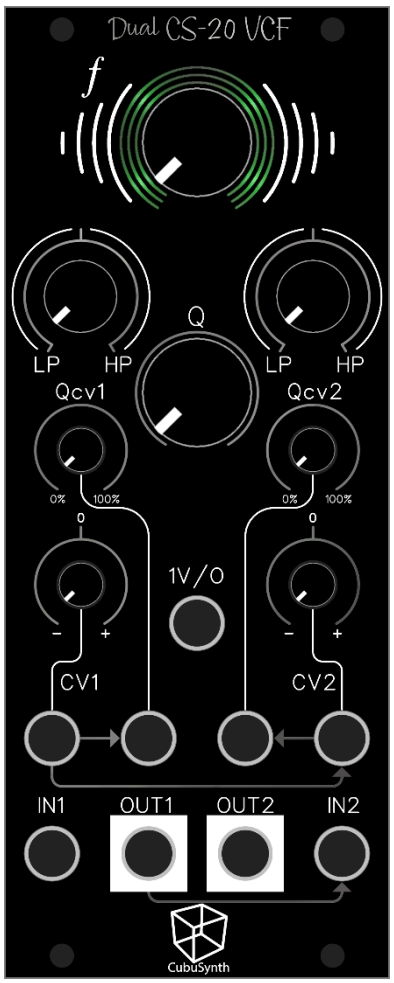
CubuSynth

Dual CS-20 VCF

Dual / Stereo Multimode VCF with Self-oscillating Resonance and intuitive Routing and CV modulation Matrix



Build Guide

PCB V1.4 March 2023

Written and Illustrated by Ruben Sponar

CubuSynth

Introduction

The CubuSynth Dual CS-20 VCF is a dual / stereo multimode VCF / Phaser / VCO, inspired by the legendary Korg MS-20, with CV control over frequency and resonance. The resonance can self-oscillate and features a 1V/Oct input, stable over at least 2~3 octaves.
Each of the two filter cores has 2 stages of Low Pass and High Pass filtering, which can be blended.
The Frequency CV can be “attenuverted” (with inverting attenuator on CV input). The resonance CV comes with an attenuator.

This Build Guide is written for buiders with experience in soldering and assembling PCBs. Due to the complexity of the build, the guide is focused on the steps that require special care or techniques. Therefore, not every component value is described and listed as a single step.

The components and quantity needed for each step are shown like this.

Quantity	Name	Designator

Tools Required

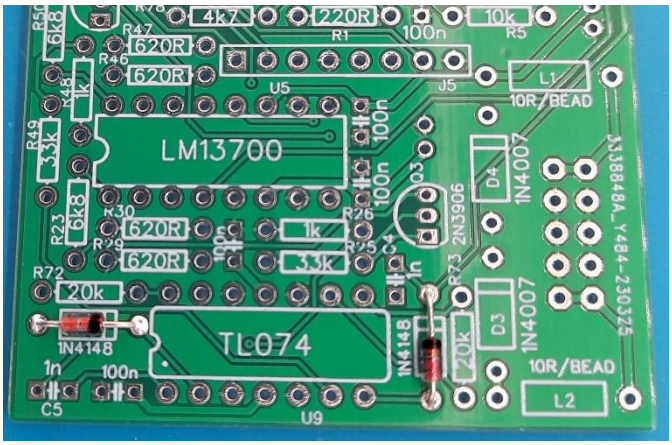
Soldering iron (+wire)
side-cutter
snipe nose plier
flat head screwdriver
Nut wrench / driver M8
Digital Multimeter
Helping (third) hand / PCB holder

BUILD GUIDE

STEP 1 (Main PCB)
1N4148 Diodes

2	1N4148	D2,D1

Identify the 1N4148 diodes and put them in place. Orientation is Important! Make sure the line on the diodes lines up with the stripe on the PCB silkscreen.

