



# Configuring 400G Digital Coherent Optics

**Table 1: Feature History Table**

Feature Name	Release Information	Description
Support for DP04QSDD-HE0 Optical Module	Release 7.10.2	<p>This release introduces support for the Cisco 400G QSFP-DD High-Power (Bright) Optical Module, Ethernet Variant.</p> <p>The Cisco 400G QSFP-DD High-Power (Bright) Optical module is an enhanced version of the currently available QSFP-DD ZR+ Optical Module, leveraging the same operational modes but providing as a major enhancement the increase of the Tx Optical Power up to +1dBm.</p> <p>From this release, the DP04QSDD-HE0 optical module is supported on the following router and line cards -</p> <p>Router:</p> <ul style="list-style-type: none"> <li>• Cisco 8202-32FH-M</li> </ul> <p>Line cards:</p> <ul style="list-style-type: none"> <li>• 88-LC0-34H14FH</li> <li>• 88-LC0-36FH</li> </ul>
Support for DP04QSDD-HE0 Optical Module	Release 7.10.1	<p>This release introduces support for the Cisco 400G QSFP-DD High-Power (Bright) Optical Module DP04QSDD-HE0, Ethernet Variant on the Cisco 8608 router.</p>

Feature Name	Release Information	Description
oFEC Traffic Configuration for QDD-400G-ZRP-S	Release 7.9.1	<p>New Modulation and DAC Rate traffic configurations are supported on QDD-400G-ZRP-S optical module:</p> <ul style="list-style-type: none"> <li>• 400G-TXP-1x1-16 QAM</li> <li>• 4x100G-MXP-1x1-16 QAM</li> <li>• 3x100G-MXP-1x1-8 QAM</li> <li>• 2x100G-MXP-1x1-QPSK</li> <li>• 2x100G-MXP-1x1.25-16 QAM</li> </ul> <p>This increases the interoperability of the QDD-400G-ZRP-S optical module across network components supporting these formats.</p> <p>From this release, the DP04QSDD-HE0 optical module is supported on the Cisco 8201-32FH and Cisco 8201-24H8FH routers.</p>
Support for QDD-400G-ZRP-S Optical Module	Release 7.9.1	This release introduces support for the Cisco 400G QSFP-DD-ZRP-S Ethernet Variant on the Cisco 88-LC0-34H14FH line card.

Cisco offers a range of the new 400G Digital Coherent QSFP-DD optical modules. The optical modules that are available are:

- QDD-400G-ZR-S
- QDD-400G-ZRP-S
- DP04QSDD-HE0

This chapter describes the QDD-400G-ZR-S, QDD-400G-ZRP-S, and DP04QSDD-HE0 optical modules and their supported configurations. The following fixed-port routers, line cards, from the indicated Cisco IOS XR software releases, support these optical modules.

**Table 2: Fixed-Port Routers and Line Cards that Support QDD-400G-ZR-S, QDD-400G-ZRP-S and DP04QSDD-HE0 Optical Modules from Indicated Cisco IOS XR Software Releases**

Fixed-Port Routers	Optics PID	Minimum IOS XR Software Release
Cisco 8201	QDD-400G-ZR-S	Release 7.3.15
	QDD-400G-ZRP-S	
Cisco 8202	QDD-400G-ZR-S	Release 7.3.15
	QDD-400G-ZRP-S	

<b>Fixed-Port Routers</b>	<b>Optics PID</b>	<b>Minimum IOS XR Software Release</b>
Cisco 8101-32FH	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2
Cisco 8201-32FH	DP04QSDD-HE0	Release 7.9.1
Cisco 8201-24H8FH	DP04QSDD-HE0	Release 7.9.1
Cisco 8608	DP04QSDD-HE0	Release 7.10.1
Cisco 8202-32-FH-M	DP04QSDD-HE0	Release 7.10.2
<b>Line Cards</b>	<b>Optics PID</b>	<b>Minimum IOS XR Software Release</b>
8800-LC-36FH	QDD-400G-ZR-S	Release 7.3.15
	QDD-400G-ZRP-S	
88-LC0-36FH-M	QDD-400G-ZR-S	Release 7.3.15
	QDD-400G-ZRP-S	
88-LC0-36FH	QDD-400G-ZR-S	Release 7.3.2
	QDD-400G-ZRP-S	
	DP04QSDD-HE0	Release 7.10.2
88-LC0-34H14FH	QDD-400G-ZRP-S	Release 7.9.1
	DP04QSDD-HE0	Release 7.10.2



**Note** QDD-400G-ZR-S and QDD-400G-ZRP-S are not supported on 8102-64H fixed-port routers.

QDD-400G-ZRP-S and DP04QSDD-HE0 are not supported on odd-numbered ports of the following routers and line cards:

- Cisco 8201
- Cisco 8202
- 8800-LC-36FH
- 88-LC0-36FH-M

The QDD-400G-ZR-S and QDD-400G-ZRP-S 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 QDD-400G-ZR-S and QDD-400G-ZRP-S 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 QDD-400G-ZR-S and QDD-400G-ZRP-S 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 QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules, the Cisco IOS XR software operates the fans at a higher speed to cool these optical modules.

