Daniel Heaton

Lab 1 – Reading and Sorting Resistors

Names: Daniel Heaton, Ken Fischer
Date: 08/22/13

The purpose of this lab is to:
Learn the resistor color code using 15 resistors which must be sorted from smallest to largest value. Build a resistor kit that includes 15 resistors and, sort resistors based on color code from smallest to largest and measure the resistance of each resistor and verify sorting

Equipment needed:

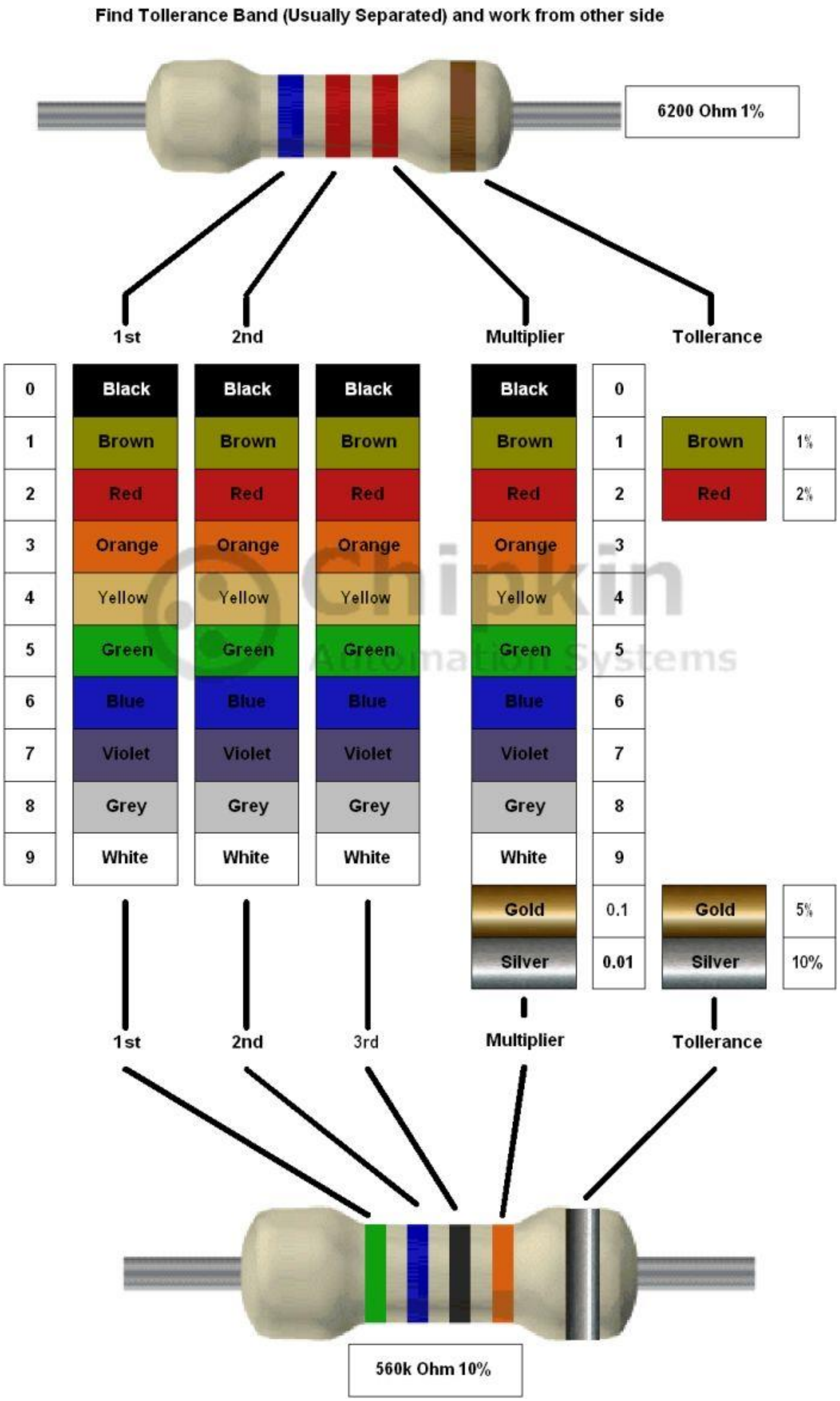
1 – Digital Multimeter
1 – 15 unique resistors

	Color Code	Measured Value
100 =	brown, black, brown, gold	98.47
220 =	red, red, brown, gold	217.04
330 =	orange, orange, brown, gold	326.057
470 =	yellow, violet, brown, gold	468.14
1K =	brown, black, red, gold	993.9
2.2K =	red, red, red, gold	2.205K
3.3K =	Orange, orange, red gold	3.26K
4.7K =	yellow, violet, red, gold	4.7362K
10K =	brown, black, orange, gold	9.928K
22K =	red, red, orange, gold	22.04K
33K =	orange, orange, orange, gold	32.993K
47K =	yellow, violet, orange, gold	47.05K
100K =	brown, black, yellow, gold	100.10K
1M =	brown, black, green, gold	.9941M

Observations: Almost all readings were below the rated resistance of the resistor.

Notes: Resistors were read using a “GW INSTEK GDM-8245 Dual Display Digital Multimeter.” The test results were easier to read when the multimeter settings were in the correct range.

Resistor color code chart:



Lab 2 – Resistor Variability

Names: Ken Fischer, Daniel Heaton
Date: 8/29/13

The purpose of this lab is to:
Learn the how resistors vary using 25 resistors with the same color code.

Select a set of 25 resistors.
Measure and record the resistance of each resistor.

Equipment needed:

1 – Digital Multimeter
1 – 25 resistors with the same color code.

Resistor color code = Yellow, Purple, Red
Resistor value = 4700Ω
Resistor tolerance = Gold

Using Microsoft Excel plot the resistor values and determine:

Smallest resistance = 4.6248
Largest resistance = 4.7942
Average resistance = 4.69339
Standard Deviation = 0.040872

Do any of your resistor values exceed the part tolerance? No

Resistor Evaluation:

Smallest	4.6248
Largest	4.7942
Average	4.69339
Standard Deviation	0.040872
Standard Deviation Percentage	0.87%

Sample	Measured Value
1	4.6355kΩ
2	4.6365kΩ
3	4.7271kΩ
4	4.6810kΩ
5	4.6467kΩ
6	4.7011kΩ
7	4.7304kΩ
8	4.7203kΩ
9	4.7133kΩ
10	4.6302kΩ
11	4.6313kΩ
12	4.6552kΩ
13	4.6885kΩ
14	4.7188kΩ
15	4.6774kΩ
16	4.7942kΩ
17	4.7185kΩ
18	4.6974kΩ
19	4.7177kΩ
20	4.7105kΩ
21	4.6248kΩ
22	4.6874kΩ
23	4.7255kΩ
24	4.7480kΩ
25	4.7030kΩ
26	4.7297kΩ
27	4.7270kΩ
28	4.7036kΩ
29	4.6472kΩ
30	4.6739kΩ

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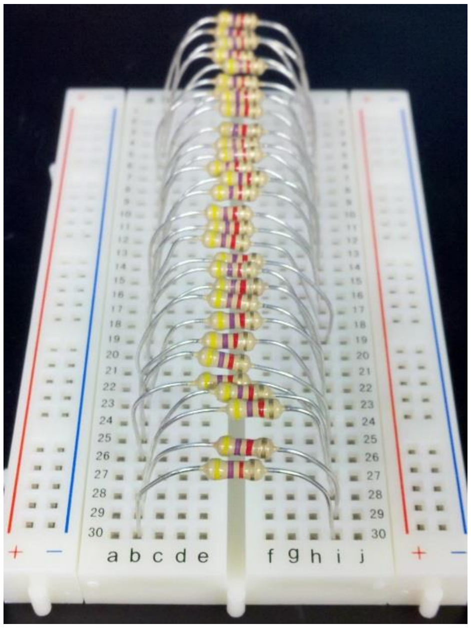
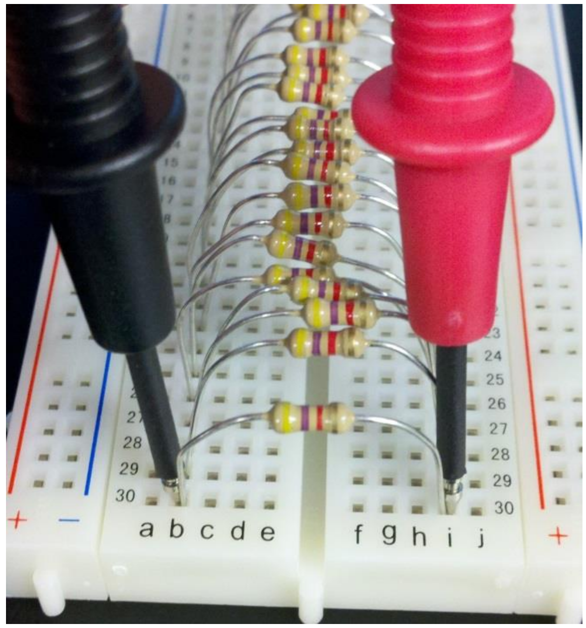
Measure

1 Power on digital multimeter.

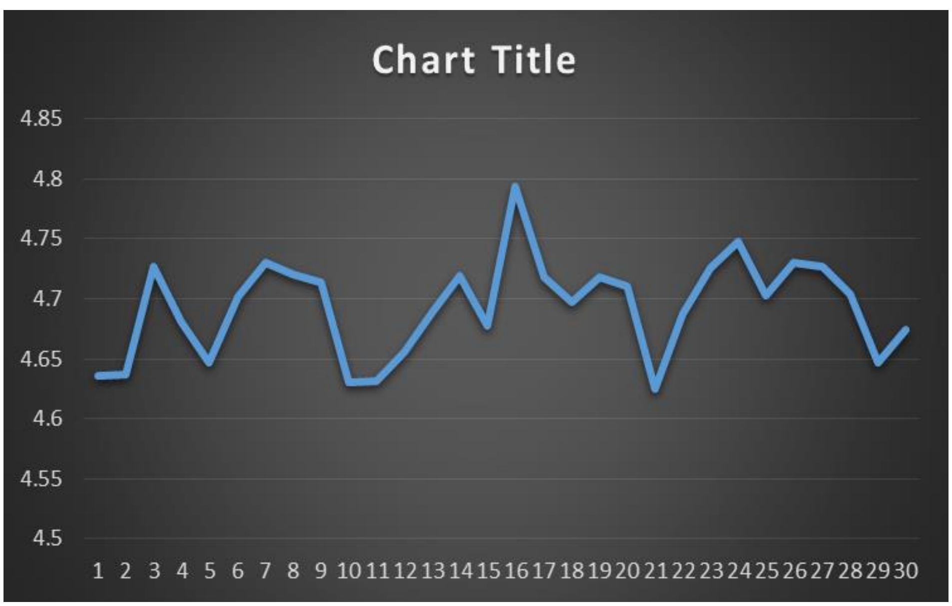
2 With multimeter set to Ohms, place probe on each end of the resistor. Adjust the multimeter's setting from mega (M) down to micro (µ) ohms to get an accurate reading or resistor.





Resistor variation demonstrated in a scatter plot graph:

1	4.6355
2	4.6365
3	4.7271
4	4.681
5	4.6467
6	4.7011
7	4.7304
8	4.7203
9	4.7133
10	4.6302
11	4.6313
12	4.6552
13	4.6885
14	4.7188
15	4.6774
16	4.7942
17	4.7185
18	4.6974
19	4.7177
20	4.7105
21	4.6248
22	4.6874
23	4.7255
24	4.748
25	4.703
26	4.7297
27	4.727
28	4.7036
29	4.6472
30	4.6739



Observations:

Lab 3 – Series Resistors

Names: Daniel Heaton & Kenneth Fischer
Date: 9/5/13

The purpose of this lab is to:
Experiment with series circuits and verify that the simulation, analysis (calculations) and test results all agree.

From the resistor kit select 3 resistors (10K, 2.2K and 4.7K)

Measure and record the value of each resistor. Connect the resistors as shown in Figure 1. Measure and record the total resistance, RT. Then connect the resistors as shown in Figure 2, the 9V come from the Elvis II (Modular Engineering Educational Laboratory Platform). Then measure and record with the Digital Multimeter the current and voltages of the series circuit.

Equipment needed:

1 – Digital Multimeter
1 – Elvis II
3 – Resistors.

