SAVO

Saturn **A**tari **V**ideo **O**utput

by Piotr D. Kaczorowski

Instruction Manual

31 Jan 2023

The seamless AV signals upgrade toolkit for the Atari XL/XE series.

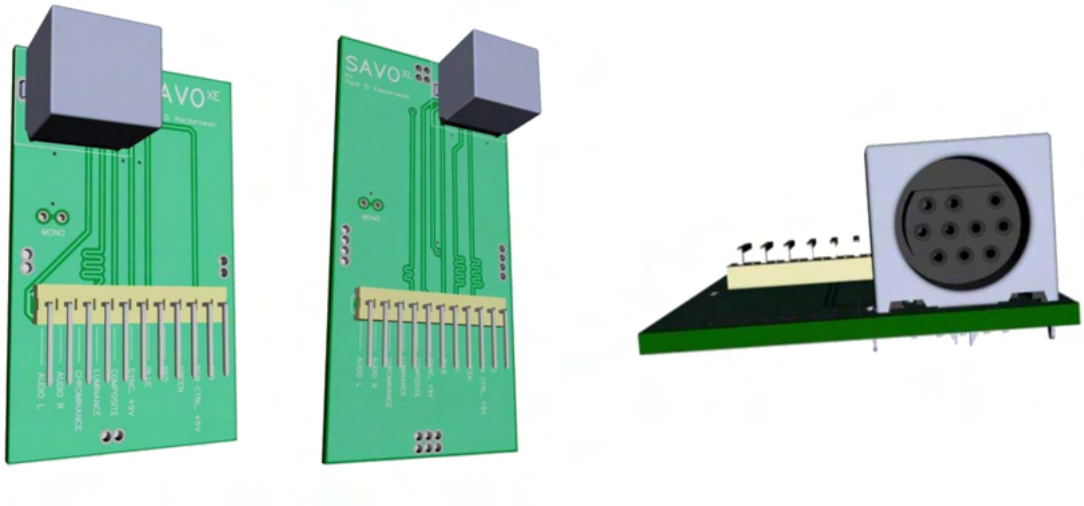
No more drilling the Atari case. No more homemade AV cables.

SAVO – (SEGA) Saturn Atari Video Connector

by Piotr D. Kaczorowski

SAVO is the connector board with the audio/video output of the Sega Saturn, which is mounted instead of the RF modulator. SAVO boards prevent the computer case from being drilled open or cut when new audio/video signals are added to the Atari microcomputer. SAVO is compatible with any Sega Saturn cable by using the Sega Saturn mini DIN10 jack.

SAVO is a simple board with no additional electronics and does not inherently generate or amplify audio or video signals. The main purpose of SAVO is the ability to install AV extensions without drilling the Atari case and making homemade cables.



Available versions:

- SAVO XE – compatible with Atari 65XE / 800XE /130XE
- SAVO XL – compatible with Atari 600XL / 800XL

Upcoming versions:

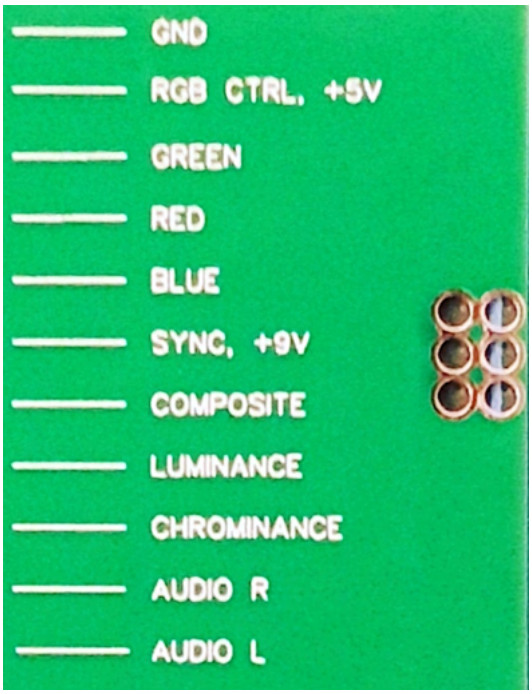
- SAVO XEGS – compatible with Atari XEGS
- SAVO 1200XL – compatible with Atari 1200XL

Compatibility:

