Modifying a USB sound fob to act as a repeater interface for app_rpt

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This document explains how to modify a USB sound fob to work as a repeater interface for app_rpt. For a guide on setting up and configuring Asterisk, app_rpt, and chan_usbradio.c please see http://app-rpt.qrvc.com/usbradio.pdf

The following materials and tools are required:

1. USB sound fob based on the CM108 chip
2. 10K ohm 1/8W 5% through hole resistor. Digi Key P/N 10KEBK-ND
3. 68K ohm 1/8W 5% through hole resistor. Digi Key P/N 68KEBK-ND
4. 470K ohm 1/8W 5% through hole resistor. Digi Key P/N 470KEBK-ND
5. Two 10 microfarad 25V non-polarized electrolytic capacitors. Digi Key P1176-ND
6. BAT43 or equivalent schottky diode in DO-35 package. Digi Key 497-2492-1-ND
7. 2N4401 NPN bipolar transistor in a TO-92 package. Digi Key 2N4401-ND
8. Plastic sleeving and heat shrink tubing
9. Hot melt glue and glue gun
10. Male D-sub connector and hood
11. 1ft. of 5 conductor shielded cable with 28awg stranded wires or smaller.
12. Temperature controlled Soldering iron with a fine tip, and 0.020" diameter solder
13. Precision cutters and long nose pliers.

Below is a picture of a typical USB sound fob. This is one which was purchased for $7.95. **When shopping for a suitable sound fob, it is important to purchase one which uses the CM108 chip,** as that is the only version supported.

The first thing to do is open up the case. The case is usually press-fit together with four plastic posts on one side and 4 sockets for the posts on the other side. Getting the case to come apart requires a small thin bladed screwdriver. Work the screwdriver along the seams until one side starts to separate, then work on the other side. Be very careful with the use of downward pressure. You don't want the screwdriver going in and damaging the components on the board. Pry the case open near the audio jacks since they will be removed anyway. Once the case is separated, you should have something like this:
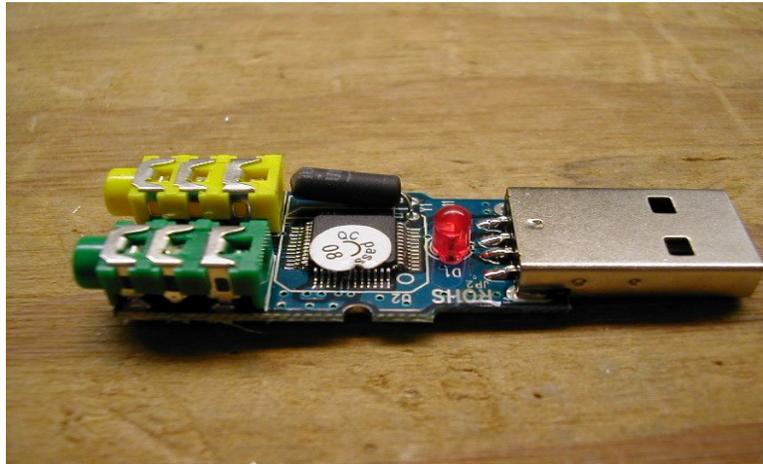

