

40GBASE-ER4 and OTU3 QSFP+ 1310nm 40km LC Transceiver for SMF

QSFPER4-LL



Application

- 40GBASE-ER4 40G Ethernet
- OTU3, OTU3e1, OTU3e2

Features

- Hot Pluggable QSFP+ form factor
- Supports 39.8Gb/s to 44.6 Gb/s aggregate bit rates
- Power dissipation <3.5W
- 18.5dB link insertion loss budget
- RoHS-6 compliant
- Single 3.3V power supply
- Maximum link length of 40km on Single Mode Fiber (SMF)
- Commercial operating case temperature range: 0°C to 70°C
- Uncooled 4x10Gb/s CWDM transmitter
- XLPI electrical interface
- Duplex LC receptacles
- Built-in digital diagnostic functions, including optical power monitoring

Description

QSFP+ transceiver modules are designed for use in 40 Gigabit Ethernet links and 4x10G OTN client interfaces over single mode fiber. They are compliant with the QSFP+ MSA , IEEE 802.3bm 40GBASE-ER4 and OTU3 requirements specified in ITU-T Recommendation G.695 as adapted to a 40km interface. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The optical transceiver is RoHS compliant per Directive 2011/65/EU.

Product Specifications

I.General Product Characteristics

| Parameter | Value | Unit | Notes | | | |
|---|--|-------|-------------------------------------|-------------------|------------|------|
| Module Form Factor | QSFP+ | | | | | |
| Number of Lanes | 4 Tx and 4 Rx | | | | | |
| Maximum Aggregate Data Rate | 44.6 | Gb/s | | | | |
| Maximum Data Rate per Lane | 11.2 | Gb/s | | | | |
| Protocols Supported | Typical applications include OTN OTU3, 40G Ethernet, Infiniband, SATA/SAS3 | | | | | |
| Electrical Interface and Pin-out | 38-pin edge connector | | Pin-out as defined by the QSFP+ MSA | | | |
| Maximum Power Consumption | 3.5 | Watts | | | | |
| Management Interface | Serial, I2C-based, 400 kHz maximum frequency | | As defined by the QSFP+ MSA | | | |
| Data Rate Specifications | Symbol | Min | Typ. | Max | Units | Ref. |
| Bit Rate per Lane | BR | 9.95 | | 11.15 | Gb/sec | 1 |
| Bit Error Ratio | BER | | | 10 ⁻¹² | | 2 |
| Link distance on SMF-28 | d | 0.002 | | 40 | kilometers | 3 |

Notes:

- Compliant with 40GBASE-ER4 and XLPP1 per IEEE 802.3bm, OTU3 C4S1-2D1 per ITU-T Rec.
- G.695 and OTU3e1/OTU3e2 per ITU-T G-Series Rec. Supplement 43. Compatible with
- 1/10 Gigabit Ethernet and 1/2/4/8/10G Fibre Channel.
- Tested with a PRBS 231-1 test pattern.
- Per 40GBASE-ER4, IEEE 802.3bm. Links longer than 30km are considered to be
- Engineered links, with losses less than the worst case specified for the fiber type.

II. Absolute Maximum Ratings

| Parameter | Symbol | Min | Typ. | Max | Unit | Ref. |
|----------------------------|-----------------------|------|------|-----|------|------|
| Maximum Supply Voltage | Vcc1, VccTx, VccRx | -0.5 | | 3.6 | V | |
| Storage Temperature | Ts | -40 | | 85 | ° C | |
| Case Operating Temperature | Top | 0 | | 70 | ° C | |
| Relative Humidity | RH | 0 | | 85 | % | 1 |
| Damage Threshold, per Lane | DT | 3.4 | | | dBm | |

Notes:

1. Non-condensing..

III. Electrical Characteristics (TOP = 0 to 70°C, VCC = 3.1 to 3.47 Volts)

| Parameter | Symbol | Min | Typ. | Max | Unit | Ref. |
|-----------------------|--------------------------|-----|------|------|------|------|
| Supply Voltage | Vcc1, VccTx, VccRx | 3.1 | | 3.47 | V | |
| Supply Current | Icc | | | 1.13 | A | |
| Transmit turn-on time | | | | 2000 | ms | 1 |

Transmitter (per Lane)

| | | | | | | |
|--|--------|--------------------------------------|-----------------------|------|----------|---|
| Single ended input voltage tolerance | VinT | -0.3 | | 4.0 | V | |
| Differential data input swing | Vin,pp | 120 | | 1200 | mVpp | 2 |
| Differential input threshold | | | 50 | | mV | |
| AC common mode input voltage tolerance (RMS) | | 15 | | | mV | |
| Differential input return loss | | Per IEEE P802.3ba, Section 86A.4.1.1 | | | dB | 3 |
| J2 Jitter Tolerance | Jt2 | 0.17 | | | UI | |
| J9 Jitter Tolerance | Jt9 | 0.29 | | | UI | |
| Data Dependent Pulse Width Shrinkage | DDPWS | 0.07 | | | UI | |
| Eye mask coordinates {X1, X2, Y1, Y2} | | | 0.11, 0.31 95, 350 | | UI mV | 4 |

