# Introduction

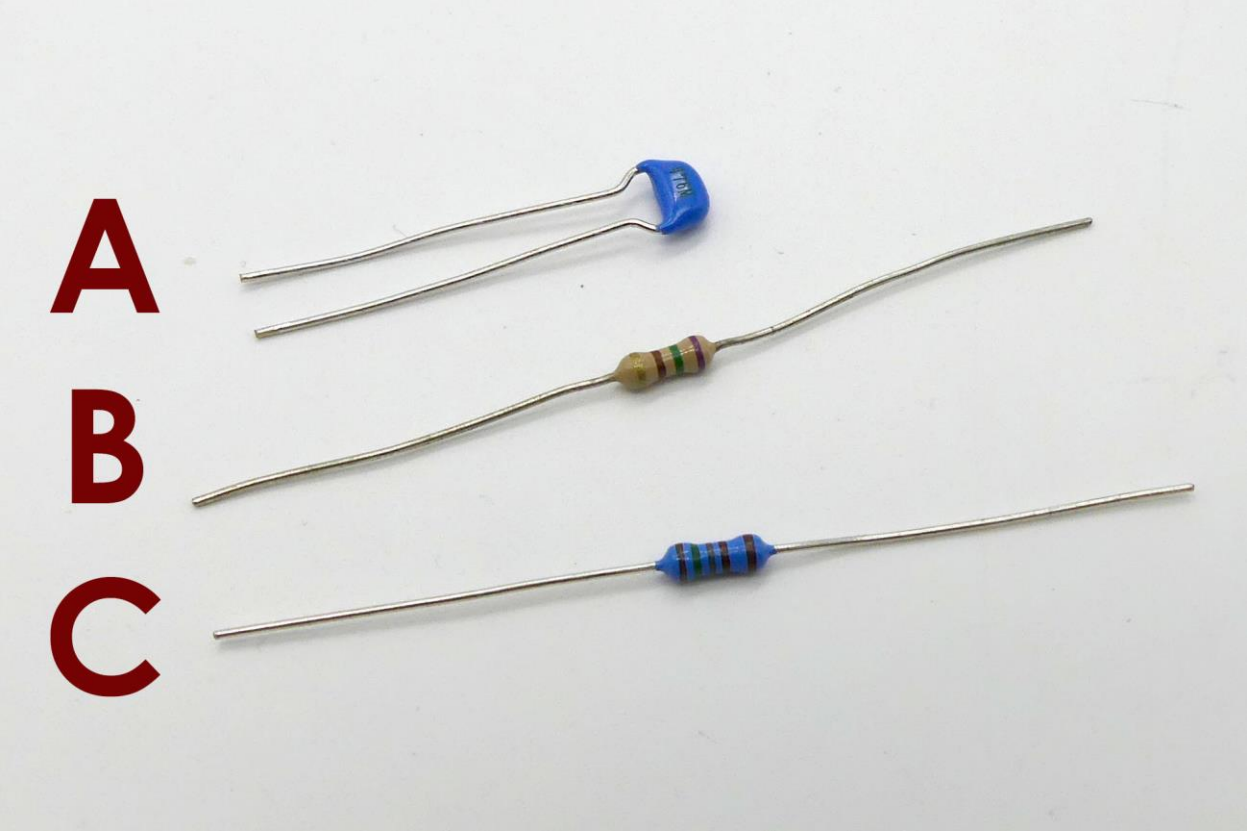
This is a kit to fix two issues with the first generation of the Spengler Link and Spengler Sound Board combination.

There are two main issues when the boards are combined in normal use:

1) A high frequency whine can be heard from the speaker when the wand is off and the volume is near the maximum.

2) When the volume level of the Spengler Sound Board is above about 1/2 volume, a hissing sound occurs. Depending on the boards this can be subtle or very obnoxious. In the worst cases a resistor on the sound board (R2, near the center edge of the board on the side that has the speaker connector and the audio input jack) can get hot and possibly smoke.

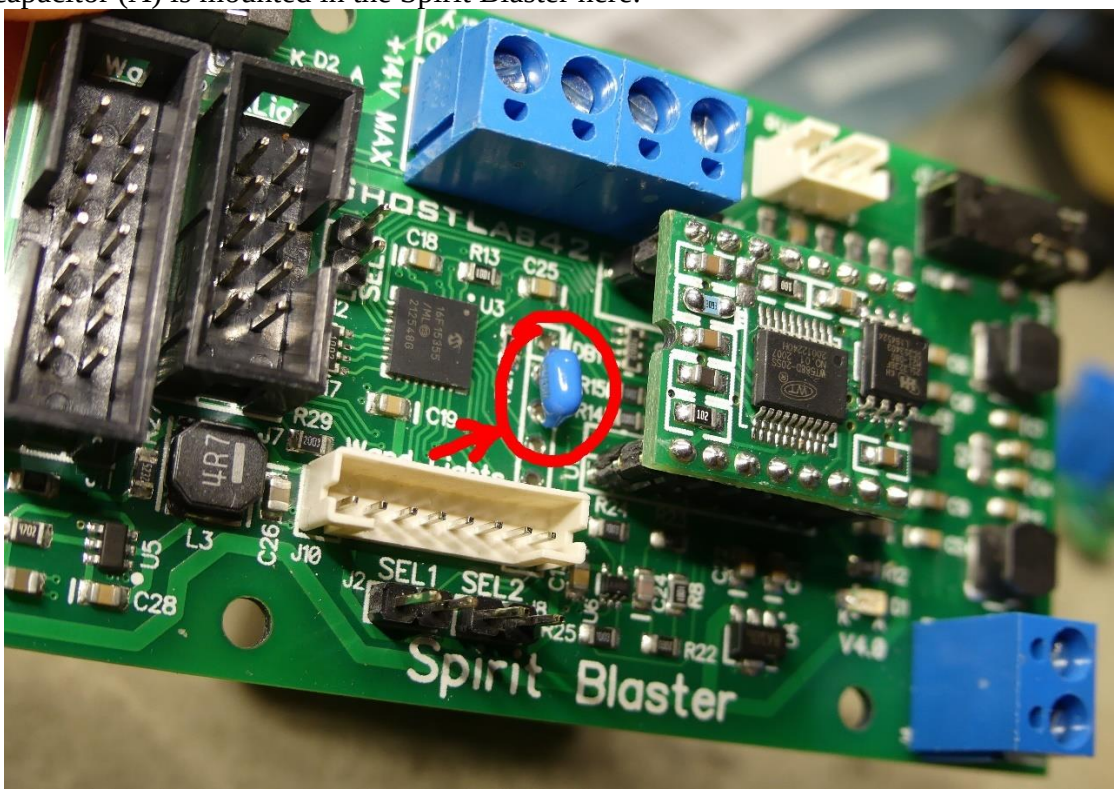
This kit contains three parts, two for the Spengler Sound board and one for the Spengler Link, that needs to be added to fix or significantly reduce the issues:



