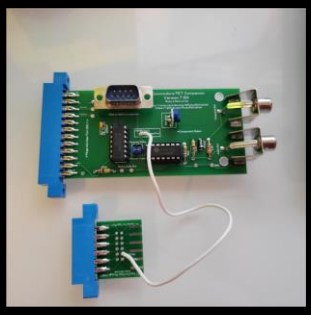
COMMODORE PET COMPANION

EXTERNAL COMPOSITE AND RGB2HDMI VIDEO AND AUDIO

This board was created to help with Commodore PET diagnostics and to enhance your Commodore PET experience.

COMMODORE PET COMPANION

EXTERNAL COMPOSITE AND RGB2HDMI VIDEO AND AUDIO



Created by Rudy's Retro Intel

The initial idea of building this board was to help while I worked on Commodore PET computers. While repairing many PETs, I was not happy with constantly power cycling the internal monitor, which adds additional stress to an aging system. Plus having to pull out the main board, do repairs, and then reinsert it back into the PET case to test. With the PET Companion board, you can now remove the main board, do repairs, and test with an external monitor.

PETs with 9" monitor need no changes. PETs with the 12" inch monitor, a different "EDIT" ROM version is needed and was created by Steven Gray. This is only needed for composite output.
http://www.6502.org/users/sjgray/projects/editrom/index.html

From the original schematic (in the book called The PET Revealed), I modified the design to incorporate external audio which is displayed briefly by starting up the Space Invader game. Next, additional components were added to sharpen the video output and to help protect the PET Companion board from over voltages injected via the video connection. Additionally, RGB2HDMI connection was added.

If you are performing Commodore PET repairs or just want to enhance your system, I believe the PET Companion board will suit your needs.

Rudy's Retro Intel

https://www.youtube.com/c/RudysRetroIntel

***** I have created this document based on my own work with my Commodore PET computer. It is offered without any warranty or guarantee. I\we are not liable for any mistakes, harms, or losses that may arise from using this board. This board is a hobbyist project. By using the PET Companion board, you agree to waive all\any right(s) to take legal action against me\us.***

Current Version

The latest version is 7.x has the following features:

1. External video with composite connection via the RCA jack.
2. Video select which allows for connections to the 9-inch (Normal) or 12-inch (Inverse) PET computer. Both monitor types will handle the output differently so this is needed. Normal setting is used for RGB2HDMI connection.
3. External RGB2HDMI connection via DB9 port.
4. External audio with connection via the RCA jack. If the PET Companion was purchased at the World of Commodore, an RCA to 3.5mm jack is included. This will allow for desktop speakers to be connected.
5. Solder points if you want to use a different audio connection.

Manual can be found on GitHub: **https://github.com/RudyRetroIntel/Commodore-PET-Companion**
YouTube channel: **https://www.youtube.com/@RudysRetroIntel**

Recognition

I would like to thank the following people for their help, advice, and input on this project.

- Nick Hampshire's book "The PET Revealed" from 1979. **https://www.computinghistory.org.uk/det/1396/The-Pet-Revealed/**
- Steven Gray **http://www.6502.org/users/sjgray/myprojects.html**
- Dave Bradley – 8 – Bit Commodore Man **https://www.youtube.com/@DRBradleyPhotography**
- Geek With Social Skills **https://www.youtube.com/@geekwithsocialskills**
- Adrian's Digital Basement **https://www.youtube.com/@adriansdigitalbasement**
- Chuck Hutchins **https://www.youtube.com/@HutchCA**
- Mike RavenWolf Retro Tech **https://www.youtube.com/@RavenWolfRetroTech**

Usage for Entertainment

Since there are PETs that have no speaker and others have a tiny speaker (beeper), you can use this board to get external audio. Playing games like Space Invaders is more enjoyable with sound. The external audio port comes with its own RCA jack for easy connection to a Commodore 1701/1702 monitor which has an audio amplifier and speaker. If you want to use a different type of jack, there are solder point on the board to allow for different connections like 3.5mm jack.

If you would like to use an external composite video for gaming, programing, etc. ensure that you are using a monitor that has a built-in video amplifier like the Commodore 1701/1702 monitor. Connecting to other connections like capture cards, may not produce the best quality as they do not amplify the video signals.

