



# CHAPTER 4

## Optical Amplifier Cards

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This chapter describes the optical amplifier cards used in Cisco ONS 15454 dense wavelength division multiplexing (DWDM) networks. For installation and card turn-up procedures, refer to the *Cisco ONS 15454 DWDM Procedure Guide*. For card safety and compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information* document.



### Note

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Unless otherwise specified, “ONS 15454” refers to both ANSI and ETSI shelf assemblies.

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Chapter topics include:

- [4.1 Card Overview, page 4-1](#)
- [4.2 Class 1M Laser Safety Labels, page 4-4](#)
- [4.3 OPT-PRE Amplifier Card, page 4-6](#)
- [4.4 OPT-BST Amplifier Card, page 4-10](#)
- [4.5 OPT-BST-E Amplifier Card, page 4-14](#)
- [4.6 OPT-BST-L Amplifier Card, page 4-18](#)
- [4.7 OPT-AMP-L Card, page 4-22](#)
- [4.8 OPT-AMP-17-C Card, page 4-27](#)
- [4.9 OPT-AMP-C Card, page 4-31](#)
- [4.10 OPT-RAMP-C Card, page 4-35](#)

## 4.1 Card Overview

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



### Note

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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 [“1.16.1 Card Slot Requirements” section on page 1-61](#) for a list of slots and symbols.

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Optical amplifiers are used in amplified nodes (such as hub nodes), amplified OADM nodes, and line amplifier nodes. The seven types of ONS 15454 DWDM amplifiers are:

- Optical Preamplifier (OPT-PRE)

- Optical Booster amplifier (OPT-BST)
- Optical Booster Enhanced amplifier (OPT-BST-E)
- Optical Booster L-Band amplifier (OPT-BST-L)
- Optical L-Band preamplifier (OPT-AMP-L)
- Optical C-Band amplifier (OPT-AMP-17-C).
- Optical C-band high-gain high-power amplifier (OPT-AMP-C)
- Optical C-band long-haul span loss reduction (in unregenerated sections) amplifier (OPT-RAMP-C)

**Note**


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The OPT-AMP-L preamplifier, OPT-AMP-C, and OPT-AMP-17-C amplifiers are software-configurable as a preamplifier or as a booster amplifier.

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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 card and operation, administration, maintenance, and provisioning (OAM&P) functions such as provisioning, controls, and alarms.

## 4.1.1 Applications

Using CTC (CTC > Card > Provisioning), the following amplifiers can be configured as booster or preamplifiers:

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

The amplifier functions as a booster amplifier when equipped in slots 1, 3, 5, 13, 15, 17 and as a preamplifier when equipped in Slots 2, 4, 6, 12, 14, 16. If the node is installed using the CTP NE update configuration file, the amplifier role is automatically implemented by CTP and hence, no manual configuration is necessary.

**Note**


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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.

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For more information about the supported configurations and network topologies, see [Chapter 10, “Node Reference”](#) and [Chapter 11, “Network Reference.”](#)

## 4.1.2 Card Summary

[Table 4-1](#) lists and summarizes the functions of each optical amplifier card.

**Table 4-1** *Optical Amplifier Cards for the ONS 15454*

Card	Port Description	For Additional Information
<b>OPT-PRE</b>	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 “ <a href="#">4.3 OPT-PRE Amplifier Card</a> ” section on page 4-6.
<b>OPT-BST</b>	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 “ <a href="#">4.4 OPT-BST Amplifier Card</a> ” section on page 4-10.
<b>OPT-BST-E</b>	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 “ <a href="#">4.5 OPT-BST-E Amplifier Card</a> ” section on page 4-14.
<b>OPT-BST-L</b>	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 “ <a href="#">4.6 OPT-BST-L Amplifier Card</a> ” section on page 4-18.
<b>OPT-AMP-L</b>	The OPT-AMP-L L-band preamplifier have 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 “ <a href="#">4.7 OPT-AMP-L Card</a> ” section on page 4-22.
<b>OPT-AMP-17-C</b>	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 “ <a href="#">4.8 OPT-AMP-17-C Card</a> ” section on page 4-27.
<b>OPT-AMP-C</b>	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 “ <a href="#">4.9 OPT-AMP-C Card</a> ” section on page 4-31.
<b>OPT-RAMP-C</b>	The OPT-RAMP-C C-band amplifier is a two-slot card and uses the span fiber to amplify the optical signal. It has five sets of optical ports located on the faceplate and operates in Slots 1 to 5 and 12 to 16.	See the “ <a href="#">4.10 OPT-RAMP-C Card</a> ” section on page 4-35.

## 4.1.3 Card Compatibility

Table 4-2 lists the Cisco Transport Controller (CTC) software compatibility for each optical amplifier card.

**Table 4-2** *Software Release Compatibility for Optical Amplifier Cards*

Card Type	R4.5	R4.6	R4.7	R5.0	R6.0	R7.0	R7.2	R8.0	R8.5	R9.0
OPT-PRE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OPT-BST	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OPT-BST-E	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4-2 Software Release Compatibility for Optical Amplifier Cards (continued)

Card Type	R4.5	R4.6	R4.7	R5.0	R6.0	R7.0	R7.2	R8.0	R8.5	R9.0
OPT-BST-L	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
OPT-AMP-L	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
OPT-AMP-17-C	No	No	No	No	No	No	No	Yes	Yes	Yes
OPT-AMP-C	No	No	No	No	No	No	No	No	Yes	Yes
OPT-RAMP-C	No	No	No	No	No	No	No	No	No	Yes

## 4.2 Class 1M Laser Safety Labels

This section explains the significance of the safety labels attached to the optical amplifier cards. The faceplates of the cards are clearly labeled with warnings about the laser radiation levels. You must understand all warning labels before working on these cards.

### 4.2.1 Class 1M Laser Product Statement

Figure 4-1 shows the Class 1M Laser Product statement. Class 1M lasers are products that produce either a highly divergent beam or a large diameter beam. Therefore, only a small part of the whole laser beam can enter the eye. However, these laser products can be harmful to the eye if the beam is viewed using magnifying optical instruments.

Figure 4-1 Class 1M Laser Product Statement



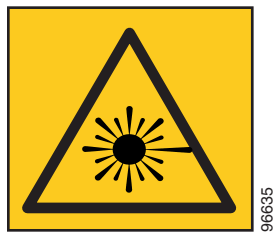
### 4.2.2 Hazard Level 1M Label

Figure 4-2 shows the Hazard Level 1M label. This label is displayed on the faceplate of the cards. The Hazard Level label warns users against exposure to laser radiation calculated in accordance with IEC60825-1 Ed.1.2.

**Figure 4-2** Hazard Level Label

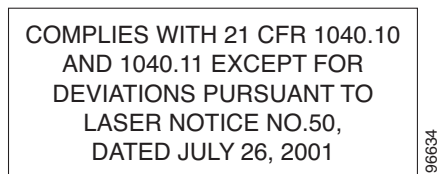
## 4.2.3 Laser Source Connector Label

Figure 4-3 shows the Laser Source Connector label. This label indicates that a laser source is present at the optical connector where the label appears.

