

LabReport 1

Arnav Yadnopavit
EE24BTECH11007

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Aim

To characterize the electrical behavior of a Diode, BJT, and MOSFET by plotting their I-V characteristics using Cadence Virtuoso simulations and standard SPICE models.

Apparatus

- Cadence Virtuoso Suite with Spectre Simulator
- Commercially available SPICE models:
 - 1N4148 Diode
 - 2N3904 NPN BJT
 - 2N3906 PNP BJT
 - 2N7000 N-channel MOSFET

Theory

1. Diode

A diode allows current to flow in one direction and blocks it in the reverse. The I-V characteristic shows exponential rise in forward bias and negligible reverse current until breakdown.

2. BJT (Bipolar Junction Transistor)

A BJT has three terminals: emitter, base, and collector. Its operation depends on base-emitter voltage and collector-emitter voltage. The output characteristic I_C vs V_{CE} is plotted at constant I_B .

3. MOSFET (Metal-Oxide Semiconductor FET)

MOSFETs operate in cutoff, linear, and saturation regions. The drain current I_D vs drain-source voltage V_{DS} is plotted for various gate-source voltages V_{GS} .

Circuit Diagrams

1. Diode I-V Characterization

Forward bias circuit with DC voltage sweep.

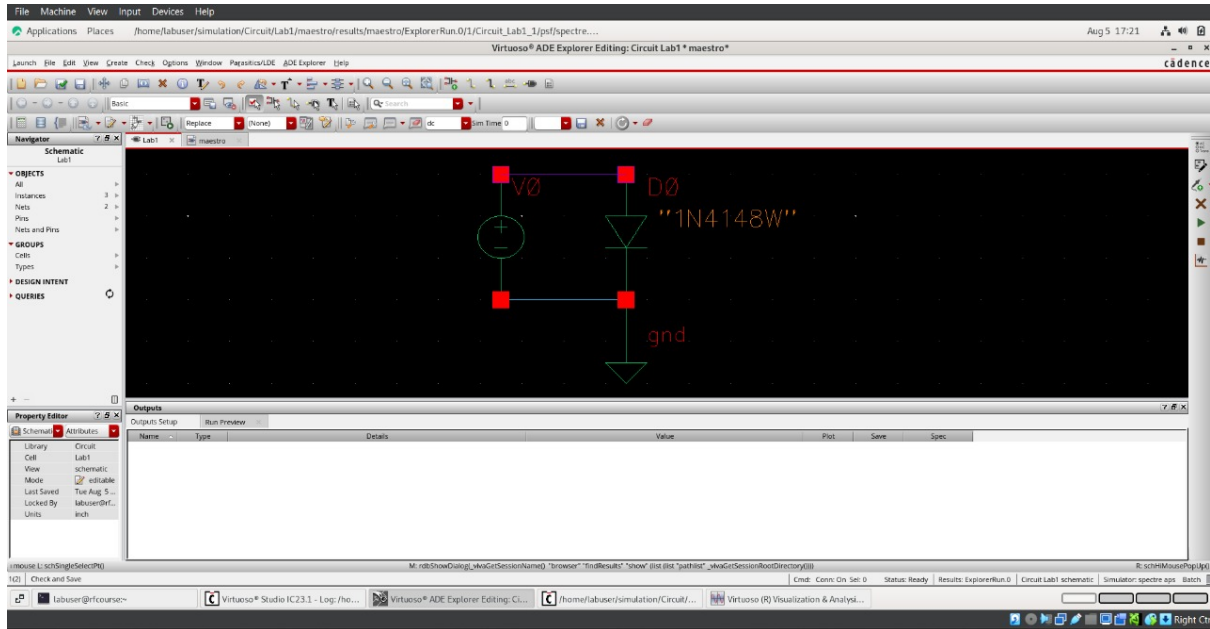


Figure 1: Circuit for Diode I-V Characterization

2. BJT I-V Characterization

DC sweep of V_{CE} for multiple I_B values.

