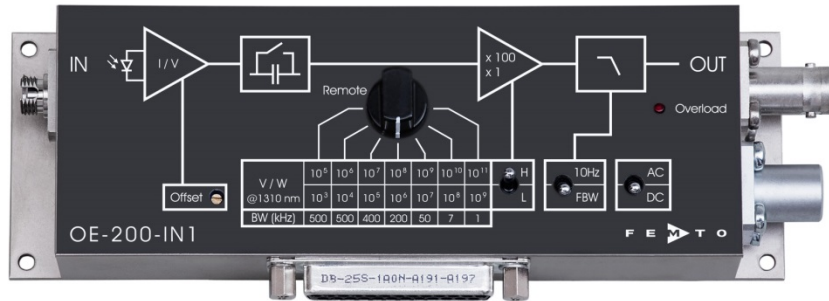


# Variable Gain Photoreceiver – Fast Optical Power Meter



The picture shows model OE-200-IN1-FC with fiber optic input.

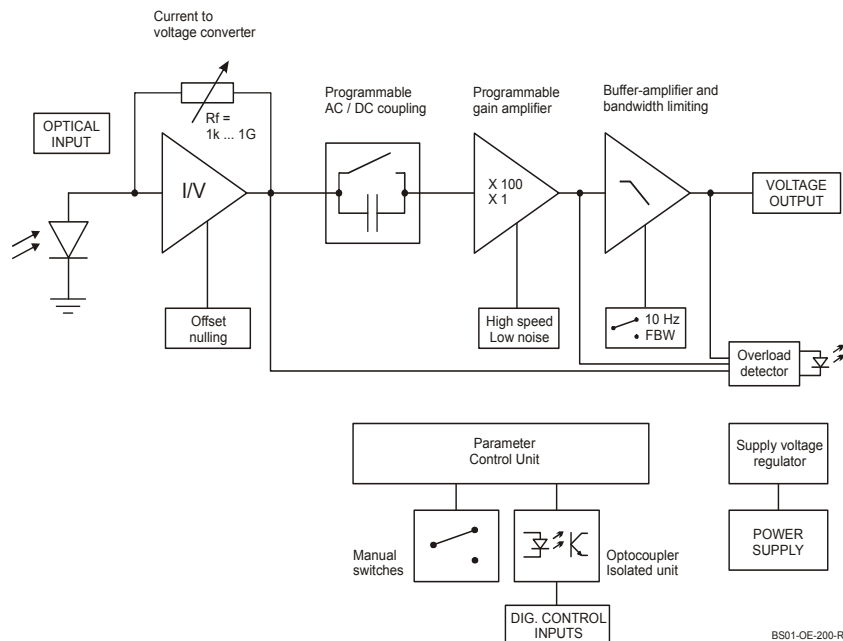
Features

- InGaAs-PIN detector, active diameter 0.3 mm (free space versions), 80 µm integrated ball lens (FC version)
- Spectral range 900 - 1700 nm
- Very low noise, NEP down to 7 fW/√Hz
- Bandwidth up to 500 kHz
- Conversion gain adjustable from 1 x 10<sup>3</sup> up to 1 x 10<sup>11</sup> V/W
- Optical free-space input 1.035"-40 threaded, alternatively 25 mm diameter unthreaded
- Fiber optic input available as permanently mounted FC-input (for calibrated precision measurements)
- Factory calibrated at 1310 nm (fiber optic FC version only)
- Full manual and remote control capability

Applications

- All-purpose very low-noise photoreceiver (O/E converter)
- Time resolved optical pulse and power measurements
- Optical front-end for oscilloscopes, spectrum analyzers, A/D converters and lock-in amplifiers
- Fast fiber optic power meter

Block Diagram



BS01-OE-200-R5

## Variable Gain Photoreceiver – Fast Optical Power Meter

Available Versions

OE-200-IN1-FST

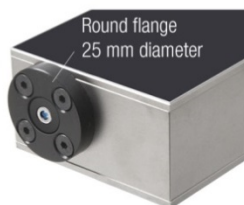


Internal threaded coupler ring with 30 mm outer diameter (included)

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

(Please note: Using the fiber-adapters PRA-FC and PRA-FSMA is not recommended as the small size of the active area can drastically reduce the coupling efficiency)

OE-200-IN1-FS



25 mm dia. unthreaded flange for free space applications compatible with many optical standard accessories.

