

Informations about the „uHeld64“ Boards

(Final Prototype)

Last Changes

Mittwoch, 14. Juni 2023

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1 Features

The dream of a C64 Handheld becomes true! With the dimensions of 107x159x40mm the boards are very small. This was made possible by placing the components on both sides of the boards, instead of only on one side as usual.

But it is not only the size that is impressive, but also the equipment:

- Complete C64 Micro-Keyboard
- Raspberry Pi Zero slot for an internal Pi1541
- Slot for Joystick Adapter board with 2 Joystick Ports
- Expansion Port
- S-Video Socket
- Headphone Jack
- Volume Control
- Loudspeaker option
- Stripe-Fix Option

1.1 Memory Controller

The uHeld64 is deliberately based on the MMU 252535-01 or 251715-01 (for both variants the Color-RAM socket U31 must be equipped with a 2114 SRAM). Because the 64-pin IC is almost indestructible (in contrast to the old PLA IC of the old C64 model), and should last longer than all other highly integrated ICs of the C64. A further advantage is the saving of many more ICs, as well as the high distribution, because millions of the last C64 II model were produced until the 90s (from 1987-1994). And last but not least you get a suitable socket for this IC, even though this IC is far away from the usual 2.54 pitch. And since the board can be equipped with SRAM, there is no VSP bug anymore, so there is nothing against using the 469 PLA/MMU IC.

2 Supply Voltage

For the board, a 5V drop-down voltage regulator is used, with a fixed filtered input voltage of 12V. For example the Pololu D36V28F5. Of course any other 5V voltage regulator can be used, but it should be noted that each regulator has different specifications and functions which should be studied carefully before use to determine if it is suitable for the intended application. If a voltage regulator without overcurrent protection/short circuit protection/polarity reversal protection is used, an additional external fuse circuit should be used to prevent possible damage.

In the case of the Pololu D36V28F5, the exact characteristics of the controller can be found on the website <http://pololu.com>. This controller has reverse polarity protection up to 40 V, undervoltage and overvoltage protection at the output, overcurrent protection and short-circuit protection. A thermal shutdown function also helps to prevent damage from overheating, and a soft start function limits the inrush current and allows the output voltage to rise gradually during start-up.

For the connection of a 12V plug-in power supply unit a placeholder for a 2.1 mm panel jack is provided (inner conductor +12V, outer conductor earth/GND).

It should also be noted that a voltage source in the form of a power supply unit or a battery/accumulator must not only be able to supply the correct voltage but also the necessary current (at least 12V/1A). Car chargers or toy train transformers are not suitable as voltage sources and will lead to damage to any components that may be fitted or to malfunctioning of the circuit board. Before connecting the voltage source, check the correct polarity and the correct polarity of all placed components. If a power supply unit is used as a voltage source, it is imperative that it complies with VDE regulations.

Important: Before ICs are inserted into the sockets of the board, all voltage input pins of each IC should be checked while the power supply is on to ensure that the correct voltage is applied to all ICs and their corresponding pins.

3 Board Areas

3.1 9V Board Voltage

For the 9V voltage, which is provided for the SID chip, a 9V (placeholder U37) Step-Up converter is required. For example the U3V12F9 from Pololu. It is up to you which regulators are used, if they are suitable for this case.

3.2 Clock Generator Circuit

Around the 8701 IC, as well as the two crystals for PAL and NTSC frequencies, you can choose between PAL and NTSC with the jumper (J14). Of course, the VIC II chip must be changed accordingly.

3.3 Kernel/Basic ROM

The U22 socket is equipped with an EPROM/EEPROM (28C256=32K).

