smartoptics

DCP-108

Technical Description

dcp-release-12.0.1

Contents

1   Introduction

This manual provides the technical description for DCP-108. The DCP-108 is a traffic unit with 8 transponder functions on same board. The DCP-108 card belongs to the DCP-series and it can be mounted in DCP-2 chassis.

1.1   General

The DCP-108 consists of eight independent transponders with QSFP28 support on all ports. This card will take one slot in a DCP-2 chassis.

Figure 1.   *Front view of DCP-108 plug-in unit.*

The DCP 108 has support for 40G with QSFP+ on the client side and 40G PAM4 on the line side as well as for 100G with QSFP28 on the client side and 100G PAM4 on the line side. This includes support for any type of QSFP28 client type (with and without FEC) in a high density (1.6 Tbit/s in 1U) module at a very low cost per Gbit. In addition to the use as transponder, the DCP-108 can also be used as repeater or media converter
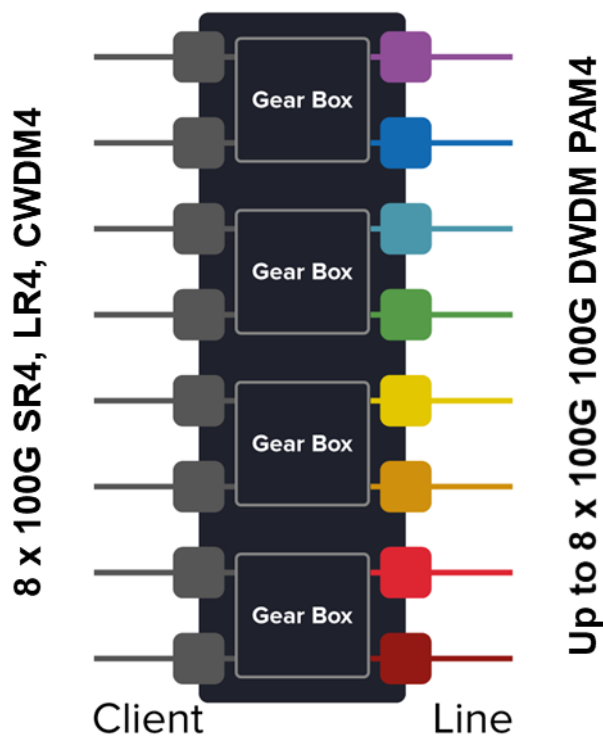
Figure 2. *Functional diagram for DCP-108.*

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	2023-07-05	First version of R8.1.1 Added support for 10G transceivers to be used in DCP-108 Updated converter part number
8.1.2 A	2023-08-09	Updated alarm list
8.1.3 A	2023-10-06	No update
8.1.4 A	2023-10-12	No update
8.1.4 B	2023-10-23	Updated severity on eMMC alarm
8.1.5 A	2023-11-02	No update
8.1.6 A	2023-11-17	Updated severity 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	2024-07-01	Added 32G transceivers Added support for 40G DWDM

| 10.0.2 A	2024-09-05	No update
11.0.1 A	2024-12-12	Added support for coherent QSFP28 Added performance parameters for coherent QSFP28 Added support for tunable 10G and 25G
12.0.1 A	2025-06-24	Added a chapter about dynamic update of certified transceiver list
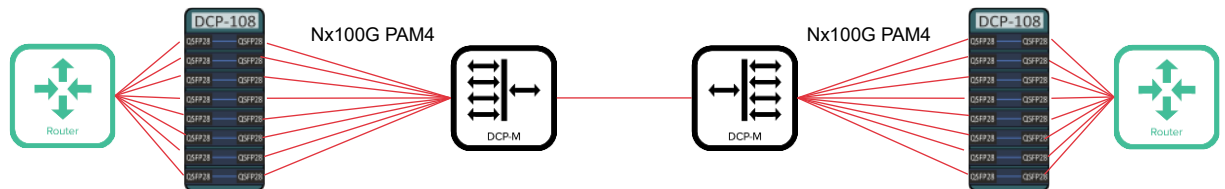
2 Applications

The DCP-108 Addresses two principal cases:

- Switches and routers without PAM4 support
- Wholesale providers in need of demarcation
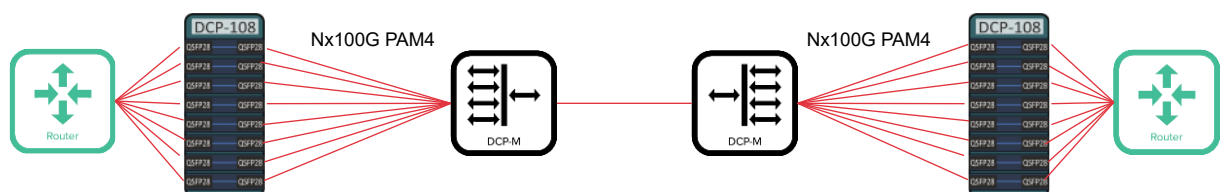
2.1 Switches and routers without PAM4 support

