DCP-F

User Manual

dcp-release-12.0.1

DCP-F-A22

DCP-F-R22

DCP-F-DE22

DCP-F-RA12

DCP-F-VG

smartoptics

The specifications and information within this manual are subject to change without further notice. All statements, information and recommendations are believed to be accurate but are presented without warranty of any kind. Users must take full responsibility for their application of any products.

Contents

1 Introduction

1.1 General

The DCP-F family is designed for maximum configuration flexibility with the active units available as individual modules plugged directly into the standard Smartoptics DCP-2 chassis, each module occupying one slot. The module also has an integrated expansion field for optional passive plug-in modules (PPM), used for example for dispersion compensation.

The DCP-F units are used to amplify aggregated optical signals and depending on where they are installed in the network they function as a pre-amplifier, booster-amplifier or line amplifiers. The units can be leveraged on their own in point-to-point applications, as well as in ROADM-based rings and mesh networks. They may also be used to expand the functionality of the DCP-M and they may also be combined with e.g. the Smartoptics H-series Passive Optical Networking Platform in active/passive configurations.

This manual provides an overview of the amplifier units within the DCP-Family. The following products are described:

Product	Description
DCP-F-R22	2-port ROADM, EDFA amplifier with 22 dB Gain, 2-Port Optical Channel Monitor, 1RU plug-in unit, with support for 2 x Passive Plug-in Modules (PPM’s)
DCP-F-A22	EDFA amplifier with 22 dB Gain, 1RU plug-in unit, with support for 2 x Passive Plugin Modules (PPM’s)
DCP-F-DE22	Dual Equalizer, EDFA amplifier with 22 dB Gain, 2-Port Optical Channel Monitor, 1RU plug-in unit, with support for 2 x Passive Plug-in Modules (PPM’s)
DCP-F-VG	EDFA amplifier with variable gain from 15-25dB Gain, 1RU plug-in unit, with support for 2 x Passive Plugin Modules (PPM’s)
DCP-F-RA12	Raman amplifier with 12dB Gain, 1RU plug-in unit, with support for 2 x Passive Plugin Modules (PPM’s)

The major difference between the DCP-F units is that channel power is automatically equalized for DCP-F-R22 and DCP-F-DE22 units, where for DCP-F-A22, DCP-F-RA12 and DCP-F-VG the channels need to be manually attenuated.

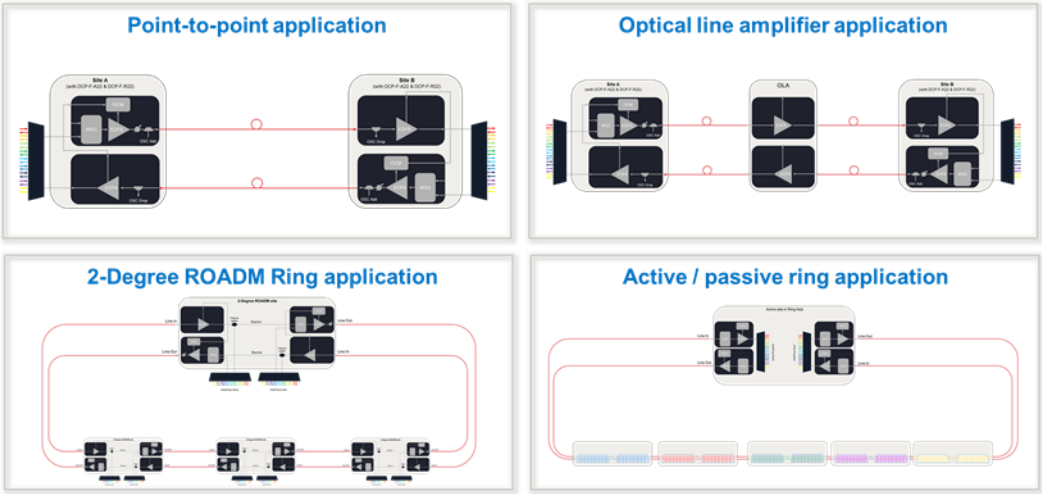


Figure 1. *Pre-amp only, point-to-point link with DCP-F-A22*

1.2 In commercial confidence

The manual is provided in commercial confidence and shall be treated as such.

1.3 Document Revision History

Revision	Date	Description of changes
8.1.1 A	2023-06-29	Release version of DCP-F user manual for R8.1.1 Added chapter about replacement of ILA with shelf controller
8.1.1 B	2023-08-16	Added PPM-DCM10
8.1.3 A	2023-10-06	No update
8.1.4 A	2023-10-12	Added description for alarm “loss of optical output power” Added alarm “transceiver missing” Updated descriptions in alarm table
8.1.5 A	2023-11-02	No update
8.1.6 A	2023-11-17	Updated ILA ETH port picture Updated ILA patch cord picture Updated servity on eMMC alarm
8.1.7 A	2024-01-04	No update
9.0.1 A	2024-01-19	No update
10.0.1 A	2024-06-25	Added chapter about waste management Added show alarm list Added support for OSC SO-SFP-L50D-C51

10.0.2 A	2024-09-05	No update
11.0.1 A	2024-12-12	No update
11.1.1 A	2025-01-23	Added DCP-F-VG and DCP-RA12
11.3.1 A	2025-04-24	Updated DCP-F-VG and DCP-F-RA12 pictures
12.0.1 A	2025-06-23	Added text about embedded ILA for DCP-M32-CSO-ZR+ Added picture for Etherent connections to DCP-SC-28P

2 Safety Precaution

2.1 General Safety Precautions

The following are the general safety precautions:

The equipment should be used in a restricted access location only.

No internal settings, adjustments, maintenance, and repairs may be performed by the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved.

Always observe standard safety precautions during installation, operation and maintenance of this product.

2.2 Electrical Safety Precautions

Warning: Dangerous voltages may be present in the cables connected to the DCP-2.

Never connect electrical cables to a DCP-2 unit if it is not properly installed and grounded.

Disconnect the power cable before removing a pluggable power supply unit.

Grounding: For your protection and to prevent possible damage to equipment when a fault condition occurs on the cables connected to the equipment (for example, a lightning strike or contact with high voltage power lines), the case of the DCP-2 unit must be properly grounded at all times. Any interruption of the protective (grounding) connection inside or outside the equipment, or the disconnection of the protective ground terminal, can make this equipment dangerous. Intentional interruption is prohibited.

When a DCP-2 is installed in a rack, make sure that the rack is properly grounded and connected to a reliable, low resistance grounding system.

Connect the DCP-2 via an external cable to ground. See Section 4.2.8 for further details.

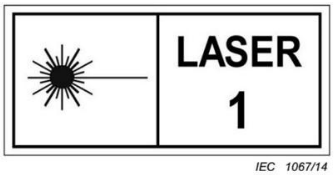
If AC power is used, the grounding must also be made through the AC power cable, which should be inserted in a power outlet with a protective ground contact. Therefore, the power cable plug must always be inserted in a socket outlet provided with a protective ground contact, and the protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

2.3 Laser Safety Classification

The DCP-2 complies with Class 1. The incorporated laser has a divergent beam, operates within the wavelength span of 1530 – 1563 nm and has a maximum output of +20 dbm.

The following warning applies to Class 1 laser products.

Invisible Laser Radiation: Do not view directly with optical instruments.



Class 1 Laser Warning.

Laser Safety Statutory Warning and Operating Precautions

All personnel involved in equipment installation, operation, and maintenance must be aware that the laser radiation is invisible. Therefore, the personnel must strictly observe the applicable safety precautions and in particular, must avoid looking straight into optical connectors, either directly or using optical instruments.

In addition to the general precautions described in this section, be sure to observe the following warnings when operating a product equipped with a laser device. Failure to observe these warnings could result in fire, bodily injury, and damage to the equipment.

Warning: To reduce the risk of exposure to hazardous radiation:

Do not try to open the enclosure. There are no user serviceable components inside.

Do not operate controls, adjust, or perform procedures to the laser device other than those specified herein.

Allow only authorized service technicians to repair the unit.

2.4 Protection against Electrostatic Discharge

An electrostatic discharge (ESD) occurs between two objects when an object carrying static electrical charges touches or is brought near the other object. Static electrical charges appear as a result of friction between surfaces of insulating materials or separation of two such surfaces. They may also be induced by electrical fields.

Routine activities, such as walking across an insulating floor, friction between garment parts, and friction between objects, can easily build charges up to levels that may cause damage, especially when humidity is low.

Caution: DCP-2 contains internal components sensitive to ESD. To prevent ESD damage, do not touch internal components or connectors. If you are not using a wrist strap, before touching a DCP-2 or performing any internal settings on the DCP-2, it is recommended to discharge the electrostatic charge of your body by touching the frame of a grounded equipment unit.

Whenever feasible during installation, use standard ESD protection wrist straps to discharge electrostatic charges. It is also recommended to use garments and packaging made of anti-static materials, or materials that have a high resistance, yet are not insulators.

2.5 Site Requirements

This section describes the DCP-2 site requirements.

PHYSICAL REQUIREMENTS

The DCP-2 unit can be mounted in a 19-inch, 23-inch, or ETSI rack with the GND cable connected. The rack depth needs to be at least 600 mm.

All the electrical connections are made to the back panel. The optical traffic connections are made in the front panel.

POWER REQUIREMENTS

AC-powered DCP-2 units should be installed within 3m (10 feet) of an easily accessible, grounded AC outlet capable of furnishing the required AC supply voltage, of 100-127VAC (3A) and 200-240VAC (1,5A) maximum.

DC-powered DCP-2 units require a -48VDC (-40V to -72V) (Max 7A @ -48V) DC power source with the positive terminal grounded. In addition, the DC power connector contains the chassis (frame) ground terminal.

AMBIENT REQUIREMENTS

The ambient operating temperature of the DCP-2 is 0° to +45°C/+32° to +113°F, at a relative humidity of 5% to 85% RH non-condensing.

The DCP-2 is cooled by free air convection and a pluggable cooling fan unit. The DCP supports front-to-back cooling. The intakes/outtakes are positioned in the front and back.

Caution: Do not obstruct these vents.

The DCP-2 contains a fan speed control for lower noise, improved MTBF, and power savings.

ELECTROMAGNETIC COMPATIBILITY CONSIDERATIONS

The DCP-2 is designed to comply with the electromagnetic compatibility (EMC) requirements according to ETSI EN 300 386 V2.1.1 class A. To meet these standards, the following conditions are necessary:

The DCP-2 must be connected to a low resistance grounding system.

The DCP-2 RJ45 Ethernet interfaces ETH0 – ETH4 as well as the DCP-F RJ45 Ethernet interfaces ETH1 – ETH2 can be used for intra-building connections provided that a Cat 5e (or higher) class shielded cable is used. The cables must not be electrically connected directly to outside-plant cables.

Warning: The intra-building port(s) (DCP-2 ETH0-ETH4 and DCP-F ETH1-ETH2 management ports) of the equipment or subassembly is suitable for connection to intra building or unexposed wiring or cabling only. The intra-building port(s) of the equipment or subassembly MUST NOT be metallically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 2 ports as described in GR-1089-CORE) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

Warning: The intra-building port(s) (DCP-2 ETH0-ETH4 and DCP-F ETH1-ETH2 management ports) of the equipment or subassembly must use shielded intra-building cabling/wiring that is grounded at both ends.

Maximum allowed cable length for intra-building connections is 100m.

The DCP-2 must be installed in a CBN (common bonding network) per NEBS GR-1089.

The DCP-2 is designed to be used in Network Telecommunication Facilities.

Common DC return (DC-C) Is applicable for the DCP-2.

3 APPLICATIONS

3.1 Point-to-Point

In one of the simplest applications, Point-to-Point networks are linear setups characterized by a single-span fiber link with a fixed set of DWDM channels that needs to be transported between the two sites. Depending on distance/attenuation between the sites

3.1.1 Pre-Amp

The pre-amplifier increases the transmission distance and is used to amplify the optical signal to the required level to ensure that it can be detected by the transceiver. Dispersion compensation is recommended to be positioned after the pre-amplifier to achieve the best OSNR performance.

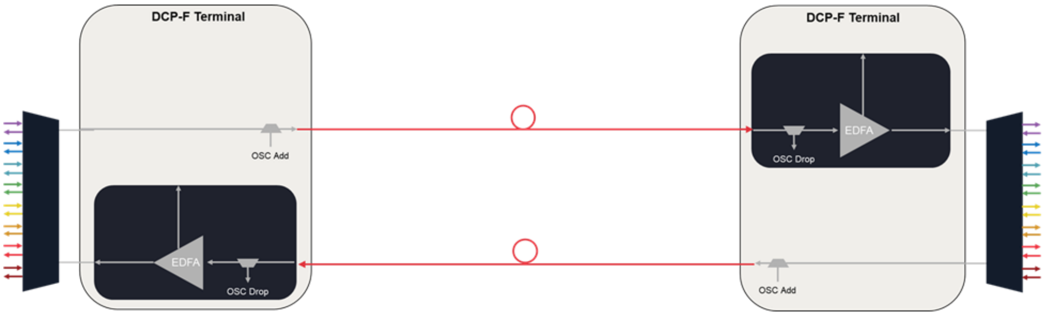


Figure 1. *Pre-amp only, point-to-point link with DCP-F-A22*

3.1.2 Booster

The booster amplifier increases the transmission distance by adding little optical noise to the system and maintaining a high optical signal to noise ratio, OSNR.

Booster amplifiers are preferably selected if the noise characteristic is unknown of the receiver. Dispersion compensation is recommended to be positioned in front of the Booster. When the DCP-F-R22 is used as a booster it equalizes the optical spectral of the incoming wavelengths prior to amplification and transportation over the fiber.

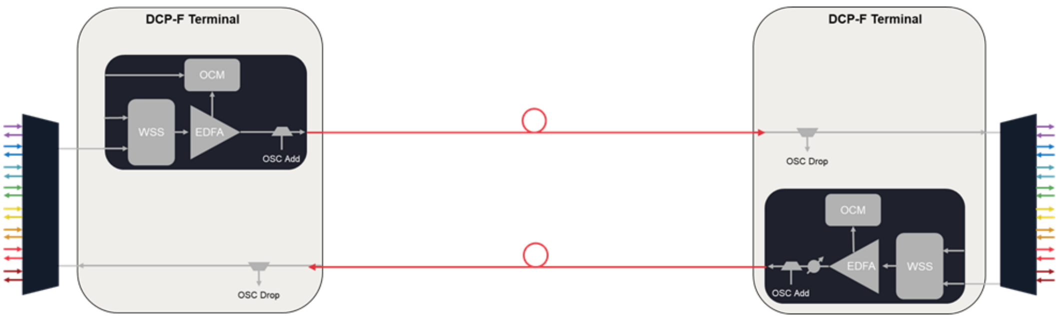


Figure 2. *Booster only, point-to-point link with DCP-F-R22*

3.1.3 Booster & Pre-Amp

By using both booster and pre-amplifiers it is possible to achieve maximum transmission distance between 2 sites. The DCP-F-R22 is recommended to be used as a booster as it equalizes the optical spectral of the incoming wavelengths prior to amplification and transportation over the fiber. The DCP-F-A22 is used as pre-amp and patching the DCP-F-A22 Optical Channel Monitor Tx port to DCP-F-R22 integrated Optical Channel Monitor (OCM) Rx port makes it possible to monitor the Lines spectrum also on the receiving side.