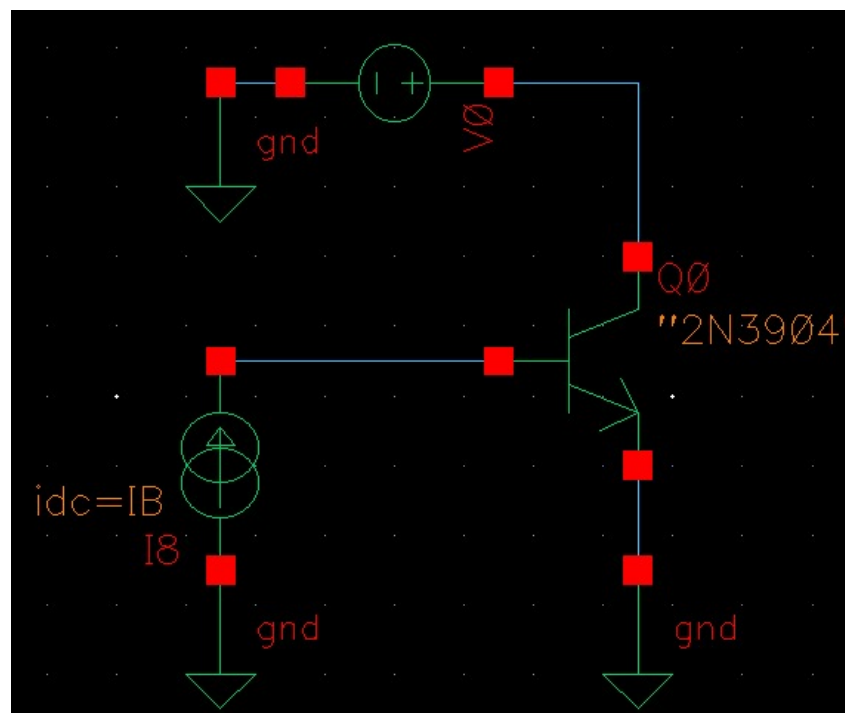


Figure 2: Circuit for NPN BJT I-V Characterization

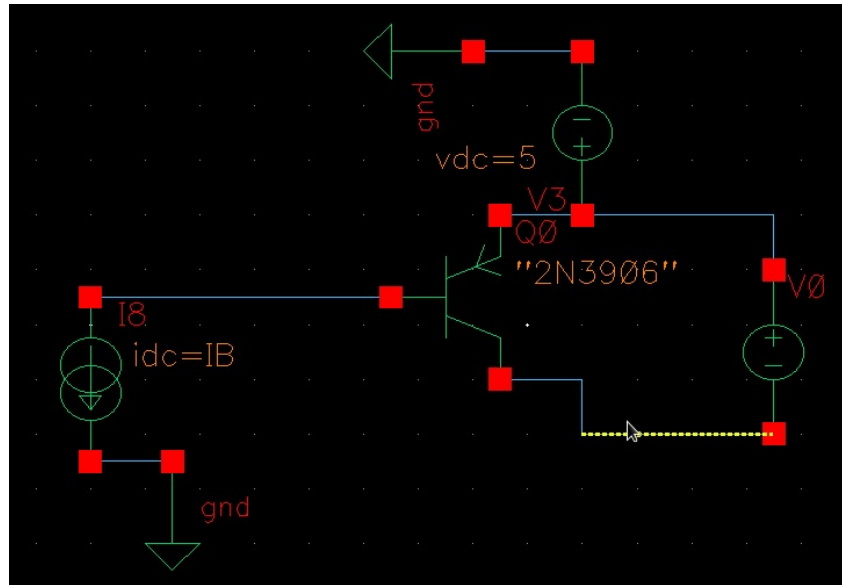


Figure 3: Circuit for PNP BJT I-V Characterization

3. MOSFET I-V Characterization

DC sweep of $V_{DS}(V_0)$ for multiple $V_{GS}(V_1)$ values.

