

Colecovision Pause Mod with Power/Flashing Pause LED

Installation Instructions

Version 1.1 – 26/Sep/2019 by Ikrananka

Contents

Changelog	2
Introduction	3
FAQ	3
The Kit	4
Tools Needed	4
Step 1: Disassemble Colecovision	5
Step 2: Cut Hole for Pause Switch and LED	6
Step 3: Install Pause Switch Wire Assembly	9
Step 4: Install LED Holder and Custom Spacer	10
Step 5: Install Power/Pause Mod Circuit Board	11
Step 6: Install Motherboard Wire Assembly	14
Step 7: Cut and Reinstall Bottom RF Shield	22
Step 8: Reinstall Motherboard	23
Step 9: Test Pause Mod	25
Step 10: Adjust Pause LED Flashing Frequency (optional)	26
Step 10: Reassemble Colecovision	28
The Finished Article	29
Hole Template	30

Changelog

v1.1 (26/Sep/2019) Version 1.0 of this guide connected the purple wire to the BUSRQ pin of the Z80 CPU. It was thought that this would provide a more robust means of pausing the Z80 compared to using the typical WAIT pin connection that Yurkie, Parkfun and the Add-A-Halt commercial product used. However, further testing has indicated that this may in fact be the other way around and that using the WAIT pin may in fact be the more robust.

This came to light when pausing BurgerTime (during the second level), using an AtariMax Ultimate SD. The game would occasionally crash upon unpausing when connected to the BUSRQ pin. Further testing of this when instead connected to the WAIT pin revealed what appeared to be much less frequent crashes. While the game still very occasionally crashes this will occur with ANY hardware-based pause mod and is not specific to this flashing LED pause mod. One interesting observation was that the game didn't crash during brief testing using an original BurgerTime cartridge. So, this issue may also be unique to playing games using multicarts or more specifically the Ultimate SD cart.

As such, this installation manual has been updated to show the purple wire being connected to the WAIT pin as opposed to the BUSRQ pin.

Future releases of the flashing pause mod PCB (v1.2+) will have the BUSRQ text (next to the input pins) changed to WAIT to reflect this.

v1.0 (17/Sep/2019) Original release.

Introduction

This mod for the ColecoVision has two functions. The first is to provide a continuously lit red power LED. This LED will illuminate whenever the ColecoVision is turned on and not paused. The second function is to provide a hardwired, physical switch, to pause operation of the ColecoVision allowing you to pause a game at any point and resume play at your leisure. A unique feature of this mod is that when paused the power/pause LED flashes to indicate that the system is paused. The rate of flashing is user adjustable from 0.6 to 3.0Hz. When pause is turned off the flashing LED reverts to being continuously lit (until the system is either paused again or is turned off).

The pause function is achieved by pulling the WAIT line of the ColecoVision's Z80 CPU low. This in effect pauses all Z80 processing and therefore pauses the game you're playing. However, the audio is not paused and will continue to emit the last note/tone which can be very annoying. Therefore, this mod not only allows you to pause the Z80 processor but also disconnects the audio output whenever pause is engaged.

FAQ

Q. Will this work with Super Game Module (SGM1) games?

A. Yes (if you wire the audio as recommended later in this document). All SGM enhanced games still use the Z80 processor and so they will pause when the Z80 is paused just like any other ColecoVision game. However, SGM enhanced audio is fed to the ColecoVision via the expansion port (EXAUD), bypassing the ColecoVision's onboard sound from the SN76489A. Therefore, it is important that when paused, audio is disconnected from a location after the point where audio from the SN76489A and EXAUD combine. This is easy to do and instructions for this are provided later in this document.

Q. Will this work with the upcoming Super Game Module 2 (SGM2)?

A. Yes and No. According to the latest information from Opcode Games, the SGM2 will be backwards compatible with SGM1 games and the pause mod will function in the same way as described in the answer above. However, SGM2 specific games will use the new Z80 and/or 16-bit CPUs that are contained in the SGM2 unit and these **cannot** be paused using this mod. However, Opcode Games has stated that "pause will be implemented in software for these games because of the dual CPU design" and so a hardware pause solution is not needed. You never know, perhaps Opcode Games will make the SGM2s power LED flash when a game is paused!!!

Q. Does this work with the Expansion Module #1?

A. No. The expansion module #1 uses its own processor and audio chip and like the SGM2 **cannot** be paused by this mod. Be aware that moving the pause switch to the pause position while playing an expansion module #1 game may disconnect the audio so leave the switch in the normal position when playing these games.

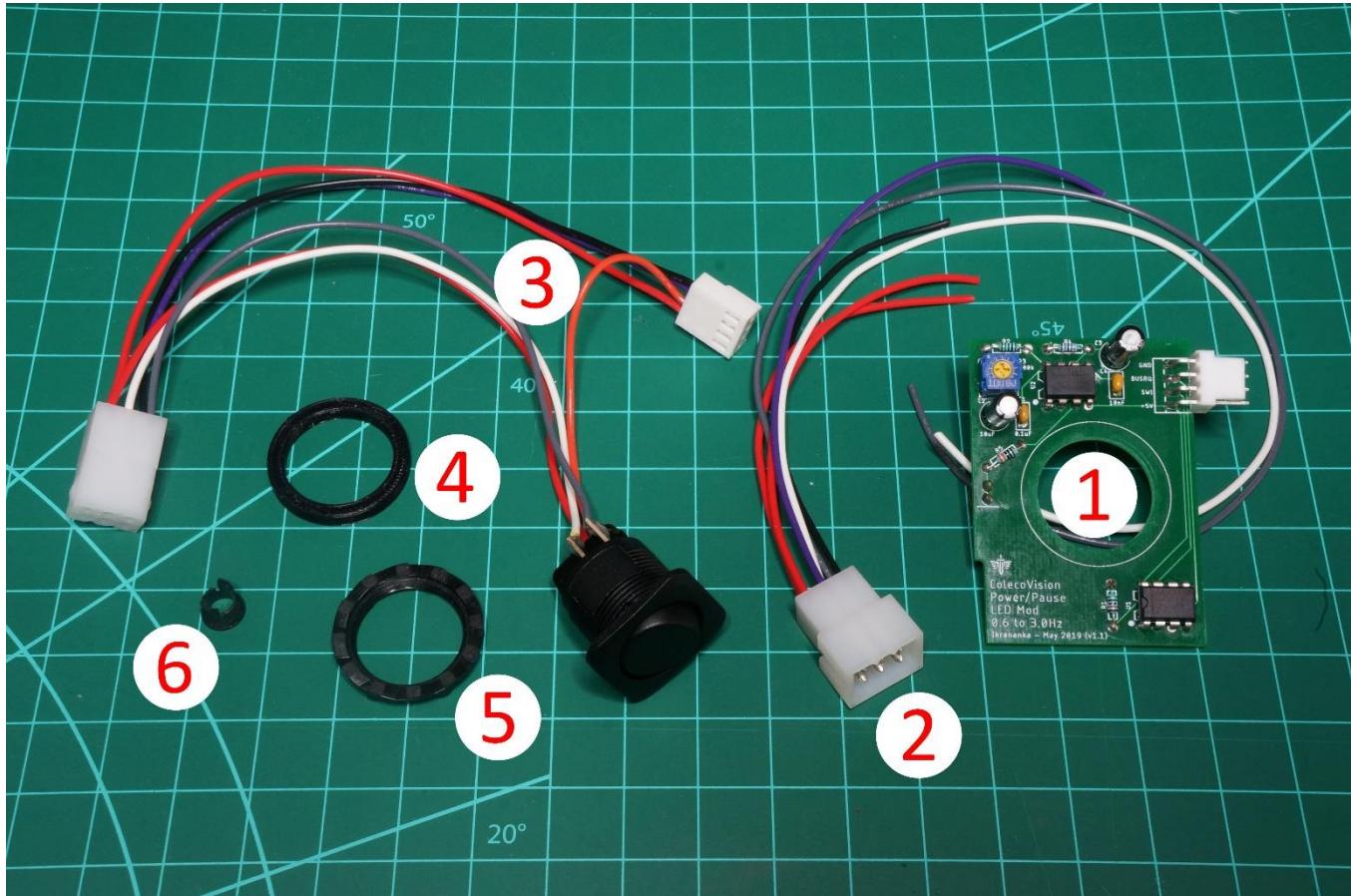
Q. Is the mod reversible?

A. The mod is mostly reversible other than the fact that you must drill two large holes in the ColecoVision's top housing. These holes are obviously **not** reversible.

Q. Can the switch and circuit board be removed for maintenance/troubleshooting?

A. Yes. Assuming you don't use any glue during the installation, which isn't necessary, then the switch and circuit board can be easily removed.

The Kit



The installation kit contains the following items:

1. ColecoVision Power/Pause LED Mod circuit board.
2. Motherboard wire assembly.
3. Pause switch wire assembly (includes pause switch).
4. Circuit board custom spacer.
5. Pause switch nut (used to hold switch and circuit board in place).
6. LED holder.

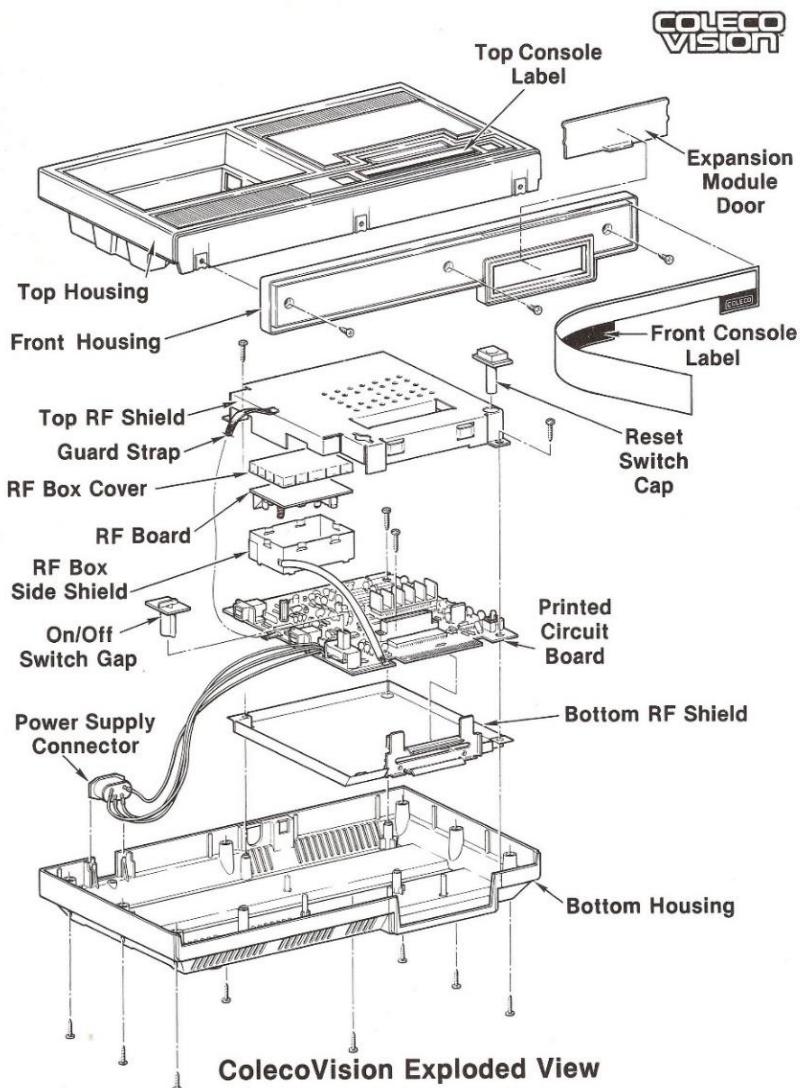
Tools Needed

- Phillips screwdriver
- Variable speed electric drill
- 1/4" drill bit
- Step drill bit up to 25/32" (alternatively a step drill bit up to 3/4" and a half round double-cut file)
- Anti-static mat with wrist strap (optional)
- Soldering iron and solder
- Xacto knife (or equivalent)
- Tin snips (to cut the bottom RF shield)

Step 1: Disassemble ColecoVision

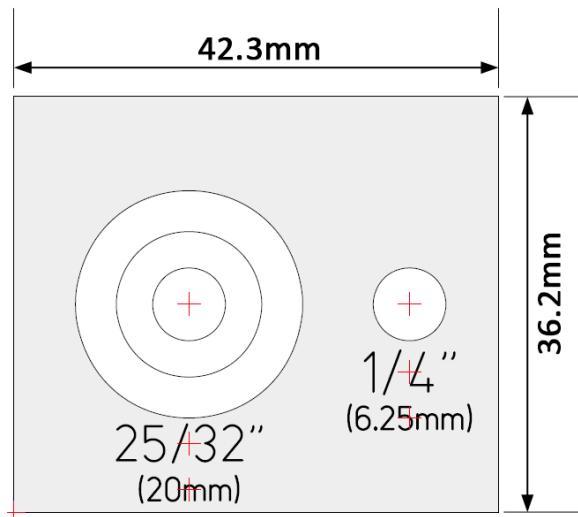
There are many guides available for disassembly of a ColecoVision unit and so here I will simply state the directions given in the official ColecoVision Technical Manual:

1. Turn unit over so that bottom is in an upright position.
2. Remove eight bottom screws.
3. Turn unit back over so that top is once again in the upright position.
4. To remove top housing, carefully pull out and up in front, then do the same for the back, do this back and forth, until the top housing pops off. At this point do not tamper with the front housing. There is never a need for it to be removed.
5. Remove reset switch and on/off switch caps.
6. Unsolder and unscrew top RF shield and ground strap and remove.
7. Remove two screws from printed circuit board (motherboard) and remove.
8. Remove the bottom RF shield.

