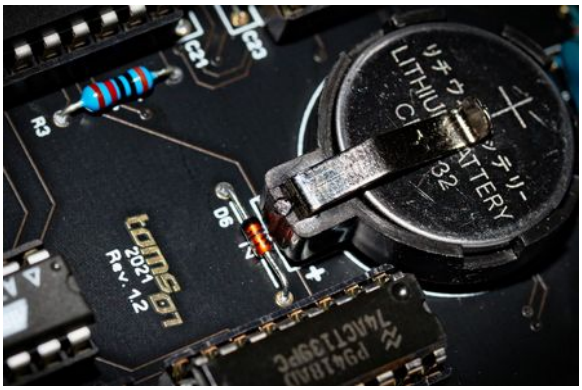
CMD-HD Replica Design by toms01

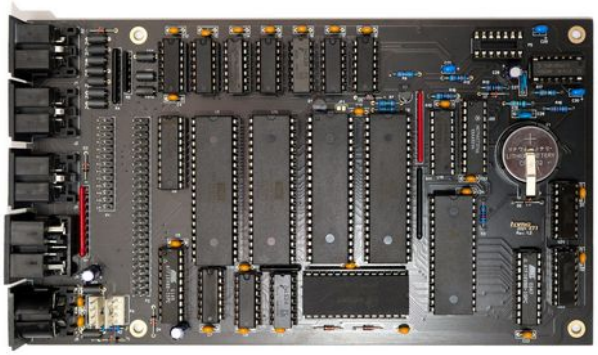
A board review on revision 1.2 by M.Kanet / June 2021

At the beginning of January 2021 I had the opportunity to test the first version of a CMD-HD replica board from toms01. The board already worked without problems on various C64 and with various extensions.

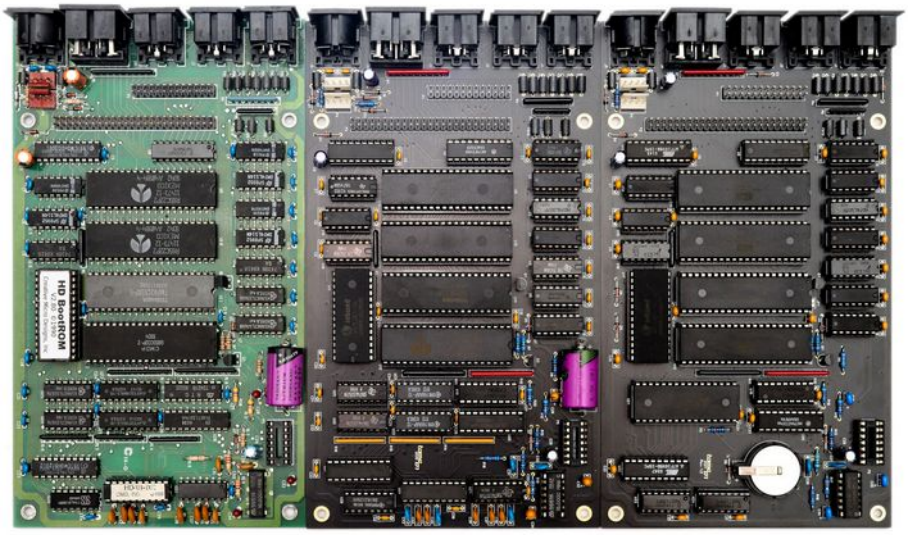
Now I had the chance to test the revised version 1.2 of the board.



First of all here is a photo of the new replica board V1.2 from toms01 (Figure-01)