Most switches and routers have QSFP28 port for 100GbE. The only DWDM optics for 100G in QSFP28 form factor today is PAM4. However, not all switches and routers support the PAM4 QSFP28 modules. Then it is possible to use DCP-108 as a media converter with QSFP28 DWDM PAM4 optics on the line and some simpler grey optics on the client.

2.2 Wholesale
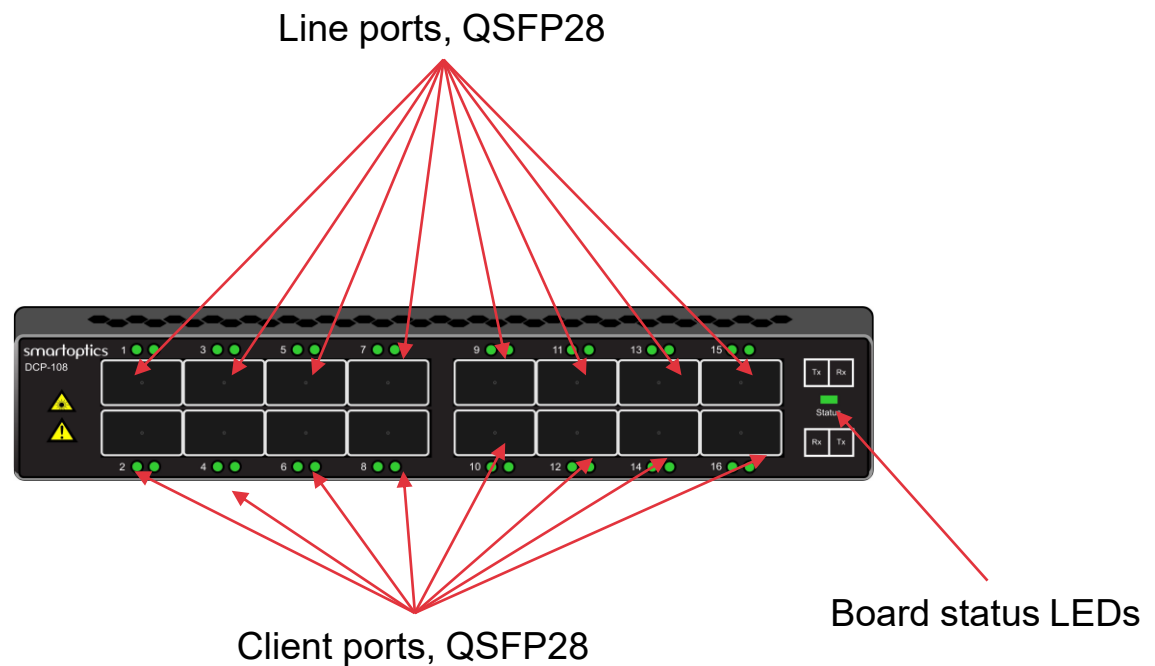
In the wholesale case the DCP-108 is used for demarcation. This means that the operator will use the client ports on DCP-108 as hand-off point to the end customer. In this scenario it is important to be able to read performance data on the client and line ports.

3 Functional description

3.1 Front layout

The front layout of DCP-108 is quite simple and it is dominated by the QSFP28 ports for the clients and lines. The front also contains some LEDs.

Line ports, QSFP28

Client ports, QSFP28

Board status LEDs

Traffic LEDs for Tx and Rx ports can show Green or Yellow light.
Green means OK.
Yellow means that there is a warning or alarm.

The LED for board status can show Green or Red light.
Green means OK.
Red means that there is a critical or major active alarm.

3.1.1 Traffic LEDs

The traffic LED's are used to indicate the status of the traffic.

Rx Off	Not receiving any light.
Rx Fault (yellow)	Receiving light but with alarm (loss of lock).
Rx On (green)	Receiving light and lock on the signal.
Tx Off	Tx is disabled.
Tx Fault (yellow)	An active alarm on the transmitter side (e.g Tx Faulty).
Tx On	Transmitting and no active alarm.

