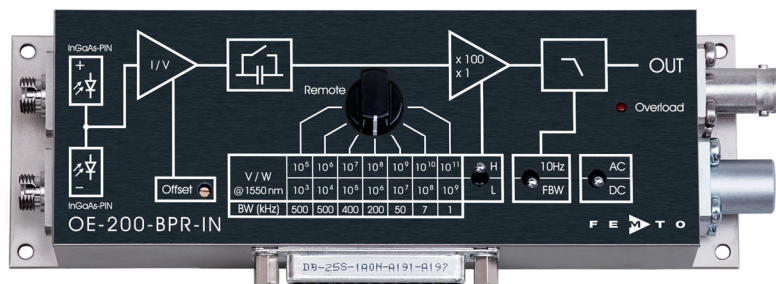


Variable Gain Balanced Photoreceiver



The picture shows model OE-200-BPR-IN-FC

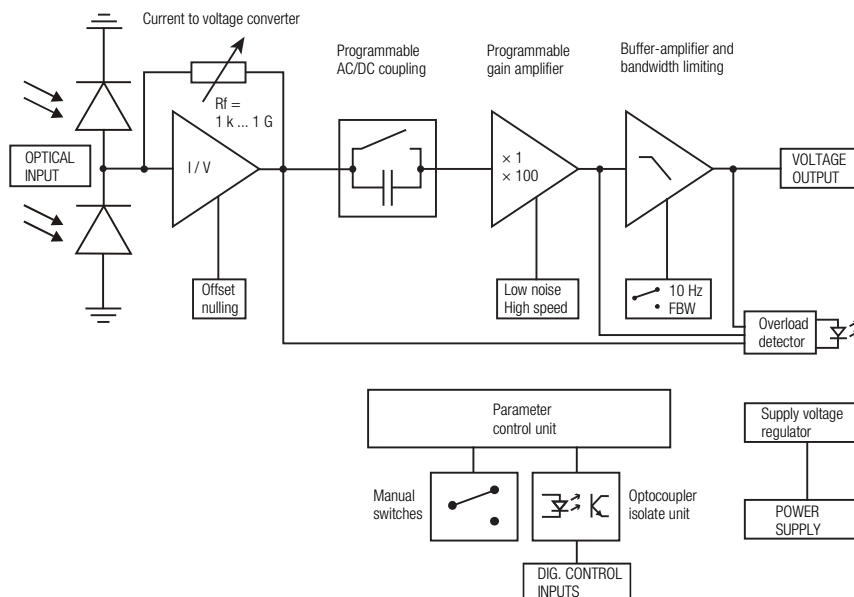
Features

- **Balanced InGaAs-PIN detectors, active diameter 80 μm, integrated ball lens**
- **Common-Mode Rejection Ratio (CMRR) 50 dB typ.**
- **Spectral range 900 - 1700 nm**
- **Very low noise, NEP down to 6 fW/√Hz**
- **Bandwidth up to 500 kHz**
- **Conversion gain adjustable from 1 x 10³ up to 1 x 10¹¹ V/W**
- **FC Fiber optic inputs**
- **Factory calibrated at 1550 nm**
- **Full manual and remote control capability**

Applications



- **Heterodyne detection**
- **Spectroscopy**
- **Differential optical front-end for oscilloscopes, spectrum analyzers, A/D converters and lock-in amplifiers**

Block Diagram



BS01-OE-200-BPR_R1

Variable Gain Balanced Photoreceiver

Intended Use	<p>The OE-200-BPR-IN is a low-noise, balanced variable gain photoreceiver. It is designed for fast and precise conversion of the difference between optical signals into equivalent output voltages. Operation is largely self-explanatory. If in doubt, consult this document or contact support@femto.de.</p> <p>For safe operation, please refer to the damage thresholds specified in the "Absolute Maximum Ratings", "Temperature Range" and "Power Supply" sections of this document.</p> <p>The operating environment must be free of smoke, dust, grease, oil, condensing moisture, and other contaminants that could affect the operation or performance.</p>																									
Related balanced Model	OE-200-BPR-SI-FC	Balanced Si-PIN, Ø 1.2 mm, 320 - 1060 nm, conversion gain calibrated at 850 nm, 2 × FC fiber connectors (fix/permanent)																								
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Available Accessories	<p>PRA-PAP</p>  <p>PS-15-25-L</p> 	<p>Alternative mounting option: post adapter plate, easy to mount on FEMTO photoreceiver series OE, FWPR, PWPR, HCA-S and LCA-S</p> <p>Power Supply input: 100 – 240 VAC output: ±15 VDC</p>																								

