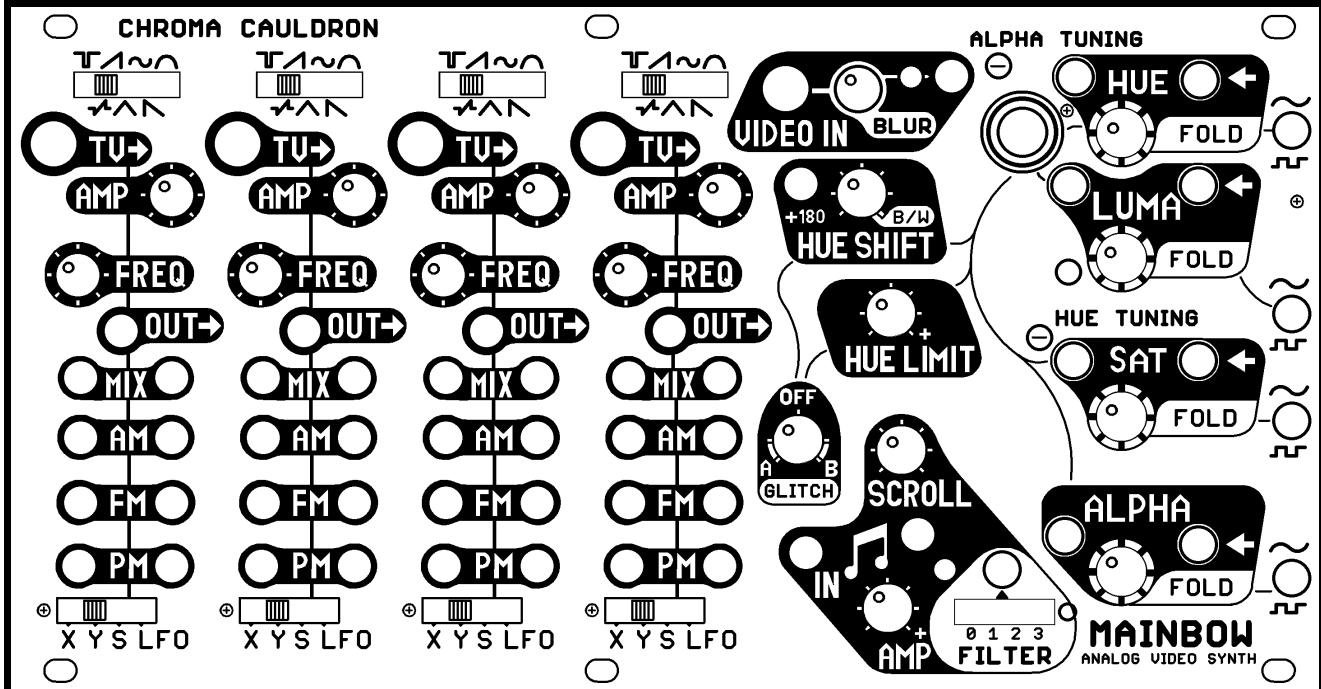


CHROMA CAULDRON

MAINBOW

ANALOG VIDEO SYNTH



Requires Eurorack case and power supply

Features:

- LZX compatible 0-1v signalling.
- Music visualization system.
- Built in splitters at all inputs.
- **Eurorack module.** 3U x 48HP (128.5 x 243.84mm)
- DIY kit uses only easy to solder thru-hole components.

Colour video encoder and synchronizer

- Hue, Saturation, Luminance, Alpha(transparency) input channels.
- Can synchronize to an external video signal or operate independently.
- Wavefolding and hard/soft control on all inputs.
- Fine control over hue and glitch effects.

Four video function generators

- Monochrome NTSC/PAL output in addition to 0-1v output.
- Four Modulation inputs (Phase, Frequency, Amplitude, Mix)
- Four oscillation modes (Horizontal, Vertical, Scrolling, LFO)
- Seven Waveforms (Pulse, Heartbeat, +Ramp, Triangle, Sin, -Ramp, Log)

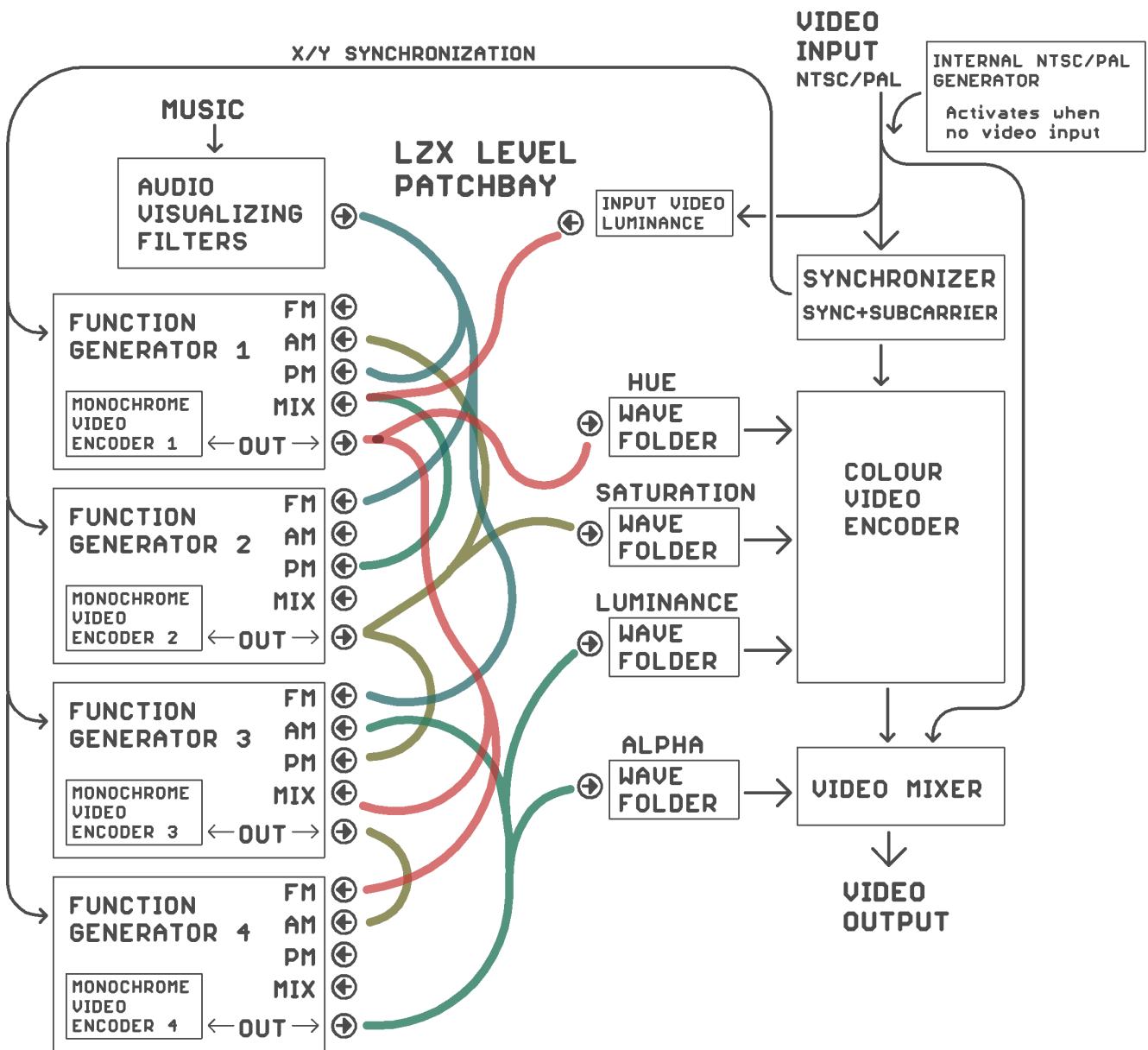


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Construction guide

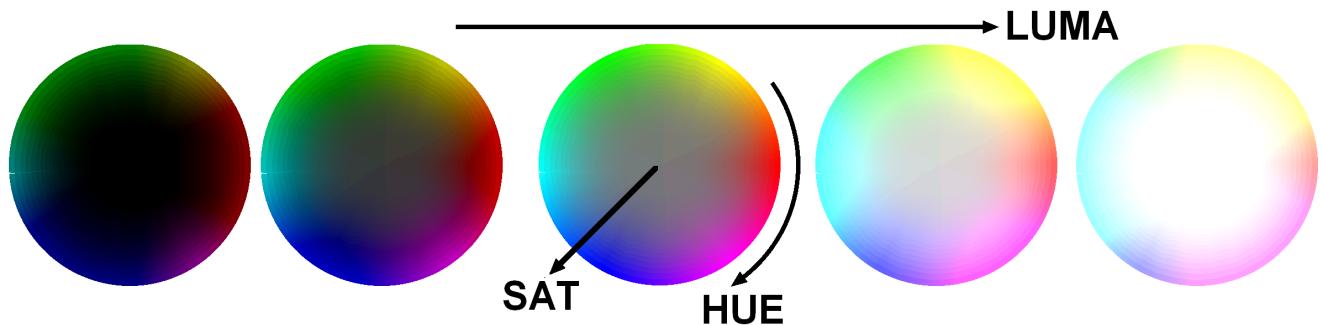
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HSL Colour Space

Hue: Rotation around a continuous colour wheel.