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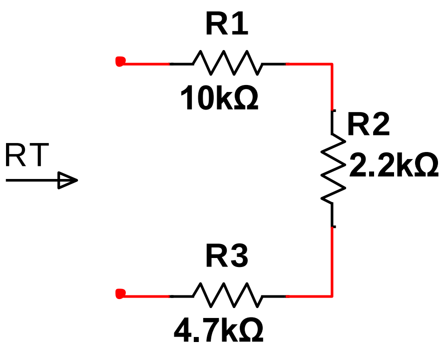
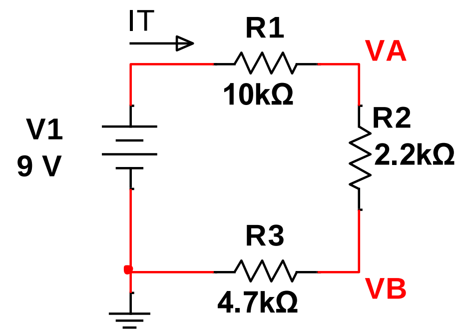
Calculate





	Measured (Lab)	Calculated (.Xls)	Simulated (Multisim)
R1=	9.924k	10K	9.18K
R2=	2.2001K	2.2K	2.2005K
R3=	4.680K	4.7K	4.684K
RT=	16.807	16.9K	16.796K

Measured = using Digital Multimeter
Calculated = based on color code and Excel values
Simulated = Multisim simulation

	Measured (Lab)	Calculated (.Xls)	Simulated (Multisim)
IT=	0.5327A	0.5325A	N/A
V1=	9.002V	9V	9V
VA=	3.670V	3.67425V	3.675V
VB=	2.500V	2.50275V	2.503V

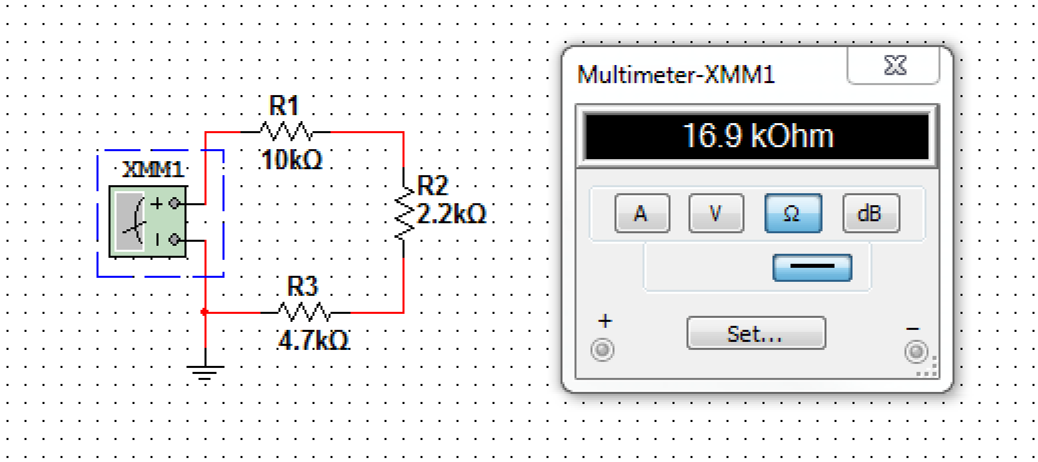
Measured = using Digital Multimeter
Calculated = based on color code and Excel values
Simulated = Multisim simulation

Excel formula for give circuit:

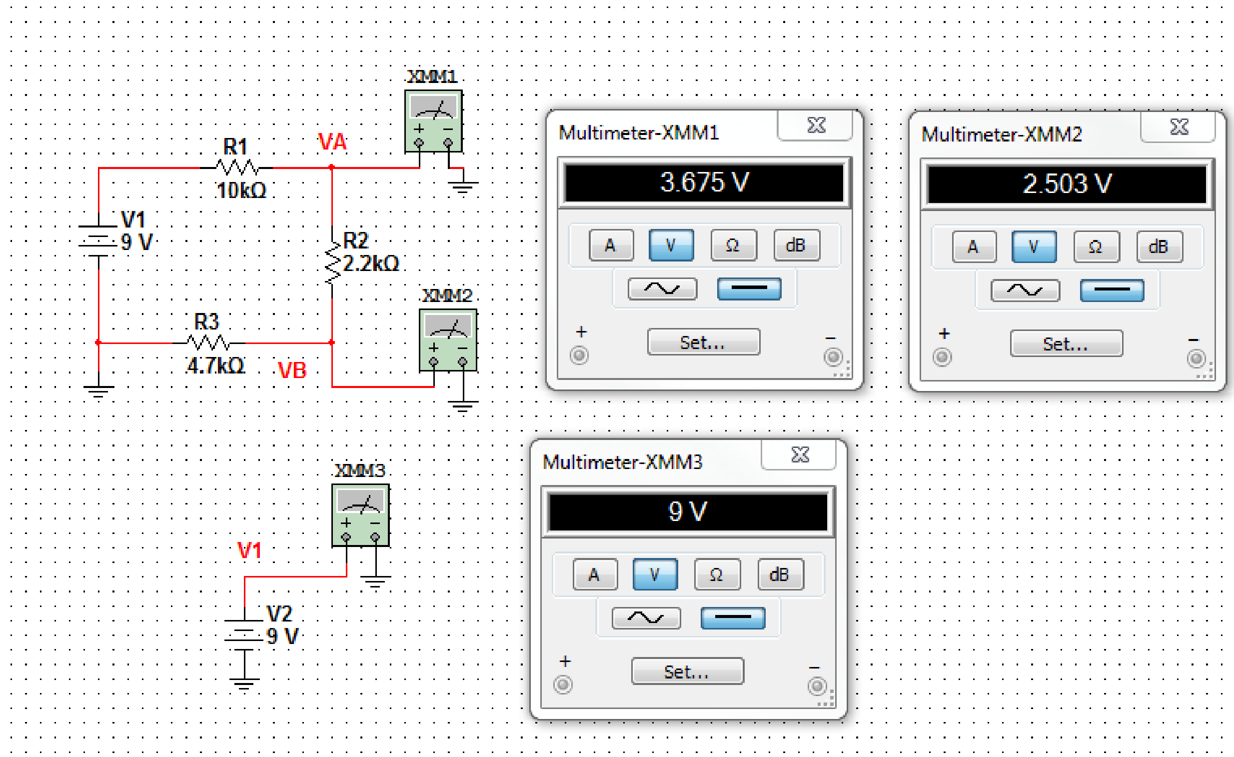
	Measured (Lab)	Calculated (.Xls)	Simulated (Multisim)
IT=	0.5327A	0.5325A	N/A
V1=	9.002V	9V	9V
VA=	3.670V	=(0.5325)*(2.2+4.7)	3.675V
VB=	2.500V	=(0.5325)*(4.7)	2.503V

Simulate

Multisim simulation of given circuit:



Multisim simulation of given circuit:



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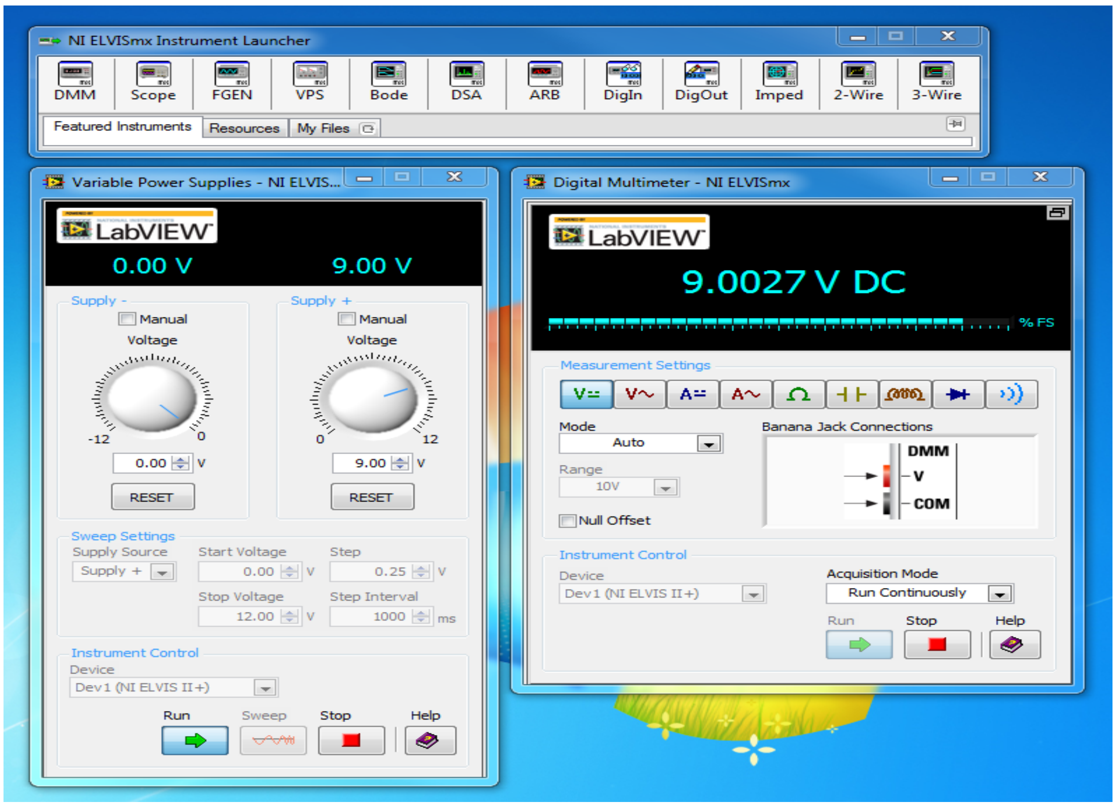
Measure

1. Power on multimeter and Elvis prototype board and software.

2. Measure the actual resistance of each resistor and their total resistance using the multimeter. Place the postive prove on one end of the resistor and place the negative probe on the other end of the resistor. Repeat for each resistor. For total resistance place the multimeter in place of the power supply and measure the resistance throughout the whole circuit.

3. Complete circuit assembly and set Elvis power supply to 9V D.C..

LabVie screen shot using the ELVIS multimeter function:



4. Measure the voltage at points Va & Vb. With the multimeter set to volts, place the positive probe on given point and the negative probe on ground. Repeat for each point.

5. Measure the total current. Open the circuit in between R1 and the power supply. With the multimeter set to Amps, place the positive probe on the power supply lead end and the negative probe on R1 resistor to complete the circuit.

Observations:

Lab 5 – Series Circuit 3 Equal Resistors

Names: Daniel Heaton, Ken Fischer
Date: 09/12/13

The purpose of this lab is to:
To learn how voltage and current behaves in a series resistor circuit with equal valued resistors.

Equipment needed:

- Elvis prototype board
- Elvis software LabVIEW
- Digital multimeter
- 3 1kΩ resistors

Calculate

Excel sereies resistor circuit data:

V1=	9	volts
R1=	1.0E+3	ohms
R2=	1.0E+3	ohms
R3=	1.0E+3	ohms
RT=	3.0E+3	ohms
IT=	3.0E-3	amps
ER1=	3.0	volts
ER2=	3.0	volts
ER3=	3.0	volts
Va=	6.0	volts
Va=	6.0	volts
Vb=	3.0	volts
Vb=	3.0	volts

Excel formulas for sereies resistor circuit:

	A	B	C
1	V1=	9	volts
2	R1=	1000	ohms
3	R2=	1000	ohms
4	R3=	1000	ohms
5	RT=	=SUM(B2:B4)	ohms
6	IT=	=SUM(B1/B5)	amps
7	ER1=	=SUM(B6*B2)	volts
8	ER2=	=SUM(B6*B3)	volts
9	ER3=	=SUM(B6*B4)	volts
10	Va=	=SUM(B6*(B3+B4))	volts
11	Va=	=SUM(B1-(B2*B6))	volts
12	Vb=	=SUM(B6*B4)	volts
13	Vb=	=SUM(B10-(B6*B4))	volts

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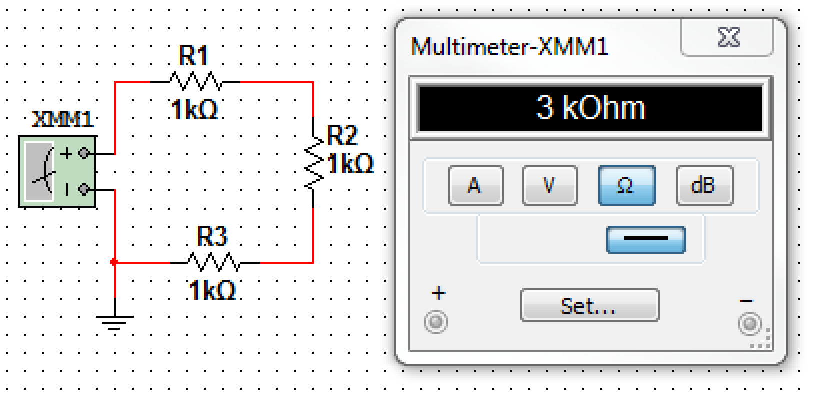
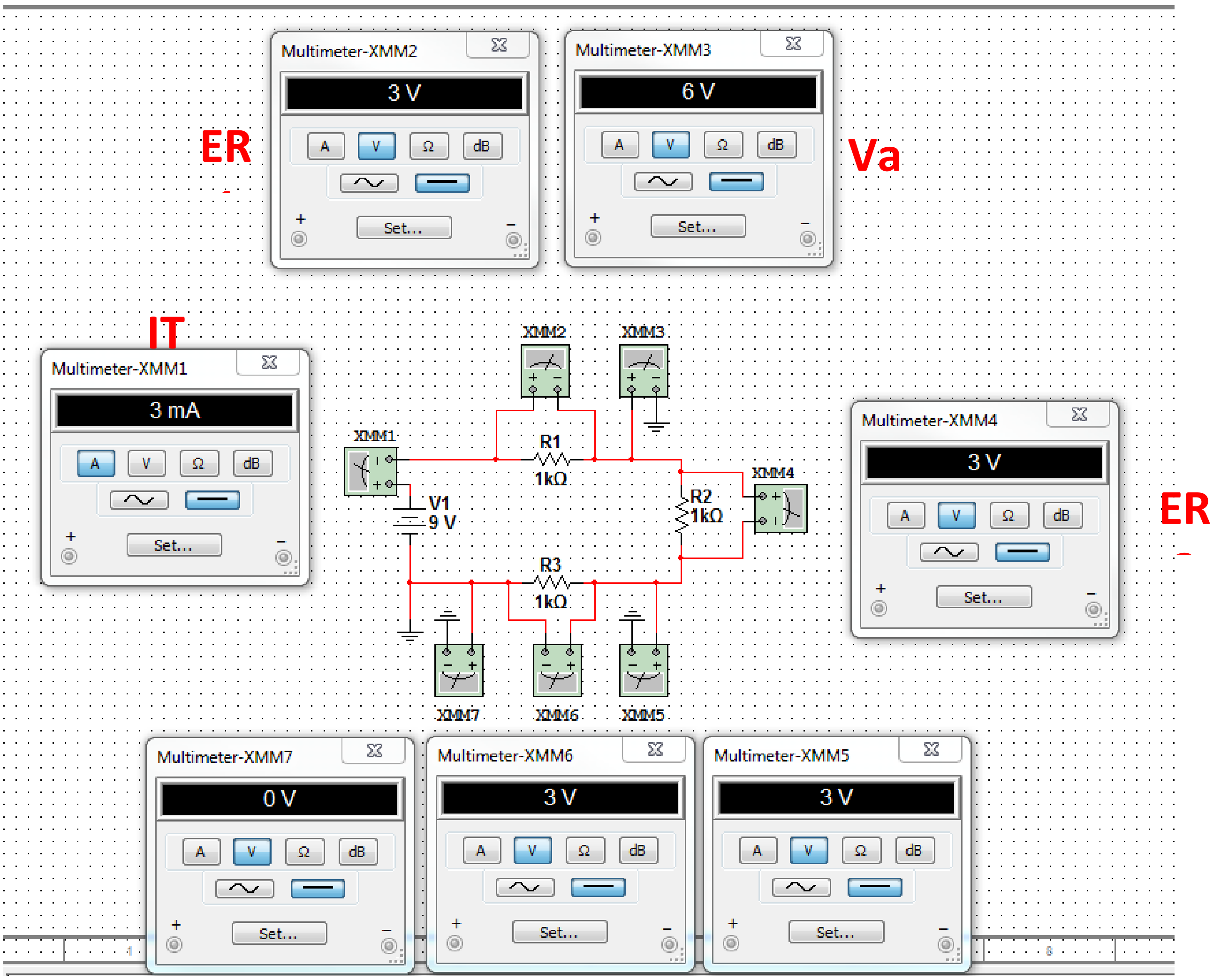
Simulate

