MUSTAFA SMAILI

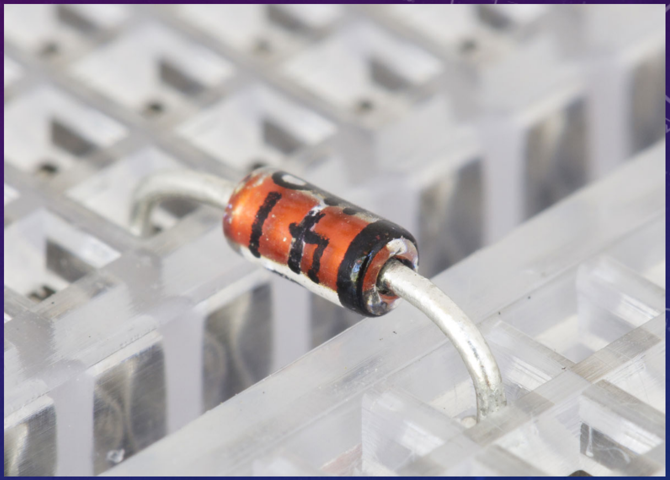
EECT121 LAB NOTEBOOK

CIRCUIT ANALYSIS

CONTENTS

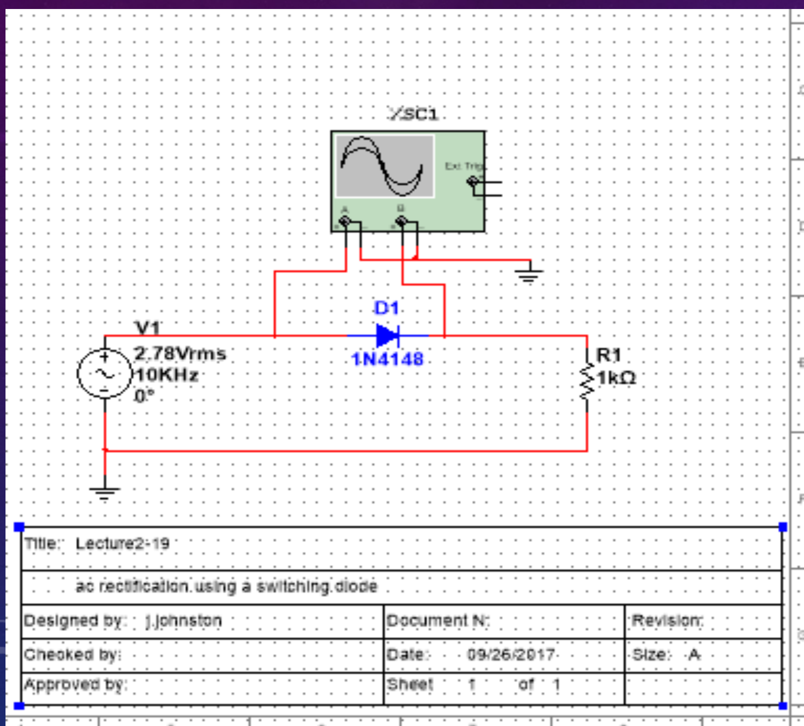
LAB 1-DIODES

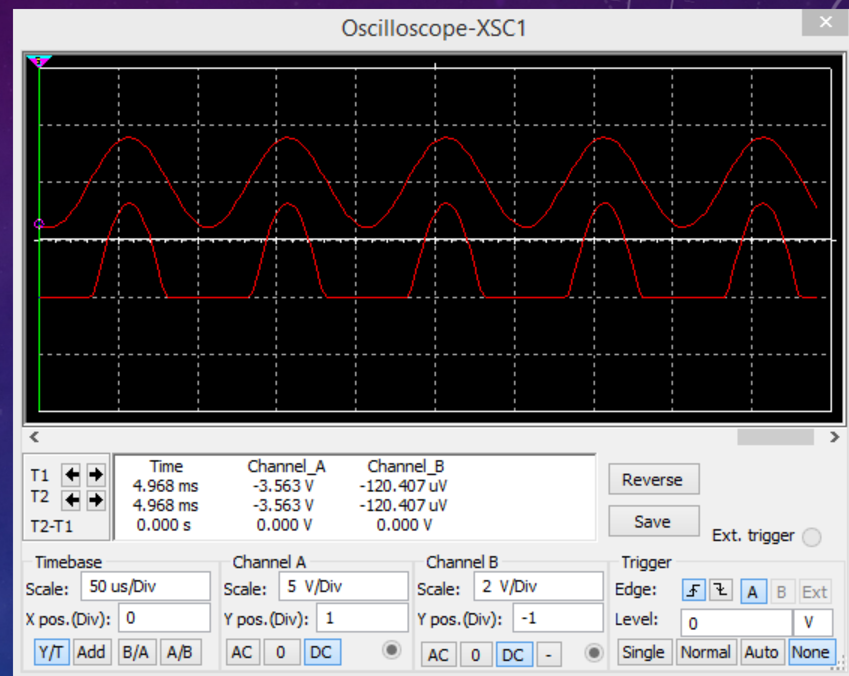
1 x 1N4148-
http://ivytechengineering.com/info/stores/diodes/files/1n4148.pdf
1 x 1kΩ resistor
Ocilliscope and Function generator



- In this lab we experiment switching diodes using Multisim then built and tested for functionality with an oscilloscope.
- We were also tasked with developing a procedure for characterizing this component

LAB 1 MULTISIM



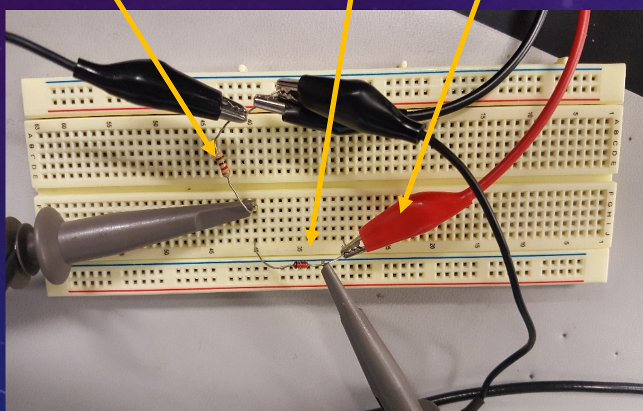


LAB 1 PICTURES

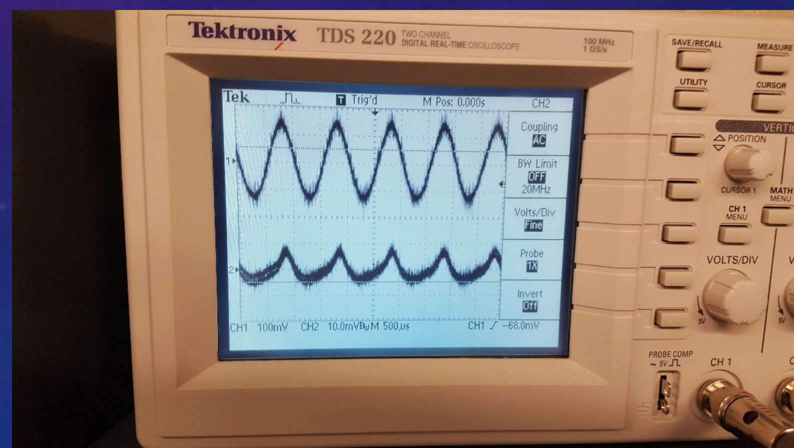
1kΩ
resistor

1n4148
Switching diode

Function generator



- Oscilloscope captured measurements



CONCLUSION

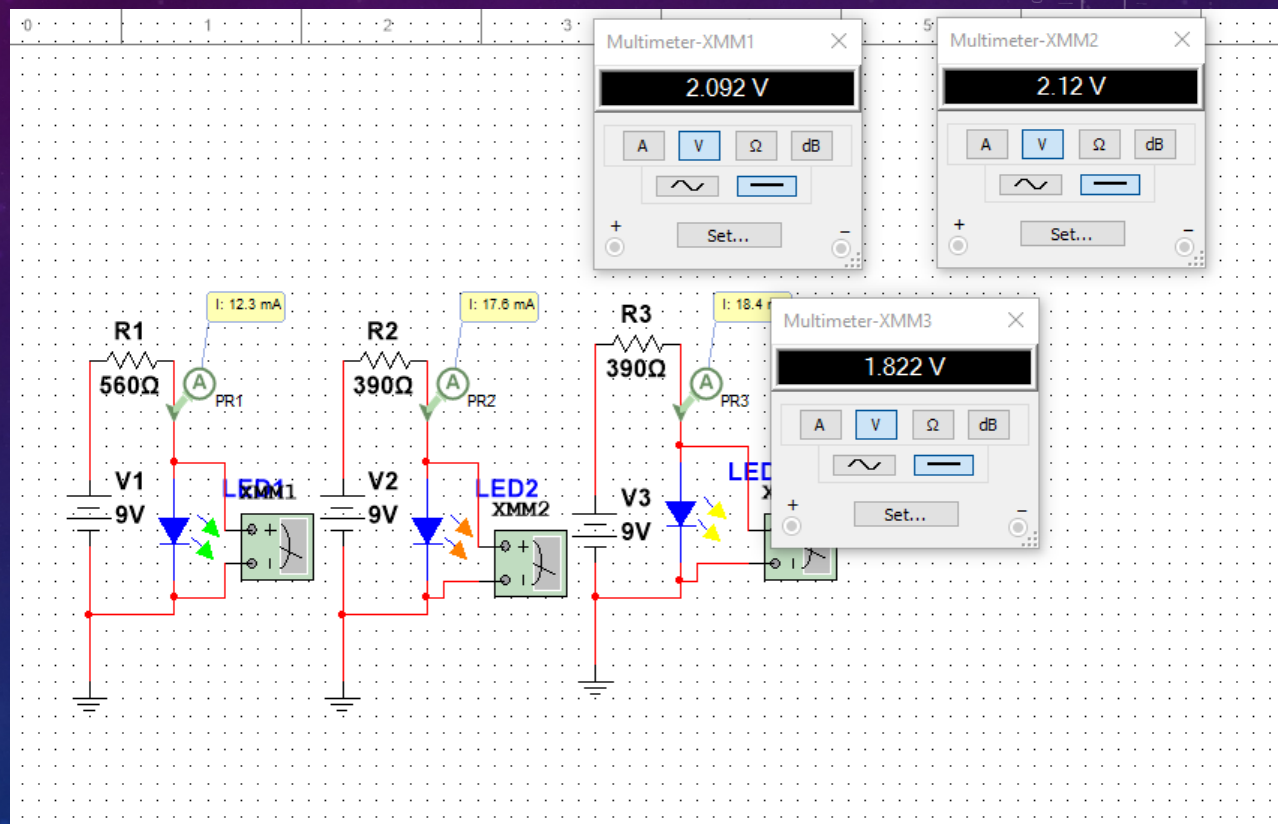
- Observations: Our component meet all expected measurements and values found in the data sheet. The was a simple lab build that required a lot of research and though in how to characterize our component the 1N4148.

LAB 2-LED

Equipment and parts needed:
1 – GDM-8245 Multi-meter
1 – HY1802D DC Power source
1 – Breadboard
1 – LED – 08L53GD - Green
1 – LED – 08L53YD - Yellow
1 – LED – 08L53ED - Amber
1 – 560 Ω Resistor

- The procedure for this lab is to first, measure the values for the parts being used in the lab, including the resistor and any diodes. After measuring the values, build a circuit using a bread board, making sure to include a ground, and voltage source. Once the circuit is built, measure the voltage drops across the resistor and the LED. After determining the voltage drop, calculate the currant using Ohm's law with the measured resistance and voltage drops at specific points within the circuit. Try and test different values of resistors to determine if the parameters given in the data table for the given LED is correct on min/max current. Record findings below.

MULTISIM


Multimeter-XMM1
2.092 V
Multimeter-XMM2
2.12 V
Multimeter-XMM3
1.822 V
I: 12.3 mA
I: 17.6 mA
R1
560Ω
PR1
V1
9V
LED1
XMM1
R2
390Ω
PR2
V2
9V
LED2
XMM2
R3
390Ω
PR3
V3
9V
Set...

