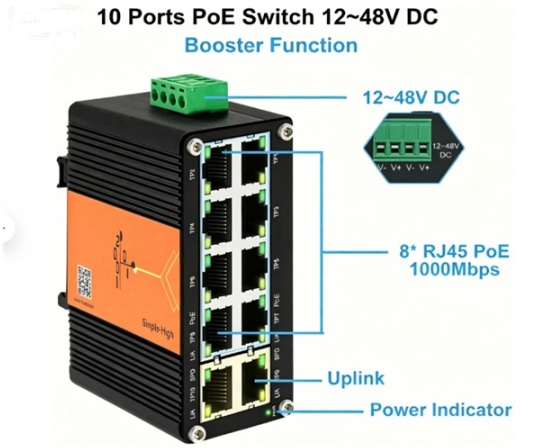
Noise from optical receivers



AI Overview

The primary noise sources in optical receivers include shot noise, thermal noise, dark current noise, relative intensity noise (RIN), and amplifier-induced noise, all of which degrade the signal-to-noise ratio and affect receiver sensitivity.

Key Noise Types

Shot Noise: This arises from the discrete nature of charge carriers in the photodetector. When electrons and holes cross a potential barrier, such as in a PN junction diode, random fluctuations occur, producing shot noise. Its power spectral density follows a Poisson distribution and is proportional to the average photocurrent . Thermal Noise: Also known as Johnson-Nyquist noise, thermal noise is generated by the random motion of electrons in resistive components. It is independent of the optical signal and depends only on temperature and resistance. Reducing temperature or resistance can lower thermal noise . Dark Current Noise: Even in the absence of light, photodetectors exhibit a small reverse leakage current. This dark current fluctuates randomly, contributing to the total noise and affecting the minimum detectable signal . Relative Intensity Noise (RIN): RIN represents fluctuations in the laser's output power. It is a source of optical noise that directly modulates the received signal, particularly in high-speed or high-power systems . Amplifier and Multiplication Noise: In receivers using avalanche photodiodes (APDs) or optical pre-amplifiers, additional noise arises from the gain process. APDs introduce multiplication noise, while optical amplifiers contribute amplified spontaneous emission (ASE) noise, which can mix with the signal to produce beat noise .

Impact on Receiver Performance

Article Content

4 ways signal noises impact optical devices

Shot noise, dark noise, 1/f noise, and thermal noise are all types of optical noises that can impact a sensor''s

Noise Principles in Optical Fiber Communication

This chapter contains sections titled: Introduction Receiver Thermal Noise Dark Shot Noise Signal Shot Noise

Briefly discuss the possible sources of noise in optical fiber receiver ...

Noise: Noise is a term generally used to refer to any spurious or undesired disturbances that mask the received signal in a

Receiver noise

RECEIVER NOISE Noise corrupts the transmitted signal in a fiber optic system. This means that noise sets a lower limit on the

Lecture 15: Receiver Design

Electrical Shot Noise The shot noise generated in the photodetection process is physically due to the “quantum granularity” of the

Optical receiver with noise sources.

Download scientific diagram | Optical receiver with noise sources. from publication: Optical Receiver for Optical Time Domain

Optical Receiver Sensitivity Evaluation in Presence of Noise in Digital ...

Optical receiver adds noise; usually thermal noise and shot noise. In communication systems, where electrical, radio or optical

Optical Receiver Sensitivity Evaluation in Presence of Noise in Digital ...

The optical receiver adds two types of noise namely thermal noise and shot noise. Since optical amplifiers are based on the principle

Lecture 15: Receiver Design

Optical Signal-to-Noise Ratio (OSNR) OSNR is an extremely important parameter in optically amplified systems A poor OSNR

Analysis of optical amplifier noise in coherent optical communication ...

The analysis quantifies in particular how optical image rejection receiver configurations reduce the influence of optical amplifier noise

Noise Analysis and Design Considerations for Equalizer-Based Optical ...

Optical receiver front ends that are intentionally designed to have a bandwidth low enough that significant intersymbol

Multi-Rate Low-Noise Optical Receiver Front-End

Conventional optical receivers are mostly optimized for single data rate. In this work, after examining conventional

Suppression of beat noise from optical amplifiers using coherent receivers

Coherent optical fiber communications have been studied intensively because of their high receiver sensitivity and high-frequency

Signal-to-noise ratio

To describe the signal quality without taking the receiver into account, optical signal-to-noise ratio (OSNR) is used. OSNR is the ratio

Optical Receivers | part of Fiber-Optic Communication Systems

The chapter deals with various noise sources that limit the signal-to-noise ratio in optical receivers, and also describes the technique

Shot Noise Optimal Receiver Filters for Coherent and Non-Coherent

In this paper, we investigate optimal receiver filter design with respect to shot noise in both non-coherent and

Low-Noise Front-End Amplifier Design for 10Gbps Optical Receiver

A critical performance metric for optical receiver is sensitivity which is limited by noise. In optical receivers, achieving a low-noise

Optical Noise

Optical systems can be subject to shot noise and optical noise, in addition to the standard thermal noise. These require

Noise Theory of Coherent Optical Receivers

This chapter analyzes the noise components impairing the coherent optical detection, comparing two receiver

Optical Receiver

An optical receiver usually consists of a photodetector and an electrical circuit for transimpedance amplification and signal

Optical Transmitters, Receivers, and Noise

Further, high-performance optical receiver structures and their noise properties are outlined, both for the fiber channel

Optical and Unified Noise Figure, and Homodyne Noise Figure

Traditional optical noise figure Fpnf was defined in 1990ies, for optical direct detection receivers (DD RX). Problematic aspects, in

The FOA Reference For Fiber Optics

Measuring Reflectance or Return Loss Reflectance Reflectance (which has also been called "back reflection" or optical return loss) of

Optical Receivers | part of Fiber-Optic Communication Systems

The design of an optical receiver depends on the modulation format used by the transmitter. The chapter deals with various noise

The Ultimate Guide to Optical Noise

Discover the causes of optical noise, its effects on signal quality, and practical methods to minimize its impact on

Noise Processes in Optical Receivers

The sources of noise processes observed in optical receivers originate from a wide range of devices, including photodetectors and

Noise Analysis and Design Considerations for Equalizer-Based

The noise analysis of these front ends presents several challenges. This paper derives integrated input-referred noise

Noise Theory of Coherent Optical Receivers

Because of the electrical processing of signal photocurrents, the noise theory of the coherent optical receiver deals

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