DIY Guide - Building Franky v1.1, the SEGA Audio and Videocard for MSX
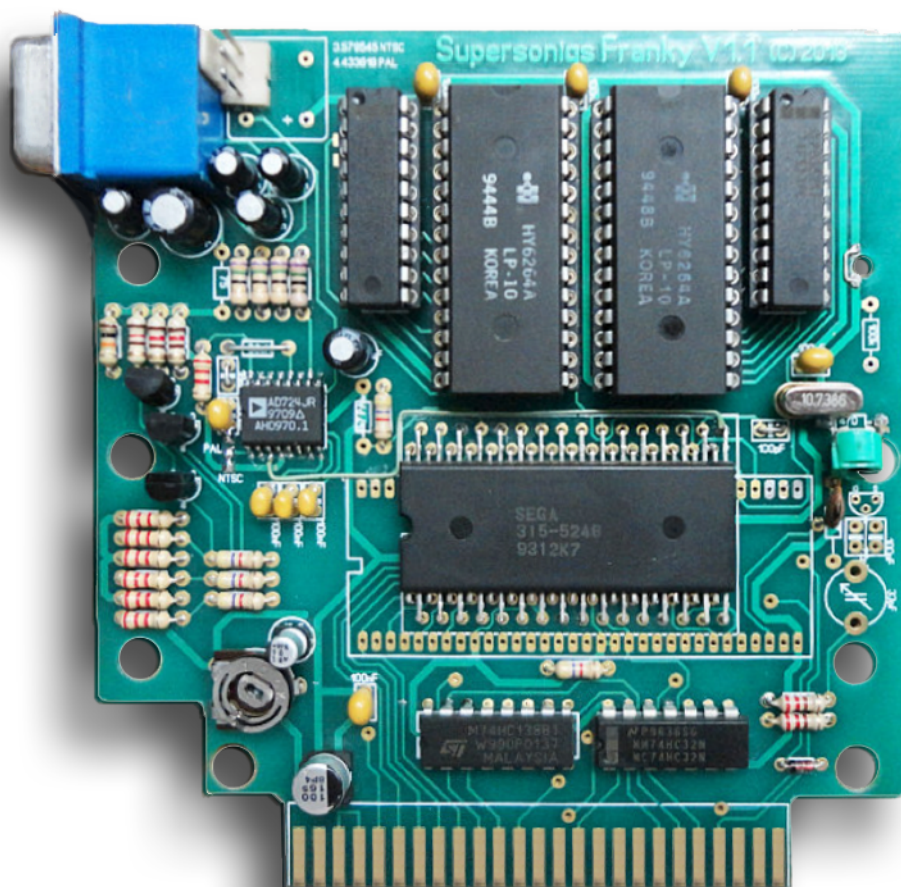
SUPERSONIQS

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Introduction

Thanks to FRS and MSXPró, there is now a DIY guide for building a Franky VDP card yourself. Not only did they document the steps needed, but they also added extra functionality to the card like using real VGA monitors (those that accept 15Khz signals), better sound and separate audio and CVBS-video connectors. Please note that these modifications are made for the 1.1 revision pcb. Some modification might not be applicable on the first version (v1.0) of the Franky pcb without deep knowledge of electronics.

Please read the instructions in this document first before purchasing components and starting any assembly.

This translation and publication is made with permission from FRS and MSXpró. The website of MSXpró can be found at http://www.msxpro.com.

Please note: although we at SuperSoniqs likes these tweaks and instructions, we do not guarantee the working of any of these modifications and we can not offer extensive support on DIY-projects.

Materials needed

Materials needed for the assembly of Franky (from scratch) with the modifications included:

Integrated circuit (when not mentioned, DIP):

1 - 74HCT32 or 74LS32
1 - 74HCT138 or 74LS32
2 - 74HC573, 74HCT573 or 74LS573
1 - 74HCT04 SMD (SOIC8 package)
2 - HY6264, or any equivalent SRAM 8KB or 2 - HY62256, or any equivalent SRAM 32KB.
Narrow SRAMs (300 mils) can also can be used. See below on the VRAM.
1 - Master System VDP. May be 315-5124 (SMS I) or 315-5246 (SMS II)
1 - AD724 (SMD version only)

Transistors:

3 - BC558

Diode:

1 - 1N4148

Resistors (all 1 / 8W):

5 - 75R
3 - 120R

7 - 2K2
5 - 4K7
1 - 10K

Capacitors:

5 - Electrolytic 10uF x 16V
2 - Electrolytic 100uF x 16V
1 - Electrolytic 220uF x 16V
1 - Ceramic 33pF
9 - Multi-Layer 100nF (or small ceramics, but multi-layered fits better)

Miscellaneous:

1 - Trimpot 100K (small phenolic)
1 - Mini Trimmer 30pf (green)
1 - DE-15 connector (VGA) female, PCI, 90
1 - Crystal 10.7386MHz HC49/S (low profile)
2 - 20-pin sockets
2 - 28-pin sockets (choose wide or narrow, according to the SRAM that is using)
2 - Golden RCA connectors arrested for nuts, one yellow and one red or white
1 - Connector assembly Molex KK 3-pin, full (pin contact and accommodation)

Thin, shielded, two-way wire for the A/V mod. Wire-wrap wire for the other connections

In our example the Franky is set to NTSC, because the PAL version generates the European PAL version (pure, 50Hz) and not the Brazilian PAL-M standard. Therefore, install the 4K7 resistor that is marked as NTSC left side of the VDP. And solder the NTSC solder bridge of the AD724.

The two electrolytic capacitors which are located in the south of the PCB should be mounted lying down, or if you want something cleaner, you can use aluminum SMD capacitors, carefully straightening their terminals, and entering into the holes on the board. With this type of capacitor, the cartridge enclosure closes perfectly.

There is a 75R resistor on the board that has no function. It's the empty marking seen on the picture, next to the 220uF capacitor and the VGA connector.
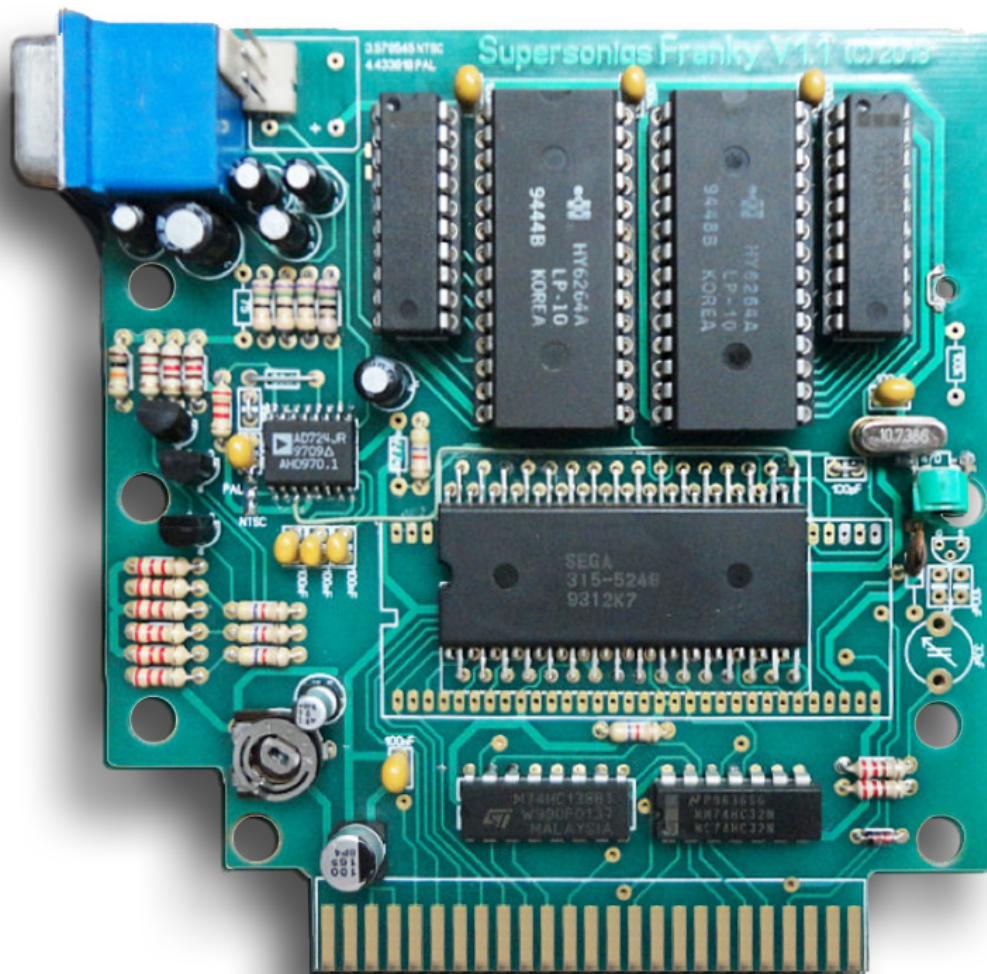
The photo above can be used as a reference for mounting. The value of all components are on the pcb itself, just follow what's printed. Some pcb's have blurred values on the text of the electrolytic capacitors. Please look below for the correct values of these capacitors:
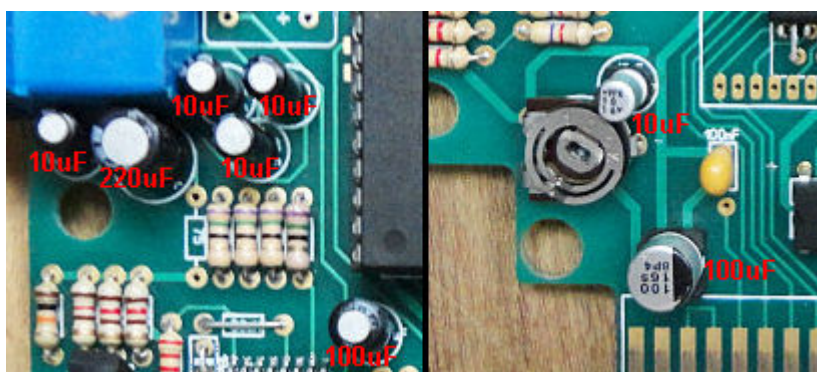