Multisim circuit measuring total resistance:



Multisim circuit measuring total current, voltage across each resistor and voltage after each resistor:



Added out of curiosity

ER

Vb

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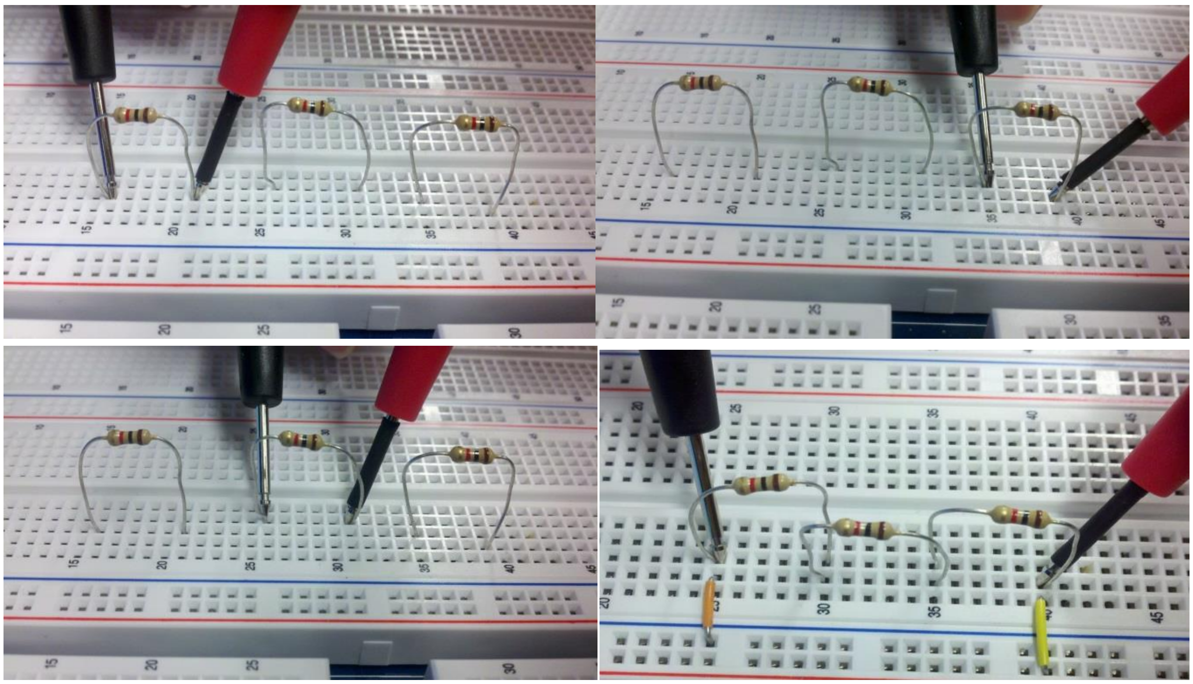
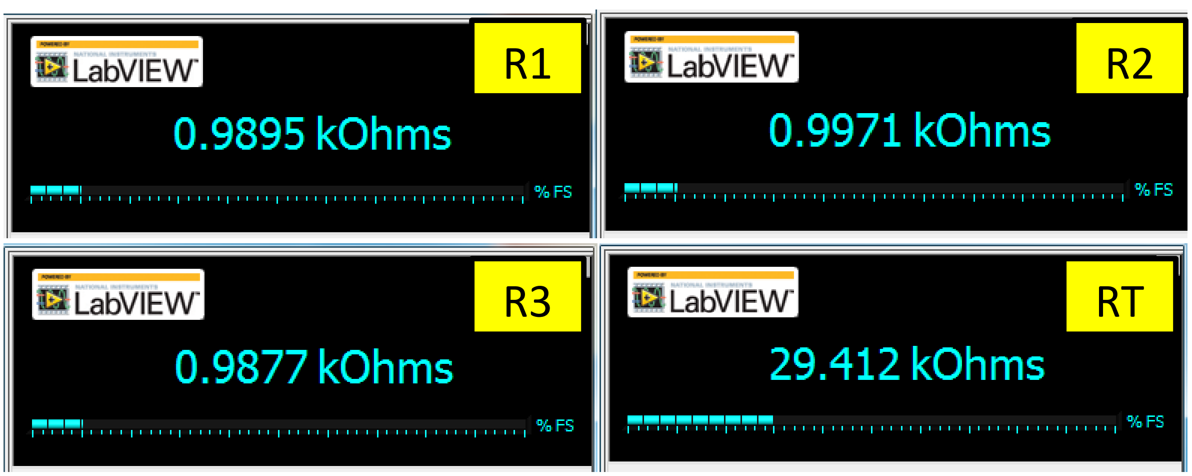
Measure

1. Power on multimeter and Elvis prototype board and software.

2. With the Elvis simulation multimeter set for measuring ohms, measure the actual resistance of each resistor and their total resistance. Place the postive prove on one end of the resistor and place the negative probe on the other end of the resistor. For total resistance place the resistor in series and place a probe on each end of the resistors.



Resistor values shown in LabView software.



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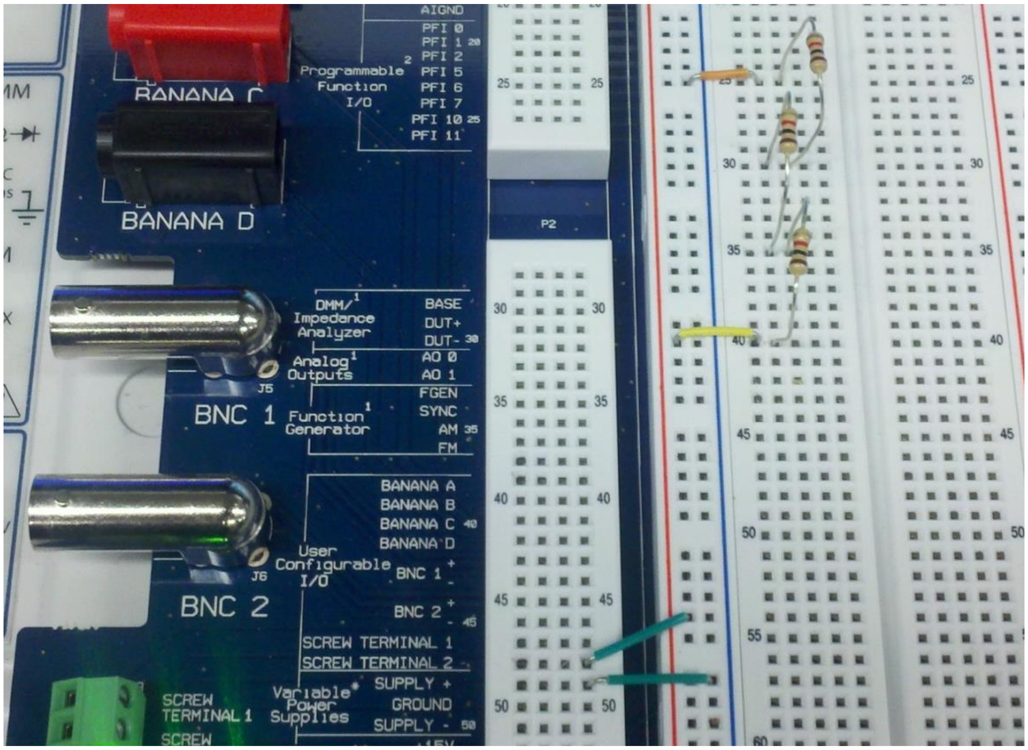
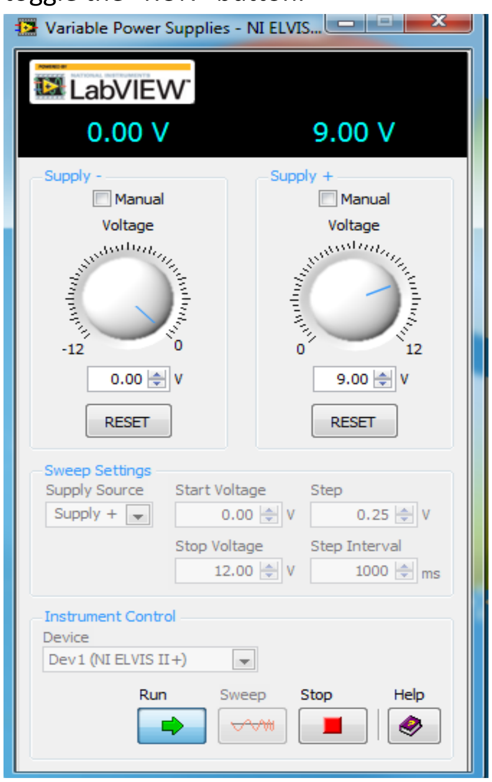
3. Build the circuit on Elvis.



4. Open the “Variable Power Supplies” program in the NI Elvis software. Set voltage supply to 9V and toggle the “RUN” button.



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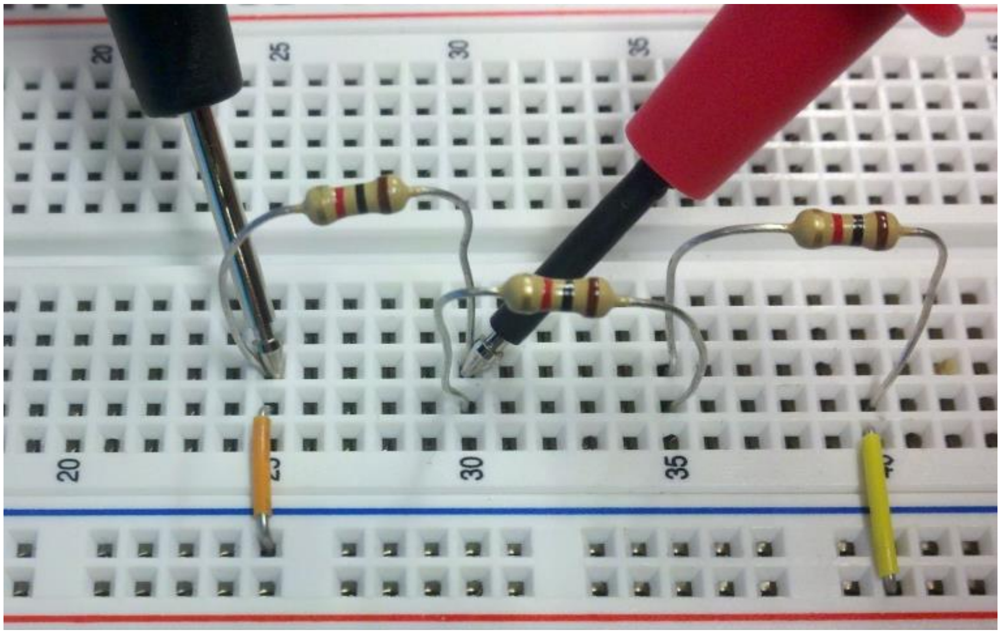
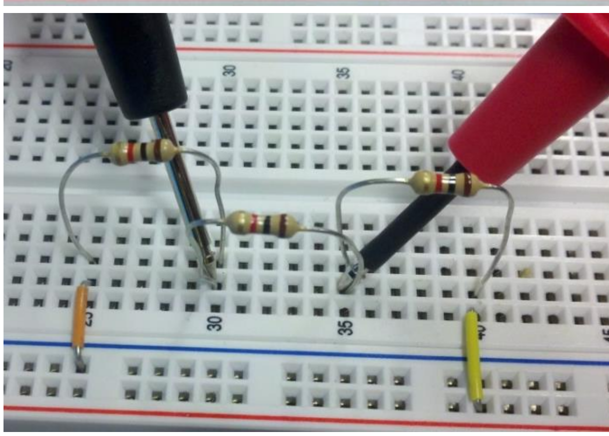
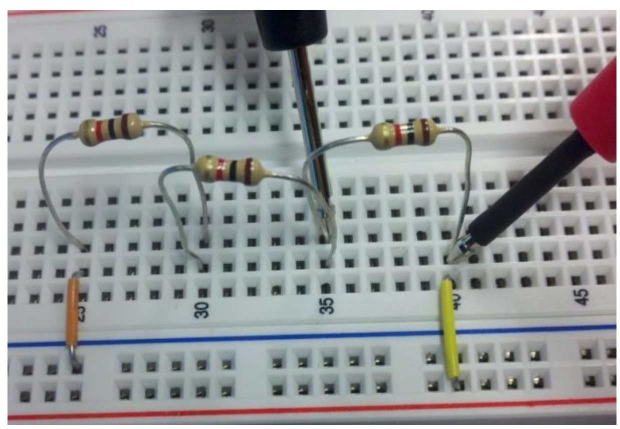
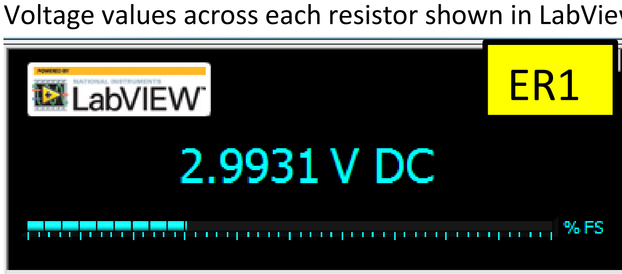
5. Measure the voltage across each resistor. With the Elvis simulation multimeter set for measuring voltage, place the positive probe on the positive end of the resistor and the negative probe on the negative end of the resistor.

