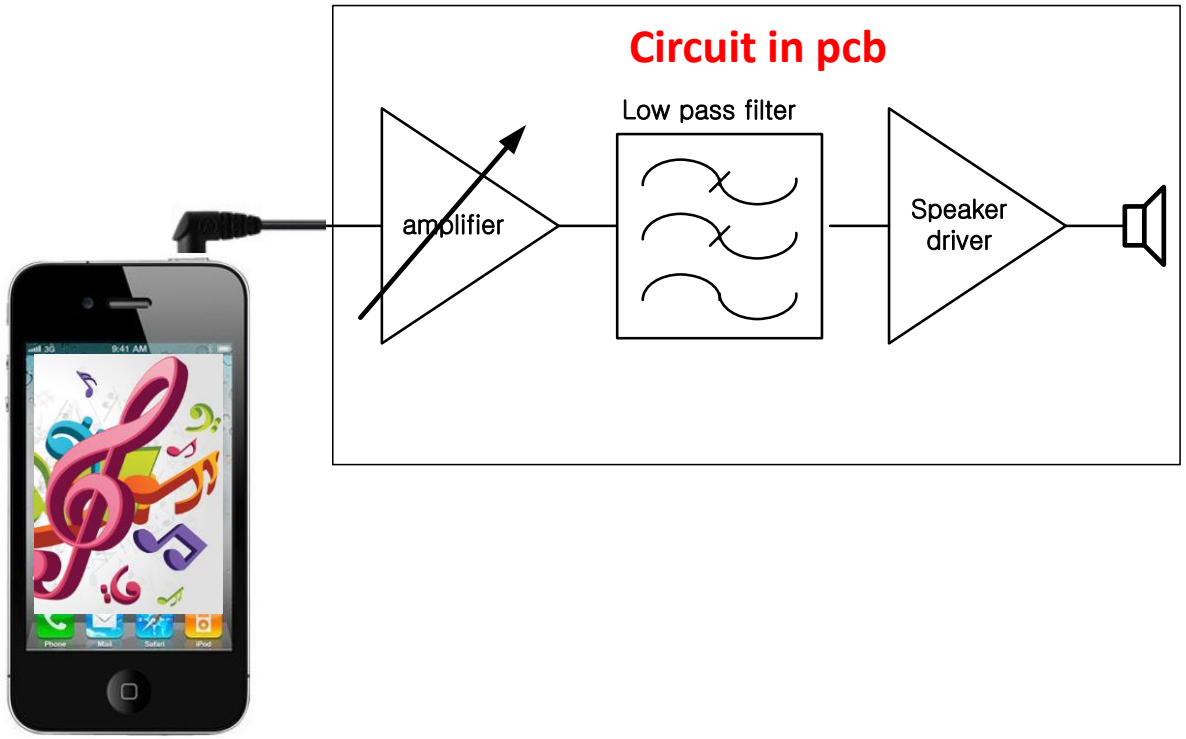
Electronic Circuit Design and Experiment II Project

