

Product Specification

40GE SWDM4 QSFP+ Optical Transceiver Module

FTL4S1QE2C

PRODUCT FEATURES

- Hot-pluggable QSFP+ form factor
- 300m operation over duplex OM3 MMF 400m over duplex OM4 MMF, 500m over duplex OM5 MMF
- Supports 41.2 Gb/s aggregate bit rate
- Uncooled 4x10Gb/s SWDM transmitter
- Built-in SWDM mux and demux
- Power dissipation < 3.5W
- Commercial case temperature range 0°C to 70°C
- XLPP electrical interface
- Duplex LC receptacles
- Built-in digital diagnostic functions, including Tx/Rx power monitoring



APPLICATIONS

- 40G Ethernet over duplex MMF
- Allows upgrades from 10GBASE-SR without changing fiber plant

FTL4S1QE2C 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 IEEE 802.3ba XLPP electrical interface³. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The optical transceiver is compliant as described in Application Note AN-2038.

PRODUCT SELECTION

FTL4S1QE2C

FTL: Finisar transceiver Q: QSFP+ form factor C: Commercial temperature range
4: 4 optical WDM channels E: Ethernet
S1: Shortwave WDM 2: Second generation product

I. Pin Descriptions

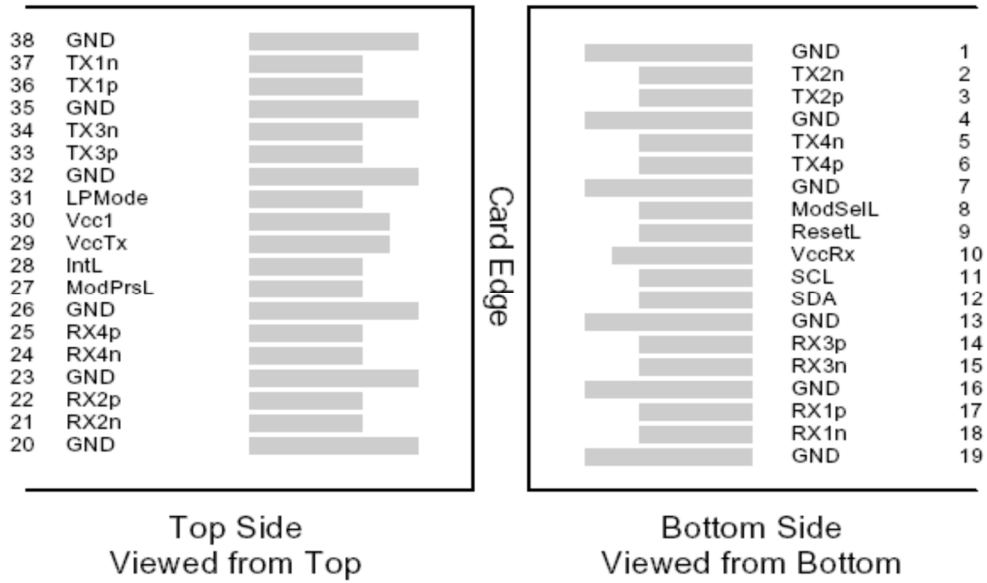


Figure 1 – QSFP+ MSA-compliant 38-pin connector

| 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 | |
| Protocols Supported | 40G Ethernet | | |
| Electrical Interface and Pin-out | 38-pin edge connector | | Pin-out as defined by the QSFP+ MSA |
| Maximum Power Consumption | 3.5 | Watts | 1 |
| Management Interface | Serial, I2C-based, 400 kHz maximum frequency | | As defined by the QSFP+ MSA |

Notes:

1. Will be <3.5W in link established mode. If the input optical signal is without data, the CDR will keep searching and push the power consumption over the maximum spec.

| Data Rate Specifications | Symbol | Min | Typ | Max | Units | Ref. |
|--------------------------|--------|-----|-----|-------------------|--------|------|
| Bit Rate per Lane | BR | | | 10.3125 | Mb/sec | 1 |
| Bit Error Ratio | BER | | | 10 ⁻¹² | | 2 |
| Link distance on OM3 | d | 0 | | 300 | meters | |
| Link distance on OM4 | d | 0 | | 400 | meters | |

Notes:

1. Compliant with XLPPPI per 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 | 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 | 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} | | | 0.9 | A | 1 |
| 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} | 200 | | 400 | mV _{pp} | 6, 7 |
| | | 300 | | 600 | | |
| | | 400 | | 800 | | |
| | | 600 | | 1200 | | |
| AC common mode output voltage (RMS) | | | | 7.5 | mV | |
| Termination mismatch at 1 MHx | | | | 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 | mVpp | |

Notes:

1. Will be <3.5W in link established mode. If the input optical signal is without data, the CDR will keep searching and push the supply current over the maximum spec.
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.
7. Output voltage is settable in 4 discrete steps via I2C.

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

Per-channel optical characteristics vary over the 4 wavelengths. Below are the worst-case

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|--|-----------------------|-----------------------------------|--------------------------|------|-------|------|
| Transmitter | | | | | | |
| Signaling Speed per Lane | | | 10.3125 | | GBd | 1 |
| Lane center wavelengths | | | 850 880 910 940 | | nm | |
| Spectral width @ 850nm | SBW | | | 0.53 | | |
| Spectral width @ 880nm, 910nm, 940nm | SBW | | | 0.59 | nm | |
| Total Average Launch Power | P _{OUT} | -1.5 | | 9.0 | dBm | 3 |
| Average Launch Power per Lane | TXP _x | -7.5 | | 3.0 | dBm | 2,3 |
| Transmit OMA per Lane | TxOMA | -5.5 | | 3 | dBm | 2 |
| Difference in Launch Power between any 2 lanes (OMA) | TxOMA _{DIFF} | | | 4.5 | dB | |
| Launch Power Tx OMA - TDP | | -7.6 | | | dBm | |
| Transmitter and Dispersion Eye Closure @ 850nm | TDEC | | | 3.7 | dB | |
| Transmitter and Dispersion Eye Closure @ 880nm | TDEC | | | 4.0 | dB | |
| Transmitter and Dispersion Eye Closure @ 910nm | TDEC | | | 4.5 | dB | |
| Transmitter and Dispersion Eye Closure @ 940nm | TDEC | | | 5.0 | dB | |
| Optical Extinction Ratio | ER | 2.0 | | | dB | |
| Average launch power of OFF transmitter, per lane | | | | -30 | dBm | |
| Relative Intensity Noise | RIN | | | -128 | dB/Hz | 4 |
| Optical Return Loss Tolerance | | 12 | | | dB | |
| Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} | | 0.23, 0.34, 0.43, 0.27, 0.35, 0.4 | | | | |
| Receiver | | | | | | |
| Signaling Speed per Lane | | | 10.3125 | | GBd | 5 |
| Lane center wavelengths | | | 850 880 | | nm | |

| | | | 910 940 | | | |
|--|------------------|------|------------|------|-----|-----|
| Average Receive Power per Lane | RXP _x | -9.0 | | 3.0 | dBm | 2,6 |
| Receive Power (OMA) per Lane | RxOMA | | | 3 | dBm | 2 |
| Receiver Sensitivity (OMA) per Lane | Rxsens | | | -9.1 | dBm | 2,7 |
| Stressed Receiver Sensitivity (OMA) per Lane @ 850nm | SRS | | | -5.7 | dBm | 2 |
| Stressed Receiver Sensitivity (OMA) per Lane @ 880nm, 910nm, 940nm | SRS | | | -4.4 | dBm | 2 |
| Return Loss | RL | | | 12 | dB | |
| LOS De-Assert | LOS _D | | | -10 | dBm | |
| LOS Assert | LOS _A | -30 | | | dBm | |
| LOS Hysteresis | | 0.5 | | | dB | |

Notes:

1. Transmitter consists of 4 lasers operating at 10.3Gb/s each.
2. This value varies among the 4 channels. The value shown is for the worst-case channel.
3. Minimum value is informative.
4. Maximum value is informative. TDP guarantees Tx performance
5. Receiver consists of 4 photodetectors operating at 10.3 Gb/s each.
6. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.
7. Maximum value is informative based on a theoretical perfect unstressed optical source

VI. Memory Map and Control Registers

Compatible with SFF-8636 (QSFP+)². See Finisar Application Note AN-2104⁶ for details of the EEPROM memory map.

VII. Environmental Specifications

Finisar FTL4S1QE2C 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 FTL4S1QE2C transceivers are RoHS-6 compliant.⁴ Copies of certificates are available at Finisar Corporation upon request.

