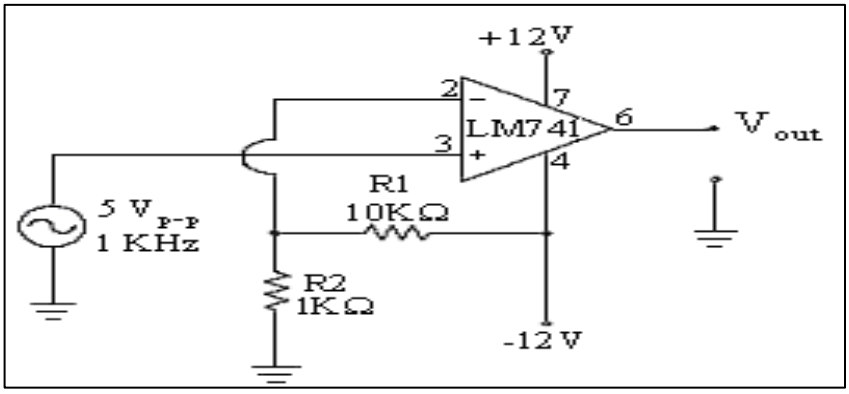
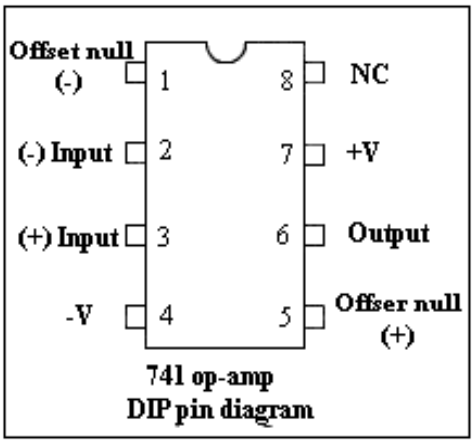
Electronics Lab
Lab Session 7: Operational Amplifier

Students Names	ID#
Rami Yahia ali hassan **sande Ghassan Fatehi Qanaeer**	1838264 1834471

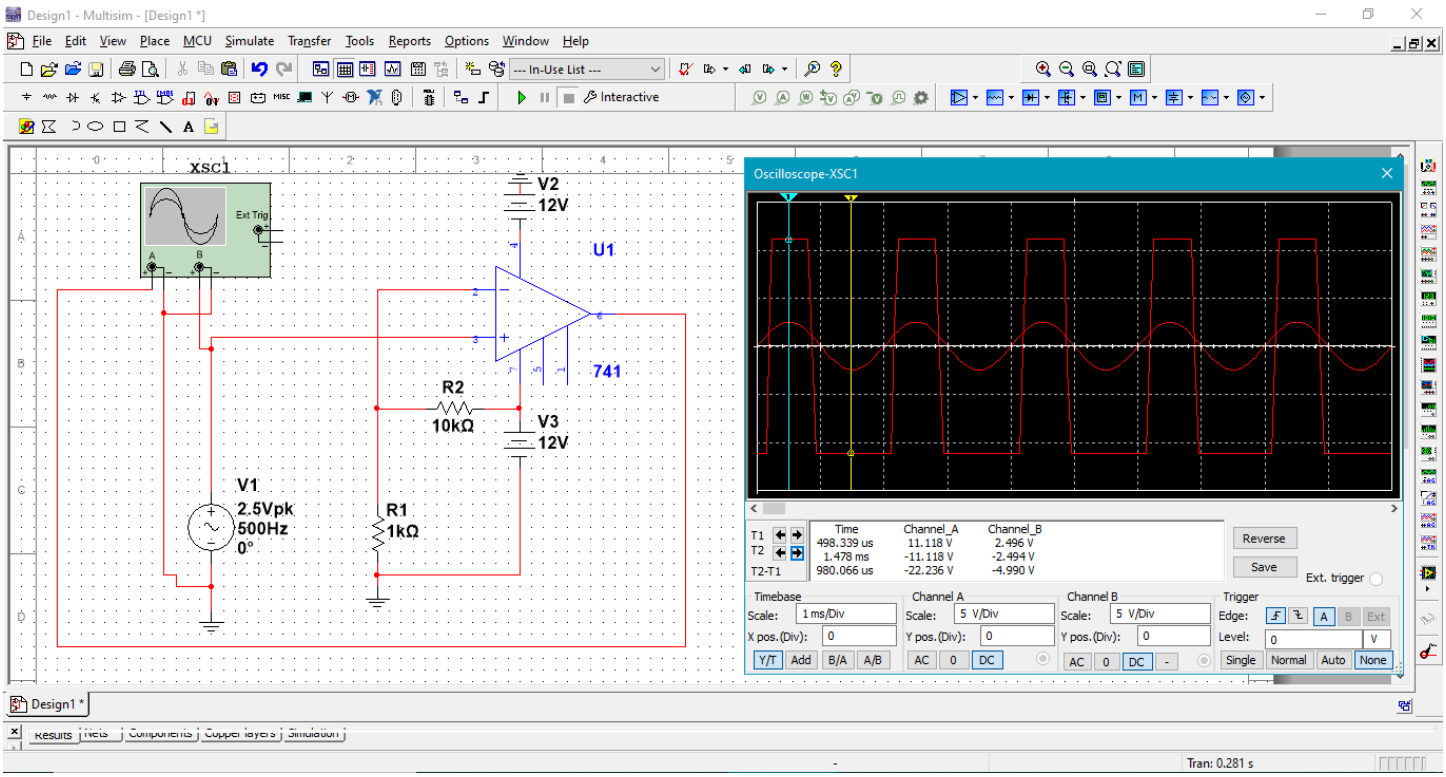
Part1: Comparator with 741 IC Used as a Level Detector

1. Construct the circuit shown below, connect a 500 Hz., 5-V_{p-p} to the input. Sketch the input SIGNAL , Vref and the output signal on the same graph,



