USER'S GUIDE

25-Gbit/s, 850-nm VCSEL

Model 1784

Caution – Use of controls or adjustments or performance 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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Warranty

Newport Corporation guarantees its products to be free of defects for one year from the date of shipment. This is in lieu of all other guarantees, expressed or implied, and does not cover incidental or consequential loss. Information in this document is subject to change without notice.

Document Number PN 90065888 Rev B

1. Operation

1.1 Introduction

The Model 1784 VCSEL (vertical–cavity surface–emitting laser) is an 850–nm, multimode device intended for use in laboratory or production environments for testing of 25–Gbit/s components and for breadboarding of communication systems. When used with the Model 1484–A–50 Receiver (amplified photodiode), the pair is capable of testing fiber performance for high data rate transmission, or they can be used for transmission of digital signals over short distances.

The laser is housed in a high–performance microwave housing to minimize distortion of input signals. A bias current is supplied internally (Figure 1), and the high-speed input is connected to a 50-ohm transmission line which is AC coupled to the laser (there is no driver circuit). In Figure 1, V_{bias} is determined by the Bias Control Knob on the front panel. The VCSEL output is coupled into a 0.1–m, 50–µm core graded–index fiber via a GRIN lens, and internally connected to a front panel FC connector.

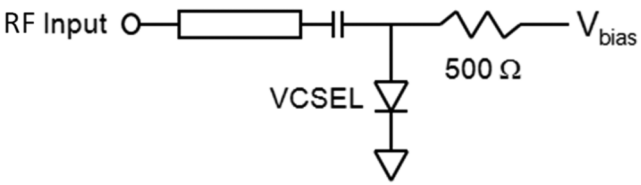

Figure 1. Schematic of VCSEL circuit.

1.2 Precautions

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

1. 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.

2. 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.

3. Make sure the optical connector is clean and undamaged before connecting it to the detector module.

4. To maintain protection from hazards, only use with power supplies which provide ±15V with a 0.3 A (or less) current limit.

1.3 Using the Model 1784

The Model 1784 is designed to be driven directly by a 50–ohm source at speeds up to 25 Gbit/s. Its small size enables you connect it directly to the source, eliminating lossy RF cables. The 50–µm output fiber permits connection to 50–µm core, or larger, fiber.

The Model 1784 is intended for use in laboratory or production environments. During operation, it may be connected directly to the output of your driving instrument such that it is suspended by the RF Input connector. It also may rest on a surface and be connected to an RF cable or other device.

Connections and Power (see Figure 2):

1. Connect the RF Input connector on the back of the unit to the output of your driving instrument. Be sure the source voltage is less than that specified by Figure 4 to avoid damage and obtain good performance.

2. Connect the power supply to the Power Input using the appropriate cable provided. Use either the New Focus 0901 power supply, or another ±15V supply.

3. Clean and connect the FC/PC connector of the fiber optic cable (user supplied) to the VCSEL FC/PC Output on the front panel.

4. Turn on the Model 1784 Power Switch (the PWR indicator should illuminate) and adjust the Bias Control Knob and driver voltage as desired. (See Bias Adjustment below.)

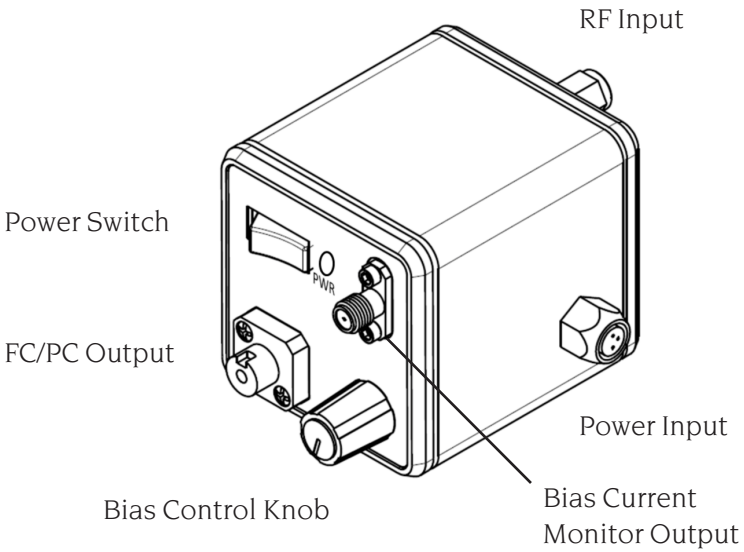

Figure 2. Connector and control descriptions.

Bias Adjustment

Figure 3 can be used to determine approximate operating levels for the VCSEL. 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 1784, and the input voltage swing should be set to give the desired optical power swing. Note that the graph shows typical values, and that precise values of optical output should be determined by measurement. To avoid damaging the VCSEL observe the input voltage limits detailed in Figure 4.

