CHAPTER 5

Provision Optical Amplifier Cards

This chapter describes the optical amplifier cards used in Cisco ONS 15454 dense wavelength division multiplexing (DWDM) networks and related procedures.

For card safety and compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document.

Note The cards described in this chapter are supported on the Cisco ONS 15454, Cisco ONS 15454 M6, Cisco ONS 15454 M2 platforms, unless noted otherwise.

Note Unless otherwise specified, "ONS 15454" refers to both ANSI and ETSI shelf assemblies.

Note In this chapter, "RAMAN-CTP" refers to the 15454-M-RAMAN-CTP card. "RAMAN-COP" refers to the 15454-M-RAMAN-COP card.

Chapter topics include the nine types of ONS 15454 DWDM amplifiers:

- 5.1 Card Overview, page 5-2
- 5.2 Class 1M Laser Safety Labels, page 5-7
- 5.3 OPT-PRE Amplifier Card, page 5-7
- 5.3.3 Related Procedures for OPT-PRE Card, page 5-11
- 5.4 OPT-BST and OPT-BST-E Amplifier Card, page 5-11
- 5.4.3 Related Procedures for OPT-BST and OPT-BST-E Cards, page 5-15
- 5.5 OPT-BST-L Amplifier Card, page 5-15
- 5.5.3 Related Procedures for OPT-BST-L Card, page 5-19
- 5.6 OPT-AMP-L Card, page 5-20
- 5.6.3 Related Procedures for OPT-AMP-L Card, page 5-24
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- 5.8 OPT-AMP-C Card, page 5-30
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- 5.9 OPT-RAMP-C and OPT-RAMP-CE Cards, page 5-34
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- 5.10 RAMAN-CTP and RAMAN-COP Cards, page 5-39
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- 5.11.4 Related Procedures for OPT-EDFA-17 and OPT-EDFA-24 Cards, page 5-49

5.1 Card Overview

This section provides summary and compatibility information for the optical amplifier cards.

Note Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. Cards should be installed in slots that have the same symbols. See the *Cisco CPT and Cisco ONS 15454 Hardware Installation Guide* for a list of slots and symbols.

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 TCC2/TCC2P/TCC3/TNC/TNCE/TSC/TSCE card and operation, administration, maintenance, and provisioning (OAM&P) functions such as provisioning, controls, and alarms.

5.1.1 Applications

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 Chapter 12, “Node Reference” and Chapter 13, “Network Reference.”

5.1.2 Card Summary

Table 5-1 lists and summarizes the functions of each optical amplifier card.

Table 5-1 Optical Amplifier Cards for the ONS 15454

Card	Port Description	For Additional Information
OPT-PRE	The OPT-PRE amplifier has five optical ports (three sets) located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "5.3 OPT-PRE Amplifier Card" section on page 5-7.
OPT-BST	The OPT-BST amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "5.4 OPT-BST and OPT-BST-E Amplifier Card" section on page 5-11.
OPT-BST-E	The OPT-BST-E amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "5.4 OPT-BST and OPT-BST-E Amplifier Card" section on page 5-11.
OPT-BST-L	The OPT-BST-L L-band amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "5.5 OPT-BST-L Amplifier Card" section on page 5-15.
OPT-AMP-L	The OPT-AMP-L L-band preamplifier has five sets of optical ports located on the faceplate. It is a two-slot card that operates in Slots 1 to 6 and 12 to 17.	See the "5.6 OPT-AMP-L Card" section on page 5-20.
OPT-AMP-17-C	The OPT-AMP-17-C C-band low-gain preamplifier/booster amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "5.7 OPT-AMP-17-C Card" section on page 5-25.
OPT-AMP-C	The OPT-AMP-C C-band high-gain, high-power preamplifier/booster amplifier has five sets of optical ports located on the faceplate. It operates as a preamplifier when equipped and provisioned in Slots 2 to 6 and 11 to 16 or as a booster amplifier when equipped and provisioned in Slot 1 and 17.	See the "5.8 OPT-AMP-C Card" section on page 5-30.
OPT-RAMP-C	The OPT-RAMP-C C-band amplifier has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the "5.9 OPT-RAMP-C and OPT-RAMP-CE Cards" section on page 5-34.
OPT-RAMP-CE	The OPT-RAMP-CE C-band amplifier has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the "5.9 OPT-RAMP-C and OPT-RAMP-CE Cards" section on page 5-34.
RAMAN-CTP	The RAMAN-CTP amplifier is a single-slot card and has six optical ports located on the faceplate. The RAMAN-CTP and RAMAN-COP units must be installed in adjacent slots (Slots 2 and 3, 4 and 5, or 6 and 7) in the ONS 15454 M6 chassis and Slots 2 and 3 in the ONS 15454 M2 chassis.	See the "5.10 RAMAN-CTP and RAMAN-COP Cards" section on page 5-39.
RAMAN-COP	The RAMAN-COP amplifier has one optical port located on the faceplate. It is a single-slot card and works in conjunction with the RAMAN-CTP amplifier.	See the "5.10 RAMAN-CTP and RAMAN-COP Cards" section on page 5-39.

Table 5-1 Optical Amplifier Cards for the ONS 15454 (Continued)

Card	Port Description	For Additional Information
OPT-EDFA-17	The OPT-EDFA-17 amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "5.11 OPT-EDFA-17 and OPT-EDFA-24 Cards" section on page 5-45
OPT-EDFA-24	The OPT-EDFA-24 amplifier has four sets of optical ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the "5.11 OPT-EDFA-17 and OPT-EDFA-24 Cards" section on page 5-45

5.1.3 Card Compatibility

Table 5-2 lists the Cisco Transport Controller (CTC) software compatibility for each optical amplifier card.

Table 5-2 Software Release Compatibility for Optical Amplifier Cards up to Release 5.0

Card Type	R4.5	R4.6	R4.7	R5.0
OPT-PRE	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM
OPT-BST	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM
OPT-BST-E	No	No	15454-DWDM	15454-DWDM
OPT-BST-L	No	No	No	No
OPT-AMP-L	No	No	No	No
OPT-AMP-17-C	No	No	No	No
OPT-AMP-C	No	No	No	No
OPT-RAMP-C	No	No	No	No
OPT-RAMP-CE	No	No	No	No
RAMAN-CTP	No	No	No	No
RAMAN-COP	No	No	No	No
OPT-EDFA-17	No	No	No	No
OPT-EDFA-24	No	No	No	No

Table 5-3 Software Release Compatibility for Optical Amplifier Cards Release 6.0 and Later

Card Type	R6.0	R7.0	R7.2	R8.0	R8.5	R9.0	R9.1	R 9.2	R 9.2.1	R 9.3
OPT-PRE	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6
OPT-BST	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6
OPT-BST-E	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6
OPT-BST-L	No	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM
OPT-AMP-L	No	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM
OPT-AMP-17-C	No	No	No	15454-DWDM	15454-DWDM	15454-DWDM	15454-DWDM	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6
OPT-AMP-C	No	No	No	No	15454-DWDM	15454-DWDM	15454-DWDM	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6	ONS 15454, 15454-M2, 15454-M6
OPT-RAMP-C	No	No	No	No	No	15454-DWDM	15454-DWDM	ONS 15454, 15454-M6	ONS 15454, 15454-M6	ONS 15454, 15454-M6
OPT-RAMP-CE	No	No	No	No	No	No	15454-DWDM	ONS 15454, 15454-M6	ONS 15454, 15454-M6	ONS 15454, 15454-M6
RAMAN-CTP	No	No	No	No	No	No	No	No	No	15454-M2, 15454-M6
RAMAN-COP	No	No	No	No	No	No	No	No	No	15454-M2, 15454-M6
OPT-EDFA-17	No	No	No	No	No	No	No	No	No	ONS 15454, 15454-M2, 15454-M6
OPT-EDFA-24	No	No	No	No	No	No	No	No	No	ONS 15454, 15454-M2, 15454-M6

5.1.4 Optical Power Alarms and Thresholds

Table 5-4 lists the alarms and related thresholds for the OPT-BST, OPT-BST-E, OPT-BST-L, OPT-AMP-L, OPT-AMP-17-C, and OPT-AMP-C cards.

Table 5-4 Alarms and Thresholds

Port	Alarms	Thresholds
LINE RX	LOS	None
	LOS-P	LOS-P Fail Low
	LOS-O	LOS-O Fail Low
LINE TX	OPWR-FAIL	OPWR Fail Low
OSC TX	None	None
OSC RX	None	None
COM TX	None	None
COM RX	LOS-P	LOS-P Fail Low

5.2 Class 1M Laser Safety Labels

For information about safety labels, see the "G.1 Safety Labels" section on page G-1.

5.3 OPT-PRE Amplifier Card

Note For OPT-PRE card specifications, see the OPT-PRE Amplifier Card Specifications section in the *Hardware Specifications* document.

Note For OPT-PRE card safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

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.

5.3.1 OPT-PRE Faceplate Ports and Block Diagram

The OPT-PRE amplifier has five optical ports located on the faceplate:

- MON is the output monitor port
- COM RX (receive) is the input signal port
- COM TX (transmit) is the output signal port
- DC RX is the MAL input signal port
- DC TX is the MAL output signal port

Figure 5-1 shows the OPT-PRE amplifier card faceplate.