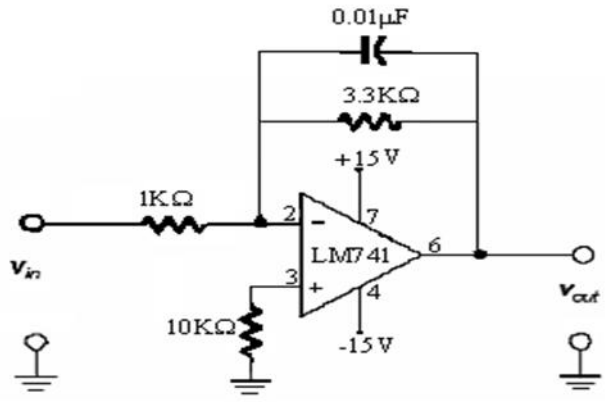


V_{ref} = (-12*R2)/R1+R2 =-12*1/(10+1)=-1.09

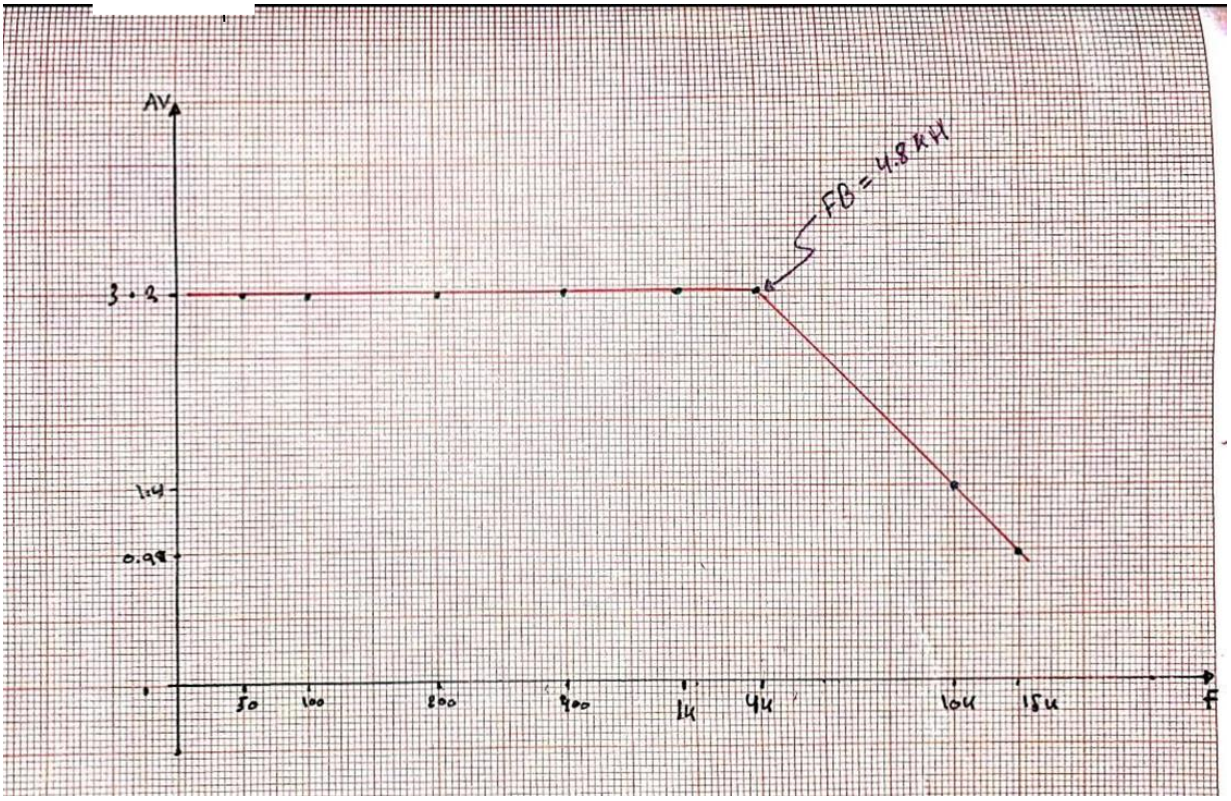


Part 4: Integrator

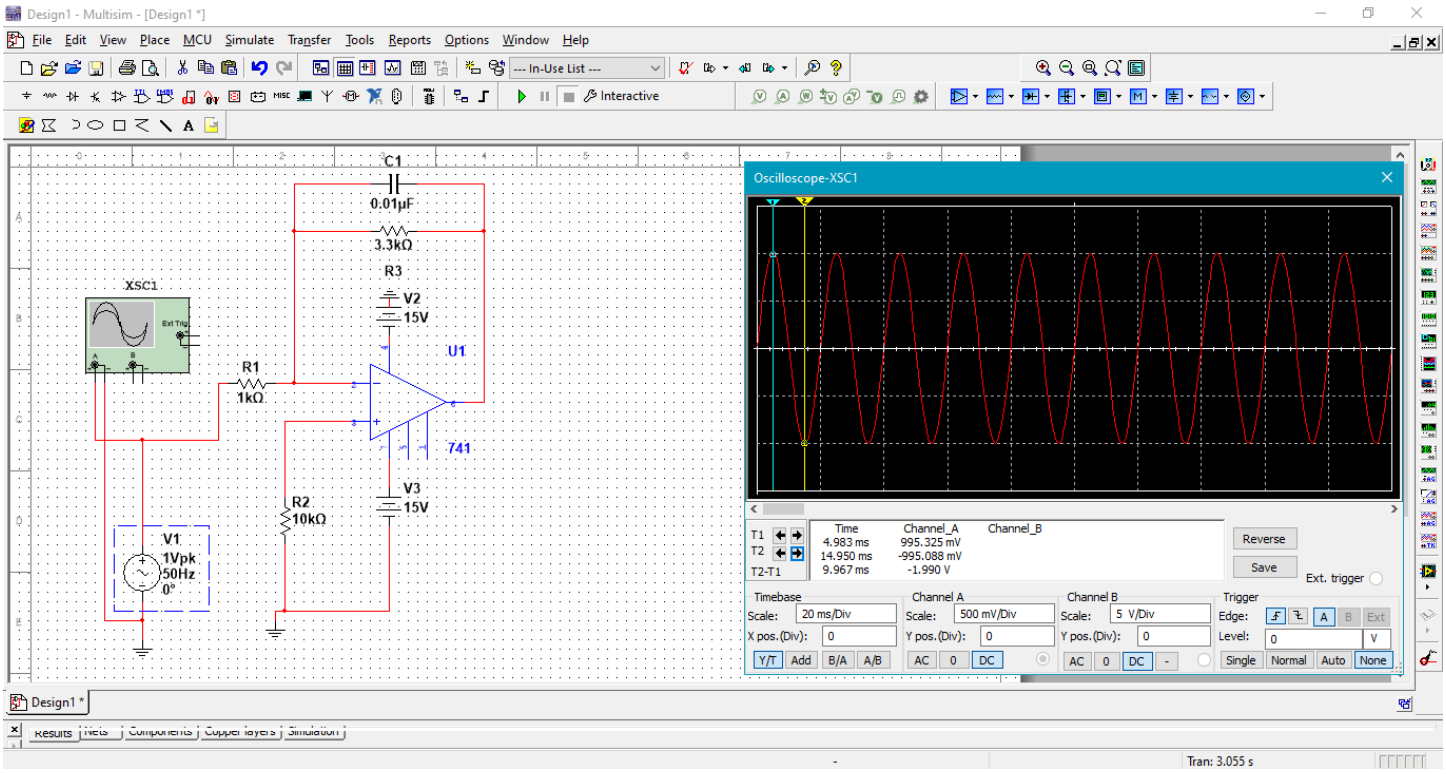
1. Construct the circuit shown below, apply a 2 $\boxed{V_{p-p}}$ of sine wave.
2. Vary the frequency of V_{in} frown 200Hz to 50KHz. Calculate the gain. And record the results in the Table 1, ***and then plot the gain vs. frequency on semi-log graph paper.***

