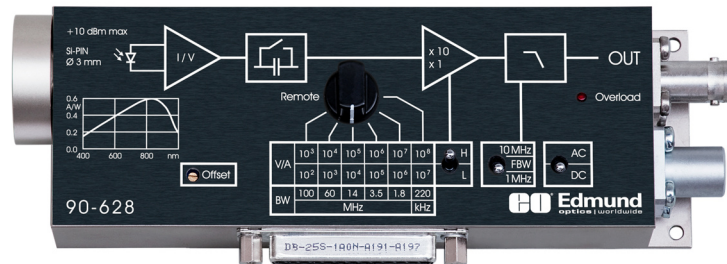


## 100 MHz Variable Gain Photoreceiver



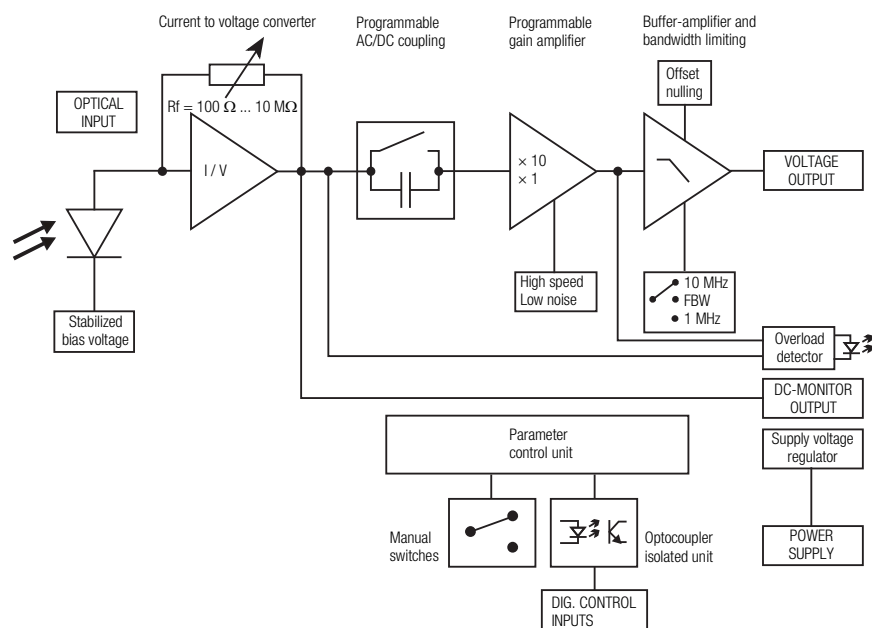
### Features

- 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 fW/√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



## 100 MHz Variable Gain Photoreceiver

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Intended Use          | <p>The #90-628 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 our support.</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> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Related Models        | See further information for following models on <a href="http://www.edmundoptics.com">www.edmundoptics.com</a> :                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| InGaAs Versions       | #90-630<br><br>#90-629                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | InGaAs-PIN, Ø 80 µm, 900 - 1700 nm<br>FC fiber receptacle<br><br>InGaAs-PIN, Ø 300 µm, 800 - 1700 nm<br>1.035"-40 threaded flange                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Available Accessories | #90-631<br>#90-632<br>#90-633<br><br>#59-180                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <br>FC/PC, FC/APC and FSMA Fiber-adapter with external 1.035"-40 thread<br><br><br>Power Supply<br>input: 100 – 240 VAC<br>output: ±15 VDC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Specifications        | Test conditions<br><br>Gain<br>Transimpedance gain<br>Gain accuracy<br><br>Frequency Response<br>Lower cut-off frequency<br>Upper cut-off frequency (–3 dB)<br><br>Input<br>Optical CW saturation power<br>Noise equivalent power (NEP)<br><br>Detector<br>Detector type<br>Active area<br>Spectral range<br>Sensitivity<br>Dark current<br><br>Output<br>Output voltage rang<br>Output impedance<br>Max. output current<br>Slew rate<br>Output offset compensation<br><br>Indicator LED<br>Function<br><br>Digital Control<br>Control input voltage range<br>Control input current<br>Overload output                           | $V_s = \pm 15 \text{ V}$ , $T_A = 25 \text{ }^\circ\text{C}$ , output load impedance $50 \text{ } \Omega$ , warm-up 20 minutes (min. 10 minutes recommended)<br><br>$1 \times 10^2 \dots 1 \times 10^8 \text{ V/A}$ (output load $50 \text{ } \Omega$ )<br>$\pm 1 \text{ } \%$ electrical, between settings<br><br>DC / 100 Hz, switchable<br>up to 100 MHz (see table below), switchable to 1 MHz or 10 MHz<br><br>see table below<br>see table below<br><br>Si-PIN photodiode<br>3 mm diameter<br>320 - 1000 nm<br>0.59 A/W typ. (@ 850 nm)<br>0.1 nA typ.<br><br>$\pm 1 \text{ V}$ (@ $50 \text{ } \Omega$ output load), for linear amplification<br>$50 \text{ } \Omega$ (designed for $50 \text{ } \Omega$ load)<br>$\pm 40 \text{ mA}$ (short-circuit proof)<br>1000 V/µs<br>adjustable by offset potentiometer and external control voltage, output offset compensation range min. $\pm 100 \text{ mV}$<br><br>overload<br><br>LOW bit: $-0.8 \text{ V} \dots +1.2 \text{ V}$ , HIGH bit: $+2.3 \text{ V} \dots +12 \text{ V}$<br>0 mA @ 0 V, 1.5 mA @ +5 V, 4.5 mA @ +12 V<br>non active: $<0.4 \text{ V}$ @ 0 ... $-1 \text{ mA}$<br>active: typ. 5 ... 5.1 V @ 0 ... 2 mA |

