California State University Sacramento
Electrical and Computer Science Department

EEE 108L Lab - Section 05
Laboratory Experiment Number 8: Lab Report

A Common-Emitter Design Exercise

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Abstract

For this laboratory experiment is a design exercise that involves a common-emitter amplifier. In this lab we were given the set CE7 which contained the following. In this lab we will also be using 2n2222 BJT.

Set CE7	Load Resistance	R_L	1k	Ω	±5%
	Voltage gain	v_o/v_s	2	V/V	±10%
	Power supply voltage	V_{CC}	5	V	±5%
	Minimum swing capability	$v_{out\,max}$	0.42	V_{pp}	≥ spec.
	Input Resistance	R_{in}	15k	Ω	≥ spec.

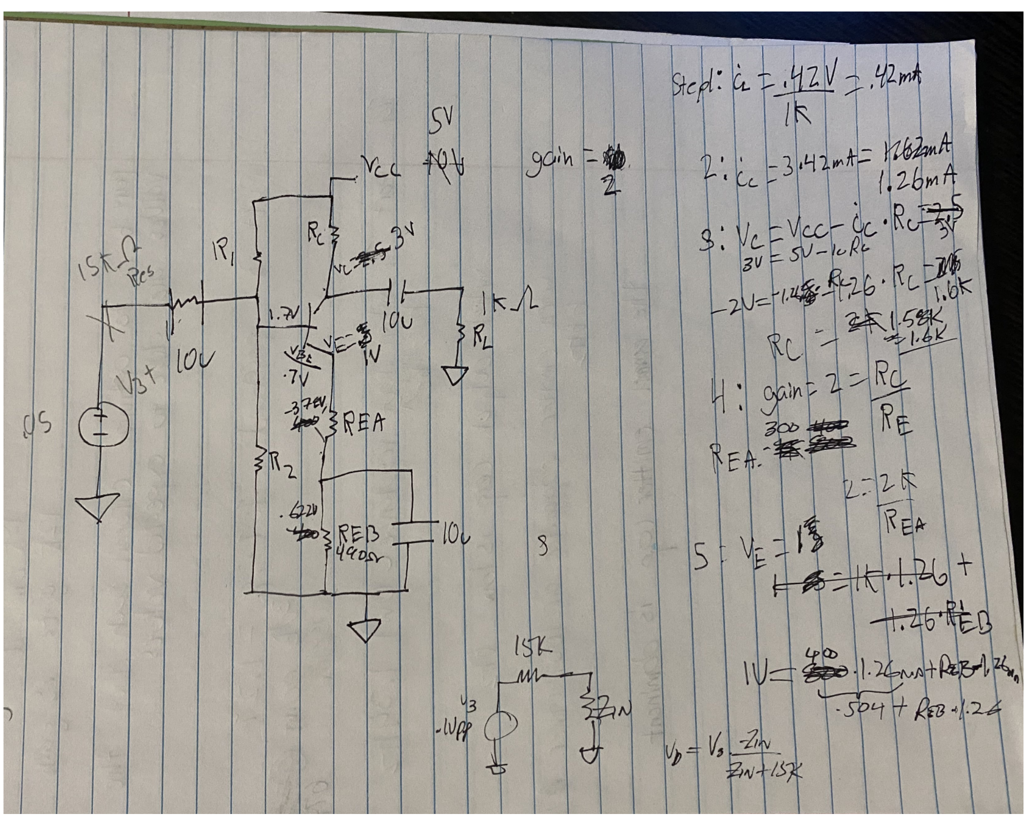
Part 1: Preliminary Calculations

STEP 1A:

Assuming that,

REA = 0

RL = ∞



STEP 1B:

1: $i_L = \frac{.42V}{1k} = .42mA$

2: $i_C = 1.26mA$

3: $V_C = V_{CC} - i_C \cdot R_C = 2.984$

4: $\text{gain} = 2 = \frac{R_C}{R_E}$

5) $V_E = 1V = 1.26mA \cdot \overset{R_{EA}}{300} + 1.26mA \cdot R_{EB}$

$R_{EB} = 490$

6 ~~$V_{BE} = V_B$~~

$V_B = V_E + V_{BE} = 1V + .7 = 1.7$

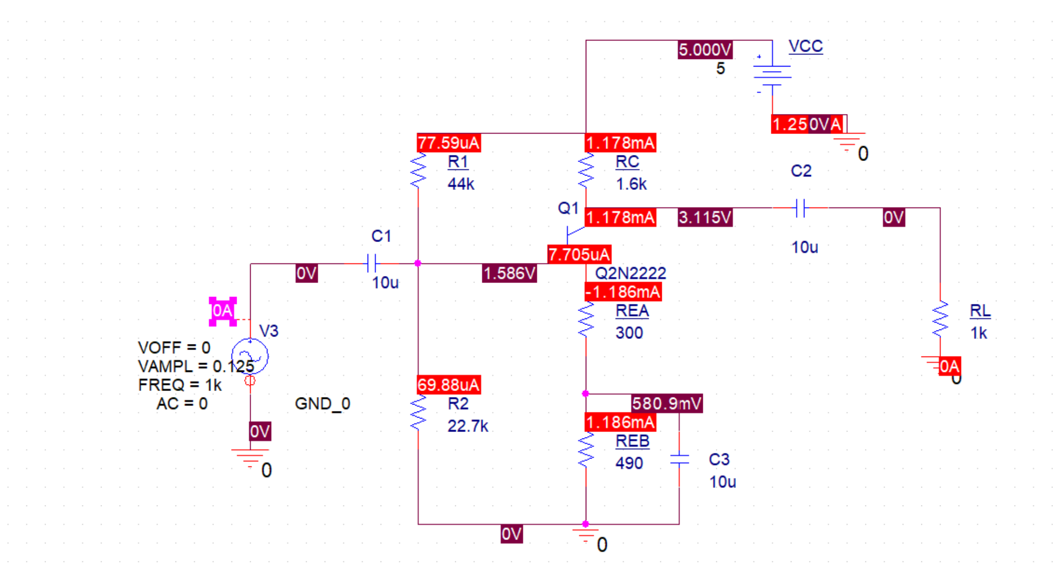
$V_B = 1.7V = \frac{5R_2}{R_1 + R_2}$ $\quad R_1 = 8.8k$

