

Common-Source and Cascode FET Amplifiers

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Description

A common-source FET amplifier M1 is given with transistor parameters: $V_{tn} = 2V$, $K_n = 1.2mA/V^2$, $C_{GD} = 0.8pF$, $C_{GS} = 5pF$, and external capacitors = $10uF$. For part 1 we analyzed this amplifier to obtain its voltage gain $A_V = 4.92$, and its high break frequency $f_H = 8.094MHz$. During our DC analysis we also found I_D to be $0.994mA \approx 1mA$.

For the second part, a common-gate FET amplifier was added in series with the first to produce a cascode. Both transistors have the same parameters as before. This time our results were: $A_V = 4.914$, $f_H = 12.06MHz$, and $I_D = 0.994mA \approx 1mA$.

Analysis

The cascode is composed of the original common-source FET amplifier connected to a common-gate amplifier. Because the common-gate amplifier adds no voltage gain to the circuit the overall midband voltage gain stayed the same between both configurations. The benefit of the cascode comes in the circuit's frequency response. Because the second transistor is added, there is no direct coupling between the input and output. This removes the Miller effect and produces a higher bandwidth. We see this in the improved, higher high break frequency. The drain current I_D also stays the same.

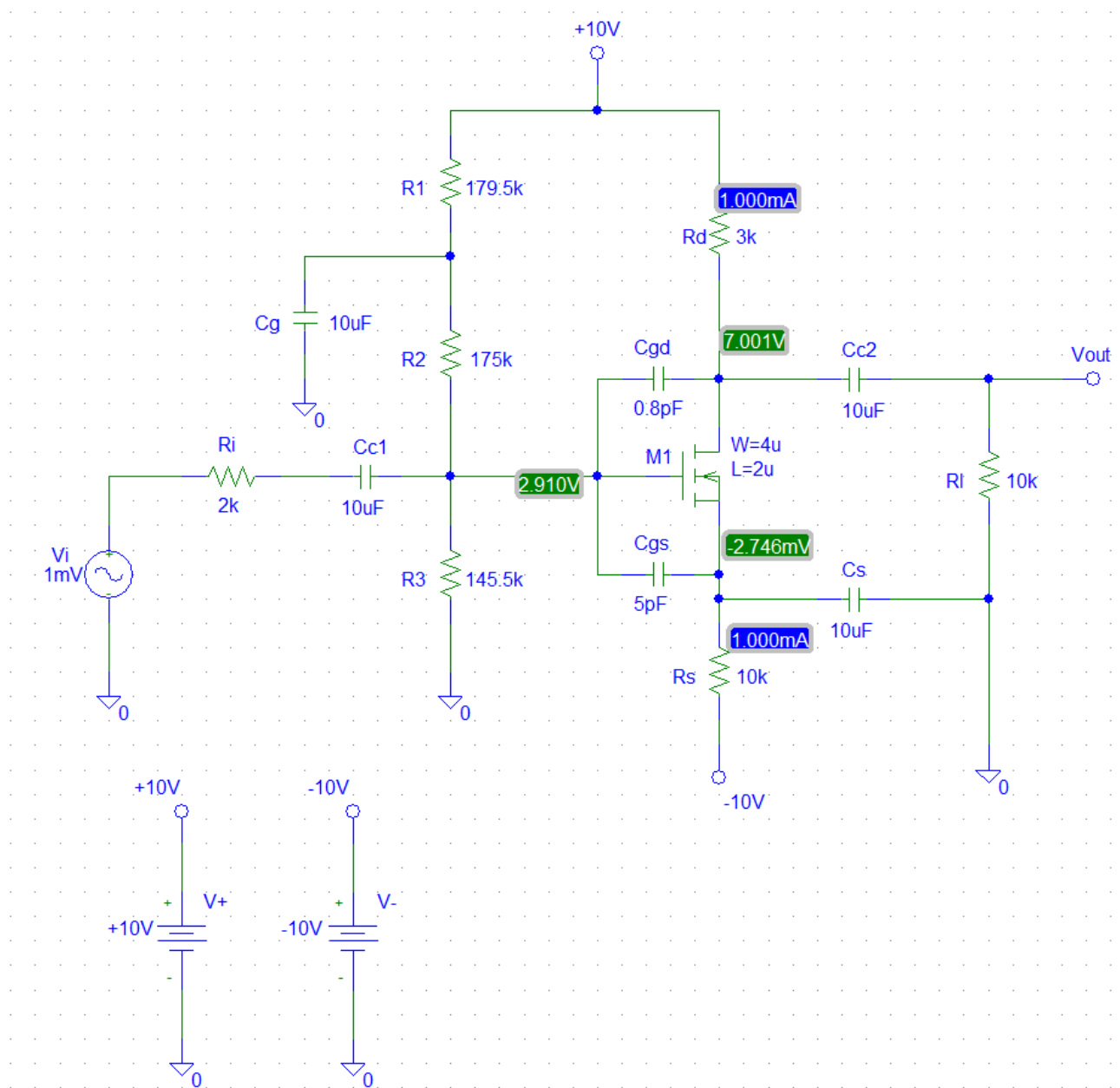


Figure 1: The common-source amplifier

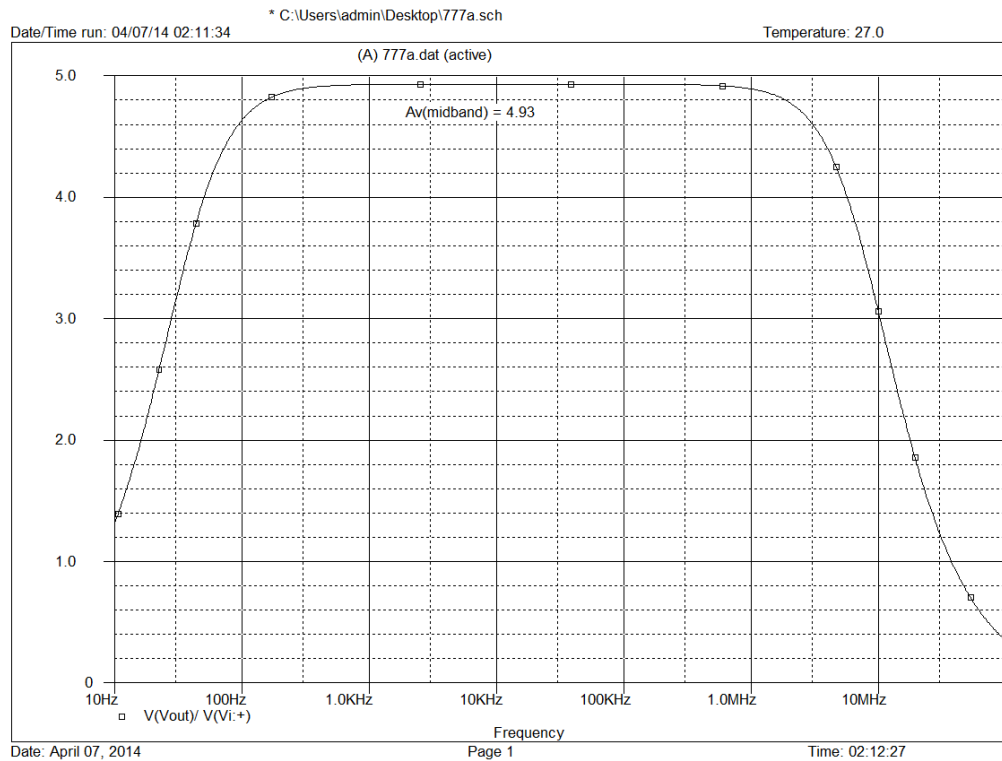


Figure 2: The common-source amplifier midband voltage gain

