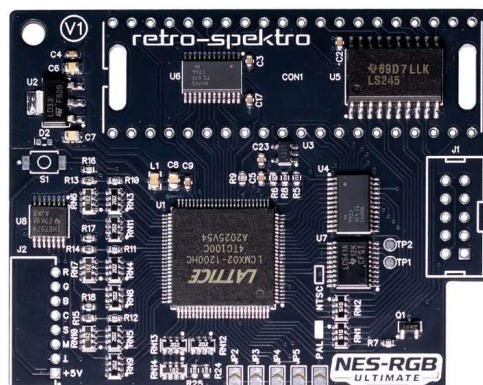


NES-RGB ULTIMATE

INSTALLATION GUIDE

FPGA RGB VIDEO UPGRADE FOR NES / FAMICOM

- TRUE RGB OUTPUT
- FPGA VIDEO PROCESSING
- MULTIPLE PALETTES
- SCART / MINI-DIN SUPPORT
- PAL & NTSC COMPATIBLE



OVERVIEW

NES-RGB Ultimate is a hardware FPGA-based video solution designed for Nintendo Entertainment System consoles. The module replaces the original video generation path with a modern programmable logic implementation while preserving authentic hardware operation.

KEY ADVANTAGES

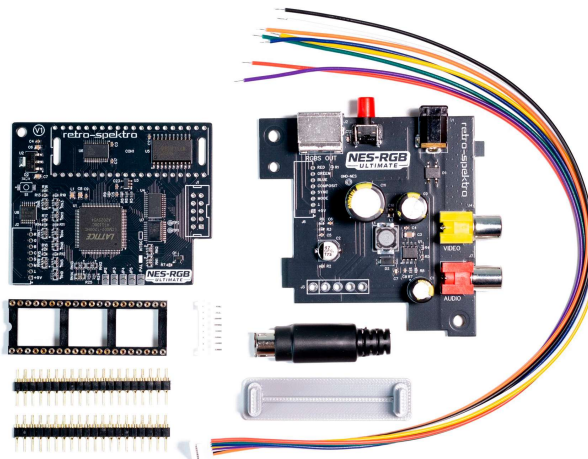
- FPGA hardware implementation
- Clean RGB video output
- Multiple selectable palettes
- Compact installation design, no hole drill
- Optimized power module



WARNING Installation requires soldering skills and electronic repair experience

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REQUIRED TOOLS



Soldering iron
Fine Tip, 100W



Solder
(Leaded)



Flux



Desoldering Braid



Flush Cutters



Screwdriver
(PH Philips)



Isopropyle
Alcohol (IPA)



Desoldering
Pump

01 Introduction

NES-RGB Ultimate is an FPGA-based hardware video solution for Nintendo Entertainment System consoles. It is not software emulation and reproduces video timing in dedicated programmable logic.

Unlike traditional RGB modifications that rely on stacking an additional board directly above the original PPU, NES-RGB Ultimate replaces the video generation stage with a modern FPGA-based solution, eliminating many of the analog limitations and artifacts inherent to the original hardware design.

FEATURES

Clean RGB video output

No vertical jailbars, banding, or color interference commonly associated with the original PPU architecture.

True hardware implementation – not software emulation

The video subsystem is recreated in dedicated FPGA logic hardware, providing deterministic timing and authentic console behavior without emulation layers or software rendering.

Clean Composit video output

The composite signal is recreated using FPGA logic hardware and output to an 8-pin connector, as well as to a standard RCA jack on the side of the console.

FPGA video processing

Modern Lattice FPGA implementation recreates the video output path with exceptional signal integrity and stability.

Improved Audio Output

The sound is used from the console's main processor, with a filter applied to reduce noise from the digital logic.

Multiple selectable palettes

Instant palette switching support with carefully tuned color profiles inspired by classic CRT displays and studio monitors. One-button switching, default palette selection using jumpers.

Minimalist integrated design

No bulky daughterboards mounted above the PPU.

No fragile flying wires across the motherboard.

No case drilling, only original holes used.

Simple installation

The module installs directly in place of the original chip and requires only connection to a dedicated clean power source.

Optimized power architecture

Custom filtered power section with low-noise regulation for improved image stability and reduced interference.

Designed for modern displays

Built specifically for today's RGB monitors, scalars, OSSC/RetroTINK setups, and professional video equipment where original composite artifacts become highly visible.

02 Prepare

NES Front Loader (NES-001) Disassembly

Before starting the installation, turn on the console and check its operation.

Required Tools

- Phillips screwdriver #1 or #2
- Small container for screws

Step 1 – Remove Outer Shell

1. Disconnect all cables and remove any cartridge.
2. Turn the console upside down.
3. Remove the six Phillips screws from the bottom of the case.
4. Turn the console upright and lift off the upper cover.

Step 2 – Remove RF Shield

1. Locate the upper metal RF shield.
2. Remove the seven screws securing the shield.
3. Lift the RF shield away from the console.

Step 3 – Remove Cartridge Loading Mechanism

1. Remove the six screws securing the cartridge tray.
2. Note the locations of any longer screws for reassembly.
3. Lift out the loading mechanism and set it aside.

Step 4 – Remove 72-Pin Connector (Optional)

1. Grasp the cartridge connector firmly.
2. Pull it straight away from the motherboard while gently rocking it side to side.
3. Set the connector aside for cleaning, replacement, or modification.

Step 5 – Remove Mainboard

1. Disconnect the controller and power/reset harness connectors.
2. Lift the motherboard from the lower shell.

Step 6 – Installation Ready

The console is now fully disassembled and ready for:

- NES-RGB Ultimate installation
- Capacitor replacement (optional)
- PPU removal
- Connector servicing

03 PPU Removal

Before installing the NES-RGB Ultimate module, locate the original Picture Processing Unit (PPU) on the motherboard.

The PPU is a 40-pin DIP integrated circuit manufactured by Ricoh and is typically marked with one of the following part numbers:

- RP2C02
- RP2C02A
- RP2C02B
- RP2C02C
- RP2C02D
- RP2C02E
- RP2C02G
- RP2C02H
- RP2C07
- RP2C07A

The PPU is located adjacent to the cartridge connector and is usually labeled "RP2C02" (NTSC systems) or "RP2C07" (PAL systems).

To install the NES-RGB Ultimate module, the original PPU must be completely removed from the motherboard.

Important: Verify the part number before proceeding. Do not remove the CPU or any other integrated circuit.

Required Tools

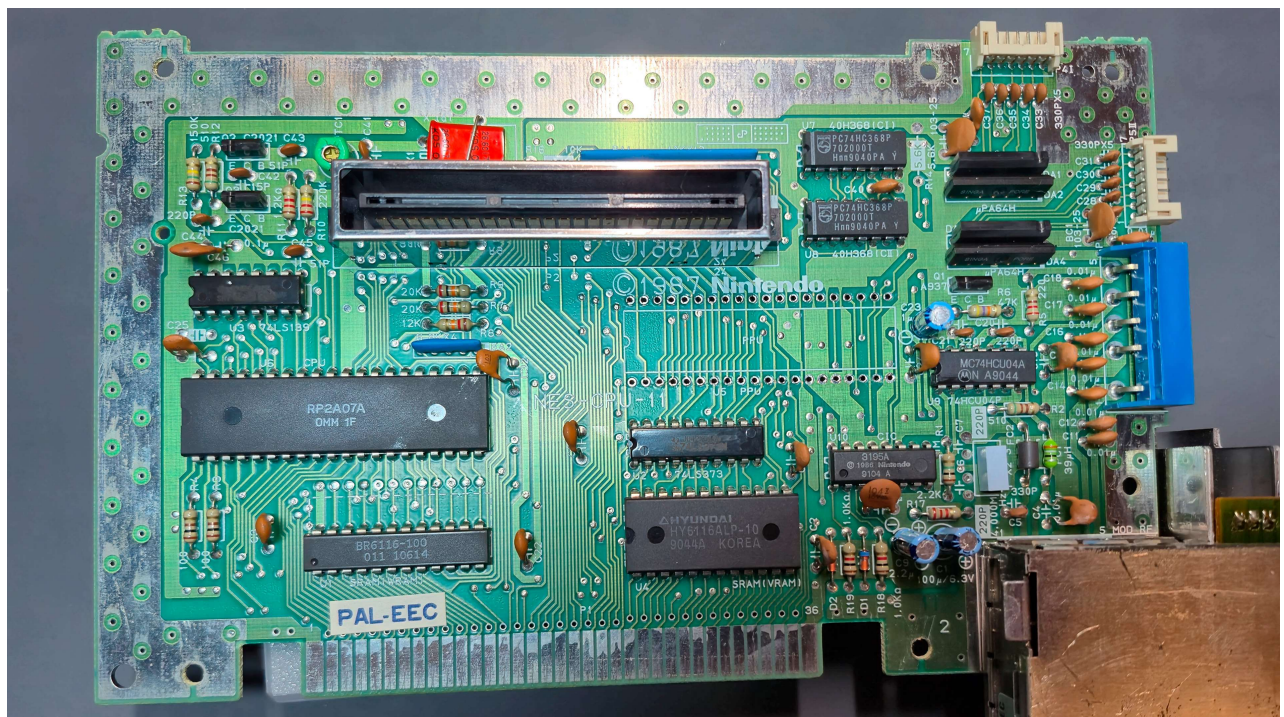
- Soldering Iron, fine tip
- Solder
- Desoldering Braid
- Flux

Step 1 – Desoldering PPU

1. Locate PPU chip, put new solder on each contact.
2. Apply a thin layer of flux to the contact pads on the back of the board and use a solder braid to remove all the solder from the contacts.