For best video quality and for video capture, you can use the RGB2HDMI port. To use this port, you will need to purchase a RGB2HDMI adapter board that connects to the PET Companion via cable. This board is not included with the PET Companion card. You can search the term" RGB2HDMI" to find a reseller.

Tape port pass through allows for connecting other devices like SD2PET FUTURE that need power from the tape port. Just connect the PET Companion boards and then connect your other devices to the tape pass through connector.

Usage for Diagnostics

This board can be used to determine if the Commodore PET's internal monitor or main logic board (motherboard) is defective by isolating the main logic board from the monitor board. By connecting the PET Companion board and disconnecting the internal monitor, we can determine if the issue(s) are related to main logic board or not. If there is no video, yet when you use the PET Companion board you get video, then the issue is related to the monitor section.

If the monitor is working but you need to perform other work, you can use the PET Companion board and leave the internal monitor disconnected. As you are doing repairs and checks, you may need to reboot or reset the PET computer. Powering the internal monitor on and off for testing can reduce the longevity of the components inside the monitor. Once the PET computer is fixed, you can disconnect the PET Companion board and start using the internal monitor again. However, you can leave the PET Companion connected to get external video and audio.

Using PET Companion for External Composite Output with 9-inch Internal Monitor PET

The majority of Commodore PETs use the 9-inch internal monitor. To verify, measure the screen diagonally, corner to corner. It should be 9-inches. These computers do not require any changes to the PET Companion board or the PET itself. Follow these steps.

1. Power off the Commodore PET computer.
2. Connect the PET Companion board to the User Port located at the back of the computer. This port is located basically between two other ports (IEEE port and TAPE port). **DO NOT CONNECT TO THE IEEE PORT.**
3. Connect the tape adapter board to the TAPE port. This is the smallest of port on the back of the PET computer. *Ensure you see the label to determine which side faces upwards*.

4. Set the output video to **Normal** by changing the jumper.
5. Connect an RCA cable to the video (Composite Output) connector.
6. Connect the other end of the video RCA cable into your monitor. Ensure you connect to the monitor's video input only.
7. Connect an RCA cable to the audio (Audio Output) connector on the board. Ensure you connect to audio input of your monitor, VCR, or other audio devices.
8. Power on the external monitor and\or audio device.
9. Power on the Commodore PET computer. You should now see video on the external monitor. External audio will only be heard if you are playing a game with sound or program that uses sound. Recommend trying Space Invader to determine if sound output is working.
10. Adjust 10K potentiometer to fine tune picture quality. You may also have to adjust the setting on your monitor.

Your output should look similar to this. In this picture a Commodore 1702 monitor is used as it has inputs for video and audio.

The Commodore PET 9-inch internal monitors, like in the 2001 series computer, the external video will be off center and shifted to the right a bit, however all characters are shown. This is normal due to an artifact and cannot be adjust with the PET or PET Companion board. If your external monitor has horizontal adjustments, you can use it correct this issue.