Peel the QC sticker off the chip and verify it is a CM108. If it isn't a CM108, it cannot be used. Then using a pair of precision cutters, remove the 3.5mm jacks by cutting the metal connections on the side of the jack as shown:
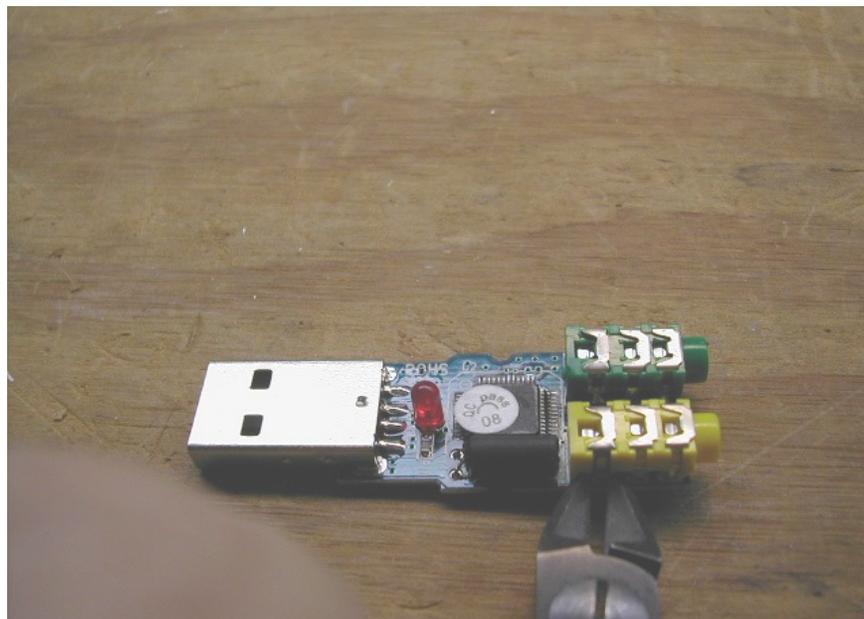
Once the connections are free on the outsides of each jack, rock them back and forth to cause the inner connections to break free as shown:
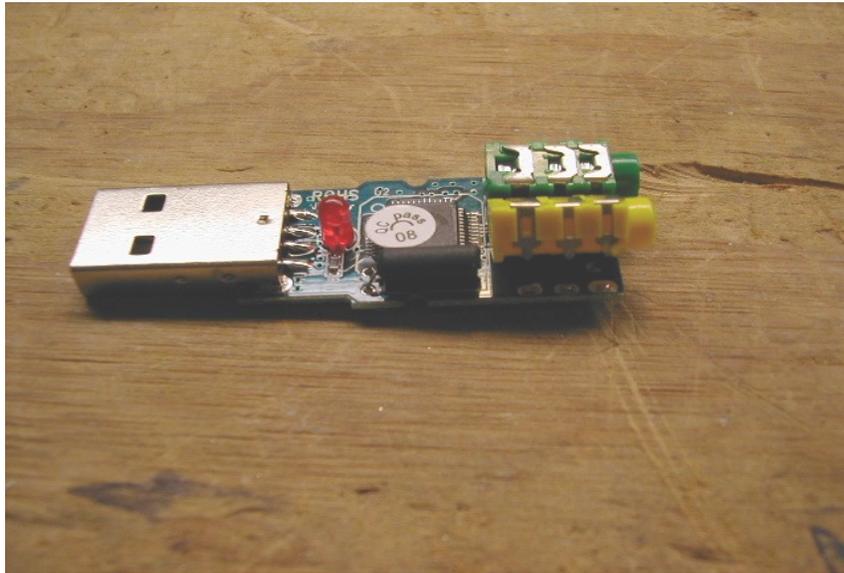

When both jacks are removed, your board should look like this:
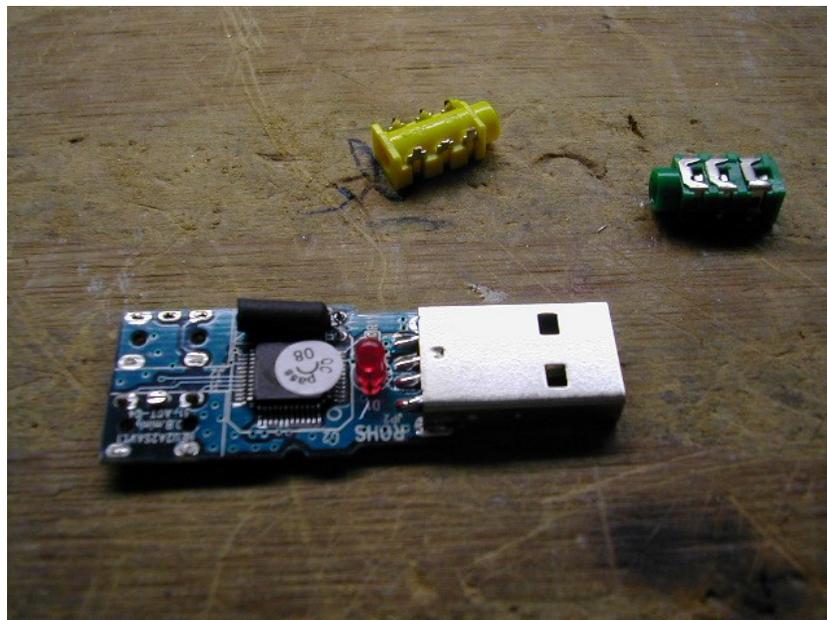
Do not be tempted to clean out the pins from the holes used by the jacks, The traces on the board lift very easily.