EXCELL

Green

Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated	Calculated
Input Voltage (DC)		Resistor (Ω)		Voltage across LED		Currant (mA)	
9	9.052	560	554	2.092	2.043	12.355	12.7E-3
9	9.045	680	679	2.077	2.013	10.181	10.4E-3
9	9.045	780	778	2.067	1.994	8.889	9.1E-3
9	9.044	900	897	2.056	1.974	7.717	7.9E-3
9	9.045	1k	978	2.048	1.965	6.952	7.2E-3

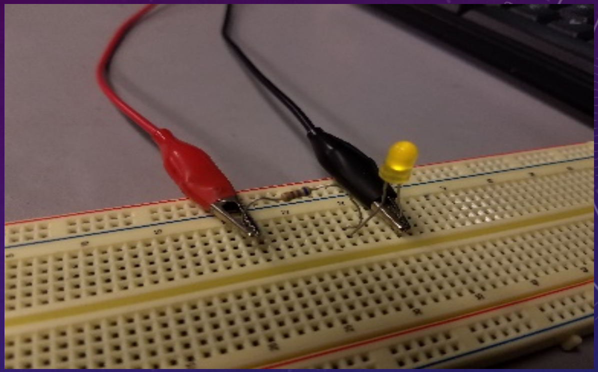
Yellow

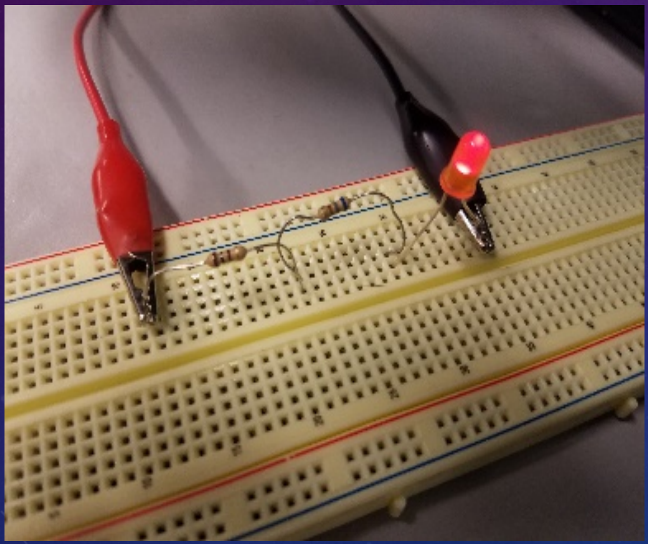
Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated	Calculated
Input Voltage (DC)		Resistor (Ω)		Voltage across LED		Currant (mA)	
9	9.045	560	554	1.803	1.995	12.852	12.7E-3
9	9.044	680	679	1.793	1.966	10.599	10.4E-3
9	9.047	780	778	1.786	1.952	9.249	9.1E-3
9	9.045	900	897	1.778	1.934	8.024	7.9E-3
9	9.043	1k	978	1.773	1.928	7.227	7.3E-3

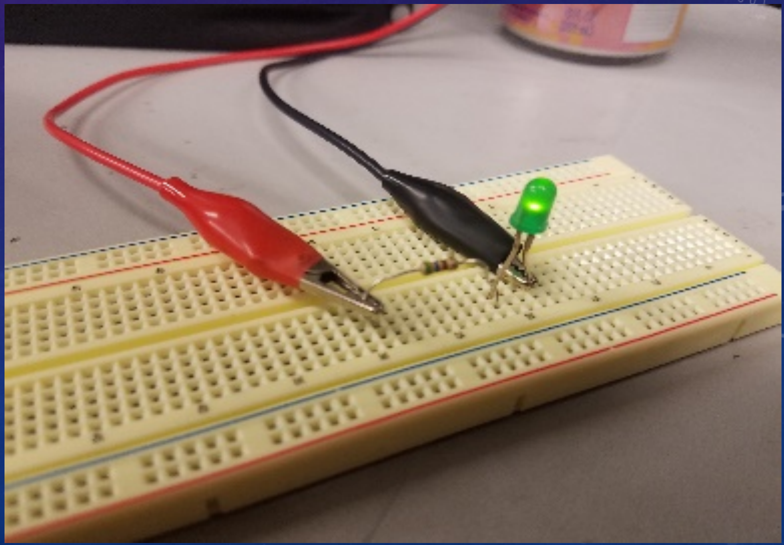
Amber

Simulated	Measured	Simulated	Measured	Simulated	Measured	Simulated	Calculated
Input Voltage (DC)		Resistor (Ω)		Voltage across LED		Currant (mA)	
9	9.045	560	554	1.803	1.863	12.852	13.0E-3
9	9.041	680	679	1.793	1.835	10.599	10.6E-3
9	9.043	780	778	1.786	1.827	9.249	9.3E-3
9	9.046	900	897	1.778	1.804	8.024	8.1E-3
9	9.042	1k	978	1.773	1.796	7.227	7.4E-3

LAB 2 PICTURES



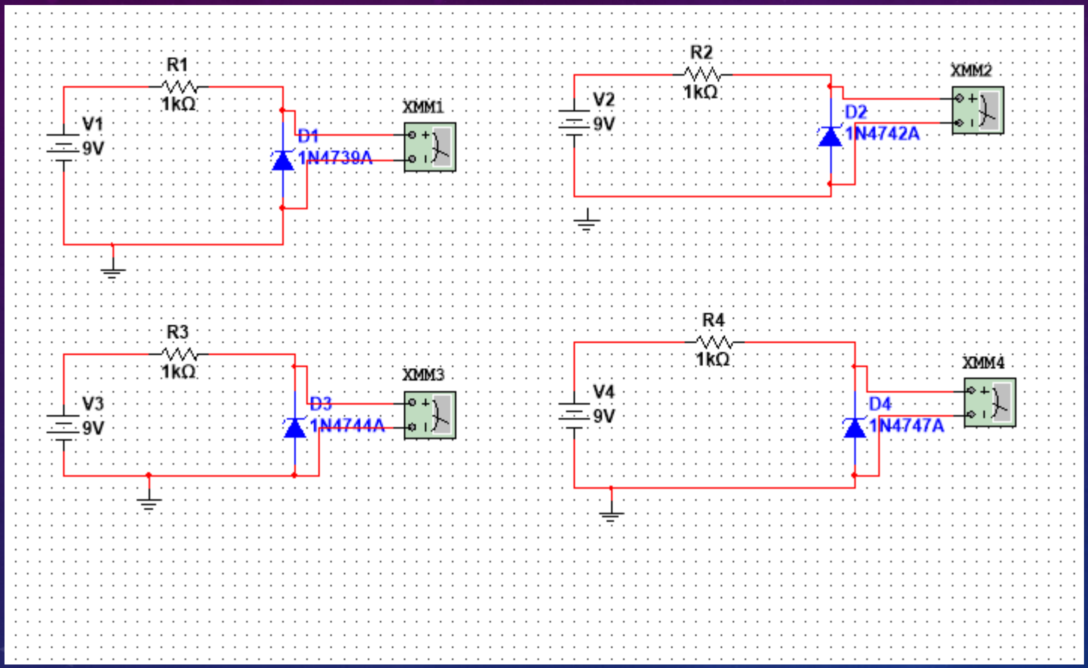




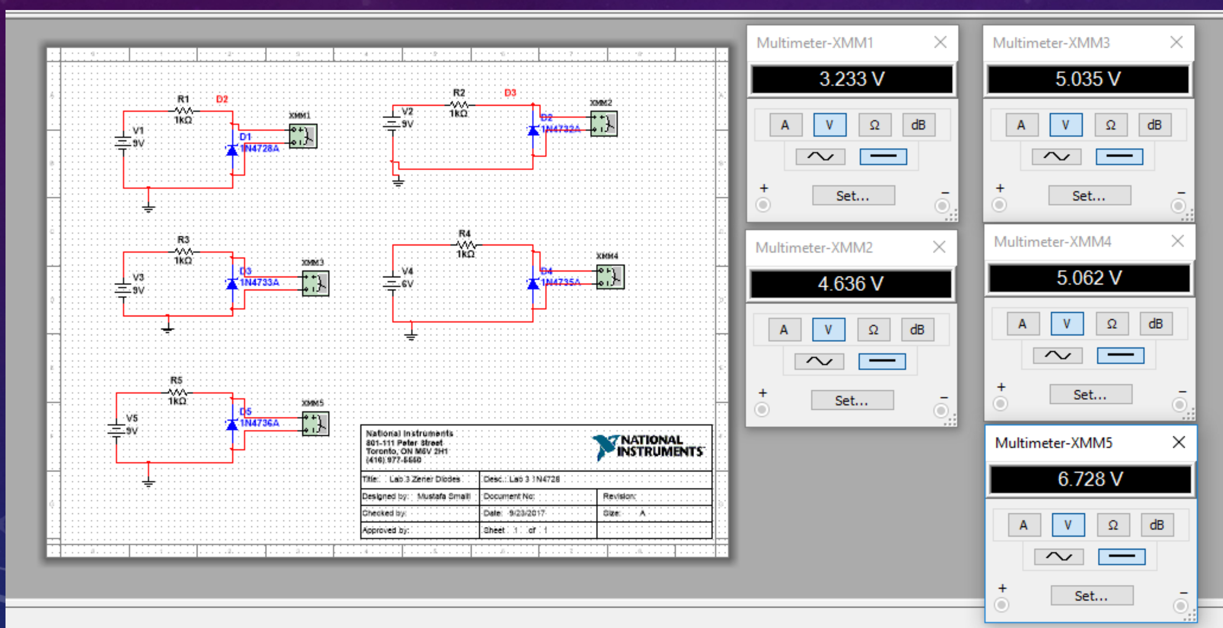
CONCLUSION

- In this lab, we built three different circuits with a 9 volt DC power supply, a resistor, and an LED. We used different resistor ratings to observe the changes to the brightness of the LED. We noticed that with less resistance, the LED illuminated more light. Some of the problems we ran into included: using too high a rating of resistor and not having any light emitted, and another one was that we only had an "Amber" option for LED in Multisim, but only had "Orange" in the lab. Over all we were able to get the each circuit to work.

LAB 3 MULTISIM



MULTISIM CONTINUE



EXCEL

Zener Diodes				
1N4728	Vz	V in	Multisim	Test
	3.3v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	2.999	2.999916
		3.5	3.16	3.21054
		4	3.183	3.235662
		4.5	3.195	3.248417
		5	3.203	3.256989
		5.5	3.209	3.26344
		6	3.214	3.268613
		6.5	3.219	3.272945
		7	3.222	3.276643
		7.5	3.225	3.279882
		8	3.228	3.282765
		8.5	3.231	3.285361
		9	3.233	3.287722

1N4732	Vz	V in	Multisim	Test
	4.7v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	3	3
		3.5	3.2	3.5
		4	4	4
		4.5	4.486	4.496587
		5	4.576	4.618575
		5.5	4.595	4.639617
		6	4.606	4.651248
		6.5	4.614	4.659294
		7	4.62	4.665444
		7.5	4.625	4.67042
		8	4.629	4.674611
		8.5	4.633	4.678208
		9	4.636	4.681368

1N4733	Vz	V in	Multisim	Test
	5.1v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	3	3
		3.5	3.5	3.5
		4	4	4
		4.5	4.5	4.5
		5	4.93	4.92654
		5.5	4.982	4.97985
		6	4.999	4.98965
		6.5	5.01	5.00154
		7	5.017	5.01685
		7.5	5.023	5.02245
		8	5.027	5.03056
		8.5	5.031	5.03068
		9	5.035	5.03498

1N4735	Vz	V in	Multisim	Test
	6.2v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	3	3
		3.5	3.5	3.5
		4	4	4
		4.5	4.5	4.5
		5	5	5
		5.5	5.043	5.03245
		6	5.062	5.05986
		6.5	5.073	5.07156
		7	5.081	5.08064
		7.5	5.087	5.08568
		8	5.092	5.08954
		8.5	5.096	5.09564
		9	5.099	5.09845

EXCEL CONTINUE

1N4736	Vz	V in	Multisim	Test
	6.8v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	3	3
		3.5	3.5	3.5
		4	4	4
		4.5	4.5	4.5
		5	5	5
		5.5	5.5	5.5
		6	6	6
		6.5	6.5	6.5
		7	6.678	6.66598
		7.5	6.701	6.70023
		8	6.714	6.71325
		8.5	6.722	6.72135
		9	6.728	6.72486

1N4739	Vz	V in	Multisim	Test
	9.1v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	3	3
		3.5	3.5	3.5
		4	4	4
		4.5	4.5	4.5
		5	5	5
		5.5	5.5	5.5
		6	6	6
		6.5	6.5	6.5
		7	7	7
		7.5	7.5	7.5
		8	8	8
		8.5	8.5	8.5
		9	8.941	8.98568

1N4742	Vz	V in	Multisim	Test
	12v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	3	3
		3.5	3.5	3.5
		4	4	4
		4.5	4.5	4.5
		5	5	5
		5.5	5.5	5.5
		6	6	6
		6.5	6.5	6.5
		7	7	7
		7.5	7.5	7.5
		8	8	8
		8.5	8.5	8.5
		9	9	9

EXCEL

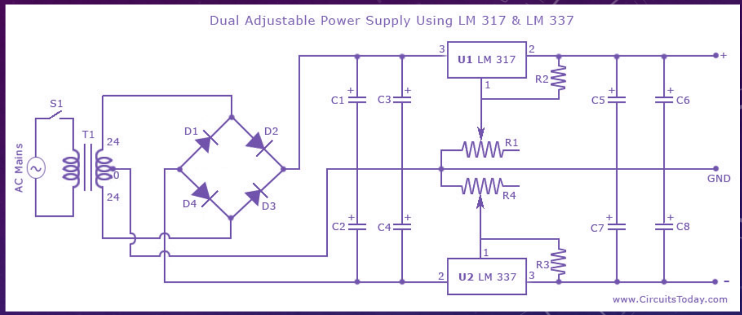
1N4744	Vz	V in	Multisim	Test
	15v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	3	3
		3.5	3.5	3.5
		4	4	4
		4.5	4.5	4.5
		5	5	5
		5.5	5.5	5.5
		6	6	6
		6.5	6.5	6.5
		7	7	7
		7.5	7.5	7.5
		8	8	8
		8.5	8.5	8.5
		9	9	9

