# TSQL4-E11GH7C Optical Transceiver

## Single-Mode 40GBASE ER4 Transceiver, With Diagnostic Monitoring Duplex QSFP+ ER4 40km Transceiver

### Features

- Compliant with 40G Ethernet, IEEE802.3bm and 40GBASE-ER4 Standard
- QSFP+ MSA compliant
- Compliant with QDR/DDR Infiniband data rates
- Up to 11.2Gb/s data rate per wavelength
- 4 CWDM lanes MUX/ DEMUX design
- Up to 40km transmission on single mode fiber (SMF)
- Operating case temperature: 0 to 70°C
- Maximum power consumption 4.5W
- LC duplex connector
- RoHS compliant

### Applications

- 40GBASE-ER4 Ethernet Links
- Infiniband QDR and DDR interconnects
- Client-side 40G Telecom connections

### Description

This product is a 40Gb/s transceiver module designed for optical communication applications compliant with the 40GBASE-ER4 of the IEEE 802.3bm standard.

The module converts 4 input channels of 10Gb/s electrical data to 4 channels of CWDM optical signals and then multiplexes them into a single channel for 40Gb/s optical transmission. Reversely on the receiver side, the module de-multiplexes a 40Gb/s optical input into 4 channels of CWDM optical signals and then converts them to 4 output channels of electrical data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G.694.2.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP+ Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.



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## Absolute Maximum Ratings

These values represent the damage threshold of the module. Stress in excess of any of the individual Absolute Maximum Ratings can cause immediate catastrophic damage to the module even if all other parameters are within Recommended Operating Conditions.

| Parameters | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Power Supply Voltage | VCC | -0.5 | +3.6 | V |
| Storage Temperature | Tc | -40 | +85 | °C |
| Relative Humidity | RH | 0 | 85 | % |
| Damage Threshold, Each Lane | Thd | 3.8 | | Dbm |

## Recommended Operating Conditions

| Parameter | Symbol | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Power Supply Voltage | VCC | 3.15 | 3.30 | 3.45 | V |
| Operating Case Temperature | Tca | 0 | | 70 | °C |

## Electrical Characteristics

| Parameter | Symbol | Min. | Typical | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| **Transmitter** | | | | | | |
| Input Differential Impedance | Rin | - | 100 | - | Ω | 1 |
| Single-Ended Input Voltage Tolerance | | -0.3 | - | 4.0 | V | 3 |
| Ac Common Mode Input Voltage Tolerance | | 15 | - | - | Mv | |
| Differential Input Voltage Swing Threshold | | 50 | - | - | Mvp-P | |
| Differential Input Voltage Swing, Per Lane | Vin | 190 | - | 700 | Mvp-P | |
| **Receiver** | | | | | | |
| Output Differential Impedance | Rout | | 100 | | Ω | 1 |
| Differential Output Swing, Per Lane | Vout | 300 | | 850 | Mv | 2 |
| Ac Common Mode Output Voltage Tolerance | | | | 7.5 | Mv | |
| Single-Ended Output Voltage | | -0.3 | | 4.0 | V | |
| Differential Output Return Loss | | See Ieee 802.3bm 86a.4.2.1 | | | Db | |
| Common Mode Output Return Loss | | See Ieee 802.3bm 86a.4.2.2 | | | Db | |
| Output Transition Time (20% To 80%) | | 28 | | | Ps | |

**Notes:**

[1] AC coupled.

[2] Into 100 ohm differential termination.

[3] Referred to TP1 signal common. The single ended input voltage tolerance is the allowable range of the instantaneous input signals.