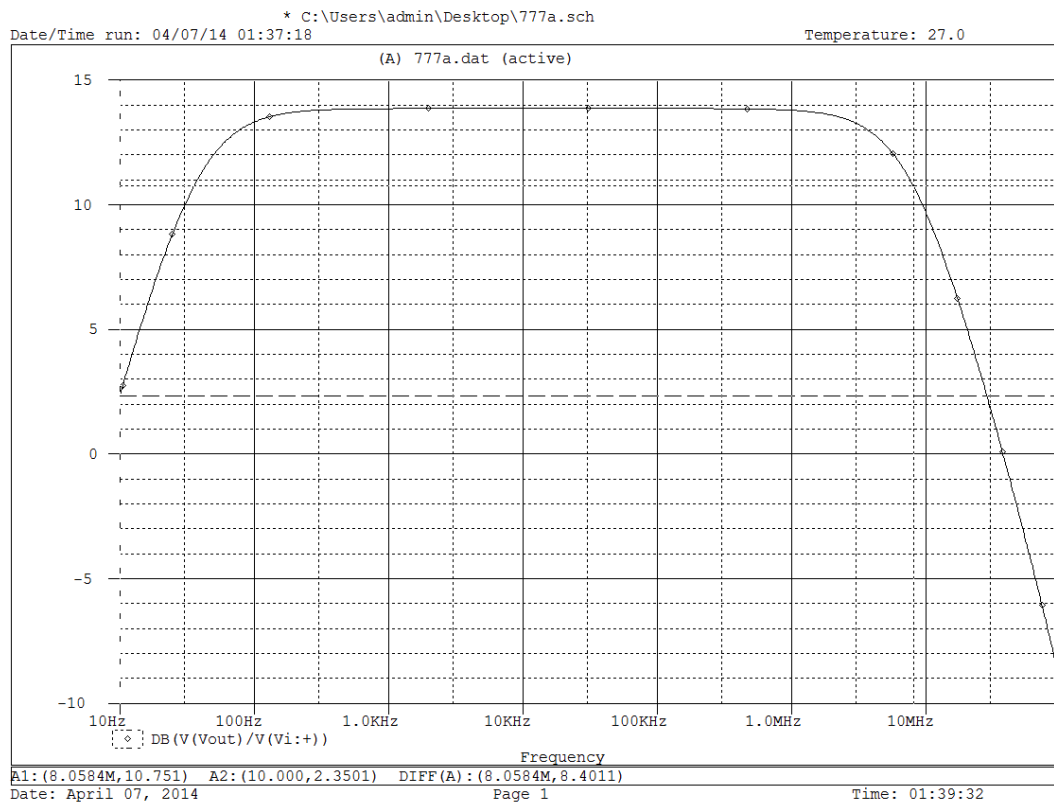


Figure 3: The common-source amplifier high break frequency

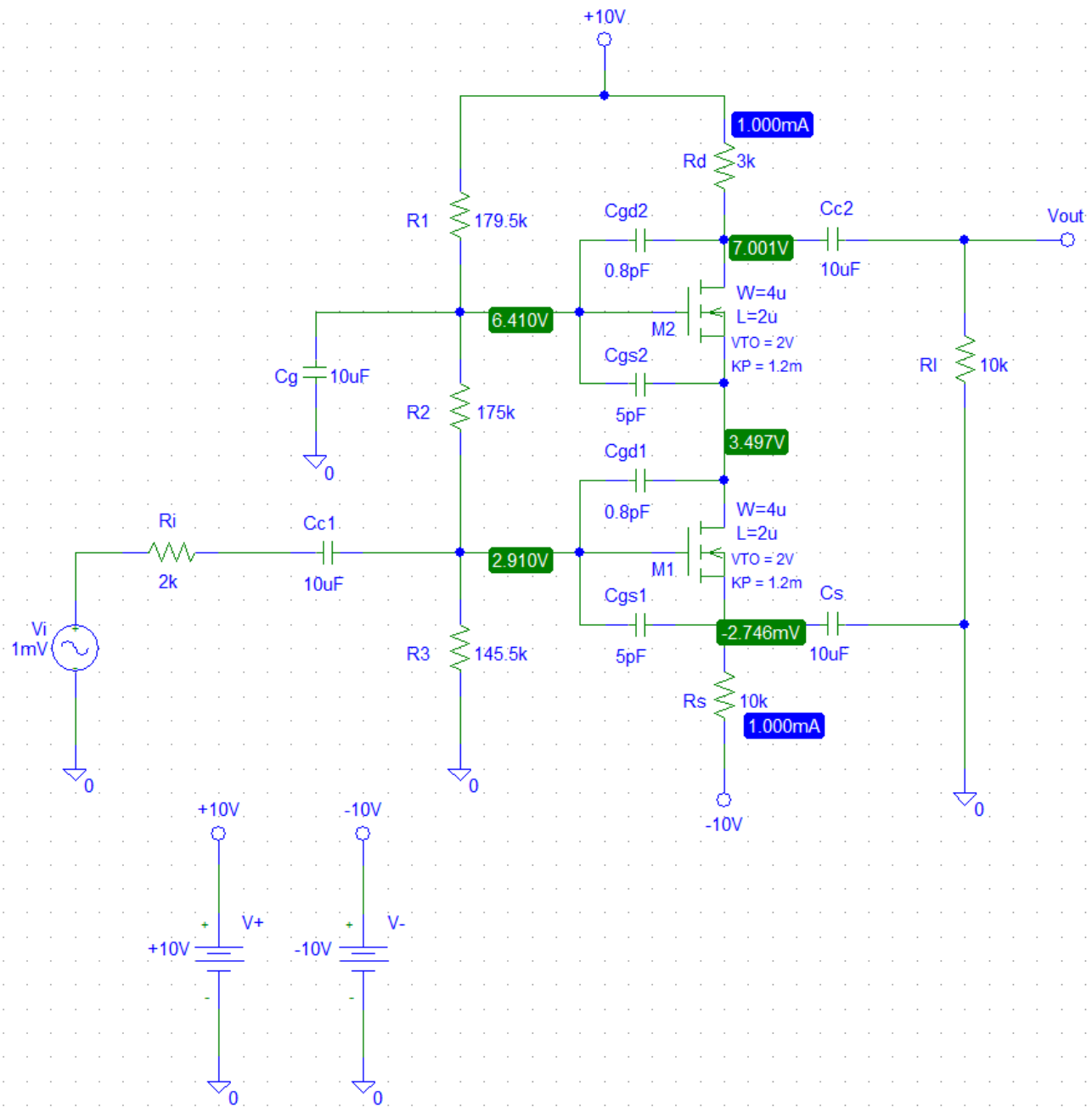


Figure 4: The FET cascode amplifier

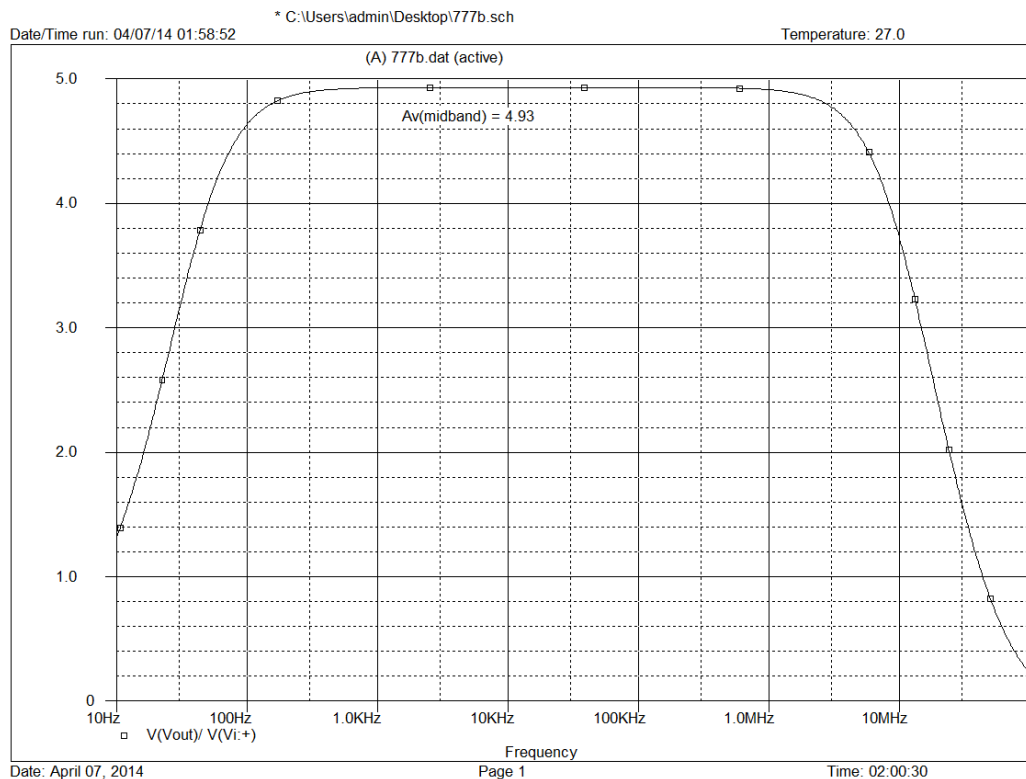


Figure 5: The cascode amplifier midband voltage gain

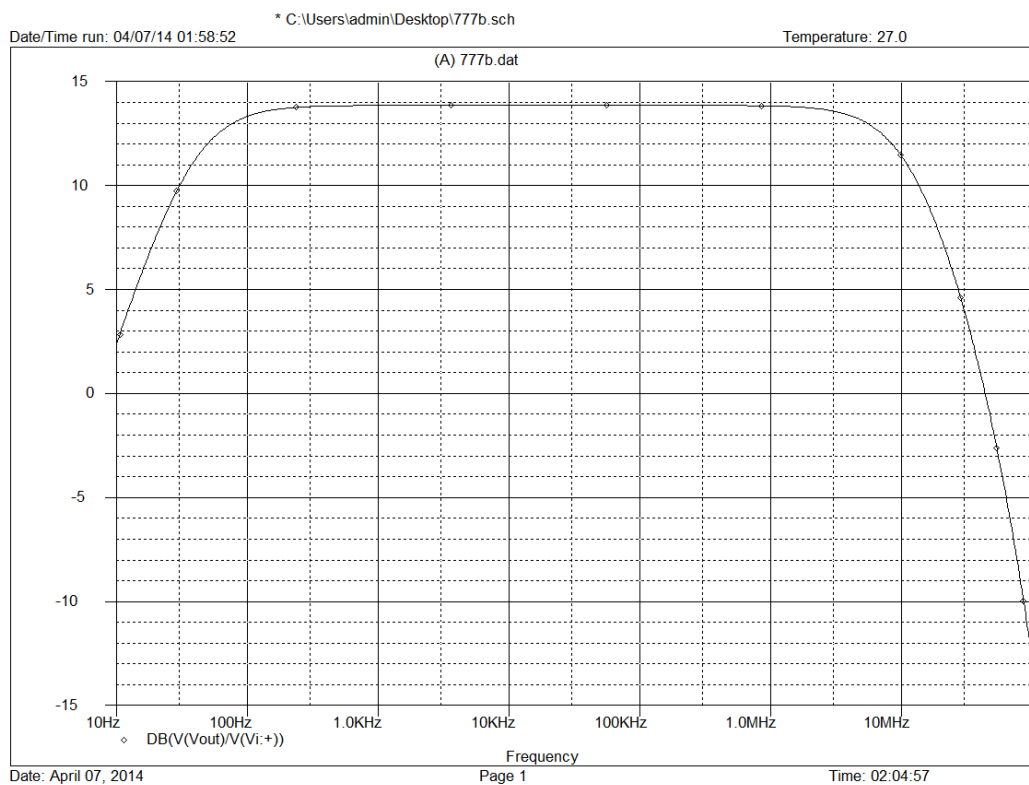


Figure 6: The cascode amplifier high break frequency