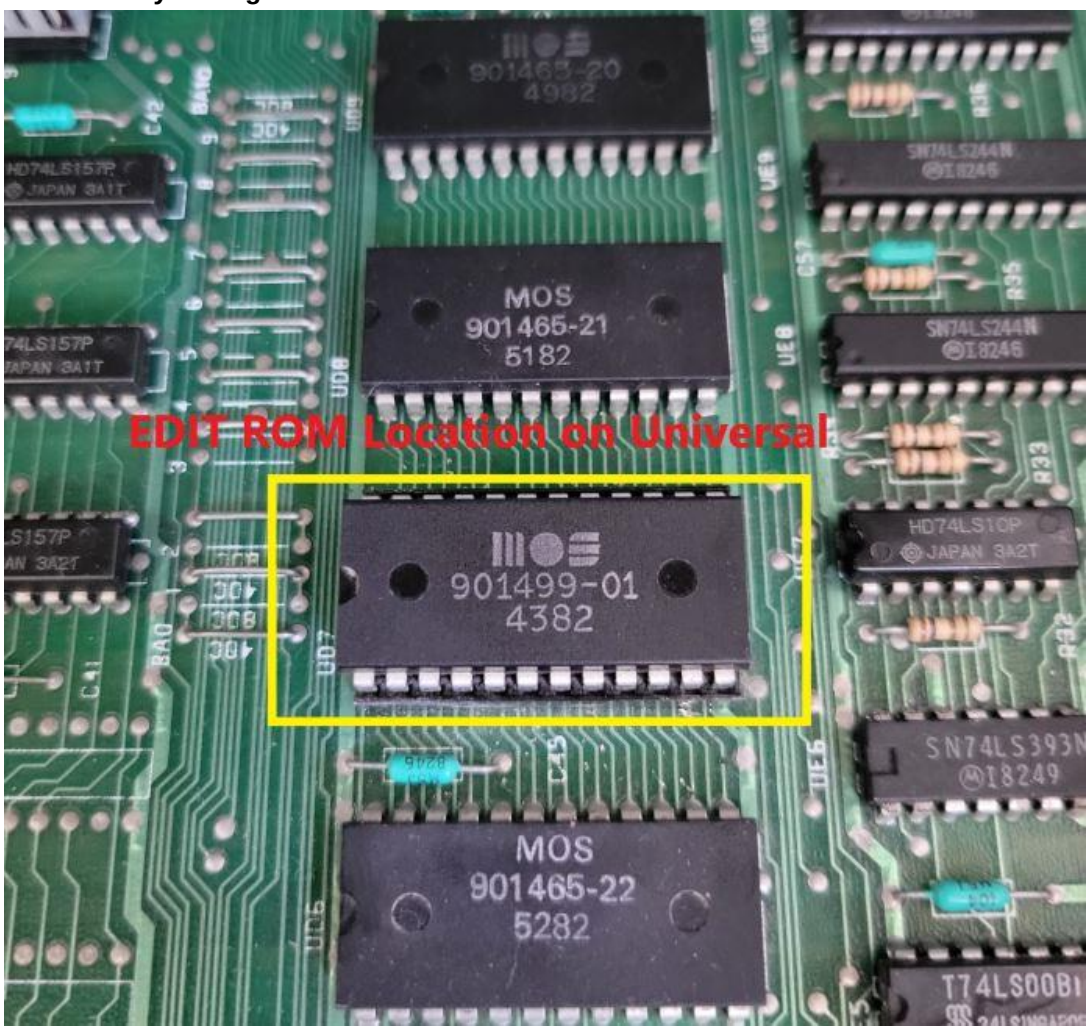
*Initial tests were performed on a Commodore PET 2001-16N and 4016 however, other 9-inch internal monitor versions should work without issue. Testing will continue and this documentation will be updated as needed.

**Commodore PET computer repairs are beyond the scope of this documentation. This documentation is only provided for the PET Companion board.

Using PET Companion for External Composite Output with 12-inch Internal Monitor PET

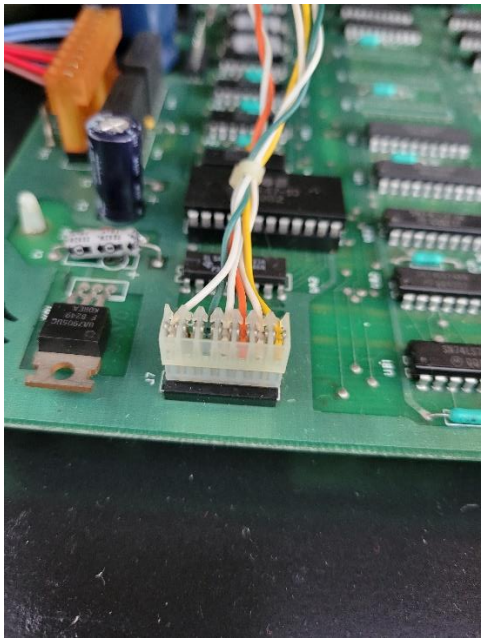
Measure the screen diagonally. It should be 12-inches. These computers (4032, 8032, SuperPET, etc.) do require changes to the PET and the PET Companion board to get *composite* output. Follow these steps.