1N4747	Vz	V in	Multisim	Test
	20v	0	0	0
		0.5	0.5	0.5
		1	1	1
		1.5	1.5	1.5
		2	2	2
		2.5	2.5	2.5
		3	3	3
		3.5	3.5	3.5
		4	4	4
		4.5	4.5	4.5
		5	5	5
		5.5	5.5	5.5
		6	6	6
		6.5	6.5	6.5
		7	7	7
		7.5	7.5	7.5
		8	8	8
		8.5	8.5	8.5
		9	9	9

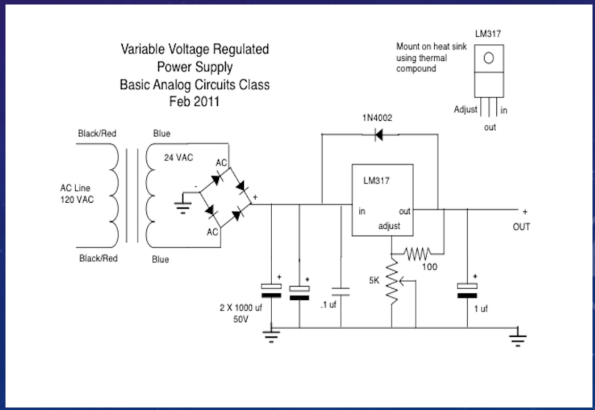
LAB 4-DUAL 9V SP

Procedures

- $\pm$9 VDC Output (5% Tolerance), 120 VAC Input
- Output Ripple ≤ 100mV
- All Linear Components
- Start-up time < 100ms
- Included Circuit Protection
- Maximum Material Cost $25

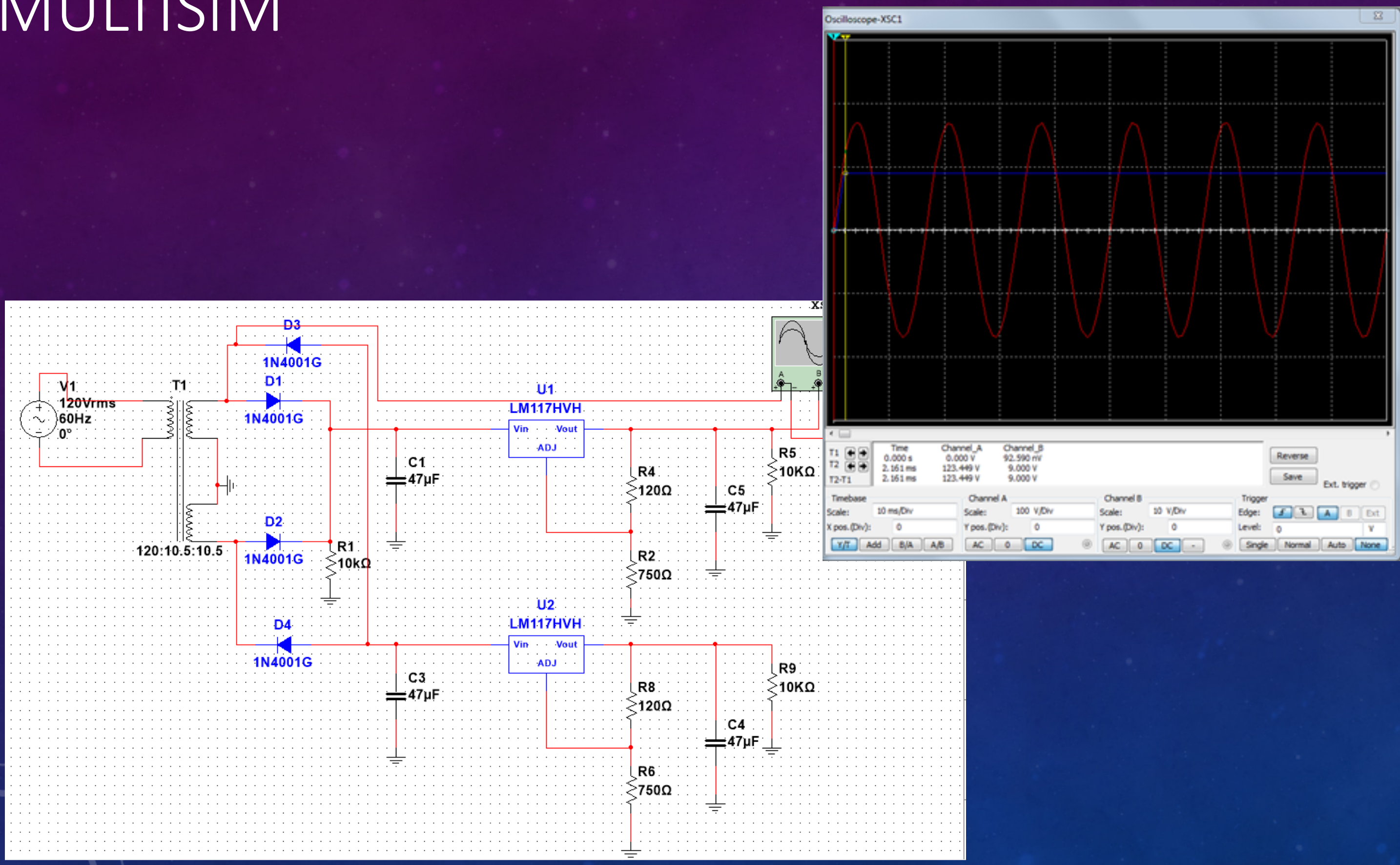


http://circuit-diagram.hqew.net/Dual-Adjustable-Power-Supply-Using-LM-317-_8273.html



http://www.kleebtronics.com/powersupply

MULTISIM

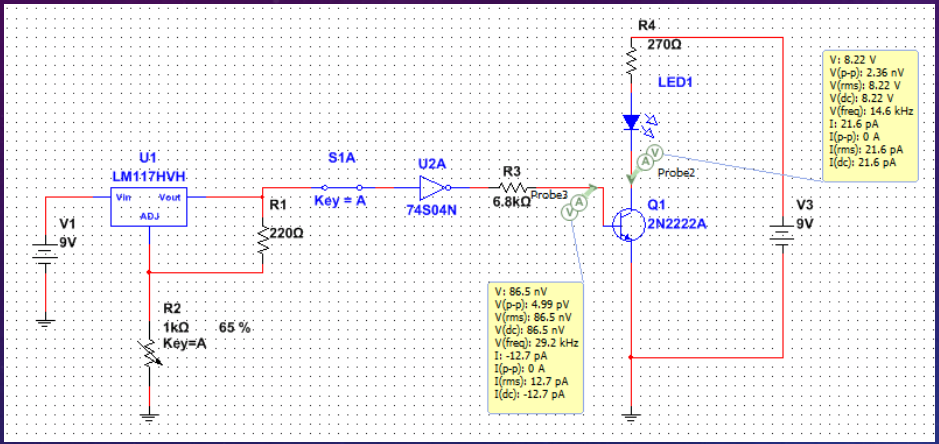


V1
120Vrms
60Hz
0°
T1
120:10.5:10.5
D3
1N4001G
D1
1N4001G
D2
1N4001G
D4
1N4001G
R1
10kΩ
C1
47µF
C3
47µF
U1
LM117HVH
U2
LM117HVH
Vin
Vout
ADJ
R4
120Ω
R2
750Ω
R8
120Ω
R6
750Ω
C5
47µF
C4
47µF
R5
10KΩ
R9
10KΩ
Oscilloscope-XSC1
Reverse
Save

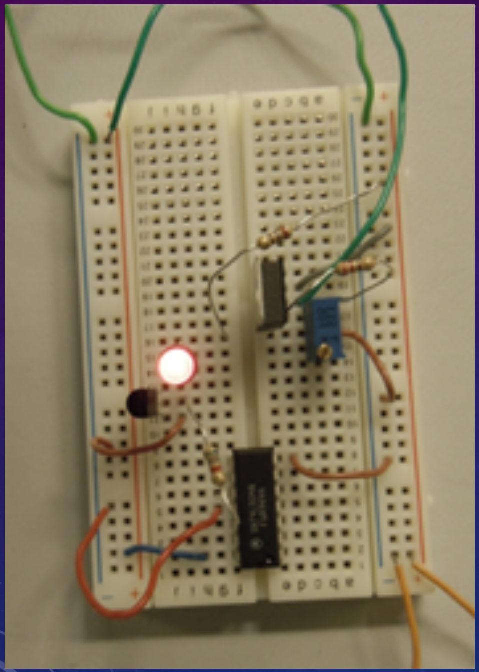
LAB 5-NPN LED

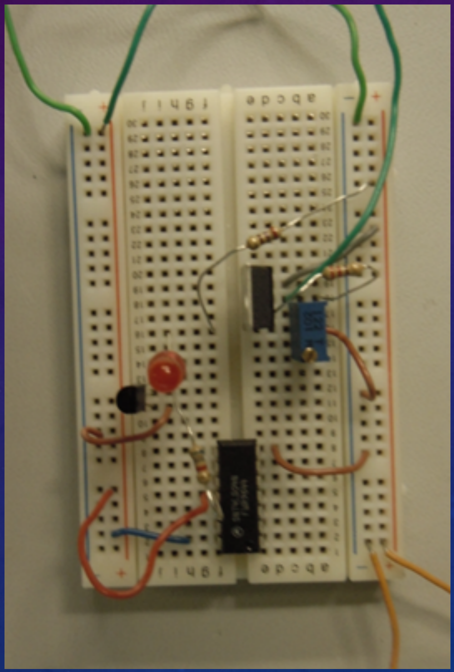
- GW Instek LCR meter model#: LCR-819 SN#: E120998
- DC Power Supply Model# HY1802D
- Digital Multi Meter Brand: GwInstek Model #: GDM-8245 SN: CL860332
- LM317 Voltage Regulator
- 74LS04 Hex Inverter
- 2N2222 NPN Transistor
- 3 – 1KΩ Resistor, 270 KΩ, 6.8KΩ
- 1 – Breadboard
- 1 – Wire kit
- 1 – Transistor 2N2222A
- Hex inverters 74L504D

MULTISIM


R4
270Ω
LED1
V: 8.22 V
V(p-p): 2.36 nV
V(rms): 8.22 V
V(dc): 8.22 V
V(freq): 14.6 kHz
I: 21.6 pA
I(p-p): 0 A
I(rms): 21.6 pA
I(dc): 21.6 pA
Probe2
U1
LM117HVH
Vin
Vout
ADJ
S1A
Key = A
U2A
74S04N
R3
6.8kΩ
Probe3
R1
220Ω
V1
9V
Q1
2N2222A
V3
9V
R2
1kΩ
65 %
Key=A
V: 86.5 nV
V(p-p): 4.99 pV
V(rms): 86.5 nV
V(dc): 86.5 nV
V(freq): 29.2 kHz
I: -12.7 pA
I(p-p): 0 A
I(rms): 12.7 pA
I(dc): -12.7 pA

PICTURES





CONCLUSION

- A transistor can be used as a switch
- First we struggled having the light to blink but then we figured it out.
- The switch inverter was with problems. Once it was grounded properly the circuit worked how it suppose to work

LAB 6-CE AMPLIFIER

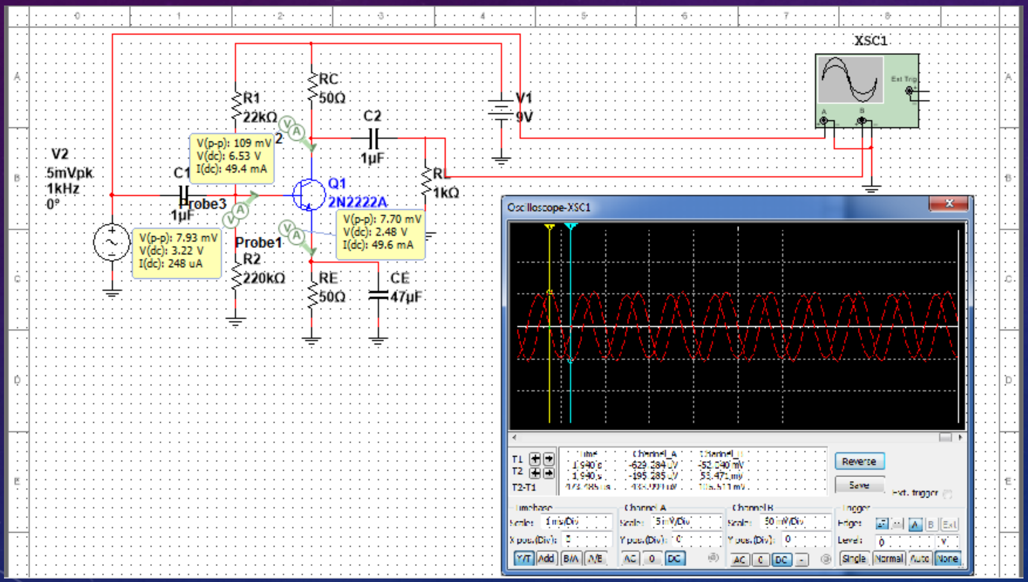
- To understand the operational characteristics of a common emitter (CE) amplifier and be able determine the maximum output available from a basic CE amplifier

Procedures:
Run a baseline simulation to see exactly where you are at with circuit performance
To determine an appropriate load line
To design the RC and RC resistor values
To design the R1 and R2 resistor values
The output amplitude can be adjusted by modifying the value of the CE capacitator.