**Figure 4-3** Laser Source Connector Label

## 4.2.4 FDA Statement Label

The FDA Statement labels are shown in Figure 4-4 and Figure 4-5. These labels show compliance to FDA standards and that the hazard level classification is in accordance with IEC60825-1 Am.2 or Ed.1.2.

**Figure 4-4** FDA Statement Label

**Figure 4-5** *FDA Statement Label*

COMPLIES WITH 21 CFR 1040.10  
AND 1040.11 EXCEPT FOR  
DEVIATIONS PURSUANT TO  
LASER NOTICE NO.50,  
DATED JUNE 24, 2007

282324

## 4.2.5 Shock Hazard Label

Figure 4-6 shows the Shock Hazard label. This label alerts you to an electrical hazard within the card. The potential for shock exists when you remove adjacent cards during maintenance or touch exposed electrical circuitry on the card.

**Figure 4-6** *Shock Hazard Label*

65541

## 4.3 OPT-PRE Amplifier Card

**Note**

For hardware specifications, see the [“A.5.1 OPT-PRE Amplifier Card Specifications”](#) section on page A-14.

**Note**

For OPT-PRE card safety labels, see the [“4.2 Class 1M Laser Safety Labels”](#) section on page 4-4.

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**

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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.

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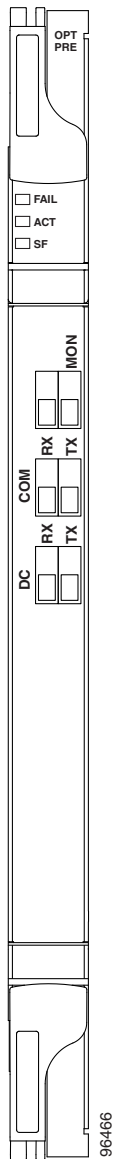
## 4.3.1 OPT-PRE Faceplate Ports

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 4-7 shows the OPT-PRE amplifier card faceplate.

**Figure 4-7** OPT-PRE Faceplate



## 4.3.2 OPT-PRE Block Diagrams

Figure 4-8 shows a simplified block diagram of the OPT-PRE card's features.



Figure 4-8 OPT-PRE Block Diagram

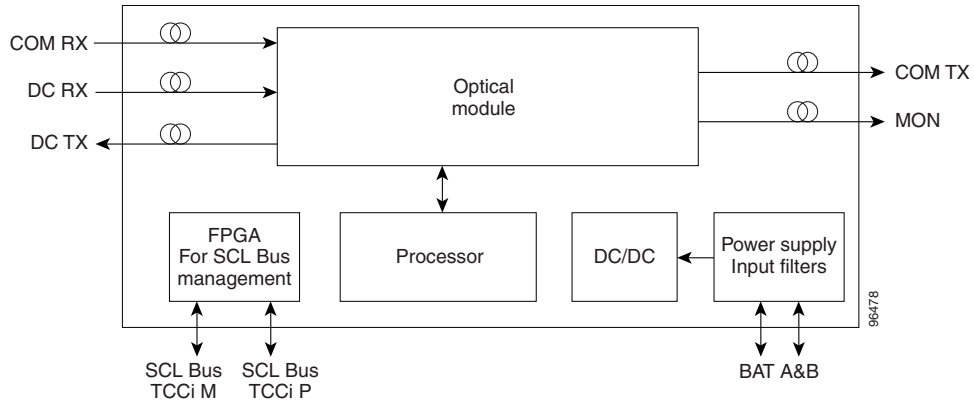
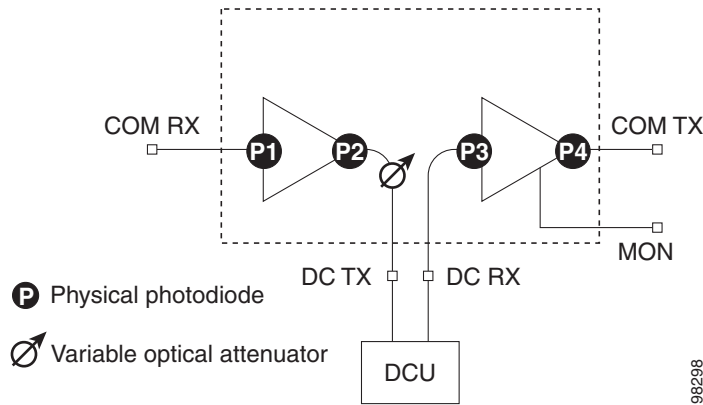


Figure 4-9 shows the a block diagram of how the OPT-PRE optical module functions.

Figure 4-9 OPT-PRE Optical Module Functional Block Diagram



### 4.3.3 OPT-PRE Power Monitoring

Physical photodiodes P1, P2, P3, and P4 monitor the power for the OPT-PRE card. Table 4-3 shows the returned power level values calibrated to each port.

Table 4-3 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, Release 9.0*.

## 4.3.4 OPT-PRE Amplifier Card-Level Indicators

Table 4-4 shows the three card-level LED indicators on the OPT-PRE amplifier card.

**Table 4-4** OPT-PRE Amplifier Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or that an internal hardware failure occurred. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OPT-PRE is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS on one or more of the card’s ports. The amber SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

## 4.3.5 OPT-PRE Ampifier Port-Level Indicators

You can determine the status of the card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

## 4.4 OPT-BST Amplifier Card



**Note**

For hardware specifications, see the [“A.5.2 OPT-BST Amplifier Card Specifications”](#) section on [page A-15](#).



**Note**

For OPT-BST card safety labels, see the [“4.2 Class 1M Laser Safety Labels”](#) section on [page 4-4](#).

The OPT-BST is designed to ultimately support up to 80 channels at 50-GHz channel spacing. The OPT-BST is a C-band, DWDM EDFA with optical service channel (OSC) add-and-drop capability. When an OPT-BST installed in the an ONS 15454, an OSCM card is also needed to process the OSC. You can install the OPT-BST 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
- 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 details on ALS provisioning for the card, refer to the *Cisco ONS 15454 DWDM Procedure Guide*. For information about using the card to implement ALS in a network, see the “[11.9 Network Optical Safety](#)” section on page 11-19.

**Note**

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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.

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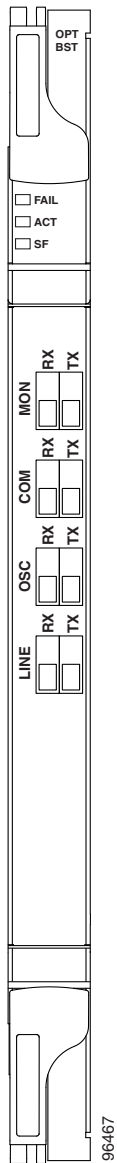
## 4.4.1 OPT-BST Faceplate Ports

The OPT-BST 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 4-10 shows the OPT-BST amplifier card faceplate.

