

# Finisar

## Product Specification

### WDM SFP Transceiver with APD Receiver

#### FWLF16197Dxx

#### PRODUCT FEATURES

- Up to 1.25 Gb/s data links
- Hot-pluggable SFP footprint
- Built-in digital diagnostic functions
- Uncooled DFB laser transmitter in 8 CWDM wavelengths
- APD Receiver
- Very low jitter
- Metal enclosure, for lower EMI
- Single 3.3V power supply
- Operating temperature range: 0°C to 70°C



#### APPLICATIONS

- Metro Access Rings and Point-to-Point networking for Gigabit Ethernet and Fibre Channel

Finisar's FWLF16197Dxx CWDM Small Form Factor Pluggable (SFP) transceivers are designed for operation in Metro Access Rings and Point-to-Point networks using Gigabit Ethernet and Fibre Channel networking equipment. They are available in eight different CWDM wavelengths. Digital diagnostics functions are available via an I<sup>2</sup>C serial bus. In addition, they comply with the Small Form Factor Pluggable Multi-Sourcing Agreement (MSA)<sup>1</sup>.

#### PRODUCT SELECTION

|                     |
|---------------------|
| <b>FWLF16197Dxx</b> |
|---------------------|

xx : (See next page)

| Wavelength | xx | Clasp Color Code | Wavelength | xx | Clasp Color Code |
|------------|----|------------------|------------|----|------------------|
| 1471 nm    | 47 | Gray             | 1551 nm    | 55 | Yellow           |
| 1491 nm    | 49 | Violet           | 1571 nm    | 57 | Orange           |
| 1511 nm    | 51 | Blue             | 1591 nm    | 59 | Red              |
| 1531 nm    | 53 | Green            | 1611 nm    | 61 | Brown            |

## 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. Not supported.                                                                 |      |
| 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                                                                            | 4    |
| 8   | LOS                | Loss of Signal indication. Logic 0 indicates normal operation.                                    | 5    |
| 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. 100 ohm termination between TD+ and TD-, AC Coupled thereafter. |      |
| 19  | TD-                | Transmitter Inverted DATA in. See TD+                                                             |      |
| 20  | V <sub>EET</sub>   | Transmitter Ground (Common with Receiver Ground)                                                  | 1    |

### Notes:

- Circuit ground is internally isolated from chassis ground.**
- Laser output disabled on T<sub>DIS</sub> > 2.0V or open, enabled on T<sub>DIS</sub> < 0.8V.
- Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 5.5V. MOD\_DEF(0) pulls line low to indicate module is plugged in.
- Finisar 2x receiver achieves simultaneous 1x and 2x operation without active control.
- LOS is open collector output. Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 5.5V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

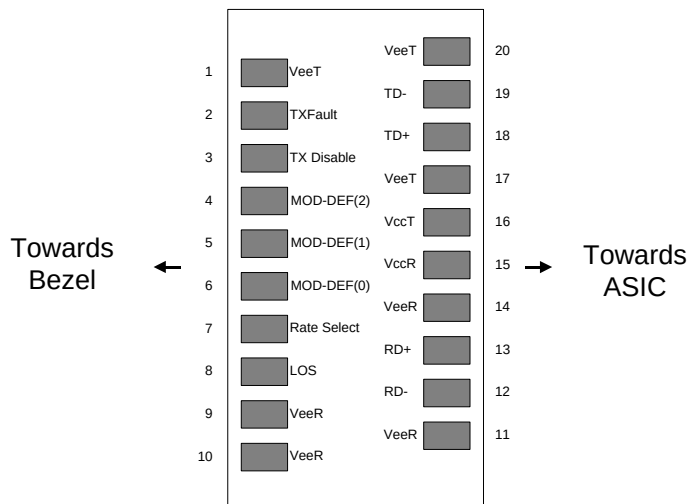


Diagram of Host Board Connector Block Pin Numbers and Names

## II. Absolute Maximum Ratings

| Parameter                  | Symbol          | Min  | Typ | Max | Unit | Ref. |
|----------------------------|-----------------|------|-----|-----|------|------|
| Maximum Supply Voltage     | V <sub>CC</sub> | -0.5 |     | 4.7 | V    |      |
| Storage Temperature        | T <sub>S</sub>  | -40  |     | 85  | °C   |      |
| Case Operating Temperature | T <sub>OP</sub> | 0    |     | 70  | °C   |      |

