



# Configuring QDD Optical Line System

*Table 1: Feature History Table*

Feature Name	Release Information	Description
QDD Optical Line System	Release 24.4.1	

Feature Name	Release Information	Description
		<p>Introduced in this release on: NCS 540 Series Routers (select variants only*)</p> <p>The QDD Optical Line System (OLS) is a new pluggable optical amplifier that interconnects two routers or switches for transmitting traffic on a limited number of coherent optical channels over a single span point-to-point link. With the QDD OLS pluggable, it's now possible to obtain the functionality of amplification into a QSFP-DD module that can be plugged into a port of the router or switch.</p> <p>The benefits of this pluggable are:</p> <ul style="list-style-type: none"> <li>• Provides compact solution for amplification.</li> <li>• Provides extended reach.</li> <li>• Increases fiber bandwidth.</li> <li>• Lowers power dissipation.</li> </ul> <p>This feature introduces the following:</p> <ul style="list-style-type: none"> <li>• <b>CLI:</b> <ul style="list-style-type: none"> <li>• <b>controller ots (QDD OLS)</b></li> <li>• <b>rx-low-threshold</b></li> <li>• <b>tx-low-threshold</b></li> <li>• <b>ampli-control-mode</b></li> <li>• <b>egress-ampli-gain</b></li> <li>• <b>egress-ampli-power</b></li> <li>• <b>egress-ampli-safety-control-mode</b></li> <li>• <b>egress-ampli-osri</b></li> <li>• <b>show controllers ots (QDD OLS)</b></li> </ul> </li> <li>• <b>YANG Data Model:</b> <ul style="list-style-type: none"> <li>• Cisco-IOS-XR-controller-ots-oper.yang</li> <li>• Cisco-IOS-XR-controller-ots-cfg.yang</li> <li>• Cisco-IOS-XR-pmengine-oper.yang</li> <li>• Cisco-IOS-XR-pmengine-cfg.yang</li> <li>• Cisco-IOS-XR-pmengine-clear-act.yang</li> </ul> </li> </ul> <p>* The QDD Optical Line System is now supported</p>

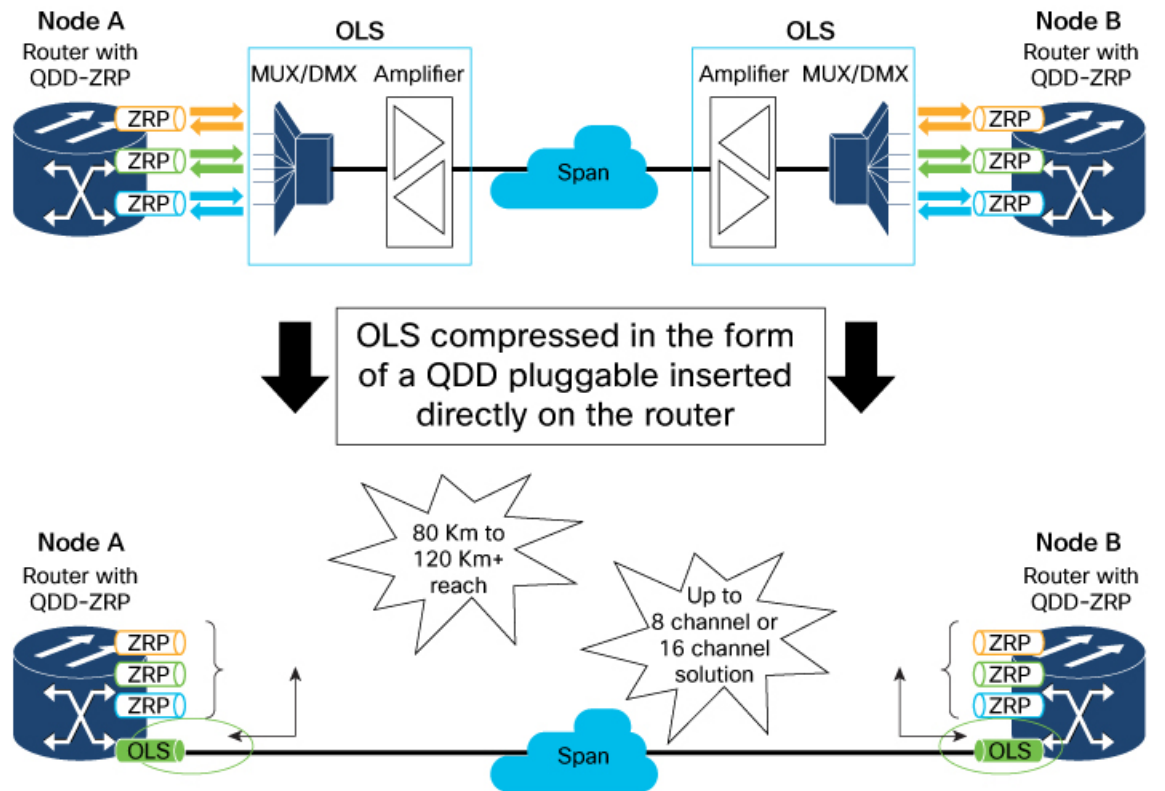
Feature Name	Release Information	Description
		on the following hardware: <ul style="list-style-type: none"> <li>• N540-24Q8L2DD-SYS</li> </ul>

