

**DATASHEET 6.4**

# TQD013-TUNC-SO

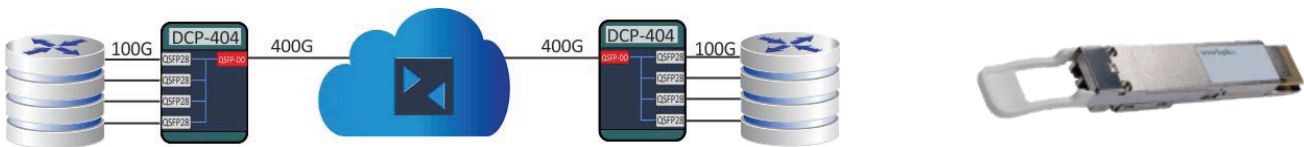
**QSFP-DD, OIF 400ZR, OpenZR+, Coh Tunable, High-power, CMIS5.0, LC**

## OVERVIEW

The TQD013-TUNC-SO 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 output power of 0dBm unlocks the potential for the module to transmit 400G signals in already existing, 100GHz spacing, ROADM architectures.

The OpenZR+ MSA provides a flexible solution for operators having routers that not yet have migrated to 400G services. The TQD013-TUNC-SO can as an example be used in the Smartoptics DCP-404 Muxponder to combine up to 4x 100G flows to a 100G/200G/300G/400G OpenZR+ signal to be transported over an optical network.



The below table lists the OIF 400ZR and OpenZR+ modes supported by TQD013-TUNC-SO.

CMIS Application Code	Host format	Electrical interface	Payload	FEC	Modulation	Line Symbol Baud Rate	MSA format
1	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	CFEC	DP-16QAM	59.8GBd	OIF 400ZR, app code 0x01
2	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	CFEC	DP-16QAM	59.8GBd	OIF 400ZR, app code 0x02
3	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	oFEC	DP-16QAM	60.1GBd	OpenZR+ MSA
4	2 x 200GBASE-R	2x 200GAUI-4 (2x 200G)	400G	oFEC	DP-16QAM	60.1GBd	OpenZR+ MSA
5	4 x 100GBASE-R	4x 100GAUI-2 (2x 50G)	400G	oFEC	DP-16QAM	60.1GBd	OpenZR+ MSA
6	400GBASE-R	1x 400GAUI-8 (8x 50G)	400G	oFEC	DP-16QAM	60.1GBd	OpenZR+ MSA, Enhanced
7	2 x 200GBASE-R	2x 200GAUI-4 (2x 200G)	400G	oFEC	DP-16QAM	60.1GBd	OpenZR+ MSA, Enhanced
8	4 x 100GBASE-R	4x 100GAUI-2 (2x 50G)	400G	oFEC	DP-16QAM	60.1GBd	OpenZR+ MSA, Enhanced
9	2 x 100GBASE-R	2x 100GAUI-2 (2x 50G)	200G	oFEC	DP-QPSK	60.1GBd	OpenZR+ MSA
10	1 x 100GBASE-R	1x 100GAUI-2 (2x 50G)	100G	oFEC	DP-QPSK	30.1GBd	OpenZR+ MSA

11	3 × 100GBASE-R	3x 100GAUI-2 (2x 50G)	300G	oFEC	DP-8QAM	60.1GBd	OpenZR+ MSA
12	3 × 100GBASE-R	3x 100GAUI-2 (2x 50G)	300G	oFEC	DP-8QAM	60.1GBd	OpenZR+ MSA, Enhanced
13	4 × 100GBASE-R	4x 100GAUI-2 (2x 50G)	400G	CFEC	DP-16QAM	59.8GBd	OIF400ZR app code 0x01
14	2 × 100GBASE-R	2x 100GAUI-2 (2x50G)	200G	oFEC	DP-16QAM	30.1GBd	OpenZR+ MSA, Enhanced
15	100GBASE-R	1x CAUI-4 w/o FEC	100G	oFEC	DP-QPSK	30.1GBd	OpenZR+ MSA

TQD013-TUNC-SO will automatically configure the above via the Application modes. For 400G applications, the TQD013-TUNC-SO 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 signal.

**Note! CMIS application codes 6, 7, 8 and 12 are not interoperable with the OpenZR+ MSA. These modes have been enhanced in to increase the optical performance on the Media side.**

## TECHNICAL DATA

The optical characteristics are into Generic and Application code sections. The *Generic* section defines the common characteristics, independent of the selected application modes. The *Application* code section defines application code based optical characteristics.

