

# Rudy's Retro Intelligence



## Commodore Super PET - SP9000 2 Board Version Diagnostics Manual

## Version 3.0 Created in September 2024

*Created by Rudy's Retro Intel*

*Updated in November 2024*

The purpose of this manual is to help identifying issues and the repair of a Commodore SuperPET (SP9000) computer. Excluded from this manual is the repair of the 8032 motherboard which is used in the SuperPET.

This manual will only cover the **SuperPET with the "2 Board Version"** The other version **"3 Board Version"** is not covered in this manual. Check my GitHub page for updates on 3 board version.

The SuperPET board I used to create this manual is the:

**SUPER PET COMBO BD. ASSY NO. 9000007 1482**

**FAB NO. 9000008 REV. B**

**ARTWORK NO. 9000017 REV. B**

*This manual can be used for REV A., B. and D boards.*

For the latest version of this document and other diagnostic manuals, use the links below.

<https://github.com/RudyRetroIntel/Vintage-Computer-Diagnostics>

You can find my videos here.

<https://www.youtube.com/@RudysRetroIntel>

### Contributors



**Chuck Hutchins -** Technical help with his many years of experience on the Commodore computers. Have a look at his collection and knowledge on his YouTube channel: <https://www.youtube.com/@HutchCA>



**David Bradley -** Provided several SuperPET boards for comparisons which allowed me to take measurement and fix my SuperPET board and several of his boards. See his many Commodore related videos here:

<https://www.youtube.com/@DRBradleyPhotography>

*"Sharing knowledge, we can ensure that the Commodore SuperPET computers can be repaired and enjoyed now and into the future.  
Rudy's Retro Intel"*

**\*\* This document is based on the work I have performed on my Commodore SuperPET (SP9000) computer and is provided "as is". I\we do not take any responsibility for errors and\or damages that may occur when repairing your Commodore SuperPET (SP9000) computer. This information is provided freely to all SuperPET computer owners. Please ensure you know how to perform electronics\electrical work. If not, please contact someone who has these skills before starting. \*\***

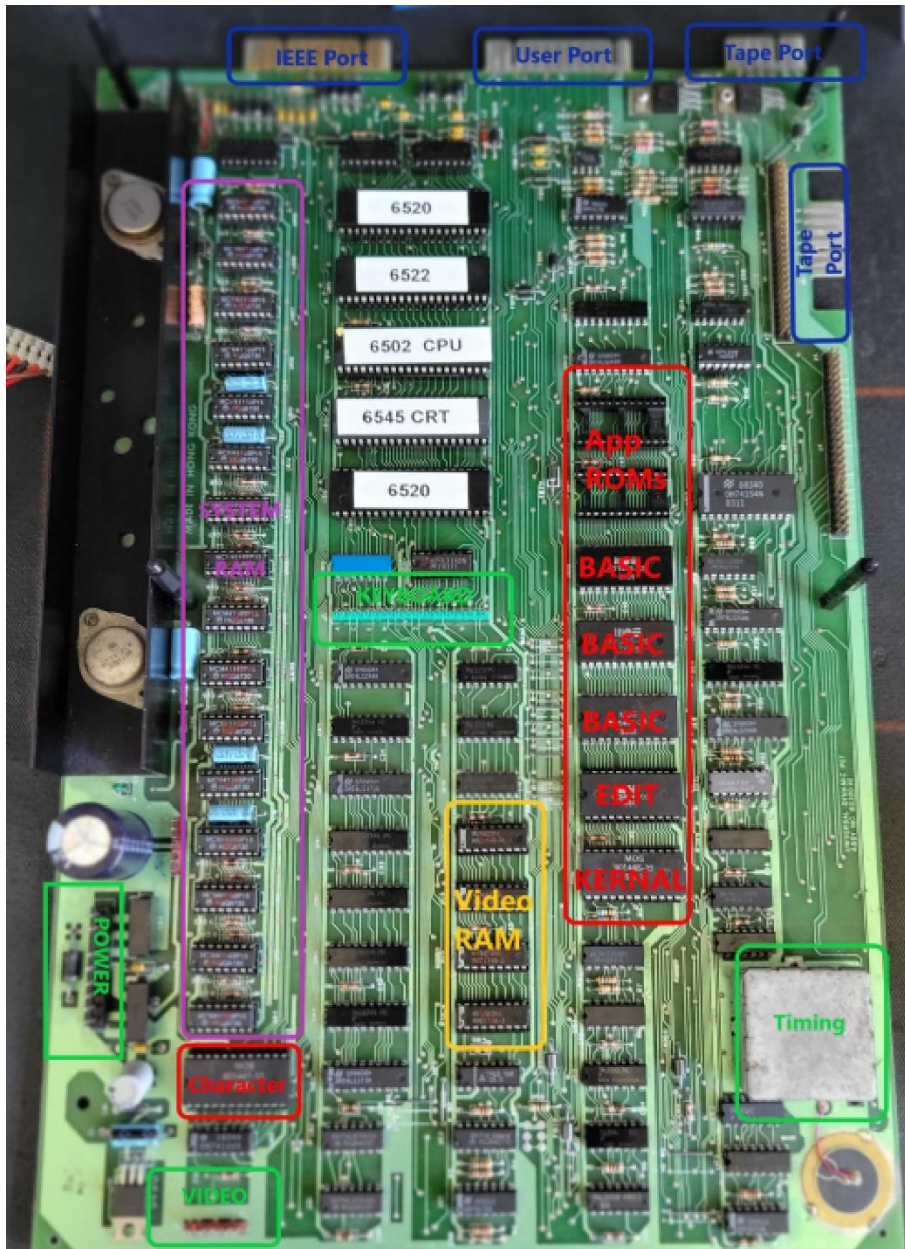
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## SuperPET Motherboard Modifications (8032)

The SuperPET computer was built on a Commodore PET 8032 computer which helped to reduce cost of designing a completely new computer system.

### 8032 Motherboard with identifications



## Commodore PET 8032

### Original

901465-19: BASIC ROM  
901465-20: BASIC ROM  
901465-21: BASIC ROM  
901465-22: KERNAL ROM  
Character ROM: 901447-10

### BASIC ROM Bug Fix

901465-23: BASIC ROM  
901465-20: BASIC ROM  
901465-21: BASIC ROM  
901465-22: KERNAL ROM  
Character ROM: 901447-10

6545 used in 12"inch screen PETs for  
H-Sync and V-Sync

6522 VIA (Versatile Interface Adapter)

6520 PIA (Peripheral Interface Adapter)

### Video RAM

4 x 2114 RAM ICs

### Main System RAM

16 x 4116 RAM ICs

CPU: 6502 (1 Mhz)

