# *F i n i s a r*

# Product Specification

## Fast Ethernet RoHS Compliant Long-Wavelength SFP Transceiver
### FTLF1217P2xTL

## PRODUCT FEATURES

- Up to 200 Mb/s bi-directional data links

- Hot-pluggable SFP footprint

- Built-in digital diagnostic functions

- 1310nm LED-based transmitter

- Duplex LC connector

- RoHS Compliant and Lead-Free

- Up to 2km on 62.5/125μm MMF

- Metal enclosure, for lower EMI

- Single 3.3V power supply

- Low power dissipation

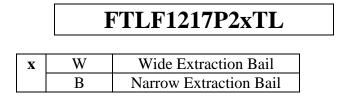- Industrial operating temperature range: -40°C to 85°C

## APPLICATIONS

- 125 Mb/s 100Base-FX Ethernet / FDDI

- 200 Mb/s ESCON

- 155 Mb/s Multimode SONET OC-3 SR-0

- 51 Mb/s Multimode SONET OC-1 SR-0

Finisar's FTLF1217P2xTL Small Form Factor Pluggable (SFP) transceivers are compatible with the Small Form Factor Pluggable Multi-Sourcing Agreement (MSA)[1]. They are simultaneously compatible with 100Base-FX, FDDI, ESCON, and Multimode SONET OC-3 SR-0 and OC-1 SR-0 standards as specified in IEEE Std 802.3[2], ISO/IEC 9314-3[3], Enterprise Systems Architecture/390[4], and ANSI T1.416.01-1999[5], respectively. They are RoHS compliant and lead-free per Directive 2002/95/EC[4] and Finisar Application Note AN-2038. Digital diagnostics functions are available via the 2-wire serial bus specified in the SFP MSA.

## PRODUCT SELECTION

### FTLF1217P2xTL

| x | W | Wide Extraction Bail |
|---|---|---|
| | B | Narrow Extraction Bail |

## I.    Pin Descriptions

| Pin | Symbol | Name/Description | Ref. |
|-----|--------|------------------|------|
| 1 | $V_{EET}$ | Transmitter Ground  (Common with Receiver Ground) | 1 |
| 2 | $T_{FAULT}$ | Transmitter Fault. | 2 |
| 3 | $T_{DIS}$ | Transmitter Disable. LED output disabled on high or open. | 3 |
| 4 | MOD_DEF(2) | Module Definition 2. Data line for Serial ID. | 4 |
| 5 | MOD_DEF(1) | Module Definition 1. Clock line for Serial ID. | 4 |
| 6 | MOD_DEF(0) | Module Definition 0. Grounded within the module. | 4 |
| 7 | Rate Select | No connection required | |
| 8 | LOS | Loss of Signal indication.  Logic 0 indicates normal operation. | 5 |
| 9 | $V_{EER}$ | Receiver Ground  (Common with Transmitter Ground) | 1 |
| 10 | $V_{EER}$ | Receiver Ground  (Common with Transmitter Ground) | 1 |
| 11 | $V_{EER}$ | Receiver Ground  (Common with Transmitter Ground) | 1 |
| 12 | RD- | Receiver Inverted DATA out.  AC Coupled | |
| 13 | RD+ | Receiver Non-inverted DATA out.  AC Coupled | |
| 14 | $V_{EER}$ | Receiver Ground  (Common with Transmitter Ground) | 1 |
| 15 | $V_{CCR}$ | Receiver Power Supply | |
| 16 | $V_{CCT}$ | Transmitter Power Supply | |
| 17 | $V_{EET}$ | Transmitter Ground  (Common with Receiver Ground) | 1 |
| 18 | TD+ | Transmitter Non-Inverted DATA in.  AC Coupled. | |
| 19 | TD- | Transmitter Inverted DATA in.  AC Coupled. | |
| 20 | $V_{EET}$ | Transmitter Ground  (Common with Receiver Ground) | 1 |

