THORLABS

Balanced Amplified Photodetectors

PDB210 Series
Operation Manual

2012

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Contents

We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to live up to your expectations and improve our products permanently we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. We and our international partners are looking forward to hearing from you.

Thorlabs GmbH

Warning

Sections marked by this symbol explain dangers that might result in personal injury or death. Always read the associated information carefully, before performing the indicated procedure.

Attention

Paragraphs preceeded by this symbol explain hazards that could damage the instrument and the connected equipment or may cause loss of data.

Note

This manual also contains "NOTES" and "HINTS" written in this form.

Please read these advices carefully!

1 General Information

Thorlabs PDB210 Series Balanced Amplified Photodetectors consist of two well-matched, large-area photodiodes and an ultra-low noise, high-speed transimpedance amplifier that generates an output voltage (RF OUTPUT) proportional to the difference between the photo currents in the two photodiodes, i.e. the two optical input signals. Additionally, the unit has two fast monitor outputs (MONITOR+ and MONITOR-) to measure the individual optical input power level as well as low frequency modulated signals on each detector separately.

The PDB210 Series new slim line housing has three tapped holes (8/32 or M4) for convenient mounting to the optical setup. The input aperture is fitted with both an external SM1 and an internal SM05 thread that is compatible with any number of Thorlabs 1" and ½" threaded accessories. The supplied SM1T1 adapter allows to mount to input aperture any outer threaded SM1 accessories, e.g., external optics, filters, apertures or fiber adapters, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories.

The PDB210 Series is supplied with an external linear power supply.

The "Getting Started" 4 section gives an overview of how to set up the PDB210 Series Balanced Amplified Photodetectors. Subsequent sections contain detailed information about principle of operation, operating suggestions and technical specifications.

1.1 Safety

Attention

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly as it was designed for.
All modules must only be operated with proper shielded connection cables.
Only with written consent from *Thorlabs* may changes to single components be carried out or components not supplied by *Thorlabs* be used.
This precision device is only serviceable if properly packed into the complete original packaging including the plastic foam sleeves. If necessary, ask for a replacement package.

1.2 Ordering Codes and Accessories

The following models of the PDB210 Series are available:

PDB210A 1 MHz, fixed gain, large area Balanced Amplified Photodetectors with Si PIN photo diodes

PDB210A2 1 MHz, fixed gain, large area Balanced Amplified Photodetectors with UV enhanced Si PIN photo diodes

PDB210C 1 MHz, fixed gain, large area Balanced Amplified Photodetectors with InGaAs PIN photodiodes

All versions are available with imperial (8/32) or metric (M4) mounting holes. Metric versions are marked "**/M**"

According to Thorlabs general detector part numbering system, appendix "A" indicates Si photodiodes while appendix "C" indicates InGaAs photodiodes.

Thorlabs offers on request AC-coupled versions. Special versions (open detector - cover glass removed) are available as well - please contact Thorlabs 23 for details.

2 Installation

This section is intended to provide information how to set up quickly the PDB210 Series Balanced Amplified Photodetectors. More details and advanced features are described in further sections.

2.1 Parts List

Inspect the shipping container for damage.

If the shipping container seems to be damaged, keep it until you have inspected the contents and you have inspected the item mechanically and electrically.

Verify that you have received the following items within the package:

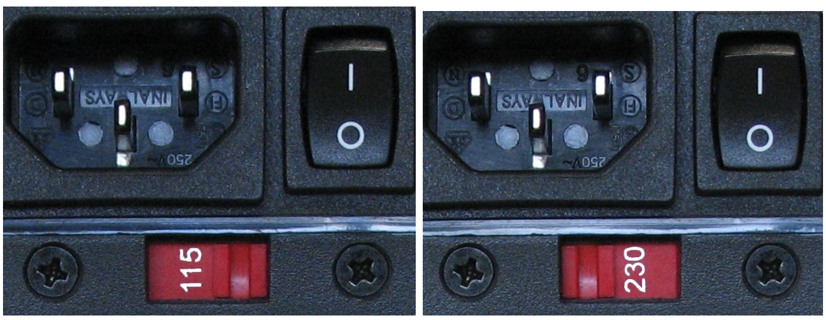
1. PDB210x Balanced Amplified Photodetector
2. 2 pcs. SM1T1 (SM1 internal thread) adapter
3. 2 pcs. metal cover caps for input aperture
4. Power supply (±12V, 0.2A), switchable to 115V or 230V line voltage
5. Operation manual

2.2 Getting Started

Note

Please check prior to operation, if the indicated line voltage range on the power supply matches with your local mains voltage! If you want use your own power supply, Thorlabs offers an appropriate power connector cable.

- Carefully unpack the unit and accessories. If any damage is noticed, do not use the unit. Contact Thorlabs 23 and have us replace the defective unit.
- If required, mount the unit on your optical table or application. The unit has three tapped mounting holes 21.
- Remove the metal cover caps on the optical inputs to detect your optical signal.
- If required, mount external optics, filters, apertures or fiber adapters.
- Set the power supply to your local mains voltage (115 or 230 VAC):



- Connect the DC output cable of the power supply to the POWER IN jack.
- Connect the power supply to the AC outlet, turn power supply on
- Connect RF OUTPUT with coaxial cable to the data acquisition device.
- If necessary, connect monitor outputs (MONITOR+, MONITOR-) to measure the optical input power for each channel individually.

3 Operating Instruction

- Turn the power switch of the power supply and on the PDB210 Series to **I**. The green LED next to the DC input connector indicates correct power supply.
- Adjust the optical source(s) to the optical input(s).MONITOR outputs can be used for convenient alignment of free space input beams. The maximum output voltage swing of the MONITOR outputs is 10V for high impedance loads (1.5 V into 50 Ω loads). Saturation of the MONITOR outputs will occur at optical input power greater than 1 mW.
- The RF output signal must not exceed the maximum RF OUTPUT voltage swing (see Technical Data 14) to avoid saturation. External neutral density filters or attenuators are recommended to reduce the input light level in critical cases.
- For balanced operation illuminate both photodetectors simultaneously and use either the RF OUTPUT or the MONITOR outputs to fine-tune the optical power balance by observing voltage on a digital voltmeter or other low-frequency measurement device.
- Do not exceed a maximum power density of 4 W/cm^2 for maximum linearity performance when measuring focused beams, fiber outputs, or small diameter beams.
- Thorlabs S120-xx series fiber adapters can be easily mounted to the optical inputs. Thorlabs offers such adapters as well for single-mode fibers (connector styles FC, SC, ST and LC) and for multi-mode fibers (connector SMA)
- After finishing measurements, turn power off.

Note

To prevent saturation of the balanced amplifier make sure that the power difference between the optical inputs remains less than the saturation power level (see "RF OUT CW Saturation Power" in section Technical Data 14).

Attention

The damage threshold of the photo diodes is 20mW! Exceeding this value will permanently destroy the detector!

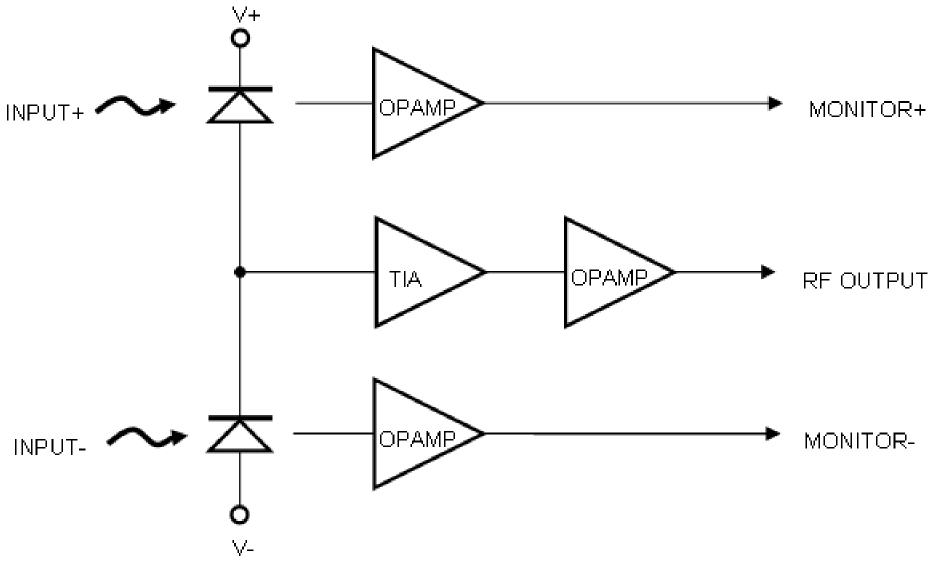
3.1 Operating Principle

Thorlabs PDB210 Series Balanced Amplified Photodetectors consist of two well-matched, large-area photodiodes and an ultra-low noise, high-speed transimpedance amplifier that generates an output voltage (**RF OUTPUT**) proportional to the difference between the photo currents of the two photodiodes, i.e. the difference of between the two optical input signals.

