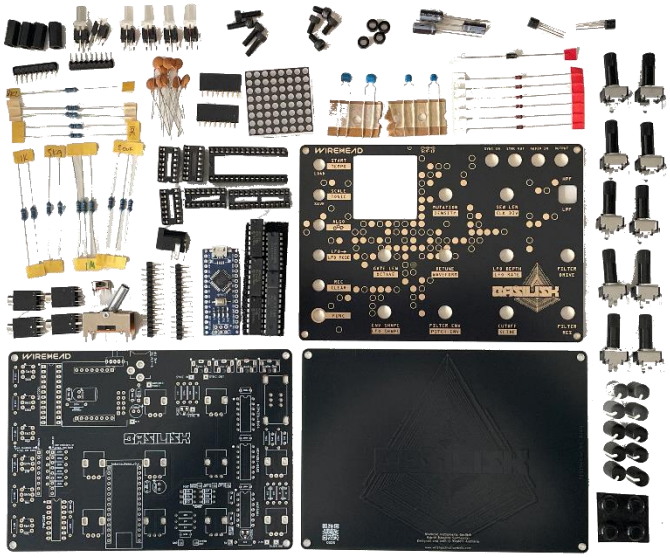
BASILISK

ANALOG-HYBRID GENERATIVE BASSLINE SYNTHESIZER



CONSTRUCTION MANUAL

HARDWARE REVISION 1.1
FIRMWARE REVISION 1.00

TL;DR

I *rarely* read the manual, so I can't expect you to either 😊. But if you read nothing else, please read this to save yourself some problems during the build.

ARDUINO NANO PINS

To enable the Arduino Nano to fit into the DIP30 socket, the legs must be shorter than a standard Nano. The best way to do this is to insert the long-ends of the pin header into the Nano, then trim the excess from the top-side of the Nano.

POLARISED COMPONENTS

Components with a polarity will only work if they are inserted in the correct orientation. Incorrect placement will cause them to not work correctly, and…

IN SOME CASES THIS WILL DESTROY THE COMPONENT!

Check these thoroughly **before soldering** and again before powering the unit:

- Illuminated switches SW1 – SW6 (coloured leg towards inside)
- 100uF Electrolytic capacitors (long-leg to +)
- BC337 transistor & LM336Z (**don't mix these up** – check the label!)
- Resistor network RN471 and RN105
- Diode D1-D7
- Arduino Nano
- All ICs (MAX7221, MCP6004, MCP4251-103 & 104, CD74HC165
- 8x8 LED Matrix

All other components can either be inserted any orientation, or the PCB will only allow the correct orientation.

If components are damaged and require replacement, in most cases we recommend sourcing these from a local supplier as shipping costs for single components can be prohibitive.

ALIGNMENT WITH FRONT PANEL

To ensure the interface components align with the holes in the front panel, it is good practice to place them firmly into the PCB and then…

TEST-FIT THE FRONT PANEL BEFORE SOLDERING THESE COMPONENTS!

Even small misalignment of these components can make things not fit together during assembly, or can make knobs and switches not function smoothly.

- Switches SW1-SW6
- Potentiometers
- 3.5mm jacks
- LED matrix
- Filter mode switch

CLEANING

The switches are sensitive to cleaning residue – please ensure any cleaning fluid does not enter into the switches, or use lots of contact cleaner to flush out sticky cleaning fluid.

CONTENTS

INTRODUCTION

The **Basilisk** is a hybrid synthesizer featuring dual digital oscillators driven through a 12dB resonant analog filter and paired with a build-in generative sequencer.

The Basilisk will take you on a sonic exploration adventure – from driving basslines and melodic leads to Vangelis-inspired brass or thumping tribal percussion, the Basilisk is a powerhouse of sound design packaged with a melodic and intuitive generative sequencer inspired by the likes of Elektron & Music Thing.

With analog sync and external audio input, it plays great by itself or with your favourite external gear.

SOUND SYNTHESIS

- Dual digital oscillators (saw, square, pulse)
- Slide and detune
- Attack/decay EG for cutoff and/or pitch
- LFO with sample&hold, multiple waveforms and selectable destination, eg cutoff, modulation envelope, detune, octave note length

FILTER

- 12dB analog low-pass/high-pass MS20-style filter
- Saturated input-drive section (-20dB - +20dB gain) with soft-clipping
- Analog resonance control from none to screaming self-oscillation
- External audio input (route through the drive & modulated filter section)

SEQUENCER

- Built-in generative sequencer with 1-16 steps, clock division, multiple scales, tonics & algorithms
- Sequence mutates/evolves at user-defined rate & note-density
- Selectable tonic, octave & scale – Ionian (Major), Minor (Dorian), Pentatonic, Phrygian, Octaves, Fifths
- Control tempo by tap-tempo, manual dial or external sync
- Analog sync input & output (Eurorack and Volca / Pocket Operator compatible)
- 16-step parameter-lock recording of synth parameters

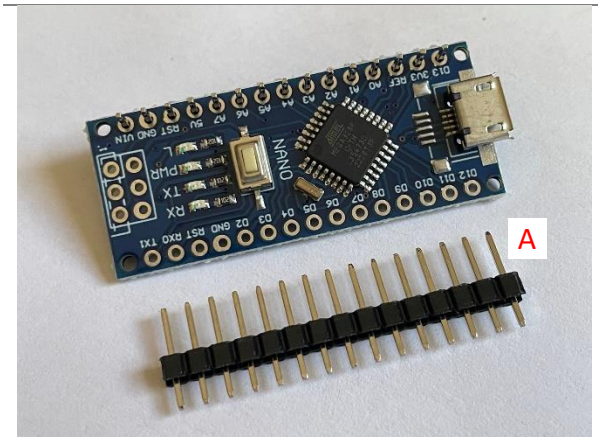
HARDWARE

- Digital oscillators (32KHz 14-bit)
- Sync input / output (0-5V rising-edge)
- Powered by an Arduino Nano V3
- 142mm (w) x 100mm (d) x 40mm (h)
- 7-12V DC or micro USB powered.
- Current draw 70mA @ 12VDC (v1.0 hardware)