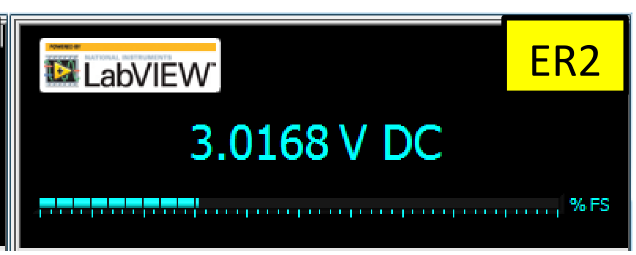


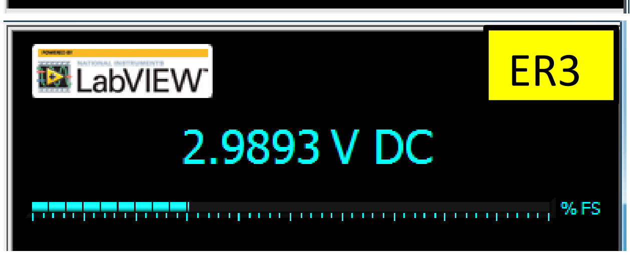




Voltage values across each resistor shown in LabView software.







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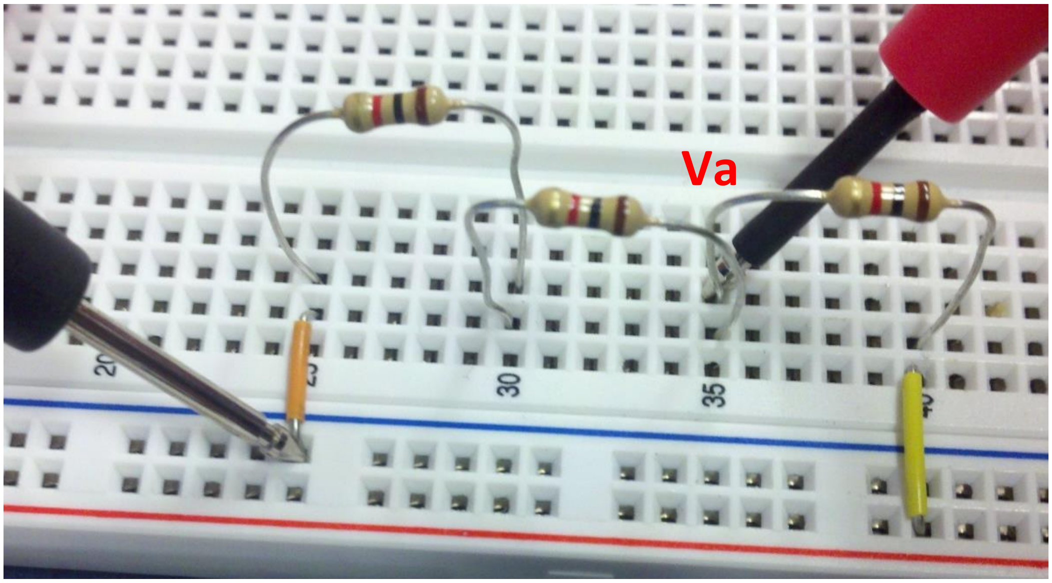
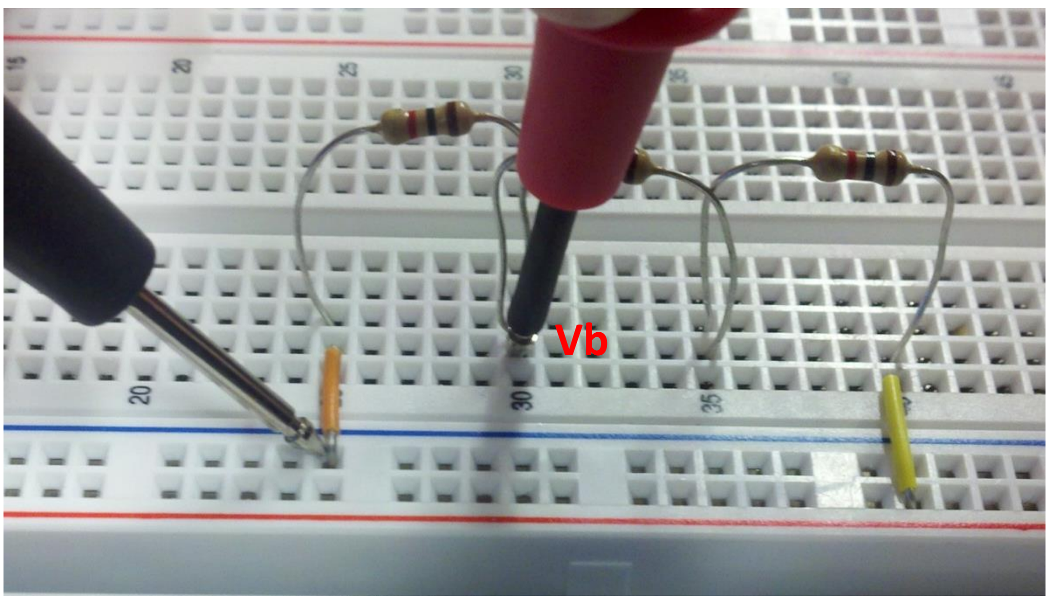
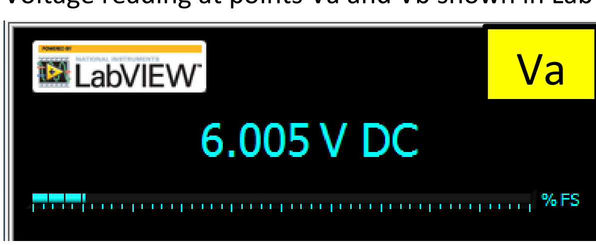
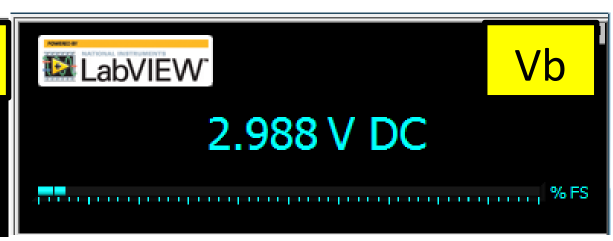
6. Measure the voltage at points Va and Vb. With the Elvis simulation multimeter set for measuring voltage, place the positive probe on the positive end of the resistor at the given point and place the negative prove on ground.



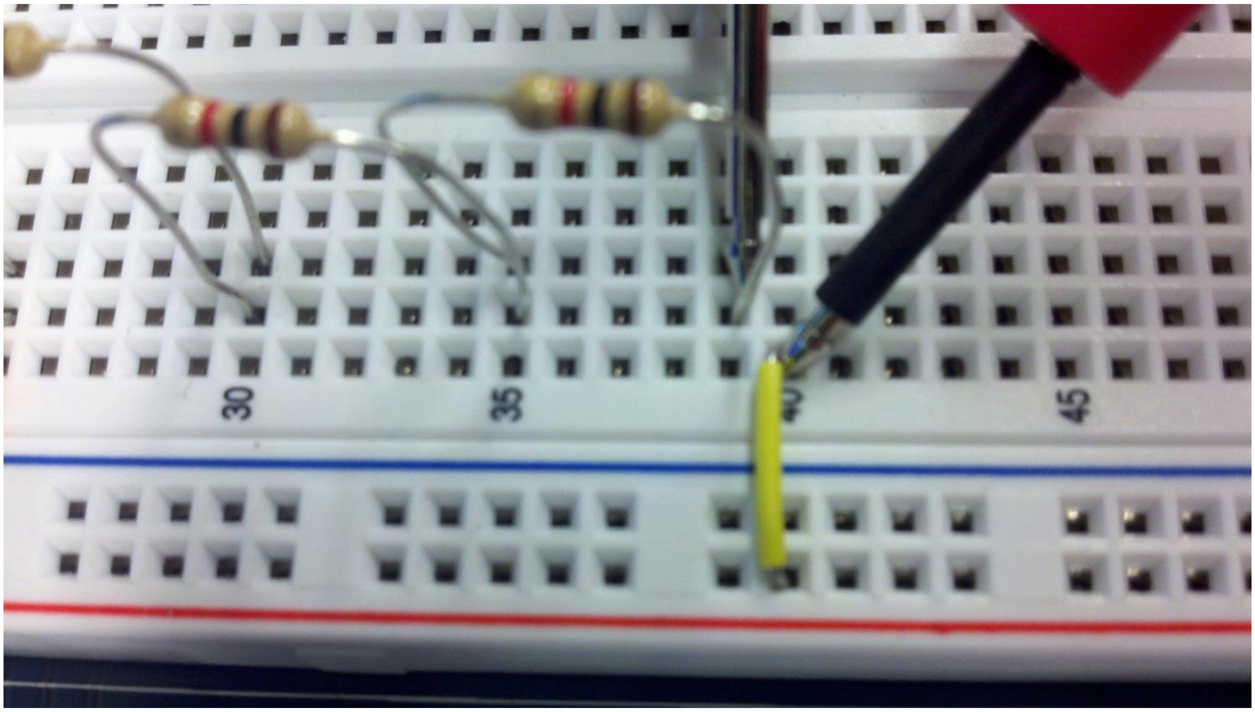


Voltage reading at points Va and Vb shown in LabView software.





7. Measure the total current. Open the circuit in between R1 and the power supply. With the multimeter set to Amps, place the positive probe on the power supply lead end and the negative probe on R1 resistor to close the circuit.



LabView is not sensitive enough to measure total current therefore; the digital multimeter was used for this measurement.

Observations: All measurements coincided with the calculated and simulated values. It was interesting to see that with equal resistors in series the voltage dropped equally across each resistor and that the voltage was divided by the number of resistors in the circuit.

Daniel Heaton

Lab 6A – Parallel Resistor with Equal Values

Names: Daniel Heaton, Ken Fischer
Date: 09/19/13

The purpose of this lab is to:
To learn how current behaves in a parallel circuit with equal valued resistors.

Equipment needed:
- Elvis prototype board and software
- Digital Multimeter
- 4 resistors (2 - 6.2kΩ & 2 -2.2kΩ)

Calculate

Excel parallel resistor circuit data:

	A	B	C	D	E
1	VT =	9	V		
2	R1a =	6.8E+3	Ω		
3	R1b =	2.2E+3	Ω		
4	R1 =	9.0E+3	Ω		
5	R2a =	6.8E+3	Ω		
6	R2b =	2.2E+3	Ω		
7	R2 =	9.0E+3	Ω		
8	RT =	4.5E+3	Ω	Reciprocal	
9	RT =	4.5E+3	Ω	Equal Value Branches	
10	RT =	4.5E+3	Ω	Product-Over-The-Sum	
11	IT =	0.002	mA		
12	IR1 =	0.001	mA		
13	IR2 =	0.001	mA		

Excel formulas for parallel resistor circuit:

	A	B	C
1	VT =	9	V
2	R1a =	6800	Ω
3	R1b =	2200	Ω
4	R1 =	=B2+B3	Ω
5	R2a =	6800	Ω
6	R2b =	2200	Ω
7	R2 =	=B5+B6	Ω
8	RT =	=1/((1/B4)+(1/B7))	Ω
9	RT =	=B4/2	Ω
10	RT =	=(B4*B7)/(B4+B7)	Ω
11	IT =	=B1/B8	mA
12	IR1 =	=B8/B4*B11	mA
13	IR2 =	=B8/B7*B11	mA

