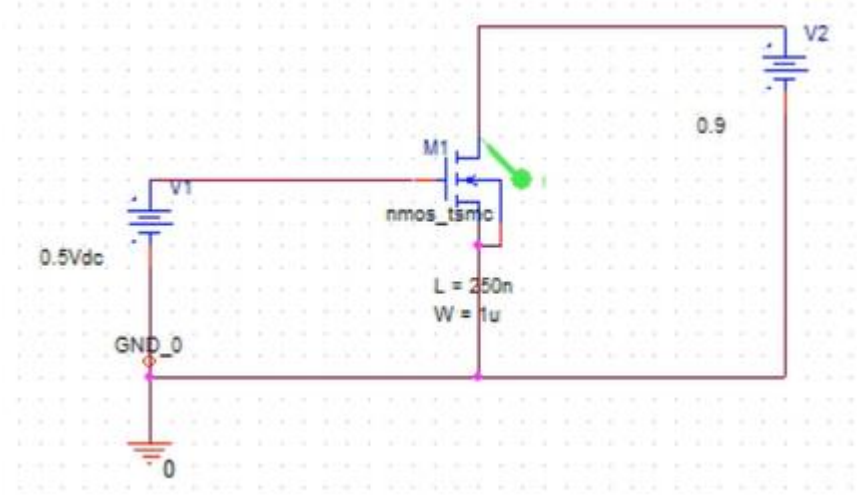
Prelab 1, Analog Integrated Curcuits

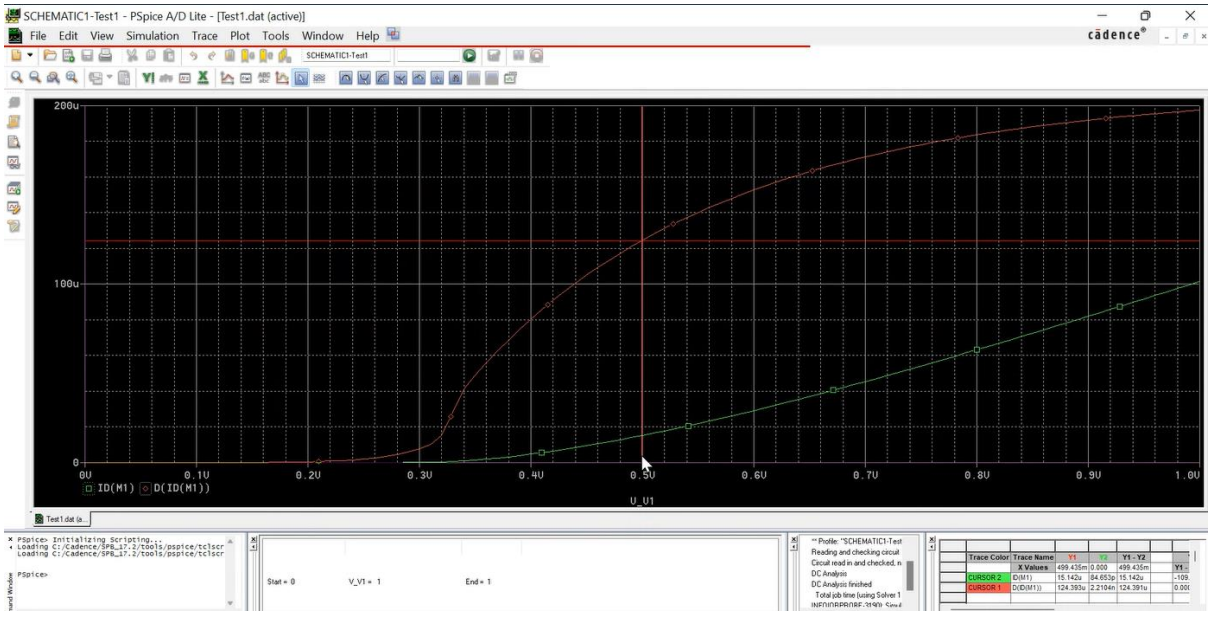
Ole Janse, Finn Rautenberg, 29.11.2022, Lübeck