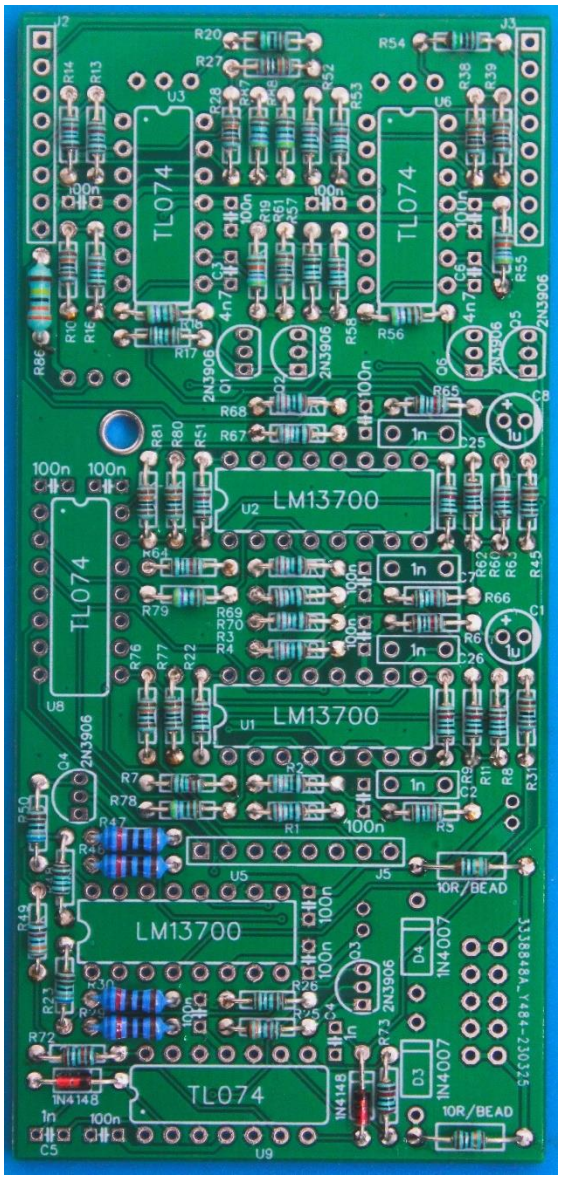


STEP 2 (Main PCB)
Resistors

2	10R/BEAD	L1,L2
8	220R	R70,R69,R68,R67,R4,R3,R2,R1
4	620R	R47,R46,R30,R29
4	1k	R17,R57,R48,R26
2	1k5	R54,R20
6	4k7	R79,R78,R56,R18,R88,R87
2	6k8	R50,R23
20	10k	R16,R58,R66,R65,R64,R63,R62,R60,R53,R51,R22,R13, R11,R9,R8,R7,R6,R5,R52,R14
2	20k	R73,R72
2	33k	R49,R25
12	100k	R81,R80,R77,R76,R45,R39,R38,R31,R28,R27,R61,R10
2	470k	R55,R19
1	3M3	R86

There is different ways to go, you might already have developed your own method to place the components and solder.
You can always select the resistors of the same value, place them, turn the board around and solder in place. Trim the solder legs and move on to the next value.
Another method is to place all resistors and solder them from the top, without turning around the board.

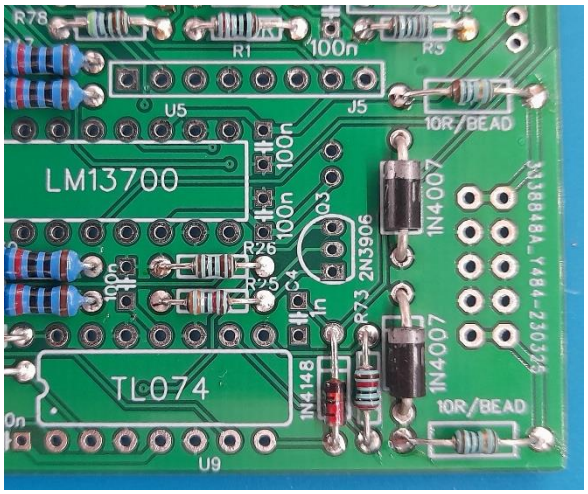
Here is a picture of all resistors in place.
To help keeping track of the already placed components, print the BOM and cross out the parts you already soldered.



STEP 3 (Main PCB)
1N4007 Diodes

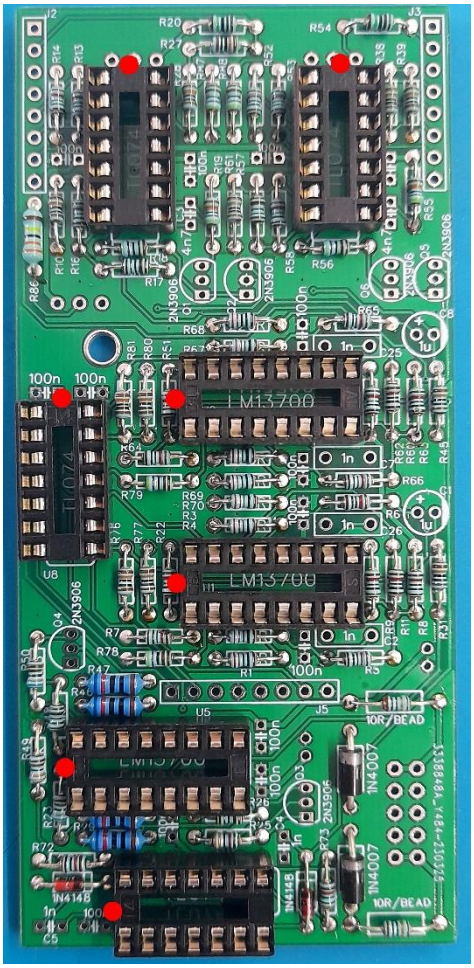
2	1N4007	D4,D3

Identify the 1N4007 diodes and put them in place. Orientation is Important! Make sure the line on the diodes lines up with the stripe on the PCB silkscreen. Then solder.



