A Wideband LNA with an Excellent Gain Flatness for 60 GHz 16QAM Modulation in 65 nm CMOS

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1 Background
• IEEE 802.15.3c specification
  • 9 GHz unlicensed bandwidth
  • 2.16 GHz/ch
  • Several Gbps data transfer
    • QPSK ⇒ 3.5 Gbps
    • 16QAM ⇒ 7 Gbps
• 57 59 61 63 65 66 GHz unlicensed bandwidth
• Several Gbps data transfer
• QPSK ⇒ 3.5 Gbps
• 16QAM ⇒ 7 Gbps

2 LNA circuit design
• Consideration of LNA design
  • Multi-stage for high gain
  • Input matching for low noise
  • ESD protection
  • Inter-stage matching for gain flatness and low power loss
• Wideband four-stage LNA with excellent gain flatness
  • 3-dB bandwidth: 23 GHz
  • Variable gain: 6.3 dB to 17.5 dB
  • IIP3: -1.8 dBm
  • NF: < 4.3 dB

3 Measurement results
• Condition of measurement results
  • VDD = 1.0 V
  • Power = 24 mW
  • Vb1/Vb2 = 0.6 V

4 Conclusion
• Gain flatness is important in receivers
• Gain flatness influence the EVM of 16QAM modulation
• Gain degradation is requested less than 1dB in 16QAM modulation
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