FREQUENCY CENTRAL

Build documentation for:

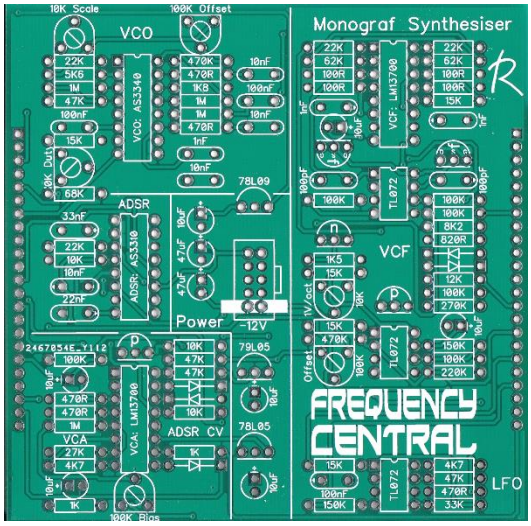
MONOGRAF SYNTHESISER

Monograf is a fixed signal path monophonic synth voice with many unique features, including a number of patch points for flexibilty within a modular setting. Our aim was to design the simplest full featured and good sounding single VCO synth within as small a space as possible, while offering a broad sonic palette and fast setup times. Monograf includes the following elements:

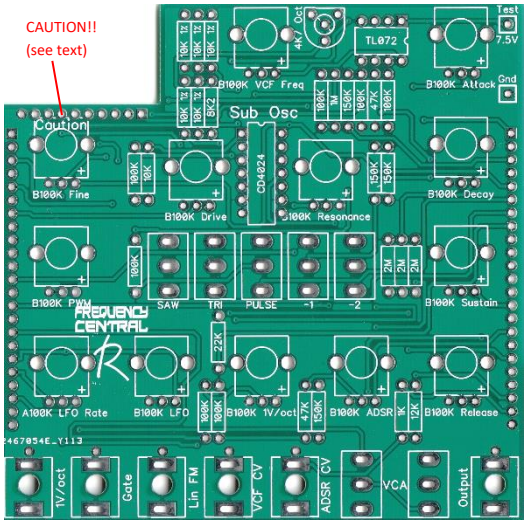
- Onboard LFO for PWM, and onboard sub osc for thick and juicy synth lines
- Super stable AS3340 based VCO featuring sawtooth, triangle and square waveforms, as well as rotary switch control of octaves and an onboard LFO for PWM. Features highly accurate 1V/octave tracking, as well as extenal CV control of linear FM.
- Sub oscillator featuring -1 octave and -2 octave square waveforms. Add a big bottom to your sound.
- 5 toggle switches for fast waveform selection, allows for super quick changes. Additionally, the triangle waveform is routed directly to the VCA, bypassing the VCF, to maintain a rumbling low end with higher resonance settings, this is a little known modular trick which was practised by the ancients (!?).
- 12dB/octave OTA lowpass VCF based upon ARP Odyssey Mk1 ‘whiteface’. A very characterful VCF with cutting resonance whose audio inputs can be driven into clipping via a dedicated Drive control. The chosen level of drive can have a profound effect over the character of the filter, and heavy drive will saturate the input while simultaneously reducing resonance. Cutoff frequency can be controlled manually, from the LFO, from the ADSR, normalised from a 1V/oct source, or from an external CV.
- Vintage ARP style VCA with gated/ADSR/drone options via two toggle switches.
- AS3310 based ADSR for super snappy envelopes. CV control of envelope output is available for velocity controlled dynamics etc.

Monograf features a 3 PCB set:

- Main PCB
- Control PCB
- Octave switch PCB



The Main PCB contains the main elements of the synthesiser: VCO, VCF, VCA, ADSR, PWM LFO, and power section. Each section is labelled appropriately.



The Control PCB mounts all of the control elements, potentiometers and switches, as well as interface sockets.

The TL072 on the Control PCB performs waveform mixing, and buffering for the octave switch circuit.

The sub oscillator is also mounted on this PCB (CD4024).

The Octave PCB interfaces to the Control PCB via a header.