- VBXE
- VBXL – (VBXE for Atari XL)
- UAV
- Spectre AV
- Sophia 2 (partly)
- TK II Stereo
- PokeyMax

Signals that can be passed via SAVO

The back side of SAVO board has the following signals:



- RGB - red, green, blue signals provided by VBXE or Sophia 2*
- Composite - provided by Atari XL** motherboard, UAV, Spectre AV
- S-Video - provided by Atari XL/XE motherboard, UAV, Spectre AV
- mono audio - provided by Atari XL/XE motherboard
- stereo audio - provided by PokeyMax, TK-II -Stereo or other compatible stereo card

plus aux signals:

- RGB Ctrl – video signal selector
- SYNC – not used (added for Sega Saturn compatibility)

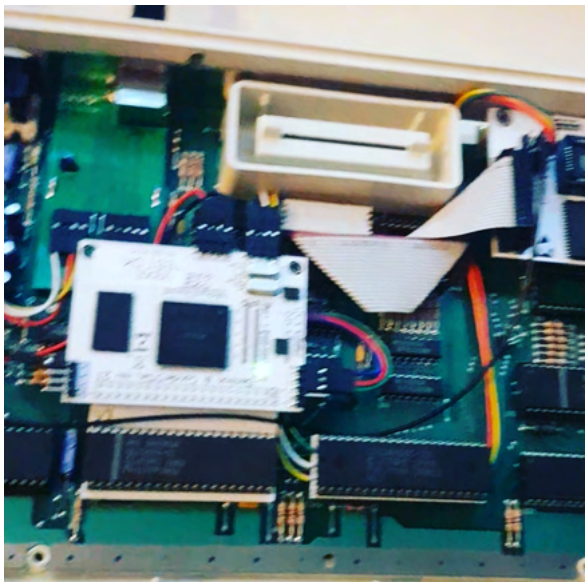
* - Connecting Sophia 2 to SAVO requires an advanced installation. Sophia 2 can generate analogue RGB signals, but SAVO does not come with a standard cable to connect Sophia 2's output port. Currently you need to make it yourself.

** - RF modulator in Atari XE machines generates a composite signal. If it is removed, there will be no composite signal present on until either UAV or Spectre AV mod is installed.

Typical use cases and the installation:

1. SAVO XE/XL installed together with VBXE / VBXL

   Each of these SAVO boards prevents drilling the casing to output new RGB signals from your Atari. Typically the cases were drilled to install an Euro SCART, DB15 or DB9 socket. One of the solutions was also to modify the motherboard and replace the DIN5 socket with DIN13, similar to the one found in Atari ST. Each of these methods was usually irreversible and damaged the retro hardware.



The SAVO XL with VBXL in the Atari 600XL PAL

Installation:

a) RF modulator and connecting VBXE signals

After installing VBXE, remove the RF modulator and install the SAVO board at its space. Now connect the red, green and blue signals of VBXE to corresponding SAVO inputs.

b) Synchronization

According to VBXE documentation this can be Composite (not available in XE after removing the RF modulator), Luminance or ">CSYNC" (present on pin #15 of CD4050 IC) via a 470R resistor (to lower the signal from TTL level to TV standard).

The synchronization should be connected to the SAVO Composite pin.

Connecting luminance to SAVO Composite pin with SAVO RGB Ctrl pin not connected (RGB Ctrl = 0V) and connecting chrominance to SAVO Chrominance pin will provide S-Video signal via Sega Saturn to Euro SCART cable.

c) RGB Ctrl – video output selector

RGB Ctrl **should not** be connected from VBXE (VBXL).

Connect +5V from the motherboard (one of the signal soldering points of RF modulator) to the "RGB Ctrl, +5V" connector on the SAVO board. The supplied cable has a 180R resistor which lowers the +5V signal to 2.9V, i.e. is between 1-3V and allows the RGB signal to be selected. The range 0-1V is reserved for the composite or S-Video signal.

d) Composite

If you have an Atari XL or an Atari with UAV or Spectre AV mod installed, connect composite to the SAVO Composite pin. It is also used as synchronization signal for the RGB output (see section b).

e) S-Video

Connect luminance (mono) to SAVO Luminance pin and chrominance (color) to SAVO Chrominance pin.

