Assembly Instructions for Audio Amplifier

The circuit board you will be using is one half inch less in width than the board in Figures 1 and 2, but the same height. Figure 1 is a photo of the bottom side of the completed circuit board. The 8 pin IC socket is positioned in the center of the board with pins 1 and 8 on the right side and pins 4 and 5 on the left side. The top edge of the board faces toward the front of the amplifier when assembled. If you flip the board over by placing the top edge at the bottom, you would see the top of the board as seen in Figure 2. Comparing the two views, each component will be on the same side of the board. For example, capacitor C1 is on the left half of the board in both Figure 1 and Figure 2. However, a component positioned somewhere on the top half of the board in the bottom view will be positioned on the bottom half in the top view. And a component positioned somewhere on the bottom half of the board in the bottom view will be positioned in the top half in the top view. For example, capacitor C4 is on the top half in Figure 1 and on the bottom half in Figure 2. While you can't see the components from the bottom view, you can see their wires. The labels for the components in Figure 1 have arrows pointing to the wires of the components. For components with polarity, C1 and C3, the arrow pointing to the positive wire is labeled with a positive sign (+).

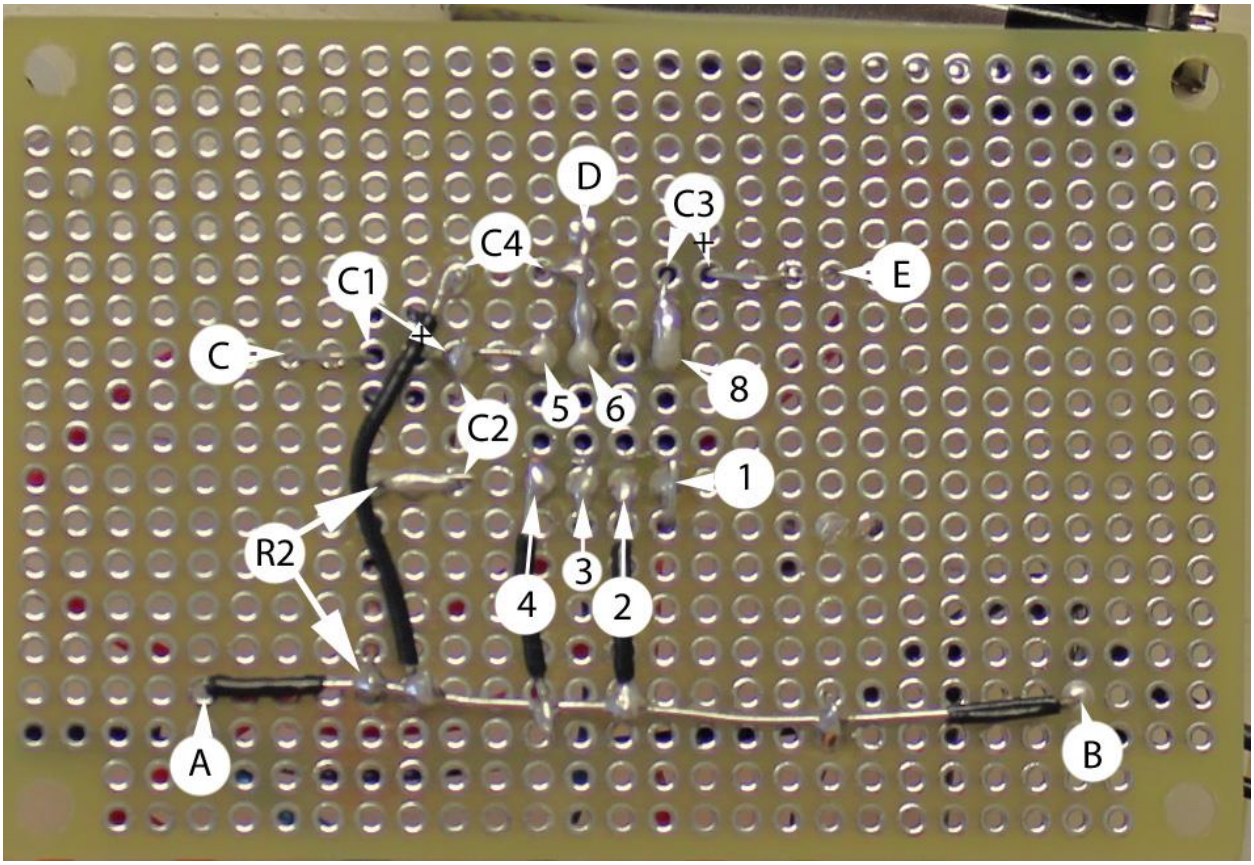

Figure 1 Bottom side of circuit board

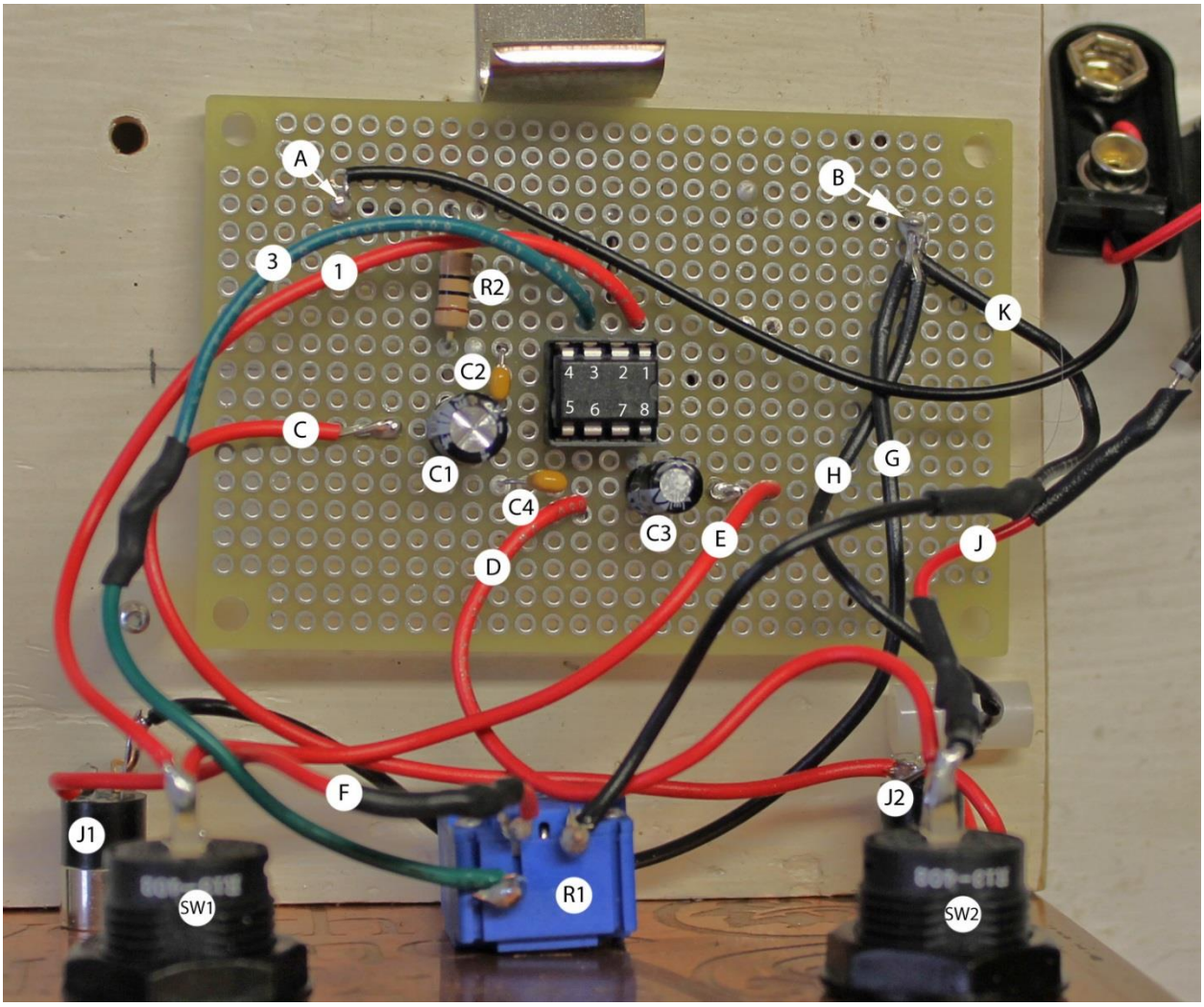

Figure 2 Top side of circuit board

1. Insert the 8 pin IC socket into the center of the board as seen in Figure 2. Figure 2 also shows the IC chip (LM386) inserted in the socket, but you won't insert the chip until you are finished assembling the circuit board. The notch of the socket should be facing toward the right (pins 1 and 8 are on the right side). While holding the socket firmly on the board, turn the board over and bend the pins outward with a small screw driver to affix the socket to the board (to keep it from falling off).