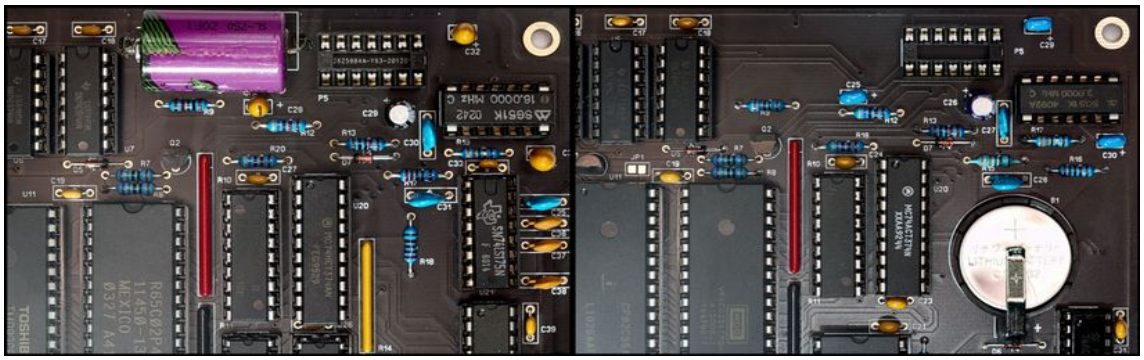


The revision 1.2 looks much tidier. After that I removed the board of my CMD-HD and compared it with the original and revision 1 (Figure-02).



From left to right: The original board from CMD, revision 1 and the new revision 1.2 of the replica.

The biggest change might be the change from a fixed battery to a battery holder for a CR2032. This allows to replace the battery for the internal RTC real-time clock if needed.
On the left the revision 1 with the fixed battery, on the right the revision 1.2 with the new CR2032 battery holder (Figure-03).

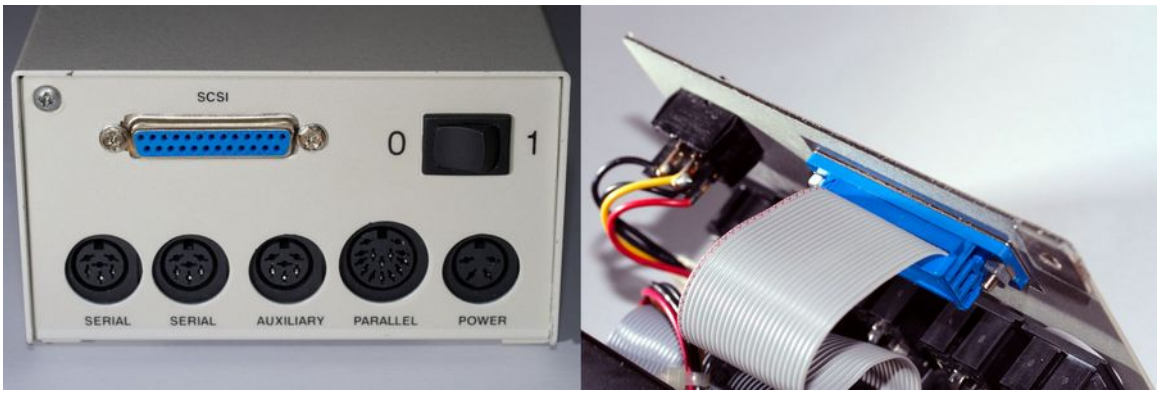


Also the clock (top right of the picture) could be reduced from 16Mhz to 2MHz.

For this test I was also provided with the front panel and the DB25 SCSI connector (Figure-04):

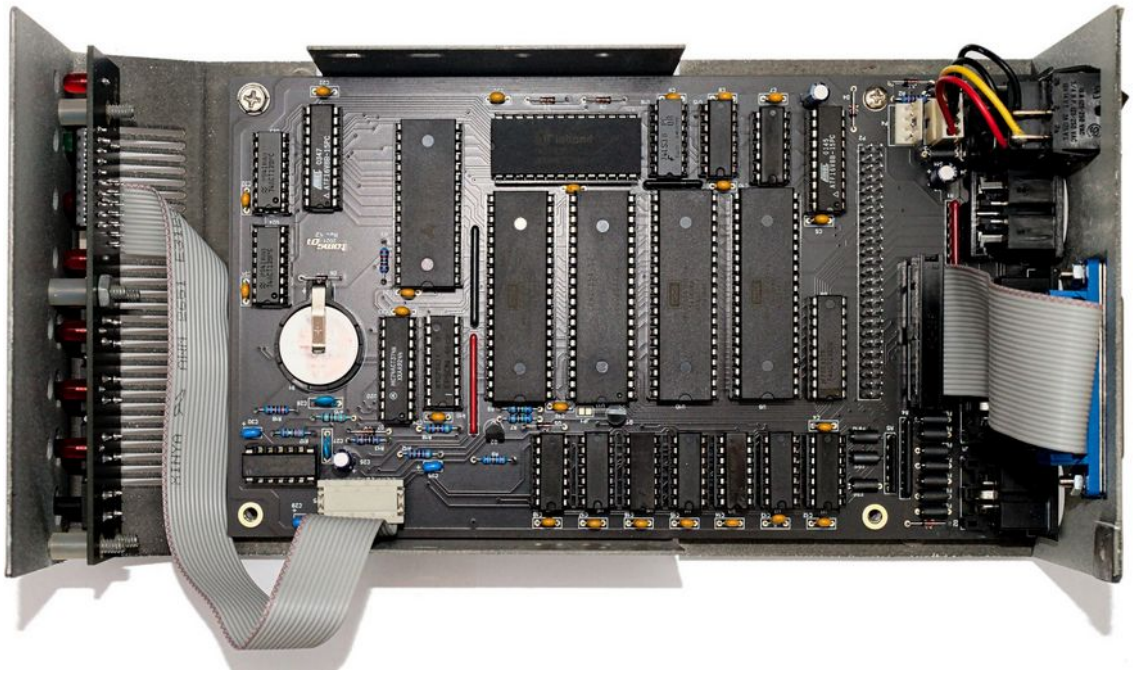
- Left/green the original board, below in black the replica.
- Right/top the original DB25 connector female/male threaded screw. This allows the screws of a DB25 connector to be attached to the housing.
- Right/bottom the replica. To fix the DB25 socket in the housing I used screws+nuts.

The DBV25 cable set fits into the existing opening of the CMD-HD (Figure-05):



When installing, you should pay attention to the alignment, since the ribbon cable is plugged directly onto the board. In the example above this succeeded without twisted ribbon cable.

Next, the replica had to be put back into the case. There were probably various manufacturing tolerances at CMD and not every board or every case was exactly the same size. The revision 1 was at least for my case about 0.5mm wider than the original. Revision 1.2 has been optimized a bit and now fits easily and without force into the metal case. Also the holes for the mounting screws are in the right place. (Figure-06)



Then connected the connectors for the front panel, the cable for the ext. SCSI connector and the on/off switch to the board.

For the first tests I chose a SCSI2SD drive (version V5.1), which was equipped with an already formatted 1Gb sd-card. (Figure-07)

A C64mk2 with CMD-SuperCPU64 and CMD-RAMLink was used as the first test environment. Additional drives were two SD2IEC. The CMD-HD was connected serially to the C64 and via the parallel cable to the CMD-RAMLink.

After switching on, the CMD-HD starts with the RESET procedure, the LEDs show the test progress. The SD card was already formatted, so the CMD-HD is ready for operation (Figure-08):

We now continue with the software tests, first with cbmHDscsi and cbmSCSIcopy (Figure-09):

cbmHDscsi replaces the LLFormat utility of CMD. The SD card can be formatted without problems and new partitions can also be created without difficulty.

The SD card has been set up so that two drives with different SCSI IDs are available. Therefore the SD card appears 2x in the drive menu.

cbmSCSIcopy is a DiskCopy utilitiy to copy partitions between different SCSI devices on the CMD-HD. For testing an IomegaZIP 100 was connected to the DB25 socket of the CMD-HD.

Since both cbmHDscsi and cbmSCSIcopy recognize the Iomega drive, the external SCSI connection via the DB25 socket should work. Finally, a partition was copied from a ZIP100 disk to the CMD-HD.

For testing, the SD card adapter was replaced with an original SCSI hard drive in the meantime. There were no problems with the hard drive either.

The next test was performed with copy1581. The program copies disks or partitions to D81 files. Test environment was the CMD-HD as source/destination and a NativeMode partition on the CMD-RAMLink as buffer for the D81 files (Figure-10).

During the tests with copy1581, the SWAP-8/9 and WriteProtect buttons on the CMD-HD were also checked. No problems detected.

Here are a few measurement results:

Test environment	*Connection*	*Time*
CMD81 -> RL/D81 / SCPU	parallel port	3:12 min
	serial cable	6:23 min
RL/D81 -> CMD81 / SCPU	parallel port	4:07 min
	serial cable	7:30 min
RL/D81 -> CMD81	parallel port	5:58 min
	serial cable	9:04 min
SD2IEC D81 -> RL/D81 / SCPU	serial cable	5:13 min
RL/D81 -> SD2IEC D81 / SCPU	serial cable	7:27 min

The time shows that the parallel port of the CMD-HD works. The times of the SD2IEC are given as a reference to better classify the other results.

Intermediate conclusion: The replica works like the original or like revision 1 of the board.

Next came the test of the GEOS-TurboDOS integrated in the CMD-HD (Figure-11).

All tests so far without problems.

Finally, a few remarks:

The original front panel is connected to the case via five screws. CMD probably did not take manufacturing tolerances into account at the time: The PCB is very difficult to pull off over the screws. Partially, the PCB bends visibly.

The replica board was manufactured after the original board and can therefore only be put on the screws with a lot of force. My suggestion would be to make the hole 0.5-1.0mm larger. The board is secured with nuts, so nothing can wobble later.

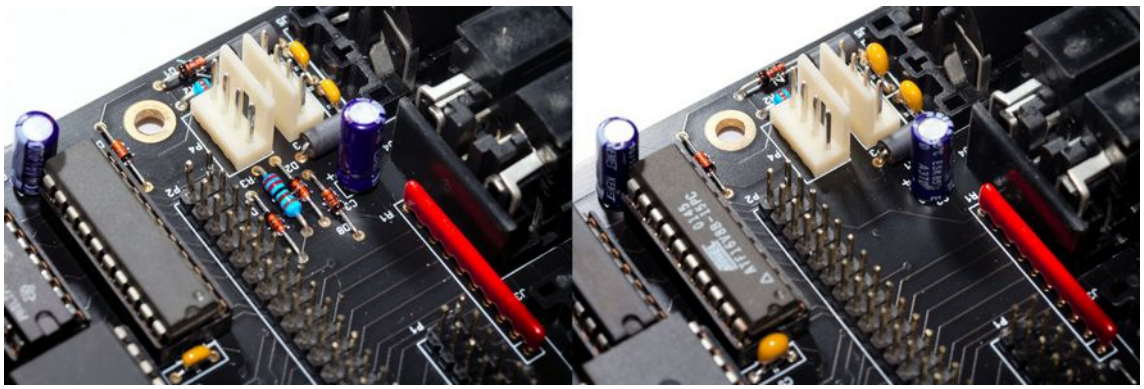
Boards should be easy to install and remove. Because CMD did not take tolerances into account, the error LED was damaged when the original board was reinstalled. Despite great care. A new LED fixed the problem.

Here are some more pictures. The LEDs on the front panel (Figure-12):

On the original board the LEDs were soldered individually, i.e. with different distance to the board itself. As you can see on picture 10, it might make more sense to install the LEDs directly on the board: On my HD, the LED had permanently pressed through the foil over the years.

The original board in my CMD-HD also required additional spacer rings: The spacer sleeves alone did not provide the correct distance to the front panel.
If the distance is too small, then the buttons are constantly under "pressure". If the distance is too large, then the buttons can no longer be pressed in. Every millimeter counts here.

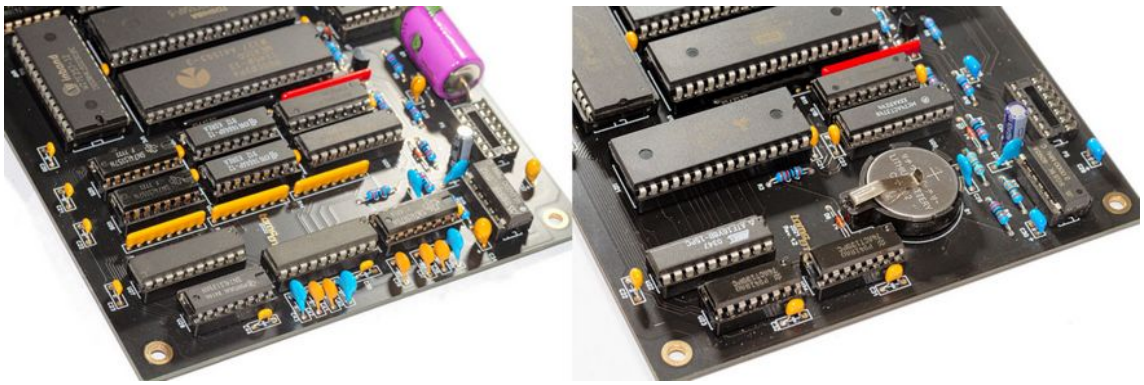
Here are a few more comparison pictures (Figure-13).