2024

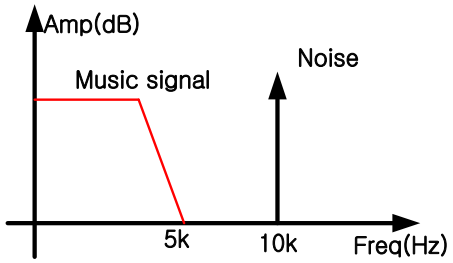
Project Goals

Implementation of a Speaker Driver Circuit with a Low Pass Filter

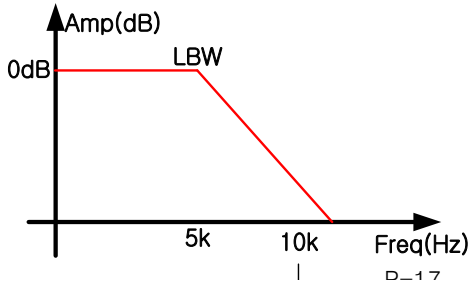


Project Description

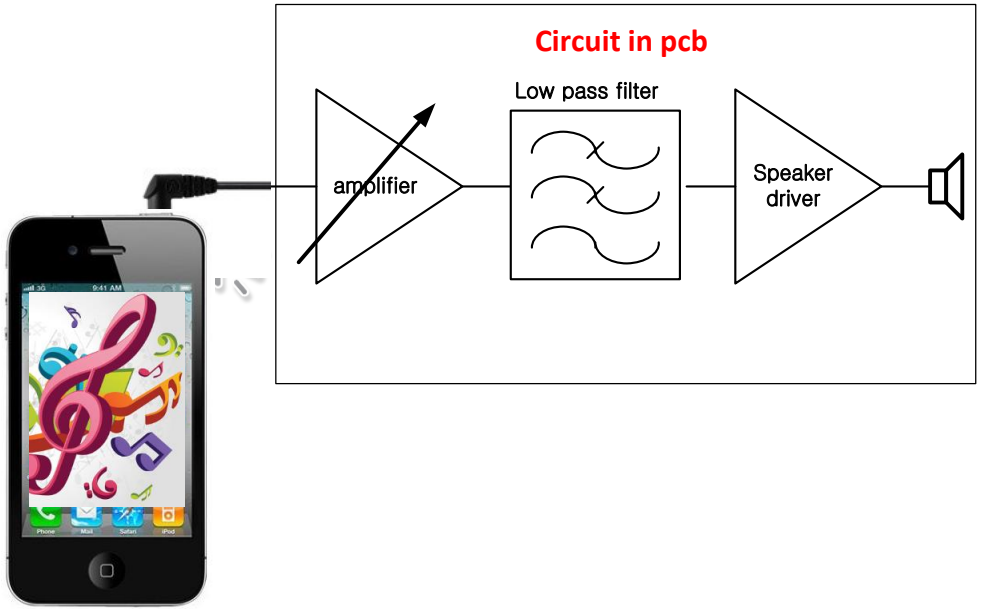
1. The audio source (MP3) currently has noise (single tone) at 10kHz. See the figure (a) below.



a) Frequency domain of input music



b) Bode plot of filter



2. The speaker driving system we are designing needs to include a filter to remove 10kHz noise.
3. Although humans can hear frequencies from 20Hz to 20,000Hz, typically only frequencies below 5kHz are perceived as important signals in most music.
4. Therefore, the system should include a low-pass filter that minimizes noise at 10kHz while preserving frequencies below 5kHz with minimal distortion.
5. The amplifier should have adjustable gain, which can be achieved using a variable resistor.
6. The speaker driver will use the LM741 (UA741) operational amplifier.

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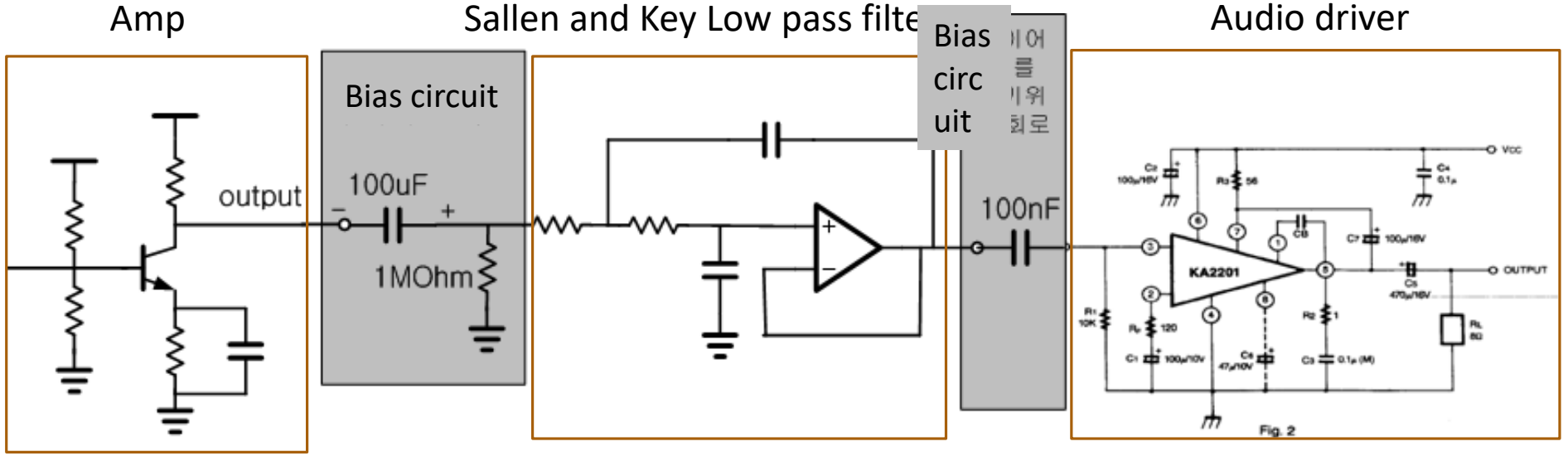
Project Schedule

	Tue	비고	contents
11w	11/12		Project Orientation / PSPICE simulation (submit report)
12w	11/19		PADS Schematic
13w	supplementary course		PADS Schematic& Layout
14w	11/26		PADS Layout (submut CAM file)
15w	12/10		PCB soldering
16w	12/17		PCB soldering & test