f) Task: Determine the transconductance g_m of the transistor at VGS = 0.5 V



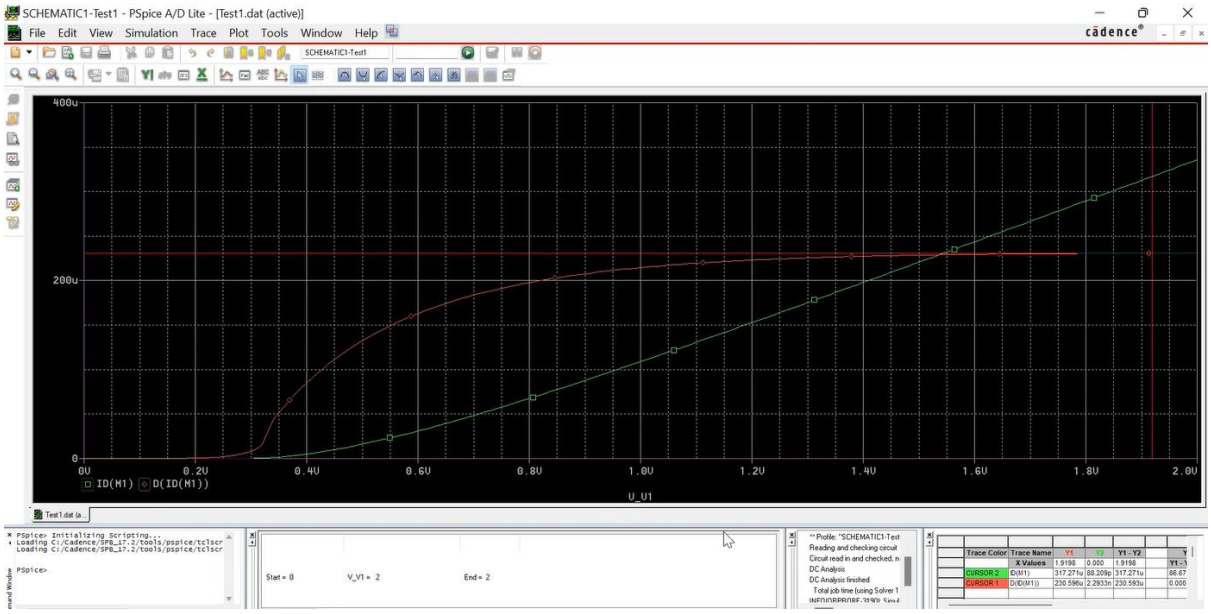
Simulation of DC-Sweep of G_gs,dc from 0V to 1V

Plot of I_d,dc and the slope g_m= I_d,dc/V_gs,dc at G_gs,dc=0,5V by D(I(IM1)



g_m= 124 µS @ V_gs,dc=0,5V

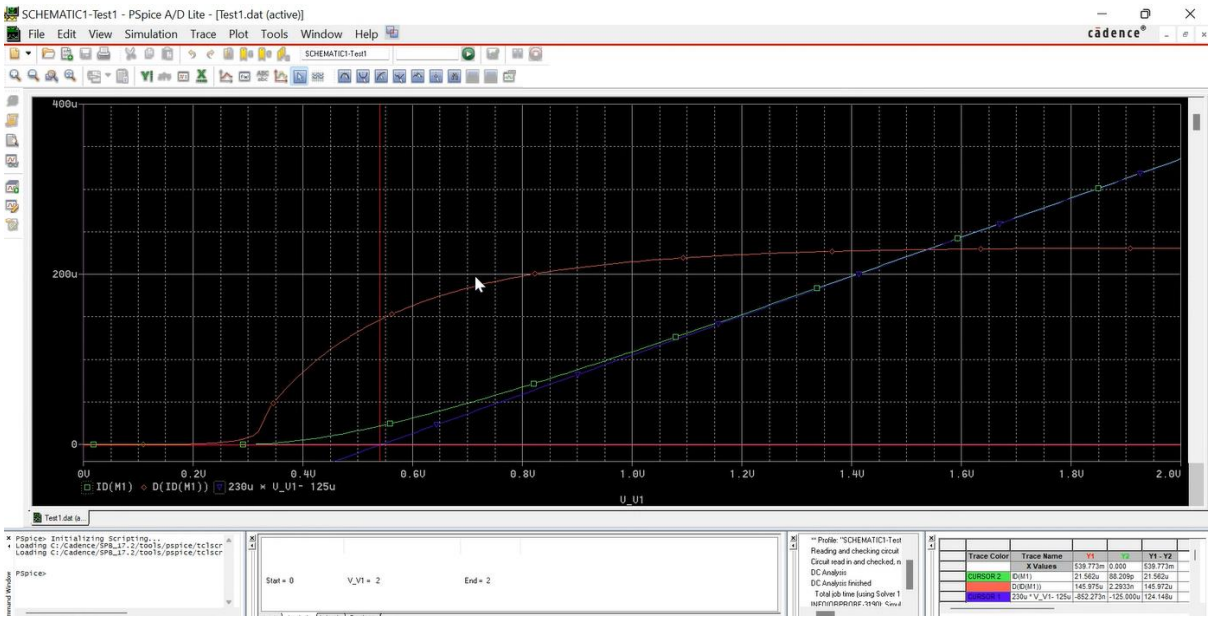
g) Task: Determine the transistor V_th value by sketching the tangent line at the highest slope of I_d,dc/V_gs,dc and determin the voltage of U_gs,dc at I_d,dc=0A of the tangent



