Extracting Spice Parameters for Diodes

There are 5 DC spice parameters for a diode

IS (Igen) Saturation current (Given in Amps)
N (n) Emission Coefficient (No Units)
RS Parasitic resistance (Given in Ω)
BV Breakdown Voltage (Given in Volts)
IBV Breakdown Current (Given in Amps)

GMIN is a small resistance
To prevent a value of zero current form Flowing. Usually set to 10^{-12}S

$$I_s := 1 \times 10^{-7}$$

$$n := 2$$

$$r_s := 100$$

$$V_t := .0259$$

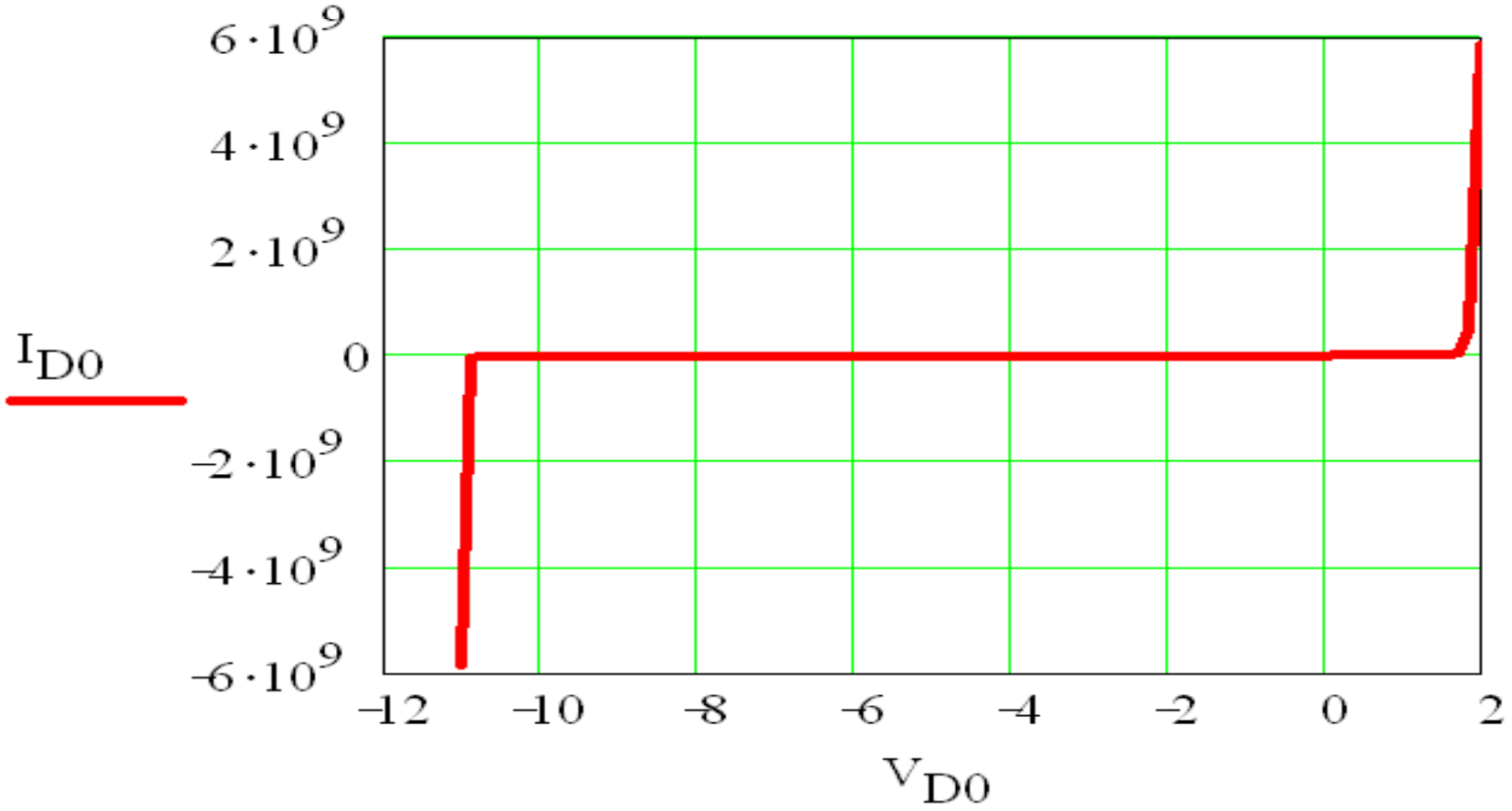
$$BV := 10$$

$$G_{min} := 1 \times 10^{-9}$$

$$IBV := I_s \cdot \frac{BV}{V_t}$$

$$I_{D0_i} := \begin{cases} \left[I_s \cdot \left(e^{\frac{V_{D0_i}}{n \cdot V_t}} - 1 \right) + V_{D0_i} \cdot G_{min} \right] & \text{if } V_{D0_i} > -BV \\ (-IBV) & \text{if } V_{D0_i} = -BV \\ \left[-I_s \cdot \left[e^{\frac{-\left(BV + V_{D0_i}\right)}{V_t}} - 1 + \frac{BV}{V_t} \right] \right] & \text{if } V_{D0_i} < -BV \end{cases}$$

Full Diode Response



n and Igen extraction (Rs small)

