Lab 9 The Complete Audio Amplifier

Name ______________________________ **Section** ______

Purpose

* To measure time and frequency using an analog oscilloscope.
* To generate various waveforms using a function generator and measure the amplitude and frequency of each.

Equipment

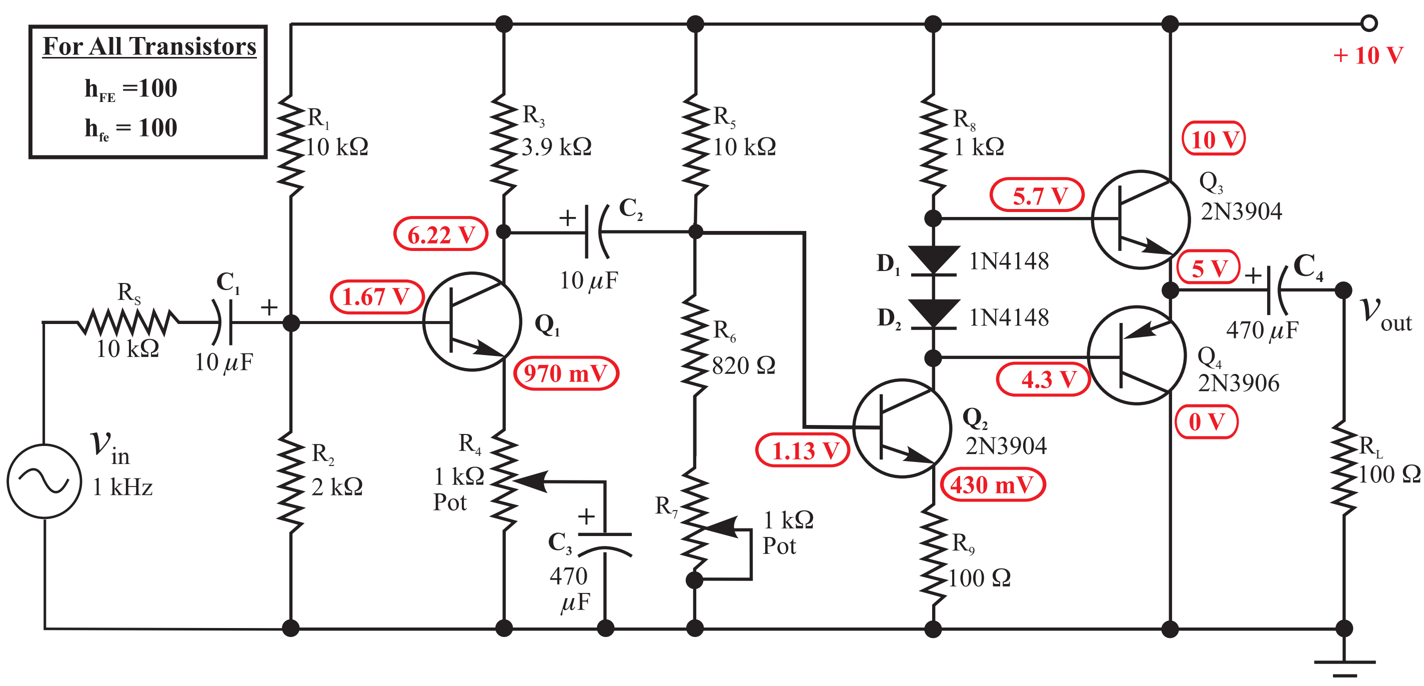
1 - Function Generator	8 Resistors	2 - 100 Ω	2 – Capacitors	2 - 470 μF
1 - Power Supply		1 - 820 Ω		2 - 10 μF
1 - Digital VMulti Meter		1 - 1 k Ω		
2 Diodes 1N4148		1 - 2 k Ω		
2 - Potentiometers 1 kΩ		1 - 3.9 k Ω		
4 - Transistors: 3- 2N3904, 1- 2N3906		2 - 10 k Ω		

Discussion

In this lab, we will build a complete audio amplifier. The first transistor is a Class A input stage with a variable gain. The 1 kΩ potentiometer in the emitter circuit of Q_1 is used to vary the swamping level of the stage. Depending on where we set the potentiometer, we can greatly vary the gain of this stage.

The second transistor, Q_2, is the driver transistor for the final stage. The driver transistor serves two purposes. Firstly, it is a current source that sets up the dc biasing circuit through the compensating diodes. By adjusting R_7, we control the midpoint biasing of Q_3 and Q_4. Secondly, Q_2 is a large signal amplifier that is heavily swamped. Note that there is no bypass capacitor across R_9. This reduces its gain to about 8.7. The heavy swamping helps reduce distortion caused by the non-linearity of r'_e

The final stage is a typical class AB push pull emitter follower. Q_3 and Q_4 are a matched complementary pair.



