



Exercise: The Diode

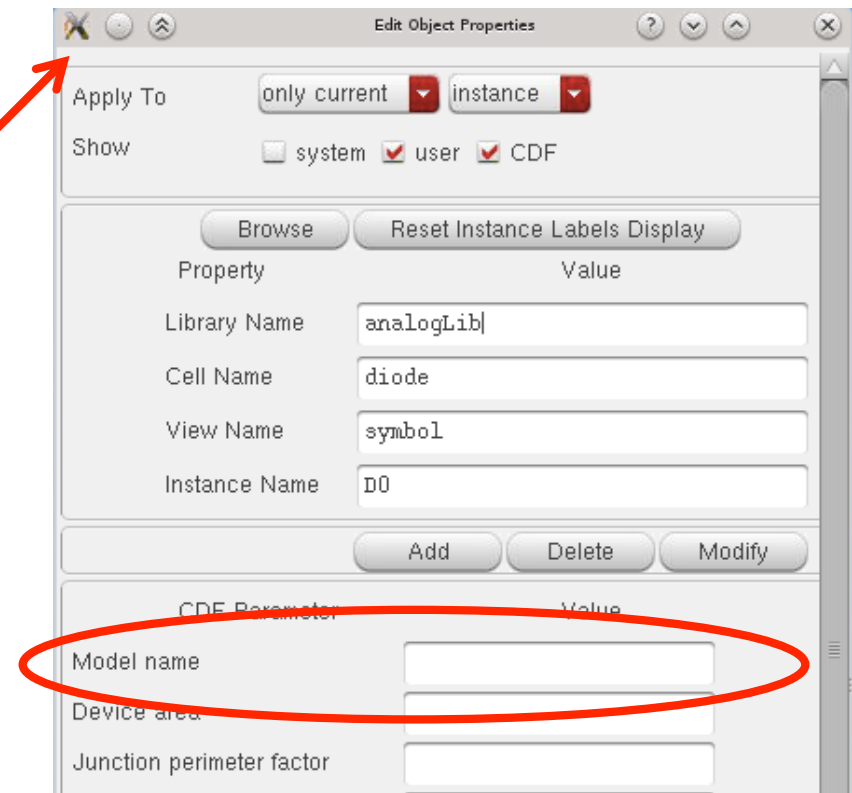
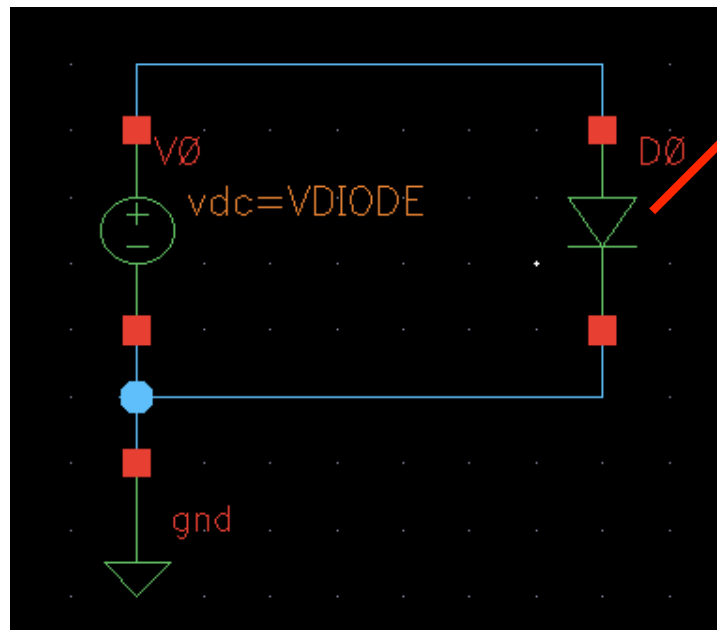
Prof. Dr. P. Fischer

Lehrstuhl für Schaltungstechnik und Simulation
Uni Heidelberg



DC Characteristic

- Create the following schematic.
 - The diode is taken from analogLib
 - Note that NO model is associated to this 'generic' diode



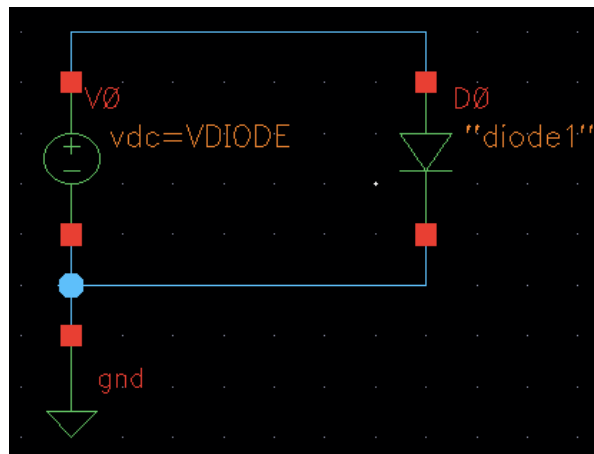


Trying a DC simulation

- Perform a DC simulation of VDIODE from 0...1V
 - An error occurs:

```
Error found by spectre during hierarchy flattening.
ERROR (CMI-2119): D0: Instance (of type diode) requires the use of a model.
```

