CANVAS
MODULAR ∨ SYNTH

BEGINNERS KIT

DRAFT 18.2.26
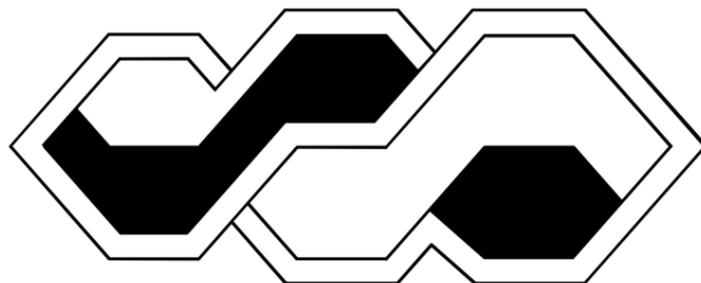
eatingVoltage.com

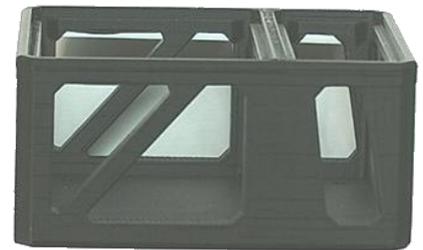# TABLE OF CONTENTS

Welcome, fellow synth-builder, here begins your journey. Unpack and gaze at material kit contents now, if not already happened.

IN THE BOX

lose parts

▶ BASE18 PCB base plate
▶ BUS PCB
▶ BUS TOPPLATE
▶ 3DP RAILS: A / B / C (stuck together with magnets)
▶ 3DP BUS HOUSING
▶ BASE18 WOODEN BASE
▶ BUNCH OF PATCH CABLES
▶ MODULE ASSEMBLY JIG ─────────
▶ UNIVERSAL SCREWDRIVER
▶ THIS MANUAL

in 15 paper baggies, used in the following order

▶ BASE18 STEP 1
▶ BASE18 STEP 2
▶ BASE18 STEP 3
▶ SHPE
▶ VCO
▶ LISTEN
▶ PEEK
▶ VCA
▶ VCF
▶ FLUX
▶ TALLY
▶ 4MIX
▶ SLEW
▶ DERB
▶ EVLV

HOW TO READ THIS MANUAL

This manual will teach you how to build and use the CΛNVΛS starter kit. Starting with the base, we will then progress module by module by building, calibrating and testing each one before making some patches learning in depth about functions and features.

Order of progress

Build knowledge and CΛNVΛS modular synth piece by piece, page by page.

Note the bags **labels**. Each bag's contents are grouped in the same **sequence** you'll use them during **assembly**. Keep the current bag close to check this sequence frequently when building.

The appendix of this booklet contains detailed information about the synthesizer and its components.

Let's get building, calibrating, testing and patching.

THE JOURNEY
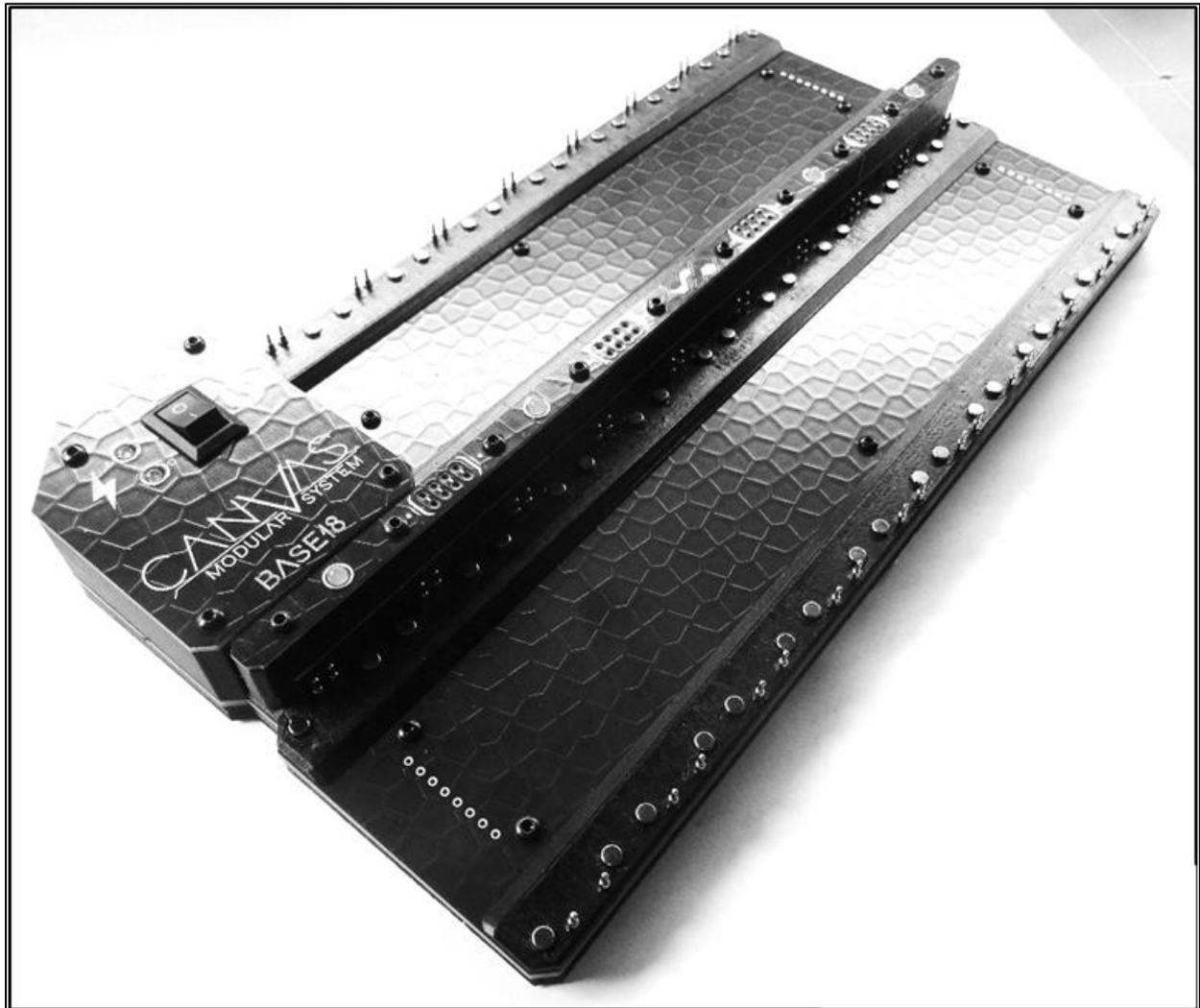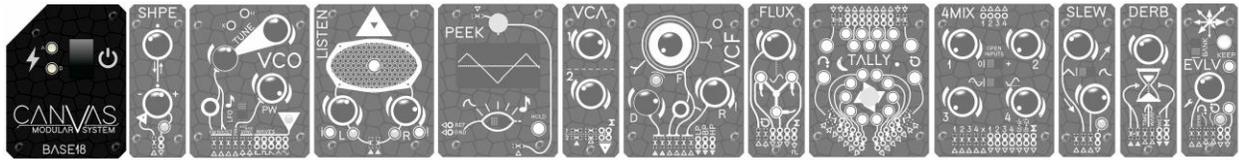
Start your synth building journey with BΛSE18, the empty canvas, providing the modules with power.

Power it using a **USB-C power supply**. Λnything is enough to get you started, after a while you might want to find a 2.5Λ power supply.

