Atari 400/800 Super Color CPU Card

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Introduction

Hi,

Thank you for your purchase of a Super Colour CPU Card! I hope you enjoy this piece of hardware for our beloved Atari 8-bit computer systems.

The Super Colour CPU Card (shortened to SCCC) is a replacement for the genuine, made-by-Atari CPU card found in all Atari 400 or Atari 800 computers. The advantages over the original card are:

- The SCCC can handle both PAL and NTSC with a single PCB
- The SCCC can handle both common types of CPU. You can use the genuine 6502B (2 MHz version of the classic 6502 MOS CPU) or the Atari-specialized version called "Sally" (6502C)
- You get the BEST picture quality without using GTIA or ANTIC FPGA emulation actually existing on this planet ☺

Please read the whole manual completely at least once, even if you´re a professional. The installation of the SCCC is very easy and only three wires must be soldered. These wires are needed for a sound breakout together with your new superb, UAV enhanced picture.

The SCCC works fine in any Atari 400 or Atari 800 computer using PAL or NTSC. Because the RF modulator isn´t used anymore, there´s no difference if PAL-I, PAL-B/G or any other subversion is used.

Attention: Don´t use a FGTIA (special version of GTIA for SECAM television system)! This special version has a different pinout and can´t used with the SCCC! Do NOT try it!

Please check the parts included in the kit:

- The SCCC plug-in card itself (not populated with ANTIC, GTIA or CPU)
- One video (and audio, too) cable with DIN 5 pin coupling for breakout (external)
- One internal audio cable with 3 pin Dupont connector

All installation instructions are the same for PAL or NTSC systems unless otherwise noted.

Starting

It may sound silly, but before you attempt installation, test the functionality of the Atari 400 or Atari 800 first. Connect your Atari 400 / Atari 800 to a television or monitor, plug in the power supply and turn it on.

- Does it produce a picture?
- Does "ATARI MEMO PAD" appear on the screen (if no cartridge is inserted)?
- Do the background and foreground colours change after approx 9 minutes of operation?

When **all** these simple tests are passed, go ahead. Otherwise please do troubleshooting first. The existing, genuine Atari CPU card itself is hardly ever the source of trouble, unlike the chips plugged into it (ANTIC, GTIA or CPU).

Now open your computer. If you don´t know how to open your Atari 400 or Atari 800 computer, refer to the Atari Field Service Manuals found at AtariMania and other sources on the web – just ask aunt Google ☺

Very short how-to:

- Remove plastic body housing (two shell parts) of the computer
- Unscrew all screws
- Remove power PCB (side PCB)
- Remove upper part of the metal cage
- Remove keyboard to prevent the thin cable from breaking (Atari 400)

You must not remove the metal ground plate. The three wires to solder will be soldered at the top (component) side of the mainboard. No access to the solder (bottom) side of the mainboard is needed.

If your computer is an Atari 800, you don´t need to remove the plastic enclosure for the RAM cards and the personality board.

Installing the SCCC

The CPU card is located at the rear of the mainboard. Remember the way the card is plugged in! All components on the CPU card face away from the computer´s centre. The connector for the CPU card doesn't have any protection against wrong insertion, so be careful.

Unplug the genuine Atari CPU card and remove the three 40 pin chips. You will find all possible part numbers written on the SCCC PCB, so that you don´t need to write down which chip goes in which socket. By the way, there are four (known… maybe more) versions of the genuine CPU card made by Atari with different positions and orientations of ANTIC, GTIA and CPU, so looking at the chips themselves is the one and only safe way to identify them.

These three chips must be plugged into the empty sockets of the SCCC. The SCCC uses high quality, machine-head precision sockets. Please be sure that all pins of the three major Atari custom chips are straight and not bent in any way.

On the SCCC sockets you will find a notch – this indicates where pin 1 of each chip has to point to. The Atari custom chips also have such a notch or a single dot at one corner of the chip. This dot points to pin 1.

Attention! Some versions of ANTIC or GTIA have their markings upside down! So only use the notch or dot as orientation for pin 1, not the letters / characters on the chip!