## 100 MHz Variable Gain Photoreceiver

### Specifications (continued)

Performance depending  
on Gain Setting

| Gain setting (low noise) (V/A)  | 10 <sup>2</sup> | 10 <sup>3</sup> | 10 <sup>4</sup> | 10 <sup>5</sup> | 10 <sup>6</sup> | 10 <sup>7</sup> |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Upper cut-off frequency (–3 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 (√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 <sup>3</sup> | 10 <sup>4</sup> | 10 <sup>5</sup> | 10 <sup>6</sup> | 10 <sup>7</sup> | 10 <sup>8</sup> |
| Upper cut-off frequency (–3 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 (√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           |

\* 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 × 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.

### DC Monitor Output

| Monitor output gain          | Mode                           | Monitor gain                |
|------------------------------|--------------------------------|-----------------------------|
|                              | Low noise                      | Gain setting divided by –1  |
|                              | High speed                     | 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) |                             |

### Ext. Offset Control

|                                |       |
|--------------------------------|-------|
| Control voltage range          | ±10 V |
| Offset control input impedance | 15 kΩ |

### Optical Input Connector

|                       |                                            |
|-----------------------|--------------------------------------------|
| Material flange       | 1.4305 stainless steel, nickel-plated      |
| Material 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) |

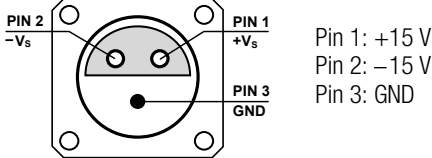
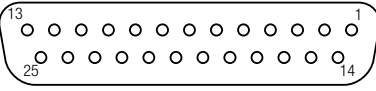
### Case

|          |                          |
|----------|--------------------------|
| 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   |

# 100 MHz Variable Gain Photoreceiver

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Absolute Maximum Ratings | <p>Optical input power (CW) 12 mW</p> <p>Digital control input voltage <math>-5\text{ V}/+16\text{ V}</math> relative to digital ground DGND (pin 9)</p> <p>Analog control input voltage <math>\pm 15\text{ V}</math> relative to analog ground AGND (pin 3)</p> <p>Power supply voltage <math>\pm 20\text{ V}</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Connectors               | <p>Input 1.035"-40 threaded flange for free space applications</p> <p>Output BNC jack (female)</p> <p>Power supply LEMO® series 1S, 3-pin fixed socket (mating plug type: FFA.1S.303.CLAC52)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                          | <p>Control port Sub-D 25-pin, female, qual. class 2</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|                          | <p>Pin 1: +12 V (stabilized power supply output*)</p> <p>Pin 2: -12 V (stabilized power supply output*)</p> <p>Pin 3: AGND (analog ground for pins 1 - 8)</p> <p>Pin 4: +5 V (stabilized power supply output*)</p> <p>Pin 5: digital output: overload (referred to pin 3)</p> <p>Pin 6: DC Monitor output</p> <p>Pin 7: NC</p> <p>Pin 8: offset control voltage input</p> <p>Pin 9: DGND (ground for digital control pins 10 - 16)</p> <p>Pin 10: digital control input: gain, LSB</p> <p>Pin 11: digital control input: gain</p> <p>Pin 12: digital control input: gain, MSB</p> <p>Pin 13: digital control input: AC/DC</p> <p>Pin 14: digital control input: high speed / low noise</p> <p>Pin 15: upper cut-off frequency limit 10 MHz</p> <p>Pin 16: upper cut-off frequency limit 1 MHz</p> <p>Pin 17 - 25: NC</p> <p>*stabilized power supply output current<br/> <math>\pm 12\text{ V}</math>: max. <math>\pm 20\text{ mA}</math>, <math>+5\text{ V}</math>: max. <math>30\text{ mA}</math></p> |

