# Automatic Power Control

This chapter describes the Automatic Power Control optical application for Cisco NCS 1010.

***Table 1: Feature History***

| Feature Name | Release Information | Feature Description |
|---|---|---|
| APC enhancements | Cisco IOS XR Release 7.9.1 | APC (Automatic Power Control) on NCS 1010 now supports C+L band networks in addition to C band only networks. Also, APC is enhanced to perform power correction even when it doesn't have end-to-end network visibility. This ensures that the operational section of the network always has power at the target PSD profile, and when the network comes up, the traffic restoration is faster. |



# Overview of Automatic Power Control

On a fiber, the power level may vary between channels. Over long distances and multiple amplifications, these differences in power levels can result in deterioration of the quality of some channels. Automatic Power Control (APC) corrects the power level differences and ensures that power for different channels is according to the target power profile for the spectrum. APC compensates for the degradation of the network over time. APC is enabled if automatic link bring up is enabled.

APC is a network-level feature that is distributed among different nodes. An APC domain is a set of nodes that is controlled by the same instance of APC at the network level. An APC domain identifies a portion of the network that can be independently regulated. The source OLT node acts as the APC Manager or Domain Manager for all the nodes in the path. The subsequent nodes in the path act as APC agent nodes. The manager node enables APC on agent nodes, monitors DISCREPANCY and initiates regulation if correction is required. To avoid large power fluctuations, APC adjusts power levels incrementally. APC performs power correction in steps of +/-0.8dB. This is applied to each iteration until the optimal power level is reached.

APC is direction-specific. You can enable APC for each direction at the transmitting OLT node. The source node enables and controls different parameters in all ILA nodes on the path and the far-end OLT ingress EDFA.

The following table lists the parameters that APC configures and controls in different nodes.

| Node | Parameters |
|---|---|
| Transmitting OLT | EDFA Gain<br>EDFA Tilt<br>VOA Attenuation<br>WSS Attenuation |
| ILA | EDFA Gain<br>EDFA Tilt<br>VOA Attenuation<br>DGE Attenuation |
| Receiving OLT | EDFA Gain<br>EDFA Tilt<br>WSS Attenuation |

When you enable APC, APC controls these parameters. APC overrides any manual configuration. When you disable APC, user configuration is applied.

APC divides the C band spectrum into 32 equal parts. APC uses 33 frequencies across the C band to divide the band. We call these 33 frequencies, **setpoints**. Each setpoint is 150 GHz apart from the adjacent setpoints. You can configure a power profile across the spectrum using these setpoints. You can configure the target PSD for each OLT and ILA node on a link.

APC applies amplification and attenuation as required at channel level and composite signal level to ensure that the channels are at the target power level. You can configure the target power spectral densities for 33 points across the band. If you enable link tuner, link tuner sets the target PSDs for APC on all nodes in the path.

APC performs the following functions:

- APC monitors the current PSD against the target PSD for each channel (ASE and user channel) and changes the amplifier parameters including VOA, WSS, and DGE to achieve the target PSD.
- APC detects optical network changes on the path and alters the amplifier parameters on the nearest nodes to compensate for the changes. APC performs these alterations in multiple steps.
- APC collects measurements from other link nodes at the transmitting OLT to precisely locate optical network changes.

From Cisco IOS XR Release 7.9.1, NCS 1010 supports C+L band networks. Before Cisco IOS XR Release 7.9.1, APC did not start regulating the power levels in a link until the full topology was discovered by OSPF. From Cisco IOS XR Release 7.9.1, APC regulation begins as soon as it discovers any part of the topology. At a transmitting OLT, it starts power correction at the OLT and subsequent ILA nodes even if the complete OLT-OLT link has not been discovered. When APC detects a partial topology, the NCS 1010 raises the PARTIAL-TOPOLOGY alarm, and after the regulation is complete APC moves to BLOCKED state.

**Note**

- If the input slice power of a channel is below psd-min and APC is unable to bring the channel above psd-min even after setting the WSS attenuation to 0dB, APC declares the channel as failed.
- After APC regulation, all channel powers must be above psd-min (-24-dBm default) and at least one channel should be within 0.5 dB of psd-min.