The QDD OLS is a pluggable optical amplifier that interconnects two routers or switches for transporting a limited number of coherent optical channels over a single span point-to-point link.

Currently, an optical line system (OLS) requires a separate Cisco Network Convergence System 1000 Series or Cisco Network Convergence System 2000 Series optical system with dedicated 48 or 64 channels MUX/DMX units and amplifiers. The new QDD OLS module provides amplification functionality in a QSFP module, while the passive cables provide MUX/DMX functionality. With this solution, you can compress a point-to-point DWDM system directly into the routing or switching platform.

The new optical line system can now transport 8 or 16 optical channels without any additional optical hardware unit. With the use of external passive MUX/DMX units (examples for these) along with this setup, it's also possible to obtain up to 32 optical channels.

Figure 1: QDD Optical Line System



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## Supported Routers and MPAs

The support of the QDD OLS pluggable on the routers and MPA is explained as follows:

- The QDD OLS pluggable can be directly inserted into the N540-24Q8L2DD-SYS routers.

## Supported Wavelength or Frequency Configuration

For each channel supported through ONS-BRK-CS-8LC or ONS-BRK-CS-16LC passive/mux cable, the wavelength or the frequency must be configured according to the table below.

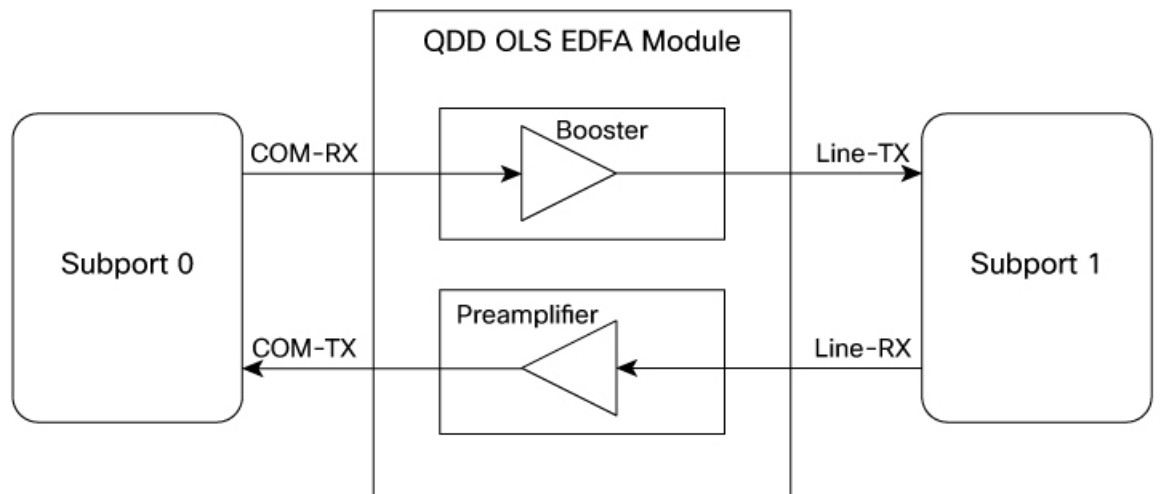
*Table 2: QDD OLS Operating Signal Wavelength Range*

