

Information about the uEliteBoard64

(Final Prototype)

Last changes

19.09.2023

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1 Features

The special thing about the uEliteBoard64 is the many new possibilities it offers. The many options and the many measuring points invite you to tinker and experiment.

1.1 Measuring Points

It was very important to get very easy and direct access to all possible circuit points. Therefore, where possible, measuring points were created on the board. Care was taken that the hole of the measurement point is slightly larger than the tip of an oscilloscope probe ($>1.2\text{mm}$). So that the tip can be "put in" and the hand is free again. This allows several probes to be "placed" in the circuit at the same time.

1.2 Memory Controller

The uEliteBoard64 is deliberately based on the MMU 252535-01 or 251715-01. 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, since many 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 with the "optional" OnBoard SRAM solution (instead of 41464 DRAM) there is also no VSP bug anymore, there is nothing against using the 469 PLA/MMU IC.

1.3 The HAT Placeholder

Beside all the already integrated possibilities, which normally cover the board with wires by additional modifications, and thus clog the space in the C64, there is now space to push the possibilities to the limit: the "HAT" placeholder with 27 pins.

This allows you to plug additional "HAT" plug-in boards onto the board without any fuss, and thus to expand the functions of the board immediately. For larger and more comprehensive "HAT" plug-in boards, 2 drill holes have been created for mechanical board connections.

2 Supply Voltage

For the board is the use of a 5V drop down voltage regulator, 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 features that 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, under and over voltage protection at the output, over current 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.

To connect a 12V power supply, a placeholder is provided for a 2.1 mm panel jack (inner conductor +12V, outer conductor ground/GND), as well as for an old C64 power jack. However, even with the C64 Power socket only a 12V power supply and a 5V regulator should be used, because with voltages < 10V problems in system stability occur.

A new three-pole "toggle switch" or an old six-pole "C64 Power Switch" can be used as power switch. Please also note 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 a voltage source and will lead to damage to any components fitted or malfunction of the board. Before connecting the voltage source, the correct polarity

must be checked, as well as the correct polarity of all placed components. If a power supply unit is used as a voltage source, it must comply with VDE regulations.

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

3 Board Areas

3.1 12V/9V Board voltages

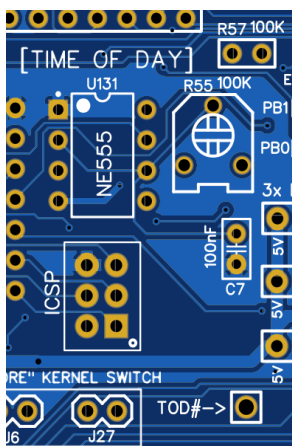
For the 9V/12V voltages, which are provided for the cartridge drive, VIC II and SID chips, 9V (placeholder U37) and 12V (placeholder U36) step-up converters are required. For example the U3V12F9 and U3V12F12 from Pololu. It is up to you which regulators are used, if they are suitable for this case.

3.2 Clock generator circuit

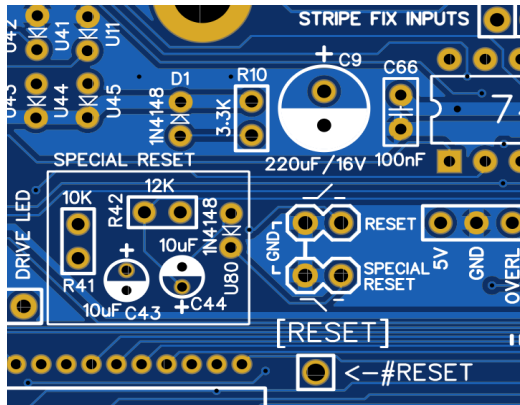
Around the 8701 IC, as well as the two crystals for PAL and NTSC frequencies, you can choose between PAL and NTSC with the jumper (J1). Of course, the VIC II chip has to be changed accordingly, and the VDD supply voltage for the VIC II has to be set between 12V and 5V. Instead of the 8701 IC there is also enough space left for an 8701 replica board. If only a black and white picture is visible, you should adjust the 40pF trimmer or follow the chroma signal line.

3.3 Time of Day

The TOD frequency of 50-60 Hz can be set with potentiometer R55 to the right of the NE555 IC.



3.4 Reset



In order to avoid that one port has to be occupied from outside (user port, serial port, expansion port) to use a reset switch on the C64, two RESET pin pairs have been placed on the board. One normal "RESET" pin pair and one "SPECIAL-RESET" pin pair that allows to perform a system reset even with reset protected programs.

