

## Product Specification

### OC-48 LR-2/STM L-16.2 Multirate 2x10 SFF Transceiver

#### FTLF1621S1xCL

#### PRODUCT FEATURES

- Up to 2.67Gb/s bi-directional data links
- Standard 2x10 pin SFF footprint (MSA compliant)
- Analog diagnostics functions
- Uncooled 1550nm DFB laser transmitter
- APD Receiver
- Duplex LC connector
- Very low jitter
- Metal enclosure, for lower EMI
- Single 3.3V power supply
- Low power dissipation <900mW typical
- Extended operating temperature range: -10°C to 70°C



#### APPLICATIONS

- SONET OC-48 LR-2 / SDH STM L-16.2
- SONET OC-12 LR-2 / SDH STM L-4.2
- SONET OC-3 LR-2 / SDH STM L-1.2
- Gigabit Ethernet / 1x/2x Fibre Channel

Finisar's FTLF1621S1xCL Small Form Factor (SFF) transceivers are compatible with the Small Form Factor Multi-Sourcing Agreement (MSA)<sup>1</sup>. They comply with SONET OC-48 LR-2 (SDH STM L-16.2) standards<sup>2</sup>, and are compatible with Gigabit Ethernet as specified in IEEE Std 802.3<sup>3</sup>, Fibre Channel FC-PI 13.0<sup>4</sup>, SONET OC-12 and SONET OC-3 standards<sup>2</sup>. The transceivers are RoHS compliant and lead-free per Directive 2002/95/EC<sup>5</sup> and Finisar Application Note AN-2038<sup>6</sup>

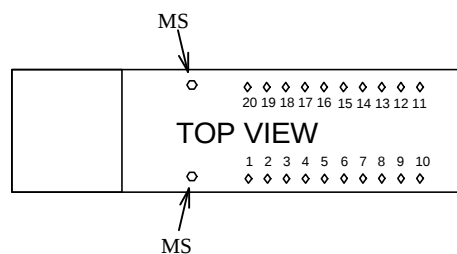
#### PRODUCT SELECTION

#### FTLF1621S1xCL

|   |   |                                    |
|---|---|------------------------------------|
| x | G | 2 Grounding Pins, Short EMI shield |
|   | M | 6 Grounding Pins, Short EMI shield |
|   | K | 2 Grounding Pins, Long EMI shield  |
|   | H | 6 Grounding Pins, Long EMI shield  |

## I. Pin Descriptions

| Pin   | Symbol           | Name/Description                                                                                                                                                                         | Logic Family   |
|-------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| MS    | MS               | Mounting Studs for mechanical attachment. <b>Chassis ground is internally isolated from circuit ground.</b> Connection to chassis ground is recommended.                                 | NA             |
| 1     | PD               | Receiver Power Monitor. This pin must be connected to a positive voltage supply (Vcc), preferably via a small resistor. Supplies photocurrent and may be used to monitor received power. | Analog Current |
| 2,3,6 | V <sub>EER</sub> | Receiver Ground (Common with Transmitter Ground)                                                                                                                                         | NA             |
| 4,5   | NC               | Not Connected.                                                                                                                                                                           |                |
| 7     | V <sub>CCR</sub> | Receiver Power Supply                                                                                                                                                                    | NA             |
| 8     | SD               | Signal Detect. Logic 1 indicates normal operation.                                                                                                                                       | LVTTL          |
| 9     | RD-              | Receiver Inverted DATA out. AC Coupled                                                                                                                                                   | CML            |
| 10    | RD+              | Receiver Non-inverted DATA out. AC Coupled                                                                                                                                               | CML            |
| 11    | V <sub>CCT</sub> | Transmitter Power Supply                                                                                                                                                                 | NA             |
| 12,16 | V <sub>EET</sub> | Transmitter Ground (Common with Receiver Ground)                                                                                                                                         | NA             |
| 13    | T <sub>DIS</sub> | Transmitter Disable                                                                                                                                                                      | LVTTL          |
| 14    | TD+              | Transmitter Non-Inverted DATA in. AC Coupled.                                                                                                                                            | CML<br>ECL     |
| 15    | TD-              | Transmitter Inverted DATA in. AC Coupled.                                                                                                                                                | CML<br>ECL     |
| 17    | Bmon-            | Laser Bias Monitoring (-).                                                                                                                                                               | Analog Voltage |
| 18    | Bmon+            | Laser Bias Monitoring (+)<br>.(Bmon+ - Bmon-) = 10Ω x laser bias current.                                                                                                                | Analog Voltage |
| 19    | Pmon-            | Laser Power Monitoring (-). Current implementation connects this pin to ground                                                                                                           | Analog Voltage |
| 20    | Pmon+            | Laser Power Monitoring (+)<br>.(Pmon+ - Pmon-) = 200Ω x mon. photodiode current.                                                                                                         | Analog Voltage |



