

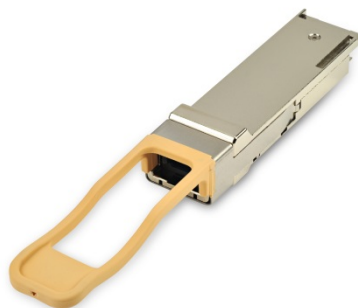
## Product Specification

### 40BASE-SR4/10GBASE-SR 300m QSFP+ Gen2 Optical Transceiver Module

#### FTL410QD2C

#### PRODUCT FEATURES

- Four-channel full-duplex transceiver module
- Hot Pluggable QSFP+ form factor
- Maximum link length of 300m on OM3 Multimode Fiber (MMF) and 400m on OM4 MMF
- Multirate capability: 1.06Gb/s to 10.5Gb/s per channel
- Unretimed XLPI electrical interface
- Low power dissipation: <1.5W
- Reliable VCSEL array technology
- Commercial operating case temperature range: 0°C to 70°C
- Single 1x12 MPO receptacle
- RoHS-6 Compliant (lead-free)



#### APPLICATIONS

- 40GBASE-SR4 40G Ethernet
- Breakout to 10GBASE-SR Ethernet
- Proprietary interconnections

Finisar's FTL410QD2C QSFP+ transceiver modules are designed for use in 40 Gigabit per second links over parallel multimode fiber, including breakout to four 10 Gigabit per second links. They are compliant with the QSFP+ MSA<sup>1,2</sup> and IEEE 802.3ba 40GBASE-SR4<sup>3</sup> and compatible with IEEE 802.3ae 10GBASE-SR<sup>4</sup>. The optical transceiver is compliant per the RoHS Directive 2011/65/EU<sup>5</sup>. See Finisar Application Note AN-2038 for more details<sup>6</sup>.

#### PRODUCT SELECTION

|                   |
|-------------------|
| <b>FTL410QD2C</b> |
|-------------------|

## I. Pin Descriptions

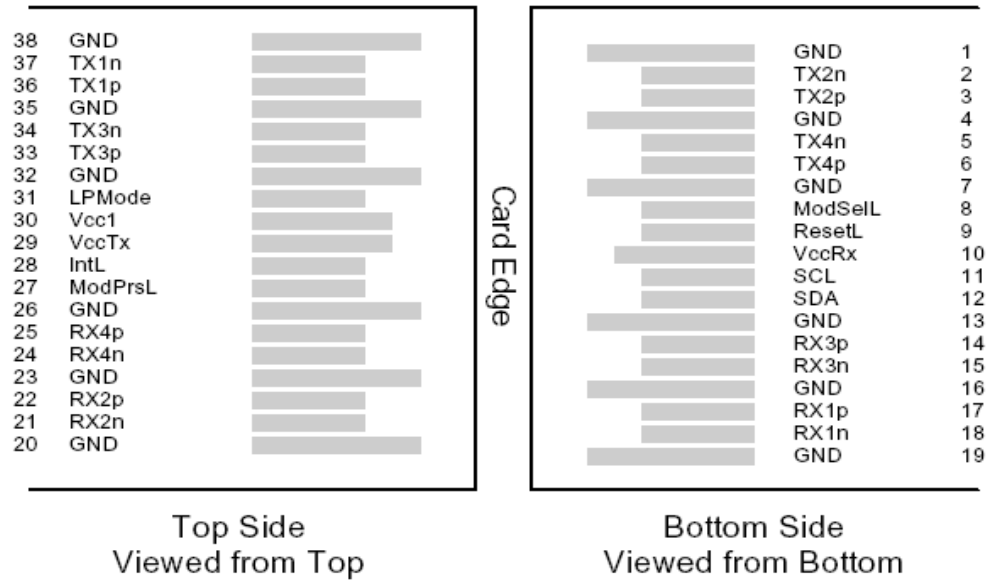


Figure 1 – QSFP+ MSA-compliant 38-pin connector

| 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+   |       |   |
| Number of Lanes                   | 4 Tx and 4 Rx   |       |   |
| Maximum Aggregate Data Rate       | 42.0  | Gb/s  |   |
| Maximum Data Rate per Lane        | 10.5  | 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 per End | 1.5   | Watts | Varies with output voltage swing and pre-emphasis settings (see Figure 2) |
| 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     | 1062 |     | 10500      | Mb/sec | 1    |
| Bit Error Ratio          | BER    |      |     | $10^{-12}$ |        | 2    |
| Link distance on OM3 MMF | d      |      |     | 300        | meters | 3    |
| Link distance on OM4 MMF | d      |      |     | 400        | meters | 3    |

Notes:

1. Compliant with 40G and 10G\* Ethernet. Compatible with 1 Gigabit Ethernet and 1/2/4/8/10G Fibre Channel.
2. Tested with a PRBS  $2^{31}-1$  test pattern.
3. Per 40GBASE-SR4 and 10GBASE-SR IEEE 802.3ba

\* Max launch power exceeds 10G Ethernet specification by 1 dB, which is well within the guardband of receiver overload.

### III. Absolute Maximum Ratings

| Parameter                  | Symbol   | Min  | Typ | Max | Unit | Ref. |
|----------------------------|--|------|-----|-----|------|------|
| Maximum Supply Voltage     | V <sub>cc1</sub> ,<br>V <sub>ccTx</sub> ,<br>V <sub>ccRx</sub> | -0.5 |     | 3.6 | V    |      |
| Storage Temperature        | T <sub>S</sub>   | -40  |     | 85  | °C   |      |
| Case Operating Temperature | T <sub>OP</sub>  | 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<sub>OP</sub> = 0 to 70°C, V<sub>CC</sub> = 3.15 to 3.45 Volts)

| Parameter                                    | Symbol   | Min                                     | Typ                   | Max  | Unit             | Ref. |
|--|--|---|-----------------------|------|------------------|------|
| Supply Voltage                               | V <sub>cc1</sub> ,<br>V <sub>ccTx</sub> ,<br>V <sub>ccRx</sub> | 3.15                                    |                       | 3.45 | V                |      |
| Supply Current                               | I <sub>cc</sub>  |   |                       | 350  | mA               |      |
| <b>Link turn-on time</b>                     |  |   |                       |      |                  |      |
| Transmit turn-on time                        |  |   |                       | 2000 | ms               | 2    |
| <b>Transmitter (per Lane)</b>                |  |   |                       |      |                  |      |
| Single ended input voltage tolerance         | V <sub>inT</sub>   | -0.3                                    |                       | 4.0  | V                |      |
| Differential data input swing                | V <sub>in,pp</sub>   | 180                                     |                       | 1200 | mV <sub>pp</sub> | 3    |
| Differential input threshold                 |  |   | 50                    |      | mV               |      |
| AC common mode input voltage tolerance (RMS) |  | 15                                      |                       |      | mV               |      |
| Differential input return loss               |  | Per IEEE P802.3ba,<br>Section 86A.4.1.1 |                       |      | dB               | 4    |
| J2 Jitter Tolerance                          | J <sub>t2</sub>  | 0.17                                    |                       |      | UI               |      |
| J9 Jitter Tolerance                          | J <sub>t9</sub>  | 0.29                                    |                       |      | UI               |      |
| Data Dependent Pulse Width Shrinkage         | DDPWS  | 0.07                                    |                       |      | UI               |      |
| Eye mask coordinates {X1, X2<br>Y1, Y2}      |  |   | 0.11, 0.31<br>95, 350 |      | UI<br>mV         | 5    |
| <b>Receiver (per Lane)</b>                   |  |   |                       |      |                  |      |
| Single-ended output voltage                  |  | -0.3                                    |                       | 4.0  | V                |      |
| Differential data output swing               | V <sub>out,pp</sub>  | 0                                       |                       | 800  | mV <sub>pp</sub> | 7,8  |
| AC common mode output voltage (RMS)          |  |   |                       | 7.5  | mV               |      |
| Termination mismatch at 1 MHz                |  |   |                       | 5    | %                |      |
| Differential output return loss              |  | Per IEEE P802.3ba,<br>Section 86A.4.2.1 |                       |      | dB               | 4    |
| Common mode output return loss               |  | Per IEEE P802.3ba,<br>Section 86A.4.2.2 |                       |      | dB               | 4    |
| Output transition time, 20% to 80%           |  | 28                                      |                       |      | ps               |      |
| J2 Jitter output                             | J <sub>o2</sub>  |   |                       | 0.42 | UI               |      |

