Configuring 400G Digital Coherent Optics

The following 400G Digital Coherent QSFP-DD optical modules are supported:

- QDD-400G-ZR-S
- QDD-400G-ZRP-S

Note

- The information in this chapter applies to all supported 400G Digital Coherent QSFP-DD optical modules unless otherwise specified.
- To determine the transceivers that Cisco hardware device supports, refer to the Transceiver Module Group (TMG) Compatibility Matrix tool.

This chapter describes the 400G Digital Coherent QSFP-DD optical modules and their supported configurations.

Table 1: Hardware and Software Support

Hardware PID	Optics PID	Minimum IOS XR Software Release	
NCS-57C3-MODS-SYS	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.8.1	
NCS-57C3-MOD-SYS	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.8.1	
NCS-57D2-18DD-SYS	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.8.1	
	NC57-MOD-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.8.1
NCS-57C1-48Q6D-S		QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.5.2

NCS-57B1-6D24H-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2	
	NC57-24DD	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2
NC57-18DD-SE		QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2
NC57-36H6D-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2	
	NCS-57B1-5D24H-SE	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2

The 400G Digital Coherent QSFP-DD optical modules enable wavelength-division multiplexing (WDM) functionality in the router. These optical modules are DWDM C-band (196.1 THz to 191.3 THz) tunable optical modules. They can be used in both transponder and muxponder modes.

Cisco IOS XR software creates optics and coherent DSP controllers to configure and monitor the performance of the 400G Digital Coherent QSFP-DD optical modules. Optics controllers are used to configure and monitor optical parameters, such as frequency, chromatic dispersion, transmitted output power, modulation, and so on. Coherent DSP controllers are used to monitor network performance parameters like pre- and post-forward error correction (FEC) bit-error rate (pre-FEC BER, post-FEC BER), error corrected bits (EC-BITS), and so on. Forward error correction (FEC) is configured using optical controllers and monitored using coherent DSP controllers.

The 400G Digital Coherent QSFP-DD optical modules support traffic configuration and firmware download. The Cisco IOS XR software collects performance monitoring data and alarms using versatile DOM (VDM).

Due to more power consumption by the 400G Digital Coherent QSFP-DD optical modules, the Cisco IOS XR software operates the fans at an higher speed to cool these optical modules.

The 400G Digital Coherent QSFP-DD optical module configuration is divided into the following categories:

- Traffic configuration – Comprises configuring DAC rate, muxponder mode, modulation, and FEC parameters. Applicable for optics controllers:
  - Configuring DAC Rate, on page 18
  - Configuring Muxponder Mode, on page 11
  - Configuring Modulation, on page 16
  - Configuring FEC, on page 20
- Optical configuration – Comprises configuring frequency, chromatic dispersion, and optical transmit power. Applicable for optics controllers:
  - Configuring Frequency, on page 5
  - Configuring Chromatic Dispersion, on page 7
  - Configuring Optical Transmit Power, on page 9

- Performance monitoring (PM) – Enables or disables performance monitoring in optical modules. You can also configure PM parameters that comprise signal power, chromatic dispersion, optical signal-to-noise ratio (OSNR), and differential group delay (DGD). Applicable for optics controllers and coherent DSP controllers:
  - Configuring Performance Monitoring, on page 22
  - Configuring PM Parameters, on page 22
- Loopback configuration – Configures loopback. Applicable for coherent DSP controller:
  - Configuring Loopback, on page 21
- Alarms threshold configuration – Configures thresholds for monitoring alarms that include optical signal-to-noise ratio (OSNR), differential group delay (DGD), chromatic dispersion (cd high and low), and so on. Applicable for optics controllers:
  - Configuring Alarms Threshold, on page 25

The following table contains the possible traffic configuration values for the 400G Digital Coherent QSFP-DD optical modules, in the transponder and muxponder mode:

Restrictions and Limitations

- 400G Digital Coherent QSFP-DD optical modules are supported on all 400G ports of NC57-MOD-S line cards.
- 400G Digital Coherent QSFP-DD optical modules are supported on all 400G ports of fixed-port routers.
- For supported combinations of QDD-400G-ZRP and other optical modules on the NCS-57D2-18DD-SYS, NCS-57B1-6D24H-S, NCS-57B1-5D24-SE, NCS-57C1-48Q6-SYS, NCS-57C3-MOD-SYS, and NCS-57C3-MODS-SYS routers, see the "Network Interfaces" section in the *Hardware Installation Guide for Cisco NCS 5700 Series Fixed-Port Routers*.
- 400G Digital Coherent QSFP-DD optical modules are supported only on 400G even-numbered ports (at the top row) of the line cards. In addition, the following points describe the limitations of specific line cards:
  - NC57-24DD: All twelve 400G even-numbered ports support 400G Digital Coherent QSFP-DD optical modules.
  - NC57-18DD-SE: Up to a maximum of six 400G Digital Coherent QSFP-DD optical modules are supported in the 400G even-numbered ports.
  - NC57-36H6D-S: Up to a maximum of six 400G Digital Coherent QSFP-DD optical modules are supported in the 400G even-numbered ports.
- The following platform combination doesn't support native 400G speed but can operate in 4x100G mode:
  - NCS-57C3-MOD-S/-SE-S with NC57-MPA-2D4H-S in MPA slot1
  - NC55-MOD-A-SE-S with NC57-MPA-2D4H-S
  - NCS-55A2-MOD-S/-HD-S/-HX-S with NC57-MPA-2D4H-S

FPD Upgrades Enabled for QDD-400G-ZR-S and QDD-400G-ZRP-S Optical Modules

Table 2: Feature History Table

Feature Name	Release Information	Feature Description
FPD Upgrades Enabled for QDD-400G-ZR-S and QDD-400G-ZRP-S Optical Modules	Release 7.3.2	This feature allows you to perform Field Programmable Device (FPD) upgrades on the QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules to ensure they have the latest fixes and features. For more information about the optic module portfolio, see the Cisco 400G Digital Coherent Optics QSFP-DD Optical Modules Data Sheet.

Although an FPD upgrade is not mandatory in this release, we recommend upgrading the FPD to the latest version in the subsequent releases to ensure that all the latest fixes and features are enabled on the optical modules.

The QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules have two internal FPD image banks: image banks A and B. These image banks contain running and programmed FPD versions, which are fetched during boot-up. The active image is fetched from bank A, while the standby image is fetched from bank B. To upgrade the optical modules, you must perform the FPD upgrade twice, once for the active image bank and once for the standby image bank. After each upgrade, you must disable and re-enable the QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules using the **controller optics** command to activate the latest firmware.

See the ***Upgrading Field-Programmable Device*** chapter in the *System Management Configuration Guide for Cisco NCS 5500 Series Routers* for details on the procedure to upgrade the FPD.

