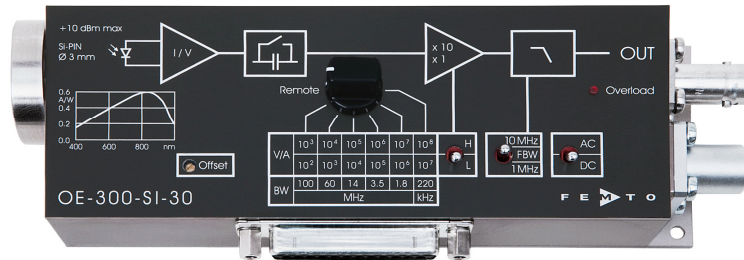


100 MHz Variable Gain Photoreceiver



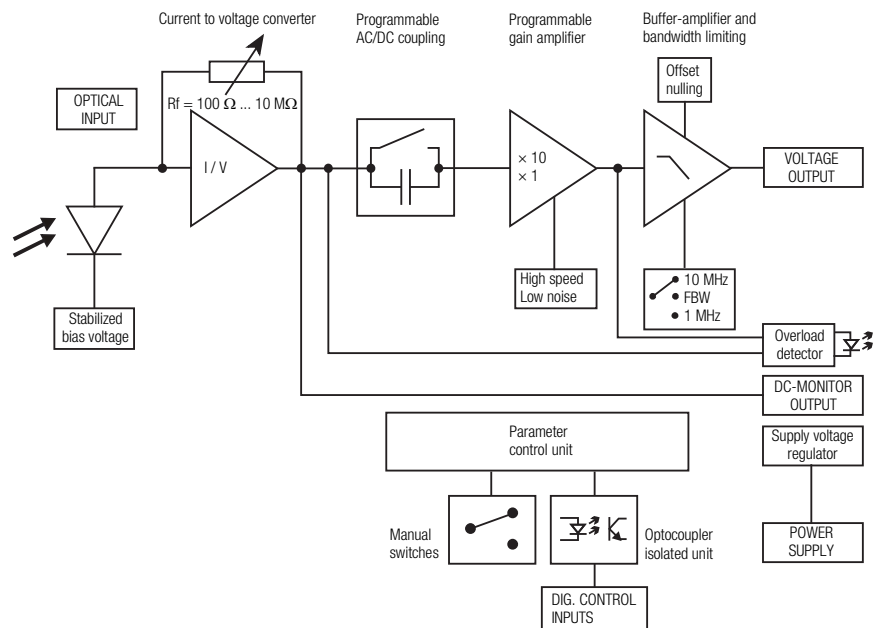
Features

- Adjustable transimpedance gain from 10^2 to 10^8 V/A
- Wide bandwidth up to 100 MHz
- Si-PIN photodiode covering the 320 to 1000 nm wavelength range
- Large optical detector size 3 mm diameter
- High dynamic input range up to 10 mW optical power
- Very low noise, NEP down to $81 \text{ fW}/\sqrt{\text{Hz}}$
- Switchable low pass filters for minimizing wideband noise
- Free-space input 1.035"-40 threaded, easily convertible to fiber optic input (FC and FSMA) with optionally available screw-on adapters
- 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

100 MHz Variable Gain Photoreceiver

<p>Intended Use</p>	<p>The OE-300-SI-30 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-SI-30-FST</p>  <p>1.035"-40 threaded flange with internally threaded coupler ring (outer diameter 30 mm) for free space applications. Compatible with many optical standard accessories and for use with various types of fiber connector adapters.</p> <p>Optionally available: Fiber adapters PRA-FC, PRA-FCA and PRA-FSMA. With the relative large 3 mm dia. photodiode installed in the OE-300-SI-30 input coupling is not critical. However, standard SM 9/125 fibers (PC or APC) with low numerical aperture (NA) are recommended for ensuring near 100% coupling efficiency.</p>
<p>Related OE-300 Models</p>	<p>See separate datasheets for following models on www.femto.de:</p> <p>OE-300-SI-10-FST Si-PIN, 1 mm × 1 mm, 320 - 1000 nm 1.035"-40 threaded flange</p> <p>OE-300-IN-01-FC InGaAs-PIN, Ø 80 µm, 900 - 1700 nm FC fiber receptacle only</p> <p>OE-300-IN-03-FST InGaAs-PIN, Ø 300 µm, 800 - 1700 nm 1.035"-40 threaded flange</p>
<p>Available Accessories</p>	<p>PRA-FC PRA-FCA PRA-FSMA</p>  <p>Fiber-adapter with external 1.035"-40 thread</p> <p>PRA-PAP</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>PS-15-25-L</p>  <p>Power Supply input: 100 – 240 VAC output: ±15 VDC</p>

