

# Finisar

## Product Specification

### Multi-rate CWDM Pluggable SFP Transceiver

#### FWLF16217Dxx

#### PRODUCT FEATURES

- Up to 2.67 Gb/s bi-directional data links
- Hot-pluggable SFP footprint
- Built-in digital diagnostic functions
- Uncooled DFB laser transmitter in 8 possible 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 SONET, Gigabit Ethernet and Fibre Channel

Finisar's FWLF16217Dxx CWDM Small Form Factor Pluggable (SFP) transceivers are designed for operation in Metro Access Rings and Point-to-Point networks using SONET, 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

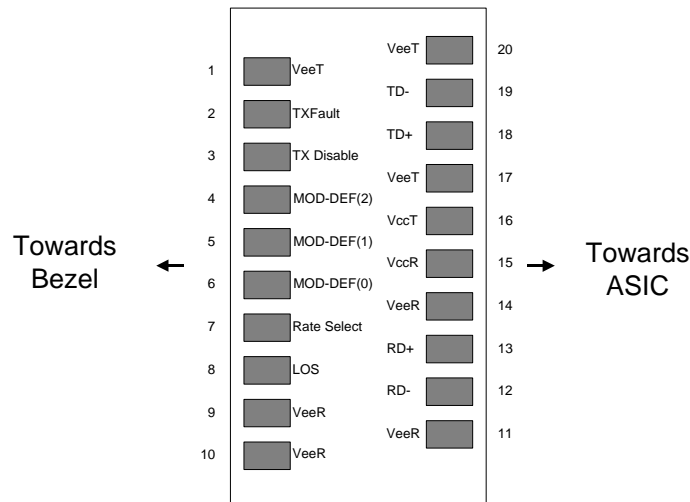
| Wavelength | xx | Clasp Color Code | Wavelength | xx | Clasp Color Code |
|------------|----|------------------|------------|----|------------------|
| 1471 nm    | 47 | Gray             | 1551 nm    | 55 | Yellow           |
| 1491 nm    | 49 | Violet           | 1571 nm    | 57 | Orange           |
| 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>        |                       | 210 | 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 | 180                             | ps   | 4    |
| Data output fall time          | t <sub>f</sub>         |                       | 100 | 180                             | 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 %, 2.488Gb/s
5. Loss Of Signal is LVTTTL. 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. Low Speed Signals**

| Parameter              | Symbol     | Min | Typ | Max  | Units | Notes/Conditions   |
|------------------------|------------|-----|-----|------|-------|--|
| RX_LOS Assert Level    |            | -41 |     |      | dBm   |  |
| RX_LOS Deassert Level  |            |     |     | -30  | dBm   |  |
| RX_LOS Hysteresis      |            | 0.5 | 2   |      | dB    |  |
| RX_LOS Assert Delay    | t_loss_on  |     |     | 100  | μsec  | From detection of loss of signal to assertion of RX_LOS  |
| RX_LOS Negate Delay    | t_loss_off |     |     | 100  | μsec  | From detection of presence of signal to negation of RX_LOS   |
| TX_DISABLE Assert Time | t_off      |     |     | 10   | μsec  | Rising edge of TX_DISABLE to fall of output signal below 10% of nominal  |
| TX_DISABLE Negate Time | t_on       |     |     | 1000 | μsec  | Falling edge of TX_DISABLE to rise of output signal above 90% of nominal. Time indicated is under steady-state temperature conditions. |
| TX_DISABLE Reset Time  | t_reset    | 10  |     |      | μsec  | TX_DISABLE HIGH before TX_DISABLE set LOW  |
| TX_FAULT Assert        |            |     |     | 100  | μsec  | From fault to assertion of TX_FAULT  |
| Initialization Time    |            |     |     | 300  | msec  | From power on to negation of TX_FAULT using TX_DISABLE   |