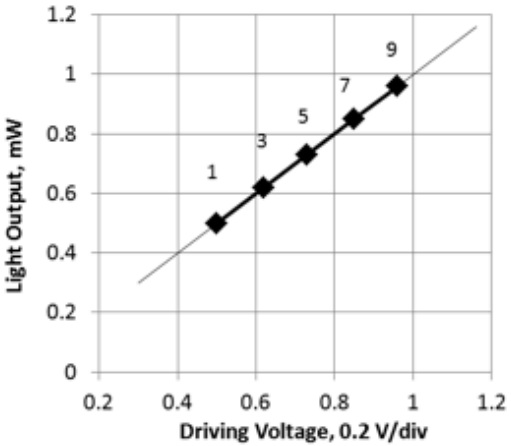

Figure 3. Typical light output versus driving voltage showing bias points.

The voltage is that which a 50–ohm source would produce across a 50–ohm load. Use this graph to determine bias setting and input voltage swing for your particular application. For example, for a low level of 0.6 mW and a high level of 1 mW, set the Bias Control Knob to 5 and set the driver for a peak–peak voltage of about 0.27 V.

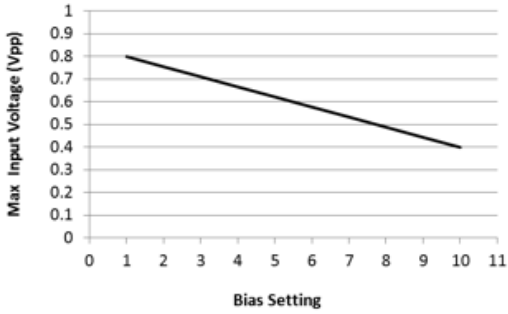

Figure 4. Maximum allowed peak–peak input voltage versus setting on the Bias Control Knob.

The voltage is that which a 50–ohm source would produce across a 50–ohm load. This voltage is used since it is what most instruments indicate for their output level.

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 laser is damaged the voltages on the Bias Monitor output will change. (See Troubleshooting below).

High–Speed Response As a directly modulated laser, the Model 1784'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 bias levels. 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 large–signal modulation, as the optical power level in the low state approaches zero the ringing becomes more pronounced. Hence a smaller extinction ratio (ratio of high to low power) produces cleaner eye diagrams. Note, however, 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. An example application for small signal operation is to use the VCSEL as an E/O converter on a port of a network analyzer.

Output Modal Properties The VCSEL output is coupled into the internal 50–µm core multimode fiber with a somewhat defocused GRIN lens. This enables Class I laser operation, and also reduces noise in the presence of optical feedback. The coupling also results in excitation of cladding modes which are not stripped internally, so an external mandrel–wrap (several turns of the fiber around a half-inch diameter mandrel, for example) is advised if cladding modes are unacceptable.

Input Impedance The VCSEL is intended to be driven by a 50–ohm source. While the nominal small signal input impedance is 90 ohms, the electrical reflection created by this impedance mismatch will be minimal 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 in mind if noise appears excessive. The specified value of noise is obtained when used with the Model 1484–A–50 Receiver. It is possible that other receivers may produce significantly higher noise levels. Fiber length can also influence noise characteristics.

2. Troubleshooting

Excessive Noise Reflections back into the laser can affect performance, primarily the noise level. Fiber length can also influence noise characteristics. If noise is higher than expected check to see if high back reflections may be the cause.

Low Light Output Dirty fibers are a possible cause for low output. First, check whether the fiber used with the Model 1784 is clean. Next, with a suitable microscope and the power disconnected, check the internal fiber tip inside the FC connector on the front panel. If dirt is apparent, it may be possible to clean this fiber by inserting a small swab. If unable to clean, contact Newport for assistance.

Another possible cause of low output is damage either by static discharge or by excessive input voltage. Both these causes can result in lowered light output and a change in the bias current indicated on the Bias Monitor. The monitor voltage for bias setting 6 is recorded on the data sheet shipped with each unit. If it is suspected that the device has been damaged, the voltage on the Bias Monitor can be compared with the factory obtained value. Discrepancies of more than 0.15 V indicate possible damage. If such symptoms occur, contact Newport for assistance.

3. Specifications

	Min.	Typ.	Max.
Wavelength		850 nm	
Bit Rate		25 Gbit/s	
Output Power	750 µW	800 µW	
Small Signal Bandwidth		18 GHz	
Low Freq. Cutoff		10 MHz	
Small Signal Gain	0.75 mW/V	1.0 mW/V	
Impulse FWHM*		32 ps	35 ps
RMS noise		2.3%	2.8%
Small Signal Input Impedance		90 ohms	
RF Input Connector (Wiltron K), male		2.92 mm	
Output Connector		FC/PC	
Output Fiber		50 µm multimode	
Power Supply		±15V, 50 mA	
Operating Temp.	10 °C		35 °C
Storage Temp.	-20 °C		70 °C
Operating Altitude	2 km		

Specifications apply at bias setting = 6 and with a Model 1484–A–50 Receiver used for measurement.

* Input is negative impulse; high/low optical power ratio = 3 dB. Bias setting = 10.

Technical Support

Information and advice about the operation of any Newport product is available from our technical support engineers. For quickest response, ask for "Technical Support" and know the model and serial number for your product.

Hours: 5:00–5:00 PST, Monday through Friday (excluding holidays).

Toll Free: 1-866-NUFOCUS (1-866-683-6287)
(from USA & Canada only)

Support is also available by fax and email:

Fax: (408) 987-3178

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.