

Product Specification

40GBASE-LR4 QSFP+ Optical Transceiver Module

FTL4C1QE1C

PRODUCT FEATURES

- Hot-pluggable QSFP+ form factor
- Supports 41.2 Gb/s aggregate bit rates
- Power dissipation < 3.5W
- RoHS-6 compliant (lead-free)
- Commercial case temperature range 0°C to 70°C
- Single 3.3V power supply
- Maximum link length of 10km on Single Mode Fiber (SMF)
- Uncooled 4x10Gb/s CWDM transmitter
- XLPI electrical interface
- Duplex LC receptacles
- Built-in digital diagnostic functions, including Tx/Rx power monitoring



APPLICATIONS

- 40GBASE-LR4 40G Ethernet

Finisar's FTL4C1QE1C QSFP+ transceiver modules are designed for use in 40 Gigabit Ethernet links over single mode fiber. They are compliant with the QSFP+ MSA^{1,2} and IEEE 802.3ba 40GBASE-LR4³. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The transceiver is RoHS compliant per Directive 2011/65/EU⁴ and Finisar Application Note AN-2038⁵.

PRODUCT SELECTION

FTL4C1QE1C

- E: 40GBASE-LR4 compliant optical interface
- 1: First generation product
- C: Commercial temperature rate

I. Pin Descriptions

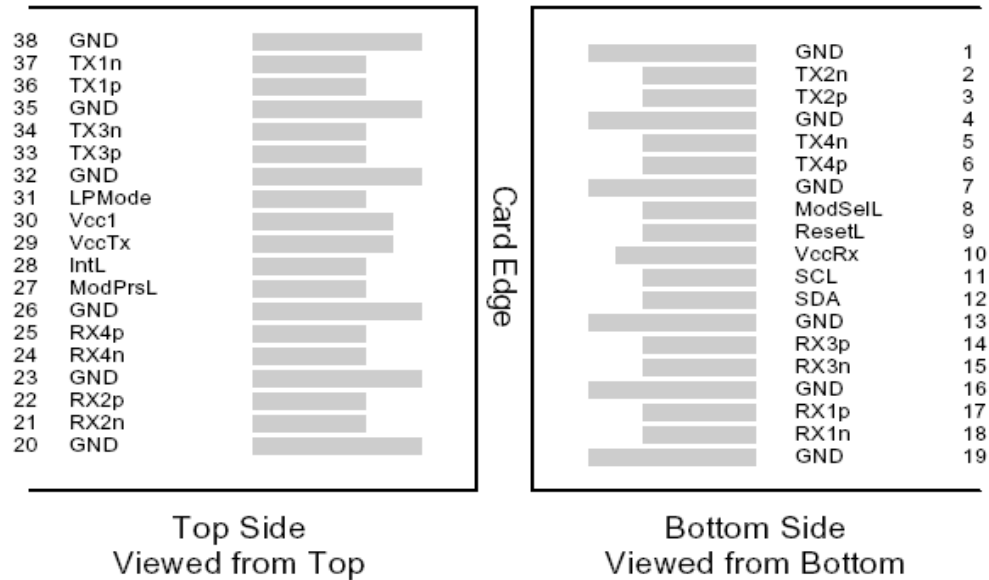


Figure 1 – QSFP+ MSA-compliant 38-pin connector

| 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 Finisar. |
| Protocols Supported | Typical applications include 40G Ethernet, Infiniband, Fibre Channel, 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 | | | 10,313 | Mb/sec | 1 |
| Bit Error Ratio | BER | | | 10^{-12} | | 2 |
| Link distance on SMF-28 | d | | | 10 | kilometers | 3 |

Notes:

1. Compliant with 40GBASE-LR4 and XLPP1 per IEEE 802.3ba. Compatible with 1/10 Gigabit Ethernet and 1/2/4/8/10G Fibre Channel.
2. Tested with a PRBS $2^{31}-1$ test pattern.
3. Per 40GBASE-LR4, IEEE 802.3ba

III. Absolute Maximum Ratings

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|----------------------------|--|------|-----|-----|------|------|
| Maximum Supply Voltage | V _{cc1} , V _{ccTx} , V _{ccRx} | -0.5 | | 3.6 | V | |
| Storage Temperature | T _S | -40 | | 85 | °C | |
| Case Operating Temperature | T _{OP} | 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 | V _{cc1} , V _{ccTx} , V _{ccRx} | 3.1 | | 3.47 | V | |
| Supply Current | I _{cc} | | | 1.13 | A | |
| Link turn-on time | | | | | | |
| Transmit turn-on time | | | | 2000 | ms | 2 |
| Transmitter (per Lane) | | | | | | |
| Single ended input voltage tolerance | V _{inT} | -0.3 | | 4.0 | V | |
| Differential data input swing | V _{in,pp} | 120 | | 1200 | mV _{pp} | 3 |
| 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 | J _{t2} | 0.17 | | | UI | |
| J9 Jitter Tolerance | J _{t9} | 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 | |
| Differential data output swing | V _{out,pp} | 0 | | 800 | mV _{pp} | 6 |
| 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 | J _{o2} | | | 0.42 | UI | |
| J9 Jitter output | J _{o9} | | | 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 | | | mV _{pp} | |