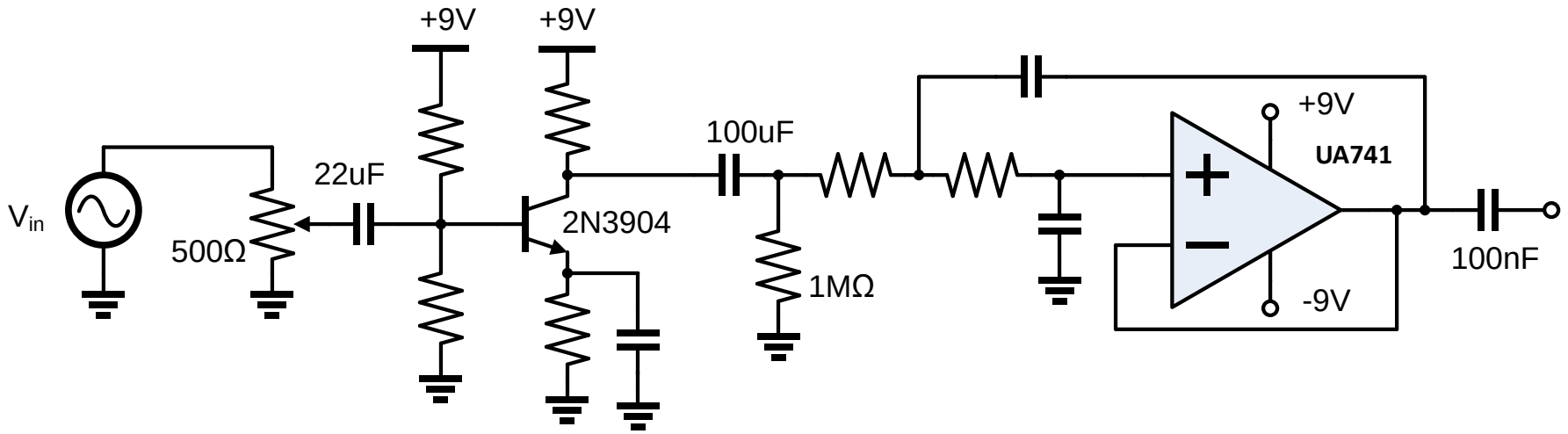
Circuit Configuration



1. Configure an amplifier and a low-pass filter for simulation
2. Design a low-pass filter that minimizes noise at 10 kHz while minimally distorting frequencies below 5 kHz
3. The amplifier's gain should be adjustable

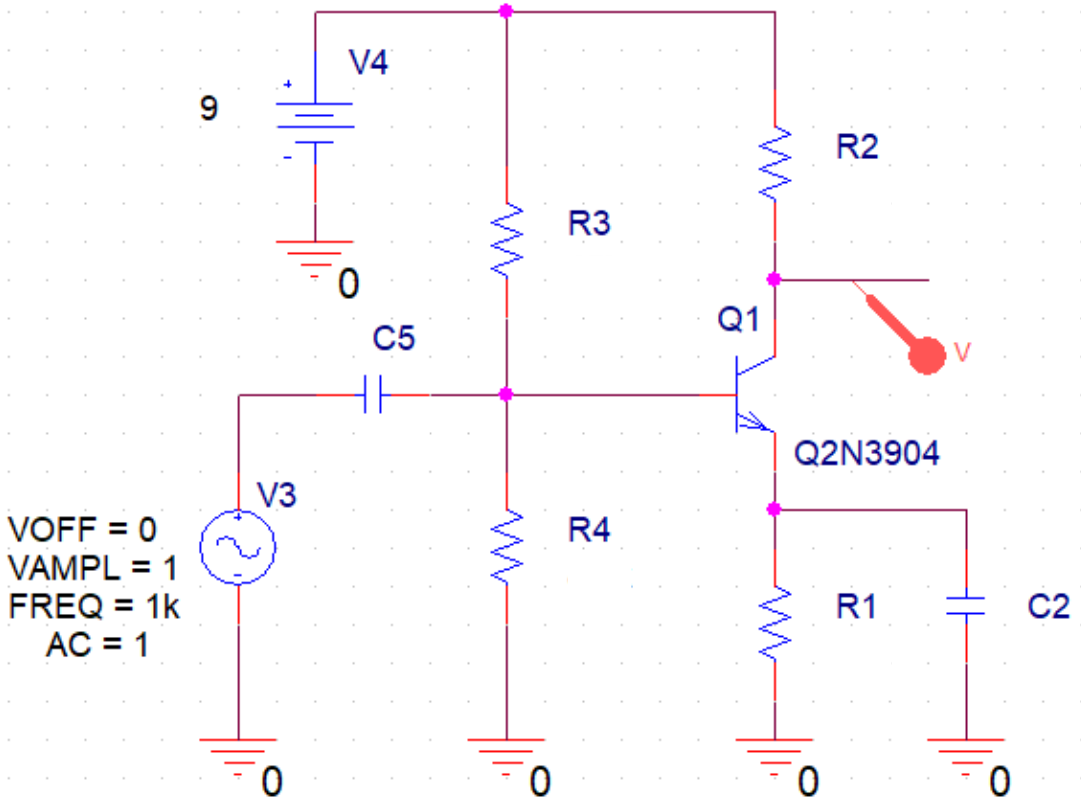
1. PSPICE Simulation

Amp & Low pass filter



1. PSPICE Simulation

Example)



