

USER'S GUIDE

80-MHz Balanced Photoreceivers

Model 18X7




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Introduction

Overview

The New Focus Model 18X7 balanced photoreceiver consists of two matched photodiodes and a high-speed amplifier that generates an output voltage proportional to $I_2 - I_1$, the difference between the photocurrents in the two photodiodes.

The Quick Start and General Principles sections below give an overview of setting up the photoreceiver and understanding its principles and design. The sections that follow give detailed information about the technical specifications.

Operation

Quick Start

The following parts are supplied with the Model 18X7 balanced photoreceiver:

- Model 0923 M8B-to-M8B connector power cable
- Model 0924 M8B-to-banana plug power cable
- Model 1225 SMA-to-BNC adapter

The steps below describe the basics of setting up and using the photoreceiver.

1. Use one of the supplied power cables to connect the photoreceiver to a ± 15 -volt power source that can supply 200 mA (the minimum current requirement for DC power supply is 100mA).

For the New Focus Model 0901 power supply, use the 0923 M8B-to-M8B cable. For other power supplies, use the 0924 M8B-to-banana plug power cable.



When using the M8B-to-banana plug cable, take care to hook up the banana plugs as follows to avoid damaging the photoreceiver: Red = +15 V, Black = -15 V, Green = Ground.

2. Mount the photoreceiver to your optical table.
3. Connect the optical source to both optical inputs. For the Model 1807, it is possible to align a small free-space beam through the FC adapter, onto the $1 \times 0.84 \text{ mm}^2$ photodiode. The Model 1817 has a much smaller diode (0.1 mm active area diameter), and we do not recommend use with free-space beams. The FC adapter for both types of 18X7 photoreceiver will accommodate either multi-mode or single-mode fiber.



To prevent saturation of the amplifier, keep the difference between the input powers less than the saturation power shown in Specifications.



The optical power must remain below the absolute maximum power listed in Specifications. Exceeding the maximum power may damage the photodiode and the amplifier.

4. Individually block each photodiode input to check and adjust the optical inputs so that the output voltages are in the desired -2.5 to $+2.5 \text{ V}$ range (with 50Ω load).

Illuminate both diodes simultaneously and use the output to fine-tune the optical power balance between the two diodes while observing voltage on a digital voltmeter or other low-frequency measurement device.

- Finally, connect the output SMA connector to the desired load or instrument via a 50-Ω coaxial cable.

General Principles

The New Focus Model 18X7 balanced photoreceiver consists of two matched photodiodes and a high-frequency amplifier that generates an output voltage proportional to $I_2 - I_1$, the difference between the photocurrents in the two photodiodes. Figure 1 shows a functional block diagram of the balanced photoreceiver, and Figure 2 shows the mechanical drawing.

Figure 1:
Functional
block diagram
of the
Model 18X7

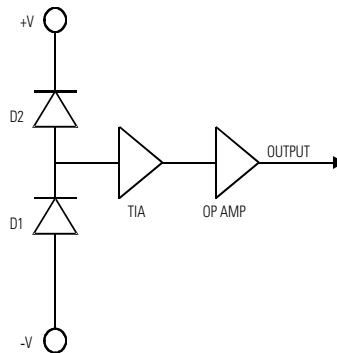
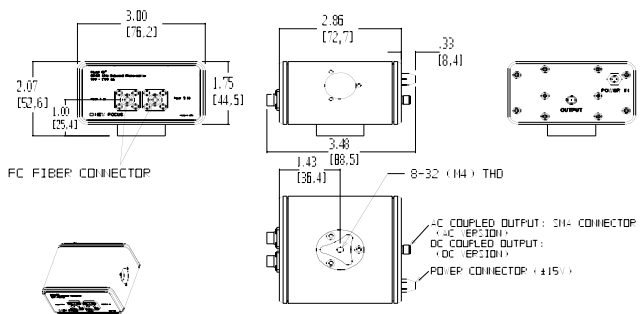


Figure 2:
Mechanical
drawing of the
balanced
photoreceiver

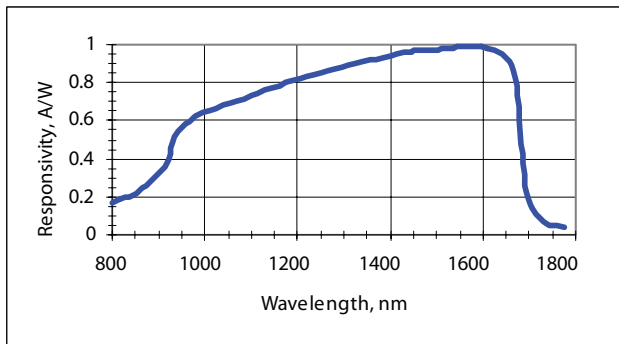
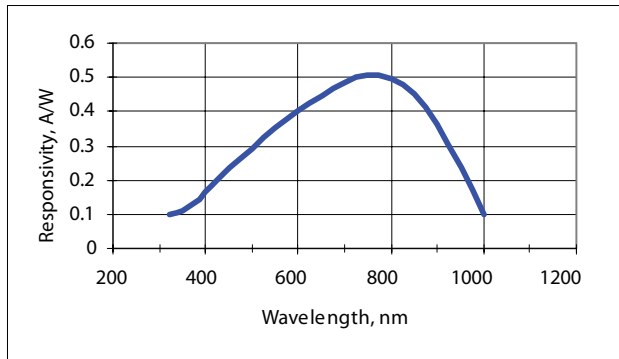


Unless otherwise noted, dimensions are in inches with metric dimensions in mm in brackets.