**Figure 4-10** OPT-BST Faceplate



## 4.4.2 OPT-BST Block Diagrams

Figure 4-11 shows a simplified block diagram of the OPT-BST card's features.

Figure 4-11 OPT-BST Block Diagram

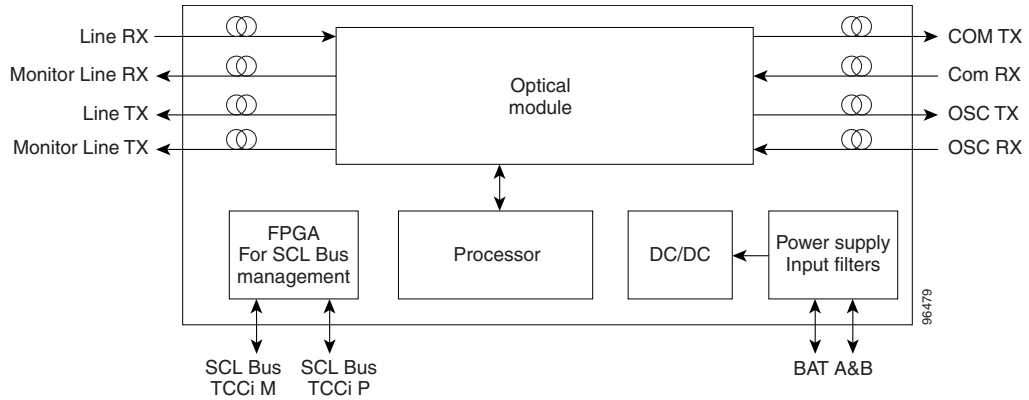
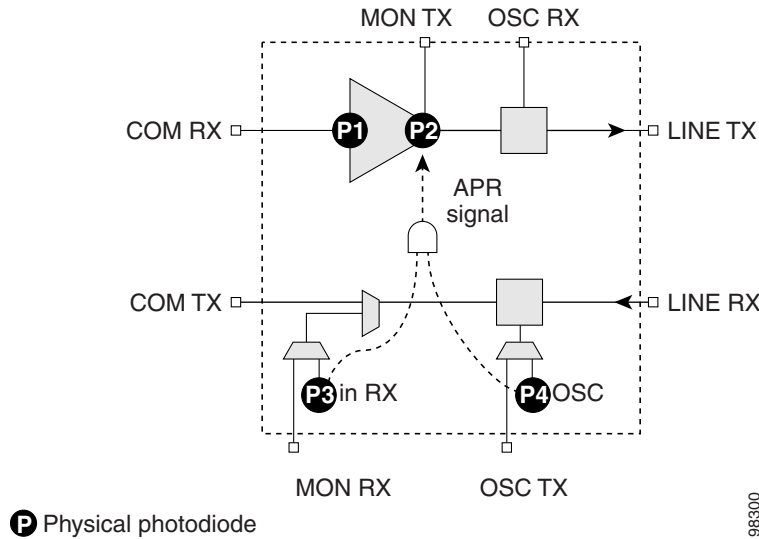


Figure 4-12 shows a block diagram of how the OPT-BST optical module functions.

Figure 4-12 OPT-BST Optical Module Functional Block Diagram



**P** Physical photodiode

### 4.4.3 OPT-BST Power Monitoring

Physical photodiodes P1, P2, P3, and P4 monitor the power for the OPT-BST card. Table 4-5 shows the returned power level values calibrated to each port.

Table 4-5 OPT-BST Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	Input Com	COM RX
P2	Output Line (Total Output)	LINE TX
	Output Line (Signal Output)	

**Table 4-5** OPT-BST Port Calibration (continued)

Photodiode	CTC Type Name	Calibrated to Port
P3	Output COM	LINE RX
P4	Output OSC	

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, Release 9.0*.

## 4.4.4 OPT-BST Card-Level Indicators

Table 4-6 describes the three card-level LED indicators on the OPT-BST card.

**Table 4-6** OPT-BST Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or that an internal hardware failure occurred. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OPT-BST is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS on one or more of the card’s ports. The amber SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

## 4.4.5 OPT-BST Port-Level Indicators

You can determine the status of the card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

## 4.5 OPT-BST-E Amplifier Card

**Note**

For hardware specifications, see the “[A.5.3 OPT-BST-E Amplifier Card Specifications](#)” section on [page A-15](#).

**Note**

For OPT-BST-E safety labels, see the “[4.2 Class 1M Laser Safety Labels](#)” section on [page 4-4](#).

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. The OPT-BST-E is a C-band, DWDM EDFA with OSC add-and-drop capability. When an OPT-BST-E installed, an OSCM card is needed to process the OSC. You can install the OPT-BST-E in Slots 1 to 6 and 12 to 17. The card’s features include:

- Fixed gain mode (with programmable tilt)
- True variable gain
- Gain range of 8 to 23 dBm with the tilt managed at 0 dBm in constant gain mode and output power mode
- Enhanced gain range of 23 to 26 dBm with unmanaged tilt
- Built-in VOA to control the 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.

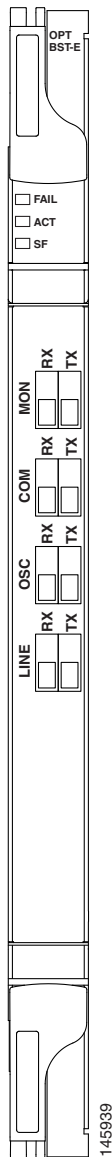
## 4.5.1 OPT-BST-E Faceplate Ports

The OPT-BST-E 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 4-13 shows the OPT-BST-E amplifier card faceplate.

**Figure 4-13** OPT-BST-E Faceplate



## 4.5.2 OPT-BST-E Block Diagrams

Figure 4-14 shows a simplified block diagram of the OPT-BST-E card's features.