Prepare one end of the 5 conductor cable by separating the shield, twisting it tightly, then soldering it to the ground on the board below as shown. The shield is soldered to the point where the sleeve contact of the microphone jack used to connect.
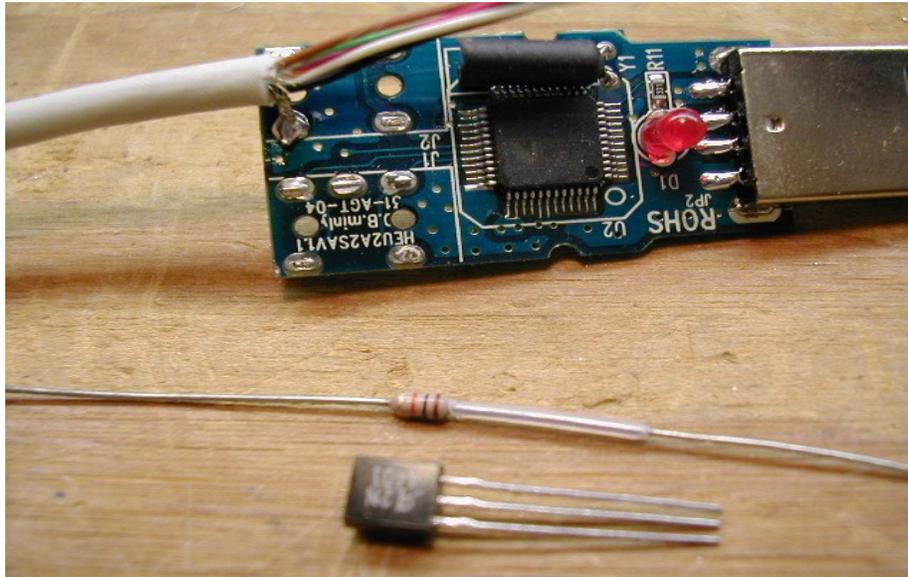

Now we connect some wires to points on the board. For the multiconductor cable I'm using, white is receive audio, black is transmit audio, brown is auxiliary audio, red is PTT, and green is COR. For now we will solder down the receive audio (white), transmit audio (black) , and auxiliary audio (brown) wires as shown:
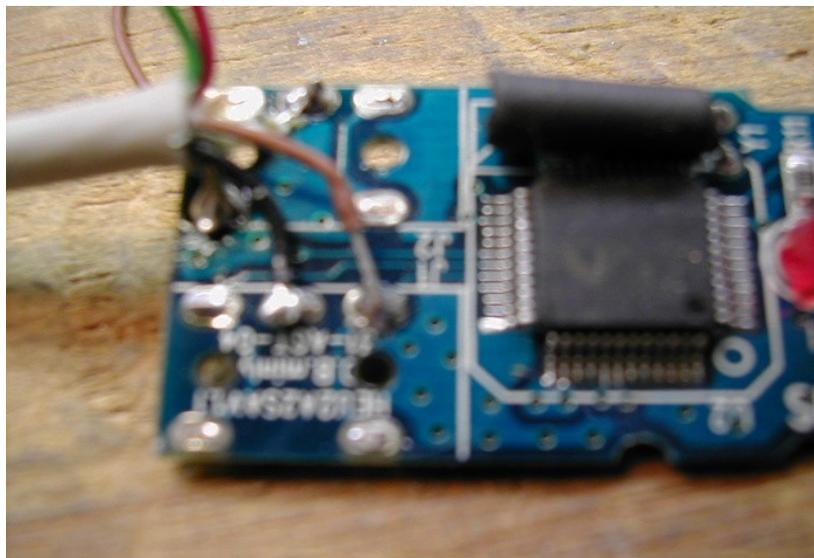

Note that the rxaudio (white) lead is connected to the middle pin of the mic connector at the top.