1. Power off the Commodore PET.
2. Carefully remove the “EDIT” ROM from the main board and replace it with an EPROM that has the updated version from Steven Gray. *This EPROM is not included with this board*. If you do not have an EPROM programmer, you can find electronic parts provider that can “burn” this EPROM for you. Mr. Cray’s site has the ROM file needed. The “EDIT” ROM is located at UD7 on the Universal main board. If you are using another main board version, ensure you locate the proper ROM to remove. Part number is 901499-01. Ensure the notch on the EPROM is facing the same direction as the original EPROM. **Failure to do so may damage the EPROM.**



This “EDIT” ROM version was created by Steven Gray. See link below.
http://www.6502.org/users/sjgray/projects/editrom/index.html

3. **Disconnect the internal monitor cable**. Do not power up the internal monitor while using the PET Companion board. The “EDIT” ROM changes the frequency so that an external monitor can be used. ***** You cannot use both the internal and external monitors at the same time when using composite video output, however this change is not needed when connecting video via RGB2HDMI adapter. *****



4. Change the external video Jumper to **INVERSE** as the video signal is inverted and needs to be switched.
5. Connect the PET Companion board to the User Port located at the back of the computer. This port is located basically between two other ports (IEEE port and TAPE port).
6. Connect the tape adapter board the TAPE port. This is the smallest of ports on the back of the PET computer. Ensure it is facing correctly and not put in upside down.

7. Connect an RCA cable to the video (Composite Output) connector.
8. Connect the other end of the video RCA cable into your monitor. Ensure you connect to the monitor's video input only.
9. Connect an RCA cable to the audio (Audio Output) connector on the board. Ensure you connect to audio input of your monitor, VCR, or other audio devices.
10. Power on the external monitor and audio device
11. Power on the Commodore PET computer. You should now see video on the external monitor only. External audio will only be heard if you are playing a game with sound or a program that uses sound. Recommend trying Space Invader to determine if sound output is working. No video is produced on the PET's internal monitor as it was disconnected. If you are seeing video on the internal monitor, *immediately turn off the compute*r and follow step 3 in this section. Leaving the internal monitor connect, damages may occur.

*Initial tests were performed on a Commodore PET 4032 and other 12-inch PET series computer should work without issue. This includes any other PETs that use the "Universal" main board like the Commodore 8032 and SuperPET computer. Testing will continue and this documentation will be updated as needed.

** Commodore PET computer repairs are beyond the scope of this documentation. This documentation is only provided for the PET Companion board.

Using PET Companion for External RGB2HDMI Output

Using the RGB2HDMI video connection is the same on all Commodore PETs, regardless of monitor size. There are no changes to be made.

1. Connect the RGB2HDMI cable (not included) to the PET Companion board. This will be the DB9 port.
2. Ensure external video jumper is set to **NORMAL**
3. Connect PET Companion board to the **User Port** of the PET.
4. Connect the HDMI cable from RGB2HDMI unit (not included) to the external monitor or TV.
5. Power up the Commodore PET.
6. Ensure pinouts of cables match the RGB2HDMI adapter documentation.

PET Companion Board Troubleshooting

Issue: Nothing is working

Fix: Power off you Commodore PET immediately!! Check connections:

1. Ensure that the PET Companion board is connect to the User port and not IEEE port.
2. Ensure that the PET Companion board is connect with the IC and components facing upwards.
3. Ensure PET Companion smaller board, which is the TAPE adapter is facing the proper way. If not, no +5VDC is present which is required for the board to work.
4. Ensure all ICs are fully pressed down into each socket.
5. If still not working, see section “Issue: No video”.

Issue: Video is inverted. Seeing black letters on white background

Fix: Power off the computer, disconnect the PET Companion board and set the jumper setting for the external video to **Normal** for the PET that has a 9-inch internal monitor and **Inverse** for a PET that has a 12-inch internal monitor. Next, plug the PET Companion board back into the PET’s User port and tape adapter, and power on. *DO NOT make this change with power on.*

Issue: No video

Fix:

1. Ensure that you have followed the steps mentioned earlier in this documentation. Depending if the Commodore PET internal monitor size, the setup will be very different. Ensure you are using the correct one.
2. Ensure monitor is powered on.
3. Adjust the brightness and\or contrast of your monitor.
4. Check to ensure your composite cable good. At times they can go bad without doing anything to them. Verify that the cable is working.
5. Test and replace diode with 1N4007 closet to the Composite Output connection. *Ensure the band on the diode face the same way as indicated on the board. Failure to do so will result in no video.*
6. Test and replace capacitor with 2200pF.
7. Test and replace 10K potentiometer. The 10K potentiometer should read 2.8K Ohms
8. Test and replace ICs 4011 and\or 4066.

Issue: Picture is not clear, scrambled, or off screen

Fix:

1. Adjust 10K potentiometer to fine tune the picture.

2. Adjust the settings on your monitor. This includes Horizontal and\or Vertical position

3. If using the RGB2HDMI connection, check the settings in the RGB2HDMI board (not included). See their documentation on settings as this is not covered in this manual.