Notes:
1. Circuit ground is internally isolated from chassis ground.
2. $T_{FAULT}$ is an open collector/drain output, which should be pulled up with a 4.7k – 10k Ohms resistor on the host board. Pull up voltage should be between 2.0V to Vcc + 0.3V. A high output indicates an LED fault, i.e. LED open or short.  Low indicates normal operation. In the low state, the output is pulled to <0.8V.
3. LED output disabled on $T_{DIS}$ >2.0V or open, enabled on $T_{DIS}$ <0.8V.
4. Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 3.6V.  MOD_DEF(0) pulls line low to indicate module is plugged in.
5. LOS is open collector output.  Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.
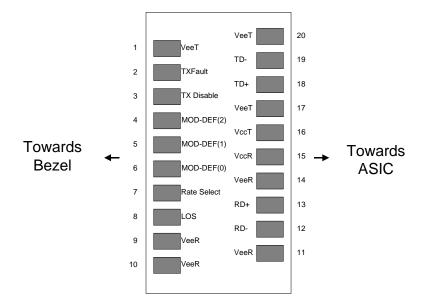
| | | |
|---|---|---|
| 1 | VeeT | |
| 2 | TXFault | |
| 3 | TX Disable | |
| 4 | MOD-DEF(2) | |
| 5 | MOD-DEF(1) | |
| 6 | MOD-DEF(0) | |
| 7 | Rate Select | |
| 8 | LOS | |
| 9 | VeeR | |
| 10 | VeeR | |

| | | |
|---|---|---|
| VeeT | | 20 |
| TD- | | 19 |
| TD+ | | 18 |
| VeeT | | 17 |
| VccT | | 16 |
| VccR | | 15 |
| VeeR | | 14 |
| RD+ | | 13 |
| RD- | | 12 |
| VeeR | | 11 |

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**Diagram of Host Board Connector Block Pin Numbers and Names**

## II.    Absolute Maximum Ratings

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| Maximum Supply Voltage | Vcc | -0.5 | | 4.0 | V | |
| Storage Temperature | $T_S$ | -40 | | 85 | °C | |
| Case Operating Temperature | $T_A$ | -40 | | 85 | °C | |
| Relative Humidity | RH | 0 | | 85 | % | 1 |

## III.    Electrical Characteristics $(T_A = \text{-40 to 85 °C}, V_{CC} = \text{3.0 to 3.6 Volts})$

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| Supply Voltage | Vcc | 3.0 | | 3.6 | V | |
| Supply Current | Icc | | | 300 | mA | |
| **Transmitter** | | | | | | |
| Input differential impedance | $R_{in}$ | | 100 | | Ω | 2 |
| Single ended data input swing | Vin,pp | 250 | | 1200 | mV | 3 |
| Transmit Disable Voltage | $V_D$ | 2 | | Vcc | V | 4 |
| Transmit Enable Voltage | $V_{EN}$ | Vee | | Vee+ 0.8 | V | |
| **Receiver** | | | | | | |
| Single ended data output swing | Vout,pp | 250 | 450 | 900 | mV | 5 |
| Data output rise/fall time ≤ 155 Mb/s | $t_r/t_f$ | 0.6 | | 5.0 | ns | 6 |
| LOS Fault | $V_{LOS\ fault}$ | 2 | | $Vcc_{HOST}$ | V | 7 |
| LOS Normal | $V_{LOS\ norm}$ | Vee | | Vee+0.5 | V | 7 |
| Power Supply Rejection | PSR | 100 | | | mVpp | 8 |
| Systematic Jitter Contribution | RX Δ SJ | | | 2.0 | ns | 9 |
| Contributed Duty Cycle Distortion | RX Δ DCD | | | 1.0 | ns | 10 |
| Data Dependent Jitter Contribution | RX Δ DDJ | | | 1.2 | ns | 10 |
| Random Jitter Contribution @ OC-3 and OC-1 | RX Δ RJ | | | 0.6 | ns | 9 |
| Random Jitter Contribution @ FE | RX Δ RJ | | | 0.76 | ns | 10 |

Notes:
1. Non condensing.
2. Connected directly to TX data input pins.  AC coupling from pins into driver IC.
3. We recommend <600mV for best EMI performance.
4. Or open circuit.
5. Into 100 ohms differential termination.
6. 10 – 90 %
7. LOS is an open collector output.  Should be pulled up with 4.7k – 10kohms on the host board. Normal operation is logic 0; loss of signal is logic 1. Maximum pull-up voltage is 5.5V.
8. Receiver sensitivity is compliant with power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value applied through the recommended power supply filtering network.
9. Peak-to-peak measurement for OC-3 SR-0 or OC-1 SR-0 operation measured with a PRBS $2^{23}$-1 test pattern.
10. Peak-to-peak measurement based on 4B/5B encoded Fast Ethernet pattern referenced in FDDI PMD[3] Annex A.5