The QDD-400G-ZR-S and QDD-400G-ZRP-S 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 15](#)
  - [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 8](#)
  - [Configuring Chromatic Dispersion, on page 9](#)
  - [Configuring Optical Transmit Power, on page 11](#)
- 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 24](#)
  - [Configuring PM Parameters, on page 24](#)
- 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 28](#)

The following table contains the possible traffic configuration values for the QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules, in the transponder and muxponder mode:

**Table 3: 400G Digital Coherent QSFP-DD Traffic Configuration Values**

	<b>QDD-400G-ZR-S</b>	<b>QDD-400G-ZRP-S</b>	<b>DP04QSDD-HE0</b>
Client Speed	1x400G, 4x100G	1x400G, 4x100G, 3x100G, 2x100G, 1x100G  <b>Note</b> Release 7.3.15 supports only 1x400 and 4x100 client speed.	1x400G, 4x100G, 3x100G, 2x100G, 1x100G
Trunk Speed	400G	400G, 300G, 200G, 1x100  <b>Note</b> Release 7.3.15 supports only 400G trunk speed.	400G, 300G, 200G, 100G
Frequency	C-Band, 196.1 To 191.3 THz	C-Band, 196.1 To 191.3 THz	C-Band, 196.1 To 191.3 THz
FEC	cFEC	oFEC, cFEC	oFEC
Modulation	16QAM	16QAM, 8QAM, QPSK  Release 7.3.15 supports only 16QAM.	16QAM, 8QAM, QPSK
DAC-Rate	1x1	1x1.25 (oFEC), 1x1 (cFEC)	1x1.25, 1x1
Chromatic Dispersion (CD)	-2400 to +2400	Release 7.3.15: -80000 to +80000  Release 7.3.2: -160000 to +160000	-160000 to +160000
Transmitted (Tx) Power	Each optical module has its own transmitting (TX) power range. You can change the transmitting (TX) power value based on the module capability.	Each optical module has its own transmitting (TX) power optimal values. You can change the transmitting (TX) power value based on the module capability.	Each optical module has its own transmitting (TX) power optimal values. You can change the transmitting (TX) power value based on the module capability.

### 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 4: 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 5: QDD-400G-ZRP-S Transponder and Muxponder Configuration Values**

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate	OpenZR+ Support
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	oFEC	1x1	
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 Client, 100G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1	
4x100G-MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	cFEC	1x1	
3x100G-MXP	3 clients, 100G speed	1 trunk, 400G speed	8 QAM	oFEC	1x1.25	
3x100G-MXP	3 Client, 100G speed	1 trunk, 400G speed	8 QAM	oFEC	1x1	
2x100G-MXP	2 clients, 100G speed	1 trunk, 200G speed	QPSK	oFEC	1x1.50	
2x100G-MXP	2 Client, 100G speed	1 trunk, 400G speed	QPSK	oFEC	1x1	

<b>TXP/MXP</b>	<b>Client</b>	<b>Trunk</b>	<b>Modulation</b>	<b>FEC</b>	<b>DAC Rate</b>	<b>OpenZR+ Support</b>
2x100G-MXP	2 Client, 100G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25	
1x100G-MXP	1 client, 100G speed	1 trunk, 100G speed	QPSK	oFEC	1x1.50	

The high optical performance DP04QSDD-HE0 QSFP-DD pluggable coherent optical module is developed for easy deployment in Reconfigurable Optical Add/Drop Multiplexer (ROADM) line systems.