Variable Gain Balanced Photoreceiver

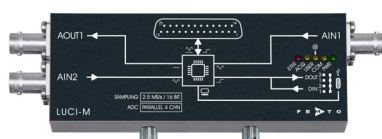
Available Accessories
(continued)

LUCI-10



Compact digital I/O interface for USB remote control, supports opto-isolation of amplifier signal path from PC USB port, 16 digital outputs, 3 opto-isolated digital inputs, bus-powered operation

LUCI-M



Compact, universal USB system for data acquisition (DAQ) and control, up to 4 parallel 16 bit ADC channels with 2.5 MS/s, 3 12 bit DAC channels, 24 digital I/O s galvanic isolation from computer

Specifications

Test conditions

$V_S = \pm 15\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, output load impedance $1\text{ M}\Omega$, warm-up 20 minutes (min. 10 minutes recommended)

Gain

Conversion gain

$1 \times 10^3 \dots 1 \times 10^{11}\text{ V/W}$ (@ 1550 nm, output load $\geq 100\text{ k}\Omega$)

Gain accuracy

$\pm 1\%$ electrical, between settings

Conversion gain accuracy

$\pm 5\%$ (@ $P_{OPT} \leq 1\text{ mW}$, 1550 nm) guaranteed by factory calibration*

* factory verified with SM 9/125, FC/APC, NA 0.13 (when using FC/PC fiber connector, coupling efficiency may differ slightly.) Coupling efficiency depends on fiber type, fibers with core diameter larger than $62.5\text{ }\mu\text{m}$ will significantly reduce the coupling efficiency

Gain drift

see table below

Frequency Response

Lower cut-off frequency

DC / 1 Hz, switchable

Upper cut-off frequency (-3 dB)

up to 500 kHz (see table below), switchable to 10 Hz

Input

Input offset current (dark current)

2 pA typ for each photo diode.

Common mode rejection

50 dB typ.

Input offset compensation range

$\pm 600\text{ pA}$, adjustable by offset potentiometer or $\pm 400\text{ pA}$, adjustable by external control voltage

Input offset drift

see table below

Noise equivalent power (NEP)

see table below

Max. differential CW power

see table below

Max. optical CW balanced power (common mode power)

10 mW (on each photodiode, @ 1550 nm)

Detector

Detector type

InGaAs-PIN photodiode

Active area

$\varnothing 80\text{ }\mu\text{m}$, integrated ball lens

Spectral range

900 - 1700 nm

Sensitivity

0.89 A/W (@ 1310 nm) , 0.97 A/W (@ 1550 nm)

Output

Output voltage

$\pm 10\text{ V}$ (@ $\geq 100\text{ k}\Omega$ output load)

Output impedance

$50\text{ }\Omega$ (terminate with $\geq 10\text{ k}\Omega$ load)

Max. output current

$\pm 30\text{ mA}$ (short-circuit proof)

Variable Gain Balanced Photoreceiver

Specifications (continued)

Performance depending on Gain Setting

Gain setting (low noise) (V/W)**	10 ³	10 ⁴	10 ⁵	10 ⁶	10 ⁷	10 ⁸	10 ⁹
Upper cut-off frequency (-3 dB)	500 kHz	500 kHz	400 kHz	200 kHz	50 kHz	7 kHz	1.1 kHz
Rise/fall time (10 % - 90 %)	700 ns	700 ns	900 ns	1.8 μs	7 μs	50 μs	300 μs
NEP (√/Hz)**	21 pW	2.4 pW	510 fW	130 fW	44 fW	14 fW	6 fW
Measured at	10 kHz	10 kHz	10 kHz	1 kHz	1 kHz	100 Hz	100 Hz
Integr. input noise (RMS)***	29 nW	3.3 nW	635 pW	170 pW	51 pW	6.7 pW	1.1 pW
Input offset drift (/°C)**	40 nW	4 nW	0.4 nW	34 pW	3.4 pW	0.5 pW	0.4 pW
Gain drift (/°C)	0.008%	0.008%	0.008%	0.01%	0.01%	0.01%	0.02%
Optical CW saturation power**	2 mW	1 mW	0.1 mW	10 μW	1 μW	0.1 μW	10 nW
Gain setting (high speed) (V/W)**	10 ⁵	10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	10 ¹¹
Upper cut-off frequency (-3 dB)	500 kHz	500 kHz	400 kHz	200 kHz	50 kHz	7 kHz	1.1 kHz
Rise/fall time (10 % - 90 %)	700 ns	700 ns	900 ns	1.8 μs	7 μs	50 μs	300 μs
NEP (√/Hz)**	13 pW	1.8 pW	450 fW	130 fW	45 fW	15 fW	6 fW
Measured at	10 kHz	10 kHz	10 kHz	1 kHz	1 kHz	100 Hz	100 Hz
Integr. input noise (RMS)***	13 nW	1.9 nW	510 pW	150 pW	46 pW	6.4 pW	1.1 pW
Input offset drift (/°C)**	40 nW	4 nW	0.4 nW	34 pW	3.4 pW	0.5 pW	0.4 pW
Gain drift (/°C)	0.008%	0.008%	0.008%	0.01%	0.01%	0.01%	0.02%
Optical CW saturation power**	0.1 mW	10 μW	1 μW	0.1 μW	10 nW	1 nW	0.1 nW