100 MHz Variable Gain Photoreceiver

<p>Available Accessories (continued)</p>	<p>LUCI-10</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>																																																																																																		
<p>Specifications</p> <p>Gain</p> <p>Frequency Response</p> <p>Input</p> <p>Performance depending on Gain Setting</p> <p>Detector</p> <p>Output</p>	<p>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)</p> <p>Transimpedance gain $1 \times 10^2 \dots 1 \times 10^8\ \text{V/A}$ (output load $50\ \Omega$)</p> <p>Gain accuracy $\pm 1\%$ electrical, between settings</p> <p>Lower cut-off frequency DC / 100 Hz, switchable</p> <p>Upper cut-off frequency ($-3\ \text{dB}$) up to 100 MHz (see table below), switchable to 1 MHz or 10 MHz</p> <p>Optical CW saturation power see table below</p> <p>Noise equivalent power (NEP) see table below</p> <table border="1"> <thead> <tr> <th>Gain setting (low noise) (V/A)</th> <th>10^2</th> <th>10^3</th> <th>10^4</th> <th>10^5</th> <th>10^6</th> <th>10^7</th> </tr> </thead> <tbody> <tr> <td>Upper cut-off frequency ($-3\ \text{dB}$)</td> <td>100 MHz</td> <td>60 MHz</td> <td>14 MHz</td> <td>3.5 MHz</td> <td>1.8 MHz</td> <td>220 kHz</td> </tr> <tr> <td>Rise/fall time (10 % - 90 %)</td> <td>3.35 ns</td> <td>5.85 ns</td> <td>22.7 ns</td> <td>74 ns</td> <td>203 ns</td> <td>1.65 μs</td> </tr> <tr> <td>NEP ($\sqrt{\text{V/Hz}}$, @ 850 nm)</td> <td>325 pW</td> <td>26 pW</td> <td>3.2 pW</td> <td>745 fW</td> <td>292 fW</td> <td>89 fW</td> </tr> <tr> <td>Measured at</td> <td>10 MHz</td> <td>6 MHz</td> <td>1.4 MHz</td> <td>350 kHz</td> <td>180 kHz</td> <td>22 kHz</td> </tr> <tr> <td>Integr. input noise (RMS)*</td> <td>5.5 μW</td> <td>430 nW</td> <td>56 nW</td> <td>8.7 nW</td> <td>1.9 nW</td> <td>130 pW</td> </tr> <tr> <td>CW saturation power (@ 850 nm)</td> <td>10 mW</td> <td>1.7 mW</td> <td>170 μW</td> <td>17 μW</td> <td>1.7 μW</td> <td>170 nW</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Gain setting (high speed) (V/A)</th> <th>10^3</th> <th>10^4</th> <th>10^5</th> <th>10^6</th> <th>10^7</th> <th>10^8</th> </tr> </thead> <tbody> <tr> <td>Upper cut-off frequency ($-3\ \text{dB}$)</td> <td>80 MHz</td> <td>60 MHz</td> <td>14 MHz</td> <td>3.5 MHz</td> <td>1.8 MHz</td> <td>220 kHz</td> </tr> <tr> <td>Rise/fall time (10 % - 90 %)</td> <td>3.55 ns</td> <td>6.05 ns</td> <td>23.1 ns</td> <td>74 ns</td> <td>203 ns</td> <td>1.65 μs</td> </tr> <tr> <td>NEP ($\sqrt{\text{V/Hz}}$, @ 850 nm)</td> <td>232 pW</td> <td>11 pW</td> <td>2.4 pW</td> <td>700 fW</td> <td>245 fW</td> <td>81 fW</td> </tr> <tr> <td>Measured at</td> <td>8 MHz</td> <td>6 MHz</td> <td>1.4 MHz</td> <td>350 kHz</td> <td>180 