Lab 8: BJT Amplifier Configurations

ECEN 325 - 511

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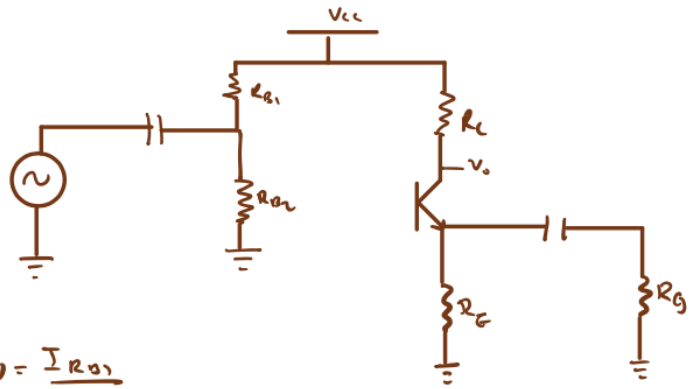
Purpose

The purpose of this was to understand the properties of the BJT amplifier configurations and to investigate the small signal performances.

Calculations

1)



$N = \frac{I_{RB1}}{I_B}$

$V_{RE} = 1V$

$V_{RC} = V_{cc} - V_o - R_c \cdot 0.2$

$I_c \leq \frac{\beta}{R_i} \frac{1}{\frac{N}{V_{RE}+0.7} + \frac{N}{V_{cc}-V_{RE}-0.7} + \frac{A_v}{N R_c}}$

$= 2.8mA$

$R_c = \frac{V_{RC}}{I_c} = 1k\Omega$ $\quad R_{B1} = \frac{\beta(V_{cc} - V_{RE} - 0.7)}{N I_c}$

$R_E = \frac{V_{RE}}{I_c} = 357.14\Omega$ $\quad R_{B2} = \frac{(V_{RE}+0.7)(\beta)}{N I_c}$

$R_{B1} = 11.785 k\Omega$

$R_{B2} = 6.07k\Omega$

$R_g = \frac{R_L}{|A_v|} - V_s = \frac{1k\Omega}{25} - re$

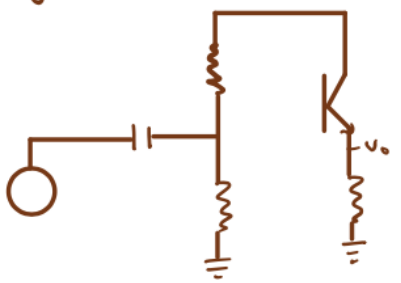
$R_e = V_T / I_c$ $\quad$ Thermal volt $= V_T = 25mV$

$R_e = 25mV/2 = 8.92\Omega$

$R_g = \frac{1k\Omega}{25} - 8.92 = 31.07\Omega$

$R_{B1} = 11.785k\Omega$
$R_{B2} = 6.07k\Omega$
$R_g = 31.07\Omega$
$R_c = 8.982\Omega$
$R_E = 357.14\Omega$

2) Figure 6



$$V_{RB2} = \frac{R_{B2}}{R_{B1} + R_{B2}} V_{cc} = 1.7V$$

$$V_{RE} = V_{RB2} - 0.7 \approx 1V$$

$$I_E = V_{RE} \,|\, R_E = 2.8mA$$

$$r_e = \frac{V_C}{I_C} = \frac{25mV}{2.8mA} = 8.928\Omega$$

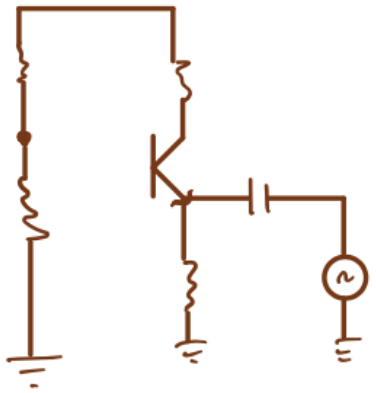
$$|AV| = \frac{R_E}{R_e + R_E} = \frac{357.1\Omega}{8.928 + 332.14\Omega} = .9756$$

$$R_i = R_{B1} \,||\, R_{B2} \,||\, (\beta + 1)(r_e + R_E) = 3614.7\Omega$$

$$R_o = R_E \,||\, r_C = 8.71\Omega$$

$A_V = .9756$
$R_i = 3614.7$
$R_o = 8.71$

3) Figure 8



$R_{B1} = 11.785\,k\Omega$

$R_{B2} = 6.07\,k\Omega$

$R_C = 1k\Omega$

$R_E = 357.14\,\Omega$

$V_{RB2} = 1.7\,V$

$V_{RE} = 1\,V$

$I_A = 2.8\,mA$

$A_V = \frac{R_L}{r_e}$ $\qquad r_e = 25mV / 2.8mA = 2.928\,\Omega$

$A_V = \frac{1k\Omega}{8.928} = 112.01$

$R_i = R_E \,||\, R_B = 8.71\,\Omega$

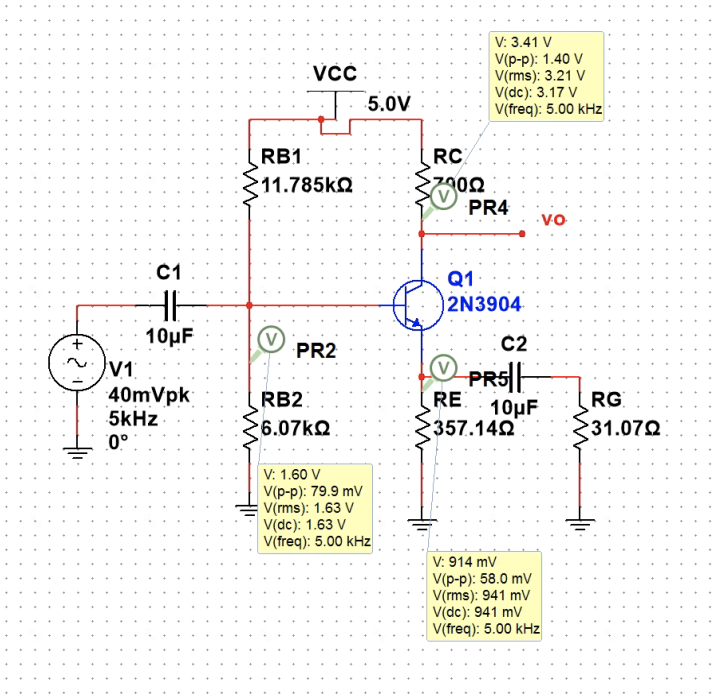
$R_O = 1k\Omega$

$A_V = 112.01$
$R_i = 8.71$
$R_O = 1k$

Simulations (on Multisim)

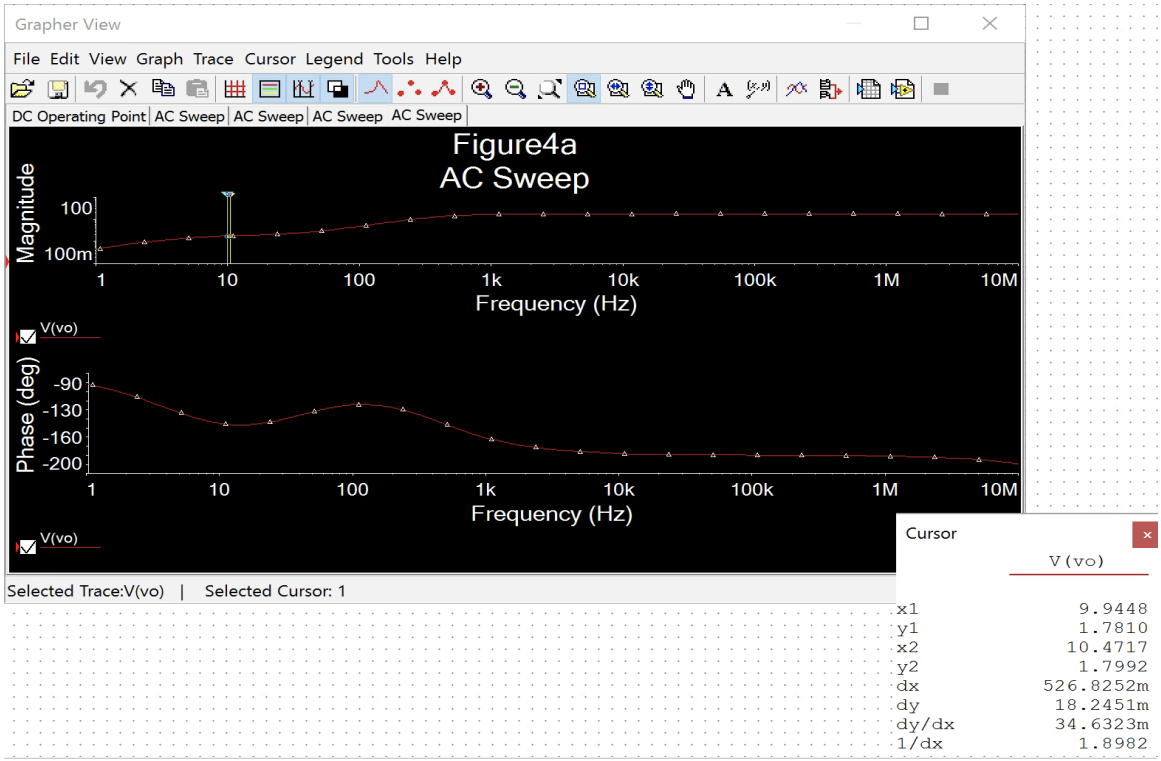
Figure 4a

Schematic / DC operating point 4a

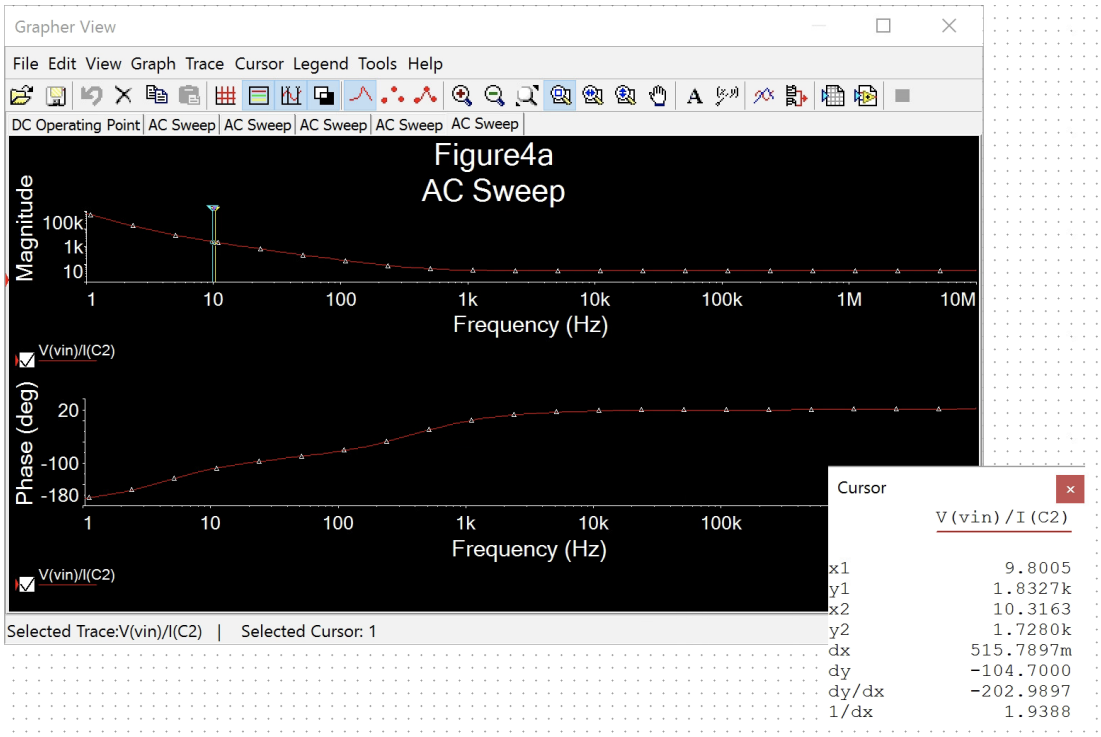


AC simulation 4a

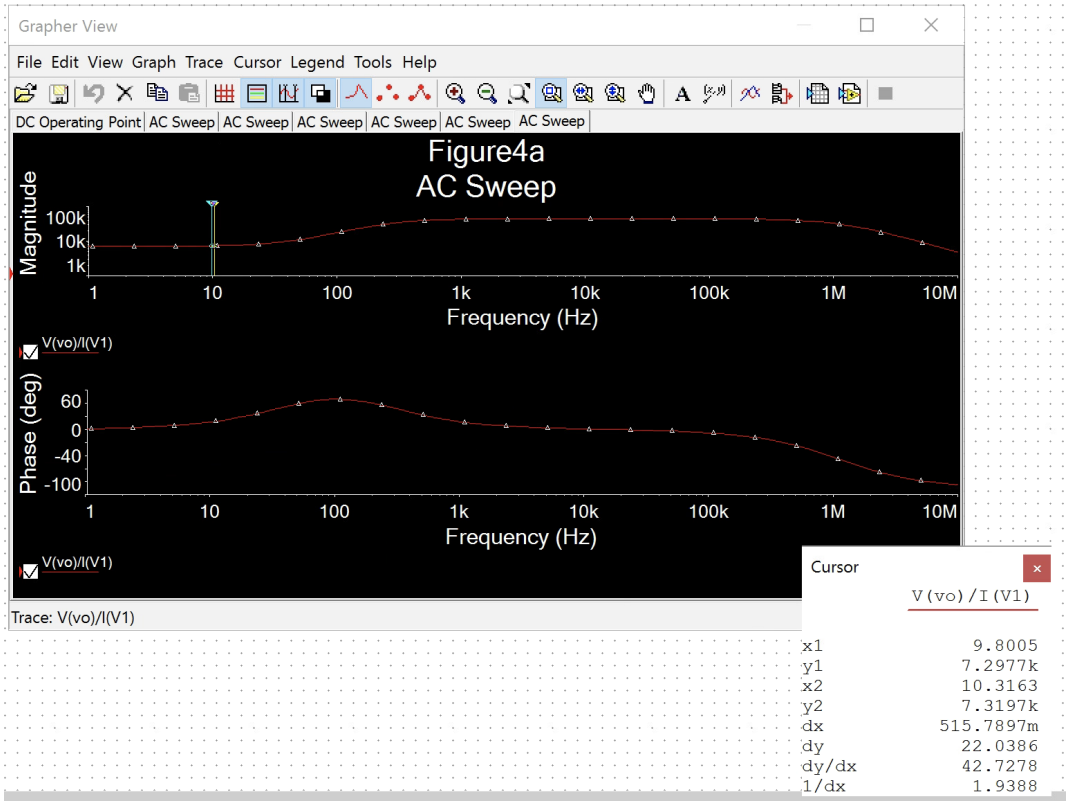
A_v



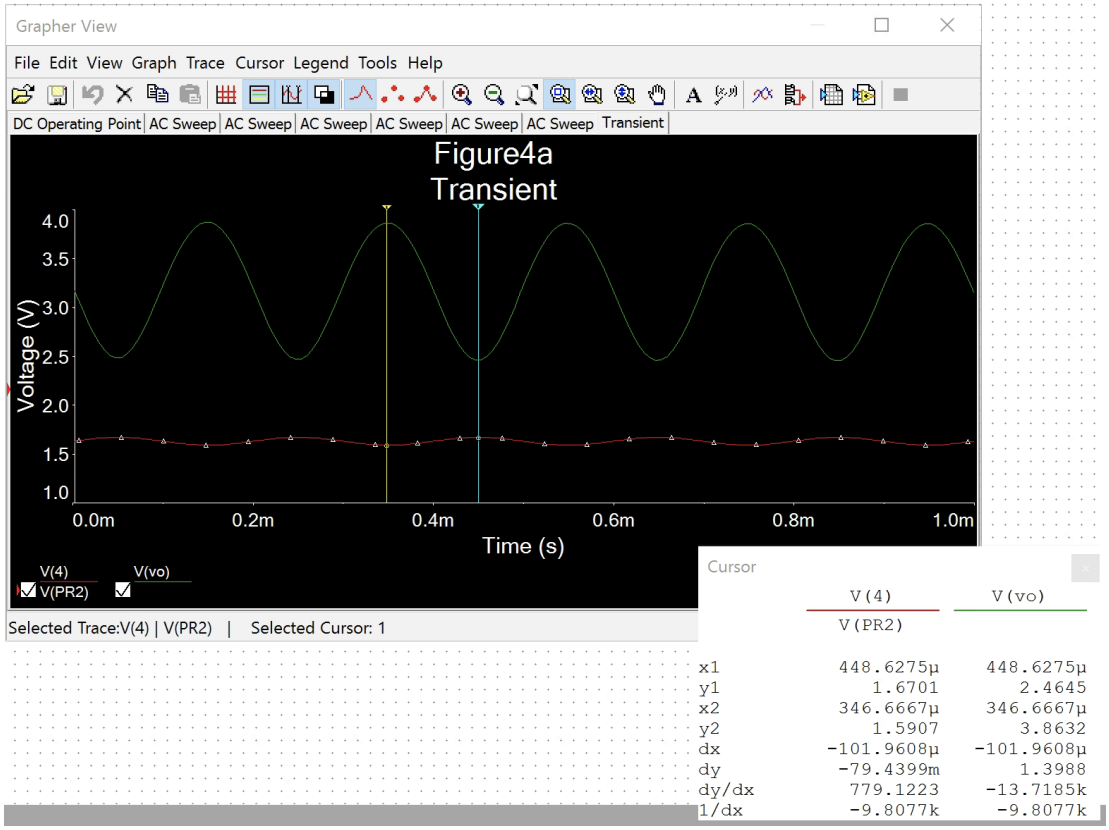
R_i


Grapher View
File Edit View Graph Trace Cursor Legend Tools Help
DC Operating Point | AC Sweep | AC Sweep | AC Sweep | AC Sweep | AC Sweep
Figure4a
AC Sweep
Magnitude
100k
1k
10
1
10
100
1k
10k
100k
1M
10M
Frequency (Hz)
V(vin)/I(C2)
Phase (deg)
20
-100
-180
1
10
100
1k
10k
100k
Frequency (Hz)
V(vin)/I(C2)
Selected Trace:V(vin)/I(C2) | Selected Cursor: 1
Cursor
V(vin)/I(C2)
x1 9.8005
y1 1.8327k
x2 10.3163
y2 1.7280k
dx 515.7897m
dy -104.7000
dy/dx -202.9897
1/dx 1.9388

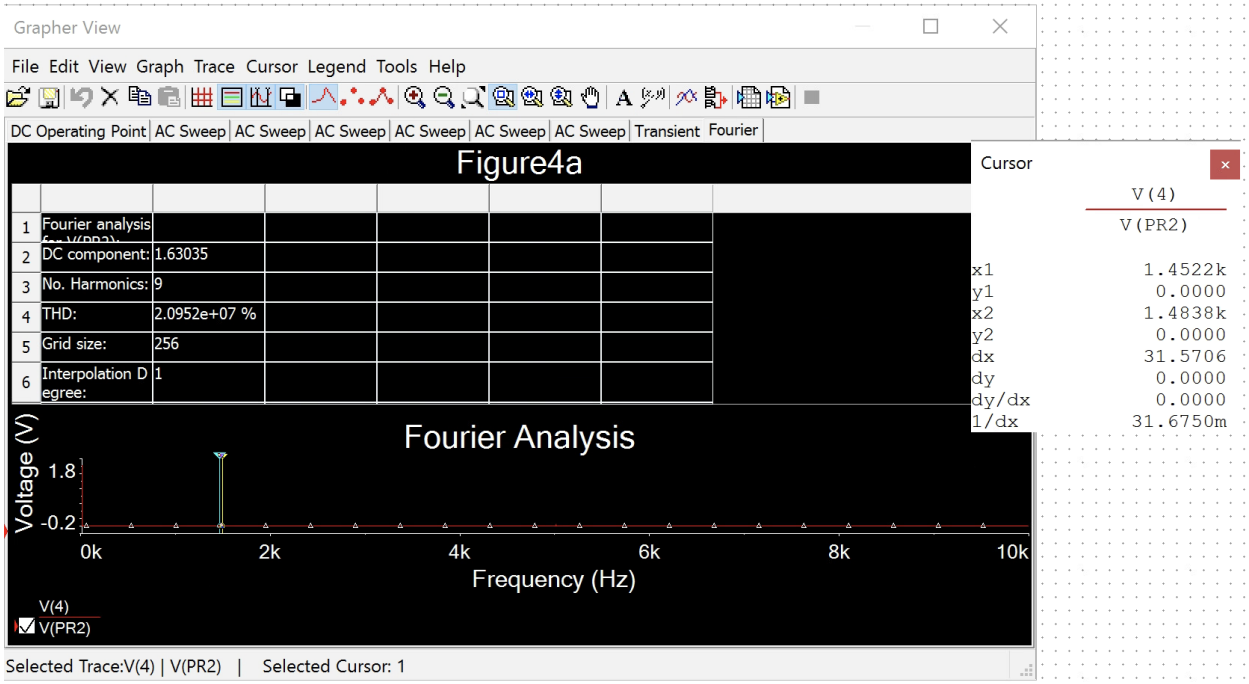
R_o


Grapher View
File Edit View Graph Trace Cursor Legend Tools Help
DC Operating Point | AC Sweep | AC Sweep | AC Sweep | AC Sweep | AC Sweep | AC Sweep
Figure4a
AC Sweep
Magnitude
100k
10k
1k
1
10
100
1k
10k
100k
1M
10M
Frequency (Hz)
V(vo)/I(V1)
Phase (deg)
60
0
-40
-100
1
10
100
1k
10k
100k
1M
10M
Frequency (Hz)
V(vo)/I(V1)
Trace: V(vo)/I(V1)
Cursor
V(vo)/I(V1)
x1 9.8005
y1 7.2977k
x2 10.3163
y2 7.3197k
dx 515.7897m
dy 22.0386
dy/dx 42.7278
1/dx 1.9388