### View APC Status and Information

Use the **show olc apc** command to view APC status.

The following sample is an output of **show olc apc**.

```
RP/0/RP0/CPU0:OLT1#show olc apc

Controller      : Ots0/0/0/0
APC Status      : WORKING

Node RID        : 10.1.1.1
Internal State  : IDLE

Node RID        : 10.99.1.2
Internal State  : IDLE

Node RID        : 10.99.2.2
Internal State  : IDLE

Node RID        : 10.99.4.1
Internal State  : IDLE

Node RID        : 10.1.1.5
Internal State  : DISCREPANCY
```

APC Status is the status of APC in the complete path. The following table lists and describes the APC Statuses.

| APC Status | Description |
|---|---|
| BLOCKED | APC moves to BLOCKED state if:<br>• there is an event in the network which resulted in topology failure<br>• an amplifier safety event like APR or OSRI has been triggered in the network<br>• APC is locally disabled on agent node |
| PAUSED | APC is paused using the **apc-pause** command. |
| IDLE | APC regulation has been completed successfully. All the channels in the network have achieved the target PSD provided by Link-tuner or configured by user |
| WORKING | APC detected a DISCREPANCY between current and target PSD. APC regulation is in progress to converge the power to target PSD. |
| DISABLED | APC is disabled. |

| | |
|---|---|
| PARTIAL-TOPOLOGY NODE-BLOCKED | APC has limited visibility. APC manager does not have visibility to the full OLT-OLT topology. APC manager tries to correct the power levels on the agent nodes that are reachable and after the regulation is complete, APC moves to BLOCKED state. |

Internal State is the state of APC on each individual node. The following table lists and describes the internal states.

| **APC Internal State** | **Description** |
|---|---|
| DISCREPANCY | The APC manager flags an agent node which needs correction when there is a discrepancy between target PSD and current PSD. This state is temporary and lasts until APC starts power correction and goes into CORRECTING state. |
| CORRECTING | APC correction is in progress on the node |
| OOR | APC-OUT-OF-RANGE condition is raised on an agent node when APC fails to regulate and achieve the target PSD power level because the requested gain or attenuation setpoint cannot be set due to one of the following conditions:<br>• Amplifier gain is exhausted in the current gain range.<br>• WSS range (0-25dB) is exhausted for a single or multiple channels.<br>• DGE range (0-3dB) is exhausted for a single or multiple channels.<br>• Spanloss increased and amplifier gain is insufficient to achieve target PSD |
| IDLE | APC regulation has been completed successfully. All the channels in the network have achieved the target PSD provided by Link-tuner or configured by user |

| | |
|---|---|
| BLOCKED | APC is unable to perform for the following reasons:<br>• OSRI has shut down the amplifier: AMPLI-SHUT<br>• APC is disabled locally on the node: USER-DISABLED<br>• Gain Estimation is in progress: GAIN-ESTIMATION-IN-PROGRESS<br>• Amplifier auto power reduction is enabled: AMPLI-APR-ENABLED<br>• Amplifier is shut because of loss of input power: AMPLI-SHUT<br>• An event in the network resulted in topology failure.<br>• APC is BLOCKED as Band Failure Recovery sets Safe mode because of a band failure event in C+L network: BAND-FAILURE |

The following sample is an output of **show olc apc** command when OSRI has shut down an amplifier in the link.

```
RP/0/RP0/CPU0:ios#sh olc apc
Thu Jul  7 13:21:05.807 UTC

Controller      : Ots0/0/0/0
APC Status      : BLOCKED

Node RID        : 10.1.1.1
Internal State  : IDLE

Node RID        : 10.1.1.2
Internal State  : BLOCKED
Blocked Reason  : [ AMPLI-SHUT ]

Node RID        : 10.1.1.3
Internal State  : DISCREPANCY

Node RID        : 10.1.1.4
Internal State  : DISCREPANCY

Node RID        : 10.1.1.5
Internal State  : DISCREPANCY
```

