



# Specifications

The following material describes the specifications for the ONS 15216 EDFA3. The sections in this chapter describe the following:

- [2.1 Optical Specification, page 2-1](#)
- [2.2 Operation Modes, page 2-4](#)
- [2.3 Gain Tilt Control, page 2-5](#)
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## 2.1 Optical Specification

The specified values are valid over the full temperature range and full lifetime of the ONS 15216 EDFA3. ONS 15216 EDFA3 optical specifications are listed and described in [Table 2-1](#) through [Table 2-5](#).

**Table 2-1 Wavelength Specification**

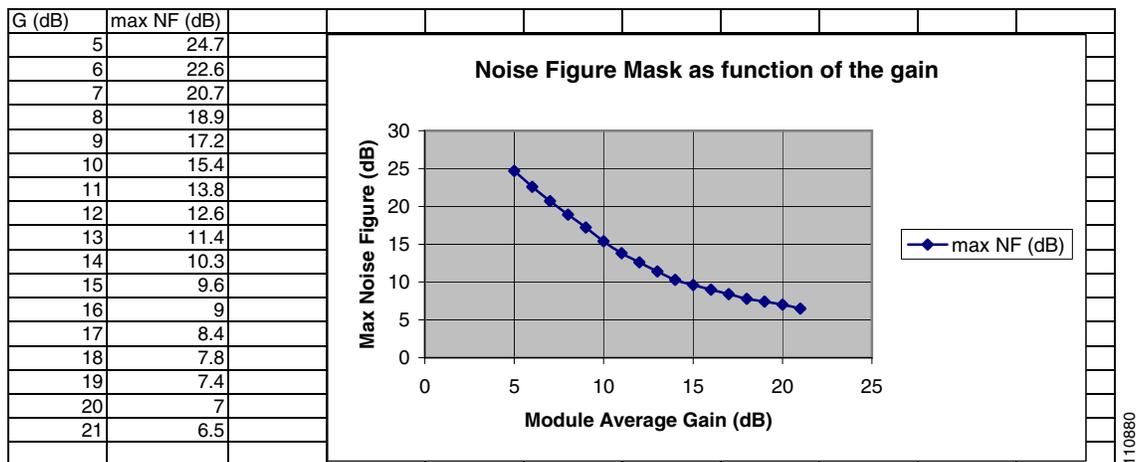
Parameter	Comment	Value	Unit
DWDM <sup>1</sup> channel wavelength plan, 100 GHz	4 skip 1	ITU-T wavelength grid channels 20 to 59	—
DWDM channel wavelength plan, 50 GHz	8 skip 2	ITU-T wavelength grid channels 19.5 to 59	—
Channel spacing	—	100 and 50	GHz
Total operating wavelength range	—	1530.0 to 1561.3	nm

1. DWDM = dense wavelength division multiplexing

**Table 2-2** *Optical Parameters*

Parameter	Comment	Min	Typ	Max	Unit
Gain ripple (peak to valley)	Tilt setpoint = 0 dB	—	—	1.5	dBm
Gain set resolution	Constant Gain mode	—	—	0.1	dB
Output power set resolution	Constant Power mode	—	—	0.1	dB
Mid-stage loss range	—	3	—	9	dB
Maximum total mid-stage output power	—	—	—	15	dBm
Maximum per-channel mid-stage output power	At 32 channels	—	—	0	dBm
Noise Figure at $G \geq 21$ dB	VOA <sup>1</sup> at minimum loss	—	—	6.5	dB
Noise Figure at $G = 5$ dB	Tilt setpoint = 0 dB	—	—	24.7	dB
Noise Figure at $5 < G < 21$ dB	See <a href="#">Figure 2-1</a>	—	—	—	—
Polarization dependent gain	—	—	—	0.5	dB
Polarization mode dispersion	—	—	—	0.7	ps
Optical return loss	All optical ports	40	—	—	dB