Saturation: Shifts from grey to intense colour.

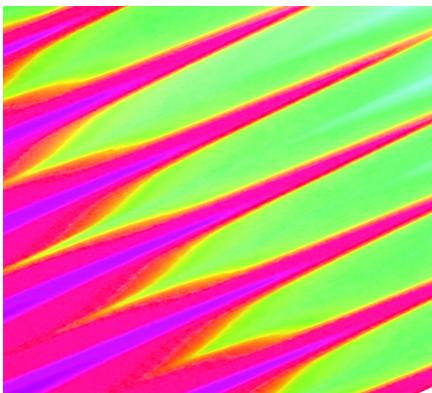
Luminance: darkens and lightens.



HSL simplifies producing vibrant colourful patterns. Every colour in the rainbow can be produced by controlling the hue channel. In RGB this would require different signals to all three channels.

Alpha Channel

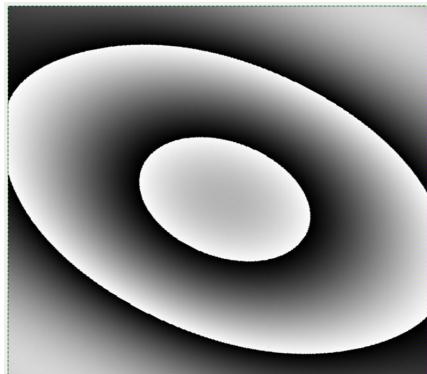
The alpha channel allows keying and blending with an external video signal. It produces a fade to black if no external video is present.



Synthesized Video



External Video



Alpha Channel



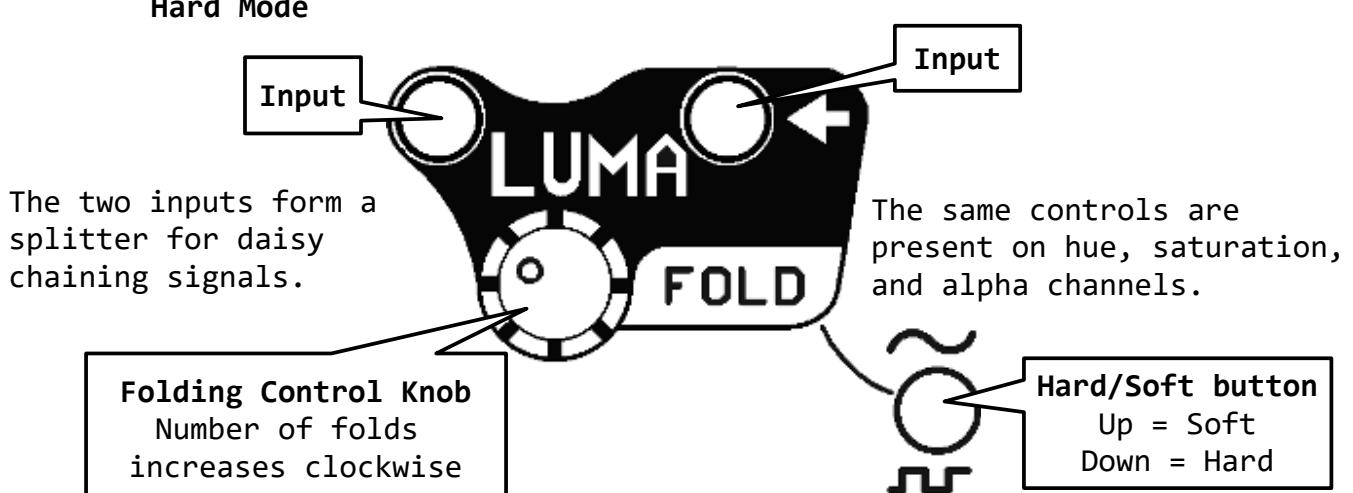
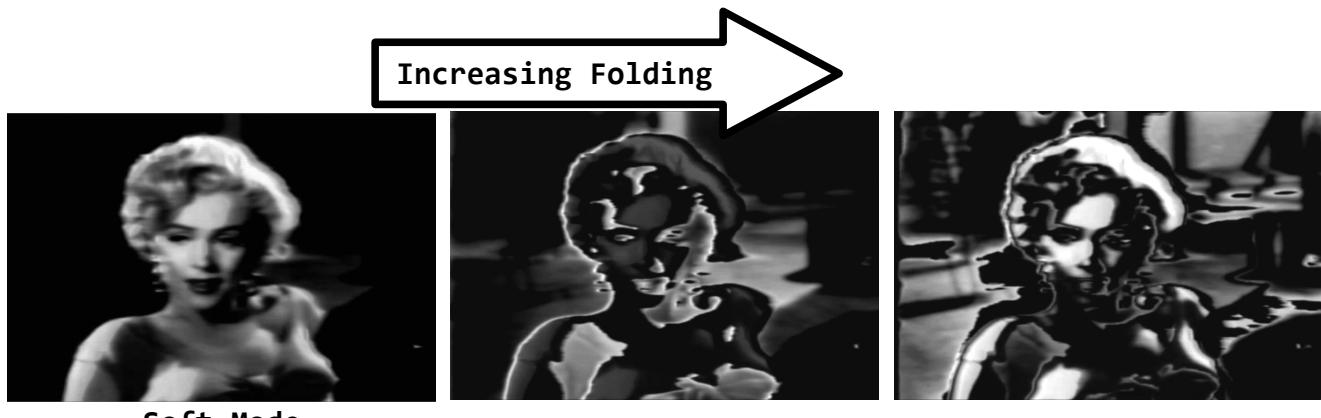
Video Output

Wavefolding

All four video encoder inputs have a wavefolder and hard/soft button. Wavefolding can bring the channel from 0% to 100% up to eight times as the control signal goes from 0v to 1v. This adds significant depth and complexity to synthesized patterns. The number of folds is controlled by the fold knob. This knob also sets the constant value of a channel if no input signal is applied.

