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USER'S GUIDE

125-MHz Photoreceivers

Models 1801 and 1811



These photodetectors are sensitive to electrostatic discharges and could be permanently damaged if subjected to any discharges. Ground your-self adequately prior to handling these detectors or making connections. A ground strap provides the most effective grounding and minimizes the likelihood of electrostatic damage.



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Operation

Introduction

The New Focus Models 1801 and 1811 125-MHz, low-noise photoreceivers address the needs of the photodetector community in the area of low-noise, high-gain, RF photoreception. These photoreceivers are available either DC or AC coupled. Their typical bandwidth is 125 MHz with a current gain of 40 V/mA.

The performance of these units is achieved through the use of solid RF design together with the implementation of some of the latest advances in commercially available amplifier chips. The detector is shielded to avoid RF pickup. New Focus offers two models to match your different wavelength needs. The specifications at the rear of the manual list each model's characteristics.

These units address nearly all of the general purpose needs of the RF photoreception community. They all have a very large gain–bandwidth product, low noise, high drive capability and a large dynamic range. These receivers will enable wide bandwidth low-noise detection of signals distributed over fiber-optic cables or found in high resolution spectroscopy, fiber-optic sensors, optical metrology, and many other applications.

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Handling Precautions

Whenever handling the photoreceiver, 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.
- Make sure the optical connector is clean and undamaged before connecting it to the detector module.

Using the Photodetector

To obtain optical input:

1. Plug one end of the power cable to the connector on the back of the module and the other end into a ±15-V power supply. (We recommend the New Focus Model 0901 power supply.) Turn on the supply.

   Two different power cables have been shipped with your detector: a Model 0921 banana plug-to-microconnector cable and a Model 0922 microconnector-to-microconnector cable. If you have a New Focus Model 0901 power supply, use the Model 0922 cable on one of the supply's 0.3-A microconnector outputs. Do not use the Model 0921 on the Model 0901 power supply's 0.1-A banana outputs since they do not provide enough current for the receiver. Use the Model 0921 cable only with a power supply other than the 0901

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providing a minimum of 0.25 A of current on ±15 V. The convention of the three banana plugs is:

Banana Plug	Voltage
Red	+15 V
Green	COM/GND
Black	-15 V

2. Turn on the optical beam.
3. For free-space beam input, align the module so that the beam is incident on the detector surface.

   For fiber-optic input, connect the fiber-optic cable from your optical source to the FC input connector on the front of the module. The detector is designed to receive an FC/PC connectorized fiber.

Note: *To operate the receiver in the linear region, keep the input power levels well below the cw saturation power specification on page 12. (The input power is wavelength dependent and is inversely proportional to the responsivity.)*

To set up the output connection:

1. If your RF measurement instrument has a male connector, connect it directly to the SMA female output connector (labeled "AC" on AC-coupled units) on the back of the module.
2. If your instrument has a female connector, connect with the appropriate cable.
3. On AC-coupled units, monitor the DC bias on the output labeled "DC" with the provided SMB-to-BNC cable.

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Theory

The Model 1801 photoreceiver contains a silicon/PIN photodiode. The Model 1811 contains an InGaAs/PIN photodiode. In both models, the photodiode is followed by a low-noise transimpedance amplifier acting as a pre-amp with a compensating amplifier as the output stage. A functional block diagram of the DC-coupled version is shown in Figure 1.

The AC-coupled versions incorporate two extra blocking capacitors, a choke, and a DC bias monitor circuit. The corner frequency of the high-pass filter on the AC-coupled output is approximately 25 kHz. The corner frequency of the low-pass filter on the DC bias monitor output is approximately 50 kHz. Refer to Figure 2 for a functional block diagram.

The compensating amplifier allows us to use a large-area diode, which is intrinsically low speed, while maintaining a large bandwidth with flat response. This is accomplished by having the gain of the output stage increase with frequency. As a result of the increasing gain the noise floor of the receiver increases starting at approx. 40 MHz and having a soft peak at approximately 110 MHz. The equivalent input noise current at the peak is greater than the low-frequency noise by a factor of 10. Typical frequency response and noise floor is shown in Figure 5.

The transimpedance amplifier in the AC path has an absolute maximum input current of 5 mA and therefore the maximum input optical power is 7 mW. Figure 3 and Figure 4 show the responsivity of the photodiodes. Power is delivered through a connector on the back of the unit and the entire package is shielded to eliminate RF pickup.