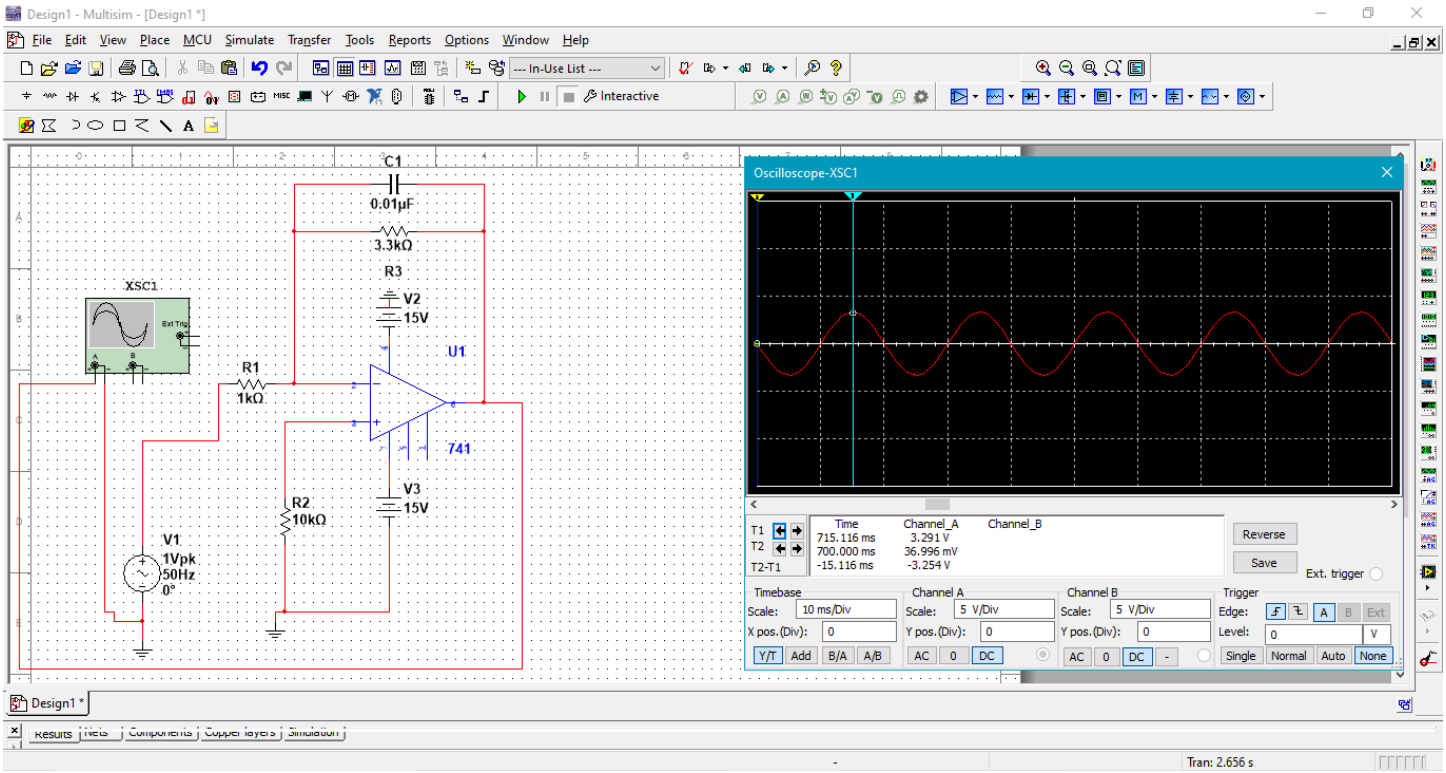


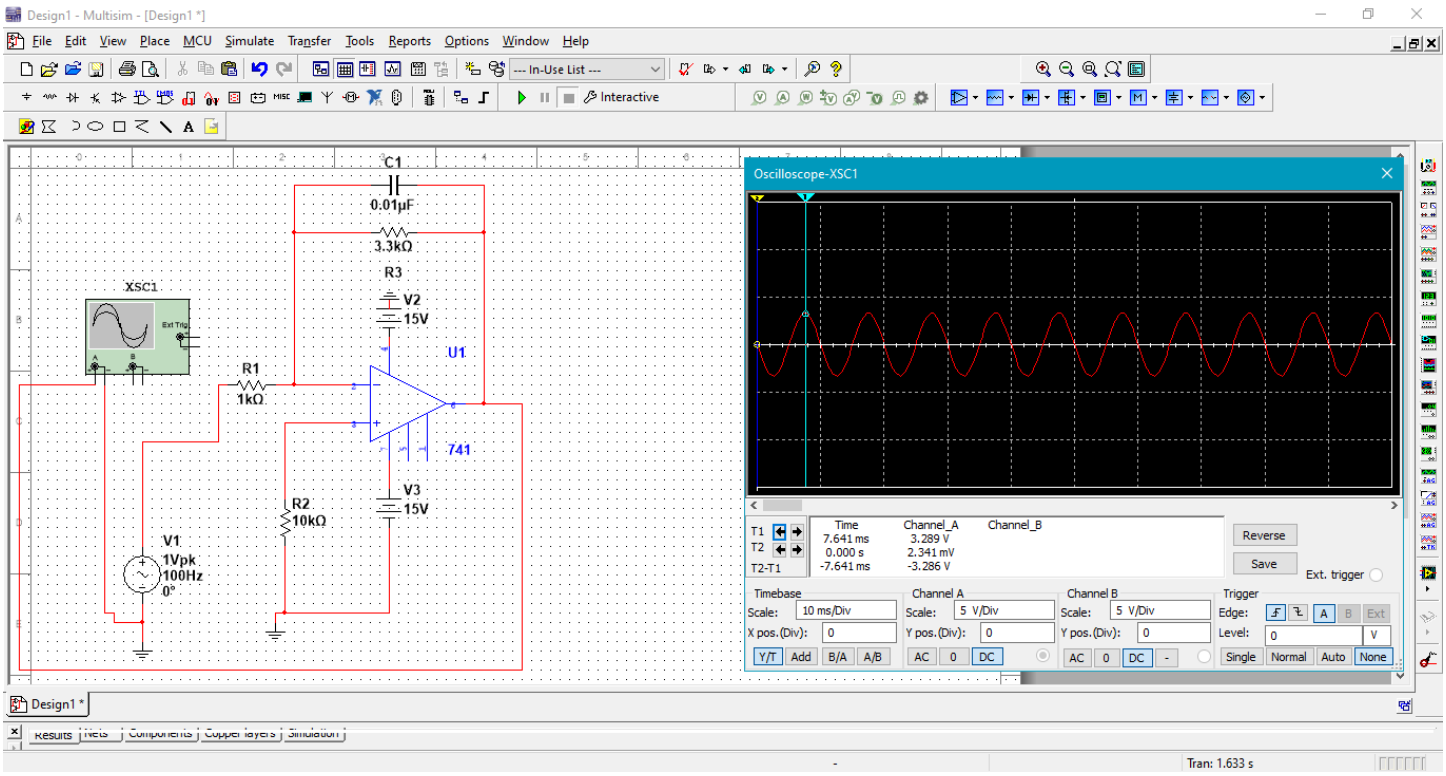
Frequency (Hz)	V_{in} (Volt)	V_{out} (Volt)	Av
50Hz	1V	3.291V	3.291
100Hz	1V	3.289V	3.289
200Hz	1V	3.282V	3.282
400Hz	1V	3.276V	3.276
1K	1V	3.219V	3.219
10K	1V	1.407V	1.407
15K	1V	0.990V	0.99

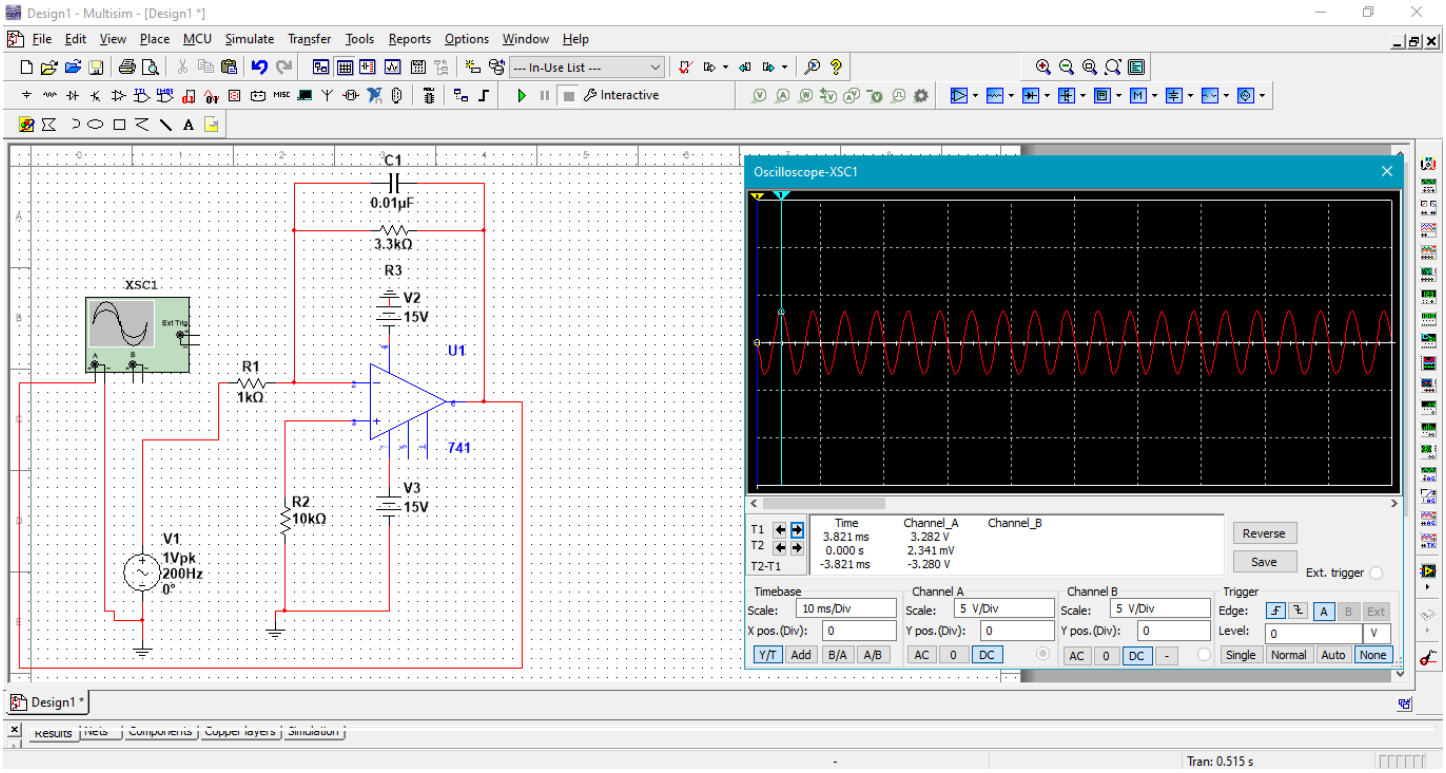


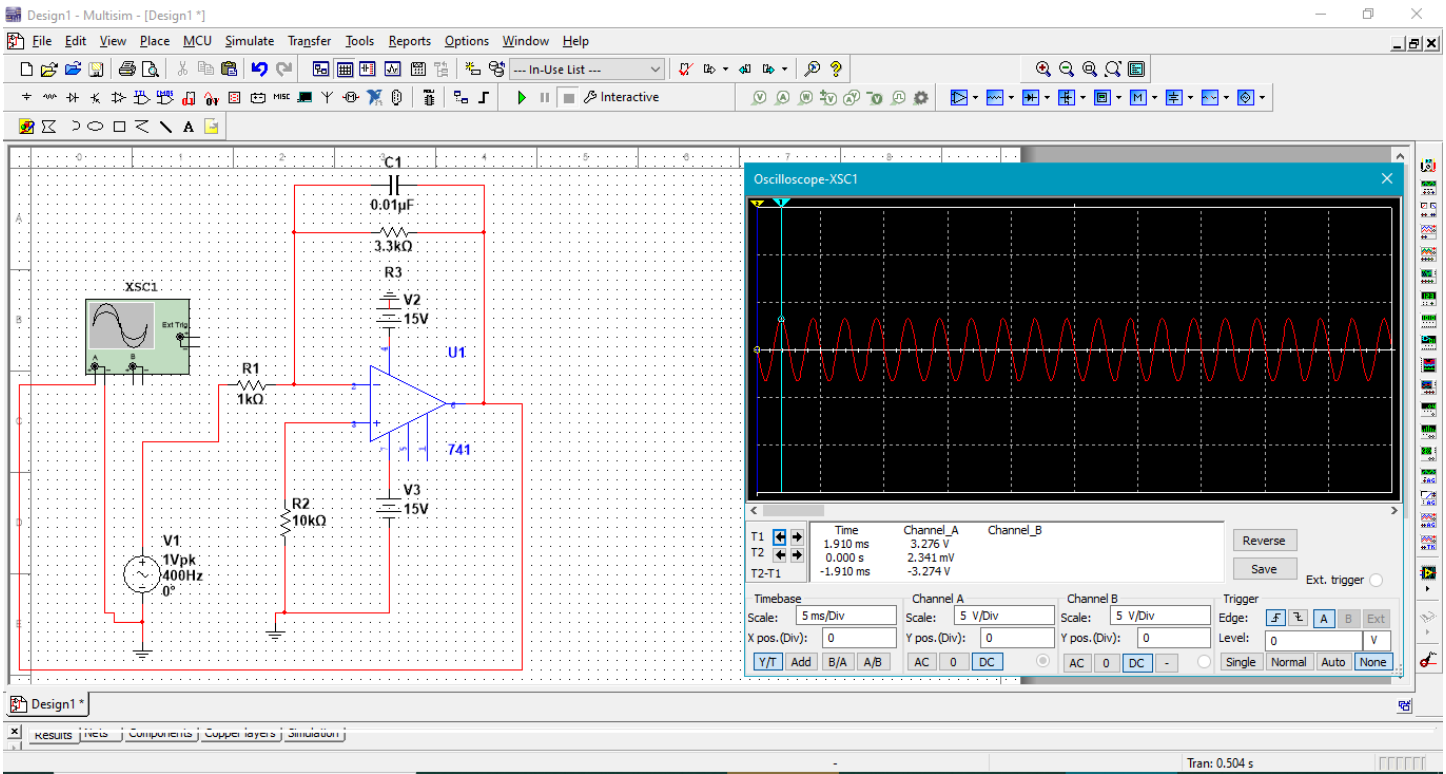
The Break Frequency of the Integrator circuit FB =1/2*Pi*Cf*RC= 1/(2*Pi*3.3*1000*10*10^-9)=4822.8 HZ