0000-2000 = BASIC

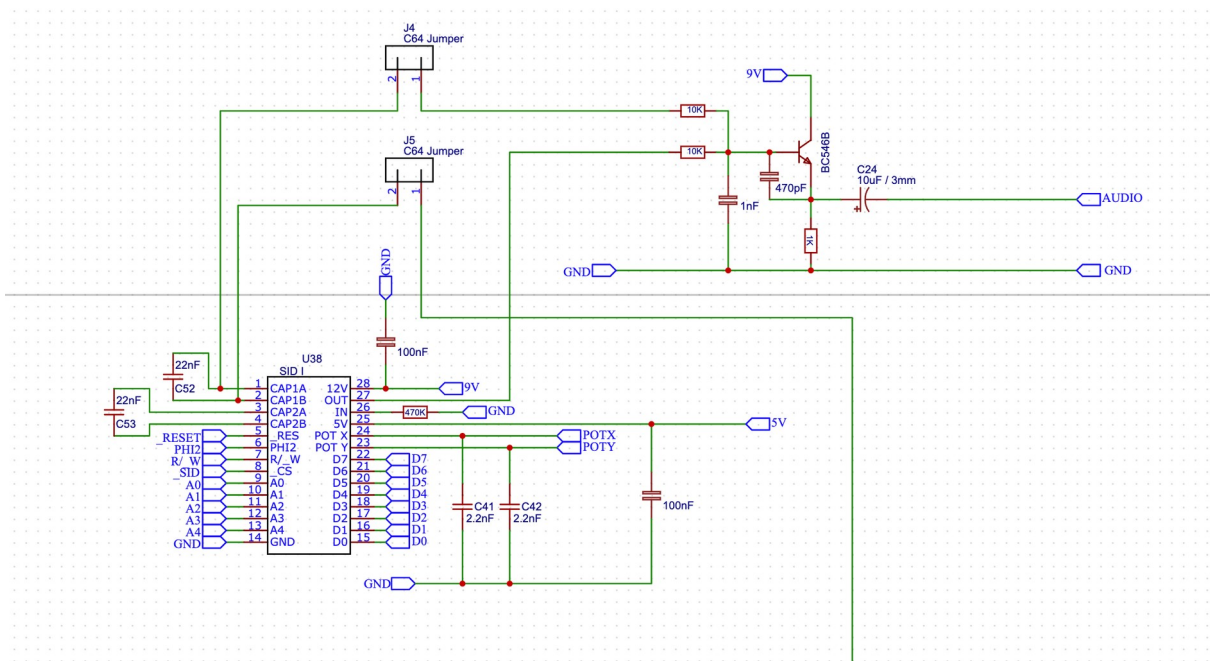
2000-3FFF = KERNEL

7000-7FFF = CHARS

3.4 VIC II

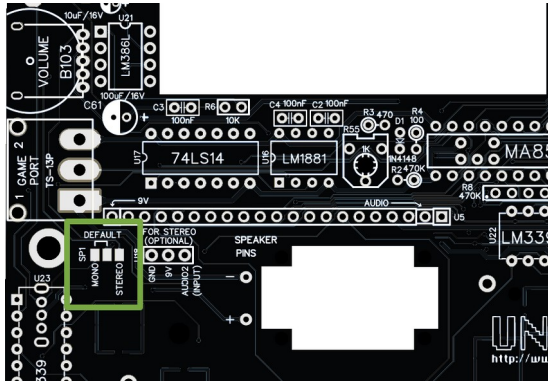
Depending on the TV standard set, a PAL/NTSC VIC II type (8562 or 8565 for 5V only) can be inserted into the U32 socket.

The easiest way is to use a replica SID, as this saves the step-up voltage regulator, generates less heat, and you can also be on the safe side regarding a possible loss of an original SID. If you still want to install an original SID, you can use the appropriate step-up voltage regulator (6581: 12V, 8580: 9V). Note that other capacitors are needed (C52/C53 470pF instead of 22nF), a 1K resistor from "SID" Out Pin 27 to GND, and the 470K resistor for the 8580 DIGI fix should be removed:



If the 6581 is used, you have to expect that it does not work properly with 5V, because the voices are often only correct with 4.85V.

3.6 SID audio signal on both sides

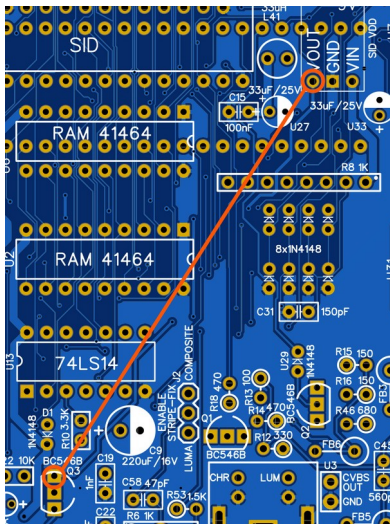


In order for the SID audio signal to be present on both sides of the headphone jack, the "mono" jumper on the back of the board must be soldered.

3.7 Fix Audio Problems

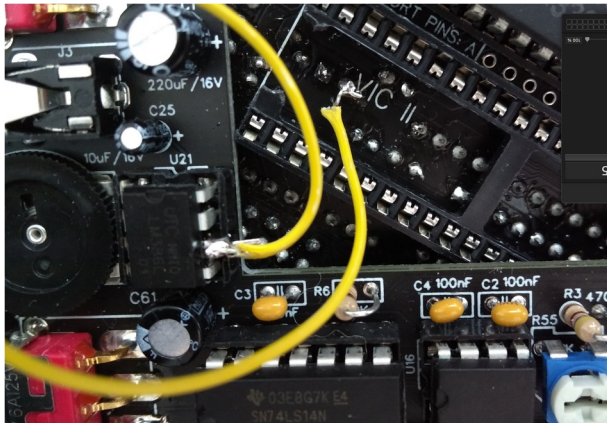
Older uHeld64 boards work with a voltage of 5V at the audio transistor Q3 on the motherboard, and work perfectly with an ARMSID. There should be no audio problems at all, neither at the headphone output nor at the speaker output.

How do I recognize newer boards? Newer uHeld64 boards have a direct connection between the VOUT pin of the 9V regulator and the upper pin of the Q3 audio transistor:

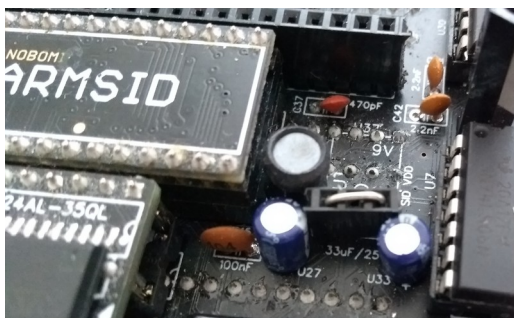


Background: On newer uHeld64 boards the 5V voltage at the upper pin of the audio transistor Q3 has been replaced by 9V to prevent audio distortion when using a SID 8580. However, this 9V voltage is not provided to the LM386L at pin 6 (supply voltage) on the upper keyboard board. For this an additional pin was missing on the 20 pin connector.

Therefore, on the newer boards, a connection must be made from the VOUT pin of the 9V voltage regulator, to pin 6 of the LM386L (bend up pin 6 of the LM386L / remove it from the socket). **However, this fix is not necessary on the very new version 1.5**, as a 21st pin has been added for this purpose, as well as an optional 9V/5V solder jumper on the back of the board.



If the newer boards still use an ARMSID, then it is sufficient to omit the 9V regulator and to insert a jumper instead, so that the 5V input voltage is forwarded to the OUT pin of the 9V voltage regulator, and the audio transistor Q3 still receives the 5V. The LM386L does not have to be changed then.



However, if this jumper is not plugged in, the sound will be too quiet/noisy.

3.8 Stripe Fix

If excessive vertical stripes are visible on the screen, they can be reduced with the Stripe Fix potentiometer R6 (bottom). To do this, the "Enable Stripe-Fix" jumper J16 must be closed first.

3.9 Internal PI1541

To ensure that the internal Pi1541 functions reliably, the CIA 6526 (U8) socket should be equipped with a CSG 6526/216A on the rear side if possible. According to one user, MOS 6526/216A should also work, but during my tests I already had problems with MOS 6526/216A chips. Furthermore the following files on the SD-card of the Raspberry pin should be changed.