On the next page you will find the different part numbers to identify each custom chip safely.

Identifying the Atari custom chips

Here is a complete (I hope so…) list of known part numbers and how to use them to identify the three custom chips in your Atari 400 or Atari 800 computer:

CPU:

"6502B" (no Atari part number) or "CO14377"   ➔ The original MOS one, 6502B setting for SCCC
"CO14806" or "UM6502I"   ➔ This is the "Sally" CPU, 6502C setting for SCCC

A wrong CPU setting can´t damage anything. The computer will just not start if the CPU setting is wrong. In case of doubt (maybe there are CPUs with different markings in the wild) try both settings. Nothing can go "kaputt" ☺

ANTIC:

"CO14887"   ➔ ANTIC (PAL), most common version in PAL Atari 400/800
"CO12296"   ➔ ANTIC (NTSC), most common version in NTSC Atari 400/800

"CO21698"   ➔ ANTIC "E" (PAL), normally only found in XL/XE systems, but works also fine
"CO21697"   ➔ ANTIC "E" (NTSC), normally only found in XL/XE systems, but works also fine

GTIA (or CTIA):

"CO14889"   ➔ GTIA for PAL systems (all Atari 8-Bit computers)
"CO14805"   ➔ GTIA for NTSC systems (all Atari 8-Bit computers)
"CO12295"   ➔ CTIA (only NTSC), the ancestor of today´s GTIA

With these lists you should be able to easily identify the custom chips. Install the GTIA (or CTIA) in the leftmost socket (beside the colour pot), the ANTIC in the middle socket and the CPU in the right socket.

Setup of the SCCC

Before you insert the SCCC in the CPU card slot you need to set up the jumper found on the SCCC. At the lower left side you find a single jumper with three pins. Look at the marking of the PCB: one position is for PAL custom chips, the other for NTSC. Set this jumper to the correct position depending on the system you use.

At the right side of the SCCC PCB you will find five jumpers. All these five jumpers must be completely set to the position 1-2 or 2-3 depending on the type of CPU you´ve inserted.

Please also look at the markings below these five jumpers. There are different batches of SCCC PCBs where I changed the meaning of pins here, so you´ll need to look at the SCCC itself to see how to set the jumpers for your CPU.

The last jumper is marked with "C.INV" which means "Colour Inversion". By default this jumper is open. When you close it, the colour signal coming from the GTIA is logically inverted. See last page of this manual for more information.

By default, the SCCC is set to work with NTSC and the 6502B CPU installed.

The last steps are to connect the cables to the SCCC…

Installing the cables

To make the whole thing work, the two cables which come with your SCCC must be installed. The black cable is for the internal audio (sound) connection. It remains completely under/within the metal cage and doesn´t need a breakout anywhere.

The grey cable with the DIN 5 pin coupling at one end is for the new high quality video and audio output. You don´t need to drill any holes: just use the hole for the colour pot on the genuine Atari CPU cards. It´s located at the metal cage´s rear, upper right edge. You can use any typical Atari XL/XE video cable (CVBS or S-Video type) to connect your SCCC to the monitor or television.