The following sample is an output of **show olc apc** command when APC is disabled locally on a node.

```
RP/0/RP0/CPU0:ios#sh olc apc
Thu Jul  7 13:22:44.145 UTC

Controller      : Ots0/0/0/0
APC Status      : BLOCKED

Node RID        : 10.1.1.1
Internal State  : IDLE

Node RID        : 10.1.1.2
```

```
Internal State  : BLOCKED
Blocked Reason  : [ USER-DISABLED ]

Node RID        : 10.1.1.3
Internal State  : DISCREPANCY

Node RID        : 10.1.1.4
Internal State  : DISCREPANCY

Node RID        : 10.1.1.5
Internal State  : DISCREPANCY
```

The following sample is an output of **show olc apc** command when Gain Estimation is in progress on a node.

```
RP/0/RP0/CPU0:ios#sh olc apc
Tue Jun 7 11:43:10.801 UTC

Controller : Ots0/0/0/0
APC Status : BLOCKED

Node RID : 10.1.1.1
Internal State : DISCREPANCY

Node RID : 10.1.1.2
Internal State : DISCREPANCY

Node RID : 10.1.1.3
Internal State : BLOCKED
Blocked Reason : [ GAIN-ESTIMATION-IN-PROGRESS ]
```

The following sample is an output of **show olc apc** command when amplifier auto power reduction is enabled on a node.

```
RP/0/RP0/CPU0:ios#sh olc apc
Thu Jul  7 13:21:49.530 UTC

Controller      : Ots0/0/0/0
APC Status      : BLOCKED

Node RID        : 10.1.1.1
Internal State  : IDLE

Node RID        : 10.1.1.2
Internal State  : BLOCKED
Blocked Reason  : [ AMPLI-APR-ENABLED ]

Node RID        : 10.1.1.3
Internal State  : DISCREPANCY

Node RID        : 10.1.1.4
Internal State  : DISCREPANCY

Node RID        : 10.1.1.5
Internal State  : DISCREPANCY
```

The following sample is an output of **show olc apc** command when band failure has occurred and the APC manager has visibility only to a partial topology.

```
RP/0/RP0/CPU0:ios#show olc apc
Wed Jan 18 12:21:28.195 UTC

Controller      : Ots0/0/0/0
APC Status      : BLOCKED
Blocked Reason  : [ PARTIAL-TOPOLOGY  NODE-BLOCKED ]
```

```
Node RID        : 10.1.1.1
Internal State  : IDLE

Node RID        : 10.1.1.2
Internal State  : BLOCKED
Blocked Reason  : [ BAND-FAILURE ]
```

You can view the local status of APC on each node using the **show olc apc-local** command. This command shows if APC is enabled or disabled on the node.

The following sample is an output of **show olc apc-local** command.

```
RP/0/RP0/CPU0:ios#show olc apc-local
Mon Apr 11 06:59:14.679 UTC

Controller : Ots0/0/0/0

TX Status : ENABLED
RX Status : ENABLED
```

You can view the target PSDs configured for all setpoints using the **show olc apc-local target-psd-profile** command. The output shows the source of the PSD configuration also. The target PSD source can be Link Tuner or Configuration.

The following sample is an output of **show olc apc-local target-psd-profile** command on a C band node..

```
RP/0/RP0/CPU0:ios#show olc apc-local target-psd-profile
Tue Apr 26 10:19:24.910 UTC
Controller          : Ots0/0/0/0
Target PSD source   : Configuration
--------------------------------------------------------------------------------
Setpoint                Frequency                       Target PSD
                           (THz)                    (dBm/12.5 GHz)
--------------------------------------------------------------------------------
01                    191.337494                         15.0
02                    191.488678                         15.0
03                    191.639847                         -4.1
04                    191.791016                         -4.1
05                    191.942184                         -4.1
06                    192.093353                         -4.1
07                    192.244537                         -4.1
08                    192.395706                         -4.1
09                    192.546875                         -4.1
10                    192.698044                         -4.1
11                    192.849213                         -4.1
12                    193.000397                         -4.1
13                    193.151566                         -4.1
14                    193.302734                         -4.1
15                    193.453903                         -4.1
16                    193.605072                         -4.1
17                    193.756256                         -4.1
18                    193.907425                         -4.1
19                    194.058594                         -4.1
20                    194.209763                         -4.1
21                    194.360931                         -4.1
22                    194.512115                         -4.1
23                    194.663284                         -4.1
24                    194.814453                         -4.1
25                    194.965622                         -4.1
26                    195.116791                         -4.1
27                    195.267975                         -4.1
28                    195.419144                         -4.1
29                    195.570312                         -4.1
```

```
30                    195.721481                          -4.1
31                    195.872650                          -4.1
32                    196.023834                          -4.1
33                    196.175003                          -4.1
```