File: config.txt

```
kernel_address=0x1f00000  
force_turbo=1
```

```
boot_delay=1  
arm_freq=1100  
over_voltage=8  
sdram_freq=500  
sdram_over_voltage=2
```

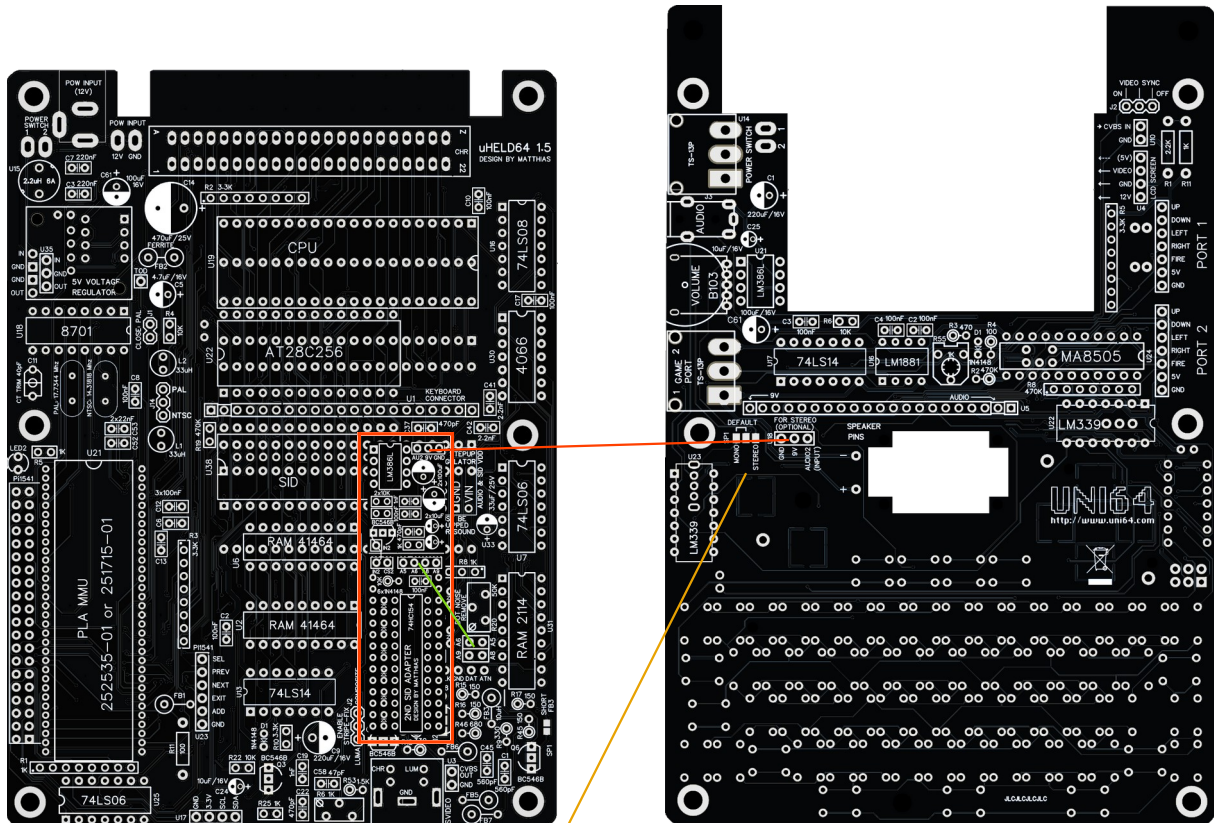
File: options.txt

```
invertIECInputs = 1  
invertIECOutputs = 1  
splitIECLines = 1
```

Problematic demos, which even with an original C64 and a Pi1541 drive partly do not work according to user reports, ran perfectly in tests on the uHeld64.

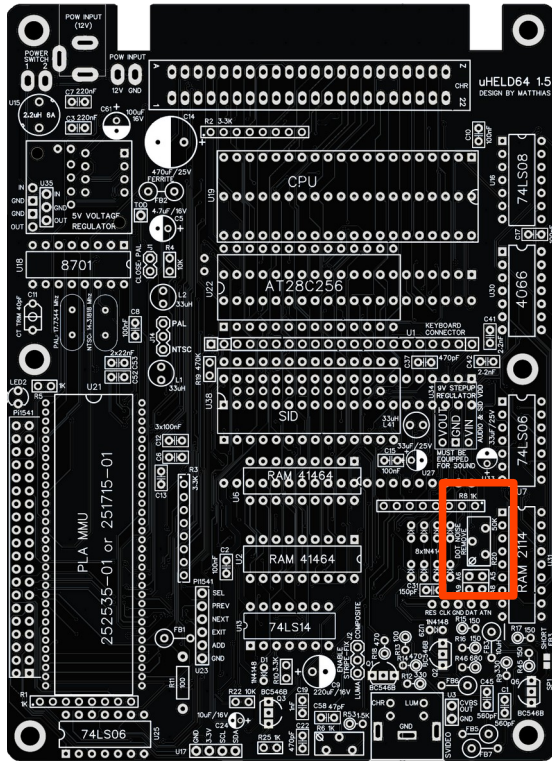
4 New Features in the Version 3

4.1 Stereo SID Option with uSID64



The 2nd SID socket adapter board is placed as a whole on the uHELD64 mainboard (take care of good isolation), and the pins A5 to A9 (green) are connected to each other. Additionally the pins AU2, 9V and GND (red) are connected to the upper keyboard board of the uHELD64 on the backside. Finally the solder bridge is changed from mono to Stereo on the keyboard board.

4.2 VIC-II DOT NOISE REMOVE

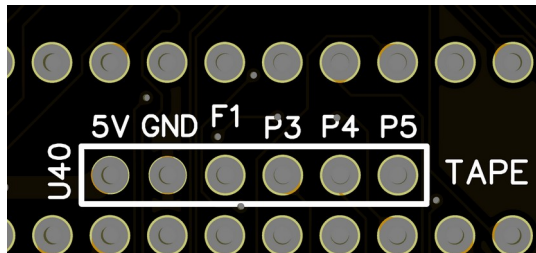


The PAL version of the VIC-II 8565 shows from time to time numerous dots in the screen frame, which can be eliminated with the help of the 50K potentiometer. The calibration is done with the help of the C64 tool "Dot Noise Calibration Tool.prg".

