



DWDM Cards

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

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6.1 DWDM Card Overview

The DWDM card overview section summarizes card functions, power consumption, and temperature ranges.



Note

Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. The cards are then installed into slots displaying the same symbols. See the [“1.13.1 Card Slot Requirements”](#) section on page 1-43 for a list of slots and symbols.

6.1.1 DWDM Cards

ONS 15454 DWDM cards are grouped into the following categories:

- Optical service channel cards provide bidirectional channels that connect all the ONS 15454 DWDM nodes and transport general-purpose information without affecting the client traffic. ONS 15454 optical service channel cards include the Optical Service Channel Module (OSCM) and the Optical Service Channel and Combiner/Separator Module (OSC-CSM).
- Optical amplifier cards are used in amplified DWDM nodes, including hub nodes, amplified OADM nodes, and line amplified nodes. The cards are composed of three main modules: an optical plug-in, a microprocessor, and a DC/DC converter. Optical amplifier cards include the Optical Preamplifier (OPT-PRE) and Optical Booster (OPT-BST) amplifier.
- Dispersion compensation units are installed in the ONS 15454 dispersion compensation shelf when optical preamplifier cards are installed in the DWDM node. Each DCU module can compensate a maximum of 65 km of single-mode fiber (SMF-28) span. DCUs can be cascaded to extend the compensation to 130 km.
- Multiplexer and demultiplexer cards multiplex and demultiplex DWDM optical channels. The cards are composed of three main modules: optical plug-in, microprocessor, and the DC/DC converter. ONS 15454 multiplexer and demultiplexer cards include the 32-Channel Multiplexer (32 MUX-O), the 32-Channel Demultiplexer (32 DMX-O), and the 4-Channel Multiplexer/Demultiplexer (4MD-xx.x).
- Optical Add/Drop Multiplexer (OADM) cards are mainly divided into two groups: band OADM and channel OADM cards. Band OADM cards add and drop one or four bands of adjacent channels; they include the 4-Band OADM (AD-4B-xx.x) and the 1-Band OADM (AD-1B-xx.x). Channel OADM cards add and drop one, two, or four adjacent channels; they include the 4-Channel OADM (AD-4C-xx.x), the 2-Channel OADM (AD-2C-xx.x) and the 1-Channel OADM (AD-1C-xx.x). The cards are composed of three main modules: optical plug-in, microprocessor, and the DC/DC converter.

Table 6-1 lists the Cisco ONS 15454 DWDM cards.

Table 6-1 DWDM Cards for the ONS 15454

Card	Port Description	For Additional Information...
Optical Service Channel Modules		
OSCM	The OSCM has one set of optical ports and one Ethernet port located on the faceplate. It operates in Slots 8 and 10.	See the “6.2 OSCM Card” section on page 6-8.
OSC-CSM	The OSC-CSM has three sets of optical ports and one Ethernet port located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the “6.3 OSC-CSM Card” section on page 6-13.
Optical Amplifiers		
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 “6.4 OPT-PRE Amplifier” section on page 6-18.
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 “6.5 OPT-BST Amplifier” section on page 6-23.

Table 6-1 DWDM Cards for the ONS 15454 (continued)

Card	Port Description	For Additional Information...
Multiplexer and Demultiplexer Cards		
32 MUX-O	The 32 MUX-O has five sets of ports located on the faceplate. It operates in Slots 1 to 5 and 12 to 16.	See the “6.6 32 MUX-O Card” section on page 6-28.
32 DMX-O	The 32 DMX-O has five sets of ports located on the faceplate. It operates in Slots 1 to 5 and 12 to 16.	See the “6.7 32 DMX-O Card” section on page 6-32.
4MD-xx.x	The 4MD-xx.x card has five sets of ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the “6.8 4MD-xx.x Card” section on page 6-36.
Optical Add/Drop Multiplexer Cards		
AD-1C-xx.x	The AD-1C-xx.x card has three sets of ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the “6.9 AD-1C-xx.x Card” section on page 6-42.
AD-2C-xx.x	The AD-2C-xx.x card has four sets of ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the “6.10 AD-2C-xx.x Card” section on page 6-47.
AD-4C-xx.x	The AD-4C-xx.x card has six sets of ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the “6.11 AD-4C-xx.x Card” section on page 6-52.
AD-1B-xx.x	The AD-1B-xx.x card has three sets of ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the “6.12 AD-1B-xx.x Card” section on page 6-57.
AD-4B-xx.x	The AD-4B-xx.x card has six sets of ports located on the faceplate. It operates in Slots 1 to 6 and 12 to 17.	See the “6.13 AD-4B-xx.x Card” section on page 6-64.

6.1.2 Card Power Requirements

Table 6-2 lists power requirements for individual cards.

Table 6-2 Individual Card Power Requirements

Card Name	Watts	Amperes	BTU/Hr
OSCM	Nominal 23 W	Nominal 0.48 A	Nominal 78.48 BTUs
	Maximum 26 W	Maximum 0.54 A	Maximum 88.71 BTUs
OSC-CSM	Nominal 24 W	Nominal 0.5 A	Nominal 81.89 BTUs
	Maximum 27 W	Maximum 0.56 A	Maximum 92.12 BTUs
OPT-PRE	Minimum 25 W	Minimum 0.52 A	Minimum 85.3 BTUs
	Nominal 30 W	Nominal 0.56 A	Nominal 102.36 BTUs
	Maximum 39 W	Maximum 0.81 A	Maximum 88.71 BTUs

Table 6-2 Individual Card Power Requirements (continued)

Card Name	Watts	Amperes	BTU/Hr
OPT-BST	Nominal 30 W	Nominal 0.63 A	Nominal 102.36 BTUs
	Maximum 39 W	Maximum 0.81 A	Maximum 88.71 BTUs
32 MUX-0	Nominal 16 W	Nominal 0.33 A	Nominal 54.59 BTUs
	Maximum 25 W	Maximum 0.52 A	Maximum 85.3 BTUs
32 DMX-0	Nominal 16 W	Nominal 0.33 A	Nominal 54.59 BTUs
	Maximum 25 W	Maximum 0.52 A	Maximum 85.3 BTUs
4MD-xx.x	Nominal 17 W	Nominal 0.35 A	Nominal 58.0 BTUs
	Maximum 25 W	Maximum 0.52 A	Maximum 85.3 BTUs
AD-1C-xx.x	Nominal 17 W	Nominal 0.35 A	Nominal 58.0 BTUs
	Maximum 25 W	Maximum 0.52 A	Maximum 85.3 BTUs
AD-2C-xx.x	Nominal 17 W	Nominal 0.35 A	Nominal 58.0 BTUs
	Maximum 25 W	Maximum 0.52 A	Maximum 85.3 BTUs
AD-4C-xx.x	Nominal 17 W	Nominal 0.35 A	Nominal 58.0 BTUs
	Maximum 25 W	Maximum 0.52 A	Maximum 85.3 BTUs
AD-1B-xx.x	Nominal 17 W	Nominal 0.35 A	Nominal 58.0 BTUs
	Maximum 25 W	Maximum 0.52 A	Maximum 85.3 BTUs
AD-4B-xx.x	Nominal 17 W	Nominal 0.35 A	Nominal 58.0 BTUs
	Maximum 25 W	Maximum 0.52 A	Maximum 85.3 BTUs

6.1.3 Card Temperature Ranges

Table 6-3 shows C-Temp and I-Temp compliant cards and their product names.



Note

The I-Temp symbol is displayed on the faceplate of an I-Temp compliant card. A card without this symbol is C-Temp compliant.

Table 6-3 Optical Card Temperature Ranges and Product Names for the ONS 15454

Card	C-Temp Product Name (+23 to +131 degrees Fahrenheit, -5 to +55 degrees Celsius)	I-Temp Product Name (-40 to +149 degrees Fahrenheit, -40 to +65 degrees Celsius)
OSCM	OSCM	—
OSC-CSM	OSC-CSM	—
OPT-PRE	OPT-PRE	—
OPT-BST	OPT-BST	—
32 MUX-0	32 MUX-O	—
32 DMX-0	32 DMX-O	—

Table 6-3 Optical Card Temperature Ranges and Product Names for the ONS 15454 (continued)

Card	C-Temp Product Name (+23 to +131 degrees Fahrenheit, -5 to +55 degrees Celsius)	I-Temp Product Name (-40 to +149 degrees Fahrenheit, -40 to +65 degrees Celsius)
4MD-xx.x	4MD-xx.x	—
AD-1B-xx.x	AD-1B-xx.x	—
AD-2C-xx.x	AD-2C-xx.x	—
AD-4B-xx.x	AD-4B-xx.x	—
AD-1C-xx.x	AD-1C-xx.x	—
AD-4C-xx.x	AD-4C-xx.x	—

6.1.4 Multiplexer, Demultiplexer, and OADM Card Interface Classes

The 32MUX-O, 32WSS, 32DMX, 32 DMX-O, 4MD-xx.x, AD-1C-xx.x, AD-2C-xx.x, and AD-4C-xx.x cards have different input and output optical channel signals, depending upon the interface card where the input signal originates. The input interface cards have been grouped in classes listed in [Table 6-4](#). The subsequent tables list the optical performances and output power of each interface class.

Table 6-4 ONS 15454 Card Interfaces Assigned to Input Power Classes

Input Power Class	Card
A	10-Gbps multirate transponder with forward error correction (FEC) or 10-Gbps muxponder with FEC
B	10-Gbps multirate transponder without FEC
C	OC-192 LR ITU
D	2.5-Gbps multirate transponder, both protected and unprotected, with FEC enabled
E	2.5-Gbps multirate transponder, both protected and unprotected, without FEC enabled
F	2.5-Gbps multirate transponder, both protected and unprotected, in regenerate and reshape (2R) mode
G	OC-48 ELR 100 GHz

10-Gbps cards that provide signal input to OADM cards have the optical performances listed in [Table 6-5](#). 2.5-Gbps card interface performances are listed in [Table 6-6 on page 6-6](#).

Table 6-5 10-Gbps Interface Optical Performances

Parameter	Class A		Class B		Class C	
	Power limited	OSNR ¹ limited	Power limited	OSNR limited	Power limited	OSNR limited
Optical signal to noise ratio (OSNR) sensitivity	23 dB	9 dB	23 dB	9 dB	23 dB	9 dB

Table 6-5 10-Gbps Interface Optical Performances (continued)

Parameter	Class A		Class B		Class C	
	Power sensitivity	-24 dBm	-18 dBm	-20 dBm	-20 dBm	-22 dBm
Dispersion power penalty	2 dB	0 dB	3 dB	4 dB	2 dB	2 dB
Dispersion OSNR penalty	0 dB	2 dB	0 dB	0 dB	0 dB	0 dB
Dispersion compensation tolerance	+/-800 ps/nm		+/-1,000 ps/nm	+/-800 ps/nm	+/-1,200 ps/nm	+/-1,000 ps/nm
Maximum bit rate	10 Gbps		10 Gbps		10 Gbps	
Regeneration	3R ²		3R		3R	
FEC	Yes		Yes		Yes	
Threshold	Optimum		Average		Average	
Maximum BER ³	10 ⁻¹⁵		10 ⁻¹²		10 ⁻¹²	
Power overload	-8 dBm		-8 dBm		-9 dBm	
Transmitted power range	0 ÷ (+2) dBm		0 ÷ (+2) dBm		+3 ÷ (+6) dBm	

1. OSNR = optical signal-to-noise ratio

2. 3R = retime, reshape, and regenerate

3. BER = bit error rate

Table 6-6 2.5-Gbps Interface Optical Performances

Parameter	Class D		Class E		Class F		Class G	
	Power limited	OSNR limited	Power limited	OSNR limited	Power limited	OSNR limited	Power limited	OSNR limited
OSNR sensitivity	14 dB	7 dB	14 dB	11 dB	15 dB	15 dB	14 dB	14 dB
Power sensitivity	-31 dBm	-23 dBm	-28 dBm	-23 dBm	-24 dBm	-24 dBm	-27 dBm	-24 dBm
Dispersion power penalty	2 dB	0 dB	2 dB	0 dB	3 dB	3 dB	2 dB	2 dB
Dispersion OSNR penalty	0 dB	2 dB	0 dB	2 dB	0 dB	0 dB	0 dB	0 dB
Dispersion compensating tolerance	-1,200 to +5,400 ps/nm		-1,200 to +5,400 ps/nm		-1,200 to +2,720 ps/nm		-1,200 to +5,400 ps/nm	
Maximum bit rate	2.5 Gbps		2.5 Gbps		2.5 Gbps		2.5 Gbps	
Regeneration	3R		3R		3R		3R	
FEC	Yes		No		No		No	
Threshold	Average		Average		Average		Average	

Table 6-6 2.5-Gbps Interface Optical Performances (continued)

Parameter	Class D	Class E	Class F	Class G
Maximum BER	10^{-15}	10^{-12}	10^{-12}	10^{-12}
Power overload	-9 dBm	-10 dBm	-9 dBm	-9 dBm
Transmitted power range	-4.5 to +1 dBm	-4.5 to +1 dBm	-4.5 to +1 dBm	-2 to 0 dBm

Tables 6-7 and 6-8 give the transmit output power ranges of 10-Gbps and 2.5-Gbps interfaces, respectively. These values, decreased by patch cord and connector losses, are also the input power values for the OADM cards.

Table 6-7 10-Gbps Interface Transmit Output Power Range or OADM Input Power Range

Parameter	Value					
	Class A		Class B		Class C	
	Min.	Max.	Min.	Max.	Min.	Max.
Power at Tx	0 dBm	+2 dBm	0 dBm	+2 dBm	+3 dBm	+6 dBm

Table 6-8 2.5-Gbps Interface Transmit Output Power Range or OADM Input Power Range

Parameter	Value							
	Class A		Class B		Class C		Class D	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Power at Tx	-4.5 dBm	+1 dBm	-4.5 dBm	+1 dBm	-4.5 dBm	+1 dBm	-2 dBm	0 dBm

6.1.5 DWDM Card Channel Allocation Plan

ONS 15454 DWDM multiplexers, demultiplexers, channel OADM, and band OADM cards are designed for use with specific channels. In most cases, the channels for these cards are either numbered (1 to 32) or delimited (odd or even). Client interfaces must comply with these channel assignments to be compatible with ONS 15454.

Table 6-9 lists the channel IDs and wavelengths assigned to the DWDM channels.

Table 6-9 DWDM Channel Allocation Plan

Channel Number	Channel ID	Frequency (THz)	Wavelength (nm)
1	30.3	195.9	1530.33
2	31.2	195.8	1531.12
3	31.9	195.7	1531.90
4	32.6	195.6	1532.68
5	34.2	195.4	1534.25

Table 6-9 DWDM Channel Allocation Plan (continued)

Channel Number	Channel ID	Frequency (THz)	Wavelength (nm)
6	35.0	195.3	1535.04
7	35.8	195.2	1535.82
8	36.6	195.1	1536.61
9	38.1	194.9	1538.19
10	38.9	194.8	1538.98
11	39.7	194.7	1539.77
12	40.5	194.6	1540.56
13	42.1	194.4	1542.14
14	42.9	194.3	1542.94
15	43.7	194.2	1543.73
16	44.5	194.1	1544.53
17	46.1	193.9	1546.12
18	46.9	193.8	1546.92
19	47.7	193.7	1547.72
20	48.5	193.6	1548.51
21	50.1	193.4	1550.12
22	50.9	193.3	1550.92
23	51.7	193.2	1551.72
24	52.5	193.1	1552.52
25	54.1	192.9	1554.13
26	54.9	192.8	1554.94
27	55.7	192.7	1555.75
28	56.5	192.6	1556.55
29	58.1	192.4	1558.17
30	58.9	192.3	1558.98
31	59.7	192.2	1559.79
32	60.6	192.1	1560.61

6.2 OSCM Card

An optical service channel (OSC) is a bidirectional channel connecting two adjacent nodes in a DWDM ring. For every DWDM node (except Terminal Nodes), two different OSC termination are present, one for the West side and another for the East. The channel transports OSC overhead that is used to manage ONS 15454 DWDM networks. The OSC signal uses the 1510-nm wavelength and does not affect client traffic. The primary purpose of this channel is to carry clock synchronization and orderwire channel communications for the DWDM network. It also provides transparent links between each node in the network. The OSC is an OC-3 formatted signal.

There are two versions of the OSC modules: the OSCM, and the OSC-CSM, which contains an OSC wavelength combiner and separator component in addition to the OSC module. For information about the OSC-CSM, see the “6.3 OSC-CSM Card” section on page 6-13. Figure 6-1 shows the OSCM faceplate.