QDD-400G-ZR-S Transponder and Muxponder Configuration Values

The following table contains the possible Transponder and Muxponder configuration values for the QDD-400G-ZR-S optical module:

Table 3: QDD-400G-ZR-S Transponder and Muxponder Configuration Values

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
400G-TXP	1 client, 400G speed	1 trunk, 400G	16 QAM	cFEC	1x1
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G	16 QAM	cFEC	1x1

QDD-400G-ZRP-S Transponder and Muxponder Configuration Values

The following table contains the possible Transponder and Muxponder configuration values for the QDD-400G-ZRP-S optical module:

Table 4: QDD-400G-ZRP-S Transponder and Muxponder Configuration Values

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	cFEC	1x1
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	cFEC	1x1
3x100G-MXP	3 clients, 100G speed	1 trunk, 300G speed	8 QAM	oFEC	1x1.25
2x100G-MXP	2 clients, 100G speed	1 trunk, 200G speed	QPSK	oFEC	1x1.5
1x100G-MXP	1 client, 100G speed	1 trunk, 100G speed	QPSK	oFEC	1x1.5

- Configuring Frequency, on page 5
- Configuring Chromatic Dispersion, on page 7
- Configuring Optical Transmit Power, on page 9
- Configuring Muxponder Mode, on page 11
- Configuring Modulation, on page 16
- Configuring DAC Rate, on page 18
- Configuring FEC, on page 20
- Configuring Loopback, on page 21
- Configuring Performance Monitoring, on page 22
- Configuring PM Parameters, on page 22
- Configuring Alarms Threshold, on page 25
- Alarms Troubleshooting, on page 27

Configuring Frequency

You can configure frequency on optics controllers. You can select any C band frequency between the range 196.1 to 191.3 THz, in both ITU and NON-ITU channels.

Note The 100MHz-grid keyword accepts only frequency values as user input. The 50GHz-grid keyword accepts frequency, ITU-channel, or wavelength values as user input. The Cisco IOS XR software then caculates the frequency for a given wavelength or ITU-channel.

Frequency Configuration Example

The following example shows how to configure frequency on the optics controller:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#dwdm-carrier 100MHz-grid frequency 1921500
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration:

```
Router#show run controller optics 0/2/0/16
Fri May 28 01:42:32.488 UTC
controller Optics0/2/0/16
 dwdm-carrier 100MHz-grid frequency 1921500
 cd-low-threshold -5000
 cd-high-threshold -5000
!
```

Verification

This example shows how to verify the frequency configuration:

```
Router#show controller optics 0/2/0/16
Fri May 28 01:47:23.953 UTC
 Controller State: Up
 Transport Admin State: In Service
 Laser State: Off
 LED State: Off
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZRP
         DWDM carrier Info: C BAND, MSA ITU Channel=80, Frequency=192.15THz,
         Wavelength=1560.200nm
         Alarm Status:
         -------------
         Detected Alarms: None
         LOS/LOL/Fault Status:
         Alarm Statistics:
         -------------
         HIGH-RX-PWR = 0            LOW-RX-PWR = 0
         HIGH-TX-PWR = 0            LOW-TX-PWR = 0
         HIGH-LBC = 0               HIGH-DGD = 0
         OOR-CD = 0                 OSNR = 0
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0 mA
         Actual TX Power = -40.00 dBm
         RX Power = -40.00 dBm
         RX Signal Power = -40.00 dBm
         Frequency Offset = 0 MHz
         Laser Temperature = 0.00 Celsius
         Laser Age = 0 %
         DAC Rate = 1x1.25
         Performance Monitoring: Enable
         THRESHOLD VALUES
         ----------------
         Parameter                High Alarm  Low Alarm  High Warning  Low Warning
         -----------------------  ----------  ---------  ------------  -----------
         Rx Power Threshold(dBm)         13.0      -24.0          10.0        -22.0
         Tx Power Threshold(dBm)          0.0      -16.0          -2.0        -14.0
         LBC Threshold(mA)               0.00       0.00          0.00         0.00
```

```
        Temp. Threshold(celsius)       80.00      -5.00         75.00         0.00
        Voltage Threshold(volt)         3.46       3.13          3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -10.00 dBm
        Configured CD High Threshold = -5000 ps/nm
        Configured CD lower Threshold = -5000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  60.1385459900 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -26000 ps/nm  CD-MAX 26000 ps/nm
        Second Order Polarization Mode Dispersion = 0.00 ps^2
        Optical Signal to Noise Ratio = 0.00 dB
        Polarization Dependent Loss = 0.00 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 0.00 ps
        Temperature = 21.00 Celsius
        Voltage = 3.42 V
 Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZRP
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E30-19E
        Rev Number              : 10
        Serial Number           : ACA244900GN
        PID                     : QDD-400G-ZRP-S
        VID                     : ES03
        Firmware Version        : 161.06
        Date Code(yy/mm/dd)     : 20/12/08
!
```

Configuring Chromatic Dispersion

You can configure chromatic dispersion on optics controllers. When you configure the maximum and minimum values for chromatic dispersion for any data rate, ensure that the minimum difference between the configured values is equal to or greater than 1000 ps/nm.

The following table lists the default CD search range:

Table 5: Default CD Search Range

Muxponder Rate	FEC Value	Default CD Search Range (Min-Max)
400	OFEC	-26000 to +26000
400	CFEC	-2400 to +2400
300	OFEC	-50000 to +50000
200	OFEC	-50000 to +50000
100	OFEC	-80000 to +80000

Note For **cd-max** and **cd-min** range details, see the controller optics command.

Chromatic Dispersion Configuration Example

This example shows how to configure chromatic dispersion on the optics controller:

```
Router#configure
Router(config)#controller optics 0/0/0/13
Router(config-Optics)#cd-max 4000
Router(config-Optics)#cd-min -4000
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration for the optics controller:

```
Router#show run controller optics 0/0/0/13
Thu May 13 12:24:42.353 UTC
controller Optics0/0/0/13
 cd-min -4000
 cd-max 4000
 !
```

Verification

This example shows how to verify the configured chromatic dispersion values for the optics controller:

```
Router#show controller optics 0/0/0/13
 Controller State: Up
 Transport Admin State: In Service
 Laser State: On
 LED State: Green
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZR
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm
         Alarm Status:
         -------------
         Detected Alarms: None
         LOS/LOL/Fault Status:
         Alarm Statistics:
         -------------
         HIGH-RX-PWR = 0            LOW-RX-PWR = 0
         HIGH-TX-PWR = 0            LOW-TX-PWR = 0
         HIGH-LBC = 0               HIGH-DGD = 0
         OOR-CD = 0                 OSNR = 35
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0 %
         Actual TX Power = -7.87 dBm
         RX Power = -8.27 dBm
         RX Signal Power = -8.43 dBm
         Frequency Offset = 130 MHz
         Performance Monitoring: Enable
         THRESHOLD VALUES
         ----------------
         Parameter                High Alarm  Low Alarm  High Warning  Low Warning
         -----------------------  ----------  ---------  ------------  -----------
```

