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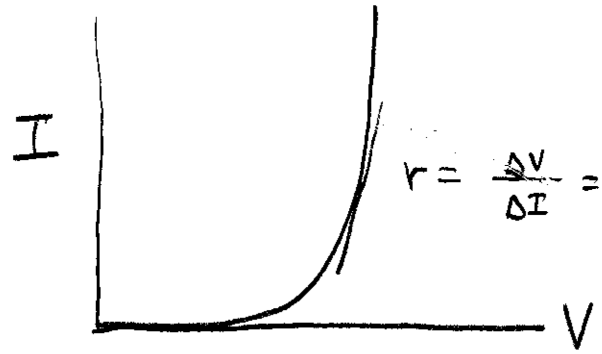
SEP 4, 93

DYNAMIC RESISTANCE OF FOWARD-BIASED PN JUNCTION



$r = \frac{\Delta V}{\Delta I} = \frac{1}{\text{slope}}$

$\text{slope} = \frac{di}{dv}$

$I = I_s(e^{V/nV_T} - 1)$ Eq 1

$\frac{dI}{dv} = \frac{I_s}{nV_T} e^{V/nV_T}$ Eq 2

Note from Eq 1, $e^{V/V_T} = \frac{I}{I_s} + 1 = \frac{I + I_s}{I_s}$

So,

$\frac{dI}{dv} = \frac{I_s}{nV_T}\left(\frac{I + I_s}{I_s}\right) = \frac{I + I_s}{nV_T}$ ($I_s \to 0$)

Since I ranges from μA to mA

and I_s ranges from pA to nA

we approximate the slope as $\frac{dI}{dv} \simeq \frac{I}{nV_T}$

$r = \frac{nV_T}{I} = \frac{nkT}{qI} \simeq \frac{.026}{I}$ at room temp ($n=1$)

$$\boxed{r = \frac{nkT}{qI}} \quad \text{OR} \quad \boxed{r = \frac{.026}{I}}$$