## 100 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", "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   |

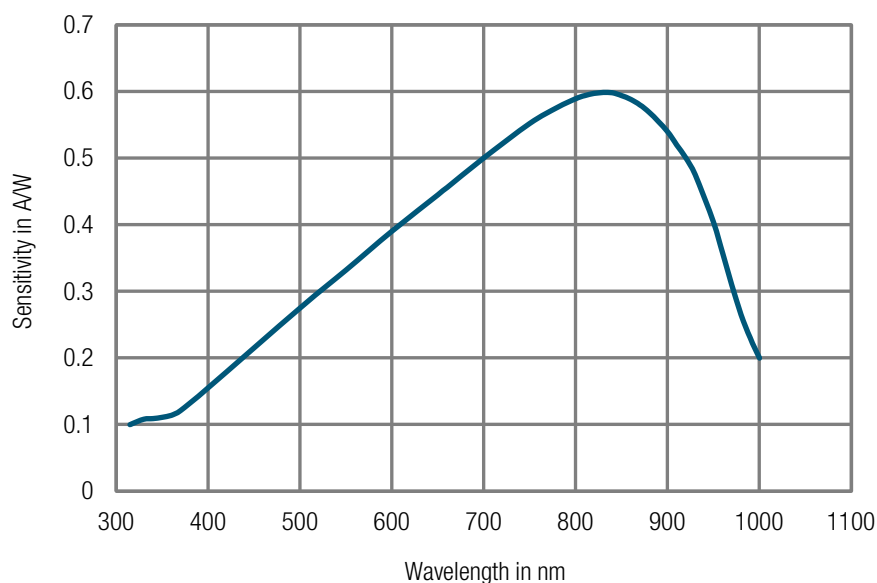
#### High speed / low noise setting

| Mode            | Pin 14 |
|-----------------|--------|
| low noise mode  | LOW    |
| high speed mode | HIGH   |

### Scope of Delivery

#90-628, internally threaded coupler ring, LEMO® 3-pin connector, datasheet, transport package