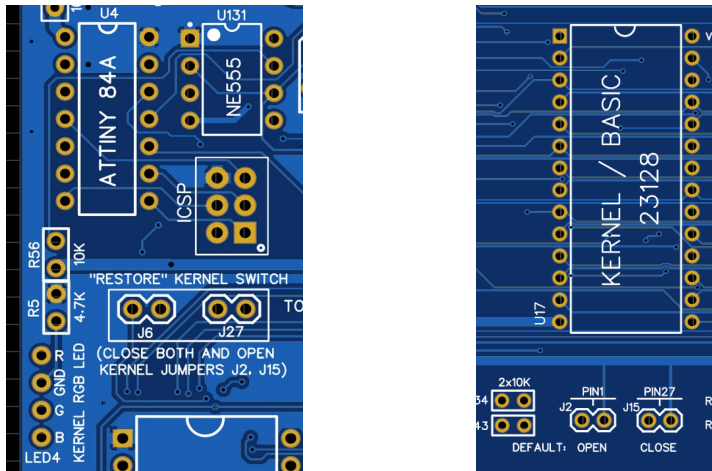
3.5 Kernel/Basic ROM

The U17 socket is either equipped with the original kernel basic ROM MOS 251913 chip, or with an EPROM/EEPROM (256=32K/512=64K). If the original MOS chip is used, make sure that jumper J2 is open (0V) and jumper J15 is closed (5V). If an EPROM or an EEPROM is used, jumper J2/J15 must be closed (5V) or left open (0V) according to the address pins of the EPROM. **For example, with a W27C512 EPROM, jumper J15 must remain open.**

Example: 32K EPROM (28C256):

- 1. BASIC 0000-1FFF (8K)
- 1. KERNEL 2000-3FFF (8K)
- 2. BASIC 4000-5FFF (8K)
- 2. KERNEL 6000-7FFF (8K)

3.6 Kernel Switching (RESTORE KEY)

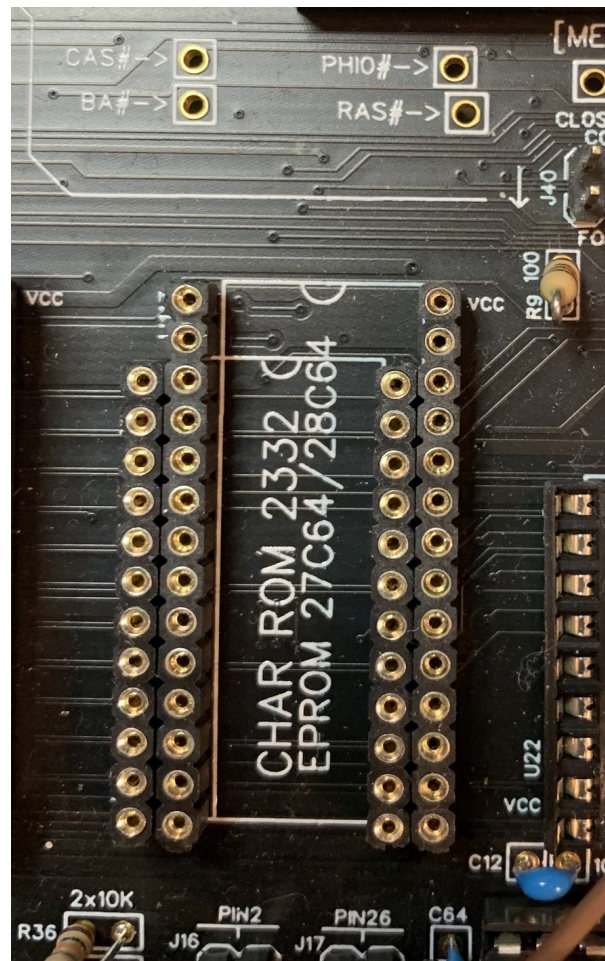


In order to provide a simple kernel switching option directly on the board, an ATTINY 84A placeholder was created, which quasi "remotely controls" the kernel jumpers J2/J15. For the remote control to work, not only the jumpers J6/J27 must be closed, but also the kernel jumpers J2/J15 must be opened. An own Kernel-Switch Firmware for the ATTINY 84A can be transferred through the existing ICSP port (ICSP 5V is not wired, therefore the C64 must be switched on to transfer firmware). To switch the kernel, hold the RESTORE key longer than 2 seconds. Then the colors rotate every second. When the desired color is reached, release the RESTORE button and a RESET is executed.