**referred to 1550 nm

*** The integrated input noise is measured with a shaded input in the full bandwidth ("FBW") setting (referred to 1550 nm).

The input referred peak-peak noise can be calculated from the RMS noise as follows:

$$P_{\text{Input noise peak-to-peak}} = P_{\text{Input noise RMS}} \times 6$$

The output noise is given by:

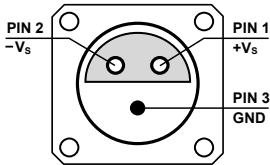
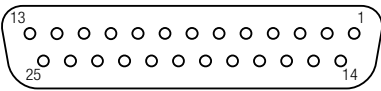
$$U_{\text{Output noise RMS}} = P_{\text{Input noise RMS}} \times \text{gain}$$

$$U_{\text{Output noise peak-to-peak}} = U_{\text{Output noise RMS}} \times 6 = P_{\text{Input noise RMS}} \times \text{gain} \times 6$$

The integrated noise will be reduced considerably by setting the low pass filter to "10 Hz" instead of "FBW".

Indicator LED	Function	overload
Digital Control	Control input voltage range	LOW bit: -0.8 V ... +1.2 V, HIGH bit: +2.3 V ... +12 V
	Control input current	0 mA @ 0 V, 1.5 mA @ +5 V, 4.5 mA @ +12 V
	Overload output	non active: <0.4 V @ 0 ... -1 mA active: typ. 5 ... 5.1 V @ 0 ... 2 mA
Ext. Offset Control	Control voltage range	±10 V
	Offset control input impedance	20 kΩ
	Conversion factor	40 pA/V
Optical Input Connector	Material FC receptacle	nickel silver
Power Supply	Supply voltage	±15 V (±14.75 V ... ±16.5 V)
	Supply current	±110 / -80 mA typ. (depends on operating conditions, recommended power supply capability min. ±200 mA)
Case	Weight	360 g (0.79 lbs)
	Material	AlMg4.5Mn, nickel-plated
Temperature Range	Storage temperature	-40 °C ... +80 °C
	Operating temperature	0 °C ... +60 °C