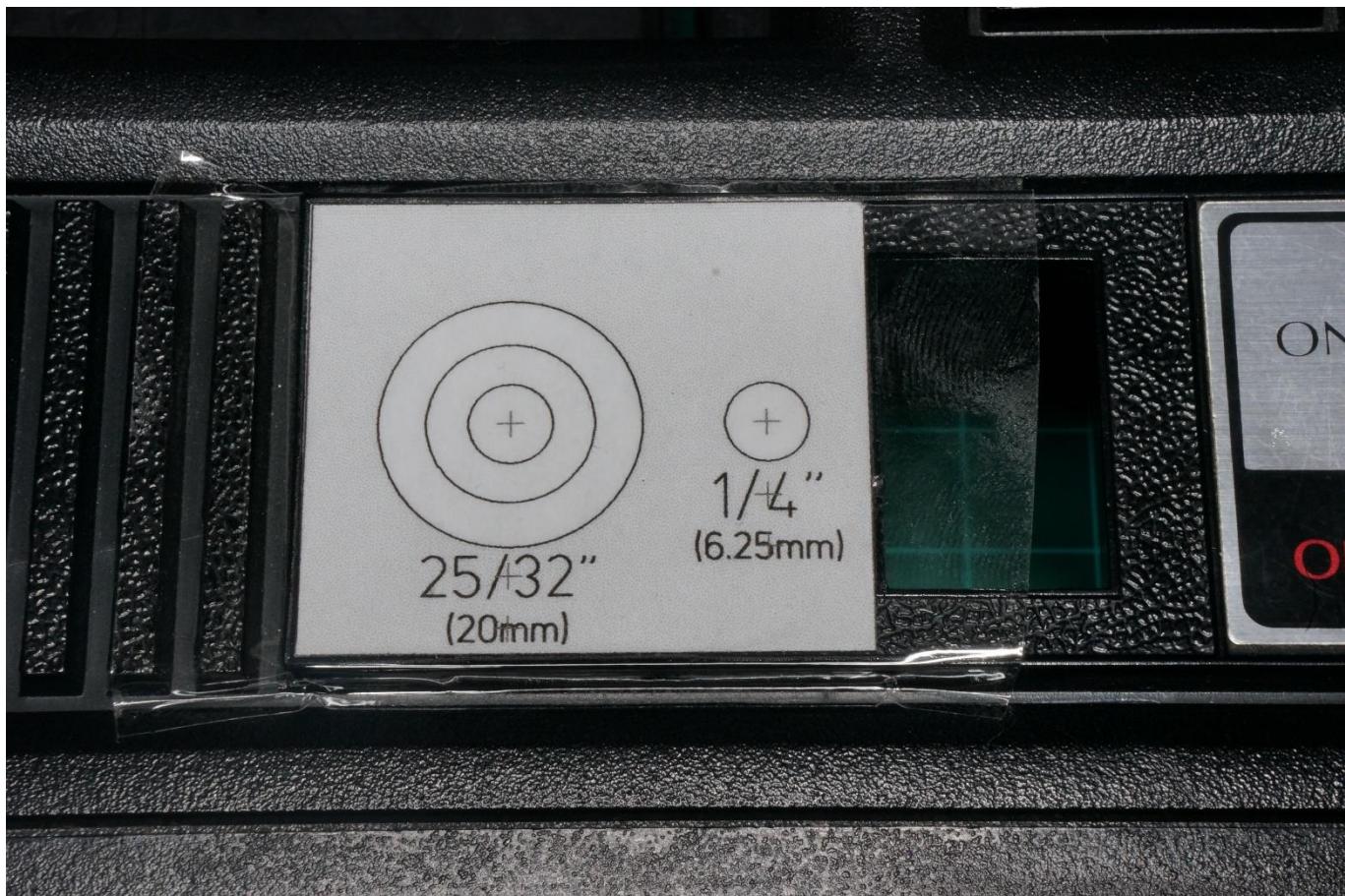


Step 2: Cut Hole for Pause Switch and LED

Print out the pause switch and LED hole template provided at the end of this document. Ensure that any print scaling is set to either actual size or 100%. Verify that the printed dimensions (mm) are as shown below.



Use sticky tape to mount the template to the top housing of your ColecoVision in the area to the left of the power switch. The outer rectangle should fit snugly within the slightly raised ridges in that area.



Drilling large holes in the ColecoVision case can be tricky, but with care, and the right tools, can be done easily and with accuracy. Personally, I use a drill press set to around 850 rpm, a 1/4" HSS drill bit for the LED hole and a step drill bit and half round double cut file for the large pause switch hole. Further details below.

Drill Bits

For the large pause switch hole, it is best to start by drilling a much smaller hole (say 1/4") and then drilling progressively larger and larger holes until the desired size is reached. I highly recommend that you use a step drill bit to do this as this not only eliminates the need to keep changing drill bits but also greatly aids in ensuring that each time a larger hole is drilled that it is accurately centred over the prior smaller hole. Personally, I use the largest of the step drill bits in the kit shown below. This is a 1/4" to 3/4" nine step drill bit (1/16" increments) that works very well for the pause mod hole. However, the largest size of 3/4" is slightly too small (1/32" or 0.8mm) for the target 25/32" hole. To overcome this, I use a half-round "double-cut" file to gradually increase the hole size to 25/32" using the template as my guide.

The concentric rings on the template are there as an aid to accurately step drilling the large pause switch hole. The circle diameters are 1/4", 1/2" and finally the target 25/32".



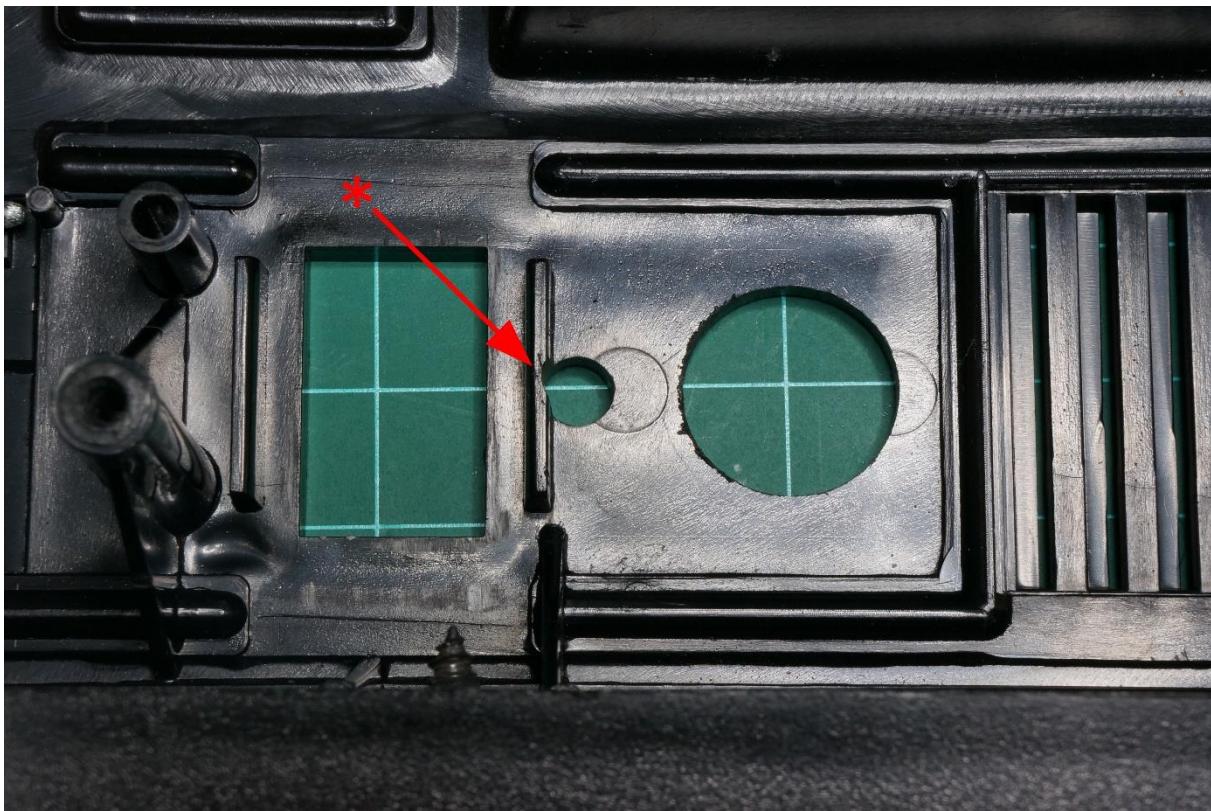
Drill Speed

When drilling into plastic it is essential that you don't use too high a drill speed or too much downward force. Doing so can lead to significant heat build-up which can in turn melt the plastic. This can cause the drill bit to jam and/or cause the hole to become an awful mess of misshapen plastic. This will leave you with such a mess that it is extremely difficult, if not impossible when doing this by hand, to accurately drill into again.

Therefore, use a variable speed drill and set it to within the 800 to 1,000 rpm range. No faster! When drilling, press down with gentle force and let the drill do the work. Take your time and do not try and rush the process by pushing down aggressively.

The Finished Holes

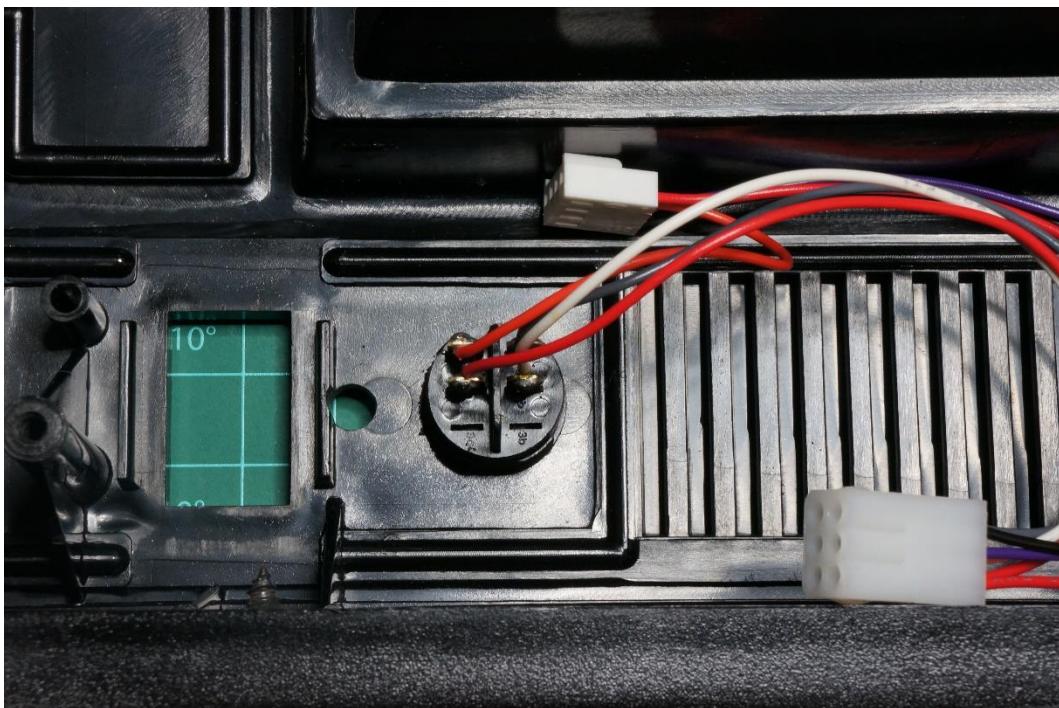
Here's what you're trying to achieve:



* Notice how the 1/4" LED hole slightly cuts into the power switch guide. This is by design and is not a problem.

