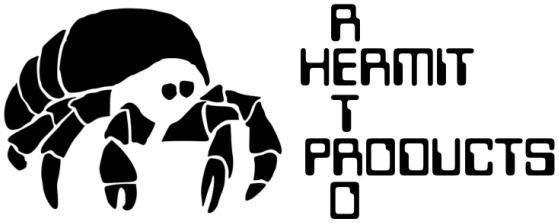
Hermit Retro ZXZero

Assembly Instructions

Hermit Retro Products Ltd.



ABSTRACT

A guide on how to assemble the Hermit Retro ZXZero

Version 1.2

support@hermitretro.com

1 Table of Contents

2 Introduction

Welcome to the Assembly Instructions for the Hermit Retro ZXZero Board. We would recommend an initial read through the document just to see what's involved and what you'll need before starting assembly.

To make assembly fairly straight-forward, we recommend doing things in the documented order. You can, if you wish, free-style it, but it will make things slightly more difficult!

The component choices have been, as far as possible, all through-hole for easier assembly. Unfortunately, the Micro SD holder is SMT (or Surface Mount Technology) and requires much finer soldering skills. Whilst it can be soldered with an iron (search YouTube for "drag soldering"), a rework station is recommended.

The build should take around 1-2 hours.

If you find any issues with the instructions, or sections that aren't clear, drop us a line at support@hermitretro.com

3 Components and Bill of Materials

If you are reading these instructions, you have probably opted for the self-assembly option for the Hermit Retro ZXZero Board. You will require printed circuit boards, components and connectors to build this project, all of which are available from our Online Store at https://hermitretro.com.

3.1 Bill of Materials

You can, however, source your own components and we supply a Bill of Materials that enables you to do that.

The online vendor, part number and last checked unit price are listed. We have attempted to stay with a single supplier as much as possible to save on shipping. However, please note you may need to buy multiples of an items just to get one.

3.2 Connectors, Cables and Power Supplies

You will also need a 1.5A 5VDC centre-positive power supply with a 2.1mm diameter centre pin and a suitable HDMI cable for connecting the Hermit Retro ZX Spectrum to your display of choice. The Bill of Materials document contains links to suppliers of these items if you don't want to buy from us.

4 Tools

You will require:

- 40W soldering iron with a suitable tip
- Lead-free solder (1mm diameter or smaller)
- Helping hands
- PP3 facemask or fume extractor
- Rework station/heat gun (*optional but* ***recommended***)
- Solder paste (*optional but* ***recommended***)
- Flux (*optional but* ***recommended***)
- Desoldering pump or solder braid (*optional*)
- Loupe or magnifying glass (*optional but* ***recommended***)
- A sharp craft knife
- Good adhesive such as Gorilla Glue

We would recommend you solder in a well-lit and well-ventilated area.

5 Printed Circuit Boards

There are 4 PCBs that comprise the Hermit Retro ZXZero Board:

1. The Hermit Retro ZXZero PCB -- the main board
2. The USB Stem PCB -- this is soldered onto the Raspberry Pi Zero
3. The USB Riser PCB -- this correctly heights the USB socket
4. The Backplane PCB -- this correctly heights the HDMI and DB9 sockets

There is an optional fifth board:

5. The Test Board -- this helps you test your MicroSD and USB Stem soldering

6 Assembling the Raspberry Pi Zero

Components:

- 1 x Raspberry Pi Zero (or Zero W) with headers
- 1 x USB Stem PCB
- 1 x 4-way PCB header
- 4 x M2 screws
- 4 x M2 nuts

1. If you do have a Raspberry Pi Zero or Zero W without headers populated, solder a header block onto the Raspberry Pi Zero *ensuring they are correctly oriented as shown in* Figure 1: Raspberry Pi Zero with correctly oriented header block*!*

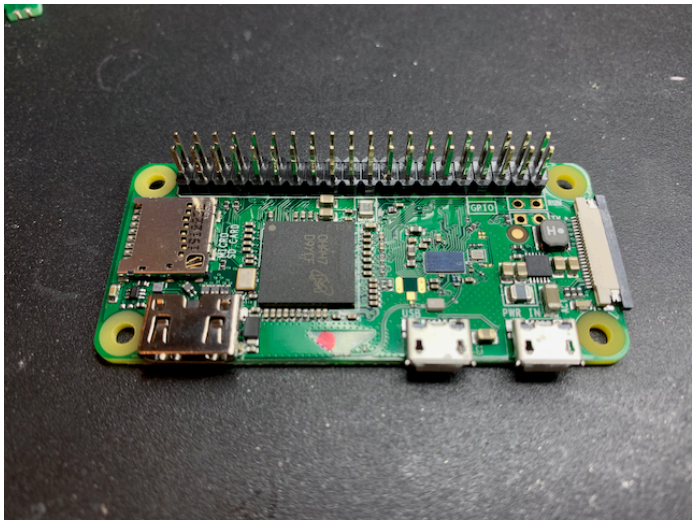


Figure 1: Raspberry Pi Zero with correctly oriented header block

2. Screw the USB Stem PCB tightly onto the Raspberry Pi Zero on the underside such that the edge pads on the USB Stem are sitting over 4 pads on the Raspberry Pi Zero

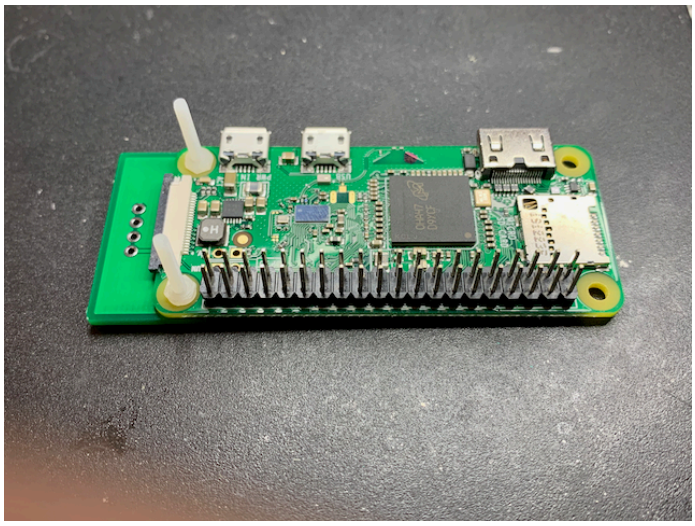


Figure 2: Attach the USB Stem PCB to the Raspberry Pi Zero

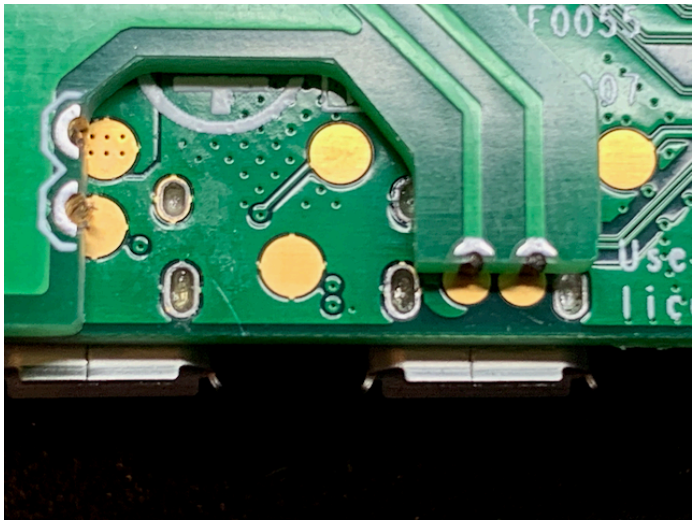


Figure 3: Ensure the USB Stem PCB is correctly lined up

3. Solder the USB Stem PCB to the Raspberry Pi Zero. This can be a bit fiddly and might require some serious blobs of solder