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Prelab

1) Using the ***Class B Driver Section in the notepak*** as a guide, prove all the dc calculations for Table 1.
2) Assuming that R_4 is set for maximum gain, prove the ac results in Table 2.
3) **Build the circuit before you come to the lab**

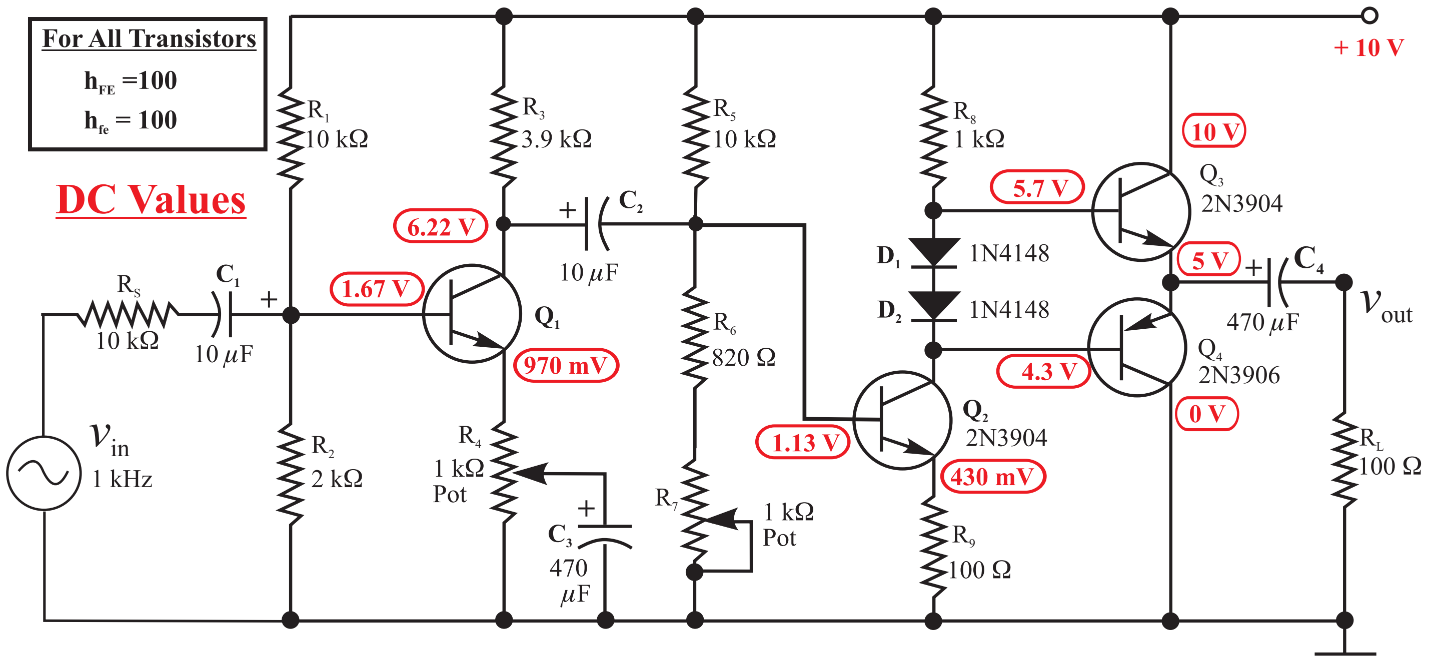

Table 1 dc Values	V_{BQ1}	V_{CQ1}	V_{EQ1}	V_{BQ2}	V_{CQ2}	V_{EQ2}	V_{BQ3}	V_{CQ3}	V_{EQ3}	V_{BQ4}	V_{CQ4}	V_{EQ4}
Calculated	1.67 V	6.22 V	970 mV	1.13 V	4.3 V	430 mV	5.7 V	10 V	5 V	4.3 V	0 V	5 V
Measured												