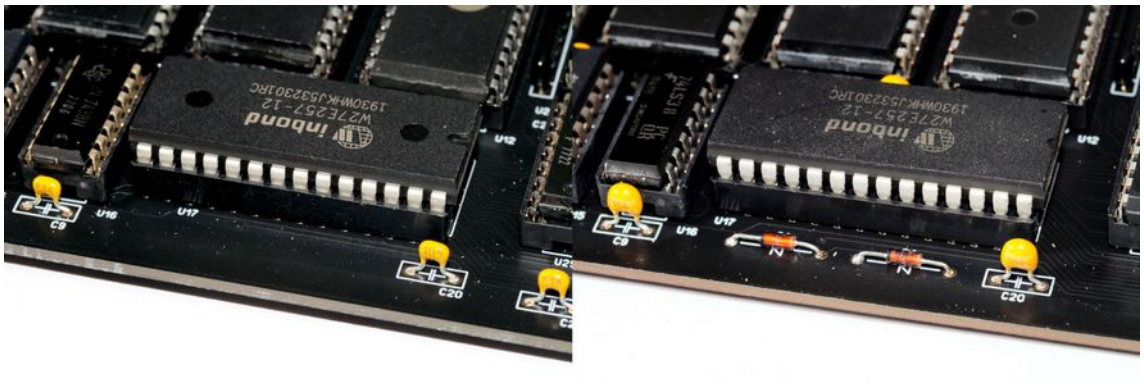
On the left the revision 1, on the right the revision 1.2. Also here the board was optimized.

After consultation with the developer, further optimizations were carried out (Figure-14):

> ***DRAM to SRAM (swapped) and then the multiplexers etc. fell out. And also the resistor networks. This also allowed the one GAL to be replaced by discrete logic (only two GALs in total). Among other things, a design flaw in the use of the clock backup battery was also fixed. This should now last longer and not unnecessarily "power" other areas when the drive is off.***

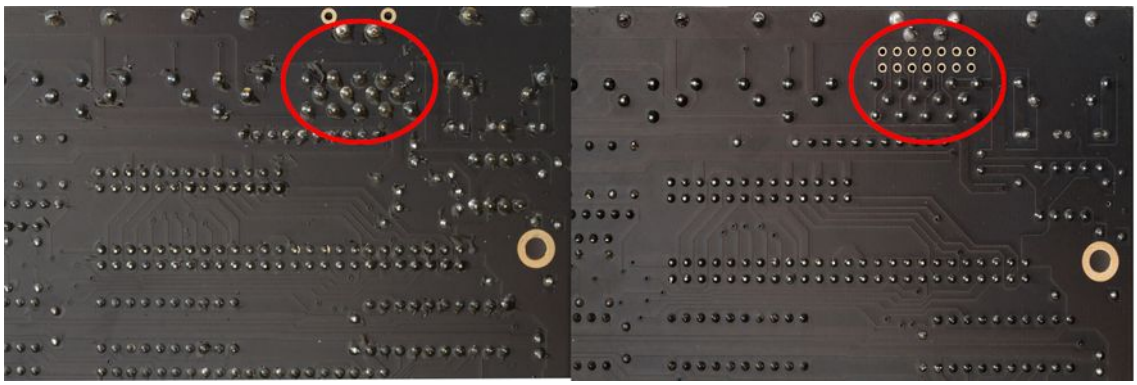


Some components were also "moved" or became necessary due to the previously mentioned optimizations (Figure-15):



The shown changes are needed so that both types (N/S) of the currently manufactured VIA W65C22 from WDC can be used.

