

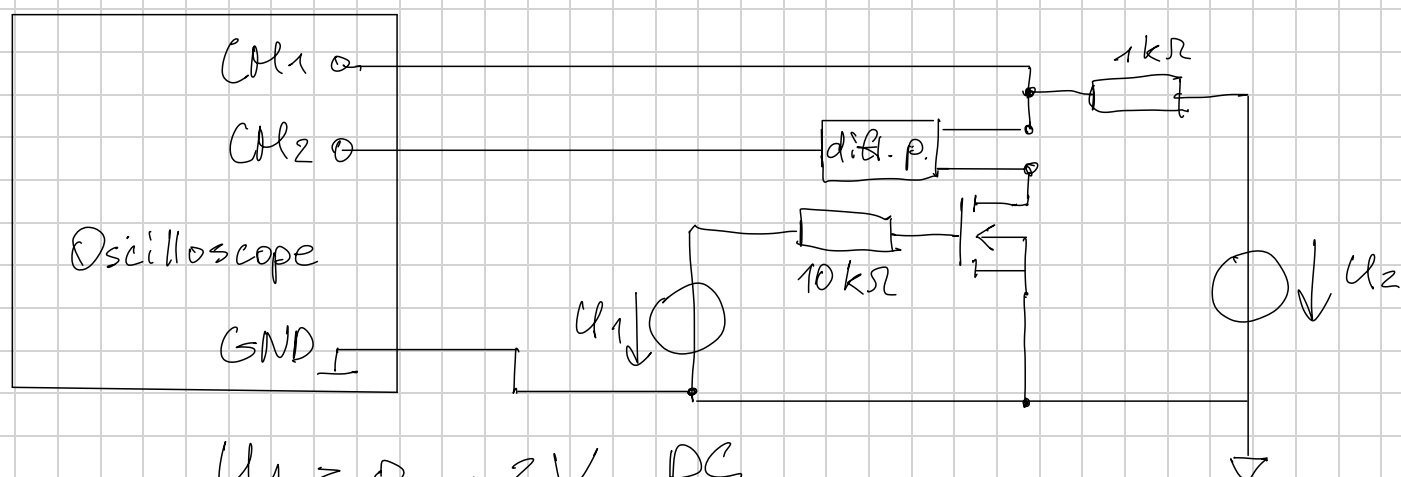
## Preparation 0

- $V_{DS} = 200 \text{ V DC}$   
drain - source
- $I_D = 300 \text{ mA}$   
drain - current

$V_{th} = 1.8 \text{ V (max)}$   
gate-source threshold voltage

- The gate-series resistor limits the charging current and prevents the transistor from overheating