2. Cut a 2 ½ inch piece of black wire (solid, 22 gauge). Remove all the insulation from the wire but do not discard the insulation. Cut two pieces of the insulation, each about ¼ inch long. Insert these, one on each end of the wire, so that there is about ¼ inch of bare wire on each end of the wire.
3. Bend the bare ends of the wire you just prepared and insert the ends through the board from the bottom side (see points A and B in Figure 1). This wire will serve as the negative power bus. The short pieces of insulation are there to remind you that this wire is the negative bus. Notice that most of this wire is bare on the bottom side, so that you can make connections to it. The ends of the wire protrude through the board to the top side. Later, you will connect point A on

the top side to the negative wire of the battery and at point B you will connect three wires for additional negative bus connections (see Figure 2).

4. Prepare black wires (solid, 22 gauge) and connect from the negative power bus to pins 2 and 4 of the IC socket as seen in Figure 1.
5. Cut a 4 inch piece of red wire (stranded, 22 gauge). Strip off about 3/8 inch of insulation from one end. Twist the strands of the bare end and lightly coat with solder to prevent fraying (too much solder will make the wire too large to fit through a board hole). This will be the wire labeled "D" in Figure 2. Insert the stripped end of the wire through the top of the board in the position seen in Figure 2. Turn the board over and the bend the bare end of wire "D" over so that it touches pin 6 of the IC socket. Trim any excess wire and solder.
6. Insert capacitor C4 though the top of the board as seen in Figure 2. Turn the board over. Bend the C4 wire closest to wire "D" so that it touches wire "D". Trim any excess and solder the wire of C4 to wire "D".
7. Prepare a black wire (solid, 22 gauge) to connect between the negative power bus and the other wire of capacitor C4. Solder the wire in place at both ends.
8. Insert capacitor C1 through the top of the board as seen in Figure 2. The negative wire should be to the left. Turn the board over. Bend the positive wire over to connect with pin 5 of the IC socket (the positive wire is labeled with a [+] in Figure 1). Trim any excess wire and solder the positive wire of C1 to pin 5.
