1 Measurements & Parameter Extraction

1.1 Line Width/Misalignment

1.1.1 Measured line widths

Nominal Linewidth	ACTV (dark field)	POLY (clear field)	CONT (dark field)	METAL (clear field)
2μm	3	4	1.869	2520

1.1.2 Misalignment

1.2 Four-Point Resistors [2a, 2b]

1.2.1 Measurement Setup

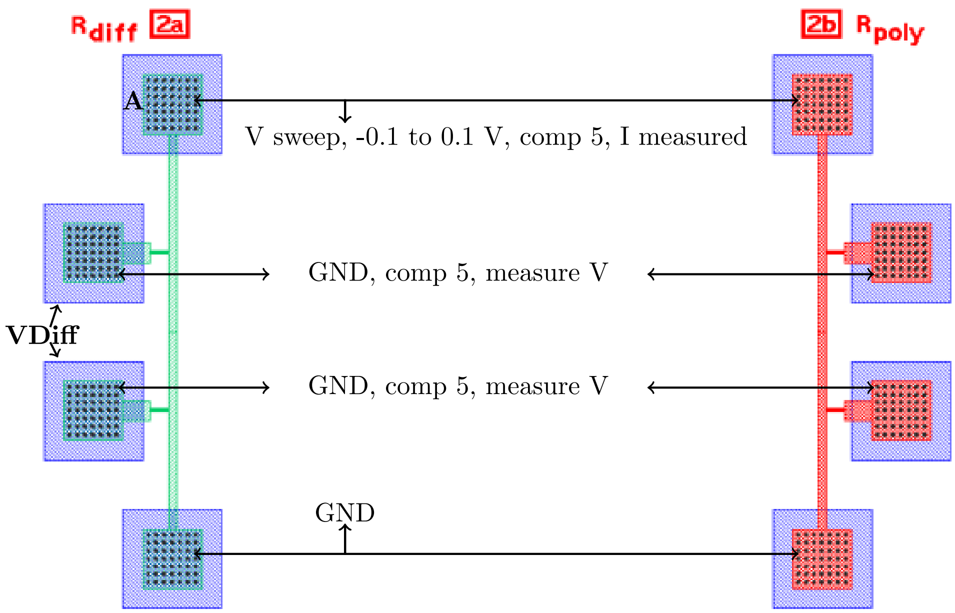


Figure 1: Device 2a is a diffusion resistor and 2b is a poly resistor.

1.2.2 I-V plot for the diffusion resistor, 2a

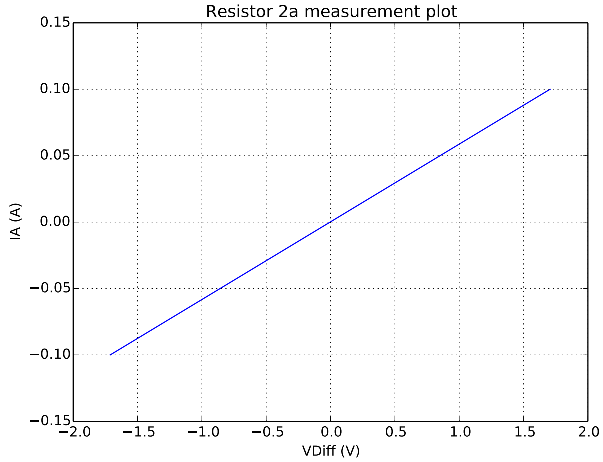


Figure 2: A plot of the measurement data taken for resistor 2a. The plot is based off of 2 data points.

From the plot above we can calculate our resistance. Note that the slope of the above plot will be equal to 1/R. Since I = V/R, where I is our dependent variable (y axis) and V is our independent variable (X axis). A resistance of $R = 17\,\Omega$ was calculated. Our width and length values are $10\mu m$ and $200\mu m$. This means that

$$R_s = \frac{W}{L} R_{\text{diff}} = \frac{10}{200} 17 = 0.85\,\Omega$$

From the previous lab report we have a junction depth of $1\,\mu m$. This means that our Resistivity is $\rho = R_s x_j = 0.85 \times 10^{-4}$ Ω-cm. Using the Irvin curves in Jaeger [1], we can estimate the surface concentration $N_0 \approx 10^{21}$. Now the mobility can be calculated using a table of values from Appendix xx.

$$\mu_e = \mu_{\text{min}} + \frac{\mu_0}{1 + (N/N_{\text{ref}})^\alpha} = 92 + \frac{1268}{1 + (10^{21}/1.3 \times 10^{17})^{0.91}} = 92.37\,\text{cm}^2/V - s$$

1.2.3 I-V plot for the poly resistor, 2b

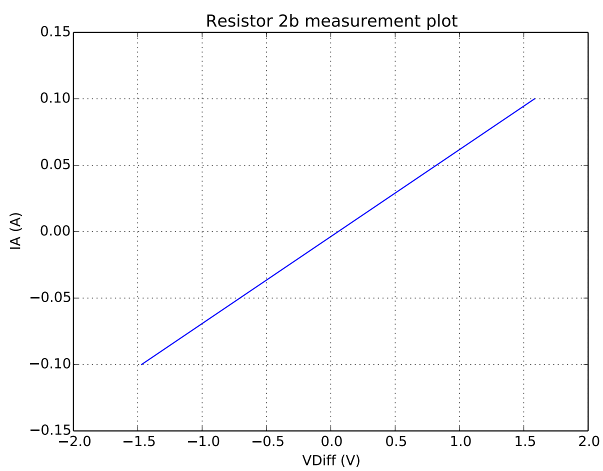


Figure 3: A plot of the measurement data taken for resistor 2b. The plot is based off of 2 data points.

From the plot above we calculate a 1/slope value of 15. Hense $R = 15\,\Omega$. Our Resistivity is then $\rho = R_s t_{\text{poly}}$ where t_{poly} is the polysilicon thickness which is 0.4 μm, Hense $\rho = 6\,\Omega$-μm.

