

You will be using a solder-able breadboard as your circuit board. The bottom **edge** of the top **side** of board is printed with "sparkfun.com" and at the top **edge** "PTH-protoboard-30." All components sit on the top **side** of the board. The bottom **side** of board does not have "sparkfun.com" printed on it, only "PTH-protoboard-30." The wires of all components are pushed through the board from the top **side** and are soldered to the board on the bottom **side**.

The board works just like a breadboard. Looking at the top side, next to the bottom edge of the board there are two rows of 29 holes each. The lower-most row is labeled with a (+) sign and the row above it with a (-) sign. In the directions, these rows of holes are named as the **bottom positive power bus** and **bottom negative power bus**. Near the top edge are another set of two rows of holes, also marked with (+) and (-). In the directions, these rows of holes are named as the **top positive power bus** and **top negative power bus**. The remainder of the holes on the board are organized into ten columns labeled **a** through **j** (labeled at left and right sides of board). Each column has 30 holes, labeled **1** through **30**. The directions reference each hole on the board with the column followed by hole number. For example, the first hole of column **a** is designated **a1**. The last hole of column **a** is designated **a30**.

1. Insert 8 pin IC chip socket in rows 14 through 17 of solder-able breadboard as seen in Figure 1. The notch in socket should be on right side (arrow in Figure 1). Solder 8 pins on bottom side of board.

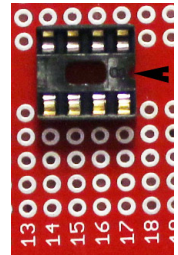


Figure 1:

Keep in mind that this board works just like a breadboard, except that you solder the connections for a permanent board. Review how a breadboard works if the connections in this lesson don't make sense to you. There is a schematic for the wiring on page 14.

2. Solder C1 (100 μ F) to board. **Negative** wire to hole b4, **positive** wire to hole b14.

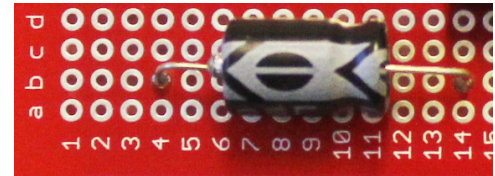


Figure 2

3. Solder C2 to board, one wire to hole d12 the other wire to hole c14

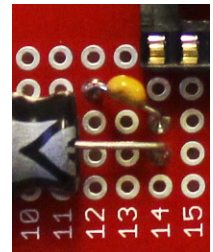


Figure 3

4. Solder R2 to board, one wire to hole e3 the other wire to hole e12



Figure 4

5. Solder **negative** wire of C3 (10 μ F) to hole h19 and **positive** wire to hole h17

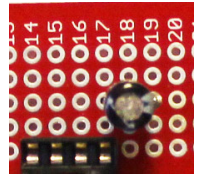


Figure 5

6. Solder one wire of C4 to hole a15 and the other wire to a nearby hole in bottom negative power bus (Figure 6).

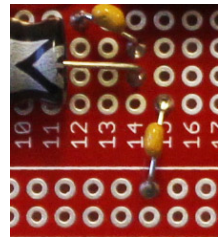


Figure 6

7. Solder **negative** wire (with silver band) of Schottky diode to hole h24 and the other wire to hole h30

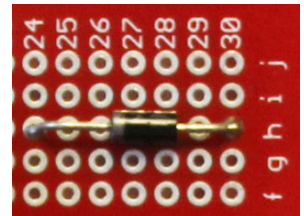


Figure 7

8. Prepare a red stranded wire (22 AWG) 5 inches long. Strip one end and solder to hole f24. As with all stranded wires in this project, you will need to twist the strands tightly together before the wire will slip through a hole in the board.

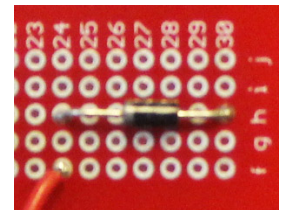


Figure 8

9. Solder the 9 volt battery strap to board. The red wire to hole f30 and black wire to last hole to right of bottom negative power bus (see Figure 9).

