

TZXCassette Mod Guide

Stuart Brand

V0.2

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Overview, Design and Build Notes

Overview

What is a TZXCassette?

This is a modification of a TZXDuino/Arduitaape device that condenses the original design to fit inside the shell of a cassette tape, allowing ZX Spectrum +2 machines to load software from an SDCard . The +2 does not have a line in and cannot use the existing TZXDuino/Arduitaape without a cassette adapter.

Okay then, what is a TZXDuino?

This is a very clever device that uses an Arduino, SD Card Reader 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. The TZXDuino 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 (Mmmmm... shiny!)

This TZX Cassette Mod document is a guide for putting TZXDuino/MaxDuino/Arduitaape hardware into a Cassette Tape. This is only a modification of the existing form factor, the firmware and technical elements are unchanged. For programming/updating the firmware, the TZXDuino Blog page should be consulted.

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

Why did I do this?

There are smaller components available now than when the device was conceived, and I built one just to see if it could be done and as a means of reducing stress on the mechanical components of the DataCorder, these things won't last forever.

I sent an innocent tweet with a video of it working which became 'quite popular'. This has spurred me on to write this guide.

I have built a few now and from iterative improvements, have made this easier to build and so that this works as a standalone unit.

Design and Build Notes.

Most cassette cases have a depth of around 4.5/5.0mm 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. I have alternate solder points to use as the previous wiring used the original contacts on the PCB and is fiddlier than it needs to be.

Case selection and trimming.

I have found a great source for Cassette tapes (<https://tapeline.info/v2/index.php>) these give 5mm depth, have a range of styles and is an ethical source so no original tapes will be harmed (unless you want to of course!) It is possible to crack the bonded ones open but I recommend going with screwed together cases.

To glue or not to glue?

The design uses Gorilla clear tape, it's the right thickness, *really* sticky and looks nice. The layout is designed so that parts 'butt up' against each other but hot glue would be easier. The tape cases are sensitive to heat so I would advise testing hot glue first to ensure that it doesn't warp the case.

Amplifier or not?

The original Hardware uses an amp for some models. As this is going through a cassette adapter head this is no longer required as it has more than enough oomph to transmit to the receiving head.

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, soz.
- Keep checking the fit as you go.
- Take care when soldering the components inside the case, the cases are really thin and they'll melt. The addition of Gorilla Tape creates a thermal barrier to allow soldering the parts when in place and helps with the layout.
- 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.
- Wipe parts with Isopropyl alcohol before adhering the tape. This will ensure a good bond.

Be patient, these are tricky to build and a misstep will cost you a lot of time. If you feel the urge to rush when you have that 'nearly there' feeling, take a walk, have a coffee, and come back to it. I like to think that when the parts are in place and soldered, I am only half way there as the bulk of the time is taken in closing the case.

Personal tips.

My personal method is to try to stay calm during the build. These builds are far easier now I have a method and it helps to know that it is possible to do. I use these tricks to keep my patience levels high.

Put some music on.

I will put some headphones on and listen to something calming while I work.

Take breaks.

Walk away every now and again and allow your eyes to refocus and stretch. It also helps to take a moment to consider your next steps.

Use all the tools you can!

I have fat fingers so weave wires with tweezers, I also have a set of helping hands with magnification and lighting.

Stick the wiring guide to the wall.

I have a copy printed in large font on a wall, I use that to refer to and it'll stretch my eye muscles by focussing on the distance.

Mantra for the frustrating parts.

I'll recite this in my head, and take some deep breaths when my patience is wearing thin.

"If a string is in a knot, patience will untie it. Patience can do many things, did you ever try it? If it was sold at any shop, I should like to buy it, but you and I must find our own, no other can supply it."

Part List.

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

30 AWG Silicon Wire

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

TP4056 Lithium Battery Power Charger

<https://www.amazon.co.uk/gp/product/B0778Z9TFH/>

0.96" I2C IIC 12864 128X64 Pixel OLED LCD Display.

<https://www.amazon.co.uk/AZDelivery-Display-160-Pixels-0-91-OLED-Raspberry/dp/B07FYG8MZN>

Arduino Nano V3.0, Nano board CH340/ATmega328P

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

Micro SD Card Reader Module 3.3V Card Adapter for Arduino.

<https://www.amazon.co.uk/gp/product/B07XLKNCCF/>

Tactile Switches if you're drilling the shell.

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

Tactile Switches for hidden button option.

<https://uk.rs-online.com/web/p/tactile-switches/0255667/>

Upgrade Option, super sensitive play switch.

<https://uk.rs-online.com/web/p/tactile-switches/1789276/>

Double Sided Perfboard.

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

Gorilla Glue 3044101 Heavy-Duty Double Sided Mounting Tape, 25.4 mm x 1.52 m Clear

<https://www.amazon.co.uk/gp/product/B01FMXKIOM/>

Lithium Polymer Battery - 110mAh 401528 size.

<https://coolcomponents.co.uk/products/lithium-polymer-battery-110mah>

SPDT Vertical Micro Slide Switch.

<https://www.amazon.co.uk/gp/product/B07BMPVDMD/>

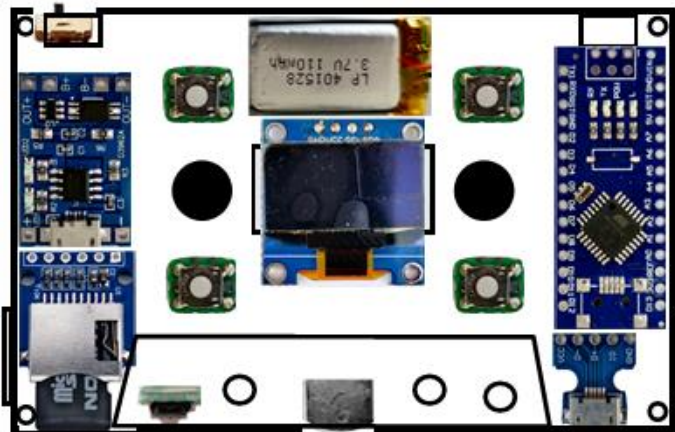
Car Cassette Adapter head.

You should be able to use any adapter, you just need the tape head from it. Some heads are double length which makes them tricky to fit, avoid the DigitNow ones as they are double size. I know these ones have small heads, these are ideal and are commonly available.