|  |     |    |                       |      |          |   |
|--|-----|----|-----------------------|------|----------|---|
| J9 Jitter output                           | Jo9 |    |                       | 0.65 | UI       |   |
| Eye mask coordinates #1 {X1, X2<br>Y1, Y2} |     |    | 0.29, 0.5<br>150, 425 |      | UI<br>mV | 6 |
| Eye mask coordinates #2 {X1, X2<br>Y1, Y2} |     |    | 0.29, 0.5<br>125, 500 |      | UI<br>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. Valid for all settings in Figure 2.
6. Hit ratio = 5 x 10E-5. Valid only for the shaded settings in Figure 2.
7. AC coupled with 100Ω differential output impedance.
8. Settable in 4 discrete steps via the I2C interface. See Figure 2 for Vout settings.

| Power (mW) |     | Pre-Emphasis into 100ohms (mV) |      |      |      |
|------------|-----|--------------------------------|------|------|------|
|            |     | 0                              | 125  | 175  | 325  |
| Vout (mV)  | 0   | 599                            |      |      |      |
|            | 317 | 751                            | 935  | 971  | 1075 |
|            | 422 | 787                            | 971  | 1007 | 1111 |
|            | 739 | 883                            | 1055 | 1103 | 1190 |

**Figure 2 – Power Dissipation (mW, maximum) vs. Rx Output Conditions****V. Optical Characteristics (T<sub>OP</sub> = 0 to 70°C, V<sub>CC</sub> = 3.15 to 3.45 Volts)**

| Parameter  | Symbol           | Min                               | Typ  | Max  | Unit  | Ref. |
|--|------------------|-----------------------------------|------|------|-------|------|
| <b>Transmitter (per Lane)</b>                            |                  |                                   |      |      |       |      |
| Signaling Speed per Lane                                 |                  |                                   | 10.5 |      | GBd   | 1    |
| Center wavelength  |                  | 840                               |      | 860  | nm    |      |
| RMS Spectral Width                                       | SW               |                                   |      | 0.40 | nm    |      |
| Average Launch Power per Lane                            | TXP <sub>x</sub> | -7.5                              |      | 0.5  | dBm   | 2    |
| Transmit OMA per Lane                                    | TxOMA            | -2.5                              |      | 3.0  | dBm   | 3    |
| Difference in Power between any two lanes [OMA]          | DP <sub>x</sub>  |                                   |      | 4.0  | dB    |      |
| Peak Power per Lane                                      | PP <sub>x</sub>  |                                   |      | 4.0  | dBm   |      |
| Launch Power [OMA] minus TDP per Lane                    | P-TDP            | -6.5                              |      |      | dBm   |      |
| TDP per Lane   | TDP              |                                   |      | 3.5  | dBm   |      |
| Optical Extinction Ratio                                 | ER               | 3.0                               |      |      | dB    |      |
| Optical Return Loss Tolerance                            | ORL              |                                   |      | 12   | dB    |      |
| Encircled Flux   | FLX              | > 86% at 19 um<br>< 30% at 4.5 um |      |      | dBm   |      |
| Average launch power of OFF transmitter, per lane        |                  |                                   |      | -30  | dBm   |      |
| Relative Intensity Noise                                 | RIN              |                                   |      | -128 | dB/Hz |      |
| Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} |                  | 0.23, 0.34, 0.43, 0.27, 0.35, 0.4 |      |      |       |      |

