EE230: Experiment No.8
Logarithmic Amplifier

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1 Overview of the experiment

1.1 Aim of the experiment

We have to plot IV characteristic using the given data and then do the simulation and calculations for linear region.

1.2 Methods

I first plotted the IV characteristic using the given data and observed the linear region for the same.Then I calculated the saturation current(I_s), n,R and wrote expression for $Vout1$ and found V_{offset} and ratio of R3 and R2.I took random value for R1.Then I did the simulation and adjusted V_{offset} to make the V_{out} vs lnV_{in} with slope 1 amd passing through (0,0).

2 Design

IV characteristic:

Chart Title
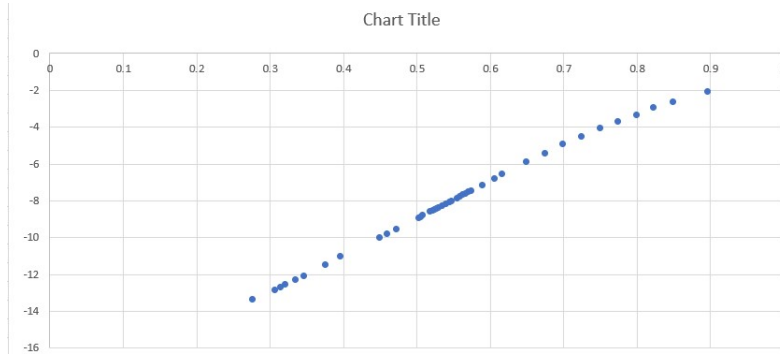
Linear region starts from V=0.397, ln(Id)=-11.0747 and end at V=0.7, ln(Id)= -4.98.

For calculation of I_s and n:

$$ln(I_d) = (V_d)/n(V_T) + ln(I_s) \tag{1}$$

$$(ln(I_d) + 11.0747)/(V_d - 0.397) = (-4.98 + 11.0747)/(0.7 - 0.397) \tag{2}$$

$$ln(I_d) = 20.1145V_d - 18.61 \tag{3}$$

$$ln(I_s) = -18.61 \tag{4}$$

$$I_s = 8.275nA \tag{5}$$

$$1/nV_T = 20.1145 \tag{6}$$

$$n = 2 \tag{7}$$

$$R = 411ohm \tag{8}$$

$$V_{out1} = -nV_T ln(V_{in}) + nV_T ln((I_s)R) \tag{9}$$

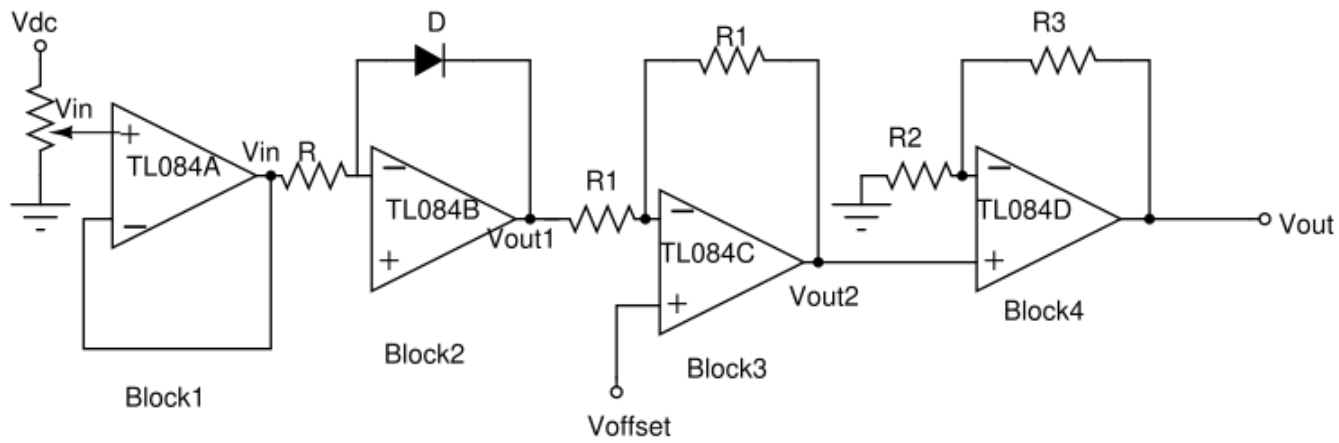$$V_{out1} = -0.05ln(V_{in}) - 0.65 \tag{10}$$

