Ultrastable distributed radio-frequency quartz oscillator based signal

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Radio-frequency (RF) distributed ultra-stable oscillators based on ultra-stable Boitiers à Vieillissement Amélioré (BVA) are needed for spectral density of phase noise and short term stability. With recent progress in ultra-stable RF sources [1-3], noise of distribution amplifiers must be the weakest possible to keep the noise floor the lowest. Thus we achieve a high performance distribution amplifier (DA). For a 1s integration time, it must be better than 2.5×10^{-14} [1]. A DA is realized and its design and performances are presented. An ultra-stable BVA oscillator is then integrated and is fully characterized to validate the system at its highest level. The design is optimized for low noise signals to be delivered at RF to be integrated with a BVA reference oscillator. A good isolation is expected and it is necessary that output power keep a good flatness for both RF outputs. Our purpose consists in optimizing the performances of this device to allow integration of the best available commercial BVA oscillators. A set of two distribution amplifiers is realized for characterization of the floor of both of these boards. We deduce their performances by analyzing the results of S_Φ, the spectral density of phase noise measurement. $S_\Phi(1\text{Hz})$ in the range of – 141 dB.rad²/Hz at RF with a 1/f slope. It is obtained by measuring the phase noise of two similar outputs of the DA. We deduce the value considering that the two output have identical contribution to the noise. Estimation of the frequency stability in terms of Allan variance is resepctively $\sigma_y(\tau) = 1.4 \times 10^{-14}$ and 7.3×10^{-15} at 1s for the 5 and 10 MHz. These are similar to state-of-the-art results [4] and low enough for distribution of the BVA's. For determining the performance of the system in terms of short term frequency stability, main principle is based on Dual Mixer Time Difference Multiplication (DMTDM) [2,5]. Thanks to the use of the best reference signal for evaluate the performance of the designed and realized DA, measurements clearly show that the developed DA is accurate for the new generation of RF state-of-the-art BVA oscillators. We demonstrated flicker frequency modulation (FFM) floor better than 4.5×10^{-14} $\pm 2.5 \times 10^{-15}$ at 12 s with an intrinsic noise floor about 6×10^{-15} at 1 s with a $\tau^{-1/2}$ slope.

References :

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