# Product Specification

# 200GBASE-SR4 QSFP56
# Optical Transceiver Module

# FTCC8612E2PCM

## PRODUCT FEATURES

- Four-channel full-duplex transceiver module
- Hot-pluggable QSFP56 form factor
- Supports 212.5Gb/s aggregate bit rate
- Maximum link length of 100m on OM4 Multimode Fiber
- 200GAUI-4 C2M electrical interface (4x50Gb/s PAM4 retimed)
- 4x50Gb/s PAM4 VCSEL transmitter
- Power dissipation below 4.5W
- RoHS-6 compliant
- Operating case temperature range: 0°C to 70°C
- Single 3.3V power supply
- MPO-12 connector
- I2C management interface

## APPLICATIONS

- 200G 100m on OM4 with FEC

Coherent FTCC8612E2PCM 200G QSFP56 SR4 transceiver modules are designed for use in 200 Gigabit Ethernet interfaces over multi-mode fiber. They are compliant with the QSFP MSA[1] and portions of IEEE 802.3-2018[5] and 802.3cd[6]. Digital diagnostics functions are available via the I2C interface, as specified by the CMIS 4.0[4]. The transceiver is RoHS compliant per Directive 2011/65/EU[2]. SFF-8636 could be supported by customized version.

## PRODUCT SELECTION

**FTCC8612E2PCM**

1: 100m max reach with OM4
E: Ethernet protocol
P: Pull-tab type release
C: Commercial temperature range 0-70C
M: MPO connector

## I. Pin Descriptions

QSFP56 pin-out as being defined by QSFP MSA[1].

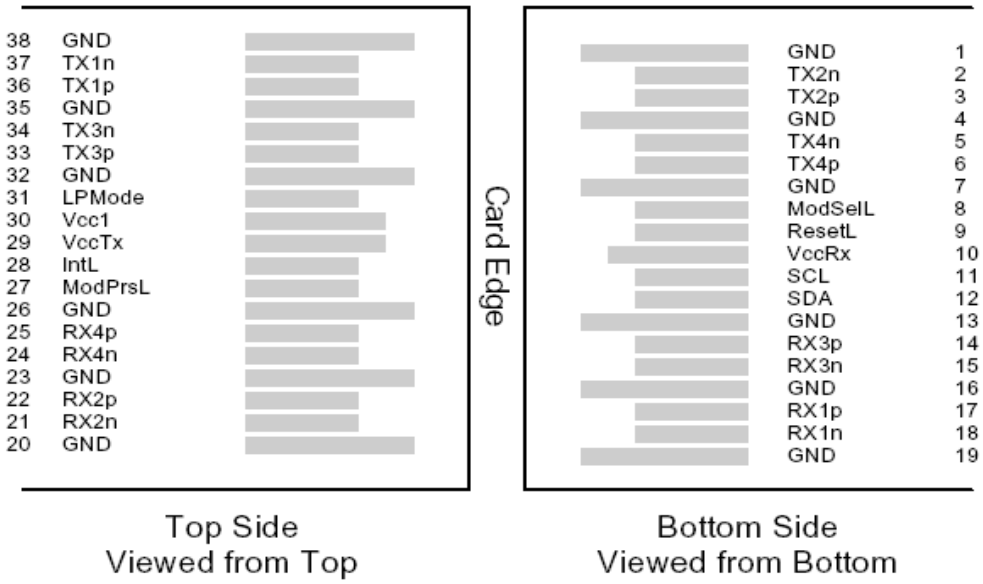


**Figure 1 – QSFP-compliant 38-pin connector (per SFF-8679)**

| 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. Absolute Maximum Ratings

Module performance is not guaranteed beyond the operating range (see Section VI). Exceeding the limits below may damage the transceiver module permanently.

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| Maximum Supply Voltage | Vcc | -0.5 | | 3.6 | V | |
| Storage Temperature | $T_S$ | -40 | | 85 | °C | |
| Case Operating Temperature | $T_{OP}$ | 0 | | 70 | °C | 1 |
| Relative Humidity | RH | 15 | | 85 | % | 2 |
| Receiver Damage Threshold, per Lane | $P_{Rdmg}$ | 5 | | | dBm | |

Notes:
1. 48-hour excursions, maximum
2. Non-condensing.