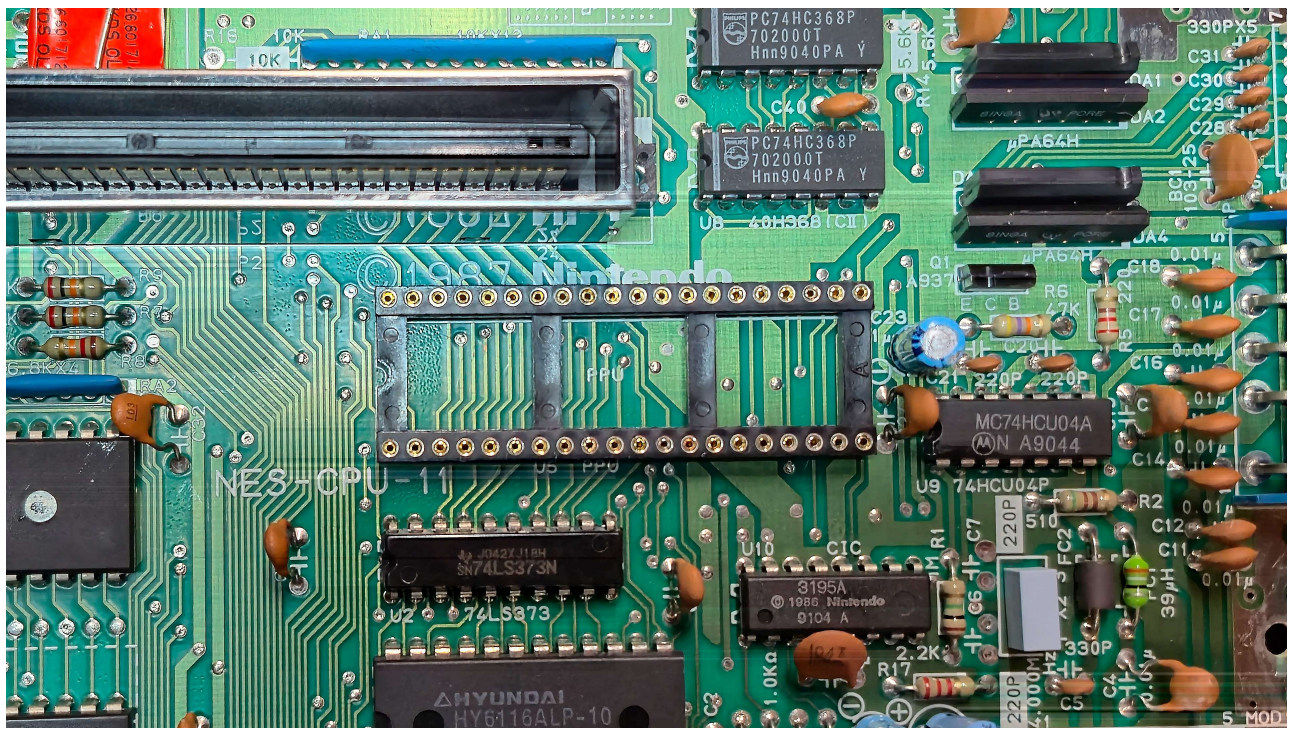


3. Do the same on the other side of the board, facing the chip.
Be careful, the board has through-hole metallization; gently apply the solder braid to avoid damaging the solder traces.
4. Carefully remove the chip and wipe the soldering areas with isopropyl alcohol on both sides, inspect the holes and tracks for breaks.



Step 2 – Install DIP 40 Socket

1. Place the DIP 40 collet panel onto the chip, holding it in place with your hand or using a bluestack.



2. Solder the panel into place.

Step 3 – Checking functionality

1. Align the PPU pins and clean them of solder using a soldering iron and flux. Wipe them with isopropyl alcohol.
2. Install the PPU into the DIP 40 panel.



3. Connect the controllers and the power connector, turn on the console and check its functionality.
4. Remove the PPU.

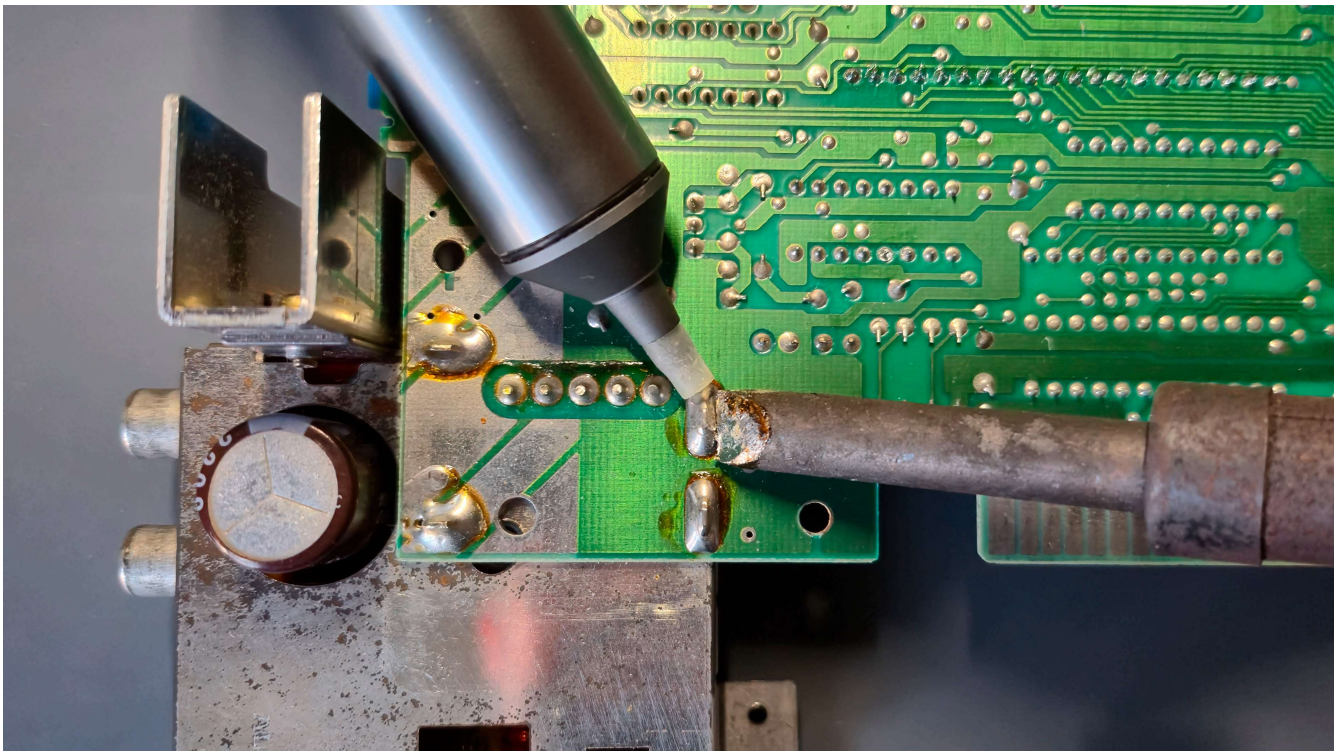
04 Power Supply Removal

Required Tools

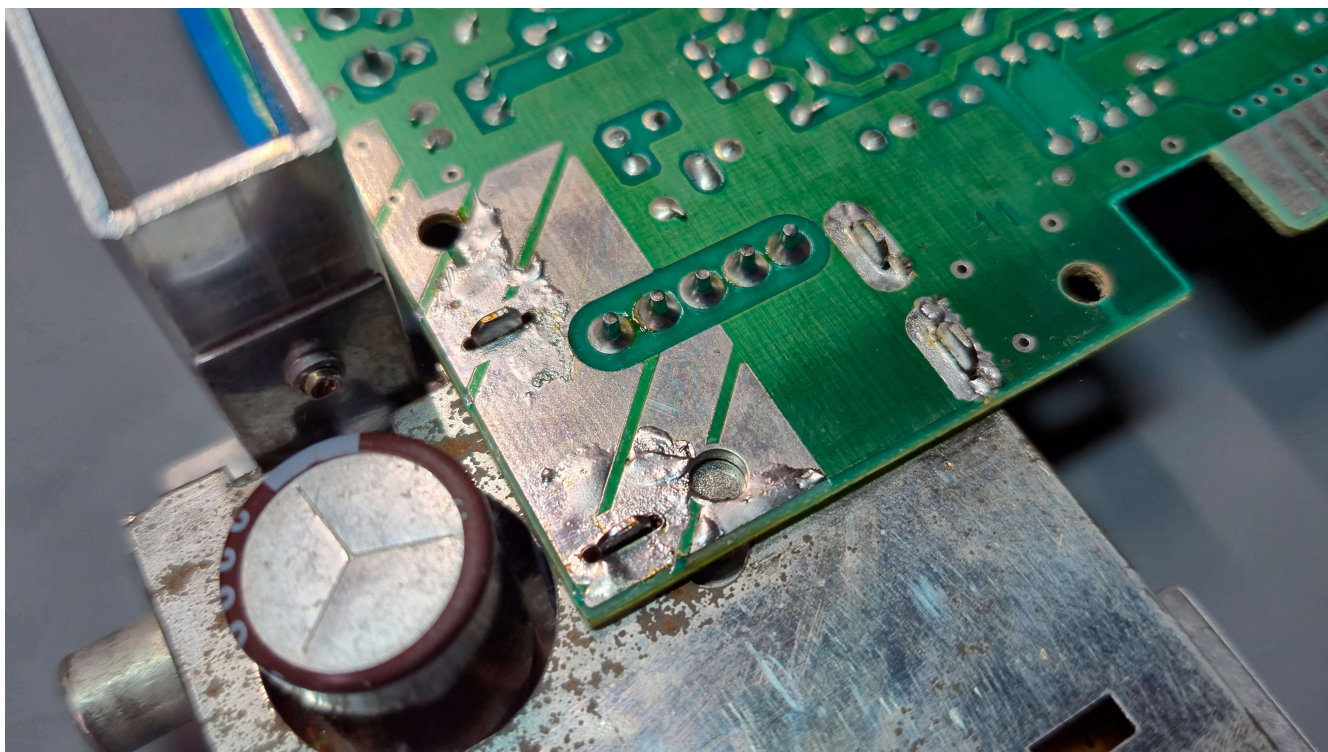
- Soldering Iron, 100W
- Solder
- Desoldering Braid
- Flux

