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Accession number:20114214440411

Title:Responsivity and noise of self-mixing photodetection schemes

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Source title:IEEE Journal of Quantum Electronics

Abbreviated source title:IEEE J. Quantum Electron.

Volume:47

Issue:11

Issue date:2011

Publication year:2011

Pages:1428-1433

Article number:6029275

Language:English

ISSN:00189197

CODEN:IEJQA7

Document type: Journal article (JA)

Publisher:Institute of Electrical and Electronics Engineers Inc., 445 Hoes Lane / P.O. Box 1331, Piscataway, NJ 08855-1331, United States

Abstract:Responsivity and noise properties of the self-mixing (SM) detection process are analyzed. Starting with the photodiode and SM laser scheme as a detector of weak optical echoes from remote targets, we find equivalence to a coherent homodyne detection of the returning signal. In particular, in the VIS-NIR wavelength range, echoes can be detected down to about-90 dB of relative amplitude, typically. Then we consider the laser-diode voltage self-mixing (LV-SM) detection and find it is also a coherent homodyne scheme, though noise performance is limited by shot-noise of the bias current and by the relatively small signal supplied as an output. Theoretical results are finally compared to recent experimental data, finding a substantial agreement and confirming that the LV-SM is an attractive alternative to conventional photo-detection, especially for THz waves and other spectral ranges where good low-noise detectors may be difficult to employ.

Number of references:9