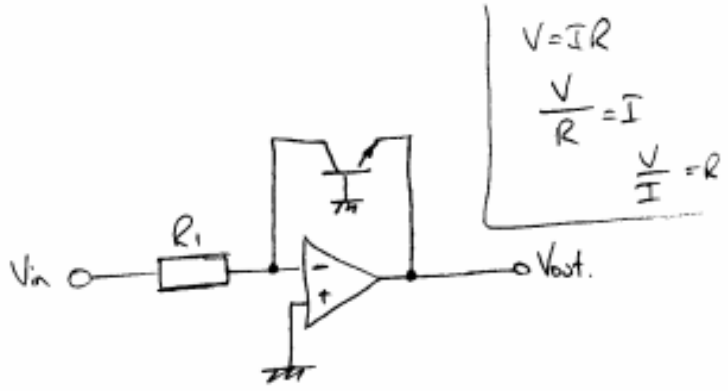
Logarithmic Amplifier.



$$I_e = I_{GeO}\left(e^{V_{Ge}/V_t}\right)$$

$$I_c = \alpha I_e.$$

$$I_c = \alpha I_{GeO}\left(e^{V_{Ge}/V_t}\right)$$

$$V_t = \frac{KT}{q}$$

$$I_{R1} = \frac{V_{in}}{R_1}$$

$$I_c = I_{R1}$$

$$V_{Ge} = -V_{out}.$$

$$\frac{V_{in}}{R_1} = \alpha I_{GeO}\left(e^{-V_{out}/V_t}\right)$$

$$\frac{V_{in}}{R_1 \alpha I_{GeO}} = e^{-V_{out}/V_t}$$

$$\log\left(\frac{V_{in}}{R_1 \alpha I_{GeO}}\right) = \frac{-V_{out}}{V_t}$$

$$V_t . \log\left(\frac{V_{in}}{R_1 \alpha I_{GeO}}\right) = -V_{out}.$$

Exponential Amplifier

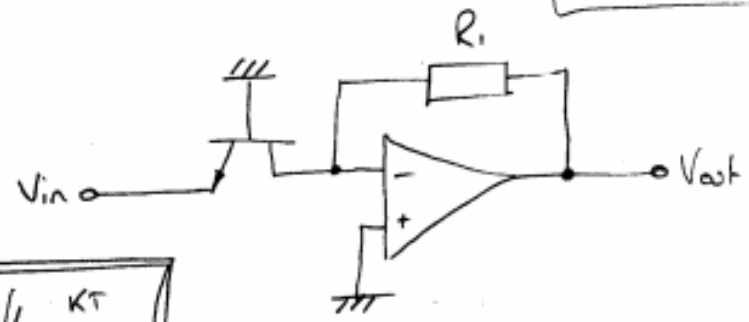
$V = IR$

$\frac{V}{R} = I \quad \frac{V}{I} = R$

$$I_e = I_{leD}\left(e^{V_{be}/V_t}\right)$$

$$I_c = \alpha I_e$$

$$I_c = \alpha I_{leD}\left(e^{V_{be}/V_t}\right)$$



$$V_t = \frac{KT}{q}$$

$$V_{be} = -V_{in}$$

$$I_{R1} = \frac{V_{out}}{R_1}$$

$$I_c = I_{R1}$$

$$\frac{V_{out}}{R_1} = \alpha I_{leD}\left(e^{-V_{in}/V_t}\right)$$

$$V_{out} = R_1 \alpha I_{leD}\left(e^{-V_{in}/V_t}\right)$$