## III. Electrical Characteristics (T<sub>OP</sub> = 0 to 70 °C, V<sub>CC</sub> = 3.15 to 3.60 Volts)

| Parameter                      | Symbol                 | Min                   | Typ | Max                             | Unit | Ref. |
|--------------------------------|------------------------|-----------------------|-----|---------------------------------|------|------|
| Supply Voltage                 | V <sub>CC</sub>        | 3.15                  |     | 3.60                            | V    |      |
| Supply Current                 | I <sub>CC</sub>        |                       | 200 | 300                             | mA   |      |
| <b>Transmitter</b>             |                        |                       |     |                                 |      |      |
| Input differential impedance   | R <sub>in</sub>        |                       | 100 |                                 | Ω    | 1    |
| Single ended data input swing  | V <sub>in,pp</sub>     | 250                   |     | 1200                            | mV   |      |
| Transmit Disable Voltage       | V <sub>D</sub>         | V <sub>CC</sub> – 1.3 |     | V <sub>CC</sub>                 | V    |      |
| Transmit Enable Voltage        | V <sub>EN</sub>        | V <sub>EE</sub>       |     | V <sub>EE</sub> + 0.8           | V    | 2    |
| Transmit Disable Assert Time   |                        |                       |     | 10                              | us   |      |
| <b>Receiver</b>                |                        |                       |     |                                 |      |      |
| Single ended data output swing | V <sub>out,pp</sub>    | 250                   |     | 800                             | mV   | 3    |
| Data output rise time          | t <sub>r</sub>         |                       | 100 | 260                             | ps   | 4    |
| Data output fall time          | t <sub>f</sub>         |                       | 100 | 260                             | ps   | 4    |
| LOS Fault                      | V <sub>LOS fault</sub> | V <sub>CC</sub> – 0.5 |     | V <sub>CC</sub> <sub>HOST</sub> | V    | 5    |
| LOS Normal                     | V <sub>LOS norm</sub>  | V <sub>EE</sub>       |     | V <sub>EE</sub> +0.5            | V    | 5    |
| Power Supply Rejection         | PSR                    | 100                   |     |                                 | mVpp | 6    |

### Notes:

1. Connected directly to TX data input pins. AC coupled thereafter.
2. Or open circuit.

3. Into 100 ohms differential termination.
4. 20 – 80 %
5. Loss Of Signal is LVTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
6. 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.

