USER'S GUIDE

12-GHz Amplified Photoreceivers

Model 1580

Includes the low-frequency "-LF" Option

CAUTION!

These photoreceivers are sensitive to electrostatic discharges and could be permanently damaged if subjected even to small discharges. Ground yourself adequately prior to handling these receivers or making connections. A ground strap provides the most effective grounding and minimizes the likelihood of electrostatic damage.

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Warranty

New Focus, Inc. 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.

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Operation

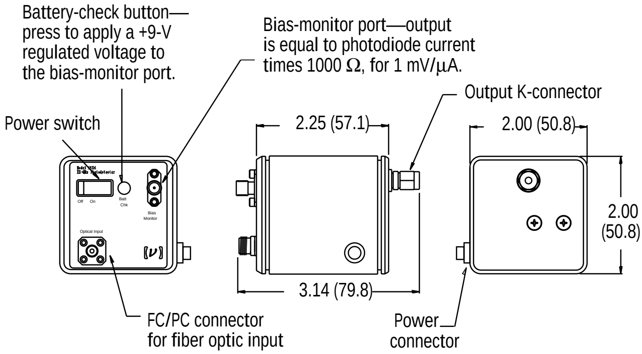
Introduction

High-speed measurements down to a few microwatts are easy with the Model 1580 amplified photoreceiver. This module converts optical signals to electronic signals, in effect, giving any high-speed/high-frequency instrument in your lab an optical input. The small size of the module allows you to connect it directly to your test instrument. This eliminates the need to follow the photoreceiver with coaxial cable, which can seriously distort picosecond pulses and attenuate microwave signals.

The Model 1580 uses a GaAs PIN photodiode designed for high responsivity in the 780–870-nm wavelength range. The internal 62.5-µm multimode fiber which delivers light to the photodiode permits the use of input fibers with cores of 62.5 µm or smaller, including single-mode fibers. The high-speed amplifier which follows the photodiode produces a clean impulse response with minimal ringing, making the Model 1580 ideal for digital communication measurements.

The Model 1580 has a negative conversion gain due to the inverting amplifier used. If you are using an oscilloscope and you want a positive output, use the 'scope's inverting x(-1) function.

Figure 1: Model 1580 photoreceiver module



Handling Precautions

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

- Prior to handling the detector or making connections, be sure to ground yourself adequately—even small electrostatic discharges could permanently damage the detector. 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.
- Make sure the optical connector is clean and undamaged before connecting it to the detector module.

Connecting the Power Supply and Bias

1. Prior to handling the detector, ground yourself with a grounding strap to prevent electrostatic damage to the receiver.
2. Connect the power cable to the power supply. Two power cables were included with the receiver; use the appropriate cable for your power supply.

Connecting to a New Focus power supply: Use the cable with the two Microtech connectors. Connect the cable to one of the power supply's 300-mA outputs.

Connecting to another power supply: Use the cable with the Microtech connector on one end and three banana plugs on the other end. Be careful to connect the banana plugs to the power supply as follows; connect the red plug to a well-regulated, +15-V, 200-mA source; connect the black plug to a -15-V, 200-mA source; connect the green plug to the common ground of the two sources.

3. Connect the bias-monitor port to a voltmeter.
4. Press and hold the Batt Chk button and observe the bias monitor output.

   The regulated positive voltage is momentarily applied to the bias-monitor SMA connector. A reading of 9 V indicates proper connection.
5. Release the Batt Chk button and observe the voltage level on the voltmeter. This voltage is the DC offset plus dark current. This dark voltage should be less than 10 mV.

Note: *If you are coupling light into a fiber, use the voltmeter to monitor the photocurrent to help optimize the coupling.*

Microwave connection and set-up

1. Connect the photoreceiver module's microwave connector to a test instrument that has a 50-Ω input, such as an oscilloscope or spectrum analyzer, or to another 50-Ω load. If necessary, use a

high-frequency cable (best performance is achieved without a cable).

CAUTION!

For the low-frequency ("-LF") version, be sure to include the DC block between the receiver and the test instrument to prevent damage to the equipment.

2. To avoid connector damage and signal distortion, be sure that the cable and the instrument you intend to connect to the module have compatible connectors. See "Appendix I: Microwave Connectors" on page 15 for a list of compatible connectors.

Connecting the Receiver to the Optical Input

1. Before connecting the input fiber to the photoreceiver, measure the power in the fiber to ensure it is within the safe operating range. For a pulsed input, determine the maximum (peak) power.

You may want to use the New Focus Model 2011-FC 200-kHz Photoreceiver for this purpose; it has a higher maximum pulse power, and has the sensitivity to aid in fiber alignment.

2. Connect the fiber-optic cable to the fiber-optic input.

Characteristics

Photoreceiver Characteristics

Model #	1580
Wavelength Range	400–870 nm
3-dB Bandwidth (electrical)	12 GHz (typical) 10 GHz (minimum)
Low-Frequency Cutoff Low-Frequency (-LF) Version	2 MHz 10 kHz
Rise Time	34 ps
Conversion Gain	–400 V/W
Responsivity	0.4 A/W
Transimpedance Gain	1000 V/A
Output Impedance	50 Ω
Noise Equivalent Power (NEP)	50 pW/ $\sqrt{Hz}$
cw Saturation Power	1.5 mW
Maximum Pulse Power	1.5 mW
Detector Material/Type	GaAs/PIN
Input Fiber	62.5-µm multimode
Optical Input Connector	FC/PC
Electrical Output Connector	Wiltron K
Power Requirements	±15 V, 200 mA

Values taken at 850 nm.

