FREQUENCY CENTRAL

Build documentation for:

PRODUCT

MODULAR SYNTHESISER

Product is a full featured modular synthesiser which you can use without patching. Or you can use it as the heart of your modular system. Each component part is fully modular, but also features pre-patched normalised signal paths for fast set up of new and exciting sounds.

Product features a motherboard on which all pots, switches and sockets are mounted, this is also where the pre-patched normalising happens. So the onboard LFO is available for both FM and PWM of the VCO. The three VCO waveforms are available at the three VCF signal inputs. 1V/oct input, LFO and ADSR are available at the three VCF signal inputs. By some cunning switching, the VCA can be operated by either ADSR or gate input, alternatively it can be set to drone position. Also available are signal outputs from the LFO and noise generator. All pre-patched connections can be broken simply by inserting a jack into the relevant socket.

To simplify the building process, there are three daughterboards that plug into the Product motherboard: VCO daughterboard, VCF/VCA daughterboard, and ADSR/noise daughterboard. First you can build and calibrate the VCO daughterboard, plug it into the Product motherboard, get it running and have some fun with it. Then build the VCF/VCA daughterboard, and add it to you expanding modular synthesiser. Finally build the ADSR/noise daughterboard, and your synth is complete. The other advantage of building your synth this way, is that it’s really easy to replace one section if you *just can’t* get it to work.

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. Other transistor types can be used (eg 2N3904/2N3906), but please observe the correct pinout. Please observe the correct polarity of the electrolytic capacitors.

Bill of Materials			
33R 100R x 2 330R x 3 470R x 2 820R 1K x 14 1K2 1K5 2K2 x 4 2K7 x 2 3K 4K7 x 5 6K8 8K2 10K x 12 10K 1% x 5* 12K x 4 15K x 6 18K** 22K x 6 33K x 7 47K x 12 56K x 3 68K x 1 82K 91K x 2 100K x 20 150K x 4 180K x 2 220K x 2 470K x 4 560K x 1 1M x 2 2M2 x 3 All resistors ¼ watt metal film	22pF x 1 100pF x 1 470pF x 3 2.2nF x 2 5.6nF x 1 10nF x 2 100nF x 8 220nF x 2 1uF bipolar x 1 1uF electrolytic x 1 10uF electrolytic x 3 47uF electrolytic x 5 220uF electrolytic x 1	CA3046 x 2*** LM13700 x 1 TL071 x 1 TL072 x 6 TL084 x 1 BC547 x 18 BC557 x 8 2N5485 x 1 78L09 x 1 1N4148 x 9 8 pin IC socket x 7 14 pin IC socket x 3 16 pin socket x 1	A100K x 4 (or this)**** B100K x 5 (or these)**** A500K x 1 A1M x 2 B100K x 4 C50K x 1***** 3.5mm socket x 19 SPDT toggle x 4 Rotary switch 1K trimmer x 3 2K trimmer x 2* 4K7 trimmer 10K trimmer x 1 50K trimmer x 1 100K trimmer x 2 10K trimmer x 1 (Rotary Switch PCB) Male 40 pin header x 3 (cut to size) Female 40 pin header x 3 (cut to size) 10 pin box header x 1 Big knob x 2 Little knob x 7

* 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.

** 18K: This is the resistor, which along with the Scale trimmer, sets the 1V/octave trim. Marked with an asterisk on the PCB.