The following sample is an output of **show olc apc-local target-psd-profile** command on an L band node.

```
RP/0/RP0/CPU0:ios#sh olc apc-local target-psd-profile
Wed Jan 18 12:12:02.236 UTC
Controller          : Ots0/0/0/0
Target PSD source   : Configuration
--------------------------------------------------------------------------------
Setpoint                Frequency                        Target PSD
                          (THz)                       (dBm/12.5 GHz)
--------------------------------------------------------------------------------
01                    186.050000                          -6.4
02                    186.201000                          -6.3
03                    186.352000                          -6.2
04                    186.503000                          -6.2
05                    186.654000                          -6.1
06                    186.805000                          -6.1
07                    186.956000                          -6.0
08                    187.107000                          -6.0
09                    187.258000                          -5.9
10                    187.409000                          -5.9
11                    187.560000                          -5.9
12                    187.711000                          -5.8
13                    187.862000                          -5.7
14                    188.013000                          -5.7
15                    188.164000                          -5.6
16                    188.315000                          -5.5
17                    188.466000                          -5.5
18                    188.617000                          -5.4
19                    188.768000                          -5.4
20                    188.919000                          -5.3
21                    189.070000                          -5.2
22                    189.221000                          -5.2
23                    189.372000                          -5.1
24                    189.523000                          -5.1
25                    189.674000                          -5.0
26                    189.825000                          -5.0
27                    189.976000                          -4.9
28                    190.127000                          -4.9
29                    190.278000                          -4.8
30                    190.429000                          -4.7
31                    190.580000                          -4.7
32                    190.731000                          -4.6
33                    190.882000                          -4.6
```

You can view the detailed information about APC on each node using the **show olc apc-local regulation-info** command. This command provides the following information:

- Controller
- APC Domain Manager
- Internal Status
- Minimum PSD
- Last correction timestamp
- Gain range

- Amplifier and attenuation parameters: Configured and current values and available ranges
- Detailed information on the channels

  The following details are available:

  - Center frequency of each channel
  - Channel width
  - Channel ID
  - Channel Source (ASE or user channel)
  - Slice number of the center frequency of the channel in the WSS
  - PSD of the channel at the input of the amplifier
  - Target PSD for the channel
  - Current PSD of the channel
  - Discrepancy between current and target PSD
  - The configured attenuation on the WSS (OLT) or DGE (ILA) for the channel

You can view the APC information for only the Tx or Rx direction using the **tx|rx** keyword with the **show olc apc-local regulation-info controller ots** *R/S/I/P* command.

The following sample is an output of **show olc apc-local regulation-info** command.

```
RP/0/RP0/CPU0:ios#show olc apc-local regulation-info controller ots 0/0/0/0 tx
Wed Jul  6 05:01:45.177 UTC
Controller            : Ots0/0/0/0
Domain Manager        : 10.1.1.1
Internal Status       : OOR
Direction            : TX
PSD Minumum          : -24.0 (dBm/12.5 GHz)
Gain Range           : Normal
Last Correction      : 2022-07-06 05:01:28

  Device Parameters                 Min   Max  Configuration Operational
=========================================================================
  Egress Ampli Gain (dB)           :15.4  29.4 19.5          19.5
  Egress Ampli Tilt (dB)           :-5.0  3.1  -2.2          -2.2
  TX Ampli Power (dBm)             : -    22.4  -            21.4
  TX VOA Attenuation (dB)          :0.0   20.0 0.0          0.0
  Egress WSS/DGE Attenuation (dB)  :0.0   25.0  -            -


Channel Center Channel Channel Channel Spectrum   Ampli-Input      Target       Current
 Discrepancy Channel Slice
  Frequency     Width    ID    Source  Slice Num      PSD           PSD           PSD
              Attn Config
    (THz)       (GHz)                            (dBm/12.5 GHz)(dBm/12.5 GHz)(dBm/12.5 GHz)
    (dB)        (dB)
=============================================================================================

 191.375000    75.00     1      OCh       13          -23.2         -4.6          -4.9
     0.2        7.1
 191.449997    75.00     -      ASE       37          -23.0         -4.6          -4.7
     0.1        9.2
 191.524994    75.00     -      ASE       61          -23.1         -4.6          -4.7
```

