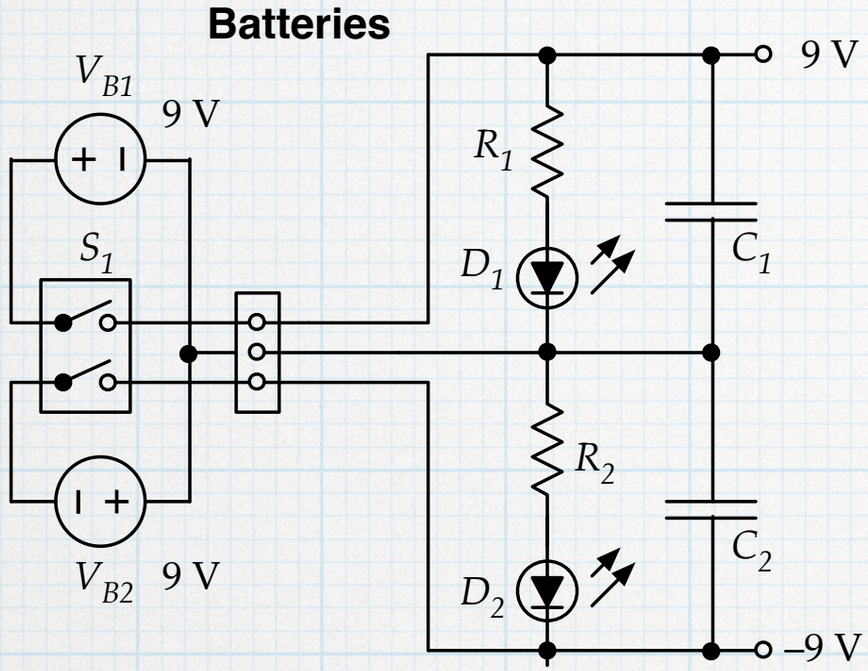
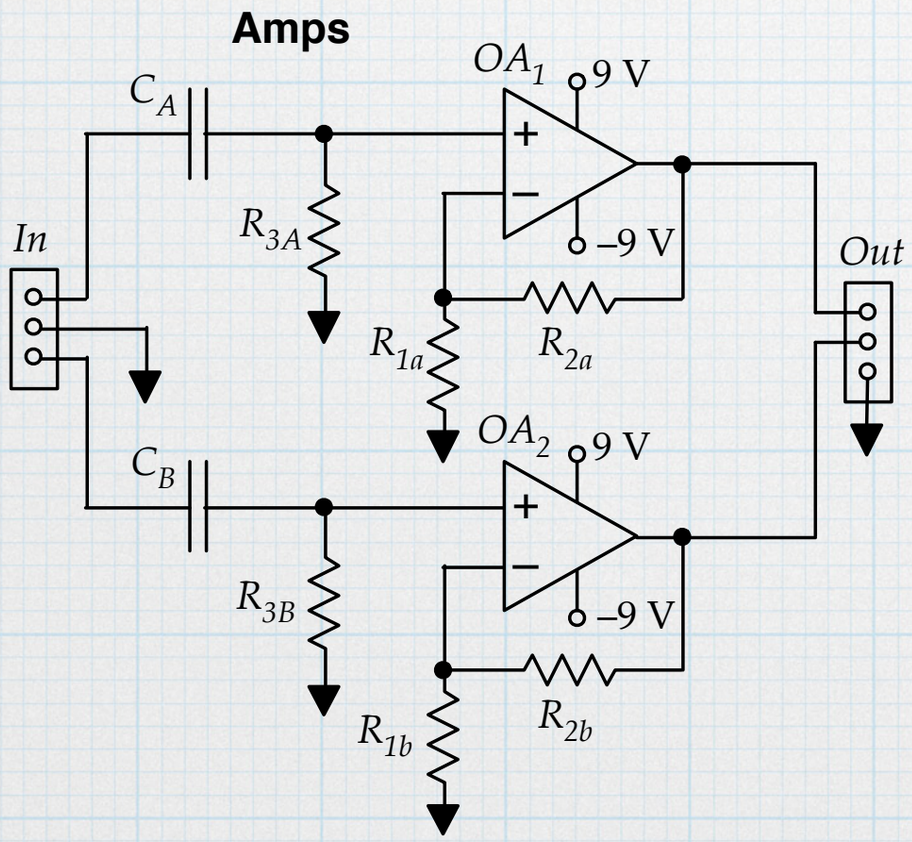
Altoids Amp


The Original Celebrated
ALTOIDS
CURIOUSLY STRONG MINTS
CINNAMON
Artificially Flavored
NET WT 1.76 OZ (50g)

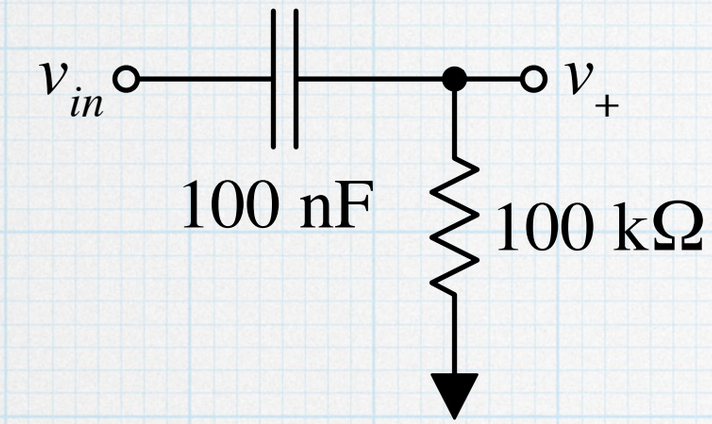

ALTOIDS
9V
12-2021
PILE ALCALINE
Energizer
INDUSTRIAL
ALKALINE BATTERY

The circuit

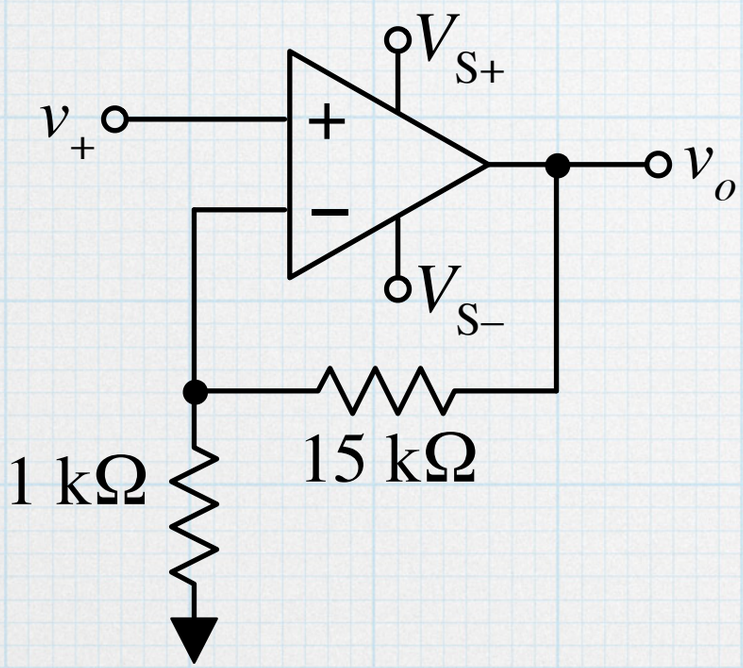




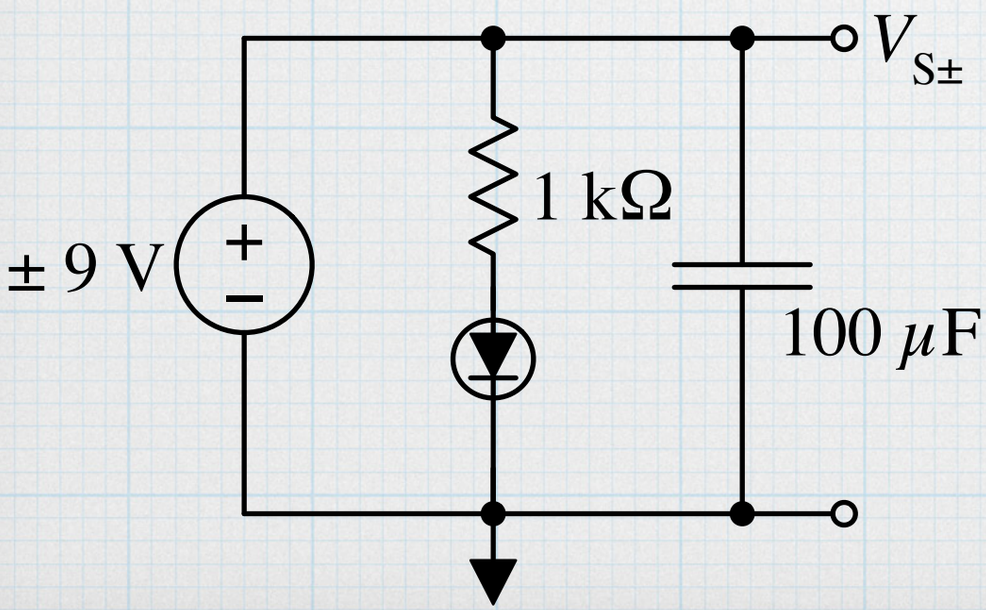
op amp	TL082	
feedback resistor	R_{1a}, R_{1b}	1 kΩ
feedback resistor	R_{2a}, R_{2b}	15 kΩ
input filter capacitor	C_A, C_B	0.1 μF
input filter resistor	R_{3A}, R_{3B}	100 kΩ
power supply capacitors	C_1, C_2	100 μF
LED current limiting resistors	R_1, R_2	1 kΩ
power supply indicator LEDs	D_1, D_2	



The input *RC* combination serves as a high-pass filter (f_c = 16 Hz). More importantly, the series capacitor provides decoupling to prevent DC voltages from accidentally damaging our music source.



A simple non-inverting amp with gain of 16. With ±9 V supplies, the output should be able to go to ±7 V without clipping. That would probably be quite loud.



Power provided with two 9-V batteries. The 100 μF capacitors serve to by-pass current spikes on the power lines. The (optional) LEDs are on/off indicators.

Bill of Materials

DigiKey prices
as of Oct. 2018.

Prices listed are for buying in quantities of 10 or more. If bought individually, parts will be about 10% more expensive.