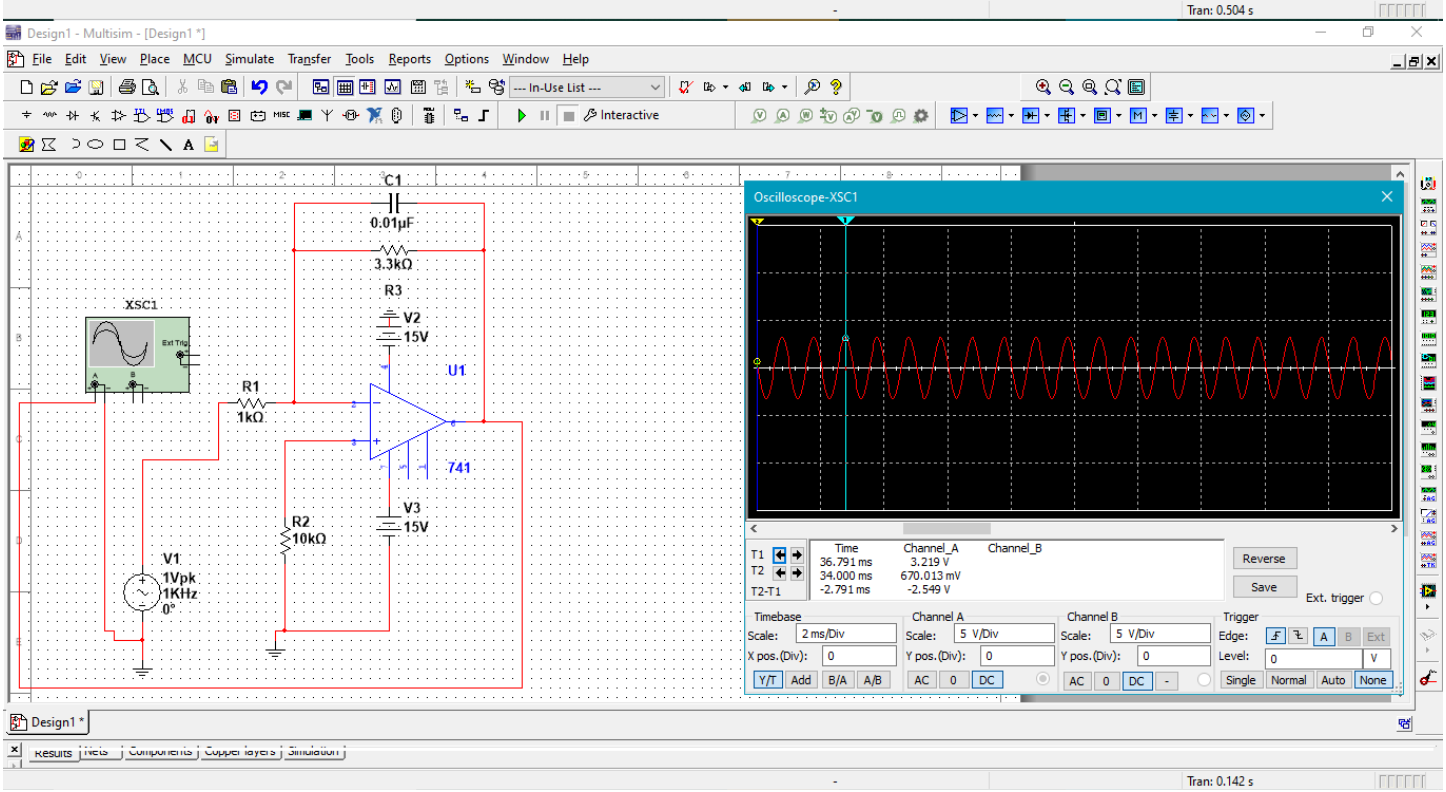

Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
C1
0.01µF
3.3kΩ
R3
XSC1
V2
15V
U1
R1
1kΩ
741
R2
10kΩ
V3
15V
V1
1Vpk
50Hz
0°
Oscilloscope-XSC1
Time Channel_A Channel_B
T1 4.983 ms 995.325 mV
T2 14.950 ms -995.088 mV
T2-T1 9.967 ms -1.990 V
Reverse
Save
Ext. trigger
Timebase
Scale: 20 ms/Div
X pos.(Div): 0
Channel A
Scale: 500 mV/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Results
Tran: 3.055 s

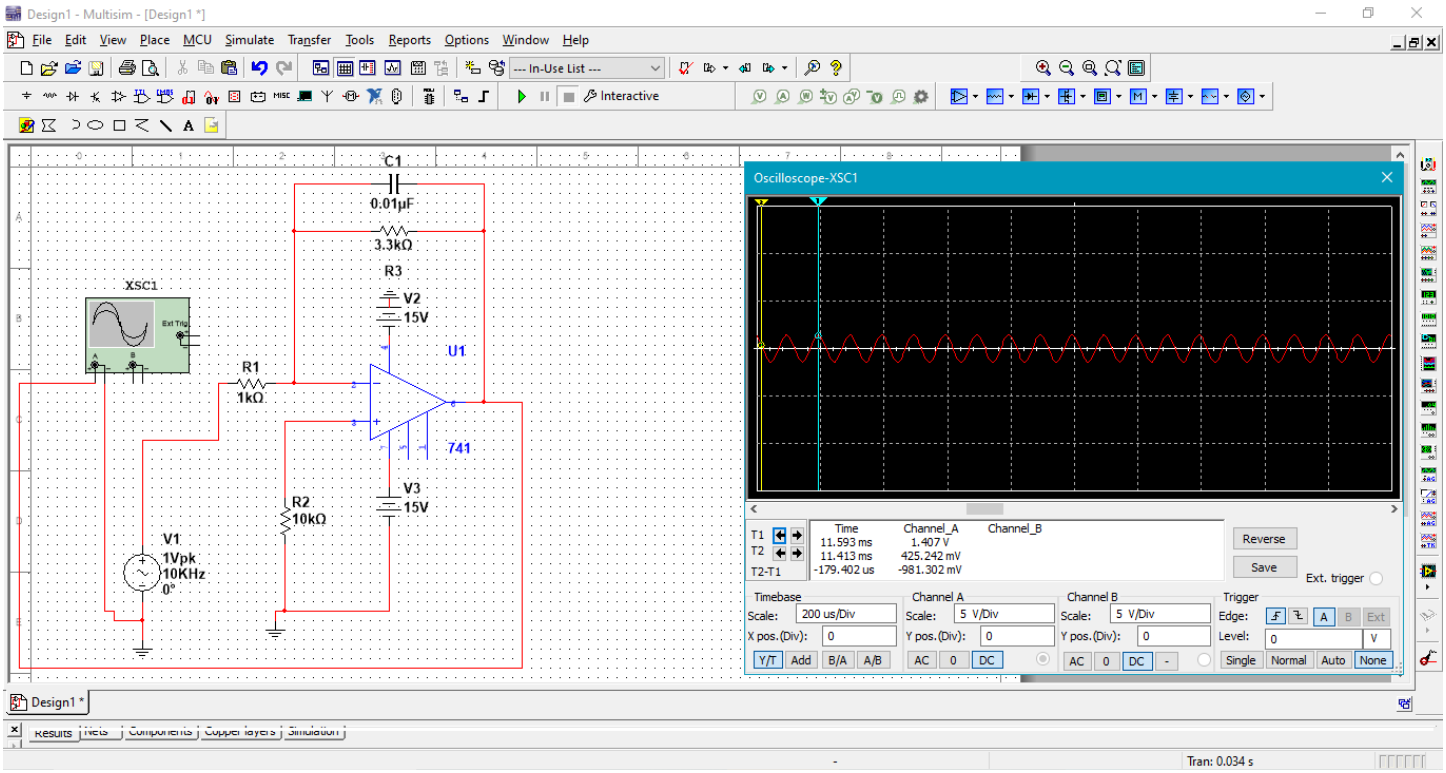

Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
C1
0.01µF
3.3kΩ
R3
XSC1
V2
15V
U1
R1
1kΩ
741
R2
10kΩ
V3
15V
V1
1Vpk
50Hz
0°
Oscilloscope-XSC1
Time Channel_A Channel_B
T1 715.116 ms 3.291 V
T2 700.000 ms 36.996 mV
T2-T1 -15.116 ms -3.254 V
Reverse
Save
Ext. trigger
Timebase
Scale: 10 ms/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Results
Tran: 2.656 s