Receiver (per Lane)

| | | | | | | |
|---|---------------------|-------------------------------------|--|------|----------|---|
| Single-ended output voltage | | -0.3 | | 4.0 | V | |
| Differential data output swing | V _{out,pp} | 0 | | 800 | mVpp | 5 |
| AC common mode output voltage (RMS) | | | | 7.5 | mV | |
| Termination mismatch at 1 MHz | | | | 5 | % | |
| Differential output return loss | | Per IEEE P802.3ba,Section 86A.4.2.1 | | | dB | 3 |
| Common mode output return loss | | Per IEEE P802.3ba,Section 86A.4.2.2 | | | dB | 3 |
| Output transition time, 20% to 80% | | 28 | | | ps | |
| J2 Jitter output | Jo2 | | | 0.42 | UI | |
| J9 Jitter output | Jo9 | | | 0.65 | UI | |
| Eye mask coordinates #1 {X1, X2, Y1, Y2} | | 0.29, 0.5 150, 425 | | | UI mV | 4 |
| Power Supply Ripple Tolerance | PSR | 50 | | | mVpp | |

Notes:

1. From power-on and end of any fault conditions.
2. After internal AC coupling. Self-biasing 100Ω differential input.
3. 10 MHz to 11.1 GHz range
4. Hit ratio = 5 x 10E-5.
5. AC coupled with 100Ω differential output impedance.

IV. Optical Characteristics (TOP = 0 to 70°C, VCC = 3.1 to 3.47 Volts)

| Parameter | Symbol | Min | Typ. | Max | Unit | Ref. |
|---|--------------------|------------------------------------|--|-------|-------|------|
| Transmitter (per Lane) | | | | | | |
| Signaling Speed per Lane | | 9.95 | | 11.15 | GBd | 1 |
| Lane Center wavelengths (range) | | | 1264.5-1277.5 1284.5-1297.5 1304.5-1317.5 1324.5-1337.5 | | nm | |
| Total Average LaunchPower | P _{out} | | | 10.5 | dBm | |
| Average Launch Power per Lane | TXP _x | -2.7 | | 4.5 | dBm | 2 |
| Transmit OMA per Lane | TxOMA | 0.3 | | 5.0 | dBm | |
| Difference in Power between any two lanes (OMA) | DP _x | | | 4.7 | dB | |
| Transmitter Dispersion Penalty | TDP | | | 2.6 | dB | |
| Launch Power (OMA) minus TDP per Lane | P-TDP | -0.5 | | | dBm | |
| Optical Extinction Ratio | ER | 5.5 | | | | |
| Sidemode Suppression ratio | SS _{Rmin} | 30 | | | dB | |
| Average launch power of OFF transmitter, per lane | | | | -30 | dBm | |
| Relative Intensity Tolerance | RIN | | | -128 | dB/Hz | 3 |
| Optical Return Loss Tolerance | ORL | | | 20 | | |
| Transmitter Reflectance | | | | -12 | dB | |
| Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} | | (0.25, 0.4, 0.45, 0.25, 0.28, 0.4) | | | | |
| Jitter Generation | | Per OTL3.4 section 4.14.1 | | | | |

Receiver (per Lane)

| | | | | | | |
|--|------------------|-------|--|-------|-----|---|
| Signaling Speed per Lane | | 9.95 | | 11.15 | GBd | 4 |
| Lane Center wavelengths (range) | | | 1264.5-1277.5 1284.5-1297.5 1304.5-1317.5 1324.5-1337.5 | | nm | |
| Receive Power (OMA) per Lane | RxOMA | | | -4.0 | dBm | |
| Average Receive Power per Lane | RXP _x | -21.2 | | -4.5 | dBm | 5 |
| Receiver Sensitivity (OMA) per Lane | Rxsens | | | -19 | dBm | |
| Stressed Receiver | SRS | | | -16.8 | dBm | |
| Damage Threshold per Lane | P _{MAX} | | | 3.8 | dBm | |
| Return Loss | RL | | | -26 | dB | |
| Jitter Tolerance | | | Per OTL3.4, G.8251 | | | |
| Vertical eye closure penalty, per lane | | | | 2.2 | | |
| Receive electrical 3dB upper cutoff frequency, per lane | | | | 12.3 | GHz | |
| LOS De-Assert | LOS _D | | | TBD | dBm | |
| LOS Assert | LOS _A | TBD | | | dBm | |
| LOS Hysteresis | | | 1 | | dB | |

Notes:

1. Transmitter consists of 4 lasers operating at up to 11.2 Gb/s each, +/- 20ppm
2. Minimum value is informative.
3. RIN is scaled by $10 \cdot \log(10/4)$ to maintain SNR outside of transmitter.
4. Receiver consists of 4 photodetectors operating at up to 11.15 Gb/s each, +/- 100ppm
5. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.