## II. Absolute Maximum Ratings

| Parameter                       | Symbol          | Min  | Typ | Max    | Unit | Notes |
|---------------------------------|-----------------|------|-----|--------|------|-------|
| Maximum Supply Voltage          | V <sub>CC</sub> | -0.5 |     | 4.5    | V    |       |
| Storage Temperature             | T <sub>S</sub>  | -40  |     | 85     | °C   |       |
| Case Operating Temperature      | T <sub>OP</sub> | -10  |     | 70     | °C   |       |
| Relative Humidity               | RH              | 0    |     | 85     | %    | 1     |
| Lead Soldering Temperature/Time |                 |      |     | 260/10 | °C/s |       |

## III. Electrical Characteristics (T<sub>OP</sub> = -10 to 70 °C, V<sub>CC</sub> = 3.00 to 3.60 Volts)

| Parameter                                      | Symbol                   | Min                   | Typ | Max                   | Unit | Notes |
|------------------------------------------------|--------------------------|-----------------------|-----|-----------------------|------|-------|
| Supply Voltage                                 | V <sub>CC</sub>          | 3.00                  |     | 3.60                  | V    |       |
| Supply Current                                 | I <sub>CC</sub>          |                       | 270 | 340                   | 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   |       |
| 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    | 3     |
| Transmit Disable Assert Time                   |                          |                       |     | 10                    | us   |       |
| <b>Receiver</b>                                |                          |                       |     |                       |      |       |
| Single ended data output swing                 | V <sub>out,pp</sub>      | 300                   | 400 | 800                   | mV   | 4     |
| Data output rise time                          | t <sub>r</sub>           |                       | 100 | 175                   | ps   | 5     |
| Data output fall time                          | t <sub>f</sub>           |                       | 100 | 175                   | ps   | 5     |
| SD Assert                                      | V <sub>SD assert</sub>   | V <sub>CC</sub> – 0.5 |     | V <sub>CC</sub>       | V    | 6     |
| SD De-Assert                                   | V <sub>SD deassert</sub> | V <sub>EE</sub>       |     | V <sub>EE</sub> +0.5  | V    | 6     |
| Power Supply Rejection                         | PSR                      | 100                   |     |                       | mVpp | 7     |
| Total Generated Receiver Jitter (peak to peak) | J <sub>RXP-P</sub>       |                       |     | 0.07                  | UI   | 8     |
| Total Generated Receiver Jitter (rms)          | J <sub>RXRMS</sub>       |                       |     | 0.007                 | UI   | 8     |

### Notes:

1. Non condensing.
2. AC coupled.
3. Or open circuit.
4. Into 100 ohms differential termination.
5. 20 – 80 %
6. Signal Detect is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
7. All transceiver specifications are compliant with a power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value applied through the power supply filtering network shown on page 23 of the Small Form-factor Pluggable (SFP) Transceiver MultiSource Agreement (MSA)<sup>2</sup>, September 14, 2000.
8. Parameters per GR-253<sup>2</sup> section 5.6 for OC-48B.