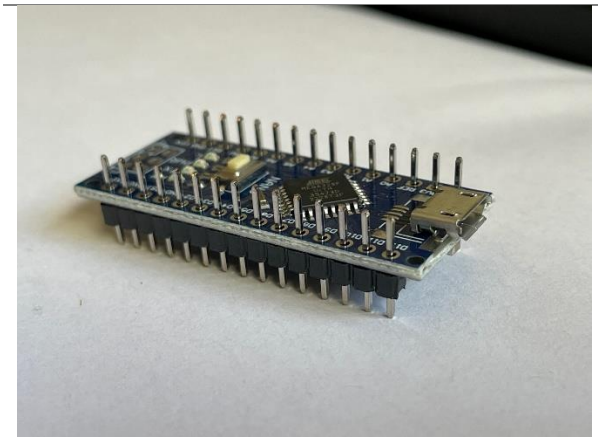
BILL OF MATERIALS

Part	Count	Description	
Resistors			
R102	3	Resistor THT 102 1k	
R103	2	Resistor THT 103 10k	
R104	2	Resistor THT 104 100k	
R105	3	Resistor THT 105 1M	
R204	3	Resistor THT 204 200K	
R392	2	Resistor THT 392 3K9	
R822	1	Resistor THT 822 8K2	
Resistor Network Arrays			
RN105	1	Resistor Array 100k 9pin	
RN470	1	Resistor Array 470 9pin	
Capacitors			
C104CER	7	100n ceramic capacitor	
C107ELEC	3	100u electrolytic capacitor	
C225MON	2	2u2 monolithic capacitor (bigger)	DON'T MIX THESE UP! READ THE LABEL!
C333MON	2	33n monolithic capacitor (smaller)	
C472CER	1	4n7 ceramic capacitor	
Semiconductors			
1N4004	1	Diode	
1N914	6	Small Signal Diode	
LM336Z-2.5	1	LM336 Voltage Regulator 2.5V TO92	DON'T MIX THESE UP! READ THE LABEL!
BC337TO92	1	NPN Transisitor TO92	
Electromechanical			
PTV09A-4025U-B103	10	Bourns 10K 20% 9MM 25mm shaft 40-knurl	
TS-22E01AT15	1	TS22 Baton Toggle Switch	
SK12D07	1	Mini Toggle Switch	
DIPSKT14	3	14-pin DIP socket	
DIPSKT16	1	16-pin DIP socket	
DIPSKT24	1	24-pin DIP socket	
DIPSKT32	1	32-pin DIP socket for Arduino Nano 3.0	
IDCSKT8X1	2	8x1 header socket	
PJ358	4	3.5mm jack - Stereo switched	
PWRDCSKT2.1	1	Power socket, DC, 2.1mm	
Hardware			
SCREWHEXM306	4	Screw, Hex head, M3, 6mm	
SCREWHEXM310	4	Screw, Hex head, M3, 10mm	
SPACEHEXM312BLK	4	Spacer, Hex, M3, 12mm, Black	
WASHM325	4	M3 aluminium washer M3*6*2.5	
FOOT10X4	4	Silicone 10mm x 4mm rubber foot pad	
Integrated Circuits			
CD74HC165	1	74HC165 Parallel-in-Serial-Out Multiplexer	
MAX7221	1	MAX7221 slew-limited LED driver	
MCP4251-B103-P	1	MCP4251 Digital Potentiometer linear 10K	
MCP4251-B104-P	1	MCP4251 Digital Potentiometer linear 100K	
MCP6004	1	MCP6004 Op Amp	
CD74HC165	1	74HC165 Parallel-in-Serial-Out Multiplexer	

STEP BY STEP CONSTRUCTION GUIDE



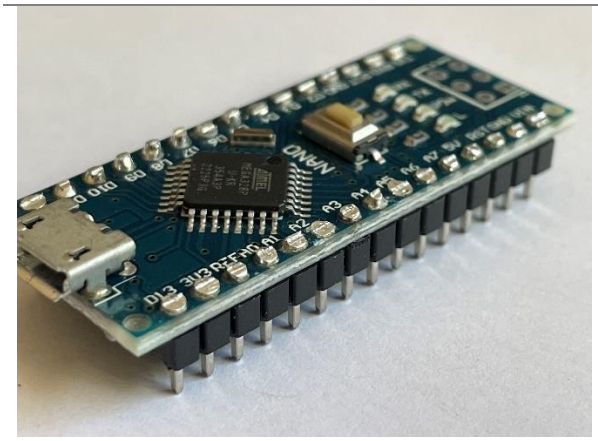
Insert the longer legs of the Arduino Nano (marked A) through the Nano's PCB holes.



The Arduino Nano should now look like this.

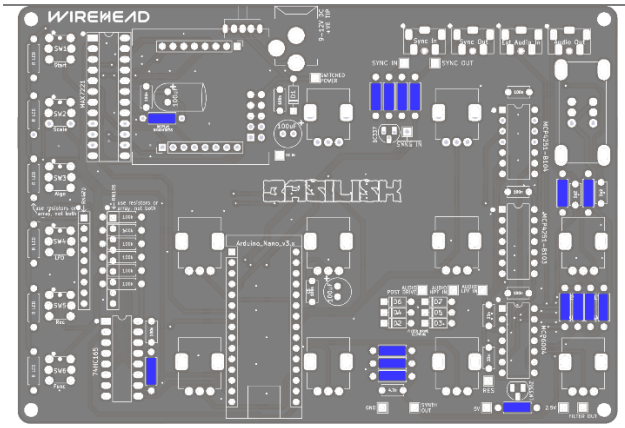
It is good practice to rest the Nano in the unpopulated Basilisk PCB to ensure the pins are aligned at 90 degrees to the Arduino PCB before soldering.

Solder all pins of the Arduino Nano.



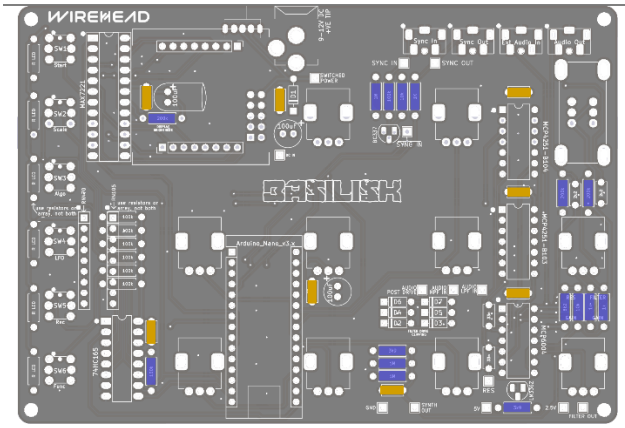
Trim the excess from the top using side-cutters.

