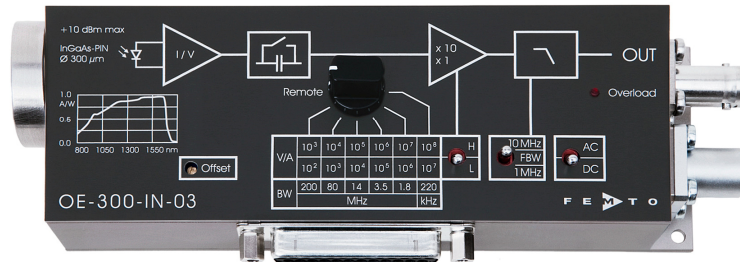


200 MHz Variable Gain Photoreceiver



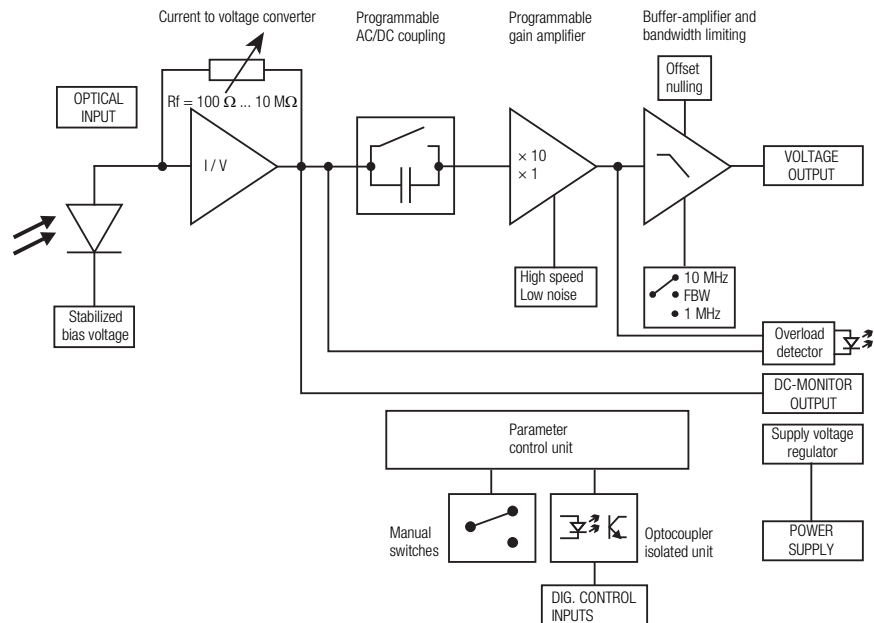
Features

- Adjustable transimpedance gain from 10^2 to 10^8 V/A
- Wide bandwidth up to 200 MHz
- InGaAs-PIN photodiode covering the 800 to 1700 nm wavelength range
- High dynamic input range up to 10 mW optical power
- Very low noise, NEP down to $52 \text{ fW}/\sqrt{\text{Hz}}$
- Switchable low pass filters for minimizing wideband noise
- Free-space input 1.035"-40 threaded
- Full manual and remote control capability

Applications





- All-purpose low-noise photoreceiver (O/E converter) for the MHz range
- Time resolved optical pulse and power measurements
- Laser intensity noise measurements (RIN)
- Optical front-end for oscilloscopes, spectrum analyzers, A/D converters and RF lock-in amplifiers