**V. Optical Characteristics ( $T_{OP} = 0$  to  $70$  °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   | 2    |
| Optical Wavelength                | $\lambda$   | (x-6.5) | (x)  | (x+6.5) | nm    | 3    |
| Wavelength Temperature Dependence |             |         | 0.08 | 0.125   | nm/°C |      |
| Spectral Width (-20dB)            | $\sigma$    |         |      | 1       | nm    | 4    |
| Optical Extinction Ratio          | ER          | 8.2     |      |         | dB    | 5    |
| Sidemode Suppression ratio        | $SSR_{min}$ | 30      |      |         | dB    |      |
| Optical Rise/Fall Time            | $t_r/ t_f$  |         |      | 180     | ps    | 6    |
| RIN                               | RIN         |         |      | -120    | dB/Hz |      |
| Transmitter Jitter Generation     |             |         |      | 75      | mUI   | 7    |
| Dispersion Penalty at 80km        |             |         |      | 2.5     | dB    | 8    |
| <b>Receiver</b>                   |             |         |      |         |       |      |
| Optical Input Power               | $P_{in}$    | -28     |      | -9      | dBm   | 9    |
| Optical Center Wavelength         | $\lambda_C$ | 1450    |      | 1620    | nm    |      |
| Receiver Jitter Generation        |             |         |      | 75      | mUI   | 7    |
| Optical Return Loss               |             | 27      |      |         | dB    |      |

**Notes:**

- Parameters are specified over temperature and voltage, at end of life unless otherwise noted
- Class 1 Laser Safety per FDA/CDRH and IEC-825-1 regulations.
- Over case temperature of 0 to 70 °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.
- Full width, -20dB from peak
- Measured filtered at 2.488 Gb/s. Min represents worst-case ER over temperature and at end of life.
- Unfiltered, 20% to 80%
- Measured per GR-253 section 5.6 for OC-48 B.
- SMF-28 fiber used. 80kms represents 1600ps/nm at 1610nm. Measured at 2.488Gb/s with a PRBS  $2^{23}-1$  pattern at a  $BER < 10^{-12}$
- $P_{in}$  represents the range of input powers where  $BER < 10^{-12}$ .  $P_{in}$  is valid over all data rates specified in Section IV.

**VI. General Specifications**

| Parameter           | Symbol | Min   | Typ | Max  | Units  | Ref.   |
|---------------------|--------|-------|-----|------|--------|--|
| Data Rate           | BR     | 0.155 |     | 2.67 | Gb/sec | OC-3/12 compatible. Not compliant w/ all OC-3/12 specifications such as min ER (OC-48 compliance takes precedence) |
| Total System Budget | --     | 28    | 30  |      | dB     | @2.67 Gb/s, BER < 10 <sup>-12</sup> w/ PRBS 2 <sup>23</sup> -1. Does not include dispersion penalty                |

**VII. Environmental Specifications**

| 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    |      |

**VIII. 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.

## IX. Digital Diagnostic Functions

All Finisar SFPs support the 2-wire serial communication protocol outlined in the SFP MSA5. These SFPs use an Atmel AT24C01A 128 byte E2PROM with an address of A0h (see table below for E2PROM contents). For details on interfacing with the E2PROM, see the Atmel data sheet titled “AT24C01A/02/04/08/16 2-Wire Serial CMOS E2PROM.”<sup>6</sup>

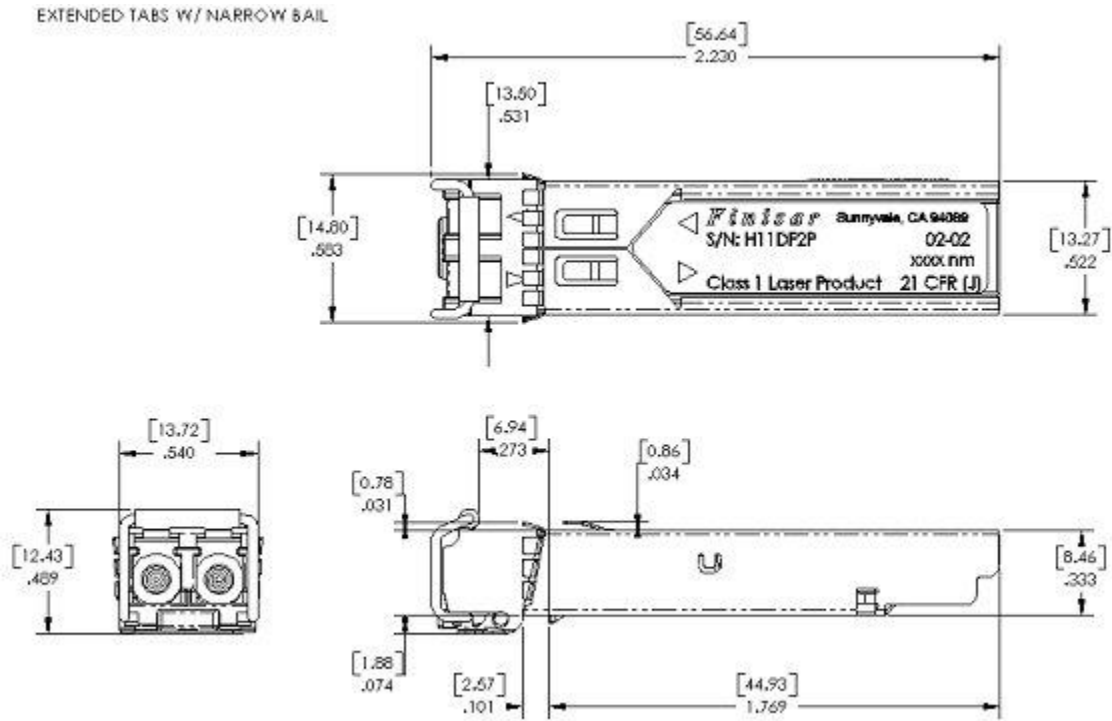
Finisar’s CWDM SFPs also support extended diagnostic features as described in Finisar Applications Note AN-2030, “Digital Diagnostic Monitoring Interface for Optical Transceivers”<sup>7</sup>, and additional information is available in SFF standard titled: “Digital Diagnostic Monitoring Interface for Optical Transceivers (SFF-8472 rev9.3). A controller IC that monitors system parameters such as laser current, module temperature, transmitter power, and received power is accessible at address A2H.

