

# TZX Cassette Mod Guide

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V0.1

(Draft)

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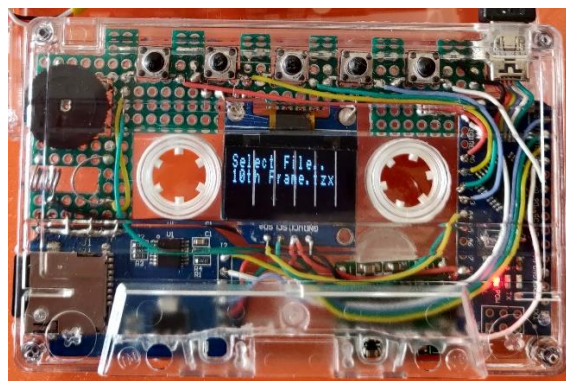
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## Overview, Design and Build Notes

### Overview

#### What is a TZXDduino?

This is a very clever piece of kit. It uses an Arduino, SD Card Reader, amplifier and display to work as a virtual tape deck. It creates the best balance between authenticity and convenience for loading software onto a ZX Spectrum. This was created by Andrew Beer, and is maintained by Duncan Edwards. My thanks go out to them as this is a great device and very useful.



The finished build used in this documentation

This TZX Cassette Mod document is a guide for putting TZXDduino/MaxDuino/Arduitaape hardware into a Cassette Tape. This is only a modification of the existing form factor so the firmware and technical elements are unchanged. For updating the firmware, the TZXDduino Blog page should be consulted. There is a small change to the code as the screen needs to be fitted upside down and this is documented on Page 19

<http://arduitape.blogspot.com/>

#### Why did I do this?

There are some smaller components available now than when the device was conceived, and I built one just to see if it could be done. I posted this to the Spectrum for Everyone FaceBook forum and it proved to be very popular with people saying that they wanted one too.

I built another couple and found a method for reliably fitting it all in so I have documented the build in the hope that others can have one of these too.

Having an SD loader device in a cassette tape just seemed 'right'. They look cool and store away in a standard cassette case which I think is pretty nifty. 😊

## Design and Build Notes.

Most cassette cases have a depth of around 4.5 mm so this presents the greatest challenge. There are workarounds for this, and they are listed below.

### **Arduino**

The Arduino I used is 7mm tall with the USB port intact. This will either need to be relocated or an alternative Arduino should be sought.

### **Headphone socket**

I could not find a commercially available headphone socket that was slim enough so a custom port will need to be fashioned. An alternative for this would be to have a cable running from the case to carry the signal to the computer.

### **Case selection and trimming.**

Select a Cassette Tape of low value/rarity that has screws, This will aid in sealing up the unit and making later changes. Ultrasonically bonded cases are not suitable for this as it is difficult to disassemble these without cracking. Rotary tools are too aggressive for Cassette cases as they are comparatively fragile so I recommend the use of small hand files and a lot of patience.

### **To glue or not to glue?**

I use a spare PCB, cut to size and solder tabs to 'lock' the components in place. The PCB ends up being quite thin in places and the whole build would be easier if hot glue is used. This is an option you may wish to take advantage of.

### **Amplifier or not?**

I have not needed to use the amplifier to successfully load games but there are apparently some hard of hearing machines that need this so I have it included in the plans. The audio pin (09) on the Arduino can be wired straight to the middle pin of the potentiometer should this be omitted. There is a version for the 128k +2 outlined later in the guide that will need an amplifier to drive the sending head.

### **+2 Version?**

Of course there is! The +2 is great! There is an addendum at the end of this guide that shows how to use an in car cassette adapter instead of a standard Cassette Tape. This will load software via the play head in the +2 as there is no other audio input.

## Any final tips?

- Care is critical for this project, it is possible to destroy the components if wired/modded incorrectly. I, of course take no responsibility for this. 😊
- Keep checking the fit as you go.
- Don't solder the components inside the case, the cases are really thin and they'll melt.
- Test that the components work first. It may help to build it outside the case first to ensure it works as expected.
- Solder wires over the top of the pads and not through, this will enable a flatter profile for the wiring which is critical.
- Be neat! Route your wires carefully, the thickness really stacks up when wires cross each other.

## Part List.

These are only suggested parts, there are several clones/alternatives that are pretty much the same. Silicon sheathed wire is best for redirecting the USB port as the sheathing does not shrink back when heated.

30 AWG Wire

<https://www.amazon.co.uk/TUOFENG-Elec...>

0.96" I2C IIC 12864 128X64 Pixel OLED LCD Display

<https://www.amazon.co.uk/gp/product/B...>

Arduino Nano V3.0, Nano board CH340/ATmega328P

<https://www.amazon.co.uk/gp/product/B...>

Micro SD Card Reader Module 5V Card Adapter for Arduino.

<https://www.amazon.co.uk/gp/product/B...>

B103 Potentiometer

<https://www.amazon.co.uk/16mmx2mm-Ste...>

Tactile Switches

<https://www.amazon.co.uk/Andux-Switch...>

Double Sided Perfboard

<https://www.amazon.co.uk/gp/product/B...>

Super Mini PAM8403 Digital Power Amplifier Board 2 \* 3W

<https://www.amazon.co.uk/dp/B00LODGV64/>

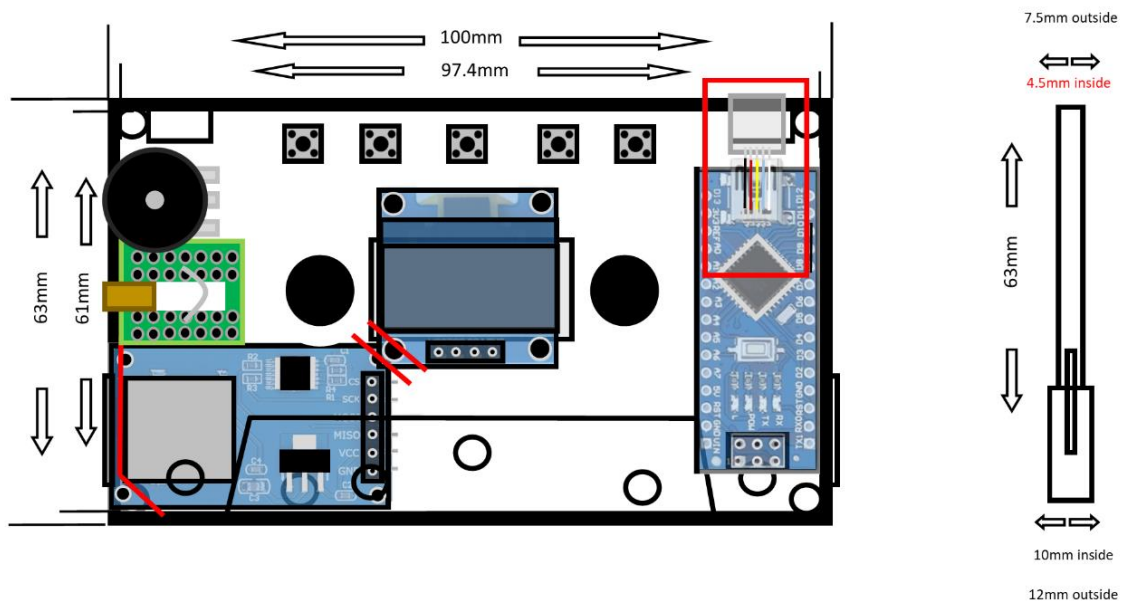
+2 Version:

Car Cassette Adapter

<https://www.amazon.co.uk/DIGITNOW-Cassette-Adapter-Smartphone-through-Black-1/dp/B01I02WT94/>