<https://www.youtube.com/@RudysRetroIntel>





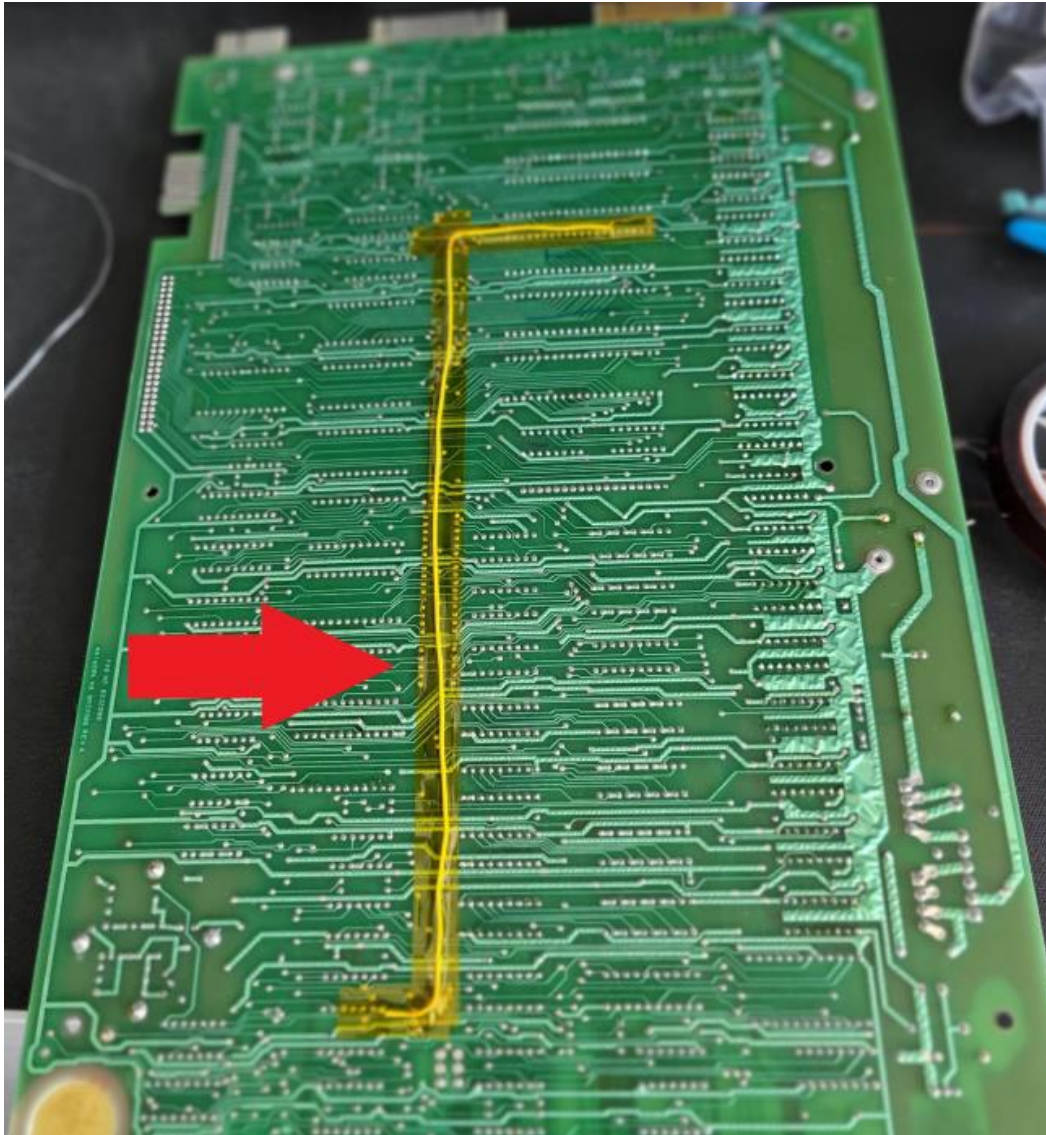
In order to get the PET 8032 (8032) to work as a SuperPET, there are 2 modifications needed so that it will work with the SuperPET daughter board.

- Motherboard jumper wire installation
- Upgrade the Character ROM

### Motherboard jumper wire installation

A jumper wire is needed to pass through a clock signal from the 8032 to the daughter board

Verify\Install a wire from **UD3** pin 1 - 74LS393 connected to **U17** pin 35 – 6502 CPU



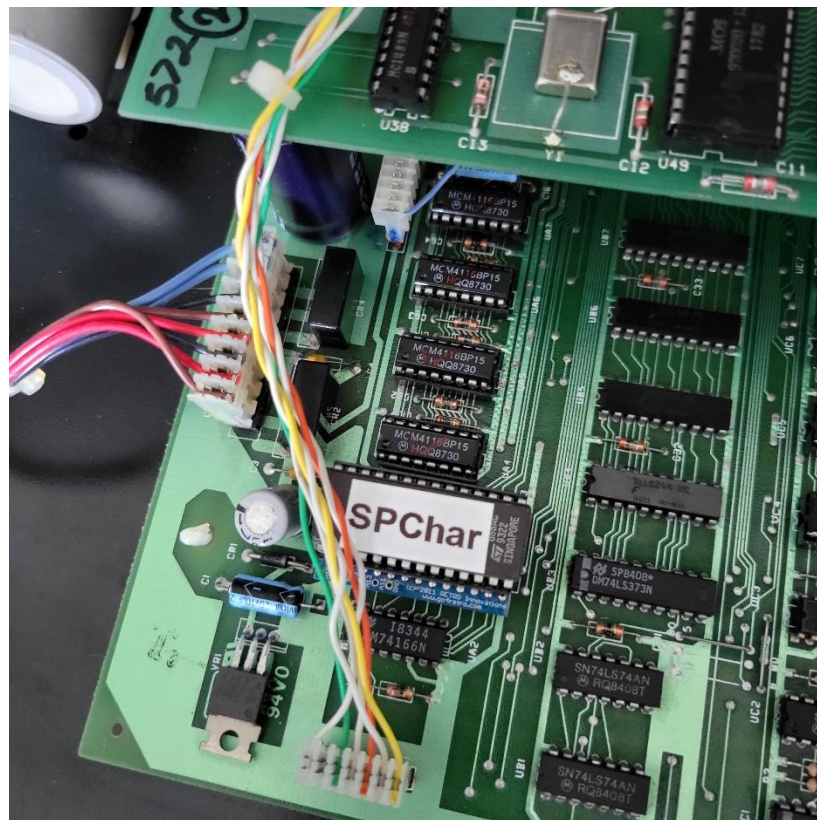
## Character ROM modification

The character ROM is the 901340-01 which is different from the original character ROM found on the 8032 motherboards.

SuperPET character ROM, is made of 2 halves. The first half has the original 8032-character ROM and the second half of this ROM contains a true ASCII character set and an APL character set. Without this modified character ROM, the SuperPET board will not work.

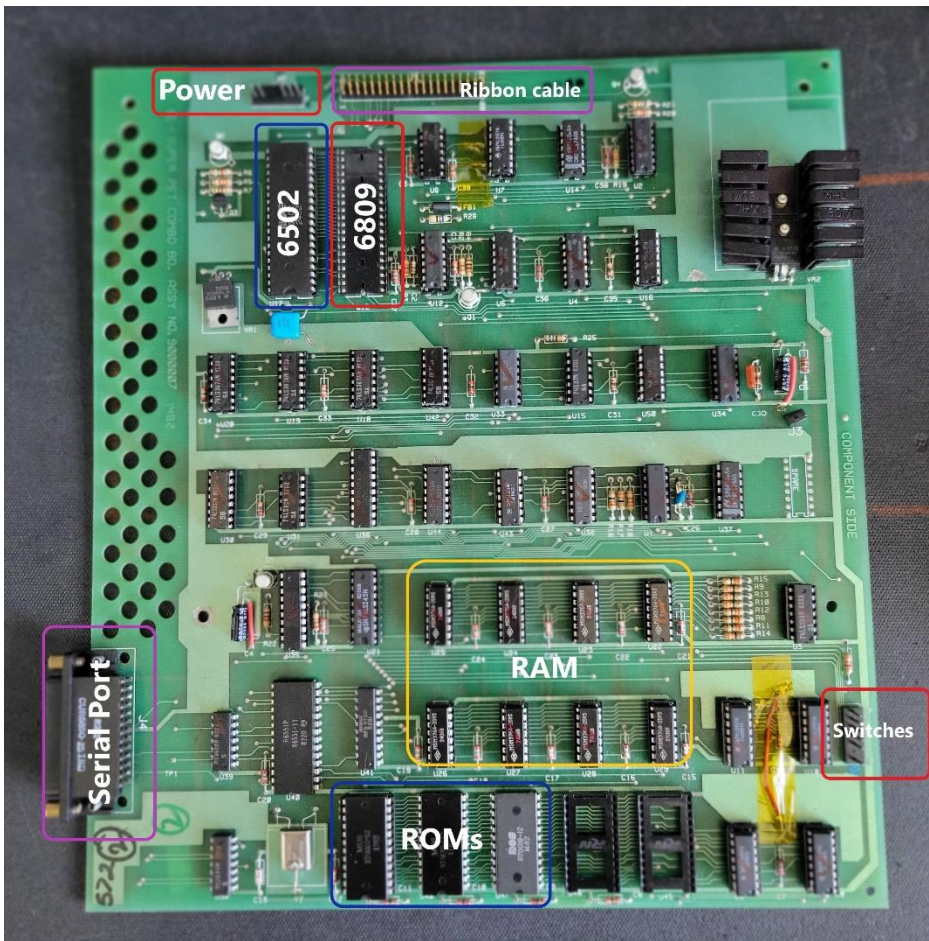
You can find the ROM image file here:

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





## The Super PET board (2 board version)



### Commodore Super PET Board

6502 CPU: At U17  
6809 CPU: At U13

RAM: At U22 - U29 - 3764. The 4164 can be used

970018-12: At U47 "Waterloo A000-BFFF" ROM  
970019-12: At U48 System's operating firmware  
970020-12: At U49 System's operating firmware

The "Waterloo A000-BFFF" ROM is part of the system's firmware and contains essential software for the operation of the Super PET. If this ROM is missing or faulty, the system may not function correctly.

Power: At J5 - Get power from main 8032 board

Ribbon Cable: At J1 - Replaces CPU (6502) on the main 8032 motherboard

Switches: At J2 - To switch between 6502,6809, and other modes

Serial Port: At J4 - Standard RS232 connection is used.

NOTE: 8032 motherboard must be completely working \tested or the Super PET board will not work.

<https://www.youtube.com/@RudysRetroIntel>



The Commodore SuperPET is comprised of the following:

- Commodore 8032 motherboard with modifications.
- Daughter board with connects to the 8032 via a ribbon cable and a power cable.

There are 2 versions of the Super PET daughter boards:

- Older version is made up of 3 boards. One for the memory, one is for the CPUs and the large motherboard which is the 8032 board.
- Newer version is made up of 2 boards. One houses the CPUs, memory and additional support logic. The other is the 8032 board.

Before starting, check the following:

- Check to ensure the ribbon cable is connect into the 6502 socket on the 8032 motherboard and to the SuperPET daughter board.
- Check to ensure the power cable is connected from the 8032 motherboard and to the SuperPET daughter board.

## SuperPET Parts

Location	Part Number	Description
U22-U29	4164 (8)	64K x 1 dynamic RAM
U17	6502	CPU
U40	6551	ACIA
U41	901889-01	6702 encoder
U13	6809E	CPU
U47	970018-12	2764 EPROM Waterloo A000-BFFF
U48	970019-12	2764 EPROM Waterloo C000-DFFF
U49	970020-12	2764 EPROM Waterloo E000-FFFF

*970018-12: At U47 "Waterloo A000-BFFF" ROM*

*970019-12: At U48 System's operating software or firmware*

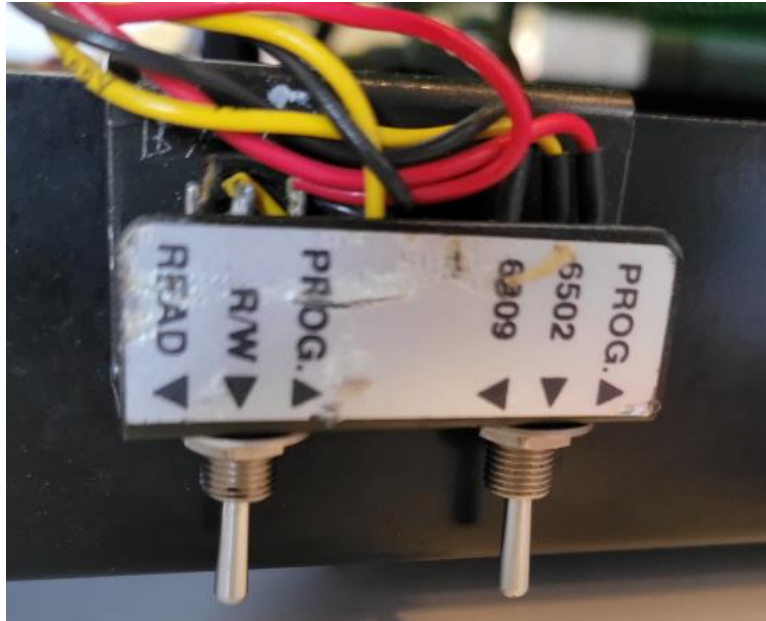
*970020-12: At U49 System's operating software or firmware*

- RAM: At U22 - U29 are 3764 RAM ICs, however the 4164 RAM ICs can be used
- The "Waterloo A000-BFFF" ROM is part of the system's firmware and contains essential software for the operation of the Super PET. If this ROM is missing or faulty, the system may not function correctly.
- Power: At J5 - Gets power from main 8032 board
- Ribbon Cable: At J1 - Replaces CPU (6502) on the 8032 motherboards. The 6502 is placed onto the daughter board.
- Switches: At J2 - To switch between 6502,6809, and other modes which are Read, Read\Write and Program.