Additionally, the unit has two monitor outputs (**MONITOR+** and **MONITOR-**) to observe the optical input power level on each photodiode separately. Due to their increased cut-off frequency, these outputs can also be used to measure low frequency modulated signals on each detector separately.

The PDB210 Series is powered by an external linear power supply (±12 V, 200 mA - included) via a PICO M8 power connector.

Below is a functional block diagram of the PDB210 Series Balanced Amplified Photodetectors:



3.2 Optical Inputs

The optical input is of free space type. Open beams should be carefully aligned to the detectors. To avoid overfill of the active detector area, use with large beam diameters additional focusing lenses in front of the optical input. Thorlabs offers a large variety of lenses and mounting accessories. The housing is compatible with any number of Thorlabs 1” and ½” threaded accessories. This allows convenient mounting of external optics, filters, apertures or fiber adapters, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories.

For fiber coupled applications, Thorlabs S120-xx series fiber adapters can be easily mounted to the optical inputs. Thorlabs offers such adapters as well for single-mode fibers (connector styles FC, SC, ST and LC) and for multi-mode fibers (connector SMA).

The RF OUTPUT will saturate at an optical input power greater than CW Saturation Power listed in Specifications 14. If necessary, use external neutral density filters or attenuators to reduce the input light level. Please note, that the PDB210x Balanced Amplified Photodetectors are very sensitive to unwanted stray light. It's important to shield carefully the input apertures from any unwanted light sources. Common techniques are baffling or other opaque barriers like black cloths, beam tubes or use appropriate band pass filters in front of the detector to minimize the influence of stray light.

Do not exceed a maximum power density of 4 W/cm^2 for maximum linearity performance when measuring focused or small diameter beams. Always try to illuminate the whole detector active area to prevent nonlinearities. Equal power densities on both detectors are important for maximum common mode noise suppression (CMRR).

The PDB210 Series can be used in balanced mode (both inputs are illuminated) as well as in single detector mode. In single detector mode, the RF OUTPUT swing depends on which INPUT is used, it is positive for INPUT+ and negative for INPUT-.

In single detector mode the optical input power should be below the CW saturation power listed in specification to avoid saturation of the RF OUTPUT amplifier.

In balanced mode the power difference between the optical inputs should be less than the CW Saturation Power. If necessary, use external neutral density filters or attenuators to reduce the input light level.

Attention

The optical damage threshold is 20 mW. Exceeding this value will permanently damage the photodiodes!

3.3 Electrical Outputs

The Thorlabs PDB210 Series has three BNC output connectors:

- **MONITOR +**
- **MONITOR -**
- **RF OUTPUT**

RF OUTPUT delivers an output voltage proportional to the difference between the photo currents of the two photodiodes This voltage can by calculated to:

$$U_{RF,OUT} = \left(P_{opt,1} - P_{opt,2}\right) \times \Re(\lambda) \times G$$

with: $\Re(\lambda)$ - responsivity of the photo diode at given wavelength

$P_{opt,1}$ and $P_{opt,2}$ - optical input power

G - transimpedance gain of the RF output

The responsivity $\Re(\lambda)$ for a given wavelength can be read from the individual curves in section Technical Data 14 to estimate the **RF OUTPUT** voltage. Please note that the given responsivity curves represent typical values - individual responsivity may deviate.

The maximum output voltage swing of the **RF OUTPUT** is ±10V for high impedance loads and ±3.5 V into 50 Ω.

The optical input saturation power (see Technical Data 14) of the balanced detector is the min. value, as it's given at the wavelength with the highest responsivity of the detector. Away from this wavelength, the saturation will be reached at a higher input power level. The output signal should not exceed the maximum output voltage to avoid saturation. Therefore the optical input power (or the power difference between the optical inputs) should not exceed CW Saturation Power listed in Specifications.

MONITOR Outputs

The signal monitor outputs (**MONITOR+** and **MONITOR-**) allow observation of the input power level and can be used as individual power indicators. These outputs can also be used to measure low frequency modulated signals on each detector separately. The maximum output voltage swing of the **MONITOR** output is +10 V for high impedance loads (+1.5 V into 50 Ω). Saturation of **MONITOR** outputs will occur at optical input power level greater than 1 mW, depending on the detector's wavelength response.

MONITOR outputs can be used to roughly adjust equal input power levels on each detector for balanced operation. While the DC component of the **RF OUTPUT** in balanced mode is zero, the **MONITOR** outputs provide capability to independently observe the individual optical input power. **MONITOR** outputs of the unit are also convenient to use for free-space beam alignment.

The amplifier offset voltage is factory set to zero at 23°C ambient temperature. A small drift during a short warm-up period (~5min) may occur. For exact DC light level measurements a constant temperature environment is recommended.

3.4 Mounting

The PDB210 Series is housed in a rugged shielded aluminum enclosure. This new slim line housing has three tapped holes (8/32 or M4) for convenient mounting to the optical setup. The input aperture is fitted with both an external SM1 and an internal SM05 thread that is compatible with any number of Thorlabs 1” and ½” threaded accessories. The supplied SM1T1 adapter allows to mount to input aperture any outer threaded SM1 accessories, e.g., external optics, filters, apertures or fiber adaptors, as well as providing an easy mounting mechanism using the Thorlabs cage assembly accessories.

Electrical connectors and the **ON/OFF** switch are located on the side surfaces of the housing. This eases access and minimizes the thickness of the PDB210 Series Balanced Amplified Photodetectors.

For maximum flexibility the PDB210 Series has three 8-32 (M4 for metric version) tapped mounting holes to mount the unit to a post or pedestal:

3.5 AC Coupling of the Outputs

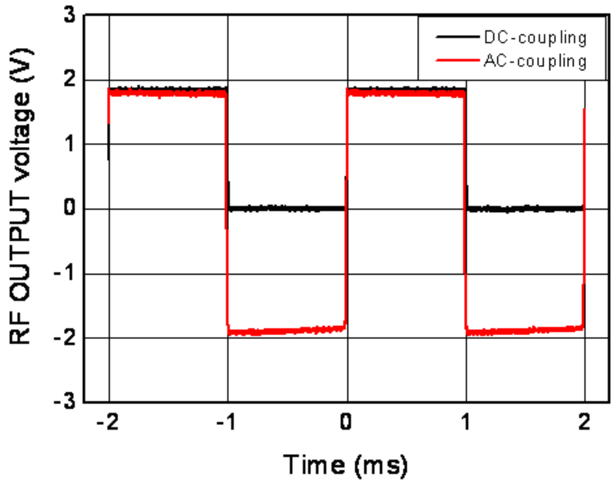
Beside the standard DC coupling of the **RF OUTPUT**, AC coupled versions for any model of PDB210 Series are available on request. AC coupling blocks the CW component (the unmodulated part) of the optical input signal. However, large CW components of the optical input signal will decrease linearity of the detectors.

AC coupling helps to improve the measurement capabilities in applications, where a comparably weak frequency modulated signal shall be measured on a strong CW background signal, which could saturate the amplifier. With AC coupling, equalizing of CW power levels on both inputs is not mandatory for noise cancellation. However, for optimal noise suppression the signal of interest (e.g. the modulated part) should be well balanced. AC coupling is also recommended when using the balanced detector in combination with a chopper and lock-in amplifier to further decrease noise level. Therefore lower cut-off frequency is optimized to work with chopper frequencies down to 100 Hz.