Responsivity and Input Power

The Model 1807 uses a matched pair of silicon photodiodes, while the Model 1817 uses a matched pair of InGaAs photodiodes. Figure 3 shows the typical responsivity of the photodiodes.

Figure 3:
Typical
responsivities
of the Silicon
and InGaAs PIN
photodiodes in
Model 1807
(top) and
Model 1817
(bottom)



Gain, Bandwidth and Noise

The amplifier is a low-noise device with low output impedance. The amplifier's transimpedance gain is 40 V/mA.

Depending on wavelength (see typical responsivity curves in Figure 3), the amplifier will reach saturation levels when the difference between the two photo inputs is approximately 110 μ W (for responsivity of 0.5 A/W). For a high-impedance load, the maximum output voltage will be approximately ± 4 V before the

amplifier is saturated. For a 50-Ω load, the maximum output voltage will be approximately ± 2 V before saturation.

The 3-dB bandwidth is typically in excess of 80 MHz for the Model 18X7 photoreceivers.

Figures 4 and 5 show typical frequency responses for the two photoreceivers.

Figure 4:
Model 1807
typical
frequency
response (top)
and noise
spectrum
(bottom).

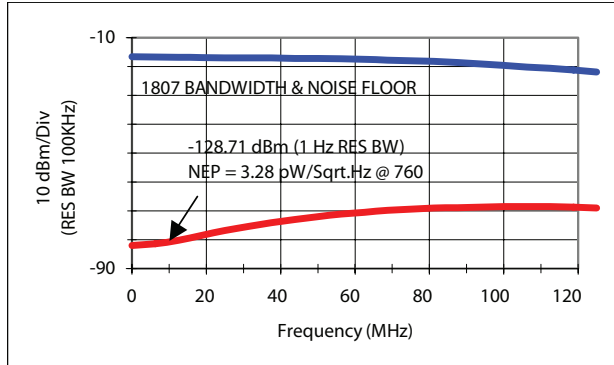
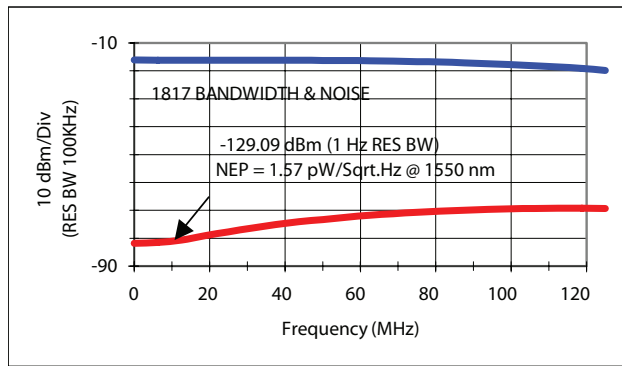


Figure 5:
Model 1817
typical
frequency
response (top)
and noise
spectrum
(bottom).



Figures 4 and 5 also show the typical noise spectrum. Model 1807 has a minimum noise-equivalent power (NEP) of 3.3 pW/ $\sqrt{\text{Hz}}$ from DC-10MHz. NEP versus frequency is shown in Figure 4.

For Model 1817, minimum NEP is 1.6 pW/ $\sqrt{\text{Hz}}$ from DC-10MHz, and NEP versus frequency is shown in

Figure 5. Therefore, the integrated noise from DC-80MHz is $195 \text{ nW}_{\text{rms}}$ for Model 1807 and $85 \text{ nW}_{\text{rms}}$ for Model 1817. This input optical noise level is the approximate minimum optical signal that can be detected with these photoreceivers.

To detect a weaker signal, you can reduce the noise by adding an electronic bandpass filter at the output of the photoreceiver, or consider the 125 kHz bandwidth Nirvana Auto-balanced Photoreceiver, Model 20X7, or use lock-in amplifier and chopper techniques to further narrow your measurement bandwidth.

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 of your photoreceiver.

Phone: (408) 919-1500

Fax: (408) 980-8883

Support is also available by 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.

Specifications

	Model 1807	Model 1817
Wavelength Range	320–1000 nm	900–1700 nm
3-dB Bandwidth	DC–80 MHz	DC–80 MHz
Common Mode Rejection Ratio	25 dB typical	25 dB typical
Conversion Gain	2×10^4 V/W	4×10^4 V/W
Typical Max. Responsivity	0.5 A/W @760nm	1.0 A/W @1550nm
Transimpedance Gain	4×10^4 V/A	4×10^4 V/A
Output Impedance	50 Ω	50 Ω
Minimum NEP	3.3 pW/ $\sqrt{\text{Hz}}$	2.5 pW/ $\sqrt{\text{Hz}}$
CW Saturation Power (Differential) (μW)	110 @ 760 nm	55 @ 1550 nm
Max. Differential Power (Damage Threshold) (mW)	10 @ 760 nm	5 @ 1550 nm
Max. Power per Photo-diode (Damage Threshold) (mW)	10 @ 760 nm	5 @ 1550 nm
Detector Material/Type	Si/PIN	InGaAs/PIN
Detector Active Area	0.4 mm diameter	0.1 mm diameter
Optical Input	FC	FC
Electrical Output	SMA	SMA
Package Dimension	3.00 x 2.86 x 2.07 inches	3.00 x 2.86 x 2.07 inches
Power Supply Requirement	± 15 V DC, <200 mA (Model 0901 recommended)	± 15 V DC, <200 mA (Model 0901 recommended)