## III. Electrical Characteristics (EOL, $T_{OP}$ = 0 to +70 °C, $V_{CC}$ = 3.135 to 3.465 Volts)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| Supply Voltage | Vcc | 3.135 | 3.3 | 3.465 | V | |
| Supply Current | Icc | | | 1.595 | A | |
| Module total power | P | | | 4.5 | W | 1 |
| **Transmitter** | | | | | | |
| Signaling rate per lane | | 26.5625± 100 ppm. | | | GBd | |
| Differential peak-peak input voltage tolerance | Vin,pp,diff | 900 | | | mV | 2 |
| Differential input return loss | | Per equation (83E–5) IEEE802.3-2018 | | | dB | |
| Differential to common mode input return loss | | Per equation (83E–6) IEEE802.3-2018 | | | dB | |
| Differential termination mismatch | | | | 10 | % | |
| Module stress input test | | Per 120E.3.4.1 IEEE802.3-2018 | | | | 3 |
| Single-ended voltage tolerance range | | -0.4 | | 3.3 | V | |
| DC common mode voltage | | -350 | | 2850 | mV | 4 |
| **Receiver** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Signaling rate per lane | | 26.5625± 100 ppm. | | | Gbd | |
| AC common-mode output voltage (RMS) | | | | 17.5 | mV | |
| Differential peak-to-peak output voltage | | | | 900 | mV | |
| Near-end ESMW (Eye symmetry mask width) | | 0.265 | | | UI | |
| Near-end Eye height, differential (min) | | 70 | | | mV | |
| Far-end ESMW (Eye symmetry mask width) | | 0.2 | | | UI | |
| Far-end Eye height, differential (min) | | 30 | | | mV | |
| Far-end pre-cursor ISI ratio | | -4.5 | | 2.5 | % | |
| Differential output return loss | | Per equation 83E-2 IEEE802.3-2018 | | | | |
| Common to differential mode conversion return loss | | Per equation 83E-3 IEEE802.3-2018 | | | | |
| Differential termination mismatch | | | | 10 | % | |
| Transition time (min, 20% to 80%) | | 9.5 | | | ps | |
| DC common mode voltage | | -350 | | 2850 | mV | 4 |

Notes:
1. Maximum total power value is specified across the full temperature and voltage range.
2. With the exception to 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.
3. Meets specified BER
4. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

## IV. Optical Characteristics (EOL, $T_{OP}$ = 0 to +70 °C, $V_{CC}$ = 3.135 to 3.465 Volts)

Meets 200GBASE-SR4 as being defined by IEEE P802.3cd

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| **Transmitter** | | | | | | |
| Signaling rate (each lane (range) | | 26.5625± 100 ppm | | | GBd | |
| Modulation format | | PAM4 | | | | |
| Lane wavelength (range) | | 840 to 860 | | | nm | |
| RMS spectral width | | | | 0.6 | nm | 1 |
| Average launch power, each lane | | | | 4 | dBm | |
| Average launch power, each lane | | -6.5 | | | dBm | |
| Outer Optical Modulation Amplitude (OMAouter), each lane | | -4.5 | | 3 | dBm | 2 |
| Launch power in OMAouter minus TDECQ, each lane | | -5.9 | | | dBm | |
| Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane | | | | 4.5 | dB | |
| TDECQ – 10log$_{10}$($C_{eq}$), each lane | | | | 4.5 | dB | 3 |
| Average launch power of OFF transmitter, each lane | | | | -30 | dBm | |
| Extinction ratio | | 3 | | | dB | |
| Transmitter transition time, each lane | | | | 34 | pS | |
| $RIN_{12}OMA$ | | | | -128 | dB/Hz | |
| Optical return loss tolerance | | | | 12 | dB | |
| Encircled flux | | ≥ 86% at 19μm<br>≤ 30% at 4.5μm | | | | 4 |

Notes:
1. RMS spectral width is the standard deviation of the spectrum.
2. Even if the TDECQ < 1.4 dB, the OMAouter (min) must exceed this value.
3. $C_{eq}$ is a coefficient defined in 121.8.5.3, which accounts for the reference equalizer noise enhancement.
4. If measured into type A1a.2 or type A1a.3, or A1a.4, 50 μm fiber, in accordance with IEC 61280-1-4.

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| **Receiver** | | | | | | |
| Signaling rate (each lane (range) | | 26.5625± 100 ppm | | | GBd | |
| Modulation format | | PAM4 | | | | |
| Lane wavelength (range) | | 840 to 860 | | | nm | |
| Damage threshold, each lane | | 5 | | | dBm | 1 |
| Average receive power, each lane | | | | 4 | dBm | |
| Average receive power, each lane | | -8.4 | | | dBm | 2 |
| Receive power (OMAouter), each lane | | | | 3 | dBm | |
| Receiver reflectance | | | | -12 | dB | |
| Receiver sensitivity (OMAouter), each lane | | | | Equation (138–1) | dBm | 3 |
| Stressed receiver sensitivity (OMAouter), each lane | | | | -3.4 | dBm | 4 |
| Conditions of stressed receiver sensitivity test: | | | | | | 5 |
| Stressed eye closure for PAM4 (SECQ), lane under test | | 4.5 | | | dB | |
| SECQ – $10\log_{10}(C_{eq})_f$, each lane (max) | | 4.5 | | | dB | 6 |
| OMAouter of each aggressor lane | | 3 | | | dBm | |
| LOS De-Assert | | | | -9 | dBm | |
| LOS Assert | | -30 | | -10 | dBm | |
| LOS Hysteresis | | 0.5 | | | dB | |