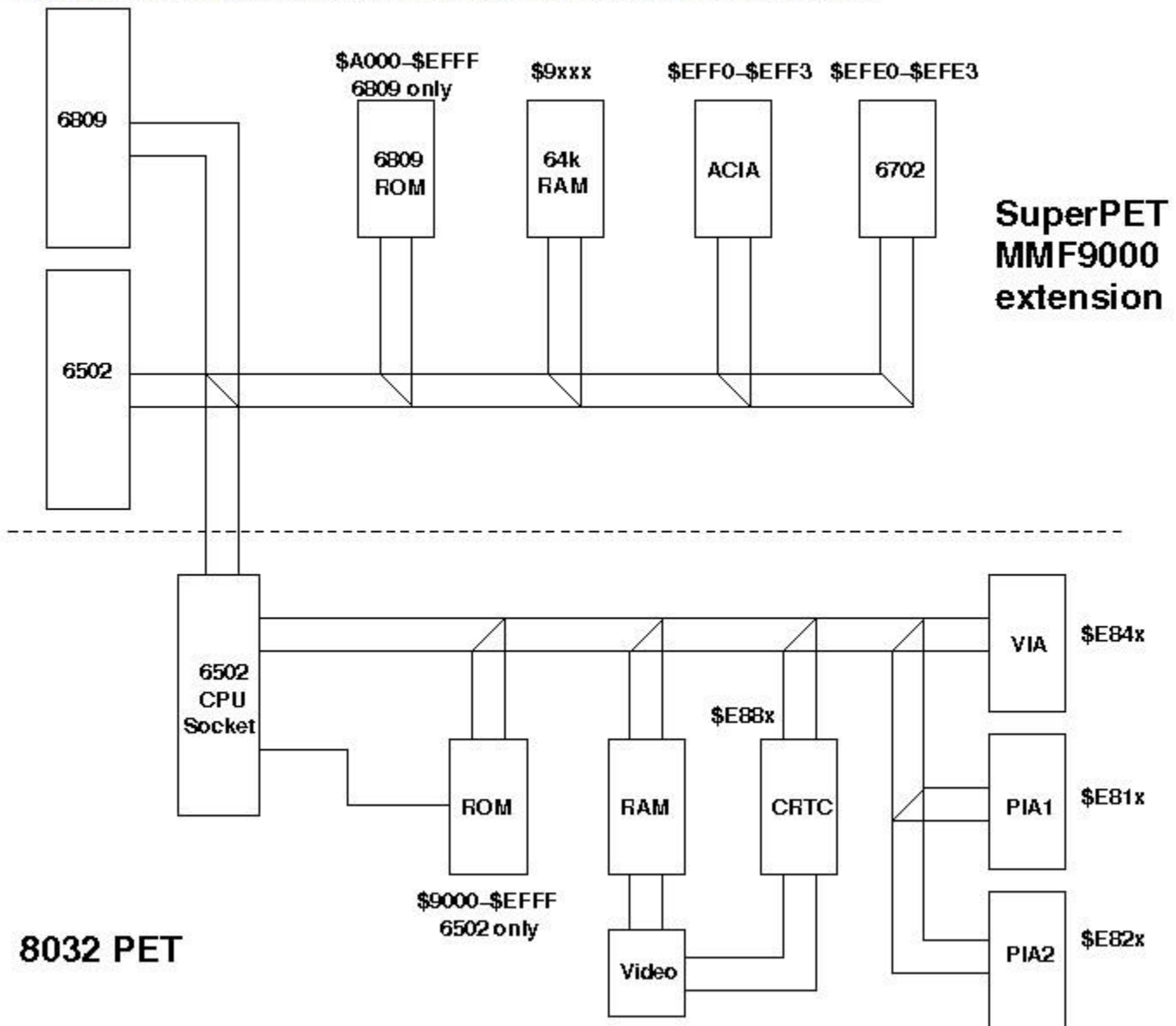
## Switch Setting and Usage

For general purposes, leave the 2<sup>nd</sup> switch to **R\W** (Read and Write). The usage of these switches will not be covered in this manual. You can find the programming language manuals or SuperPET user manual for details on how\when to use these switches. The only switches used to repair a SuperPET is 1) leaving the memory switch to **R\W** and 2) switching between 6502 (8032 PET) and the 6809 (SuperPET) modes.



## Basic Operation of the SuperPET

The following diagram shows an overview on the SuperPET extensions



\*This diagram was found randomly on the internet. If you know who created this diagram, please let me know so that I can credit them in this document.

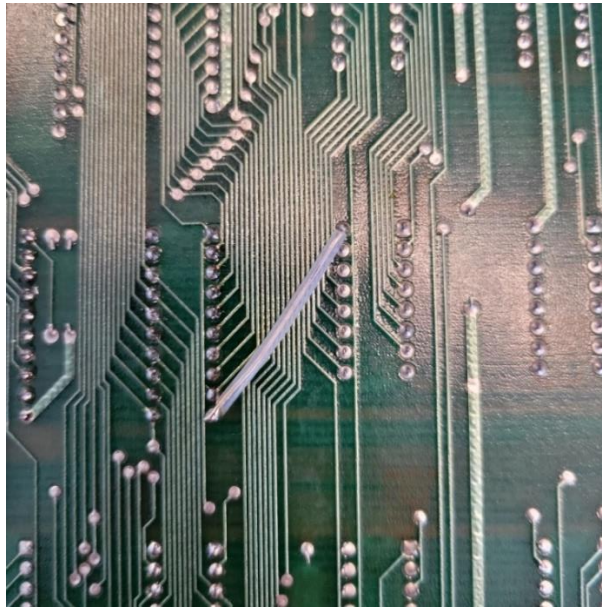
### Jumper Wires on SuperPET board

There are 2 jumper wires on the bottom side of the SuperPET board, and 1 on the top side. Ensure they are there and connected properly. **Note:** on the REV D. board, there are **no** jumper wires. The rest of the board is the same as REV A. and REV B.

### Bottom Side Jumper Wires

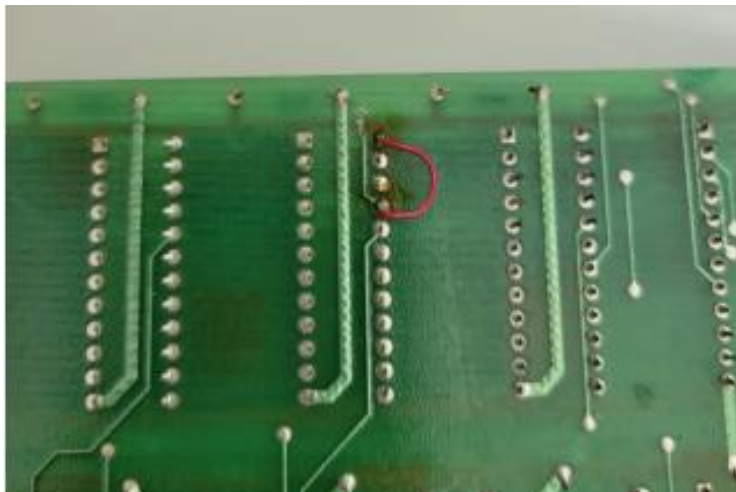
Verify\Install a wire from **U21** pin 10 -74LS245 connected to **U25** pin 16 – 4164 RAM.

*\*This jumper wire **is not** required on the REV A board **ARTWORK NO. 9000017 REV. A***

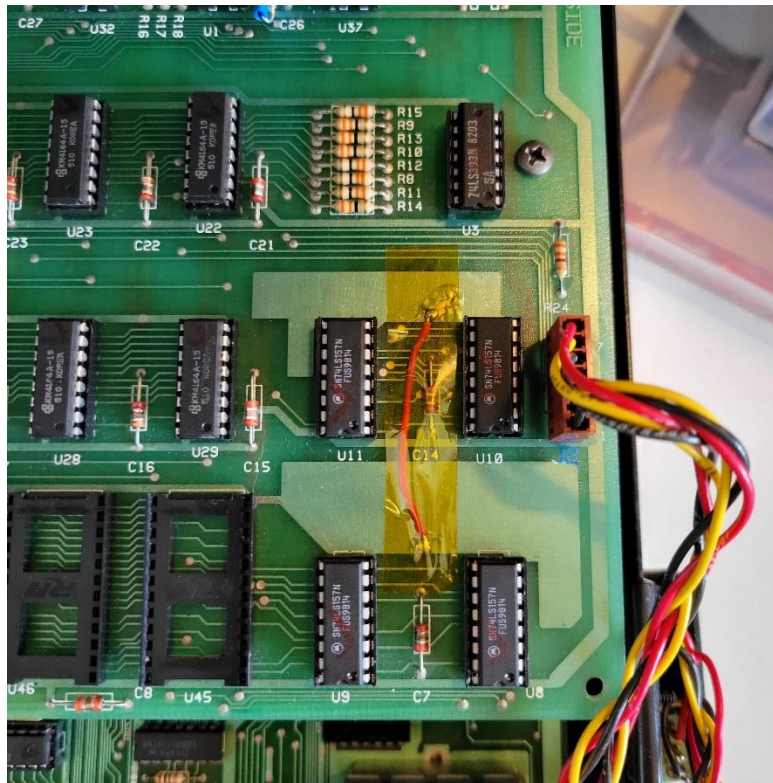


Verify\Install a wire from **U46** – Blank ROM socket Pin 24 to 21.

*\*This jumper wire **is** required on the REV A board **ARTWORK NO. 9000017 REV. A***



## Top Side Jumper Wire



Verify\Install a wire from the 2 locations as per above picture as there are no markings on the daughter board as to where exactly to install this jumper wire.