Variable Gain Balanced Photoreceiver

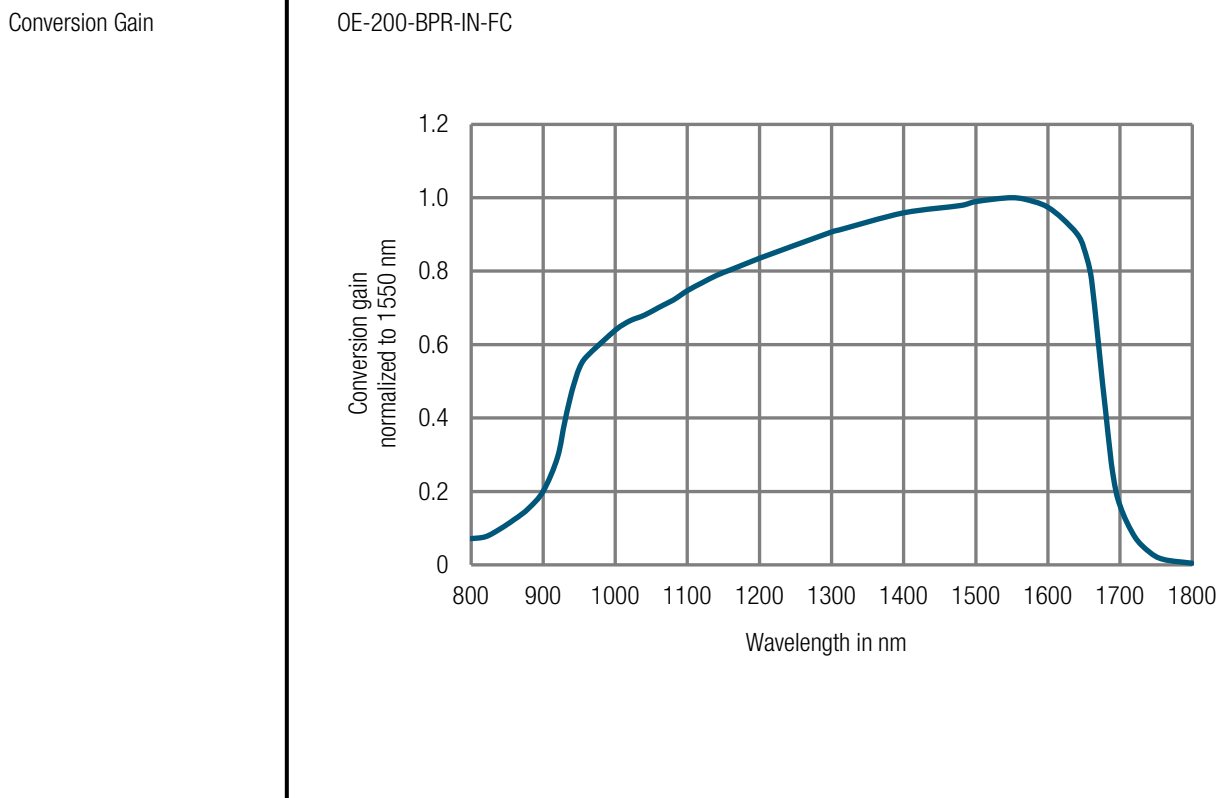
<p>Absolute Maximum Ratings (Damage Threshold)</p>	<p>Optical input power (CW) 20 mW for each photodiode Digital control input voltage $-5\text{ V}/+16\text{ V}$ relative to digital ground DGND (pin 9) Analog control input voltage $\pm 15\text{ V}$ relative to analog ground AGND (pin 3) Power supply voltage $\pm 20\text{ V}$</p>
<p>Connectors</p>	<p>Input $2 \times$ FC fiber optic connectors Output BNC jack (female) Power supply LEMO® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52)</p> <div style="text-align: center;">  <p style="margin-left: 100px;">Pin 1: +15 V Pin 2: -15 V Pin 3: GND</p> </div> <p>Control port</p> <div style="text-align: center;">  </div> <p>Pin 1: +12 V (stabilized power supply output*) Pin 2: -12 V (stabilized power supply output*) Pin 3: AGND (analog ground) Pin 4: +5 V (stabilized power supply output*) Pin 5: digital output: overload (referred to pin 3) Pin 6: signal output (connected to BNC) Pin 7: NC Pin 8: input offset control voltage Pin 9: DGND (ground for digital control pins 10 - 14) Pin 10: digital control input: gain, LSB Pin 11: digital control input: gain Pin 12: digital control input: gain, MSB Pin 13: digital control input: AC/DC Pin 14: digital control input: high speed / low noise Pin 15 - 25: NC</p> <p>*stabilized power supply output current $\pm 12\text{ V}$: max. $\pm 50\text{ mA}$, $+5\text{ V}$: max. 30</p>