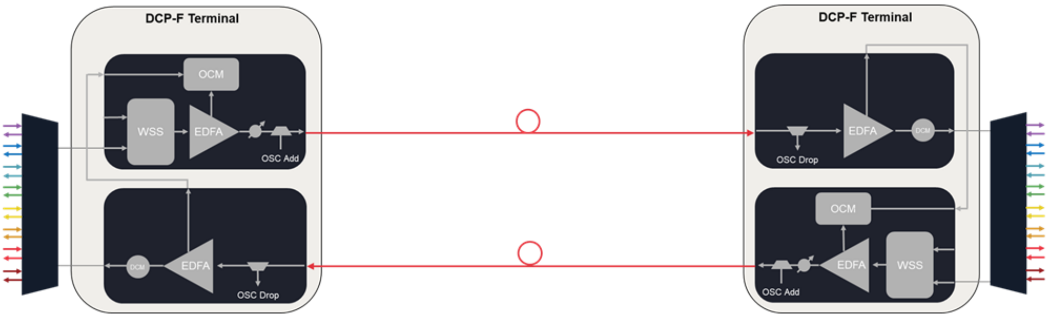


Figure 3. *Pre-amp & Booster, point-to-point link with DCP-F-A22 and DCP-F-R22.*

3.1.4 Point-to-point with Booster & Pre-Amp plus Raman

The distance can be extended by adding Raman amplifiers in addition to booster and pre-amp EDFAs. The Raman amplifier should be used in counter propagating mode, i.e. it should sit at the receiving end of the fiber and inject optical light in the reverse direction compared to the optical signal.

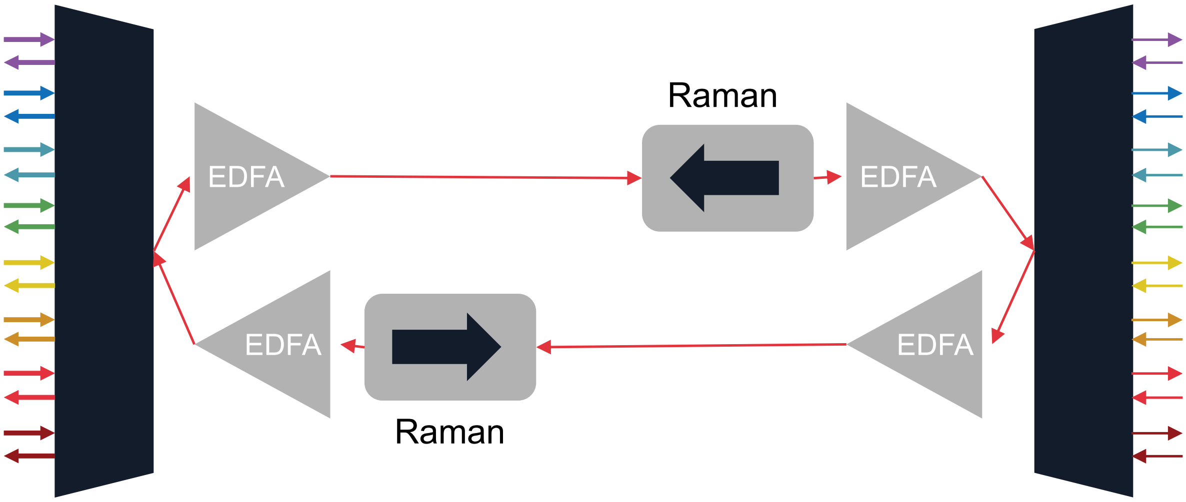


Figure 4. *Point-to-point with pre-amp, booster and Raman*

The Raman unit has very high optical power, +27dBm, but should be classified as laser class 1M on system level when all laser safety mechanisms are used.

3.2 Optical line amplifiers

The optical line amplifiers are used when both a booster and pre-amplifier are not enough due to the distance and optical loss. For these longer distances the DCP-F-A22 and its integrated Erbium-Doped Fiber Amplifier (EDFA) is an efficient tool for amplification and signal regeneration. The total distance possible to bridge and the maximum distance between amplifiers is dependent on the modulation format used for the line system. The DCP-F-A22 and DCP-F-VG used as optical line amplifiers are compatible with any other combination of DCP-F-R22 and DCP-F-R22 units as well as with the DCP-M family.

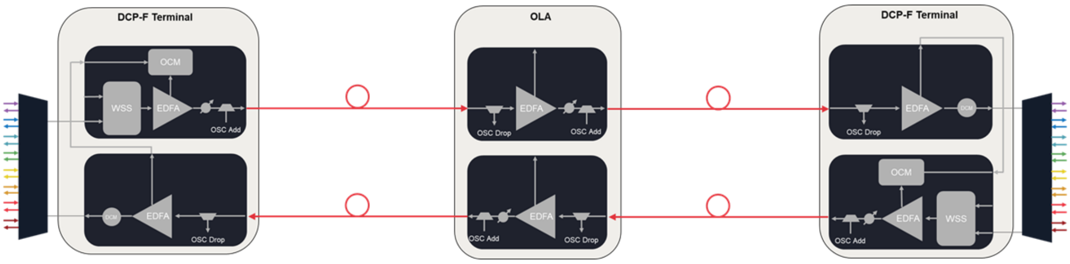


Figure 5. *DCP-F-A22 as optical line amplifier with DCP-F units*

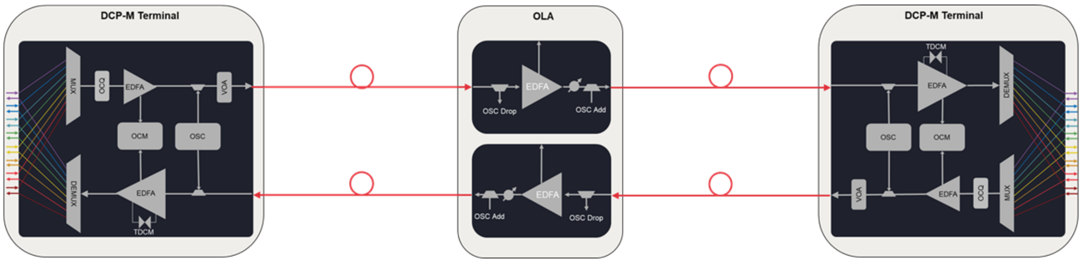


Figure 6. *DCP-F-A22 as optical line amplifier together with DCP-M units*

For DCP-M32-CSO-ZR+ it is also possible to use ILAs in embedded mode. Then the configuration of gain and VOA is automatically set.

3.2.1 Line Equalizing

To support extended reach and eliminate channel power disparity it is recommended to use DCP-F-DE22/DCP-F-A22 combo as the line amplifier after 8 spans as it will perform equalization on the individual wavelengths and remove degradation due to amplifier gain variations or fiber tilt loss. Where equalization is required, it’s recommended to place the combination on the spans with lower loss.

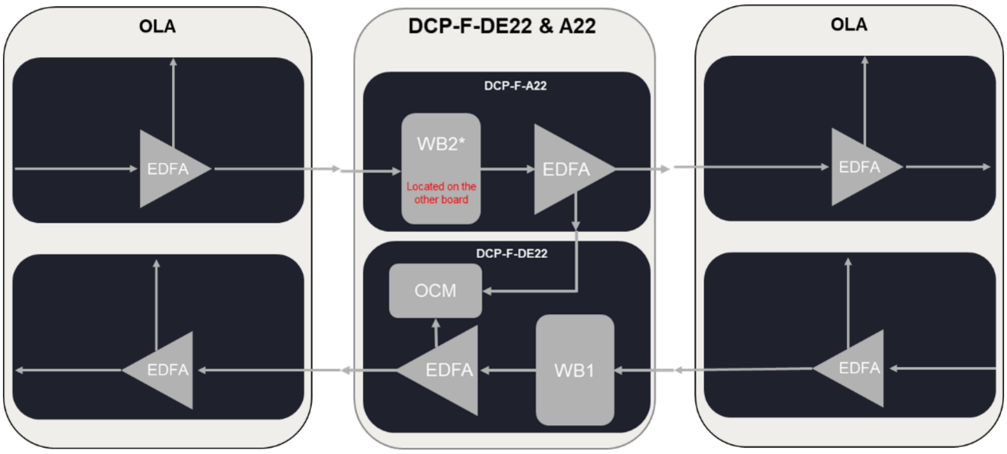


Figure 7. *DCP-F-DE22/A22 combo as optical line amplifier with equalization*

3.3 2-degree ROADM

2-degree ROADMs, the standard building block of a metro access ring, are easily configured by combing one DCP-F-A22 and one DCP-F-R22 for each signal direction, i.e. using one 1U chassis with two active units per degree.

A 2-degree also has two Mux/Demux modules - one for each degree. A wavelength can only be connected to the Mux/Demux port that is on the same degree. For example, a wavelength received on the east facing units can only be terminated on the east facing Mux/Demux module.

With a 2-degree ROADM network element, a passthrough wavelength can easily be provisioned between West and East signal directions.

The received signals on the “West” fiber path is first amplified via the DCP-F-A22 before being connected to PPM-OCU-50-50 100% port.

One of the 50% ports is then connected to the express Rx on the “East” DCP-F-R22 where the WSS controls which EDFA Rx or Express Rx wavelengths are routed to the “East” line-out port.

The second 50% port is connected to the local add/drop/demux lines rx port where all wavelengths received on the line-in port are visible on the drop port,

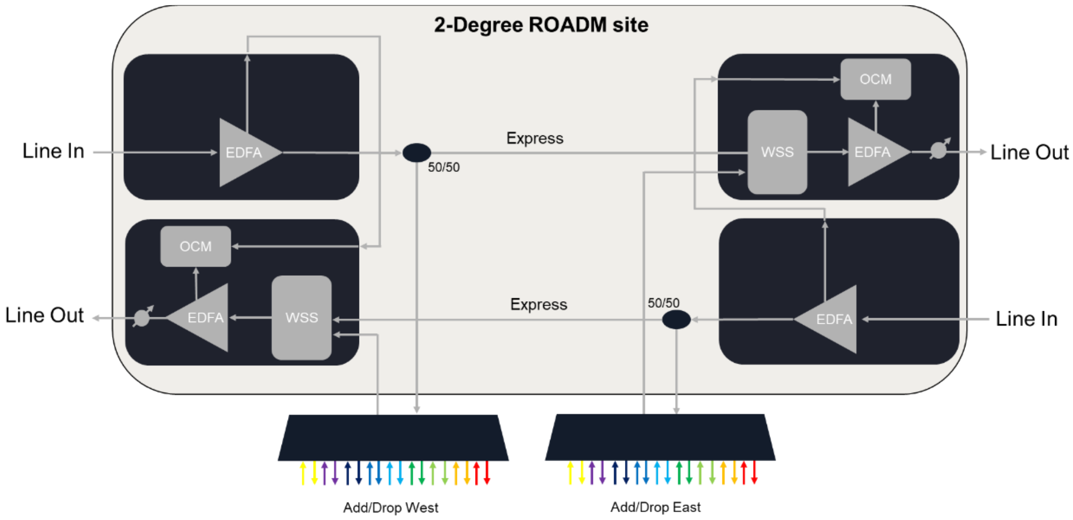


Figure 8. *2 degree ROADM Site with preamplifier*

3.4 Active/Passive

It is often desirable to use passive optical multiplexers in parts of the metro access network. The multiplexers are then typically deployed in a chain and at various distances from the active node, hence the signal strength will vary for different sets of wavelengths, emanating from different multiplexers. The DCP-F-DE22/A22 combo can be used for spectral equalization of incoming wavelengths from the passive multiplexers before the EDFA amplifier as well as for power balancing of the outgoing signal to the passive multiplexers, ensuring optimal performance of the optical links.

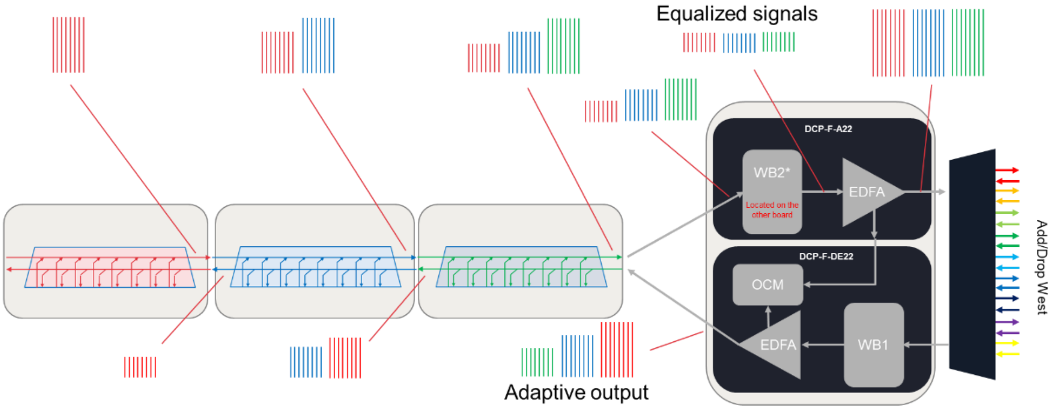


Figure 9. *Active/Passive chain configuration application*

As a concrete topology example, the illustration below shows how to create a hybrid active/passive access ring using the DCP-F-DE22, DCP-F-A22 and H-series multiplexers. The H-series multiplexers are installed in manholes, on poles or at other industrial temperature (-40 °C to +85 °C) locations without any need for external power, and the optical channels are then conveniently aggregated at one single active site

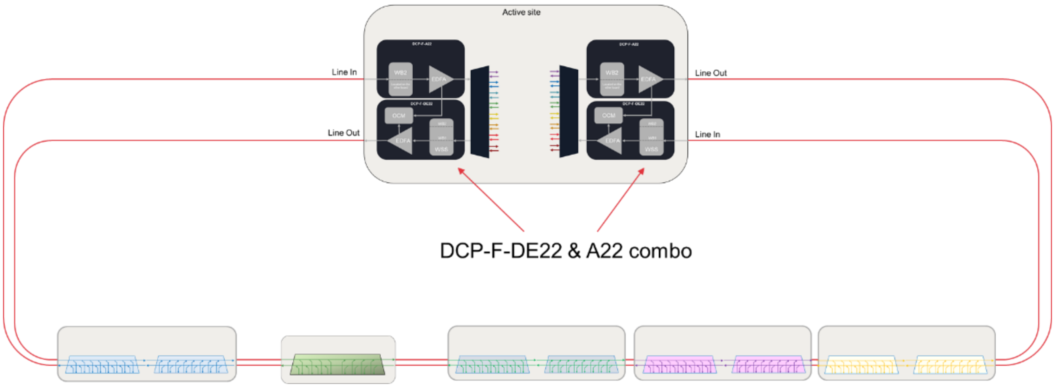


Figure 10. *Active/Passive ring with DCP-F-DE22, DCP-F-A22 at one active site and remote signal aggregation with the H-series Passive Optical Networking Platform.*

3.5 Line amplifier in ROADM systems

The DCP-F-A22 is supported as a line amplifier in ROADM systems, together with a shelf controller. For information on how to set up the shelf controller see the "Shelf controller User Manual". This section will handle how to connect the DCP-F unit optically. It is mandatory that a line amplifier in a ROADM system contain:

- One DCP-F-A22 or DCP-F-CG in each direction.
- One VOA-SFP in each direction. The VOA-SFP should be placed in SFP position 1.
- One OSC transceiver in each direction. The OSC transceiver should be 1510 nm and placed in SFP position 2.
- One OSC add/drop filter in each direction. The OSC add/drop filter should be placed in PPM position 1. The OSC should be connected to communicate in the same direction as EDFA Rx for each slot module.
- Example of connections in West and East direction below.