Step 3: Install Pause Switch Wire Assembly

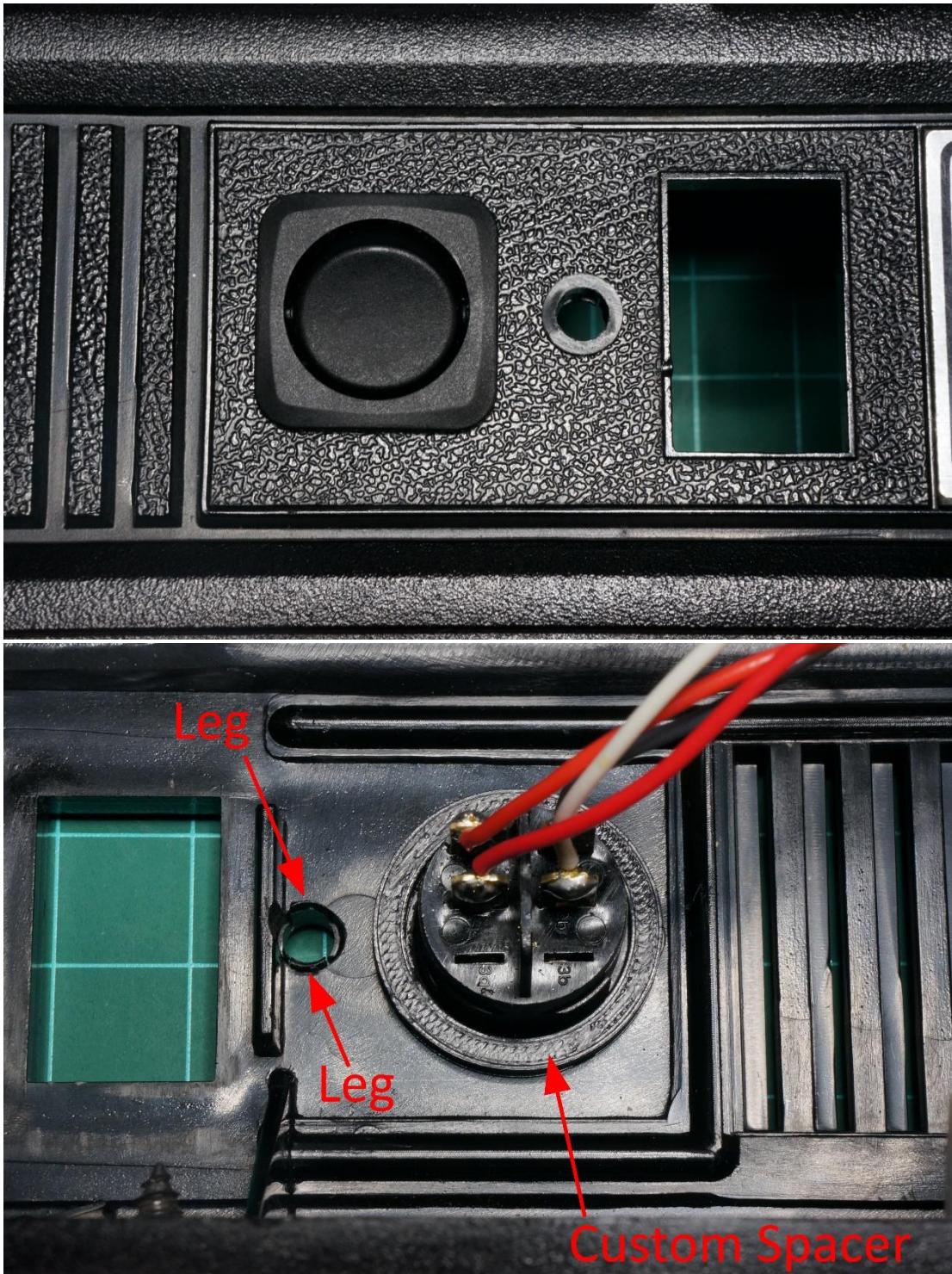
From the top of the ColecoVision housing, thread the pause switch wire assembly through the large 25/32" hole, Molex connectors first. Press the pause switch into place ensuring that the switch is orientated so that the switch's wire connections are located as shown below. There should be a snug fit between the threaded round body of the switch and the hole. If the switch does not fit, then remove the pause switch wire assembly and use a half round double-cut file to adjust the hole size. Test fit the pause switch again and repeat the filing as necessary until the pause switch fits snugly. Take your time and don't make the hole too big – it is best that it is a snug fit as this will help prevent the switch from moving (turning) once fully installed.



Step 4: Install LED Holder and Custom Spacer

With the top of the ColecoVision's top housing facing you, insert the LED holder into the 1/4" hole that you previously cut (see photos below). Ensure that the two "legs" of the LED holder are orientated as shown. Optionally apply a small drop of medium thickness superglue to the LED holder to hold it permanently in place, however I personally haven't found a need to do this.

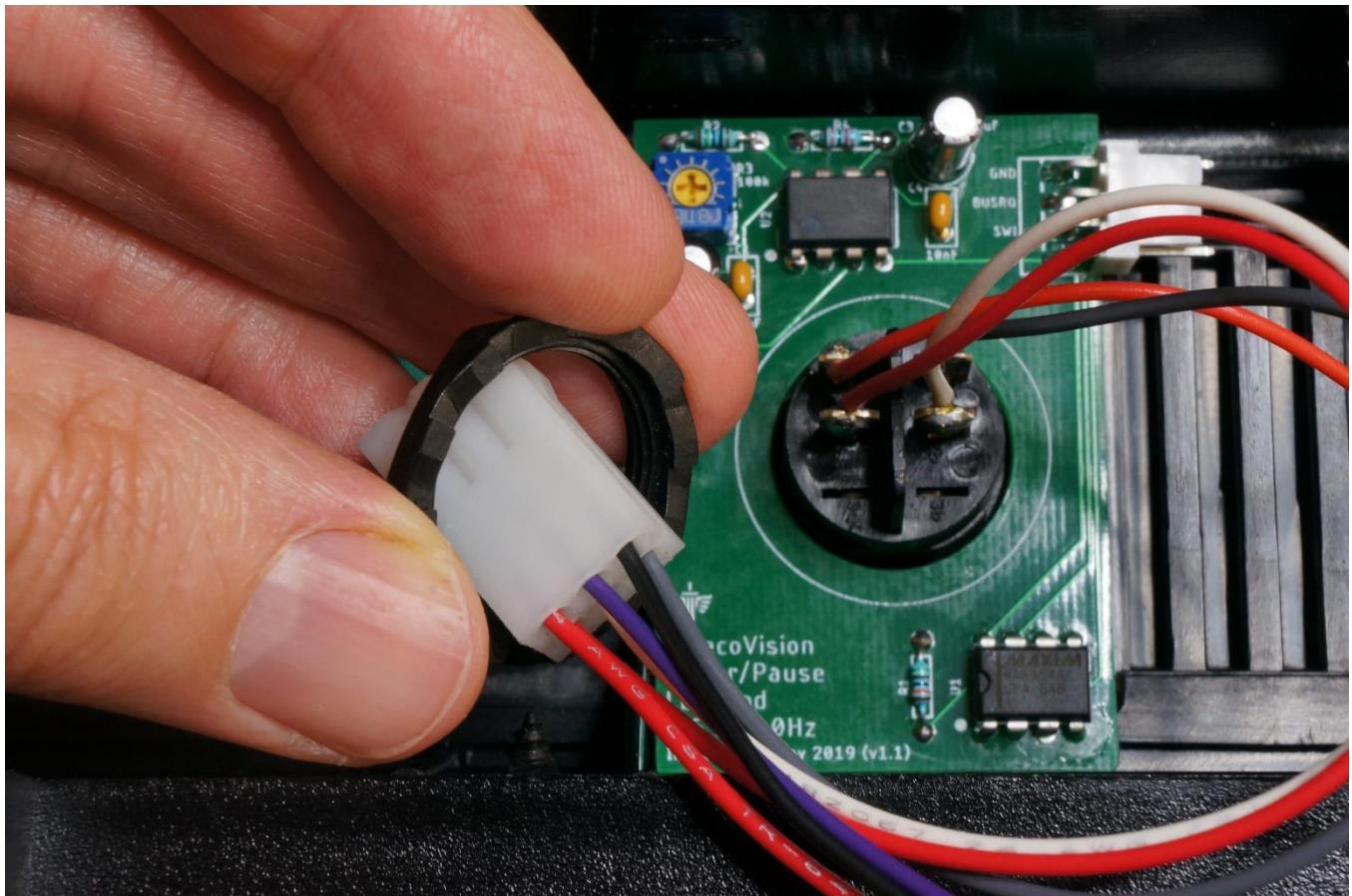
Turn the top housing over and thread the switch wire assembly, Molex connectors first, through the custom spacer. Slide the spacer over the round body of the switch until it is flush with the ColecoVision's top housing.



Step 5: Install Power/Pause Mod Circuit Board

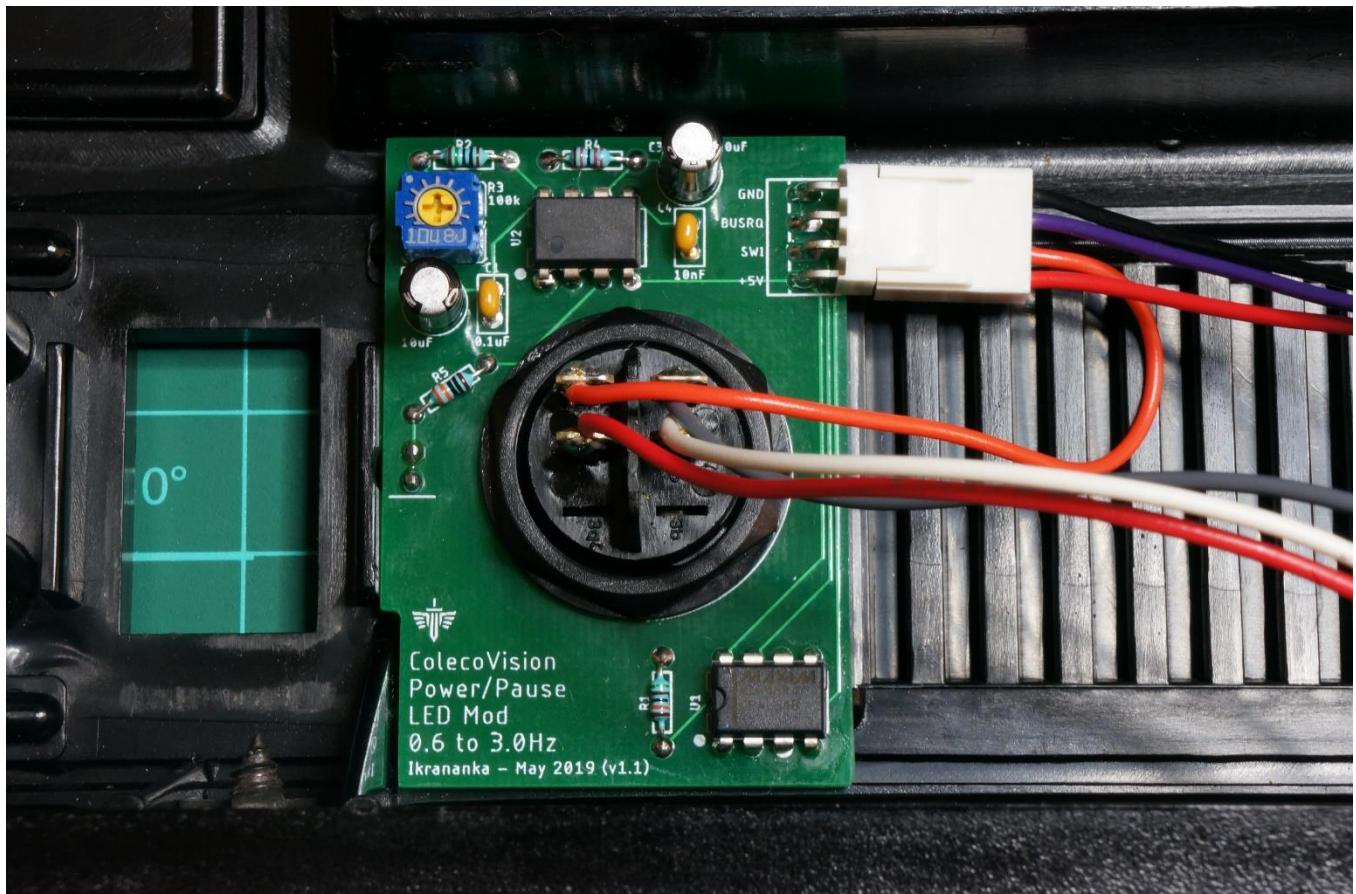
Now thread the switch wire assembly, Molex connectors first, through the power/pause mod circuit board from the LED side to the side with the electrical components on it. Slide the circuit board over the round body of the switch, red LED side down, ensuring that the red LED slides into the rear of the LED holder. Press the entire circuit board down to ensure that it is flush with the ColecoVision housing.

Next, thread the switch wire assembly, Molex connectors first, through the pause switch nut from the smooth side to the side with the teeth (see photo below).