Next, we add the 10K resistor shown prepped above with some plastic tubing to pin 13 of the CM108. To get access to pin 13 on this particular board, I had to temporarily bend the crystal up and out of the way. Make a 90 degree bend in the resistor lead so that it can be soldered to pin1 3 as shown in the picture below. Be very careful not to place undue force on the resistor lead after it is soldered to the pin, as the pin will break away from the pad if you are not careful.
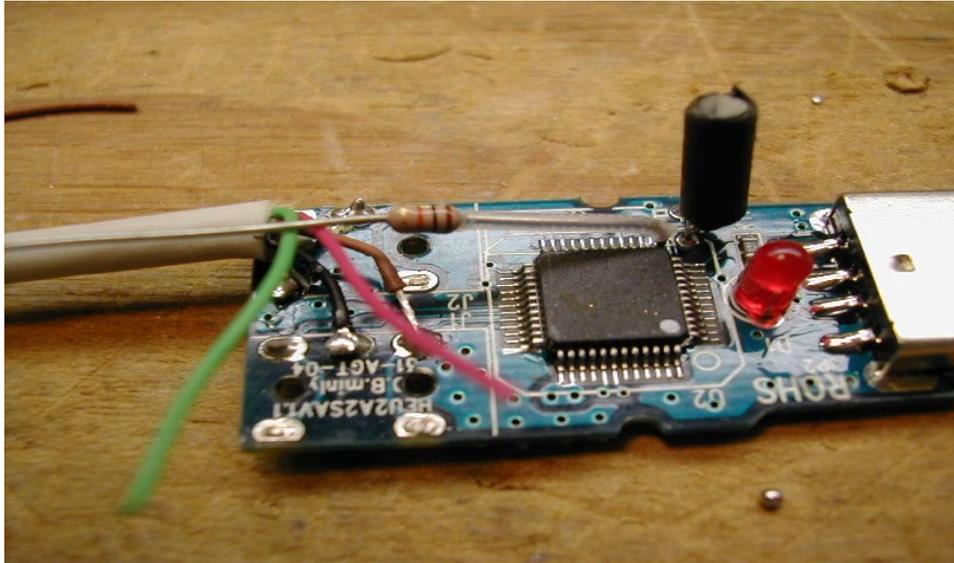

Next, we attach the 2N4401 transistor as shown:
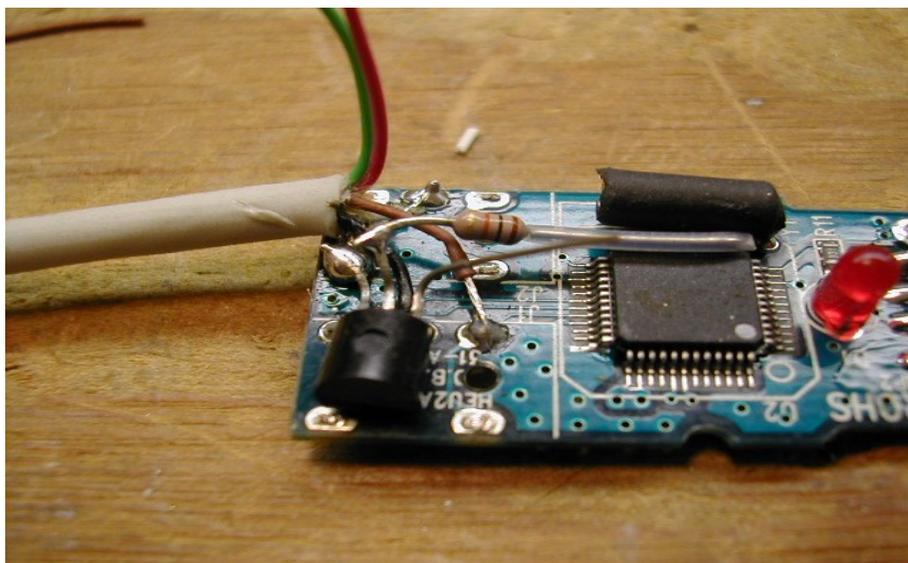
The free end of the 10K resistor attached to the middle pin (base) of the 2N4401. The transistor is mounted flat side down and the leftmost lead (emitter) is soldered to ground at the same point used by the cable shield. Note that the crystal was bent back down to its original orientation.

