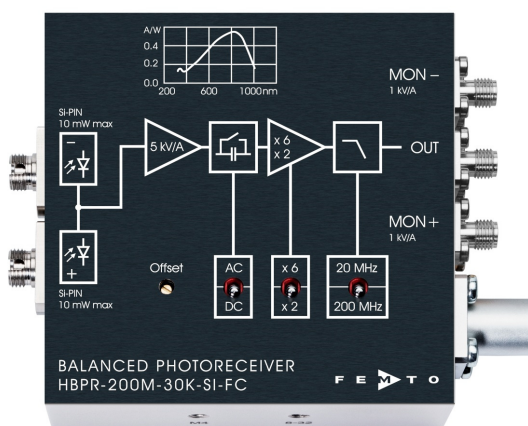


High-Speed Balanced Photoreceiver



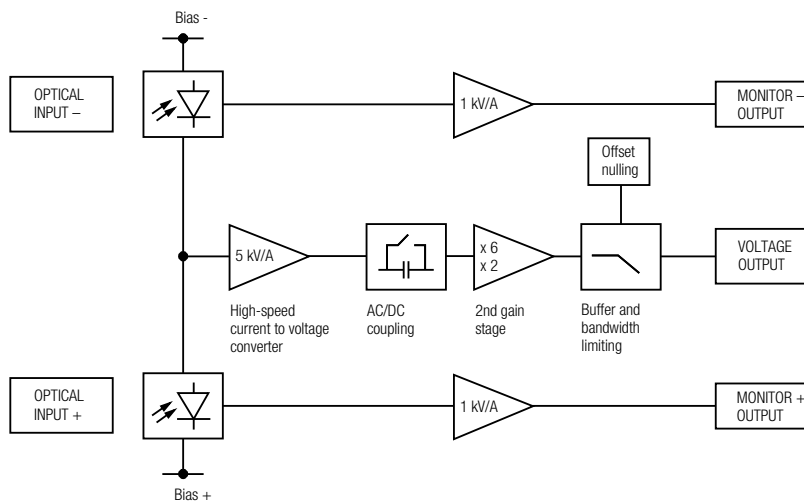
Features

- **Bandwidth DC to 200 MHz**
- **Common-Mode Rejection Ratio (CMRR) 45 dB typ.**
- **Si-PIN photodiodes**
- **FC fiber optic inputs**
- **Spectral range 320 – 1000 nm**
- **Very low NEP, down to 7.8 pW/√Hz**
- **Transimpedance gain switchable 10×10^3 V/A, 30×10^3 V/A**
- **High dynamic input range up to 2×10 mW balanced optical power**
- **Fast monitor outputs with 10 MHz bandwidth and 1×10^3 V/A gain**
- **Switchable low pass filter for minimizing wideband noise**
- **UNC 8-32 and M4 tapped holes for mounting on standard posts with metric and imperial thread**

Applications

- **Spectroscopy**
- **Heterodyne detection**
- **Optical coherence tomography (OCT)**
- **Optical delay measurement**
- **Differential optical front-end for oscilloscopes, spectrum analyzers, A/D converters and RF lock-in amplifiers**

Block Diagram



BS-HBPR_R2

High-Speed Balanced Photoreceiver

Intended Use

The HBPR-200M-30K-SI-FC photoreceiver consists of a combination of two anti-parallel connected photodiodes with a subsequent low-noise transimpedance amplifier. It is designed for fast conversion of the tiny difference of two optical signals into an equivalent output voltage. Operation is mostly self-explanatory. If in doubt, consult this document or contact support@femto.de.

For safe operation, please refer to the damage thresholds specified in the "Absolute Maximum Ratings", "Temperature Range" and "Power Supply" sections of this document.

The operating environment must be free of smoke, dust, grease, oil, condensing moisture, and other contaminants that could affect the operation or performance.

Application Notes

The damage threshold of 12 mW for each photodiode mentioned in the "Absolute Maximum Ratings" section applies to reasonably homogeneous illumination of the photodiodes. Extreme focusing of the light beam can lead to damage to the photodiodes, even at significantly lower light power.

To achieve optimum performance, it is recommended that the CW light intensity at both inputs be well balanced. The monitor outputs can be used for continuous balance control. For setups with arbitrarily varying CW offset, the photoreceiver's AC mode can be helpful. Using AC mode increases the CW offset range to 850 μ W (@ 850 nm), regardless of the gain setting.

Available Version

HBPR-200M-30K-SI-FC



fix/permanent FC fiber connectors
for high coupling efficiency, excellent conversion gain
accuracy and common mode rejection ratio (CMRR)

Related Models

Various free space or fiber coupled HBPR models, with bandwidth up to 500 MHz, in the spectral range from 320 nm to 1700 nm are available.