**IV. Optical Characteristics (T<sub>OP</sub> = -10 to 70°C, V<sub>CC</sub> = 3.00 to 3.60 Volts)**

| Parameter                                         | Symbol                          | Min  | Typ | Max   | Unit  | Notes |
|---------------------------------------------------|---------------------------------|------|-----|-------|-------|-------|
| <b>Transmitter</b>                                |                                 |      |     |       |       |       |
| Output Opt. Pwr: 9/125 SMF                        | P <sub>OUT</sub>                | -2   |     | +3    | dBm   | 1     |
| Optical Wavelength                                | $\lambda$                       | 1500 |     | 1580  | nm    |       |
| Spectral Width (-20dB)                            | $\sigma$                        |      |     | 1     | nm    |       |
| Optical Extinction Ratio                          | ER                              | 8.2  |     |       | dB    |       |
| Sidemode Suppression ratio                        | SSR <sub>min</sub>              | 30   |     |       | dB    |       |
| Optical Rise/Fall Time                            | t <sub>r</sub> / t <sub>f</sub> |      |     | 180   | ps    | 2     |
| Relative Intensity Noise                          | RIN                             |      |     | -120  | dB/Hz |       |
| Total Generated Transmitter Jitter (peak to peak) | J <sub>TXP-P</sub>              |      |     | 0.07  | UI    | 3     |
| Total Generated Transmitter Jitter (rms)          | J <sub>TXrms</sub>              |      |     | 0.007 | UI    | 3     |
| Dispersion Penalty at 80 km                       |                                 |      |     | 2.0   | dB    | 4     |
| <b>Receiver</b>                                   |                                 |      |     |       |       |       |
| Average Rx Sensitivity @ 2.67Gb/s                 | R <sub>SENS1</sub>              | -9   |     | -28   | dBm   | 5     |
| Average Rx Sensitivity @ OC-48                    | R <sub>SENS1</sub>              | -9   |     | -28   | dBm   | 5     |
| Average Rx Sensitivity @ 2X Fibre Channel         | R <sub>SENS2</sub>              | -9   |     | -28   | dBm   | 6     |
| Average Rx Sensitivity @ Gigabit Ethernet         | R <sub>SENS3</sub>              | -9   |     | -30   | dBm   | 6     |
| Average Rx Sensitivity @ OC-12                    | R <sub>SENS4</sub>              | -9   |     | -29   | dBm   | 7     |
| Average Rx Sensitivity @ OC-3                     | R <sub>SENS5</sub>              | -15  |     | -30   | dBm   | 7     |
| Optical Center (Input) Wavelength                 | $\lambda_C$                     | 1270 |     | 1620  | nm    |       |
| Receiver Reflectance                              | R <sub>Rx</sub>                 |      |     | -27   | dB    |       |
| SD Assert                                         | SD <sub>A</sub>                 |      |     | -28   | dBm   |       |
| SD De-Assert                                      | SD <sub>D</sub>                 | -41  |     |       | dBm   |       |
| SD Hysteresis                                     |                                 | 0.5  |     |       | dB    |       |

**Notes:**

1. Class 1 Laser Safety per FDA/CDRH and EN (IEC) 60825 regulations.
2. Unfiltered, 20 - 80%
3. Parameters per GR-253<sup>2</sup> section 5.6 for OC-48B.
4. SMF-28 fiber used. 80kms represents 1600ps/nm at 1550nm. Measured at 2.488Gb/s with a PRBS 2<sup>23</sup>-1 pattern extrapolated to BER<10<sup>-12</sup>.
5. With worst-case extinction ratio at 10<sup>-10</sup> BER. Measured with a PRBS 2<sup>31</sup>-1 test pattern interspersed with 72 consecutive ones and 72 consecutive zeros.
6. With worst-case extinction ratio. Measured with a PRBS 2<sup>7</sup>-1 test pattern.
7. With worst-case extinction ratio. Measured with a PRBS 2<sup>23</sup>-1 test pattern.