kHz</td> <td>22 kHz</td> </tr> <tr> <td>Integr. input noise (RMS)*</td> <td>3.6 μW</td> <td>275 nW</td> <td>54 nW</td> <td>8.6 nW</td> <td>1.9 nW</td> <td>130 pW</td> </tr> <tr> <td>CW saturation power (@ 850 nm)</td> <td>1.7 mW</td> <td>170 μW</td> <td>17 μW</td> <td>1.7 μW</td> <td>170 nW</td> <td>17 nW</td> </tr> </tbody> </table> <p>* The integrated input noise is measured with a shaded input in the full bandwidth ("FBW") setting (referred to 850 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.</p> <p>The input referred peak-peak noise can be calculated from the RMS noise as follows:</p> $P_{\text{Input noise peak-to-peak}} = P_{\text{Input noise RMS}} \times 6$ <p>The output noise is given by:</p> $U_{\text{Output noise RMS}} = P_{\text{Input noise RMS}} \times \text{gain}$ $U_{\text{Output noise peak-to-peak}} = U_{\text{Output noise RMS}} \times 6 = P_{\text{Input noise RMS}} \times \text{gain} \times 6$ <p>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.</p> <p>Detector type Si-PIN photodiode</p> <p>Active area 3 mm diameter</p> <p>Spectral range 320 - 1000 nm</p> <p>Sensitivity 0.59 A/W typ. (@ 850 nm)</p> <p>Dark current 0.1 nA typ.</p> <p>Output voltage rang $\pm 1\ \text{V}$ (@ $50\ \Omega$ output load), for linear amplification</p> <p>Output impedance $50\ \Omega$ (designed for $50\ \Omega$ load)</p> <p>Max. output current $\pm 40\ \text{mA}$ (short-circuit proof)</p> <p>Slew rate 1000 V/μs</p> <p>Output offset compensation adjustable by offset potentiometer and external control voltage, output offset compensation range min. $\pm 100\ \text{mV}$</p>	Gain setting (low noise) (V/A)	10^2	10^3	10^4	10^5	10^6	10^7	Upper cut-off frequency ($-3\ \text{dB}$)	100 MHz	60 MHz	14 MHz	3.5 MHz	1.8 MHz	220 kHz	Rise/fall time (10 % - 90 %)	3.35 ns	5.85 ns	22.7 ns	74 ns	203 ns	1.65 μs	NEP ($\sqrt{\text{V/Hz}}$, @ 850 nm)	325 pW	26 pW	3.2 pW	745 fW	292 fW	89 fW	Measured at	10 MHz	6 MHz	1.4 MHz	350 kHz	180 kHz	22 kHz	Integr. input noise (RMS)*	5.5 μW	430 nW	56 nW	8.7 nW	1.9 nW	130 pW	CW saturation power (@ 850 nm)	10 mW	1.7 mW	170 μW	17 μW	1.7 μW	170 nW	Gain setting (high speed) (V/A)	10^3	10^4	10^5	10^6	10^7	10^8	Upper cut-off frequency ($-3\ \text{dB}$)	80 MHz	60 MHz	14 MHz	3.5 MHz	1.8 MHz	220 kHz	Rise/fall time (10 % - 90 %)	3.55 ns	6.05 ns	23.1 ns	74 ns	203 ns	1.65 μs	NEP ($\sqrt{\text{V/Hz}}$, @ 850 nm)	232 pW	11 pW	2.4 pW	700 fW	245 fW	81 fW	Measured at	8 MHz	6 MHz	1.4 MHz	350 kHz	180 kHz	22 kHz	Integr. input noise (RMS)*	3.6 μW	275 nW	54 nW	8.6 nW	1.9 nW	130 pW	CW saturation power (@ 850 nm)	1.7 mW	170 μW	17 μW	1.7 μW	170 nW	17 nW
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100 MHz Variable Gain Photoreceiver