Transient Simulation 4a



Fourier Simulation 4a



Clipping 4a

Clipping at 115mV

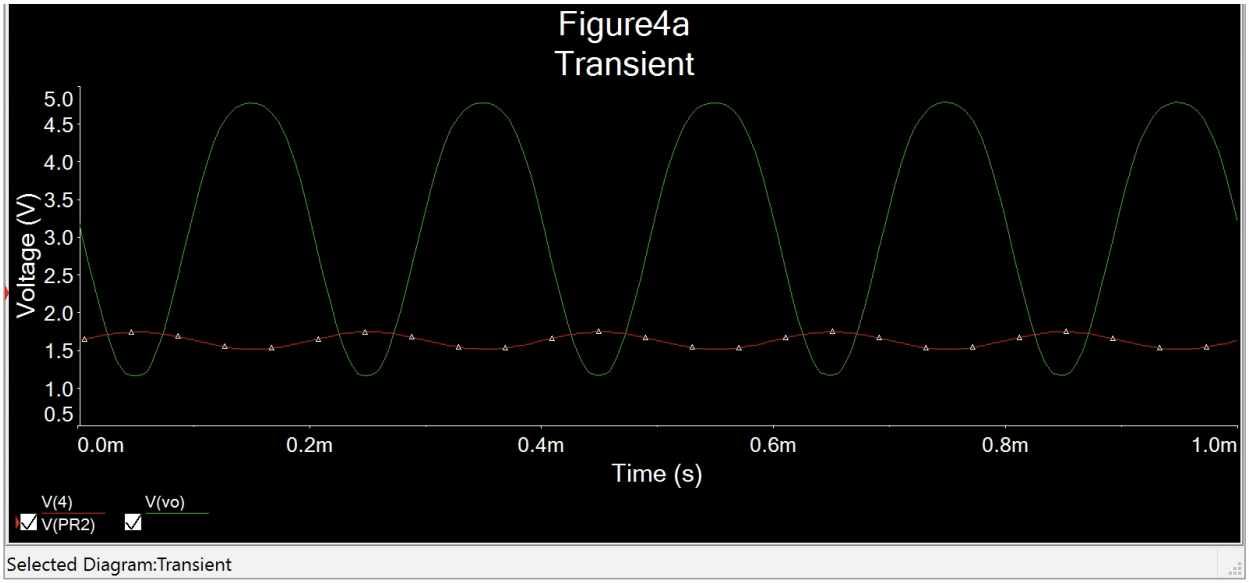
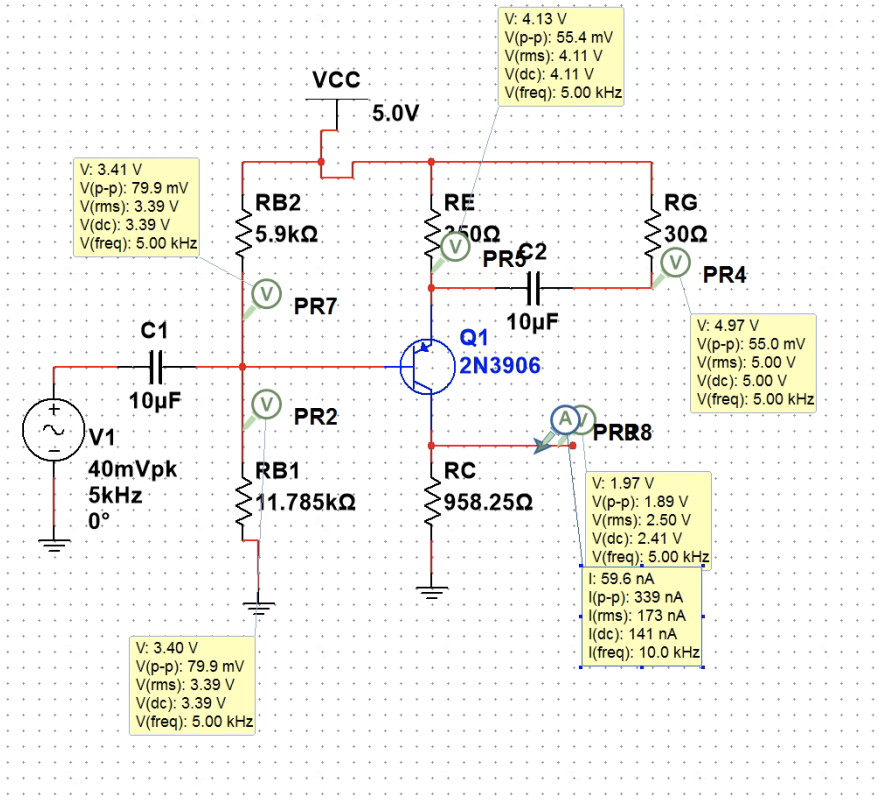


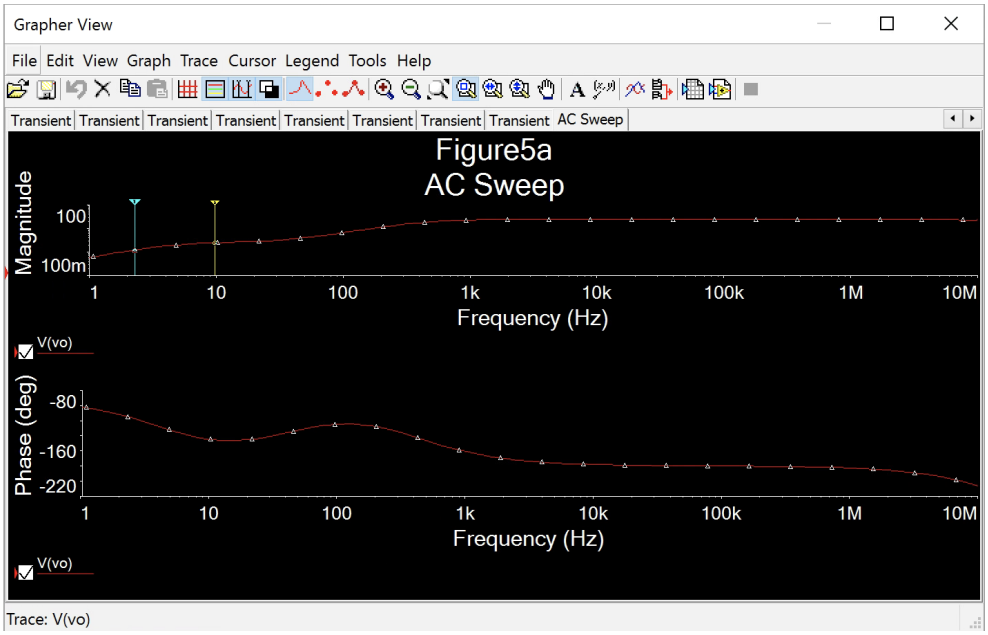
Figure 5a

Schematic/ DC operating point 5a

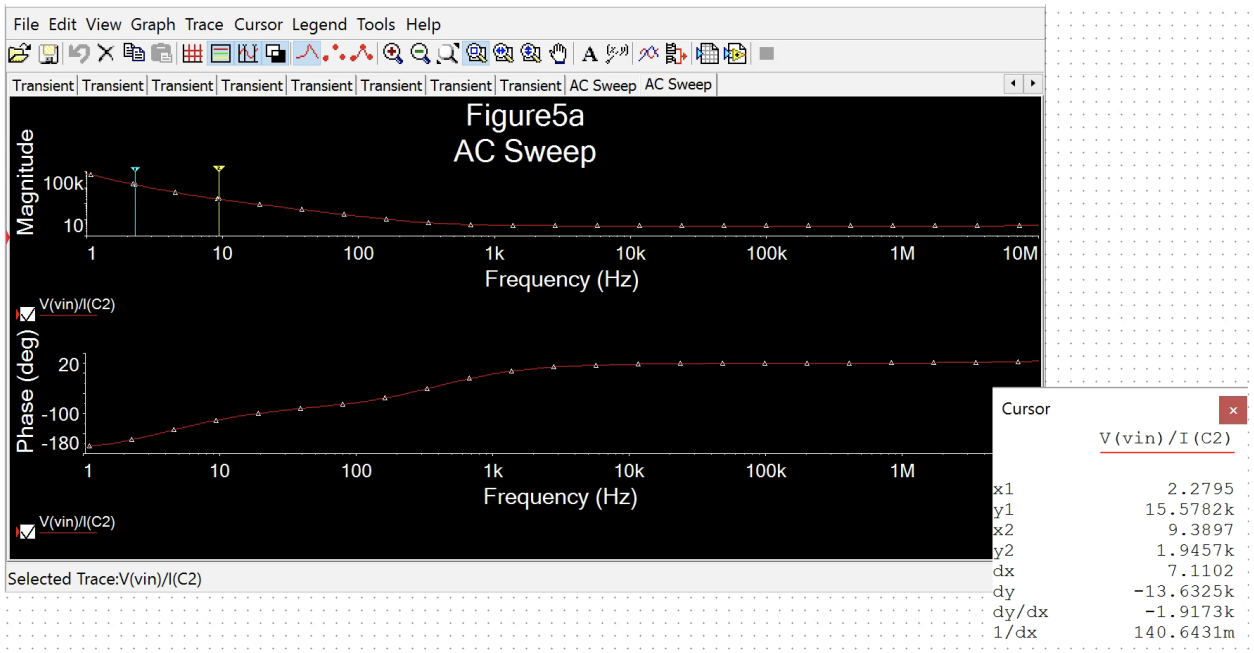


AC simulation 5a

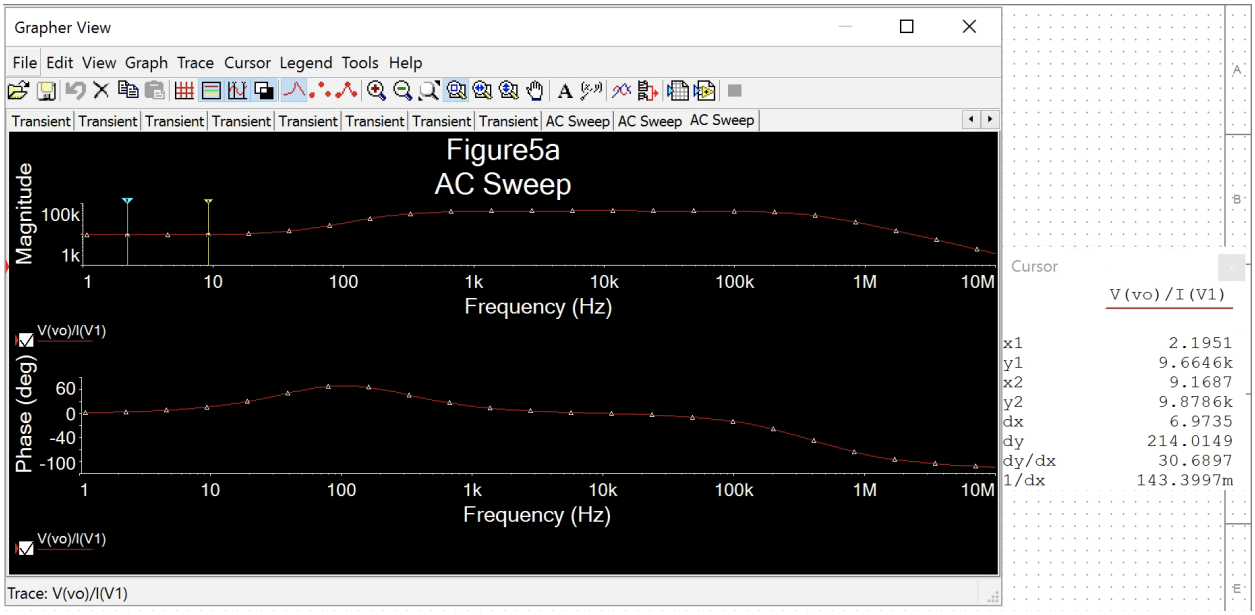
A_V



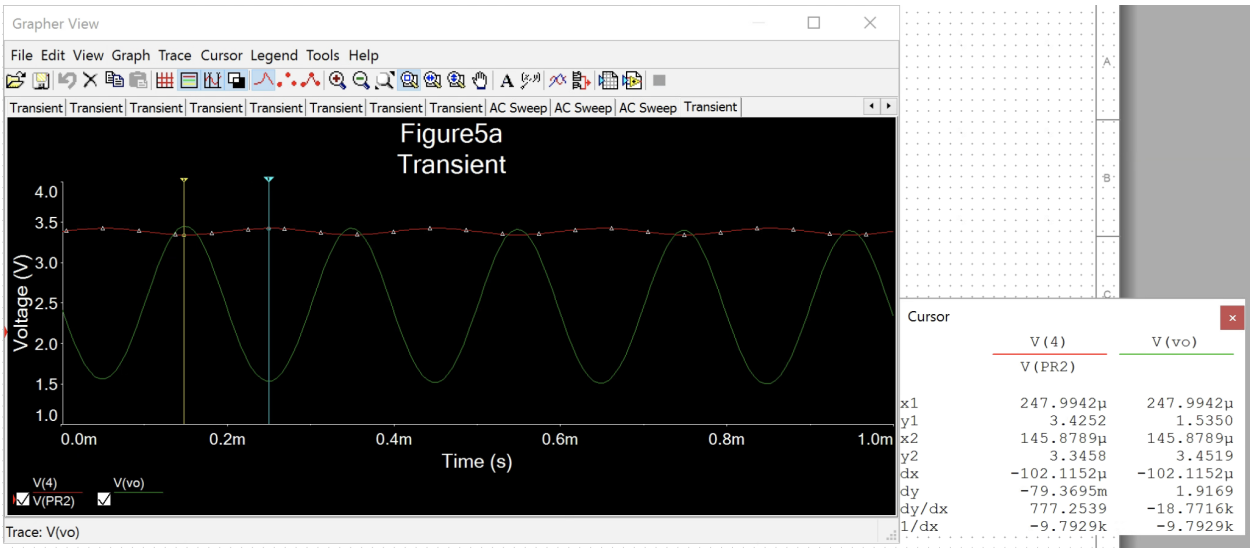
R_i



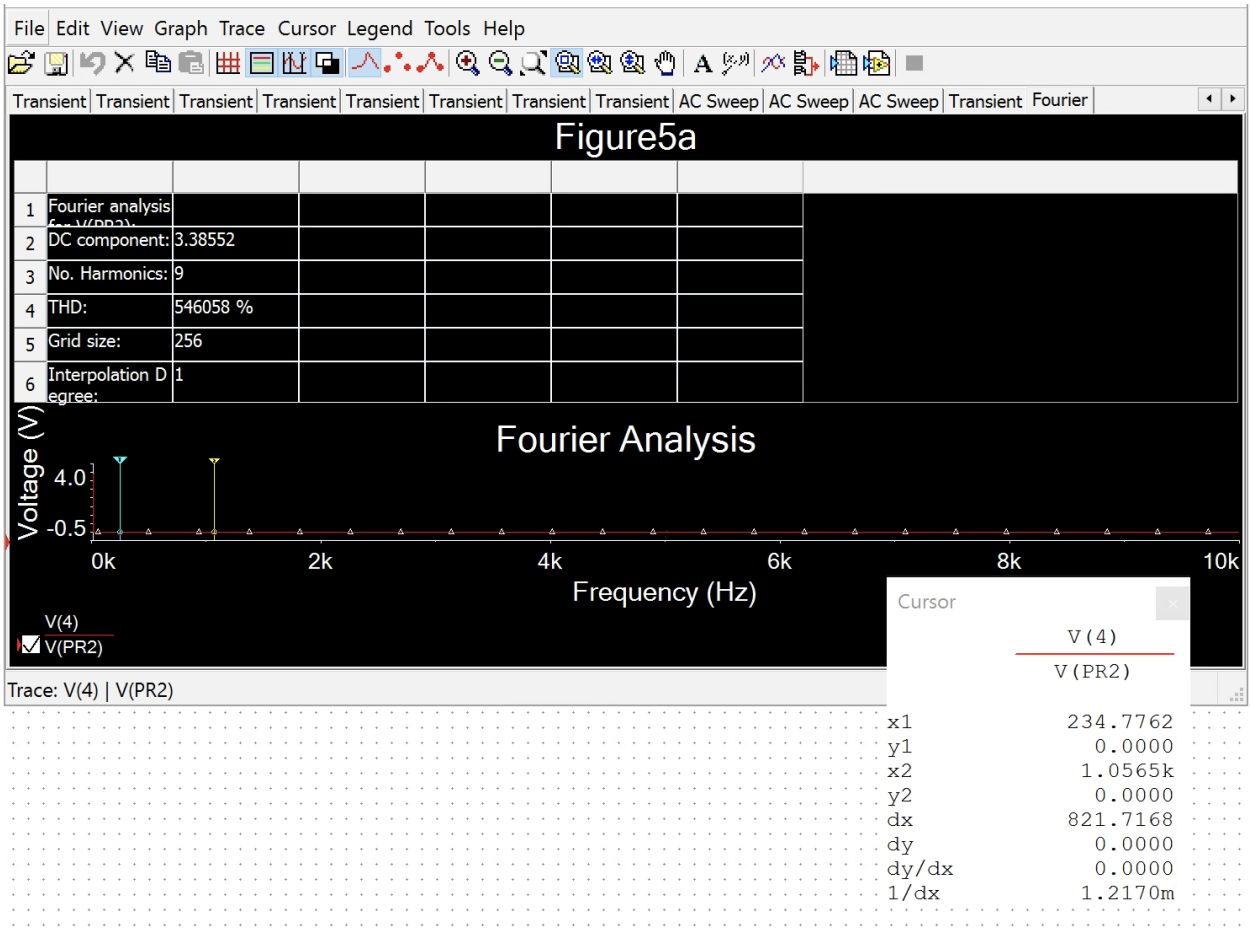
R_o



Transient Simulation 5a



Fourier Simulation 5a



Clipping 5a

Clipping at 65 mV

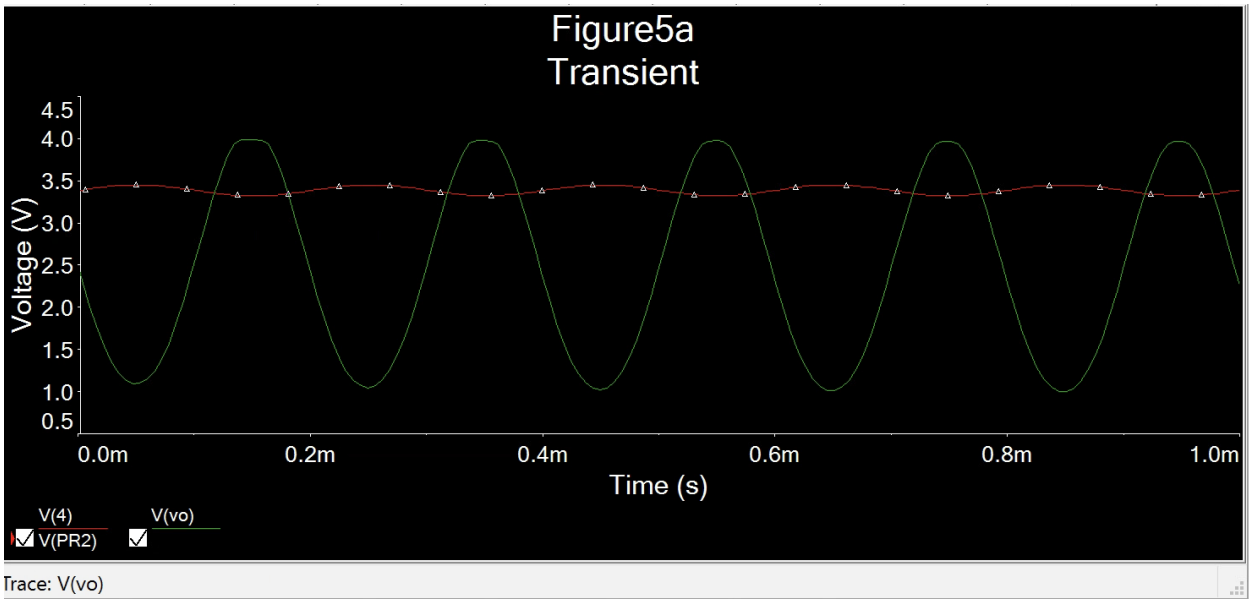
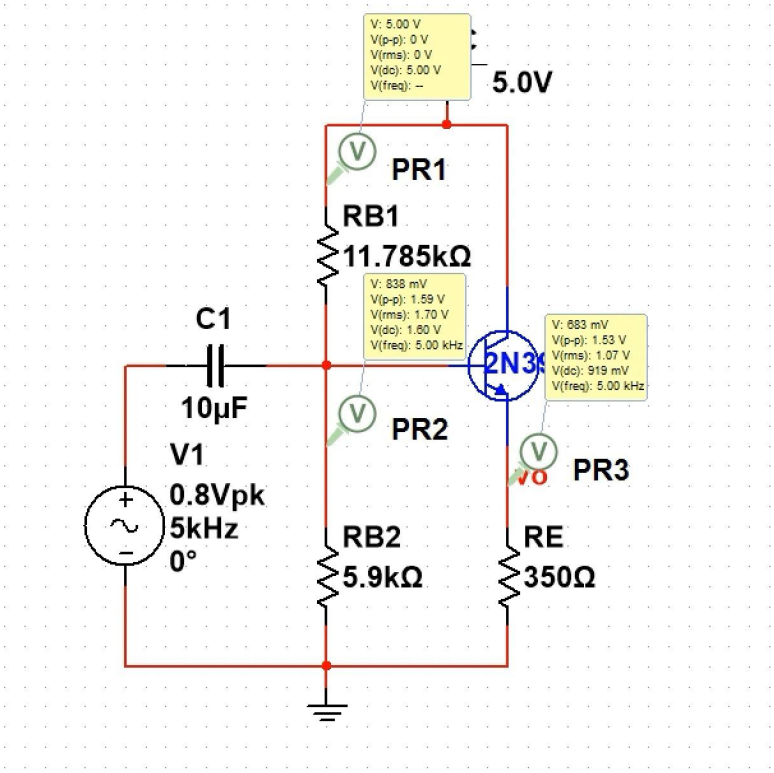