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## IV. Optical Characteristics $(T_{OP}$ = -40 to 85 °C, $V_{CC}$ = 3. 00 to 3.60 Volts)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|---|---|---|---|---|---|---|
| **Transmitter** | | | | | | |
| Output Opt. Power | $P_{OUT}$ | -20 | | -15 | dBm | 1 |
| Optical Wavelength | λ | 1280 | | 1380 | nm | |
| Spectral Width (FWHM) | σ | | 175 | | nm | 2 |
| Optical Rise/Fall Time ≤ 155 Mb/s | $t_r$/ $t_f$ | 0.6 | | 3.0 | ns | 3 |
| Optical Rise/Fall Time = 200 Mb/s | $t_r$/ $t_f$ | | | 1.7 | ns | 4 |
| Systematic Jitter Contribution | TX Δ SJ | | | 1.6 | ns | 5 |
| Contributed Duty Cycle Distortion | TX Δ DCD | | | 1.0 | ns | 6 |
| Data Dependent Jitter Contribution | TX Δ DDJ | | | 0.6 | ns | 6 |
| Random Jitter Contribution @ OC-3 and OC-1 | TX Δ RJ | | | 0.6 | ns | 5 |
| Random Jitter Contribution @ FE | TX Δ RJ | | | 0.76 | ns | 6 |
| Extinction Ratio | ER | 10 | | | dB | |
| **Receiver** | | | | | | |
| Receiver Sensitivity  = 51.8 Mb/s | RxSENS | | | -30 | dBm | 7 |
| Receiver Sensitivity  = 155 Mb/s | RxSENS | | | -30 | dBm | 7 |
| Receiver Sensitivity  = 125 Mb/s | RxSENS | | | -31 | dBm | 7 |
| Receiver Sensitivity = 200 Mb/s | RxSENS | | | -29 | dBm | 8 |
| Maximum Average Receiver Power | $Rx_{MAX}$ | | | -14 | dBm | |
| Optical Center Wavelength | $λ_C$ | 1270 | | 1600 | nm | |
| LOS De-Assert | $LOS_D$ | | | -33 | dBm | |
| LOS Assert | $LOS_A$ | -45 | | | dBm | |
| LOS Hysteresis | | 1.5 | | | dB | |

Notes:
1. Measured average power coupled into 62.5/125um fibre with NA = 0.275.  Class 1 eye safety per FDA/CDRH, IEC, and EN60825-1 safety standards.
2. Also specified to fall within the extrapolated curves in FDDI PMD[3] Figure 9, which allow trade-off between wavelength, spectral width and transmitter rise/fall times.
3. Unfiltered, 10-90%.
4. Unfiltered, 20-80%.
5. Peak-to-peak measurement for OC-3 SR-0 or OC-1 SR-0 operation measured with a PRBS 2^23-1 test pattern.
6. Peak-to-peak measurement based on 4B/5B encoded Fast Ethernet pattern referenced in FDDI PMD[3] Annex A.5
7. Specifications are for 50 micro-meter or 62.5 micro-meter fiber.
8. Specifications are for 50 micro-meter or 62.5 micro-meter fiber, based on any valid 8B/10B code pattern and measured at, or extrapolated to, $10^{-15}$ BER.

## V. General Specifications

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|---|---|---|---|---|---|---|
| Data Rate | BR | | 51.8, 155, 125, 200 | | Mb/sec | 1 |
| Bit Error Rate | BER | | | $10^{-10}$ | | |
| Max. Supported Link Length on 50/125μm or 62.5 μm MMF @ OC-1 | $L_{MAX1}$ | | 3 | | km | 2 |
| Max. Supported Link Length on 50/125μm or 62.5 μm MMF @ OC-3 | $L_{MAX2}$ | | 2 | | km | 3 |
| Max. Supported Link Length on 50/125μm or 62.5 μm MMF @ FE | $L_{MAX3}$ | | 2 | | km | 4 |
| Max. Supported Link Length on 50/125μm or 62.5 μm MMF @ ESCON | $L_{MAX4}$ | | 2 | | km | 5 |

Notes:
1. Multimode SONET OC-1 SR-0 and OC-3 SR-0, 100Base-FX and FDDI compliant as specified in ANSI T1.416.01-1999[5], IEEE Std 802.3[2], and ISO/IEC 9314-3[3] respectively. ESCON compatible as specified in Enterprise Systems Architecture/390[4].
2. At 51.8 Mb/s data rate per ANSI T1.416.01-1999[5].
3. At 155 Mb/s data rate per ANSI T1.416.01-1999[5].
4. At 125 Mb/s data rate per ISO/IEC 9314-3[3]
5. At 200 Mb/s data rate per Enterprise Systems Architecture/390[4].