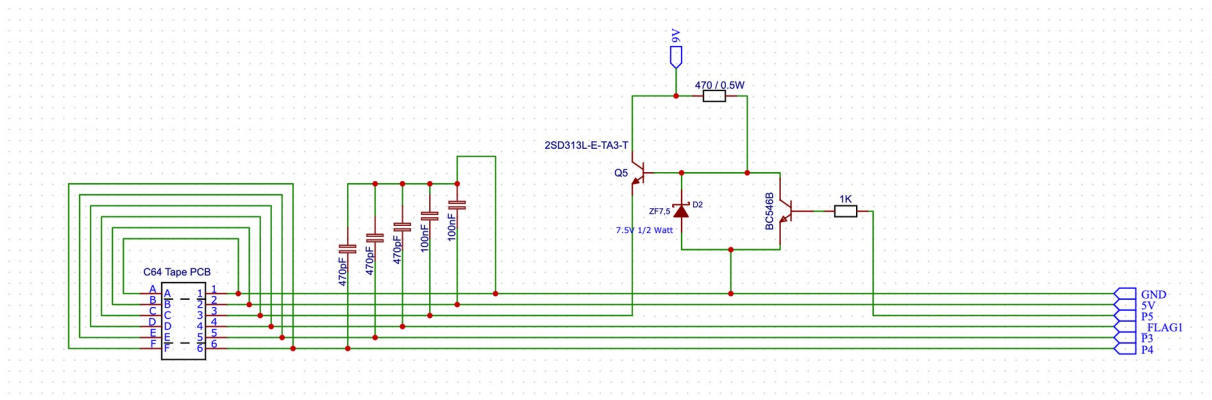
Note: At the beginning, the potentiometer should be set to the right stop (clockwise).

4.3 TAPE Pins

There is a pin header on the board for connecting an external cassette recorder (TAPE).



The pins cannot be connected directly to a TAPE, but require a small circuit:



4.4 Serial Port Pins (1541 Floppy)

There is a pin header on the board for connecting an external floppy (1541).



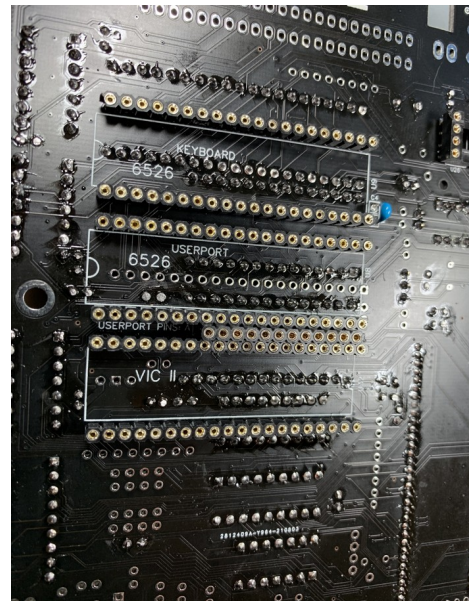
These pins can be connected directly to a floppy unlike the TAPE pins.

5 Equipping the Sockets

When equipping the sockets, a certain sequence must be followed when using female sockets on both sides of the board, as this is the best way to solder the pins.

The **pins hidden under a socket should always be soldered from the side first**, so that they cannot be missed/forgotten because they are covered by sockets. To solder the sockets are sometimes difficult, then the solder should be pushed from the side under the IC socket to the pin. With SMD 0.5mm solder it should work well.

Alternatively, round **precision skirting boards** can be used:



5.1 Mainboard

First the these sockets should be soldered:

1. Socket U19 CPU
2. Socket U9 CIA
3. Female Header U1 Keyboard Connector
4. Socket U8 CIA
5. Socket U22 AT28C256 EEPROM
6. Userport Connector Pins (A-N)
7. Socket U32 VIC-II
8. Socket U38 SID
9. Sockel U6 RAM

And then:

U2,U7,U13, U16, U26 (NE555), U30, U31

5.2 Keyboard Board

For the keyboard board these ICs should be soldered first:

1. Switch under U23 (LM339)
2. U23 (LM339)

6 Assembly instructions

6.1 Board spacing

Distance between back board and main board: 10.0 mm

Distance between main board and keyboard board: 18,0 mm

Distance between keyboard board and front board: 6.0 mm

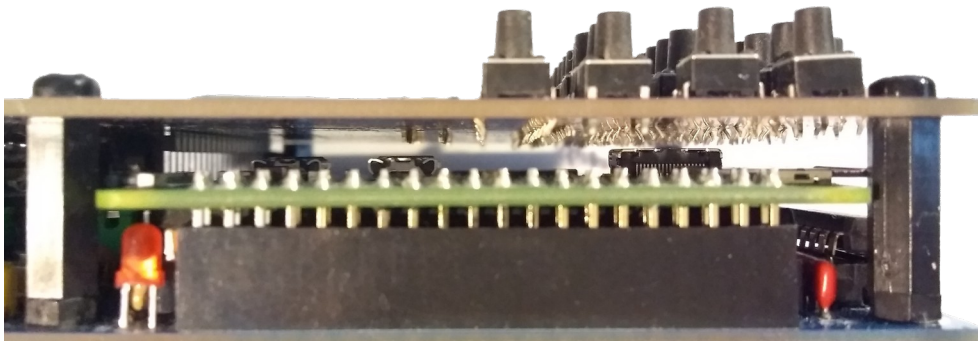
Accordingly, the correct plastic spacer bolts should be used.

Note: do not use metal bolts, otherwise conductor paths could be destroyed.

