

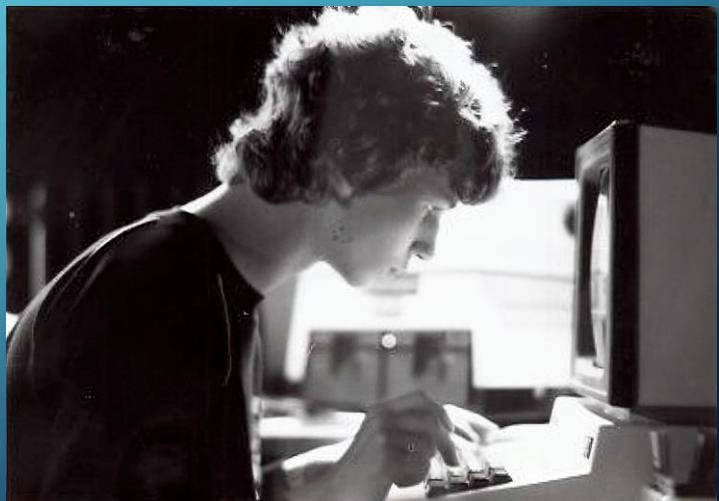
PET DIAGNOSTIC CLIP

PRESENTATION BY SVEN PETERSEN

COMMODORE USERS EUROPE, SEPT. 23RD, 2023

SVEN PETERSEN

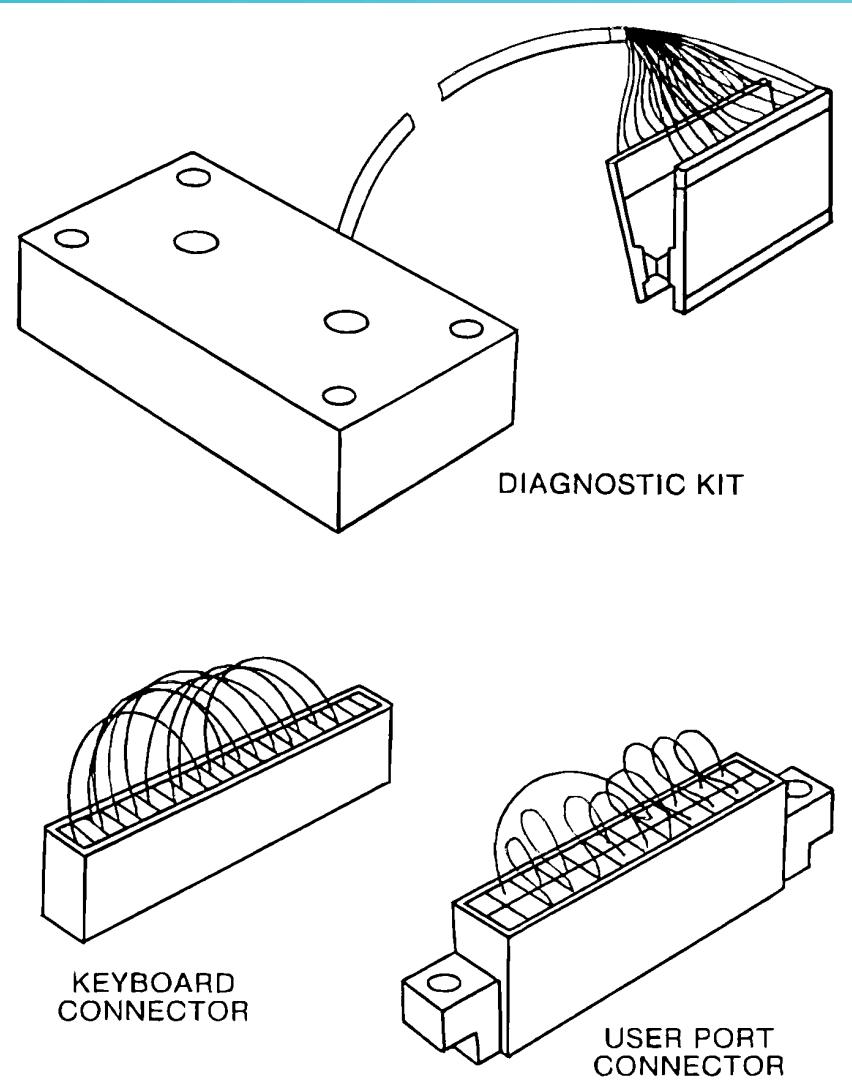
- Born 1965 in Germany
- Into electronics since 1979
- Commodore computer user since 1980
- Programming business software for the CBM8032:
1980 – 1991
- Studied electrical engineering at TU Munich
- Hardware developer since 1995
- Back into the Commodore computer hobby since 2018
- Plenty Commodore related open hardware projects on github:
<https://github.com/svenpetersen1965/>



DIAGNOSTIC CLIP

- The Diagnostic Clip is an original Commodore diagnostic tool, which clips onto the 6502 and utilizes feedbacks on the keyboard and user port to test the interfaces.
- There are two hardware versions of the box which contains the Diagnostic Software. One for non-CRTC machines and one for CRTC machines.
- There are several software versions:
 - 40 col. non-CRTC PET
 - 40 col. CRTC (CBM40xx)
 - 80 col. CRTC (CBM80xx)

The Original Commodore Diagnostic Set/Clip*



- The diagnostic software is contained in the box, that is attached to the clip cable.
- Two different versions of the box hardware for CRTC and non-CRTC computers
- The clip connector is not very reliable – it might require a couple of attempts to run the software properly.
- The DIP40 clip connector is expensive ([3M 923743-40](#) from Digikey: **\$94.07** - September 2023)
- The dongles are hand wired ⇒ hard to produce and error prone.

*Source: Commodore „Testing The PET Computer“, 1978

The Original Commodore Diagnostic Set/Clip



Photo by Manuel Alfonso de Amorim

Original Commodore Diagnostic Clip for PET with dongles and manual

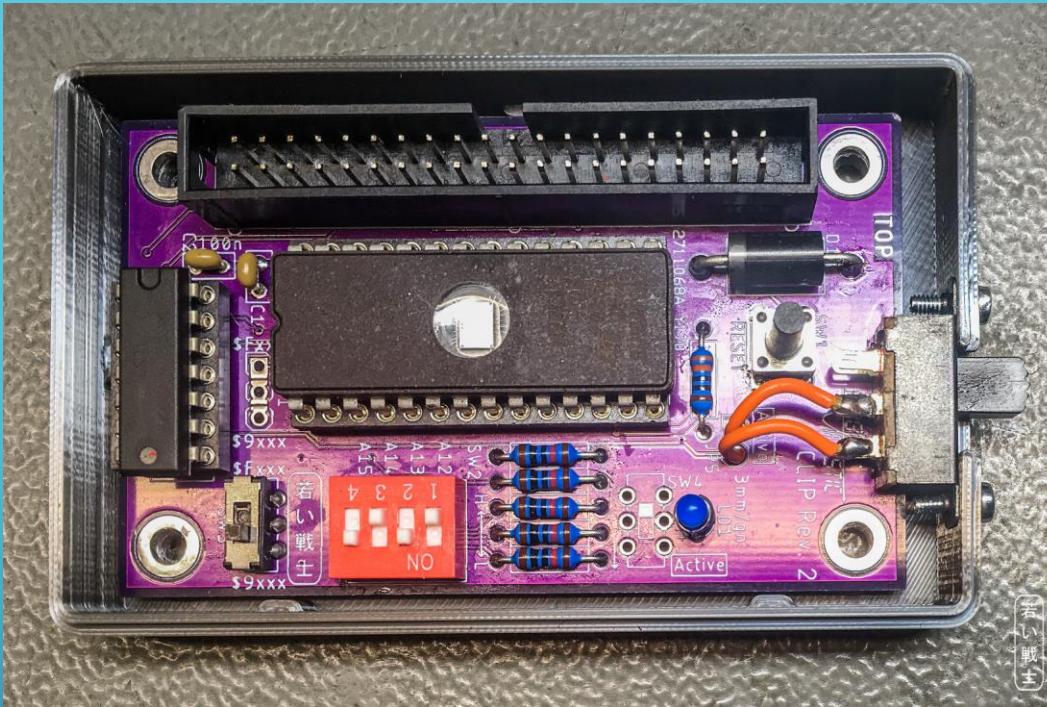
The Open Source HW Diagnostic Set/Clip*



- The clip box can contain several versions of software
- One hardware version for both the non-CRTC and the CRTC PETs
- The Clip connector is replaced by a much cheaper adapter board (con: it requires a socketed CPU)

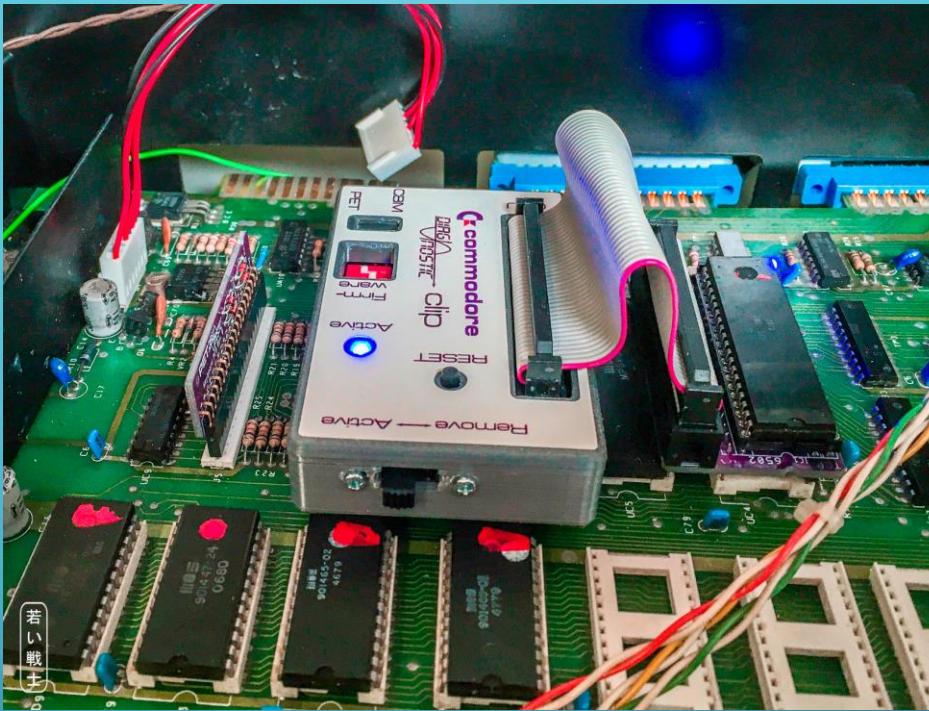
*<https://github.com/svenpetersen1965/PET-Diagnostic-Clip>

The Open Source HW Diagnostic Set/Clip



- One EEPROM with a DIP-Switch for selecting the software version
- RESET switch
- Switching between CRTC and non-CRTC circuit
- The diagnostic clip can be “removed” with a switch

The Open Source HW Diagnostic Set/Clip



Test in a CBM3016 (non-CRTC)

- The CPU/6502 is moved to the adapter board
- The adapter board is inserted into the CPU socket
- The box is connected to the adapter
- the user port and keyboard dongles are connected

Forcing The Computer To Run The Diagnostic SW

- On power-up/reset, the CPU should execute the Diagnostic Software instead of the PET Kernal

CRTC PETs

- All ROMs can be switched off with pulling the /NOROM signal LOW. This is attached to Pin 5 of the 6502, which is actually a “not connected” Pin.
- The CPU accesses the diagnostic software (EPROM inside the box) instead of the Kernal
- The address of the diagnostic EPROM is \$Fxxx. The Reset vector (\$FFFC) points to \$F000 = start of diagnostic software.
- The diagnostic software is executed

Non-CRTC PETs

- The address bits A13 and A14 are forced LOW = tied to GND
- A kernal access \$Fxxx is redirected to \$9xxx (\$F/1111_{bin} becomes \$9/1001_{bin}), this is one of the option ROMs, the socket needs to be empty for the test
- This way, the reset vector is relocated to \$9FFC, it points to \$9800
- The diagnostic software is executed on power-up/reset

The Two Parts of The Diagnostic Software

On RESET

- On Reset, the peripheral chips (PIAs, VIA and CRTC - in case there is one) are initialized
- The video RAM, the zero page and stack page are tested
- The results are displayed on screen
- The actual test software is copied to the RAM at addresses \$0200 and after and is verified and started
- It demands to **REMOVE CLIP**
- The Reset Vector is monitored for a change (due to removing the clip = normal ROMs are accessed)



The Two Parts of The Diagnostic Software

After Removing The Clip

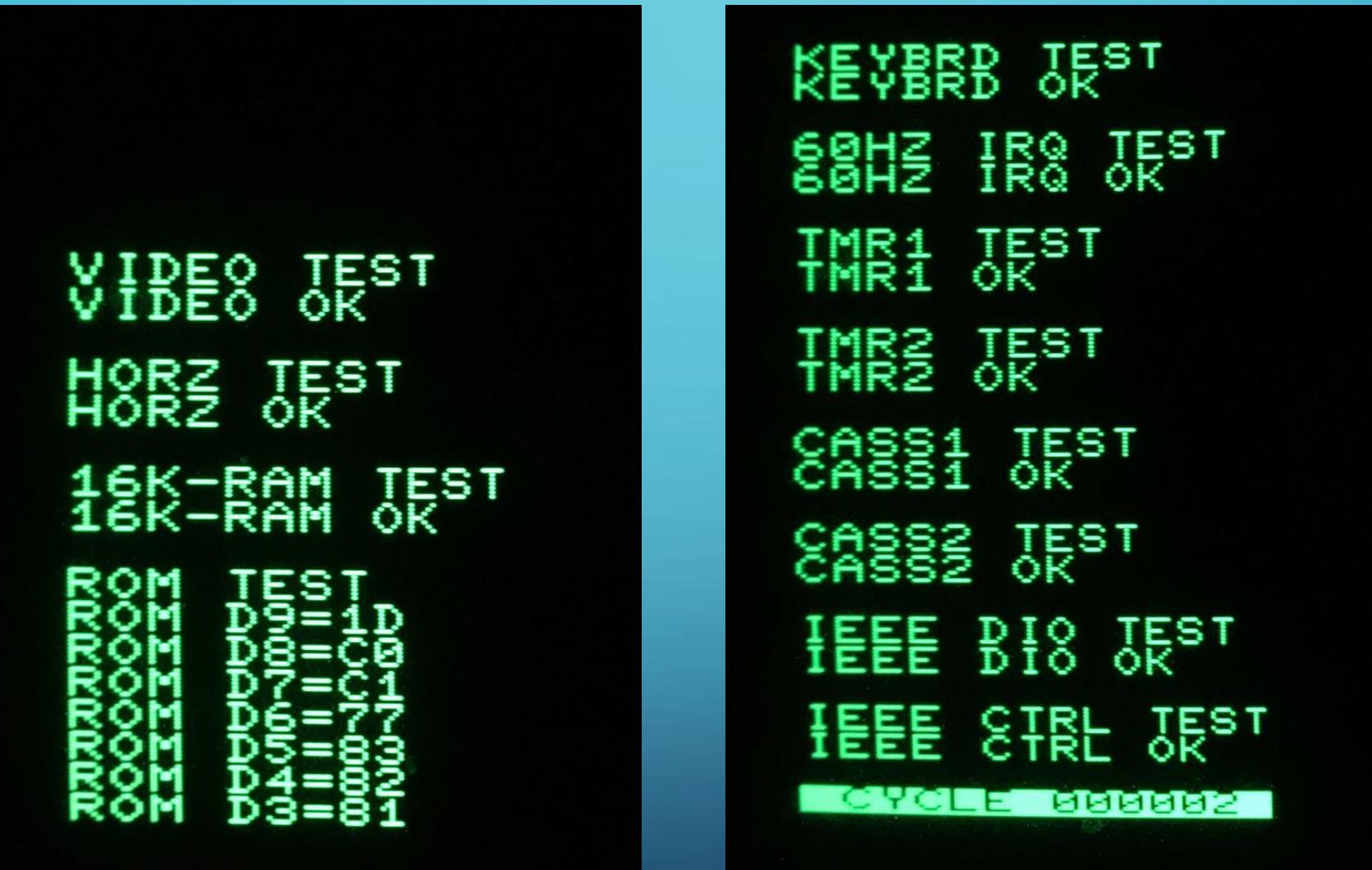
- The 6502 adapter Board does not allow to remove the clip
- Instead it can be switched **inactive**

```
VIDEO TEST: OK
CHKSM TEST:00  OK
H0RZ TEST: OK
VIDEO-RAM TEST:VIDEO OK
32K-RAM TEST:32 OK
ROM TEST: UD06=F0  UD07=5A  UD08=D8  UD09=C0  UD10=B0  UD11=6F  UD12=FF
RFRSH TEST: OK
KEYBRD TEST: OK
50HZ IRQ TEST: OK
TMR1 TEST: OK
TMR2 TEST: OK
CASS1 TEST: OK
CASS2 TEST: OK
IEEE DIO TEST: OK
IEEE CTRL TEST: OK
CYCLE 00000000
```

CRTC, 80col.

若い
戦士

The Diagnostic Software (After Removing Clip)



Diagnostic 320350g (non-CRTC, 40 col.)

The Feedback/Dongles

User Port

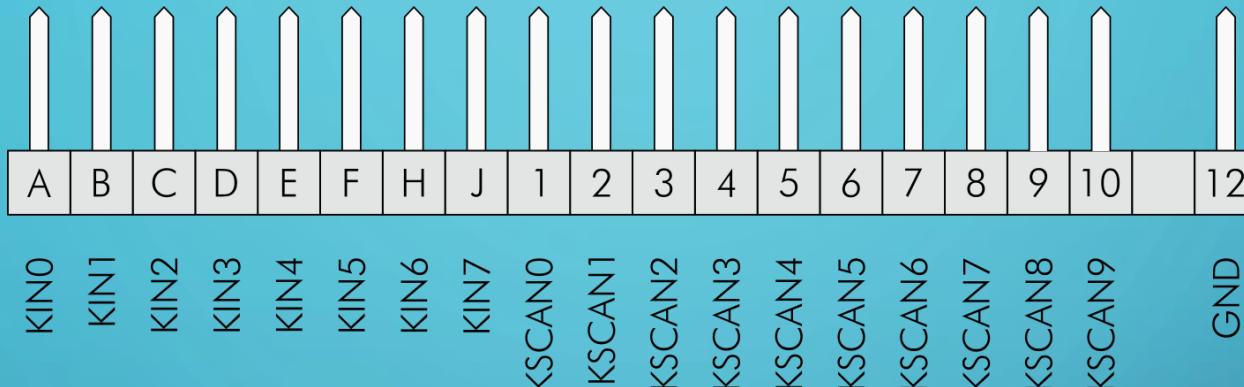
The user port dongle/PCB connects the video signals and, IEEE Control signals and DIAGSENS & GRAPHIC to the GPIO pins of the user port. Further, it connects the tape read #1/#2 to the tape write signal. Not all user port signals are involved, so the user port is not completely tested.

| Pins | Connected Signals |
|--------|-----------------------------|
| 2-B | TVVIDEO - CA1 |
| 3-C | IEEESRQ - PA0 |
| 4-D | IEEEEOI - PA1 |
| 5-E-11 | DIAGSENS - PA2 - GRAPHIC |
| 6-7-8 | TPREAD2 - TPWRITE - TPREAD1 |
| 9-K | TVVERT - PA6 |
| 10-L | TVHOR - PA7 |