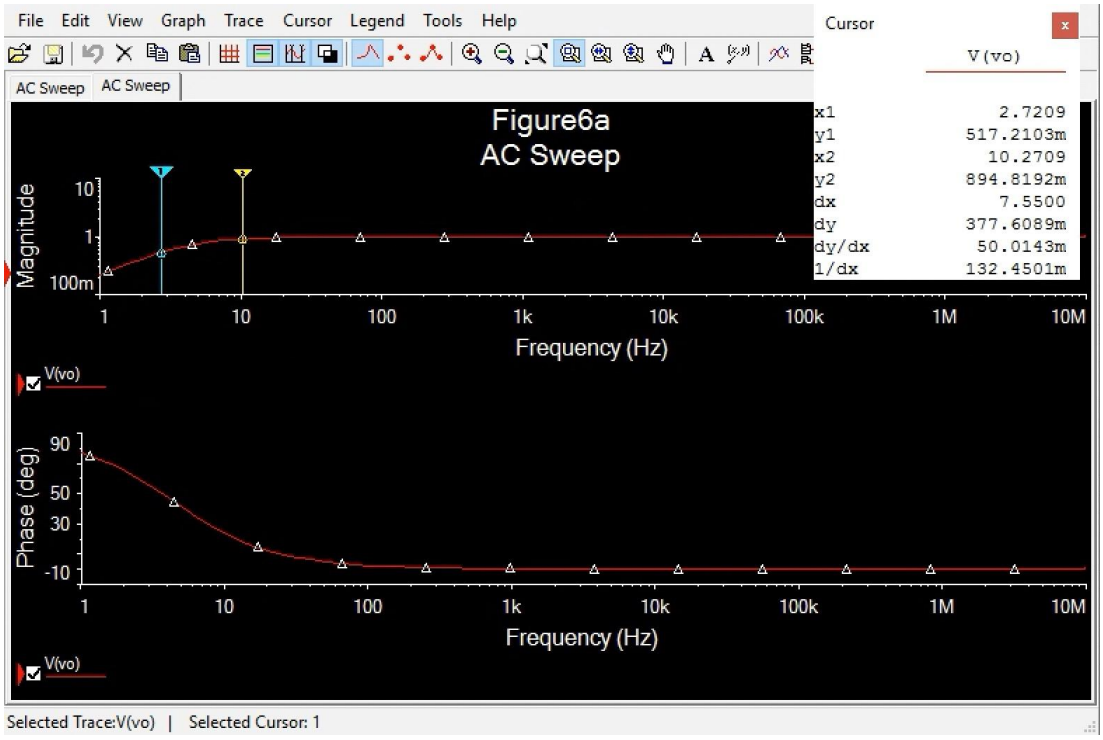
Figure 6a

Schematic/DC operating point 6a

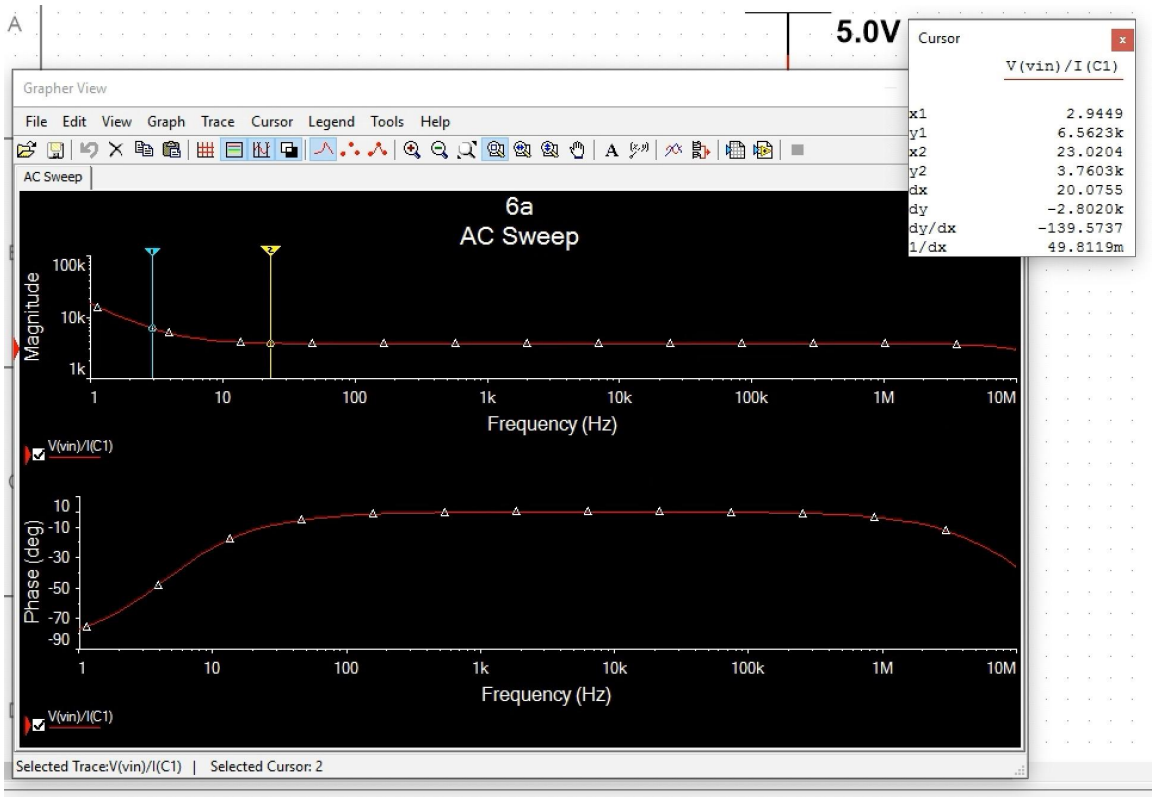


AC simulation 6a

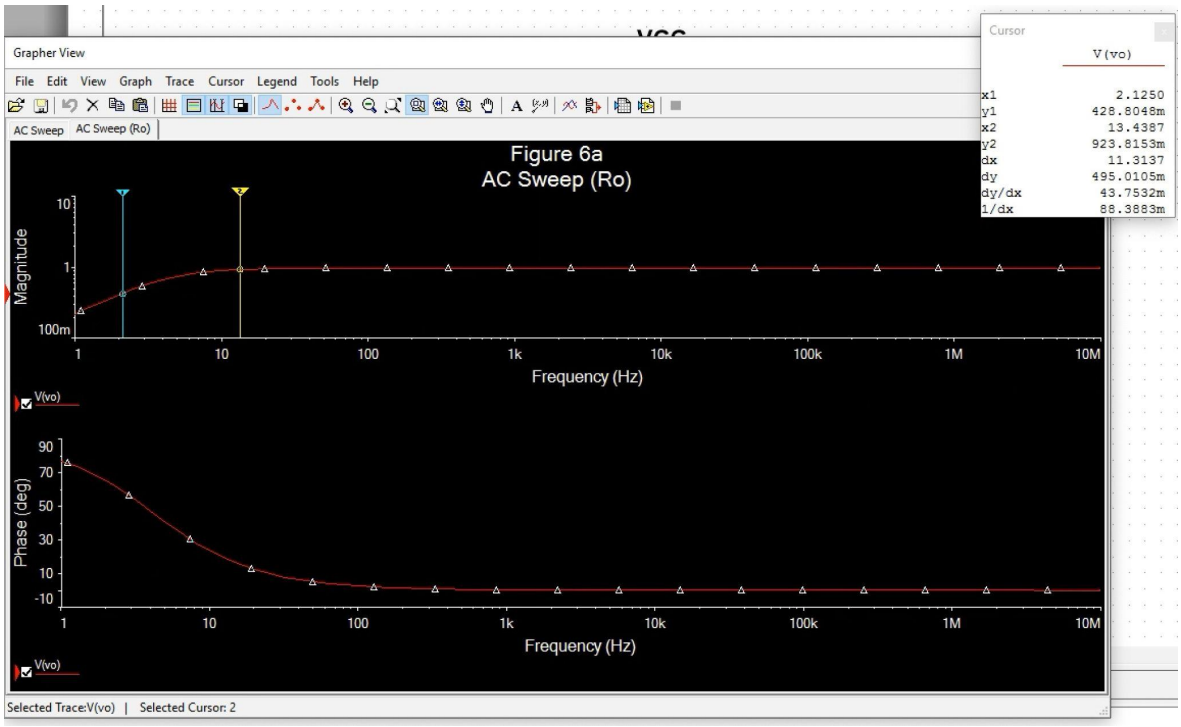
A_v



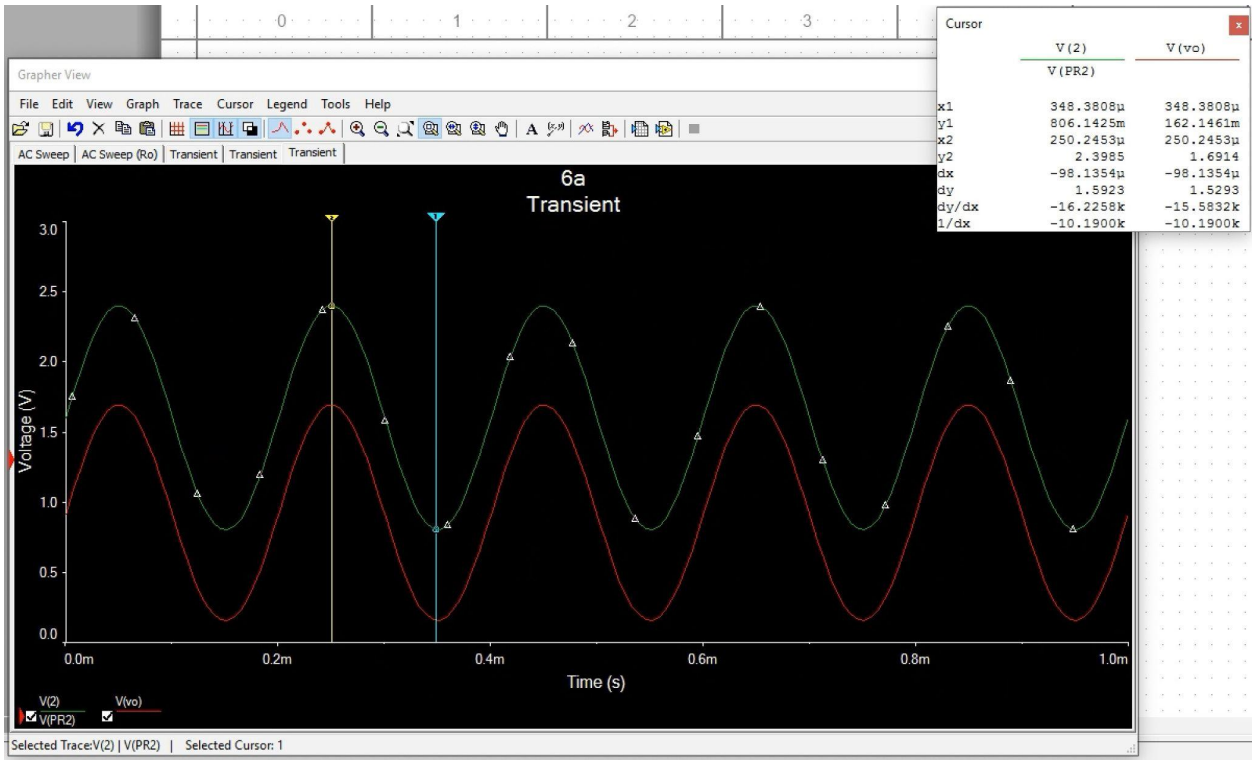
R_i


5.0V
Cursor
V(vin)/I(C1)
x1 2.9449
y1 6.5623k
x2 23.0204
y2 3.7603k
dx 20.0755
dy -2.8020k
dy/dx -139.5737
1/dx 49.8119m
Grapher View
File Edit View Graph Trace Cursor Legend Tools Help
AC Sweep
6a
AC Sweep
Magnitude
100k
10k
1k
1 10 100 1k 10k 100k 1M 10M
Frequency (Hz)
V(vin)/I(C1)
Phase (deg)
10 -10 -30 -50 -70 -90
1 10 100 1k 10k 100k 1M 10M
Frequency (Hz)
V(vin)/I(C1)
Selected Trace:V(vin)/I(C1) | Selected Cursor: 2

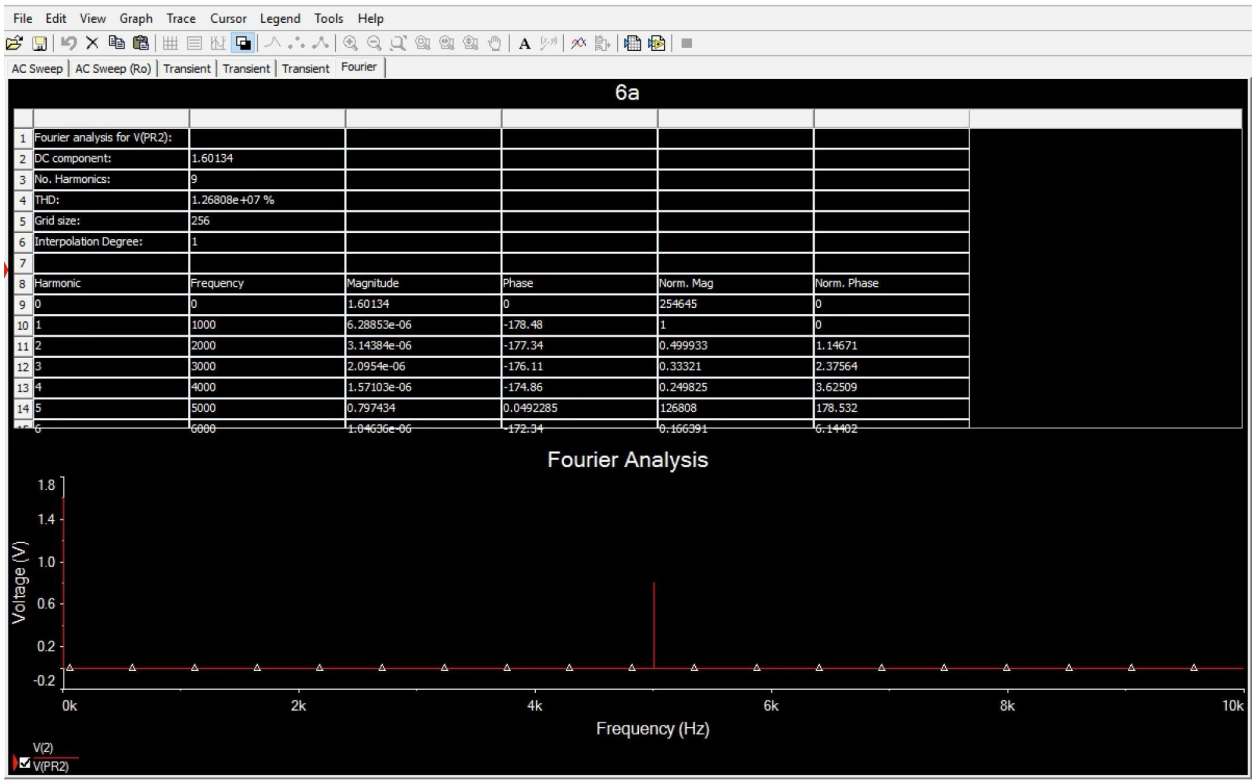
R_o


Cursor
V(vo)
x1 2.1250
y1 428.8048m
x2 13.4387
y2 923.8153m
dx 11.3137
dy 495.0105m
dy/dx 43.7532m
1/dx 88.3883m
Grapher View
File Edit View Graph Trace Cursor Legend Tools Help
AC Sweep AC Sweep (Ro)
Figure 6a
AC Sweep (Ro)
Magnitude
10
1
100m
1 10 100 1k 10k 100k 1M 10M
Frequency (Hz)
V(vo)
Phase (deg)
90 70 50 30 10 -10
1 10 100 1k 10k 100k 1M 10M
Frequency (Hz)
V(vo)
Selected Trace:V(vo) | Selected Cursor: 2

Transient Simulation 6a



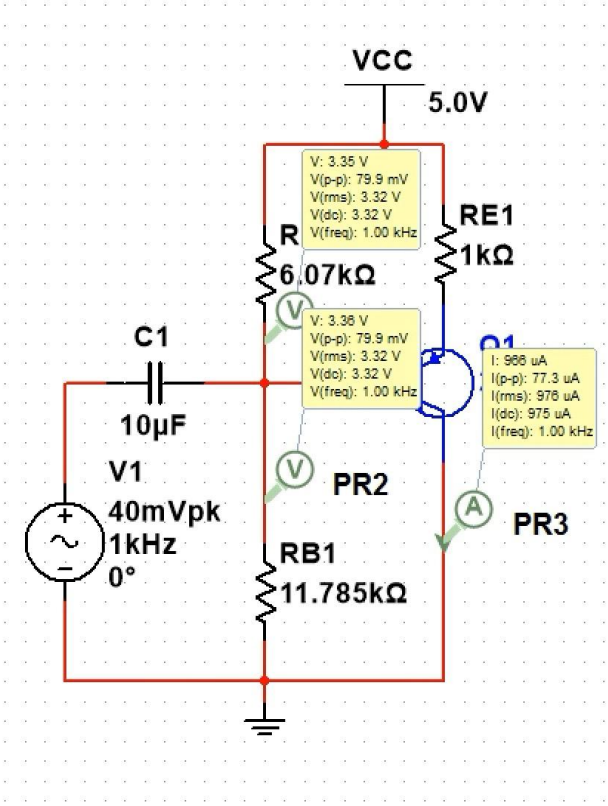
Fourier Simulation 6a



1	Fourier analysis for V(PR2):					
2	DC component:	1.60134				
3	No. Harmonics:	9				
4	THD:	1.26808e+07 %				
5	Grid size:	256				
6	Interpolation Degree:	1				
7						
8	Harmonic	Frequency	Magnitude	Phase	Norm. Mag	Norm. Phase
9	0	0	1.60134	0	254645	0
10	1	1000	6.28853e-06	-178.48	1	0
11	2	2000	3.14384e-06	-177.34	0.499933	1.14671
12	3	3000	2.0954e-06	-176.11	0.33321	2.37564
13	4	4000	1.57103e-06	-174.86	0.249825	3.62509
14	5	5000	0.797434	0.0492285	126808	178.532
15	6	6000	1.04636e-06	-172.34	0.166391	6.14402

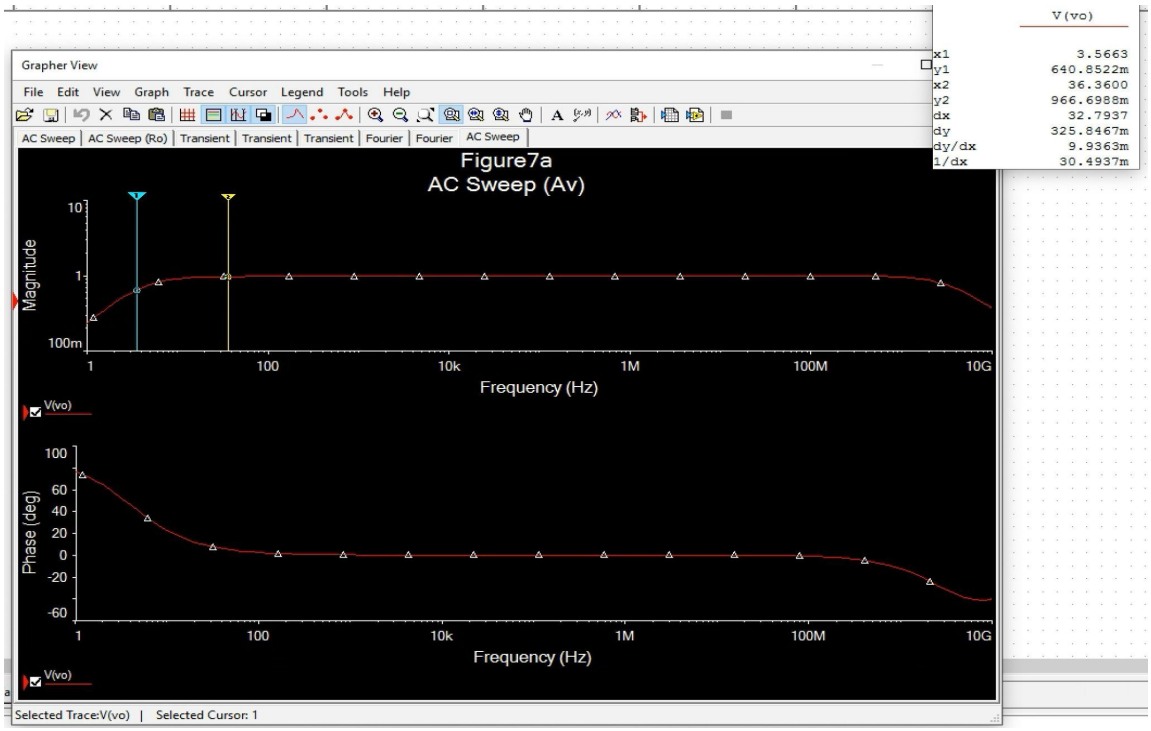
Figure 7a

Schematic/ DC operating point 7a

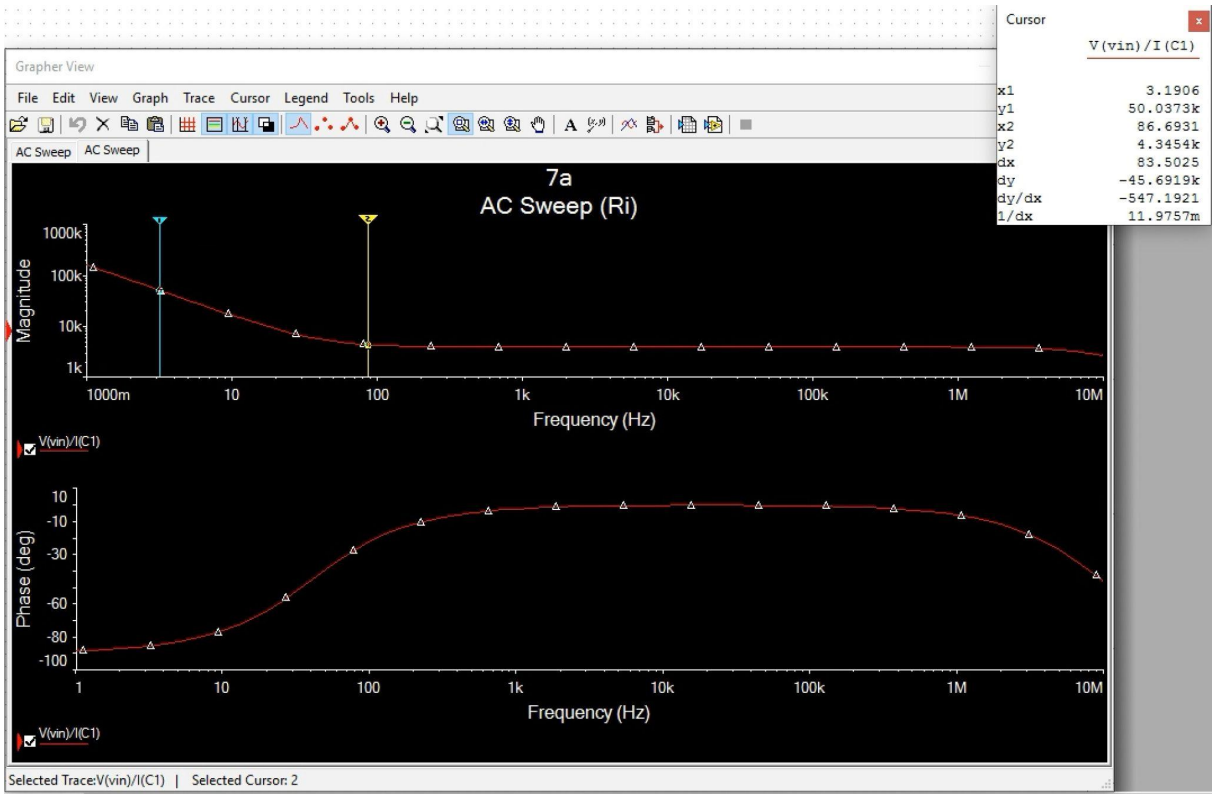


AC simulation 7a

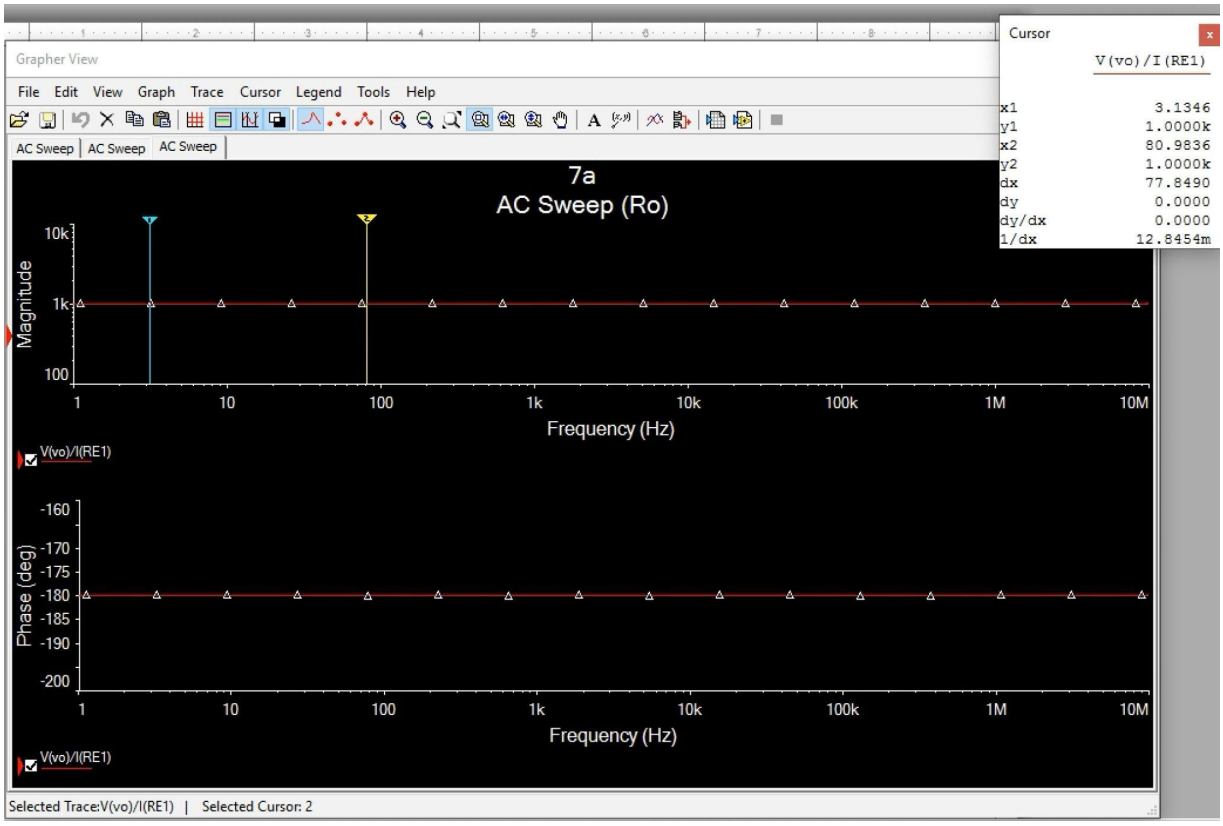
A_V



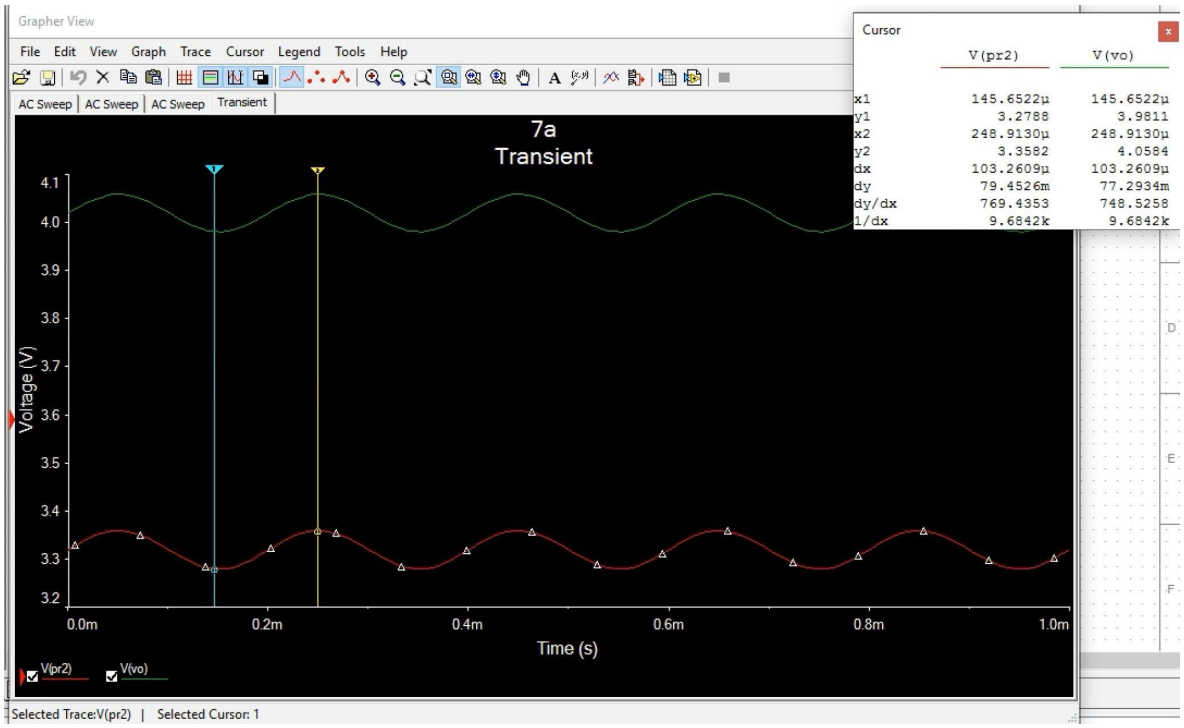
R_i


Grapher View
File Edit View Graph Trace Cursor Legend Tools Help
AC Sweep AC Sweep
7a
AC Sweep (Ri)
Magnitude
1000k
100k
10k
1k
1000m
10
100
1k
10k
100k
1M
10M
Frequency (Hz)
V(vin)/I(C1)
Phase (deg)
10
-10
-30
-60
-80
-100
Frequency (Hz)
V(vin)/I(C1)
Selected Trace:V(vin)/I(C1) | Selected Cursor: 2
Cursor
V(vin)/I(C1)
x1 3.1906
y1 50.0373k
x2 86.6931
y2 4.3454k
dx 83.5025
dy -45.6919k
dy/dx -547.1921
1/dx 11.9757m