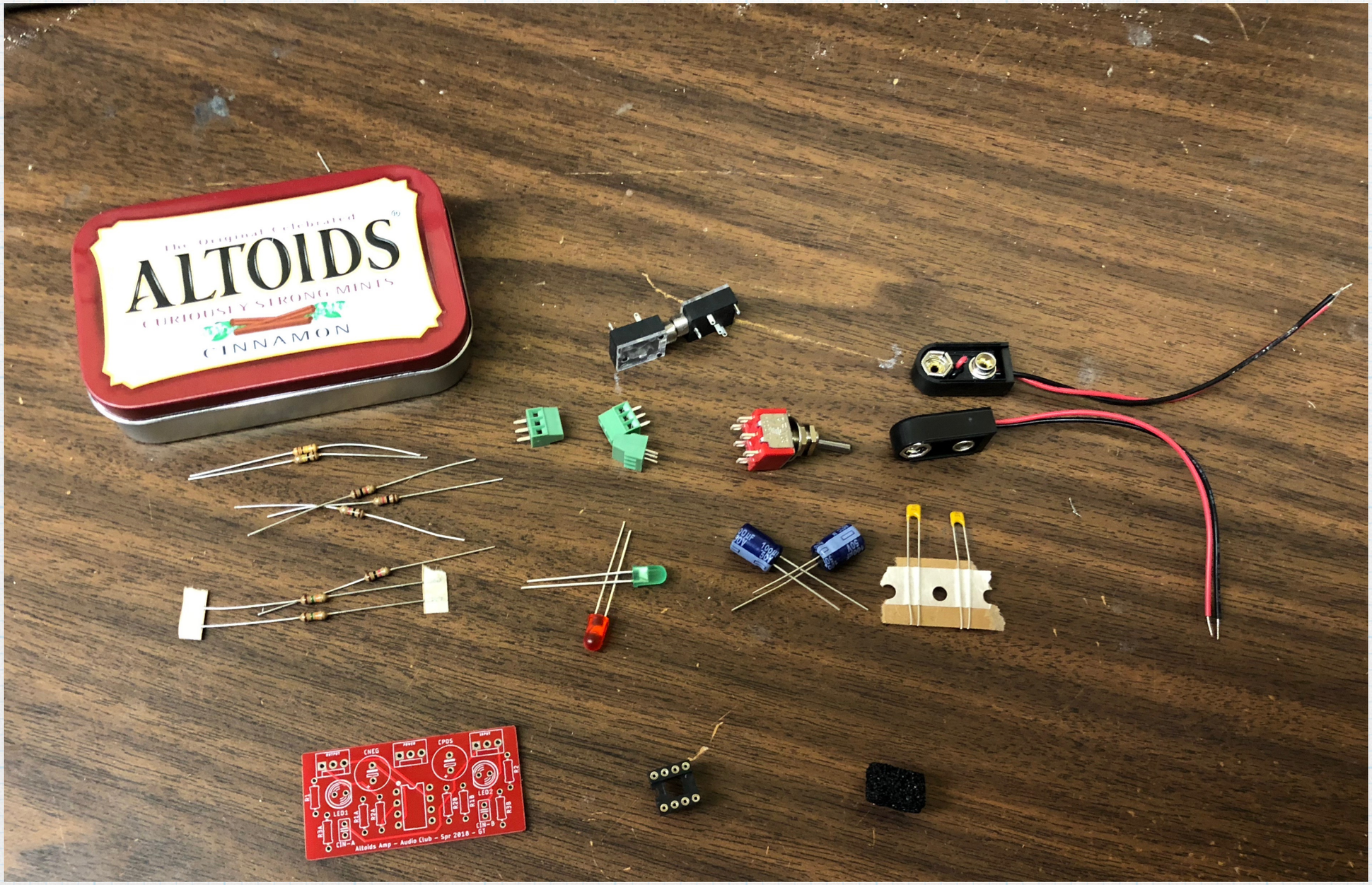
The PCB can be obtained from GT. He can also provide you with Gerber files, if you would like to order your own.

	digikey number	price	quant	total
socket	AE10011-ND	0.47	1	$0.47
TL082	296-1781-5-ND	0.66	1	$0.66
100-nF cap	BC1084CT-ND	0.16	2	$0.32
100-μF cap	P5182-ND	0.23	2	$0.46
15-kΩ resistor	CF14JT15K0CT-ND	0.04	2	$0.08
1-kΩ resistor	CF14JT1K00CT-ND	0.04	4	$0.16
100-kΩ resistor	CF14JT100KCT-ND	0.04	2	$0.08
red LED	C503B-RCN-CW0Z0AA1-ND	0.14	1	$0.14
green LED	C503B-GCN-CY0C0791-ND	0.23	1	$0.23
DPDT switch	EG2398-ND	2.89	1	$2.89
stereo jack	CP1-3515-ND	1.30	2	$2.60
battery strap	36-84-4-ND	0.53	2	$1.06
screw terminals	ED10562-ND	0.77	3	$2.31
board		1.54	1	$1.54
				$13.00

If using a perf-board, you can use whatever version you would like. GT recommends the boards with through-hole plating from Marlin P. Jones. The 4 mm x 6 mm version costs $1.29 (link below).

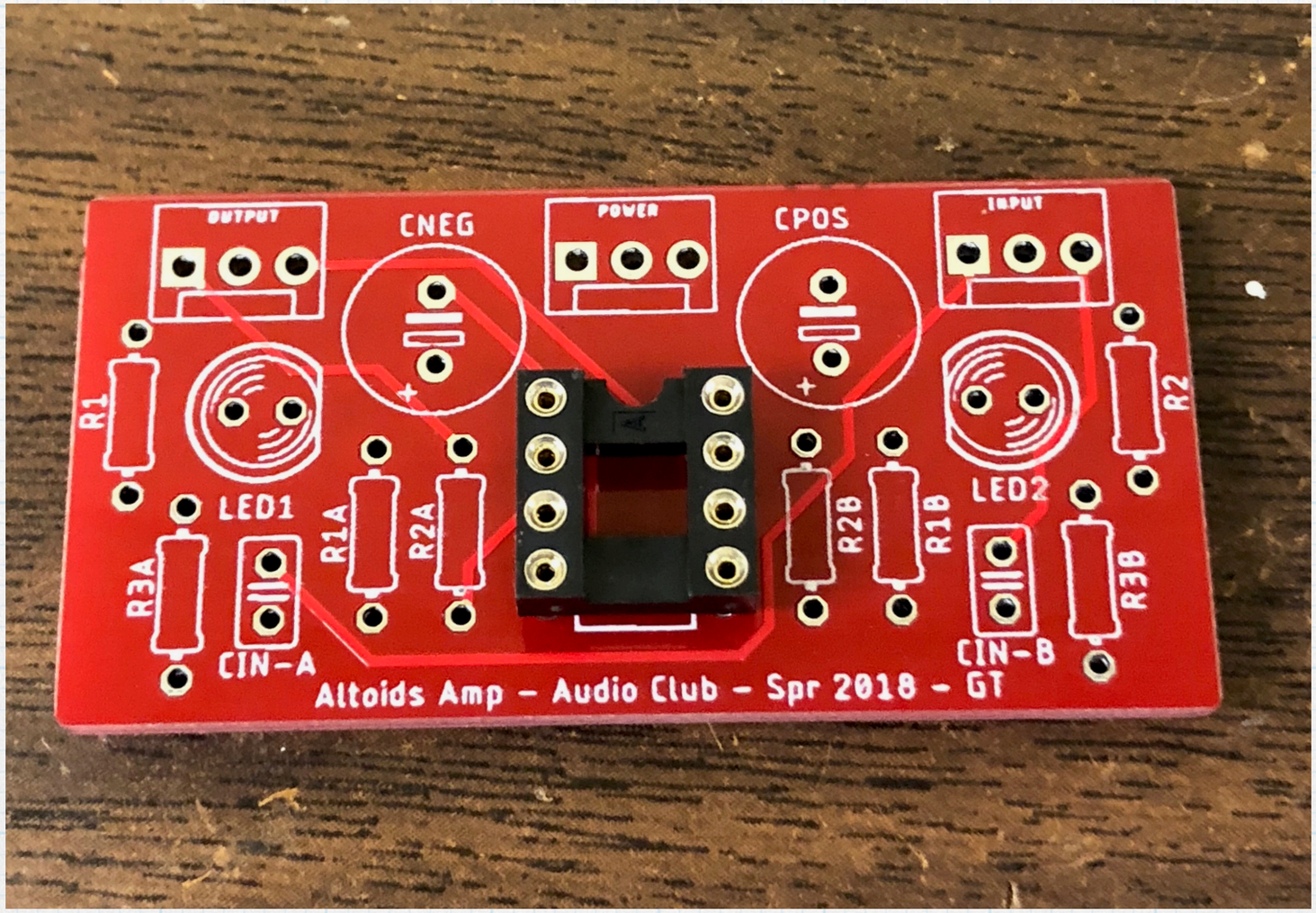
http://www.mpja.com/2-3_8in-X-1-5_8in-6X4cm-Protoboard-Double-Sided-FR-4/productinfo/31091+PB/

Gather up your parts



1. socket

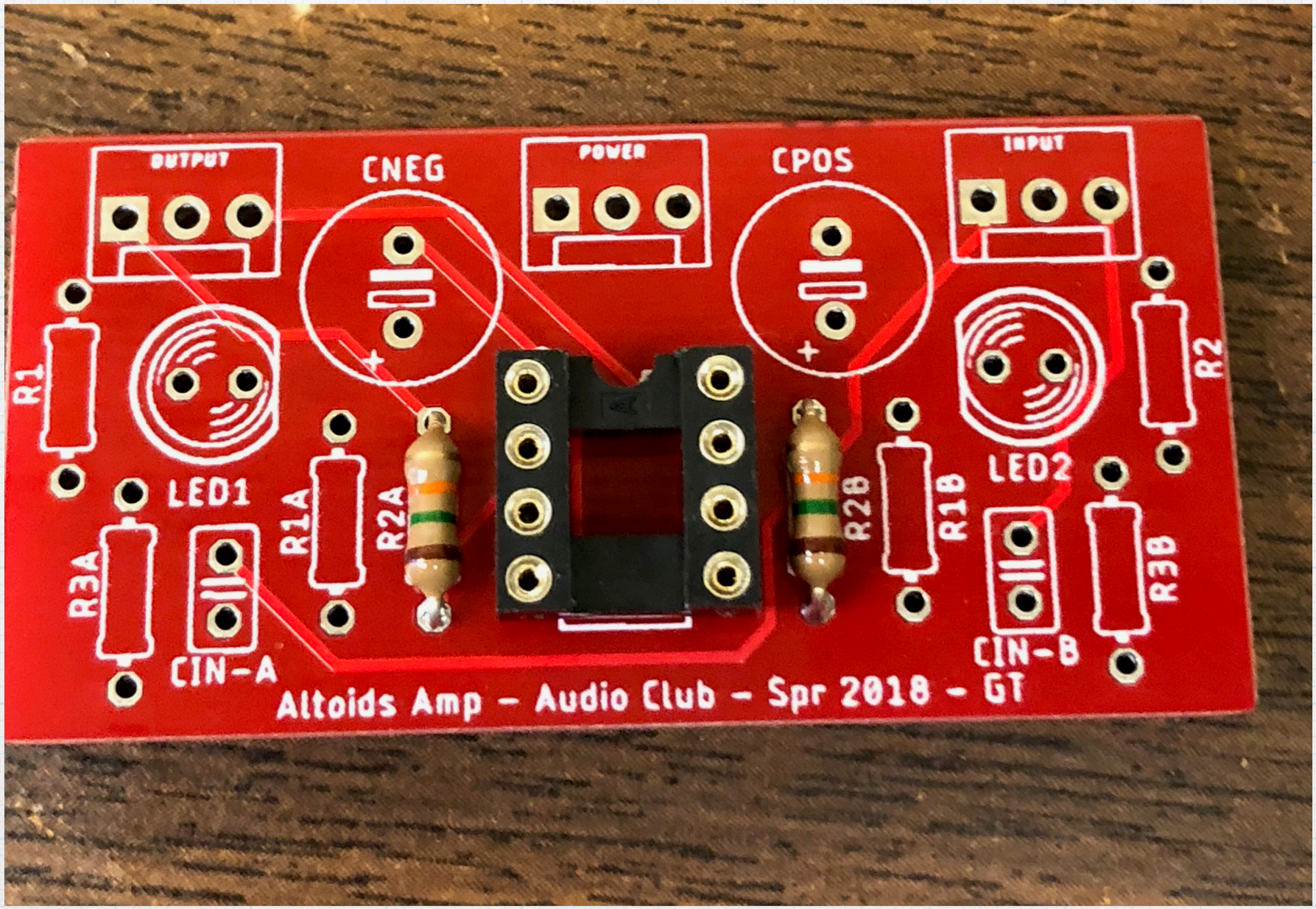
Solder in the socket. Mind the notch.