The Feedback/Dongles

Keyboard



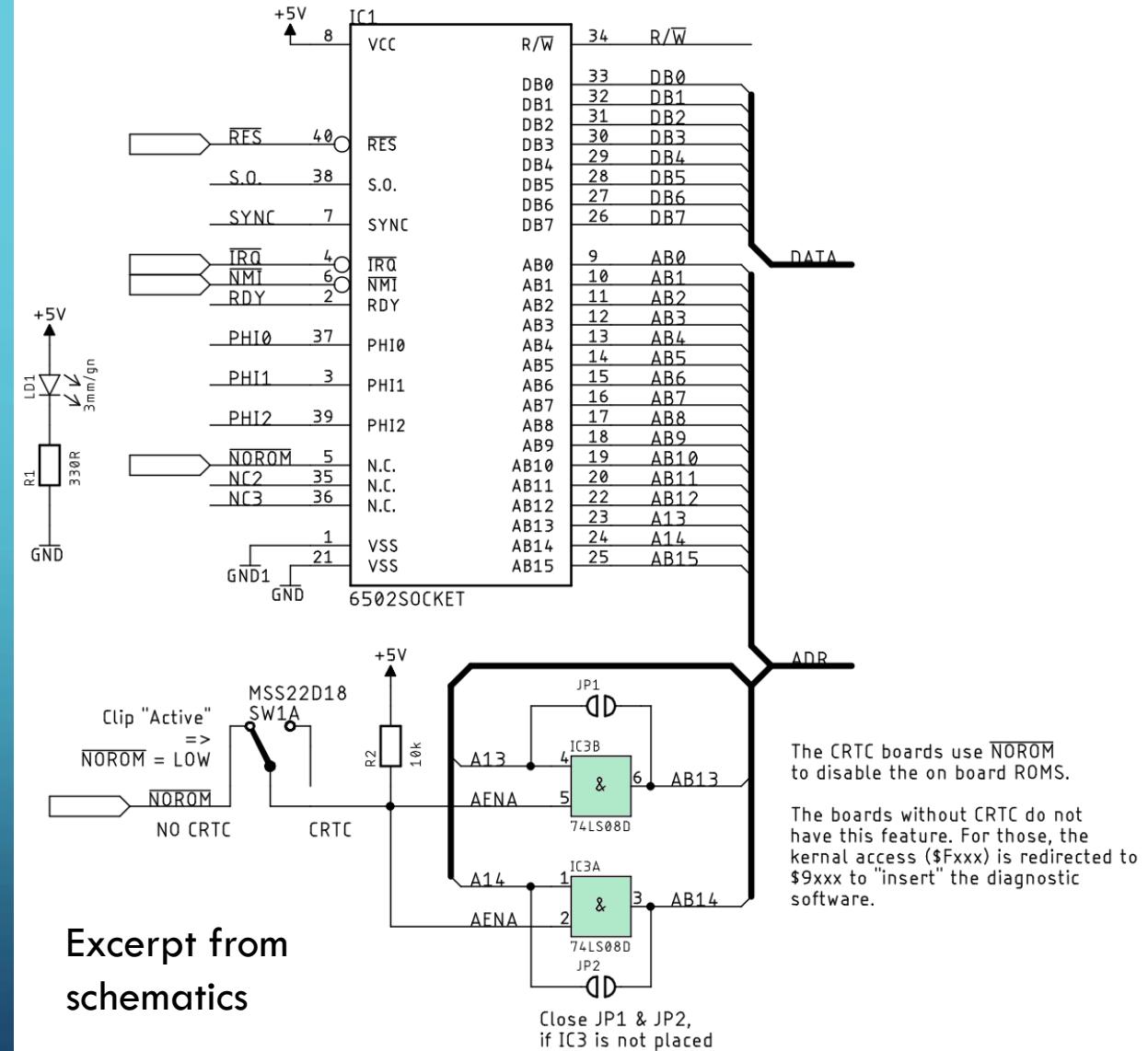
| Pins | Connected Signals |
|--------|----------------------------|
| A-1-9 | KIN0 - KeyScan0 - KeyScan8 |
| B-2-10 | KIN1 - KeyScan1 - KeyScan9 |
| C-3 | KIN2 - KeyScan2 |
| D-4 | KIN3 - KeyScan3 |
| E-5 | KIN4 - KeyScan4 |
| F-6 | KIN5 - KeyScan5 |
| H-7 | KIN6 - KeyScan6 |
| J-8 | KIN7 - KeyScan7 |