#### IV. Optical Characteristics ( $T_{OP} = 0$ to $70^{\circ}\text{C}$ , $V_{CC} = 3.15$ to $3.60$ Volts)

| Parameter                                 | Symbol      | Min     | Typ  | Max     | Unit                   | Ref. |
|-------------------------------------------|-------------|---------|------|---------|------------------------|------|
| <b>Transmitter</b>                        |             |         |      |         |                        |      |
| Output Opt. Pwr (End of Life)             | $P_{OUT}$   | +0      |      | +5      | dBm                    | 1    |
| Optical Wavelength                        | $\lambda$   | (x-6.5) | (x)  | (x+6.5) | nm                     |      |
| Wavelength Temperature Dependence         |             |         | 0.08 | 0.125   | nm/ $^{\circ}\text{C}$ |      |
| Spectral Width (-20dB)                    | $\sigma$    |         |      | 1       | nm                     |      |
| Optical Extinction Ratio                  | ER          | 9       |      |         | dB                     |      |
| Sidemode Supression ratio                 | $SSR_{min}$ | 30      |      |         | dB                     |      |
| Optical Rise/Fall Time                    | $t_r / t_f$ |         |      | 180     | ps                     | 2    |
| RIN                                       | RIN         |         |      | -120    | dB/Hz                  |      |
| Transmitter Jitter (peak to peak)         |             |         |      | 100     | ps                     |      |
| <b>Receiver</b>                           |             |         |      |         |                        |      |
| Average Rx Sensitivity                    | $R_{SENS2}$ |         |      | -29     | dBm                    | 3    |
| Maximum Input Power                       | $P_{MAX}$   | -7      |      |         | dBm                    |      |
| Optical Center Wavelength                 | $\lambda_C$ | 1270    |      | 1620    | nm                     |      |
| LOS De-Assert                             | $LOS_D$     |         |      | -32     | dBm                    |      |
| LOS Assert                                | $LOS_A$     | -42     |      |         | dBm                    |      |
| LOS Hysteresis                            |             |         | 1.0  |         | dB                     |      |
| Receiver Jitter Generation (peak to peak) |             |         |      | 160     | ps                     | 4    |
| Dispersion Penalty at 100km               |             |         |      | 2.5     | dB                     | 3,5  |

##### Notes:

1. Over case temperature of 0 to  $70^{\circ}\text{C}$ . The Transmitter Center Wavelength “x” is as specified by the customer. The current available wavelengths are: 1471, 1491, 1511, 1531, 1551, 1571, 1591, and 1611 nm. Please see the “Product Selection” section on page 1.
2. Unfiltered
3. Worst-case extinction ratio. Measured with a PRBS  $2^7-1$  test pattern, @1.25Gb/s,  $BER < 10^{-12}$ , EOL
4. Jitter added by receiver (peak to peak). Measured at -29dBm average Rx sensitivity, PRBS  $2^7-1$  test pattern.
5. Measured using 9/125 $\mu\text{m}$  SMF-28.

**V. General Specifications**

| Parameter           | Symbol | Min   | Typ | Max  | Units  | Ref.                                                              |
|---------------------|--------|-------|-----|------|--------|-------------------------------------------------------------------|
| Data Rate           | BR     | 0.622 |     | 1.25 | Gb/sec |                                                                   |
| Total System Budget | --     | 29    | 30  |      | dB     | @1.25 Gb/s, BER < 10 <sup>-12</sup><br>w/ PRBS 2 <sup>7</sup> -1. |

**VI. Environmental Specifications**

Finisar CWDM SFP transceivers have an operating temperature range from 0°C to +70°C case temperature.

| Parameter                  | 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    |      |

**VII. Regulatory Compliance**

Finisar CWDM SFP transceivers are Class 1 Laser Products. They are certified per the following standards:

| Feature           | Agency   | Standard                                                 |
|-------------------|----------|----------------------------------------------------------|
| Laser Eye Safety  | FDA/CDRH | CDRH and IEC-825<br>Class 1 Laser Product.<br>See Note 1 |
| Laser Eye Safety  | TÜV      | EN 60950<br>EN 60825-1<br>EN 60825-2                     |
| Electrical Safety | CSA      | CLASS 3862.07<br>CLASS 3862.87                           |

Note 1: Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

## **VIII. Digital Diagnostic Functions**

Finisar FWLF16197Dxx SFP transceivers support the 2-wire serial communication protocol as defined in the draft 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.