But the first step is a two-minute solder job. ☺

First make connection ready for the audio cable. This step is dependent on the computer model (Atari 400 or Atari 800). Please follow the steps for the system you have.
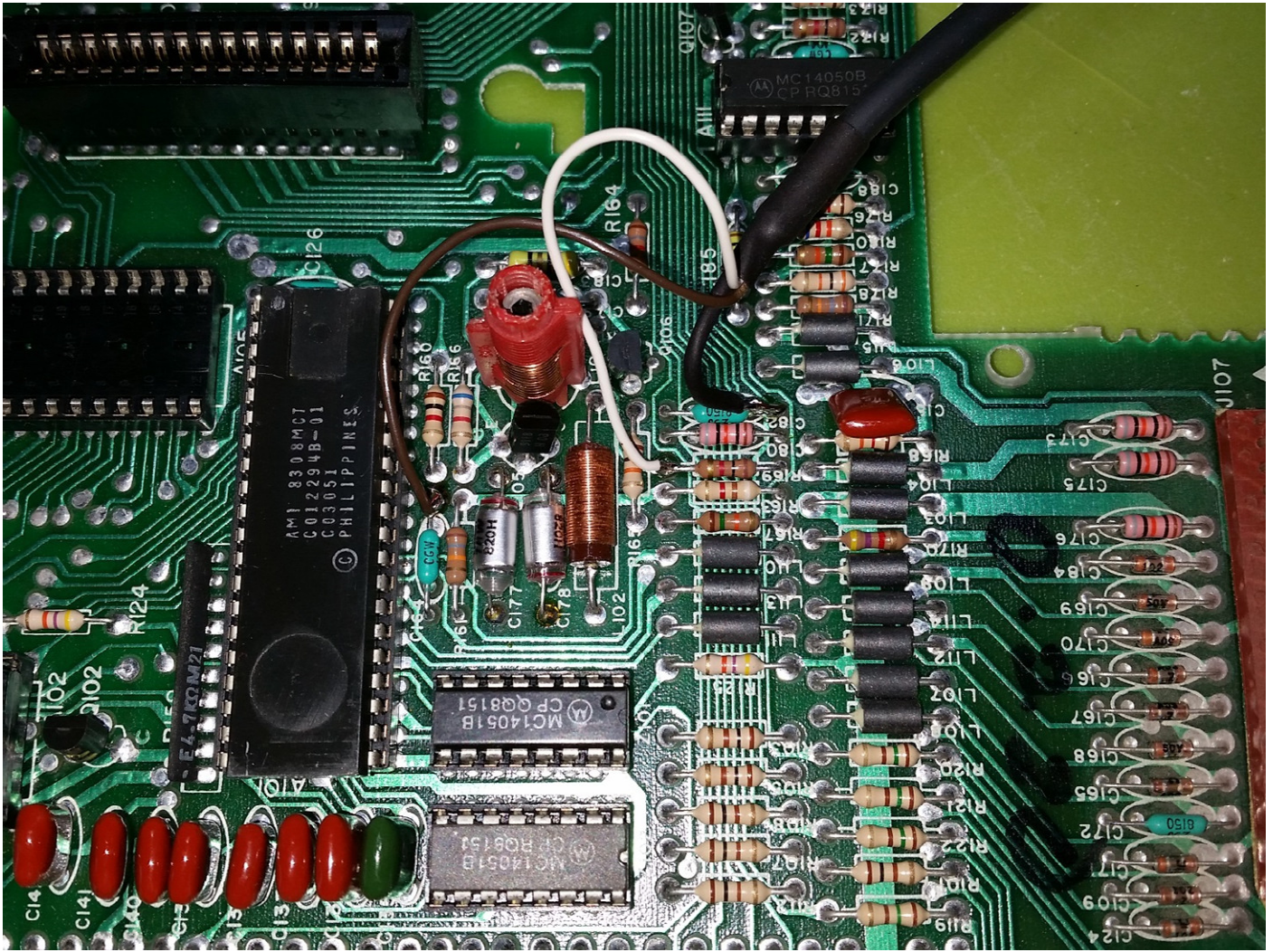
Installing the audio cable at the Atari 400 mainboard

Overview of the Atari 400 mainboard:

(There´s one chip missing, normally there´s no empty socket!)

Atari 400 mainboard solder points for internal audio cable:

How to connect the three wires:

White wire   ➔ Left side of R169
Brown wire   ➔ Top side of C164 (in junction with lower side of R160)
Black wire   ➔ Right side of C182 (Ground)

The "black wire" is the ground connection / shielding wrapped with heat shrinkable tubing.