Figure 6-1 OSCM Faceplate

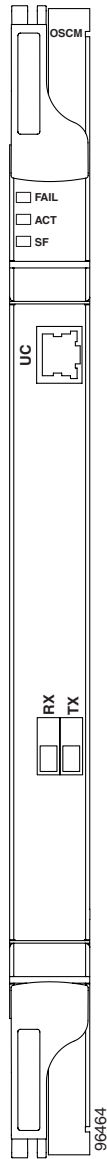
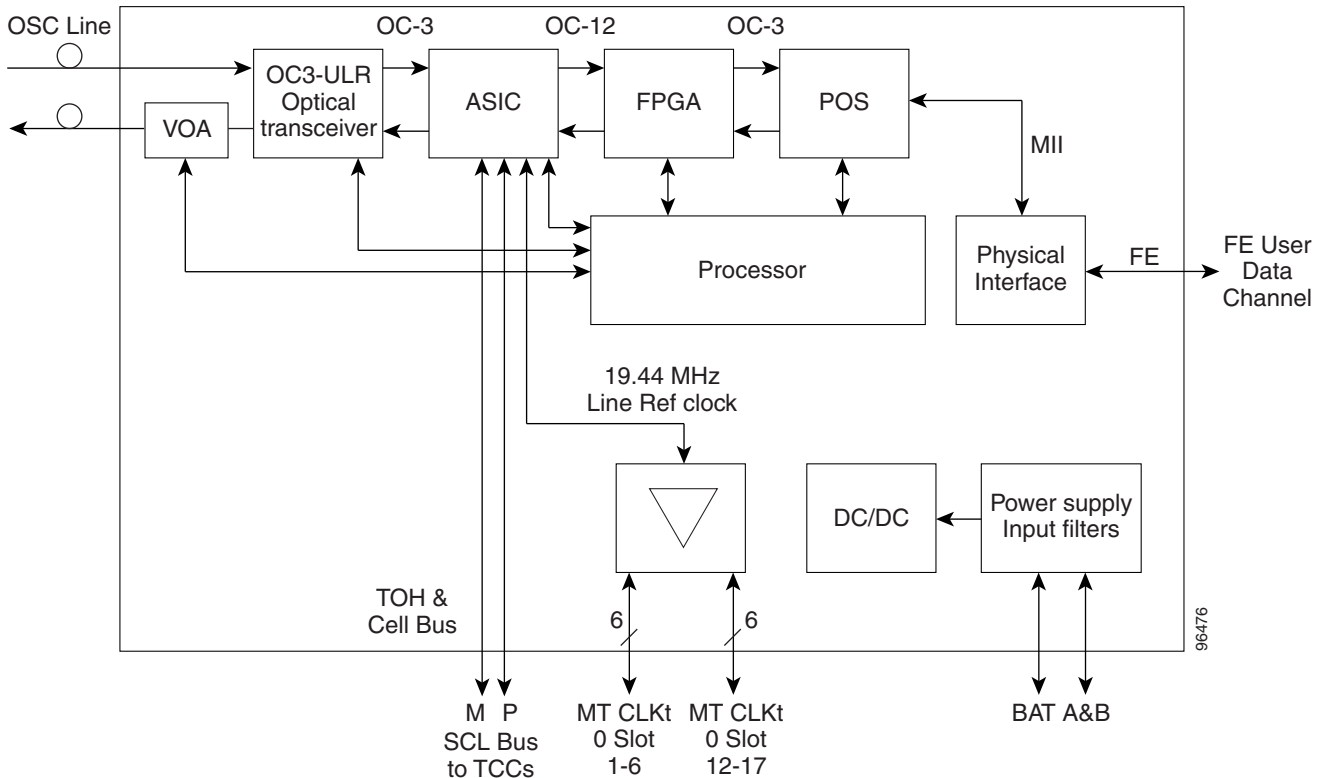


Figure 6-2 shows the OSCM block diagram.

Figure 6-2 OSCM Block Diagram



The OSCM is used in amplified nodes that include the OPT-BST booster amplifier. The OPT-BST includes the required OSC wavelength combiner and separator component. The OSCM cannot be used in nodes where you use OC-N cards, electrical cards, or cross-connect cards. The OSCM uses Slots 8 and 10, which are also cross-connect card slots.

The OSCM supports the following features:

- OC-3 formatted OSC
- Supervisory data channel (SDC) forwarded to the TCC2 cards for processing
- Distribution of the synchronous clock to all nodes in the ring
- 100BaseT FE user data channel (UDC)
- Monitoring functions such as orderwire support and optical safety

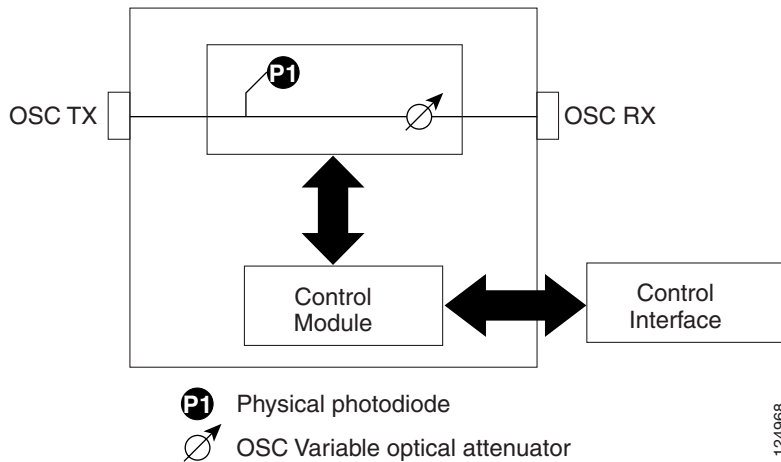
The OC-3 section data communications channel (SDCC) overhead bytes are used for network communications. An optical transceiver terminates the OC-3, then it is regenerated and converted into an electrical signal. The SDCC bytes are forwarded to the active and standby TCC2 cards for processing via the system communication link (SCL) bus on the backplane. Orderwire bytes (E1, E2, F1) are also forwarded via the SCL bus to the TCC2 for forwarding to the AIC-I card.

The payload portion of the OC-3 is used to carry the fast Ethernet UDC. The frame is sent to a packet over SONET (POS) processing block that extracts the Ethernet packets and makes them available at the RJ-45 connector.

The OSCM, which resides in the cross-connect slots and follows the ONS 15454 backplane architecture, distributes the reference clock information by removing it from the incoming OC-3 signal and then sending it to the DWDM cards. The DWDM cards then forward the clock information to the active and standby TCC2 cards.

Figure 6-3 shows the block diagram of the VOA within the OSCM.

Figure 6-3 OSCM VOA Optical Module Functional Block Diagram



6.2.1 Power Monitoring

Physical photodiode P1 monitors the power for the OSCM card. The returned power level value is calibrated to the OSC TX port. See [Table 6-10](#).

Table 6-10 OSCM VOA Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1	Output OSC	OSC TX

6.2.2 OSCM Card-Level Indicators

The OSCM card has three card-level LED indicators, described in [Table 6-11](#).

Table 6-11 OSCM 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OSCM is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L, or high BER on one or more of the card's ports. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.2.3 OSCM Port-Level Indicators

You can find 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. The OSCM has one OC-3 optical port located on the faceplate. One long-reach OSC transmits and receives the OSC to and from another DWDM node. Both data communications network (DCN) data and far-end (FE) payload are carried on this link.

6.2.4 OSCM Card Specifications

The OSCM card has the following specifications:

- Line
 - Bit rate: 155 Mbps
 - Code: Scrambled non-return to zero (NRZ)
 - Loopback modes: None
 - Connector: Duplex LC
 - Compliance: Telcordia GR-253-CORE, ITU-T G.957
- Transmitter OSC signal
 - Maximum transmitter output power: -1 dBm
 - Minimum transmitter output power: -5 dBm
 - Nominal wavelength: 1510-nm ± 10 nm
 - Variable optical attenuator (VOA) necessary in the transmit path to adjust the in-fiber optical power level
- Receiver OSC signal
 - Maximum receiver level: -8 dBm at 10^{-10} BER
 - Minimum receiver level: -40 dBm at 10^{-10} BER
 - Span budget: 40-dB span budget (about 150 km assuming fiber path loss equals 0.25 dB/km)
 - Jitter tolerance: Telcordia GR-253/G.823 compliant
- Environmental
 - Operating temperature:
 - C-Temp: -5 to $+55$ degrees Celsius ($+23$ to $+131$ degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
- Dimensions
 - Height: 12.65 in. (321.3 mm)
 - Width: 0.92 in. (23.4 mm)
 - Depth: 9.00 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.3 OSC-CSM Card

An optical service channel (OSC) is a bidirectional channel connecting all the nodes in a ring. The channel transports OSC overhead that is used to manage ONS 15454 DWDM networks. The OSC uses the 1510-nm wavelength and does not affect client traffic. The primary purpose of this channel is to carry clock synchronization and orderwire channel communications for the DWDM network. It also provides transparent links between each node in the network. The OSC is an OC-3 formatted signal.

There are two versions of the OSC modules: the OSCM, and the OSC-CSM which contains a combiner and separator module in addition to the OSC module. For information about the OSCM, see the “6.2 OSCM Card” section on page 6-8. Figure 6-4 shows the OSC-CSM faceplate.

Figure 6-4 OSC-CSM Faceplate

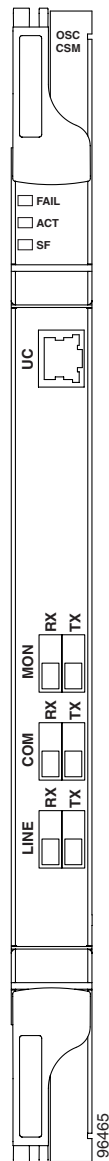


Figure 6-5 shows the OSC-CSM block diagram.

Figure 6-5 OSC-CSM Block Diagram

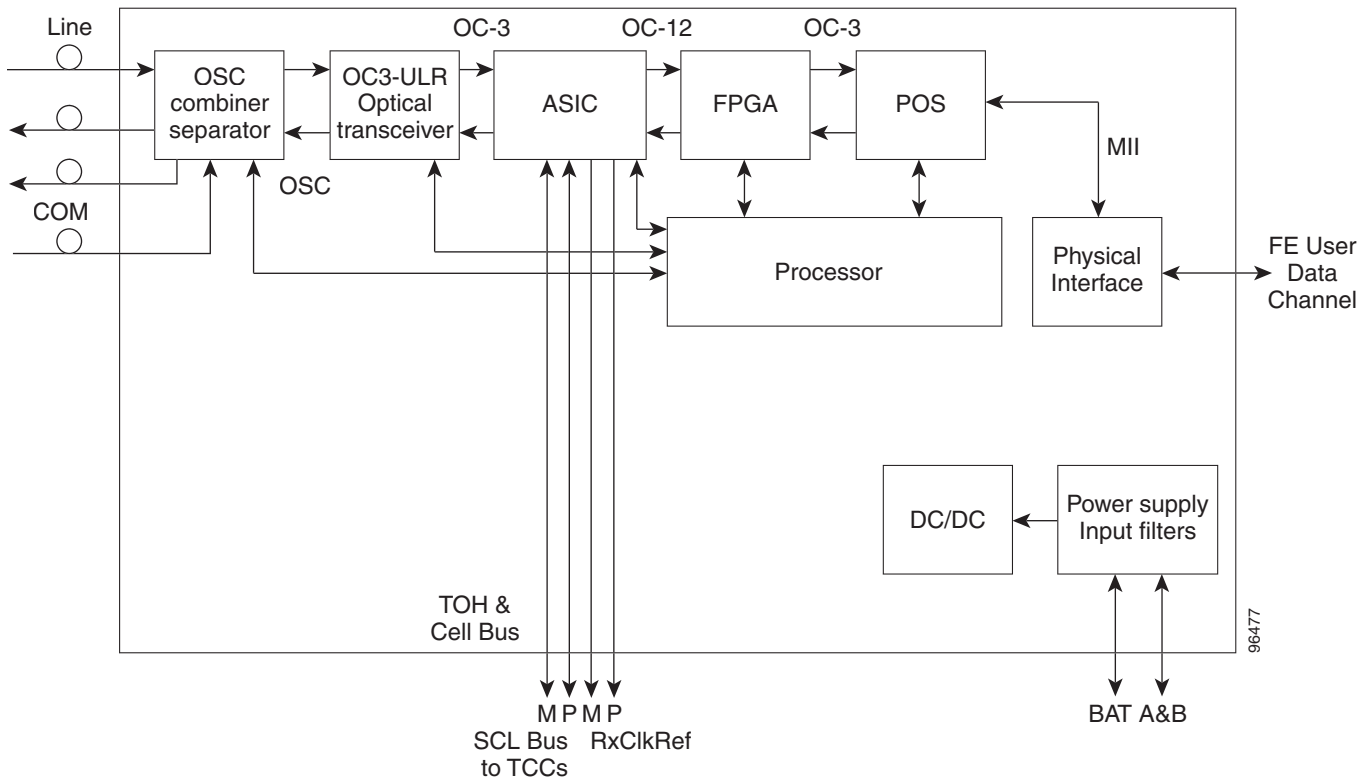
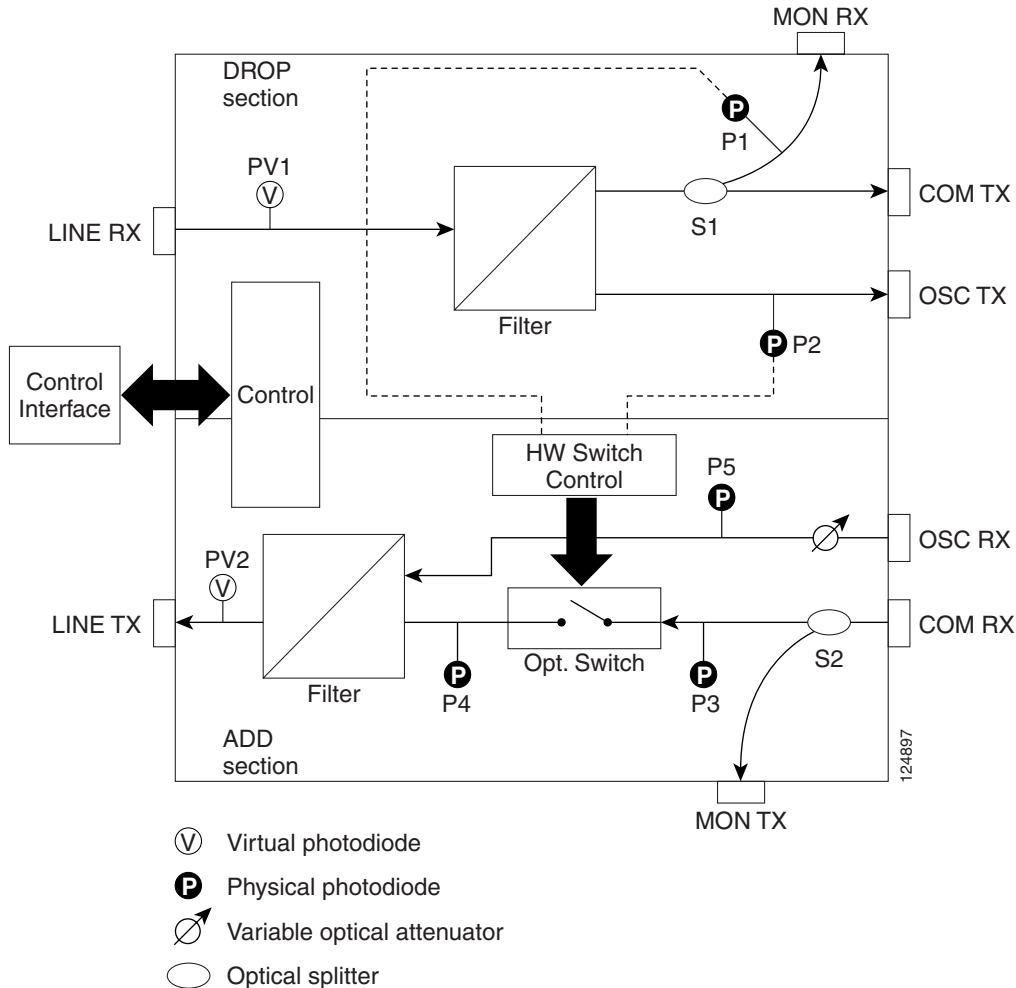


Figure 6-6 shows the OSC-CSM optical module functional block diagram.