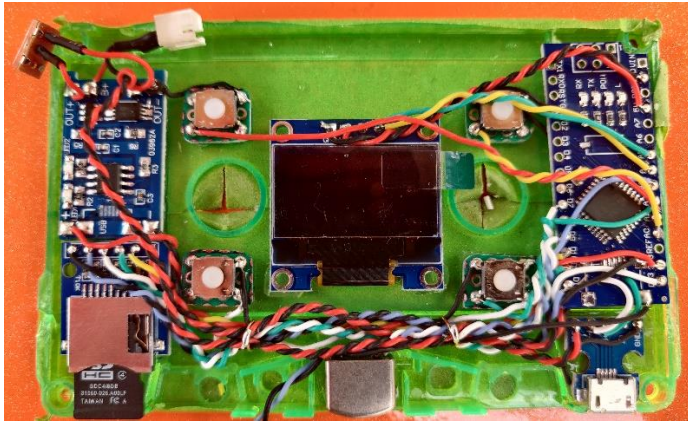
Overall Layout.

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



Mask up the outside of the cassette with masking tape (I use frog masking tape) The case will be skating round the desk a lot during the build and will get scratched. An added advantage is that you get to peel and reveal your work at the end! :-)

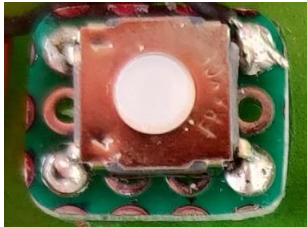
This is how the wiring ends up, it uses the wider, bottom end of the tape as a conduit and makes things easier.



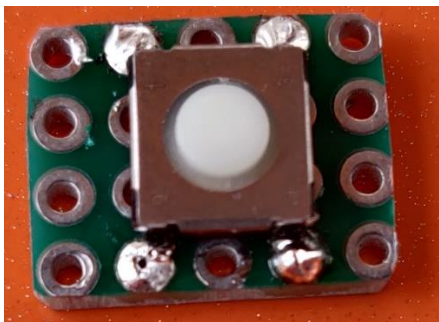
I recommend uploading the firmware now whilst the device is unmodified. This will aid in any required diagnostics later.

Button Supports.

To support the buttons inside the case, I cut a 4 by 3 hole section out of the perfboard and soldered the switches for left/right, stop and root. I applied Gorilla Tape to the underside but left the protective plastic on the tape to peel off and stick later. This stuff is sticky and gummy, when working with this, it helps to moisten the scissors as this'll stop them sticking to the tape.



I cut a 4x5 section for the play button that fits in the well the erase head would occupy. I use a very sensitive 0.5 Newton switch, this means that you only need to nudge the play button on the Spectrum slightly and reduces stress on the mechanism.



If you use the switches in the parts list and gorilla tape, the height will be perfect to use the natural flex of the tape shell to depress the buttons. You can adjust the sensitivity of the buttons by adding a small layer of thin double-sided tape under the button supports. This will save you from having to drill the case and preserves the cassette tape look.

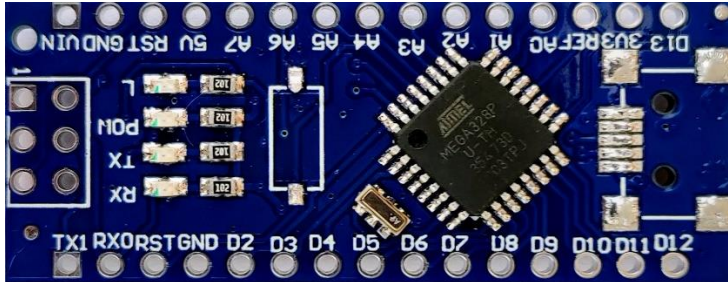
If you are using standard tactile switches on stalks, you can use double sided tape or hot glue to put them in place and put them through holes in the case.

Component Trim and prep

Thanks to different parts and layout, the need to trim the components has been reduced and the relocation of the USB port is much easier.

Arduino

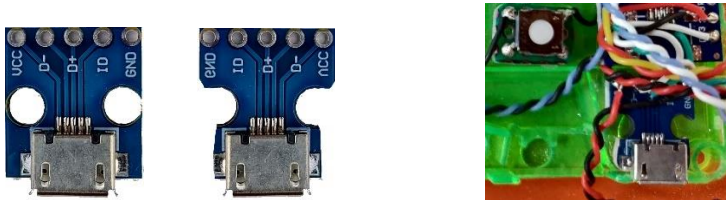
Remove the existing USB port and reset switch.



I used a heat gun for this but, if care is taken, a soldering iron can be used. If you strip the tracks, it is okay as I have found alternate solder points for the USB port.

External USB port.

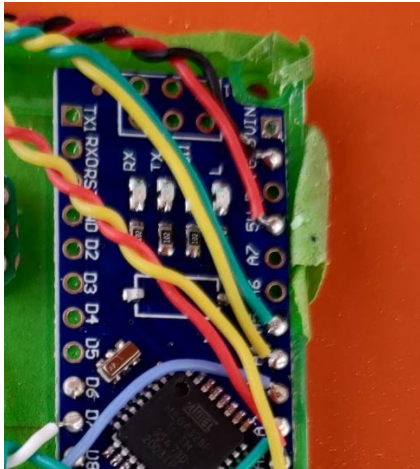
File down the port as shown so that this will fit in the bottom right of the case and apply adhesive tape to the bottom, keeping the protective layer to peel off and stick later.



Place (but do not stick yet!) the USB port in position and gently file the hole in the shell for the port. I put masking tape inside the case to prevent scratches.

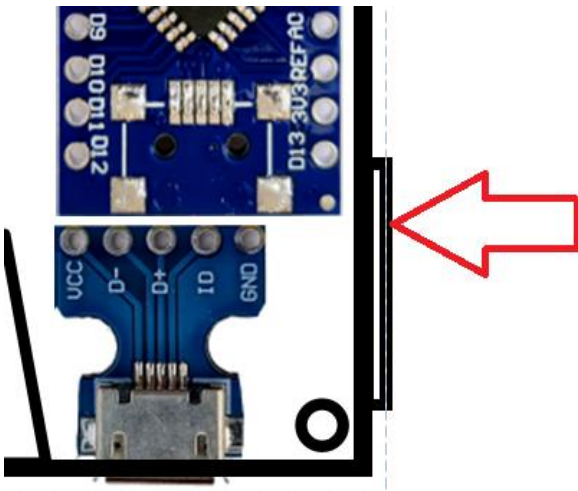


If required, also trim the write protect recess on the top right of the case to allow room for the Arduino

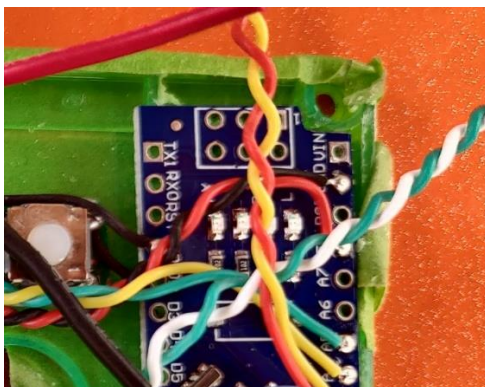


USB/Arduino Gap.

