# *F i n i s a r*
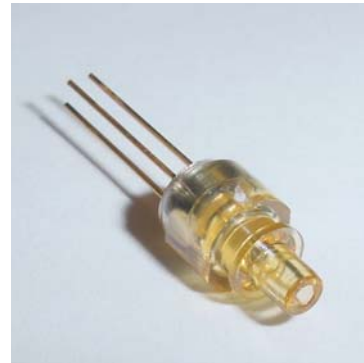
## Product Specification
## 4.25Gbps 850nm VCSEL, LC TOSA
## HFE4192-581, HFE4192-582

**PRODUCT FEATURES**

- 850nm multi-mode oxide isolated VCSEL

- Capable of modulation operation from DC to 5Gbps

- TO-46 tilt window metal can component, prealigned into LC Sleeve

- Designed for drive currents between 3-15mA average

- Packaged with a back monitor

- Attenuated window can

This product is a high-performance 850nm VCSELs (Vertical Cavity Surface-Emitting Lasers) designed for high-speed data communications and packaged with a custom designed power monitor diode. The power monitor diode can be used with appropriate feedback control circuitry to set a maximum power level for the VCSEL. These combined features simplify design for high data rate communication and eye safety.

It is designed to be used with inexpensive silicon or gallium arsenide detectors, but excellent performance can also be achieved with some indium gallium arsenide detectors.

The low drive current requirement makes direct drive from PECL (Positive Emitter Coupled Logic) or ECL (Emitter Coupled Logic) gates possible and eases driver design.

VCSELs produce circularly symmetric, non-astigmatic, narrow divergence beams that, with appropriate lensing, fiber couple all of the emitter power. This LC TOSA product is pre-aligned and focused fiber optic transmitters designed to interface with 50/125 and 62.5/125 m multi-mode fiber

## PRODUCT SELECTION

| Part Number | Description |
|---|---|
| HFE4192-581 | LC TOSA with attenuated optics, monitor photodiode, normal polarity |
| HFE4192-582 | LC TOSA with attenuated optics, monitor photodiode, reverse polarity |

## I. Absolute Maximum Ratings

| Parameter | Rating |
|---|---|
| Storage Temperature | -40 to +85°C |
| Case Operating Temperature | -40* to +85°C |
| Lead Solder Temperature | 260°C, 10 sec. |
| Laser continuous average current | 12mA |
| Laser peak forward current with pulse width less than 1us | 18mA |
| Laser reverse voltage | 5V |
| Photodiode reverse voltage | 5V |
| Photodiode reverse current | 2mA |
| ESD Exposure (Human Body Model) | 225V[1] |

[1]Heel and wrist straps must be used on a properly grounded workstation

INVISIBLE LASER RADIATION
DO NOT VIEW DIRECTLY WITH
OPTICAL INSTRUMENTS
10mW at 820 - 860nm
CLASS 1M LASER PRODUCT

COMPLIES WITH IEC/EN 60825-1
Ed1.2:2001
COMPLIES WITH 21 CFR 1040.10
AND 1040-10.11 EXCEPT FOR
DEVIATION PURSUANT TO
LASER NOTICE NO.50
DATED 26 JULY 2001

Advanced Optical Components
600 Millennium Drive,
Allen, TX 75013

LASER RADIATION
AVOID EXPOSURE TO BEAM
CLASS 1M LASER PRODUCT

## Notice

Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operations section for extended periods of time may affect reliability.