1. VOA = variable optical attenuator

**Figure 2-1** *Noise Figure Mask as a Function of the Gain***Table 2-3** *Optical Parameters—Standard Gain Range*

Parameter	Comment	Min	Max	Unit
Input signal power range	Full channel load	-4	12	dBm
	Single channel	-22	-6	dBm
Maximum output signal power	Full channel load	17.0	17.5	dBm
	Single channel	-1.0	-0.5	dBm
Standard gain range	—	5	21	dB

**Table 2-3** *Optical Parameters—Standard Gain Range (continued)*

Parameter	Comment	Min	Max	Unit
Gain tilt error	Tilt setpoint = 0 dB	—	+ 0.5	dB
Gain tilt range	—	-3	+3	dB

**Table 2-4** *Optical Parameters—Extended Gain Range*

Parameter	Comment	Min	Max	Unit
Input signal power range	Full channel load	-21.5	-4	dBm
	Single channel	-39.5	-22	dBm
Maximum output signal power	Full channel load	17.0	17.5	dBm
	Single channel	-1.0	-0.5	dBm
Extended gain range	—	21	38.5	dB
Gain tilt error Tilt setpoint = 0 dB	Gain tilt error for each dB of gain setpoint higher than 21dB	—	-0.7	dB/dB

**Table 2-5** *Power Monitoring Specifications*

Parameter	Min	Typ	Max	Unit
Input power measurement range	-39.5	—	12	dBm
Output power measurement range	-1	—	18	dBm
Power monitor measurement resolution	—	—	0.1	dB
Optical monitor port taps	-23	-20	-19	dB

## 2.1.1 Optical Safety Functions

The optical safety functions implemented on the ONS 15216 EDFA3 are:

- [2.1.1.1 Optical Safety Remote Interlock](#)
- [2.1.1.2 Automatic Laser Shutdown](#)
- [2.1.1.3 Automatic Power Reduction](#)

### 2.1.1.1 Optical Safety Remote Interlock

The optical safety remote interlock (OSRI) function allows you to manually shut down the EDFA3 pump lasers using a TL1 command (ED-DWDM) or SNMP object (cerent15216EdfaGenericEdfa3Osri). This function is designed for safety purposes to avoid the risk for the operator to manage hazardous optical power level. The total time for laser shutdown after receiving a disable command is 100 ms.



**Note**

The OSRI parameter must be set to DISABLE in order for the ONS 15216 EDFA3 to operate properly. Setting the OSRI parameter to ENABLE will activate the interlock, preventing the ONS 15216 EDFA3 from producing an optical output signal.

### 2.1.1.2 Automatic Laser Shutdown

The ONS 15216 EDFA3 performs an automatic laser shutdown (ALS) when a loss of input power (that is, power falls below the FailLow threshold) is detected at the input port of both stages:

- COM RX (first stage input port)
- DC RX (second stage input port)

The ALS shuts down the optical power at the following two optical output ports:

- DC TX (first stage output port)
- COM TX (second stage output port)

### 2.1.1.3 Automatic Power Reduction

The automatic power reduction function is used by the amplifier during the recovery after an ALS event. When the loss of signal (LOS) event is no longer present at the amplifier input, before going to the original power setpoint, the amplifier undergoes a transition to a safe reduced output power level of 8 dBm for 9 seconds.

## 2.1.2 Transient Suppression

Table 2-6 shows transient suppression specifications.

**Table 2-6** *Transient Suppression Specifications*

Input Power Excursion (dB)	Maximum Undershoot and Overshoot	Maximum Settling Time (milliseconds)	Gain Error (dB)
15	3.7	500	1.7
6	2.2	800	1.7
3	-1.8	500	1.7

The previously indicated transient suppression specifications are referred to the following conditions:

- The values are for both ADD and DROP events
- Required input switch speed = 100 milliseconds (objective input switch speed = 5 milliseconds)
- The ONS 15216 EDFA3 is set in the standard range
- There is a flat output profile (with +/- 0.5 dB tolerance)
- The power per channel > -19 dBm

## 2.2 Operation Modes

The ONS 15216 EDFA3 can be driven in one the following working modes:

- [2.2.1 Constant Output Power Mode, page 2-5](#)
- [2.2.2 Constant Gain Mode, page 2-5](#)

## 2.2.1 Constant Output Power Mode

When the ONS 15216 EDFA3 is driven in Constant Output Power mode, the signal output power is set to the provisioned value. The user provisions the total power of the amplifier, while the firmware of the internal optical module automatically sets the output power of the two amplifier stages.