V. Pin Description

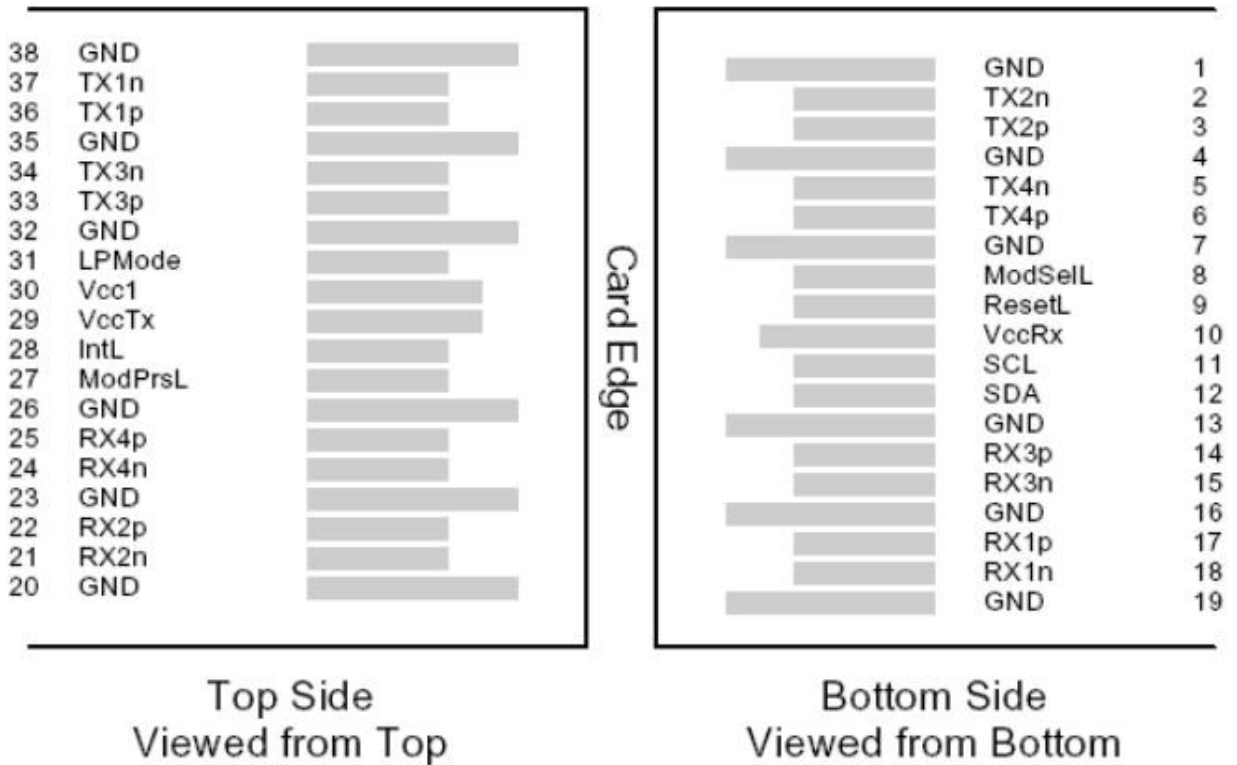


Figure 1 – QSFP+ MSA-compliant 38-pin connector

| Pin | Symbol | Name/Description | Notes |
|-----|---------|-------------------------------------|-------|
| 1 | GND | Ground | 1 |
| 2 | Tx2n | Transmitter Inverted Data Input | |
| 3 | Tx2p | Transmitter Non-Inverted Data Input | |
| 4 | GND | Ground | 1 |
| 5 | Tx4n | Transmitter Inverted Data Input | |
| 6 | Tx4p | Transmitter Non-Inverted Data Input | |
| 7 | GND | Ground | 1 |
| 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 | 1 |
| 14 | Rx3p | Receiver Non-Inverted Data Output | |
| 15 | Rx3n | Receiver Inverted Data Output | |
| 16 | GND | Ground | 1 |
| 17 | Rx1p | Receiver Non-Inverted Data Output | |
| 18 | Rx1n | Receiver Inverted Data Output | |
| 19 | GND | Ground | 1 |
| 20 | GND | Ground | 1 |
| 21 | Rx2n | Receiver Inverted Data Output | |
| 22 | Rx2p | Receiver Non-Inverted Data Output | |
| 23 | GND | Ground | 1 |
| 24 | Rx4n | Receiver Inverted Data Output | |
| 25 | Rx4p | Receiver Non-Inverted Data Output | |
| 26 | GND | Ground | 1 |
| 27 | ModPrsL | Module Present | |
| 28 | IntL | Interrupt | |
| 29 | Vcc Tx | +3.3 V Power supply transmitter | |
| 30 | Vcc1 | +3.3 V Power Supply | |
| 31 | LPMMode | Low Power Mode | |
| 32 | GND | Ground | 1 |
| 33 | Tx3p | Transmitter Non-Inverted Data Input | |

| | | | |
|----|------|-------------------------------------|---|
| 34 | Tx3n | Transmitter Inverted Data Input | |
| 35 | GND | Ground | 1 |
| 36 | Tx1p | Transmitter Non-Inverted Data Input | |
| 37 | Tx1n | Transmitter Inverted Data Input | |
| 38 | GND | Ground | 1 |

Note:

Circuit ground is internally isolated from chassis ground.

VI. Mechanical Specifications

The mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