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°C to +75°C <sup>1)</sup>
Storage temperature	-40°C to +85°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). 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. The provisional Tx power range of the module is 10dB.
- 3). Set to comply with 400G modes. Can be changed on individual modules to fully support other modes.

Parameter	Value
MSA	QSFP-DD MSA's, CMIS5.0
Misc	Sync-E support, LLDP, RMON
Power consumption, EOL	23.6W @400G
	23.0W @300G
	22.0W @200G
	19.0W @100G
Tx Power	Min 1dBm <sup>2)</sup>
Tx In-band OSNR	Min 38dB/0.1nm
Tx Out-Of-Band OSNR	Min 42dB/0.1nm
Rx_LOS Assert	-28.0dBm <sup>3)</sup>
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

## OPTICAL SPECIFICATION - APPLICATION CODES

The table below lists the primary optical parameters for each supported application code.

Appl mode	Line rate	Host format	Tx Power <sup>1)</sup>	Rx sens @ high OSNR	Rx @ OSNR <sup>2)</sup>	Rx OSNR @0.5dB penalty <sup>2)</sup>	Rx OSNR @1dB penalty <sup>2)</sup>	CDC range @0.5dB OSNR penalty
1	400G	1x 400GAUI-8	1dBm	-20dBm	26dB@-12dBm	26.5dB@-14dBm	27.0dB@-15dBm	2 400 ps/nm
2	400G	1x 400GAUI-8	1dBm	-20dBm	26dB@-12dBm	26.5dB@-14dBm	27.0dB@-15dBm	2 400 ps/nm
3	400G	1x 400GAUI-8	1dBm	-21dBm	23.4dB@-12dBm	23.9dB@-14dBm	24.4dB@-16dBm	13 000 ps/nm
4	400G	2x 200GAUI-4	1dBm	-21dBm	23.4dB@-12dBm	23.9dB@-14dBm	24.4dB@-16dBm	13 000 ps/nm
5	400G	4x 100GAUI-2	1dBm	-21dBm	23.4dB@-12dBm	23.9dB@-14dBm	24.4dB@-16dBm	13 000 ps/nm
6	400G	1x 400GAUI-8	1dBm	-21dBm	23.1dB@-12dBm	23.6dB@-14dBm	24.1dB@-16dBm	13 000 ps/nm
7	400G	2x 200GAUI-4	1dBm	-21dBm	23.1dB@-12dBm	23.6dB@-14dBm	24.1dB@-16dBm	13 000 ps/nm
8	400G	4x 100GAUI-2	1dBm	-21dBm	23.1dB@-12dBm	23.6dB@-14dBm	24.1dB@-16dBm	13 000 ps/nm
9	200G	2x 100GAUI-2	1dBm	-29dBm	14.8dB@-18dBm	15.3dB@-20dBm	15.8dB@-22dBm	50 000 ps/nm
10	100G	1x 100GAUI-2	1dBm	-32dBm	11.5dB@-20dBm	12.0dB@-23dBm	12.5dB@-25dBm	80 000 ps/nm
11	300G	3x 100GAUI-2	1dBm	-22dBm	20.3dB@-15dBm	20.8dB@-17dBm	20.5dB@-19dBm	50 000 ps/nm
12	300G	3x 100GAUI-2	1dBm	-23dBm	19.5dB@-15dBm	20.0dB@-17dBm	21.3dB@-19dBm	50 000 ps/nm
13	400G	4x 100GAUI-2	1dBm	-20dBm	26dB@-12dBm	26.5dB@-14dBm	27.0dB@-15dBm	2 400 ps/nm
14	200G	2x 100GAUI-2	1dBm	-24dBm	19.3dB@-15dBm	19.8dB@-18dBm	20.3dB@-20dBm	30 000 ps/nm
15	100G	1x CAUI-4 w/o FEC	1dBm	-32dBm	11.5dB@-20dBm	12.0dB@-23dBm	12.5dB@-25dBm	80 000 ps/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. The provisional Tx power range of the module is 10dB.

2). Specified as [Min OSNR Value @ Min Rx power for the OSNR value].

### 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-16QM:	85 000 ps/nm
200G OFEC DP-QPSK:	100 000 ps/nm
100G OFEC DPQPSK:	160 000 ps/nm

## ORDERING INFORMATION

Ordering code	Item Name
TQD013-TUNC-SO	QSFP-DD OpenZR+ HPow Coh-T SM CMIS5.0

### 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.

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