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 = 5×10^{-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)

| 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} | | | 8.3 | dBm | |
| Transmit OMA per Lane | $TxOMA$ | -4.0 | | 3.5 | dBm | |
| Average Launch Power per Lane | TXP_x | -7.0 | | 2.3 | dBm | 2 |
| Optical Extinction Ratio | ER | 3.5 | | | dB | |
| Sidemode Suppression ratio | SSR_{min} | 30 | | | dB | |
| Average launch power of OFF transmitter, per lane | | | | -30 | dBm | |
| Relative Intensity Noise | RIN | | | -128 | dB/Hz | 3 |
| 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 | 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 | $RxOMA$ | | | 3.5 | dBm | |
| Average Receive Power per Lane | RXP_x | -13.7 | | 2.3 | dBm | 5 |
| Receiver Sensitivity (OMA) per Lane | $Rxsens$ | | | -11.5 | dBm | |
| Stressed Receiver Sensitivity (OMA) per Lane | SRS | | | -9.6 | dBm | |
| Damage Threshold per Lane | P_{MAX} | | | 3.3 | dBm | |
| Return Loss | RL | | | -26 | dB | |
| Vertical eye closure penalty, per lane | | | | 1.9 | dB | |
| Receive electrical 3 dB upper cutoff frequency, per lane | | | | 12.3 | GHz | |
| LOS De-Assert | LOS_D | | | -15 | 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. RIN is scaled by $10 \cdot \log(10/4)$ to maintain SNR outside of transmitter.
4. Receiver consists of 4 photodetectors operating at 10.3Gb/s each.
5. 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+). Please see Finisar Application Note AN-2104⁶.

VII. Environmental Specifications

Finisar FTL4C1Q 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

Finisar FTL4C1Q transceivers are RoHS-6 Compliant. Copies of certificates are available at Finisar Corporation upon request.

FTL4C1Q transceiver modules are Class 1 laser eye safety compliant per IEC 60825-1.

IX. Mechanical Specifications

The FTL4C1Q mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

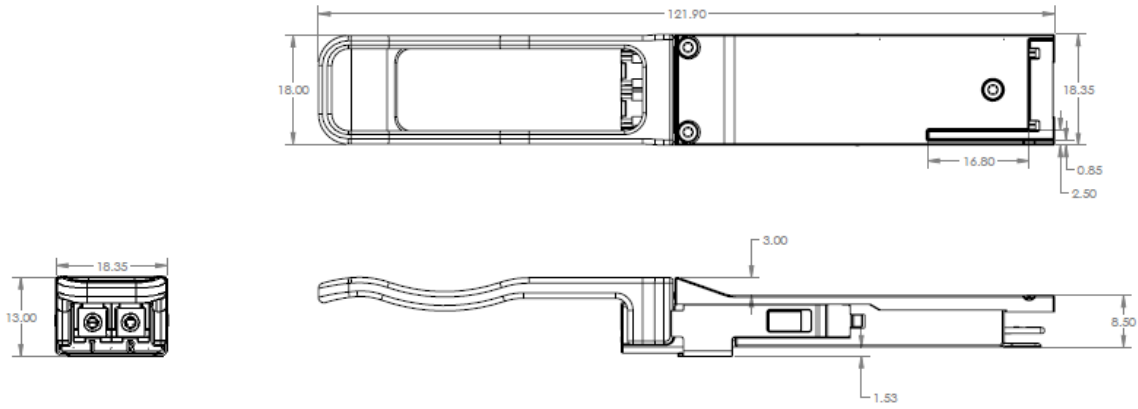


Figure 2 – FTL4C1Q mechanical drawing



Figure 3 – FTL4C1QE1C production label

X. References

1. INF-8438i – Specification for QSFP (Quad Small Formfactor Pluggable) Transceiver, Rev 1.0, November 2006.
2. SFF-8436 – Specification for QSFP+ Copper and Optical Transceiver, Rev 4.7, February 2013.
3. IEEE 802.3ba – PMD Type 40GBASE-LR4.
4. Directive 2011/65/EU of the European Council Parliament and of the Council, “on the restriction of the use of certain hazardous substances in electrical and electronic equipment,” June 8, 2011, which supercedes the previous RoHS Directive 2002/95/EC.
5. “Application Note AN-2038: Finisar Implementation of RoHS Compliant Transceivers”, Finisar Corporation, January 21, 2005.
6. “Application Note AN-2104: QSFP+ 40G LR4 Transceiver EEPROM Mapping,” Rev. A, Finisar Corporation, June, 2013.

XI. For More Information

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