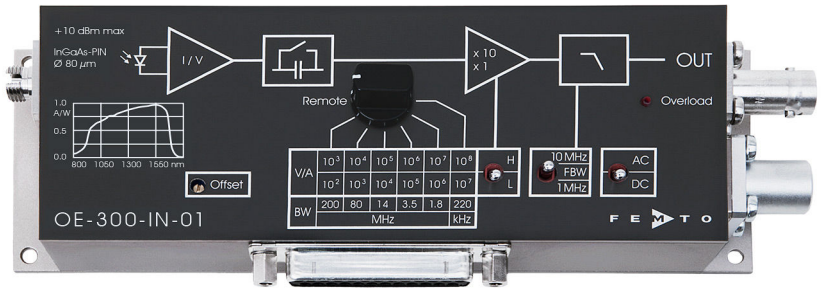
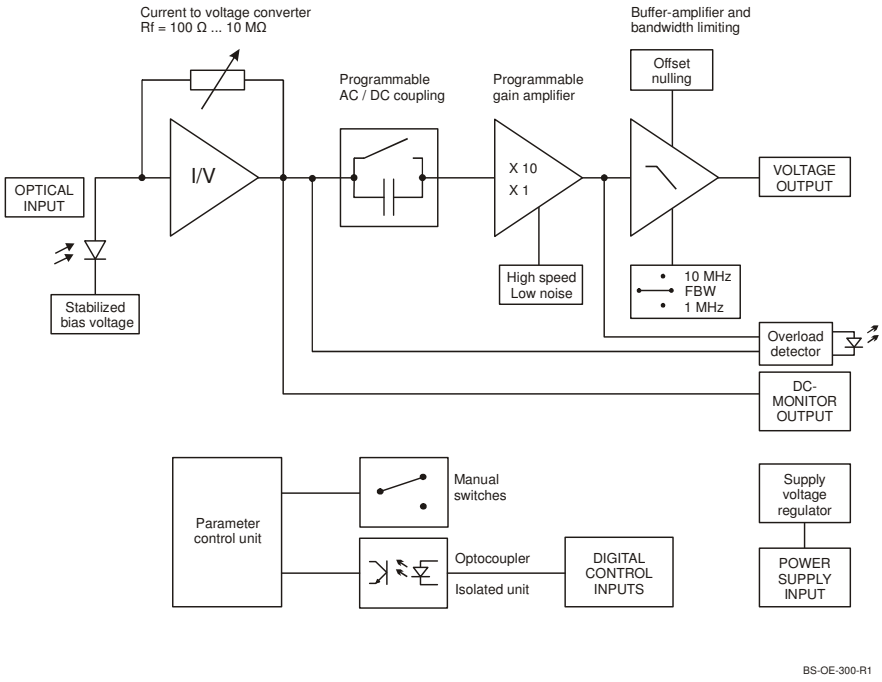
200 MHz Variable Gain Photoreceiver



The image shows model OE-300-IN-01-FC.

Features	• **Adjustable transimpedance gain from 10^2 to 10^8 V/A** • **Wide bandwidth up to 200 MHz** • **InGaAs-PIN photodiode covering the 900 to 1700 nm wavelength range** • **FC fiber optic input** • **High dynamic input range up to 10 mW optical power** • **Very low noise, NEP down to 47 fW/vHz** • **Switchable low pass filters for minimizing wideband noise** • **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	