The PTT (red) lead is then attached to the rightmost pin of the 2N4401 (collector) as shown:
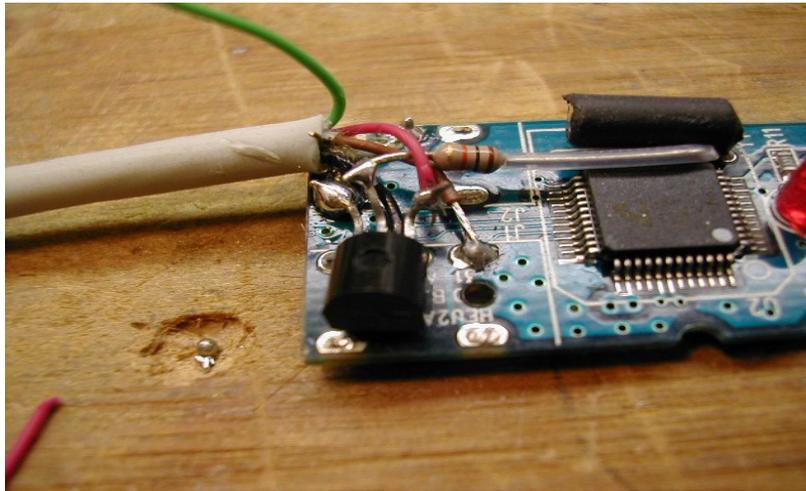
Now we prep the BAT43 diode similar to how we prepped the 10K resistor and solder the prepped end to pin 48 of the CM108, and the other end to the COR (green) wire. Note that the banded end (cathode) of the diode connects to the green wire:
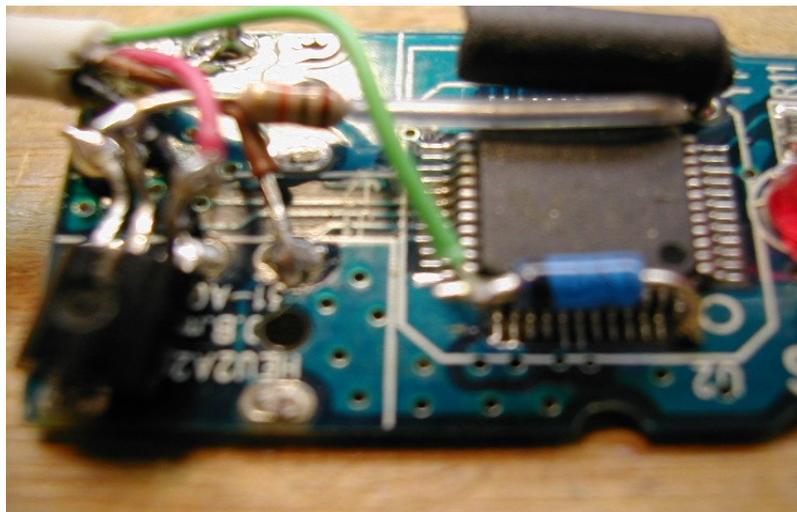

Because of the way the parts are mounted, it would be a good idea to secure the diode and transistor with some glue. I used hot melt glue as it is removable. Silicone RTV should be avoided due to its acid content.

This completes the internal modifications. The rest of the parts are installed inside of the D-sub connector hood. The case halves can now be snapped back over the board.

We now focus on assembly of the D-sub connector and the components installed inside the connector hood. The first thing to do is prep the other end of the multiconductor cable by stripping off 1.5 inches of the jacket. Separate the braid from the conductors, twist it tightly together, slip a small piece of heat shrink tubing over the braid as shown:
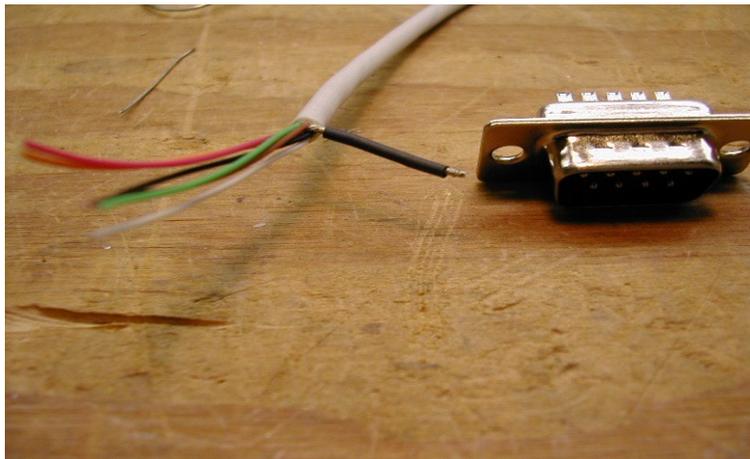

