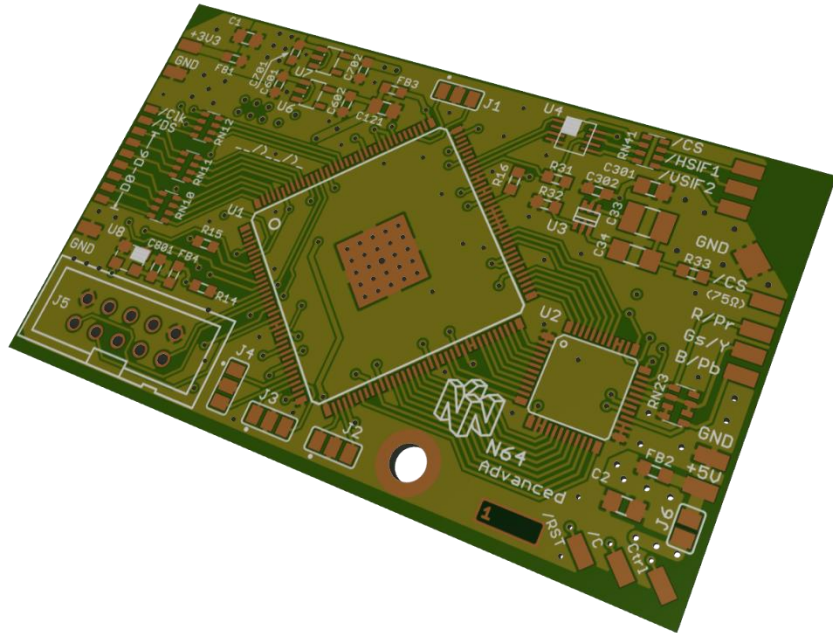
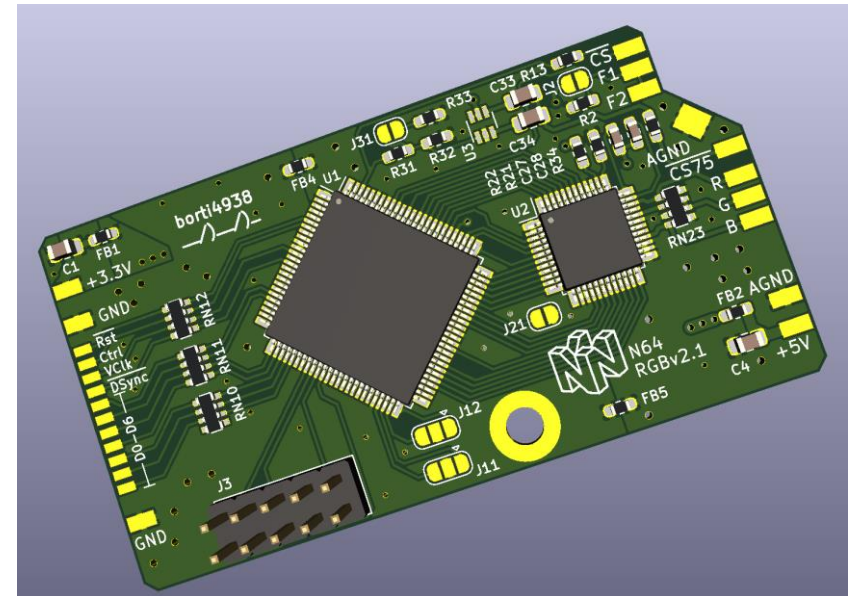


N64 Advanced and N64RGB Version 2.1

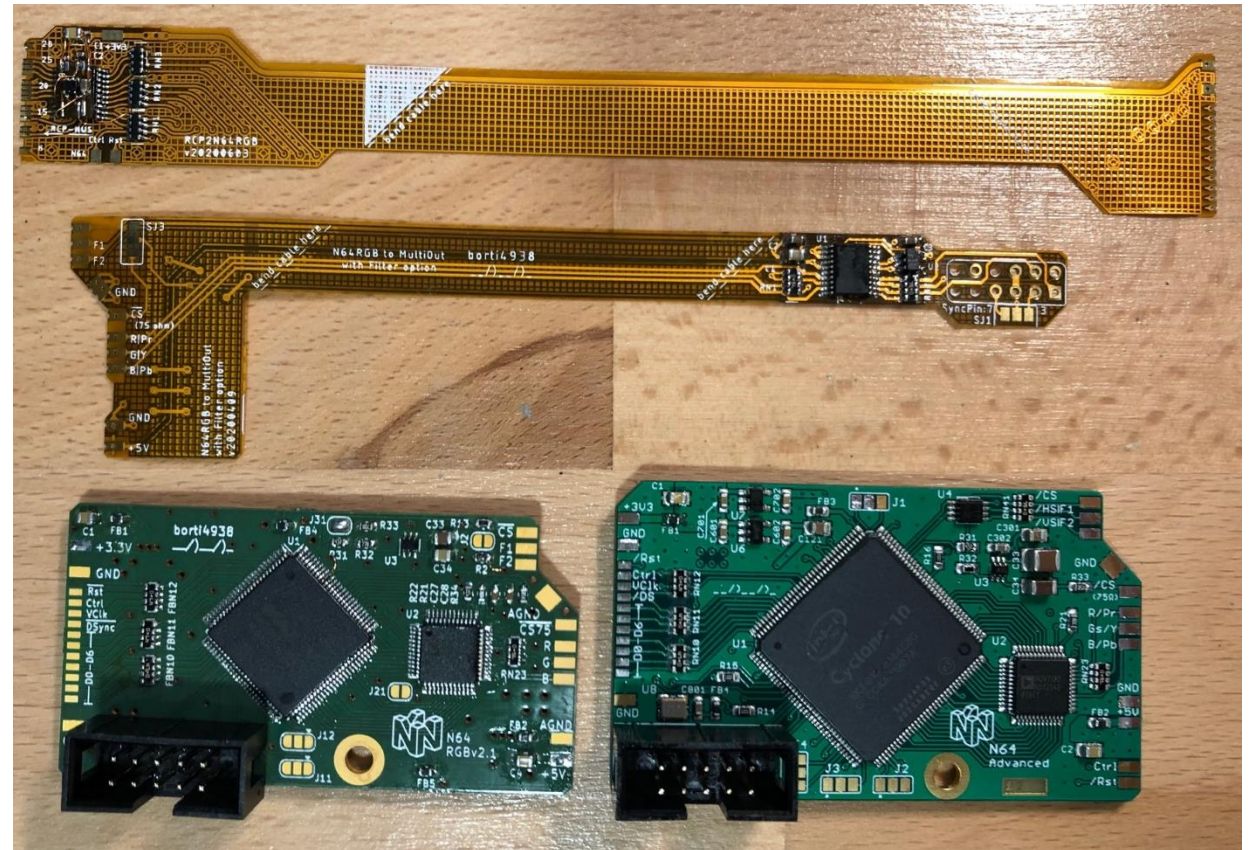


Installation and Setup Guide



Content

- Open the Console
- Preparation
- Solder Work
 - Console
 - Modding Kit
- Settings (Solder Jumper)
- Cable SetupController
 - In Game Routines (all versions)
- Menu (N64A only feature)
- Firmwareupdate



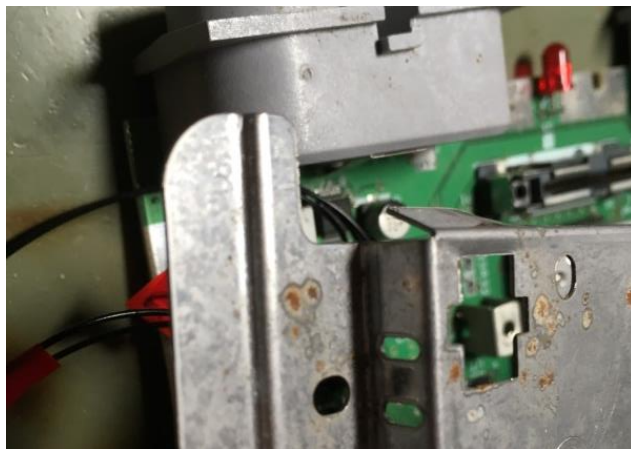
(pictures often show prototypes or earlier PCB versions)

Open the Console



- Remove Jumper Pak / Expansion Pak
- Remove screws from bottom side of the console (needs 4.5mm game bit tool)
- Lift up the top housing
- Remove marked screws from inside (in some later consoles heat sink is designed differently)
- Pull out the mainboard and remove heat sink and RF shield
- **Hint:** Now you have a good chance to clean up your N64 shell under hot water.