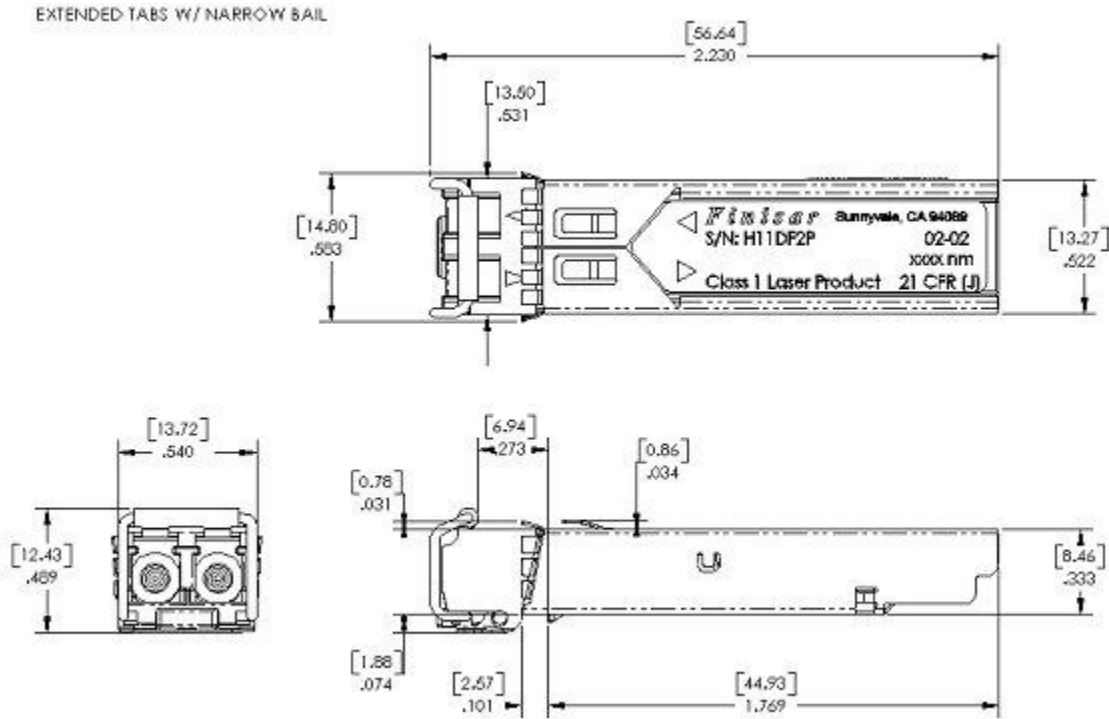
The standard SFP serial ID provides access to identification information that describes the transceiver's capabilities, standard interfaces, manufacturer, and other information.

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".