OE-200-IN1-FC



fix/permanent FC fiber connector for highest coupling efficiency and best conversion gain accuracy ( $\pm 5\%$ )

Since illumination conditions with the permanently mounted fiber optic connector are well defined, the FC model is delivered with a factory calibrated conversion gain at 1310 nm.

The electro optical conversion gain factors of the FST and FS free space models are set to fit nominally at 1310 nm.

## Variable Gain Photoreceiver – Fast Optical Power Meter

Related OE-200 Models

@ 850 nm

See separate datasheets for following models on [www.femto.de](http://www.femto.de):

- OE-200-SI-FST                      Si-PIN, Ø 1.2 mm, 320 - 1060 nm  
free space input, 1.035"-40 threaded flange
- OE-200-SI-FS                      Si-PIN, Ø 1.2 mm, 320 - 1060 nm  
free space input, 25 mm dia. unthreaded flange
- OE-200-SI-FC                      Si-PIN, Ø 1.2 mm, 320 - 1060 nm  
FC fiber connector (fix/permanent)
- OE-200-UV-FST                    Si-PIN, 1.1 x 1.1 mm<sup>2</sup>, 190 - 1000 nm  
free space input, 1.035"-40 threaded flange
- OE-200-UV-FS                    Si-PIN, 1.1 x 1.1 mm<sup>2</sup>, 190 - 1000 nm  
free space input, 25 mm dia. unthreaded flange
- OE-200-UV-FC                    Si-PIN, 1.1 x 1.1 mm<sup>2</sup>, 190 - 1000 nm  
FC fiber connector (fix/permanent)

@ 1550 nm

- OE-200-IN2-FST                    InGaAs-PIN, Ø 300 µm, 900 - 1700 nm  
free space input, 1.035"-40 threaded flange
- OE-200-IN2-FS                    InGaAs-PIN, Ø 300 µm, 900 - 1700 nm  
free space input, 25 mm dia. unthreaded flange
- OE-200-IN2-FC                    InGaAs-PIN, integrated ball lens, 900 - 1700 nm  
FC fiber connector (fix/permanent)
- OE-200-S                            customized versions available on request

Available Accessories

PRA-PAP



post adapter plate, easy to mount on FEMTO photoreceiver series OE, FWPR, PWPR, HCA-S and LCA-S



PS-15-25-L



power supply, input: 100 - 240 VAC, output: ±15 VDC

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

## Variable Gain Photoreceiver – Fast Optical Power Meter

Specifications	<p>Test conditions <math>V_s = \pm 15\text{ V}</math>, <math>T_A = 25\text{ }^\circ\text{C}</math>, output load impedance <math>1\text{ M}\Omega</math></p>
Gain	<p>Conversion gain <math>1 \times 10^3 \dots 1 \times 10^{11}\text{ V/W}</math> (@ 1310 nm, output load <math>\geq 100\text{ k}\Omega</math>)</p> <p>Gain accuracy <math>\pm 1\%</math> electrical, between settings</p> <p>Conversion gain accuracy</p> <p style="margin-left: 20px;">OE-200-IN1-FST/FS (@ <math>P_{\text{OPT}} \leq 2\text{ mW}</math>, 1310 nm) free space <math>\pm 15\%</math></p> <p style="margin-left: 20px;">OE-200-IN1-FC (@ <math>P_{\text{OPT}} \leq 1\text{ mW}</math>, 1310 nm) fixed fiber input connector <math>\pm 5\%</math> guaranteed by factory calibration*</p> <p>* Factory verified with SM 9/125, FC/APC, NA 0.13 (when using FC/PC fiber connector, coupling efficiency may differ slightly). In general, coupling efficiency depends on fiber type. Standard SM 9/125 fibers with low numerical aperture (NA) are recommended. Fibers with core diameter larger than <math>62.5\text{ }\mu\text{m}</math> will significantly reduce the coupling efficiency.</p> <p>Gain drift see table below</p>
Frequency Response	<p>Lower cut-off frequency DC / 1 Hz, switchable</p> <p>Upper cut-off frequency (<math>-3\text{dB}</math>) up to 500 kHz (see table below), switchable to 10 Hz</p>
Detector	<p>Detector type InGaAs-PIN photodiode</p> <p>Active area <math>\varnothing 300\text{ }\mu\text{m}</math> (free space versions) <math>\varnothing 80\text{ }\mu\text{m}</math>, integrated ball lens (FC version)</p> <p>Spectral range 900 - 1700 nm</p> <p>Sensitivity 0.87 A/W (@ 1310 nm) 0.95 A/W (@ 1550 nm)</p>
Input	<p>Input offset current (dark current) 2 pA typ.</p> <p>Input offset drift see table below</p> <p>Input offset compensation range <math>\pm 600\text{ pA}</math>, adjustable by offset potentiometer or <math>\pm 400\text{ pA}</math>, adjustable by external control voltage</p> <p>Optical CW saturation power see table below</p> <p>Noise equivalent power (NEP) see table below</p>