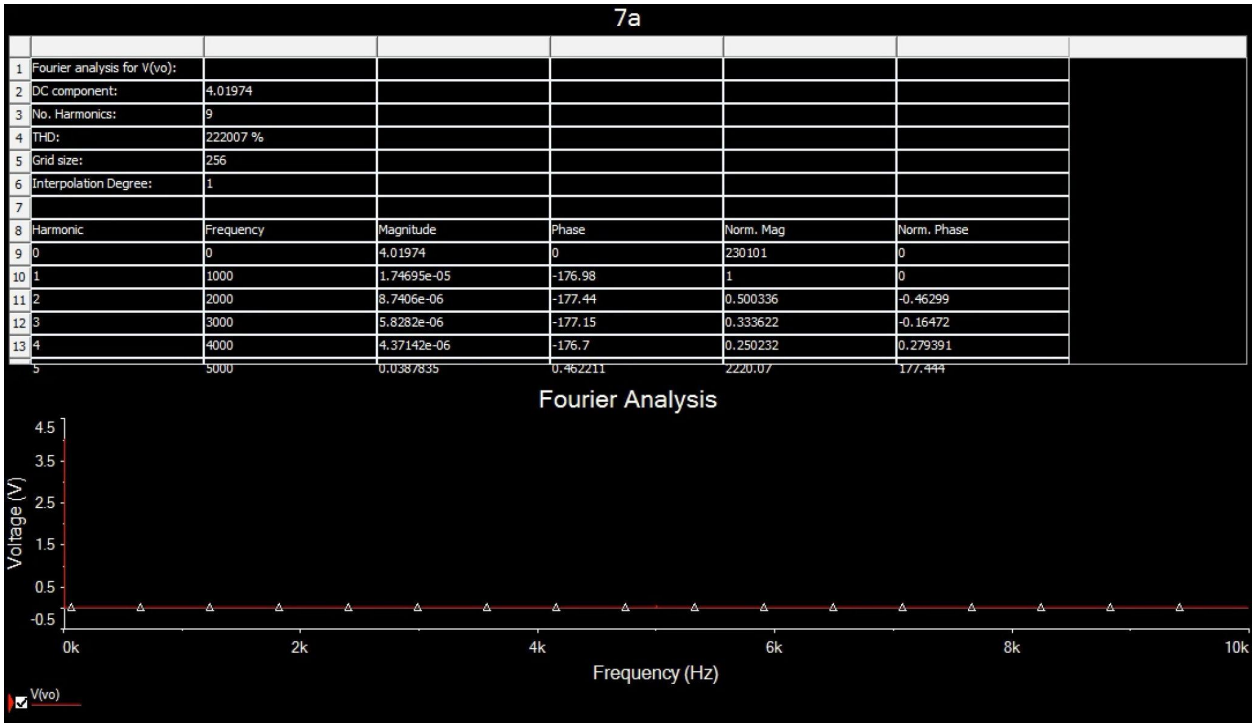
R_o


Grapher View
File Edit View Graph Trace Cursor Legend Tools Help
AC Sweep AC Sweep AC Sweep
7a
AC Sweep (Ro)
Magnitude
10k
1k
100
1
10
100
1k
10k
100k
1M
10M
Frequency (Hz)
V(vo)/I(RE1)
Phase (deg)
-160
-170
-175
-180
-185
-190
-200
Frequency (Hz)
V(vo)/I(RE1)
Selected Trace:V(vo)/I(RE1) | Selected Cursor: 2
Cursor
V(vo)/I(RE1)
x1 3.1346
y1 1.0000k
x2 80.9836
y2 1.0000k
dx 77.8490
dy 0.0000
dy/dx 0.0000
1/dx 12.8454m

Transient Simulation 7a



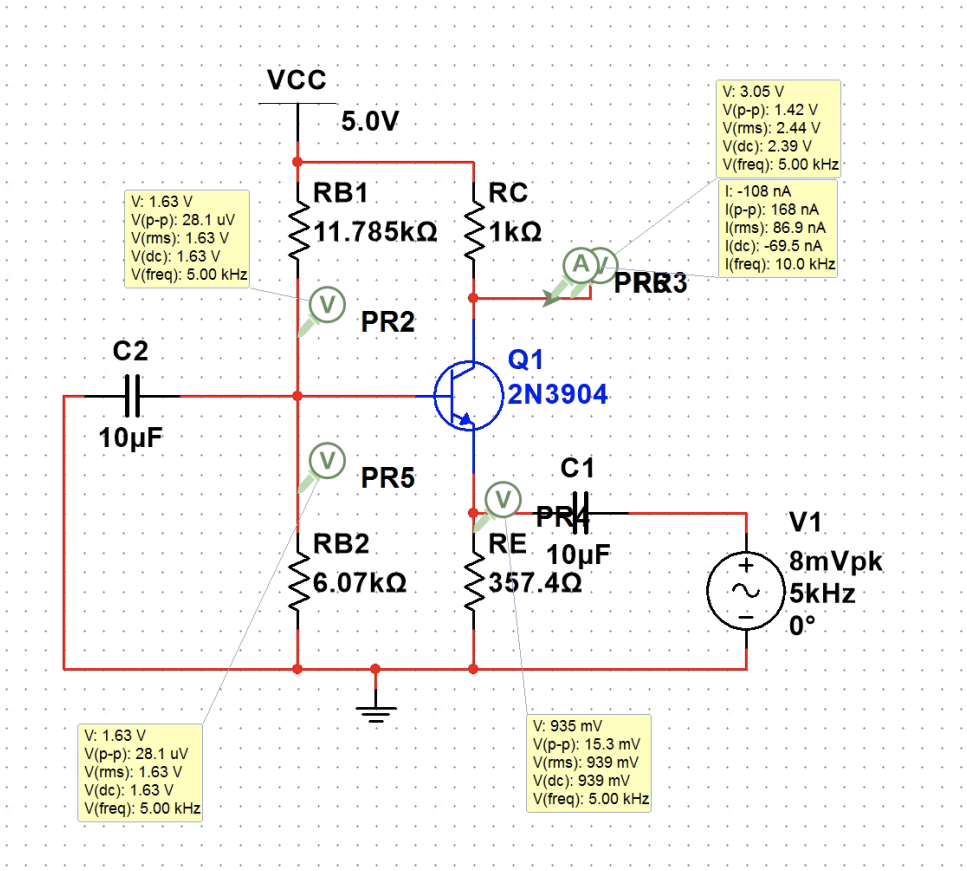
Fourier Simulation 7a



1	Fourier analysis for V(vo):					
2	DC component:	4.01974				
3	No. Harmonics:	9				
4	THD:	222007 %				
5	Grid size:	256				
6	Interpolation Degree:	1				
7						
8	Harmonic	Frequency	Magnitude	Phase	Norm. Mag	Norm. Phase
9	0	0	4.01974	0	230101	0
10	1	1000	1.74695e-05	-176.98	1	0
11	2	2000	8.7406e-06	-177.44	0.500336	-0.46299
12	3	3000	5.8282e-06	-177.15	0.333622	-0.16472
13	4	4000	4.37142e-06	-176.7	0.250232	0.279391
	5	5000	0.0387835	0.462211	2220.07	177.444

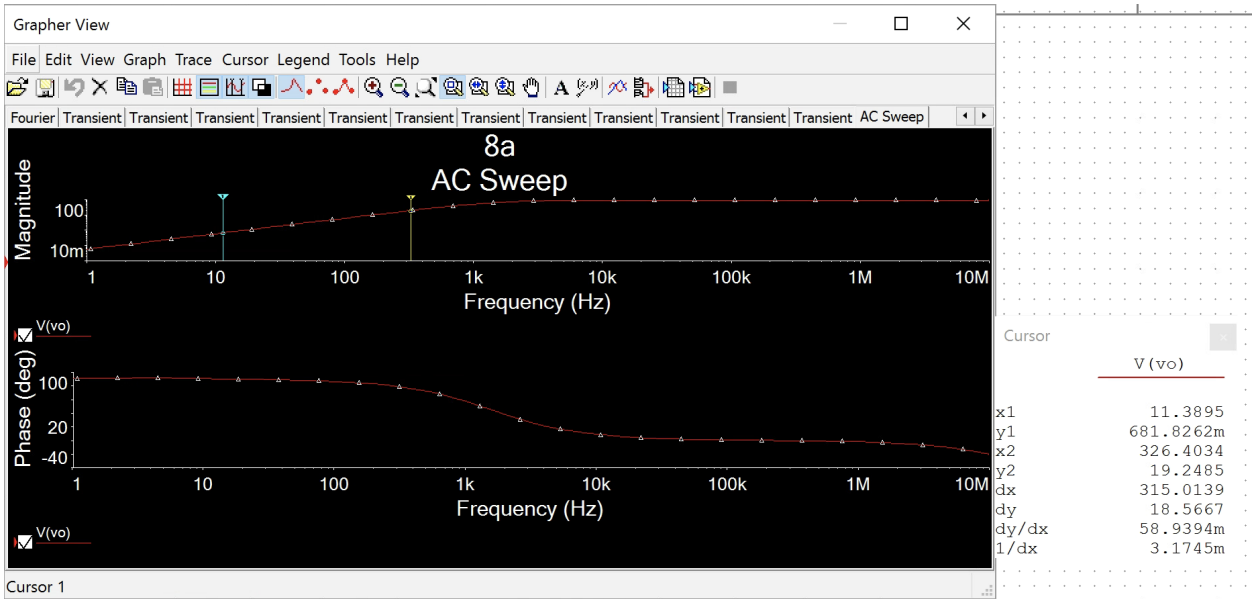
Figure 8a

Schematic/ DC operating point 8a

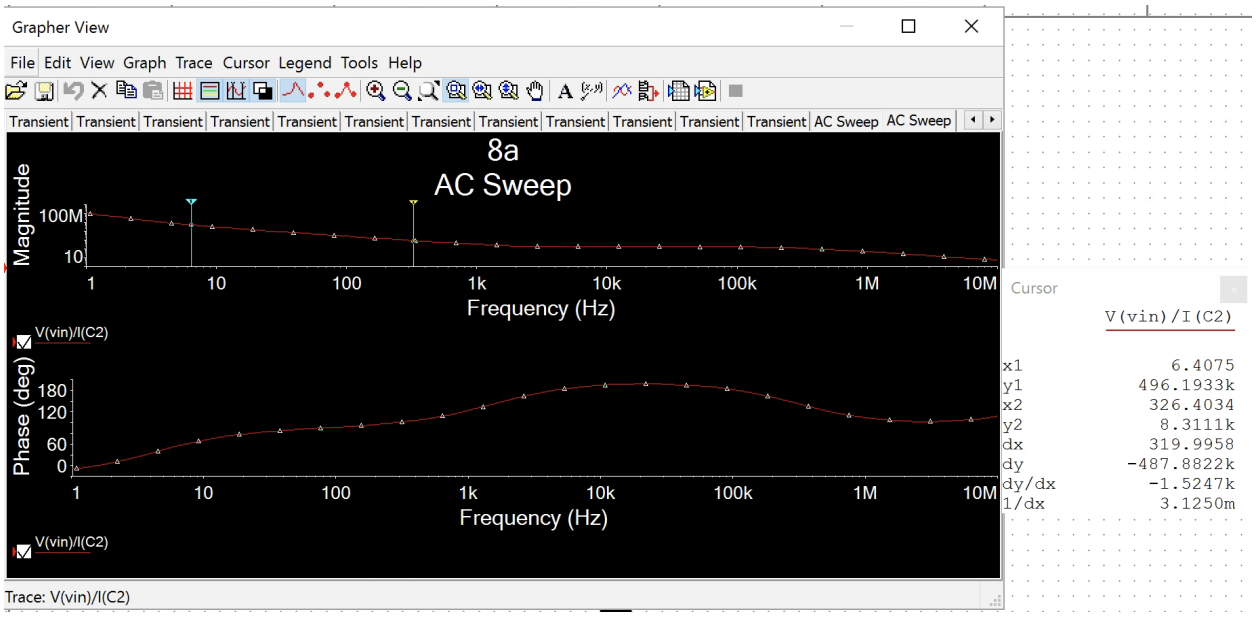


AC simulation 8a

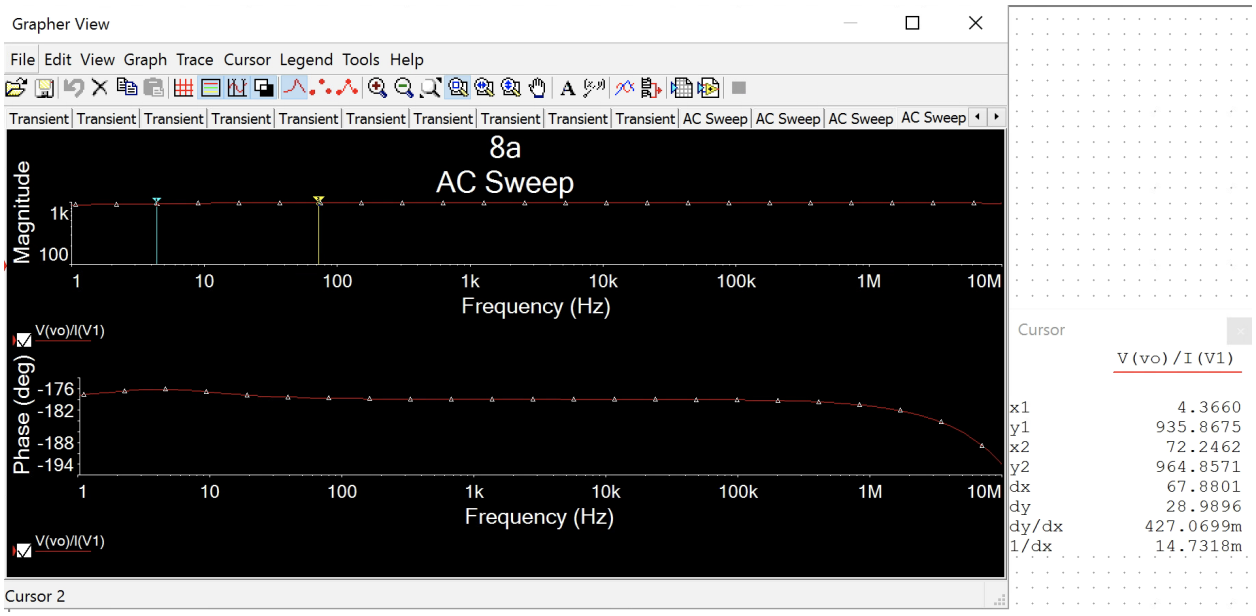
A_V



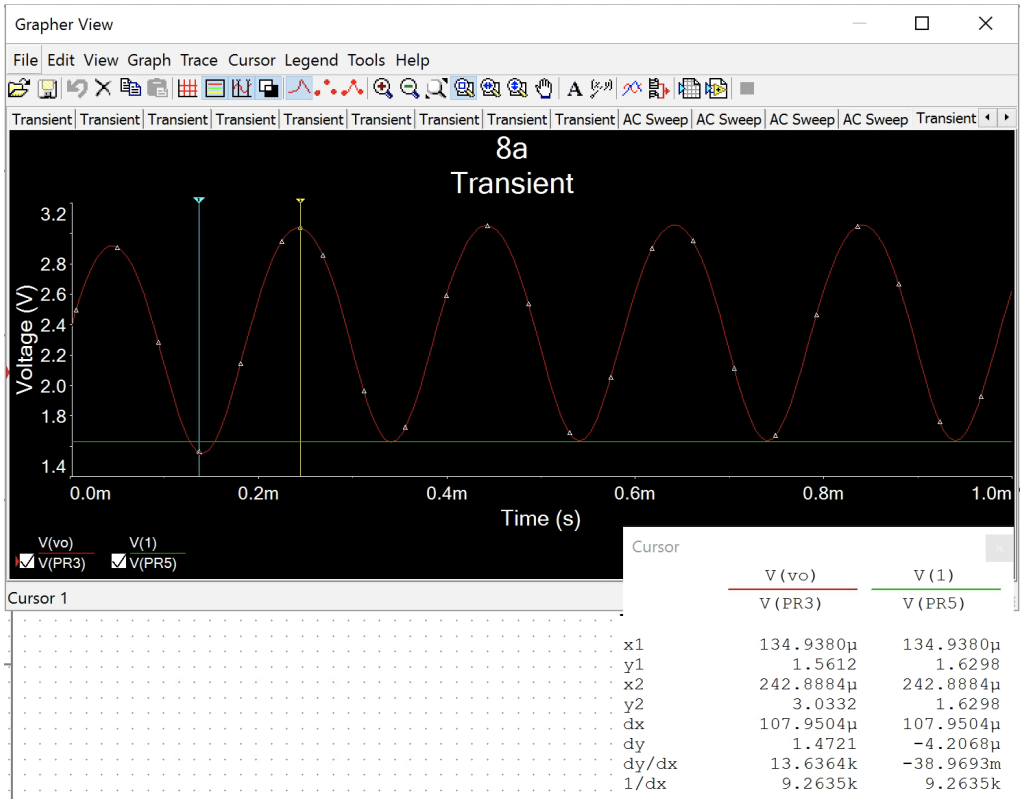
R_i


Grapher View
File Edit View Graph Trace Cursor Legend Tools Help
8a
AC Sweep
Magnitude
100M
10
1
10
100
1k
10k
100k
1M
10M
Frequency (Hz)
V(vin)/I(C2)
Phase (deg)
180
120
60
0
Frequency (Hz)
V(vin)/I(C2)
Trace: V(vin)/I(C2)
Cursor
V(vin)/I(C2)
x1 6.4075
y1 496.1933k
x2 326.4034
y2 8.3111k
dx 319.9958
dy -487.8822k
dy/dx -1.5247k
1/dx 3.1250m

R_o


Grapher View
File Edit View Graph Trace Cursor Legend Tools Help
8a
AC Sweep
Magnitude
1k
100
1
10
100
1k
10k
100k
1M
10M
Frequency (Hz)
V(vo)/I(V1)
Phase (deg)
-176
-182
-188
-194
Frequency (Hz)
V(vo)/I(V1)
Cursor 2
Cursor
V(vo)/I(V1)
x1 4.3660
y1 935.8675
x2 72.2462
y2 964.8571
dx 67.8801
dy 28.9896
dy/dx 427.0699m
1/dx 14.7318m

Transient Simulation 8a



Fourier Simulation 8a

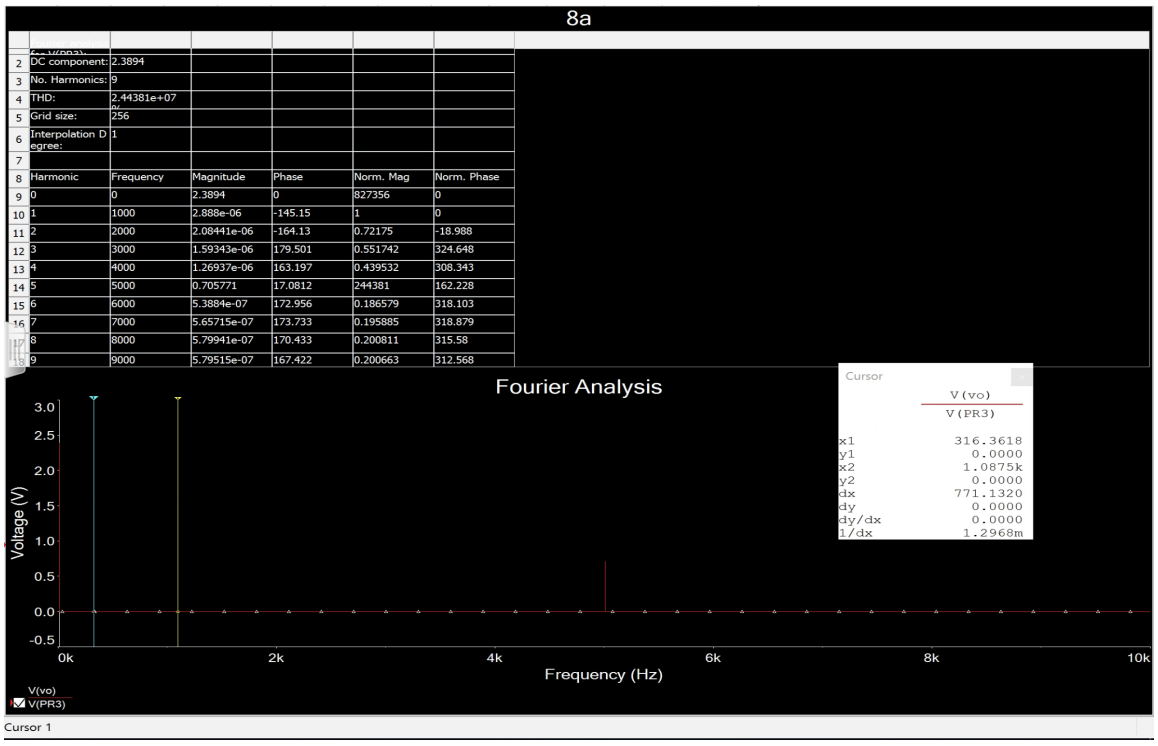
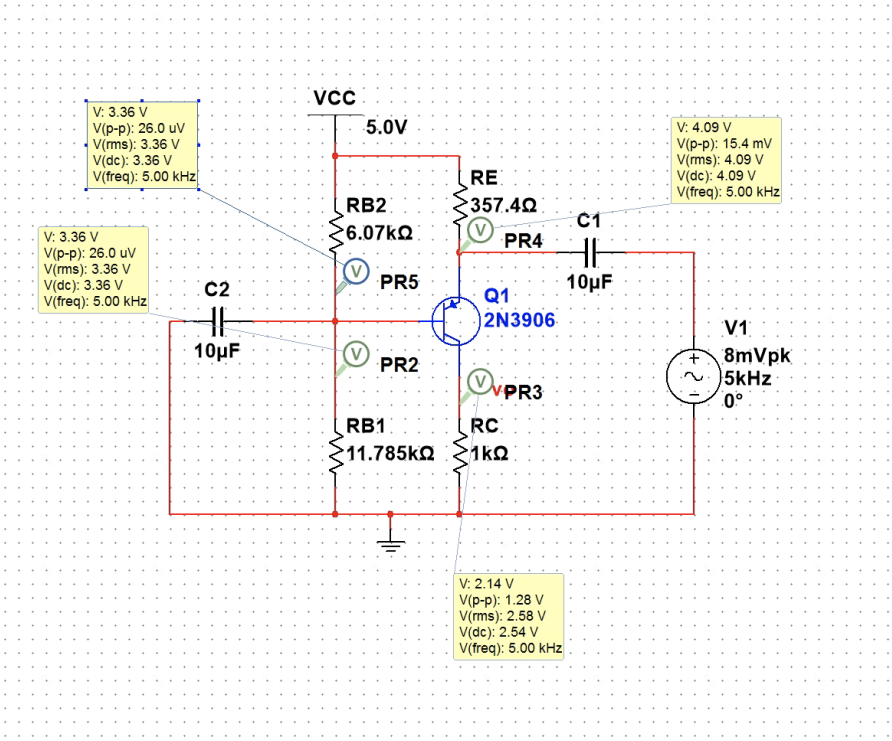