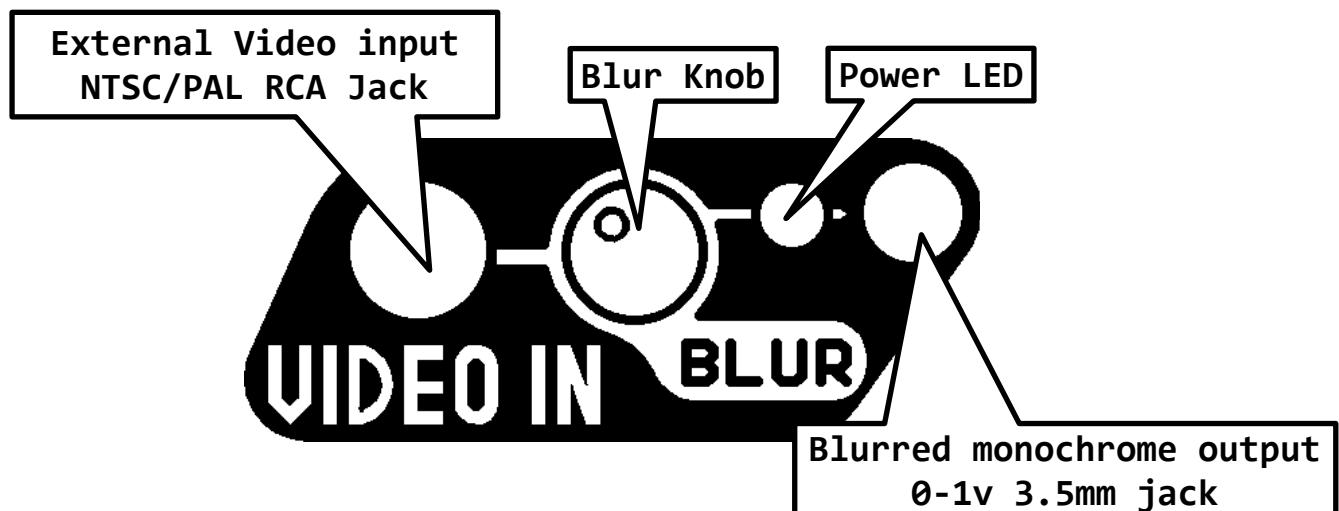
The hard/soft button changes the channel from a continuous gradient to two discrete values.

Example: Turning up luminance folding in hard and soft modes. Luminance input is external video. Saturation is set to 0 for a monochrome output.



External Video Input

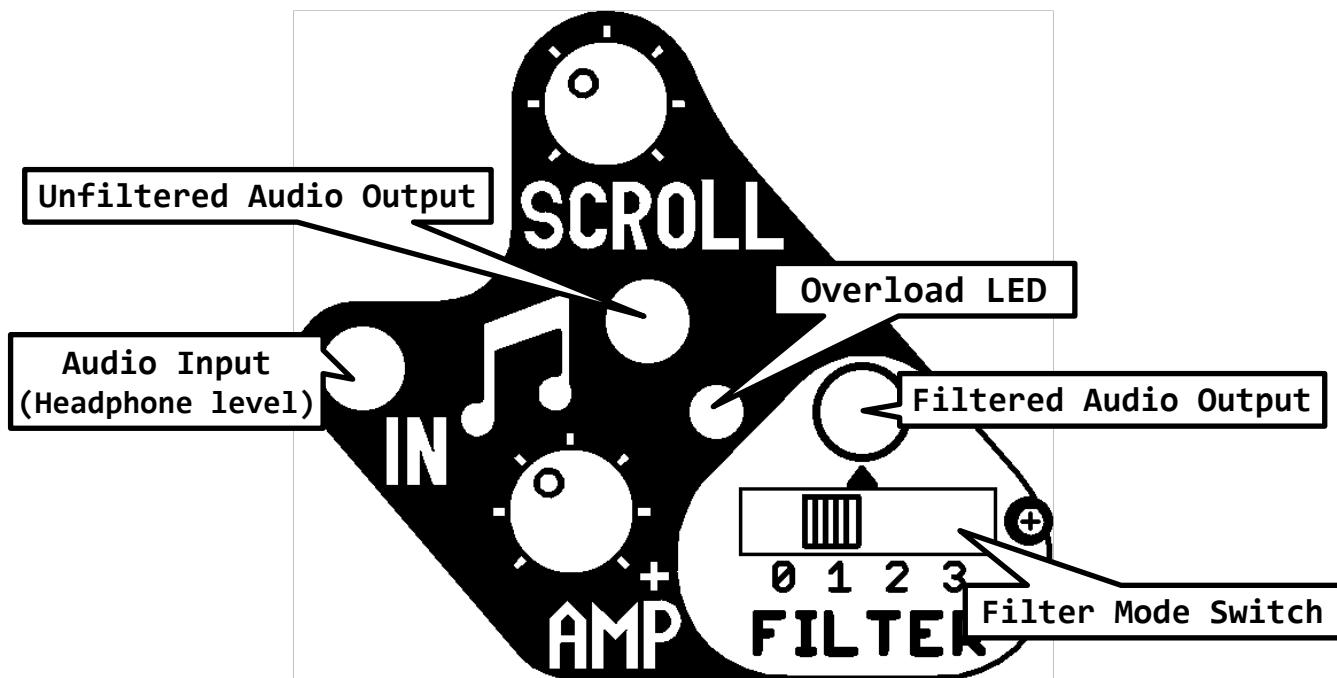
This provides the background layer used by the alpha channel. Also a monochrome version of this signal is converted to 0-1v signalling levels. This allows the function generators and video encoder to be modulated by the external video. Variable blurring is useful for removing noise and pixelation. It also produces a liquid metal effect when used with wavefolding.



Power LED should always be dimly lit.

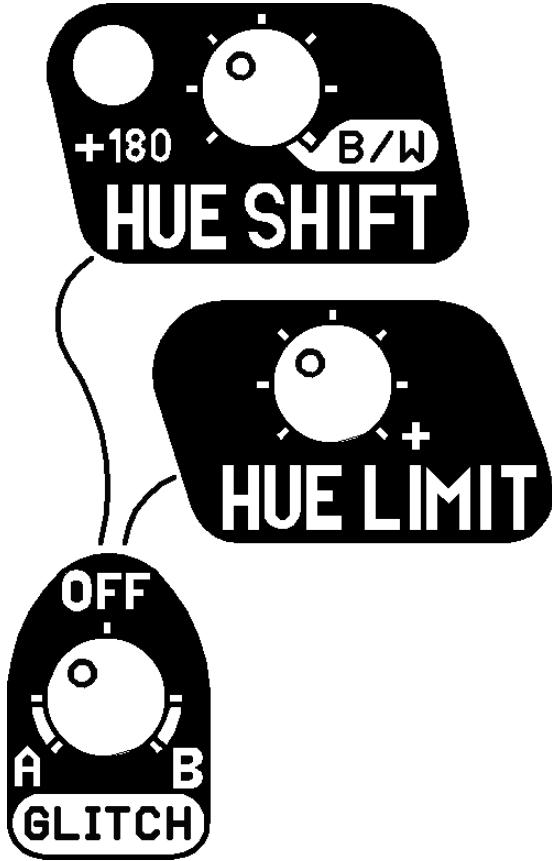
Audio Processor

Running unfiltered music directly into a video synthesiser produces a flickery mess regardless of how mellow the music is. Mainbow's audio system converts music into scrolling amplitude waves that look nicer. The audio input accepts a headphone level signal directly from a device such as a Walkman or iPod. It is not meant to accept the 0-1v signalling used elsewhere in this module.



- **Amp Knob.** The audio input can be amplified to varying levels before filtering. This allows a wide range of input volume levels.
- **Scroll Knob.** Sets how fast amplitude waves scroll up or down the screen.
- **Overload LED.** This indicates the amplification is set too high. Filters are oversaturating and will not work properly.
- **Unfiltered Output** (3.5mm jack). Provides an amplified and DC offset adjusted copy of the input signal.
- **Filter Mode switch.**
 - 0) Interlaced amplitude graph.
 - 1) Simple beat detector. Scroll knob sets the decay rate.
 - 2) Scrolling amplitude graph.
 - 3) Centred amplitude graph.

Extra Hue Controls



Hue Shifter

Defines the starting angle of rotations around the colour wheel. Adjusting it will shift the hue of all synthesized patterns. Turning the knob fully clockwise disables the hue channel producing monochrome output. Turning it fully counter-clockwise can produce colour glitches.