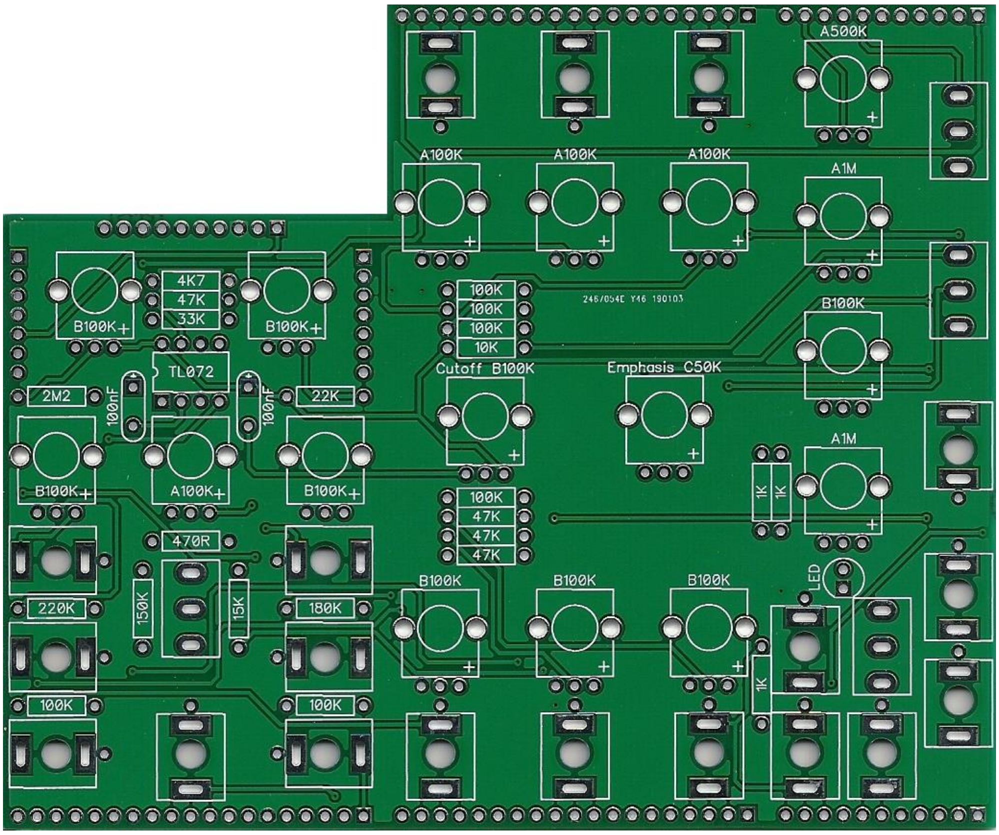
*** CA3046 can still be got for some suppliers such as Banzai, Das Musikding, Small Bear and some reputable Ebay sellers. http://dsmcz.com/prestashop/en/ sell UL1111 for only £1.53, they are functionally identical to CA3046. Alfa Rpar will shortly be releasing a CA3046 clone. The PCBs also includes pads for SMD LM3046.

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

***** If you can't get C50K, use B50K instead

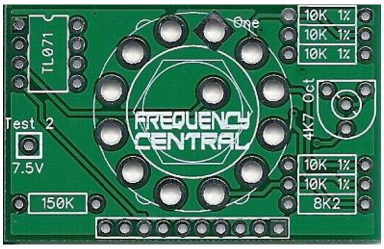
<u>Product motherboard assembly</u>

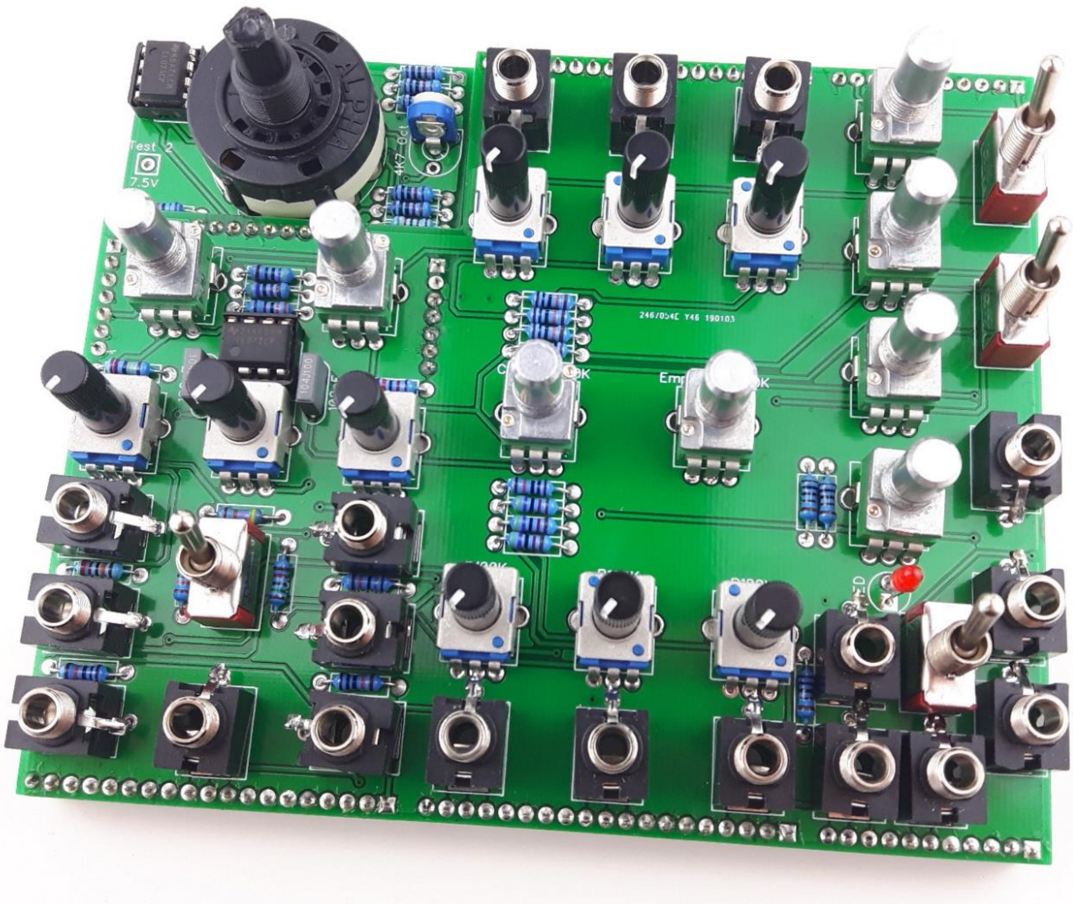
1. Solder all resistors
2. Solder the IC socket
3. Solder the two capacitors
4. Place the eight metal shaft pots and the four switches on the PCB, and fold over the mounting tabs of the pots at the rear of the PCB, then place the panel over them. This will assure that they are correctly positioned. Flip the whole lot over and solder the pots into place.
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 nine 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.
7. Cut **seven female** headers to size and solder them into place. Make sure that they stick out of the bottom of the PCB. **See photo below.**
8. Cut **one male** header to size and solder it in place. Make sure it sticks out of the bottom of the PCB. **See photo below.**