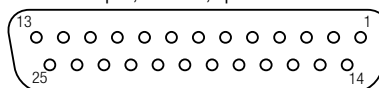
Specifications (continued)		
DC Monitor Output	<p>Monitor output gain</p> <p>Monitor output polarity</p> <p>Monitor output voltage range</p> <p>Monitor output bandwidth</p> <p>Monitor output impedance</p>	<p>Mode _____ Monitor gain _____</p> <p>Low noise Gain setting divided by -1</p> <p>High speed Gain setting divided by -10</p> <p>inverting</p> <p>±1 V (@ ≥1 MΩ load)</p> <p>DC ... 1 kHz</p> <p>1 kΩ (designed for ≥1 MΩ load)</p>
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	15 kΩ
Optical Input Connector	Material FST flange	1.4305 stainless steel, nickel-plated
	Material FST coupler ring	1.4305 stainless steel, glass bead blasted
Power Supply	Supply voltage	±15 V (±14.75 V ... ±16.5 V)
	Supply current	±110 / -90 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
Absolute Maximum Ratings	Optical input power (CW)	12 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	1.035"-40 threaded flange for free space applications
	Output	BNC jack (female)
	Power supply	LEMO® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52)
	<p>PIN 1: +15 V PIN 2: -15 V PIN 3: GND</p>	

100 MHz Variable Gain Photoreceiver

Connectors (continued)

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

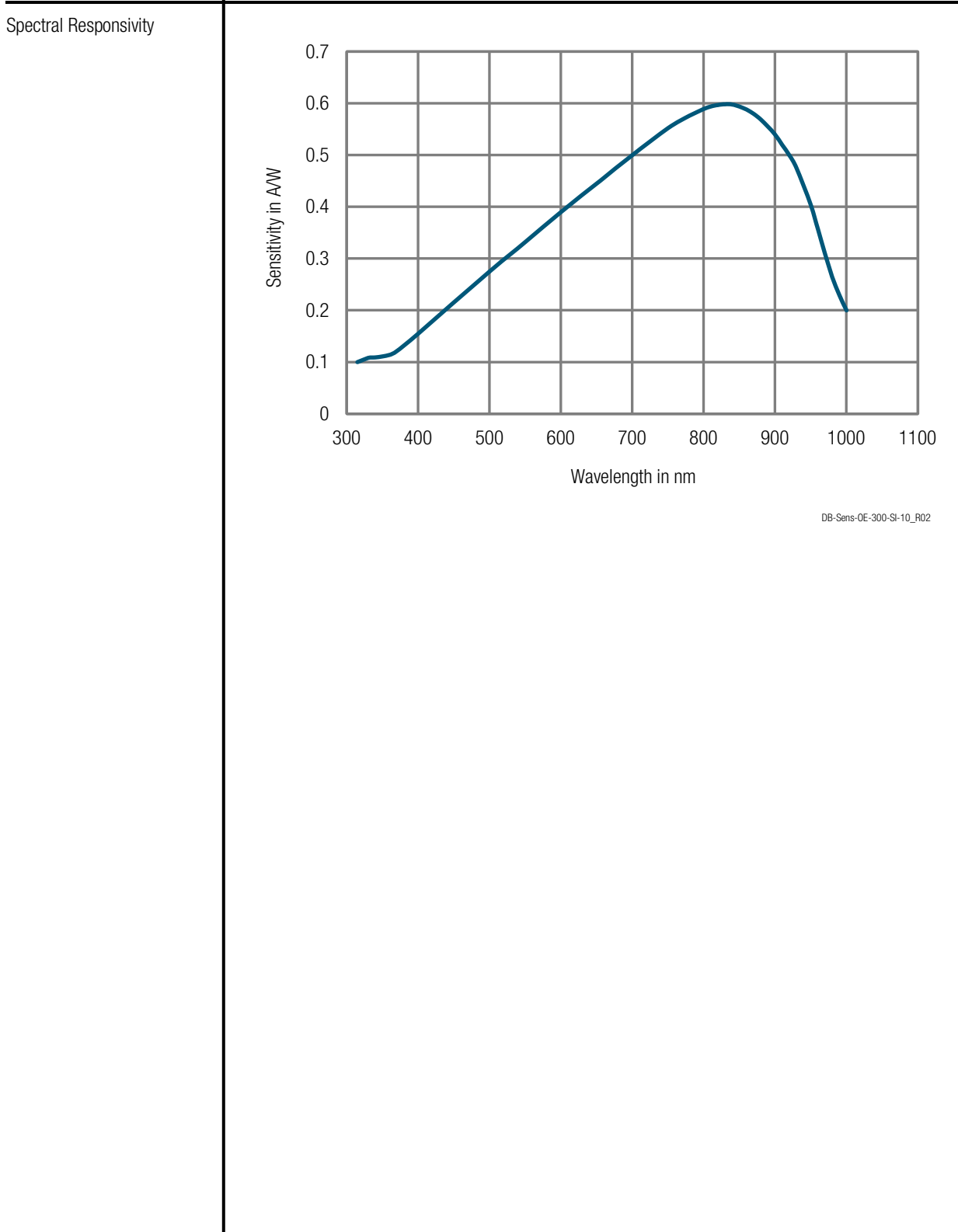
Upper cut-off freq. limit	Pin 15	Pin 16
full bandwidth	LOW	LOW
10 MHz	HIGH	LOW
1 MHz	LOW	HIGH