3.7 Character-ROM

The U15 socket can be equipped with the original Char-ROM MOS 901225 chip, or the U113 socket with an EPROM/EEPROM (64=8K/128=16K). If an EPROM or an EEPROM is used, jumper J16/J17 should be closed (5V) or left open (0V) according to the address pins of the EPROM.

Socket: Either normal female header sockets are used, and must choose one of the two ROM places, or round precision sockets are used, as shown in the picture:

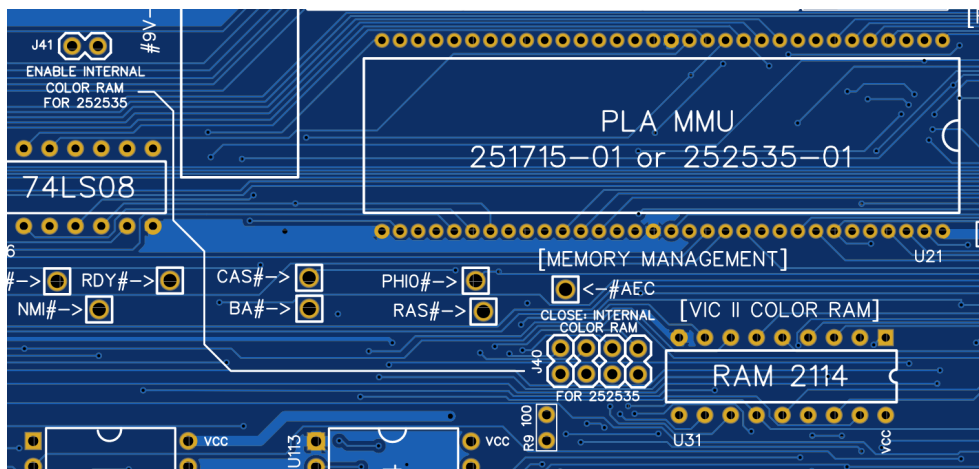


3.8 DRAM/SRAM

Two types of RAM can be used on the uEliteBoard64, once the normal DRAM chips 41464 (2x) in the sockets U22/U23, or "optionally" the sockets **U104 / U2 / U105** can be equipped with a **UM61512AK-15 / 74HCT573 / 74HCT32** chip. During tests LS and HC types could also be used without visible problems. Instead of equipping the sockets U104/U2/U105 with ICs, an SRAM adapter board can also be plugged onto the DRAM sockets U22/U23.

3.9 Internal Color RAM

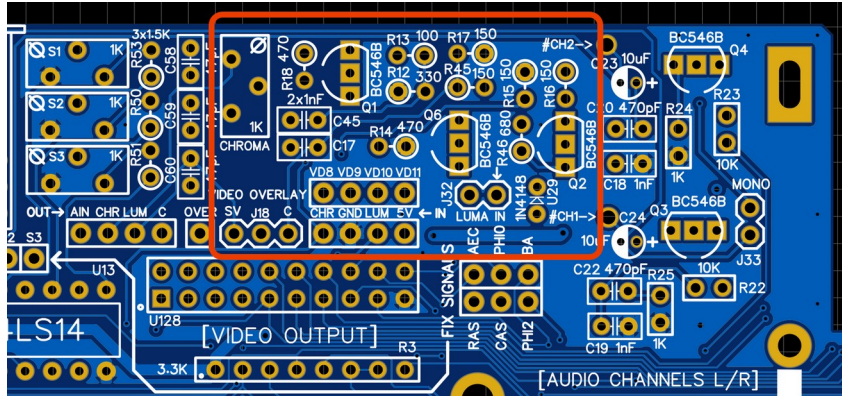
If a MMU 252535 is used, the internal instead of the external Color RAM can be used. For this purpose the jumpers J41 (left) and J40 (middle) must be closed.