$R_2 = 21.4k$

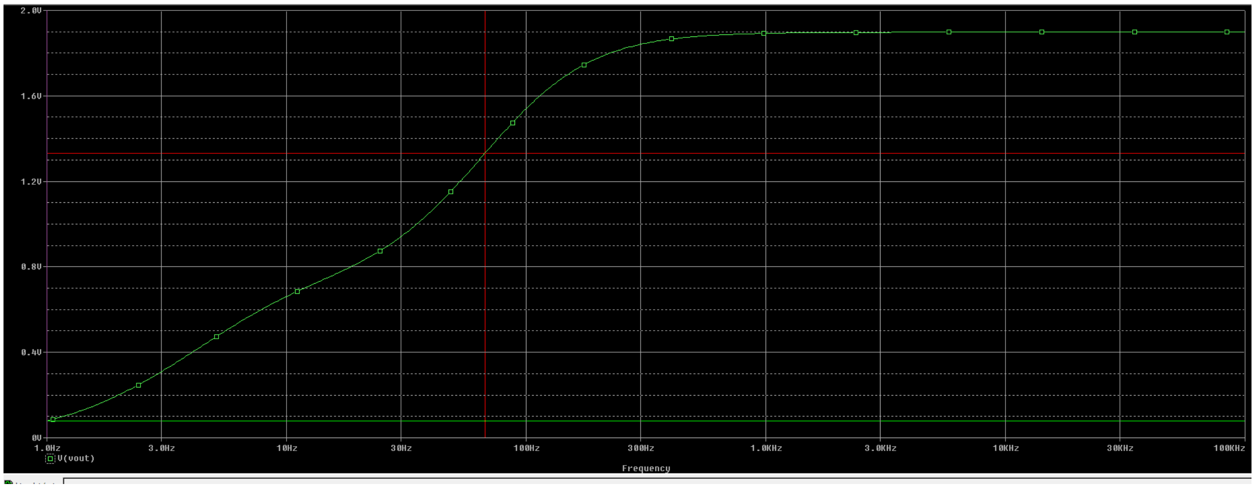
$R_{in} = 15k = \frac{R_1 \cdot R_2}{R_1 + R_2}$

Part 2: Spice Simulations

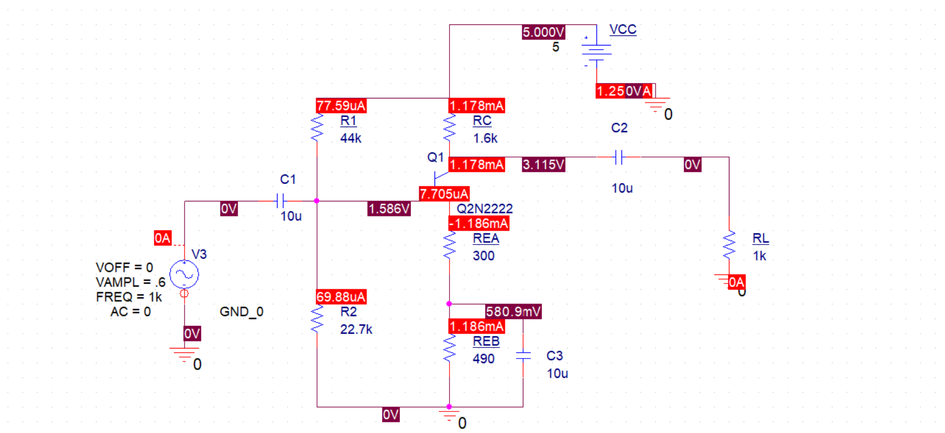
STEP 2:

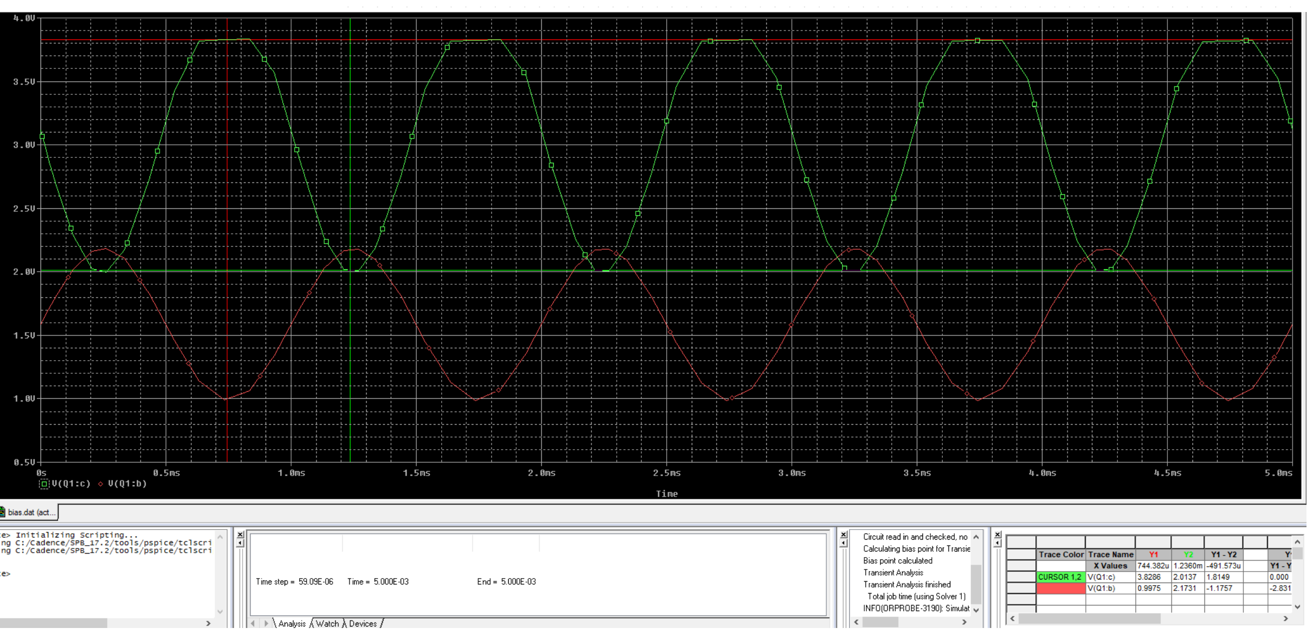


STEP 3: AC sweep

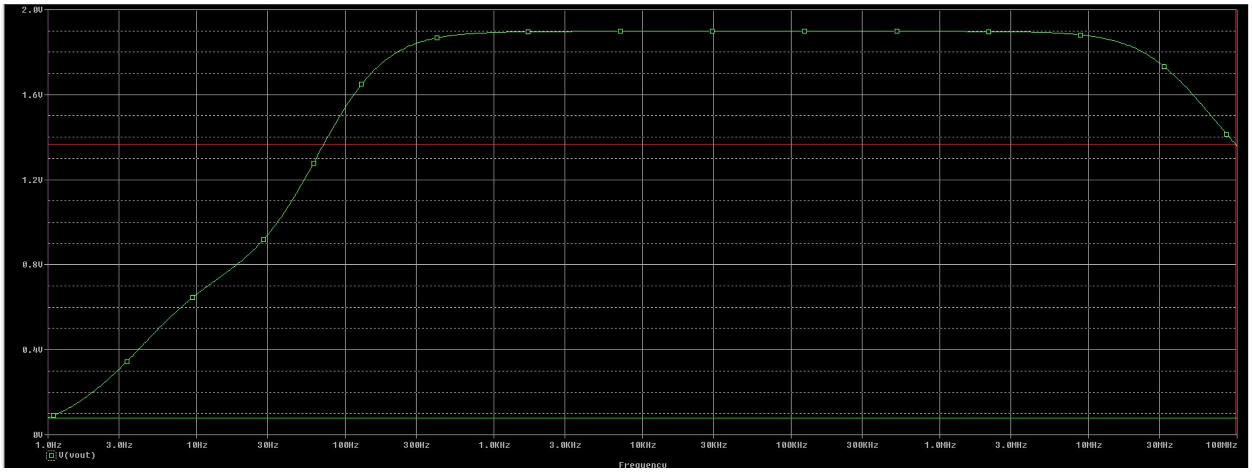


STEP 4:





STEP 5:



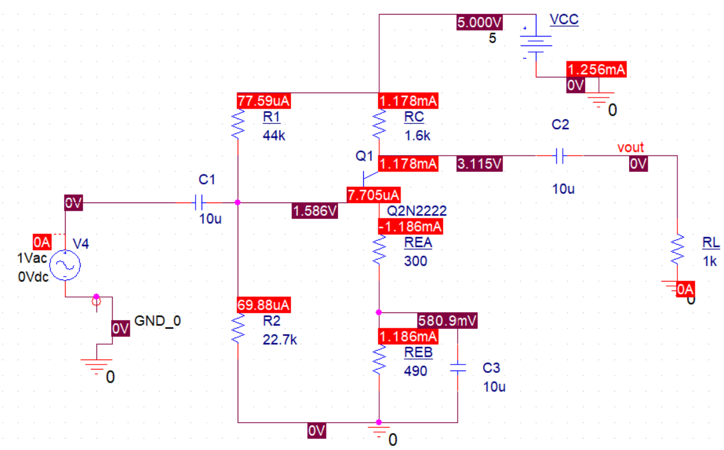
STEP 6:

VB = VE + VBE = 1V + 0.7V = 1.7V

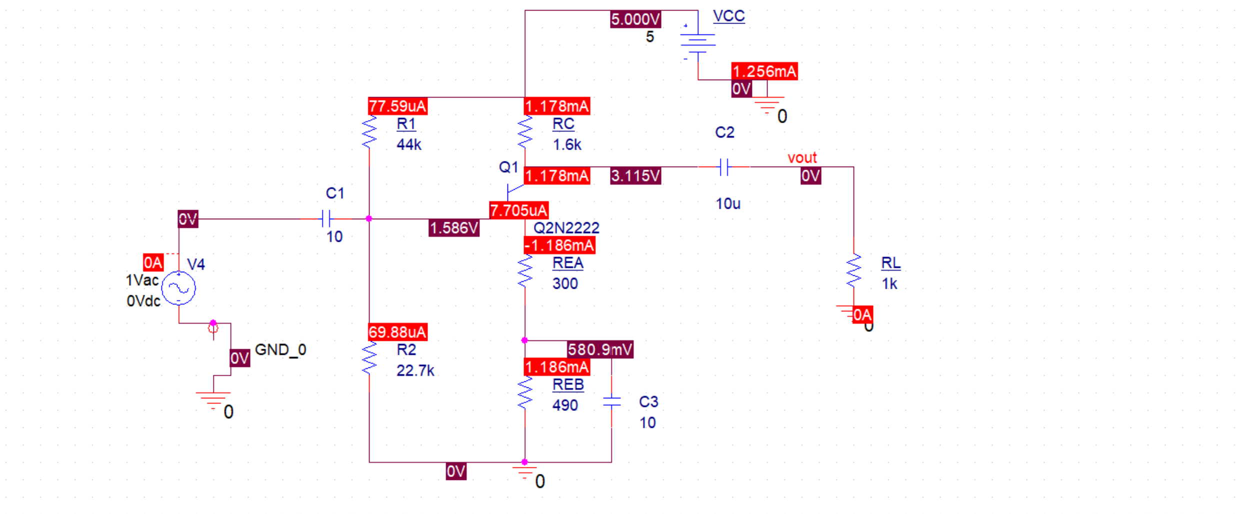
VB = 1.7V

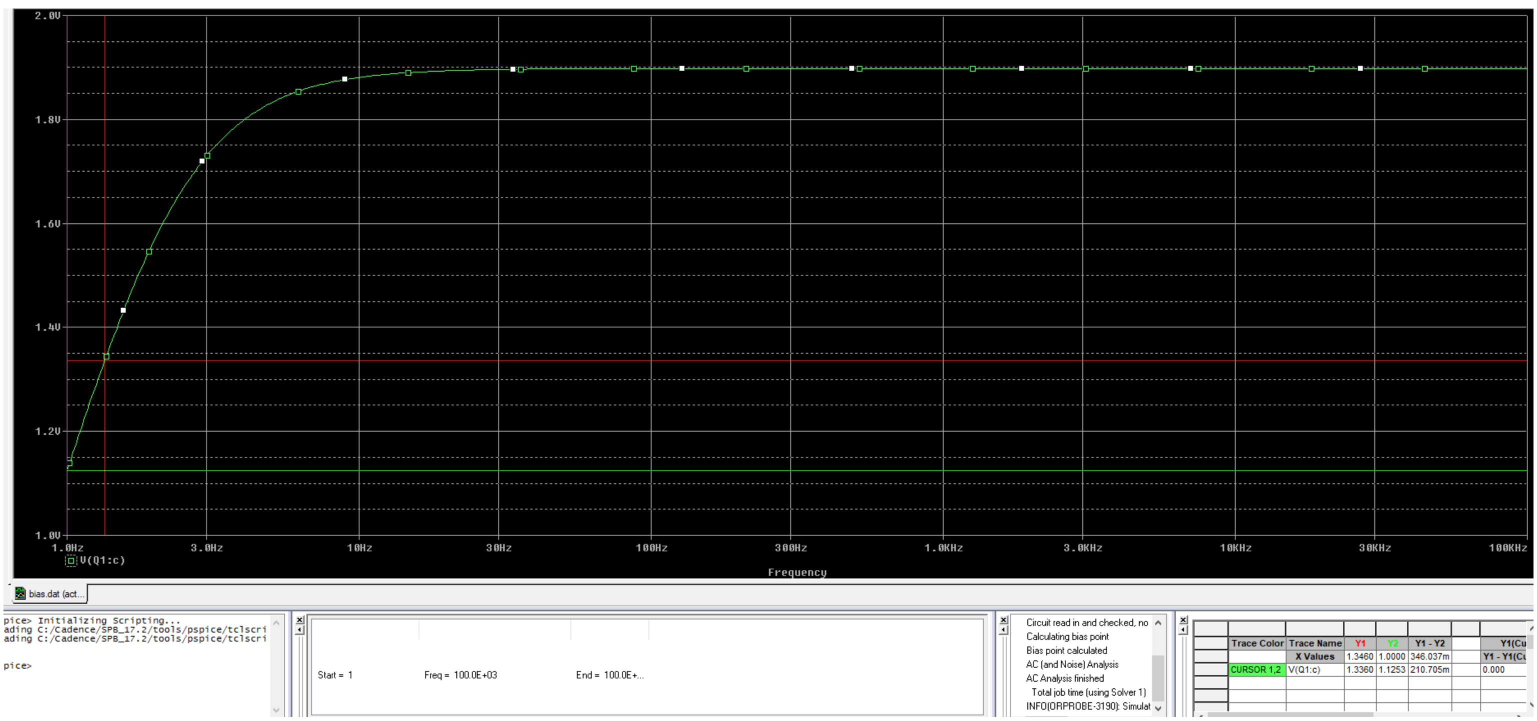
Rin = 15k

New schematic:



STEP 7:


5.000V
VCC
5
1.256mA
0V
0
77.59uA
R1
44k
1.178mA
RC
1.6k
C2
vout
Q1
1.178mA
3.115V
0V
C1
10u
0V
7.705uA
10
1.586V
Q2N2222
-1.186mA
0A
V4
REA
1Vac
300
RL
0Vdc
1k
0A
69.88uA
R2
22.7k
GND_0
0V
580.9mV
1.186mA
REB
490
C3
10
0
0V
0


2.0V
1.8V
1.6V
1.4V
1.2V
1.0V
1.0Hz
3.0Hz
10Hz
30Hz
100Hz
300Hz
1.0KHz
3.0KHz
10KHz
30KHz
100KHz
V(Q1:c)
Frequency
bias.dat (act...
Start = 1
Freq = 100.0E+03
End = 100.0E+...
Circuit read in and checked, no
Calculating bias point
Bias point calculated
AC (and Noise) Analysis
AC Analysis finished
Total job time (using Solver 1)
Trace Color
Trace Name
Y1
Y2
Y1 - Y2
X Values
1.3460
1.0000
346.037m
CURSOR 1,2
V(Q1:c)
1.3360
1.1253
210.705m
0.000

Part 3: Laboratory Experiment

STEP 8:

The values of the circuit components include:

R1 = 43kΩ

R2 = 22kΩ

REB = 470Ω

Rc = 1.6kΩ

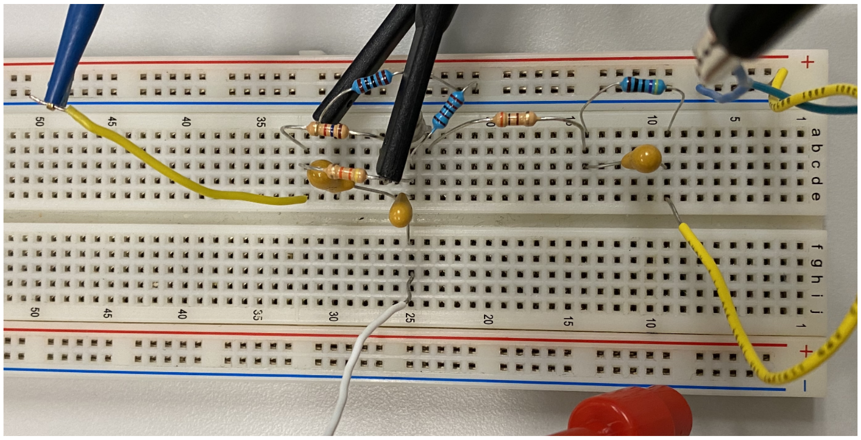
REA = 300Ω

RL - 1kΩ

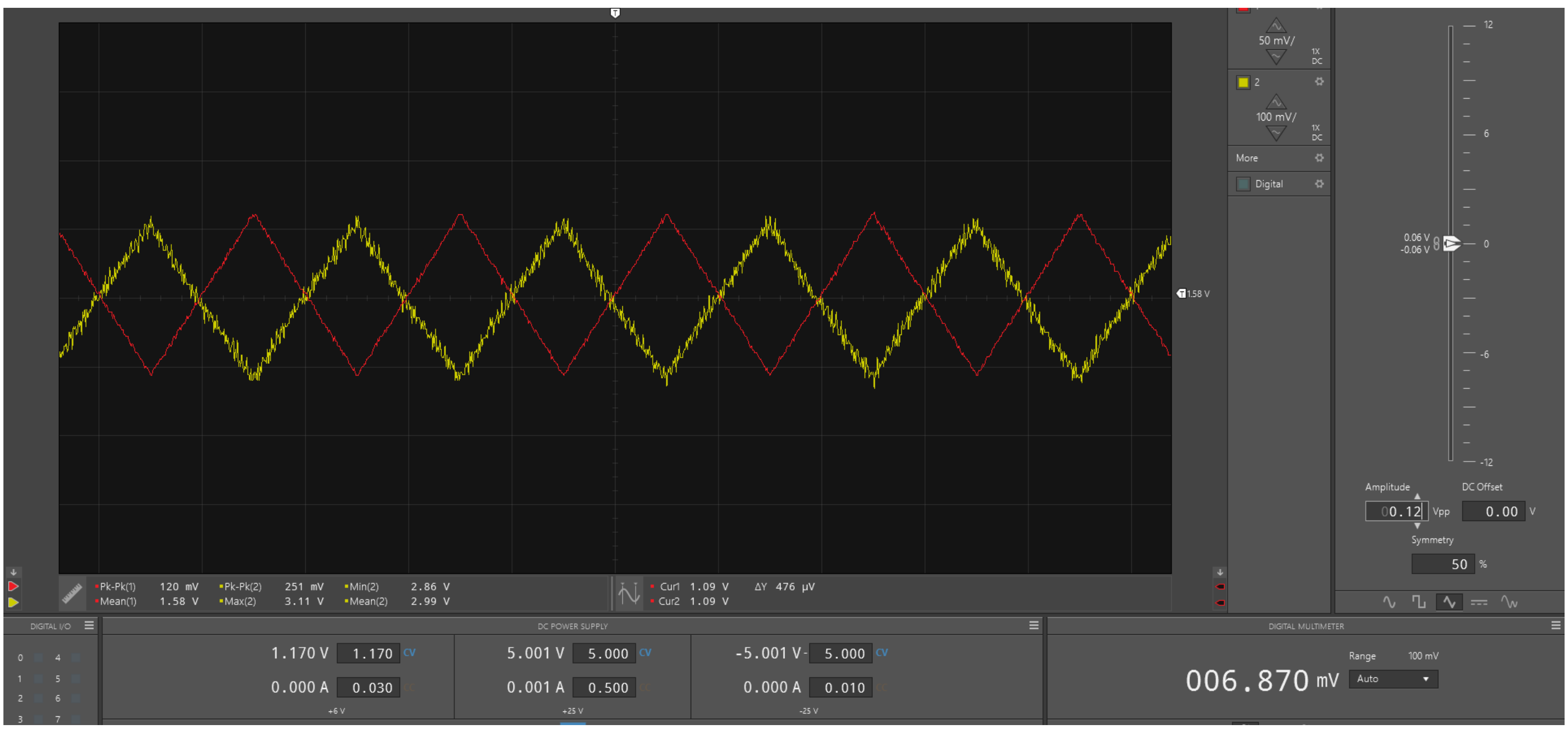
C1 = 10u

C2 = 4.7u

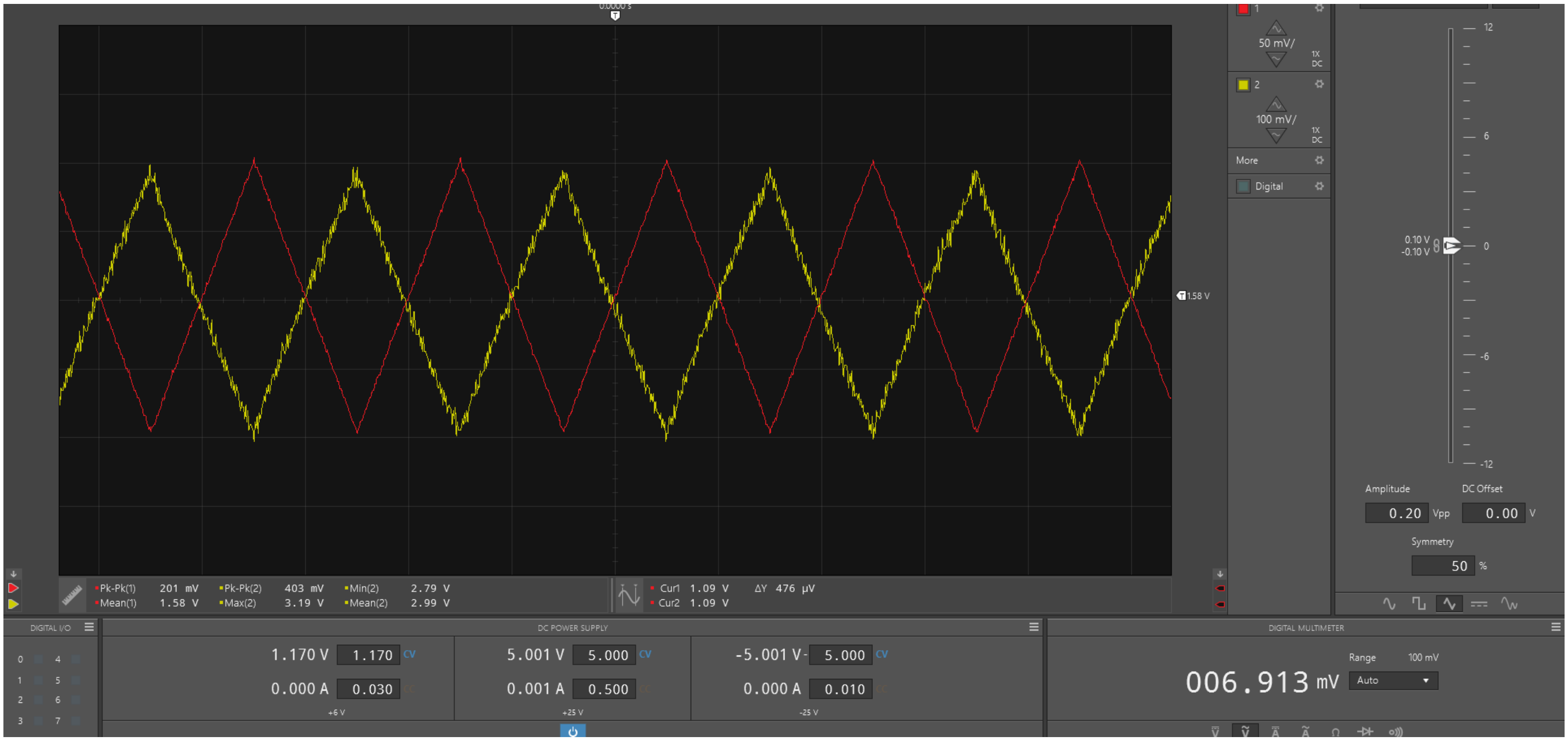
C3 = 4.7u



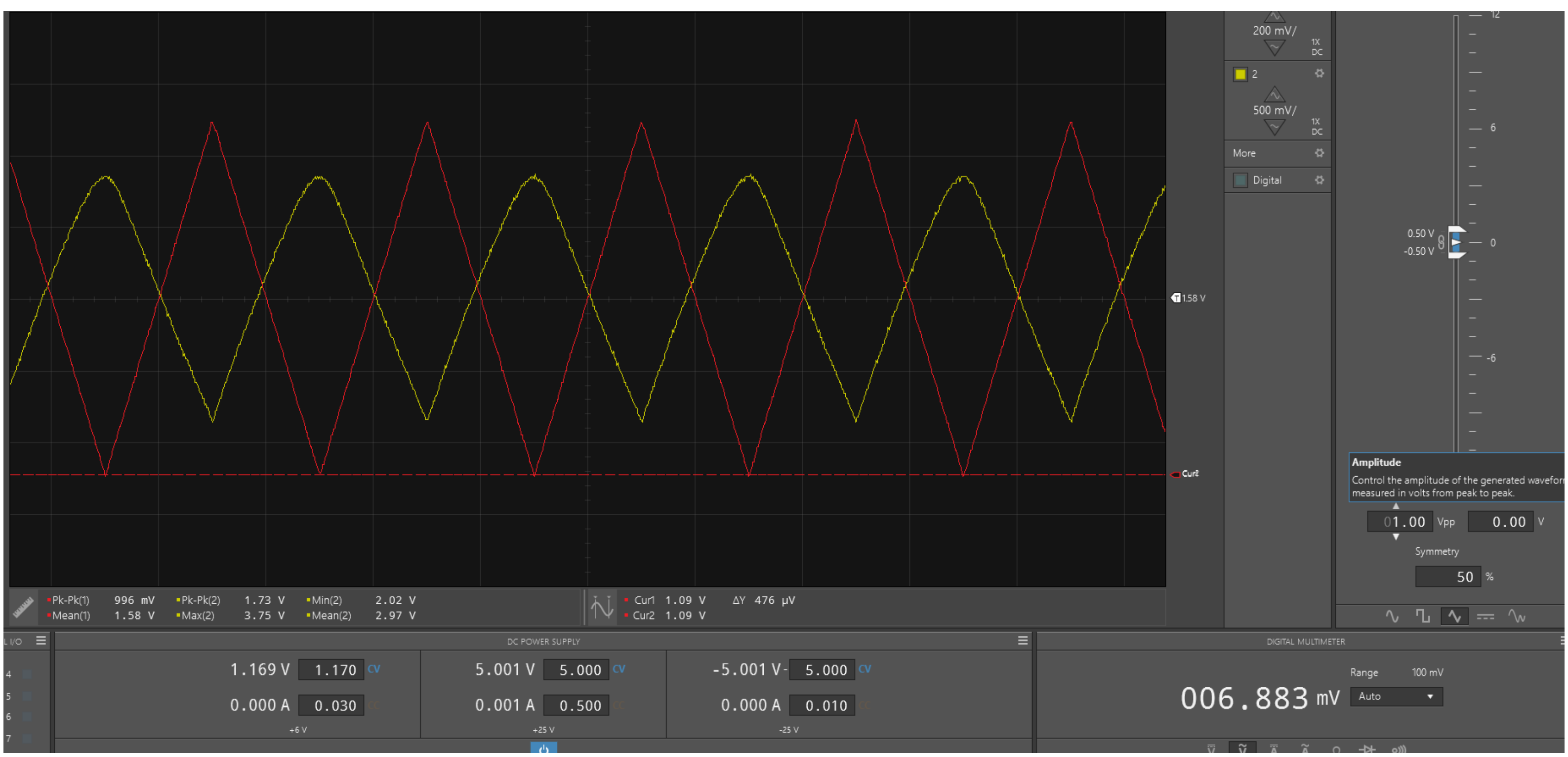
Collector current = 2.99/(1.6x10^3) = 1.86mA



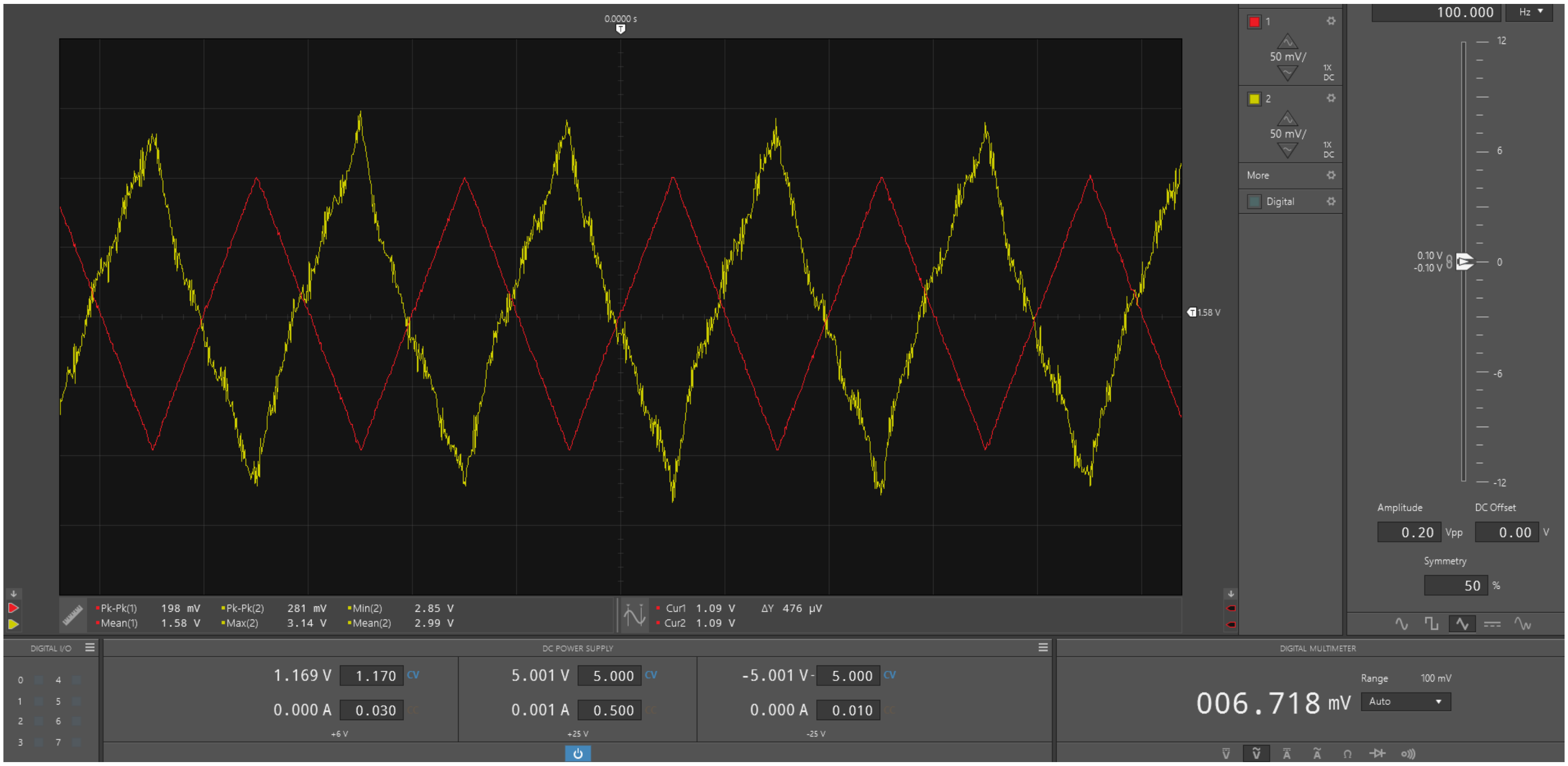
STEP 9:



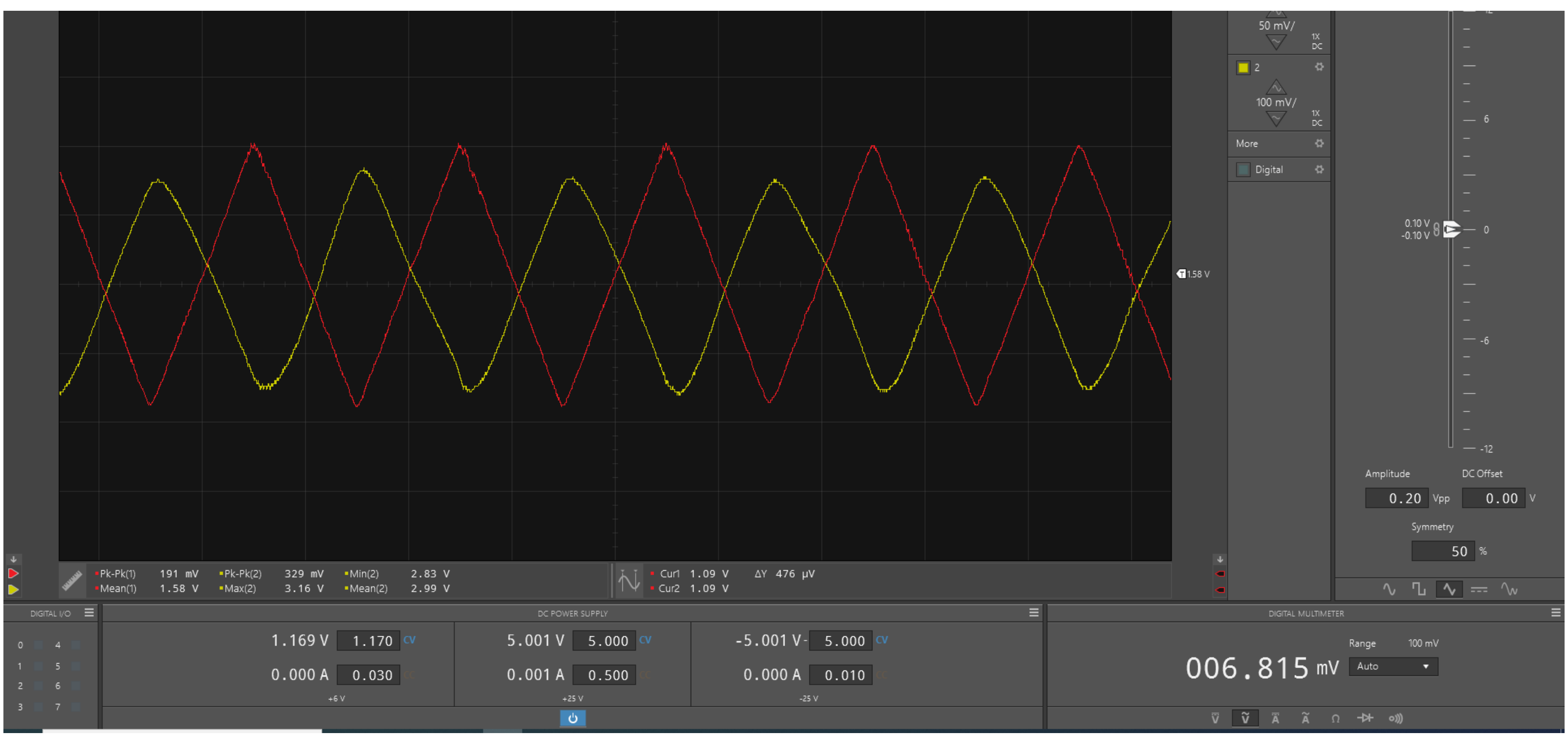
STEP 10:



STEP 11:



Pk-Pk(1) 198 mV
Mean(1) 1.58 V
Pk-Pk(2) 281 mV
Max(2) 3.14 V
Min(2) 2.85 V
Mean(2) 2.99 V
Cur1 1.09 V
Cur2 1.09 V
ΔY 476 µV
100.000 Hz
Amplitude 0.20 Vpp
DC Offset 0.00 V
Symmetry 50 %
DC POWER SUPPLY
1.169 V 1.170
0.000 A 0.030
5.001 V 5.000
0.001 A 0.500
-5.001 V 5.000
0.000 A 0.010
DIGITAL MULTIMETER
006.718 mV
Range 100 mV
Auto

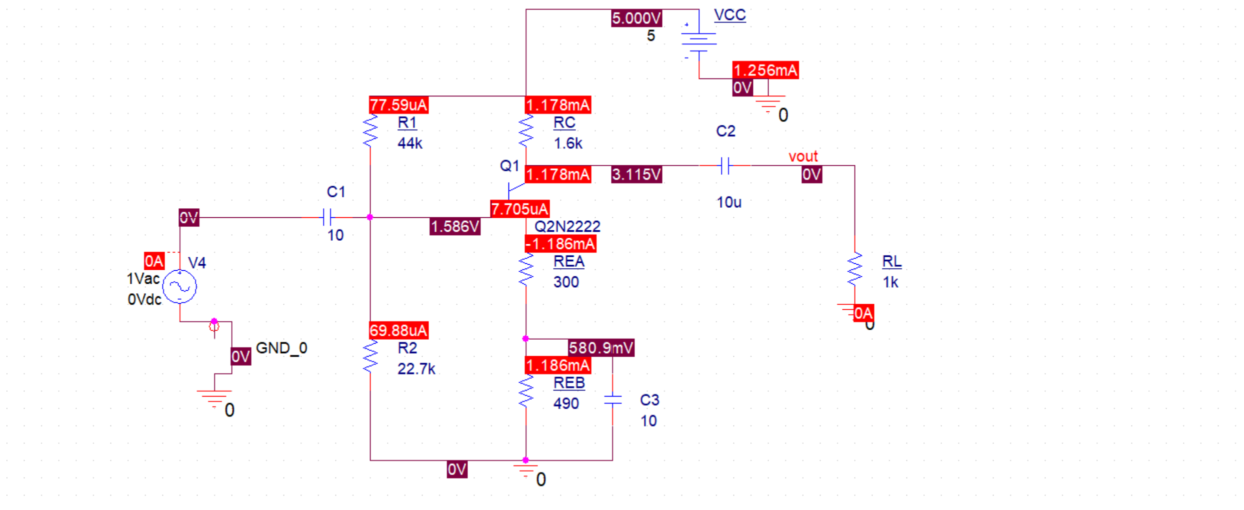


Pk-Pk(1) 191 mV
Mean(1) 1.58 V
Pk-Pk(2) 329 mV
Max(2) 3.16 V
Min(2) 2.83 V
Mean(2) 2.99 V
Cur1 1.09 V
Cur2 1.09 V
ΔY 476 µV
Amplitude 0.20 Vpp
DC Offset 0.00 V
Symmetry 50 %
DC POWER SUPPLY
1.169 V 1.170
0.000 A 0.030
5.001 V 5.000
0.001 A 0.500
-5.001 V 5.000
0.000 A 0.010
DIGITAL MULTIMETER
006.815 mV
Range 100 mV
Auto

CONCLUSION:

ITEM 1:

Final schematic:



The state the collector current: is seen in step 8. Collector current = 2.99/(1.6x10^3) = 1.86mA

Value of Vbb: 1 + 0.7 = 1.7V

ITEM 2: To justify that our amplifier circuit has bias stability against variations of B Beta can be seen in the pspice temperature simulations.