The only IC's that can be socketed are both SRAMs and their respective 74xx573 ICs. The 74HCT138 and 74HCT32 cannot be socketed, if you do this the cartridge enclosure won't close anymore.

The DE-15 connector (VGA-type connector) need to have its side "ears" cut off. But by doing this the metal shielding gets loose, so you need to reattach this to the connector with glue, preferably on the basis of cyanoacrylate (super-bonder or similar).

Solder the pads to the IC pin corresponding to the VRAM size you decide to use.

For the VRAM, you can choose to install 16KB (two 8KB SRAMs) or 64KB (two 32KB SRAMs). According to your choice of VRAM size, you must weld the corresponding pads on 74HCT573 which is next to the VGA connector. But as the SMS VDP recognizes only 16KB, we strongly recommend that you solder the pads to configure it to 16KB.
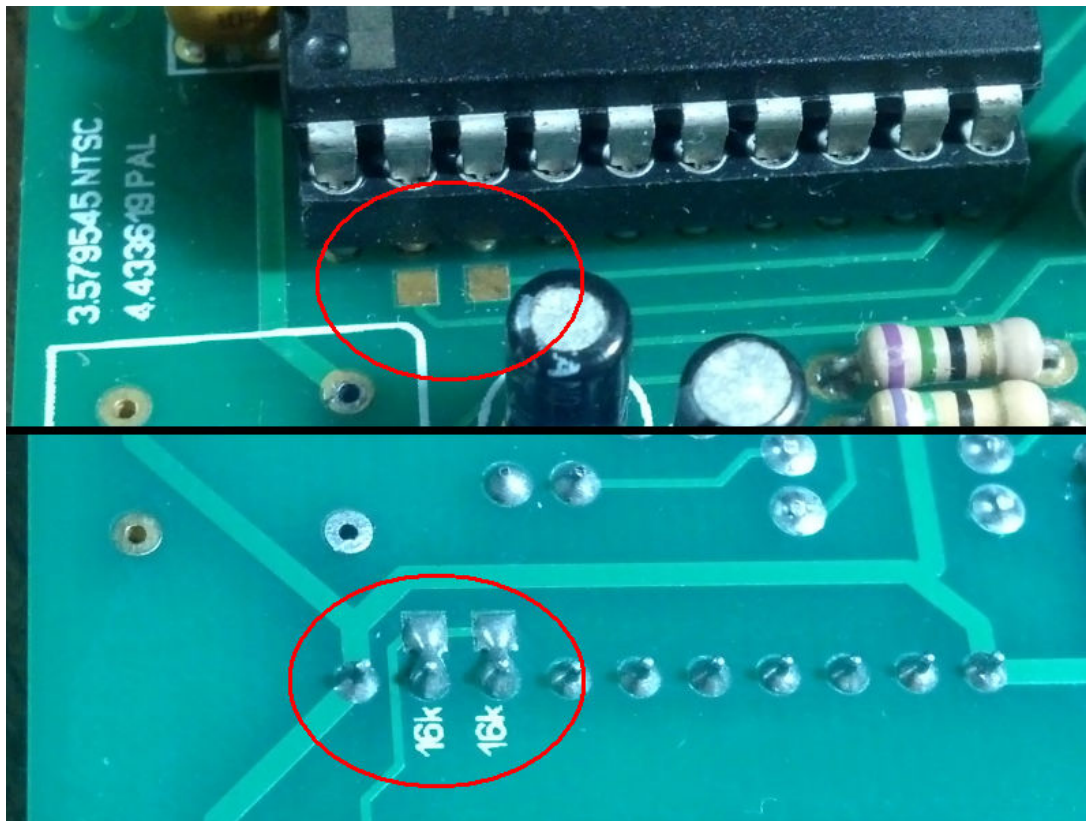
If you use the Philips NMS-1250 cartridge enclosure instead of a Sunrise Moonsound type enclosure, the Philips enclosure could then only be closed with 3 of its 4 screws. However, you'll be able to the place 4th screw by making up a extra hole in the pcb, but this hole will go through a copper trail. This can be fixed by soldering a small metal wire to go around the hole. You can see it laying next to the new drill hole at the top right in the first picture of this article.

To mark the spot of the hole to be made is simple: mount the plate in the box, and insert in the screw hole a sharp object and make a mark on the pcb. Drill the hole with a 3mm drill and place the jumper as I did (check the first photo of this document). The plastic post from the cartridge enclosure has to be cut at the same height of the plastic reinforcement that holds it the side of the box.

The following are the RECOMMENDED modifications for Franky.

Audio volume boost

Just swap the original trimpot 10K for a 100K. (Note: if you are assembling the PCB from the list at the beginning of the article, it's already listed there as a 100K trimpot)

With this mod we will have a considerable improvement in the Franky audio volume.

How does it work? The pull-up 10K to 10K trimpot forms a divider that reduces the output level at 50%, when the trimpot is adjusted to the maximum volume. Switching to the 100K reduction passes for only about 10% when the trimpot is set to maximum volume.

Clock Generator for VDP

The original design of Franky multiplies the MSX CPUCLK slot signal for the VDP of Franky. Because the SEGA VDP also has circuits for generating the clock, we will use the SEGA VDP clock for this guide, because we can build the card with less components (and thus easier to build).

Please do note that using the crystal connected directly to the VDP has the advantage of using Franky in Turbo MSX'es that alter the frequency of MSX bus CPUCLK pin. For this reason we strongly recommend that you use the crystal instead of the clock multiplier circuit. Keep in mind though that too fast Turbo's might still overrun the VDP speed.