| Parameter   | Symbol           | Min      | Typ  | Max   | Unit    | Ref. |
|---|------------------|----------|------|-------|---------|------|
| <b>Receiver (per Lane)</b>                              |                  |          |      |       |         |      |
| Signaling Speed per Lane                                |                  |          | 10.5 |       | GBd     | 4    |
| Center wavelength                                       |                  | 840      |      | 860   | nm      |      |
| Damage Threshold  | DT               | 3.4      |      |       | dBm     |      |
| Average Receive Power per Lane                          | RXP <sub>x</sub> | -9.9     |      | 2.4   | dBm     |      |
| Receive Power (OMA) per Lane                            | RxOMA            |          |      | 3.0   | dBm     |      |
| Unstressed Receiver Sensitivity (OMA) per Lane          | URS              |          |      | -11.1 | dBm     |      |
| Stressed Receiver Sensitivity (OMA) per Lane            | SRS              |          |      | -7.5  | dBm     |      |
| Peak Power, per lane                                    | PP <sub>x</sub>  |          |      | 4     | dBm     |      |
| Receiver Reflectance                                    | Rfl              |          |      | -12   | dB      |      |
| Vertical eye closure penalty, per lane                  |                  |          |      | 1.9   | dB      |      |
| Stressed eye J2 jitter, per Lane                        |                  |          |      | 0.3   | UI      |      |
| Stressed eye J9 jitter, per Lane                        |                  |          |      | 0.47  | UI      |      |
| OMA of each aggressor lane                              |                  |          |      | -0.4  | dBm     |      |
| Rx jitter tolerance: Jitter frequency and p-p amplitude |                  | (75, 5)  |      |       | kHz, UI |      |
|   |                  | (375, 1) |      |       | kHz, UI |      |
| LOS De-Assert   | LOS <sub>D</sub> |          |      | -12   | dBm     |      |
| LOS Assert  | LOS <sub>A</sub> | -30      |      |       | dBm     |      |
| LOS Hysteresis  |                  | 0.5      |      |       | dBm     |      |

**Notes:**

1. Transmitter consists of 4 lasers operating at a maximum rate of 10.5Gb/s each.
2. The maximum launch power of 0.5 dBm is well within the guardband of receiver overload specifications for commercially available 10GBASE-SR SFP+ transceivers from Finisar and other vendors.
3. Even if TDP is <0.9dB, the OMA min must exceed this value.
4. Receiver consists of 4 photodetectors operating at a maximum rate of 10.5Gb/s each.

**VI. Memory Map and Control Registers**

Compatible with SFF-8436 (QSFP+). Please see Finisar Application Note AN-2079<sup>7</sup>.

**VII. Environmental Specifications**

Finisar FTL410QE2C 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 <sub>op</sub>  | 0   |     | 70  | °C    |      |
| Storage Temperature          | T <sub>sto</sub> | -40 |     | 85  | °C    |      |

## VIII. Regulatory Compliance

Finisar FTL410QD2C transceivers are RoHS-6 Compliant. Copies of certificates are available at Finisar Corporation upon request.

FTL410QD2C transceiver modules are Class 1 laser eye safety compliant per IEC 60825-1.