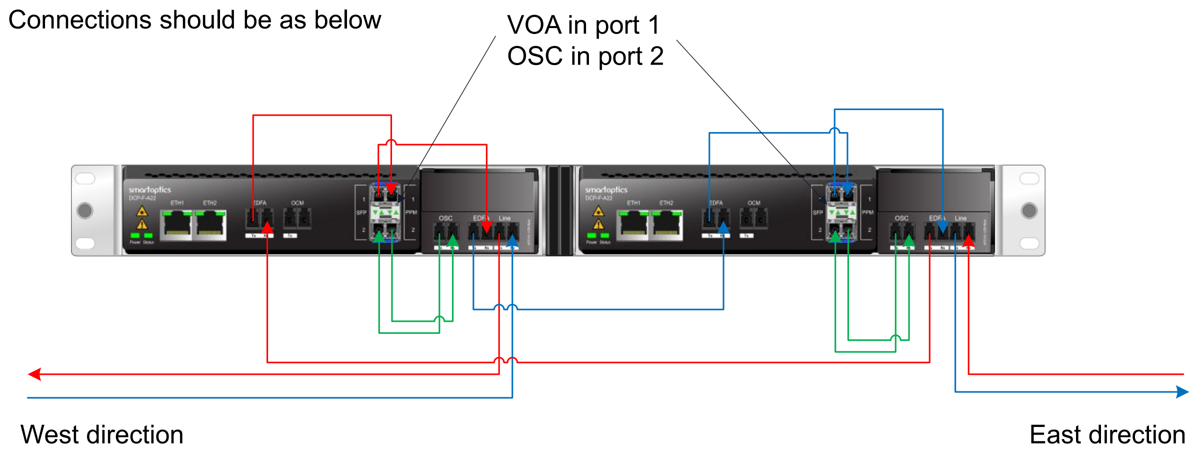


Figure 11. *Example of optical connections from/to a line amplifier site in a DCP ROADM Network. East + West direction.*

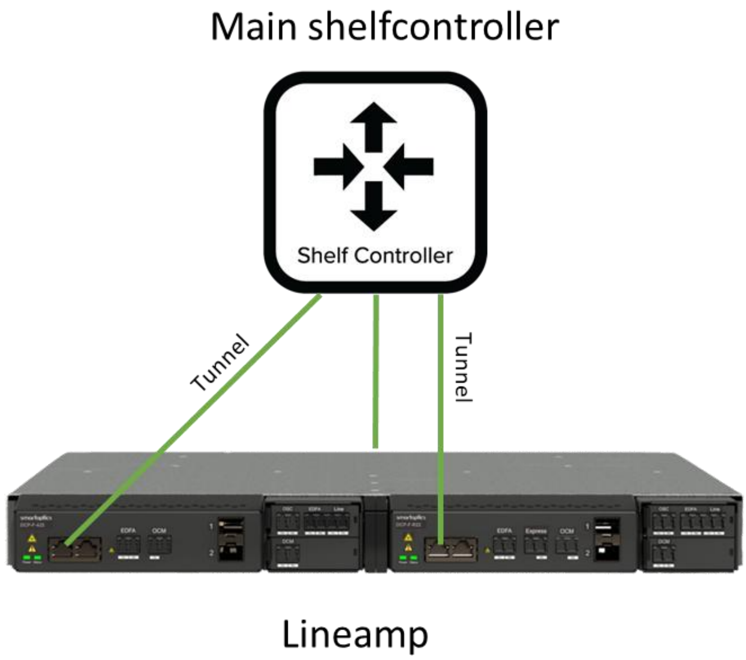


Figure 12. *Management connections from/to a line amplifier site in a DCP ROADM Network.*

The main shelf controller should be connected with ETH1 on each slot module to the shelf controllers tunnel ports. The management should be connected to ETH4 in the DCP-2 backside ethernet connections.

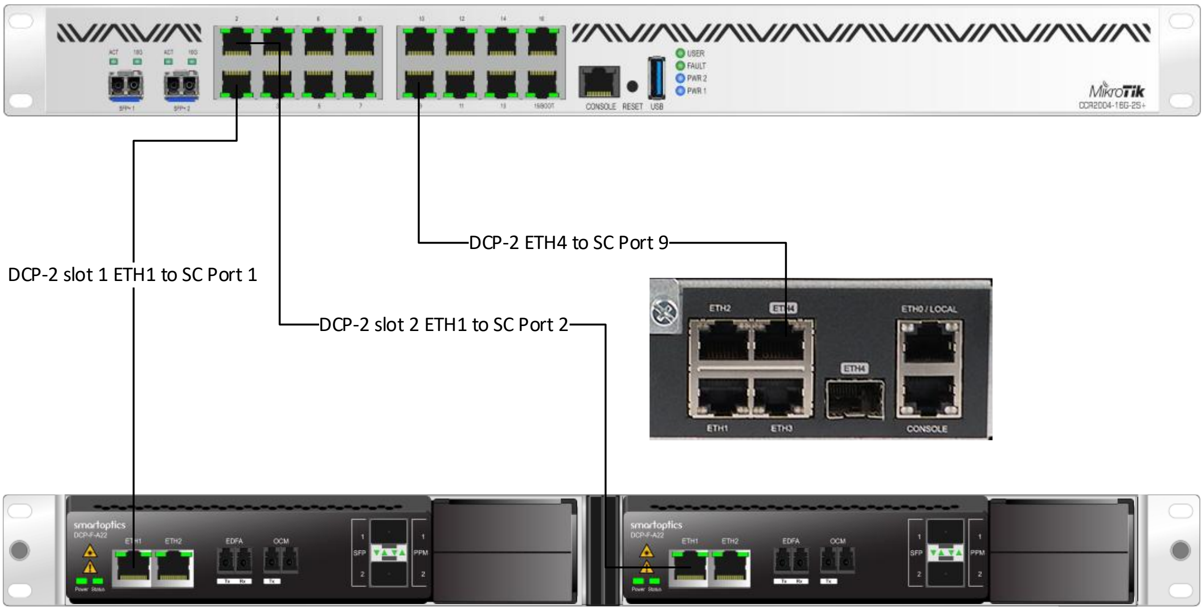


Figure 13. *Management ETH connections for DCP-2 in ILA to shelf controller, SO-SHELF-CTRL-XX.*

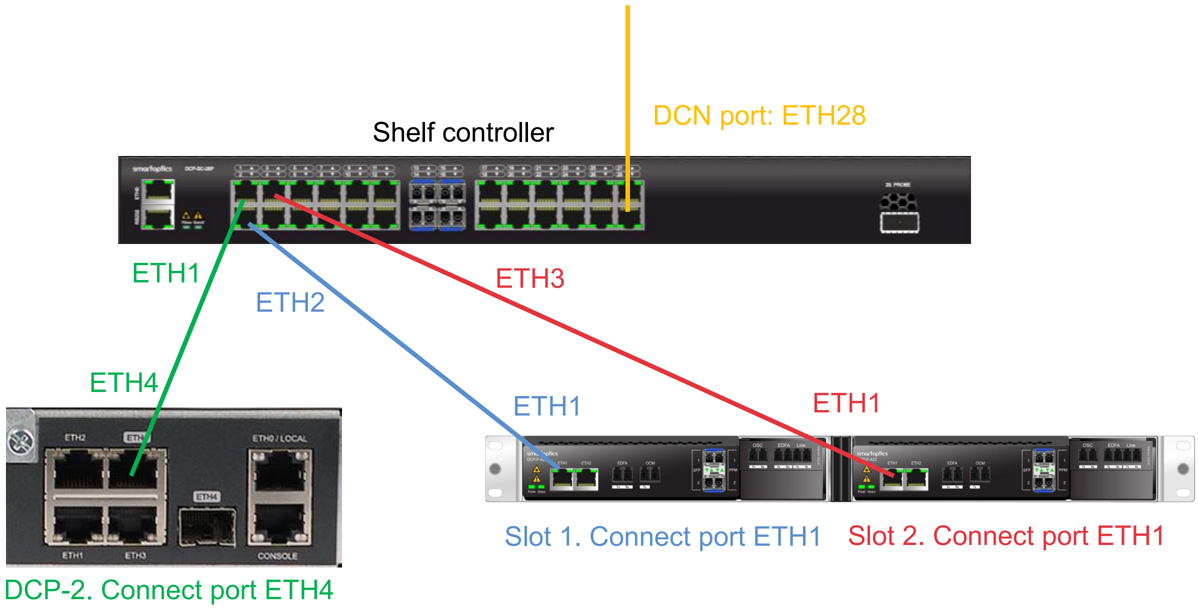


Figure 14. *Management ETH connections for DCP-2 in ILA to shelf controller, DCP-SC-28P..*

3.5.1 Replacement of ILA with shelf controller

See the DCP-R User Manual for instructions how to replace an ILA with shelf controller.

4 Functional description

4.1 DCP-F-A22

The DCP-F-A22 is a dedicated EDFA amplifier with an optical monitor port and with room for two Passive Plug-in Modules (PPM).

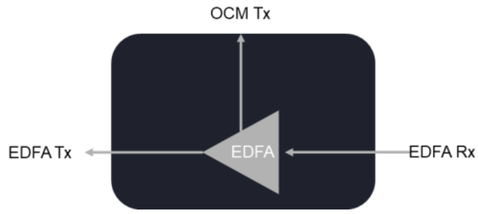


Figure 15. *DCP-F-A22*

4.1.1 DCP-F-A22 front connections

The DCP-F-A22 is an active unit that provides optical amplification for DWDM signals. The unit has a built-in fixed gain amplifier optimized at 22 dB gain.

The DCP-F-A22 has the following front connections. The incoming light enters at EDFA RX and exits amplified at EDFA TX. A small part of the light is tapped (1%, 20 dB) exits at the monitor port OCM TX.

In the SFP ports transceivers with transmission speeds up to 1 Gbit/s are supported as well as variable optical attenuators (VOA-SFP:s) and optical time domain reflectometers (OTDRs).

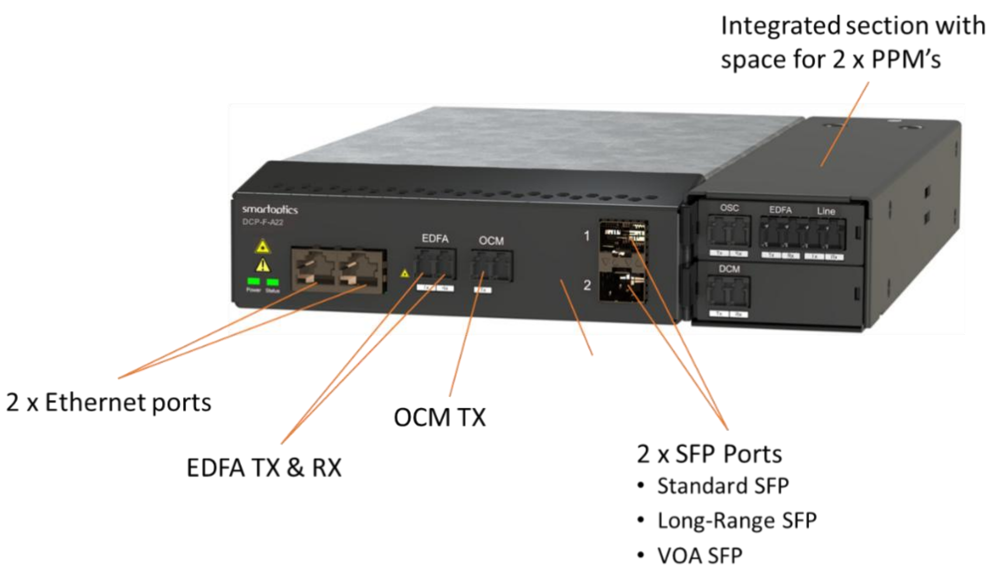


Figure 16. *DCP-F-A22 Front connections*

4.2 DCP-F-R22

The DCP-F-R22 is an active unit that provides wavelength path switching, optical equalization, amplification and wavelength channel monitoring.

With the above mentioned features the DCP-F-R22 unit becomes true plug-and-play, where optical power levels are auto-configured based on expected configured channel count.

Figure 17. *DCP-F-R22*

4.2.1 DCP-F-R22 front connections

The DCP-F-R22 has the following front connections. EDFA RX and Express Rx are two entrances to the wavelength selective switch (WSS). Added channels on one of these ports automatically blocks the same channel on the other port. Both these ports exits on EDFA Tx port, which also has inbuilt optical monitoring. The other optical monitoring port can be connected through OCM RX.

In the SFP ports transceivers with transmission speeds up to 1 Gbit/s are supported as well as variable optical attenuators (VOA-SFP:s) and optical time domain reflectometers (OTDRs).