Issue: No audio out

Fix:

1. Ensure you have followed step about and are getting correct image. If not please read and correct.
2. Ensure that the 1 trace has been removed and the jumper wire is placed. See section called **“Notes and Correction”**

PET Companion KIT Assembly Guide

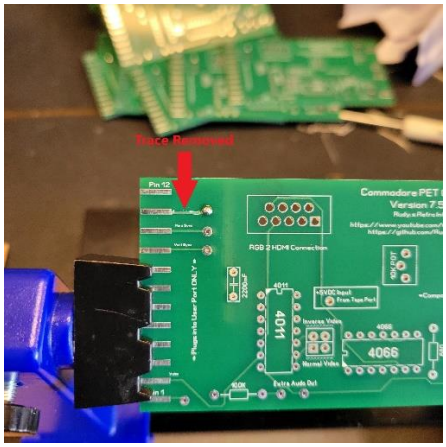
To assemble the PET Companion kit, you will need the following tools.

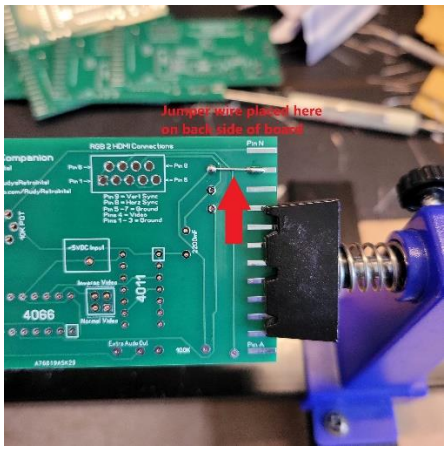
- Soldering iron
- Solder – with lead works best
- Flux – If your solder doesn't have already inside
- Solder wick
- Small flat head screw driver
- Multimeter
- Ethyl Alcohol (rubbing alcohol) 90% or higher
- Well-lit area

Notes and Correction

Here are some small changes to the PET Companion board. Please read.

1. Capacitor marking is incorrect. The value marked is 2200mF, however the correct value 2200pF
2. The 1N4007 diode location and orientation is correct, however the holes are a bit to close to each other, therefore when installing, the diode will sit higher on the board and will not be flush. This causes no issues with operations.
3. Due to an incorrect location of a trace, 1 trace is removed and a jumper is placed on opposite side of the board. *These changes have already been made, if you have purchased the boards at the World of Commodore*. If you don't see them, then you will have to make these changes or the audio will not work.





These are the recommended order for component installation.

