NETWORK ANALYSIS AND SYNTHESIS

NOISELESS SPEAKER

April 30, 2023

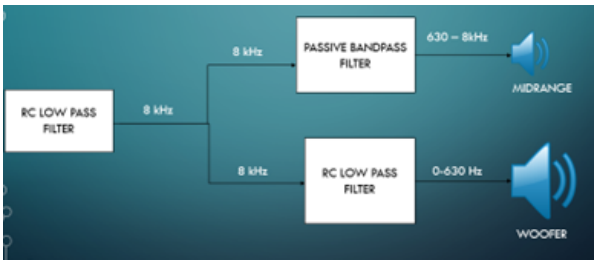
1 OBJECTIVE

Design and demonstration of a noiseless speaker.Using lowpass RC filter, bandpass filter, midrange speaker and woofer speaker.

2 INTRODUCTION

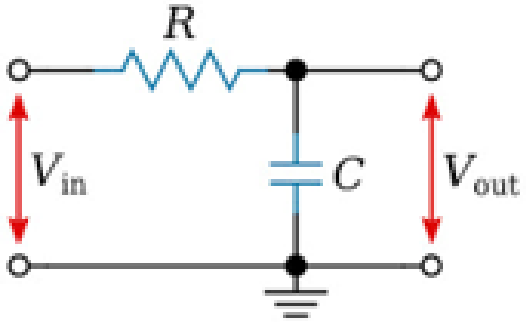
Noiseless speaker is a device which reduces noise in the input wave and gives an output sound wave that is noiseless.
WHAT IS NOISE IN A SIGNAL?
Noise is a general term for unwanted modification that a signal may suffer. Noise in a sound can be hiss or hum.

3 BLOCK DIAGRAM



4 THEORY OF FILTERS

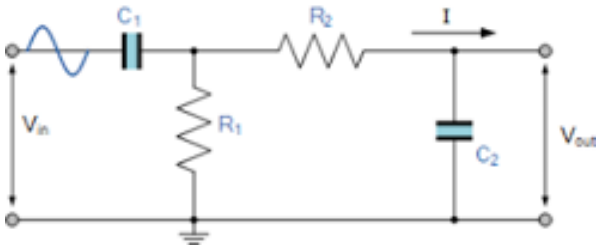
4.1 RC LOW PASS FILTER



- Passes low-frequency signals and blocks high frequency signals
- Capacitor-reactive device (resistance offered changes depending on the frequency of the signal)

- C offers lower resistance as the frequency of the signal increases.
- A capacitor offers very low impedance to a very high frequency signal.
- High frequency signals go through C, as they represent a low-impedance path.
- Current always takes the path of least resistance.
- So high-frequency signals normally take the capacitor path, while low-frequency signals don't; they go through to output.

4.2 BANDPASS FILTER



- Bandpass filter that does not require power and does not give amplification of the input signal.
- Composed of high pass filter and low pass filter
- The high-pass filter passes all frequencies above the low
- cutoff frequency point and the low-pass filter passes all frequencies below the high cutoff frequency point.
- All the frequencies in between these 2 cutoff frequency points form the passband of the bandpass filter circuit.