3.10 VIC II

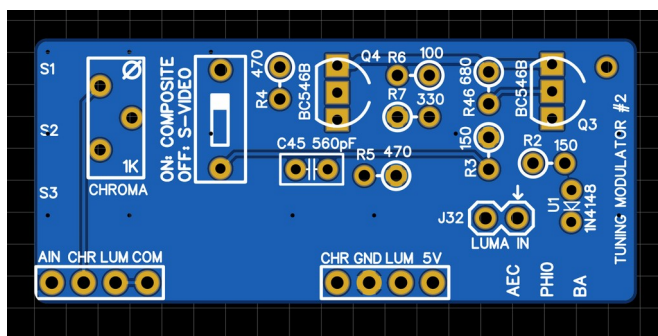
Depending on which VIC II type is plugged into socket U32, the VDD voltage must also be adjusted with jumper J5 (12V/5V). If this is not done, the VIC II will be damaged!

3.11 Video / Modulator / Overlay

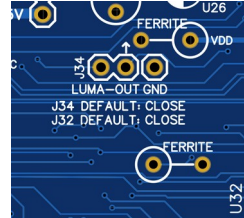
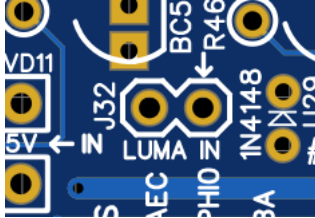


There are several possibilities for video output. Either the OnBoard video circuit is used, or the 2x4 modulator contacts (OUT: AIN|CHR|LUM|C and IN: CHR|GND|LUM|5V) are used to connect your own modulator board to the uEliteBoard64. **If a modulator board attachment is used, the components located in the red frame must not be soldered to the uEliteBoard64.** In addition to this, an overlay pin is provided, which allows a video overlay signal to be applied to the LUMA output pin. The J13 defines whether the overlay is displayed in composite or S-Video signal.

This is what a sample modulator board looks like:

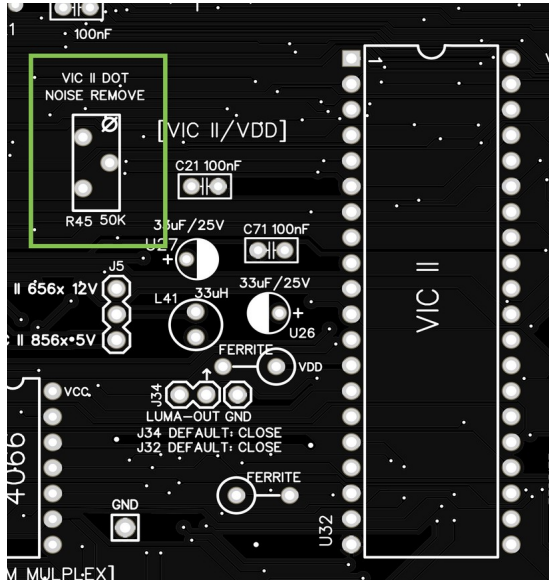


Jumper J32 (Modulator) / J34 (VIC II):



These two jumpers route the LUMA signal through the board from the VIC II to the modulator. If you want to prevent signal falsification by the board, these jumpers can be left open and a shielded cable can be connected from the J34 VIC II ("OUT" pin, marked with an arrow) to J32 in the modulator ("IN" pin, marked with an arrow). The pin "GND" is for a shielded line. **Please note: Jumpers J32/J34 must either be closed or the arrows must be connected with a jumper. If the jumpers are left unconnected, no picture is displayed on the monitor.**

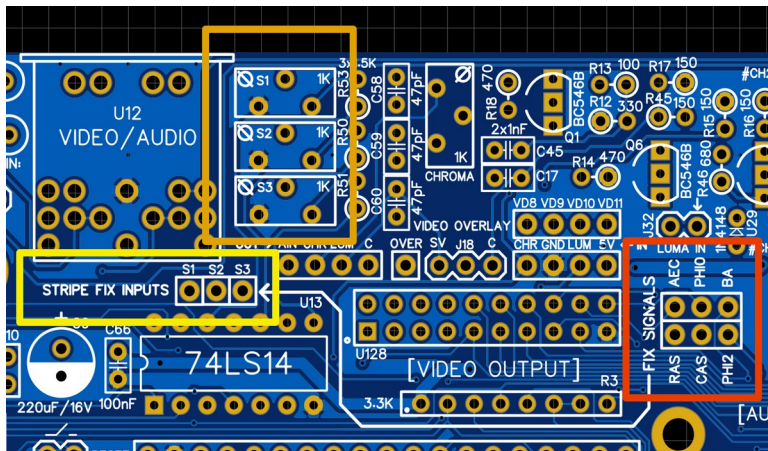
3.12 VIC-II DOT NOISE REMOVE



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).