Slide the nut over the round body of the switch. While pressing down on the circuit board with one hand, use the other hand to hand screw the nut onto the switch until it is as tight as you can make it. I haven't found a need to tighten this using any tools, as hand tight as you can make it should be enough. However, if you made your 25/32" hole too large and the switch isn't tight and snug in the hole then you may need to use tools to tighten the switch nut further. Optionally, you could use thread lock or superglue to hold the nut in place, however personally I haven't found a need to do this and prefer to be able to have the option to remove the entire pause mod should the need arise (e.g. for switch cleaning, circuit board repair etc.).

Now, take the four position Molex connector on the switch wire assembly and connect it to the circuit board as shown below. Ensure that you connect this the right way around. The small locking ramp on the connector should be facing you, as you slide it on, and should mate with the locking part of the connector on the circuit board. When correctly inserted the black wire goes to the GND pin and the red wire to the +5V pin.



Turn the ColecoVision housing over and you will see the red LED protruding slightly from the LED holder. If you didn't glue the LED holder in place earlier then press down on the black lip of the LED holder (do NOT press down on the red LED) in case it moved up when the LED was inserted. It should look something like that shown on the next page. Note that I designed this so that the LED only protrudes a little above the LED holder and does not actually "lock" into the holder. Firstly, I prefer the more subtle look with the LED being more recessed and when it is turned on it is far less distracting, and secondly with the LED not "locked" in the holder it allows for the circuit board (and attached LED) to be easily removable.

Top View

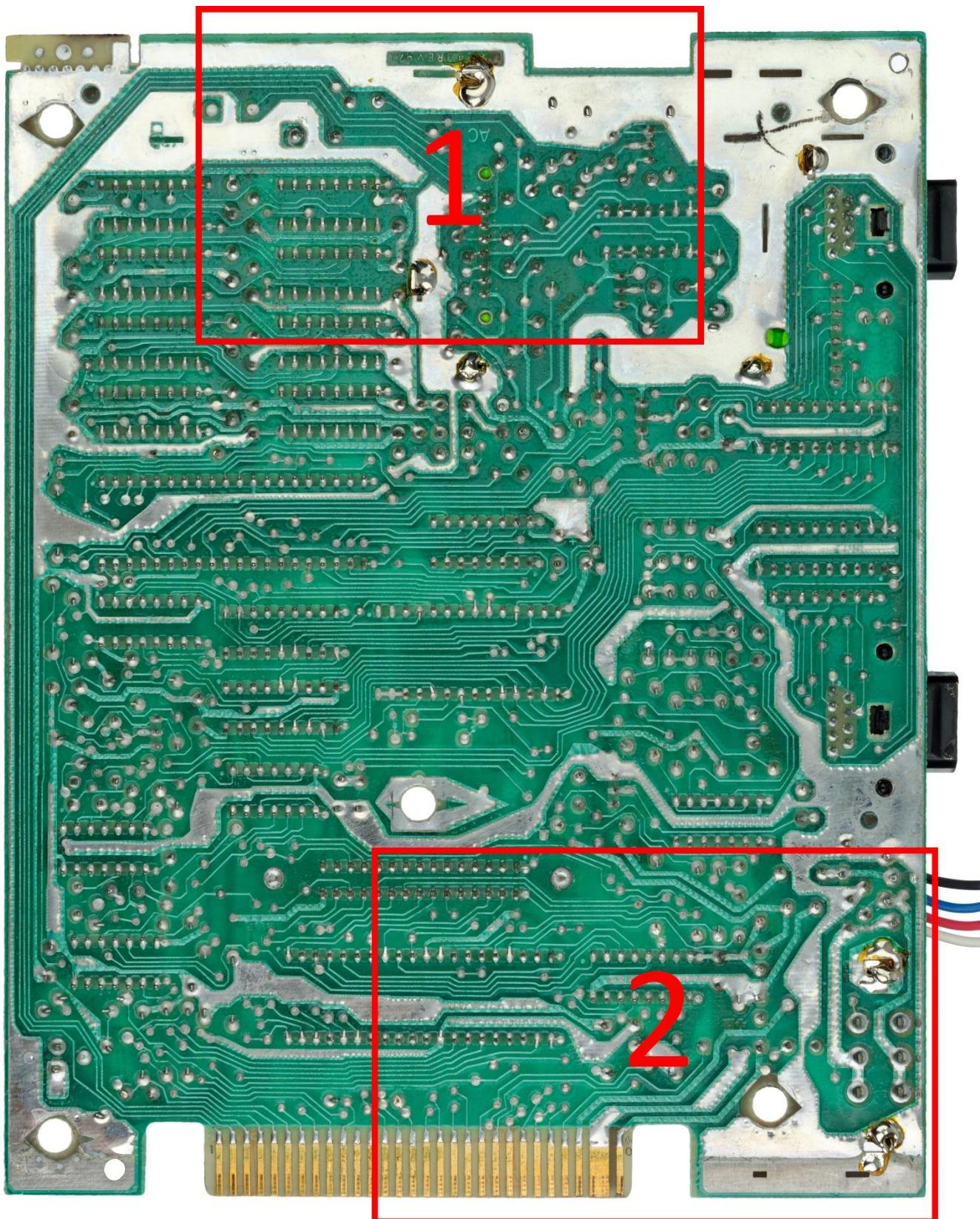


Side View



Step 6: Install Motherboard Wire Assembly

Take the ColecoVision motherboard and turn it over so that the underside is facing you and the expansion port connector is closest to you. There are two areas of the motherboard that we'll be focussing on:



Section 1 - Audio

There are several different ways to wire the pause switch audio. These depend on how you obtain audio from your ColecoVision when connecting it to your TV or monitor.

- *Original RF*

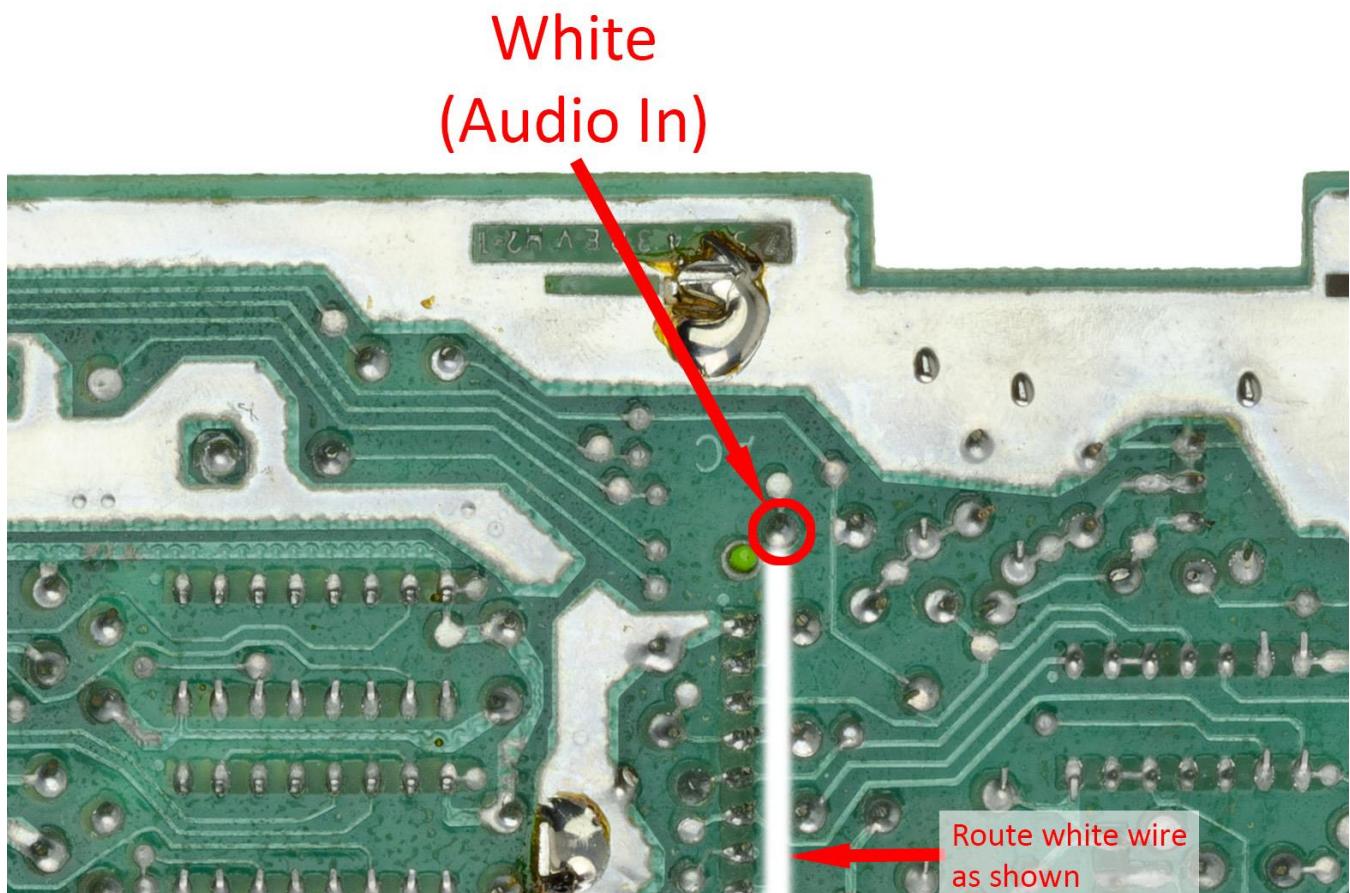
If you use your ColecoVision as it was originally designed and connect an RF cable to it then audio is combined within the RF signal. Follow instructions “**Option ‘A’ – Original RF**” below to wire up the audio side of the pause mod.

- *Audio Socket(s)*

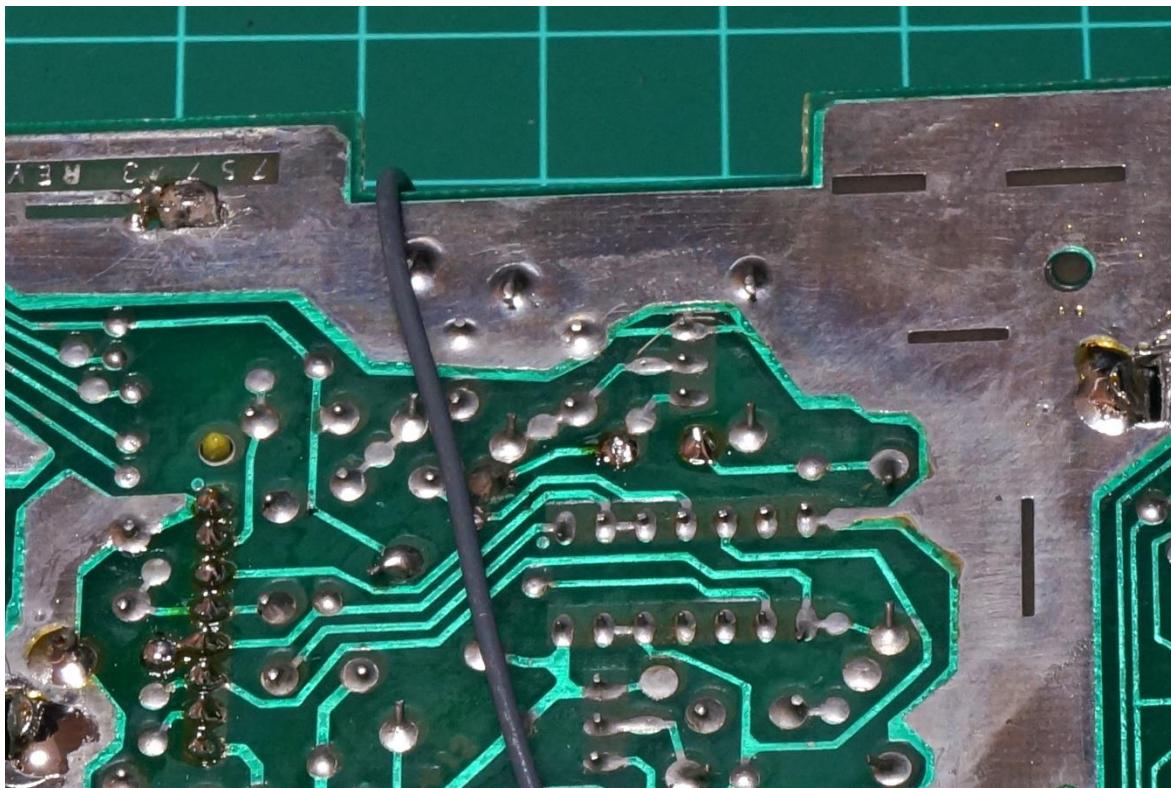
If you have a ColecoVision that has been modified to have dedicated audio output socket(s) (often done at the same time as a video output mod) then follow instructions “**Option ‘B’ – Audio Socket(s)**” to wire up the audio side of the pause mod.