Simulation of DC-Sweep of G_gs,dc from 0V to 2V

The highest slope was determined at V_gs,dc=1,91V with g_m=230 uS

A linear straight was applied as Tangent to I_dc,dc (Cursor Y1) with the parameter 230u * V_VGDC – 125u which crossed I_d,dc = 0A at U_gs,dc = U_th = 539mV (Cursor Y2)



i) Task: Determine the linear (triode) region of the transistor

To satisfy linear region

- V_gs,dc < V_th = 539mV → always fulfilled because V_gs,dc = 500mV < 539mV
- and V_ds,dc < V_gs,dc – V_th = 500mV – 539mV = -39mV (Sim zeigt das bis ~164mV ende von V_ds,dc linearer Bereich :/ Ist V_th oder Formel falsch?)

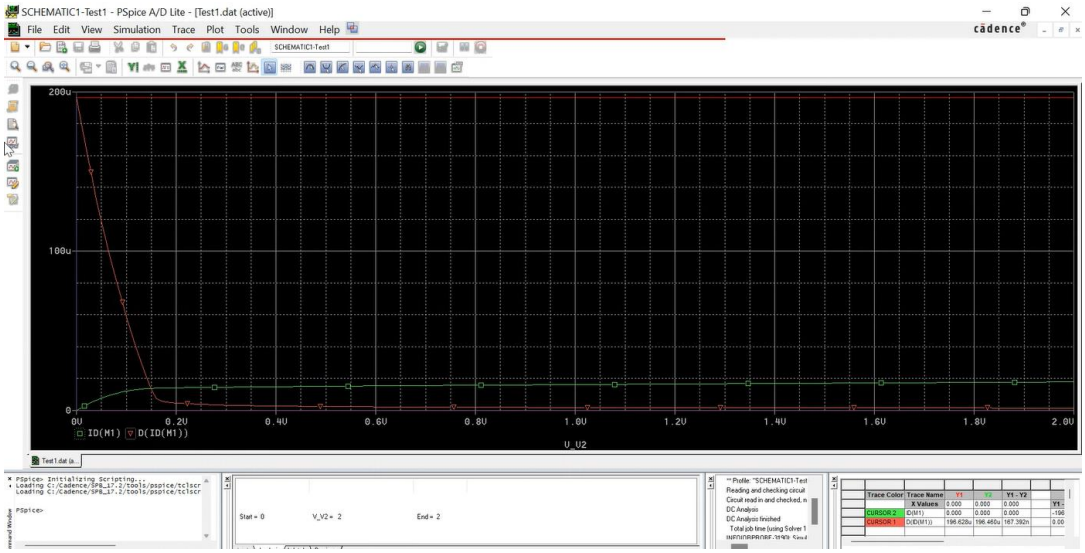
Simulation of DC-Sweep of G_ds,dc from 0V to 2V
Plot of I_d,dc