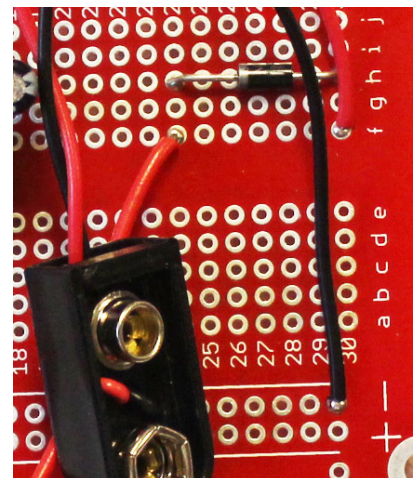


Figure 9

10. Prepare a solid black wire (22 AWG) and solder to hole a3 and a nearby hole in bottom negative power bus (see Figure 10).

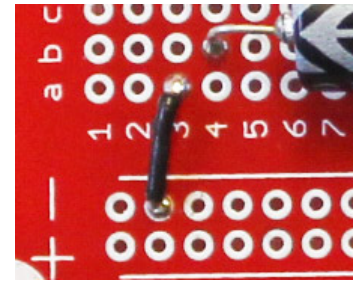


Figure 10

11. Prepare a red stranded wire (22 AWG) 6 inches long. Strip one end of wire and solder to hole a4.

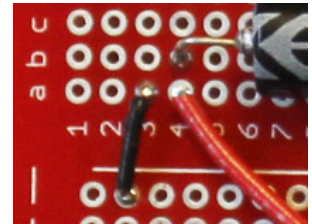


Figure 11

12. Prepare a solid black wire (22 AWG) about 2 inches long. Strip both ends and solder to top and bottom negative power bus (see Figure 12).

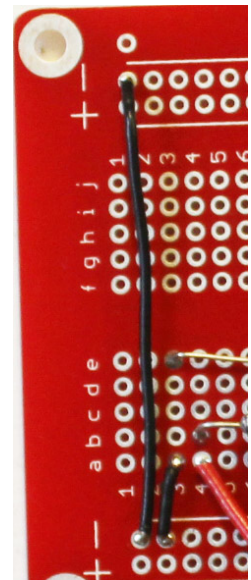


Figure 12

13. Prepare a short solid black wire (22 AWG) and solder one end to hole j16 and the other end to a nearby top negative power bus hole (see Figure 13).

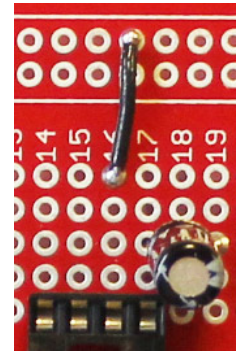


Figure 13

14. Prepare a 5 inch long stranded red wire (22 AWG). Strip one end and solder it to hole b15 (see Figure 14).

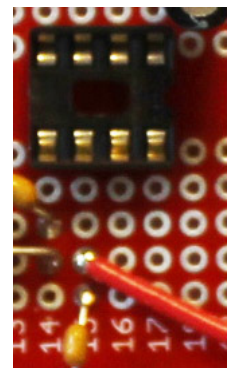


Figure 14

15. Prepare a short black solid wire (22 AWG) and solder one end to hole j14 and the other end to a nearby top negative power bus hole (see Figure 15).