IMPORTANT: Be careful of damaging the Nano's components when trimming the pins.



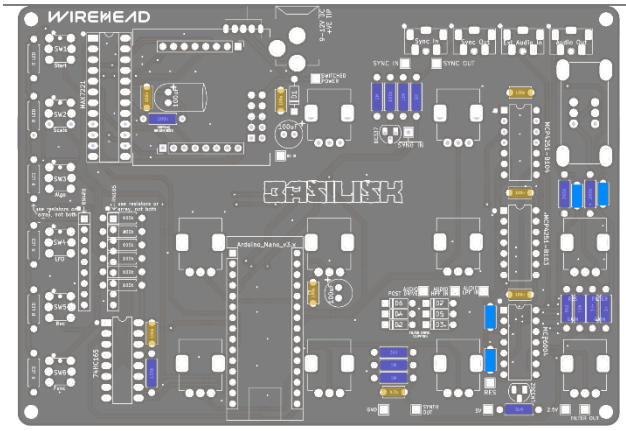
Place all resistors, solder all pins and trim all legs to 1-2mm length

(note layout may vary slightly between board revisions)



Place ceramic capacitors, solder all pins and trim all legs to 1-2mm length.

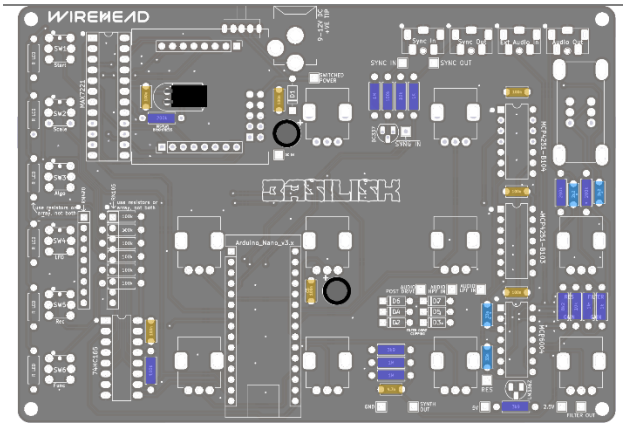
Be sure to place the 4.7nF capacitor in the correct position.



Place monolithic capacitors, solder all pins and trim all legs to 1-2mm length.

The capacitors have their value printed on the shell, be sure to place them in the correct position.

The 2.2uF capacitors are much larger than the 33nF (placed under the switch).

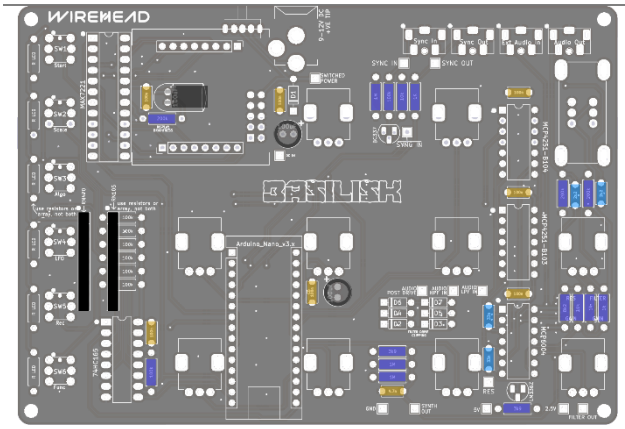


Place the 100uF electrolytic capacitors & solder all pins

IMPORTANT: note correct orientation of these components indicated by the silkscreen – long leg goes to the + sign. incorrect placement will damage or destroy these components.

IMPORTANT: To fit the LED matrix the 100uF capacitors in the top left must all be mounted flat against the PCB.

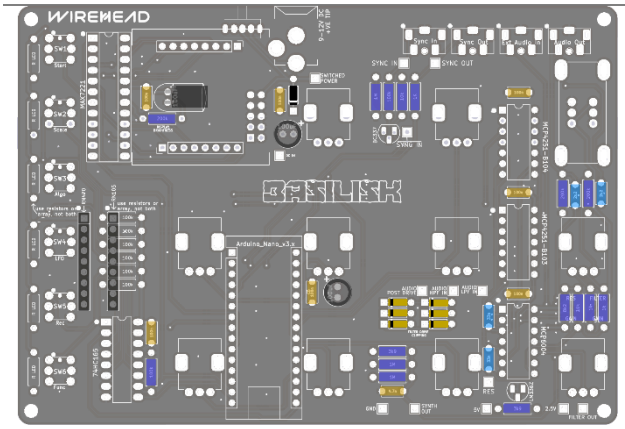
IMPORTANT: Fold the capacitor legs BEFORE soldering.



Place the resistor arrays.

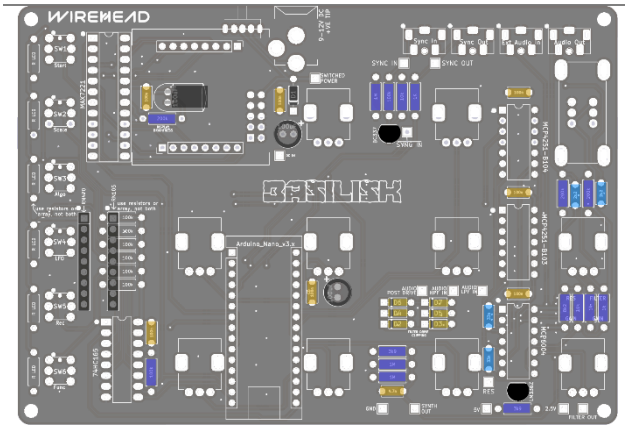
IMPORTANT: note correct orientation of these components with the dot at the top as indicated by the silkscreen.

IMPORTANT: The arrays have their value printed on the shell, be sure to place them in the correct position.



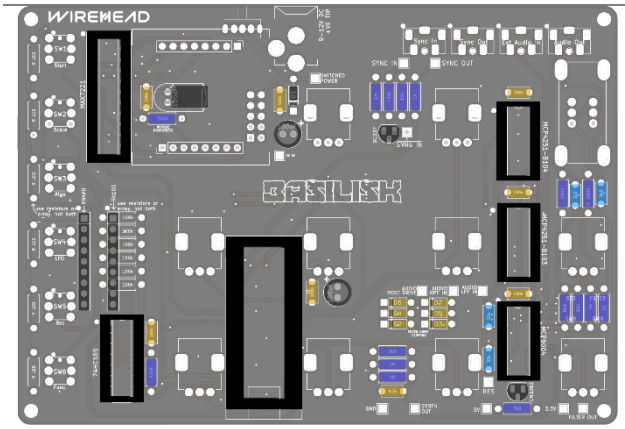
Place the diodes D1 – D7.