5 CALCULATIONS

5.1 RC LOW PASS FILTER 1

$$f_c = \frac{1}{2\pi RC},$$

$$f_c = 8KHz$$

$$R = 50\ ohms$$

$$hence\ C = 398.089\ nF$$

5.2 BANDPASS FILTER

$$low\ cutoff\ frequency = \frac{1}{2\pi R_2 C_2} = 630\ Hz$$

$$high\ cutoff\ frequency = \frac{1}{2\pi R_1 C_1} = 8\ KHz$$

therefore on solving,

$C_1 = 100\ nF$ $\quad$ $C_2 = 1nF$

$R_1 = 2528\ ohm$ $\quad$ $R_2 = 19904\ ohm$

5.3 RC LOW PASS FILTER 2

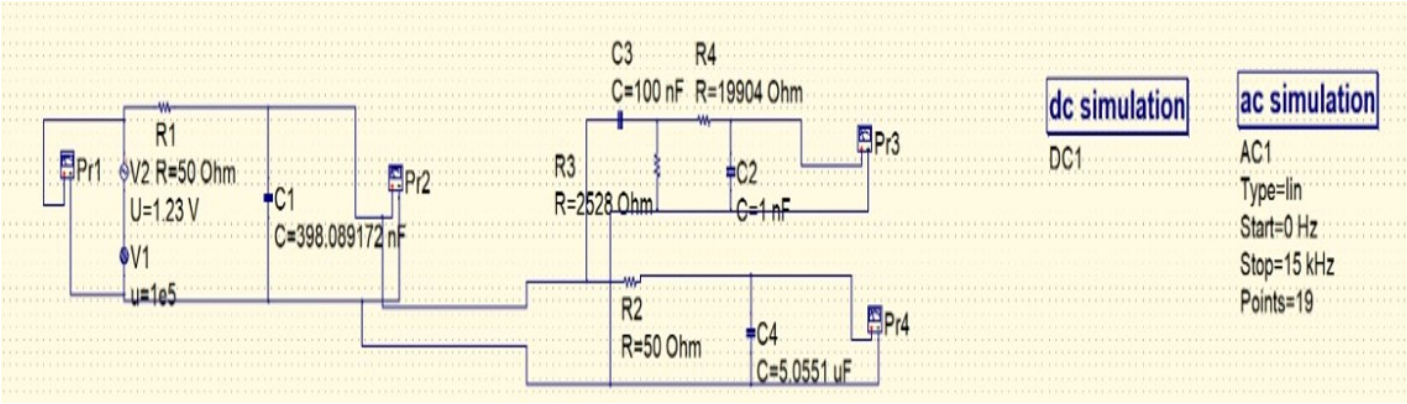
$$f_c = \frac{1}{2\pi RC},$$

$$f_c = 630\ Hz$$

$$R = 50\ ohms$$

$$hence\ C = 5.055\ \mu F$$

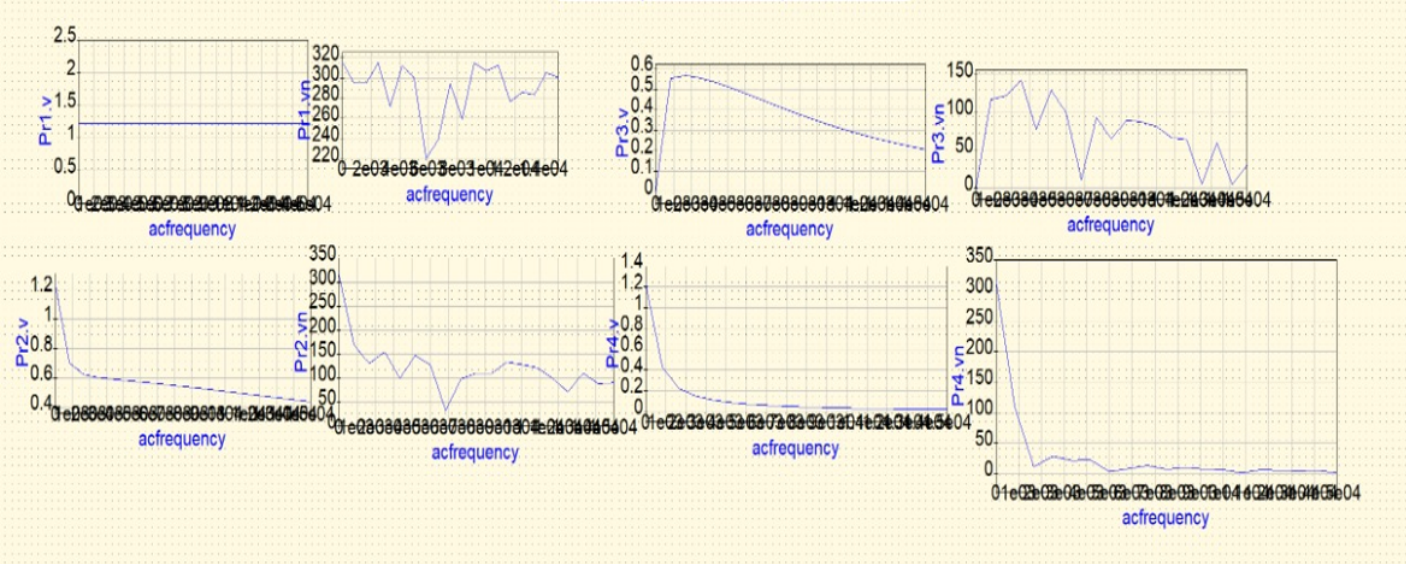
6 QUCS IMPLEMENTATION



7 TABLE

acfrequency	Pr1.v	Pr1.vn	Pr2.v	Pr2.vn	Pr3.v	Pr3.vn	Pr4.v	Pr4.vn
0	1.23	316	1.23	316	0	3.11e-08	1.23	316
833	1.23	295	0.702 / -19.8°	169	0.553 / 11.1°	117	0.423 / -72.8°	109
1.67e03	1.23	295	0.625 / -16.1°	131	0.567 / -7.26°	122	0.221 / -85.4°	11.6
2.5e03	1.23	315	0.604 / -15.8°	155	0.554 / -19°	142	0.148 / -91.7°	28.3
3.33e03	1.23	272	0.593 / -16.9°	99.9	0.533 / -28.7°	78.2	0.11 / -96.2°	21.7
4.17e03	1.23	313	0.584 / -18.6°	148	0.508 / -37.4°	129	0.0872 / -100°	22.3
5e03	1.23	300	0.574 / -20.6°	128	0.48 / -45.2°	99.5	0.0718 / -103°	3.32
5.83e03	1.23	220	0.565 / -22.7°	33.5	0.451 / -52.4°	11.7	0.0606 / -107°	8.31