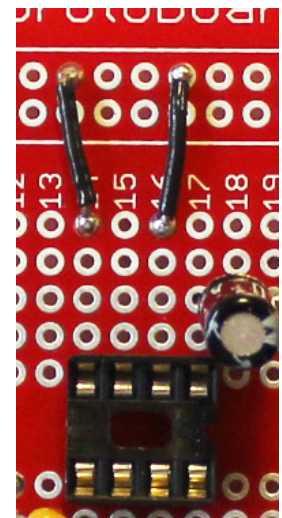


Figure 15

16. Prepare a 5 inch long stranded black wire (22 AWG) and strip one end. Solder the wire to hole f19.

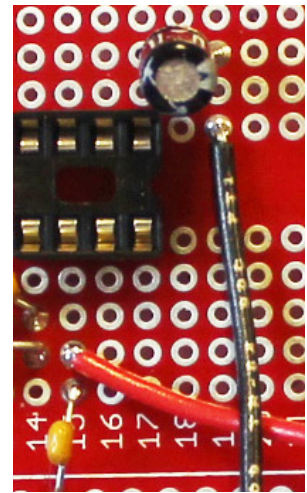


Figure 16

17. Prepare a 5 inch long stranded black wire (22 AWG) and strip one end. Solder the wire to hole a17.

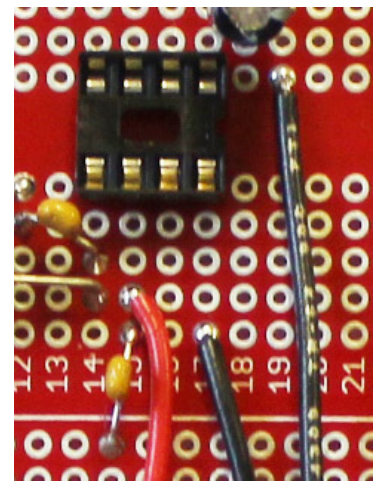


Figure 17

18. Prepare a 6 inch long stranded green wire (22 AWG) and strip one end. Solder the wire to hole h15.

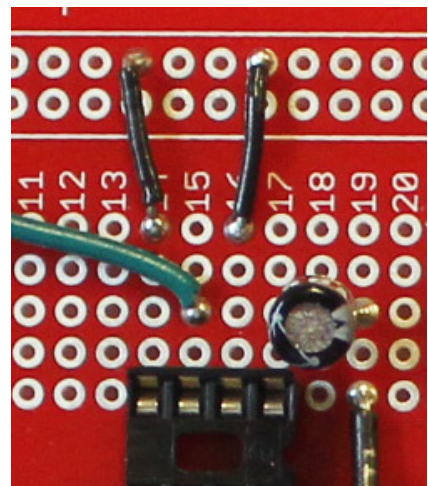


Figure 18

19. Prepare a 4 inch long stranded black wire (22 AWG) and strip one end. Solder the wire to hole second from right on bottom negative power bus (see Figure 19).

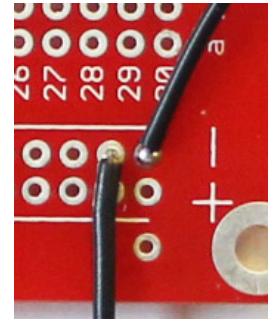


Figure 19

20. Prepare a 4 ½ inch long stranded black wire (22 AWG) and strip one end. Solder the wire to hole 9th from right end of bottom negative power bus (see Figure 20).

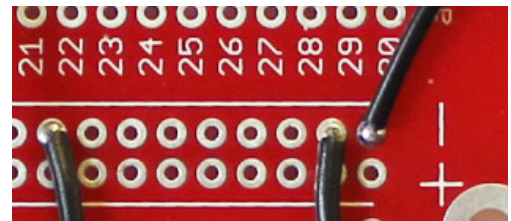


Figure 20

21. Prepare a 4 inch long stranded black wire (22 AWG) and strip one end. Solder the wire to hole 3rd from left on bottom negative power bus (see Figure 21).

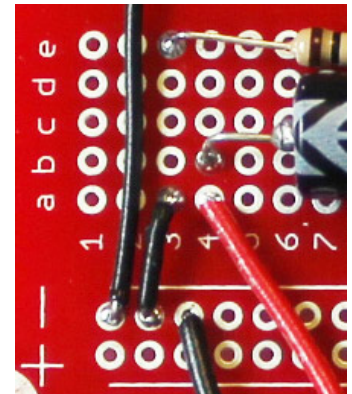


Figure 21

22. You have now finished wiring the board. Install the IC chip into the socket, making sure notch is to the right. Then attach the board to the white base with the four machine screws, spacers and nuts.

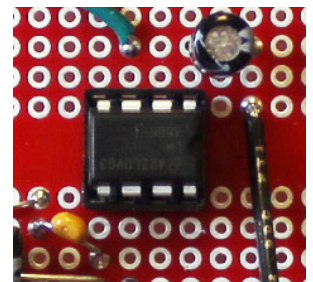


Figure 22

23. Remove the audio output jack from the face plate to make it easier to solder the wires to it. Prepare a short red solid wire (22 AWG) and solder it to the bottom lug as seen in Figure 23. The other end of the wire should be stripped with a little extra insulation removed so that some bare wire is present after you bend the wire and insert it into the top lug. The extra wire is where the arrow points. This is where you will attach another wire.