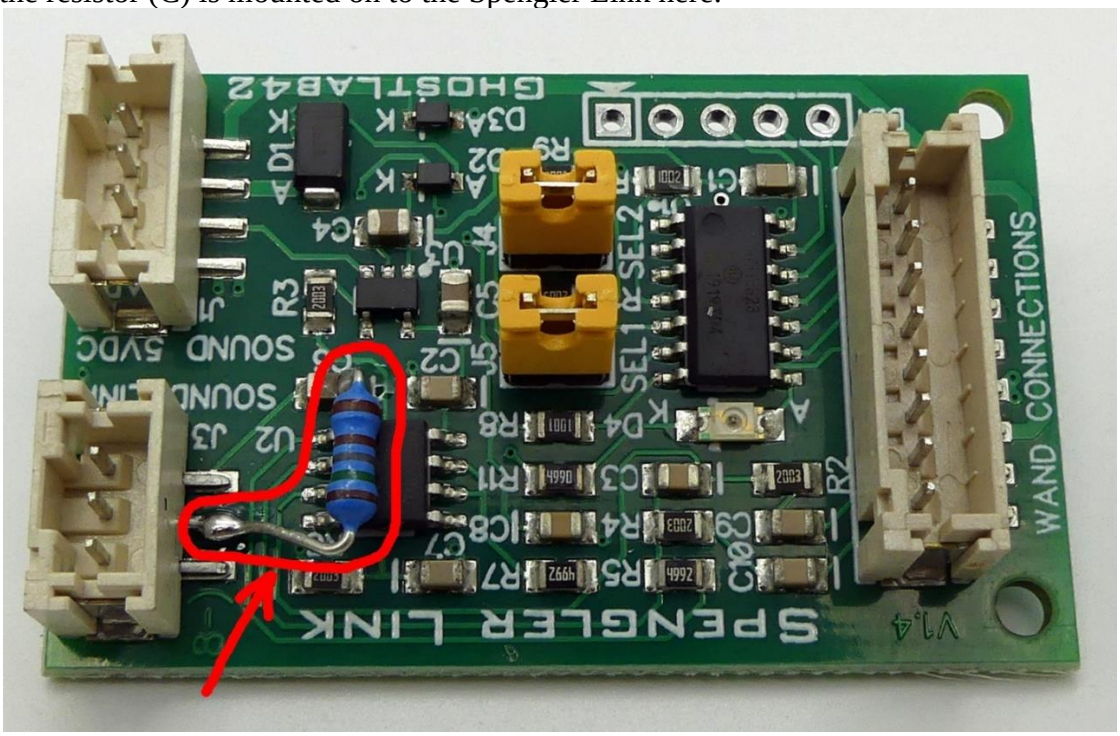

Part (A) is a 47uF cap that needs to be added to the Spengler Sound board, part (B) is a 750 Ohm resistor (Violet, Green, Brown) that can optionally be added to the sound board and part (C) is a 1.57 kOhm resistor that needs to be added to the Spengler Link board.

***Adding the parts to the boards:***

The capacitor (A) is mounted in the Spirit Blaster here:




And the resistor (C) is mounted on to the Spengler Link here:

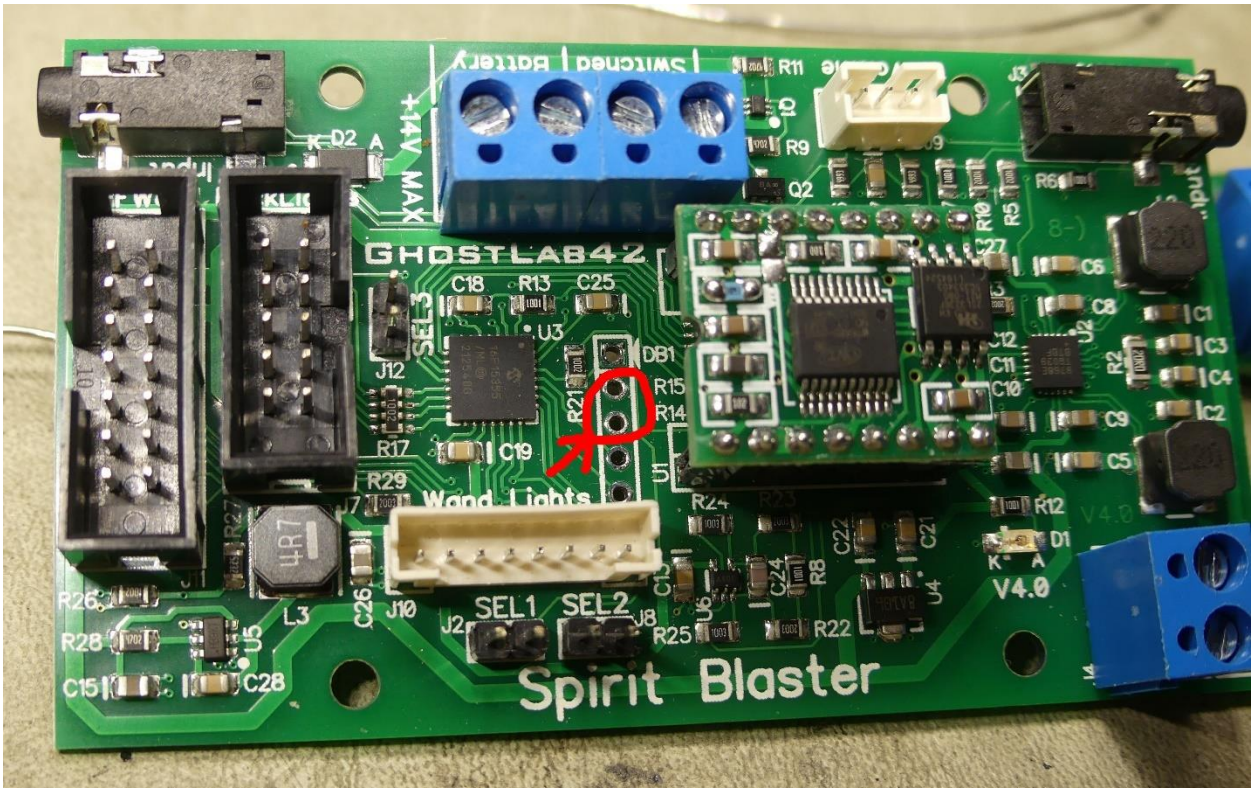


*Capacitor (A) mounting to the Spengler sound board.*

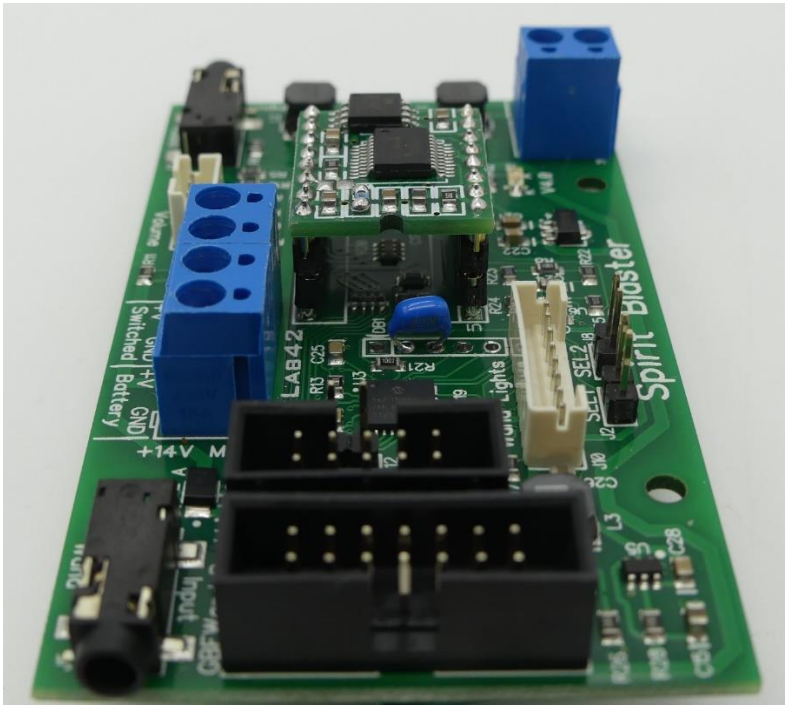
The new 5V power supply for the V4.0 Spirit Blaster board (new because the previous part was not available) is more efficient under light loads, but the switching frequency is a high-pitched audio frequency. This switching frequency gets coupled into the Link's amplifier, so we need some additional filtering on the 5V to lower the amount of that coupled signal. The next board design will use yet another power supply design, so should not have this issue. The cap will reduce the high pitched tone (or "whine") but may not completely eliminate it.

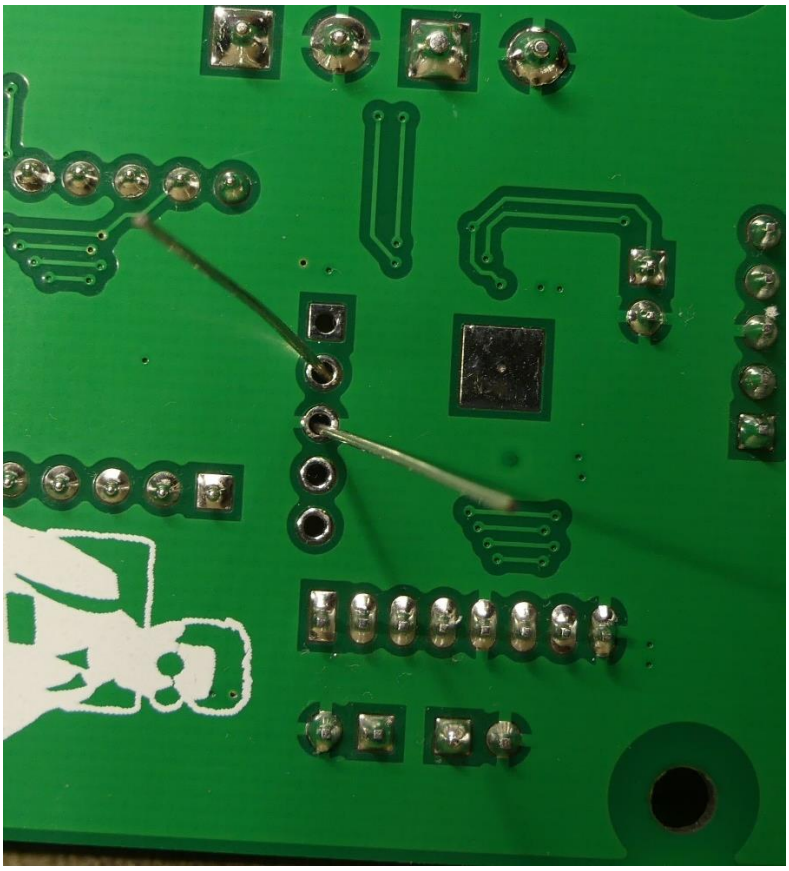
Remove the Capacitor from any paper packaging so that the two wires are free. The part orientation does not matter, but the two holes that are used for mounting this part are critical.