Key to PCB screen print:

n: This signifies NPN BC547 transistors. Note the correct pinout as shown by the half circles.
p: This signifies PNP BC557 transistors. Note the correct pinout as shown by the half circles.
f: This signifies 2N5485 FET. Note the correct pinout as shown by the half circles.

The PCB shows the correct orientation for BC547/BC557/2N5485. Other transistor types can be used (eg 2N3904/2N3906), but please observe the correct pinout.

Please observe the correct polarity for the diodes and electrolytic capacitors.

Bill of Materials

100R	x 4
470R	x 5
820R	x 1
1K	x 3
1K5	x 1
1K8	x 1
4K7	x 2
5K6	x 1
8K2	x 2
10K	x 4
10K 1%*	**x 5**
12K	x 2
15K	x 5
22K	x 5
27K	x 1
33K	x 1
47K	x 6
62K	x 2
68K	x 1
100K	x 13
150K	x 6
220K	x 1
270K	x 1
470K	x 2
1M	x 5
2M	x 3

All resistors ¼ watt metal film.

100pF x 2

1nF x 3
10nF x 4
22nF x 1
33nF x 1
100nF x 3

10uF x 7
47uF x 2

AS3310 x 1
AS3340 x 1
LM13700 x 2

CD4024 x 1
TL072 x 4

2N5485 x 2
BC547x 1
BC557 x 2

1N4148 x 5

78L05 x 1
78L09 x 1
79L05 x 1

8 pin IC socket x 4
14 pin IC socket x 1
16 pin IC socket x 4

A100K x 1

B100K x 9

B100K x 3
(or these)**

4K7 trimmer vertical (5K is fine)

