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Millimeter-Wave Silicon Power Amplifiers for 5G Wireless Communications

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Abstract : Exploding demands for more data, faster data transmission speed, less interference, more users, more wireless devices, and better reliable service-far exceeding those provided in the current mobile communications networks in the RF spectrum below 6 GHz-has led the wireless communication industry to focus on higher, previously unallocated spectrums. High frequencies in RF spectrum near (around 28 GHz) or within the millimeter-wave regime is the logical solution to meet these demands. This high-frequency RF spectrum is of increasingly important for wireless communications due to its large available bandwidths that facilitate various applications requiring large-data high-speed transmissions, reaching up to multi-gigabit per second, of vast information. It also resolves the traffic congestion problems of signals from many wireless devices operating in the current RF spectrum (below 6 GHz), hence handling more traffic. Consequently, the wireless communication industries are moving towards 5G (fifth generation) for next-generation communications such as mobile phones, autonomous vehicles, virtual reality, and the Internet of Things (IoT). The U.S. Federal Communications Commission (FCC) proved on 14th July 2016 three frequency bands for 5G around 28, 37 and 39 GHz. We present some silicon-based RFIC power amplifiers (PA) for possible implementation for 5G wireless communications around 28, 37 and 39 GHz. The 16.5-28 GHz PA exhibits measured gain of more than 34.5 dB and very flat output power of 19.4±1.2 dBm across 16.5-28 GHz. The 25.5/37-GHz PA exhibits gain of 21.4 and 17 dB, and maximum output power of 16 and 13 dBm at 25.5 and 37 GHz, respectively, in the single-band mode. In the dual-band mode, the maximum output power is 13 and 9.5 dBm at 25.5 and 37 GHz, respectively. The 10-19/23-29/33-40 GHz PA has maximum output powers of 15, 13.3, and 13.8 dBm at 15, 25, and 35 GHz, respectively, in the single-band mode. When this PA is operated in dual-band mode, it has maximum output powers of 11.4/8.2 dBm at 15/25 GHz, 13.3/3 dBm at 15/35 GHz, and 8.7/6.7 dBm at 25/35 GHz. In the tri-band mode, it exhibits 8.8/5.4/3.8 dBm maximum output power at 15/25/35 GHz.
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