card Name	R10.0	R10.1	R10.3	R10.5	R10.5.2/R10.6.1
OPT-EDFA-17	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015	NCS 2002, NCS 2006, NCS 2015
OPT-EDFA-24	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006	NCS 2002, NCS 2006, NCS 2015	NCS 2002, NCS 2006, NCS 2015
EDRA-1-26	NCS 2006	NCS 2006	NCS 2006	NCS 2006, NCS 2015	NCS 2006, NCS 2015
EDRA-1-35	NCS 2006	NCS 2006	NCS 2006	NCS 2006, NCS 2015	NCS 2006, NCS 2015
EDRA-2-26	NCS 2006	NCS 2006	NCS 2006	NCS 2006, NCS 2015	NCS 2006, NCS 2015
EDRA-2-35	NCS 2006	NCS 2006	NCS 2006	NCS 2006, NCS 2015	NCS 2006, NCS 2015

OPT-PRE Amplifier Card

Note For OPT-PRE card safety labels, see Class 1M Laser Product Cards.

The OPT-PRE is a C-band, DWDM, two-stage erbium-doped fiber amplifier (EDFA) with midamplifier loss (MAL) that can be connected to a dispersion compensating unit (DCU). The OPT-PRE is equipped with a built-in variable optical attenuator (VOA) that controls the gain tilt and can also be used to pad the DCU to a reference value. You can install the OPT-PRE in Slots 1 to 6 and 12 to 17. The card is designed to support up to 80 channels at 50-GHz channel spacing. The OPT-PRE features include:

- Fixed gain mode with programmable tilt
- True variable gain
- Fast transient suppression
- Nondistorting low-frequency transfer function
- Settable maximum output power
- Fixed output power mode (mode used during provisioning)
- MAL for fiber-based DCU
- Amplified spontaneous emissions (ASE) compensation in fixed gain mode
- Full monitoring and alarm handling with settable thresholds
- Four signal photodiodes to monitor the input and output optical power of the two amplifier stages through CTC

- An optical output port for external monitoring

Note The optical splitter has a ratio of 1:99, resulting in about 20 dB-lower power at the MON port than at the COM TX port.

For more information about the OPT-PRE Amplifier card, see http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/product_data_sheet0900aecd800e4d24.html

OPT-PRE Card Functions

The functions of the OPT-PRE card are:

- OPT-PRE Card Power Monitoring
- Card level indicators
- Port-Level Indicators

OPT-PRE Card Power Monitoring

Physical photodiodes P1, P2, P3, and P4 monitor the power for the OPT-PRE card. The following table shows the returned power level values calibrated to each port.

Table 2: OPT-PRE Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	Input Com	COM RX
P2	Output DC	DC TX
P3	Input DC	DC RX
P4	Output COM (Total Output)	COM TX
	Output COM (Signal Output)	

For information on the associated TL1 AIDs for the optical power monitoring points, refer the “CTC Port Numbers and TL1 Aids” section in *Cisco NCS 2000 Series TL1 Command Guide*.

Related Procedures for OPT-PRE Card

The following is the list of procedures and tasks related to the configuration of the OPT-PRE card:

- NTP-G30 Install the DWDM Cards

- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs
- NTP-G38 Provision OSC Terminations
- NTP-G37 Run Automatic Node Setup
- NTP-G51 Verify DWDM Node Turn Up
- NTP-G76 Verify Optical Span Loss Using CTC
- NTP-G74 Monitor DWDM Card Performance
- DLP-G140 View Power Statistics for Optical Amplifier, 40-SMR1-C, and 40-SMR2-C Cards
- NTP-G77 Manage Automatic Power Control

OPT-BST and OPT-BST-E Amplifier Card

Note For OPT-BST and OPT-BST-E cards safety labels, see "Class 1M Laser Product Cards". .

The OPT-BST is designed to ultimately support up to 80 channels at 50-GHz channel spacing. The OPT-BST-E amplifier card is a gain-enhanced version of the OPT-BST card. It is designed to support up to 80 channels at 50-GHz channel spacing. Both the cards are C-band, DWDM EDFA with optical service channel (OSC) add-and-drop capability. When an OPT-BST or an OPT-BST-E is installed, an OSCM card is also needed to process the OSC. You can install the OPT-BST and OPT-BST-E cards in Slots 1 to 6 and 12 to 17. The card's features include:

- Fixed gain mode (with programmable tilt)
- Gain range of 5 to 20 dB in constant gain mode and output power mode for an OPT-BST card
- Gain range of 8 to 23 dBm with the tilt managed at 0 dBm in constant gain mode and output power mode for an OPT-BST-E card
- Enhanced gain range of 23 to 26 dBm with unmanaged tilt with OPT-BST-E card
- True variable gain
- Built-in VOA to control gain tilt
- Fast transient suppression
- Nondistorting low-frequency transfer function
- Settable maximum output power
- Fixed output power mode (mode used during provisioning)
- ASE compensation in fixed gain mode
- Full monitoring and alarm handling with settable thresholds
- Optical Safety Remote Interlock (OSRI), a CTC software feature capable of shutting down optical output power or reducing the power to a safe level (automatic power reduction)
- Automatic laser shutdown (ALS), a safety mechanism used in the event of a fiber cut. For information about using the card to implement ALS in a network, see "Network Optical Safety". .