Block Diagram



BS01-OE-300_R2

200 MHz Variable Gain Photoreceiver

<p>Intended Use</p>	<p>The OE-300-IN-03 is a high speed 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.</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>							
<p>Available Version</p>	<p>OE-300-IN-03-FST</p> 	<p>1.035"-40 threaded flange for free space applications compatible with many optical standard accessories</p> <p>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</p>						
<p>Related OE-300 Models</p>	<p>See separate datasheets for following models on www.femto.de:</p> <table border="0"> <tr> <td>OE-300-SI-10-FST</td> <td>Si-PIN, 1 × 1 mm, 400 - 1000 nm 1.035"-40 threaded flange</td> </tr> <tr> <td>OE-300-SI-30-FST</td> <td>Si-PIN, Ø 3 mm, 320 - 1000 nm 1.035"-40 threaded flange</td> </tr> <tr> <td>OE-300-IN-01-FC</td> <td>InGaAs-PIN, Ø 80 µm, 900 - 1700 nm FC fiber receptacle only</td> </tr> </table>		OE-300-SI-10-FST	Si-PIN, 1 × 1 mm, 400 - 1000 nm 1.035"-40 threaded flange	OE-300-SI-30-FST	Si-PIN, Ø 3 mm, 320 - 1000 nm 1.035"-40 threaded flange	OE-300-IN-01-FC	InGaAs-PIN, Ø 80 µm, 900 - 1700 nm FC fiber receptacle only
OE-300-SI-10-FST	Si-PIN, 1 × 1 mm, 400 - 1000 nm 1.035"-40 threaded flange							
OE-300-SI-30-FST	Si-PIN, Ø 3 mm, 320 - 1000 nm 1.035"-40 threaded flange							
OE-300-IN-01-FC	InGaAs-PIN, Ø 80 µm, 900 - 1700 nm FC fiber receptacle only							
<p>Available Accessories</p>	<p>PRA-PAP</p>  <p>PS-15-25-L</p>  <p>LUCI-10</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> <p>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</p>						

200 MHz Variable Gain Photoreceiver

Specifications

Test conditions

$V_S = \pm 15\text{ V}$, $T_A = 25\text{ }^\circ\text{C}$, output load impedance $50\ \Omega$, warm-up 20 minutes (min. 10 minutes recommended)

Gain

Transimpedance gain
Gain accuracy

$1 \times 10^2 \dots 1 \times 10^8\text{ V/A}$ (output load $50\ \Omega$)
 $\pm 1\%$ electrical, between settings

Frequency Response

Lower cut-off frequency
Upper cut-off frequency (-3 dB)

DC / 100 Hz, switchable
up to 200 MHz (see table below),
switchable to 1 MHz or 10 MHz

Input

Optical CW saturation power
Noise equivalent power (NEP)

see table below
see table below

Performance depending on Gain Setting

Gain setting (low noise) (V/A)	10^2	10^3	10^4	10^5	10^6	10^7
Upper cut-off frequency (-3 dB)	200 MHz	80 MHz	14 MHz	3.5 MHz	1.8 MHz	220 kHz
Rise/fall time (10 % - 90 %)	1.9 ns	3.45 ns	27 ns	85 ns	212 ns	1.6 μs
NEP ($\sqrt{\text{Hz}}$, @ 1550 nm)	192 pW	23 pW	1.9 pW	410 fW	152 fW	55 fW
Measured at	20 MHz	8 MHz	1.4 MHz	350 kHz	180 kHz	22 kHz
Integr. input noise (RMS)*	4.8 μW	370 nW	23 nW	3.4 nW	0.82 nW	64 pW
CW sat. power (@ 1550 nm)	10 mW	1.0 mW	100 μW	10 μW	1.0 μW	100 nW
Gain setting (high speed) (V/A)	10^3	10^4	10^5	10^6	10^7	10^8
Upper cut-off frequency (-3 dB)	175 MHz	80 MHz	14 MHz	3.5 MHz	1.8 MHz	220 kHz
Rise/fall time (10 % - 90 %)	2.3 ns	3.6 ns	27 ns	85 ns	210 ns	1.7 μs
NEP ($\sqrt{\text{Hz}}$, @ 1550 nm)	137 pW	6.8 pW	1.4 pW	360 fW	127 fW	52 fW
Measured at	18 MHz	8 MHz	1.4 MHz	350 kHz	175 kHz	22 kHz
Integr. input noise (RMS)*	2.9 μW	270 nW	20 nW	3.3 nW	0.82 nW	64 pW
CW sat. power (@ 1550 nm)	1.0 mW	100 μW	10 μW	1.0 μW	100 nW	10 nW

* The integrated input noise is measured with a shaded input in the full bandwidth ("FBW") setting (referred to 1550 nm). The measurement bandwidth is $3 \times$ the upper cut-off frequency at the specific gain setting; filter slope is a 1st order roll-off.

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 "1 MHz" or "10 MHz" instead of "FBW". This is especially useful for continuous wave (CW) measurements.

Detector

Detector type
Active area
Spectral range
Sensitivity
Dark current

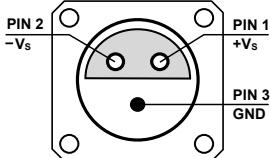
InGaAs-PIN photodiode
300 μm diameter
800 - 1700 nm
0.95 A/W typ. (@ 1550 nm)
0.1 nA typ.