Tools

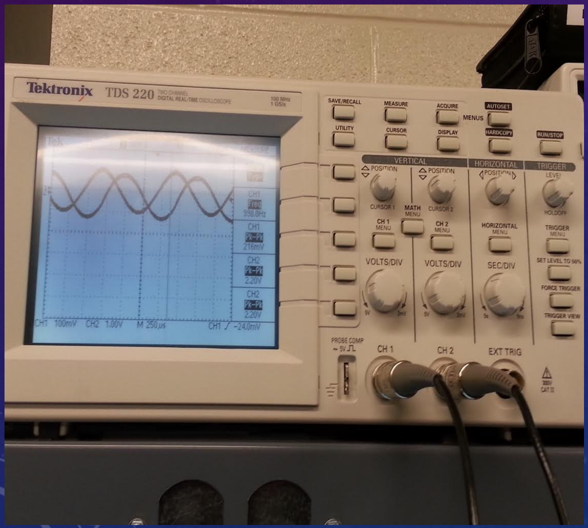
- Gw instek LCR METER LCR-819
- DC power supply
- Signal Generator
- Oscilloscope
- Digital multimeter
- Breadboard and wire
- 22kΩ Resistor
- 47Ω Resistor
- 1kΩ Resistor
- 150kΩ Resistor
- 1µF Capacitor
- 22µF Capacitor
- 47µF Capacitor
- 2N2222 NPN Transistor

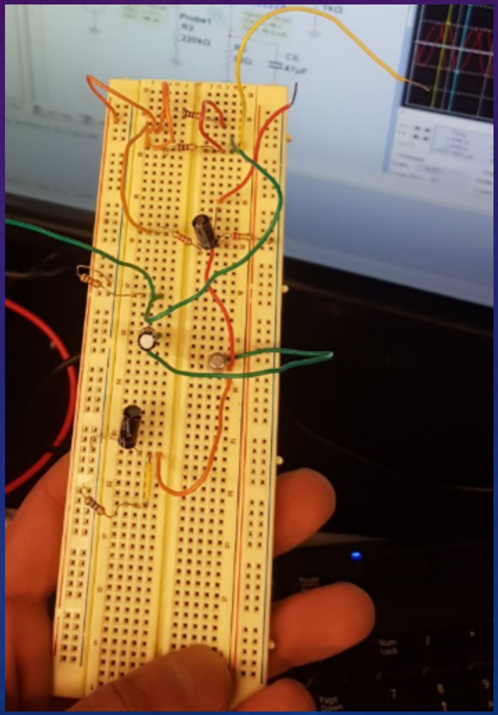
MULTISIM



XSC1
V2
5mVpk
1kHz
0°
R1
22kΩ
RC
50Ω
C2
1µF
V1
9V
RL
1kΩ
C1
1µF
Q1
2N2222A
Probe1
Probe3
R2
220kΩ
RE
50Ω
CE
47µF
V(p-p): 109 mV
V(dc): 6.53 V
I(dc): 49.4 mA
V(p-p): 7.93 mV
V(dc): 3.22 V
I(dc): 248 uA
V(p-p): 7.70 mV
V(dc): 2.48 V
I(dc): 49.6 mA
Reverse

PICTURE





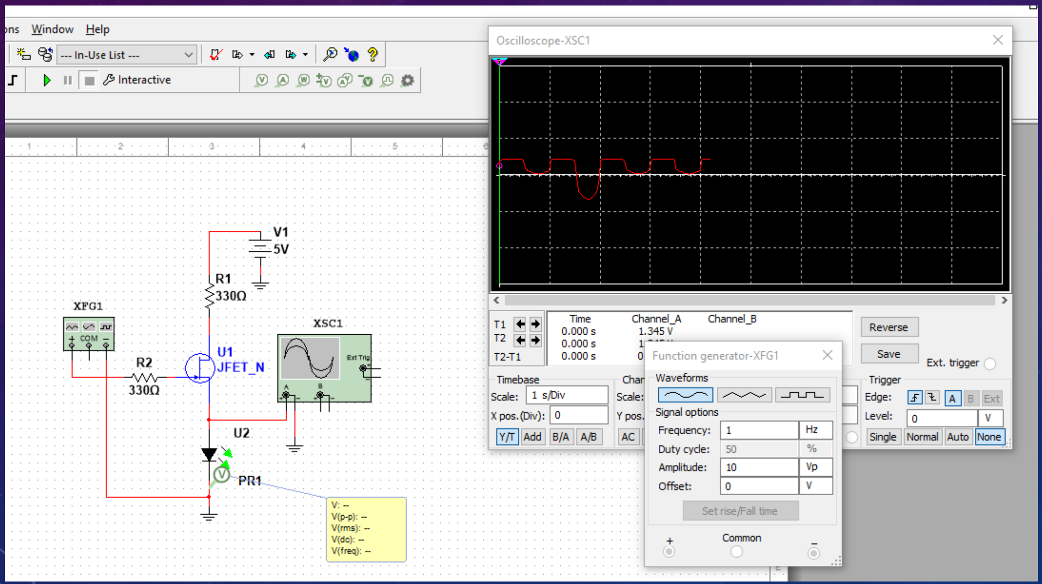
CONCLUSION

- The common emmiter amplifier circuit has a resistor in its collector circuit, the current flowing through this resistor produces the voltage output of the amplifier.
- The function generator could not create a 10mV wave that the circuit was originally designed for. This was fixed by finding out the lowest voltage that the function generator could produce and the schematic was redesigned for that voltage.

LAB 7-JFET LED

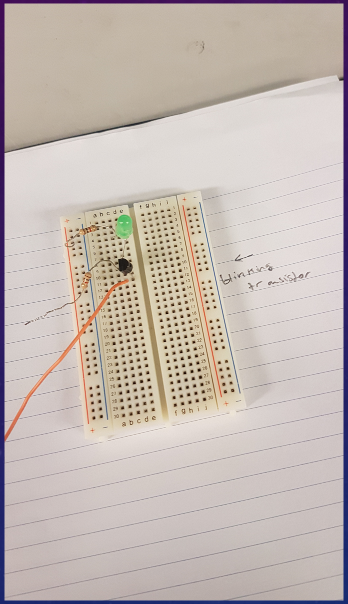
- 1 resistors –4.7KΩ
- 1 – Breadboard
- 1 – Wire kit
- 1 – Transistor 2N5457
- LED
- FUNCTION GENERATOR

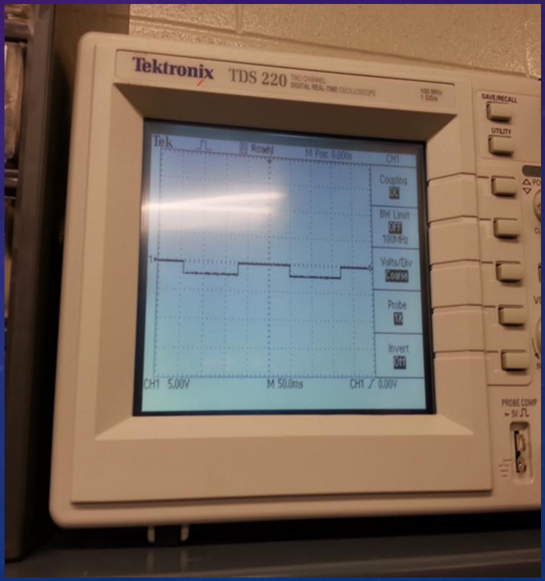
MULTISIM



Window
Help
--- In-Use List ---
Interactive
V1
5V
R1
330Ω
XFG1
XSC1
R2
330Ω
U1
JFET_N
U2
PR1
Oscilloscope-XSC1
Time
Channel_A
Channel_B
Reverse
Save
Ext. trigger
Timebase
Scale:
1 s/Div
X pos.(Div):
Y/T
Add
B/A
A/B
AC
Trigger
Edge:
Level:
Single
Normal
Auto
None
Function generator-XFG1
Waveforms
Signal options
Frequency:
1
Hz
Duty cycle:
50
%
Amplitude:
10
Vp
Offset:
0
V
Set rise/Fall time
Common

PICTURES


blinking transistor


Tektronix
TDS 220
Tek
Coupling
BW Limit
Volts/Div
Probe
Invert
CH1 5.00V
M 50.0ms

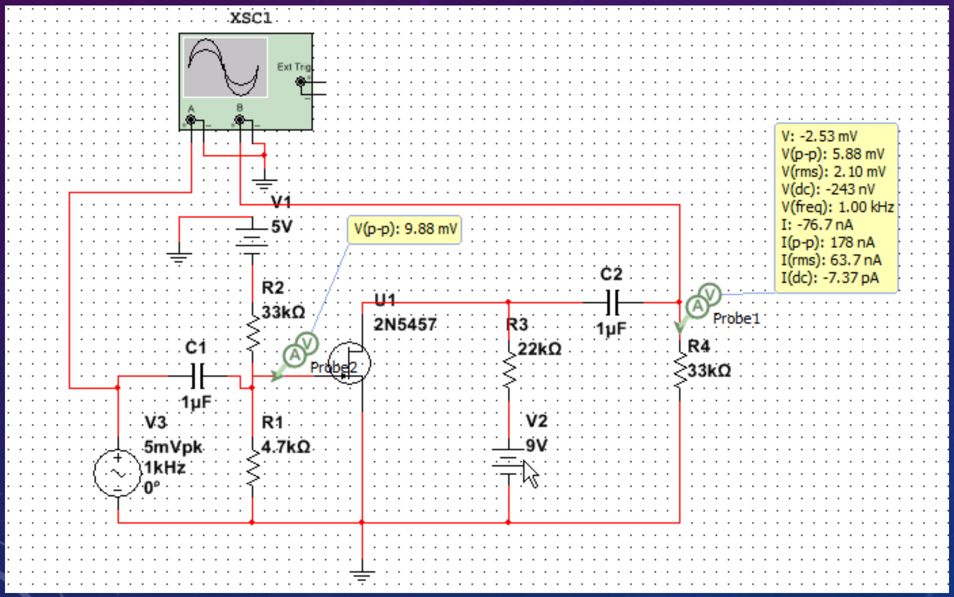
LAB 8-JFET TRANSISTOR

- Build a circuit using N-Type JFET

Equipments

- Oscilloscope Brand: Tektronix Model #: TDS220 SN: B083266
- Digital Multi Meter Brand: GwInstek Model #: GDM-8245 SN: CL860332
- Function Generator Brand: GwInstek Model #: GFG-8210 SN: C705245
- GW Instek LCR meter model#: LCR-819 SN#: E120998
- DC Power Supply Model# HY1802D

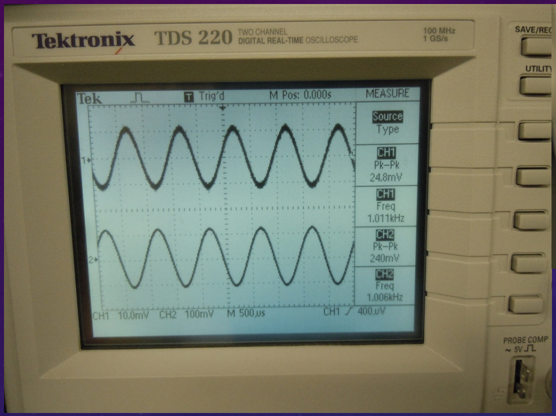
MULTISIM



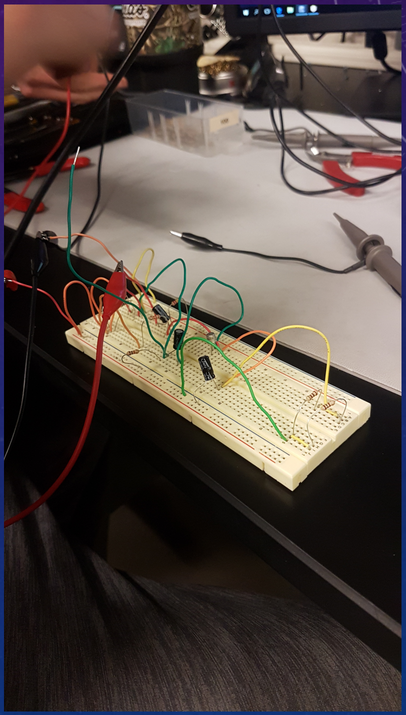
Model of 2N5457 used in the simulations

.model 2N5457DHJ NJF(Vto=-1.372
Beta=1.125m Lambda=2.3m
+ Vtotc=-2.5m Is=181.3f Isr=1.747p
N=1 Nr=2 Xti=3 Alpha=2.543u
+ Vk=152.2 Cgd=4p M=.3114 Pb=.5
Fc=.5 Cgs=4.627p Kf=10.45E-18
+ Betatce=-.5 Rd=1 Rs=1 Af=1)

