

SUPER SNOOPER BIG EAR

Audio Amplifier

AA-1D 151204

This kit teaches how amplifiers take a small signal and "magnify" it to drive a small speaker or headphone. It's based on the LM386 Low Voltage Power Amplifier. This chip is not a toy; it's designed to be used in a variety of consumer-electronics applications such as AM-FM radio amplifiers, portable tape or CD players, intercom's, TV sound systems, etc. Provides up to 1 watt of low-distortion audio power. Harmonic distortion is 0.2%; voltage gain up to 46dB.

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THEORY OF OPERATION

This kit is based on the LM1458 Dual Operational Amplifier chip and the LM386 Low Voltage Audio Power Amplifier. This chip is not just a toy; it's designed to be used in AM-FM radio amplifiers, portable tape or CD players, intercoms, TV sound systems, etc.

GENERAL THEORY: WHAT AMPLIFIERS DO

If you've ever hooked a microphone directly up to a speaker and expected to hear anything, you know such a setup won't work. And we're not talking about just microphones! Lots of electronic devices produce small signals, and to drive a speaker (or even headphones) these signals need to be *amplified* - that is, increased. Power amplifiers take a voltage input and allow us to supply a large amount of current. With current we can operate headphones or speakers.

SPECIFIC THEORY: AUDIO PREAMP SECTION

There are two kinds of "amplifiers," *preamps* and *power amps*. Preamps take *tiny* signals and amplify them enough to drive a power amp; power amps generally drive speakers. You'd feed a microphone into a preamp section of this kit, and the preamp output into the power amp sections.

This preamp is based on a Dual Operational Amplifier, or "Op-Amp." What is an op-amp? Basically it's a linear amplifier with two inputs [Inverting (-) and Non-Inverting (+)] and one output. If a signal is applied to the Inverting input, its polarity is reversed at the output; if applied to the Non-inverting input, output polarity remains the same. In this circuit, C5 and C9 capacitively couple the signal to the input pins through a couple of resistors (more on them in a moment).

The amount any amplifier increases the input signal is called "Gain." An Op-Amp's gain depends upon a Feedback Resistor that funnels some of the amplified output signal back to the **Inverting** Input, thus reducing the gain. Gain is independent of supply voltage, and in the Audio Preamp section, is determined as follows:

(We recommend a well-filtered and regulated +7 to +15 volts, which can be obtained from the EBPS-4 or EBPS-5 kits or a 9v battery)

In our circuit, the "1/2 positive supply voltage" (called the "Bias" voltage) is obtained from a voltage divider consisting of R4 and R5. C5 filters this "bias" point. R1 supplies power to the microphone.

Finally, potentiometer R6 acts as a volume control. The LM386 is an audio power amplifier IC used to drive a small speaker or headphones. C3 couples the audio signal to the speaker.

REAL WORLD ENGINEERING: POWER OUTPUT

We have to be realistic about power output! What is "power?" Well, electromotive force (or "voltage") by itself does no work. But if an electrical conductor (a "load") is hooked up across a voltage source, electrons *move* in the conductor; this movement is called *current*, measured in *amperes*. The product of the electrical pressure (voltage) and movement (amperes) does accomplish work. *Power* is the way we measure the rate of doing work, and we measure it in *watts*. One volt causing one amp to flow in a conductor produces one watt of power. The formula is: POWER=VOLTS X AMPERES. So, for example, 5 volts causing 0.2 amperes of current produces one watt (POWER=5 Volts X 0.2 Amps).

Here's the thing: the LM386N-1 Audio Power Amplifier chip has a typical power output of 325 milliwatts, or 325 *thousandths* of a watt (0.325 watts). Doesn't sound like much, does it? The truth is, this is plenty for driving headphones or a small speaker. But, as stated above, we've got to be realistic. If you have a big speaker, designed to be driven by a 30 watt or 60 watt stereo amplifier, the AA-1D will *not* make it work (and, in fact, trying to drive such a speaker would probably cause the chip to overheat. Remember, "watts=heat." And in electronics, excessive heat is no good.) This kit is designed to drive a "portable-radio-sized" speaker, and it does that very well. Just don't overdo it and try to drive those "king-sized" speakers in your living room; it won't work!