Remove (or do not mount when building from scratch) the following components that are at the right of the VDP, marked below with colored ellipses:
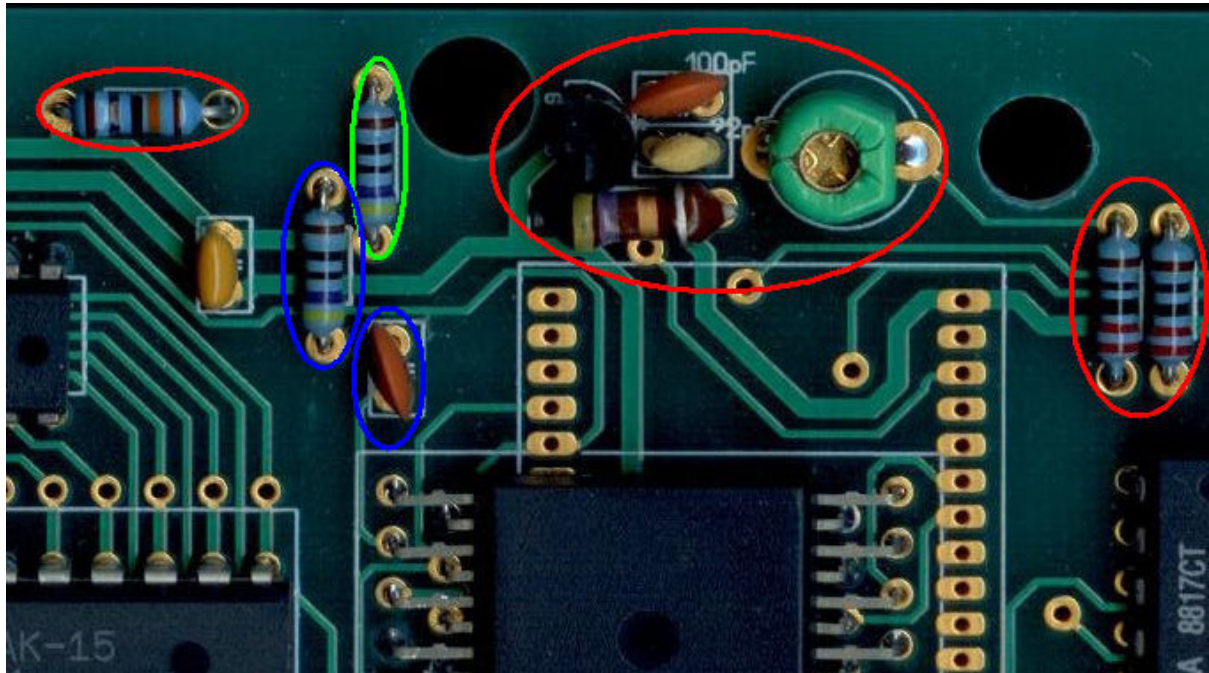
Solder a 10.7386MHz crystal HC49/S (low profile) in the place of the resistor marked with the blue ellipse.

Place a jumper in the place where the capacitor is marked with the blue ellipse.

Solder the trimmer 30pf (green) in the place of the resistor that is marked with a green ellipse. Put the flat side of the trimmer facing the jumper that was installed in place of the capacitor. The terminals of the trimmer are thicker than the holes, bend the terminals in 90 degree as you will see in the two photos below and solder it on the pads.

The left pin of the trimmer must also be soldered to the crystal metal casing, since this point is the GND of the board, also grounding the housing of the crystal and also providing better mechanical fixing.