**DP04QSDD-HE0 Transponder and Muxponder Configuration Values**

The following table contains the possible Transponder and Muxponder configuration values for the DP04QSDD-HE0 optical module:

*Table 6: DP04QSDD-HE0 Transponder and Muxponder Configuration Values*

<b>TXP/MXP</b>	<b>Client</b>	<b>Trunk</b>	<b>Modulation</b>	<b>FEC</b>	<b>DAC Rate</b>
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25
100G-TXP	1 Client, 100G speed	1 trunk, 400G speed	QPSK	oFEC	1x1.50
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25
3x100G-MXP	3 clients, 100G speed	1 trunk, 400G speed	8 QAM	oFEC	1x1.25
2x100-MXP	2 Client, 100G speed	2 Client, 100G speed	QPSK	oFEC	1x1.50

- [Configuring Frequency, on page 8](#)
- [Configuring Chromatic Dispersion, on page 9](#)
- [Configuring Optical Transmit Power, on page 11](#)
- [Configuring Muxponder Mode, on page 15](#)
- [Configuring Modulation, on page 16](#)
- [Configuring DAC Rate, on page 18](#)
- [Configuring FEC, on page 20](#)
- [Configuring Loopback, on page 21](#)
- [Disable Auto-Squelching, on page 23](#)
- [Configuring Performance Monitoring, on page 24](#)
- [Configuring PM Parameters, on page 24](#)
- [Configuring Alarms Threshold, on page 28](#)

# 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 calculates 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 7: 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

### 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 QDD-400G-ZR-S and QDD-400G-ZRP-S optical module has its own optical transmit (TX) power range. You can change the optical transmit (TX) power value based on the module capability. For "Transmitter specifications", see the [Cisco 400G Digital Coherent Optics QSFP-DD Optical Modules Data Sheet](#).

Table 8: Optical Transmit Power Values

Optical Module	Trunk Speed <sup>1,3</sup>	PS-NM	Optical Transmit Power (Tx) Shaping	Interval	Supported Range of Optical Transmit Power (Tx) Values (in units of 1dBm) <sup>2</sup>		
					Minimum Value	Maximum Typical Value	Maximum Worst Case Value
QDD400G-ZR-S	400G	0-S	No	1	-10	-8	-6
QDD400G-ZR-P-S	400G	1-E	Yes	1	-13	-11	-9
	<b>Note</b>	0-S Modulation = 16QAM			-10	-8	-6
	300G	1-E			-12	-10	-8
	<b>Note</b>	0-E Modulation = 8QAM			-11	-9	-7
		0-S			-10	-8	-6
	200G	1-S			-10.5	-8.5	-6.5
	<b>Note</b>	0-S Modulation = QPSK			-8.5	-6.5	-4.5
	200G	1-E			-11	-9	-7
<b>Note</b>	Modulation = 8QAM						
200G	1-E	-10	-8	-6			
<b>Note</b>	Modulation = 16QAM						
100G	1-S	-6	-4	-2			
<b>Note</b>	Modulation = QPSK						

Table 9: Optical Transmit Power Values

Optical Module	Trunk Speed <sup>1,3</sup>	Optical Transmit Power (Tx) Shaping	Interval	Supported Range of Optical Transmit Power (Tx) Values (in units of 0.1dBm) <sup>2</sup>		
				Minimum Value	Maximum Typical Value	Maximum Worst Case Value
QDD-400G-ZR-S	400G	No	1	-150	-100	-100

Optical Module	Trunk Speed <sup>1,3</sup>	Optical Transmit Power (Tx) Shaping	Interval	Supported Range of Optical Transmit Power (Tx) Values (in units of 0.1dBm) <sup>2</sup>		
				Minimum Value	Maximum Typical Value	Maximum Worst Case Value
QDD-400G-ZRPS	400G	Yes	1	-150	-110	-130
	300G			-150	-104	-119
	200G			-150	-90	-105
	100G			-150	-59	-75
DP04QSDD-HE0	400G	Yes	1	-150	0	20
	300G			-150	0	20
	200G			-150	0	20

1. Release 7.3.15 supports 4x100G muxponder mode or trunk speed.

2. The default optical transmit power (Tx) value is -10 dBm, however with Tx shaping enabled the maximum power in 1x400G, 4x100G, 3x100, 2x100G, and 1x100G modes may be less than -10 dBm.

3. Release 7.3.2 and future releases support 3x100G, 2x100G, and 1x100G muxponder modes or trunk speed.

### 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 QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules in the 400G transponder mode.

Using the **breakout muxponder mode** command, you can configure muxponder mode on optics controllers. Based on the muxponder mode, you can choose the modulation.

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

- 4x100

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

- 4x100
- 3x100
- 2x100




---

**Note** Release 7.3.15 supports only 4x100 muxponder mode.

---

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

- [QDD-400G-ZR-S Transponder and Muxponder Configuration Values, on page 6](#)
- [QDD-400G-ZRP-S Transponder and Muxponder Configuration Values, on page 6](#)

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:

- [QDD-400G-ZR-S Transponder and Muxponder Configuration Values, on page 6](#)
- [QDD-400G-ZRP-S Transponder and Muxponder Configuration Values, on page 6](#)

### 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 and DP04QSDD-HE optical module.



**Note** QDD-400G-ZR-S supports 1x1 dac-rate in cFEC mode. QDD-400G-ZRP-S and DP04QSDD-HE supports 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: QSPDD 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 and DP04QSDD-HE optical module. 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 and DP04QSDD-HE supports 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.