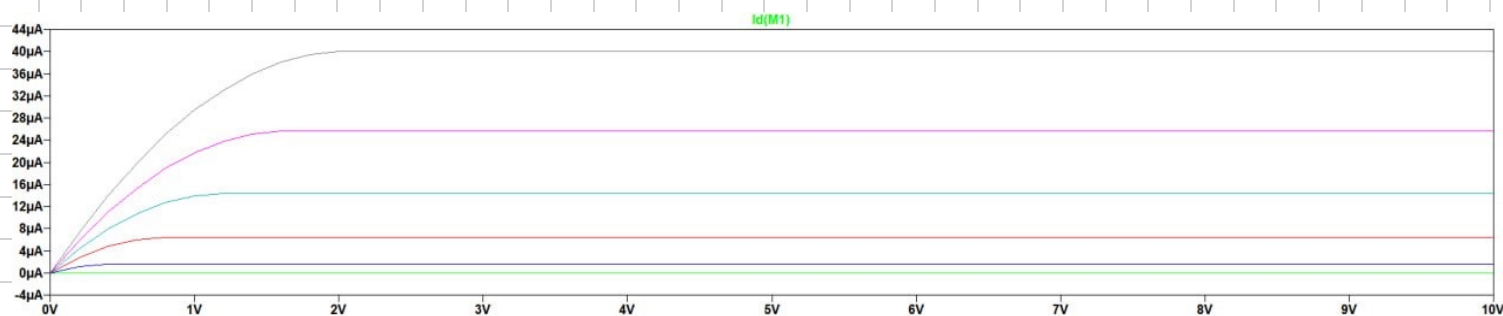
## Part 1



$U_1 = 0 \dots 2 \text{ V DC}$

$U_2 = 0 - 10 \text{ V sine wave}$

## Expected behaviour

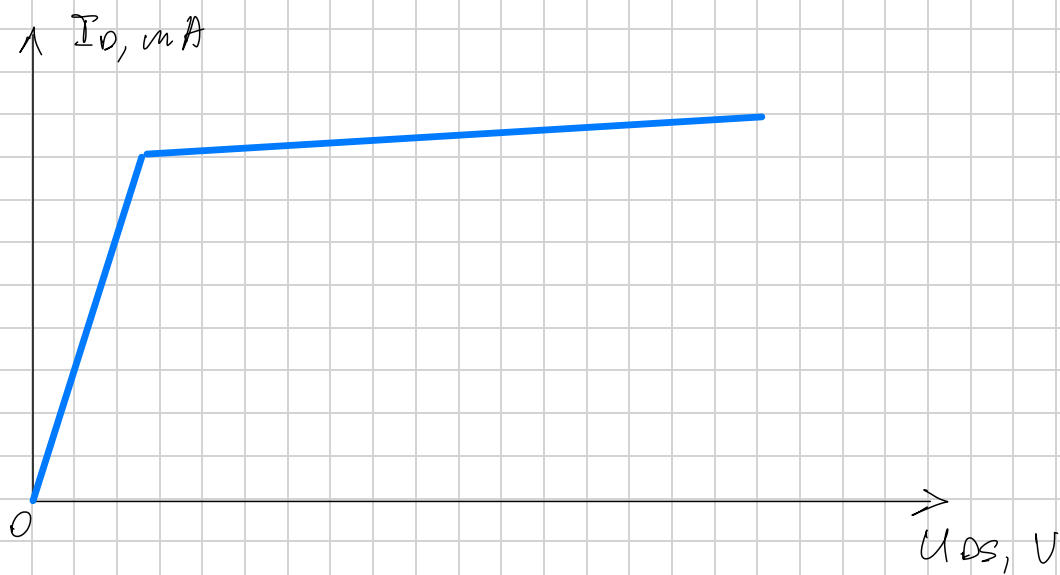


Measured results

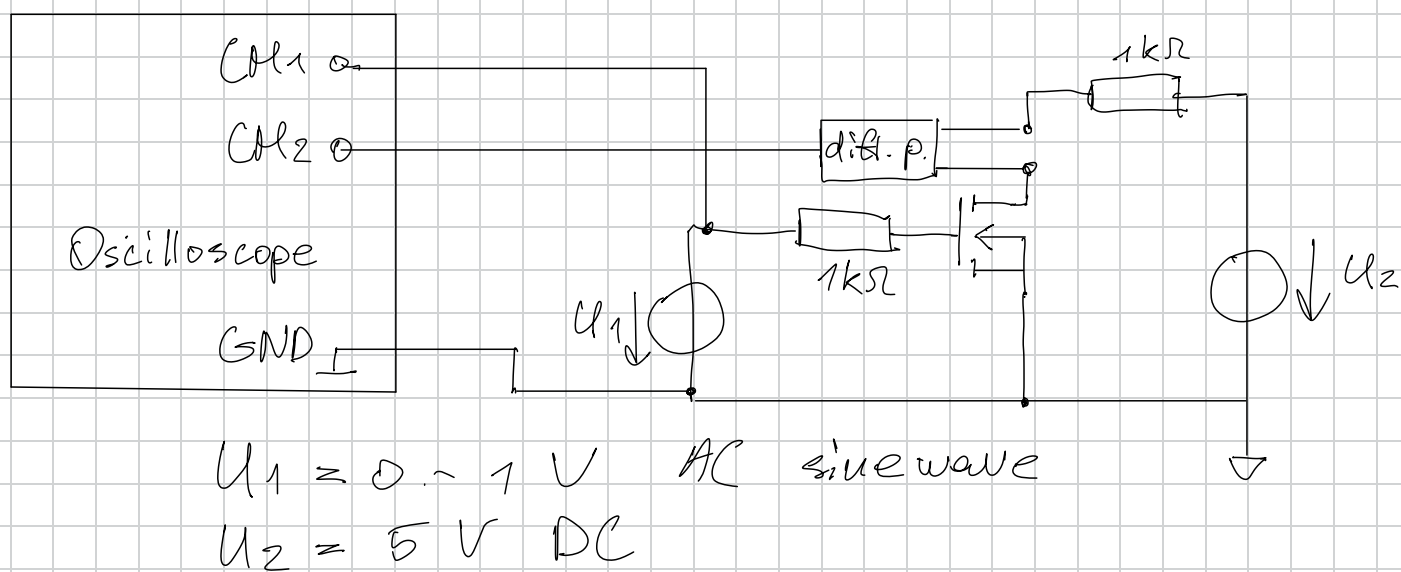
$U_{GS}, \text{V}$	0,56	0,63	0,73	0,8	0,85
$V_{DS}, \text{V}$	6,15	6,14	5,88	5,11	4,29
$I_{D}, \text{mA}$	11 μA	45 μA	0,28	1,04	1,9