Please note, that AC coupling slightly increases noise figures at lower frequencies, measurement bandwidth of the RF OUTPUT is not affected by AC coupling.

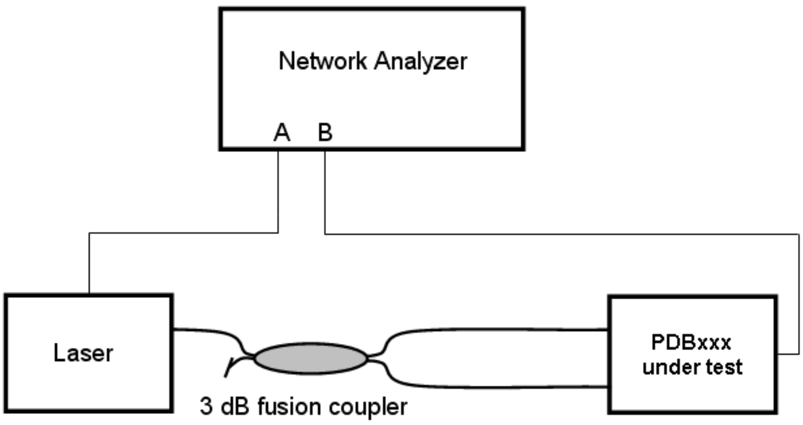
The figure below shows the comparison of AC and DC coupled RF Output signals when modulating the input signal with a mechanical chopper at a frequency of 500 Hz.

Note: Input signal for AC coupling was increased by factor 2 to allow direct waveform comparison



3.6 CMRR and Frequency Response

An important specification for balanced amplifiers is it's ability to suppress common mode noise, which is reflected in the Common Mode Rejection Ratio (CMRR). In the setup as described below, the Device under Test (DuT) - here a PDB210 Series balanced detector - is tested for CMRR. A common mode signal is generated, which is canceled out when the amplifier is in balanced mode.



A network analyzer is used as signal generator (output A) and receiver (input B) The receiver is synchronized with the signal generator and measures selectively at the same frequency. A laser light source is modulated by the signal generator (port A) and acts as transmitter. To the laser output a 3 dB fusion coupler is connected, splitting the modulated light signal into two paths.Depending on the measurement task, one or both coupler outputs are connected to the inputs of the DuT, for example using S120-FC adapters. One of the DuT's outputs is connected to the network analyzers Port B.

Frequency response measurements

The frequency response of each signal path can be measured by connecting only one coupler output to the appropriate input. This way, the frequency response curves of the RF OUTPUT from INPUT + and INPUT- can be measured, as well as the frequency responses of the MONITOR outputs, as shown in the individual technical data.

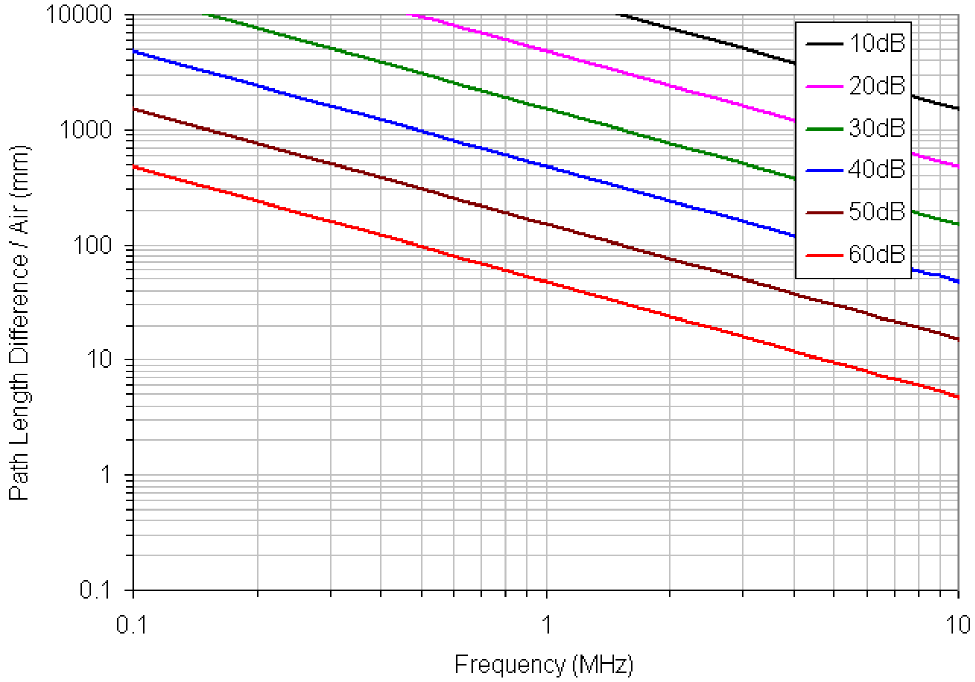
CMRR measurement

For Common Mode Rejection measurement, both outputs of the fusion coupler are connected to both inputs of the DuT. The optical power level at both inputs must be well matched ("balanced") in order to achieve the optimal common mode suppression. Now the common mode rejection can be measured as a function of frequency. The frequency response of the RF OUTPUT must be considered when calculating the CMRR - it is the difference between the RF OUTPUT signal at a given frequency and the measured common mode or balanced output signal - at the same frequency. Typical measurement curves can be found in the individual technical data.

3.7 Recommendations

Thorlabs PDB210 Series Balanced Amplified Photodetectors can eliminate noise sources to allow precise measurements. The PDB210 Series is designed to be used in a dual beam setup: one optical path for measurement and one invariant reference path. If set up properly, the PDB210 Series can reduce common mode noise for more than 35 dB over the specified frequency range. Below are given some recommendations to achieve an optimal common mode suppression:

- To obtain the maximum possible common mode rejection (common mode noise suppression), equal power levels on each photodetector are essential. Any power imbalance will be amplified and hence decrease the possible noise reduction
- Equal power densities on both detectors are important as well to obtain maximum possible common mode rejection. Always try to illuminate the whole active area of the detectors to prevent nonlinearities. Focused high power beams may lead to frequency response degradation, resulting in dramatically reduced common mode rejection.
- Equal optical path lengths are very important for common mode noise suppression especially at higher frequencies. Any path length difference will introduce a phase difference between the two signals, which will decrease the noise reduction capability of the balanced detector. The figure on next page shows the maximum allowed path length difference in air to obtain a desired CMRR. For fiber based application the maximum path length difference must divided by 1.5.



- Avoid etalon effects (interference fringes caused between two optical surfaces) in optical paths. Using angle polished optical connectors will greatly reduce etalon effects in a fiber based setup. Effects like residual frequency modulation, polarization noise, polarization wiggle or spatial modulation can also degrade common mode noise suppression. For further details contact Thorlabs. In general, reducing sources of differential losses in the optical paths (other than the measurement itself) will improve the common mode noise reduction.
- Please note, that the PDB210 Series Balanced Amplified Photodetectors are very sensitive to unwanted stray light. Carefully shielding of the Balanced Amplified Photodetectors from any unwanted light sources is essential.
- Another critical point can be electrostatic coupling of electrical noise associated with ground loops. In most cases an electrically isolated post (see Thorlabs parts TRE or TRE/M) will suppress electrical noise coupling. Always try to identify the electrical noise sources and increase the distance to the PDB210 Series Balanced Detector. Different common ground points can also be tested.

4 Maintenance and Service

Protect the PDB210 Series from adverse weather conditions. The PDB210 Series is not water resistant.

Attention

To avoid damage to the instrument, do not expose it to spray, liquids or solvents!

The unit does not need a regular maintenance by the user. It does not contain any modules and/or components that could be repaired by the user himself. If a malfunction occurs, please contact Thorlabs 23 for return instructions.

Do not remove covers!

To clean the PDB210 Series series housing, use a mild detergent and damp cloth. Do not soak the unit in water or use solvent based cleaners.

When cleaning the windows of the photodetectors, please remember that is a sensitive optical device. Gently blow off any debris using compressed air and wipe gently with an optic tissue wetted with propane or alcohol.