9. Bend the negative wire of C1 into a U-shape, and insert it back through the board so that the end is on the top side of the board.
10. Cut a 5 1/4 inch piece of red wire (stranded, 22 gauge). This will be the wire labeled "C" in Figure 2. Strip about ¼ inch of insulation off one end of the wire and twist the strands to keep them together. Bend the wire around the end of the negative wire of capacitor C1 on the top side of the board as seen in Figure 2 and solder in place.
11. Insert capacitor C2 through the top of the board as seen in Figure 2. Turn the board over. Connect the top wire of C2 (Figure 1) to the wire that connects to pin 5 of the IC socket and solder.
12. Bend the other wire of C2 over to the left (the one closer to the bottom of the board in Figure 1).
13. Insert resistor R2 into the board as seen in Figure 2. Turn the board over. Bend the top wire of R2 over to the right to connect with the unsoldered wire of C2 and then solder R2 to C2.
14. Solder the free end of R2 to the negative power bus as seen in Figure 1.
15. Insert the capacitor C3 through the top of the board as seen in Figure 2. The negative wire should be toward the left. Turn the board over. Bend the negative wire over to touch pin 8 of the IC socket. Trim any excess wire and solder the negative wire of C3 to pin 8 (Figure 1).
16. Bend the positive wire of C3 into a U-shape and insert it back into the board so that its end is now on the top side of the board (point E in Figure 1).
17. Cut a 4 inch piece of red wire (stranded, 22 gauge) and strip ¼ inch of insulation off one end. Twist the strands of the wire to keep them together. This will be the wire labeled "E" in Figure 2. Wrap wire "E" around the positive wire of C3 on the top side of the board and solder (Figure 2).
18. Cut a 4 ½ inch piece of red wire (stranded, 22 gauge) and strip ¼ inch of insulation off one end. This will be the wire labeled "1" in Figure 2. Twist the strands on the end of the wire and lightly