## VI. Environmental Specifications

Finisar 1310nm SFP transceivers have an industrial operating temperature range from –40°C to +85°C case temperature.

| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|---|---|---|---|---|---|---|
| Case Operating Temperature | $T_{op}$ | -40 | | 85 | °C | |
| Storage Temperature | $T_{sto}$ | -40 | | 85 | °C | |


## VII. Regulatory Compliance

Finisar transceivers are Class 1 eye safety products and comply with US FDA regulations. These products are certified by TÜV and CSA to meet the Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950. Copies of certificates are available at Finisar Corporation upon request. Copies of the referenced certificates are available at Finisar Corporation upon request.

### VIII.    Digital Diagnostic Functions

Finisar FTLF1217P2xTL SFP transceivers support the 2-wire serial communication protocol as defined in the SFP MSA[1]. It is very closely related to the E$^2$PROM defined in the GBIC standard, with the same electrical specifications.

The standard SFP serial ID provides access to identification information that describes the transceiver's capabilities, standard interfaces, manufacturer, and other information.

Additionally, Finisar SFP transceivers provide a unique enhanced digital diagnostic monitoring interface, which allows real-time access to device operating parameters such as transceiver temperature, bias current, transmitted optical power, received optical power and transceiver supply voltage.  It also defines a sophisticated system of alarm and warning flags, which alerts end-users when particular operating parameters are outside of a factory set normal range.

The SFP MSA defines a 256-byte memory map in E$^2$PROM that is accessible over a 2-wire serial interface at the 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface makes use of the 8 bit address 1010001X (A2h), so the originally defined serial ID memory map remains unchanged. The interface is identical to, and is thus fully backward compatible with both the GBIC Specification and the SFP Multi Source Agreement. The complete interface is described in Finisar Application Note AN-2030: "Digital Diagnostics Monitoring Interface for SFP Optical Transceivers".

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Transceiver Controller (DDTC) inside the transceiver, which is accessed through a 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL, Mod Def 1) is generated by the host.  The positive edge clocks data into the SFP transceiver into those segments of the E$^2$PROM that are not write-protected.  The negative edge clocks data from the SFP transceiver.  The serial data signal (SDA, Mod Def 2) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

For more information, please see the SFP MSA documentation[1,7] or Finisar Application Note AN-2030.

Please note that evaluation board FDB-1018 is available with Finisar ModDEMO software that allows simple to use communication over the 2-wire serial interface.

## IX.  Digital Diagnostic Specifications

FTLF1217P2xTL transceivers have internally calibrated digital diagnostics.

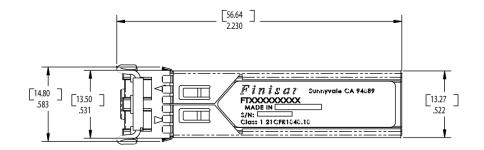| Parameter | Symbol | Min | Typ | Max | Units | Ref. |
|---|---|---|---|---|---|---|
| **Accuracy** | | | | | | |
| Internally measured transceiver temperature | $DD_{Temperature}$ | | | $\pm\,3$ | °C | |
| Internally measured transceiver supply voltage | $DD_{Voltage}$ | | | $\pm\,100$ | mV | |
| Measured TX bias current | $DD_{Bias}$ | | | $\pm\,10$ | % | 1 |
| Measured TX output power | $DD_{Tx\text{-}Power}$ | | | $\pm\,3$ | dB | |
| Measured RX received average optical power | $DD_{Rx\text{-}Power}$ | | | $\pm\,3$ | dB | |
| **Dynamic Range for Rated Accuracy** | | | | | | |
| Internally measured transceiver temperature | $DD_{Temperature}$ | -40 | | 85 | °C | |
| Internally measured transceiver supply voltage | $DD_{Voltage}$ | 3.0 | | 3.6 | V | |
| Measured TX bias current | $DD_{Bias}$ | 0 | | 70 | mA | |
| Measured TX output power | $DD_{Tx\text{-}Power}$ | -22 | | -13 | dBm | |
| Measured RX received average optical power | $DD_{Rx\text{-}Power}$ | -33 | | -12 | dBm | |
| **Max Reporting Range** | | | | | | |
| Internally measured transceiver temperature | $DD_{Temperature}$ | -40 | | 125 | °C | |
| Internally measured transceiver supply voltage | $DD_{Voltage}$ | 2.8 | | 4.0 | V | |
| Measured TX bias current | $DD_{Bias}$ | 0 | | 80 | mA | |
| Measured TX output power | $DD_{Tx\text{-}Power}$ | -24 | | -11 | dBm | |
| Measured RX received average optical power | $DD_{Rx\text{-}Power}$ | -35 | | -10 | dBm | |