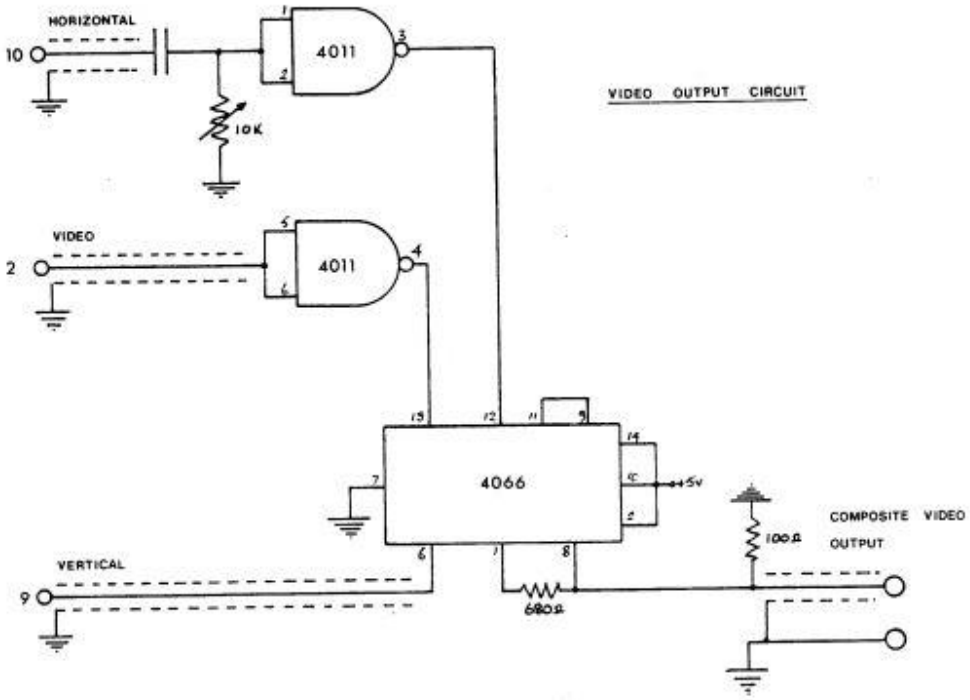
1. Clean both sides of the board with Ethyl Alcohol 90% or higher. Wipe and clean all areas of the board for best results when soldering.
2. ***Check to see which side of the board the components need to be install on.*** The correct side has a picture of all the components on it. The back side, where no components are to be installed, has the pin out labeling for the RGB2HDMI connector. This step is critical as installing components in back side of the board will not work.
3. Install and solder the all resisters. (100k x 2, 680k and 3.3k).
4. Install and solder the diode (1N4007). Ensure the band on the diode face the same way as indicated on the board. Failure to do so will result in no video.
5. Install and solder the capacitor (2200pF) which is non-polar.
6. Install and solder the jumper blocks (2 x 2 pin headers). This is labeled Normal and Inverse video.
7. Install and solder the sockets (2x 14 pin sockets). Note the marking on the board for PIN 1.
8. Install and solder the potentiometer (10k POT).
9. Install and solder the Composite Out and Audio Out RCA jacks (RCA jacks).
10. Install and solder the DB9 male connector – RGB2HDMI port.
11. Install and solder the 2x24 pin female edge connector (User Port). Ensure the connector is on straight. Pre bending the leads in a hard surface will help keep the connector straight when soldering.
12. Install and solder the 2x6 pin female edge connector (Tape Port). Ensure the connector is on straight.
13. Place the jumper onto the 2 pins where the header is located. Place the jumper to “Normal Video” which the 2 lower pins beside each other. *Failure to place this jumper will result in no video.*
14. Install and solder a wire that goes into the small board for the tape port (5VDC Input). This should be stranded wire 24-26 AWG. Length should be 5-6 inches or 12-15cm.
15. Install and solder the wire from step 11 to the main board (5VDC).
16. With your screw driver and multimeter, adjust the 10k POT to read 2.8k ohms. This is the best place to start. Once PET is powered up, you can adjust for best picture.
17. Insert the 4011 and 4066 ICs into the sockets. Note the direction and PIN 1 of each IC and the socket.
18. Connect the board to the PET User Port and to the Tape Port.
19. Connect cables to composite out and to audio out
20. Connect cable to RGB2HDMI, if you have this unit. Not include\sold with this unit.
21. Power on external monitor and audio devices
22. Power on Commodore PET
23. Once install testing are complete, go over the board with Ethyl Alcohol 90% or higher and wipe and clean all areas.
24. Enjoy

PET Companion Technical Information and Schematics

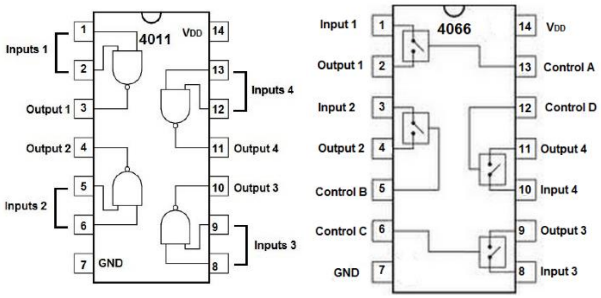
In this section, schematics that were used for this board are shown. I have not created a new schematic that shows the completed board as a whole, however I do list the changes made.

Original schematic created by Nick Hampshire and can be found in the book called “The PET Revealed” from 1979. Below is a screen shot. **https://petlibrary.tripod.com/COMPVID.HTM**

The missing value of the capacitor that comes from PIN 10 is 2200pF. The addition of the 1N4007 diode provides reverse signal protection and 3.3K resistor is used to for better external composite video.