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0.1 | 9.3 | | | | | | |
| 191.600006 | 75.00 | 4 | OCh | 85 | -23.1 | -4.5 | -4.7 |
| 0.1 | 8.0 | | | | | | |
| 191.675003 | 75.00 | - | ASE | 109 | -23.0 | -4.5 | -4.5 |
| 0.0 | 9.1 | | | | | | |
| 191.750000 | 75.00 | 6 | OCh | 133 | -23.0 | -4.4 | -4.6 |
| 0.1 | 8.0 | | | | | | |
| 191.824997 | 75.00 | - | ASE | 157 | -23.1 | -4.4 | -4.6 |
| 0.1 | 9.3 | | | | | | |
| 191.899994 | 75.00 | 8 | OCh | 181 | -23.0 | -4.4 | -4.4 |
| 0.0 | 8.0 | | | | | | |
| 191.975006 | 75.00 | - | ASE | 205 | -23.0 | -4.3 | -4.5 |
| 0.1 | 9.1 | | | | | | |
| 192.050003 | 75.00 | 10 | OCh | 229 | -23.0 | -4.3 | -4.5 |
| 0.1 | 8.2 | | | | | | |
| 192.125000 | 75.00 | - | ASE | 253 | -22.9 | -4.3 | -4.3 |
| 0.0 | 9.0 | | | | | | |
| 192.199997 | 75.00 | 12 | OCh | 277 | -22.8 | -4.2 | -4.3 |
| 0.0 | 8.3 | | | | | | |
| 192.274994 | 75.00 | - | ASE | 301 | -22.9 | -4.2 | -4.4 |
| 0.1 | 9.0 | | | | | | |
| 192.350006 | 75.00 | 14 | OCh | 325 | -22.6 | -4.2 | -4.2 |
| 0.0 | 8.3 | | | | | | |
| 192.425003 | 75.00 | - | ASE | 349 | -22.8 | -4.2 | -4.3 |
| 0.1 | 8.7 | | | | | | |
| 192.500000 | 75.00 | 16 | OCh | 373 | -22.4 | -4.1 | -3.9 |
| -0.2 | 8.1 | | | | | | |
| 192.574997 | 75.00 | - | ASE | 397 | -22.7 | -4.1 | -4.2 |
| 0.1 | 8.6 | | | | | | |
| 192.649994 | 75.00 | 18 | OCh | 421 | -22.6 | -4.1 | -4.2 |
| 0.1 | 8.1 | | | | | | |
| 192.725006 | 75.00 | - | ASE | 445 | -22.7 | -4.0 | -4.2 |
| 0.1 | 8.6 | | | | | | |
| 192.800003 | 75.00 | 20 | OCh | 469 | -22.7 | -4.0 | -4.1 |
| 0.1 | 7.9 | | | | | | |
| 192.875000 | 75.00 | - | ASE | 493 | -22.6 | -4.0 | -4.0 |
| 0.0 | 8.4 | | | | | | |
| 192.949997 | 75.00 | 22 | OCh | 517 | -22.6 | -3.9 | -4.1 |
| 0.1 | 7.6 | | | | | | |
| 193.024994 | 75.00 | - | ASE | 541 | -22.5 | -3.9 | -4.0 |
| 0.1 | 8.2 | | | | | | |
| 193.100006 | 75.00 | 24 | OCh | 565 | -22.7 | -3.8 | -4.0 |
| 0.1 | 7.5 | | | | | | |
| 193.175003 | 75.00 | - | ASE | 589 | -22.7 | -3.8 | -4.0 |
| 0.1 | 8.2 | | | | | | |
| 193.250000 | 75.00 | 26 | OCh | 613 | -22.5 | -3.8 | -3.9 |
| 0.1 | 7.2 | | | | | | |
| 193.324997 | 75.00 | - | ASE | 637 | -22.6 | -3.8 | -4.0 |
| 0.2 | 8.1 | | | | | | |
| 193.399994 | 75.00 | 28 | OCh | 661 | -22.7 | -3.7 | -3.9 |
| 0.1 | 7.2 | | | | | | |
| 193.475006 | 75.00 | - | ASE | 685 | -22.5 | -3.7 | -3.8 |
| 0.1 | 8.0 | | | | | | |
| 193.550003 | 75.00 | 30 | OCh | 709 | -22.7 | -3.7 | -3.8 |
| 0.1 | 7.0 | | | | | | |
| 193.625000 | 75.00 | - | ASE | 733 | -22.7 | -3.6 | -3.8 |
| 0.1 | 8.1 | | | | | | |
| 193.699997 | 75.00 | 32 | OCh | 757 | -22.7 | -3.6 | -3.7 |
| 0.1 | 6.7 | | | | | | |
| 193.774994 | 75.00 | - | ASE | 781 | -22.7 | -3.5 | -3.7 |
| 0.1 | 8.2 | | | | | | |
| 193.850006 | 75.00 | 34 | OCh | 805 | -22.7 | -3.5 | -3.7 |
| 0.1 | 6.6 | | | | | | |
| 193.925003 | 75.00 | - | ASE | 829 | -22.7 | -3.5 | -3.6 |

```
    0.1        8.1
194.000000    75.00      36      OCh        853         -22.8          -3.5          -3.7
    0.2        6.6
194.074997    75.00       -      ASE        877         -22.8          -3.4          -3.6