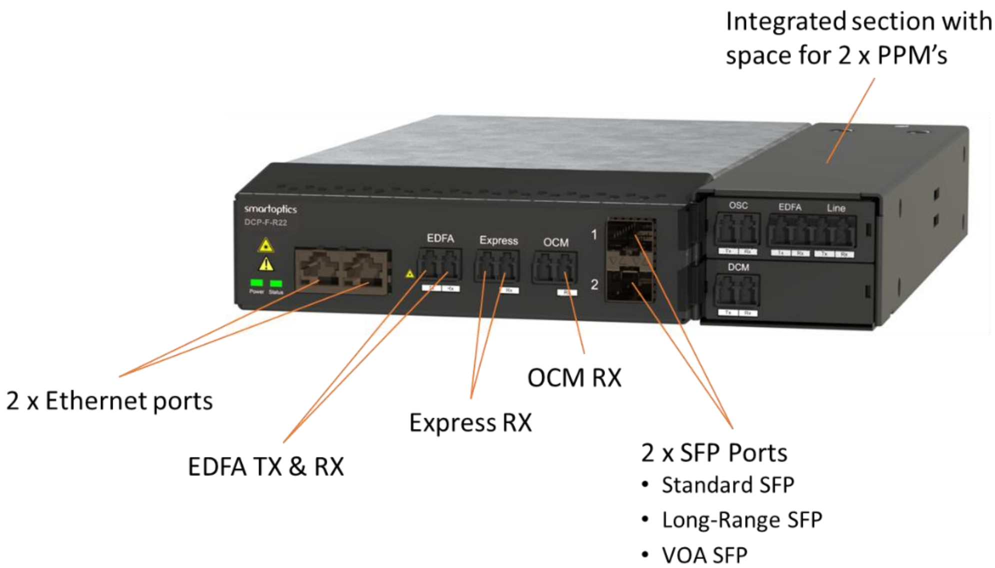


Figure 18. *DCP-F-R22 front connections*

4.3 DCP-F-DE22

The DCP-F-DE22 is an active unit that provides 2 optical equalizers, amplification, and wavelength channel monitoring.

The DCP-F-DE22 contains two individual wavelength blockers (WB) which is used to spectrally balance the channel powers. It also contains 2 OCM ports where one is internally connected to one of the equalizer paths and the other OCM port is connected externally.

With the above mentioned features the DCP-F-DE22 unit becomes true plug-and-play, where optical power levels are auto-configured based on expected configured channel count.

Figure 19. *DCP-F-DE22*

It is possible to configure a mode for combined DCP-F-DE22 and DCP-F-A22 modules when they are located in the same DCP-2 chassis. In this mode the control loop in DCP-F-DE22 will interact with the DCP-F-A22 and read the calibration data for the monitor port.

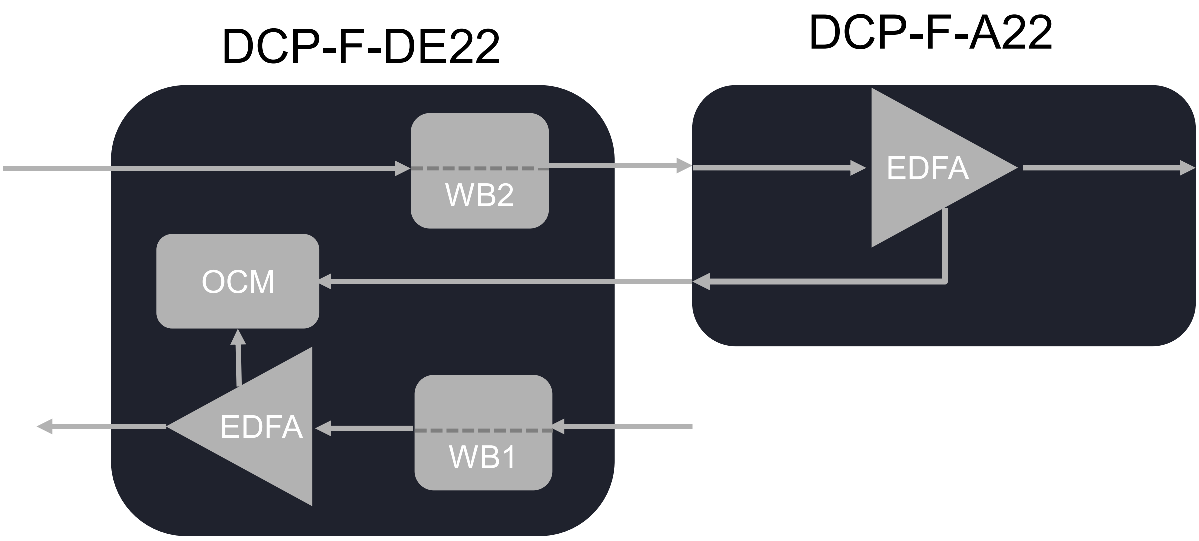


Figure 20. *Combined mode for DCP-F-DE22 + DCP-F-A22*

4.3.1 DCP-F-DE22 front connections

The DCP-F-DE22 is an active unit with two individual equalizers. One of the equalizers has amplification, EDFA TX & RX. The other, EQ TX & RX, can be connected with or without amplification. If amplification is needed with both equalizers the DCP-F-DE22 can be complemented with a DCP-F-A22.

The DCP-F-DE22 has the following front connections. The incoming light that enters at EDFA RX exits amplified and equalized at EDFA TX. The EDFA TX port has in-built optical monitoring.

The incoming light that enters at EQ RX exits equalized at EQ TX. For the channels to be equalized the optical monitoring port, OCM RX, need to be connected either through a passive coupler or through the monitor port of a DCP-F-A22.

In the SFP ports transceivers with transmission speeds up to 1 Gbit/s are supported as well as variable optical attenuators (VOA-SFP:s) and optical time domain reflectometers (OTDRs).

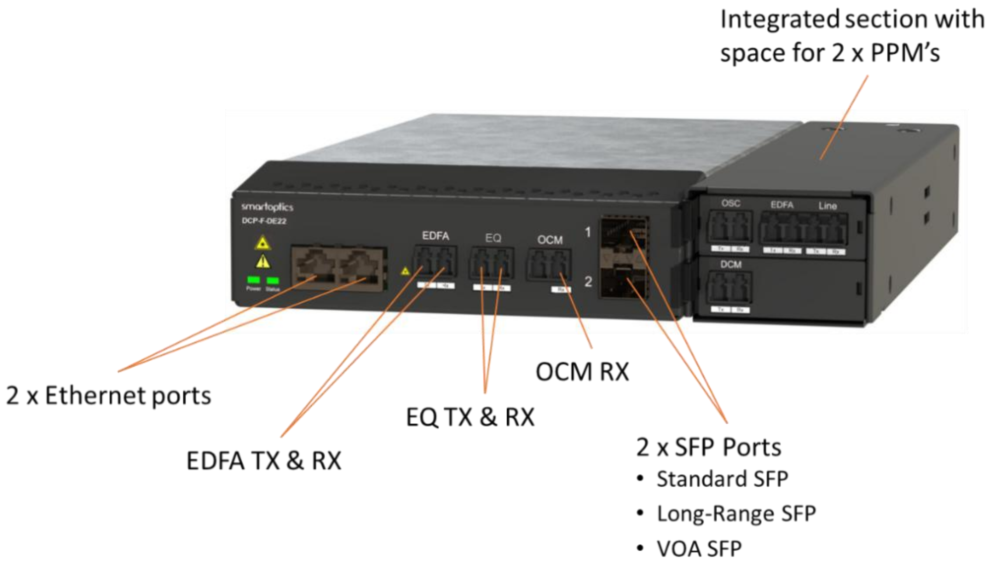


Figure 21. *DCP-F-R22 front connections*

4.4 DCP-F-VG

The DCP-F-VG is a dedicated EDFA amplifier with an optical monitor port and with room for two Passive Plug-in Modules (PPM).

Figure 22. *DCP-F-VG*

4.4.1 DCP-F-VG front connections

The DCP-F-VG is an active unit that provides optical amplification for DWDM signals. The unit has a variable gain amplifier optimized for 15-25 dB gain.

The DCP-F-VG has the following front connections. The incoming light enters EDFA RX and exits amplified at EDFA TX. A small part of the light is tapped (1%, 20 dB) exits at the monitor port OCM TX.

In the SFP ports transceivers with transmission speeds up to 1 Gbit/s are supported as well as variable optical attenuators (VOA-SFP:s) and optical time domain reflectometers (OTDRs).

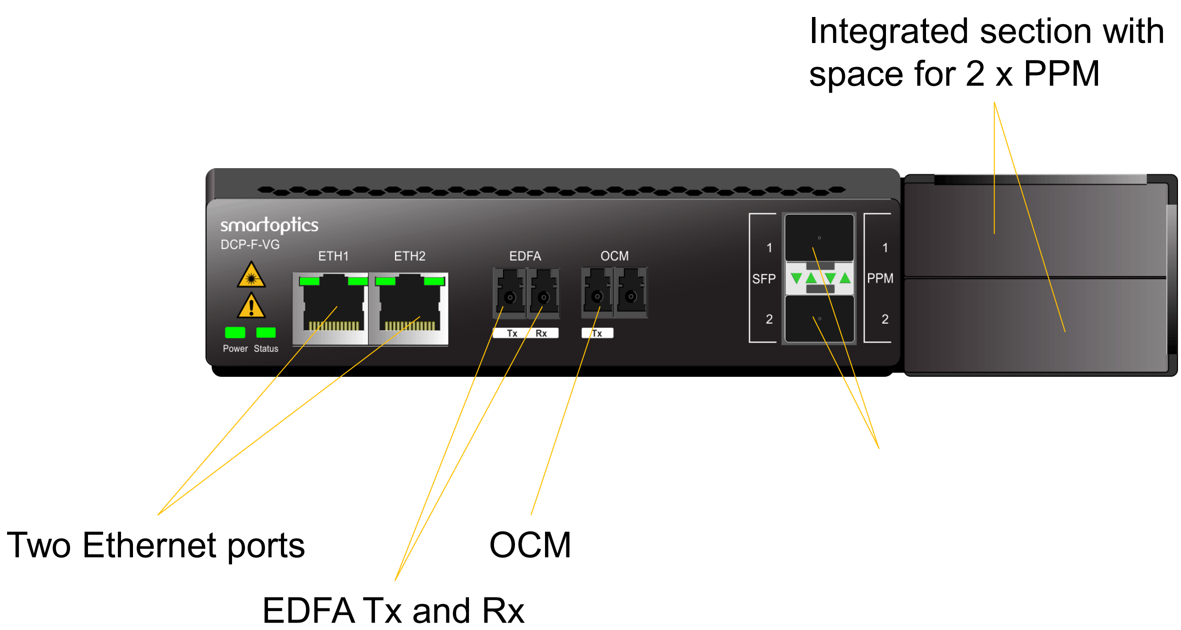


Figure 23. *DCP-F-VG Front connections*

4.5 DCP-F-RA12

The DCP-F-RA12 is a dedicated Raman amplifier with an optical monitor port and with room for two Passive Plug-in Modules (PPM).

Figure 24. *DCP-F-RA12*

4.5.1 DCP-F-RA12 front connections

The DCP-F-RA12 is an active unit that provides optical amplification for DWDM signals. The unit can give up to 12 dB gain on standard G.652 fiber.

The DCP-F-RA12 has the following front connections. The line Rx port uses E2000 connector because the optical power levels are quite high. There is also an OTDR port where it is possible to connect OTDR signals with wavelengths in the range 1600-1670nm.

A small part of the light is tapped (1%, 20 dB) exits at the monitor port Mon TX.

In the SFP ports transceivers with transmission speeds up to 1 Gbit/s are supported as well as variable optical attenuators (VOA-SFP:s) and optical time domain reflectometers (OTDRs).

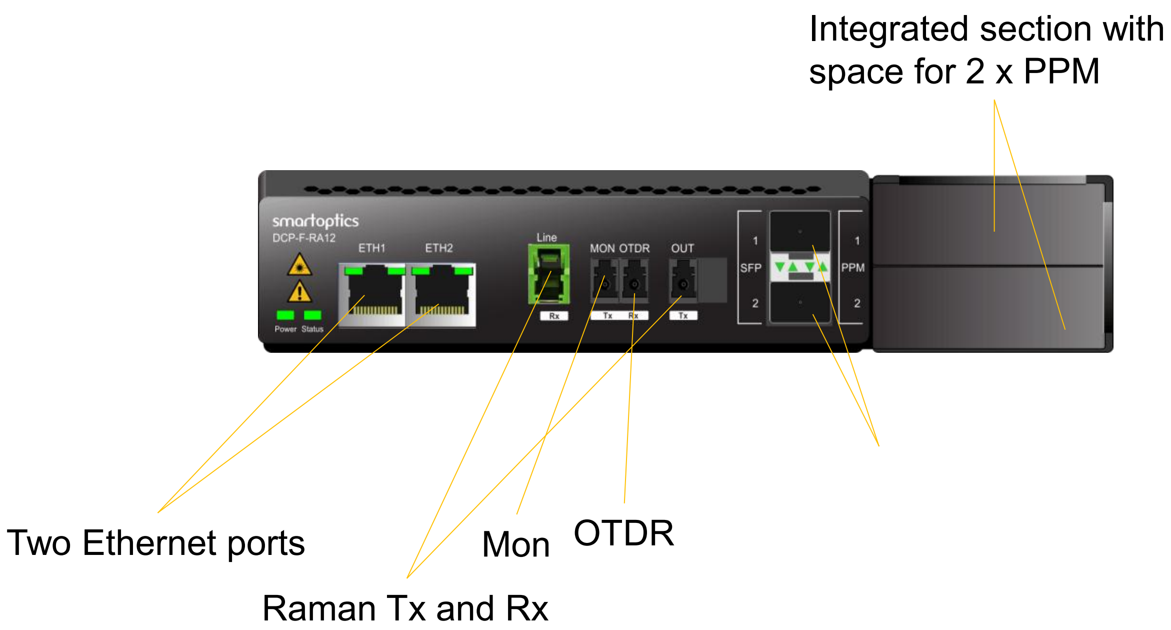


Figure 25. *DCP-F-RA12 Front connections*

4.6 PPM Modules

DCP-F has two internal expansion slots or Passive Plug-in Modules (PPM). The Passive Plug-in Modules (PPM) extends the functionality even further and can be used for optional dispersion compensation, OADM for Optical Surveillance Channel (OSC), or as passive splitters.

