PAGE No.
DATE / /

Lab 4 Log - Antilog - Amplifier

1. The values were plotted using Python on Jupyter Notebook.

2. For Diode D1 :
   Ideality factor (n) = 1.880
   Saturation Current (I_S) = $4.097e^{-09}$ A

   For Diode D2 :
   Ideality factor (n) = 1.852
   Saturation Current (I_S) = $4.994e^{-09}$ A

3. LTSPICE model file created.

4.

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

$$I_D = I_S e^{V_D/nV_T}$$

$$V_D = nV_T \left(\ln(I_D) - \ln(I_S)\right)$$

$$\ln(I_D) = V_D/nV_T + \ln(I_S)$$

from plotting the graphs ⇒

for D1 Vd = 0.5V Id = $1.192e^{-04}$ A
Vd = 0.6V Id = $9.315e^{-04}$ A

for D2 Vd = 0.5V Id = $1.698e^{-04}$ A
Vd = 0.6V Id = $1.368e^{-03}$ A

PAGE No.
DATE / /

for D_1, $R = \frac{V_{in}}{(I_d)_{max}}$

$V_{in} = +15\,V$ $\quad I_d = 9.315 \times 10^{-4}\,A$

$\Rightarrow R = \frac{15}{9.315 \times 10^{-4}} = 1.6103 \times 10^{4}\,\Omega$

$= 16.103\,K\Omega$

5. $I_D = \frac{V_{in}}{R}$ $\quad V_{out1} = -V_D$

$V_{out1} = nV_T\left(\ln(I_S R) - \ln(V_{in})\right)$

$V_{out1} = -a_1 \ln(V_{in}) + a_2$

$a_1 = n_1 V_T = 0.048645$

$a_2 = n_1 V_T \ln(I_S R) = -0.35625967791100094$

6. let $R_1 = 10K$

from circuit $\quad V_{out2} = -V_{out1} + 2V_{b1}$

~~From~~ $\quad = a_1 \ln(V_{in}) - a_2 + 2V_{b1}$

$\Rightarrow V_{b1} = \frac{a_2}{2} = -0.178129838$

PAGE No.
DATE / /

7. $V_{out3} = -a_1 \beta \ln(V_{in}) = \ln\left(V_{in}^{-a_1\beta}\right)$

$\beta = \frac{R_{22}}{R_{21}}$ $\qquad V_{D2} = V_{b2} - V_{out3}$

$$V_{out} = R_3 I_{D2} + V_{b2}$$

$$= R_3 I_{S2} e^{\frac{V_{b2} - V_{out3}}{n_2 V_T}} + V_{b2}$$

$$V_{out} = R_3 I_{S2} e^{\frac{V_{b2}}{n_2 V_T}} V_{in}^{\frac{n_1}{n_2}\beta} + V_{b2}$$

$$V_{R_3} = V_{out} - V_x = R_3 I_{S_2} e^{\frac{V_{b2}}{n_2 V_T}} V_{in}^{\frac{n_1}{n_2}\beta}$$

$$V_{R_3} = b_1 V_{in}^{b_2}$$

$b_1 = R_3 I_{S_2} e^{\frac{V_{b2}}{n_2 V_T}}$ $\qquad b_2 = \frac{n_1}{n_2}\beta\left(\frac{R_{22}}{R_{21}}\right)$

$b_1 = 1$ $\qquad b_2 = \frac{1}{2}$

$\Rightarrow \quad 1 = R_3 I_{S_2} e^{\frac{V_{b2}}{n_2 V_T}} \quad -①$ $\qquad \frac{1}{2} = \frac{n_1}{n_2}\frac{R_{22}}{R_{21}}$

from plotted graphs,
$(V_d)_{max} = 0.6V$ to get the diode in linear region $\Rightarrow V_{b2} = 0.6V$