High speed / low noise setting

Mode	Pin 14
low noise mode	LOW
high speed mode	HIGH

100 MHz Variable Gain Photoreceiver

Scope of Delivery	OE-300-SI-30, internally threaded coupler ring, LEMO® 3-pin connector, datasheet, transport package	
Ordering Information	OE-300-SI-30-FST	1.035"-40 threaded flange for free space applications and for use with various types of optical standard accessories



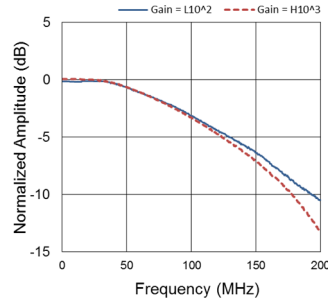
100 MHz Variable Gain Photoreceiver

Typical Performance Characteristic

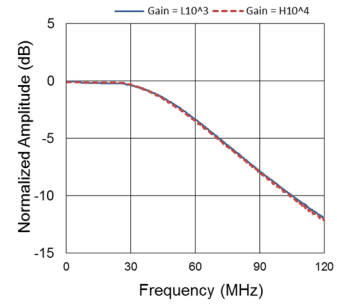
Frequency response

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

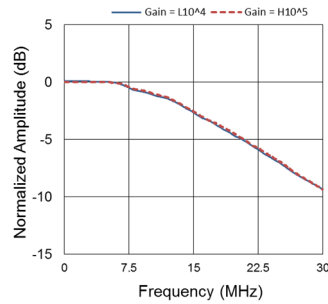
Gain setting: $L10^2, H10^3$



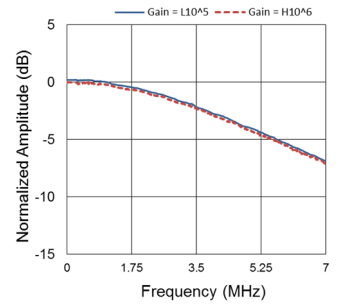
Gain setting: $L10^3, H10^4$



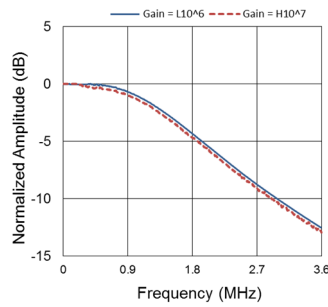
Gain setting: $L10^4, H10^5$



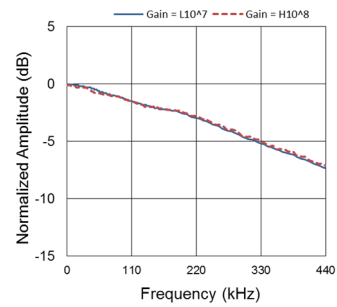
Gain setting: $L10^5, H10^6$