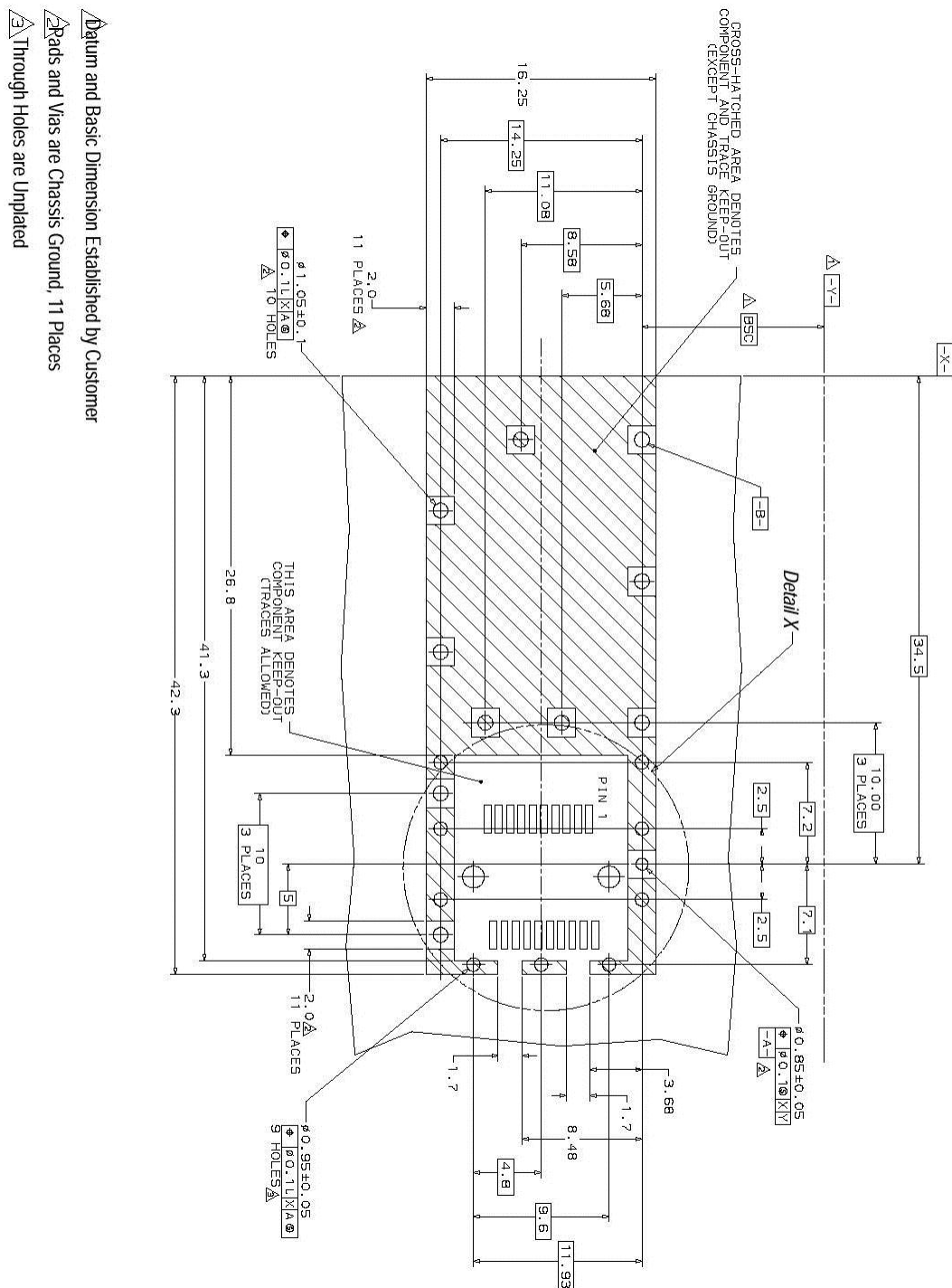
## IX. Mechanical Specifications

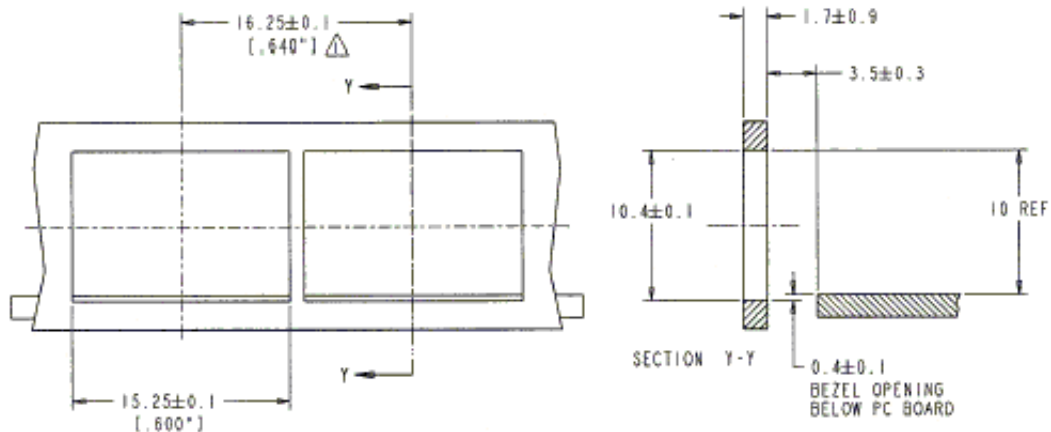
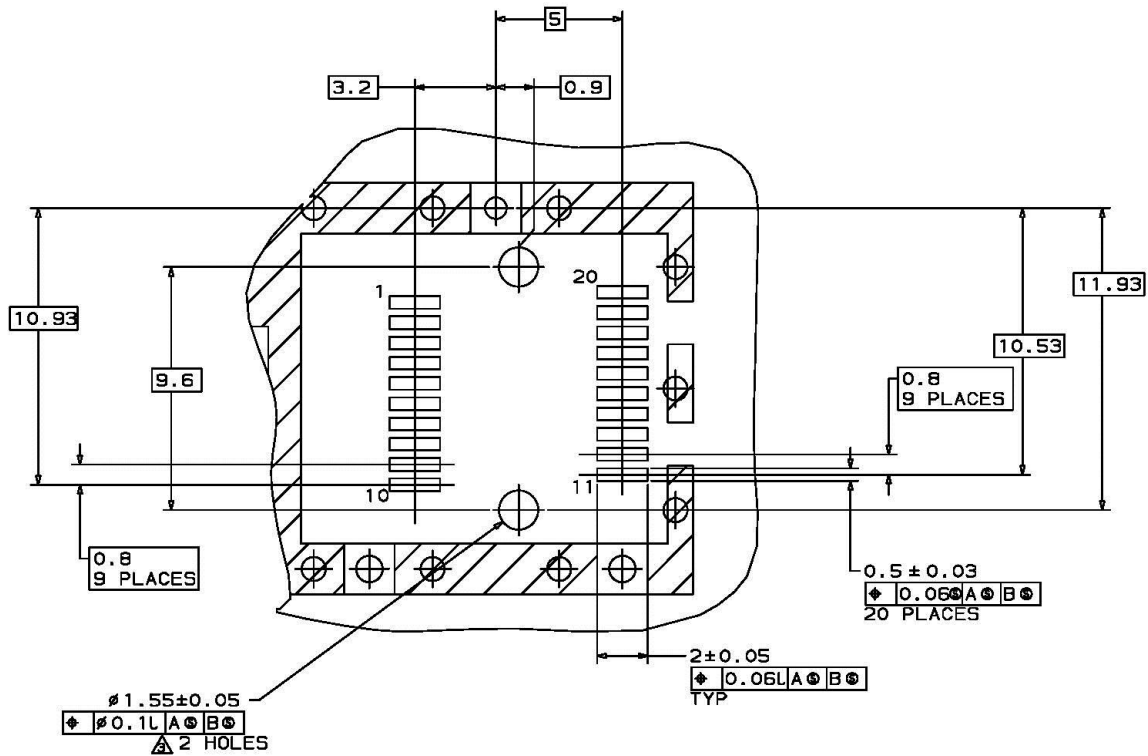
Finisar's Multi-rate CWDM Small Form Factor Pluggable (SFP) transceivers are compatible with the dimensions defined by the SFP Multi-Sourcing Agreement (MSA).



FWLF16197Dxx (dimensions are in inches)

## X. PCB Layout and Bezel Recommendations





NOTES:

△ MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY

2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

## **XI. References**

1. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000. Documentation is currently available at Finisar upon request.
2. IEEE Std 802.3. IEEE Standards Department, 2000.<sup>(\*)</sup>
3. “Fibre Channel Draft Physical Interface Specification (FC-PI 10.0)”. American National Standard for Information Systems.<sup>(\*)</sup>

(\*) Neither IEEE 802.3 nor FC-PI 10.0 specifies a 16xx nm DFB single mode interface. The FWLF16197Dxx complies with these specifications except for the following optical parameters, which have different values: transmitter wavelength, receiver sensitivity, and transmit output power. See Section IV for details.

## **XII. For More Information**

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