

# Building an Audio Amplifier

March 2025



# What Is It?

- A quick-to-build Audio Amplifier connected to an 8-ohm Speaker
- Experiment with it, to see what you can do with it!
- The Audio Amplifier is powered from a 9V battery.

# Board Overview

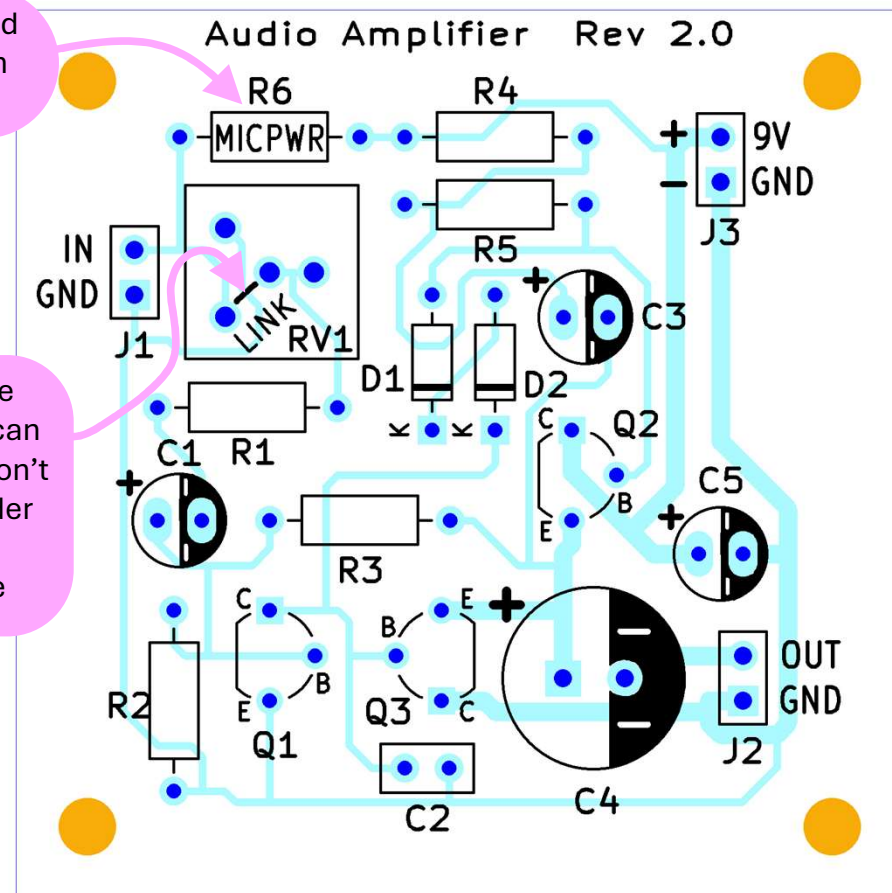
A quick-to-assemble Audio Amplifier!

## Parts List

Ref	Value
R1, R4	1k Resistor
R2, R6	10k Resistor
R3	47k Resistor
R5	1.5k Resistor
RV1	10k Trimmer Resistor
D1, D2	1N4148 Diode
Q3	PNP Transistor (BC559)
Q1, Q2	NPN Transistor (BC549)
C2	1nF Capacitor (Ceramic)
C1, C3, C5	10uF Capacitor (Polarized)
C4	470uF Capacitor (Polarized)

R6 is only required if you're using an Electret Mic

RV1 adjusts the input level. You can omit RV1 if you don't have it, and solder a wire short as shown here



# Tips

- **Electret Microphone**

- The mic needs to be soldered with the correct orientation. Observe the markings or use a multimeter to confirm which pin is connected to the metal can of the mic, which will be the GND connection
- If you're not using an electret mic, then you don't need resistor R6 (R6 provides power to the mic)

- **Audio Level**

- If the audio input level is too high, the output will distort. Adjust RV1 to control the level. If you don't have RV1, then you need to solder a wire link to as shown on the board markings.