    0.1        8.3
194.149994    75.00      38      OCh        901         -22.7          -3.4          -3.5
    0.1       10.9
194.225006    75.00       -      ASE        925         -22.8          -3.3          -3.5
    0.1        8.2
194.300003    75.00      40      OCh        949         -22.9          -3.3          -3.5
    0.1        7.1
194.375000    75.00       -      ASE        973         -22.8          -3.3          -3.4
    0.1        8.4
194.449997    75.00      42      OCh        997         -22.9          -3.2          -3.5
    0.2        7.3
194.524994    75.00       -      ASE       1021         -22.9          -3.2          -3.4
    0.1        8.4
194.600006    75.00      44      OCh       1045         -22.8          -3.2          -3.3
    0.1        7.2
194.675003    75.00       -      ASE       1069         -22.8          -3.2          -3.3
    0.1        8.4
194.750000    75.00      46      OCh       1093         -22.9          -3.1          -3.4
    0.2        7.3
194.824997    75.00       -      ASE       1117         -22.8          -3.1          -3.2
    0.1        8.2
194.899994    75.00      48      OCh       1141         -22.8          -3.0          -3.3
    0.2        6.9
194.975006    75.00       -      ASE       1165         -22.9          -3.0          -3.2
    0.1        8.3
195.050003    75.00      50      OCh       1189         -22.8          -3.0          -3.1
    0.1        6.6
195.125000    75.00       -      ASE       1213         -22.9          -3.0          -3.1
    0.1        8.3
195.199997    75.00      52      OCh       1237         -22.9          -2.9          -3.1
    0.1        6.3
195.274994    75.00       -      ASE       1261         -23.0          -2.9          -3.0
    0.1        8.1
195.350006    75.00      54      OCh       1285         -23.1          -2.8          -3.0
    0.1        6.4
195.425003    75.00       -      ASE       1309         -23.2          -2.8          -3.0
    0.1        8.3
195.500000    75.00      56      OCh       1333         -23.1          -2.8          -2.9
    0.1        6.2
195.574997    75.00       -      ASE       1357         -23.4          -2.8          -3.0
    0.2        8.2
195.649994    75.00      58      OCh       1381         -23.4          -2.7          -2.9
    0.1        6.4
195.725006    75.00       -      ASE       1405         -23.4          -2.7          -2.8
    0.1        8.5
195.800003    75.00      60      OCh       1429         -23.6          -2.7          -2.8
    0.1        6.6
195.875000    75.00       -      ASE       1453         -23.7          -2.6          -2.9
    0.2        8.7
195.949997    75.00      62      OCh       1477         -23.7          -2.6          -2.8
    0.2        6.9
196.024994    75.00       -      ASE       1501         -23.6          -2.5          -2.7
    0.1        9.0
196.100006    75.00      64      OCh       1525         -23.7          -2.5          -2.7
    0.1        7.1


ASE - Noise Loaded Channel
OCh - Optical Channel
```