Figure 5-1 OPT-PRE Faceplate

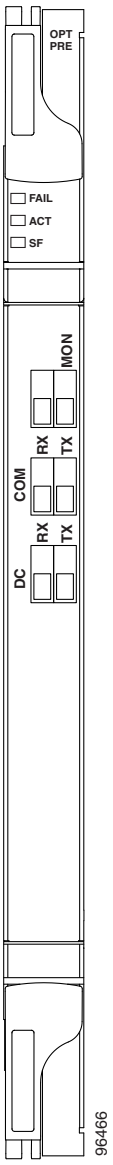


Figure 5-2 shows a simplified block diagram of the OPT-PRE card's features.

Figure 5-2 OPT-PRE Block Diagram

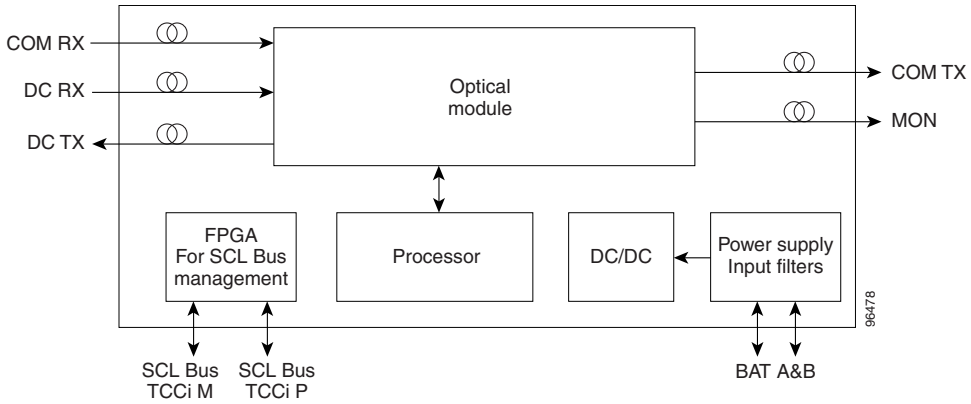
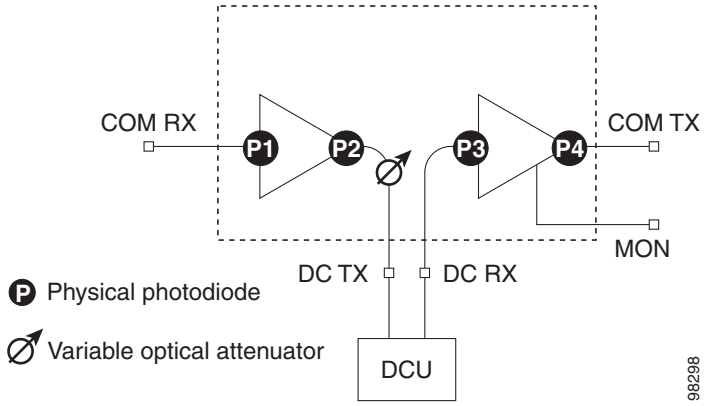


Figure 5-3 shows the a block diagram of how the OPT-PRE optical module functions.

Figure 5-3 OPT-PRE Optical Module Functional Block Diagram



5.3.2 OPT-PRE Card Functions

The functions of the OPT-PRE card are:

- 5.3.2.1 OPT-PRE card Power Monitoring
- Card level indicators—Table G-4 on page G-9
- G.4 Port-Level Indicators, page G-9

5.3.2.1 OPT-PRE card Power Monitoring

Physical photodiodes P1, P2, P3, and P4 monitor the power for the OPT-PRE card. Table 5-5 shows the returned power level values calibrated to each port.

Table 5-5 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 ONS SONET TL1 Command Guide.

5.3.3 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, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78
- NTP-G38 Provision OSC Terminations, page 14-126
- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- NTP-G76 Verify Optical Span Loss Using CTC
- NTP-G74 Monitor DWDM Card Performance
- NTP-G77 Manage Automatic Power Control
- NTP-G107 Remove Permanently or Remove and Replace DWDM Cards

5.4 OPT-BST and OPT-BST-E Amplifier Card

Note For OPT-BST and OPT-BST-E hardware specifications, see the OPT-BST Amplifier Card Specifications and OPT-BST-E Amplifier Card Specifications sections in the *Hardware Specifications* document.

Note For OPT-BST and OPT-BST-E cards safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

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 in the an ONS 15454, 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 the "13.11 Network Optical Safety" section on page 13-30.

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.

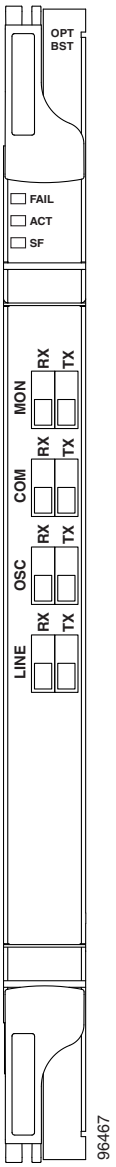
5.4.1 OPT-BST and OPT-BST-E Faceplate Ports and Block diagram

The OPT-BST and OPT-BST-E amplifier has eight optical ports located on the faceplate:

- MON RX is the output monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port.
- LINE TX is the output signal port.
- LINE RX is the input signal port (receive section).
- COM TX is the output signal port (receive section).
- OSC RX is the OSC add input port.
- OSC TX is the OSC drop output port.

Figure 5-4 shows the OPT-BST amplifier card faceplate.

Figure 5-4 OPT-BST Faceplate



The OPT-BST-E card faceplate is the same as that of the OPT-BST card.

Figure 5-5 shows a simplified block diagram of the OPT-BST and OPT-BST-E card's features.

Figure 5-5 OPT-BST and OPT-BST-E Block Diagram

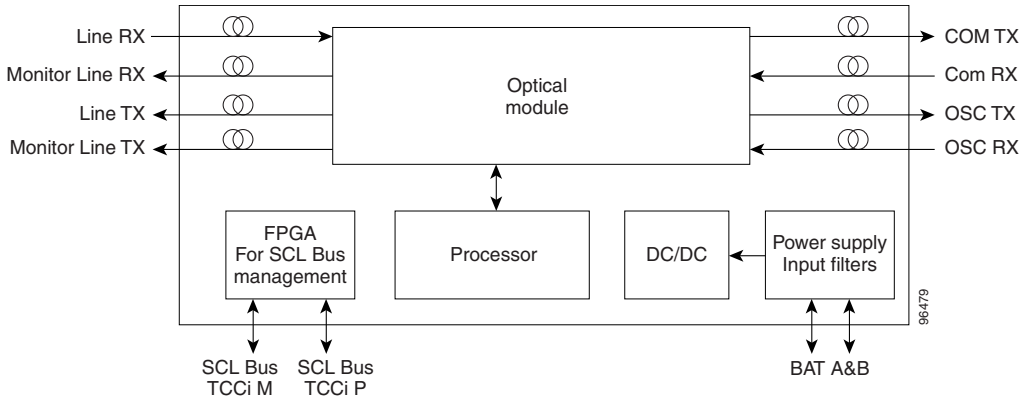
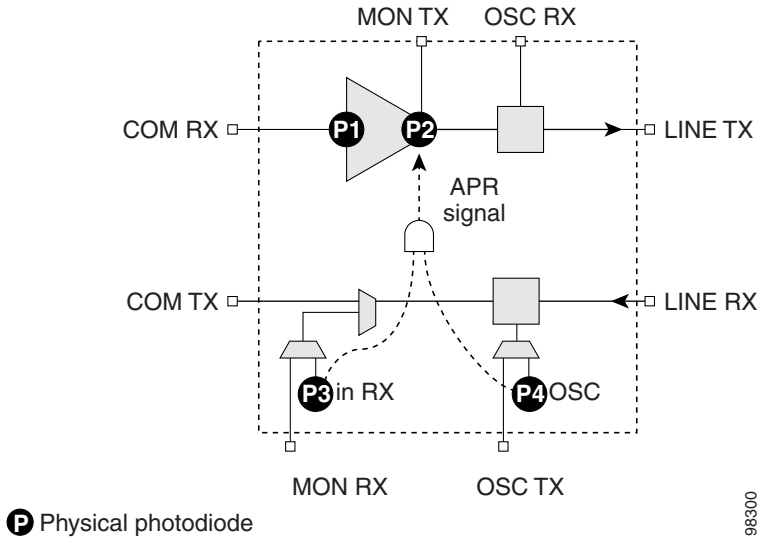


Figure 5-6 shows a block diagram of how the OPT-BST and OPT-BST-E optical module functions.

Figure 5-6 OPT-BST and OPT-BST-E Optical Module Functional Block Diagram



5.4.2 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—Table G-4 on page G-9
- G.4 Port-Level Indicators, page G-9

5.4.2.1 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. Table 5-6 shows the returned power level values calibrated to each port.

Table 5-6 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 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 ONS SONET TL1 Command Guide.*

5.4.3 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, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78
- NTP-G38 Provision OSC Terminations, page 14-126
- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- 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-G107 Remove Permanently or Remove and Replace DWDM Cards

5.5 OPT-BST-L Amplifier Card

(Cisco ONS 15454 only)

Note For OPT-BST-L card specifications, see the OPT-BST-L Amplifier Card Specifications section in the *Hardware Specifications* document.