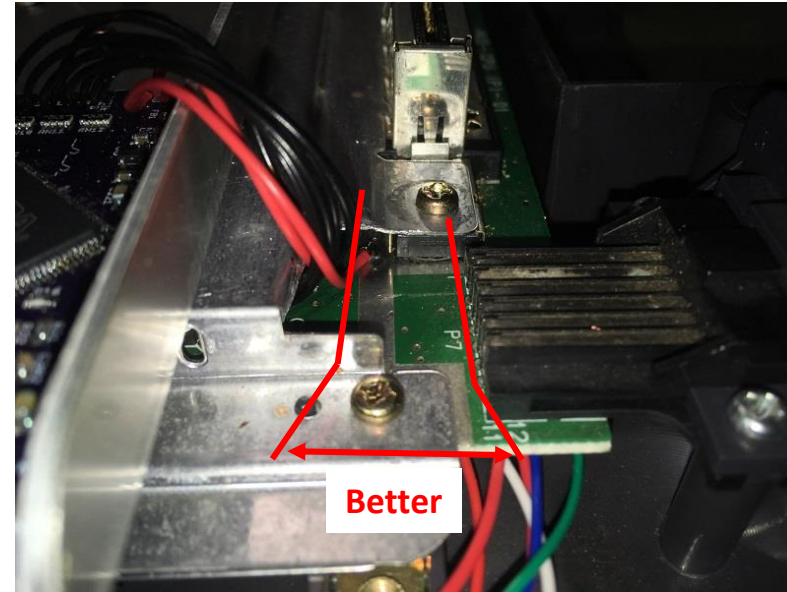
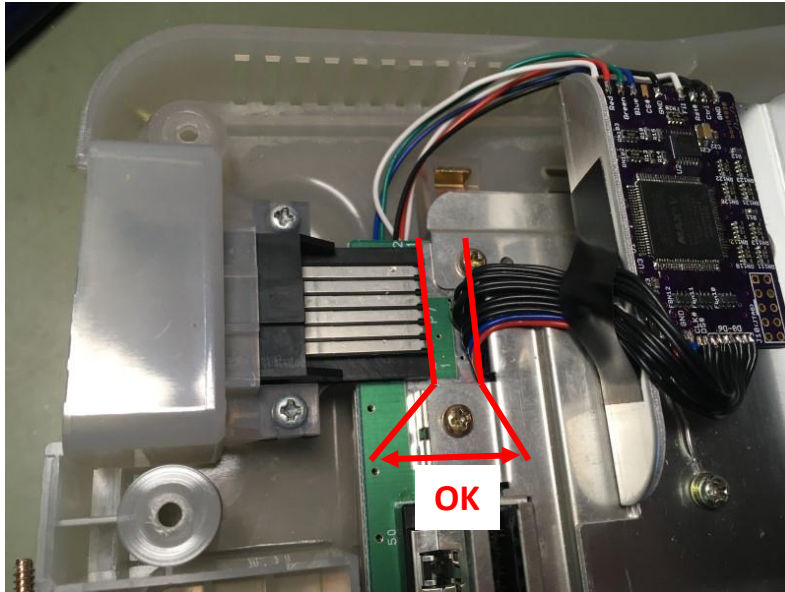
Preparation – Top RF shield



- Next to the MultiOut and the cartridge slot
 - Locate the tap in the RF shield closing the gap to the N64 mainboard
 - Bend away or remove this tap or even cut off a small piece out of the RF shield as shown here
- At the front side between reset button and controller port:
 - Slightly bend off the tap here
- This helps later to fit the connection wire

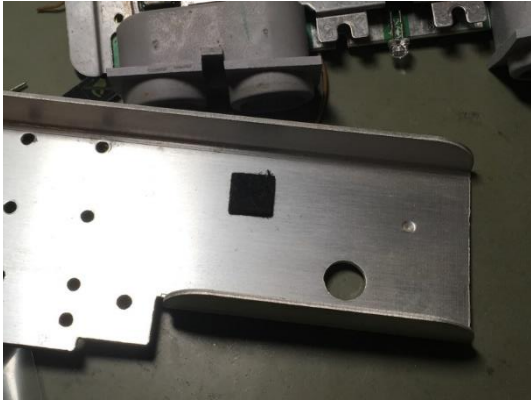
Preparation – Top RF shield

-- Interference issue--



- Later, the data lines as well as the clock will be routed close to the MultiAV
- The distance between both is a crucial issue as your wires act as interferer
- Hence, have tap bend might be ok, but it is better to cut some piece of the RF shield away to further increase the distance between MultiAV and data lines

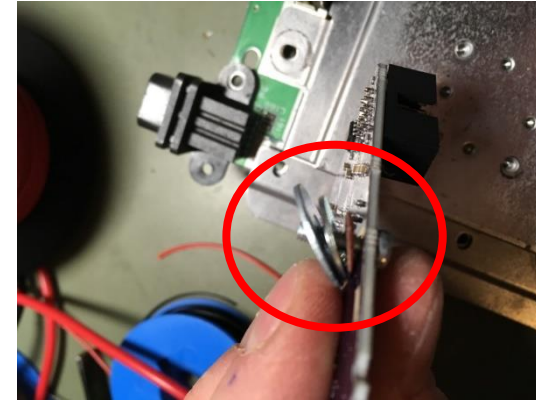
Preparation – Mount the PCB



- Put a small piece of a flat isolating foam or glider under the top left of the PCB (OPTIONAL)



- Apply some amount of solder to the mounting hole
- This helps later to have a better connection to the screw



Mounting material:

- Screw
(M3 diameter, min. 10mm, max. 14mm)
- 3x washer below PCB:
 - isolating or small outer diameter (three traces are close to the mounting hole)
 - a slightly larger washer
 - a large washer
(such that this washer does not fit through the mounting hole of the heat sink)

Preparation – Mount the PCB



- Place the PCB on top of the heat sink



- Fasten screw from the bottom side of the heat sink
- Use another washer and a (locking) nut
- **Attention:**
 - Do not place the washer into the RF shield area!
 - Do not stress the PCB to much!

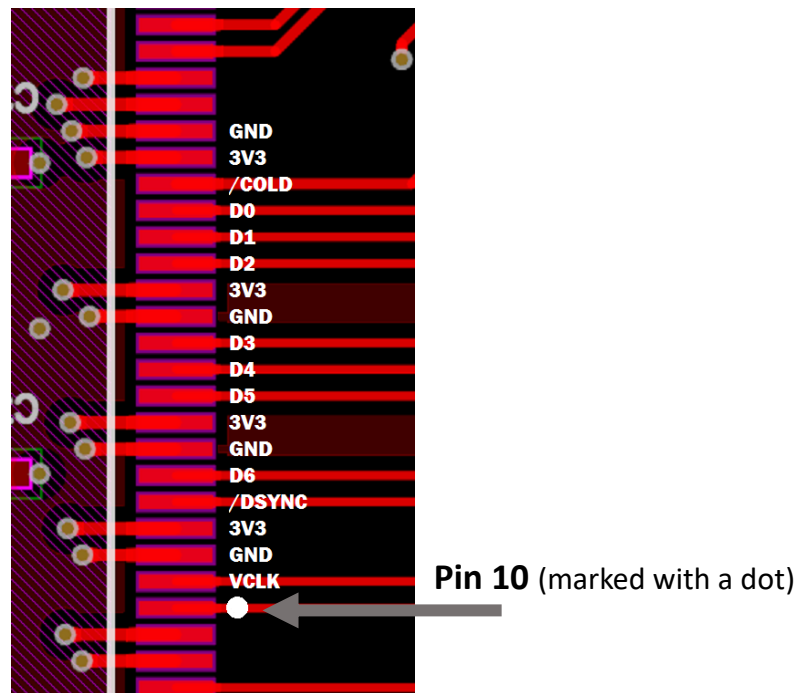
Solder Work – Console

-- digital video signals --

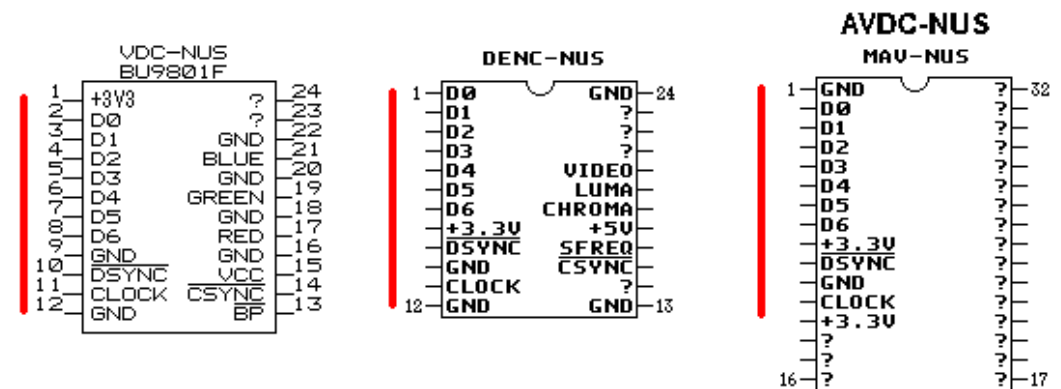
Most of the signals needed has to be taken from video processor output; the **RCP-NUS**.

Next to the RCP-NUS is the video encoder, where several types are used during the variety of N64 designs.

The pinouts are given below. Basically we need D0-D6, /DSYNC and /CLK (or VCLK or CLOCK) for the modding board.