### Spectral Responsivity



DB-Sens-OE-300-SI-10\_R02

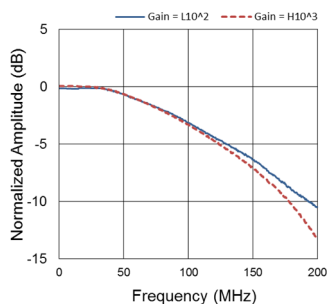
# 100 MHz Variable Gain Photoreceiver

Typical Performance  
Characteristic

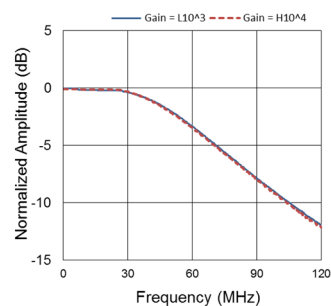
Frequency response

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

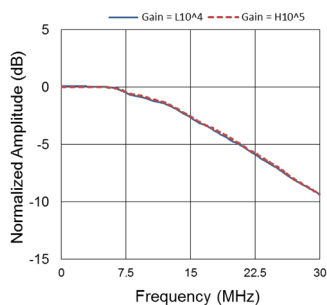
Gain setting:  $L10^2, H10^3$



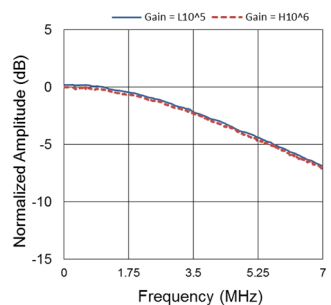
Gain setting:  $L10^3, H10^4$



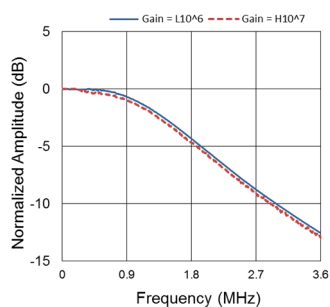
Gain setting:  $L10^4, H10^5$



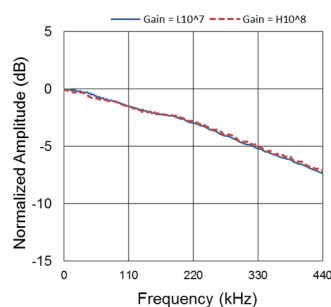
Gain setting:  $L10^5, H10^6$



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



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

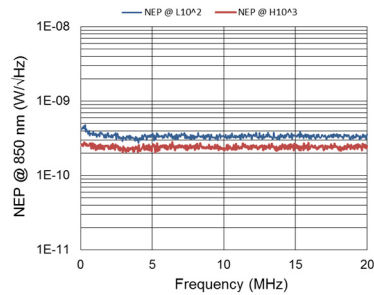


# 100 MHz Variable Gain Photoreceiver

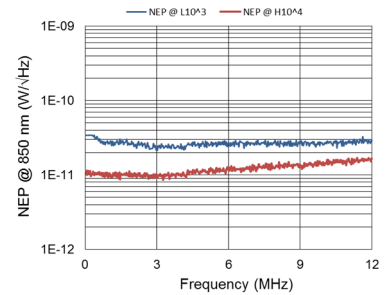
Typical Performance  
Characteristic (continued)

Input noise equivalent power (NEP)

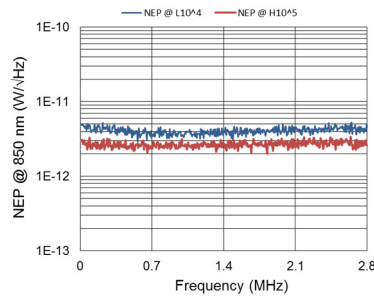
Gain setting  $L10^2, H10^3$



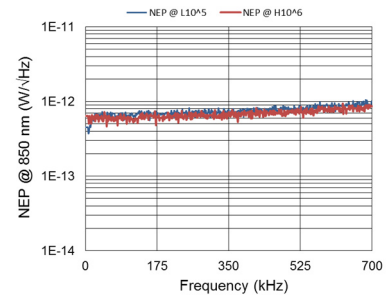
Gain setting  $L10^3, H10^4$



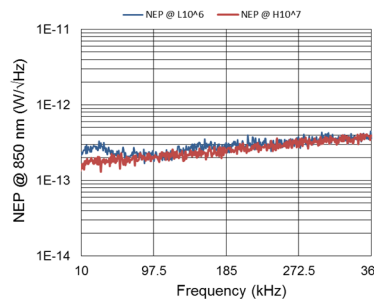
Gain setting:  $L10^4, H10^5$



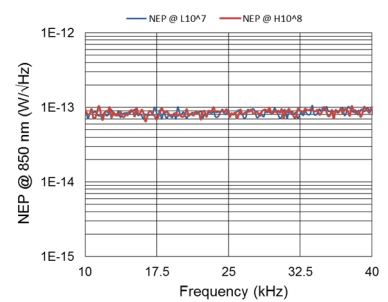
Gain setting:  $L10^5, H10^6$



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



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

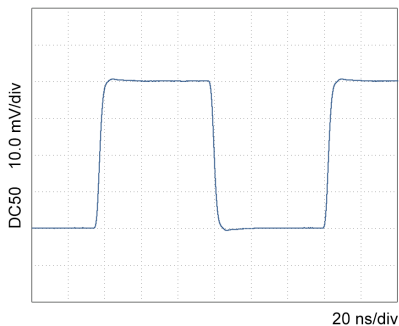


## 100 MHz Variable Gain Photoreceiver

Typical Performance  
Characteristic (continued)