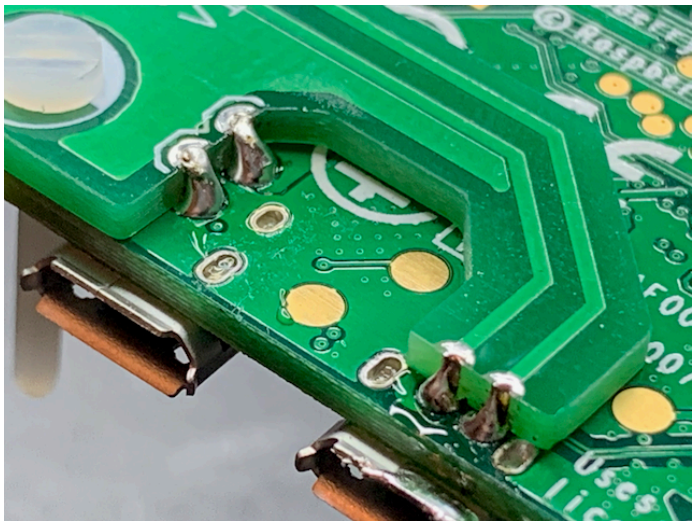


Figure 4: USB Stem PCB soldered to the Raspberry Pi Zero

4. Screw the other two M2 screws onto the Raspberry Pi Zero
5. Solder the 4-pin header strip JP2 onto the underside of the USB Stem PCB

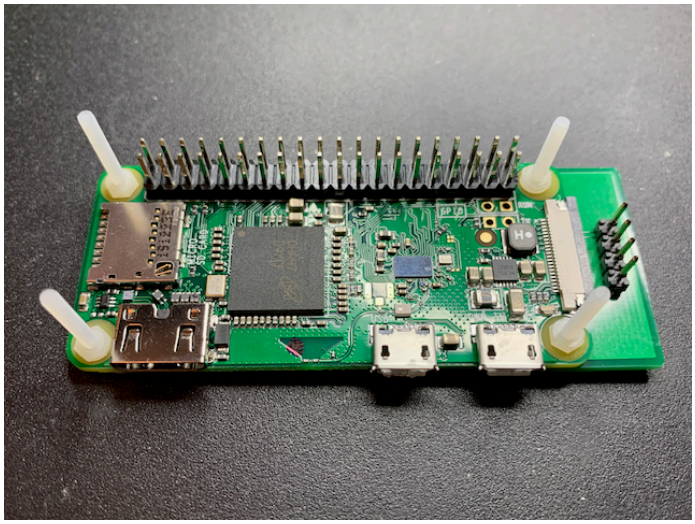


Figure 5: USB Stem completely fitted to the Raspberry Pi Zero

7 Assemble the HDMI Ribbon

Components:

- 1 x Male Mini HDMI Connector
- 1 x Female Full-Size HDMI Connector
- 1 x FFC Ribbon

1. Lift or pull out the black retainer on both connectors
2. If your HDMI connectors have the “pull-out” type of retainer:
    - Push the HDMI ribbon into each connector. The exposed tracks on the ribbon should face UPWARDS. Ensure the ribbon is fully inserted;
    - Otherwise, push the HDMI ribbon into each connector. The exposed tracks on the ribbon should face DOWNWARDS. Ensure the ribbon is fully inserted
3. Push down/in the black retainer on each connector to hold the ribbon in place

8 Assemble the Test Board (Optional)

We optionally provide a Test PCB which enables you to check that the USB Stem PCB and the external Micro SD card are soldered down correctly before committing to soldering the Raspberry Pi Zero onto the main Hermit Retro ZXZero PCB.

If you do not have a Test PCB or don't wish to use it, you can omit this section.

!!! The Test PCB regulator allows for 5->30V DC input. However, input voltages above 12VDC will result in the regulator becoming EXTREMELY HOT. If you want to use input voltages above 12VDC, we recommend either the use of a heatsink or swapping the regulator with a switching variant such as the OKI-78SR-5/1.5-W36-C (RS: 796-2132) which has an identical pin-out !!!

- Solder all the components onto the Test PCB EXCEPT the two long header strips U$2 and U$4 on the underside of the board. If you solder them before using the Test Board on the Hermit Retro ZX Spectrum PCB, it won't fit! Ensure that the Milligrid connector U$9 is soldered onto the UNDERSIDE of the PCB

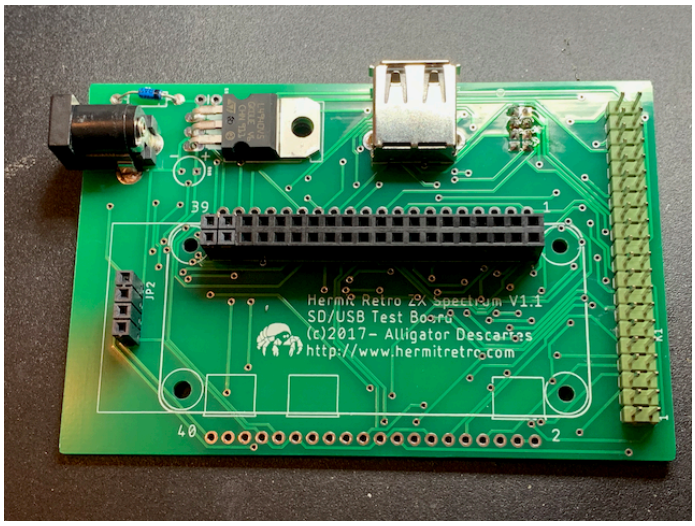


Figure 6: Assembled Test PCB

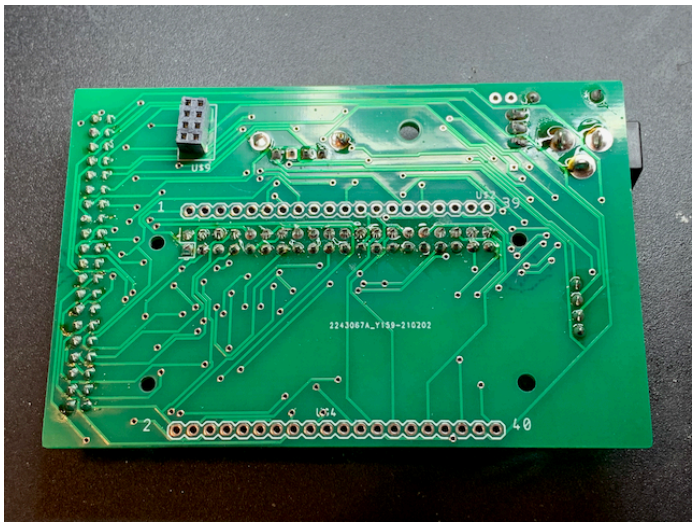


Figure 7: Underside of assembled Test PCB

- Flash the diagnostic software onto the SD card (see below)
- Connect a monitor via the HDMI ribbon
- Plug in a USB device (such as a keyboard, stick, game controller...)
- Plug the power supply into the test board
- The diagnostic program should boot and auto-test various aspects of the board