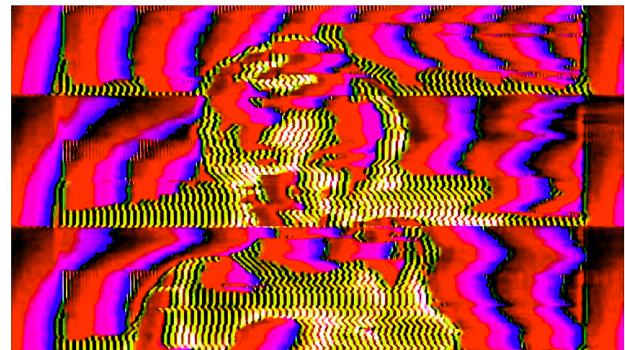
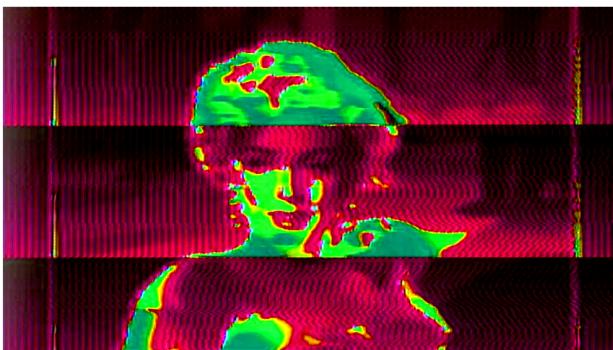
Hue Limiter

Collapses the range of hues that can be encoded. For example you may want to generate patterns ranging from pink to blue instead of the entire rainbow. This can be achieved by limiting the hue range and setting the starting point with the shifter.

Glitch

Replaces some hues with glitchy lines and rainbows. Different glitches can be generated by turning the knob clockwise and counter clockwise. Centre the knob to disable the glitching effects.

Example Glitch Effects



Function Generators

Mainbow contains four function generators. Elaborate patterns emerge when they modulate each other. All modulation inputs have a built in splitter for easy daisy chaining. Function generators output both monochrome NTSC/PAL and 0-1v signalling.



Waveform Switch

Selects one of seven waveforms.

Monochrome Video Out (RCA Jack)

Run to a TV to see what the function generator is doing. It's fun and useful to see the intermediate steps of video synthesis.

Amplitude Knob

Sets the amplitude of the output signal.

Frequency Knob

Sets the Frequency of the output signal.

0-1v output (RCA Jack)

Patch to modulation inputs of other function generators and the colour video encoder.

Mix input (Dual 3.5mm jacks)

Mixes another signal with this function generator in a 50% ratio.

Amplitude Modulation input (Dual 3.5mm jacks)

Multiplies output amplitude by another signal.

Frequency Modulation input (Dual 3.5mm jacks)

Multiplies output frequency by another signal.

Phase Modulation Input (Dual 3.5mm jacks)

Shifts waveform phase by another signal. Only active in X,Y modes.

Oscillation Mode Switch

X: Horizontal patterns.

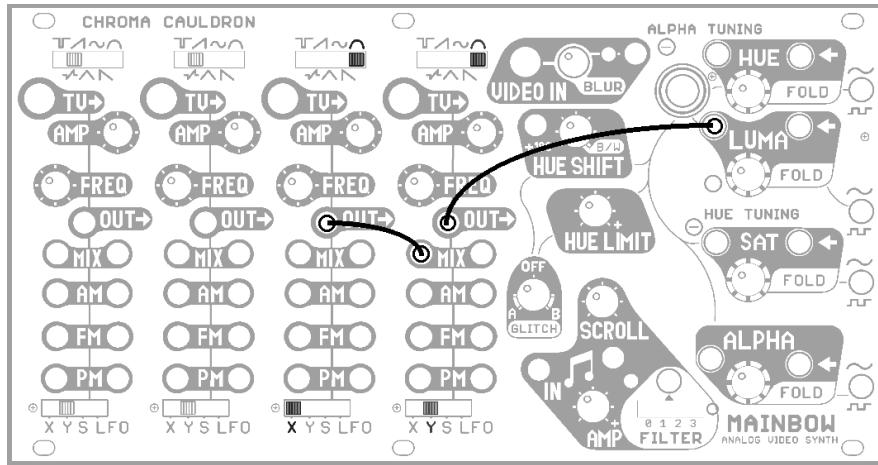
Y: Vertical patterns.

S (Scroll): Scrolling vertical patterns.

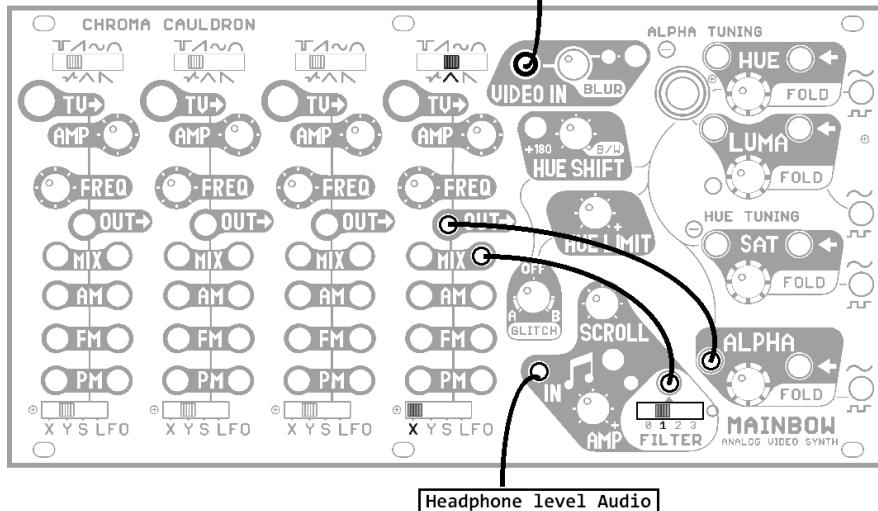
LFO: Low frequency oscillations.