There are five PPM versions available:

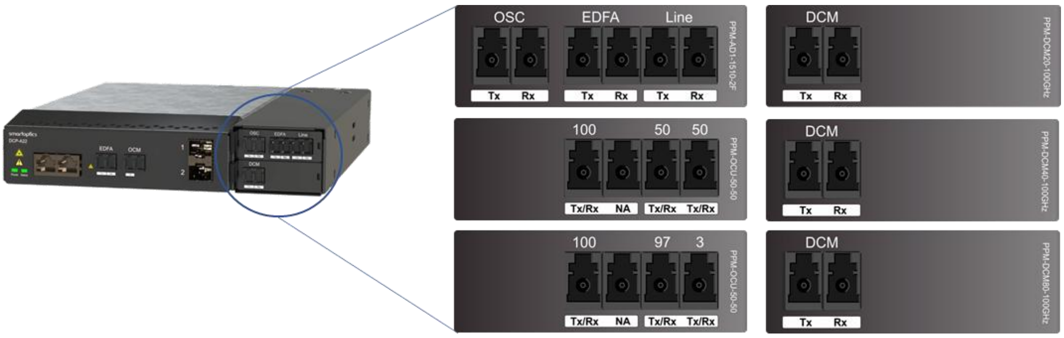


Figure 26. *PPM Modules*

4.6.1 PPM-AD1-1510-2F

The PPM-AD1-1510-2F is an OSC Add/drop filter that is intended to enable insertion of an OSC channel between the optical amplifiers (EDFA) and the line fiber. The Add/drop filter operates at CWDM channel 1511nm.

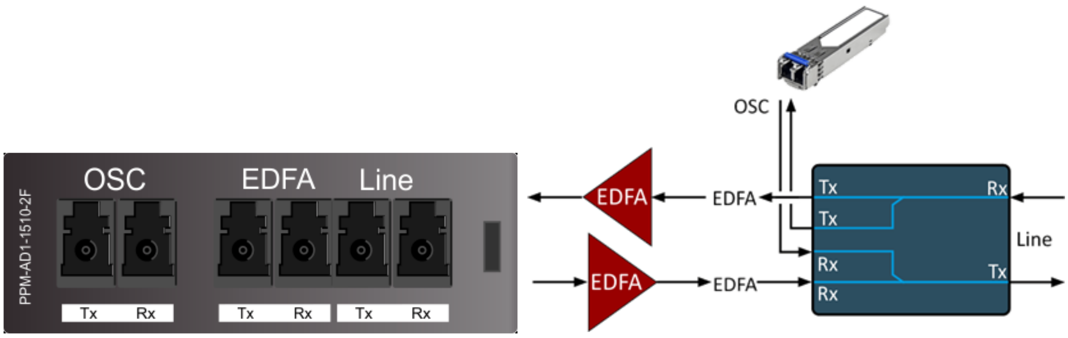


Figure 27. *PPM-AD1-1510-2F*

4.6.2 PPM-AD1-1625-2F

The PPM-AD1-1625-2F is an OSC Add/drop filter that is intended to enable insertion of an OSC channel between the optical amplifiers (EDFA) and the line fiber. The Add/drop filter operates at CWDM channel 1625nm.

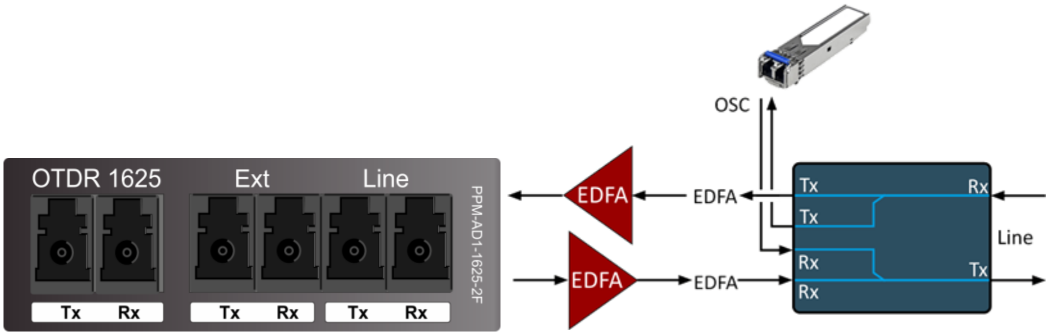


Figure 28. *PPM-AD1-1625-2F*

4.6.3 PPM-DCM10-100GHz

The PPM-DCM10-100GHz modules contain a channelized Fiber Bragg Grating (FBG) dispersion compensating component that provides the opposite dispersion of a 10km SM-fiber length.

Figure 29. *PPM-DCM10-100GHz*

4.6.4 PPM-DCM20-100GHz

The PPM-DCM20-100GHz modules contain a channelized Fiber Bragg Grating (FBG) dispersion compensating component that provides the opposite dispersion of a 20km SM-fiber length.

Figure 30. *PPM-DCM20-100GHz*

4.6.5 PPM-DCM40-100GHz

The PPM-DCM40-100GHz modules contain a channelized Fiber Bragg Grating (FBG) dispersion compensating component that provides the opposite dispersion of a 40km SM-fiber length.

Figure 31. *PPM-DCM40-100GHz*

4.6.6 PPM-DCM80-100GHz

The PPM-DCM80-100GHz modules contain a channelized Fiber Bragg Grating (FBG) dispersion compensating component that provides the opposite dispersion of a 80km SM-fiber length.

Figure 32. *PPM-DCM80-100GHz*

4.6.7 PPM-OCU-50-50

The PPM-OCU-50-50 module is a C-band optical coupler where the signal is split or combined with the ratio 50% - 50%. The 50/50-coupler is required for a 2-degree ROADM setup.

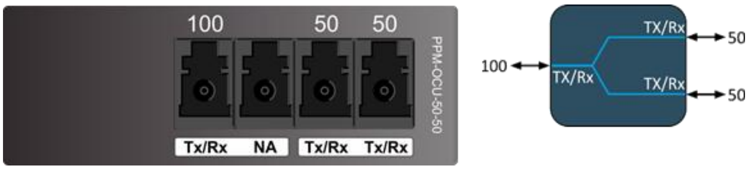


Figure 33. *PPM-OCU-50-50*

4.6.8 PPM-OCU-97-3

The PPM-OCU-97-3 module is a C-band optical coupler where the signal is split or combined with the ratio 97% - 3%. The 97/3-coupler is intended for cases where a smaller portion of the optical signal is to be connected to e.g. an Optical Channel Monitoring (OCM) function

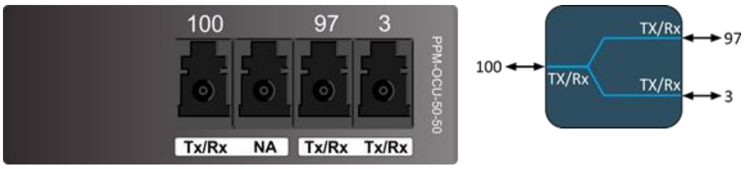


Figure 34. *PPM-OCU-97-3*

4.6.9 PPM-DUMMY

The PPM-DUMMY is a module that contains the same detection electronics as the other PPM modules but lack any optical ports and functionality.

Figure 35. *PPM-DUMMY*

4.7 Visual indicators

The front panels visual indicators are:

4.7.1 Power LED

Power supply status is represented by the Power LED.

Function	Indication	Description
Power	Green	Normal operation.
Power	Off	Power is not connected to the DCP-F unit

4.7.2 Status LED

The status LED is initiated as green and then turns red during start-up. After start-up, the status LED represents the current system status.

Function	Indication	Description
Status LEDs	Green	No active alarm
Status LEDs	Red	Any active alarm of severity Critical or Major

4.7.3 DCP-F-A22 LEDs

The DCP-F-A22 has the following transmission related LEDs and behaviour:

Function	Indication	Description
EDFA Tx	Green	The EDFA port is currently transmitting light.
EDFA Tx	Off	The EDFA port is currently not transmitting any light.
EDFA Rx	Green	The EDFA port is currently receiving light
EDFA Rx	Off	The EDFA port is not receiving any light.
OCM Tx	Green	The port is currently transmitting light.
OCM Tx	Off	The port is not transmitting light.

4.7.4 DCP-F-R22 LEDs

The DCP-F-R22 has the following transmission related LEDs and behaviour:

Function	Indication	Description
EDFA Tx	Green	The EDFA port is currently transmitting light.
EDFA Tx	Off	The EDFA port is currently not transmitting any light.
EDFA Rx	Green	The EDFA port is currently receiving light on a channel that is open in the WSS.
EDFA Rx	Off	The EDFA port is not receiving light on a channel that is open in the WSS.
Express Rx	Green	The Express port is currently receiving light on a channel that is open in the WSS.
Express Rx	Off	The Express port is not receiving light on a channel that is open in the WSS.
OCM Rx	Green	The port is currently receiving light.
OCM Rx	Off	The port is not receiving light.

4.7.5 DCP-F-DE22 LEDs

The DCP-F-DE22 has the following transmission related LEDs and behaviour:

Function	Indication	Description

EDFA Tx	Green	The EDFA port is currently transmitting light.
EDFA Tx	Off	The EDFA port is currently not transmitting any light.
EDFA Rx	Green	The EDFA port is currently receiving light on a channel that is open in the WB.
EDFA Rx	Off	The EDFA port is not receiving light on a channel that is open in the WB.
EQ Rx	Green	The EQ port is currently receiving light on a channel that is open in the WB.
EQ Rx	Off	The EQ port is not receiving light on a channel that is open in the WB.
EQ Tx	Green	The EQ port is currently transmitting light on a channel that is open in the WB.
EQ Tx	Off	The EQ port is not transmitting light on a channel that is open in the WB.
OCM Rx	Green	The port is currently receiving light.
OCM Rx	Off	The port is not receiving light.

4.7.6 DCP-F-VG LEDs

The DCP-F-A22 has the following transmission related LEDs and behaviour:

Function	**Indication**	**Description**
EDFA Tx	Green	The EDFA port is currently transmitting light.
EDFA Tx	Off	The EDFA port is currently not transmitting any light.
EDFA Rx	Green	The EDFA port is currently receiving light
EDFA Rx	Off	The EDFA port is not receiving any light.
OCM Tx	Green	The port is currently transmitting light.
OCM Tx	Off	The port is not transmitting light.

4.7.7 DCP-F-RA12 LEDs

The DCP-F-RA12 has the following transmission related LEDs and behaviour:

Function	Indication	Description
Out Tx	Green	The EDFA port is currently transmitting light.
Out Tx	Off	The EDFA port is currently not transmitting any light.
Line Rx	Green	The EDFA port is currently receiving light
Line Rx	Off	The EDFA port is not receiving any light.

4.8 Optical Gain

The most basic property of an EDFA amplifier is its operating gain, which is the amount by which the input optical signal is amplified. The gain is measured in dB and is settable for the DCP-F family. A gain of 10 dB means the input optical signal is amplified by a factor of 10, while a gain of 30 dB means the input optical signal is amplified by a factor of 1000.

The amplifiers are designed to be flat at a certain gain value, If the gain is changed from this optimum value the gain curve will tilt and different WDM channels will have different gain and in a chain of amplifiers this will lead to a large mismatch between channels at the end of the link.

The operational gain of the EDFA amplifier should be calculated to ensure proper network performance as a gain set higher than the optimum flat gain will be tilted to the right i.e. shorter wavelengths will be amplified more than longer wavelengths and a gain set to a lower value will give the opposite result.

Great care should be taken to avoid saturation of the amplifiers, and a basic rule is that the amplifiers gains should be equal or lower than the losses through the previous link.

4.8.1 Parameters used to configure the EDFA interface

Parameter	Description	Format/Values
Interface	The interface name	If-c/s/edfa1
description	The logical name given to the interface for identification purposes.	Free text
Monitor Port Offset	Power offset that is added to the optical channel powers measured by the OCM	dB
AdminStatus	The administrative status of the EDFA interface.	**up**: Specifies if the EDFA interface is enabled **down**: Specifies if the EDFA interface is disabled
Status [Rx/Tx]	The operational status of the EDFA optical interfaces.	**up**: Normal operation **down**: Alarm is detected or its configured adminstatus is down
Optical Rx power	The current measured receive power of the EDFA.	dBm
Optical Tx power	The current measured optical transmit power of the EDFA.	dBm
Set Gain	Specifies the required constant gain.	20 to 28 dB for DCP-F-A22 15 to 30 dB for DCP-F-VG
Actual Gain	The current measured gain of the EDFA.	dB
LOS alarm	A setting to override the fixed LOS Alarm Threshold of -32 dBm.	**enable**: Normal operation **disable**: Loss of Signal alarm is not reported for power levels below -32 dBm.

4.9 Variable optical attenuator, VOA

Besides gain, an amplifier is also characterized by the range of supported input and output optical power levels. To ensure proper network performance a Variable Optical Attenuator (VOA) can be used to attenuate and balance the optical line signals. The DCP-F allows VOA-SFP´s to be installed into the DCP-F SFP ports. Upon electrical power loss the VOA is set to max attenuation, i.e. “dark mode” and during normal operation the attenuation can be set between 0 to 20dB.

VOAs can be used both in SFP port 1 and 2 on the DCP-F units.

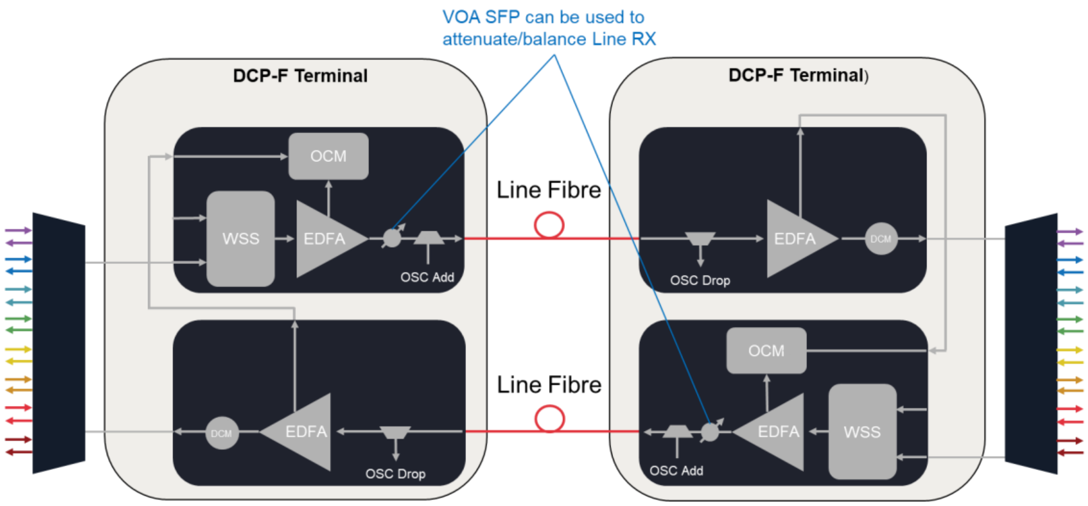
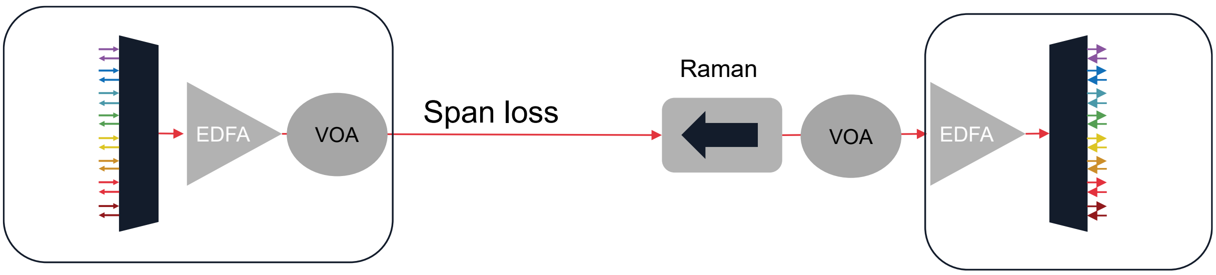


Figure 36. *Variable Optical Attenuator*

In optical transmission there is a phenomenon, non-linear effects, that can reduce the quality of transmission. High power levels into the fiber leads to more non-linear effects. It is therefore important that the VOA is placed at the booster transmit as shown in the picture above. Reducing power levels before going into the fiber is vital when minimizing non-linear effects in the fiber. If the VOA is placed on the receive side, high optical power is sent into the fiber and the attenuation is made after this effect has already occurred.