IMPORTANT: note correct orientation of these components: larger black diode has stripe facing down (D1) and smaller glass diodes (D2-D7) have stripe facing left, as shown on the silkscreen.



Place the transistor and voltage regulator.

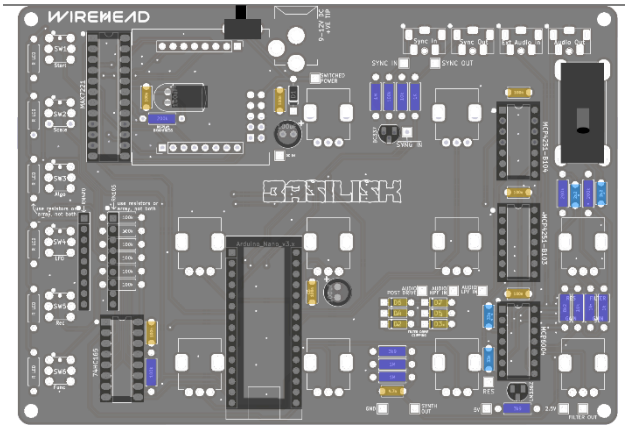
IMPORTANT: These components look very similar but have their type printed on the shell. Be sure to place them in the correct position.



Place the IC sockets.

For each socket, hold it flat on the board whilst soldering 1 pin. Check that the socket is mounted flat against the PCB before continuing to solder the other pins.

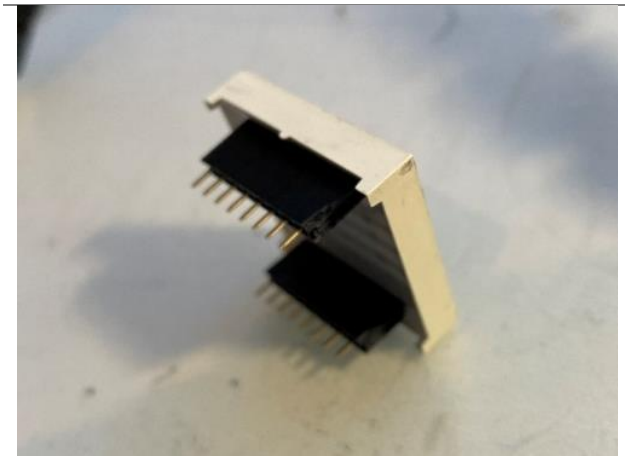
Whilst the sockets are not polarised, it is highly recommended to place the notch at the top to align with the IC polarity to avoid confusion



Place the switches.

IMPORTANT: Make sure the HPF/LPF switch is aligned carefully. The panel hole is large enough for some misalignment, but the switch will function better if it is aligned well.

IMPORTANT: For both switches, hold flat on the board whilst soldering 1 pin. Check that the switch is mounted flat against the PCB before continuing to solder the other pins.

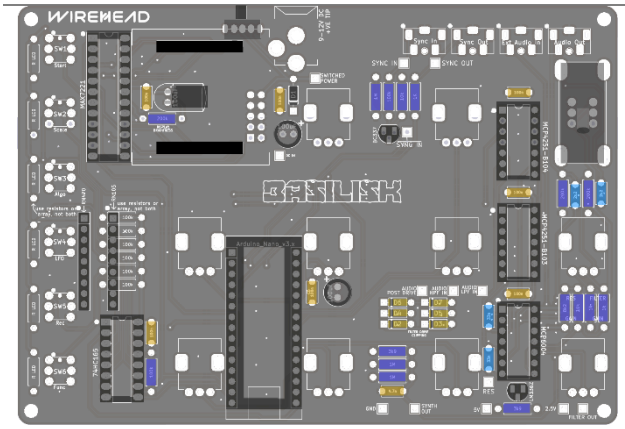


Insert the LED matrix into the 1x8 headers then loosely place into the sockets on the PCB

IMPORTANT: DO NOT SOLDER THESE YET!!

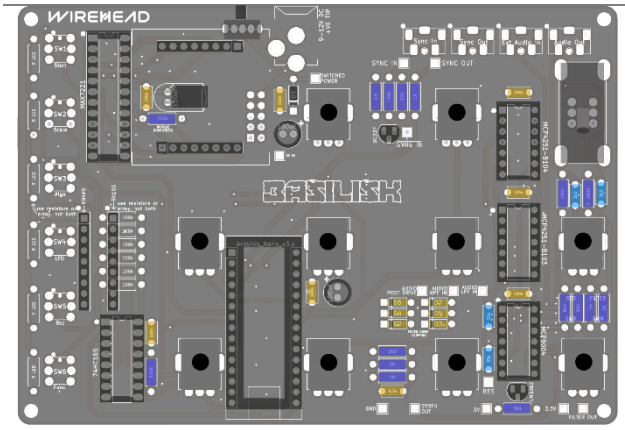
Using the front panel, align the LED cutout with the LED matrix at the same time as aligning the potentiometer shafts with their corresponding holes. The LED matrix should fit snugly through the cut-out.

A good way to do this is to attach the 12mm spacers to the **front panel**, place the panel over the PCB, then attach the main PCB to the panel using at least 2 screws to accurately position the panel.



Keeping the front panel and LED matrix in place, solder pins 1 and 8 of both header sockets.

Once in place, remove the front panel and LED matrix, then solder all remaining pins of the header sockets



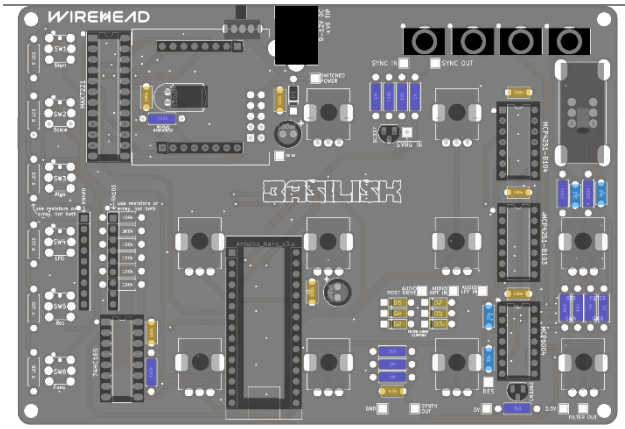
Place all 10 potentiometers.