```
        Rx Power Threshold(dBm)          1.9       -28.2          0.0        -25.0
        Tx Power Threshold(dBm)          0.0       -15.0         -2.0        -16.0
        LBC Threshold(mA)               0.00        0.00         0.00         0.00
        Temp. Threshold(celsius)       80.00       -5.00        75.00        15.00
        Voltage Threshold(volt)         3.46        3.13         3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -6.00 dBm
        Configured CD High Threshold = 80000 ps/nm
        Configured CD lower Threshold = -80000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  59.8437500000 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -4000 ps/nm  CD-MAX 4000 ps/nm
        Second Order Polarization Mode Dispersion = 5.00 ps^2
        Optical Signal to Noise Ratio = 36.30 dB
        Polarization Dependent Loss = 0.40 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 4.00 ps
        Temperature = 54.00 Celsius
        Voltage = 3.37 V
Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZR
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E20-19E
        Rev Number              : 10
        Serial Number           : ACA2447003L
        PID                     : QDD-400G-ZR-S
        VID                     : ES03
        Firmware Version        : 61.12
        Date Code(yy/mm/dd)     : 20/12/02
```

Configuring Optical Transmit Power

You can set the transmit power of the optical signal.

Each 400G Digital Coherent QSFP-DD optical module has its own optical transmit (TX) power range. User can change the optical transmit (TX) power value based on the module capability. For "Transmitter specifications", see the following data sheets:

- *Cisco 400G Digital Coherent Optics QSFP-DD Optical Modules Data Sheet*

Table 6: Optical Transmit Power Values

Optical Module	Trunk Speed	Optical Transmit Power (Tx) Shaping	Interval	Supported Range of Optical Transmit Power (Tx) Values (in units of 0.1dBm)[1]		
				Minimum Value	Maximum Value - Typical	Maximum Value - Worst Case
QDD-400G-ZR-S	400G	No	1	-150	-100	-100

Optical Module	Trunk Speed	Optical Transmit Power (Tx) Shaping	Interval	Supported Range of Optical Transmit Power (Tx) Values (in units of 0.1dBm)[1]		
				Minimum Value	Maximum Value - Typical	Maximum Value - Worst Case
QDD-400G-ZRP-S	400G	Yes	1	-150	-110	-130
	300G			-150	-104	-119
	200G			-150	-90	-105
	100G			-150	-59	-75

1. The default optical transmit power (Tx) value is -10 dBm, however with TX shaping enabled the maximum power in 1x400G, 4x100G, 3x100G, 2x100G, and 1x100G modes may be less than -10 dBm.

Transmitting Power Configuration Example

The following example shows how to configure the optical transmit (TX) power on the optics controller:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#transmit-power -125
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration for the optics controller:

```
Router#show run controller optics 0/2/0/16
Thu May 13 12:52:35.020 UTC
controller Optics0/0/0/1
 cd-min -4000
 cd-max 4000
 transmit-power -125
!
```

Verification

This example shows how to verify the configured optical transmit power for the optics controller:

```
Router#show controller optics 0/2/0/16
Fri May 28 02:52:06.182 UTC
 Controller State: Up
 Transport Admin State: In Service
 Laser State: Off
 LED State: Off
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZRP
         DWDM carrier Info: C BAND, MSA ITU Channel=80, Frequency=192.15THz,
         Wavelength=1560.200nm
         Alarm Status:
         -------------
         Detected Alarms: None
         LOS/LOL/Fault Status:
         Alarm Statistics:
         -------------
```

```
        HIGH-RX-PWR = 0            LOW-RX-PWR = 0
        HIGH-TX-PWR = 0            LOW-TX-PWR = 0
        HIGH-LBC = 0               HIGH-DGD = 0
        OOR-CD = 0                 OSNR = 0
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 0
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 mA
        Actual TX Power = -40.00 dBm
        RX Power = -40.00 dBm
        RX Signal Power = -40.00 dBm
        Frequency Offset = 0 MHz
        Laser Temperature = 0.00 Celsius
        Laser Age = 0 %
        DAC Rate = 1x1.25
        Performance Monitoring: Enable
        THRESHOLD VALUES
        ----------------
        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         13.0      -24.0          10.0        -22.0
        Tx Power Threshold(dBm)          0.0      -16.0          -2.0        -14.0
        LBC Threshold(mA)               0.00       0.00          0.00         0.00
        Temp. Threshold(celsius)       80.00      -5.00         75.00         0.00
        Voltage Threshold(volt)         3.46       3.13          3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -12.50 dBm
        Configured CD High Threshold = -5000 ps/nm
        Configured CD lower Threshold = -5000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  60.1385459900 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -4000 ps/nm  CD-MAX 4000 ps/nm
        Second Order Polarization Mode Dispersion = 0.00 ps^2
        Optical Signal to Noise Ratio = 0.00 dB
        Polarization Dependent Loss = 0.00 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 0.00 ps
        Temperature = 20.00 Celsius
        Voltage = 3.41 V
Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZRP
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E30-19E
        Rev Number              : 10
        Serial Number           : ACA244900GN
        PID                     : QDD-400G-ZRP-S
        VID                     : ES03
        Firmware Version        : 161.06
        Date Code(yy/mm/dd)     : 20/12/08
```

Configuring Muxponder Mode

By default, the Cisco IOS XR software configures the 400G Digital Coherent QSFP-DD optical modules in the 400G transponder mode.

However, you can configure muxponder mode on optics controllers. Based on the muxponder mode, you can choose the modulation.

Table 7: Supported Ports and Command for Configuring Muxponder Mode

Platforms with 400G Direct Ports	**Direct Ports (n) with 400G**	**ZR/ZRP**	**Bright ZRP**	**Mode**	**Command**
NC57-24DD	n = 0,2,4,6,8,10,12,14,16,18,20,22	7.3.2/7.5.1	–	400G	*Default*
NC57-18DD-SE	n = 18,20,22	7.3.2/7.5.1	–	4x100G	**controller optics** *0/x/0/n* **breakout** *4x100*
NC57-MOD-S	n = 8,9	7.8.1	–	3x100G	**controller optics** *0/x/0/n* **breakout** *3x100*
NCS-57B1-6D24H-S	n = 24,25,26,27,28,29	7.3.2/7.5.1	–	1x100G	**controller optics** *0/x/0/n* **breakout** *1x100*
NCS-57B1-5D24H-SE	n = 24,25,26,27,28	7.3.2/7.5.1	–		
NCS-57C1-48Q6D-S	n = 0,2,4	7.5.2/7.7.1	–		
Platforms with Flex Port Pairs	**Port Pairs (n,n+1) sharing 400G**	**ZR/ZRP**	**Bright ZRP**	**Mode**	**Command**
NC57-18DD-SE (max 6 ZR or 3 ZRP)	n = 0,2,4,6,8,10,12,14,16,24,26,28	7.3.2/7.5.1	–	400G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *400*
NC57-36H6D-S	n = 24,26,28,30,32,34	7.3.2/7.5.1	–	4x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *4x100*
				3x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *3x100*
				2x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *2x100-pam4*
				1x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *1x100*
Platforms with Flex Port Quads	**Port Quads (n - n+3) sharing 400G, Direct Ports m with 400G**	**ZR/ZRP**		**Mode**	**Command**
NCS-57D2-18DD-S	n = 0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60, m = 64,65	7.8.1	–	400G	**controller optics** *0//0/0/{n | m}* **speed** *400*

	4x100G	**controller optics** *0//0/0/{n | m}* **speed** *4x100*
	3x100G	**controller optics** *0//0/0/{n | m}* **speed** *3x100*
	2x100G	**controller optics** *0//0/0/{n | n+3 | m}* **speed** *2x100*
	1x100G	**controller optics** *0//0/0/{n | n+3 | m}* **speed** *1x100*

Table 8: Other Platform Combinations: Supported Ports and Commands for Configuring Muxponder Mode

Platforms with NC57-MPA-2D4H-S in 800G mode, (0,1) and (2,3) sharing 400G	**MPA Slots**	**ZR/ZRP**	**Bright ZRP**	**Mode**	**Command**
NCS-57C3-MOD-(S/SE-S)	m = 2,3	7.8.1	–	400G	**hw-module port-range** *{0 1 | 2 3}* **instance** *m* **location** *0/x/CPU0* **mode** *400*
NC57-MOD-S	m = 1,2	7.8.1	–	4x100G	**hw-module port-range** *{0 1 | 2 3}* **instance** *m* **location** *0/x/CPU0* **mode** *4x100*
				3x100G	**hw-module port-range** *{0 1 | 2 3}* **instance** *m* **location** *0/x/CPU0* **mode** *3x100*
				2x100G	**controller optics** *0/x/m/{0 | 1 | 2 | 3}* **breakout** *2x100*
				1x100G	**controller optics** *0/x/m/{0 | 1 | 2 | 3}* **breakout** *1x100*
Platforms with NC57-MPA-2D4H-S in 400G mode, (0,1,2,3) sharing 400G	**MPA Slots**	**ZR/ZRP**	**Bright ZRP**	**Mode**	**Command**
NCS-57C3-MOD-(S/SE-S)	m = 1	7.8.1	–	4x100G	**hw-module port-range** *0 3* **instance** *m* **location** *0/x/CPU0* **mode** *4x100*
NCS-55A2-MOD-(S/SE-S/SE-H-S/HD-S/HX-S)	m = 1,2	7.5.1	–	3x100G	**hw-module port-range** *0 2* **instance** *m* **location** *0/x/CPU0* **mode** *3x100*

Note The 400G Digital Coherent QSFP-DD optical modules are supported on NCS-57C3-MOD-SYS and NCS-57C3-MODS-SYS fixed-port routers through NC57-MPA-2D4H-S MPA. Following are the supported breakout combinations on the NCS-57C3-MOD-SYS and NCS-57C3-MODS-SYS routers using NC57-MPA-2D4H-S MPA.

Note The following line cards do not support CVR-QSFP-SFP10G and any 1Gbps optics:

- NCS-57B1-6D24-SYS
- NCS-57B1-5DSE-SYS
- NC57-24DD
- NC57-18DD-SE
- NC57-36H-SE
- NC57-36H6D
- NC57-MOD-S

Table 9: Supported Ports and Commands for Configuring Breakout on NCS-57C3-MOD Routers

Breakout mode	MPA slot 1 command	MPA slots 2 and 3 command
1x100	**breakout** *muxponder mode*	**breakout** *muxponder mode*
2x100 PAM4	**hw-module port-range** [*0 1 | 2 3*]	Not Supported
2x100	Not Supported	**breakout** *muxponder mode*
3x100	**hw-module port-range** [*0 2*]	**hw-module port-range** [*0 1 | 2 3*]
4x100	**hw-module port-range** [*0 3*]	**hw-module port-range** [*0 1 | 2 3*]
400	Not Supported	**hw-module port-range** [*0 1 | 2 3*]

Muxponder mode options available for QDD-400G-ZR-S are:

- 4x100

Muxponder mode options available for QDD-400G-ZRP-S are:

- 4x100
- 3x100
- 2x100 (or 2x100-PAM4)

- 1x100

See the following tables for the modulation values, based on the muxponder mode:

- Table 3: QDD-400G-ZR-S Transponder and Muxponder Configuration Values, on page 4
- Table 4: QDD-400G-ZRP-S Transponder and Muxponder Configuration Values, on page 5
- #unique_258 unique_258_Connect_42_section_agy_yc2_jxb

Using the **no breakout** *muxponder mode* command, you can switch from the muxponder mode to the transponder mode, on optics controllers.

Muxponder Mode Configuration Example

The following example shows how to configure muxponder mode on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/13
Router(config-Optics)#breakout 4x100
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Note In the above example, the Cisco IOS XR software creates four Ethernet clients with 100GE speed, which can be verified using the **show interfaces brief | include** *R/S/I/P* command.

Running Configuration

This example shows the running configuration for the optics controller:

```
Router#show run controller optics 0/0/0/13
Thu May 13 12:24:42.353 UTC
controller Optics0/0/0/13
 cd-min -4000
 cd-max 4000
 breakout 4x100
 !
```

Verification

This example shows how to verify the muxponder mode configuration:

```
Router#show interfaces brief | include 0/0/0/13
 Hu0/0/0/13/0           up          up               ARPA  1514  100000000
 Hu0/0/0/13/1           up          up               ARPA  1514  100000000
 Hu0/0/0/13/2           up          up               ARPA  1514  100000000
 Hu0/0/0/13/3           up          up               ARPA  1514  100000000
```

Transponder Mode Configuration Example

The following example shows how to switch to the transponder mode, on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/13
Router(config-Optics)#no breakout 4x100
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Note The Cisco IOS XR software creates a single 400GE interface, which can be verified using the **show interfaces brief | include** *R/S/I/P* command.

Running Configuration

This example shows the running configuration for the optics controller. The breakout configuration is absent in the running configuration.

```
Router#show run controller optics 0/0/0/13
Thu May 13 13:51:20.330 UTC
controller Optics0/0/0/13
 cd-min -4000
 cd-max 4000
 transmit-power -100
 !
```

Verification

This example shows how to verify the transponder mode configuration:

```
Router#show interfaces brief | include 0/0/0/13
FH0/0/0/13          up          up               ARPA  1514  400000000
```

Configuring Modulation

You can configure modulation on optics controllers. Based on the muxponder mode, you can choose the modulation.

Note The system accepts any modulation value that is entered. However, if the modulation value is outside the supported range, it is not configured on the optical module. Instead, the optical module is auto-configured with a valid modulation value. To view this value, use the **show controller optics** *R/S/I/P* command.

See the following tables for the supported modulation values:

- Table 3: QDD-400G-ZR-S Transponder and Muxponder Configuration Values, on page 4
- Table 4: QDD-400G-ZRP-S Transponder and Muxponder Configuration Values, on page 5

Modulation Configuration Example

The following example shows how to configure modulation on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/1
Router(config-Optics)#modulation 16Qam
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration:

```
Router#show run controller optics 0/0/0/1
controller Optics0/0/0/1
```

```
 cd-min -4000
 cd-max 4000
 transmit-power -100
 modulation 16Qam
!
```

Note Use the **show controller optics** *R/S/I/P* command to verify the modulation value of the optical module.

Verification

This example shows how to verify the configured modulation value for the optics controller:

```
Router#show controller optics 0/0/0/1
 Controller State: Up
 Transport Admin State: In Service
 Laser State: On
 LED State: Green
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZR
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm
         Alarm Status:
         -------------
         Detected Alarms: None
         LOS/LOL/Fault Status:
         Alarm Statistics:
         -------------
         HIGH-RX-PWR = 0            LOW-RX-PWR = 0
         HIGH-TX-PWR = 0            LOW-TX-PWR = 0
         HIGH-LBC = 0               HIGH-DGD = 0
         OOR-CD = 0                 OSNR = 35
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0 %
         Actual TX Power = -7.87 dBm
         RX Power = -8.27 dBm
         RX Signal Power = -8.43 dBm
         Frequency Offset = 130 MHz
         Performance Monitoring: Enable
         THRESHOLD VALUES
         ----------------
         Parameter                High Alarm  Low Alarm  High Warning  Low Warning
         -----------------------  ----------  ---------  ------------  -----------
         Rx Power Threshold(dBm)         1.9      -28.2           0.0        -25.0
         Tx Power Threshold(dBm)         0.0      -15.0          -2.0        -16.0
         LBC Threshold(mA)              0.00       0.00          0.00         0.00
         Temp. Threshold(celsius)      80.00      -5.00         75.00        15.00
         Voltage Threshold(volt)        3.46       3.13          3.43         3.16
         LBC High Threshold = 98 %
         Configured Tx Power = -6.00 dBm
         Configured CD High Threshold = 80000 ps/nm
         Configured CD lower Threshold = -80000 ps/nm
         Configured OSNR lower Threshold = 9.00 dB
         Configured DGD Higher Threshold = 80.00 ps
         Baud Rate =  59.8437500000 GBd
         Modulation Type: 16QAM
         Chromatic Dispersion 0 ps/nm
         Configured CD-MIN -4000 ps/nm  CD-MAX 4000 ps/nm
         Second Order Polarization Mode Dispersion = 5.00 ps^2
```

```
        Optical Signal to Noise Ratio = 36.30 dB
        Polarization Dependent Loss = 0.40 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 4.00 ps
        Temperature = 54.00 Celsius
        Voltage = 3.37 V
 Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZR
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E20-19E
        Rev Number              : 10
        Serial Number           : ACA2447003L
        PID                     : QDD-400G-ZR-S
        VID                     : ES03
        Firmware Version        : 61.12
        Date Code(yy/mm/dd)     : 20/12/02
```

Configuring DAC Rate

You can set the DAC (digital to analog conversion) sampling rate on optics controllers. You can modify the DAC sampling rate only on the QDD-400G-ZRP-S optical modules.

Note QDD-400G-ZR-S supports 1x1 dac-rate in cFEC mode. QDD-400G-ZRP-S optical modules support 1x1 dac-rate in cFEC mode and 1x1.25 dac-rate in oFEC mode.

DAC Rate Configuration Example

The following example shows how to set the DAC rate on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/1
Router(config-Optics)#dac-rate 1x1
```

Verification

This example shows the running configuration:

```
Router#show run controller optics 0/0/0/1
Thu May 13 12:52:35.020 UTC
controller Optics0/0/0/1
 cd-min -4000
 cd-max 4000
 transmit-power -100
 modulation 16Qam
 DAC-Rate 1x1
!
!
```

Verification

This example shows how to verify the configured DAC rate for the optics controller:

```
Router#show controller optics 0/0/0/1
 Controller State: Up
 Transport Admin State: In Service
 Laser State: On
 LED State: Green
```

```
FEC State: FEC ENABLED
Optics Status
        Optics Type:  QSFPDD 400G ZR
        DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
        Wavelength=1552.524nm
        Alarm Status:
        -------------
        Detected Alarms: None
        LOS/LOL/Fault Status:
        Alarm Statistics:
        -------------
        HIGH-RX-PWR = 0            LOW-RX-PWR = 0
        HIGH-TX-PWR = 0            LOW-TX-PWR = 0
        HIGH-LBC = 0               HIGH-DGD = 0
        OOR-CD = 0                 OSNR = 35
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 0
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = -7.87 dBm
        RX Power = -8.27 dBm
        RX Signal Power = -8.43 dBm
        Frequency Offset = 130 MHz
        DAC Rate = 1x1
        Performance Monitoring: Enable
        THRESHOLD VALUES
        ----------------
        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         1.9      -28.2           0.0        -25.0
        Tx Power Threshold(dBm)         0.0      -15.0          -2.0        -16.0
        LBC Threshold(mA)              0.00       0.00          0.00         0.00
        Temp. Threshold(celsius)      80.00      -5.00         75.00        15.00
        Voltage Threshold(volt)        3.46       3.13          3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -6.00 dBm
        Configured CD High Threshold = 80000 ps/nm
        Configured CD lower Threshold = -80000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  59.8437500000 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -4000 ps/nm  CD-MAX 4000 ps/nm
        Second Order Polarization Mode Dispersion = 5.00 ps^2
        Optical Signal to Noise Ratio = 36.30 dB
        Polarization Dependent Loss = 0.40 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 4.00 ps
        Temperature = 54.00 Celsius
        Voltage = 3.37 V
Transceiver Vendor Details
        Form Factor            : QSFP-DD
        Optics type            : QSFPDD 400G ZR
        Name                   : CISCO-ACACIA
        OUI Number             : 7c.b2.5c
        Part Number            : DP04QSDD-E20-19E
        Rev Number             : 10
        Serial Number          : ACA2447003L
        PID                    : QDD-400G-ZR-S
        VID                    : ES03
        Firmware Version       : 61.12
        Date Code(yy/mm/dd)    : 20/12/02
```

Configuring FEC

You can configure forward error correction (FEC) only on optics controllers. You can modify FEC only on the QDD-400G-ZRP-S optical modules. FEC is a feature that is used for controlling errors during data transmission. This feature works by adding data redundancy to the transmitted message using an algorithm. This redundancy allows the receiver to detect and correct a limited number of errors occurring anywhere in the message, instead of having to ask the transmitter to resend the message.

Note QDD-400G-ZR-S supports cFEC (concatenated forward error correction). QDD-400G-ZRP-S support cFEC and oFEC (open forward error correction).

FEC Configuration Example

The following sample shows how to configure FEC on the optics controller:

```
Router#configure
Router(config)#controller optics 0/0/0/13
Router(config-Optics)#fec CFEC
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration:

```
Router#show controllers optics 0/0/0/13
controller Optics0/0/0/1
 cd-min -4000
 cd-max 4000
 transmit-power -100
 fec CFEC
 modulation 16Qam
 DAC-Rate 1x1.25
!
```

Verification

This example shows how to verify the FEC configuration for the optics controller:

```
Router#show controller coherentdsp 0/0/0/13
Thu May 27 17:28:51.960 UTC
Port                                          : CoherentDSP 0/0/0/13
Controller State                              : Down
Inherited Secondary State                     : Normal
Configured Secondary State                    : Maintenance
Derived State                                 : Maintenance
Loopback mode                                 : Internal
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable
Bandwidth                                     : 400.0Gb/s

Alarm Information:
LOS = 6 LOF = 0 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 0 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0     FLEXO_GIDM = 0
```

```
FLEXO-MM = 0    FLEXO-LOM = 0   FLEXO-RDI = 0
FLEXO-LOF = 5
Detected Alarms                                  : LOS
Bit Error Rate Information
PREFEC  BER                                      : 5.0E-01
POSTFEC BER                                      : 0.0E+00
Q-Factor                                         : 0.00 dB
Q-Margin                                         : -7.20dB
OTU TTI Received

FEC mode                                         : C_FEC
```

Configuring Loopback

You can configure internal or line loopback on coherent DSP controllers. Loopback can be performed only in the maintenance mode.

Loopback Configuration Example

This example shows how to enable internal loopback configuration on coherent DSP controllers:

```
Router#config
Router(config)#controller coherentDSP 0/0/0/4
Router(config-CoDSP)#secondary-admin-state maintenance
Router(config-CoDSP)#loopback internal
Router(config-CoDSP)#commit
```

Running Configuration

This example shows the running configuration on coherent DSP controllers:

```
Router#show run controller coherentdsp 0/0/0/4
Thu May 13 19:51:08.175 UTC
controller CoherentDSP0/0/0/4
 secondary-admin-state maintenance
 loopback internal
!
```

Verification

This example shows how to verify the loopback configuration on coherent DSP controllers:

```
Router#show controller coherentdsp 0/0/0/4
Thu May 27 17:28:51.960 UTC
Port                                             : CoherentDSP 0/0/0/4
Controller State                                 : Down
Inherited Secondary State                        : Normal
Configured Secondary State                     : Maintenance
Derived State                                    : Maintenance
Loopback mode                                  : Internal
BER Thresholds                                   : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                           : Enable
Bandwidth                                        : 400.0Gb/s
Alarm Information:
LOS = 6 LOF = 0 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 0 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0     FLEXO_GIDM = 0
FLEXO-MM = 0    FLEXO-LOM = 0   FLEXO-RDI = 0
FLEXO-LOF = 5
Detected Alarms                                  : LOS
Bit Error Rate Information
```

```
PREFEC  BER                                     : 5.0E-01
POSTFEC BER                                     : 0.0E+00
Q-Factor                                        : 0.00 dB
Q-Margin                                        : -7.20dB
OTU TTI Received
FEC mode                                        : C_FEC
```

Configuring Performance Monitoring

Performance monitoring (PM) parameters are used by service providers to gather, store, set thresholds for, and report performance data for early detection of problems. The user can retrieve both current and historical PM counters for the various controllers in 30-second, 15-minute, and 24-hour intervals.

Performance monitoring can be configured on optics controllers and coherent DSP controllers.

To stop performance monitoring on optics or coherent DSP controllers, use the **perf-mon disable** keyword.

Configuring PM Parameters

The performance monitorning (PM) threshold and the threshold crossing alert (TCA) reporting status can be configured for optics controllers and coherent DSP controllers:

Table 10: PM Thresholds and TCA Report Status for Optics Controllers

PM Parameters	Description
CD	Sets the CD (chromatic dispersion) threshold or TCA reporting status.
DGD	Sets the DGD (differential group delay) threshold or TCA reporting status.
LBC	Sets the LBC (laser bias current) threshold or TCA reporting status in mA.
FREQ-OFF	Sets the FREQ-OFF (low signal frequency offset) threshold or TCA reporting status in Mhz.
OPR	Sets the OPR (optical power RX) threshold or TCA reporting status in uW or dbm.
OPT	Sets the OPT (optical power TX) threshold or TCA reporting status in uW or dbm.
OSNR	Sets the OSNR (optical signal-to-noise ratio) threshold or TCA reporting status.
PCR	Sets the PCR (polarization change rate) threshold or TCA reporting status.
PDL	Sets the PDL (polarization dependent loss) threshold or TCA reporting status.

PM Parameters	Description
RX-SIG	Sets the RX-SIG (receiving signal power) threshold or TCA reporting status in uW or dbm.
SNR	Sets the SNR (signal-to-noise ratio) threshold or TCA reporting status.
SOPMD	Sets the SOPMD (second order polarization mode dispersion) threshold or TCA reporting status.

Table 11: PM Thresholds TCA Report Status for Coherent DSP Controllers

PM Parameters	Description
Q	Sets the Q threshold or TCA reporting status.
Q-margin	Sets the Q margin threshold or TCA reporting status.
EC-BITS	Sets the EC-BITS (error corrected bits) threshold or TCA reporting status.
PostFEC BER	Sets the post-FEC BER threshold or TCA reporting status.
PreFEC BER	Sets the pre-FEC BER threshold or TCA reporting status.
UC-WORDS	Sets the UC-WORDS (uncorrected words) threshold or TCA reporting status.

Performance Monitoring Configuration Example

This example shows how to enable performance monitoring and set PM thresholds on the optics controller:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#perf-mon enable
Router(config-Optics)#pm 30-sec optics threshold cd max 100
Router(config-Optics)#pm 30-sec optics threshold cd min -100
Router(config-Optics)#commit
```

Running Configuration

This example shows the running configuration on optics controllers:

```
Router#show run controller optics 0/2/0/16
Thu May 13 20:18:55.957 UTC
controller Optics0/2/0/16
pm 30-sec optics threshold cd max 100
pm 30-sec optics threshold cd min -100
 perf-mon enable
!
```

Verification

This example shows how to verify the PM parameters on optics controllers. Verify the configuration changes in the Configured Threshold fields:

```
Router#show controller optics 0/2/0/16 pm current 30-sec optics 1
  Thu May 27 17:58:49.889 UTC
Optics in the current interval [17:58:30 - 17:58:49 Thu May 27 2021]
Optics current bucket type : Valid
            MIN       AVG       MAX      Operational      Configured      TCA   Operational
      Configured     TCA
                                          Threshold(min)   Threshold(min) (min) Threshold(max)
   Threshold(max) (max)
LBC[mA ]      : 0.0       0.0       0.0      0.0               NA              NO   100.0
           NA              NO
OPT[dBm]      : -9.98     -9.98     -9.98    -15.09            NA              NO   0.00
          NA              NO
OPR[dBm]      : -40.00    -40.00    -40.00   -30.00            NA              NO   8.00
          NA              NO
CD[ps/nm]     : 0         0         0        -80000          -100          NO   100
    100          NO
DGD[ps ]      : 0.00      0.00      0.00     0.00              NA              NO   80.00
          NA              NO
SOPMD[ps^2]   : 0.00      0.00      0.00     0.00              NA              NO   2000.00
          NA              NO
OSNR[dB]      : 0.00      0.00      0.00     0.00              NA              NO   40.00
          NA              NO
PDL[dB]       : 0.00      0.00      0.00     0.00              NA              NO   7.00
          NA              NO
PCR[rad/s]    : 0.00      0.00      0.00     0.00             NA              NO   2500000.00
       NA              NO
RX_SIG[dBm]   : -40.00    -40.00    -40.00   -30.00            NA              NO   1.00
          NA              NO
FREQ_OFF[Mhz]: 0          0         0        -3600             NA              NO   3600
          NA              NO
SNR[dB]       : 0.00      0.00      0.00     7.00              NA              NO   100.00
          NA              NO

Last clearing of "show controllers OPTICS" counters never
!
```

Performance Monitoring Configuration Example

This example shows how to enable performance monitoring and set PM thresholds and TCA reporting status on the coherent DSP controller:

```
Router#config
Router(config)#controller CoherentDSP0/2/0/16
Router(config-CoDSP)#perf-mon enable
Router(config-CoDSP)#pm 30-sec fec report Q max-tca enable
Router(config-CoDSP)#pm 30-sec fec report Q-margin max-tca enable
Router(config-CoDSP)#pm 30-sec fec report Q min-tca enable
Router(config-CoDSP)#pm 30-sec fec report Q-margin min-tca enable
Router(config-CoDSP)#pm 30-sec fec threshold Q max 1200
Router(config-CoDSP)#pm 30-sec fec threshold Q-margin max 500
Router(config-CoDSP)#pm 30-sec fec threshold Q min 900
Router(config-CoDSP)#pm 30-sec fec threshold Q-margin min 280
Router(config-CoDSP)#commit
```