On the Atari XE without additional composite signal generator, please also connect luminance to SAVO Composite pin. This signal is used as sync or as part of S-Video via Euro SCART. It is not necessary to connect luminance as sync to SAVO Composite pin, if you have a "Luminance on Sync" cable.

f) Mono Audio

Connect the mono audio signal from the solder point for RF modulator to the SAVO Left Audio or Right Audio gold pin and short the blue "Mono" jumper.

You can find the correct solder point with a multimeter by performing a continuity test. It should be connected to the 1st pin of the LM358 (small 8-pin IC near the RF modulator), which is an operational amplifier used to mix different audio signals from the motherboard.

g) Stereo Audio

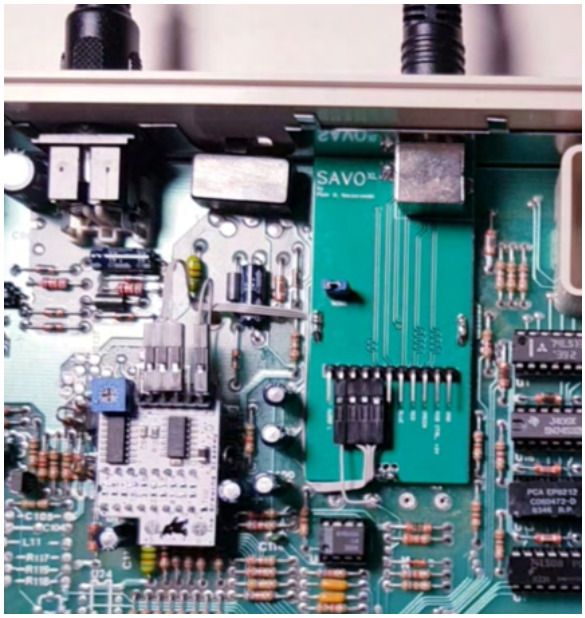
Connect the left and right channels from the installed stereo board and open the blue "mono" jumper to separate the left/right paths on the board.

h) GND

Connecting GND to the pin on SAVO is not necessary if the board is properly installed/soldered. SAVO GND pin is connected to the ground layers - both top and bottom, to the solder pads and to the output socket housing. If you just want to test the SAVO board without soldering it to the motherboard, connect the GND directly via wire. It can be connected from VBXE or from any other GND point of the motherboard.

2. SAVO XL installed in Atari 600XL NTSC

SAVO XL can be used in the Atari 600XL NTSC to provide legacy audio/video output without drilling any hole in Atari housing, even for the DIN5 monitor connector which is not present in this version of the Atari microcomputer.



The SAVO XL in the Atari 600XL NTSC

Installation:

a) RF modulator

Remove RF modulator and install SAVO board in this place.

b) UAV / Spectre AV

Install the UAV or Spectre AV mod following their installation manual. Do not install DIN5 monitor connector, as it is not necessary.

c) Connecting video to SAVO XL

Connect the video output signals from UAV / Spectre AV to the corresponding pins on the SAVO board: composite, luminance and chrominance.

d) Connecting audio

Audio is installed in the same way as described in sections 1f and 1g above.

Replacing RF Modulator with SAVO board

Removing the RF modulator is not an easy task and requires some practice in soldering. The correct method is to remove the old solder with the desoldering gun or solder wick and apply new solder in place of the old one. Then you can use the soldering iron to heat each soldering point and delicately pry the RF module until it is completely desoldered.

It is important that you do not destroy the previous soldering pads by overheating them. However, in the worst case scenario, if the old solder pads are damaged, you can still solder the SAVO board, but you might need to connect GND signal with the wire, as it might be not connected via RF modulator soldering points.

There are several methods for attaching SAVO boards to the motherboard:

a) SAVO XL - use additional gold pins 2mm (0.078") to mount SAVO with a slight distance above the surface of the motherboard.

b) SAVO XE - you should place an additional insulating foil on the motherboard and solder the SAVO board directly via this foil on the motherboard - as flat as possible. Please note that the mini DIN10 connector has a little protrusion at the bottom and lifting slightly the back side of SAVO PCB will make the connector parallel to the Atari case, allowing easier connection of the supplied cable.