Output

Output voltage rang
Output impedance
Max. output current
Slew rate
Output offset compensation

$\pm 1\text{ V}$ (@ $50\ \Omega$ output load), for linear amplification
 $50\ \Omega$ (designed for $50\ \Omega$ load)
 $\pm 40\text{ mA}$ (short-circuit proof)
1000 V/ μs
adjustable by offset potentiometer and external control voltage, output offset compensation range min. $\pm 100\text{ mV}$

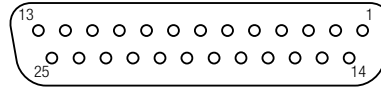
200 MHz Variable Gain Photoreceiver

Specifications (continued)								
DC Monitor Output	Monitor output gain Monitor output polarity Monitor output voltage range Monitor output bandwidth Monitor output impedance	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border-bottom: 1px solid black;">Mode</td> <td style="border-bottom: 1px solid black;">Monitor gain</td> </tr> <tr> <td>Low noise</td> <td>Gain setting divided by -1</td> </tr> <tr> <td>High speed</td> <td>Gain setting divided by -10</td> </tr> </table> inverting ±1 V (@ ≥1 MΩ load) DC ... 1 kHz 1 kΩ (designed for ≥1 MΩ load)	Mode	Monitor gain	Low noise	Gain setting divided by -1	High speed	Gain setting divided by -10
Mode	Monitor gain							
Low noise	Gain setting divided by -1							
High speed	Gain setting divided by -10							
Indicator LED	Function	overload						
Digital Control	Control input voltage range Control input current Overload output	LOW bit: -0.8 V ... +1.2 V, HIGH bit: +2.3 V ... +12 V 0 mA @ 0 V, 1.5 mA @ +5 V, 4.5 mA @ +12 V non active: <0.4 V @ 0 ... -1 mA active: typ. 5 ... 5.1 V @ 0 ... 2 mA						
Ext. Offset Control	Control voltage range Offset control input impedance	±10 V 15 kΩ						
Optical Input Connector	Material FST flange Material FST coupler ring	1.4305 stainless steel, nickel-plated 1.4305 stainless steel, glass bead blasted						
Power Supply	Supply voltage Supply current	±15 V (±14.75 V ... ±16.5 V) ±110 / -90 mA typ. (depends on operating conditions, recommended power supply capability min. ±200 mA)						
Case	Weight Material	360 g (0.79 lbs) AlMg4.5Mn, nickel-plated						
Temperature Range	Storage temperature Operating temperature	-40 °C ... +80 °C 0 °C ... +60 °C						
Absolute Maximum Ratings	Optical input power (CW) Digital control input voltage Analog control input voltage Power supply voltage	12 mW -5 V/+16 V relative to digital ground DGND (pin 9) ±15 V relative to analog ground AGND (pin 3) ±20 V						
Connectors	Input Output Power supply	1.035" -40 threaded flange for free space applications BNC jack (female) LEMO® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52) <div style="text-align: center; margin-top: 10px;">  </div> <div style="margin-left: 20px; margin-top: 5px;"> Pin 1: +15 V Pin 2: -15 V Pin 3: GND </div>						
Connectors (continued)								

200 MHz Variable Gain Photoreceiver

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: digital output: overload (referred to pin 3)
- Pin 6: DC Monitor output
- Pin 7: NC
- Pin 8: offset control voltage input
- Pin 9: DGND (ground for digital control pins 10 - 16)
- 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: upper cut-off frequency limit 10 MHz
- Pin 16: upper cut-off frequency limit 1 MHz
- Pin 17 - 25: NC

*stabilized power supply output current
 ±12 V: max. ±20 mA, +5V: max. 30 mA

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", "DC", "L" (low noise mode) and "FBW", 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.