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



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

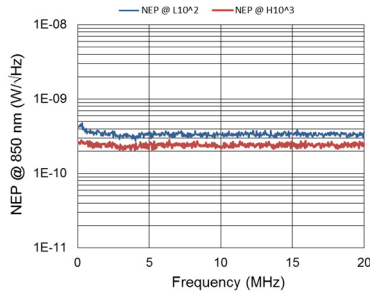


100 MHz Variable Gain Photoreceiver

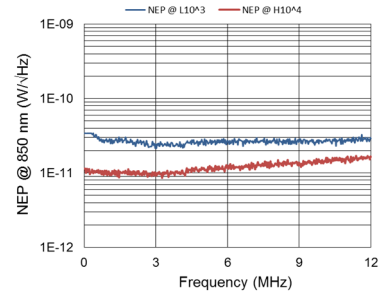
Typical Performance Characteristic (continued)

Input noise equivalent power (NEP)

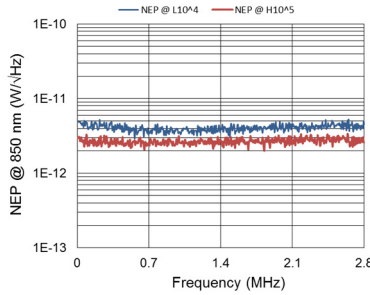
Gain setting $L10^2, H10^3$



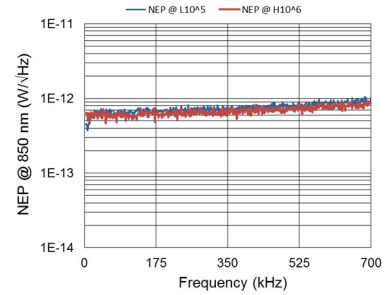
Gain setting $L10^3, H10^4$



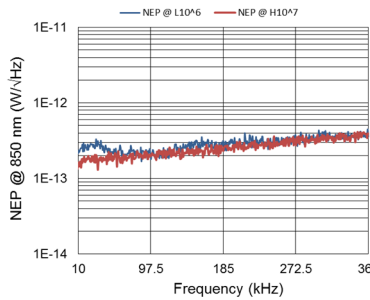
Gain setting: $L10^4, H10^5$



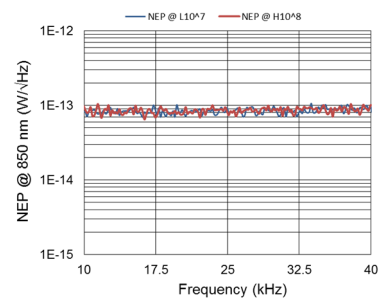
Gain setting: $L10^5, H10^6$



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



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

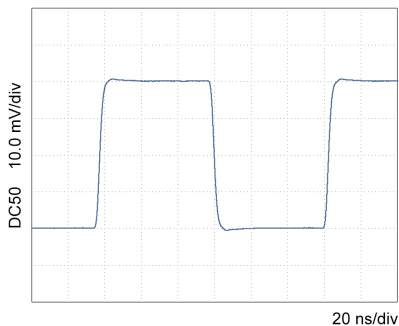


100 MHz Variable Gain Photoreceiver

Typical Performance
Characteristic (continued)

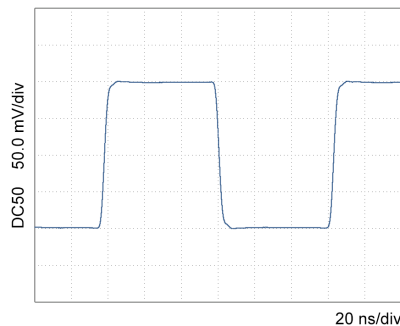
Signal pulse response
Signal pulse response