6.67e03	1.23	239	0.555 / -24.8°	98.6	0.422 / -59°	93.2	0.0522 / -109°	13.4
7.5e03	1.23	294	0.544 / -27°	111	0.393 / -65.1°	65.2	0.0455 / -112°	7.23
8.33e03	1.23	260	0.534 / -29.1°	110	0.366 / -70.7°	90	0.0402 / -115°	10
9.17e03	1.23	315	0.522 / -31.1°	134	0.341 / -75.8°	87.2	0.0358 / -117°	7.38
1e04	1.23	307	0.511 / -33.1°	129	0.317 / -80.6°	81.4	0.0321 / -120°	6.49
1.08e04	1.23	313	0.499 / -35°	122	0.295 / -85°	66.7	0.029 / -122°	1.38
1.17e04	1.23	277	0.487 / -36.9°	100	0.274 / -89.1°	64.3	0.0263 / -124°	6.59
1.25e04	1.23	286	0.476 / -38.7°	71.8	0.255 / -92.9°	5.07	0.0239 / -126°	5.16
1.33e04	1.23	284	0.464 / -40.4°	111	0.238 / -96.5°	60.6	0.0219 / -128°	4.24
1.42e04	1.23	305	0.453 / -42°	88.5	0.222 / -99.8°	5.28	0.0201 / -129°	5.16
1.5e04	1.23	301	0.441 / -43.5°	91.1	0.207 / -103°	31.3	0.0185 / -131°	1.61

8 GRAPHS



9 RESULTS

Finally we get an output that is noiseless, which is signal below 8KHz only, and anything above that is filtered.

10 REFERENCES

https://www.etcourse.com/overview-filters-crossover-network.html
http://www.learningaboutelectronics.com/Articles/Bandpass-filter-calculator.php
https://www.youtube.com/watch?v=BW8umg5WHiE

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