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Available Versions	OE-300-IN-01-FC	FC fiber optic input
Related OE-300 Models	See separate datasheets for following models on www.femto.de:	
	OE-300-SI-10-FST	Si-PIN, 1 mm x 1 mm, 400 - 1000 nm 1.035”-40 threaded flange
	OE-300-SI-10-FS	Si-PIN, 1 mm x 1 mm, 400 - 1000 nm 25 mm dia. unthreaded flange
	OE-300-SI-30-FST	Si-PIN, ø 3 mm, 320 - 1000 nm 1.035”-40 threaded flange
	OE-300-SI-30-FS	Si-PIN, ø 3 mm, 320 - 1000 nm 25 mm dia. unthreaded flange
	OE-300-IN-03-FST	InGaAs-PIN, ø 300 µm, 800 - 1700 nm 1.035”-40 threaded flange
	OE-300-IN-03-FS	InGaAs-PIN, ø 300 µm, 800 - 1700 nm 25 mm dia. unthreaded flange
	OE-300-S	customized versions available on request
Available Accessories	PRA-PAP 	post adapter plate, easy to mount on FEMTO photoreceiver series OE, FWPR, HCA-S and LCA-S
	PS-15 	power supply, input: 100 - 240 VAC, output: ±15 VDC, +400/–250 mA
	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

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Specifications

Test conditions: $V_S = \pm 15$ V, $T_A = 25$ °C, system impedance = 50 Ω

Gain

Transimpedance gain	1 x 10^2 ... 1 x 10^8 V/A
Gain accuracy	±1 %

Frequency Response

Lower cut-off frequency	DC/100 Hz, switchable
Upper cut-off frequency	up to 200 MHz (see table below), switchable to 1 MHz or 10 MHz

Input

Noise equivalent power (NEP)	see table below
Max. CW saturation power	see table below

Detector

Detector	InGaAs-PIN photodiode
Active area	Integrated ball lens, suitable for fibers up to 62.5 µm core diameter
Spectral response	900 - 1700 nm
Sensitivity R	0.95 A/W typ. @ 1550 nm
Dark current	0.02 nA typ.

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
NEP (/√Hz, @ 1550 nm)	180 pW	22 pW	1.9 pW	390 fW	140 fW	50 fW
Measured at	20 MHz	8 MHz	1.4 MHz	350 kHz	180 kHz	22 kHz
Integrated input noise (RMS)*	4.9 µW	380 nW	23 nW	3.3 nW	0.84 nW	71 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
NEP (/√Hz, @ 1550 nm)	132 pW	6.3 pW	1.4 pW	350 fW	113 fW	47 fW
Measured at	18 MHz	8 MHz	1.4 MHz	350 kHz	180 kHz	22 kHz
Integrated input noise (RMS)*	3.0 µW	285 nW	21 nW	3.2 nW	0.84 nW	71 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 x 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:

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

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

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.

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Specifications (continued)

Output	Output voltage range	±1 V (@ 50 Ω load), for linear amplification
	Output impedance	50 Ω (designed for 50 Ω load)
	Slew rate	1000 V/µs
	Max. output current	±40 mA
	Output offset compensation	adjustable by offset potentiometer and external control voltage, output offset compensation range min. ±100 mV
Ext. Offset Control	Control voltage range	±10 V
	Offset control input impedance	15 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	non active: <0.4 V @ 0 ... –1 mA active: typ. 5 ... 5.1 V @ 0 ... 2 mA
Power Supply	Supply voltage	±15 V
	Supply current	+110/–90 mA (depends on operating conditions, recommended power supply capability min ±200 mA)
	Stabilized power supply output	±12 V, max. 20 mA, +5 V, max. 150 mA
Case	Weight	320 g (0.74 lb.)
	Material	AlMg4.5Mn, nickel-plated
DC Monitor Output	Monitor output gain	Mode: Low noise — Monitor gain: Gain setting divided by –1 Mode: High speed — Monitor gain: Gain setting divided by –10
	Monitor output polarity	inverting
	Monitor output voltage range	±1 V (@ ≥1 MΩ load)
	Monitor output bandwidth	DC ... 1 kHz
	Monitor output impedance	1 kΩ (designed for ≥1 MΩ load)
Temperature Range	Storage temperature	–40 ... +80 °C
	Operating temperature	0 ... +60 °C
Absolute Maximum Ratings	Max. CW power (averaged)	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

