Lecture 13

- Last time:
  - MOS charge storage
  - MOS capacitor
- Today:
  - MOS field effect transistor (MOSFET) current-voltage characteristics

HW & Solutions

Due: [Date]
MOSFET Concept

Lateral current carried by inversion charge controlled by gate

Advantages: no DC control power required, relatively simple to fabricate

Add 4th terminal to MOS capacitor:
MOSFET Layout

All contacts the same size...

The size...
N-MOSFET Cross Section

- N-CHANNEL

- Gate oxide
- n⁺ polysilicon gate
- Interconnect
- Bulk interconnect
- Drain interconnect
- n⁺ drain diffusion
- Source diffusion
- Channel length > 500 μm

- p⁺-Si
- p-Si
Modern MOSFET Cross Section
MOSFET "Analog" Symbols

VDD

Vgs = 0

Vgs > 0

Vgs < 0

VDD

n-channel MOSFET

p-channel MOSFET

Source

Drain

Gate

VDD

VDD

VDD

n-inversion layer

p+ - Bulk or Body

Source

Drain

Gate

Higher Potential

Draw is Higher Potential
Measuring "Drain Characteristic"

Typical...

Choose $V_{SB} = 0 V$
“Square-Law” I-V Characteristics

\[ V_{ds} = V_{gs} - V_{th} = V_{gs} - 1V \]

\[ V_{gs} = 3V \]

\[ V_{gs} = 0, 0.5, 1V \]

(triode region)

constant current (saturation) region

(Vds = 2V)

(Vds = 0.5, 1V)

(cutoff region)

100

600 500 400 300 200 100

I_{D1} (\mu A)

Depôt EECS

University of California at Berkeley

R. T. Howe

EECS 105 Spring 2002 Lecture 13

CLASSIC.
"Linear" I-V Characteristics

- Constant current (saturation) region
- Current source

\[ V_{TH} = 0.6 \text{ V} \]
\[ \alpha \left( V_{GS} - V_{TH} \right)^{1/3} \]
\[ (V_{GS} - 0.6V)^{1/3} = 0.5 \]
\[ (2.1 - 0.6)^{1/3} = 1.5 \]