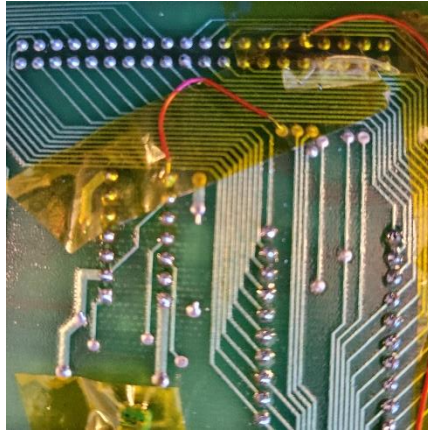
*\*This jumper wire **is not** required on the REV A board **ARTWORK NO. 9000017 REV. A***



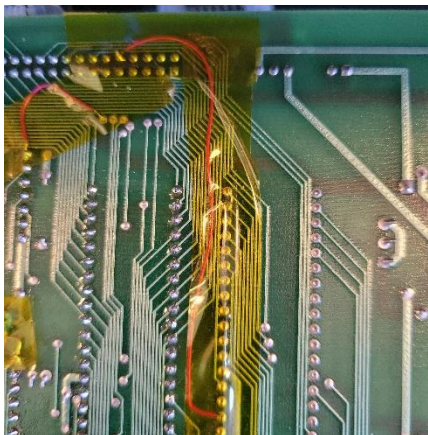
### Additional Jumper Wires Required on ARTWORK NO. 9000017 REV. A

These are the jumper wires required on the REV. A board **and not** on the REV B. board. Please know which version you are working. See bottom of the SuperPET board for REV versions.

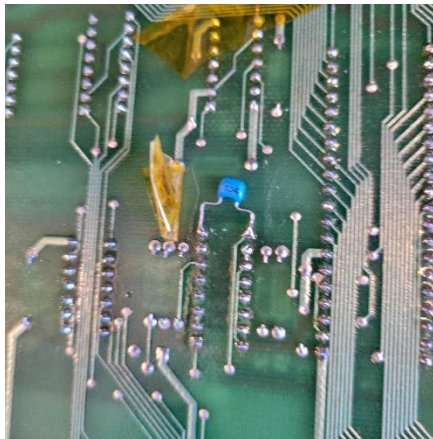
Jumper Wire (short wire) from **U6** Pin 8 connected to CPU ribbon cable connector header Pin6



Jumper Wire (longer wire) from **U17** (6502 CPU) Pin 36 connected to Pin36 on the CPU ribbon cable connector



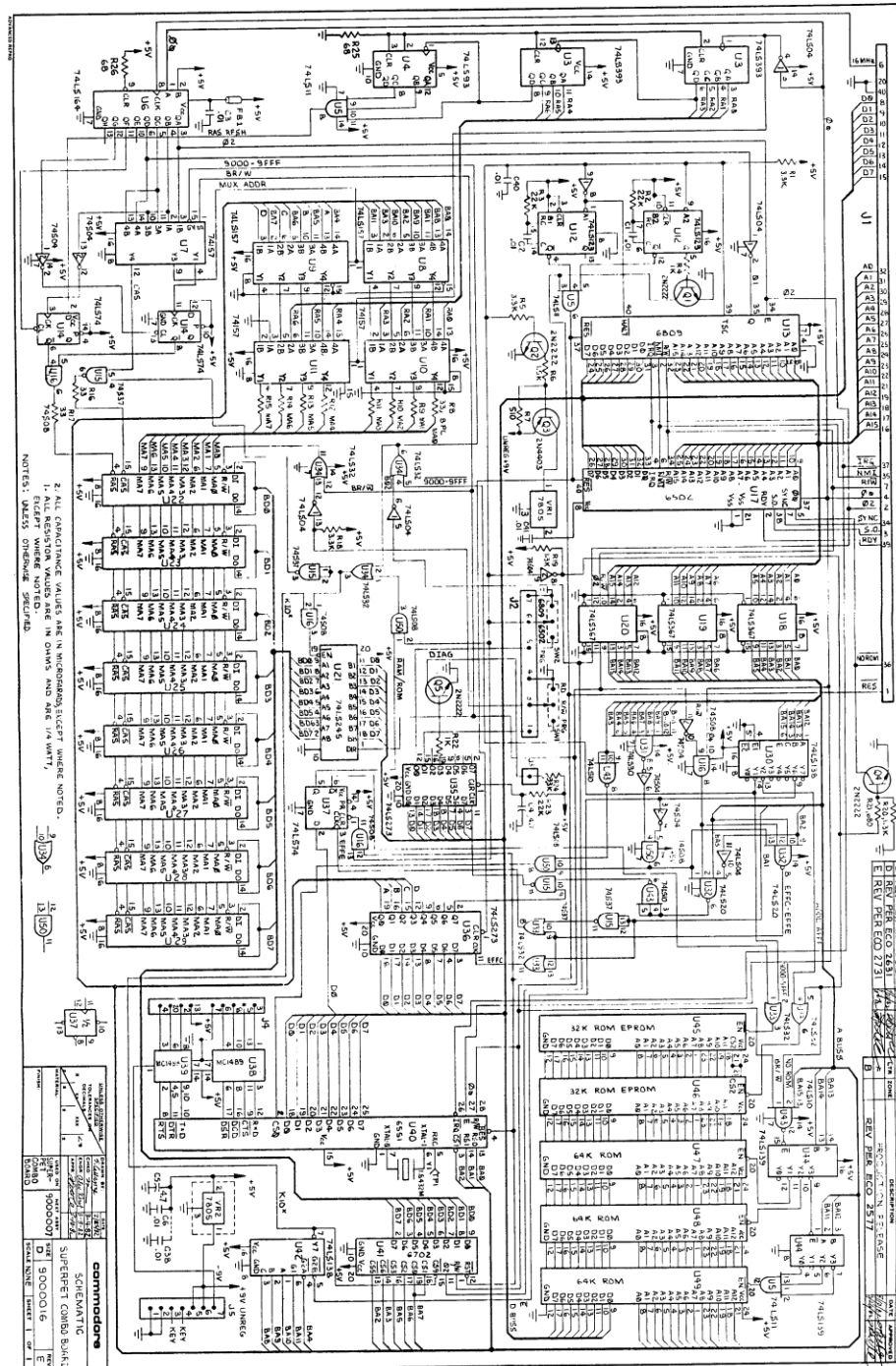
Capacitor (0.1uF) from **U12** Pin 8 connected to **U12** Pin9 (same IC).



## SuperPET Single Board Version Schematic

This is a sample of the full schematics which can be found here:

<https://www.zimmers.net/anonftp/pub/cbm/firmware/computers/pet/SuperPET/index.html> or here  
<https://github.com/RudyRetrolntel/Vintage-Computer-Diagnostics>



## SuperPET Symptoms and Diagnostics

In the following sections, symptoms are presented and diagnoses. Please note that there could be several faulty\failed ICs.

1. Ensure you remove all ICs in sockets and clean the sockets with an electronic cleaner before starting.
2. Check to ensure the ribbon cable is connect into the 6502 socket on the 8032 motherboard and to the SuperPET daughter board. Verify that the ribbon cable is good. With multimeter, check both ends of the ribbon cable for breaks and\or shorts.
3. Check to ensure the power cable is connected from the 8032 motherboard and to the SuperPET daughter board. Ensure power is coming into the daughter board.
4. Check voltages at voltage regulators at **VR1** and **VR2**.

The steps above are basic troubleshooting and will not be covered in this manual.

### Most Common Defective ICs

After repairing many "2 board" Super PETs daughter boards, I have found the following IC should be checked first as they tend to become defective most often.