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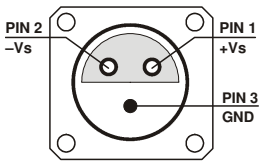
Connectors	Input	FC fiber optic receptacle
	Output	BNC jack (female)
	Power supply	Lemo® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52) Pin 1: +15 V Pin 2: –15 V Pin 3: GND



	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: digital output: overload (referred to pin 3) Pin 6: DC Monitor output Pin 7: NC (= not connected) Pin 8: output 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 (= not connected)
Scope of Delivery	OE-300-IN-01-FC, Lemo® 3-pin connector, datasheet, transport package	

200 MHz Variable Gain Photoreceiver

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.

Gain setting

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

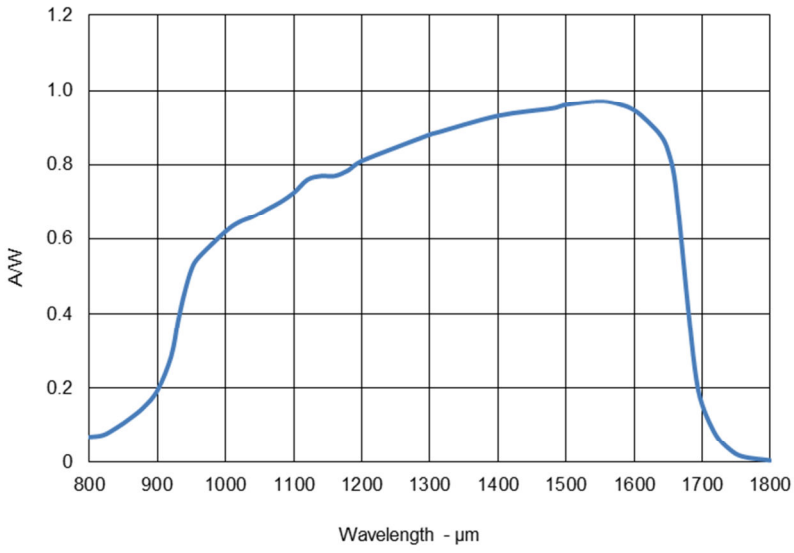
Low pass filter setting

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

Spectral Responsivity



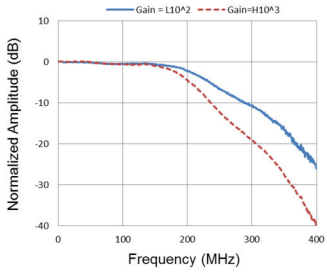
200 MHz Variable Gain Photoreceiver

Typical Performance Characteristic

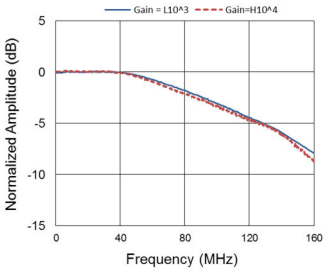
Frequency response

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

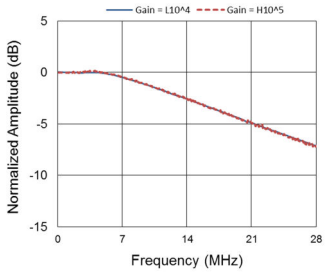
Gain setting: $L10^2$, $H10^3$



