60GHz Low Noise Amplifier for Automotive Radar Application

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Introduction

The development of 5G has allowed higher data throughput along with latency as low as 1ms. This improvement is beneficial for “Mission-Critical Services” such as: autonomous driving and remote surgery. The purpose of mmWave radar is the ability to detect and identify surrounding objects despite harsh weather conditions such as rain, snow, and fog. In the USA and Canada, the unlicensed mmWave band is 57GHz – 64GHz (BW=7GHz). In a radar system, the range resolution is dependent on the available bandwidth. In both 24GHz and 77GHz mmWave bands, their available bandwidth is 5GHz which limits their accuracy of detection. At mmWave, a radar has the ability to classify objects by applying complex algorithms and digital signal processing. All of the components of the radar such as the PCB and Antenna Array could be designed in a compact form factor due to the lower wavelength.

Methodology

A radar system at 60GHz would allow computers to process data quickly to produce real-time decisions about the surrounding environment. A radar works similarly to wireless communication systems which has a transmitter and receiver. The receiver portion contains an antenna, Low Noise Amplifier, Mixer, Filter, Baseband Amplifier and ADC. The antenna captures the RF signal over-the-air. The LNA then boosts the received signal, while adding low noise. The mixer converts the RF signal into a lower frequency (baseband) signal. The baseband signal is filtered and amplified again to remove spurious noise. The baseband signal is then processed for digital signal processing. All of the components of the radar are designed in Keysight ADS with TSMC 65nm technology.

Two-Stage Cascade CMOS LNA

The purpose of the Low Noise Amplifier is to amplify the RF signal while introducing minimum amounts of noise which impacts the noise of the entire receiver system. The noise figure of the LNA is added directly to the noise figure of the entire receiver system. In addition, the gain of the LNA reduces the noise contribution for all the components in the later stages.

The 60GHz Low Noise Amplifier for Automotive Radar Application was designed in Keysight ADS with TSMC 65nm technology.