STEP 4 (Main PCB)
IC sockets

4	IC-Socket 14pin	U3,U6,U8,U9
3	IC-Socket 16pin	U5,U2,U1



Look for the dip-14 and dip-16 sockets.
Oriantation is important to know how to place the ICs later!
The place for the notch is marked on the PCB with a "D shape", in this Picture marked red for clarification.

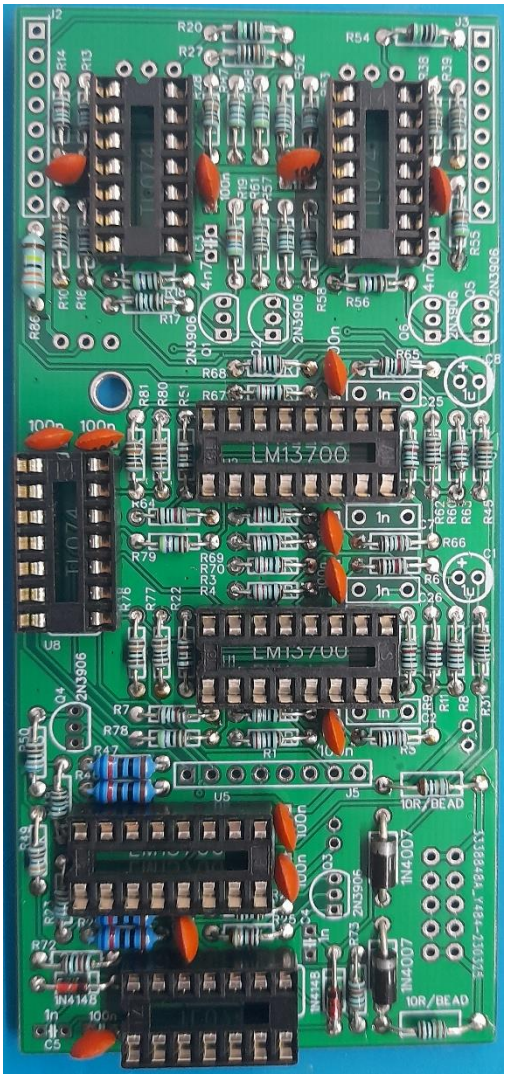
You can use tape to hold them in place, put the other PCB on top or bend 2 pins of each socket inwards, so they don't fall when turning the board around. Then solder everything.

STEP 5 (Main PCB)
100nf ceramic capacitors

14	100n	C24,C23,C22,C21,C20,C19,C18,C17,C16,C15,C14,C13,C12,C11

Find the 100nf ceramic capacitors
They are marked as "104"

Orientation doesn't matter. Put them in place and bend the solder legs outwards, so they don't fall when turning around the board.
Solder all of them in place. On the next page you can see the placement of the 100n capacitors

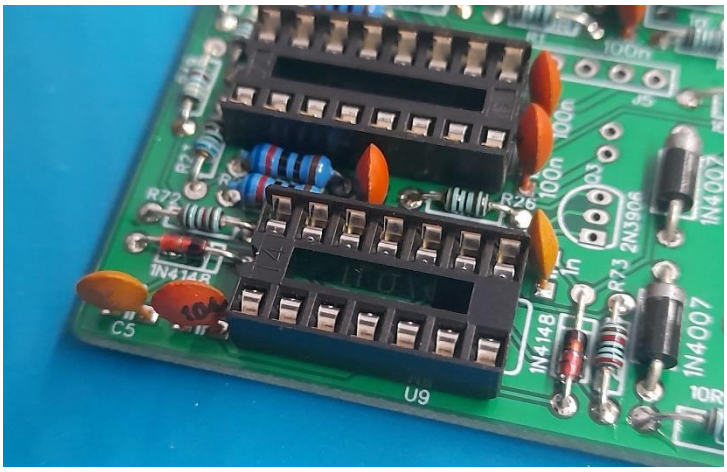


STEP 6 (Main PCB)
1nf ceramic capacitors

2	1n ceramic	C5,C4

The 1nf ceramic capacitors are marked as "102"

Place them in their spots and bend the solder legs outwards.
Turn the board around and solder them in place.