$$a_1 = -0.05 \tag{11}$$

$$a_2 = -0.65 \tag{12}$$

$$V_{offset} = a_2/2 = -0.325V \tag{13}$$

$$1/(1 + (R_3/R_2)) = -a_1 \tag{14}$$

$$R_3 : R_2 = 19 : 1 \tag{15}$$

Let R_1=1kohm

3 Simulation results

3.1 Code snippet

logarithmic amp
.include TL084.txt
.include 1N4148_1.txt

```
    x1 1 20 3 4 2 TL084
vcc1 3 0 15
vcc2 4 0 -15
vin 1 0 dc 0
rt 20 2 0
x2 0 5 7 8 6 TL084
r 2 5 411
d1 5 6 1N4148
VCC3 7 0 +15
vcc4 8 0 -15
x3 10 9 12 13 11 TL084
r11 6 9 10K
r12 9 11 10k
vcc5 12 0 15
vcc6 13 0 -15
voff 10 0 -0.325
X4 11 14 15 16 17 TL084
```
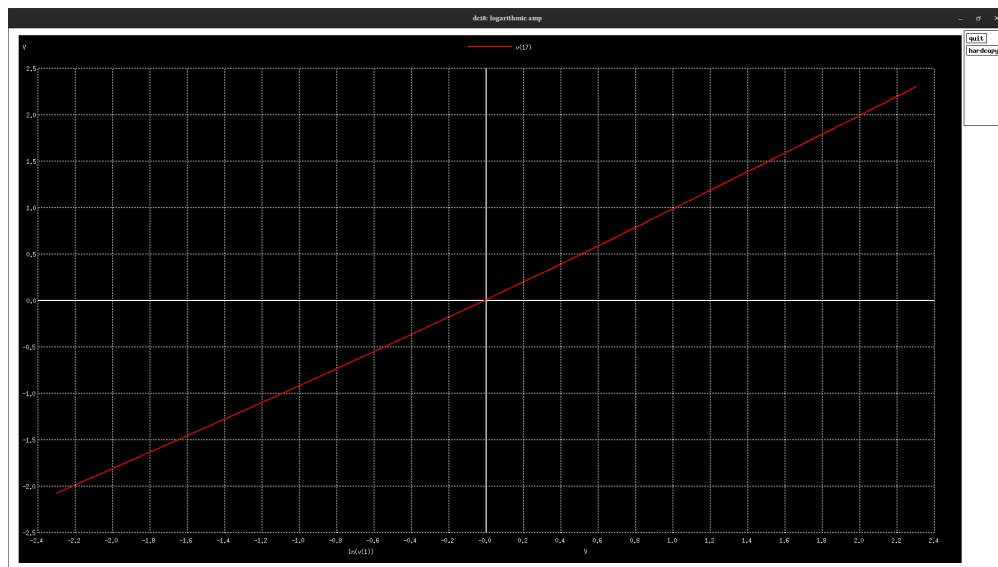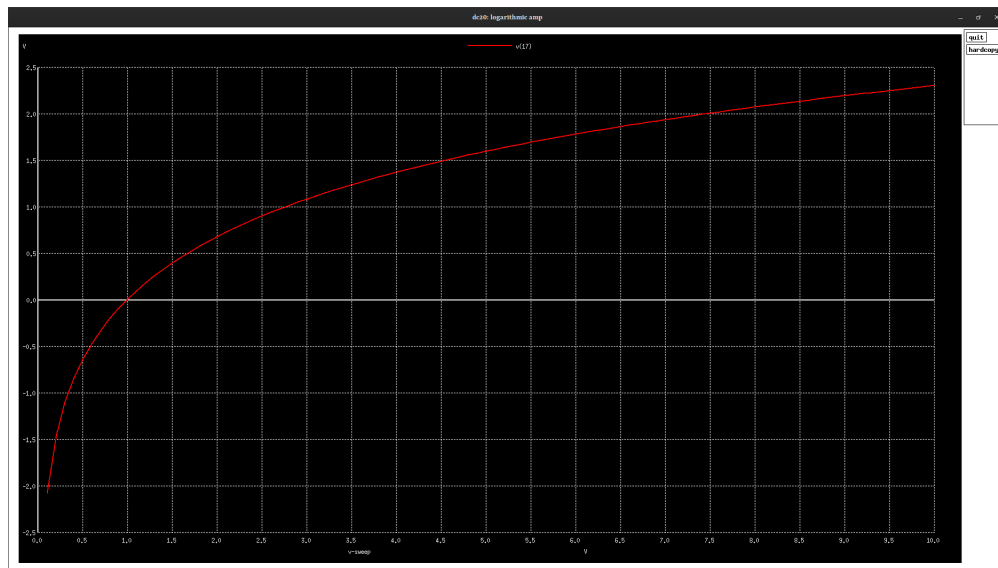
```
r2 14 0 1k
r3 14 17 14.5k
vcc7 15 0 15
vcc8 16 0 -15
.dc vin 0.1 10 0.1
.control
run
plot v(17)
print v(17)
.endc
.end
```

3.2   Simulation results

4 Experimental results

I got the following results:
I_s=8.275nA, n=2, R=411ohm, V_{out1}=-0.325V,
R_1=1kohm, R_3:R_2=19:1

5 Experiment completion status

I have completed all parts of the experiment in lab only.