coat with solder. Insert the wire through the top of the board next to pin 1 of the IC socket. Turn the board over. Bend the wire over to touch pin 1 of the IC socket. Trim any excess wire and solder wire to pin 1.

19. Cut a 5 inch piece of green wire (stranded, 22 gauge) and strip ¼ inch of insulation off one end. This will be the wire labeled "3" in Figure 2. Twist the strands on the end of the wire and lightly coat with solder. Insert the wire through the top of the board next to pin 3 of the IC socket. Turn the board over. Bend the wire over to touch pin 3 of the IC socket. Trim any excess wire and solder wire to pin 3.
20. Bend the stripped end of the black battery wire around the wire at point A on the top side of the board and solder (Figure 2). This connects the negative side of the battery to the negative power bus on the board.
21. Prepare three black wires (stranded, 22 gauge) as follows: Wire "K" 4 inches long, Wire "G" 6 inches long and Wire "H" 3 ½ inches long (Figure 2). Strip ¼ inch of insulation off one end of each wire, twist the ends to prevent fraying and solder these three wires to the wire on the top side of the board at point B.
22. You have completed wiring the circuit board. Now insert the IC chip into its socket. Make sure the notch on the chip matches the notch on the socket.
23. Mount the circuit board onto the wood base using four 1 inch machine screws and four ½ inch spacers. The spacers are used to elevate the board above the base so that the wire connections underneath the board do not touch the base.
24. You are now ready to connect the wires from the circuit board to their proper locations on the components mounted on the front panel. The two toggle switches (SW1 and SW2) seen in Figure 2 are not the same style as the ones you will use, but have the same function (single pole, single throw switches – function as on/off switches). SW2 is the power switch, which connects power from the 9 volt battery to the circuit board. SW1 is a gain switch. When SW1 is on (closed) the amplification factor at maximum volume setting is 200. When SW1 is off (open), the amplification factor is 20 at maximum volume setting. This allows you to select from two different ranges of amplification. R1 is the potentiometer (adjustable resistor) used to adjust the volume of the sound output. J1 is the input jack and J2 is the output jack for the sound signal. You will connect your crystal radio to J1 and your headphones to J2. The jacks seen in Figure 2 are not the same as the ones you will use. In order to save some money, you will use some used jacks. The used jacks already have some wires connected to them, so you will connect those wires to the proper wires from the circuit board.
25. Strip ¼ inch of insulation from the free end of wire "1" (Figure 2). Twist the end to prevent fraying. Connect and solder this wire to one of the lugs of SW1.
26. Strip ¼ inch of insulation from the free end of wire "E" (Figure 2). Twist the end to prevent fraying. Connect and solder this wire to the other lug of SW1.
27. Strip ¼ inch of insulation from the free end of wire "G" (Figure 2). Twist the end to prevent fraying. Slip a piece of heat shrink tubing over the wire. Connect and solder this wire to the bare wire of J1.
28. Cut a 3 inch piece of red wire (stranded, 22 gauge) and strip ¼ inch of insulation from each end. Twist the strands on each end to keep them from fraying. This will be wire "F" in Figure 2. Solder one end to the red wire of J1. Place a piece of heat shrink tubing on the wire. Then solder the other end to the proper lug of R1 as seen in Figure 2. Now slide the two heat shrink

tubing pieces to cover the two solder joints of J1. Ask an adult to help you heat the tubing to finish the job.

