

The CaDD Hybrid video card for the TI994A Peripheral Expansion Box.

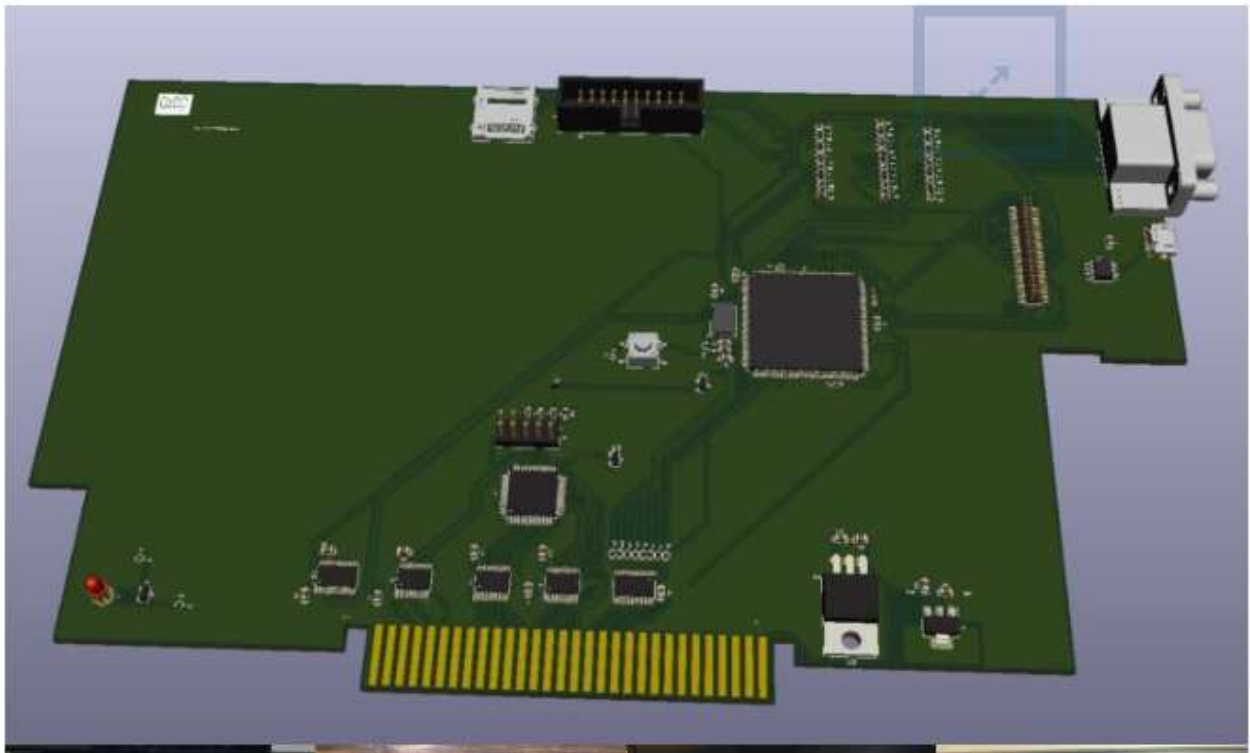


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(1) Introduction:

Introducing the CaDD PEB video card. The card was designed to replace the TMS9918A VDP chip with a more modern video processor. Originally the design was going to do a full implementation of the V9938 without having to supply a DSR to enable compatibility with the TMS9918A. To accomplish this, the card implements the graphics, and bitmap mode like the 9918 still allowing access to the 192K RAM. This theoretically breaks software designed for the V9938 GR1 and GR2, but since no software seems to be available for the TI in these modes it seemed like the correct choice as the goal was to make the card seamlessly work with all TI99/4A software. The card was introduced at the Chicago faire several years ago with some interest, the card originally had to compete against the F18A, since we had been working on our implementation of the F18A for PC99W it was decided to add it to the video card. Since many new games are being developed for the F18A it was the only logical choice. Since the code base for PC99W is identical to the CaDD video card any updates to PC99W are easily added to the video card. On the original card we used an STM32F746, this is fine for only implementing the V9938, that has full hardware acceleration for GR4 – GR7 plus vertical scroll it was not fast enough for the F18A having a GPU, and 2 tile layers with vertical and horizontal scroll. It was decided to change the chip to a faster STM32H743 in the same package. A simple port of the code and the new hybrid VDP is up and running. Many have asked why not make the video upgrade for the console, first the V9938 uses an extra address line, leading to the end user having to solder a wire. Second the RAM is external to the processor requiring a larger board. Third the micro uses a full 16 BPP buffer for the video; it is used for double buffering the TI video via a U/V scaler that scales the video from (512 256) x (192 212 230) to 640x480. Even removing the CPLD, and buffers the board still requires a fair amount of real estate. And lastly the hole in the console for the VGA connector. Using the PEB allows for only one via to be drilled on the console, and a single wire from the console for the video interrupt. A special board was created that has the GROM clock, and a header for the interrupt cleaning up the installation. The single interrupt wire can be run out of any hole in the console, requiring no cutting.

(2) Shift 838:

The decision to have Chris Schneider AKA(Shif838) was easy. After purchasing several PEB boards from Chris it was clear that Chris could build a high quality product in larger quantities than CaDD, also allowing CaDD to work on other TI projects. Additionally Chris does full function test on all products, when it arrives you know it works.

(3) Installation:

(a) Disassembling the console:

Tools required:

- (a) #1 Philips screwdriver
- (b) Drill bit
- (c) Flat blade screwdriver

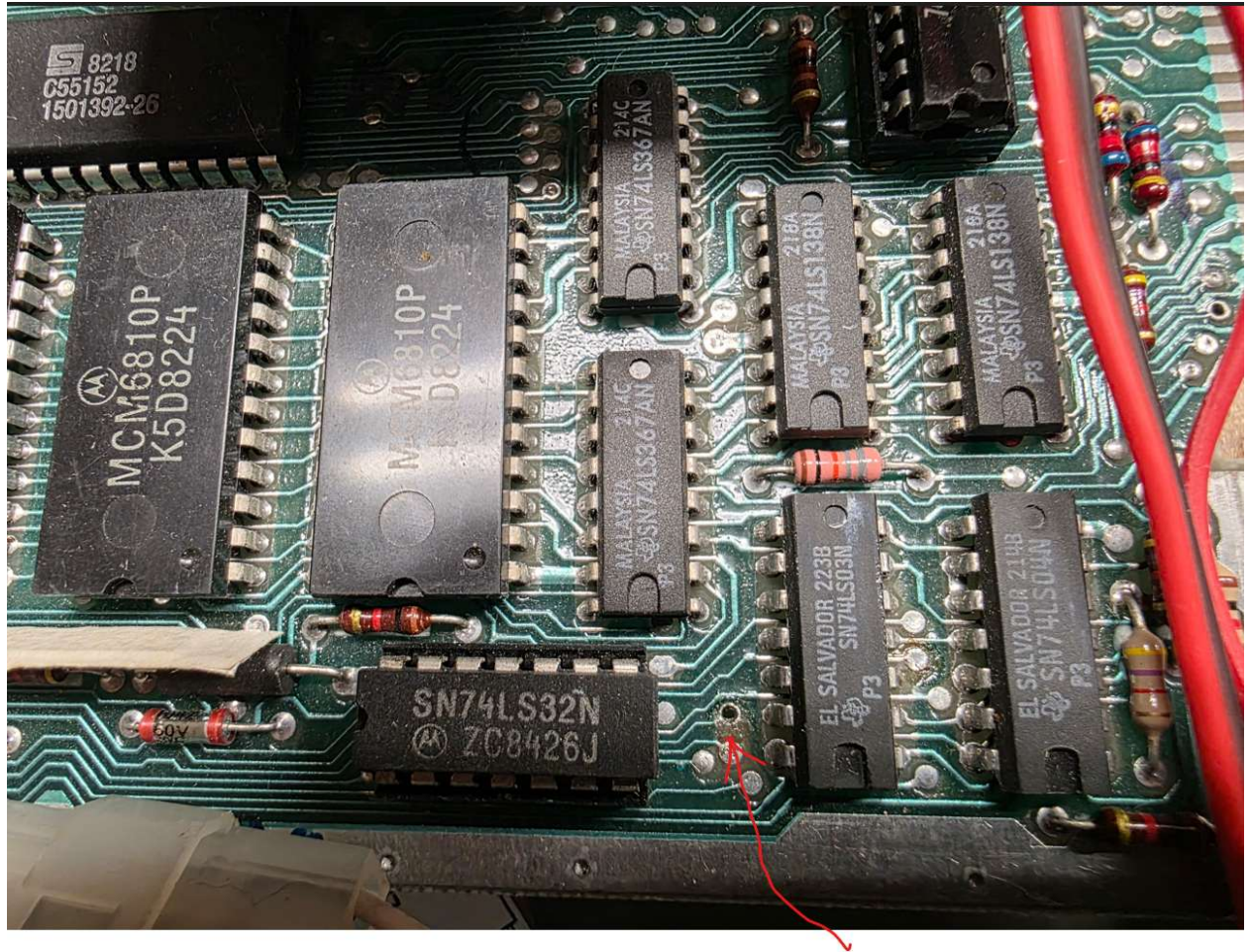
Safety:

There are many sharp surfaces on PCB's, and shields. Be careful removing all parts.

Remove all cords connected to the console, next remove all the Philips screws from bottom cover, and gently remove the outer power switch. Slight uniform pressure under each side will break it free. Remove the bottom cover, and all Philips screws that are holding the power supply, main board, and keyboard. Next support all three boards and turn the cover top side up. Next remove the cover, keyboard connector, and power supply connector.

Remove the shield from the main board, locate, and remove the TMS9918A, replace it with the CaDD GROM clock board, and drill the indicated via in pictorial. Locate and check continuity of via from top to bottom of the board, verifying it is an open connection.

(Optional for experienced technicians) Remove all VDP RAM chips, the can be used on other stock consoles without VDP mod. Connect a wire from the header on the GROM board, and run it out anywhere you like on the console. You can remove the heat sink that was covering the VDP. Do not remove the smaller heat sink on the clock chip. Replace the shield, and reverse the process to re-assemble. Take care not to pinch any wires. Also re-align all connectors so the pins are connected to the correct ones. Do not force anything together it will go together easily one all parts are aligned.



Drill this VIA.

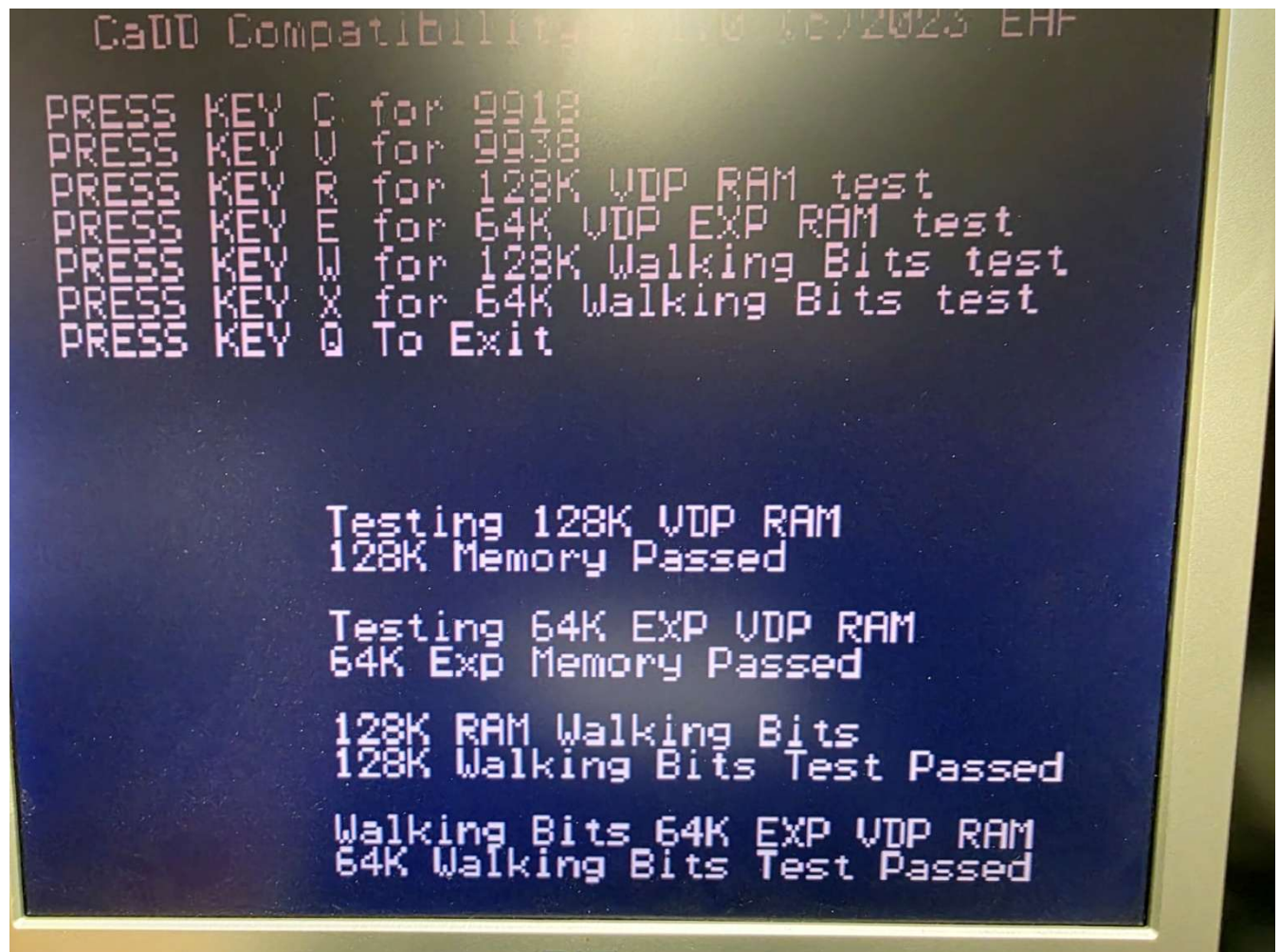
(4) Usage:

Power the PEB first followed by the console, the TI title screen should appear on the VGA monitor. If you have a Final GROM you have instant access to many TI software programs. To run software for the V9938 or F18A just launch it, no other steps are necessary, if you run an F18A program you cannot run a V9938 program without a hardware reset. Power down the console first followed by the PEB. Power the PEB first followed by the Console the launch V9938 software. If you are in V9938 mode and the software was written to do a soft boot you can run subsequent V9938 programs without a hardware reset. There are a couple of TMS9918 games that use automatic wrapping of VDP memory, run the CaDD hybrid software and select 9918

compatibility this will cause the VDP to automatically wrap at 0x4000. Select V9938 to switch back. Once in F18A mode the CaDD Hybrid software has no effect until hardware reset.

(5) Test Software:

This program is included to test the video card. It allows the user to test all 192 K of RAM, as well as tailor the cards behavior for compatibility with a few games. One game that requires it is MASH, as the helicopters are not shown because the memory on the V9938 does not wrap at 0x4000.



(6) Specifications:

V9938:

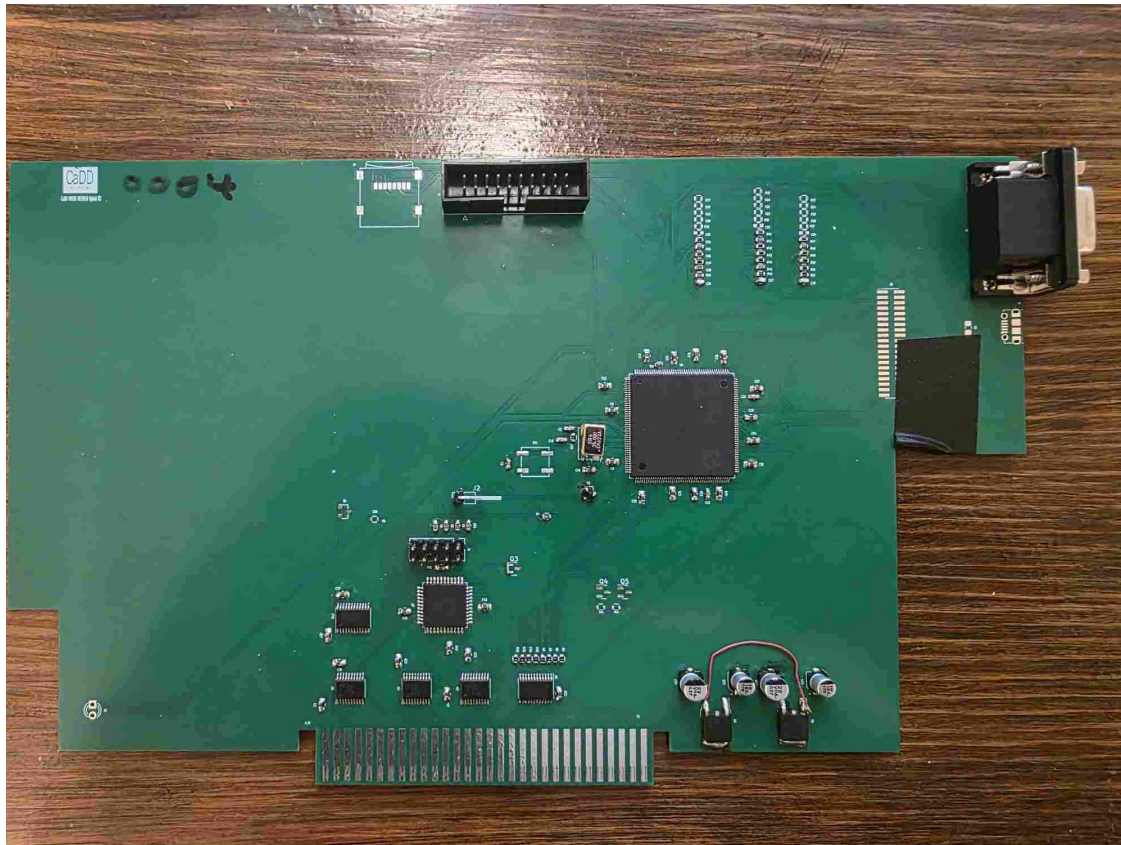
- (a) Text
- (b) Text 80
- (c) Graphic 1
- (d) Graphic 2(also called bitmap mode)
- (e) GR3
- (f) GR4 4 bits per pixel
- (g) GR5 2 bits per pixel 512x(192 212)
- (h) GR6 4 bits per pixel (512x(192 212)
- (i) GR7 8 bits per pixel (256(192 212)
- (j) Interleave fully implemented doubling vertical resolution
- (k) Vertical Scroll
- (l) 192K VDP RAM