Place one pin of a 33pF capacitor in the through-hole that is just left of the spot where's the 4,7uF inductor mark and its upper pin in the pad that was reserved for the upper inductor pin.
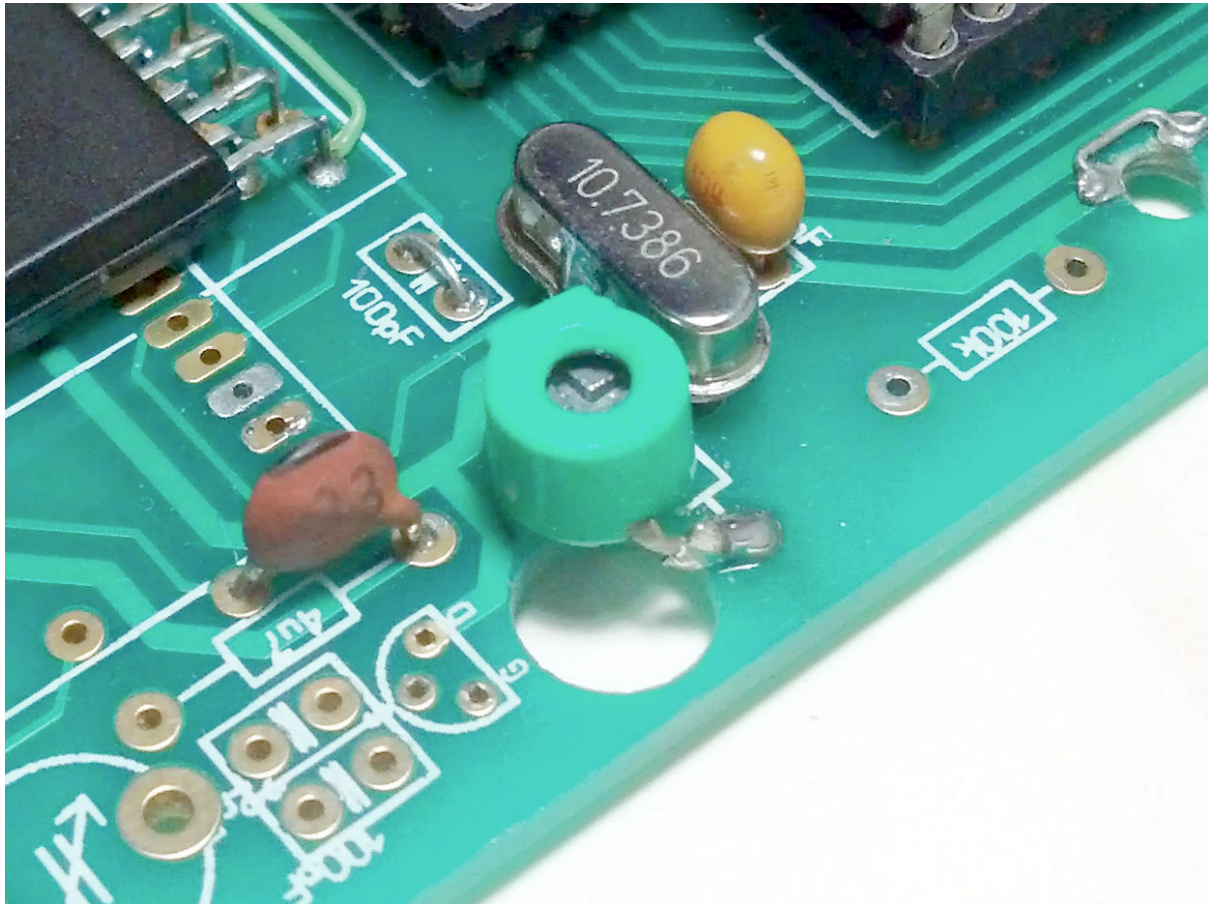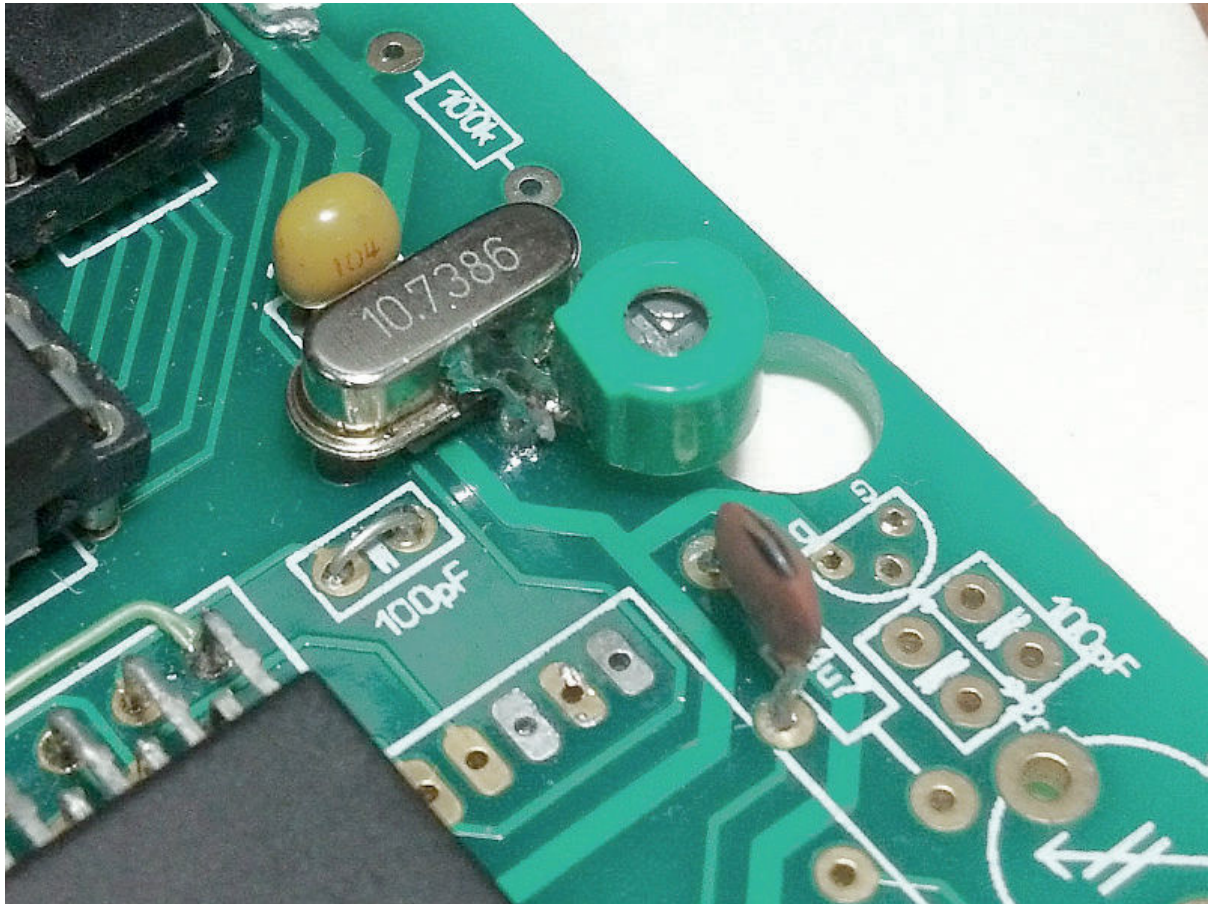
At the bottom of the face plate, add a wire connecting the pin-36 of the SMS-II VDP to the point indicated in the photo below.
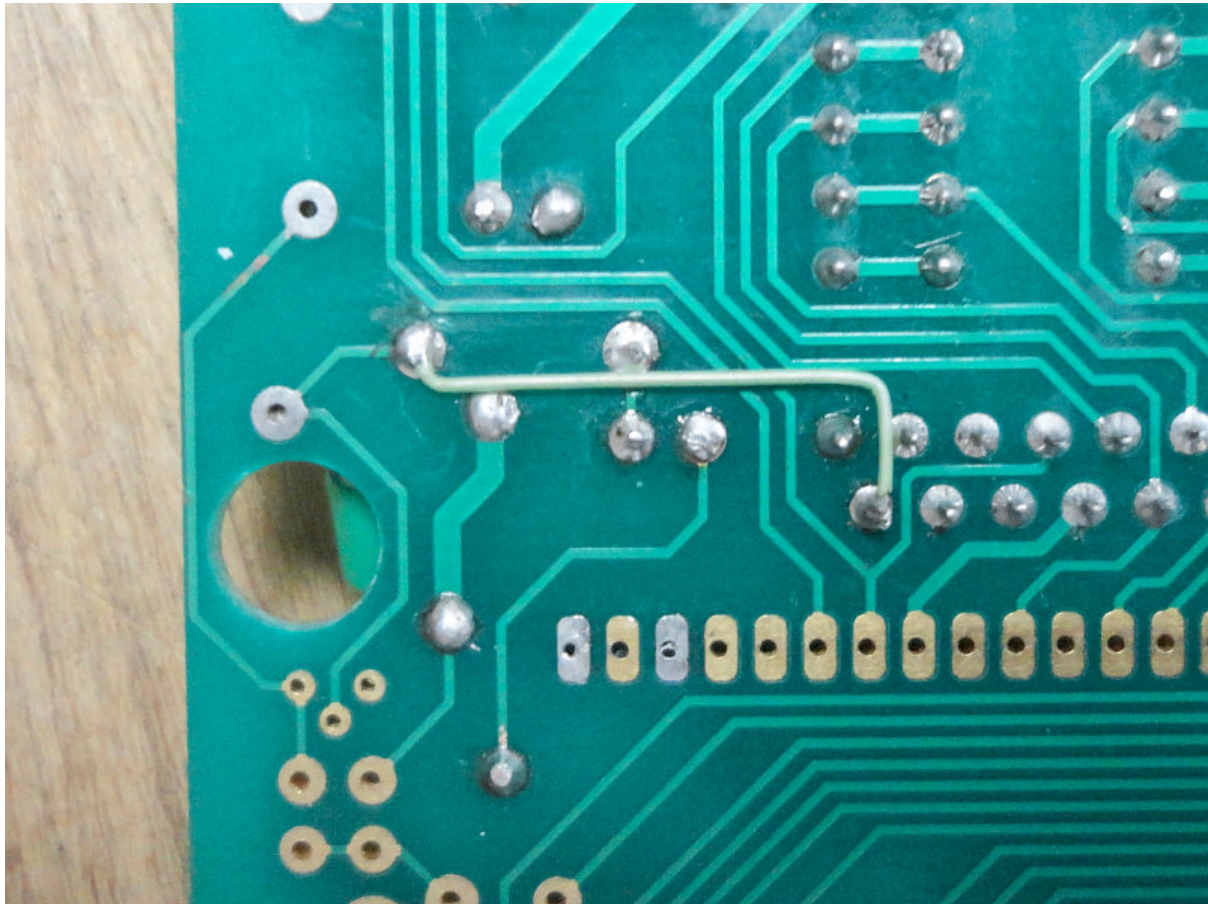
This way the VDP will now work with the crystal oscillator. Adjust the trimmer for correct color reproduction, using the CVBS output of Franky to check the results.