Gain setting

	Low noise	High speed		
Gain (V/A)	Gain (V/A)	Pin 12	Pin 11	Pin 10
	Pin 14=LOW	Pin 14=HIGH	MSB	LSB
10 ²	10 ³	LOW	LOW	LOW
10 ³	10 ⁴	LOW	LOW	HIGH
10 ⁴	10 ⁵	LOW	HIGH	LOW
10 ⁵	10 ⁶	LOW	HIGH	HIGH
10 ⁶	10 ⁷	HIGH	LOW	LOW
10 ⁷	10 ⁸	HIGH	LOW	HIGH

AC/DC setting

Coupling	Pin 13
DC	LOW
AC	HIGH

Low pass filter setting

Upper cut-off freq. limit	Pin 15	Pin 16
full bandwidth	LOW	LOW
10 MHz	HIGH	LOW
1 MHz	LOW	HIGH

High speed / low noise setting

Mode	Pin 14
low noise mode	LOW
high speed mode	HIGH

Scope of Delivery

OE-300-IN-03, internally threaded coupler ring, LEMO® 3-pin connector, datasheet, transport package

200 MHz Variable Gain Photoreceiver

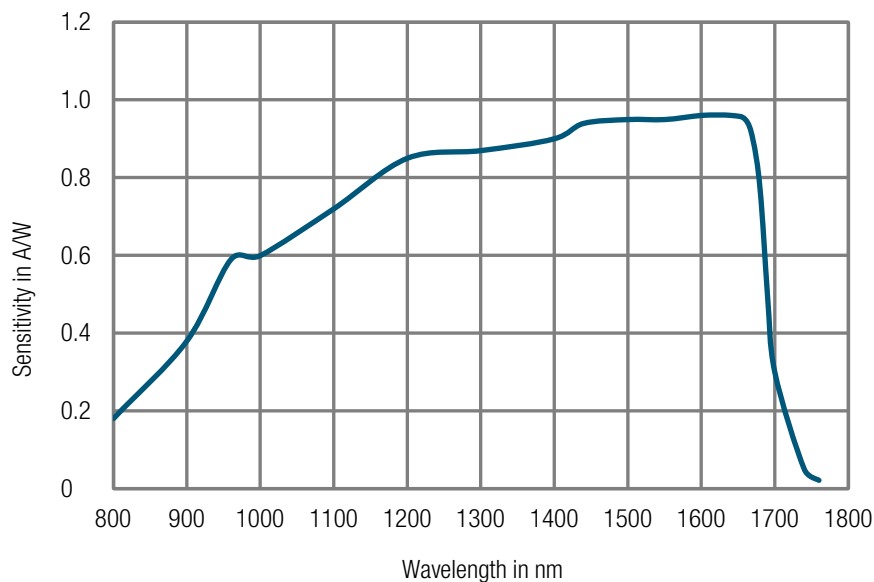
Ordering Information

OE-300-IN-03-FST

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

Spectral Responsivity

OE-300-IN-03-FST



DB-Sens-OE-300-IN-03-FST_R2

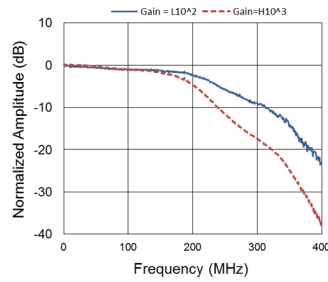
200 MHz Variable Gain Photoreceiver

Typical Performance Characteristic

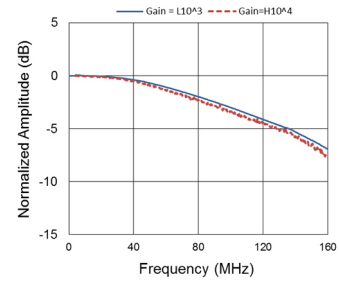
Frequency response