Gain setting L10²



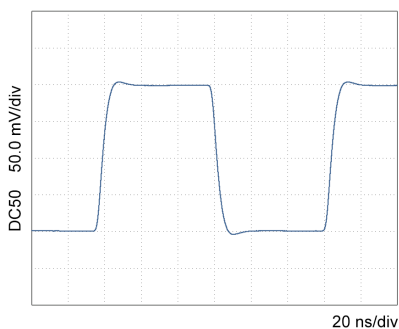
Rise: 3.35 ns Fall: 3.36 ns

Gain setting H10³



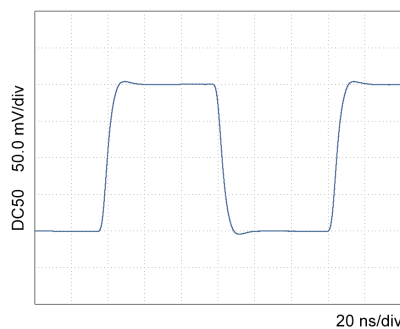
Rise: 3.51 ns Fall: 3.55 ns

Gain setting L10³



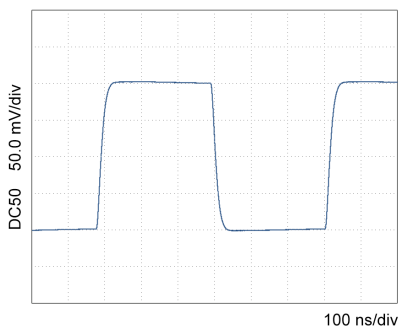
Rise: 5.83 ns Fall: 5.87 ns

Gain setting H10⁴



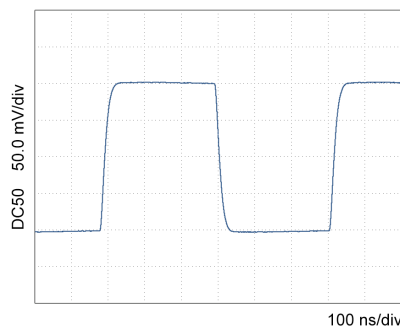
Rise: 6.03 ns Fall: 6.06 ns

Gain setting L10⁴



Rise: 22.73 ns Fall: 22.58 ns

Gain setting H10⁵

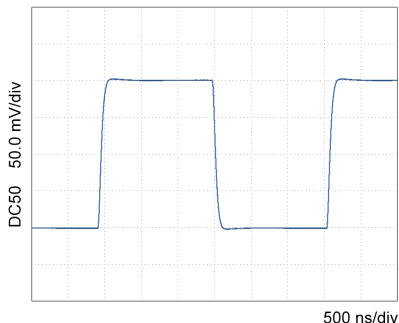


Rise: 23.14 ns Fall: 22.98 ns

100 MHz Variable Gain Photoreceiver

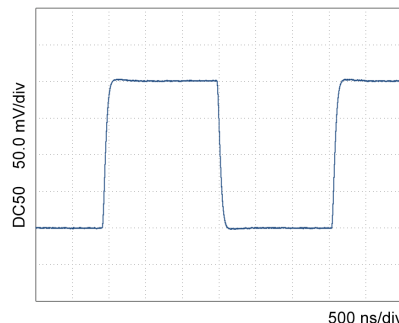
Typical Performance
Characteristic (continued)