Optional: You can disconnect the CPUCLK signal 74HCT32 MSX bus. To do this, cut the track shown in the picture below (upper side of the PCB) and solder the indicated jumper (at the bottom side of the PCB).
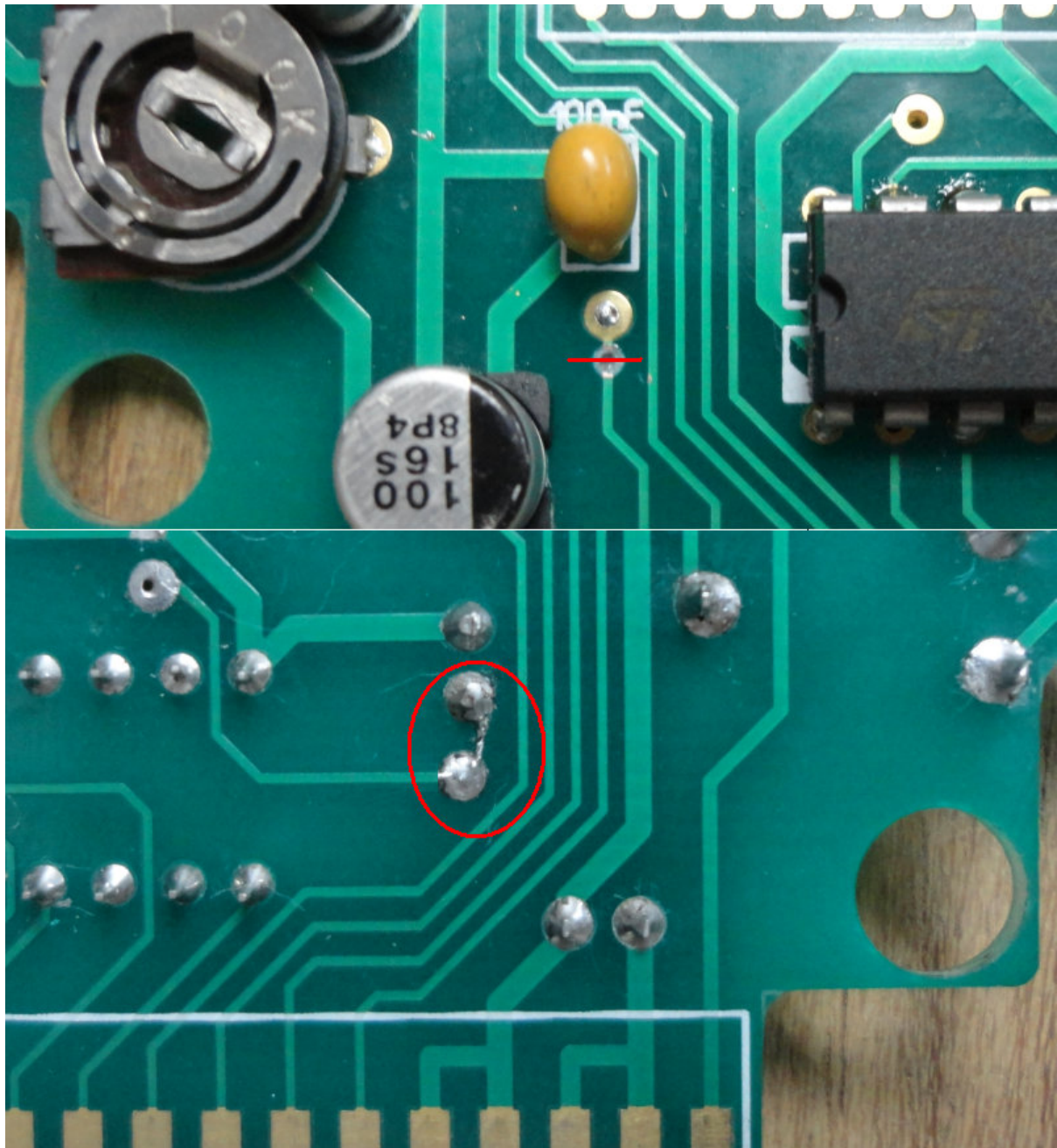
This will connect to GND the input of the two gates of the 74HCT32 that received the CPUCLK MSX bus, disabling these two logic gates.

TV encoder

The Franky allows the use of 3 types of TV encoder. The best choice for TV systems is the AD724 NTSC mode, for the fact that when in this mode it can be connected directly to the SMS VDP CPUCLK pin, saving a crystal on the board and freeing up space for the installation of the composite video connector.

To use the AD724 is necessary to solder jumpers in place of the 68uH inductor and the 18pF capacitor, as seen in the picture. Install only the resistor at the "NTSC" marking.

- NTSC only: Since we did the previous mod to have the clock directly generated by the VDP, the clock crystal that is adjacent to the VGA connector is no longer needed for NTSC. But for PAL mode use you'll still have to install it. If you use the SMS VDP I (315-5124) solder a wire on its pin-34, and if you use the SMS VDP II (315-5246) connect the wire to its pin-33. Then connect the other end of the wire to the AD724 pin-3.
- PAL only: Install a 4-pin 4.4336MHz DIP8 crystal oscillator in the space by the side of the VGA connector
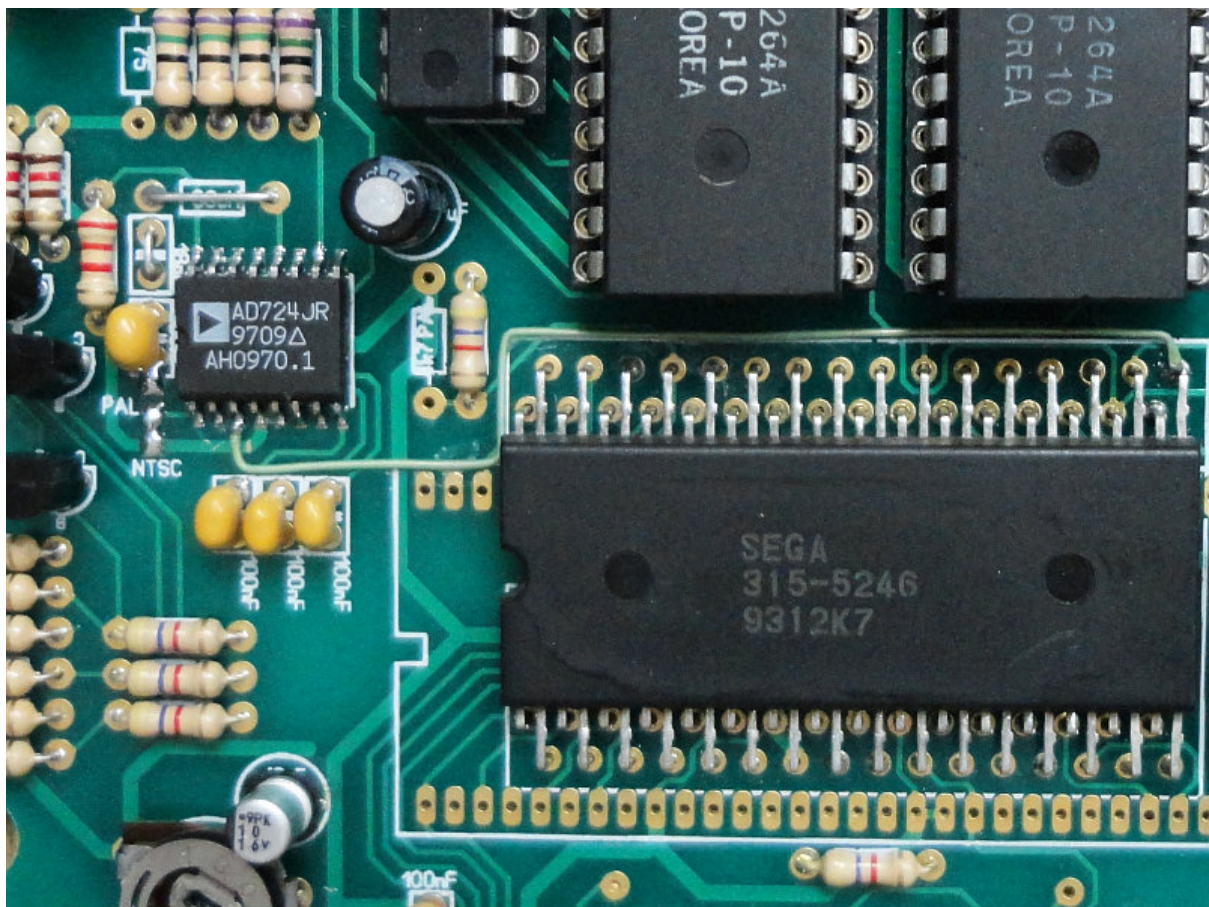
Optional: For those who want to put a switch to allow the selection the VDP mode between 50Hz or 60Hz, just solder connector pins in the two pads reserved for the resistor marked as PAL, then connect the external switch to them.

This way, without such switch (in the case of maintenance for example) or with the switch open, the VDP will be set to 60Hz, because of the pull-down caused by the 4K7 resistor. Closing this switch applies 5V to the VDP selection pin, effectively disabling the resistor and changing the VDP mode to 50Hz as a result.

VGA output 15kHz on DE-15

The original Franky does NOT support the direct connection of a VGA monitor to its DE-15 connector. However, you can make it ready for direct connection to an (older) VGA monitor that has 15Khz support like the Samsung 510N or LG M1721A. Only make this modification if you have a 15 Khz compliant VGA monitor and you do not want to use the default analog RGB support and signals for SCART, J-SCART or J-RGB.

Please note that this modification as-is is only applicable to Franky V1.1 revision pcb's. The Franky V1.0 revision pcb's had the pin-out mirrored which was corrected by adding wires and cutlines to get 1chipMSX cable compliant. As such, the below cutlines and wire locations will not match 1-on-1 with Franky V1.0 pcb's.