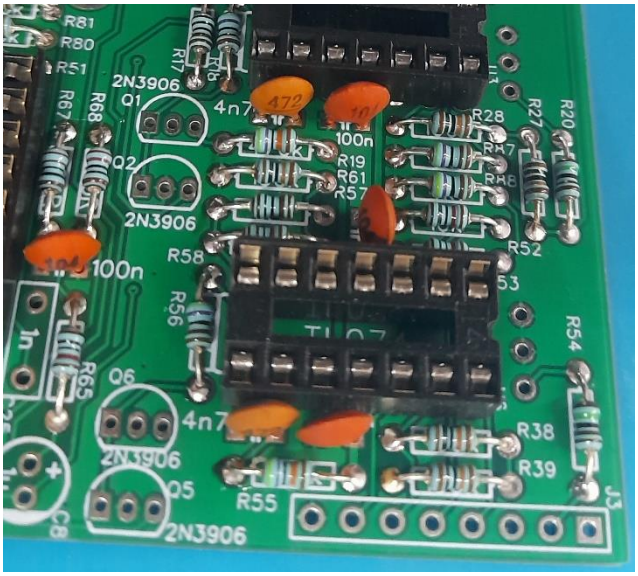


STEP 7 (Main PCB)
4.7nf ceramic capacitors

2	4n7	C6,C3

Find the 4.7nf ceramic capacitors
They are marked as "472"

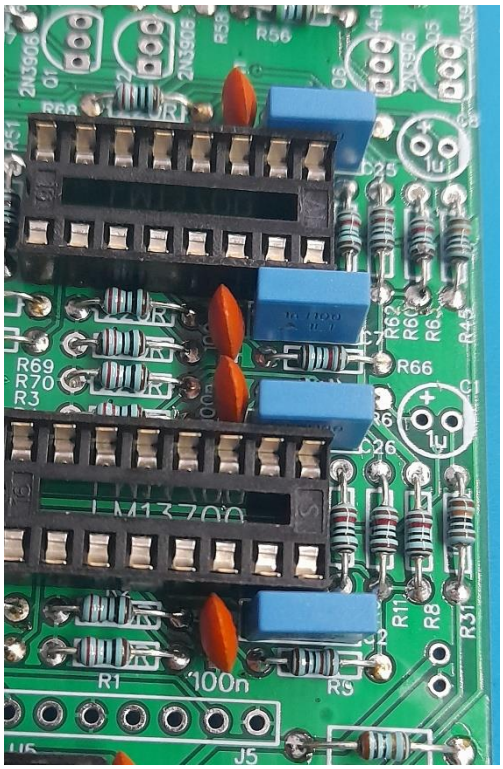
Place them as shown in the picture and solder them from the other side of the board.



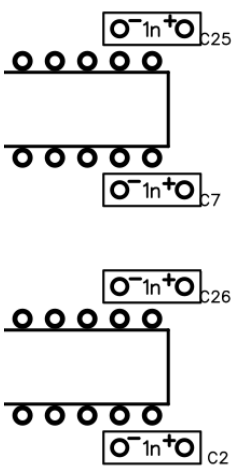
STEP 8 (Main PCB)
1nf boxed capacitors

4	1n Boxed	C2,C7,C25,C26

Place the 1nf boxed capacitors. You could use any capacitor type with 1nf, but since those are the filtering caps, it is recommended to use high quality boxed or polystyrene capacitors.
Orientation doesn't matter.*



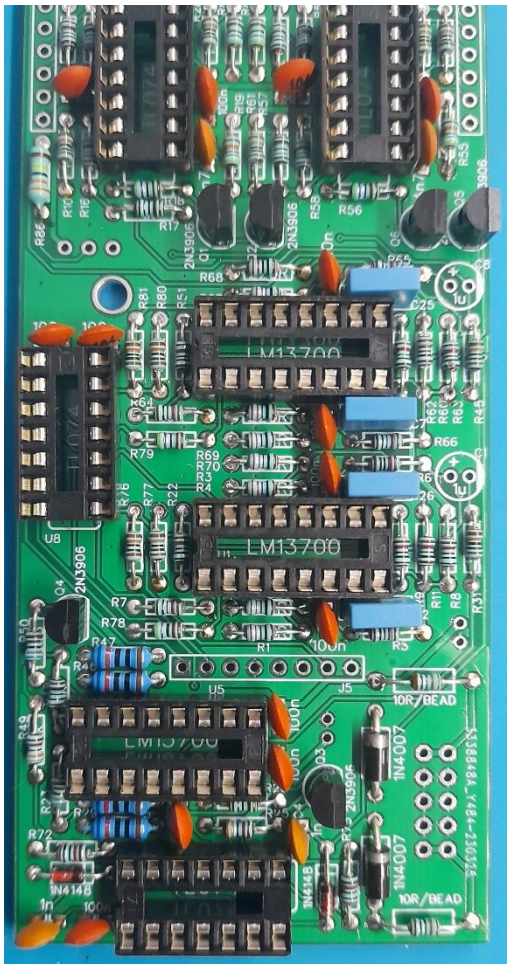
*In case you decide to use special capacitors, check its specs, it might have Polarity. Below you can see the orientation (+/-).