**Note**

- In the previous sample output, the channel source is ASE for channels that are empty and for channels that failed due to power level dropping below psd-min. For dropped channels, channel ID is present and the channel source is ASE. ASE or Noise loader fills noise across the spectrum with a spacing of 75 GHz for wherever optical cross connects are not present.

# Configure APC

If you enable link tuner, the link tuner sets the target PSDs for APC on all nodes in the path.

You can configure the target power spectral densities for 33 points across the band. The 33 PSD values divide the entire spectrum into 150-GHz steps. APC uses the corresponding PSD value if the channel frequency corresponds to a configured point. If the central frequency is not on a configured position, APC computes the target PSD for a channel by extrapolating from the two adjacent steps.

Use the following commands to set the target PSDs for single-band for each node on a C-band network.

**configure**

**optical-line-control**

**controller ots** *Rack/Slot/Instance/Port*

**psd** *<1-33> value*

**commit**

**end**

The following is a sample configuration that sets the psd to 15 dBm/12.5 GHz for the setpoints 1 and 2.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#psd 1 150
RP/0/RP0/CPU0:ios(config-olc-ots)#psd 2 150
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

Use the following commands to set the target PSDs for dual-band for each node on a C+L band network.

**configure**

**optical-line-control**

**controller ots** *Rack/Slot/Instance/Port*

**dual-band-psd** *<1-33> value*

**commit**

**end**

### Example

The following is a sample configuration that sets the dual-band psd values to -50 and -49 on setpoints 1 and 2 respectively, on the 0/0/0/0 controller .

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#dual-band-psd 1 -50
RP/0/RP0/CPU0:ios(config-olc-ots)#dual-band-psd 2 -49
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

### Disable APC

To disable APC for a link, execute the following commands on the transmitting OLT node.

**configure**

**optical-line-control**

**controller ots** *Rack/Slot/Instance/Port*

**apc disable**

**commit**

**end**

The following is a sample configuration that disables APC.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc disable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Important**

- When you disable APC, NCS 1010 sets all setpoints to values in the configuration. If there is no configuration, NCS 1010 sets all setpoints to default values. Disabling APC is traffic impacting.
- For BFR to work, APC must be enabled on both C and L-band devices. We recommended to pause BFR before running the **apc-pause** or **apc disable** commands.

### Enable APC

To enable APC for a link, execute the following commands on the transmitting OLT node.

**configure**

**optical-line-control**

**controller ots** *Rack/Slot/Instance/Port*

**apc enable**

**commit**

**end**

The following is a sample configuration that enables APC.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc enable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

### Pause APC

If you want to modify the network without APC compensating for the changes, you can pause APC. Use the following commands to pause APC.

**configure**

**optical-line-control**

**controller ots** *Rack/Slot/Instance/Port*

**apc-pause**

**commit**

**end**

The following is a sample configuration that pauses APC.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc pause
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Note**

- If you run the **apc-pause** command when APC is in idle state, APC remains in the idle state until APC detects changes in the network that requires power correction. APC changes the status to paused after it detects changes, but does not perform power correction.
- Running the **apc-pause** command, does not pause channel startup.

### Disable APC on an ILA Node

If you want to manually disable APC on a particular node. For example, consider a scenario where the headend OLT encounters a headless event. For any power correction required at agent nodes, APC manager is unavailable to initiate regulation. Also, you cannot perform any adjustments as APC is enabled and user-configuration of target-psd does not take effect. This command gives you an option to disable APC locally on an agent node to perform the parameter adjustments manually. Use the **apc-local disable** command to disable APC on an agent node.

Use the following commands to disable APC on an ILA node.

**configure**

**optical-line-control**

**controller ots** *Rack/Slot/Instance/Port*

**apc-local [ RX | TX ] disable**

**commit**

**end**

The following is a sample configuration that disables APC locally.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc-local RX disable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

### Configure Target Drop PSD

Link Tuner does not set the target PSD for drop ports. The default target PSD for drop ports is -8.0 dBm/12.5 GHz. The NCS 1010 applies drop PSD configuration for channels with cross connect configurations. Use the **drop-psd** command to set the desired drop-psd.