Running Configuration

This example shows the running configuration on coherent DSP controllers:

```
Router#show run controller coherentdsp 0/2/0/16
Thu May 13 19:56:09.136 UTC
controller CoherentDSP0/2/0/16
 pm 30-sec fec report Q max-tca enable
 pm 30-sec fec report Q-margin max-tca enable
 pm 30-sec fec report Q min-tca enable
 pm 30-sec fec report Q-margin min-tca enable
```

```
pm 30-sec fec threshold Q max 1200
pm 30-sec fec threshold Q-margin max 500
pm 30-sec fec threshold Q min 900
pm 30-sec fec threshold Q-margin min 280
perf-mon enable
!
```

Verification

This example shows how to verify the PM parameters on coherent DSP controllers. Verify the configuration changes in the highlighted fields:

```
Router#show controllers coherentdsp 0/2/0/16 pm current 30-sec fec
Thu May 27 23:04:54.167 UTC
g709 FEC in the current interval [23:04:30 - 23:04:54 Thu May 27 2021]
FEC current bucket type : Valid
    EC-BITS   : 0                       Threshold : 111484000000          TCA(enable)  :
YES
    UC-WORDS  : 0                       Threshold : 5                     TCA(enable)  :
YES
                                      MIN       AVG        MAX      Threshold      TCA
 Threshold     TCA
                                                                        (min)     (enable)
   (max)     (enable)
PreFEC BER                    :     0E-15     0E-15     0E-15      0E-15        NO
0E-15        NO
PostFEC BER                   :     0E-15     0E-15     0E-15      0E-15        NO
0E-15        NO
Q[dB]                         :      0.00      0.00      0.00      9.00  YES 120.00  YES
Q_Margin[dB]                  :      0.00      0.00      0.00      2.80  YES  5.00   YES
 !
```

Configuring Alarms Threshold

The alarms threshold can be configured for monitoring alarms on optics controllers:

Table 12: Alarms Threshold Parameters for Optics Controllers

Alarm Threshold Parameters	Description
CD	Sets the CD (chromatic dispersion) alarm threshold (cd-low-threshold and cd-high-threshold).
DGD	Sets the DGD (differential group delay) alarm threshold.
LBC	Sets the LBC (laser bias current) threshold in mA.
OSNR	Sets the OSNR (optical signal-to-noise ratio) alarm threshold.

Alarm Threshold Configuration Example

This example shows how to configure alarm threshold on the optics controller:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#cd-low-threshold -2000
```

```
Router(config-Optics)#cd-high-threshold 2000
Router(config-Optics)#commit
```

Running Configuration

This example shows the running configuration on the optics controller:

```
Router#show run controller optics 0/2/0/16
Thu May 13 20:18:55.957 UTC
controller Optics0/2/0/16
 cd-low-threshold 2000
 cd-high-threshold 2000
!
```

Verification

This example shows how to verify the alarm threshold on optics controllers:

```
Router#show controller optics 0/2/0/16
Fri May 28 01:04:33.604 UTC
 Controller State: Up
 Transport Admin State: In Service
 Laser State: Off
 LED State: Off
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZRP
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm
         Alarm Status:
         -------------
         Detected Alarms: None
         LOS/LOL/Fault Status:
         Alarm Statistics:
         -------------
         HIGH-RX-PWR = 0            LOW-RX-PWR = 0
         HIGH-TX-PWR = 0            LOW-TX-PWR = 0
         HIGH-LBC = 0               HIGH-DGD = 0
         OOR-CD = 0                 OSNR = 0
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0 mA
         Actual TX Power = -40.00 dBm
         RX Power = -40.00 dBm
         RX Signal Power = -40.00 dBm
         Frequency Offset = 0 MHz
         Laser Temperature = 0.00 Celsius
         Laser Age = 0 %
         DAC Rate = 1x1.25
         Performance Monitoring: Enable
         THRESHOLD VALUES
         ----------------
         Parameter                High Alarm  Low Alarm  High Warning  Low Warning
         -----------------------  ----------  ---------  ------------  -----------
         Rx Power Threshold(dBm)         13.0      -24.0          10.0        -22.0
         Tx Power Threshold(dBm)          0.0      -16.0          -2.0        -14.0
         LBC Threshold(mA)               0.00       0.00          0.00         0.00
         Temp. Threshold(celsius)       80.00      -5.00         75.00         0.00
         Voltage Threshold(volt)         3.46       3.13          3.43         3.16
         LBC High Threshold = 98 %
         Configured Tx Power = -10.00 dBm
         Configured CD High Threshold = -5000 ps/nm
         Configured CD lower Threshold = -5000 ps/nm
         Configured OSNR lower Threshold = 9.00 dB
```