## IX. Mechanical Specifications

The FTL410QD2C mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

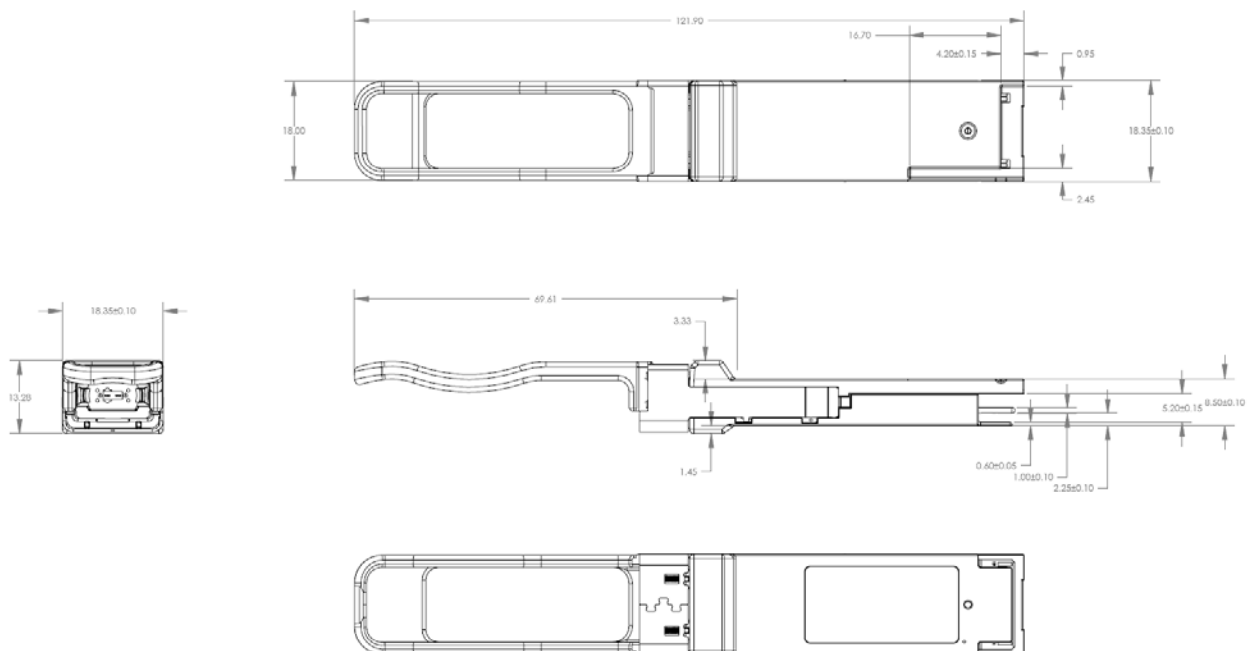


Figure 3 – FTL410QD2C mechanical drawing



Figure 4 – FTL410QD2C product label

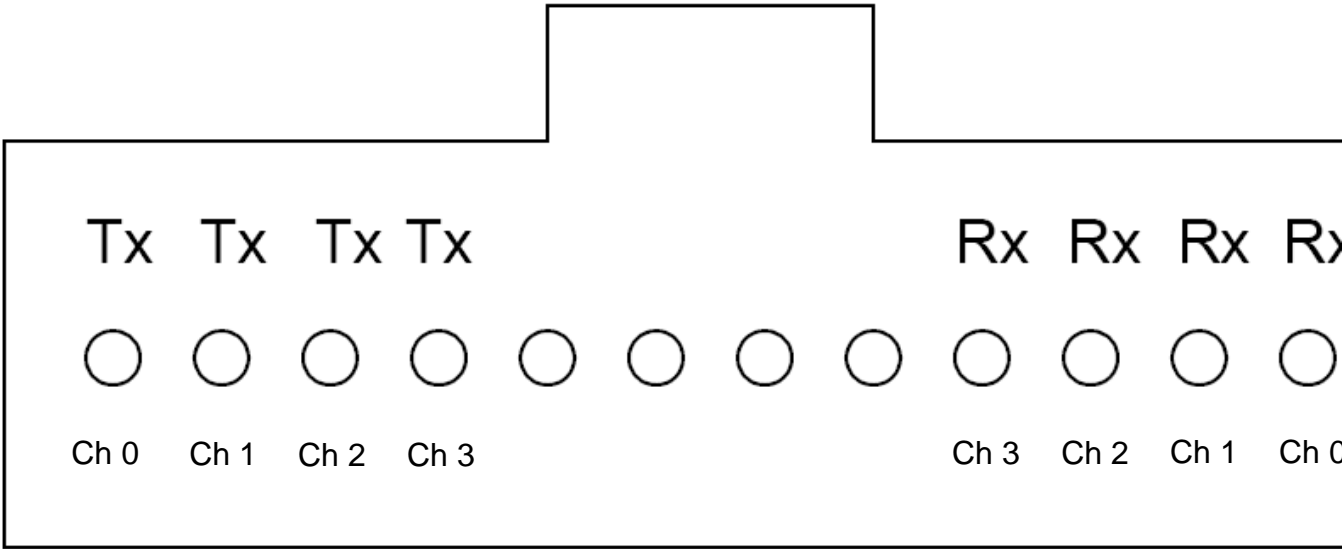


Figure 5 – FTL410QD2C optical lane assignment  
(front view of MPO receptacle)



**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-SR4.
4. IEEE 802.3ae – PMD Type 10GBASE-SR.
5. 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”. Certain products may use one or more exemptions as allowed by the Directive.
6. “Application Note AN-2038: Finisar Implementation of RoHS Compliant Transceivers”.
7. “Application Note AN-2079: QSFP Module EEPROM Mapping”, Rev. G, Finisar Corporation, May, 2013.

**XI. For More Information**

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