SO-TQSFPDD4CCZRP

QSFP-DD, OIF 400ZR & OpenZR+, Coh Tunable, LC

OVERVIEW

The SO-TQSFPDD4CCZRP is an QSFP-DD form-factor (type 2a) DWDM transceiver conforming to the OIF 400ZR for 400Gbps as well as the OpenZR+ MSA for 100Gbps to 400Gbps Ethernet applications.

The OpenZR+ MSA provides a flexible solution for operators having routers that not yet have migrated to 400G services. The SO-TQSFPDD4CCZRP can as an example be used in the Smartoptics DCP-404 Muxponder to combine 4x 100G flows to a 400G OpenZR+ signal to be transported over an optical network.

OpenZR+ is currently only defined for amplified line systems. OIF 400ZR is defined for both amplified as well as un-amplified configurations. The Application Mode 2 (OIF app code 0x02) corresponds to the un-amplified OIF 400ZR configuration.

The below table lists the OIF 400ZR and OpenZR+ modes supported by SO-TQSFPDD4CCZRP.

CMIS Application Code	Host format	Electrical interface	Payload	FEC	Modulation	Operating reach	MSA format
1	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	CFEC	DP-16QAM	80km	OIF 400ZR app code 0x01
2	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	CFEC	DP-16QAM	25km	OIF 400ZR app code 0x02
3	4 × 100GBASE-R	4x 100GAUI-2 (2x 50G)	400G	CFEC	DP-16QAM	80km	OIF 400ZR extension
4	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	oFEC	DP-16QAM	120km	OpenZR+ MSA (small PMD)
5	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	oFEC	DP-16QAM	450km	OpenZR+ MSA
6	4 × 100GBASE-R	4x 100GAUI-2 (2x 50G)	400G	oFEC	DP-16QAM	450km	OpenZR+ MSA
7	3 × 100GBASE-R	3x 100GAUI-2 (2x 50G)	300G	oFEC	DP-8QAM	600km	OpenZR+ MSA
8	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	oFEC	DP-16QAM	450km	OpenZR+ MSA, Enhanced mode[1]
9	4 × 100GBASE-R	4x 100GAUI-2 (2x 50G)	400G	oFEC	DP-16QAM	450km	OpenZR+ MSA Enhanced mode[1]
10	3 × 100GBASE-R	3x 100GAUI-2 (2x 50G)	300G	oFEC	DP-8QAM	600km	OpenZR+ MSA Enhanced mode[1]
11	2x 100GBASE-R	2x 100GAUI-2 (2x 50G)	200G	oFEC	DP-QPSK	1000km	OpenZR+ MSA
12	2x 100GBASE-R	2 x CAUI4 (4x 25G) w/o FEC	200G	oFEC	DP-QPSK	1000km	OpenZR+ MSA
13	1x 100GBASE-R	1x 100GAUI-2 (2x 50G)	100G	oFEC	DP-QPSK	2000km	OpenZR+ MSA
14	1x 100GBASE-R	1 x CAUI4 (4x 25G) w/o FEC	100G	oFEC	DP-QPSK	2000km	OpenZR+ MSA

1) Enhanced mode grants better optical performance but is not fully interoperable with OpenZR+.

The SO-TQSFPDD4CCZRP will automatically configure the above via the Application modes. The SO-TQSFPDD4CCZRP asynchronously (GMP) maps an Ethernet signal from a switch/router to an intermediate 400ZR frame structure, then adapts the frame structure to the selected FEC engine. The encoded signal is subsequently DSP framed and modulated for transmission as a coherent Dual Polarity coherent signal.

TECHNICAL DATA

The optical characteristics are separated into OIF 400ZR and OpenZR+ sections. The performance is compliant with the respective specifications but can exceed the minimum requirements on some parameters.