$$I = Igen\left(e^{\frac{Vq}{nkT}} - 1\right)$$

In forward bias where: $e^{\frac{Vq}{nkT}} \gg 1$

$$I = Igen \times e^{\frac{Vq}{nkT}}$$

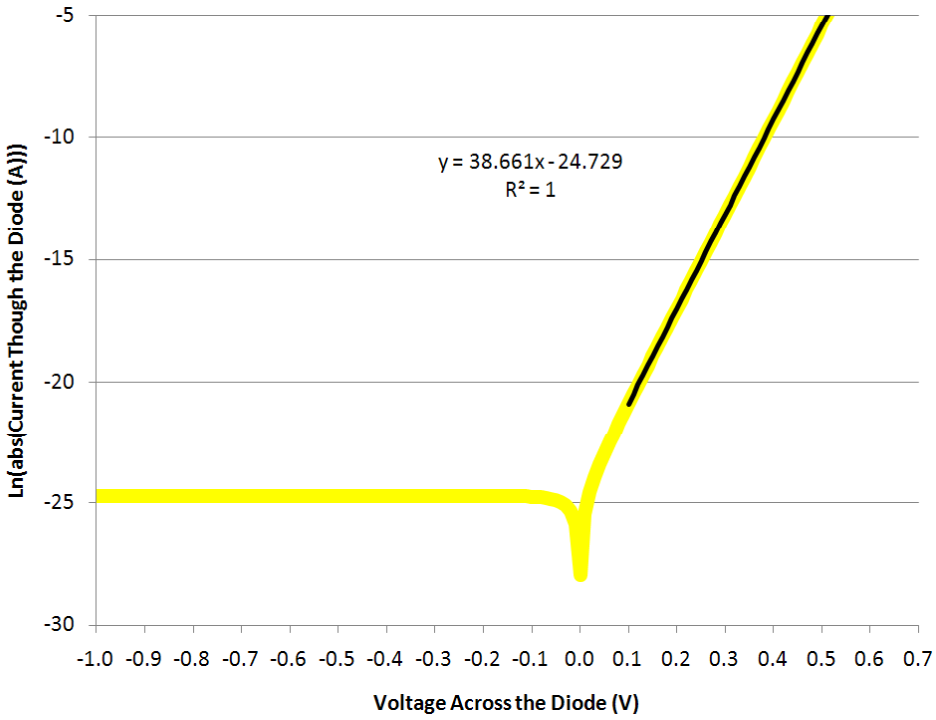