BASE18 — STEP1 — RAILS & PINS

Take the big PCB, the plastic rails and grab the first bag:
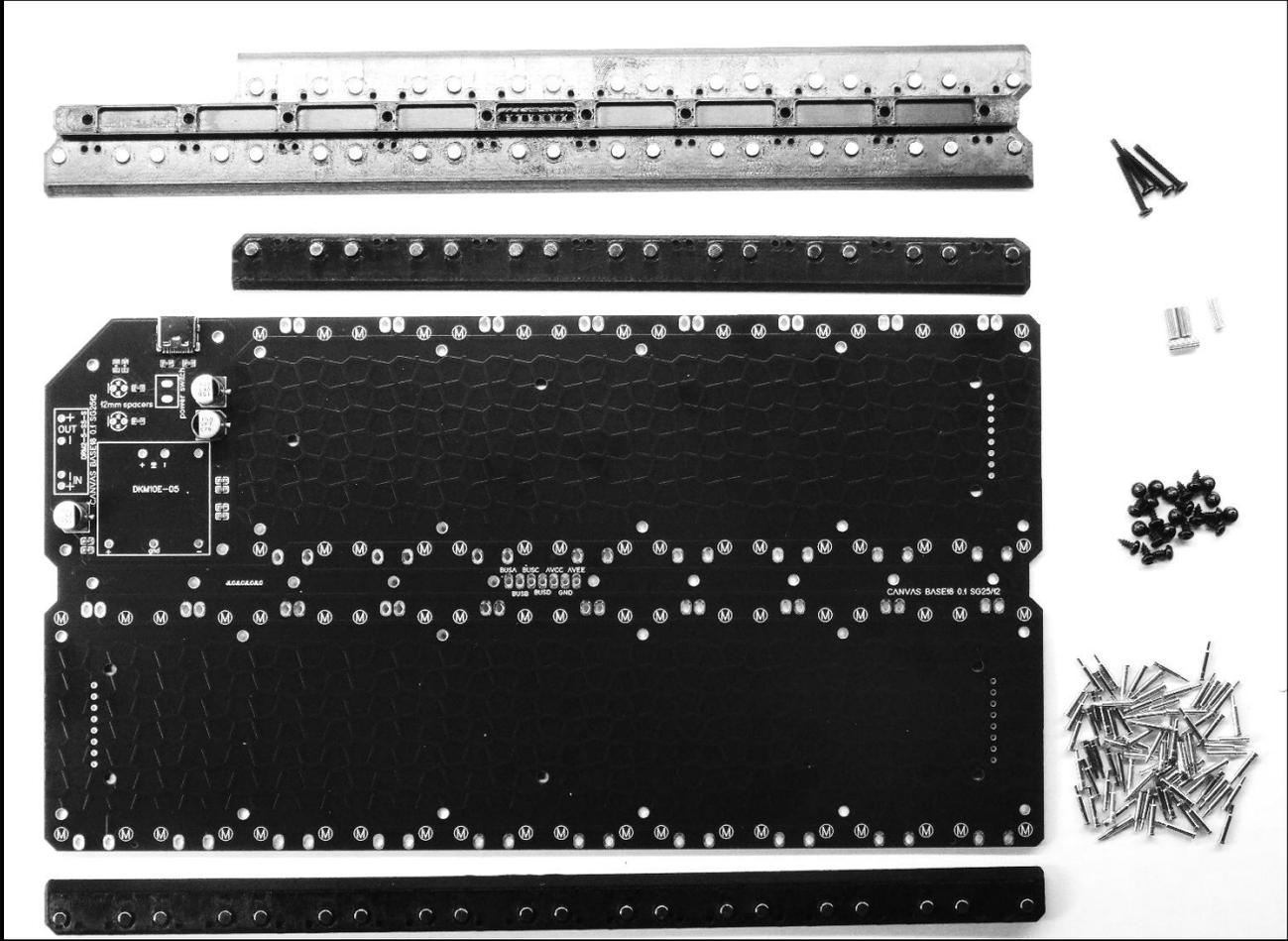
1a) Use **4x M2x14** screws to mount **temporary feet** to facilitate assembly of the pins. Use the **four holes** in corners marked with a **white ring** on back side of pcb.
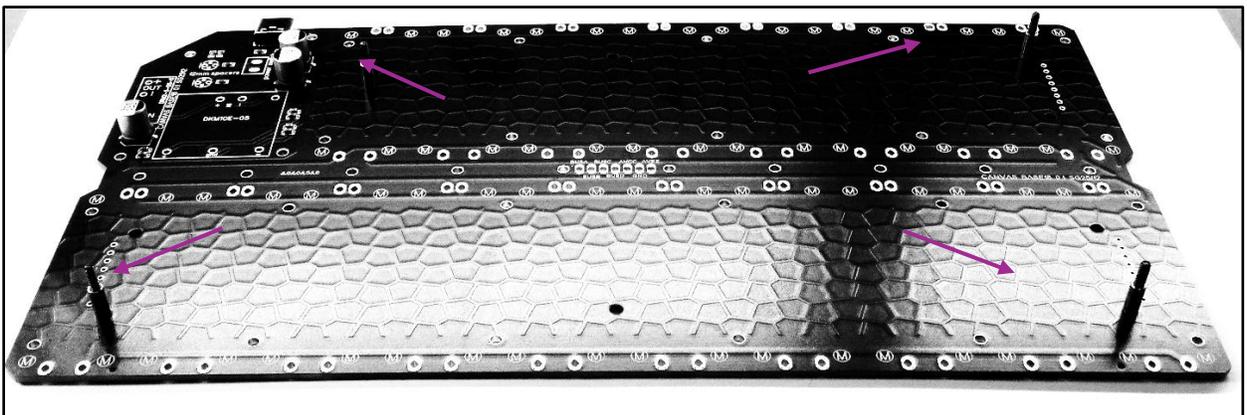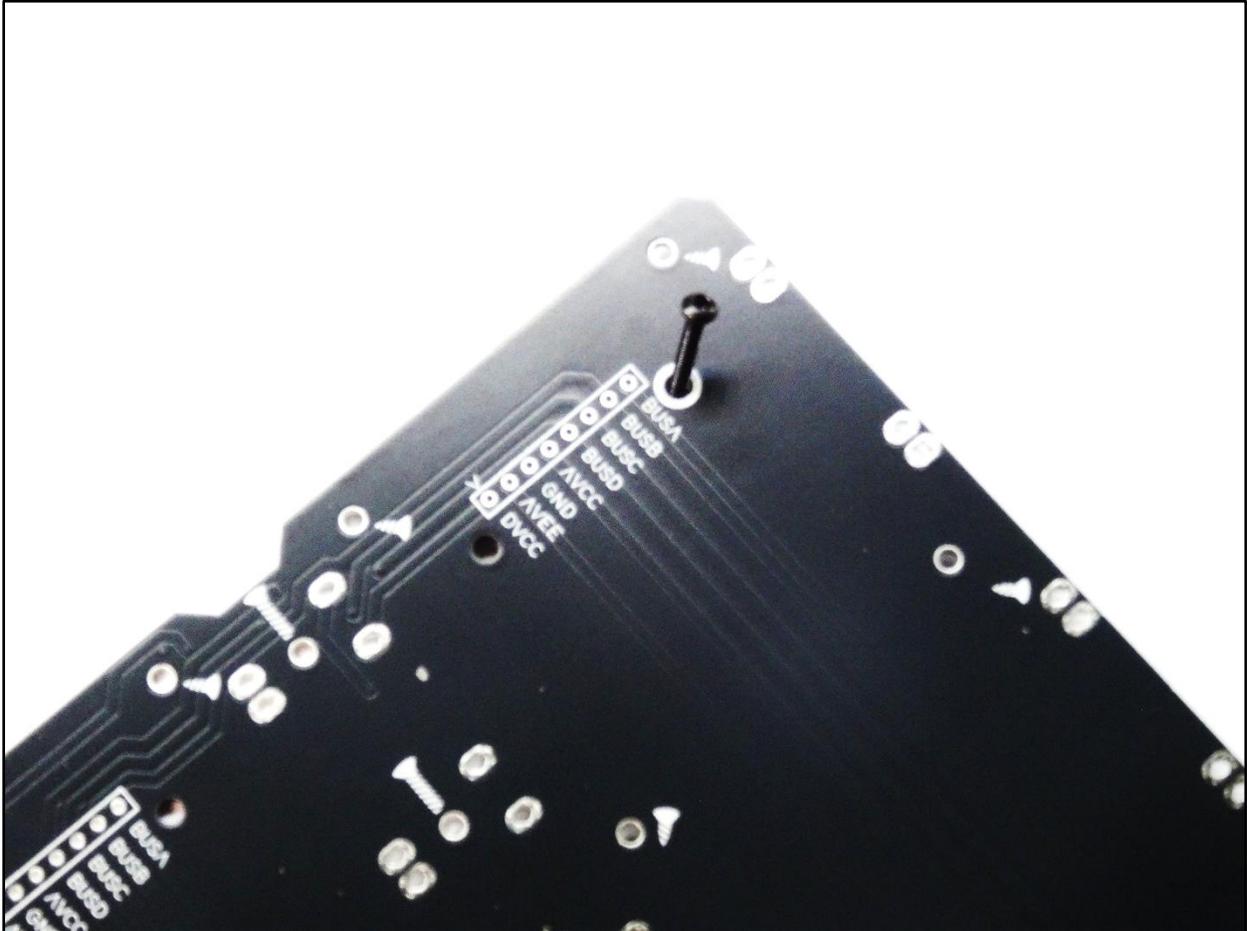
1b) attach the 3 rails using **a few pins**. Hold rail in place and insert pins from the back:

