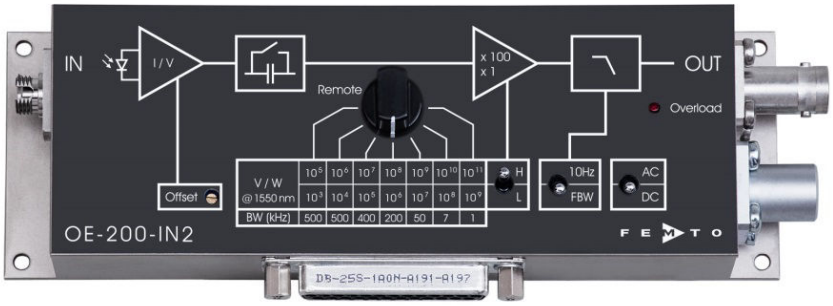
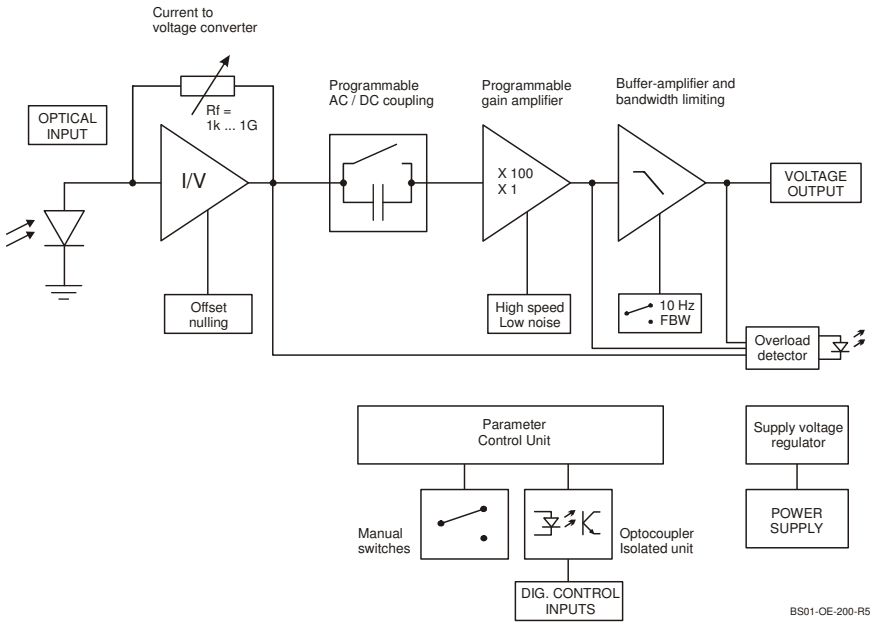
Variable Gain Photoreceiver - Fast Optical Power Meter



The picture shows model OE-200-IN2-FC with fiber optic input.

Features	• **Conversion gain switchable from 1 x 10^3 to 1 x 10^{11} V/W** • **InGaAs-PIN detector** • **Spectral range 900 - 1700 nm** • **Calibrated at 1550 nm (fiber optic "-FC" version only)** • **Bandwidth up to 500 kHz** • **Local and remote control**
Applications	• **Fast fiber optic power meter** • **Spectroscopy** • **General purpose opto-electronic measurements** • **Optical receiver for use with lock-in amplifiers**
Block Diagram	

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Specifications

Test conditions		$V_S = \pm 15$ V, $T_A = 25$ °C, load impedance 1 MΩ
Gain		
	Conversion gain	1×10^3 ... 1×10^{11} V/W (@ 1550 nm, load ≥ 100 kΩ)
	Gain accuracy	±1 % electrical, between settings
	Conversion gain accuracy	OE-200-IN2-FS: ±15 % electro-optical
	(@ $P_{OPT} \leq 2$ mW, @ 1550 nm)	OE-200-IN2-FC: ±5 % electro-optical (9/125 SM fiber)
	Gain drift	see table below
Frequency Response		
	Lower cut-off frequency	DC / 1 Hz, switchable
	Upper cut-off frequency	up to 500 kHz (see table below), switchable to 10 Hz
	Gain flatness	±0.1 dB
Input		
	Noise equivalent power (NEP)	see table below
	Max. CW saturation power	see table below
	Offset current compensation	±600 pA, adjustable by offset potentiometer or ±400 pA, adjustable by external control voltage
Detector		
	Detector	InGaAs-PIN photodiode
	Active area	∅ 300 µm (free space "-FS" version only)
	Spectral response	900 … 1700 nm
	Sensitivity	0.95 A/W (@ 1550 nm)
	Dark current	2 pA typ.

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, 1550 nm)	22 pW	2.5 pW	500 fW	150 fW	47 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)*	23 nW	2.8 nW	650 pW	180 pW	51 pW	7.5 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%
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, 1550 nm)	15 pW	2.0 pW	520 fW	150 fW	48 fW	15 fW	7 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	560 pW	160 pW	48 pW	7.2 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%
CW saturation power	0.1 mW	10 µW	1 µW	0.1 µW	10 nW	1 nW	0.1 nW

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

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Specifications (continued)

Output	Output voltage range	±10 V (@ ≥100 kΩ load)
	Output impedance	50 Ω (terminate with ≥100 kΩ load for best performance)
	Max. output current	±30 mA
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	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
Power Supply	Supply voltage	±15 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	320 g (0.74 lb.)
	Material	AlMg4.5Mn, nickel-plated
Temperature Range	Storage temperature	–40 ... +80 °C
	Operating temperature	0 ... +60 °C