Note For OPT-BST-L safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

The OPT-BST-L is an L-band, DWDM EDFA with OSC add-and-drop capability. The card is well suited for use in networks that employ dispersion shifted (DS) fiber or SMF-28 single-mode fiber. The OPT-BST-L is designed to ultimately support 64 channels at 50-GHz channel spacing, but in Software R9.0 and earlier it is limited to 32 channels at 100-GHz spacing.When an ONS 15454 has an OPT-BST-L installed, an OSCM card is needed to process the OSC. You can install the OPT-BST-L in Slots 1 to 6 and 12 to 17. The card's features include:

- Fixed gain mode (with programmable tilt)
- Standard gain range of 8 to 20 dB in the programmable gain tilt mode
- True variable gain
- 20 to 27 dB gain range in the uncontrolled gain tilt mode
- 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
- OSRI
- ALS

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.

5.5.1 OPT-BST-L Faceplate Ports and Block Diagram

The OPT-BST-L amplifier has eight optical ports located on the faceplate:

- MON RX is the output monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port.
- LINE TX is the output signal port.
- LINE RX is the input signal port (receive section).
- COM TX is the output signal port (receive section).
- OSC RX is the OSC add input port.

- OSC TX is the OSC drop output port.

Figure 5-7 shows the OPT-BST-L card faceplate.

Figure 5-7 OPT-BST-L Faceplate

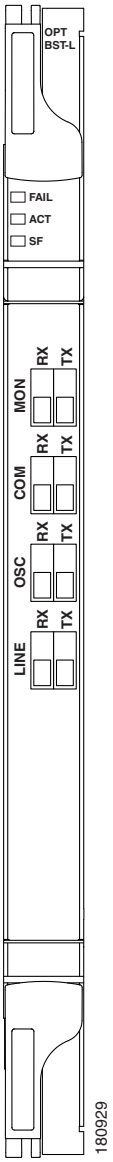


Figure 5-8 shows a simplified block diagram of the OPT-BST-L card's features.

Figure 5-8 OPT-BST-L Block Diagram

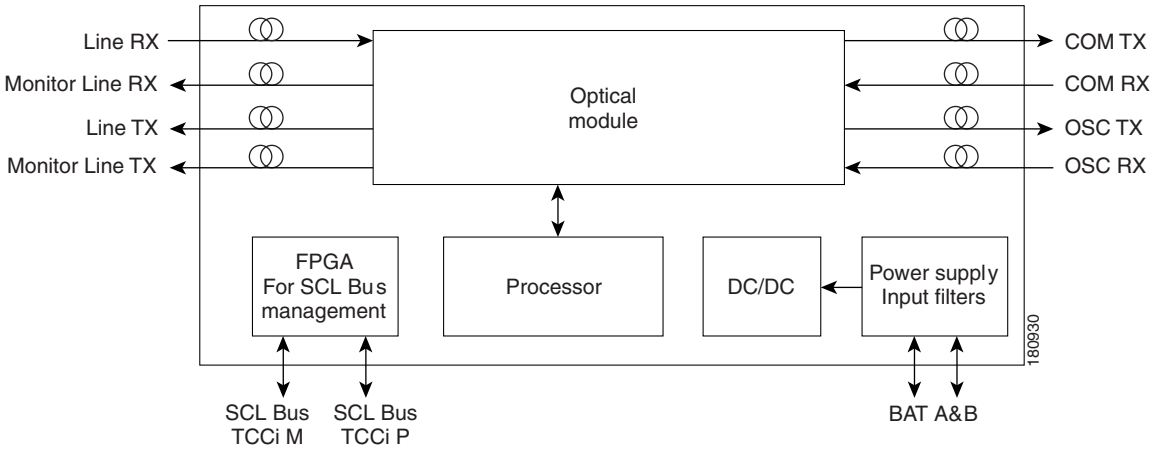
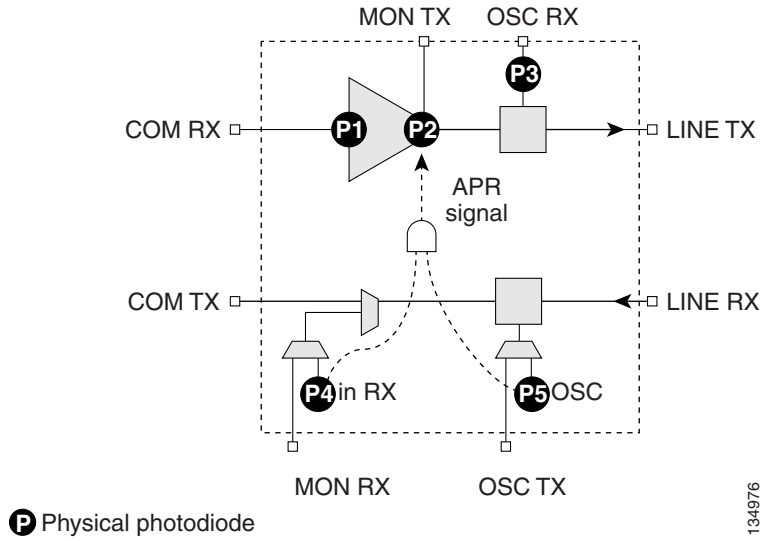


Figure 5-9 shows a block diagram of how the OPT-BST-L optical module functions.

Figure 5-9 OPT-BST-L Optical Module Functional Block Diagram



5.5.2 OPT-BST-L Card Functions

The functions of the OPT-BST-L card are:

- 5.5.2.1 OPT-BST-L Card Power Monitoring
- Card level indicators—Table G-4 on page G-9
- G.4 Port-Level Indicators, page G-9

5.5.2.1 OPT-BST-L Card Power Monitoring

Physical photodiodes P1, P2, P3, P4, and P5 monitor the power for the OPT-BST-L card. Table 5-7 shows the returned power level values calibrated to each port.

Table 5-7 OPT-BST-L 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 OSC	OSC RX	OSC Power	Supported
P4	Input Line	LINE RX	Channel Power	Supported
P5	Input Line	LINE RX	OSC Power	Supported

The power values on the OSC-TX and COM-TX ports are calculated by adding the insertion loss (IL) to the power values reported from P4 and P5.

The OSC power on the LINE TX is calculated by adding the IL to the power reported from P3.

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 ONS SONET TL1 Command Guide.*

5.5.3 Related Procedures for OPT-BST-L Card

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

- NTP-G30 Install the DWDM Cards, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78
- NTP-G38 Provision OSC Terminations, page 14-126
- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- 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-G107 Remove Permanently or Remove and Replace DWDM Cards

5.6 OPT-AMP-L Card

(Cisco ONS 15454 only)

Note For OPT-AMP-L card specifications, see the OPT-AMP-L Preamplifier Card Specifications section in the *Hardware Specifications* document.

Note For OPT-AMP-L card safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

The OPT-AMP-L is an L-band, DWDM optical amplifier card consisting of a two-stage EDFA with midstage access loss (MSL) for an external DCU and OSC add-and-drop capability. Using CTC, the card is provisionable as a preamplifier (OPT-PRE) or booster amplifier (OPT-BST), and is well suited for use in networks that employ DS or SMF-28 fiber. The amplifier can operate up to 64 optical transmission channels at 50-GHz channel spacing in the 1570 nm to 1605 nm wavelength range.

When an OPT-AMP-L installed, an OSCM card is needed to process the OSC. You can install the two-slot OPT-AMP-L in Slots 1 to 6 and 12 to 17.

The card has the following features:

- Maximum power output of 20 dBm
- True variable gain amplifier with settable range from 12 to 24 dBm in the standard gain range and 24 dBm to 35 dbM with uncontrolled gain tilt
- Built-in VOA to control gain tilt
- Up to 12 dBm MSL for an external DCU
- Fast transient suppression; able to adjust power levels in hundreds of microseconds to avoid bit errors in failure or capacity growth situations
- Nondistorting low frequency transfer function
- Midstage access loss for dispersion compensation unit
- Constant pump current mode (test mode)
- Constant output power mode (used during optical node setup)
- Constant gain mode
- Internal ASE compensation in constant gain mode and in constant output power mode
- Full monitoring and alarm handling capability
- Optical safety support through signal loss detection and alarm at any input port, fast power down control (less than one second), and reduced maximum output power in safe power mode. For information on using the card to implement ALS in a network, see the "13.11 Network Optical Safety" section on page 13-30.

Note Before disconnecting any OPT AMP-L fiber for troubleshooting, first make sure the OPT AMP-L card is unplugged.

5.6.1 OPT-AMP-L Faceplate Ports and Block Diagrams

The OPT-AMP-L amplifier card has ten optical ports located on the faceplate:

- MON RX is the output monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port.
- LINE TX is the output signal port.
- LINE RX is the input signal port (receive section).
- COM TX is the output signal port (receive section).
- OSC RX is the OSC add input port.
- OSC TX is the OSC drop output port.
- DC TX is the output signal to the DCU.
- DC RX is the input signal from the DCU.

Figure 5-10 shows the OPT-AMP-L card faceplate.

Figure 5-10 OPT-AMP-L Faceplate

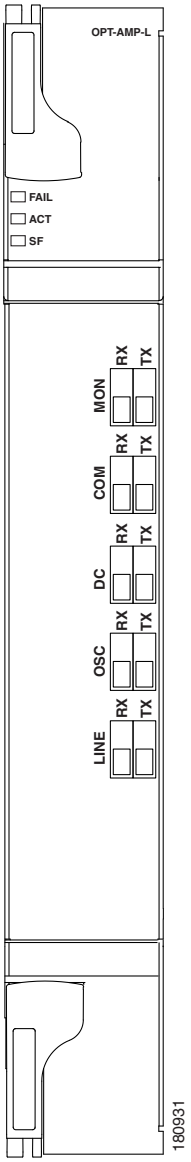


Figure 5-11 shows a simplified block diagram of the OPT-AMP-L card's features.

