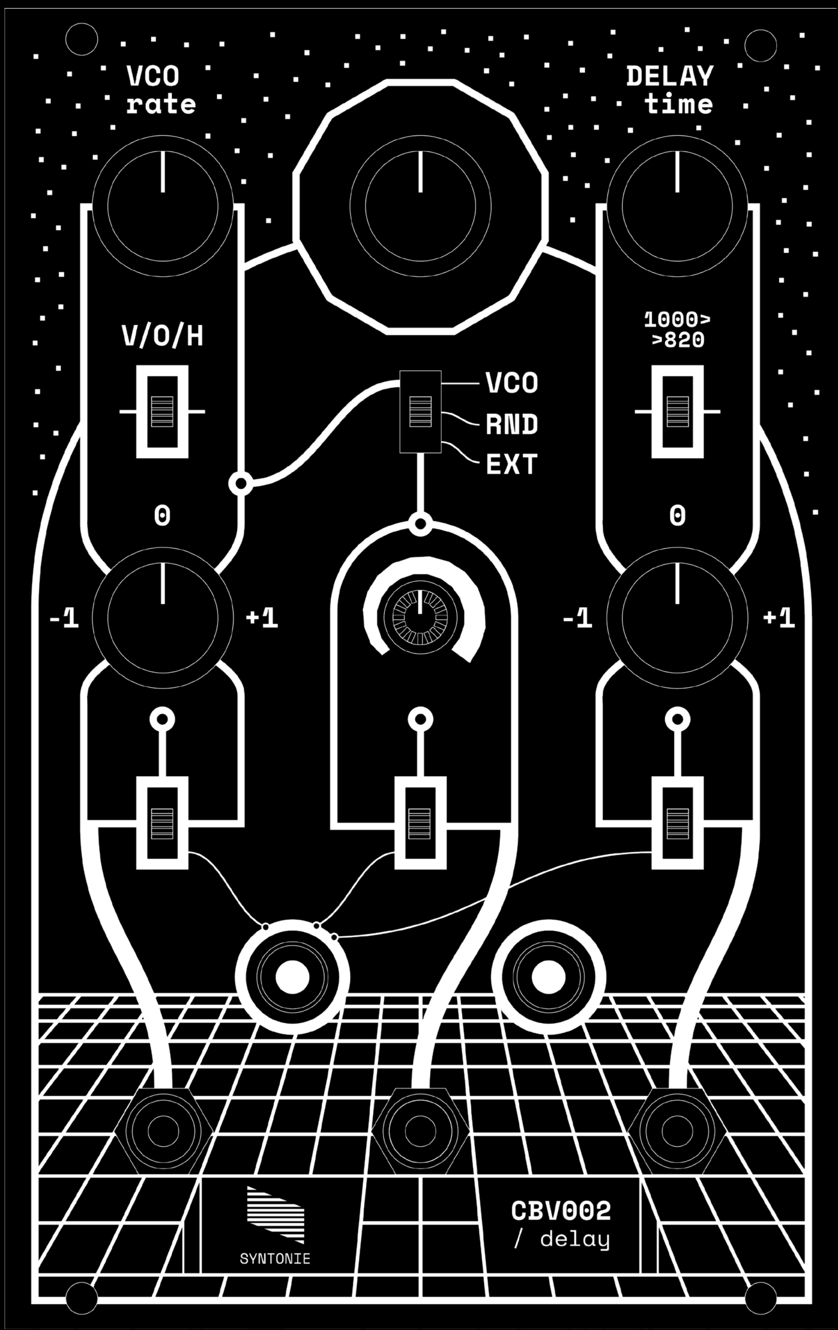
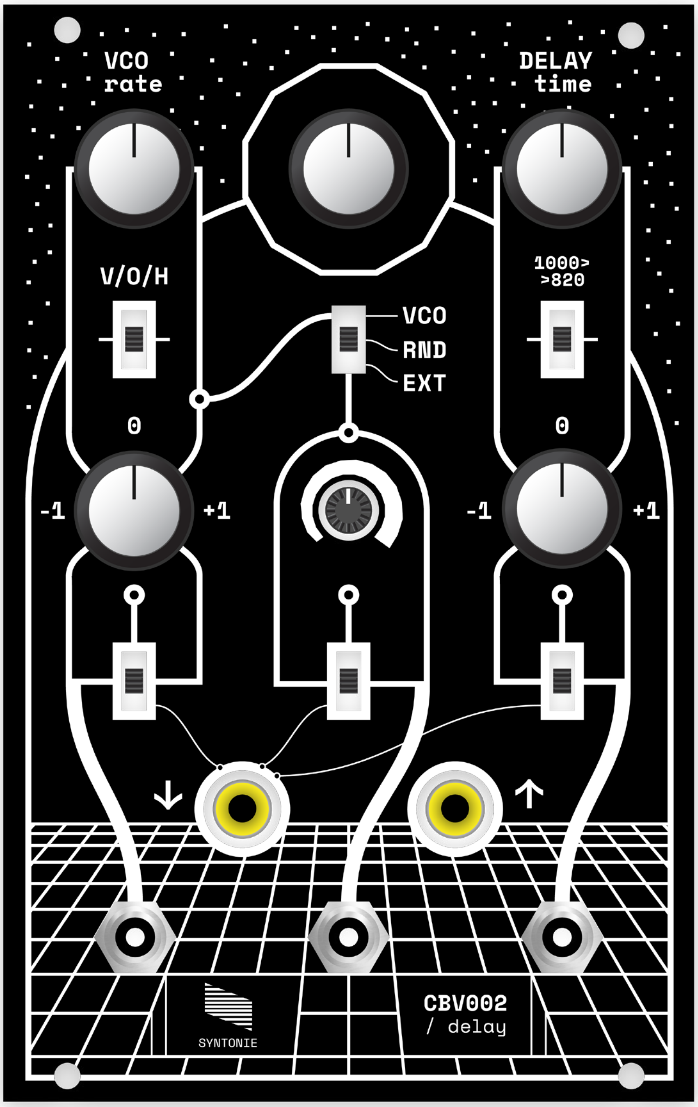
CBV002