Depending on the Tape Shell you use, there may be too little room to fit the USB port and Arduino together

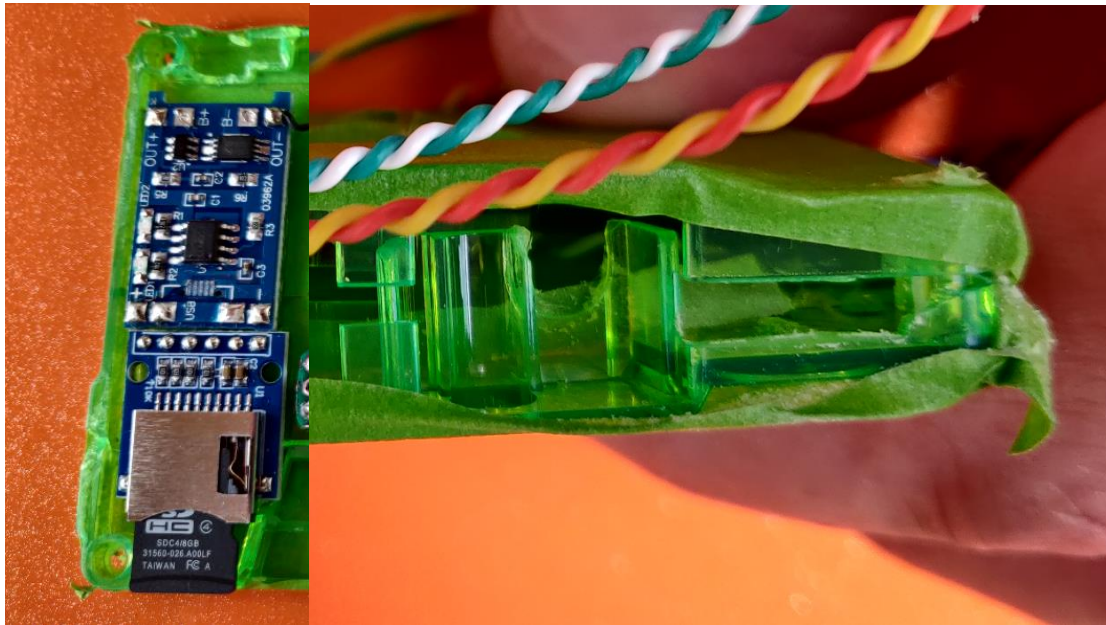


You can file the top corner of the Arduino to give you some extra room here. Be careful!



SD Card Slot

Add Gorilla tape to the underside of the SDCard module and charging unit. And then, using a spare SD card in the slot, file the gap for the card to slide in and out:

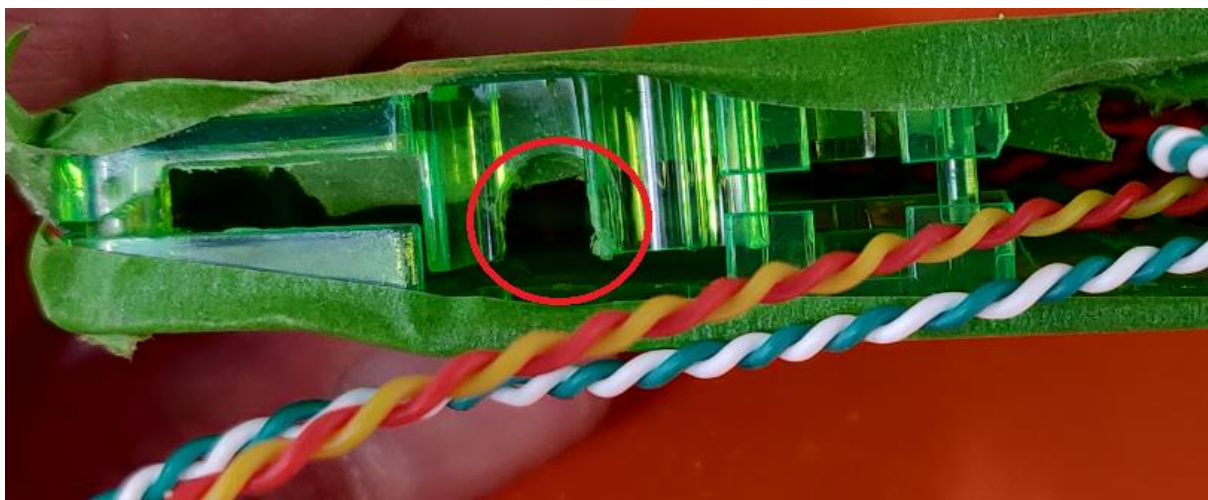


Once you're happy with the placement, Pre-solder the solder points on the USB Port and SD Reader then peel the protective layer and stick them in place.

Now would be a good time to create a space in the shell for the play button wire and the transmission head.

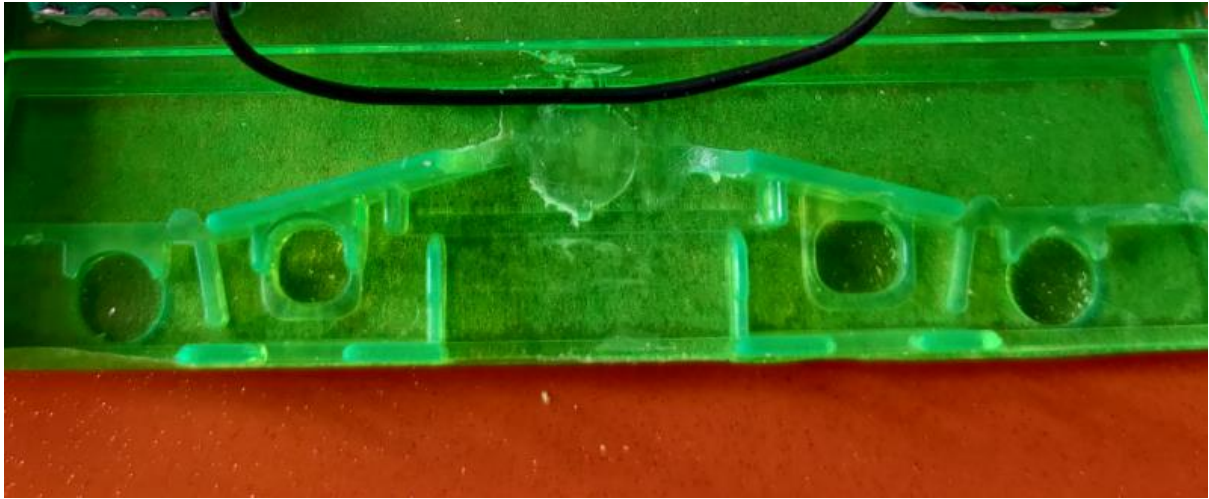
Play Button gap.