Note The optical splitters each have a ratio of 1:99. The result is that MON TX and MON RX port power is about 20 dB lower than COM TX and COM RX port power.

For more information about the OPT-BST and OPT-BST-E Amplifier cards, see http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/product_data_sheet0900aecd802be30a.html

OPT-BST and OPT-BST-E Card Functions

The functions of the OPT-BST and OPT-BST-E cards are:

- 5.4.2.1 OPT-BST and OPT-BST-E cards Power Monitoring
- Card level indicators
- Port-Level Indicators

OPT-BST and OPT-BST-E cards Power Monitoring

Physical photodiodes P1, P2, P3, and P4 monitor the power for the OPT-BST and OPT-BST-E cards. The following table shows the returned power level values calibrated to each port.

Table 3: Port Calibration

Photodiode	CTC Type Name	Calibrated to Port	Power	PM Parameter
P1	Input Com	COM RX	Channel Power	Supported
P2	Output Line (Total Output)	LINE TX	Channel Power	Supported
	Output Line (Signal Output)			
P3	Input Line	LINE RX	Channel Power	Supported
P4	Input Line	LINE RX	OSC Power	Supported

The power on the OSC-TX and COM-TX ports are calculated by adding the insertion loss (IL) to the power reported from P3 and P4.

The PM parameters for the power values are listed at Optics and 8b10b PM Parameter Definitions.

For information on the associated TL1 AIDs for the optical power monitoring points, refer the “CTC Port Numbers and TL1 Aids” section in *Cisco NCS 2000 Series TL1 Command Guide*.

Related Procedures for OPT-BST and OPT-BST-E Cards

The following is the list of procedures and tasks related to the configuration of the OPT-BST and OPT-BST-E cards:

- NTP-G30 Install the DWDM Cards
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs
- NTP-G38 Provision OSC Terminations
- NTP-G37 Run Automatic Node Setup
- NTP-G51 Verify DWDM Node Turn Up
- NTP-G76 Verify Optical Span Loss Using CTC
- NTP-G74 Monitor DWDM Card Performance
- DLP-G140 View Power Statistics for Optical Amplifier, 40-SMR1-C, and 40-SMR2-C Cards
- NTP-G77 Manage Automatic Power Control

OPT-AMP-17-C Card

Note For OPT-AMP-17-C safety labels, see "Class 1M Laser Product Cards"..

The OPT-AMP-17-C is a 17-dB gain, C-band, DWDM EDFA amplifier/preamplifier with OSC add-and-drop capability. It supports 80 channels at 50-GHz channel spacing in the C-band (that is, the 1529 nm to 1562.5 nm wavelength range). When the system has an OPT-AMP-17-C installed, an OSCM card is needed to process the OSC. You can install the OPT-AMP-17-C in Slots 1 to 6 and 12 to 17.

The card's features include:

- Fixed gain mode (no programmable tilt)
- Standard gain range of 14 to 20 dB at startup when configured as a preamplifier
- Standard gain range of 20 to 23 dB in the transient mode when configured as a preamplifier
- Gain range of 14 to 23 dB (with no transient gain range) when configured as a booster amplifier
- True variable gain
- Fast transient suppression
- Nondistorting low-frequency transfer function
- Settable maximum output power
- Fixed output power mode (mode used during provisioning)
- ASE compensation in fixed gain mode
- Full monitoring and alarm handling with settable thresholds

- OSRI
- ALS

For more information about the OPT-AMP-17-C card, see http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/product_data_sheet0900aecd800e4d24.html

OPT-AMP-17-C Card Functions

The functions of the OPT-AMP-17-C card are:

- G.33 Automatic Power Control
- Card level indicators
- Port-Level Indicators
- OPT-AMP-17-C Card Power Monitoring

OPT-AMP-17-C Card Power Monitoring

Physical photodiodes P1, P2, P3, P4, and P5 monitor power for the OPT-AMP-17-C card. The following table shows the returned power level values calibrated to each port.

Table 4: OPT-AMP-17-C Port Calibration

Photodiode	CTC Type Name	Calibrated to Port	Power	PM Parameter
P1	Input COM	COM RX	Channel Power	Supported
P2	Output Line (Total Output)	LINE TX	Channel Power	Supported
	Output Line (Signal Output)			
P3	Input Line	LINE RX	Channel Power	Supported
P4	Input Line	LINE RX	OSC Power	Supported
P5	Input OSC	OSC RX	OSC Power	Supported

The power on the OSC-TX and COM-TX ports are calculated by adding the insertion loss (IL) to the power reported from P3 and P4.

The OSC power on the LINE TX is calculated by adding the IL to the power reported from P5.

The PM parameters for the power values are listed in the Optics and 8b10b PM Parameter Definitions document.

For information on the associated TL1 AIDs for the optical power monitoring points, refer the “CTC Port Numbers and TL1 Aids” section in *Cisco NCS 2000 Series TL1 Command Guide*.