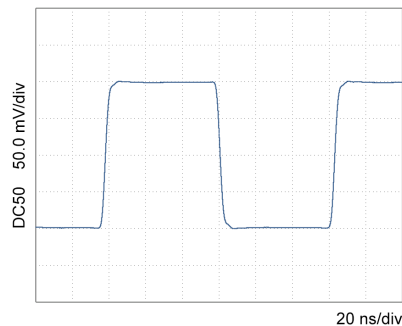
Signal pulse response

Gain setting L10<sup>2</sup>



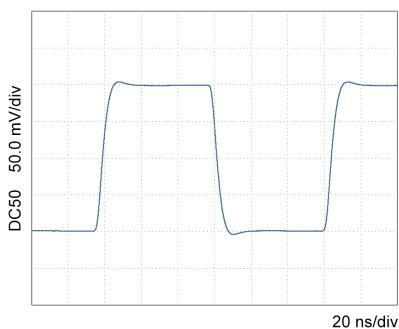
Rise: 3.35 ns Fall: 3.36 ns

Gain setting H10<sup>3</sup>



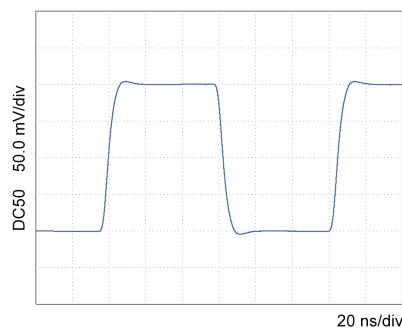
Rise: 3.51 ns Fall: 3.55 ns

Gain setting L10<sup>3</sup>



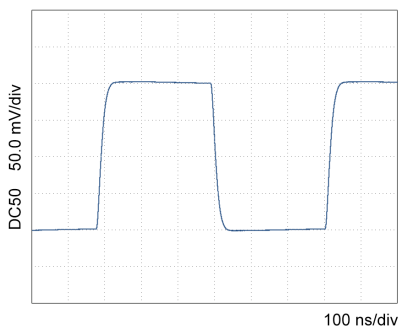
Rise: 5.83 ns Fall: 5.87 ns

Gain setting H10<sup>4</sup>



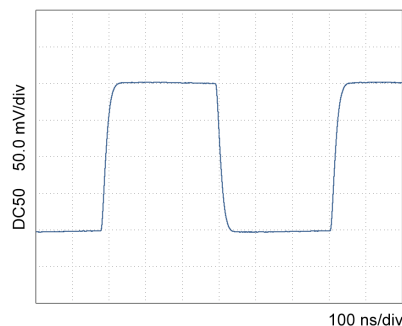
Rise: 6.03 ns Fall: 6.06 ns

Gain setting L10<sup>4</sup>



Rise: 22.73 ns Fall: 22.58 ns

Gain setting H10<sup>5</sup>

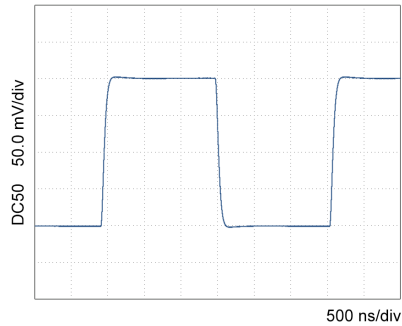


Rise: 23.14 ns Fall: 22.98 ns

## 100 MHz Variable Gain Photoreceiver

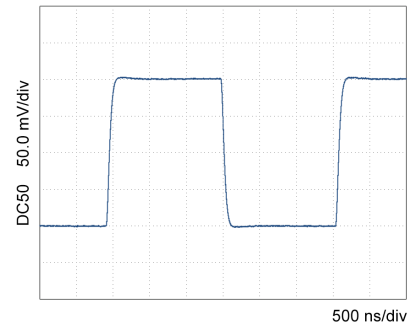
Typical Performance  
Characteristic (continued)