---

**Note** Line loopback mode is supported only on Cisco 8000 series line cards and fixed-port routers based on Q100 and Q200 silicon.

---

### 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      FLEXP_GIDM = 0
FLEXP-MM = 0      FLEXP-LOM = 0  FLEXP-RDI = 0
FLEXP-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

```

# Disable Auto-Squelching

Table 10: Feature History Table

Feature Name	Release Information	Description
Disable Auto-Squelching	Release 7.11.1	<p>This release introduces support to disable Auto squelching. This helps to detect weak signals that are hidden within the laser source noise. By disabling Auto squelch, you can reduce the processing overhead in systems that have stable laser sources and minimal noise, helping you optimize the performance of your system. When the Auto squelch function is enabled, the optical module will generate a local fault signal on the host side if it detects a fault on the media side. By default, Auto squelch is enabled.</p> <p>The feature introduces these changes:</p> <p><b>CLI:</b>The following keyword has been added.</p> <ul style="list-style-type: none"> <li>• <b>host auto-squelch disable</b></li> </ul> <p><b>YANG DATA models:</b></p> <ul style="list-style-type: none"> <li>• New XPath for <code>Cisco-IOS-XR-controller-optics-cfg</code> (see <a href="#">Github</a>, <a href="#">YANG Data Models Navigator</a>)</li> </ul>

This release introduces the support to disable auto-squelch functionality on the module on the host side. When enabled, the squelch function is activated on the module when no suitable media-side input signal from the remote end is available to be forwarded to the host-side output (example: Rx LOS is asserted). Auto squelching is commonly used to suppress unwanted noise from laser sources in communication systems. When disabled and no valid signal is detected on the module from the remote end, the module will generate a local fault towards the NPU. However, disabling auto-squelching provides you with expanded signal detection. This enables you to detect extremely weak signals that are embedded within the laser source noise. Also, by eliminating the need to continuously monitor and suppress unwanted noise, system resources can be allocated more efficiently, leading to improved performance.

In this feature, we introduced the **host auto-squelch disable** command to disable the auto-squelch functionality when there is an invalid input signal from the remote end. This feature provides you with the flexibility to customize the system's behavior according to your requirements.

### Disabling Laser Squelching Configuration Example

This example shows how to disable laser squelching for a host on controller optics:

```
router#config
router(config)#controller 0/0/0/0
router(config-Optics)#host auto-squelch disable
router(config-Optics)#commit
```

#### Verification

This example shows how to verify the laser squelching disabled configuration:

```
router#show controllers optics 0/0/0/0
Host Squelch Status: disable
```

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

**Table 11: 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.



PM Parameters	Description
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.
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 12: 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.
Host-Intf-0-FEC-BER	<p>Sets the Host-Intf-0-FEC-BER threshold or TCA reporting status, where:</p> <ul style="list-style-type: none"> <li>• AVG - specifies the number of corrected bits received from the host interface prior to a PM interval.</li> <li>• MIN - specifies the minimum number of corrected bits received from the host interface over a sub-interval and prior to a PM interval.</li> <li>• MAX - specifies the maximum number of corrected bits received from the host interface over a sub-interval and prior to a PM interval.</li> </ul>

PM Parameters	Description
Host-Intf-0-FEC-FERC	<p>Sets the Host-Intf-0-FEC-FERC threshold or TCA reporting status, where:</p> <ul style="list-style-type: none"> <li>• AVG - specifies the number of frames received from the host interface during a sub-interval.</li> <li>• MIN - specifies the minimum number of frames received from the host interface with uncorrected errors over a sub-interval and prior to a PM interval.</li> <li>• MAX - specifies the maximum number of frames received from the host interface with uncorrected errors over a sub-interval and prior to a PM interval.</li> </ul>

### 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 Configured	AVG TCA	MAX	Operational Threshold (min)	Configured Threshold (min)	TCA (min)	Operational Threshold (max)
LBC[mA]	: 0.0	0.0	0.0	0.0	NA	NO	100.0
OPT[dBm]	: -9.98	-9.98	-9.98	-15.09	NA	NO	0.00
OPR[dBm]	: -40.00	-40.00	-40.00	-30.00	NA	NO	8.00
CD[ps/nm]	: 0	0	0	-80000	<b>-100</b>	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

Threshold      TCA                      MIN      AVG      MAX      Threshold      TCA
(max)          (enable)                  (min)    (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 13: 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: QSPDD 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
  WV-LOL = 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                 : QSPDD 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
```

!