Related Procedures for OPT-AMP-17-C Card

The following is the list of procedures and tasks related to the configuration of the OPT-AMP-17-C card:

- NTP-G143 Import the Cisco Transport Planner NE Update Configuration File
- NTP-G30 Install the DWDM Cards
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs
- NTP-G38 Provision OSC Terminations
- NTP-G37 Run Automatic Node Setup
- NTP-G51 Verify DWDM Node Turn Up
- NTP-G76 Verify Optical Span Loss Using CTC
- NTP-G74 Monitor DWDM Card Performance
- DLP-G140 View Power Statistics for Optical Amplifier, 40-SMR1-C, and 40-SMR2-C Cards
- NTP-G77 Manage Automatic Power Control
- NTP-G160 Modify OPT-AMP-L, OPT-AMP-17-C, OPT-AMP-C, OPT-RAMP-C, OPT-RAMP-CE, 15454-M-RAMAN-CTP, 15454-M-RAMAN-COP, OPT-EDFA-17, and OPT-EDFA-24 Card Line Settings and PM Thresholds

OPT-AMP-C Card

Note For OPT-AMP-C card safety labels, see "Class 1M Laser Product Cards".

The OPT-AMP-C card is a 20-dB output power, C-band, DWDM EDFA amplifier/preamplifier. It contains mid-stage access loss for a Dispersion Compensation Unit (DCU). To control gain tilt, a VOA is used. The VOA can also be used to attenuate the signal to the DCU to a reference value. The amplifier module also includes the OSC add (TX direction) and drop (RX direction) optical filters.

The OPT-AMP-C card supports 80 channels at 50-GHz channel spacing in the C-band (that is, the 1529 nm to 1562.5 nm wavelength range). When the system has an OPT-AMP-C card installed, an OSCM card is needed to process the OSC. You can install the OPT-AMP-C card in Slots 1 to 6 and 12 to 17. Slots 2 to 6 and Slots 12 to 16 are the default slots for provisioning the OPT-AMP-C card as a preamplifier, and slots 1 and 17 are the default slots for provisioning the OPT-AMP-C card as a booster amplifier.

The card's features include:

- Fast transient suppression
- Nondistorting low-frequency transfer function
- Mid-stage access for DCU
- Constant pump current mode (test mode)
- Fixed output power mode (mode used during provisioning)

- Constant gain mode
- ASE compensation in Constant Gain and Constant Output Power modes
- Programmable tilt
- Full monitoring and alarm handling capability
- Gain range with gain tilt control of 12 to 24 dB
- Extended gain range (with uncontrolled tilt) of 24 to 35 dB
- Full monitoring and alarm handling with settable thresholds
- OSRI
- ALS

For more information about the OPT-AMP-C card, see http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/prod_data_sheet0900aecd8072b322.html.

OPT-AMP-C Card Functions

The functions of the OPT-AMP-C card are:

- OPT-AMP-L and OPT-AMP-C Cards Power Monitoring
- Card level indicators
- Port-Level Indicators

Related Procedures for OPT-AMP-C Card

The following is the list of procedures and tasks related to the configuration of the OPT-AMP-C card:

- NTP-G143 Import the Cisco Transport Planner NE Update Configuration File
- NTP-G30 Install the DWDM Cards
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs
- NTP-G38 Provision OSC Terminations
- NTP-G37 Run Automatic Node Setup
- NTP-G51 Verify DWDM Node Turn Up
- NTP-G76 Verify Optical Span Loss Using CTC
- NTP-G74 Monitor DWDM Card Performance
- DLP-G140 View Power Statistics for Optical Amplifier, 40-SMR1-C, and 40-SMR2-C Cards
- NTP-G77 Manage Automatic Power Control
- NTP-G160 Modify OPT-AMP-L, OPT-AMP-17-C, OPT-AMP-C, OPT-RAMP-C, OPT-RAMP-CE, 15454-M-RAMAN-CTP, 15454-M-RAMAN-COP, OPT-EDFA-17, and OPT-EDFA-24 Card Line Settings and PM Thresholds

OPT-RAMP-C and OPT-RAMP-CE Cards

Note For OPT-RAMP-C or OPT-RAMP-CE card safety labels, see "Class 1M Laser Product Cards".

The OPT-RAMP-C card is a double-slot card that improves unregenerated sections in long spans using the span fiber to amplify the optical signal. Different wavelengths in C-band receive different gain values. To achieve Raman amplification, two Raman signals (that do not carry any payload or overhead) are required to be transmitted on the optical fiber because the gain generated by one signal is not flat. The energy of these Raman signals transfer to the higher region of the spectrum thereby amplifying the signals transmitted at higher wavelengths. The Raman effect reduces span loss but does not compensate it completely.

When the Raman optical powers are set correctly, a gain profile with limited ripple is achieved. The wavelengths of the Raman signals are not in the C-band of the spectrum (used by MSTP for payload signals). The two Raman wavelengths are fixed and always the same. Due to a limited Raman gain, an EDFA amplifier is embedded into the card to generate a higher total gain. An embedded EDFA gain block provides a first amplification stage, while the mid stage access (MSA) is used for DCU loss compensation.

