

## Product Specification

## 2.125 Gb/s RoHS Compliant Short-Wavelength SFP Transceiver

**FTLF8519P3ByL**

## PRODUCT FEATURES

- Up to 2.125 Gb/s bi-directional data links
- Hot-pluggable SFP footprint
- Built-in digital diagnostic functions
- 850nm Oxide VCSEL laser transmitter
- Duplex LC connector
- RoHS Compliant and Lead-Free
- Up to 550m on 50/125µm MMF, 300m on 62.5/125µm MMF
- Metal enclosure, for lower EMI
- Single 3.3V power supply
- <500mW power dissipation
- Industrial operating temperature range: -40°C to 85°C



## APPLICATIONS

- 1.25 Gb/s 1000Base-SX Ethernet
- Dual Rate 1.063/2.125 Gb/s Fibre Channel
- Wireless – CPRI, OBSAI, LTE

Finisar's FTLF8519P3xyL Small Form Factor Pluggable (SFP) transceivers are compatible with the Small Form Factor Pluggable Multi-Sourcing Agreement (MSA)<sup>1</sup>. They are simultaneously compatible with Gigabit Ethernet as specified in IEEE Std 802.3<sup>2</sup> and Fibre Channel FC- PI-2 Rev. 5.0<sup>3</sup>. The transceiver is RoHS compliant and per Directive 2011/65/EU<sup>4</sup>. Finisar Application Note AN-2038. Digital diagnostics functions are available via the 2-wire serial bus specified in the SFP MSA.

## PRODUCT SELECTION

**FTLF8519P3xyL**

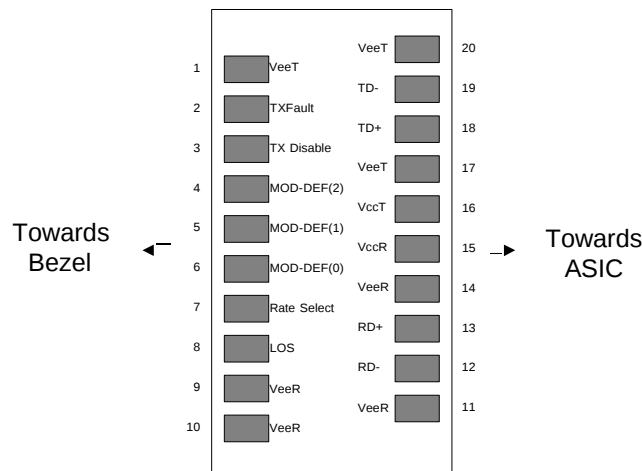
|          |   |                                     |
|----------|---|-------------------------------------|
| <b>y</b> | N | Extended Temperature, -20 to 85°C   |
|          | T | Industrial Temperature, -40 to 85°C |

**I. Pin Descriptions**

| Pin | Symbol             | Name/Description                                               | Ref. |
|-----|--------------------|----------------------------------------------------------------|------|
| 1   | V <sub>EET</sub>   | Transmitter Ground (Common with Receiver Ground)               | 1    |
| 2   | T <sub>FAULT</sub> | Transmitter Fault.                                             |      |
| 3   | T <sub>DIS</sub>   | Transmitter Disable. Laser output disabled on high or open.    | 2    |
| 4   | MOD_DEF(2)         | Module Definition 2. Data line for Serial ID.                  | 3    |
| 5   | MOD_DEF(1)         | Module Definition 1. Clock line for Serial ID.                 | 3    |
| 6   | MOD_DEF(0)         | Module Definition 0. Grounded within the module.               | 3    |
| 7   | Rate Select        | No connection required                                         |      |
| 8   | LOS                | Loss of Signal indication. Logic 0 indicates normal operation. | 4    |
| 9   | V <sub>EER</sub>   | Receiver Ground (Common with Transmitter Ground)               | 1    |
| 10  | V <sub>EER</sub>   | Receiver Ground (Common with Transmitter Ground)               | 1    |
| 11  | V <sub>EER</sub>   | 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 <sub>EER</sub>   | Receiver Ground (Common with Transmitter Ground)               | 1    |
| 15  | V <sub>CCR</sub>   | Receiver Power Supply                                          |      |
| 16  | V <sub>CCT</sub>   | Transmitter Power Supply                                       |      |
| 17  | V <sub>EET</sub>   | 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 <sub>EET</sub>   | Transmitter Ground (Common with Receiver Ground)               | 1    |

**Notes:**

1. Circuit ground is internally isolated from chassis ground.
2. Laser output disabled on T<sub>DIS</sub> > 2.0V or open, enabled on T<sub>DIS</sub> < 0.8V.
3. 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.
4. 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.