Channel Spacing	Total Bandwidth	Wavelength		Frequency	
		Start	End	Start	End
8 channels - 200 GHz spaced	19.2 nm	1539.1 nm	1558.4 nm	192.375 THz	194.775 THz
16 channels - 100 GHz spaced	2.4 THz				

## Functional Description of QDD OLS

The QDD OLS pluggable contains the COM side and the Line side as shown in the figure below:

*Figure 2: Functional Description of QDD OLS*



Each physical port of the QDD OLS pluggable is represented as two ots controllers (support 0 and support 1). COM port is support 0 and Line port is support 1.

The Gain of the Booster is associated to subport 1 while the gain of the Preamplifier is associated to subport 0.

Controller	Optical Ports
ots R/S/I/P/0	COM-RX (booster input)
	COM-TX (preamplifier output)
ots R/S/I/P/1	LINE-RX (preamplifier input)
	LINE-TX (booster output)

## QDD OLS Configurations

The following section contains the QDD OLS configuration details.

### Configuring the Operational Mode, Amplifier Gain, and Amplifier Output Power

You can configure the mode of operation of the OLS pluggable to either gain control or power control mode.

In the gain control mode, you can configure the desired gain value of the OLS pluggable.

In the power control mode, you can configure the desired output power (TX) of the OLS pluggable.

#### Gain Control Operational Mode and Amplifier Gain Configuration Example

The following example shows how to configure the gain control operational mode and the amplifier gain of the OLS pluggable:

```
Router#config
Router(config)#controller ots 0/0/2/1/0
Router(config-Ots)#ampli-control-mode manual
Router(config-Ots)#egress-ampli-gain 150
Router(config-Ots)#commit
Router(config-Ots)#exit
Router(config)#exit
```

#### Running Configuration

This example shows the running configuration for the OLS pluggable:

```
Router#show run controller optics 0/0/2/1/0
controller Ots0/0/2/1/0
  ampli-control-mode manual
  egress-ampli-gain 150
!
```

#### Verification

This example shows how to verify the configured gain control operational mode and amplifier gain of the OLS pluggable:

```
Router#show controllers ots 0/0/2/1/0
Thu Mar 23 21:33:49.862 UTC

Controller State: Up
```

Transport Admin State: In Service

LED State: Green

Alarm Status:

-----

Detected Alarms: None

Alarm Statistics:

-----

RX-LOS-P = 4  
 RX-LOC = 0  
 TX-POWER-FAIL-LOW = 1  
 INGRESS-AUTO-LASER-SHUT = 0  
 INGRESS-AUTO-POW-RED = 0  
 INGRESS-AMPLI-GAIN-LOW = 0  
 INGRESS-AMPLI-GAIN-HIGH = 0  
 EGRESS-AUTO-LASER-SHUT = 0  
 EGRESS-AUTO-POW-RED = 0  
 EGRESS-AMPLI-GAIN-LOW = 4  
 EGRESS-AMPLI-GAIN-HIGH = 1  
 HIGH-TX-BR-PWR = 0  
 HIGH-RX-BR-PWR = 0  
 SPAN-TOO-SHORT-TX = 0  
 SPAN-TOO-SHORT-RX = 0

Parameter Statistics:

-----

Total Tx Power = 16.72 dBm  
 Rx Signal Power = -22.29 dBm  
 Tx Signal Power = 16.53 dBm  
 Egress Ampli Gain = 14.7 dB  
 Egress Ampli OSRI = OFF

Configured Parameters:

-----

**Egress Ampli Gain = 15.0 dB**  
 Egress Ampli Power = 4.0 dBm  
 Egress Ampli OSRI = OFF  
**Ampli Control mode = Manual**  
 Rx Low Threshold = -30.0 dBm  
 Tx Low Threshold = -5.0 dBm

Temperature = 27.92 Celsius

Voltage = 3.33 V

Optical Module Details

Optics type	: QDD DUAL EDFA
Name	: CISCO-II-VI
OUI Number	: 00.90.65
Part Number	: 60P310001
Rev Number	: 01
Serial Number	: IFB26520001
PID	: ONS-QDD-OLS
VID	: VES1
Firmware Version	: 0.10
Date Code (yy/mm/dd)	: 23/02/22
Fiber Connector Type	: CS