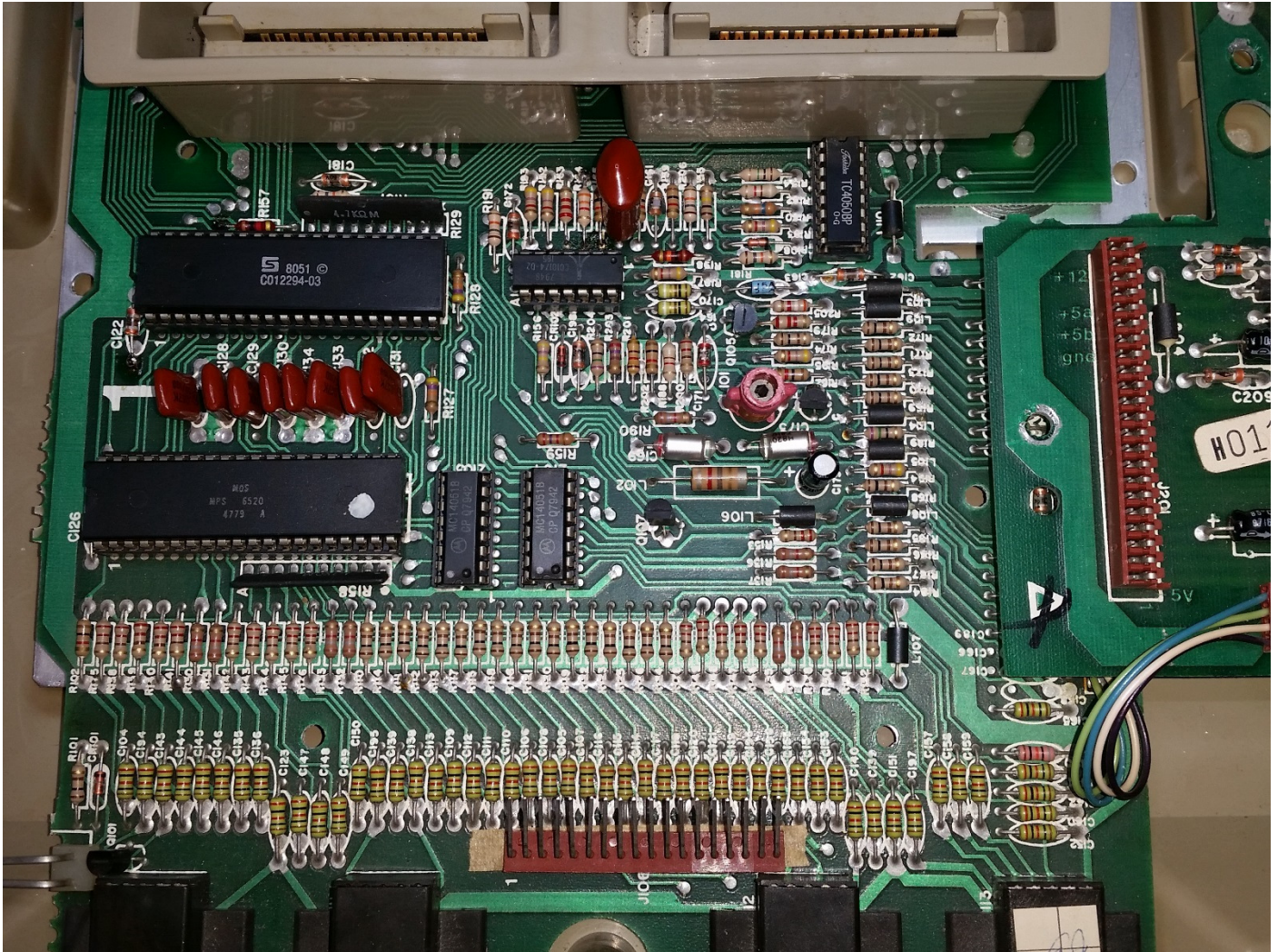**Attention:**

If you don´t want to use the audio connection, please solder all three wires together and use some duct tape to prevent short-circuits. Leaving the three pin Dupont connector at the SCCC unconnected can damage the audio amplifier chip on the SCCC!

That´s all for audio cable installation at the Atari 400 mainboard. Go ahead with "Installing the video cable".

Installing the audio cable at the Atari 800 mainboard

Overview of the Atari 800 mainboard:

Go ahead with the next page.

Atari 800 mainboard solder points for internal audio cable:

How to connect the three wires:

Brown wire	➜ Lower side of R193
White AND black wire	➜ Together at the lower side of C198 (Ground)

The "black wire" is the ground connection / shielding wrapped with heat shrinkable tubing.

Attention:

If you don´t want to use the audio connection, please solder all three wires together and use some duct tape to prevent short circuits. Leaving the three pin Dupont connector at the SCCC unconnected can damage the audio amplifier chip on the SCCC!

That´s all for audio cable installation at the Atari 800 mainboard. Go ahead with the next page.

Installing the video cable

This is the final installation part of the SCCC. Take the pre-configured video cable and put the loose wire ends through the colour pot hole in the metal cage (upper part). Don´t re-assemble the metal cage at this time!
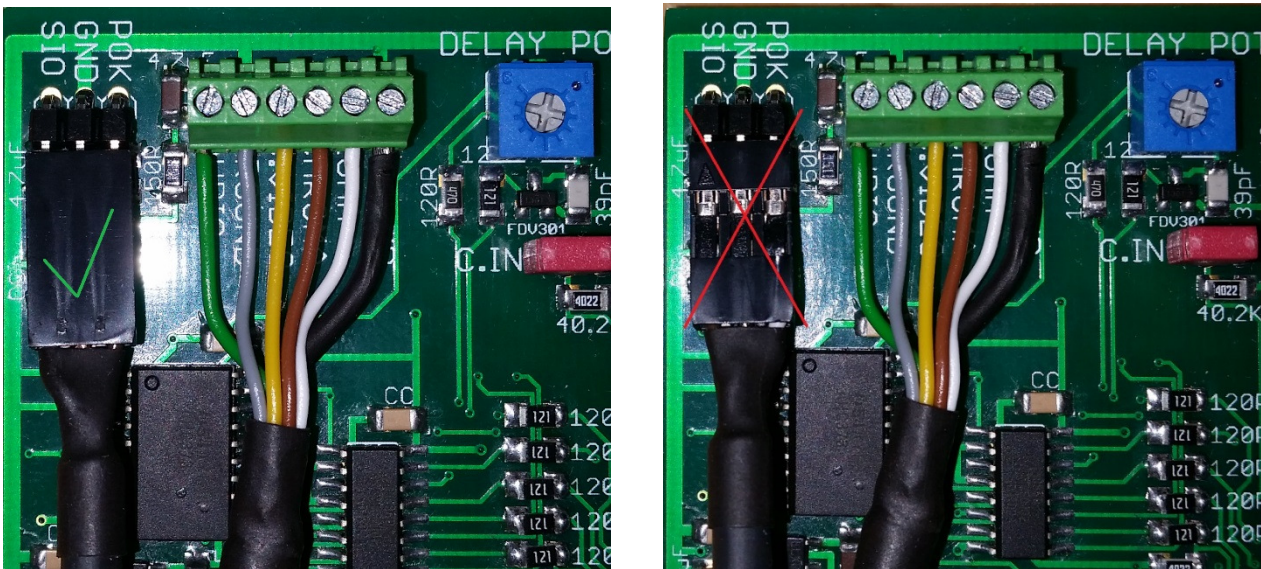
Use a small fine screwdriver and mount the six wires to the green terminal block. Use the following order from the left to the right:

GREEN, GREY, YELLOW, BROWN, WHITE, BLACK

The "black wire" is the ground connection / shielding wrapped with heat shrinkable tubing.

Attention: **Please use the right size of screwdriver for the terminal screws! Using a too big screwdriver may destroy the terminal block!**