STEP 9 (Main PCB)
Transistors

6	2N3906	Q6,Q5,Q4,Q3,Q2,Q1

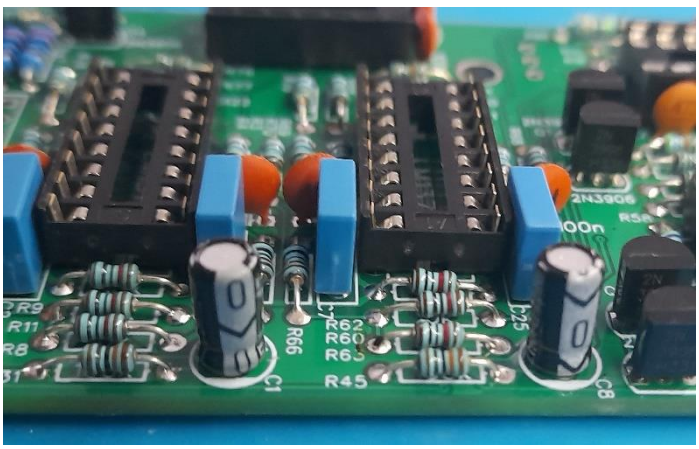
Take the 2N3906 transistors, put them in place and make sure the orientation is correct. The outline of the transistor has to match with the silkscreen on the PCB like shown in the picture.
They will stand off the PCB by around 1-2mm. Do not try to push them all the way down.
Then turn around the board an solder.



STEP 10 (Main PCB)
1uf Electrolytic capacitors

2	1u	C8,C1

Place the two 1uf capacitors on the PCB with the white line on the capacitor facing towards the white mark on the PCB. The longer leg of the capacitor goes through the hole marked with "+"

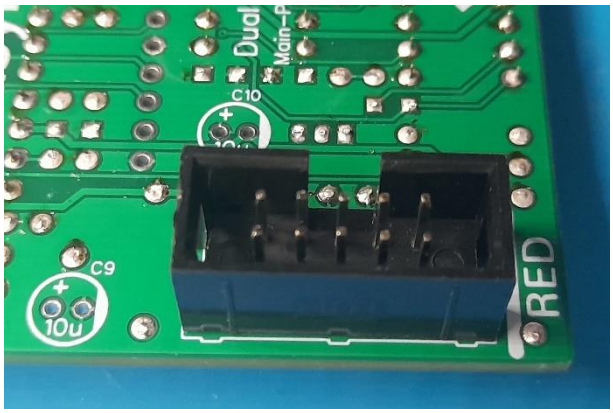


CubuSynth

STEP 11 (Main PCB)
Power header

1	EURORACK10	SV1

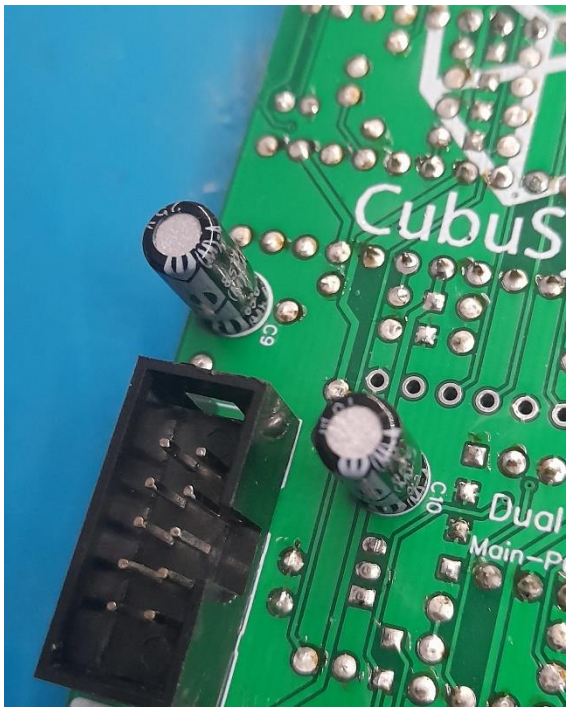
Turn around the board and place the Pin Header for Power like shown.
Orientation of the Power Header is very important to be able to insert the power cable the correct way.
Put some tape, to hold it in place while soldering from the other side or push it against the PCB with your fingers while soldering the first Pin. Be careful to not touch the one Pin you are soldering, it gets very hot!



STEP 12 (Main PCB)
10uf Electrolytic capacitors

2	10u	C10,C9

Place the two 10uf capacitors on the bottom of the PCB, with the white/grey line on the capacitor facing towards the white mark on the PCB. The longer leg of the capacitor goes through the hole marked with "+"

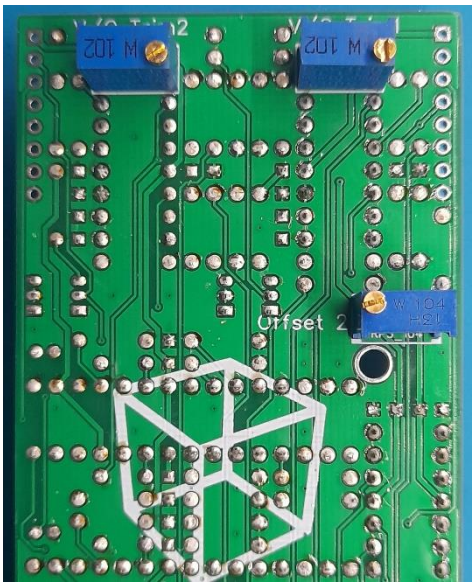


STEP 13 (Main PCB)
Trimmer

2	3296W Trimmer 1k (102)	RP1_102, RP2_102
1	3296W Trimmer 100k (104)	RP3_104

Place the 100k Trimmer according to the marking on the PCB, like shown in the picture.
You can bend the legs outwards, so it stays in place.