### Power Control Operational Mode and Amplifier Output Power Configuration Example

The following example shows how to configure the power control operational mode and the amplifier output power of the OLS pluggable :

```
Router#config
Router(config)#controller ots 0/0/2/1/0
Router(config-Ots)#ampli-control-mode powermode
Router(config-Ots)#egress-ampli-power 50
Router(config-Ots)#commit
Router(config-Ots)#exit
Router(config)#exit
```

### Running Configuration

This example shows the running configuration for the OLS pluggable:

```
Router(controller-Ots)#show run controller ots 0/0/2/1/0
controller Ots0/0/2/1/0
  ampli-control-mode powermode
  egress-ampli-power 50
!
```

### Verification

This example shows how to verify the configured power control operational mode and amplifier output power of the OLS pluggable:

```
Router#show controllers ots 0/0/2/1/0
Thu Jun  1 08:56:37.236 UTC

Controller State: Up

Transport Admin State: In Service

LED State: Green

Alarm Status:
-----
Detected Alarms: None

Alarm Statistics:
-----
RX-LOS-P = 4
RX-LOC = 0
TX-POWER-FAIL-LOW = 1
INGRESS-AUTO-LASER-SHUT = 0
INGRESS-AUTO-POW-RED = 0
INGRESS-AMPLI-GAIN-LOW = 0
INGRESS-AMPLI-GAIN-HIGH = 0
EGRESS-AUTO-LASER-SHUT = 0
EGRESS-AUTO-POW-RED = 0
EGRESS-AMPLI-GAIN-LOW = 4
EGRESS-AMPLI-GAIN-HIGH = 1
HIGH-TX-BR-PWR = 0
HIGH-RX-BR-PWR = 0
SPAN-TOO-SHORT-TX = 0
SPAN-TOO-SHORT-RX = 0

Parameter Statistics:
-----
Total Tx Power = 5.00 dBm
Rx Signal Power = -22.29 dBm
Tx Signal Power = 4.99 dBm
Egress Ampli Gain = 3.2 dB
Egress Ampli OSRI = OFF
```

```

Configured Parameters:
-----
Egress Ampli Gain = 15.0 dB
Egress Ampli Power = 5.0 dBm
Egress Ampli OSRI = OFF
Ampli Control mode = Power
Rx Low Threshold = -30.0 dBm
Tx Low Threshold = -5.0 dBm

Temperature = 29.33 Celsius
Voltage = 3.34 V

```

#### Optical Module Details

```

Optics type           : QDD DUAL EDFA
Name                  : CISCO-II-VI
OUI Number            : 00.90.65
Part Number           : 60P310001
Rev Number            : 01
Serial Number         : IFB26520001
PID                   : ONS-QDD-OLS
VID                   : VES1
Firmware Version      : 0.10
Date Code (yy/mm/dd) : 23/02/22
Fiber Connector Type  : CS

```

## Configuring the Low-Threshold Power

You can set the low-threshold power of the optical signal (RX and TX) that can be received or transmitted from the OLS pluggable.

### Low-Threshold Power Configuration Example

The following example shows how to configure the optical receive (RX) low-threshold power on the OLS pluggable:

```

Router#config
Router(config)#controller ots 0/0/2/1/0
Router(config-Ots)#rx-low-threshold -200
Router(config-Ots)#commit
Router(config-Ots)#exit
Router(config)#exit

```




---

**Note** To configure the optical transmit (TX) low-threshold power on the OLS pluggable, use the **tx-low-threshold tx-low** command.

---

### Running Configuration

This example shows the running configuration for the OLS pluggable:

```

Router#show run controller ots 0/0/2/1/0
controller Ots0/0/2/1/0
  rx-low-threshold -200
!
!

