

# High-Speed Balanced Photoreceiver



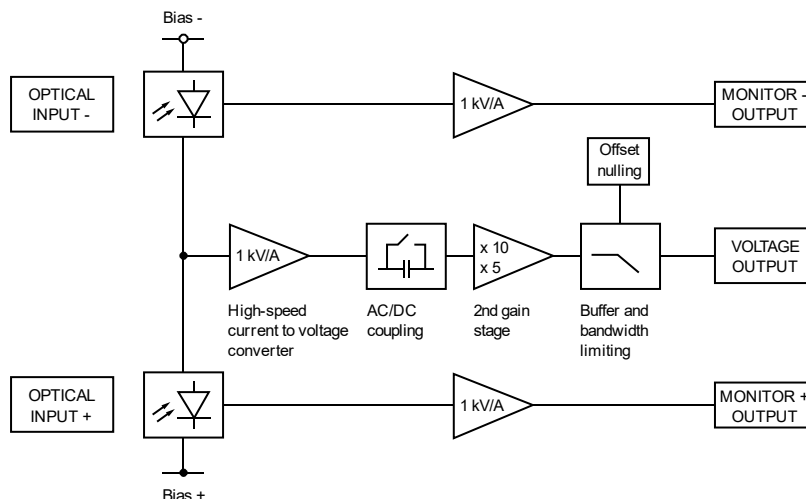
Features

- Bandwidth DC to 500 MHz
- Common-Mode Rejection Ratio (CMRR) 40 dB typ.
- SI-PIN detectors, 0.4 mm active diameter
- Spectral range 320 - 1000 nm
- Very low NEP, down to 12 pW/√Hz
- Transimpedance gain switchable  $5 \times 10^3$  V/A,  $10 \times 10^3$  V/A
- High dynamic input range up to  $2 \times 10$  mW balanced optical power
- Fast monitor outputs with 10 MHz bandwidth and  $1 \times 10^3$  V/A gain
- Switchable low pass filter for minimizing wideband noise
- Free-space input 1.035"-40 threaded, alternatively 25 mm diameter unthreaded
- Easily convertible to fiber optic input (FC and FSMA) with optionally available screw-on adapters
- 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



# High-Speed Balanced Photoreceiver

Available Input Versions

HBPR-500M-10K-SI-FST



Picture shows two 1.035"-40 threaded flanges with internally threaded coupler rings mounted (outer diameter 30 mm)

1.035"-40 threaded flange for free space applications, compatible with many optical standard accessories.

Optional: Fiber adapters PRA-FC, PRA-FCA, PRA-FSMA



HBPR-500M-10K-SI-FS



25 mm dia. unthreaded flange 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.

Example: FC input



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

See further information and separate datasheets on [www.femto.de](http://www.femto.de)

Available Accessories

PRA-FC  
PRA-FCA  
PRA-FSMA



fiber-adapter with external 1.035"-40 thread (suitable for FST models only)