1.3 Four-Point Contact Resistor [17a, 17b]

1.3.1 Measurement Setup

1.3.2 I-V plot for 17a

1.3.3 I-V plot for 17b

1.4 Four-Point Contact-Chain Resistor [2c, 2d]

1.4.1 Measurement Setup

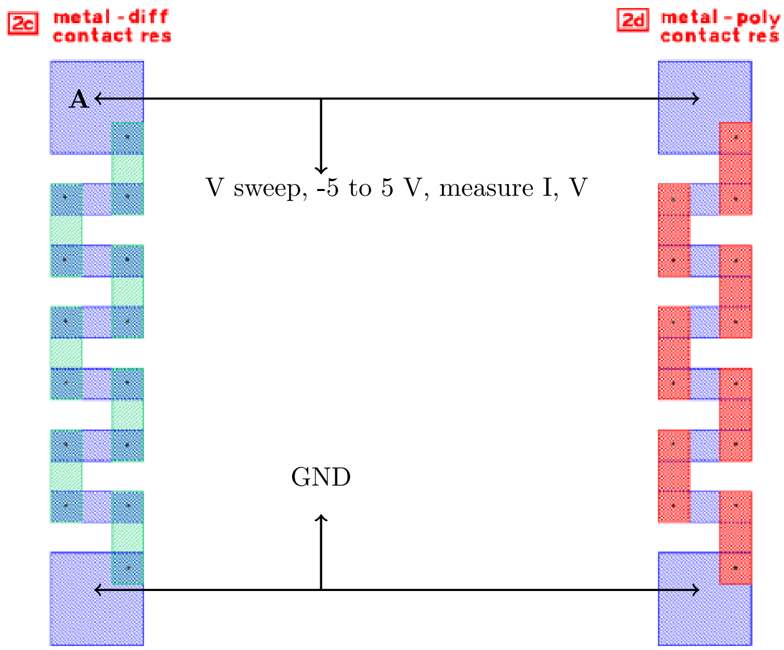


Figure 4: Chain resistor setup for diffusion and poly resistors.

1.4.2 b. I-V plot for diffusion resistor, 2c

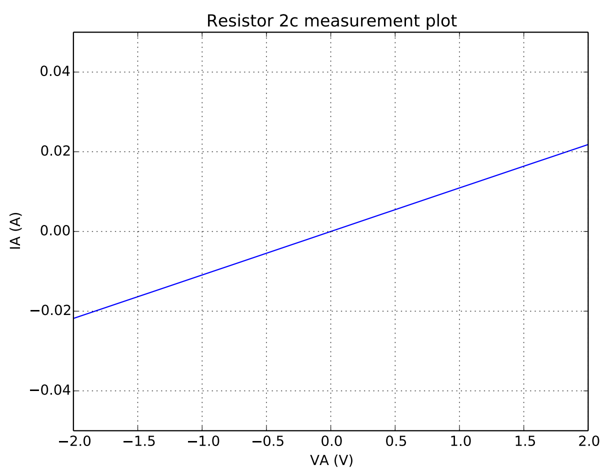


Figure 5: A plot of the measurement data taken for resistor 2c. The plot is based off of 2 data points.

i. Extract the resistance
ii. Extract metal-to-diffusion contact resistance

1.4.3 b. I-V plot for poly resistor, 2d

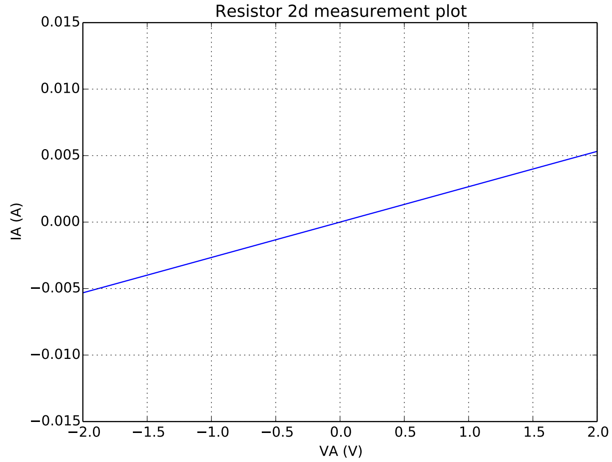


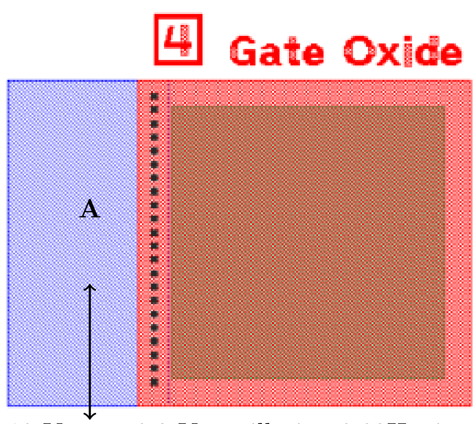
Figure 6: A plot of the measurement data taken for resistor 2d. The plot is based off of 2 data points.

i. Extract the resistance
ii. Extract metal-to-poly contact resistance

1.5 Gate Oxide Capacitor, 4

1.5.1 Measurement Setup

Stage connector set to GND



V sweep, -10 to 10 V, step 0.2 V, oscillation 0.02Hz, integration medium

Figure 7: Gate capacitor setup.

1.5.2 C-V plot of gate oxide capacitor w/ lights ON

Minimum capacitance

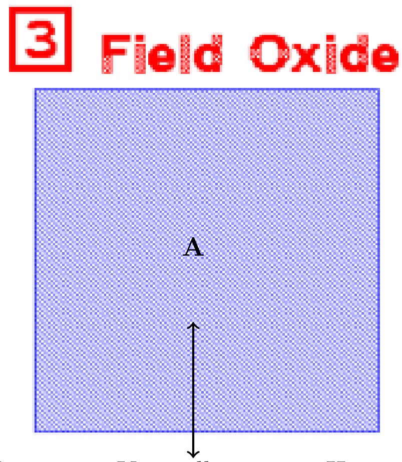
1.5.3 C-V plot of gate oxide capacitor w/ lights OFF

minimum capacitance ...

1.6 Field Oxide Capacitor, 3

1.6.1 Measurement Setup

Stage connector set to GND



V sweep, -5 to 5 V, step 0.2 V, oscillation 0.02Hz, integration medium

Figure 8: Field oxide capacitor setup.

1.6.2 C-V plot of field oxide capacitor

Minimum capacitance

1.6.3 Capacitance in the accumulation region

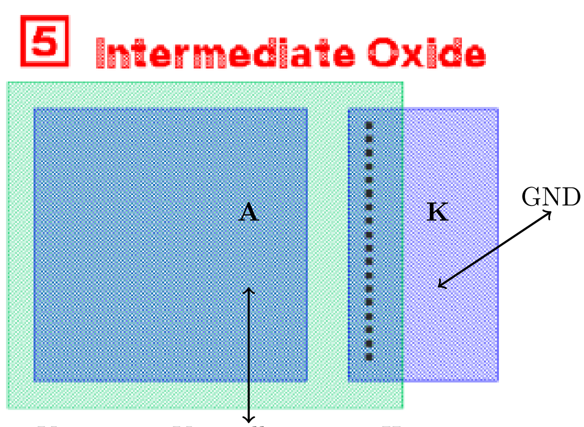
minimum capacitance ...

1.6.4 Field oxide thickness

stuff...

1.7 Intermediate Oxide Capacitors, 5

1.7.1 Measurement Setup



V sweep, -5 to 0 V, step 0.2 V, oscillation 0.02Hz, integration medium

Figure 9: Intermediate oxide capacitor setup.

1.7.2 C-V plot of intermediate oxide capacitor

stuff ...

1.7.3 Capacitance in the accumulation region

stuff...

1.8 Diode, 7

1.8.1 Measurement setups for forward and reverse operations

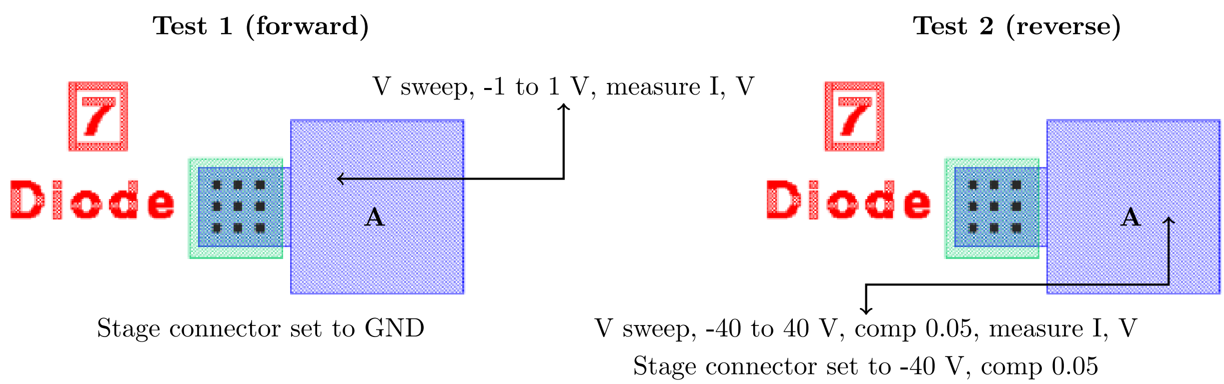


Figure 10: Two tests were performed on this diode; both measurement setups are shown above.

1.8.2 I-V plots for forward and reverse operation

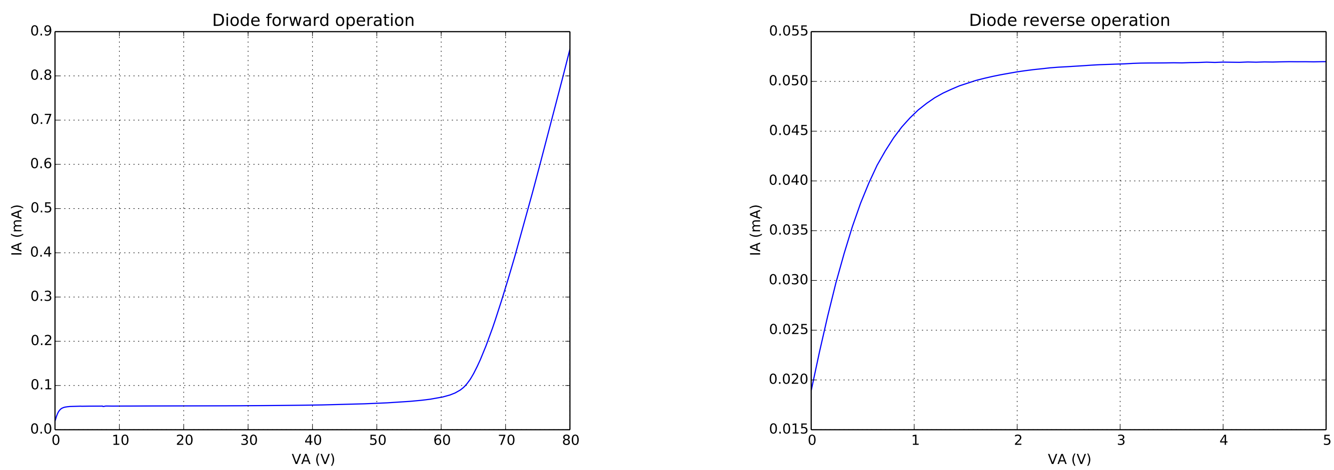


Figure 11: Plots of forward and reverse operation of Diode 7.