Circuit bent delay ¬
User documentation / build guide



SYNTONIE



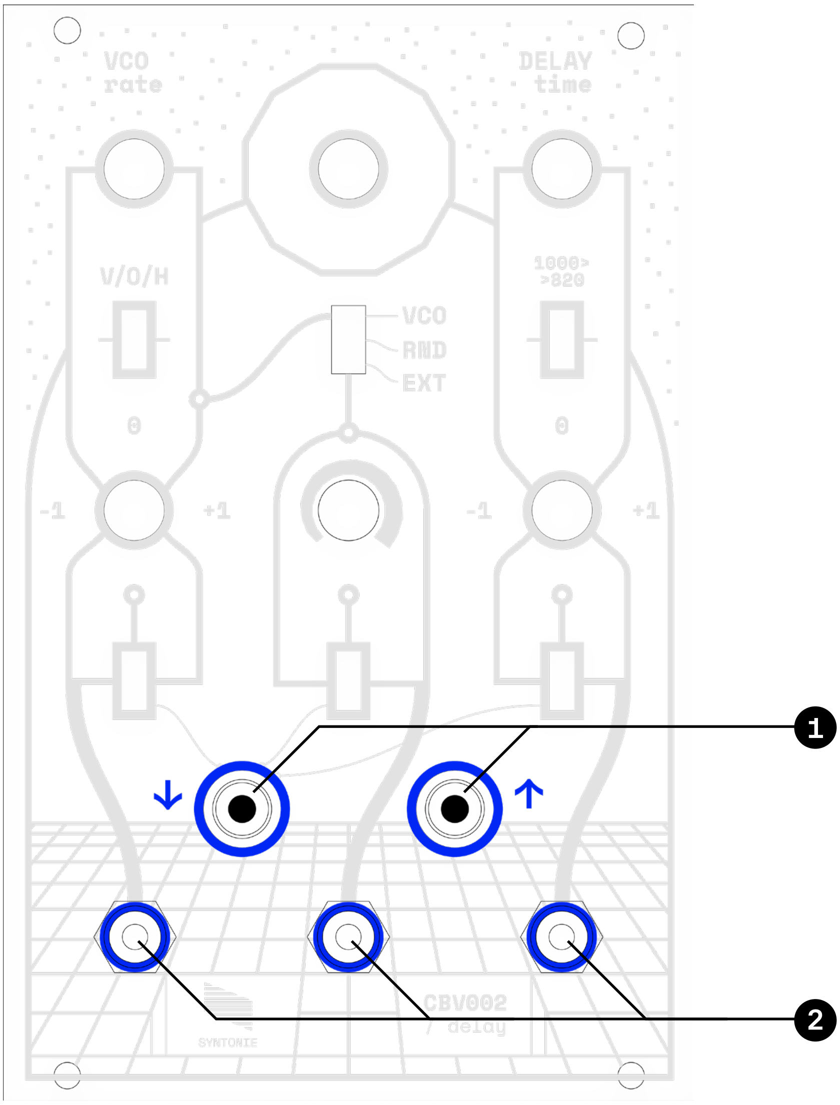
CBV002 is a eurorack adaptation of the Discret11, which is based on an analog encryption system of the same name used by pay TV services/channels throughout the 90s in Europe.

It works by delaying the signal by fractions of milliseconds resulting in an horizontal displacement and hue shift.

Specifications

- 16HP
- 120mA +12V
- 60mA -12V
- 0mA +5V
- 45mm deep

Special thanks to: **Lars Larsen** and **Phil Baljeu** for the Cadet and Castle DIY series, from which I used essential building blocks / **Drew Pauper** for his work in analog glitch, and specifically for a discussion that initially inspired the reproduction of the Discret11 effect / **Iker Muruaga** for the enclosure design / **Lorenzo Ferronato** for the front panel and documentation design // And of course, **everyone who has supported Syntonie until now & those who will support it in the future.**

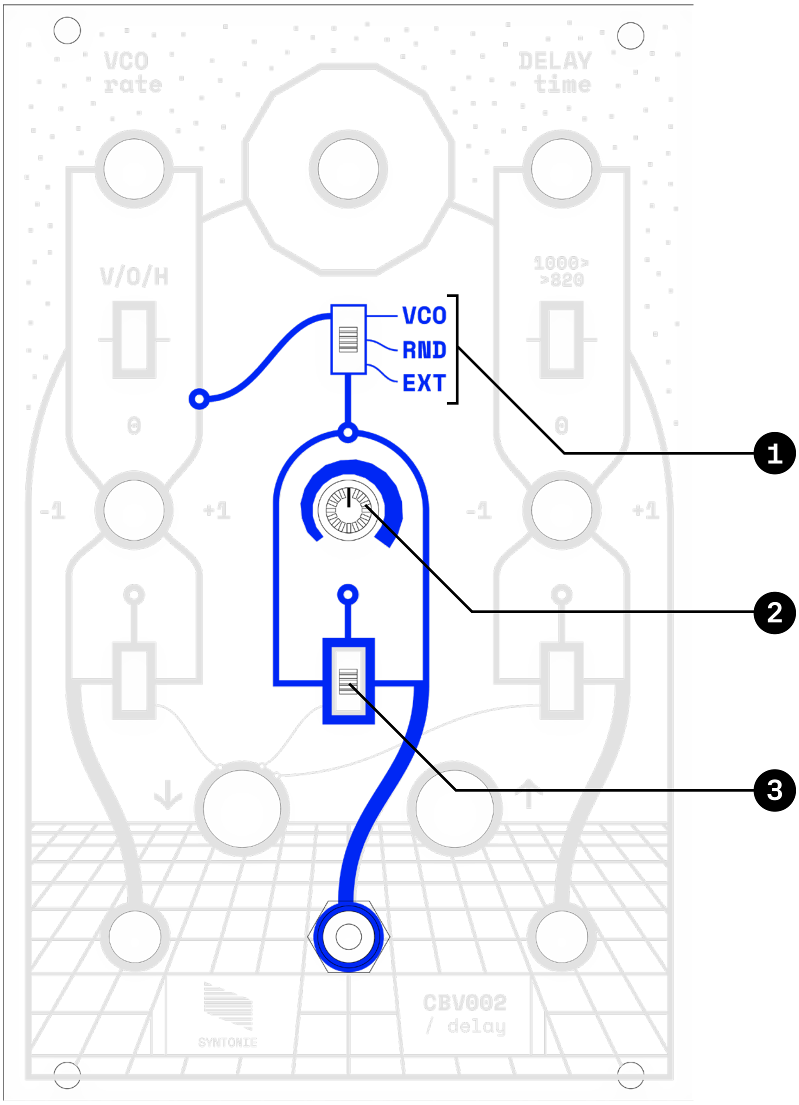


(1) Composite Video IN (left) - OUT (right) / `1Vpp, 75ohm`
(2) CV Inputs / `0-1V, 100k ohm`

CBV002 processes composite video through the RCA input & output.

CV (2) inputs allow for:

- ¬ frequency modulation of the internal oscillator
- ¬ keying between original and delayed video
- ¬ control over delay time