To make this modification, cut the two tracks shown in the photo below:
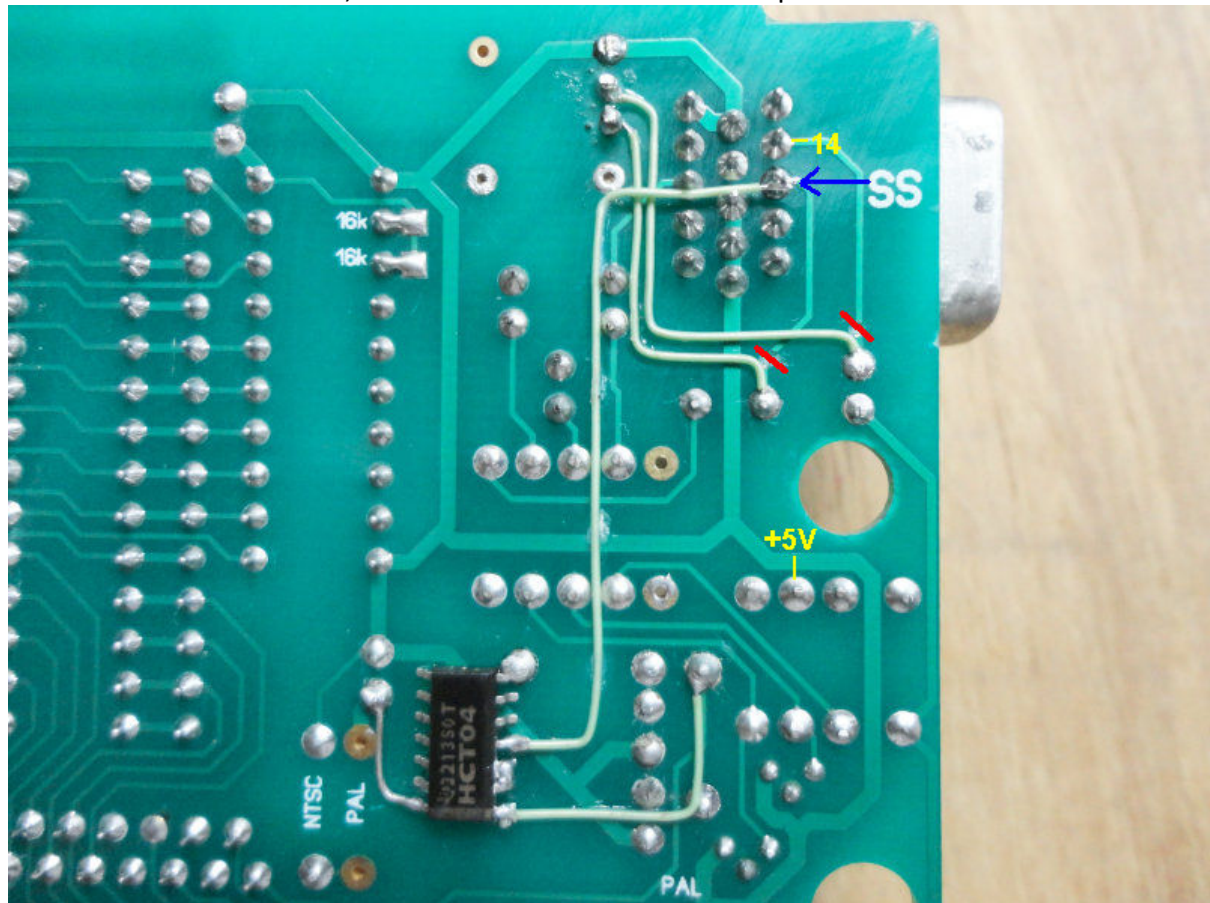
Add one 74HCT04 (SOIC 8, SMD) as shown on the photo.

Two green wires coming just below the cut-off points are part of the next modification.

If you do not want to put the above 74HCT04 and you don't care about a longer wires crossing the cartridge, you can do the following:

Connect the VDP pin-30 (CSYNC) to the pins 4 and 5 of the 74HCT32.

Connect the 74HCT32 pin-6 to the pin-13 of DE-15 connector (indicated by the blue arrow in the picture above).

Optional: If you plan to use your Franky with a VGA->SCART adapter cable, you must connect the + 5V to VSYNC pin (11) of the VGA connector. To do this, connect a 75R resistor to the pins indicated by yellow numbers in the picture above. Please note that this might eventually cause incompatibility issues with some real VGA monitors.

A/V output with RCA connectors

Because the cartridge enclosing of Franky has some space left, it is possible to mount RCS connectors for audio and video. You'll need some extra work, but the result is worth your extra effort. The RCA connectors used are this one:

I have chosen to put the connectors recessed in the cartridge enclosure. In this case, the holes should be slightly larger than the diameter of the connectors so the RCA plugs can enter correctly.

Here's how I fixed the connectors to make them recessed:

The plate holding the connectors is a 3mm polycarbonate, but you use any other thick plastic that accept to be glued with cyanoacrylate.

