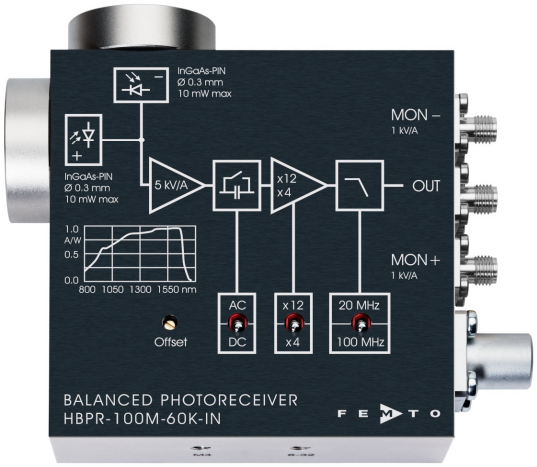
High-Speed Balanced Photoreceiver



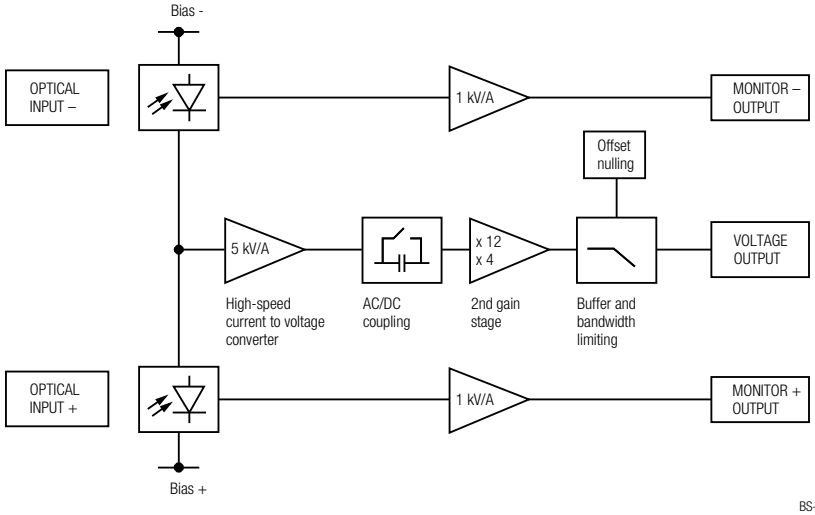
Features

- **Bandwidth DC to 100 MHz**
- **Common-Mode Rejection Ratio (CMRR) 50 dB typ.**
- **InGaAs-PIN detectors, 0.3 mm active diameter**
- **Spectral range 800 – 1700 nm**
- **Very low NEP, down to 3.7 pW/√Hz**
- **Transimpedance gain switchable 20 × 10^3 V/A, 60 × 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**
- **Free-space input 1.035"-40 threaded**
- **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-100M-60K-IN-FST 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 275 µW (@ 1550 nm), regardless of the gain setting.

Available Version

HBPR-100M-60K-IN-FST

1.035"-40 threaded flanges with internally threaded coupler rings mounted (outer dia. 30 mm), for free space applications, compatible with many optical standard accessories

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 ∅ 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-FC	Si-PIN ∅ 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-FC	Si-PIN ∅ 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 ∅ 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 ∅ 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 ∅ 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 ∅ 0.08 mm, DC – 100 MHz, 900 – 1700 nm, CMRR 55 dB, gain 2.0×10^4 / 6.0×10^4 V/A switchable
HBPR-200M-30K-IN-FC	InGaAs-PIN ∅ 0.08 mm, DC – 200 MHz, 900 – 1700 nm, CMRR 50 dB, gain 1.0×10^4 / 3.0×10^4 V/A switchable
HBPR-500M-10K-IN-FC	InGaAs-PIN ∅ 0.08 mm, DC – 500 MHz, 900 – 1700 nm, CMRR 45 dB, gain 5.0×10^3 / 10.0×10^3 V/A switchable

Free space versions with 1.035"-40 threaded flanges

HBPR-200M-30K-IN-FST	InGaAs-PIN ∅ 0.3 mm, DC – 200 MHz, 800 – 1700 nm, CMRR 45 dB, gain 1.0×10^4 / 3.0×10^4 V/A switchable
HBPR-450M-10K-IN-FST	InGaAs-PIN ∅ 0.3 mm, DC – 450 MHz, 800 – 1700 nm, CMRR 35 dB, gain 5.0×10^3 / 10.0×10^3 V/A switchable

Available Accessory

PS-15-25-L

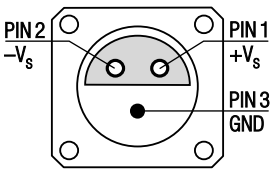
Power Supply
Input: 100 – 240 VAC
Output: ±15 VDC