**U19** – 74LS367

**U47** – ROM 970018-12: At U47 "Waterloo A000-BFFF" ROM

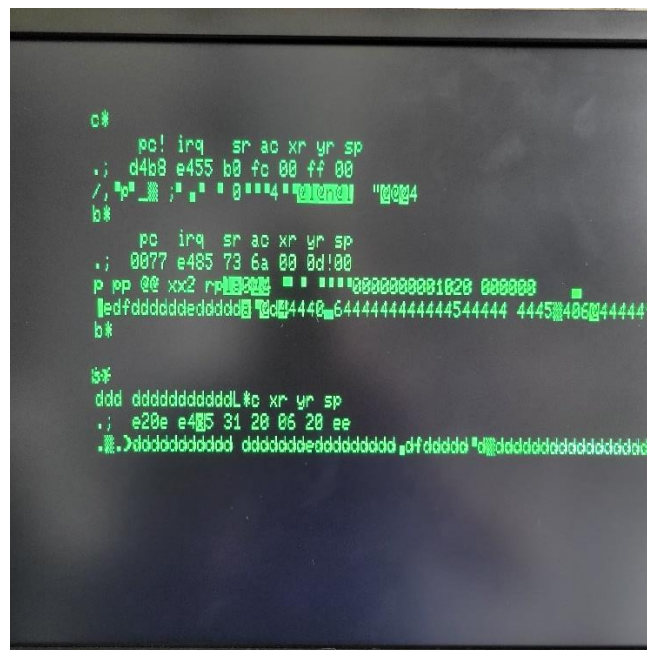
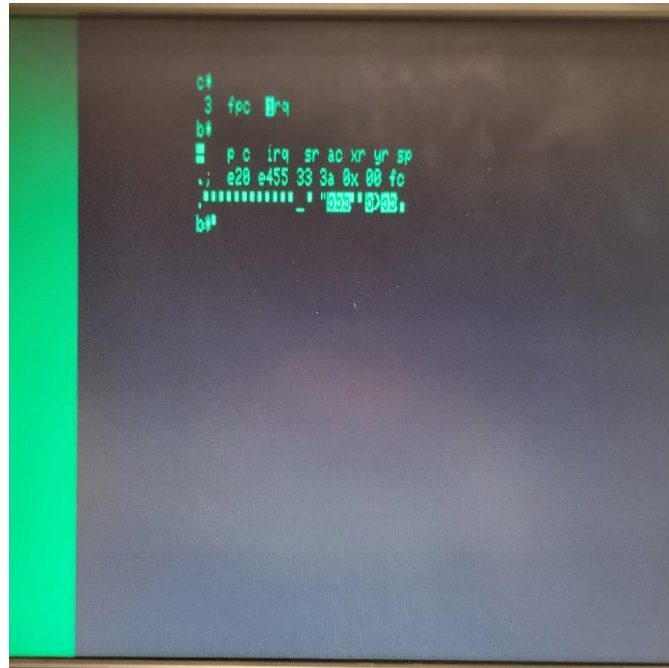
**U49** – ROM 970020-12: At U49 System's operating software or firmware

**U17** – 6502 CPU

**U13** – 6809 CPU

Continue with the rest of this manual if the above ICs check out as good. I recommend placing heat sinks on all the ROMs ICs at they get hot when running in 6809 mode. This is why they tend to go bad.

**Symptoms:** With side switches set to either 6502(8032) or 6809(SuperPET) the following errors are show:



**Diagnoses:** The jumper wire on the back side of the 8032 is missing, disconnected or not connected to the correct pins. Review and correct. See page 4.

Check the 6502 CPU at **U17**. Check the 2 set of switches are in working order. Clean or replace as needed. Ensure switches are connected the SuperPET daughter board. Regardless of which daughter board you are using this modification needs to be done.



**Symptoms:** SuperPET is working with switch to 6502 (8032) mode, however when switching to 6809 (SuperPET) you see the following:

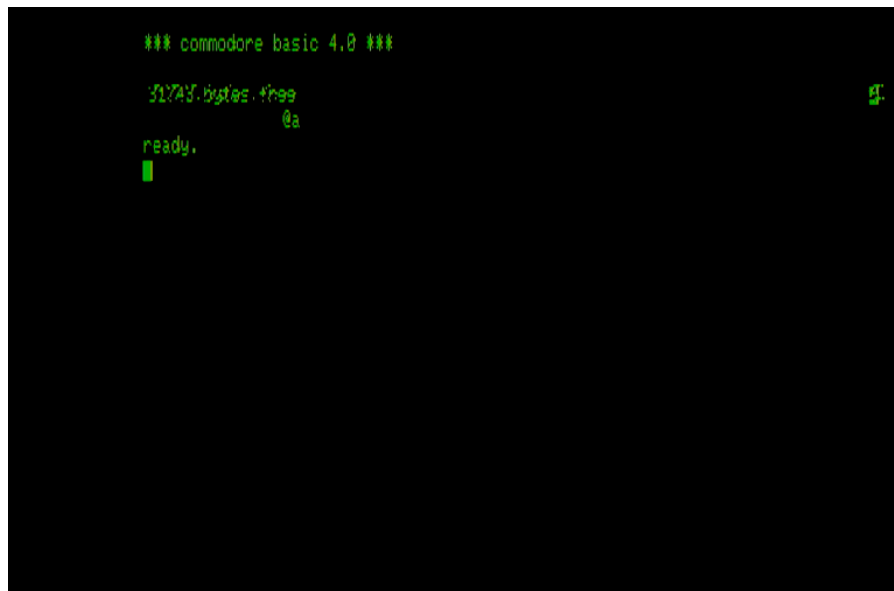


**Diagnoses:** The character ROM on the 8032 motherboard is missing the second half of the data. Replace the character ROM with the 901340-01. Burn the ROM onto an EPROM and with an adapter you can replace the ROM.

If the character ROM is correct, then issue is with the ROM itself. Burn a new EPROM and replace. Regardless of which daughter board you are using this modification needs to be done.

See **Character ROM modification** section in this manual for more information. This is located on *page 5*.

**Symptoms:** 6502 works but when switching to 6809 you get the same screen or garbage. Keyboard not responding.



**Diagnoses:** Check\replace **U47**, **U48** and\or **U49**. Check each ROM and replace. If ROM(s) are good, check their support logic ICs:

**U5** – 74LS11

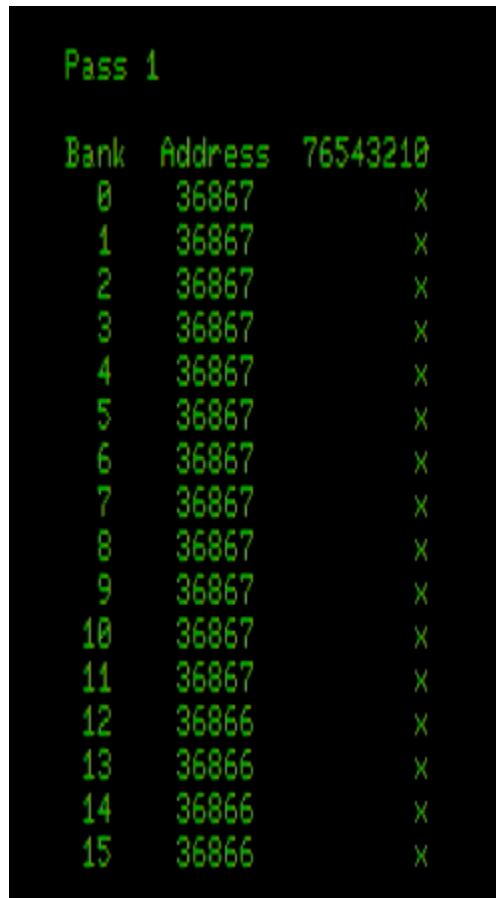
**U44** – 74LS139

**U43** – 74LS10

**U33** – 74LS32

Also check\replace 6809 CPU in **U13**

**Symptoms:** When running the SuperPET memory test software, you see “X” s on the screen.



Bank	Address	76543210
0	36867	X
1	36867	X
2	36867	X
3	36867	X
4	36867	X
5	36867	X
6	36867	X
7	36867	X
8	36867	X
9	36867	X
10	36867	X
11	36867	X
12	36866	X
13	36866	X
14	36866	X
15	36866	X

**Diagnoses:** There is a memory test software that can test all the RAM in the SuperPET daughter board called “spetmemtest.prg”.