NTSC only: You need to make 2 holes spaced by 2.54mm on the spot where the clock crystal should be originally installed and place there the 3-pin KK connector or even a 3-pin bar. I prefer the KK as its polarized to avoid the insertion of the connector in the wrong way.
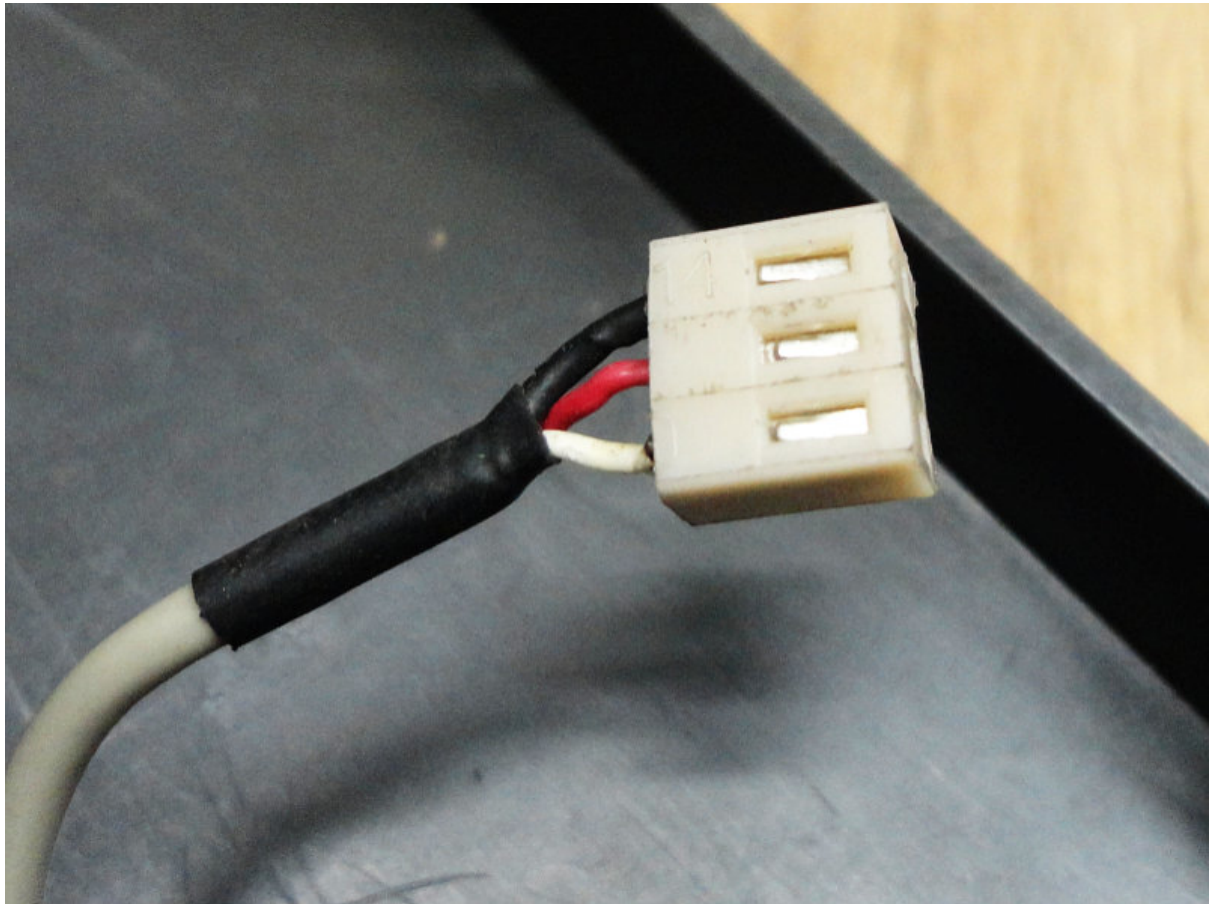
One of the connector pins will fit in the clock crystal hole labeled GND. See how it should look:
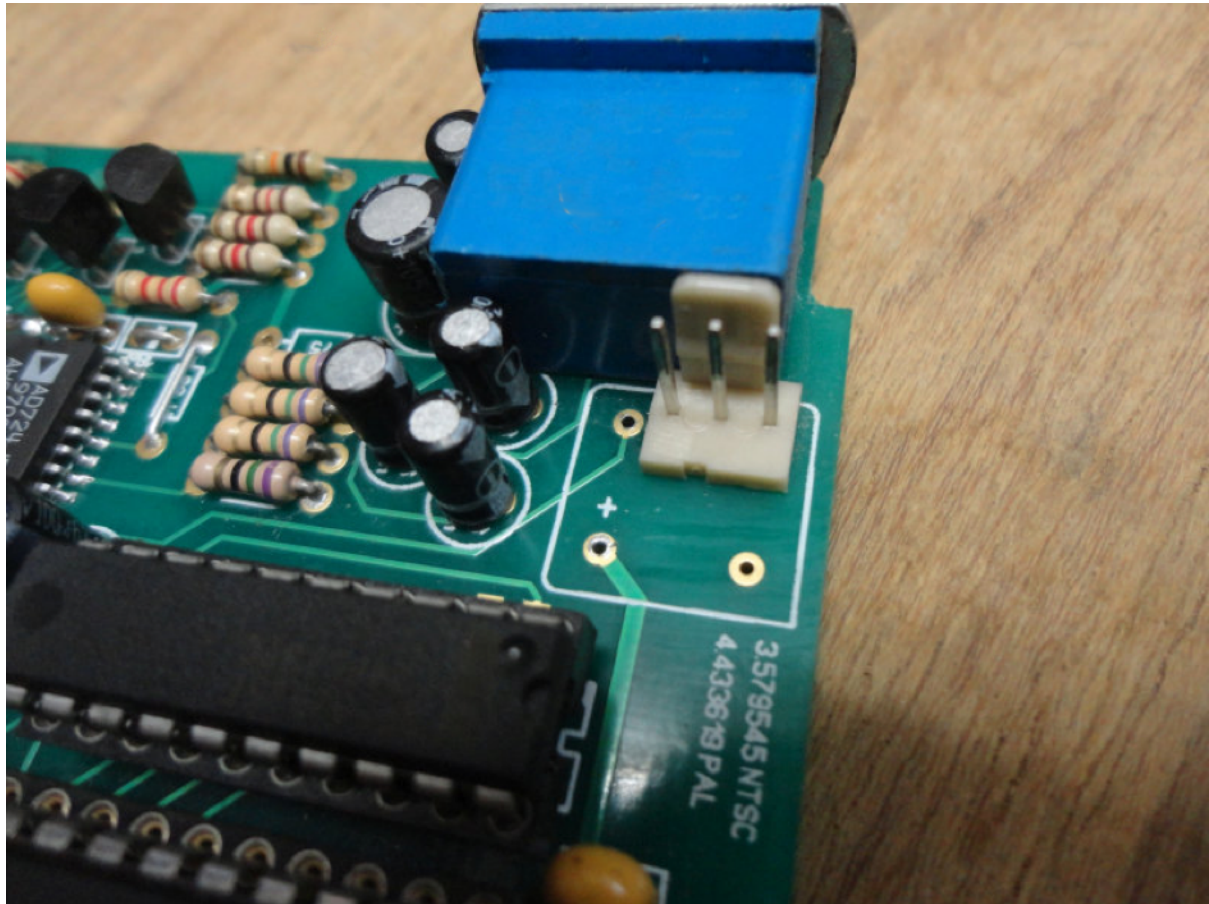
But due to the small height of the enclosure I needed to shorten the KK connector. Otherwise the box won't close. The connector housing must be shortened 8mm in height.