## V. General Specifications

| Parameter                                                    | Symbol            | Min | Typ | Max        | Units | Notes |
|--------------------------------------------------------------|-------------------|-----|-----|------------|-------|-------|
| Data Rate                                                    | BR                | 155 |     | 2667       | Mb/s  | 1     |
| Bit Error Rate                                               | BER               |     |     | $10^{-12}$ |       | 2     |
| Max. Supported Link Length on 9/125µm SMF @ OC-48            | L <sub>MAX1</sub> |     | 80  |            | km    | 3     |
| Max. Supported Link Length on 9/125µm SMF @ 2X Fibre Channel | L <sub>MAX2</sub> |     | 85  |            | km    | 3     |
| Max. Supported Link Length on 9/125µm SMF @ Gigabit Ethernet | L <sub>MAX3</sub> |     | 100 |            | km    | 3     |
| Max. Supported Link Length on 9/125µm SMF @ OC-12            | L <sub>MAX4</sub> |     | 100 |            | km    | 3     |
| Max. Supported Link Length on 9/125µm SMF @ OC-3             | L <sub>MAX5</sub> |     | 100 |            | km    | 3     |

### Notes:

1. SONET OC-48 LR-2/SDH STM L-16.2 compliant. Compatible with Gigabit Ethernet, 1X/2X Fibre Channel, SONET OC-12 and OC-3. Supports FEC at 2.67Gb/s.
2. Tested with a PRBS  $2^{31}-1$  test pattern interspersed with 72 consecutive ones and 72 consecutive zeros unless otherwise specified.
3. Attenuation of 0.275 dB/km is used for the link length calculations (per GR-253 CORE). A 2dB penalty is included for dispersion on >2Gb/s data rates. Distances are indicative only. Please refer to the Optical Specifications in Table IV to calculate a more accurate link budget based on specific conditions in your application.

## VI. Environmental Specifications

| Parameter                  | Symbol           | Min | Typ | Max | Units |
|----------------------------|------------------|-----|-----|-----|-------|
| Case Operating Temperature | T <sub>op</sub>  | -10 |     | 70  | °C    |
| Storage Temperature        | T <sub>sto</sub> | -40 |     | 85  | °C    |

## VII. Regulatory Compliance

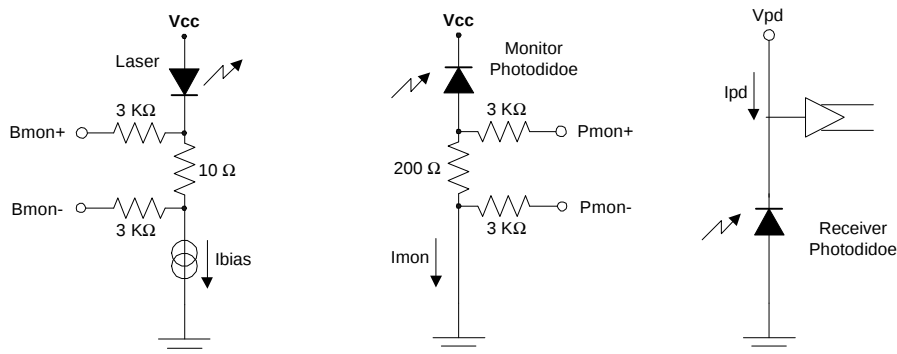
Finisar transceivers are Class 1 Laser Products and comply with US FDA regulations. These products are certified by TÜV and CSA to meet the Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950. Copies of certificates are available at Finisar Corporation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