PS-15



power supply, input: 100 - 240 VAC, output: ±15 VDC, +400/-250 mA

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Specifications	Test conditions	$V_S = \pm 15\text{ V}$ , $T_A = 25\text{ }^\circ\text{C}$ , signal output terminated with $50\ \Omega$ , Monitor outputs terminated with $1\ \text{M}\Omega$
Gain	Transimpedance gain	$5 \times 10^3\ \text{V/A}$ (2 <sup>nd</sup> gain x5), $10 \times 10^3\ \text{V/A}$ (2 <sup>nd</sup> gain x10) switchable (@ $50\ \Omega$ load)
	Gain accuracy	$\pm 1\%$ electrical
	Conversion gain	$2.55 \times 10^3\ \text{V/W}$ typ. (@ 2 <sup>nd</sup> gain x5, 760 nm) $5.1 \times 10^3\ \text{V/W}$ typ. (@ 2 <sup>nd</sup> gain x10, 760 nm)
	Common mode rejection ratio (CMRR)	50 dB typ. ( $f \leq 100\ \text{MHz}$ ) 40 dB typ. ( $f \leq 500\ \text{MHz}$ )
Frequency Response	Lower cut-off frequency	DC / 10 Hz, switchable
	Upper cut-off frequency	500 MHz (@ 2 <sup>nd</sup> gain x5); 460 MHz (@ 2 <sup>nd</sup> gain x10), switchable to 20 MHz
Time Response	Rise/fall time (10 % - 90 %)	0.85 ns (@ 2 <sup>nd</sup> gain x5); 0.95 ns (@ 2 <sup>nd</sup> gain x10) 17.5 ns (low pass filter 20 MHz)
Input	Noise equivalent power (NEP)	minimum $12\ \text{pW}/\sqrt{\text{Hz}}$ (@ 760 nm) $13\ \text{pW}/\sqrt{\text{Hz}}$ (@ 760 nm, 20 MHz) $29\ \text{pW}/\sqrt{\text{Hz}}$ (@ 760 nm, 200 MHz) $60\ \text{pW}/\sqrt{\text{Hz}}$ (@ 760 nm, 500 MHz)
	Maximum differential CW power for linear amplification	$400\ \mu\text{W}$ (@ 2 <sup>nd</sup> gain x5, DC-coupled, 760 nm) $200\ \mu\text{W}$ (@ 2 <sup>nd</sup> gain x10, DC-coupled, 760 nm) $2.5\ \text{mW}$ (@ AC-coupled, 760 nm)
	Max. optical CW balanced power (common mode power)	10 mW (on each photodiode, @ 760 nm)
	Monitor optical saturation power (limited by Maximum Rating)	12 mW (@ 760 nm)
Detector	Detector	SI-PIN photodiode
	Active area	$\varnothing 400\ \mu\text{m}$
	Spectral range	320 - 1000 nm
	Sensitivity	$0.51\ \text{A/W}$ typ. (@ 760 nm)
Signal Output	Output voltage range	$\pm 1.0\ \text{V}$ (@ $50\ \Omega$ load) for linear operation and low harmonic distortion
	Max. output voltage	$\pm 2.0\ \text{V}$ (@ $50\ \Omega$ load)
	Offset voltage compensation	$\pm 100\ \text{mV}$ typ., adjustable by offset potentiometer
	Output impedance	$50\ \Omega$ (terminate with $50\ \Omega$ load)
	Slew rate	$2800\ \text{V}/\mu\text{s}$
	Max. output current	70 mA
	Output return loss S22	$-30\ \text{dB}$ @ $< 100\ \text{MHz}$ $-20\ \text{dB}$ @ $< 800\ \text{MHz}$
	Output noise	$2.5\ \text{mV}_{\text{RMS}}$ ( $16\ \text{mV}_{\text{PP}}$ ) (@ 2 <sup>nd</sup> gain x5) $4.1\ \text{mV}_{\text{RMS}}$ ( $27\ \text{mV}_{\text{PP}}$ ) (@ 2 <sup>nd</sup> gain x10) $0.25\ \text{mV}_{\text{RMS}}$ ( $1.7\ \text{mV}_{\text{PP}}$ ) typ. (@ 2 <sup>nd</sup> gain x5, BW: 20 MHz) $0.4\ \text{mV}_{\text{RMS}}$ ( $2.5\ \text{mV}_{\text{PP}}$ ) typ. (@ 2 <sup>nd</sup> gain x10, BW: 20 MHz) (@ $50\ \Omega$ load, no signal on detectors, measurement bandwidth 2 GHz)

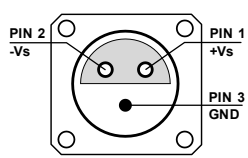
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### Specifications (Continued)