Turn around the board and solder.

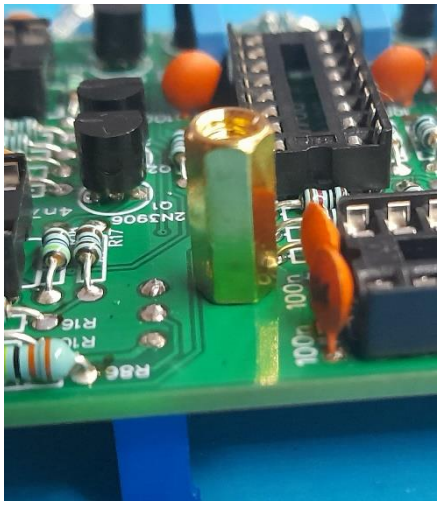


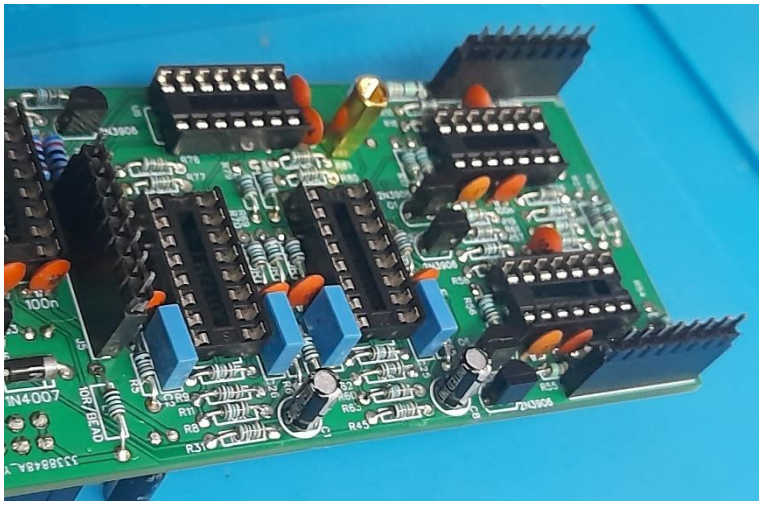
STEP 14 (Main PCB)
M3 Standoffs /Screws & Pin Headers

3	HDR-F-2.54_1x8	J5,J3,J2
3	HDR-M-2.54_1x8	J6,J4,J1
1	M3 Spacer 11mm	
2	M3 Screw Philips Head	

Place the screw in the hole of the PCB and place the spacer, so it stands off on the side with all components like in the pictue on the left.

Then put together the male and female pin headers and place them on the PCB like shown in the picture below on the right.

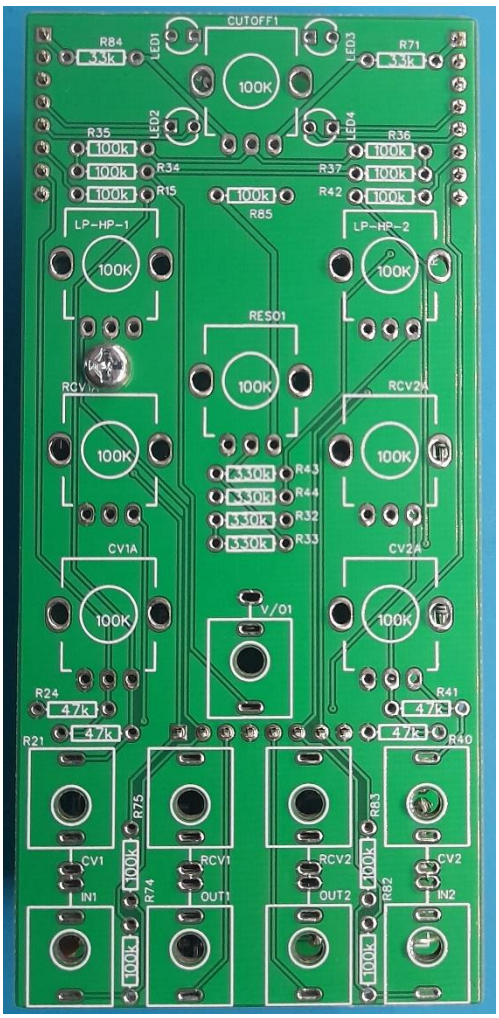




Now place the other PCB on top, so all Pins go into their holes and fix the PCBs together with the M3 screw.

