ABSTRACT

Broadband RF Front-End Design for Multi-Standard Receiver with High-Linearity and Low-Noise Techniques

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Future wireless communication devices must support multiple standards and features on a single-chip. The trend towards software-defined radio requires flexible and efficient RF building blocks which justifies the adoption of broadband receiver front-ends in modern and future communication systems. The broadband receiver front-end significantly reduces cost, area, pins, and power, and can process several signal channels simultaneously. This research is mainly focused on the analysis and realization of the broadband receiver architecture and its various building blocks (LNA, Active Balun-LNA, Mixer, and trans-impedance amplifier) for multi-standard applications. In the design of the mobile DTV tuner, a direct-conversion receiver architecture is adopted achieving low power, low cost, and high dynamic-range for DVB-H standard. The tuner integrates a single-ended RF variable gain amplifier (RFVGA), a current-mode passive mixer, and a combination of continuous and discrete-time baseband filter with built-in anti-aliasing. The proposed RFVGA achieves high dynamic-range and gain-insensitive input impedance matching performance. The current-mode passive mixer achieves high gain, low noise, and high linearity with low power supplies. A wideband common-gate LNA is presented that overcomes the fundamental trade-off between power and noise match without compromising its stability. The proposed architecture can achieve the minimum noise figure over the previously reported feedback amplifiers in common-gate configuration. The proposed architecture achieves broadband impedance matching, low noise, large gain, enhanced linearity, and wide bandwidth concurrently by employing an efficient and reliable dual negative-feedback. For the wideband Inductorless Balun-LNA, active single-to-differential architecture has been proposed without using any passive inductor on-chip which occupies a lot of silicon area. The proposed Balun-LNA features lower power, wider bandwidth, and better gain and phase balance than previously reported architectures of the same kind. A surface acoustic wave (SAW)-less direct conversion receiver targeted for multistandard applications is proposed and fabricated with TSMC 0.13?m complementary metal-oxide-semiconductor (CMOS) technology. The target is to design a wideband SAW-less direct coversion receiver with a single low noise transconductor and current-mode passive mixer with trans-impedance amplifier utilizing feed-forward compensation. The innovations in the circuit and architecture improves the receiver dynamic range enabling highly linear direct-conversion CMOS front-end for a multi-standard receiver.