Figure 6-6 OSC-CSM Optical Module Functional Block Diagram



The OSC-CSM is used in unamplified nodes. This means that the booster amplifier with the OSC wavelength combiner and separator is not required for OSC-CSM operation. The OSC-CSM can be installed in Slots 1 to 6 and 12 to 17. The cross-connect cards enable functionality on the OC-N cards and electrical cards.

The OSC-CSM supports the following features:

- Optical combiner and separator module for multiplexing and demultiplexing the optical service channel to or from the wavelength division multiplexing (WDM) signal
- OC-3 formatted OSC
- Supervisory data channel (SDC) forwarded to the TCC2 cards for processing
- Distribution of the synchronous clock to all nodes in the ring
- 100BaseT FE UDC
- Monitoring functions such as orderwire support and optical safety
- Optical safety: Signal loss detection and alarming, fast transmitted power shut down by means of an optical 1x1 switch
- Optical safety remote interlock (OSRI), a feature capable of shutting down the optical output power

- Automatic laser shutdown (ALS), a safety mechanism used in the event of a fiber cut

The WDM signal coming from the line is passed through the OSC combiner and separator, where the OSC signal is extracted from the WDM signal. The WDM signal is sent along with the remaining channels to the COM port (label on the front panel) for routing to the OADM or amplifier units, while the OSC signal is sent to an optical transceiver.

The OSC is an OC-3 formatted signal. The OC-3 SDCC overhead bytes are used for network communications. An optical transceiver terminates the OC-3, and then it is regenerated and converted into an electrical signal. The SDCC bytes are forwarded to the active and standby TCC2 cards for processing via the SCL bus on the backplane. Orderwire bytes (E1, E2, F1) are also forwarded via the SCL bus to the TCC2 for forwarding to the AIC-I card.

The payload portion of the OC-3 is used to carry the fast Ethernet UDC. The frame is sent to a POS processing block that extracts the Ethernet packets and makes them available at the RJ-45 front panel connector.

The OSC-CSM distributes the reference clock information by removing it from the incoming OC-3 signal and then sending it to the active and standby TCC2s. The clock distribution is different from the OSCM card because the OSC-CSM does not use Slot 8 or 10 (cross-connect card slots).

**Note**

S1 and S2 (see [Figure 6-6](#)) are optical splitters with a splitter ratio of 2:98. The result is that the power at the MON TX port is about 17 dB lower than the relevant power at the COM RX port, and the power at the MON RX port is about 20 dB lower than the power at the COM TX port. The difference is due to the presence of a tap coupler for the P1 photodiode.

6.3.1 Power Monitoring

Physical photodiodes P1, P2, P3, and P5 monitor the power for the OSC-CSM card. Their function is as follows:

- P1 and P2: The returned power value is calibrated to the LINE RX port, including the insertion loss of the previous filter (the reading of this power dynamic range has been brought backward towards the LINE RX output).
- P3: The returned value is calibrated to the COM RX port.
- P5: The returned value is calibrated to the LINE TX port, including the insertion loss of the subsequent filter.

The returned power level values are calibrated to the ports as shown in [Table 6-12](#).

Table 6-12 OSC-CSM Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1	Out Com	LINE RX
P2	Input OSC	LINE RX
P3	In Com	COM RX
P5	Output Osc	LINE TX

6.3.2 OSC-CSM Card-Level Indicators

The OSC-CSM card has three card-level LED indicators, described in [Table 6-13](#).

Table 6-13 OSC-CSM 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the OSC-CSM is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition such as LOS, LOF, AIS-L, or high BER on one or more of the card's ports. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.3.3 OSC-CSM Port-Level Indicators

You can find 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. The OSC-CSM has a UC port and three sets of ports located on the faceplate.

6.3.4 OSC-CSM Card Specifications

The OSC-CSM card has the following specifications:

- Line
 - Bit rate: 155 Mbps
 - Code: Scrambled NRZ
 - Loopback modes: None
 - Connector: Duplex LC
 - Compliance: Telcordia GR-253-CORE, ITU-T G.957
- Transmitter OSC signal
 - Maximum transmitter output power: –2 dBm
 - Minimum transmitter output power: –24 dBm
 - Nominal wavelength: 1510-nm +/-10 nm
 - VOA is necessary in the transmit path to adjust the in-fiber optical power level
- Receiver OSC signal
 - Maximum receiver level: –8 dBm at 10^{-10} BER
 - Minimum receiver level: –40 dBm at 10^{-10} BER



Note The minimum acceptable power level for the OSC receiver signal is -40dBm. Set the LOS-P alarm threshold accordingly in the same power range.



Note The minimum power level that CTC can read is -41dBm. CTC reports all values lower than -41dBm as -41.1dBm and not the actual measured value. When CTC reports -41.1dBm, the OSC-CSM card raises a LOS-P alarm.

- Span loss budget: 35- dB span budget (approximately 140 km assuming that the fiber path loss is equal to 0.25 dB/km)
- Jitter tolerance: Telcordia GR-253/G.823 compliant
- Environmental
 - Operating temperature:
 - C-Temp: -5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 95%, noncondensing
- Dimensions
 - Height: 12.65 in. (321.3 mm)
 - Width: 0.92 in. (23.4 mm)
 - Depth: 9.00 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.4 OPT-PRE Amplifier

Optical amplifiers are used in amplified nodes, such as hub nodes, amplified OADM nodes, and line amplifier nodes. There are two forms of amplifiers, the Optical Pre-amplifier (OPT-PRE) and the Optical Booster (OPT-BST) amplifier. For more information about the OPT-BST card, see the “[6.5 OPT-BST Amplifier](#)” section on page 6-23. The optical amplifier card architecture includes an optical plug-in module with a controller that manages optical power, laser current, and temperature control loops. The amplifier also manages communication with the TCC2, and operations, administration, maintenance, and provisioning (OAM&P) functions such as provisioning, controls, and alarms.

Optical amplifiers have a linear power feature that enables them to be kept in the constant gain mode if the gain is less than 28 dB. However, for longer span solutions it is necessary to place the amplifier in constant power mode. In constant power mode, automatic power control (APC) requirements change. This is because span loss degradation does not effect the system and amplifiers are not able to automatically modify the output power for variations in the number of channels when provisioning changes and a failure occurs.

Figure 6-7 shows the OPT-PRE amplifier faceplate.

Figure 6-7 OPT-PRE Faceplate

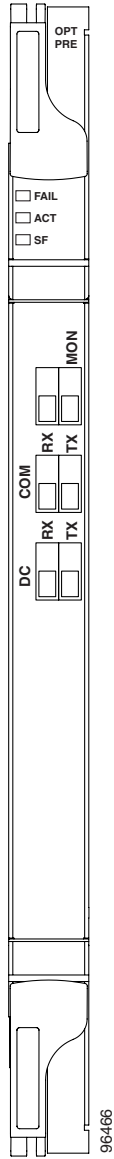


Figure 6-8 shows the OPT-PRE block diagram.

Figure 6-8 OPT-PRE Block Diagram

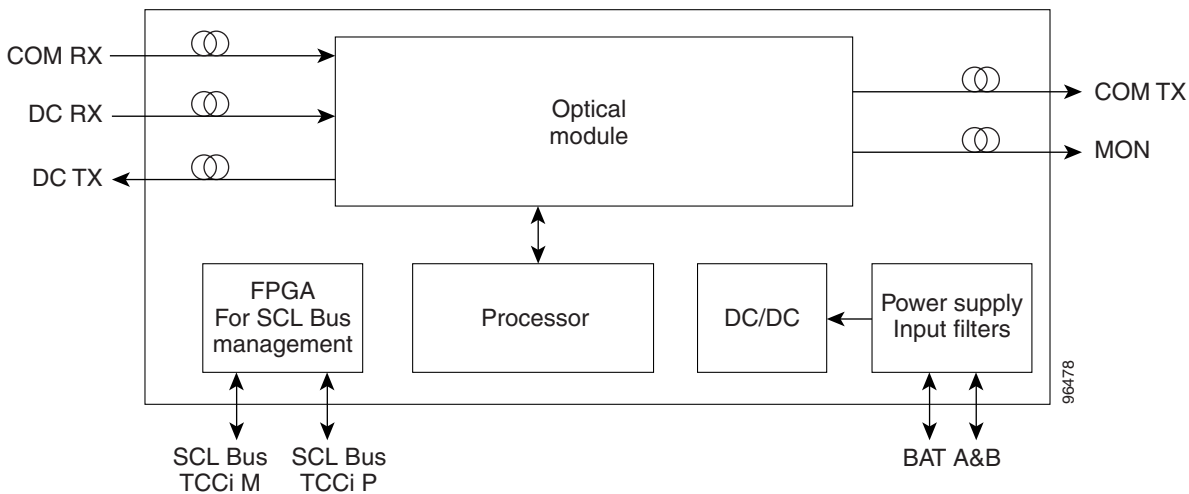
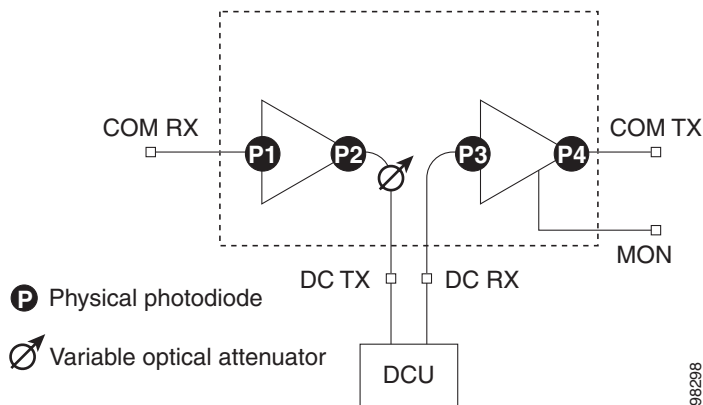


Figure 6-9 shows the OPT-PRE optical module functional block diagram.

Figure 6-9 OPT-PRE Optical Module Functional Block Diagram



The OPT-PRE is designed to support 64 channels at 50-GHz channel spacing, but currently, Software R4.6 supports 32 channels at 100 GHz. The OPT-PRE is a C-band DWDM, two-stage erbium-doped fiber amplifier (EDFA) with mid-amplifier loss (MAL) for allocation to a dispersion compensation unit (DCU). To control the gain tilt, the OPT-PRE is equipped with a built-in VOA. The VOA 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 OPT-PRE features:

- 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
- Optical safety features that include signal loss detection and alarming, fast power down control and reduced maximum output power in safe power mode
- 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. The result is that the power at the MON port is about 20 dB lower than the power at the COM TX port.

6.4.1 Power Monitoring

Physical photodiodes P1, P2, P3, and P4 monitor the power for the OPT-PRE card. The returned power level values are calibrated to the ports as shown in [Table 6-14](#).

Table 6-14 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)	

6.4.2 OPT-PRE Amplifier Card-Level Indicators

The OPT-PRE amplifier has three card-level LED indicators, described in [Table 6-15](#).

Table 6-15 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 there is an internal hardware failure. 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 illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.4.3 OPT-PRE Port-Level Indicators

You can find 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. The OPT-PRE amplifier has five optical ports located on the faceplate. MON is the output monitor port. COM Rx is the input signal port. COM Tx is the output signal port. DC Rx is the MAL input signal port. DC Tx is the MAL output signal port.

6.4.4 OPT-PRE Amplifier Specifications

The OPT-PRE amplifier has the following specifications:

- Optical characteristics:
 - Total operating wavelength range: 1530 to 1561.3 nm
 - Gain ripple (peak to valley): 1.5 dB
 - MAL range (for DCU): 3 to 9 dB
 - Gain range: 5 to 38.5 dBm in constant power mode, 5 to 28 dBm in constant gain mode
 - Minimum gain (standard range): 5.0 dBm
Maximum gain (standard range with programmable gain tilt): 21 dBm
Maximum gain (extended range with uncontrolled gain tilt): 38.5 dBm
 - Gain and power regulation over/undershoot: 0.5 dB
 - Limited maximum output power: 17.5 dBm
 - Maximum output power (with full channel load): 17 dB
 - Minimum output power (with one channel): -1 dBm
 - Input power (Pin) range at full channel load: -21.5 to 12 dBm
 - Input power (Pin) range at single channel load: -39.5 to -6 dBm
 - Noise figure at G^3 21 dB = 6.5 dB
 - OSC filter drop (channels) insertion loss maximum: 1 dB
 - OSC filter drop (OSC) insertion loss maximum: 1.8 dB
 - OSC filter add (OSC) insertion loss maximum: 1.3 dB
 - Optical connectors: LC-UPC/2
- Environmental
 - Operating temperature:
C-Temp: -5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 85%, noncondensing
- Dimensions
 - Height: 12.65 in. (332 mm)
 - Width: 0.92 in. (24 mm)
 - Depth: 9.00 in. (240 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.5 OPT-BST Amplifier

Optical amplifiers are used in amplified nodes such as hub nodes, amplified OADM nodes, and line amplifier nodes. There are two forms of amplifiers, the Optical Preamplifier (OPT-PRE) and the Optical Booster (OPT-BST) amplifier. The optical amplifier card architecture includes an optical plug-in module with a controller that manages optical power, laser current, and temperature control loops. The amplifier also manages communication with the TCC2 and OAM&P functions such as provisioning, controls, and alarms.

Optical amplifiers have a linear power feature that enables them to be kept in the constant gain mode. The OPT-BST gain range is 5 to 20 dB in constant gain mode and output power mode. In constant power mode, automatic power control (APC) requirements change. This is because span loss degradation does not effect the system and amplifiers are not able to automatically modify the output power for variations in the number of channels when provisioning changes and a failure occurs.

Figure 6-10 shows the OPT-BST amplifier faceplate.

Figure 6-10 OPT-BST Faceplate

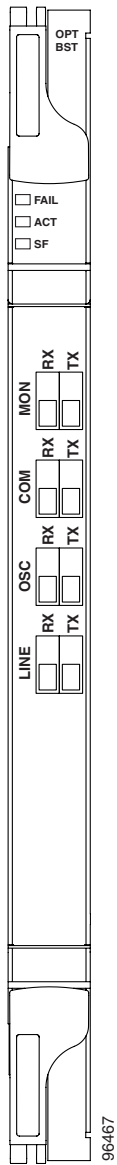


Figure 6-11 shows the OPT-BST amplifier block diagram.

Figure 6-11 OPT-BST Block Diagram

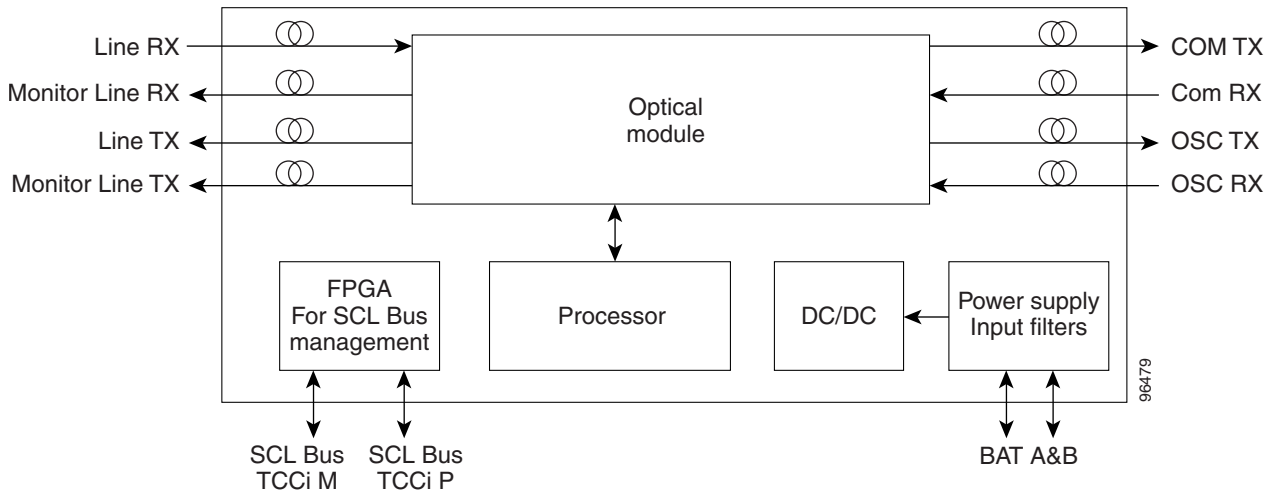


Figure 6-12 shows the OPT-BST optical module functional block diagram.