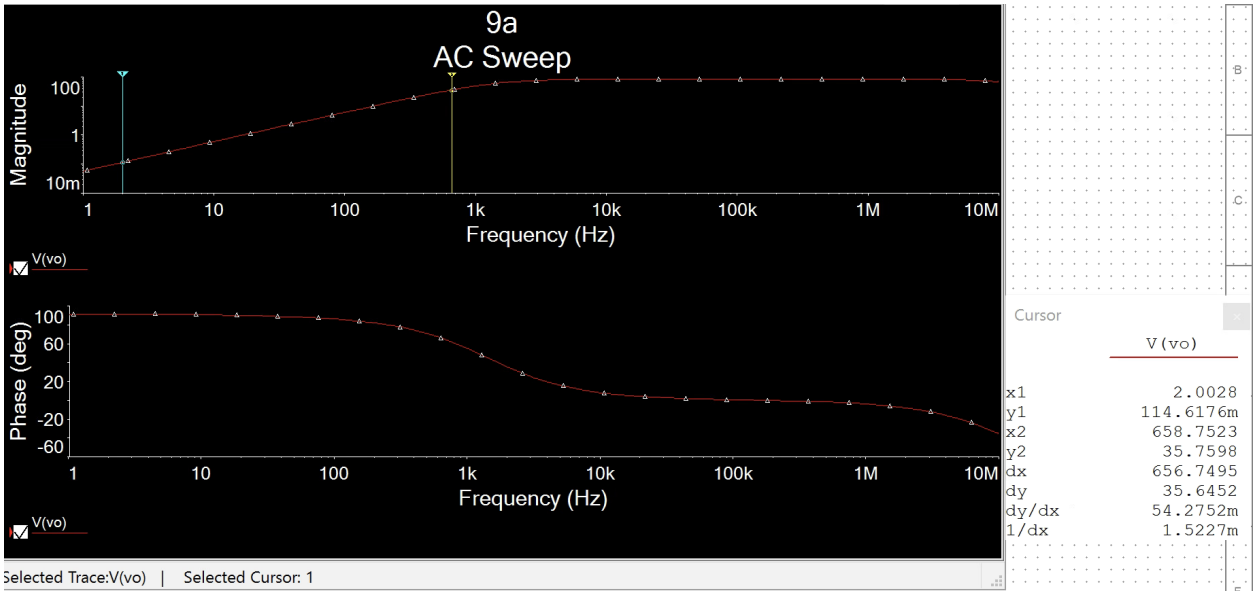
Figure 9a

Schematic/ DC operating point 9a

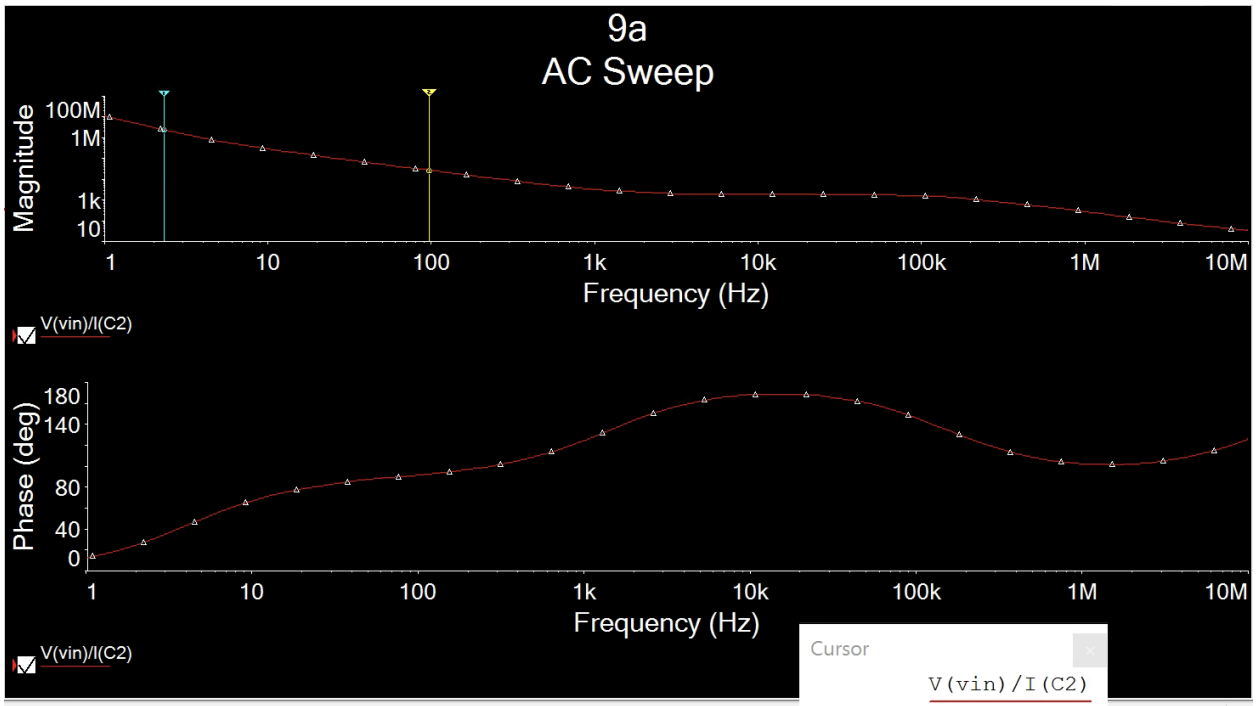


AC simulation 9a

A_V



R_i



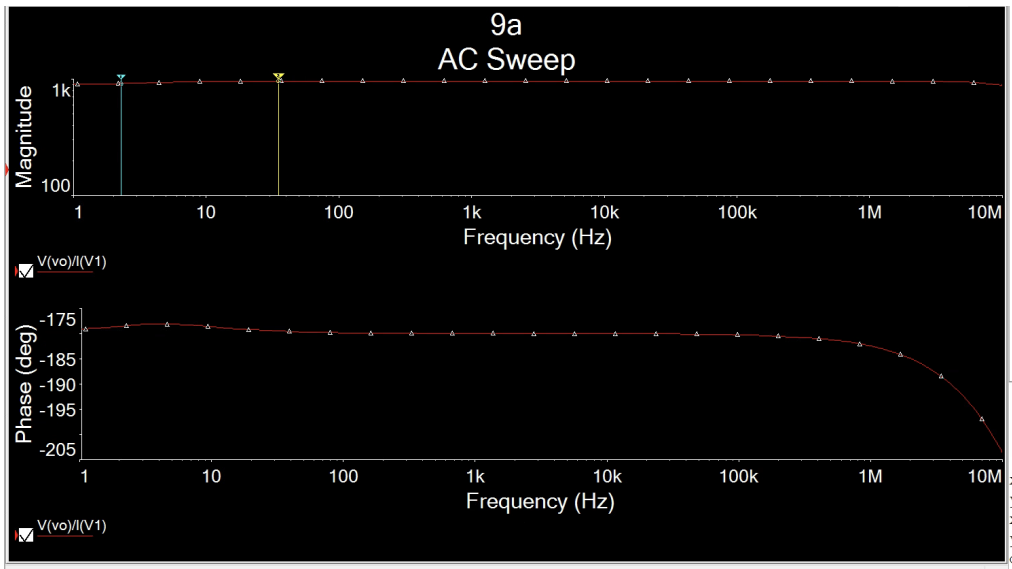
Cursor

V(vin)/I(C2)

Cursor 2

x1	2.3123
y1	2.3633M
x2	96.9677
y2	27.0593k
dx	94.6554
dy	-2.3362M
dy/dx	-24.6815k
1/dx	10.5646m

R_o



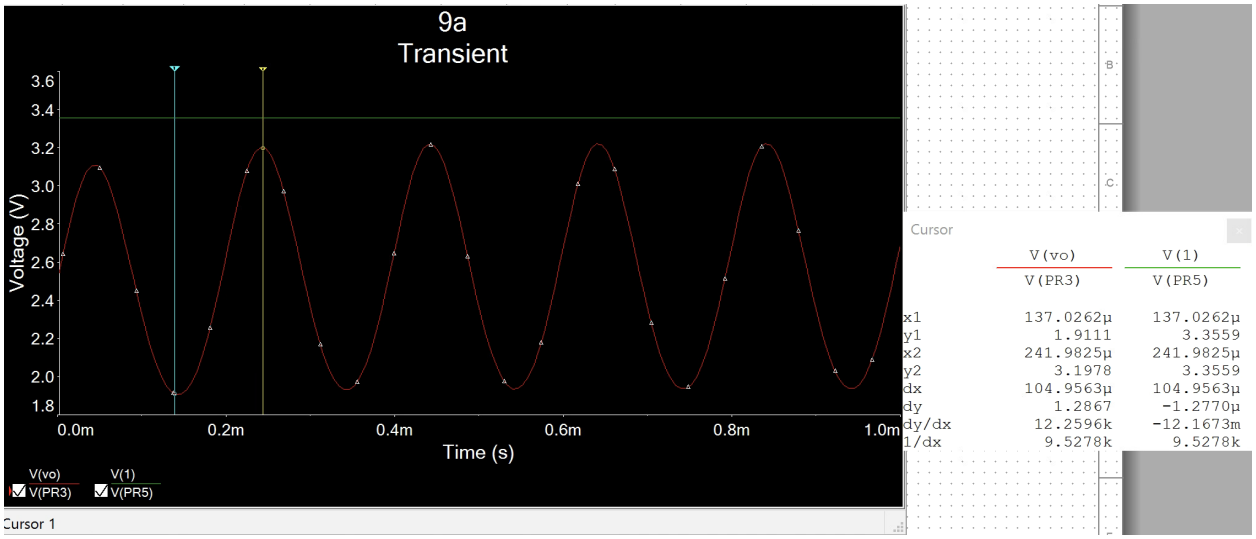
Cursor

V(vo)/I(V1)

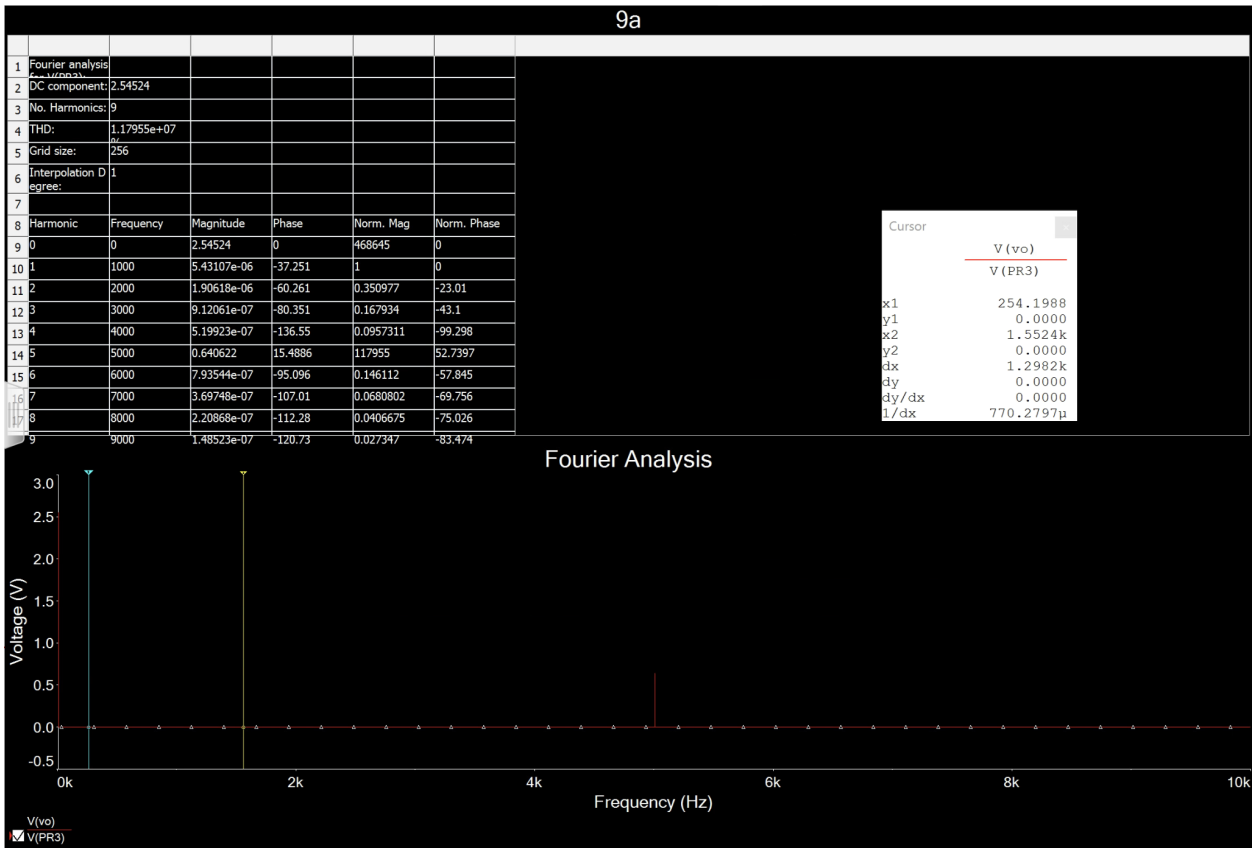
Trace: V(vo)/I(V1)

x1	2.2813
y1	914.5796
x2	35.1012
y2	960.9697
dx	32.8198
dy	46.3901
dy/dx	1.4135
1/dx	30.4694m