Pinout RCP-NUS

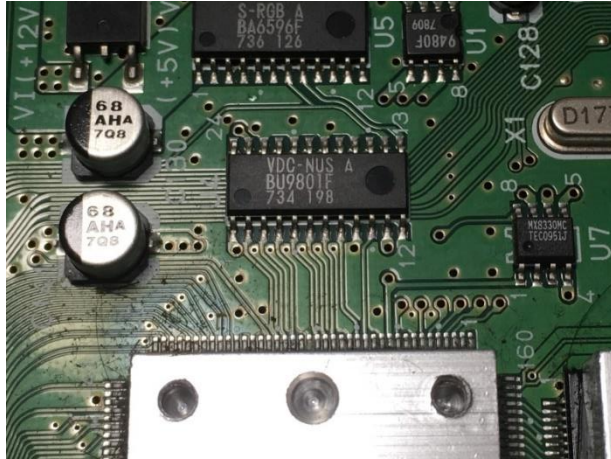


Pinouts of different encoder chips used in the N64

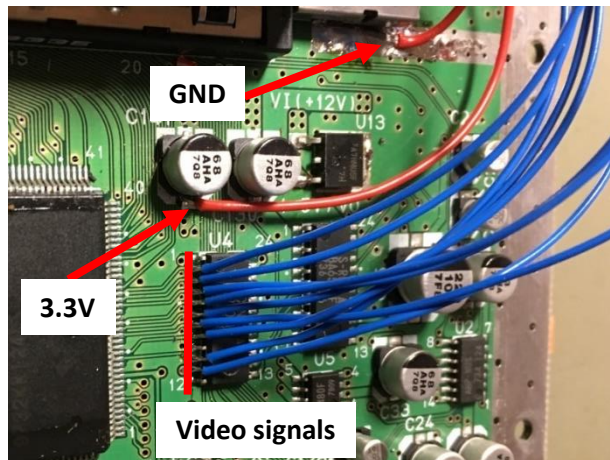
RCP-NUS picture by Marshall
Encoder picture by Viletim

Solder Work – Console

-- digital video signals and 3.3V and GND --

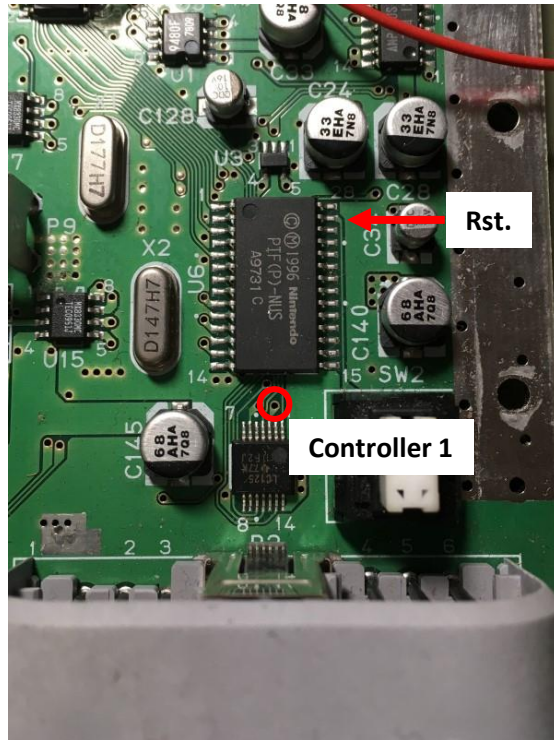


- Locate the video encode (here a VDC-NUS)
- Solder a bunch of wires to the video signal pins
 - You may use an adapter if you have a MAV-NUS or AVDC-NUS encoder (see README)
- Solder two additional wires one for 3.3V (can be picked off C141) and one for GND (large GND plain)
- Route all wires approximately to the MultiAV port



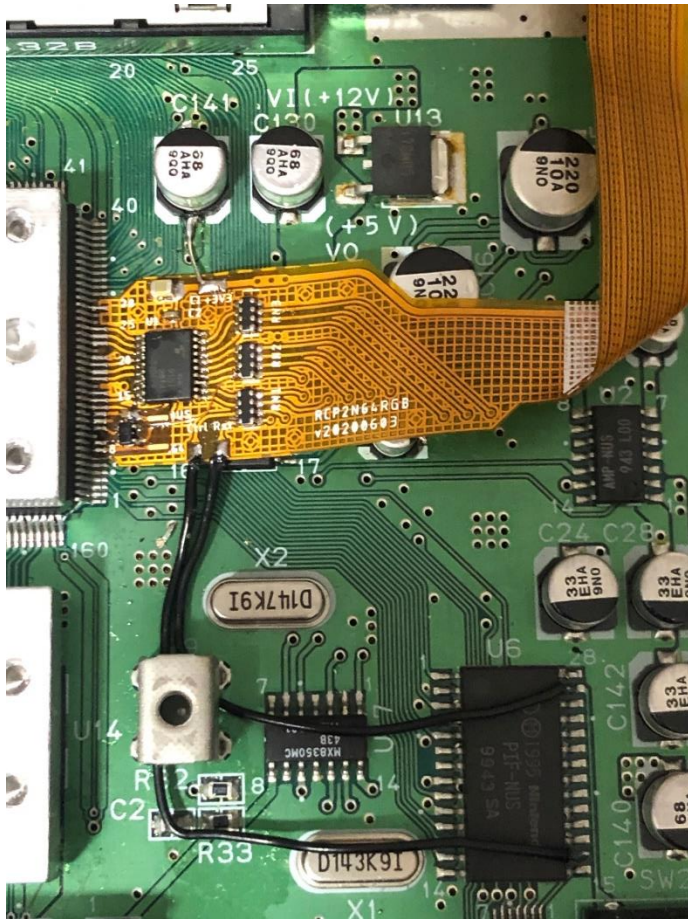
Solder Work – Console

-- Controller and Reset --



- All signals for the controller and the reset can be picked off the PIF-NUS which is located next to the reset button
- Solder the following wires:
 - One for reset (PIF-NUS pin 27)
 - One for the controller input
in my case: the marked via, sometimes also PIF-NUS pin 16
in any case: search for a suitable connection to the middle pin of controller port 1

-- Using the flex cable --

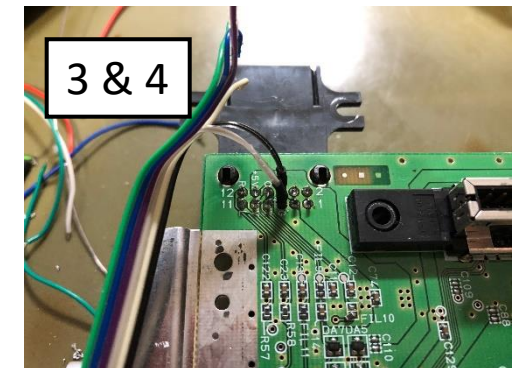
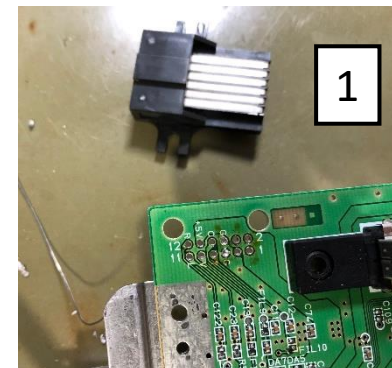
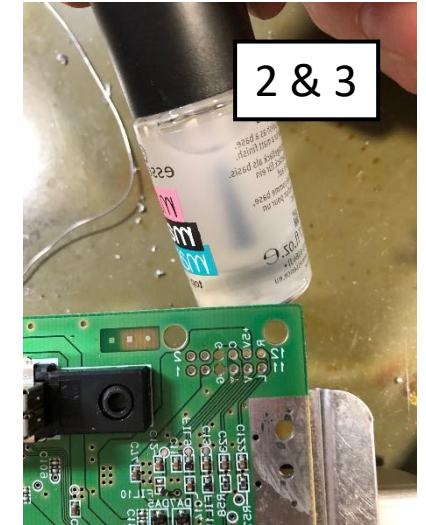
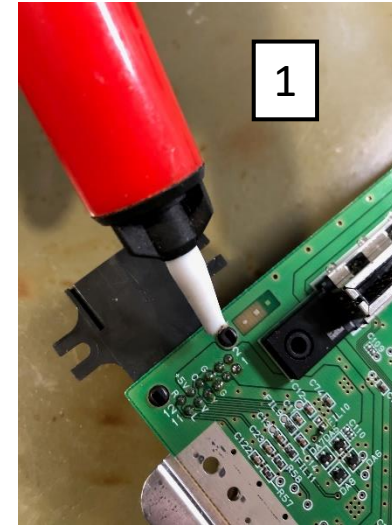


- If using the flex cable, solder the RCP connector side to the RCP-NUS as shown
 - first pin bottom – 8
 - last pin to – 28
- Connect 3.3V to the flex
 - e.g. taken from C141
- Connect Ctrl. and reset
 - reset from PIF-NUS pin 27
 - Controller from PIF-NUS pin 16
 - Make sure that PIF-NUS pin 16 is connected to the middle pin of controller port 1, otherwise search for a suitable connection point
- Note: when using the flex you need to cut the RF shield near the MultiOut as shown a few pages above