Option ‘A’ – Original RF

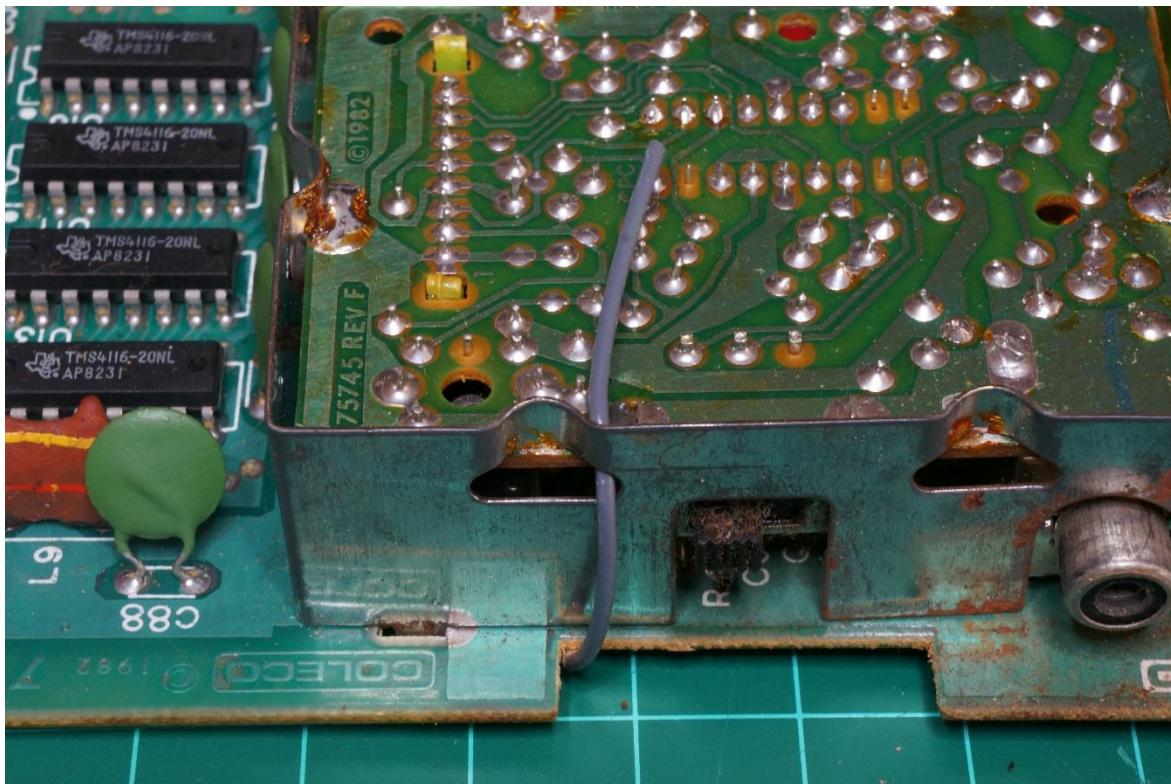
Laying the white (audio in) wire on the motherboard along the route shown below, solder the white wire to the point highlighted with the red circle.



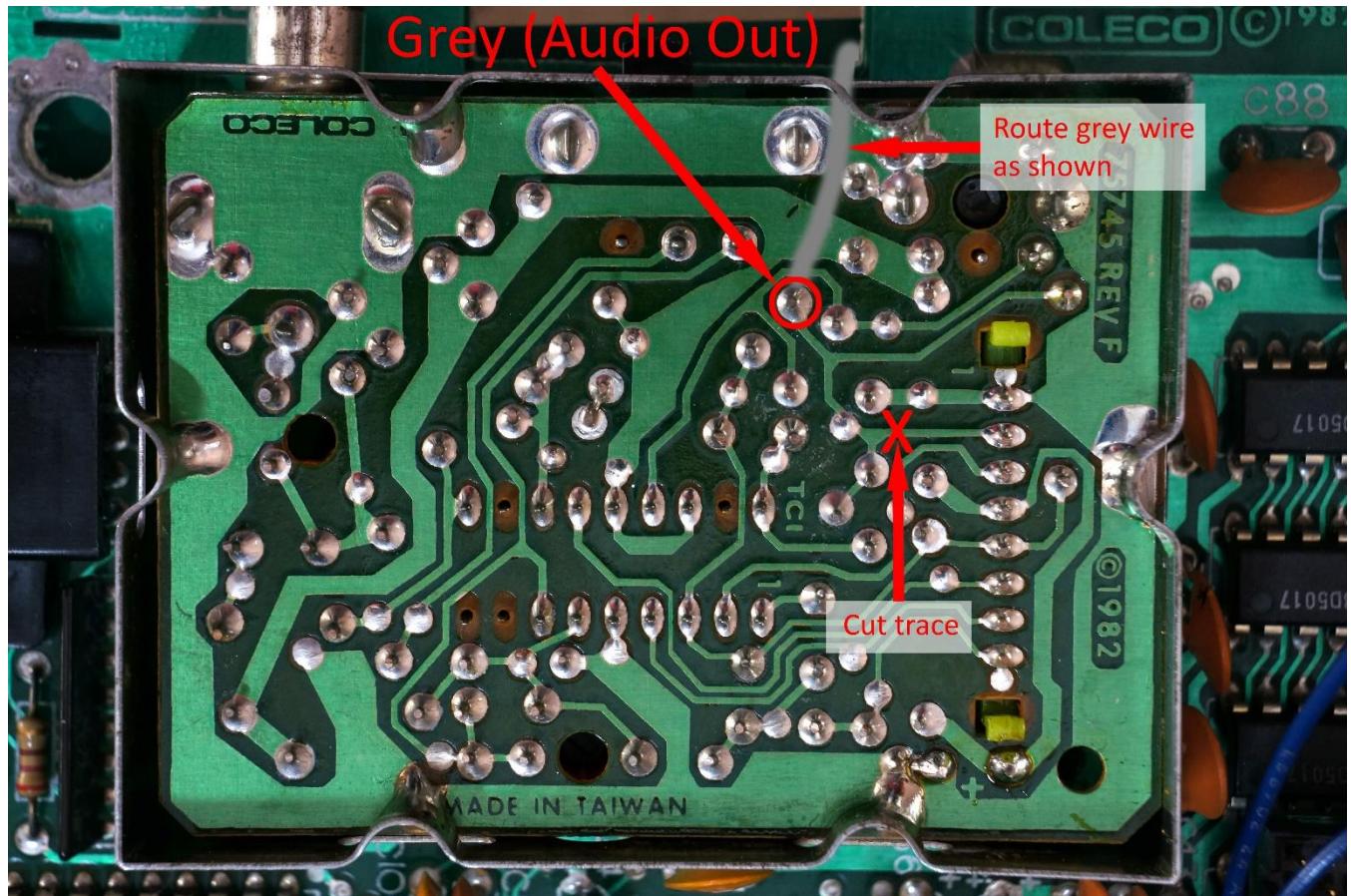
Now, route the grey (audio out) wire up to, and over, the recessed area of the motherboard as shown (note that the white wire isn't shown in the photo below).



Keeping the grey wire in position, flip the motherboard over and remove the top cover from the RF box. Thread the grey wire through the recessed area in the RF box so that the end of the wire is on top of the RF daughterboard in the position shown. It's a tight squeeze for the wire but it does fit!



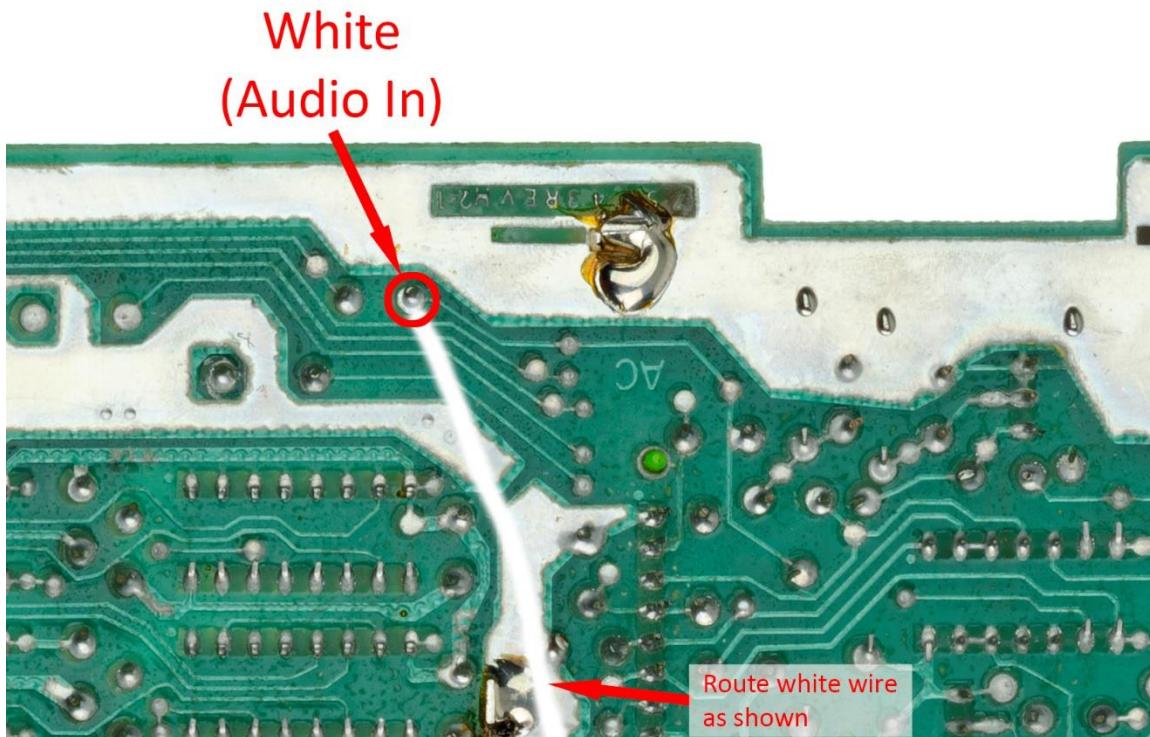
Solder the grey wire to the point highlighted with the red circle. Also, using an Xacto knife or similar, cut the trace at the point marked with a red X.



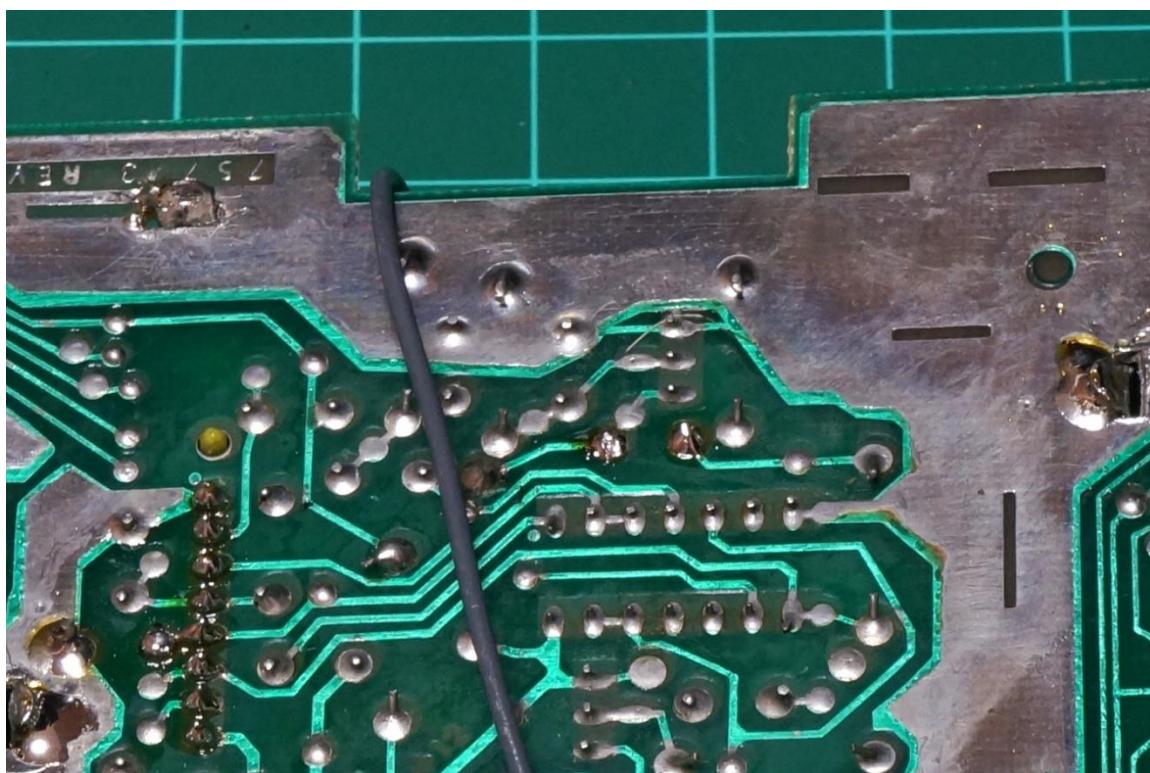
Now, jump to section 2 where instructions are provided for soldering the rest of the wires.