Figure 6-12 OPT-BST Optical Module Functional Block Diagram

The OPT-BST is designed to support 64 channels at 50-GHz channel spacing, but currently, Software R4.6 supports 32 channels at 100 GHz. The OPT-BST is a C-band DWDM EDFA with OSC add-and-drop capability. When an ONS 15454 has an OPT-BST installed, it is only necessary to have the OSCM to process the OSC. You can install the OPT-BST in Slots 1 to 6 and 12 to 17. To control the gain tilt, the OPT-BST is equipped with a built-in VOA.

The OPT-BST 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
- ASE compensation in fixed gain mode
- Full monitoring and alarm handling with settable thresholds
- Optical safety features, including signal loss detection and alarming, fast power down control, and reduced maximum output power in safe power mode
- OSRI, which is a feature capable of shutting down the optical output power or reducing the power to a safe level (automatic power reduction)
- ALS, which is a safety mechanism used in the event of a fiber cut

**Note**

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

6.5.1 Power Monitoring

Physical photodiodes P1, P2, P3, and P4 monitor the power for the OPT-BST card. The returned power level values are calibrated to the ports as shown in [Table 6-16](#).

Table 6-16 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)	
P3	Output COM	LINE RX
P4	Output OSC	

6.5.2 OPT-BST Amplifier-Level Indicators

The OPT-BST amplifier has three card-level LED indicators, described in [Table 6-17](#).

Table 6-17 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.

Table 6-17 OPT-BST Card-Level Indicators (continued)

Card-Level Indicators	Description
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 illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.5.3 OPT-BST Port-Level Indicators

You can find 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. 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.

6.5.4 OPT-BST Amplifier Specifications

The OPT-BST amplifier has the following specifications:

- Optical characteristics:
 - Total operating wavelength range: 1530 to 1561.3 nm
 - Gain ripple (peak to valley): 1.5 dB
 - Gain range: 5 to 20 dBm with programmable gain tilt
 - Gain and power regulation over/undershoot: 0.5 dB
 - Limited maximum output power: 17.5 dBm
 - Maximum output power (with full channel load): 17 dB
 - Minimum output power (with one channel): -1 dBm
 - Input power (Pin) range at full channel load: -3 to 12 dBm
 - Input power (Pin) range at single channel load: -21 to -6 dBm
 - Noise figure at G^3 20 dB = 6 dB
 - OSC filter drop (channels) insertion loss maximum: 1 dB
 - OSC filter drop (OSC) insertion loss maximum: 1.8 dB
 - OSC filter add (OSC) insertion loss maximum: 1.3 dB
 - Optical connectors: LC-UPC/2
- Environmental
 - Operating temperature:
 - C-Temp: -5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 85%, noncondensing

- Dimensions
 - Height: 12.65 in. (332 mm)
 - Width: 0.92 in. (24 mm)
 - Depth: 9.00 in. (240 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.6 32 MUX-O Card

The 32-channel multiplexer card (32 MUX-O) multiplexes 32 100-GHz-spaced channels identified in the channel plan. The 32 MUX-O card takes up two slots in an ONS 15454 and can be installed in Slots 1 to 5 and 12 to 16. The 32 MUX-O features include:

- Arrayed waveguide grating (AWG), which enables full multiplexing functions for the channels.
- Each single-channel port is equipped with VOAs for automatic optical power regulation prior to multiplexing. In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available.
- Each single-channel port is monitored using a photodiode to enable automatic power regulation.
- An additional optical monitoring port with 1/99 splitting ratio is available.

[Figure 6-13](#) shows the 32 MUX-O faceplate.

Figure 6-13 32 MUX-O Faceplate

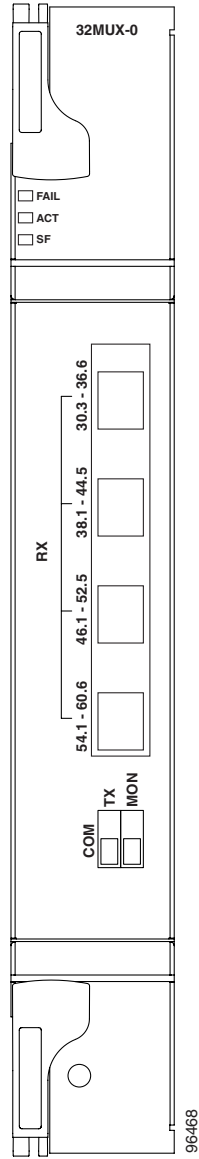


Figure 6-14 shows the 32 MUX-O block diagram.

Figure 6-14 32 MUX-O Block Diagram

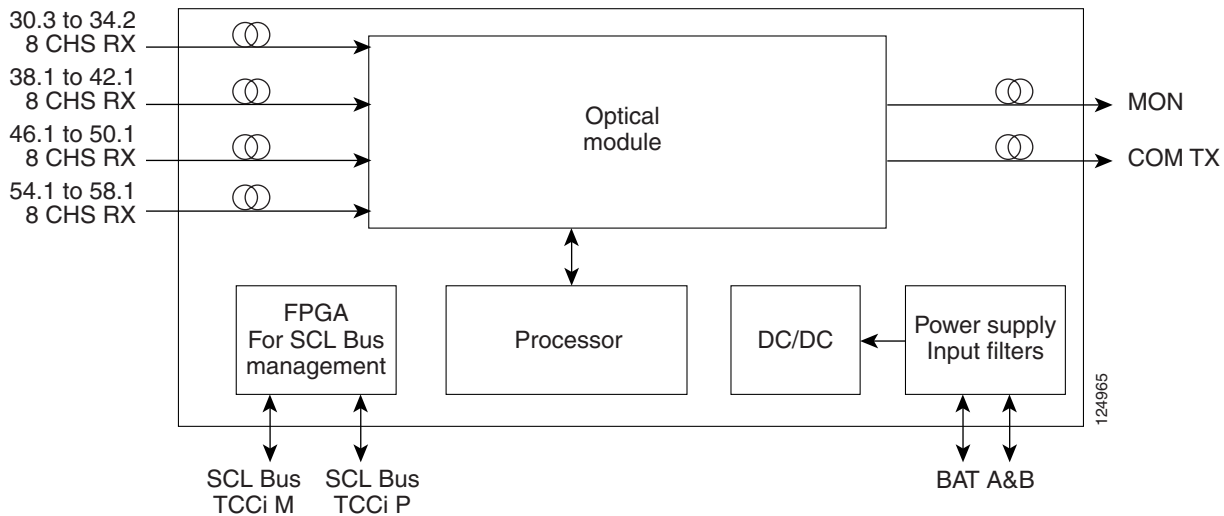
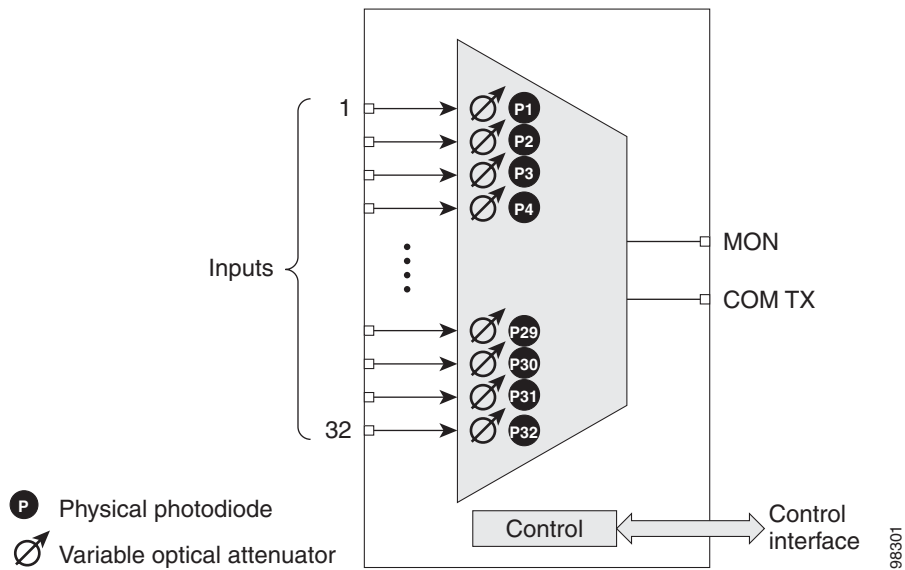


Figure 6-15 shows the 32MUX-O optical module functional block diagram.

Figure 6-15 32MUX-O Optical Module Functional Block Diagram



6.6.1 Power Monitoring

Physical photodiodes P1 through P32 monitor the power for the 32 MUX-O card. The returned power level values are calibrated to the ports as shown in [Table 6-18](#).

Table 6-18 32 MUX-O Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1 - P32	ADD	COM TX

6.6.2 32 MUX-O Card-Level Indicators

The 32 MUX-O card has three card-level LED indicators, described in [Table 6-19](#).

Table 6-19 32 MUX-O 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the 32 MUX-O is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure on one or more of the card's ports. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.6.3 32 MUX-O Port-Level Indicators

You can find 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. The 32 MUX-O card has five sets of ports located on the faceplate.

COM Tx is the line output. MON is the optical monitoring port. The xx.x-yy.y Rx ports represent the four groups of 8 channels ranging from xx.x wavelength to yy.y wavelength according to the channel plan.

6.6.4 32 MUX-O Card Specifications

The 32 MUX-O card optical specifications are listed in [Table 6-20](#).



Note

For power specifications, refer to the [“6.1.4 Multiplexer, Demultiplexer, and OADM Card Interface Classes”](#) section on page 6-5.

Table 6-20 32 MUX-O Optical Specifications

Parameter	Note	Condition	Min	Max	Unit
Tx filter shape (–1 dB bandwidth)	All standard operating procedure (SOP) and within whole operating temperature range	In 1/32—Out beginning of life (BOL)	+/- 180	+/- 300	pm
		In 1/32—Out end of life (EOL)	+/- 160		
Insertion loss	All SOP and within whole operating temperature range	In 1/32—Out BOL	4	8.0	dB
		In 1/32—Out EOL		8.5	
Variable optical attenuation (VOA) dynamic range	—	—	25		dB
Optical monitor tap-splitting ratio on monitor port	Optical monitor port with respect to output port in multiplexer only	—	19	21	dB
Maximum optical input power	—	—	300	—	mW

The 32 MUX-O card has the following additional specifications:

- Environmental
 - Operating temperature:
 - C-Temp: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 95% relative humidity (RH)
- Dimensions
 - Height: 12.65 in. (321.3 mm)
 - Width: 1.84 in. (46.8 mm)
 - Depth: 9.00 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.7 32 DMX-O Card

The 32-Channel Demultiplexer (32 DMX-O) card demultiplexes 32 100-GHz-spaced channels identified in the channel plan. The 32 DMX-O takes up two slots in an ONS 15454 and can be installed in Slots 1 to 5 and 12 to 16. The DMX-O features include:

- AWG that enables the full demultiplexing functions.
- Each single-channel port is equipped with VOAs for automatic optical power regulation after demultiplexing. In the case of electrical power failure, the VOA is set to its maximum attenuation for safety purposes. A manual VOA setting is also available.
- Each single-channel port is monitored using a photodiode to enable automatic power regulation.

Figure 6-16 shows the 32 DMX-O card faceplate.

Figure 6-16 32 DMX-O Faceplate

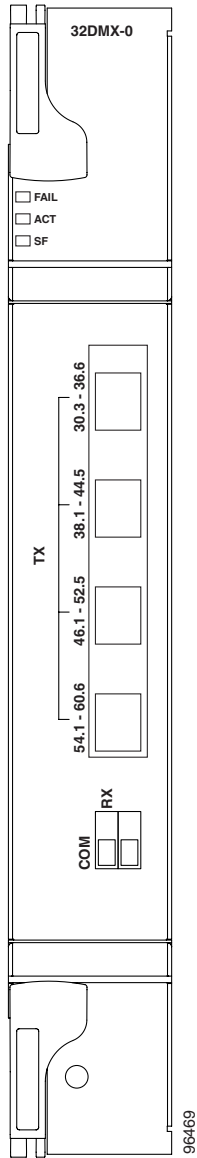


Figure 6-17 shows the 32 DMX-O block diagram.

Figure 6-17 32 DMX-O Block Diagram

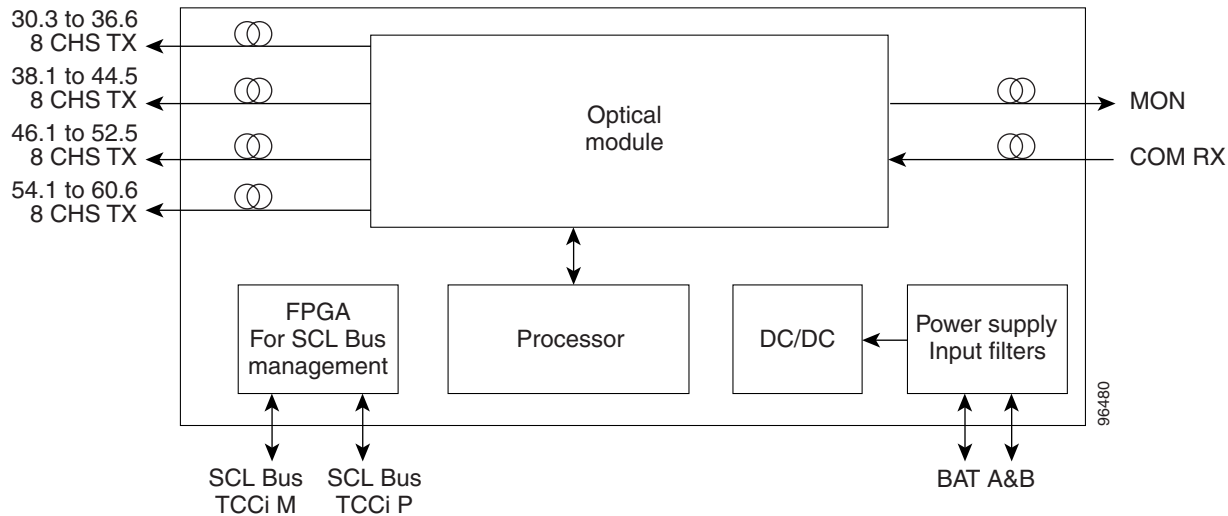
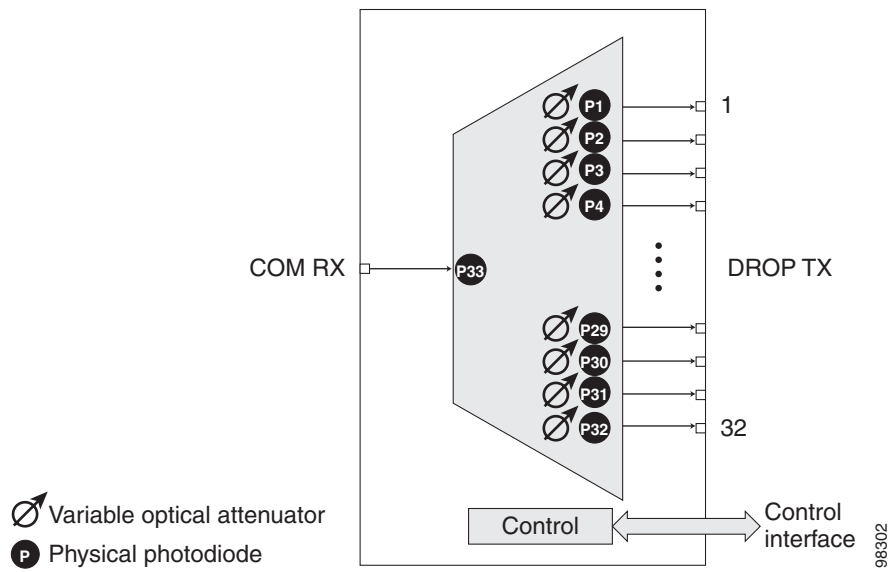




Figure 6-18 shows the 32 DMX-O optical function block diagram.

Figure 6-18 32 DMX-O Optical Function Diagram



 Variable optical attenuator
 Physical photodiode

6.7.1 Power Monitoring

Physical photodiodes P1 through P32 and P33 monitor the power for the 32 DMX-O card. The returned power level values are calibrated to the ports as shown in [Table 6-21](#).