```

### Verification



This example shows how to verify the configured optical receive (RX) low-threshold power value for the OLS pluggable:

```
Router#show controllers ots 0/0/2/1/0
```

```
Controller State: Up
```

```
Transport Admin State: In Service
```

```
LED State: Yellow
```

```
Alarm Status:
```

```
-----
```

```
Detected Alarms:
```

```
    RX-LOS-P
```

```
Alarm Statistics:
```

```
-----
```

```
RX-LOS-P = 0
```

```
RX-LOC = 0
```

```
TX-POWER-FAIL-LOW = 0
```

```
INGRESS-AUTO-LASER-SHUT = 0
```

```
INGRESS-AUTO-POW-RED = 0
```

```
INGRESS-AMPLI-GAIN-LOW = 0
```

```
INGRESS-AMPLI-GAIN-HIGH = 0
```

```
EGRESS-AUTO-LASER-SHUT = 0
```

```
EGRESS-AUTO-POW-RED = 0
```

```
EGRESS-AMPLI-GAIN-LOW = 0
```

```
EGRESS-AMPLI-GAIN-HIGH = 0
```

```
HIGH-TX-BR-PWR = 0
```

```
HIGH-RX-BR-PWR = 0
```

```
SPAN-TOO-SHORT-TX = 0
```

```
SPAN-TOO-SHORT-RX = 0
```

```
Parameter Statistics:
```

```
-----
```

```
Total Tx Power = -50.00 dBm
```

```
Rx Signal Power = -50.00 dBm
```

```
Tx Signal Power = -50.00 dBm
```

```
Egress Ampli Gain = 0.0 dB
```

```
Egress Ampli OSRI = OFF
```

```
Configured Parameters:
```

```
-----
```

```
Egress Ampli Gain = 20.0 dB
```

```
Egress Ampli Power = 8.0 dBm
```

```
Egress Ampli OSRI = OFF
```

```
Ampli Control mode = Manual
```

```
Rx Low Threshold = -20.0 dBm
```

```
Tx Low Threshold = -5.0 dBm
```

```
Temperature = 14.29 Celsius
```

```
Voltage = 3.37 V
```

```
Optical Module Details
```

```
Optics type           : QDD DUAL EDFA
Name                  : CISCO-ACCELINK
OUI Number            : 00.00.00
Part Number           : EDFA-211917-QDD
Rev Number            : 19
Serial Number         : ACW2631Z00X
```

```

PID : ONS-QDD-OLS=
Firmware Version : 1.09
Date Code (yy/mm/dd) : 22/06/02
Fiber Connector Type : CS

```

## Configuring the Optical Safety Remote Interlock (OSRI)

To shut down the amplifier, use the Optical Safety Remote Interlock (OSRI) configuration. This configuration is used during the maintenance of the pluggable, debugging scenarios, and when the OLS pluggable isn't in use. With this configuration enabled, the output power can still be a maximum of -15dBm based on the input power.

### OSRI Configuration Example

The following example shows how to configure the Optical Safety Remote Interlock (OSRI) on the OLS pluggable:

```

Router#config
Router(config)#controller ots 0/0/2/1/0
Router(config-Ots)#egress-ampli-osri on
Router(config-Ots)#commit
Router(config-Ots)#exit
Router(config)#exit

```

### Running Configuration

This example shows the running configuration for the OLS pluggable:

```

Router#show run controller optics 0/0/2/1/0
controller Ots0/0/2/1/0
  egress-ampli-osri on
!

```

### Verification

This example shows how to verify the configured OSRI for the OLS pluggable:

```

Router#show controllers ots 0/0/2/1/0

Thu Jun  1 09:04:10.335 UTC

Controller State: Up

Transport Admin State: In Service

LED State: Green

```

```

Alarm Status:
-----
Detected Alarms: None

Alarm Statistics:
-----
RX-LOS-P = 4
RX-LOC = 0
TX-POWER-FAIL-LOW = 1
INGRESS-AUTO-LASER-SHUT = 0
INGRESS-AUTO-POW-RED = 0
INGRESS-AMPLI-GAIN-LOW = 0
INGRESS-AMPLI-GAIN-HIGH = 0
EGRESS-AUTO-LASER-SHUT = 0
EGRESS-AUTO-POW-RED = 0
EGRESS-AMPLI-GAIN-LOW = 4