Note: A socket is not absolutely necessary. You can solder the op-amp chip directly to the board. But if you do that, it becomes very difficult to remove the chip if it is burned out or you would like to try a different amplifier.

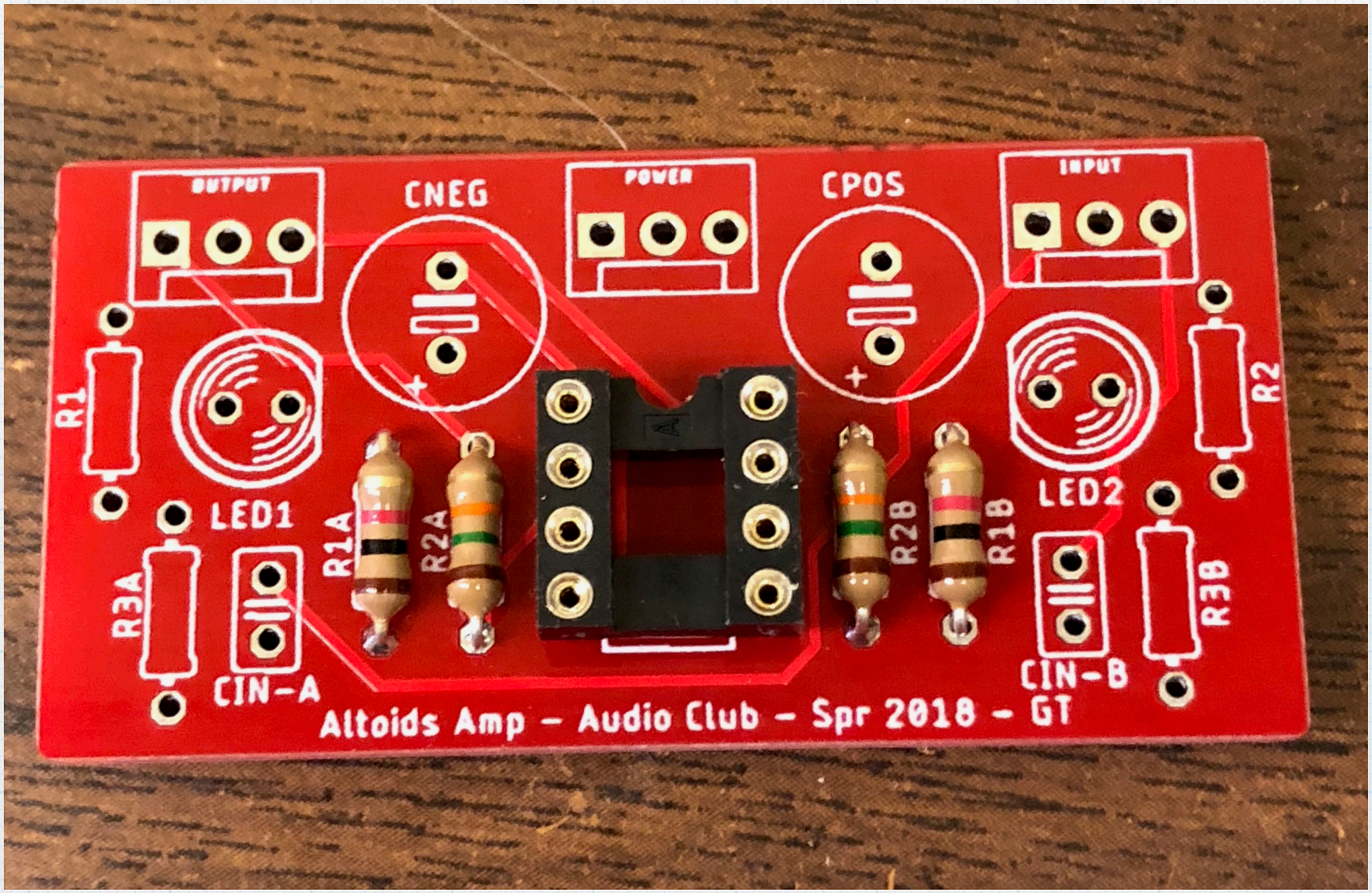
2. Feedback resistors

Solder in the two feedback resistors — R_{2A} and R_{2B}, each having values of 15 kΩ.



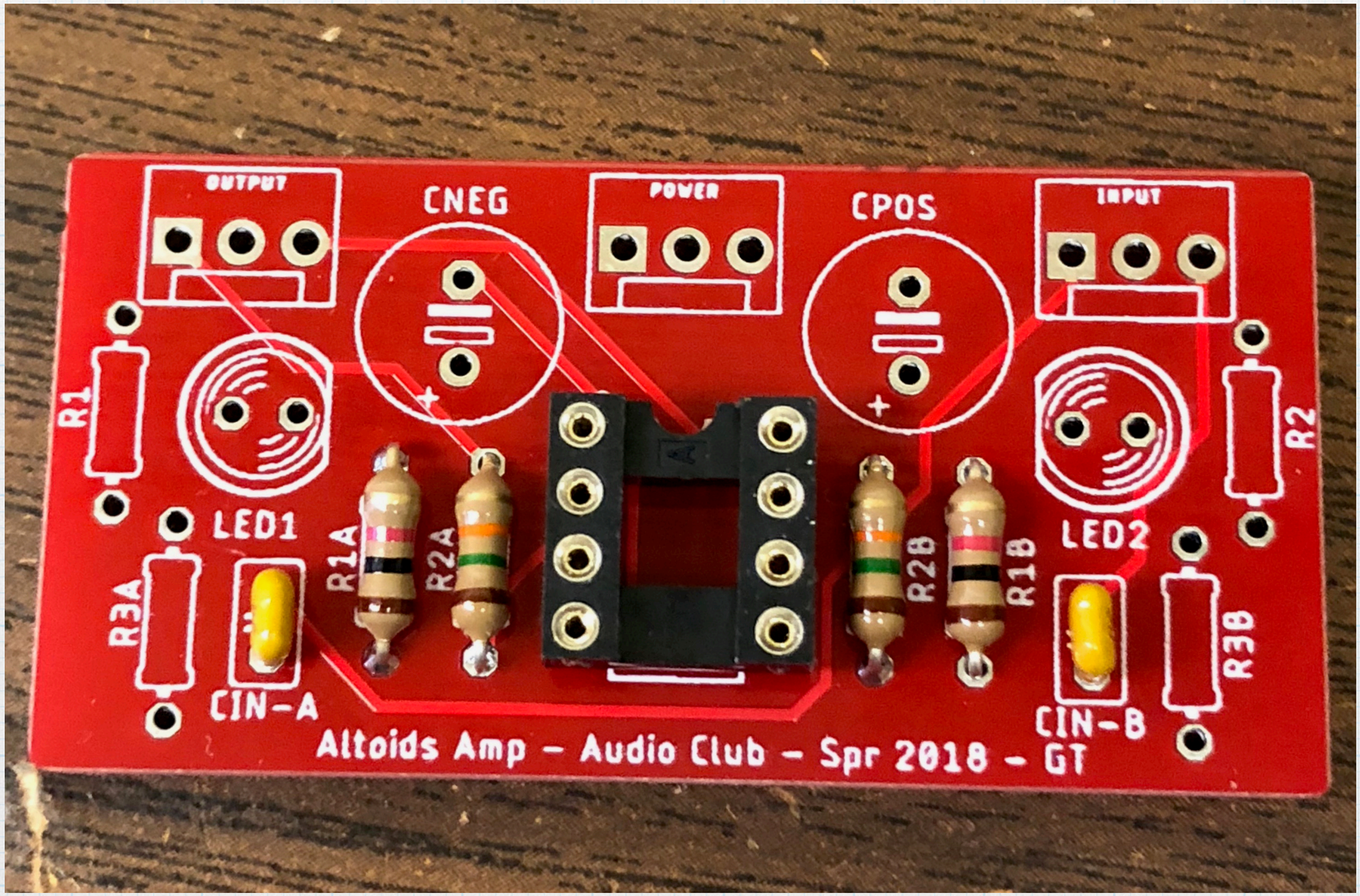
3. Feedback resistors

Solder in the other two resistors in the feedback networks — R_{1A} and R_{1B}. Both are 1-kΩ resistors.