Monitor Outputs	Monitor output gain	$1 \times 10^3$ V/A (@ $\geq 100$ k $\Omega$ load)
	Monitor output voltage range	0 ... +10 V (@ $\geq 100$ k $\Omega$ load)
	Monitor output impedance	50 $\Omega$ (terminate with $\geq 100$ k $\Omega$ load)
	Monitor output max. output current	30 mA typ.
	Monitor output bandwidth	DC ... 10 MHz
	Monitor output noise	0.6 mV <sub>RMS</sub> (4 mV <sub>PP</sub> ) (@ 100 k $\Omega$ load, no signal on detectors, measurement bandwidth 200 MHz)
	Input Flange	Material
Coupler Ring (FST version only)	Material	1.4305 stainless steel, glass bead blasted
Power Supply	Supply voltage	$\pm 15$ V ( $\pm 14.5$ V ... $\pm 16.5$ V)
	Supply current	-90 / +120 mA (depends on operating conditions, recommended power supply capability min. $\pm 200$ mA)
Case	Weight	410 g (0.9 lbs)
	Material	AlMg3Mn, nickel-plated
Temperature Range	Storage temperature	-40 ... +85 °C
	Operating temperature	0 ... +60 °C

Absolute Maximum Ratings	Max. CW power (averaged)	12 mW (on each photodiode)
	Power supply voltage	$\pm 20$ V

Connectors	Input	FS version	25 mm dia. unthreaded flange for free space applications
		FST version	1.035"-40 threaded flange for free space applications and for use with various types of optical standard accessories
	Output	SMA jack (female)	
	Power supply	Lemo® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52)	



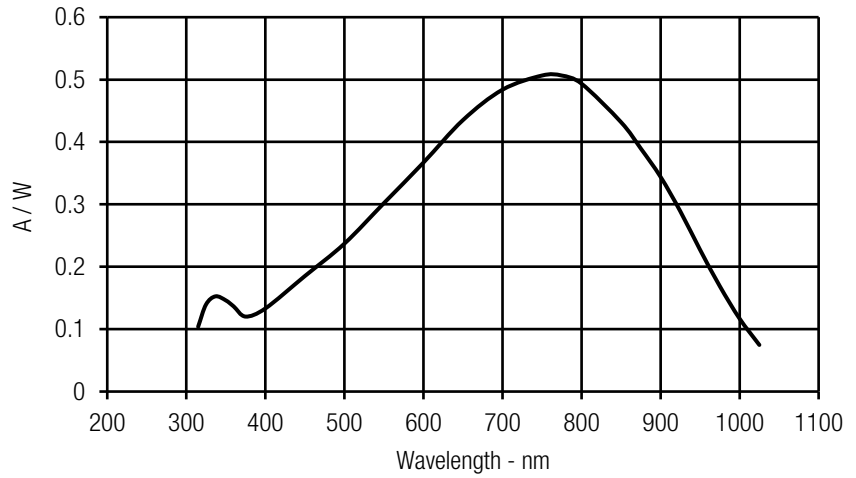
PIN 1: +15 V  
PIN 2: -15 V  
PIN 3: GND

Scope of Delivery	HBPR-500M-10K-SI, 2 x threaded coupler ring (FST version only), Lemo® 3-pin connector, 3 x adapter SMA (male) to BNC (female), datasheet	
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Ordering Information	HBPR-500M-10K-SI-FS	25 mm dia. unthreaded flange for free space applications
	HBPR-500M-10K-SI-FST	1.035"-40 threaded flange for free space applications and for use with various types of optical standard accessories

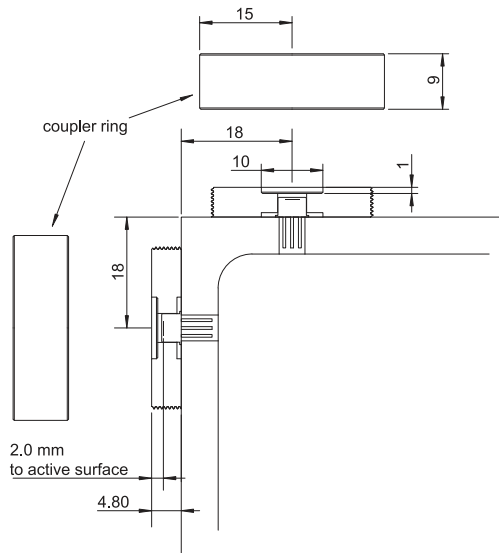
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Spectral Responsivity