In the box

The SAVO package is delivered with the following parts:

- the SAVO board (XE or XL)
- 2mm gold pins for mounting
- Sega Saturn to Euro SCART cable
- optional insulating foil for the SAVO XE version

Sega Saturn cables available on the market

Sega Saturn console was launched in 1994. It still has a large retro fan base to this day. Looking for a "no drilling, no homemade cables" solution, the Sega Saturn AV connector proved to be perfect fit. It is a size of "S-Video" connector and fits into the opening of the RF modulator's antenna jack. The Sega Saturn socket has 10 pins that gives plenty of options to pass all sorts of AV signals including: RGB, S-Video, Composite, Stereo Audio and auxiliary signals.

A Sega Saturn to Euro SCART cable is included in the SAVO kit, but there are many more cables on the market that could come in handy. The cables differ in both the quality of workmanship and the pinout. The cable that you will provided with SAVO board, proved to transmit very good quality image and sound. However, you can find other cables that will have the following signals:

- Sega Saturn to Euro SCART
- Sega Saturn to RCA: Composite + stereo audio
- Sega Saturn to RCA + S-Video: Composite + stereo audio + s-video)
- Sega Saturn to RGBs RCA: Red, Blue, Green, Composite on Sync + stereo audio

Both standard Sega Saturn cable and the one supplied with SAVO has a feature called "Composite on Sync". There are also cables marked as "Luminance on Sync" available and they have luminance signal soldered on pin #20 of Euro SCART connector, instead of composite signal. If you are using such a cable, please plan your installation accordingly. Your display device (TV or monitor) will sync with the signal connected to SAVO Luminance pin, rather than SAVO Composite pin.