Traffic case		Traffic LED function	
Rx	Tx	Rx	Tx
Off	Off	◯	◯
Off	Fault	◯	🟡
Off	On	◯	🟢
Fault	Off	🟡	◯
On	Off	🟢	◯
On	Fault	🟢	🟡
On	On	🟢	🟢
Fault	Fault	🟡	🟡

3.1.2   Status LED

The status LED is Red during startup (both warm start and cold start).

When the software is up and running it shall reflect the highest severity of the module.

Green   No active alarms.

Red   At least 1 active Critical or Major alarm.

3.2   Client port configuration

The client side can support QSFP28 transceivers that follow the QSFP28 MSA and that have power class 7 (max 5W power consumption). Each of the 8 client ports can be configured individually with different settings and transceivers independently of the other ports.

Different options of QSFP28 transceivers can be used, e.g. SR4, LR4, CWDM4, ER4, ZR4, PAM4 and coherent.
It is also possible to use a QSFP28 to SFP28 converter that can host SFP/SFP+/SFP28 transceivers.
See chapter Technical Specifications for supported formats and transceivers.
FEC can be enabled or disabled on the client and line port.

All client ports have the possibility to use third party QSFP28 as long as they have supported formats and follow the QSFP28 MSA.

3.3 Line port configuration

The line side also support QSFP28 pluggables that follow the QSFP28 MSA and that have power class 7 (max 5W power consumption). Each of the 8 line ports can be configured individually with different settings and pluggables independently of the other ports.

Different options of QSFP28 pluggables can be used, e.g. SR4, LR4, CWDM4, ER4, ZR4, PAM4 and coherent. See chapter Technical Specifications for supported formats and pluggables.
FEC can be enabled or disabled on the line port.

All line ports have the possibility to use third party QSFP28 as long as they have supported formats and follow the QSFP28 MSA.

3.3.1 Traffic modes

From software release 10.0.1 it is possible to select 10GbE, 25GbE, 32GFC, 40GbE or 100GbE as traffic format. Other traffic formats are also presented in the CLI, but those are not verified by Smartoptics in R11.0.1.

```
admin@hostname>config slot 2 transponder 3 service converter
10GbE-10GbE     16GFC-16GFC     1GbE-1GbE       25GbE-25GbE     25GbE-25GbE-FEC
32GFC-32GFC     4GFC-4GFC       8GFC-8GFC
OC192-OC192     OTU-OTU         OTU1e-OTU1e     OTU2-OTU2       OTU2e-OTU2e
STM64-STM64
```

Note that all ports on DCP-108 use QSFP28 transceivers. For 40G and 100G the transceivers have QSFP28 form factor, but for other formats it is required to use a converter from QSFP28 to SFP/SFP+/SFP28, e.g. CVR-QSFP28-SFP28.

Tunable 10G and 25G transceivers can be used.

3.3.2 PAM4 configurations

DCP-108 supports 40G and 100G PAM4. Two versions of PAM4 transceivers are supported, SO-QSFP28-Dxx and SO-QSFP28-Dxx-A. For both of them it is required to have an active line system because of the power budget and dispersion tolerance.
The SO-QSFP28-Dxx has two carriers with 50Gb/s in each. For this unit it is not possible to do regeneration.

The SO-QSFP28-Dxx-A has one carrier with 100Gb/s. For this unit it is possible to do regeneration.

Note that the use of the single carrier unit SO-QSFP28-Dxx-A requires that DCP-M is set to manual format detection mode.
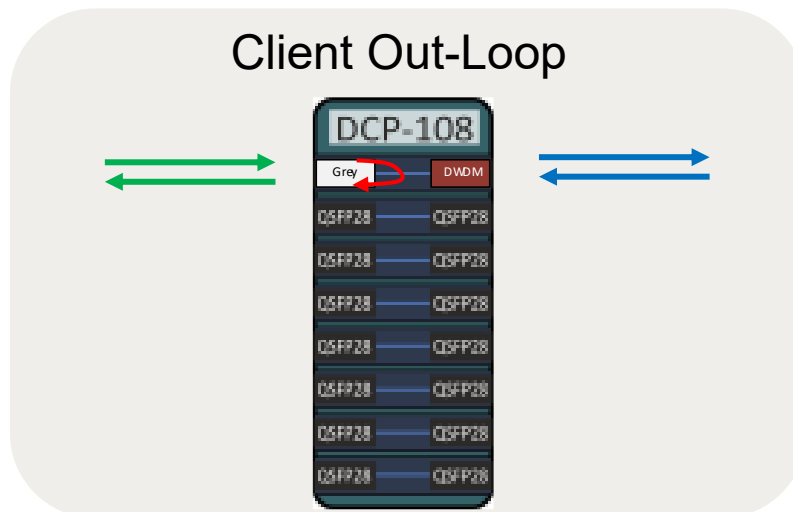
3.4 Loop back

Two different loop back settings are possible for the client side. A warning will be raised during the time that a port is configured in loop back mode.