1. PSPICE Simulation

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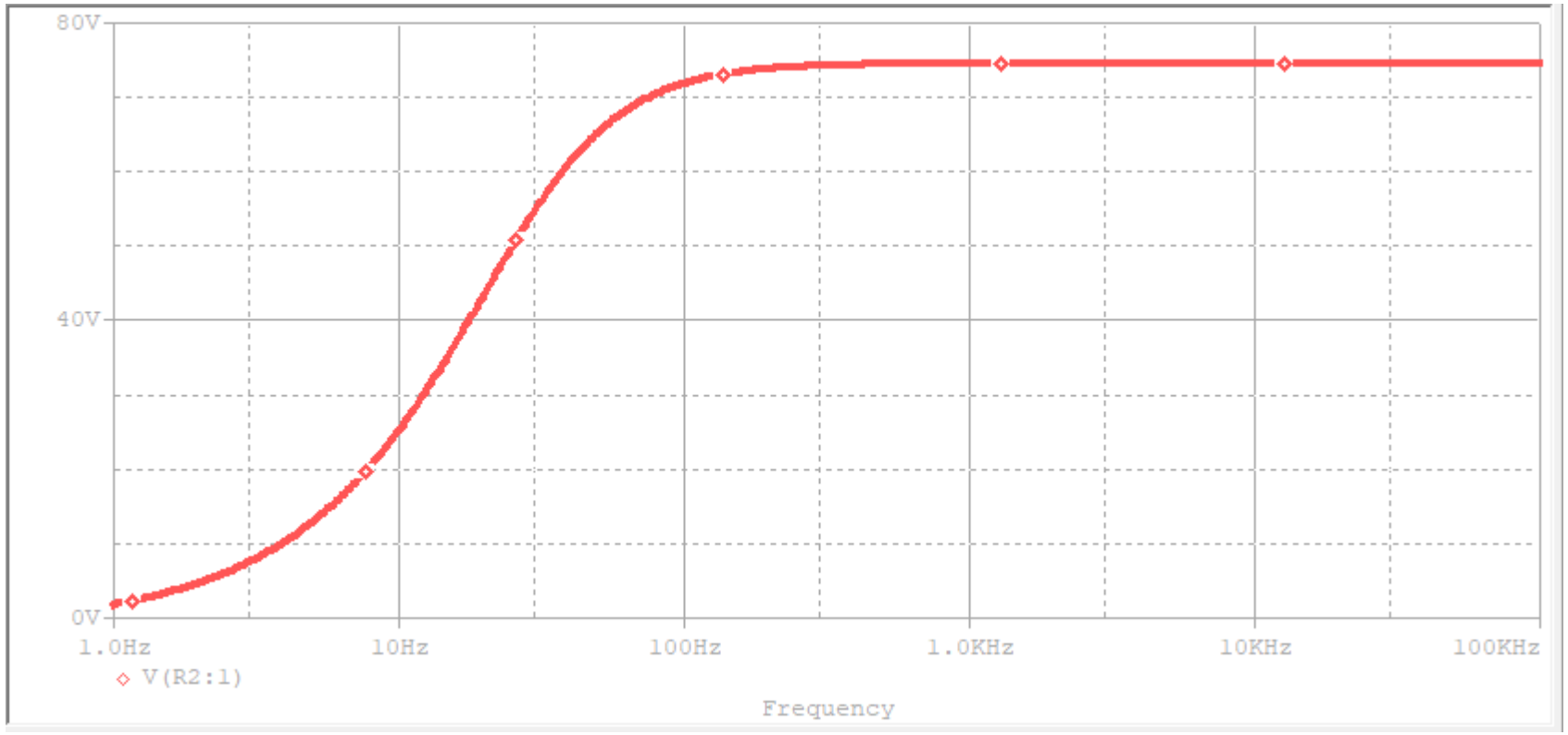