29. Strip ¼ inch of insulation from the free end of wire "3" (Figure 2). Twist the strands to prevent fraying. Connect and solder this wire to the proper lug of R1.
30. Strip ¼ inch of insulation from the free end of wire "K" (Figure 2). Twist the strands to prevent fraying. Connect and solder this wire to the proper lug of R1.
31. Strip ¼ inch of insulation from the free end of wire "C" (Figure 2). Twist the strands to prevent fraying. Slide a piece of heat shrink tubing over the wire. Connect and solder this wire to both black and red wires of J2.
32. Strip ¼ inch of insulation from the free end of wire "H" (Figure 2). Twist the strands to prevent fraying. Slide a piece of heat shrink tubing over the wire. Connect and solder this wire to the bare wire of J2. Now slide the two heat shrink tubing pieces to cover the two solder joints of J2. Ask an adult to help you heat the tubing to finish the job.
33. Strip ¼ inch of insulation from the free end of wire "D" (Figure 2). Twist the strands to prevent fraying. Connect and solder this wire to one of the lugs of SW2.
34. Cut the red wire from the battery connector in half and strip the insulation off each end of the two pieces. Twist the strands to prevent fraying. You will insert the Schottky diode into the wire for polarity protection. Slip a piece of heat shrink tubing on each piece of red wire. Connect the side of the diode without the band to the red wire going to the battery and connect the side with the band to the free piece of red wire. Solder both connections, using heat shrink tubing to cover these joints.
35. Connect the free end of the red battery wire (wire "J") to the remaining lug of SW2.

Congratulations, you have finished assembly of the audio amplifier!