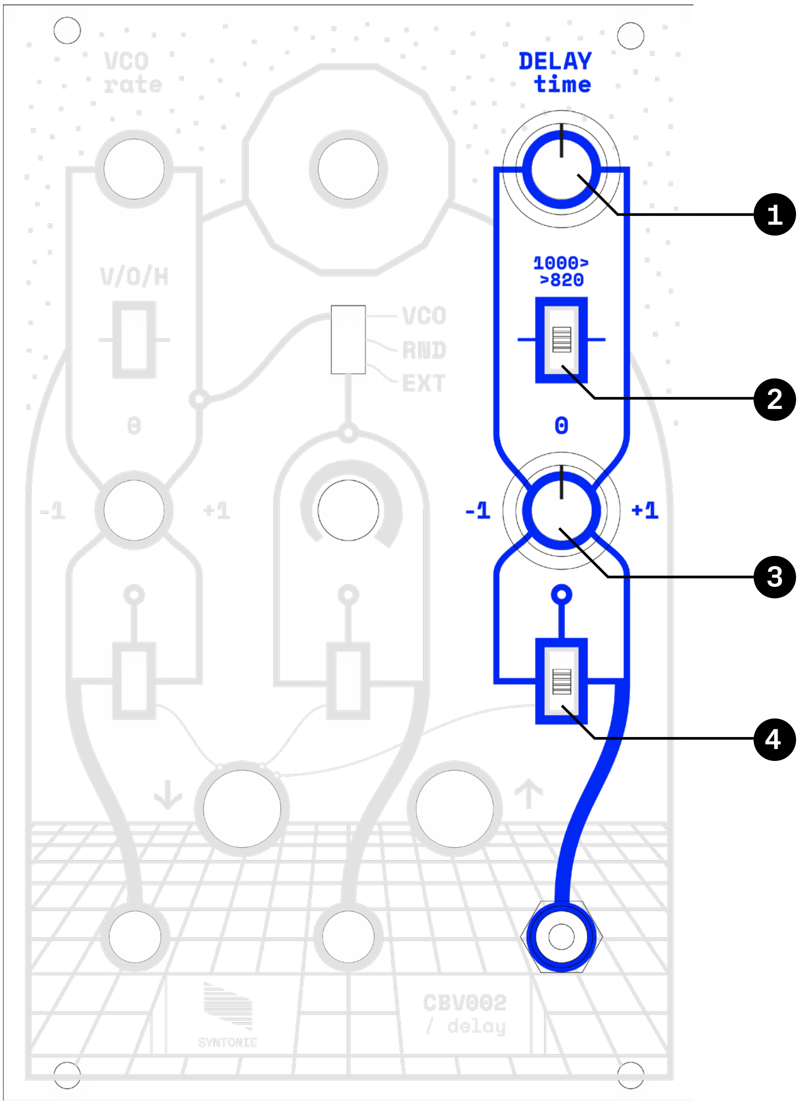


This section switches between the original and the delayed video signal using a control voltage. The source selection switch **(1)** allows the user to choose which signal will be used for keying:

- ¬ **VCO**: internal square wave VCO
- ¬ **RND**: internal VCO through a random gate circuit
- ¬ **EXT**: external signal through the CV input

Knob **(2)** affects the threshold of the CV input (only works in **EXT**).
Input selection switch **(3)** allows the choice of:

- ¬ external CV input through the 3.5mm jack when UP **(↑)**
- ¬ video input modulation when DOWN **(↓)**, original/delayed video will now by the input video signal



This section affects the delay time, changing the horizontal displacement &/or hue shift.

Delay time knob **(1)** allows for manual control over the delay time.

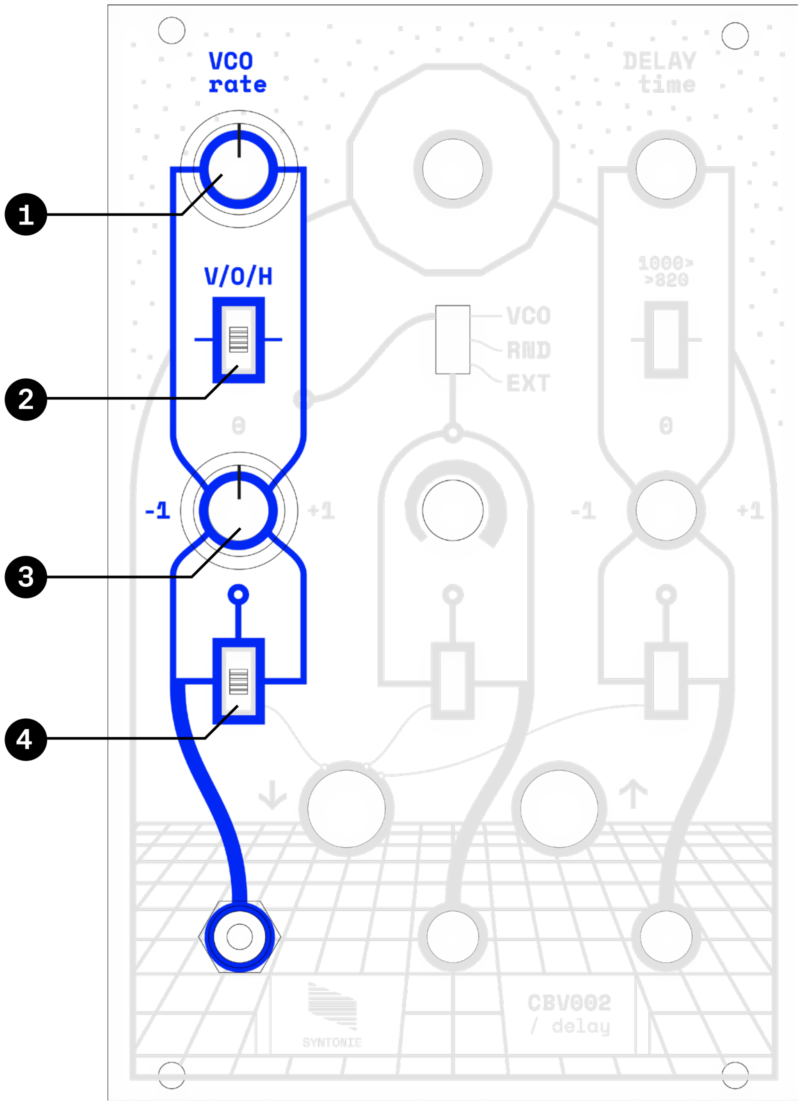
Delay preset switch **(2)** set the initial delay time (from around 820ns to 1000ns)

Delay CV attenuverter **(3)** attenuates and/or inverts the signal coming from the Delay CV input

Input selection switch **(4)** allows for the choice of :

- ¬ external CV input through the 3.5mm jack when UP **(↑)**
- ¬ video input modulation when DOWN **(↓)**, original/delayed video will now be delayed based on the input video signal (can cause instability of the signal)

Note that even if the Delay CV input can accept high frequencies, an internal filter attenuates it in order to minimize CV bleeding through TO the video signal at higher frequencies.



This section features a square VCO that can be used for keying. The result is similar to the original Discret11 effect which worked by delaying the signal at line rate.

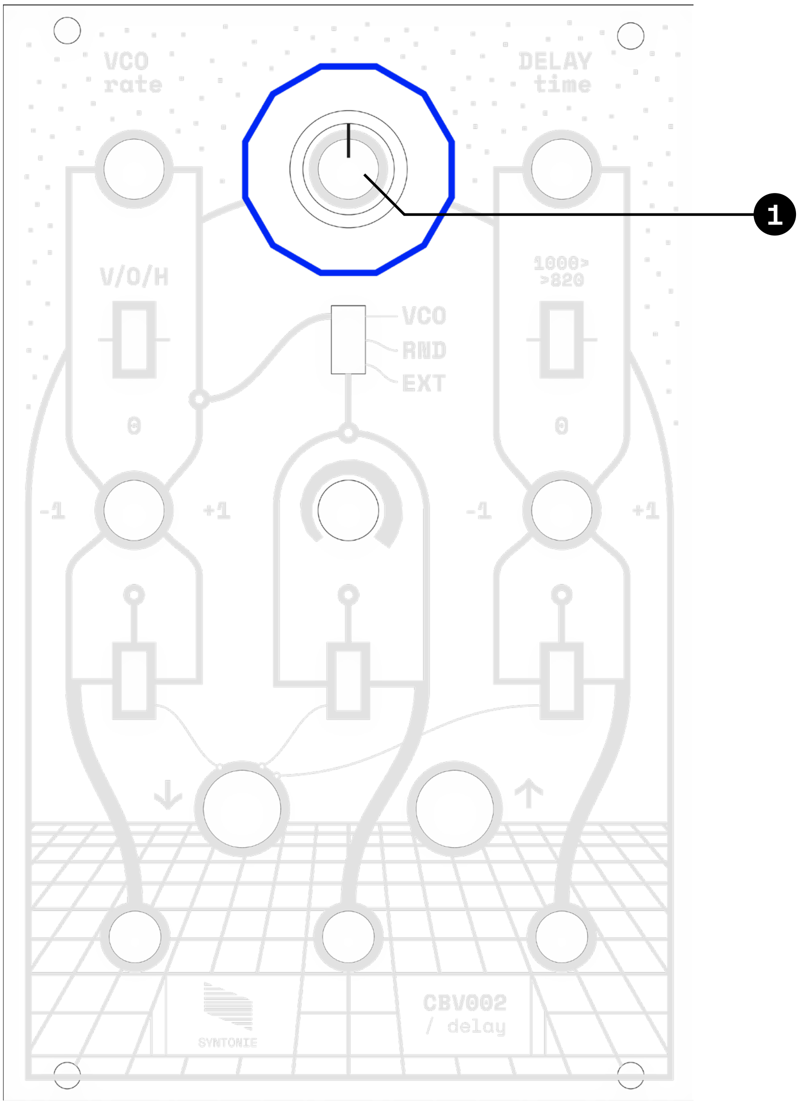
VCO rate knob (1) allows for manual control/adjusting of the VCO's frequency

Frequency range switch (2) allows for selecting either the Vertical and Horizontal range, as well as an unsynced oscillation mode when the switch is centered.