**VIII. Analog Diagnostics Functions** ( $T_{op} = -10^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ ,  $V_{CC} = 3.00$  to  $3.60$  Volts)

| Parameter                          | Symbol          | Min | Typ | Max      | Unit | Notes |
|------------------------------------|-----------------|-----|-----|----------|------|-------|
| <b>Transmitter</b>                 |                 |     |     |          |      |       |
| Monitor photodiode current monitor | Pmon+,<br>Pmon- | 0   |     | $V_{CC}$ | V    | 1     |
| Laser bias current monitor         | Bmon+,<br>Bmon- | 0   |     | $V_{CC}$ | V    | 2     |
| <b>Receiver</b>                    |                 |     |     |          |      |       |
| Received photocurrent              | Rpd             | 0   |     | 1        | mA   | 3     |
| Photodiode responsivity            | R               | 0.5 | 0.9 | 1.0      | A/W  |       |
| Applied voltage at PD pin          | Vpd             | 2.4 |     | $V_{CC}$ | V    | 3     |

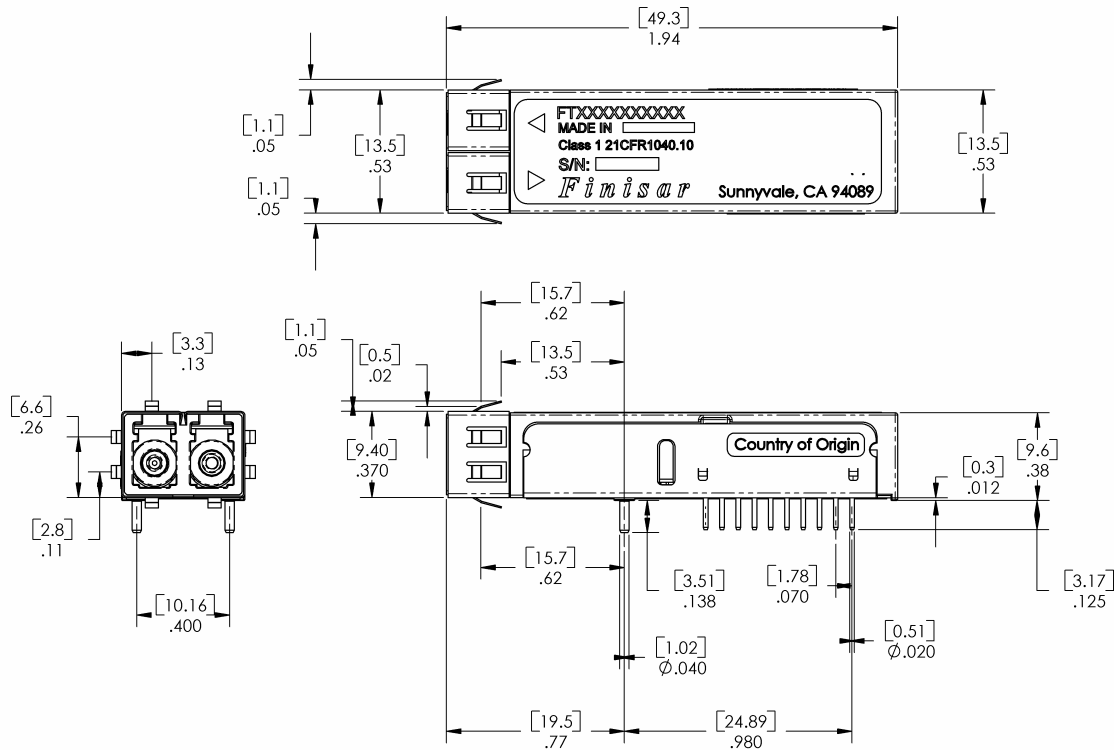
Notes:

1. Pins 19 and 20 provide an analog voltage output proportional to the monitor photodiode current, per the following formula:  $I_{BIAS} = .V(Pmon+ - Pmon-) / 200\Omega$ . The figure below shows the equivalent circuit.
2. Pins 17 and 18 provide an analog voltage output proportional to the laser bias current, per the following formula:  $I_{BIAS} = .V(Bmon+ - Bmon-) / 10\Omega$ . The figure below shows the equivalent circuit.
3. Pin 1 is used to monitor the received photocurrent. It must be connected to a positive voltage within the range specified above. The current that flows into this pin is the received photocurrent. The received power is given by the photocurrent multiplied by the photodiode responsivity.