Step 1 – Desolder Shild Contacts

1. Use a soldering iron with at least 100 watts of power. Apply fresh solder to the contact areas.



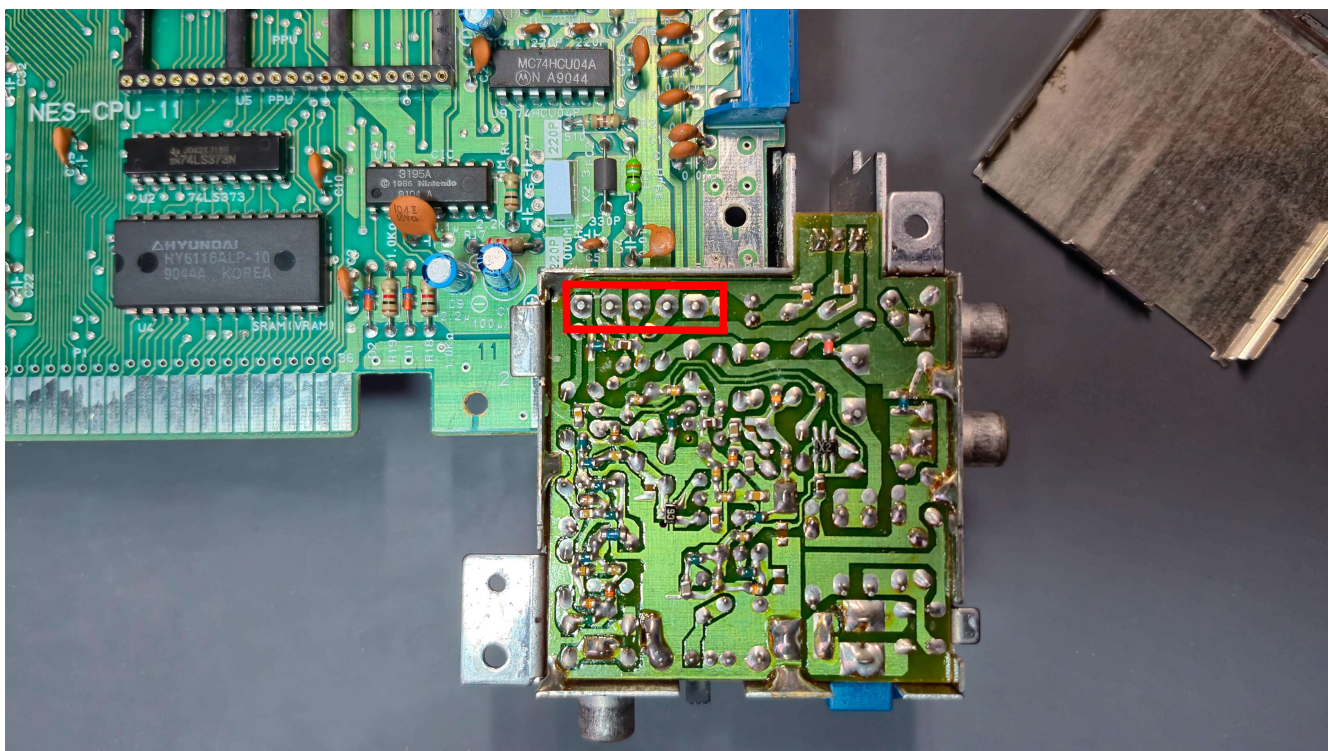
2. Desolder four contacts of the power supply (modulator) on the bottom of the board. Use flux, a desoldering tool, and desoldering braid.



View of desoldered contacts

Step 2 – Desolder main connector

1. Turn the board over and lift it up with a screwdriver and remove the power supply cover.



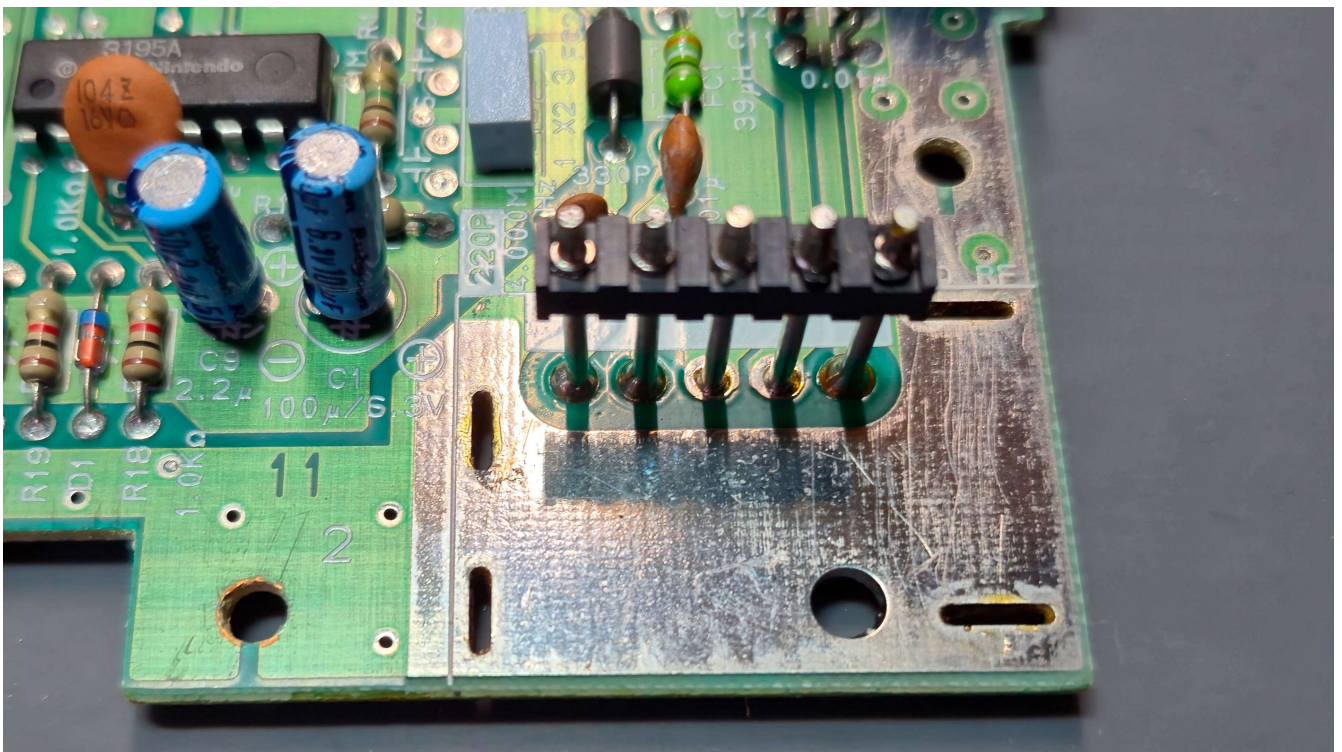
2. Apply fresh solder to the contact areas
3. Desolder five contacts of the power supply (modulator) on the top of the board. Use flux, a desoldering tool, and desoldering braid.