GENERIC

Parameter	Value
Technology	DWDM QSFP-DD type 2a
Transmission media	SM (2x LC)
Nominal wavelengths	191.3 - 196.1THz (tunable) 100GHz
Interface standards	OIF 400ZR / OpenZR+
Operating temperature	+15^{O}C to +75^{O}C [1]
Storage temperature	-40^{O}C to +85^{O}C
DDM functions	Total received power
	Coherent channel power
	OSNR, eSNR, PDL, dispersion, DGD
	Case temperature

[1] The module will turn up from cold start at ambient temperature as low as -5C and will reach specifications after self-heating up to min temperature.

[2] Set to comply with 400G modes. Can be changed on individual modules to fully support other modes.

Parameter	Value
MSA	QSFP-DD MSA's, CMIS4.1
Misc	Sync-E support, LLDP, RMON
Power consumption	Typical 23.1W, Worst case 23.6W @400G
	Typical 22.3W, Worst case 22.8W @300G
	Typical 21.3W, Worst case 21.8W @200G
	Typical 18.2W, Worst case 18.7W @100G
Tx In-band OSNR	Min 42dB/0.1nm
Tx Out-Of-Band OSNR	Min 42dB/0.1nm
Rx_LOS Assert	-28.0dBm[2]
Receiver turn-up	Max 30ms from warm start
	Max 120s from cold start
Absolute max conditions	Rx signal input power: +13dBm
	Rx total input power: +15dBm

Safety/regulatory compliance:
TUV/UL/FDA (contact Smartoptics for latest certification information)
RoHS compliance

OIF 400ZR

Parameter	Value
Typical reach	80-120km OIF 400ZR app code 0x01
	10dB OIF 400ZR app code 0x02
Interface standards	OIF 400ZR
Protocol support	1x 400GbE
Chromatic dispersion	2400ps/nm
FEC type	CFEC
Power budget	0 – 10dB app code 0x02

Parameter	Value
Transmitter data:	
Output power 400G [1]	Min -10.0dBm [2]
	Max -6.0dBm [2]
Modulation	DP-16QAM
Receiver data:	
Input power range	0 to -12dBm [2] OIF 400ZR app code 0x01
Receiver sensitivity	-20dBm OIF 400ZR app code 0x02
OSNR tolerance 400G	26dB@-12dBm
	26.5dB@-14dBm & 0.5dB penalty
	27dB@-15dBm & 1dB penalty
Pre-FEC BER	Max 1.25x10^{-2}

[1] The module transmit power can be provisioned up to the maximum available TX power. If the TX power is not provisioned by the host, the module TX power will default to the maximum available power, which can be any power level in the specified 4dB range.
[2] Average power

OpenZR+

There are 11 OpenZR+ modes that can be set. The table below lists the primary optical parameters.

Appl mode	Line rate	Host format	Tx Power [1]	Rx sens @ high OSNR	Rx @ OSNR	Rx OSNR @0.5dB penalty	Rx OSNR @1dB penalty	CDC range [2]
4	400G	1x 400GAUI-8	-10dBm to -6dBm	-20dBm	23.9dB@-12dBm	24.2dB@-14dBm	24.7dB@-16dBm	13 000ps/nm
5	400G	1x 400GAUI-8	-13dBm to -9dBm	-21dBm	23.4dB@-12dBm	23.9dB@-14dBm	24.4dB@-16dBm	13 000ps/nm
6	400G	4x 100GAUI-2	-13dBm to -9dBm	-21dBm	23.4dB@-12dBm	23.9dB@-14dBm	24.4dB@-16dBm	13 000ps/nm
7	300G	3x 100GAUI-2	-12dBm to -8dBm	-22dBm	20.3dB@-15dBm	20.8dB@-17dBm	21.3dB@-19dBm	26 000ps/nm
8	400G	1x 400GAUI-8	-13dBm to -9dBm	-21dBm	23.1dB@-12dBm	23.6dB@-14dBm	24.1dB@-16dBm	13 000ps/nm
9	400G	4x 100GAUI-2	-13dBm to -9dBm	-21dBm	23.1dB@-12dBm	23.6dB@-14dBm	24.1dB@-16dBm	13 000ps/nm
10	300G	3x 100GAUI-2	-12dBm to -8dBm	-23dBm	19.5dB@-15dBm	20.0dB@-17dBm	20.5dB@-19dBm	26 000ps/nm
11	200G	2x 100GAUI-2	-10.5dBm to -6.5dBm	-29dBm	15dB@-18dBm	15.5dB@-20dBm	16dB@-22dBm	50 000ps/nm
12	200G	2x CAUI4 w/o FEC	-10.5dBm to -6.5dBm	-29dBm	15dB@-18dBm	15.5dB@-20dBm	16dB@-22dBm	50 000ps/nm
13	100G	1x 100GAUI-2	-6dBm to -2dBm	-32dBm	11.8dB@-20dBm	12.3dB@-23dBm	12.8dB@-25dBm	80 000ps/nm
14	100G	1x CAUI4 w/o FEC	-6dBm to -2dBm	-32dBm	11.8dB@-20dBm	12.3dB@-23dBm	12.8dB@-25dBm	80 000ps/nm