Option B – Audio Output Socket(s)

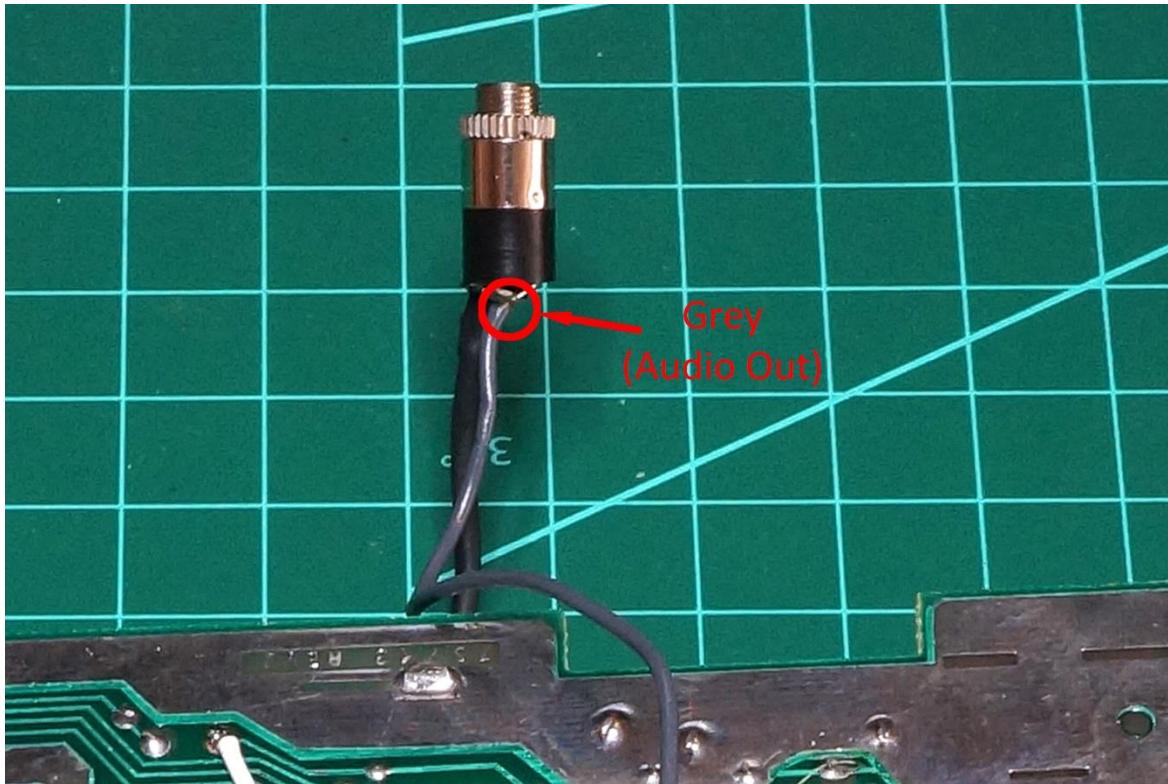
Laying the white (audio in) wire on the motherboard along the route shown below, solder the white wire to the point highlighted with the red circle.



Now, route the grey wire up to, and over, the recessed area of the motherboard as shown (note that the white wire isn't shown in the photo below).

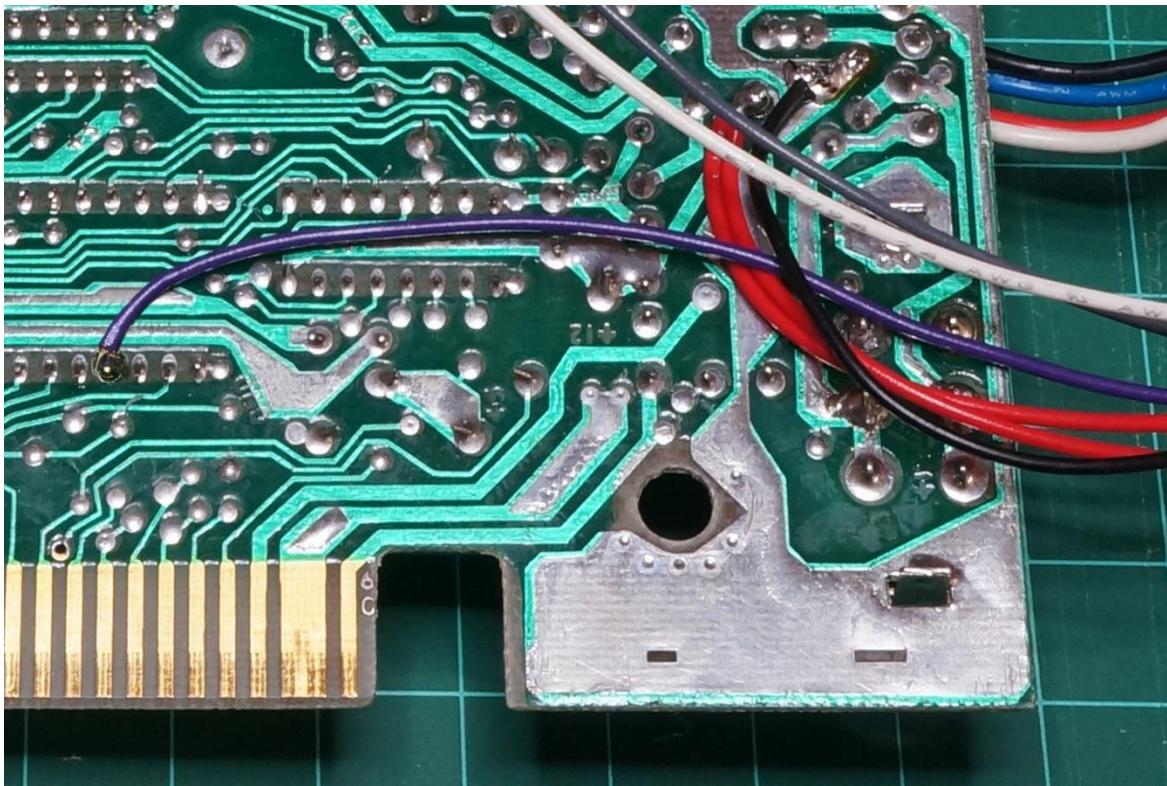
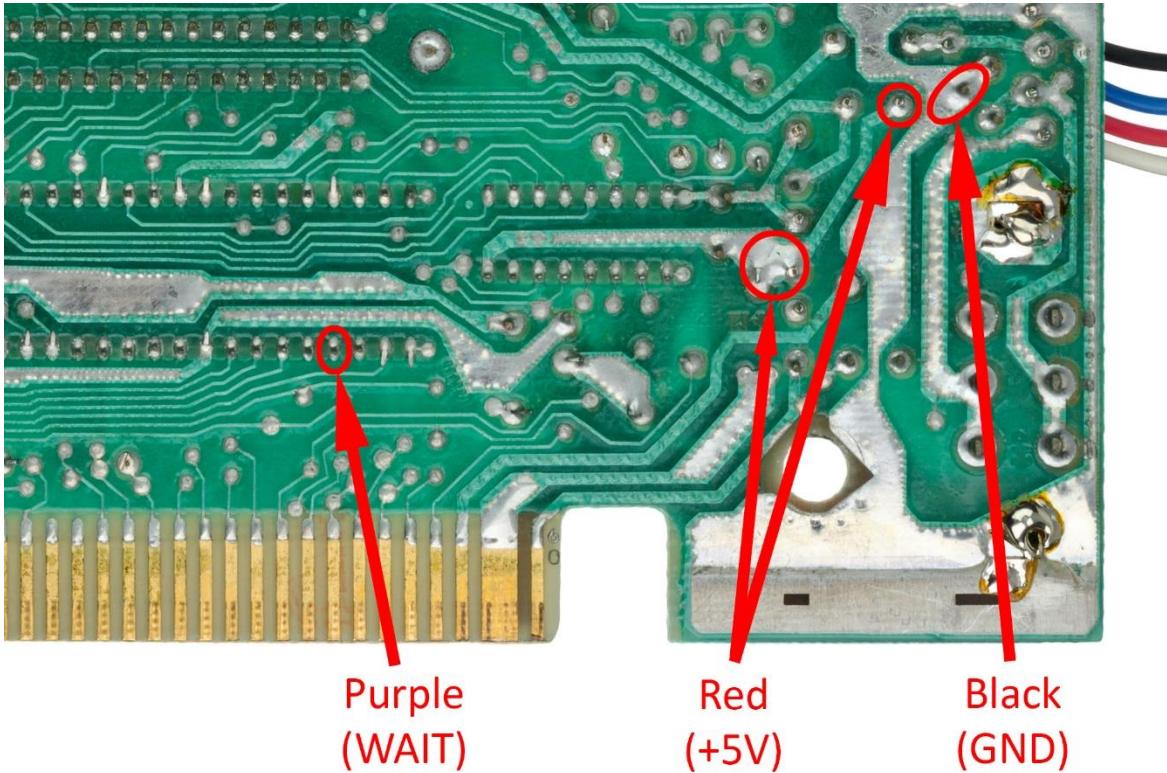


The grey wire should be soldered to the audio connection of your audio jack. The example below shows the grey wire connected to a 3.5mm TRS headphone jack.

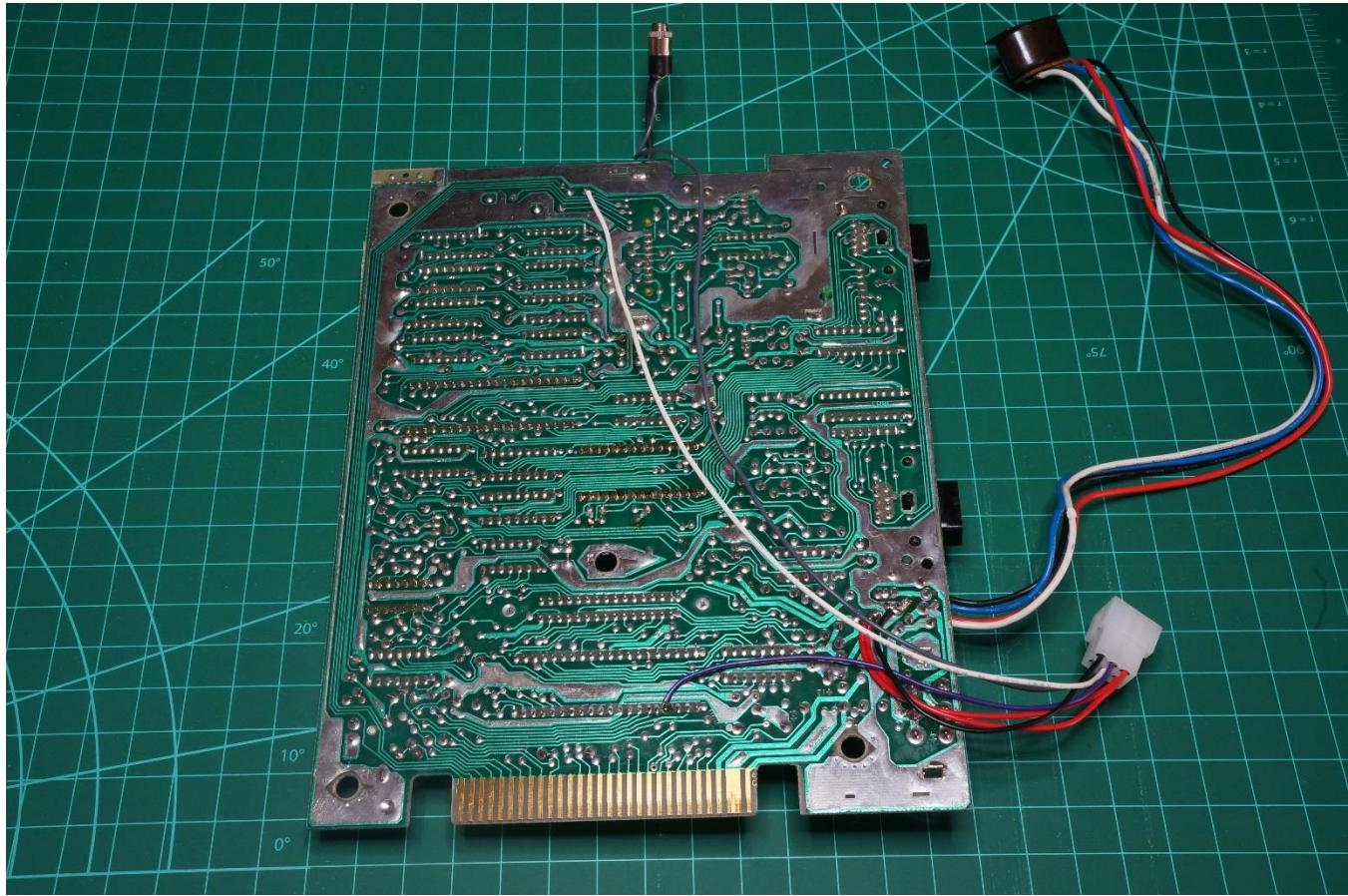


Section 2 – Remaining Connections

Solder the remaining wires, Purple (WAIT), two Red (+5V) and Black (GND) to the points indicated below. The two red wires can be soldered to either of the two locations shown. The wires should be routed to the lower right side of the board. The second image below gives an example of the routing that I chose for these wires.