View of desoldered contacts

Step 3 – Remove Power Supply

1. Remove the power supply from the main board.



05 NES-RGB Power Supply Installation

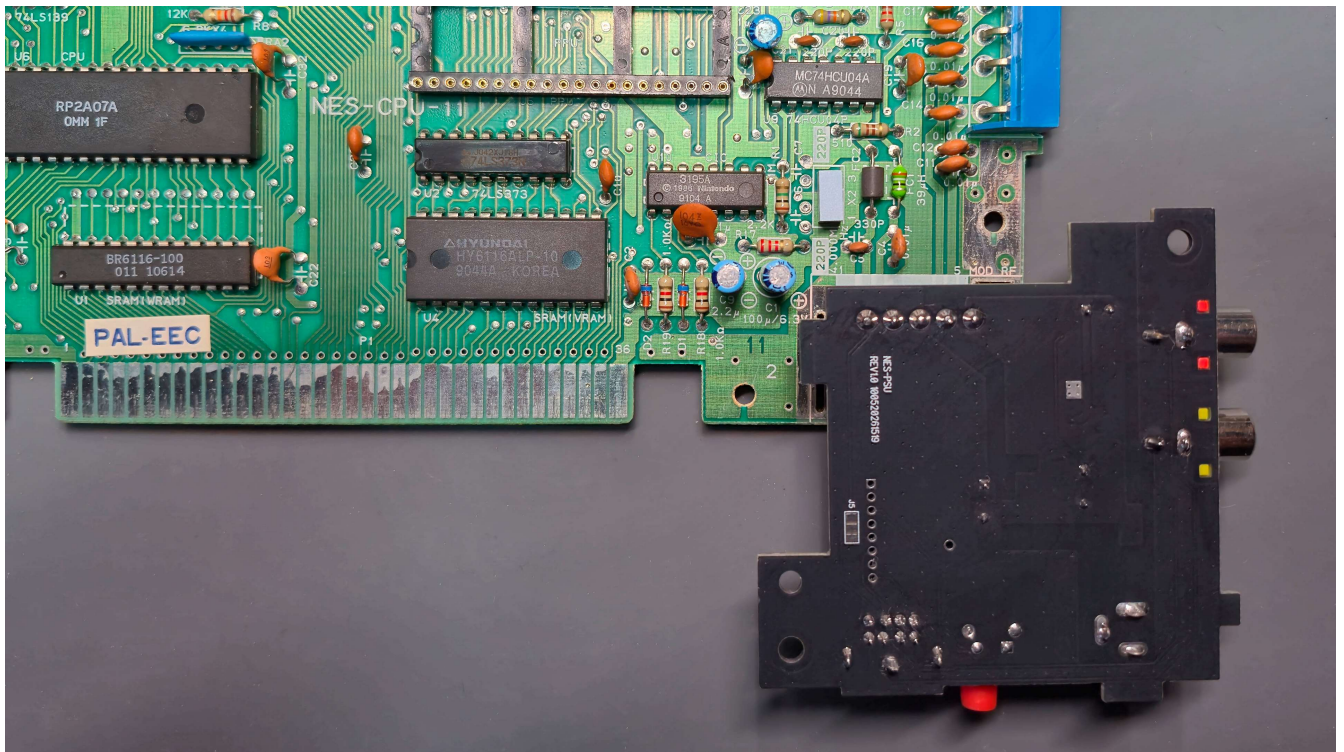
Required Tools

- Soldering Iron, fine tip
- Solder

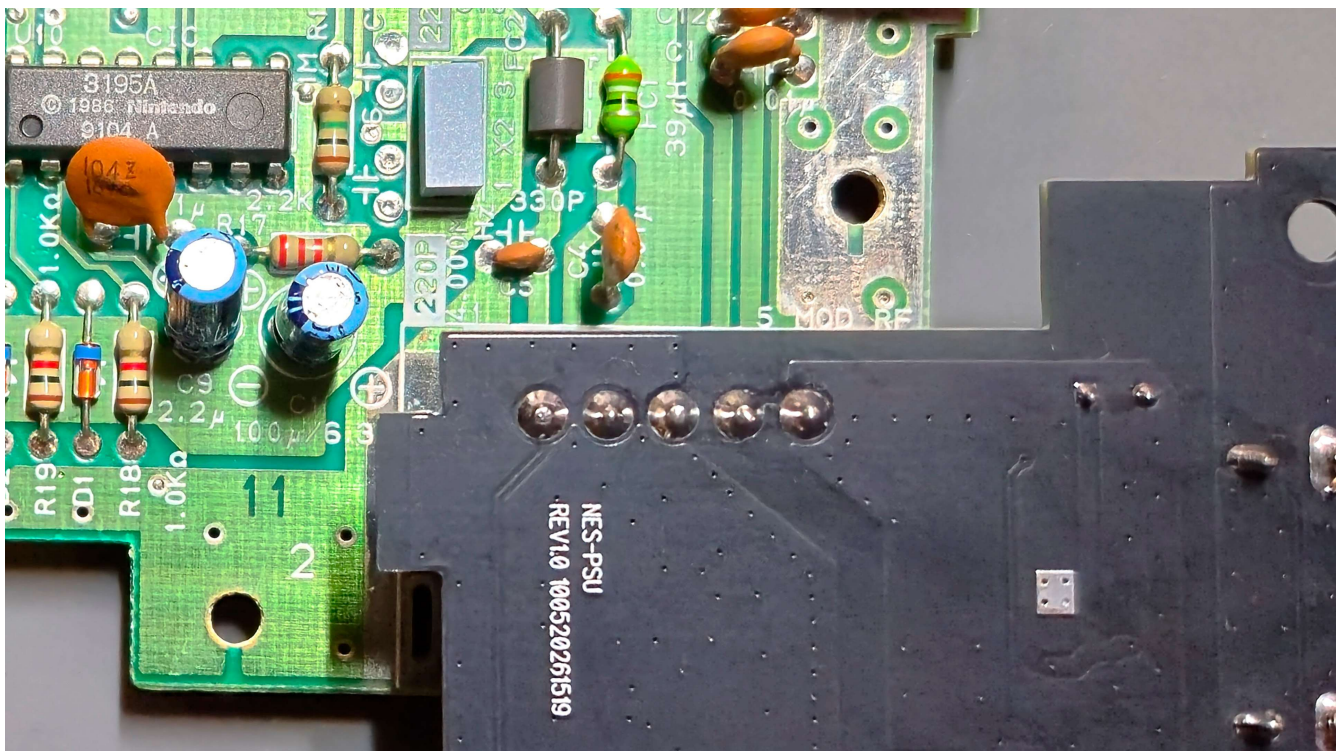
- Flux

Step 1 – Install NES-RGB Power Supply module

1. Place the power supply board onto the five pins of the main board. Align both boards so they are horizontal.

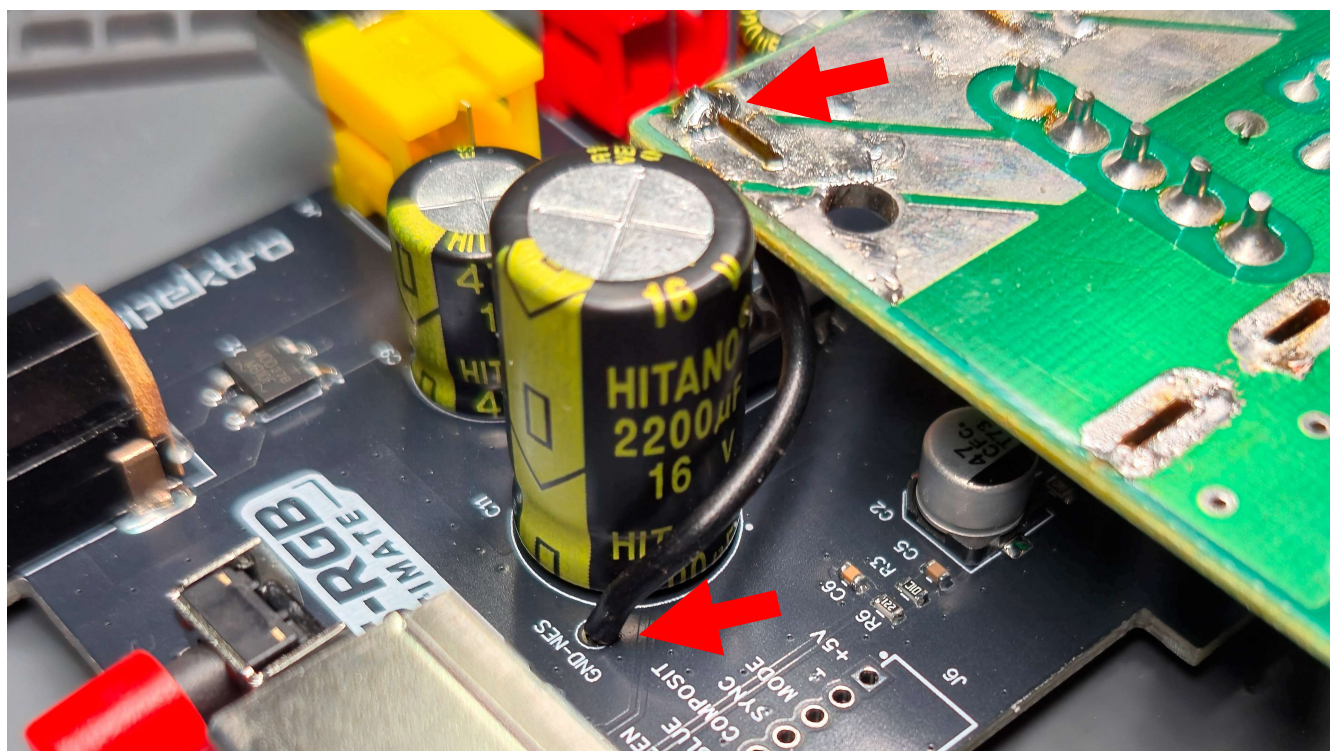


2. Solder the five contacts on the power supply board.



Step 2 – Installing a grounding contact

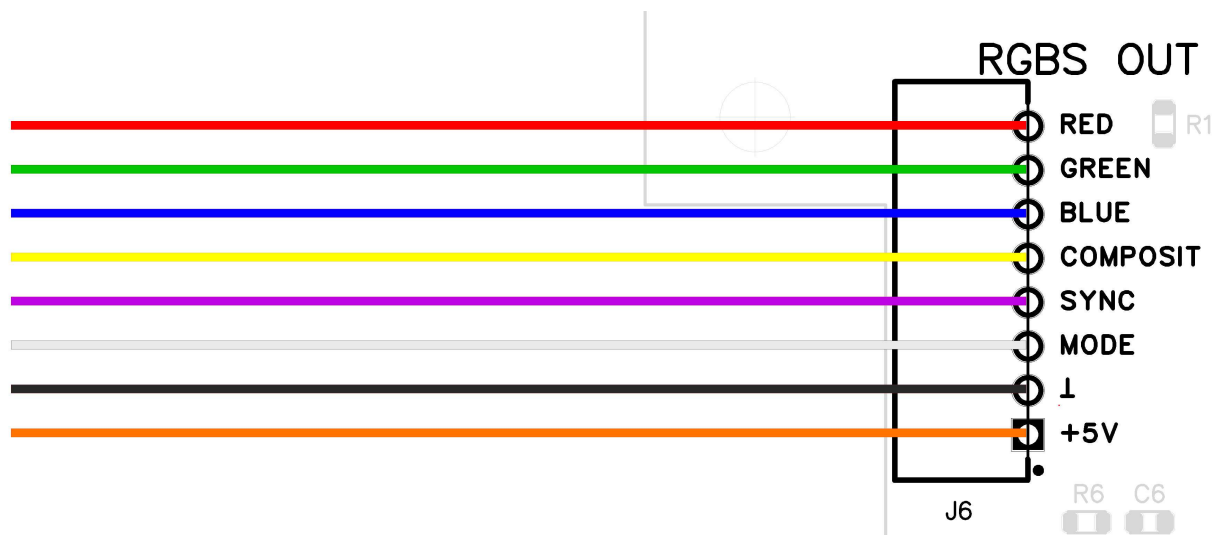
1. Take a piece of black cable 22AWG from the set of wires
2. Solder one end to the power supply board marked GND-NES