## Overall Layout.

Once you have selected your case and have it open. Put the internal parts of the cassette, spools and screws aside for later. I have designed the layout have room for the components and to leave plenty of space for wires



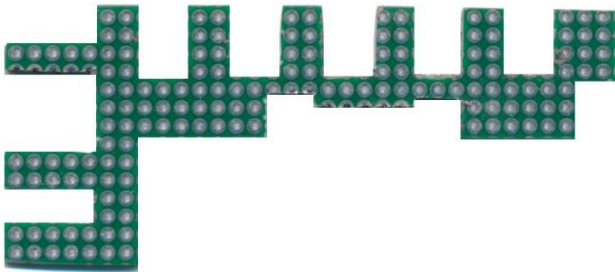
I recommend uploading the firmware now whilst the device is unmodified. This will aid in any required diagnostics later. When updating the firmware, please make the change in the code to rotate the screen as this needs to be fitted upside down for the build to work. This is documented on Page 19

## The PCB and Case.

Trim a PCB in the shape shown ensuring it locates snugly in the top left of the case. This will be for the switches, headphone port and volume control.

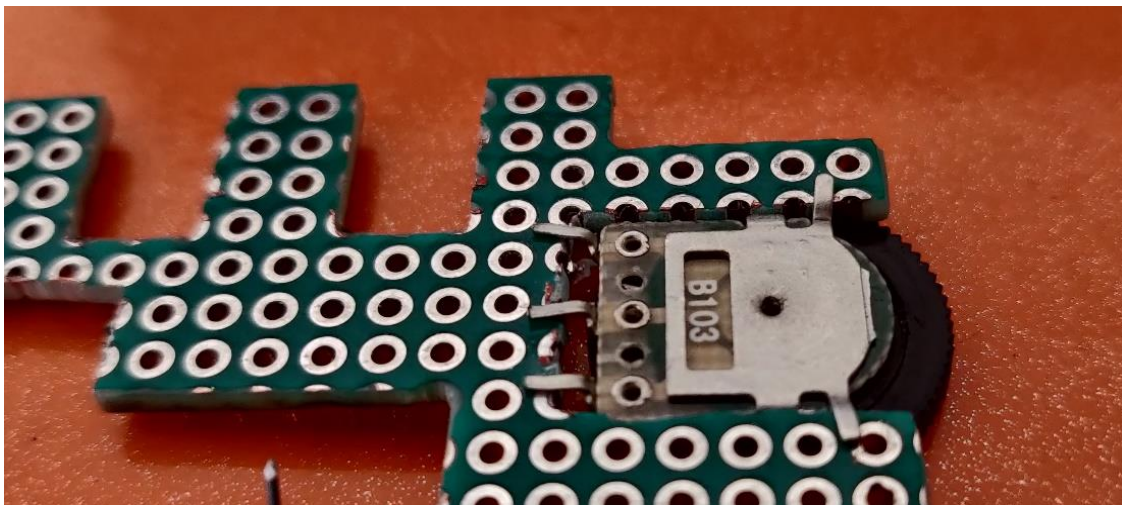
The cut-outs are to ensure that the parts fit 'inside' the PCB. When mounted on the surface, they are just that bit too tall so sinking them into the PCB will help with this. If you can find switches that have a lower profile you can skip the 5 notches at the top.

Alternatively, you can skip this step and use hot glue.



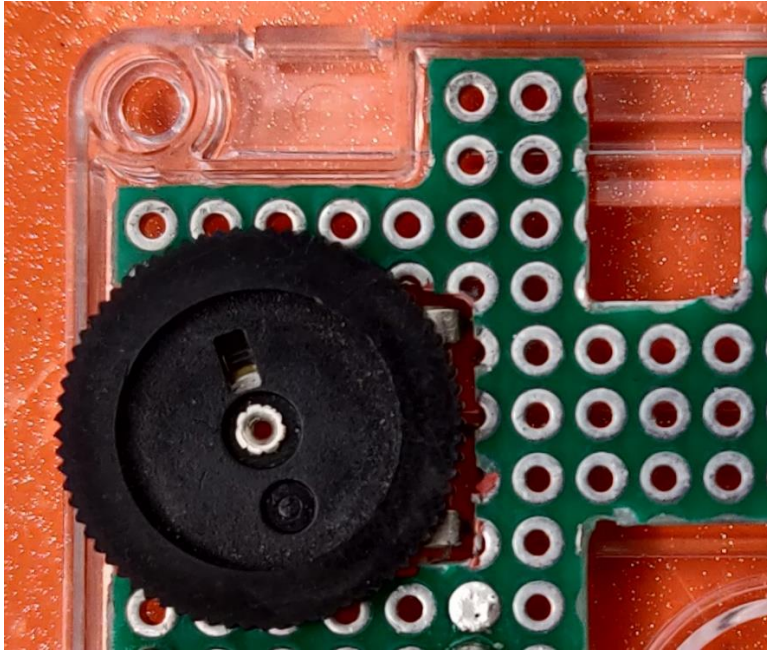
## Volume Control.

Place the volume control inside the cut-out of the PCB, making sure that there is room for the wheel to rotate.

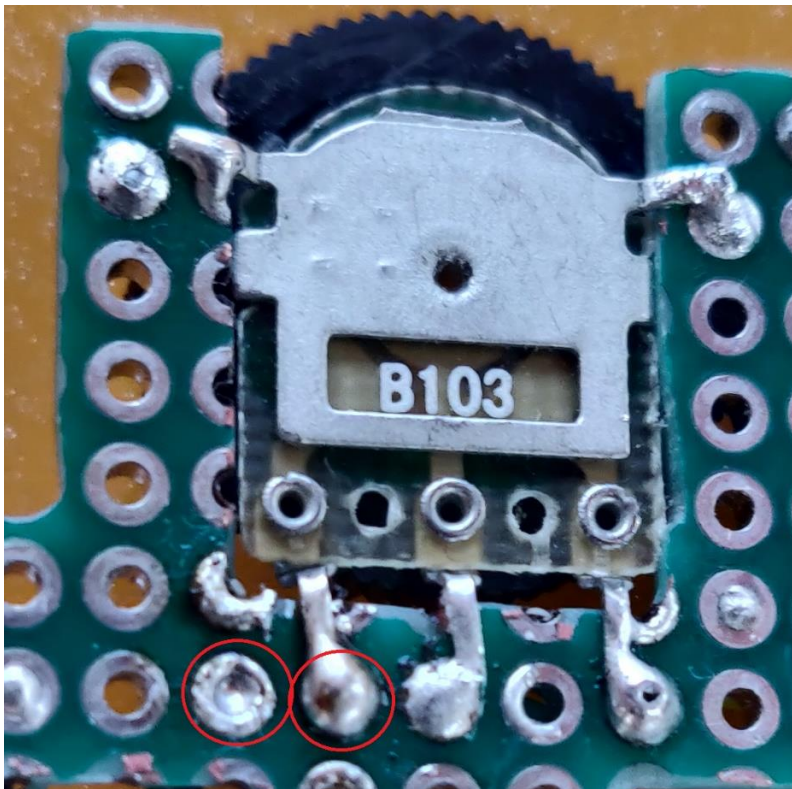




Before soldering, adjust the position of the volume wheel so that it only just sticks out of the case.



