A Large Variable Ratio On-Chip Inductor with Spider Legs Shield
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1. Background

Radio Band Spreading Widely

A chip can support only a narrow band. The chip possible to support wide band is necessary.

2. Proposed Structure of Variable Inductor

Conventional Variable Inductor

Metal plate cancels magnetic flux. But...

Some of fluxes cannot be canceled.

Proposed Variable Inductor

Shield metals cancel the undesired flux.

\[ \frac{Q_{\text{max}}}{Q_{\text{min}}} \text{ increases. Thus, variable ratio increases.} \]

3. Result of Simulation

Simulation Method

Magnetic Field around the Inductor

Magnetic flux is reduced by the shield metal.

Simulated by HFSS(Ansoft).

Variable Range of Inductance Value

\[
\begin{array}{c|c|c|c|c}
\text{Shield width } W & \text{Conventional} & \text{Proposed} & \text{Variable ratio } r & \% \text{ up} \\
\hline
165 \mu m & 1.03 & 0.83 & 14% & \\
250 \mu m & 2.53 & 2.37 & 14% & \\
\end{array}
\]

4. Conclusion

- The maximum variable ratio of inductance is 2.87 @ 5 GHz
- The variable ratio increases 14% @ 5 GHz

The proposed variable inductor can be applied to Si CMOS RF circuits, and improves the tuning range of circuits.