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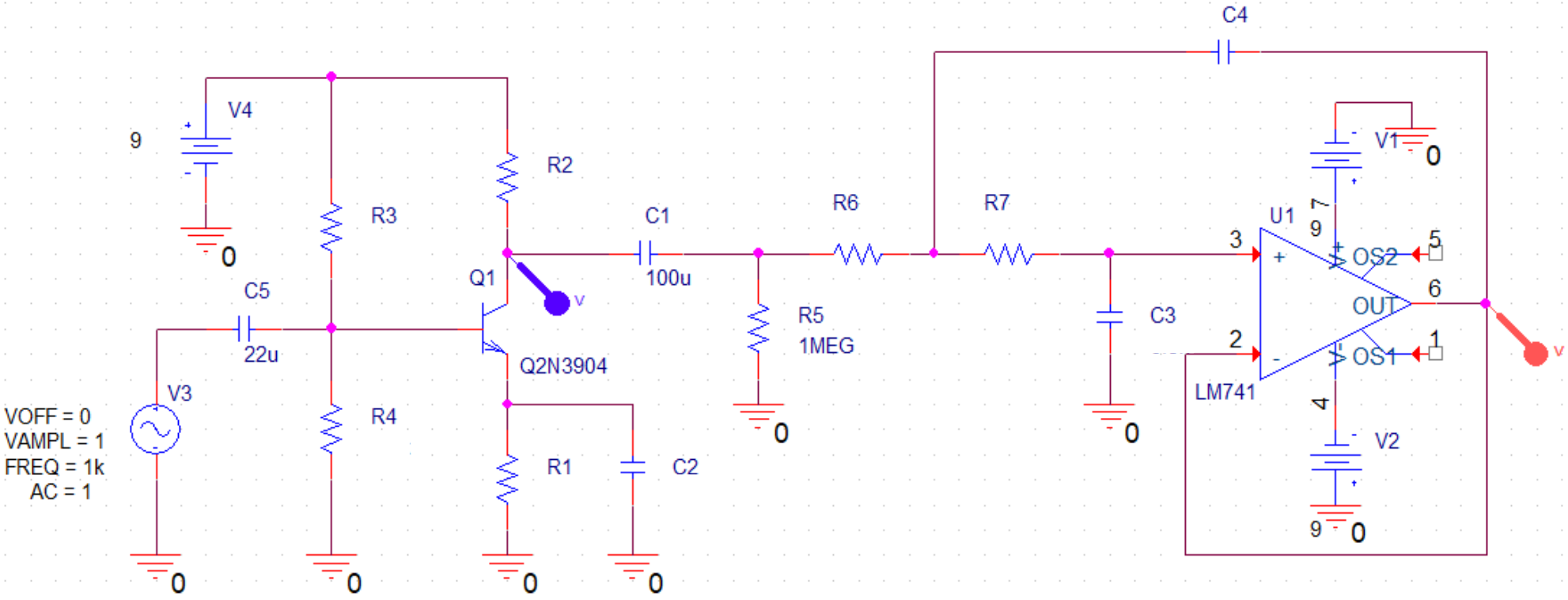

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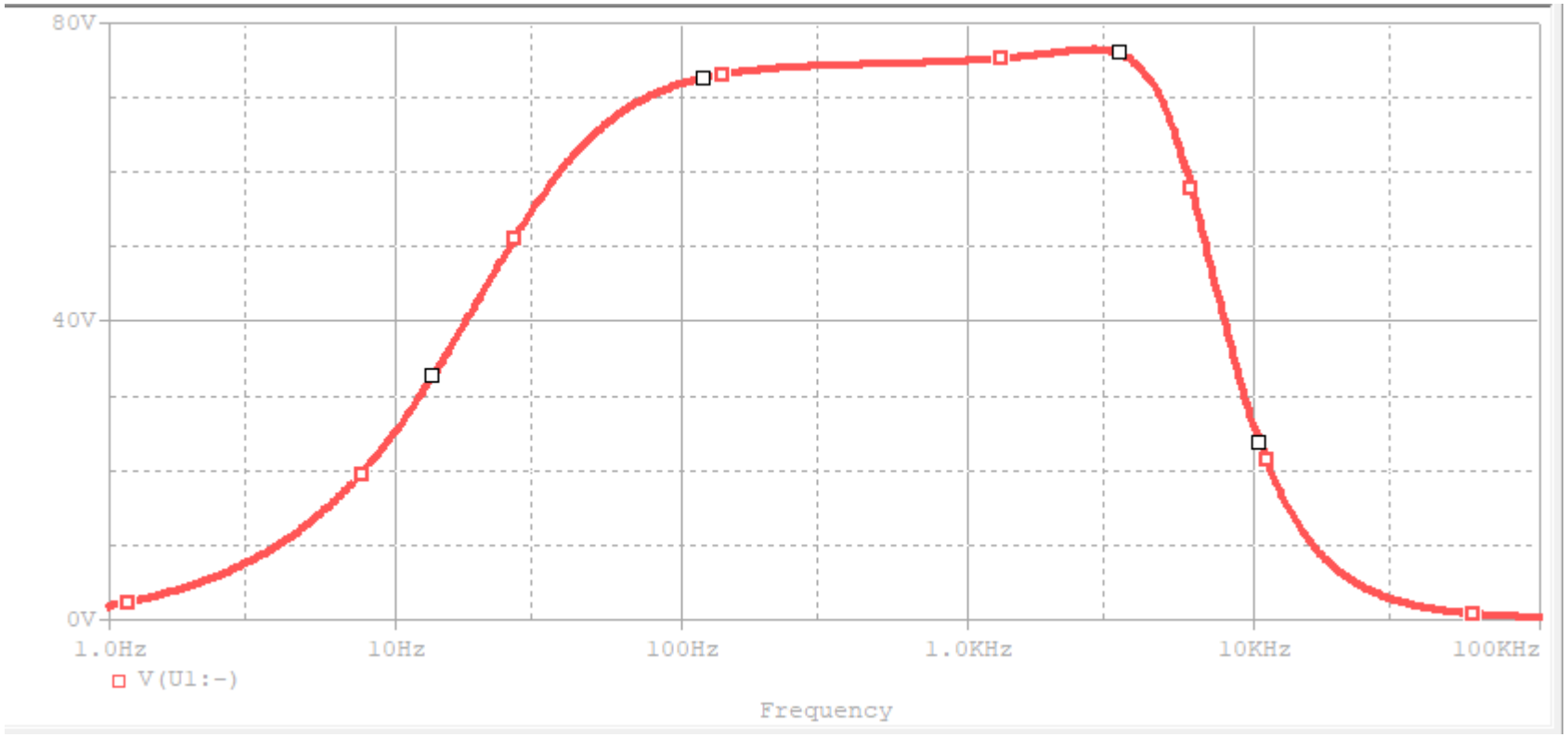