## Notice

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation to equipment, take normal ESD precautions when handling this product

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## II.     Electro-Optical Characteristics ($T_A$=25 $^o$C unless otherwise stated)

| VCSEL Parameters | Test Condition | Symbol | Min. | Typ. | Max. | Units | Notes |
|---|---|---|---|---|---|---|---|
| Average Fiber Coupled Power | $I_F$ = 7mA | $P_{OC}$ | | 0.4 | | mW | 2 |
| Minimum coupling efficiency including wiggle | $I_F$ = 7mA | | 55 | | | % | 2 |
| Threshold Current | | $I_{TH}$ | 0.5 | 1.5 | 2 | mA | |
| Threshold Current maximum deviation from 25$^o$C value | $T_A$ = 0$^o$C to 70$^o$C | $\Delta I_{TH}$ | -0.5 | | 1 | mA | 3 |
| | $T_A$ = 25$^o$C to 85$^o$C | $\Delta I_{TH}$ | | | 1.7 | mA | 3 |
| | $T_A$ = -40$^o$C to 25$^o$C | $\Delta I_{TH}$ | | | 1.5 | mA | 3 |
| Temperature at minimum threshold current | | $T_O$ | -30 | | 10 | $^o$C | 3 |
| Slope Efficiency | $T_A$ = 25$^o$C | η | 0.05 | 0.07 | 0.09 | mW/mA | 4 |
| | $T_A$ = -40$^o$C | η | | | 0.13 | mW/mA | |
| | $T_A$ = 85$^o$C | η | 0.035 | | | mW/mA | |
| Slope Efficiency Temperature variation | $T_A$ = -40$^o$C to 85$^o$C | Δη/ΔT | | -6000 | | ppm/ $^o$C | 5 |
| Peak Wavelength | $I_F$ = 7mA, $T_A$ = -40$^o$C to 85$^o$C | $\lambda_P$ | 830 | 850 | 860 | nm | |
| $\lambda_P$ Temperature Variation | $I_F$ = 7mA, $T_A$ = -40$^o$C to 85$^o$C | $\Delta\lambda_P$/ΔT | | 0.06 | | nm/$^o$C | |
| Spectral Bandwidth, RMS | $I_F$ = 7mA | Δλ | | | 0.65 | nm | |
| Laser Forward Voltage | $I_F$ = 7mA | $V_F$ | | 1.8 | 2.0 | V | |
| Laser Resonance Frequency | $I_F$/$I_{TH}$ = 4 | ROF | 5 | | | GHz | 10 |
| Minimum Bias Relative to $I_{th}$ | $T_A$ = -40$^o$C to 85$^o$C | r | | 4 | | | 10 |
| Rise and Fall Times | Pavg = 0.400mW, Extinction Ratio = 10 | $t_r$ $t_f$ | | | 90 90 | ps | 6 |
| Relative Intensity Noise | 1 GHz BW, $I_F$ = 7mA | RIN | | -130 | -122 | dB/Hz | |
| Series Resistance | $I_F$ = 7mA , $T_A$ = 25$^o$C | $R_S$ | 25 | 35 | 50 | Ω | |
| | $T_A$ = -40$^o$C | $R_S$ | | | 60 | Ω | |
| | $T_A$ = 85$^o$C | $R_S$ | 20 | | | Ω | |
| Series Resistance Temperature Coefficient | $I_F$ = 7mA, $T_A$ = -40$^o$C to 85$^o$C | $\Delta R_s$/ΔT | | -3000 | | ppm/ $^o$C | 7 |
| **Photodiode Parameters** | **Test Condition** | **Symbol** | **Min.** | **Typ.** | **Max.** | **Units** | **Notes** |
| Monitor Current | Po = 0.4mW, $T_A$ = 25$^o$C | $I_{PD}$ | 0.3 | 0.5 | 0.85 | mA | 8 |
| | Po = 0.4mW, $T_A$ = -40$^o$C | $I_{PD}$ | 0.27 | 0.5 | 0.95 | | 8 |
| | Po = 0.4mW, $T_A$ = +85$^o$C | $I_{PD}$ | 0.27 | 0.5 | 0.95 | mA | 8 |
| Mon. Current Temp. Variation | Po = 0.4mW, -40$^o$C to85$^o$C | $\Delta I_{PD}$/ΔT | -0.1 | 0 | 0.1 | %/ $^o$C | 8 |
| Monitor Current Tracking | | Deltrk | .8 | 1 | 1.2 | | 8,9 |
| Dark Current | Po = 0mW, $V_R$ = 3V | $I_D$ | | | 20 | nA | |
| PD Capacitance | $V_R$ = 0V, Freq = 1MHz $V_R$ = 3V, Freq = 1MHz | C | | 75 40 | 100 55 | pF | |