1.8.3 Extract the turn-on voltage and the series resistance

1.9 MOSFETs of Varying Length, [8a-d]

1.9.1 Measurement setups

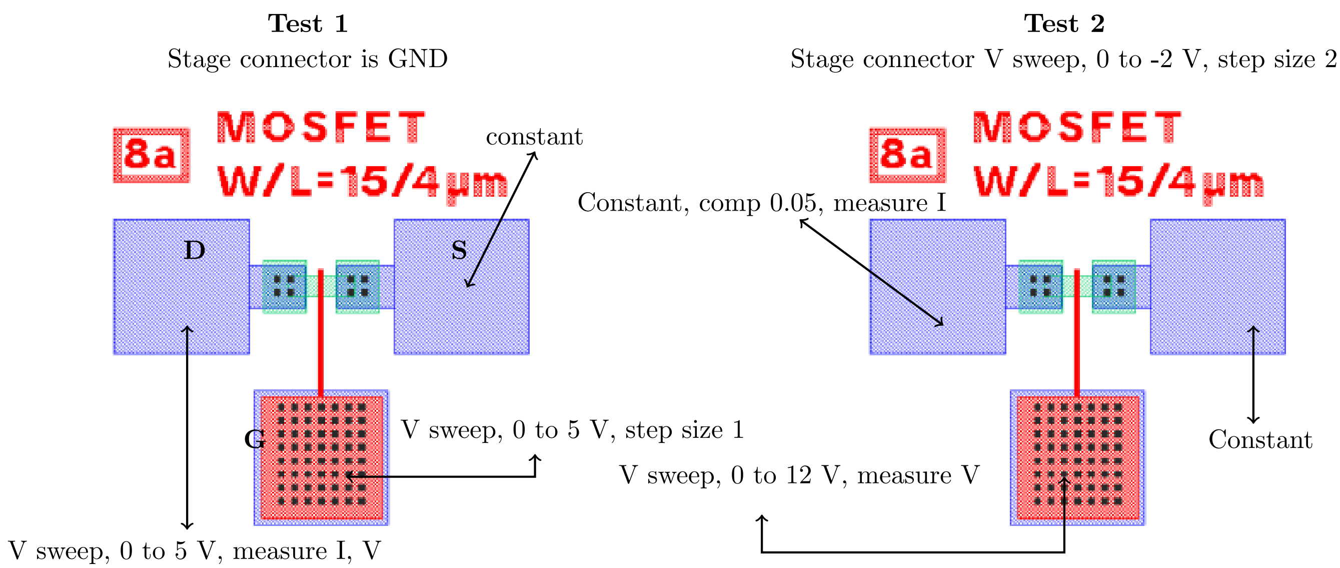


Figure 12: Measurement setup for Mosfet 8a. The same setup is used for Mosfets 8a-d. The only difference is the channel length which changes from 4 (8a) to 6 (8b) to 8 (8c) to 10 (8d) microns.

1.9.2 Plots of I_D-V_D, sweeping V_G

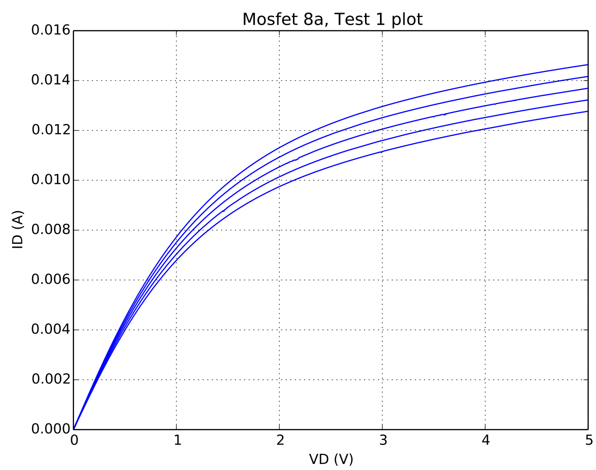


Figure 13: Test 1 for Mosfet 8a

Calculate stuff here...

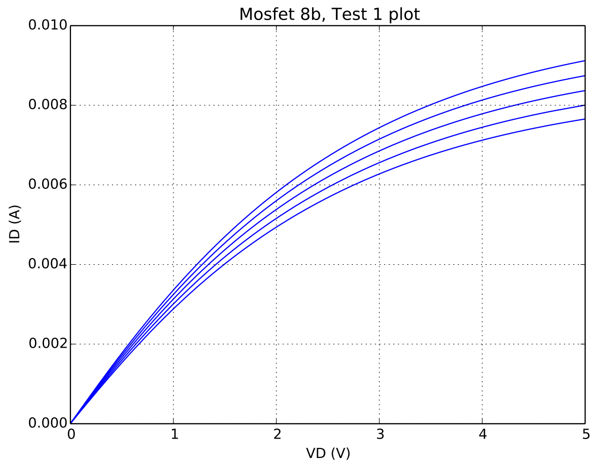


Figure 14: Test 1 for Mosfet 8b

Calculate stuff here...

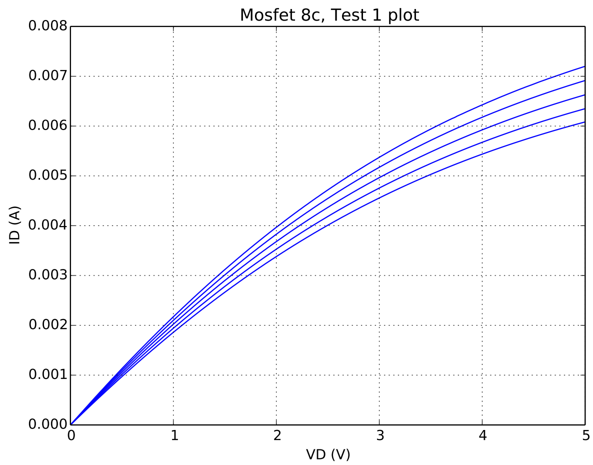


Figure 15: Test 1 for Mosfet 8c

Calculate stuff here...