The holes are near the center of the board in a line of 5 holes that are designated as "DB1". The two holes that are needed are the center hole and the hole above that, next to the hole with the square pad. See the image below to locate the two holes:

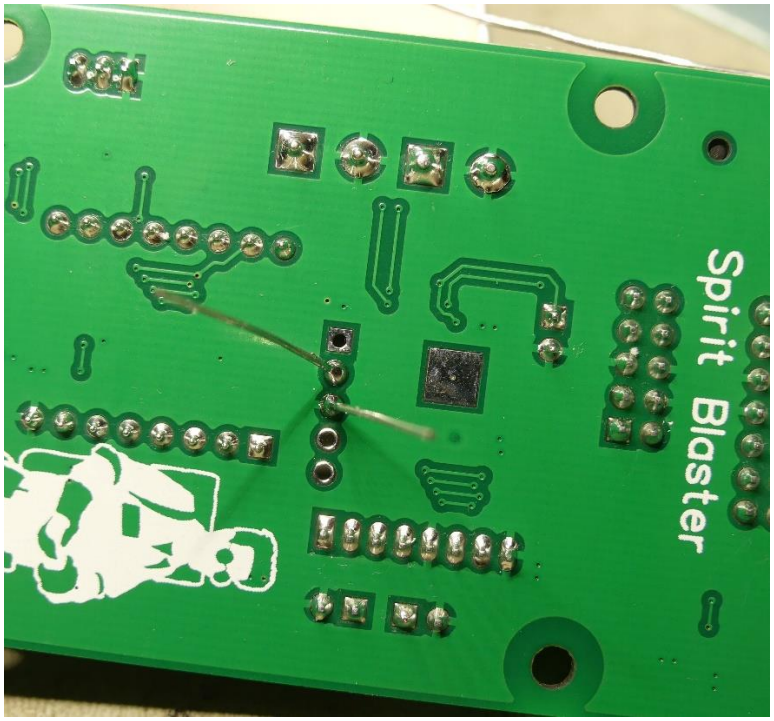


Now place the part in the hole from the top side of the board so that the wires stick out the bottom side of the board.

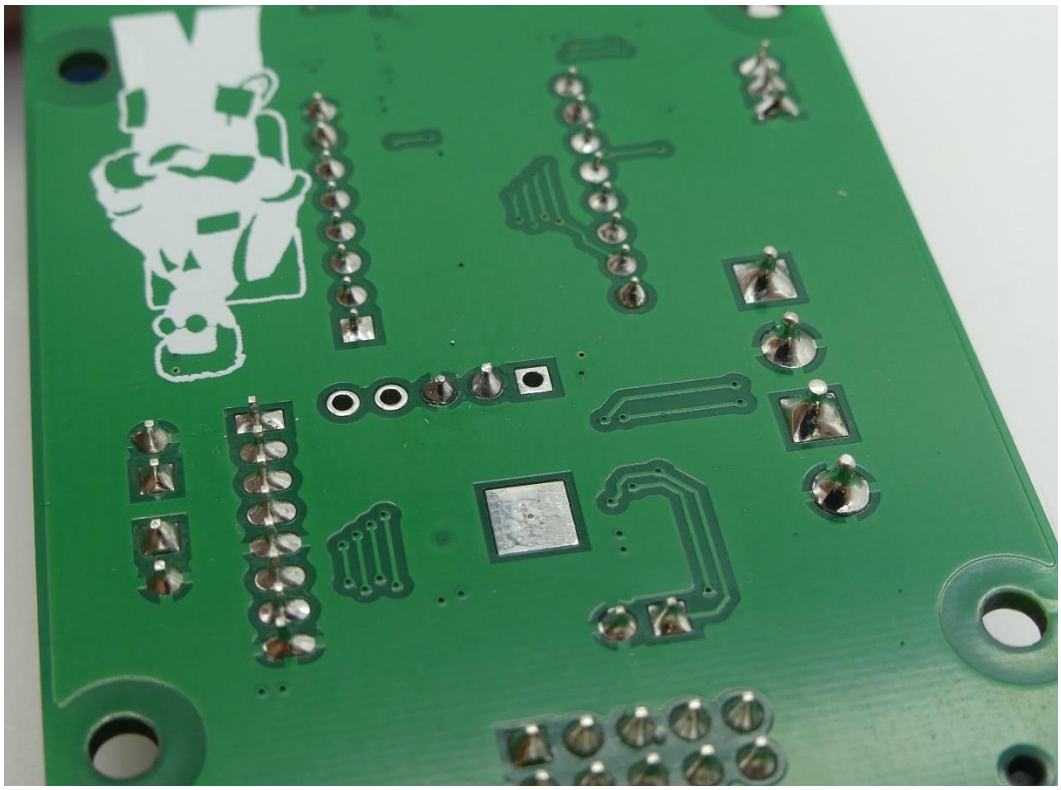


Solder the two wires on the bottom side of the board:




Then cut the excess wires off:

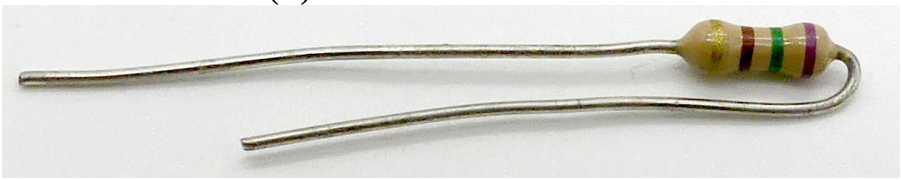


*Optional Resistor (B) mounting to the Spengler Sound board:*

The voltage regulator is a switching regulator that switches at an audio frequency when lightly loaded. The added capacitor (A) will reduce the amount of signal that gets coupled but it may still be audible and annoying. Any resistor of about 500 to 800 ohms could be used.

Adding the resistor (B) will increase the load on the regulator and the resulting frequency will be much higher, so can greatly reduce or eliminate the high pitched whine. The only down side of adding this part is that it will drain another few mA from the battery when the battery is turned on even if there is no sounds being amplified. This part is only needed if you still hear the whine after adding capacitor (A), but can be added for more margin if you wish.

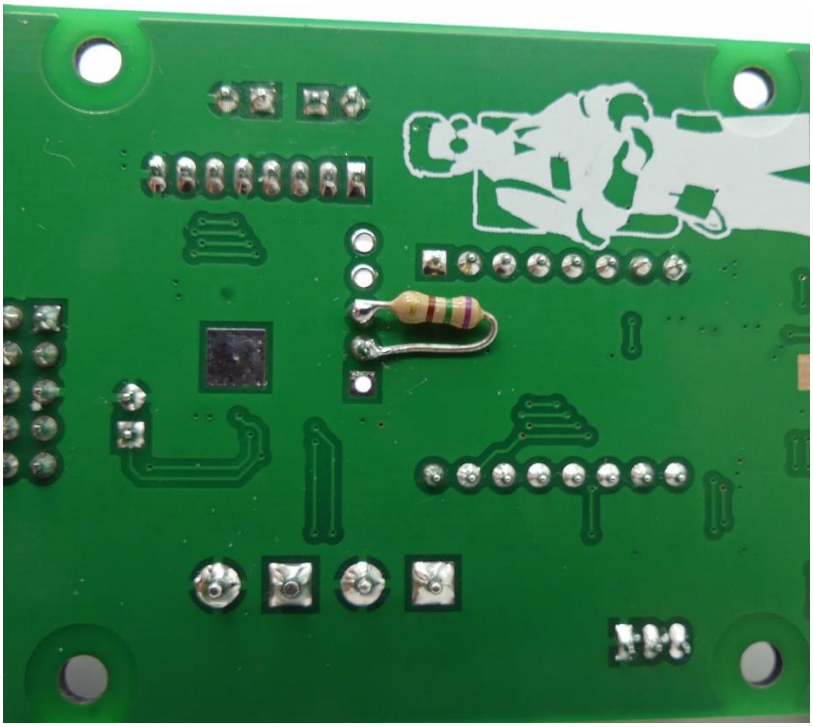
First bend the leads of the resistor (B) like this:



Then cut off the leads to about this length (slightly longer can also work fine):



Now solder the two leads to the bottom side of the sound board across the two leads of the added capacitor (A):



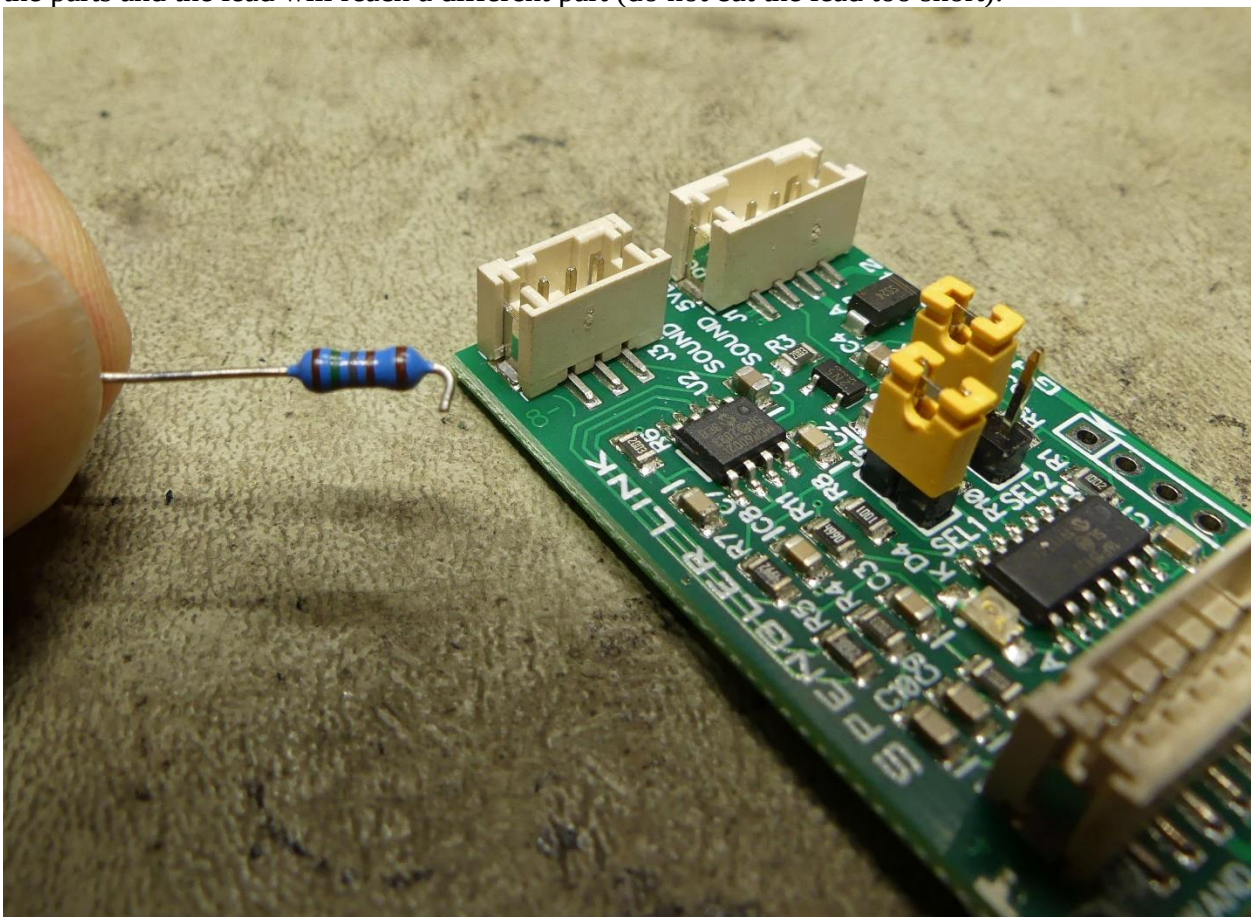
*Resistor (C) mounting to the Spengler Link board:*

The output amplifier in the V1.4 Spengler Link design reacts to the loading of some of the audio cables and goes into a high frequency oscillation, usually only at higher volume levels. This is not audible, but causes the audio amplifier to output a lot of power that can make the resistor R2 on the Spengler sound board get very hot. The oscillation is not at a constant frequency, so this can also be accompanied by a ”hiss” or white noise sound that can be fairly loud.