Now use the 23 M2x4 screws to **fix the rails** in place. Screw from the back. Look at the symbols on the PCB. These screws are very short and screw into plastic, so be especially gentle and **don't overtighten**:
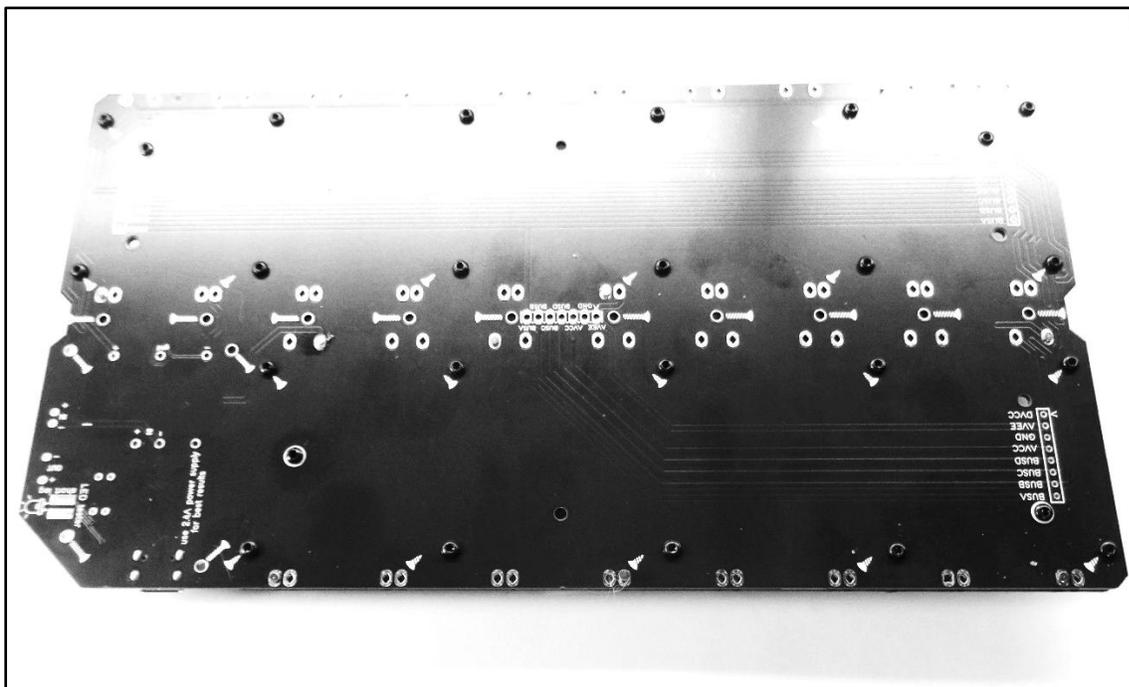
1c) Insert the pins one by one from the back. Push down with fingernail.
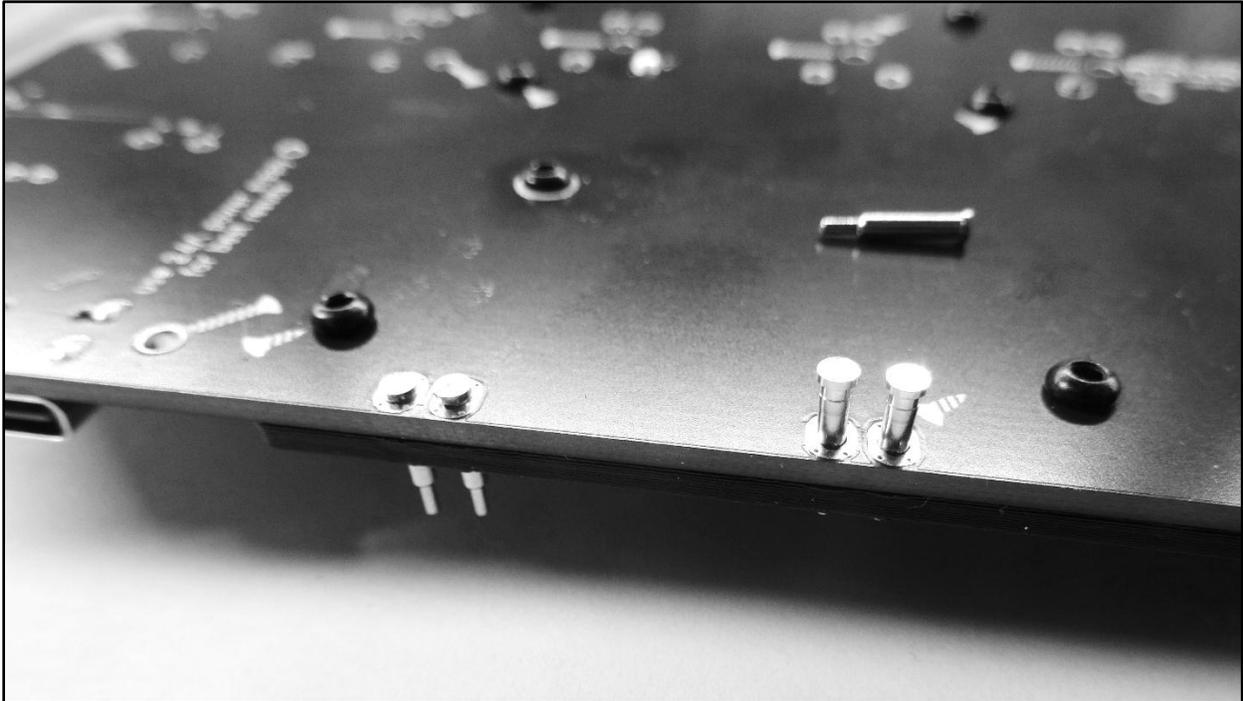
Solder the pins. Use a big tip if available. Push down vertically with the iron to get final position. **Try and feel the pins finding their place,** as they heat and melt the plastic of the rail.

The solder joints should look shiny, covering both the golden brass of the pin and the silver pad of the PCB.

Don't forget the 7 pins in the middle. These are used to connect to the bus bar later.

Fix solder bridges with wick.

Finally remove the temporary feet. Keep the 4 M2x14 screws and 4 threaded inserts for the next step.

BASE18 - STEP 2 – POWER ON

Grab next baggie and get parts ready.
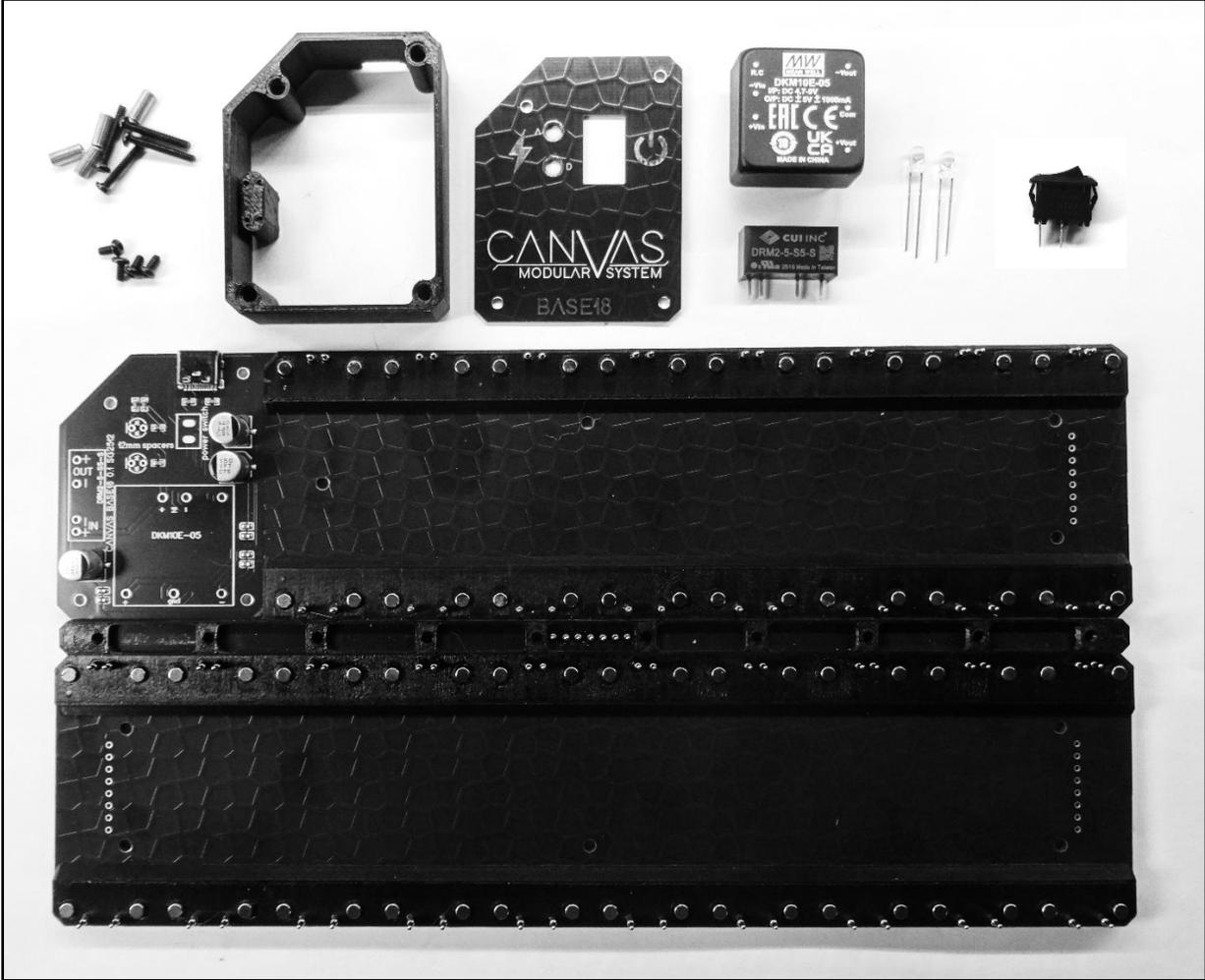
2a)

Prepare the Power supply housing. Install the 4 threaded inserts before screwing on the top plate using 4 M2x4 screws.
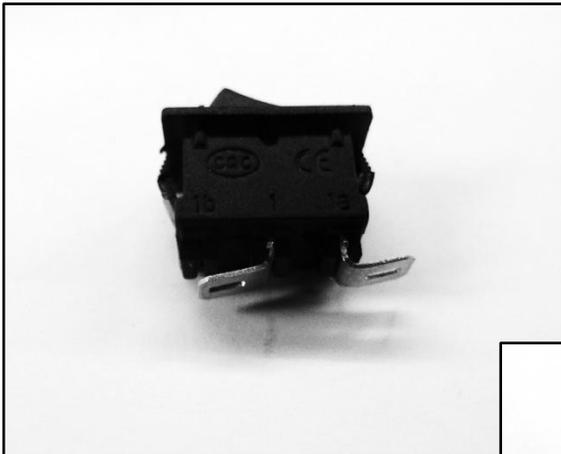
Bend the legs of the switch...

...and click it minding orientation.

2b) Soldering.

Solder length of wire to switch port as in the picture.

Use big tip for the big power brick. Flush trim legs:

Use the led spacer attached to the case.
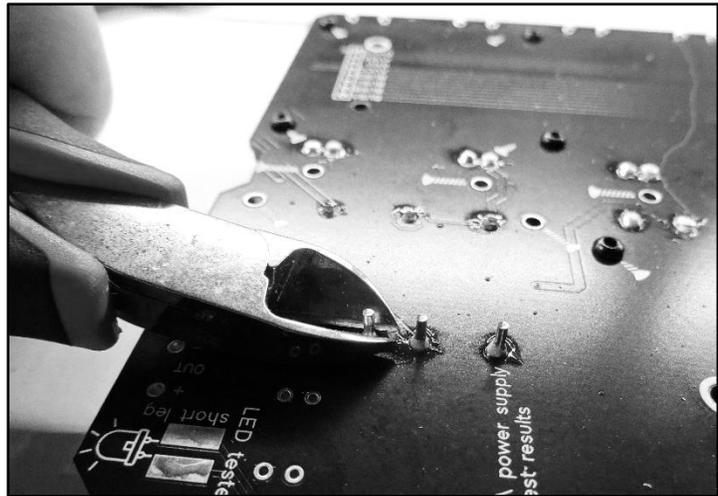
Finally **test** by powering with USB-C. **Both LEDs lighting up?** Well done. Not yet? Inspect the back side. Find the short and try again until fixed.
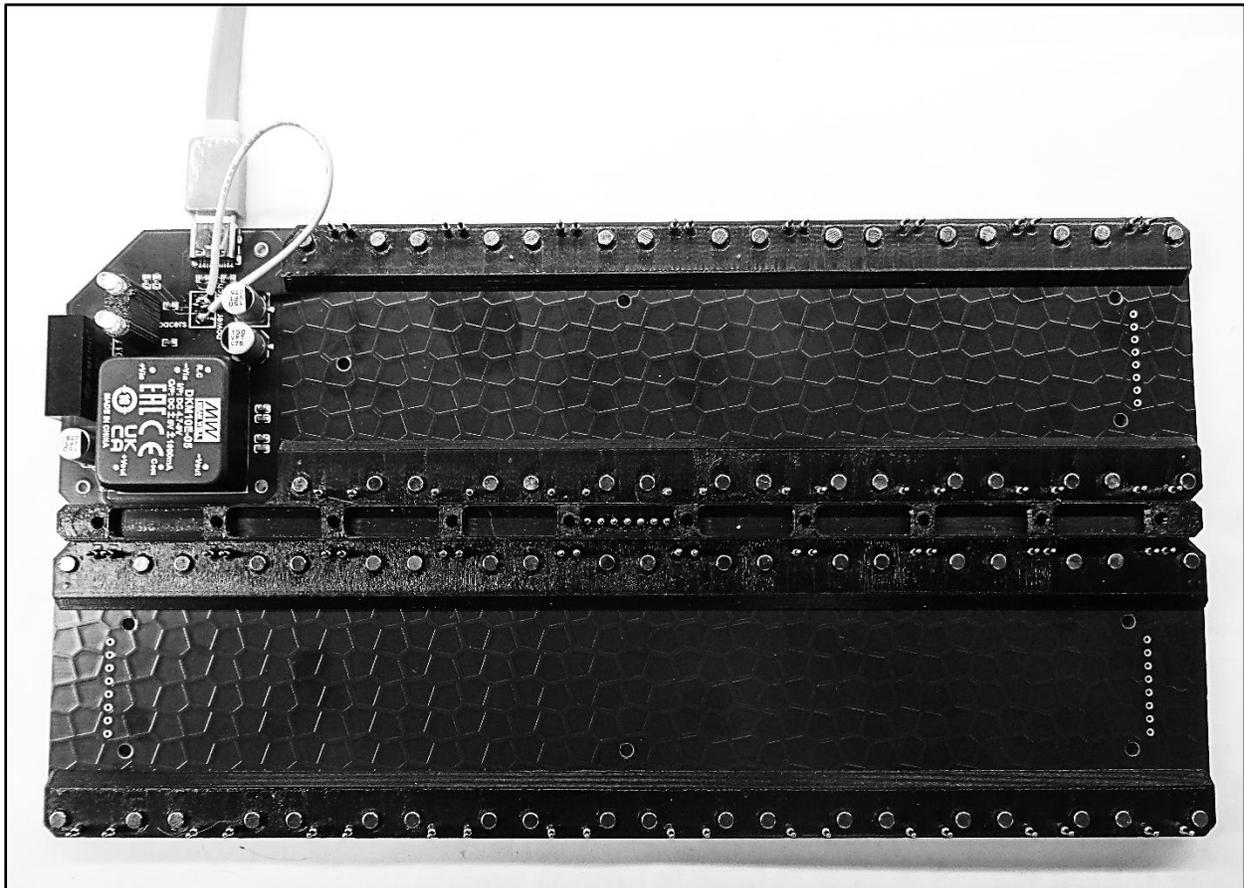
2c) mount the housing

Cut the wire in the middle. Remove isolation and pretin ends and switch. Solder very carefully. Use 350°C at most and be quick.
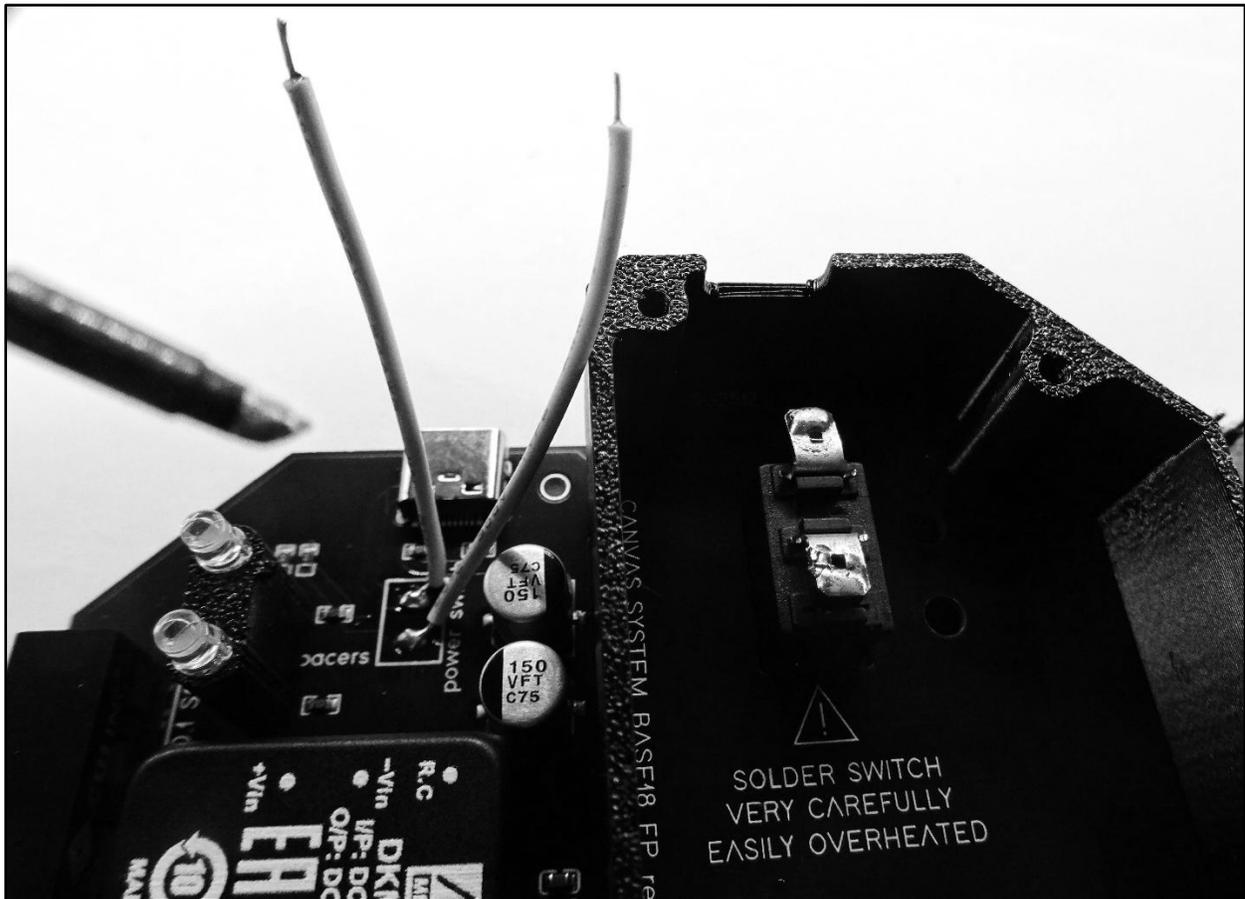
Finally attach the housing using 4 M2x14 screws from bottom side. Twist housing assembly it a few times to manage the wires.

Done for step 2!

BASE18 - STEP 3 — BUS BAR
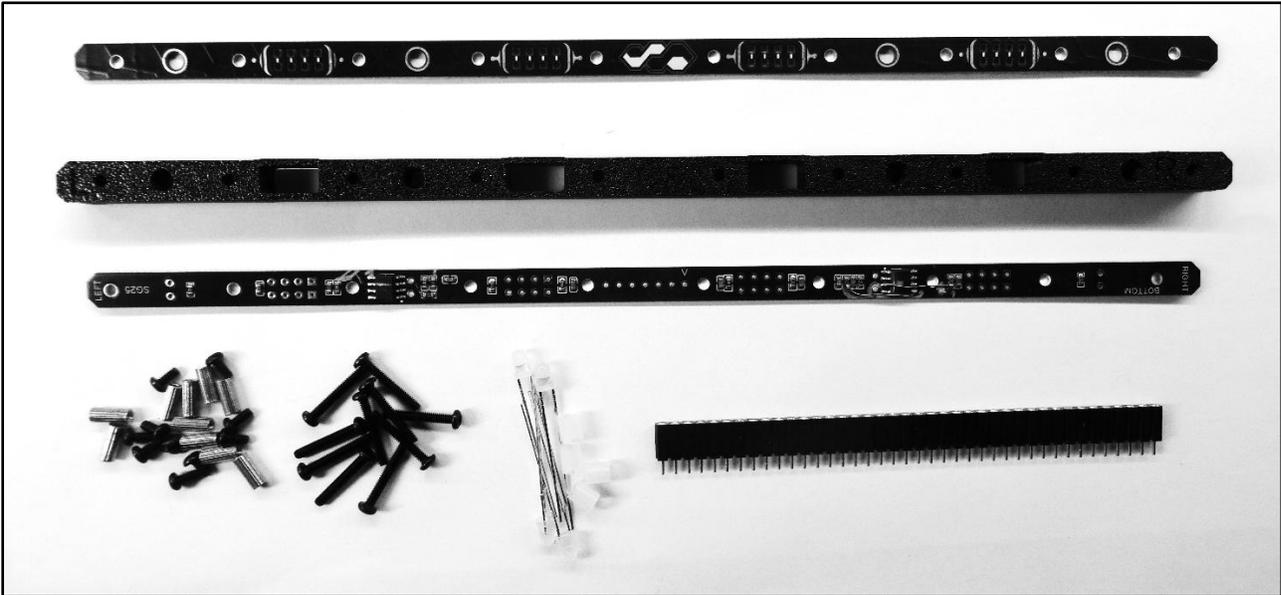
3a) Put the 10 inserts into the plastic part. Install the top plate using 10 M2x4 screws. Mind the orientation.
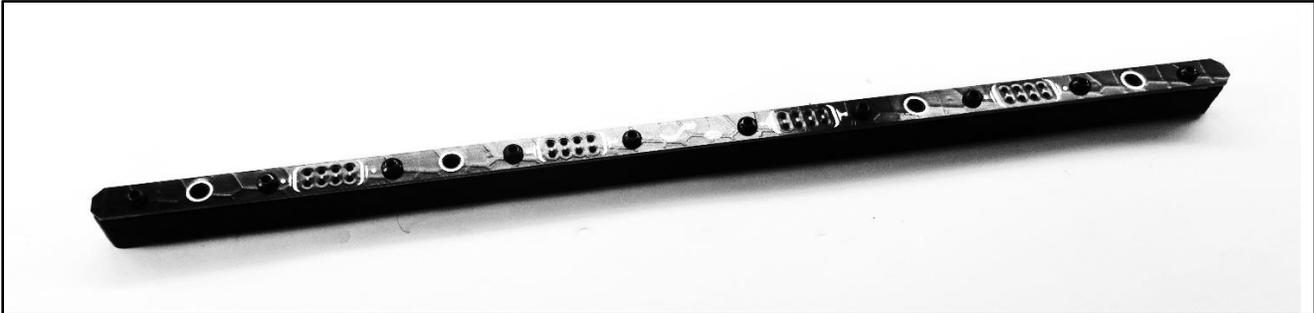
3b) Solder the circuit board.

Break patch points into 16 pieces of 4. Use flat nose pliers instead of wire snips. Breaking works better than cutting.

Put the patch points and the LEDs in place without soldering yet.

Then use the case assembly from 3a to fix all the parts in place. Be sure to insert the parts tightly.

Mind the orientation. The parts combine in one way only.

Use a few patch cables to make a stand and solder everything.
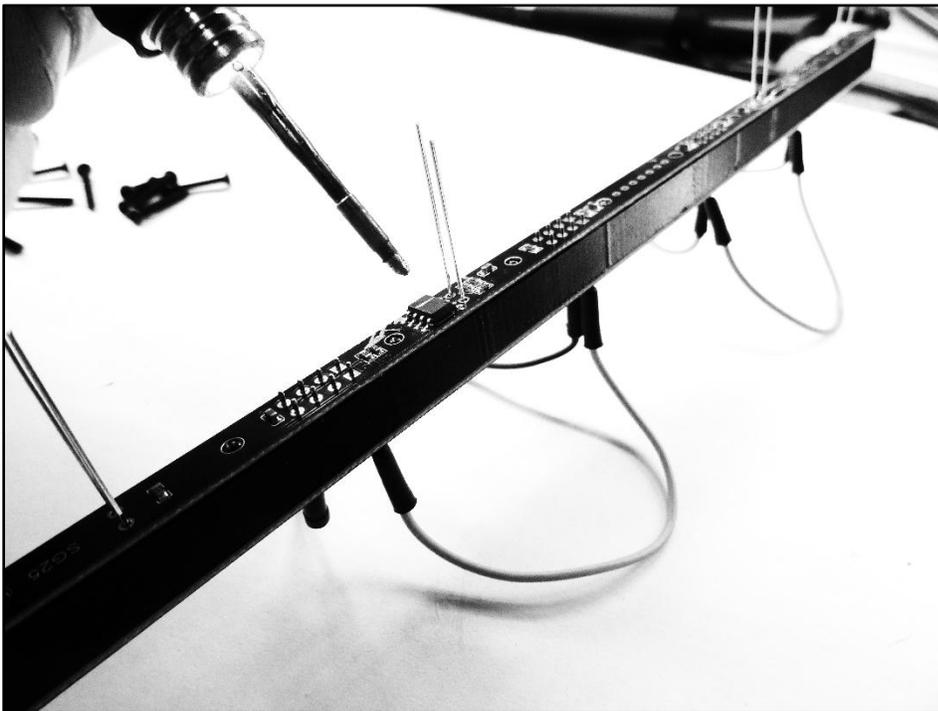
3c) bus installation and testing

Use only two M2x14 screws to install the bus bar. Use the center screw holes neighboring the connector. You are now ready for testing.

Power up. Are both power-LED still on? Good. Now use a single patch cable. When one end is inserted into one of the patch points, the other end is held between fingers, you should see one of the LEDs lighting up in pink.
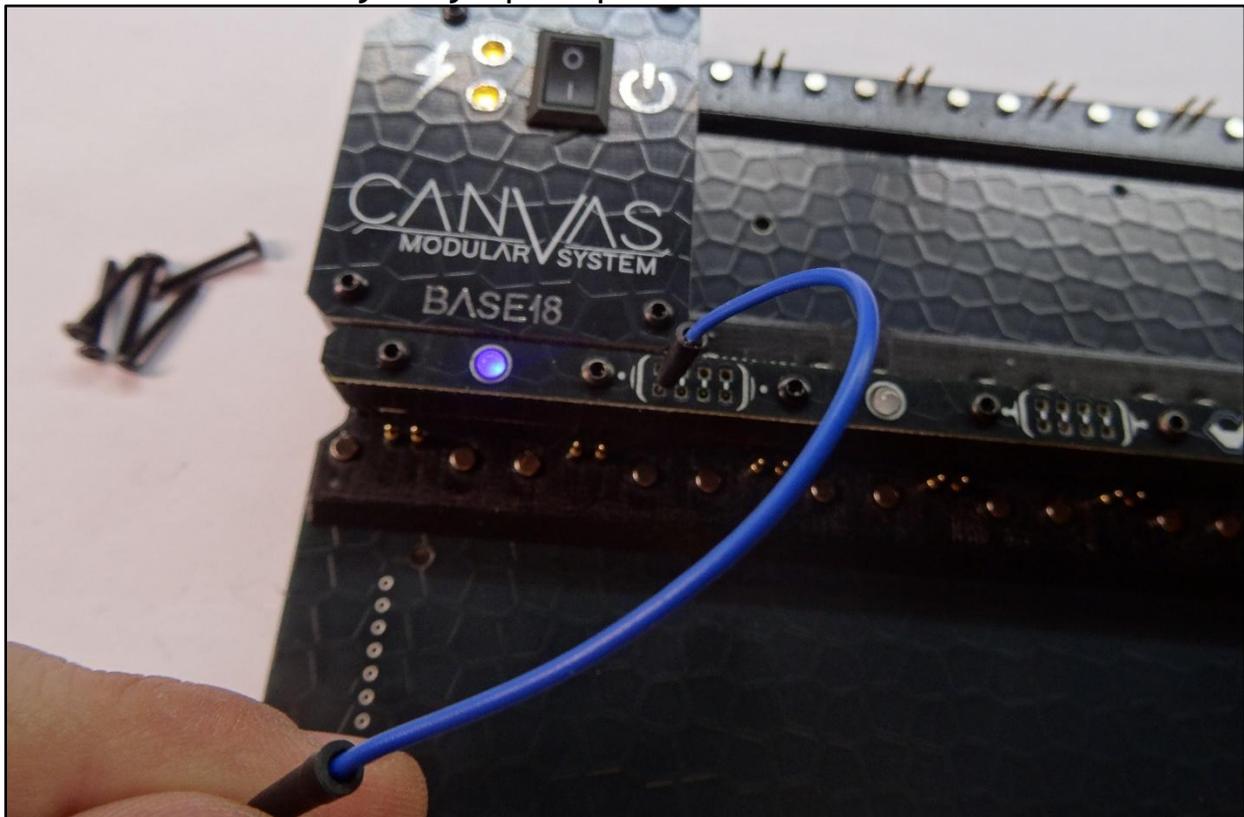
The LED will show you the signal on the corresponding bus. Your finger touching the connector makes your body an antenna. The sensitive LED is showing red and blue switching at 50 times per second (50 Hertz) appearing pink to our perception.

▶ Can you figure out which patch points correspond to the four LED?

If everything works, use the remaining M2x14 screws.

BASE18 - STEP 4 — FINISH
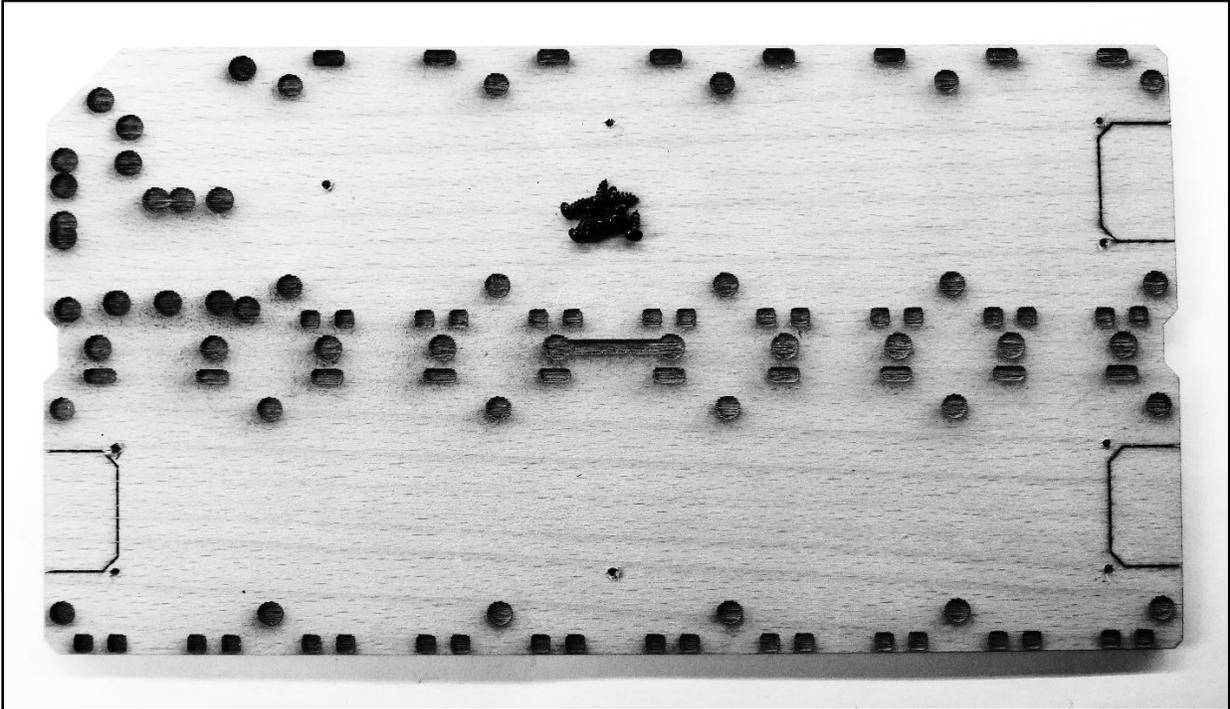
Attach the wooden base using the 10 M2x5 screws. Screw from top through base into wood. Be gentle, don't overtighten screws.