Notes:
1) Reliability is a function of temperature, see www.adopco.com for details.
2) For the purpose of these tests, $I_F$ is DC current.
3) Threshold current varies as $(T_A - T_O)^2$. It may either increase or decrease with temperature, depending upon relationship of $T_A$ to $T_O$. The magnitude of the change is proportional to the threshold at $T_O$.
4) Slope efficiency is defined as $\Delta P_O/\Delta I_F$.
5) To compute the value of Slope Efficiency at a temperature T, use the following equation:
$$\eta(T) \approx \eta(25^oC)*[1+(\Delta\eta/\Delta T)*(T-25)]$$
6) Rise and fall times specifications are the 20% - 80%. Most of the devices will measure <80ps fall time.
7) To compute the value of Series Resistance at a temperature T, use the following equation:
$$R_S(T) \approx R_S(25^oC)*[1+(\Delta R_S/\Delta T)*(T-25)]$$
8) These specifications are for the TOSA component alone. Reflections introduced by any subsequent higher level assembly may affect these values.
9) Monitor current tracking is defined as follows:
$$\text{Deltrk} = \frac{\text{IPD(Po} = 0.75\text{mW}) / 0.75\text{mW}}{\text{IPD(Po} = 0.45\text{mW}) / 0.45\text{mW}}$$
10) Relaxation Oscillation Frequency (ROF) is determined by the relationship:
$$\text{ROF} = \frac{1}{2\pi} \cdot \sqrt{\frac{r-1}{t_c \cdot \tau_2} - \frac{r}{t_2}}$$

Where $r= I_F/I_{TH}$, $t_c$ is the photon lifetime (2.5ps), and $\tau_2$ is the spontaneous emission lifetime (1ns). Both $t_c$ and $\tau_2$ are functions of temperature. When operating at high temperature, the r ($I_F/I_{TH}$) value can be significantly reduced and still maintain adequate speed performance. This is recommended in order to preserve reliability.

## III.    Typical Performance Curves

**Emitted Power vs. Current:** Power varies approximately linearly with current above threshold.
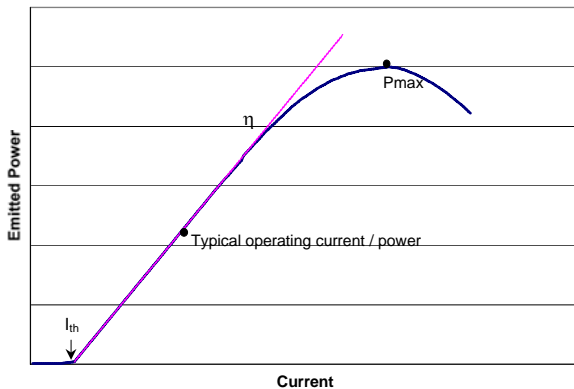
**Threshold Current vs. Temperature:** Threshold current varies parabolically with temperature; thus it can be nearly constant for a limited temperature range.
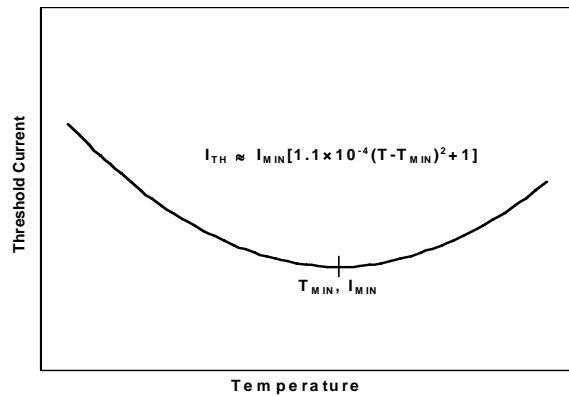
## IV.      Environmental Specifications

