

This paper presents new circuit topologies and design techniques for low-phase-noise (PN) complementary metal-oxide-semiconductor (CMOS) millimeter-wave quadrature voltage-controlled oscillator (QVCO) and VCOs. A transformer-coupled QVCO topology with extra phase shift is proposed to replace the coupling transistors, which eliminates coupling transistors' noise, decouples the tradeoff between PN and phase error, and improves the PN performance. This technique is demonstrated in a millimeter-wave QVCO with a measured PN of -119.2 dBc/Hz at 10-MHz offset of a 56.2-GHz carrier and a tuning range of 9.1%. In addition, an inductive-divider-feedback technique is proposed in an LC VCO design to improve the transconductance linearity, resulting in a larger signal swing and lower PN compared with the conventional LC VCOs. The effectiveness of this approach is demonstrated in a 76 and a 90-GHz VCO design, both fabricated in a 65-nm CMOS process, with an FOMT of 173.6 and 173.1 dBc/Hz, respectively.