Figure 5-11 OPT-AMP-L Block Diagram

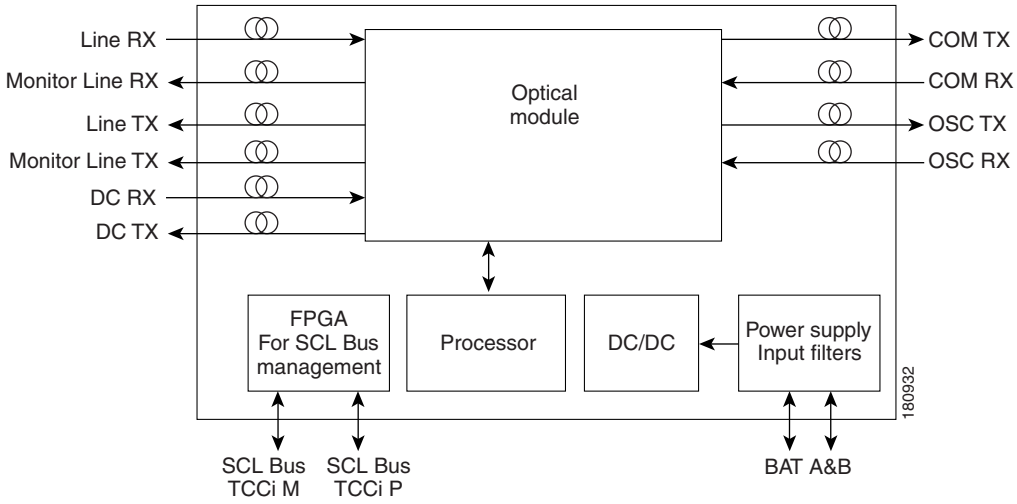
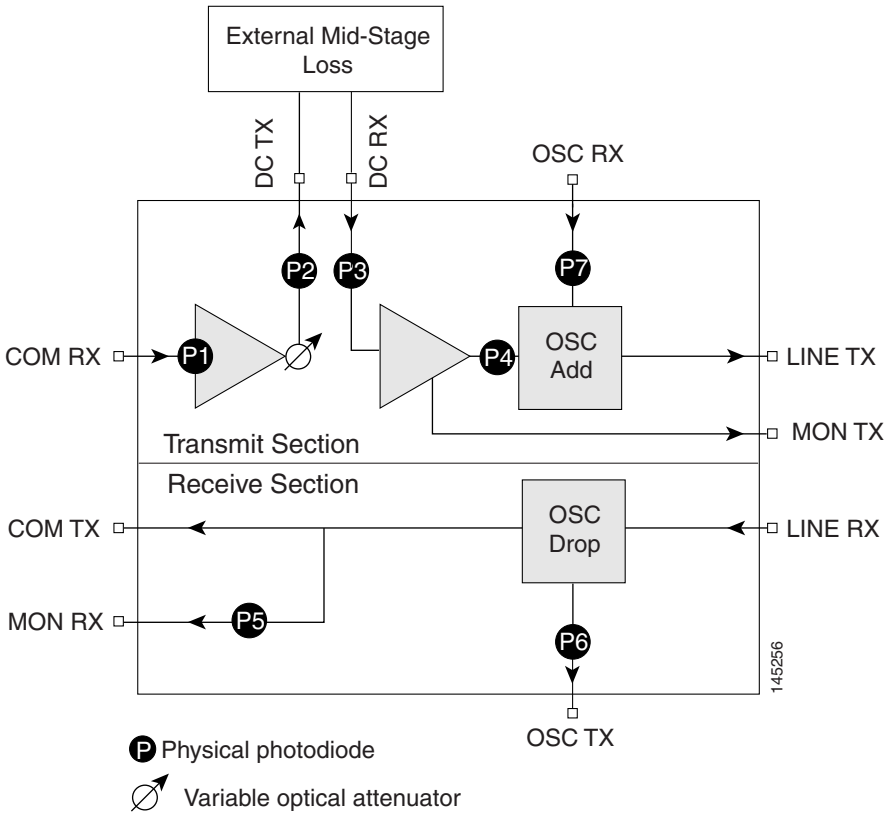


Figure 5-12 shows a block diagram of how the OPT-AMP-L optical module functions.

Figure 5-12 OPT-AMP-L Optical Module Functional Block Diagram



5.6.2 OPT-AMP-L Card Functions

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

- 5.6.2.1 OPT-AMP-L and OPT-AMP-C cards Power Monitoring
- Card level indicators—Table G-4 on page G-9
- G.4 Port-Level Indicators, page G-9

5.6.2.1 OPT-AMP-L and OPT-AMP-C cards Power Monitoring

Physical photodiodes P1 through P7 monitor the power for the OPT-AMP-L and OPT-AMP-C cards. Table 5-8 shows the returned power level values calibrated to each port.

Table 5-8 Port Calibration

Photodiode	CTC Type Name	Calibrated to Port	Power	PM Parameter
P1	Input COM	COM RX	Channel Power	Supported
P2	Output DC (total power)	DC TX	Channel Power	Supported
	Output DC (signal power)			
P3	Input DC (input power)	DC RX	Channel Power	Supported
P4	Output Line (total power)	LINE TX	Channel Power	Supported
	Output Line (signal power)			
P5	Input Line	LINE RX	Channel Power	Supported
P6	Input Line	LINE RX	OSC Power	Supported
P7	Input OSC	OSC RX	OSC Power	Supported

The power values on the OSC-TX and COM-TX ports are calculated by adding the insertion loss (IL) to the power values reported from P5 and P6.

The power values on the LINE TX port is calculated by adding the IL to the power value reported from P7.

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 ONS SONET TL1 Command Guide.*

5.6.3 Related Procedures for OPT-AMP-L Card

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

- NTP-G143 Import the Cisco Transport Planner NE Update Configuration File, page 14-47
- NTP-G30 Install the DWDM Cards, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78
- NTP-G38 Provision OSC Terminations, page 14-126

- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- 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, page 21-27
- NTP-G107 Remove Permanently or Remove and Replace DWDM Cards

5.7 OPT-AMP-17-C Card

Note For OPT-AMP-17-C card specifications, see the OPT-AMP-17-C Amplifier Card Specifications section in the *Hardware Specifications* document.

Note For OPT-AMP-17-C safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

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 an ONS 15454 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

5.7.1 OPT-AMP-17-C Faceplate Ports and Block Diagrams

The OPT-AMP-17-C amplifier card has eight optical ports located on the faceplate:

- MON RX is the output monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port.
- LINE TX is the output signal port.
- LINE RX is the input signal port (receive section).
- COM TX is the output signal port (receive section).
- OSC RX is the OSC add input port.
- OSC TX is the OSC drop output port.

Figure 5-13 shows the OPT-AMP-17-C amplifier card faceplate.

Figure 5-13 OPT-AMP-17-C Faceplate

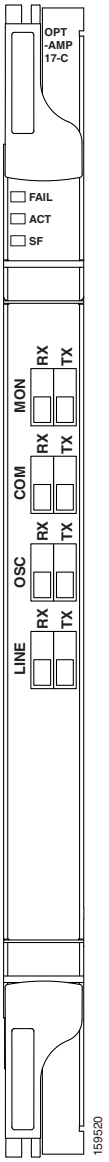


Figure 5-14 shows a simplified block diagram of the OPT-AMP-17C card's features.