$\frac{1}{2} = \frac{1.880}{1.852}\frac{R_{22}}{R_{21}}$

~~from ① ⇒ taking log~~

$\Rightarrow \frac{R_{22}}{R_{21}} = 0.492553 = \beta$

let $R_{21} = 10\ k\Omega$

$\Rightarrow R_{22} = 4.92553\ k\Omega$

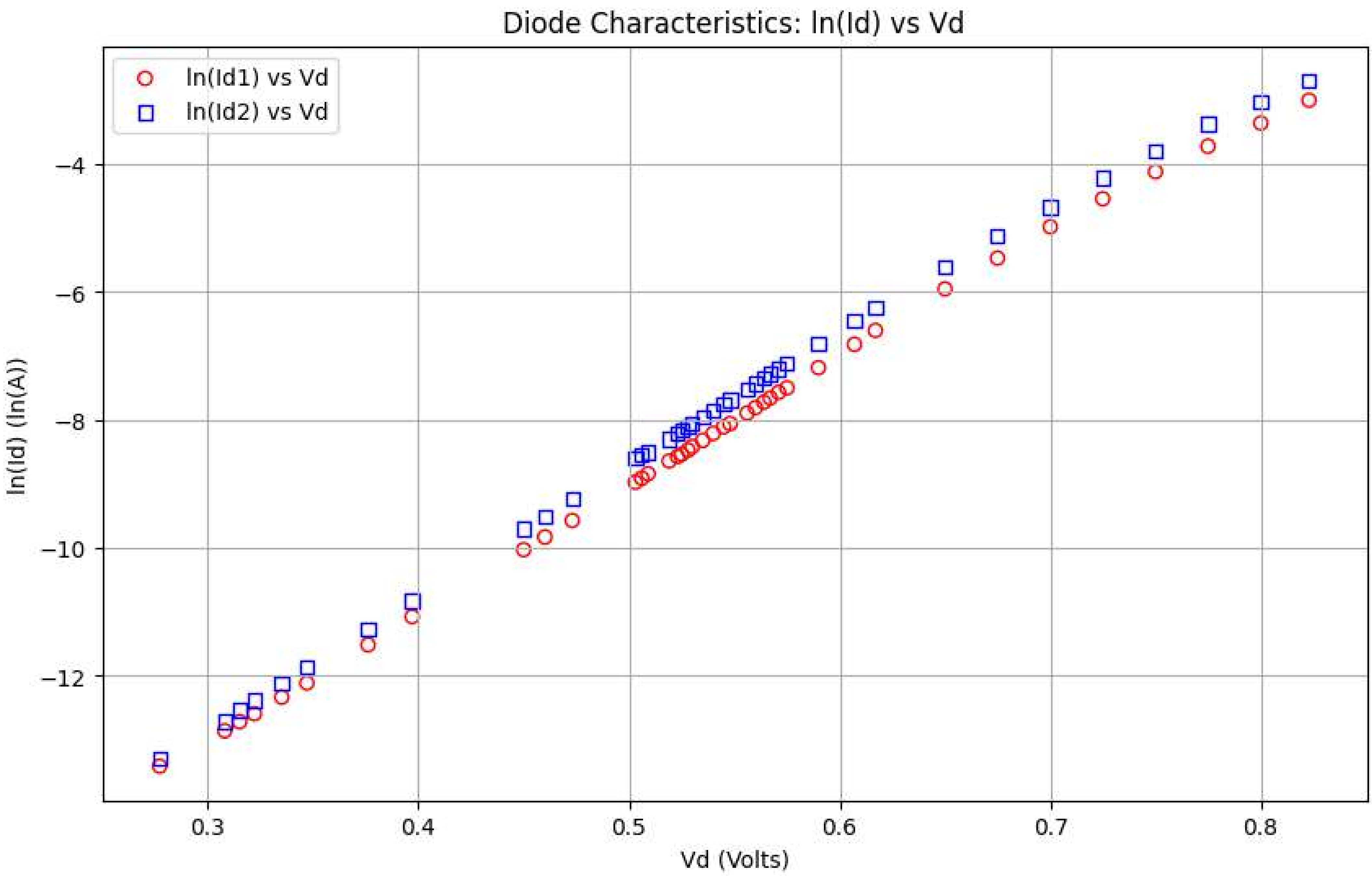
PAGE No.
DATE / /

from ① and using $V_{b_2} = 0.6V$

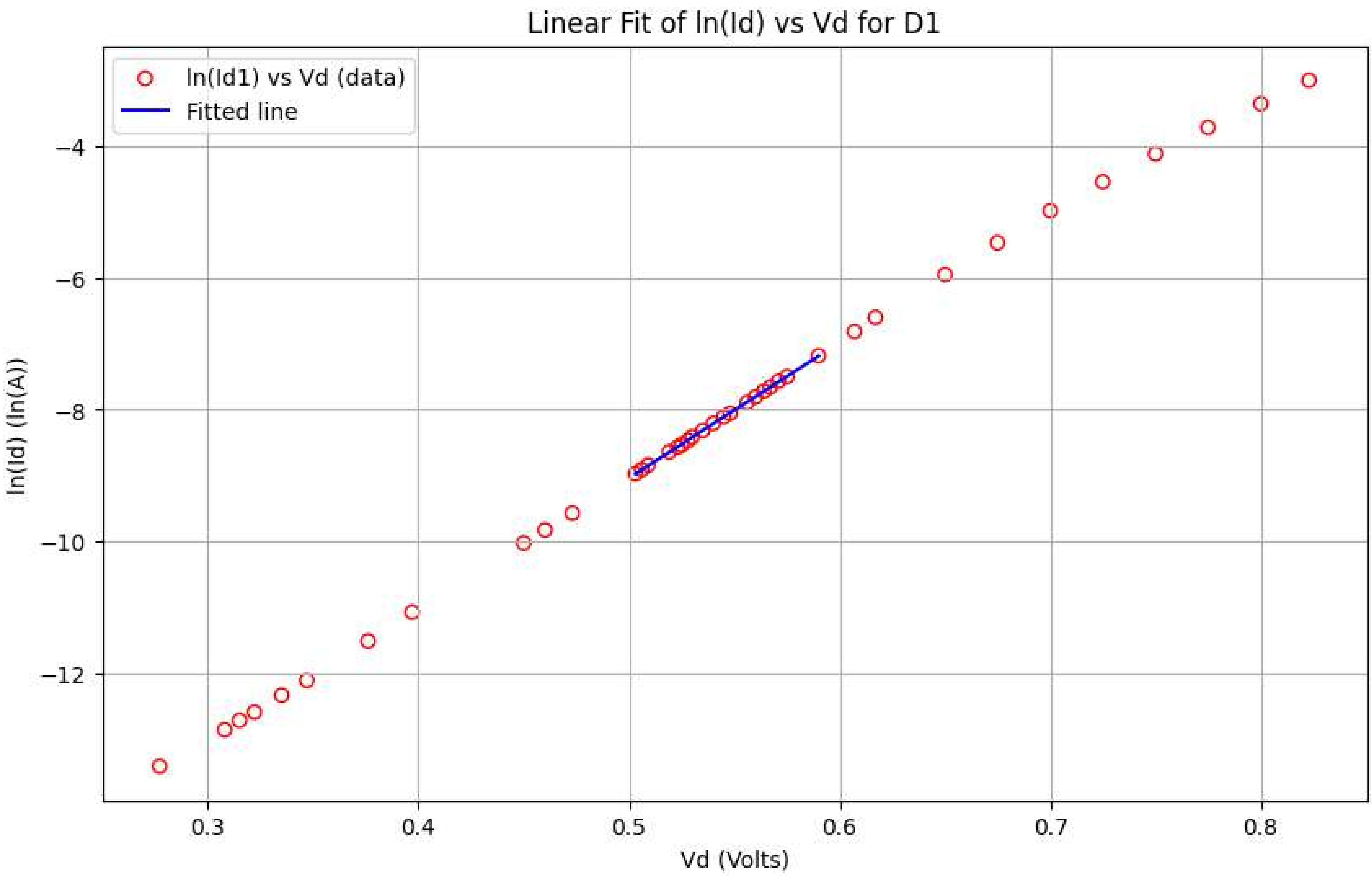
$$\Rightarrow \quad 1 = R_3 I_{S_2} e^{\frac{V_{b2}}{n_2 V_T}}$$