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

## V.      Regulatory Compliance

| Feature | Agency | Standard | Certificate Number |
|---------|--------|----------|--------------------|
| Laser Eye Safety | FDA/CDRH | CDRH 21 CFR 1040 and Laser Notice 50 | |

Copies of the referenced certificates are available at Finisar Corporation upon request.

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## VI.  Mechanical Specifications

| Number | HFE4192-581 | HFE4192-582 |
|:---:|---|---|
| 1 | VCSEL Cathode | VCSEL Anode |
| 2 | VCSEL Anode | VCSEL Cathode |
| 3 | Monitor Diode Cathode | Monitor Diode Cathode |
| 4 | Monitor Diode Anode (Case) | Monitor Diode Anode (Case) |
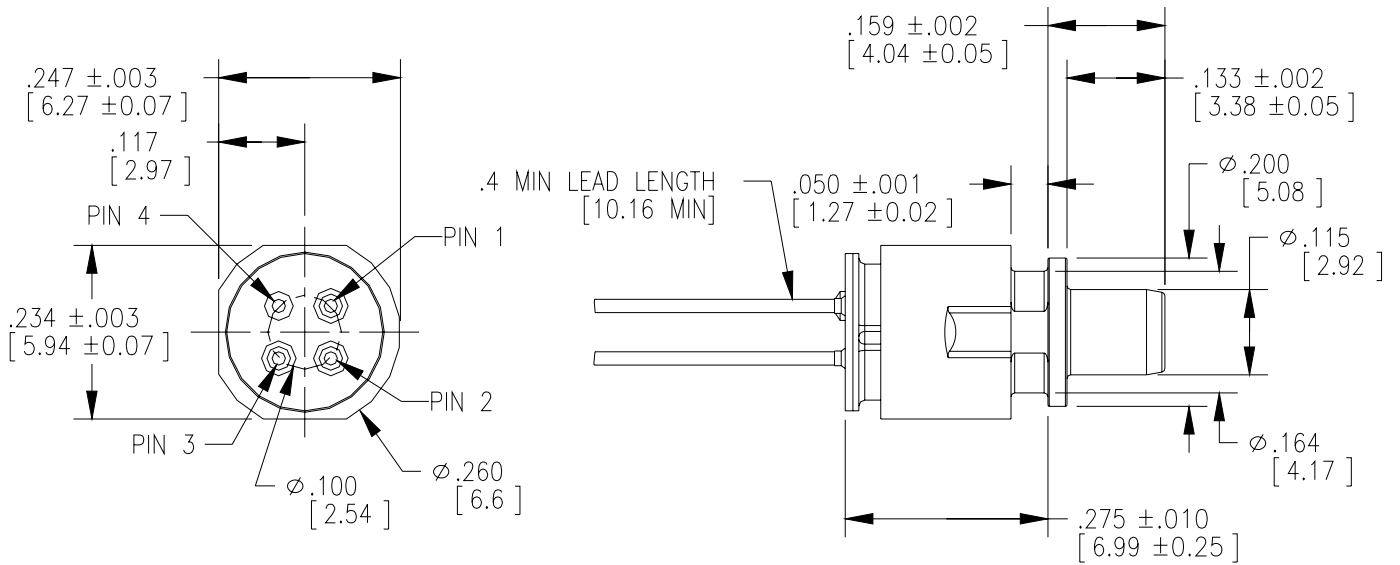
All dimensions are in inches. [mm]

## VII.    Revision History

| Revision | Date | Description |
|----------|------|-------------|
| A1 | 4/26/2013 | • Document created. |

## VIII.   For More Information

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