Table 6-21 32 DMX-O Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1 - P32	DROP	DROP TX Channel
P33	INPUT COM	COM RX

6.7.2 32 DMX-O Card-Level Indicators

The 32 DMX-O card has three card-level LED indicators, described in [Table 6-22](#).

Table 6-22 32 DMX-O 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the 32 DMX-O is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure on one or more of the card's ports. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.7.3 32 DMX-O Port-Level Indicators

You can find 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. The 32 DMX-O card has five sets of ports located on the faceplate. MON is the output monitor port. COM Rx is the line output. The xx.x-yy.y Tx ports represent the four groups of eight channels ranging from xx.x wavelength to yy.y wavelength according to the channel plan.

6.7.4 32 DMX-O Card Specifications

The 32 DMX-O card optical specifications are listed in [Table 6-23](#).



Note

For power specifications, refer to the [“6.1.4 Multiplexer, Demultiplexer, and OADM Card Interface Classes”](#) section on page 6-5.

Table 6-23 32 DMX-O Optical Specifications

Parameter	Note	Condition	Min	Max	Unit
Rx filter shape (–1 dB bandwidth)	All SOP and within whole operating temperature range	In 1/32—Out BOL	+/- 180	+/- 300	pm
		In 1/32—Out EOL	+/- 160		
Insertion loss	All SOP and within whole operating temperature range	In 1/32—Out BOL	4	8.0	dB
		In 1/32—Out EOL		8.5	
VOA dynamic range	—	—	25	—	dB
Maximum optical input power	—	—	300	—	mW

The 32 DMX-O card has the following additional specifications:

- Environmental
 - Operating temperature:
 - C-Temp: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 95% RH
- Dimensions
 - Height: 12.65 in. (321.3 mm)
 - Width: 1.84 in. (46.8 mm)
 - Depth: 9.00 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.8 4MD-xx.x Card

The 4-Channel Multiplexer/Demultiplexer (4MD-xx.x) card multiplexes and demultiplexes four 100-GHz-spaced channels identified in the channel plan. The 4MD-xx.x card is designed to be used with band OADMs (both AD-1B-xx.x and AD-4B-xx.x). There are eight versions of this card that correspond with the eight sub-bands specified in [Table 6-24](#). The 4MD-xx.x can be installed in Slots 1 to 6 and 12 to 17.

The 4MD-xx.x has the following features implemented inside a plug-in optical module:

- Passive cascade of interferential filters perform the channel multiplex/demultiplex function.
- Software controlled VOAs at every port of the multiplex section to regulate the optical power of each multiplexed channel.
- Software monitored photodiodes at the input and output multiplexer and demultiplexer ports for power control and safety purposes.
- Software-monitored “virtual photodiodes” at the common DWDM output and input ports. A “virtual photodiode” is a firmware calculation of the optical power at that port. This calculation is based on the single channel photodiode reading and insertion losses of the appropriated paths.

[Table 6-24](#) shows the band IDs and the add/drop channel IDs for the 4MD-xx.x card.

Table 6-24 4MD-xx.x Channel Sets

Band IDs	Add/Drop Channel IDs
Band 30.3 (A)	30.3, 31.2, 31.9, 32.6
Band 34.2 (B)	34.2, 35.0, 35.8, 36.6
Band 38.1 (C)	38.1, 38.9, 39.7, 40.5
Band 42.1 (D)	42.1, 42.9, 43.7, 44.5
Band 46.1 (E)	46.1, 46.9, 47.7, 48.5
Band 50.1 (F)	50.1, 50.9, 51.7, 52.5
Band 54.1 (G)	54.1, 54.9, 55.7, 56.5
Band 58.1 (H)	58.1, 58.9, 59.7, 60.6

Figure 6-19 shows the 4MD-xx.x faceplate.

Figure 6-19 4MD-xx.x Faceplate

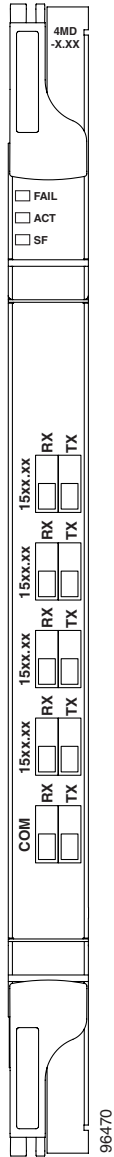


Figure 6-20 shows the 4MD-xx.x block diagram.

Figure 6-20 4MD-xx.x Block Diagram

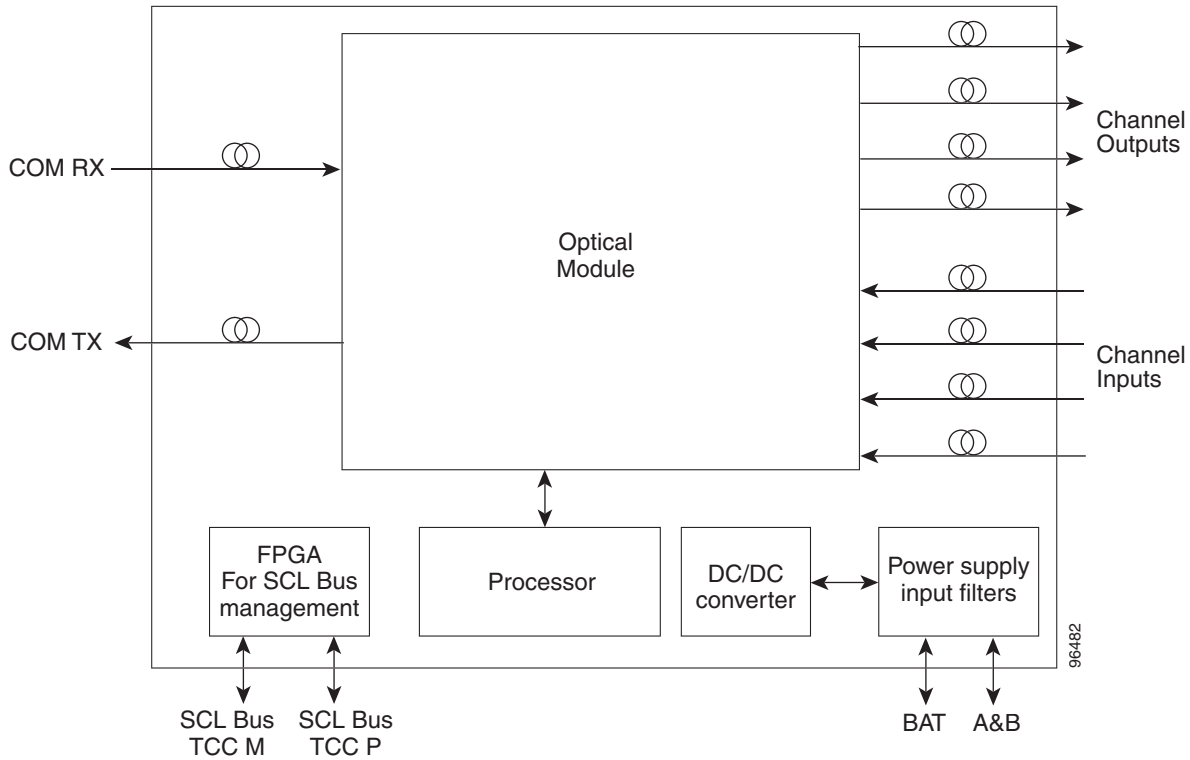
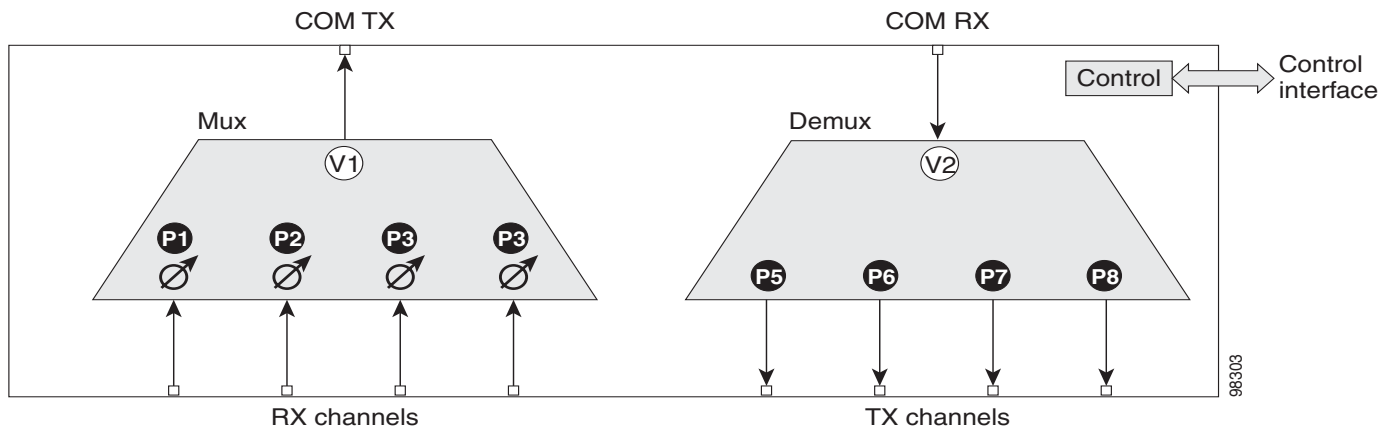


Figure 6-21 shows the 4MD-xx.x optical function block diagram.

Figure 6-21 4MD-xx.x Optical Function Diagram



- Ⓟ Virtual photodiode
- Ⓟ Physical photodiode
- Ⓟ Variable optical attenuator

The Optical Module shown in Figure 6-21 is optically passive and consists of a cascade of interferential filters that perform the channel mux/demux functions.

VOAs are present in every input path of the multiplex section in order to regulate the optical power of each multiplexed channel. Some optical input and output ports are monitored by means of photodiodes implemented both for power control and for safety purposes. An internal control manages VOA settings and functionality as well as photodiode detection and alarm thresholds. The power at the main output and input ports is monitored through the use of “virtual photodiodes.” A virtual photodiode is implemented in the firmware of the plug-in module. This firmware calculates the power on a port, summing the measured values from all single channel ports (and applying the proper path insertion loss) then providing the TCC2 with the obtained value.

6.8.1 Power Monitoring

Physical photodiodes P1 through P8, and virtual photodiodes V1 and V2 monitor the power for the 4MD-xx.x card. The returned power level values are calibrated to the ports as shown in [Table 6-25](#).

Table 6-25 4MD-xx.x Port Calibration

Photodiode	CTC “Type” Name	Calibrated to Port
P1 - P4	ADD	COM TX
P5 - P8	DROP	DROP TX Channel
V1	OUT COM	COM TX
V2	IN COM	COM RX

6.8.2 4MD-xx.x Card-Level Indicators

The 4MD-xx.x card has three card-level LED indicators, described in [Table 6-26](#).

Table 6-26 4MD-xx.x 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the 4MD-xx.x card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure on one or more of the card’s ports. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.8.3 4MD-xx.x Port-Level Indicators

You can find 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. The 4MD-xx.x card has five sets of ports located on the faceplate. COM Rx is the line input. COM Tx is the line output. The 15xx.x Tx ports represent demultiplexed channel Outputs 1 to 4. The 15xx.x Rx ports represent multiplexed channel Inputs 1 to 4.

6.8.4 4MD-xx.x Card Specifications

The 4MD-xx.x card optical specifications are listed in [Table 6-27](#).



Note

For power specifications, refer to the “[6.1.2 Card Power Requirements](#)” section on page 6-3.

Table 6-27 32 MUX-O Optical Specifications

Parameter	Note	Condition	Min	Max	Unit
Trx filter shape (−0.5 dB bandwidth TrxBW ₂)	All SOP and within whole operating temperature range	COM Rx—xx.xx Tx COM Rx—yy.yy Tx COM Rx—zz.zz Tx COM Rx—kk.kk Tx xx.xx Rx—COM Tx yy.yy Rx—COM Tx zz.zz Rx—COM Tx kk.kk Rx—COM Tx	+/- 180	—	pm
Insertion loss demultiplexer section	All SOP and within whole operating temperature range	COM Rx—xx.xx Tx	—	1.9	dB
		COM Rx—yy.yy Tx	—	2.4	dB
		COM Rx—zz.zz Tx	—	2.8	dB
		COM Rx—kk.kk Tx	—	3.3	dB
Insertion loss multiplexer section	All SOP and within whole operating temperature range (Two connectors included)	xx.xx Rx—COM Tx	—	3.6	dB
		yy.yy Rx—COM Tx	—	3.2	dB
		zz.zz Rx—COM Tx	—	3.0	dB
		kk.kk Rx—COM Tx	—	2.6	dB
VOA dynamic range	—	—	25	—	dB
Maximum optical input power	—	—	300	—	mW

The 4MD-xx.x card has the following additional specifications:

- Environmental
 - Operating temperature:
 - C-Temp: −5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: 5 to 95% RH
- Dimensions
 - Height: 12.65 in. (321.3 mm)
 - Width: 0.92 in. (23.4 mm)

- Depth: 9.00 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.9 AD-1C-xx.x Card

The 1-Channel OADM (AD-1C-xx.x) card passively adds or drops one of the 32 channels utilized within the 100-GHz-spacing of the DWDM card system. Thirty-two versions of this card—each designed only for use with one wavelength—are used in the ONS 15454 DWDM system. Each wavelength version of the card has a different part number.

The AD-1C-xx.x can be installed in Slots 1 to 6 and 12 to 17.

The AD-1C-xx.x has the following internal features:

- Two passive optical interferential filters perform the channel add and drop functions.
- One software-controlled VOA regulates the optical power of the inserted channel.
- Software-controlled VOA regulates the insertion loss of the express optical path.
- Internal control of the VOA settings and functions, photodiode detection, and alarm thresholds.
- Software-monitored virtual photodiodes (firmware calculations of port optical power) at the common DWDM output and input ports.

Figure 6-22 shows the AD-1C-xx.x faceplate.

Figure 6-22 AD-1C-xx.x Faceplate

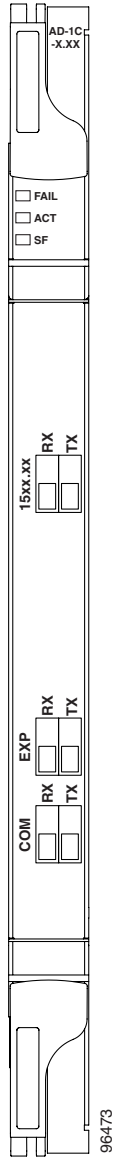


Figure 6-23 shows the AD-1C-xx.x block diagram.