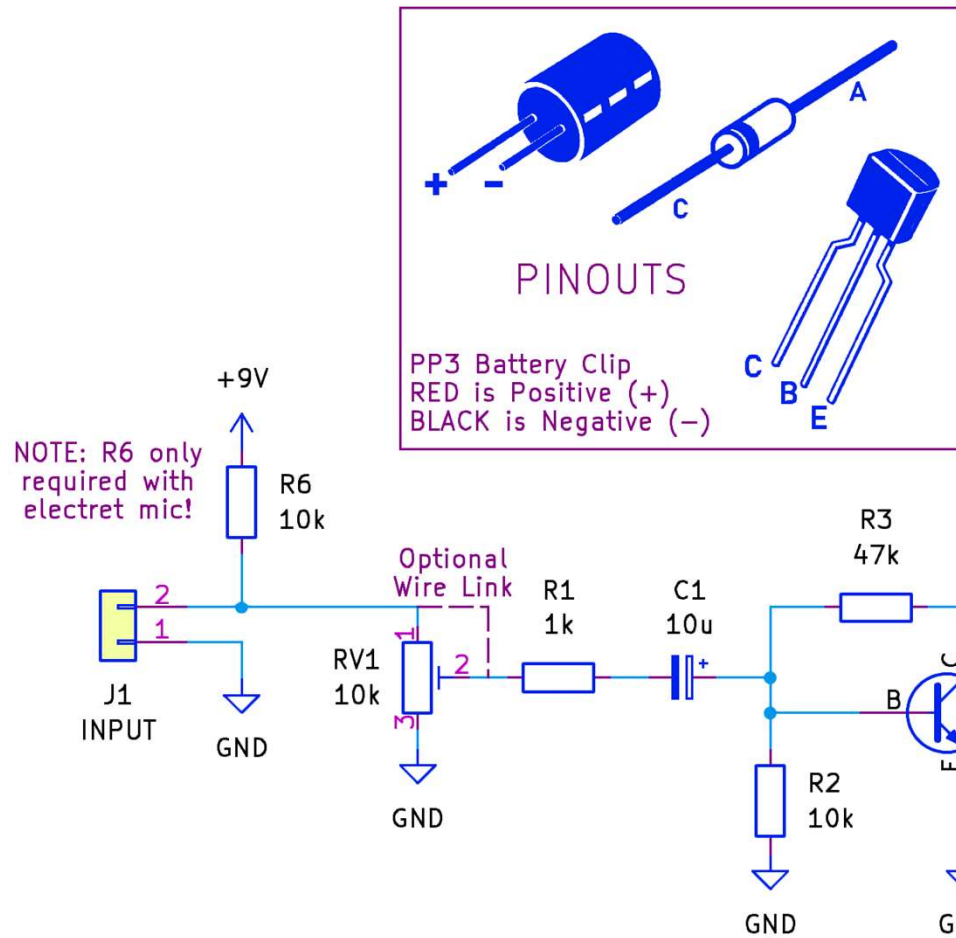
- **Component Orientation is Important**

- Resistors, and the ceramic capacitor, can go in either way
- The polarized capacitors (electrolytic capacitors) have a band marking the negative side
- The diodes have a band that indicates the Cathode (K) end
- Follow the graphic outlines marked on the board accordingly, for all components
- It isn't essential to observe speaker polarity

- **Careful not to short the battery!**

- Use the holes on the board to provide a bit of strain relief and separation for the battery connections and any other wires

## For Your Reference

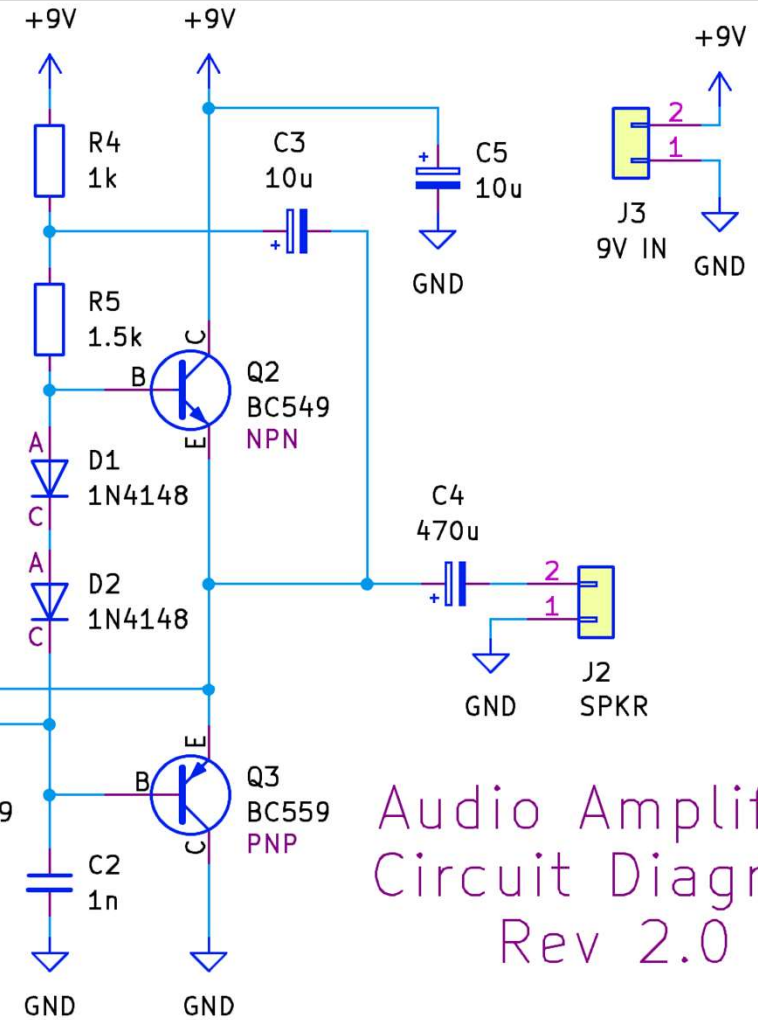


**RESISTOR COLOR CODE DIGIT VALUES**

0 BLACK	1 BROWN	2 RED	3 ORANGE	4 YELLOW	5 GREEN	6 BLUE	7 PURPLE	8 GRAY	9 WHITE	↓ LAST BAND
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**SECOND-TO-LAST BAND: NUMBER OF ZEROS**