5 Appendix

Comments and explanations to the individual specifications

- **Typical max. responsivity** is the peak responsivity $\Re(\lambda)_{max}$ of the photo diode.
- **Transimpedance and conversion gain [V/A]** is the ratio of output voltage to photo current, it is wavelength independent. Values to RF output are always given into a high impedance load. For 50 Ω loads these values are divided by two.
- **Conversion gain [V/W]** is the ratio of output voltage to input optical power, by other words

  $$G_{CONV} = G_{TRANS} \times \Re(\lambda)$$

  This formula shows, that the conversion gain is dependent on the actual wavelength. In specifications, it is given only for the peak responsivity wavelength of the photo diode. Values to RF output are always given into a high impedance load. For 50 Ω loads these values are divided by two.
- **NEP** (Noise Equivalent Power) is commonly stated for DC to 10 MHz frequency range, this is a usual criteria for balanced detectors. If different, the frequency range is stated individually.
- **Integrated noise** is always given from DC to the actual detector's bandwidth, measured as RMS power into a 50 Ω load.
- **Overall output noise voltage** [V_{RMS}] is the value which can be measured across a 50 Ω load at large bandwidth, e.g., if connect the RF output to a 50 Ω terminated scope input.
- **Max. input power** is the damage threshold of the photo diode.
- **Typical noise spectra** (diagrams): These spectra were measured using an electrical spectrum analyzer (resolution bandwidth 100 kHz, video bandwidth 10 kHz unless otherwise noted). The INPUTs of the balanced detectors under test were blocked. The lower curve in the diagram was measured with the same setup and the balanced detectors under test switched off , i.e., it represents the measurement system's noise floor.
- **Monitor outputs** are designed for use with high impedance loads (e.g., high-Z scope input etc.), but can also drive 50 Ω loads. Monitor outputs conversion gain is 10 V/mW, given at the detectors peak responsivity and high impedance load.
- **Typical frequency response curves** are measured using the setup described in section "CMRR and Frequency Response" 9

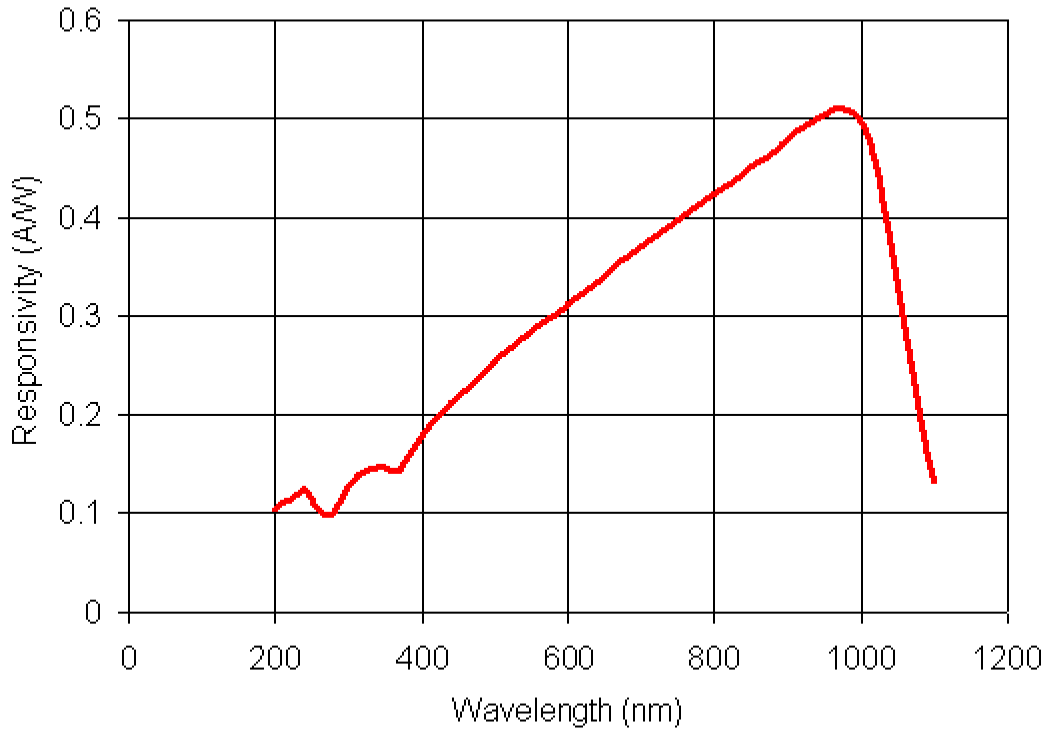
5.1 Technical Data

Model	PDB210A2	PDB210A	PDB210C
Detector Type	UV Enhanced Si/PIN	Si/PIN	InGaAs/PIN
Wavelength Range	190 to 1100 nm	320 to 1060 nm	800 to 1700 nm
Max. Responsivity, typ.	0.5 A/W @ 960 nm	0.6A/W @ 920 nm	1.0A/W @ 1550 nm
Diameter of Active Detector Area	4.1 mm	5 mm	3 mm
RF OUTPUT Bandwidth (3dB)	DC to 1 MHz		
Common Mode Rejection Ratio	min. 30 dB typ. 40 dB	40 dB	30 dB
RF OUTPUT Transimpedance Gain High Z load 50 Ω load	 500 x 10^3 V/A 175 x 10^3 V/A		
RF OUTPUT Conversion Gain High Z load 50 Ω load	 250 x 10^3 V/W 83 x 10^3 V/W	 300 x 10^3 V/W 100 x 10^3 V/W	 500 x 10^3 V/W 175 x 10^3 V/W
RF OUTPUT CW Saturation Power	36μW @ 960 nm	33μW @ 920nm	20μW @ 1550nm
RF OUTPUT Voltage Swing High Z load 50 Ω load	 max. 10 V max. 3.5V		
MONITOR Output Conversion Gain High Z load 50 Ω load	@ 960 nm 10 V/mW 1.5 V/mW	@ 920 nm 10 V/mW 1.5 V/mW	@ 1550 nm 10 V/mW 1.5 V/mW
MONITOR Output Voltage Swing High Z load 50 Ω load	 max. 10 V max. 1.5V		
Min. NEP (DC to 1 MHz)	2.4 pW/√Hz	2.2 pW/√Hz	16 pW/√Hz
Optical Inputs	free space		
Photo Diode Damage Threshold	20 mW		
Electrical Outputs	BNC, 100Ω impedance		
RF OUT Coupling	DC (AC coupling on request)		
General			
DC Power Supply	± 12V @ 200mA		
Operating Temperature Range [1])	0 - 40 °C		
Storage Temperature Range	-40 to 70 °C		
Dimensions (W x H x D)	83.9 mm x 53.4 mm x 21 mm		
Weight	0.15 kg (w/o power supply)		

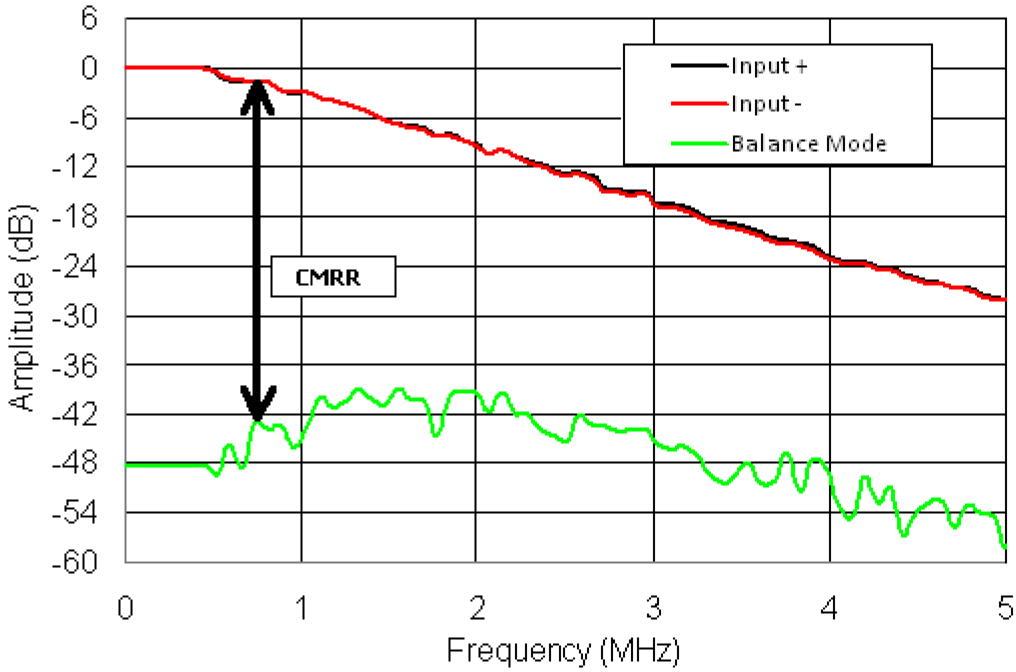
[1]) non-condensing

All technical data are valid at 23 ± 5°C and 45 ± 15% rel. humidity (non condensing)