**Figure 4-14** OPT-BST-E Block Diagram

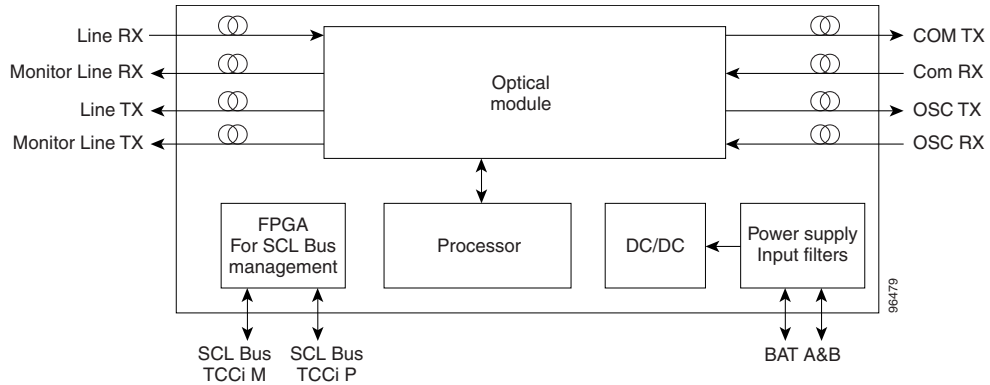
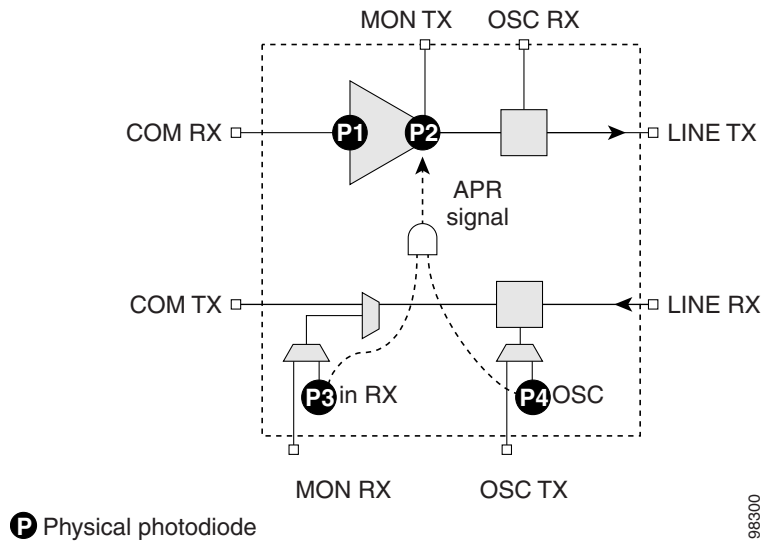


Figure 4-15 shows a block diagram of how the OPT-BST-E optical module functions.

**Figure 4-15** OPT-BST-E Optical Module Functional Block Diagram



**P** Physical photodiode

## 4.5.3 OPT-BST-E Power Monitoring

Physical photodiodes P1, P2, P3, and P4 monitor the power for the OPT-BST-E card. Table 4-7 shows the returned power level values calibrated to each port.

**Table 4-7** OPT-BST-E Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	Input Com	COM RX
P2	Output Line (Total Output)	LINE TX
	Output Line (Signal Output)	

**Table 4-7** OPT-BST-E Port Calibration (continued)

Photodiode	CTC Type Name	Calibrated to Port
P3	Output COM	LINE RX
P4	Output OSC	

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, Release 9.0*.

## 4.5.4 OPT-BST-E Card-Level Indicators

Table 4-8 describes the three card-level LED indicators on the OPT-BST-E amplifier card.

**Table 4-8** OPT-BST-E Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or that an internal hardware failure occurred. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OPT-BST-E is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS on one or more of the card’s ports. The amber SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

## 4.5.5 OPT-BST-E Port-Level Indicators

You can determine the status of the card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

## 4.6 OPT-BST-L Amplifier Card

**Note**

For hardware specifications, see the “[A.5.4 OPT-BST-L Amplifier Card Specifications](#)” section on [page A-16](#).

**Note**

For OPT-BST-L safety labels, see the “[4.2 Class 1M Laser Safety Labels](#)” section on [page 4-4](#).

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.

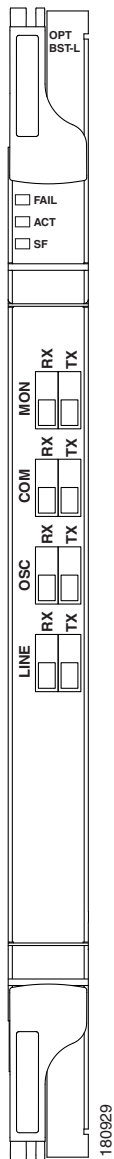
## 4.6.1 OPT-BST-L Faceplate Ports

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 4-16 shows the OPT-BST-L card faceplate.

**Figure 4-16** OPT-BST-L Faceplate



## 4.6.2 OPT-BST-L Block Diagrams

Figure 4-17 shows a simplified block diagram of the OPT-BST-L card's features.

Figure 4-17 OPT-BST-L Block Diagram

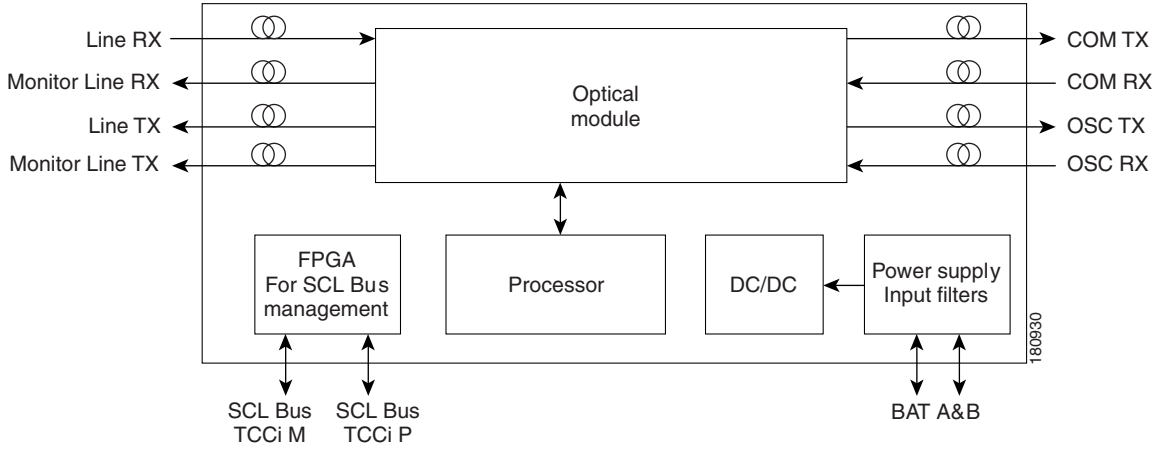
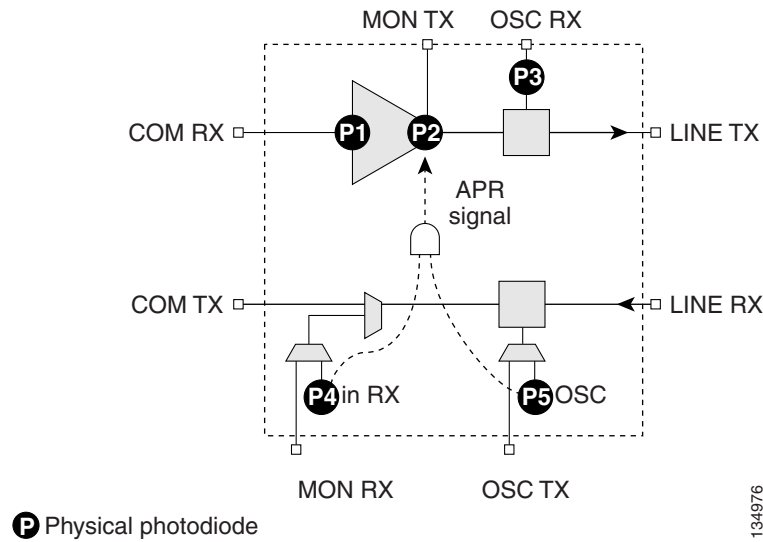


Figure 4-18 shows a block diagram of how the OPT-BST-L optical module functions.