IMPORTANT: DO NOT SOLDER THESE YET!!

Push the components firmly against the board. Check that the pots are mounted flat against the PCB before soldering the pins.

Using the front panel, align all potentiometer shafts with their corresponding holes. Keeping the front panel in place, solder 1 pin of each component.

Once in place, remove the front panel then solder all remaining pins. You may want to leave the side-lugs unsoldered until after fully fitting the panel and testing the potentiometers all rotate smoothly.



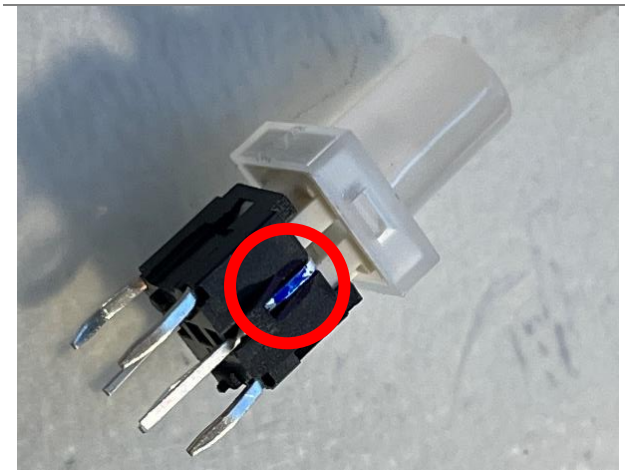
Place all 4 audio jacks and the DC power socket

IMPORTANT: DO NOT SOLDER THESE YET!!

Push the jacks firmly against the board. Check that the jack is mounted flat against the PCB before soldering the pins.

Using the front panel, align all jack sockets with their corresponding holes. Keeping the front panel in place, solder 1 pin of each component.

Once in place, remove the front panel then solder all remaining pins

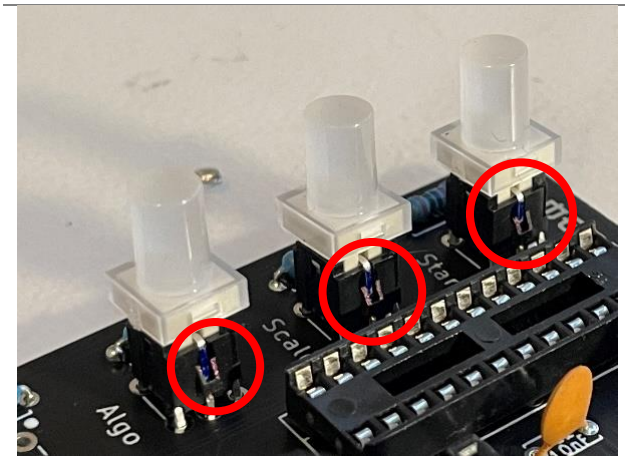


Place all switches SW1-SW6.

IMPORTANT: DO NOT SOLDER THESE YET!!

SUPER IMPORTANT: these components have a polarity. Check to make sure the small guiding pin on the underside of the switch is aligned with the guide hole in the PCB (towards the top of the PCB). The switches also have a coloured stripe which indicates the LED colour.

IMPORTANT: If you have multiple colours in your kit, use one colour for the FUNC button (bottom left) the other colour for the remaining switches

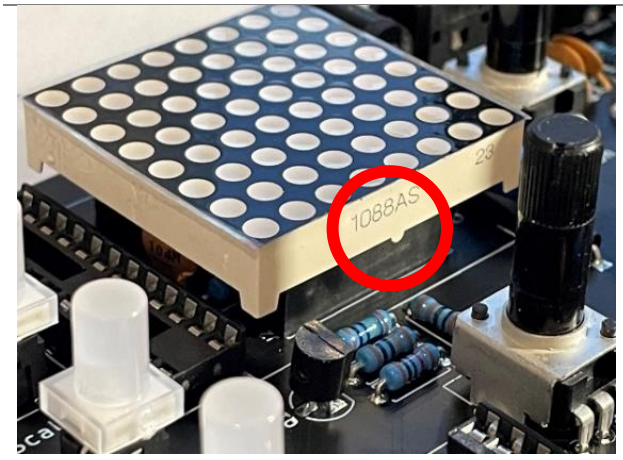


The coloured stripe on each switch which indicates the LED colour must be facing the INSIDE of the synth.

Push the components firmly against the board. Check that the pots are mounted flat against the PCB before soldering the pins.

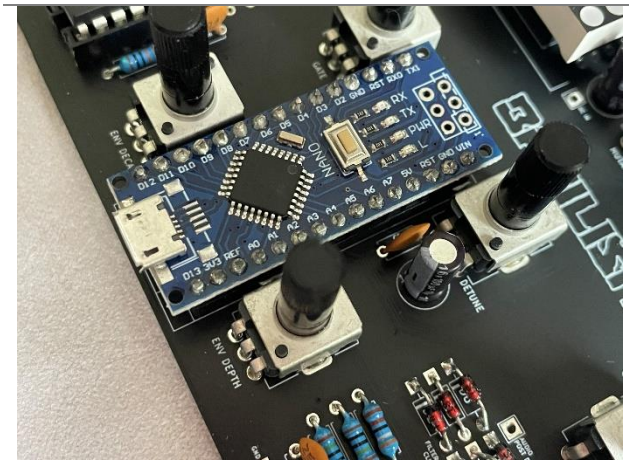
Using the front panel, align all switch caps with their corresponding holes. Keeping the front panel in place, solder 1 pin of each component.

Once in place, remove the front panel then solder all remaining pins



Insert the LED matrix into the sockets J1/J2.

IMPORTANT: note the orientation of the LED matrix – the side with the small tab in the centre of the plastic enclosure should be towards the Arduino Nano



Insert the Arduino Nano V3 into the socket. Note this will be a firm fit so place one side into the socket then use both thumbs to apply even pressure and snap the Arduino fully into the socket.

