

# QSFP-DD 100GE DP-QPSK 450KM ETH/OTN

QSFP-DD 100G Ethernet/OpenROADM Coherent Tunable SM 450km, Encryption, CMIS5.0, LC

## OVERVIEW

The TQD011-TUNC-SO is an QSFP-DD form-factor (type 2a) DWDM transceiver for 100Gbps Ethernet, OTN and OpenROADM applications. The transceiver is intended for use in interconnect applications between data centers with switches, routers etc. having QSFP-DD support but where the services are limited to 100Gbps.

TQD011-TUNC-SO conforms to both the 100G option of OpenZR+ and the OpenROADM 3.0/4.0, using the powerful Open Forward Error Correction (oFEC) scheme giving a Net Coding Gain (NCG) of 11.6dB at a pre-FEC BER of  $2.0 \times 10^{-2}$ . TQD011-TUNC-SO also supports the OpenROADM 2.0 with the media format OTU4 and SC-FEC giving a Net Coding Gain (NCG) of 9.4dB at a pre-FEC BER of  $4.5 \times 10^{-3}$

The Chromatic Dispersion Compensation (CDC) limit of TQD011-TUNC-SO is 8600ps/nm providing an operating range of 450km in amplified links.

TQD011-TUNC-SO also allows AES-256 encryption through I<sup>2</sup>C.

The transceiver is managed via I<sup>2</sup>C interface and according to CMIS 5.0.

The TQD011-TUNC-SO supports the following CMIS application codes:

CMIS Application code	Host format	Payload	Media Format	FEC	Modulation	Media Symbol Baud rate	Operating range	Encryption support
1	CAUI4	100G	OpenZR+	oFEC	DP-QPSK	30.1Gbd	450km	No
2	CAUI4 KR4 FEC	100G	OpenZR+	oFEC	DP-QPSK	30.1Gbd	450km	No
3	100GAUI-2 KP4 FEC	100G	OpenZR+	oFEC	DP-QPSK	30.1Gbd	450km	No
4	CAUI4	100G	FlexO-1	oFEC	DP-QPSK	31.6Gbd	450km	Yes
5	CAUI4 KR4 FEC	100G	FlexO-1	oFEC	DP-QPSK	31.6Gbd	450km	Yes
6	100GAUI-2 KP4 FEC	100G	FlexO-1	oFEC	DP-QPSK	31.6Gbd	450km	Yes
7	OTL4.4	100G	FlexO-1	oFEC	DP-QPSK	31.6Gbd	450km	Yes
8	CAUI4	100G	OTU4	SC-FEC	DP-DQPSK	28.0Gbd	450km	Yes
9	CAUI4 KR4 FEC	100G	OTU4	SC-FEC	DP-DQPSK	28.0Gbd	450km	Yes
10	100GAUI-2 KP4 FEC	100G	OTU4	SC-FEC	DP-DQPSK	28.0Gbd	450km	Yes
11	OTL4.2	100G	OTU4	SC-FEC	DP-DQPSK	28.0Gbd	450km	Yes

## TECHNICAL DATA

The optical characteristics are divided 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)
Typical reach	Unamplified: 130km Dispersion limited: 450km
Nominal wavelengths	Tunable C-band
Interface standards	OpenZR+ and OpenROADM
Protocol support	100GBASE-R SyncE
Power consumption	17.0W (Class 8)
Operating temperature	0°C to +75°C
Storage temperature	-40°C to +85°C

Parameter	Value
Transmit VOA dynamic range	0 - 10dB
Transmit wavelengths	191.275 - 196.125THz in minimum 6.25GHz steps
Tx In-Band OSNR	Min 34dB/0.1nm
Tx Out-Of-Band OSNR	Min 30dB/0.1nm
Rx Overload <sup>1)</sup>	Signal power: 13dBm Total power: 15dBm
Wavelength switch time	Max 86s channel to channel
DDM	Yes
MSA compliance	QSFP-DD MSA OpenZR+ MSA, OpenROADM MSA, CMIS 5.0

<sup>1)</sup> Specified to be within the pre-FEC BER range of the selected application code. Rx damage threshold is located at 16dBm.

### 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	Maximum, Tx Power <sup>1)</sup>	Rx sens @ high OSNR <sup>2)</sup>	Rx @ OSNR	Rx OSNR @0.5dB penalty	Rx OSNR @1dB penalty	CDC range @0.5dB OSNR penalty
1	100G	CAUI4	-5.0dBm to 0dBm	-32dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
2	100G	CAUI4 KR4 FEC	-5.0dBm to 0dBm	-32dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
3	100G	100GAUI-2 KP4 FEC	-5.0dBm to 0dBm	-32dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
4	100G	CAUI4	-5.0dBm to 0dBm	-32dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
5	100G	CAUI4 KR4 FEC	-5.0dBm to 0dBm	-32dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
6	100G	100GAUI-2 KP4 FEC	-5.0dBm to 0dBm	-32dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
7	100G	OTL4.2	-5.0dBm to 0dBm	-32dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
8	100G	CAUI4	-5.0dBm to 0dBm	-30dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
9	100G	CAUI4 KR4 FEC	-5.0dBm to 0dBm	-30dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
10	100G	100GAUI-2 KP4 FEC	-5.0dBm to 0dBm	-30dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm
11	100G	OTL4.4	-5.0dBm to 0dBm	-30dBm	15.5dB@-20dBm	16.0dB@-23dBm	16.5dB@-25dBm	8 600 ps/nm

1) The module transmit power can be provisioned up to the maximum available TX power which is somewhere in the range between -5.0 to 0dBm. The Tx power can be provisioned with up to 10dB below the maximum available power level. If the TX power is not provisioned by the host, the module TX power will default to the maximum available power.

2) Rx sensitivity is specified at a OSNR > 36dB,

FEC modes	Latency [ $\mu$ s]	Encryption Enabled [ $\mu$ s]
oFEC	11	13.5
SC-FEC	20	22.5

## ORDERING INFORMATION

Ordering code	Description
TQD011-TUNC-SO	QSFP-DD 100G Ethernet/OTN/OpenROADM, Coherent Tuneable SM 450km Encryption CMIS5.0 LC

## 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. DAC: Direct Attach Cable. Electrical cable with attached connectors. AOC: Active Optical Cable. Optical cable with attached connectors.
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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