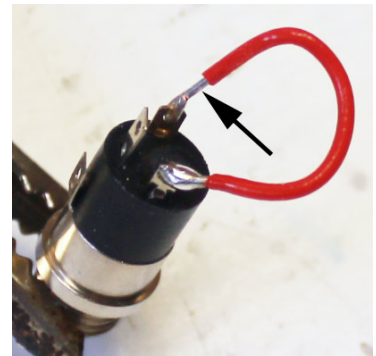


Figure 23

24. Find the red wire soldered to hole a4. Strip the other end and wrap it around the bare part of the wire in Figure 23, where the arrow is pointing. Then solder both wires to the lug on the left side as seen in Figure 24.



Figure 24

25. Find the black wire soldered to the bottom negative power bus, second hole from the right. Strip the other end. Attach to the center lug of the audio output jack and solder as seen in Figure 25.

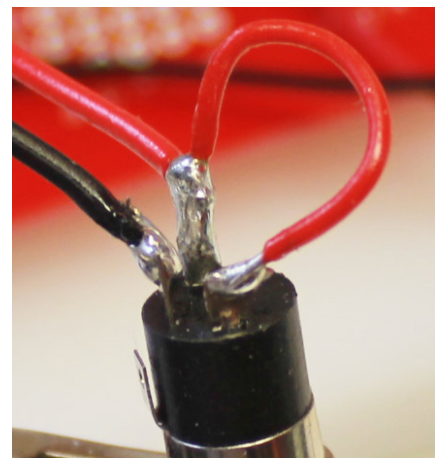


Figure 25

26. Reattach the audio output jack to the face plate as seen in Figure 26.

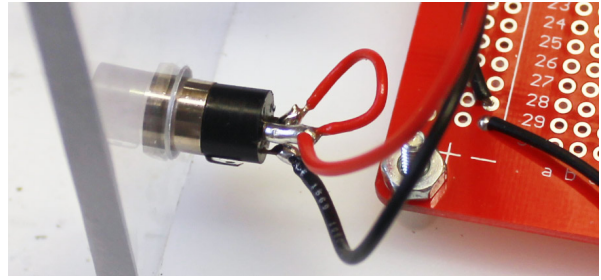


Figure 26

27. Remove the solder tab from the red binding post. Prepare a red stranded wire (22 AWG) 4 ½ inches long. Strip one end and solder it to the solder tab as seen in Figure 27.



Figure 27

28. Reattach the solder tab with red wire to the red binding post as seen in Figure 28.



Figure 28

29. Cut the red wire to fit between the red binding post and its connection to R1 (the blue pot in Figure 29). There are three wires on R1. Make sure you connect the red wire to the correct one. There are two wires near the back of the pot and one that is nearer the face plate. The red wire connects to the rear wire on the right side as seen in Figure 29. Before you solder the red wire to the pot, slide a short piece of heat shrink tubing on the wire (do this only if you are working in the GEAR lab and have access to the heat gun). After you solder the wire to the pot, slide the heat shrink tubing in place and heat with heat gun to fix in place.

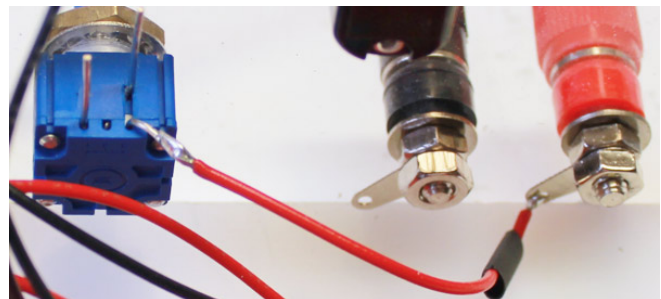


Figure 29

30. Figure 30 shows the heat shrink tubing in place for red wire on the pot (R1).

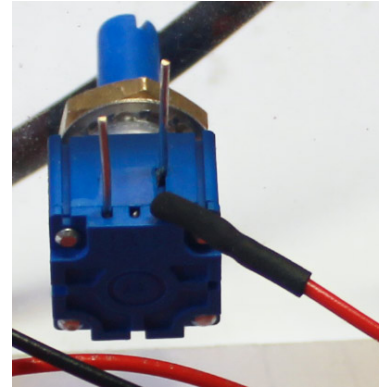


Figure 30

31. Remove the solder tab for the black binding post. Find the black wire connected to bottom negative power bus near the black binding post (see Figure 31). Strip free end of wire and solder to solder tab. Then reinstall the tab on the black binding post.