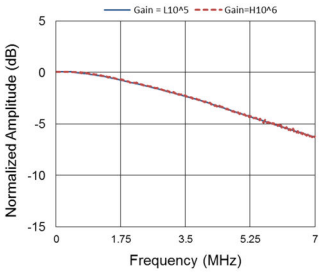
Gain setting: $L10^3$, $H10^4$



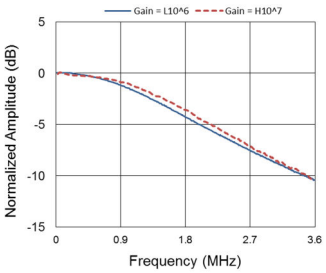
Gain setting: $L10^4$, $H10^5$



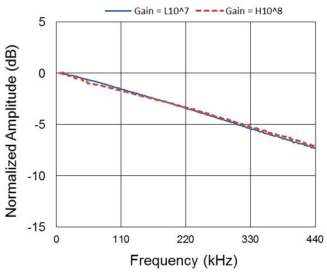
Gain setting: $L10^5$, $H10^6$



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



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



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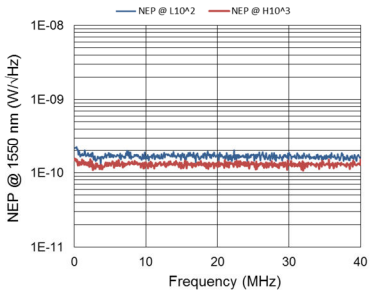
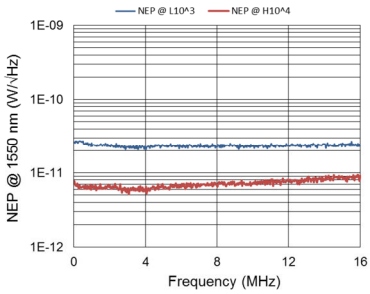
Typical Performance Characteristic (continued)

Input noise equivalent power (NEP)

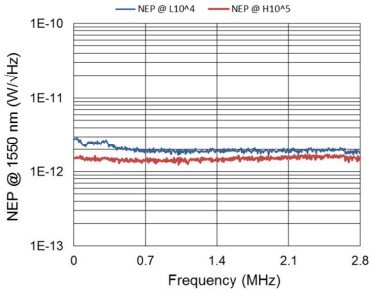
Gain setting $L10^2$, $H10^3$



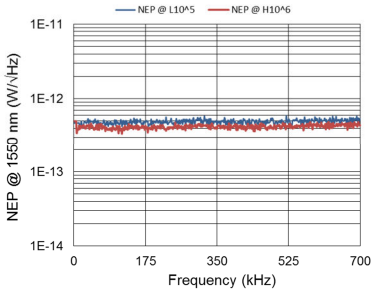
Gain setting $L10^3$, $H10^4$



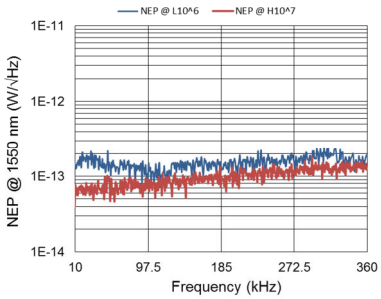
Gain setting: $L10^4$, $H10^5$



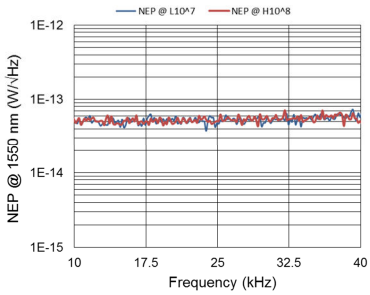
Gain setting: $L10^5$, $H10^6$



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



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



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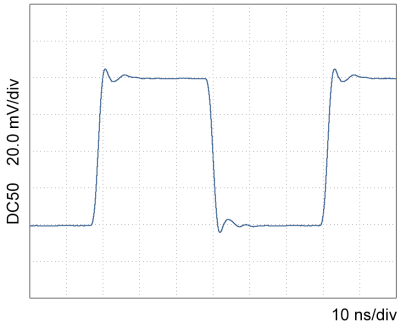
Typical Performance Characteristic (continued)

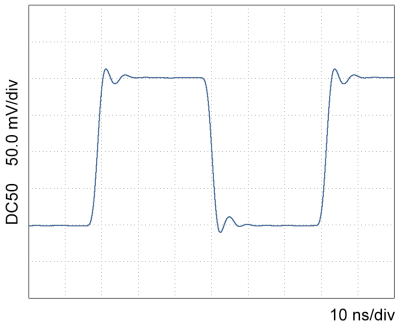
Signal pulse response

Gain setting L10[2]



