EE230: Lab 8
Logarithmic Amplifier

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1 Overview of the experiment

1.1 Aim of the experiment

1. Designing a Logarithmic Amplifier using the given procedure and then simulating the designed circuit using NGSpice.

1.2 Methods

The circuit diagrams for the Logarithmic Amplifier was provided in the lab handout, using which I built the circuit using NGSpice and obtained the required plots.

2 Design & Working

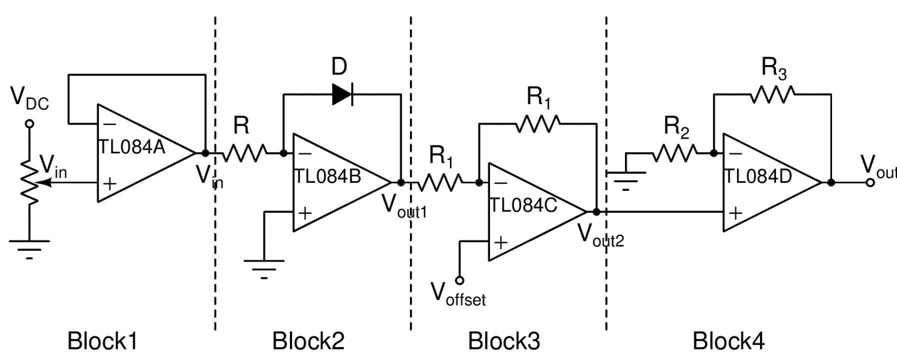


Fig. Logarithmic Amplifier

3 Experimental results

We know that for a pn junction diode,

$$I_D \approx I_S * e^{V_D/\eta V_T} \tag{1}$$

Using the Op-Amp characteristics, we know that

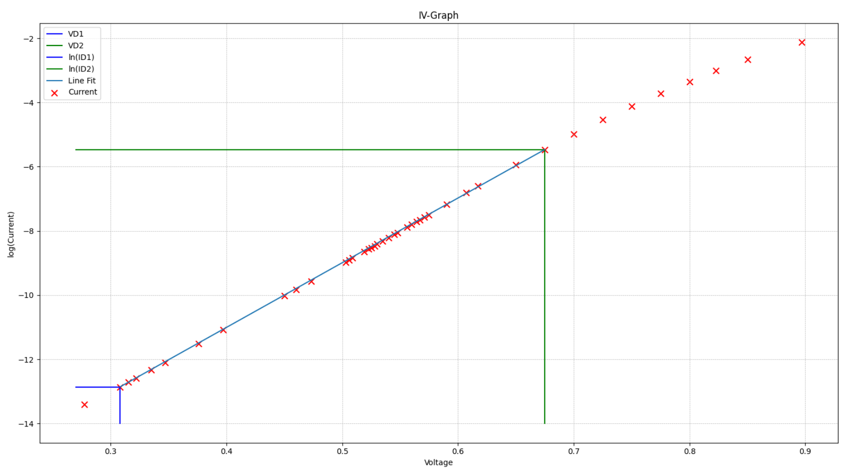
$$I_D = V_{in}/R$$
$$V_{out1} = -V_D$$

Substituting in the Diode equation and rearranging,

$$V_{out1} = \eta V_T * (ln(I_S R) - ln(V_{in}))$$
$$V_{out1} = a_1 ln(V_{in}) + a_2$$

where,

$$a_1 = -\eta V_T$$
$$a_2 = \eta V_T ln(I_S R)$$



Using the above figure, we obtain:

$$I_S = 6.314 \times 10^{-}9$$
$$\eta = 1.9164$$
$$R = 10/I_{D_2} = 2364\Omega$$
$$a_1 = -0.0496$$
$$a_2 = -0.5516$$

Further, we can choose $V_{offset} = a_2/2$ and $\frac{1}{1+R_3/R_2} = -a_1$

$$V_{offset} = -0.2758V$$
$$R_3/R_2 = 19.1613$$

Now, we have obtained the final Output-Input characteristics as:

$$V_{out} = ln(V_{in}) \tag{2}$$

Upon performing DC analysis on V_{in} using NGSpice, we obtain the following plots: