

C64 Troubleshooting

Last Changes

Montag, 18. Oktober 2021

Table of Contents

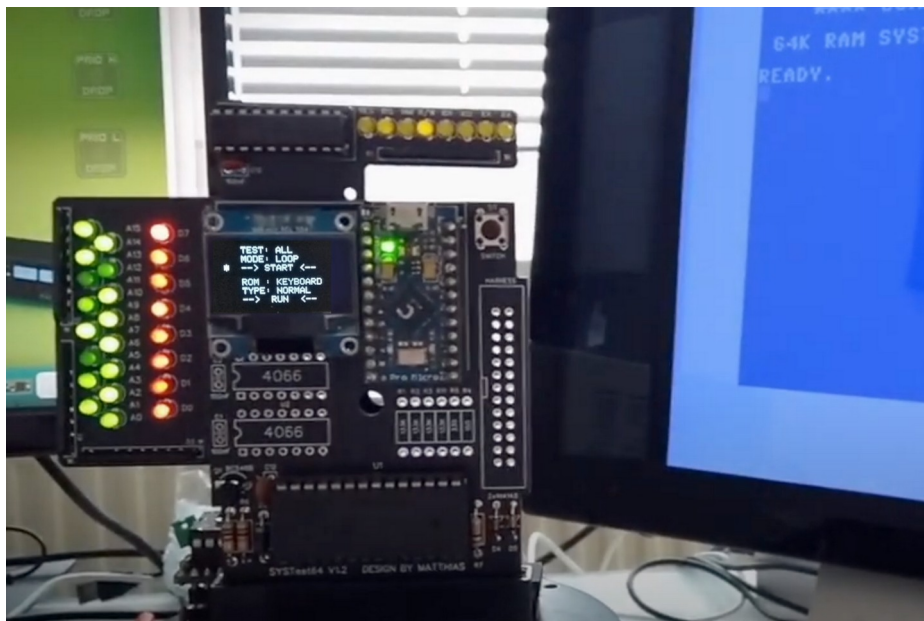
1	The Beginning.....	2
2	The Supply Voltage.....	3
3	The Signals.....	4
3.1	It all starts with the Quartz.....	4
3.2	The Video-Clock.....	5
3.3	The System-Clock.....	6
3.4	Other signals.....	7
3.5	Data- and Address Bus.....	9
4	Other notes.....	10
5	Other Tests.....	11
5.1	The Module-Test (Kernel-, Basic- und Char-ROM).....	11

1 The Beginning

Especially for a novice, but also for advanced electronics enthusiasts, troubleshooting the C64 can sometimes be difficult. The first question that often arises is, where do I start?

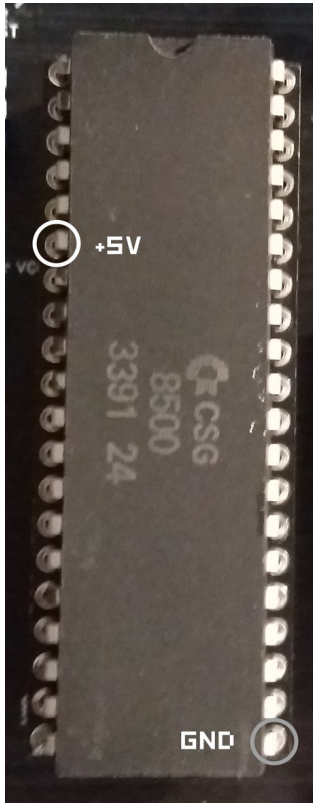
I would like to give a little help to give systematic initial troubleshooting and to check all obvious sources of error.

Of course, troubleshooting is easier and more automatic with the new SYSTest64 module, as this test module tests the most basic signals completely independently and can eliminate the need for an oscilloscope.



2 The Supply Voltage

Before measuring anything else, make sure that the supply voltage is present and reaches the ICs.

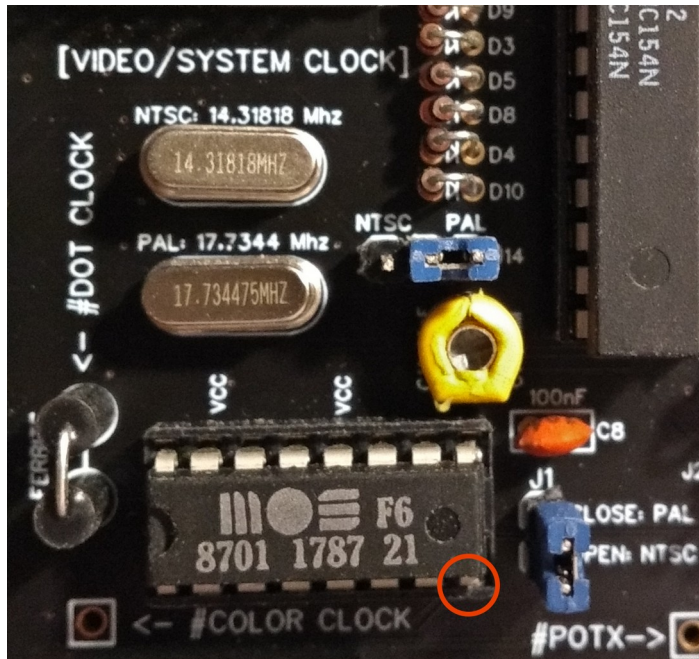


To do this, measure the voltage between pin 6 (+5V, white circle) and pin 21 (GND) on the CPU (6510/8500), which should be approx. 4.8-5.1V.

3 The Signals

3.1 It all starts with the Quartz

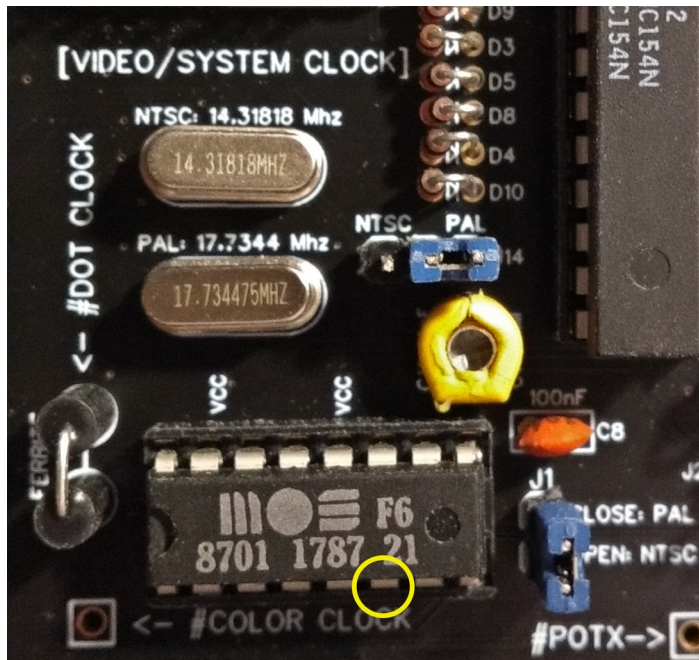
The silver component with 17.734476 MHz (PAL, in Europe) or 14.31818 MHz (NTSC, USA/Japan)



This quartz clock must be applied to pin 8 (red circle) of IC 8701 (clock generator).

3.2 The Video-Clock

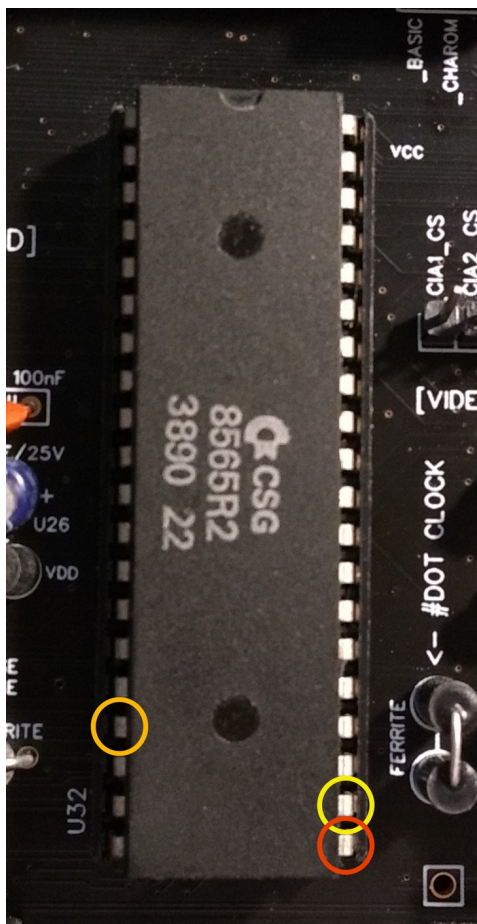
If the quartz clock is Ok, the video clock of 7.88 Mhz (PAL) or 8.18 Mhz (NTSC) is used.



This video clock must be applied to pin 6 (yellow circle) of IC 8701.

3.3 The System-Clock

If the video clock is Ok, the system clock of 0.985248 Mhz (PAL) or 1.022727 MHz (NTSC) is used.