4.9.1 VOA settings after Raman unit

In some cases, the total Raman gain and pre-amplifier gain is higher than needed. Then it is required to use a VOA between the Raman unit and the pre-amplifier.



The settings for the VOA must be done manually and will depend on the components between the booster and pre-amplifier.

The pre-amplifier gain for a link with DCP-R and Raman can be calculated with the formula:
G_preamp_dB = span_loss_dB + 2x OSC_filter_loss_dB + Line_VOA_dB – Raman_gain_dB + Raman_VOA_dB

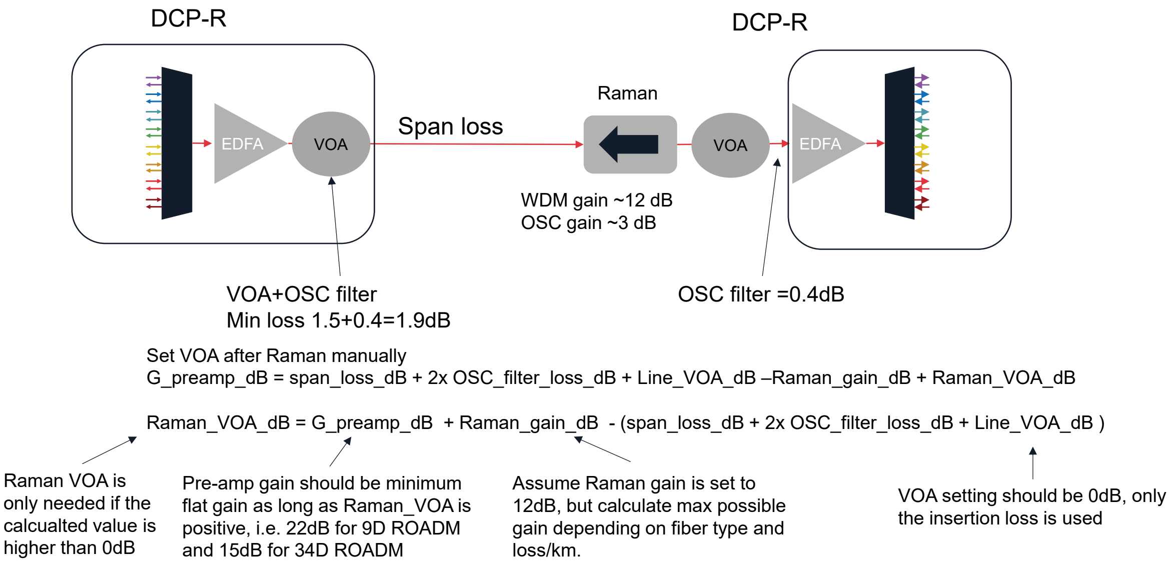
Here the Raman VOA value is calculated with the formula:
Raman_VOA_dB = G_preamp_dB + Raman_gain_dB - (span_loss_dB + 2x OSC_filter_loss_dB + Line_VOA_dB)

Raman VOA is only needed if the calculated value (Raman_VOA_dB) is higher than 0dB.

Pre-amp gain (G_preamp_dB) should be minimum flat gain as long as Raman_VOA is positive, i.e. 22dB for 9D ROADM and 15dB for 34D ROADM.

Assume Raman gain (Raman_gain_dB) is set to 12dB, but calculate max possible gain depending on fiber type and loss/km.

The parameter Line_VOA_dB includes both the line VOA setting and the insertion loss of the line VOA. Normally, the line VOA setting should be 0dB. Then only the insertion loss is used.



For DCP-F cases it might be necessary to adjust the formula since line VOA and OSC filters are optional.

CLI commands for setting and reading Raman gain and VOA attenuation.

4.10 OSC

The OSC enables turning up of the optical layer without any service wavelengths and once a connection is established between the sites a communication channel is created and actual distance is measured as well as optical span loss. For actual distance the values are only measurable (and updated) upon OSC initialization with the far-end, new updated values occur only after fiber reconnect or cold restart.

Note that OSC transceivers can only be used in SFP port 2 on the DCP-F units.

4.10.1 show osclinkview

This command presents the operational and optical status of the link/optical line between the sites. The displayed parameters contain information from the OSC only. A more detailed output is available using the command 'show osclinkview detail'.

```
admin@dcpf-189>show osclinkview
  Local system                                  Fiber           Remote system
  ===========================================  ===============  ===========================================
                                        Power  Loss             Power
  Hostname  Interface    Status  Alarm  [dBm]  [dB]  Direction  [dBm]  Interface     Hostname
  --------  -----------  ------  -----  -----  ----  ---------  -----  ------------  ---------------------
  dcpf-189  if-1/1/2-tx  up      ok       3.7  11.8    >>>>>     -8.1  if-1/line-rx  DCP-M40-PAM4-ER---180
  dcpf-189  if-1/1/2-rx  up      ok     -16.8  11.1    <<<<<     -5.7  if-1/line-tx  DCP-M40-PAM4-ER---180
  dcpf-189  if-1/2/2-tx  up      ok       3.3  10.3    >>>>>     -7.0  if-1/line-rx  DCP-M40-PAM4-ER---181
  dcpf-189  if-1/2/2-rx  up      ok     -21.1   0.2    <<<<<    -20.9  if-1/line-tx  DCP-M40-PAM4-ER---181

admin@dcpf-189>
```

This command shows the status of the link, the optical power levels at Tx and Rx for both local and remote sites, the link loss and alarm status.

Column definitions:

- Local System: This section presents the parameters for the local system.

- Hostname: Name of the local system.
- Interface: Identifying Line Tx or Rx port.
- Status: Identifies the status of the Tx and Rx port. Status level can be up, down or idle. Idle is present if the channel has never been activated.
- Alarm: Identifies the alarm status of the port/interface.
- Power: Optical OSC power present at the line interface.

- Fiber: This section presents the parameters of the fiber between the systems.

- Loss: Calculated fiber loss between the systems.
- Direction: Illustrating the direction of light travelling in the fiber.

- Remote System: This section presents the parameters for the remote system and uses the same definitions as the local system.

4.10.1.1 show osclinkview detail

```
admin@dcpf-189>show osclinkview detail
  Local system                                 Fiber                                                 Remote system
  ===========================================  ====================================================  ==========================================
                                        Power  Loss  Attenuation  Length  Disp.                      Power
  Hostname  Interface    Status  Alarm  [dBm]  [dB]  [dB/km]      [km]    [ps/nm]  Fiber  Direction  [dBm]  Interface     Hostname
  --------  -----------  ------  -----  -----  ----  -----------  ------  -------  -----  ---------  -----  ------------  ---------------------
  dcpf-189  if-1/1/2-tx  up      ok       3.7  11.8         0.29    40.3      673  G.652    >>>>>     -8.1  if-1/line-rx  DCP-M40-PAM4-ER---180
  dcpf-189  if-1/1/2-rx  up      ok     -16.8  11.1         0.27    40.3      673  G.652    <<<<<     -5.7  if-1/line-tx  DCP-M40-PAM4-ER---180
  dcpf-189  if-1/2/2-tx  up      ok       3.3  10.3            -     0.0        -  G.652    >>>>>     -7.0  if-1/line-rx  DCP-M40-PAM4-ER---181
  dcpf-189  if-1/2/2-rx  up      ok     -21.1   0.2            -     0.0        -  G.652    <<<<<    -20.9  if-1/line-tx  DCP-M40-PAM4-ER---181

admin@dcpf-189>
```

The detail command gives access to additional fiber link parameters.

Additional column definitions:

- Length: Measured fiber length by the local system.
- Disp: Displays the calculated dispersion based on the measured fiber length.
- Fiber: Displays the fiber type configured, currently only G.652 is supported.
- Direction: Illustrating the direction of light travelling in the fiber.

4.11 Optical Channel 'OCh'

The term optical channel 'OCh' is used in the DCP-F family of products. The OCh is a term to individualize channels that do not have a dedicated physical port. An OCh in DCP-F terms is a channel that is part of a control loop. In a control loop the power level of a channel is regulated towards a target value. The number of OCh:s present on an EDFA, Express or EQ port is hardware supported from 1-96. In R7.0.1 software 48 channels are supported.

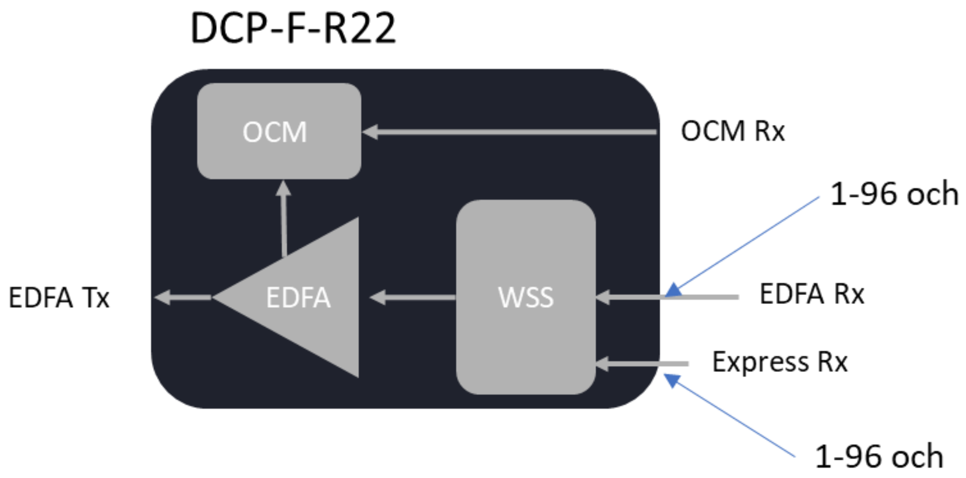


Figure 37. *Och in a DCP-F-R22*

In DCP-F-R22 the same channel cannot be configured on EDFA and Express port at the same time. In DCP-F-DE22 the same channel can be configured on EDFA and EQ port, since this unit contains individual wavelength blockers and not a WSS.

4.12 Optical Channel Monitor, OCM

In the DCP-F family the OCM, WSS and WB are all flexgrid components which means that all channel configurations can be changed dynamically. The HW supports that both the width and central frequency can be altered by configuration. Currently in R7.0.1 the width is fixed to 100GHz and central frequencies are fixed to the ITU-T 100 GHz channel plan. Future releases will contain other channel spacing settings. The optical channel monitor will monitor the channel powers individually according to the set channel plan. This channel information is then used both for presentation and power regulation.

4.13 Wavelength blocker

The wavelength blocker is a component with one input and one output. The component can attenuate individual channels and also block channels completely.

4.14 Wavelength selective switch

A wavelength selective switch, WSS, is a component with at least 2 inputs and one output. For each channel it is possible to choose which port it should pass and from which it should be blocked. In the DCP-F-R22 when adding a channel on one port it is automatically blocked on the other. The WSS can also attenuate individual channels.

4.15 Optical Time Domain Reflectometer, OTDR

An Optical Time Domain Reflectometer, OTDR, is a unit that will send out short optical pulses into a fiber and measure the time for reflections to return. The measured time is then recalculated into distance. Then the OTDR will provide a table with distances to reflection points, e.g. ODFs, bad splices, fiber cuts etc.

Event ID	Distance (m)
1	xx
2	yy
3	zz

Figure 38. *Example of a table with reflection points for an OTDR measurement*

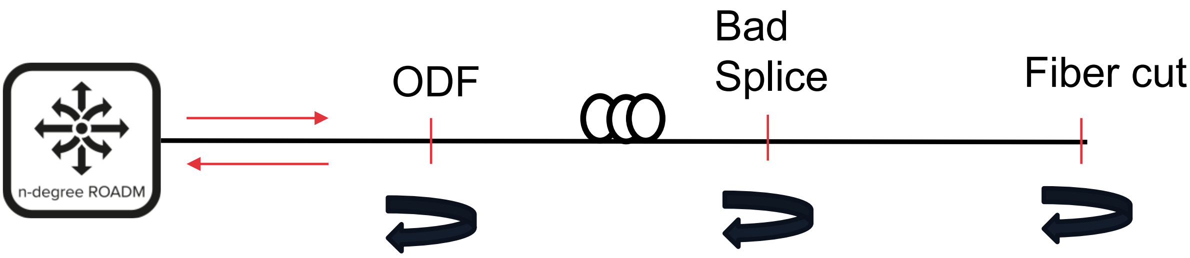


Figure 39. *Example of reflection points in OTDR measurements*

The DCP-F units support OTDR-SFPs to be installed in SFP port 2 only. The OTDR-SFPs can be used for both OSC and OTDR functionality. Two different CWDM wavelengths are supported in this release; 1491, 1511nm. Two different bit rates are available, 155Mb/s and 1Gb/s, but only 155Mb/s version is supported in this release.

Note that the OSC traffic gets traffic interruption during the OTDR measurement. This is around 2s.

4.16 Management Architecture

Smartoptics Embedded software is Linux-based and uses Yocto as an open-source collaboration framework. The below figure shows the principal architecture of the system management. The currently implemented APIs are CLI and SNMP.