Figure 4-18 OPT-BST-L Optical Module Functional Block Diagram



P Physical photodiode

### 4.6.3 OPT-BST-L Power Monitoring

Physical photodiodes P1, P2, P3, P4, and P5 monitor the power for the OPT-BST-L card. Table 4-9 shows the returned power level values calibrated to each port.

Table 4-9 OPT-BST-L Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	Input COM	COM RX

**Table 4-9** OPT-BST-L Port Calibration (continued)

Photodiode	CTC Type Name	Calibrated to Port
P2	Output Line (Total Output)	LINE TX
	Output Line (Signal Output)	
P3	Output OSC-RX	OSC-RX
P4	Output COM	LINE RX
P5	Output OSC-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, Release 9.0*.

## 4.6.4 OPT-BST-L Card-Level Indicators

Table 4-10 shows the three card-level LEDs on the OPT-BST-L card.

**Table 4-10** OPT-BST-L Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or that an internal hardware failure occurred. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OPT-BST-L is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS on one or more of the card’s ports. The amber SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

## 4.6.5 OPT-BST-L Port-Level Indicators

You can determine the status of the card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

## 4.7 OPT-AMP-L Card

**Note**

For hardware specifications, see the “[A.5.5 OPT-AMP-L Preamplifier Card Specifications](#)” section on [page A-17](#).

**Note**

For OPT-AMP-L card safety labels, see the “[4.2 Class 1M Laser Safety Labels](#)” section on [page 4-4](#).

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 details on ALS provisioning for the card, refer to the *Cisco ONS 15454 DWDM Procedure Guide*. For information on using the card to implement ALS in a network, see the “11.9 Network Optical Safety” section on page 11-19.

**Note**

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

## 4.7.1 OPT-AMP-L Faceplate Ports

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

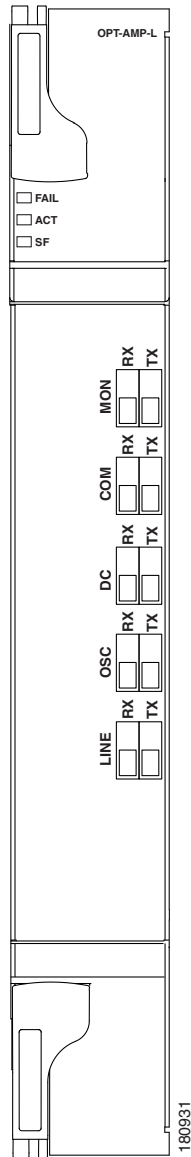
- MON RX is the output monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port.
- LINE TX is the output signal port.
- LINE RX is the input signal port (receive section).
- COM TX is the output signal port (receive section).
- OSC RX is the OSC add input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

## 4.7.2 OPT-AMP-L Block Diagrams

- 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 4-19 shows the OPT-AMP-L card faceplate.

**Figure 4-19** OPT-AMP-L Faceplate



## 4.7.2 OPT-AMP-L Block Diagrams

Figure 4-20 shows a simplified block diagram of the OPT-AMP-L card's features.



Figure 4-20 OPT-AMP-L Block Diagram

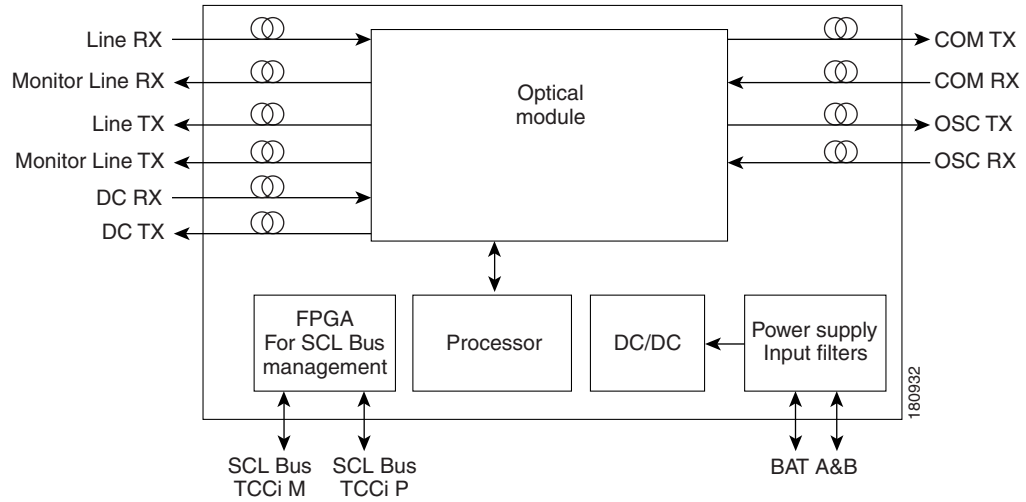
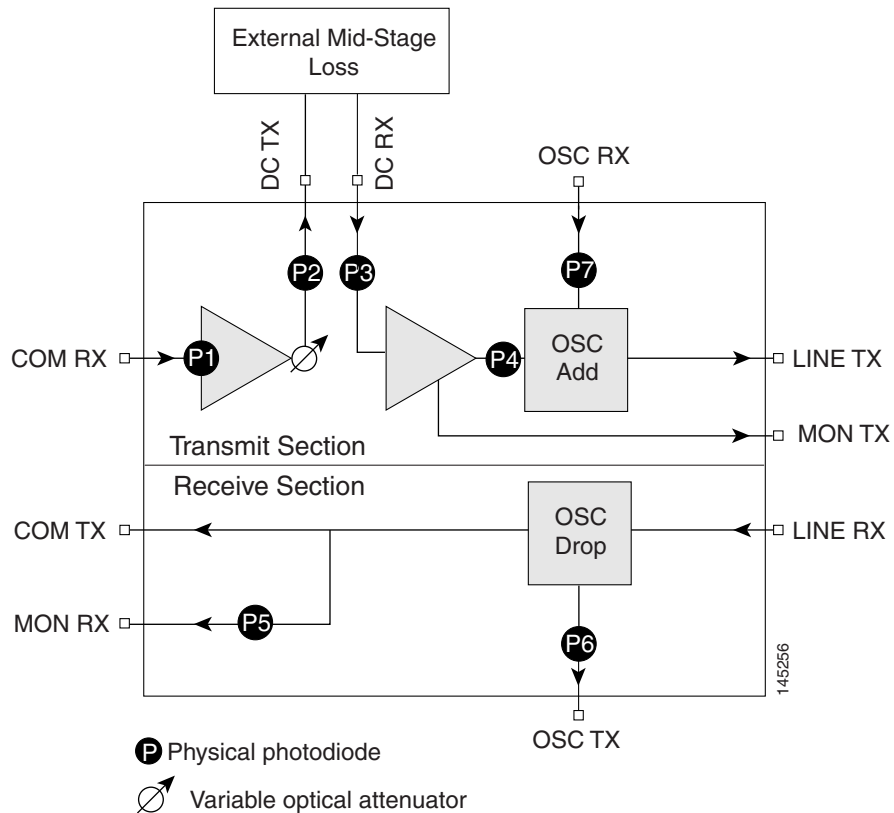


Figure 4-21 shows a block diagram of how the OPT-AMP-L optical module functions.