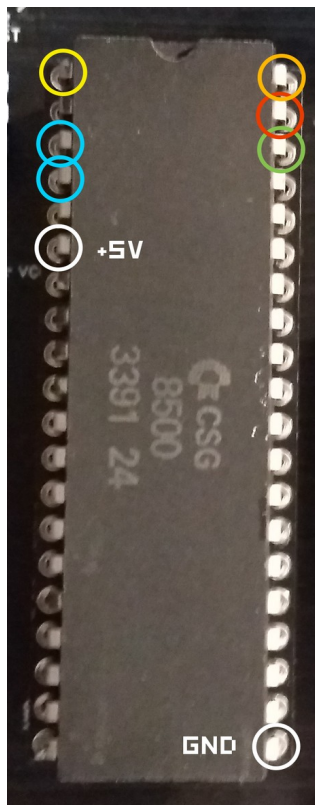


This system clock must be present at pin 17 (orange circle) of the VIC-II.

If this is not present, check whether the video clock at pin 22 (yellow circle) of 7.88 MHz (PAL) or 8.18 MHz (NTSC) and the quartz clock at pin 21 (red circle) of 17.734476 MHz (PAL, in Europe) or 14.31818 MHz (NTSC, USA/Japan) are present. If this is the case, the VIC-II chip is probably defective.

3.4 Other signals

Further measurements on the CPU (6510/8500) pins will now follow in order to isolate the fault and find possible clues to the cause.



1. Pin 1 (yellow circle) is the incoming system clock of 0.985248 Mhz (PAL) or 1.022727 MHz (NTSC). If not present, check/replace VIC-II (page 6).
2. If this is OK, the next step is pin 39 (red circle), which should also be 0.985248 MHz (PAL) or 1.022727 MHz (NTSC).
3. If this is also OK, the next step is to RESET pin 40 (orange circle). This should jump from 0V to 5V (high) after about 0.4 seconds after switching on the C64. If this does not happen, then something is defective in the reset generator circuit (1K pullup resistor network , 220uF capacitor, 1N4148 diode).

4. If the reset is also OK, continue with NMI/IRQ pins 3 and 4 (blue circles). These two pins should indicate 5V (high). If something is wrong here, the polarity of the 3.3K resistor networks and the IC 74LS06 should be checked first.

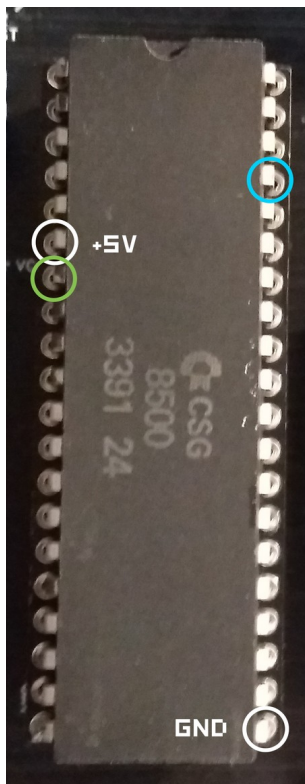
5. Continue with R/W pin 38 (red circle), here you should see a wild signal jumping back and forth. If only a steady clock signal can be observed there, then the RAM should be checked. If, on the other hand, the R/W signal is constantly at 5V (high), then either there is no contact at all with the RAM or the RAM is completely defective.

3.5 Data- and Address Bus

Depending on how the signals behave here, conclusions can be drawn about possible defect causes.

Blue circle: Data pin

Green circle: Address pin



If there is little activity on the data or address bus (not a wild mess), then the Kernel/Basic ROM chip may be defective.

If there is nothing at all on the data bus, then there may be something wrong with the RAM.

4 Other notes

If non-original C64 boards are used and these are independently equipped with different chips, then it can easily happen that certain signals no longer move in an optimal delay time window. Then it can happen, if for example a module or a replica SID is plugged in, that after switching on the C64 the cursor has disappeared. There are a few other side effects that could be observed.

Therefore, it is sometimes necessary to use certain ICs with certain year numbers. Even though alleged C64 professionals/cracks who work a lot with such old chips have claimed the opposite, and according to IC manufacturers and manufacturing processes do not differ, "in practice" one nevertheless finds that the chips do behave differently depending on the year of manufacture. That's why you should keep it like Bill Herd, who puts practice before theory ;-)

For example, CPU CSG ICs from 1990 behave differently from CPU CSG ICs from 1991. Those from 1991, for example, bring back the flashing cursor in certain chip constellations.

An NOS 251715 IC bought in an online shop can also cause problems in certain constellations in conjunction with RAM, although the use of SRAM could provide a remedy here.

5 Other Tests

5.1 The Module-Test (Kernel-, Basic- und Char-ROM)

If a faulty C64 is in front of you (especially if it does not show a picture), and at first glance everything seems to be OK, a module test should first be carried out.

This requires an Ultimax module such as "Jupiter Lander" or "Kickman". This is a good way to test whether there is a problem with the Kernel/Basic or Char-Rom. An Ultimax Module does not need these ROMs to work.

As an alternative to these game modules, the SYSTest64 module can also be used, as the first RAM-Test is carried out in Ultimax mode. If this RAM-Test appears on a problematic C64, then this is the first indication that something is wrong with some ROM Chips in the C64.