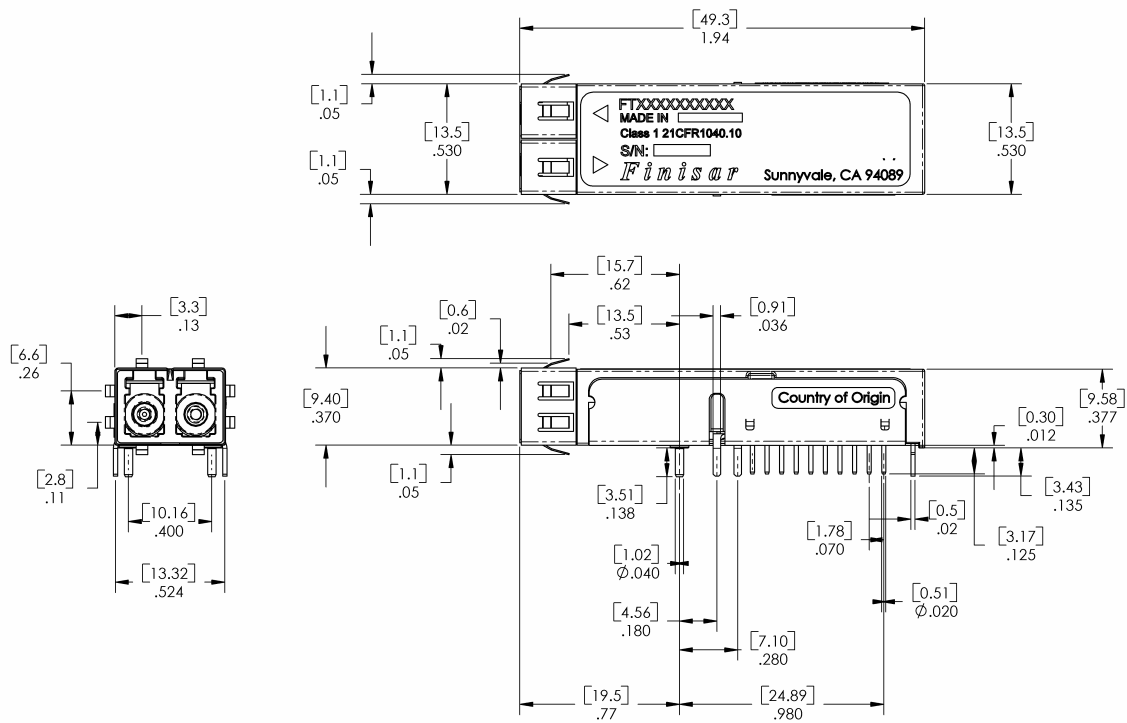
**Analog monitoring function connections.**

## IX. Mechanical Specifications

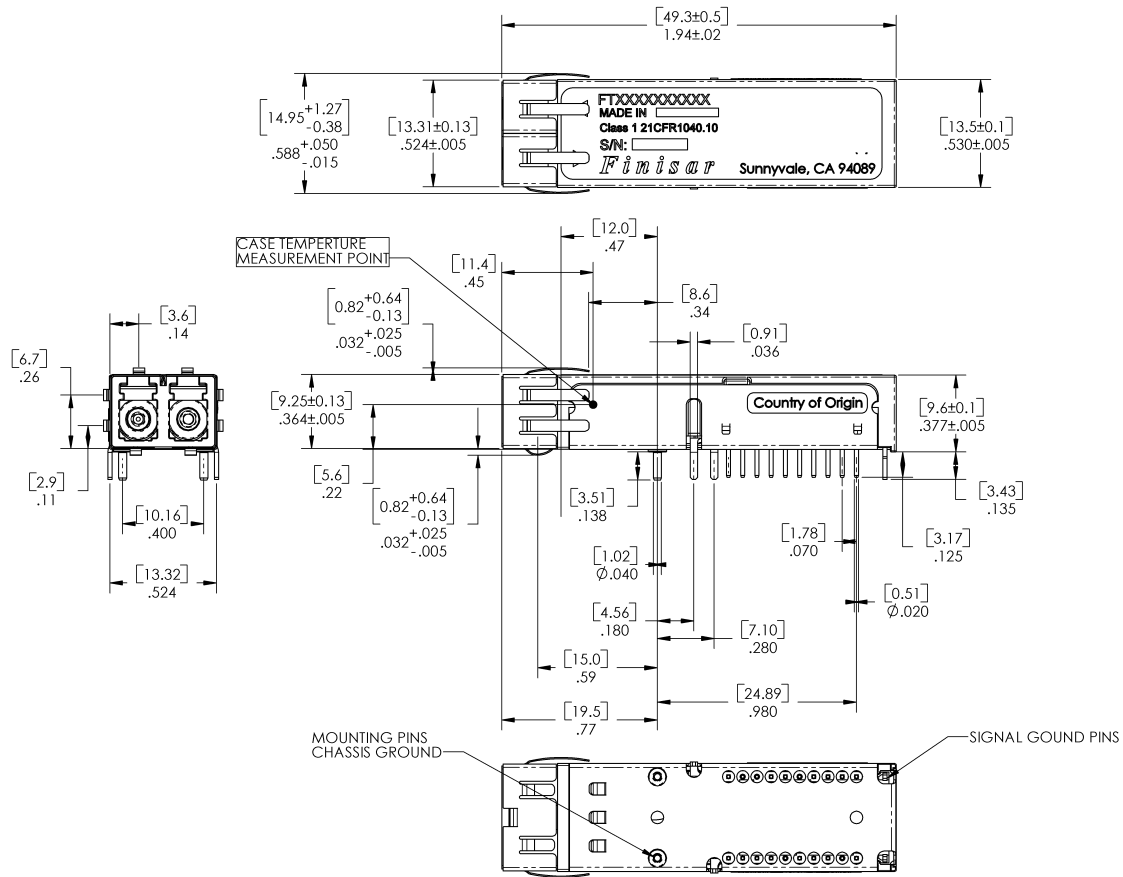
Finisar's OC-48/STM-16 Small Form Factor (SFF) transceivers comply with the standard dimensions defined by the Small Form Factor Multi-Sourcing Agreement (MSA).