IMPORTANT: note the orientation of the Arduino – the USB port should be at the bottom of the board

CLEAN UP

Ensure all component legs are trimmed to less than 2mm in length

Clean flux from the board using isopropyl alcohol or similar cleaning fluid

IMPORTANT: make sure you don't get cleaning fluid into the switches – it will make them stick and not work smoothly. Solutions include:

- Cleaning around the switches (noting it can wick in through the alignment hole in the switch footprint)
- cleaning the rest of the PCB BEFORE placing the switches
- using contact cleaner spray to flush out any residue from sticky switches

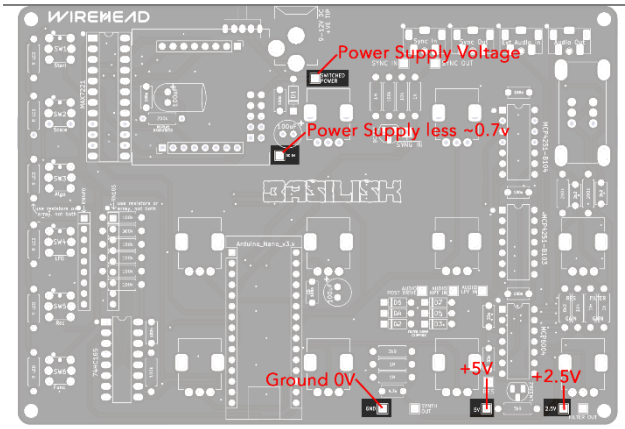
****BEFORE APPLYING ANY POWER****

****DO NOT INSERT ANY OTHER IC****

READ ON FOR TESTING STEP 1

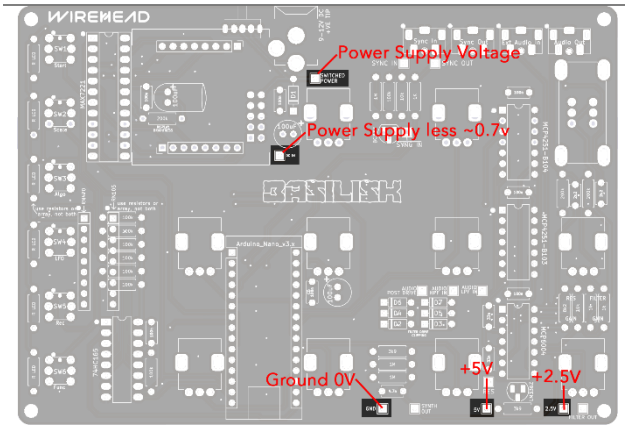
TESTING STEP 1

Visually inspect all solder joints and ensure they are solid and have good connection between the PCB pad and the component leg.



Using a multimeter with continuity mode, ensure there are no shorts between any of the power supply test points (GND, SWITCHED POWER, DC IN, 5V, 2.5V).

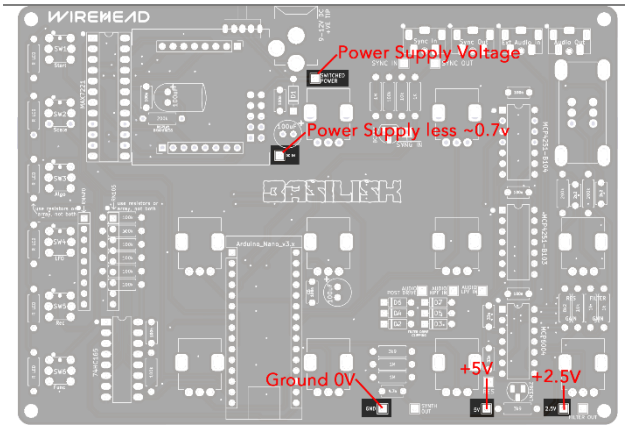
IMPORTANT: **if you find any shorts you must locate the fault and fix it before applying power to the unit!**



The Basilisk uses the Arduino's 5V voltage regulator to generate 5V.

Ensure the Arduino is correctly inserted in the socket, then insert a USB cable into the Arduino's USB socket:

- All switch LEDs should light up. The display will be blank until you place the MAX7221 IC
- test the 5V test points against GROUND and confirm it is showing about +5V
- test the 2.5V test points against GROUND and confirm it is showing about +2.5V

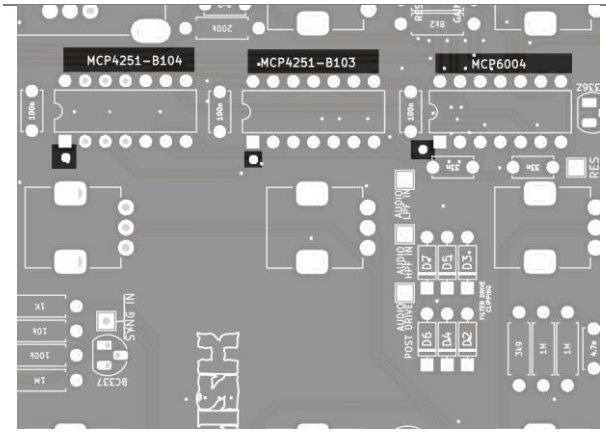


Disconnect the USB cable, connect 9-12V DC to the power jack and **turn the power switch on**

- All switch LEDs should light up. The display will be blank until you place the MAX7221 IC
- Test the DC IN test point against GROUND and confirm showing between +6 to +12V DC
- Test the 5V test point against GROUND and confirm it is showing about +5V
- Test the 2.5V test point against GROUND and confirm it is showing about +2.5V

** NOW YOU CAN PLACE ALL OTHER INTEGRATED CIRCUITS **

TESTING STEP 2



Insert the other ICs

IMPORTANT: ensure pin 1 notch/stripe is aligned with the silkscreen dot (top of the socket)

The MAX7221 and CD74HC165 will only fit into their own sockets.

IMPORTANT: The MCP6004, MCP4251-103 and MCP4251-104 are all DIP14 size. Check the silkscreen on the board to make sure you place them in the correct socket.

IMPORTANT: placing them in the incorrect socket or placing them in the wrong direction may damage or destroy the component.

Now apply power via DC or USB.

The display should show the firmware version then the Wirehead logo.

Make sure [SEQ LEN] is turned fully clockwise.

Plug audio cable into the [AUDIO OUT] jack and press [START].

You should see the sequencer running on screen and hear the sequence playing

Adjust the [CUTOFF] control. You should hear a smooth transition from low to high cutoff frequency as you turn clockwise.

IMPORTANT – IMPORTANT - IMPORTANT

Turn all knobs and press all switches and confirm all functions work correctly before proceeding!