$$ln(I) = \frac{Vq}{nkT} + ln(Igen)$$

$$y = mx + b$$

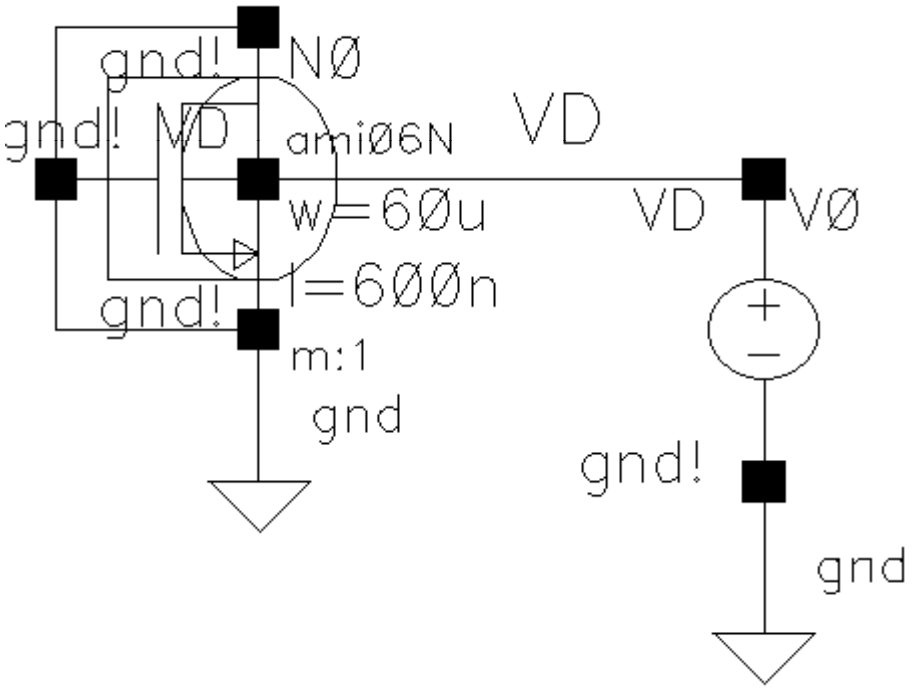
$$m = \frac{q}{nkT}$$

$$n = \frac{q}{mkT} = \frac{1}{.026 \times 38.661} = 0.998$$

$$Igen = e^{b} = 1.82 \times 10^{-11} A$$