3.13 Stripe-Fix



Interference signals AEC, RAS, BA, RAS, CAS, PHI2 can be fed into the LUMA signal via the "FIX SIGNALS" pins (red) to the "STRIPE INPUTS" pins S1-S3 (yellow) using a cable jumper. The strength of the inverted signal feed can then be determined using the trimmer potentiometers S1,S2,S3 (orange). In the best case, this has the effect that the disturbances are faded out.

How to proceed:

First you choose one of the interference signals under "Fix Signals" ,which you want to filter. Now take a jumper and connect the signal of "Fix Signals" to one of the S1,S2,S3 "Stripe Fix Inputs" inputs. Depending on which input you have assigned, you must now use the corresponding potentiometer S1,S2,S3. If the interference signal on the screen is not filtered out correctly, you should try another interference signal. If the elimination of the signal is not 100% successful, you can now apply a second interference signal to another filter input to try to eliminate the remaining interference.

The following is recommended: S1 = PHI0, S2 = RAS

This should produce a streak-free image (with bridge - on page 12)

3.14 SID

The SID area offers an automatic addressing of the plugged SID chips I-II-III by means of 7 diodes (1N4148) and the address decoder IC 74HC154. This IC can also be replaced by an adapter board with two 74LS138. The automatic address coding provides the following addresses for the SIDs:

SID I: D400, SID II: D420, D500, SID III: D440, D520, D600 (optional: I/O1 and I/O2)

CAPS filter for 8580

If an 8580 SID is used, the "CAPS Filter" jumpers must be closed. Be careful, because users have reported that wrong filter capacitors have damaged SID ICs.

Digi-Fix for 8580

If an 8580 SID is used, the "Digi-Fix" jumper must be closed so that samples (speech/drums/etc.) are played louder.

Audio 1K Resistor for 6581

If a 6581 SID is used, the "Audio 1K" jumper must be closed.

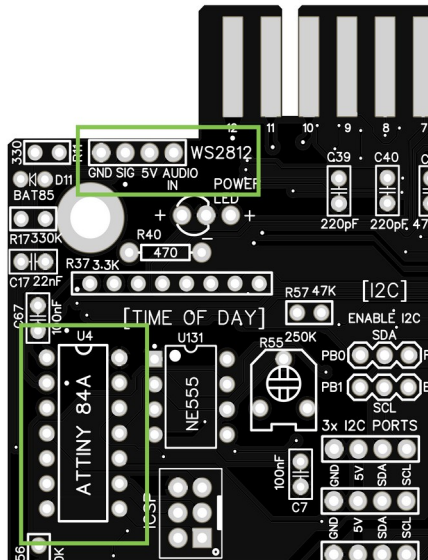
Audio-Channels L/R

Each SID audio output can be routed to either the left or right audio channel.

Voltages

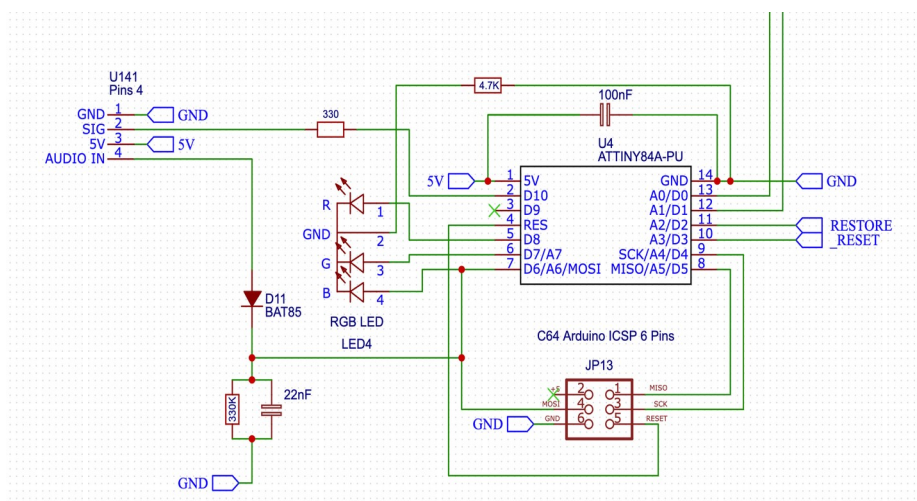
As with the VIC II, the SID must also be set to the correct VDD voltage and 12V or 9V, depending on the model. If you do not do this, you run the risk of destroying the SID. **If you want to be on the safe side, you should only use replica SIDs**