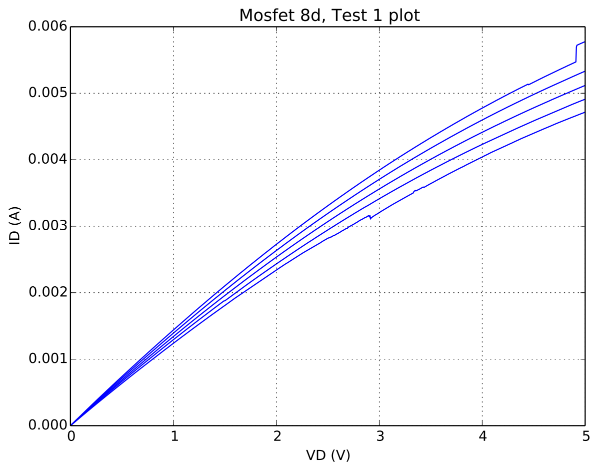


Figure 16: Test 1 for Mosfet 8d

Calculate stuff here...

1.9.3 Plots of I_D-V_G, sweeping V_B

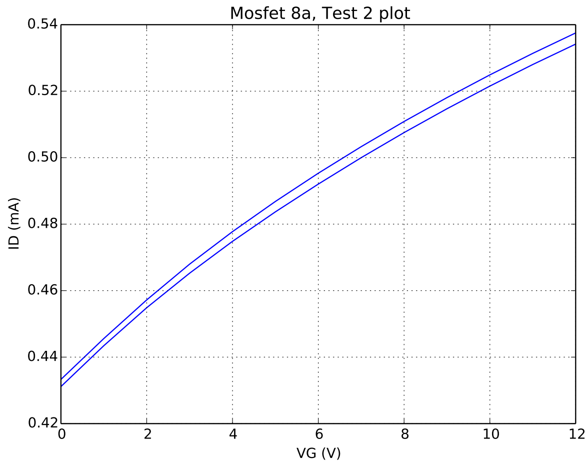


Figure 17: Test 2 for Mosfet 8a

Calculate stuff here...

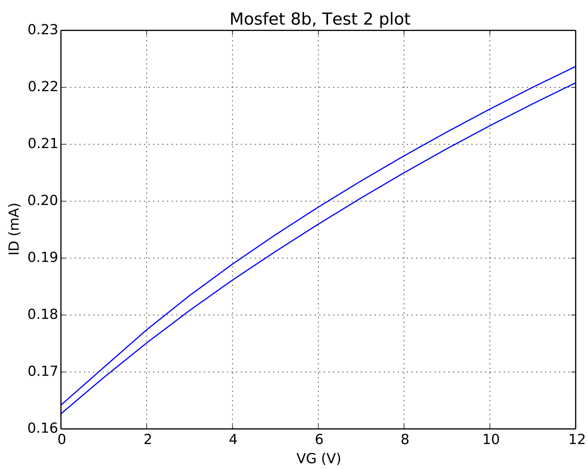


Figure 18: Test 2 for Mosfet 8b

Calculate stuff here...

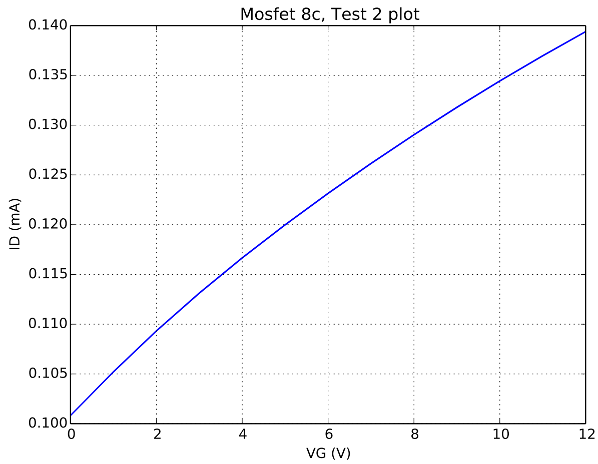


Figure 19: Test 2 for Mosfet 8c

Calculate stuff here...

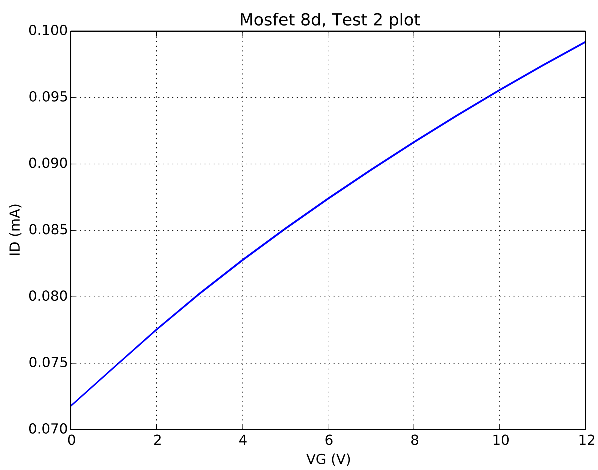


Figure 20: Test 2 for Mosfet 8d

Calculate stuff here...