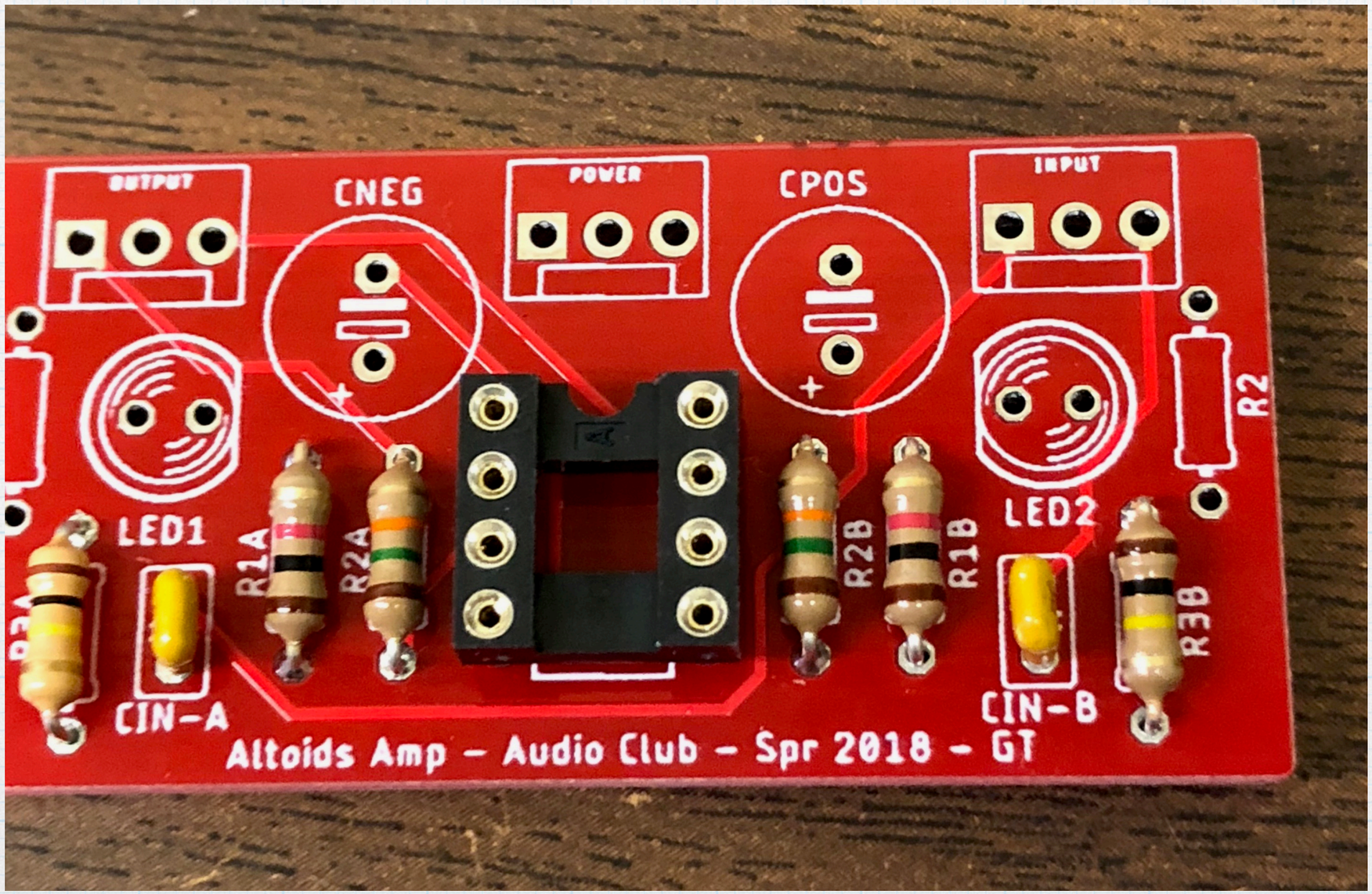
4. Filter capacitors

Solder in the two 100-nF capacitors used in the input high-pass filters — C_A and C_B.



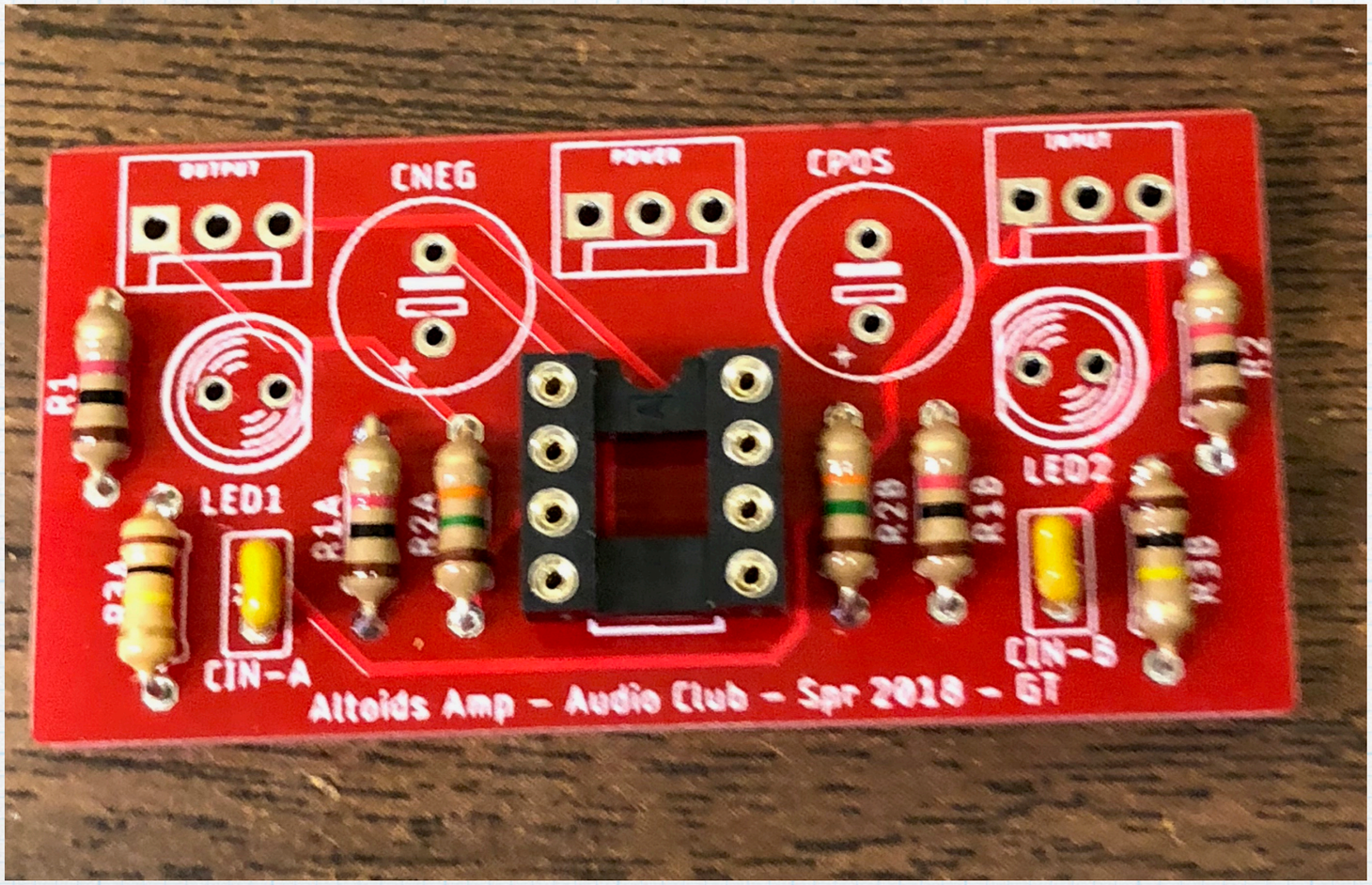
5. And the filter resistors

Add the 100-kΩ resistors that are part of the high-pass filters — R_{3A} and R_{3B}.



6. light-emitting diodes

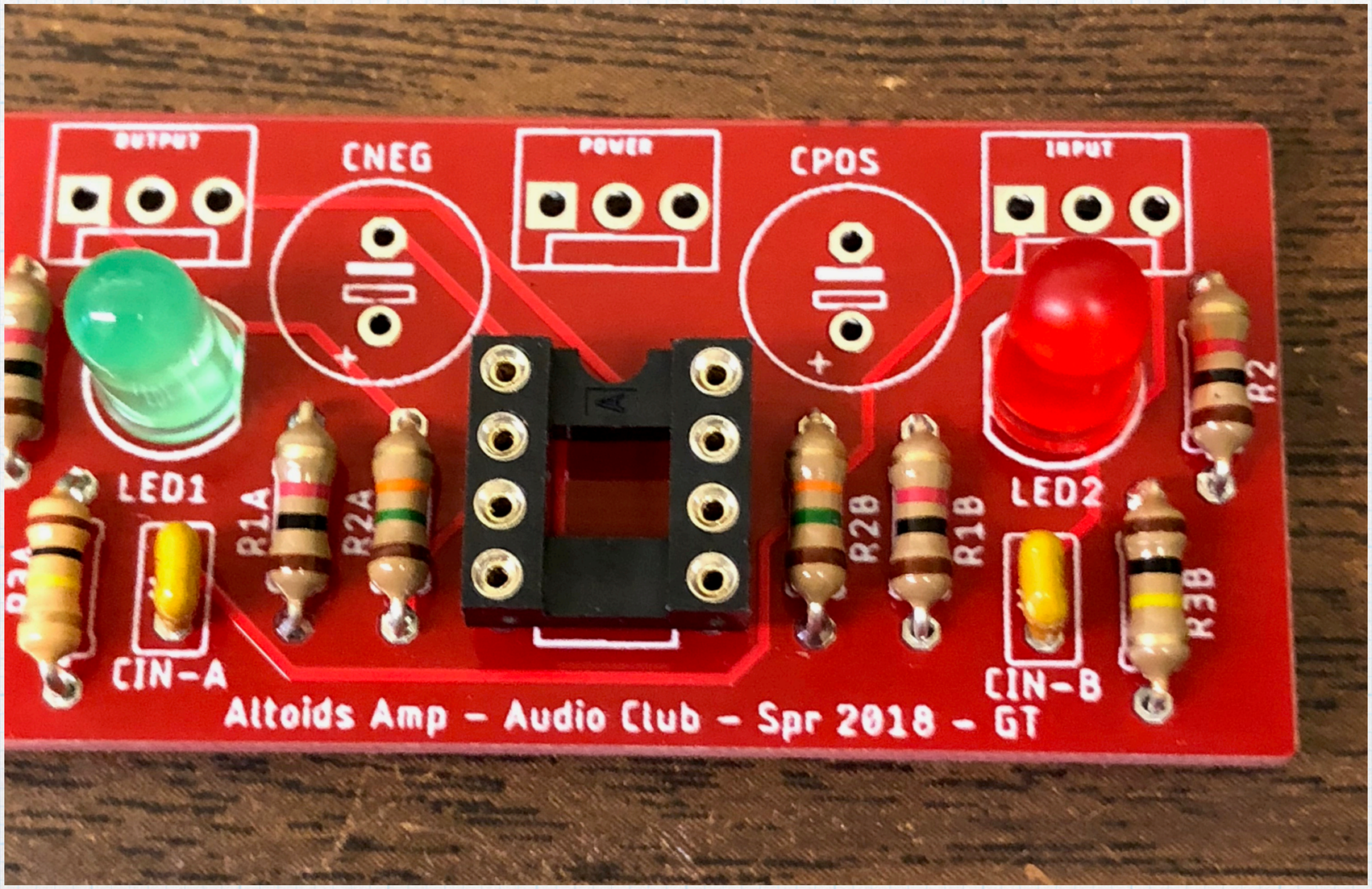
Add the two 1-kΩ current limiting resistors (R_1 and R_2) for the LEDs.



