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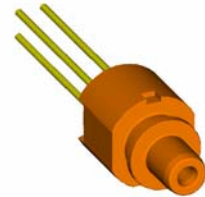
## Product Specification

2.5Gbps 850nm VCSEL, LC TOSA

**HFE4190-441, HFE4191-441**

### PRODUCT FEATURES

- 850nm multi-mode oxide isolated VCSEL
- Extended Temperature Range Operation (– 40 to +85 deg operating range)
- Capable of modulation operation from DC to 2.5Gbps
- 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



These products are 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.

These products are designed to be used with inexpensive silicon or gallium arsenide detectors, but excellent performance can also be achieved with some indium gallium arsenide detectors (see HFD3180-103 and HFD3180-108 product data sheets).

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

### PRODUCT SELECTION

Part Number	Description
HFE4190-441	LC TOSA with attenuated TO-46 component, VCSEL with Back Monitor Photodiode, Anode of VCSEL common with Photodiode Cathode
HFE4191-441	LC TOSA with attenuated TO-46 component, VCSEL with Back Monitor Photodiode, Cathode of VCSEL common with Photodiode Anode

## 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
ESD Exposure (Human Body Model)	225V <sup>1</sup>

<sup>1</sup>Heel and wrist straps must be used on a properly grounded workstation



### 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

## II. Electro-Optical Characteristics

VCSEL Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Average Fiber Coupled Power	$I_F = 7\text{mA}$	$P_{OC}$		0.500		mW	2
Minimum coupling efficiency including wiggle	$I_F = 7\text{mA}$		55			%	2
Threshold Current		$I_{TH}$	0.5	1.8	2.5	mA	
Threshold Current maximum deviation from 25°C value	$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$	$\Delta I_{TH}$	-0.5		1	mA	3
	$T_A = 25^\circ\text{C}$ to $85^\circ\text{C}$	$\Delta I_{TH}$			1.7	mA	3
	$T_A = -40^\circ\text{C}$ to $25^\circ\text{C}$	$\Delta I_{TH}$			2.5	mA	3
Temperature at minimum threshold current		$T_O$	-20		50	°C	3
Slope Efficiency	$T_A = 25^\circ\text{C}$	$\eta$	0.04	0.125	0.16	mW/mA	4
	$T_A = -40^\circ\text{C}$	$\eta$			0.200	mW/mA	
	$T_A = 85^\circ\text{C}$	$\eta$	0.03			mW/mA	
Slope Efficiency Temperature variation	$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$	$\Delta\eta/\Delta T$		-6000		ppm/°C	5
Peak Wavelength	$I_F = 7\text{mA}$ , $T_A = 0^\circ\text{C}$ to $85^\circ\text{C}$	$\lambda_P$	830	850	860	nm	
$\lambda_P$ Temperature Variation	$I_F = 7\text{mA}$ , $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$	$\Delta\lambda_P/\Delta T$		0.06		nm/°C	
Spectral Bandwidth, RMS	$I_F = 7\text{mA}$	$\Delta\lambda$			0.65	nm	
Laser Forward Voltage	$I_F = 7\text{mA}$	$V_F$		1.8	2.0	V	
Rise and Fall Times	$P_{avg} = 0.625\text{mW}$ , Extinction Ratio = 10	$t_r$ $t_f$			130 150	ps	6
Relative Intensity Noise	1 GHz BW, $I_F = 7\text{mA}$	RIN		-130	-122	dB/Hz	
Series Resistance	$I_F = 7\text{mA}$ , $T_A = 25^\circ\text{C}$	$R_S$	25	35	50	$\Omega$	
	$T_A = -40^\circ\text{C}$	$R_S$			60	$\Omega$	
	$T_A = 85^\circ\text{C}$	$R_S$	20			$\Omega$	
Series Resistance Temperature Coefficient	$I_F = 7\text{mA}$ , $T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$	$\Delta R_S/\Delta T$		-3000		ppm/°C	7
Photodiode Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Monitor Current	$P_{oc} = 0.5\text{mW}$ , $T_A = 25^\circ\text{C}$	$I_{PD}$	0.1		0.6	mA	
	$P_{oc} = 0.5\text{mW}$ , $T_A = -40^\circ\text{C}$	$I_{PD}$	TBD		TBD		
	$P_{oc} = 0.5\text{mW}$ , $T_A = +85^\circ\text{C}$	$I_{PD}$	TBD		TBD	mA	
Monitor current Temperature Variation	$P_{oc} = 0.5\text{mW}$ , $0^\circ\text{C}$ to $70^\circ\text{C}$	$\Delta I_{PD}/\Delta T$		TBD		%/°C	
Monitor Current Tracking		Deltrk		TBD			8
Dark Current	$P_o = 0\text{mW}$ , $V_R = 3\text{V}$	$I_D$			20	nA	
PD Capacitance	$V_R = 0\text{V}$ , Freq = 1MHz $V_R = 3\text{V}$ , Freq = 1MHz	C		75 40	100 55	pF	

Notes:

1. Reliability is a function of temperature, see [www.finisar.com](http://www.finisar.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:  