$$\Rightarrow \quad R_3 = 730.9106$$

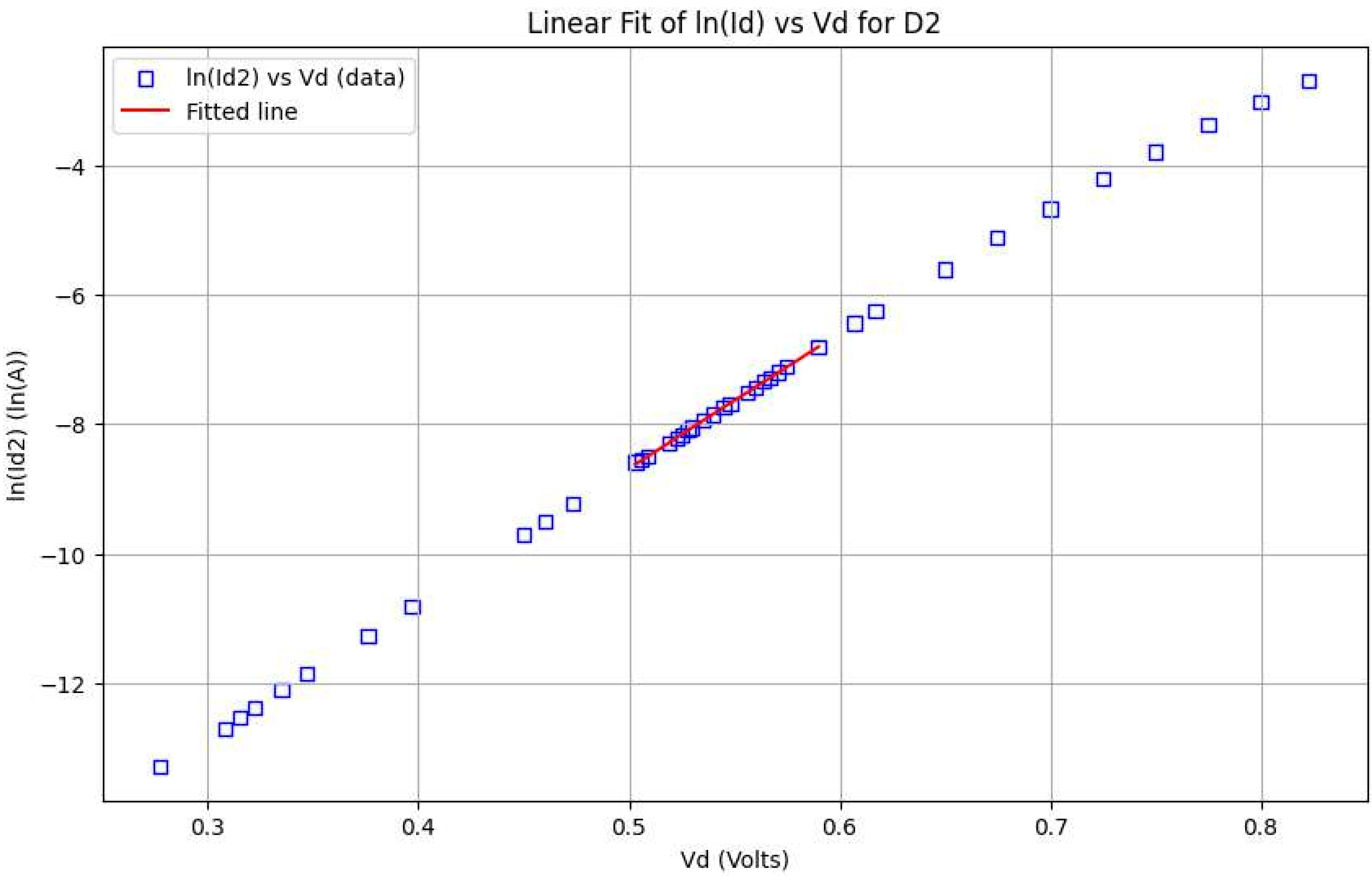
Naman
31/01/25



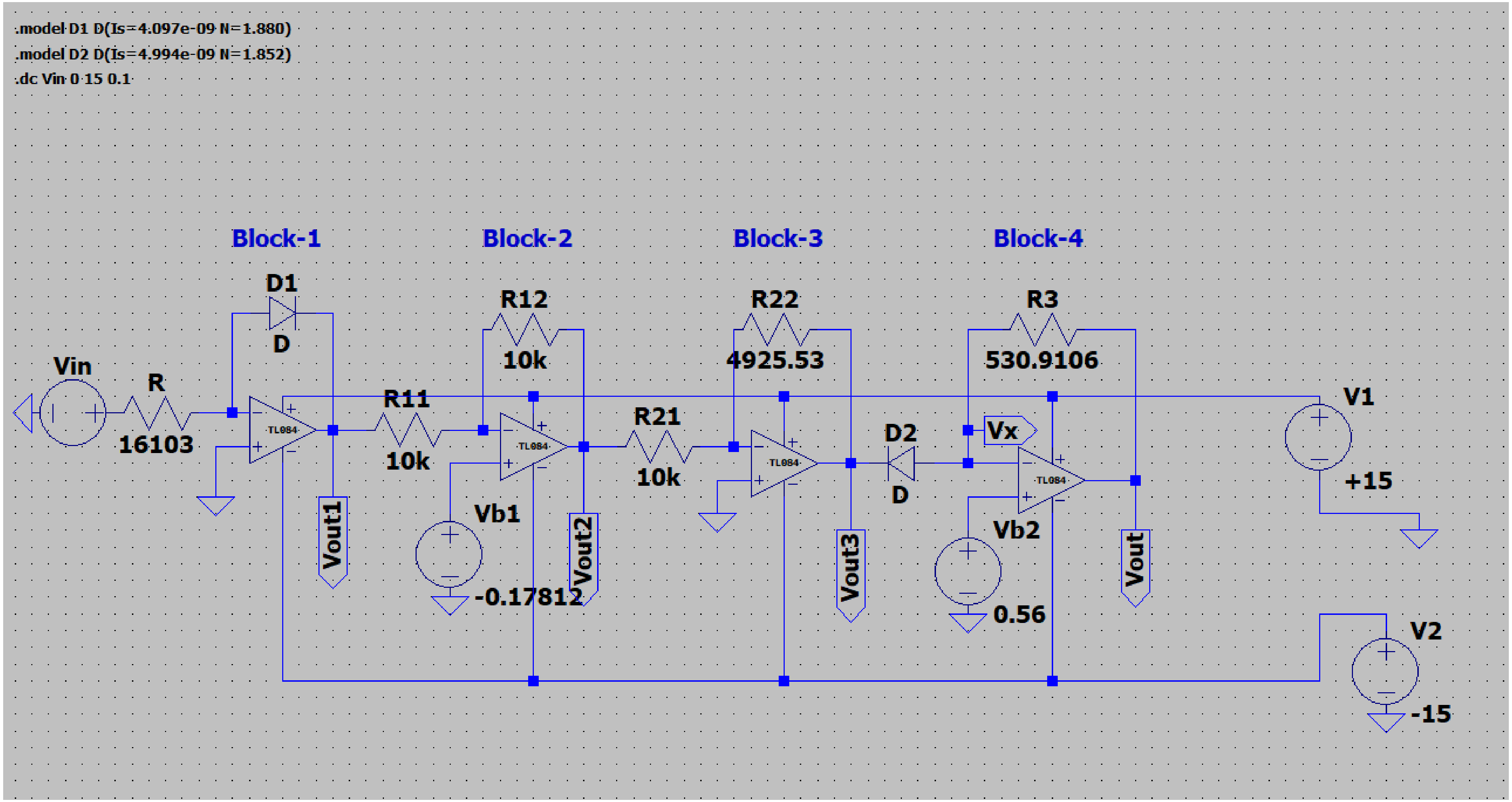
Diode Characteristics: ln(Id) vs Vd
ln(Id1) vs Vd
ln(Id2) vs Vd
ln(Id) (ln(A))
Vd (Volts)
−4
−6
−8
−10
−12
0.3
0.4
0.5
0.6
0.7
0.8