9 Hermit Retro ZXZero Stage 1

Components:

- 1 x Hermit Retro ZXZero PCB
- 1 x Micro SD card holder
- 1 x Milligrid male header
- 1 x 0R resistor
- 1 x 0.1uF 0805 SMD capacitor

1. We recommend that you now solder the Micro SD card holder U$2 onto the Hermit Retro ZXZero PCB. This can be most easily achieved with solder paste and a rework station. However, drag-soldering will also work well.
2. Solder the 0.1uF capacitor
3. Solder the 0R resistor marked R21

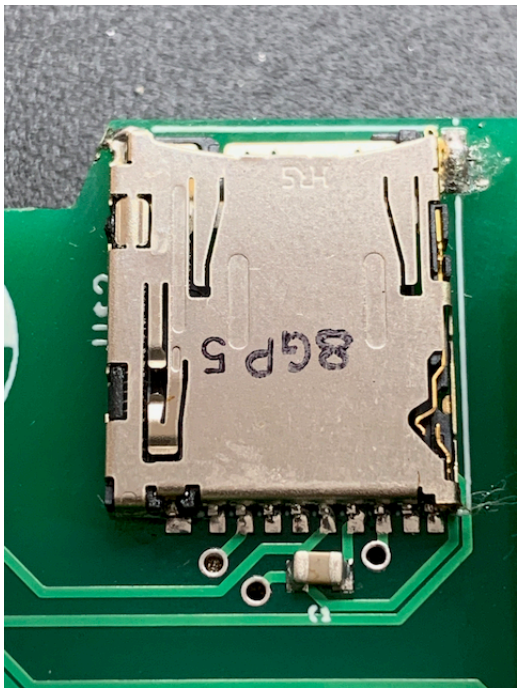


Figure 8: Soldered MicroSD holder and capacitor

9.1 Using the Optional Test PCB

If you are using a Test PCB:

4. Fit the Milligrid connector U$9
5. Plug the assembled Raspberry Pi Zero into the Test PCB
6. Connect the Test PCB onto the Hermit Retro ZXZero PCB via the Milligrid connectors
7. Plug a MicroSD card into the external MicroSD slot on the Hermit Retro ZXZero PCB
8. Connect your monitor to the Raspberry Pi Zero via the HDMI ribbon
9. Plug the power supply into the Test PCB whilst holding down the switch on the Test PCB. The unit should power up and boot into the diagnostics program

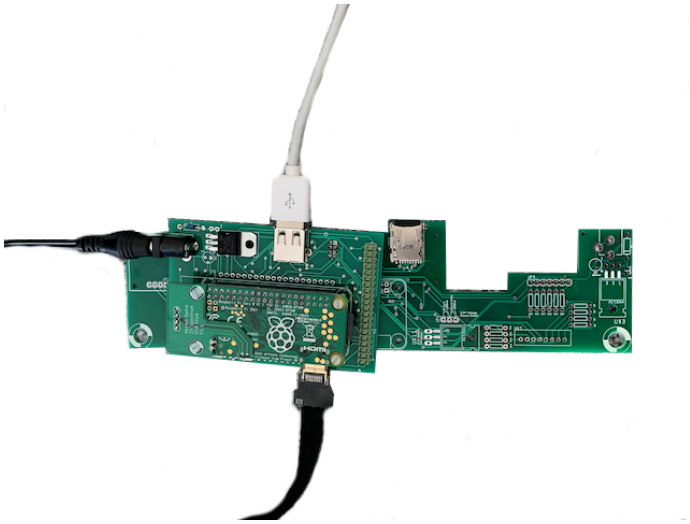


Figure 9: Test PCB mounted on Main PCB

At this stage, don't worry about failures other than USB or MicroSD. They should both report as working.

- If the USB test fails, double-check your soldering of the USB Stem PCB onto the Raspberry Pi Zero
- If the MicroSD test fails, double-check your soldering of the MicroSD card and the R21 resistor

Once you have checked your soldering, repeat the tests above until the tests pass.

Once the tests for USB and MicroSD pass, you should:

1. Power off the Test Board
2. Disconnect the Test Board from the Hermit Retro ZXZero PCB
3. Disconnect the HDMI ribbon completely and remove the female connector. You will need this for the Backplane PCB assembly
4. Carefully unplug the Raspberry Pi Zero from the Test Board

10 Assembling the Backplane PCB

We recommend assembly of the Backplane PCB now as it requires glue to cure!

Components:

- 1 x Backplane PCB
- 3 x M2 screws
- 9 x M2 nuts
- 1 x DB9 connector
- 2 x 3-way PCB right-angle headers
- 2 x Jumper Coupler
- 1 x 7-way PCB header

- 1 x HDMI female socket

1. Fit the 3 M2 screws to the upper-left, upper-right and lower-left corners of the Backplane PCB. You do not need to populate the lower-right hole. Screw the first 3 M2 nuts tight under the board to hold the screws firmly in place

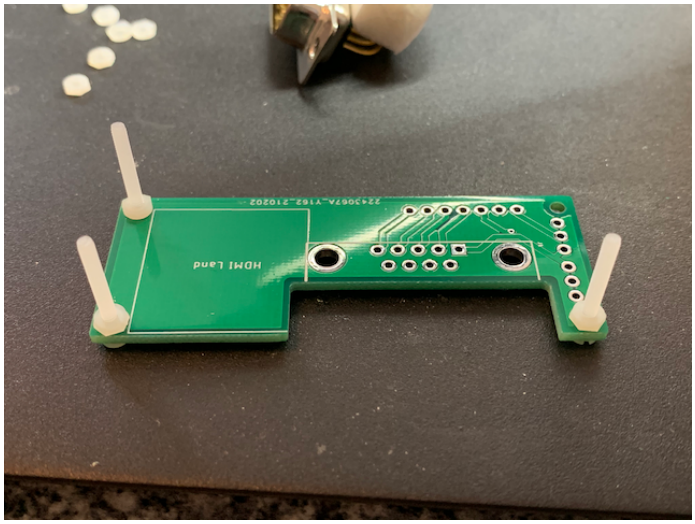


Figure 10: Fit M2 screws and nuts to Backplane PCB

2. Screw the second 3 M2 nuts onto each screw such that the height between the underside of the PCB and the underside of the nut is exactly 4mm. This is to ensure correct levelling of the board in the ZX Spectrum case slot.

