

Amplifier with Output Stage

The project is to design and build a Class AB audio power amplifier capable of amplifying the signal from a microphone (you supply the microphone) to be heard across a room. No integrated circuits (i.e. no operational amplifier chips) are allowed in this project, only discrete transistors and discrete components. The amplifier must be complete with a power switch and volume control.

Once you pass off a working design, you will need to write a report about this project. The report will need to contain a detailed analysis for you to get full extra credit points. The analysis will consist of the dc analysis and the ac analysis for the amplifiers. It will also need to contain a table similar to that of Table 14.1 from the spice simulation example shown in Chapter 14.

Some of the following questions and answers may help you in your design.

Questions

Question 1

Explain how the microphone in your amplifier works. How, exactly, does it convert waves of air pressure (sound) into electrical signals?

[file 01535](#)

Question 2

Your amplifier design will almost certainly require more than one stage of transistors to properly match the impedance of the microphone to that of the loudspeaker. Identify the topology of each transistor stage (common-emitter, common-collector, common-base, etc.), and explain what the primary form of gain for each stage is (voltage gain, or current gain).

[file 01534](#)

Question 3

While Class A amplifier circuits are simpler to design and build, they are rarely used for high-power applications. Why is this? Why are Class B amplifier designs much more popular for high-power applications? Would it be practical for you to build a microphone amplifier such as this using nothing but Class A circuitry?

[file 01536](#)

Question 4

Explain how you plan to test for and eliminate (if necessary) any *crossover distortion* from your amplifier circuit. Do you suspect crossover distortion will be more noticeable at low volume levels or high volume levels? Explain why.

[file 01533](#)

Question 5

Sound pressure is often measured in units of dBA. You should be familiar with decibels as a unit of amplifier gain, but what does "dbA" actually mean? How is 0 dBA objectively defined?

[file 01537](#)

Answers

Answer 1

The answer to this question depends on what type of microphone you use:

- Condenser: variable capacitance
 - Dynamic: electromagnetic induction
 - Crystal: piezoelectricity
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Answer 2

The answer to this question, of course, will vary with your particular design of circuit.

Answer 3

Class A amplifiers are much less *efficient* than Class B amplifiers: a great deal more of the electrical power energizing the circuit gets wasted in the form of heat.

Answer 4

Crossover distortion is detected by using an oscilloscope to display the output waveform, and is eliminated through proper biasing of the push-pull transistor pair. This type of distortion is generally more noticeable at low volume levels, but I'll let you explain exactly why!

Answer 5

0 dBA = 1 pW/m² ≈ "Threshold of human hearing"