127.
Accession number:20113014182015
Title:Monolithically integrated photonic heterodyne system
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Source title:Journal of Lightwave Technology
Abbreviated source title:J Lightwave Technol
Volume:29
Issue:15
Issue date:2011
Publication year:2011
Pages:2229-2234
Article number:5779689
Language:English
ISSN:07338724
CODEN:JLTEDG
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: This paper presents the results from the first monolithically integrated photonic heterodyne system that allows the two optical sources to be mutually phase locked by locking to an external optical reference. High-spectral-purity signals of up to 50 GHz have been demonstrated from this first fabricated device, where the tuning range was limited by losses in the input waveguide. Successful phase locking was accomplished through short signal propagation delay of less than 2 ns achieved by monolithic integration and custom-made fast loop electronics. The approach can be extended to generate signals at >; 1 THz.