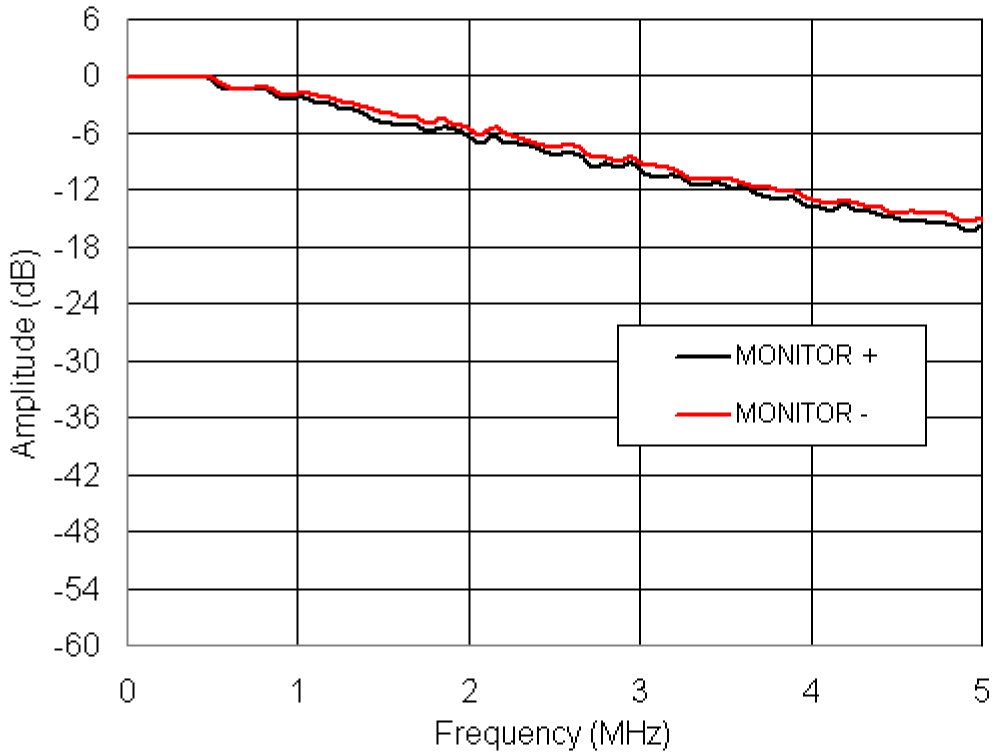
5.1.1 PDB210A2



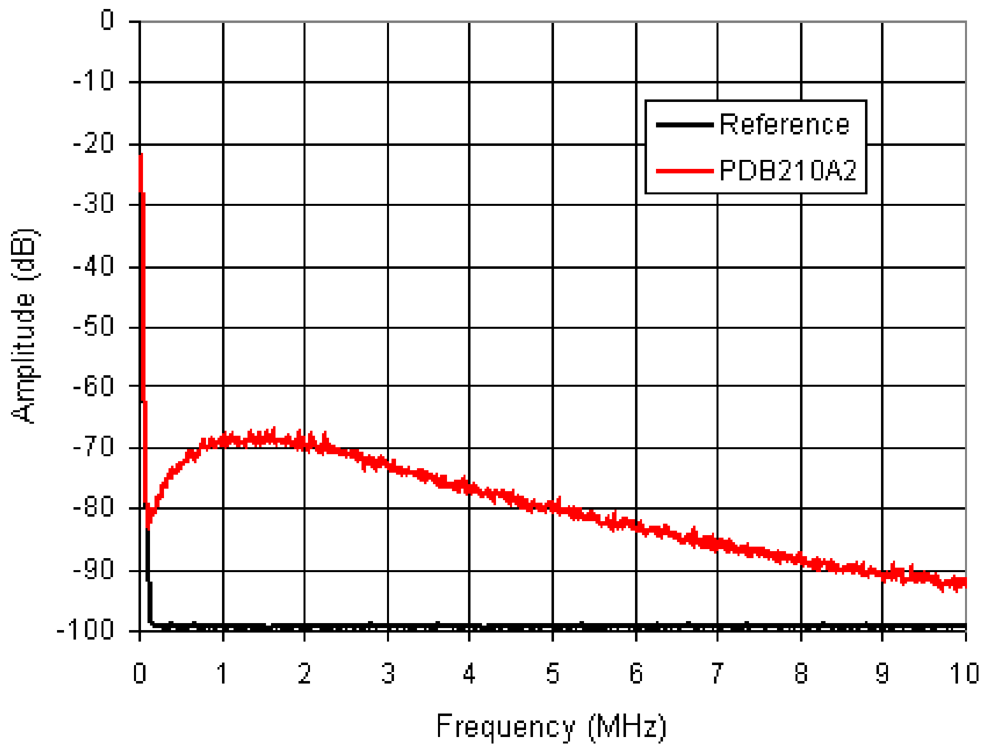
PDB210A2 - Typical Detector Responsivity