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

**II. Absolute Maximum Ratings**

| Parameter                  | Symbol          | Min  | Typ | Max | Unit | Ref. |
|----------------------------|-----------------|------|-----|-----|------|------|
| Maximum Supply Voltage     | V <sub>CC</sub> | -0.5 |     | 4.0 | V    |      |
| Storage Temperature        | T <sub>S</sub>  | -40  |     | 85  | °C   |      |
| Case Operating Temperature | T <sub>A</sub>  | -40  |     | 85  | °C   |      |
| Commercial Temperature     |                 | -5   |     | 70  |      |      |
| Extended Temperature       |                 | -20  |     | 85  |      |      |
| Industrial Temperature     |                 | -40  |     | 85  |      |      |
| Relative Humidity          | RH              | 0    |     | 85  | %    | 1    |

**III. Electrical Characteristics (T<sub>A</sub>, V<sub>CC</sub> = 3.15 to 3.46 Volts)**

| Parameter                         | Symbol                 | Min             | Typ | Max                   | Unit | Ref. |
|-----------------------------------|------------------------|-----------------|-----|-----------------------|------|------|
| Supply Voltage                    | V <sub>CC</sub>        | 3.15            |     | 3.46                  | V    |      |
| Supply Current                    | I <sub>CC</sub>        |                 | 120 | 144                   | mA   |      |
| <b>Transmitter</b>                |                        |                 |     |                       |      |      |
| Input differential impedance      | R <sub>in</sub>        |                 | 100 |                       | Ω    | 2    |
| Single ended data input swing     | V <sub>in,pp</sub>     | 250             |     | 1200                  | mV   | 3    |
| Transmit Disable Voltage          | V <sub>D</sub>         | 2               |     | V <sub>CC</sub>       | V    | 4    |
| Transmit Enable Voltage           | V <sub>EN</sub>        | V <sub>EE</sub> |     | V <sub>EE</sub> + 0.8 | V    |      |
| <b>Receiver</b>                   |                        |                 |     |                       |      |      |
| Single ended data output swing    | V <sub>out,pp</sub>    | 250             | 450 | 550                   | mV   | 5    |
| Data output rise time             | t <sub>r</sub>         |                 | 90  | 175                   | ps   | 6    |
| Data output fall time             | t <sub>f</sub>         |                 | 90  | 175                   | ps   | 6    |
| Mask Margin                       |                        |                 | 45% |                       |      |      |
| LOS Fault                         | V <sub>LOS fault</sub> | 2               |     | V <sub>CCHOST</sub>   | V    | 7    |
| LOS Normal                        | V <sub>LOS norm</sub>  | V <sub>EE</sub> |     | V <sub>EE</sub> +0.5  | V    | 7    |
| Power Supply Rejection            | PSR                    | 100             |     |                       | mVpp | 8    |
| Deterministic Jitter Contribution | RX ΔDJ                 |                 |     | 51.7                  | ps   | 9    |
| Total Jitter Contribution         | RX ΔTJ                 |                 | <65 | 122.4                 | ps   | 10   |

**Notes:**

1. Non condensing.
2. Connected directly to TX data input pins. AC coupling from pins into laser driver IC.
3. We recommend <600mV for best EMI performance.
4. Or open circuit.
5. Into 100 ohms differential termination.
6. 20 – 80 %
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. Typical peak-to-peak jitter (=6\*RMS width of Jitter).
10. Measured with DJ-free data input signal. In actual application, output DJ will be the sum of input DJ and ΔDJ.
11. If measured with TJ-free data input signal. In actual application, output TJ will be given by:

$$TJ_{OUT} = DJ_{IN} + \Delta DJ + \sqrt{(TJ_{IN} - DJ_{IN})^2 + (\Delta TJ - \Delta DJ)^2}$$

