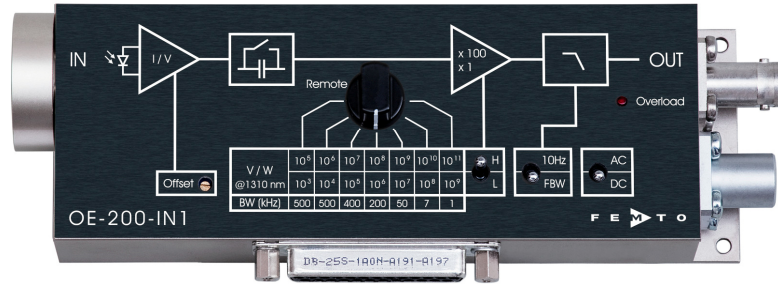


# Variable Gain Photoreceiver – Fast Optical Power Meter



The picture shows model OE-200-IN1-FST

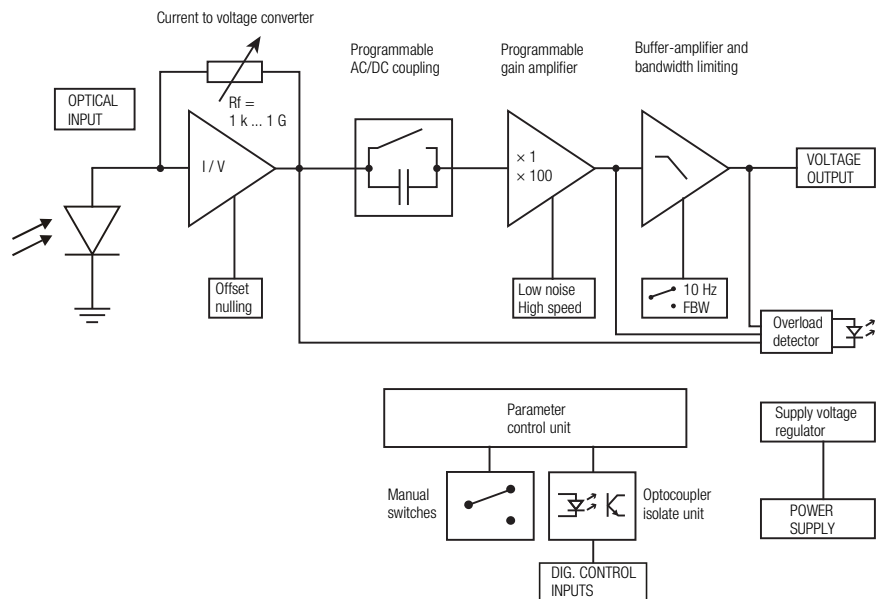
Features

- InGaAs-PIN detector, active diameter 0.3 mm (FST version), 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 × 10<sup>3</sup> up to 1 × 10<sup>11</sup> V/W
- Free-space input 1.035"-40 threaded
- Fiber optic input available as permanently mounted FC-input
- 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\_R7

## Variable Gain Photoreceiver – Fast Optical Power Meter

**Intended Use**

The OE-200-IN1 is a ultra-low noise variable gain photoreceiver. It is designed for fast and precise conversion of small optical signals into equivalent output voltages. 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.

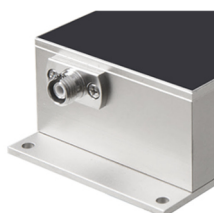
**Available Versions**

**OE-200-IN1-FST**



1.035"-40 threaded flange with internally threaded coupler ring (outer diameter 30 mm) for free space applications, compatible with many optical standard accessories

**OE-200-IN1-FC**



Fix/permanent FC fiber connector for high coupling efficiency and excellent 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 factor of the FST free space model is set to fit nominally at 1310 nm.

**Related OE-200 Models**

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

**Si Versions**

- OE-200-SI-FST      Si-PIN,  $\varnothing$  1.2 mm, 320 - 1060 nm, conversion gain adjusted at 850 nm, free space input, 1.035"-40 threaded flange
- OE-200-SI-FC      Si-PIN,  $\varnothing$  1.2 mm, 320 - 1060 nm, conversion gain calibrated at 850 nm, FC fiber connector (fix/permanent)
- OE-200-UV-FST      Si-PIN,  $1.1 \times 1.1$  mm<sup>2</sup>, 190 - 1000 nm conversion gain adjusted at 850 nm, free space input, 1.035"-40 threaded flange
- OE-200-UV-FC      Si-PIN,  $1.1 \times 1.1$  mm<sup>2</sup>, 190 - 1000 nm conversion gain calibrated at 850 nm, FC fiber connector (fix/permanent)