$$V_{Supply} = \pm 15 V_{DC}; R_{Load} = 50 \Omega$$

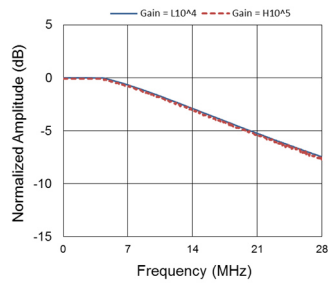
Gain setting: $L10^2, H10^3$



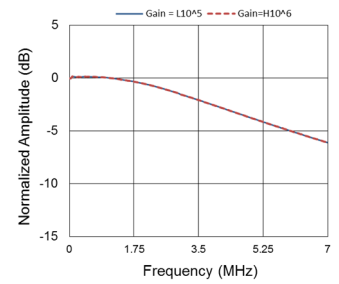
Gain setting: $L10^3, H10^4$



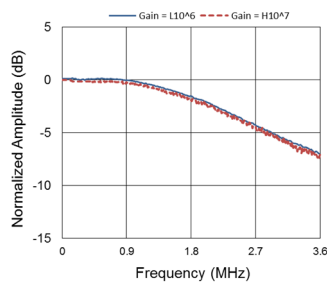
Gain setting: $L10^4, H10^5$



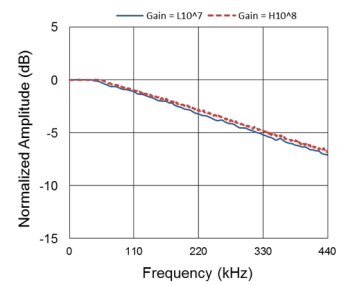
Gain setting: $L10^5, H10^6$



Gain setting: $L10^6, H10^7$



Gain setting: $L10^7, H10^8$

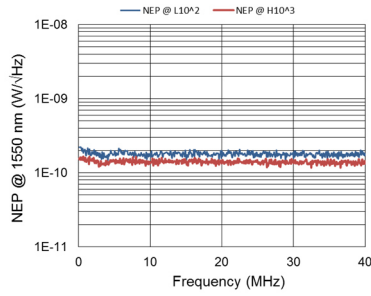


200 MHz Variable Gain Photoreceiver

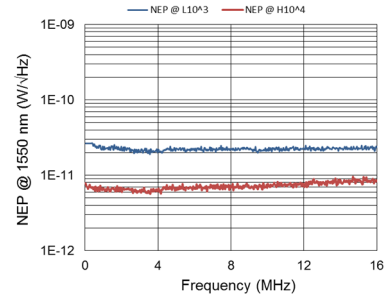
Typical Performance
Characteristic (continued)

Input noise equivalent power (NEP)

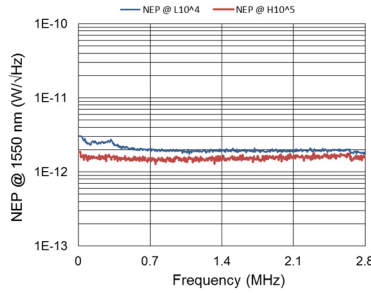
Gain setting L10², H10³



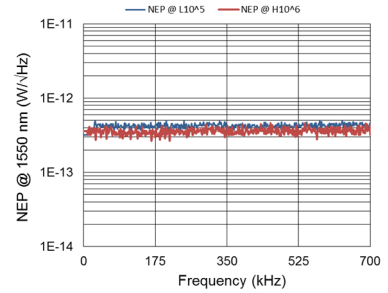
Gain setting L10³, H10⁴



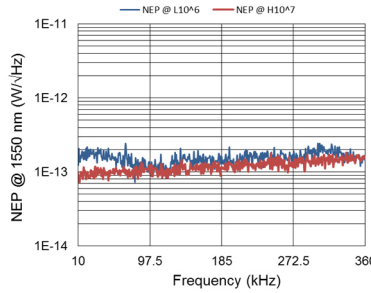
Gain setting: L10⁴, H10⁵



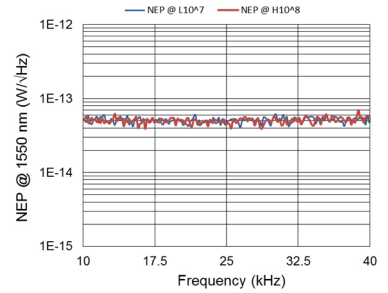
Gain setting: L10⁵, H10⁶



Gain setting: L10⁶, H10⁷



Gain setting: L10⁷, H10⁸

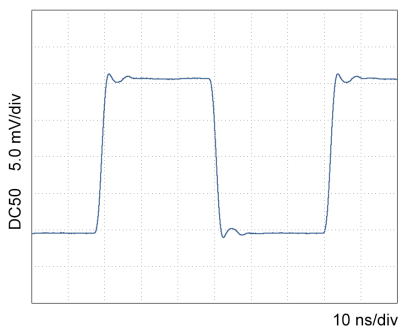


200 MHz Variable Gain Photoreceiver

Typical Performance
Characteristic (continued)