Example Patches

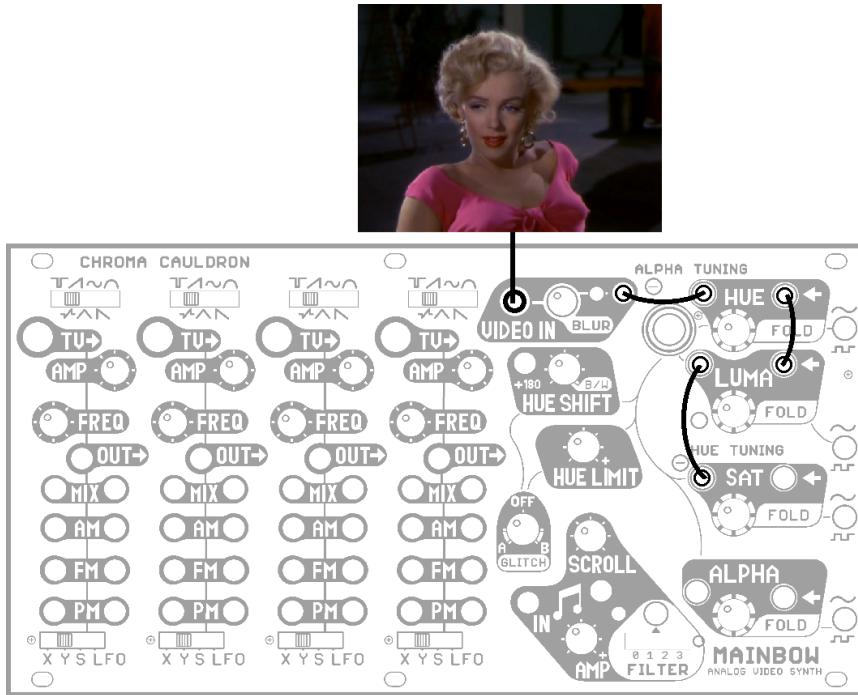
Circle



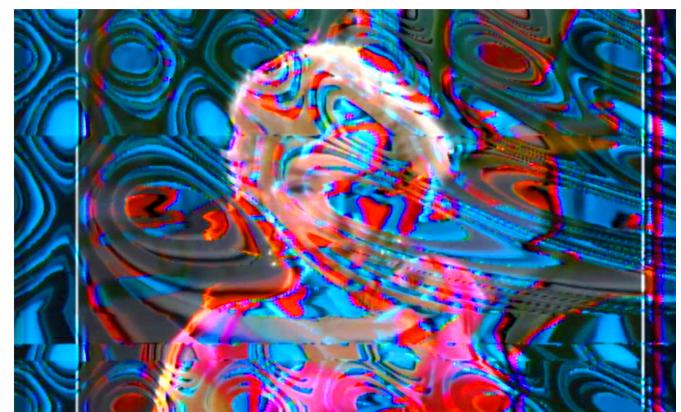
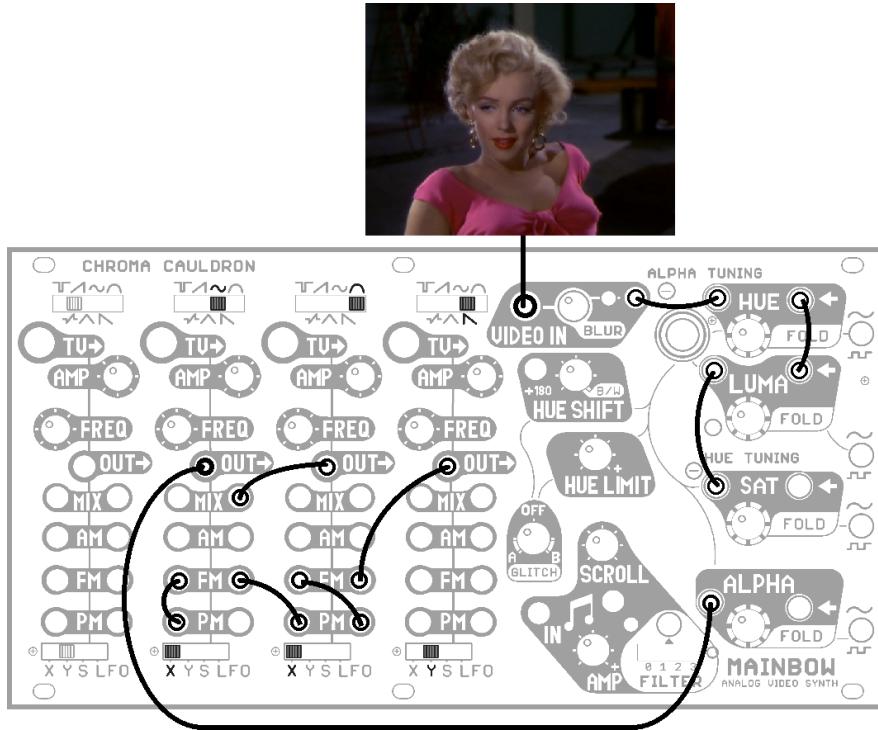
Music amplitude graph overlay



Recolourizer



Abstract pattern recolourizer overlay



Component list

Resistors

<u>Value</u>	<u>Colour Code</u>				<u>Quantity</u>
75Ω	violet	green	black	gold	6
330Ω	orange	orange	brown	gold	16
470Ω	yellow	violet	brown	gold	10
1kΩ	brown	black	red	gold	56
2kΩ	red	black	red	gold	17
2.4kΩ	red	yellow	red	gold	1
3kΩ	orange	black	red	gold	13
5.1kΩ	green	brown	red	gold	2
10kΩ	brown	black	orange	gold	27
20kΩ	red	black	orange	gold	4
51kΩ	green	brown	orange	gold	20
100kΩ	brown	black	yellow	gold	5
150kΩ	brown	green	yellow	gold	1

