

**DATASHEET 6.1****QSFP28 100G-ER4****QSFP28, 100G Ethernet ER4, SM 1296/1300/1305/1309nm, 40km, 18dB, LC, E-temp, I-temp****TQ2009-SL4X-SO**

The TQ2009-SL4x-SO is a QSFP28 form-factor transceiver for 100 Gbps Ethernet (100GBASE-ER4) applications. It is intended for use in inter- and intra-connect applications within and between data centers between switches, routers, storage equipment etc. The optical performance is in accordance with the 100G 4WDM-40 MSA standard, i.e. for optical distances up to 40km over a SingleMode (SM) fiber.

TQ2009-SL4x-SO uses four LANWDM channels/lanes @ 25.78 Gbps to transport an Ethernet signal.

Forward Error Correction (FEC) is required in the host equipment in order to ensure reliable system operation at the specified distance. The FEC type shall be as defined in IEEE802.3bj, i.e. Reed Solomon RS(528,514). The below optical parameters will provide a bit error ratio (BER) of 5×10^{-5} . FEC will render in the required BER of better than 1×10^{-12} .

Without FEC the distance performance will be reduced to 30km and the power budget to about 16dB.

TQ2009-SL4x-SO is provided in a E-temp version (TQ2009-SL4E-SO) and an I-temp version (TQ2009-SL4I-SO).

TECHNICAL DATA

Parameter	Value
Technology	Grey QSFP28
Transmission media	SM (2x LC)
Typical reach	40km
Nominal wavelength	Lane 1: 1295.56nm Lane 2: 1300.05nm Lane 3: 1304.58nm Lane 4: 1309.14nm
Interface standards	100G 4WDM-40 MSA
Bit rate support	103.12Gbps ¹⁾ 25.78Gbps ²⁾
Protocol support	100GbE
Power budget	10 – 18dB
Optical path penalty	2dB
Power consumption	< 5W for TQ2009-SL4I-SO < 5.5W for TQ2009-SL4E-SO
Operating temperature	-20°C to +85°C (TQ2009-SL4E-SO) -40°C to +85°C (TQ2009-SL4I-SO)
Storage temperature	-40°C to +85°C

- 1) Aggregated line rate 100GbE
- 2) Per lane
- 3) Average power
- 4) Specified at BER 5x10⁻⁵



Parameter	Value
Transmitter data:	
Output power, total	Max +12.5dBm ³⁾
Output power, per lane	Min: -0.3dBm ³⁾ Max: +6.5dBm ³⁾
Transmit wavelength	1294.53 – 1296.59nm 1299.02 – 1301.09nm 1303.54 – 1305.63nm 1308.09 – 1310.19nm
Receiver data:	
Minimum input power, per lane	-18.3dBm ^{3) 4)}
Overload (max power), per lane	-3.5dBm ^{3) 4)}
Wavelength range	1294.53 – 1296.59nm 1299.02 – 1301.09nm 1303.54 – 1305.63nm 1308.09 – 1310.19nm
LOS Assert	Min -35dBm
LOS De-assert	Max -25dBm
LOS Hysteresis	Min 0.5dB
DDM	Yes
MSA compliance	QSFP28 MSA 100G 4WDM-40

Safety/regulatory compliance:

TUV/UL/FDA (contact Smartoptics for latest certification information)

RoHS compliance

ORDERING INFORMATION

Ordering number	Description
TQ2009-SL4E-SO	QSFP28, 100G Eth 4WDM-40, SM 1296/1300/1305/1309nm, 40km, 18dB, LC, E-temp
TQ2009-SL4I-SO	QSFP28, 100G 4WDM-40 MSA, SM 1296/1300/1305/1309nm, 40km, 18dB, LC, I-temp

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.

GENERAL DEFINITIONS

Parameter	Description
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.

Smartoptics makes no warranties or representations, expressed or implied, of any kind relative to the information or any portion thereof contained in this document or its adaptation or use, and assumes no responsibility or liability of any kind, including, but not limited to, indirect, special, consequential or incidental damages, for any errors or inaccuracies contained in the information or arising from the adaptation or use of the information or any portion thereof. The information in this document is subject to change without notice.