Figure 4-21 OPT-AMP-L Optical Module Functional Block Diagram



## 4.7.3 OPT-AMP-L Power Monitoring

Physical photodiodes P1 through P7 monitor the power for the OPT-AMP-L card. [Table 4-11](#) shows the returned power level values calibrated to each port.

**Table 4-11** OPT-AMP-L Port Calibration

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

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, Release 9.0*.

## 4.7.4 OPT-AMP-L Card-Level Indicators

[Table 4-12](#) shows the three card-level LEDs on the OPT-AMP-L card.

**Table 4-12** OPT-AMP-L Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or that an internal hardware failure occurred. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OPT-AMP-L is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS on one or more of the card’s ports. The amber SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

## 4.7.5 OPT-AMP-L Port-Level Indicators

You can determine the status of the card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

## 4.8 OPT-AMP-17-C Card

**Note**

For hardware specifications, see the “[A.5.6 OPT-AMP-17-C Amplifier Card Specifications](#)” section on [page A-17](#).

**Note**

For OPT-AMP-17-C safety labels, see the “[4.2 Class 1M Laser Safety Labels](#)” section on [page 4-4](#).

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

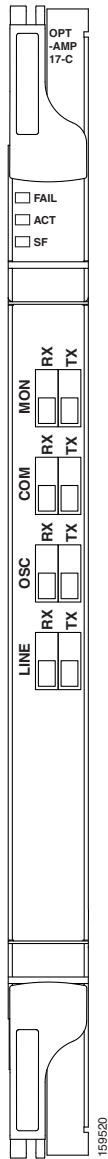
### 4.8.1 OPT-AMP-17-C Faceplate Ports

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 4-22 shows the OPT-AMP-17-C amplifier card faceplate.

**Figure 4-22** OPT-AMP-17-C Faceplate



## 4.8.2 OPT-AMP-17-C Block Diagrams

Figure 4-23 shows a simplified block diagram of the OPT-AMP-17C card's features.

Figure 4-23 OPT-AMP17-C Block Diagram

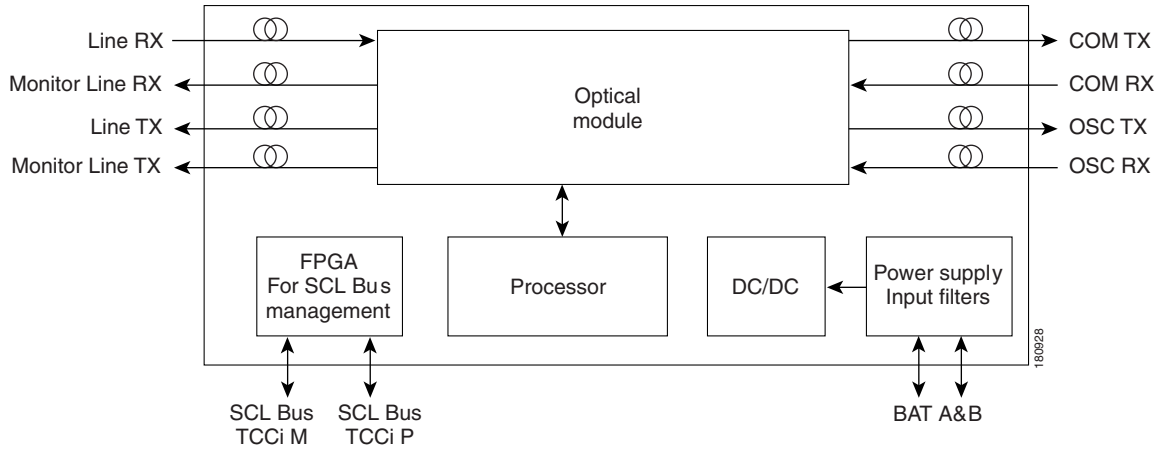
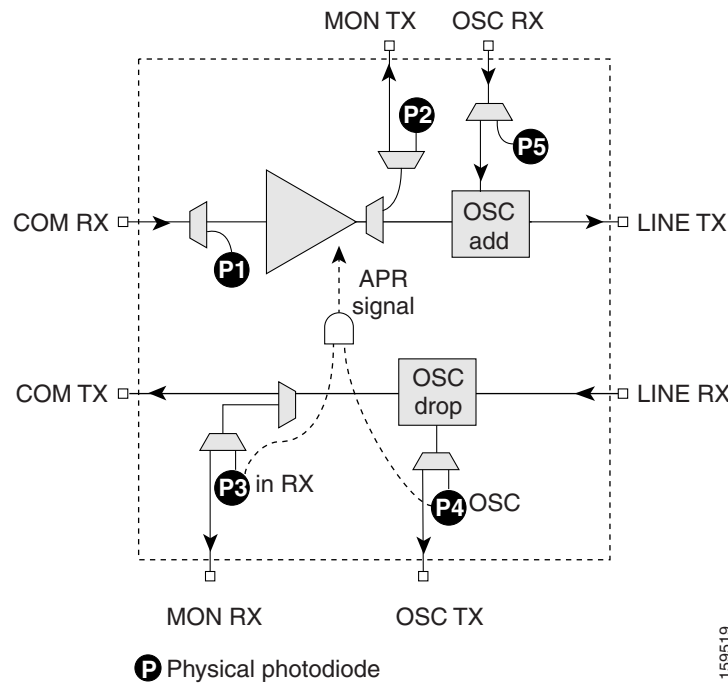


Figure 4-24 shows how the OPT-AMP-17-C optical module functions.

Figure 4-24 OPT-AMP-17-C Optical Module Functional Block Diagram



## 4.8.3 OPT-AMP-17-C Automatic Power Control

A transient gain range of 20 to 23 dB is available to APC in order to permit other amplifiers to reach their expected set points. However, operation in this range is not continuous. At startup, the OPT-AMP-17-C card caps the gain at a maximum of 20 dB.

**Note**

When the OPT-AMP-17-C operates as a booster amplifier, APC does not control its gain.

## 4.8.4 OPT-AMP-17-C Power Monitoring

Physical photodiodes P1, P2, P3, P4, and P5 monitor power for the OPT-AMP-17-C card. [Table 4-13](#) shows the returned power level values calibrated to each port.

**Table 4-13** OPT-AMP-17-C Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	Input COM	COM RX
P2	Output Line (Total Output)	LINE TX
	Output Line (Signal Output)	
P5	Output OSC-RX	OSC-RX
P3	Output COM	LINE RX
P4	Output OSC-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, Release 9.0*.

## 4.8.5 OPT-AMP-17-C Card-Level Indicators

[Table 4-14](#) shows the three card-level LEDs on the OPT-AMP-17-C card.