## Transmitter Specifications – Optical

| Parameter | | Symbol | Min | Typical | Max | Unit | Notes |
|---|---|---|---|---|---|---|---|
| Center Wavelength | Ch0 | λ0 | 1264.5 | 1271 | 1277.5 | nm | |
| | Ch1 | λ1 | 1284.5 | 1291 | 1297.5 | nm | |
| | Ch2 | λ2 | 1304.5 | 1311 | 1317.5 | nm | |
| | Ch3 | λ3 | 1324.5 | 1331 | 1337.5 | nm | |
| Data Rate, each lane | | | | 10.3125 | | Gb/s | |
| Side Mode Suppression Ratio | | SMSR | 30 | | | dB | |
| Total Average Launch Power | | PT | | | 10.5 | dBm | |
| Average Launch Power, each Lane | | PAVG | -2.7 | | 4.5 | dBm | |
| Optical Modulation Amplitude (OMA), each Lane | | POMA | 0.3 | | 5 | dBm | 1 |
| Difference in Launch Power between any Two Lanes (OMA) | | Ptx,diff | | | 4.7 | dB | |
| Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane | | | -05 | | | dBm | |
| TDP, each Lane | | TDP | | | 2.6 | dB | |
| Extinction Ratio | | ER | 5.5 | | | dB | |
| Relative Intensity Noise | | RIN | | | -128 | dB/Hz | 12dB reflection |
| Optical Return Loss Tolerance | | TOL | | | 20 | dB | |
| Transmitter Reflectance | | RT | | | -12 | dB | |
| Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3} | | | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4} | | | | |
| Average Launch Power OFF Transmitter, each Lane | | Poff | | | -30 | dBm | |

## Receiver Specifications – Optical

| Parameter | | Symbol | Min | Typical | Max | Unit | |
|---|---|---|---|---|---|---|---|
| Center Wavelength | Ch0 | λ0 | 1264.5 | 1271 | 1277.5 | nm | |
| | Ch1 | λ1 | 1284.5 | 1291 | 1297.5 | nm | |
| | Ch2 | λ2 | 1304.5 | 1311 | 1317.5 | nm | |
| | Ch3 | λ3 | 1324.5 | 1331 | 1337.5 | nm | |
| Data Rate, each lane | | | | 10.3125 | | Gb/s | |
| Damage Threshold, each Lane | | THd | 3.8 | | | dBm | 2 |
| Average Receive Power, each Lane | | | -19 | | -4.5 | dBm | |
| Receiver Reflectance | | RR | | | -26 | dB | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Receive Power (OMA), each Lane | | | | -4 | dBm | |
| Receiver Sensitivity (OMA), each Lane | SEN | | | -19 | dBm | 3 |
| Average receive power, each lane (min) | | | | -21.2 | dBm | |
| Difference in Receive Power between any Two Lanes (OMA) | Prx,diff | | | 7.5 | dB | |
| LOS Assert | LOSA | -35 | | | dBm | |
| LOS Deassert | LOSD | | | -23 | dBm | |
| LOS Hysteresis | LOSH | 0.5 | | | dB | |
| Receiver Electrical 3 dB upper Cutoff Frequency, each Lane | Fc | | | 12.3 | GHz | |