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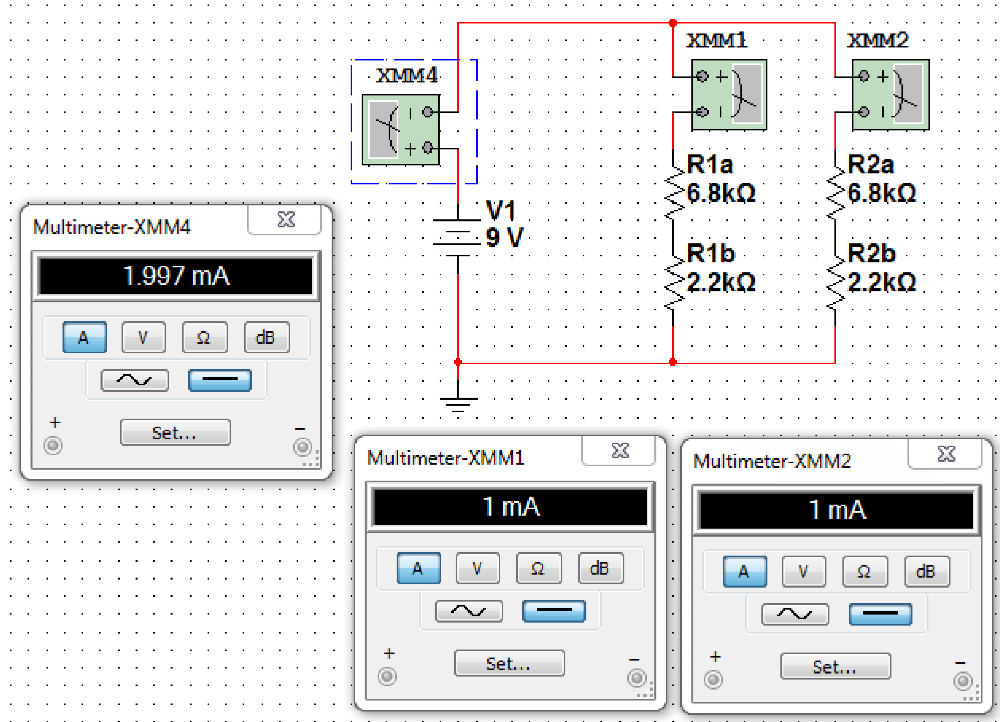
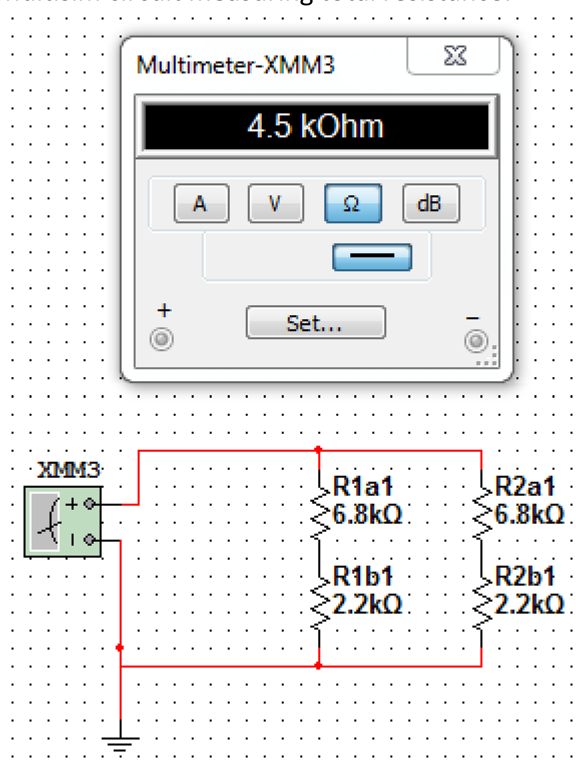
Simulate

Multisim circuit measuring total current and the current through points IR1 and R2:



Multisim circuit measuring total resistance:



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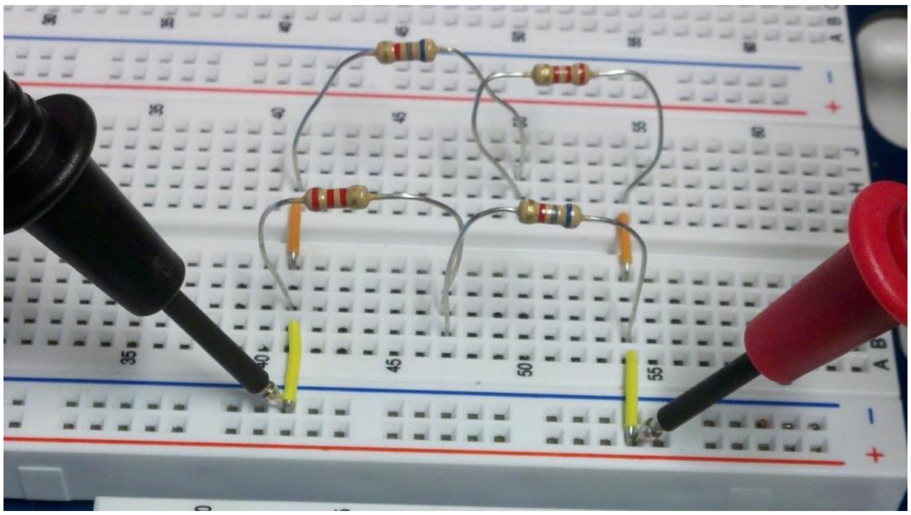
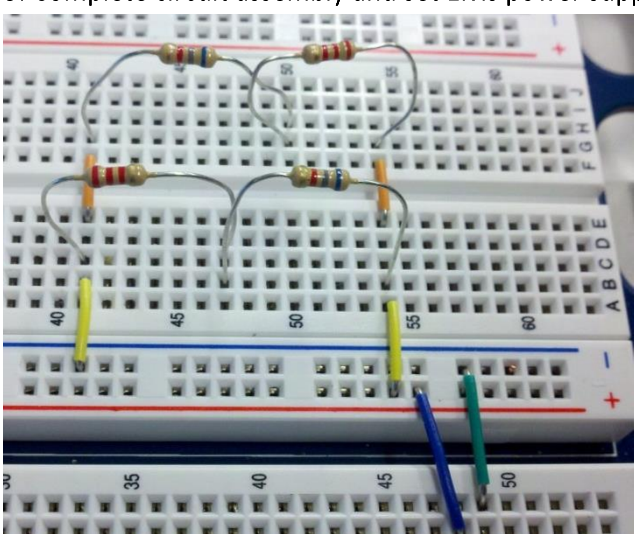
Measure

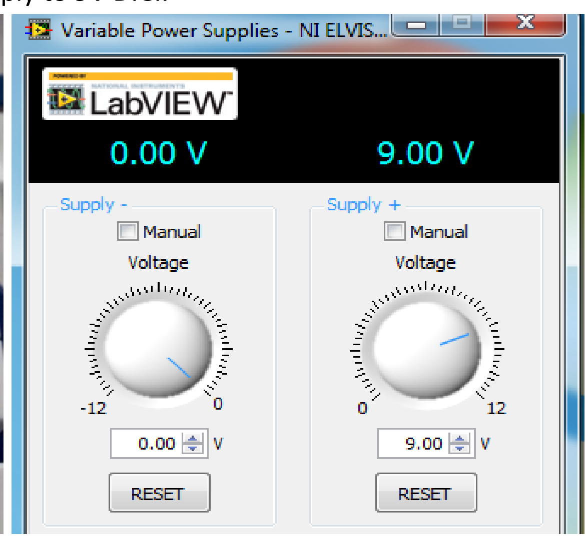
1. Power on multimeter and Elvis prototype board and software.

2. Measure the actual resistance of each resistor and their total resistance using the multimeter. Place the postive prove on one end of the resistor and place the negative probe on the other end of the resistor. Repeat for each resistor. For total resistance place the multimeter in place of the power supply and measure the resistance throughout the whole circuit.

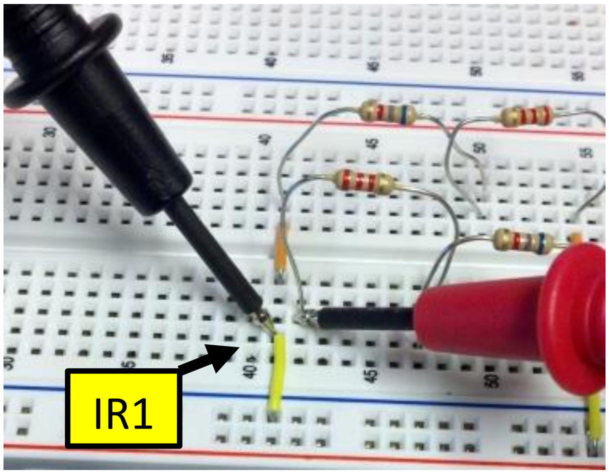


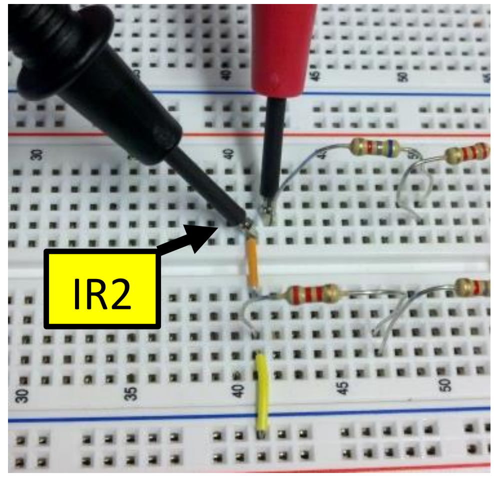
3. Complete circuit assembly and set Elvis power supply to 9V D.C..





4. Measure the current going through points IR1 and IR2. Open the circuit at a given point. With the multimeter set to Amps, place the positive probe on the positive open end of the circuit and the negative probe on the negative open end to complete the circuit.





Measured results:

VT =	9	V			
R1a =	6.7174	Ω	R2a =	6.743	Ω
R1b =	2.1964	Ω	R2b =	2.1844	Ω
R1 =	8.9127	Ω	R2 =	8.928	Ω
IR1 =	0.9998	mA	IR2 =	0.9974	mA

Observations: All measurements coincided with the calculated and simulated values. The voltage remained the same going into R1 & R2, but the total current was divided between the two branches.

Lab 6B – Parallel Resistors with Different Values

Names: Daniel Heaton, Ken Fischer
Date: 09/19/13

The purpose of this lab is to:
To learn how current behaves in a parallel circuit with different valued resistors.

Equipment needed:

- Elvis prototype board and software
- Digital Multimeter
- 4 resistors (1kΩ, 2.2kΩ, 4.7kΩ & 10kΩ)

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Calculate

Excel circuit data:

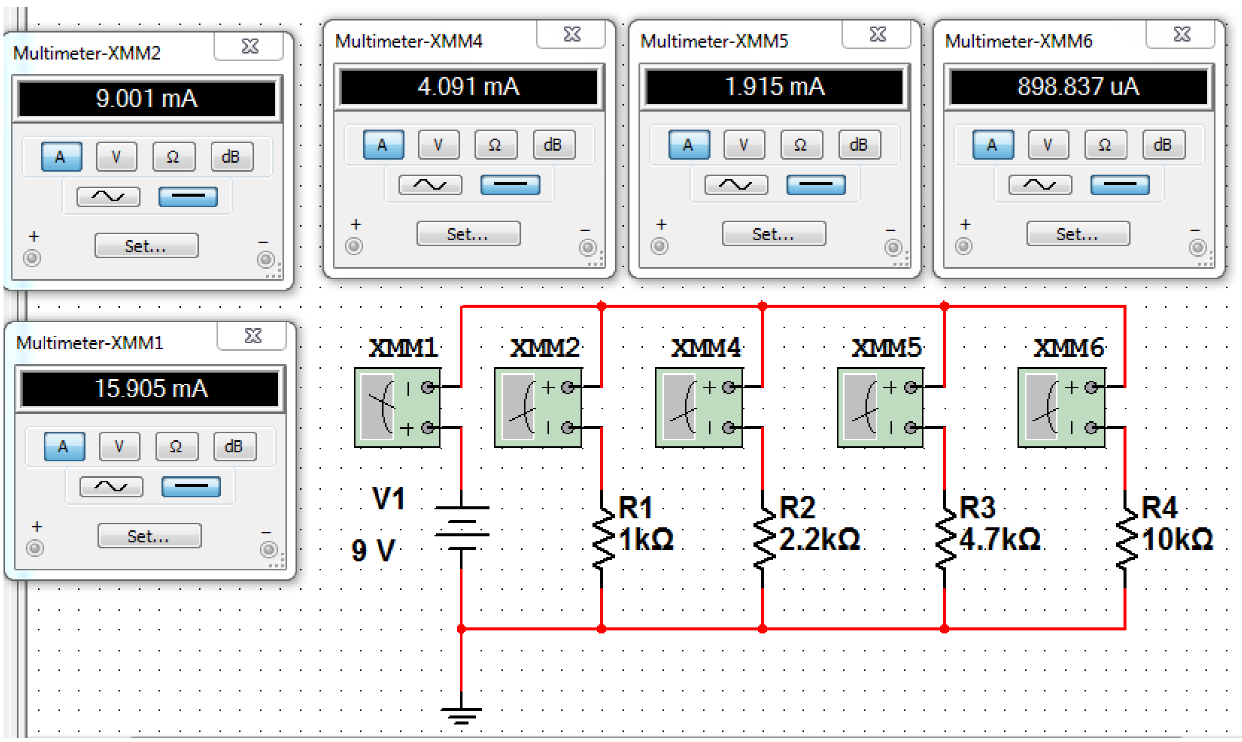
	A	B	C
1	VT =	9	V
2	R1 =	1.0E+3	Ω
3	R2 =	2.2E+3	Ω
4	R3 =	4.7E+3	Ω
5	R4 =	10.0E+3	Ω
6	RT =	565.8E+0	Ω
7	IT =	15.9E-3	A
8	IR1 =	9.0E-3	A
9	IR2 =	4.1E-3	A
10	IR3 =	1.9E-3	A
11	IR4 =	900.0E-6	A

Excel formulas for circuit:

	A	B	C
1	VT =	9	V
2	R1 =	1000	Ω
3	R2 =	2200	Ω
4	R3 =	4700	Ω
5	R4 =	10000	Ω
6	RT =	=1/((1/B2)+(1/B3)+(1/B4)+(1/B5))	Ω
7	IT =	=B1/B6	A
8	IR1 =	=B6/B2*B7	A
9	IR2 =	=B6/B3*B7	A
10	IR3 =	=B6/B4*B7	A
11	IR4 =	=B6/B5*B7	A

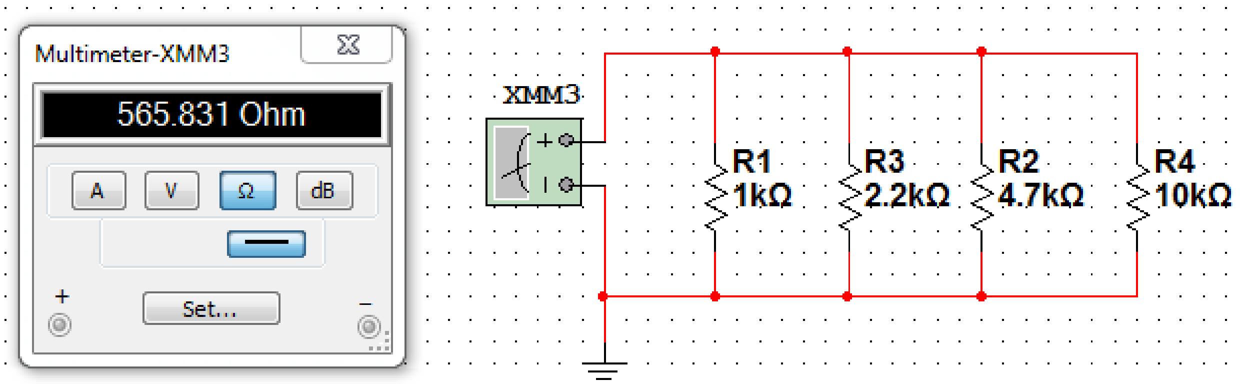
Simulate

Multisim circuit measuring IT, IR1, IR2, IR3 & IR4:



Daniel Heaton

Multisim circuit measuring total resistance:



Measure

1. Power on multimeter and Elvis prototype board and software.

2. Measure the actual resistance of each resistor and their total resistance using the multimeter. Place the postive prove on one end of the resistor and place the negative probe on the other end of the resistor. Repeat for each resistor. For total resistance place the multimeter in place of the power supply and measure the resistance throughout the whole circuit.

