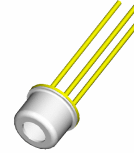


### High Speed VCSEL 2.5Gbps

#### FEATURES

- Designed for drive currents between 3 and 12 mA
- Optimized for low dependence of electrical properties over temperature
- High speed  $\geq 1$  GHz
- Two different laser/photodiode polarities
- Attenuating coating
- Packaged with a photodetector



The HFE409x-341 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. The power monitor diode can be used with appropriate feedback control circuitry to set a maximum power level for each VCSEL. In addition, built-in power attenuation reduces the effective slope efficiency. These combined features simplify design for high data rate communication and eye safety.

The HFE409x-341 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-341 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-341 is designed to interface with 50/125 and 62.5/125  $\mu\text{m}$  multimode fiber. They product circularly symmetric, non-astigmatic, narrow divergence beams that, with appropriate lensing, fiber couple all of the emmitter power.



# Fiber Optic LAN Components

## High Speed VCSEL 2.5Gbps

HFE409x-341

### ABSOLUTE MAXIMUM RATINGS

Parameter	Rating
Storage Temperature	-40 to +100°C
Operating Temperature	0 to +70°C
Lead Solder Temperature	260°C, 10 sec.
Laser Diode Reverse Voltage ( $I_R=10 \mu\text{A}$ )	5 V
Laser Continuous Forward Current, Heat-Sinked	12 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.

### ELECTRO-OPTICAL CHARACTERISTICS ( $T_A=25^\circ\text{C}$ unless otherwise stated)

VCSEL Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Peak Operating Current	Adjustable to establish operating power	$I_{\text{peak}}$		10	15	mA	1
Optical Power Output	$I_F=7\text{mA}$	$P_o$		0.8		mW	1
Threshold Current		$I_{\text{TH}}$	1	1.8	2.5	mA	
Threshold Current Temperature Variation	$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$	$\Delta I_{\text{TH}}$	-1		1	mA	2
Slope Efficiency		$\eta$	0.08	0.14	0.25	mW/mA	3
Slope Efficiency Temperature variation	$T_A = 0^\circ\text{C}$ to $70^\circ\text{C}$	$\Delta\eta / \Delta T$		-4500		PPM/ $^\circ\text{C}$	
Peak Wavelength	$I_F=7 \text{ mA}$	$\lambda_p$	830	850	860	nm	
$\lambda_p$ Temperature Variation	$I_F=7 \text{ mA}$	$\Delta\lambda_p/\Delta T$		0.06		nm/ $^\circ\text{C}$	
Spectral Bandwidth, RMS	$I_F=7 \text{ mA}$	$\Delta\lambda$			0.85	nm	
Laser Forward Voltage	$I_F=7 \text{ mA}$	$V_F$		1.8	2.2	V	
Laser Reverse Voltage	$I_R=10 \mu\text{A}$	$BVR_{\text{LD}}$		-10		V	
Rise and Fall Times	Prebias Above Threshold, 20%-80%	$t_r$ $t_f$			130 150	ps	4
Relative Intensity Noise	1 GHz BW, $I_F=7 \text{ mA}$	RIN		-130	-122	dB/Hz	
Series Resistance	$I_F=7 \text{ mA}$	$R_S$	22	35	50	Ohms	
Series Resistance Temperature Coefficient	$I_F=7 \text{ mA}$ , $0^\circ\text{C}$ to $70^\circ\text{C}$	$dR_S/dT$		-3000		PPM/ $^\circ\text{C}$	
Beam Divergence		$\theta$	15		30	Degrees	5
Photodiode Parameters	Test Condition	Symbol	Min.	Typ.	Max.	Units	Notes
Monitor Current	$P_o = 0.8\text{mW}$	$I_{\text{PD}}$		0.35		mA	
Monitor current Temperature Variation	$P_o = 0.8\text{mW}$	$\Delta I_{\text{PD}}/\Delta T$		0.2		%/ $^\circ\text{C}$	
Dark Current	$P_o = 0\text{mW}$ , $V_R=3\text{V}$	$I_D$			20	nA	
PD Reverse Voltage	$P_o = 0\text{mW}$ , $I_R=10 \mu\text{A}$	$BVR_{\text{PD}}$	30	115		V	6
PD Capacitance	$V_R=0\text{V}$ , Freq=1MHz	C		75	100	pF	
	$V_R=3\text{V}$ , Freq=1MHz			40	55		

# Fiber Optic Components

## High Speed VCSEL 2.5Gbps VCSEL

HFE409x-341

### Notes:

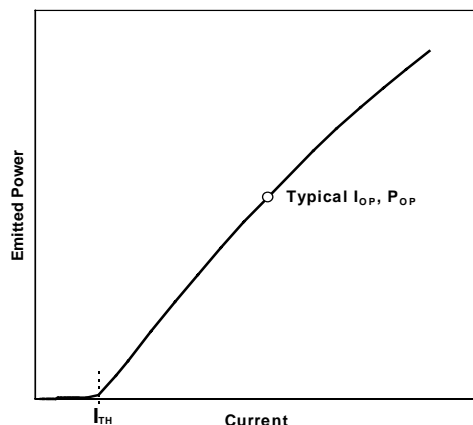
1. Operating power is set by the peak operating current  $I_{PEAK} = I_{BIAS} + I_{MODULATION}$ .
2. Operation at temperatures outside the specified range may result in the threshold current exceeding the maximums defined in the electro-optical characteristics table.
3. Slope efficiency is defined as  $\Delta P_o / \Delta I_f$  at a total power output of 0.8 mW. Slope efficiency is intentionally lowered to the values shown by optical attenuation.
4. Rise and fall times are sensitive to drive electronics
5. Beam divergence is defined as the total included angle between the  $1/e^2$  intensity points. Beam divergence

varies between 15deg and 30deg depending upon operating conditions. 30deg is expected to be worst case divergence. It is recommended that the optics be design for an NA of 0.3.