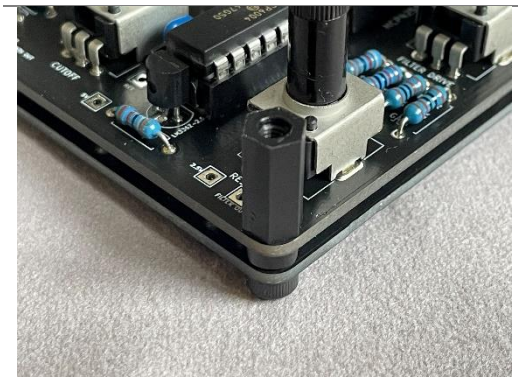
NOW WE CAN COMPLETE THE CONSTRUCTION...

FINAL ASSEMBLY

For each mounting hole in the rear panel insert a 10mm-long hex screw through from the underside of the rear panel then attach an M3 washer

An easy way to do this is to place all the screws into the rear panel, then while holding the panel vertically with the inside face towards you, gently place the bottom edge on your desk and flip the panel on it's back, keeping the screws in place.

Place the main PCB onto the screws & washers



Once in place, attach a 12mm M3 nylon spacer to each screw

Place the front panel over all components, being careful to ensure the potentiometer, audio jacks, switches and LED matrix all fit through their respective holes

Once the front panel is in place, insert the 6mm hex screws through the front panel and screw into the nylon spacers.

Place the silicone feet onto the base of the unit.

The LED Matrix is covered with a plastic protection sticker. This can be left on or removed depending on your preference. It looks glossier with the plastic left on, or more matt if removed.

TROUBLESHOOTING

Problem	Possible Causes	Recommended Action
No LED switches light up when powered on	Diode D1 inserted incorrectly	Check that the stripe on diode D1 orientation of diode D1. If incorrect, desolder and orientate correctly. If problem persists, diode may have been damaged – replace component
	Power supply or cable cannot provide adequate voltage or current (7-12V, at least 100mA at 12VDC)	Replace power supply Replace power cable Replace USB cable
	Power supply incorrect polarity	Replace/configure power supply to ensure positive tip
Some LED switches light up but not others	Some switches inserted incorrectly	Check that switch orientation is as per construction manual. If incorrect desolder (these are tricky!) and orientate correctly
Switches don't work smoothly	Front panel misaligned	Remove front panel and check if problem persists. If this fixes it, resolder the switch to realign the switch
	Cleaning fluid residue in switch	Cleaning the PCB with isopropyl alcohol tends to dissolve the flux and then gets into the switch, making it stick. Use contact cleaner to flush out the residue. Personally, I clean the board before I solder the switches and leave them uncleaned – seems to be easier and less fuss!
Potentiometers don't work smoothly	Front panel misaligned	Remove front panel and check if problem persists. If this fixes it, resolder the pot and realign.
Display does not show anything when powered on	Matrix inserted incorrectly	Check that orientation is as per construction manual. If incorrect remove and orientate correctly.
	MAX7221 IC inserted incorrectly	Check that the orientation is as per construction manual. If incorrect, remove and orientate correctly. If problem persists, IC may have been damaged – replace component
Display does not show anything when powered on	Power supply unstable or power cable plugged in	Replace power supply / cable Replace power cable

Problem	Possible Causes	Recommended Action
Display does not show anything when powered on	Power supply unstable or power cable plugged in	Replace USB cable
Display is 100% lit up	Power supply unstable or insufficient current	Replace power supply / cable Replace USB cable
	Poor solder-joints on MAX7221 IC	Check all solder joints
Controls don't work or unreliable	Pins not fully soldered	Check all solder joints and rework as required. Make sure to check the soldering of the Arduino pins as well as the main PCB
Sync input not working as expected	Transistor BC337 inserted incorrectly	Check that the orientation is as per silkscreen and you haven't mixed up the transistor and the LM336Z-2.5 voltage regulator. If incorrect, desolder and orientate correctly. If problem persists, component may have been damaged – replace component
	Input signal is insufficient voltage to trigger the sync	Check voltage received from the sending device using test point [SYNC IN]
Display works but NO SOUND	Current control settings are making synth output inaudible frequencies	Move knobs to make audible sounds – especially turn [CUTOFF] clockwise, turn [AMP DECAY] clockwise, turn [OCTAVE] clockwise
	Sequence contains no notes	Turn [SEQ LEN] fully clockwise, turn [MUTATION] fully clockwise and hold [FUNC] and turn [MUTATION/DENSITY] fully clockwise
	Sequencer not running	Press [START]
	Tempo is too slow	Remove all sync cables and set internal clock tempo by holding [START] and turning [MUTATION]. Clock division may be too slow – adjust by holding [FUNC] and turning [CLK DIV]
	Audio cable not plugged in	This happens 😂 plug it in!
	Cable connected to [AUDIO IN] but without any input	Conncting a cable to the [AUDIO IN]
	MCP6004 not correctly placed	Check the MCP6004 is properly placed and orientated
	HPF/LPF switch not properly switched to one option	Make sure switch is fully up or down

Problem	Possible Causes	Recommended Action
Sound is not working, too quiet or is distorted	Other issues	Using an oscilloscope, monitor the signal path using the various test points and email your results to Wirehead
Sequencer stops or accelerates randomly	Interference received on sync input Unusual tap-tempo input	Hold [FUNC] and tap [START/TEMPO] to reset tempo control Replace sync cable
Cutoff frequency doesn't change smoothly, or audio is distorted (not in a good way!)	Incorrect placement of MCP4251-103 and MCP4251-104	These chips are similar but have different resistance values. Make sure they are in the correct socket as shown on the silkscreen
External audio input doesn't work as expected	Misaligned diodes in gain circuit External audio source signal is too weak (< 1V p-p) or has other issues Poorly soldered External Audio jack Poorly soldered HPF/LPF switch	Turn [FILTER GAIN] to max Check the clipping diodes to ensure the polarity is correct Using an oscilloscope, check the audio path test points (especially AUDIO LPF IN and AUDIO HPF IN to validate that the signal is being received)
Control components don't align with front panel holes	Components soldered at an angle	Rework solder joints to re-align component to be 100% vertical. This can be tricky!
Front panel hits the top of the Arduino nano and doesn't fit properly	Arduino Nano not seated correctly in socket	With both thumbs, push the Nano firmly into the socket
	Different Arduino Nano used with 'standard' length pins or mini-USB connector	The Basilisk ships with a Nano with shortened pins and micro-USB connector to fit into the provided IC socket. If you have used a different Nano than the one provided, carefully shorten the pins by ~2mm with a side-cutter, ensuring all pins are the same length. Alternatively source longer spacers than those provided. Up to 15mm will work without an issue