PICTURES


Tektronix
TDS 220
Tek
Trig'd
M Pos: 0.000s
MEASURE
Source
Type
CH1
Pk-Pk
24.8mV
CH1
Freq
1.011kHz
CH2
Pk-Pk
240mV
CH2
Freq
1.006kHz
CH1 10.0mV CH2 100mV M 500µs CH1 / 400µV


1.0009
POWER
FREQUENCY
SWEEP
DUTY
OFFSET
AMPL
FUNCTION GENERATOR



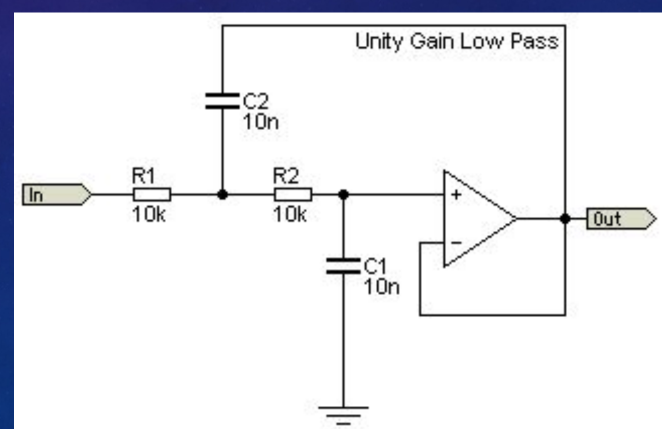
LAB 9-LOW PASS FILTER

- Find a design on the web and calculate the proper values for the Capacitors and resistors so the circuit will cut-off frequencies above 1kHz (Min. -3dB).
- Build the circuit in MultiSim13 and run an AC circuit analysis to conform your calculations are correct.
- The topology used was 'Sub-Bessel' Sallen-Key and acquired at:
- http://sound.westhost.com/articles/active-filters.htm#s3

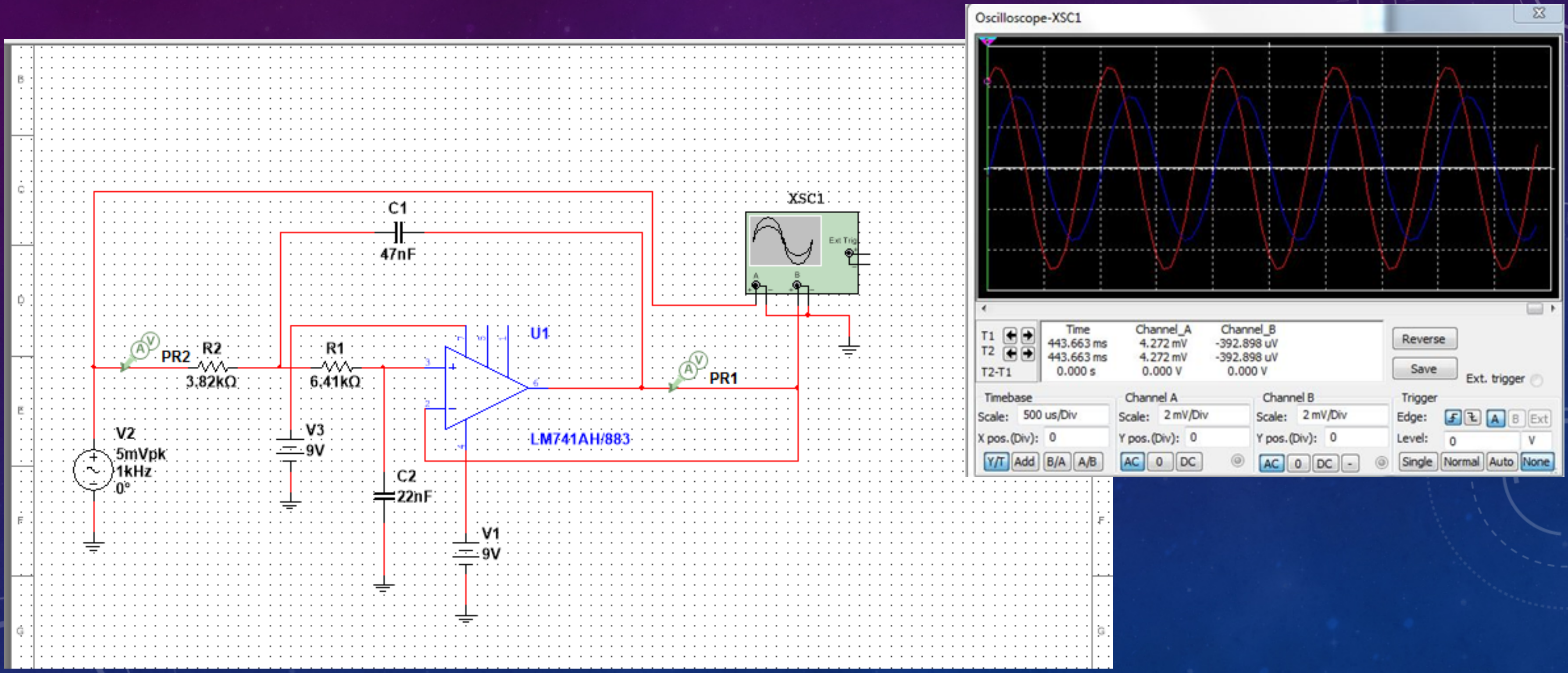
The general formula for a filter is ...

$f_o = 1 / (2 * \pi * R * C)$ Where R is resistance, C is capacitance, and f_o is the cutoff frequency

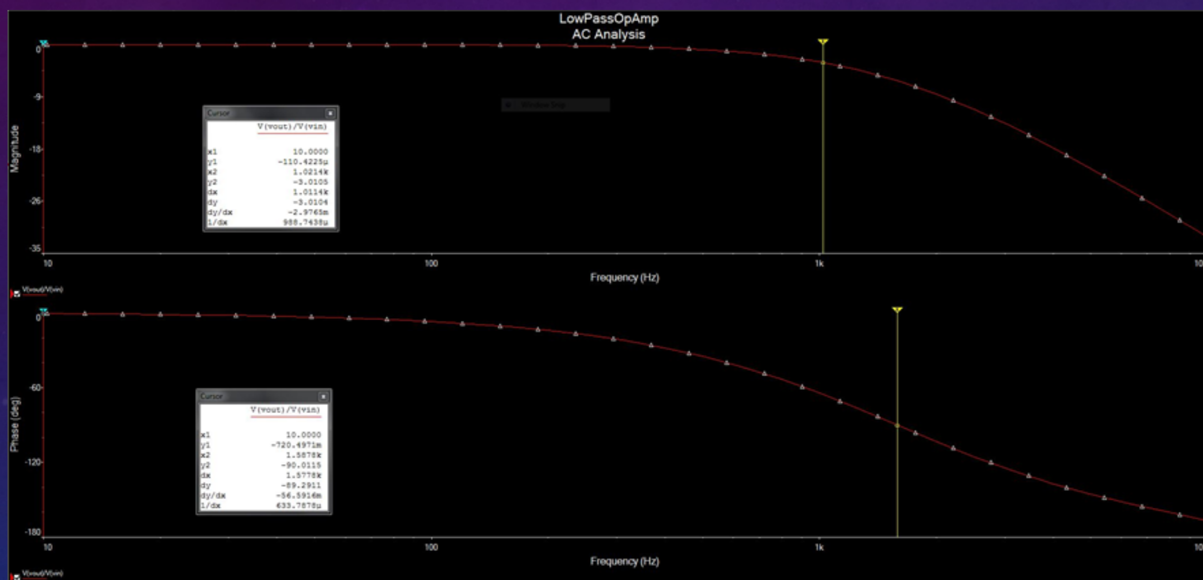
... however, this is modified (sometimes dramatically) once we start using filters of second order and higher.



MULTISIM



Oscilloscope-XSC1
XSC1
C1
47nF
R2
3.82kΩ
R1
6.41kΩ
PR2
PR1
U1
LM741AH/883
V2
5mVpk
1kHz
0°
V3
9V
C2
22nF
V1
9V
Time
Channel_A
Channel_B
T1
T2
T2-T1
443.663 ms
4.272 mV
-392.898 uV
0.000 s
0.000 V
Reverse
Save
Ext. trigger
Timebase
Scale: 500 us/Div
X pos.(Div): 0
Channel A
Scale: 2 mV/Div
Y pos.(Div): 0
Channel B
Scale: 2 mV/Div
Y pos.(Div): 0
Trigger
Edge:
Level: 0 V
Y/T Add B/A A/B
AC 0 DC
Single Normal Auto None


LowPassOpAmp
AC Analysis
Magnitude
0
-9
-18
-26
-35
10
100
1k
10k
Frequency (Hz)
Cursor
V(vout)/V(vin)
x1 10.0000
y1 -110.4225µ
x2 1.0214k
y2 -3.0105
dx 1.0114k
dy -3.0104
dy/dx -2.9765m
1/dx 988.7438µ
V(vout)/V(vin)
Phase (deg)
0
-60
-120
-180
10
100
1k
10k
Frequency (Hz)
Cursor
V(vout)/V(vin)
x1 10.0000
y1 -720.4971m
x2 1.5878k
y2 -90.0115
dx 1.5778k
dy -89.2911
dy/dx -56.5916m
1/dx 633.7878µ
V(vout)/V(vin)

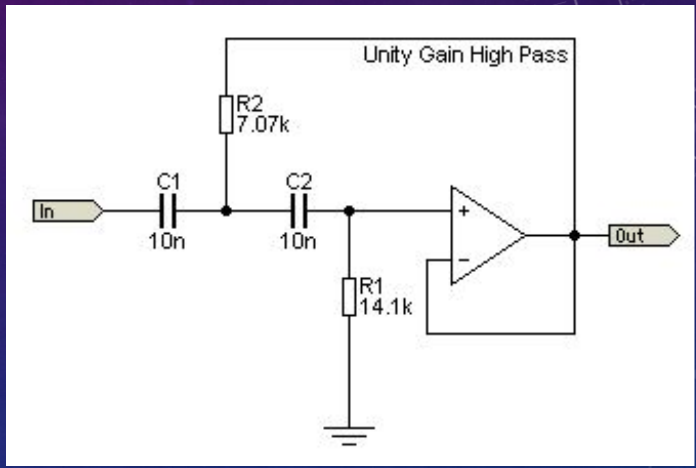
EXCEL AND CONCLUSION

The calculations may be unpredictable for second order filter

	A	B	C	D
1	A(0)	1		
2	a(1)	1.4142		
3	b(1)	1		
4	c1	22.0E-9		
5	c2	44.0E-9	47.0E-9	
6	r1	3.82E+3		
7	r2	6.41E+3		
8	Fc	1.0E+3	Hz	
9				

LAB 10-HIGH PASS FILTER

Find a design on the web and calculate the proper values for the Capacitors and resistors so the circuit will cut-off frequencies below 1kHz.
Build the circuit in MultiSim13 and run an AC circuit analysis to conform your calculations are correct.
The topology used was 'Butterworth' Sallen-Key and acquired at:
http://sound.westhost.com/articles/active-filters.htm#s3

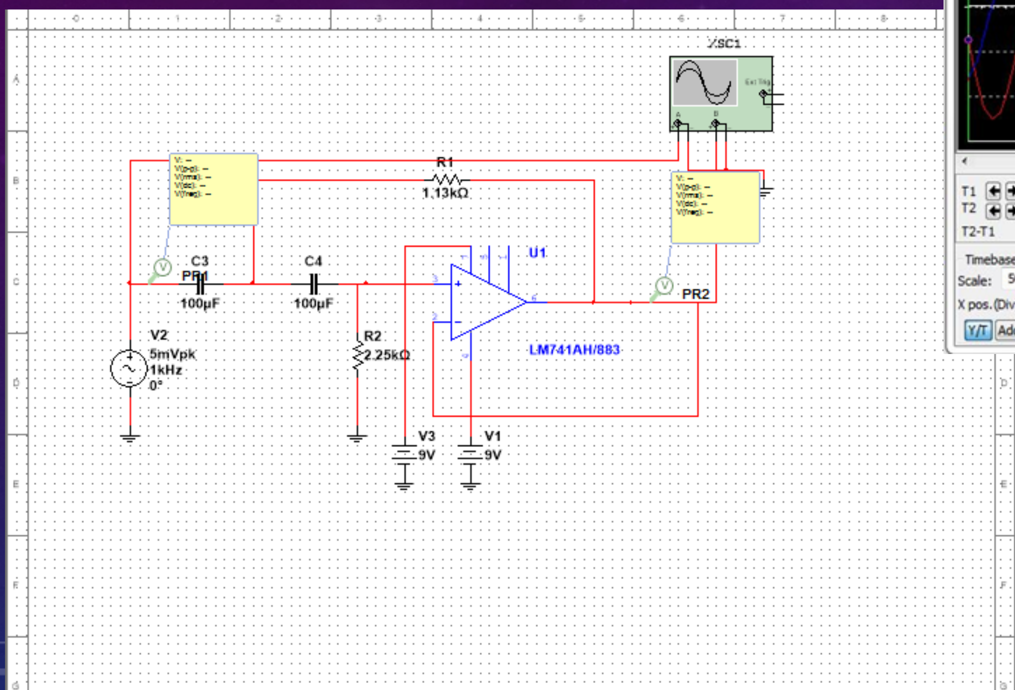


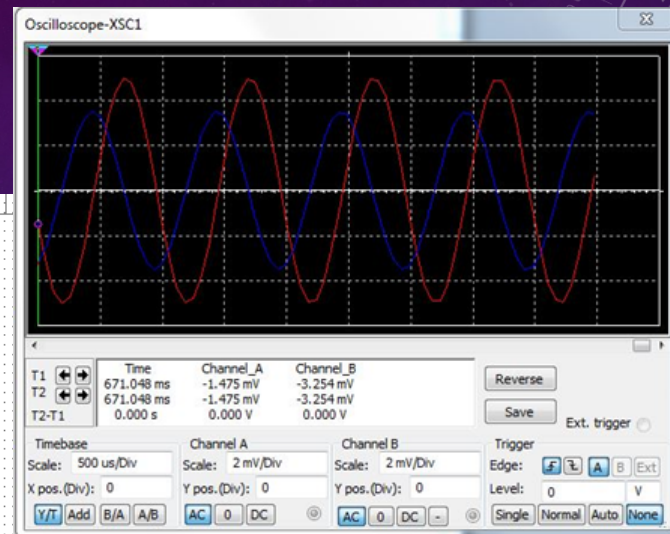
This is the standard unity gain Sallen-Key circuit. The values are set for a Q of 0.707, so the behaviour is Butterworth. As you can see, for the low pass filter we change the value of C (10nF) as follows ...