Figure 6-23 AD-1C-xx.x Block Diagram

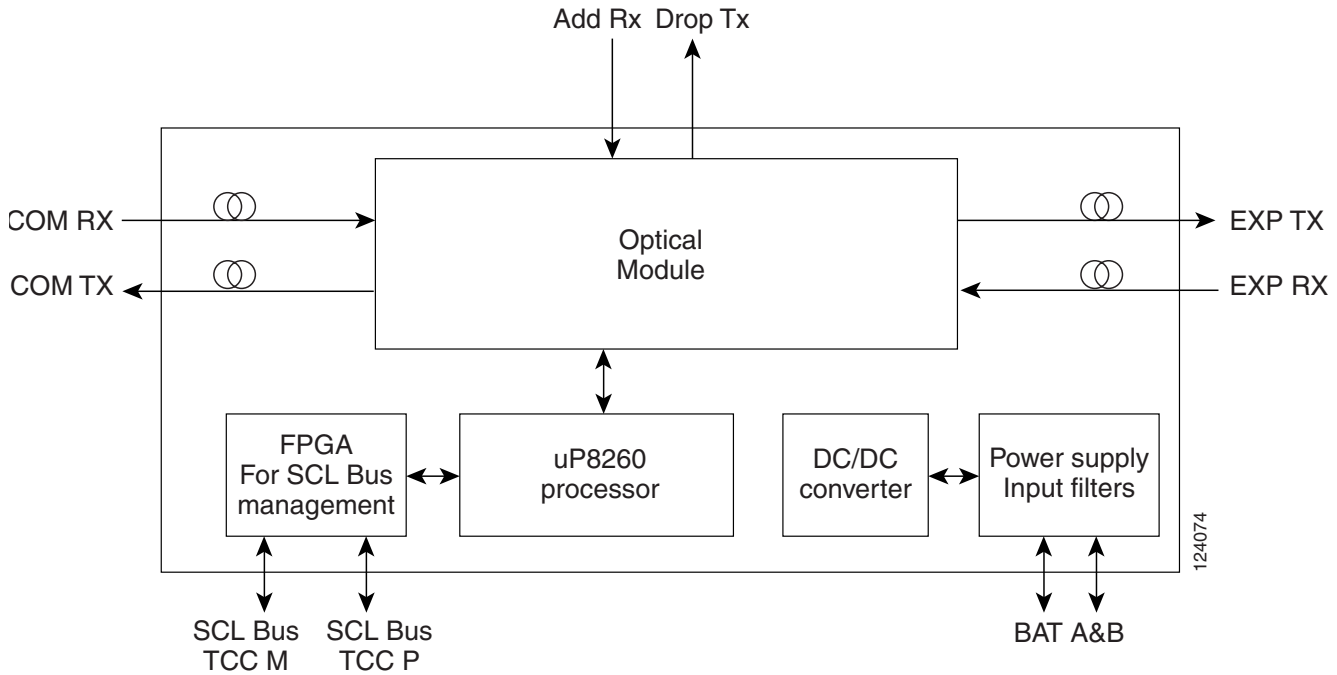
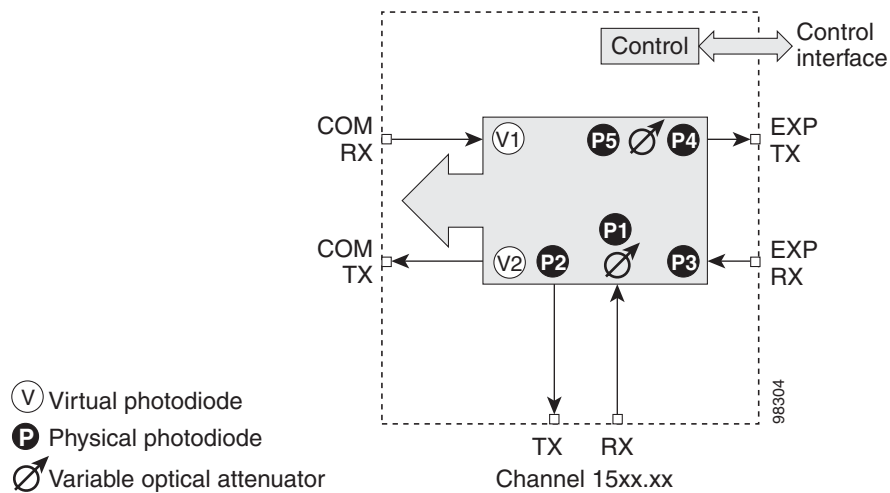


Figure 6-24 shows the AD-1C-xx.x optical module functional block diagram.

Figure 6-24 AD-1C-xx.x Optical Module Functional Block Diagram



6.9.1 Power Monitoring

Physical photodiodes P1 through P4, and virtual photodiodes V1 and V2 monitor the power for the AD-1C-xx.x card. The returned power level values are calibrated to the ports as shown in [Table 6-28](#).

Table 6-28 AD-1C-xx.x Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1	ADD	COM TX
P2	DROP	DROP TX Channel
P3	IN EXP	EXP RX
P4	OUT EXP	EXP TX
V1	IN COM	COM RX
V2	OUT COM	COM TX

6.9.2 AD-1C-xx.x Card-Level Indicators

The AD-1C-xx.x card has three card-level LED indicators, described in [Table 6-29](#).

Table 6-29 AD-1C-xx.x 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the AD-1C-xx.x card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure. The SF LED also illuminates when the transmitting and receiving fibers are incorrectly connected. When the fibers are properly connected, the LED turns off.

6.9.3 AD-1C-xx.x Port-Level Indicators

You can find the status of the card port 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. The AD-1C-xx.x has six LC-PC-II optical ports: two for add/drop channel client input and output, two for express channel input and output, and two for communication.

6.9.4 AD-1C-xx.x Card Specifications

Table 6-30 lists the AD-1C-xx.x optical specifications.

Table 6-30 AD-1C-xx.x Card Optical Specifications

Parameter	Condition	Note	Min	Max	Unit
Trx filter shape (-0.5 dB bandwidth) TrxBW ₂	COM Rx—xx.xx Tx xx.xx Rx—COM Tx	All SOP and within whole operating temperature range	+/- 180	—	pm
Rfx filter shape (-0.5 dB bandwidth) RfxBW ₂	COM Rx—Exp Tx Exp Rx—COM Tx	All SOP and within whole operating temperature range	+/- 180	—	pm
Insertion loss (drop section)	COM Rx—xx.xx Tx	All SOP and within whole operating temperature range (two connectors included)	—	2.0	dB
Insertion loss (express section)	COM Rx—Exp Tx Exp Rx—COM Tx	VOA at minimum attenuation; all SOP and within whole operating temperature range (two connectors included)	—	2.4 or 1.2	dB
Insertion loss (add section)	xx.xx Rx—COM Tx	VOA at minimum attenuation; all SOP and within whole operating temperature range (two connectors included)	—	2.6	dB
VOA dynamic range	—	—	30	—	dB
Maximum optical input power	—	—	300	—	mW

AD-1C-xx.x optical input and output power vary with amplifier output levels and the class of transponder interfaces used. See Table 6-4 on page 6-5 through Table 6-8 on page 6-7 for this information.

The AD-1C-xx.x card has the following additional specifications:

- Environmental
 - Operating temperature:
 - C-Temp: -5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: Telcordia GR-63 5.1.1.3 compliant; 5 to 95% RH
- Dimensions
 - Height: 12.650 in. (321.3 mm)
 - Width: 0.92 in. (23.4 mm)
 - Depth: 9.0 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.10 AD-2C-xx.x Card

The 2-Channel OADM (AD-2C-xx.x) card passively adds or drops two adjacent 100-GHz channels within the same band. Sixteen versions of this card—each designed for use with one pair of wavelengths—are used in the ONS 15454 DWDM system. The card bidirectionally adds and drops in two different sections on the same card to manage signal flow in both directions.

Each version of the card has a different part number.

The AD-2C-xx.x has the following features:

- Passive cascade of interferential filters perform the channel add and drop functions.
- Two software-controlled VOAs in the add section, one for each add port, regulate the optical power of inserted channels.
- Software-controlled VOAs regulate insertion loss on express channels.
- Internal control of the VOA settings and functions, photodiode detection, and alarm thresholds.
- Software-monitored virtual photodiodes (firmware calculation of port optical power) at the common DWDM output and input ports.

The AD-2C-xx.x cards are provisioned for the wavelength pairs in [Table 6-31](#). In this table, channel IDs are given rather than wavelengths. To compare channel IDs with the actual wavelengths they represent, see [Table 6-9 on page 6-7](#).

Table 6-31 AD-2C-xx.x Channel Pairs

Band ID	Add/Drop Channel ID
Band 30.3 (A)	30.3, 31.2
	31.9, 32.6
Band 34.2 (B)	34.2, 35.0
	35.8, 36.6
Band 38.1 (C)	38.1, 38.9
	39.7, 40.5
Band 42.1 (D)	42.1, 42.9
	43.7, 44.5
Band 46.1 (E)	46.1, 46.9
	47.7, 48.5
Band 50.1 (F)	50.1, 50.9
	51.7, 52.5
Band 54.1 (G)	54.1, 54.9
	55.7, 56.5
Band 58.1 (H)	58.1, 58.9
	59.7, 60.6

Figure 6-25 shows the AD-2C-xx.x faceplate.

Figure 6-25 AD-2C-xx.x Faceplate

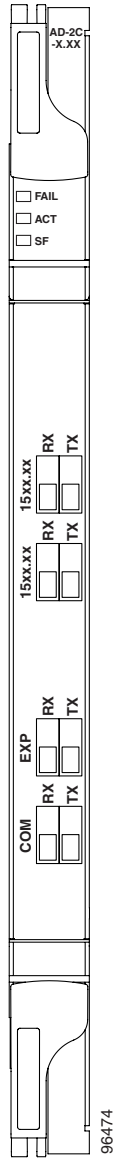


Figure 6-26 shows the AD-2C-xx.x block diagram.

Figure 6-26 AD-2C-xx.x Block Diagram

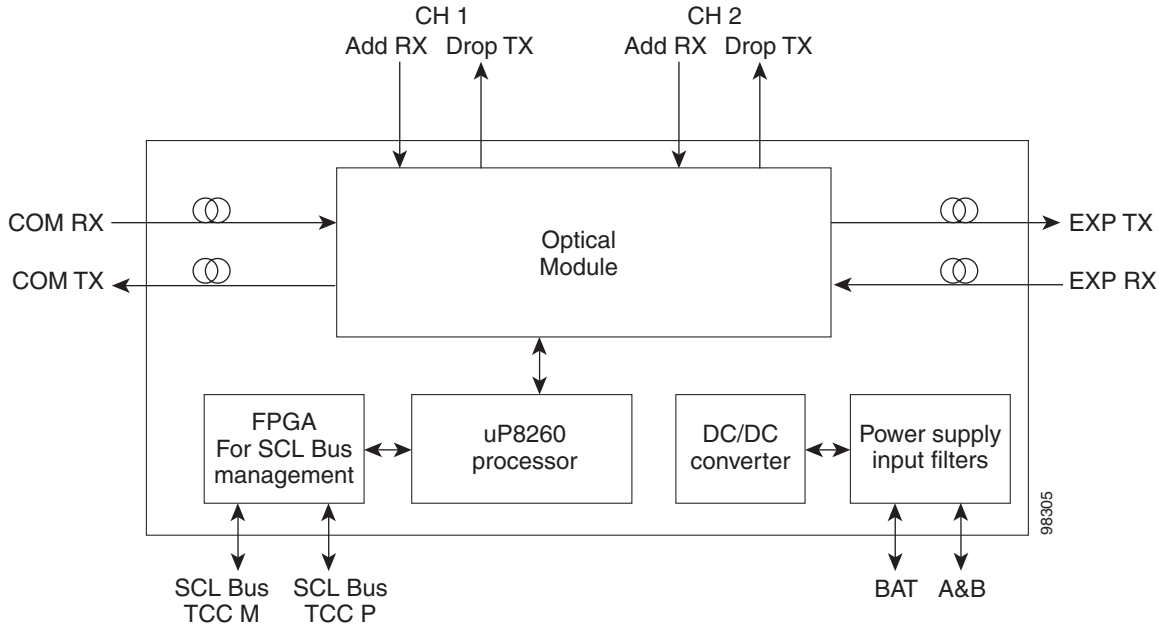
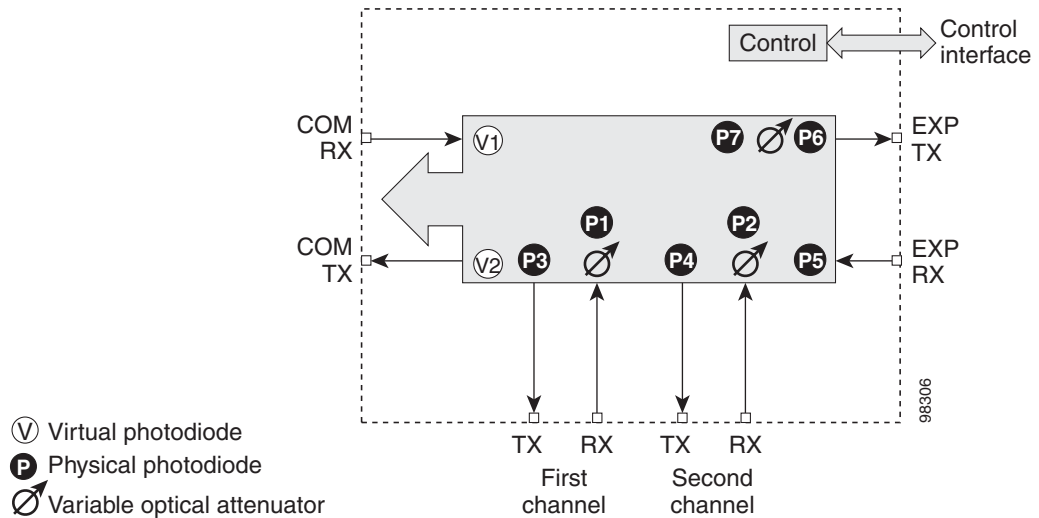


Figure 6-27 shows the AD-2C-xx.x optical function block diagram.

Figure 6-27 AD-2C-xx.x Optical Function Diagram



- Ⓟ Virtual photodiode
- Ⓟ Physical photodiode
- ⊘ Variable optical attenuator

6.10.1 Power Monitoring

Physical photodiodes P1 through P6, and virtual photodiodes V1 and V2 monitor the power for the AD-2C-xx.x card. The returned power level values are calibrated to the ports as shown in [Table 6-32](#).

Table 6-32 AD-2C-xx.x Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1 and P2	ADD	COM TX
P3 and P4	DROP	DROP TX Channel
P5	IN EXP	EXP RX
P6	OUT EXP	EXP TX
V1	IN COM	COM RX
V2	OUT COM	COM TX

6.10.2 AD-2C-xx.x Card-Level Indicators

The AD-2C-xx.x card has three card-level LED indicators, described in [Table 6-33](#).

Table 6-33 AD-2C-xx.x 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the AD-2C-xx.x card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.10.3 AD-2C-xx.x Port-Level Indicators

You can find the status of the card port 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. The AD-2C-xx.x card has eight LC-PC-II optical ports: four for add/drop channel client input and output, two for express channel input and output, and two for communication.

6.10.4 AD-2C-xx.x Card Specifications

Table 6-34 lists the AD-2C-xx.x optical specifications.

Table 6-34 AD-2C-xx.x Card Optical Specifications

Parameter	Note	Condition	Min	Max	Unit
Trx filter shape (−0.5 dB bandwidth) TrxBW ₂	All SOP and within whole operating temperature range	COM Rx—xx.xx Tx	+/- 180	—	pm
		COM Rx—yy.yy Tx			
		xx.xx Rx—COM Tx			
		yy.yy Rx—COM Tx			
Rfx filter shape (−0.5 dB bandwidth) RfxBW ₂	All SOP and within whole operating temperature range	COM Rx—Exp Tx	+/- 180	—	pm
		Exp Rx—COM Tx			
Insertion loss (drop section)	All SOP and within whole operating temperature range (two connectors included)	COM Rx—xx.xx Tx	—	2.0	dB
		COM Rx—yy.yy Tx		2.4	
Insertion loss (express section)	VOA at minimum attenuation; all SOP and within whole operating temperature range (two connectors included)	COM Rx—Exp Tx	—	2.7	dB
		Exp Rx—COM Tx		1.6	
Insertion loss (add section)	VOA at minimum attenuation; all SOP and within whole operating temperature range (two connectors included)	xx.xx Rx—COM Tx	—	3.1	dB
		yy.yy Rx—COM Tx		2.7	
VOA dynamic range	—	—	30	—	dB
Maximum optical input power	—	—	300	—	mW

AD-2C-xx.x optical input and output power vary with amplifier output levels and the class of transponder interfaces used. See Table 6-4 on page 6-5 through Table 6-8 on page 6-7 for this information.

The AD-2C-xx.x has the following additional specifications:

- Environmental
 - Operating temperature:
 - C-Temp: −5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: Telcordia GR-63 5.1.1.3 compliant; 5 to 95% RH
- Dimensions
 - Height: 12.650 in. (321.3 mm)
 - Width: 0.92 in. (23.4 mm)
 - Depth: 9.0 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.11 AD-4C-xx.x Card

The 4-Channel OADM (AD-4C-xx.x) card passively adds or drops all four 100-GHz-spaced channels within the same band. Eight versions of this card—each designed for use with one band of wavelengths—are used in the ONS 15454 DWDM system. The card bidirectionally adds and drops in two different sections on the same card to manage signal flow in both directions. There are eight versions of this card with eight part numbers.

The AD-4C-xx.x has the following features:

- Passive cascade of interferential filters perform the channel add and drop functions.
- Four software-controlled VOAs in the add section, one for each add port, regulate the optical power of inserted channels.
- Two software-controlled VOAs regulate insertion loss on express and drop path, respectively.
- Internal control of the VOA settings and functions, photodiode detection, and alarm thresholds.
- Software-monitored virtual photodiodes (firmware calculation of port optical power) at the common DWDM output and input ports.

The AD-4C-xx.x cards are provisioned for the wavelength pairs in [Table 6-35 on page 6-52](#). In this table, channel IDs are given rather than wavelengths. To compare channel IDs with the actual wavelengths they represent, see [Table 6-9 on page 6-7](#).