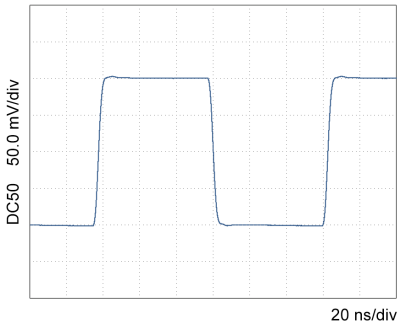
Rise: 1.84 ns Fall: 1.90 ns

Gain setting H10[3]



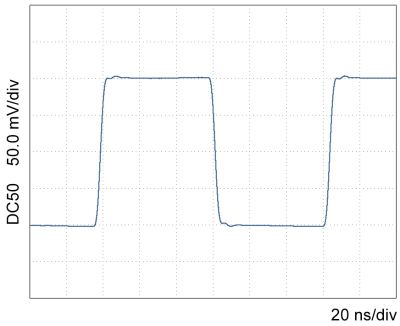
Rise: 2.27 ns Fall: 2.32 ns

Gain setting L10[3]



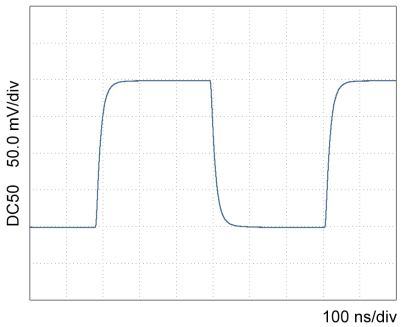
Rise: 3.30 ns Fall: 3.41 ns

Gain setting H10[4]



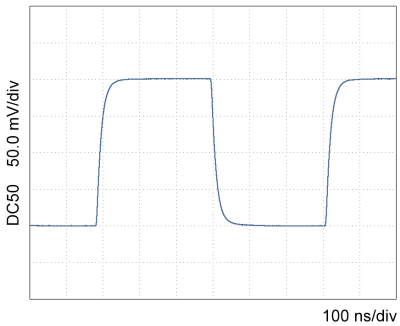
Rise: 3.44 ns Fall: 3.52 ns

Gain setting L10[4]



Rise: 26.42 ns Fall: 26.49 ns

Gain setting H10[5]



Rise: 26.77 ns Fall: 27.01 ns

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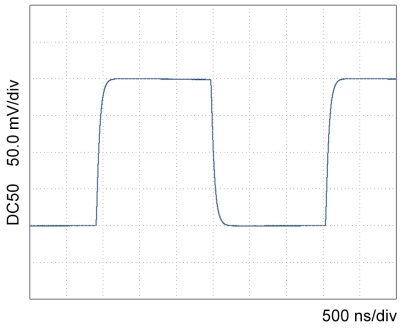
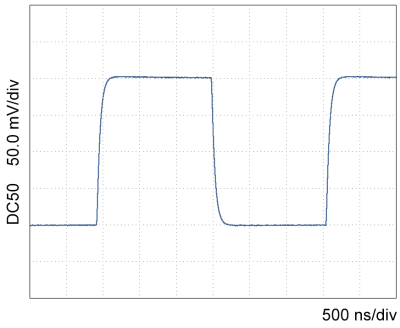
Typical Performance Characteristic (continued)

Gain setting L10[5]



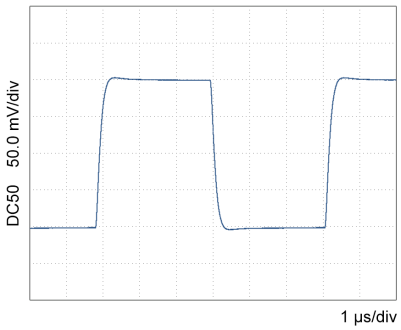
Rise: 88.40 ns Fall: 90.48 ns

Gain setting H10[6]



