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Additive phase-noise in frequency conversion in LLRF systems

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This contribution focuses on phase-noise added during frequency conversion in low level radio frequency (LLRF) control systems. The stability of beams'parameters in linear accelerators depends on the stability of amplitude and phase of the accelerating field. A LLRF control system regulates the electromagnetic field inside accelerating modules based on the input RF signals. Typically those signals are converted to an intermediate frequency (IF) using an active mixer. This field detection scheme necessitates synthesis of a heterodyne/local oscillator (LO) signal which is often generated using a passive mixer. Additive close–to-carrier phase noise can be observed in the investigated circuits.
According to the author's best knowledge, there is no work presenting research on the phase noise characteristics of an active mixer. The influence of the LO signal power level on the phase noise of the output signal was measured and two hypotheses were made. Further measurements of the AM-PM and PM-AM conversion were made to verify one of the hypotheses.
The fidelity of the LO signal is partially determined by the phase noise of the IF signal. The possibility of constructing an analytical model for selected types of frequency dividers which are used for LO synthesis was considered.
The phase noise of the output signal of a passive mixer is typically calculated using a small-signal model based on modulation theory. Measurements'results indicate that the power level of the input signals has a non-linear effect on phase noise beyond the noise floor.

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Yes

Description

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