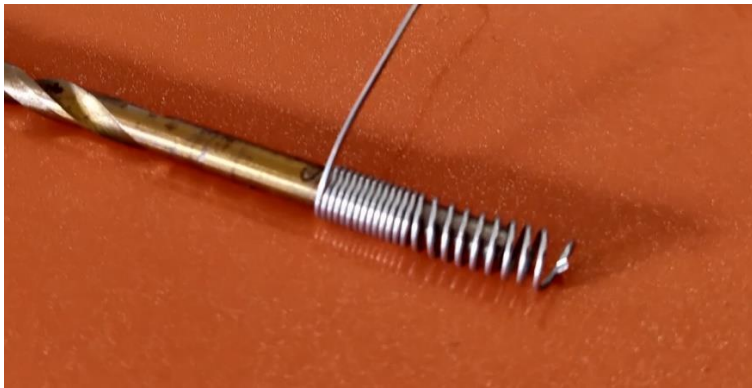
Once Adjusted, solder it in place, and take care that the tabs are flat to the board and not to bridge the contacts as shown:



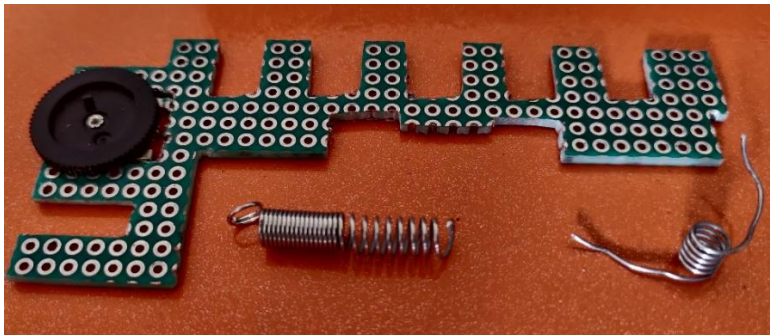


## Headphone port.

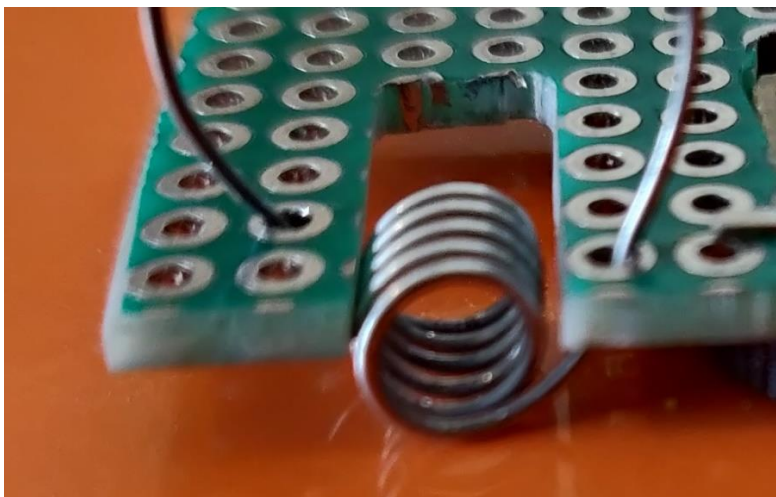
Use an old steel spring that has a 3.5mm inside diameter, if it is smaller than this, you can 'Unwind it' to the right diameter by putting it on a 3.5mm drill bit shaft and twisting



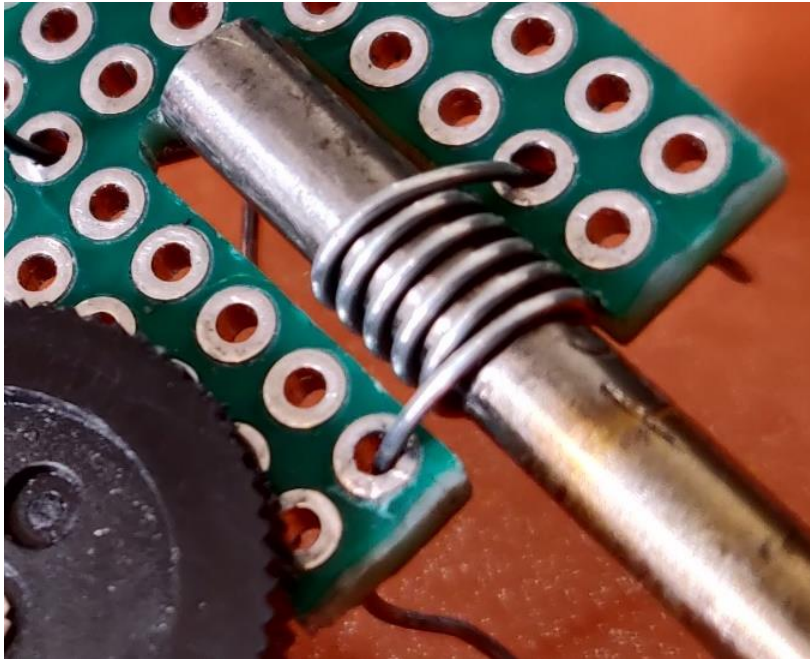
Cut and trim the spring as shown on the right:



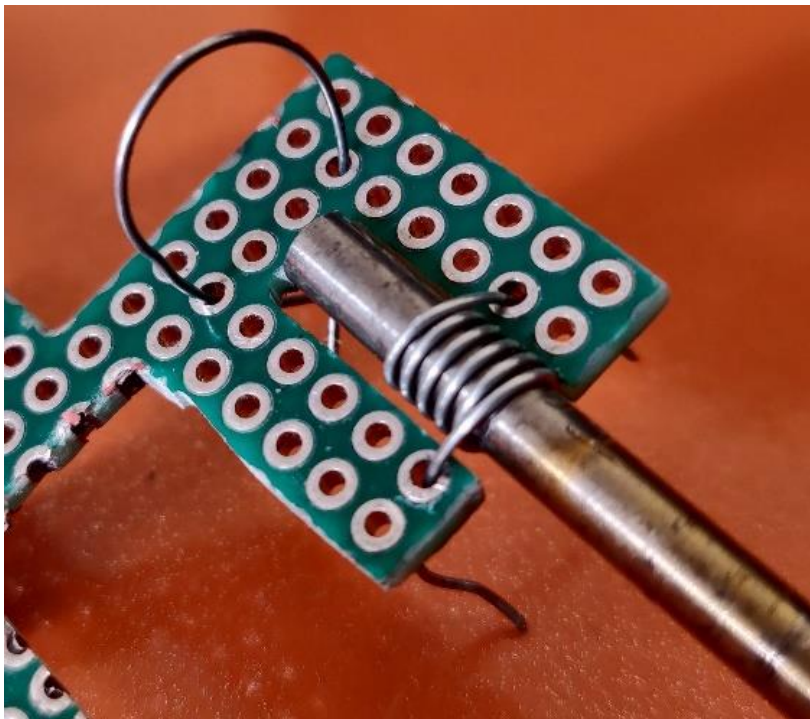
Place the modified spring into the PCB



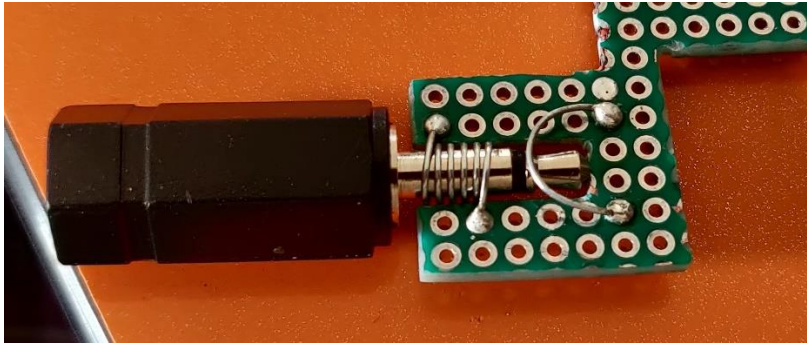
Solder the spring in place so that it sits level with the bottom of the PCB, using a 3.5mm drill bit to keep it located whilst soldering will help.