We can now attach the wires which connect directly to the connector pins. These would be ground, COR and PTT. The cable shield (ground) gets soldered to pin 5. The PTT (red) lead gets soldered to pin 7, and the COR lead (green) gets soldered to pin 4:

We then make up the receive audio voltage divider out of a 68K ohm and a 470K ohm resistor as shown:

The loose end of the 68K resistor gets soldered to pin 5 (some plastic sleeving slipped over the bare wire would be helpful) . The junction of the 68K and the 470K is soldered the white wire, and the loose end of the 470K resistor goes pin 3 of the D-sub connector:
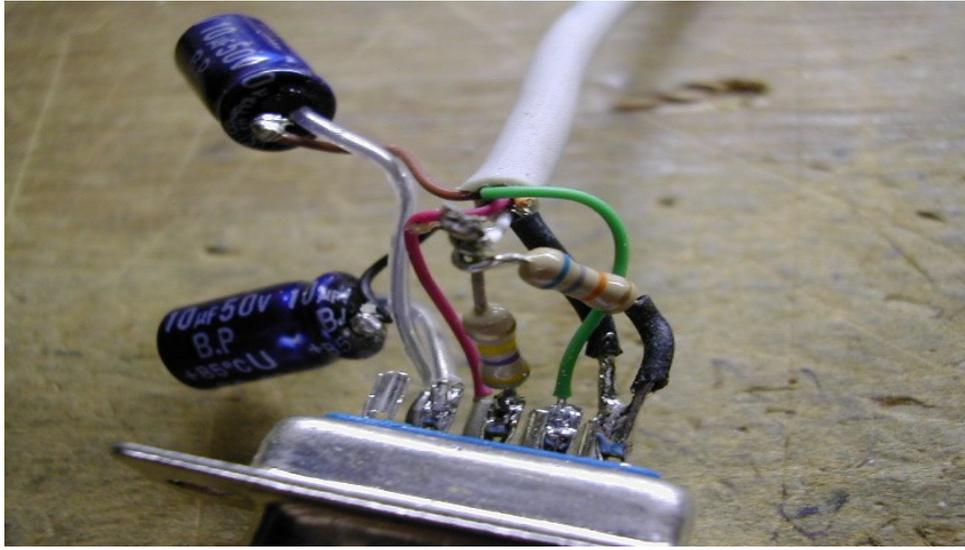
Next we connect the transmit audio (black) wire (through a 10 microfarad non polarized electrolytic capacitor as shown below to pin 2 of the D-sub connector. Be sure to use plastic sleeving over the bare lead of the capacitor to avoid a short circuit.
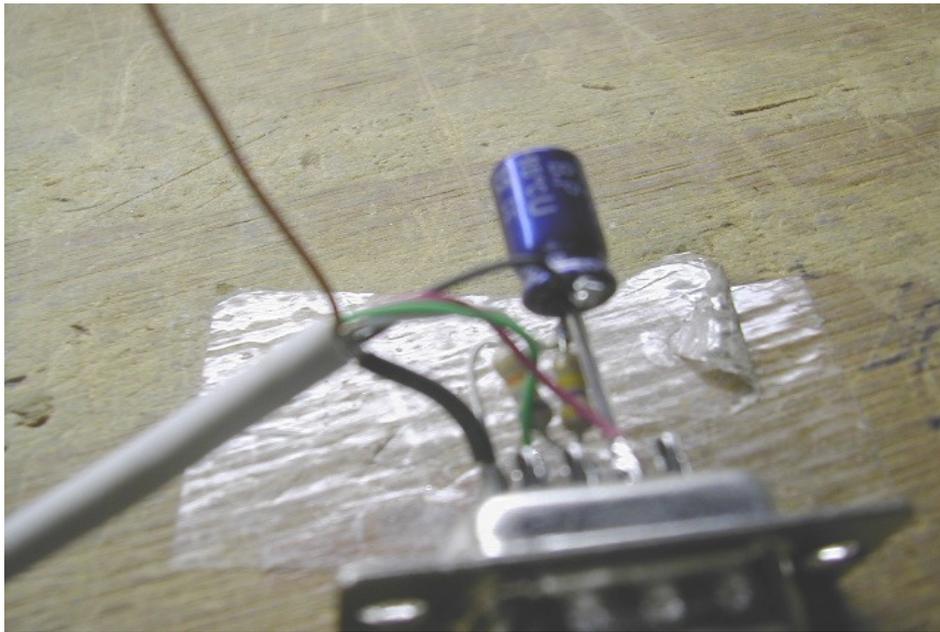