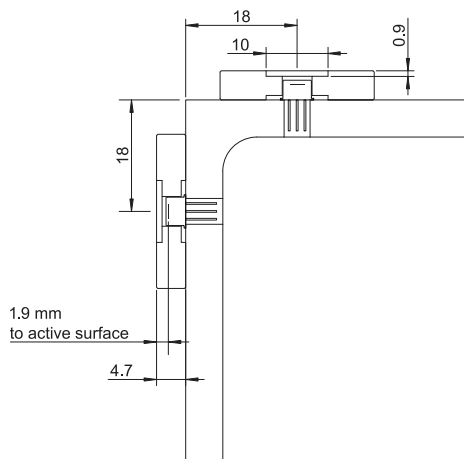


Detector Position

HBPR-500M-10K-SI-FST (1.035"-40 threaded free space input)



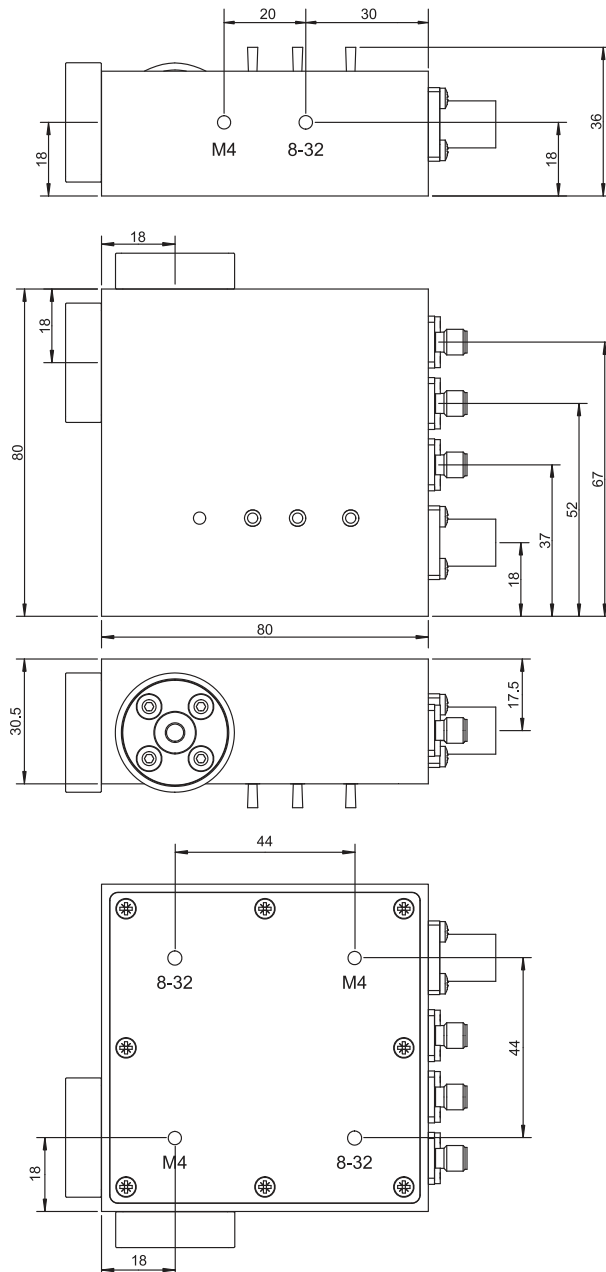
HBPR-500M-10K-SI-FS (25 mm dia. unthreaded free space input)



# High-Speed Balanced Photoreceiver

Dimensions

Case dimensions for HBPR-500M-10K-SI (FS/FST model):



All measures 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

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