**IV. Optical Characteristics (T<sub>A</sub> V<sub>CC</sub> = 3.15 to 3.46 Volts)**

| Parameter                                  | Symbol                          | Min   | Typ | Max   | Unit  | Ref. |
|--------------------------------------------|---------------------------------|-------|-----|-------|-------|------|
| <b>Transmitter</b>                         |                                 |       |     |       |       |      |
| Output Opt. Pwr: 50 or 62.5 MMF            | P <sub>OUT</sub>                | -9    |     | -2.5  | dBm   | 1    |
| Optical Wavelength                         | λ                               | 830   |     | 860   | nm    |      |
| Spectral Width                             | σ                               |       |     | 0.85  | nm    |      |
| Optical Modulation Amplitude @ 2.125 Gb/s  | OMA                             | 196   |     |       | μW    | 2    |
| Optical Modulation Amplitude @ 1.0625 Gb/s | OMA                             | 156   |     |       | μW    | 2    |
| Optical Rise/Fall Time                     | t <sub>r</sub> / t <sub>f</sub> |       | 100 | 150   | ps    | 3    |
| Relative Intensity Noise                   | RIN                             |       |     | -120  | dB/Hz |      |
| Deterministic Jitter Contribution          | TX ΔDJ                          |       | 20  | 56.5  | ps    | 4    |
| Total Jitter Contribution                  | TX ΔTJ                          |       | <65 | 119   | ps    | 5    |
| Extinction Ratio @ 1.25 Gb/s               | ER                              | 9     |     |       | dB    |      |
| Mask Margin                                |                                 |       | 45% |       |       |      |
| <b>Receiver</b>                            |                                 |       |     |       |       |      |
| Receiver Sensitivity = 1.0625 Gb/s         | RxSENS                          |       |     | -18   | dBm   | 6    |
| Receiver Sensitivity = 2.125 Gb/s          | RxSENS                          |       |     | -17   | dBm   | 6    |
| Receiver Sensitivity = 1.25 Gb/s           | RxSENS                          |       |     | -18   | dBm   | 7    |
| Stressed RX sens. =1.0625 Gb/s             |                                 | 0.058 |     |       | mW    | 8    |
| Stressed RX sens. =2.125 Gb/s              |                                 | 0.100 |     |       | mW    | 8    |
| Stressed RX sens. =1.25 Gb/s               |                                 |       |     | -13.5 | dBm   | 9    |
| Average Receiver Power                     | Rx <sub>MAX</sub>               |       |     | 0     | dBm   |      |
| Receiver Elec. 3 dB cutoff freq.           |                                 |       |     | 1500  | MHz   |      |
| Optical Center Wavelength                  | λ <sub>C</sub>                  | 770   |     | 860   | nm    |      |
| Optical Return Loss                        |                                 | 12    |     |       | dB    |      |
| LOS De-Assert                              | LOS <sub>D</sub>                |       |     | -20   | dBm   |      |
| LOS Assert                                 | LOS <sub>A</sub>                | -30   |     |       | dBm   |      |
| LOS Hysteresis                             |                                 | 0.5   |     |       | dB    |      |

**Notes:**

1. Class 1 Laser Safety per FDA/CDRH, IEC, and EN60825-1 laser safety standards.
2. Equivalent extinction ratio specification for Fibre Channel. Allows smaller ER at higher average power.
3. Unfiltered, 20-80%. Complies with FC 1x and 2x eye mask when filtered.
4. Measured with DJ-free data input signal. In actual application, output DJ will be the sum of input DJ and ΔDJ.
5. If measured with TJ-free data input signal. In actual application, output TJ will be given by:

$$TJ_{OUT} = DJ_{IN} + \Delta DJ + \sqrt{(TJ_{IN} - DJ_{IN})^2 + (\Delta TJ - \Delta DJ)^2}$$

6. Specifications are for 50 micro-meter or 62.5 micro-meter fiber
7. As measured with 9dB extinction ratio.
8. Measured with conformance signals defined in FC-PI-4 Rev. 6.1 specifications.
9. Measured with conformance signals defined in IEEE 802.3 specifications.