This is on the upper half of the case.



Transmission Head gap:

Trim upper and lower sides of the case to allow room for the transmission head.



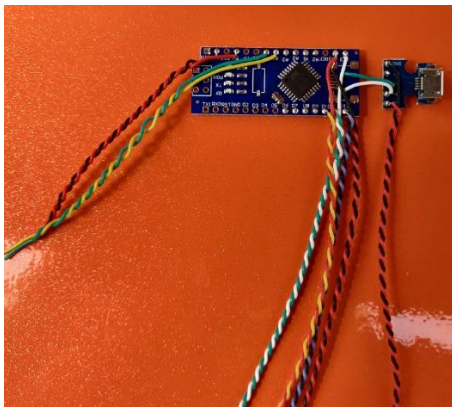
Wiring to the Arduino

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

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

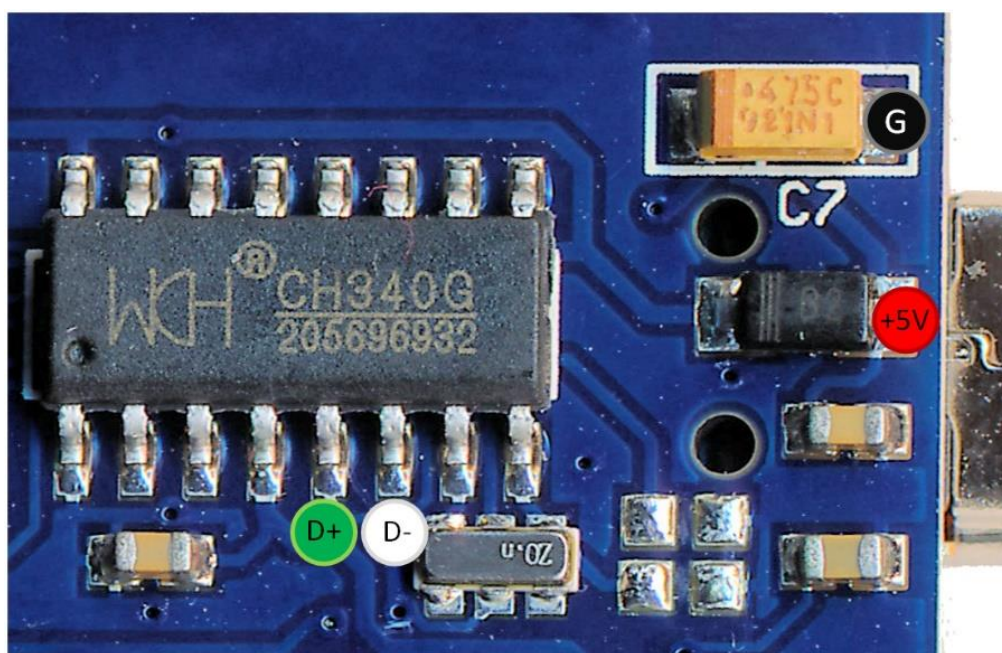
As mentioned, wire mounts up when you have 4.5mm to work with and you can follow the original pinouts and skip this section if you wish but using the wiring guide will ensure you can fit everything in. It can get messy really quickly and this will obstruct the case when you are trying to close it up.

It helps to solder the wires to the Arduino first, leaving plenty of spare length for later and twisting them into pairs.

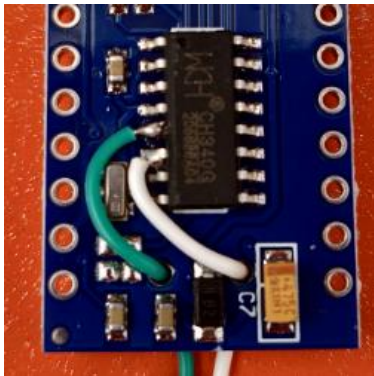


USB Port redirection

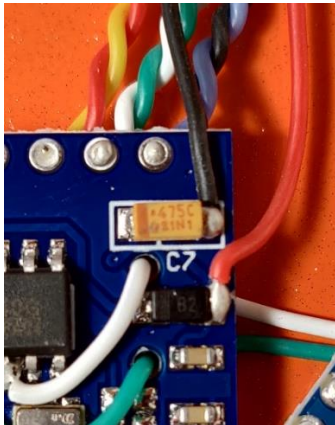
Solder some short wires, about an inch long to D+ and D- (Green and White)



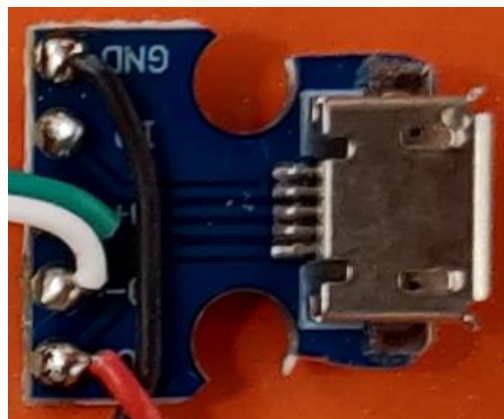
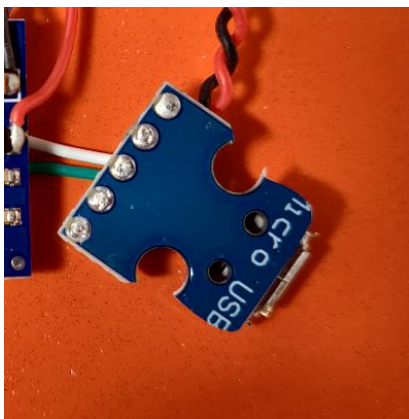
Run the White and Green wires up through the holes in the PCB:



Solder red and black wires to the alternate power points that are long enough, when twisted together to reach the upper left of the case, leave plenty of spare length. This will eventually go to the switch on the top left of the case. When done, twist them together.