## Variable Gain Photoreceiver – Fast Optical Power Meter

Specifications (continued)

Performance Depending  
on Gain Setting

Gain setting (low noise) (V/W)**	10 <sup>3</sup>	10 <sup>4</sup>	10 <sup>5</sup>	10 <sup>6</sup>	10 <sup>7</sup>	10 <sup>8</sup>	10 <sup>9</sup>
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)**	22 pW	2.7 pW	560 fW	170 fW	51 fW	16 fW	7 fW
Measured at	10 kHz	10 kHz	10 kHz	1 kHz	1 kHz	100 Hz	100 Hz
Integr. input noise (RMS)***	25 nW	3.2 nW	750 pW	200 pW	56 pW	8.3 pW	1.3 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 <sup>5</sup>	10 <sup>6</sup>	10 <sup>7</sup>	10 <sup>8</sup>	10 <sup>9</sup>	10 <sup>10</sup>	10 <sup>11</sup>
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)**	16 pW	2.2 pW	550 fW	170 fW	52 fW	16 fW	8 fW
Measured at	10 kHz	10 kHz	10 kHz	1 kHz	1 kHz	100 Hz	100 Hz
Integr. input noise (RMS)***	15 nW	2.2 nW	630 pW	180 pW	52 pW	7.5 pW	1.2 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 1310 nm

\*\*\* The integrated input noise is measured with a shaded input in the full bandwidth ("FBW") setting (referred to 1310 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:

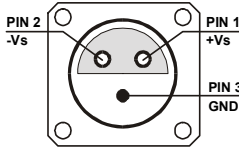
$$U_{\text{Output noise RMS}} = P_{\text{Input noise RMS}} \times \text{gain}$$

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

The integrated noise will be reduced considerably by setting the low pass filter to "10 Hz" instead of "FBW". This is especially useful for continuous wave (CW) measurements.

Output	Output voltage range	±10 V (@ ≥100 kΩ output load)
	Max. output current	±30 mA (short-circuit proof)
	Output impedance	50 Ω (terminate with ≥100 kΩ)
Indicator LED	Function	overload
Digital Control	Control input voltage range	LOW bit: -0.8 ... +1.2 V, HIGH bit: +2.3 ... +12 V
	Control input current	0 mA @ 0 V, 1.5 mA @ +5 V, 4.5 mA @ +12 V
	Overload output	nonactive: <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
Power Supply	Supply voltage	±15 V (±14.75 ... ±16.5 V)
	Supply current	+110/-80 mA (depends on operating conditions, recommended power supply capability min. ±200 mA)
	Stabilized power supply output	±12 V, max. 50 mA, +5 V, max. 30 mA
Case	Weight	360 g (0.79 lb)
	Material	AlMg4.5Mn, nickel-plated
Temperature Range	Storage temperature	-40 ... +80 °C
	Operating temperature	0 ... +60 °C

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Absolute Maximum Ratings	Optical input power (CW)	20 mW
	Digital control input voltage	–5 V/+16 V relative to digital ground DGND (pin 9)
	Analog control input voltage	±15 V relative to analog ground AGND (pin 3)
	Power supply voltage	±20 V
Connectors	Input	OE-200-IN1-FST      1.035"-40 threaded flange for free space applications
		OE-200-IN1-FS      25 mm unthreaded flange for free space applications
		OE-200-IN1-FC      FC fiber optic connector
	Output	BNC 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
		
	Control port	Sub-D 25-pin, female, qual. class 2 Pin 1: +12 V (stabilized power supply output) Pin 2: –12 V (stabilized power supply output) Pin 3: AGND (analog ground for pins 1 - 8) Pin 4: +5 V (stabilized power supply output) Pin 5: overload output: HIGH = 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
Scope of Delivery	OE-200-IN1, internally threaded coupler ring (FST version only), Lemo® 3-pin connector, datasheet, transport package	

## Variable Gain Photoreceiver – Fast Optical Power Meter

Remote Control Operation

General

Remote control input bits are opto-isolated and connected by a logical OR function to the local switch settings. For remote control set the corresponding local switches to “Remote”, “AC” and “H” and select the desired setting via a bit code at the corresponding digital inputs. Mixed operation, e.g. local AC/DC setting and remote controlled gain setting, is also possible. The switch setting “FBW / 10 Hz” of the low pass signal filter is not remote controllable.

Gain setting

Low noise Gain (V/W) Pin 14=HIGH	High speed Gain (V/W) Pin 14=LOW	Pin 12 MSB	Pin 11	Pin 10 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