Now plug in the Dupont connector from the internal audio cable. The side with the flat, clean surface must be on top. Look at the pictures:
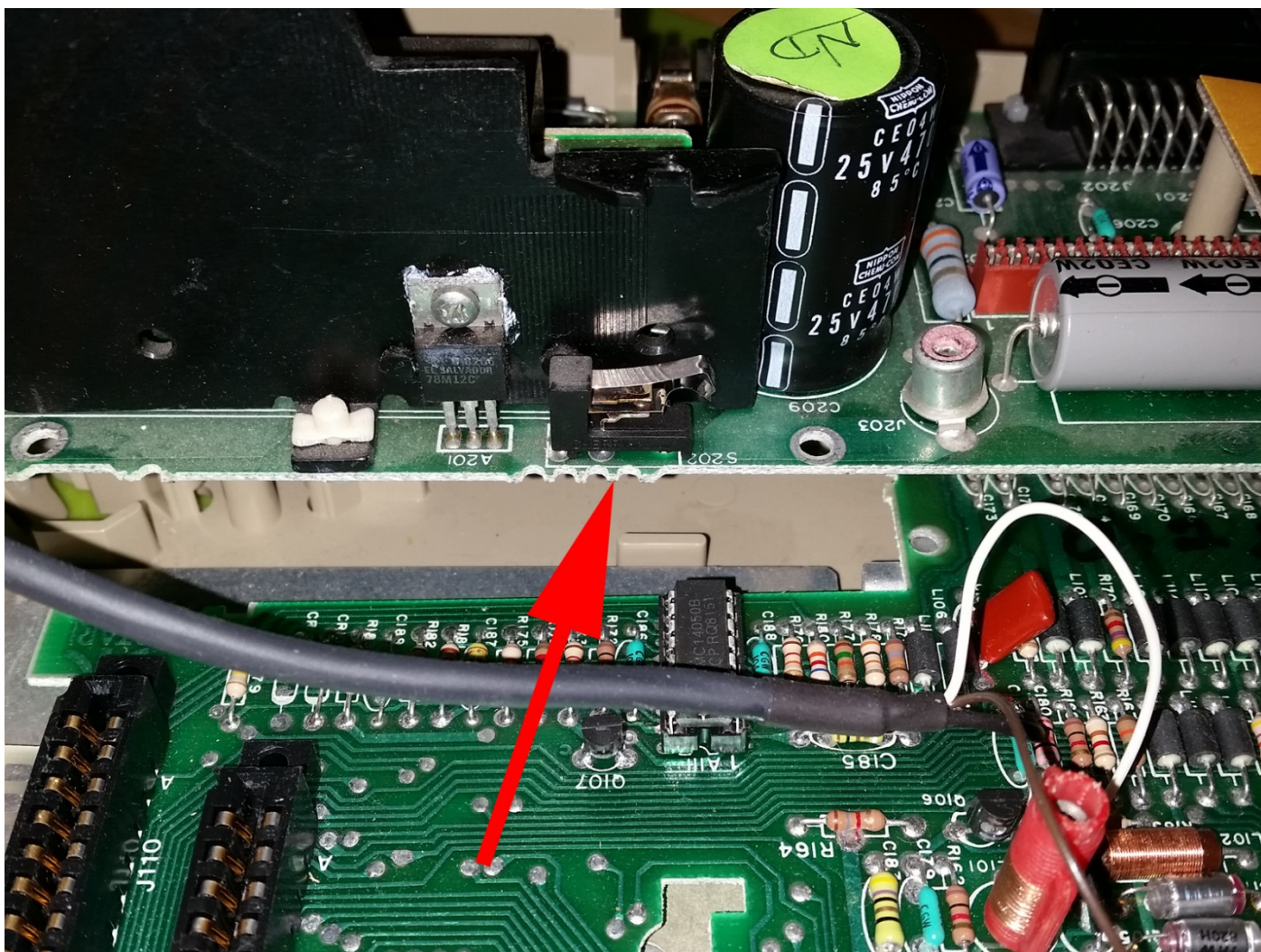

At last, insert the SCCC in the CPU card slot. The major three chips, the colour pot etc. must point to the rear of the Atari 400 / 800 mainboard.

Attention: Wrong insertion may kill all components on the SCCC!

First you should perform a run test before you install the metal cage again. Second, you need to adjust the colour pot and maybe the Delay Pot for an optimal picture on your monitor or television.

Re-assemble the power board of your computer and start the system. You have to manually press the contact switch down and hold it (see picture on next page). You can use a wooden peg or something similar – but nothing made of metal! This switch is loaded with 9 volts AC, and any connection to the mainboard will kill your Atari!