In R7.0 release it is only the client loopback that is implemented, but line side loopback is considered for later releases.
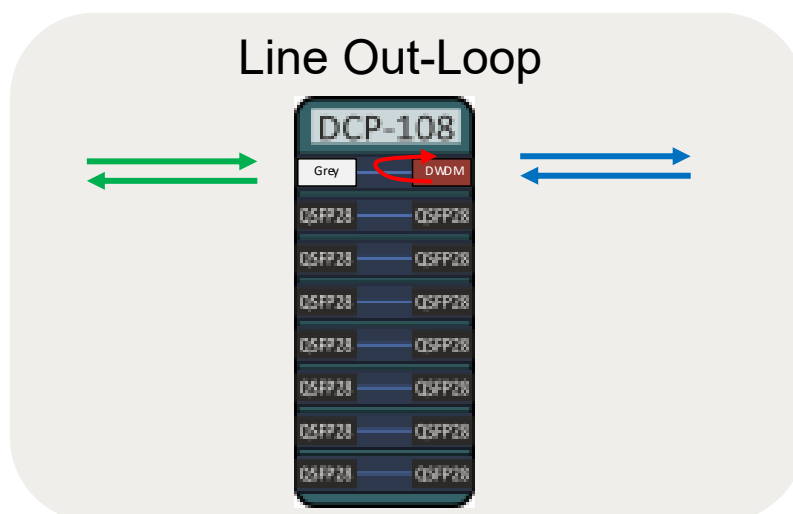
3.4.1 Client Out-loop

The client out-loop can be used to loop the signal back to the client equipment or to a test instrument connected on the client port. The loop is mainly done on the ports of the ASIC sitting after the QSFP28. No real data processing is done inside the ASIC for the looped signal.

3.4.2 Line Out-loop
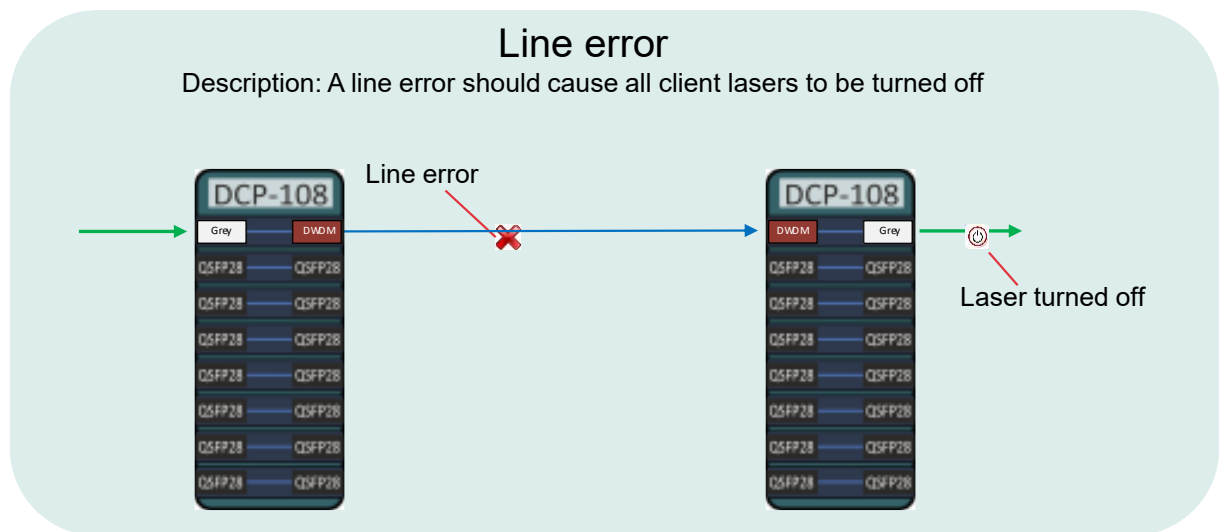
The line out-loop can be used to loop the signal back to the line side without processing data inside the card. The loop is mainly done on the ports of the ASIC sitting after the QSFP28. No real data processing is done inside the ASIC for the looped signal.
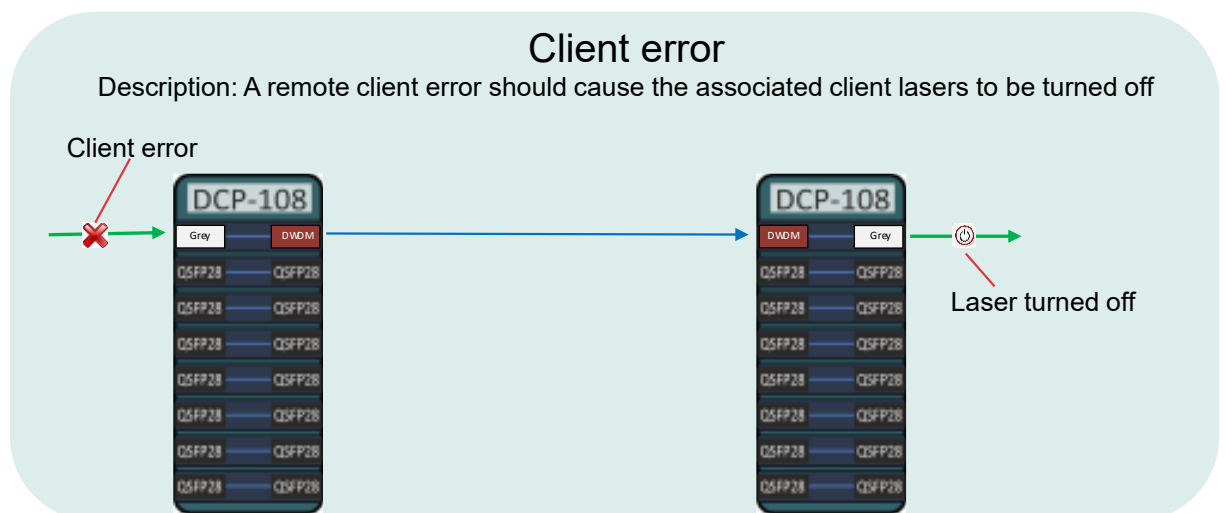
3.5　　　　Link loss forwarding