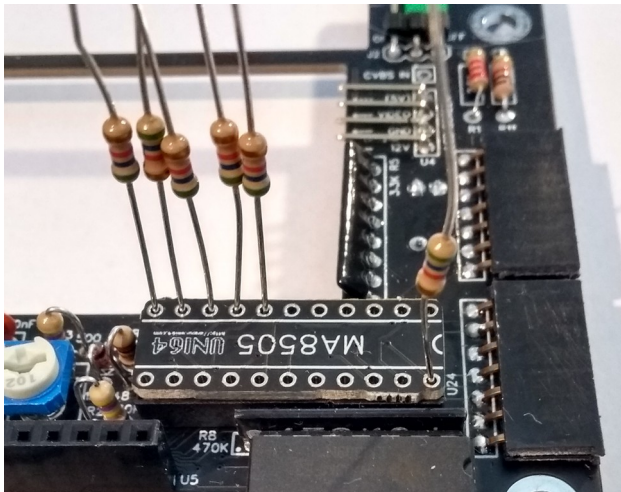
Micro-Switches height: with the distance of 6mm for the Front Panel, you need Micro Switches with a height of 8mm

6.2 Pi1541 Zero Board

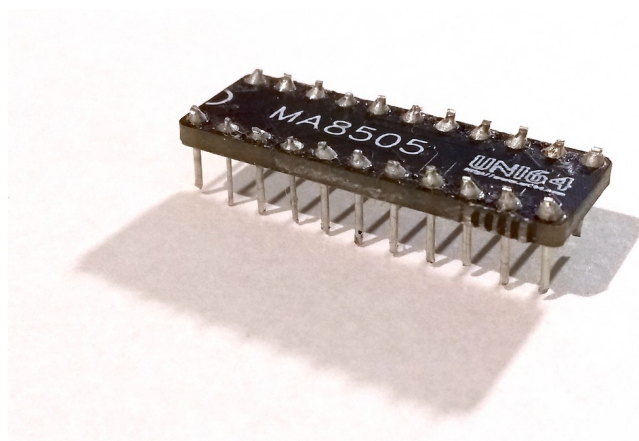
When placing the Raspberry Pi Zero, care must be taken that the upper components of the RPi Zero (especially the MiniHDMI Connector) do not touch the pins of the keyboard board (micro buttons). To do this, it may be necessary to remove the black pin header spacers and shorten the header pins.



6.3 MA8505 Joystick Port Switch IC

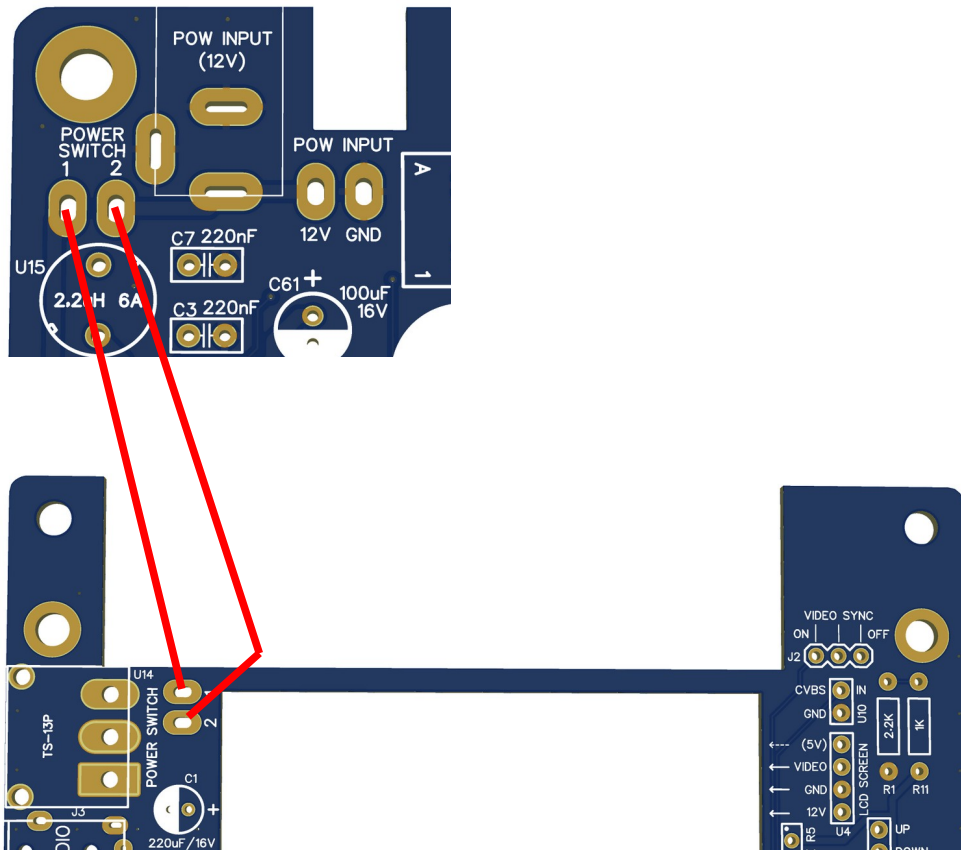


As you can see on the picture, the usual IC pin headers cannot be used because of the small distance between Mainboard and Keyboard board. Instead, wires must be used that are soldered from above.



6.4 12V Power Switch Connection

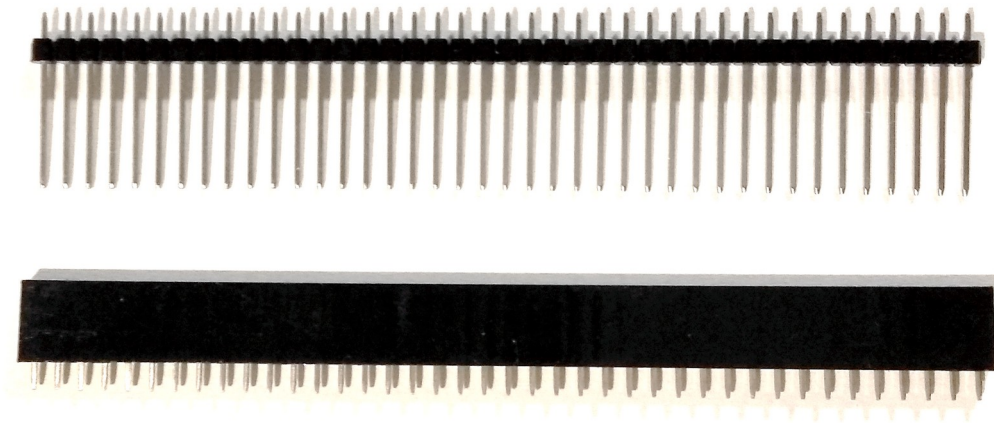
The "Power Switch 1 2" pins exist on the **Mainboard** (left) and on the **Keyboard Board** (left) and must be connected 1 to 1. So pin „1“ with pin „1“ and pin „2“ with pin „2“.