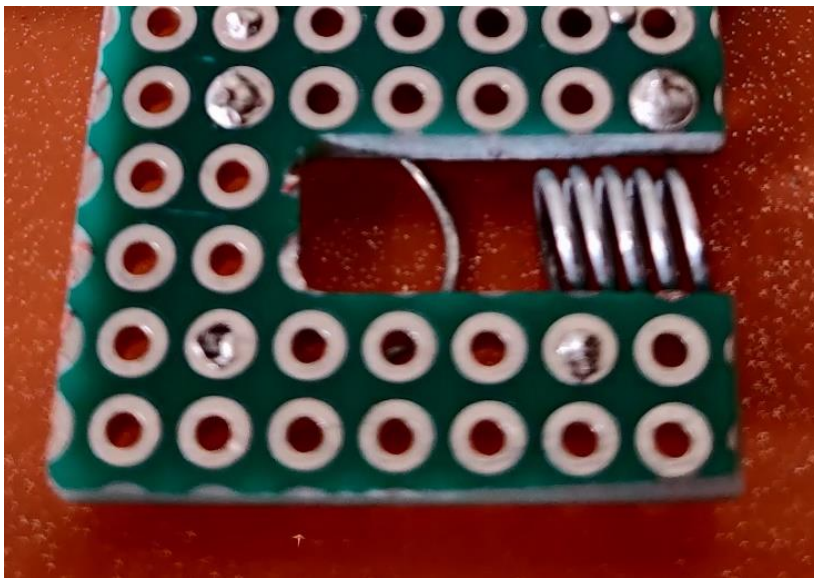
Create a second loop of wire and place it in the PCB as shown,



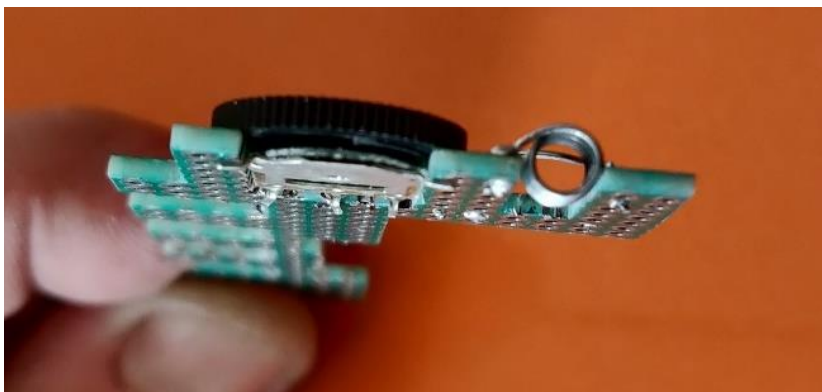
Adjust the loop until it contacts the tip of the plug and solder it in place. You can adjust the tension at the tip to create a loose/snug fit after soldering.



Trim the underside of the board flat.



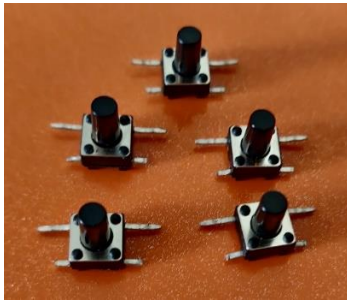
You should now have a nice, flat profile.





## Switches.

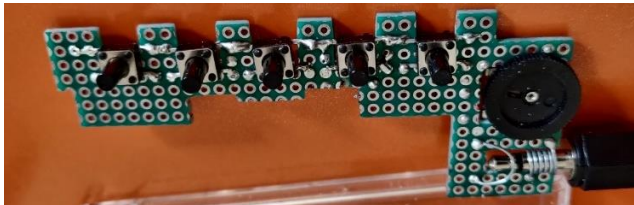
Trim the switches as shown, this will help you save wires later by having a ground rail:



Solder them in place making sure that the switches sit inside the dips in the board. If soldered on top of the board, they may not fit inside the case.



Once soldered, they should look like this

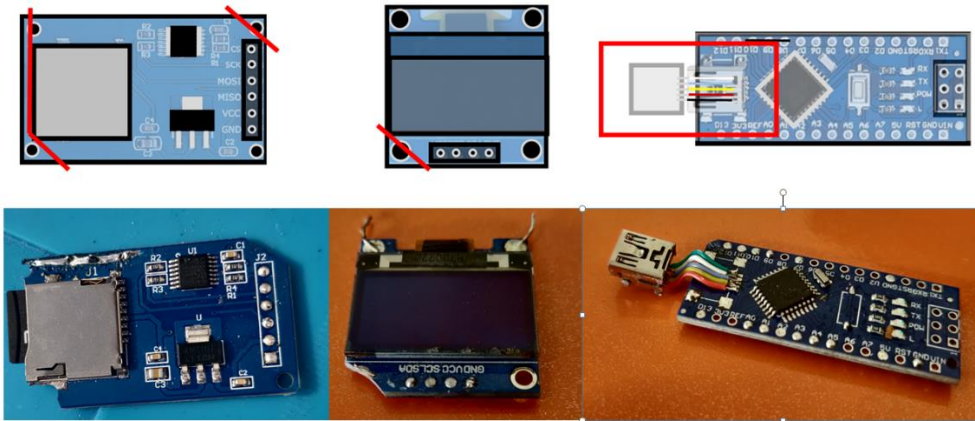


File the case to make room for the components and test fit.

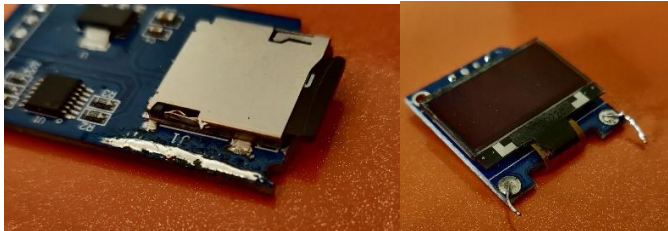


## Component Trim, Prep and Fit.

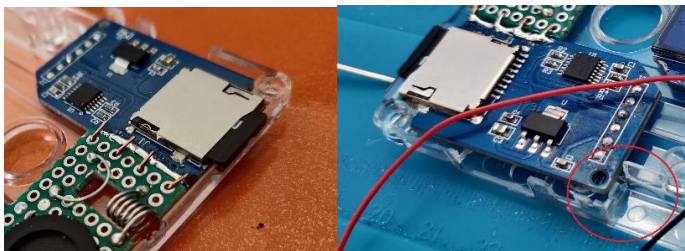
Trim the red edges and remove the pin headers from the display and SD Card Reader. Make sure that the areas of the PCB are not populated or have tracks on them or this will cause it to stop functioning. Remove the reset switch and extend the USB port.



Scrape some of the insulation from the SD card reader and put some solder there. I used tiny copper wire 'tabs' to hold things in place, if you would like to do this, solder this now. If you're using hot glue then you can skip this part.