Link loss forwarding is a setting that can be enabled or disabled via CLI commands. Link loss forwarding can be disabled by setting client laser forced on to enable. Default is that link loss forwarding is on. When link loss forwarding is enabled the client lasers will be turned off in case of an error on the client or line side

Link loss forwarding for line errors

Link loss forwarding for client errors

3.6 Performance monitoring

Many optical performance parameters are available on the DCP-108. The performance value presented is the current value for the last second. Accumulated or historical data are not presented.

Performance parameters on board level

Parameter	Unit	Description
Temperature	C°	Board temperature

Table 1. Performance parameters on board level

Performance parameters on client ports

Parameter	Unit	Description
Optical Rx power	dBm	Received power level per lane
Optical Tx power	dBm	Transmitted power level per lane
Temperature	C°	QSFP28 temperature
Tx bias current	mA	Laser bias current

Table 2. Performance parameters on client ports

Performance parameters on the line ports (non-coherent)

Parameter	Unit	Description
Optical Signal Rx power	dBm	Received signal power level
Optical Tx power	dBm	Transmitted power level
Tx bias current	mA	Laser bias current
Temperature	C°	QSFP56-DD temperature

Table 3. Performance parameters on the line port (non-coherent)

It is also possible to turn on FEC for some traffic formats and then the FEC counters can be monitored by using the command "*show interface diagnostics*".
Two values will be shown for each parameter, per second value and accumulated value.

Performance parameters for FEC counters

Parameter	Unit	Description
Uncorrected errors	errors	Number of errors that have not been corrected
Corrected errors	errors	Number of errors that have been corrected

Corrected 0 -> 1	errors	Number of bits identified as 0, but that have corrected to 1.
Corrected 1 -> 0	errors	Number of bits identified as 1, but that have corrected to 0.

Table 4. FEC counters in interface diagnostics

Performance parameters on the line ports (coherent)

Parameter	Unit	Description
Optical Signal Rx power	dBm	Received signal power level
Optical Tx power	dBm	Transmitted power level
eSNR	dB	Electrical SNR (signal to noise ratio) on the electrical side of the QSFP28
Temperature	C°	QSFP56-DD temperature
OSNR	dB	Optical Signal to Noise Ratio
Q-value	dB	Q-value
Q-margin	dB	Q-margin
Chromatic dispersion	ps/nm	Chromatic dispersion compensation in the module. The chromatic dispersion on the fiber has opposite sign.
Pre-FEC BER avg	Errors per second	Average bit error rate before FEC corrections.
Pre-FEC BER current	Errors per second	Current bit error rate before FEC corrections. See FEC diagnostics to see corrected and uncorrected errors for post-FEC BER.