PDB210A2 - Typical RF OUTPUT frequency response

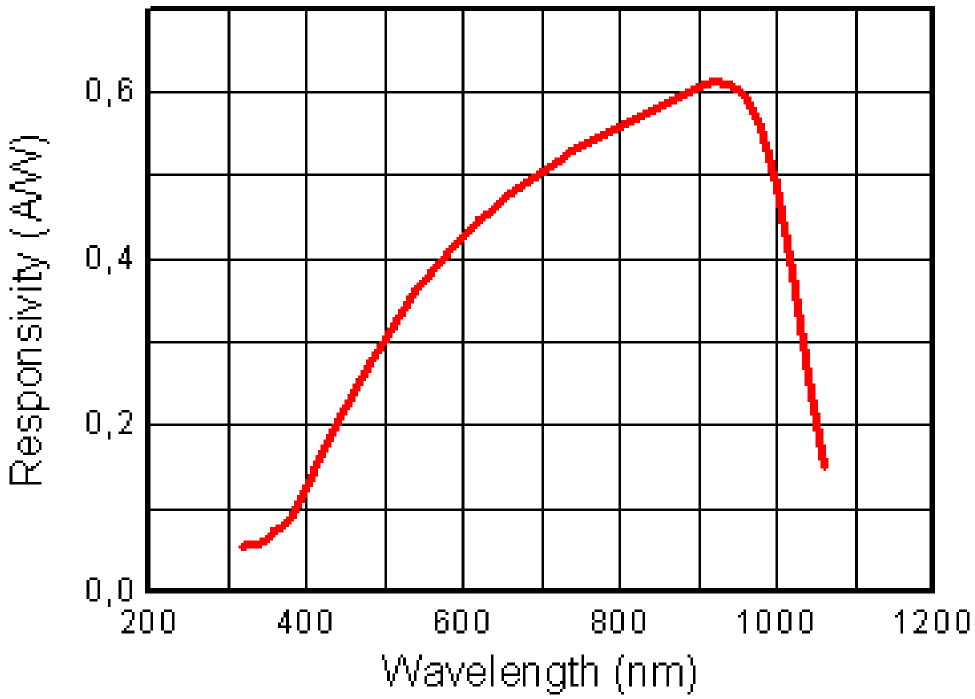


PDB210A2 - Typical frequency response of the MONITOR OUTPUTS

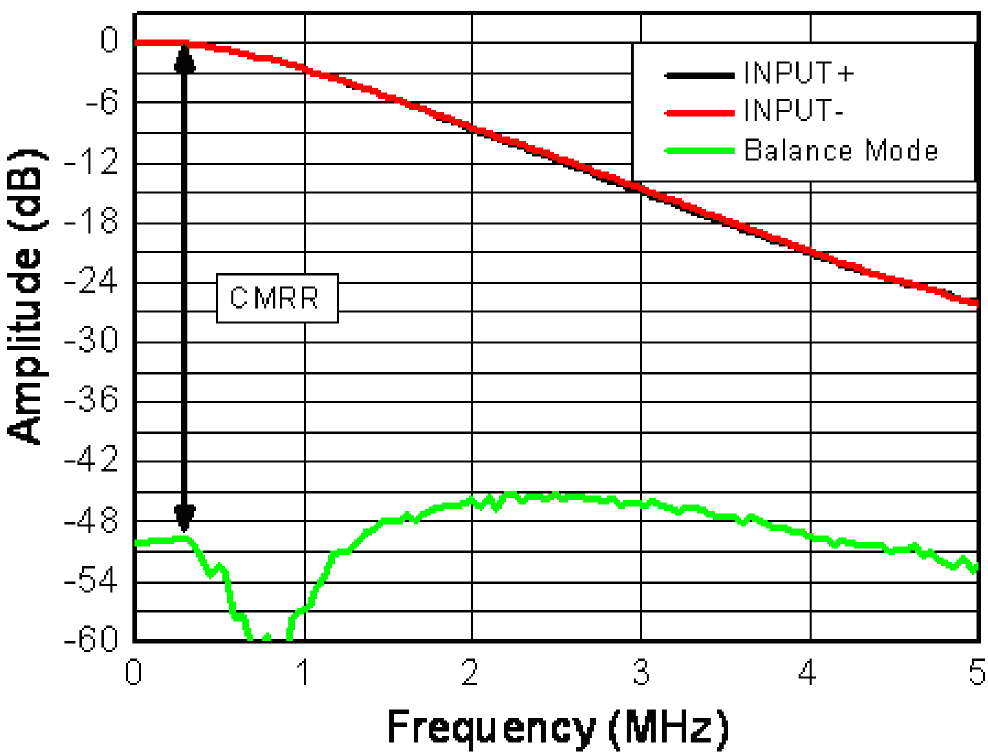


PDB210A2 - Typical Spectral Noise

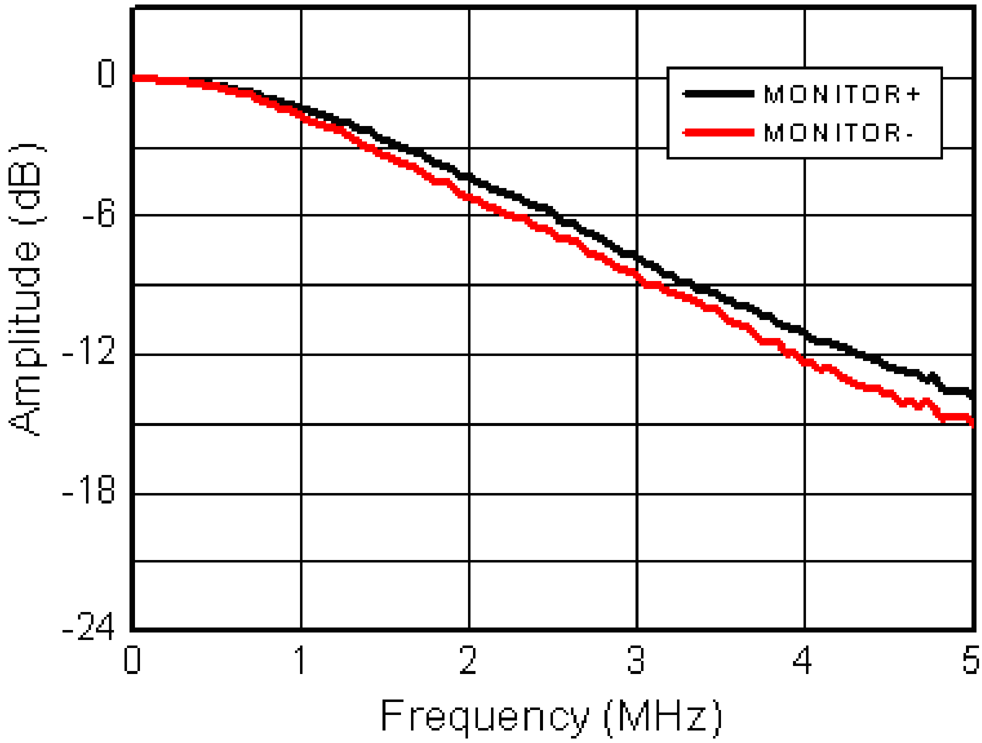
5.1.2 PDB210A



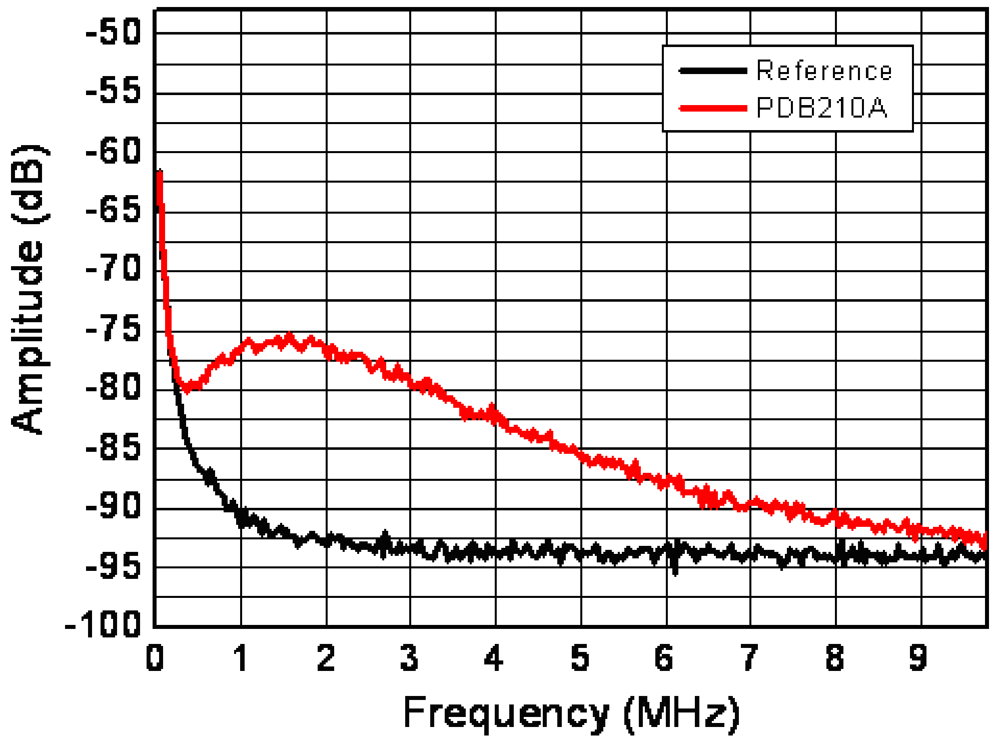
PDB210A - Typical Detector Responsivity



PDB210A - Typical RF OUTPUT frequency response

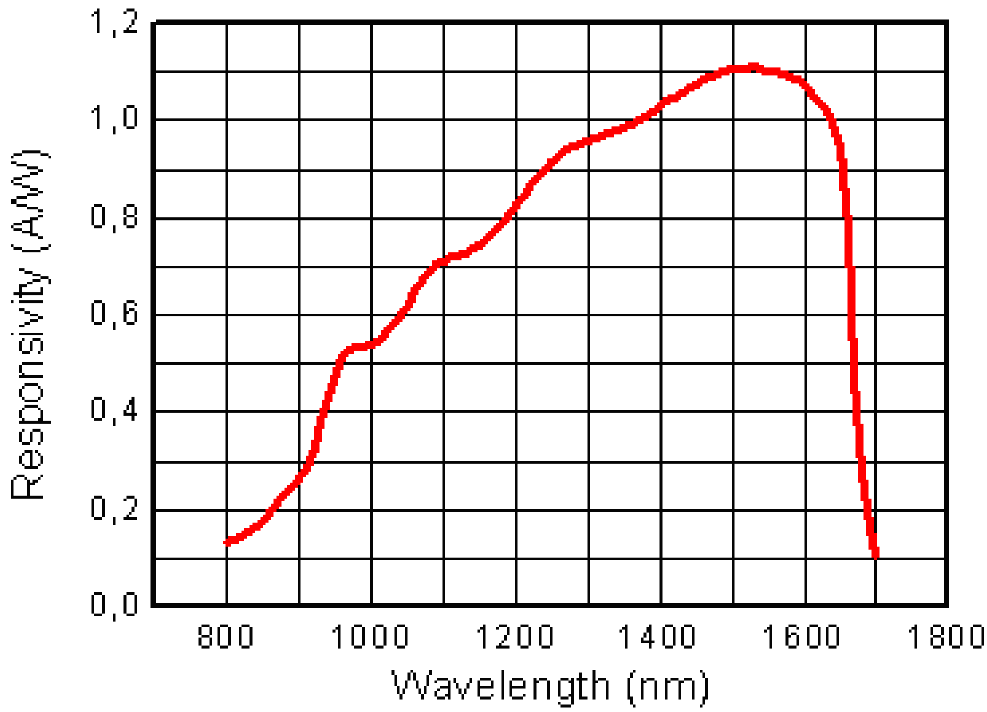


PDB210A - Typical frequency response of the MONITOR OUTPUTS

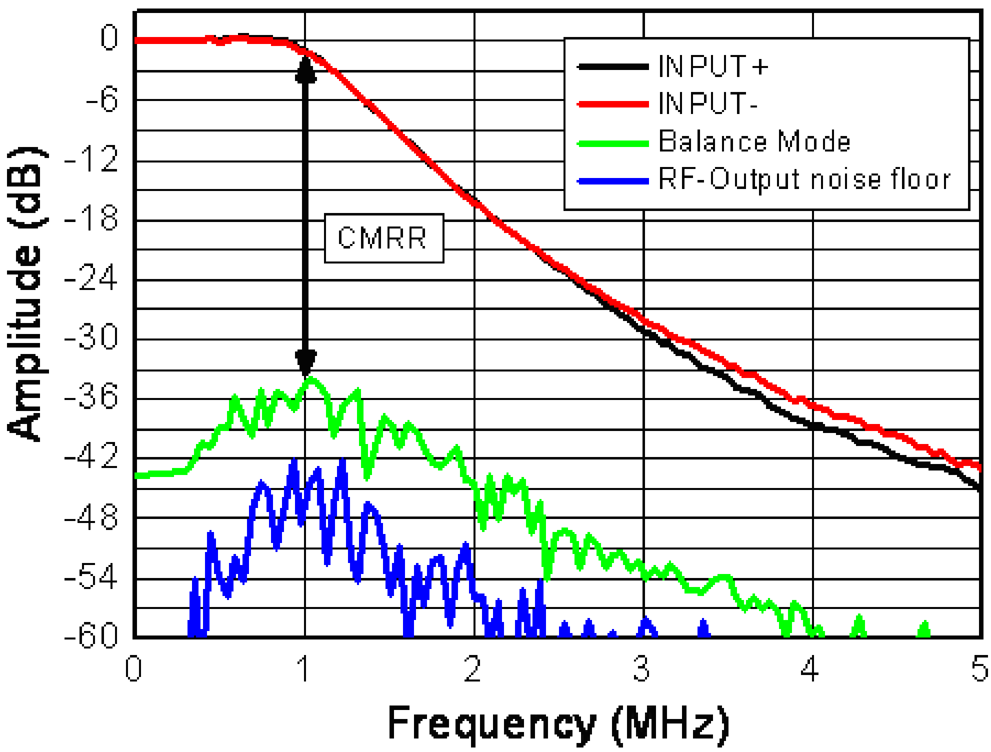


PDB210A - Typical Spectral Noise

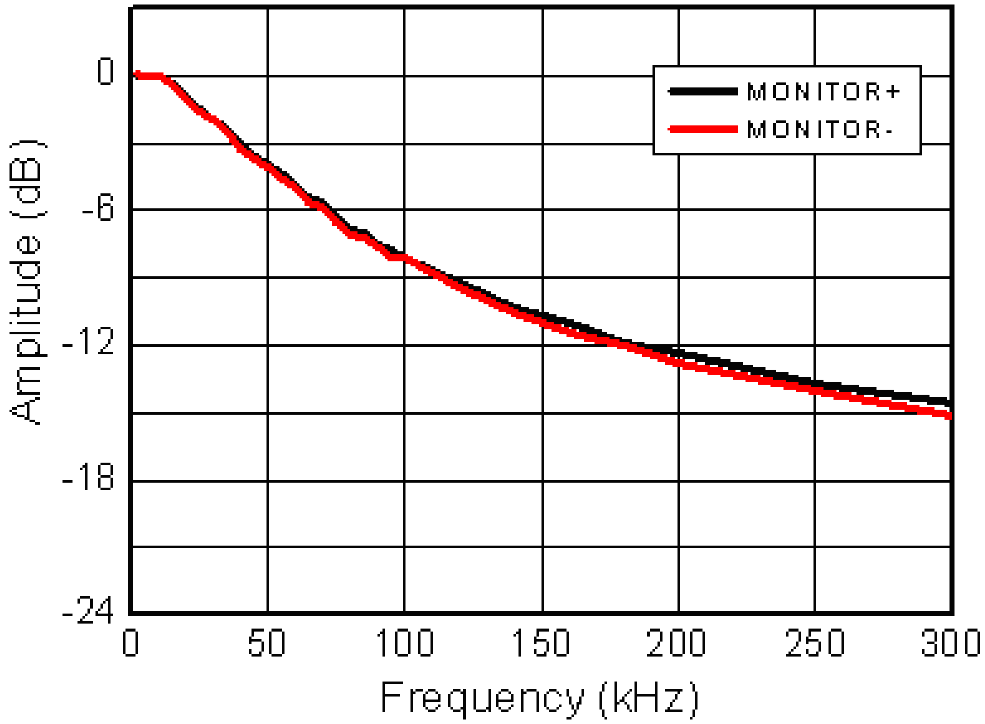
5.1.3 PDB210C



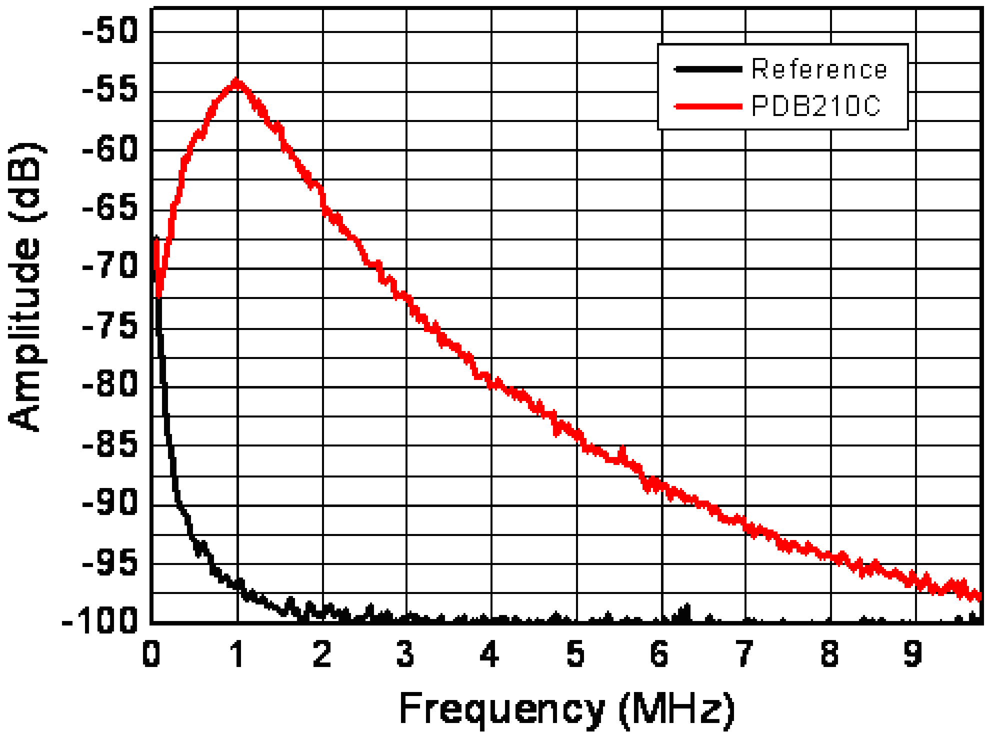
PDB210C - Typical Detector Responsivity



PDB210C - Typical RF OUTPUT frequency response

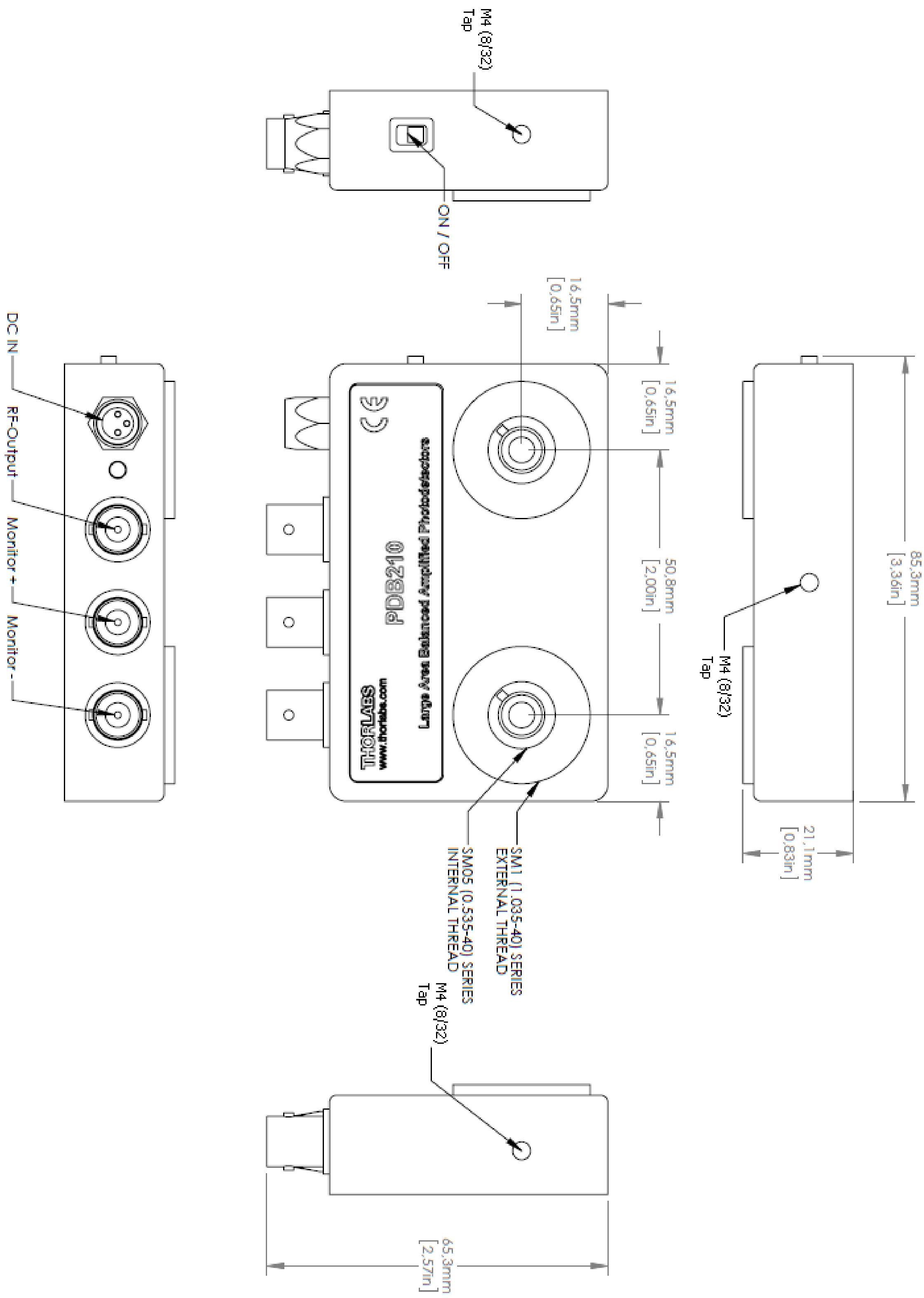


PDB210C - Typical frequency response of the MONITOR OUTPUTS



PDB210C - Typical Spectral Noise

5.2 Dimensions



Mechanical Drawing PDB210x Series

5.3 Certifications and Compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance is given to the following specifications as listed in the Official Journal of the European Communities:	
	EN 61326	EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A Radiated and Conducted Emissions[1] and Immunity[2]
	IEC 61000-4-2	Electrostatic Discharge Immunity (Performance Criterion C)
	IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity (Performance Criterion B)[2]
FCC EMC Compliance	Emissions comply with the Class B Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B [1]	
Australia / New Zealand Declaration of Conformity - EMC	Complies with the Radiocommunications Act and demonstrated per EMC Emission standard1,2	
	AS/NZS 2064	Industrial, Scientific, and Medical Equipment: 1992

[1] Using high-quality shielded interface cables.

[2] Minimum Immunity Test requirement.

5.4 Thorlabs Worldwide Contacts

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Thorlabs 'End of Life' Policy (WEEE)