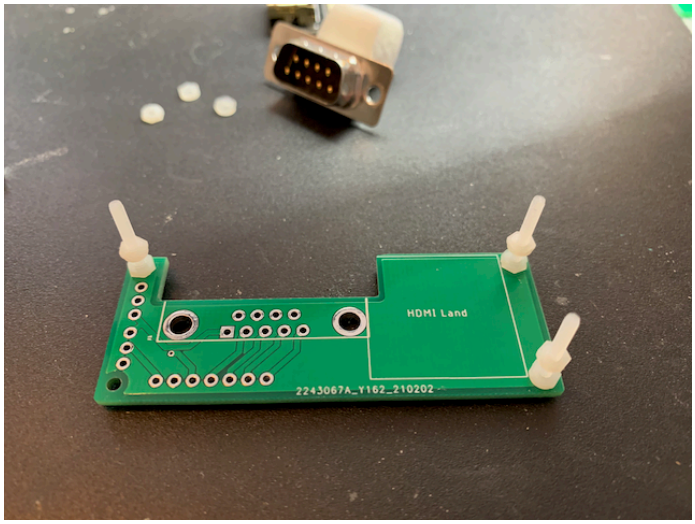


Figure 11: Fit second set of M2 nuts onto the Backplane PCB

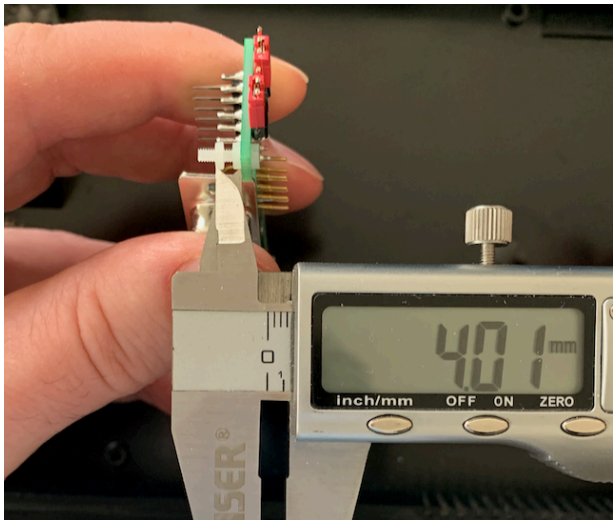


Figure 12: Ensure the correct spacing for M2 nuts (5mm)

3. Solder the DB9 connector onto the Backplane PCB. It should be levelled as per the image with the bottom edge of the connector aligned with the upper surface of the PCB. We would recommend tacking in two pins only just now in case minor adjustments are required later

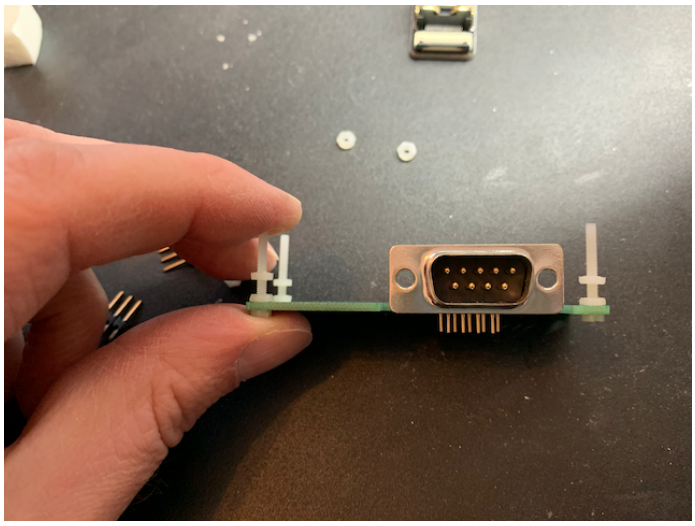


Figure 13: Tack the DB9 connector at the correct level

4. Solder the two 3-way jumpers with the jumpers facing off the board. Fit the jumpers into the default position

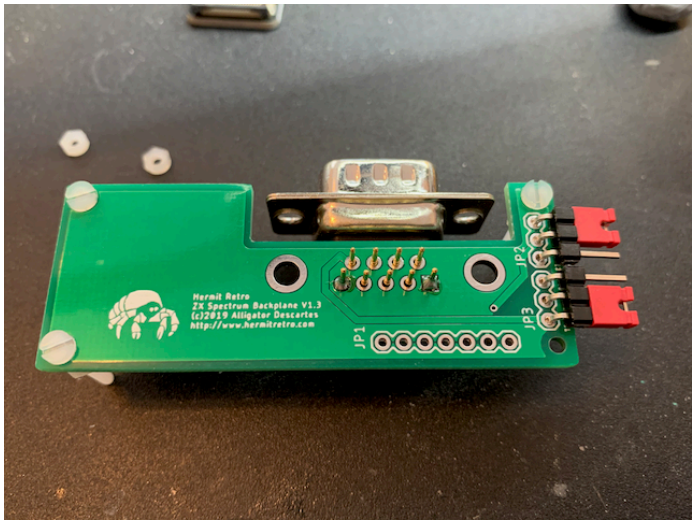


Figure 14: Solder Backplane PCB jumpers

5. Solder the 7-pin header onto the underside of the Backplane PCB

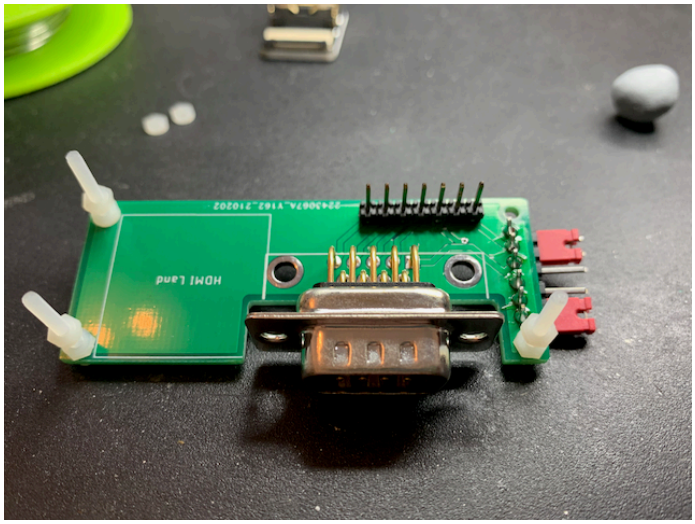


Figure 15: 7-way PCB header onto Backplane PCB

6. Screw the remaining 3 M2 nuts onto the ends of the screws. You're just storing them for later
7. Glue the HDMI socket beside the DB9 in the marked area on the **UNDERSIDE** of the Backplane PCB. We recommend Gorilla Glue or some other sort of strong adhesive. Apply it liberally to the Backplane PCB where the HDMI socket will sit. You can make this a tight fit beside the DB9 socket. It should protrude such that the HDMI socket edge is at the same distance as the DB9 socket edge. Once positioned, clamp the socket to cure for 24 hours. Some adhesive coming up the sides of the HDMI board is fine as it'll form a stronger bond, but **avoid getting adhesive into the HDMI socket or ribbon connector/mechanism.**

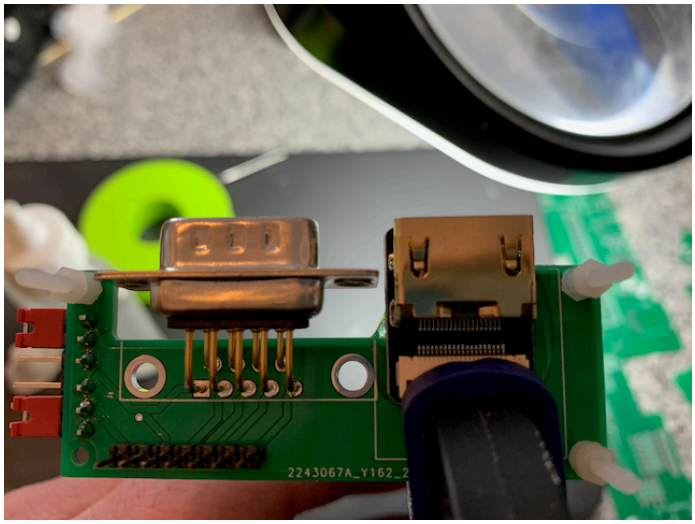


Figure 16: Glued and clamped HDMI socket

11 USB Riser Board

Components:

- 1 x USB Riser PCB
- 1 x USB socket
- 1 x 4-way PCB header
- 2 x M2 screws
- 6 x M2 nuts

1. Solder the USB socket onto the USB Riser PCB
2. Solder the 4-pin header onto the USB Riser Board with the black block on the **UNDERSIDE** of the USB Riser PCB

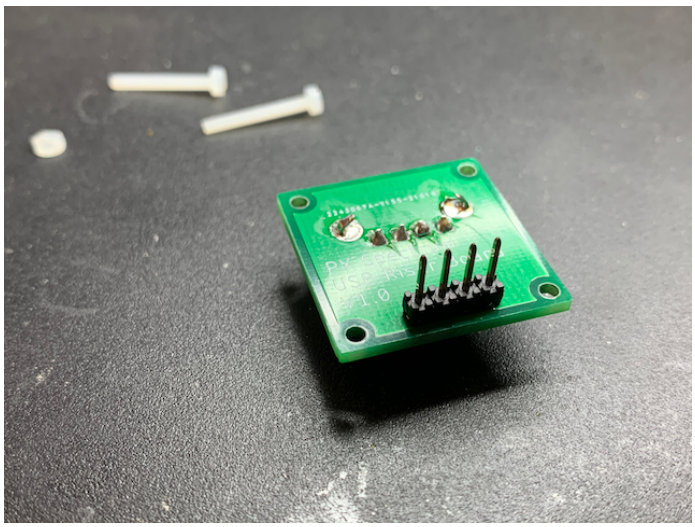


Figure 17: USB Riser 4-way header

3. Screw two M2 screws into the corners opposite the 4-way header and screw two M2 nuts on each screw to retain the screw and provide a standoff for the board

4. Screw the remaining 2 M2 nuts loosely onto the end of the screws to keep them safe for later!

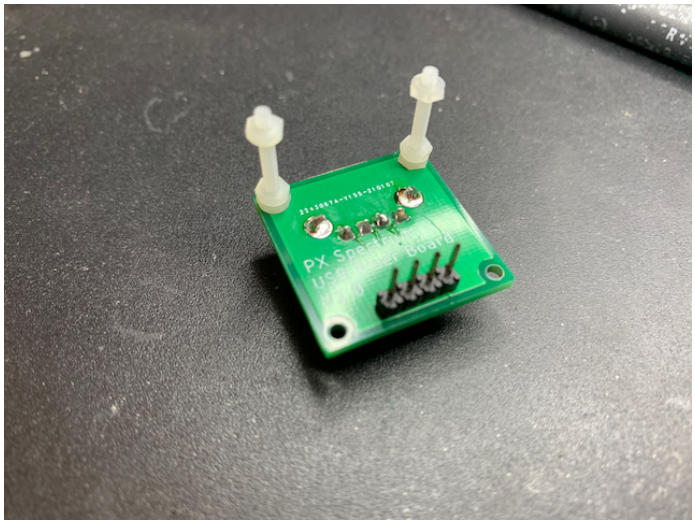


Figure 18: Completed USB Riser PCB

12 Hermit Retro ZXZero Board Stage 2

Solder the remaining components onto the Hermit Retro ZXZero PCB.

Components:

- 1 x right-angled tactile switch
- 1 x 3.5mm jack socket
- 1 x L4940V5 regulator
- 1 x 2.1mm DC power jack
- 1 x BAT48 diode
- 20 x 10k Ohm Resistors
- 1 x 5-way membrane connector
- 1 x 8-way membrane connector

1. Solder the menu switch S2
2. Solder the I2C connector U$4
3. Solder the 5V regulator U$3. You should push the legs slightly into the three holes then bend the component over until it lies flat on the PCB and the hole lines up. Tack the component down then solder the legs

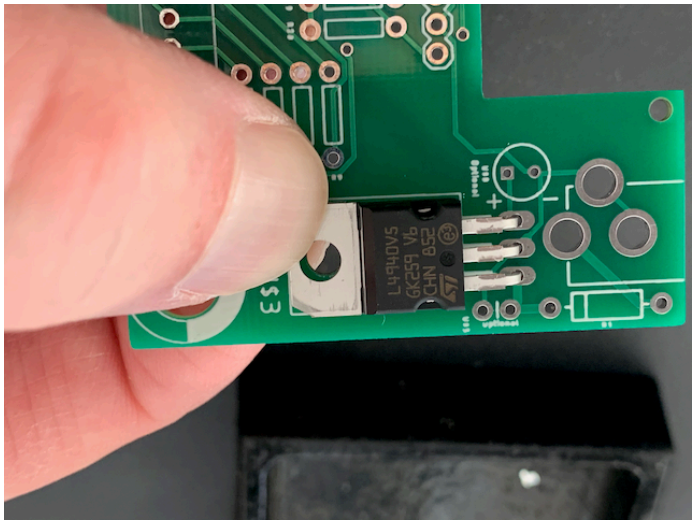


Figure 19: Fit the 5V regulator

4. Solder the DC power jack J3. Ensure you fully flood the pads and jack legs to ensure a good connection
5. Solder the diode D1. Ensure you match the diode polarity with that marked on the PCB

