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USER'S GUIDE

10-Gbit/s 850-nm VCSEL

Model 1780



Caution - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Caution - The use of optical instruments with this product will increase eye hazard.

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Contents

Operation 5

Introduction 5
Handling Precautions 6
Getting Started 6

Troubleshooting 11

Excessive Noise 11
Lowered Light Output 11

Characteristics 13

Customer Service 15

Technical Support 15
Service 15

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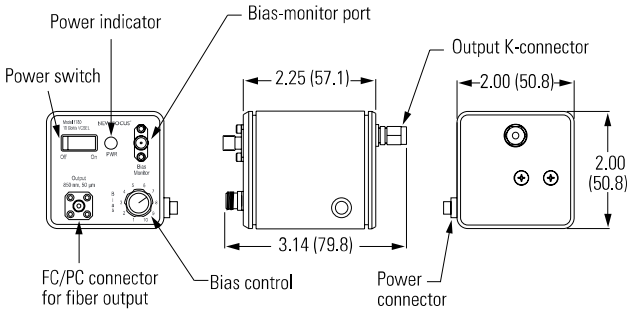
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Operation

Introduction

The Model 1780 VCSEL (vertical-cavity surface-emitting laser) is an 850-nm, multimode device intended for use in laboratory or production environments for testing 10-Gbit/s components and fiber, or for breadboarding of communication systems. When used with the New Focus Model 1580 Receiver, it is capable of testing fiber performance for high data-rate transmission, or it can be used for error-free transmission of digital signals over short distances.

Figure 1: Model 1780 VCSEL module



The laser is housed in a high-performance microwave housing to minimize distortion of input signals. A bias current is supplied internally via a high-impedance circuit (Figure 2), and the high-speed input is AC-coupled to a 50-ohm transmission line which delivers the input signal directly to the laser (there is no driver circuit). The VCSEL output is coupled via a GRIN lens into a 50-µm-core fiber which connects to the FC/PC bulk-

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head connector on the front panel. It can be used with either 50-µm or 62.5-µm fiber.

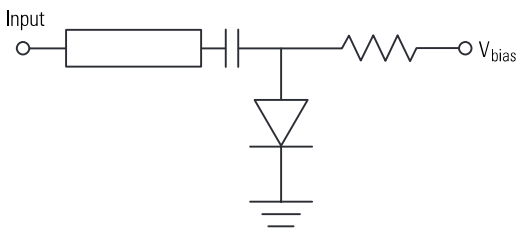


Figure 2: Schematic of VCSEL circuit. V_{bias} is set by the Bias control knob.

Handling Precautions

Whenever handling the VCSEL, make sure to follow these precautions:

- Prior to handling the unit or making connections, be sure to ground yourself adequately—even small electrostatic discharges could permanently damage the device. A ground strap provides the most effective grounding and minimizes the likelihood of electrostatic damage.
- Do not over torque the microwave K-connector. Excessive torque can damage connectors. We recommend using a 5/16" torque wrench rated at 8 in-lbs.
- Make sure the optical connector is clean and undamaged before connecting it to the detector module.

Getting Started

The Model 1780 is designed to be driven directly by a 50-ohm source at speeds up to 10 Gbit/s. Its small size enables you connect it directly to the source, eliminating lossy RF cables. The 50-µm-core output fiber per-

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mits connection to fiber with either a 50-µm or 62.5-µm core via the FC/PC connector.