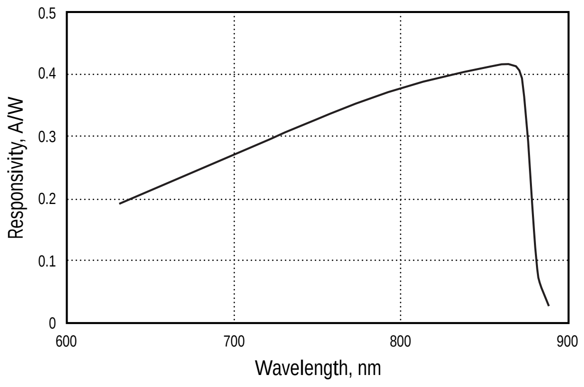
Bias-Monitor Characteristics

Model #	1580
DC Gain	1 mV/µA
DC Offset (max.)	10 mV
Output Impedance	10 kΩ
Bandwidth	50 kHz

Responsivity

A graph of the typical and predicted responsivity of the Model 1580 is shown below.

Figure 2: Responsivity vs. wavelength for Model 1580



Troubleshooting

Testing the Photodiode

The photodiode can be damaged by electrostatic discharge or excessive optical power, which can lead to an increased dark (or *offset*) voltage. A damaged photodiode can result in a degraded responsivity and frequency/impulse response. See “Checking the DC-Offset Voltage,” below.

Other problems, such as a damaged amplifier, are more difficult to diagnose. If the response from your receiver is lower than you expect, contact New Focus to arrange for a repair (see “Customer Service” on page 13).

Checking the DC-Offset Voltage

1. With no light on the photodetector, turn the detector on.

2. Use a voltmeter to measure the Bias Monitor output voltage. This voltage is the DC offset plus dark current.

3. If the output is >10 mV, then the detector is probably damaged and will need to be returned to New Focus.

If the output is <10 mV, then perform the Basic Optical Test described below.

Basic Optical Test

To quickly test the photodiode in your receiver, run this simple DC optical test.

1. Turn the receiver on.
2. Using a voltmeter or oscilloscope, measure the output voltage from the Bias Monitor on the front panel of the bias supply.

   With no light on the detector, the Bias Monitor voltage should be <10 mV.
3. Illuminate the photodetector.
4. With the voltmeter or oscilloscope, you should observe a DC output voltage.

   If you know the optical power and wavelength, you can calculate the expected output voltage (V_{out}) using the expression: $V_{out} = P_{in} \cdot R \cdot G$, where P_{in} is the input optical power (watts), R is the photodetector's responsivity (A/W, see page 10), and G is the amplifier's transimpedance gain (V/A). The gain of the bias monitor port is 1000 V/A.

If the output voltage is low, then contact New Focus to arrange for a repair (see "Customer Service" on page 13).

Customer Service

Technical Support

Information and advice about the operation of any New Focus product is available from our technical support engineers.

Engineers are on duty from 8:00–5:00 PST, Monday through Friday (excluding holidays). For quickest response, ask for "Technical Support" and know the model number for your receiver. The model number is printed on the front panel of the receiver.

Phone: (408) 980-8088
Fax: (408) 980-8883

Support is also available by email.

Email: techsupport@newfocus.com

We typically respond to email within one business day.

Service

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

Appendix I: Microwave Connectors

The performance you obtain from the Model 1580 photoreceiver depends largely on the instruments you use to measure their outputs and how the connections are made to the instruments.

Connect the male connector of the photoreceiver directly to the female connector of the instrument. (For the low-frequency version, be sure to include a DC block between the receiver and the instrument.)

If you need to use an adapter, make sure it is designed for your frequency range of interest. The following table lists a few connectors and the frequency ranges in which they may be used. For more information, request Application Note 1. If you use an intervening coaxial cable, select a cable with sufficiently low loss in the frequency range of interest.

Connector	Frequency Range	Compatibility
BNC	DC–2 GHz	——
SMA	DC–18 GHz	Wiltron K, 3.5 mm
3.5 mm	DC–34 GHz	SMA, Wiltron K
Wiltron K	DC–40 GHz	SMA, 3.5 mm
2.4 mm	DC–55 GHz	Wiltron V
Wiltron V	DC–65 GHz	2.4 mm
New Focus also offers the following adapters: Model 1225 Male-SMA to Female-BNC Model 1226 Female-SMA to Male-BNC Model 1227 40-GHz Flex Cable, Female-K to Male-K		

Appendix II:
Inside the Photoreceiver

A gold-plated microwave housing inside the photoreceiver module contains the high-frequency circuitry. This housing is bolted to a printed-circuit board which regulates the bias for the photodiode and amplifies the DC photocurrent for the monitor port. The optical signal is brought from the front-panel connector to the microwave housing with 62.5-µm-core multimode fiber.

Figure 3: Simplified schematic of the Model 1580 photoreceiver module