Figure 5-14 OPT-AMP17-C Block Diagram

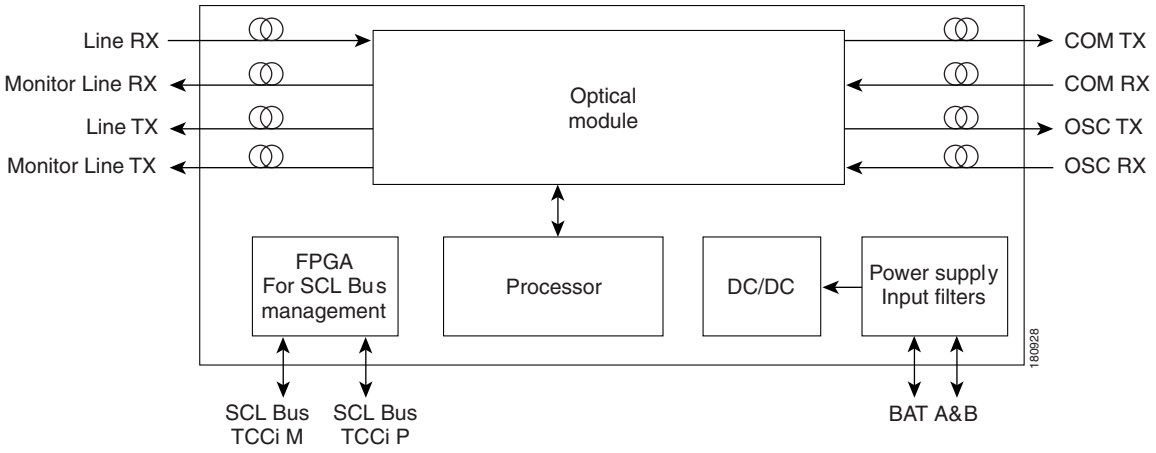
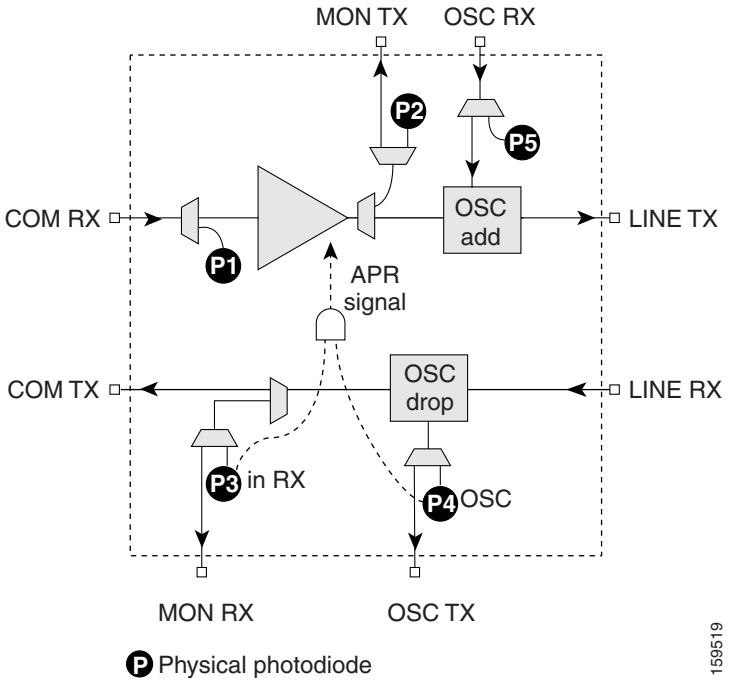


Figure 5-15 shows how the OPT-AMP-17-C optical module functions.

Figure 5-15 OPT-AMP-17-C Optical Module Functional Block Diagram



5.7.2 OPT-AMP-17-C Card Functions

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

- G.33 Automatic Power Control, page G-25
- 5.7.2.1 OPT-AMP-17-C card Power Monitoring
- Card level indicators—Table G-4 on page G-9

- G.4 Port-Level Indicators, page G-9

5.7.2.1 OPT-AMP-17-C card Power Monitoring

Physical photodiodes P1, P2, P3, P4, and P5 monitor power for the OPT-AMP-17-C card. Table 5-9 shows the returned power level values calibrated to each port.

Table 5-9 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 ONS SONET TL1 Command Guide.*

5.7.3 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, page 14-47
- NTP-G30 Install the DWDM Cards, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78
- NTP-G38 Provision OSC Terminations, page 14-126
- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- 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, page 21-27
- NTP-G107 Remove Permanently or Remove and Replace DWDM Cards

5.8 OPT-AMP-C Card

Note For OPT-AMP-C card specifications, see the OPT-AMP-C Amplifier Card Specifications section in the *Hardware Specifications* document.

Note For OPT-AMP-C card safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

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 an ONS 15454 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

5.8.1 OPT-AMP-C Card Faceplate Ports and Block Diagrams

The OPT-AMP-C amplifier card has 10 optical ports located on the faceplate:

- MON RX is the output monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port.
- COM TX is the output signal port (receive section).
- DC RX is the input DCU port.
- DC TX is the output DCU port.
- OSC RX is the OSC add input port.
- OSC TX is the OSC drop output port.
- LINE RX is the input signal port (receive section).
- LINE TX is the output signal port.

Figure 5-16 shows the OPT-AMP-C amplifier card faceplate.

Figure 5-16 OPT-AMP-C Card Faceplate

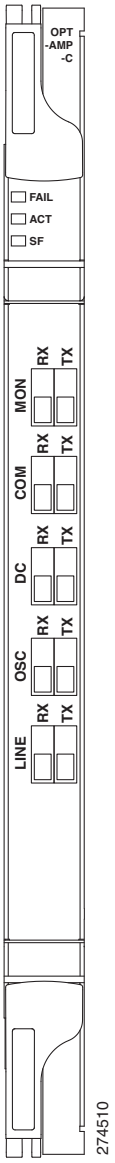


Figure 5-17 shows a simplified block diagram of the OPT-AMP-C card features.

Figure 5-17 OPT-AMP-C Block Diagram

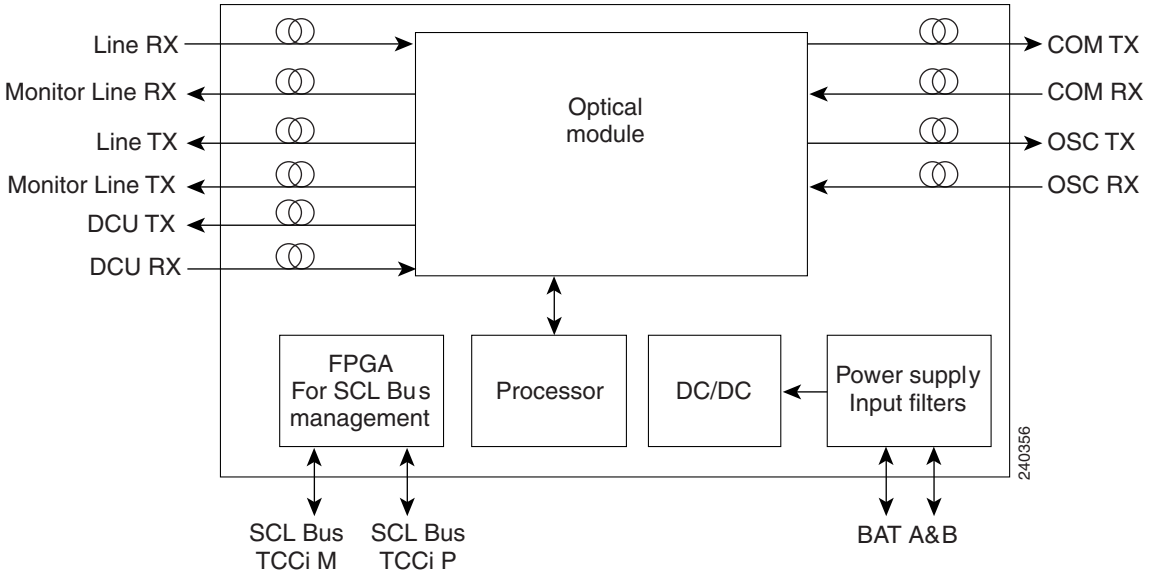
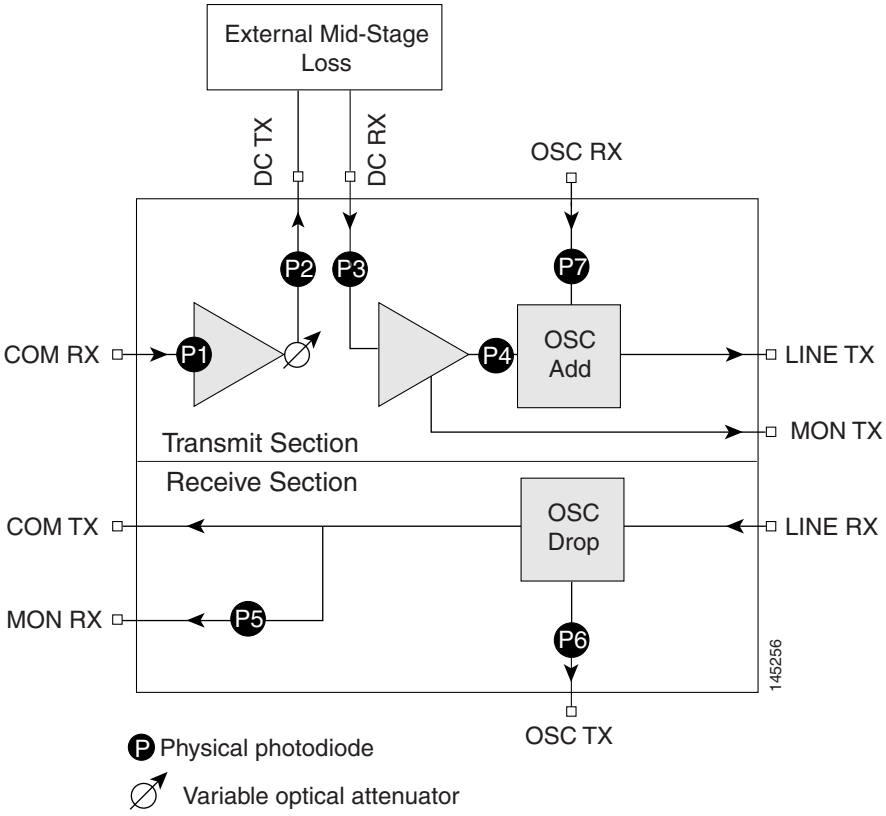


Figure 5-18 shows how the OPT-AMP-C optical module functions.