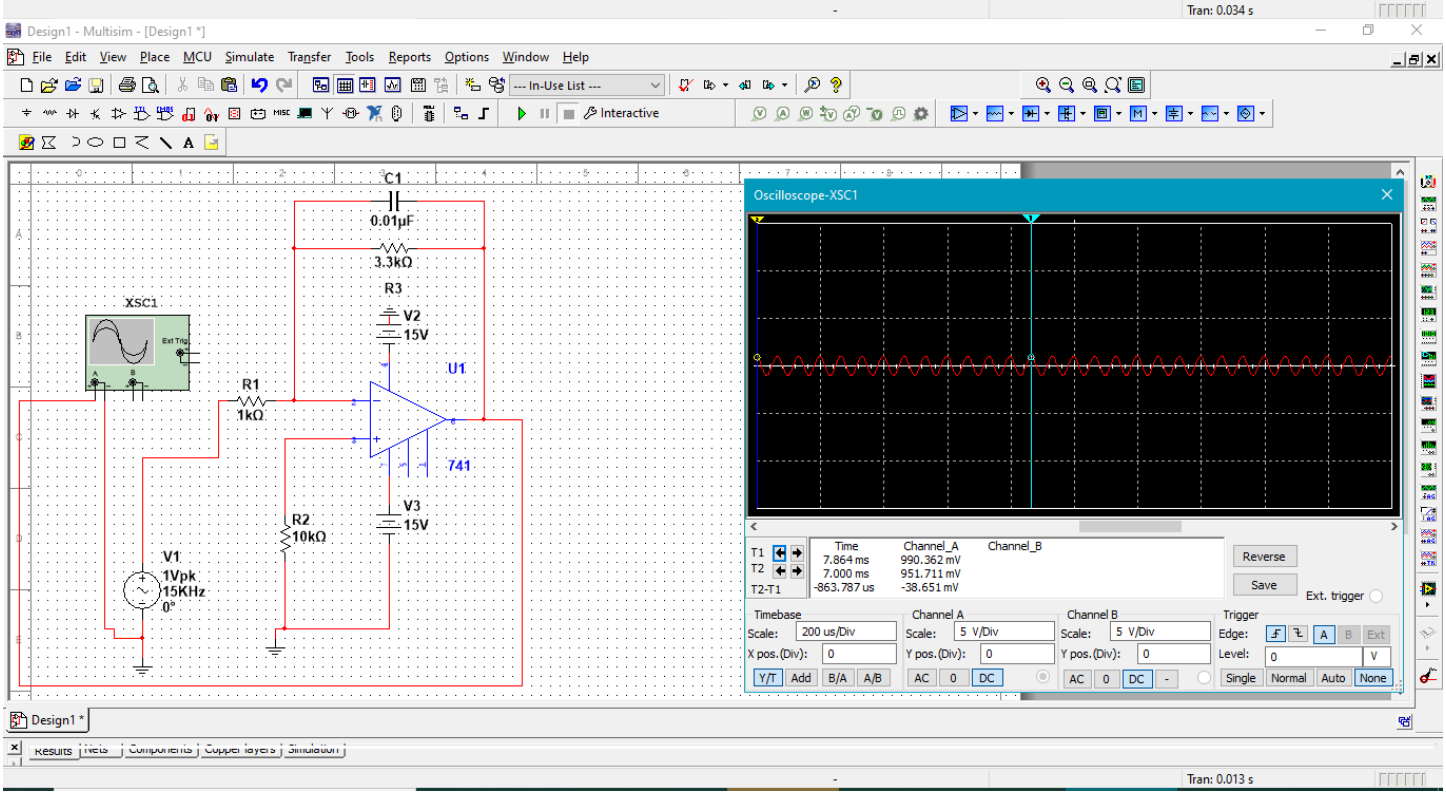

Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
--- In-Use List ---
Interactive
C1
0.01µF
3.3kΩ
R3
V2
15V
XSC1
U1
R1
1kΩ
741
R2
10kΩ
V3
15V
V1
1Vpk
100Hz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
7.641 ms
3.289 V
0.000 s
2.341 mV
-7.641 ms
-3.286 V
T1
T2
T2-T1
Reverse
Save
Ext. trigger
Timebase
Scale: 10 ms/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Results Nets Components Copper layers Simulation
Tran: 1.633 s


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
--- In-Use List ---
Interactive
C1
0.01µF
3.3kΩ
R3
V2
15V
XSC1
U1
R1
1kΩ
741
R2
10kΩ
V3
15V
V1
1Vpk
200Hz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
3.821 ms
3.282 V
0.000 s
2.341 mV
-3.821 ms
-3.280 V
T1
T2
T2-T1
Reverse
Save
Ext. trigger
Timebase
Scale: 10 ms/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Results Nets Components Copper layers Simulation
Tran: 0.515 s


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
C1
0.01µF
3.3kΩ
R3
V2
15V
XSC1
U1
R1
1kΩ
741
R2
10kΩ
V3
15V
V1
1Vpk
400Hz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
T1
1.910 ms
3.276 V
T2
0.000 s
2.341 mV
T2-T1
-1.910 ms
-3.274 V
Reverse
Save
Ext. trigger
Timebase
Scale: 5 ms/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Results
Tran: 0.504 s


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
C1
0.01µF
3.3kΩ
R3
V2
15V
XSC1
U1
R1
1kΩ
741
R2
10kΩ
V3
15V
V1
1Vpk
1KHz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
T1
36.791 ms
3.219 V
T2
34.000 ms
670.013 mV
T2-T1
-2.791 ms
-2.549 V
Reverse
Save
Ext. trigger
Timebase
Scale: 2 ms/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Results
Tran: 0.142 s

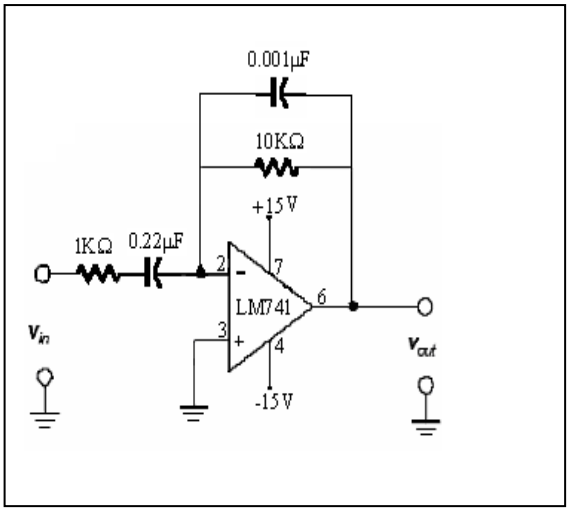

Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
C1
0.01µF
3.3kΩ
R3
V2
15V
XSC1
U1
R1
1kΩ
741
R2
10kΩ
V3
15V
V1
1Vpk
10KHz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
11.593 ms
1.407 V
11.413 ms
425.242 mV
-179.402 us
-981.302 mV
Reverse
Save
Ext. trigger
Timebase
Scale: 200 us/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Single
Normal
Auto
None
Design1 *
Tran: 0.034 s