Table 5. Performance parameters on the line port (coherent)

3.7 Alarms

The DCP-2 keeps a list of the alarms currently detected on the system and collected by 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. Previously cleared alarms can be found in the alarm log.

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.

The alarms available for DCP-108 are listed in the table below:

ALARM MESSAGE	LOCATION	SEVERITY	INTERPRETATION
Loopback enabled	if-<chassi>/<slot>/<Interface>	Warning	Loopback Enabled is raised when a interface is configured in loopback mode.
Loss of lock	if-<chassi>/<slot>/<Interface>	Critical	Loss of lock has been detected on the interface. Check that the input signal format is correct.
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.
Transmitter failure	if-<chassi>/<slot>/<Interface>	Major	The transceiver is not transmitting. Replace the optical module.
Transceiver missing	if-<chassi>/<slot>/<Interface>	Critical	The Transceiver has been removed. Insert an Transceiver or disable the alarm with "clear interface portreset <interface_id>"
eMMC failure		Minor	The memory is not formatted. Contact support.
PM-BIP error threshold exceeded [1s]	if-<chassi>/<slot>/<Interface>	Major	The BIP error counter per second shows a higher number than the configured threshold

Table 6. Alarm list

3.8 Dynamic update of certified transceiver list

From R12.0.1 it is possible to update the list of certified transceivers dynamically. The system contains one file with Smartoptics certified transceivers that is installed from start, but it is also possible to add an additional file with transceivers that should be treated as certified. See DCP-Series_User_Manual for more information.

4 Spare part handling

4.1 Replacing DCP-108 card

A new DCP-108 card that is inserted in same slot as the replaced unit will automatically get the same configuration as the previous one. If the SW revision on the new card is different it is necessary to upgrade the SW to same release as the chassis.

The SW for the new traffic card can be upgraded by running the same swupgrade commands as for the whole DCP-2 chassis. It is only the boards with the wrong SW that will be upgraded. DCP-2 chassis and other slot modules with correct SW from start will not be affected by the upgrade.

5   Technical Specifications

CERTIFIED 40G AND 100G TRANSCEIVERS FOR CLIENT SIDE OF DCP-108	
PART NUMBER	Description
SO-QSFP28-100G-DR	QSFP28 100G Eth DR SM 500m
SO-QSFP28-100G-FR	QSFP28 100G Eth FR SM 2km
SO-QSFP28-100G-FRA	QSFP28 100G Eth FR 1271nm SM 2km
SO-QSFP28-100G-FRB	QSFP28 100G Eth FR 1291nm SM 2km
SO-QSFP28-100G-FRC	QSFP28 100G Eth FR 1311nm SM 2km
SO-QSFP28-100G-FRD	QSFP28 100G Eth FR 1331nm SM 2km
SO-QSFP28-100G-LR	QSFP28 100G Eth LR SM 10km
SO-QSFP28-100G-LRA	QSFP28 100G Eth LR 1271nm SM 10km
SO-QSFP28-100G-LRB	QSFP28 100G Eth LR 1291nm SM 10km
SO-QSFP28-100G-LRC	QSFP28 100G Eth LR 1311nm SM 10km
SO-QSFP28-100G-LRD	QSFP28 100G Eth LR 1331nm SM 10km
SO-QSFP28-AOCXM	QSFP28 100GE AOC 1m
SO-QSFP28-CWDM4	QSFP28 100GE CWDM4 SM 2km
SO-QSFP28-DXX-A	QSFP28 100GE PAM4 DWDM 100GHz Ver A
SO-QSFP28-ER4	QSFP28, 100GE ER4 1310nm SM 40km
SO-QSFP28-LR4	QSFP28 100GE LR4 OTU4 1310nm SM 10km
SO-QSFP28-LR4-10L	QSFP28 100GE LR4 1310nm SM 10km
SO-QSFP28-PCUXM	QSFP28 100GE DAC Xm pass
SO-QSFP28-PSM4	QSFP28 100GE 1310nm SM 2km MPO
SO-QSFP28-SR4	QSFP28 100GE SR4 850nm MM 100m MPO
SO-QSFP28-ZR4	QSFP28 100G Eth ZR4 SM 80km
SO-QSFP-LR4	QSFP+ 40GE LR4 OTN CWDM4 SM 10km
SO-QSFP-SR4	QSFP+ 40GE 850nm MM 150m@OM4 MPO
TQ2026-OXXC-SO	QSFP28 100GE O-DWDM 100GHz 25km Oxxx
TQ2020-BXXC-SO	QSFP28 BiDi 100G xxxx/yyyy SM 10km
TQ2021-BXXC-SO	QSFP28 BiDi 100G xxxx/yyyy SM 20km