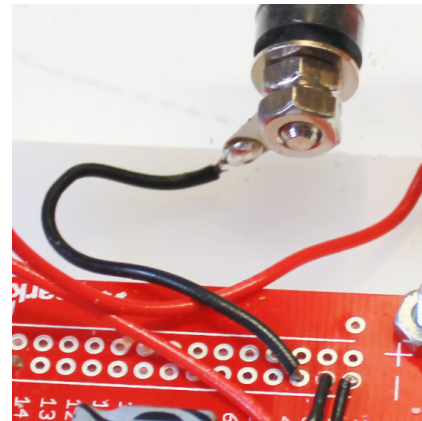


Figure 31

32. Find the black wire soldered to bottom negative power bus, 9th hole from right side. This wire will connect to one of wires on the pot, R1. The correct wire on the pot is the rear wire on the left as seen in Figure 32. Trim the black wire to fit to the pot. Slip a piece of heat shrink tubing over the wire and solder wire to the pot. Then slip the heat shrink tubing into place and heat to fix.

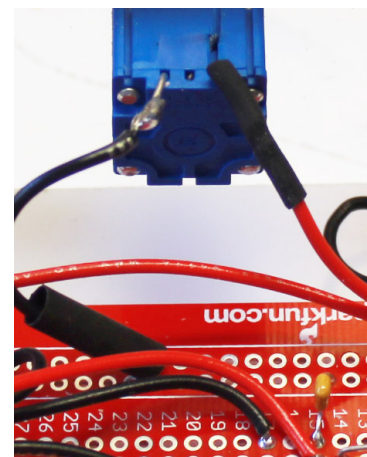


Figure 32

33. Find the only green wire soldered to the board at hole h15. This wire is soldered on the last free wire on the pot, R1, as seen in Figure 33. First trim wire to fit. Then add heat shrink tubing. Solder and then fix heat shrink tubing in place.

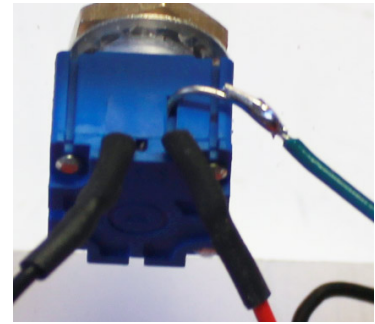


Figure 33

34. Now you will solder connections to on/off switch on right side of amplifier (as seen from the front). This is the power switch for the amplifier. Find the red wire soldered to hole f24. Strip the free end and solder to one of the heavy wires attached to the switch as seen in Figure 34. If you use heat shrink tubing, you will need to take care to make a compact solder joint. Otherwise, the tubing won't slide over the soldered joint.



Figure 34

35. Now find the red wire soldered to hole b15. Strip the free end of this wire and solder to the other heavy wire of the power switch as seen in Figure 35.

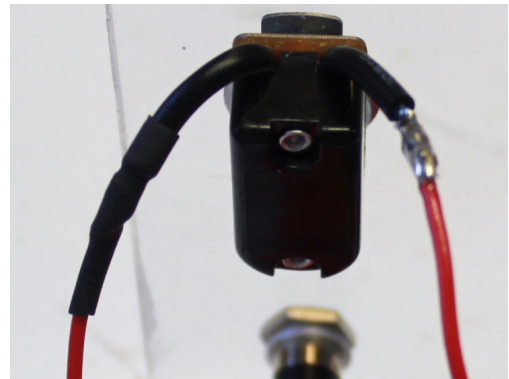


Figure 35

36. Now you will solder wires to the remaining on/off switch (on left side as seen from front). Find the black wire soldered to hole a17. Strip the other end and solder to the switch as seen in Figure 36.

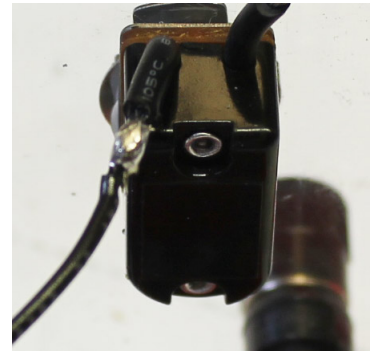


Figure 36

37. Find the black wire soldered to hole f19. Strip the free end and solder to the remaining wire on the switch as seen in Figure 37. Congratulations! You have completed the wiring of the audio amplifier.