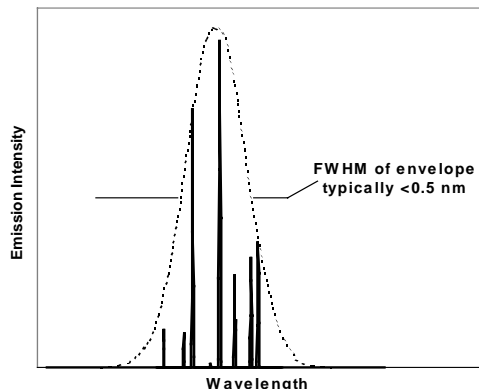
6. To safeguard the VCSEL from current spike damage, short the VCSEL anode and cathode to each other during photodiode BVR verification testing. Additionally to safeguard the PIN photodiode, limit the photodiode reverse voltage in accordance with the absolute maximum rating.

### TYPICAL PERFORMANCE CURVES

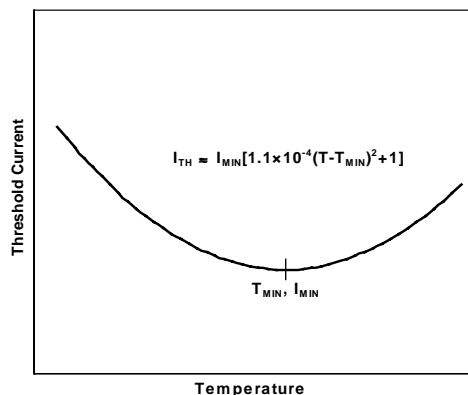
**Emitted Power vs. Current:** Power varies approximately linearly with current above threshold.



**Emission Intensity vs. Wavelength:** Typical 10 mA spectrum comprises multiple lines corresponding to multiple transverse modes.



**Threshold Current vs. Temperature:** Threshold current varies parabolically with temperature; thus it can be nearly constant for a limited temperature range.



### 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.



The VCSEL is a class IIIb laser and should be treated as a potential eye hazard. Due to the size of the component, the applicable warning logotype, aperture label, and certification/identification label cannot be placed on the component itself. These labels can be found on the individual envelope in which the VCSEL unit is packaged, or attached to the shipping package.

# Fiber Optic LAN Components

## High Speed VCSEL 2.5Gbps VCSEL

HFE409x-341

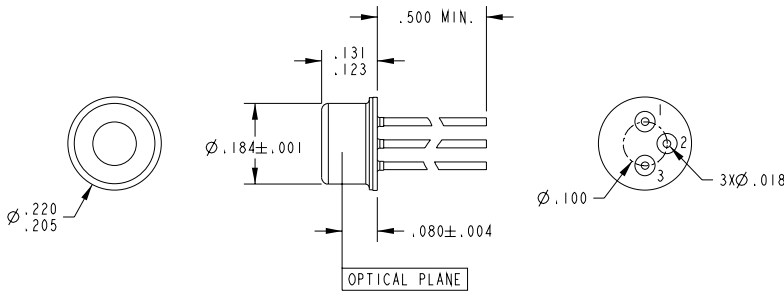
### ORDER GUIDE

Catalog Listing	Description
HFE4091-341	Attenuated VCSEL with Back Monitor Photodiode - VCSEL Cathode Common
HFE4092-341	Attenuated VCSEL with Back Monitor Photodiode - VCSEL Anode Common

### TELEPHONE

1-800-367-6786 (USA)  
 1-800-737-3360 (Canada)  
 +49 (0) 89 35813310 (Germany)  
 +65-580-3312 (Singapore)  
 +44 (0) 118 981 9511 (UK)

### MOUNTING DIMENSIONS (for reference only): in./(mm)



PIN #	HFE4091-341	HFE4092-341
1	VCSEL ANODE	VCSEL CATHODE
2	VCSEL CATHODE/PD ANODE	VCSEL ANODE/PD CATHODE
3	PD CATHODE	PD ANODE

### FAX

1-972-470-4326 (Customer Response Center)  
 1-972-470-4549 (Fax on demand)  
 +49 (0) 89 3599971 (Germany)  
 +65 445 3033 (Singapore)  
 +44 (0) 118 981 7513 (UK)

### INTERNET

<http://www.honeywell.com/VCSEL>  
[VCSEL@honeywell.com](mailto:VCSEL@honeywell.com)

### WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Commencing with the date of shipment, Honeywell's warranty runs for 18 months. If warranted goods are returned to Honeywell during that period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and is **in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose.**

While we provide application assistance, personally and through our literature, it is up to the customer to determine the suitability of the product in the application.

Specifications may change at any time without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

### SALES AND SERVICE

Honeywell Sensing and Control 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:

08/09/02

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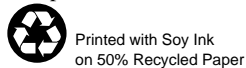
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