The OPT-RAMP-CE card is a 20 dBm output power, gain-enhanced version of the OPT-RAMP-C card and is optimized for short spans. The OPT-RAMP-C and OPT-RAMP-CE cards can support up to 80 optical transmission channels at 50-GHz channel spacing over the C-band of the optical spectrum (wavelengths from 1529 nm to 1562.5 nm). To provide a counter-propagating Raman pump into the transmission fiber, the Raman amplifier provides up to 500 mW at the LINE-RX connector. The OPT-RAMP-C or OPT-RAMP-CE card can be installed in Slots 1 to 5 and 12 to 16, and supports all network configurations. However, the OPT-RAMP-C or OPT-RAMP-CE card must be equipped on both endpoints of a span.

The Raman total power and Raman ratio can be configured using CTC. The Raman configuration can be viewed on the Maintenance > Installation tab.

The features of the OPT-RAMP-C and OPT-RAMP-CE card include:

- Raman pump with embedded EDFA gain block
- Raman section: 500 mW total pump power for two pump wavelengths
- EDFA section:
  - OPT-RAMP-C: 16 dB gain and 17 dB output power
  - OPT-RAMP-CE: 11 dB gain and 20 dB output power
- Gain Flattening Filter (GFF) for Raman plus EDFA ripple compensation
- MSA for DC units
- VOA for DC input power control
- Full monitoring of pump, OSC, and signal power
- Fast gain control for transient suppression
- Low-FIT (hardware-managed) optical laser safety
- Hardware output signals for LOS monitoring at input photodiodes
- Optical service channel add and drop filters

- Raman pump back-reflection detector

For more information about the OPT-RAMP-C and OPT-RAMP-CE cards, see http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/data_sheet_c78-500925.html.

OPT-RAMP-C and OPT-RAMP-CE Card Functions

The functions of the OPT-RAMP-C and OPT-RAMP-CE card are:

- 5.9.2.1 OPT-RAMP-C and OPT-RAMP-CE Cards Power Monitoring, page 5-36
- Card level indicators
- Port-Level Indicators

OPT-RAMP-C and OPT-RAMP-CE Cards Power Monitoring

Physical photodiodes PD1 through PD12 monitor the power for the OPT-RAMP-C and OPT-RAMP-CE cards.

Table 5: OPT-RAMP-C and OPT-RAMP-CE Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
PD1	EDFA DWDM Input Power	LINE-RX
PD2	EDFA Output Power (pre-VOA attenuation)	DC-TX (port with 0 dB VOA attenuation)
PD3	DCU Input Power	DC-TX
PD4	DCU Output Power	DC-RX
PD5	DWDM Input Power	COM-RX
PD6	OSC ADD Input Power	OSC-RX
PD7	OSC DROP Output Power	OSC-TX
PD8	Pump 1 in-fiber Output Power	LINE-RX
PD9	Pump 2 in-fiber Output Power	LINE-RX
PD10	Total Pump in-fiber Output Power	LINE-RX
PD11	Back-Reflected Pump Power	LINE-RX
PD12	Remnant Pump Power	LINE-TX

For information on the associated TL1 AIDs for the optical power monitoring points, refer the “CTC Port Numbers and TL1 Aids” section in *Cisco NCS 2000 Series TL1 Command Guide*.

Fiber and Connector Losses in Raman Link Configuration

This document provides important guidelines to be followed when configuring a Raman link regardless of whether you are configuring the Raman link using the Raman installation wizard or the Cisco Transport Planner (CTP) XML file. Ensuring the desired gain and gain flatness is critical to the success of the configuration.

The Raman installation wizard automatically addresses any deviation in connector and fiber splice loss values by displaying warning messages appropriately, provided they are within the limits detailed in Table 6: Limit for Connector Losses, on page 14. However, configuration of the Raman link using the CTP XML file is based on the algorithms within CTP. Any deviation in the connector and fiber splice losses values leads to unpredictable behavior of the entire system, in terms of Raman tilt and optical signal-to-noise ratio (OSNR). For these reasons, configuring the Raman link using the Raman installation wizard is preferred than configuring using the CTP XML file.

Table 6: Limit for Connector Losses, on page 14 contains the following fields:

- Conditions—Limit for connector losses were measured under the following conditions:
  - No splice losses—Ideal conditions.
  - Splice 0.1 dB every 2 km or 0.2 dB splice every 4 km—The maximum acceptable values that can be considered when configuring Raman link.
  - Splice 0.1 dB every 4 km—The limit for connector losses values shows a realistic situation.
- Fiber type—The various fiber types used are:
  - Single Mode Fiber (SMF)
  - Enhanced large effective area fiber (ELEAF)
  - TrueWave RS (TW-RS)
- Target Gain—Expected Raman gain.
- Minimum Span [dB]-For the Raman link configuration to be successful, the span loss should be equal or greater than the value shown in Table 6: Limit for Connector Losses, on page 14.
- Limit for Connector Losses—Connector losses values that must not exceed for configuration to be successful.

Limit for Connector Losses

Note Table 6: Limit for Connector Losses, on page 14 shows values that were estimated under ideal test condition and may differ depending on the actual fiber type used, distance, etc.