1. PSPICE Simulation

1.0pF	10pF	100pF	1.0nF	10nF	100nF	1.0uF	10uF
1.2pF	12pF	120pF	1.2nF	12nF	120nF	1.2uF	12uF
1.5pF	15pF	150pF	1.5nF	15nF	150nF	1.5uF	15uF
1.8pF	18pF	180pF	1.8nF	18nF	180nF	1.8uF	18uF
2.2pF	22pF	220pF	2.2nF	22nF	220nF	2.2uF	22uF
2.7pF	27pF	270pF	2.7nF	27nF	270nF	2.7uF	27uF
3.3pF	33pF	330pF	3.3nF	33nF	330nF	3.3uF	33uF
3.9pF	39pF	390pF	3.9nF	39nF	390nF	3.9uF	39uF
4.7pF	47pF	470pF	4.7nF	47nF	470nF	4.7uF	47uF
5.6pF	56pF	560pF	5.6nF	56nF	560nF	5.6uF	56uF
6.8pF	68pF	680pF	6.8nF	68nF	680nF	6.8uF	68uF

100nF	1.0uF	10uF	100uF	1.0F	10F	100F
150nF	1.5uF	12uF	108uF	1.1F	11F	110F
220nF	2.0uF	15uF	120uF	1.2F	12F	120F
330nF	2.2uF	16uF	124uF	1.3F	13F	150F
470nF	3.0uF	18uF	130uF	1.4F	15F	220F
680nF	3.3uF	20uF	140uF	1.5F	16F	330F
	4.0uF	21uF	145uF	1.6F	17F	470F
	4.7uF	22uF	150uF	1.7F	18F	666F
	5.0uF	24uF	161uF	1.8F	20F	
	5.6uF	25uF	170uF	2.0F	22F	
	6.8uF	27uF	180uF	2.1F	23F	
	7.0uF	30uF	189uF	2.2F	24F	
	8.0uF	33uF	200uF	2.5F	25F	
	8.2uF	35uF	210uF	2.6F	26F	
		36uF	216uF	2.7F	27F	
		39uF	220uF	2.8F	28F	
		40uF	230uF	2.9F	30F	
		43uF	233uF	3.0F	31F	
		47uF	240uF	3.1F	32F	
		50uF	243uF	3.3F	33F	
		53uF	250uF	3.4F	34F	
		56uF	270uF	3.5F	36F	
		60uF	300uF	3.6F	37F	
		68uF	320uF	3.7F	38F	
		72uF	324uF	3.9F	39F	
		75uF	330uF	4.0F	40F	
		82uF	340uF	4.1F	41F	
		88uF	350uF	4.2F	47F	
			370uF	4.3F	48F	

378uF	4.6F	50F
380uF	4.7F	55F
390uF	4.8F	56F
400uF	5.0F	60F
420uF	5.1F	62F
430uF	5.4F	66F
450uF	5.5F	68F
460uF	5.6F	76F
470uF	5.8F	
480uF	6.0F	
500uF	6.5F	
510uF	6.8F	
520uF	7.2F	
540uF	7.4F	
550uF	7.6F	
560uF	7.8F	
590uF	8.2F	
620uF	8.3F	
645uF	8.4F	
650uF	8.7F	
680uF	9.0F	
700uF	9.6F	
708uF		
730uF		
800uF		
820uF		
850uF		
860uF		