Then you can solder all Pins on both sides (both PCBs)

After that, you can unscrew the M3 screws/header and carefully take apart the 2 Boards.

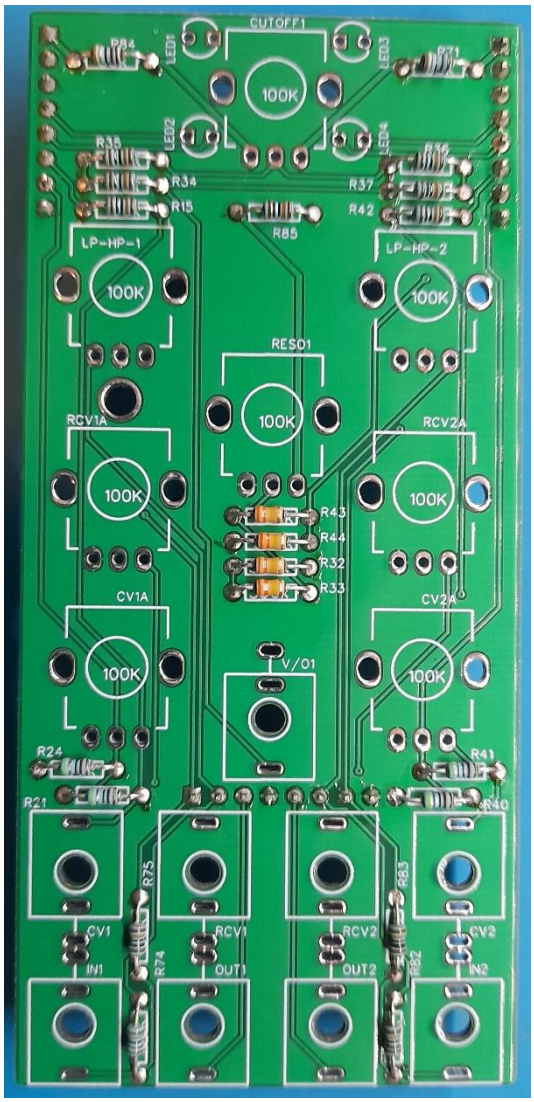


STEP 15 (control PCB)
Resistors

2	33k	R84,R71
4	47k	R41,R40,R24,R21
11	100k	R83,R82,R75,R74,R42,R37,R36,R35,R34,R15,R85
4	330k	R44,R43,R33,R32

Now take the other (control-) PCB, place the resistors as marked on the PCB.
On the next page, you can see a picture with all the resistors in place.

Resistors in place

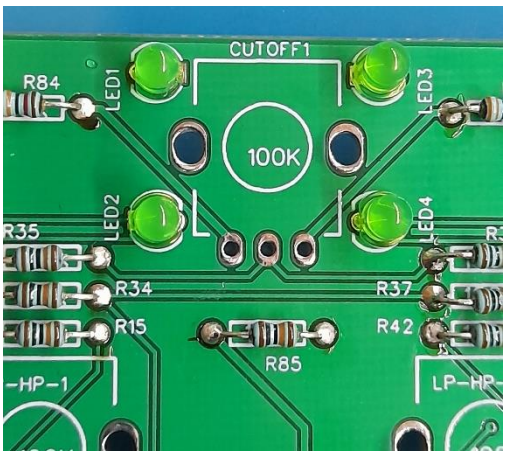


STEP 16 (control PCB)
LEDs

4	LED-TH-3mm_R	LED4,LED3,LED2,LED1

Place the LEDs on the PCB. Orientation is Important!
The longer leg goes into the square hole.

Bend the solder legs outwards so they stay in place and solder them.



CubuSynth

STEP 17 (control PCB)
Controls

4	B100K Pot	CUTOFF,LP-HP-1,LP-HP-2,RESO
4	B100K Tall Trimmer	CV1A,CV2A,RCV1A,RCV2A,
9	PJ-301M	CV1,CV2,IN1,IN2,OUT1,OUT2,RCV1,RCV2,V/O1

First, place fix the M3 spacer, like shown in the picture.

Now take the Potentiometers and jacks and put them in place as marked on the PCB but don't solder yet.