Table 6: Limit for Connector Losses

Conditions	Fiber Type	Minimum Span Loss [dB]		Target Gain [dB]		Limit for Connector Losses (dB)
		OPT-RAMP-C	OPT-RAMP-CE	Min	Max	
No splice loss	SMF	21	15	7	8.5	1.6
	ELEAF	21	15	7	10	1.3
	TW-RS	24	18	9	13.5	1.1
Splice 0.1 dB every 2 km or 0.2 dB splice every 4 km	SMF	21	15	7	8.5	0.7
	ELEAF	21	15	7	10	0.5
	TW-RS	24	18	9	13.5	0.2
Splice 0.1 dB every 4 km	SMF	21	15	7	8.5	1.2
	ELEAF	21	15	7	10	0.9
	TW-RS	24	18	9	13.5	0.6

Related Procedures for OPT-RAMP-C and OPT-RAMP-CE Cards

The following is the list of procedures and tasks related to the configuration of the OPT-RAMP-C and OPT-RAMP-CE cards:

- NTP-G30 Install the DWDM Cards
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs
- NTP-G38 Provision OSC Terminations
- NTP-G37 Run Automatic Node Setup
- NTP-G51 Verify DWDM Node Turn Up
- NTP-G201 Configure the Raman Pump on an MSTP Link
- NTP-G76 Verify Optical Span Loss Using CTC
- NTP-G74 Monitor DWDM Card Performance
- DLP-G140 View Power Statistics for Optical Amplifier, 40-SMR1-C, and 40-SMR2-C Cards
- NTP-G77 Manage Automatic Power Control
- NTP-G160 Modify OPT-AMP-L, OPT-AMP-17-C, OPT-AMP-C, OPT-RAMP-C, OPT-RAMP-CE, 15454-M-RAMAN-CTP, 15454-M-RAMAN-COP, OPT-EDFA-17, and OPT-EDFA-24 Card Line Settings and PM Thresholds

RAMAN-CTP and RAMAN-COP Cards

Note The RAMAN-CTP and RAMAN-COP cards are supported in R9.3.02 and later.

Note For RAMAN-CTP and RAMAN-COP cards safety labels, see "Class 1M Laser Product Cards".

The single-slot RAMAN-CTP and RAMAN-COP cards support counter and co-propagating Raman amplification on very long unregenerated spans.

The cards manage up to 96 ITU-T 50-GHz spaced channels over the C-band of the optical spectrum (wavelengths from 1528.77 nm to 1566.72 nm). The counter-propagating RAMAN-CTP card is the master unit. The co-propagating RAMAN-COP card is the slave unit and can be used only when the counter-propagating unit is present. The RAMAN-CTP card and the RAMAN-COP card must be installed in adjacent slots for Cisco NCS 2000 Series chassis. However, these adjacent slots must not be used to install two RAMAN-CTP or two RAMAN-COP cards.

The RAMAN-CTP card can be calibrated either manually or using the Automatic Raman Pump Amplification (ARPC) procedure from the Card tab in the Provisioning panel in CTC. When the RAMAN-COP card is used, the RAMAN-CTP card can be calibrated only using the manual option. ARPC is supported only in the NCS Flex package.

The features of the RAMAN-CTP and RAMAN-COP cards include:

- Raman section: 1000 mW total pump power for four pumps and two wavelengths
- Embedded distributed feedback (DFB) laser at 1568.77 nm to be used for optical safety and link continuity (in RAMAN-CTP card only)
- Photodiodes to enable monitoring of Raman pump power
- Photodiodes to enable monitoring of the DFB laser and signal power (in RAMAN-CTP card only)
- Hardware managed automatic laser shutdown (ALS) for optical laser safety
- Hardware output signals for loss of signal (LOS) monitoring at input photodiodes
- Raman pump back reflection detector to check for excessive back reflection

Important Notes Regarding Patchcord Installation

Warning Avoid eye or skin exposure to direct or scattered radiation.

- Two E-2000 PS PC to F-3000s SM PC patchcords are shipped with the RAMAN-CTP card.
- One E-2000 PS PC to E-2000 PS PC patchcord is shipped with the RAMAN-COP card.
- Connect the F-3000s SM PC connector to the RAMAN-CTP card before connecting the E2000 PS PC high optical power connector to the card.

- The F-3000s SM PC connector is mechanically and optically compatible with the LC PC connectors and the LC PC mating adapters. If the connectors are clean, the standard connectors and the F-3000s SM PC connectors can be used for optical power of 250 mW and higher.

RAMAN-CTP and RAMAN-COP Cards Power Monitoring

Physical photodiodes P1 through P10 monitor the power for the RAMAN-CTP card.

Table 7: RAMAN-CTP Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	DFB in-fiber Output Power	LINE-TX
P2	DWDM RX Input Power	LINE-RX
P3	Pump 1 in-fiber Output Power	LINE-RX
P4	Pump 2 in-fiber Output Power	LINE-RX
P5	Total Pump in-fiber Output Power	LINE-RX
P6	Back-Reflected Pump Power	LINE-RX
P7	DWDM TX Input Power	COM-RX
P8	Total Co-Pump in-fiber Output Power	LINE-TX
P9	DFB Input Power	LINE-RX
P10	ASE Input Power	LINE-RX

Physical photodiodes P3 through P6 monitor the power for the RAMAN-COP card.