±5% GOLD	±1% BROWN	±0.5% GREEN	±0.1% PURPLE
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# Audio Amplifier Circuit Diagram Rev 2.0



Diode

Band indicates  
the Cathode (K)

Transistor

C  
B  
E

Ceramic Capacitor

Not Polarized.  
Insert either way!

P  
o  
l  
a  
r  
i  
t  
y

Electrolytic  
(Polarized)  
Capacitor

Band indicates  
the negative end

Electret Mic Elements

GND

GND

GND

Connection to can

Hard to tell!  
Use a multimeter.

# For Your Reference: How Does It Work?

- **Push-Pull Output Transistors Q2 and Q3**

- The two totem-pole transistors Q2 and Q3 operate in a push-pull arrangement, to drive the output high or low; these two transistors provide the current gain for the amplifier.

- **Output Transistors Biasing**

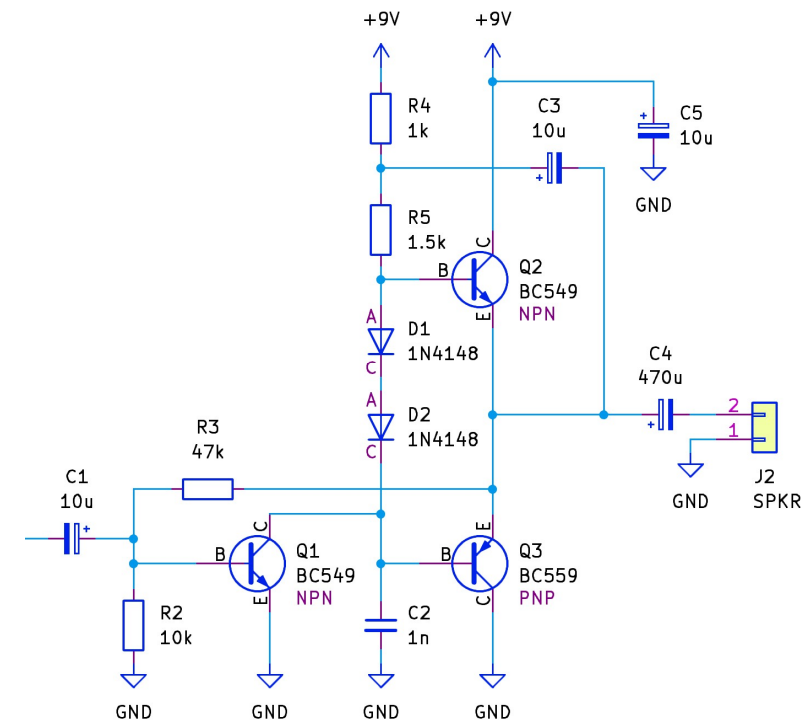
- If the input changes slightly but the transistors do not conduct, then that is distortion! The solution is to always have the transistors conducting slightly
- The two diodes ensure there's always 1.2V of difference (i.e. two 'diode drops') between the base voltages for both output transistors, and this is used to ensure that both transistors are always slightly conducting.
- For instance, if the output happens to be at 4V, then the top transistor base voltage has to be around 4.6V (because when conducting, a transistor has 0.6V difference between base and emitter), and that means that the lower transistor voltage has to be about 3.4V (two diode drops less than 4.6V); that ensures that the lower transistor is conducting too.
- Capacitor C3 is interesting; it is used to provide extra bias to the top transistor so that the output voltage can swing higher when needed; the way it works is that if you assume C3 has charged to some voltage level, then when the output swings high, the left side of C3 has to swing high too, and that turns on the transistor harder. C3 is known as a bootstrap capacitor.
- The lower transistor doesn't have such a bootstrap capacitor; it doesn't need the extra help in turning on, since transistor Q1 can relatively easily pull the base of Q3 low.

- **Voltage Gain**

- The purpose of transistor Q1 is to perform as a common-emitter amplifier, providing voltage gain for the overall amplifier circuit.

- **Overall Negative Feedback**

- Resistor R7 forms the control loop for this combined circuit, in order to ensure that the output remains an undistorted representation of the input (but amplified).



# Problems?

Ask John Alexander! 😊