Solder Work – Console

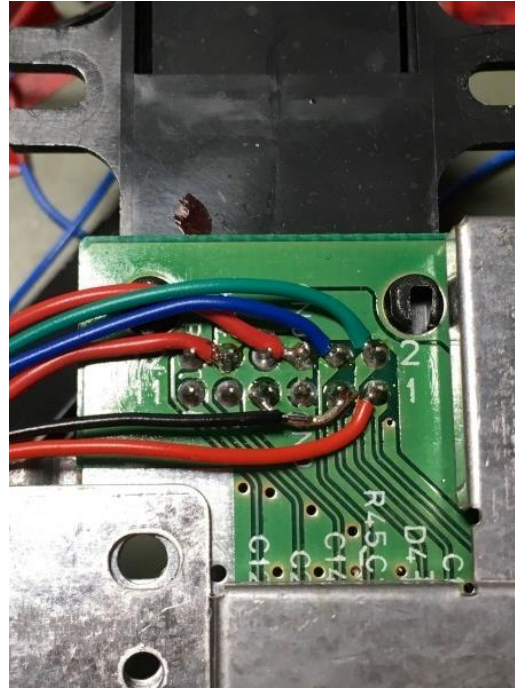
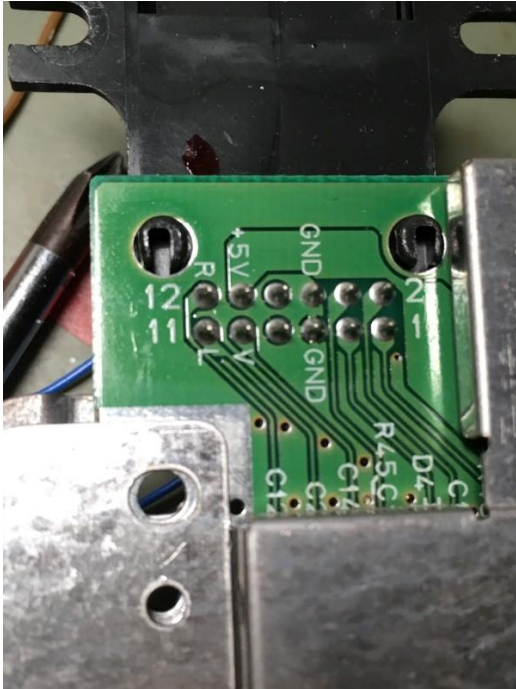
-- MultiAV port – GND insulation --

- This step is
 - **Recommended** for the N64RGBv1
 - **Optional** for the N64RGBv2 and N64Advanced, yet from the electrical point of view recommended
- Insulate the GND from the MultiOut:
 1. **Desolder** the MultiOut connector
 2. **Drill** out the GND pads
 3. **insulate** the drills (either with varnish or small shrink tubes) in case of tiny copper remains
 4. **Solder** MultiOut back into place
- Why is it needed?
 - By placing the modding board rather far away from the mainboard the installation creates a so called GND loop
 - If the GND loop is too long, some current (switching current) will flow to GND over signal wires, i.e. also over the video outputs which will be visible in distortions / noise
 - This is very dominant on the N64RGBv1 as the digital and analog circuit are supplied by 3.3V.
On the N64RGBv2 and N64Adv, the digital and analog part are supplied with 3.3V and 5V, respectively. So the effect is neglectable to my experience.



Solder Work – Console

-- MultiAV port – analoge video output --



- Prepare some wires for:

- Pin 1: Red / Pr
- Pin 2: Green / Y
- Pin 3: Sync *
- Pin 4: Blue / Pb
- Pin 5 / 6: GND
- Pin 7: Sync *
- Pin 10: +5V

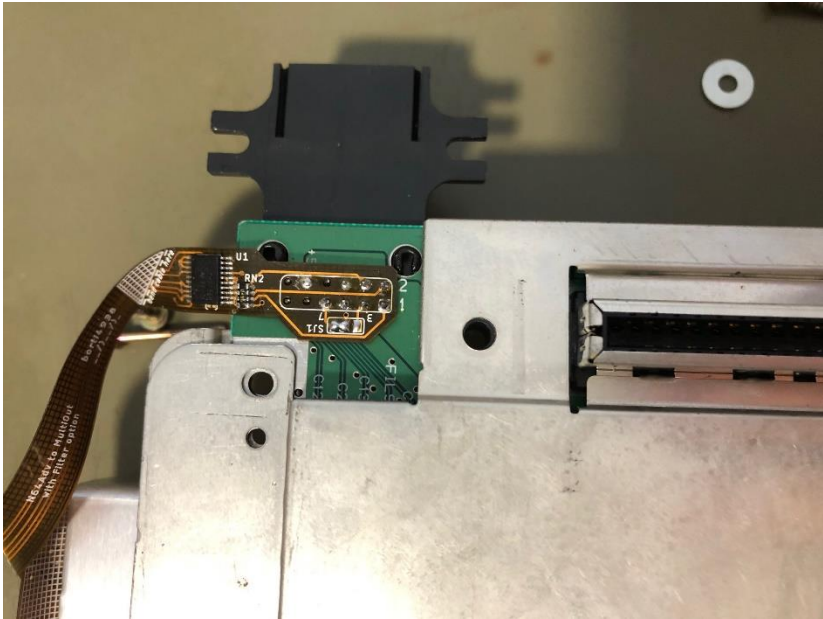
*** Sync:**

You need to take the composite sync out of the modding board. Depending on your RGB cable, you need to use pin 3 (sync on csync cable) or pin 7 (sync on luma cable). I soldered a bridge between both pins to make it useable with both types of cables.

Sometimes pin 3 / 7 is used in your stock console. **Make sure that the pin / these pins is / are unconnected.**

Solder Work – Console

-- MultiAV port – analog video output with flex cable--



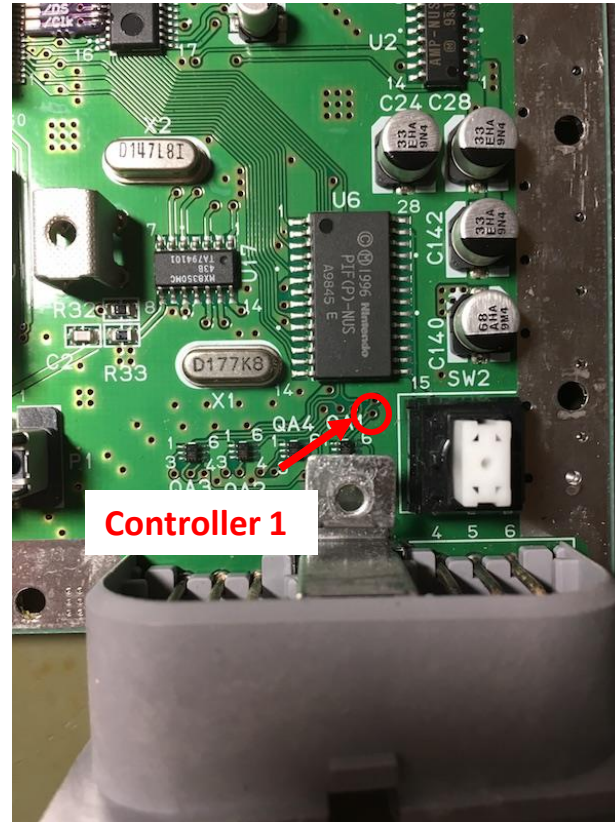
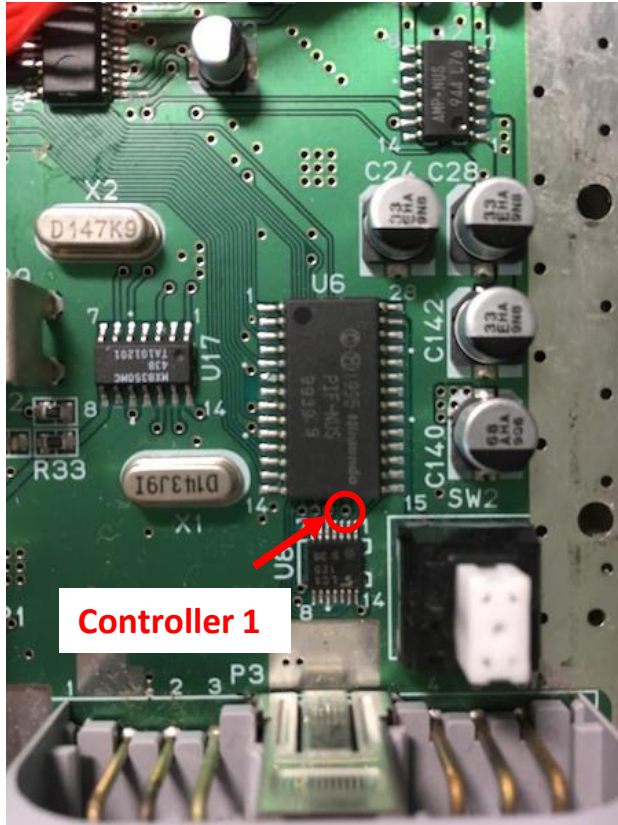
- Simply connect the flex cable as shown with the MultiOut
- Make sure that you prepared the GND as presented two pages above, ideally

* Sync:

You need to take the composite sync out of the modding board. Depending on your RGB cable, you need to use pin 3 (sync on csync cable) or pin 7 (sync on luma cable). Use SJ1 to determine this. You may close both sides of SJ1. Sometimes pin 3 / 7 is used in your stock console. **Make sure that the pin / these pins is / are unconnected.**

Solder Work – Miscellaneous

-- Other PIF-NUS configurations and proper Controller 1 solder points --



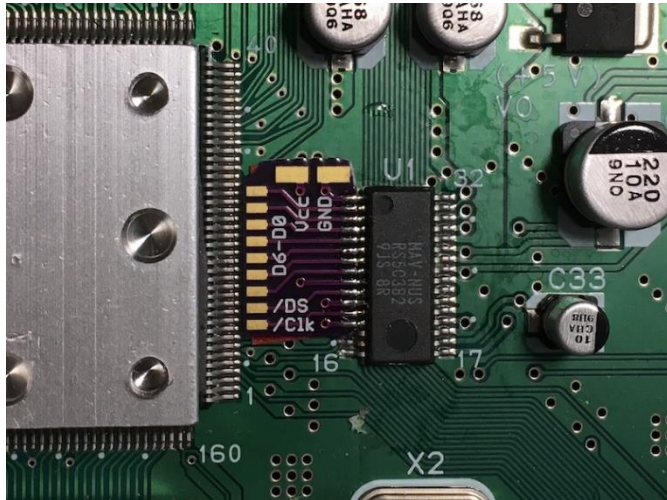
Solder Work – Miscellaneous

-- Break Out Adapter --

RCP2Pads

(no picture atm)

- RCP2Pads flex breakout
 - This flex is a small version of the RCP2N64RGB flex cable (e.g. use this to limit costs)
 - Connect the RCP2Pads in the same way as the RCP2N64RGB and use wires to connect the flexible break out board to the modding board.



- MAV-NUS break out (outdated)
 - The MAV-NUS and the AVDC-NUS have a small pitch of 0.8mm
 - You may want to use the MAV-NUS breakout board to work on a 1.27mm pitch
 - Check connectivity between the RCP-NUS and the pads on the breakout with a DMM
 - Check for adjacent shorts

Solder Work – Miscellaneous

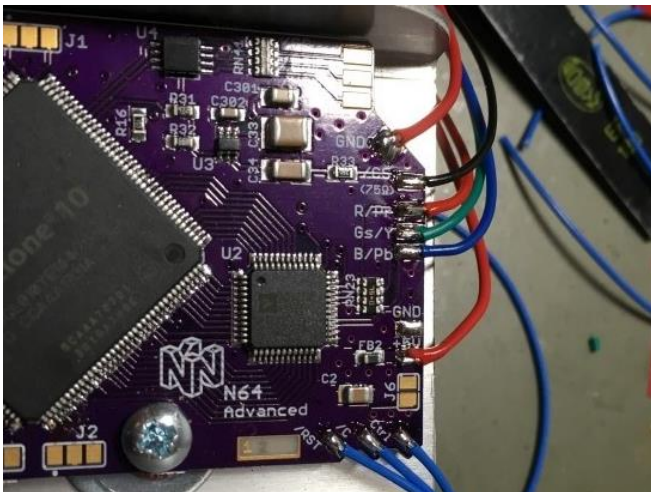
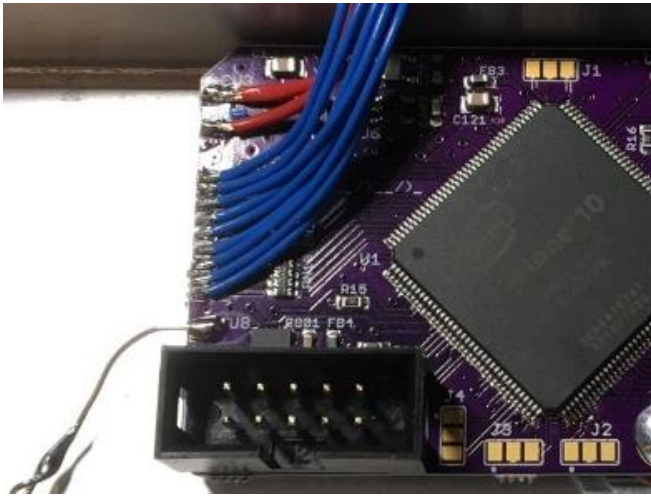
-- Marking wires --



- If you use loose wires as I do, you may mark them before you go on

Solder Work – Modding Kit

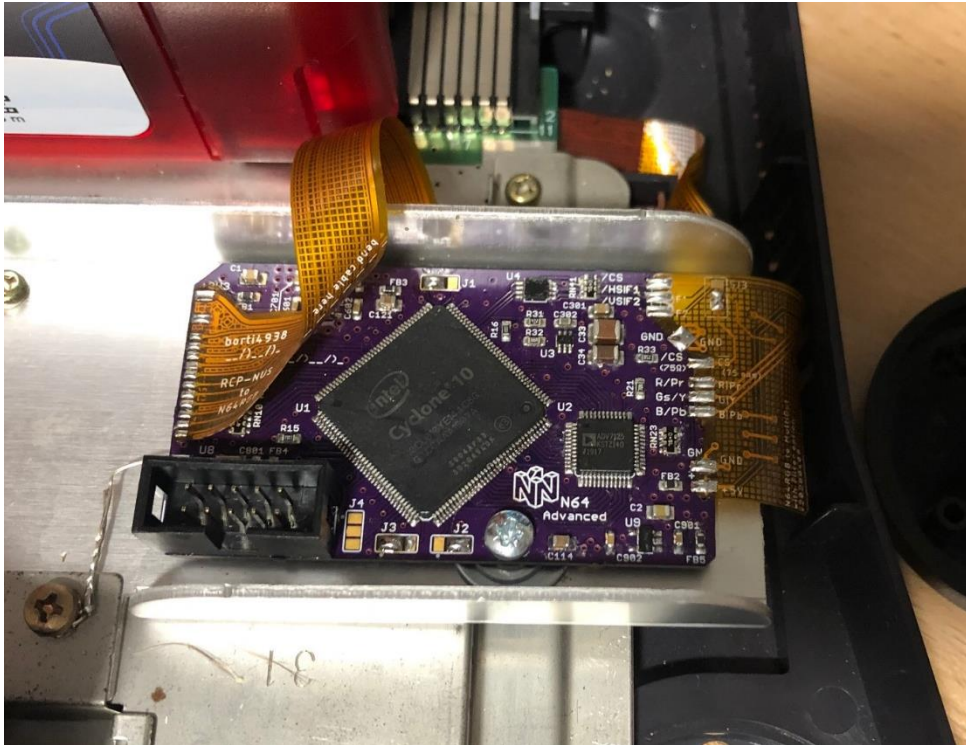
-- With wires --



- Reassemble the top RF shield and heat sink on top of the N64 mainboard
 - Make sure that you do not squeeze any of the wires you prepared
 - For that you cut and/or bend the taps of the RF shield
- Connect +3.3V and GND to the left hand side of the modding kit
- Connect /Rst., Ctrl. (Controller), the seven data lines and /DSYNC and VCLK to the appropriate pads
- Connect the video lines, GND and +5V to the right hand side of the modding kit
- set jumpers to finish your installation

Solder Work – Modding Kit

-- With Flexible Cables --



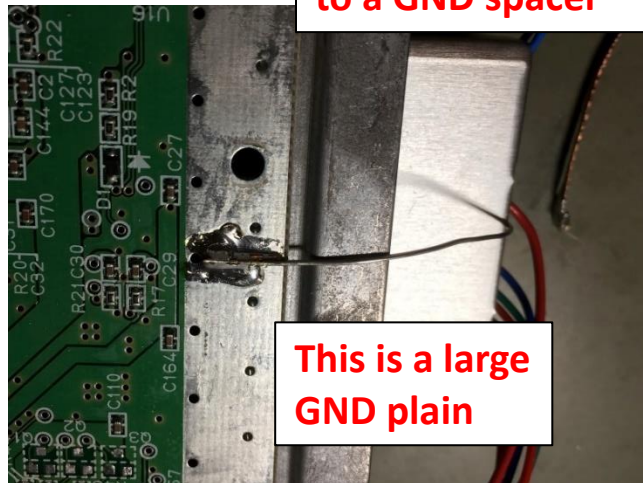
- With the full flex cables, you simply have to solder flex cables to the modding board
- Some hints:
 - Gently bend the cables as marked on silk screen
 - Check for adjacents shorts
- set jumpers to finish your installation