Note: The LEDs are not absolutely necessary. If you want, you can leave out the diodes and resistors entirely without affecting the operation of the amplifiers. You can also use different colors, if you want.

7. LEDs

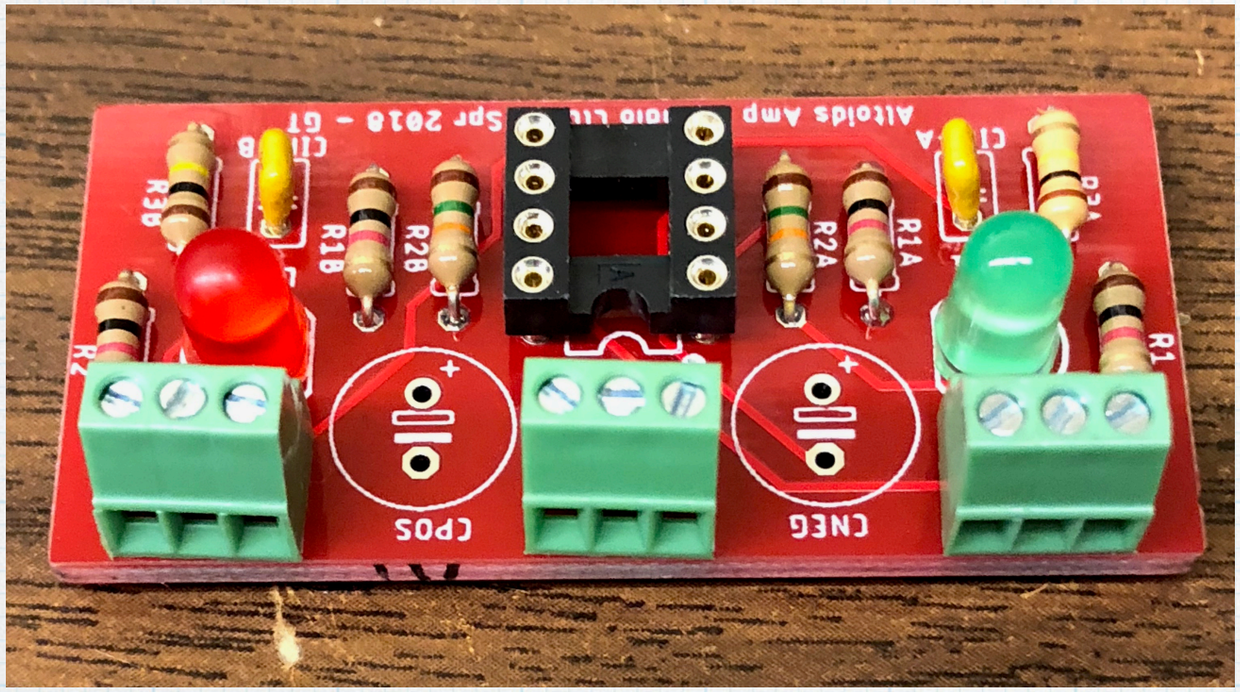
Add the two LEDs. Either color can go in either spot. But mind the polarity of the LEDs. If they are backwards, they will not light up.



Note: The LEDs are not absolutely necessary. If you want, you can leave out the diodes and resistors entirely without affecting the operation of the amplifiers. You can also use different colors, if you want.

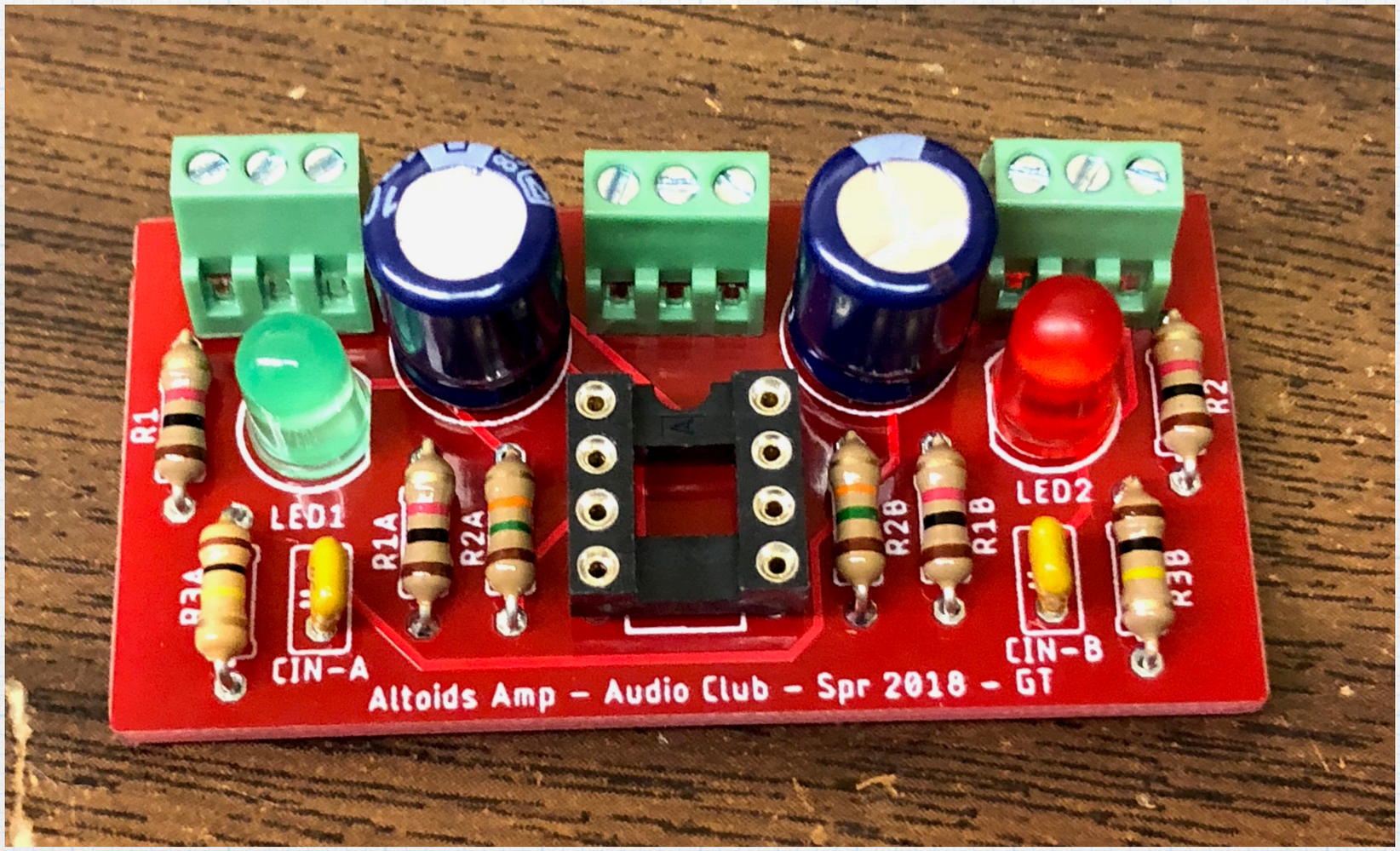
8. Connectors

Add the three connectors. Make sure that the wire openings face outward.



9. Big capacitors

Next, solder in the two electrolytic capacitors for the power supplies. Mind the polarity! The through-hole for the positive pin is indicated on the board. If you get these in backwards, they might explode!



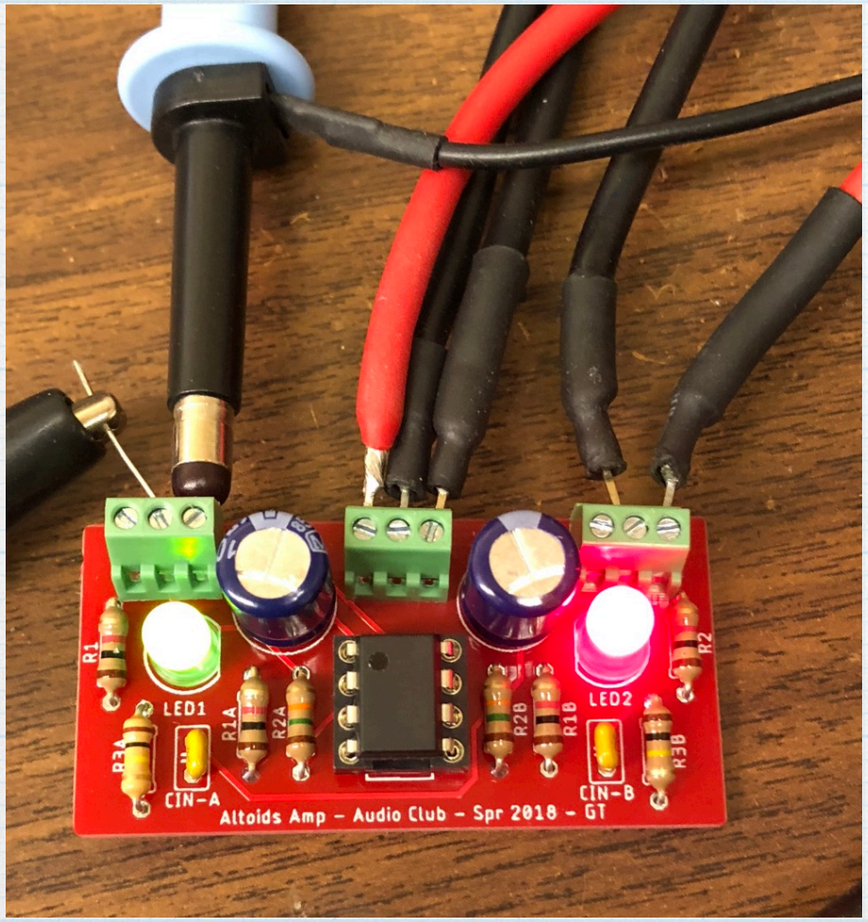
10. Add the amplifier chip.

