

## Product Specification

### 850nm Single Mode VCSEL TO-46 Package

#### HFE4093-332

#### PRODUCT FEATURES

- Designed for drive currents between 1 and 5 mA
- Optimized for low dependence of electrical properties over temperature
- High speed  $\geq 1$  GHz
- Packaged with a photodetector



The HFE409x-332 is a high-performance 850 nm VCSEL (Vertical Cavity Surface-Emitting Laser) packaged for high-speed data communications. This product combines all the performance advantages of the VCSEL with a custom designed power monitor diode, and is designed for ease of use by the module designer and manufacturer. The power monitor diode can be used with appropriate feedback control circuitry to set a maximum power level for each VCSEL, simplifying design for high data rate communication and eye safety.

The HFE409x-332 is a high radiance VCSEL designed to convert electrical current into optical power that can be used in fiber optic communications and other applications. As the current varies above threshold, the light intensity increases proportionally.

The HFE409x-332 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 EML (Emitter Coupled Logic) gates possible and eases driver design.

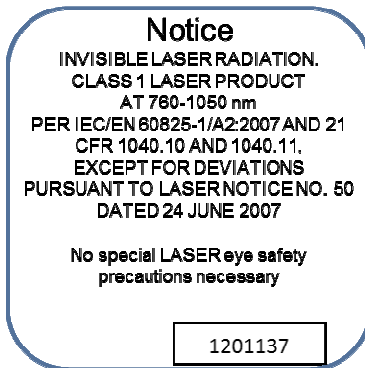
The HFE409x-332 is designed to interface with single mode or 50/125 and 62.5/125 mm multimode fiber. HFE409x-332 produces a circularly symmetric, non-astigmatic, narrow divergence beams that, with appropriate lensing, fiber couple all of the emitter power.

#### PRODUCT SELECTION

Part Number	Description
HFE4093-332	Un-attenuated VCSEL with Back Monitor Photodiode - VCSEL Anode Common

## I. Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	-40 to +85°C
Case Operating Temperature	0* to +50°C
Lead Solder Temperature	260°C, 10 sec.
Reverse Power Supply Voltage	5V
Laser continuous forward current	4mA
ESD Exposure (Human Body Model)	100V <sup>1</sup>



### 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 ( $T_{OP} = 25C$ unless otherwise stated)

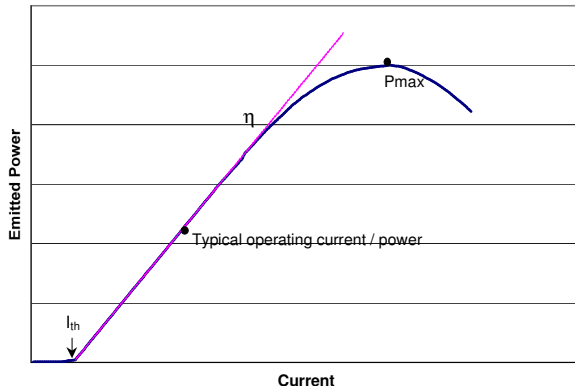
VCSEL Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Optical Power Output	$I_F=4mA$	$P_o$	0.7	1		mW	1
Threshold Current		$I_{TH}$			1.5	mA	
Threshold Current Temperature Variation	$T_A = 0^{\circ}C$ to $70^{\circ}C$	$\Delta I_{TH}$	-1.5		1.5	mA	2
Slope Efficiency		$\eta$	0.25	0.35	0.6	mW/mA	3
Slope Efficiency Temperature variation	$T_A = 0^{\circ}C$ to $70^{\circ}C$	$\Delta\eta / \Delta T$		-6000		PPM/ $^{\circ}C$	
Peak Wavelength	$I_F=4 mA$	$\lambda_p$	835		870	nm	
$\lambda_p$ Temperature Variation	$I_F=4 mA$	$\Delta\lambda_p/\Delta T$		0.06		nm/ $^{\circ}C$	
Laser Forward Voltage	$I_F=4 mA$	$V_F$		1.9	2.5	V	
Laser Reverse Voltage	$I_R=10 \mu A$	$BVR_{LD}$		-10		V	
Rise and Fall Times	Prebias Above Threshold, 20%-80%	$t_r, t_f$		150		ps	4
Series Resistance	$I_F=4 mA$	$R_S$	75	110	150	Ohms	
Series Resistance Temperature Coefficient	$I_F=4 mA, 0^{\circ}C$ to $70^{\circ}C$	$dR_S/dT$		-2000		PPM/ $^{\circ}C$	
Side Mode Suppression Ratio	$I_F=4mA$	SMSR	15	30		dB	
Change in wavelength with current		$\Delta\lambda_p/\Delta I$		0.25		mA/nm	
Beam Divergence		$\Theta_{FWHM}$		11	20	Degrees	
Photodiode Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Monitor Current	$P_o = 1mW$	$I_{PD}$		0.035		mA	
Monitor current Temperature Variation	$P_o = 1mW$	$\Delta I_{PD}/\Delta T$		0.2		%/ $^{\circ}C$	
Dark Current	$P_o = 0mW, V_R=3V$	$I_D$			20	nA	
PD Reverse Voltage	$P_o = 0mW, I_R=10 \mu A$	$BVR_{PD}$	30	115		V	5
PD Capacitance	$V_R=0V, Freq=1MHz$ $V_R=3V, Freq=1MHz$	$C$		75 40	100 55	pF	

