# 60GHz 帯コモンソースおよびカスコード増幅器の比較

A comparison between common-source and cascode topologies for 60GHz amplifier design in 65nm CMOS

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## 1. Introduction

Both common-source (CS) and cascode (Cas.) topologies are utilized in millimeter-wave (MMW) circuit design. CS topology, which has reasonable power gain and small noise figure, is widely used in MMW amplifier designs. The good isolation between input and output of Cas. topology is also attractive in mm-wave amplifier design.

In this paper, the comparison of CS topology, Cas. topology, and a gain-boost Cas. topology which uses a transmission line (TL) at the gate of the common-gate transistor are carried out considering the gain, the isolation and the stability factor. A one-stage amplifier using Cas. topology are implemented.

## 2. Comparison between the CS and Cas. topologies

At lower frequency, the Cas. topology has the advantage of higher gain performance, and lower power consumption than the CS topology. As the operation frequency increased, cascode transistors have a larger parasitic capacitance which shorts the small signal current and reduce the gain. A gain-boost technique with using the inductance $L_{TL}$ at the common-gate transistor of the Cas. topology is reported in [1], which can increase the power gain of this topology. In order to compare the performances of the CS topology, Cas. topology, and the gain-boost Cas. topology in MMW ranges, three topologies as shown in Fig. 1 are fabricated using 65-nm CMOS technology. In Fig. 1(c), 100 μm guide micro-strip transmission line (MSTL) [2] is utilized to instead the inductance.

The measurement results (Fig. 2) show that as the frequency increased, the maximum gain of the Cas. topology decreased faster than the CS topology. The same maximum gain can be obtained around 60 GHz. While the gain-boost Cas. topology achieves a higher maximum gain. Both the Cas. topology and the gain-boost Cas. topology have about -30dB reverse isolation at 60GHz while the reverse isolation of CS topology is only -13dB at 60GHz.

## 3. One-stage amplifiers using gain-boost Cas. topology

The stability factor of the gain-boost Cas. topology becomes worse at 60GHz as analyzed in [3]. In order to verify this issue, a one-stage amplifier using the gain-boost structure is fabricated. The input and output impedance matching are realized by the MSTL. The measurement results of the one-stage amplifier are shown in Fig. 3. The power consumption of the one-stage amplifier is 6mW.

## 4. Conclusion

The gain-boost Cas. topology has higher maximum gain and better reverse isolation than the CS topology at 60GHz. The one-stage amplifier using the gain-boost Cas. topology obtains a 7dB power gain and unconditional stability with only 6mW power consumption.

**Acknowledgements**

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**References**

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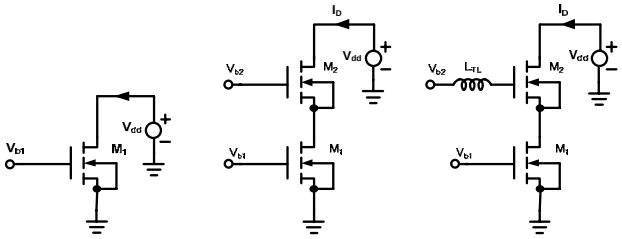
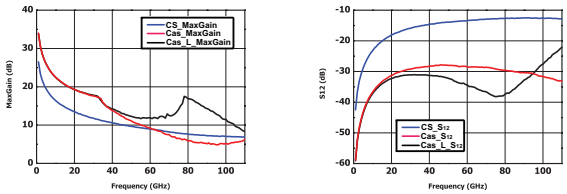



(a)　(b)　(c)

Fig. 1 (a) CS topology. (b) Cas. topology. (c) Gain-boost Cas. topology.




(a)　(b)

Fig. 2 The measured MSG/MAG and isolation S12 of the CS, Cas, and gain-boost Cas. topologies. (a) MSG/MAG, (b) S12.

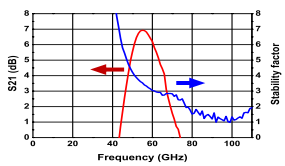



Fig. 3 Measure results of one-stage amplifier.