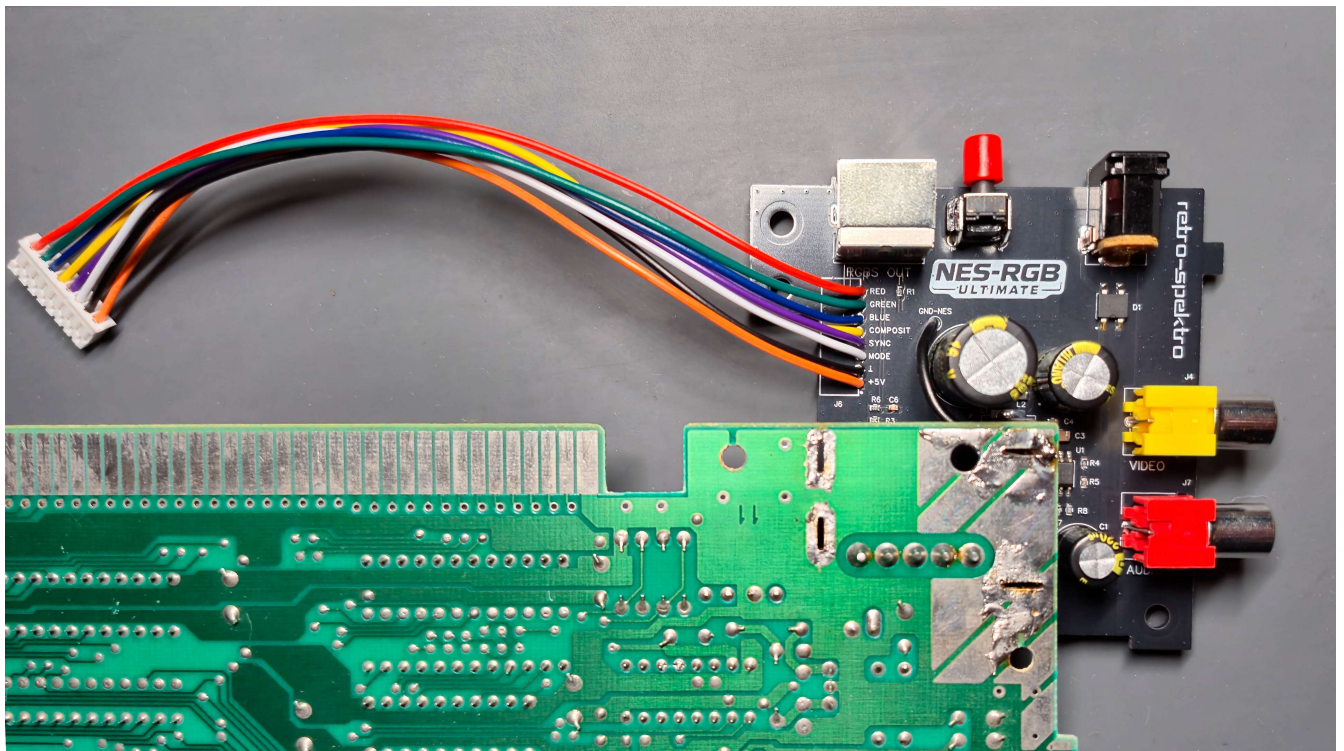
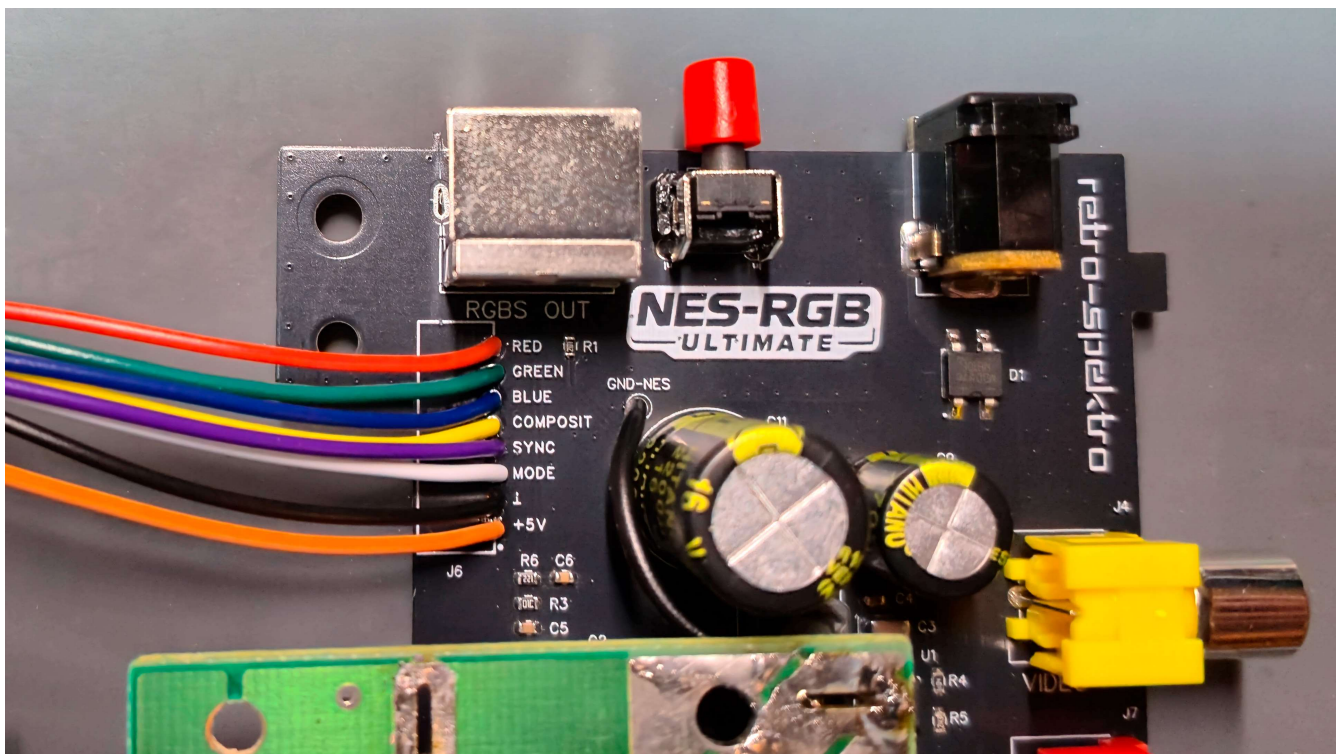


3. Solder the other end to the ground of the console board in the far corner where the ground shield contact was located.

Step 3 – Installing the main cable

1. From the wire kit, take an eight-pin cable and shorten its length to 15 cm (6 inch).
2. Remove the insulation and tin contacts.
3. Install all eight contacts into the power supply board according to the colors and solder them on the other side.