Use the following commands to set the desired drop-psd.

**configure**

**optical-line-control**

**controller ots** *Rack/Slot/Instance/Port*

**drop-psd** *value*

**commit**

**end**

The following is a sample configuration that sets the target PSD at drop ports to –25 dBm/12.5 GHz.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#drop-psd -250
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
Tue Apr 26 09:50:12.055 UTC
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

### Configure Minimum PSD

If the PSD of a channel with minimum attenuation at the amplifier input on an OLT is less than the minimum PSD, APC marks the channel as failed and replaces the channel using ASE source. The default minimum PSD is –24 dBm/12.5 GHz. Use the **psd-min** command to set the desired minimum PSD.

Use the following commands to set the desired minimum PSD.

**configure**

**optical-line-control**

**controller ots** *Rack/Slot/Instance/Port*

**psd-min** *value*

**commit**

**end**

The following is a sample configuration that sets the minimum PSD to –25 dBm/12.5 GHz.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#psd-min -250
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
Tue Apr 26 09:50:12.055 UTC
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

### Path Loss

On a C+L band configuration, to launch correct power into the transmission fiber, optical applications need data about loss between the LINE-TX port of the L-band device to the LINE-TX port of the C-band device. This data, also known as path loss, is calculated from the following components:

- Patch cord loss between the LINE-TX port of the L-band device to the L-Band-RX port of the C-band device.
- Insertion loss between the L-Band-RX port of the C-band device and the LINE-TX port of the C-band device.
- Insertion loss due to the Raman modules inside the C-band device.

Use the **show olc partner-band-loss** command to view the Patchcord Loss and Path Loss values. The following output is a sample of the **show olc partner-band-loss** command executed on a C-band device.

```
RP/0/RP0/CPU0:P2B_DT_01#show olc partner-band-loss
Wed Feb 1 12:51:59.605 UTC

Controller                                  : Ots0/0/0/0
Partner IP address                          : 10.1.1.2
Partner Controller                          : Ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX            : 2.3 dB
L-LINE-TX Patchcord Loss                    : 1.0 dB
Loss Measurement Timestamp                  : 2023-02-01 12:51:54
```

The following output is a sample of the **show olc partner-band-loss** command executed on an L-band device.

```
RP/0/RP0/CPU0:P1BL_DT_10#show olc partner-band-loss
Wed Feb 1 12:51:59.605 UTC

Controller                                  : Ots0/0/0/0
Partner IP address                          : 10.1.1.3
Partner Controller                          : ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX          : 2.3 dB
L-LINE-TX Patchcord Loss                    : 1.0 dB
Loss Measurement Timestamp                  : 2023-02-01 12:51:54
```

You can view the Patchcord Loss and Path Loss values for individual controllers using the **show olc partner-band-loss controller ots r/s/i/p** command. The following output is a sample of the **show olc partner-band-loss controller ots r/s/i/p** command executed on a C-band device.

```
RP/0/RP0/CPU0:P2B_DT_01#show olc partner-band-loss controller Ots 0/0/0/0
Wed Feb 1 12:51:59.605 UTC

Controller                                  : Ots0/0/0/0
Partner IP address                          : 10.1.1.2
Partner Controller                          : Ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX          : 1.9 dB
L-LINE-TX Patchcord Loss                    : 1.2 dB
Loss Measurement Timestamp                  : 2023-02-01 12:51:54
```

The following output is a sample of the **show olc partner-band-loss controller ots r/s/i/p** command executed on an L-band device.

```
RP/0/RP0/CPU0:P1BL_DT_10#show olc partner-band-loss controller Ots 0/0/0/0
Wed Feb 1 12:51:59.605 UTC

Controller                                  : Ots0/0/0/0
Partner IP address                          : 10.1.1.3
Partner Controller                          : Ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX            : 1.9 dB
L-LINE-TX Patchcord Loss                    : 1.2 dB
Loss Measurement Timestamp                  : 2023-02-01 12:51:54
```