Figure 37

38. Before you install the 9 volt battery, make sure both on/off switches are in the off position. To protect the battery wires, slip a small, black P clamp over the wires as seen in Figure 38 at the arrow. Attach the clamp to board with the machine screw at the corner of board. Attach a fresh 9 volt battery to the battery strap and insert battery in the holding clip. Your amplifier is now ready for use.

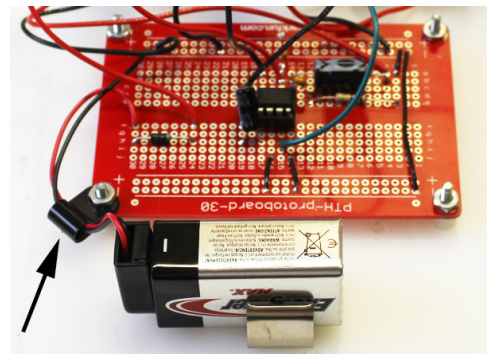


Figure 38

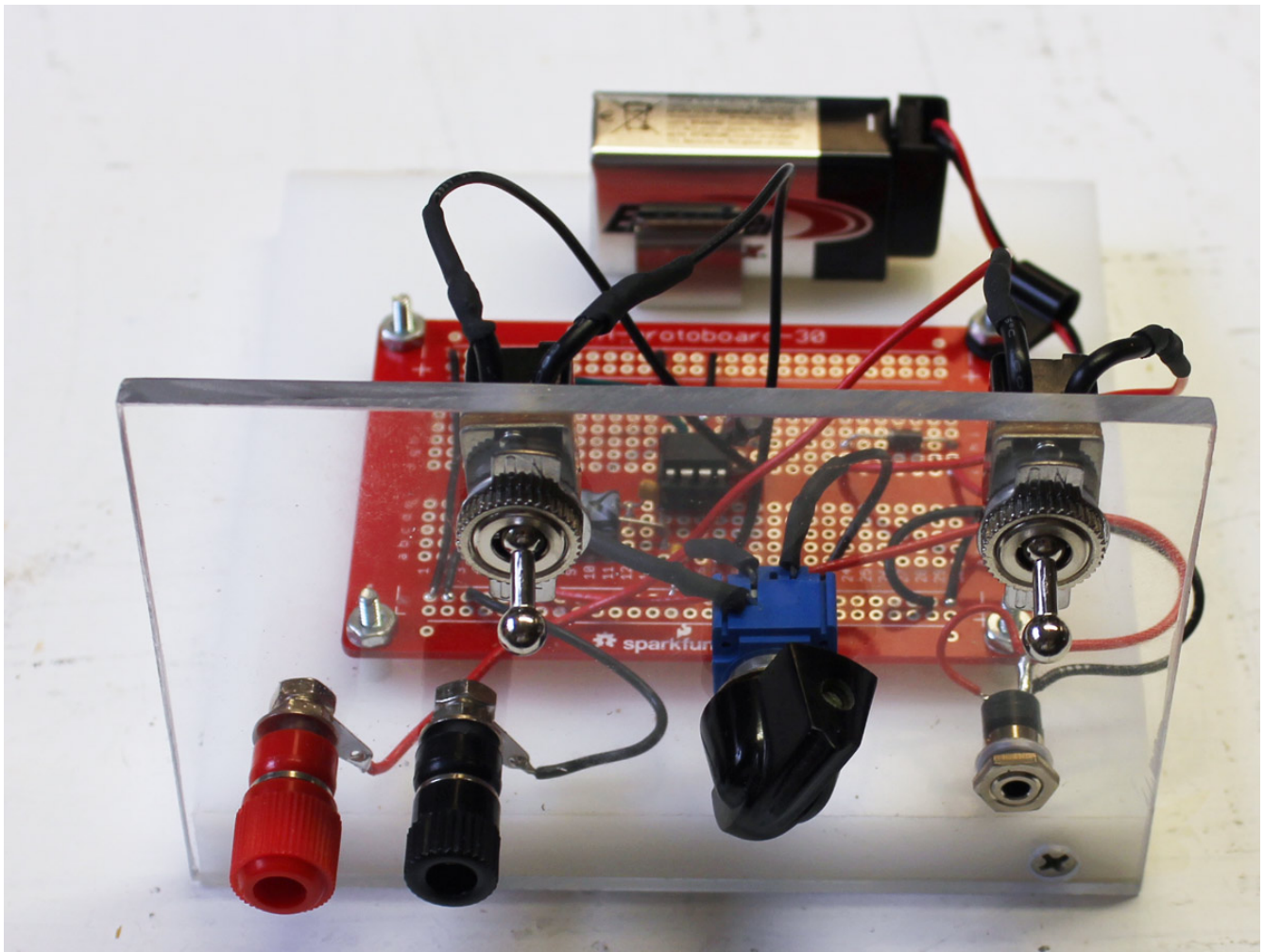