The auxiliary audio (brown) wire is the last connection to be made. It is connected through a 10 microfarad nonpolarized capacitor to pin 6 of the D-sub connector. Be sure to use plastic sleeving over the bare capacitor lead to avoid a short circuit:

Once all of the parts are soldered in place, install the hood and position the parts and the wires so that they are not crimped by the connector hood:
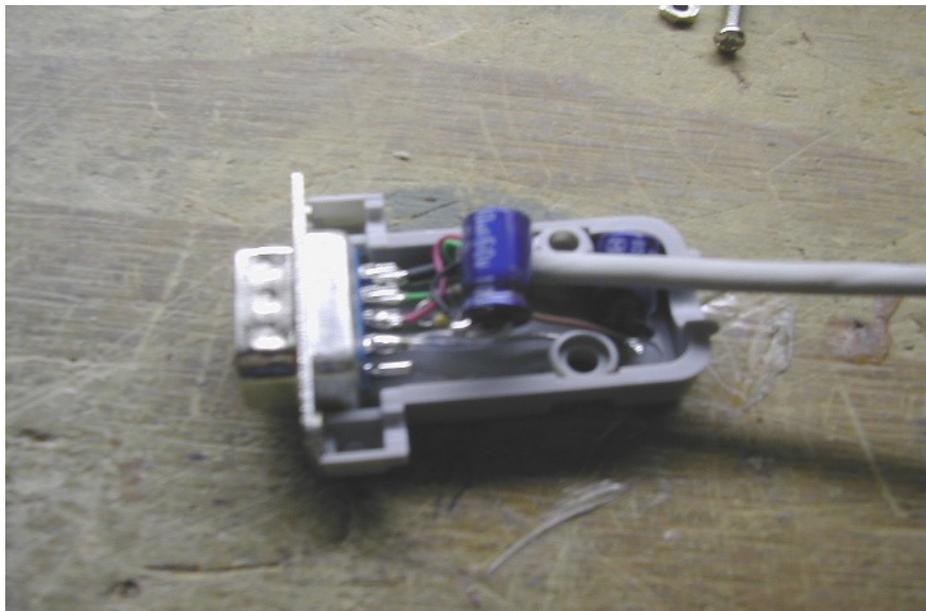
The completed assembly looks like this:
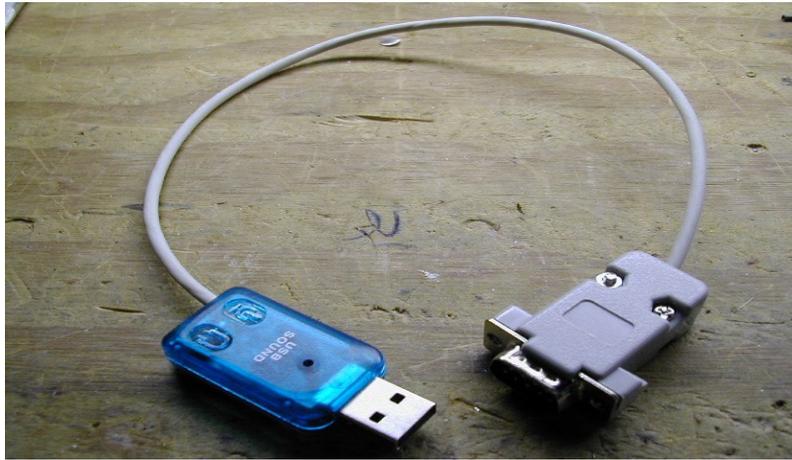
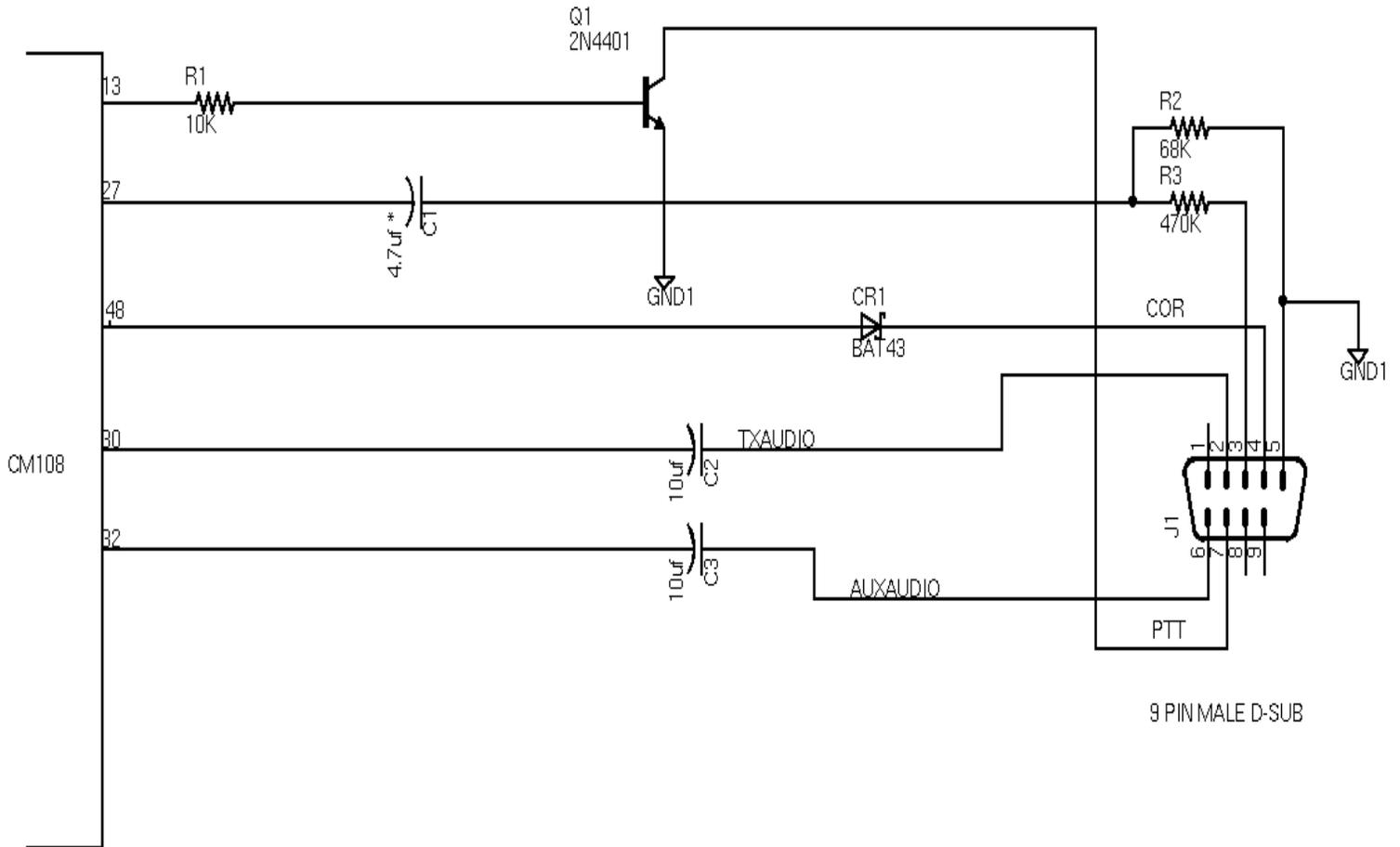**Interfacing the FOB to your radio or repeater (easy method: 3 signals + ground)**

1. Connect pin 3 of the DB-9 connector to your receiver's discriminator output
2. Connect pin 2 of the DB-9 connector to your transmitter's microphone input
3. Connect pin 7 of the DB-9 connector to your transmitter's PTT input (gnd = KEY)
4. Connect pin 5 of the DB-9 connector to the receiver and transmitter DC ground.

In the usbradio.conf config file, make sure the following options are set:

hwtype=0
rxboost=0
carrierfrom=dsp
ctcssfrom=dsp
txctcssdefault=88.5 (or CTCSS tone of your choosing)
rxctcssfreq=88.5 (or CTCSS tone of your choosing)
txctcssfreq=88.5 (or CTCSS tone of your choosing)
txtoctype=notone
rxctcssrelax=1
rxdemod=flat
txprelim=no
txmixb=no
invertptt=0

Follow the radio tuning procedure in usbradio.pdf to set the levels.

The schematic diagram below can be used to check all of the connections if need be:

* PART OF ORIGINAL CIRCUIT