1. PSPICE Simulation

1.0	10	100	1.0K	10K	100K	1.0M
1.1	11	110	1.1K	11K	110K	1.1M
1.2	12	120	1.2K	12K	120K	1.2M
1.3	13	130	1.3K	13K	130K	1.3M
1.5	15	150	1.5K	15K	150K	1.5M
1.6	16	160	1.6K	16K	160K	1.6M
1.8	18	180	1.8K	18K	180K	1.8M
2.0	20	200	2.0K	20K	200K	2.0M
2.2	22	220	2.2K	22K	220K	2.2M
2.4	24	240	2.4K	24K	240K	2.4M
2.7	27	270	2.7K	27K	270K	2.7M
3.0	30	300	3.0K	30K	300K	3.0M
3.3	33	330	3.3K	33K	330K	3.3M
3.6	36	360	3.6K	36K	360K	3.6M
3.9	39	390	3.9K	39K	390K	3.9M
4.3	43	430	4.3K	43K	430K	4.3M
4.7	47	470	4.7K	47K	470K	4.7M
5.1	51	510	5.1K	51K	510K	5.1M
5.6	56	560	5.6K	56K	560K	5.6M
6.2	62	620	6.2K	62K	620K	6.2M
6.8	68	680	6.8K	68K	680K	6.8M
7.5	75	750	7.5K	75K	750K	7.5M
8.2	82	820	8.2K	82K	820K	8.2M
9.1	91	910	9.1K	91K	910K	9.1M