Table 6-35 AD-4C-xx.x Channel Sets

Band ID	Add/Drop Channel IDs
Band 30.3 (A)	30.3, 31.2, 31.9, 32.6
Band 34.2 (B)	34.2, 35.0, 35.8, 36.6
Band 38.1 (C)	38.1, 38.9, 39.7, 40.5
Band 42.1 (D)	42.1, 42.9, 43.7, 44.5
Band 46.1 (E)	46.1, 46.9, 47.7, 48.5
Band 50.1 (F)	50.1, 50.9, 51.7, 52.5
Band 54.1 (G)	54.1, 54.9, 55.7, 56.5
Band 58.1 (H)	58.1, 58.9, 59.7, 60.6

Figure 6-28 shows the AD-4C-xx.x faceplate.

Figure 6-28 AD-4C-xx.x Faceplate

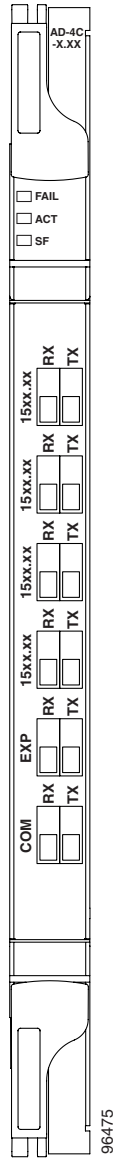


Figure 6-29 shows the AD-4C-xx.x block diagram.

Figure 6-29 AD-4C-xx.x Block Diagram

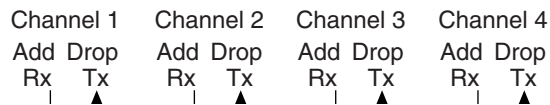
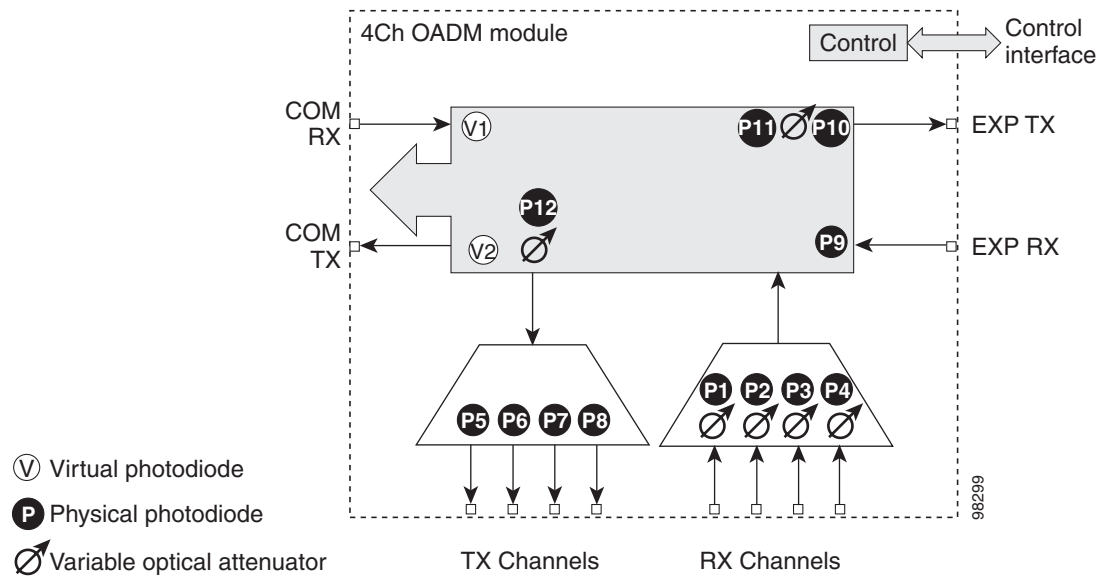


Figure 6-30 shows the AD-4C-xx.x optical module functional block diagram.

Figure 6-30 AD-4C-xx.x Optical Module Functional Block Diagram



6.11.1 Power Monitoring

Physical photodiodes P1 through P10, and virtual photodiodes V1 and V2 monitor the power for the AD-4C-xx.x card. The returned power level values are calibrated to the ports as shown in [Table 6-36](#).

Table 6-36 AD-4C-xx.x Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1 - P4	ADD	COM TX
P5 - P8	DROP	DROP TX Channel
P9	IN EXP	EXP RX
P10	OUT EXP	EXP TX
V1	IN COM	COM RX
V2	OUT COM	COM TX

6.11.2 AD-4C-xx.x Card-Level Indicators

The AD-4C-xx.x card has three card-level LED indicators, described in [Table 6-37](#).

Table 6-37 AD-4C-xx.x 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the AD-4C-xx.x card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure or condition. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.11.3 AD-4C-xx.x Port-Level Indicators

You can find the status of the card port 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. The AD-4C-xx.x card has 12 LC-PC-II optical ports: eight for add/drop channel client input and output, two for express channel input and output, and two for communication.

6.11.4 AD-4C-xx.x Card Specifications

Table 6-38 lists the AD-4C-xx.x optical specifications.

Table 6-38 AD-4C-xx.x Optical Specifications

Parameter	Note	Condition	Min	Max	Unit
Channel grid	See Table 6-9	—	—	—	—
Trx filter shape (−0.5 dB bandwidth) TrxBW ₂	All SOP and within whole operating temperature range	COM Rx—xx.xx Tx COM Rx—yy.yy Tx COM Rx—zz.zz Tx COM Rx—kk.kk Tx xx.xx Rx—COM Tx yy.yy Rx—COM Tx	+/- 180	—	pm
Rfx filter shape (−1 dB bandwidth) RfxBW ₂	All SOP and within whole operating temperature range	COM Rx—Exp Tx Exp Rx—COM Tx	—	—	pm
Insertion loss (drop section)	All SOP and within whole operating temperature range (two connectors included)	COM Rx—xx.xx Tx	—	5.5	dB
		COM Rx—yy.yy Tx		5.0	
		COM Rx—zz.zz Tx		4.5	
		COM Rx—kk.kk Tx		4.1	
Insertion loss (express section)	VOA at minimum attenuation; all SOP and within whole operating temperature range (two connectors included)	COM Rx—Exp Tx	—	2.7	dB
		Exp Rx—COM Tx		1.2	
Insertion loss (add section)	VOA at minimum attenuation; all SOP and within whole operating temperature range (two connectors included)	xx.xx Rx—COM Tx	—	3.9	dB
		yy.yy Rx—COM Tx		4.3	
		zz.zz Rx—COM Tx		4.5	
		kk.kk Rx—COM Tx		4.9	
VOA dynamic range	—	—	30	—	dB
Maximum optical input power	—	—	300	—	mW

AD-4C-xx.x optical input and output power vary with amplifier output levels and the class of transponder interfaces used. See Table 6-4 on page 6-5 through Table 6-8 on page 6-7 for this information.

The AD-4C-xx.x has the following additional specifications:

- Environmental
 - Operating temperature:
 - C-Temp: −5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: Telcordia GR-63 5.1.1.3 compliant; 5 to 95% RH
- Dimensions
 - Height: 12.650 in. (321.3 mm)

- Width: 0.92 in. (23.4 mm)
- Depth: 9.0 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.12 AD-1B-xx.x Card

The 1-Band OADM (AD-1B-xx.x) card passively adds or drops a single band of four adjacent 100-GHz-spaced channels. Eight versions of this card with eight different part numbers—each version designed for use with one band of wavelengths—are used in the ONS 15454 DWDM system. The card bidirectionally adds and drops in two different sections on the same card to manage signal flow in both directions. This card can be used when there is asymmetric adding and dropping on each side (east or west) of the node; a band can be added or dropped on one side but not on the other.

The AD-1B xx.x can be installed in Slots 1 to 6 and 12 to 17.

The AD-1B-xx.x has the following features:

- Passive interferential filters perform the channel add and drop functions.
- Two software-controlled VOAs regulate the optical power flowing in the express and drop OADM paths (drop section).
- Output power of the dropped band is set by changing the attenuation of the VOA drop.
- The VOA express is used to regulate the insertion loss of the express path.
- Internal controlled VOA settings and functions, photodiode detection, and alarm thresholds.
- Software-monitored virtual photodiode (firmware calculation of port optical power) at the common DWDM output.

Figure 6-31 shows the AD-1B-xx.x faceplate.

Figure 6-31 AD-1B-xx.x Faceplate

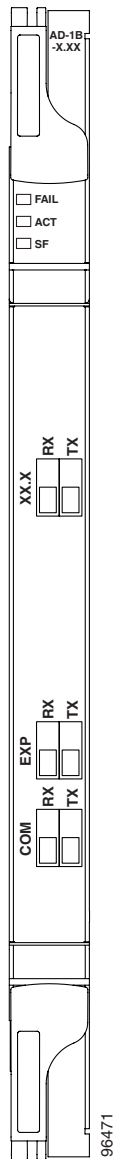


Figure 6-32 shows the AD-1B-xx.x block diagram.

Figure 6-32 AD-1B-xx.x Block Diagram

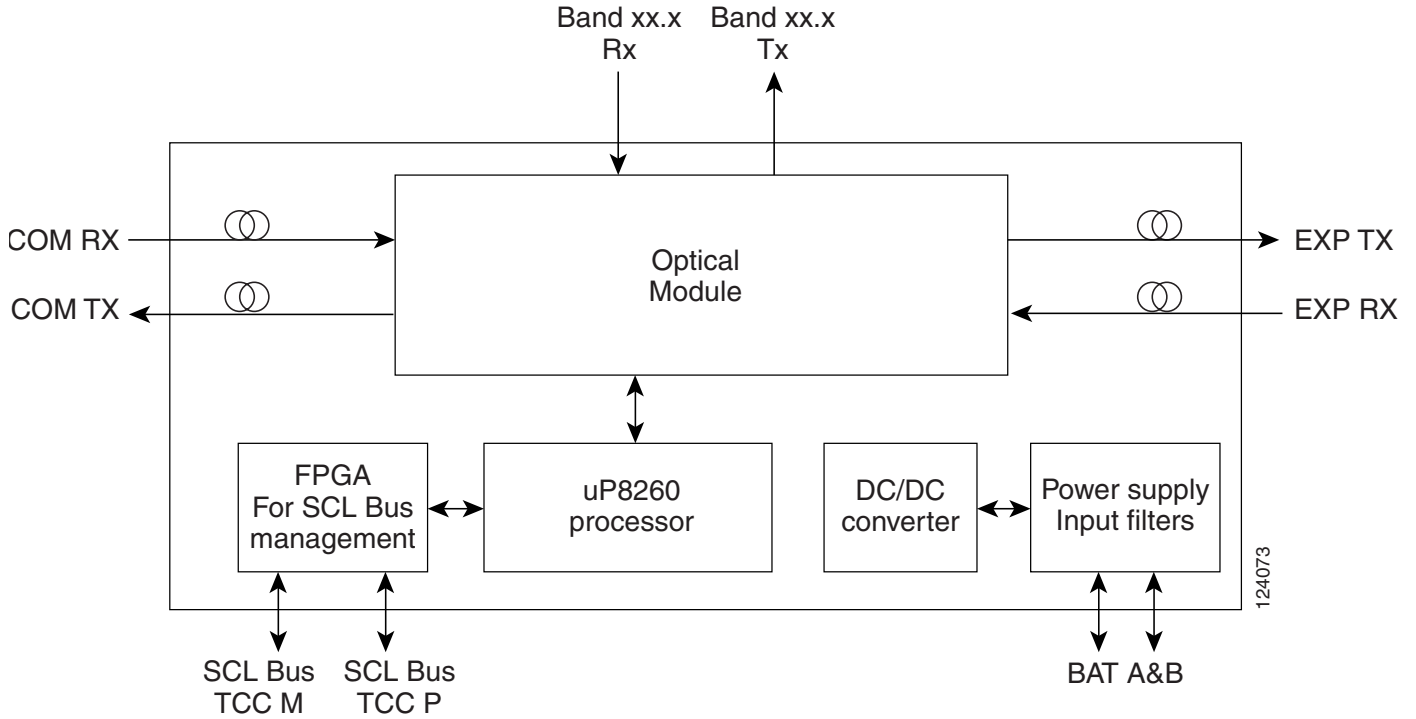
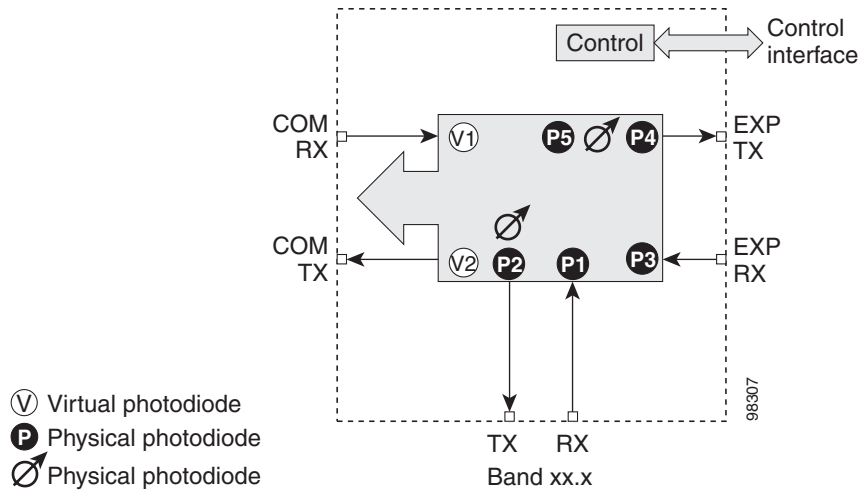


Figure 6-33 shows the AD-1B-xx.x optical module functional block diagram.

Figure 6-33 AD-1B-xx.x Optical Module Functional Block Diagram



6.12.1 Power Monitoring

Physical photodiodes P1 through P4, and virtual photodiodes V1 and V2 monitor the power for the AD-1B-xx.x card. The returned power level values are calibrated to the ports as shown in [Table 6-39](#).

Table 6-39 AD-1B-xx.x Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1	ADD	BAND RX
P2	DROP	BAND TX
P3	IN EXP	EXP RX
P4	OUT EXP	EXP TX
V1	IN COM	COM RX
V2	OUT COM	COM TX

6.12.2 AD-1B-xx.x Card-Level Indicators

The AD-1B-xx.x card has three card-level LED indicators, described in [Table 6-40](#).

Table 6-40 AD-1B-xx.x 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the AD-1B-xx.x card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.12.3 AD-1B-xx.x Port-Level Indicators

You can find the status of the card port 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. The AD-1B-xx.x has six LC-PC-II optical ports: two for add/drop channel client input and output, two for express channel input and output, and two for communication.

6.12.4 AD-1B-xx.x Card Specifications

[Table 6-41](#) lists the unit names, band IDs, channel IDs, frequencies, and wavelengths assigned to the eight versions of the AD-1B-xx.x card.

Table 6-41 AD-1B-xx.x Channel Allocation Plan by Band

Unit Name	Band ID	Channel ID	Frequency (GHz)	Wavelength (nm)
AD-1B-30.3	B30.3	30.3	195.9	1530.33
		30.7	195.85	1530.72
		31.1	195.8	1531.12
		31.5	195.75	1531.51
		31.9	195.7	1531.90
		32.2	195.65	1532.29
		32.6	195.6	1532.68
		33.3	195.55	1533.07
AD-1B-34.2	B34.2	34.2	195.4	1534.25
		34.6	195.35	1534.64
		35.0	195.3	1535.04
		35.4	195.25	1535.43
		35.8	195.2	1535.82
		36.2	195.15	1536.22
		36.6	195.1	1536.61
		37.0	195.05	1537.00
AD-1B-38.1	B38.1	38.1	194.9	1538.19
		38.5	194.85	1538.58
		38.9	194.8	1538.98
		39.3	194.75	1539.37
		39.7	194.7	1539.77
		40.1	194.65	1540.16
		40.5	194.6	1540.56
		40.9	194.55	1540.95
AD-1B-42.2	B42.1	42.1	194.4	1542.14
		42.5	194.35	1542.54
		42.9	194.3	1542.94
		43.3	194.25	1543.33
		43.7	194.2	1543.73
		44.1	194.15	1544.13
		44.5	194.1	1544.53
		44.9	194.05	1544.92

Table 6-41 AD-1B-xx.x Channel Allocation Plan by Band (continued)

Unit Name	Band ID	Channel ID	Frequency (GHz)	Wavelength (nm)
AD-1B-46.1	B46.1	46.1	193.9	1546.12
		46.5	193.85	1546.52
		46.9	193.8	1546.92
		47.3	193.75	1547.32
		47.7	193.7	1547.72
		48.1	193.65	1548.11
		48.5	193.6	1548.51
		48.9	193.55	1548.91
AD-1B-50.1	B50.1	50.1	193.4	1550.12
		50.5	193.35	1550.52
		50.9	193.3	1550.92
		51.3	193.25	1551.32
		51.7	193.2	1551.72
		52.1	193.15	1552.12
		52.5	193.1	1552.52
		52.9	193.05	1552.93
AD-1B-54.1	B54.1	54.1	192.9	1554.13
		54.5	192.85	1554.54
		54.9	192.8	1554.94
		55.3	192.75	1555.34
		55.7	192.7	1555.75
		56.1	192.65	1556.15
		56.5	192.6	1556.96
		56.9	192.55	1556.96
AD-1B-58.1	B58.1	58.1	192.4	1558.17
		58.5	192.35	1558.58
		58.9	192.3	1558.98
		59.3	192.25	1559.39
		59.7	192.2	1559.79
		60.2	192.15	1560.20
		60.6	192.1	1560.61
		61.0	192.05	1561.01

Table 6-42 lists AD-1B-xx.x optical specifications.