V_pinch,off ~ 150mV

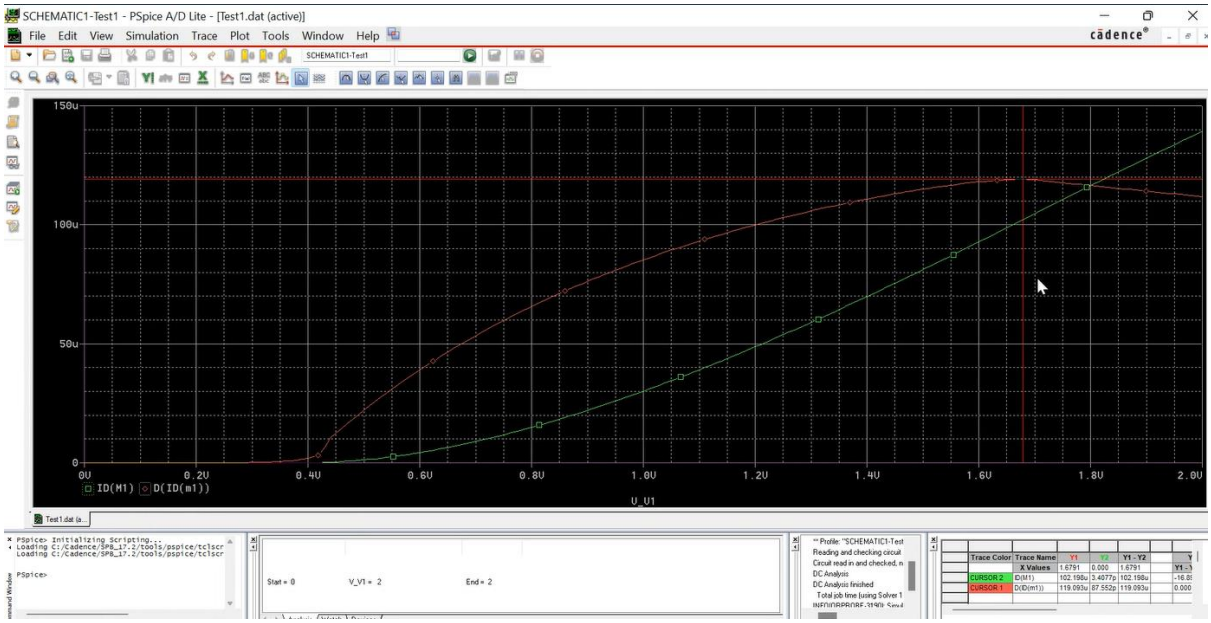
j) Task: Determin small signal output resistance r_ds = r_o. Determine slope r_o = I_d,dc/D_ds,dc

- r_ds = 5,10 kOhm @ V_ds,dc = 0V
- r_ds = 8,41 kOhm @ V_ds,dc = 50mV
- r_ds = 515,4 kOhm @ V_ds,dc = 0,9V

Simulation of DC-Sweep of G_ds,dc from 0V to 2V
Plot of I_d,dc and Derivation D(ID(M1))



k) Task: Repeat for L=1µm j)