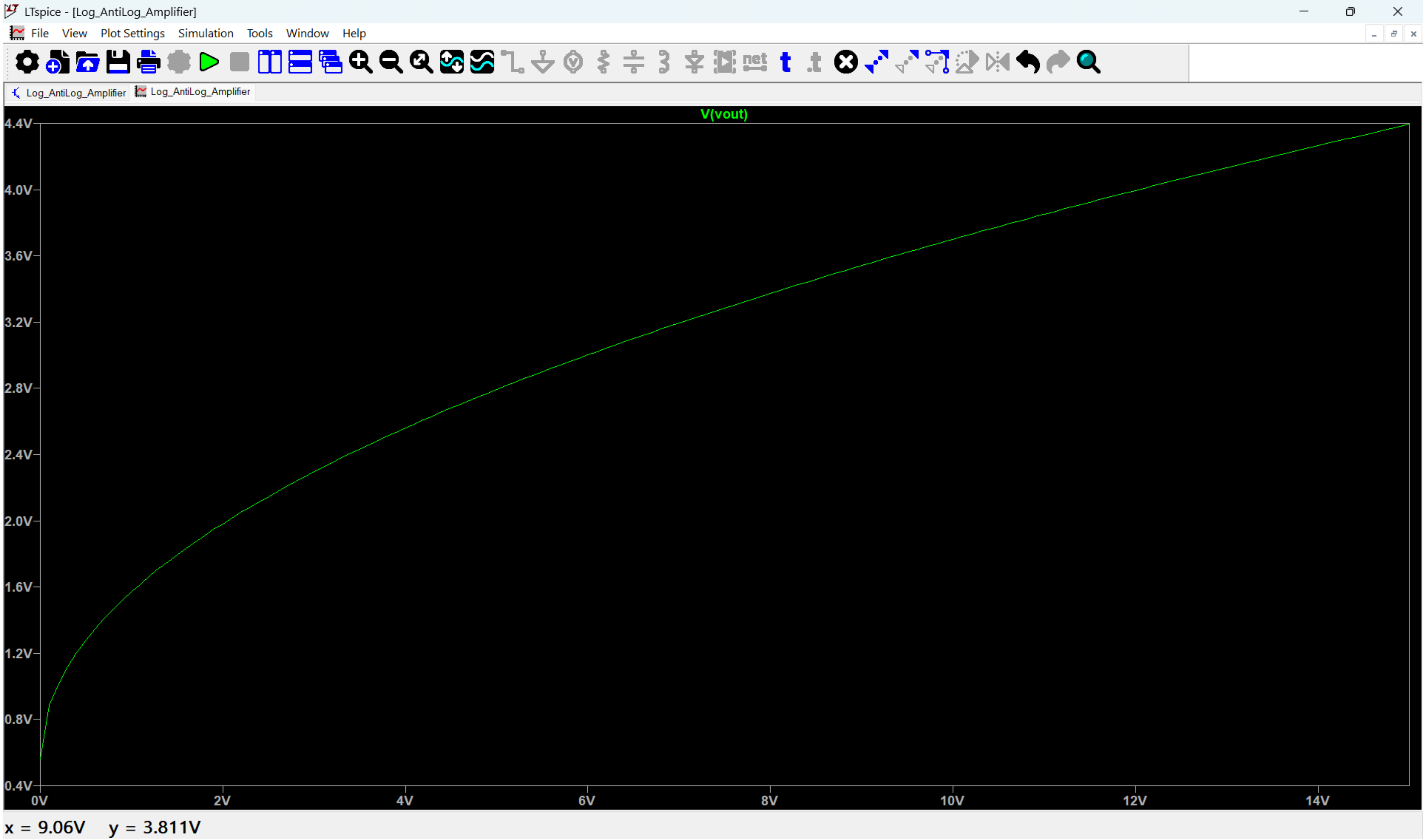


Linear Fit of ln(Id) vs Vd for D1
ln(Id1) vs Vd (data)
Fitted line
−4
−6
−8
−10
−12
ln(Id) (ln(A))
0.3
0.4
0.5
0.6
0.7
0.8
Vd (Volts)



Linear Fit of ln(Id) vs Vd for D2
ln(Id2) vs Vd (data)
Fitted line
ln(Id2) (ln(A))
Vd (Volts)
−4
−6
−8
−10
−12
0.3
0.4
0.5
0.6
0.7
0.8


.model D1 D(Is=4.097e-09 N=1.880)
.model D2 D(Is=4.994e-09 N=1.852)
.dc Vin 0 15 0.1
Block-1
Block-2
Block-3
Block-4
D1
D
R12
10k
R22
4925.53
R3
530.9106
Vin
R
16103
R11
10k
R21
10k
D2
D
Vx
V1
+15
TL084
Vout1
Vb1
-0.17812
Vout2
Vout3
Vb2
0.56
Vout
V2
-15



LTspice - [Log_AntiLog_Amplifier]
File View Plot Settings Simulation Tools Window Help
Log_AntiLog_Amplifier
Log_AntiLog_Amplifier
V(vout)
4.4V
4.0V
3.6V
3.2V
2.8V
2.4V
2.0V
1.6V
1.2V
0.8V
0.4V
0V
2V
4V
6V
8V
10V
12V
14V
x = 9.06V y = 3.811V