**InGaAs Versions**

- OE-200-IN2-FST      InGaAs-PIN,  $\varnothing$  300  $\mu$ m, 900 - 1700 nm, conversion gain adjusted at 1550 nm, free space input, 1.035"-40 threaded flange
- OE-200-IN2-FC      InGaAs-PIN, integrated ball lens, 900 - 1700 nm, conversion gain calibrated at 1550 nm, FC fiber connector (fix/permanent)

## Variable Gain Photoreceiver – Fast Optical Power Meter

Available Accessories

PRA-PAP



Alternative mounting option:  
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

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  
Gain accuracy

$1 \times 10^3 \dots 1 \times 10^{11}\text{ V/W}$  (@ 1310 nm, output load  $\geq 100\text{ k}\Omega$ )  
 $\pm 1\%$  electrical, between settings

Conversion gain accuracy

OE-200-IN1-FST (@  $P_{OPT} \leq 2\text{ mW}$ , 1310 nm)  $\pm 15\%$  nominal  
OE-200-IN1-FC (@  $P_{OPT} \leq 1\text{ mW}$ , 1310 nm)  $\pm 5\%$  guaranteed  
by factory calibration, verified with SM 9/125, FC/APC, NA 0.13  
Coupling efficiency depends on fiber type. When using FC/PC  
fiber connector, coupling efficiency may differ slightly. 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  
Upper cut-off frequency ( $-3\text{ dB}$ )

DC / 1 Hz, switchable  
up to 500 kHz (see table below), switchable to 10 Hz

Input

Input offset current (dark current)  
Input offset drift  
Input offset compensation range  
  
Optical CW saturation power  
Noise equivalent power (NEP)

2 pA typ.  
see table below  
 $\pm 600\text{ pA}$ , adjustable by offset potentiometer or  
 $\pm 400\text{ pA}$ , adjustable by external control voltage  
  
see table below  
see table below

## 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.

Detector

Detector type	InGaAs-PIN photodiode
Active area	∅ 300 μm (FST version) ∅ 80 μm, integrated ball lens (FC version)
Spectral range	900 - 1700 nm
Sensitivity (FST version)	0.87 A/W (@ 1310 nm) , 0.95 A/W (@ 1550 nm)
Sensitivity (FC version)	0.89 A/W (@ 1310 nm) , 0.97 A/W (@ 1550 nm)

Output

Output voltage	±10 V (@ ≥100 kΩ output load)
Output impedance	50 Ω (terminate with ≥100 kΩ load)
Max. output current	±30 mA (short-circuit proof)

Indicator LED

Function	overload
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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

## Variable Gain Photoreceiver – Fast Optical Power Meter

Specifications (continued)

Optical Input Connector	Material FST flange Material FST coupler ring Material FC receptacle	1.4305 stainless steel, nickel-plated 1.4305 stainless steel, glass bead blasted nickel silver
Power Supply	Supply voltage Supply current	$\pm 15\text{ V}$ ( $\pm 14.75\text{ V} \dots \pm 16.5\text{ V}$ ) $\pm 110 / -80\text{ mA}$ typ. (depends on operating conditions, recommended power supply capability min. $\pm 200\text{ mA}$ )
Case	Weight Material	360 g (0.79 lbs) AlMg4.5Mn, nickel-plated
Temperature Range	Storage temperature Operating temperature	$-40\text{ }^\circ\text{C} \dots +80\text{ }^\circ\text{C}$ $0\text{ }^\circ\text{C} \dots +60\text{ }^\circ\text{C}$

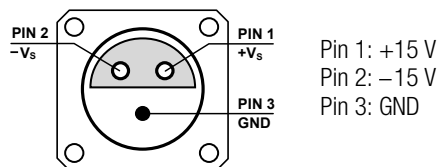
Absolute Maximum Ratings	Optical input power (CW) Digital control input voltage Analog control input voltage Power supply voltage	20 mW $-5\text{ V}/+16\text{ V}$ relative to digital ground DGND (pin 9) $\pm 15\text{ V}$ relative to analog ground AGND (pin 3) $\pm 20\text{ V}$
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Connectors

Input OE-200-IN1-FST 1.035"-40 threaded flange for free space applications  
OE-200-IN1-FC FC fiber optic connector

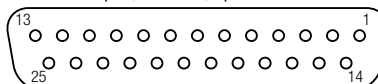
Output BNC jack (female)

Power supply LEMO® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52)



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)
- 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

\*stabilized power supply output current  
 $\pm 12\text{ V}$ : max.  $\pm 50\text{ mA}$ ,  $+5\text{ V}$ : max.  $30\text{ mA}$

## Variable Gain Photoreceiver – Fast Optical Power Meter

Remote Control Operation

General

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.

Mixed operation, e.g. local gain setting and remote controlled AC/DC setting, is also possible.

Switch setting “FBW / 10 Hz” of the low pass signal filter is not remote controllable.