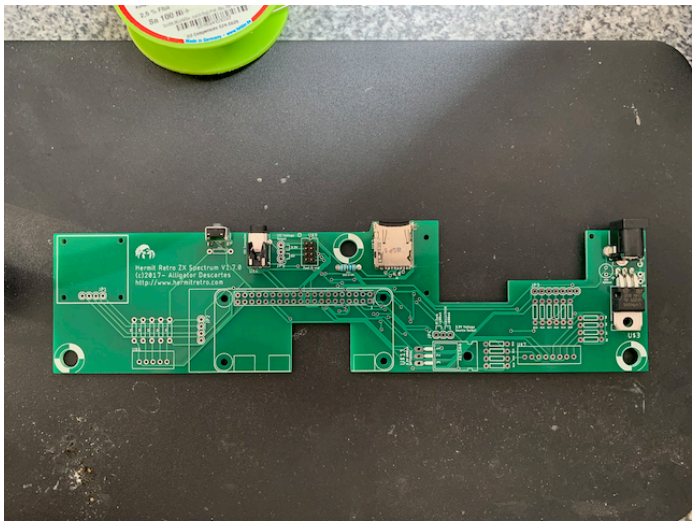


Figure 20: After soldering of power stage

6. Solder all the remaining resistors. They are all 10K Ohm.
7. Solder the two jumper selector blocks JP5 and JP4

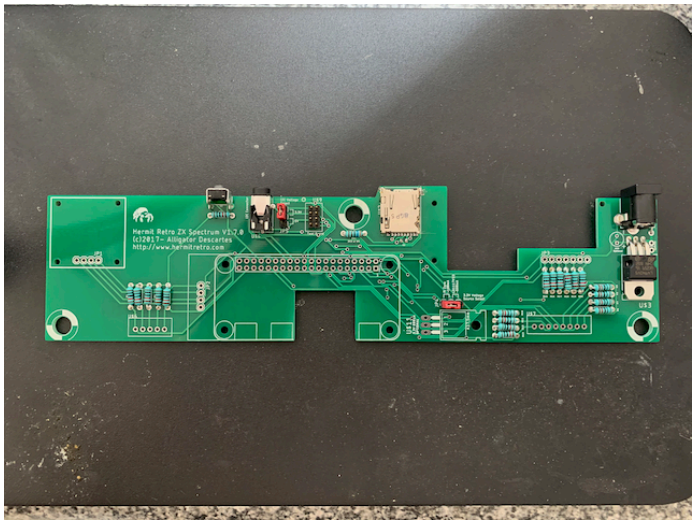


Figure 21: After soldering resistors and jumpers

8. Solder the leftmost keyboard membrane connector

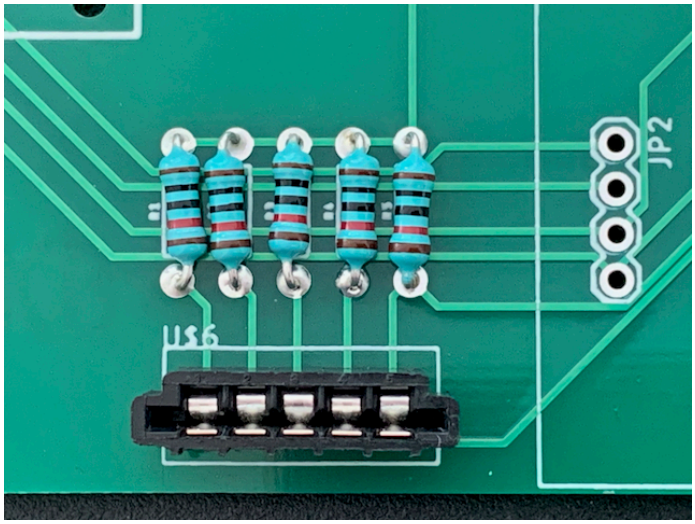


Figure 22: Orientation of 5-pin membrane connector

9. Solder the rightmost keyboard membrane connector

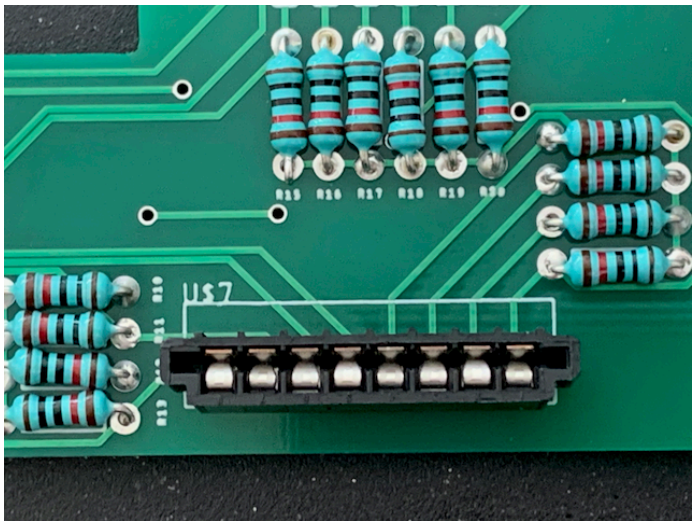


Figure 23: Orientation of 8-pin membrane connector

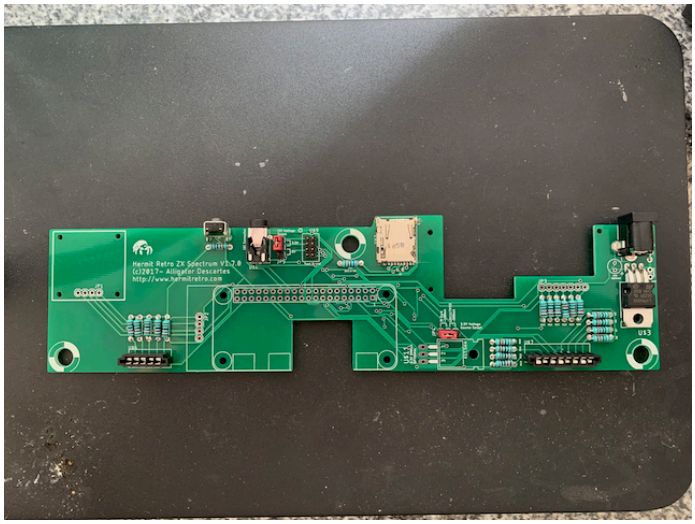


Figure 24: After population of membrane connectors

10. Unscrew the loose M2 nuts from the corner screws on the Raspberry Pi Zero
11. Fit the Raspberry Pi Zero and stem into the appropriate holes. Push the board down such that the HDMI connector on the Raspberry Pi Zero is flush. The pin headers will be slightly lifted from the board
12. Solder the Raspberry Pi Zero onto the Hermit Retro Spectrum PCB. We recommend tacking two pads to ensure the board is level. Once it looks OK, solder all the remaining pins including the USB stem pins
13. Replace the nuts on the M2 screws and tighten them. Snip off the remaining screw flush with the nut

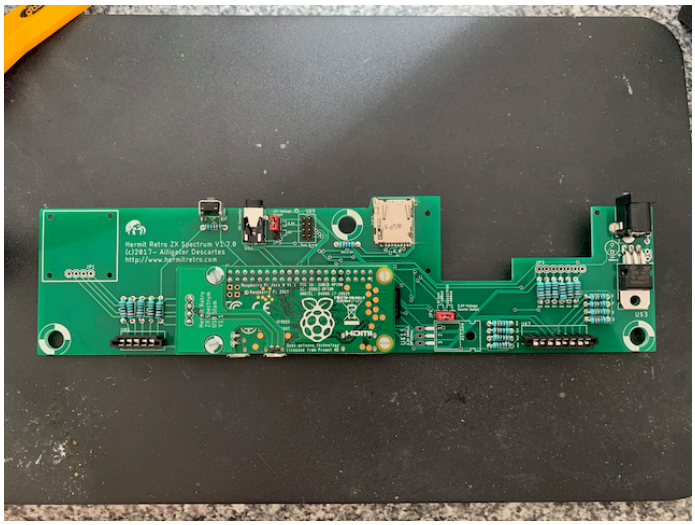


Figure 25: After fitting of Raspberry Pi Zero

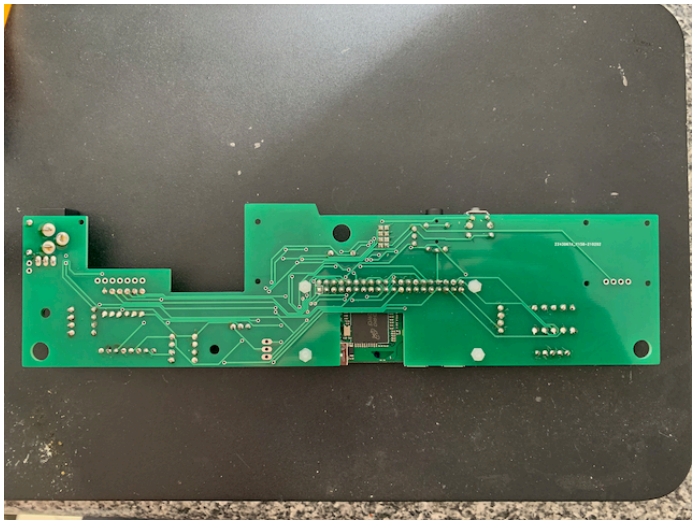


Figure 26: Underside after fitting of Raspberry Pi Zero

13 Fit the Backplane PCB

!!! Wait for the glue to fully cure. Ensure it has by inserting an HDMI cable and putting some force onto it !!!