Transient Simulation 9a



Fourier Simulation 9a

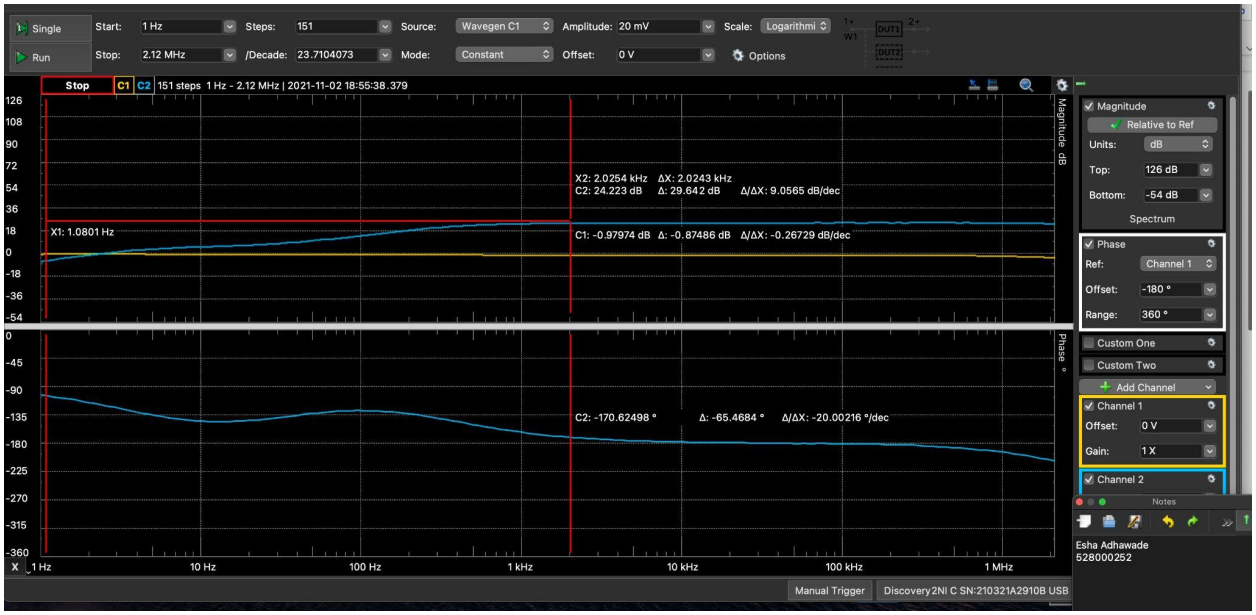


Measurements

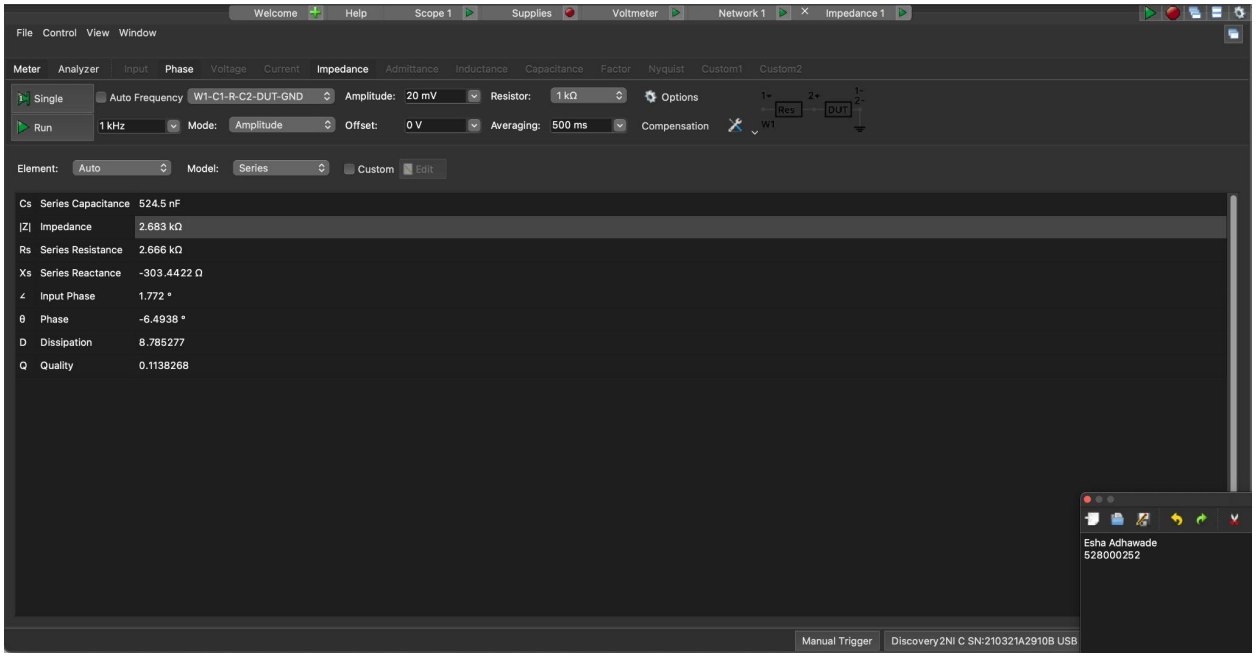
Figure 4

Voltmeter in Data Tables

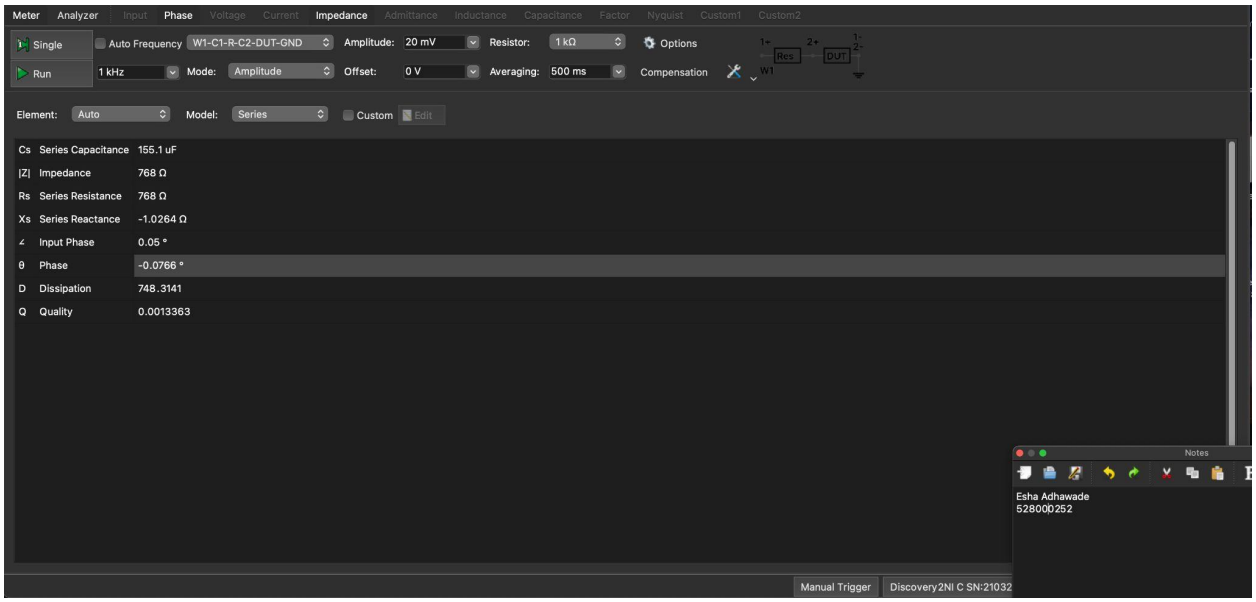
A_V



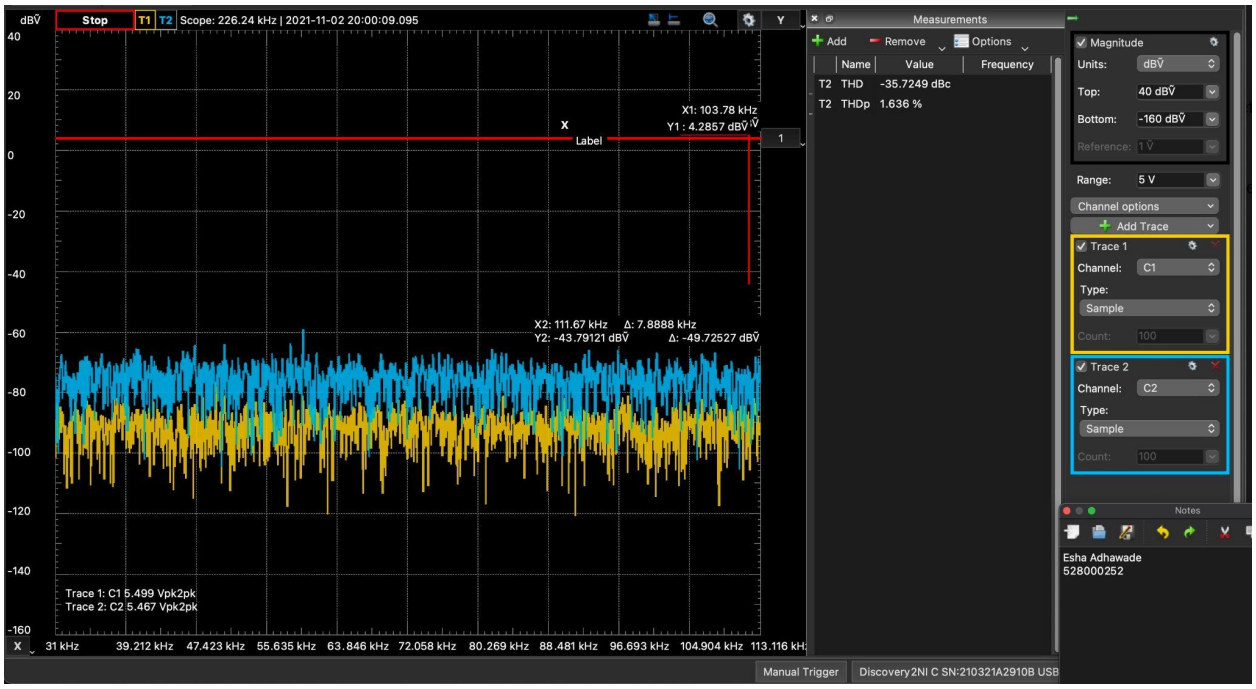
R_i



R_o



THD

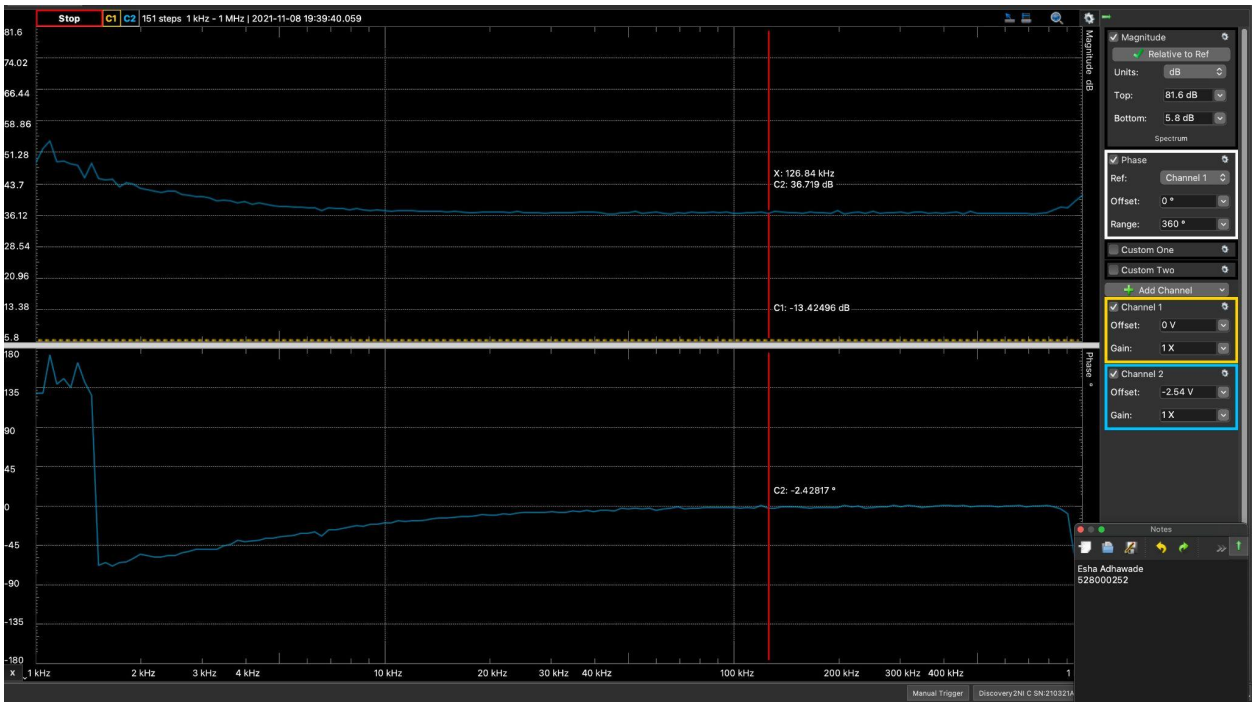


Clipping - 107mV

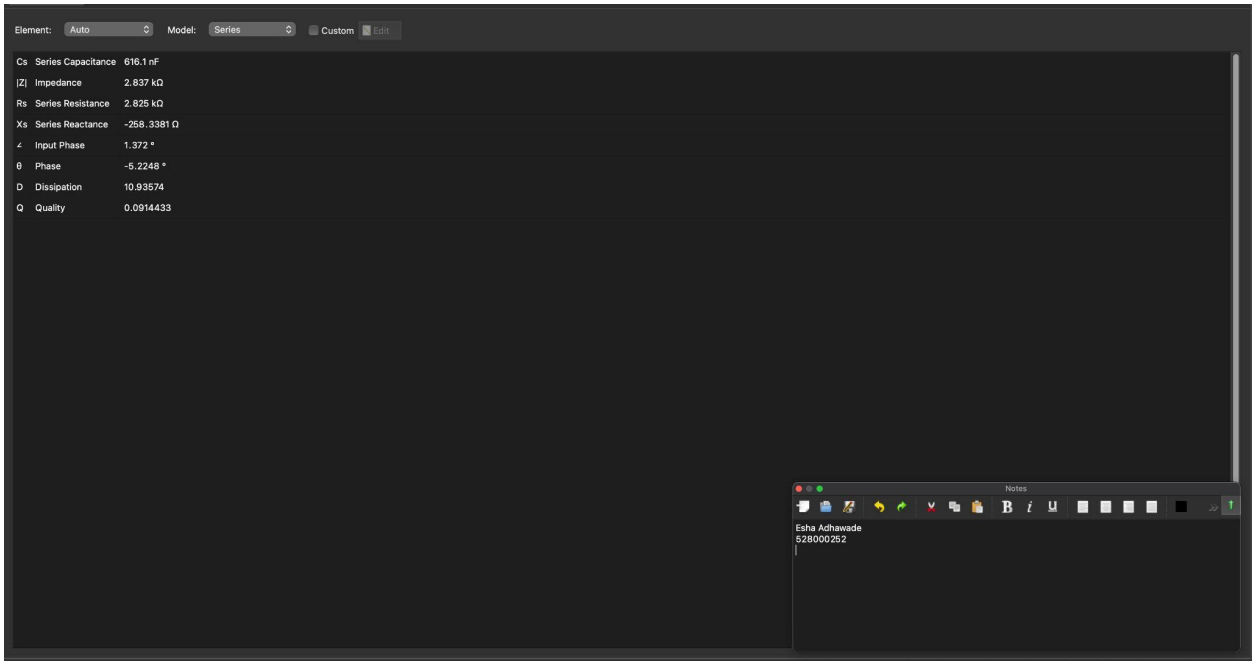
Figure 5

Voltmeter in Data Tables

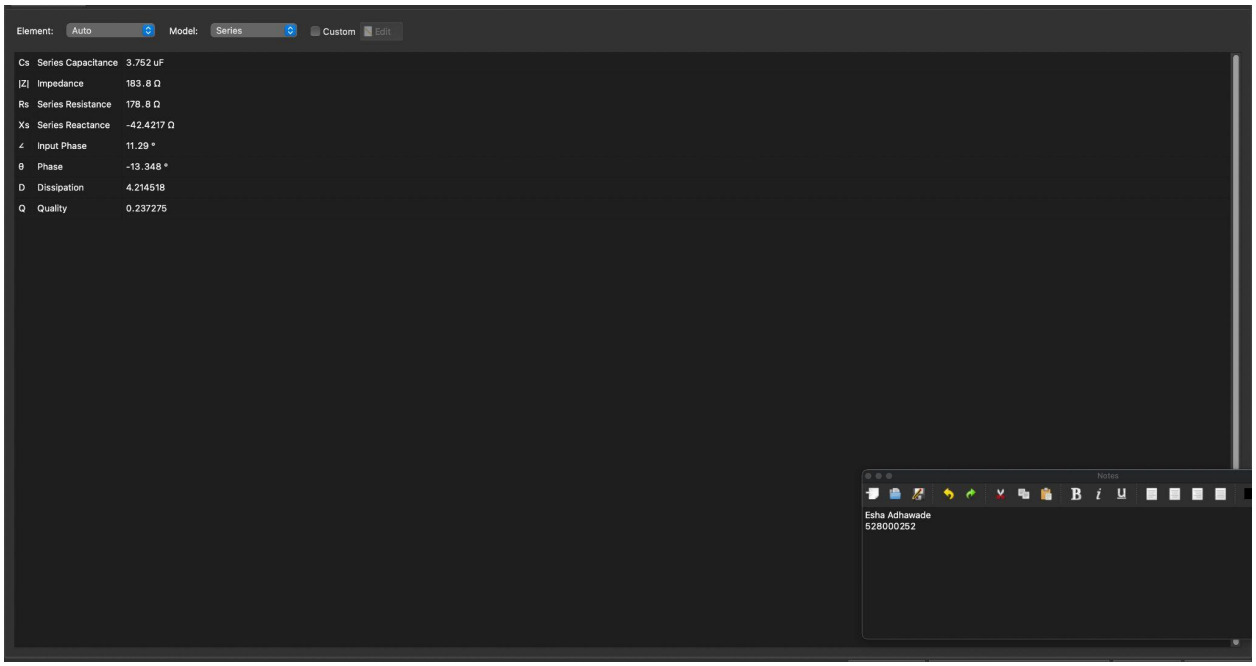
A_V



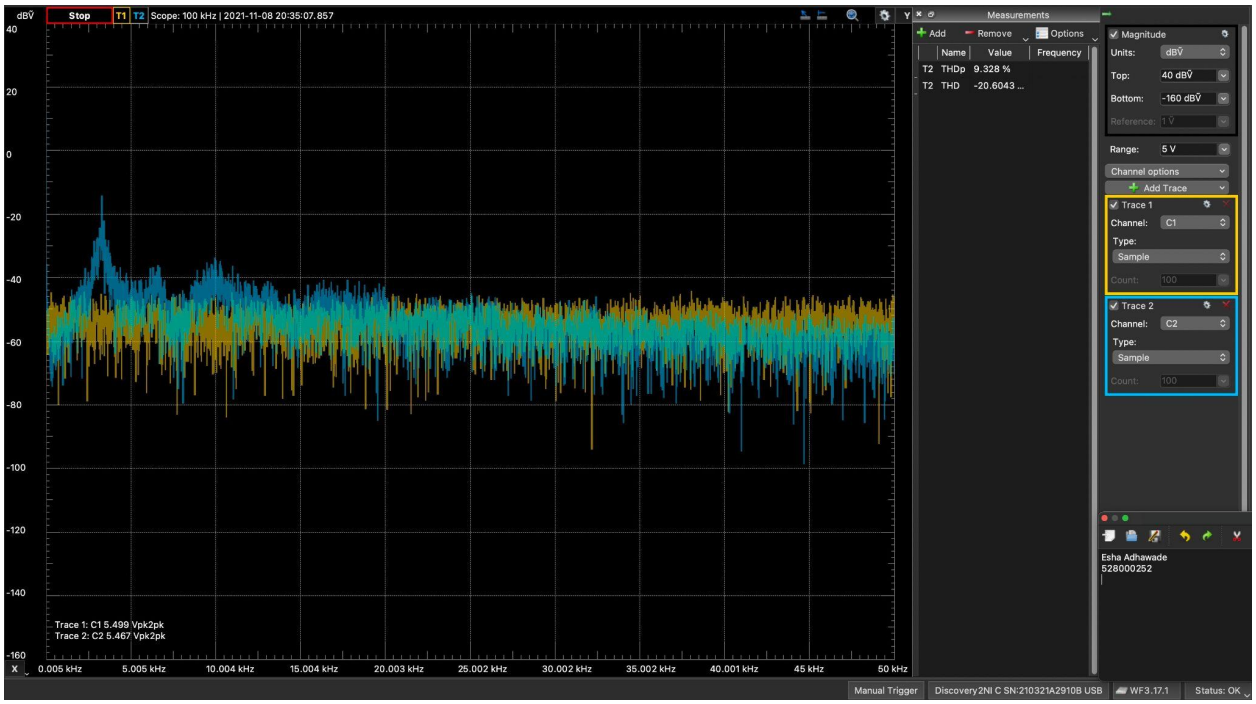
R_i



R_o


Element: Auto
Model: Series
Custom
Edit
Cs Series Capacitance 3.752 uF
|Z| Impedance 183.8 Ω
Rs Series Resistance 178.8 Ω
Xs Series Reactance -42.4217 Ω
∠ Input Phase 11.29 °
θ Phase -13.348 °
D Dissipation 4.214518
Q Quality 0.237275
Notes
Esha Adhawade
528000252

THD


dBV
Stop
T1
T2
Scope: 100 kHz | 2021-11-08 20:35:07.857
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
Trace 1: C1 5.499 Vpk2pk
Trace 2: C2 5.467 Vpk2pk
0.005 kHz
5.005 kHz
10.004 kHz
15.004 kHz
20.003 kHz
25.002 kHz
30.002 kHz
35.002 kHz
40.001 kHz
45 kHz
50 kHz
Measurements
Add
Remove
Options
Name
Value
Frequency
T2 THDp 9.328 %
T2 THD -20.6043 ...
Magnitude
Units: dBV
Top: 40 dBV
Bottom: -160 dBV
Reference: 1 V
Range: 5 V
Channel options
Add Trace
Trace 1
Channel: C1
Type:
Sample
Count: 100
Trace 2
Channel: C2
Type:
Sample
Count: 100
Esha Adhawade
528000252
Manual Trigger
Discovery2NI C SN:210321A2910B USB
WF3.17.1
Status: OK

Clipping

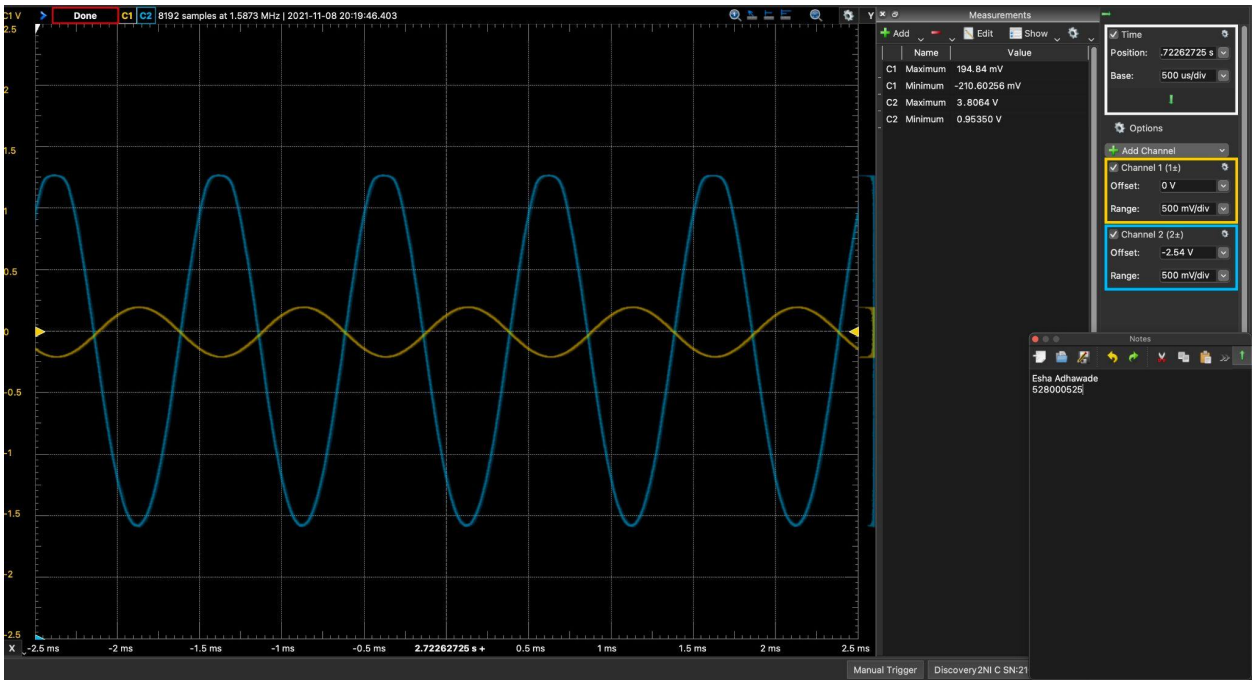
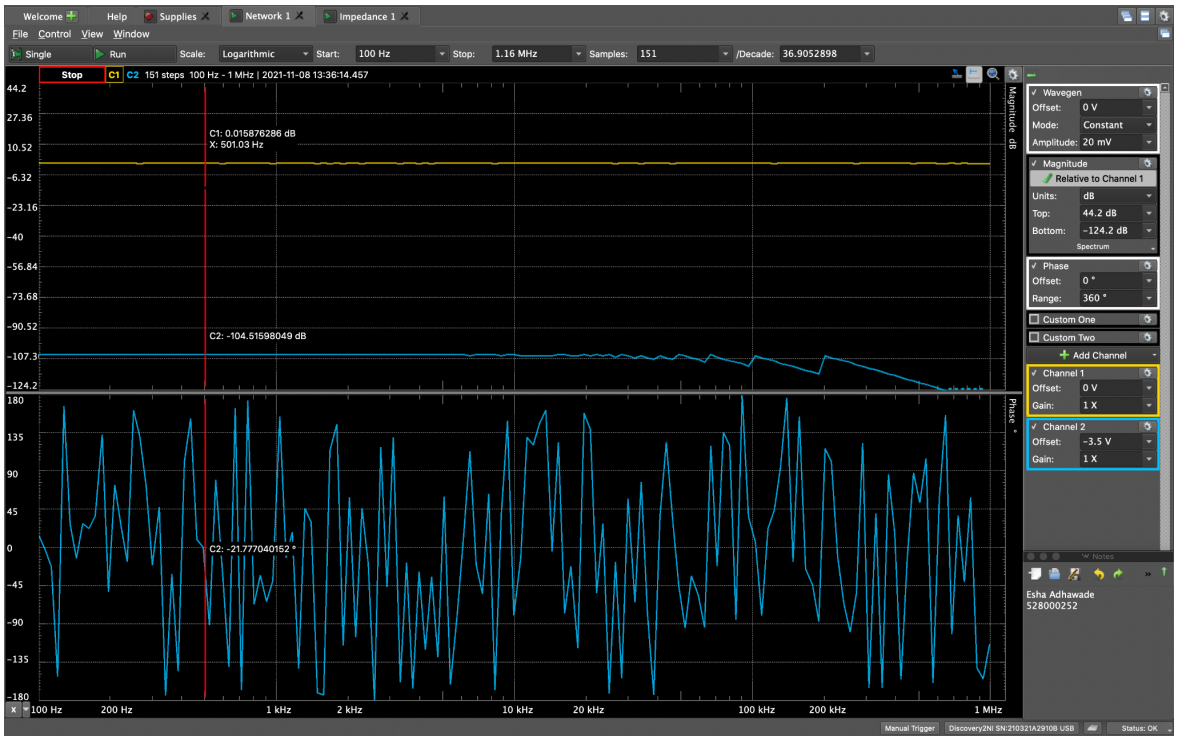


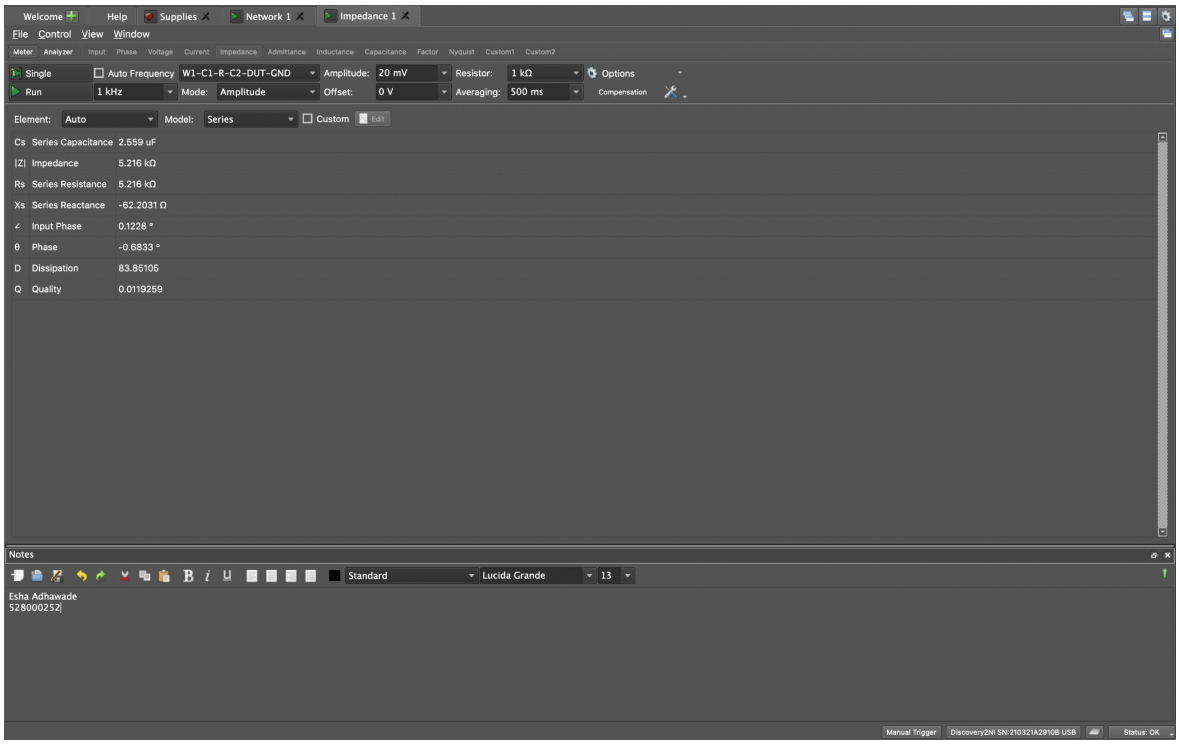
Figure 6

Voltmeter in Data Tables

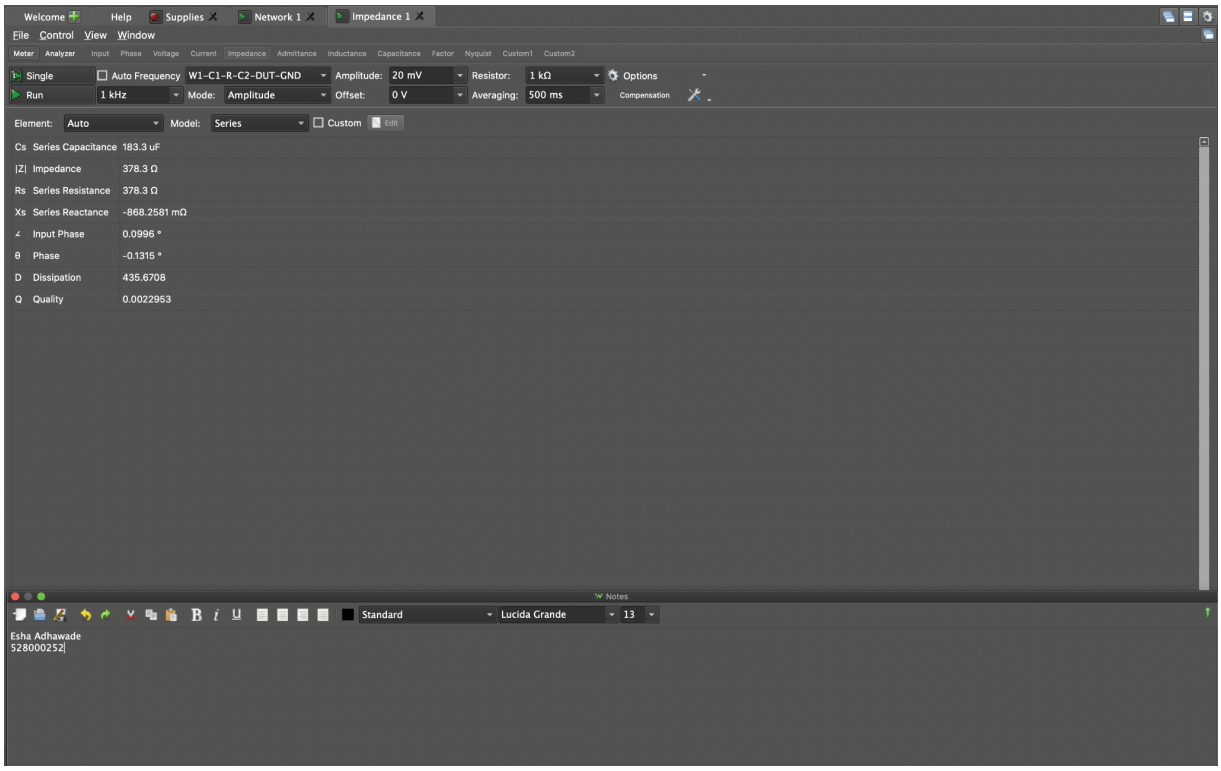
A_V



R_i


Welcome
Help
Supplies
Network 1
Impedance 1
File Control View Window
Meter Analyzer Input Phase Voltage Current Impedance Admittance Inductance Capacitance Factor Nyquist Custom1 Custom2
Single
Auto Frequency
W1-C1-R-C2-DUT-GND
Amplitude: 20 mV
Resistor: 1 kΩ
Options
Run
1 kHz
Mode: Amplitude
Offset: 0 V
Averaging: 500 ms
Compensation
Element: Auto
Model: Series
Custom
Edit
Cs Series Capacitance 2.559 uF
|Z| Impedance 5.216 kΩ
Rs Series Resistance 5.216 kΩ
Xs Series Reactance -62.2031 Ω
∠ Input Phase 0.1228 °
θ Phase -0.6833 °
D Dissipation 83.85105
Q Quality 0.0119259
Notes
Standard
Lucida Grande
13
Esha Adhawade
528000252
Manual Trigger
Discovery2NI SN:210321A2910B USB
Status: OK