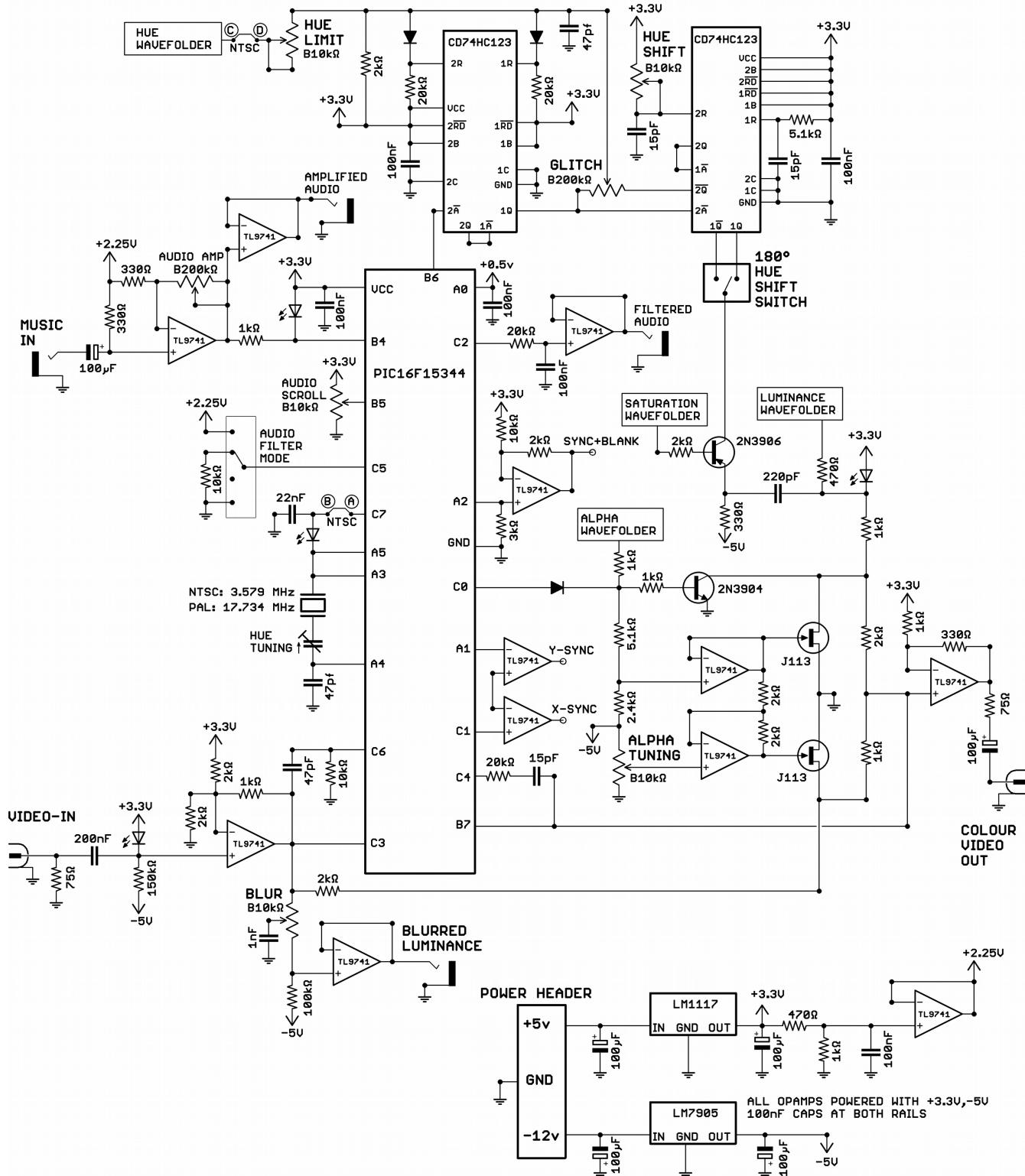
Capacitors

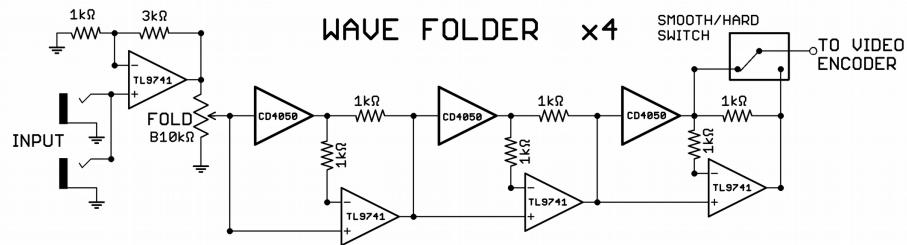
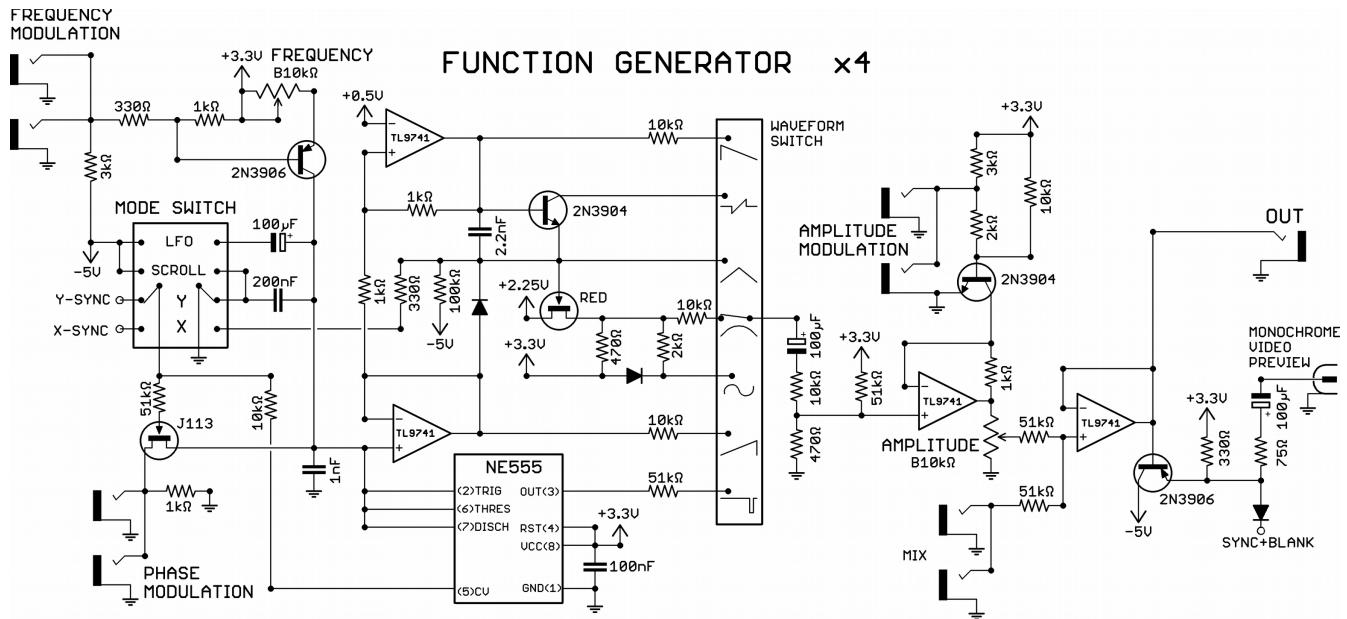
<u>Value</u>	<u>Code</u>	<u>Quantity</u>	<u>Discrete semiconductors</u>	
			<u>Name</u>	<u>Quantity</u>
15pF	150	3	1N914 diode	15
47pF	470	3	Blue 5mm LED	4
220pF	221	1	J113 transistors	6
1nF	102	5	2N3904 transistor	9
2.7nF	272	4	2N3906 transistor	9
22nF	223	1	Red transistor	4
100nF	104	31	Piezo Crystal	1
220nF	224	5		
100uF	100uF	18		

Controls

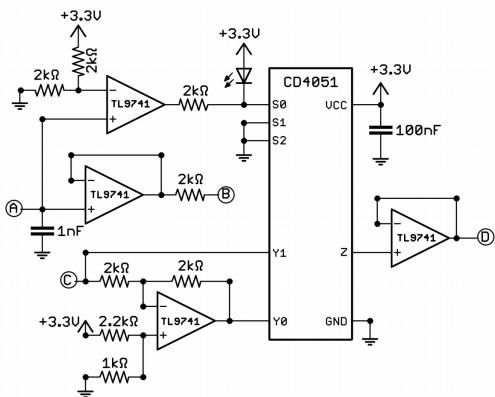
		<u>Integrated Circuits</u>
2P4T switch	5	NE555P
2P2T pushbutton	5	TL974IN
1P7T switch	4	CD74HC4050
tuning capacitor	1	CD74HC123
10kΩ trimpot	1	LM1117
10kΩ potentiometer	16	LM7905
200kΩ potentiometer	2	PIC16F15344
		<u>Misc</u>
RCA	6	M3 Screw Posts
3.5mm	48	Heat Sinks
16pin power header	1	Tiny screws
		M3 screws
IC Sockets		M3 nuts
8 pin	4	Knobs
14 pin	11	
16 pin	4	
20 pin	1	

VIDEO SYNCHRONIZER, ENCODER, MIXER





PAL PHASE ALTERNATOR



The PAL Phase alternator is on a separate board only sold with the PAL version.