```

```

EGRESS-AMPLI-GAIN-HIGH = 1
HIGH-TX-BR-PWR = 0
HIGH-RX-BR-PWR = 0
SPAN-TOO-SHORT-TX = 0
SPAN-TOO-SHORT-RX = 0

Parameter Statistics:
-----
Total Tx Power = -50.00 dBm
Rx Signal Power = -22.36 dBm
Tx Signal Power = -50.00 dBm
Egress Ampli Gain = 0.0 dB
Egress Ampli OSRI = ON

Configured Parameters:
-----
Egress Ampli Gain = 15.0 dB
Egress Ampli Power = 5.0 dBm
Egress Ampli OSRI = ON
Ampli Control mode = Power
Rx Low Threshold = -30.0 dBm
Tx Low Threshold = -5.0 dBm

Temperature = 27.90 Celsius
Voltage = 3.34 V

```

#### Optical Module Details

```

Optics type           : QDD DUAL EDFA
Name                  : CISCO-II-VI
OUI Number            : 00.90.65
Part Number           : 60P310001
Rev Number            : 01
Serial Number         : IFB26520001
PID                   : ONS-QDD-OLS
VID                   : VES1
Firmware Version      : 0.10
Date Code (yy/mm/dd) : 23/02/22
Fiber Connector Type  : CS

```

## Configuring Safety Control Mode

You can enable safety control mode only on subport 1.

With `safety-control-mode` set as **auto** and if LOS is detected on the line RX, the line TX normalizes the signal output power to 8 dBm and the ALS (automatic laser shutdown) and APR (automatic power reduction) alarms are raised.

### Safety Control Configuration Example

The following example shows how to enable safety control mode on the OLS pluggable (on subport 1):

```

Router#config
Router(config)#controller ots 0/0/2/1/1
Router(config-Ots)#egress-ampli-safety-control-mode auto
Router(config-Ots)#commit
Router(config-Ots)#exit
Router(config)#exit

```

### Running Configuration

This example shows the running configuration for the OLS pluggable:

```
Router#show run controller ots 0/0/2/1/1
controller Ots0/0/2/1/1
  ampli-control-mode manual
  egress-ampli-gain 230
  egress-ampli-safety-control-mode auto
!
```

### Verification

This example shows how to verify the configured safety control mode:

```
Router#show controllers ots 0/0/2/1/1

Thu Jun  1 09:04:17.550 UTC

Controller State: Down

Transport Admin State: In Service

LED State: Yellow

Alarm Status:
-----
Detected Alarms:
                RX-LOS-P
                EGRESS-AUTO-LASER-SHUT
                EGRESS-AUTO-POW-RED
                EGRESS-AMPLI-GAIN-HIGH

Alarm Statistics:
-----
RX-LOS-P = 12
RX-LOC = 0
TX-POWER-FAIL-LOW = 1
INGRESS-AUTO-LASER-SHUT = 0
INGRESS-AUTO-POW-RED = 0
INGRESS-AMPLI-GAIN-LOW = 0
INGRESS-AMPLI-GAIN-HIGH = 0
EGRESS-AUTO-LASER-SHUT = 13
EGRESS-AUTO-POW-RED = 13
EGRESS-AMPLI-GAIN-LOW = 2
EGRESS-AMPLI-GAIN-HIGH = 12
HIGH-TX-BR-PWR = 0
HIGH-RX-BR-PWR = 0
SPAN-TOO-SHORT-TX = 0
SPAN-TOO-SHORT-RX = 0

Parameter Statistics:
-----
Total Tx Power = 8.08 dBm
Rx Signal Power = -50.00 dBm
Tx Signal Power = 5.61 dBm
Egress Ampli Gain = 28.9 dB
Egress Ampli Safety Control mode = auto
Egress Ampli OSRI = OFF

Configured Parameters:
-----
Egress Ampli Gain = 23.0 dB
Egress Ampli Power = 3.0 dBm
Egress Ampli Safety Control mode = auto
Egress Ampli OSRI = OFF
Ampli Control mode = Manual
```

```
Rx Low Threshold = -30.0 dBm
Tx Low Threshold = -5.0 dBm
```

```
Temperature = 23.00 Celsius
Voltage = 3.36 V
```

#### Optical Module Details

```
Optics type           : QDD DUAL EDFA
Name                  : CISCO-ACCELINK
OUI Number            : 00.00.00
Part Number           : EDFA-211917-QDD
Rev Number            : 24
Serial Number         : ACW2651Z001
PID                   : ONS-QDD-OLS
VID                   : VES1
Firmware Version      : 2.04
Date Code (yy/mm/dd) : 22/12/27
Fiber Connector Type  : CS
```

## OLS Alarms Troubleshooting

This section contains the procedures for troubleshooting alarms.