!!! You will need to bend the 2 3-way jumpers to a 45 degree angle to allow them to sit on top of the DC barrel jack !!!

- Fit the backplane onto the Hermit Retro ZX Spectrum ZXZero PCB. The 3 screws should align with the holes and the 7-way header should fit through the main PCB
- Screw M2 nuts onto the screws. Once tight, double-check the 5mm clearance as described above when building the Backplane PCB originally
- Snip the protruding ends of the M2 screws flush to the nut

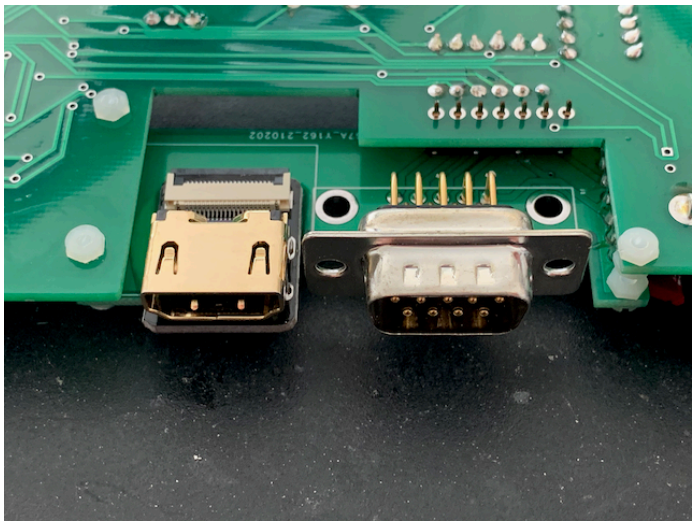


Figure 27: Fit of Backplane PCB

- Check the level of the backplane in the case. If you need to raise/lower the DB9 connector, you can do so by reheating the two pins you soldered previously and nudge them

Figure 28: Level check of Backplane PCB in case

- Once you are happy with the level, solder the remaining DB9 pins and the 7-way connector onto the main board

14 Fit the USB Riser Board

1. Unscrew the two loose M2 nuts on the USB Riser PCB
2. Fit the USB Riser PCB onto the Hermit Retro ZXZero PCB in the marked area

Figure 29: Fit the USB Riser PCB

3. Screw the M2 nuts tightly onto the M2 screws and snip flush to the nut

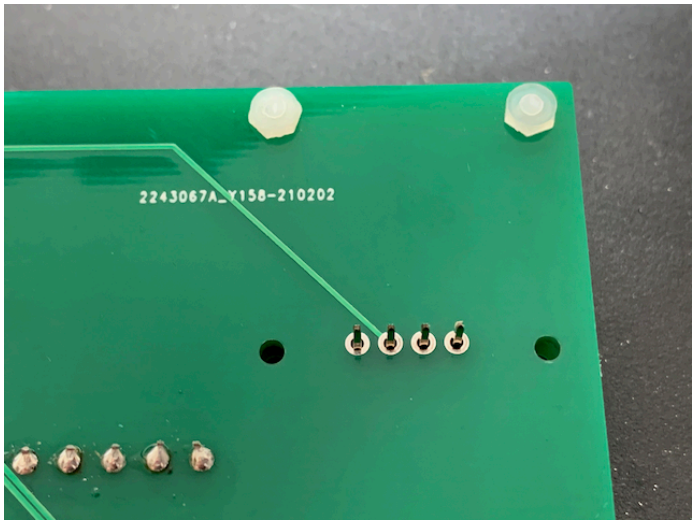


Figure 30: Fit USB Riser M2 nuts

4. Solder the 4-way header

15 Connect the HDMI ribbon

1. Connect the HDMI ribbon to the glued HDMI connector on the Backplane PCB
2. Plug the other end into the Mini HDMI socket on the Raspberry Pi Zero

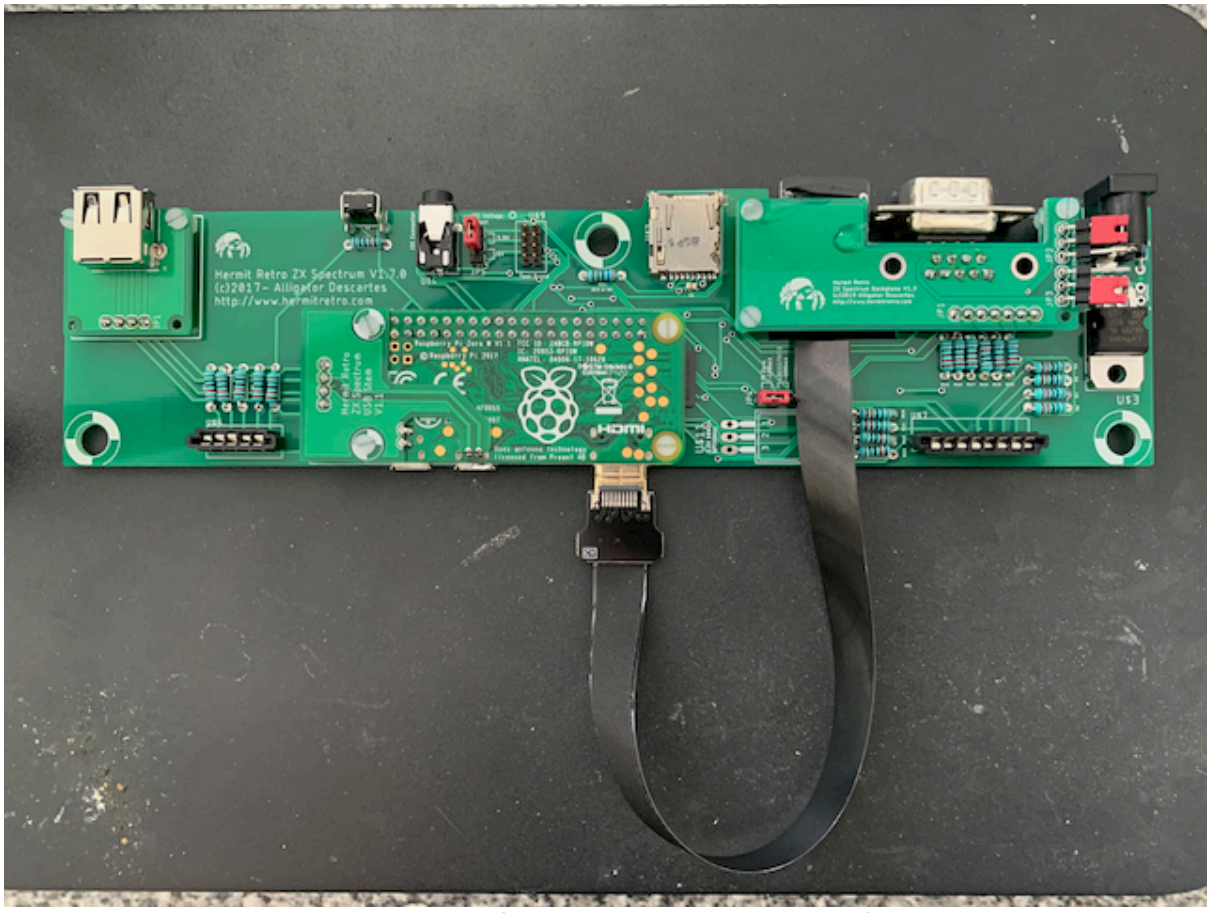


Figure 31: Complete Hermit Retro ZX Spectrum Board

16 Hermit Retro ZXZero PCB Jumpers

16.1 JP4 3.3V Source Selector

- If you HAVE NOT fitted the optional 5V->3.3V regulator U$11, fit a jumper to the two leftmost pins on JP4. This will use the Raspberry Pi Zero's own 3.3V power rail which is rated at around 100mA
- If you HAVE fitted the optional 5V->3.3V regulator U$11, you can either:
    - Fit a jumper to the two leftmost pins to obtain 3.3V from the Raspberry Pi Zero's own rail
    - Fit a jumper to the two rightmost pins to obtain 3.3V via the LD1117V33 regulator which can supply up to 800mA on 3.3V