Figure 5-18 OPT-AMP-C Optical Module Functional Block Diagram



5.8.2 OPT-AMP-C Card Functions

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

- 5.6.2.1 OPT-AMP-L and OPT-AMP-C cards Power Monitoring
- Card level indicators—Table G-4 on page G-9
- G.4 Port-Level Indicators, page G-9

5.8.3 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, page 14-47
- NTP-G30 Install the DWDM Cards, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78
- NTP-G38 Provision OSC Terminations, page 14-126
- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- 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, page 21-27
- NTP-G107 Remove Permanently or Remove and Replace DWDM Cards

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

(Cisco ONS 15454 and ONS 15454 M6 only)

Note For OPT-RAMP-C and OPT-RAMP-CE specifications, see the OPT-RAMP-C Amplifier Card Specifications and OPT-RAMP-CE Amplifier Card Specifications sections in the *Hardware Specifications* document.

Note For OPT-RAMP-C or OPT-RAMP-CE card safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

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

5.9.1 Card Faceplate Ports and Block Diagrams

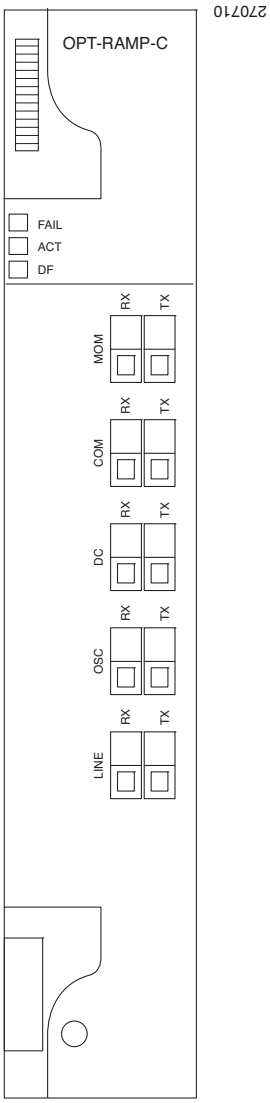
The OPT-RAMP-C and OPT-RAMP-CE cards have ten optical ports located on the faceplate:

- MON RX is the output monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port (receive section).
- COM TX is the output signal port.

- DC RX is the input DCU port.
- DC TX is the output DCU port.
- OSC RX is the OSC add input port.
- OSC TX is the OSC drop output port.
- LINE RX is the input signal port (receive section).
- LINE TX is the output signal port.

Figure 5-19 shows the OPT-RAMP-C card faceplate.

Figure 5-19 OPT-RAMP-C Faceplate



The OPT-RAMP-CE card faceplate is the same as that of the OPT-RAMP-C card.

Figure 5-20 shows a simplified block diagram of the OPT-RAMP-C and OPT-RAMP-CE card features.

Figure 5-20 OPT-RAMP-C and OPT-RAMP-CE Block Diagram

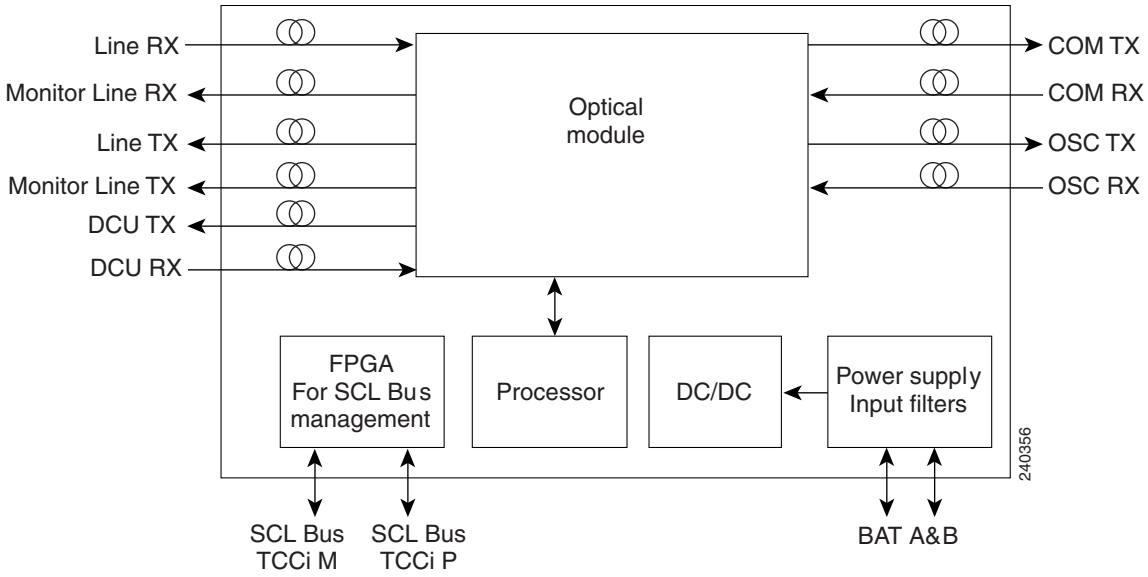
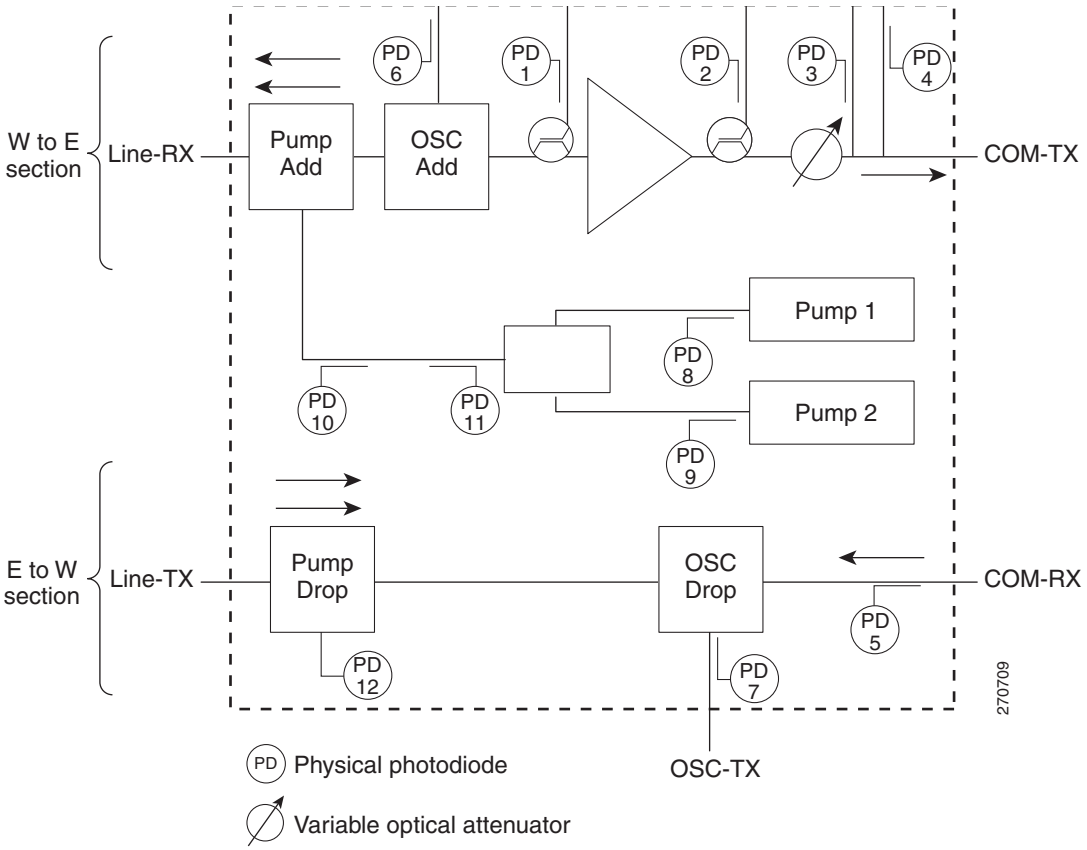


Figure 5-21 shows a block diagram of how the OPT-RAMP-C and OPT-RAMP-CE card functions.

Figure 5-21 OPT-RAMP-C and OPT-RAMP-CE Card Functional Block Diagram



Two Raman pump lasers are combined internally and launched in-fiber at the LINE-RX port, thereby counter-propagating with the DWDM signal. An EDFA gain block provides further amplification of the DWDM signal, which allows regulated output power entry in the mid stage access and acts upon the VOA attenuation. While the optical filters are present for the OSC add and drop functions, the OSC signal counter-propagates with the DWDM signal. Two monitor ports, MON-RX and MON-TX, are provided at the EDFA input and output stages and are used to evaluate the total gain ripple. A total of 12 photodiodes (PDs) are provided, allowing full monitoring of RP power, DWDM power, and OSC power in each section of the device. In particular, PD12 allows the detection of the remnant Raman pump power at the end of the counter-pumped span, while PD11 detects the amount of Raman pump power backscattered by the LINE-RX connector and transmission fiber.

The EDFA section calculates the signal power, considering the expected ASE power contribution to the total output power. The signal output power or the signal gain can be used as feedback signals for the EDFA pump power control loop. The ASE power is derived according to the working EDFA gain. PD2, PD3, and PD4 provide the total power measured by the photodiode and the signal power is derived by calculating the total power value. The insertion loss of the main optical path and the relative optical attenuation of the two monitor ports are stored into the card's not-volatile memory.

5.9.2 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 5-38
- Card level indicators—Table G-4 on page G-9
- G.4 Port-Level Indicators, page G-9

5.9.2.1 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 (see Table 5-10).