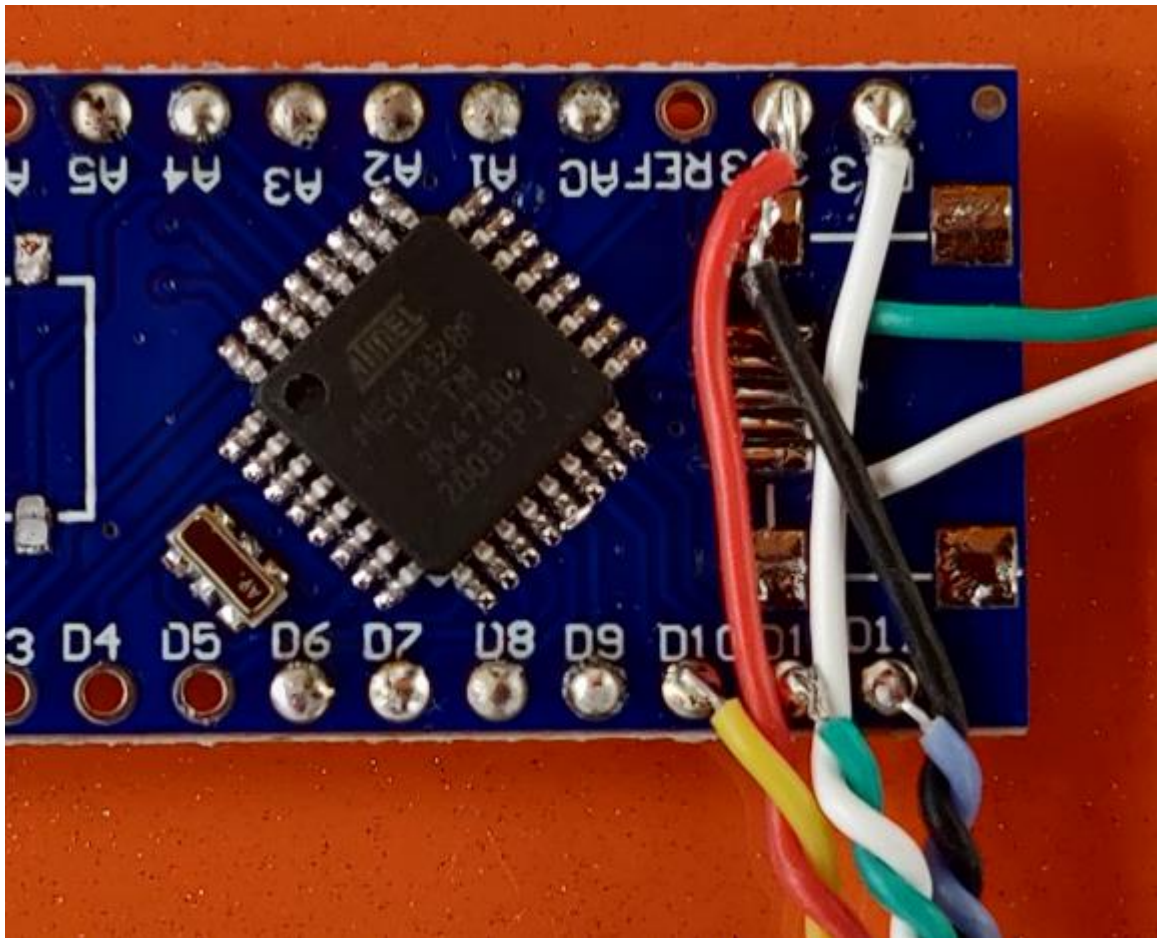


Solder the green and white wires to the USB port, making them as short as you can. It helps to solder the wires in the direction of the port and then curl them back on themselves.



SD Card Wiring

Solder the wires for the SD card and twist the pairs together as shown.

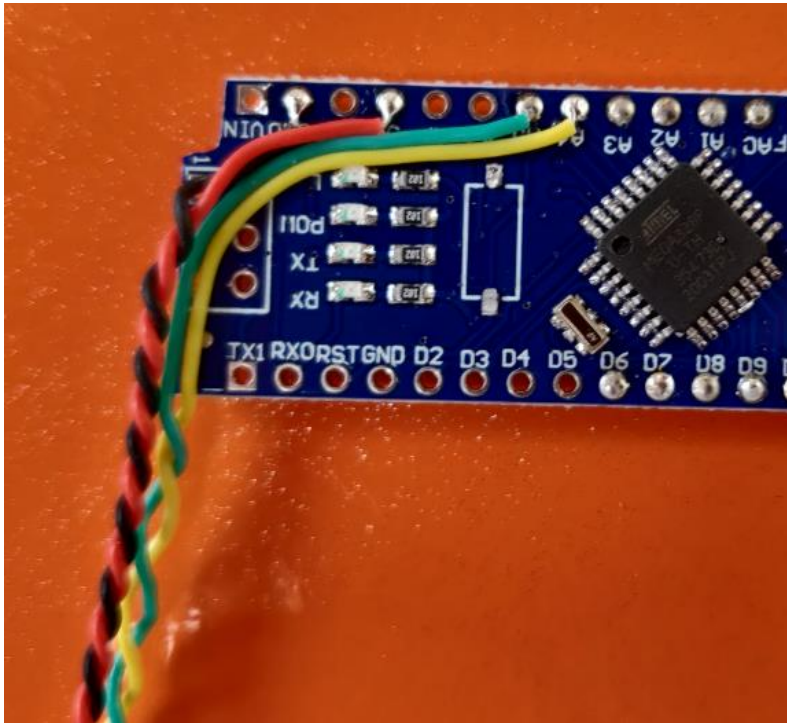


SD Card

10	Yellow	CS SDCS - SD Card chip select
11	Green	MOSI - SD Card MOSI PIN
12	Purple	MISO - SD Card MI PIN
13	White	CLK SCK - SD Card SCK PIN
3.3v	Red	3.3v
GND	Black	GND

Display

Solder the wires for the Display and twist the pairs together as shown. These will go to the middle of the shell.