1.10 MOSFETs of varying width [9a-c]

1.10.1 Measurement setup

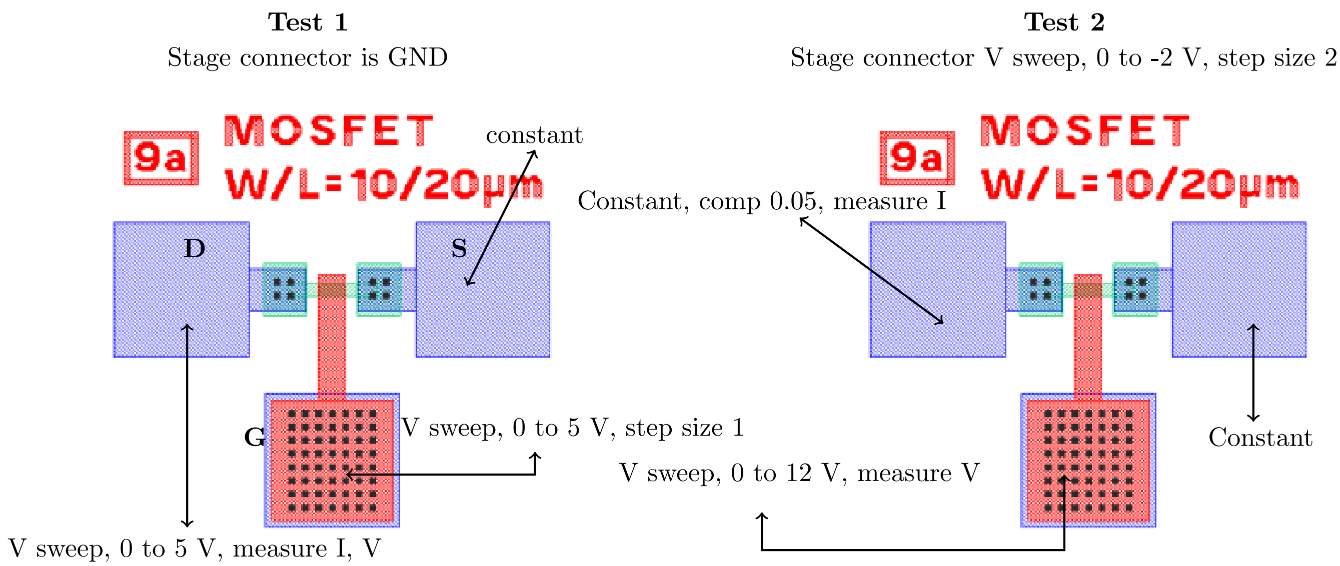


Figure 21: Measurement setup for Mosfet 9a. The same setup is used for Mosfets 9a-c. The only difference is the channel widths which changes from 10 (9a) to 15 (9b) to 20 (9c) microns.

1.10.2 Plots of I_D-V_D, sweeping V_G

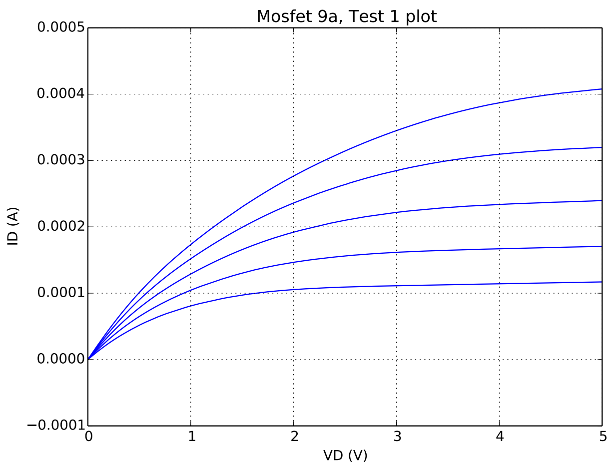


Figure 22: Test 1 for Mosfet 9a

Calculate stuff here...

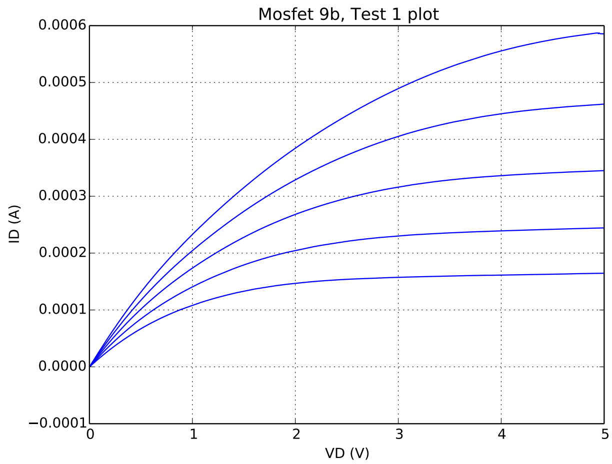


Figure 23: Test 1 for Mosfet 9b

Calculate stuff here...

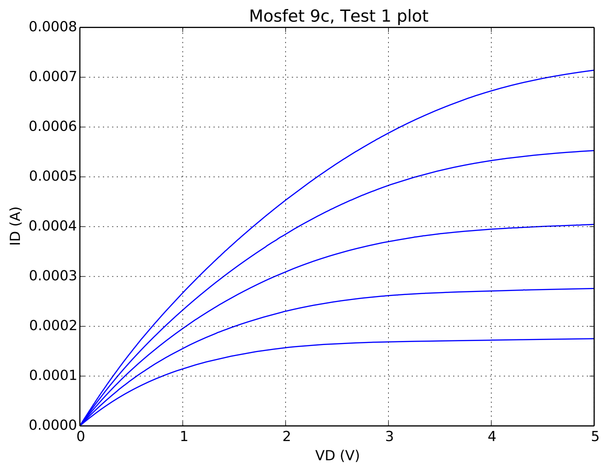


Figure 24: Test 1 for Mosfet 9c

Calculate stuff here...

1.10.3 Plots of I_D-V_G, sweeping V_B

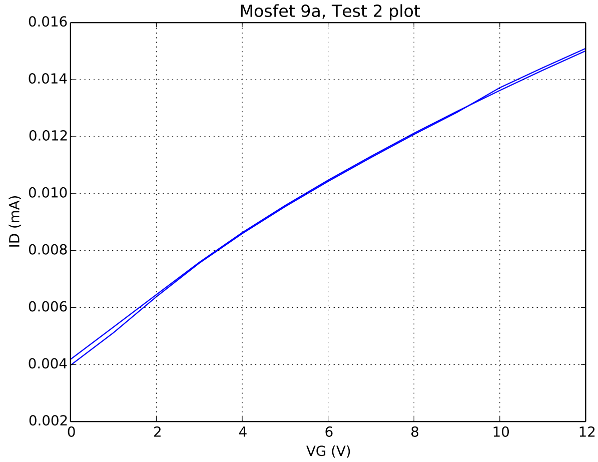


Figure 25: Test 2 for Mosfet 9a

Calculate stuff here...