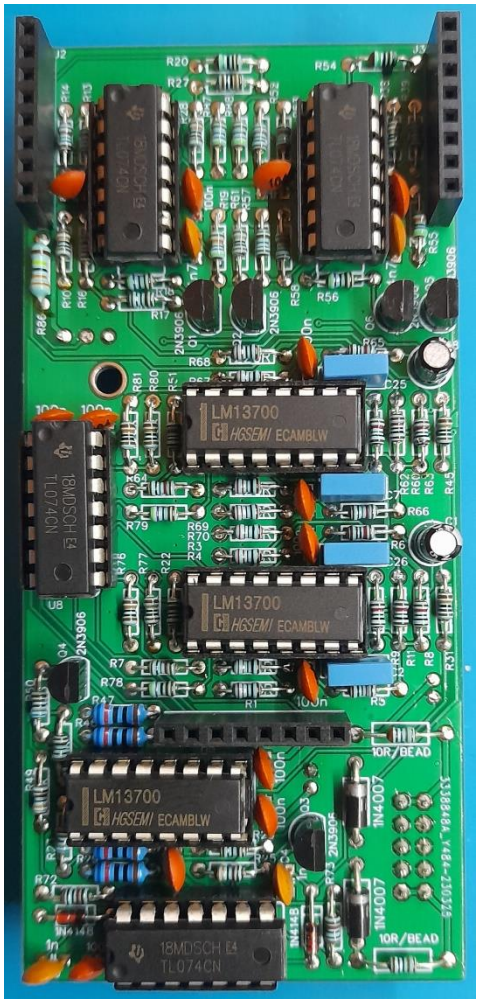
In the picture below you can see the placement.

When everything is in place, take the front panel and put it on top, so all controls go into each corresponding hole of the panel. "wiggle" the front panel into place and make sure everything fits well.

Fit all nuts to the Potentiometers and the Jacks.
Be careful when turning the board around, so that all the components stay in place.
Then solder everything.

STEP 18
Installing ICs and final check

4	TL074 / TL084	U3,U6,U8,U9
3	LM13700	U5,U2,U1

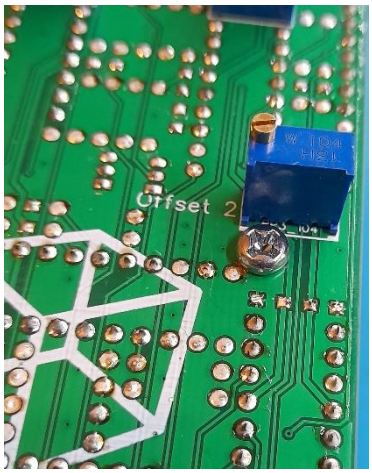


Take the Main PCB and install the Ics.
Bend the Legs of the Ics inwards a bit so they form a 90° degree angle to the body of the chip.
Make sure the orientation is correct, the notch has to match the silkscreen / the sockets placed before.

Check your soldering. If you see shorts or bad solder joints, fix it up. Then check the power pins for shorts with your multimeter.

When everything looks fine, you can connect the two boards together again, with the three Pin headers connected properly.

Then tighten the Screw on the Main PCB to the standoffs.



Step 19
Knobs

Place the knobs on the Potentiometers. For best results, turn all Potentiometers counter-clockwise and push on the knobs, so the marking points towards the left end of the surrounding circle.

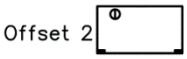
CubuSynth

Step 20 – Calibration

The Calibration process contains the two trimmers for the 1V/octave scaling and an Offset for the second Filters frequency to have them both on the same resonant frequency.

V/O Trim1:

1. Turn the Resonance (Q) knob all the way clockwise (100%) and both filter modes to LP (counterclockwise / 0%)
2. Plug the Output (OUT1) from the Module to an Oscilloscope or musical Tuner
3. Turn the Frequency down to 220hz (or a musical note of your choice)
4. Apply 1V to the 1V/O input (one octave on a keyboard)
5. Trim the V/O Trim1 on the Back of the module until the frequency doubles (440hz/ One octave above initial note)
6. Repeat steps 3-5 until the frequencies match –



V/O Trim2:

7. Plug a cable or a Jack connector to IN2 (to break connection from OUT1)
8. Repeat steps 2-6 for the Output “OUT2” and V/O Trim2

Offset 2:

9. Plug a cable or a Jack connector to IN2 (to break connection from OUT1)
10. Connect both Outputs to a mixer and mix them with same levels
11. Turn the Trimmer “Offset 2” until the frequencies of both outputs match.

Now turn the Frequency knob and assure that the frequency of both outputs stays the same over the audible range.
If not, you will notice some “swinging” or phasing between them. Go back to adjust the V/O Trimmers until they match.

This concludes the Trimming process and you can enjoy your module in perfect state.

Help

Please understand that we can't guarantee for your DIY module to work. Nevertheless we will do our best to guide you through the build or to solve problems when needed.

In case there should be parts missing in your Full DIY kits contact us to ask for replacement /

If you have trouble with your build, you can contact us at:

cubusynth@gmail.com

To be able to identify mistakes in your build, please include high quality pictures of your soldered PCBs, front+back.

https://cubusynth.com/

https://www.facebook.com/cubusynth

https://www.instagram.com/cubusynth_modular/

https://www.etsy.com/shop/CubuSynth