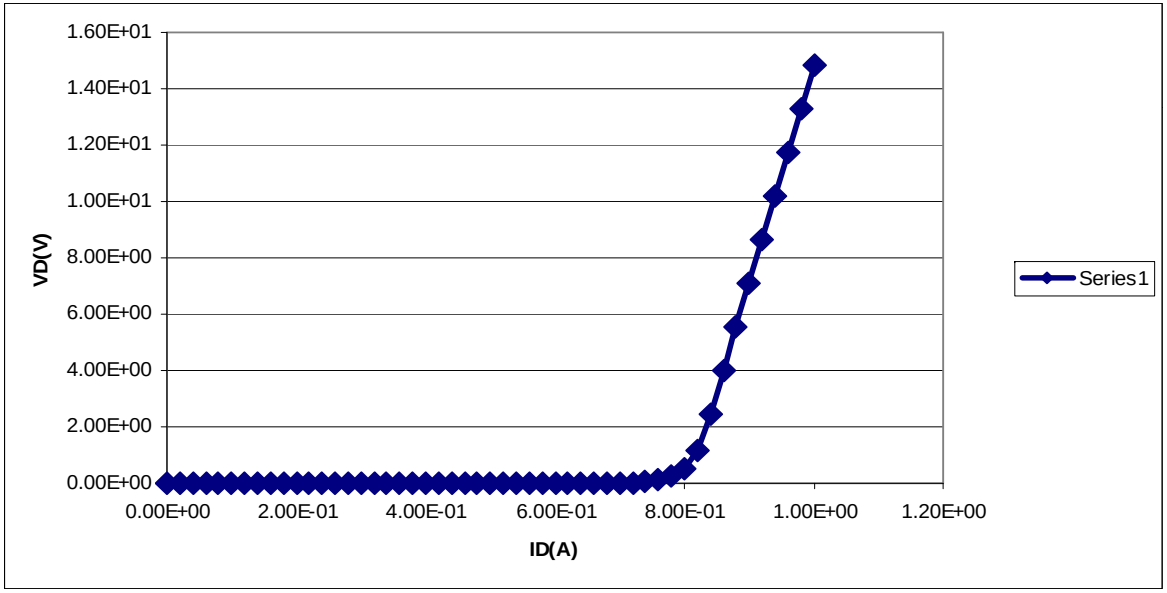


Test the diode of a NMOS

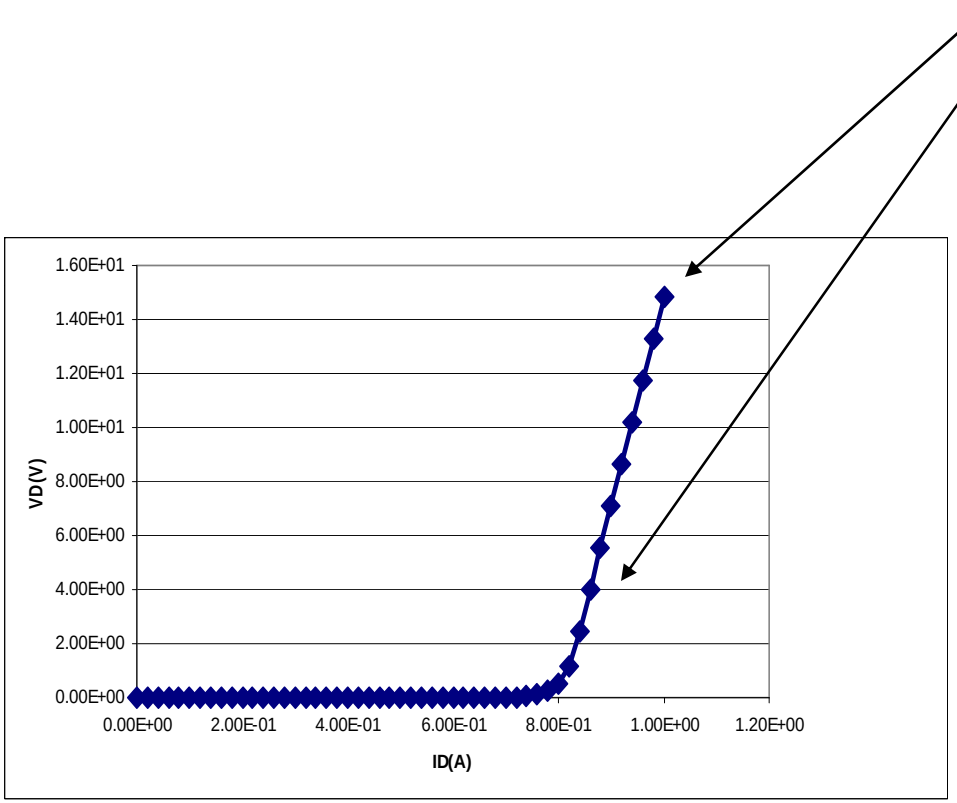


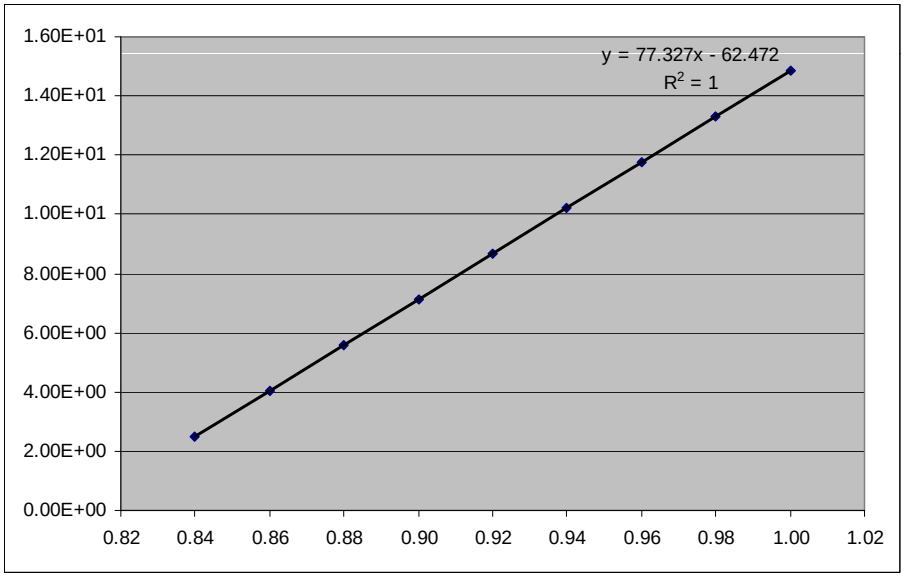
Note there are two diodes being tested.