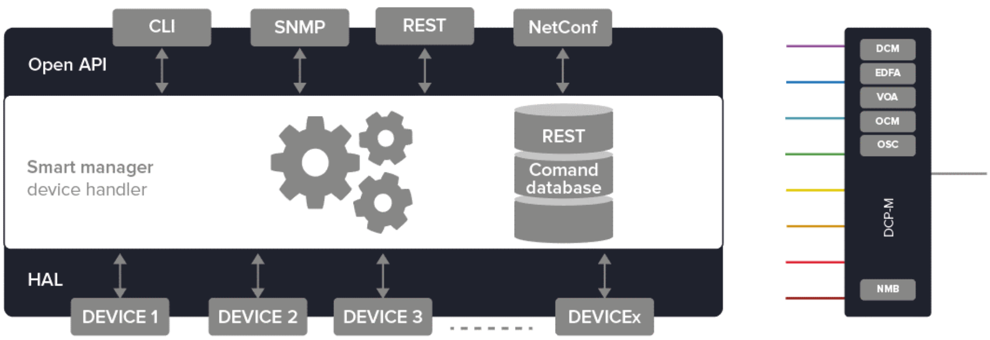


Figure 40. *Management architecture*

The devices (device 1…x) can be optical modules but can also be groups of optical components that performs a task together. The hardware abstraction layer (HAL) groups the devices to have a generic coding syntax that is not related to specific suppliers syntax.

4.17 Monitor ports

The power levels provide a measurement of optical power in dBm to one decimal place accuracy. The system determines a total loss of power, when the measured power is below the threshold used to signify a total loss of optical power, the value returned for this case is -99.0 dBm or -60.0 dBm. If a monitor point reports any of these values means that there is no light at this point.

There are two types of monitors, aggregate monitors and channel monitors. The difference between them is that the aggregate monitors report the sum of all optical power whereas the channel monitors report each channel individually. For the DCP-F family the different monitor points and their position can be viewed below. The blue marker represents an aggregate monitor, i.e. a pin diode, and the green marker represents a channel monitor point.

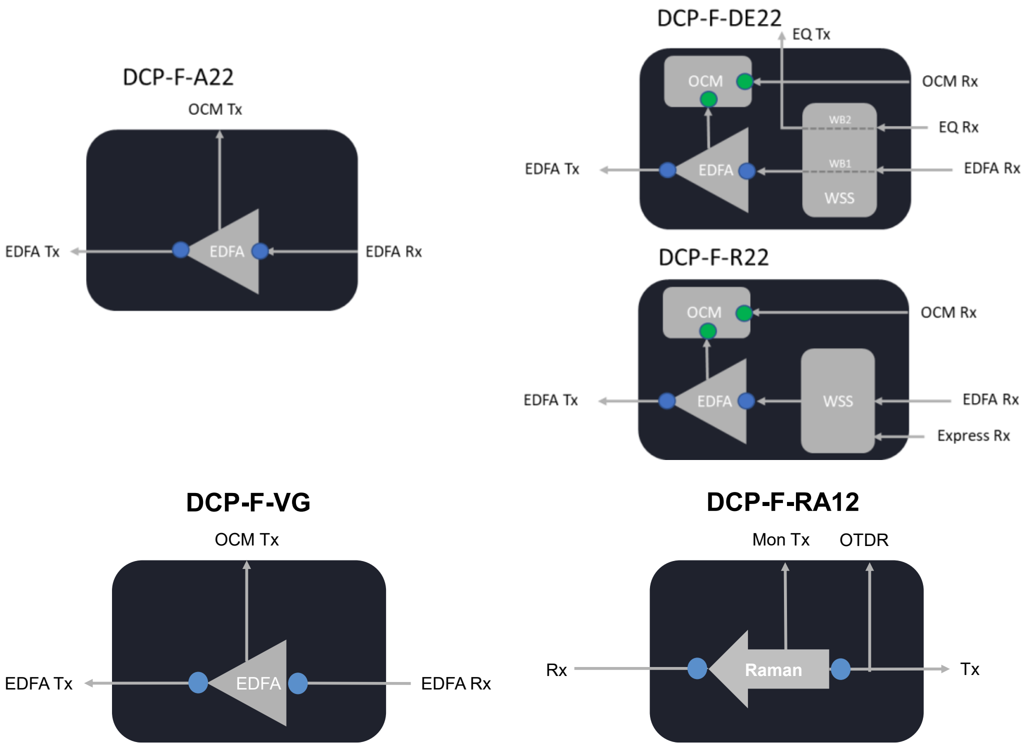


Figure 41. *Power monitor points in the DCP-F family*

4.18 Alarms

The system keeps a list of the alarms currently detected in the system. When an alarm is detected, it is added to the active alarm list. When the alarm is cleared the alarm is removed from the active alarm list. Previous cleared alarms can be found in the alarm log that contains both active and cleared alarms.

The following information is stored for each alarm:

Start time: The date and time when the alarm was detected.

End time: The date and time when the alarm was cleared

Location: The entity that caused the alarm.

Severity: The severity of the alarm.

All possible alarms can be listed with the command:
show alarm list

ALARM MESSAGE	LOCATION	SEVERITY	INTERPRETATION
Loss of optical input power	if-<chassi>/<slot>/<Interface>	Critical	The optical power of the interface has gone below the minimum power level. Check the fiber connection and/or clean the fiber connector.
Loss of optical output power	if-<chassi>/<slot>/<Interface>	Critical	This alarm will be triggered if the amplifier has adminStatus up and there is no optical power on the amplifier Tx port or if the amplifier is saturated. Saturated means that the maximum output power limit has been reached while output power is lower than input power + gain.
Loss of optical input power(OSC)	if-<chassi>/<slot>/<Interface>	Major	The OSC optical power has gone below the minimum power level. It could be because the remote ends OSC is administratively disabled or that the dark fiber has been cut or disconnected.
Loss of OSC link	if-<chassi>/<slot>/<Interface>	Major	Loss of OSC link indicates there is no communication to the remote hosts OSC channel.
Combine mode unexpected module type	if-<chassi>/<slot>	Minor	When combined mode is used it is expected that it should be a DCP-F-A22 in one slot and a DCP-F-DE22 in the other slot. This alarm will be raised if another combination is used at same time as the combined mode is active. This alarm only exists on DCP-F-DE22.
Transceiver missing	if-<chassi>/<slot>/<Interface>	Critical	The Transceiver has been removed. Insert an Transceiver or disable the alarm with “clear interface <interface_id>/all portreset”

eMMC failure	if-<chassis>/<slot>	Minor	The memory is not formatted. Contact support.

4.19 CLI interface

After a successful login, some system information is displayed on the screen.

Then press the ***tab*** key to see an overview of the available queries. You can also type "***?***" to get more detailed information of available commands and options.

```
bye         - Logout from shell.
clear       - Clear parameter.
config      - Configure system information.
exit        - Logout from shell.
logout      - Logout from shell.
ping        - Send echo messages.
quit        - Logout from shell.
reboot      - Reboot of the system.
show        - Show system information.
swupgrade   - Software image management.
techlog     - upload log for technicians.
traceroute  - Trace route to destination.
```

It is always possible to use "***tab***" in order to display more information on any query, as for the example which arguments, if any, are required to complete a query.

It is also recommended to start, type the first letters of a query and then use the Tab key to complete the query. This avoids mistakes in typing manually.

4.20 Backup and restore

The backup and restore functionality can be used to create complete backups of all configurations for chassis and slot modules and then restore exactly same configuration. Only one backup file is allowed. The backup file will be removed at reboot.

A backup is only possible if software version is same on chassis and slot modules.

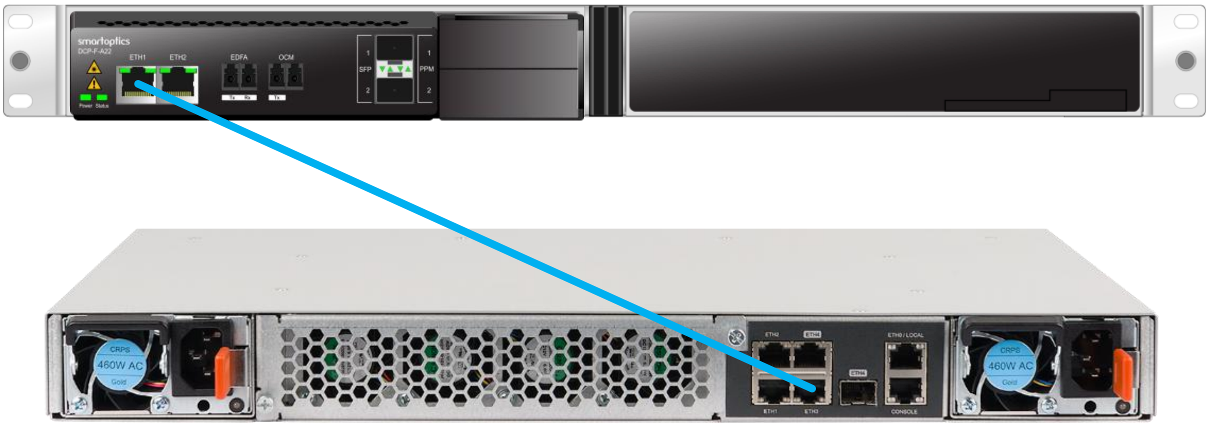
Restore is only possible if product and hardware revision is same. For HW revision the last character is allowed to be different. For SW the revision must be the same on all characters.
HW example: backup from a R1A can be restored on a R1C but not on a R2A.
SW example: backup from a R7.0.1 can be restored on a R7.0.1 but not on a R7.0.2.

4.21 Management Communication

There are two ways to achieve management communication between two DCP-F nodes, using OSC with management tunnel or the optical Eth4 port.

4.21.1 Management tunnel via OSC

A management tunnel can be created from the OSC to one of the two Eth ports, ETH1-2, on the front of the DCP-F card. The OSC has a bandwidth of 100/1000Mb/s, but a fixed bandwidth of 50Mb/s is allocated for the tunnel. A management tunnel can be used if multiple devices on site should be connected and use the OSC for communication.



In the example below Eth1 on the front of the card has been configured with a management tunnel that goes out over the OSC link. It is also necessary to connect an Ethernet cable from the front of the DCP-F card to the back of the DCP-2 chassis. In the example below the cable goes from the Eth1 port on the DCP-F card to the Eth3 port in the DCP-2.

In order to also talk to the local node it is necessary to connect locally to another Eth port as well. In this example Eth1 is used for the local connection.

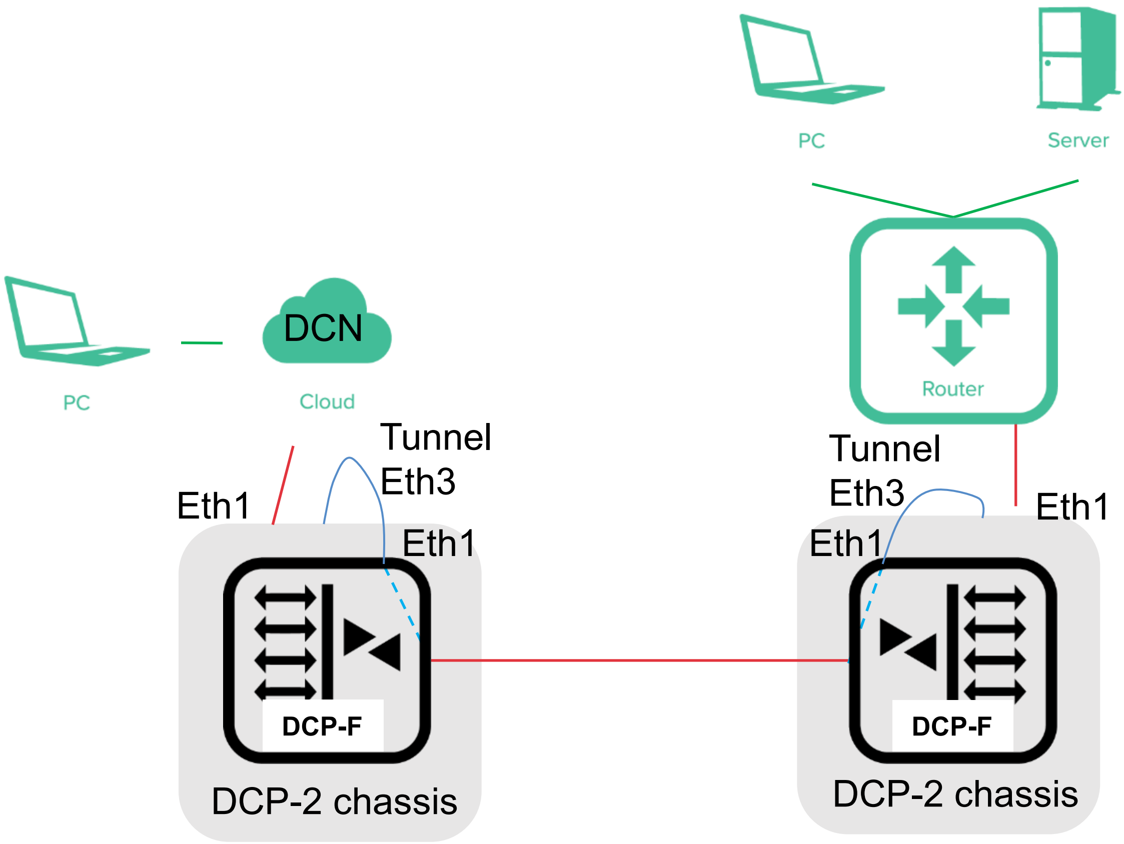
NOTE - It is mandatory to create the management tunnel before connecting the second Ethernet cable for the tunnel. In this example, Eth3.

NOTE - It is required to use a router instead of a switch when you connect multiple devices. Otherwise there is a risk for loops.

The DCP-2 nodes can be in different subnets.