3.15 WS2812 RGB LEDs



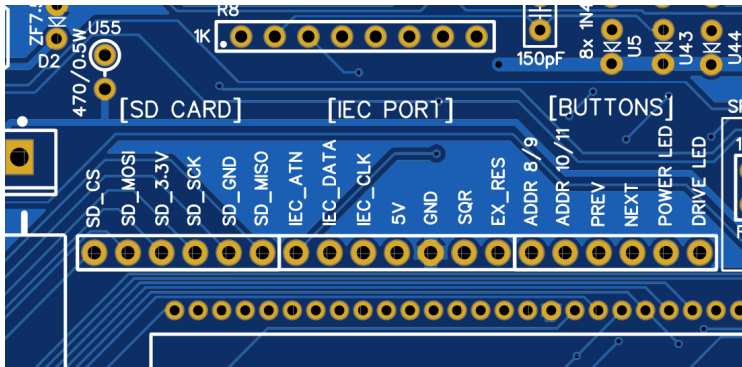
Starting with V3 there is a 4-pin WS2812 connector on the board which can be used to drive WS2812 RGB LEDs. On a small scale the existing 5V PIN can be used to connect only a few RGB LEDs. However, if more than 16 RGB LEDs are to be operated, it is advisable to connect the RGB LEDs to an additional external power supply.

The following is the circuitry for programming the ATTINY84A:



The WS2812 pins are controlled via the "SIG" pin 2.

3.16 Pi1541 Zero and MicroSD2IEC Board



The slot "SD CARD / IEC PORT / BUTTONS" on the board offers space for a small pluggable Pi1541 Zero adapter board including one RPi Zero.

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 (only for "7406 Only", without extra level shifter board)

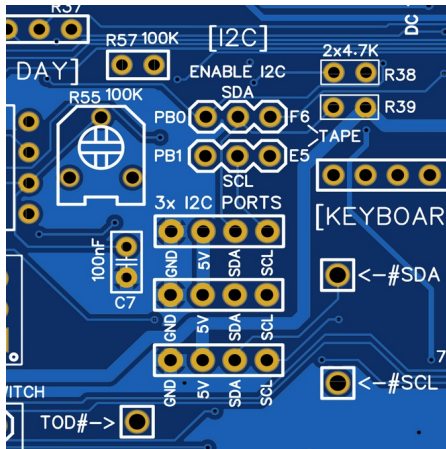
invertIECInputs = 1

invertIECOutputs = 1

With this, problematic demos, which even with an original C64 and a Pi1541 drive according to user reports sometimes do not work, worked perfectly in tests.

Furthermore a MicroSD2IEC board can be plugged in, which provides access to the MicroSD Card slot (U101) and the IEC signals. Plugged in and without further jumpers, as well as an inserted MicroSDCard with D64 files, the MicroSD2IEC board offers access via LOAD "\$",8. In addition, the button pins of the board, with cables laid under the uEliteBoard64, can be moved to another location and connected there.

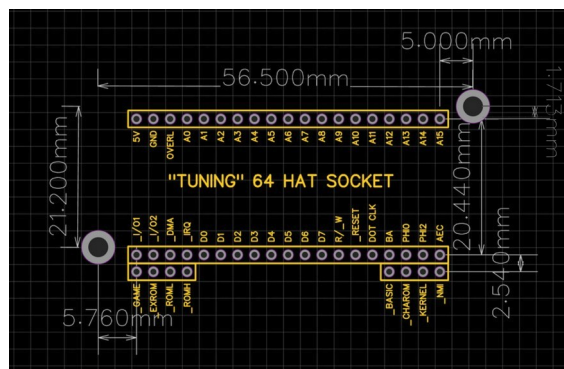
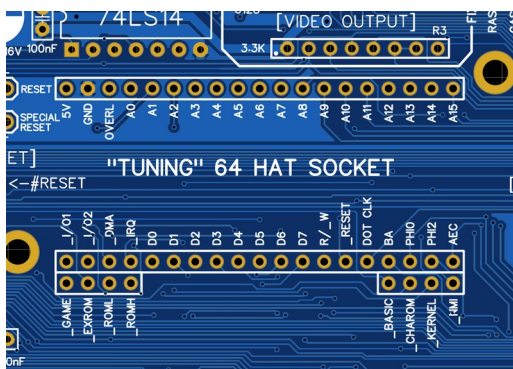
3.17 I2C Ports



I2C ports are also provided on the board, which can optionally be connected to the PB0/PB1 pins (SDA/SCL) of the user port or F6/E5 (SDA/SCL) of the tape port via jumpers.