FTL4S1QE2C transceiver modules are Class 1 laser eye safety compliant per IEC 60825-1.

CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

IX. Mechanical Specifications

The FTL4S1QE2C mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

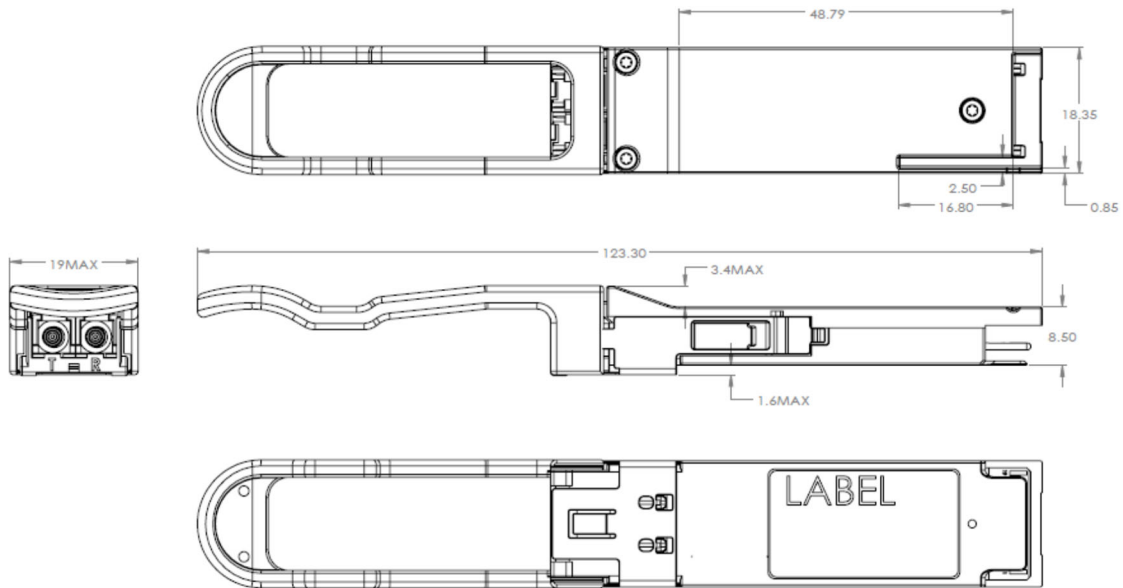


Figure 2 – FTL4S1QE2C mechanical drawing

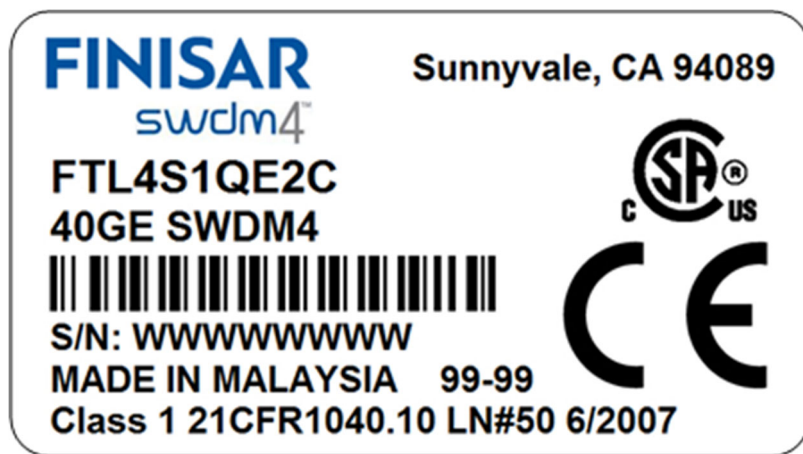


Figure 3 – FTL4S1QE2C production label

X. References

1. SFF-8436 – Specification for QSFP+ Copper and Optical Transceiver, Rev 4.8, October 2013.
2. SFF-8636 – Common Management Interface, Rev 2.7, January, 2016.
3. IEEE 802.3ba – Annex 86A “Parallel Physical Interface (nPPI) for 40GBASE-SR4 and 40GBASE-LR4 (XLPP) and 100GBASE-SR10 (CPPI)”
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

Coherent Corp.
375 Saxonburg Boulevard
Saxonburg, PA 16056
sales@coherent.com
www.coherent.com