Ch. length modulation

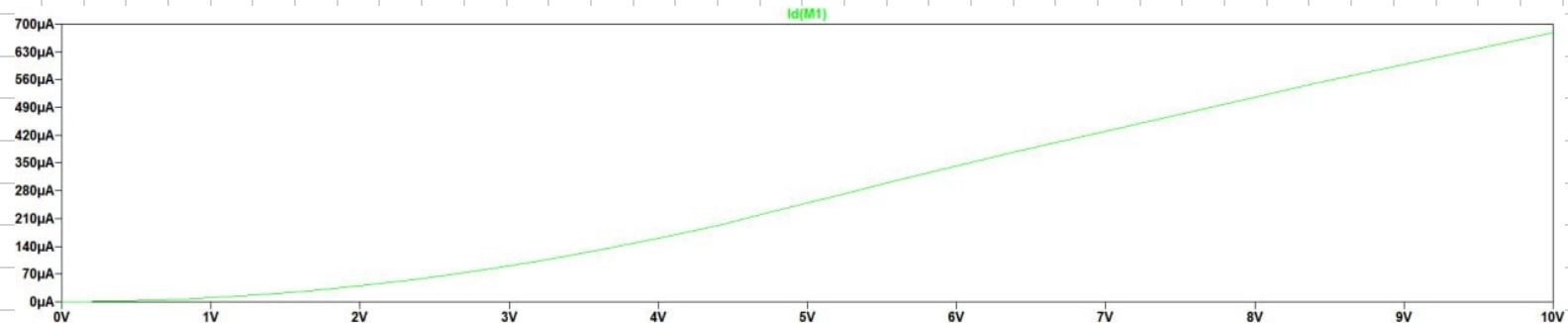
$$\lambda = \frac{\Delta I_D - I_D}{\Delta V_{DS}} = \frac{I_{D2} - I_{D1}}{I_{D1}} / (V_{DS2} - V_{DS1}) = -3,52$$



## Part 2



## Expectation



$$I_D = 1,3 \text{ mA}$$

$$U_{GS} = 0,55 \text{ V}$$

$$I_D = 0,32 \text{ mA}$$

$$U_{GS} = 0,49 \text{ V}$$

$$I_D = 1,99 \text{ mA}$$

$$U_{GS} = 0,587 \text{ V}$$

$I_D, \text{mA}$

0

← measured characteristics

$U_{GS}, \text{V}$

$$S = \frac{\Delta I_D}{\Delta U_{GS}} = \frac{I_{D2} - I_{D1}}{U_{GS2} - U_{GS1}} = 16,3 \text{ mS}$$