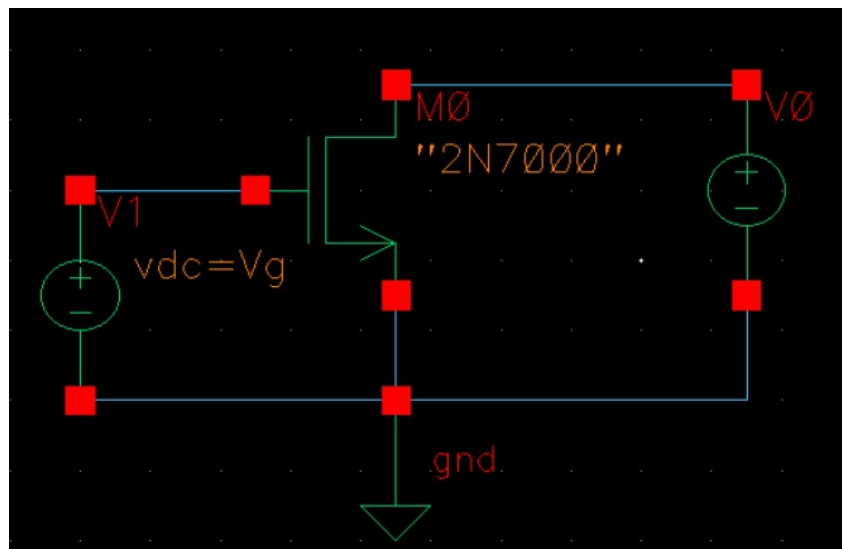


Figure 4: Circuit for Mosfet I-V Characterization

SPICE Models

For Spice Models refer to

<https://github.com/ArnavYadnopavit/EE2301-EDC-Lab/tree/main/LabReport1/SpiceModels>