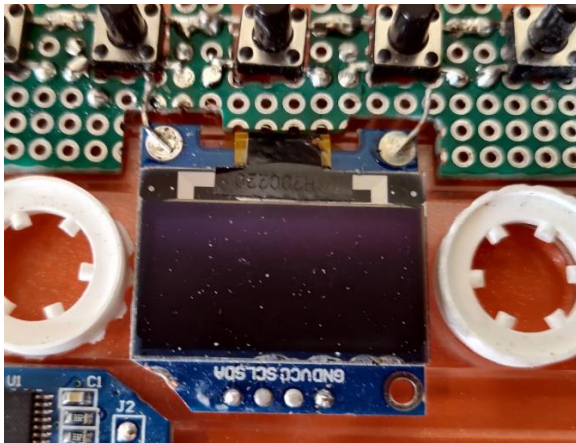
Trim the case to allow for the SD Card reader to sit flat at the bottom (refer to the overall layout, trim the top and bottom case) and use copper wire to join this to the PCB. This will hold the reader in place. You can use the case to hold the reader in place if you trim the it as shown in the second diagram (Shown in red circle). Once adjusted for fit, solder these together.



Fit the top case and file a slot for the SD Card Reader in the top case: Go slowly and ensure an SD Card slides in and out without snagging.



Use the tabs on the Display to fit it to the PCB. Fit the top case and adjust it until it lines up with the window of the cassette tape. This is upside down as it is a better fit, this will be changed in software later.

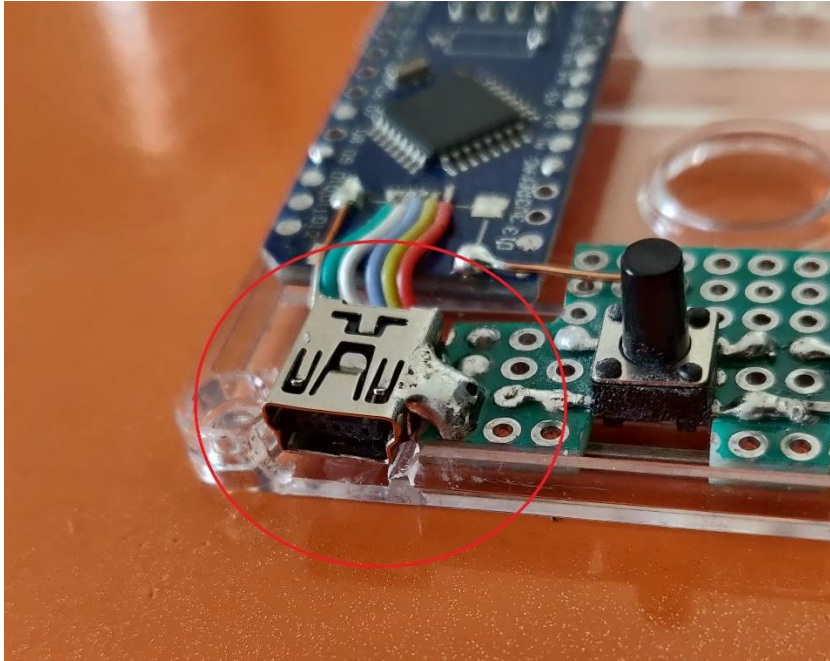


Trim the case (top and bottom) to fit the Arduino on the right (refer to the overall layout). File a hole in the case for the USB port.



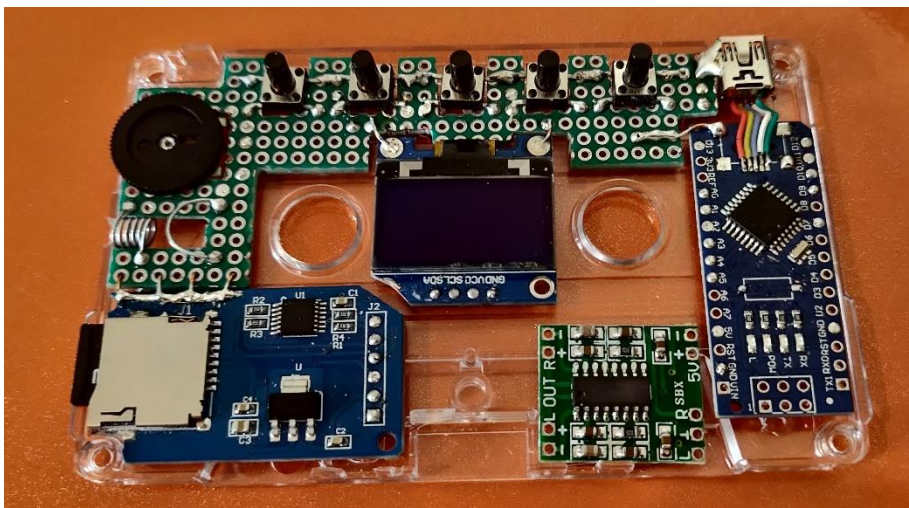


Once lined up, solder the port to the PCB. This will hold it in place. If you are using hot glue, skip this step.



Trim the case to fit the amp in place (If you're using one) and perform another test fit to ensure that the volume slides easily, the USB port can be used and the switches all click. I advise testing that the Arduino USB port works at this point as this will help to diagnose any issues later.

If you have got this far, congratulations! It's just wiring and tweaking from here on in!





## Wiring

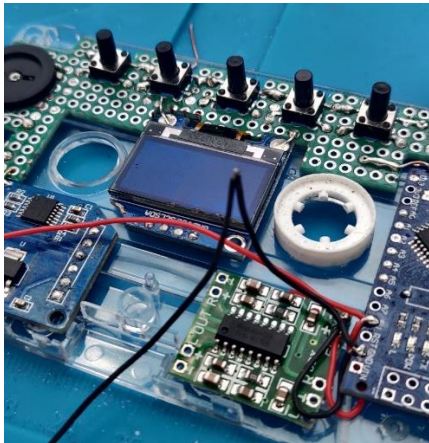
The wiring is the same as pretty much every TZXDduino device and the details are here:

<https://github.com/sadken/TZXDduino>

As mentioned, wire mounts up when you have 4.5mm to work with and you can follow the original pinouts and skip this section if you wish but using the wiring guide will ensure you can fit everything in. It can potentially get really messy really quickly and this will obstruct the case when you are trying to close it up.

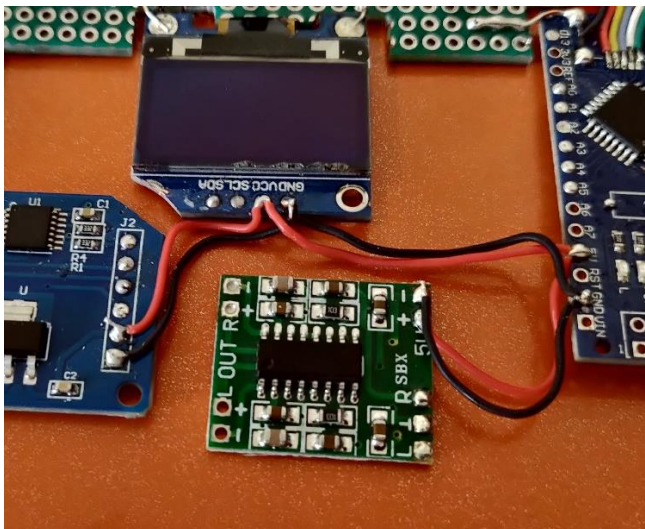
## Power.

I used a continuous wire for the +5v and ground and split the sheath (as shown) to 'daisy chain' the powered components together



- Solder a (Red) wire from 5V on the Arduino to VCC/5v on the amp, SD Card Reader and Display.
- Solder a (Black) wire from GND on the Arduino to GND on the amp, SD Card Reader and Display.

Route the wires as shown, perform a test fit of the case to ensure the wires are not snagged.