### **RX-LOS-P**

Default Severity: Critical

Logical Object: Controller

The RX-LOS-P alarm is raised when there is loss of signal.

#### **Clear the RX-LOS-P Alarm**

1. Verify the transmission (TX) at the peer end.
2. Check the fiber connections.

If the alarm does not clear, log into the Technical Support Website at <http://www.cisco.com/c/en/us/support/index.html> for more information or call Cisco TAC (1 800 553-2447).

### **RX-POWER-FAIL-LOW**

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The RX-POWER-FAIL-LOW alarm is raised when the RX power is below the configured low threshold values.

#### **Clear the RX-POWER-FAIL-LOW Alarm**

1. Verify the transmission (TX) at the peer end.
2. Check the fiber connections.

3. Increase the peer end gain or transmit-power value to obtain the RX power above the threshold.

If the alarm does not clear, log into the Technical Support Website at <http://www.cisco.com/c/en/us/support/index.html> for more information or call Cisco TAC (1 800 553-2447).

#### **TX-POWER-FAIL-LOW**

Default Severity: Critical

Logical Object: Controller

The TX-POWER-FAIL-LOW alarm is raised when the TX power is below the configured low threshold values.

#### **Clear the TX-POWER-FAIL-LOW Alarm**

1. Increase the gain or power configuration value to obtain the TX power above the threshold.

If the alarm does not clear, log into the Technical Support Website at <http://www.cisco.com/c/en/us/support/index.html> for more information or call Cisco TAC (1 800 553-2447).

#### **EGRESS-AMPLI-GAIN-LOW**

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The EGRESS-AMPLI-GAIN-LOW alarm is raised when the actual gain of the OLS pluggable is lower than the configured gain value.

#### **Clear the EGRESS-AMPLI-GAIN-LOW Alarm**

1. Configure the gain value within the optimum range.

If the alarm does not clear, log into the Technical Support Website at <http://www.cisco.com/c/en/us/support/index.html> for more information or call Cisco TAC (1 800 553-2447).

#### **EGRESS-AMPLI-GAIN-HIGH**

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The EGRESS-AMPLI-GAIN-HIGH alarm is raised when the actual gain of the OLS pluggable is higher than the configured gain value.

#### **Clear the EGRESS-AMPLI-GAIN-HIGH Alarm**

1. Verify the RX and TX values and adjust the gain within the optimum working range.

If the alarm does not clear, log into the Technical Support Website at <http://www.cisco.com/c/en/us/support/index.html> for more information or call Cisco TAC (1 800 553-2447).

#### **EGRESS-AUTO-LASER-SHUT**

Default Severity: Not-Alarmed

Logical Object: Controller

The EGRESS-AUTO-LASER-SHUT alarm is raised when there is loss of signal (LOS) on the OTS line side (subport 1)

#### **Clear the EGRESS-AUTO-LASER-SHUT Alarm**

1. Verify the fiber connections on the line side of the OLS pluggable.
2. Verify the gain or power on the line side of the peer end.

If the alarm does not clear, log into the Technical Support Website at <http://www.cisco.com/c/en/us/support/index.html> for more information or call Cisco TAC (1 800 553-2447).

#### **EGRESS-AUTO-POW-RED**

Default Severity: Not-Alarmed

Logical Object: Controller

The EGRESS-AUTO-POW-RED alarm is raised when there is loss of signal (LOS) on the OTS line side (subport 1)

#### **Clear the EGRESS-AUTO-POW-RED Alarm**

1. Verify the fiber connections on the line side of the OLS pluggable.
2. Verify the gain or power on the line side of the peer end.

If the alarm does not clear, log into the Technical Support Website at <http://www.cisco.com/c/en/us/support/index.html> for more information or call Cisco TAC (1 800 553-2447).