Attach the 4 rubber feet to finish the base18. Congrats!

MODULES ΛSSEMBLY

Every module is built from the same **layers**:
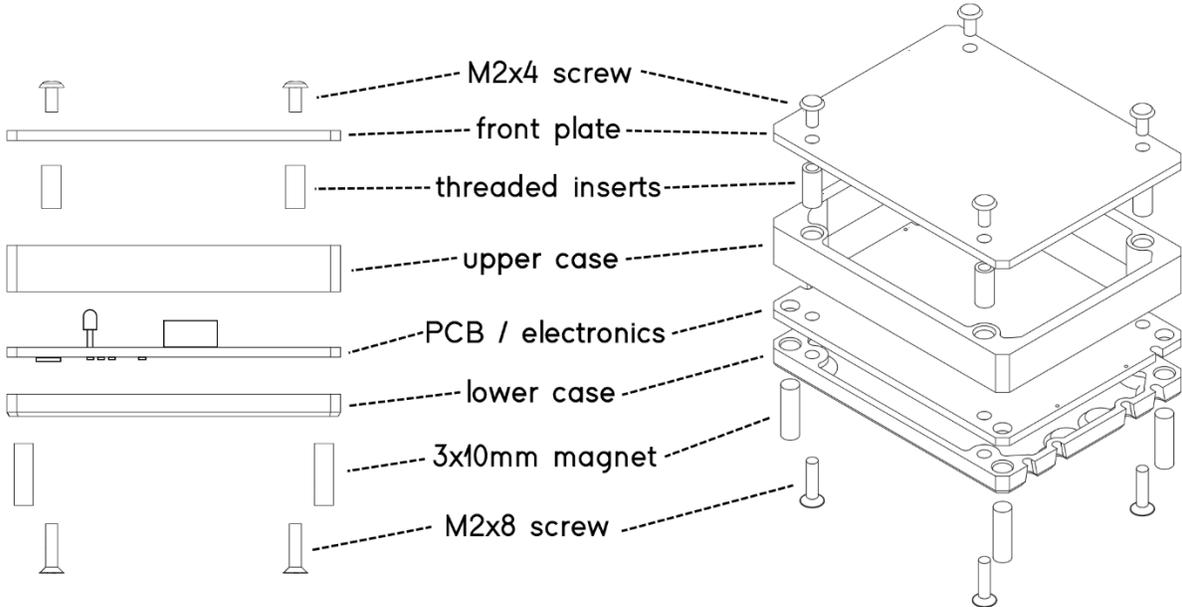
Λssemble all modules in the following **3 steps**:

▶ 1. CΛSE

Take upper case and lay on side with more holes. push in the threaded inserts using the screwdriver.

Mount front plate using M2x4 screws.
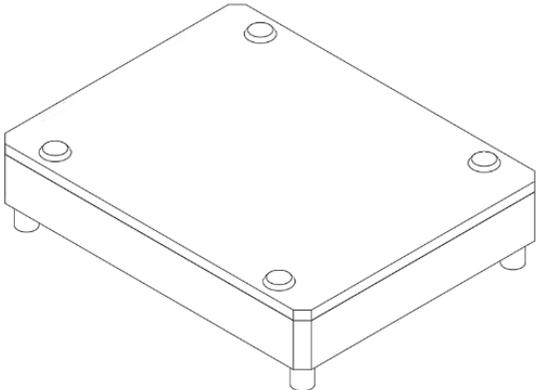
Insert 3x10mm magnets using the module assembly jig turned on the back. Snap one magnet to the jig and push down case assembly to install. Make sure magnets are seated all the way.
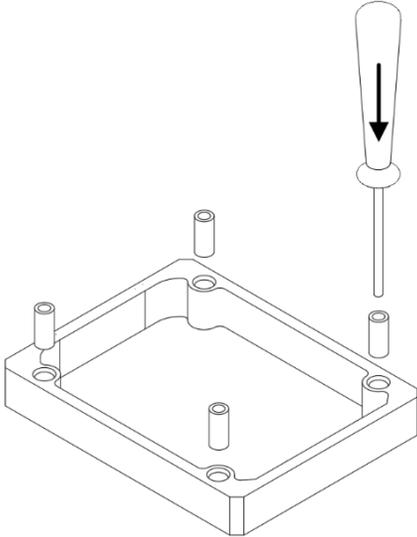
▶ 2. SOLDERING

Turn over the module assembly jig and place the empty PCB.

Solder all smd parts now: push button, trimmer, electrolytic capacitor.

Next install all other parts without soldering yet.

Install housing carefully before inspecting the part placement. You might have to push some LEDs or potentiometers in place now. Put in jig heads down and solder all joints. Pay special attention not to touch the preinstalled smd parts with your iron as things get tight. Change the orientation of the jig when needed to get room for the iron.

Read more about soldering in the appendix.

Read more about the different electronics parts in the appendix.

▶ STEP 3 - FINISHING

Use the remaining 4 screws to install the bottom case part. Install knobs if any.

SHPE
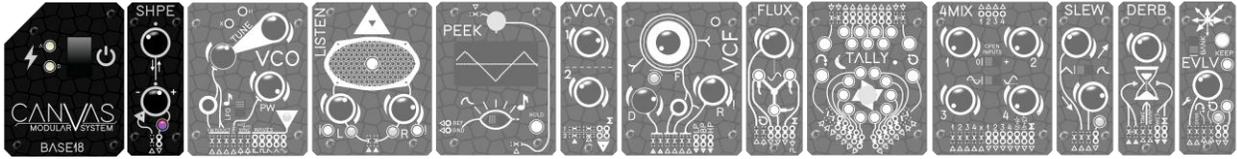
This module lets you shape a waveform. The upper knob can add or remove from the signal, the lower knob adds the input signal. Both knobs have their default positions top dead center indicated by dot on front plate.

ΛSSEMBLY

Really easy module for starters. Follow the assembly order on bag label or in previous pages.

TESTING

For now, because it's the only module, we can only test the upper knob.

▶ Turn upper knob to left and LED should turn blue, turn to the right and LED should turn red. In the middle, the LED should be off.

CORE CONCEPT: **SIGNΛLS**

In the world of modular synthesis things are easy. Everything is just a wave, a piece of information in time. Imagine it as levels of water, or a string of an instrument, that has a resting position in the middle, where nothing happens. Still waters or a string in silence. Λs electronic waves go up in the CΛNVΛS, you will see an intensifying **red light**, if they go down, a **blue light** will show.

▶ Can you find the exact dead center of the top knob?

VCO
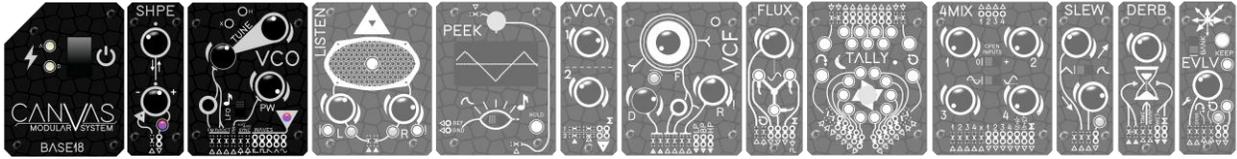
The heart of your synth, the oscillator. Oscillating all day, producing the tastiest and purest waveforms at its outputs. Use the Frequency knobs (coarse and fine) to tune the speed / pitch.

ASSEMBLY

Use order on bag label.

CALIBRATION

Power up module and remove front plate.

▶ use multimeter and trimmer to set the reference voltage to as close to 2.5V as possible.

The module has two additional trimmers accessible from the front plate. These trim the V/oct input and are needed later.

TESTING

▶ set switch to upper position, power on module: LED should be pink.
▶ set switch to lower position: LED should show slow wave.
▶ rotate upper F-Knob: this should change speed of wave.

CORE CONCEPT: **PATCHING**

Now these red and blue signals can not only exist in different places of a modular synth, you can get them to different places using the patch cables. It is these connections that bring interest and complexity and make or break a patch. Think of a patch as going from a start point to an end point. All of the modules have fundamentally two different kinds of these connection points: INPUTS and OUTPUTS. Inputs can receive a signal, outputs provide one. For now, patch from output to input. The triangles next to the patch point show this

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signal direction. Outputs are additionally marked with a white ring.

LET'S PATCH

FIRST PATCH: REMOTE

Let us try this. Lets control the frequency of
the VCO module using the upper knob of our SHPE.
The lines on the front plate often represent the logical
connection. Now, we want to control (or modulate) the tune, so
lets follow the lines leading front these controls to the patch
points.

patch from any SHPE output (white ring) to an input of the
VCO labeled 1V/oct.

Now you should be able to control the speed of the oscillator
remotely, well at least from the neighbor module.

BUILD POLICE LIGHTS

Use the VCO module and 4 patch cables to
make all the LEDs of the busbar blink.
Hint: patch from VCO output to the bus bar.
Advanced: Can you find a use for the SHPE module in your
patch?