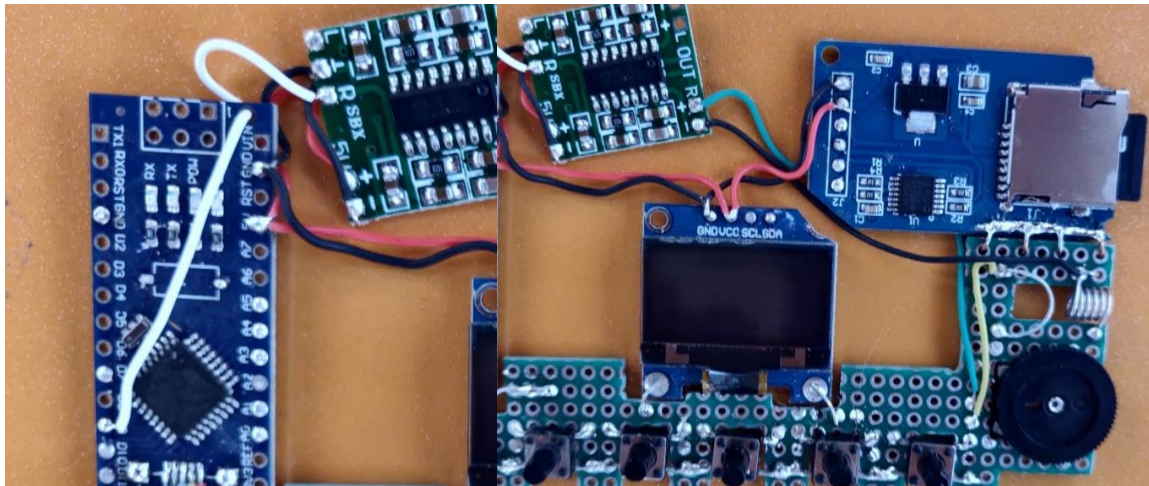
## Sound

- Solder a (White) wire from pin 09 on the Arduino to 'R' on the Amplifier, as the device is Mono, only one channel will be used.
- Solder a (Green) wire from R+ on the Amplifier to the Middle pin of the volume wheel.
- Solder a (Black) wire from R- to the spring in the headphone connector (-).
- Solder a (Yellow) wire from pin 3 of the volume wheel to the loop connector in the headphone connector (+).

Route the Black and Green wire between the SD Card Reader and the display.

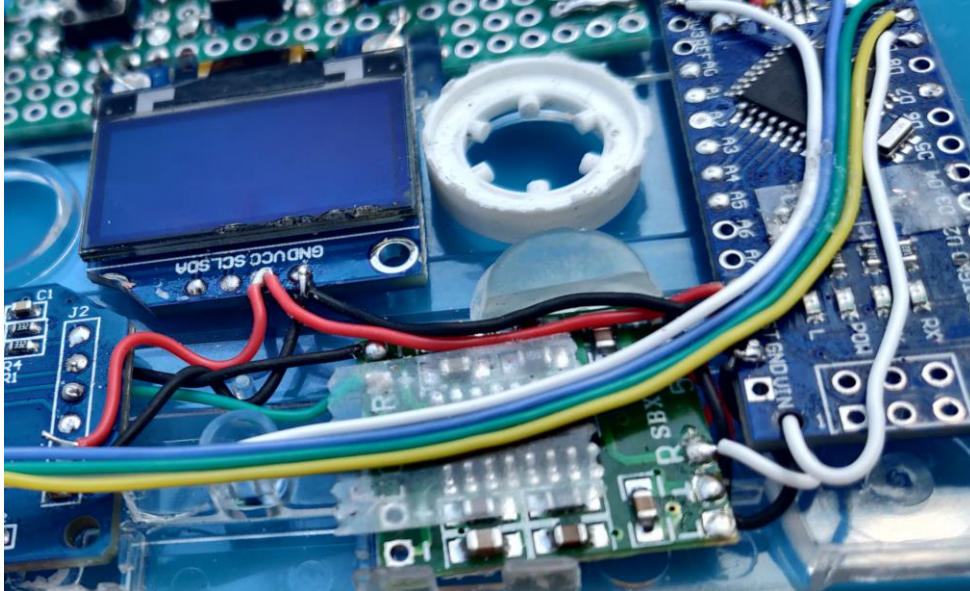
\* If you are not using the amplifier, solder a white wire from Pin 09 on the Arduino to the middle pin of the volume wheel.

\* If you are making a version for the +2, solder the green wire to the L and R of the tape head and the black wire to the ground of the tape head



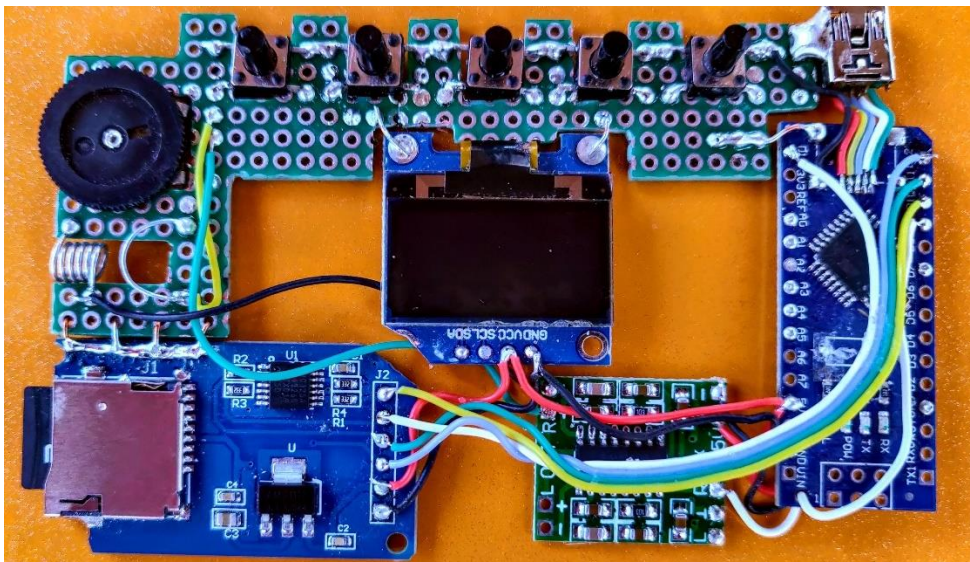
## SD Card Reader

To keep the profile of the wires low, I used a small amount of double sided tape to hold the wires in place after they had been routed and then placed a very small dot of superglue to create a ribbon cable. Once dried, remove the tape and the cable will stay in place but still be moveable.



- Solder a (Yellow) wire from Pin 10 on the Arduino to SDCS on the SD Card Reader.
- Solder a (Green) wire from Pin 11 on the Arduino to MOSI on the SD Card Reader.
- Solder a (Purple) wire from Pin 12 on the Arduino to MISO on the SD Card Reader.
- Solder a (White) wire from Pin 13 on the Arduino to SCK on the SD Card Reader.

Route the wires as shown, and perform another test fit to ensure there is no snagging.