**V. General Specifications**

| Parameter                      | Symbol | Min | Typ                      | Max        | Units  | Ref.   |
|--------------------------------|--------|-----|--------------------------|------------|--------|--------|
| Data Rate                      | BR     |     | 1.062,<br>1.25,<br>2.125 |            | Gb/sec | 1      |
| Bit Error Rate                 | BER    |     |                          | $10^{-12}$ |        | 4      |
| Fiber Length on 50/125µm MMF   | L      |     |                          | 550<br>300 | m      | 2<br>3 |
| Fiber Length on 62.5/125µm MMF | L      |     |                          | 300<br>150 | m      | 2<br>3 |

Notes:

1. Gigabit Ethernet and 1x, 2x Fibre Channel compatible, per IEEE 802.3 and FC-P1-2 Rev. 5.0 respectively.
2. At 1.0625 Gb/s Fibre Channel and 1.25 Gb/s Gigabit Ethernet data rates.
3. At 2.125 Gb/s Fibre Channel data rate.
4. 2.125Gb/s with PRBS  $2^7-1$ .

**VI. Environmental Specifications**

| Parameter                  | Symbol           | Min | Typ | Max | Units | Ref. |
|----------------------------|------------------|-----|-----|-----|-------|------|
| Case Operating Temperature | T <sub>op</sub>  | -40 |     | 85  | °C    |      |
| Commercial Temperature     |                  | -5  |     | 70  |       |      |
| Extended Temperature       |                  | -20 |     | 85  |       |      |
| Industrial Temperature     |                  | -40 |     | 85  |       |      |
| Storage Temperature        | T <sub>sto</sub> | -40 |     | 85  | °C    |      |

**VII. Regulatory Compliance**

Finisar transceivers are Class 1 Laser 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 FTLF8519P3xyL SFP transceivers support the 2-wire serial communication protocol as defined in the SFP MSA<sup>1</sup>. It is very closely related to the E<sup>2</sup>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, laser 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<sup>2</sup>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<sup>2</sup>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<sup>1,5</sup> 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**