### Notes:

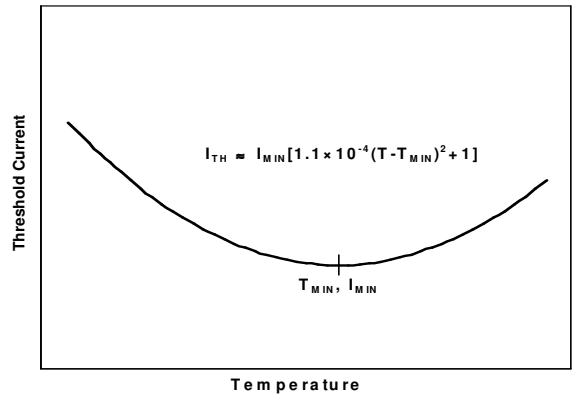
- Operating power is set by the peak operating current  $I_{PEAK}=I_{BIAS}+I_{MODULATION}$ .
- Operation at temperatures outside the specified range may result in the threshold current exceeding the maximums defined in the electro-optical characteristics table.
- Slope efficiency is defined as  $\Delta P_o/\Delta I_F$
- Rise and fall times are sensitive to drive electronics
- To safeguard the VCSEL from current spike damage, short the VCSEL anode and cathode to each other during photodiode BVR verification testing. Additionally to safeguard the PIN photodiode, limit the photodiode reverse voltage in accordance with the absolute maximum rating.

### 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.



#### Typical characteristics of single mode VCSELs

They are even more sensitive to ESD than are multi-mode VCSELs or CD lasers. They operate at currents typically below 5 mA and should never be driven at much higher currents. The spectral peak shifts significantly with current, but shifts only slowly with ambient temperature. Operation at a particular wavelength can be achieved by first setting the current at an appropriate level, then adjusting the temperature. While they are designed to stay single mode over the whole operating current range, at very high currents they may become multi-mode, increasing the spectral width and the beam divergence.

**IV. Environmental Specifications**

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Case Operating Temperature	T <sub>op</sub>	0		50	°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	9521487

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

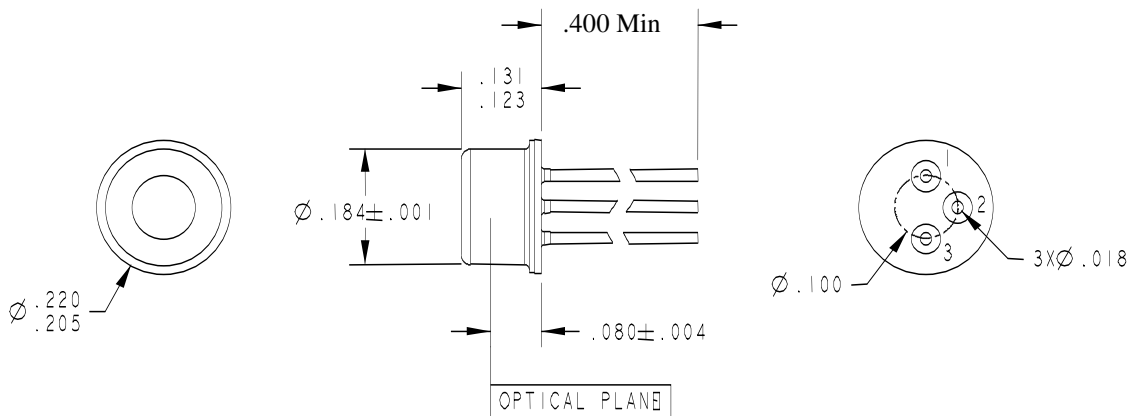
**VI. Mechanical Specifications**

PIN	Description
1	K <sub>LD</sub>
2	K <sub>PD</sub> , A <sub>LD</sub>
3	A <sub>PD</sub>

**LEAD DESCRIPTIONS**

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 mm)



**VII. Revision History**

<b>Revision</b>	<b>Date</b>	<b>Description</b>
B00	10/14/2014	• Converted to Finisar Standard Format

**VIII. For More Information**

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