**FTLF1621S1GCL – 2 pin version**

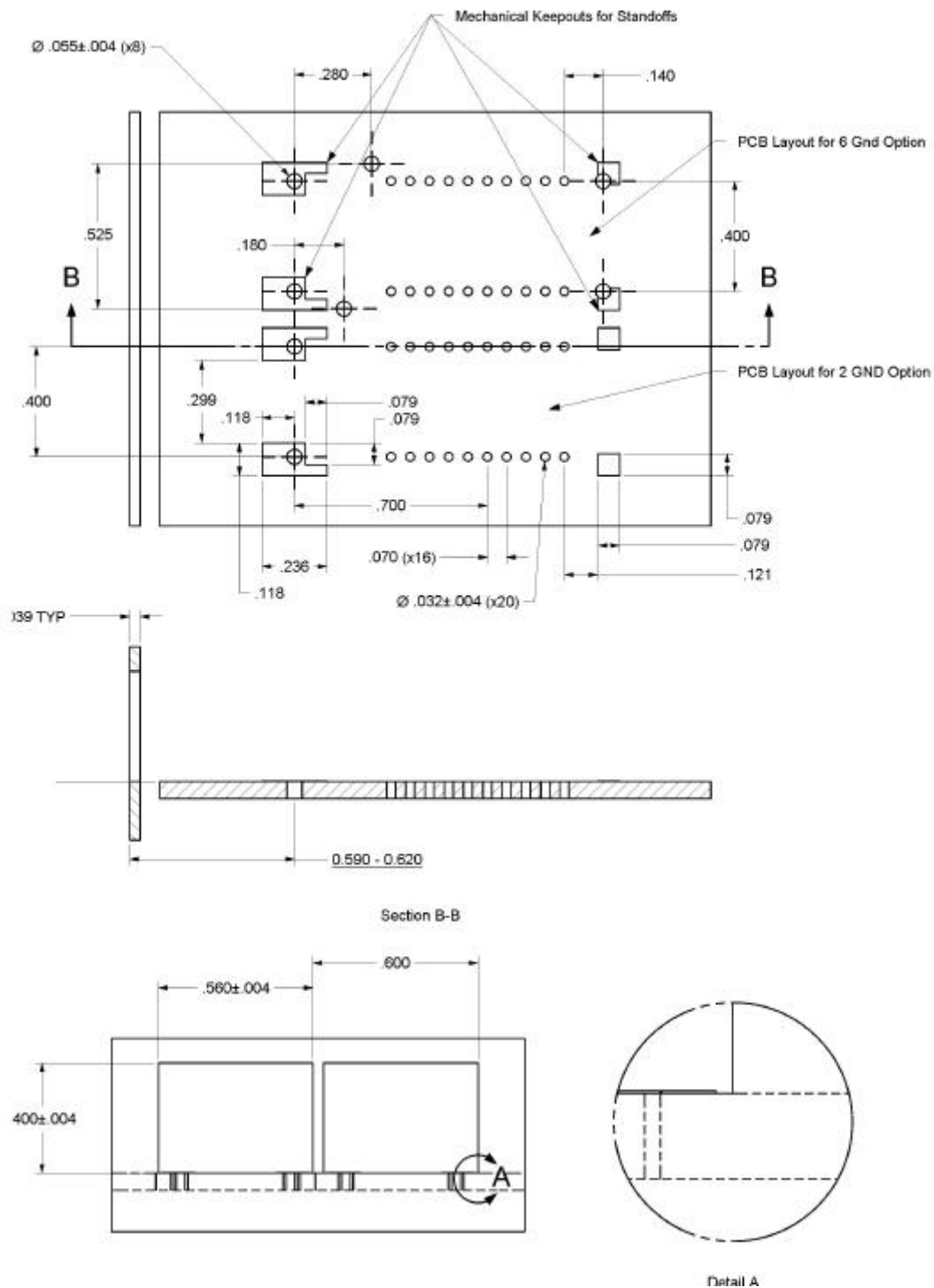


## FTLF1621S1HCL – 6 pin version



FTLF1621S1HCL – 6 pin version (Long EMI Shield)

## X. PCB Layout and Bezel Recommendations



**Minimum Recommended Module-to-Module Spacing is 0.6 inches**

## **XI. References**

1. Small Form Factor Pluggable (SFF) Transceiver Multi-Source Agreement (MSA), January 1998. Documentation is currently available from Finisar upon request.
2. “SONET Transport Systems: Common Generic Criteria”, Telcordia Technologies, GR-253-CORE, Issue 3, Sept 2000. Also refer to ITU-T G.957 Specifications
3. IEEE Std 802.3, 2002 Edition, Clause 38, PMD Type 1000BASE-LX. IEEE Standards Department, 2002. (Transmit Optical Output has a minimum Extinction Ratio of 8.2 dB only).<sup>(\*)</sup>
4. “Fibre Channel Draft Physical Interface Specification (FC-PI 13.0)”. American National Standard for Information Systems.<sup>(\*)</sup>
5. 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.
6. “Application Note AN-2038: Finisar Implementation of RoHS Compliant Transceivers”. Finisar Corporation, January 21, 2005.

(\*) Neither IEEE 802.3 nor FC-PI 13.0 specifies a 1550nm DFB single mode interface. The FTLF1621S1xCL complies with these standards except for receiver sensitivity, ER and transmit output power. See Section IV for details.

## **XII. For More Information**

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