Gain setting

Low noise Pin 14=HIGH gain (V/W)	High speed Pin 14=LOW gain (V/W)	Pin 12 MSB	Pin 11	Pin 10 LSB
10 <sup>3</sup>	10 <sup>5</sup>	LOW	LOW	LOW
10 <sup>4</sup>	10 <sup>6</sup>	LOW	LOW	HIGH
10 <sup>5</sup>	10 <sup>7</sup>	LOW	HIGH	LOW
10 <sup>6</sup>	10 <sup>8</sup>	LOW	HIGH	HIGH
10 <sup>7</sup>	10 <sup>9</sup>	HIGH	LOW	LOW
10 <sup>8</sup>	10 <sup>10</sup>	HIGH	LOW	HIGH
10 <sup>9</sup>	10 <sup>11</sup>	HIGH	HIGH	LOW

Gain settling time

<150 ms

AC/DC setting

Coupling	Pin 13
AC	LOW
DC	HIGH

Scope of Delivery

OE-200-IN1, internally threaded coupler ring (FST version only), LEMO® 3-pin connector, datasheet, transport package

Ordering Information

OE-200-IN1-FST

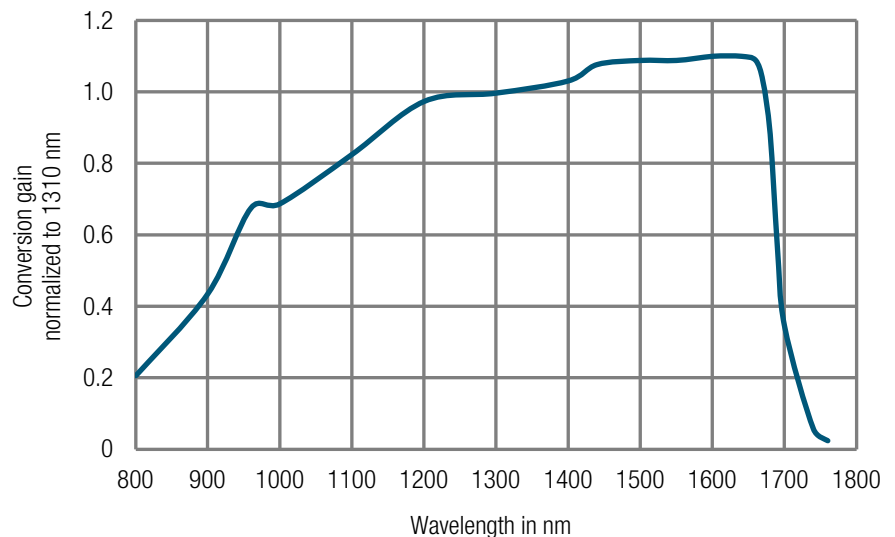
1.035"-40 threaded flange for free space applications and for use with various types of optical standard accessories.

OE-200-IN1-FC

FC fiber optic connector (fix/permanent, FC/PC and FC/APC compatible).

Conversion Gain

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

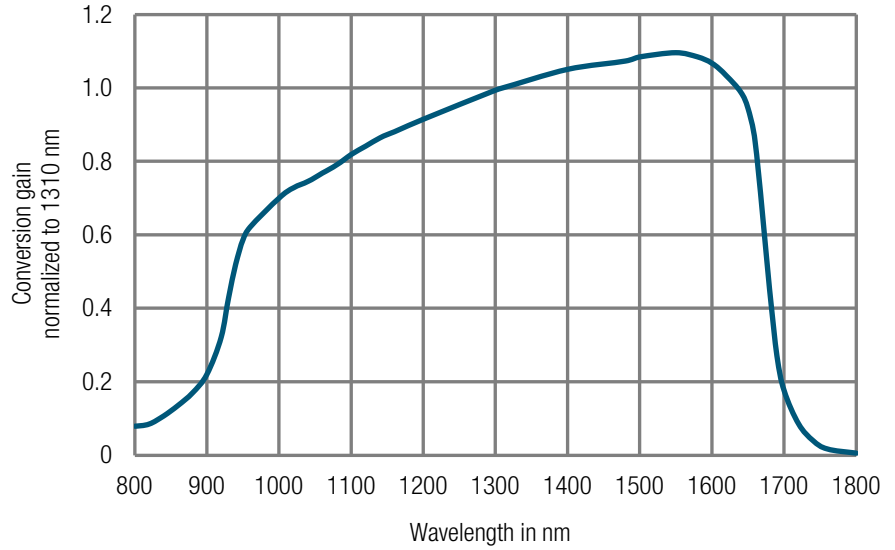


DB-Sens-OE-200-IN1-FST\_R01

## Variable Gain Photoreceiver – Fast Optical Power Meter

Conversion Gain (continued)