Do your dc Calculations here

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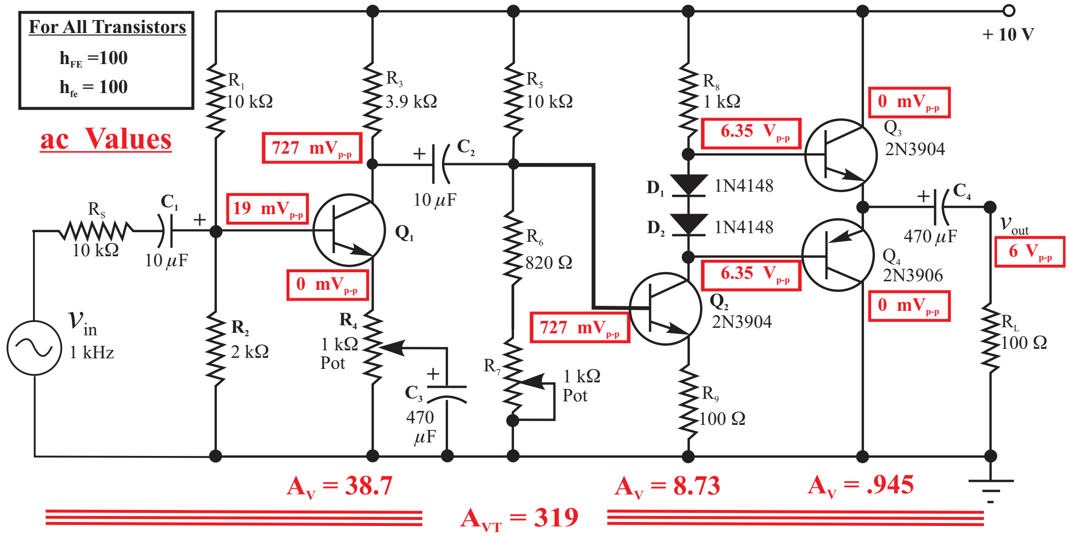
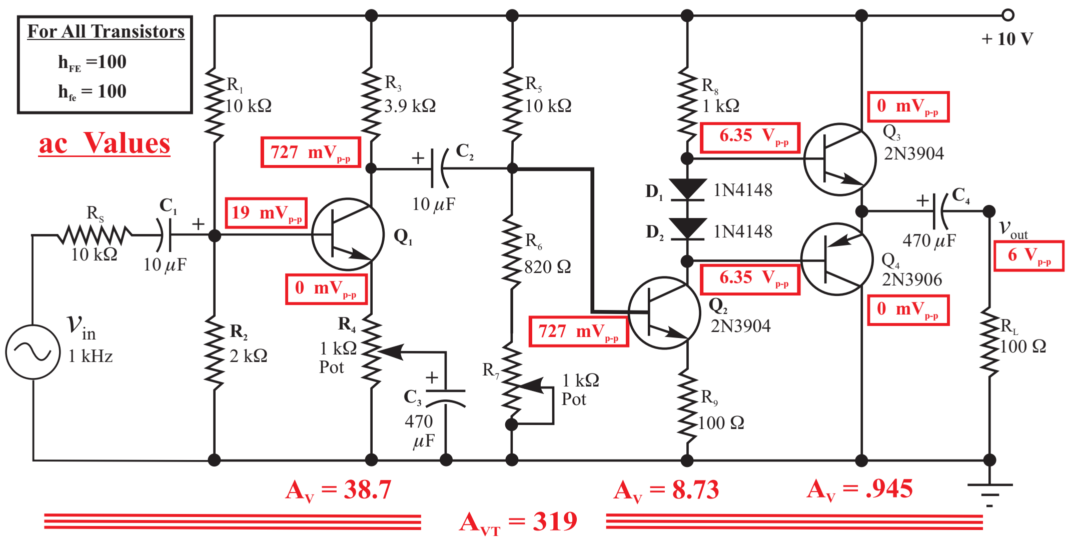


Table 2 ac Values	V_{BQ1}	V_{CQ1}	V_{BQ2}	V_{CQ2}	V_{BQ3}	V_{CQ3}	V_{EQ3}	V_{BQ4}	V_{CQ4}	V_{EQ4}
Calculated	19 $mV_{p\text{-}p}$	727 $mV_{p\text{-}p}$	727 $mV_{p\text{-}p}$	6.35 $V_{p\text{-}p}$	6.35 $V_{p\text{-}p}$	0 $V_{p\text{-}p}$	6. $V_{p\text{-}p}$	6.35 $V_{p\text{-}p}$	0 $V_{p\text{-}p}$	6. $V_{p\text{-}p}$
Measured										

Do your ac calculations here and on the top of the next page



Do this Part in the Lab

1) Hook up your circuit and set Q_3 and Q_4 for midpoint bias by adjusting R_7.

2) With the function generator off, measure and record all the values shown in Table 1.

3) Connect the generator and set the input frequency to 1 kHz. Place the scope across R_L and adjust the generator amplitude to provide a 6 $V_{p\text{-}p}$ output.

4) Measure and record all the ac values shown in Table 2. ***Note: You probably will not be able to measure*** V_{BQ1}.

5) Replace the 100 Ω resistor with a speaker. Adjust the output of the function generator to produce an audible tone. Vary the frequency and notice the tone changes.

6) Replace the function generator with a microphone. Hookup the scope across the speaker. While speaking into the microphone, adjust the scope to show you a trace of your speech. Note the change in amplitude as you speak closer, then farther from the microphone.