FTLF8519P2xyL transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

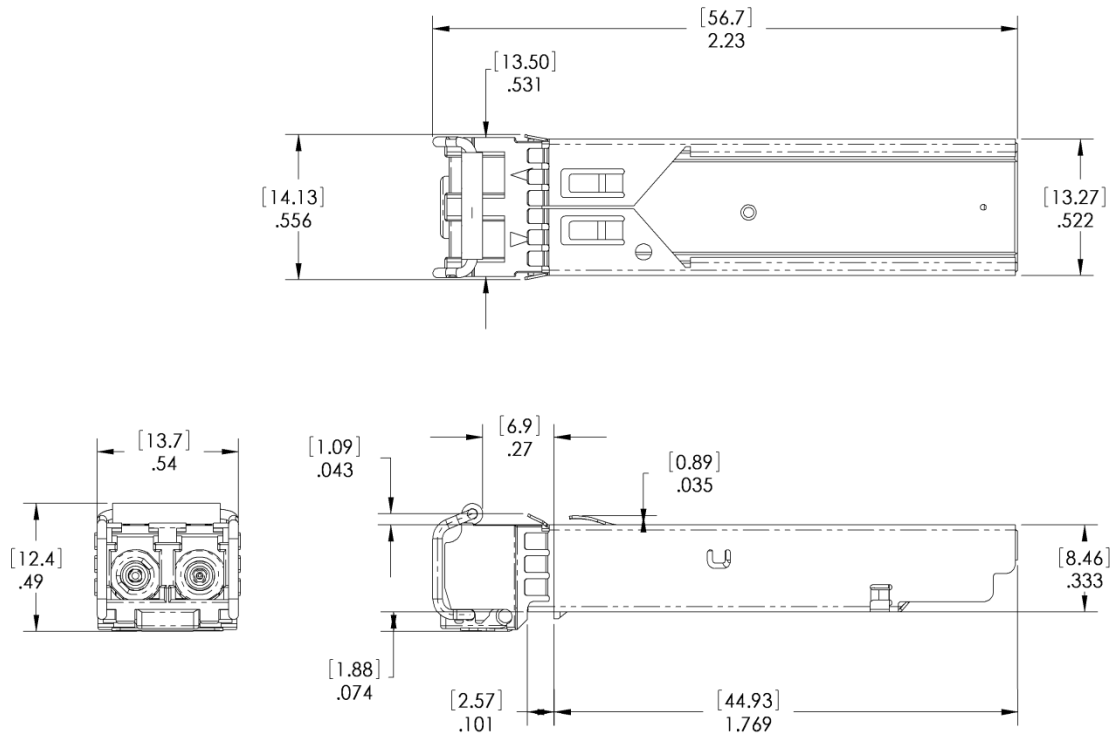
| Parameter                                      | Symbol                    | Min | Typ | Max  | Units | Ref. |
|------------------------------------------------|---------------------------|-----|-----|------|-------|------|
| <b>Accuracy</b>                                |                           |     |     |      |       |      |
| Internally measured transceiver temperature    | DD <sub>Temperature</sub> |     |     | 3    | °C    |      |
| Internally measured transceiver supply voltage | DD <sub>Voltage</sub>     |     |     | 100  | mV    |      |
| Measured TX bias current                       | DD <sub>Bias</sub>        |     |     | 10   | %     | 1    |
| Measured TX output power                       | DD <sub>Tx-Power</sub>    |     |     | 2    | dB    |      |
| Measured RX received average optical power     | DD <sub>Rx-Power</sub>    |     |     | 2    | dB    |      |
| <b>Dynamic Range for Rated Accuracy</b>        |                           |     |     |      |       |      |
| Internally measured transceiver temperature    | DD <sub>Temperature</sub> | -40 |     | 85   | °C    |      |
| Internally measured transceiver supply voltage | DD <sub>Voltage</sub>     | 3.0 |     | 3.6  | V     |      |
| Measured TX bias current                       | DD <sub>Bias</sub>        | 0   |     | 20   | mA    |      |
| Measured TX output power                       | DD <sub>Tx-Power</sub>    | -9  |     | -2.5 | dBm   |      |
| Measured RX received average optical power     | DD <sub>Rx-Power</sub>    | -20 |     | 0    | dBm   |      |
| <b>Max Reporting Range</b>                     |                           |     |     |      |       |      |
| Internally measured transceiver temperature    | DD <sub>Temperature</sub> | -40 |     | 125  | °C    |      |
| Internally measured transceiver supply voltage | DD <sub>Voltage</sub>     | 2.8 |     | 4.0  | V     |      |
| Measured TX bias current                       | DD <sub>Bias</sub>        | 0   |     | 20   | mA    |      |
| Measured TX output power                       | DD <sub>Tx-Power</sub>    | -10 |     | -2   | dBm   |      |
| Measured RX received average optical power     | DD <sub>Rx-Power</sub>    | -22 |     | 0    | dBm   |      |

Notes:

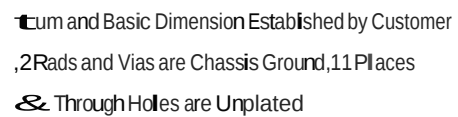
1. Accuracy of Measured Tx Bias Current is 10% of the actual Bias Current from the laser driver to the laser.

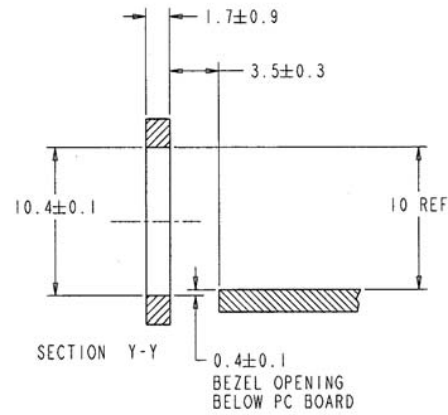
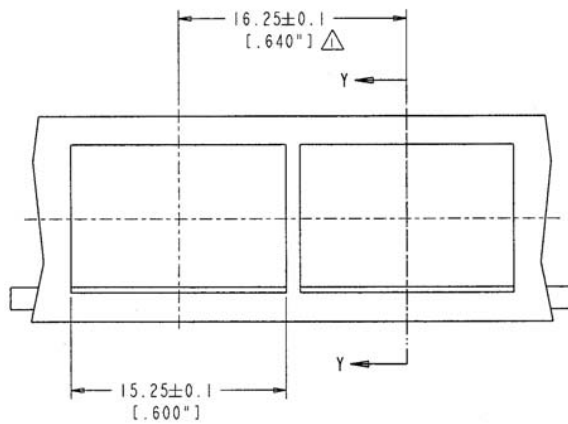
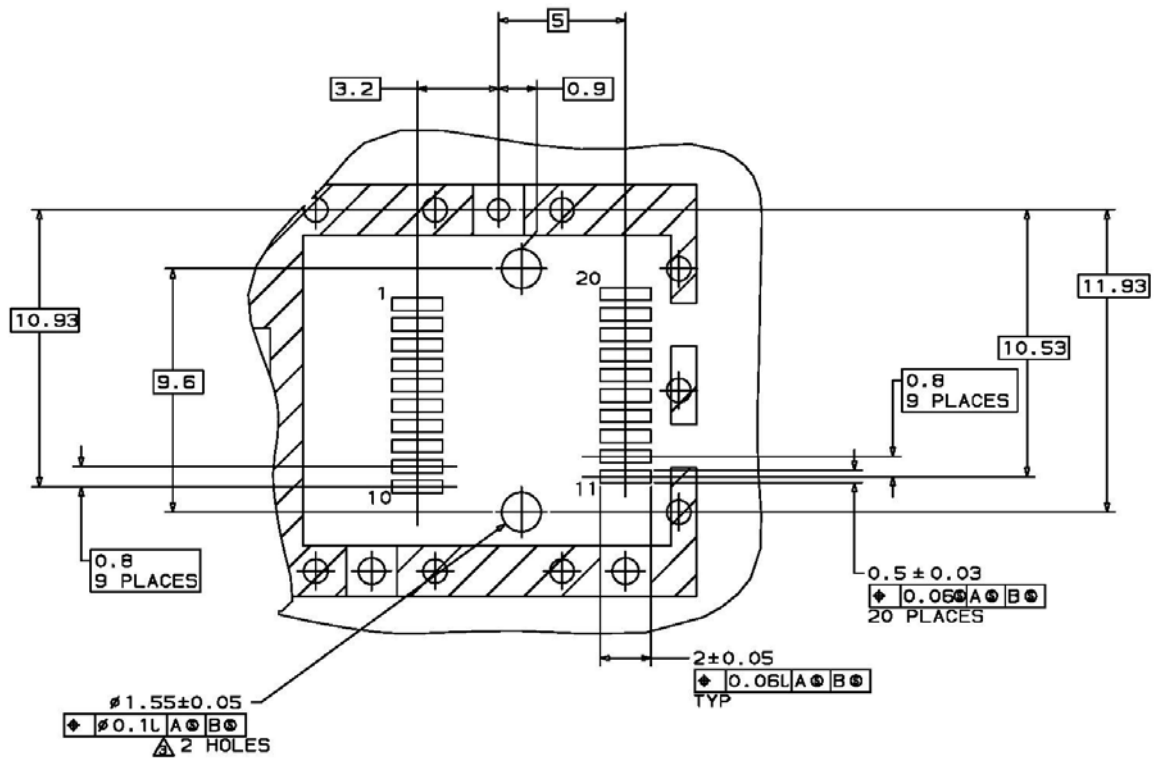
## X. Mechanical Specifications

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



**FTLF8519P3ByL**





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-SX. IEEE Standards Department, 2002.
3. “Fibre Channel Draft Physical Interface Specification (FC-PI-2 Rev. 5.0)”. American National Standard for Information Systems.
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”. 08-June 2011, which supercedes the previous ROHS Directive 2002/95/EC.
5. “Digital Diagnostics Monitoring Interface for Optical Transceivers”. SFF Document Number SFF-8472, Revision 9.3.

## **XIII. For More Information**

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