10K trimmer x 3
100K trimmer x 3

Rotary switch

SPDT x 7

3.5mm socket x 6

Male 40 pin header x 2

Female 40 pin header x 2

10 pin box header

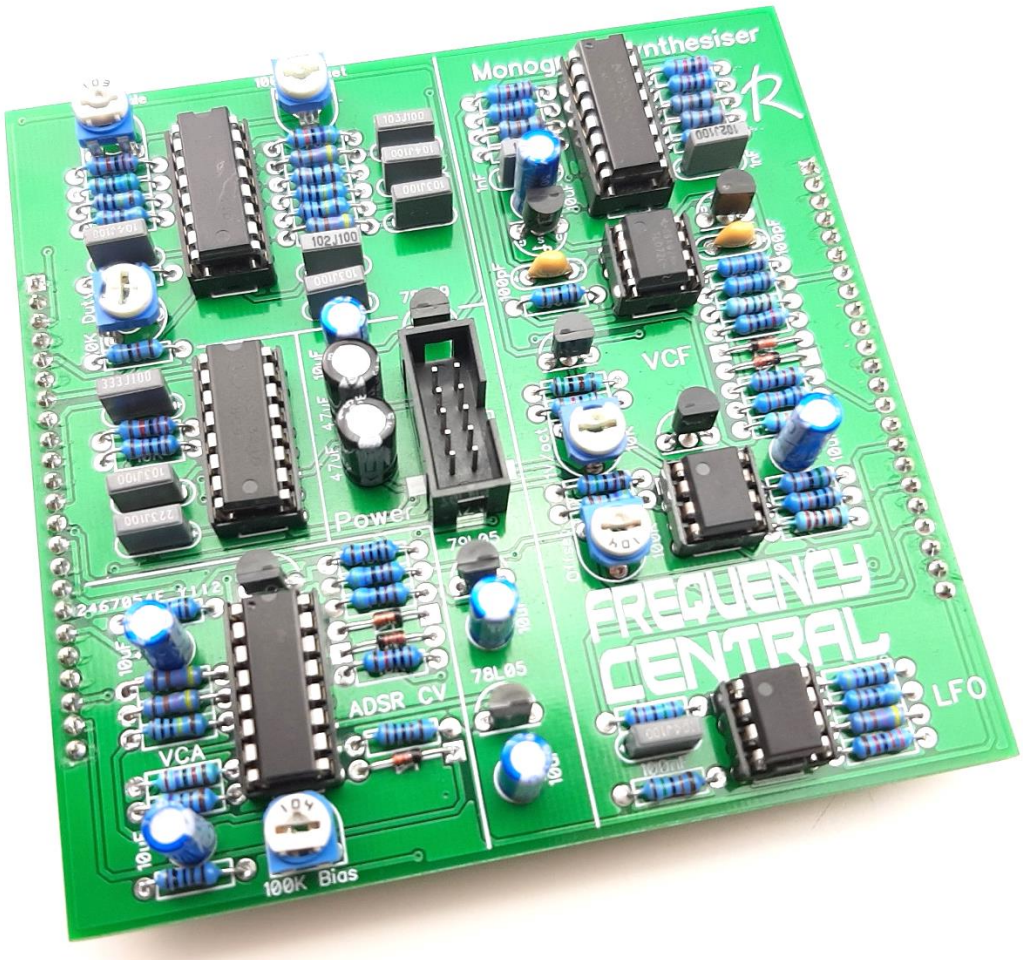
Big knob x 2
Little knob x 9

* **10K 1% x 5** These are the five matched resistors for the octave switch voltage divider ladder. They don't have to be 10K exactly, they just have to be matched to each other, so for example if they are all 9.98K that's fine. Grab a bunch of 10K resistors, measure each one, make little piles of 10k, 9.99K, 9.98K etc. Before long one of the piles will have five resistors in it, that's your matched set! Should only take 5 minutes.

** I prefer the Song Heui tall trimmers because they have a longer shaft and a white notch.

Main PCB assembly

1. Solder all resistors and diodes
2. Solder all IC sockets
3. Solder all non-electrolytic capacitors
4. Solder all 3 voltage regulators
5. Solder all transistors
6. Solder all trimmers
7. Solder the power header – if you're using box type, observe correct polarity
8. Solder all electrolytic capacitors
9. Cut male headers to size and solder them into place. Make sure that they stick out of the bottom of the PCB.



Control PCB

1. Solder all resistors

2. Solder both IC sockets

3. Solder the trimmer

4. Place the 10 metal shaft pots on the PCB, and fold over the mounting tabs of the pots at the rear of the PCB, then place the panel over them. This will assure that they are correctly positioned. Flip the whole lot over and solder the pots into place. **CAUTION!!** – the rear tab of the Fine Tune pot needs to be folded back (or cut off) to avoid fouling on the header for the Octave PCB header.

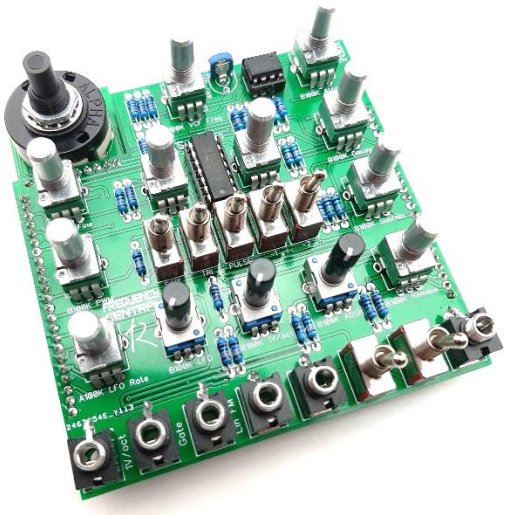
5. Place all sockets on the PCB, making sure the ground tabs line up with the PCB's ground pads, then place the panel over them. This will assure that the sockets are correctly positioned. Flip the whole lot over and solder the sockets into place. Don't forget to ground the sockets to the PCB using cut off resistor legs.

6. Place the 7 toggle switches, then place the panel over them. This will assure that the sockets are correctly positioned. Flip the whole lot over and solder the sockets into place.

7. Place the three plastic shaft pots on the PCB, fold over their mounting tabs at the rear of the PCB, then place the panel over them. This will assure that they are correctly positioned. Flip the whole lot over and solder the pots into place.