I2C clock speed, digital diagnostic accuracy and digital diagnostic range can be found in the table below. Values in the table represent the worst-case values over temperature, voltage, and life.

| Parameter                    | Symbol                    | Min | Typ | Max     | Units | Notes/Conditions                                       |
|------------------------------|---------------------------|-----|-----|---------|-------|--|
| I <sup>2</sup> C Clock Speed |                           | 0   |     | 100,000 | Hz    | Bus can be driven blind                                |
| <b>Accuracy</b>              |                           |     |     |         |       |  |
| Transceiver Temperature      | DD <sub>Temperature</sub> | -3  |     | +3      | °C    | Measured at controller IC                              |
| Transceiver Supply Voltage   | DD <sub>Voltage</sub>     | -3  |     | +3      | %     | Measured at controller IC                              |
| Tx Bias Current              | DD <sub>Bias</sub>        | -10 |     | +10     | %     |  |
| Tx Output Power              | DD <sub>TxPower</sub>     | -3  |     | +3      | dB    | 100% tested in production tested at room temp to ±2 dB |
| Received Average Power       | DD <sub>RxPower</sub>     | -3  |     | +3      | dB    | 100% tested in production tested at room temp to ±2 dB |
| <b>Range</b>                 |                           |     |     |         |       |  |
| Transceiver Temperature      | DD <sub>Temperature</sub> | -40 |     | 85      | °C    |  |
| Transceiver Supply Voltage   | DD <sub>Voltage</sub>     | 3.0 |     | 4.0     | V     |  |
| Tx Bias Current              | DD <sub>Bias</sub>        | 0   |     | 90      | mA    |  |
| Tx Output Power              | DD <sub>TxPower</sub>     | -10 |     | 5       | dBm   |  |
| Received Average Power       | DD <sub>RxPower</sub>     | -30 |     | -7      | dBm   |  |