The 6502 Ribbon Cable Adapter



- Switchable between CRTC and non-CRTC
- AND-Gates for setting A13 and A14 LOW



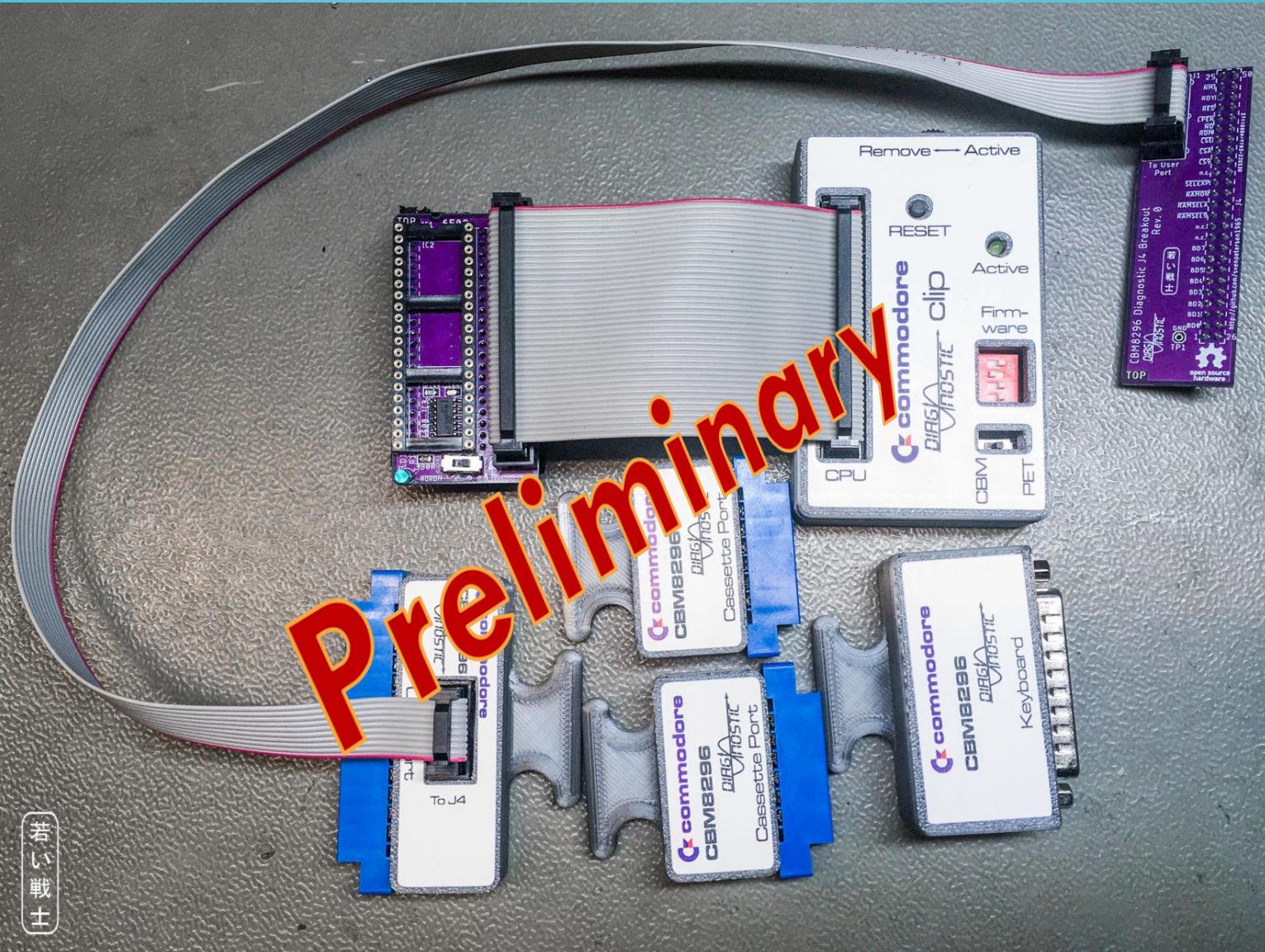
CBM8296 Diagnostic Clip



Photo by Christian Dirks

Original Commodore CBM8296 diagnostic clip

CBM8296 Diagnostic Clip



CBM8296 Diagnostic Clip

- Same Diagnostic Clip/Box and ribbon cable adapter
- Two dedicated cassette port dongles (both identical)
- An external keyboard dongle (the internal one from the PET also works)
- A different user port dongle, that connects to the expansion bus connector J4 (required for RAM bank switch testing)
- A breakout board for J4

CBM8296 Diagnostic Clip

The Problem

- I do not own a CBM8296, so I have to rely on a co-operation partner for testing
- A minor modification of the Diagnostic Box is required: Switching off the /NOROM signal, since the CBM8296 can switch it via a register.

Status

- All dongles are working
- One board worked completely with the modified box
- A 2nd board died – I guess, it is due to a broken CPU socket (this theory is not yet verified)

RESOURCES

➤ Diagnostic Software:

<http://www.zimmers.net/anonftp/pub/cbm/firmware/computers/pet/other/index.html>

➤ Feedbacks of the Dongles:

<http://www.zimmers.net/anonftp/pub/cbm/schematics/computers/pet/diagnostics.txt>

➤ Schematics of the boxes: <http://www.6502.org/users/andre/petindex/diag/index.html>

➤ Commodore Training: 40xx/80xx Service Manual: retro-commodore.eu

➤ My website: http://tech.guitarsite.de/petcmb_diag_clip.html

➤ This project on github: <https://github.com/svenpetersen1965/PET-Diagnostic-Clip>

Thank you for your attention.