Research Background & Objective

Receiver Side
Low Noise Amplifier (LNA)
- Amplify small signal without noise & distortion

Objective
Multi-Band performance
for many wireless standards in one LNA

Introduction
Multi-Band performance for many wireless standards in one LNA.

Proposed Triple-Band LNA
Two types of Triple-Band LNA circuits

1. Transformer-coupled
   - Transformer-coupled: Main - Secondary Side - Third Side
   - Transformer-coupled: Main - Secondary Side - Third Side

2. Transformer-coupled
   - Transformer-coupled: Main - Secondary Side - Third Side
   - Transformer-coupled: Main - Secondary Side - Third Side

Analysis of Triple-Band LNA
Small-Signal Equivalent Model (Triple-Band LNA)

Calculates the formula for determining resonance frequencies:

\[
\omega = \pm \sqrt{\frac{a}{2} \pm \sqrt{\frac{a}{2} + \frac{b}{2}}} \sqrt{(2a + b)^2 + 4(2a + b)^4 - 16}}
\]

Neihart’s Dual-Band LNA

Resonance frequency is

Frequency [GHz] vs. Frequency [GHz]

Scattering Parameter Analysis

High gains at matching points

Consideration

Investigation of Problems
- Chip area increase
- Noise increases (by associated circuits with inductor)

Consider inductor layout to solve these problems!!

Realization of Inductor on chip

Thick Wiring at Top Layer

Section View of LSI

Inductor is realized in high Q value at top layer on chip

(Q value is high, inductor's parasitic resistance is small)

Reference

References