SPECIFICATIONS

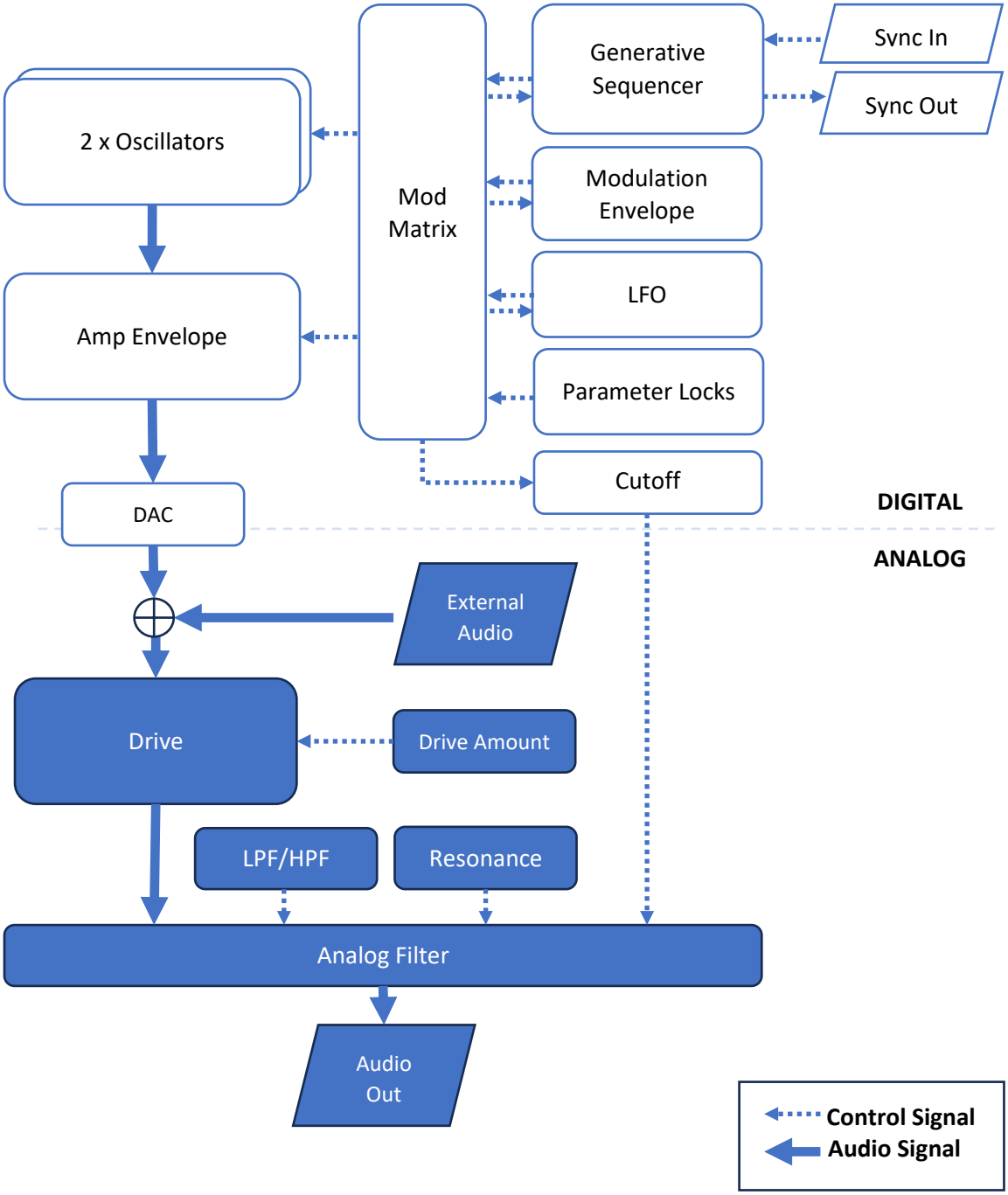
VOICE ARCHITECTURE

Voice	
Oscillators	**2 x digital oscillators, digitally mixed**
Octave	0 - 6
Waveform	Saw, Square, Pulse
Amp Decay	~4ms – ~60s
Glide Time	Off – ~1000ms
Mod Envelope	
Destinations	Filter cutoff, oscillator pitch
Depth	0 - ~75% full range
Attack time	0ms - ~3s
Decay time	4ms – ~500ms
LFO	
Depth	± 50% for cutoff. Variable for other settings
Rate	20Hz - ~5mins
Modes	Smooth, Sample & Hold
Waveform	Sine, square, saw, reverse saw, pseudorandom
Parameter locks	
Per step parameter locks	
Gate length, Detune, LFO Depth	
Envelope Shape, Filter Envelope depth, Cutoff	

SEQUENCER ARCHITECTURE

Sequencer Settings	Generative Algorithm
Sequence length	Algorithm Mode
Clock Division	Sequence mutation rate
Current step	Sequence note density
Sequence notes	
Note length	
Root Tonic	
Scale Mode	
Steps per sync pulse	

SYNTHESIS ARCHITECTURE



TECHNICAL SPECIFICATIONS

SPECIFICATIONS	
Synthesis	Dual 13-bit digital oscillators Digital VCA Analog filter: 12dB 2-pole Sallen-Key, Lowpass/Highpass
Polyphony	Monophonic
Sequencer	16 step polymetric sequencer
Modulation	Attack/decay envelope for cutoff & pitch Multi-waveform LFO Parameter locking per step
I/O	Audio out External Audio In (pre-gain & filter) Sync in / out Power 9-12v USB (power and firmware update) Eurorack power (with modification)
External sync	Sync in & out +5v sync pulse 1, 2 or 4 steps per pulse
Signal output	14-bit 32KHz DAC Mono output
Microprocessor	Arduino Nano V3 (ATMEGA328P)
Power supply	Micro USB 9-12VDC 2.1mm Positive tip Can be adapted for +12V eurorack power
Display	8 x 8 LED matrix
Power consumption	70mA @ 12VDC (v1.0 hardware)
Dimensions	142mm (w) (~28HP) x 100mm (d) x 40mm (h)

