Phase noise optoelectronic metrology system for microwaves photonics sources

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New progress in optoelectronics oscillators based on delay lines [1] or optics resonators [2,3] with modulation frequency in microwaves require low phase noise system. Here is presented a configuration of phase noise measurement system operating in X- band using a photonic delay line as a frequency discriminator. This system doesn't need any excellent frequency reference and works for any frequency between 8.2 and 12.4 GHz [4]. Oscillator frequency fluctuation is converted to phase frequency fluctuation through the delay line. The measured phase noise includes the DUT noise and the instrument background. The cross correlation decrease the cross spectrum terms of uncommon phase noise as $\sqrt{(1/m)}$, where m is the average number. Using cross correlation on 500 averages, noise floor of the instrument £(f) is respectively -150 and -170 dBc/Hz at 10^1 and 10^4 Hz from the 10 GHz carrier (-90 and -170 dBc/Hz including 2 km delay lines). There are two categories of uncertainties terms : "type A", statistic contribution such as repeatability and experimental standard deviation; "type B" due to various components and temperature control, but also to the asymmetry of the instrument. Uncertainty on £(f) strongly depends on propagation of uncertainties through the transfer function. Elementary term of uncertainty for repeatability is found to be equal to 0.68 dB. Other elementary terms still have lower contributions. For instance, temperature effects, resolution of instruments are lower. Its leads to a global uncertainty of 1.58 dB at 2σ. This calibration system is to be integrated in measurements means of the accredited laboratory to improve the Calibration Metrology Capabilities (CMC) of the national french metrology institute (LNE).

References :

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