**Table 4-14** OPT-AMP-17-C Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or that an internal hardware failure occurred. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OPT-AMP-17-C is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS on one or more of the card’s ports. The amber SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

## 4.8.6 OPT-AMP-17-C Port-Level Indicators

You can determine the status of the card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

## 4.9 OPT-AMP-C Card

**Note**

For hardware specifications, see the “[A.5.7 OPT-AMP-C Amplifier Card Specifications](#)” section on [page A-18](#).

**Note**

For OPT-AMP-C card safety labels, see the “[4.2 Class 1M Laser Safety Labels](#)” section on [page 4-4](#).

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

### 4.9.1 OPT-AMP-C Card Faceplate Ports

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

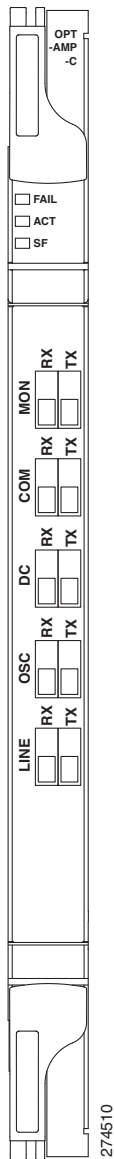
- MON RX is the output monitor port (receive section).
- MON TX is the output monitor port.
- COM RX is the input signal port.

## 4.9.1 OPT-AMP-C Card Faceplate Ports

- 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 4-25 shows the OPT-AMP-C amplifier card faceplate.

**Figure 4-25** OPT-AMP-C Card Faceplate





## 4.9.2 OPT-AMP-C Card Block Diagrams

Figure 4-26 shows a simplified block diagram of the OPT-AMP-17C card features.

Figure 4-26 OPT-AMP-C Block Diagram

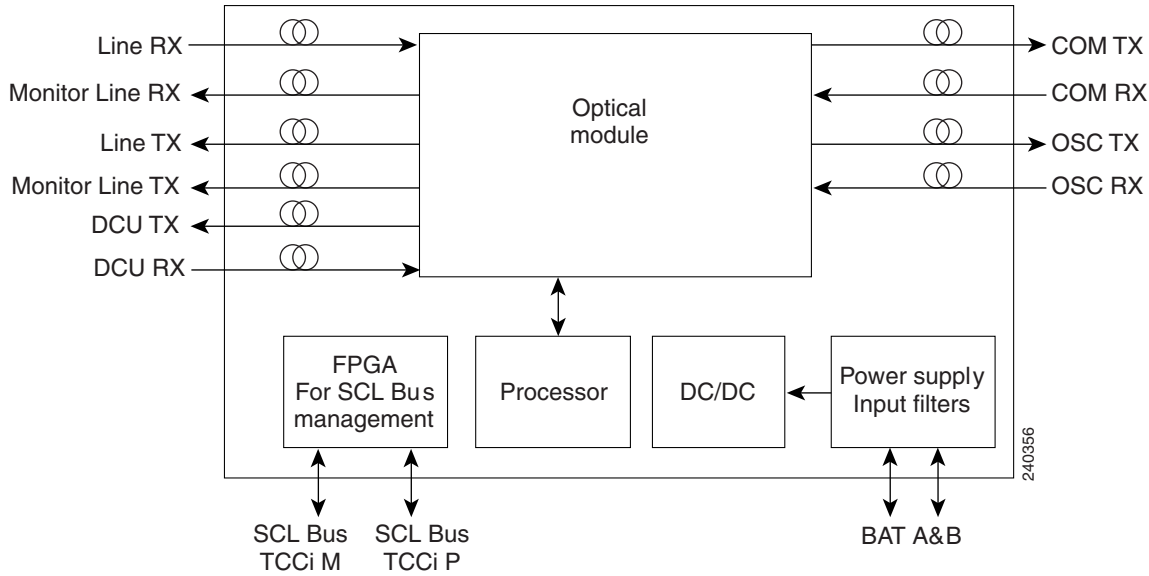
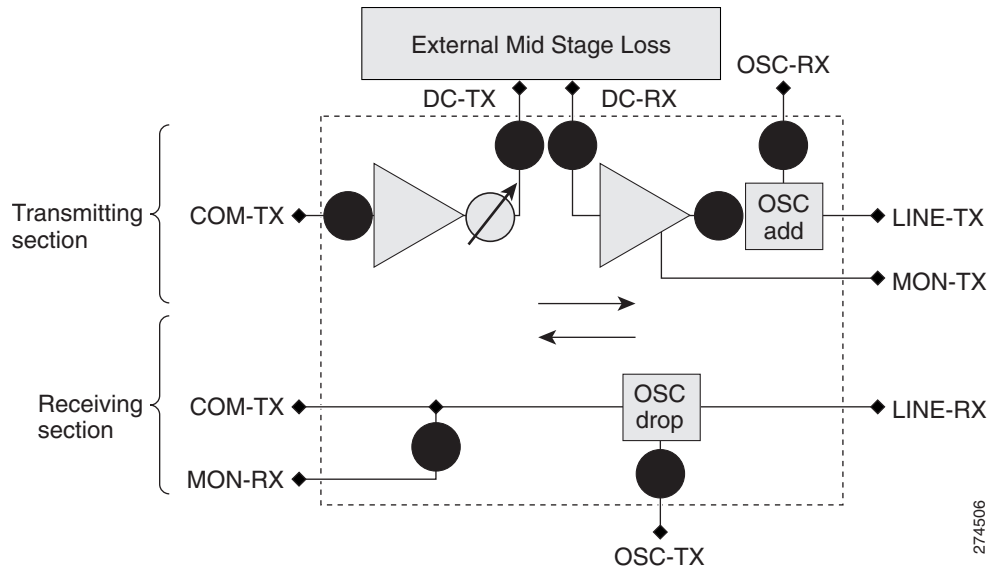


Figure 4-27 shows how the OPT-AMP-C optical module functions.

Figure 4-27 OPT-AMP-C Optical Module Functional Block Diagram



## 4.9.3 OPT-AMP-C Card Power Monitoring

Physical photodiodes P1 through P7 monitor the power for the OPT-AMP-C card (see [Table 4-15](#)).

**Table 4-15** OPT-AMP-C Port Calibration

Photodiode	CTC Type Name	Calibrated to Port
P1	Input COM Power	COM RX
P2	Output Line Transmit (total power)	Line TX
	Output Line Transmit (signal power)	
P3	Input Line Receive Power	Line RX
P4	Input OSC Receive Power	
P5	Output OSC Transmit Power	OSC-RX
P6	Output DC Transmit (total power)	DC-TX
	Output DC Transmit (signal power)	
P7	Input DC Receive Power	DC-RX

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, Release 9.0*.

## 4.9.4 OPT-AMP-C Card-Level Indicators

[Table 4-16](#) shows the three card-level LEDs on the OPT-AMP-C card.

**Table 4-16** OPT-AMP-C Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or that an internal hardware failure occurred. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OPT-AMP-C card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS on one or more of the card’s ports. The amber SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

## 4.9.5 OPT-AMP-C Card Port-Level Indicators

You can determine the status of the card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

## 4.10 OPT-RAMP-C Card

**Note**

For hardware specifications, see the “[A.5.8 OPT-RAMP-C Amplifier Card Specifications](#)” section on [page A-19](#).