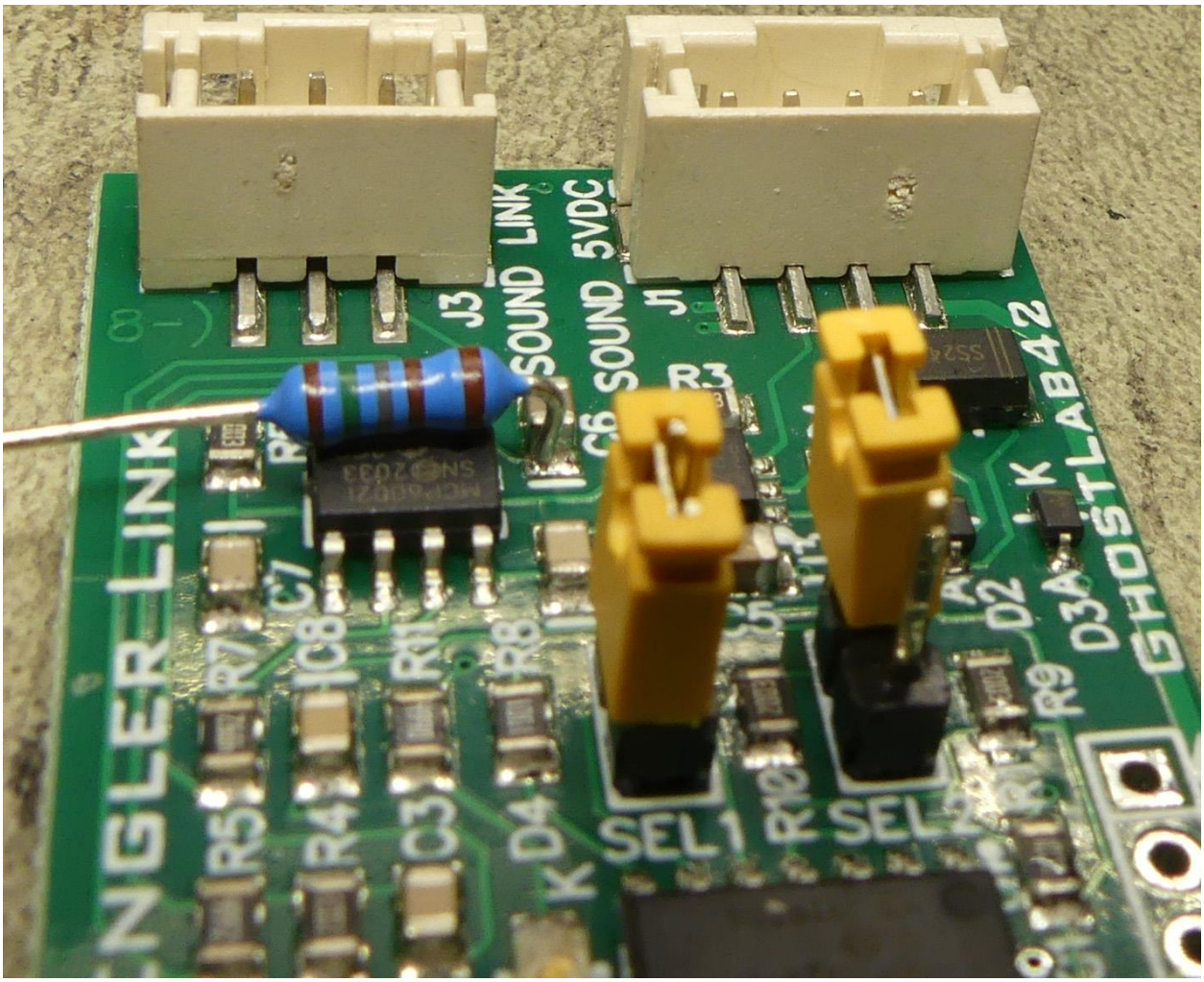
Adding a resistor to the output will provide damping of the high frequencies so will stop the oscillations (R2 should not get hot!) and remove the accompanying hissing/noise sounds.

The resistor leads need to be formed to make the connections with the leads we want and not with other leads of other parts.

Start by bending one lead at 90 degrees to the resistor and cutting it off so that it can sit on one of the parts and the lead will reach a different part (do not cut the lead too short):

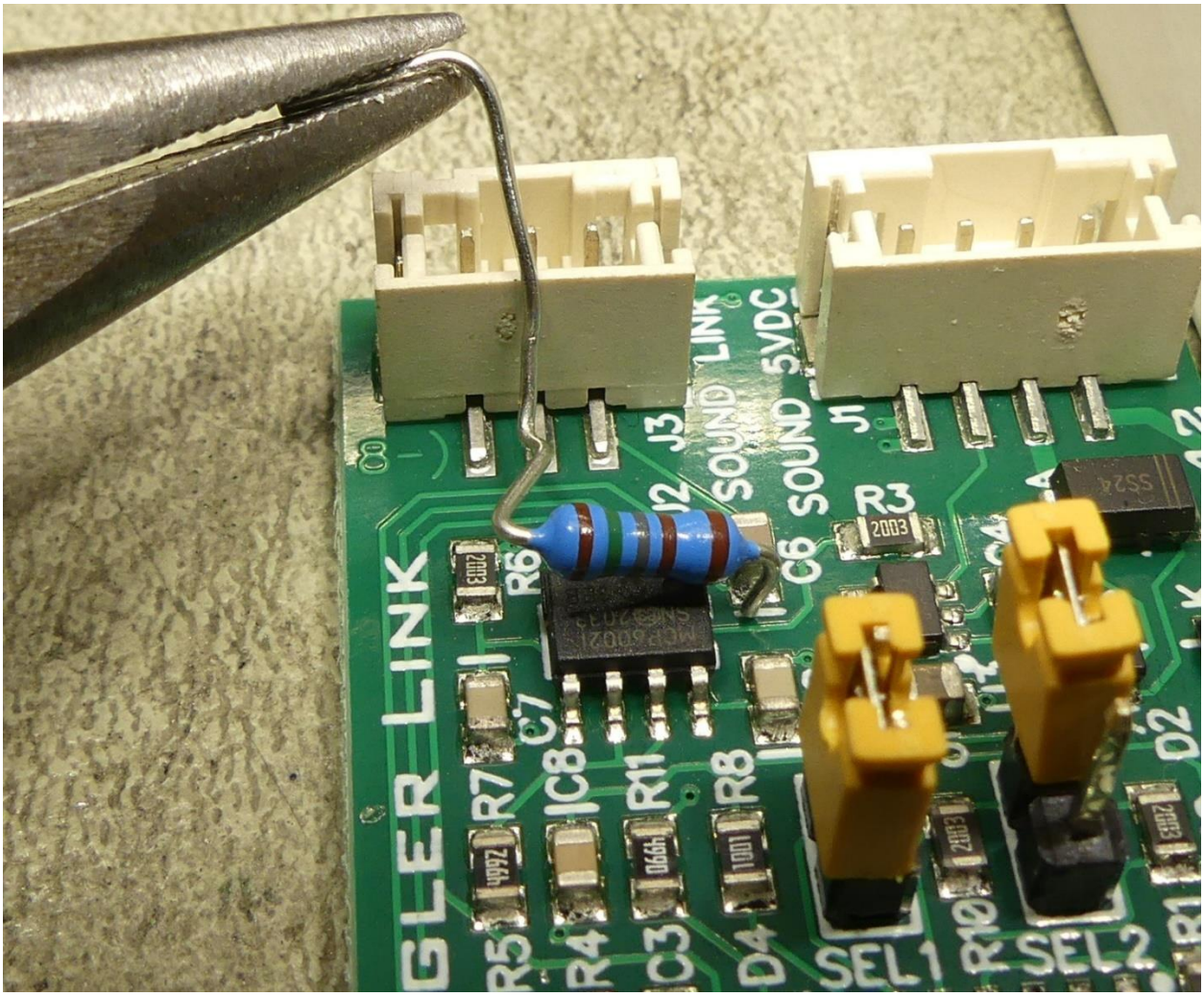


Here is a test fit to make sure the cut lead is the right length.  Do not make it too short, as it is easy to cut off a bit more, but a real pain to make it longer!