R1 = R2 = R = 10k
C1 = C * Q = 10nF * 0.707 = 7.07nF
C2 = C / Q = 10nF / 0.707 = 14.14nF

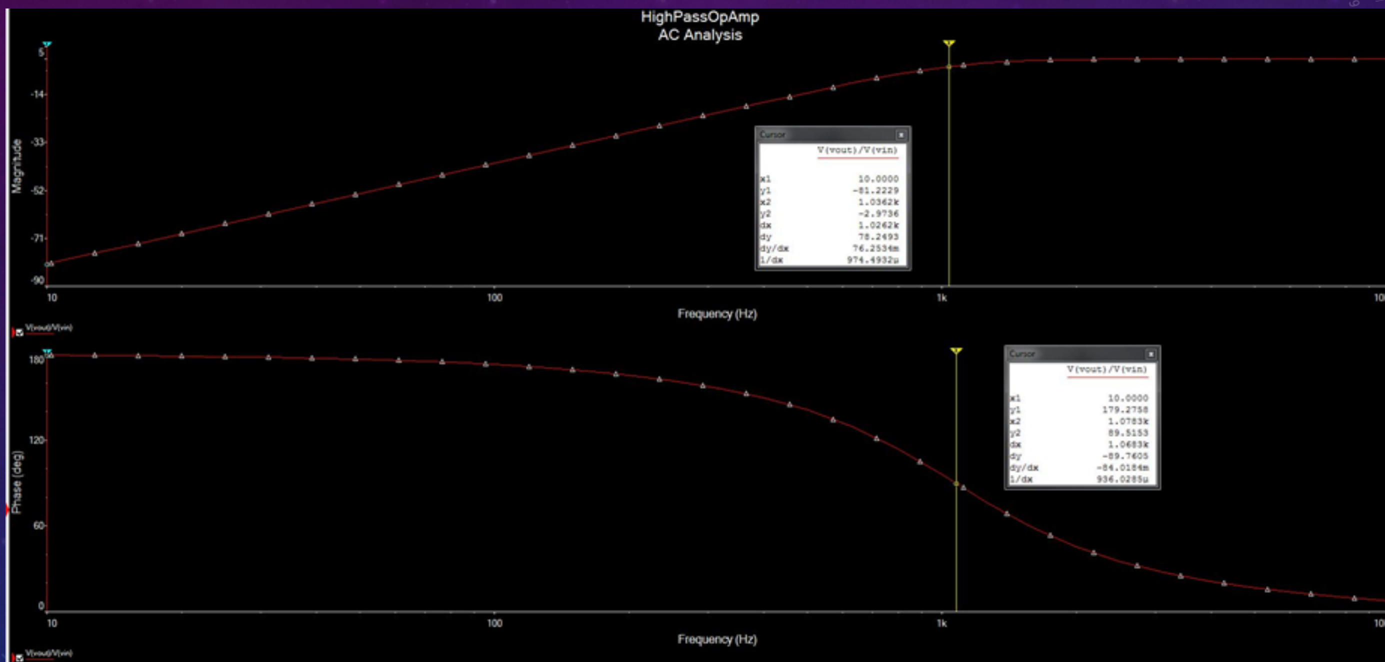
Exactly the same principle is applied to the high pass filter, except that the standardised value for R (10K) used here is modified by Q, with R1 becoming 14.14k and R2 becomes 7.07k. In many cases, it is necessary to make small adjustments to the frequency to allow the use of standard value components.

MULTISIM





	A	B	C	D	E
1	A(0)	1			
2	a(1)	1.4142			
3	b(1)	1			
4	c	100.0E-9			
5	c1	100.0E-9			
6	c2	100.0E-9			
7	r1	2.25E+3			
8	r2	1.13E+3			
9	W	1.0E+3	Hz		
10	Fc	6.3E+3			
11					
12					


HighPassOpAmp
AC Analysis
Magnitude
5
-14
-33
-52
-71
-90
Cursor
V(vout)/V(vin)
x1 10.0000
y1 -81.2229
x2 1.0362k
y2 -2.9736
dx 1.0262k
dy 78.2493
dy/dx 76.2534m
1/dx 974.4932µ
10
100
1k
10k
Frequency (Hz)
Phase (deg)
180
120
60
0
Cursor
V(vout)/V(vin)
x1 10.0000
y1 179.2758
x2 1.0783k
y2 89.5153
dx 1.0683k
dy -89.7605
dy/dx -84.0184m
1/dx 936.0285µ
10
100
1k
10k
Frequency (Hz)

CONCLUSION

- Designing and building a second order High-Pass filter is fairly easy once a topology and reliable calculation is chosen.
- No dificulties

LAB 11-BAND PASS FILTER

- Find a design on the web and calculate the proper values for the Capacitors and resistors so the circuit will notch out at 1kHz Build circuit in multisim
- Solve the calculations

MULTIPLE FEEDBACK BAND-PASS

You can visualize the band-pass nature of this circuit by inspecting its topology - R2 and C2 form a differentiator like circuit (high-pass), while C1 and R1A/B form an integrator like circuit (low-pass). Letting C1 = C2 makes the Multiple Feedback Band-pass filter straight forward to design. Just follow these simple steps.

Choose

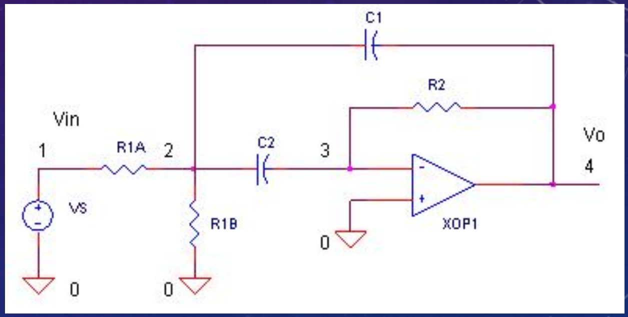
$$C = C1 = C2.$$

then calculate $k = 2\,\pi\,fo\,C$ and

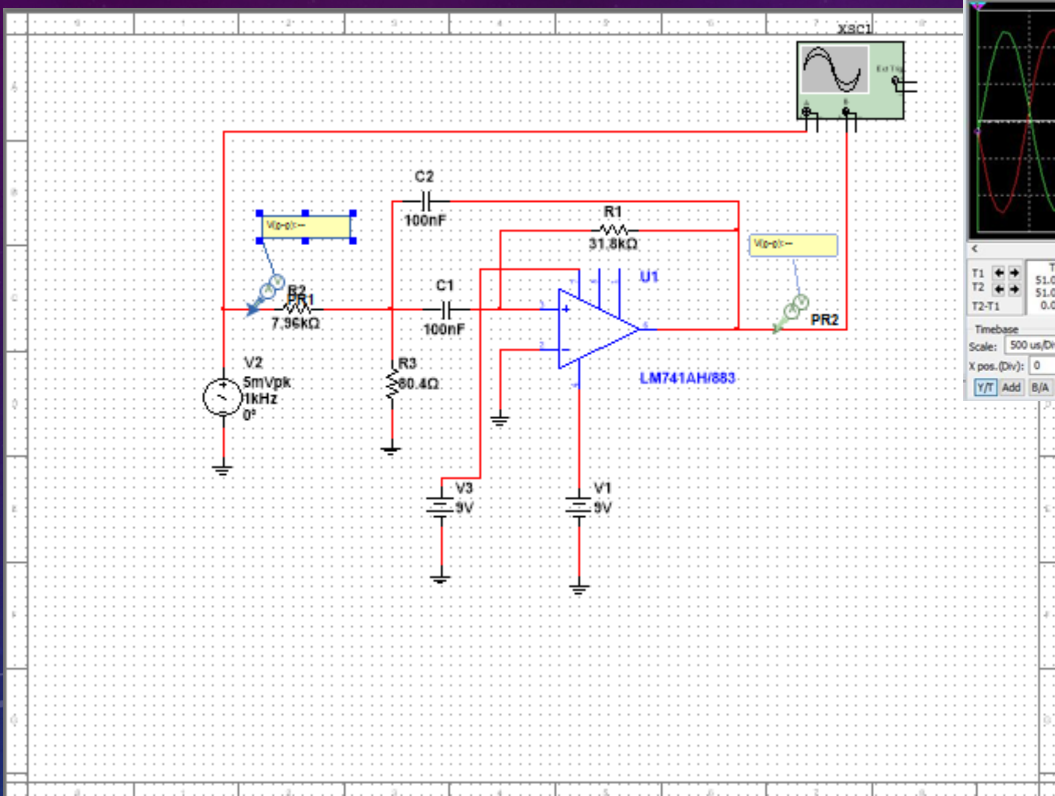
$$R1A = \frac{Q}{H \cdot k}$$

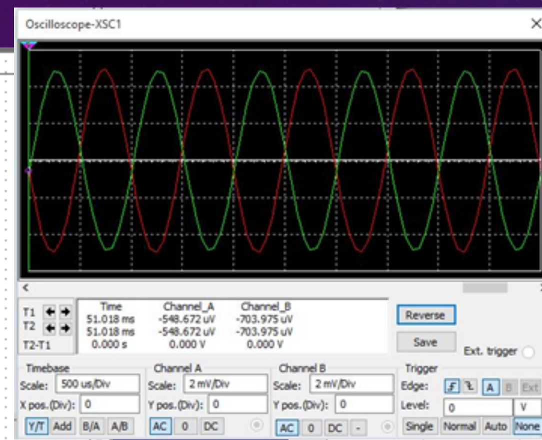
$$R1B = \frac{Q}{(2Q^2 - H)k}$$

$$R2 = \frac{2Q}{k}$$

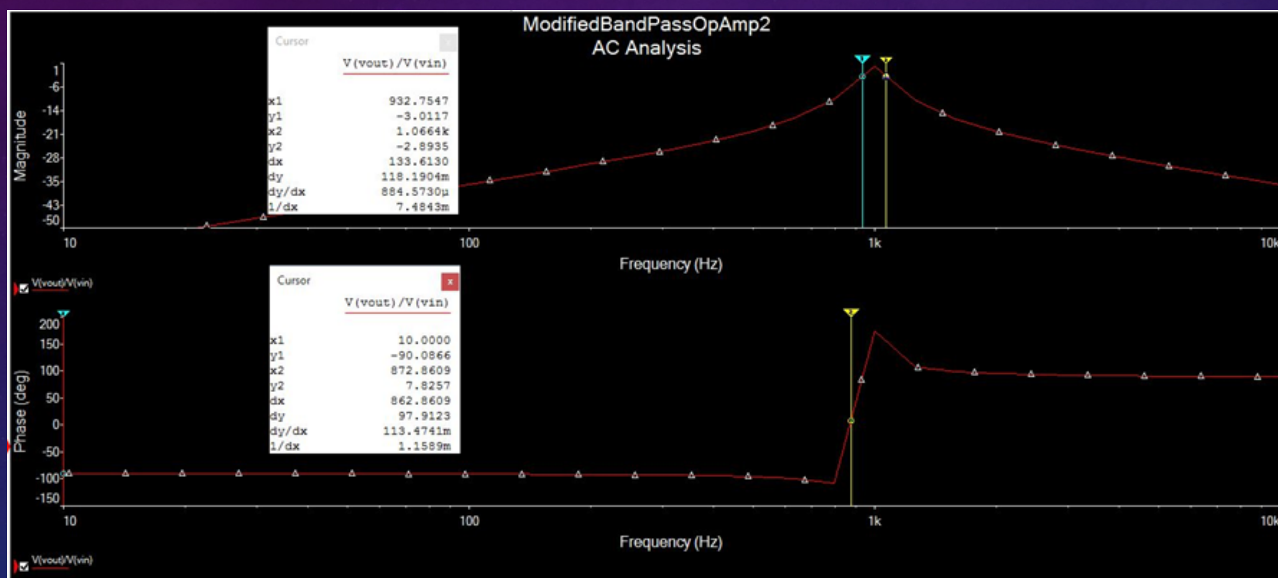


MULTISIM





			C	D
1	fm	1.0E+3	Hz	
2	Q	8	Filter quality	
3	Am	-1	Gain at fm	
4	C	100.0E-9		
5	C1	100.0E-9	47.0E-9	
6	C2	100.0E-9		
7	R2	25.46E+3		
8	R1	12.73E+3	Hz	
9	R3	100.26		
10				
11	B	196.35	Bandwidth	
12	Q	8.0		
13	Am	-1.00		
14				


