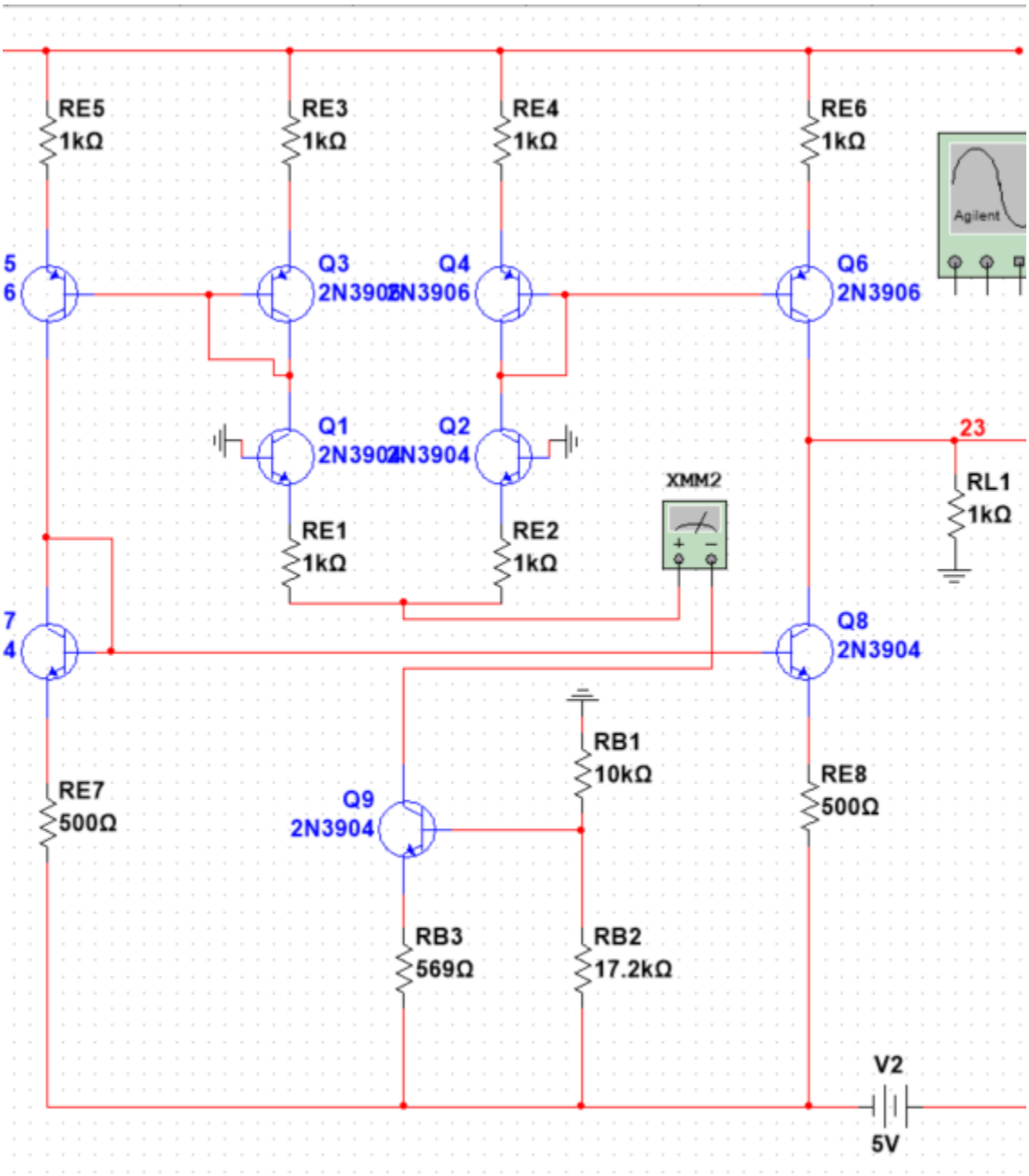
Matthew Loden

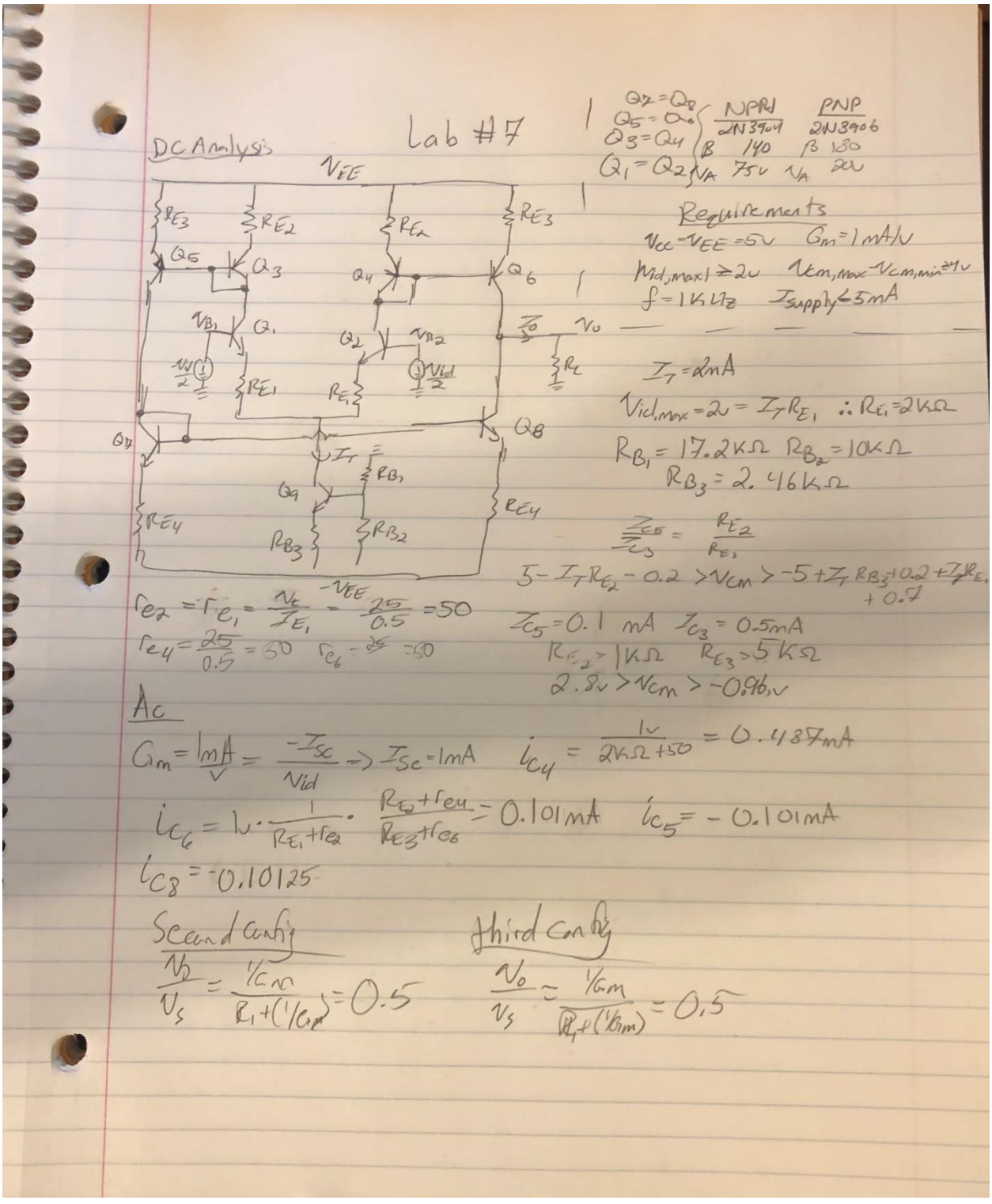
ECEN 326 – 501

LAB 7: Operational Transconductance Amplifier

Design:



Calculations:

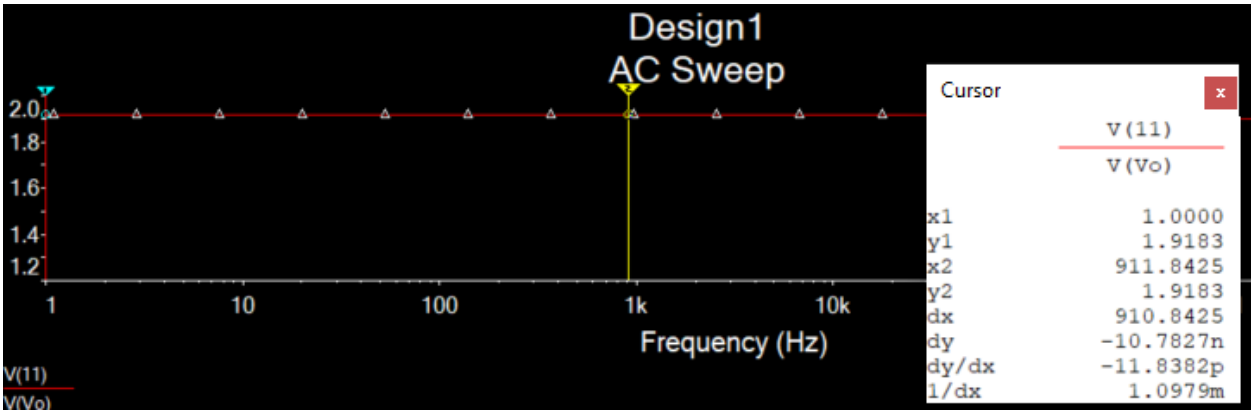


Simulations:

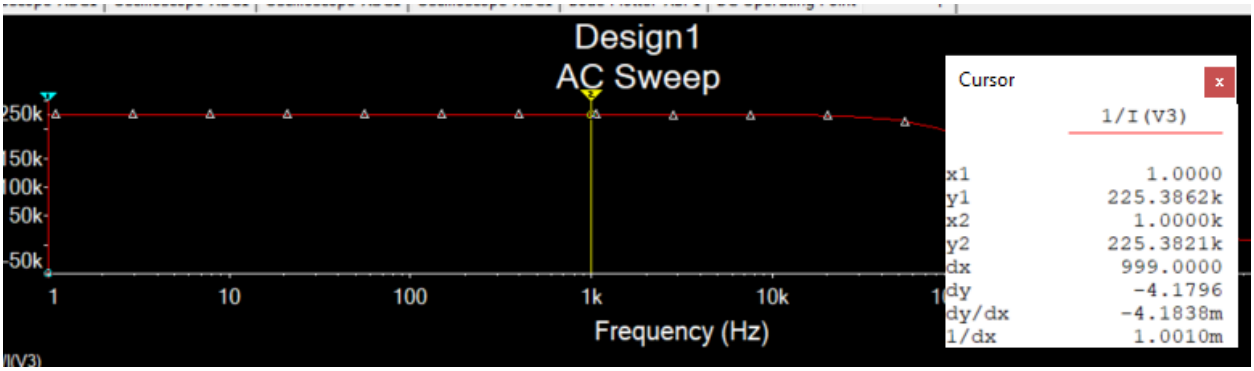
DcOp:

	Variable	Operating point value
1	-I(Q6:C) | I(Isc)	1.90433 m
2	I(V1:1) | I(Isupply)	-7.65591 m
3	I(Q9:C) | I(Itail)	3.86678 m

Gm:

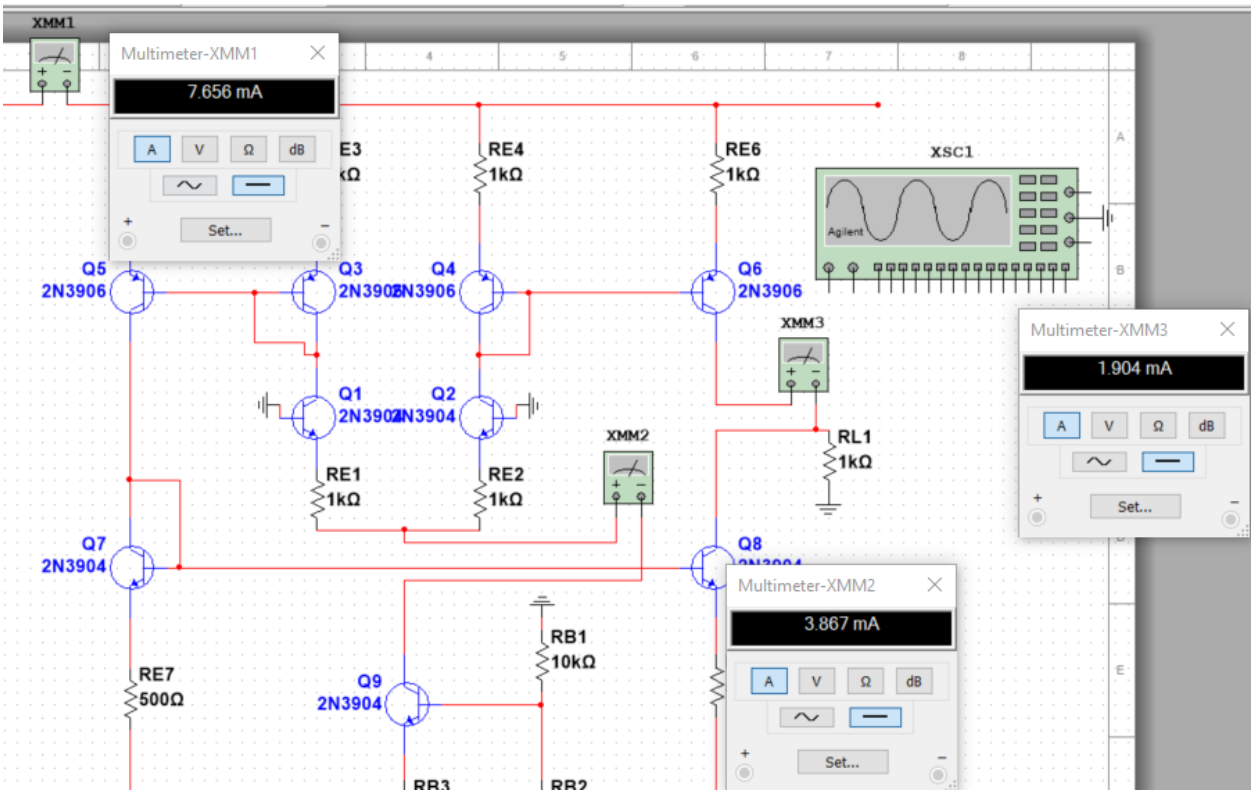


Rid:

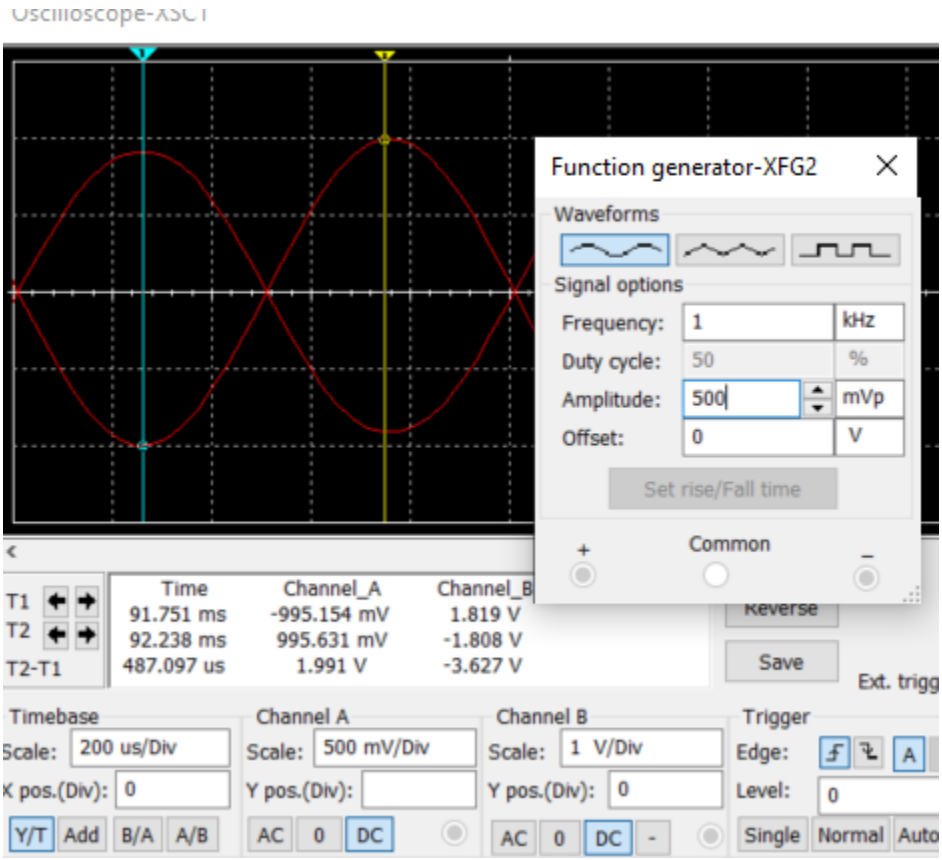


Measurements:

DcOp:

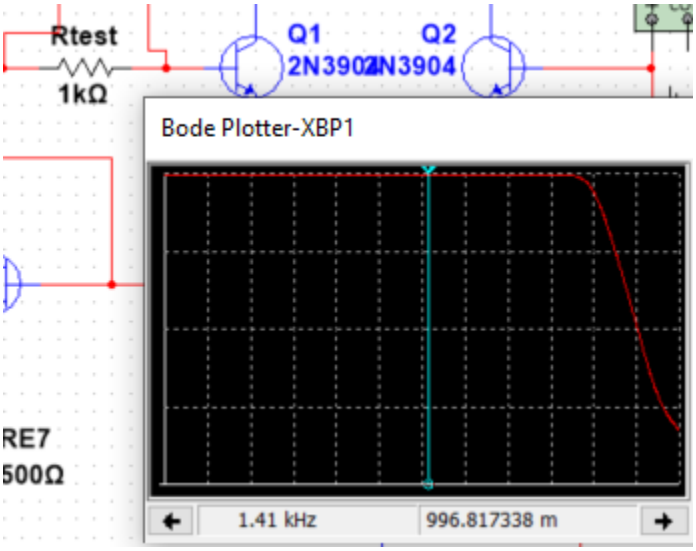

XMM1
Multimeter-XMM1
7.656 mA
A
V
Ω
dB
Set...
RE4
1kΩ
RE6
1kΩ
XSC1
Agilent
Q5
2N3906
Q3
2N3906
Q4
2N3906
Q6
2N3906
XMM3
Multimeter-XMM3
1.904 mA
Q1
2N3904
Q2
2N3904
XMM2
RL1
1kΩ
RE1
1kΩ
RE2
1kΩ
Q7
2N3904
Q8
Multimeter-XMM2
3.867 mA
RB1
10kΩ
RE7
500Ω
Q9
2N3904

Gm


Oscilloscope-XSC1
Function generator-XFG2
Waveforms
Signal options
Frequency: 1 kHz
Duty cycle: 50 %
Amplitude: 500 mVp
Offset: 0 V
Set rise/Fall time
Common
Time
Channel_A
Channel_B
T1
91.751 ms
-995.154 mV
1.819 V
T2
92.238 ms
995.631 mV
-1.808 V
T2-T1
487.097 us
1.991 V
-3.627 V
Reverse
Save
Ext. trigg
Timebase
Scale: 200 us/Div
X pos.(Div): 0
Y/T
Add
B/A
A/B
Channel A
Scale: 500 mV/Div
Y pos.(Div):
AC
0
DC
Channel B
Scale: 1 V/Div
Y pos.(Div): 0
AC
0
DC
Trigger
Edge:
Level: 0
Single
Normal
Auto

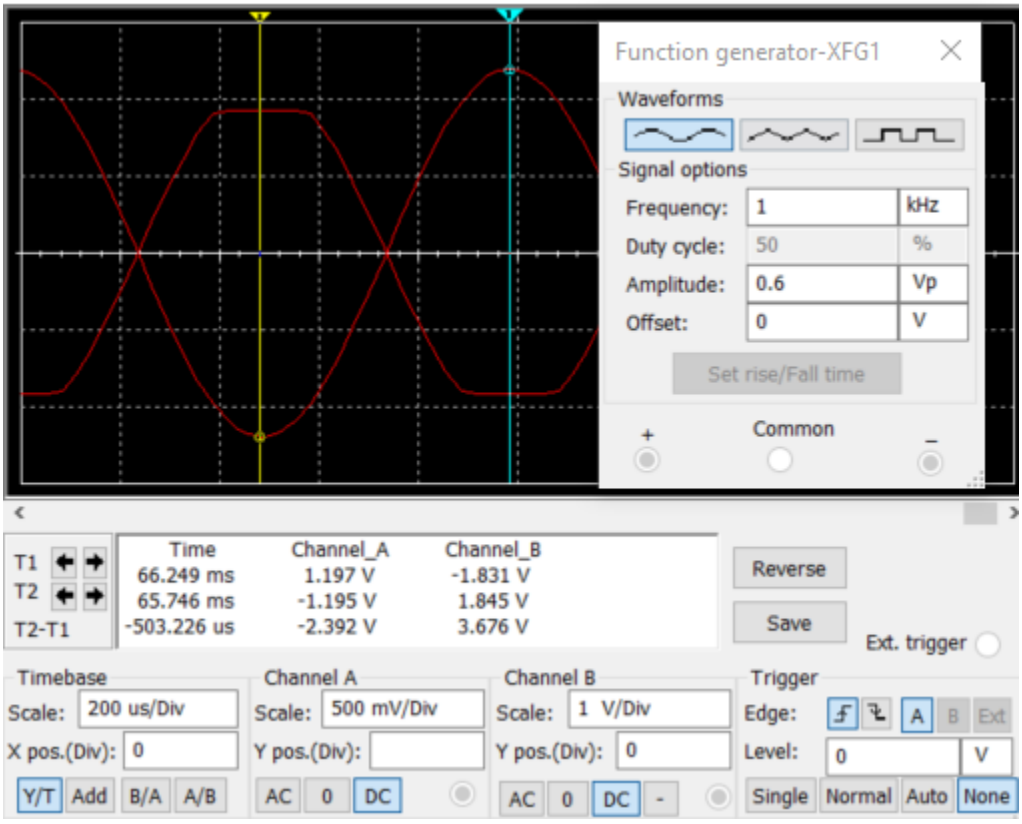
= 0.9113

Rid:

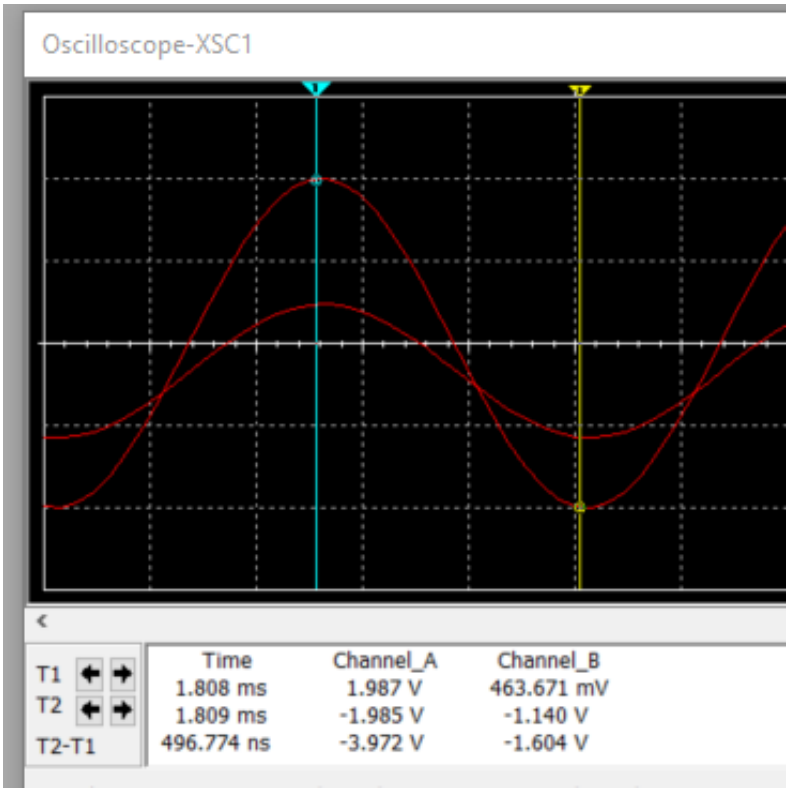


= 312.579kΩ

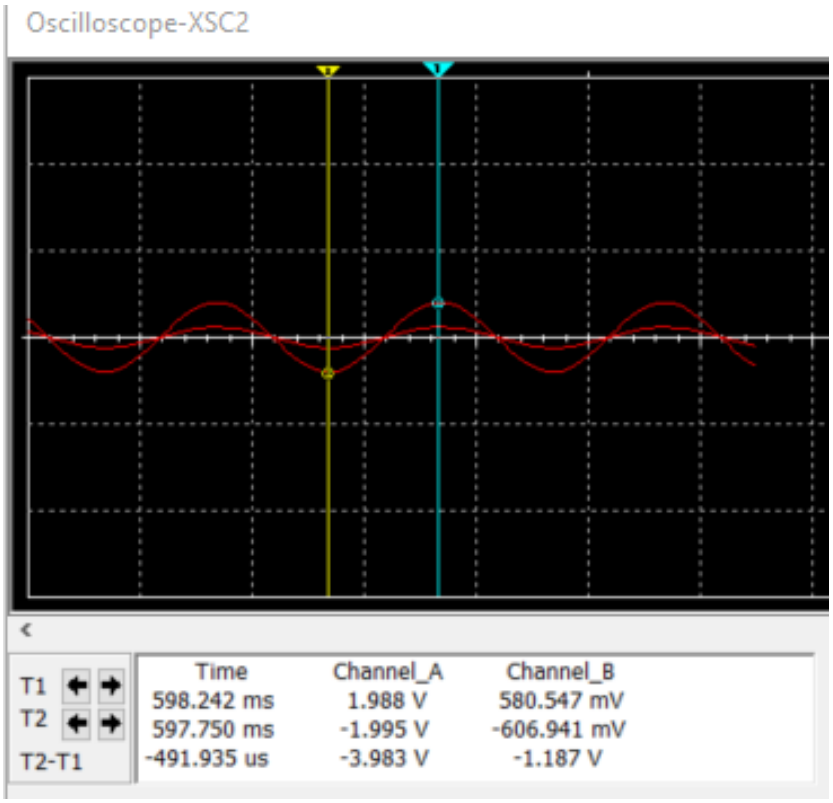
Vid max



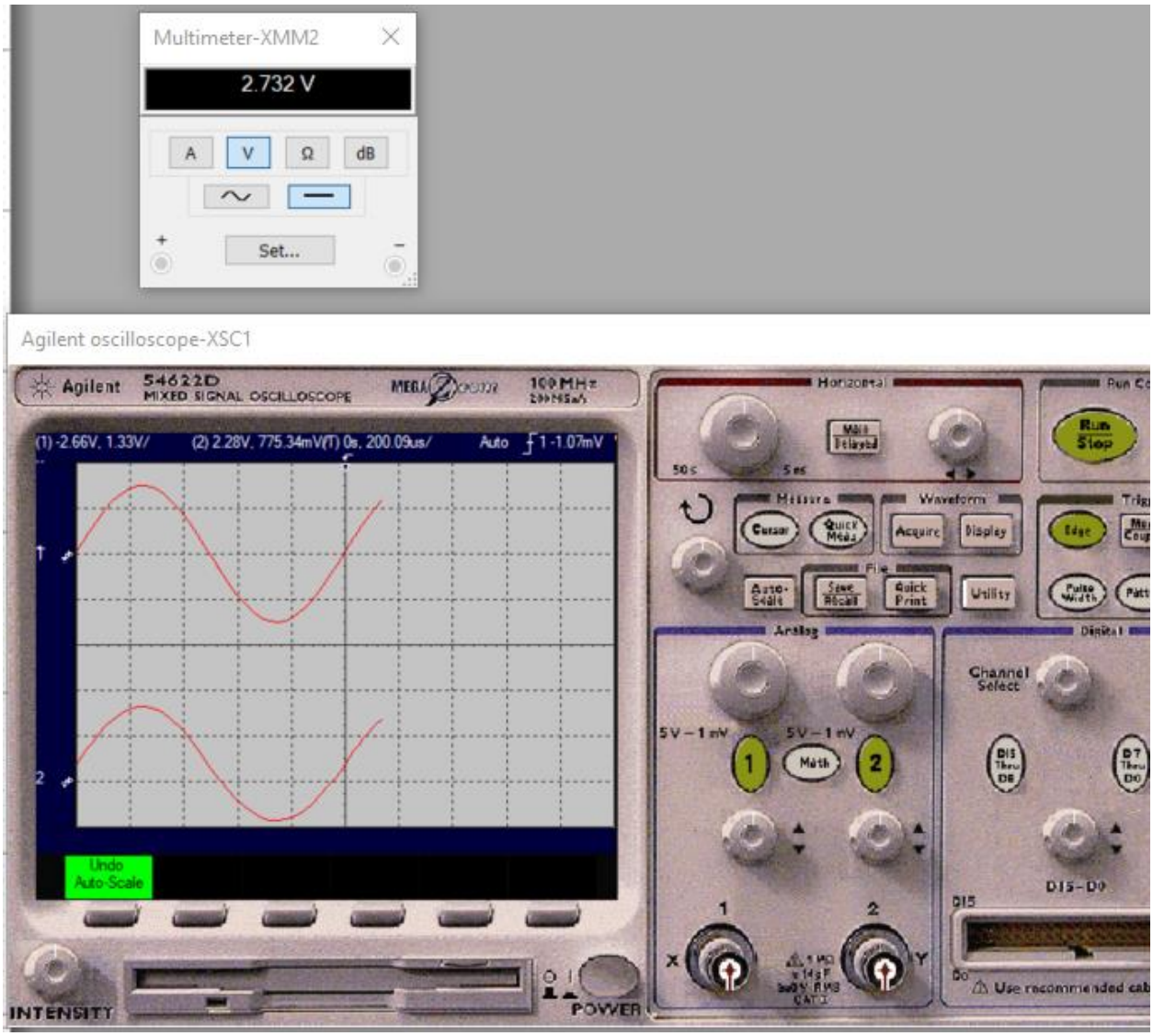
Gm Second Configuration:



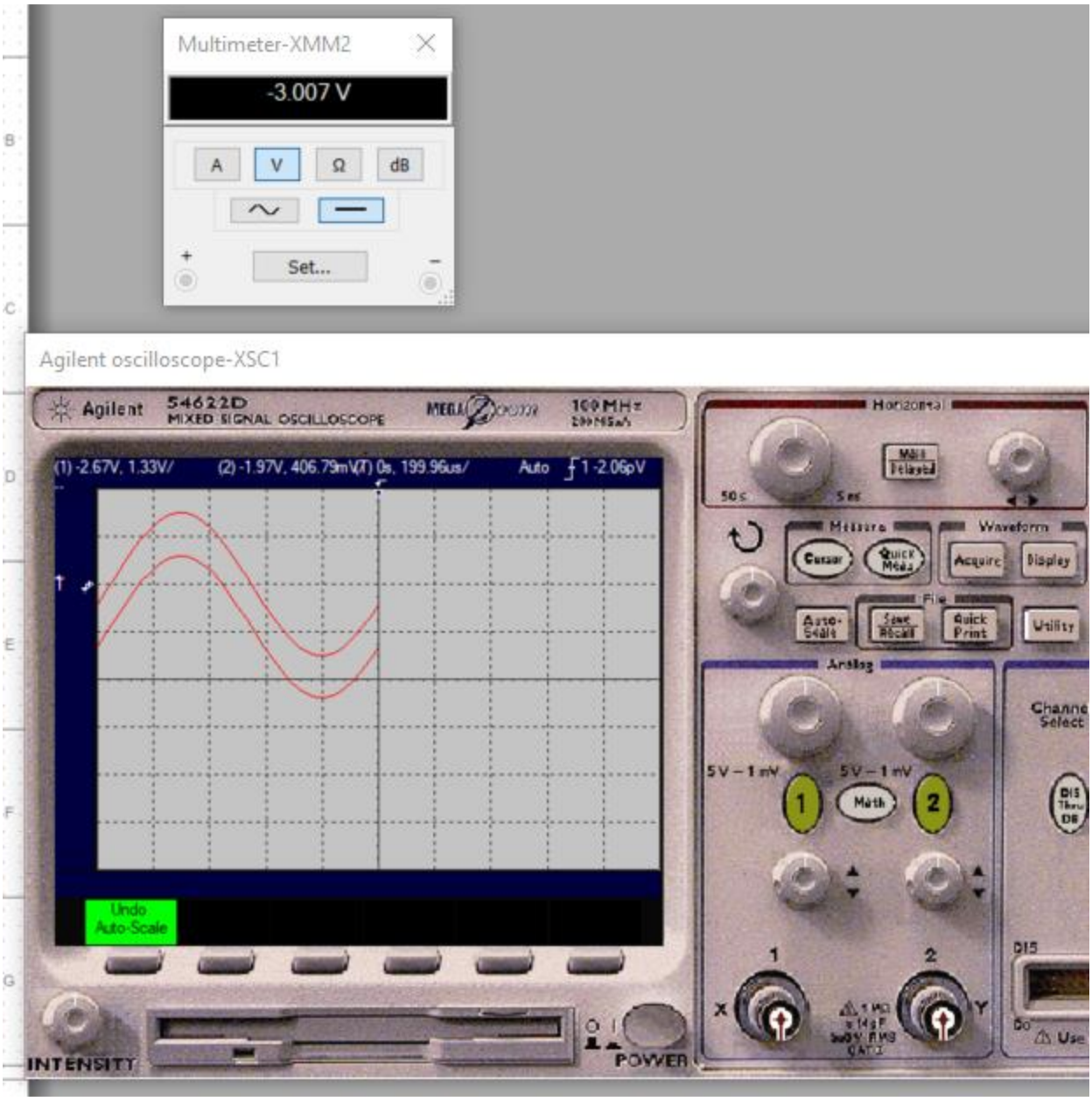
Gm Thrid Configuration:



Vcm, max


Multimeter-XMM2
2.732 V
A
V
Ω
dB
Set...
Agilent oscilloscope-XSC1
Agilent
54622D
MIXED SIGNAL OSCILLOSCOPE
100 MHz
(1) -2.66V, 1.33V/
(2) 2.28V, 775.34mV/
(T) 0s, 200.09us/
Auto
1 -1.07mV
Undo
Auto-Scale
Horizontal
Run
Stop
Measure
Waveform
Cursor
Acquire
Display
Auto-Scale
Save
Recall
Quick
Print
Utility
Analog
Channel
Select
5V – 1 mV
5V – 1 mV
1
Math
2
D15-D0
D15
INTENSITY
POWER

Vcm, min



Comparisons:

	Calculated	Simulated	Measured
Itail	2mA	3.84mA	3.867mA
Isupply	<5mA	7.6mA	7.658mA
Isc	1mA	1.9mA	1.904mA
Vid,max	>2v	-	0.6v
Rid	310.2kΩ	225kΩ	312kΩ
Vcm,min	-0.96v	-	-3.007v
Vcm,max	2.8v	-	2.73v

Gm,second	0.5	-	0.4038
Gm,third	0.5	-	0.298

Some key differences I found in my work were among the supply current measurements that I took. These values were slightly higher than allowed for in this lab so this more than likely created some errors in some of my other calculations. One of these calculations that I think it messed up was the common mode gain. The bounds for the upper limit were very similar to the calculated value however the lower limit was much lower than expected. This value still met the criteria for the lab however. The other area of concern was the current through the tail. This value was almost double what the calculated value was expected to be from the calculations. This is more than likely also tied to the problems with the supply current.