In this mode, the EDFA3 essentially works as a saturated amplifier. The output power remains constant when the input power changes. When channels are added or dropped at the amplifier input, the output channel power varies accordingly. In this mode, the amplifier is not resilient to the channel number variation at the amplifier input, so it should be used only in the installation phase.

The Constant Output Power control limits its action by constantly checking that the laser current never exceeds its maximum ratings. The control module calculates and provisions output power alarm thresholds every time the output power set point changes.

The firmware of the internal optical module compensates for the amplified spontaneous emission (ASE) noise generated by the amplifier. In other words, the amplifier computes the noise generated by the amplifier itself and sets the Signal Power to the provisioned value compensating for the Noise Power.

## 2.2.2 Constant Gain Mode

When the ONS 15216 EDFA3 is driven in Constant Gain mode, the amplifier gain is set to the provisioned value. The user provisions the total gain of the amplifier, while the firmware of the internal optical module automatically sets the gains of the two amplifier stages.

In this mode, the channel output power remains constant when the number of input channels changes. Therefore, in this mode, the amplifier is resilient to a failure of a transmitter or of an optical add/drop multiplexer (OADM) card. Also when the amplifier is in Constant Gain mode, the link can be upgraded adding or removing channels without performing any management operation on the amplifier. Therefore, this should be the preferred mode when the link is in normal operating conditions.

The firmware of the internal optical module compensates for the ASE noise generated by the amplifier. The amplifier computes the noise generated by the amplifier itself and sets the Signal Gain to the provisioned value compensating for the Noise Power.

## 2.3 Gain Tilt Control

As a default, the amplifier gain tilt is set to zero. The firmware automatically controls the internal VOA to achieve a flat gain.

The user can provision a gain tilt different from zero to compensate for gain tilt produced by other optical components preceding the amplifier. The gain tilt control is active only in the standard gain range (5 to 21 dB). The tilt can be set between  $-3$  and  $+3$  dB.

## 2.4 Alarm Thresholds

The ONS 15216 EDFA3 uses thresholds. It raises or clears alarms when these thresholds are crossed. The EDFA3 has both absolute and relative thresholds. Absolute thresholds are independent of any other parameter setpoint and can be user-provisioned, whereas the relative thresholds are automatically calculated depending on the actual setpoint of a parameter, and their values cannot be provisioned by the user.

Table 2-7 lists all the provisionable thresholds, their description, their default value and their provisioning range.

**Table 2-7 Threshold Behavior**

Threshold	Description	Default	Range
GAINTHDL	Gain Degrade Low Threshold	Gain Setpoint – 2dB	—
GAINTHDH	Gain Degrade High Threshold	Gain Setpoint + 2dB	—
LINE1TXPWRTHDL	Power Degrade Low Threshold LINE1TX Port	LINE1TXPWRSP – 2dB	—
LINE1TXPWRTHDH	Power Degrade High Threshold LINE1TX Port	LINE1TXPWRSP + 2dB	—
LINE1TXPWRTHFL	Power Fail Low Threshold LINE1TX Port	–6 dBm	–10, +14 dBm See <a href="#">Note</a> Below
LINE1RXPWRTHFL	Power Fail Low Threshold LINE1RX Port	+10 dBm	–49, +13 dBm
LINE2RXPWRTHFL	Power Fail Low Threshold LINE2RX Port	–33 dBm	–49, +15 dBm
PWRBUSMIN	Power Bus A and B Minimum Voltage	40 V	0, 47 V
PWRBUSMAX	Power Bus A and B Maximum Voltage	57 V	49, 57 V
MAXCTMP	Maximum Case Temperature	65 degrees C	60, 100 degrees C (140, 212 degrees F)
MINCTMP	Minimum Case Temperature	–5 degrees C	–10, 30 degrees C (14, 86 degrees F)