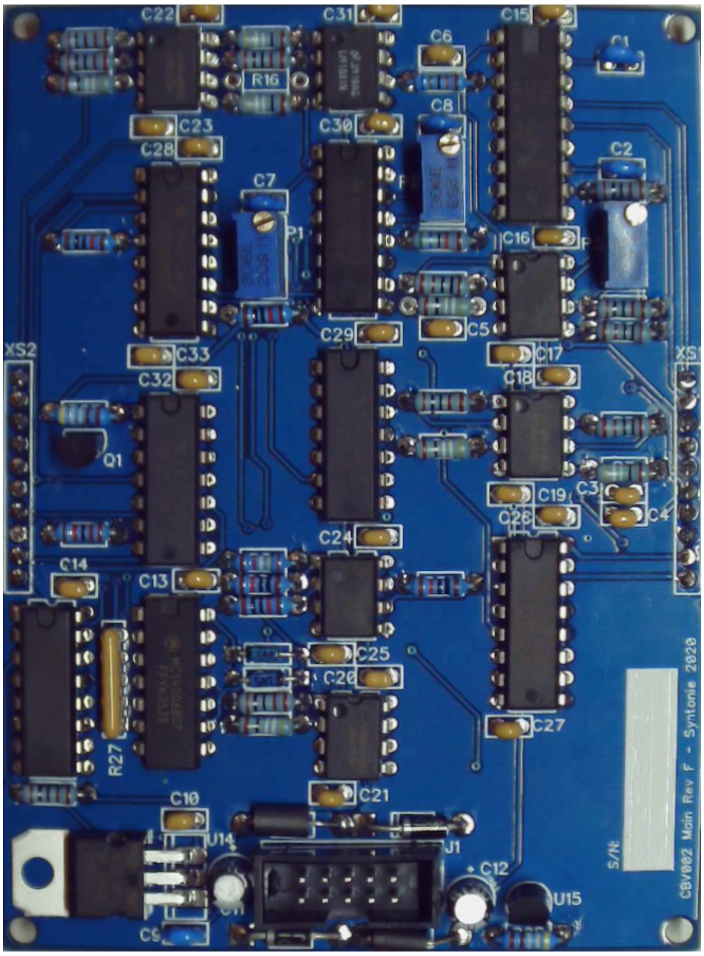
FM attenuverter (3) attenuates and/or inverts the signal coming from the FM input.

Input selection switch (4) selects either :

- ¬ external CV input through the 3.5mm jack when UP (↑)
- ¬ video input modulation when DOWN (↓), oscillator will now be frequency modulated by the input video signal.



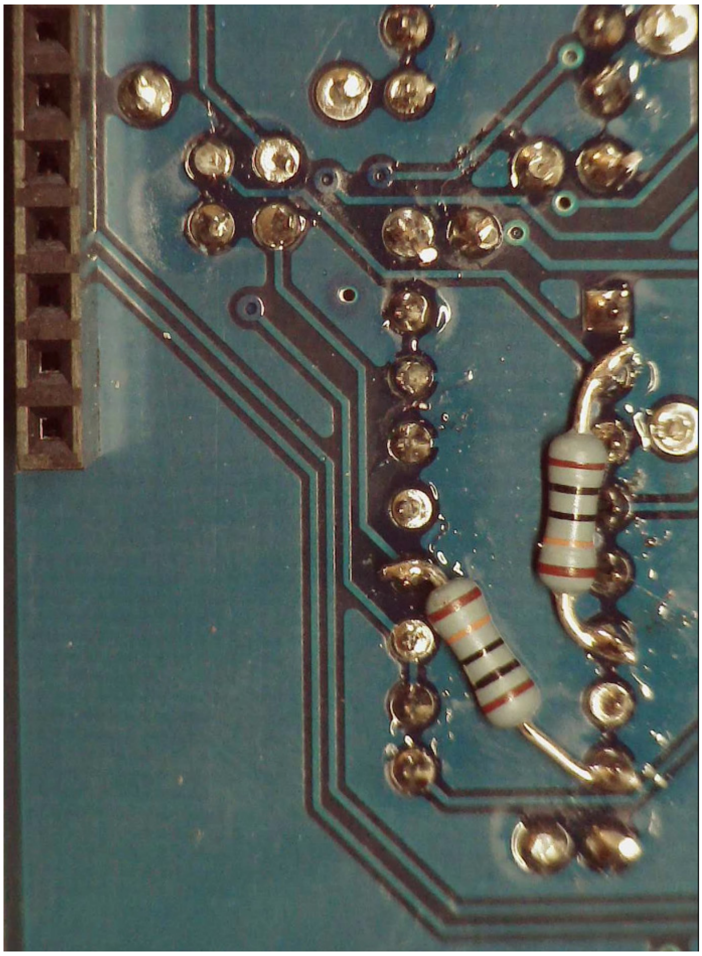
The feedback knob (1) feeds the video output signal back into the video input resulting in edge feedback or even distorsion when turned fully clockwise (→).



Use the interactive BOM to look for component placement / Find the BOM here

Place and solder the components in the following order:

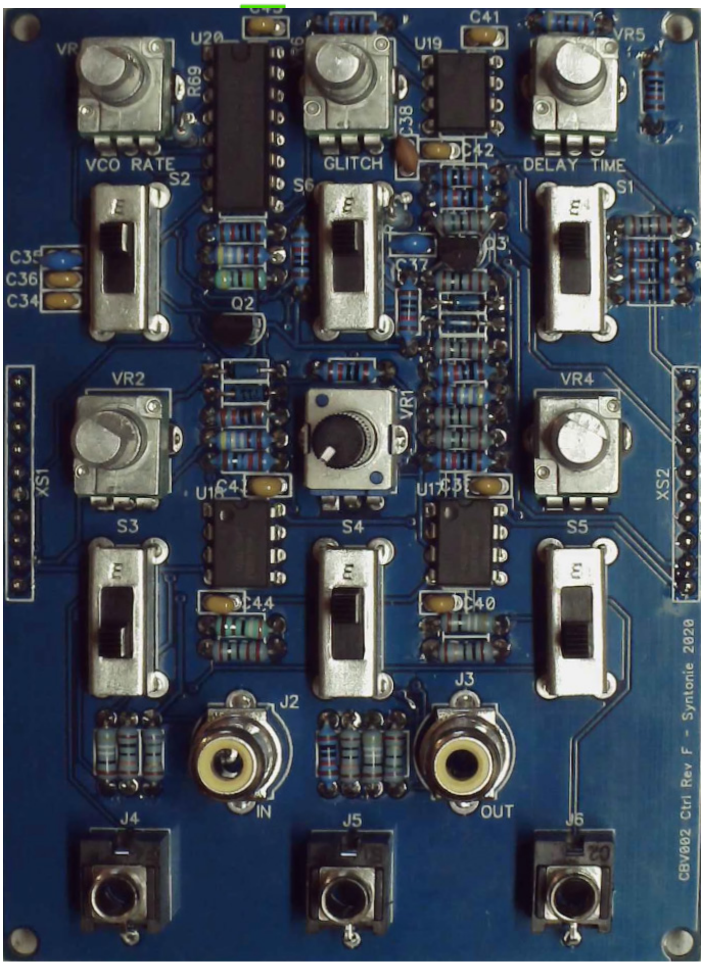
- ¬ 1 Resistors/resistor array **(pay attention to the orientation of the resistor array, square pad matches dot on the array)**
- ¬ 2 Diodes **(pay attention to the orientation)**
- ¬ 3 Ferrite beads
- ¬ 4 Capacitors **(pay attention to the orientation of electrolytic capacitors)**
- ¬ 5 Transistors/regulators **(pay attention to the orientation)**
- ¬ 6 IC sockets/ICs **(pay attention to the orientation)**
- ¬ 7 Trimmers
- ¬ 8 Connectors **(mind the orientation)**



