Lab 9: Power Transfer in AC Circuits

Josh Ortiz & James Robinson
ECEN 214 - 502
TA: Yichi Zhang
Date Performed: 4/23/19
Date Report Due: 4/30/19

Procedure

1. Build the circuit shown in figure 9.5.
2. Supply a peak to peak 8V AC power source at 10k Hz.
3. Measure the power delivered to the load resistor for load resistor values 4k, 6k, 8k, 10k, 15k, and 20k.
4. Build the circuit shown in figure 9.6 (with the values from step 2).
5. Measure the power delivered to the load resistor for shunt capacitor values .5n, .8n, 1n, 1.5n, 2n, 3n, and 4n.
6. Still using the circuit shown in figure 9.6, vary the values of the load resistor and shunt capacitor to try and get the greatest power output.
7. Record all of your results.

Data and Results

Task 1

Load Resistor (Ω)	RMS (V)	Power (W)
20000	2.24	0.00025088
3900	1.26	0.0004070769231
6200	1.735	0.0004855201613
8200	2	0.000487804878
10000	2.28	0.00051984
15000	2.203	0.0003235472667

Task 2

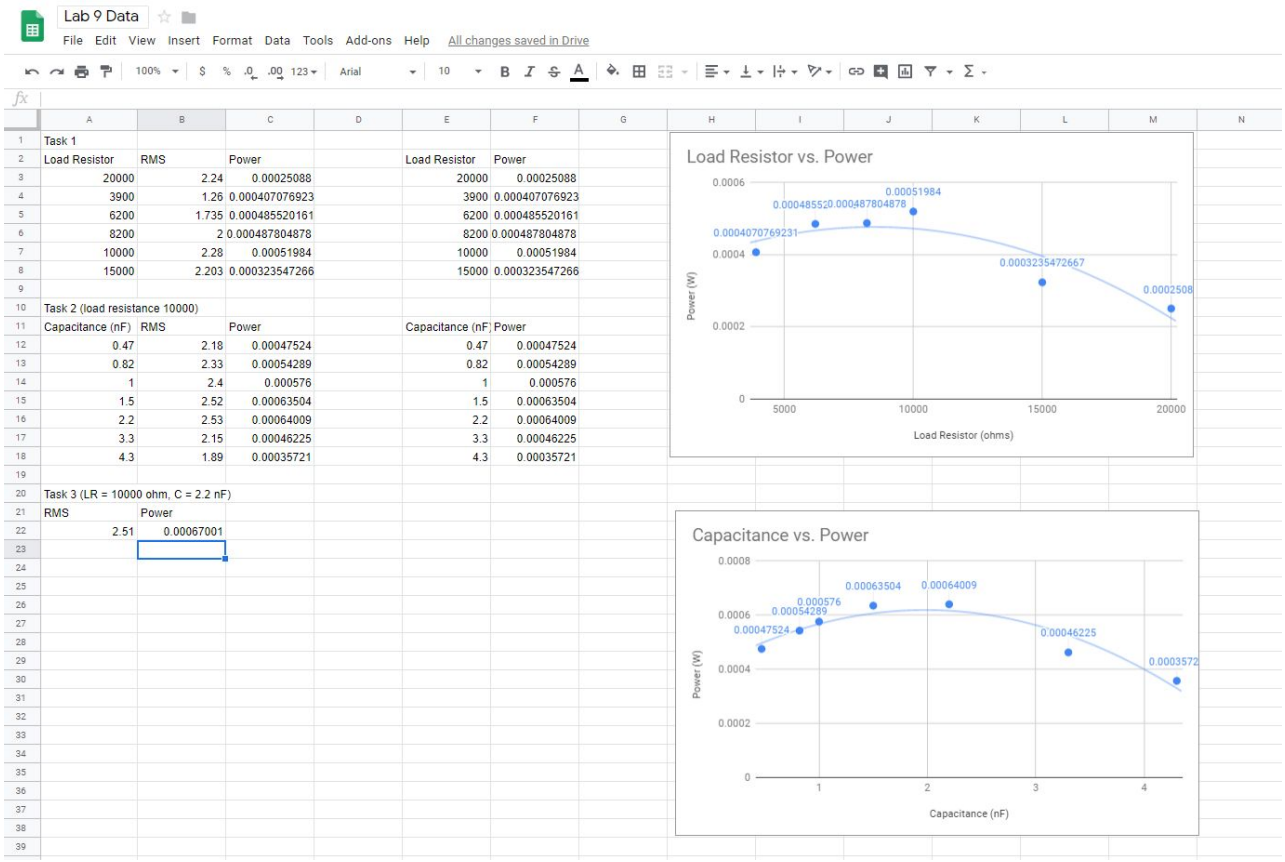
(Load Resistance = 10,000 Ω)