Observations

1. Diode I-V Plot

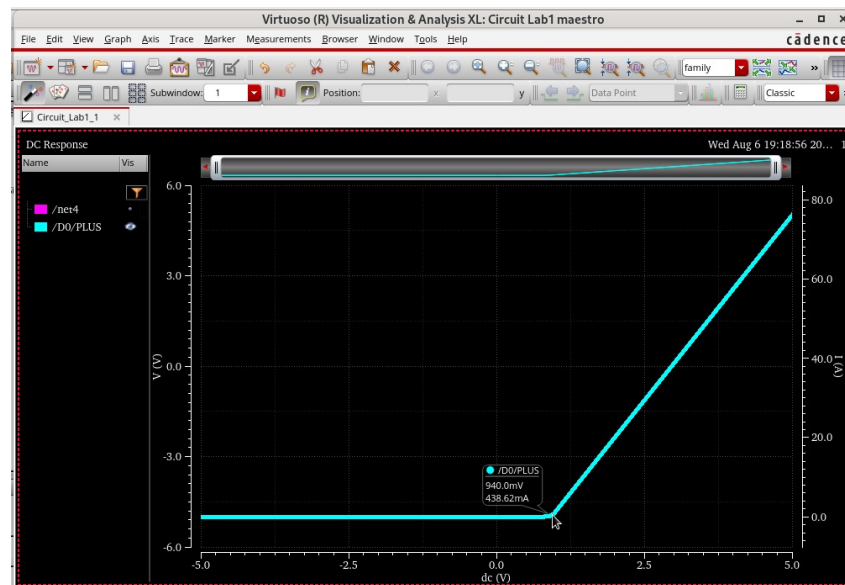


Figure 5: Plot for Diode I-V Characterization

2. BJT I-V Plot

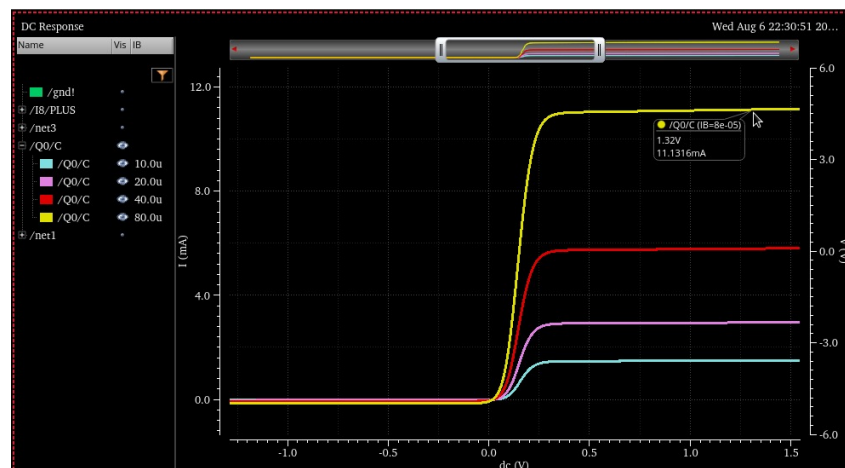


Figure 6: Plot for NPN BJT I-V Characterization

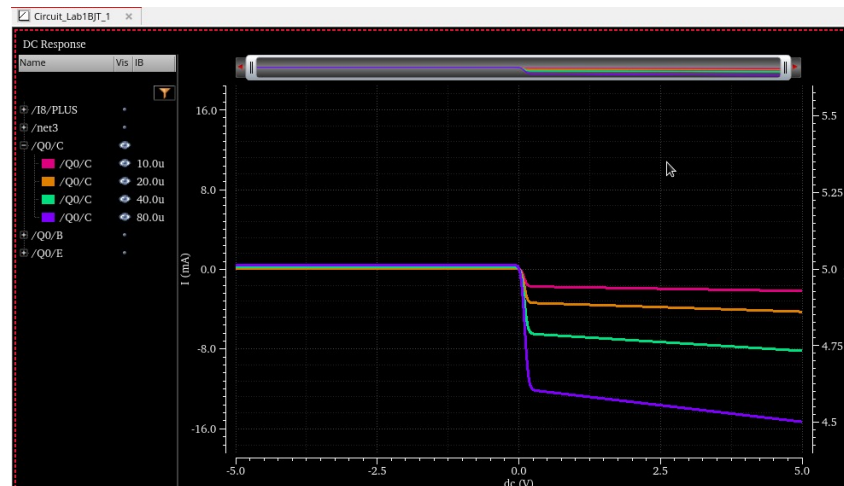


Figure 7: Plot for PNP BJT I-V Characterization

3. MOSFET I-V Plot

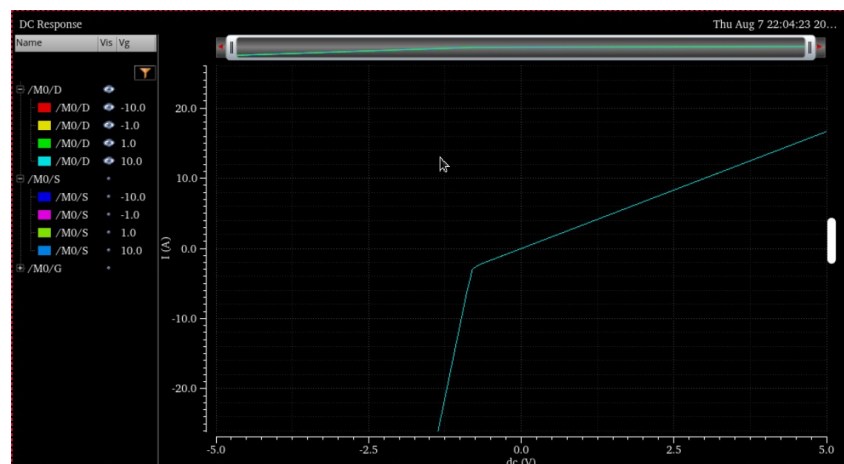


Figure 8: Plot for Mosfet I-V Characterization

Conclusion

The I-V characteristics of diode, BJT, and MOSFET were successfully simulated using Cadence Virtuoso. The plots align with theoretical expectations:

- The diode shows exponential rise in forward bias and negligible reverse current.
- The BJT exhibits clear cutoff, active, and saturation regions depending on base current.
- The MOSFET demonstrates linear and saturation behavior across various gate voltages.

This confirms the accurate modeling and simulation of semiconductor devices using SPICE models and the Cadence Virtuoso platform. For figs and SpiceModels refer to <https://github.com/ArnavYadnopavit/EE2301-EDC-Lab/tree/main/LabReport1>

Thank you!