Solder Work – Modding Kit

-- Some extra GND --



This screw is connected to a GND spacer

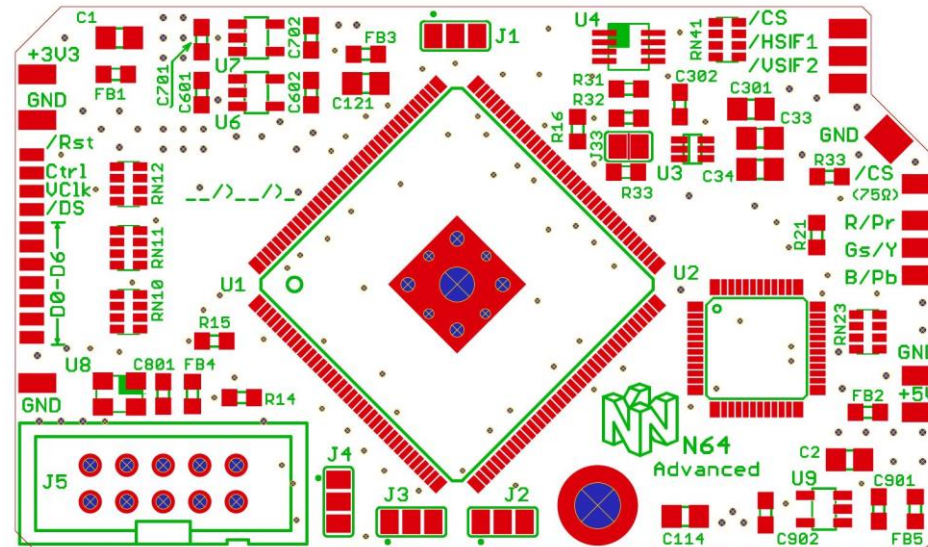


**This is a large
GND plain**

- To reduce the GND loop size, it is helpful to assemble some extra GND connections to the N64 mainboard
- If the GND is not properly designed between the N64 mainboard and modding kit some current out of the digital signals flows back to the N64 through the analog video connections. This causes visible noise!
- I assembled two extra connection: one on the left hand side of the modding PCB and one at the right hand side.

Settings – Solder Jumper (N64 Advanced)

J5: 10pin JTAG interface
for update firmware



J1: VGA sync / Filter AddOn

J1.1: - opened: output HS, VS and CS
(VGA output possible)

- closed: use filter addon

J1.2: - Use filter board in bypass mode
(e.g. to use it as a simple
NTSC output to PAL output conversion)

J33: C-Sync Level @ 75ohm termination
(/CS (75ohm) pad)

- opened: 1.87Vpp

- closed: 300mVpp (recommended)

J4: Linemode

J4.1: - opened: linedoubling enabled

- closed: no linedoubling
(beats J4.2)

J4.2: - opened: 480i pass through

- closed: 480i de-interlace (bob)

J3: Scanline strenght

(J3.2/J3.1) =

- (opened/opened): 0%

- (opened/closed): 25%

- (closed/opened): 50%

- (closed / closed): 100%

J2: RGB, RGsB, YPbPr

J2.1: - opened: RGB output

- closed: RGsB output

J2.2: - opened: RGB / RGsB output

- closed: YPbPr output (beats J2.1)

Note:

Some jumpers (J2, J3 and J4) are outdated since the menu driven fw. is up. However, J1.1 must be set if the filter board is used. The remaining jumpers are used to set defaults if the configuration cannot be loaded from flash (e.g. after a fw. update)

Notes for dual jumper:

- Jx.1 is always marked with a dot

- Closed reference is middle pad

Settings – Solder Jumper (N64 RGBv2.1)

J11: De-Blur with IGR active

J11.1: (only applicable with heuristic off)

- opened: default de-blur off
- closed: default de-blur on

J11.1: - opened: use de-blur heuristic

- closed: bypass de-blur heuristic

J12.1: IGR / Mechanical Switches

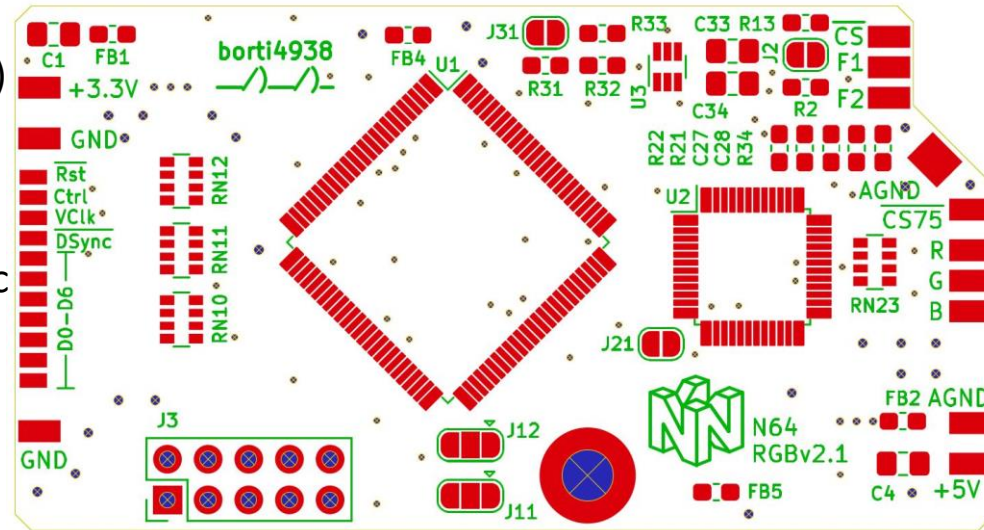
- opened: Use IGR (Ctrl. and /Rst)
- closed: Use switches at Ctrl. And /Rst pads

J12.2: 15bit mode default

- opened: 15 bit mode off by default
- closed: 15 bit mode on by default

Notes for dual jumper J11:

- J1#.1 is marked with an arrow
- Closed reference is middle pad



/Rst: Manual (only with J12.1 closed)

- opened: no de-blur or de-blur heuristic
- grounded: de-blur in any 240p case (beats heuristic)

Ctrl.: Auto (only with J12.1 closed)

- opened: bypass de-blur heuristic
- grounded: use de-blur heuristic

J2: Filtersetting (for Filter AddOn)

- opened: Use LPF
- closed: Bypass filter

J31: C-Sync Level @ 75ohm termination (/CS (75ohm) pad)

- opened: 1.87Vpp
- closed: 300mVpp (recommended)

J21: Sync on Green

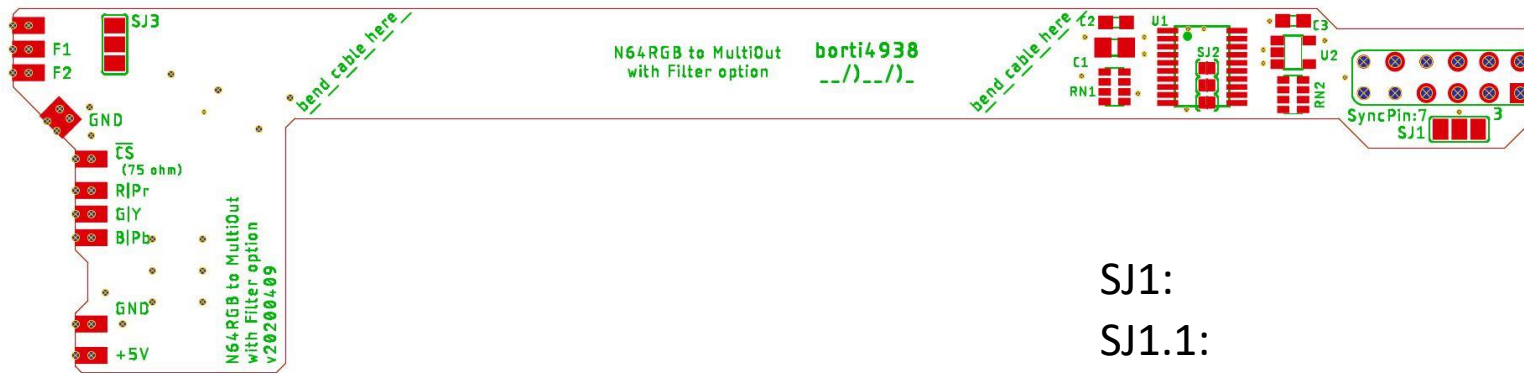
- opened: Don't use sync on green
- closed: Output sync on green

J3: 10pin JTAG interface for update firmware

Settings – Solder Jumper (N64 RGBv2.1)

SJ3: Sync source at the modding board

- J3.1: Use TTL C-Sync
- J3.2: Use 75ohm Sync
- Never use both!