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 MΩ
Gain	Transimpedance gain	20×10^3 V/A (@ 2nd gain ×4, 50 Ω load) 60×10^3 V/A (@ 2nd gain ×12, 50 Ω load)
	Gain accuracy	±1 % electrical
	Conversion gain	19×10^3 V/W typ. (@ 2nd gain ×4, 1550 nm, 50 Ω load) 57×10^3 V/W typ. (@ 2nd gain ×12, 1550 nm, 50 Ω load)
	Common mode rejection ratio (CMRR)	50 dB typ. (f ≤100 MHz)
Frequency Response	Lower cut-off frequency	DC / 10 Hz, switchable
	Upper cut-off frequency (–3 dB)	100 MHz / 20 MHz, switchable
Time Response	Rise/fall time (10 % – 90 %)	3.4 ns 17.5 ns (@ bandwidth set to 20 MHz)
Input	Noise equivalent power (NEP)	minimum 3.7 pW/√Hz (@ 1550 nm) 4.3 pW/√Hz (@ 1550 nm, 20 MHz) 7.1 pW/√Hz (@ 1550 nm, 50 MHz) 12.0 pW/√Hz (@ 1550 nm, 100 MHz)
	Maximum differential CW power (for linear amplification)	53 µW (@ 2nd gain ×4, DC-coupled, 1550 nm) 18 µW (@ 2nd gain ×12, DC-coupled, 1550 nm) 275 µW (@ AC-coupled, 1550 nm)
	Max. optical CW balanced power (common mode power)	10 mW (on each photodiode, @ 1550 nm)
	Monitor optical saturation power (limited by linear amplification)	10.5 mW (@ 1550 nm)
Detector	Detector type	InGaAs-PIN photodiode
	Active area	∅ 300 µm
	Spectral range	800 – 1700 nm
	Sensitivity	0.95 A/W typ. (@ 1550 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	2000 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 ×4) 6.2 mV RMS (41 mV peak-peak) (@ 2nd gain ×12) 0.5 mV RMS (3.1 mV peak-peak) (@ 2nd gain ×4, BW 20 MHz) 1.3 mV RMS (8.8 mV peak-peak) (@ 2nd gain ×12, 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 FST flange	1.4305 stainless steel, nickel-plated
	Material FST coupler ring	1.4305 stainless steel, glass bead blasted
Case	Weight	410 g (0.9 lbs) including coupler rings
	Material	AlMg3Mn, nickel-plated
Temperature Range	Storage temperature	–40 °C ... +85 °C
	Operating temperature	0 °C ... +60 °C
Absolute Maximum Ratings	Optical input power (CW)	12 mW (on each photodiode)
	Power supply voltage	±20 V
Connectors	Inputs	1.035"-40 threaded flanges for free space applications and for use with various types of optical standard accessories
	Outputs	SMA jacks (female)
	Power supply	LEMO® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52)



Pin 1: +15 V
Pin 2: –15 V
Pin 3: GND

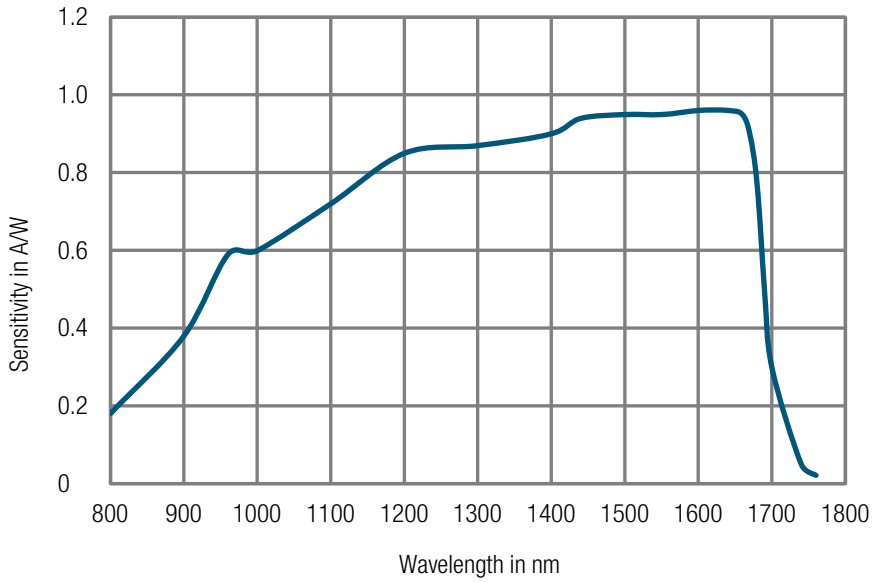
Scope of Delivery	HBPR-100M-60K-IN-FST, 2 × threaded coupler ring, Lemo® 3-pin connector, 3 × adapter SMA (male) to BNC (female), datasheet