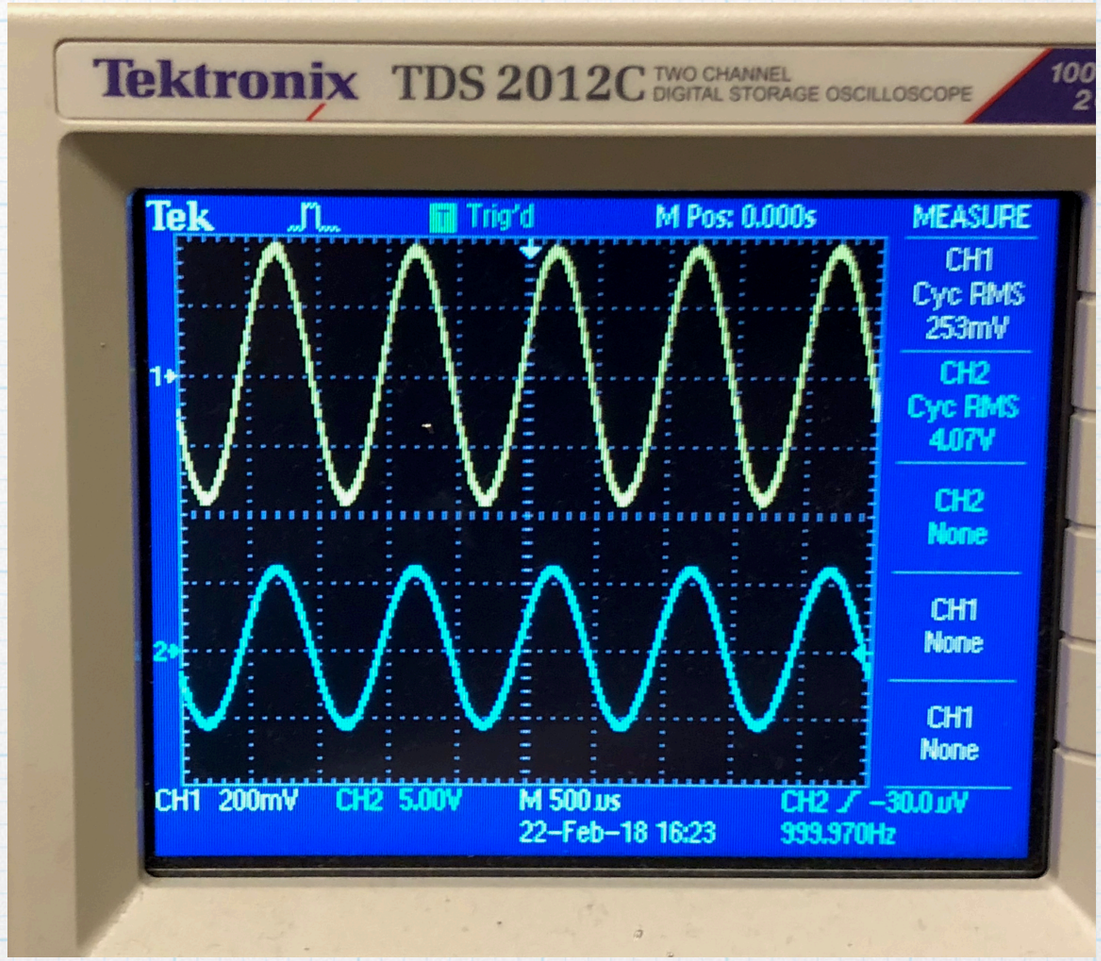
Carefully insert the TL082 amplifier into the socket. Be sure to put it in the right way.

It is probably necessary to bend in the pins a bit in order to get the chip to insert into the socket easily.

Test

If you have test equipment, this might be a good time to check the signals.

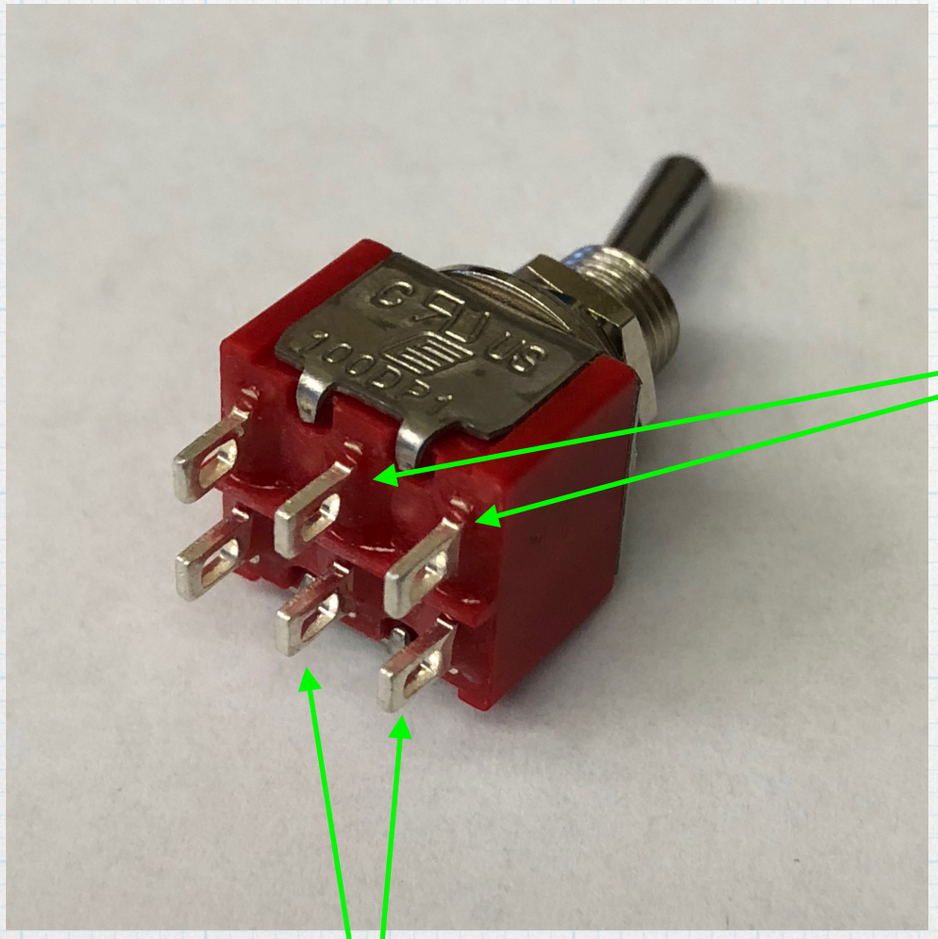




Both channels give similar results - clean output with gain of 4.07 V / 0.253 V = 16.1 — as expected.

The switch

This is a double-pole, double-throw (DPDT) switch. Two poles means that there are two switches working simultaneously. One switch is for the positive power and the other is for the negative. We really need only a single “throw”, but double-throw switches are more readily available than single-throw switches and are about the same price. We just won’t use the other side of the switch.

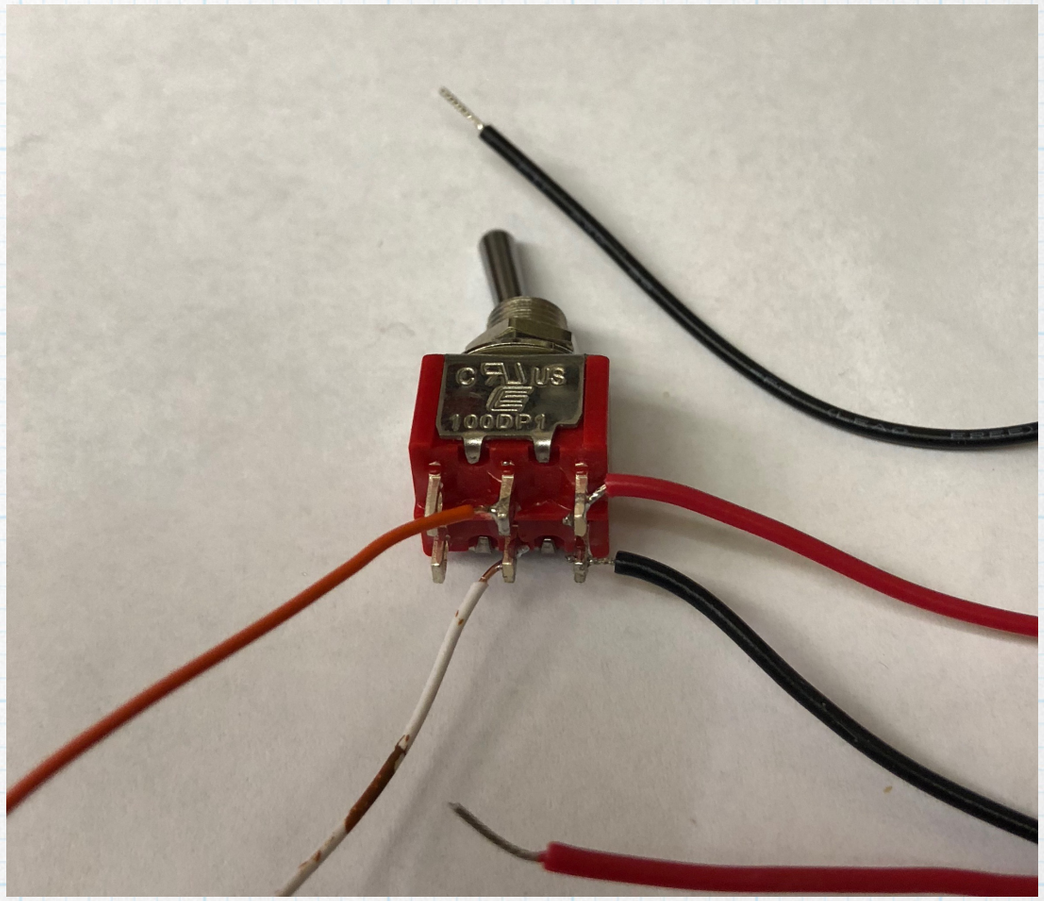


Connections for one of the switches.

And for the other.