PARTS LIST

AA-1D

Super Snooper Big Ear

Resistors:

- () 1 R1 3.3K Ohm Resistor (org,org,red)
- () 1 R2 1K Ohm Resistor (brn,blk,red)
- () 1 R3 10K Ohm Resistor (brn,blk,org)
- () 2 R4,R5 10K Ohm Resistor (brn,blk,org)
- () 1 R6 10K Ohm Trim Pot (Vertical)

Capacitors:

- () 2 C1,C2 .1uF Cer Disc or Mono
- () 1 C3 47uF Electrolytic Capacitor
- () 2 C4,C5 4.7uF Electrolytic Capacitor

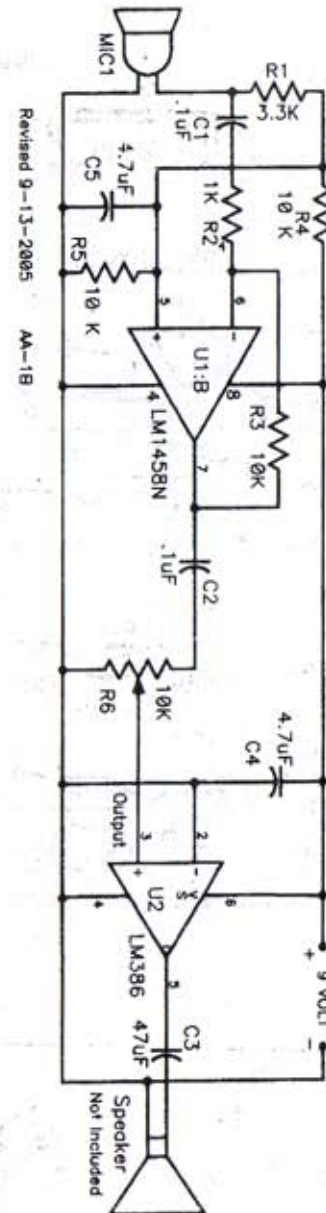
Semiconductors:

- () 1 U1 LM1458 IC Audio Output IC
- () 1 U2 LM386N-1 IC Audio Output IC

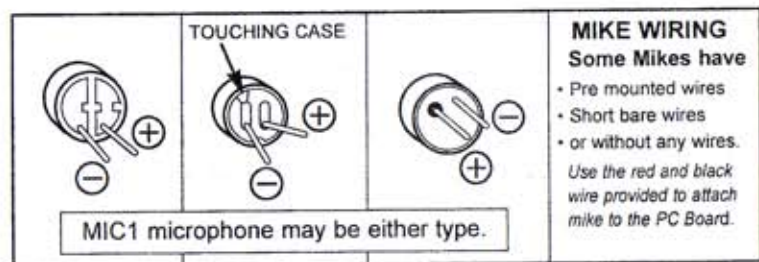
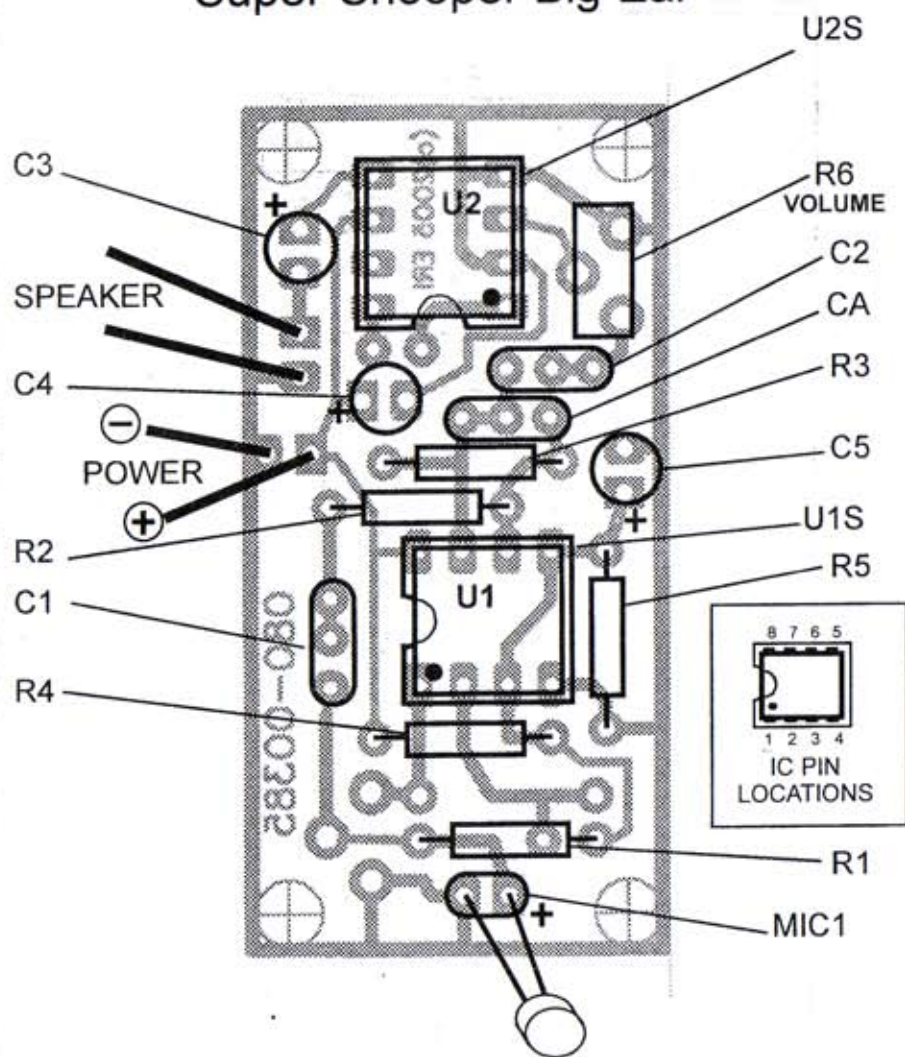
Miscellaneous:

- () 1 U1S 8 Pin IC Socket
- () 1 U2S 8 Pin IC Socket
- () 1 MIC1 Electret Microphone
- () 1 9v Battery Snap
- () 1 PCB # 080-00385

SCHEMATIC



AA-1D Super Snooper Big Ear



ASSEMBLY INSTRUCTIONS

Separate and identify each component in your kit. Our instructions will lead you through the assembly process in the most logical manor, the parts that are the lowest to the board - up to the parts that would be in the way.

FOR EACH STEP:

1. Find the proper component.
2. Insert the leads so the part is flush with the Printed Circuit Board (PCB).
3. Solder and cut off excess leads.
4. Check off and proceed to the next step.

Insert and solder all parts

Resistors:

- () Insert R1 3.3K Ohm Resistor (org,org,red)
- () Insert R2 1K Ohm Resistor (brn,blk,red)
- () Insert R3 10 K Ohm Resistor (brn,blk,org)
- () Insert R4,R5 10K Ohm Resistor (brn blk org)
- () Insert R6 10K Ohm Trim Pot (vertical)

Capacitors:

- () Insert C1,C2 .1uF Disk or Monolithic Cap
- () Insert C3 47uF Electrolytic Capacitor
(watch polarity)
- () Insert C4,C5 4.7uF Electrolytic Capacitor
(watch polarity)

Miscellaneous:

- () Insert U1S 8 Pin IC Socket (watch orientation)
- () Insert U2S 8 Pin IC Socket (watch orientation)
- () Insert MIC1 Insert and solder microphone
(watch polarity)
- () Insert 9v Battery Snap (watch polarity)

Check your work very carefully for good soldering practice, check for cold soldering, shorts, and solder bridges, see if you have all parts in the proper place. It's always best to let someone else look it over as well.

DO NOT INSERT (U1 or U2 ICs) YET

In this kit, pay special attention to the polarity of C3 C4 and C5. They're "polarized," and must be hooked up *exactly* as the Parts Placement Diagram shows.

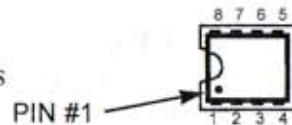
Here are some of the more common errors we find:

- (a) Parts in the wrong holes;
- (b) Solder shorts, even when the connection "looks" like it's OK;
- (c) Parts in backwards (if applicable);
- (d) Parts which are not soldered or have cold solder joints;
- (e) Wires which are "frayed" and touching other parts.

If you find any of these mistakes, fix them!

- () NOW Insert U1 **LM1458 Dual Operational Amplifier**
(watch orientation)
- () NOW Insert U2 **LM386N -1 Amplifier**
(watch orientation)

Note the integrated circuit is shaped like this:
Polarity is indicated by a "NOTCH" or a dot as indicated in drawing



TESTING INSTRUCTIONS

1. Set the volume control (R6) for mid range.
2. Connect a 9v battery to the battery connector.
3. When you speak in the microphone you should hear your voice in the speaker or headphones (you must supply these). If you have the speaker too close to the microphone or the volume control (R6) is turned up too high you will hear a loud squeal in the speaker. Your amplifier is operating, but you need to turn your volume down.
4. If the amplifier does not operate, check all of your connections and especially the orientation of the IC's and capacitors. If one of the capacitors is backwards it can cause the sound to be distorted. Also a capacitor backwards can allow your amplifier to operate for a while, become distorted and finally stop operating. Then after power is removed the same sequence can reoccur.

ADDITIONAL INFORMATION

You may want to mount the microphone inside of a tube or want to place the microphone in front of a parabolic reflector. Either of these will allow you to hear conversations from a much longer distance. They make the microphone very directional and can also reduce the background noise.

There have been several articles published about these and other ways of using amplifiers and directional microphones. You may want to read some of these articles for other ideas about using your audio amplifier. Look in electronic and amateur radio books and the internet.

The PC Board has unused holes. You may want to experiment by putting a capacitor across R3. (100pF to 1uF) This will limit the frequency response of your amplifier and can be useful to reduce wind noise for listening to conversations along way away.

This kit is sold for educational purposes only. It may be illegal to use any device to listen to a private conversation without the consent of all parties involved.

**AA-1D 151204 Super Snooper Big Ear
SPECIFICATIONS**

- Operates on 5 to 9v DC
- Will drive a small speaker
- Provides up to 1 watt of audio power
- Distortion > 0.2%
- Voltage Gain up to 46 dB
- Size: 1" x 1.95"

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