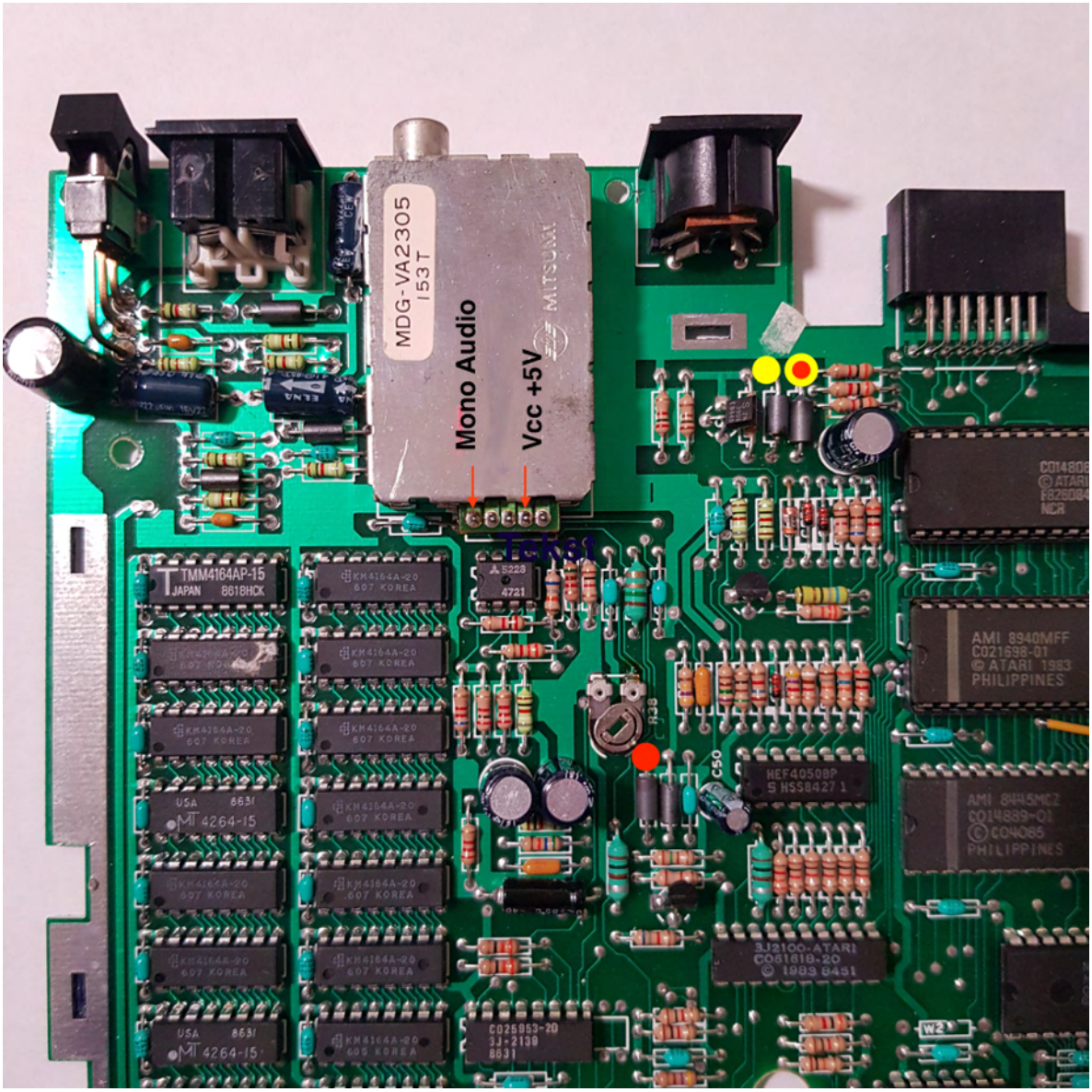
Tips and tricks

There are some things to consider when installing SAVO:

- a single-core wire is better than stranded wire (collects more noise),
- a shorter wires are better than a long ones. A long wires becomes an antennas that collect noise,
- probably there is a ready made cable available on the market and there is little sense in soldering your own cables
- to use a brand new Sega Saturn cable, remove the bottom notch with pliers,
- After removing the RF modulator from the Atari XE, it's worth installing a simple
- UltraVideoXE mod, which improves the S-Video output over the old DIN5 connector,
- I recommend watching Jonathan Halliday's videos YT about installing extensions in the Atari: *https://www.youtube.com/user/flashjazzcat*