Table 5-10 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

Table 5-10 OPT-RAMP-C and OPT-RAMP-CE Port Calibration (Continued)

Photodiode	CTC Type Name	Calibrated to Port
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 ONS SONET TL1 Command Guide.*

5.9.3 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, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78
- NTP-G38 Provision OSC Terminations, page 14-126
- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- NTP-G201 Configure the Raman Pump on an MSTP Link, page 16-4
- 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, page 21-27
- NTP-G107 Remove Permanently or Remove and Replace DWDM Cards

5.10 RAMAN-CTP and RAMAN-COP Cards

(Cisco ONS 15454 M2 and ONS 15454 M6 only)

Note For hardware specifications, see the RAMAN-CTP and RAMAN-COP Card Specifications section in the *Hardware Specifications* document.

Note For RAMAN-CTP and RAMAN-COP cards safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

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 (Slots 2 and 3, 4 and 5, or 6 and 7) in the Cisco ONS 15454 M6 chassis and Slots 2 and 3 in the Cisco ONS 15454 M2 chassis. However, these adjacent slots must not be used to install two RAMAN-CTP or two RAMAN-COP cards.

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

5.10.0.0.1 Important Notes Regarding Patchcord Installation

Warning **Invisible laser radiation may be emitted from the end of the unterminated fiber cable or connector. Do not view directly with optical instruments. Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers, and microscopes) within a distance of 100 mm may pose an eye hazard.** Statement 1056

Warning **Avoid eye or skin exposure to direct or scattered radiation.** Statement 1013

- 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.
- The patchcords used to connect the RAMAN-CTP cards to the span must use only PC connectors and not angled connectors.

5.10.1 Card Faceplate Ports and Block Diagrams

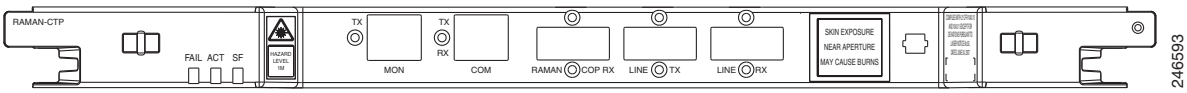
The RAMAN-CTP card has six optical ports located on the faceplate:

- MON TX is the output monitor port
- COM RX is the input signal port (receive section)
- COM TX is the output signal port

- RAMAN-COP RX is the Raman co-propagating input port
- LINE RX is the input signal port (receive section)
- LINE TX is the output signal port

Figure 5-22 shows the RAMAN-CTP card faceplate.

Figure 5-22 RAMAN-CTP Faceplate



The RAMAN-COP card has only one optical port located on the faceplate. RAMAN-TX is the Raman co-propagating output port.

Figure 5-23 shows the RAMAN-COP card faceplate.

Figure 5-23 RAMAN-COP Faceplate

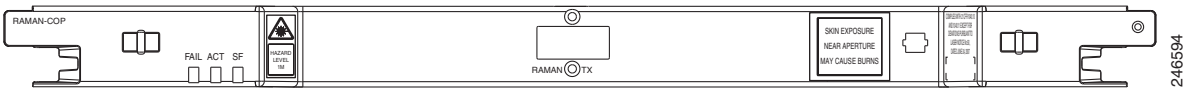
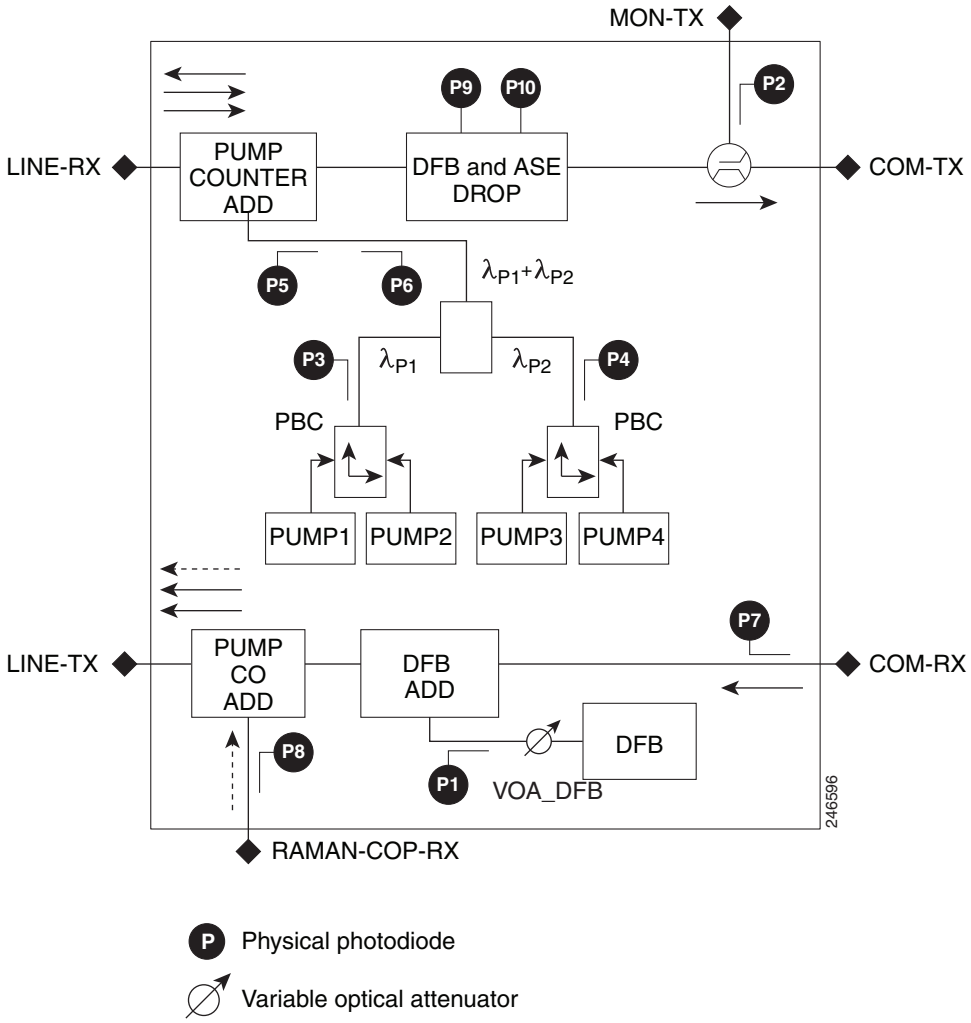


Figure 5-24 shows a block diagram of how the RAMAN-CTP card functions.

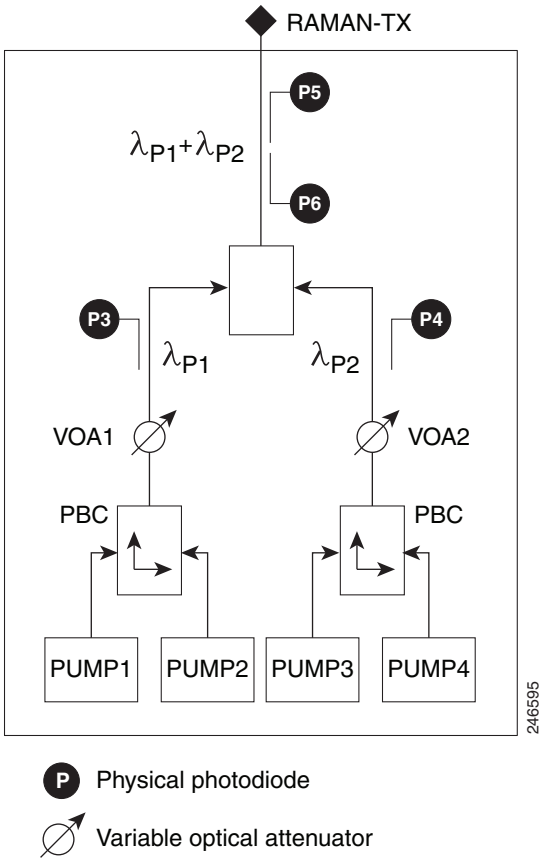
Figure 5-24 RAMAN-CTP Functional Block Diagram



Four Raman pump lasers (two for each wavelength) are combined internally and launched in-fiber at the LINE-RX port, thereby counter-propagating with the DWDM signal. The two pump lasers at the same nominal central wavelength, power, and polarization are made orthogonally polarized by the polarization beam combiner (that rotates one of the laser beams) and then coupled, resulting in a depolarized beam. A DFB laser at 1568.77 nm is used for optical safety. Optical filters for DFB add and drop are present. The DFB signal generated by the DFB laser is transmitted in-fiber, co-propagating with the DWDM signal. A MON-TX port monitors the DWDM signal at the COM-TX port. A total of ten photodiodes are provided, allowing monitoring of Raman pump (RP) power, DWDM signal power, and DFB signal power in each section of the card. In particular, P8 measures the co-propagating Raman pump power in-fiber (when the RAMAN-COP unit is present), while P6 detects the amount of Raman pump power backscattered by the LINE-RX connector and transmission fiber. P1 measures the DFB signal power transmitted in-fiber while P9 and P10 measure the DFB signal and ASE power respectively, which is received from the other line site. The insertion loss of the main optical path and the relative optical attenuation of the monitor port is stored in non-volatile memory of the card.

Figure 5-25 shows a block diagram of how the RAMAN-COP card functions.