R_o


Welcome
Help
Supplies
Network 1
Impedance 1
File Control View Window
Meter Analyzer Input Phase Voltage Current Impedance Admittance Inductance Capacitance Factor Nyquist Custom1 Custom2
Single
Auto Frequency
W1-C1-R-C2-DUT-GND
Amplitude: 20 mV
Resistor: 1 kΩ
Options
Run
1 kHz
Mode: Amplitude
Offset: 0 V
Averaging: 500 ms
Compensation
Element: Auto
Model: Series
Custom
Edit
Cs Series Capacitance 183.3 uF
|Z| Impedance 378.3 Ω
Rs Series Resistance 378.3 Ω
Xs Series Reactance -868.2581 mΩ
∠ Input Phase 0.0996 °
θ Phase -0.1315 °
D Dissipation 435.6708
Q Quality 0.0022953
Notes
Standard
Lucida Grande
13
Esha Adhawade
528000252

THD

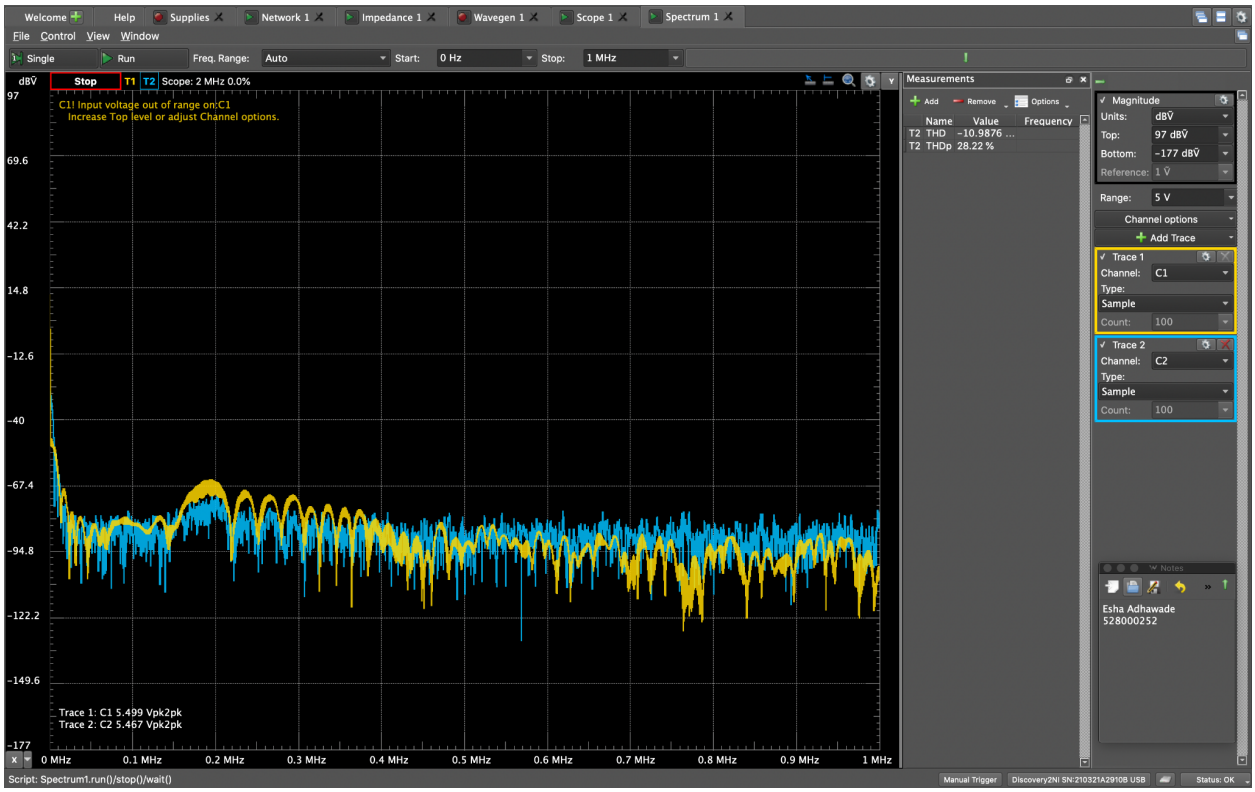
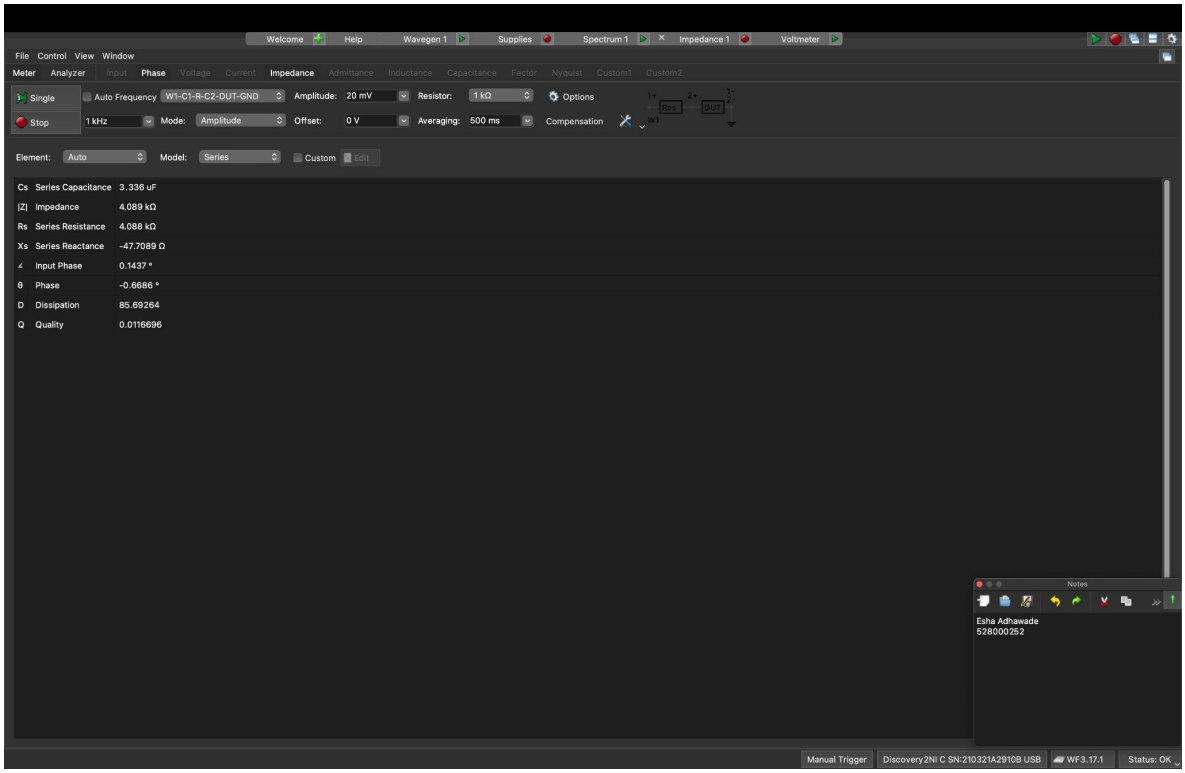

Welcome
Help
Supplies
Network 1
Impedance 1
Wavegen 1
Scope 1
Spectrum 1
File Control View Window
Single
Run
Freq. Range: Auto
Start: 0 Hz
Stop: 1 MHz
dBV
Stop
T1
T2
Scope: 2 MHz 0.0%
C1! Input voltage out of range on:C1
Increase Top level or adjust Channel options.
97
69.6
42.2
14.8
-12.6
-40
-67.4
-94.8
-122.2
-149.6
-177
Trace 1: C1 5.499 Vpk2pk
Trace 2: C2 5.467 Vpk2pk
0 MHz
0.1 MHz
0.2 MHz
0.3 MHz
0.4 MHz
0.5 MHz
0.6 MHz
0.7 MHz
0.8 MHz
0.9 MHz
1 MHz
Measurements
Add
Remove
Options
Name Value Frequency
T2 THD -10.9876 ...
T2 THDp 28.22 %
Magnitude
Units: dBV
Top: 97 dBV
Bottom: -177 dBV
Reference: 1 V
Range: 5 V
Channel options
Add Trace
Trace 1
Channel: C1
Type:
Sample
Count: 100
Trace 2
Channel: C2
Type:
Sample
Count: 100
Notes
Esha Adhawade
528000252
Script: Spectrum1.run()/stop()/wait()
Manual Trigger
Discovery2N! SN:210321A2910B USB
Status: OK

Figure 7

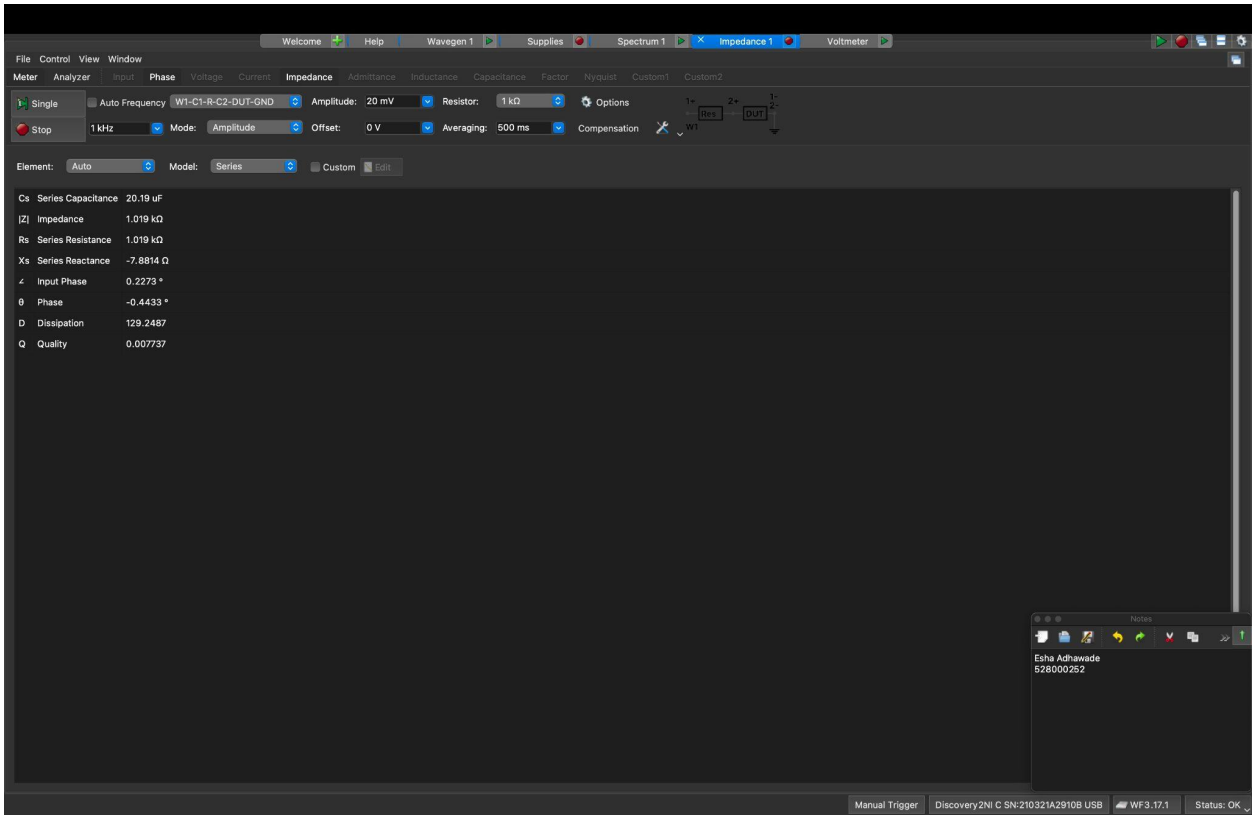
Voltmeter in Data Tables

A_V

R_i



R_o


Welcome
Help
Wavegen 1
Supplies
Spectrum 1
Impedance 1
Voltmeter
File Control View Window
Meter Analyzer Input Phase Voltage Current Impedance Admittance Inductance Capacitance Factor Nyquist Custom1 Custom2
Single
Stop
Auto Frequency
W1-C1-R-C2-DUT-GND
Amplitude: 20 mV
Resistor: 1 kΩ
Options
1 kHz
Mode: Amplitude
Offset: 0 V
Averaging: 500 ms
Compensation
Element: Auto
Model: Series
Custom
Edit
Cs Series Capacitance 20.19 uF
|Z| Impedance 1.019 kΩ
Rs Series Resistance 1.019 kΩ
Xs Series Reactance -7.8814 Ω
∠ Input Phase 0.2273 °
θ Phase -0.4433 °
D Dissipation 129.2487
Q Quality 0.007737
Notes
Esha Adhawade
528000252
Manual Trigger
Discovery2Ni C SN:210321A2910B USB
WF3.17.1
Status: OK

THD

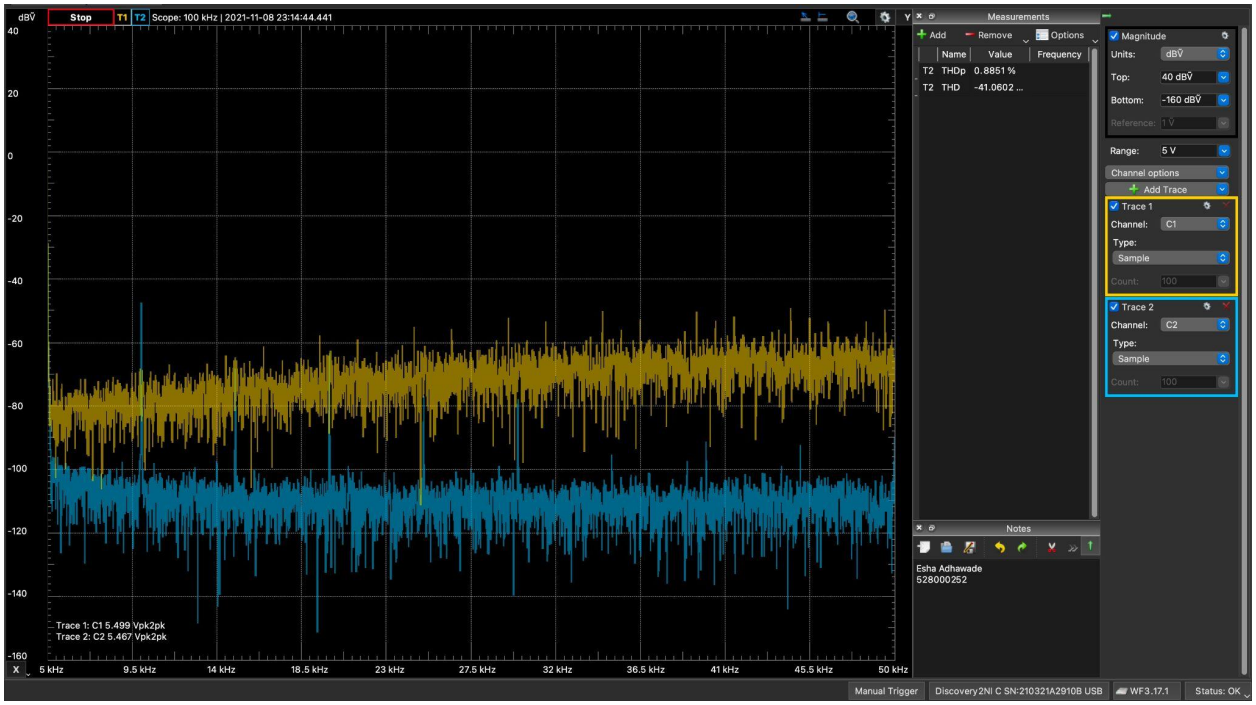
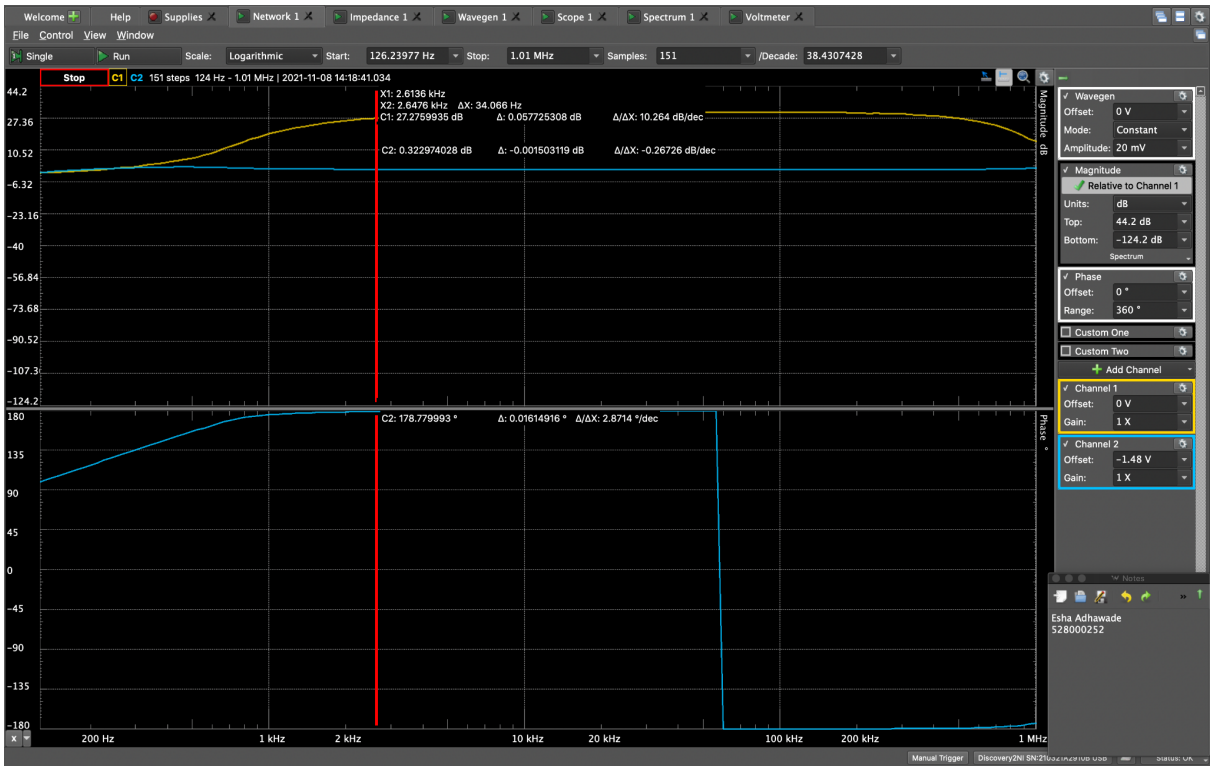

dBV
Stop
T1
T2
Scope: 100 kHz | 2021-11-08 23:14:44.441
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
Trace 1: C1 5.499 Vpk2pk
Trace 2: C2 5.467 Vpk2pk
5 kHz
9.5 kHz
14 kHz
18.5 kHz
23 kHz
27.5 kHz
32 kHz
36.5 kHz
41 kHz
45.5 kHz
50 kHz
Measurements
Add
Remove
Options
Name
Value
Frequency
T2 THDp 0.8851 %
T2 THD -41.0602 ...
Magnitude
Units: dBV
Top: 40 dBV
Bottom: -160 dBV
Reference: 1 V
Range: 5 V
Channel options
Add Trace
Trace 1
Channel: C1
Type:
Sample
Count: 100
Trace 2
Channel: C2
Type:
Sample
Count: 100
Notes
Esha Adhawade
528000252
Manual Trigger
Discovery2Ni C SN:210321A2910B USB
WF3.17.1
Status: OK