Table 6-42 AD-1B-xx.x Optical Specifications

Parameter	Note	Condition	Min	Max	Unit
-1 dB bandwidth	All SOP and within whole operating environmental range	COM Rx—Band Tx Band Rx—COM Tx	3.6	—	nm
-1 dB bandwidth	All SOP and within whole operating temperature range	COM Rx—Exp Tx Exp Rx—COM Tx	Refer to Table 6-43.		nm
Insertion loss (drop section)	All SOP and within whole operating environmental range; two connectors included, VOA set at minimum attenuation	COM Rx—Band Tx	—	3.0	dB
Insertion loss (express section)	All SOP and within whole operating environmental range; two connectors included	Exp Rx—COM Tx	—	1.6	dB
	All SOP and within whole operating environmental range; two connectors included, VOA set at its minimum attenuation	COM Rx—Exp Tx	—	2.2	
Insertion loss (add section)	All SOP and within whole operating environmental range; two connectors included	Band Rx—COM Tx	—	2.2	dB
VOA dynamic range	—	—	30	—	dB
Maximum optical input power	—	—	300	—	mW

Table 6-43 lists the range of wavelengths for the receive (express) band.

Table 6-43 AD-1B-xx.x Transmit and Receive Dropped Band Wavelength Ranges

Tx (Dropped) Band	Rx (Express) Band	
	Left Side (nm)	Right Side (nm)
B30.3	—	Wavelengths 1533.825 or higher
B34.2	Wavelengths 1533.395 or lower	Wavelengths 1537.765 or higher
B38.1	Wavelengths 1537.325 or lower	Wavelengths 1541.715 or higher
42.1	Wavelengths 1541.275 or lower	Wavelengths 1545.695 or higher
46.1	Wavelengths 1545.245 or lower	Wavelengths 1549.695 or higher
50.1	Wavelengths 1549.235 or lower	Wavelengths 1553.705 or higher
54.1	Wavelengths 1553.255 or lower	Wavelengths 1557.745 or higher
58.1	Wavelengths 1557.285 or lower	—

AD-1B-xx.x optical input and output power vary with amplifier output levels and the class of transponder interfaces used. See [Table 6-4 on page 6-5](#) through [Table 6-8 on page 6-7](#) for this information.

The AD-1B-xx.x card has the following additional specifications:

- Environmental
 - Operating temperature:
 - C-Temp: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: Telcordia GR-63 5.1.1.3 compliant; 5 to 95% RH
- Dimensions
 - Height: 12.650 in. (321.3 mm)
 - Width: 0.92 in. (23.4 mm)
 - Depth: 9.0 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

6.13 AD-4B-xx.x Card

The 4-Band OADM (AD-4B-xx.x) card passively adds or drops four bands of four adjacent 100-GHz-spaced channels. Two versions of this card with different part numbers—each version designed for use with one set of bands—are used in the ONS 15454 DWDM system. The card bidirectionally adds and drops in two different sections on the same card to manage signal flow in both directions. This card can be used when there is asymmetric adding and dropping on each side (east or west) of the node; a band can be added or dropped on one side but not on the other.

The AD1B-xx.x can be installed in Slots 1 to 6 and 12 to 17.

The AD-4B-xx.x has the following features:

- Five software-controlled VOAs regulate the optical power flowing in the OADM paths.
- Output power of each dropped band is set by changing the attenuation of each VOA drop.
- The VOA express is used to regulate the insertion loss of the express path.
- Internal controlled VOA settings and functions, photodiode detection, and alarm thresholds.
- Software-monitored virtual photodiode (firmware calculation of port optical power) at the common DWDM output port.

Figure 6-34 shows the AD-4B-xx.x faceplate.

Figure 6-34 AD-4B-xx.x Faceplate

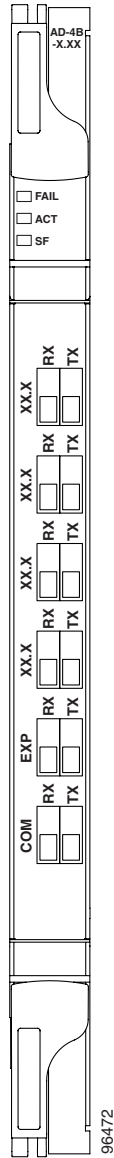


Figure 6-35 shows the AD-4B-xx.x block diagram.

Figure 6-35 AD-4B-xx.x Block Diagram

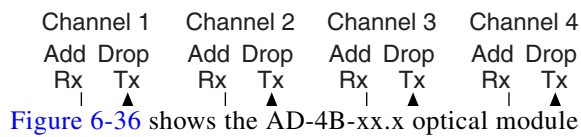
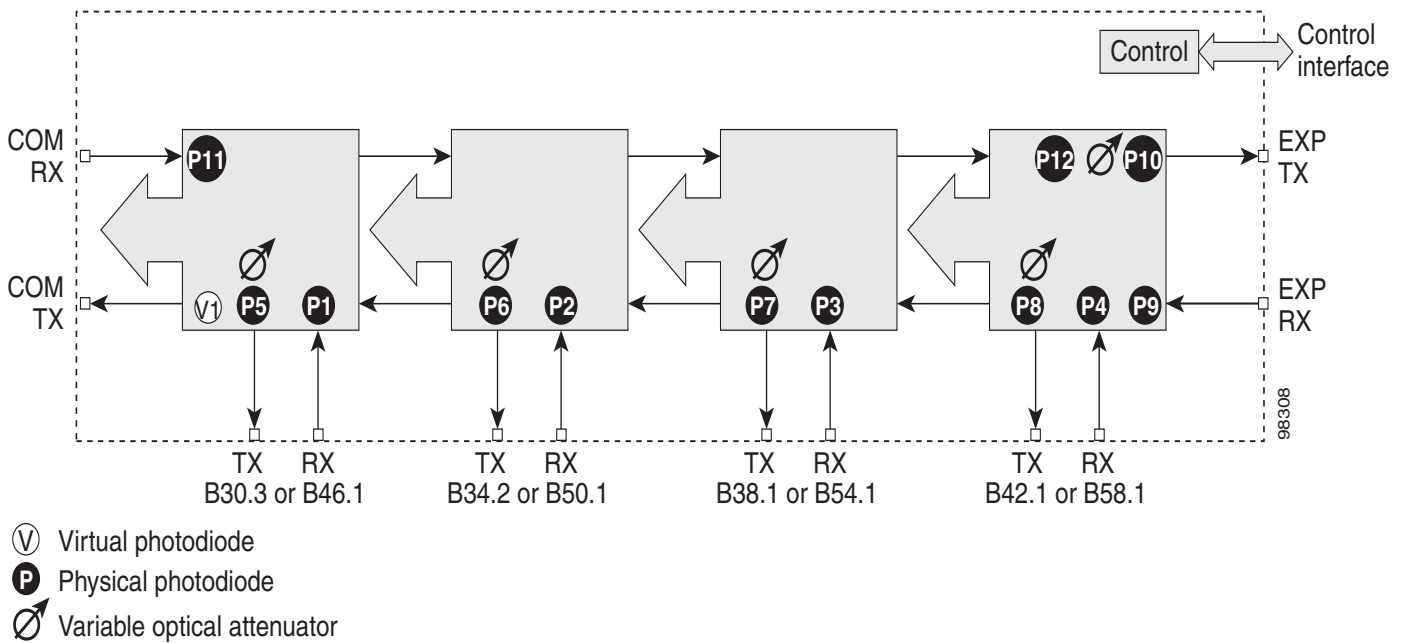


Figure 6-36 AD-4B-xx.x Optical Module Functional Block Diagram



6.13.1 Power Monitoring

Physical photodiodes P1 through P11, and virtual photodiode V1 monitor the power for the AD-4B-xx.x card. The returned power level values are calibrated to the ports as shown in [Table 6-44](#).

Table 6-44 AD-4B-xx.x Port Calibration

Photodiode	CTC "Type" Name	Calibrated to Port
P1 - P4	ADD	COM TX
P5 - P8	DROP	DROP Channel TX
P9	IN EXP	EXP RX
P10	OUT EXP	EXP TX
P11	IN COM	COM RX
V1	OUT COM	COM TX

6.13.2 AD-4B-xx.x Card-Level Indicators

The AD-4B-xx.x card has three card-level LED indicators, described in [Table 6-45](#).

Table 6-45 AD-4B-xx.x 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 there is an internal hardware failure. Replace the card if the red FAIL LED persists.
Green ACT LED	The green ACT LED indicates that the AD-4B-xx.x card is carrying traffic or is traffic-ready.
Amber SF LED	The amber SF LED indicates a signal failure. The amber SF LED also illuminates when the transmit and receive fibers are incorrectly connected. When the fibers are properly connected, the light turns off.

6.13.3 AD-4B-xx.x Port-Level Indicators

You can find the status of the card port 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. The AD-4B-xx.x has 12 LC-PC-II optical ports: eight for add/drop band client input and output, two for express channel input and output, and two for communication.

6.13.4 AD-4B-xx.x Card Specifications

[Table 6-46](#) lists the unit names, band IDs, channel IDs, frequencies, and wavelengths assigned to the two versions of the card.

Table 6-46 AD-4B-xx.x Channel Allocation Plan by Band

Unit Name	Band ID	Channel ID	Frequency (GHz)	Wavelength (nm)
AD-4B-30.3	B30.3	30.3	195.9	1530.33
		30.7	195.85	1530.72
		31.1	195.8	1531.12
		31.5	195.75	1531.51
		31.9	195.7	1531.90
		32.2	195.65	1532.29
		32.6	195.6	1532.68
		33.3	195.55	1533.07
	B34.2	34.2	195.4	1534.25
		34.6	195.35	1534.64
		35.0	195.3	1535.04
		35.4	195.25	1535.43
		35.8	195.2	1535.82
		36.2	195.15	1536.22
		36.6	195.1	1536.61
		37.0	195.05	1537.00
	B38.1	38.1	194.9	1538.19
		38.5	194.85	1538.58
		38.9	194.8	1538.98
		39.3	194.75	1539.37
		39.7	194.7	1539.77
		40.1	194.65	1540.16
		40.5	194.6	1540.56
		40.9	194.55	1540.95
	B42.1	42.1	194.4	1542.14
		42.5	194.35	1542.54
		42.9	194.3	1542.94
		43.3	194.25	1543.33
		43.7	194.2	1543.73
		44.1	194.15	1544.13
		44.5	194.1	1544.53
		44.9	194.05	1544.92

Table 6-46 AD-4B-xx.x Channel Allocation Plan by Band (continued)

Unit Name	Band ID	Channel ID	Frequency (GHz)	Wavelength (nm)
AD-4B-46.1	B46.1	46.1	193.9	1546.12
		46.5	193.85	1546.52
		46.9	193.8	1546.92
		47.3	193.75	1547.32
		47.7	193.7	1547.72
		48.1	193.65	1548.11
		48.5	193.6	1548.51
		48.9	193.55	1548.91
	B50.1	50.1	193.4	1550.12
		50.5	193.35	1550.52
		50.9	193.3	1550.92
		51.3	193.25	1551.32
		51.7	193.2	1551.72
		52.1	193.15	1552.12
		52.5	193.1	1552.52
		52.9	193.05	1552.93
	B54.1	54.1	192.9	1554.13
		54.5	192.85	1554.54
		54.9	192.8	1554.94
		55.3	192.75	1555.34
		55.7	192.7	1555.75
		56.1	192.65	1556.15
		56.5	192.6	1556.96
		56.9	192.55	1556.96
	B58.1	58.1	192.4	1558.17
		58.5	192.35	1558.58
		58.9	192.3	1558.98
		59.3	192.25	1559.39
		59.7	192.2	1559.79
		60.2	192.15	1560.20
		60.6	192.1	1560.61
		61.0	192.05	1561.01

Table 6-47 lists AD-4B-xx.x optical specifications.

Table 6-47 AD-4B-xx.x Optical Specifications

Parameter	Note	Condition	Min	Max	Unit
-1 dB bandwidth	All SOP and within whole operating environmental range	COM Rx—Band Tx Band Rx—COM Tx	3.6	—	nm
-1 dB bandwidth	All SOP and within whole operating temperature range	COM Rx—Exp Tx Exp Rx—COM Tx	Refer to Table 6-48.		nm
Insertion loss (drop section)	All SOP and within whole operating environmental range; two connectors included, VOA set at minimum attenuation	COM Rx—Band Tx 30.3/46.1	—	2.9	dB
		COM Rx—Band Tx 34.2/50.1		3.3	
		COM Rx—Band Tx 38.1/54.1		3.8	
		COM Rx—Band Tx 42.1/58.1		4.5	
Insertion loss (express section)	All SOP and within whole operating environmental range; two connectors included	Exp Rx—COM Tx	—	4.9	dB
		COM Rx—Exp Tx		3	
Insertion loss (add section)	All SOP and within whole operating environmental range; two connectors included	Band Rx 30.3/46.1—COM Tx	—	3.5	dB
		Band Rx 34.2/50.1—COM Tx		2.8	
		Band Rx 38.1/54.1—COM Tx		2.3	
		Band Rx 42.1/58.1—COM Tx		1.8	
VOA dynamic range	—	—	30	—	dB
Maximum optical input power	—	—	300	—	mW

Table 6-48 lists the range of wavelengths for the receive (express) band.

Table 6-48 AD-4B-xx.x Transmit and Receive Dropped Band Wavelength Ranges

Tx (Dropped) Band	Rx (Express) Band	
	Left Side (nm)	Right Side (nm)
B30.3	—	Wavelengths 1533.825 or higher
B34.2	Wavelengths 1533.395 or lower	Wavelengths 1537.765 or higher
B38.1	Wavelengths 1537.325 or lower	Wavelengths 1541.715 or higher

Table 6-48 AD-4B-xx.x Transmit and Receive Dropped Band Wavelength Ranges (continued)

Tx (Dropped) Band	Rx (Express) Band	
	Left Side (nm)	Right Side (nm)
B42.1	Wavelengths 1541.275 or lower	Wavelengths 1545.695 or higher
B46.1	Wavelengths 1545.245 or lower	Wavelengths 1549.695 or higher
B50.1	Wavelengths 1549.235 or lower	Wavelengths 1553.705 or higher
B54.1	Wavelengths 1553.255 or lower	Wavelengths 1557.745 or higher
B58.1	Wavelengths 1557.285 or lower	—

AD-4B-xx.x optical input and output power vary with amplifier output levels and the class of transponder interfaces used. See [Table 6-4 on page 6-5](#) through [Table 6-8 on page 6-7](#) for this information.

The AD-4B-xx.x has the following additional specifications:

- Environmental
 - Operating temperature:
 - C-Temp: –5 to +55 degrees Celsius (+23 to +131 degrees Fahrenheit)
 - Operating humidity: Telcordia GR-63 5.1.1.3 compliant; 5 to 95% RH
- Dimensions
 - Height: 12.650 in. (321.3 mm)
 - Width: 0.92 in. (23.4 mm)
 - Depth: 9.0 in. (228.6 mm)
- For compliance information, refer to the *Cisco Optical Transport Products Safety and Compliance Information*.