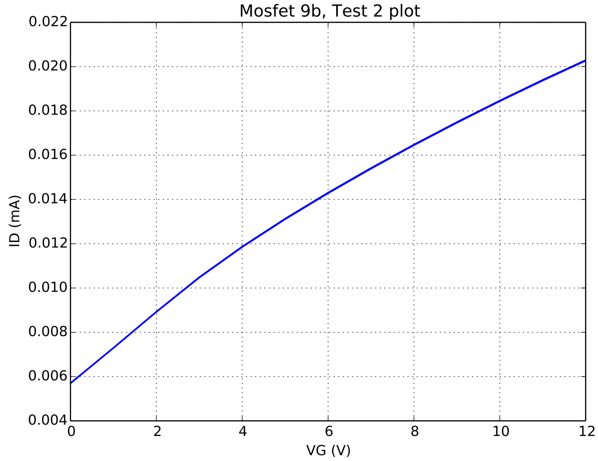


Figure 26: Test 2 for Mosfet 9b

Calculate stuff here...

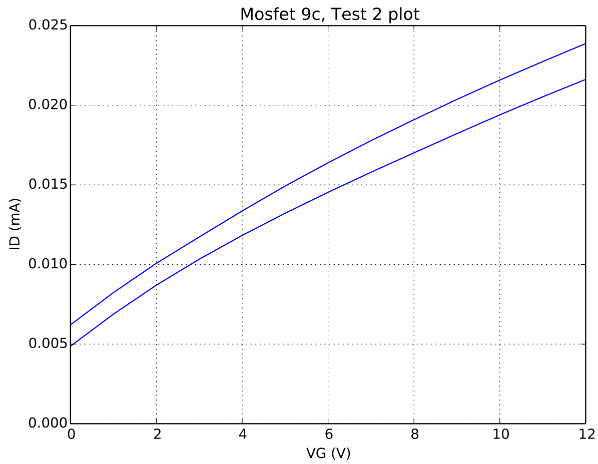


Figure 27: Test 2 for Mosfet 9c

Calculate stuff here...

1.11 Large MOSFET, 10

1.11.1 Measurement setup

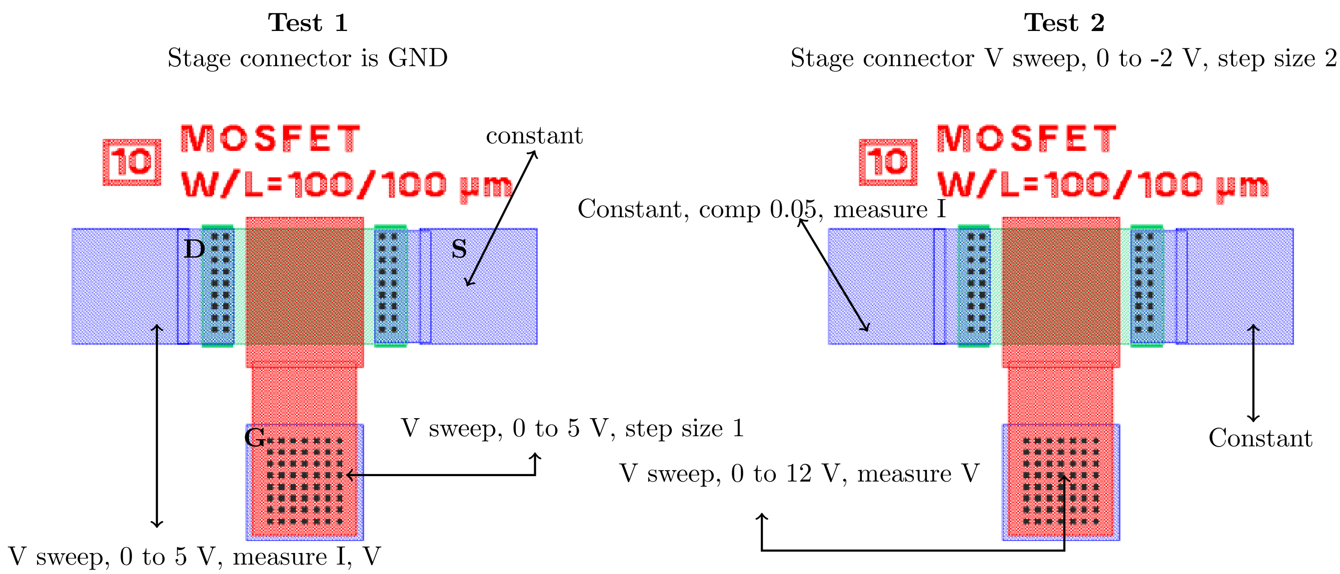


Figure 28: Measurement setup for Mosfet 10. This mosfet has very large dimensions compared to others.

1.11.2 Plots of I_D-V_D, sweeping V_G

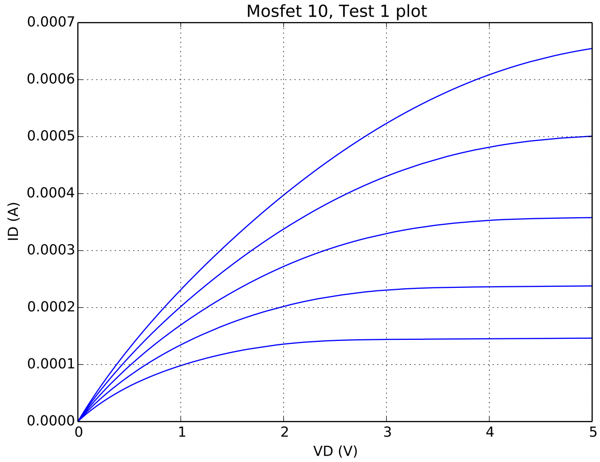


Figure 29: Test 1 for Mosfet 10

Calculate stuff here...