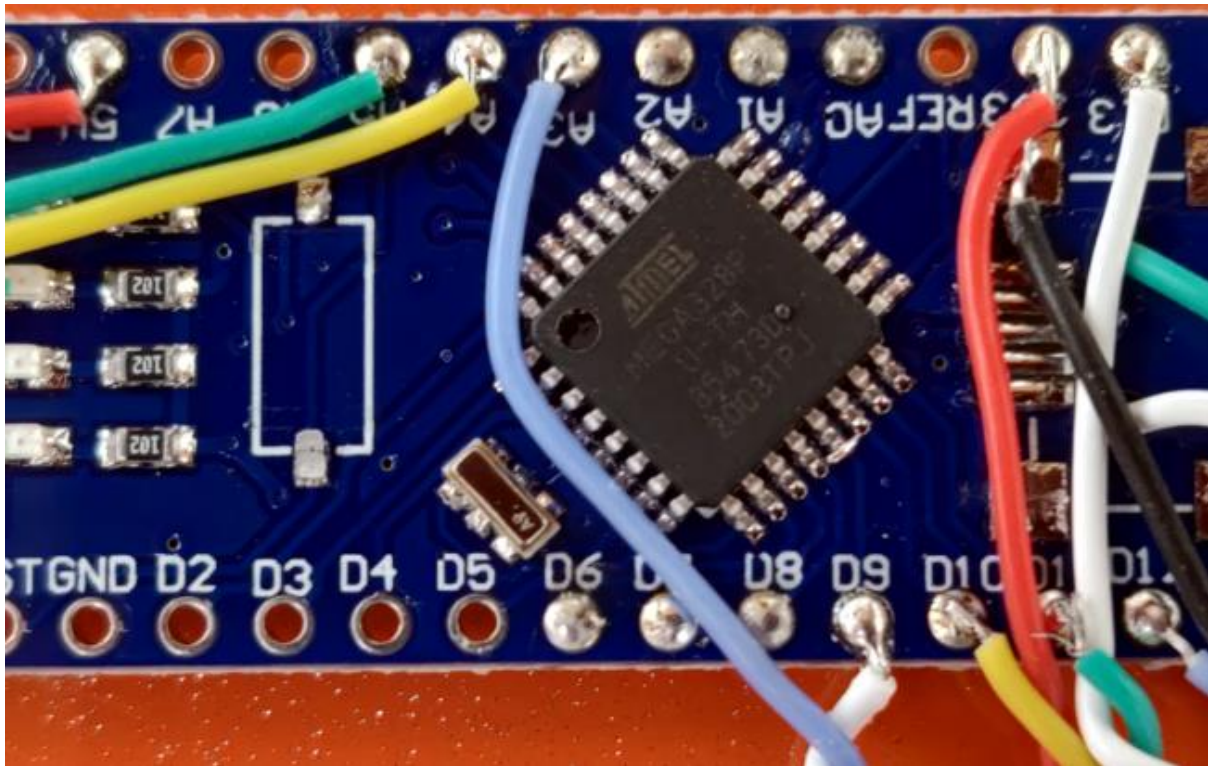


Display

A4	Yellow	SDA
A5	Green	SCL
5v	Red	VCC
GND	Black	GND

Play and Audio Out

Solder Purple and white wires to A3 and D9 respectively, this will be for Play and Audio out. These will go to the lower end of the shell



Audio

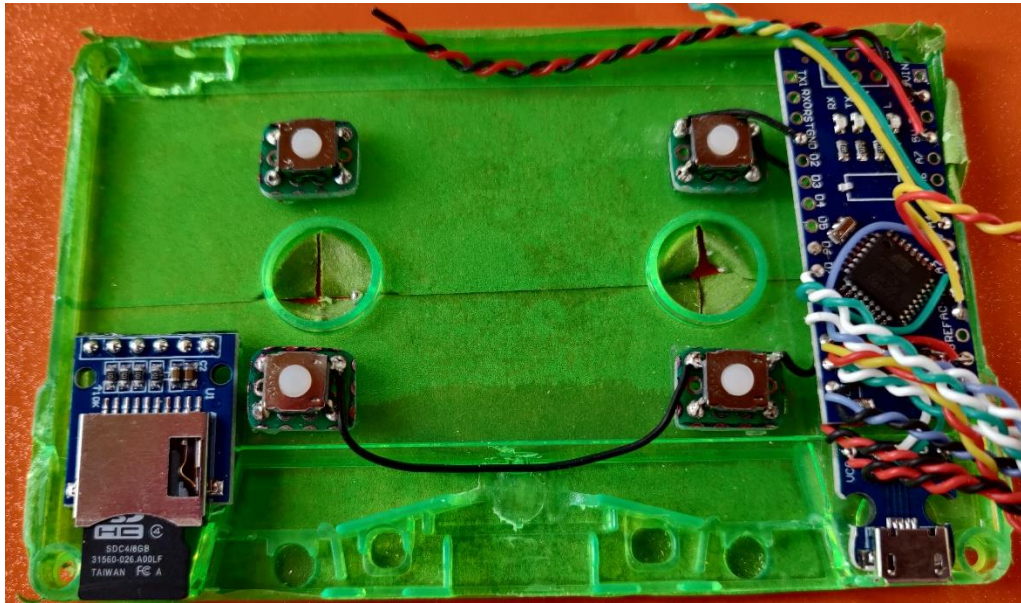
9	White	Audio Out
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Buttons