LISTEN
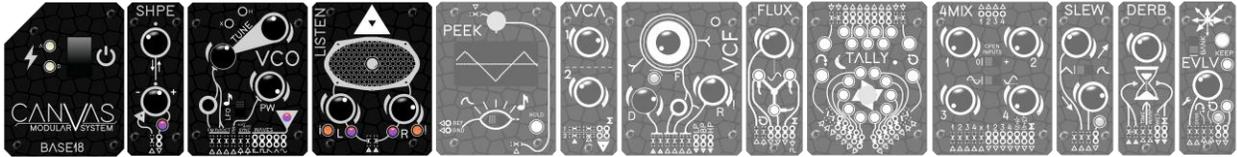
...to your tune using this module. Hear the internal speaker or plug 3.5mm jack to listen on headphones or bigger speakers. Two channels exist for left and right.

See signal clipping on orange LED. Set volume under clipping level.

ASSEMBLY

Start with the SMD-parts. Then install the speaker twisting the wires. Solder the remaining parts in case assembly.

CALIBRATION

▶ Power up module and remove front plate.
▶ Set volume of internal speaker using the CRY trimmer. Higher values might crunch. Set to personal preference.

TESTING

Patch a fast waveform from the VCO to the input. You should hear a note. Plug in headphones, the note should vanish from the speaker and appear in the headphones.

PATCHES

FIRST SOUND

Listen to the right most waveform of the VCO, the sine wave.

Patch from VCO sine output to LISTEN INPUT.
▶ How do other waveforms sound?
▶ Try listening on headphones or big speakers. Self-patch the two sides to get pseudo stereo output.

CORE CONCEPT: RHYTHM AND PITCH

Try this using the same patch as before hands on the frequency knob(s):
- ▶ Find the frequency where red and blue mix to purple on the LED for your eyes. Listen with headphones, what can you hear?
- ▶ Find the frequency for the lowest note you can hear. Watch the LED, what color can you see?

Slow vibrations or pulses register as distinct rhythmic beats, but as the repetition rate increases into the audible frequency range (roughly 20 Hz and up), they fuse into a continuous tone perceived as pitch. The reverse holds too: very low pitches blur into rapid rhythms when slowed down.

RHYTHM AND PITCH ARE ACTUALLY THE SAME THING. THE DIFFERENCE LIES IN OUR PERCEPTION ONLY.

By the way, did you already find out what the switch on the VCO does, and how it relates to the above concept?
It switches between these two worlds, the lower setting is for lower (rhythmic) frequencies (Low Frequency Oscillator), the upper setting is for audible frequencies, pitched sounds or notes.

PEEK
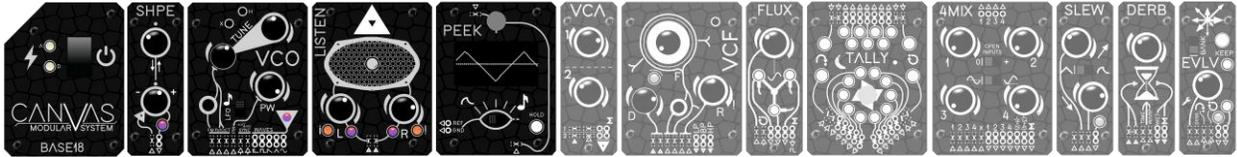
See waveforms or switch to tune pitch. Use any connection to see your signal. The scope will adapt its view dynamically to visualize the current signal optimally.

Press the **HOLD** button to enter HOLD-mode where the scope will stay in the current view. Press again to return to default.

This module provides two additional outputs only available on PEEK. **GND** (0V) and 2.5V **REF**erence. These are used for calibration of some modules. Can you find a better use?

ASSEMBLY

Take care when installing OLED screen. Solder pins to OLED board first, cutting excess pin flush on upper side.

Solder one pin only and check placement before soldering the remaining pins.

CALIBRATION

▶ Use multimeter and trimmer to set the reference voltage to as close to 2.5V as possible.

TESTING

▶ click, screen should turn on.
▶ Put switch to the left, one horizontal line from left to right should appear.
▶ Patch output of SHPE to input of PEEK. The line should be controllable by the top knob of the SHPE.

▶ Patch rightmost output of VCO to PEEK. You should see a sinewave.

PATCHES

LOOK AND LISTEN

Patch the different waveforms of the VCO to
both the PEEK and the LISTEN modules at the same time.
Compare the sound of the individual waveforms of the VCO to
their looks.

How would you describe edgier waveforms like square or saw?
What changes in comparison to triangle? What makes the

Now patch the pulse waveform. Can you find out what the last
knob (PW) on the VCO does?

SHPE REVISIT: THE INPUT

Let's patch a waveform to the input of
SHPE. PEEK at the output and play with SHPE knobs.

The lower knob sets the size or depth of the signal. At top
dead center it blocks the incoming signal completely. Turn to
left or right to let more and more through. This
function of sizing or scaling the signal is called
"attenuation". For audio this means make it
louder or quieter. Different modules include
attenuators, look for the symbol of the triangle
pointing into the knob.

VCΛ
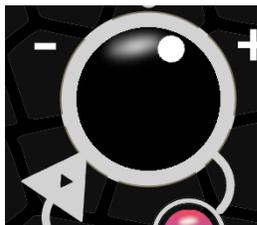
The Voltage Controlled Λmplifier. Essentially a volume knob, like an attenuator, but has an input for a control signal opening and closing the amplifier. It comes as a double unit. Last output is a mix of both outputs. Symbol for mix or sum:

$$\Sigma$$

ΛSSEMBLY

Straight forward, very easy module.

TESTING

Patch waveform to inputs, LISTEN to outputs.

Control volume from SHPE.

PΛTCHES

WΛVEFORM CUSTOMISΛTION

Use the VCΛ to mix two different waveforms
and create something new.

Choose two different waveforms from the VCO and patch them to the VCΛs inputs. LISTEN to the VCΛs mix output.

Try different combinations to create your own, unique sound.

VCF

Filter waveforms to remove Frequencies. Drive the input and add Resonance to add overtones and harmonics. Use Low Pass, Band Pass or High Pass outputs.

CALIBRATION

The screw trimmer accessible from the front is used to trim the V/oct input. Let's postpone this for now.

TESTING

PATCHES

SYNTH CAT

Yeah, no cat, no synth.

Use the VCO and VCF to play your best meow.

One hand on VCO fine tune and one hand on VCF.

Try different waveforms and resonance / drive settings.

VCF AS OSCILLATOR

Crank resonance without using any input.
The filter will go into self-oscillation, it will create a sinewave on its own. Control the pitch like it was a VCO.

FLUX

LFO, low frequency oscillator. 3 phase sine wave lfo. Use it as modulation source.

Last output is a square wave thrice as fast. Can be used as clock.

1.21 GIGAWATTS!

ASSEMBLY

Straight forward.

TESTING

Plug in, turn knob, see function on circling LED.

PATCHES

POLICE AGAIN, HEAR THE SIREN

Recreate your cities police siren. Is it possible
using the FLUX to modulate the frequency of the VCO?

Experiment with various waveforms to replicate it as closely as possible.

TALLY

- ▶ Sequence a number of steps
- ▶ divide clock
- ▶ two independent dividers or counters
- ▶ upper one divides clock by the powers of two: 2, 4, 8, 16, 32, 64
- ▶ lower one divides Clock by 10, stepping through the outputs.
- ▶ connect any output to RESet input to shorten sequence length.

🧠 RESET and CLOCK one divider from the other one and get to polyrhythmic lands.

ASSEMBLY

CALIBRATION

TESTING

PATCHES

Feed clock.

Beat and divisions

4MIX

▶ **MIX**: Set switches to default position (marked with |)

▶ use individual outputs to ΛTTENUΛTE signals. means make signal smaller / quieter.

▶ Try different switch settings to use individual outputs as **CV-SOURCE**s or Λttenuators for incoming signals. Control anything from 4MIX.

ΛSSEMBLY

Easy, straight forward module.

TESTING

PΛTCHES

Use as output mixer. Perform fading in different sounds of your patch.

🧠 Use upper set of outputs to keep away the cable birds.

SLEW

▶ Slow down the rate of change of a signal.
▶ control rate of rise and rate of fall independently
▶ Use switch to change shape.

ASSEMBLY

Read about vactrols in appendix.

TESTING

Patch slow square wave to input. Watch output led reacting differently depending on knobs positions. The higher the knobs are set, the longer it takes the output to catch up to the input.

PATCHES

PLONG - ENVELOPE

some clock into TALLY into SLEW into VCA
to get envelope.

ENVELOPE FOLLOWER

Keep rise low and fall high on a fast signal,
get envelope follower.

DERB

DElay / Rev**ERB**. Lofi delay line keeps audio in memory and outputs it after some time. Adjust duration by knob and CV.

Use WHARP Input for special effects.

TESTING

PATCHES

CHAOS IN THE FEEDBACK LOOP

Patch feedback from one of the outputs to
the other input. maybe even amplify before feeding it back.
Keep hand on volume.

EVLV

- ▶ randomly evolving CV and GATE sequencer.
- ▶ set rate and flavor of change on knob or by CV input.
- ▶ Feed clock signal to work.

🧠 connect CV to density input to change amount of active steps

🧠 hold KEEP at power up to limit sequence to 8 steps.

ASSEMBLY

TESTING

PATCHES

| CHAOS IN THE FEEDBACK LOOP |
| --- |
| Patch feedback from one of the outputs to the other input. maybe even amplify before feeding it back. Keep hand on volume. |

LIBRARY OF MOST USED COMPONENTS

LED 3mm

Mind polarization: The side with the shorter leg is the negative side. On the LED there is a flat spot.
LED in the front plate come with a little spacer. Install to keep correct distance to PCB.