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return "end of life" units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out "wheelie bin" logo (see figure below)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated.

As the WEEE directive applies to self contained operational electrical and electronic products, this "end of life" take back service does not refer to other Thorlabs products, such as:

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB's, housings etc.).

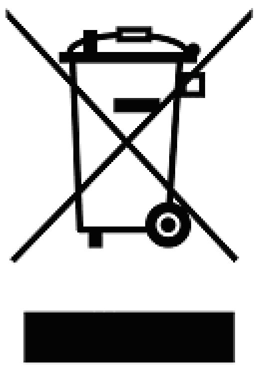
Waste treatment on your own responsibility

If you do not return an "end of life" unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

WEEE Number (Germany) : DE97581288

Ecological background

It is well known that waste treatment pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS Directive is to reduce the content of toxic substances in electronic products in the future.
The intent of the WEEE Directive is to enforce the recycling of WEEE. A controlled recycling of end-of-life products will thereby avoid negative impacts on the environment.



Crossed out "Wheelie Bin" symbol

Warranty

Thorlabs warrants material and production of the PDB210 Series for a period of 24 months starting with the date of shipment. During this warranty period Thorlabs will see to defaults by repair or by exchange if these are entitled to warranty.
For warranty repairs or service the unit must be sent back to Thorlabs. The customer will carry the shipping costs to Thorlabs, in case of warranty repairs Thorlabs will carry the shipping costs back to the customer.
If no warranty repair is applicable the customer also has to carry the costs for back shipment.
In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