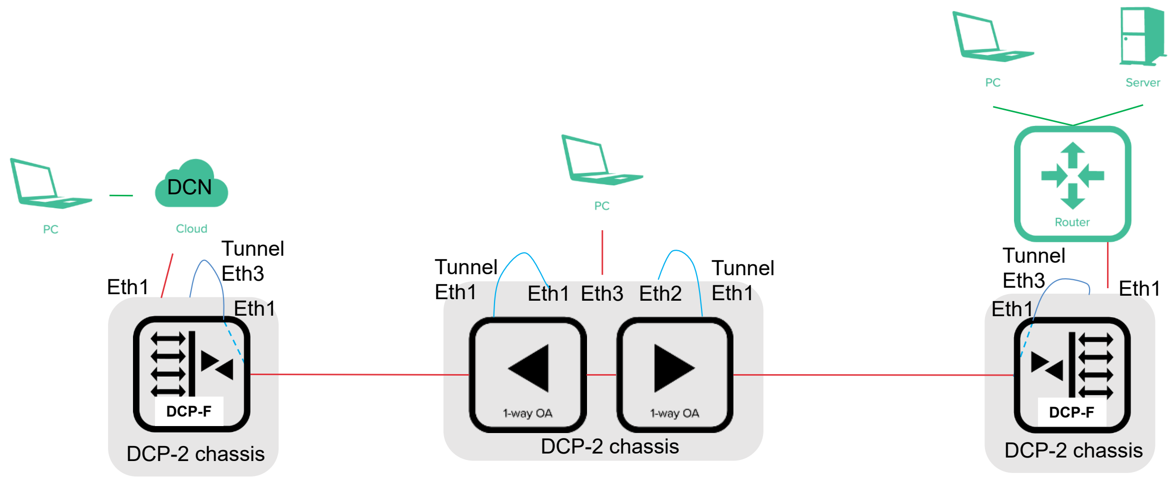
Do following steps:

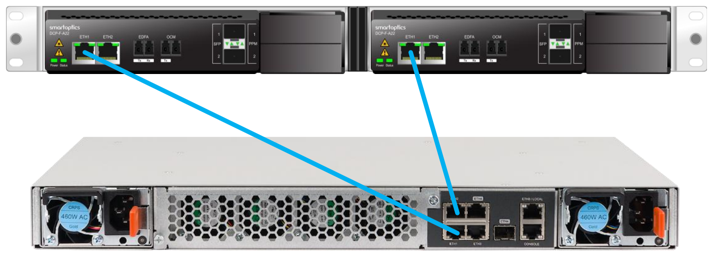
1. Connect the local Ethernet cable, example Eth1 on DCP-2 chassis.
2. Configure the management tunnel to Eth1 on the DCP-F card.
3. Connect the Ethernet cable for the tunnel, example Eth1 on DCP-F card to Eth3 on DCP-2 chassis.

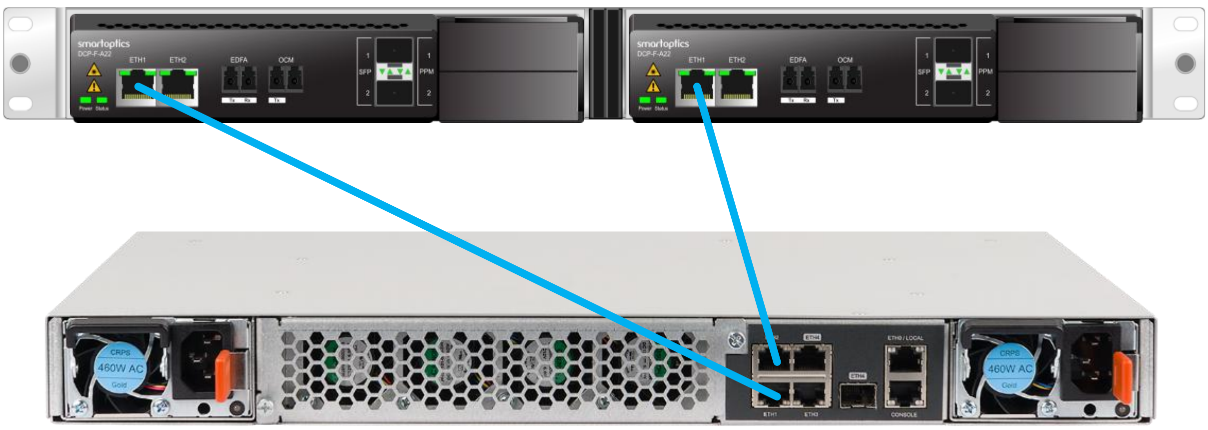


For management to a DCP-F inline amplifier site it is possible to use management tunnels. In this case a management tunnel should be created both on the terminal site and the inline amplifier site. On the DCP-F the tunnel will go from the OSC to one of the Eth ports on the front of the DCP-F card. The Eth port on the front will then be connected to one of the Eth ports in the back of the DCP-2 chassis.

For a line amplifier with two directions it is required to create on tunnel for each direction. It is recommended to have all nodes in the same subnet. Otherwise, it is necessary to configure a router to handle different IP domains. It is also necessary to use a router in the ILA site if redundant management communication is needed.





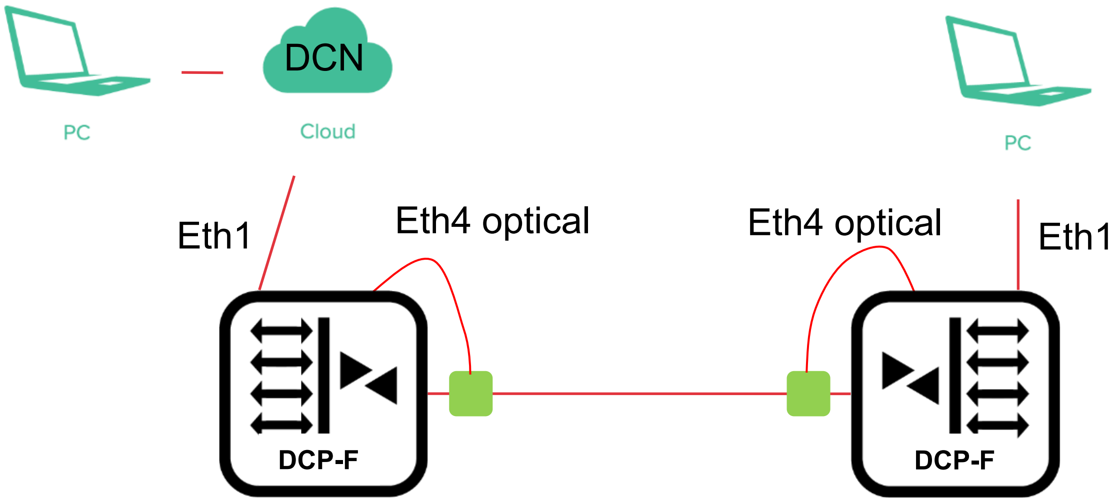


4.21.2 Remote management via Eth4 optical

The Eth4 port on the back of DCP-2 can use optical SFPs for 1Gb/s. This can be used to create a management connection to the remote site without going via OSC.

In this solution the Eth4 port will use a xWDM SFP and an xWDM filter. The connection will then terminate on the Eth4 port on the remote DCP-2 chassis. This will allow the two DCP-2 to be in same switch domain. It is required to have the two DCP-2s in the same subnet.

In the example below Eth4 is used to create an optical connection to the remote chassis. The DCP-2 chassis can be accessed locally on another Eth port, e.g. Eth1.


DCN
PC
Cloud
PC
Eth1
Eth4 optical
Eth4 optical
Eth1
DCP-F
DCP-F

5 Waste management

The HW should be treated as electronic waste when it is decommissioned and taken out of service.

6 Technical Specifications

6.1 DCP-F-A22

ENVIRONMENT	
OPERATING TEMPERATURE	0° C to 45° C
COOLING	Front-to-Back
HUMIDITY	5% to 85% RHI
ALTITUDE	3000 m (10.000 ft.)
POWER CONSUMPTION	
POWER CONSUMPTION	Max during powerup: 45W Normal operation: 40W
AMPLIFIER OPTICAL SPECIFICATION	
EDFA MAXIMUM TOTAL OUTPUT POWER	20 dBm
EDFA GAIN FLATTENED OPTIMIZED GAIN	22 dB
EDFA SETTABLE GAIN	22-28 dB
EDFA INPUT POWER RANGE	-2 to -30 dBm
EDFA NOISE FIGURE	5,5 dB
MONITOR PORT RATIO	1% (20 dB)

6.2 DCP-F-R22

ENVIRONMENT	
OPERATING TEMPERATURE	0° C to 45° C
COOLING	Front-to-Back
HUMIDITY	5% to 85% RHI
ALTITUDE	3000 m (10.000 ft.)
POWER CONSUMPTION	
POWER CONSUMPTION	Max during powerup: 45W Normal operation: 40W
AMPLIFIER OPTICAL SPECIFICATION	
EDFA MAXIMUM TOTAL OUTPUT POWER	20 dBm
EDFA GAIN FLATTENED OPTIMIZED GAIN	22 dB
EDFA SETTABLE GAIN	22-28 dB
EDFA INPUT POWER RANGE	-2 to -30 dBm
EDFA NOISE FIGURE	5,5 dB
WSS OPTICAL SPECIFICATION	
WSS RESOLUTION	6,25 GHz (Flexgrid)
WSS MIN CHANNEL WIDTH	37,5 GHz
WSS MIN CENTER FREQ	191,25 THz
WSS MAX CENTER FREQ:	196,125 THz
WSS NO CHANNELS (50 GHZ)	96 (191,35 –196,10 THz)
WSS NO CHANNELS (100 GHZ)	48 (191,3 –196,1 THz)
WSS TYPICAL IL EDFA PORT	5 dB
WSS TYPICAL IL EXPRESS PORT	11 dB
OCM OPTICAL SPECIFICATION	
OCM RESOLUTION	3,125 GHz (Flexgrid)
POWER RESOLUTION	0,1 dB
MIN DETECTION LEVEL (50 GHZ)	-40 dBm
ACCURACY	+/-0,7 dB

6.3 DCP-F-DE22

ENVIRONMENT	
OPERATING TEMPERATURE	0° C to 45° C
COOLING	Front-to-Back
HUMIDITY	5% to 85% RHI
ALTITUDE	3000 m (10.000 ft.)
POWER CONSUMPTION	
POWER CONSUMPTION	Max during powerup: 45W Normal operation: 40W
AMPLIFIER OPTICAL SPECIFICATION	
EDFA MAXIMUM TOTAL OUTPUT POWER	20 dBm
EDFA GAIN FLATTENED OPTIMIZED GAIN	22 dB
EDFA SETTABLE GAIN	22-28 dB
EDFA INPUT POWER RANGE	-2 to -30 dBm
EDFA NOISE FIGURE	5,5 dB
WB OPTICAL SPECIFICATION	
WB RESOLUTION	6,25 GHz (Flexgrid)
WB MIN CHANNEL WIDTH	37,5 GHz
WB MIN CENTER FREQ	191,25 THz
WB MAX CENTER FREQ:	196,125 THz
WB NO CHANNELS (50 GHZ)	96 (191,35 –196,10 THz)
WB NO CHANNELS (100 GHZ)	48 (191,3 –196,1 THz)
WB TYPICAL IL EDFA PORT	4 dB
WB TYPICAL IL EQ PORT	4 dB
OCM OPTICAL SPECIFICATION	
OCM RESOLUTION	3,125 GHz (Flexgrid)
POWER RESOLUTION	0,1 dB
MIN DETECTION LEVEL (50 GHZ)	-40 dBm
ACCURACY	+/-0,7 dB

REGULATORY COMPLIANCES	
EMC	Title 47 CFR Part 15 Subpart B EN55024/CISPR24: 2011 + A1:2015 EN55032:2015/CISPR32 ETSI EN 300 386 V2.1.1
SAFETY	CB (IEC 60950-1:2005+A1+A2, IEC 62368-1:2014) ETL (CSA C22.2#62368-1:2014 Ed.2, UL 62368-1:2014 Ed.2)
NEBS	Level 3
LASER SAFETY	IEC 60825-1 : 2007 (2nd Edition) IEC 60825-1:2014 (Third Edition)

6.1 DCP-F-VG

ENVIRONMENT	
OPERATING TEMPERATURE	0° C to 45° C
COOLING	Front-to-Back
HUMIDITY	5% to 85% RHI
ALTITUDE	3000 m (10.000 ft.)
POWER CONSUMPTION	
POWER CONSUMPTION	Max during powerup: TBD W Normal operation: TBD W
AMPLIFIER OPTICAL SPECIFICATION	
EDFA MAXIMUM TOTAL OUTPUT POWER	20 dBm
EDFA GAIN FLATTENED OPTIMIZED GAIN	15-25 dB
EDFA SETTABLE GAIN	15-30 dB
EDFA INPUT POWER RANGE	+5 to -40 dBm
EDFA NOISE FIGURE	8.1dB @ Gain=15dB 6.3dB @ Gain=20dB 6.0dB @ Gain=25dB
MONITOR PORT RATIO	1% (20 dB)

6.2 DCP-F-RA12

ENVIRONMENT	
OPERATING TEMPERATURE	0° C to 45° C
COOLING	Front-to-Back
HUMIDITY	5% to 85% RHI
ALTITUDE	3000 m (10.000 ft.)
POWER CONSUMPTION	
POWER CONSUMPTION	Max during powerup: TBD W Normal operation: TBD W
AMPLIFIER OPTICAL SPECIFICATION	
RAMAN MAXIMUM TOTAL OUTPUT POWER	27 dBm
RAMAN GAIN	12 dB for G.652 fiber
RAMAN SETTABLE GAIN	7-12 dB
EDFA INPUT POWER RANGE	+5 to -40 dBm
RAMAN NOISE FIGURE	0dB
MONITOR PORT RATIO	1% (20 dB)
OTDR PORT WAVELENGTH RANGE	1600-1670nm

smartoptics

6.3 Supported SFP Transceivers in DCP-F

CERTIFIED TRANSCEIVERS FOR OSC	
PART NUMBER	Description
SO-SFP-155M-L80D-C51	SFP STM1/OC3 FE CWDM 80km 1510nm
SO-SFP-155M-L120D-C51	SFP STM1/OC3 FE CWDM 120km 1510nm
SO-SFP-155M-L200D-C51	SFP STM1/OC3 FE CWDM 200km 1510nm
SO-SFP-155M-O-C51-E	SFP 155M OTDR C51 E-tmp
SO-SFP-1G-O-C51-E	SFP 1G OTDR C51 E-tmp
SO-SFP-155M-O-C49-E	SFP 155M OTDR C49 E-tmp
SO-SFP-1G-O-C49-E	SFP 1G OTDR C49 E-tmp
SO-SFP-VOA-01	SFP VOA 0-20dB, Dark, No PD
SO-SFP-L80D-C51	SFP 1GE FC CWDM 80km 1510nm
SO-SFP-L120D-C51	SFP 1GE FC CWDM 120km 1510nm
SO-SFP-L160DH-C51	SFP 1GE FC CWDM 160km HP 1510nm
SO-SFP-L160D-C51	SFP 1GE FC CWDM 160km 1510nm
SO-SFP-L50D-C51	SFP, 1G Ethernet, 1G FC, CWDM, 50km, 19dB, LC, 1510nm

Note that OSC transceivers can only be used in SFP port 2 on the DCP-F units.
VOAs can be used both in SFP port 1 and 2 on the DCP-F units.