A3	Purple	Play
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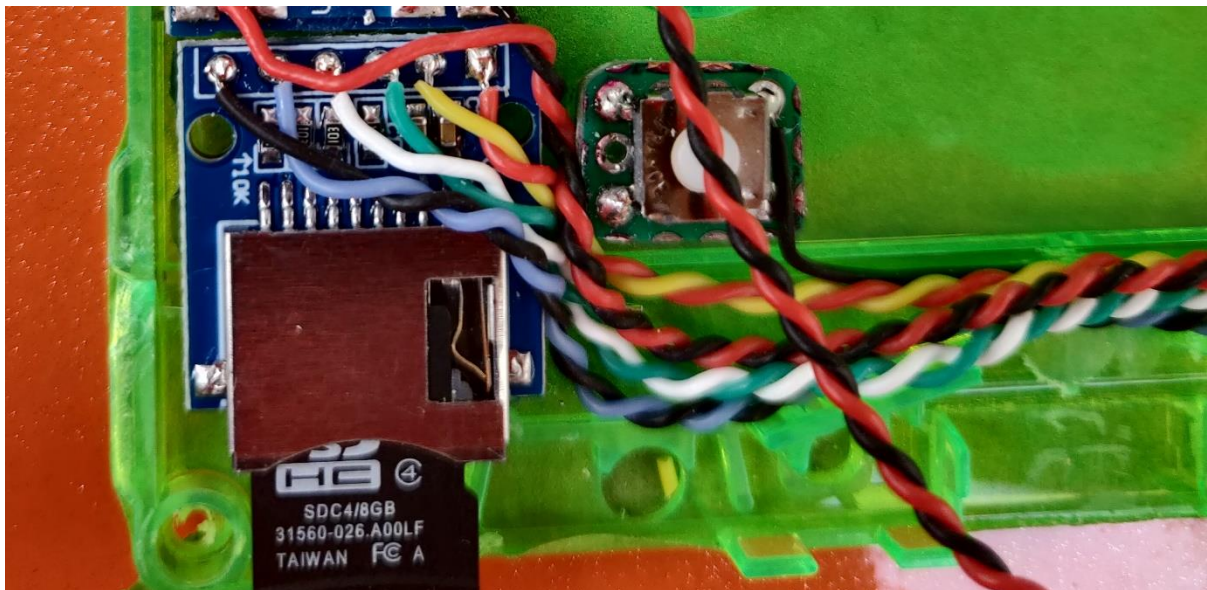
Component Placement.

Peel and stick the SD Card Reader, buttons, charging board and USB port in position, solder ground wires for the switches as shown. The black wire on the right is tucked under the board.



Solder the SD Card

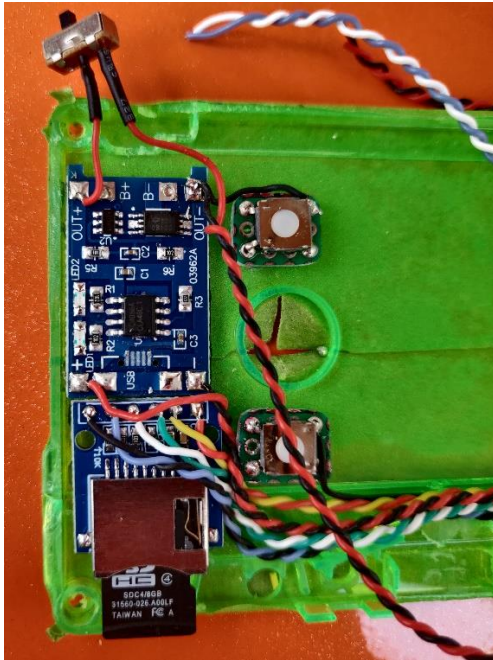
Solder the wires for the SD Card in pairs as shown. And run them through the compartment in the bottom of the shell. It gets tight but you can tuck the wires between the switch and the SD Card reader which helps.



Power

Solder the power wires as shown, the red and black wires on the upper part of the power unit (connecting to the switch) go to the Arduino and the red and black wires on the bottom of the charging unit go to the external USB port.

Solder a ground wire from OUT- to the top left switch



Fit the switch in the cassette write protect tab recess. You may need to file this out a little to fit it in. I have used a small amount of thermal plastic to hold it in position.

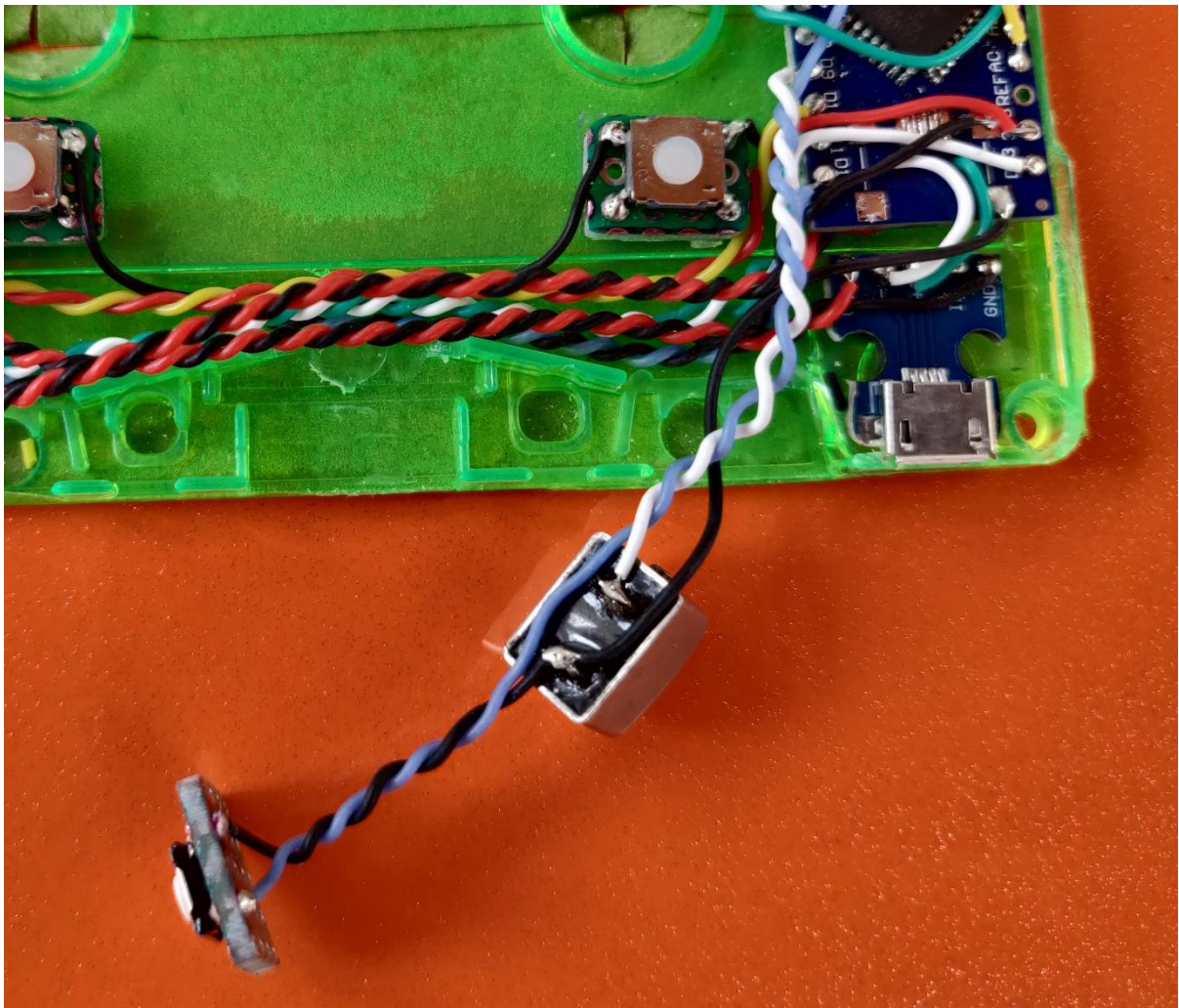


Transmission Head

When you have recovered the tape head from the Cassette Adapter, bend the legs as shown to convert this to Mono.