Gain setting L10⁵



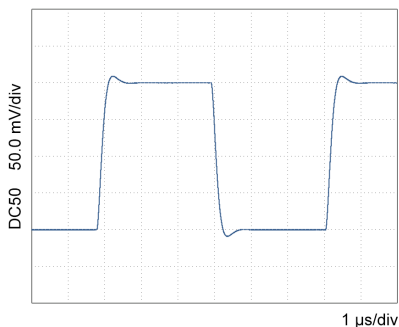
Rise: 73.72 ns Fall: 73.76 ns

Gain setting H10⁶



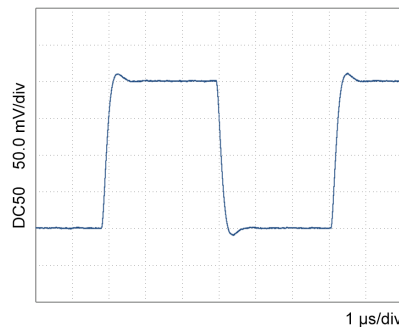
Rise: 73.76 ns Fall: 74.36 ns

Gain setting L10⁶



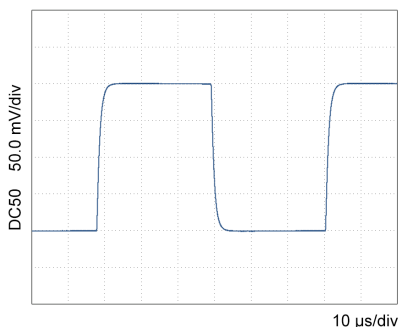
Rise: 202.64 ns Fall: 203.04 ns

Gain setting H10⁷



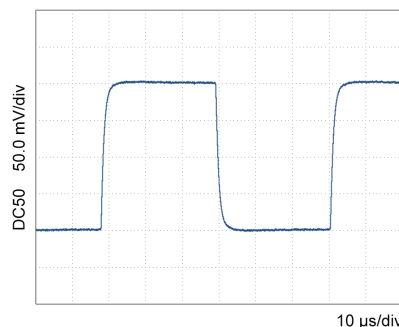
Rise: 201.28 ns Fall: 202.88 ns

Gain setting L10⁷



Rise: 1656.0 ns Fall: 1636.8 ns

Gain setting H10⁸

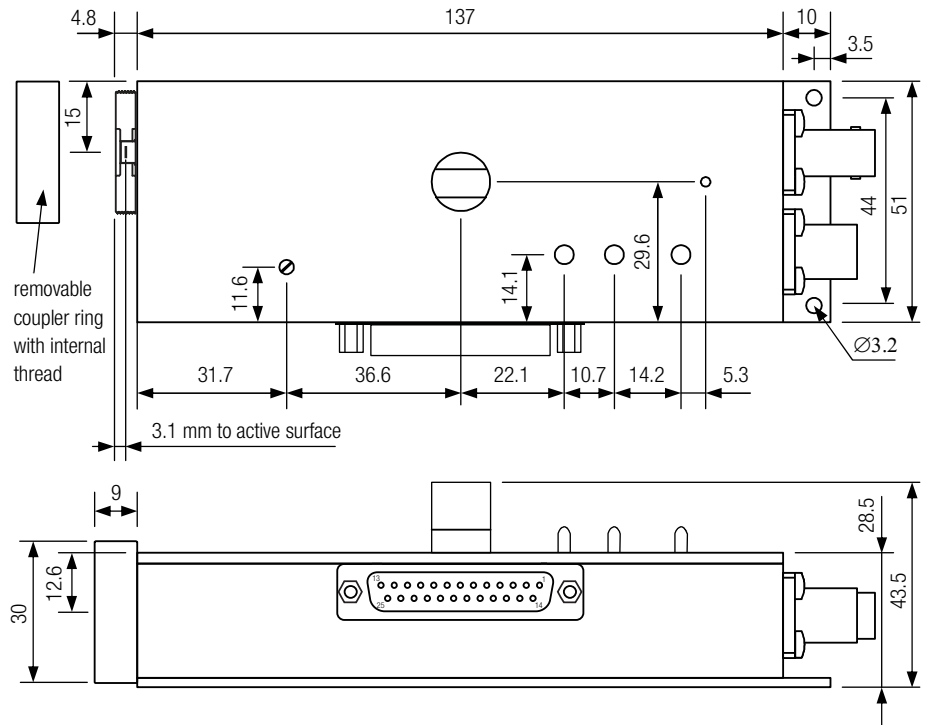


Rise: 1631.2 ns Fall: 1699.2 ns

100 MHz Variable Gain Photoreceiver

Dimensions

OE-300-SI-30-FST



all dimensions in mm unless otherwise noted

DZ-OE-300-FST_R1

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