Key location and signals on the Atari motherboards

ATARI XE

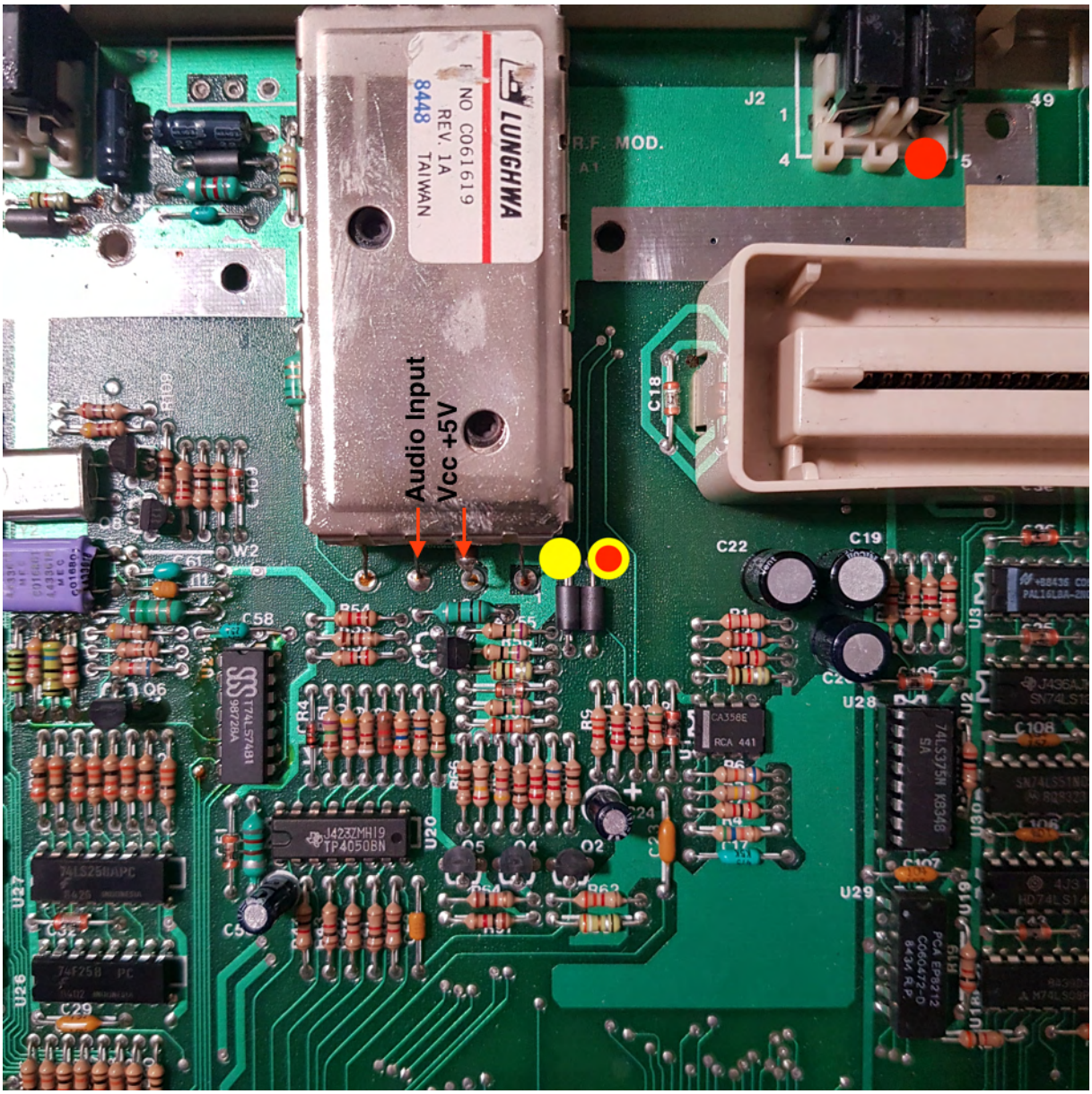


Yellow – Luminance
Red – Chrominance
Yellow-Red – Composite (not available when RF modulator is removed)

RF modulator signals from the left:

1. **Mono Audio**
2. Mono Video
3. Color Video
4. **Vcc +5V**
5. Composite (as an output signal)