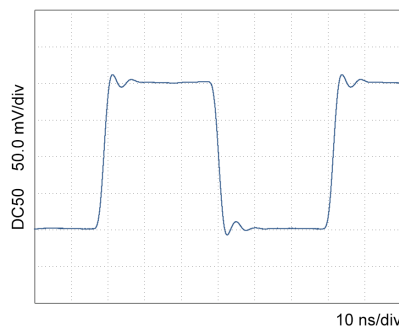
Signal pulse response

Gain setting L10²



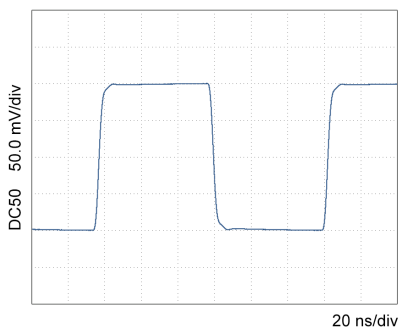
Rise: 1.92 ns Fall: 1.93 ns

Gain setting H10³



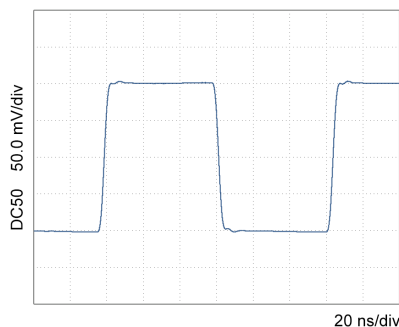
Rise: 2.28 ns Fall: 2.30 ns

Gain setting L10³



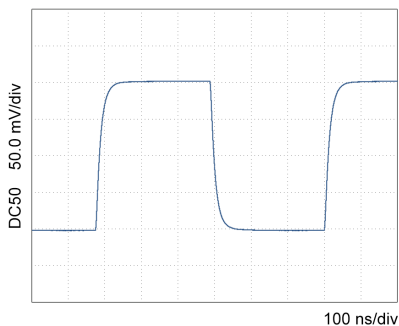
Rise: 3.45 ns Fall: 3.49 ns

Gain setting H10⁴



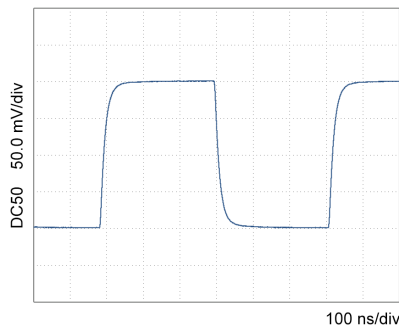
Rise: 3.59 ns Fall: 3.61 ns

Gain setting L10⁴



Rise: 25.98 ns Fall: 26.90 ns

Gain setting H10⁵

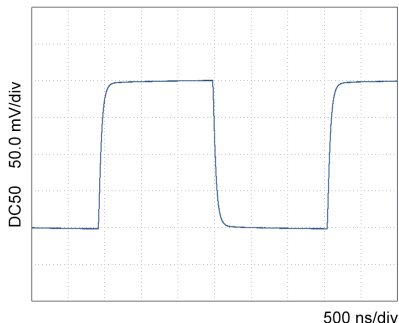


Rise: 27.24 ns Fall: 27.11 ns

200 MHz Variable Gain Photoreceiver

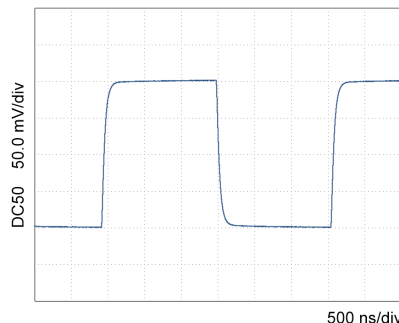
Typical Performance
Characteristic (continued)