High-Speed Balanced Photoreceiver

Ordering Information	HBPR-100M-60K-IN-FST	1.035"-40 threaded flanges for free space applications and for use with various types of optical standard accessories

Spectral Response

HBPR-100M-60K-IN-FST

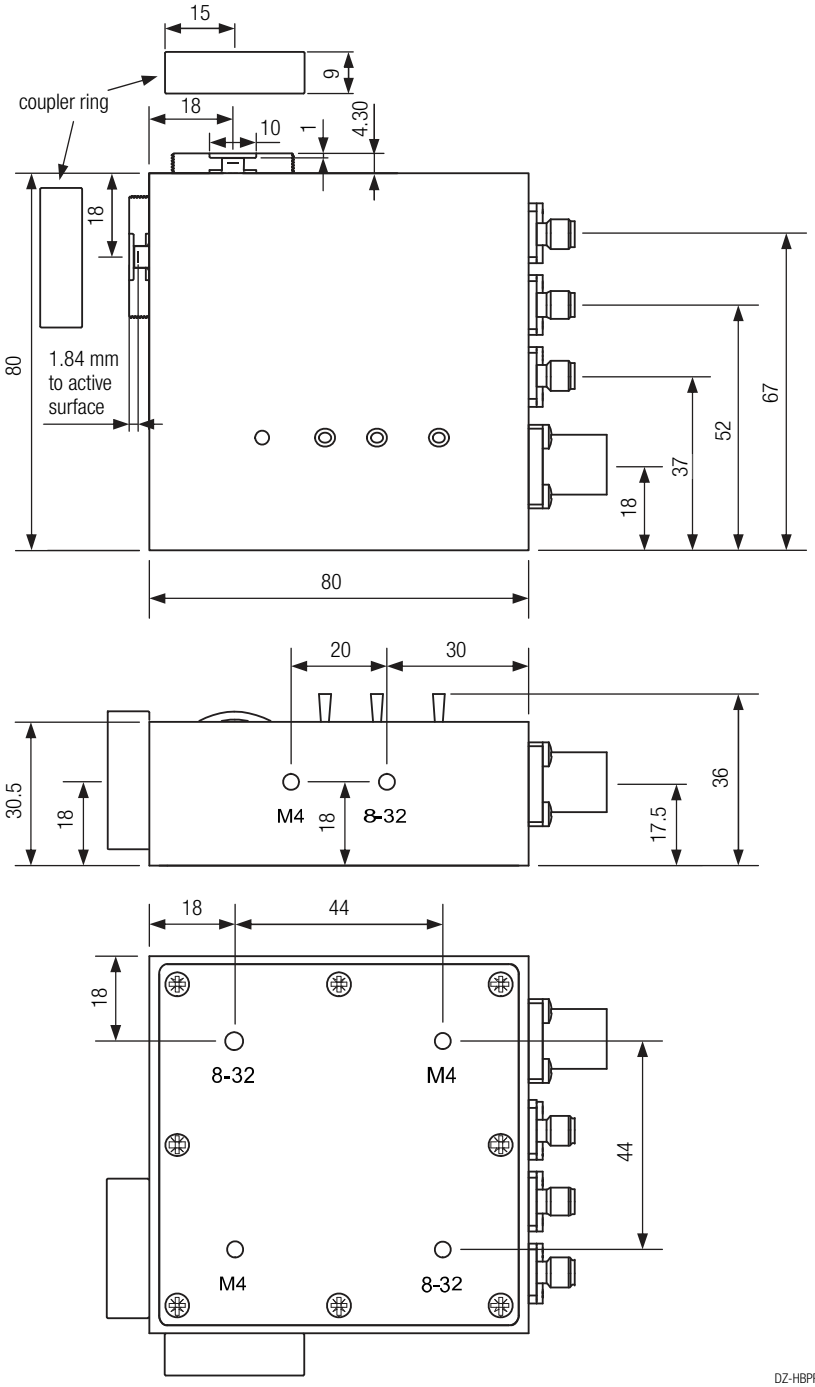


DB-Sens-HBPR-IN-FST_R2

High-Speed Balanced Photoreceiver

Dimensions

HBPR-100M-60K-IN-FST



DZ-HBPR_FST_R2

all dimensions in mm unless otherwise noted

The bottom plate may be rotated to match the appropriate mounting thread to the optical axis by unscrewing the 8 screws.

FEMTO Messtechnik GmbH
Klosterstr. 64
10179 Berlin · Germany
Phone: +49 30 280 4711-0
Fax: +49 30 280 4711-11
Email: info@femto.de
www.femto.de