Notes:
1. The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level on one lane. The receiver does not have to operate correctly at this input power.
2. Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
3. Receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 4.5 dB (see figure 2 from IEEE 802.3cd clause 138)
4. Measured with conformance test signal at TP3 (see IEEE 802.3cd 138.8.10) for the BER of 2.4E-4.
5. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.
6. Ceq is a coefficient defined in 121.8.5.3, which accounts for the reference equalizer noise enhancement.

**138.8.9 Receiver sensitivity**

Receiver sensitivity is informative and is defined for a transmitter with a value of SECQ up to 4.5 dB. Receiver sensitivity should meet Equation (138–1), which is illustrated in Figure 138–4.

$$RS = \max(-6.5, SECQ - 7.9) \quad \text{(dBm)} \qquad (138\text{–}1)$$

where

*RS* is the receiver sensitivity

*SECQ* is the SECQ of the transmitter used to measure the receiver sensitivity

The normative requirement for receivers is stressed receiver sensitivity.

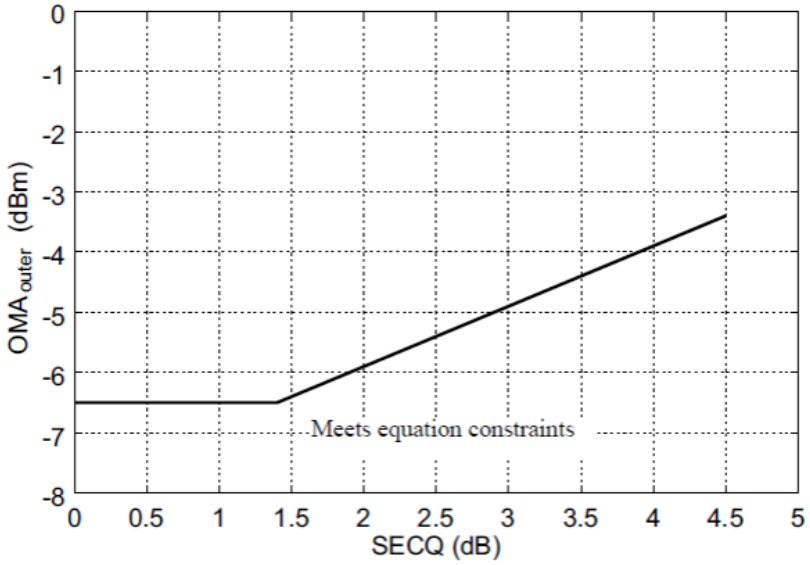


**Figure 138–4—Illustration of receiver sensitivity**

**Figure 2 – Receiver sensitivity (per IEEE 802.3cd)**

## V. General Specifications

| Parameter | | Symbol | Min | Typ | Max | Units | Ref. |
|---|---|---|---|---|---|---|---|
| Bit Rate (all wavelengths combined) | | BR | | | 212.5 | Gb/s | 1 |
| Bit Error Ratio | | BER | | | 2.4E-4 | | 2 |
| **Maximum Supported Distances** | | | | | | | |
| Fiber Type | | | | | | | |
| OM3 MMF<br>OM4 MMF | | Lmax1<br>Lmax2 | | | 70<br>100 | m | |

Notes:

1. Supports 200GBASE-SR4 per IEEE P802.3cd.
2. The typical BER is better than 1E-6 when Measured with a transmitter to produce SECQ up to 3dB.

## VI. Environmental Specifications

Coherent FTCC8612E2PCM QSFP56 SR4 transceivers have an operating case temperature range of 0°C to +70°C.

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|---|---|---|---|---|---|---|
| Case Operating Temperature | $T_{op}$ | 0 | | +70 | °C | 1 |
| Storage Temperature | $T_{sto}$ | -40 | | 85 | °C | |
| Relative Humidity | RH | 15 | | 85 | % | 2 |

Notes:
1. 48-hour excursions, maximum
2. Non-condensing.