3. Complete circuit assembly and set Elvis power supply to 9V D.C..

4. Measure the current going through points IR1, 2, 3 & 4. Open the circuit at a given point. With the multimeter set to Amps, place the positive probe on the positive open end of the circuit and the negative probe on the negative open end to complete the circuit.

5. Measure the total current. Open the circuit in between R1 and the power supply. With the multimeter set to Amps, place the positive probe on the power supply lead end and the negative probe on R1 resistor to complete the circuit.

Measured values:

VT =	9	V	IT =		mA
RI =		Ω	IR1 =		mA
R2 =		Ω	IR2 =		mA
R3 =		Ω	IR3 =		mA
R4 =		Ω	IR4 =		mA
RT =		Ω			

Observations: All measurements coincided with the calculated and simulated values.

Daniel Heaton

Lab 7 – Series Parallel Resistors

Names: Daniel Heaton, Ken Fischer
Date: 09/26/13

The purpose of this lab is to:
Investigate the behavior of current, resistance and voltage drops in a series parallel resistor circuit.

Equipment needed:

- Elvis prototype board
- Elvis software LabVIEW
- Digital multimeter
- 8 resistors (1kΩ, 2 x 470Ω, 270Ω, 2.2kΩ, 10kΩ, 4.7kΩ & 3.3kΩ)

Calculate

Part A

Hand calculations

	A	B	C	D	E	F	G
1					Pre Lab 7a		
2	VT	9	V		VA = 3.184		
3	R1	1.0E+3	Ω		R12 =	3.200E+3	Ω
4	R2	2.2E+3	Ω		R56 =	3.770E+3	Ω
5	R3	10.0E+3	Ω		Total (R5+6)+R4 paralell =	2.092E+3	Ω
6	R4	4.7E+3	Ω		Total (R5+6)+R4 +R3 paralell =	1.730E+3	Ω
7	R5	3.3E+3	Ω		R3456 =	1.730E+3	Ω
8	R6	470	Ω		R123456=	4.930E+3	Ω
9	RT	4.93E+3	Ω				

Formulas

	A	B	C	D	E	F	G
1					Pre Lab 7a		
2	VT	9	V		VA = 3.184		
3	R1	1000	Ω		R12 =	=SUM(B3+B4)	Ω
4	R2	2200	Ω		R56 =	=SUM(B7+B8)	Ω
5	R3	10000	Ω		Total (R5+6)+R4 paralell =	=(F4*B6)/(F4+B6)	Ω
6	R4	4700	Ω		Total (R5+6)+R4 +R3 paralell =	=(F5*B5)/(F5+B5)	Ω
7	R5	3300	Ω		R3456 =	=F6	Ω
8	R6	470	Ω		R123456=	=SUM(F3+F7)	Ω
9	RT	=F8	Ω				

Part B

Hand calculations

	A	B	C	D	E	F	G
11					Lab 7b		
12	VT	9	V		VA = 4.514		
13	R1	1.0E+3	Ω		R12 =	1.740E+03	Ω
14	R2a	470	Ω		R56 =	3.770E+03	Ω
15	R2b	270	Ω		R5 + R6 =	6.8E+3	Ω
16	R3	10.0E+3	Ω		Total (R5+6)+R4 paralell =	2.1E+3	Ω
17	R4	4.7E+3	Ω		Total (R5+6)+R4 +R3 paralell =	1.730E+03	Ω
18	R5	3.3E+3	Ω		R3456 =	1.730E+03	Ω
19	R6	470	Ω		R123456=	3.470E+03	Ω
20	RT	3.5E+3	Ω				

Formulas

	A	B	C	D	E	F	G
11					Lab 7b		
12	VT	9	V		VA = 4.514		
13	R1	1000	Ω		R12 =	=SUM(B13+B14+B15)	Ω
14	R2a	470	Ω		R56 =	=SUM(B18+B19)	Ω
15	R2b	270	Ω		R5 + R6 =	=SUM(B18+B20)	Ω
16	R3	10000	Ω		Total (R5+6)+R4 paralell =	=(F14*B17)/(F14+B17)	Ω
17	R4	4700	Ω		Total (R5+6)+R4 +R3 paralell =	=(F16*B16)/(F16+B16)	Ω
18	R5	3300	Ω		R3456 =	=F17	Ω
19	R6	470	Ω		R123456=	=F13+F18	Ω
20	RT	=F19	Ω				

Part C

Hand calculations

	A	B	C	D	E	F	G
23					Lab 7c		
24	VT	9	V		VA = 3.184		
25	R1	1.0E+3	Ω		R12 =	3.200E+03	Ω
26	R2	2.2E+3	Ω		R56 =	3.770E+03	Ω
27	R3	10.0E+3	Ω		Total (R5+6)+R4 paralell =	2.1E+3	Ω
28	R4	4.7E+3	Ω		Total (R5+6)+R4 +R3 paralell =	1.730E+03	Ω
29	R5	3.3E+3	Ω		R3456 =	1.730E+03	Ω
30	R6	470.0E+0	Ω		R123456=	4.930E+03	Ω
31	RT	4.930E+03	Ω		IT =	1.8E-3	A
32	VA	3.184	V		IR3 =	315.8E-6	A
33					IR4 =	6.720E-04	A
34					IR56 =	8.377E-04	A

Daniel Heaton

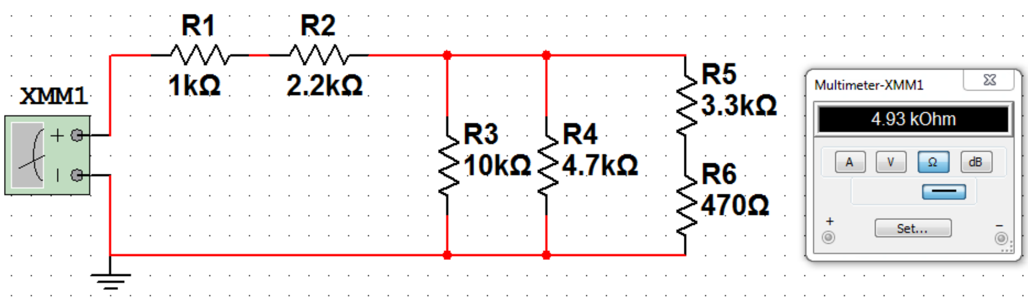
Formulas

	A	B	C	D	E	F	G
23					Lab 7c		
24	VT	9	V		VA = 3.184		
25	R1	1000	Ω		R12 =	=SUM(B25+B26)	Ω
26	R2	2200	Ω		R56 =	=SUM(B29+B30)	Ω
27	R3	10000	Ω		Total (R5+6)+R4 paralell =	=(F26*B28)/(F26+B28)	Ω
28	R4	4700	Ω		Total (R5+6)+R4 +R3 paralell =	=(F27*B27)/(F27+B27)	Ω
29	R5	3300	Ω		R3456 =	=F28	Ω
30	R6	470	Ω		R123456=	=SUM(F25+F29)	Ω
31	RT	=F30	Ω		IT =	=B24/B31	A
32	VA	3.184	V		IR3 =	=F29/B27*F31	A
33					IR4 =	=F29/B28*F31	A
34					IR56 =	=F29/F26*F31	A

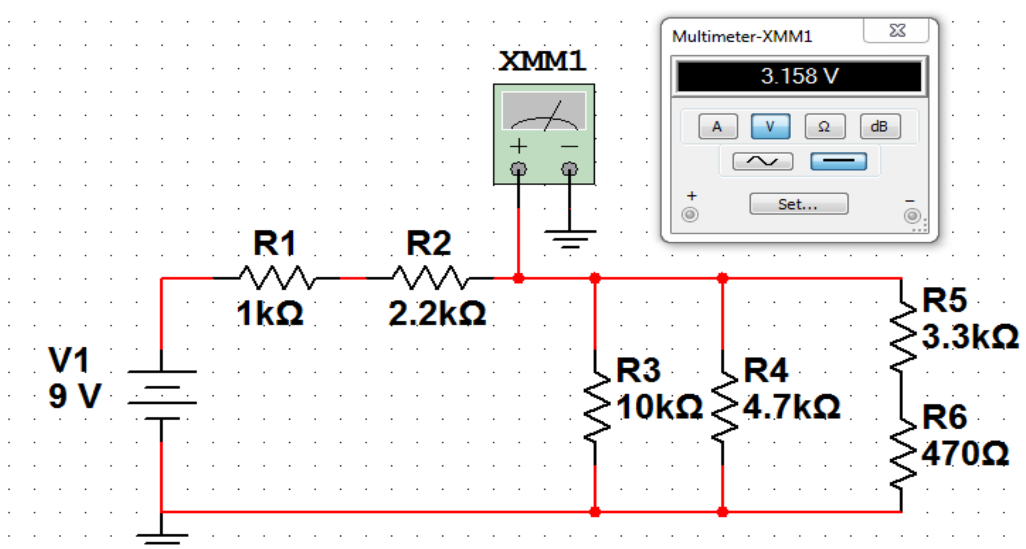
Simulate

Part A

RT Simulation



VA Simulation



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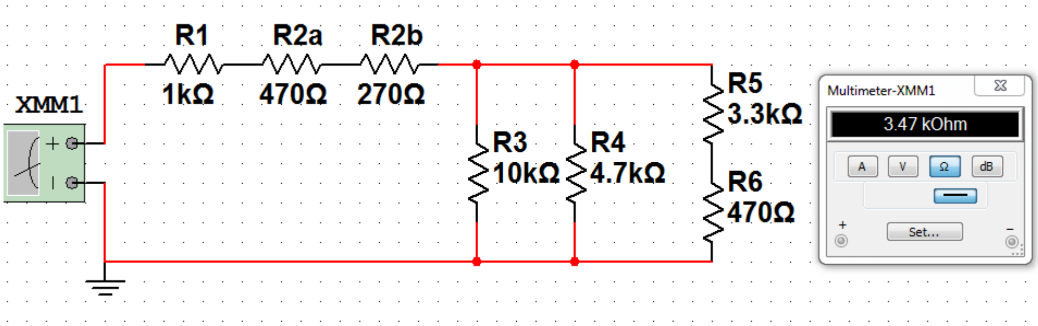
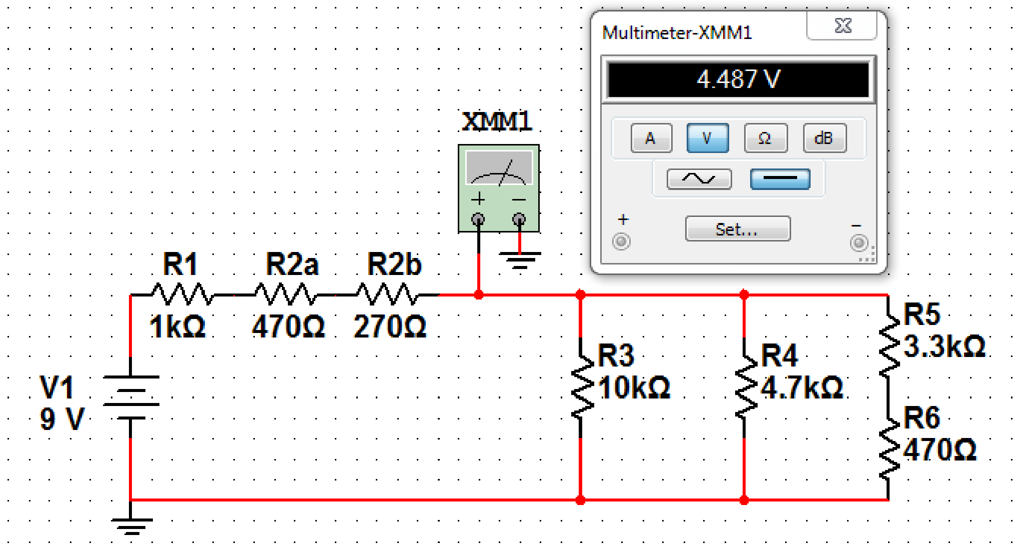
Part B