In the above screenshot, the “X” indicates memory issue at **U22** which is shown in column “0”

The column with “76543210” indicates the location of the bad RAM IC. Here is the list for all the other RAM failures:

An X in column 0 = Bad RAM in **U22**

An X in column 1 = Bad RAM in **U25**

An X in column 2 = Bad RAM in **U24**

An X in column 3 = Bad RAM in **U25**

An X in column 4 = Bad RAM in **U26**

An X in column 5 = Bad RAM in **U27**

An X in column 6 = Bad RAM in **U28**

An X in column 7 = Bad RAM in **U29**

Multiple “X” s means there are several bad RAM ICs. Replace bad RAM with 4164 as they can be used. Ensure that the replacement RAM ICs are the same speed or faster.

When running the SuperPET memory test and all RAM ICs are good, you should see no “X” s.

```
Pass 1
Bank Address 76543210
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
```



**Symptoms:** Memory related issues. Memory not working properly, memory has strange behavior, however RAM ICs test good on external RAM tester.

**Diagnoses:** Check support logic ICs:

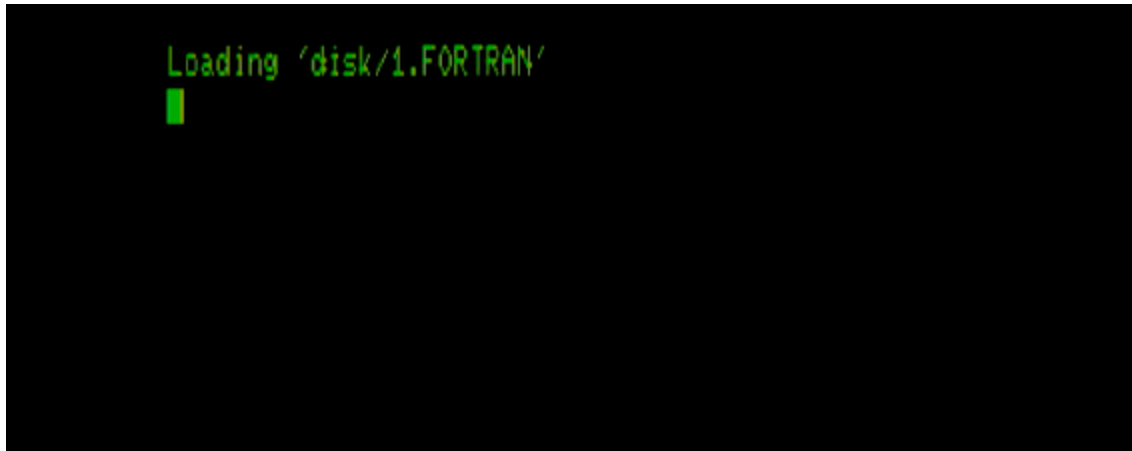
- **U3** – 74LS393
- **U4** – 74LS393
- **U7** - 74157
- **U8** – 74LS157
- **U9** – 74LS157
- **U10** – 74LS157
- **U11** – 74LS157
- **U14** – 74LS 74
- **U15** – 74S37
- **U16** – 74S08
- **U21** – 74LS245
- **U41** – 6702

**\*\*NOTE:** The 6702 at **U41** is a very RARE IC!! There are no replacements for it and Commodore has never release the logic that is within the MPS 6702 IC.

The 6702 is required for the original versions of the SuperPET software but the programs have been cracked so they don't require the 6702. You can find them here: <http://mikenaberezny.com/hardware/superpet/waterloo-languages/>

**Symptoms:** No programming language loads. 6502 and 6809 appears to be working and language file is on the diskette (or SD card). System tries to load the program but is never successful. 6809 mode appears suck and 6502 mode is working.

Here is an example trying to load FORTRAN language.

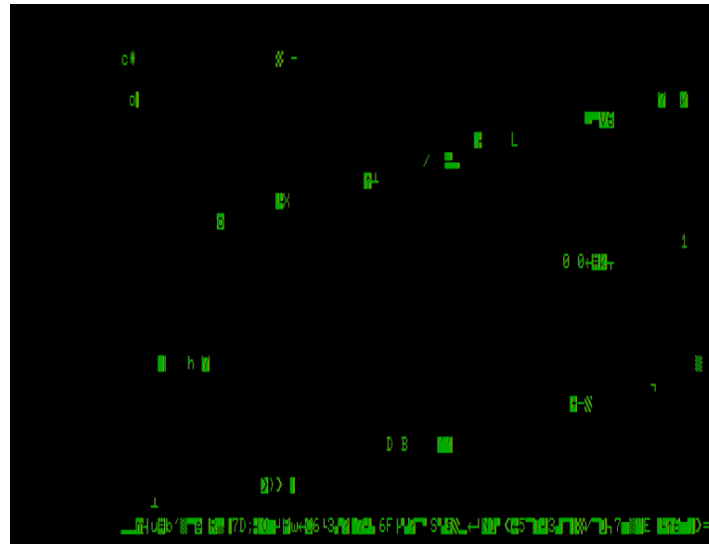


**Diagnoses:** Check\replace **U41** – 6702. This IC is required to load any development language. When testing, the language software does take a while to load.

**\*\*NOTE:** The 6702 at U41 is a very RARE IC!! There are no replacements for it and Commodore has never release the logic that is within the MPS 6702 IC.

The 6702 is required for the original versions of the SuperPET software but the programs have been cracked so they don't require the 6702. You can find them here: <http://mikenaberezny.com/hardware/superpet/waterloo-languages/>

**Symptoms:** Turning on the SuperPET with switch in 6502 or 6809 position, you see garbage on the screen, like the following:



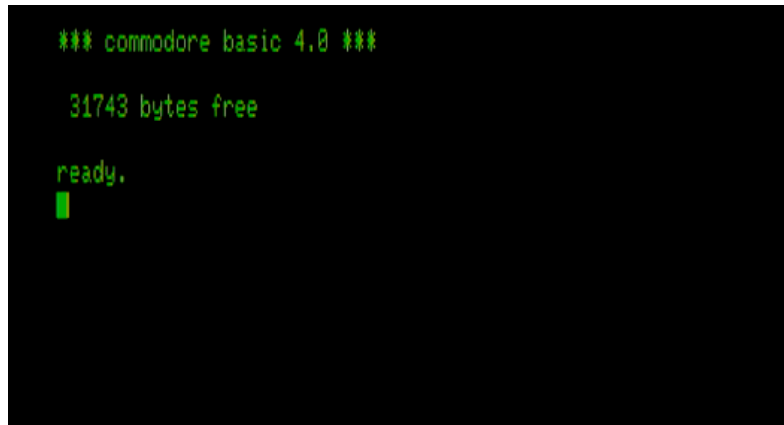
**Diagnoses:** Check\replace **U6** – 74LS164 and\or check\replace **U40** – 6551-11

**Symptoms:** System will not boot up into 6502, no video however when switching to 6809 mode you the menu or something like the following:



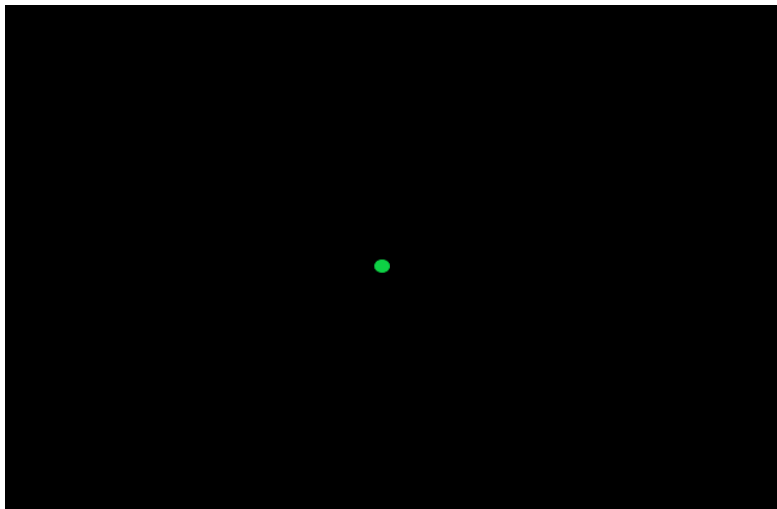
**Diagnoses:** Check\replace **U2** – 74LS04 and\or **U5** – 74LS11