One lead needs to attach to the surface mount capacitor C6 on the side closest to the black integrated circuit that the resistor is sitting on.  Before we solder this, we need to form the other lead so that it reaches the middle lead of the 3-wire connector J3.

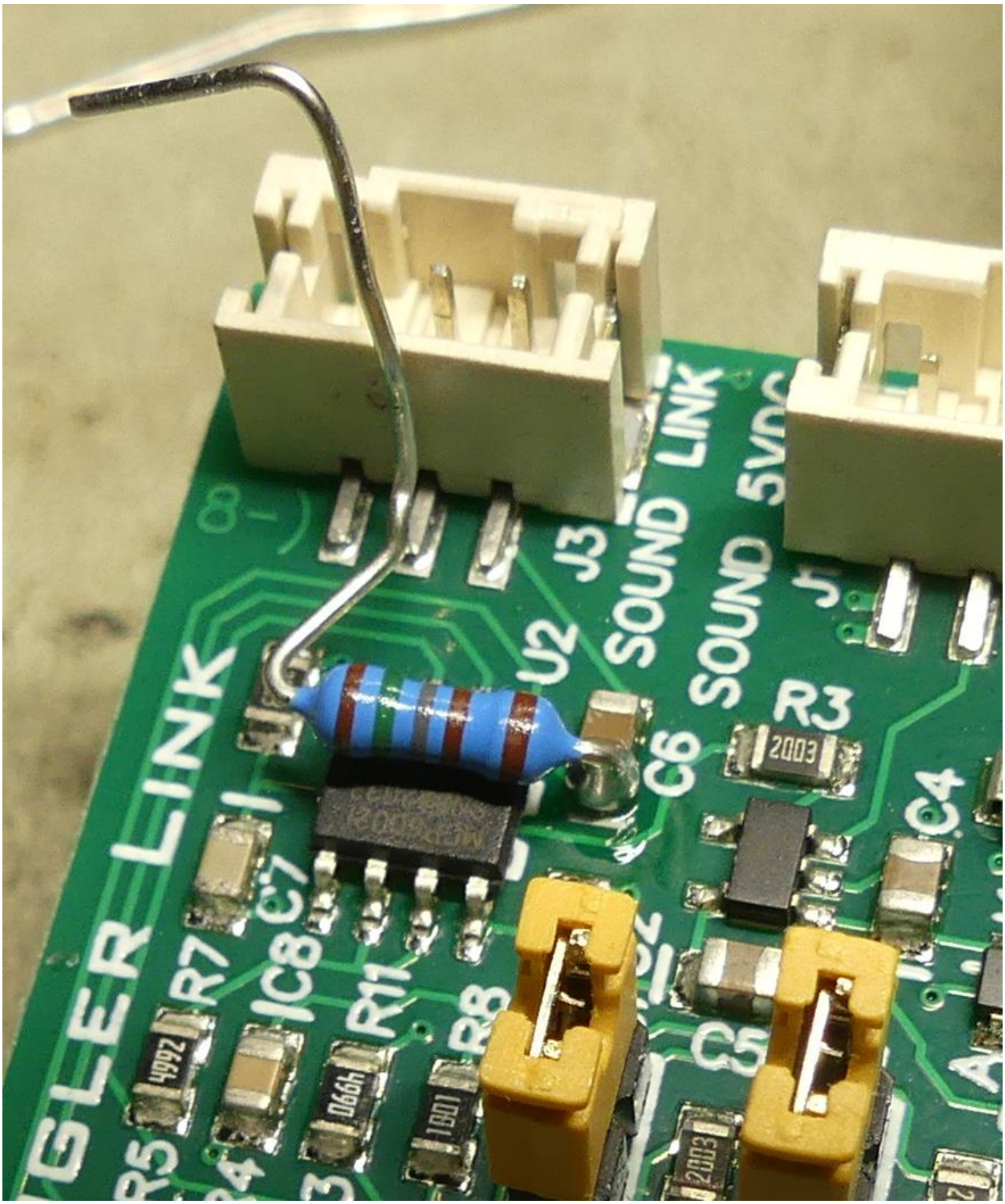
Here is a test fit of the resistor after the other lead is bent so that it can reach that middle leg of J3:



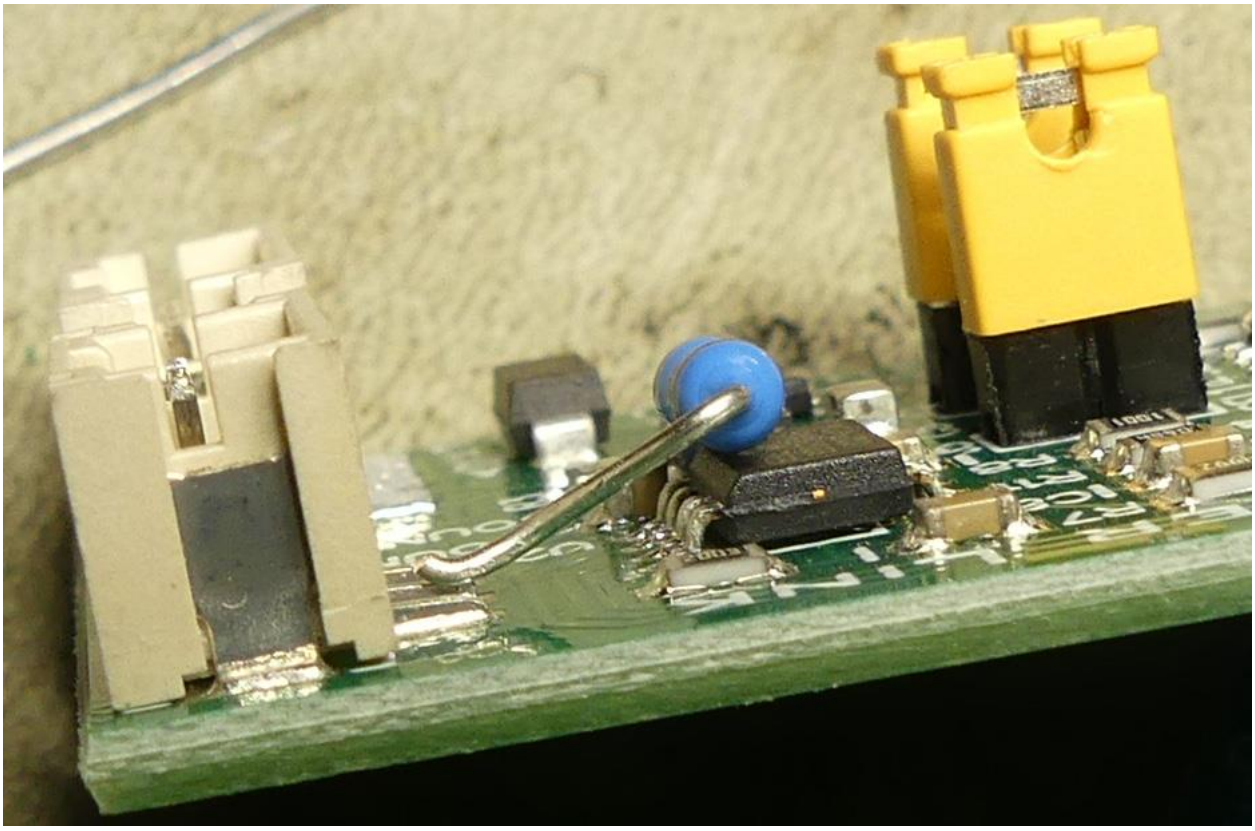

To make this easier to install, first add some solder to the parts we are going to solder:

1) One side of C6
2) The middle leg of J3
3) Both leads of the resistor where they are going to be attached to the circuit board

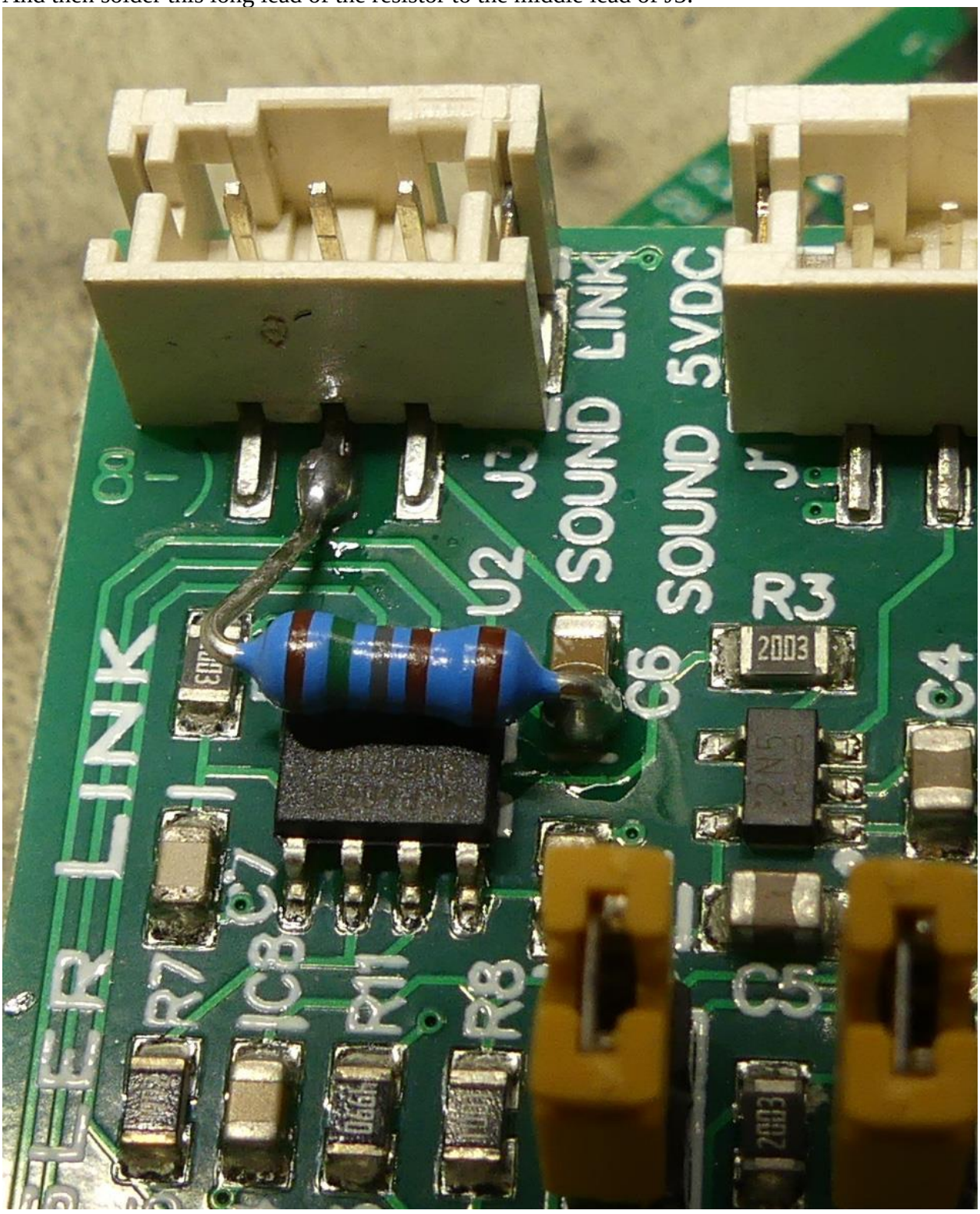
I soldered the short leg of the resistor to C6 first, and left the other resistor lead long so it was easier to hold the resistor in place while soldering the short leg.



Next cut the long lead to the desired length so it can just cover the middle leg of the 3-wire connector J3:



And then solder this long lead of the resistor to the middle lead of J3:




**The fixes are now complete!**
Both boards can be used as per the original instructions. These new components should not interfere with anything and don't require any changes to how they are mounted or connected.