Figure 39: Finished Audio Amplifier

Red and black binding posts bottom left are for audio signal input
Volume control knob is in center of face plate (pot R1)
Audio output jack (for headphone) is on lower right
Audio gain switch upper left
Power switch upper right

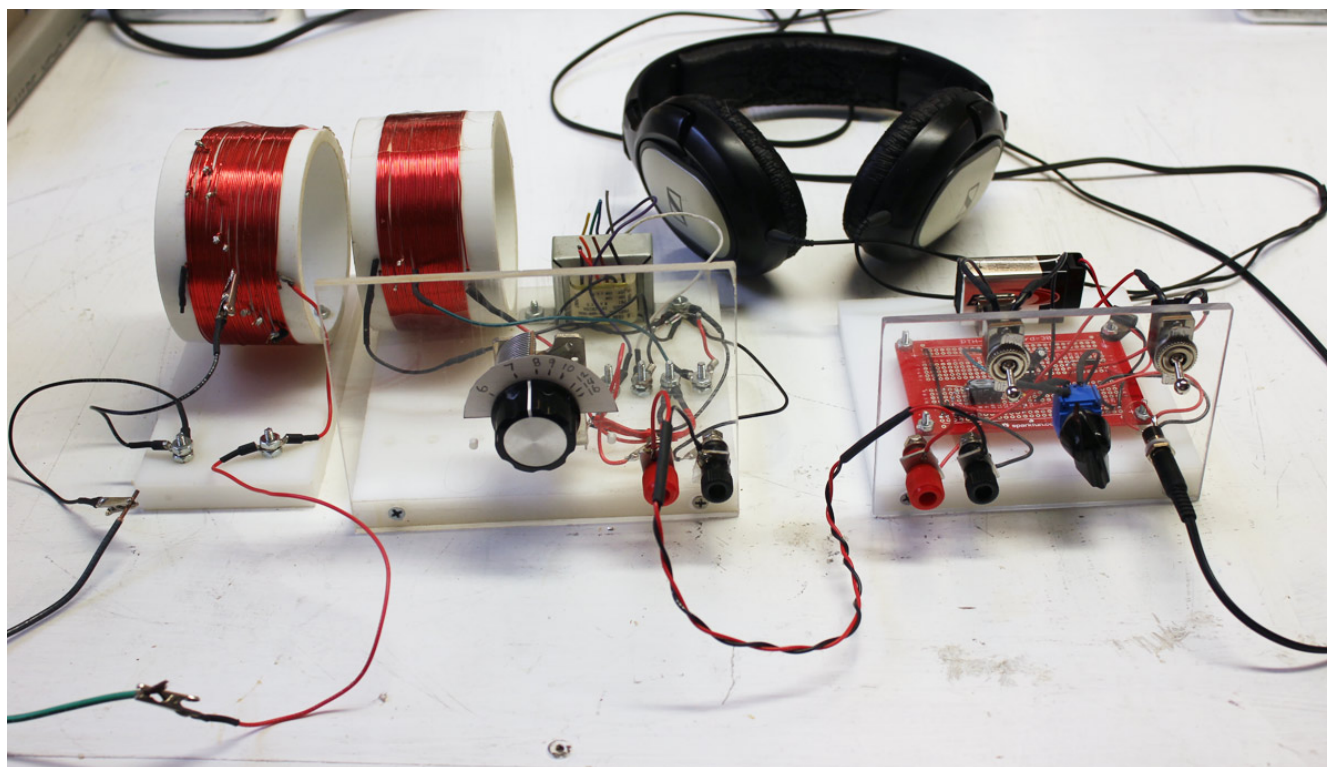


Figure 40: Audio Amplifier connected to Crystal Radio

Use two-wire connector cable between the binding posts of Crystal Radio and binding posts of Audio Amplifier. To operate amplifier:

1. Connect headphone to headphone jack on audio amplifier (jack on far right of amplifier face plate).
2. Rotate volume control knob counterclockwise until it stops (low volume position)
3. Check to make sure gain switch (the one on left side of amplifier) is off
4. Turn on amplifier (switch on right side of amplifier face plate)
5. Tune to a station on radio
6. Adjust volume with volume control. If more volume is needed, turn on gain switch (left side of face plate)

Never turn on the amplifier with volume control in any position other than fully counterclockwise.

This amplifier is capable of very loud volume if tuned to a strong station with volume turned all the way up. Be careful!

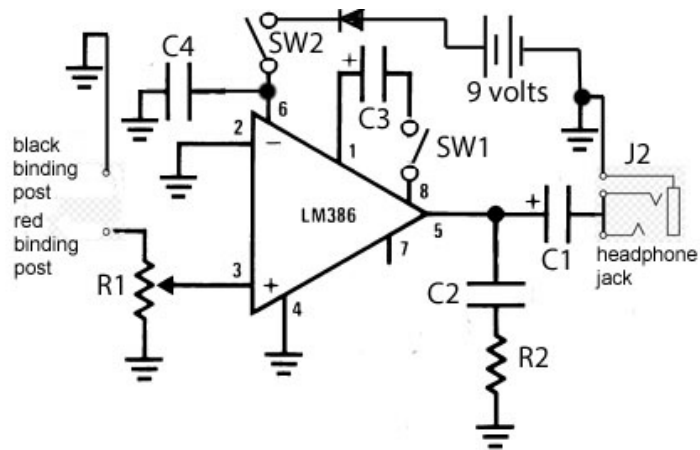


Figure 41: Audio Amplifier schematic

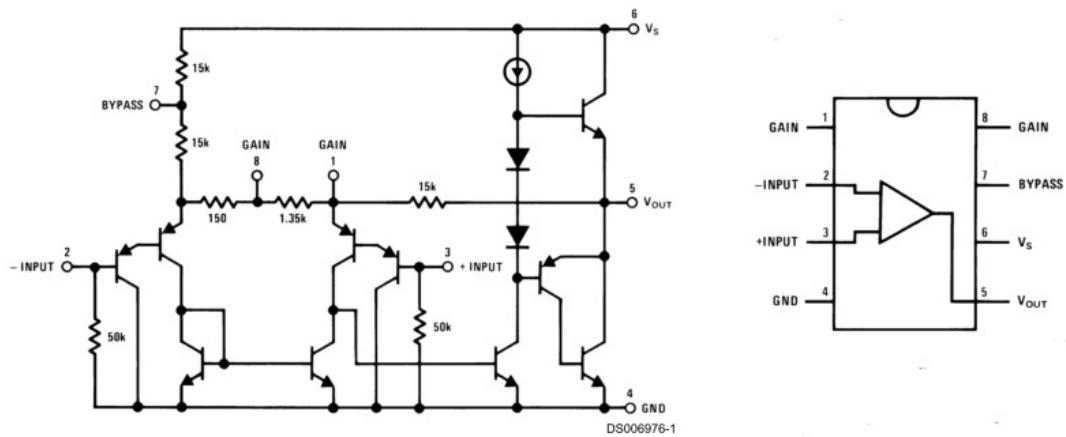


Figure 42: LM 386 audio amplifier IC chip schematic

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
C3 10 µF aluminum capacitor
IC – LM 386 audio amplifier integrated circuit
SW1 and SW2 – SPST toggle switches
J2 – 1/8” stereo phone jack
Red and Black binding posts for audio input
8 pin IC socket
Schotkky diode
PTH-protoboard-30 (Sparkfun, part number PRT-12070)
all wire listed below 22 AWG
red stranded wire 20 inches
black stranded wire 24 inches
green stranded wire 8 inches
black solid wire 12 inches
red solid wire 3 inches