Table 8: RAMAN-CTP Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P3	Pump 1 in-fiber Output Power	RAMAN-TX
P4	Pump 2 in-fiber Output Power	RAMAN-TX
P5	Total Pump in-fiber Output Power	RAMAN-TX
P6	Back-Reflected Pump Power	RAMAN-TX

The PM parameters for the power values are listed at Optics and 8b10b PM Parameter Definitions.

For information on the associated TL1 AIDs for the optical power monitoring points, see the "CTC Port Numbers and TL1 Aids" section in Cisco ONS SONET TL1 Command Guide, Release 9.8.

For more information about the RAMAN-CTP and RAMAN-COP cards, see http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/data_sheet_c78-658538.html

RAMAN-CTP and RAMAN-COP Card Functions

The functions of the RAMAN-CTP and RAMAN-COP cards are:

- Lamp Test
- Card level indicators
- Port-Level Indicators

Related Procedures for RAMAN-CTP and RAMAN-COP Cards

Caution During a software upgrade, do not unplug the RAMAN-CTP or RAMAN-COP card fibers or connectors. The ends of unterminated fibers or connectors emit invisible laser radiation.

The following is the list of procedures and tasks related to the configuration of the RAMAN-CTP and RAMAN-COP cards:

- NTP-G30 Install the DWDM Cards
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs
- NTP-G38 Provision OSC Terminations
- NTP-G37 Run Automatic Node Setup
- NTP-G51 Verify DWDM Node Turn Up
- NTP-G201 Configure the Raman Pump on an MSTP Link
- NTP-G76 Verify Optical Span Loss Using CTC
- NTP-G74 Monitor DWDM Card Performance
- DLP-G140 View Power Statistics for Optical Amplifier, 40-SMR1-C, and 40-SMR2-C Cards
- NTP-G77 Manage Automatic Power Control
- NTP-G160 Modify OPT-AMP-L, OPT-AMP-17-C, OPT-AMP-C, OPT-RAMP-C, OPT-RAMP-CE, 15454-M-RAMAN-CTP, 15454-M-RAMAN-COP, OPT-EDFA-17, and OPT-EDFA-24 Card Line Settings and PM Thresholds
- NTP-G184 Create a Provisionable Patchcord
- DLP-G690 Configure the Raman Pump Using Manual Day-0 Installation

OPT-EDFA-17 and OPT-EDFA-24 Cards

Note For OPT-EDFA-17 and OPT-EDFA-24 card safety labels, see "Class 1M Laser Product Cards".

The OPT-EDFA-17 and OPT-EDFA-24 cards are C-band, DWDM EDFA amplifiers/preamplifiers with 20-dBm output powers. These cards do not contain mid-stage access loss for a Dispersion Compensation Unit (DCU). The OPT-EDFA-17 and OPT-EDFA-24 cards provide a noise-figure optimized version of the EDFA amplifiers to cope with new modulation formats like PM-DQPSK, which do not need dispersion compensation. To control gain tilt, a VOA is used. The amplifier module also includes the OSC add (TX direction) and drop (RX direction) optical filters.

The OPT-EDFA-17 and OPT-EDFA-24 cards share the same hardware platform and firmware architecture but differ in their operative optical gain range, which is 17 dB and 24 dB respectively.

The OPT-EDFA-17 and OPT-EDFA-24 cards are true variable gain amplifiers, offering an optimal equalization of the transmitted optical channels over a wide gain range. They support 96 channels at 50-GHz channel spacing in the C-band (that is, 1528.77 nm to 1566.72 nm wavelength range). When an ONS 15454 has an OPT-EDFA-17 or OPT-EDFA-24 card installed, an OSCM card is needed to process the OSC. You can install the OPT-EDFA-17 or OPT-EDFA-24 card in Slots 1 to 6 and 12 to 17. Slots 2 to 6 and Slots 12 to 16 are the default slots for provisioning the OPT-EDFA-17 and OPT-EDFA-24 cards as a preamplifier. Slots 1 and 17 are the default slots for provisioning the OPT-EDFA-17 and OPT-EDFA-24 cards as a booster amplifier.

The main functionalities of the OPT-EDFA-17 and OPT-EDFA-24 cards are:

- Amplification of the input signal at COM-RX port towards LINE-TX port through a true-variable gain EDFA block
- Multiplexing the OSC to the LINE-TX port
- Demultiplexing the OSC from LINE-RX port
- Monitoring of the LINE input or output signal with 1% TAP splitters

The features of the OPT-EDFA-17 and OPT-EDFA-24 cards are:

- Embedded Gain Flattening Filter
- Constant pump current mode (test mode)
- Constant output power mode
- Constant gain mode
- Nondistorting low-frequency transfer function
- ASE compensation in Constant Gain and Constant Output Power modes
- Fast transient suppression
- Programmable tilt
- Full monitoring and alarm handling capability
- Gain range with gain tilt control of 5 to 17 dB (for OPT-EDFA-17 card) and 12 to 24 dB (for OPT-EDFA-24 card)

- Extended gain range (with uncontrolled tilt) of 17 to 20 dB (for OPT-EDFA-17 card) and 24 to 27 dB (for OPT-EDFA-24 card)
- Optical Safety Remote Interlock (OSRI)
- Automatic Alarm Shutdown (ALS)

For more information about the OPT-EDFA-17 and OPT-EDFA-24 cards, see http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/data_sheet_c78-658542.html

OPT-EDFA-17 and OPT-EDFA-24 Cards Power Monitoring

Physical photodiodes PD1 through PD6 monitor the power for the OPT-EDFA-17 and OPT-EDFA-24 cards.