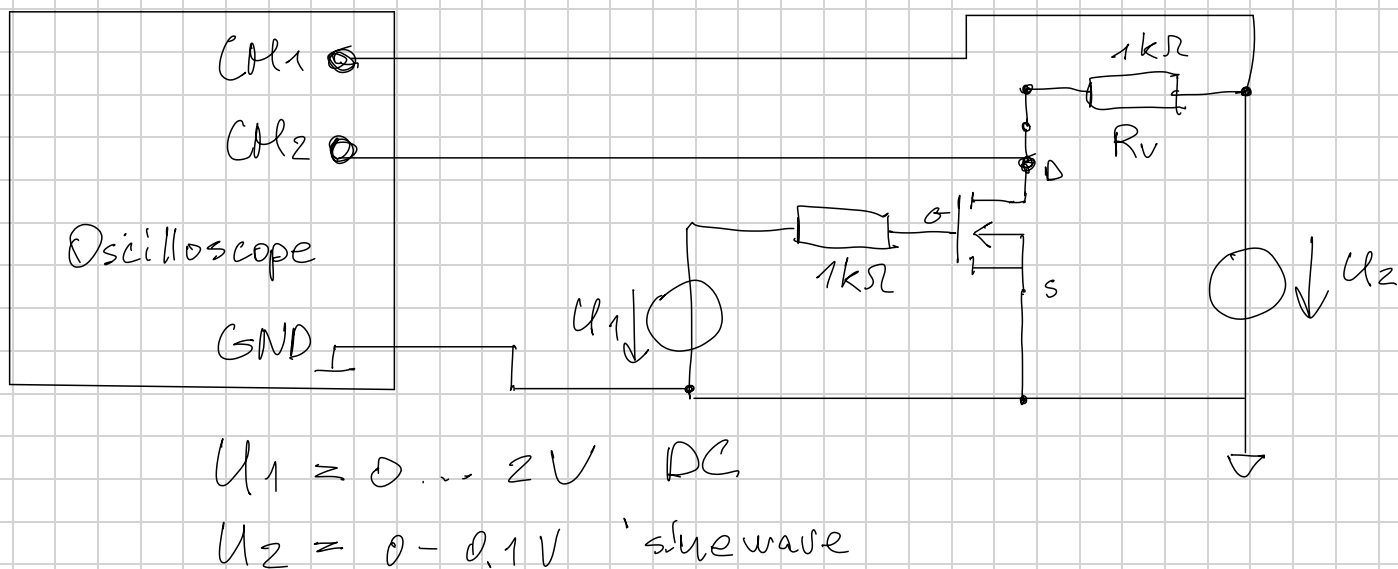
$$K = \frac{2 I_D}{(U_{GS} - \underbrace{U_{th}}_{1,8\text{V}})^2 (1 + \lambda U_{DS})} = 0,36 \text{ mS}$$

### Part 3

$$\bullet \frac{U_1}{U_2} = \frac{I \cdot (R_V + r_{DS})}{I \cdot r_{DS}} = \frac{R_V}{r_{DS}} + 1 \Rightarrow r_{DS} = \frac{R_V}{\frac{U_1}{U_2} - 1}$$