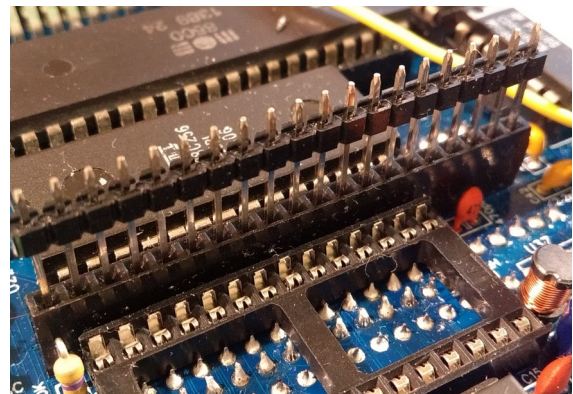
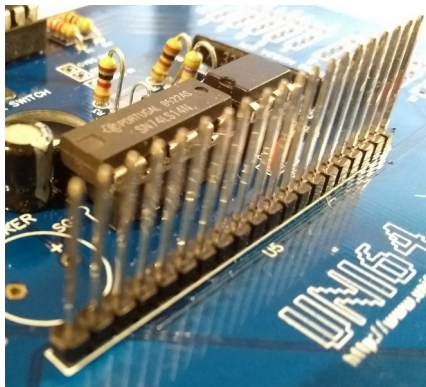
For all these connections, use slightly thicker wires designed for higher currents (approx. 3A).

6.5 Keyboard and Audio Connection

For the connection from the Mainboard to the Keyboard Board a 19mm long 20 pin male connector is needed, as well as a 11.5mm long 20 pin female connector.



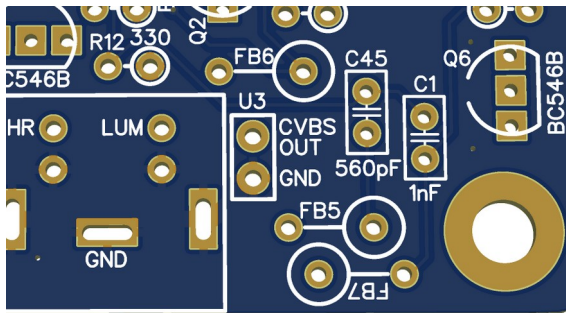
It is up to the user to decide which pin/socket connector is soldered to which board.



When plugging together, always make sure that the pin header is not accidentally plugged into the socket header offset by a few pins, as there are 5V and GND pins here that supply the **Keyboard Board** with power.

6.6 Video Connection

To establish the video connection, a wire is soldered to the "**CVBS OUT**" pin on the **Mainboard**,



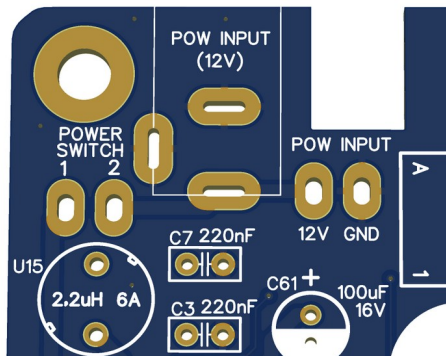
and led to the **Keyboard Board** to the connector "**CVBS IN**".



The connectors "LCD SCREEN" are connected to the LCD display (Video, GND, 12V). The 5V are optional for users who have modified their LCD Screen Board.

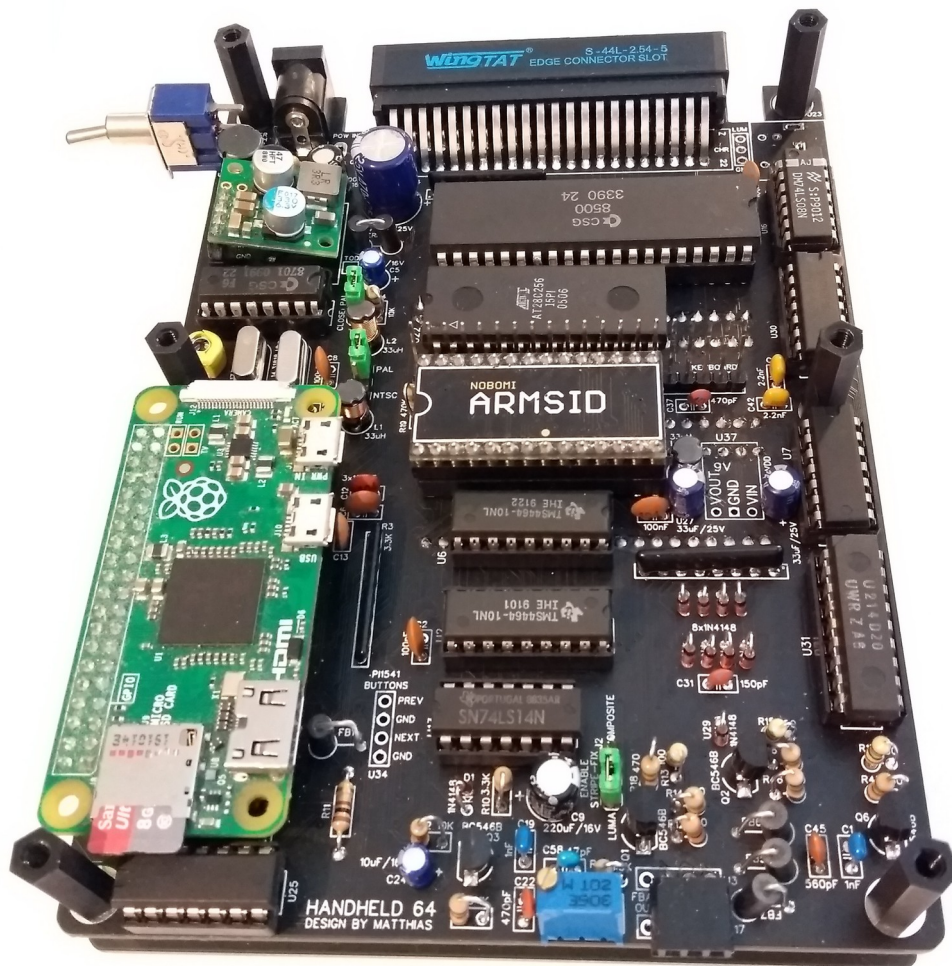
6.7 Mainboard

The **POW INPUT** connectors "**12V**" and "**GND**" are for an internal battery charger board, which has an additional connector for a 12V battery, and a 12V output, which is connected to the **12V** and **GND** pins. This battery charging board should protect the battery from deep discharge, among other things, so that it doesn't get damaged. Since there are very different charging options, it is up to everyone which solution is chosen and installed.



