Abstracts

Applications of interferometric signal processing to phase-noise reduction in microwave oscillators

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To enhance the sensitivity of oscillator phase-noise measurements, an interferometric frequency-discriminator system may be implemented. Such systems consist of a microwave interferometer, incorporating a high-Q resonator and a phase-sensitive microwave readout. Suppressing the carrier at the output of the interferometer enables the microwave readout to operate in the small-signal regime with an effective noise temperature close to its physical temperature, When used as a sensor of a frequency-control system to lock the oscillator to a selected resonant mode of a high-Q resonator, the interferometric frequency discriminator has enabled more than two orders of magnitude improvement in oscillator phase-noise performance as compared with the state-of-the-art. Thus, the phase noise of an S-band oscillator was reduced to -150 dBc/Hz at 1-kHz Fourier frequency without the use of cryogenics, and was limited by the thermal noise in the microwave interferometer. To facilitate tuning and locking, an automatically balanced microwave frequency discriminator was developed using voltage-controlled attenuators and phase shifters. Rapid frequency tuning of the oscillator was achieved by varying the interferometer phase mismatch and automatically controlling the carrier suppression without tuning the high-Q resonator.

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