

Product Specification

40GE LM4 QSFP+ Optical Transceiver Module

MTL4C2QE1C

PRODUCT FEATURES

- Hot-pluggable QSFP+ form factor
- Operates over duplex multimode fiber with dual LC receptacles
- Supports 41.2 Gb/s aggregate bit rate
- Power dissipation < 3.5W
- Commercial case temperature range 0°C to 70°C
- Maximum link length of 140m on OM3 and 160m on OM4
- Uncooled 4x10Gb/s CWDM transmitter
- XLPPI electrical interface
- Built-in digital diagnostic functions, including Tx/Rx power monitoring
- RoHS-6 compliant



APPLICATION

- 40G Ethernet over MMF

Morita semi's MTL4C2QE1C QSFP+ transceiver modules are designed for use in 40 Gigabit Ethernet links over duplex multimode fiber. They are compliant with the QSFP+ MSA^{1,2} and represent a multimode adaptation of IEEE 802.3ba 40GBASE-LR4³ referred to as LM4. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The optical transceiver is compliant per the RoHS Directive 2011/65/EU⁴. See Morita semi Application Note AN-2038 for more details.

PRODUCT SELECTION

MTL4C2QE1C

I. Pin Descriptions

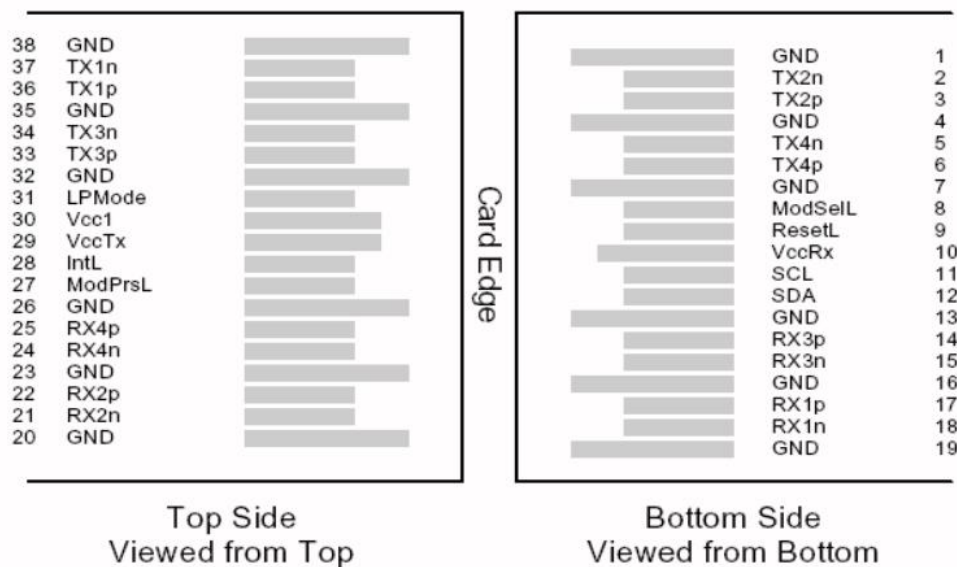


Figure 1 – QSFP+ MSA-compliant 38-pin connector

| 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 | LPMode | 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 |

Notes

1. Circuit ground is internally isolated from chassis ground.

II. General Product Characteristics

| Parameter | Value | Unit | Notes |
|---------------------------------------------------------|----------------------------------------------|-------|----------------------------------------------------------------|
| Module Form Factor | QSFP+ | | |
| Maximum Aggregate Data Rate | 41.2 | Gb/s | |
| Maximum Data Rate per Lane | 10.3 | Gb/s | Higher bit rates may be supported. Please contact Morita semi. |
| Protocols Supported Electrical Interface and Pin-out | 40G Ethernet 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 | | | 10,313 | Mb/sec | 1 |
| Bit Error Ratio | BER | | | 10 | | 2 |
| Link distance on OM3 | d | | | 140 ² | m | |
| Link distance on OM4 | d | | | 160 | m | |

Notes:

1. Adapted from 40GBASE-LR4, IEEE 802.3ba
2. Tested with a PRBS 2³¹-1 test pattern.

III. 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.

IV. Electrical Characteristics (T_{OP} = 0 to 70°C, V_{CC} = 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 | |
| Link turn-on time | | | | | | |
| Transmit turn-on time | | | | 2000 | ms | 2 |
| Transmitter (per Lane) | | | | | | |
| Single ended input voltage tolerance | VinT | -0.3 | | 4.0 | V | 3 |
| Differential data input swing | Vin,pp | 120 | | 1200 | mVpp | |
| 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 | 4 |
| 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 | 5 |
| Receiver (per Lane) | | | | | | |
| Single-ended output voltage | | -0.3 | | 4.0 | V | 6 |
| Differential data output swing | Vout,pp | 0 | | 800 | mVpp | |
| 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 | 4 |
| Common mode output return loss | | | | Per IEEE P802.3ba, Section 86A.4.2.2 | dB | 4 |
| 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 | 5 |
| Power Supply Ripple Tolerance | PSR | 50 | | | mVpp | |

Notes:

1. Maximum total power value is specified across the full temperature and voltage range.

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

V. Optical Characteristics (T_{OP} = 0 to 70°C, V_{CC} = 3.1 to 3.47 Volts, OM3 or OM4)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|----------------------------------------------------------|--------------------|-------|--------------------------------------------------------------------------|---------|-------|------|
| Transmitter | | | | | | |
| Signaling Speed per Lane | | | | 10.3125 | 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 Launch Power | P _{OUT} | | | 10.3 | dBm | |
| Transmit OMA per Lane | TxOMA | -3.0 | | 4.8 | dBm | |
| Average Launch Power per Lane | TXP _x | -7.0 | | 4.3 | dBm | 2 |
| Optical Extinction Ratio | ER | 3.5 | | | dB | |
| Transmitter Dispersion Penalty | TDP | | | 4.7 | dB | 3 |
| Transmitter OMA - TDP | TxP-TDP | | | -6.8 | dBm | |
| Sidemode Suppression ratio | SSR _{min} | 30 | | | dB | |
| Average launch power of OFF transmitter, per lane | | | | -30 | dBm | |
| Relative Intensity Noise | RIN | | | -128 | dB/Hz | 4 |
| Optical Return Loss Tolerance | | | | 20 | dB | |
| 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} | | | |
| Receiver | | | | | | |
| Signaling Speed per Lane | | | | 10.3125 | GBd | 5 |
| 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 | | | 4.8 | dBm | 6 |
| Average Receive Power per Lane | RXP _x | -10.0 | | 4.3 | dBm | |
| Receiver Sensitivity (OMA) per Lane | Rxsens | | | -10.5 | dBm | |
| Stressed Receiver Sensitivity (OMA) per Lane | SRS | | | -5.0 | dBm | |
| Damage Threshold per Lane | P _{MAX} | | | 5.5 | dBm | |
| Return Loss | RL | | | -20 | dB | |
| Vertical eye closure penalty, per lane | | | | 3.6 | dB | |
| Receive electrical 3 dB upper cutoff frequency, per lane | | | | 12.3 | GHz | |
| LOS De-Assert | LOS _D | | | -12 | dBm | |
| LOS Assert | LOS _A | -28 | | | dBm | |
| LOS Hysteresis | | | 1 | | dB | |

Notes:

1. Transmitter consists of 4 lasers operating at 10.3Gb/s each.
2. Minimum value is informative.
3. Even if TDP < 0.5 dB, TxP – TDP must be greater than this value.
4. RIN is scaled by $10 \cdot \log(10/4)$ to maintain SNR outside of transmitter.
5. Receiver consists of 4 photodetectors operating at 10.3Gb/s each.
6. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.

VI. Memory Map and Control Registers

Compatible with SFF-8436 (QSFP+ MSA)² and SFF-8636 QSFP Common Management Interface)⁶. See Morita semi Application Note AN-2104 for complete EEPROM memory maps.

VII. Environmental Specifications

Morita semi MTL4C2QE1C transceivers have an operating temperature range from 0°C to +70°C case temperature.

| Environmental Specifications | Symbol | Min | Typ | Max | Units | Ref. |
|------------------------------|------------------|-----|-----|-----|-------|------|
| Case Operating Temperature | T _{op} | 0 | | 70 | °C | |
| Storage Temperature | T _{sto} | -40 | | 85 | °C | |

VIII. Regulatory Compliance

Morita semi MTL4C2QE1C transceivers are RoHS-6 Compliant. Copies of certificates are available at Morita semi Corporation upon request.

MTL4C2QE1C transceiver modules are Class 1 laser eye safety compliant per IEC 60825-1.

IX. Mechanical Specifications

The MTL4C2Q mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

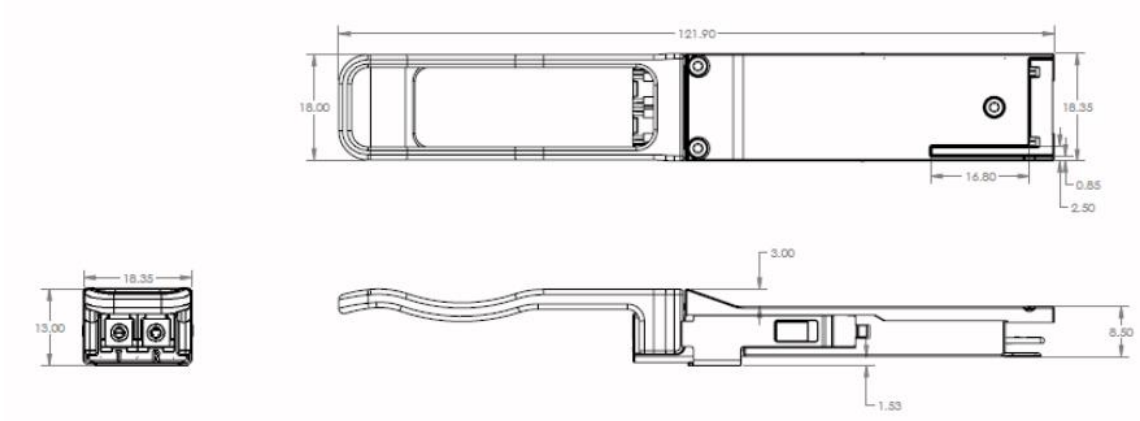


Figure 2 – MTL4C2QE1C mechanical drawing