Power supply board assembled with cable

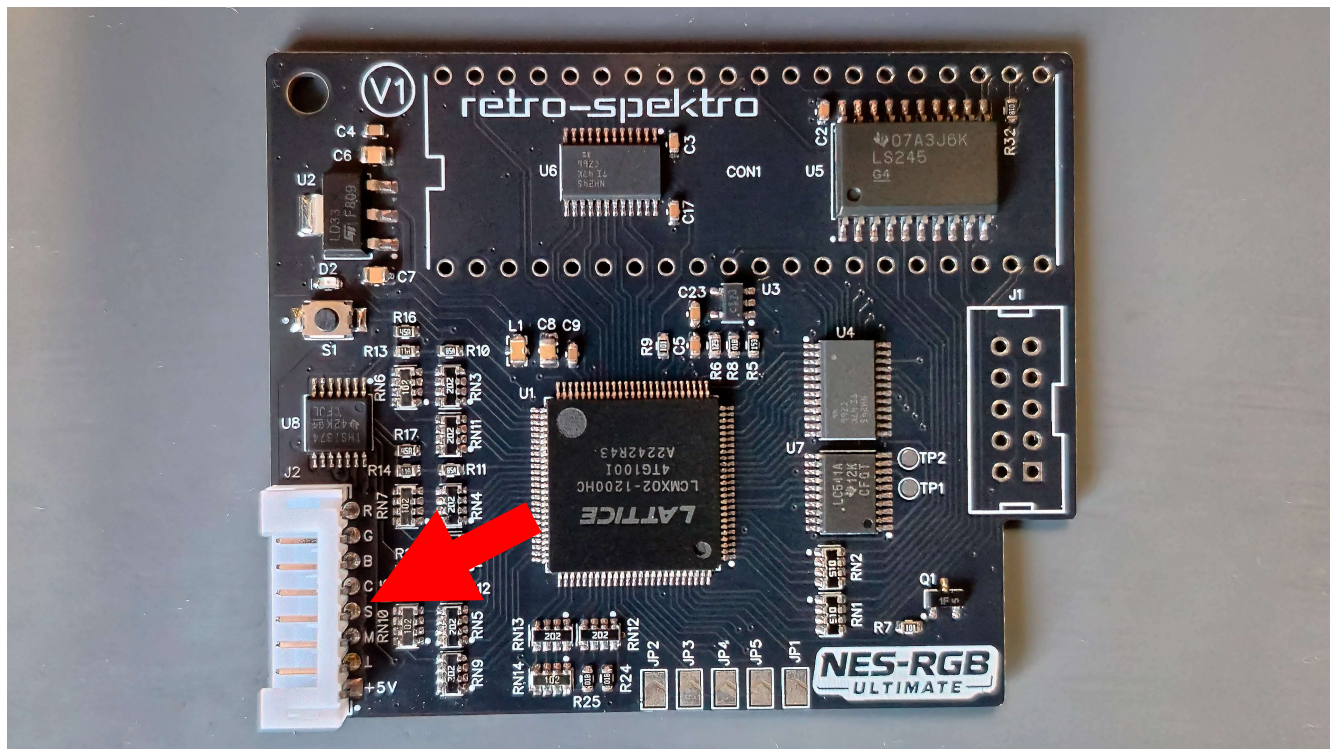
06 NES-RGB Module Installation

Required Tools

- Soldering Iron, fine tip
- Solder
- Flux

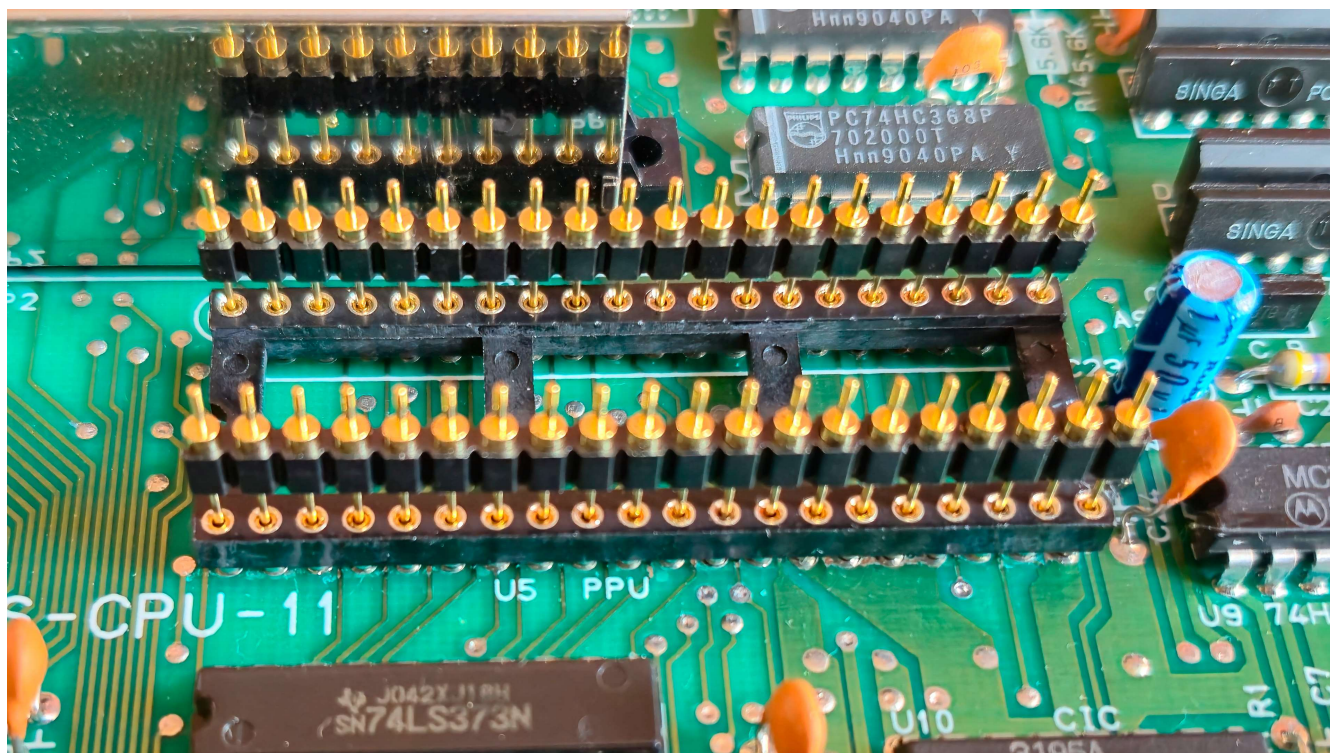
Step 1 – Solder 8 Pin JST Connector

1. Place the 8 Pin JST connector on the NES-RGB board and solder it.

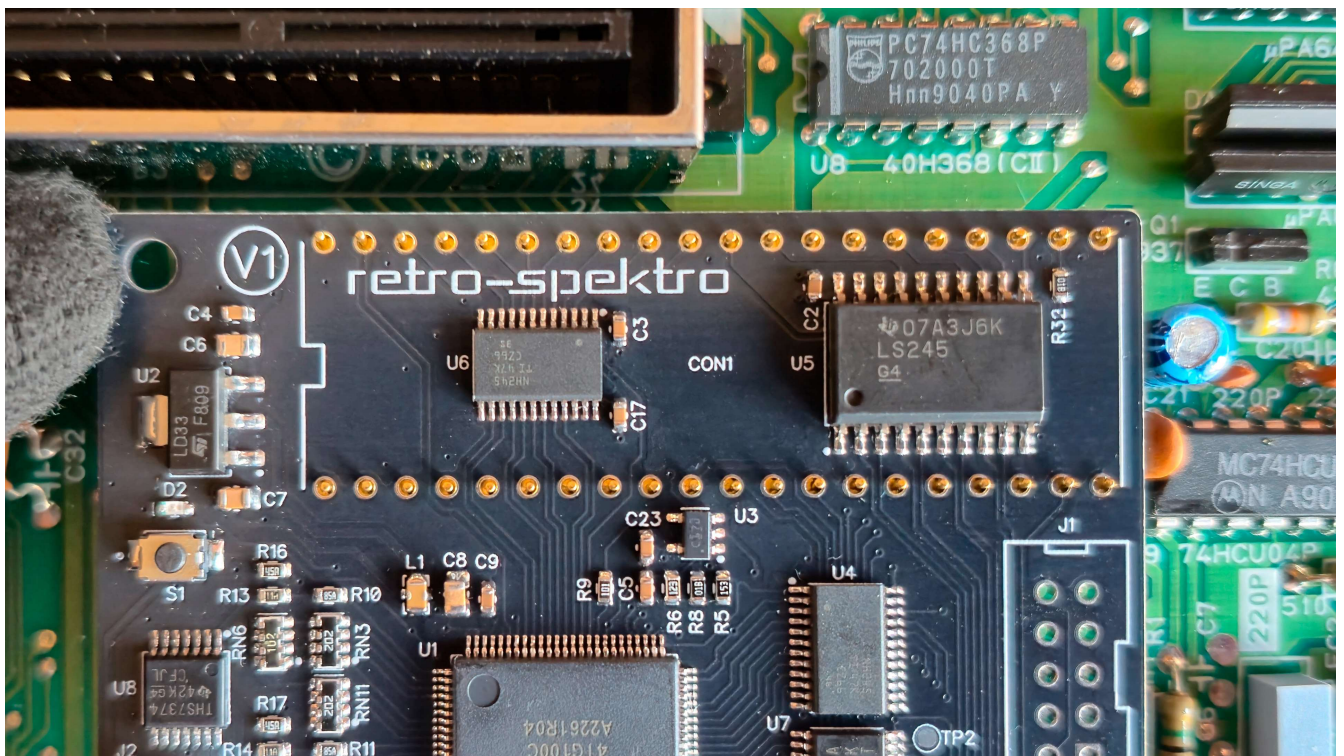


Step 2 – Solder Pin Headers

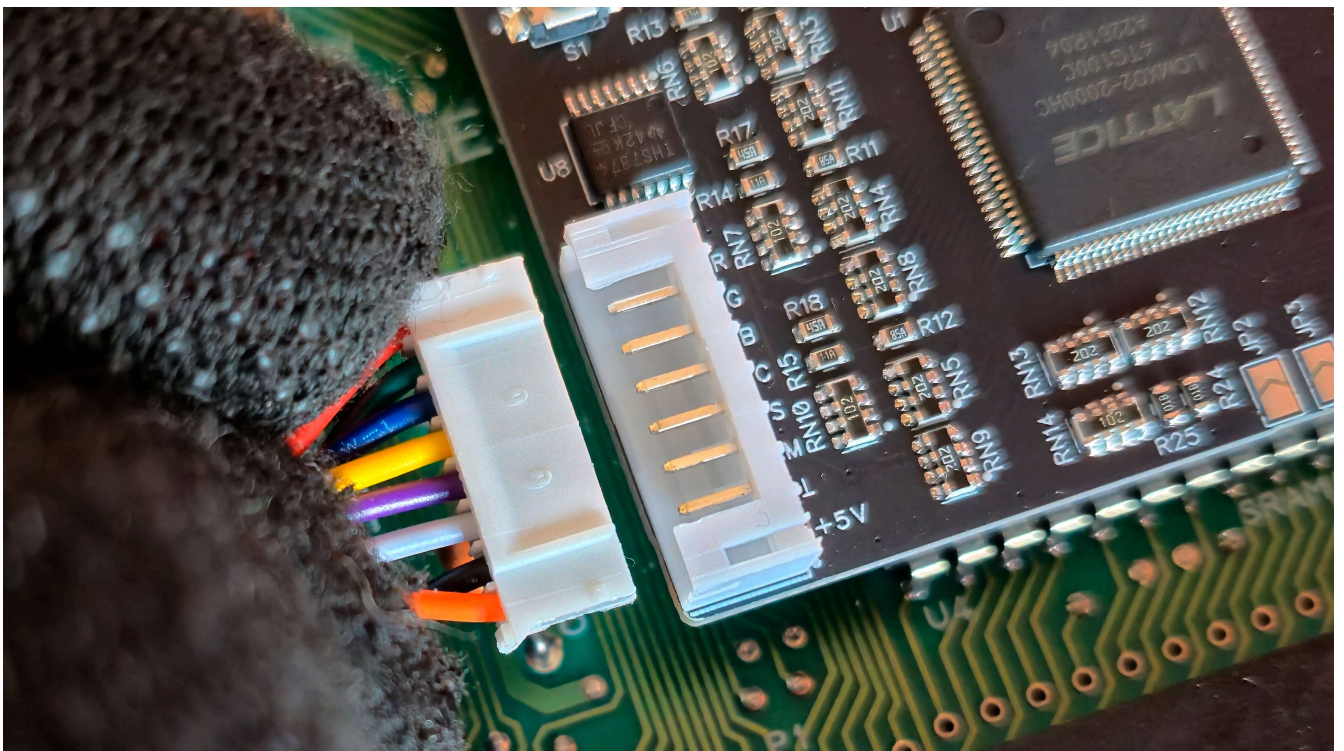
1. Take two 20-pin connectors and install them into the DIP 40 collet panel, not all the way in, just enough so that they sit level.



2. Place the NES-RGB board on these two rows of contacts and press down evenly until it stops. This will ensure the contacts fit evenly into the panel and won't break.



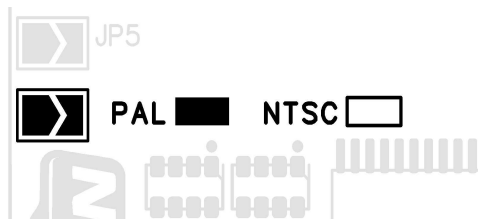
3. Solder all 40 contacts on the NES-RGB board with flux.
4. Connect 8 Pin JST main cable to the NES-RGB board



07 Configuration

Step 1 – Operational Mode

It's necessary to set the operating mode. For PAL consoles on RP2C07, solder the jumper marked PAL/NTSC on the board. For NTSC consoles on RP2C02, do not solder the jumper.

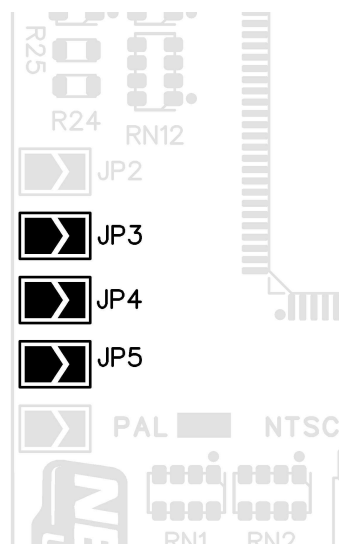


Step 2 – Palett Configuration

Palettes are switched using a button on the back of the console. A short press of the button switches the palette, and the selected palette is displayed on the screen. The selection works when the console is reset, but when the power is turned off, the palette reverts to the default, the first NES palette.