Notes:
1. Accuracy of Measured Tx Bias Current is 10% of the actual Bias Current from the driver to the LED.
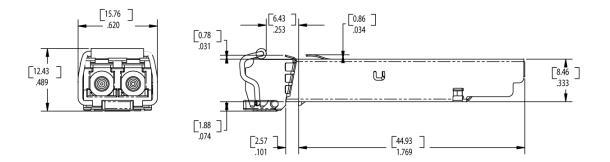
## X.    Mechanical Specifications

Finisar's Small Form Factor Pluggable (SFP) transceivers are compatible with the dimensions defined by the SFP Multi-Sourcing Agreement (MSA).
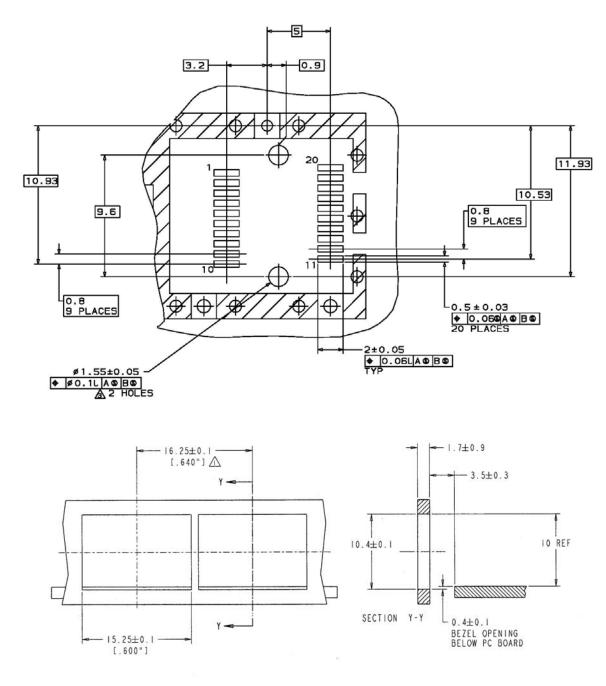


# FTLF1217P2BTL

# FTLF1217P2WTL

## XI.　PCB Layout and Bezel Recommendations

NOTES:

⚠ MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS
   ARE FOR REFERENCE ONLY

2. NOT RECOMMENDED FOR PCI EXPANSION
   CARD APPLICATIONS

## XII.    References

1. Small Form-factor Pluggable (SFP) Transceiver Multi-source Agreement (MSA). September 14, 2000.

2. IEEE Std 802.3, 2002 Edition, Clause 38, PMD Type 1000BASE-LX. IEEE Standards Department, 2002.

3. ISO/IEC 9314-3.  "Information Processing Systems – Fibre Distributed Data Interface (FDDI), Part 3, Phystical Layer Medium Dependent (PMD)."  1990.

4. Enterprise Systems Architecture/390, ESCON I/O Interface, Physical Layer.  IBM Corp., Third Edition, 1996.

5. ANSI T1.416.01-1999.  "Network to Customer Installation Interfaces – Synchronous Optical NETwork (SONET) Physical Media Dependent Specification: Multi-Mode Fiber."  ANSI, 1999.

6. Directive 2002/95/EC of the European Council Parliament and of the Council, "on the restriction of the use of certain hazardous substances in electrical and electronic equipment."  January 27, 2003.

7. "Digital Diagnostics Monitoring Interface for Optical Transceivers".  SFF Document Number SFF-8472, Revision 9.3.


## XIII.   For More Information


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