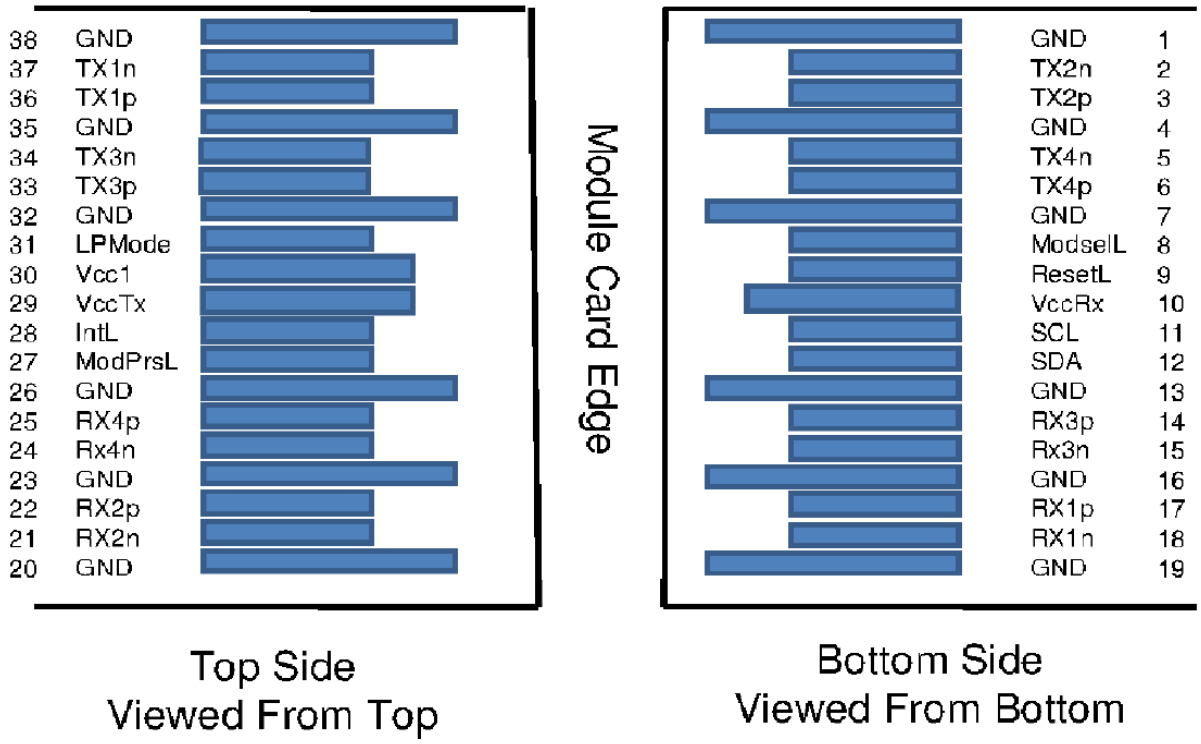
**Notes:**

[1] Even if the TDP < 0.8 dB, the OMA min must exceed the minimum value specified here.

[2] The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.

[3] Measured with conformance test signal at receiver input for BER = $1x10^{-12}$.

## Electrical Pad Layout




Top Side
Viewed From Top

Bottom Side
Viewed From Bottom

## Pin Definition

| Pin | Symbol | Name/Description |
|---|---|---|
| 1 | GND | Ground |
| 2 | Tx2n | Transmitter Inverted Data Input |
| 3 | Tx2p | Transmitter Non-Inverted Data Input |
| 4 | GND | Ground |
| 5 | Tx4n | Transmitter Inverted Data Input |
| 6 | Tx4p | Transmitter Non-Inverted Data Input |
| 7 | GND | Ground |
| 8 | ModSelL | Module Select |
| 9 | ResetL | Module Reset |
| 10 | VCC Rx | +3.3 V Power supply receiver |
| 11 | SCL | 2-wire serial interface clock |
| 12 | SDA | 2-wire serial interface data |
| 13 | GND | Ground |
| 14 | Rx3p | Receiver Non-Inverted Data Output |
| 15 | Rx3n | Receiver Inverted Data Output |
| 16 | GND | Ground |
| 17 | Rx1p | Receiver Non-Inverted Data Output |
| 18 | Rx1n | Receiver Inverted Data Output |
| 19 | GND | Ground |
| 20 | GND | Ground |
| 21 | Rx2n | Receiver Inverted Data Output |
| 22 | Rx2p | Receiver Non-Inverted Data Output |
| 23 | GND | Ground |
| 24 | Rx4n | Receiver Inverted Data Output |
| 25 | Rx4p | Receiver Non-Inverted Data Output |
| 26 | GND | Ground |
| 27 | ModPrsL | Module Present |
| 28 | IntL | Interrupt |
| 29 | VCC Tx | +3.3 V Power supply transmitter |
| 30 | VCC1 | +3.3 V Power Supply |
| 31 | LPMode | Low Power Mode |
| 32 | GND | Ground |
| 33 | Tx3p | Transmitter Non-Inverted Data Input |
| 34 | Tx3n | Transmitter Inverted Data Input |
| 35 | GND | Ground |
| 36 | Tx1p | Transmitter Non-Inverted Data Input |
| 37 | Tx1n | Transmitter Inverted Data Input |
| 38 | GND | Ground |

## Ordering Information

| Part Number | Product Description |
|---|---|
| TSQL4-E11GH7C | 40Gbps QSFP+ ER4 40km, 0°C ~ +70°C |

## Important Notice

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