Si Versions

Fiber-coupled with fix/permanent FC fiber connectors

HBPR-100M-60K-SI-FC Si-PIN $\varnothing$ 0.8 mm, DC – 100 MHz, 320 – 1000 nm, CMRR 50 dB, gain 2.0×10^4 / 6.0×10^4 V/A switchable

HBPR-500M-10K-SI-FC Si-PIN $\varnothing$ 0.4 mm, DC – 500 MHz, 320 – 1000 nm, CMRR 40 dB, gain 5.0×10^3 / 10.0×10^3 V/A switchable

Free space versions with 1.035"-40 threaded flanges

HBPR-100M-60K-SI-FST Si-PIN $\varnothing$ 0.8 mm, DC – 100 MHz, 320 – 1000 nm, CMRR 50 dB, gain 2.0×10^4 / 6.0×10^4 V/A switchable

HBPR-200M-30K-SI-FST Si-PIN $\varnothing$ 0.8 mm, DC – 200 MHz, 320 – 1000 nm, CMRR 45 dB, gain 1.0×10^4 / 3.0×10^4 V/A switchable

HBPR-500M-10K-SI-FST Si-PIN $\varnothing$ 0.4 mm, DC – 500 MHz, 320 – 1000 nm, CMRR 40 dB, gain 5.0×10^3 / 10.0×10^3 V/A switchable

High-Speed Balanced Photoreceiver

Related Models (continued)

InGaAs Versions

Fiber-coupled with fix/permanent FC fiber connectors (ball lense coupled)

HBPR-100M-60K-IN-FC InGaAs-PIN $\varnothing$ 0.08 mm, DC – 100 MHz, 900 – 1700 nm, CMRR 55 dB, gain $2.0 \times 10^4 / 6.0 \times 10^4$ V/A switchable

HBPR-200M-30K-IN-FC InGaAs-PIN $\varnothing$ 0.08 mm, DC – 200 MHz, 900 – 1700 nm, CMRR 50 dB, gain $1.0 \times 10^4 / 3.0 \times 10^4$ V/A switchable

HBPR-500M-10K-IN-FC InGaAs-PIN $\varnothing$ 0.08 mm, DC – 500 MHz, 900 – 1700 nm, CMRR 45 dB, gain $5.0 \times 10^3 / 10.0 \times 10^3$ V/A switchable

Free space versions with 1.035"-40 threaded flanges

HBPR-100M-60K-IN-FST InGaAs-PIN $\varnothing$ 0.3 mm, DC – 100 MHz, 800 – 1700 nm, CMRR 50 dB, gain $2.0 \times 10^4 / 6.0 \times 10^4$ V/A switchable

HBPR-200M-30K-IN-FST InGaAs-PIN $\varnothing$ 0.3 mm, DC – 200 MHz, 800 – 1700 nm, CMRR 45 dB, gain $1.0 \times 10^4 / 3.0 \times 10^4$ V/A switchable

HBPR-450M-10K-IN-FST InGaAs-PIN $\varnothing$ 0.3 mm, DC – 450 MHz, 800 – 1700 nm, CMRR 35 dB, gain $5.0 \times 10^3 / 10.0 \times 10^3$ V/A switchable

Available Accessory

PS-15-25-L



Power Supply

Input: 100 – 240 VAC

Output: ± 15 VDC

Specifications

Test conditions

$V_s = \pm 15$ V, $T_A = 25$ °C, output load impedance 50 Ω , warm-up 20 minutes (min. 10 minutes recommended), monitor outputs terminated with 1 M Ω

Gain

Transimpedance gain

10×10^3 V/A (@ 2nd gain $\times 2$, 50 Ω load)

30×10^3 V/A (@ 2nd gain $\times 6$, 50 Ω load)

Gain accuracy

± 1 % electrical

Conversion gain

5.4×10^3 V/W typ. (@ 2nd gain $\times 2$, 850 nm, 50 Ω load)

16.2×10^3 V/W typ. (@ 2nd gain $\times 6$, 850 nm, 50 Ω load)

Common mode rejection ratio (CMRR)

50 dB typ. ($f \leq 100$ MHz)

45 dB typ. ($f \leq 200$ MHz)

Frequency Response

Lower cut-off frequency

DC / 10 Hz, switchable

Upper cut-off frequency (–3 dB)

200 MHz / 20 MHz, switchable

Time Response

Rise/fall time (10 % – 90 %)

1.75 ns (@ 2nd gain $\times 2$); 1.85 ns (@ 2nd gain $\times 6$)

17.5 ns (@ bandwidth set to 20 MHz)

Input

Noise equivalent power (NEP)

minimum 7.8 pW/ $\sqrt{\text{Hz}}$ (@ 850 nm)