Table 7. Client transceivers for 40G and 100G

CERTIFIED 10G AND 25G TRANSCEIVERS FOR CLIENT SIDE OF DCP-108	
PART NUMBER	Description
CVR-QSFP28-SFP28	The 25G channel from SFP28 is connected to lane 1 on QSFP28 connector
SO-SFP28-L10-DXXXX-I	SFP28 25G Ethernet DWDM 192.00-196.00THz 10km 13dB I-temp LC D9200-D9600
SO-SFP28-L10E-DXXXX-I	SFP28 25G Ethernet DWDM 192.00-196.00THz 10km 18dB I-temp LC D9200-D9600
SO-SFP28-LR	SFP28, 25G/10G Ethernet LR, 1310nm, SM, 10km, 5.5dB, LC
SO-SFP28-SR	SFP28, 25G Ethernet SR, MM 850nm, 100m, 1.9dB, LC
SO-SFP28-SR3	SFP28, 25G Ethernet, 850nm, MM, DDM, 1.9dB, 200m@OM3, 300m@OM4, LC
TS2014-S30C-SO	SFP28, 25G ZR, 1300.05nm, SM, 80km, 30dB, LC
TS2014-S30I-SO	SFP28, 25G ZR, 1300.05nm, SM, 80km, 30dB, LC, I-temp
SO-SFP28-ER-I	SFP28, 25G/10G Ethernet LR, 1310nm, SM, 40km, 18dB, LC, I-temp
SO-SFP-10GE-ER-DXXX	SFP+ 10G MR DWDM 100GHz 40km D9200-D9600
SO-SFP-10GE-ZR-DXXX	SFP+ 10G MR DWDM 100GHZ 80KM D9200-D9600
SO-SFP-10GE-SR	SFP+ 10G MR 850nm MM 300m
SO-SFP-10GE-LR	SFP+ 10G MR 1310NM SM 10KM

Table 8. Client transceivers for 10G and 25G

CERTIFIED 32G TRANSCEIVERS FOR CLIENT SIDE OF DCP-108	
PART NUMBER	Description
32G-IR-DXXS-BR	SFP28 32/16/8G FC Sec DWDM 100GHz,10km
32G-IR-DXXX-BR	SFP28 32/16/8G FC,DWDM 100GHz 10km
SO-SFP28-32GFC-SD	SFP28 32G FC 25GE 850nm MM 100m
SO-SFP28-32GFC-LD	SFP28 32/16/8GFC 25GE 1310nm SM 10km

Table 9. Client transceivers for 32G

CERTIFIED 40G AND 100G TRANSCEIVERS FOR LINE SIDE OF DCP-108	
PART NUMBER	Description
SO-QSFP28-100G-DR	QSFP28 100G Eth DR SM 500m

SO-QSFP28-100G-FR	QSFP28 100G Eth FR SM 2km
SO-QSFP28-100G-FRA	QSFP28 100G Eth FR 1271nm SM 2km
SO-QSFP28-100G-FRB	QSFP28 100G Eth FR 1291nm SM 2km
SO-QSFP28-100G-FRC	QSFP28 100G Eth FR 1311nm SM 2km
SO-QSFP28-100G-FRD	QSFP28 100G Eth FR 1331nm SM 2km
SO-QSFP28-100G-LR	QSFP28 100G Eth LR SM 10km
SO-QSFP28-100G-LRA	QSFP28 100G Eth LR 1271nm SM 10km
SO-QSFP28-100G-LRB	QSFP28 100G Eth LR 1291nm SM 10km
SO-QSFP28-100G-LRC	QSFP28 100G Eth LR 1311nm SM 10km
SO-QSFP28-100G-LRD	QSFP28 100G Eth LR 1331nm SM 10km
SO-QSFP28-AOCXM	QSFP28 100GE AOC 1m
SO-QSFP28-CWDM4	QSFP28 100GE CWDM4 SM 2km
SO-QSFP28-DXX	QSFP28 100GE PAM4 DWDM 100GHz
SO-QSFP28-DXX-A	QSFP28 100GE PAM4 DWDM 100GHz Ver A
SO-QSFP28-ER4	QSFP28, 100GE ER4 1310nm SM 40km
SO-QSFP28-LR4	QSFP28 100GE LR4 OTU4 1310nm SM 10km
SO-QSFP28-LR4-10L	QSFP28 100GE LR4 1310nm SM 10km
SO-QSFP28-PCUXM	QSFP28 100GE DAC Xm pass
SO-QSFP28-PSM4	QSFP28 100GE 1310nm SM 2km MPO
SO-QSFP28-SR4	QSFP28 100GE SR4 850nm MM 100m MPO
SO-QSFP28-ZR4	QSFP28 100G Eth ZR4 SM 80km
SO-QSFP-LR4	QSFP+ 40GE LR4 OTN CWDM4 SM 10km
SO-QSFP-SR4	QSFP+ 40GE 850nm MM 150m@OM4 MPO
SO-QSFP-40G-DXXXX	QSFP+ 40G Ethernet DWDM 100GHz 11dB 8km D9210-D9600
TQ2026-OXXC-SO	QSFP28 100GE O-DWDM 100GHz 25km Oxxx
TQ2020-BXXC-SO	QSFP28 BiDi 100G xxxx/yyyy SM 10km
TQ2021-BXXC-SO	QSFP28 BiDi 100G xxxx/yyyy SM 20km
TQ2028-TUNC-SO	QSFP28, 100GBASE-ZR Coh 50GHz Tunable 80km, 22dB, SFF-8636, LC