Gain setting L10⁵



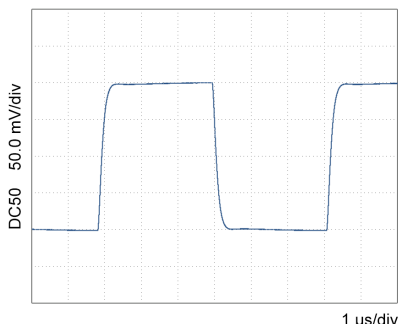
Rise: 82.24 ns Fall: 84.12 ns

Gain setting H10⁶



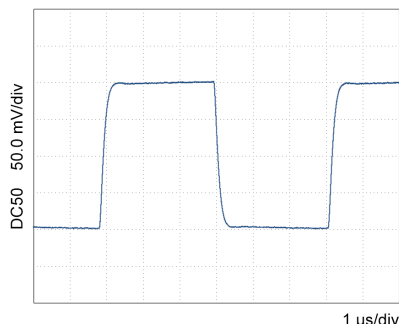
Rise: 81.92 ns Fall: 84.24 ns

Gain setting L10⁶



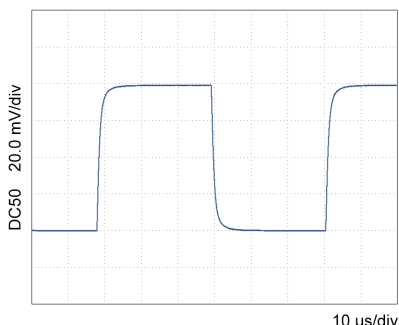
Rise: 208.6 ns Fall: 212.5 ns

Gain setting H10⁷



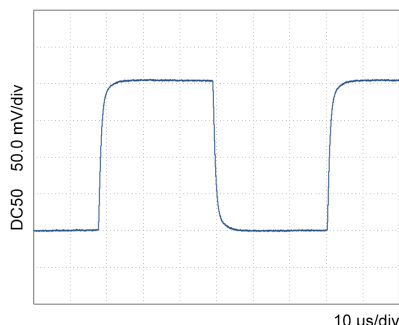
Rise: 208.8 ns Fall: 208.9 ns

Gain setting L10⁷



Rise: 1639.2 ns Fall: 1691.2 ns

Gain setting H10⁸

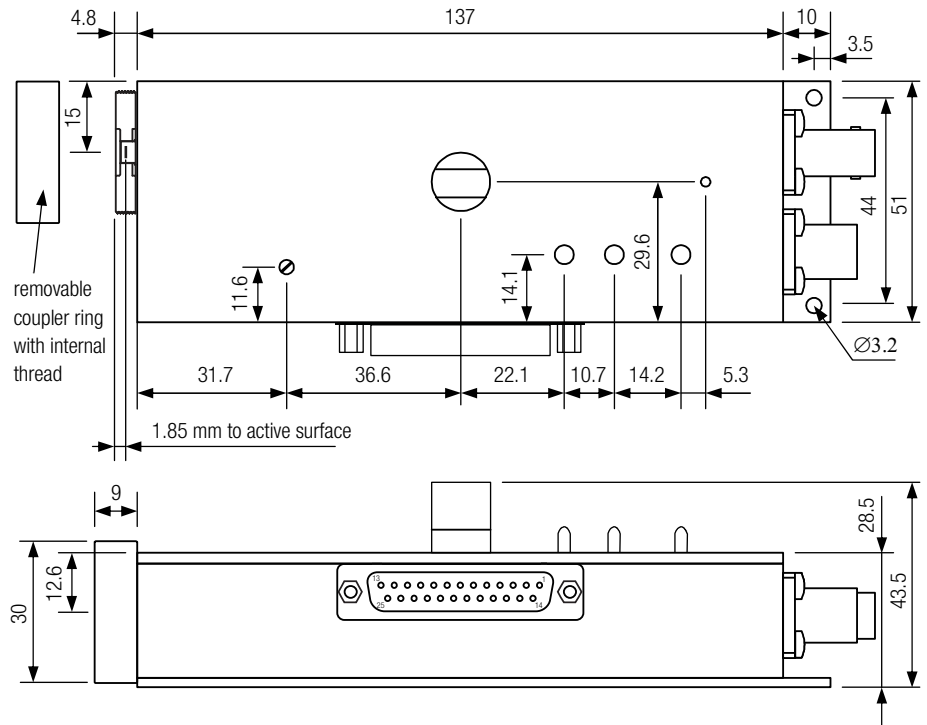


Rise: 1701.6 ns Fall: 1702.4 ns

200 MHz Variable Gain Photoreceiver

Dimensions

OE-300-IN-03-FST



all dimensions in mm unless otherwise noted

DZ-OE-300-FST_R1

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