Another improvement can be found on the bottom side of the board in the area of the 14pin socket for the parallel cable: Since the plug or socket is rather a discontinued model, a 2x7 socket strip or soldering points for such a strip was provided (Figure-16):



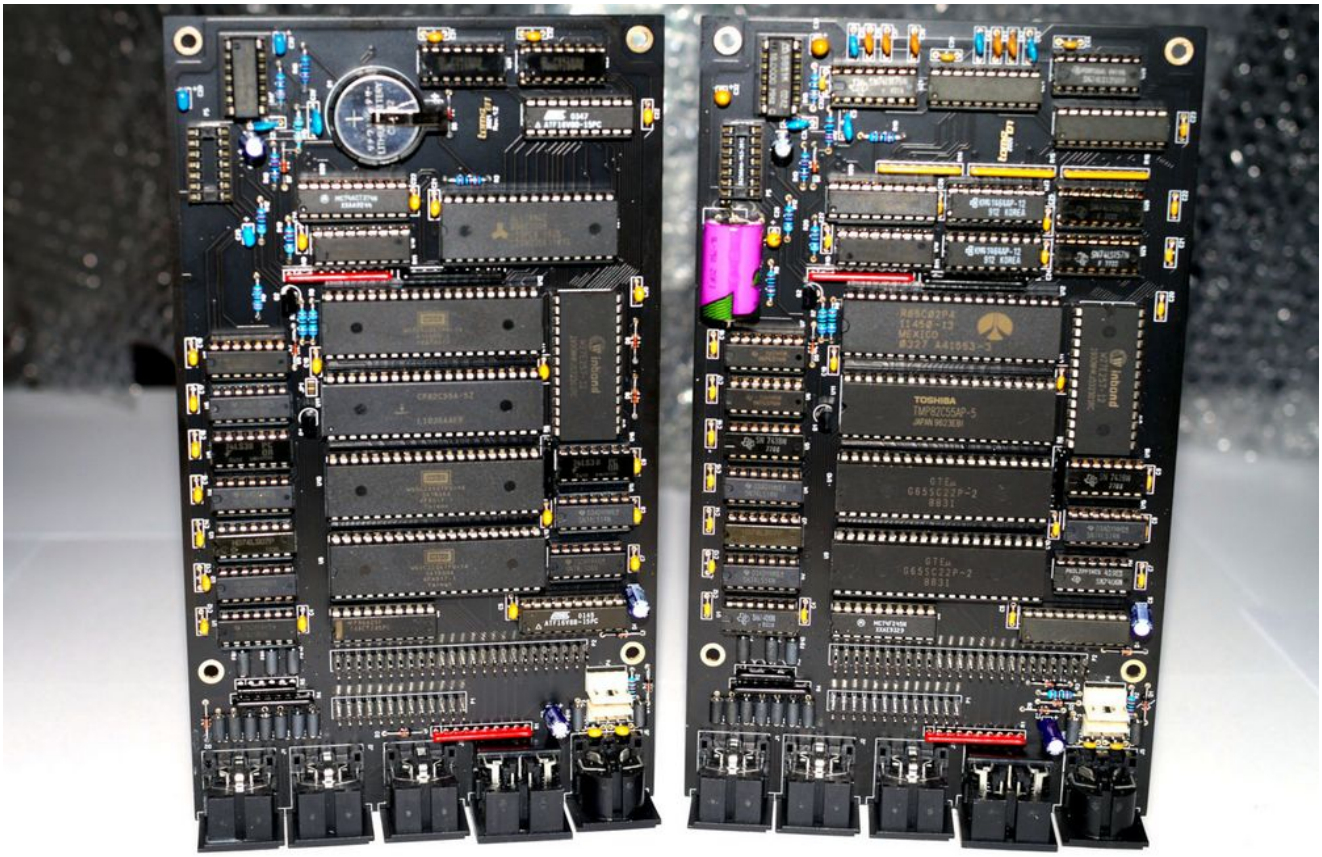
CONCLUSION:

The revision 1.2 is a significant change to version 1 or to the original board from CMD.

According to the developer, the HD is more power efficient by using SRAM and CMOS at all possible points and by using only chips that are still in production (Renesas, WDC, Microchip), the use of NOS technology is no longer necessary.

The timing on the board has been adjusted accordingly. It is also cheaper and easier to maintain to use a coin cell as clock backup battery.

Result: The new version also works here without errors.



At this point again my greatest respect and thanks to toms01 for the work done.