## VII. Regulatory Compliance

Coherent FTCC8612E2PCM QSFP56 SR4 transceivers are Class 1 Laser Products. They are certified per the following standards:

| Feature | Agency | Standard |
|---|---|---|
| Laser Eye Safety | FDA/CDRH | CDRH 21 CFR 1040.10 and Laser Notice 56 |
| Laser Eye Safety | UL/CSA/TÜV | IEC/EN 60825-1:2014<br>IEC/EN 60825-2: 2004+A1+A2 |
| Electrical Safety | UL/CSA/TÜV | IEC/UL/EN 62368-1:2014 |

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

Copies of the referenced certificates are available at Coherent upon request.

## VIII. Digital Diagnostics Functions

FTCC8612E2PCM QSFP56 SR4 transceivers support the I2C-based diagnostics interface specified by the QSFP MSA[1].

## IX. Memory Contents

Per CMIS 4.0[4]. SFF-8636 could be supported by customized version.

## XI. Mechanical Specifications

Coherent FTCC8612E2PCM QSFP56 SR4 transceivers are compatible with the QSFP MSA specification for QSFP pluggable form factor modules.

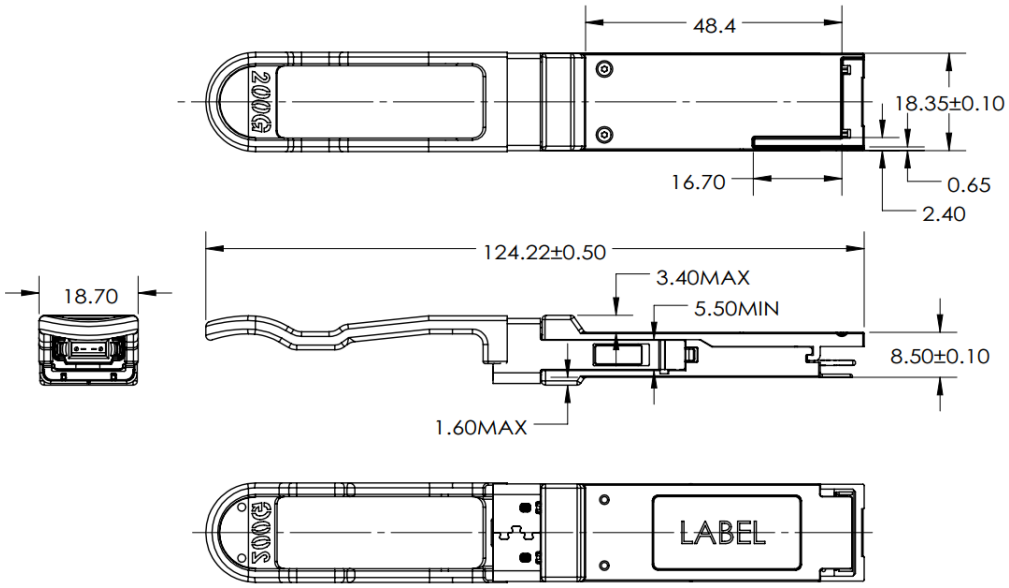


**Figure 3. FTCC8612E2PCM Mechanical Dimensions**

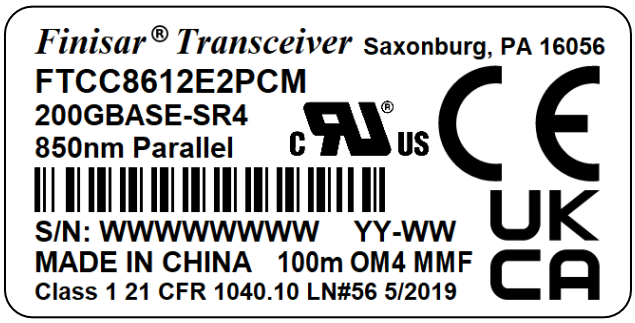


**Figure 4. Standard Product Label (not to scale)**

## XII. References

1. SFF-8665: "QSFP+ 28Gb/s 4X Pluggable Transceiver Solution (QSFP28)", Rev 1.9, June 29, 2015 and associated SFF documents referenced therein:
    i. SFF-8661
    ii. SFF-8679
    iii. SFF-8662
    iv. SFF-8663
    v. SFF-8672
    vi. SFF-8472

2. Directive 2011/65/EU of the European Parliament and of the Council, "on the restriction of the use of certain hazardous substances in electrical and electronic equipment," July 1, 2011.

3. "Application Note AN-2038: Coherent Implementation Of RoHS Compliant Transceivers", January 21, 2005.

4. Common Management Interface Specification (CMIS) Rev 4.0.

5. IEEE P802.3-2018, 200GAUI-4 Interface.

6. IEEE P802.3cd

**For More Information:**

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