Gain setting L10<sup>5</sup>



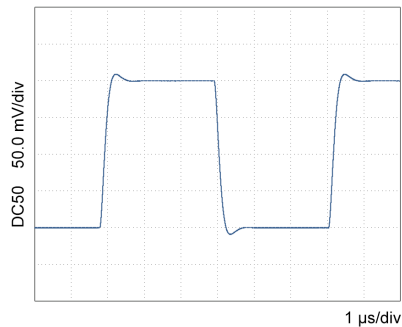
Rise: 73.72 ns Fall: 73.76 ns

Gain setting H10<sup>6</sup>



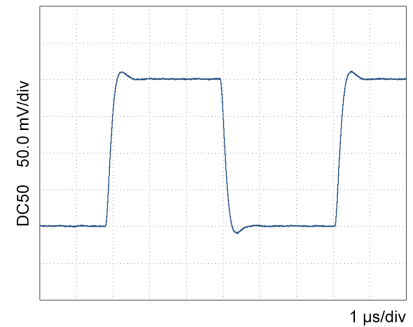
Rise: 73.76 ns Fall: 74.36 ns

Gain setting L10<sup>6</sup>



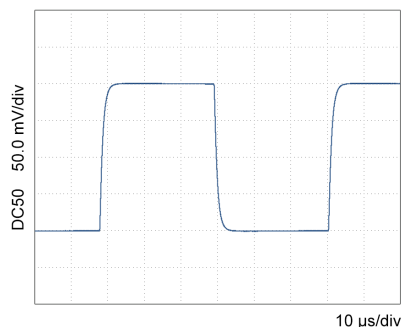
Rise: 202.64 ns Fall: 203.04 ns

Gain setting H10<sup>7</sup>



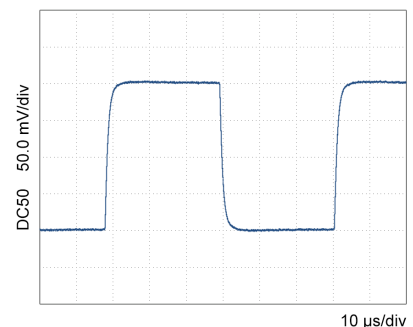
Rise: 201.28 ns Fall: 202.88 ns

Gain setting L10<sup>7</sup>



Rise: 1656.0 ns Fall: 1636.8 ns

Gain setting H10<sup>8</sup>

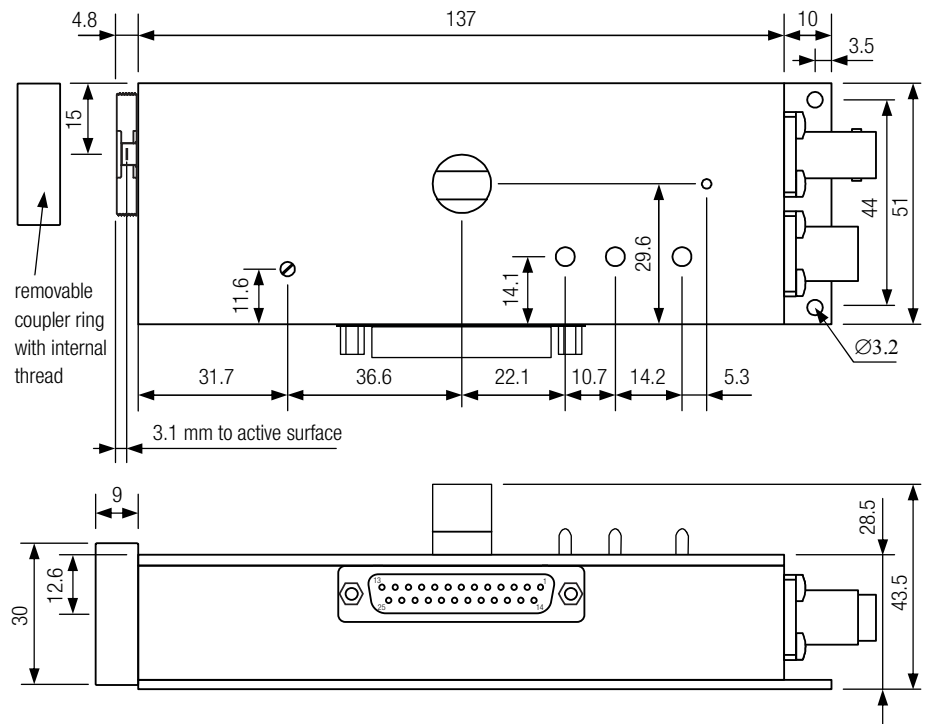


Rise: 1631.2 ns Fall: 1699.2 ns

## 100 MHz Variable Gain Photoreceiver

## Dimensions

#90-628



all dimensions in mm unless otherwise noted

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