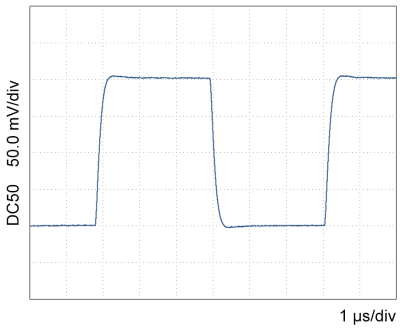
Rise: 88.56 ns Fall: 90.40 ns

Gain setting L10[6]



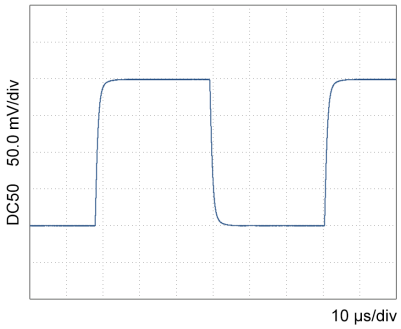
Rise: 207.20 ns Fall: 211.36 ns

Gain setting H10[7]



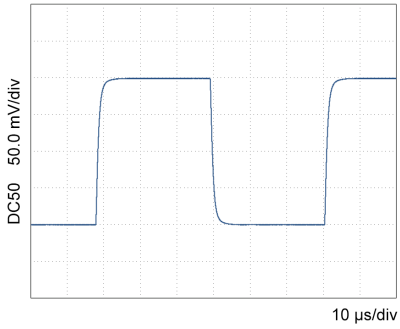
Rise: 202.32 ns Fall: 209.60 ns

Gain setting L10[7]



Rise: 1457.6 ns Fall: 1437.6 ns

Gain setting H10[8]



Rise: 1456.0 ns Fall: 1499.2 ns

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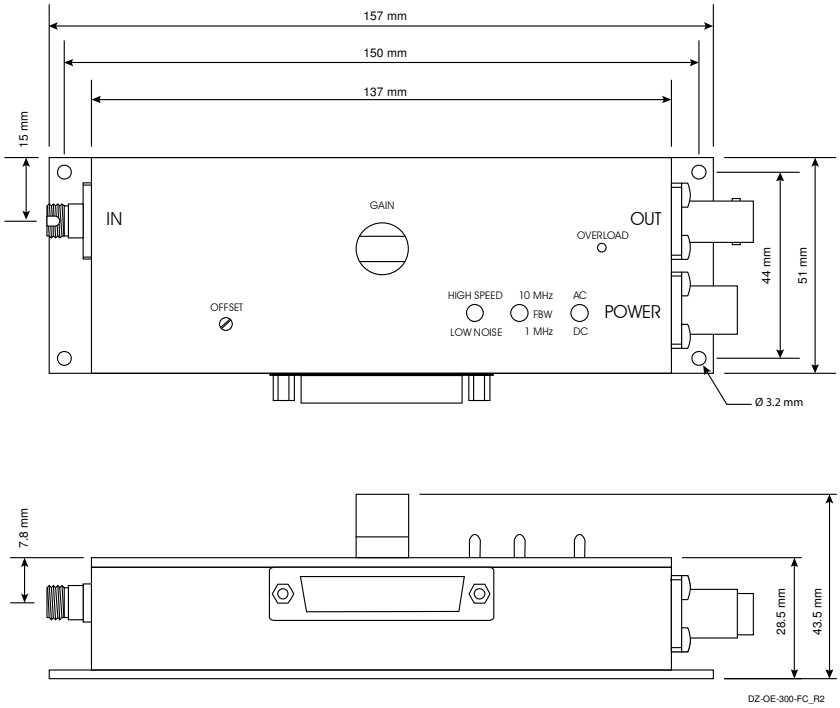
Dimensions

Fiber optic input OE-300-IN-01-FC:



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