Figure 5-25 15454-M-RAMAN-COP Functional Block Diagram



Four Raman pump lasers (two for each wavelength) are combined internally and launched in-fiber at the LINE-TX port of the counter-propagating unit, thereby co-propagating with the DWDM signal. The two pump lasers at the same nominal central wavelength, power, and polarization are made orthogonally polarized by the polarization beam combiner (that rotates one of the laser beams) and then coupled, resulting in a depolarized beam. A total of four photodiodes are provided, allowing the monitoring of RP power. In particular, P6 detects the amount of Raman pump power backscattered by the LINE-RX connector and transmission fiber.

5.10.2 RAMAN-CTP and RAMAN-COP Cards Power Monitoring

Physical photodiodes P1 through P10 monitor the power for the RAMAN-CTP card (see Table 5-11).

Table 5-11 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

Table 5-11 RAMAN-CTP Port Calibration (Continued)

Photodiode	CTC Type Name	Calibrated to Port
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 (see Table 5-12).

Table 5-12 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 in the Optics and 8b10b PM Parameter Definitions document.

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 9.3.*

5.10.3 RAMAN-CTP and RAMAN-COP Card Functions

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

- Card level indicators—Table G-4 on page G-9
- G.4 Port-Level Indicators, page G-9
- G.16 Lamp Test, page G-18

5.10.4 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, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78

- NTP-G38 Provision OSC Terminations, page 14-126
- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- NTP-G201 Configure the Raman Pump on an MSTP Link, page 16-4
- 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, page 21-27
- NTP-G184 Create a Provisionable Patchcord, page 17-63
- DLP-G690 Configure the Raman Pump Using Manual Day-0 Installation, page 16-19
- NTP-G107 Remove Permanently or Remove and Replace DWDM Cards

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

Note For OPT-EDFA-17 and OPT-EDFA-24 card specifications, see the OPT-EDFA-17 Amplifier Card Specifications and OPT-EDFA-24 Amplifier Card Specifications sections in the *Hardware Specifications* document.

Note For OPT-EDFA-17 and OPT-EDFA-24 card safety labels, see the "G.1.2 Class 1M Laser Product Cards" section on page G-4.

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. You can install the OPT-EDFA-17 or OPT-EDFA-24 card in Slots 2 and 3 in an ONS 15454 M2 chassis, and Slots 2 to 7 in an ONS 15454 M6 chassis.

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)

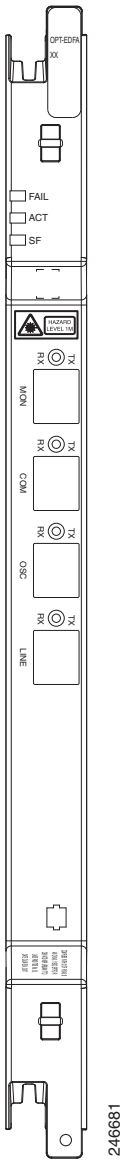
5.11.1 Card Faceplate Ports and Block Diagrams

The OPT-EDFA-17 and OPT-EDFA-24 cards have eight optical ports located on the faceplate:

- MON RX is the input monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port.
- COM TX is the output signal port (receive section).
- LINE RX is the input signal port (receive section).
- LINE TX is the output signal port.
- OSC RX is the OSC add input port.
- OSC TX is the OSC drop output port.

Figure 5-26 shows the OPT-EDFA-17 card faceplate.

Figure 5-26 OPT-EDFA-17 Card Faceplate



The OPT-EDFA-24 card faceplate is similar to that of the OPT-EDFA-17 card.

Figure 5-27 shows a simplified block diagram of the OPT-EDFA-17 and OPT-EDFA-24 card features.

Figure 5-27 OPT-EDFA-17 and OPT-EDFA-24 Block Diagram

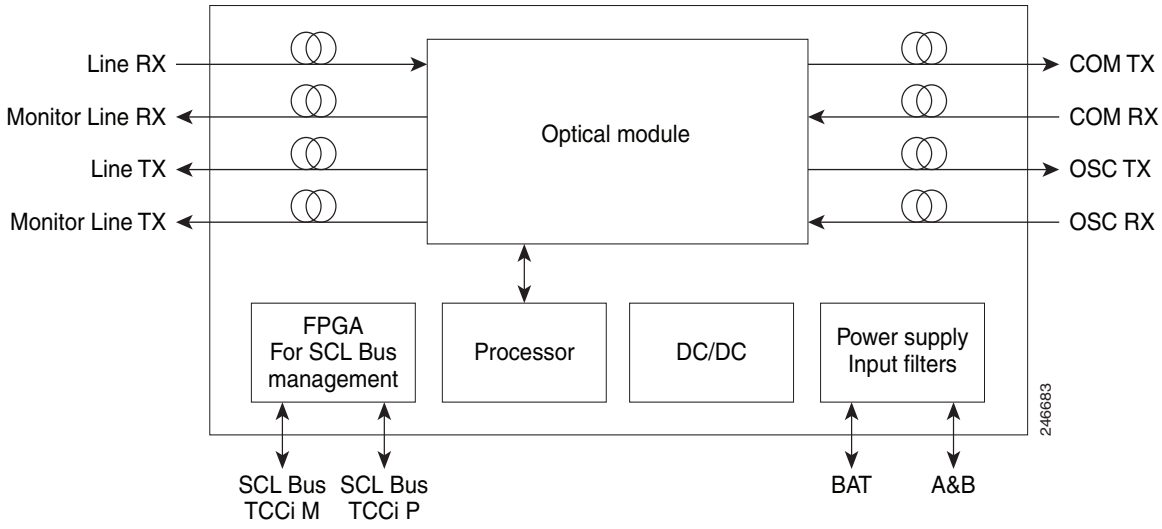
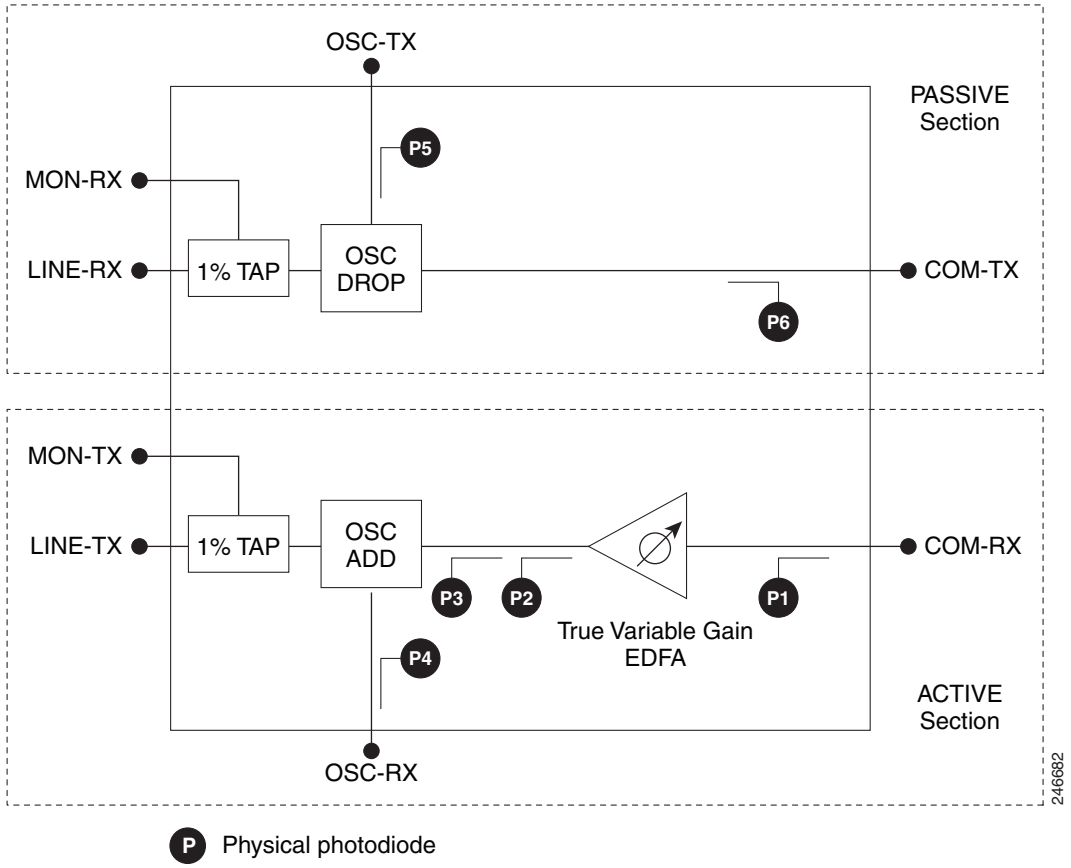


Figure 5-28 shows a block diagram of how the OPT-EDFA-17 and OPT-EDFA-24 optical modules function.

Figure 5-28 OPT-EDFA-17 and OPT-EDFA-24 Optical Modules Function



5.11.2 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 (see Table 5-13).

Table 5-13 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

5.11.3 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—Table G-4 on page G-9
- G.4 Port-Level Indicators, page G-9

5.11.4 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, page 14-47
- NTP-G30 Install the DWDM Cards, page 14-64
- NTP-G31 Install the DWDM Dispersion Compensating Units, page 14-68
- NTP-G34 Install Fiber-Optic Cables on DWDM Cards and DCUs, page 14-78
- NTP-G38 Provision OSC Terminations, page 14-126
- NTP-G37 Run Automatic Node Setup, page 14-128
- NTP-G51 Verify DWDM Node Turn Up, page 16-2
- 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, page 21-27
- NTP-G107 Remove Permanently or Remove and Replace DWDM Cards