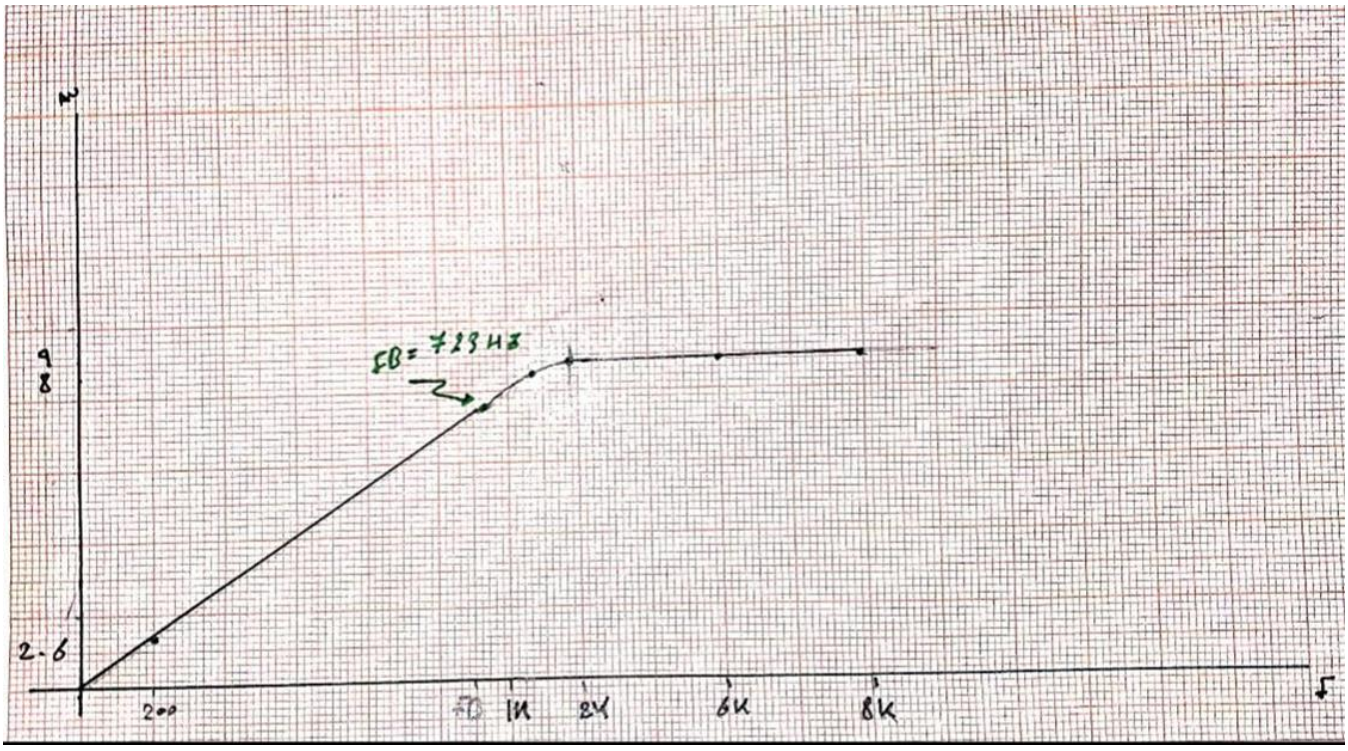

Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
C1
0.01µF
3.3kΩ
R3
V2
15V
XSC1
U1
R1
1kΩ
741
R2
10kΩ
V3
15V
V1
1Vpk
15KHz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
7.864 ms
990.362 mV
7.000 ms
951.711 mV
-863.787 us
-38.651 mV
Reverse
Save
Ext. trigger
Timebase
Scale: 200 us/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Single
Normal
Auto
None
Design1 *
Tran: 0.013 s

Part5: Differentiator

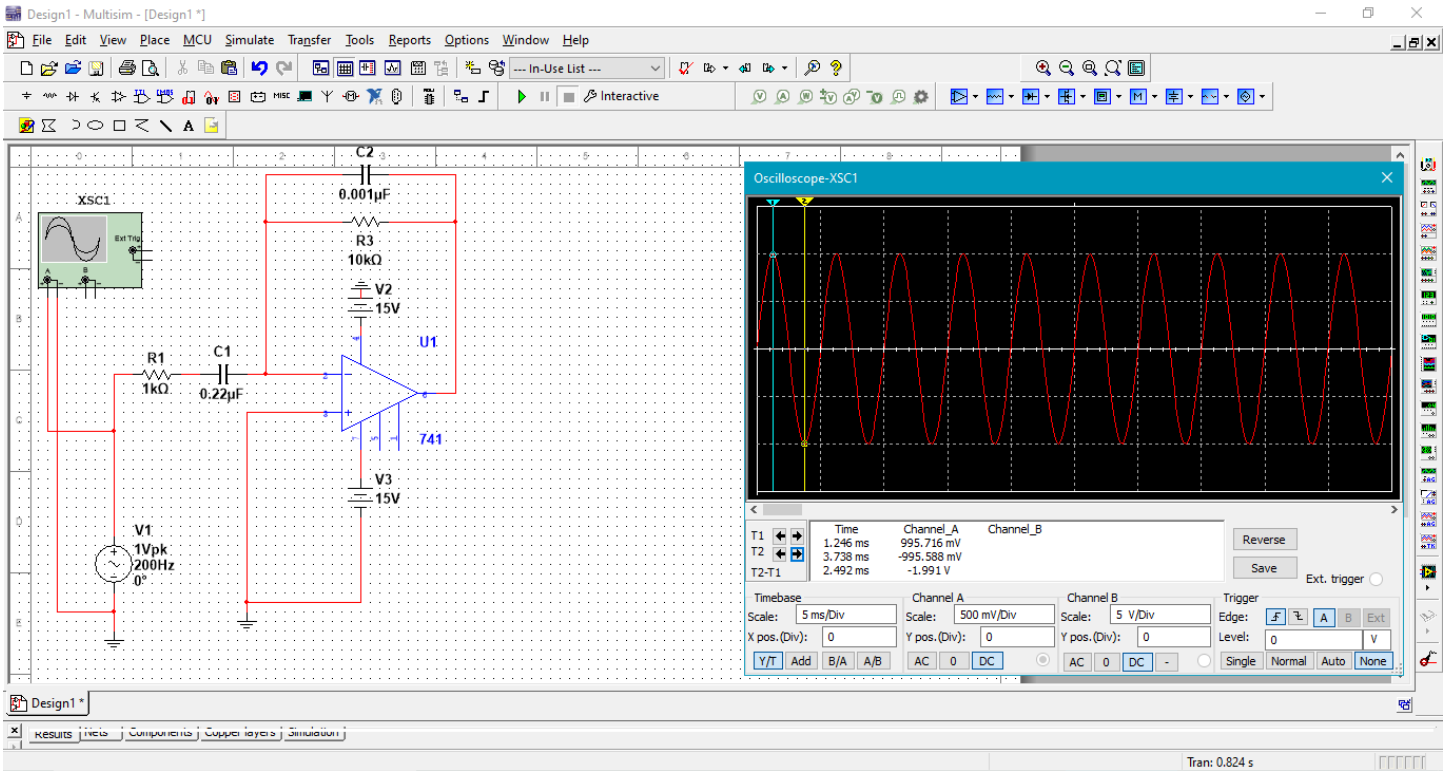
1. Connect the circuit shown. Apply a 2 $\boxed{V_{p-p}}$ sine wave.
2. Vary the frequency of V_{in} as shown in the Table 2 and record the results.
3. Calculate the gain ***and then plot the gain vs. frequency on semi-log graph pap***

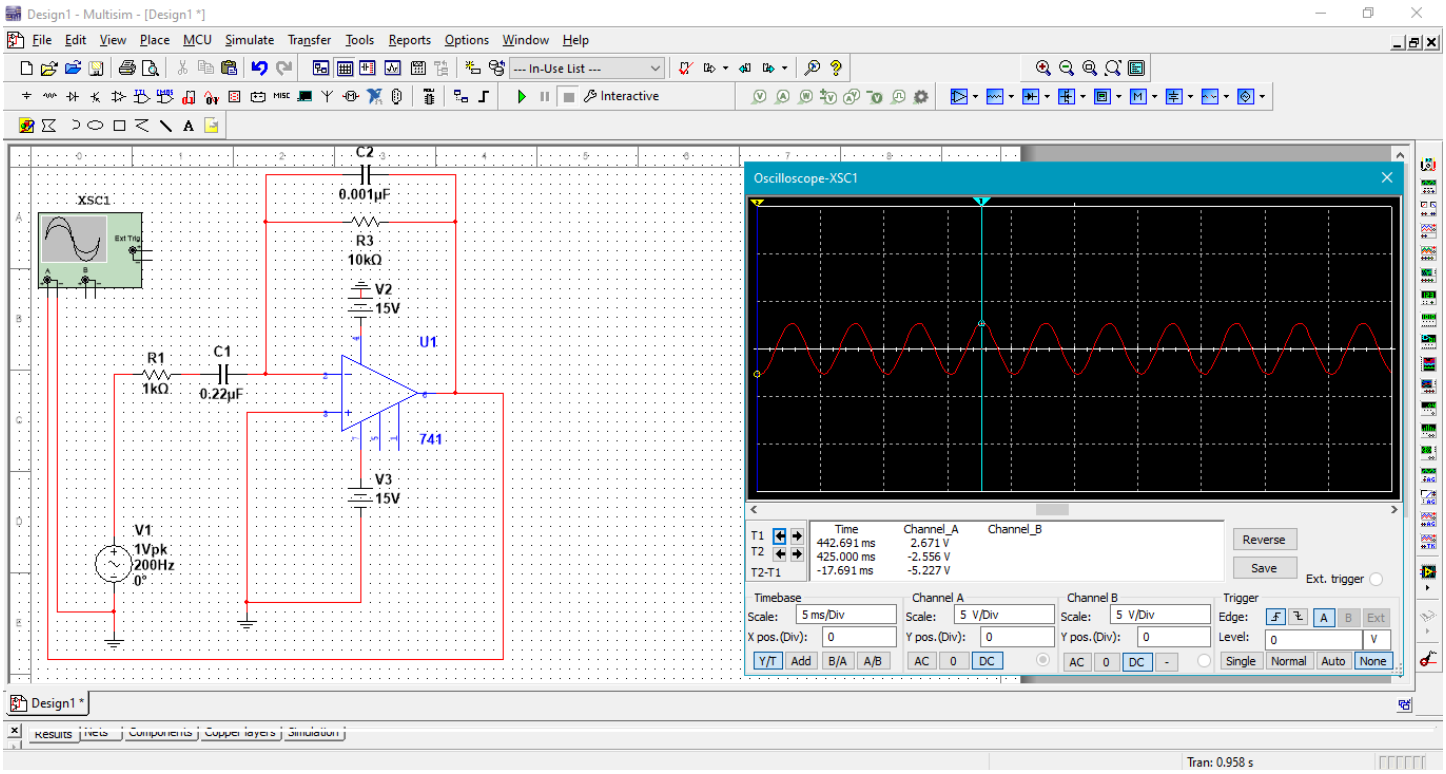
Frequency(Hz)	**PEAK V_{in} (Volt)**	**PEAK V_{out} (Volt)**	**Av**
200Hz	1V	2.671V	2.671
1K	1V	8.123V	8.123
2K	1V	9.333V	9.333
6K	1V	9.094V	9.094
8K	1V	8.569V	8.569