Table 9: OPT-EDFA-17 and OPT-EDFA-24 Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	EDFA Input Power	COM-RX
P2	EDFA Output Power	LINE-TX
P3	EDFA Output Power	LINE-TX
P4	OSC ADD Input Power	OSC-RX
P5	OSC DROP Output Power	LINE-RX
P6	COM-TX Output Power	LINE-RX

OPT-EDFA-17 and OPT-EDFA-24 Card Functions

The functions of the OPT-EDFA-17 and OPT-EDFA-24 cards are:

- Card level indicators
- Port-Level Indicators

Related Procedures for OPT-EDFA-17 and OPT-EDFA-24 Cards

The list of procedures and tasks related to the configuration of the OPT-EDFA-17 and OPT-EDFA-24 cards are:

- NTP-G143 Import the Cisco Transport Planner NE Update Configuration File
- NTP-G30 Install the DWDM Cards
- NTP-G31 Install the DWDM Dispersion Compensating Units
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs

- NTP-G38 Provision OSC Terminations
- NTP-G37 Run Automatic Node Setup
- NTP-G51 Verify DWDM Node Turn Up
- NTP-G76 Verify Optical Span Loss Using CTC
- NTP-G74 Monitor DWDM Card Performance
- DLP-G140 View Power Statistics for Optical Amplifier, 40-SMR1-C, and 40-SMR2-C Cards
- NTP-G77 Manage Automatic Power Control
- NTP-G160 Modify OPT-AMP-L, OPT-AMP-17-C, OPT-AMP-C, OPT-RAMP-C, OPT-RAMP-CE, 15454-M-RAMAN-CTP, 15454-M-RAMAN-COP, OPT-EDFA-17, and OPT-EDFA-24 Card Line Settings and PM Thresholds
- NTP-G107 Remove Permanently or Remove and Replace DWDM Cards

EDRA-1-xx and EDRA-2-xx Cards

(Cisco NCS 2006 and Cisco NCS 2015)

Note For EDRA-1-xx and EDRA-2-xx card safety labels, see the section, Class 1M Laser Product Cards.

The double-slot EDRA-1-xx and EDRA-2-xx cards are erbium-doped Raman amplifiers that support Raman amplification on long unregenerated spans.

The cards manage up to 96 ITU-T 50 GHz spaced channels over the C-band of the optical spectrum (wavelengths from 1528.77 nm to 1566.72 nm). The cards can be installed in Slots 2 to 16 in the Cisco NCS 2015 chassis and Slots 2 to 6 in the Cisco NCS 2006 chassis. The OSC pluggable used with the cards is ONS-SC-OSC-18.0=.

The cards can be used in point-to-point, ring, multi-ring, or mesh topologies and are supported on flexible nodes in these node configurations:

- Optical line amplifier nodes
- Terminal nodes
- Dynamic gain equaliser nodes

In addition to these node configuration having only EDRA cards as amplifiers, the system also supports hybrid configurations with OPT-EDFA-17, OPT-EDFA-24, RAMAN-CTP, and RAMAN-COP cards. These cards support span loss and gain values that are not supported in EDRA cards.