Note: *Note that the modal distribution at the output does not meet the encircled flux requirements for certain communications systems.*

To use the Model 1780:

1. Connect the input RF connector on the back of the unit to the source output.

   CAUTION! *Be sure the source voltage is less than that specified in Figure 3 to avoid damage and obtain good performance.*

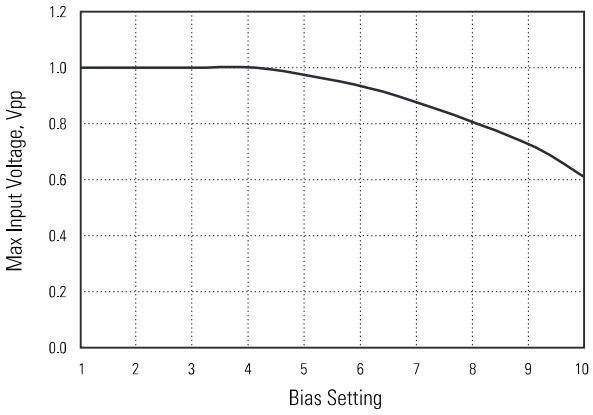


Figure 3: Maximum allowed peak-to-peak input voltage. (Voltage produced by a 50-ohm source across a 50-ohm load.

2. Connect the power supply using the appropriate cable provided. Use either the New Focus 0901 power supply, or a +15-V, 50-mA power supply.

   Note: *A negative supply is not needed. If you are using a supply other than the Model 0901, you may leave the black banana connector unconnected.*

3. Clean and connect the FC/PC connector of the fiber-optic cable (not included) to the VCSEL output on the front panel.
4. Turn on the Model 1780 power switch (the **PWR** indicator should illuminate).

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5. Adjust the bias level as desired. (See Figure 4, and "Adjusting the Bias," below.)

Adjusting the Bias

Use Figure 4 to determine approximate operating levels for the VCSEL.

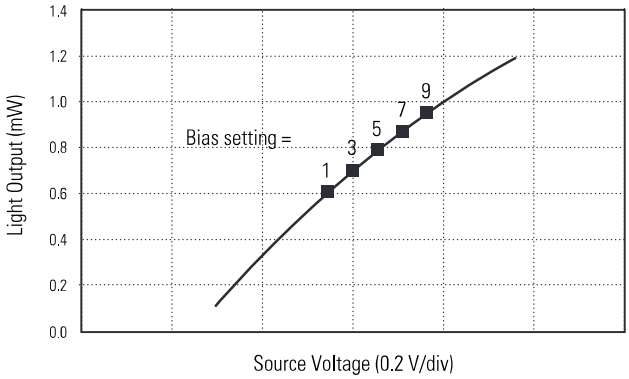


Figure 4: Typical light output versus source voltage showing bias points.

For desired optical power levels, the bias point and input-signal voltage swing can be determined—the bias point is set on the front panel of the Model 1780—and the input voltage swing should be set to give the desired optical power swing. For example, for a low level of 0.6 mW and a high level of 1 mW, set the bias to 5 and set the source for a peak-to-peak voltage of about 0.27 V.

Note that the light output is plotted versus the source voltage, *i.e.* the voltage which a 50-ohm source would produce across a 50-ohm load. This voltage is used since it is the voltage most instruments indicate for their output. Also note that the graph shows typical values, and that precise values of optical output should be determined by measurement.

Bias Monitor: The Bias Monitor on the front panel is intended primarily for use in troubleshooting. It indicates the bias current at each bias setting, so that if the

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laser is damaged the voltages on the Bias Monitor output will change. (See “Troubleshooting” on page 11).

Further Considerations

High-Speed Response

As a directly modulated laser, the Model 1780’s high-speed response will exhibit varying levels of “ringing” due to relaxation oscillation in the laser, an effect which becomes more pronounced at lower optical powers. In the time domain this effect will appear as ringing in the impulse or step response; in the frequency domain it will appear as a peak in the frequency response before the response begins to drop off.

Large-Signal Operation: Under modulation, as the power level in the low state approaches zero the ringing becomes more pronounced. Hence a smaller extinction ratio (ratio of on-to-off power) produces cleaner eye diagrams. Note that a low extinction ratio is not necessary to achieve error-free performance. In fact, it is likely that the bit-error rate of a link will be minimized by a fairly large extinction ratio.