1) The module transmit power can be provisioned up to the maximum available TX power. If the TX power is not provisioned by the host, the module TX power will default to the maximum available power, which can be any power level in the specified 4dB range.
2) Specified as [Min OSNR Value @ Min Rx power for the OSNR value].
3) CD range with less than 0.5dB OSNR penalty.

Maximum Provisionable CD range:

400G CFEC DP-16QAM:	2 400 ps/nm
400G OFEC DP-16QAM:	52 000 ps/nm
300G OFEC DP-8QAM:	100 000 ps/nm
200G OFEC DP-QPSK:	100 000 ps/nm
100G OFEC DPQPSK:	160 000 ps/nm

ORDERING INFORMATION

Ordering code	Description
SO-TQSFPDD4CCZRP	QSFP-DD OIF400G/OpenZR+ Coh Tunable Flexgrid, LC

Latency:

400G CFEC:	8us
400G OFEC:	5us
300G OFEC:	6us
200G OFEC:	7us
100G OFEC:	11us

GENERAL DEFINITIONS

Parameter	Description
Technology	Grey; Transceiver type for non-WDM applications. Electrical or optical. CWDM; Transceiver type for CWDM applications using G.694.2 channel grid. DWDM; Transceiver type for DWDM applications using G.694.1 channel grid. BiDi; Transceiver pair using two different wavelength channels operating on a single-fiber.
Transmission Media	Type of fiber, e.g. Multimode (MM) or Singlemode (SM). Number of and connector type within brackets (e.g. 2x LC, 1x MPO).
Typical reach	Nominal distance performance based on typical fiber dispersion, fiber loss and power budget properties, i.e. w/o dispersion compensation and optical amplification. Actual distance is dependent on actual optical path loss and dispersion properties.
Bit rate range	Supported bit rate range in Gigabit or Megabit per second (Gbps or Mbps).
Protocols	Protocols within supported bit rate range.
Nominal wavelength	Typical wavelength(s) from transmitter.
Interface standards	Referenced interface standards or MSA's, e.g. IEEE 802.3 standard for 10GbE services or 100G 4WDM-10 etc.
Power budget	Min and max power budget between Transmitter and Receiver w/o optical path penalties.
Dispersion tolerance/penalty	Maximum amount of tolerated dispersion and required reduction of power budget to maintain stipulated Bit Error Rate (BER) and at a given bit rate.
Temperature range	Max operating case temperature range. Standard temperature range (C-temp): 0°C to +70°C (32°F to +158°F) Extended temperature range (E-temp): typically -20°C to +75°C (-4°F to +167°F) Industrial temperature range (I-temp): -40°C to +85°C (-40°F to +185°F)
Power consumption	Worst case power consumption. Will vary over temperature.
Transmitter Output power	Average output power. Provided in min and max values.
Receiver minimum input power	Minimum average input power at specified BER, normally $1E^{-12}$. Note that some protocols require FEC to achieve sufficient BER.
Receiver max input power	Maximum average input power giving a BER, normally $1E^{-12}$.
DDM	Digital Diagnostic Monitoring functionality as defined in e.g. SFF-8472 MSA.