There are no footprints for **R72** and **R73** on the main PCB/board (no footprint), the resistors need to be soldered to the pins of **U4** on the mainboard as in the photo above (one between `pin 2` and `pin 6`, the other between `pin 8` and `pin 12`).

Make sure the resistors leads doesn't short anything.

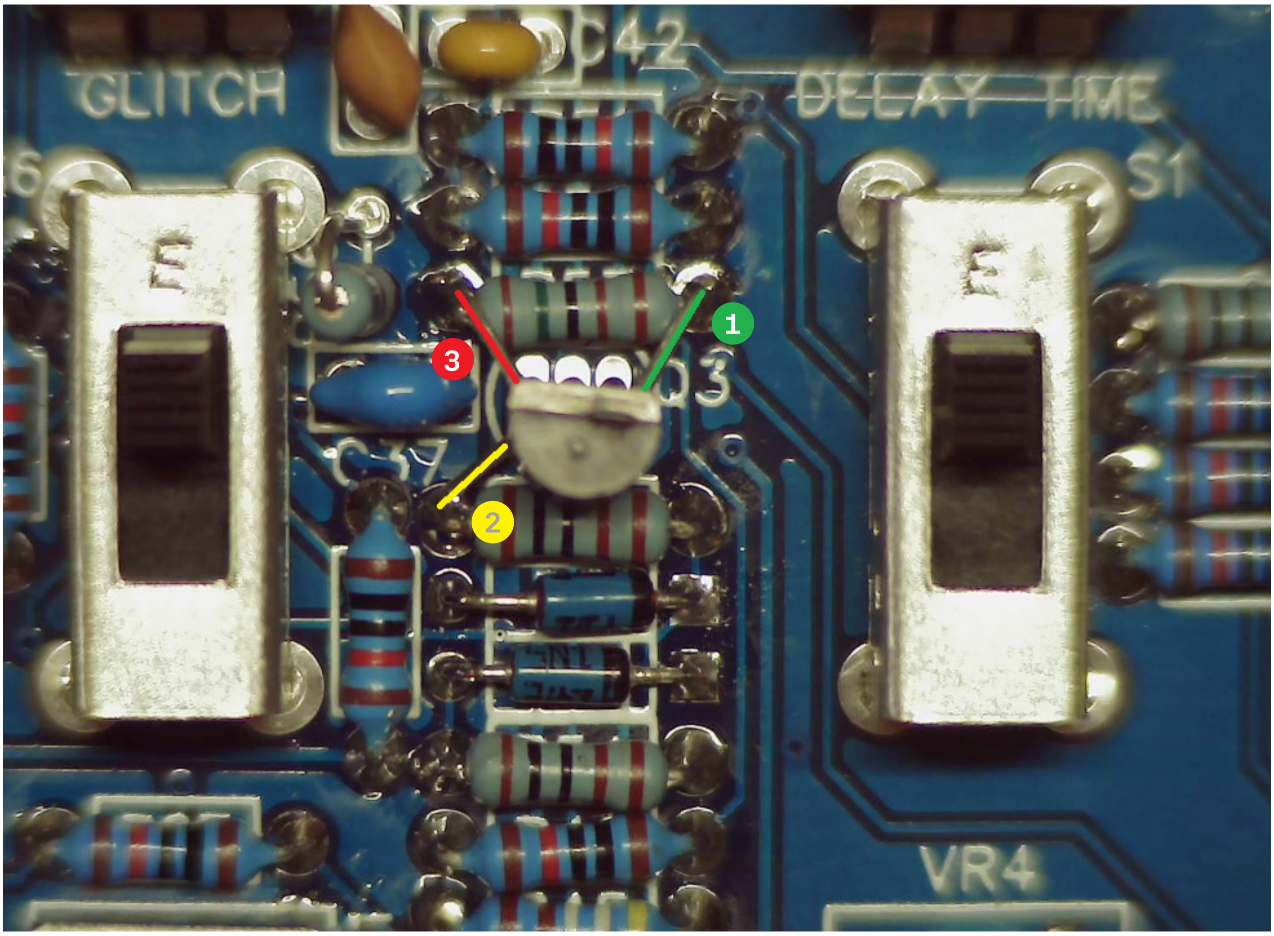
The circuit will work without this modification, however it will generate a DC voltage at the output when no cable is plugged into the RCA input of the module, and if the RCA output is connected to another input, the module will draw much more current than what is specified.



Use the interactive BOM to look for component placement / [Find the BOM here]

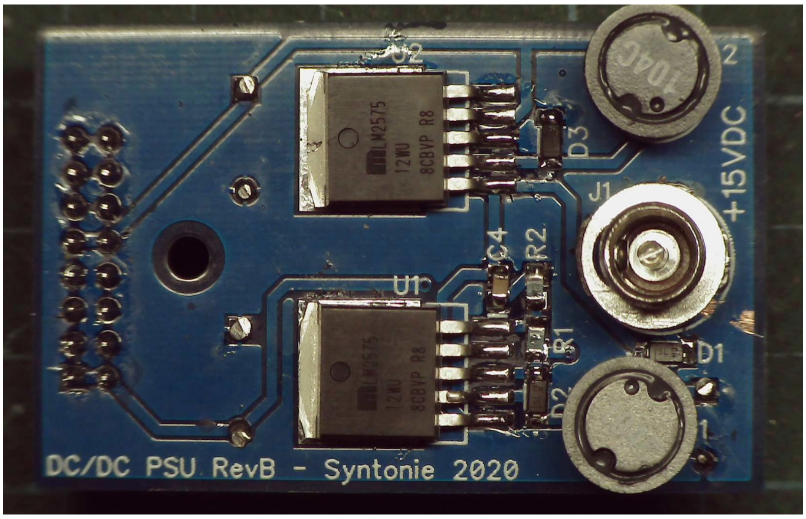
Place and solder the components in the following order:

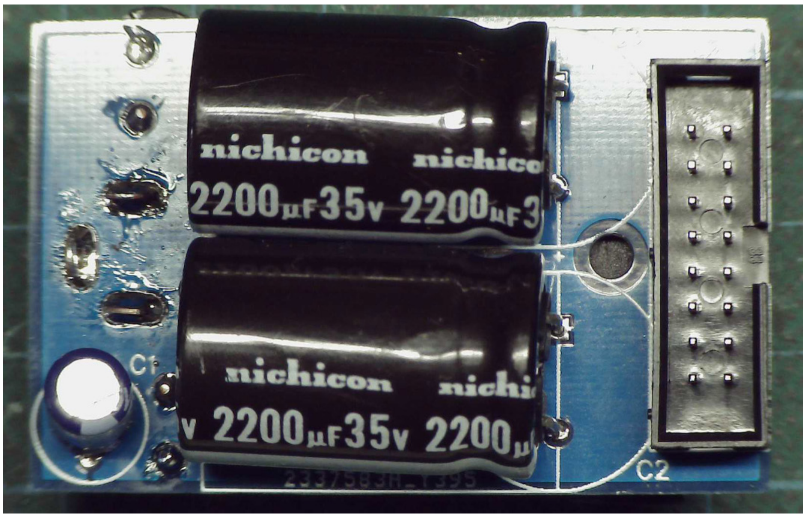
- ¬ **1** Resistors **(pay attention to the two vertically standing resistors)**
- ¬ **2** Capacitors
- ¬ **3** Transistors **(pay attention to the orientation)**
- ¬ **4** IC sockets/ICs **(pay attention to the orientation)**
- ¬ **5** Switches
- ¬ **6** Connectors
- ¬ **7** Potentiometers



`Q3` footprint got the leads of the transistor quite close together, which can be hard to solder. If you don't feel confident soldering Q3 without shorts, you can solder it like in the image above (`pin 1` and `pin 3` across `R57`, `pin 2` on left side of `R55`).

Keep the transistor oriented as shown on the silkscreen (flat side on the top).
Cut the leads of the transistor at about the half and make sure that it doesn't sit too tall, as the front panel will come above.





Place and solder the components in the following order:

- ¬ **1** Inductors
- ¬ **2** Connector **(mind the orientation)**
- ¬ **3** Capacitors **(pay attention to the orientation).** The two 2200uF caps' leads needs to be bent so the caps lie perpendicular to the board, then solder.

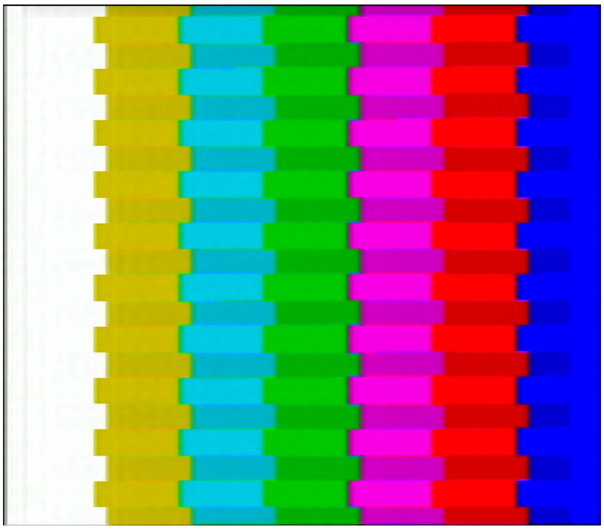
Apply a 15VDC power supply and check for +12V & -12V on the power connector's correct pins.

Once the main board and control board are connected together and power applied via a power cable to the 16 pin power connector, the circuit should pass video.

If that's not the case,check both boards/PCBs for correct component orientation/placement, cold solder joints, etc...

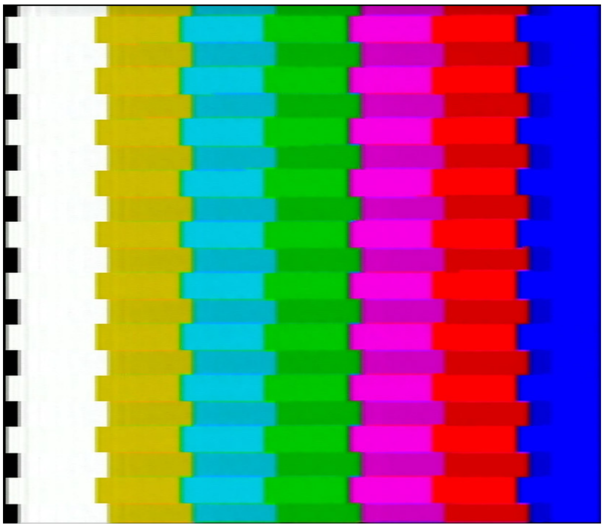
Blanking

Best way to set it visually is to switch the key source to VCO and VCO range to vertical, and use a test pattern for reference. The resulting image should display horizontal bars.

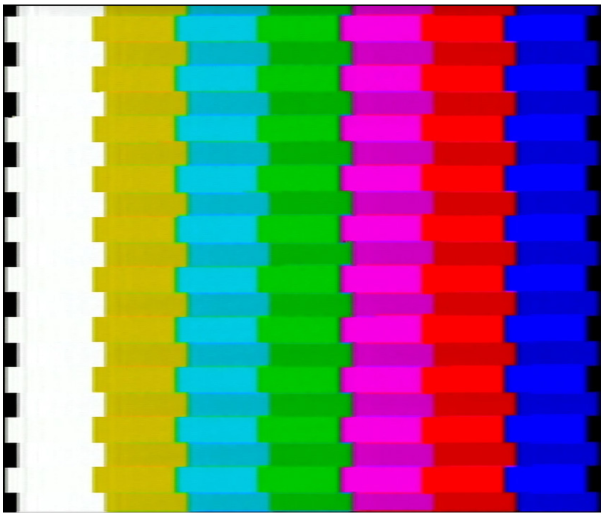


Not properly calibrated

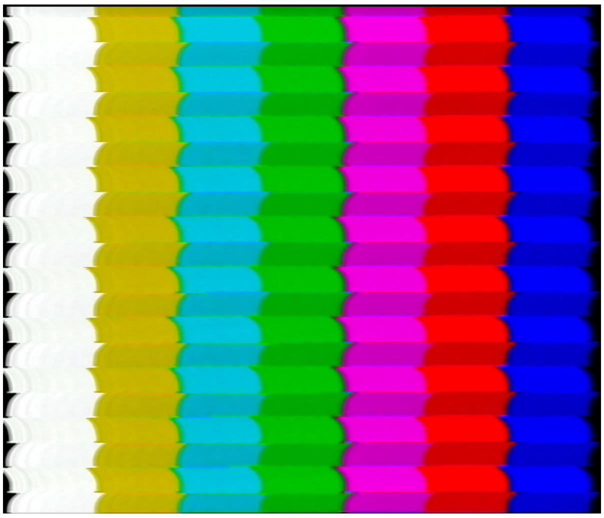
Left and right part of the picture doesn't display the delayed (darker) part fully.



Turn P1 clockwise, we can now see that the delayed part is displayed on the left. However the bars have shifted to the left, so now a little bit more is missing on the right.



Turn P2 counterclockwise, the horizontal bars should now be extended on the right, until they reach the end of the picture.