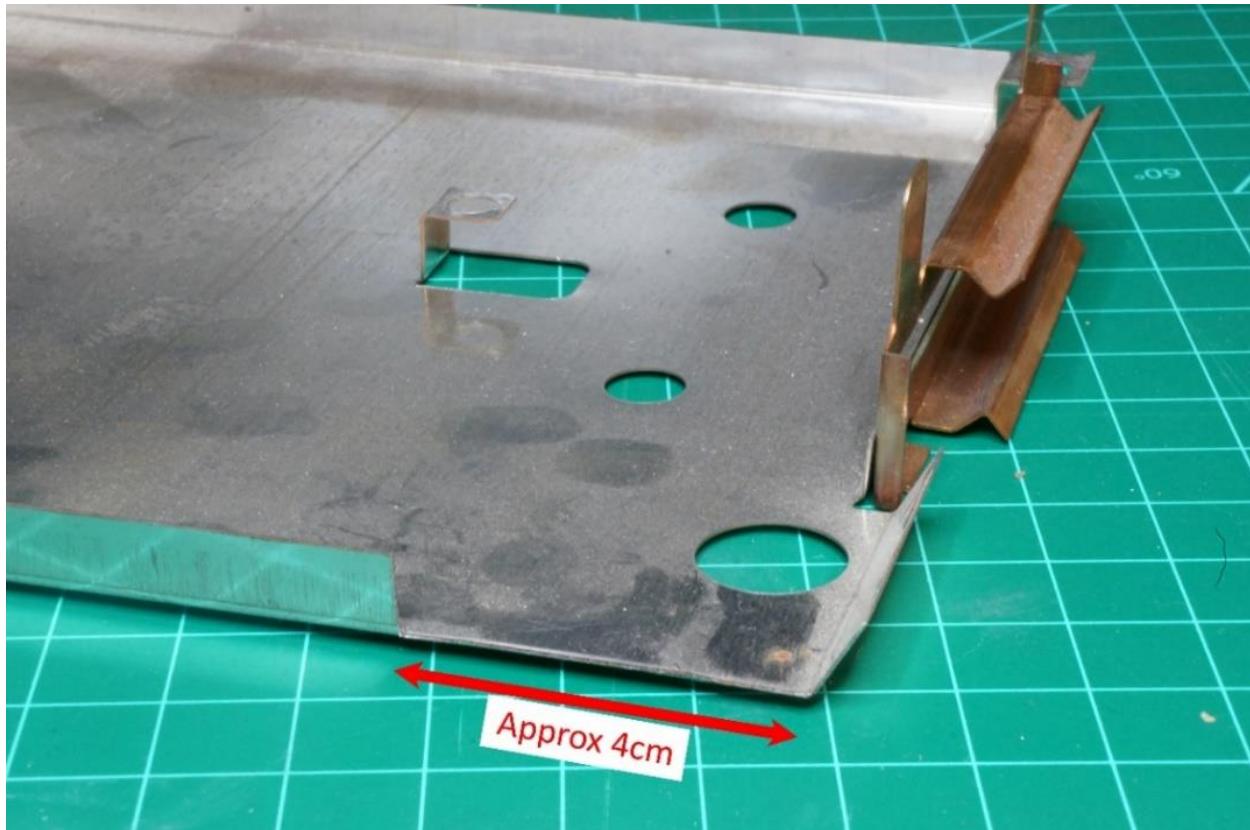


The finished wiring should look something like this:



Step 7: Cut and Reinstall Bottom RF Shield

To allow room for the new pause mod wires to pass from the back of the motherboard to the pause mod it is necessary to remove a small piece of the motherboard's bottom RF shield. Use tin snips to cut approximately 4 cm off the side of the bottom RF shield so that it is as shown below.



Reinstall the bottom RF shield in the ColecoVision's bottom housing, ensuring that the black standoffs in the bottom housing slot into the holes in the bottom RF shield.

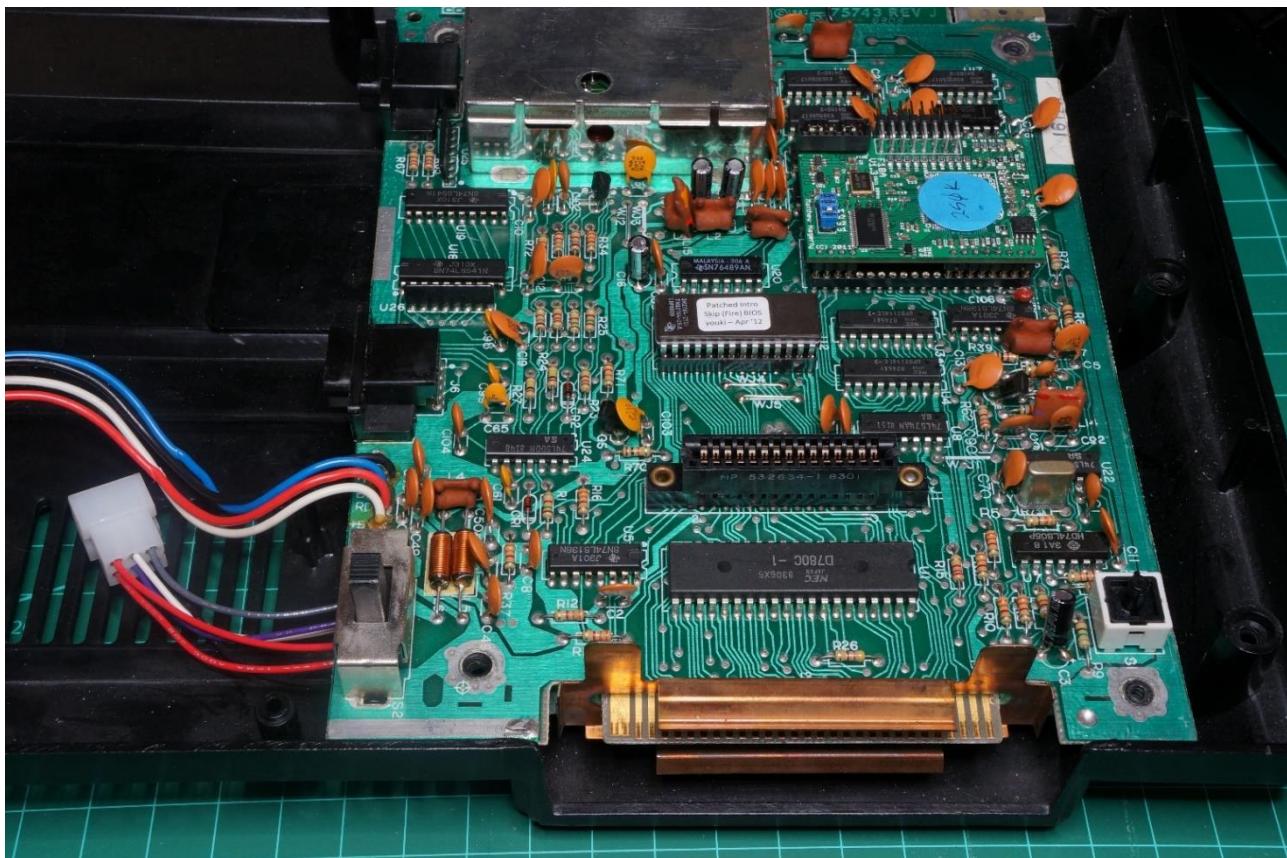
Step 8: Reinstall Motherboard

Reinstall the motherboard into the ColecoVision's bottom housing, on top of the bottom RF shield. Make sure that the new pause mod wires pass through the gap cut in the bottom RF shield and are not being pinched anywhere (see photo below).

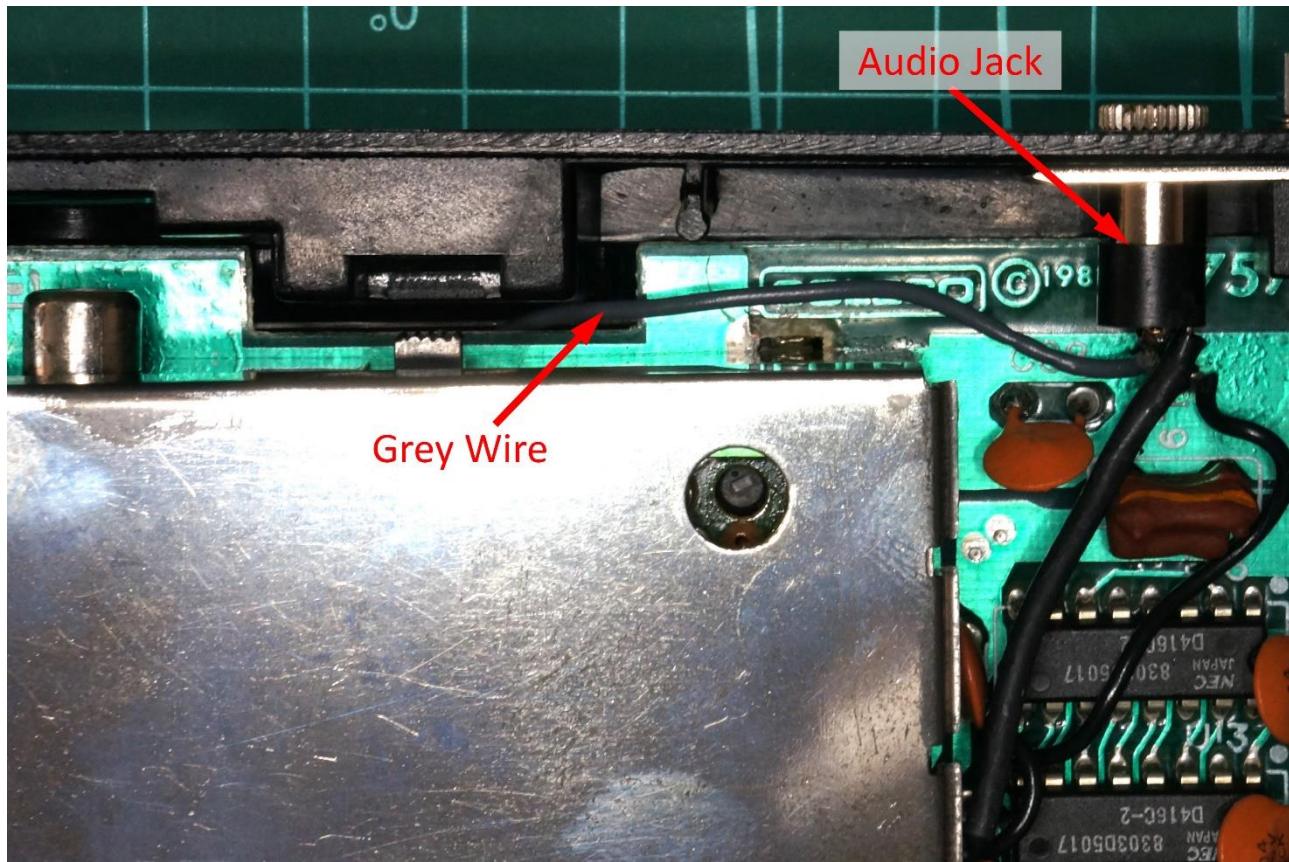
Also ensure that the grey wire at the top of the motherboard passes through the recessed portion of the motherboard and again isn't pinched between the motherboard and the RF shield (refer to the photo on the next page).

Screw the motherboard down with the two screws that were removed during disassembly. Also slide the original ColecoVision power receptacle back into its original location.

The photo below shows where the pause mod wiring and associated Molex connector should be.