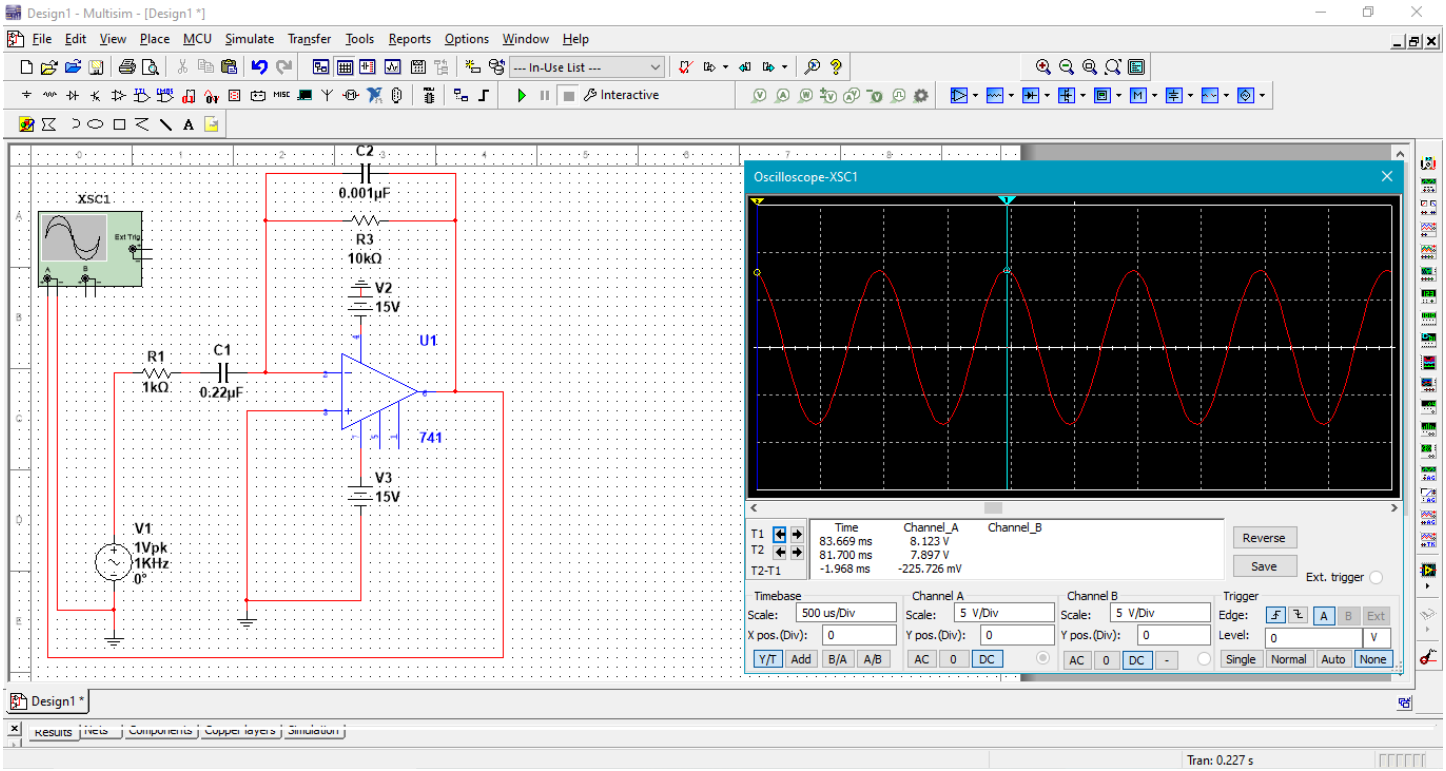


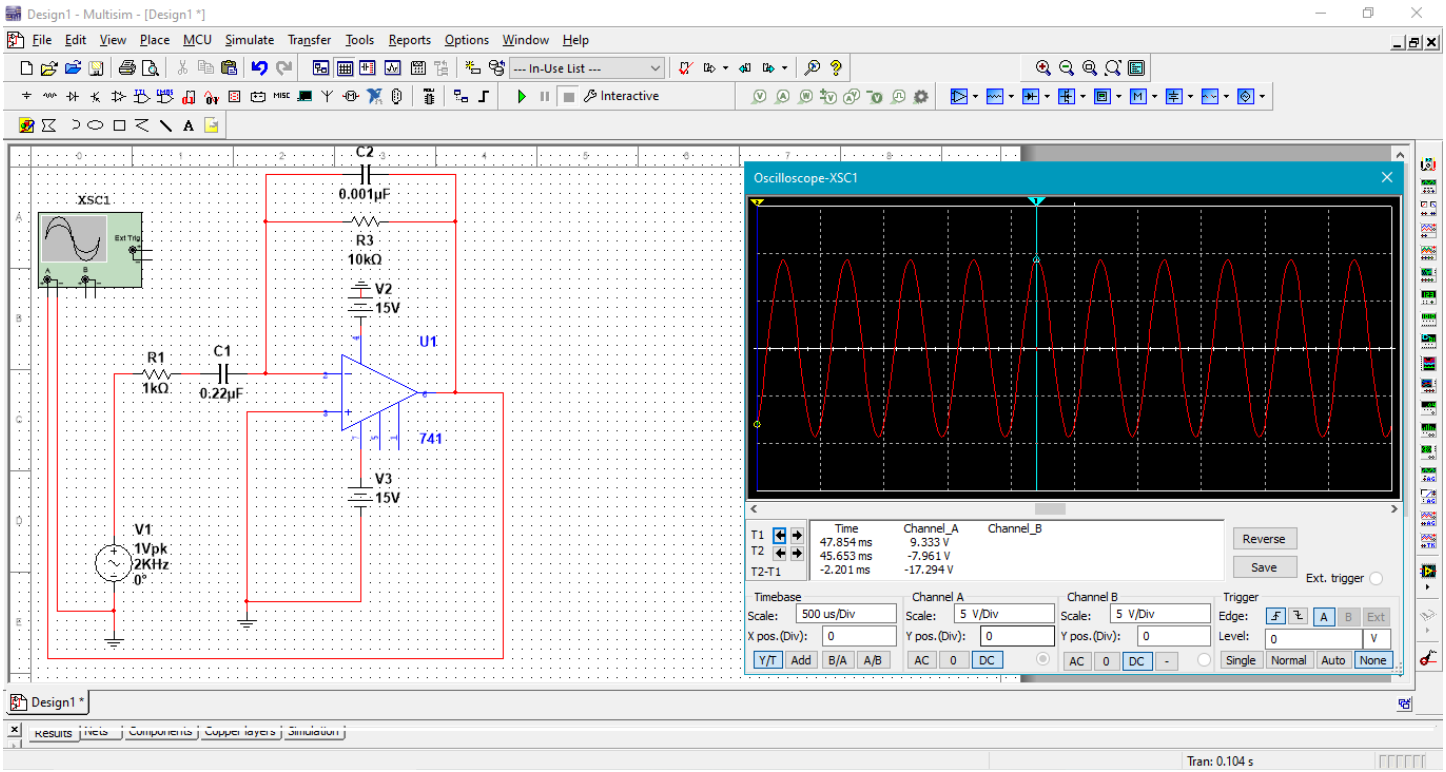


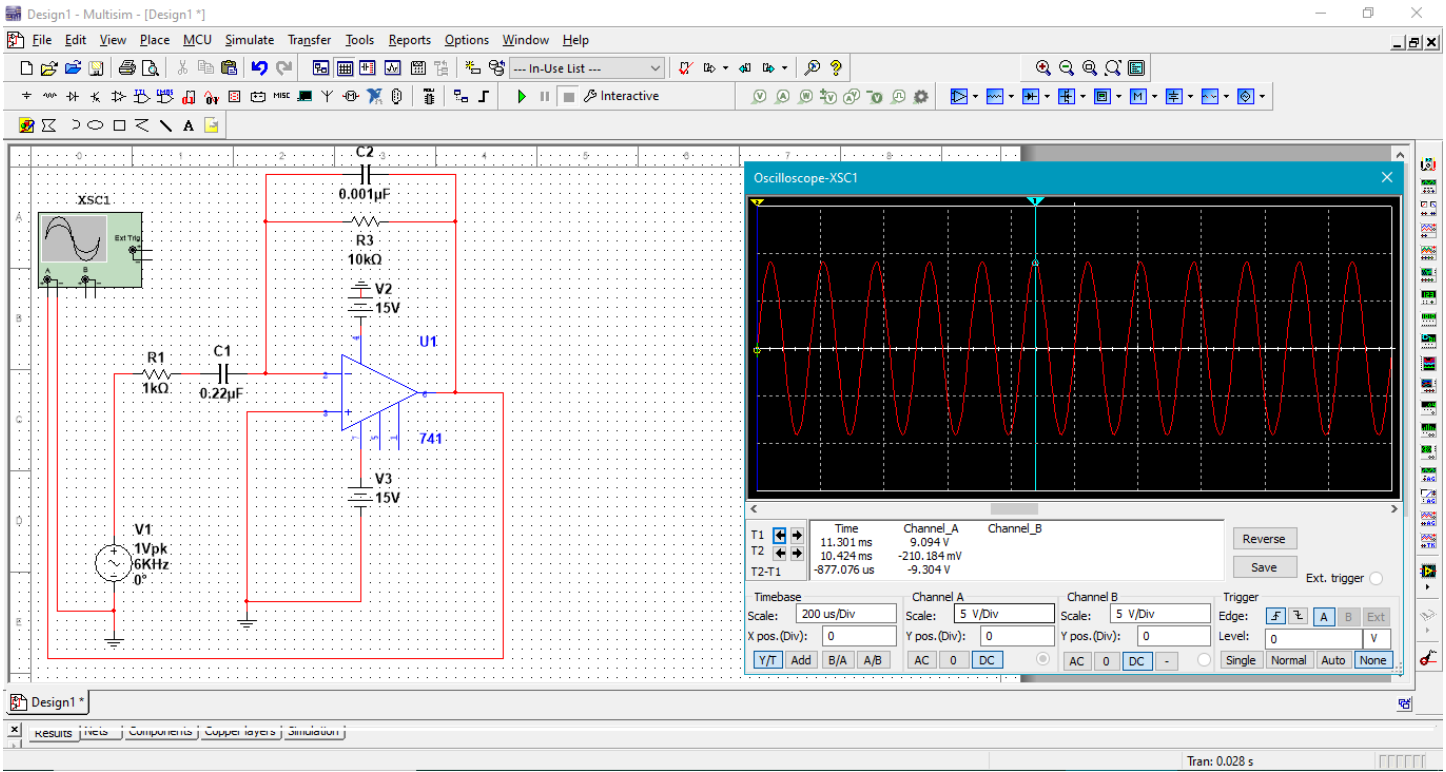
The Break Frequency of the differentiator circuit FB =1/(2Pi*R1*C1) (2*Pi*1K*0.22*10^-6)=723.4 HZ/1=

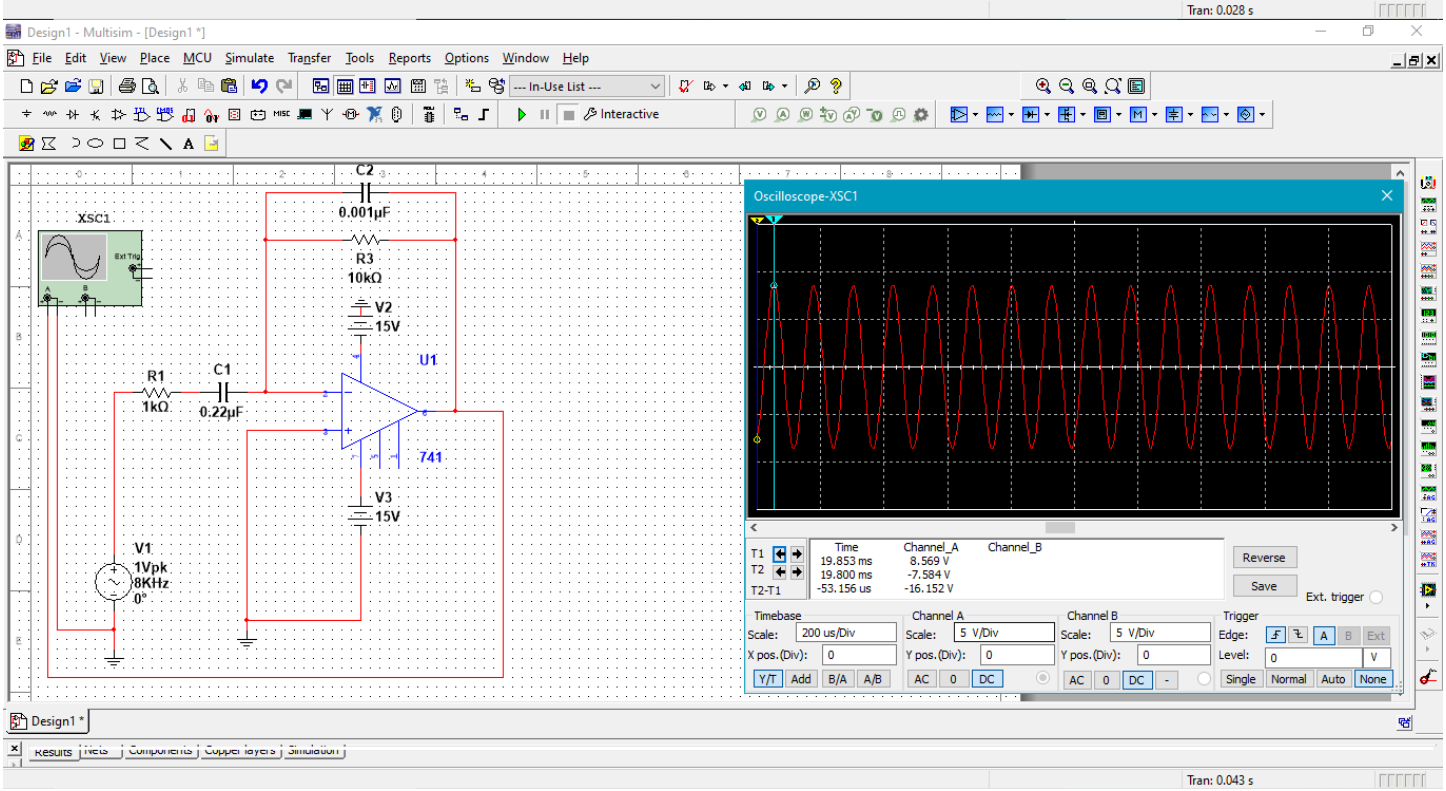

Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
--- In-Use List ---
Interactive
XSC1
C2
0.001µF
R3
10kΩ
V2
15V
U1
R1
1kΩ
C1
0.22µF
741
V3
15V
V1
1Vpk
200Hz
0°
Oscilloscope-XSC1
Time Channel_A Channel_B
1.246 ms 995.716 mV
3.738 ms -995.588 mV
2.492 ms -1.991 V
T1
T2
T2-T1
Reverse
Save
Ext. trigger
Timebase
Scale: 5 ms/Div
X pos.(Div): 0
Y/T Add B/A A/B
Channel A
Scale: 500 mV/Div
Y pos.(Div): 0
AC 0 DC
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
AC 0 DC
Trigger
Edge:
Level: 0 V
Single Normal Auto None
Design1 *
Results
Tran: 0.824 s


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
--- In-Use List ---
Interactive
XSC1
C2
0.001µF
R3
10kΩ
V2
15V
U1
R1
1kΩ
C1
0.22µF
741
V3
15V
V1
1Vpk
200Hz
0°
Oscilloscope-XSC1
Time Channel_A Channel_B
442.691 ms 2.671 V
425.000 ms -2.556 V
-17.691 ms -5.227 V
T1
T2
T2-T1
Reverse
Save
Ext. trigger
Timebase
Scale: 5 ms/Div
X pos.(Div): 0
Y/T Add B/A A/B
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
AC 0 DC
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
AC 0 DC
Trigger
Edge:
Level: 0 V
Single Normal Auto None
Design1 *
Results
Tran: 0.958 s


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
C2
0.001µF
XSC1
R3
10kΩ
V2
15V
U1
R1
1kΩ
C1
0.22µF
741
V3
15V
V1