Small-Signal Operation: For small-signal modulation, the laser bandwidth increases as you increase bias. The best small-signal performance is therefore obtained at higher bias levels. A high-speed circuit is included in the VCSEL design to flatten the frequency response at higher bias levels. Under small-signal operation, the VCSEL can act as an E/O converter.

Output Modal Properties

The VCSEL output is coupled into the internal 50-µm core multimode fiber with a GRIN lens. The coupling results in an over-filled mode condition and in excitation of cladding modes which are not stripped inter-

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nally, so an external mandrel-wrap (seven turns of the fiber around a half-inch diameter mandrel) is needed if cladding modes are unacceptable.

Input Impedance

The VCSEL is intended to be driven by a 50-ohm source. While the nominal input impedance is 60 ohms, the small electrical reflection created by this impedance mismatch will be insignificant when used with a reasonably good 50-ohm source.

Noise and Optical Feedback

Reflections back into the laser can affect its performance, primarily the noise level. Keep this fact in mind if the noise is excessive. The noise value specified on page 13 was obtained using the New Focus Model 1580 Receiver, which has roughly a –20-dB optical return loss. It is possible that receivers with worse optical return losses may produce significantly higher noise levels. Fiber length can also influence noise characteristics.

Testing of Fiber and Breadboarding Systems with a New Focus Model 1580 Receiver

The Model 1780 VCSEL can be used with the Model 1580 Receiver (amplified photodiode) to form a data link. Use this link to test fiber and breadboard systems. Typical back-to-back sensitivity is about –10.5 dBm when measured at 10 Gbit/s, with no post-amp following the Model 1580 and an error detector sensitivity of 50 mV.

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Troubleshooting

Excessive Noise

Reflections back into the laser can affect its performance, primarily the noise level. Fiber length can also influence noise characteristics.

Note: *The noise value specified on page 13 was obtained using the New Focus Model 1580 Receiver, which has roughly a –20-dB optical return loss. It is possible that receivers with worse optical return losses may produce significantly higher noise levels.*

Lowered Light Output

Static discharge or excessive input voltage may damage the VCSEL, resulting in lowered light output and a change in the bias current. The bias-monitor voltage for bias setting 6 is recorded on the data sheet shipped with your unit. If you suspect that the device has been damaged, compare the voltage on the Bias Monitor with the value on the data sheet. Discrepancies of more than 0.15 V indicate possible damage. If such a symptom occurs, contact New Focus for assistance (see page 15).

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Characteristics

Model #	1780
Wavelength	850 nm
Bit Rate	10 Gbit/s
Output Power	800 µW typical (750 µW min.)
Small-Signal Bandwidth	7.5 GHz typical (7.0 GHz min.)
Low-Frequency Cutoff	10 kHz
Small-Signal Gain	1.4 mW/V typical (1.2 mW/V min.)
Impulse FWHM*	55 ps typical (60 ps max.)
RMS Noise**	2.2 % typical (2.8 % max.)
Small-Signal Input Impedance	60 Ω
Input Connector (SMA compatible)	Wiltron K, Male
Output Connector	FC/PC
Output Fiber	50-µm Multimode
Power Supply	+15 V, 50 mA
Operating Temperature	10 to 35 °C
Storage Temperature	-20 to 70 °C

Characteristics apply for a bias setting of “6” and a receiver optical return loss of –20 dB.

* Input is negative impulse; high/low optical power ratio = 4.8 dB; bias setting = 9.

** With 10 meters of fiber, terminated with a New Focus Model 1580 Receiver; percent of CW output power.

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(from the USA & Canada only)
Phone: (408) 284-6808

Support is also available by fax and email:

Fax: (408) 980-8883
Email: techsupport@newfocus.com

We typically respond to faxes and email within one business day.

Service

In the event that the VCSEL malfunctions or becomes damaged, please contact New Focus for a return authorization number and instructions on shipping the unit back for evaluation and repair.

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