This switch must be manually pressed (and held) down to power on the computer (400 and 800).

If you have installed everything correctly, the standard blue screen with "ATARI MEMO PAD" should appear. If the background colour isn´t blue or the whole screen only black and white, then you need to make sure settings are correct (PAL or NTSC) and adjust the colour pot.

Take a small screwdriver and turn the colour pot counter-clockwise. On some televisions or monitors, the whole screen may disappear for a few seconds. Wait until the screen comes back and continue to turn the colour pot if necessary. If you reached one end of the pot and colour is not OK, then turn in other direction slowly until the colour looks right.

If your TV or monitor support it, switch off automatic tv system detection and set it manually to PAL or NTSC – this will make the correct setting of the colour pot much easier!

The colour pot setting is not dependant on the power supply you used, but different monitors and televisions may produce different colour effects. The colour pot at the SCCC is not adjustable when the computer is fully assembled, so set the colour pot to the best result with the most used monitor or TV.

In some cases, there are colour differences between CVBS (Composite Video) or S-Video (Y/C) output. The SCCC supports both output types, of course. You´ll have to decide which output format you use more often.

Hints

- Artifacting effects (for example B/W hi-res graphics which appear coloured) works only with CVBS! Some games, especially with NTSC, use this feature. Using S-Video might result in an ugly, unexpected result – even if the *quality* is much better. ☺

- If you change the GTIA chip, regardless of whether it's NTSC to PAL, PAL to NTSC, NTSC to NTSC, or PAL to PAL, you will need to adjust the colour pot again.

- The effect of adjusting the Delay Pot is less visible using PAL than when using NTSC.

Last words

Each SCCC is fully tested with a PAL and a NTSC system. In addition, both types of CPU (6502B and 6502C) are tested. So you get a fully working and tested device. If anything strange occurs, please first check all components, cables and so on. Read the manual again or, when in doubt, contact me.

Technical and some non-relevant information for the snoopy people

The SCCC is (partly of course) a 1:1 reproduction of the genuine Atari CPU card. It was my intention to use the original 74 series TTL chips to gain 100% compatibility without any side effects. Just a few changes are done to enable the usage of both CPU types. The 74 series TTL chips are only needed for enabling the DMA transfer by ANTIC. The newer "Sally" CPU has a HALT input to archive that completely – without the need of a bunch of TTL chips.

The first version uses the FMS6410 video amplifier and some selected parts for the new video circuit. The picture quality was good, but had some of the typical issues like <u>any</u> video solution – except UAV. While I was waiting for the first prototype boards, my UAV came in and I was stunned at the picture quality UAV makes possible!

So I asked Bryan if I could integrate UAV into the SCCC and he gave me permission. Again, many thanks to Bryan!

A few days later the schematics came in and so the final version of the SCCC was born – including UAV revision "D".

One of the main reasons for bad picture quality in the genuine video circuit made by Atari and also most other enhanced versions (including my first solution with the FMS6410) is the unstable power supply and power paths with a lot of noise due to system bus activity. To prevent influence on the picture quality, I added a high quality, very low noise LDO (voltage regulator) to get clean 5V power for the whole video circuit. This LDO is fed by the 12V rail existing in all 400/800 computers.

If you want to know more about UAV and how it works, please read the following thread at the AtariAge forum:

http://atariage.com/forums/topic/246613-new-video-upgrade-coming-soon/#entry3388699

In this thread all technical information about UAV and the usage of the delay pot are explained by Bryan. It's also a very interesting thread about analogue video circuitry in general.

At last, I want to say "Thank you!" to all who make this project real!

Wistedt, Germany in May 2017 - Jürgen van Radecke alias tf_hh (AtariAge nickname)

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Congratulations to Bryan Edewaard for his phantastic UAV (Ultimate Atari Video) device!

Special thanks to Jonathan Halliday and Lenore Underwood for proof reading & corrections of this manual!

You will find the latest version always here:

http://www.van-radecke.de/SuperColorCPUCard/SCCC.zip

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