```
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  60.1385459900 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -26000 ps/nm  CD-MAX 26000 ps/nm
        Second Order Polarization Mode Dispersion = 0.00 ps^2
        Optical Signal to Noise Ratio = 0.00 dB
        Polarization Dependent Loss = 0.00 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 0.00 ps
        Temperature = 21.00 Celsius
        Voltage = 3.42 V
 Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZRP
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E30-19E
        Rev Number              : 10
        Serial Number           : ACA244900GN
        PID                     : QDD-400G-ZRP-S
        VID                     : ES03
        Firmware Version        : 161.06
        Date Code(yy/mm/dd)     : 20/12/08
!
```

Alarms Troubleshooting

This section contains the procedures for troubleshooting alarms.

CD Alarm

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

Logical Object: Controller

The Chromatic Dispersion (CD) alarm is raised when the detected chromatic dispersion value is above or below the configured threshold values.

Clear the CD Alarm

Procedure

Configure threshold value within range if CD value is not within the threshold 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).

DGD Alarm

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

Logical Object: Controller

The Differential Group Delay (DGD) alarm is raised when the value of the differential group delay read by the pluggable port module exceeds the configured threshold value.

Clear the DGD Alarm

Procedure

Configure the threshold value within range if DGD value is not within the threshold 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).

FLEXO_LOF

Default Severity: Critical

Logical Object: OTN

Flexo LOF alarm is raised when loss of alignment is detected on the Flexo frame for more than 3ms.

Clear the FLEXO_LOF Alarm

Procedure

Identify and correct the underlying cause of mis-alignment. The Flexo LOF (Loss of Frame) alarm is cleared when good alignment is detected on the Flexo frame for more than 3ms.

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).

FLEXO_LOM

Default Severity: Critical

Logical Object: OTN

Flexo LOM (Loss of Multi-Frame) is raised when loss of multi-frame alignment is detected on the Flexo multi-frame for more than 10ms

Clear the FLEXO_LOM Alarm

Procedure

Identify and correct the underlying cause of mis-alignment. The Flexo LOM alarm is cleared when good multi-frame alignment is detected on the Flexo multi-frame.

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).

HI-LASERBIAS Alarm

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

Logical Object: Controller

The HI-LASERBIAS alarm is raised when the physical pluggable port laser detects a laser bias value beyond the configured high threshold.

Clear the HI-LASERBIAS Alarm

Procedure

Configure the threshold value within range if high laser bias threshold value is not within the threshold 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).

HI-RXPOWER Alarm

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

Logical Object: Controller

The HI-RXPOWER alarm occurs on the client optics controller when the measured individual lane optical signal power of the received signal exceeds the default threshold. The HI-RXPOWER alarm occurs on the trunk optics controller when the total optical signal power of the received signal exceeds the default threshold.

Clear the HI-RXPOWER Alarm

Procedure

Physically verify by using a standard power meter that the optical input power is overcoming the expected power threshold. Connect an attenuator accordingly.

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).

HI-RXPOWER Warn

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

Logical Object: Software

The HI-RXPOWER warning occurs on the client optics controller when the measured individual lane optical signal power of the received signal exceeds the default threshold. The HI-RXPOWER warning occurs on the trunk optics controller when the total optical signal power of the received signal exceeds the default threshold.

Clear the HI-RXPOWER Warn Alarm

Procedure

Physically verify by using a standard power meter that the optical input power is overcoming the expected power threshold. Connect an attenuator accordingly.

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).

HI-TEMP Alarm

Default Severity: Critical

Logical Object: Software

The HI-TEMP alarm occurs when the optical module temperature exceeds the default threshold.

Clear the HI-TEMP Alarm

Procedure

Verify the fan is intact and empty slots are blocked for cooling.

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).

HI-TEMP Warn

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

Logical Object: Software

The HI-TEMP warning occurs when the optical module temperature exceeds the default threshold.

Clear the HI-TEMP Warn Alarm

Procedure

Verify the fan is intact and empty slots are blocked for cooling

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).

HI-TXPOWER Alarm

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

Logical Object: Controller

The HI-TXPOWER alarm occurs on the client optics controller when the measured individual lane optical signal power of the transmitted signal exceeds the default threshold. The HI-TXPOWER alarm occurs on the trunk optics controller when the total optical signal power of the transmitted signal exceeds the default threshold.

Clear the HI-TXPOWER Alarm

Procedure

Physically verify by using a standard power meter that the optical output power is overcoming the expected power 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).

HI-TXPOWER Warn

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

Logical Object: Software

The HI-TXPOWER warning occurs on the client optics controller when the measured individual lane optical signal power of the transmitted signal exceeds the default threshold. The HI-TXPOWER warning occurs on the trunk optics controller when the total optical signal power of the transmitted signal exceeds the default threshold.

Clear the HI-TXPOWER Warn Alarm

Procedure

Physically verify by using a standard power meter that the optical output power is overcoming the expected power 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).

IMPROPER-REM

Default Severity: Critical

Logical Object: Software

The Improper Removal alarm is raised when a physical pluggable is not present on a service-provisioned port.

Clear the IMPROPER-REM Alarm

Procedure

Insert the appropriate QSFP.

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).

LOF

Default Severity: Critical

Logical Object: OTN

Flexo LOF alarm is raised when loss of alignment is detected on the Flexo frame for more than 3ms.

Clear the LOF Alarm

Procedure

Identify and correct the underlying cause of mis-alignment. The Flexo LOF (Loss of Frame) alarm is cleared when good alignment is detected on the Flexo frame for more than 3ms.

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).

LOL

Default Severity: Major

Logical Object: Software

LOL alarm is raised when loss of lock is detected on the receive side of the CDR (Clock and Data Recovery)

Clear the LOL Alarm

Procedure

Verify the fiber and power levels.

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).

LOM

Default Severity: Critical

Logical Object: OTN

Flexo LOM (Loss of Multi-Frame) is raised when loss of multi-frame alignment is detected on the Flexo multi-frame for more than 10ms

Clear the LOM Alarm

Procedure

Identify and correct the underlying cause of mis-alignment. The Flexo LOM alarm is cleared when good multi-frame alignment is detected on the Flexo multi-frame.

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).

LO-RXPOWER Alarm

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

Logical Object: Controller

The LO-RXPOWER alarm is raised on the client or trunk optics controller when the measured individual lane optical signal power of the received signal falls below the default threshold.

Clear the LO-RXPOWER Alarm

Procedure

Verify that the trunk-rx port is cabled correctly and clean the fiber connecting the faulty TXP/MXP card to the drop port of the DWDM card.

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).

LO-RXPOWER Warn

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

Logical Object: Software

The LO-RXPOWER warning is raised on the client or trunk optics controller when the measured individual lane optical signal power of the received signal falls below the default threshold.

Clear the LO-RXPOWER Warn Alarm

Procedure

Verify that the trunk-rx port is cabled correctly and clean the fiber connecting the faulty TXP/MXP card to the drop port of the DWDM card.

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).

LOS

Default Severity: Major

Logical Object: Software

This alarm occurs when there is a loss of signal

Clear the LOS Alarm

Procedure

Identify and correct the underlying cause of signal LOS. The alarm is cleared when signal is improved.

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).

LOS-P

Default Severity: Minor

Logical Object: OTN

This alarm occurs when there is a loss of signal.

Clear the LOS-P Alarm

Procedure

Identify and correct the underlying cause of signal LOS. The alarm is cleared when signal is improved.

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).

LO-TXPOWER Alarm

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

Logical Object: Controller

The LO-TXPOWER alarm is raised on the client or trunk optics controller when the measured individual lane optical signal power of the transmitted signal falls below the default threshold.

Clear the LO-TXPOWER Alarm

Procedure

Verify the optics detection and any failures.

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).

LO-TXPOWER Warn

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

Logical Object: Software

The LO-TXPOWER warning is raised on the client or trunk optics controller when the measured individual lane optical signal power of the transmitted signal falls below the default threshold.

Clear the LO-TXPOWER Warn Alarm

Procedure

Verify the optics detection and any failures.

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).

OOR_CD

Default Severity: Minor

Logical Object: Controller

This alarm occurs when the Chromatic Dispersion is out of range

Clear the OOR_CD Alarm

Procedure

Configure threshold value within range if CD value is not within the threshold 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).

OSNR Alarm

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

Logical Object: Controller

The Optical Signal Noise Ratio (OSNR) alarm occurs when the measured OSNR falls below the threshold.

Clear the OSNR Alarm

Procedure

Step 1 Verify the value of the minimum acceptable OSNR value of NCS 5500 using the show controller optics R/S/I/P command.

Step 2 If the value is not within the OSNR threshold range, configure the minimum acceptable OSNR value using the controller optics R/S/I/P osnr-low-threshold command in the config mode. The range is 0–4000 (in units of 01db).

Step 3 If the value is within the range of the minimum acceptable OSNR, contact TAC.

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).

UNC-WORD Alarm

Default Severity: Not Reported (NR), Not-Alarmed, Non-Service-Affecting (NSA)

Logical Object: OTN

The Uncorrected FEC Word (UNC-WORD) condition is raised when the FEC is unable to correct the frame.

Clear the UNC-WORD Alarm

Procedure

Step 1 Ensure that the fiber connector for the card is completely plugged in.

Step 2 Ensure that the ports on the far end and near end nodes have the same port rates and FEC settings.

Step 3 If the BER threshold is correct and at the expected level, use an optical test set to measure the power level of the line to ensure it is within guidelines. For specific procedures to use the test set equipment, consult the manufacturer.

Step 4 If the optical power level is good, verify that the optical receive levels are within the acceptable range.

Step 5 If receive levels are good, clean the fibers at both ends.

Step 6 If the condition does not clear, verify that a single-mode fiber is used.

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).

WVL-OOL

Default Severity: Major

Logical Object: Controller

The Wavelength Out of Lock alarm is raised when the port detects the optical input frequency to be out of range.

Clear the WVL-OOL Alarm

Procedure

Step 1 Verify the wavelength configuration.

Step 2 Verify whether the pluggable is inserted properly.

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).