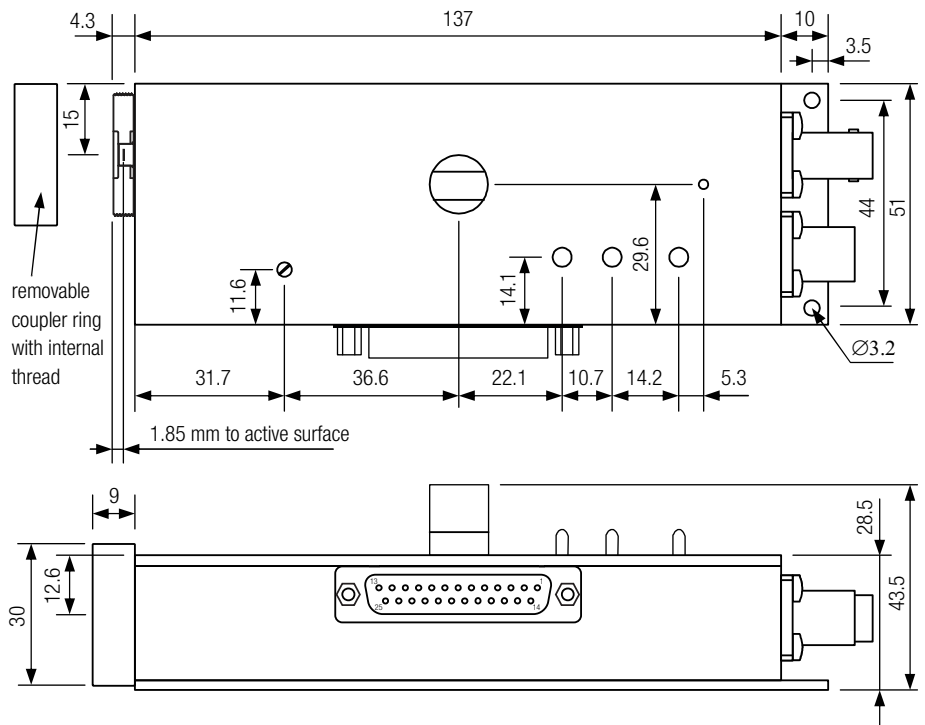
OE-200-IN1-FC (FC fiber optic input)



DB-Sens-OE-200-IN1-FC\_R01

Dimensions

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



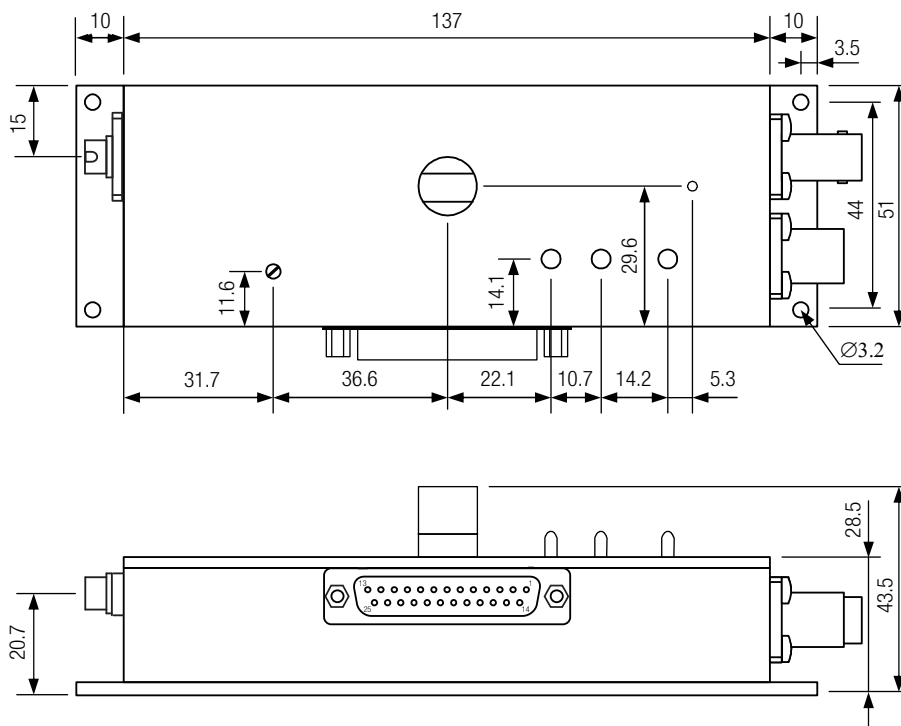
DZ-OE-200-FST\_R1

all dimensions in mm unless otherwise noted

# Variable Gain Photoreceiver – Fast Optical Power Meter

Dimensions (continued)

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



DZ-OE-200-FC\_R06

all dimensions in mm unless otherwise noted

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