Table 10. Line transceivers for 40G and 100G

CERTIFIED 10G AND 25G TRANSCEIVERS FOR LINE SIDE OF DCP-108	
PART NUMBER	Description
CVR-QSFP28-SFP28	The 25G channel from SFP28 is connected to lane 1 on QSFP28 connector
SO-SFP28-L10-DXXXX-I	SFP28 25G Ethernet DWDM 192.00-196.00THz 10km 13dB I-temp LC D9200-D9600
SO-SFP28-L10E-DXXXX-I	SFP28 25G Ethernet DWDM 192.00-196.00THz 10km 18dB I-temp LC D9200-D9600
SO-SFP28-LR	SFP28, 25G/10G Ethernet LR, 1310nm, SM, 10km, 5.5dB, LC
SO-SFP28-SR	SFP28, 25G Ethernet SR, MM 850nm, 100m, 1.9dB, LC
SO-SFP28-SR3	SFP28, 25G Ethernet, 850nm, MM, DDM, 1.9dB, 200m@OM3, 300m@OM4, LC
TS2014-S30C-SO	SFP28, 25G ZR, 1300.05nm, SM, 80km, 30dB, LC
TS2014-S30I-SO	SFP28, 25G ZR, 1300.05nm, SM, 80km, 30dB, LC, I-temp
SO-SFP28-ER-I	SFP28, 25G/10G Ethernet LR, 1310nm, SM, 40km, 18dB, LC, I-temp
SO-SFP-10GE-ER-DXXX	SFP+ 10G MR DWDM 100GHz 40km D9200-D9600
SO-SFP-10GE-ZR-DXXX	SFP+ 10G MR DWDM 100GHZ 80KM D9200-D9600
SO-SFP-10GE-SR	SFP+ 10G MR 850nm MM 300m
SO-SFP-10GE-LR	SFP+ 10G MR 1310NM SM 10KM

Table 11. Line transceivers for 10G and 25G

CERTIFIED 32G TRANSCEIVERS FOR LINE SIDE OF DCP-108	
PART NUMBER	Description
32G-IR-DXXS-BR	SFP28 32/16/8G FC Sec DWDM 100GHz,10km
32G-IR-DXXX-BR	SFP28 32/16/8G FC,DWDM 100GHz 10km
SO-SFP28-32GFC-SD	SFP28 32G FC 25GE 850nm MM 100m
SO-SFP28-32GFC-LD	SFP28 32/16/8GFC 25GE 1310nm SM 10km

Table 12. Line transceivers for 32G

GENERAL	
OPERATING TEMPERATURE	0° C to 45° C
POWER CONSUMPTION	Max during startup 108 W
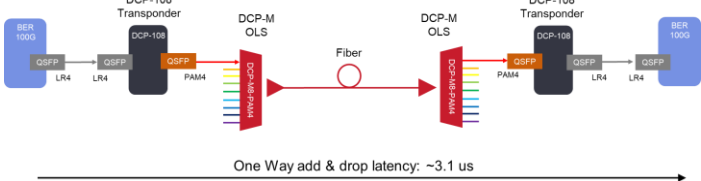
	Max during operation 66W
MTBF	49.9 years 2289 FITs
LATENCY	DCP-108 3.1µs for 100G PAM4 incl. DCP-M link One Way add & drop latency: ~3.1 us

Table 13. General parameters for DCP-108