Parts

R1 10 K ohm potentiometer

R2 10 ohm resistor ¼ watt

C1 100 µF aluminum capacitor

C2 and C4 0.1 µF ceramic capacitor

IC – LM 386 audio amplifier integrated circuit

SW1 and SW2 – SPST toggle switches

J1 and J2 – 1/8" stereo phone jacks

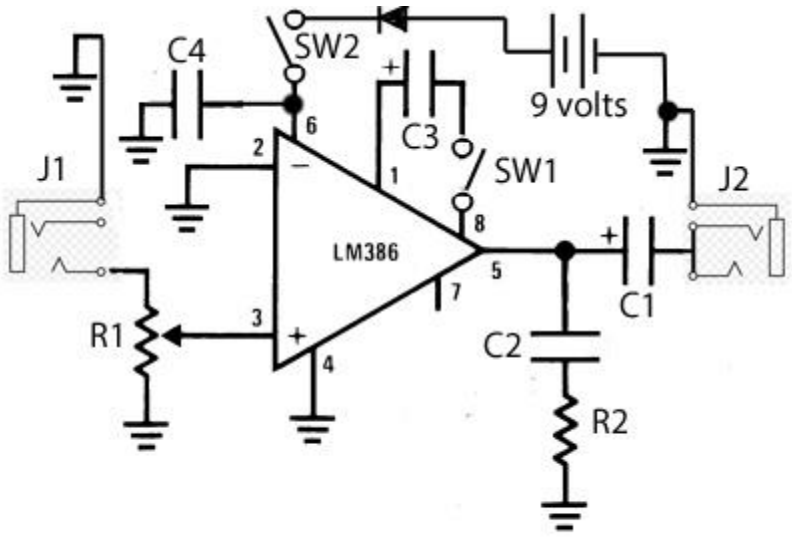

Figure 3 audio amplifier schematic

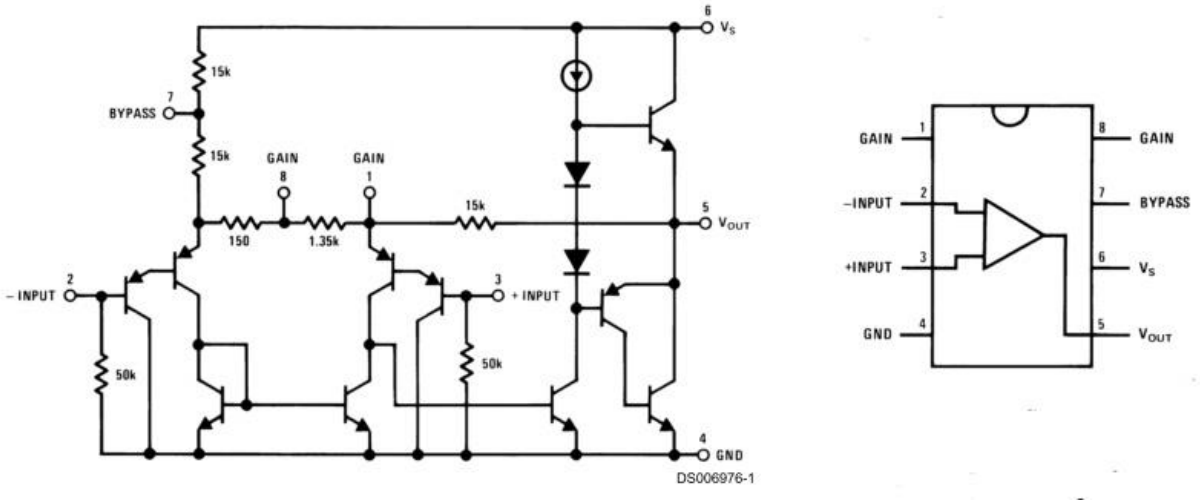

Figure 4 schematic of IC LM386 - audio amp IC chip

Audio Amplifier Project – Parts List

Part	Part number	Price each	Total Price	Supplier
Knob (1)	06M4897	$1.87	$1.87	Newark
LM 386 IC (1)	41K5102	$0.78	$0.78	Newark
10 K potentiometer (1)	06X9475	$4.95	$4.95	Newark
SPST toggle switch (2)	94T9281	$1.04	$2.08	Newark
10 ohm resistor (1)	95W5935	$0.03	$0.03	Newark
100 µF 25 V capacitor (1)	79K3589	$0.09	$0.09	Newark
PCB prototype board* (1)	54T9643	$1.10	$1.10	Newark
8 pin DIP socket (1)	AE9986-ND	$0.19	$0.19	Digikey
0.1 µF ceramic capacitor (2)	BC2665CT-ND	$0.11	$0.22	Digikey
10 µF 50 V capacitor (1)	70K9699	$0.09	$0.09	Newark
½ inch spacer (4)	878K-ND	$0.17	$0.68	Digikey
1/8" STEREO IN-LINE AUDIO JACK (2)	None – recycled old part	No charge	No charge	
9 V battery strap (1)	84-4K-ND	$0.45	$0.45	Digikey
9 V battery clip (1)	71K-ND	$0.38	$0.38	Digikey
4” x 3 ¼” metal faceplate (1)	None – recycled scrap	No charge	No charge	
4 ½” x 4” x ¾” wood base (1)	None – recycled scrap	No charge	No charge	
#4-40 steel machine screw – 1” (4)	Not available	$0.05	$0.20	Hardware store
#4-40 steel nut (4)	Not available	$0.02	$0.08	Hardware store
#6 steel wood screw ¾” (2)	Not available	$0.04	$0.08	Hardware store
#2 brass wood screw ½” (2)	Not available	$0.08	$0.16	Hardware store
Schottky diode	1N5817-TPCT-ND	$0.22	$0.22	Digikey
22 AWG solid black wire 12 inches	36792	$0.08/ft	$0.08	Jameco
22 AWG stranded black wire 18 inches	2206601	$0.05/ft	$0.07	Jameco
22 AWG stranded red wire 24 inches	2206627	$0.05/ft	$0.10	Jameco
22 AWG stranded green wire 5 inches	2206651	$0.05/ft	$0.02	Jameco
		Total	$13.92	

*board will be cut into four 2” x 2 ½” pieces, price is for one piece, not whole board