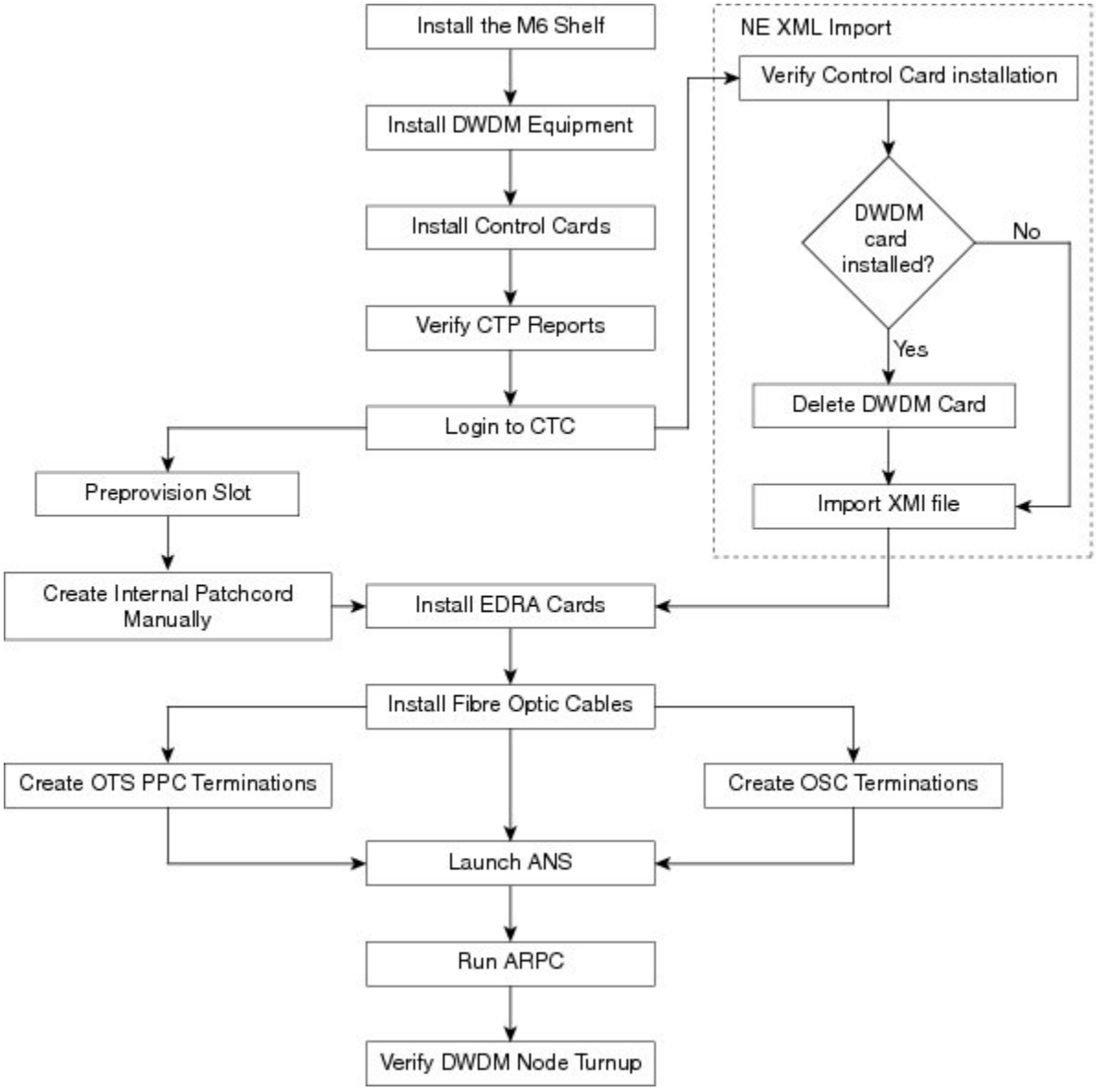
- For gain less than 15dB, OPT-EDFA-17 or OPT-EDFA-24 must be used.
- For gain greater than 35dB RAMAN-CTP (RAMAN-COP) and OPT-EDFA-17 or OPT-EDFA-24 must be used.

For more information about the EDRA-1-xx and EDRA-2-xx cards, see http://www.cisco.com/en/US/solutions/collateral/ns340/ns394/ns398/ns406/data_sheet_c78-729313.html.

EDRA Workflow Diagram

This figure shows the workflow diagram of the EDRA card. The diagram depicts the tasks required to configure the EDRA card.

Figure 1: EDRA Card Workflow Diagram



EDRA-1-xx and EDRA-2-xx Cards Power Monitoring

The following table lists the physical photodiodes that monitor the power for the EDRA-1-xx and EDRA-2-xx cards.

Table 10: EDRA-1-xx and EDRA-2-xx Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
PD1	Remnant Pump Input power	LINE-TX
PD2	OSC Add Input Power	OSC-RX
PD3	EDFA1 Input Power	LINE-RX
PD4	EDFA1 Output Power	COM-TX
PD5	EDFA2 Input Power	COM-RX
PD6	EDFA2/LINE-TX Output Power	LINE-TX
PD7	OSC Drop Output Power	LINE-TX
PD11	Pump λ1 in-fibre Output Power	LINE-RX
PD12	Pump λ2 in-fibre Output Power	LINE-RX
PD13	Pump λ3 in-fibre Output Power	LINE-RX
PD14	Pump λ4 in-fibre Output Power	LINE-RX
PD15	Total Pump in-fibre Output Power	LINE-RX
PD16	Back-Reflected Pump Power	LINE-RX
PD17	OTDR2-L Input Power	OTDR2-L-RX

The PM parameters for the power values are listed at Optics and 8b10b PM Parameter Definitions.

For information on the associated TL1 AIDs for the optical power monitoring points, see the “CTC Port Numbers and TL1 Aids” section in *Cisco NCS 2000 Series TL1 Command Guide*.

Related Procedures for EDRA-1-xx and EDRA-2-xx Cards

The list of procedures and tasks related to the configuration of the EDRA-1-xx and EDRA-2-xx cards are:

- NTP-G30 Install the DWDM Cards
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs
- NTP-G38 Provision OSC Terminations
- NTP-G37 Run Automatic Node Setup
- NTP-G51 Verify DWDM Node Turn Up
- NTP-G76 Verify Optical Span Loss Using CTC

- NTP-G74 Monitor DWDM Card Performance
- DLP-G140 View Power Statistics for Optical Amplifier, 40-SMR1-C, and 40-SMR2-C Cards
- NTP-G77 Manage Automatic Power Control
- NTP-G160 Modify OPT-AMP-L, OPT-AMP-17-C, OPT-AMP-C, OPT-RAMP-C, OPT-RAMP-CE, 15454-M-RAMAN-CTP, 15454-M-RAMAN-COP, OPT-EDFA-17, and OPT-EDFA-24 Card Line Settings and PM Thresholds
- NTP-G184 Create a Provisionable Patchcord