11. Switch and battery connections

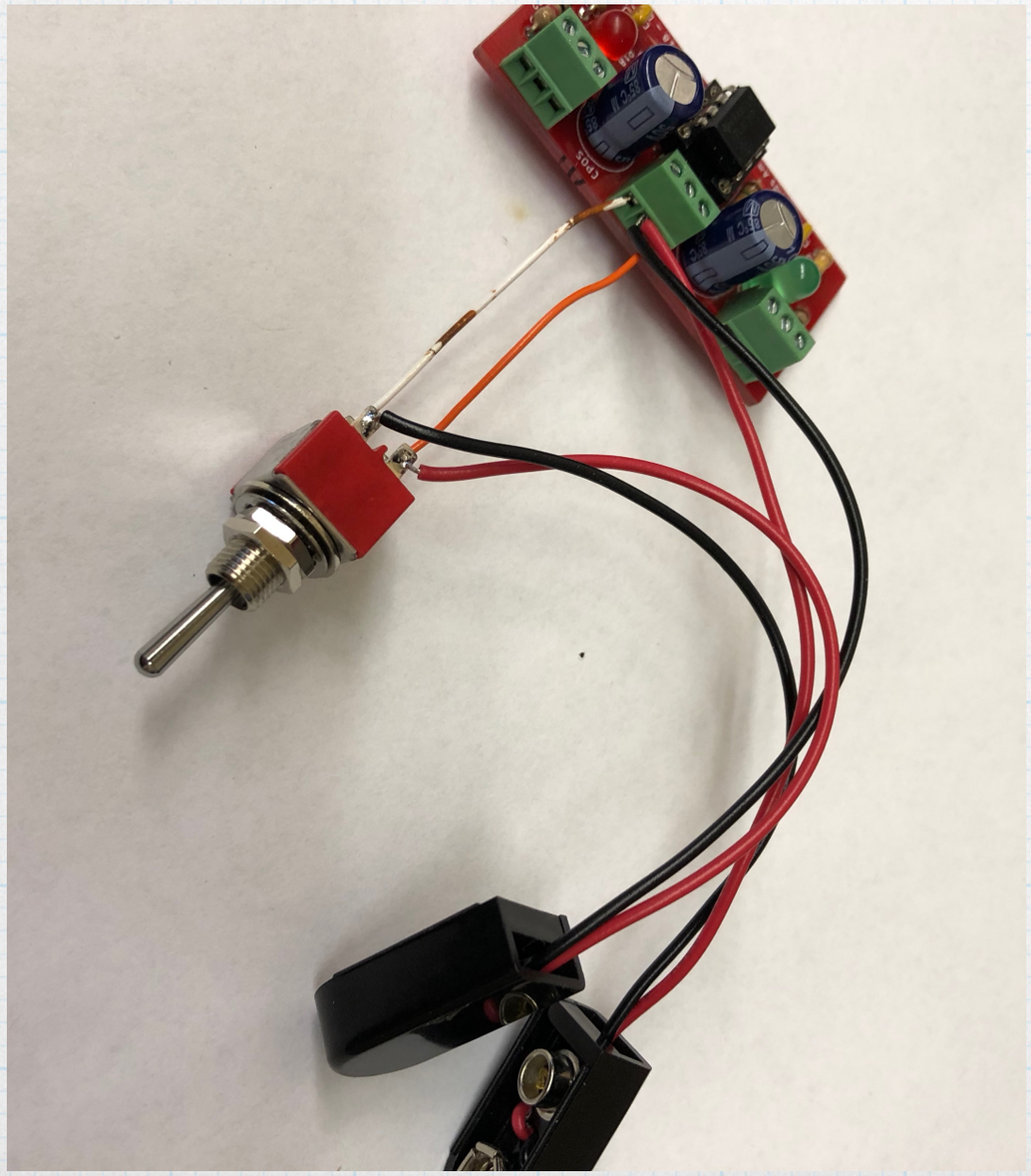
Solder the red lead of one of the battery connectors to one of the outside switch connections. Solder the black lead of the other battery connector to the other outside connection for the other switch. You can leave the battery leads at their original length. (About 4 inches typically.)

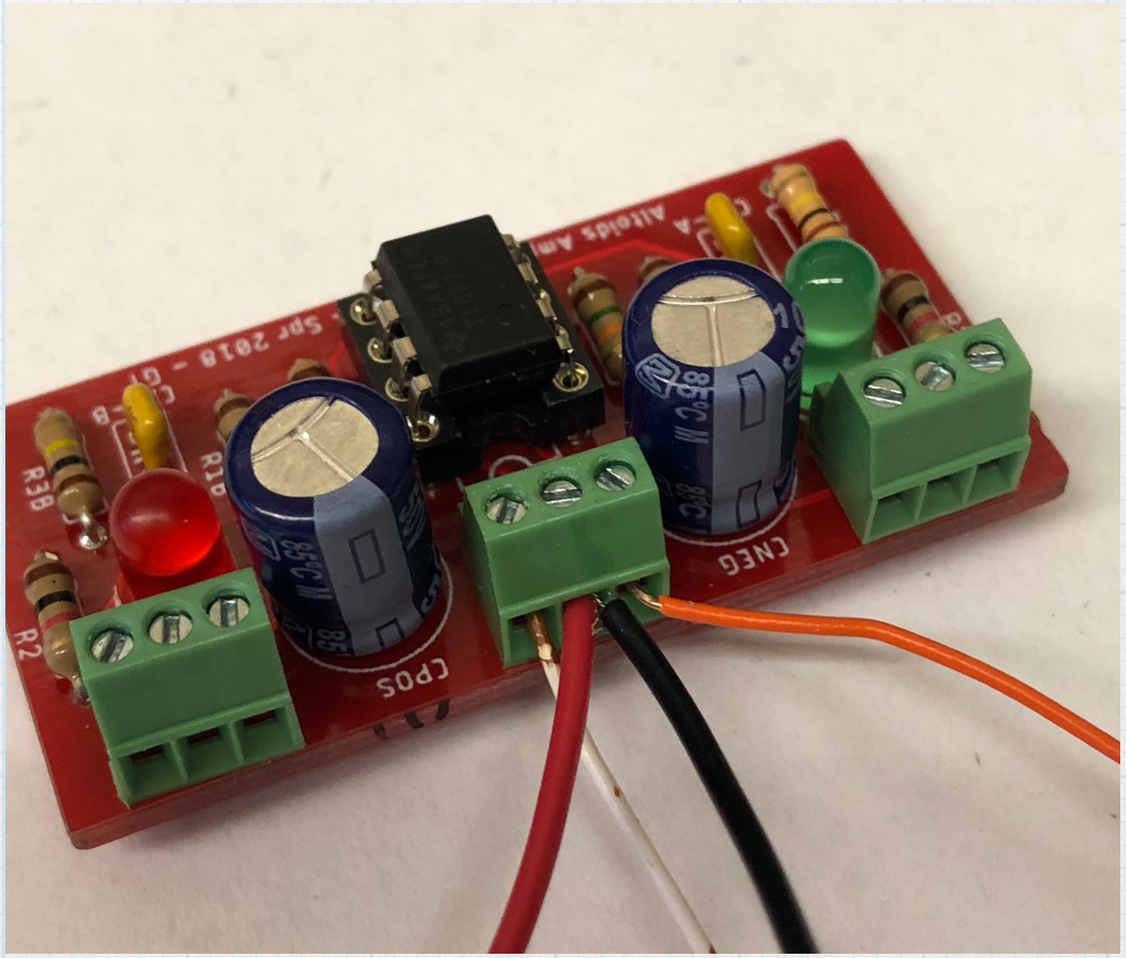


Cut two pieces of lead wire — about 2 inches long — and solder these to the center connections of the switch. Keep track of which is which. Here, the orange wire is on the same switch as the red battery lead — this is the positive power supply lead. The brown/white wire goes with the black battery lead, and this will be the negative supply lead. (Your colors may vary, depending on where you get your lead wire.)

11. Switch and battery connections

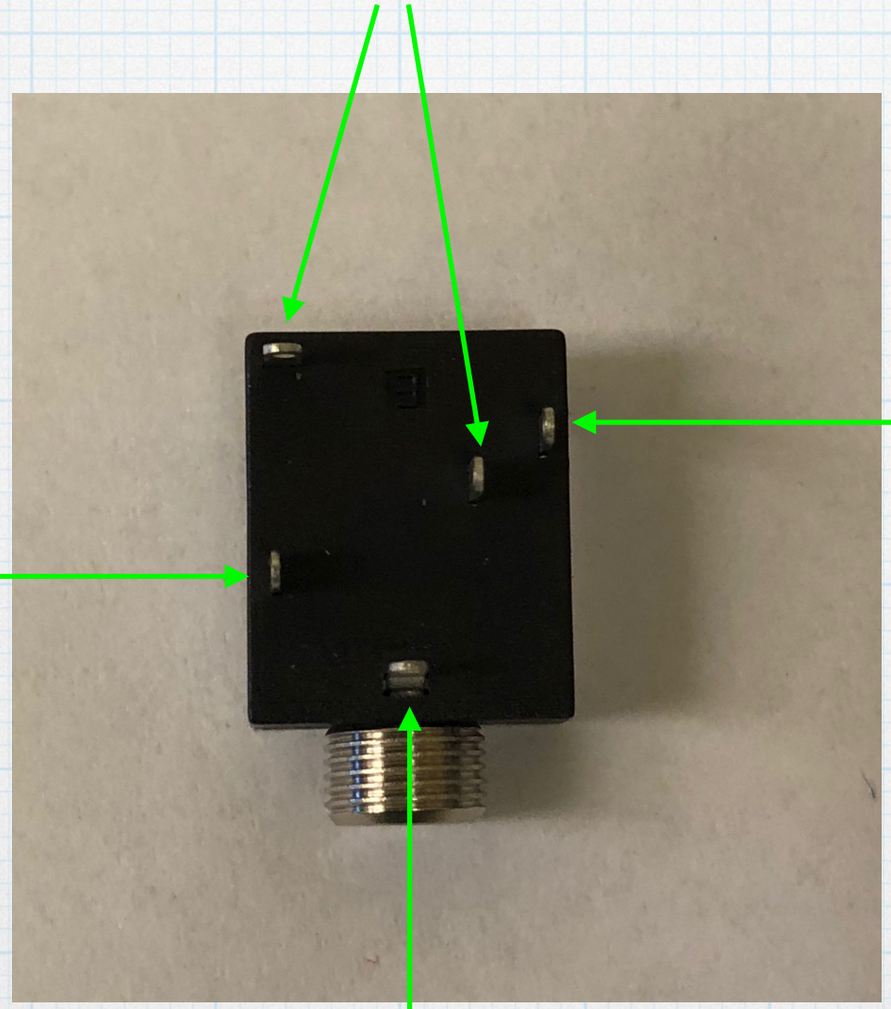
Connect the battery/switch wires to the power terminal (in the center). The free black and red battery wires are connected together to the ground (center position). Then the positive (orange in this case) and negative (brown/white here) wires are connect to VPOS and VNEG on the board. (Check the underside of the board for the positive and negative labels.)