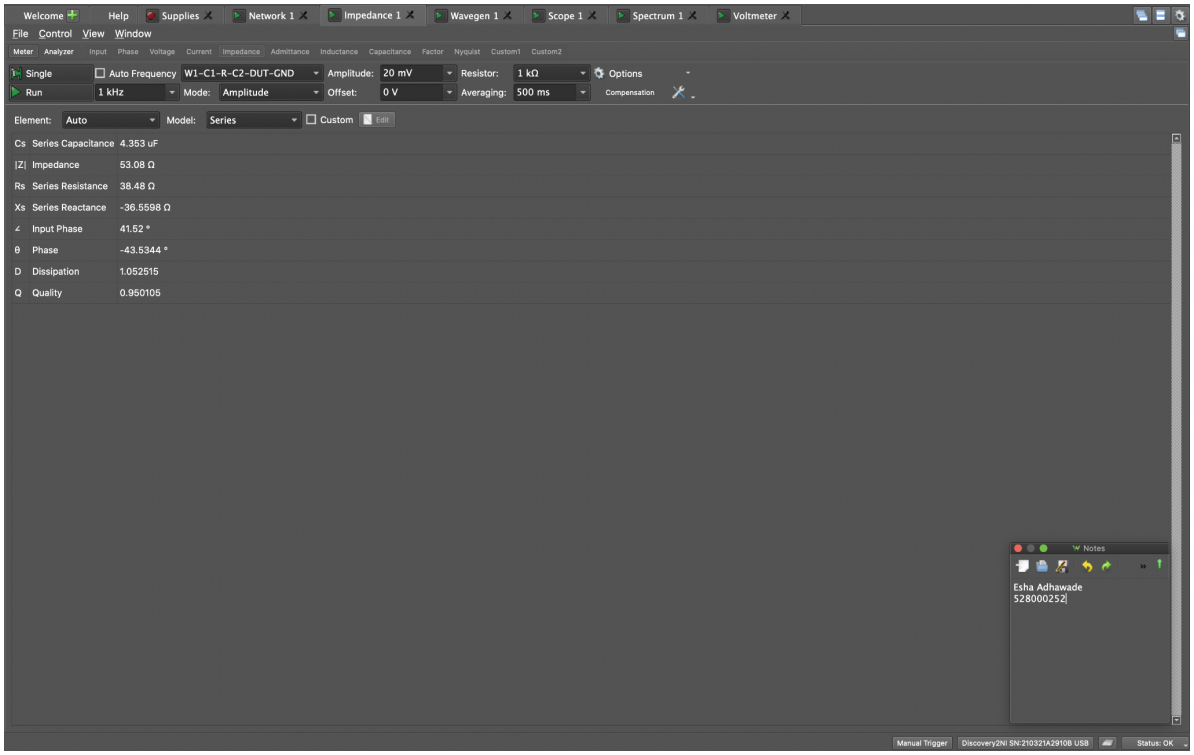
Figure 8

Voltmeter in Data Tables

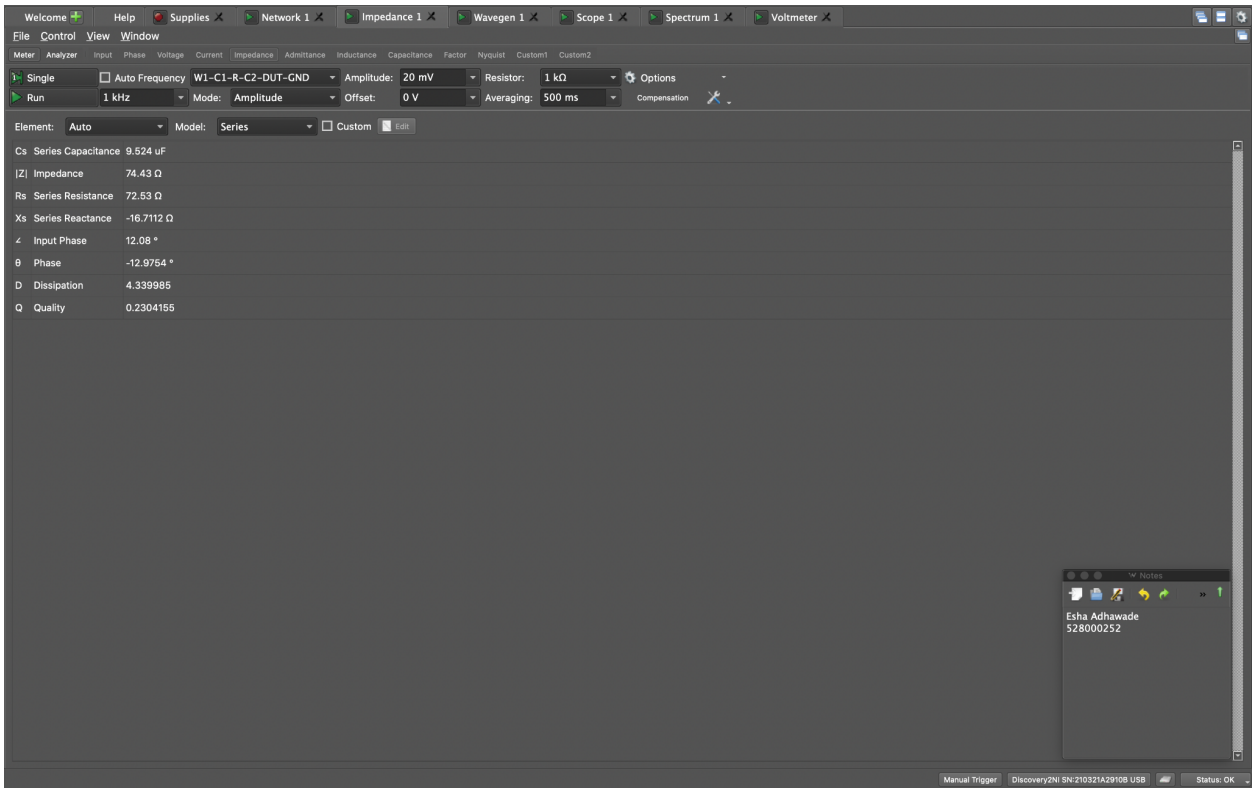
A_V



R_i



R_o


Welcome
Help
Supplies
Network 1
Impedance 1
Wavegen 1
Scope 1
Spectrum 1
Voltmeter
File Control View Window
Single
Auto Frequency
W1-C1-R-C2-DUT-GND
Amplitude: 20 mV
Resistor: 1 kΩ
Options
Run
1 kHz
Mode: Amplitude
Offset: 0 V
Averaging: 500 ms
Compensation
Element: Auto
Model: Series
Custom
Cs Series Capacitance 9.524 uF
|Z| Impedance 74.43 Ω
Rs Series Resistance 72.53 Ω
Xs Series Reactance -16.7112 Ω
∠ Input Phase 12.08 °
θ Phase -12.9754 °
D Dissipation 4.339985
Q Quality 0.2304155
Notes
Esha Adhawade
528000252
Manual Trigger
Discovery2NI SN:210321A2910B USB
Status: OK

THD

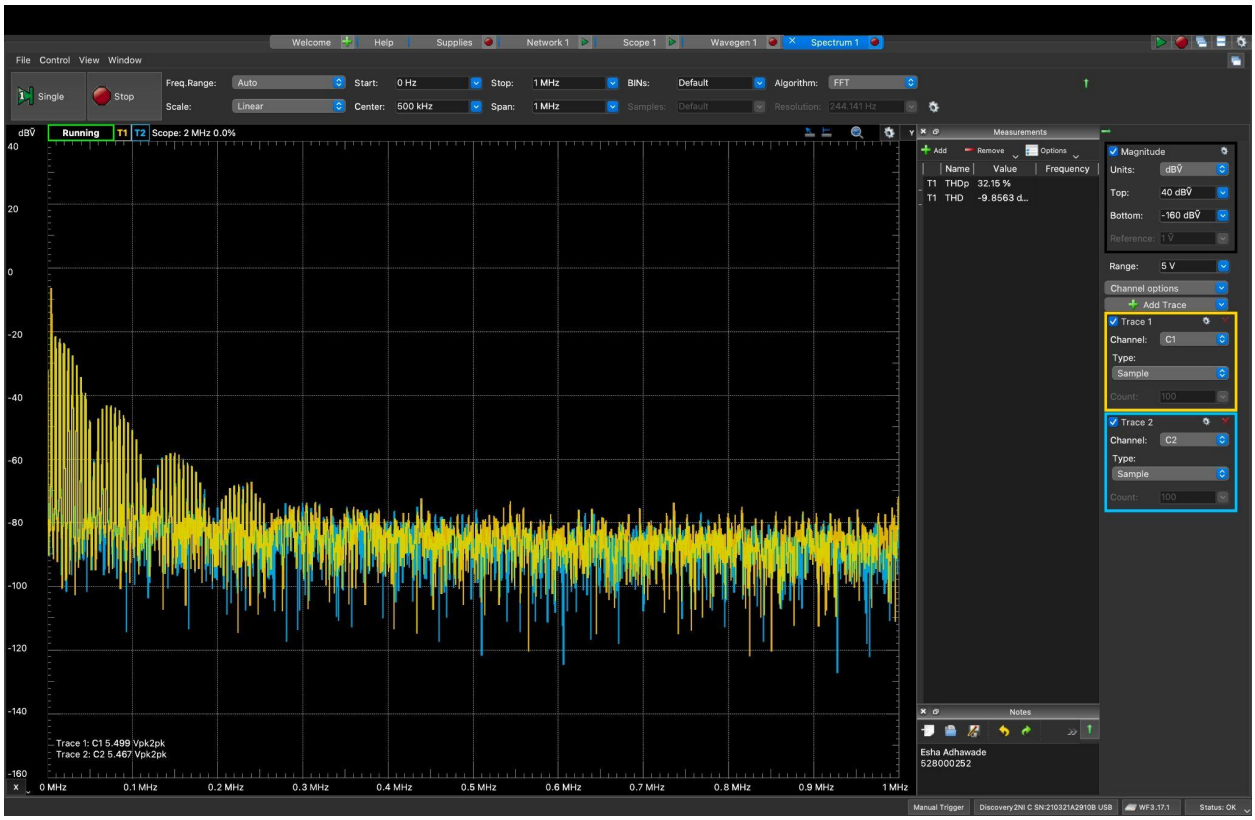
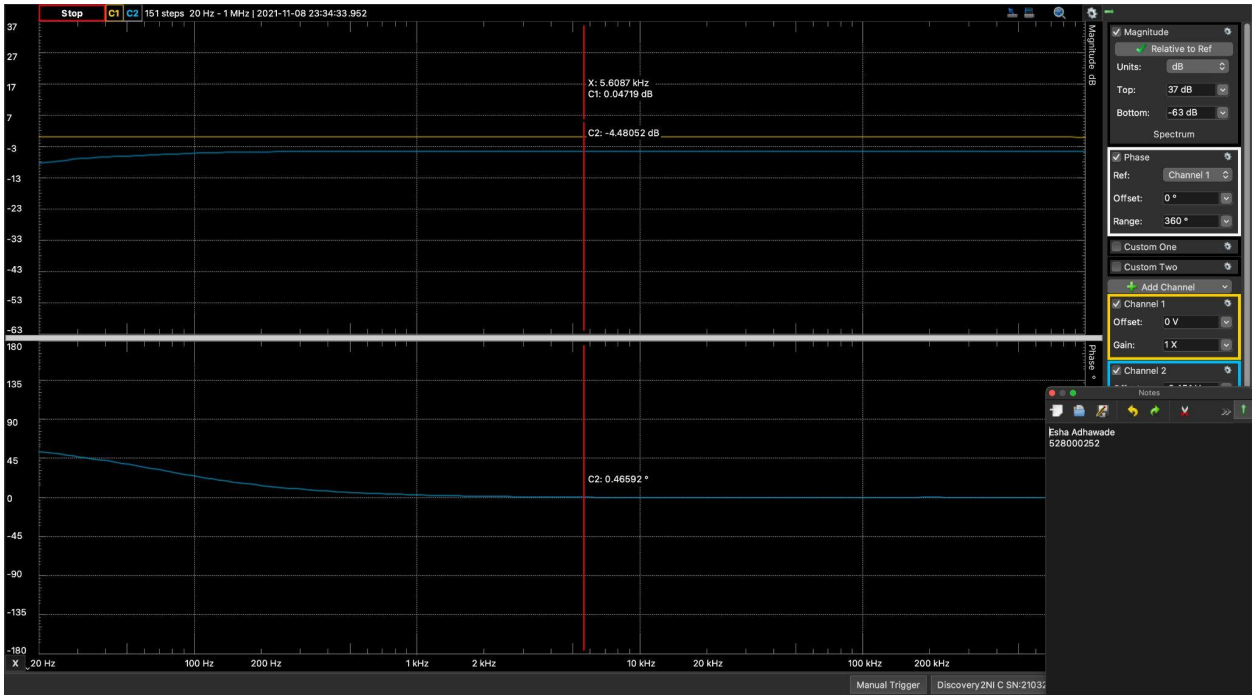

Welcome
Help
Supplies
Network 1
Scope 1
Wavegen 1
Spectrum 1
File Control View Window
Single
Stop
Freq.Range: Auto
Start: 0 Hz
Stop: 1 MHz
BINs: Default
Algorithm: FFT
Scale: Linear
Center: 500 kHz
Span: 1 MHz
Samples: Default
Resolution: 244.141 Hz
Running
T1
T2
Scope: 2 MHz 0.0%
dBV
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
0 MHz
0.1 MHz
0.2 MHz
0.3 MHz
0.4 MHz
0.5 MHz
0.6 MHz
0.7 MHz
0.8 MHz
0.9 MHz
1 MHz
Trace 1: C1 5.499 Vpk2pk
Trace 2: C2 5.467 Vpk2pk
Measurements
Add
Remove
Options
Name
Value
Frequency
T1 THDp 32.15 %
T1 THD -9.8563 d...
Magnitude
Units: dBV
Top: 40 dBV
Bottom: -160 dBV
Reference: 1 V
Range: 5 V
Channel options
Add Trace
Trace 1
Channel: C1
Type:
Sample
Count: 100
Trace 2
Channel: C2
Type:
Sample
Count: 100
Notes
Esha Adhawade
528000252
Manual Trigger
Discovery2NI C SN:210321A2910B USB
WF3.17.1
Status: OK

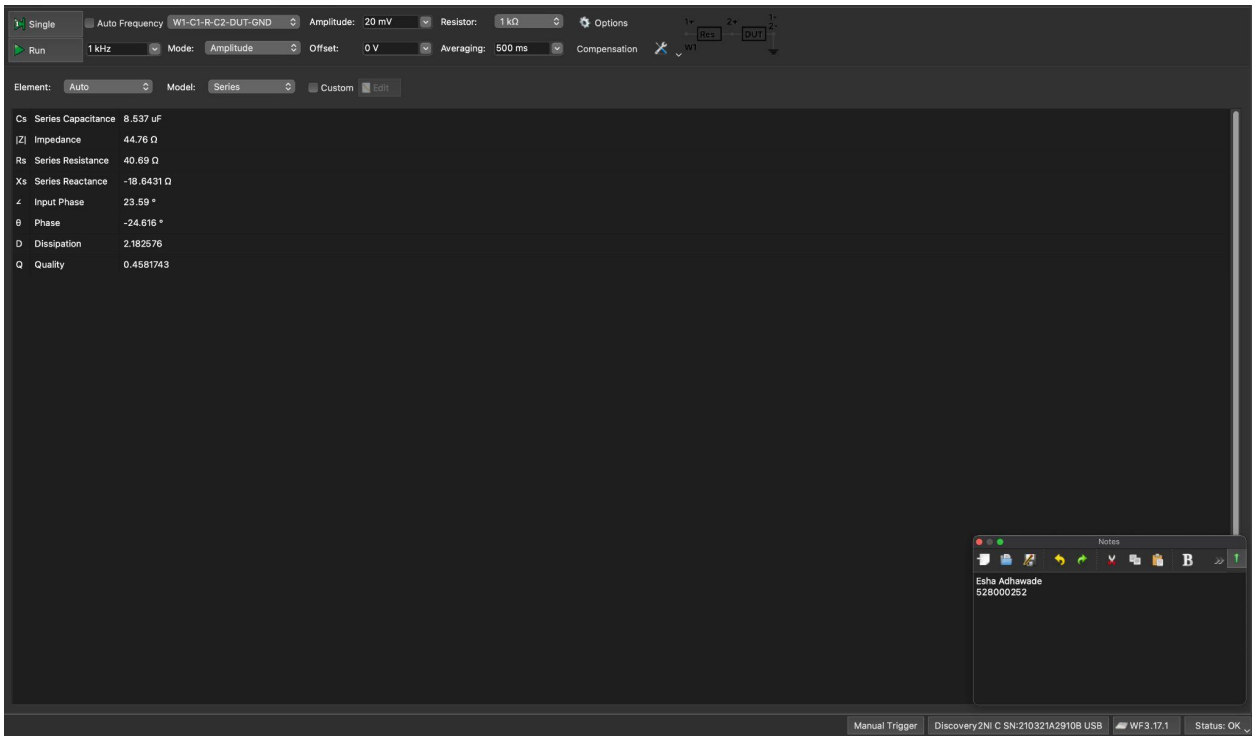
Figure 9

Voltmeter in Data Tables

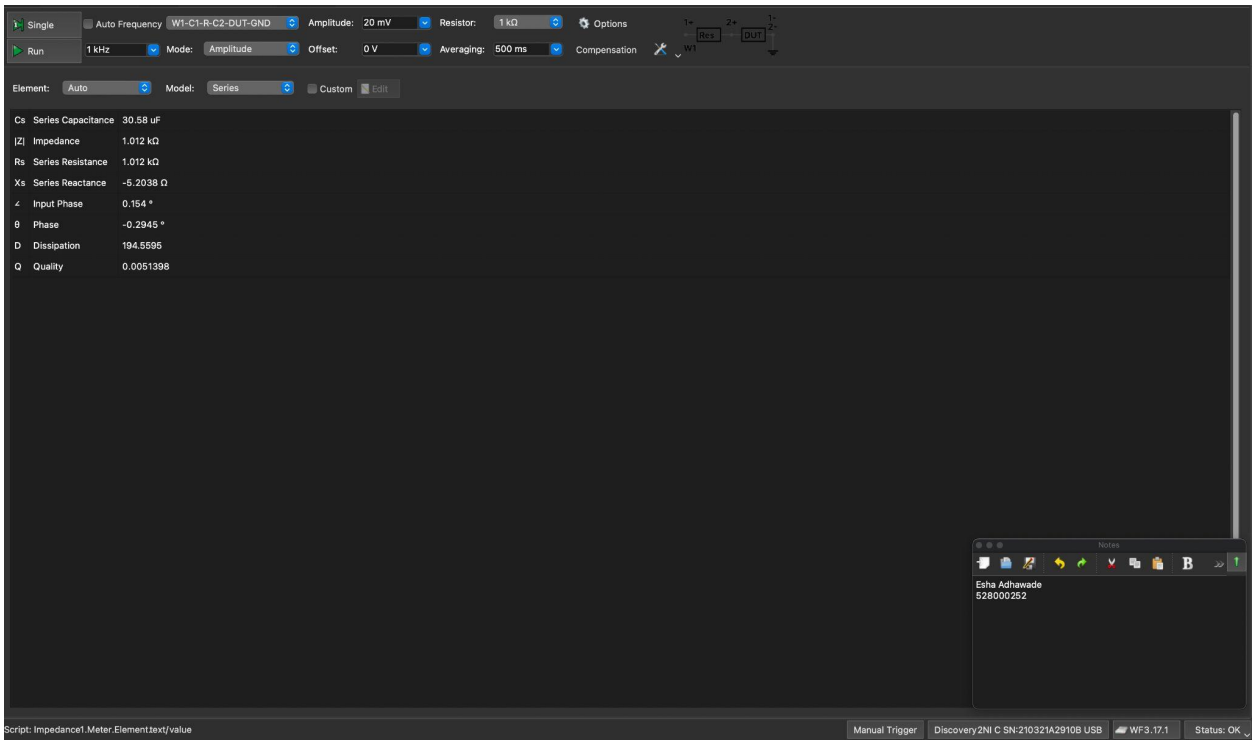
A_V



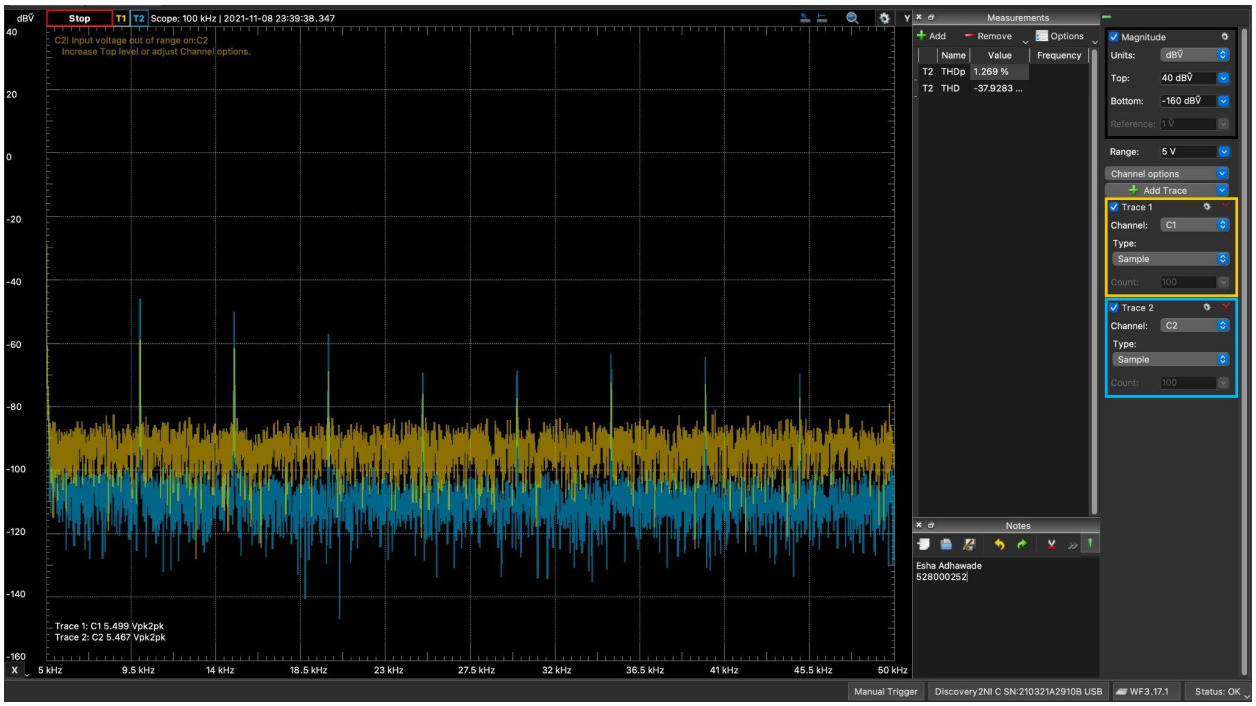
R_i



R_o


Single
Auto Frequency
W1-C1-R-C2-DUT-GND
Amplitude: 20 mV
Resistor: 1 kΩ
Options
Run
1 kHz
Mode: Amplitude
Offset: 0 V
Averaging: 500 ms
Compensation
Element: Auto
Model: Series
Custom
Edit
Cs Series Capacitance 30.58 uF
|Z| Impedance 1.012 kΩ
Rs Series Resistance 1.012 kΩ
Xs Series Reactance -5.2038 Ω
∠ Input Phase 0.154 °
θ Phase -0.2945 °
D Dissipation 194.5595
Q Quality 0.0051398
Notes
Esha Adhawade
528000252
Script: Impedance1.Meter.Element.text/value
Manual Trigger
Discovery 2NI C SN:210321A2910B USB
WF3.17.1
Status: OK

THD


dBV
Stop
T1
T2
Scope: 100 kHz | 2021-11-08 23:39:38.347
C2| Input voltage out of range on:C2
Increase Top level or adjust Channel options.
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
Trace 1: C1 5.499 Vpk2pk
Trace 2: C2 5.467 Vpk2pk
5 kHz
9.5 kHz
14 kHz
18.5 kHz
23 kHz
27.5 kHz
32 kHz
36.5 kHz
41 kHz
45.5 kHz
50 kHz
Measurements
Add
Remove
Options
Name
Value
Frequency
T2 THDp 1.269 %
T2 THD -37.9283 ...
Magnitude
Units: dBV
Top: 40 dBV
Bottom: -160 dBV
Reference: 1 V
Range: 5 V
Channel options
Add Trace
Trace 1
Channel: C1
Type:
Sample
Count: 100
Trace 2
Channel: C2
Type:
Sample
Count: 100
Notes
Esha Adhawade
528000252
Manual Trigger
Discovery 2NI C SN:210321A2910B USB
WF3.17.1
Status: OK

Data Tables

Figure 4

	Simulations	**Measurement**
V_{RB2}	1.60 V	1.572 V
V_{RE}	914 mV	982 mV
V_{RC}	3.14 V	3.013 V
$V_{O,DC}$	1.59 V	1.987 V
I_C	4.86 mA	4.01 mA
A_V	10.4717 dB	9.0565 dB
R_i	1.728k Ω	2.683k Ω
R_o	7.3197k Ω	768 Ω
THD	2.09%	1.636%

Figure 5

	Simulations	**Measurement**
V_{RB2}	3.41V	3.372V
V_{RE}	4.13 V	4.123V
V_{RC}	1.97 V	2.344V
$V_{O,DC}$	3.03 V	2.561 V
I_C	3.031 mA	2.56 mA
A_V	9.7701 dB	36.719 dB
R_i	1.9457k Ω	2.837k Ω
R_o	9.8785k Ω	183.8 Ω
THD	5.46%	9.328%

Figure 6

	Simulations	**Measurement**
V_{RB2}	838 mV	1.613V
V_{RE}	693 mV	1.102V
I_C	3.19 mA	3.21 mA
A_V	10.2704 dB	36.9 dB
R_i	3.761k Ω	5.126k Ω
R_o	923 Ω	378.3 Ω
THD	1.26%	10.98%

Figure 7

	Simulations	**Measurement**
V_{RB2}	3.35 V	3.312 V
V_{RE}	4.15 V	3.898 V
I_C	966 µA	1.038 mA
A_V	36.36 dB	8.945dB
R_i	4.3454k Ω	4.089k Ω
R_o	1k Ω	1.019k Ω
THD	2.22%	0.8851%

Figure 8

	Simulations	**Measurement**
V_{RB2}	1.63 V	2.021V
V_{RE}	933 mV	1.287V
V_{RC}	3.05 V	3.664V
$V_{O,DC}$	1.95 V	1.336V
I_C	5.41 mA	3.66 mA

A_V	19.24 dB	10.264 dB
R_i	8.311k Ω	53.08 Ω
R_o	67.88 Ω	74.43 Ω
THD	2.44%	32.15%

Figure 9

	Simulations	**Measurement**
V_{RB2}	3.36 B	3.371 V
V_{RE}	4.09 V	4.072 V
V_{RC}	2.14 V	2.578 V
$V_{O,DC}$	2.86 V	2.422 V
I_C	7.94 mA	6.72 mA
A_V	35.75 dB	4.48 dB
R_i	27.06k Ω	44.76 Ω
R_o	960.96 Ω	1.012k Ω
THD	1.17%	1.269%

Discussion

For lab 8, students learned about the different properties of a BJT amplifier. Most of the values between the simulations and measurements were pretty consistent for the circuits. If there were any minor differences, that's probably because of component differences, old breadboards, or loose wires.