If you want to set a different palette as the default when the console is turned on, you can select any from the list and solder the jumpers on the NES-RGB Ultimate board according to the table. In this case, when you turn on the console, you will start with the selected palette; switching with the button is preserved, and the selection will be made further down the list.

JP5	JP4	JP3	Palett
0	0	0	NES CLASSIC
0	0	1	CDIRECT
0	1	0	NATURAL NESTOPIA YUV
0	1	1	PLAYCHOICE-10
1	0	0	PVM STYLE
1	0	1	WaveBeam
1	1	0	SONY CXA
1	1	1	SMOOTH



Where 1 is solder

09 Reassembly

NES Front Loader (NES-001) Reassembly

Step 1 – Install Mainboard

1. Place the motherboard into the lower shell.
2. Ensure all ports are properly aligned with the rear openings.
3. Reinstall all motherboard mounting screws.
4. Reconnect any controller, power, or reset wiring removed during disassembly.

Step 2 – Install 72-Pin Connector

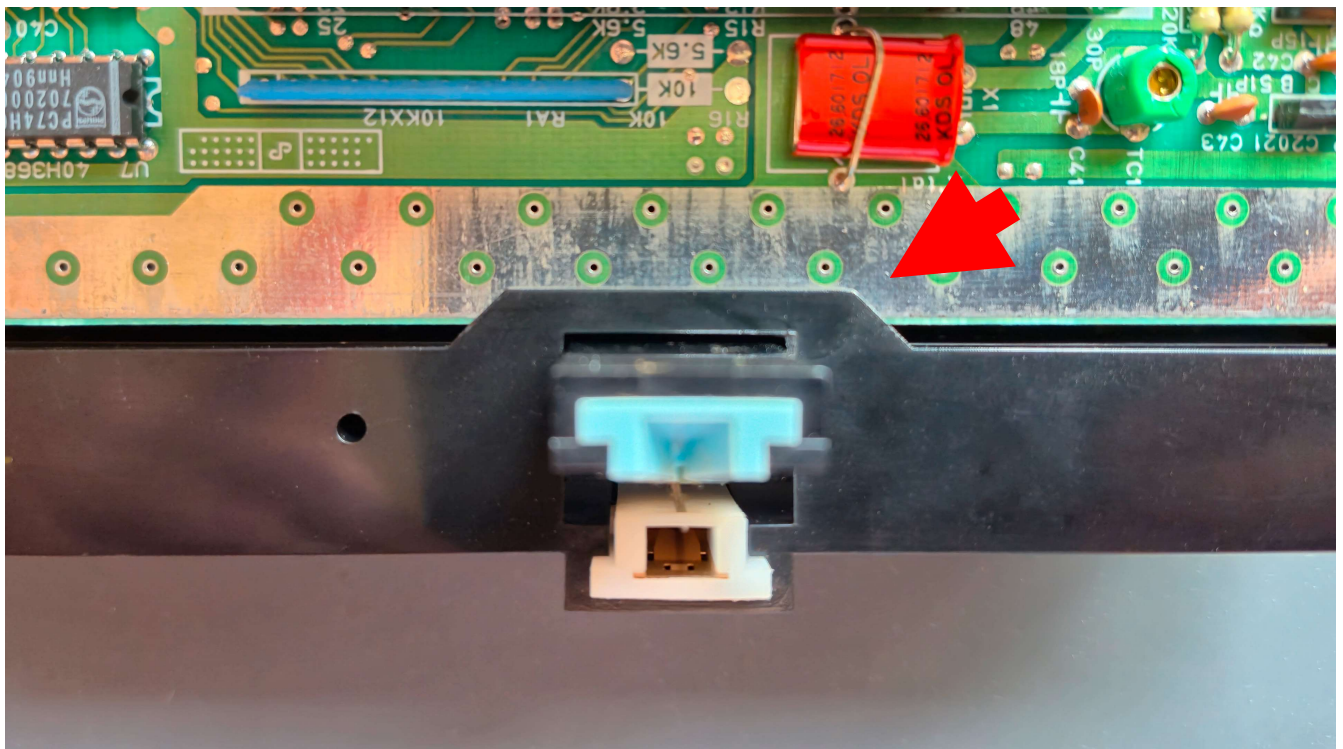
1. Align the 72-pin cartridge connector with the motherboard edge connector.
2. Press evenly on both sides until fully seated.
3. Verify that the connector sits straight and parallel to the motherboard.

Note: An improperly seated connector may cause intermittent cartridge operation.

Step 3 – Install Cartridge Loading Mechanism

1. Position the cartridge tray over the 72-pin connector.
2. Align all mounting points.
3. Reinstall the six mounting screws.
4. Verify smooth operation of the loading mechanism.

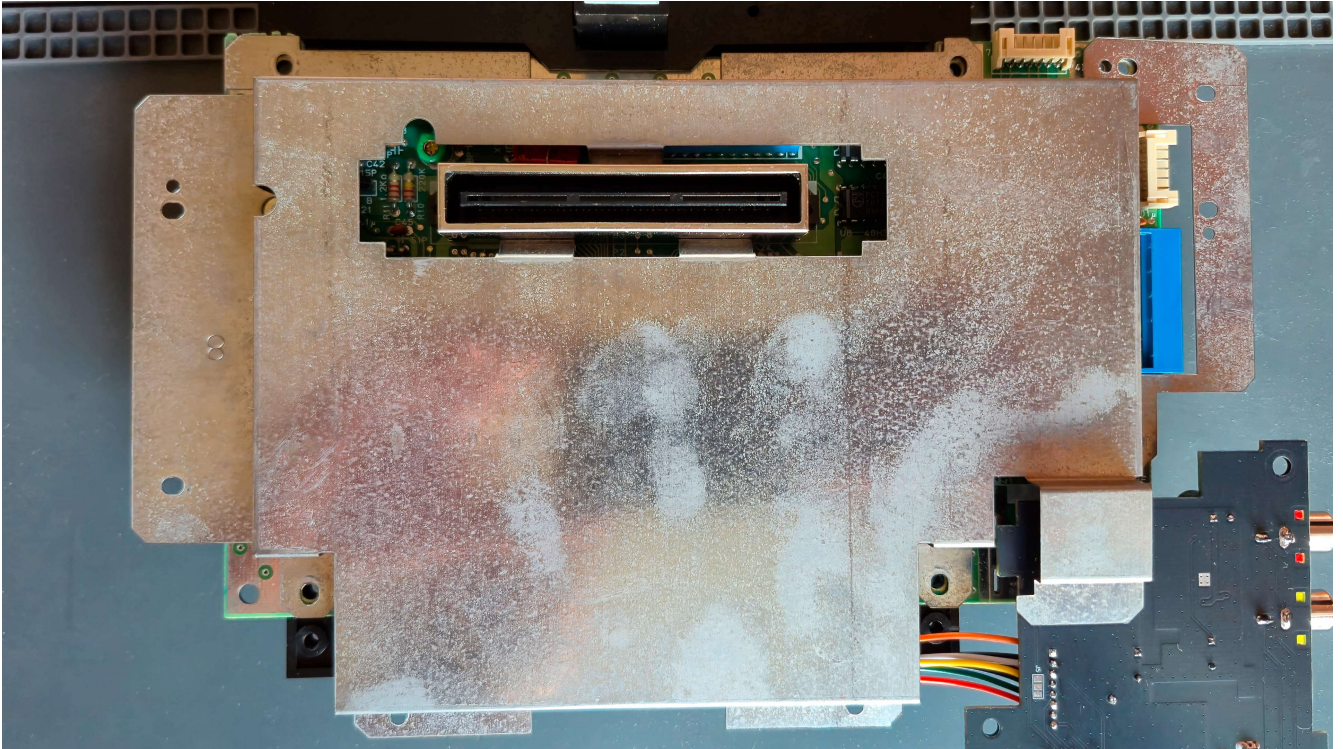
Check: The tray should move freely without binding.



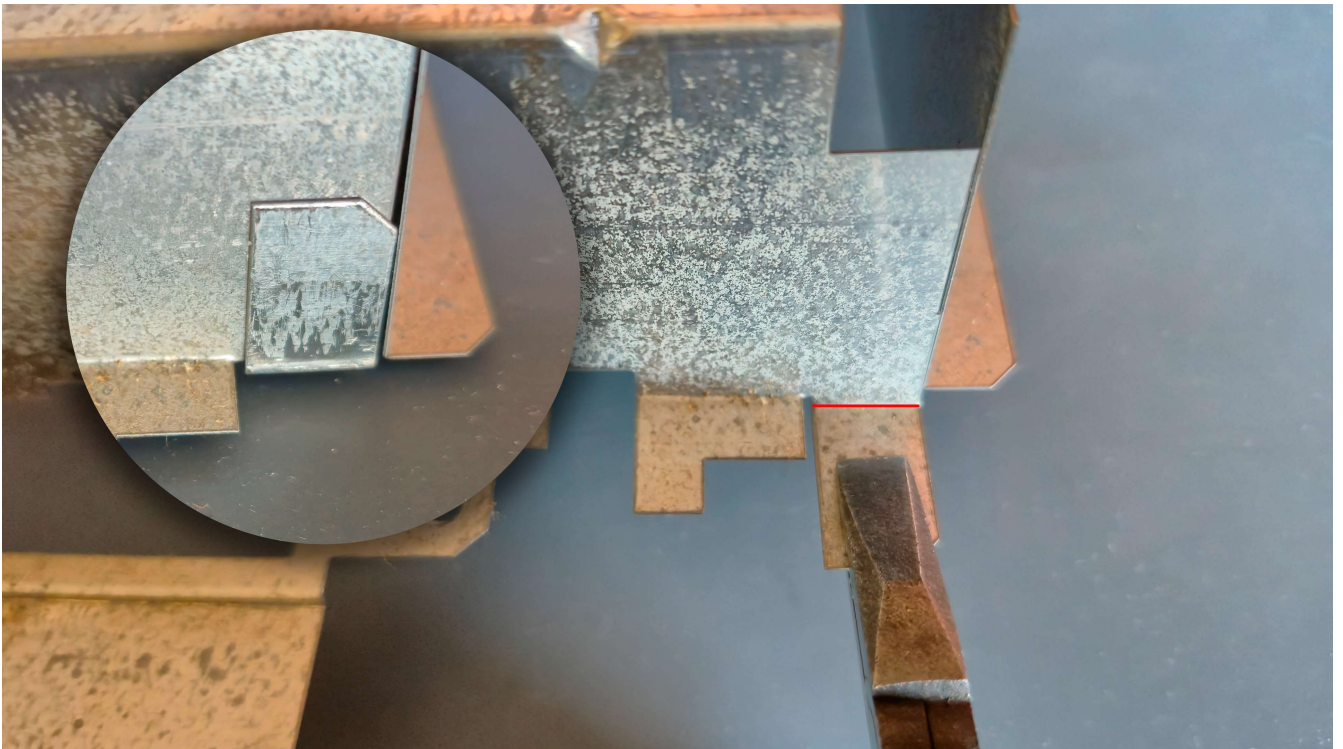
On the reverse side, the mechanism should fit behind the pcb board.