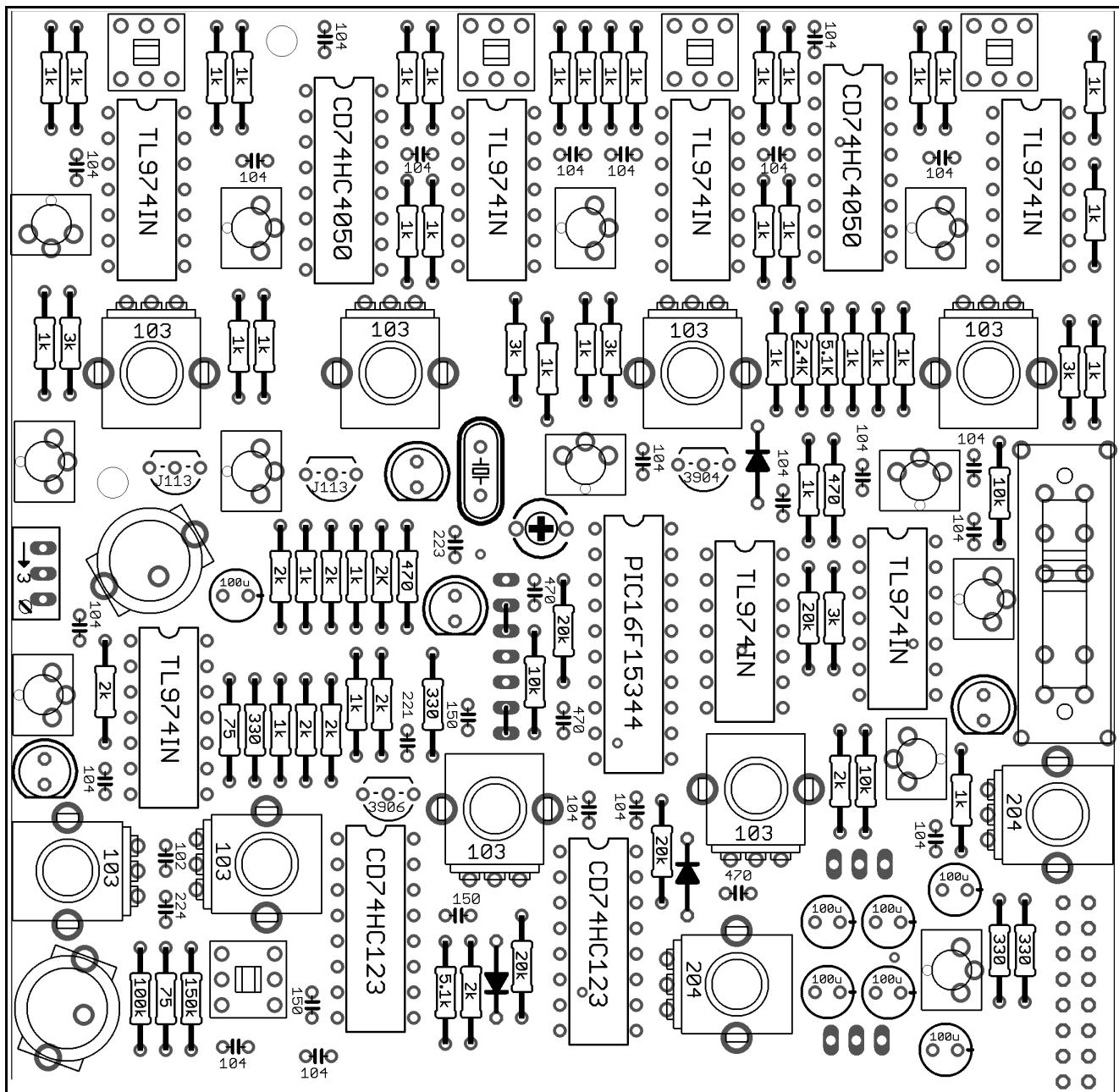
PCB

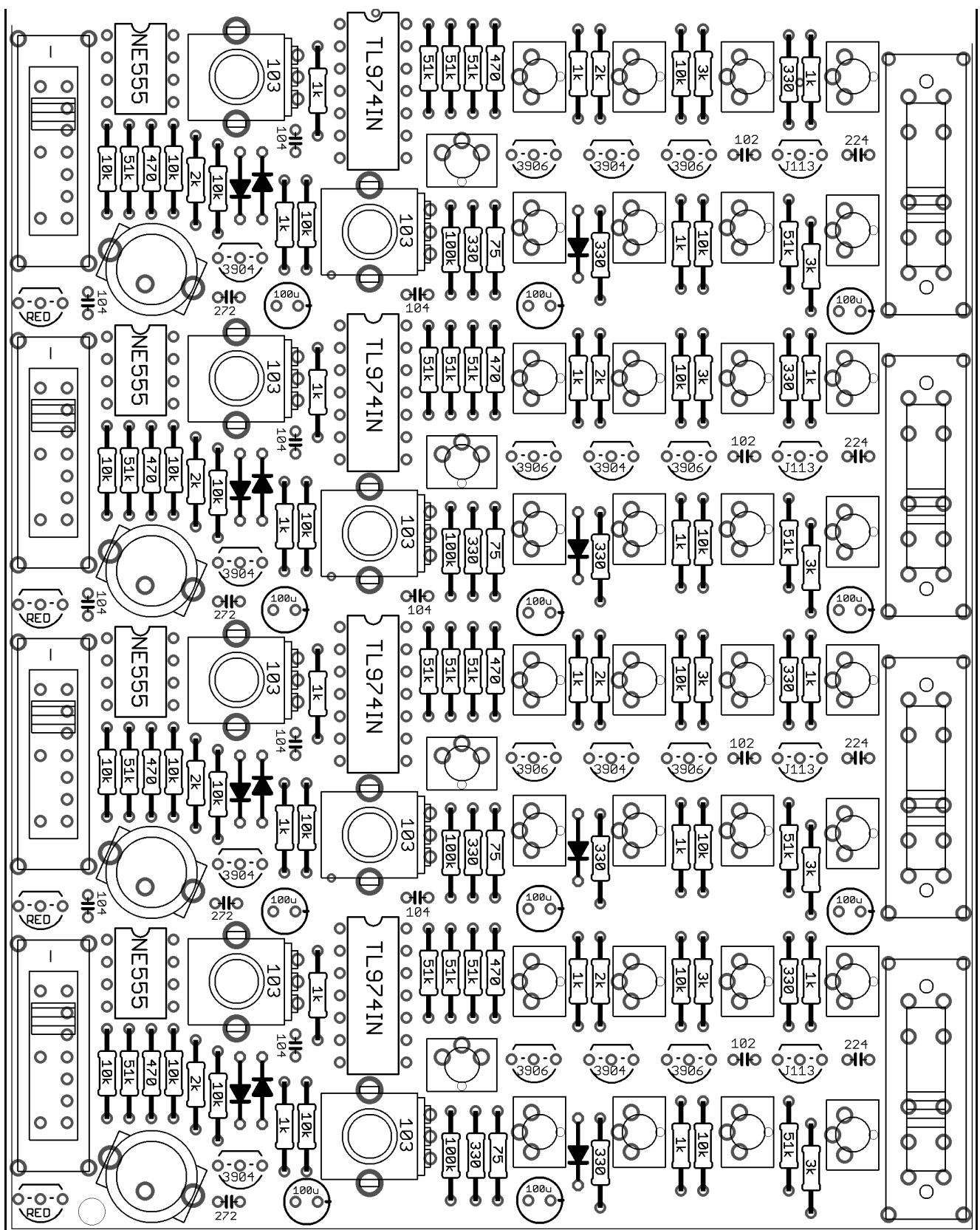
Ceramic capacitors are labelled with their numeric codes. $104 = 100\text{nF}$, etc. Some manufacturers omit trailing zeros so capacitors labelled "150" and "470" on the PCB may have "15" and "47" printed on them.

There are two different potentiometers values. 103 ($10\text{k}\Omega$) and 204 ($200\text{k}\Omega$). They look identical. A label is printed on their backside.

Electrolytic capacitors must be pushed in all the way or the case will not fit properly.

Jacks, potentiometers, and buttons will not align with panel holes if they are soldered crooked.

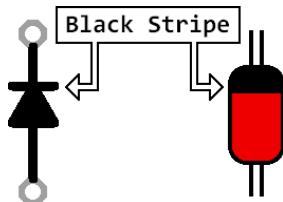




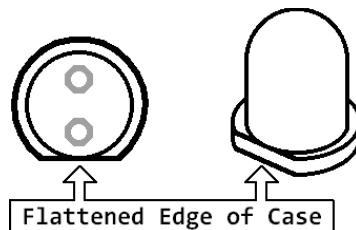
Component Polarization

Don't put these in backwards!

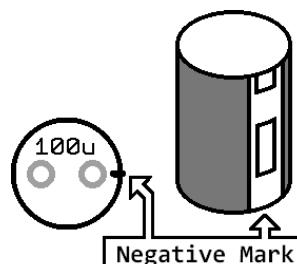
Diode



LEDs

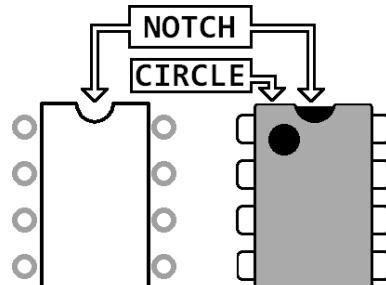


Electrolytic Capacitors



Electrolytic capacitors may explode if installed backwards.

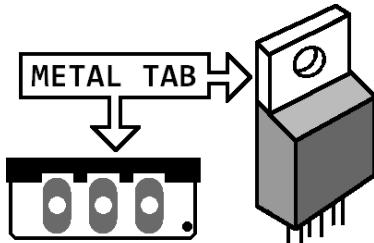
Chips



Some chips use a circle in the top left corner instead of a notch.

Chips can be permanently damaged if installed backwards. TL974INs break in a way that shorts the power supply after being reinserted correctly.

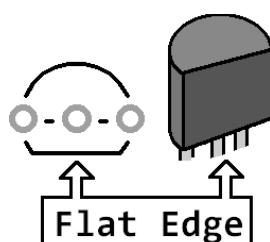
Regulators



Regulators mount on back of PCB.

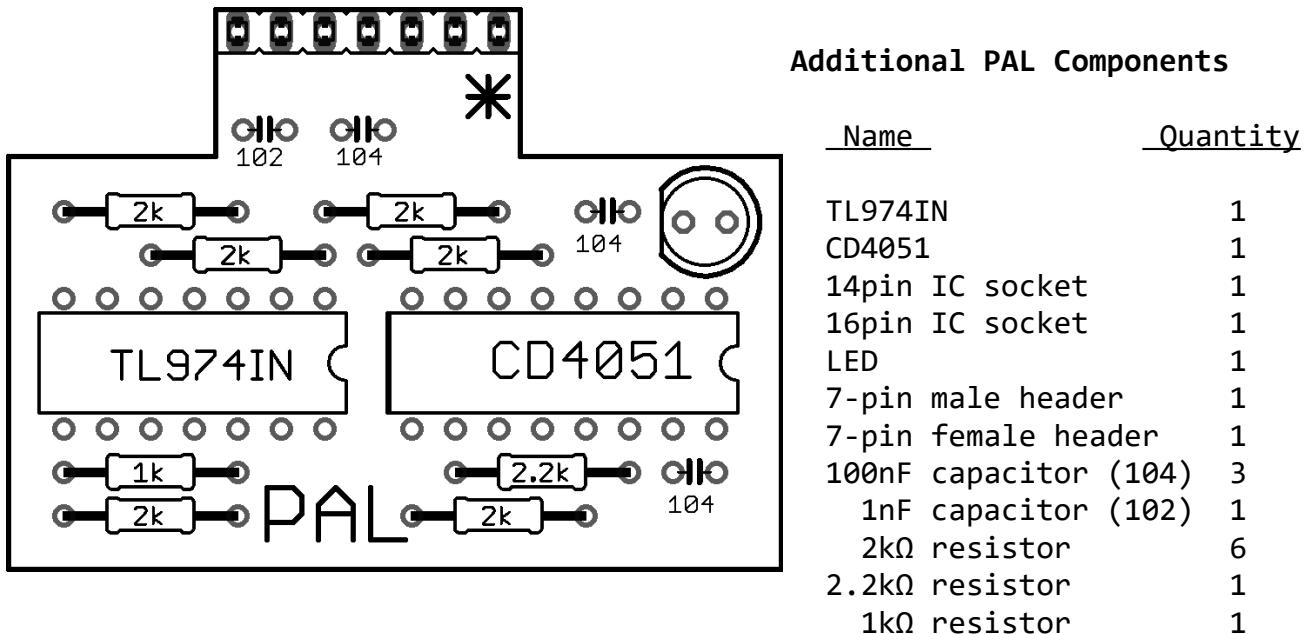
Do not bend the regulators in a way that allows their tabs to touch