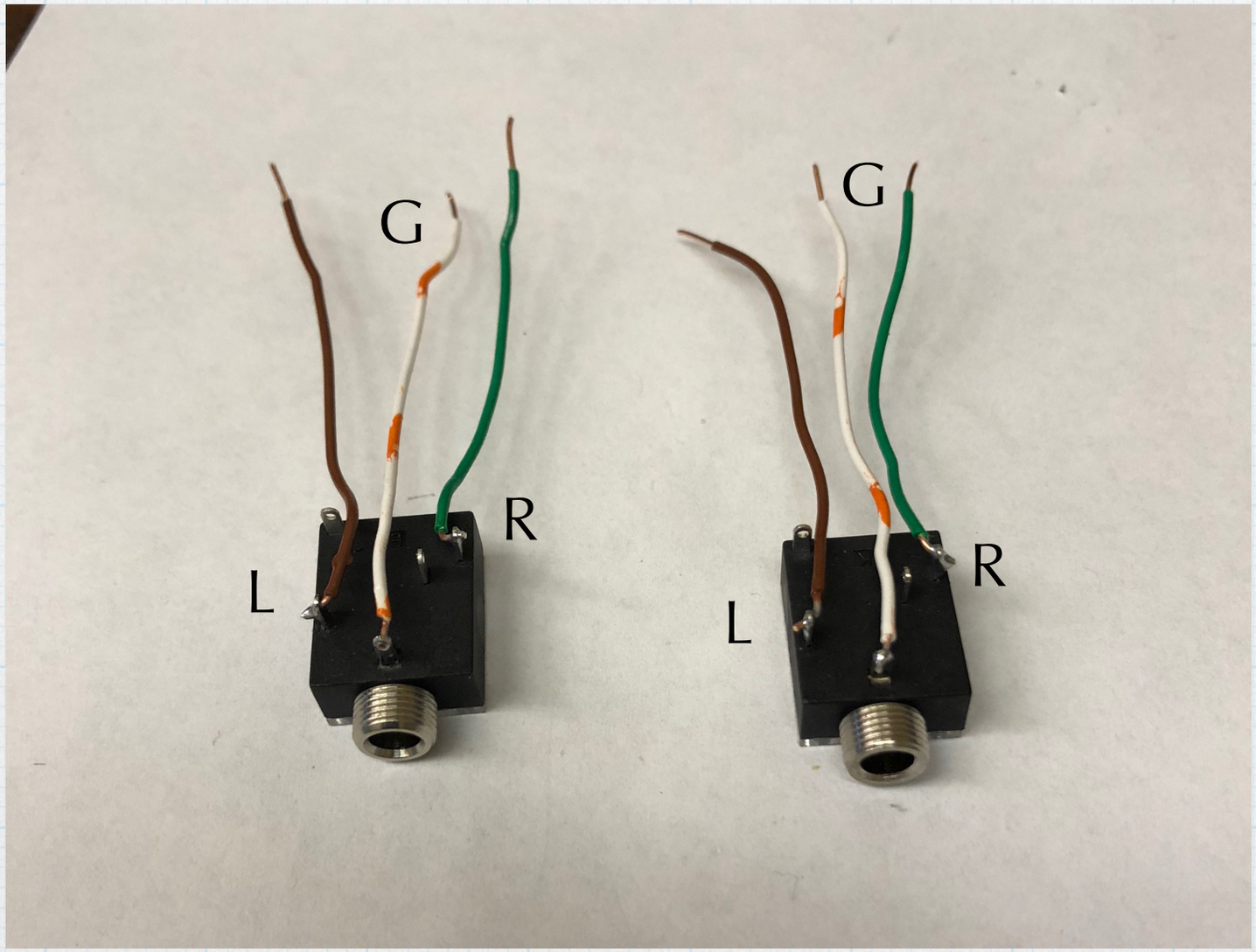
Audio jacks

The stereo jacks have 5 connectors — ground, left, right, and two switches. (We are not using the switches here.)



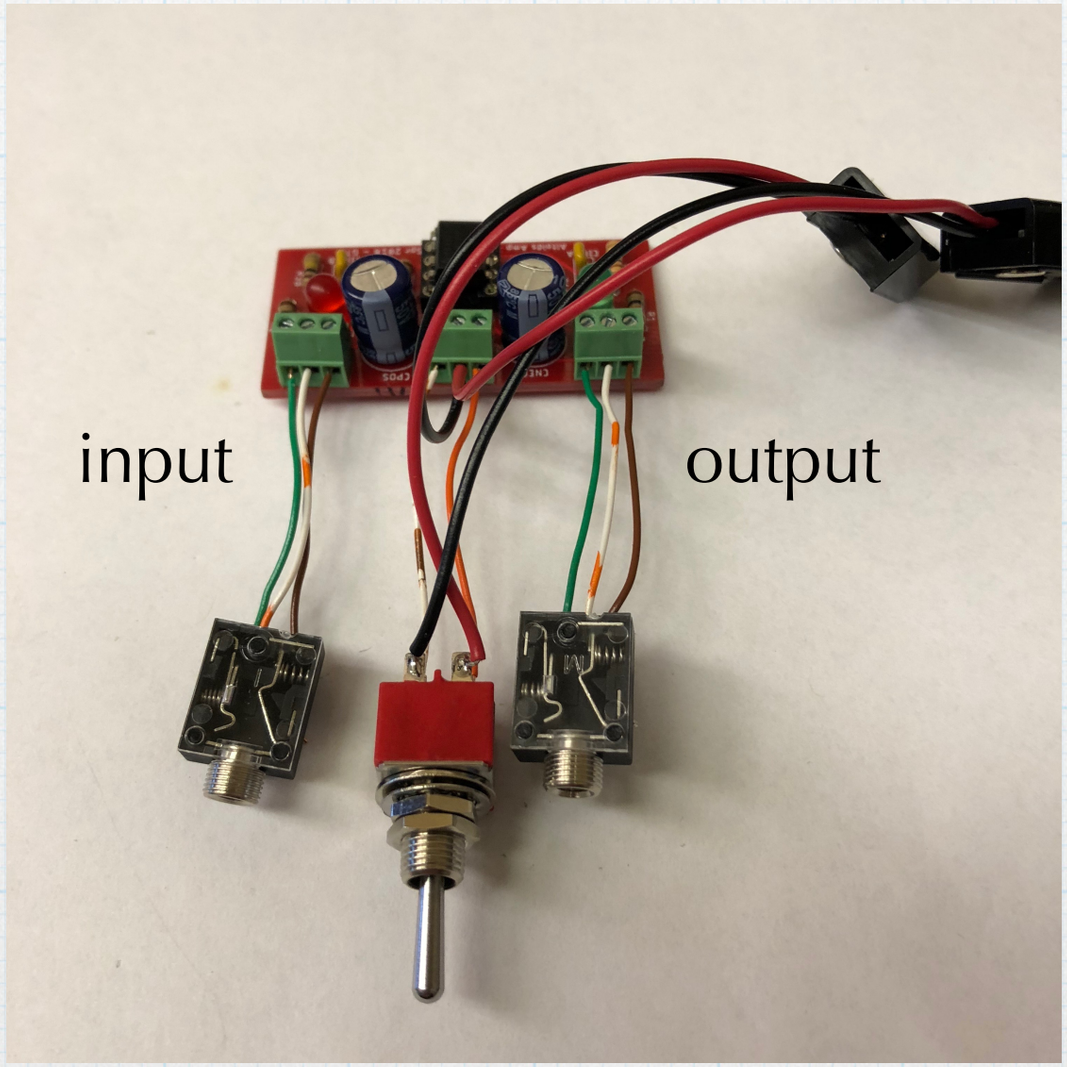
12. Audio jack connections

Cut 6 lead wires, each about 2 inches long. (Match colors if are fashion-conscious.) Strip one end of each and solder to the eyelets on the jack connectors. Cut the other ends so that lengths are uniform, and strip the insulation.



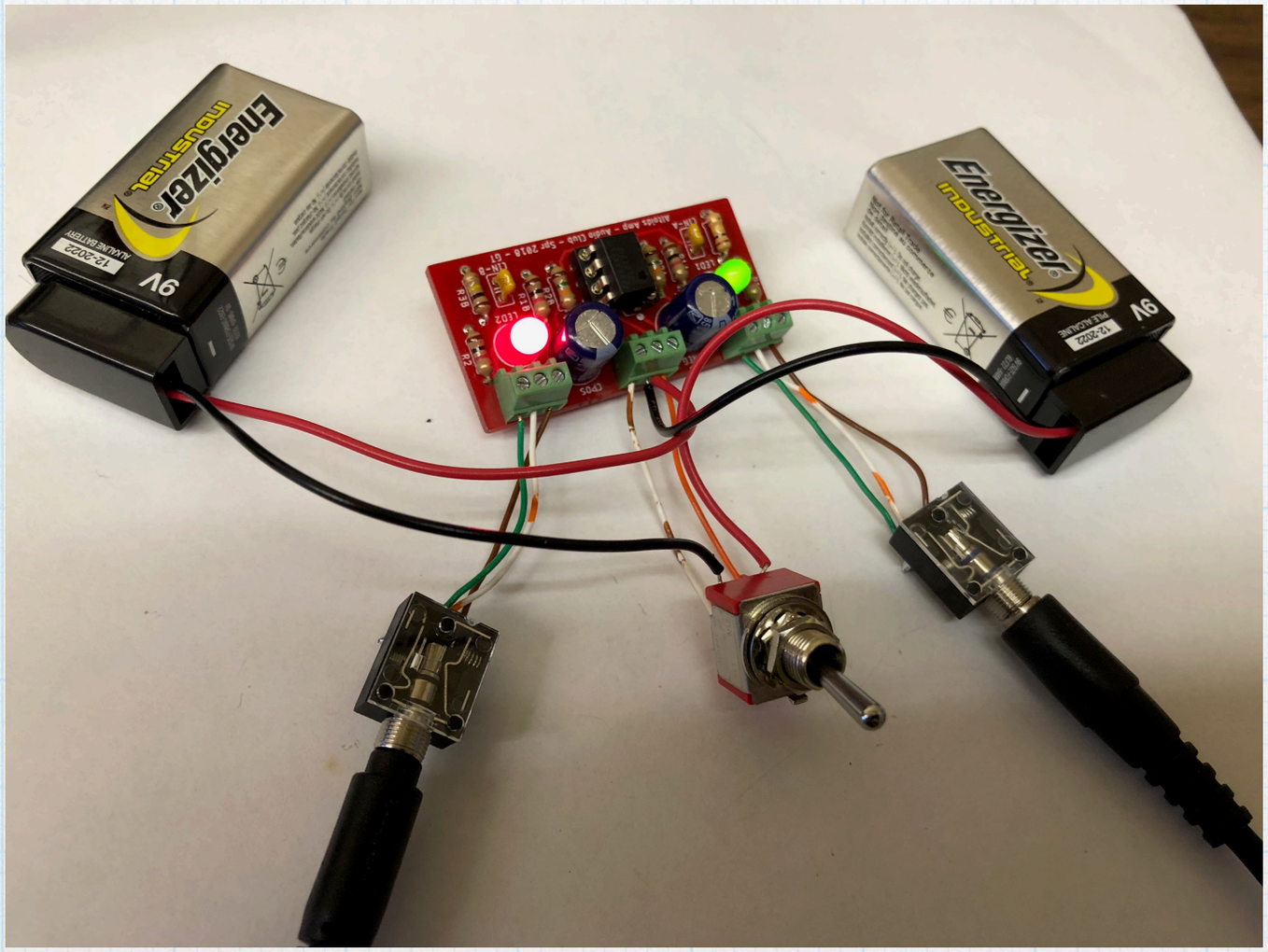
12. Audio jack connections

Connect the audio jack leads to the screw terminals on the board. L-G-R labels are on the bottom of the board. Note that the input terminal is the left one in the digram below. The output terminal is on the right. (The labels on the board were covered up by the terminals — a minor design flaw.)



Test again

Time to it give it a test. Plug in two batteries and turn on the switch. The LEDs should light up. (If you have a multimeter, you might consider checking DC voltages on the board.) Then connect a source to the input and your headphones to the output — if all has gone well, you should have some nice sound.



You are ready to mount everything into the box.