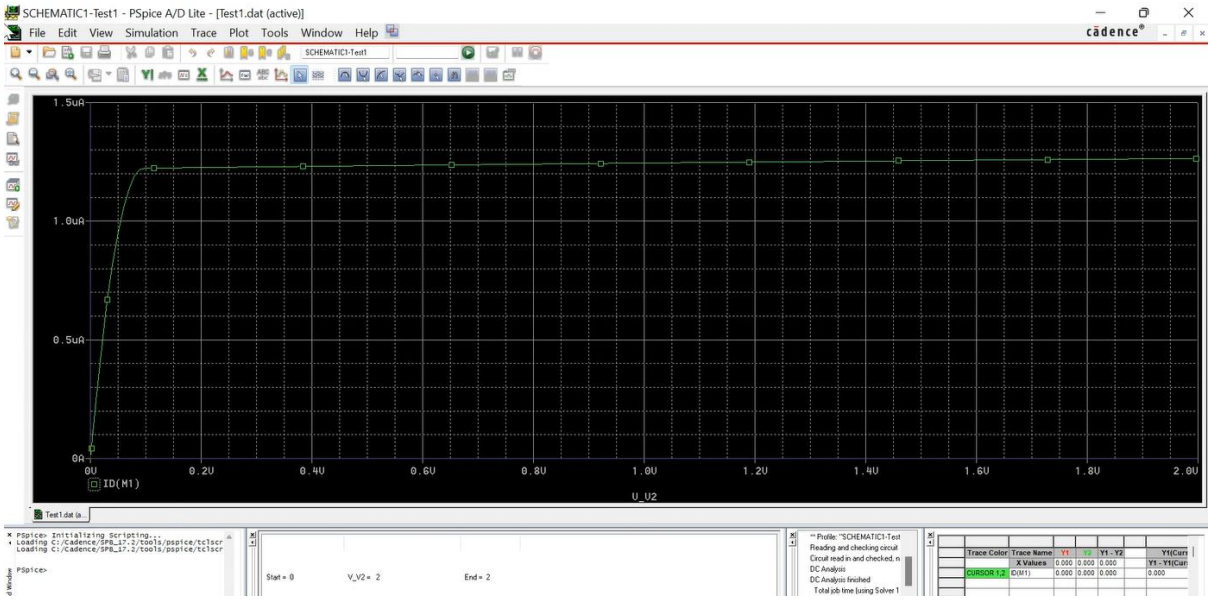


The highest slope was determined at V_gs,dc=1,67V with g_m=119 uS

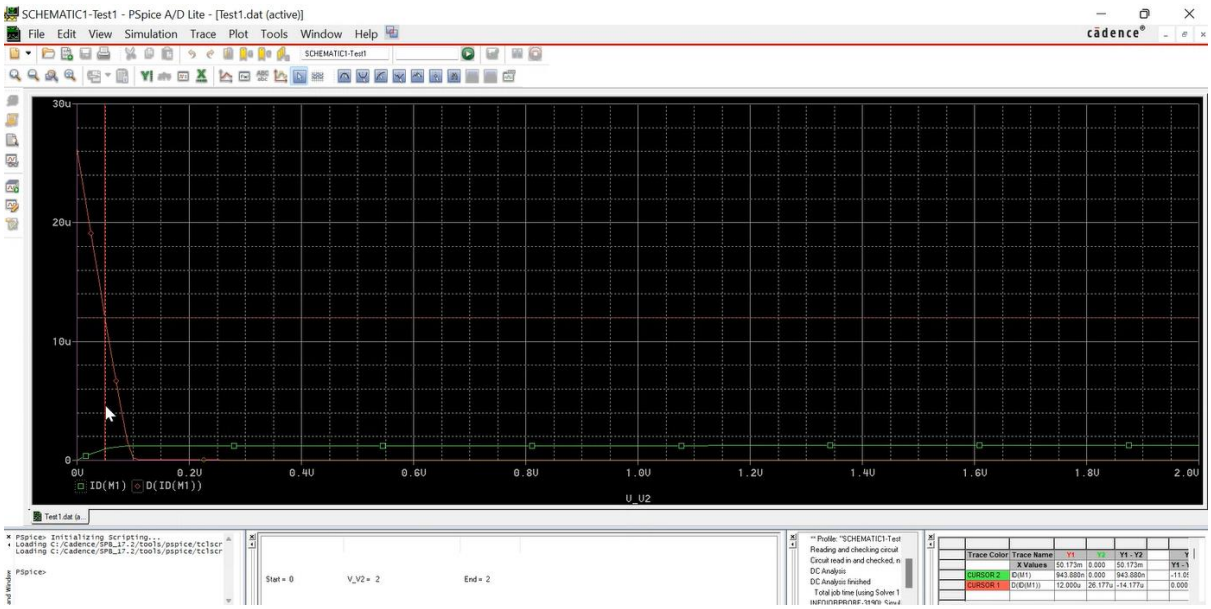
New threshold value 813mV

To satisfy linear region

- V_gs,dc < V_th = 813mV → always fulfilled because V_gs,dc = 500mV < 813mV
- and V_ds,dc < V_gs,dc – V_th = 500mV – 813mV = -313mV



V_pinch,off ~ 100mV



r_0 = 45,8 MOhm, lower channel length modulation as expected

l) Task: Determin I_d,dc for steady state by simulation, switched back to L=250nm

What todo??

m) Task: Compare values of dc sweep and bias point simulation

	Sim DC-sweep	Sim Bias Point (V_gs,dc=0,9V)
V_th	539mV	328mV
G_m	230µS	132µS
r_o	515 kOhm	512 kOhm

Deviation on V_th and g_m due to selection on V-ds,dc != 0,9V as in bias point simulation