Transistors

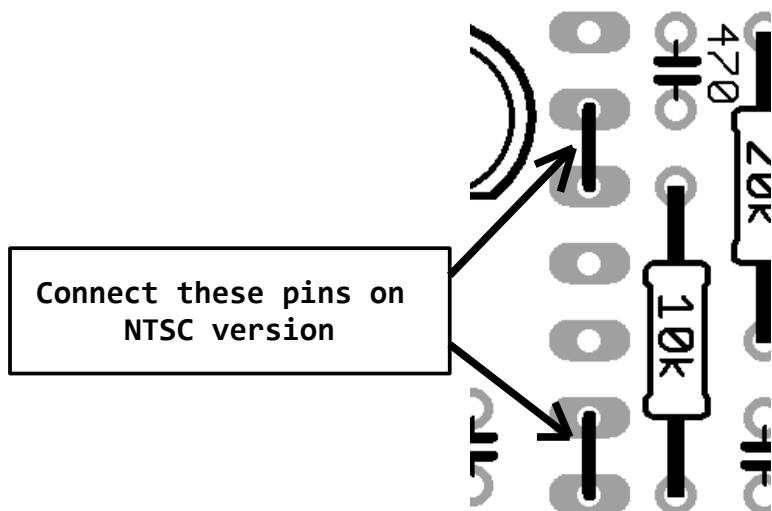


PAL Expander

The PAL version requires an expansion board. It also uses a different crystal and microcontroller hex. The expander connects to header pins on the back of the main board. Do not install backwards. Line up the *'s.



NTSC Jumpers

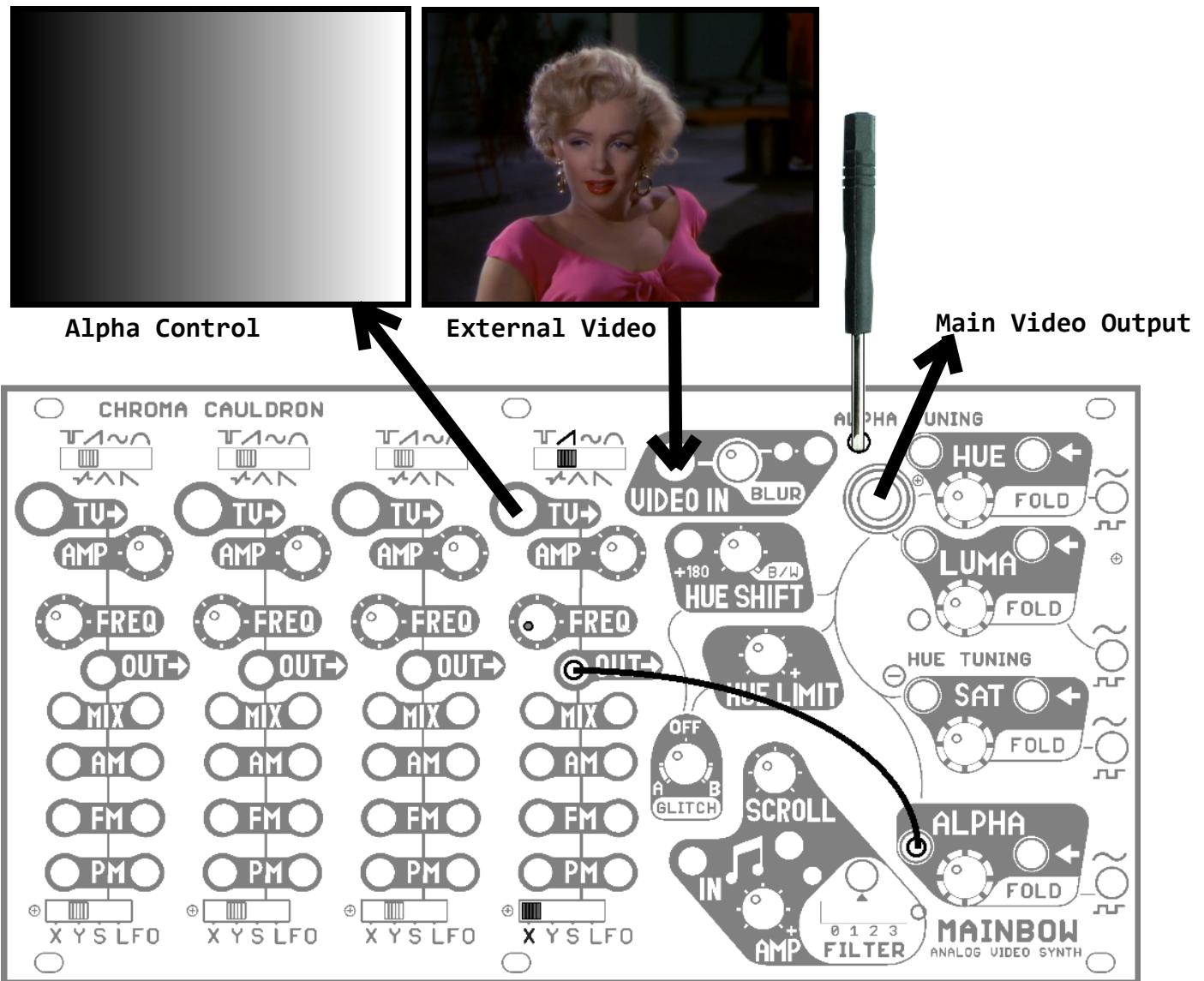


Alpha Tuning

Mainbow will not work until you do this! Really bad alpha tuning produces corrupted video that TVs do not recognize.

The alpha channel fades out the external video while simultaneously fading in the synthesized video. These fades must be symmetrical. Part of the transition will be videoless (dark) if external fades out faster than synthesized fades in. The symmetry is set by a small screwdriver potentiometer.

Alpha tuning effects brightness when Mainbow is generating a video signal independently.



Procedure:

- Set a function generator to produce a horizontal positive ramp. Turn frequency fully counter-clockwise for a single oscillation per line. Turn amplitude fully clockwise (maximum). The function generator's TV output works independently of the alpha tuning and can be used to verify it is working correctly.
- Patch the function generator output to the Alpha channel input. Turn the folding $1/8^{\text{th}}$ of a rotation clockwise (doesn't need to be precise).
- Put the alpha channel into soft mode (blue button up).
- Connect an external video signal to the video-in RCA jack.
- Connect the main video output to a TV.
- Set the Hue, Sat, and Luma channels to produce a solid colour by adjusting their fold knobs. The LED next to Luma will be dimly lit in this state.
- Turn the alpha-tuning potentiometer until there is a smooth transition between external and synthesized video. It's a geared potentiometer taking eight screwdriver rotations to go from min to max.

Colour may be glitchy if hue tuning needs to be adjusted.

Good Tuning



Too far clockwise



Too far counter-clockwise



Hue Tuning

Mainbow synchronizes its colour subcarrier to the colour-burst of an external video signal using a genlock circuit. This needs manual help sometimes. When genlock is working it's possible to produce a screen of solid colour by setting H,S,V inputs to constants. When genlock is failing the colours will appear as horizontal rainbows. Adjusting the hue tuning with a small screwdriver will fix this.

Good

A solid colour is produced when no signal is patched to hue input and glitch effect is off (centred). The solid colour changes as you adjust the hue fold, shift, and limit knobs.



Bad

Hue appears as a sequence of rainbows. The number of rainbow stripes decreases as hue tuning gets closer to the correct position.