1.11.3 Plots of I_D-V_G, sweeping V_B

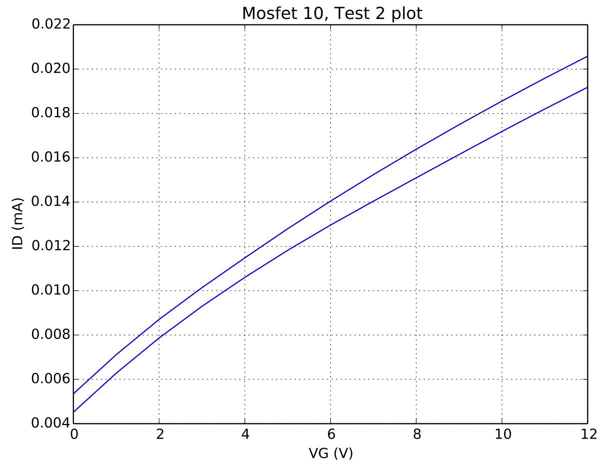


Figure 30: Test 2 for Mosfet 10

Calculate stuff here...

1.12 Inverter, 14

1.12.1 Measurement setup

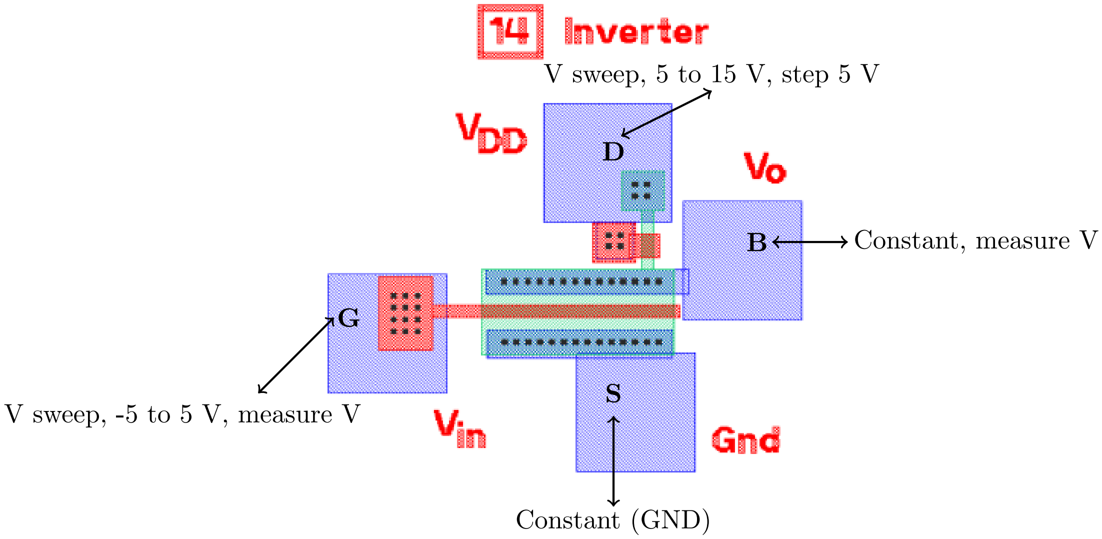


Figure 31: Setup for the inverter. Note that the source is connected to a GND and not the stage connector.

1.12.2 b. $V_{\mathbf{in}} - V_{\mathbf{out}}$ plot

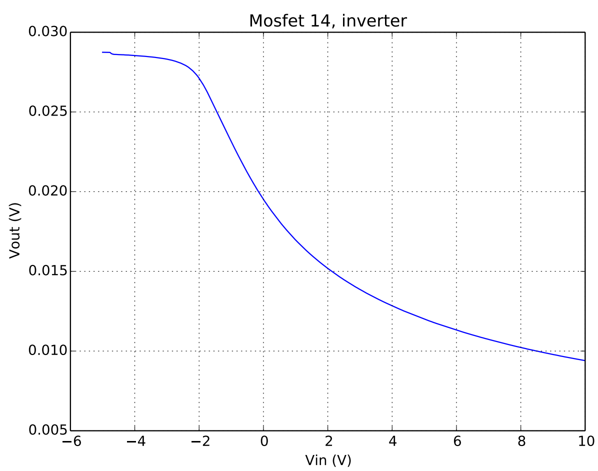


Figure 32: Plot for Inverter. Note both axis are in units of Volts.

1.12.3 Estimate V_M

calculations here....

2 Theoretical Calculations

2.1 Measured Physical Dimensions and Parameters

Parameter	Measured Value
Field t_{ox}	477.2 nm
Gate t_{ox}	86.5 nm
Intermediate t_{ox}	320 nm
X_j	1000 nm
$X_{j,\text{lateral}}$	880 nm
N_D	10^{21} cm^{-3}

2.2 Resistors [2a,2b]

2.3 Contact Resistances [17a,17b]

From jaeger Figure 7.6 [1] we that the specific contact resistivity 10^{-2} $\mu\Omega$-cm^2. The contact area of resistors 17a and 17b is $5\mu m$ by $5\mu m$. This means the theoretical contact reisistance for our contact resistors is

$$R_c = \frac{\rho_c}{A} = \frac{10^{-2}\mu\Omega - \text{cm}^2}{25\mu m} = \frac{10}{25} = 0.4\Omega$$

2.4 Contact-Chain Resistors [2c, 2d]

2.4.1 Diffusion chain resistor, 2c

R_c is the contact resistance calculated earlier and R_s is the sheet resistance calculate for the diffused resistor. η is a geometrical constant that has a value of 2.3

$$R_{\text{total}} = 7(\eta R_s + R_c) = 7((2.3)(R_s) + (0.4)) =?$$

2.4.2 Poly chain resistor, 2d

R_c is the contact resistance calculated earlier and R_s is the sheet resistance calculate for the poly resistor. η is a geometrical constant that has a value of 2.3

$$R_{\text{total}} = 7(\eta R_s + R_c) = 7((2.3)(R_s) + (0.4)) =?$$

2.5 Gate/Field Oxide Capacitors[3,4]

2.6 Diode

2.7 MOSFETs

2.7.1 MOSFETs of varying length [8] and width [9]

2.7.2 Large MOSFET

2.8 Inverter

3 Discussion

4 Optional Questions

5 Appendix

6 References

1. Jaeger, Richard. *Introduction to microelectronic fabrication.* New Jersey: Prentice Hall, 2002. Print.