Variable Gain Balanced Photoreceiver

Remote Control Operation	General	<p>Remote control input bits are opto-isolated and connected by logical OR function to local switch settings. For remote control set the corresponding local switches to "Remote", "AC" and "H" (High speed) and select the wanted setting via a bit code at the corresponding digital inputs.</p> <p>Mixed operation, e.g. local gain setting and remote controlled AC/DC setting, is also possible.</p> <p>Switch setting "FBW / 10 Hz" of the low pass signal filter is not remote controllable.</p>																																													
	Gain setting	<p>Low noise High speed</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Pin 14=HIGH</th> <th style="text-align: left;">Pin 14=LOW</th> <th style="text-align: left;">Pin 12</th> <th style="text-align: left;">Pin 11</th> <th style="text-align: left;">Pin 10</th> </tr> <tr> <th style="text-align: left;">Gain (V/W)</th> <th style="text-align: left;">Gain (V/W)</th> <th style="text-align: left;">MSB</th> <th style="text-align: left;">LSB</th> <th style="text-align: left;">LSB</th> </tr> </thead> <tbody> <tr> <td>10³</td> <td>10⁵</td> <td>LOW</td> <td>LOW</td> <td>LOW</td> </tr> <tr> <td>10⁴</td> <td>10⁶</td> <td>LOW</td> <td>LOW</td> <td>HIGH</td> </tr> <tr> <td>10⁵</td> <td>10⁷</td> <td>LOW</td> <td>HIGH</td> <td>LOW</td> </tr> <tr> <td>10⁶</td> <td>10⁸</td> <td>LOW</td> <td>HIGH</td> <td>HIGH</td> </tr> <tr> <td>10⁷</td> <td>10⁹</td> <td>HIGH</td> <td>LOW</td> <td>LOW</td> </tr> <tr> <td>10⁸</td> <td>10¹⁰</td> <td>HIGH</td> <td>LOW</td> <td>HIGH</td> </tr> <tr> <td>10⁹</td> <td>10¹¹</td> <td>HIGH</td> <td>HIGH</td> <td>LOW</td> </tr> </tbody> </table>	Pin 14=HIGH	Pin 14=LOW	Pin 12	Pin 11	Pin 10	Gain (V/W)	Gain (V/W)	MSB	LSB	LSB	10 ³	10 ⁵	LOW	LOW	LOW	10 ⁴	10 ⁶	LOW	LOW	HIGH	10 ⁵	10 ⁷	LOW	HIGH	LOW	10 ⁶	10 ⁸	LOW	HIGH	HIGH	10 ⁷	10 ⁹	HIGH	LOW	LOW	10 ⁸	10 ¹⁰	HIGH	LOW	HIGH	10 ⁹	10 ¹¹	HIGH	HIGH	LOW
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Scope of Delivery	OE-200-BPR-IN-FC, LEMO® 3-pin connector, datasheet, transport package
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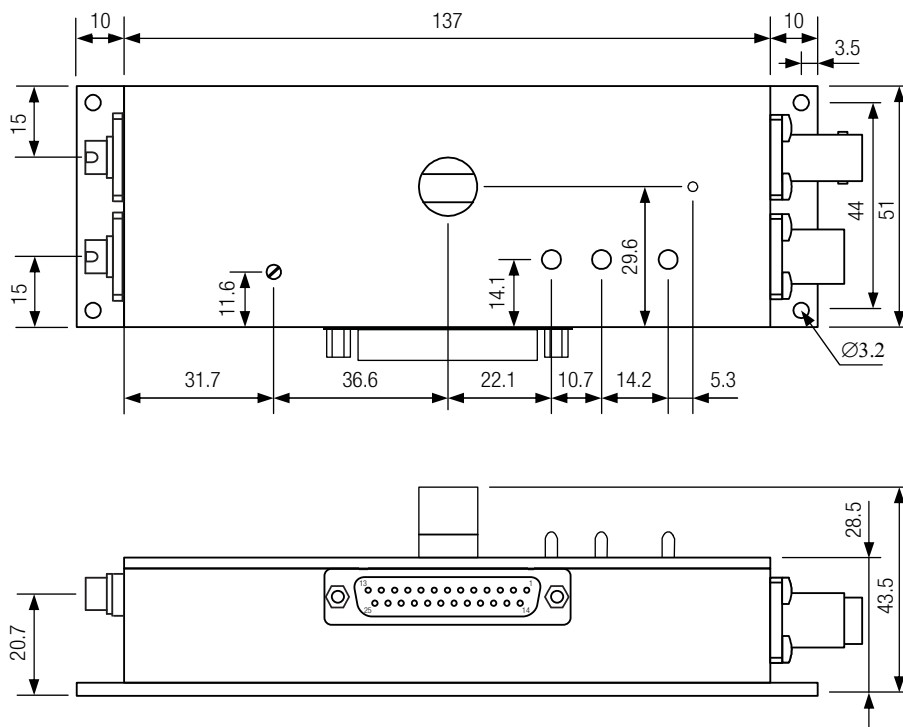
Ordering Information	OE-200-BPR-IN-FC	Balanced photoreceiver, 2 × FC fiber optic connectors (fix/permanent, FC/PC and FC/APC compatible).
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Variable Gain Balanced Photoreceiver

Dimensions

OE-200-BPR-IN-FC



DZ-OE-200-BPR-FC_R1

all dimensions in mm unless otherwise noted

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