**Note**

The maximum LINE1TXPWRTHFL threshold setting varies as a function of the LINE1TXPWRSP set point, with the following relationship:

$$(-10\text{dBm}) \leq \text{LINE1TXPWRTHFL} \leq (\text{LINE1TXPWRSP} - 3\text{dBm})$$

This relationship implies that the LINE1TXPWRTHFL threshold must always be set at least 3dBm below the LINE1TXPWRSP set point (but not below -10dBm), as a result, the maximum +14dBm LINE1TXPWRTHFL threshold can only be set when the LINE1TXPWRSP set point is also set to its maximum value of +17dBm.

(Refer to section 10.7.2 [Table 10-24](#) for LINE1TXPWRSP range)

## 2.5 Maximum Input Power Specification

The ONS 15216 EDFA3 operates at a gain setting between 5 and 21 dB, standard gain range, and between 21 and 38.5 dB, extended gain range. As the total output power of the amplifier cannot exceed 17 dBm, each gain setting has a maximum input power. The maximum input power is given by the maximum output power, 17 dBm, minus the gain setting. For example, at a gain setting of 22 dB, the maximum input power is -5 dBm. Prolonged operation beyond the maximum input power can shorten the life of the ONS 15216 EDFA3.

Optical attenuators are required to bring total input power to less than the maximum input power when operating in constant gain mode.

## 2.6 Electrical Specifications

The ONS 15216 EDFA3 uses a power supply that meets the electrical specifications listed in [Table 2-8](#).

**Table 2-8** *Electrical Specifications*

Parameter	Specification
Input voltage	-48 VDC
Maximum power consumption	45 W at ambient (50 degrees C, 122 degrees F)
Minimum supply voltage	-40 VDC
Minimum turn-on supply voltage	-43 VDC
Maximum supply voltage	-57 VDC or under
Maximum current consumption	1.5 A at 45 W

A separate AC/DC converter for use with the ONS 15216 EDFA3 can be ordered from Cisco.

### 2.6.1 Electrical Interface

[Table 2-9](#) describes the external electrical interfaces for the ONS 15216 EDFA3. See [Figure 2-3 on page 2-10](#) for a graphic showing the electrical connectors.

**Table 2-9** *External Electrical Interface*

Quantity	Type	Description	Location
2	RJ-45	Alarm ports	Front and back
2	RJ-45	Ethernet ports	With LED, front and back
1	EIA/TIA-232 (RS-232)	Port	Front
2/4	PWR SUP	Power supply	Front and back

## 2.7 Mechanical Specifications

[Table 2-10](#) lists the ONS 15216 EDFA3 mechanical specifications.