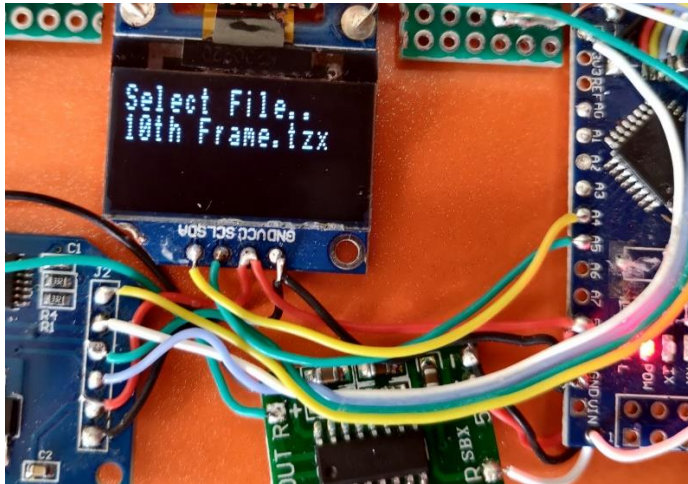




Display:

- Solder a (Yellow) wire from Pin A4 on the Arduino to SDA on the Display
- Solder a (Green) wire from Pin A5 on the Arduino to SCL on the Dis

Route the wires as shown.



Now would be a good time for another test fit and to power it on to make sure the display and SD Card Reader are working as expected.

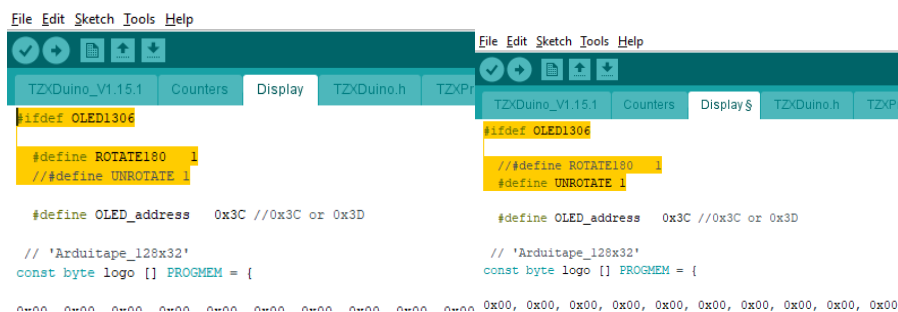
As the screen is upside down, you will need to make a change to the code in the TZXDduino so that the screen is the right way up.

In the display tab of the code, change

```
#define ROTATE180 1
//#define UNROTATE 1
```

To

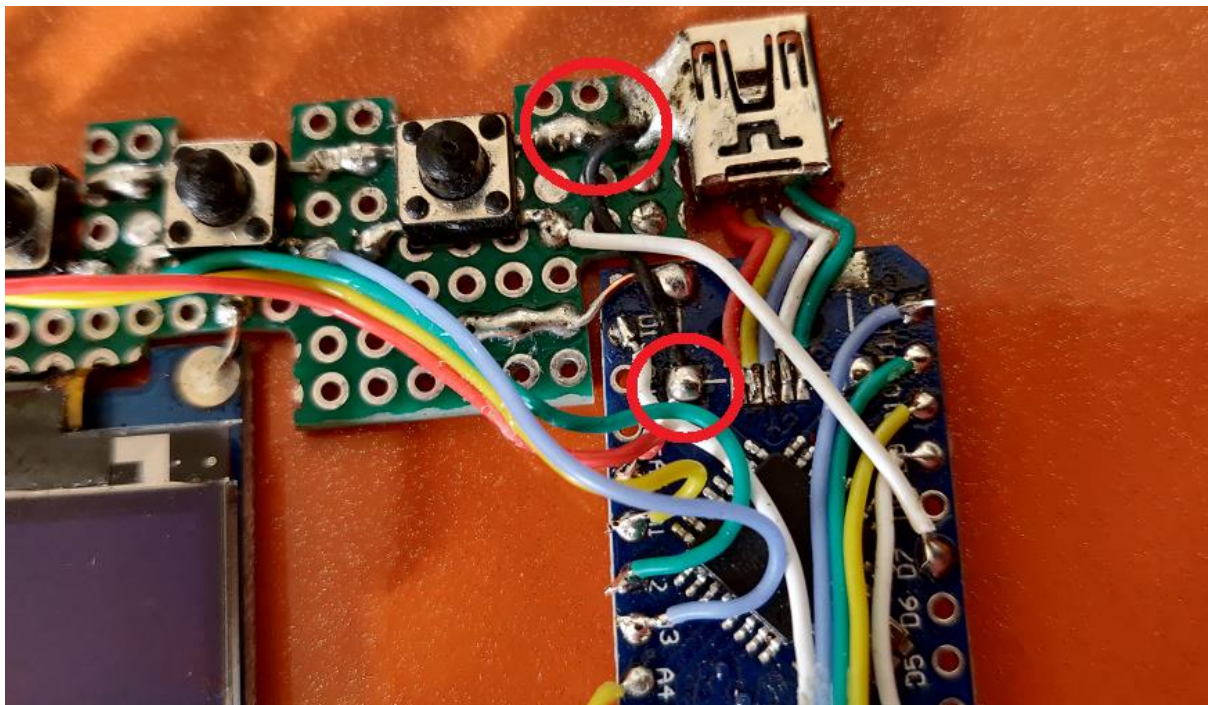
```
//#define ROTATE180 1
#define UNROTATE 1
```



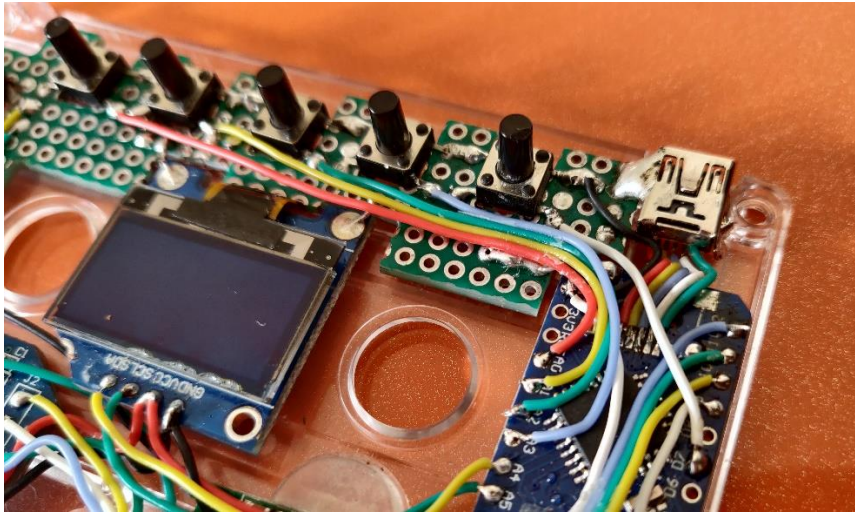
## Buttons .

Either contact on the bottom of the switches will work.

- Solder a (Red) wire from Pin A0 on the Arduino to the first switch (Down).
- Solder a (Yellow) wire from Pin A1 on the Arduino to the second switch along (UP).
- Solder a (Green) wire from Pin A2 on the Arduino to the third switch along (STOP).
- Solder a (Purple) wire from Pin A3 on the Arduino to the fourth switch along (PLAY).
- Solder a (White) wire from Pin D7 on the Arduino to the fifth switch along (ROOT).
- Solder a (Black) wire from one of the Pads left from where you removed the USB port to the ground rail of the switches.



Route the wires as shown.



Now would be a great time to test fit the case and run through a quick checklist

- Button function
- Display
- SD Card Reader
- Audio

To test the audio, I used a Gameboy speaker on a 3.5mm mono plug.