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NEP Characteristics

For Model 1801, the NEP from 0–10 MHz is 3.3 pW/$\sqrt{Hz}$ and from 10–200 MHz the NEP is 30 pW/$\sqrt{Hz}$. Therefore the integrated noise from 0–130 MHz is 328 nW_{rms} and with a conversion gain of $2.4x10^4$ V/W, the expected output noise voltage is 7.8 mV_{rms}.

For Model 1811, the NEP from 0–10 MHz is 2.5 pW/$\sqrt{Hz}$ and from 10–200 MHz the NEP it is 22.5 pW/$\sqrt{Hz}$. Therefore the integrated noise from 0–130 MHz is 246 nW_{rms} and with a conversion gain of $2.4x10^4$ V/W, the expected output noise voltage is 5.9 mV_{rms}.

Figure 1: Functional block diagram of Models 1801 & 1811 (DC Versions).

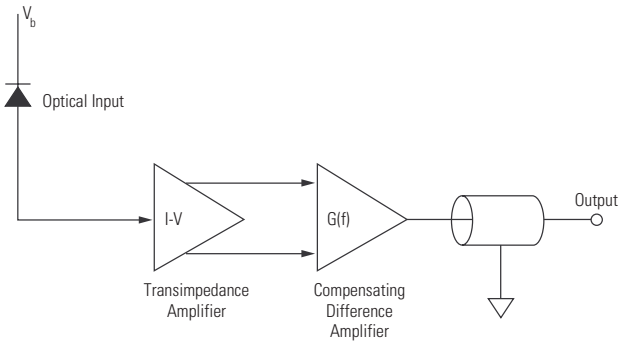
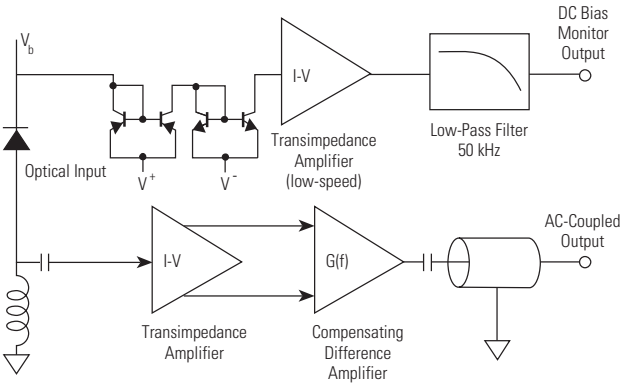


Figure 2: Functional block diagram of Models 1801 & 1811 (AC Versions).



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Figure 3: Responsivity of the photodiode used in the Model 1801 (DC Version).

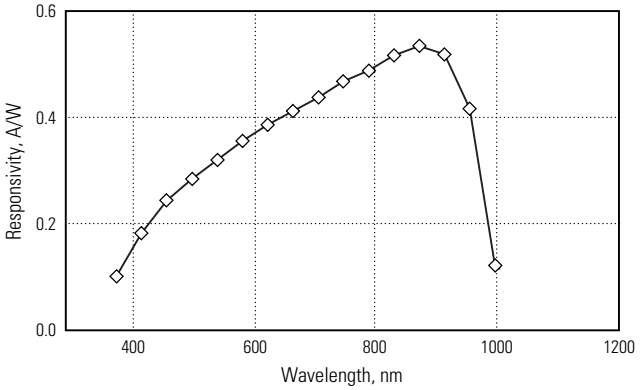


Figure 4: Responsivity of the photodiode used in the Model 1811 (DC Version)

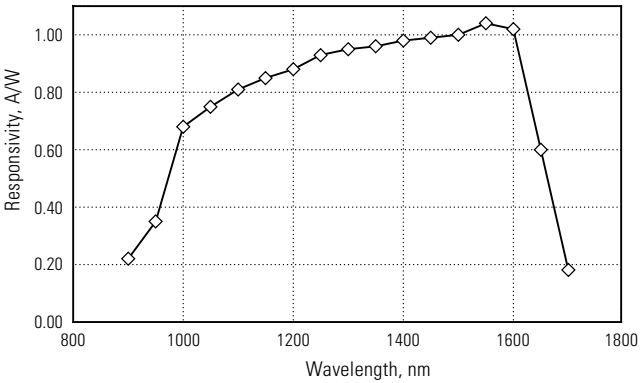
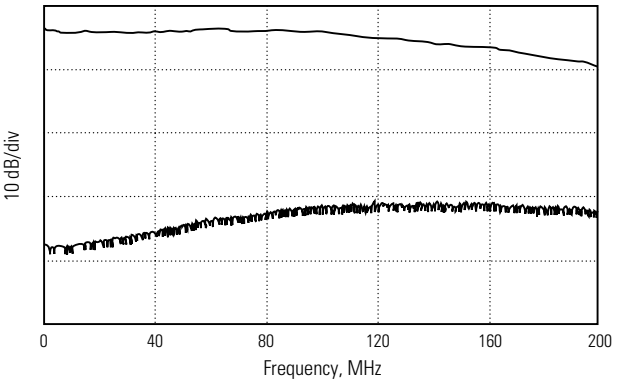