**Table 2-10 Mechanical Specifications**

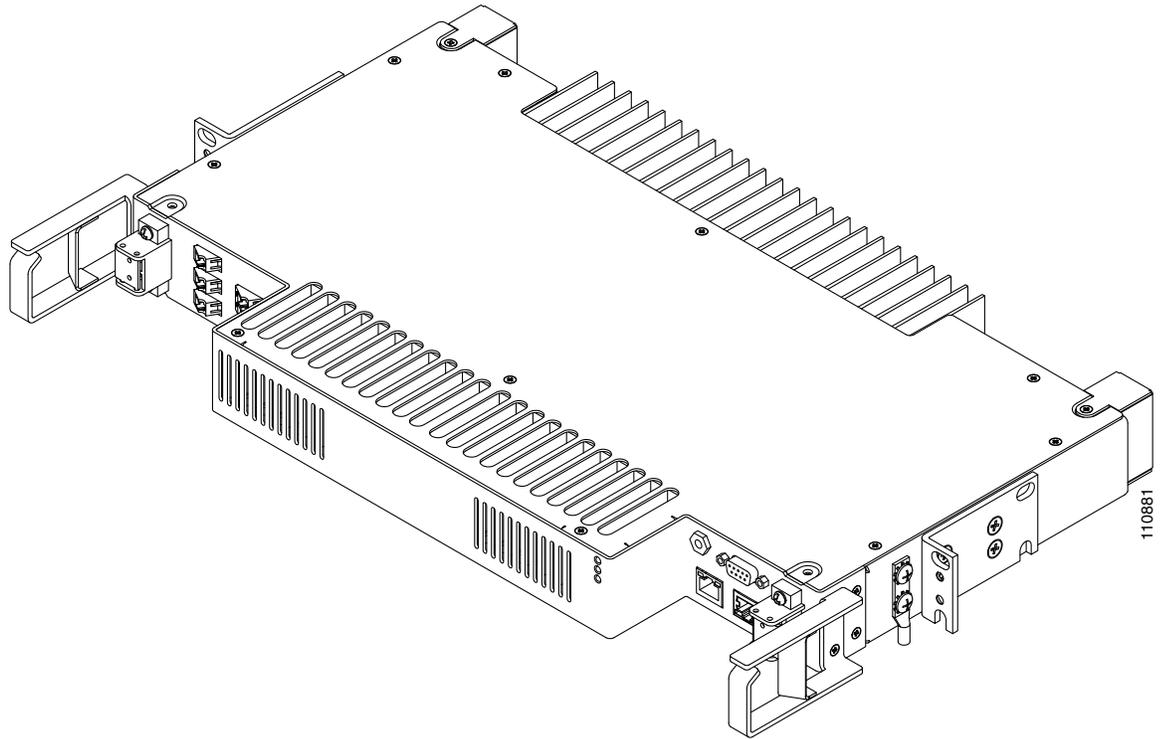
Parameter	Specification
Dimensions (H x W x D)	1-3/4 in. x 17-3/16 in. x 11 in. (4.4 cm x 43.7 cm x 27.9 cm)
Weight	5.45 lb (2.47 kg)
Ambient operating temperature	32 to 122 degrees F (0 to 50 degrees C)
Storage temperature	-40 to 185 degrees F (-40 to 85 degrees C)
Humidity operation	Relative humidities of 5 to 95%, noncondensing. With ambient temperatures above 84 degrees F (29 degrees C), the relative humidity might be limited to that corresponding to a specific humidity of 0.024 pounds of water per pound of dry air (0.01 kg per kilogram of dry air).
Humidity storage	Relative humidities of 5 to 95%, noncondensing. With ambient temperatures above 84 degrees F (29 degrees C), the relative humidity might be limited to that corresponding to a specific humidity of 0.024 pounds of water per pound of dry air (0.01 kg per kilogram of dry air).
Connector types	LC/UPC Bulkhead connectors
Mean time between failures (MTBF)	12.7 years as per the calculation procedure outlined in TR-NWT-000332, Issue 4, Method 1

## 2.8 External Features

The ONS 15216 EDFA3 has the following external features:

- Front panel LEDs, graphics, and warning displays
- Brackets for rack mounting (including reversible ears that permit front, mid, and rear mounting)
- Front and rear cooling vents
- Fiber routing and retaining feature
- Two threaded grounding studs on rear and a pair of threaded grounding holes on each side
- Screw lug (front and rear) terminal blocks for power connection
- RJ-45 connector for external alarm connection on the front and rear
- RJ-45 connector for LAN connection on the front and rear
- LC/UPC connectors for optical interface
- DB-9 female connector for craft EIA/TIA-232 (RS-232) serial interface connection (front panel only)

Figure 2-2 displays a mechanical outline of the external features of the ONS 15216 EDFA3.

**Figure 2-2 External Features**

## 2.8.1 Footprint

The ONS 15216 EDFA3 is housed in a 1-RU, 19-inch/23-inch (482-mm/584-mm), rack-mounted shelf. However, a 3-RU spacing is required for ventilation. All-front access is available for fibers, power, alarm contacts, and management interfaces. Rear access is available for power, alarm, and management interfaces.

### 2.8.1.1 Front Panel

[Figure 2-3](#) shows the ONS 15216 EDFA3 front panel in detail. The front panel provides an all-front access (fibers, power, alarm contact, and management interface) that complies with international standards.

