

The noise introduced by the APD in the optical receiver is



Article Overview

The noise in an APD optical receiver arises from shot noise, thermal noise, dark current noise, and excess noise due to the stochastic avalanche multiplication process.

Key Noise Mechanisms in APDs

1. **Shot Noise** Shot noise results from the discrete nature of charge carriers (electrons and holes) in the APD. It occurs because the photocurrent and dark current consist of randomly generated charges, leading to current fluctuations. Shot noise increases with the average photocurrent and is amplified by the APD's avalanche gain, making it a dominant noise source in low-light conditions . 2. **Dark Current Noise** Dark current is the leakage current present even without incident light. It includes bulk leakage (thermal generation of electron-hole pairs) and surface leakage (current across the device surface). Both components undergo avalanche multiplication, contributing to noise. Dark current noise is temperature-dependent and limits APD sensitivity, especially in low-light scenarios . 3. **Excess Noise (Multiplication Noise)** Avalanche multiplication is inherently random. The generation of secondary carriers during the avalanche process fluctuates, producing excess noise. This noise is characterized by the excess noise factor, which depends on the multiplication gain and the ionization coefficients of electrons and holes. Higher avalanche gain generally increases excess noise, limiting the useful gain and degrading the signal-to-noise ratio (SNR), . 4. **Thermal Noise (Johnson-Nyquist Noise)** Thermal noise arises from the random motion of charge carriers due to thermal energy in resistive elements of the APD circuit. It i...

Article Content

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Avalanche Photodiodes: A User's Guide

Figure 2: Typical gain-voltage curve for Si APDs One of the key parameters to consider when selecting an APD is the detector's

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Noise in Optical Receivers | EPFL Graph Search

This lecture covers the different types of noise present in optical receivers, starting with shot noise generated by random electron

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Optical Receivers | Springer Nature Link

The basis of all receivers in optical transmission is the internal photoelectric effect. The simplest receiver is the p-n

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Development of High Sensitivity SWIR APD Receivers

Special efforts are needed to reduce APD capacitance while maintains the same optical aperture. Spectrolab has been developing

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Receiver Noise—Shot Noise Enhancement with APD

Optical receivers with APD generally provide a higher SNR for the same incident optical power. The improvement in

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Chapter 9 Optical Receiver Design

An optical receiver consists of an optical detector, usually a PIN or APD diode, which converts the optical signal to an electrical

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Noise analysis and determination method of optimum multiplication

Abstract: Signal to noise ratio (SNR) is an important indicator to measure the performance of high-gain optical sensor. The article first

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Analysis of noise and its characteristics in avalanche photodiode

For avalanche photodiodes (APDs), the noise that arises from the gain mechanism, impact ionization, increases with

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Analysis of Fundamental Photodetection Noises and Evaluation of

Fourth, interpretation and explanation of simulation results implemented by the Optisystem software through the optical high debit

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The noise processes such as shot noise, intensity noise, thermal Nyquist noise, and multiplication noise and their

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Optical Noise

Fiber-optic communication systems that use optical amplifiers are subject to optical noise, called amplified spontaneous

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Receiver noise

Noise introduced by the receiver is either signal dependent or signal independent. Signal dependent noise results from the random

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Optical Receiver Fundamentals and Types | PDF | Signal To Noise

This document discusses an advanced optical communication lecture on optical receivers. It covers the basics of optical detection

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SENSITIVITY ANALYSIS OF APD PHOTORECEIVERS

Linear-mode APDs are used in optical receivers for applications such as optical communications and time-of-flight measurements,

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Performance comparisons between PIN and APD photodetectors for

In summary, we have compared and analyzed the performances of PIN and APD optical receivers for use in optical

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Microsoft PowerPoint

Quantum and Thermal are the important noise mechanisms in all optical receivers
RIN (Relative Intensity Noise) will also appear in

Feb 11, 2026

PIN and APD photodetector efficiencies in the longer wavelength

In this report, a performance comparison of the conventional PIN photodiode with the
Avalanche Photodiode (APD) in

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What is PIN and APD Photodiodes in Optical Transceivers

What is Photodiode? A photodiode is a semiconductor device that converts light into
electrical current. In optical

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HIGH SENSITIVITY APD OPTICAL RECEIVER APPLICATION NOTES

INTRODUCTION The Model 7511A is a high gain, low noise optical receiver employing
an avalanche photodiode

Oct 20, 2025

Free-Space Optical Data Receivers with Avalanche Detectors for

Data receiving frontends using avalanche photodiodes are used in optical free-space
communications for their effective

Jul 14, 2026

Chapter 6 PIN and APD Detectors

There are a wide variety of photodetectors that can be used for different pur-poses.
In fiber optics, two types of photodetectors are of

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Analysis of noise and its characteristics in avalanche photodiode

In addition to thermal noise, $1/f$ noise, and shot noise, APDs also exhibit additional
noise associated with the avalanche

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(PDF) Noise Reduction in Optical Communication System

Abstract and Figures The aim of this paper to find best suited filter for given photo detector i.e APD and PIN for the

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Optical Receiver Noise

The shot noise and thermal noise are the two fundamental noise mechanisms responsible for current fluctuations in all optical

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Their responsivity and noise performance significantly impact receiver performance
Common photodetector types p-i-n photodetector

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Bias-voltage and current-sense circuits make avalanche ...

Some APD-receiver applications require extremely low noise in an extended bandwidth. An APD bias supply can use

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Optical Receiver Sensitivity

In practice, most optical receivers require $NP \sim 1000$ to achieve a BER of 10^{-9} , as their performance is severely limited by thermal

Contact Us

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