SJ2: flex setup

- close all three jumper if you do not use the filter assembly

SJ1:

SJ1.1:

- closed: forward sync to pin 7 of the MultiOut

SJ1.2:

- closed: forward sync to pin 3 of the MultiOut

Notes for TTL sync:

- Sync signal comes from a 5V line driver with 75ohm output.
- In order to attenuate this for 75ohm termination, you have to have a 225ohm – 1.1kohm resistor in your cable

Notes for dual jumper SJ1 and SJ3:

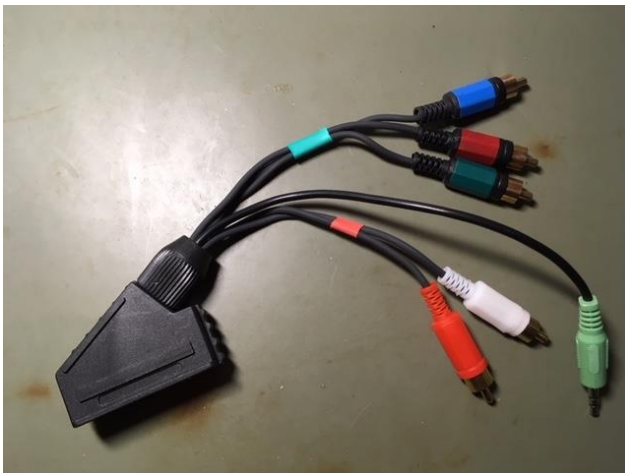
- J#.1 is where the designator is
- Closed reference is middle pad

Cable Setup

-- N64RGBv2.1 and N64 Advanced --

Name	MultiAV	SCART plug	Ref. GND in SCART	Cinch plugs	Notes
Red / Pr	1	15	13	Red plug	Using a 220uF cap in series is possible
Green / Y	2	11	9	Green plug	Using a 220uF cap in series is possible
Blue / Pb	4	7	5	Blue plug	Using a 220uF cap in series is possible
Sync	3 or 7	20	17	Not needed	Consider notes on next page
GND	5, 6	4, 5, 9, 13, 17, 18, 21		To outer ring of each plug	Pin 21 @ SCART plug is outer shield
+5V	10	16	18	Not needed	Use a 180ohm resistor in series
Audio left	11	6	4	Red plug	
Audio right	12	2	4	White plug	

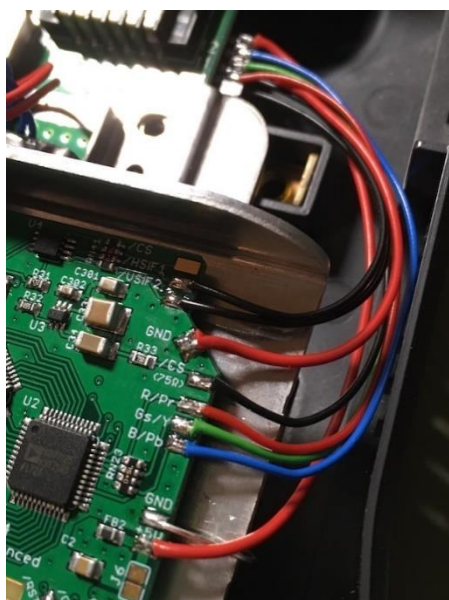
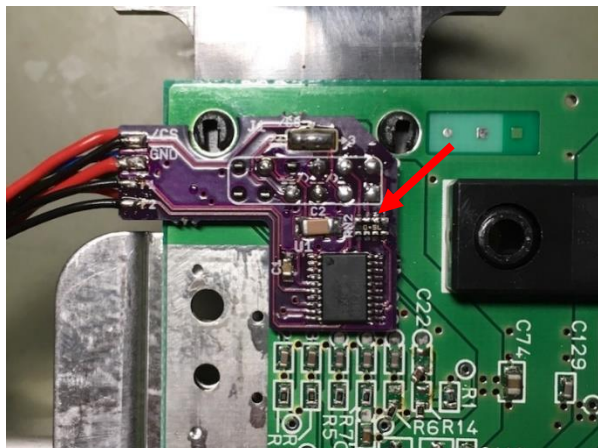
Cable Setup



- Notes on Sync:
 - **I recommend using the 75ohm compatible csync output.**
 - If you do so then run a straight wire through your cable for sync.
 - If you use TTL sync output, you have to add an additional resistor in series (N64RGv2: 0ohm to 900ohm; N64A: 270ohm to 1.1kohm) to attenuate the signal for 75ohm terminated destinations.
- RGB cables:
 - If you buy an RGB cable, buy a typical RGB cable for a NTSC SNES with sync on luma (MultiAV pin 7) or sync on csync (MultiAV pin 3).
 - If you bought a raw csync cable and if you use the 75ohm output, remove / short the resistor which is possibly installed in the sync trace.
- RGsB / YPbPr Cables:
 - With the given table you should be able to build your own component cable or to build an adapter (see pictures on left side)
 - Unfortunately, there are no cables / adapter to bought.

Cable Setup

-- Filter Add On for the N64RGBv2.1 and N64 Advanced --



- Use the Filter AddOn if your ADC device does not apply input filtering (e.g. some capture cards)
- Solder the board onto the MultiAV and decide where /CS has to go – pin 3 and/or pin 7 – depending on your setup
- All connections to the N64RGBv2 and N64A are labeled
- A note on PAL SNES RGB cables:
 - By default the N64RGBv2 and N64A are not suitable to use it with PAL SNES RGB cables
 - By using the Filter AddOn board one can convert the output such that it is possible to buy a stock PAL SNES RGB cable (with sync on luma)
 - Just use the Filter Addon board and use a 390ohm resistor array at the output (RN2, marked with a red arrow; on the flex cable, it's also RN2)
- N64RGBv2.1
 - Use J2 to use or to bypass the filter
- N64 Advanced:
 - Remind to set J1.1 on the N64A
 - Set J1.2 if you want to have the filter off, e.g. in the case you simply want to use a PAL SNES RGB cable (actually they will be set to 95MHz cut-off, which is way above the video content)

Controller – In Game Routines



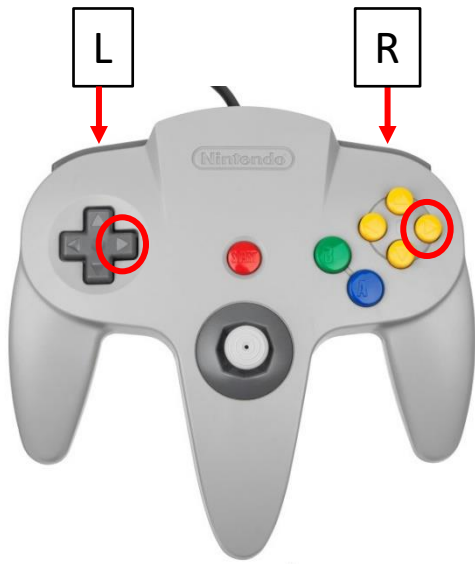
Basis for all button combinations

- The controller is able to trigger a reset or to change de-blur and 15bit mode option
- Button combination: **Start + R + Z + ...**
 - ... **A + B** : trigger a reset
 - ... **C-ri** : de-blur for 240p on
 - ... **C-le** : de-blur for 240p off
 - ... **C-up** : 15bit mode off
 - ... **C-dw** : 15bit mode on

Notes:

- Controller is only read if the actual game reads the controller
- Switching de-blur overwrites the heuristic estimation.
De-blur option is reset with each triggered reset and power cycle
- 15bit mode is reset with each power cycle
- N64A: buttons has to be enabled in menu

Menu (N64A only)



Open menu button comb.

- To open the menu press **Ri + L + R + C-ri**
- Use **Le + L + R + C-le** at every menu page to close menu or simply press **B** until menu has been closed
- Once the menu is open you have the following sub menu pages available:
 - Video-Info (shows current video processing state)
 - Configuration (configure video output)
 - Miscellaneous (configure in-game reset and quick access to deblur and 15bit mode)
 - Load/Save (save config to flash and load from flash, jumpers and N64 defaults)
 - About... (some information about the modding kit)
 - Acknowledgment... (thankfully words to some people who helped me)
 - License... (license)

Menu (N64A only) – Navigation

To navigate through the menu you are can use ...

- **D-pad up** or **down** to *select the submenu* you want to enter / *option* you want to modify
- **D-pad left** or **right** to *change an option*
- **A** or **D-pad Ri** to *enter a submenu*
- **B** to *leave a submenu* (close menu on top level menu)
- **Le + L + R + C-le** to *close menu*
- **Z + L** to *mute the menu* (menu overlay disappears as long as combination is pressed)

Notes:

- At the moment the Analoge Stick is not supported to drive the menu.

Menu (N64A only) – Conf. Options Explained

Menu Point	Description
Linedoubling – LineX2	Enables linedoubling from 240p to 480p
Linedoubling – 480i de-int. (bob)	Enables additional linedoubling from 480i to 480p - Only available if LineX2 is enabled
Linedoubling – Scanlines	Enters scanline options - Only available if LineX2 is enabled - Scanlines are only applied in linedoubling mode for 240p content
Output Format	Select between: - RGBS (separate sync) - RGBs / RGsB (sync on green or on separate sync) - YPbPr
240p Deblur	Select between Always, Auto and Off - On Auto mode the FPGA tries to estimate if N64 outputs 320x240 or 640x240 and activates DeBlur method on demand
15bit mode	Select between On and Off - In 15bit mode the color depth is reduced from standard 21bit (7bit per color) to 15bit (5bit per color) by simply cut off the LSBs
Gamma Value	Apply gamma curve on output with $I = (I_{in})^\gamma$, where I_{in} is the input intensity and γ the gamma value