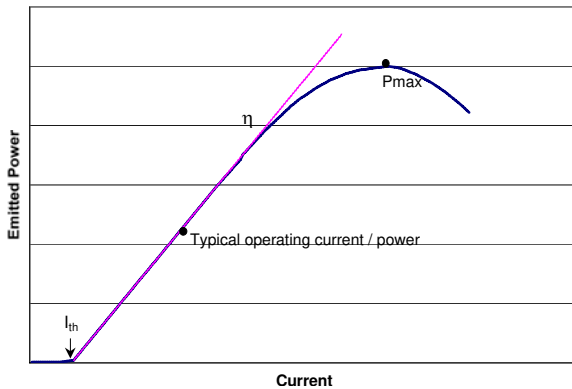
$$\eta(T) \approx \eta(25^\circ\text{C}) * [1 + (\Delta\eta / \Delta T) * (T - 25)]$$
6. Rise and fall times specifications are the 20% - 80%. Most of the devices will measure <135ps fall time. Rise and fall times are sensitive to drive electronics.
7. To compute the value of Series Resistance at a temperature T, use the following equation:  

$$R_S(T) \approx R_S(25^\circ\text{C}) * [1 + (\Delta R_S / \Delta T) * (T - 25)]$$
8. Monitor current tracking is defined as follows:

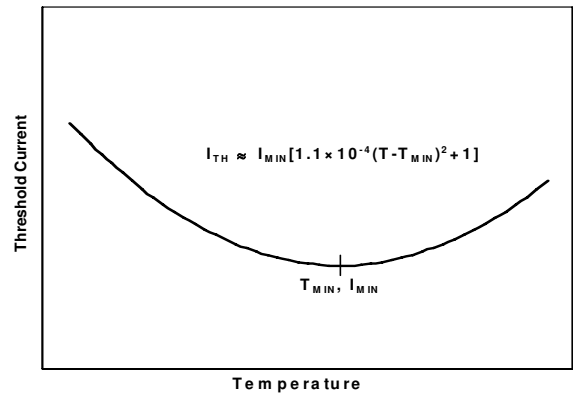
$$\text{Deltrk} = \frac{I_{PD}(P_O = 0.75\text{mW}) / 0.75\text{mW}}{I_{PD}(P_O = 0.45\text{mW}) / 0.45\text{mW}}$$

**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 <sub>op</sub>	-40		85	°C	
Storage Temperature	T <sub>sto</sub>	-40		85	°C	

**V. Regulatory Compliance**

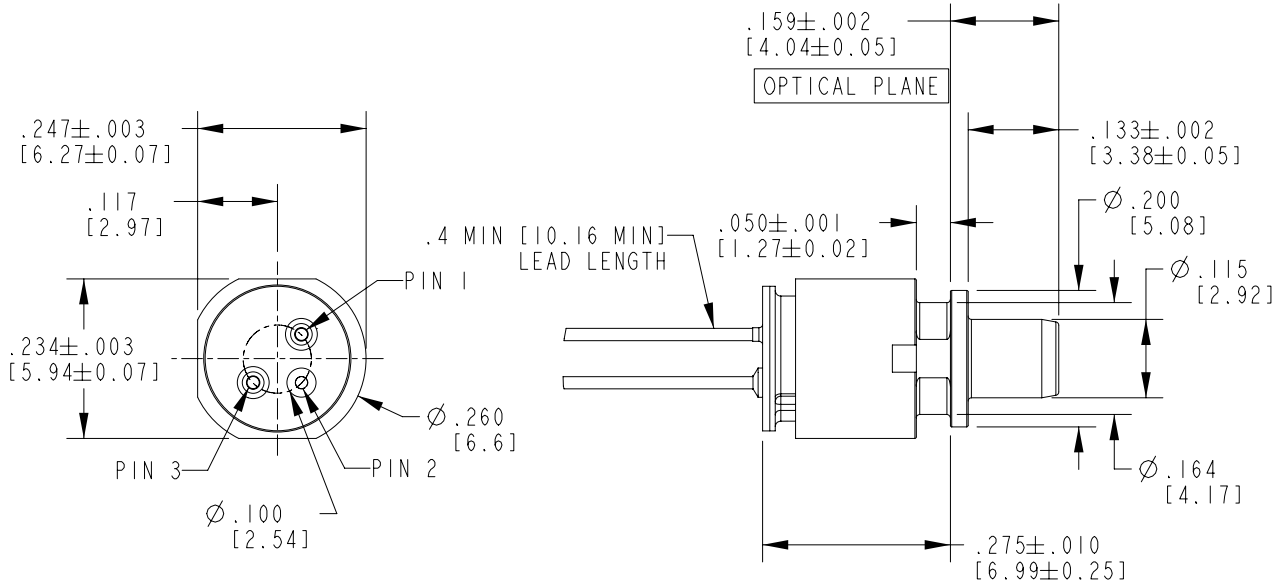
Feature	Agency	Standard	Certificate Number
Laser Eye Safety	FDA/CDRH	CDRH 21 CFR 1040 and Laser Notice 50	

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

**VI. Mechanical Specifications**

HFE4190-441		HFE4191-441	
Number	Function	Number	Function
1	K <sub>LD</sub>	1	A <sub>LD</sub>
2	K <sub>PD</sub> , A <sub>LD</sub>	2	K <sub>LD</sub> , A <sub>PD</sub>
3	A <sub>PD</sub>	3	K <sub>PD</sub>

A <sub>LD</sub>	VCSEL Anode	A <sub>PD</sub>	Monitor Photodiode Anode
K <sub>LD</sub>	VCSEL Cathode	K <sub>PD</sub>	Monitor Photodiode Cathode



(dimensions are in inches [mm])

**XI. Revision History**

<b>Revision</b>	<b>Date</b>	<b>Description</b>
A1	4/13/2013	• Document created.

**XII. For More Information**

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