DATA SHEET

850NM SINGLE MODE VCSEL TO-46 PACKAGE

HFE4093-332

FEATURES:

- Designed for drive currents between 1 and 5 mA
- Optimized for low dependence of electrical properties over temperature
- High speed ≥1 GHz
- Two different laser/ photodiode polarities
- Attenuating coating also available
- 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.

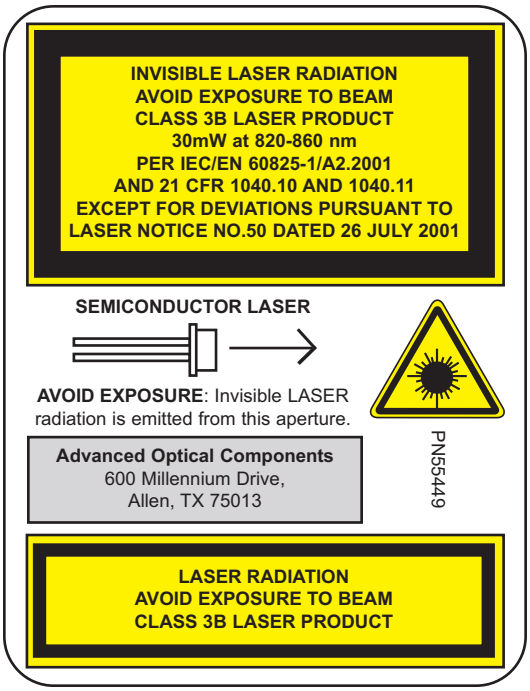
The low drive current requirement makes direct drive from PECL (Positive Emitter Coupled Logic) or EML (Emitter Coupled Logic) gates possible and eases driver design.

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

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

Finisar
Advanced Optical Components Division

ABSOLUTE MAXIMUM RATINGS



Parameter	Rating
Storage temperature	-40°C to +85°C
Operating temperature	0 to +50°C
Lead solder temperature	260°C, 10 seconds
Laser Diode Reverse Voltage (I_R=10 µA)	5 V
Laser Continuous Forward Current, Heat-Sinked	4 mA
PIN Photodiode Forward Current	10 mA

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.

ELECTRICAL-OPTICAL CHARACTERISTICS

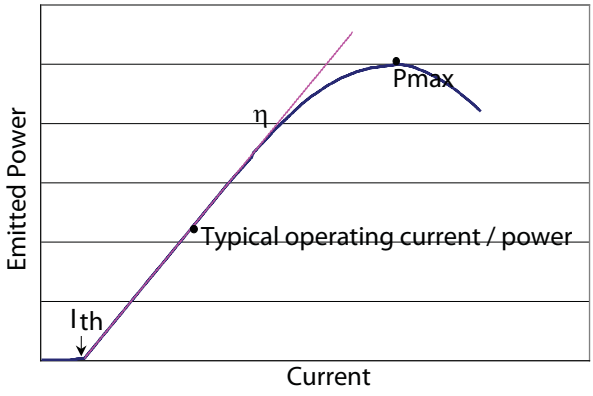
VCSEL Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Optical Power Output	I_F=4mA	Po	0.7	1		mW	1
Threshold Current		I_{TH}			1.5	mA	
Threshold Current Temper ature Variation	T_A = 0 ℃ to 70 ℃	ΔI_{TH}	-1.5		1.5	mA	2
Slope Efficiency		η	0.25	0.35	0.6	mW/mA	3
Slope Efficiency Temperature variation	T_A = 0 ℃ to 70 ℃	$\Delta\eta/\Delta T$		-6000		PPM/ ℃	
Peak Wavelength	I_F=4 mA	λ_P	835		870	nm	
λ_PTemperature Variation	I_F=4 mA	$\Delta\lambda_P\Delta T$		0.06		nm/℃	
Laser Forward Voltage	I_F=4 mA	V_F		1.9	2.5	V	
Laser Reverse Voltage	I_R=10 µA	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	175	Ohms	
Series Resistance Temp erature Coefficient	I_F=4 mA, 0 ℃ to 70 ℃	dR_S/dT		-2500		PPM/ ℃	
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		Θ_{FWHM}		11	20	Degrees	
Photodiode Parameters	**Test Condition**	**Symb ol**	**Min.**	**Typ.**	**Max.**	**Units**	**Notes**
Monitor Current	Po = 1mW	I_{PD}		0.035		mA	
Monitor current Temperature Variation	Po = 1mW	$\Delta I_{PD}/\Delta T$		0.2		%/ ℃	
Dark Current	Po =0mW, V_R =3V	I_D			20	nA	
PD Reverse Voltage	Po =0mW, I_R =10 µA	BVR_{PD}	30	115		V	5
PD Capacitance	V_R=0V, Freq=1MHz	C		75	100	pF	
	V_R=3V, Freq=1MHz			40	55		

NOTES

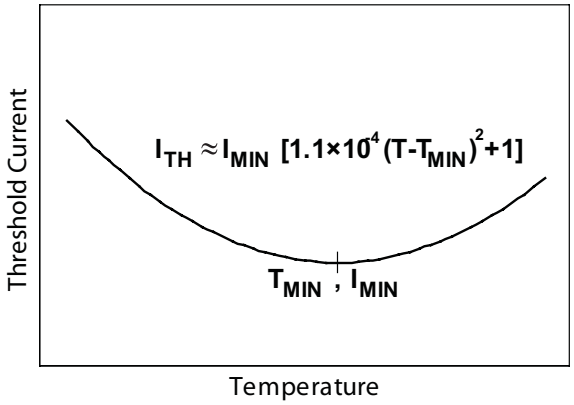
1. Operating power is set by the peak operating current $I_{PEAK}=I_{BIAS}+I_{MODULATION}$.
2. Operation at temperatures outside the specified range may result in the threshold current exceeding the maximums defined in the electro-optical characteristics table.
3. Slope efficiency is defined as $\Delta Po/ \Delta IF$
4. Rise and fall times are sensitive to drive electronics
5. 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.