**Symptoms:** SuperPET boots up but hangs and no keyboard input. Both 6809 and 6502 show the following screen.



**Diagnoses:** Check\replace **U12** – 74LS123, **U20** – 74LS367, **U18** – 74LS367 and\or check\replace **U40** – 6551-11

**Symptoms:** SuperPET show a green dot in the middle of the screen. No chirps and no power up.



**Diagnoses:** Turn off the SuperPET immediately!! This can cause damage to the monitor.

Check\replace

- **U19** – 74LS367
- **U42** – 74LS138
- **U34** – 74LS32

Recommend to replace all 3 of the above ICs with new ones due to their importance and how they may damage the monitor. These are common ICs and very inexpensive.



**Symptoms:** SuperPET continuously reboots and chirp is heard over and over again in 6502 mode. When booting directly to 6809 mode, you get a screen full of characters. Or 6502 boot fine and when you switch to 6809 and back to 6502, you see the following:

```
*** commodore basic 4.0 ***  
  
31743 bytes free  
  
ready.  
  
?syntax error in 255  
ready.
```

**Diagnoses:** Check\replace **U1** – 74LS04

**Symptoms:** SuperPET only shows a complete green screen on boot up. This is true for 6502 or 6809 modes.

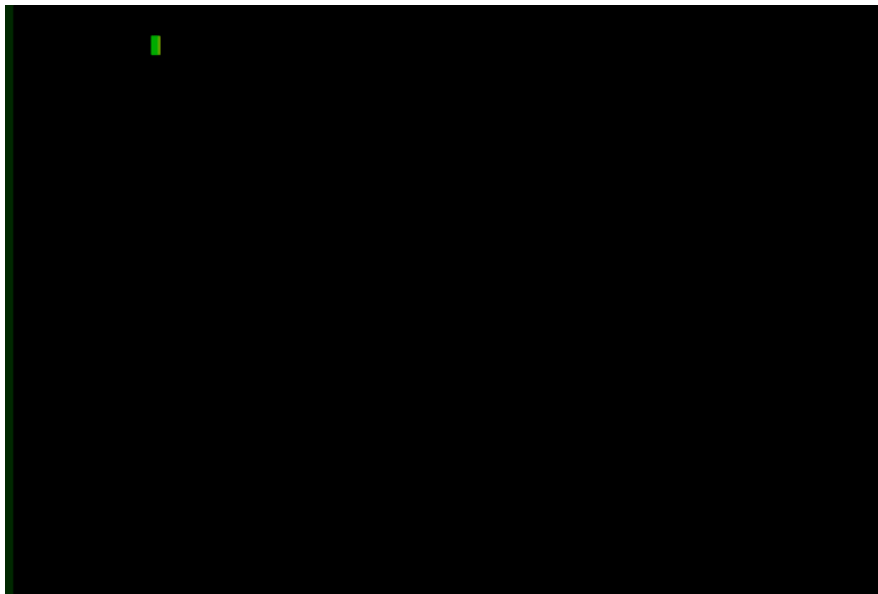


**Diagnoses:** Check\replace **U19** – 74LS367

**Symptoms:** Booting in 6502 mode, you get no beep and no prompt, just green screen,



and when switching to 6809 mode you get this, garbage or 6809 menu.



**Diagnoses:** Check\replace **U17** – 6502. When switching to 6809 mode and you seeing the above or garbage then there are also other issue(s).

## Testing Super PET Serial Port with a Real Modem

1. Switch to 6809 mode by selecting it with the toggle switches

```
Waterloo microSystems

Select :

  setup
  monitor
  apl
  basic
  edit
  fortran
  pascal
  development

█
```

2. Start up the Monitor, by pressing **m** <return>

```
Waterloo microMonitor

>█
```

3. Type: **p** <enter>

```
Waterloo microMonitor

>p
█
```

4. Hooked up a real modem or other physical modem with serial cable to the RS232 connector on the Super PET daughter board. Power on the modem.

5. Type: **at&c0** <return> **\*\*note last letter is a zero and not the letter O\*\***. You will see "OKAY " from the modem, or whatever modem you are testing with.

```
Waterloo microMonitor
>p
at&c0

OK
█
```

6. Now you can type commands and they will be echo back.
7. Type: **ati4** <return> and should see modem related information. **\*\*Note as you type this command it will be echoed back, meaning you will see double entries\*\***

```
at&c0

OK
aattii44

U.S. Robotics 56K FAX EXT Settings...

B0 E1 F1 M1 Q0 V1 X4 Y0
BAUD=2400 PARITY=E WORDLEN=7
DIAL=TONE ON HOOK CID=0

&A3 &B1 &C0 &D2 &E0 &H1 &I0 &K1
&M4 &N0 &P1 &R2 &S0 &T5 &U0 &V1

S00=000 S01=000 S02=043 S03=013 S04=010 S05=008 S06=004
S07=060 S08=002 S09=006 S10=014 S11=070 S12=050 S13=000
S15=000 S16=000 S18=000 S19=000 S21=010 S22=017 S23=019
S25=005 S27=000 S28=000 S29=020 S30=000 S31=128 S32=002
S33=000 S34=000 S35=000 S36=014 S38=000 S39=000 S40=001
S41=000 S42=010

LED #:
█
```

8. To end this type: **atz** <return> which stopped the echo.

If you are seeing your modem information, similar to what is show above then your serial port should be working. More testing with terminal related software is required.

9. Hit "RunStop" key and then type: **q** <return> which will exit back to the menu.

This test shows that the modem is accepting requests and successfully showing the results of the request back to the Super PET.

## Testing Super PET Serial Port with a Loopback Tester

Using a serial port loopback tester is another way to test, if you do not have a modem.

To create a correct DB25 pin loopback connector for a serial port, follow these steps:

1. **Get a Female DB25 Connector:** You'll need a female DB25 connector for this loopback plug.
2. **Wire the Pins:** To connect the pins.

### DB25 Pin Loopback Configuration:

1. **Pin 2 (TxD)** connected to **Pin 3 (RxD)**: This allows the data sent from the port to be received back.
2. **Pin 4 (RTS)** connected to **Pin 5 (CTS)**: This sets up the Request to Send and Clear to Send lines for flow control.
3. **Pin 6 (DSR)** connected to **Pin 20 (DTR)**: This connects the Data Set Ready and Data Terminal Ready lines.
4. **Pin 8 (DCD)** connected to **Pin 20 (DTR)**: This connects the Data Carrier Detect to the Data Terminal Ready.

Function	Pin A	Pin B
TxD to RxD	2	3
RTS to CTS	4	5
DSR to DTR	6	20
DCD to DTR	8	20

**Test the Connection:** Plug the loopback connector into the serial port and use a terminal program to send and receive data to verify the port is working correctly.

You can also use the "Monitor" for testing. Follow steps 1 - 4 in this manual's section called "**Testing Super PET Serial Port with a Real Modem**". When typing, you will see double the letters\numbers. Shown as double character because the serial port loopback tester is sending the keystroke back to the screen. You should see the same letter or number you typed. If not, there are issues with the serial port.



# Rudy's Retro Intelligence



**Commodore Super PET - SP9000  
2 Board Version Diagnostics Manual**