Forward Bias Diode
Linear

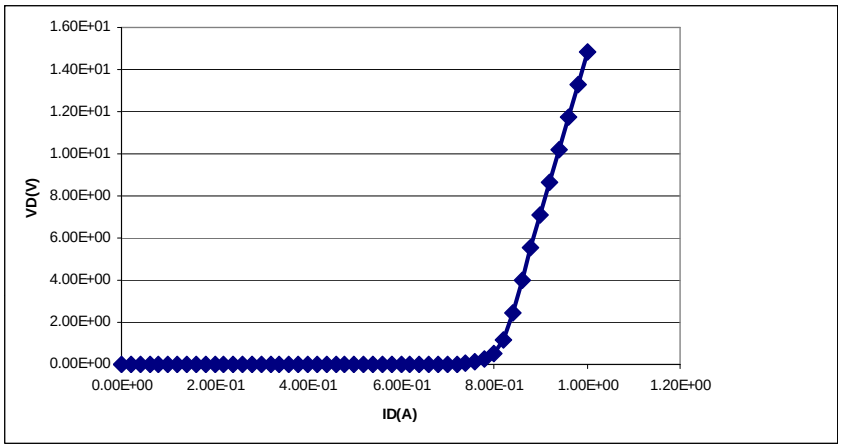


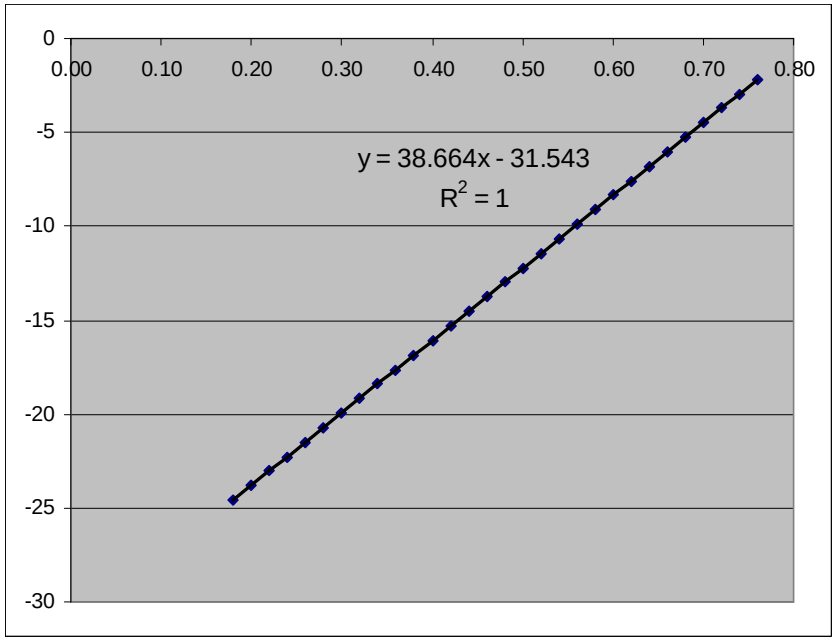
Take the RS value from the Linear part of the diode curve





Forward Bias Log Scale
(RS position omitted)



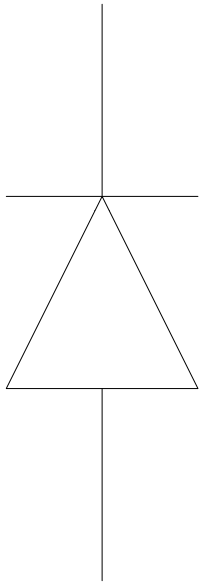


$$I_S := e^{-31.543} \qquad I_S = 2 \times 10^{-14}$$

$$n := \frac{1}{38.664 \cdot .0259} \qquad n = 0.999$$

Do not use linear
Region of Diode
Or too close to 0V.
The RS value and GMIN
Will skew the results.

Spice Capacitance Model



+

V_R

-

$$C_J = C_{JO} x (1 + V_R / V_o)^{-m}$$

m=1/2 for abrupt junctions (predep)
m=1/3 for linear junctions (limited source)