ModifiedBandPassOpAmp2
AC Analysis
Cursor
V(vout)/V(vin)
x1 932.7547
y1 -3.0117
x2 1.0664k
y2 -2.8935
dx 133.6130
dy 118.1904m
dy/dx 884.5730μ
1/dx 7.4843m
Magnitude
Frequency (Hz)
V(vout)/V(vin)
Cursor
V(vout)/V(vin)
x1 10.0000
y1 -90.0866
x2 872.8609
y2 7.8257
dx 862.8609
dy 97.9123
dy/dx 113.4741m
1/dx 1.1589m
Phase (deg)
Frequency (Hz)
V(vout)/V(vin)

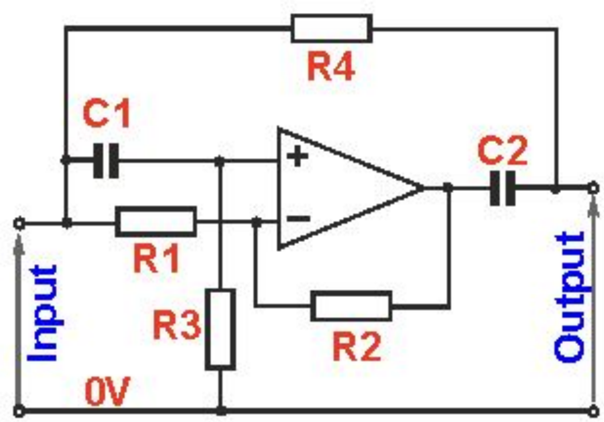
CONCLUSION

- Designing and building a Band-Pass filter is fairly easy once a topology is chosen
- Had difficulty at first understanding the calculation but after reading up a bit on the website, earlier referenced, I was able to make a spreadsheet and have it calculate the values.

LAB 12-NOTCH FILTER

- Find a design on the web and calculate the proper values for the Capacitors and resistors so the circuit will notch out at 1kHz.
- Build the circuit in MultiSim13 and run an AC circuit analysis to conform your calculations are correct.
- The topology was used and acquired at:

http://www.radio-electronics.com/info/circuits/opamp_notch_filter/opamp_notch_filter.php



Op amp notch filter circuit

$$f_{notch} = \frac{1}{2 \pi R C}$$

$$R = R3 = R4$$

$$C = C1 = C2$$

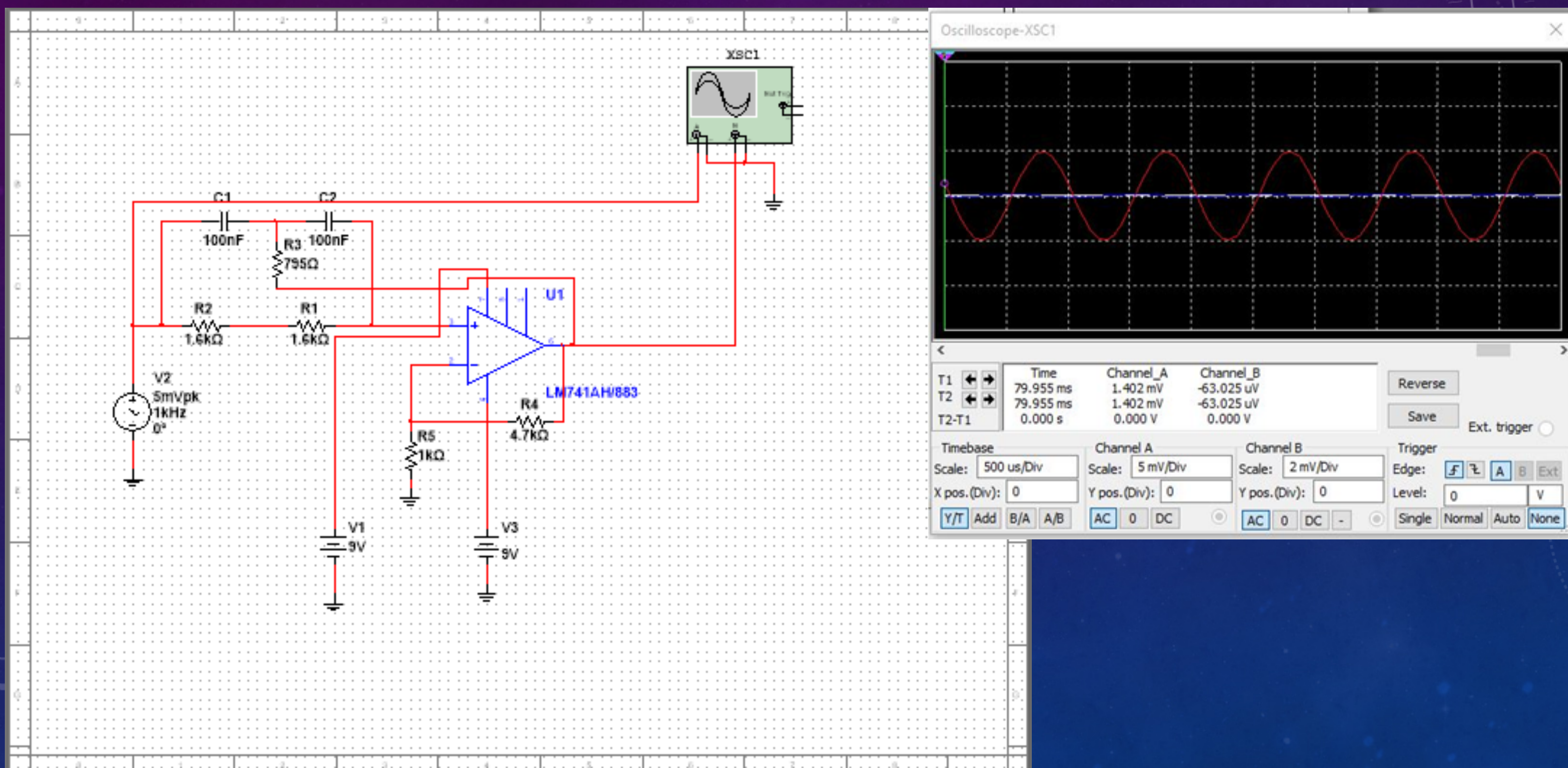
Where:

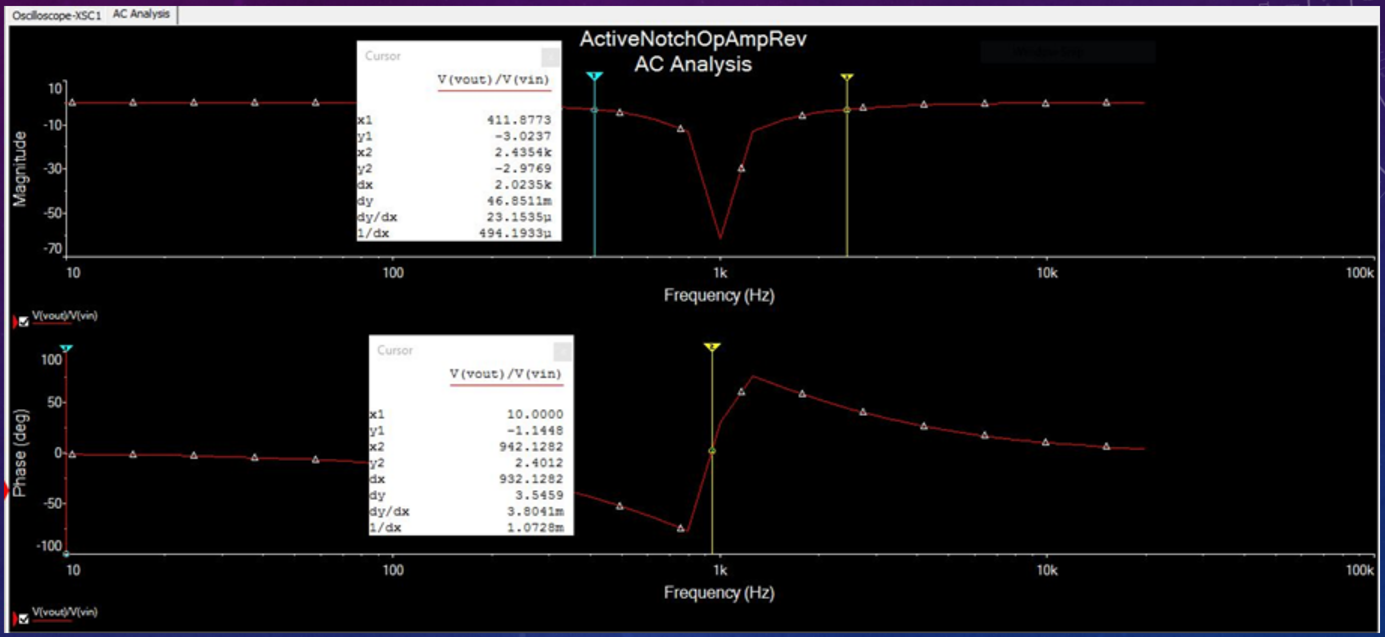
fnotch = centre frequency of the notch in Hertz

Π = 3.142

R and C are the values of the resistors and capacitors in Ω and Farads

LAB 12-NOTCH FILTER





Oscilloscope-XSC1
AC Analysis
ActiveNotchOpAmpRev
AC Analysis
Cursor
V(vout)/V(vin)
x1 411.8773
y1 -3.0237
x2 2.4354k
y2 -2.9769
dx 2.0235k
dy 46.8511m
dy/dx 23.1535µ
1/dx 494.1933µ
Magnitude
Frequency (Hz)
V(vout)/V(vin)
Cursor
V(vout)/V(vin)
x1 10.0000
y1 -1.1448
x2 942.1282
y2 2.4012
dx 932.1282
dy 3.5459
dy/dx 3.8041m
1/dx 1.0728m
Phase (deg)
Frequency (Hz)
V(vout)/V(vin)

EXCEL AND CONCLUSION

- Designing and building a Notch filter is pretty hard, however it is fairly easy once a topology is chosen.

	A	B	C	D
1	Fm	1.0E+3	Mid Freq	
2	G	5.7	Inner gain	
3	A0	6	Passband Gain	
4	Q	-0.1351351	Rejection Quality	
5	C	100.0E-9		
6	C1	100.0E-9		
7	C2	100.0E-9		
8	C3	200.0E-9		
9	R	1.6E+3		
10	R1	1.0E+3		
11	R2	4.7E+3		
12	R3	1.6E+3		
13	R4	1.6E+3		
14	R5	795.8E+0		
15				

PART LIST REVISED

PART NAME	PART#	Price	Quantity
Copper Clad Circuit Boards - CEM-1 Material Copper 3 x 4 inches single side	97BS11	$0.95	1
Terminal Blocks 2 Terminal Type Vertical	2405TB1	$0.70	1
Carbon Film Resistors 5% 1/4 W - Value 47	1300547	$0.06	1
Carbon Film Resistors 5% 1/4 W - Value 1K	130051K	$0.12	2
Carbon Film Resistors 5% 1/4 W - Value 2K	130052K	$0.06	1
Carbon Film Resistors 5% 1/4 W - Value 10K	1300510K	$0.06	1
Carbon Film Resistors 5% 1/4 W - Value 470	13005470	$0.06	1
Carbon Film Resistors 5% 1/4 W - Value 3.9K	130053.9K	$0.06	1
Female Header Receptacles No of Contacts 2 - No. of Rows Single	240202SF	$0.75	3
	Total	$2.82	

PART LIST POWER SUPPLY

Item	Part Description	Part Number	Qty	Unit Price	Total Price
1	Power Transformer 24 VCT .3A	16P124-.3	1	$5.95	$5.95
2	Silicon Rectifiers - Max Current 1A Max PIV 50	111N4001	4	$0.10	$0.40
3	Volt. Regulator Adjustable 1A	10317-T	1	$0.35	$0.35
4	Volt. Regulator Adjustable 1A	10337-T	1	$0.75	$0.75
5	In-Line Holder For 1-1- 4 x 1- 4 Fuses	2001LINL	1	$0.55	$0.55
6	Bright Red LED	08L53HD	2	$0.14	$0.28
7	Instrument Fuses 1/4 Amp	2000AGX1/4	1	$0.95	$0.95
8	Multiturn Potentiometers Top Adjust - 2K Ohm	18MPT2K	2	$0.65	$1.30
9	Electrolytic Nonpolarized Radial Capacitors - 47 uf 50V	14ERN05047U	6	$0.80	$4.80
10	RSR SPST Toggle Switch with lead wires 6 Amp 125V	17SWTOGWR	1	$0.95	$0.95
11	Electrolytic Nonpolarized Radial Capacitors - 2200 Uf	14ER0502200U	2	$0.06	$0.24
12	Electrolytic Nonpolarized Radial Capacitors - 2.2uF 50v	14ER0502.20	4	$0.06	$0.12
13	Electrolytic Nonpolarized Radial Capacitors - 100uF 50v	14ER050100U	2	$0.06	$0.12