- Now assign a model with name 'diode1' to the diode:



- Run the simulation again. You get a *different* error:

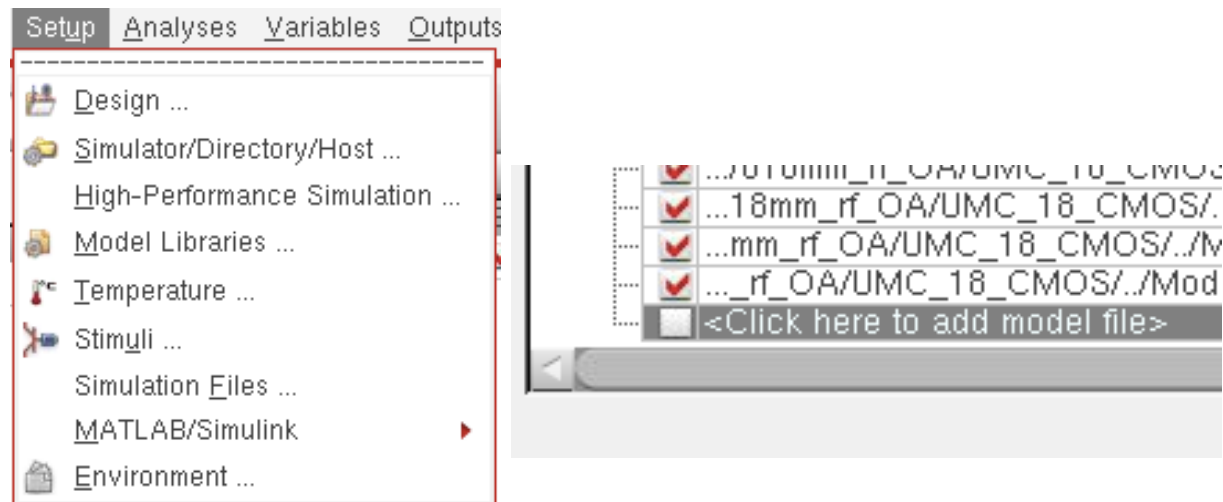
```
Error found by spectre during circuit read-in.
ERROR (SFE-23): "input.scs" 36: The instance `D0' is referencing an undefined model
```



Defining a Model

- Create a text file `MyDiode.lib` with the following model definition:


```
.MODEL diode1 d
+IS=1e-08 RS=0.05 N=1.5 EG=0.6
+XTI=0.05 BV=50 IBV=5e-08 CJO=1e-11 VJ=0.7 M=0.5
```
- The simulator needs to know about this file:
 - In Setup->Model Libraries..., add the file `MyDiode.lib`.

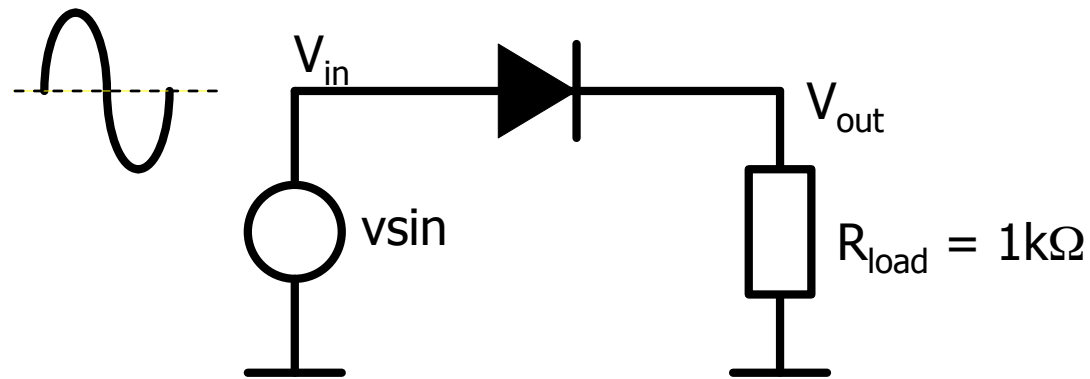


- Run the simulation again.