Solder the white wire from D9 to the one side of the tape head, solder the Purple wire to the Play switch. Run a ground wire from one of the square pads on the Arduino that were freed up when you removed the port and daisy chain them to the head and the button.



Display placement

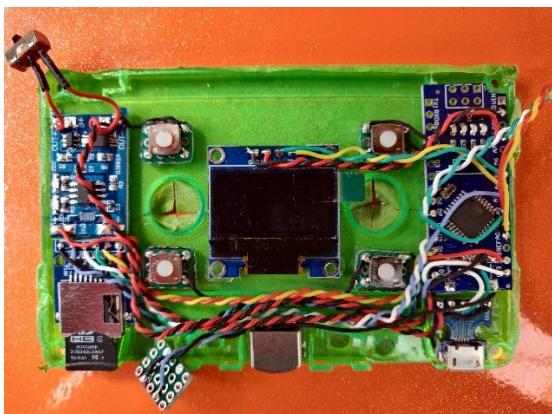
Remove the pin headers from the screen and affix small triangles of double-sided tape to the underside corners of the display.



Place the screen in position, using the battery as a straightening guide. This also ensures that the display holds the battery snugly.



Solder the wires for the display and route them as shown. This would be a good time to ensure that all the wires are tucked away as neatly as possible.

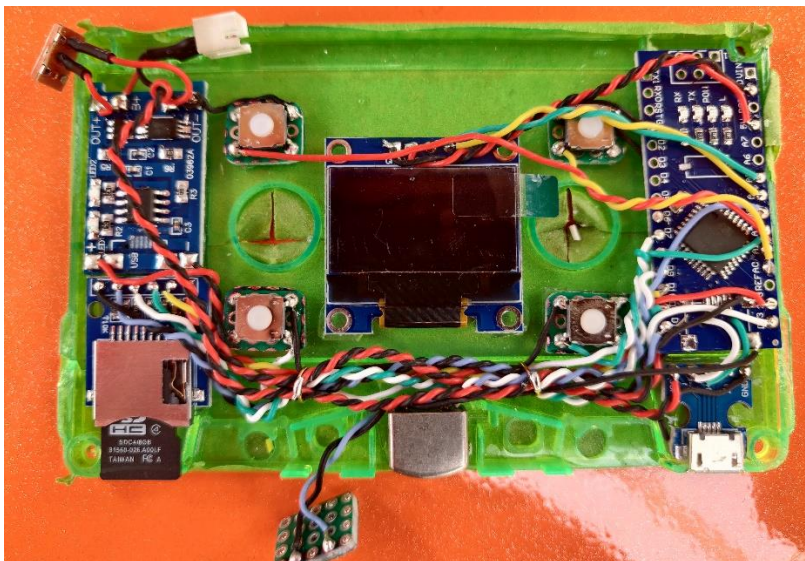


Use two layers of tape to fix the transmission head in position. The volume can be adjusted later by positioning the head closer or further from the play head .



Buttons

Solder the red, yellow, green and white wires to the buttons.



A0	Yellow	Right
A1	Red	Left
A2	Green	Stop
D7	White	Root

Battery Connection

The battery positive and negative leads should connect to the B+ and B- of the charging unit. I have used a JST connector for testing, soldering the battery straight to the charger is something I plan to do and will save space but only consider doing this if there is battery protection on the lipo circuit. If soldering directly, please take utmost care not to short the terminals in the battery.



Testing and first power up.

This is not designed to run from the 5v USB port without a battery and will not power up properly without one. As a first step, and with the power switch in the off position, connect the USB port, this will start the charging process. The charging board should light up red when charging and blue when fully charged.

Once charged, turn the power switch on and make sure that this starts correctly. It should perform the following sequence.

- Red light on the Arduino
- Display starts up
- Arduitapec logo displayed
- SD Card reads correctly

If you get to this point, test the buttons to make sure they work too. If you've got this far successfully, then congratulations, you're half way there (joke!)

Closing the case!

Make sure all wires are tucked away as flat as possible to the bottom of the shell and the play button (Purple wire, attached to the transmission head) is ready to be fed outside the case.

Get the spools from the original cassette tape and trim them down.



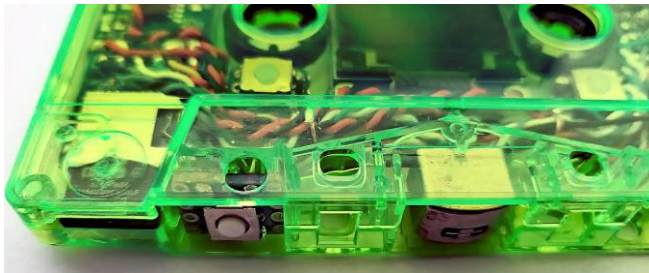
They're not actually needed so you can miss this step but they do look pretty nifty.

With the spools in place, have a final check that the wires are routed correctly, and the play switch is outside the case. I used thin solid core copper wire as micro cable ties. Wrap them round once and solder them in place.



Place the top shell on. It helps to sort to wiggle it about and give it a gentle flex. If it doesn't close, don't force it. Look at the case from the side and rock the top shell forwards, backwards left and right. You will see where it pivots and that'll tell you where the issue is.

Once you get the case closed, use some double sided tape to fit the play button in the erase head well of the cassette tape. The tip of the button should be level with the outside of the case.



Now is the time to peel back the masking tape, add the screws and unveil your new TZXCassette!

Slap that bad boy into a +2 and take a moment while a game loads to appreciate what you've done. When you started, you didn't know you could but here it is, fully working. You're amazing, play a game as a reward! It also helps to stride around smugly for about half an hour basking in the glow of your new found awesomeness!

I'd love to know how you get on, feel free to tweet me <https://twitter.com/realjamhamster> or leave a comment on my channel <https://www.youtube.com/jamhamster> :-)