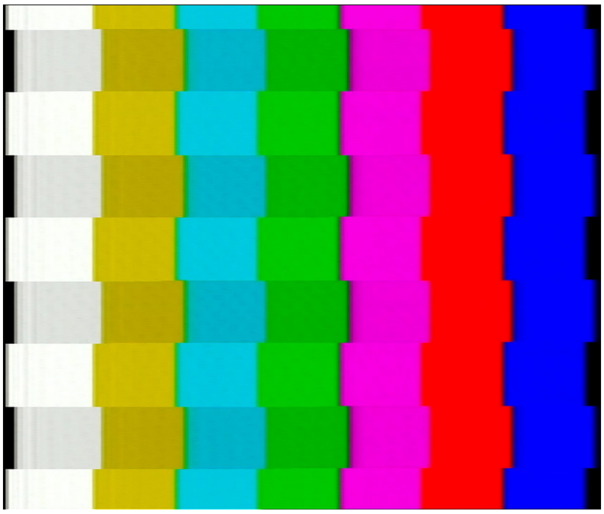


If P2 is turned counterclockwise too much, it will display something like this. Turn it clockwise until you start seeing the bars diminishing to the right, and back again until it reaches the previous example.

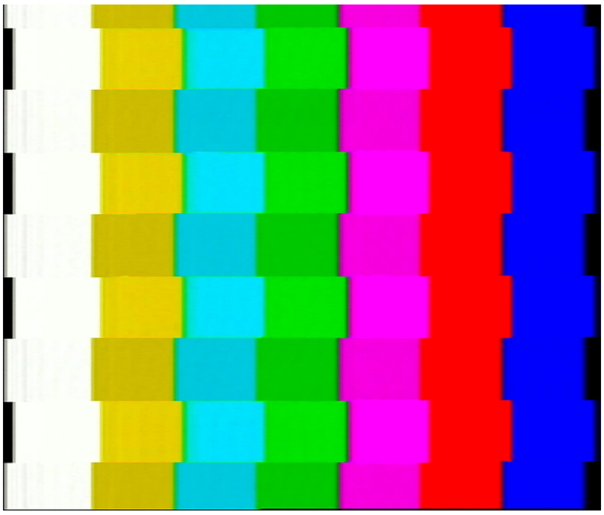
Delayed signal make-up gain

The delay chip slightly attenuates the video signal, so the delayed signal needs to be amplified to match the input video signal. Note that the delayed signal also looses a bit of linearity, so it's not really possible to match the original signal 1:1.

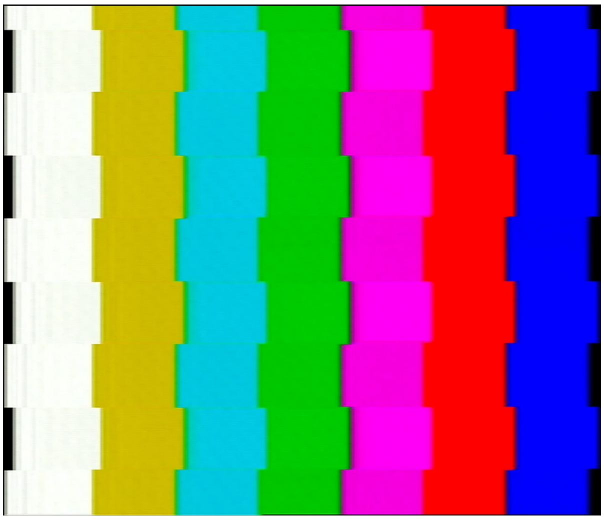
We can keep the previous calibration settings, however this time we need to turn the delay time knob so the color in the delayed signal matches the original signal as much as possible. Use the switch to set the delay to the longer delay time if the shorter setting isn't enough to reach the right colors. Adjust the delay time until you reach the right colors at max saturation (saturation will increase/decrease as you get close to matching the original video).



When moving P3, the brightness of the delayed signal should change. Here it is darker, so P3 needs to be turned counterclockwise to increase delayed signal amplitude.



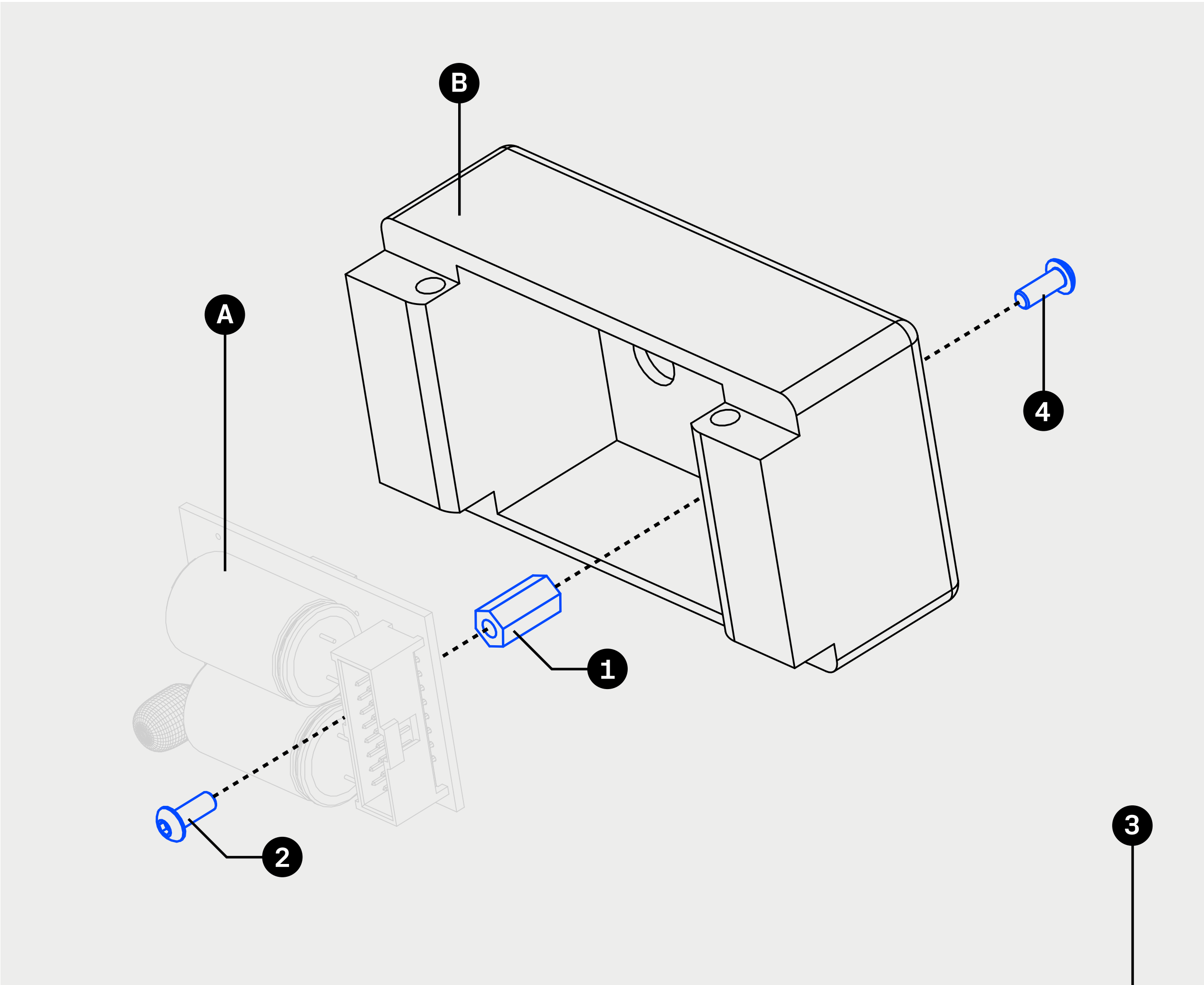
Here it is too high, so P3 needs to be turned clockwise to decrease delayed signal amplitude.