Thorlabs warrants the hard- and software determined by Thorlabs for this unit to operate fault-free provided that they are handled according to our requirements. However, Thorlabs does not warrant a fault free and uninterrupted operation of the unit, of the software or firmware for special applications nor this instruction manual to be error free. Thorlabs is not liable for consequential damages.

Restiction of Warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. Thorlabs does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs reserves the right to change this instruction manual or the technical data of the described unit at any time.

Copyright

Thorlabs GmbH has taken every possible care in preparing this Operation Manual. We however assume no liability for the content, completeness or quality of the information contained therein. The content of this manual is regularly updated and adapted to reflect the current status of the software. We furthermore do not guarantee that this product will function without errors, even if the stated specifications are adhered to.
Under no circumstances can we guarantee that a particular objective can be achieved with the purchase of this product.
Insofar as permitted under statutory regulations, we assume no liability for direct damage, indirect damage or damages suffered by third parties resulting from the purchase of this product. In no event shall any liability exceed the purchase price of the product.
Please note that the content of this User Manual is neither part of any previous or existing agreement, promise, representation or legal relationship, nor an alteration or amendment thereof. All obligations of Thorlabs GmbH result from the respective contract of sale, which also includes the complete and exclusively applicable warranty regulations. These contractual warranty regulations are neither extended nor limited by the information contained in this User Manual. Should you require further information on this product, or encounter specific problems that are not discussed in sufficient detail in the User Manual, please contact your local Thorlabs dealer or system installer.

Status: 2012