SID

To keep the heat and power consumption within limits, a replica SID with 5V should be installed instead of an original SID. For example the ARMSID. For more, see section 3.4



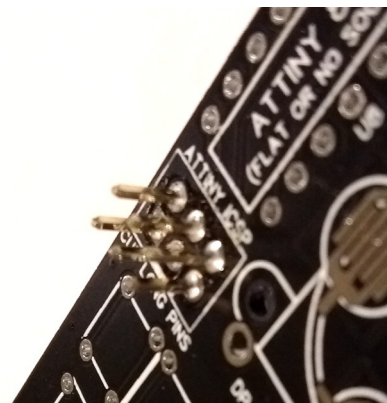
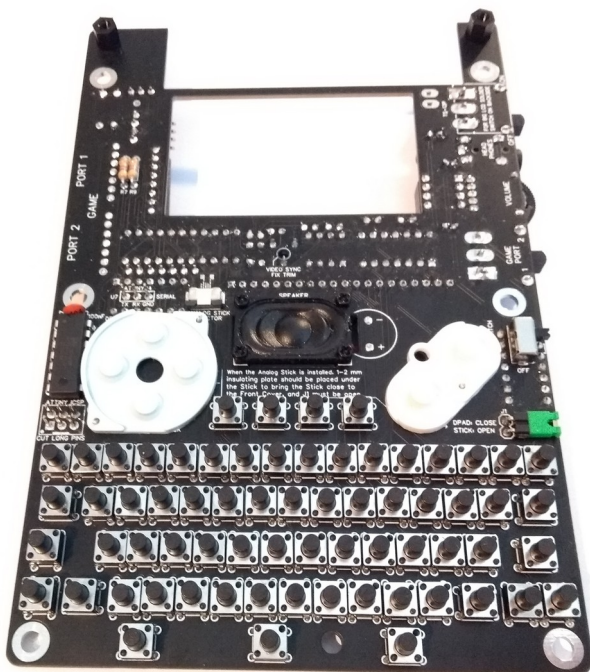
6.8 Keyboard Board

Speaker

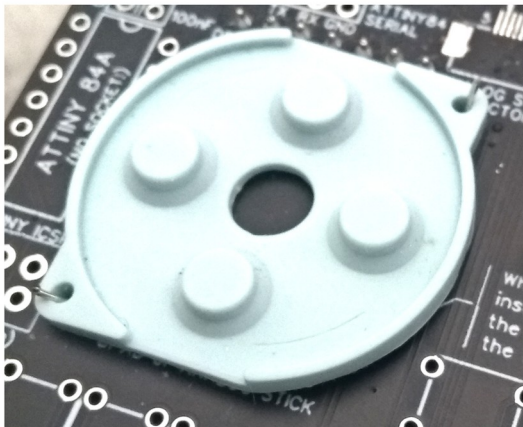
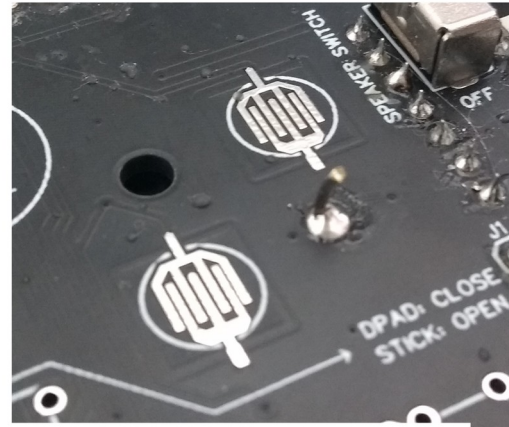
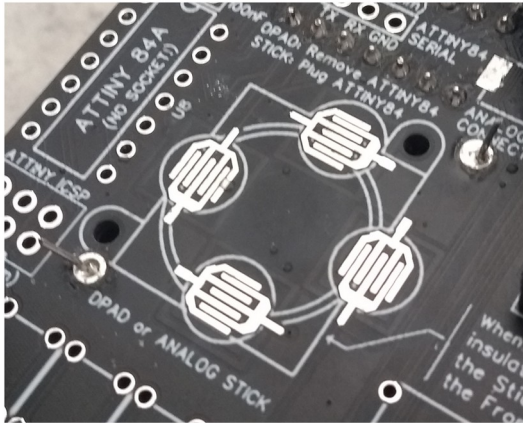
The 4 holes for mounting the speaker are too small for M2 plastic screws and have to be drilled out carefully with a 2mm drill bit beforehand.

DPAD und Analog Stick

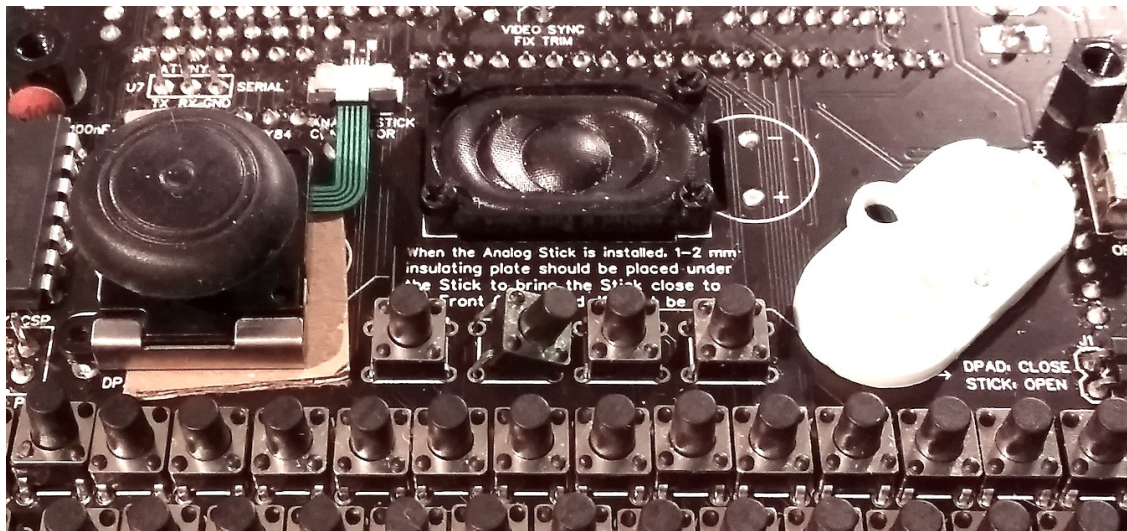
The board is designed in a way that it is very easy and fast to switch between DPAD and Analog Stick. If no Analog Stick is used and not planned, the ATtiny84 IC can be omitted. Otherwise the ATtiny84 has to be soldered directly to the board without socket (don't use a socket!) and the respective firmware for DPAD or Analog Stick has to be transferred via ICSP adapter (right picture). **The pins of the ICSP port should be exactly 5mm long.**