And the contacts must be removed from it as shown in the picture below:
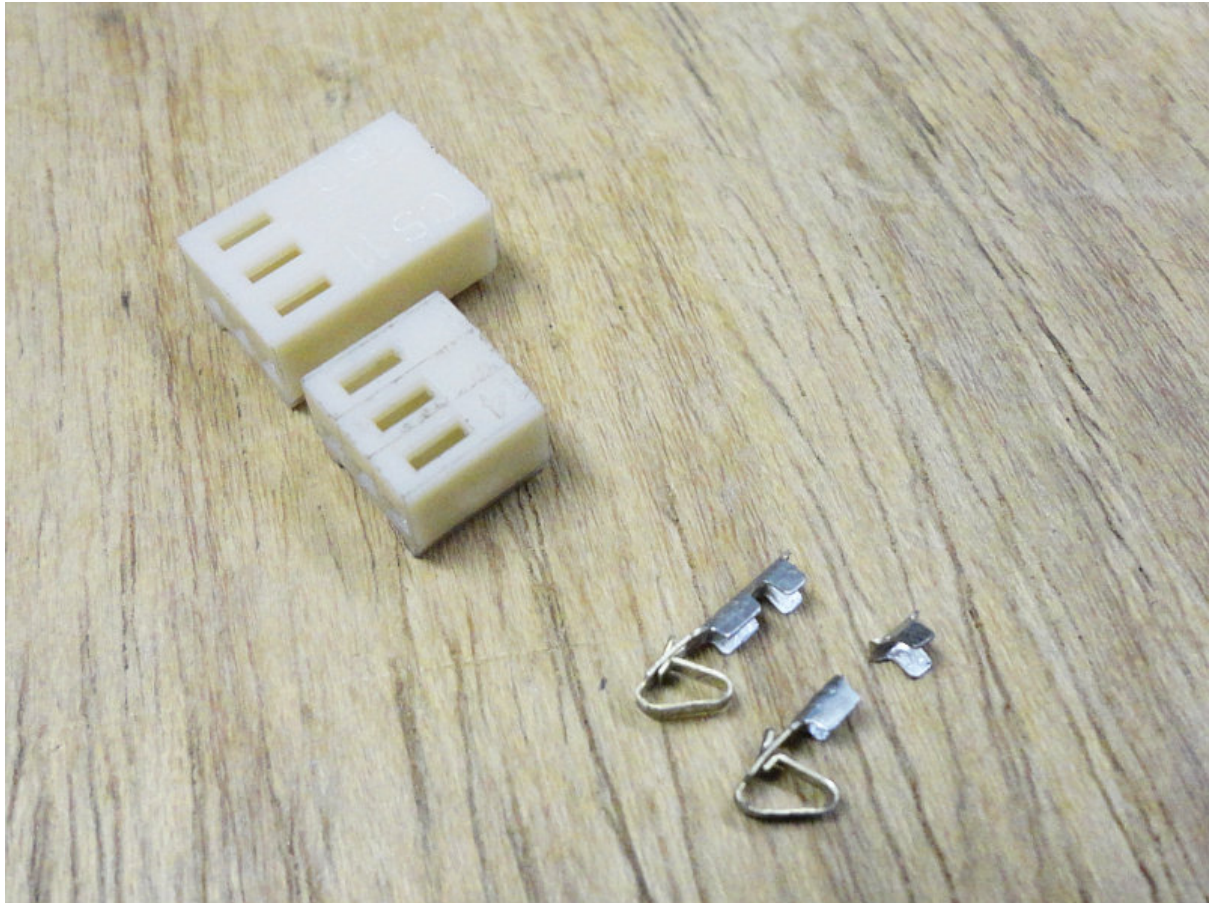
The pin must also be reduced by cutting its "teeth" as below:
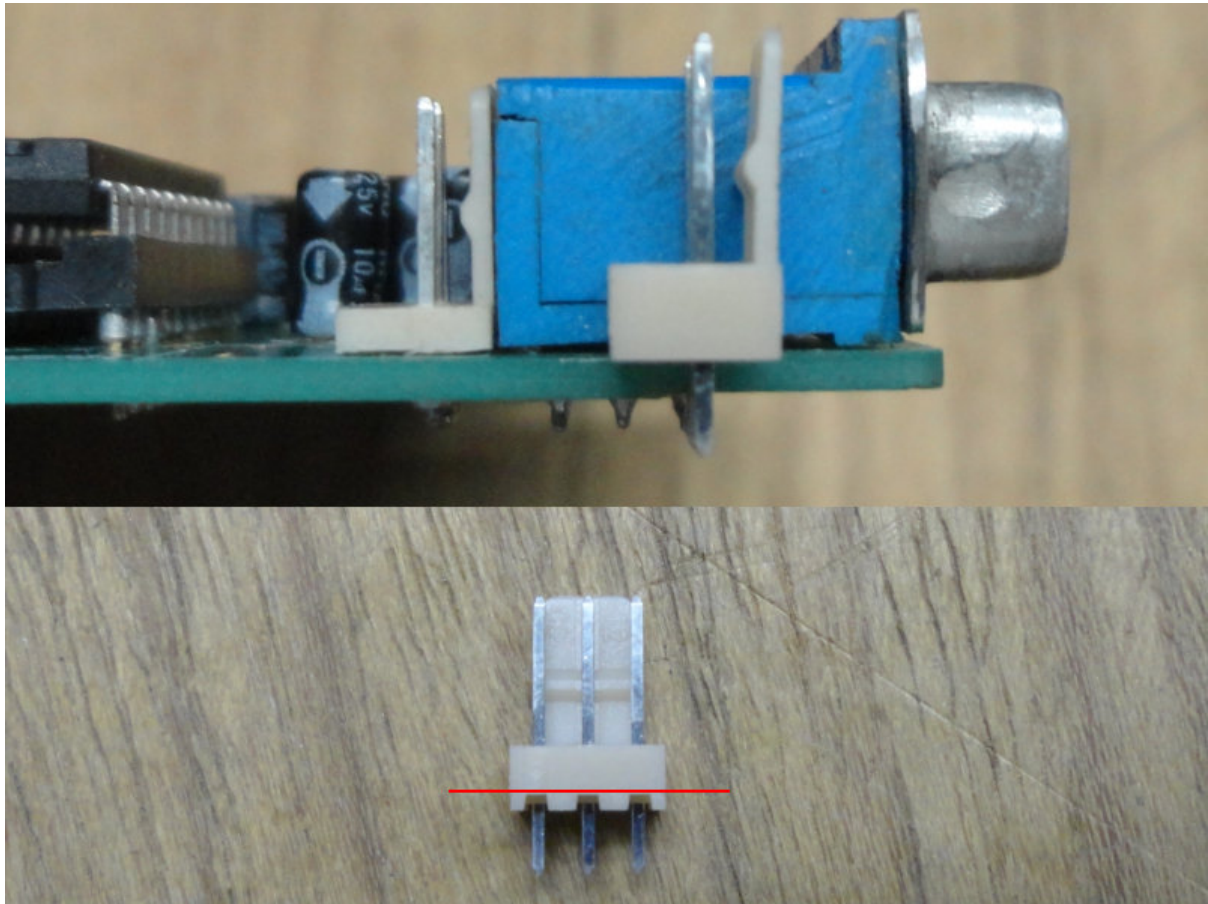
This reduction can be made with a utility knife, cutting around the entire connector, or if you prefer, you can also remove the pins with a needle-nose pliers, cut them and reinsert again.

When soldering the connector on the board, you notice that now the pins will be left with some excess solder that must be cut off.

Interconnect wires in KK connector as follows:
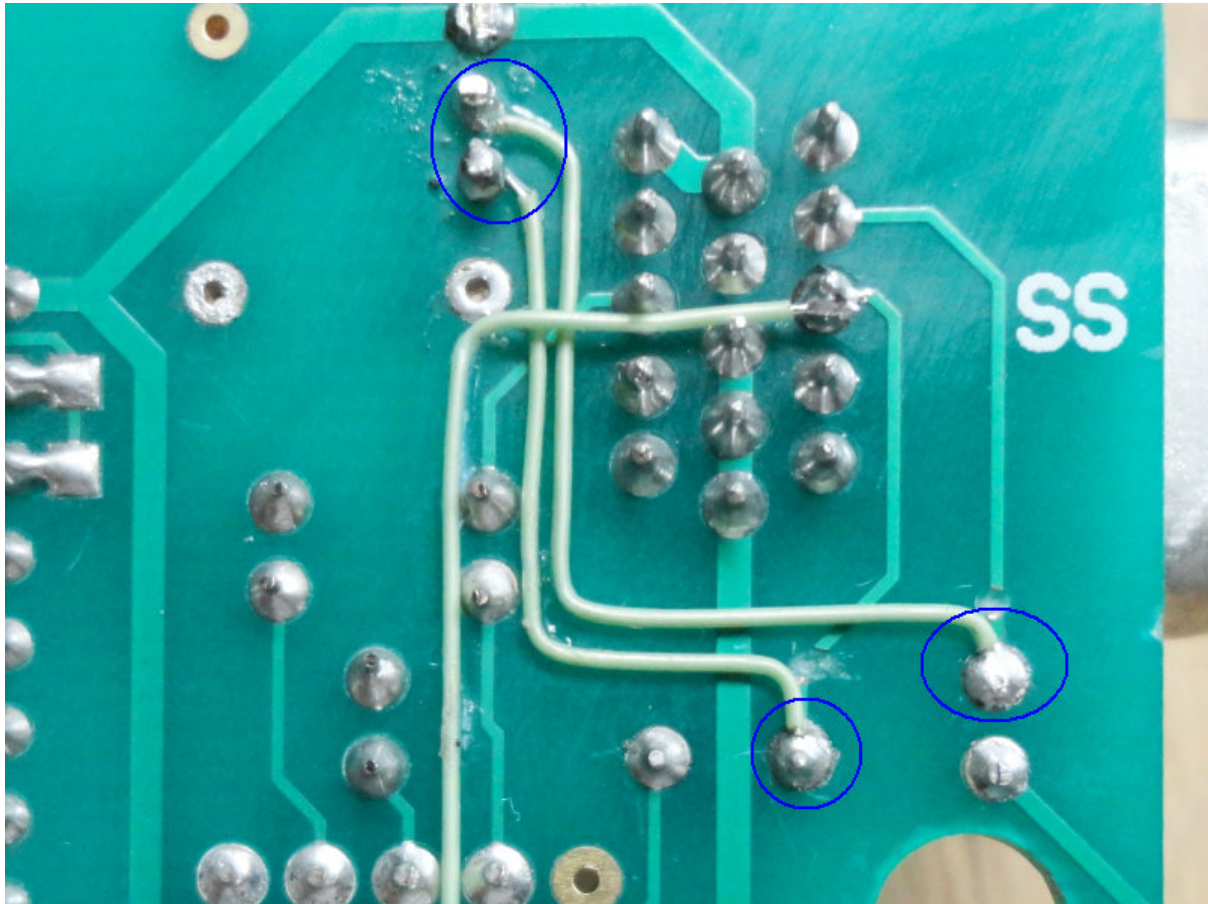
The KK connector upper pin is GND, the middle is audio and the lower is video.

With this modification, we have the AV signal on RCA connectors, without any need for adapter cables, and with the modification of the step 5, the DE-15 connector is ready to be connected to VGA monitors directly. Both outputs can even be used simultaneously.

S-Video Output (optional)

The AD724 also has S-Video output. Luma is on pin 11 and Chroma is at pin 9. You will need to put a resistor in series with a 75R electrolytic capacitor 220uF for each signal.