

Noise performance optimization of time and frequency dissemination system in presence of fiber mechanical vibration

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A detailed analysis of fiber link phase stability showed an increase of its spectral noise power in the band from 10Hz to 30Hz [Fig.1]. Environmental vibration causes mechanical deformations in the fiber which induce phase fluctuations that are converted into frequency noise¹. Therefore, the mechanical installation features of the link and ambient temperature play a critical role in noise generation. The proper design of joint time and frequency dissemination system² requires taking into account a real behavior of all system components (Fig.2). In the paper we present a simulation method of phase noise analyzing. It must be pointed out that the device models used in electrical circuit simulators (eg.SPICE), are not suitable for fiber optics modeling, so structural macro model covered exact defined parameters (phase noise, power fluctuating, etc.) was designed. Presented approach allows finding optimal system parameters (mainly transfer function of DLL feedback loop) that minimize induced frequency noise by mechanical fiber link vibration. The fiber link macro model takes into account the real acoustic noise characteristics, measured on 100 km distance-long fiber link installed along a highway.

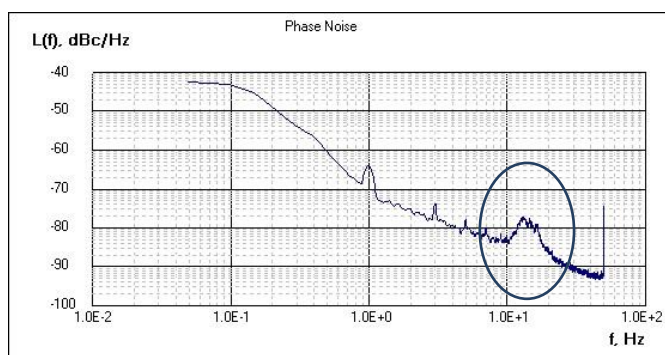


Fig. 1. Observed behavior of phase noise in fiber optic link.

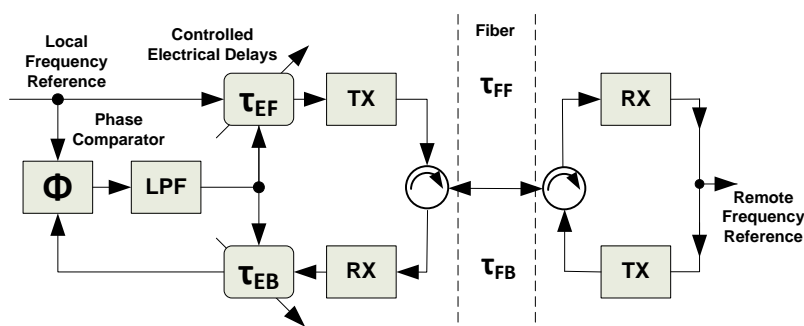


Fig. 2. Block diagram of frequency and time transfer system with active delay stabilization.

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² P. Krehlik, Ł. Śliwczyński, Ł. Buczek and M. Lipiński, "Fiber optic joint time and frequency transfer with active stabilization of the propagation delay", IEEE Trans. Instrum. Meas. vol.61 2844–51, 2012.