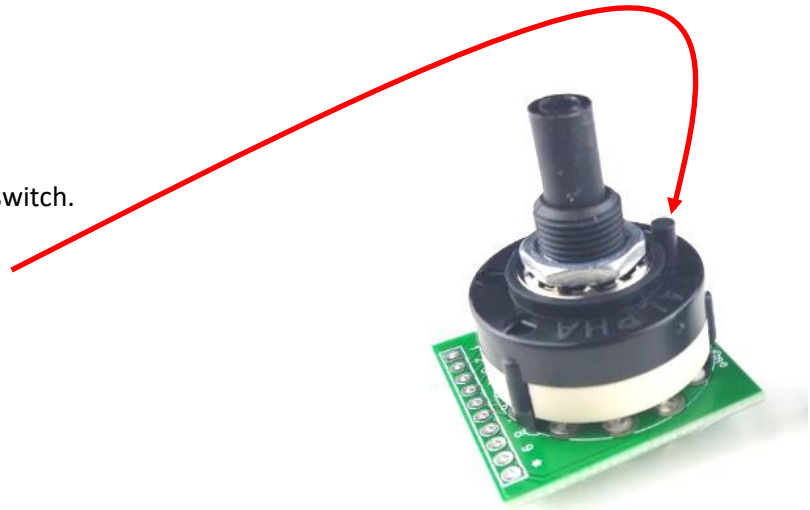
8. Cut **two female** headers (to connect the Main PCB) to size and solder them into place. Make sure that they stick out of the bottom of the PCB.

9. Cut **one male** header (to connect the Octave PCB) to size and solder it in place. Make sure it sticks out of the bottom of the PCB.



Octave Switch PCB

1. Solder the 1P12T rotary switch.
2. Cut the plastic flange off.



Final Assembly

1. Mount the Control PCB onto the panel. Tighten all mounting nuts.
2. So, the 1P12T rotary switch needs to be adjusted to be a 1P6T rotary switch. Remove the mounting nut and the washer, below them you will find another washer with a small flange at 90°, the inner part of the switch has a number of slots, drop the flange into the slot marked 6, then waggle the switch to make sure you're getting 6 positions.
3. Mount 1P12T rotary switch onto the panel, making sure the relevant pads also pass through the male header of the Control PCB. Tighten the nut. Solder the Octave Switch PCB to the Control PCB via the male header. **See photo.**
4. Plug the Main PCB into the Control PCB

Calibration

- **4K7 Octave (Control PCB):** Set the octave switch to it's highest octave position (2') and adjust trimmer until you get a reading of 7.5V at the **Test** on the octave rotary switch daughter board.

- **10K Scale (VCO):** This trimmer sets the 1V/oct tracking of the VCO, and it's really worth spending some time to get it right. On first power up, the VCO should already be pretty close to 1V/oct with the trimmer in it's mid position, as I carefully chose associated resistor values to make it so. To set it closer, play two notes an octave apart and adjust until it sounds spot on. Then play two notes two octaves apart, and adjust still further until it sounds spot on. If you have a frequency counter, still better!

- **10K Duty (VCO):** This sets the duty cycle of the square wave, should be just about spot on with the trimmer in the mid position, as I carefully chose associated resistor values to make it so. Set the Pulse Width knob to 50 (hard left), and twiddle the trimmer until you hear the easily recognisable hollow sounding square wave.

- **100K Offset (VCO):** Sets up the initial frequency of the VCO. Set Fine Tune to it's centre position, play an A on your keyboard. Adjust the Offset trimmer until you can read a frequency of 110 Hz, 220 Hz, 440 Hz, 880 Hz etc when playing octaves of A.

- **100K Bias (VCA):** set both VCA switches to the up position to send a nice snappy ADSR into CV3 input. Adjust Bias trimmer to sweet spot, ie there is no DC thump. The chances are that that the sweet spot is around the mid position.

- **10K 1V/Oct (VCF):** turn Resonance all the way to self oscillation. Patch a 1V/oct source into CV input 1, with the attenuator fully clockwise. Play octaves and adjust the V/Oct trimmer until they are spot on.

- **100K Offset (VCF):** you want to tweak this so that the filter is fully open when the Cutoff pot is fully clockwise.

RDH 04/01/20

https://www.frequencycentral.co.uk/