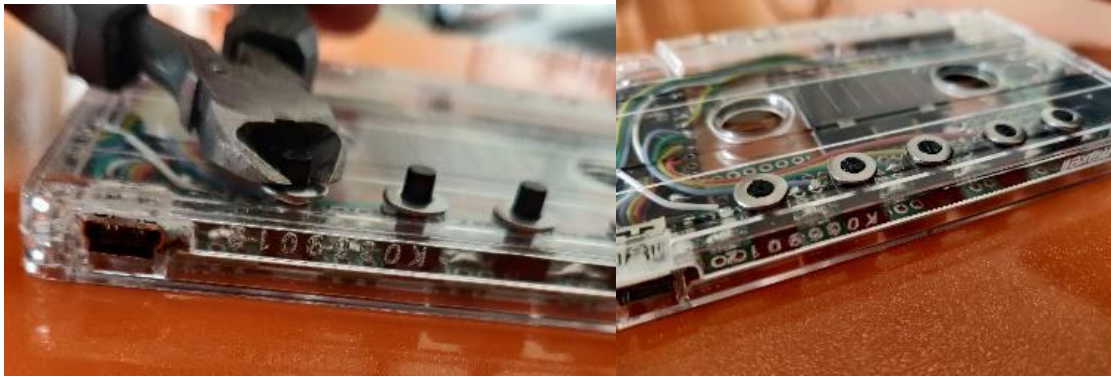
If everything went well, screw it together and load some games, you're done! 😊



## Finishing Touches.

If you're in a fussy mood there are some extra touches you can add,

I put washers over the buttons to get the height right and then snipped the top off with side cutters. I then gently sanded the tops of the buttons for comfort.

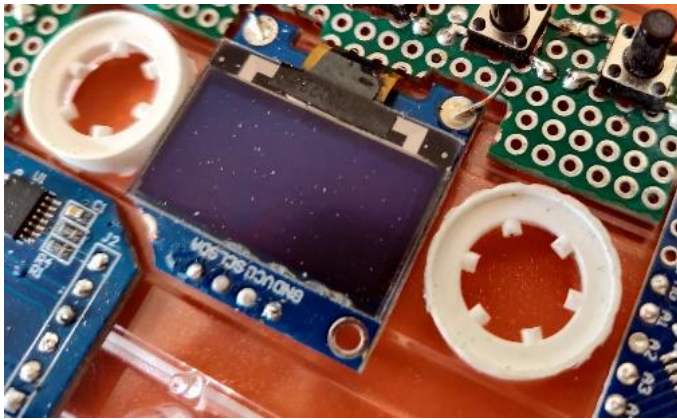


I used a half a self-adhesive rubber foot to hold the amp in place.

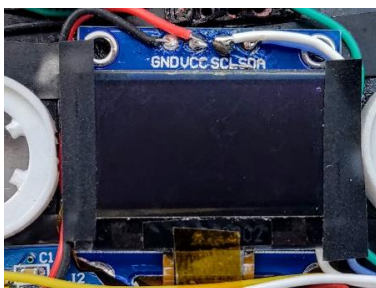




I trimmed down the spools to fit, this really works well in a Black case.



The windows in some tapes are slightly too wide so masking this area off with tape makes it look nicer.



## Addendum- +2 Modification!

The +2 doesn't get enough love so I made a version especially for them.

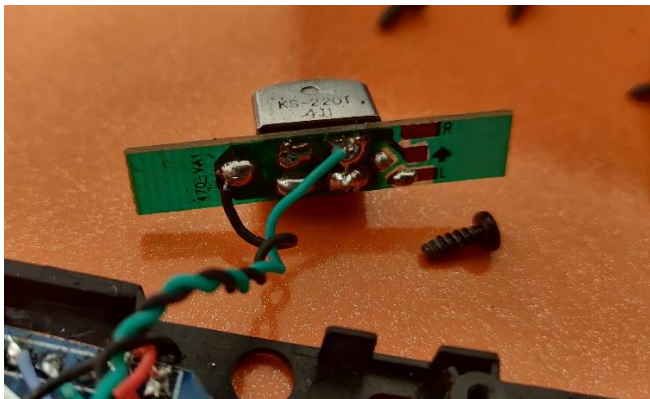


This only describes the changes required from the steps above to adapt one for a +2 this part of the guide is 'Bare bones' guide, not a detailed step by step so some experience is assumed (and required!) on behalf of the reader.

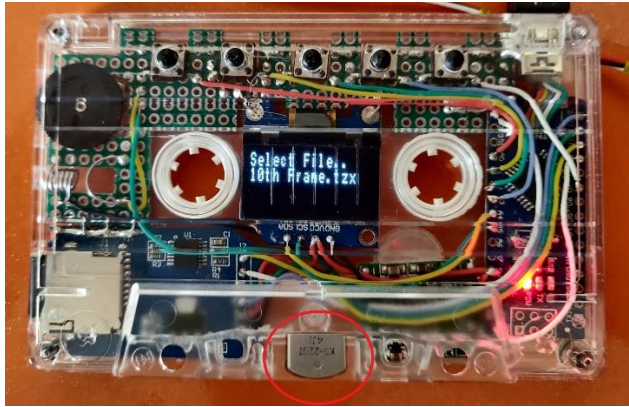
Get a standard car cassette adapter, remove the internals, and fit all of the TZXDduino parts except the headphone socket.

### Audio:

Instead of wiring to the headphone socket, connect it to the sending head of the adapter. Black would go to negative or ground and join the left and right channels on the head and solder the yellow wire to it,

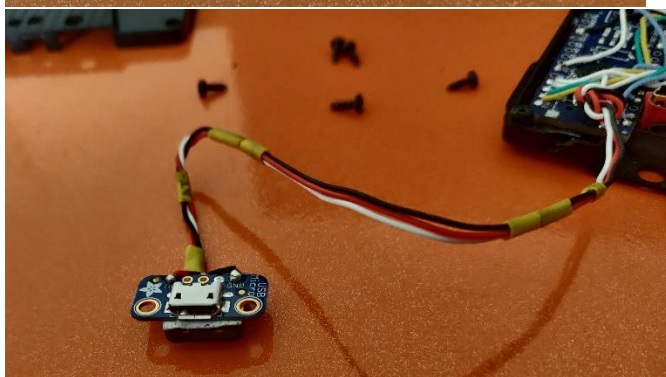
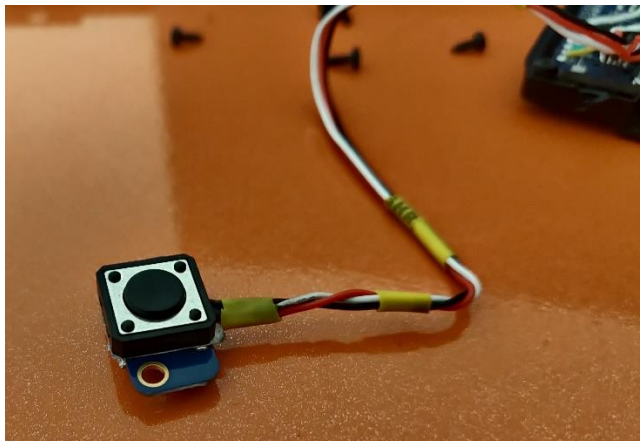


When used in my ZX Spectrum +2 Issue 3 (Grey) this works at the correct level without needing to press play on the tape deck. This means that you can omit the spring mechanism and fix the sending head in place, saving room. A mock-up of how this would look in the documented build is here:



### Remote power and play.

As the cassette is inside the machine, power and control are an issue. To counter this, I have made a remote of sorts which is a tactile button and a Micro USB port. Power and ground are connected to this port and to the Arduino (USB 5v & Ground) via a wire and the tactile switch is connected to ground on the controller and to pin A3 through the wire.



I'll update if there is a need for more details on this and I get some more parts. Good luck with your build and I'd love to know how it goes!