For the DPAD, 2 wires should be soldered into the free holes in order to be able to fit the DPAD rubber, so that it is perfectly centered. For the right pad, an additional screw is necessary. Afterwards you should check if the contacts are exactly over the contact surfaces of the board, because this is important for a low contact resistance. Otherwise there may be problems with the control.



Important: In order for the DPAD to work smoothly, special attention should be paid to the distances between the rubber buttons and the front board, and if problems occur, test without the front board first.



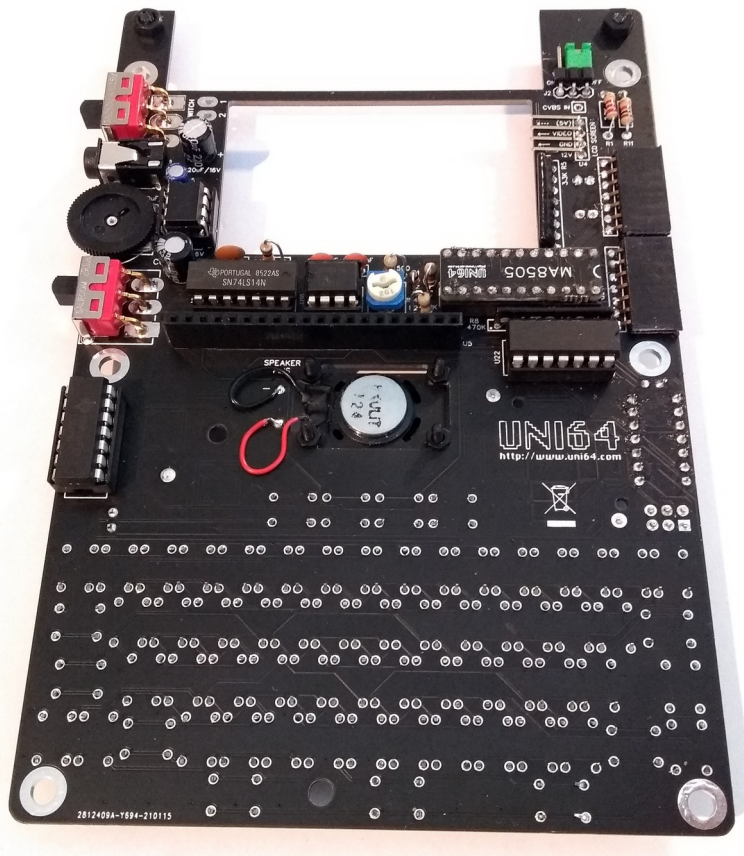
For the Analog Stick, please note that a **Nintendo Switch Analog Stick** and a **5-pin "FFC/FPC spacing of 0.5mm - Upper Contacts" flat ribbon clamp adapter** is used.

In addition, a piece of insulation (cardboard or similar) must be placed under the analog stick to prevent a short circuit on the Keyboard Board and to press the Analog Stick against the top of the Front board so that the full range of motion of the Analog Stick is available and the stick does not hit the top of the front board when it is moved back and forth.

Note: The Analog Stick does not need to be calibrated, but calibrates itself every time the uHeld64 is switched on. **If a few keys do not work after switching on, then briefly move the joystick in a circle.**

Micro-Switches

The Micro-Switches do not necessarily have to be soldered, since they are usually firmly enough in place, or are constantly pressed into position. So you can easily reuse the buttons when you change the board.



LCD Display

The LCD display is connected via the 4 contacts 12V, GND, VIDEO and 5V (optional), which supplies the display directly with 12V. The optional 5V pin is available in case a display with only 5V is used.

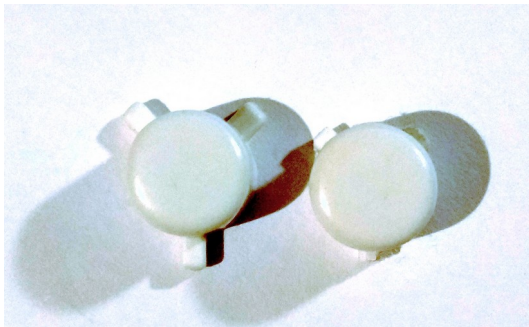
VIDEO SYNC

With the jumper J2 a video synchronization can be switched on, in case the LCD display does not show a picture. The sync signal can be adjusted with the potentiometer R55. Therefore there is a "Video Sync Fix Trim" hole on the top of the board, so that an adjustment can be made even when the Keyboard Board is mounted.

6.9 Front Board

Buttons

The 3 bars of the two buttons should be shortened by half (possibly a little more). The bars must not be cut off completely, because the buttons would then fall out of the top of the Front Board. However, the bars must be shortened because if they rotate over time, they will hit the rubber edge, and thus the key stroke will be disturbed.



7 Image Quality

To make it clear what image quality can be achieved, here are two screenshots with "ODV" Zero Latency S-VIDEO -> HDMI converter and 1080p DELL Touch Monitor (Sharpness 100%). Taken with a Moto G5 smartphone, without any processing. If the picture is worse than seen on the two screenshots, other converters/monitors/cables should be used.

