MEASURING DIODE CHARACTERISTICS
n and I_S

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9-20-97

DIODE EQUATION

$$I = I_S\left(e^{V/nV_T} - 1\right)$$

I = DIODE CURRENT IN AMPERES

I_S = REVERSE SATURATION CURRENT IN AMPERES

V = VOLTAGE ACROSS JUNCTION IN VOLTS

V_T = THERMAL VOLTAGE

$$V_T = \frac{kT}{q}$$

T = TEMPERATURE IN °K

K = BOLTZMANN'S CONSTANT

$= 1.38 \times 10^{-23}$ J/°K

q = MAGNITUDE OF ELECTRONIC CHARGE

$= 1.6 \times 10^{-19}$ C

$$V_T = \frac{1.38 \times 10^{-23}(\text{J/°K}) * T}{1.6 \times 10^{-19}\,\text{C}} = 86.25\,\mu\text{V/°K}$$

NOTE J/C = V

n = JUNCTION CONSTANT TYPICALLY BETWEEN 1 AND 2

WE WILL APPROXIMATE THE DIODE EQUATION AS

$$I = I_S e^{V/nV_T}$$

MAKE 2 MEASUREMENTS

I_1 , V_1

I_2 , V_2

I IS DIODE CURRENT

V IS DIODE VOLTAGE

FOR SMALL SIGNAL DIODES, GOOD VALUES TO USE ARE:

SET I_1 TO 1 mA AND READ V_1

SET I_2 TO 100 μA AND READ V_2

$$\frac{I}{I_s} = e^{V/nV_T}$$

$$\ln\left(\frac{I}{I_s}\right) = \frac{V}{nV_T}$$

$$nV_T \ln\left(\frac{I}{I_s}\right) = V$$

$$nV_T[\ln I_1 - \ln I_s] = V_1$$

$$nV_T[\ln I_2 - \ln I_s] = V_2$$

$$nV_T[\ln I_1 - \ln I_2] = V_1 - V_2$$

$$n = \frac{V_1 - V_2}{V_T \ln\left(\frac{I_1}{I_2}\right)}$$

MUST KNOW AMBIENT TEMPERATURE IN °K

$$I_s = I_1 * e^{\frac{-V_1}{nV_T}}$$