1Vpk
1KHz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
83.669 ms
8.123 V
81.700 ms
7.897 V
-1.968 ms
-225.726 mV
T2-T1
Reverse
Save
Ext. trigger
Timebase
Scale: 500 us/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Results
Tran: 0.227 s


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
C2
0.001µF
XSC1
R3
10kΩ
V2
15V
U1
R1
1kΩ
C1
0.22µF
741
V3
15V
V1
1Vpk
2KHz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
47.854 ms
9.333 V
45.653 ms
-7.961 V
-2.201 ms
-17.294 V
T2-T1
Reverse
Save
Ext. trigger
Timebase
Scale: 500 us/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Results
Tran: 0.104 s


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
XSC1
C2
0.001µF
R3
10kΩ
V2
15V
U1
R1
1kΩ
C1
0.22µF
741
V3
15V
V1
1Vpk
6KHz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
T1 11.301 ms 9.094 V
T2 10.424 ms -210.184 mV
T2-T1 -877.076 us -9.304 V
Reverse
Save
Ext. trigger
Timebase
Scale: 200 us/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Tran: 0.028 s


Design1 - Multisim - [Design1 *]
File Edit View Place MCU Simulate Transfer Tools Reports Options Window Help
Interactive
XSC1
C2
0.001µF
R3
10kΩ
V2
15V
U1
R1
1kΩ
C1
0.22µF
741
V3
15V
V1
1Vpk
8KHz
0°
Oscilloscope-XSC1
Time
Channel_A
Channel_B
T1 19.853 ms 8.569 V
T2 19.800 ms -7.584 V
T2-T1 -53.156 us -16.152 V
Reverse
Save
Ext. trigger
Timebase
Scale: 200 us/Div
X pos.(Div): 0
Channel A
Scale: 5 V/Div
Y pos.(Div): 0
Channel B
Scale: 5 V/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None
Design1 *
Tran: 0.043 s