RT Simulation

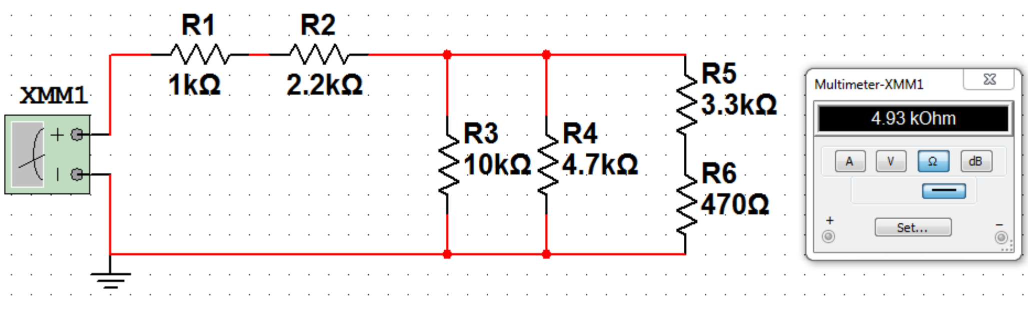


VA Simulation



Part C

RT Simulation



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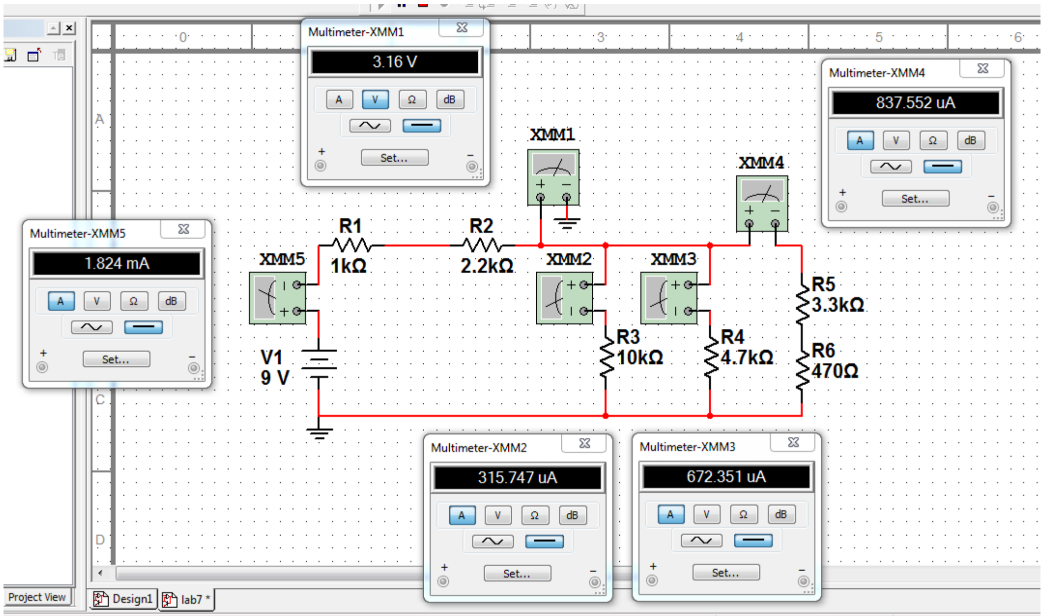
VA, IT, IR3, IR4 & IR56 Simulation



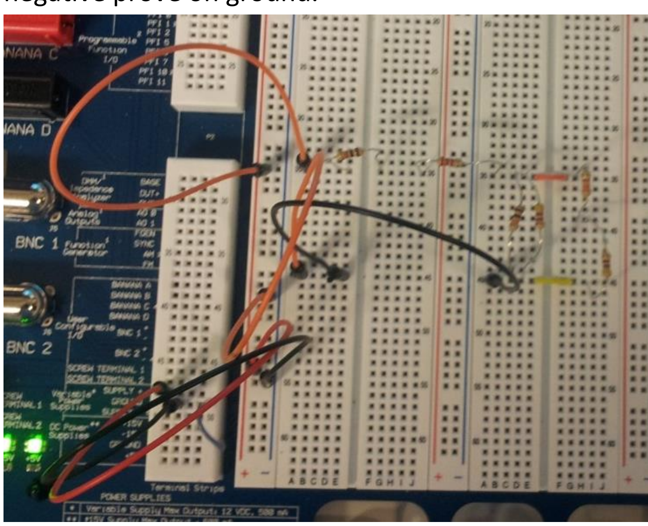
Measure

Part A

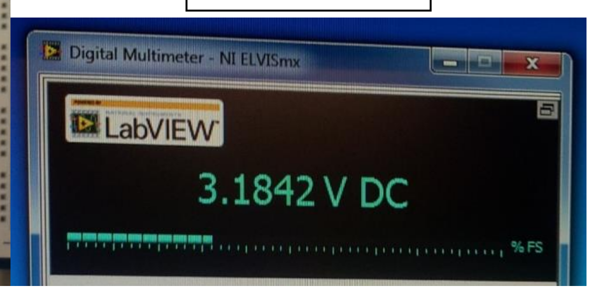
1. Power on multimeter and Elvis prototype board and software.

2. Build the given circuit and set voltage supply to 9V D.C..

3. Measure the voltage going through point VA. With the Elvis simulation multimeter set for measuring voltage, place the positive probe on the positive end of the resistor at the given point and place the negative prove on ground.



VA



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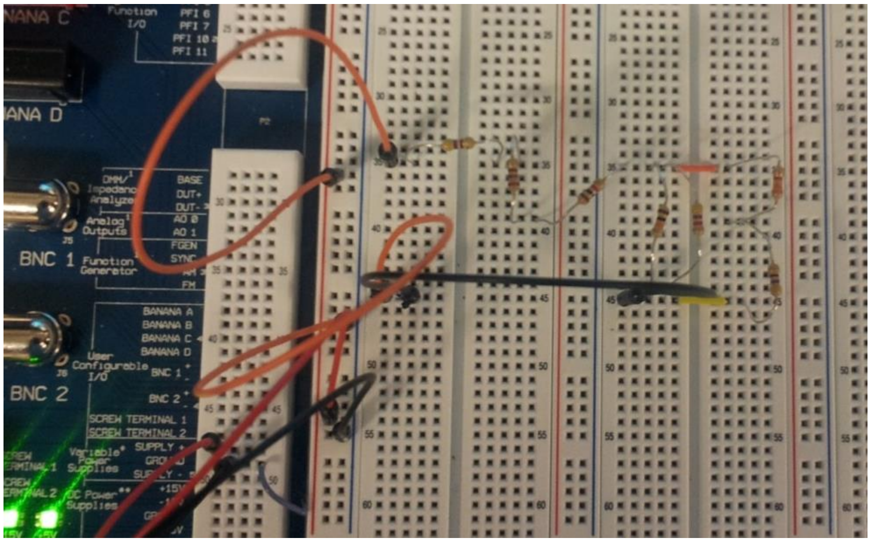
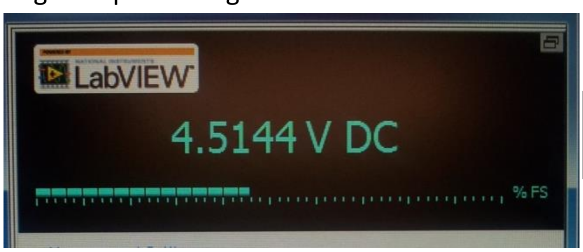
Part B

1. Replace R2 with a 470Ω (R2a) and 270Ω (R2b) resistors.



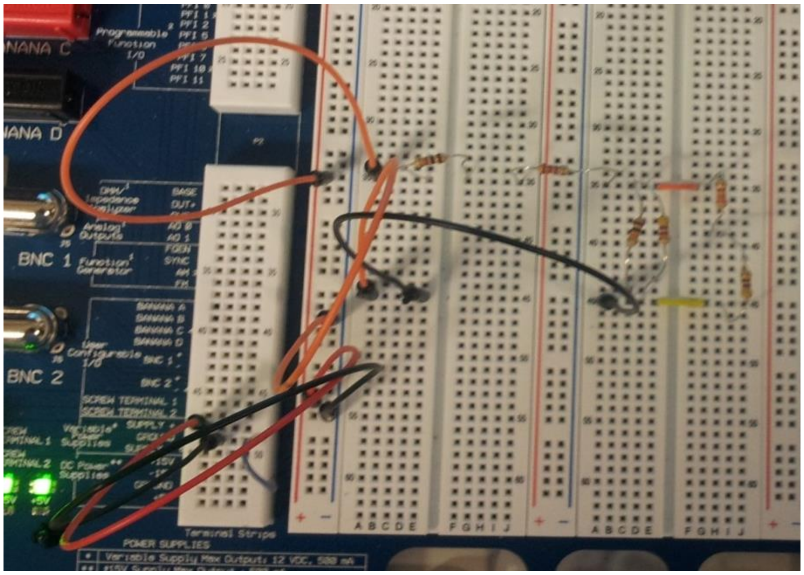
2. Measure the voltage going through point VA. With the Elvis simulation multimeter set for measuring voltage, place the positive probe on the positive end of the resistor at the given point and place the negative prove on ground.



VA

Part C

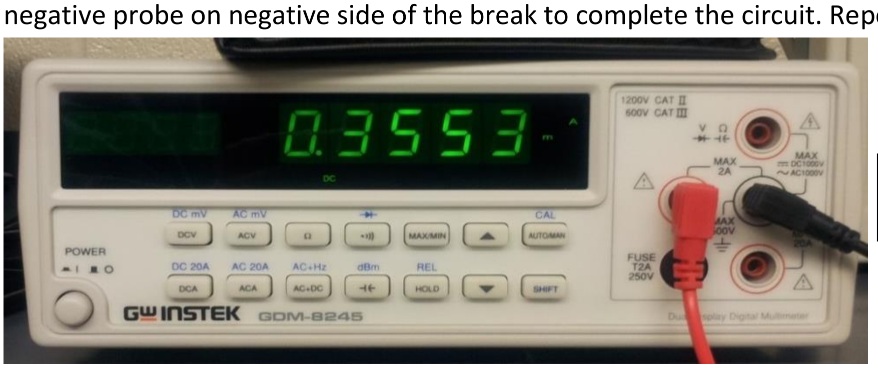
1. Replace R2a and R2b with a 2.2kΩ resistor.



2. Measure the total current. Open the circuit in between R1 and the power supply. With the multimeter set to Amps, place the positive probe on the power supply lead end and the negative probe on R1 resistor to close the circuit.

IT

3. Measure the current passing through points IR3, IR4, and IR56. Open the circuit at the given point. With the multimeter set to Amps, place the positive probe on the positive side of the break and the negative probe on negative side of the break to complete the circuit. Repeat for all the given points.



IR3

Daniel Heaton

IR4

IR56

Observations:

Lab 9 – Capacitors and Inductors in series and parallel circuits

Names: Daniel Heaton
Date: 12/10/13

The purpose of this lab is to:
Understand the behavior of capacitors and inductors in series and parallel circuits.

Equipment needed:
- 3 Capacitors
- 3 Inductors
- LCR meter
- Elvis prototype board

Calculate

Two or more unequal capacitors in series

Excel data:

	A	B	C	D	E
1		VALUE	M. VALUE		
2	C1 =	1.0E-6	876.5E-9	=	0.87652µF
3	C2 =	2.2E-6	2.0734E-6	=	2.0734µF
4	C3 =	4.7E-6	4.7728E-6	=	4.7728µF
5	CT =	599.8E-9	541.3200E-9	=	0.54132µF 541.32nF
6	CT=1/((1/B2)+(1/B3)+(1/B4))				

Excel formulas:

	A	B	C	D	E
1		VALUE	M. VALUE		
2	C1 =	0.000001	0.00000087652	=	0.87652µF
3	C2 =	0.0000022	0.0000020734	=	2.0734µF
4	C3 =	0.0000047	0.0000047728	=	4.7728µF
5	CT =	=1/((1/B2)+(1/B3)+(1/B4))	0.00000054132	=	0.54132µF 541.32nF
6	CT=1/((1/B2)+(1/B3)+(1/B4))				

Daniel Heaton

Capacitors in parallel

Excel data:

	A	B	C	D	E
1		VALUE	M. VALUE		
2	C1 =	1.0E-6	876.5E-9	=	0.87652µF
3	C2 =	2.2E-6	2.0734E-6	=	2.0734µF
4	C3 =	4.7E-6	4.7728E-6	=	4.7728µF
5	CT =	7.9E-6	7.7293E-6	=	7.7293µF
6	CT=C1+C2+C3				

Excel formulas:

	A	B	C	D	E
1		VALUE	M. VALUE		
2	C1 =	0.000001	0.00000087652	=	0.87652µF
3	C2 =	0.0000022	0.0000020734	=	2.0734µF
4	C3 =	0.0000047	0.0000047728	=	4.7728µF
5	CT =	=B2+B3+B4	0.0000077293	=	7.7293µF
6	CT=C1+C2+C3				

Inductors in series

Excel data:

	A	B	C	D	E
1		VALUE	M. VALUE		
2	L1 =	1.0E-3	1.0295E-3	=	1.0295mH
3	L2 =	2.2E-3	2.1672E-3	=	2.1672mH
4	L3 =	4.7E-3	4.3596E-3	=	4.3596mH
5	LT =	7.9E-3	8.2139E-3	=	8.2139mH
6	LT = L1+L2+L3				

Excel formulas:

	A	B	C	D	E
1		VALUE	M. VALUE		
2	L1 =	0.001	0.0010295	=	1.0295mH
3	L2 =	0.0022	0.0021672	=	2.1672mH
4	L3 =	0.0047	0.0043596	=	4.3596mH
5	LT =	=B2+B3+B4	0.0082139	=	8.2139mH
6	LT = L1+L2+L3				

Daniel Heaton

Three or more unequal inductors in parallel

Excel data:

	A	B	C	D	E
1		VALUE	M. VALUE		
2	L1 =	1.0E-3	1.0295E-3	=	1.0295mH
3	L2 =	2.2E-3	2.1672E-3	=	2.1672mH
4	L3 =	4.7E-3	4.3596E-3	=	4.3596mH
5	LT =	599.8E-6	651.5E-6	=	0.6515mH
6	LT = 1/((1/L1)+(1/L2)+(1/L3))				