1. PSPICE Simulation

Audio driver

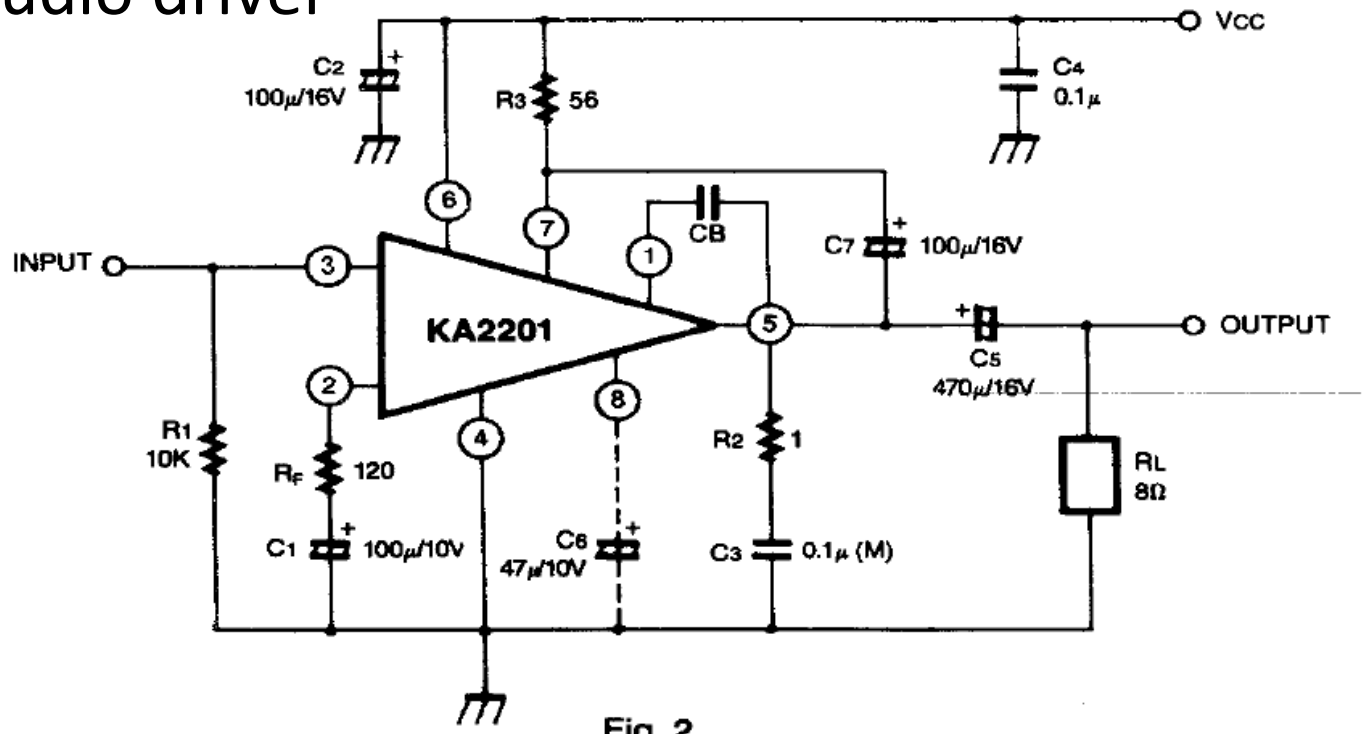


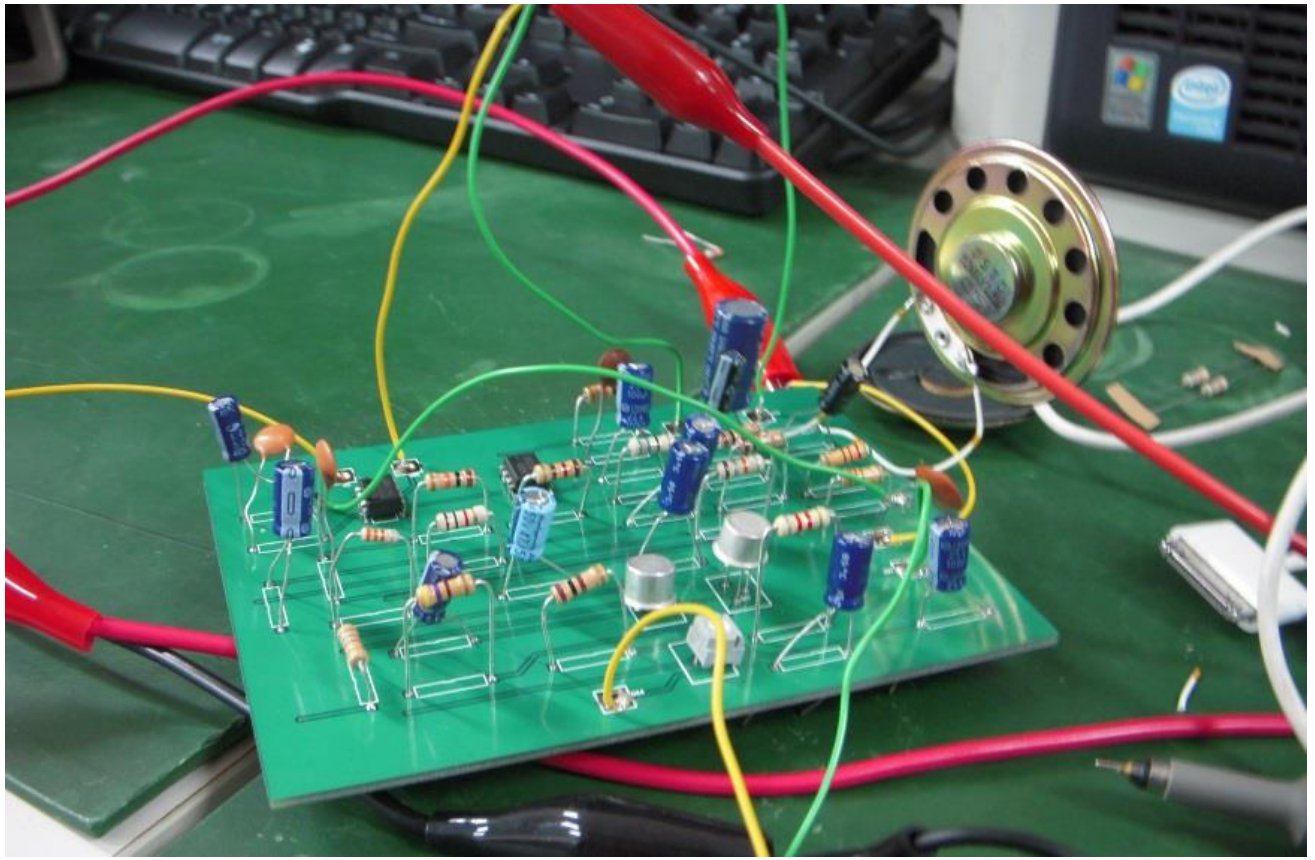
Fig. 2

The audio driver is excluded from the PSPICE simulation due to the absence of a SPICE model

2. PCB

1. Using the PADS Tool distributed by the teaching assistant, create the CAM file and proceed with ordering

3. Speaker measurement



4. Result report

PSPICE simulation & background theory

Sumary

- We will design a speaker.
- The speaker consists of an amplifier, low-pass filter, and audio driver.
- You shoulde design the amplifier and low-pass filter.
- You can simulate the amplifier and low-pass filter performance in PSpice.
- By 11:59 p.m. next Monday, you must design an amplifier and low-pass filter that meet the specified conditions and **submit a design report.**
- Starting next Tuesday, we will use a tool called PADS to create a PCB for implementing the speaker you designed.