Menu (N64A only) – Scanline Options Explained

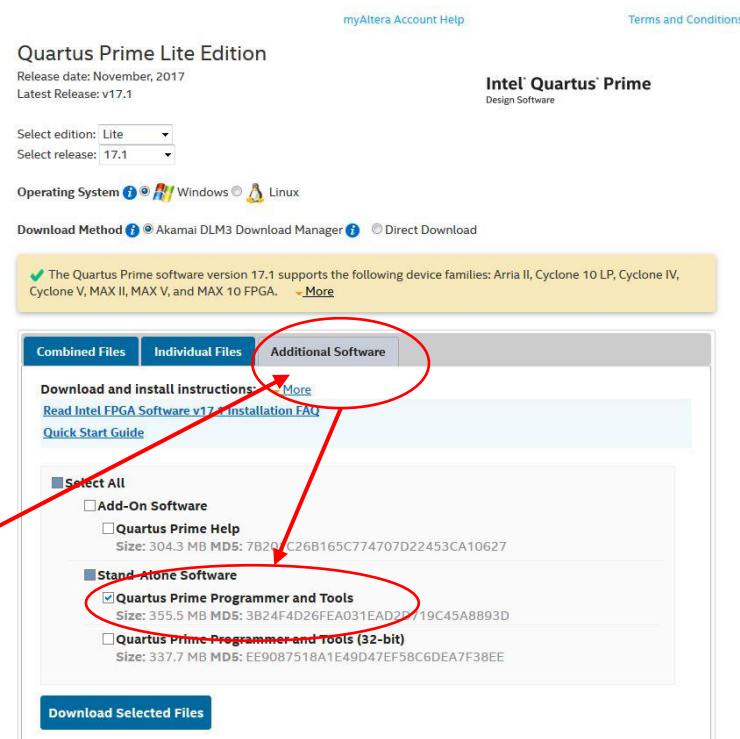
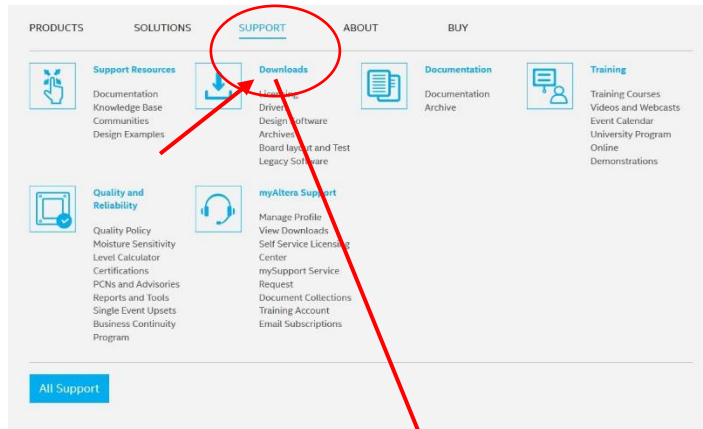
Menu Point	Description
Use Scanlines	Enables scanlines for linedubbed 240p content
Scanline ID	Choose between even and odd
Scanline Stength	Select the scanline strength with $I = s \times I_{in}$, where s is the scanline strength and I_{in} the pixel intensity
Hybrid Depth	Make scanline strength pixel-intensity dependent <ul style="list-style-type: none">- 0% means that scanlines are calculated as setup- 100% means that scanlines strength is reduced to 0 for maximum pixel intensity- (> 100%) means that scanline strength is reduced to 0 prior to maximum pixel intensity- (< 100%) means that scanlines are always drawn but slightly reduced with increasing pixel intensity
Show Sl. In OSD	Select between On and Off

Menu (N64A only) – Misc. Options Explained

Menu Point	Description
In-Game Routines - Reset	Enables in game reset button combination
In-Game Routines – Quick Access	Enables in-game routine for deblur and/or 15bit mode
Filter Add-On – Filter Cut-Off	Select the filter cut-off for the filter add-on board <ul style="list-style-type: none">- Jumper J1.1 has to be closed to have access to this option- Select between Auto, 9.5MHz, 18MHz and bypassed- Bypassed is actually not bypassed; it's 72MHz filter cut-off which is virtually a bypassed filter for SD and ED content

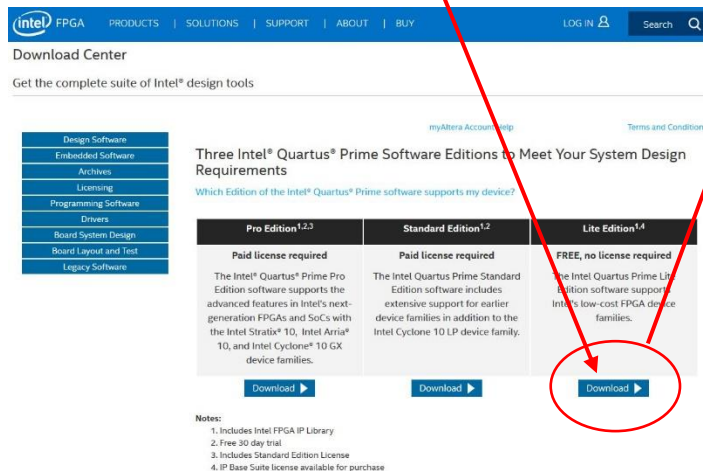
Firmwareupdate

-- Download the software tools --



1. Go to altera.com and select “Downloads” from the “SUPPORT” menu
2. Select “Download” from the “Light Edition” column of the “Design Software” (preselected)
3. Go to “Additional Software”
4. Download the “Quartus Prime Programmer and Tools software

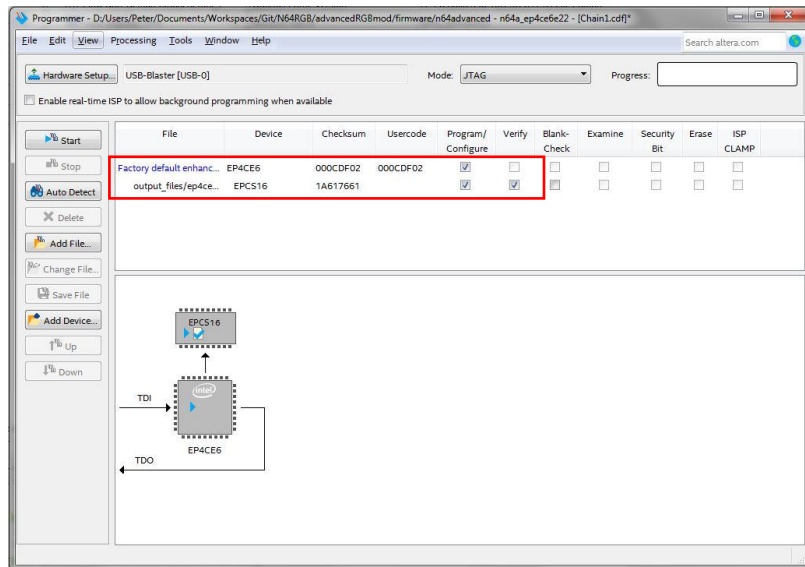
If you have the Quartus Prime edition installed, the programmer tools are already available on your computer.



Date: 22.11.2017
Website layout may change

Firmwareupdate

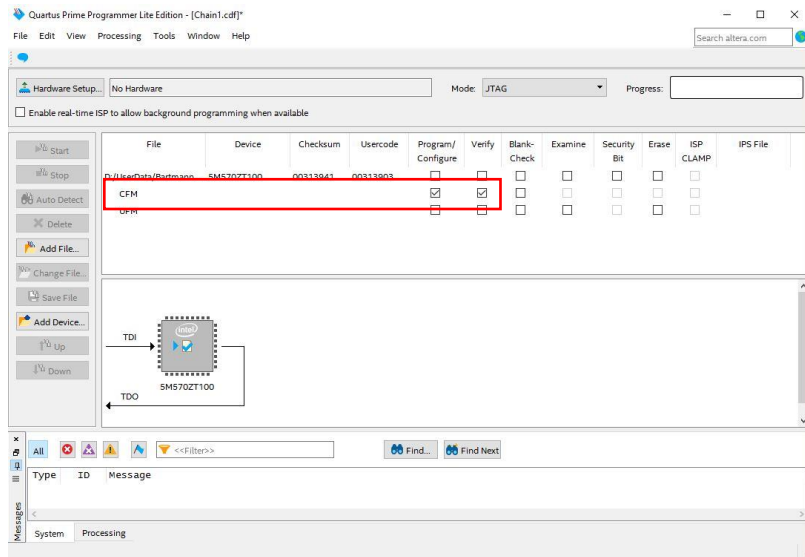
-- Update your N64 Advanced --



- Connect your PC with the USB Blaster and the USB Blaster with the modding kit J5
- Download the actual firmware build from the GitHub repository folder
advancedRGBmod/firmware/output_files/*yourFPGA*/n64_a_*yourfpga*.jic
- Open the programmer tool
- Load the previously downloaded JIC file with “Add File...”
- Check “Program/Configure” for the FPGA and “Program/Configure” and “Verify” for the Flashdevice
- Make sure that the USB Blaster is selected in the “Hardware Setup”
- Click on “Start” (the N64 has to be powered for the reference voltage) and wait for the process to be finished
- Power cycle your N64 and enjoy :)

Firmwareupdate

-- Update your N64 RGB --



- Connect your PC with the USB Blaster and the USB Blaster with the modding kit J10
- Download the actual firmware build from the GitHub repository folder
generalRGBmod/firmware/output_files/v#/n64rgb_yourcpld.pof
- Open the programmer tool
- Load the previously downloaded POF file with “Add File...”
- Check “Program/Configure” and “Verify” for the CFM part of your device
- Make sure that the USB Blaster is selected in the “Hardware Setup”
- Click on “Start” (the N64 has to be powered for the reference voltage) and wait for the process to be finished