PART LIST LAB 3

Part Name	Part Number	Part Price	QTY
Copper Clad Circuit Boards - CEM-1 Material Copper 3 x 4 inches single side	97BS11	$0.95	1.00
Terminal Blocks 2 Terminal Type Vertical	2405TB1	$0.70	1.00
Carbon Film Resistors 5% 1/4 W - Value 47	1300547	$0.06	1.00
Carbon Film Resistors 5% 1/4 W - Value 1K	130051K	$0.12	2.00
Carbon Film Resistors 5% 1/4 W - Value 2K	130052K	$0.06	1.00
Carbon Film Resistors 5% 1/4 W - Value 10K	1300510K	$0.06	1.00
Carbon Film Resistors 5% 1/4 W - Value 470	13005470	$0.06	1.00
Carbon Film Resistors 5% 1/4 W - Value 3.9K	130053.9K	$0.06	1.00
Female Header Receptacles No of Contacts 2 - No. of Rows Single	240202SF	$0.75	3.00
	Total	$2.82	

PART LIST

PART NAME	PART#	Price	Quantity
Copper Clad Circuit Boards - CEM-1 Material Copper 3 x 4 inches single side	97BS11	$0.95	1
Terminal Blocks 2 Terminal Type Vertical	2405TB1	$0.70	1
Carbon Film Resistors 5% 1/4 W - Value 47	1300547	$0.06	1
Carbon Film Resistors 5% 1/4 W - Value 1K	130051K	$0.12	2
Carbon Film Resistors 5% 1/4 W - Value 2K	130052K	$0.06	1
Carbon Film Resistors 5% 1/4 W - Value 10K	1300510K	$0.06	1
Carbon Film Resistors 5% 1/4 W - Value 470	13005470	$0.06	1
Carbon Film Resistors 5% 1/4 W - Value 3.9K	130053.9K	$0.06	1
Female Header Receptacles No of Contacts 2 - No. of Rows Single	240202SF	$0.75	3

Total$2.82

LAB10

Lab 10 – Series/Parallel Capacitors

Names:Mustafa smaili ________________, _________________

Date: ____________________

The purpose of this lab is to:
Experiment with series circuits and parallel combinations of capacitors.

The following capacitors are needed (1 each of the following): 10uF, 22uF and 47uF

Measure and record the capacitance of each capacitor using the LCR meter. Connect the capacitors as shown in Figure 1 and measure and record the total capacitance, CT. Then connect the capacitors as shown in Figure 2 and measure and record the total capacitance, CT.

Equipment needed:

1 – LCR Meter
1 – Elvis II
3 – capacitors

	Expected	Measured	Simulated
C1 =	10uF	8.18uF	10uF
C2 =	22uF	14.84uF	22uF
C3 =	47uF	33.46uF	47uF
CT =	6uF	5uF	6uF

Expected = value you expect it to be
Measured = using LCR Meter
Simulated = using Multisim

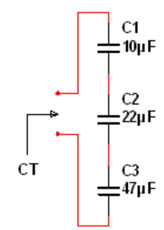


Figure 1
Series Circuit

	Expected	Measured	Simulated
C1 =	10uF	2.18uF	10uF
C2 =	22uF	17.84uF	22uF
C3 =	47uF	33.46uF	47uF
CT =	79uF	59.24uF	79uF

Expected = value you expect it to be
Measured = using LCR Meter
Simulated = using Multisim

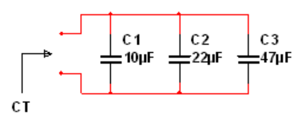


Figure 2
Parallel Circuit

LAB11

Lab 11 – RC Lab

Names: mustafa smaili , _______________, _______________

Date: ____________________

The purpose of this lab is to:
Experiment with RC (Resistor & Capacitor) circuits.

The following capacitors are needed (1 each of the following): 0.47uF, 1uF and 2.2uF

Measure and record the resistor value using the DMM and measure and record the capacitor values using the LCR meter in Table 1. Connect the resistor and capacitor as shown in Figure 1. Connect the Function Generator to the input at V1 and connect Channel 1 of the Oscilloscope to the input and Channel 2 to the output. Adjust the voltage of the Function Generator to 1Vpp at the frequencies shown in Table 2. Measure the input and output voltages using the Oscilloscope. Record the results in Table 2. Change the capacitor and retest.

Equipment needed:

1 – Digital Multimeter
1 – LCR Meter
1 – Oscilloscope
1 – Function Generator
1 – Elvis II
3 – capacitors
1 – resistor

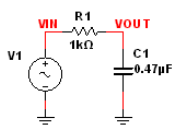


Figure 1
RC Circuit

	Capacitance or Resistance	
	Expected	Measured
C1 =	.47uF	.464
C2 =	1uF	.915uF
C3 =	2.2uF	2.1uF
R1 =	1kuF	1.001k

Table 1 – Resistance and Capacitances
Expected = value you expect it to be
Measured = using LCR Meter or DMM

	Output Voltage C = .47µF			Output Voltage C = 1µF			Output Voltage C = 2.2µF		
	Expected	Measured		Expected	Measured		Expected	Measured	
Frequency	Output Voltage	Input Voltage	Output Voltage	Output Voltage	Input Voltage	Output Voltage	Output Voltage	Input Voltage	Output Voltage
10	1	1	1	.998	1	1	.991	1	1
50	.989	1	1	.954	1	.940	.823	1	.820
100	.959	1	.98	.847	1	.840	.586	1	.600
200	.861	1	.88	.623	1	.620	.340	1	.380
300	.749	1	.76	.469	1	.480	.234	1	.260
400	.646	1	.660	.370	1	.400	.178	1	.220
500	.561	1	.580	.303	1	.340	.143	1	.180
600	.492	1	.520	.256	1	.300	.120	1	.160
700	.436	1	.460	.222	1	.260	.103	1	.160
800	.390	1	.420	.195	1	.240	.090	1	.140
900	.352	1	.380	.174	1	.220	.080	1	.140
1,000	.321	1	.360	.157	1	.200	.072	1	.140
2,000	.167	1	.200	.079	1	.140	.036	1	.120
3,000	.112	1	.160	.053	1	.100	.024	1	.056
4,000	.084	1	.104	.039	1	.056	.018	1	.048
5,000	.068	1	.088	.032	1	.048	.015	1	.048
6,000	.056	1	.080	.027	1	.040	.012	1	.040
7,000	.048	1	.072	.023	1	.032	.010	1	.032
8,000	.042	1	.064	.020	1	.032	.009	1	.032
9,000	.038	1	.064	.018	1	.032	.008	1	.032
10,000	.034	1	.056	.016	1	.032	.007	1	.032

RC Frequency Response
Expected = value you expect it to be
Measured = Using Oscilloscope

Observations: Our first run of measurements were a failure due to a bad 10x switch on the probe measuring the Vout. After a second measuring session our numbers proved compatible with the calculated results. We could have gotten higher resolution if we had continuously adjusted the amplitude for Vout signal on the scope. Bench 6 was used on the first test but results were scrapped. Bench 5 LCR was used for Capacitor measurements, Bench 8 scope was used with bench 5 Elvis for second and final test run.

LAB12

Lab 12 – Series/Parallel Inductors

Names: Mustafa Smaili, ________________, _________________

Date: ____________________

The purpose of this lab is to:
Experiment with series circuits and parallel combinations of inductors.

The following inductors are needed (1 each of the following): 1mH, 2.2mH and 4.7mH

Measure and record the inductance of each inductor using the LCR meter. Connect the inductors as shown in Figure 1 and measure and record the total inductance, LT. Then connect the inductors as shown in Figure 2 and measure and record the total inductance, LT.

Equipment needed:

1 – LCR Meter
1 – Elvis II
3 – Inductors

	Expected	Simulated	Measured
L1 =	1mH	1mH	1.01mH
L2 =	2.2mH	2.2mH	2.19mH
L3 =	4.7mH	4.7mH	4.32mH
LT =	7.9mH	7.9mH	7.58mH

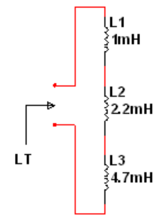


Figure 1
Series Circuit

Expected = value you expect it to be
Simulated = using Multisim
Measured = using LCR Meter

	Expected	Simulated	Measured
L1 =	1mH	1mH	1.01mH
L2 =	2.2mH	2.2mH	2.19mH
L3 =	4.7mH	4.7mH	4.32mH
LT =	.59mH	.59mH	.593mH

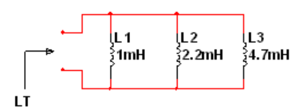


Figure 2
Parallel Circuit

Expected = value you expect it to be
Simulated = using Multisim
Measured = using LCR Meter

LAB13

Lab 13 – RL Lab

Names: Mustafa Smaili

Date:

The purpose of this lab is to:
Experiment with RL (Resistor & Inductor) circuits.

The following inductors are needed (1 each of the following): 1mH, 2.2mH and 4.7mH

Measure and record the resistor value using the DMM and measure and record the inductor values using the LCR meter in Table 1. Connect the resistor and inductor as shown in Figure 1. Connect the Function Generator to the input at V1 and connect Channel 1 of the Oscilloscope to the input and Channel 2 to the output. Adjust the voltage of the Function Generator to 1Vpp at the frequencies shown in Table 2. Measure the input and output voltages using the Oscilloscope. Record the results in Table 2. Change the inductor and retest.

Equipment needed:

1 – Digital Multimeter
1 – LCR Meter
1 – Oscilloscope
1 – Function Generator
1 – Elvis II
3 – Inductors
1 – Resistor, 100 ohm

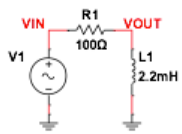


Figure 1
RL Circuit

	Inductance or Resistance	
	Expected	Measured
L1 =	2.2mH	2.12mH
L2 =	1mH	.98mH
L3 =	4.7mH	4.67mH
R1 =	100mH	99.99mH

Table 1 – Resistance and Inductances
Expected = value you expect it to be
Measured = using LCR Meter or DMM

	Output Voltage L = 2.2mH			Output Voltage L = 1mH			Output Voltage L = 4.7mH		
	Expected	Measured		Expected	Measured		Expected	Measured	
Frequency	Output Voltage	Input Voltage	Output Voltage	Output Voltage	Input Voltage	Output Voltage	Output Voltage	Input Voltage	Output Voltage
10	166mV	451mV	4.3mV	75mV	640mV	21mV	355mV	642mV	96mV
50	832mV	451mV	18.8 mV	378mV	655mV	86mV	1.7v	675mV	116mV
100	1.6v	453mV	19.6mV	7 56mV	658mV	101mV	3.5v	678mV	150mV
200	3.3V	452mV	22.1mV	1.5v	656mV	101mV	7.1v	681mV	152mV
300	4.9v	452mV	43.3mV	2.2v	659mV	114mV	10.6v	684mV	187mV
400	6.6V	450mV	44.1mV	3.0V	661mV	120mV	14.1v	688mV	214mV
500	8.3v	451mV	44.7mV	3.7v	662mV	114mV	17.5v	695mV	232mV
600	9.9v	452mV	45.3mV	4.5v	660mV	160mV	21V	696mV	271mV
700	11.5v	454mV	47.7mV	5.2v	662mV	137mV	24.3v	700mV	290mV
800	13.2v	453mV	49.8mV	6v	663mV	150mV	27.6v	705mV	302mV
900	14.8v	454mV	55.2mV	6.7v	664mV	160mV	30.9v	708mV	310mV
1,000	16.4v	456mV	60.8mV	7.5v	665mV	172mV	34v	701mV	401mV
2,000	32v	462mV	116mV	15v	676mV	230mV	61.1v	750mV	463mV
3,000	46v	465mV	168mV	22.2v	683mV	278mV	79.78v	769mV	579mV
4,000	58.2v	477mV	217mV	29.3v	688mV	305mV	91.7v	808mV	629mV
5,000	68.3v	489mV	263mV	36v	697mV	347mV	99.4v	851mV	722mV
6,000	76.5v	502mV	308mV	42.4v	707mV	384mV	104.5v	860mV	740mV
7,000	83.5v	516mV	346mV	48.4v	718mV	417mV	108vv	892mV	814mV
8,000	89.1v	527mV	379mV	54.1v	726mV	440mV	110.5v	894mV	818 mV
9,000	93.6v	536mV	406mV	59.2v	730mV	491mV	112.3v	908mV	855mV
10,000	97.3v	544mV	427mV	63.9v	736mV	490mV	113.6v	909mV	857mV

RL Frequency Response
Expected = value you expect it to be
Measured = Using Oscilloscope

Observations: Numbers were not as expected