Design of a Simple CS Amplifier

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I. CS Amplifier

The desired specs are as follows:

- $|A_v| > 40$ at $V_{DS} = V_{DD}/2 = 0.9V$
- Output swing: $400mV$
- Unity-gain frequency: $f_u = 100MHz$, $C_L = 5pF$
- $V^* = 200mV$

The transconductance can be obtained from:

$$g_m = 2\pi f_u C_L$$

this gives us

$$g_m = 3.14 \ mS$$

The current can be obtained from:

$$V^* = 2 \cdot \left(\frac{g_m}{I_D}\right)^{-1}$$

and a V^* of $200 \ mV$ corresponds to a g_m/I_D of 10.

Thus,

$$I_D = 314 \ \mu A$$

The V^* vs I_D plot for a transistor with $W = 1\mu m$, $L = 0.30\mu m$ is shown below.
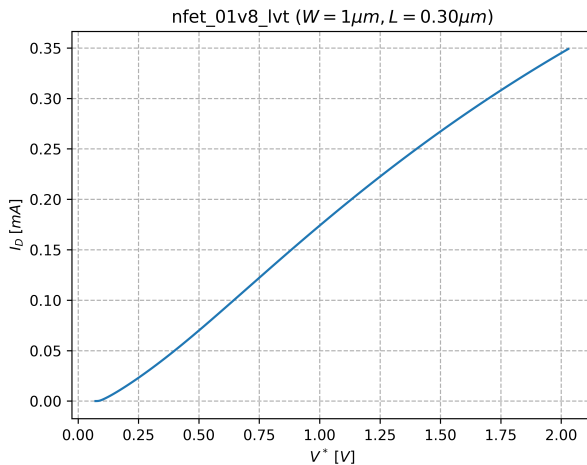

Fig. 1. I_D vs V^*

To get the desired I_D, the width should be multiplied by 21.