**Note**

For OPT-RAMP-C card safety labels, see the “[4.2 Class 1M Laser Safety Labels](#)” section on [page 4-4](#).

The OPT-RAMP-C is a double-slot unit and improves unregenerated sections in long spans using the span fiber to amplify the optical signal. To achieve Raman amplification, two Raman signals (that do not carry any payload or overhead) are transmitted on the optical fiber because the gain generated by one signal is not flat (different wavelengths in C-band receive different gain values). 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.

The card operates 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 card can be installed in Slots 1 to 5 and 12 to 16, and the card supports all network configurations. However, it can be equipped only on both endpoints of a span.

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 Raman total power and Raman ratio can be configured using CTC. For information on how to configure the Raman parameters, refer the *Cisco ONS 15454 DWDM Procedure Guide*. The Raman configuration can be viewed on the Maintenance > Installation tab.

The card’s features include:

- Raman pump with embedded EDFA gain block
- Raman section: 500 mW total pump power for two pump wavelengths
- EDFA section: 16 dB gain and 17 dB output power
- Gain Flattening Filter (GFF) for Raman plus EDFA ripple compensation
- Mid stage access 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/drop filters
- Raman pump back-reflection detector

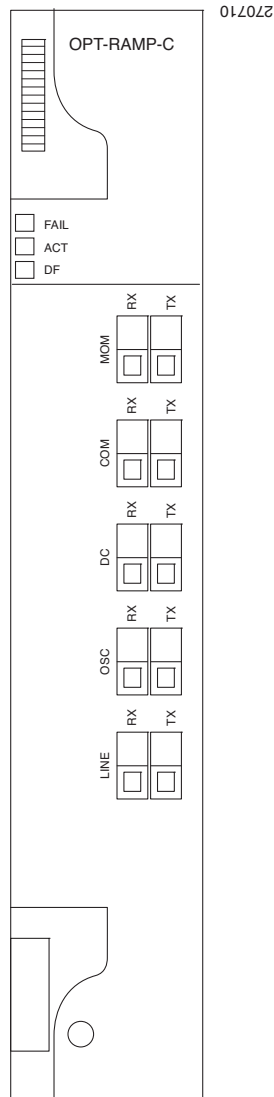
## 4.10.1 OPT-RAMP-C Card Faceplate Ports

The OPT-RAMP-C 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 (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 4-28](#) shows the OPT-RAMP-C card faceplate.

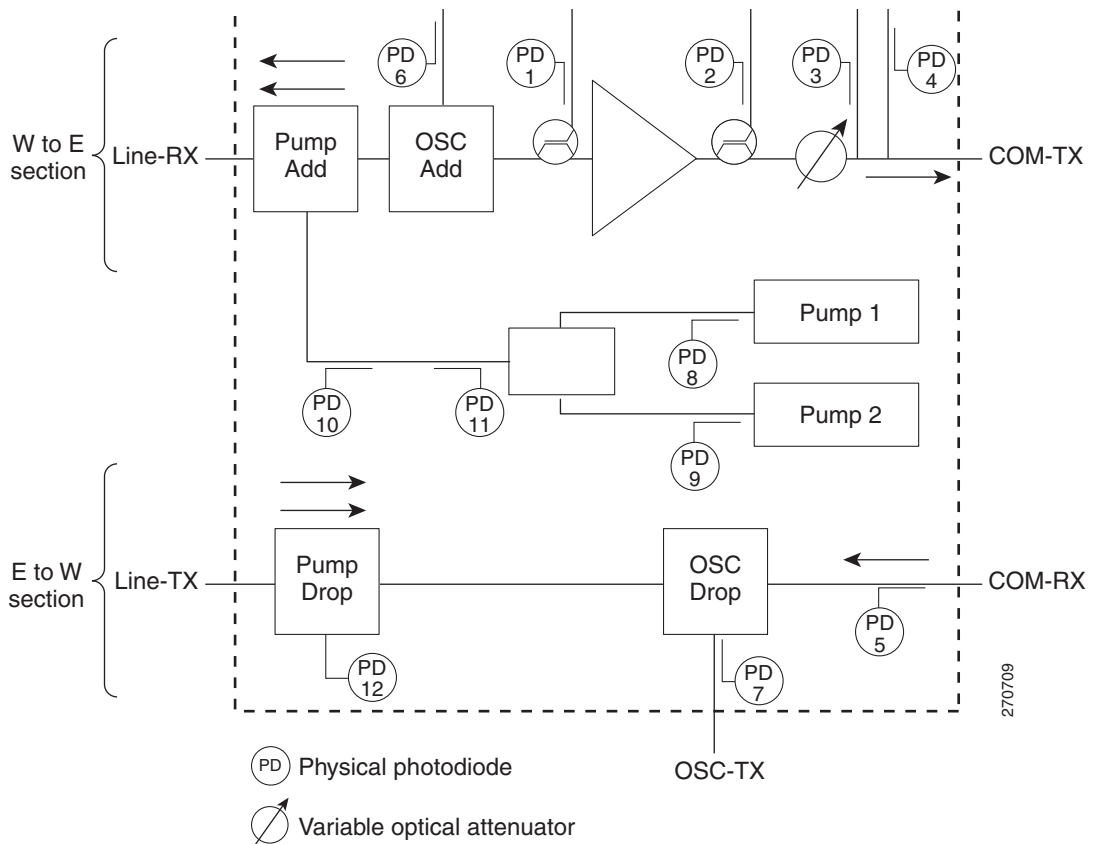
Figure 4-28 OPT-RAMP-C Faceplate



## 4.10.2 OPT-RAMP-C Card Block Diagram

Figure 4-29 shows a block diagram of how the OPT-RAMP-C card functions.

Figure 4-29 OPT-RAMP-C 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 back-scattered by the LINE-RX connector and by the 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.

### 4.10.3 OPT-RAMP-C Card Power Monitoring

Physical photodiodes PD1 through PD12 monitor the power for the OPT-RAMP-C card (see [Table 4-17](#)).

**Table 4-17** OPT-RAMP-C 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 ONS SONET TL1 Command Guide, Release 9.0*.

## 4.10.4 OPT-RAMP-C Card Level Indicators

Table 4-18 shows the three card-level LEDs on the OPT-RAMP-C card.

**Table 4-18** OPT-RAMP-C Card-Level Indicators

Card-Level Indicators	Description
Red FAIL LED	The red FAIL LED indicates that the card’s processor is not ready or that an internal hardware failure occurred. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OPT-RAMP-C card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS on one or more of the card’s ports. The amber SF LED also turns on when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

## 4.10.5 OPT-RAMP-C Card Port-Level Indicators

You can determine the status of the card ports using the LCD screen on the ONS 15454 fan-tray assembly. Use the LCD to view the status of any port or card slot; the screen displays the number and severity of alarms for a given port or slot.