Figure 5: Typical frequency response (top) and noise floor (bottom). At DC the noise floor is 3.3 pW/$\sqrt{\text{Hz}}$ for Model 1801 & 2.5 pW/$\sqrt{\text{Hz}}$ for Model 1811

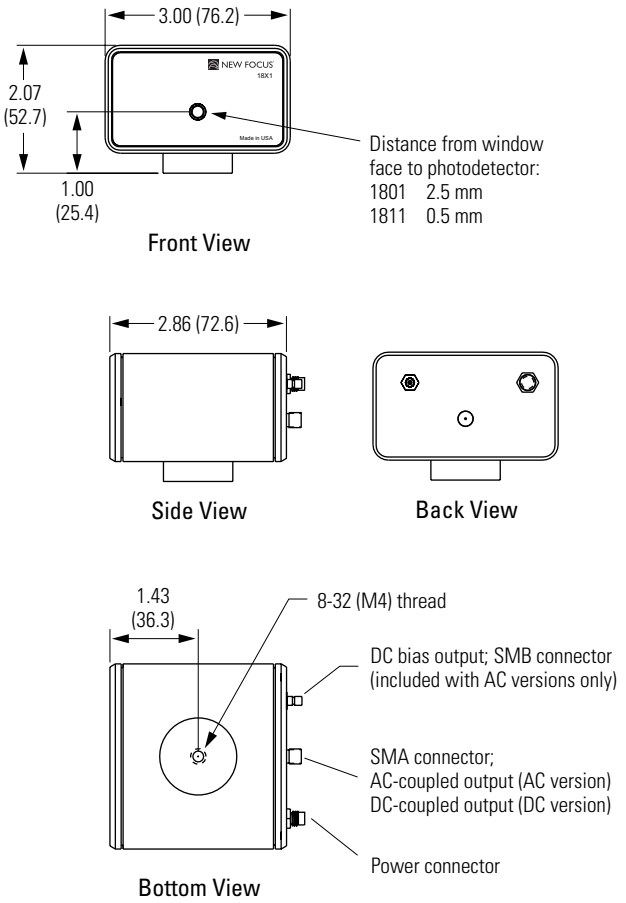


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Characteristics

Physical Specifications

Figure 6: Mechanical drawings of the Model 18X1 casing



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Photodetector Specifications

Model #	1801	1811
Wavelength Range	300–1050 nm	900–1700 nm
Coupling	DC or AC	DC or AC
3-dB Bandwidth (DC versions)	DC–125 MHz (typical)	DC–125 MHz (typical)
3-dB Bandwidth (AC versions)	25 kHz–125 MHz (typ.)	25 kHz–125 MHz (typ.)
DC Bias Monitor Bandwidth (AC versions only)	DC–50 kHz (typical)	DC–50 kHz (typical)
Risetime	3 ns (typical)	3 ns (typical)
Transimpedance Gain (AC-coupled version)	40 V/mA (AC) 1 V/mA (DC)	40 V/mA (AC) 1 V/mA (DC)
Transimpedance Gain (DC-coupled version)	40 V/mA	40 V/mA
Output Impedance	50 Ω	50 Ω
Minimum NEP*	3.3 pW/$\sqrt{\text{Hz}}$	2.5 pW/$\sqrt{\text{Hz}}$
CW Saturation Power	120 µW @ 950 nm	120 µW @ 950 nm
Maximum Pulse Power	5 mW	5 mW
Detector Material/Type	Silicon/PIN	InGaAs/PIN
Detector Diameter	0.8 mm	0.3 mm (FS) 0.1 mm (FC)
Power Requirements	±15 V DC; 250 mA	±15 V DC; 250 mA
Optical Input	FC or free space (FS)	FC or free space (FS)
RF Output	SMA	SMA
DC Bias Monitor output (AC-coupled units only)	SMB	SMB

* NEP is frequency dependent. See page 9 for more details.

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Customer Service

Technical Support

Information and advice about the operation of any New Focus product is available from our applications engineers. For quickest response, ask for "Technical Support" and know the model and serial numbers for your product.

Hours: 8:00–5:00 PST, Monday through Friday (excluding holidays).

Toll Free: 1-866-NUFOCUS (1-866-683-6287)
(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 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.

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