8.8 pW/ $\sqrt{\text{Hz}}$ (@ 850 nm, 20 MHz)

19.0 pW/ $\sqrt{\text{Hz}}$ (@ 850 nm, 100 MHz)

33.0 pW/ $\sqrt{\text{Hz}}$ (@ 850 nm, 200 MHz)

Maximum differential CW power (for linear amplification)

185 μ W (@ 2nd gain $\times 2$, DC-coupled, 850 nm)

62 μ W (@ 2nd gain $\times 6$, DC-coupled, 850 nm)

850 μ W (@ AC-coupled, 850 nm)

Max. optical CW balanced power (common mode power)

10 mW (on each photodiode, @ 850 nm)

Monitor optical saturation power (limited by maximum ratings)

12 mW (@ 850 nm)

Detector

Detector type

Si-PIN photodiode in FC fiber connector

Active area

$\varnothing$ 800 μ m, suitable for fibers up to 400 μ m core diameter

Spectral range

320 – 1000 nm

Sensitivity

0.54 A/W typ. (@ 850 nm)

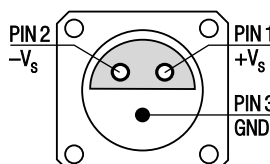
High-Speed Balanced Photoreceiver

Specifications (continued)

Output	Output voltage range ± 1.0 V (@ 50 Ω load) for linear operation and low harmonic distortion Max. output voltage ± 2.0 V (@ 50 Ω load) Offset voltage compensation ± 100 mV typ., adjustable by offset potentiometer Output impedance 50 Ω (terminate with 50 Ω load) Slew rate 2800 V/μs Max. output current 70 mA Output reflection S22 -30 dB @ < 100 MHz -20 dB @ < 800 MHz Output noise (typ.) 2.2 mV RMS (15 mV peak-peak) (@ 2nd gain $\times 2$) 6.0 mV RMS (40 mV peak-peak) (@ 2nd gain $\times 6$) 0.3 mV RMS (2.0 mV peak-peak) (@ 2nd gain $\times 2$, BW 20 MHz) 0.8 mV RMS (8.8 mV peak-peak) (@ 2nd gain $\times 6$, BW 20 MHz) (@ 50 Ω load, no signal on detectors, measurement bandwidth 2 GHz)
Monitor Outputs	Gain 1×10^3 V/A (@ ≥ 100 kΩ load) Voltage range 0 ... +10 V (@ ≥ 100 kΩ load) Output impedance 50 Ω (terminate with ≥ 100 kΩ load) Max. output current 30 mA typ. Bandwidth DC – 10 MHz Output noise 0.6 mV RMS (4 mV peak-peak) (@ 100 kΩ load, no signal on detectors, measurement bandwidth 200 MHz)
Power Supply	Supply voltage ± 15 V (± 14.5 V ... ± 16.5 V) Supply current -90 / $+120$ mA typ. (depends on operating conditions, recommended power supply capability min. ± 200 mA)
Optical Input Connector	Material FC receptacle nickel silver
Case	Weight 350 g (0.77 lbs) Material AlMg3Mn, nickel-plated
Temperature Range	Storage temperature -40 $^{\circ}$C ... $+85$ $^{\circ}$C Operating temperature 0 $^{\circ}$C ... $+60$ $^{\circ}$C

Absolute Maximum Ratings	Optical input power (CW) 12 mW (on each photodiode)
	Power supply voltage ± 20 V

Connectors	Inputs FC fiber optic connectors (FC/PC and FC/APC compatible) Outputs SMA jacks (female) Power supply LEMO® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52)
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Pin 1: +15 V
Pin 2: -15 V
Pin 3: GND