CUT SIDE

SPACER

SHORT LEG

SYMBOL ON PCB

The two most used LED colors are warm white and bicolor (red blue). Warm white LED have a clear head, while bicolor LED have a cloudy white head. PCBs show **ww** for warm white and **r b** for red/blue.
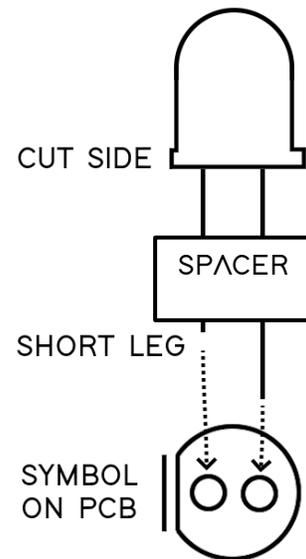
POTENTIOMETER

Knob to turn and dial an exact value. All potentiometers are the same value and identical: 100k Ohms, linear taper. Only solder when installed with the front plate on, correct placement is key. Pull potentiometers in place from front side before soldering for exact placement. The collar beneath the knob will just appear from the front side if done right.
Potentiometers come with a knob, turn shaft to one side all the way to install knob in the right orientation.

PATCH POINTS

Connection points for patch cables. Don't cut, break header rows instead.
Check correct placement before soldering by inserting cables through front plate.
Sometimes when space is tight, a nail file can help with seating.

TOGGLE SWITCH

Choose between two settings or modes. Most have a default setting indicated by white line on the front plate. If you don't know what you're doing, and you want things to stay cool, don't worry and keep the switch on the default side.

For installation orientation does not matter. Hold the switch with one hand and solder one pin only with the snake tamer technique (read more in soldering appendix). Next push on the switch and reheat the solder joint to seat the part in place. Now with the switch in place, solder the remaining two joints.

SURFACE MOUNT (SMD)

Use flux, small tip and tweezers to install the following components.

push button
This is the classic push button. It comes with a white button pusher. Don't forget it before final assembly.

PCB
PAD   PAD
COMPONENT
TIN ONLY ONE SIDE
PUSH COMP. FROM SIDE
CHECK PLACEMENT
SOLDER OTHER SIDE
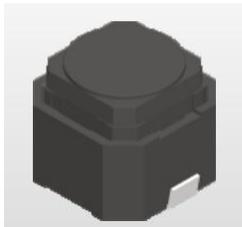
electrolytic capacitor
Correct polarization is key. Match footprint.

microtrimmer

These are used to calibrate the module after assembly using small screwdriver. Probably the hardest part to solder in this kit. Use tweezers and flux. These come in different values, so don't get them mixed up.
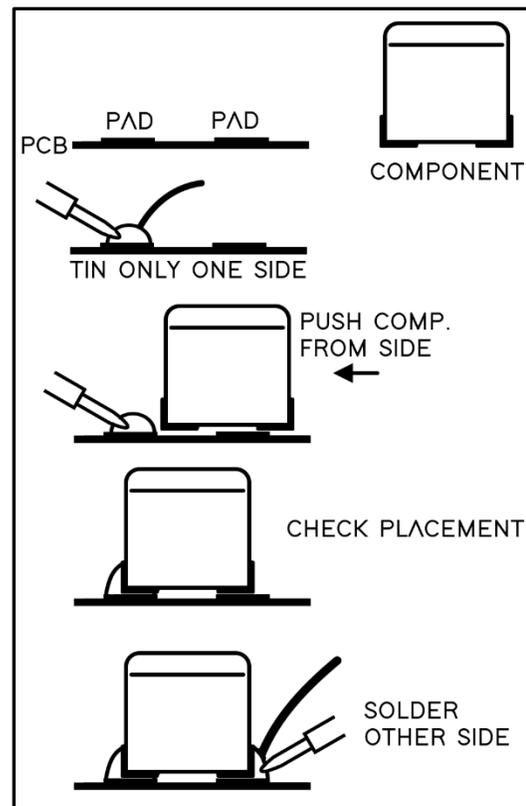
Use same soldering technique as with other parts, starting with the side with only one pin to set components in place.

LDR / Vactrol

Λ vactrol is a combination of a LED (warm white in this case) and a light dependent resistor (LDR) stuck together in darkness. The light of the LED shines on the LDR changing its resistance. The orientation of the LDR is not important, the LED is. Cathode (short leg / flat side) goes to stripe on PCB. Bend legs like the picture to align components.
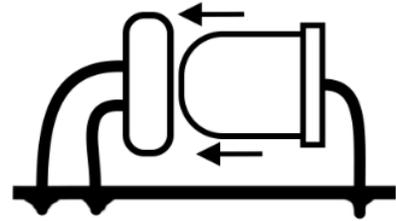
ΛBOUT SOLDERING

Most of the parts you will be soldering are through hole parts, meaning they have many legs / pins.

You will solder most of these parts from the bottom side of the PCB. This side also holds the tiny SMD components. Pay special attention to staying away from them. Choose the direction you solder from wisely. Λlmost all the solder joints have space on one side for the tip of your soldering iron.

Many of the parts you will solder have more than one pin (leg). Solder one leg at first to hold it, then push the component in place while heating with the other hand. Once it is seated, solder other legs. This may sound tedious, in fact it's a lot more tedious to fix a crooked part, so ensure perfect seating from the beginning.

Use **flux**. Solder wire contains flux, which makes the solder flow much better. With time, the flux evaporates. If you feel the solder doesn't really get liquid anymore, do yourself a favor and add some flux. Or clear solder joint using **solder wick** and resolder with fresh solder.

Λim for both the parts leg and the solder joint at once. Liquid solder likes hot surfaces.

Heat or cool: Decide, move in with the iron and get maximum heat to the component or release and don't touch the solder joint. Heat hard, cool hard. Don't just touch a little.

When soldering through hole parts like switches, LED or potentiometers you will find yourself short of one hand: One hand for the iron, one holding the part in place and nobody there to put the solder in the right place. To get out of this misery find a friend or use the **snake tamer technique**. Shape the solder wire into the shape of a dancing snake to make the solder sustain itself. Try increase the windings lying on the work surface to stabilize the solder wire. Föteli!

MODULE NOT WORKING FAQ

Q: Module doesn't turn on or restarts.

A: Are module magnets (10x3mm) pressed in all the way? If not, the module rocks back and forth and does not get power reliably. Fix by unscrewing the bottom case and inserting the magnets all the way.

A: Are the power connection pads on the module visible? If not, the bottom case is installed the wrong way around. Unscrew and reinstall to fix.

Q: My module doesn't click.

A: Are magnets the right way around? Try one by one by holding a base magnet on the edge. If one is seated the wrong way, disassemble module and pull faulty magnet with pliers. Reassembly.

Q: One or multiple ports / knobs / led don't appear to work.

A: Are the ports soldered cleanly? Apply some flux, reflow the solder.

Q: as soon as I click the module the power of the base shuts down.

A: Most likely you are dealing with a dead short over some of the power pins. Unscrew bottom case and inspect soldering.

ELECTRICAL CHARACTERISTICS

Modules klick in and have power over four pins. They can't be connected in the wrong way.

The power supply just breaks down if there is too much current. You can't destroy It by patching, we tried. If one of the two LEDs next to the power switch flickers or clears remove last module and cycle power switch.

BΛSE34 power rails: +5V (1Λ), Ground, -5V (1Λ), +5V digital (0.6Λ)

Use 2.4Λ USB power supply for best results.

output impedance: 1kΩ, (v/oct 390Ω)

input impedance: 100kΩ

digital inputs switch around 1V – or should be at 0.1v to see smaller signals?

nominal signal Level: 7dbU - 5Vpp - 1,73Vrms

RULES OF THE GAME

▶ do break the rules.

▶ everything is CV.

▶ everything is CV-controllable.

▶ keep symbols in mind.

▶ no fear, even the most disoriented patching won't harm this synth.

▶ no normaling nor hidden patches, patch yourself. Have

▶ every connection in view and mind.

▶ see any signal as lights:

▶ GATEs and TRIG Signals as white lights

▶ CV: red / blue dual color led - towards positive it gets red, towards negative blue. See audio as purple.

▶ most ports come in pairs. every input is a passive multiple,

▶ every output is available twice. no need for any more passive multiples or stacking cables. jump from port to port weaving nets.

▶ make use of bus bar: 4 signals are distributed to 6 positions all across BASE34.

▶ TRIG ▷ Inputs also read GATE ▷ signals.

▶ GATE ▷ Inputs also read CV signals.

▶ most outputs have same impedance, meaning you can

▶ mix CV ▷ by directly connecting outputs.

▶ if you don't understand what you hear, use PEEK Module

▶ or colored lights and eyes. Or just enjoy in aw.

▶ If you don't know how a switch works, leave it at the <u>default</u> position indicated by white line

▶ do rearrange modules on the fly: Snap any Module to

▶ any place on the base. whenever you have the slightest urge to change layout, do it. no unpatching needed.

▶ USB-C: power ⚡ from any USB power source.

▶ to make most of it, use a 2.5 amp capable socket.

▶ grab a power bank, go outside, let sunlight inspire you.

▶ patch, perceive outcome, patch.

▶ set sails to a direction, go with the flow.

▶ there is no mistake, but unexpected outcome.

▶ beware of strange noises

notes:

PORTS & SYMBOLS

CANVAS
MODULAR SYNTHESIZER

SIGNAL TYPES

▲ ▼	AUDIO - Fast Waveform. Listen here.
△ ▽	CV - Analog Signal. Control WHAT happens.
△ ▽	GATE - ON or OFF. Control IF it happens.
△ ▽	TRIG - Short Pulse. Control WHEN it happens.

INPUT

CONNECTED INPUTS are connected through.
▶ Use second input as copy of input signal.

UNCONNECTED INPUTS are mixing.
▶ Use more than one modulation source.

OUTPUT

Most OUTPUTS are dual identical.
▶ Have two copies of the signal.

Σ Sigma: Mixing Output.

⧖ Two way passive connection.

clock/ step

reset

calibrate

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