3.18 HAT

The HAT SOCKET allows the uEliteBoard64 to be expanded by a simple plug-in board. For larger and more comprehensive "HAT" plug-in boards, two drill holes have been created for mechanical board connections.



4 First start

Jumper-Settings:

- 8701 Frequency generator IC PAL/NTSC Jumper J1 closed (PAL)
- Quartz Frequency selection PAL/NTSC Jumper J14 to position "PAL"
- ROM socket 23128 (Kernel/Basic) Jumper J15 closed
- LUMA Jumper J34 (VIC II) closed
- LUMA Jumper J32 (Modulator) closed
- VIC-II DOT NOISE Remove potentiometer to right stop

To avoid errors at the first start, the original Kernel/Basic-ROM (251913) and Char-ROM (901225) ICs from a 250469 board should be used.

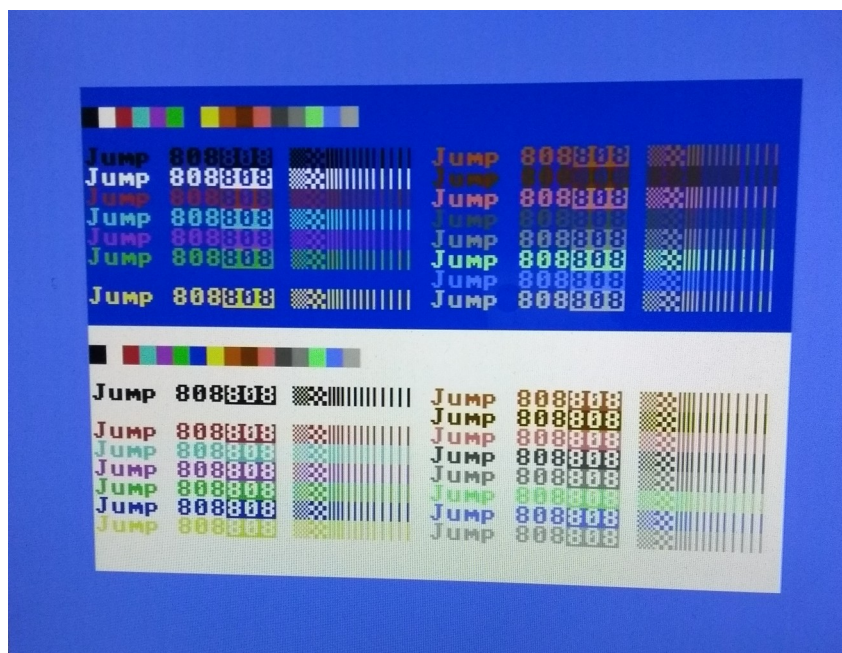
For the first start the 9V and 12V regulators, SDRAM ICs UM61512AK-15, 74HCT573, 74LS32, SIDs and the ATTiny 84 IC are not needed.

If no C64 power-on screen appears, you can continue with "Initial troubleshooting".

If no blinking cursor can be seen (especially when a cartridge is plugged in), please try another CPU / 251715 / CIA 6526.

5 Picture Quality

To make it clear what picture 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.



6 Initial troubleshooting (Black Screen)

- All jumpers inserted correctly (see "First Start")?
- No unsoldered pads?
- All diodes soldered in the right way?
- Are all ICs the right way round in the sockets, and are the sockets ok?
- All voltages ok and is there voltage on all IC sockets?
- Clock signals "Color Clock" (17.7344 Mhz) and "PHI0" (approx. 1 Mhz) available?
- Are all jumpers set to PAL?
- Are the signals RESET, DMA, NMI high?
- Was a NOS 251715 IC used? Then use SRAM
- No address movement on the address bus? (CPU defect?)
- No data movement on the data bus? (RAM defect?)
- If a picture is displayed when a kernel module (e.g. Clowns, Jupiter Lander) is plugged in (signs of defective kernel/basic ROM)
- Black and white picture? (use yellow 40pF trim capacitor, replace it if necessary, or turn the "Chroma" potentiometer in the modulator once)