Step 4 – Install RF Shield

1. Place the upper RF shield over the assembly.



2. Bend the top RF shield tab as shown in the photo.





3. Align all screw holes.
4. Reinstall the seven RF shield screws.

Step 5 – Final Inspection

Before closing the console:

- Verify all connectors are attached.
- Check that no wires are pinched.
- Confirm that the NES-RGB module is securely installed.
- Ensure all screws are tightened.
- Verify that no tools or loose parts remain inside the console.

Step 6 – Install Upper Shell

1. Place the upper case cover onto the lower shell.
2. Verify proper alignment around all edges.
3. Turn the console upside down while supporting both halves.

Step 7 – Secure Outer Shell

1. Reinstall the six bottom case screws.
2. Tighten evenly without excessive force.

Step 8 – Functional Test

1. Connect power and video cables.
2. Power on the console.

3. Verify:

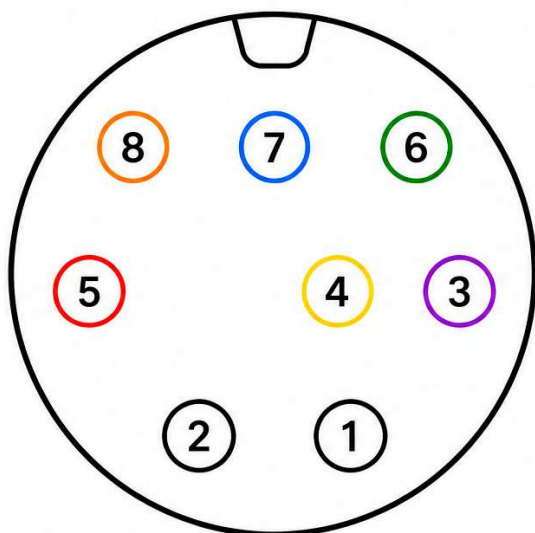
- Stable video output
- Correct RGB colors
- Audio operation
- Controller functionality
- Cartridge loading and startup

Final Check

- ✓ Motherboard secured
- ✓ 72-pin connector installed
- ✓ Cartridge tray installed
- ✓ RF shield installed
- ✓ Top cover installed
- ✓ Functional test completed

09 Pinout

MINI DIN 8 Console OUT



- ① Audio
- ② Ground
- ③ CSync
- ④ Video
- ⑤ Red
- ⑥ Green
- ⑦ Blue
- ⑧ +3V

Pin 8 - SCART switching signal
+3V to enable SCART switching

SCART Pin 16
(Switching / AV Enable)

10 Palette Switch

Palettes are switched by a button on the back of the console, with a short press, the selected palette is displayed on the screen in the upper left corner.

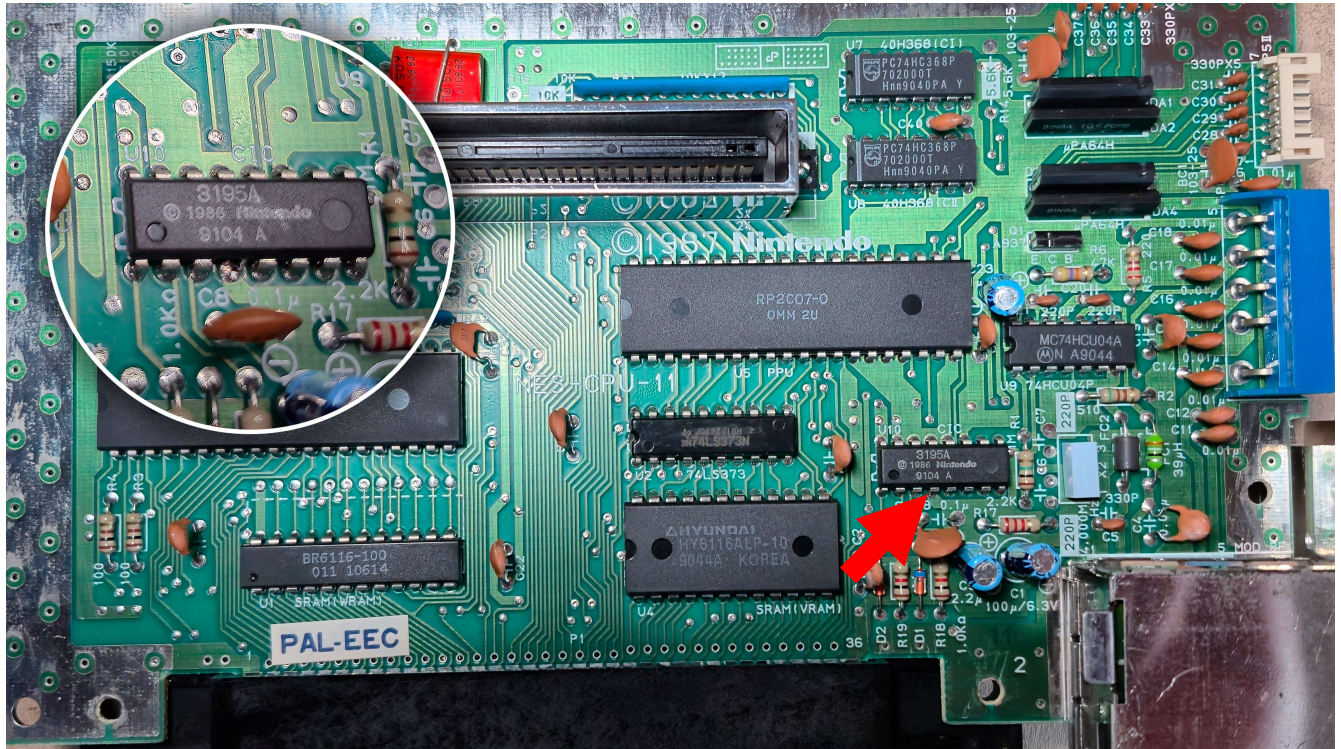
Palette	Full Name	Origin	Description	Best For
NES	NES Classic	Nintendo NES Classic Edition	Official palette used in Nintendo's NES Classic Mini. Balanced colors, moderate saturation, and a modern interpretation of the NES image. Considered a safe default choice.	General use
CDR	CDirect	Direct RGB Conversion	Raw RGB conversion of NES color indices without composite video simulation. Produces very clean and highly saturated colors, sometimes appearing more vivid than original hardware.	LCD displays, RGB purists
YUV	Natural Nestopia YUV	Nestopia Emulator	Generated using YUV decoding similar to a real NTSC television. Preserves many characteristics of composite video while maintaining excellent color balance. One of the most authentic-looking palettes.	Authentic NES appearance
P10	PlayChoice-10	RP2C03 Arcade PPU	Based on the RGB-capable PPU used in Nintendo's PlayChoice-10 arcade system. Colors are brighter, cleaner, and more arcade-like than consumer NES hardware.	Arcade enthusiasts
PVM	PVM Style	Sony Professional Video Monitor	Inspired by the appearance of NES games on Sony PVM broadcast monitors. Strong contrast, deep blacks, and highly defined colors.	CRT and retro gaming setups
WBM	WaveBeam	WaveBeam Palette	One of the most popular modern community-created NES palettes. Slightly warm color balance with carefully tuned saturation. Widely appreciated for its pleasing visual appearance.	Everyday gaming
CXA	Sony CXA	Sony CXA Video Encoder Simulation	Attempts to reproduce the look of NES systems modified with Sony CXA-based RGB encoder circuits. Produces a clean image while retaining some analog character.	RGB-modded console look
SMT	Smooth	Custom Smoothed Palette	Designed to reduce harsh color transitions and create a softer overall image. Less contrasty than other palettes and visually comfortable on modern displays.	Long play sessions

11 Troubleshooting

PAL NES Compatibility Modification (Lockout Chip Disable)

Some PAL NES consoles may continuously reset, display a flashing screen, or fail to boot certain cartridges and flash cartridges due to the internal CIC lockout system.

If these symptoms are present, the lockout chip can be disabled by isolating pin 4 of the CIC integrated circuit.



Lift or isolate pin 4 of the CIC lockout chip to disable the reset protection circuit.

Procedure

1. Locate the CIC lockout chip on the motherboard.
2. Carefully identify pin 4 using the orientation notch or dot on the package.
3. Gently lift pin 4 from the PCB pad or cut the pin so it is electrically isolated from the motherboard.
4. Verify that pin 4 no longer makes contact with the PCB.
5. Reassemble the console and test operation.

Expected Result

After the modification, the console will no longer continuously reset due to CIC lockout protection and should operate with compatible cartridges and flash cartridges.

Warning

Take care not to damage adjacent pins or PCB traces during this procedure. This modification permanently disables the original lockout function of the console.

The image is unstable, there is a breakdown in synchronization, or the screen is completely black, there is no signal

Check if the jumper PAL/NTSC (JP1) is soldered on the board. If you have a PAL console, the jumper should be soldered, but if you have an NTSC console, it should not be soldered