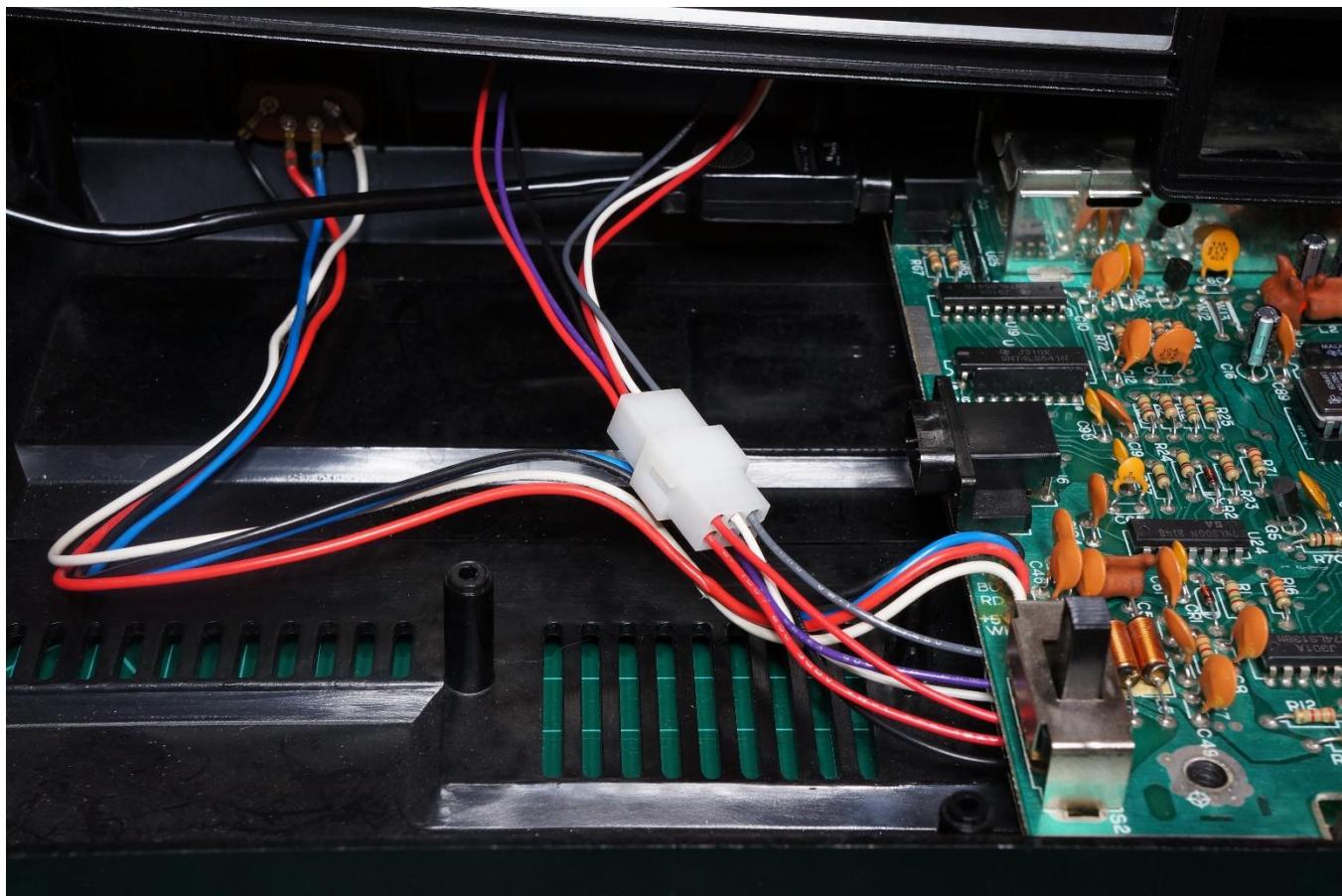


Now reinstall your audio jack if you're using one. The example below shows a 3.5mm TRS headphone jack mounted to the ColecoVision's bottom housing.



Step 9: Test Pause Mod

Place the top housing, that contains the pause PCB you installed in Step 5, over the bottom housing and connect the two pause mod Molex connectors together. They only fit in one orientation so there's no need to worry about them being connected the wrong way around.



Connect your ColecoVision to a power supply, a TV/monitor and also plug a standard controller into the Player 1 joystick port. Now, insert any game cartridge into the cartridge slot on the motherboard and turn on the ColecoVision.

Verify that the pause mod LED lights up and is continuously lit to indicate that the system is powered on and is not paused.

Start a game and when there is plenty of action onscreen and sound/music move the pause switch up into the pause position.

Verify that the pause mod LED starts to flash and that the game action and sound/music stop.

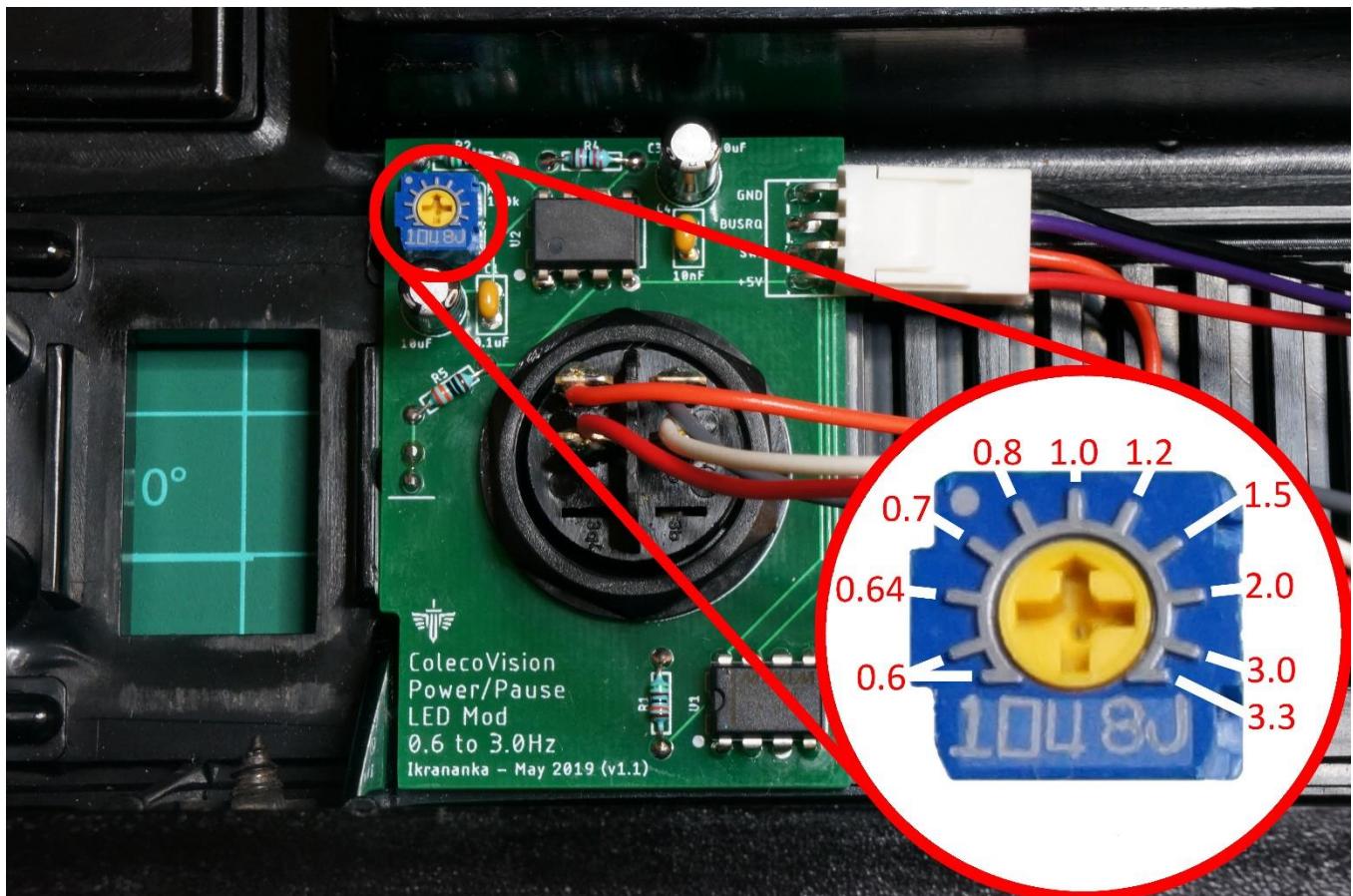
Step 10: Adjust Pause LED Flashing Frequency (optional)

Is the pause LED flashing frequency to your liking? If not, then continue reading for instructions on how to adjust the frequency. Note that currently the text on the pause mod PCB indicates that the pause frequency can be adjusted to anywhere between 0.6 to 3.0 Hz. Unfortunately, this isn't quite correct and should in fact be:

LED Flashing Frequency Range : 0.6 to 3.3 Hz

To adjust the flashing frequency, simply turn the dial on the pause mod potentiometer highlighted in the photo below. This photo also provides an approximation of the flashing frequency at each of the graduations around the dial.

Note that if you'd like a much wider frequency range then this can be achieved by replacing the 22k ohm (R4) resistor with a lower value (see technical section below).



Technical

If you're interested in changing the frequency range of this mod then the following equation can be used to determine the value of R4 to use.

$$\text{Frequency (Hz)} = \frac{1.44}{(150 + 2 * (\text{R3} + \text{R4})) * 0.00001}$$

Where:

R3 = Potentiometer resistance (ohm)

R4 = Resistor R4 resistance (ohm)

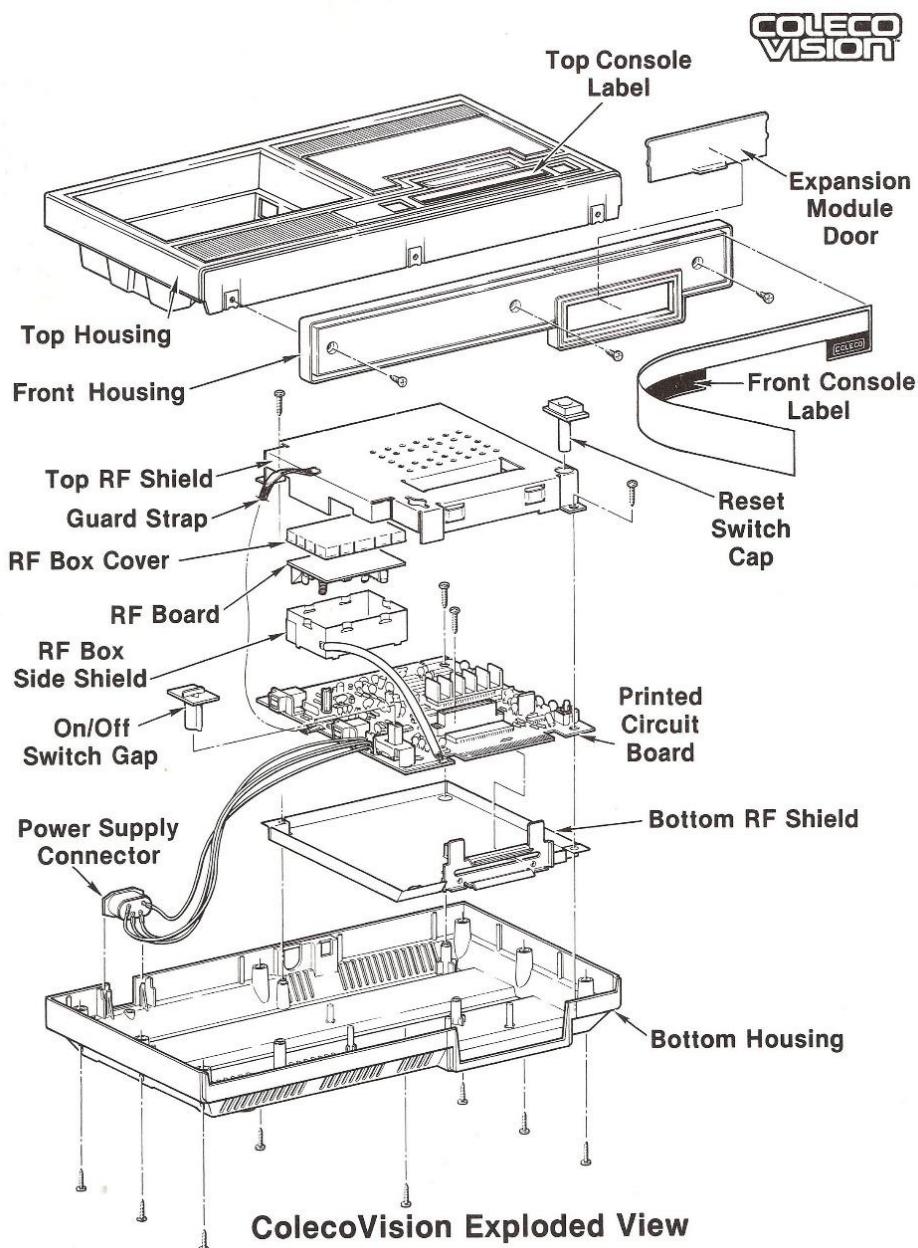
To determine the minimum frequency set R3 to 100,500 ohm (dial fully anti-clockwise)

To determine the maximum frequency set R3 to 0.3 ohm (dial fully clockwise)

Step 10: Reassemble ColecoVision

As for disassembly, I will simply state here the reassembly directions given in the official ColecoVision Technical Manual. The bottom RF shield and motherboard have already been reinstalled in the step above.

1. Replace ground strap and top RF shield with screws and solder as.
2. Replace reset switch and on/off switch caps. Double check, at this point, to make sure the reset switch is in place.
3. Place the top housing over the bottom housing and connect the pause mod Molex connectors together.
4. Replace top housing.
5. Turn unit over and replace eight bottom screws.
6. Turn back over to the original upright position and test your ColecoVision.



The Finished Article



Hole Template

The hole template can be found on the next page. Print at 100% size without scaling.