Excel formulas:

1		VALUE	M. VALUE		
2	L1 =	0.001	0.0010295	=	1.0295mH
3	L2 =	0.0022	0.0021672	=	2.1672mH
4	L3 =	0.0047	0.0043596	=	4.3596mH
5	LT =	=1/((1/B2)+(1/B3)+(1/B4))	0.00065152	=	0.6515mH
6	LT = 1/((1/L1)+(1/L2)+(1/L3))				

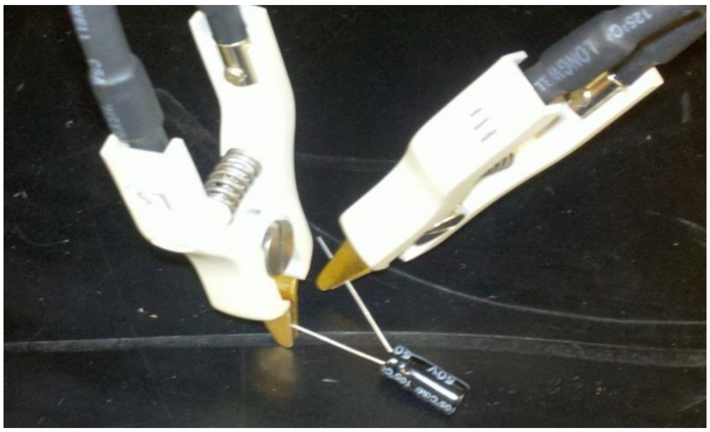
Measure

Capacitors

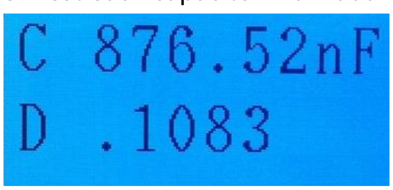
1. To measure the capacitance of a given capacitor, turn on the LCR meter and set parameters to the follow:

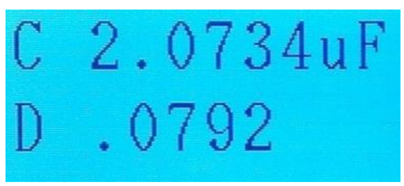
- Speed: Medi
- Display: Value
- Mode: C/D

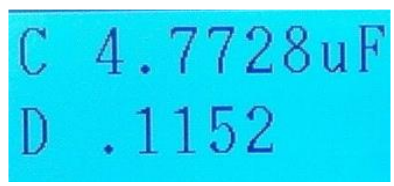
2. Connect an LCR meter probe to each of the capacitor wires. Press the “START” button to measure the capacitor.



3. Test each capacitor individually.







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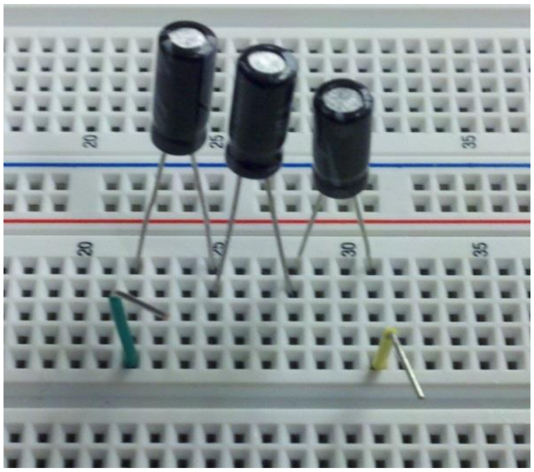
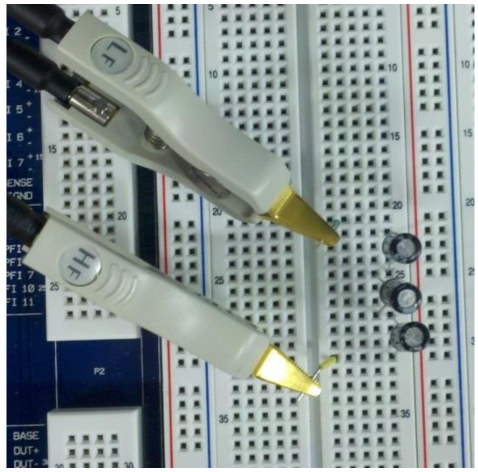
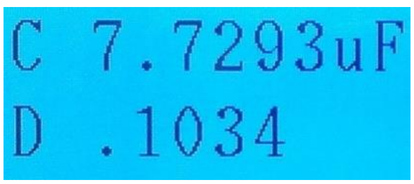
Two or more unequal capacitors in series

1. Build series circuit and connect the meter probes to each side of the circuit. Set the LCR circuit option to "SERIES" and measure the total capacitance of the circuit.

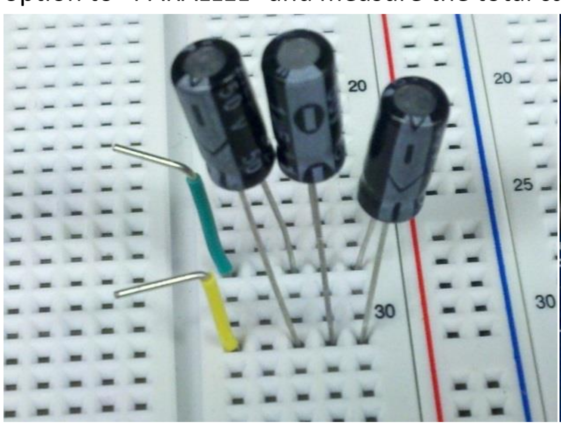


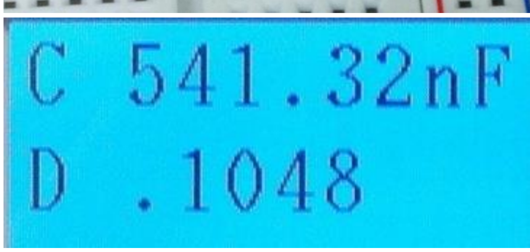




Capacitors in parallel

1. Build parallel circuit and connect the meter probes to each side of the circuit. Set the LCR circuit option to "PARALLEL" and measure the total capacitance of the circuit.

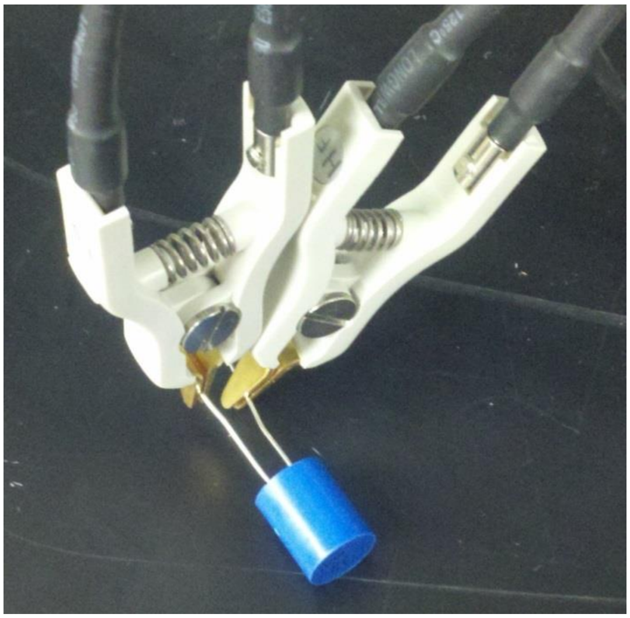




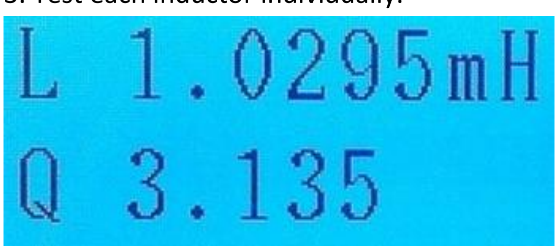
Inductors

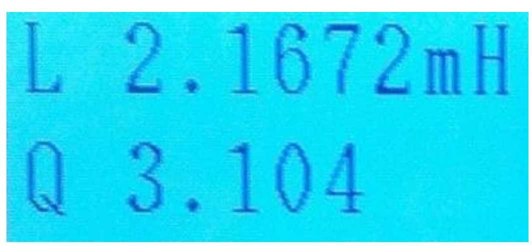
1. To measure the inductance of a given inductor, turn on the LCR meter and set parameters to the follow:
    - Speed: Medi
    - Display: Value
    - Mode: L/Q

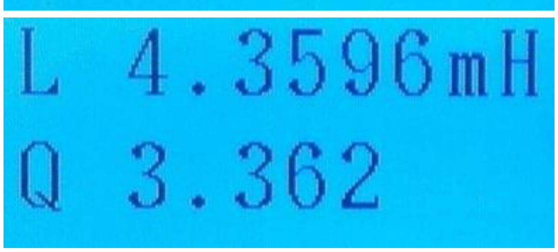
2. Connect an LCR meter probe to each of the inductor wires. Press the “START” button to measure the capacitor.



3. Test each inductor individually.

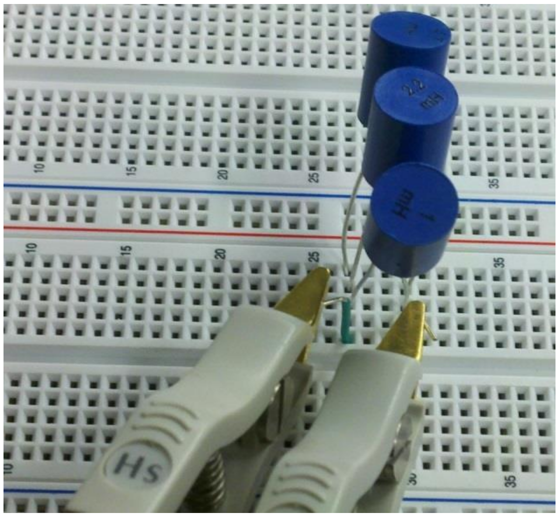


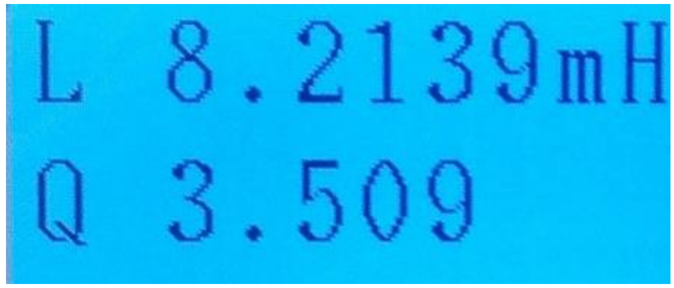




Inductors in series

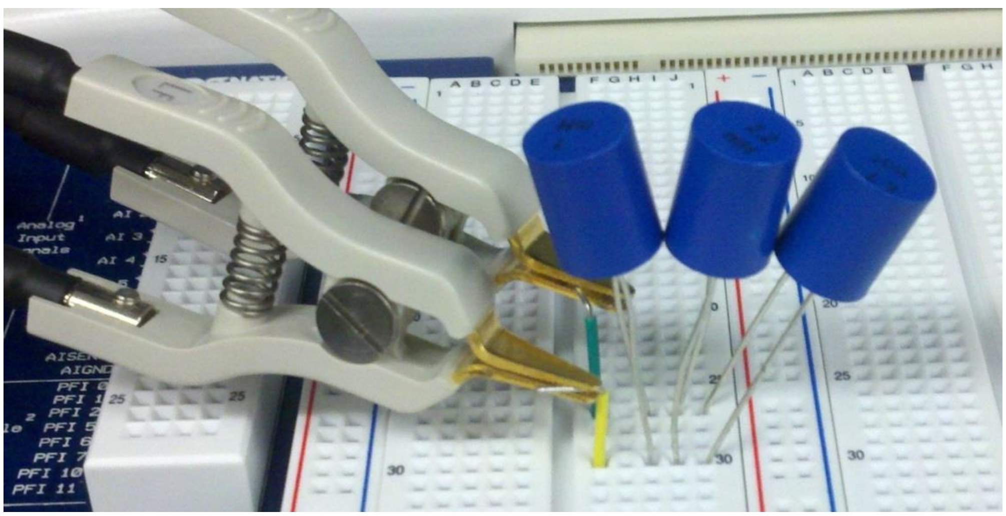
1. Build series circuit and connect the meter probes to each side of the circuit. Set the LCR circuit option to "SERIES" and measure the total inductance of the circuit.

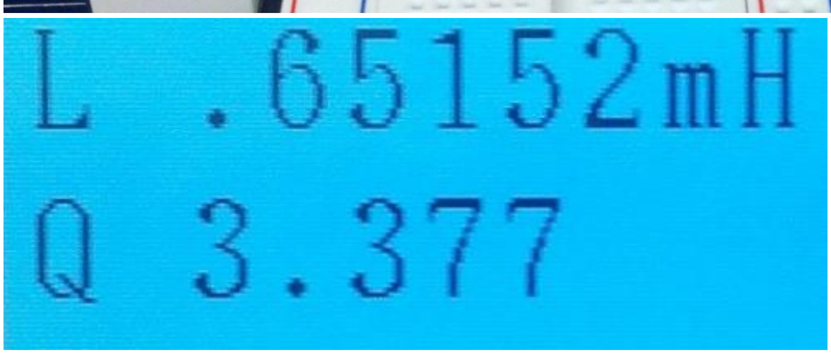




Three or more unequal inductors in parallel

1. Build parallel circuit and connect the meter probes to each side of the circuit. Set the LCR circuit option to "PARALLEL" and measure the total inductance of the circuit.





Observations:
My hand calculations were farther off the actual values than I expected. However, with the smaller units of measurement, used with compositors and inductors verses resistors, my initial perception may have been off.
It was interest to see how the capacitors and inductors act completely different in both their parallel and series circuits. This has helped me better understand the data graphs we plotted in class.