Below are the pinouts for the CD4011BE and CD4066BE ICs

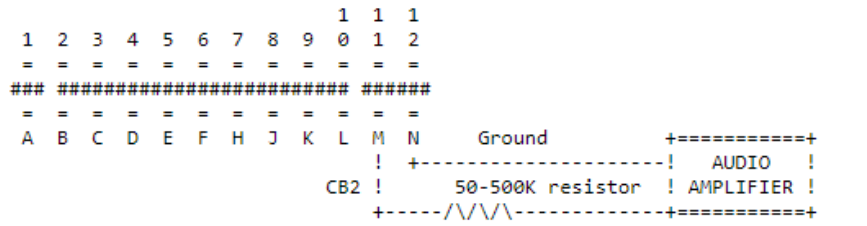


Audio schematic screen shot from **http://www.zimmers.net/cbmpics/cbm/PETx/petfaq.html**

The latest 4000/8000 (large screen PET) motherboards have a built-in piezo speaker and also have a bell sound accessible with a print: chr$(7)

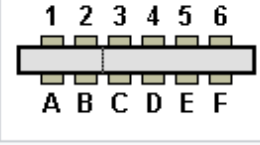
Sound Interface Diagram (use mono-spaced font to view properly)

Parallel Port:



You can get most of the parts (except the parallel port connector) at Radio Shack, including a low-cost mini amplifier. See below for a source for 12/25 edgeboard connectors.

Tape port connection pinouts. **https://www.c64-wiki.com/wiki/Cassette_Port**

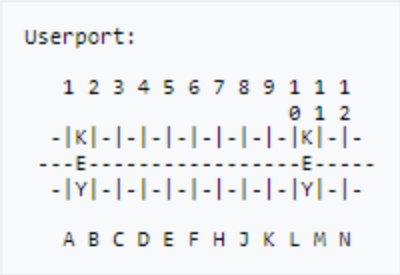


Pin Assignment

Pin	Signal	Remark
A-1	GND	Ground
B-2	+ 5V	5 Volt DC
C-3	MOTOR	Motor Control, approx. 6 Volt power supply of the motor
D-4	READ	Data Input, read data from datasette
E-5	WRITE	Data Output, write data to datasette
F-6	SENSE	Detection, if one of the keys PLAY, RECORD, F.FWD or REW is pressed

Hint: The power supply of the motor is generated out of the 9V AC and will be switched on and off by a transistor stage.

Listing of all connections on the PET's User Port as per 6502.org website. Below is a screen shot. **j2.gif (566×815) (6502.org)**



Contact	Signal	Description
1	GND	Digital ground
2	VIDEO	Video output for external screens.
3	IEEE-SRQ	Connection for testing the SRQ (Service Request).
4	IEEE-EOI	Connection for testing the EOI (End Of Identity).
5	/DIAG	If pulled low at power on, jumps to the diagnostic test routine.
6	#1 READ	Used by the test routine for checking the read function of recorder #1.
7	WRITE	Used by the test routine for checking the write function for both recorders.
8	#2 READ	Used by the test routine for checking the read function of recorder #2.
9	HORZ.	Horizontal synchronization signal. Is checked by the test routine.
10	VERT.	Vertical synchronization signal (60 Hz). Is checked by the test routine.
11	GND	Digital ground
12	GND	Digital ground
A	GND	Digital ground
B	CA1	Edge triggered connection of 6522 VIA #1 (position A5).
C	PA0	PA0..PA7 can be programmed individually for input or output.
D	PA1	
E	PA2	
F	PA3	
H	PA4	
J	PA5	
K	PA6	
L	PA7	
M	CB2	Connection CB2 of 6522 VIA #1.
N	GND	Digital ground

RGB2HDMI Connector and Cable Information

Used a network LAN cable which has the wires that are twisted in pairs inside the cable. Below is the cabling for the connector DB9 connector.

DB9 Male Connector which: *Connects to the PET Companion Board*

Video = Pin 4	- Colour I used Green
Vertical Sync = Pin 9	- Colour I used Blue
Horizontal Sync = Pin 8	- Colour I used Orange
Ground = Pin 1- 3, 5 - 7	- Colour I used: All white wires with a stripe on them and Brown

DB9 Male Connector which: *Connects to the RGB2HDMI board*

Video = Pin 4	- Colour I used Green
Vertical Sync = Pin 9	- Colour I used Blue
Horizontal Sync = Pin 8	- Colour I used Orange
Ground = Pin 1	- Colour I used: All white wires with a stripe on them
GND	- Colour I used: Brown

More details will be found with the documentation provided by your RGB2HDMI adapter board.