Absolute Maximum Ratings	Max. CW power (averaged)	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

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Connectors

Input

OE-200-IN2-FS	25 mm round flange for free space applications
OE-200-IN2-FC	FC fiber optic receptacle

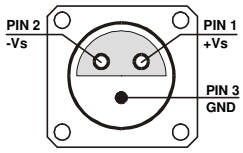
Output

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

Available Models

OE-200-IN2-FS	free space input, no calibration
OE-200-IN2-FC	FC fiber optic receptacle, calibrated at 1550 nm
OE-200-S	customized versions available on request

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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

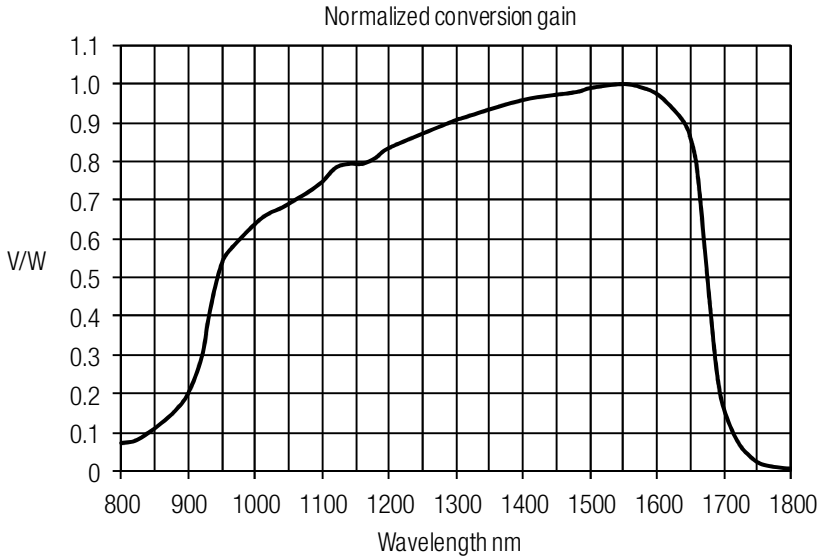
Gain settling time

<150 ms

AC/DC setting

Coupling	Pin 13
AC	LOW
DC	HIGH

Spectral Response



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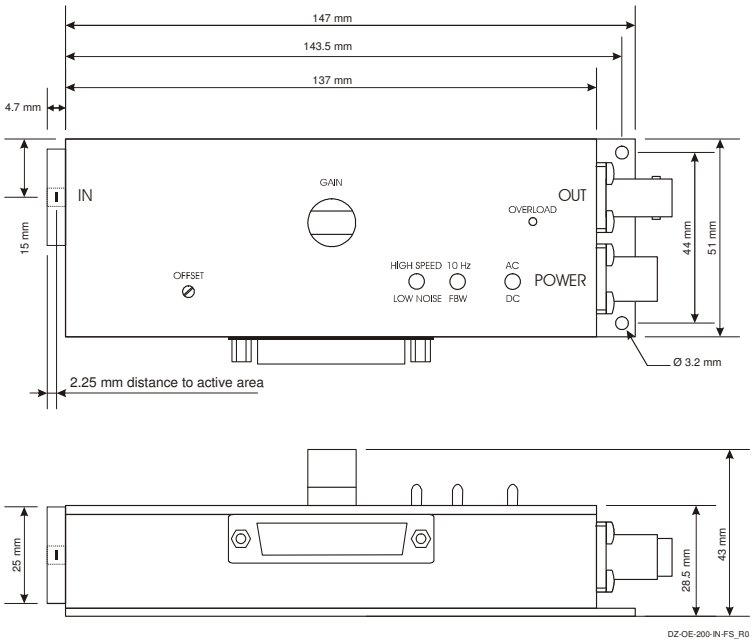
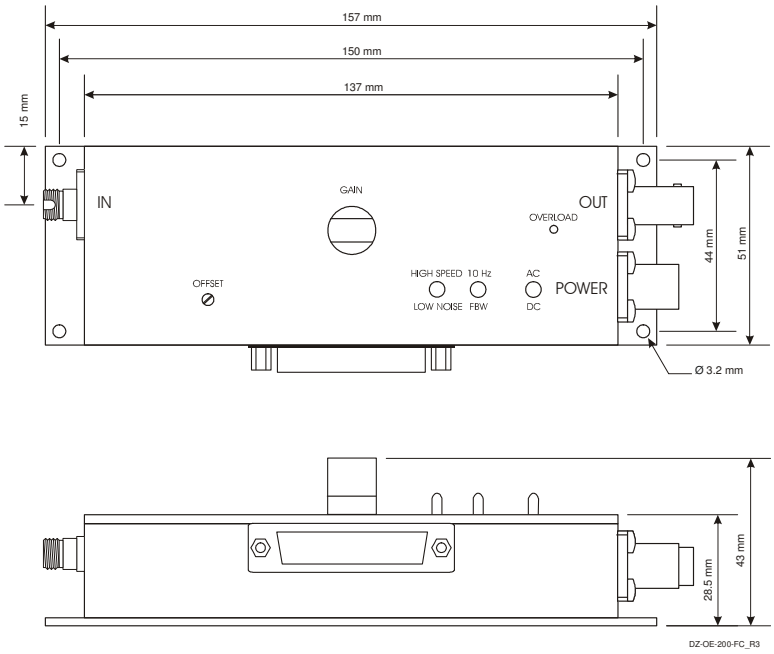
Dimensions

OE-200-IN2-FS (free space input):



OE-200-IN2-FC (fiber optic input):



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