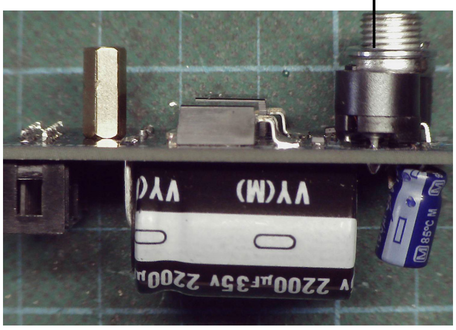
■ **P3 properly calibrated**

Once again, it's not really possible to have it perfectly matched so aim for what looks good on your display/capture card.

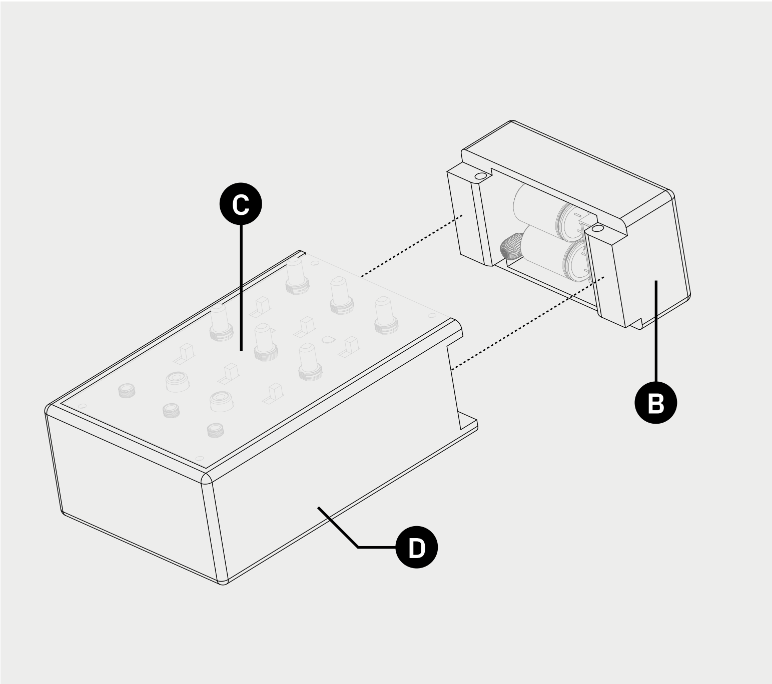
If you printed the enclosure yourself, you'll need to install M3 brass inserts in order to screw the assembly together as long as fixing the front panel to the enclosure. The enclosure has holes to fit the inserts using a soldering iron. There is 4 on the rear part and 2 on the front part.

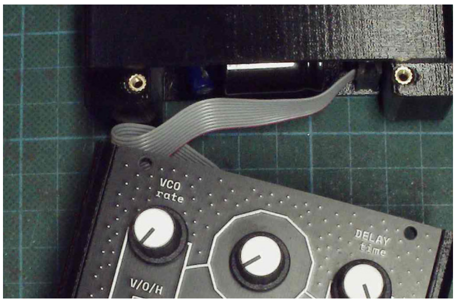


Start by fixing the power supply **(A)** to the rear part of the enclosure **(B)**. First, fix the 11mm spacer **(1)** with a 6mm screw **(2)** to the power board, leave the washer on the DC connector **(3)**.



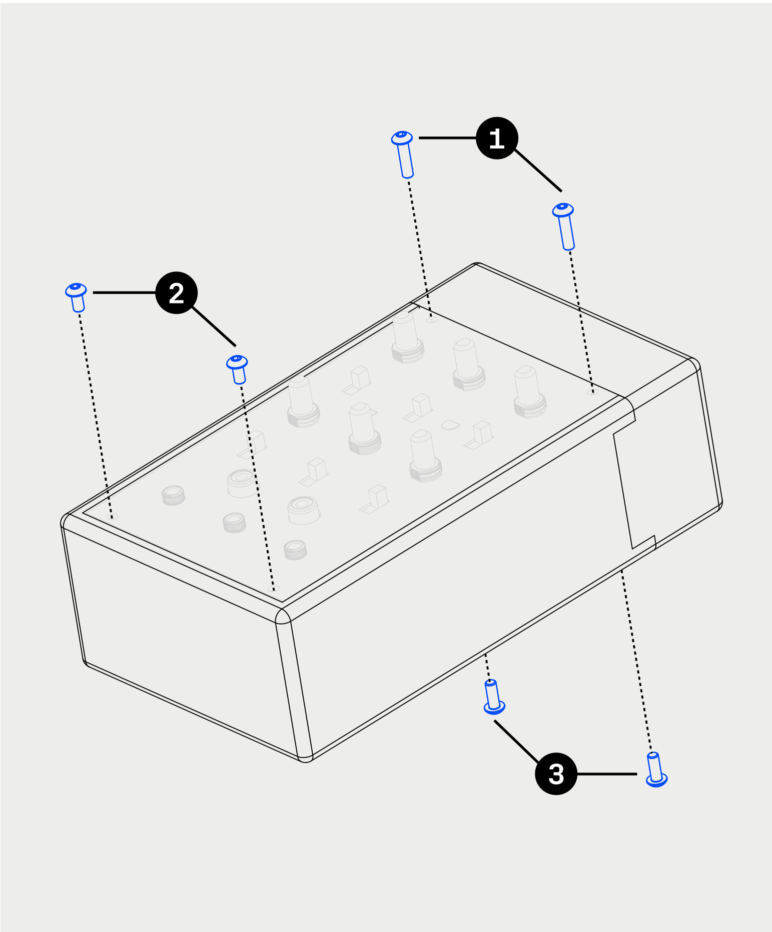
Attach the 16pin to 10pin power cable to the power board before installing it into the rear part of the enclosure. Then secure it using a 6mm screw **(4)** and the nut for the DC connector.





Connect the 16pin to 10pin connector to the module **(C)**, and slide the module **(C)** into the front part of the enclosure **(D)**.

Finally, slide the rear part of the enclosure **(B)** into the front part of the enclosure **(D)**.



Now secure the front panel, rear and front part of the enclosure using 2x 12mm screws **(1)**, then using 2x 6mm screws **(2)**, fix the front panel to the front part.

Use 2x 12mm screws **(3)** to fix the rear part to the front part from the other side.

Revision log

¬ **Rev F :** initial release

References

¬ Radio Plans n°445 – Décodeur C+
https://syntonie.fr/wp-content/uploads/2018/05/Radio-plans.pdf

¬ Yusynth – Random Gate
http://yusynth.net/Modular/EN/RANDOMGATE/index.html

¬ Vishay AN105 – FETs As Voltage-Controlled Resistors
https://www.vishay.com/docs/70598/70598.pdf

¬ Rob Schafer – Horizontal Blanking Circuit
https://www.youtube.com/watch?v=ts6LZgBIsN4

¬ LZX – Cadet III Video Input
https://github.com/lzxindustries/lzxdocs/blob/master/Cadet%20III%20Video%20Input/Cadet%20III%20Video%20Input%20Schematics.pdf

¬ LZX – Castle 010 Clock VCO
https://github.com/lzxindustries/lzxdocs/blob/master/Castle%20010%20Clock%20VCO/Castle%20010%20Clock%20VCO%20Schematics.pdf

¬ LZX – Reference Designs
https://github.com/lzxindustries/lzxdocs/blob/master/Reference%20Designs/LZX%20Interface%20Examples%20RevA.pdf

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