16.2 JP5 I2C Voltage Selector

If you are using the I2C expansion port, you can supply either 5V or 3.3V to your own boards. We would recommend 3.3V.

- If you want to use 3.3V, bridge the uppermost two pins with a jumper
- If you want to use 5V, bridge the lowermost two pins with a jumper

!!! Note that the Hermit Retro Game Controller uses 3.3V !!!

!!! Note that the Raspberry Pi Zero I2C lines are 3.3V. If you supply 5V to your I2C expansion device, you will require a regulator and level shifter for the I2C lines otherwise you risk damaging the Raspberry Pi Zero !!!

17 Backplane PCB Jumpers

There are two jumper headers on the Backplane PCB which enable you to reconfigure buttons on the Arcade-R joystick.

You can chain both left and right fire buttons to the same logical FIRE function which is the default configuration, the default being FIRE1.

17.1 JP2

This jumper header associated the left button to a logical FIRE switch. Bridging the uppermost two pins will result in the left button being associated with FIRE1, typical for right-handed players.

If you bridge the lowermost two pins, the left button will be associated with FIRE2 (which may not be supported in any games).

The suggested setting is to bridge the uppermost two pins.

17.2 JP3

This jumper header associated the right button to a logical FIRE switch. Bridging the lowermost two pins will result in the right button being associated with FIRE1, typical for left-handed players.

If you bridge the uppermost two pins, the right button will be associated with FIRE2 (which may not be supported in any games).

The suggested setting is to bridge the lowermost two pins.

18 Power-Up

- Flash the Raspberry Pi Zero MicroSD with the Hermit Retro ZXZero firmware on another computer
- Connect the monitor HDMI cable to the backplane socket
- Connect the power adapter to the power jack
- The system should boot after a few seconds

If the system doesn't boot see the Troubleshooting section.

If it does boot:

1. Unplug the power
2. Put the Hermit Retro ZXZero PCB into your case
3. Connect the two membrane ribbons to the relevant connector
4. Screw the case shut
5. Enjoy!

19 Optional Zelux Kit

If you have a Zelux membrane (anti-ghosting and LEDs!), you can acquire an optional Zelux Kit for the ZXZero board.

Firstly, the ZXZero handles power to the Zelux membrane, so you can desolder the power regulator and switch from the Zelux membrane if you have already fitted it. If you have not assembled the Zelux membrane, you should solder on the 5- and 8-way ribbons and a 2-way ribbon to one of the +/- connectors.

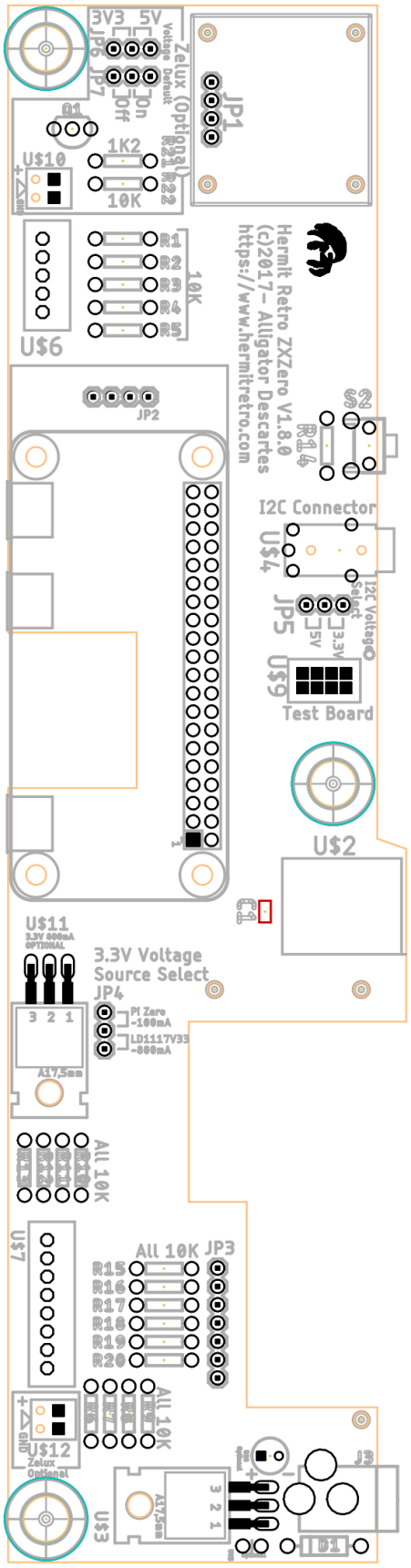
The Zelux components can be soldered to the ZXZero in any order.

Once the components are soldered:

- Move the jumper on JP4 to bridge the two right-most pins. This will now supply 3.3V via the regulator U$11 as the Zelux membrane has a higher power requirement than the Raspberry Pi Zero W 3.3V regulator can supply
- On JP6, bridge the two lower pins such that 3.3V is supplied to the Zelux membrane. You can supply 5V for brighter LEDs but there is a risk the blue LEDs will blow. We recommend that you use 3.3V
- On JP7, bridge the two uppermost pins (“ON”)
- Carefully plug the Zelux membrane into the two ZXZero connectors
- Screw the +/- 2-way ribbon into either the left-most or right-most screw terminal beside the connector block

At this point, you can reassemble your Spectrum. After rebooting, open the Fuse menu and select “Backlight”. Your Zelux LEDs should now illuminate. To de-illuminate, simply select “Backlight” again.

20 Board Diagram


3V3
5V
Voltage Default
JP6
JP7
Zelux (Optional)
On
Off
JP1
Q1
1K2
U$10
R21
R22
10K
R1
R2
R3
R4
R5
10K
U$6
Hermit Retro ZXZero V1.8.0
(c)2017- Alligator Descartes
https://www.hermitretro.com
JP2
R14
I2C Connector
U$4
I2C Voltage Select
JP5
5V
3.3V
U$9
Test Board
U$2
U$11
3.3V 800mA OPTIONAL
3.3V Voltage Source Select
JP4
3 2 1
A17,5mm
Pi Zero ~100mA
LD1117V33 ~800mA
All 10K
U$7
All 10K
JP3
R15
R16
R17
R18
R19
R20
All 10K
U$12
Zelux Optional
GND
U$3
A17,5mm
3 2 1
J3
D1