Gain settling time

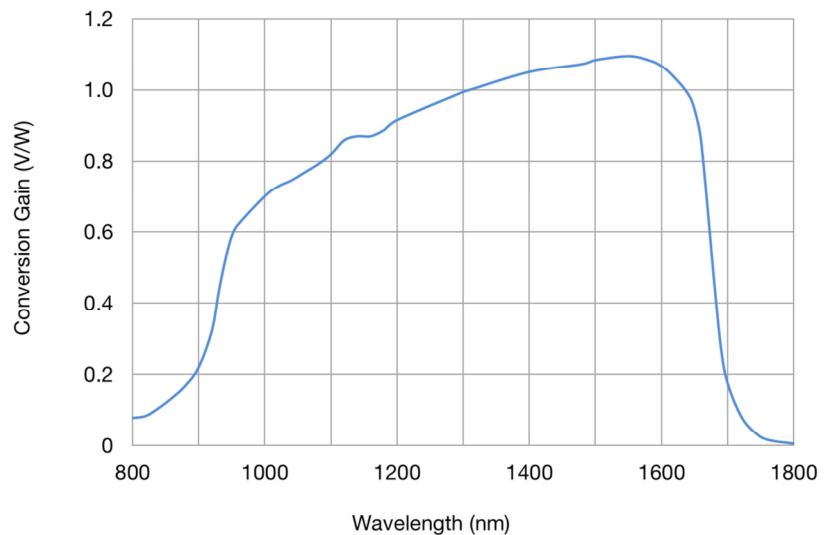
<150 ms

AC/DC setting

Coupling	Pin 13
AC	LOW
DC	HIGH

Conversion Gain

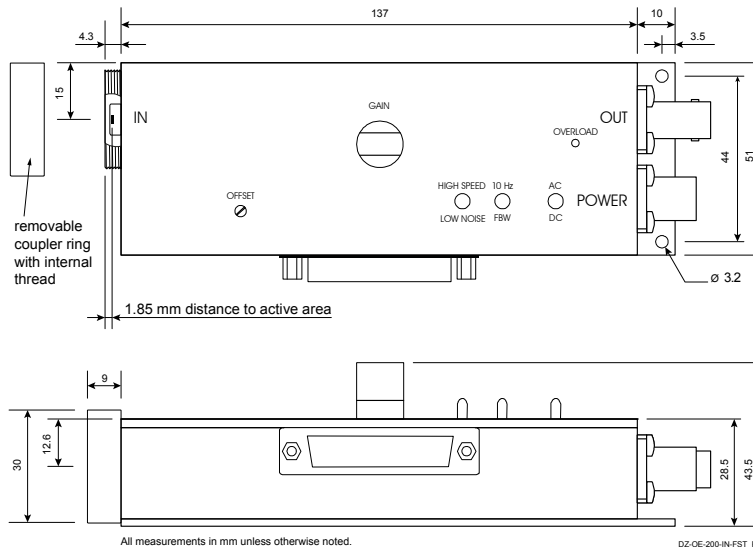
Normalized conversion gain



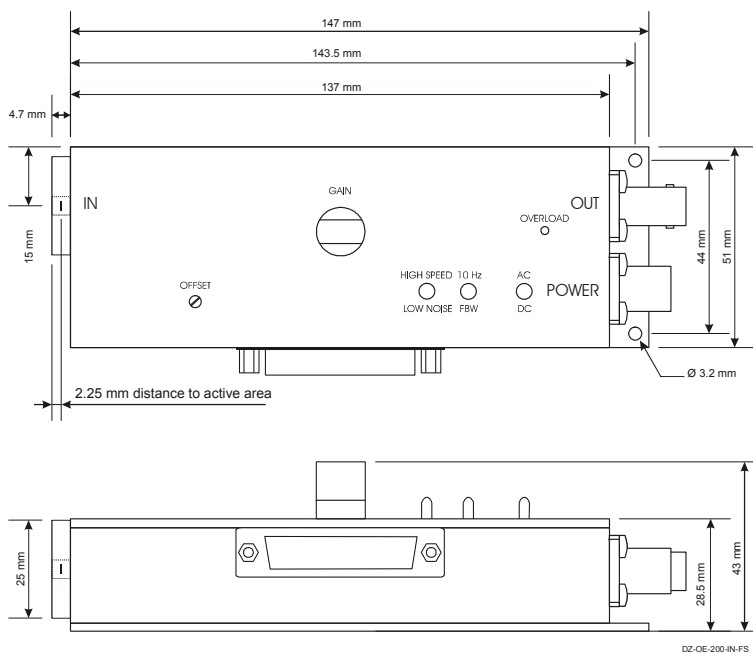
# Variable Gain Photoreceiver – Fast Optical Power Meter

Dimensions

OE-200-IN1-FST (1.035"-40 threaded free space input):



OE-200-IN1-FS (25 mm dia. unthreaded free space input):

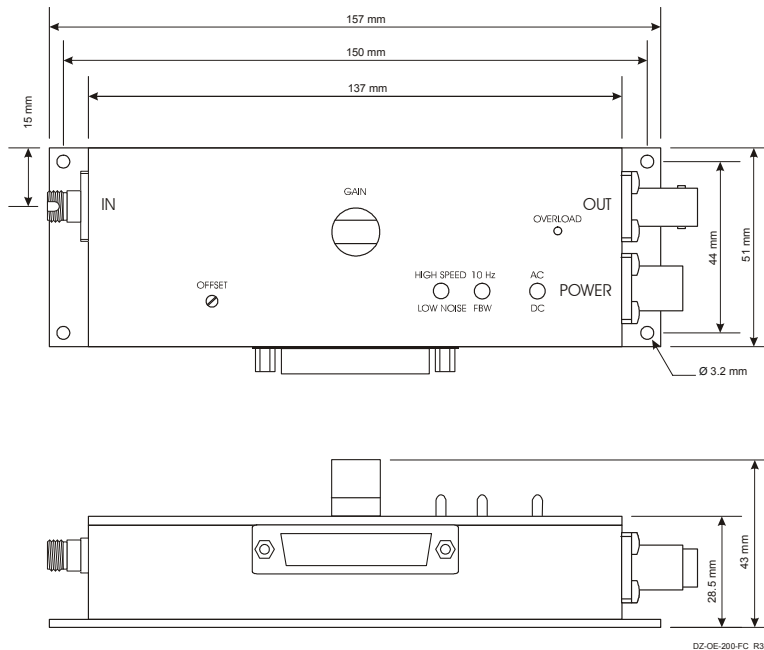




# Variable Gain Photoreceiver – Fast Optical Power Meter

Dimensions (continued)

OE-200-IN1-FC (FC fiber optic input):



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