F18A

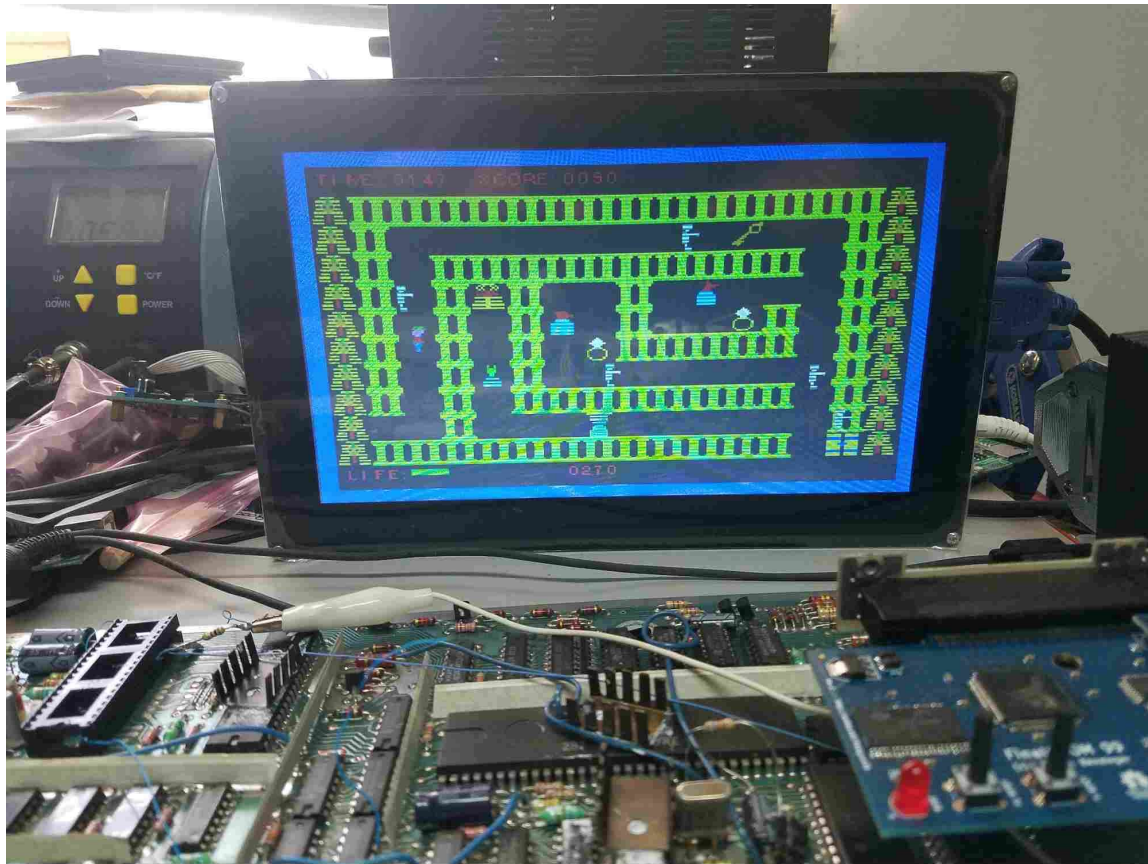
- (a) Tile layers 1, and 2
- (b) Bitmap mode
- (c) Text 80
- (d) GR1 GR2
- (e) Vertical and horizontal scroll
- (f) 16K VDP RAM
- (g) GPU

(7) Acronyms:

- (a) VDP Video Display Processor
- (b) PEB Peripheral Expansion Box
- (c) GROM Graphics Read Only Memory
- (d) RAM Random Access Memory
- (e) ROM Read Only Memory
- (f) GPU Graphics Processing Unit (TMS 9900 with some modified instructions)
- (g) GRAM Graphics Random Access Memory (Writeable GROM)
- (h) G RAM Graphics RAM referred to in F18A documentation



Prototype 4



Early Development