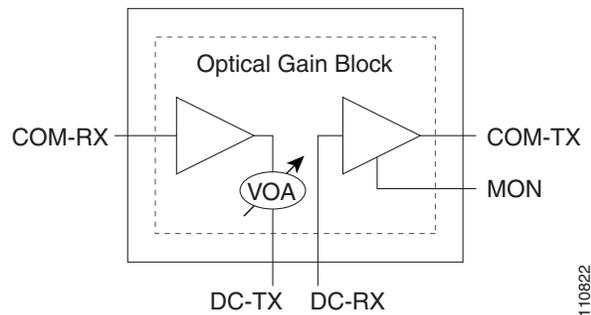
**Figure 2-3 ONS 15216 EDFA3 Front Panel**

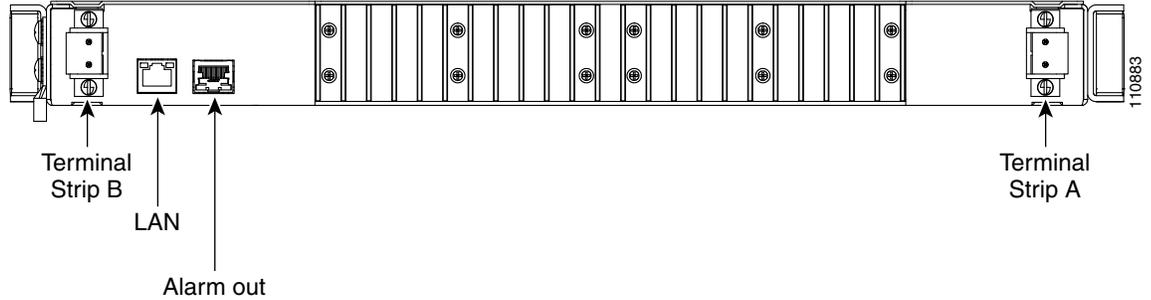
Table 2-11 describes the ONS 15216 EDFA3 front panel features.

**Table 2-11 Front Panel Features**

Feature	Description
Terminal strips A and B	Terminal strip for supplying power to the ONS 15216 EDFA3. Attach AWG 18 stranded power wires to appropriate terminals.
Threaded grounding holes	Threaded grounding holes (#10-32) to ground the ONS 15216 EDFA3.
Serial port connection (EIA/TIA-232 [RS-232])	Serial port for local or remote (modem) data communication connection.
Label	Laser warnings, designation labels, and power level warning.
Status LEDs	LEDs indicating status of power, fail, loss of signal, Ethernet link availability, and Ethernet link traffic.
Fiber input	LC/UPC fiber input port.
Fiber output	LC/UPC fiber output port.
DCU input	LC/UPC DCU input port.
DCU output	LC/UPC DCU output port.
Monitor output	LC/UPC port for fiber that taps off 1% of the output signal for monitoring purposes.
Alarm out	RJ-45 connector used for alarm system connection.
LAN	RJ-45 connector used for 10BaseT Ethernet connection.

## 2.8.1.2 Rear Panel

Figure 2-4 shows the ONS 15216 EDFA3 rear panel. Table 2-12 lists the rear panel features.

**Figure 2-4** ONS 15216 EDFA3 Rear Panel**Table 2-12** Rear Panel Features

Feature	Description
Terminal strips A and B	Terminal strip for supplying power to the ONS 15216 EDFA3. Attach AWG 18 stranded power wires to appropriate terminals.
Alarm out	RJ-45 connector used for alarm system connection.
LAN	RJ-45 connector used for 10BaseT Ethernet connection.

## 2.9 Measurement Units and Representation

Table 2-13 lists the measurement units used for the ONS 15216 EDFA3 parameters exported to the TL1 and SNMP interfaces:

**Table 2-13** Measurement Units for ONS 15216 EDFA3 Parameters

Measurement Unit	Represents
dBm	Power
dB	Gain and insertion loss
V	Power bus voltage

The TL1 interface represents the exported values as floating point. The SNMP interface represents the exported values as integers, removing the decimal point.