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.

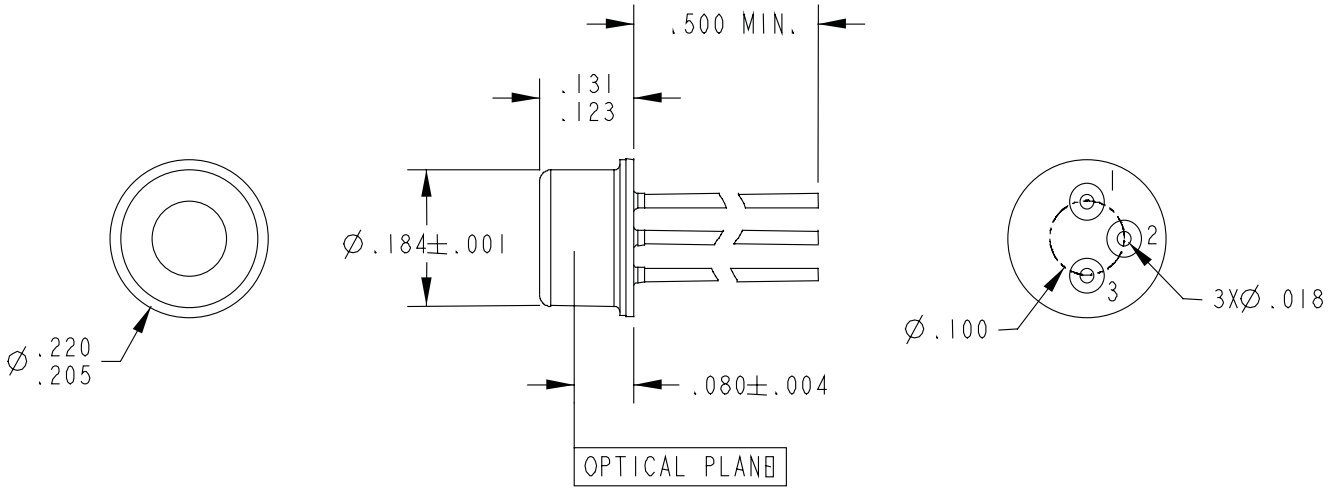


TYPICAL CHARACTERISTICS OF SINGLE MODE VCSELS

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. Despite their low operating currents, these VCSELs can emit sufficient power to be categorized as Class 3 lasers, and should be treated with the usual precautions.

MOUNTING DIMENSIONS



MOUNTING DIMENSIONS (for reference only): All dimensions are in inches.

PINOUT

HFE4093-332	
Number	**Function**
1	K_{LD}
2	K_{PD}, A_{LD}
3	A_{PD}

LEAD DESCRIPTIONS

A_{LD}	VCSEL Anode	A_{PD}	Monitor Photodiode Anode
K_{LD}	VCSEL Cathode	K_{PD}	Monitor Photodiode Cathode

ADVANCED OPTICAL COMPONENTS

Finisar's ADVANCED OPTICAL COMPONENTS division was formed through strategic acquisition of key optical component suppliers. The company has led the industry in high volume Vertical Cavity Surface Emitting Laser (VCSEL) and associated detector technology since 1996. VCSELs have become the primary laser source for optical data communication, and are rapidly expanding into a wide variety of sensor applications. VCSELs' superior reliability, low drive current, high coupled power, narrow and circularly symmetric beam and versatile packaging options (including arrays) are enabling solutions not possible with other optical technologies. ADVANCED OPTICAL COMPONENTS is also a key supplier of Fabrey-Perot (FP) and Distributed Feedback (DFB) Lasers, and Optical Isolators (OI) for use in single mode fiber data and telecommunications networks

LOCATION

- Allen, TX - Business unit headquarters, VCSEL wafer growth, wafer fabrication and TO package assembly.
- Fremont, CA – Wafer growth and fabrication of 1310 to 1550nm FP and DFB lasers.
- Shanghai, PRC – Optical passives assembly, including optical isolators and splitters.

SALES AND SERVICE

Finisar's ADVANCED OPTICAL COMPONENTS division serves its customers through a worldwide network of sales offices and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact a nearby sales office or call the number listed below.

AOC CAPABILITIES

ADVANCED OPTICAL COMPONENTS' advanced capabilities include:

- 1, 2, 4, 8, and 10Gbps serial VCSEL solutions
- 1, 2, 4, 8, and 10Gbps serial SW DETECTOR solutions
- VCSEL and detector arrays
- 1, 2, 4, 8, and 10Gbps FP and DFB solutions at 1310 and 1550nm
- 1, 2, 4, 8, and 10Gbps serial LW DETECTOR solutions
- Optical Isolators from 1260 to 1600nm range
- Laser packaging in TO46, TO56, and Optical subassemblies with SC, LC, and MU interfaces for communication networks
- VCSELs operating at 670nm, 780nm, 980nm, and 1310nm in development
- Sensor packages include surface mount, various plastics, chip on board, chipscale packages, etc.
- Custom packaging options

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