ATARI 800 XL

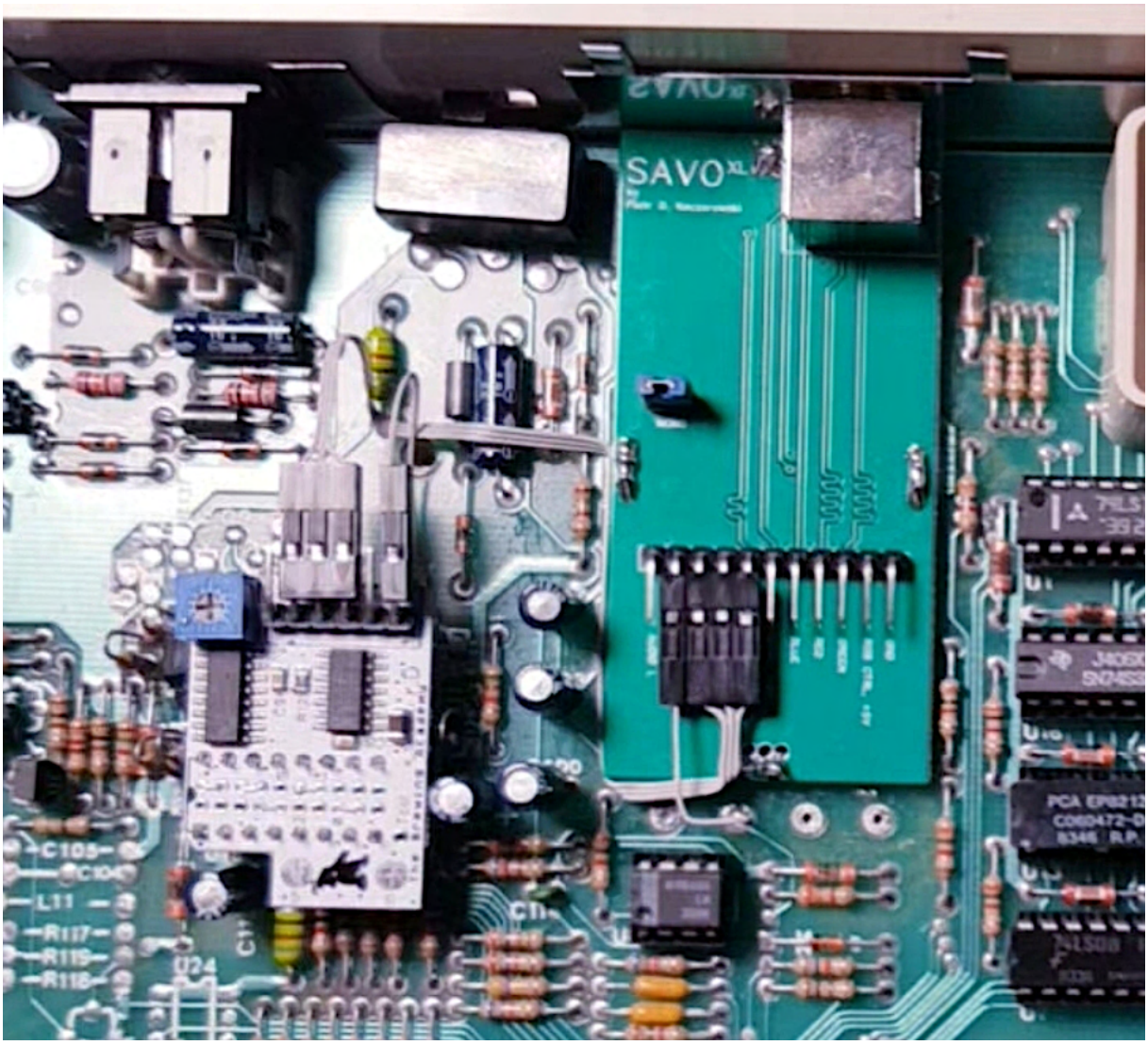


Yellow – Luminance
Red – Chrominance
Yellow-Red – Composite

RF modulator signals from the left:

1. Channel switching
2. **Audio input**
3. **Vcc +5V**
4. Video Input

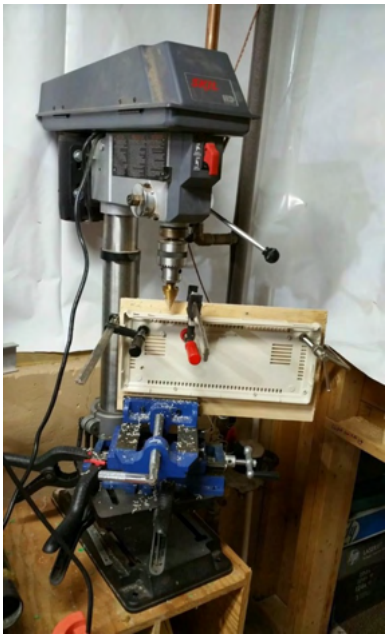
ATARI 600XL NTSC with UAV / Spectre AV



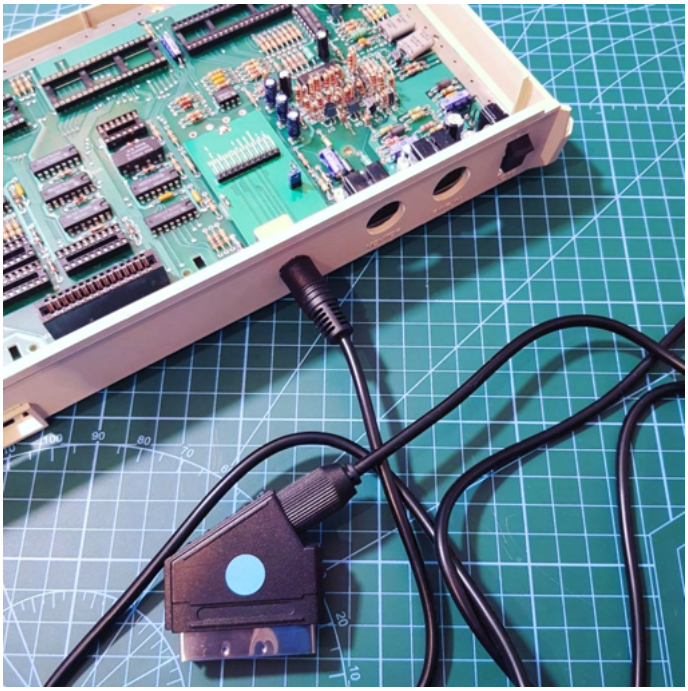
RF modulator signals from the left:

1. Channel switching
2. **Audio input**
3. **Vcc +5V**
4. Video Input

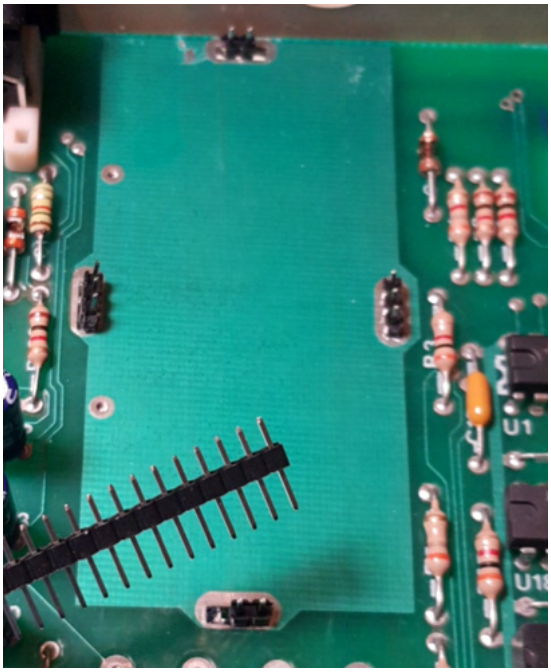
The gallery



Found on the Internet – “pre SAVO era”

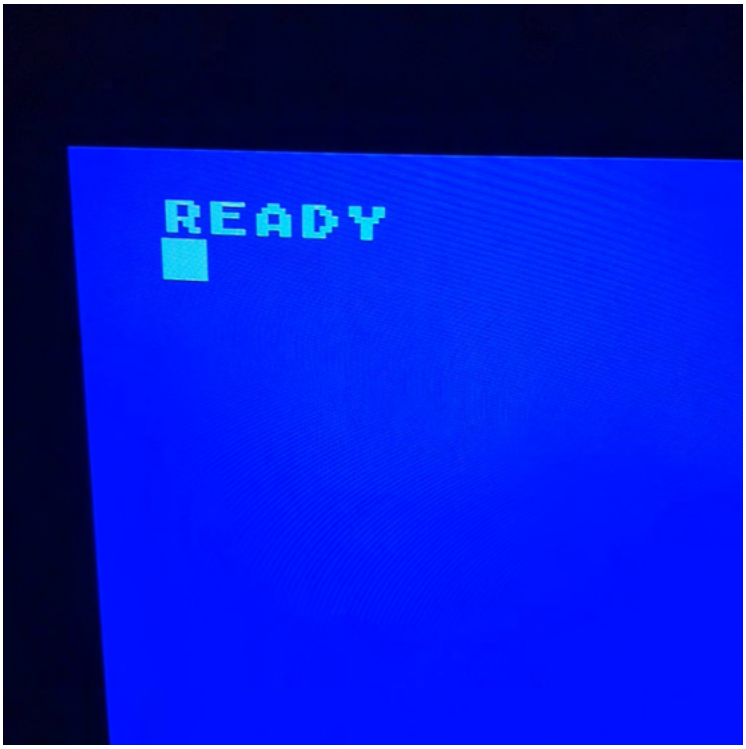


SAVO XL with Euro SCART cable connected to the Atari 600XL PAL



Extra added 2mm gold pins before mounting SAVO XL

Rear view of the Atari XE with SAVO XE installed and Sega Saturn AV socket instead of the RF modulator antenna.



VBXE (NTSC) connected via SAVO to scandoubler and via HDMI to OLED TV.

The SAVO XE installation kit.

THANK YOU

All First Customers	**Trust and Patience**
Piotr Bugaj aka Zaxon	**DipTrace crash course, prototype PCB review**
Jakub Kosiec aka lewiS	**Instruction Manual review and the First Distribution**
Przemyslaw Krawczyk aka Lotharek	**Professional retro parts production**
Sebastian Bartkowicz aka Candle`O`Sin	**Brilliant retro projects**
Thomas Cherryhomes	**The FujiNet project**
Mozzwald	**The FujiNet project**
Jonathan Halliday aka FJC	**Retro YT channel and Atari software development**
Jürgen van Radecke	**SysCheck and many brilliant retro projects for Atari and always good advice and support from ABBUC**
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Piotr Siwiński	**FB: Atari Polska and retro parts donations for R&D**
Arkadiusz Lubaszka aka Larek	**Polish Retro YT channel, Atari software developer**
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Przemysław Galanciak aka Galtron	**Atari retro hardware designer**
Łukasz Maśko aka Peri Noid	**Atari first help center in Warsaw**
Bocianu Boczansky	**Atari software designer**
Maciej Grzeszczuk aka Krap	**Atariki webside owner**
OCG Admins: Gavin Haubelt, Thomas Cherryhomes, Erric Henneke, prof. Jason Moor	**Making a great-meetings with retro Titans of the first decades of IT industry**