## X. 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).

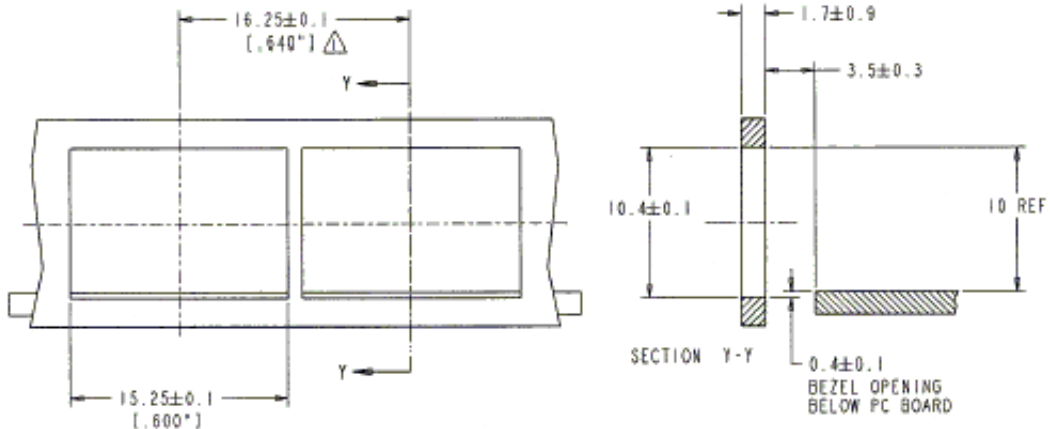
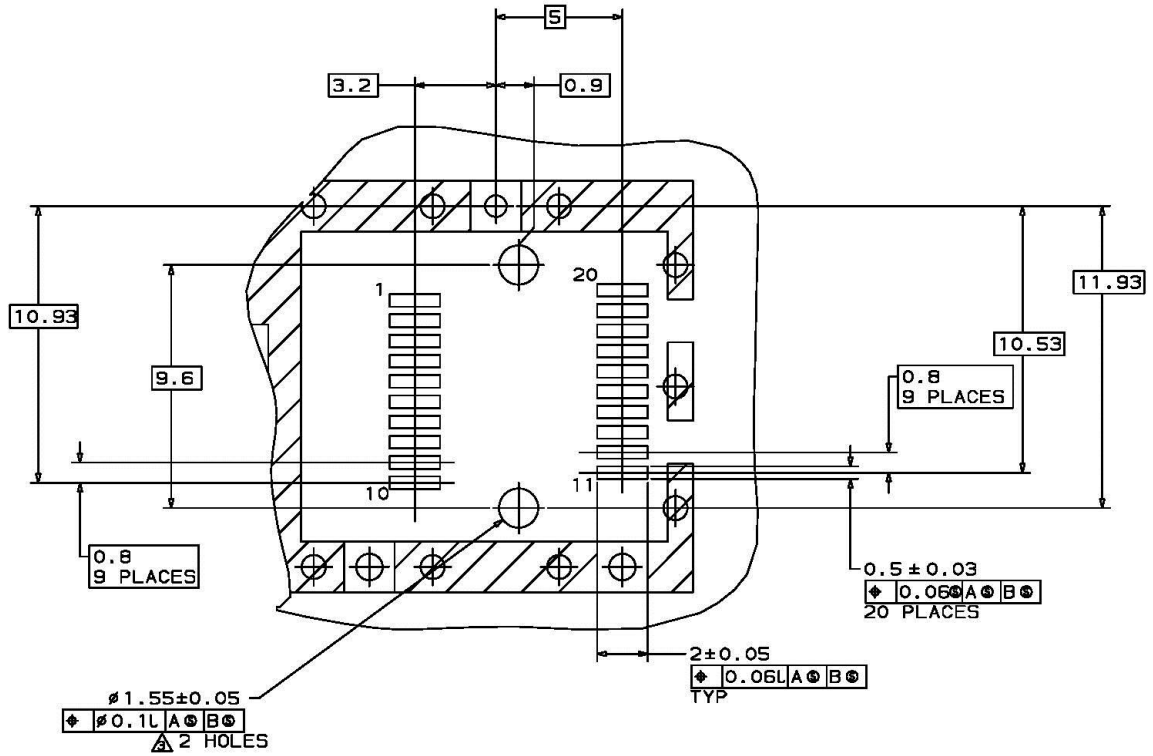


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FWLF16217Dxx Outline Drawing – units in inches [mm]







NOTES:

△ MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY

2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

## **XII. References**

1. “SONET Transport Systems: Common Generic Criteria”, Telcordia Technologies, GR-253-CORE, Issue 3, September 2000.
2. IEEE Std 802.3. IEEE Standards Department, 2000.(\*)
3. “Fibre Channel Draft Physical Interface Specification (FC-PI 10.0)”. American National Standard for Information Systems.(\*)
4. “Optical Interfaces for Course Wavelength Division Multiplexing Applications”, ITU-T Recommendation G.695, January 2005
5. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000. Documentation is currently available at Finisar upon request.
6. “AT24C01A/02/04/08/16 2-Wire Serial CMOS E2PROM”, Atmel Corporation. [www.Atmel.com](http://www.Atmel.com)
7. “Application Note AN-2030: Digital Diagnostic Monitoring Interface for Optical Transceivers”, Finisar Corporation, April 2002.
8. “Digital Diagnostic Monitoring Interface For Optical Transceivers Rev 9.3”. SFF Document No. SFF-8472.

(\*) Neither IEEE 802.3 nor FC-PI 10.0 specifies a 1621 nm DFB single mode interface. The FWLFI6217Dxx 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.

### **For More Information**

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