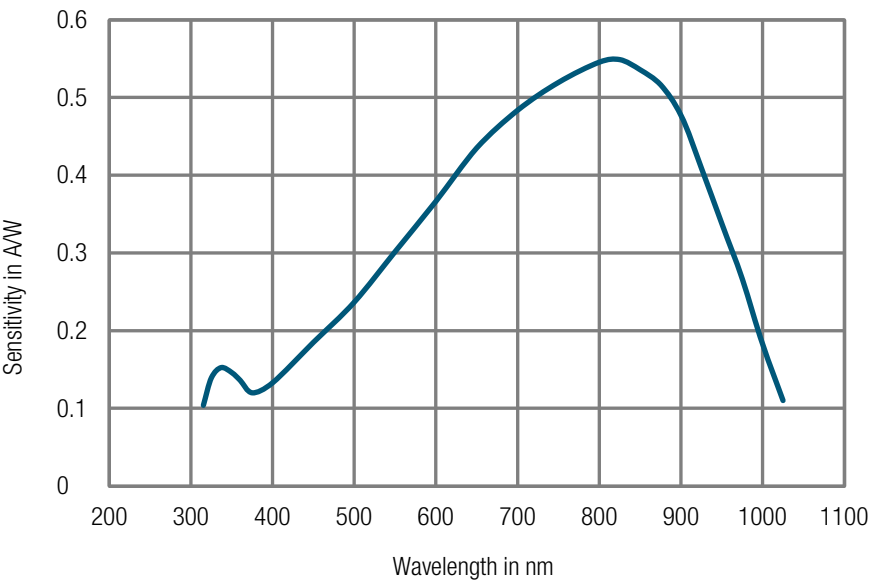
Scope of Delivery	HBPR-200M-30K-SI-FC, Lemo® 3-pin connector, 3 $\times$ adapter SMA (male) to BNC (female), datasheet
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Ordering Information	HBPR-200M-30K-SI-FC FC fiber optic connectors (FC/PC and FC/APC compatible)
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High-Speed Balanced Photoreceiver

Spectral Response

HBPR-200M-30K-SI-FC (FC fiber optic input)

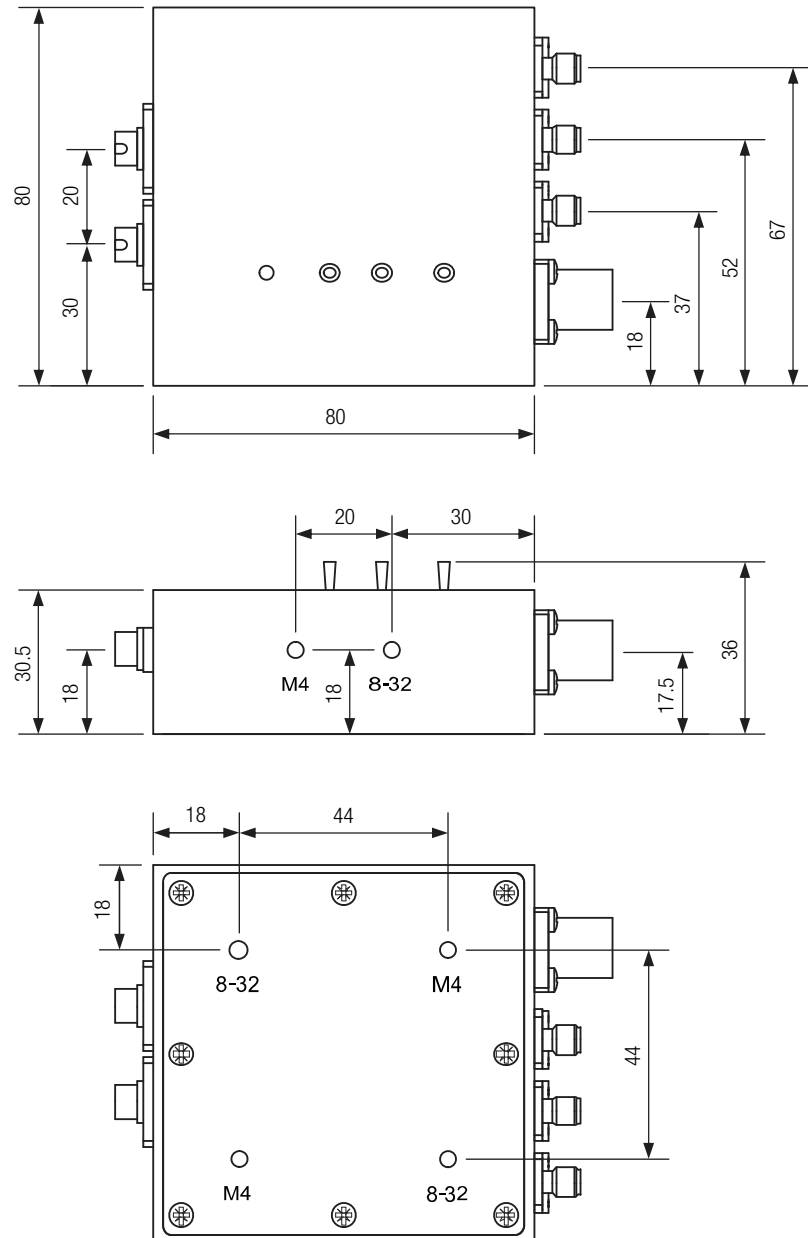


DB-Sens-HBPR-100-200-SI_R2

High-Speed Balanced Photoreceiver

Dimensions

HBPR-200M-30K-SI-FC



DZ-HBPR_FC_R2

all dimensions in mm unless otherwise noted

The base plate can be rotated if necessary. To do this, loosen the 8 screws.

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