Capacitance (nF)	RMS (V)	Power (W)
0.47	2.18	0.00047524
0.82	2.33	0.00054289
1	2.4	0.000576
1.5	2.52	0.00063504
2.2	2.53	0.00064009
3.3	2.15	0.00046225
4.3	1.89	0.00035721

Task 3

Load Resistance (Ω)	Capacitance (nF)	RMS (V)	Power (W)
10000	2.2	2.51	.00067

We did not use a lab notebook, we used Google Sheets to document our experiment values, here is a photo of our spreadsheet.



Lab 9 Data

File Edit View Insert Format Data Tools Add-ons Help All changes saved in Drive

	A	B	C	D	E	F
1	Task 1					
2	Load Resistor	RMS	Power		Load Resistor	Power
3	20000	2.24	0.00025088		20000	0.00025088
4	3900	1.26	0.000407076923		3900	0.000407076923
5	6200	1.735	0.000485520161		6200	0.000485520161
6	8200	2	0.000487804878		8200	0.000487804878
7	10000	2.28	0.00051984		10000	0.00051984
8	15000	2.203	0.000323547266		15000	0.000323547266
9						
10	Task 2 (load resistance 10000)					
11	Capacitance (nF)	RMS	Power		Capacitance (nF)	Power
12	0.47	2.18	0.00047524		0.47	0.00047524
13	0.82	2.33	0.00054289		0.82	0.00054289
14	1	2.4	0.000576		1	0.000576
15	1.5	2.52	0.00063504		1.5	0.00063504
16	2.2	2.53	0.00064009		2.2	0.00064009
17	3.3	2.15	0.00046225		3.3	0.00046225
18	4.3	1.89	0.00035721		4.3	0.00035721
19						
20	Task 3 (LR = 10000 ohm, C = 2.2 nF)					
21	RMS	Power				
22	2.51	0.00067001				
23						

Sample Calculations

$$Power = RMS^2 / Load\ Resistance$$

Discussion

Our experimental values of power came out very close to the theoretical values that we calculated. Nearly all the experimental values were lower than the theoretical values. This was undoubtedly caused by internal resistance in equipment such as batteries or wires. It could have also been due to the small margin of error that every component value has.

Choosing the correct components with the correct values undoubtedly made a large impact on the power output of our circuit. Regardless of what value we chose, our power output with the capacitor was almost always higher than the circuit without the capacitor. But once we optimized the value of the capacitor our power output was nearly 1.5 times greater than that of the circuit with no shunt capacitor. Once we optimized the value of our load resistor and our shunt capacitor the power output of our circuit was at its greatest value.

Conclusion

Our last lab in ECEN 214 was not the one that took the most time or even the most skill to implement. But I feel that this final lab gave us the greatest insight into the practical application of the things we have learned thus far. We got to see how choosing components and their values can dramatically change a circuit and the way that it functions.

We were able to choose for ourselves how to optimize the circuit that we built in this lab. Because of the practice that we had from the previous eight labs, we were confident in the decisions that we made, and the lab went well.