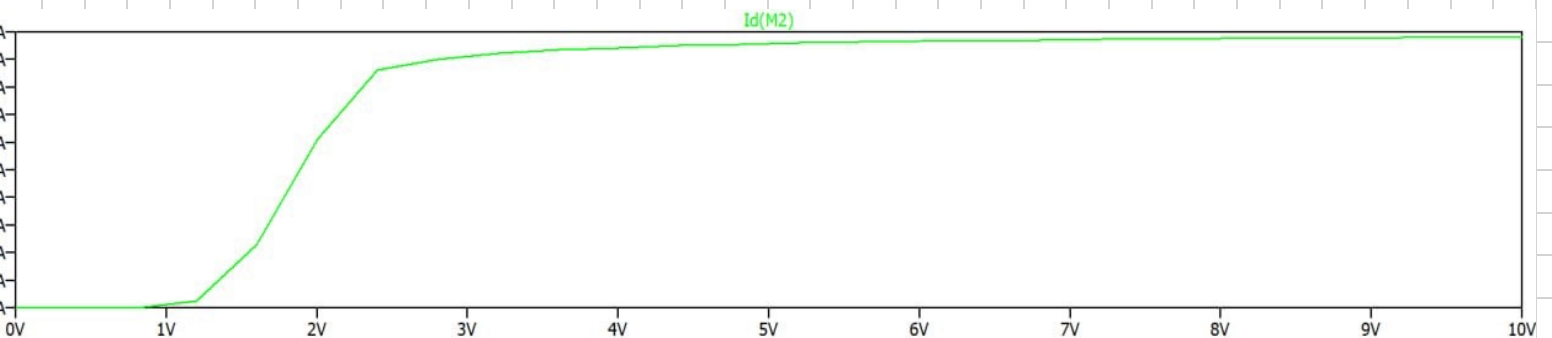
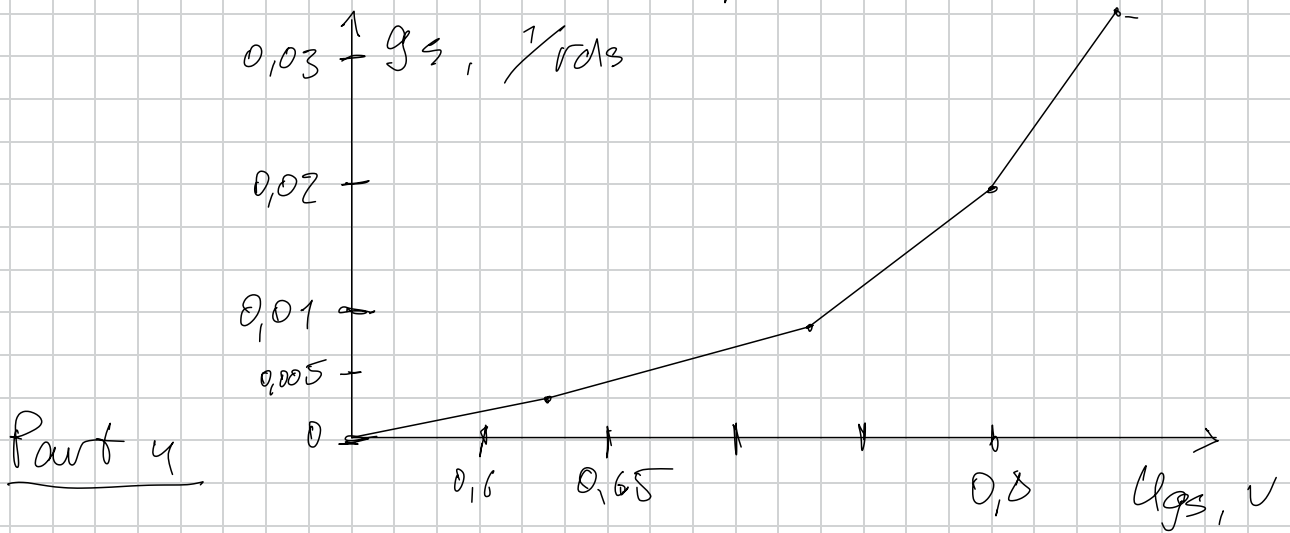
$$U_1 = U_{DS}, \quad U_2 = U_{\text{source}}$$

$$\bullet I_D = K ((U_{GS} - U_{th}) \cdot U_{DS} - \frac{1}{2} U_{DS}^2) \Rightarrow$$
$$\Rightarrow r_{DS}^{-1} = g_{DS} = \left. \frac{\Delta I_D}{\Delta U_{DS}} \right|_{U_{DS} \rightarrow 0} = K (U_{GS} - U_{th})$$



$U_{gs}, V$	0,567	0,63	0,736	0,8	0,864
$V_{1,mV}$	59,7	58,7	57,4	57,3	57,2
$V_2, V$	52,7	34,1	6,3	3,2	1,6
$r_{DS}, \Omega$	7,5 k	1,33 k	118	56	27

Transconductance  
 $K =$   
 Threshold voltage  
 $U_{th} =$



the simulation based on the lab results corresponds to the expected result!

Part 5

Expectation