Exercise 6.1: Simple Rectifier

- The diode can be used to generate a DC voltage from an AC voltage. In the simplest case, the negative parts of the AC wave are cut away:

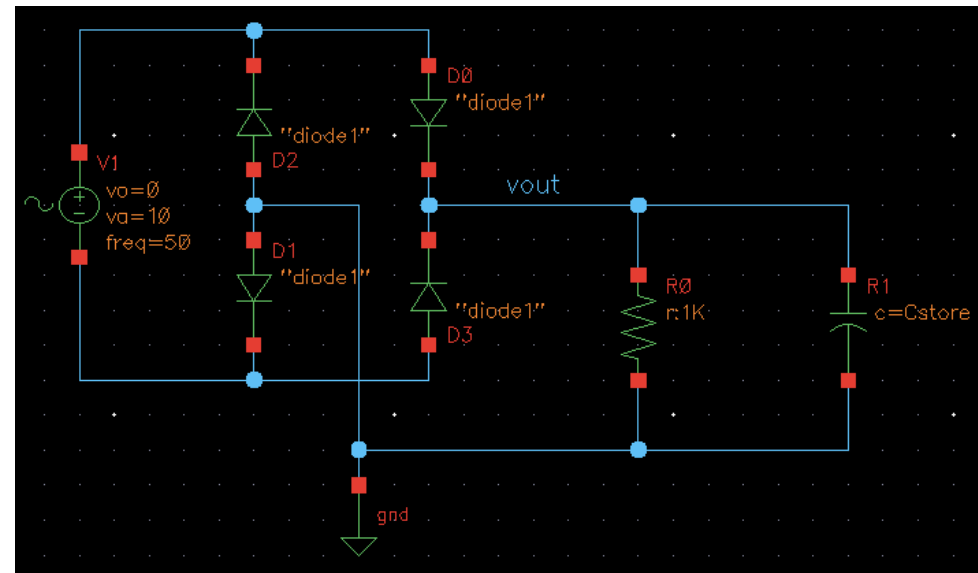
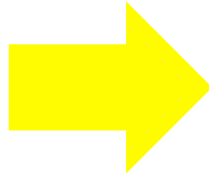
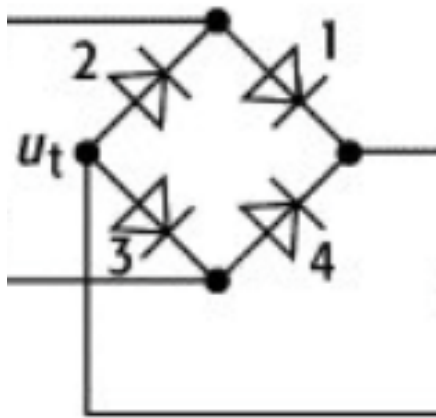


- Use a sinusoidal source `vsin` from `analogLib` (transient sim...) Set parameters Frequency = 50Hz (half way down in the parameter list), Offset = 0, Amplitude = 10V
- Look at V_{out} . What is the peak amplitude. Why not 10V?
- Change R_{load} to $1M\Omega$. How does the peak amplitude change?
- Go back to $R_{load} = 1k\Omega$. Add a capacitor of $1\mu F$ in parallel to R_{load} . What happens?
- Which C do you need to guarantee $V_{out} > 8V$? Calculate!



Exercise 6.2: Full Wave Rectifier

- The full wave rectifier ('Graetz') uses 4 diodes to utilize the negative half-wave as well:
 - make a Schematic

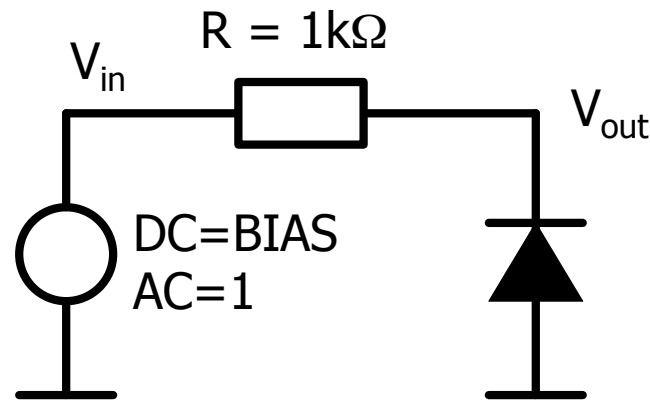


- How does V_{out} look like for $C_{store} = 0$
- How does the circuit work?
- What is the peak amplitude? Why?
- What C_{load} do you need to guarantee $V_{out} > 8V$? Calculate!



Exercise 6.3: Diode Capacitance

- A voltage dependent capacitance is part of the diode model.
- Implement the following circuit:



```
.MODEL diode1 d
+IS=1e-08 RS=0.05 N=1.5 EG=0.6
+XTI=0.05 BV=50 IBV=5e-08 CJO=1e-11
+VJ=0.7 M=0.5 FC=0.5 TT=1e-09
```

- Make an AC sweep from 1M to 1G or so for $BIAS = 1V$
 - What is the corner frequency?
- Change $BIAS$ to 10V or 0.5V
 - Does the corner frequency change?
 - Is it changing in the right 'direction'?