Rotary Switch PCB

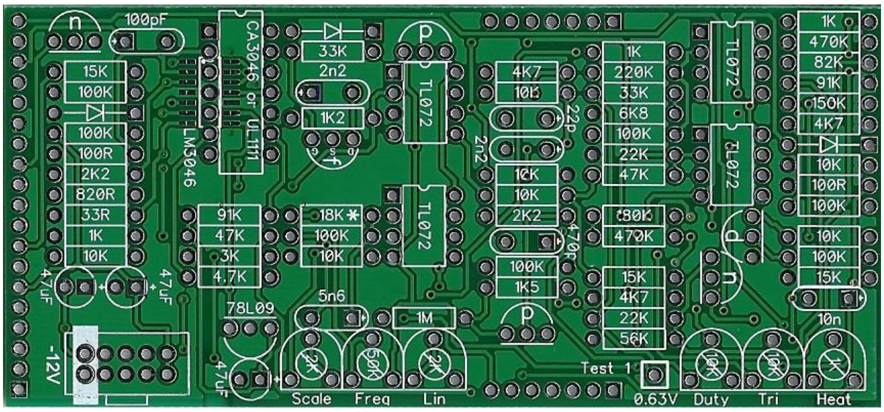
1. Solder all resistors (see note in BOM section about matching the 10K resistors)
2. Solder the IC socket
3. Solder the trimmer
4. Solder the 1P12T rotary switch. Once you have soldered it in place, snip of the tabs on the solder side of the PCB, this will stop it fouling on the Motherboard PCB once fully assembled.
5. 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.
6. Mount 1P12T rotary switch onto the panel, making sure the relevant pads also pass through the male header of the Pots 'n' sockets PCB. Tighten the nut. Solder the Octave Switch PCB to the Motherboard PCB via the male header. **See photos on this page and on page 8.**

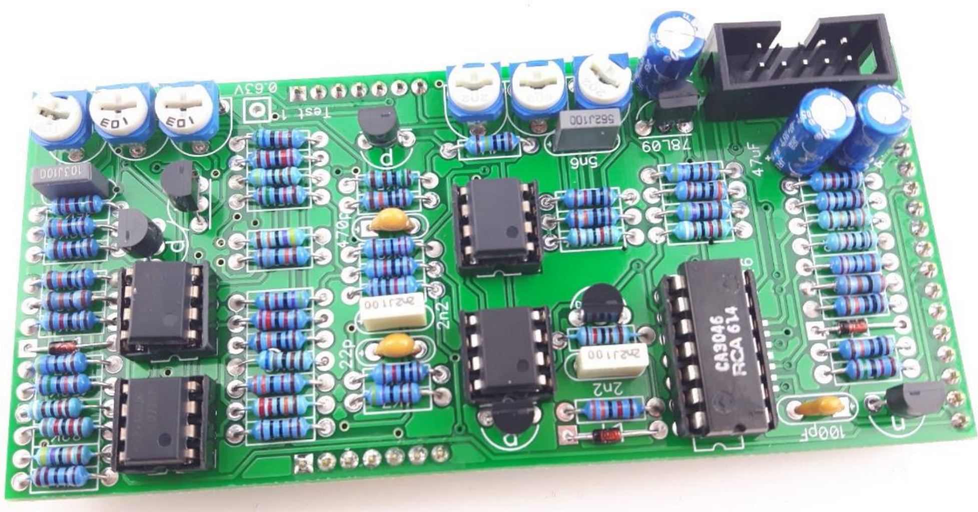




VCO PCB assembly

1. Solder all resistors. Tip – don't get 100R and 100K mixed up.
2. Solder all IC sockets
3. Solder all non-electrolytic capacitors
4. Solder all transistors
5. Solder all trimmers
6. Solder the power header – if you're using box type, observe correct polarity
7. Solder all electrolytic capacitors
8. Cut male headers to size and solder them into place. Make sure that they stick out of the bottom of the PCB.

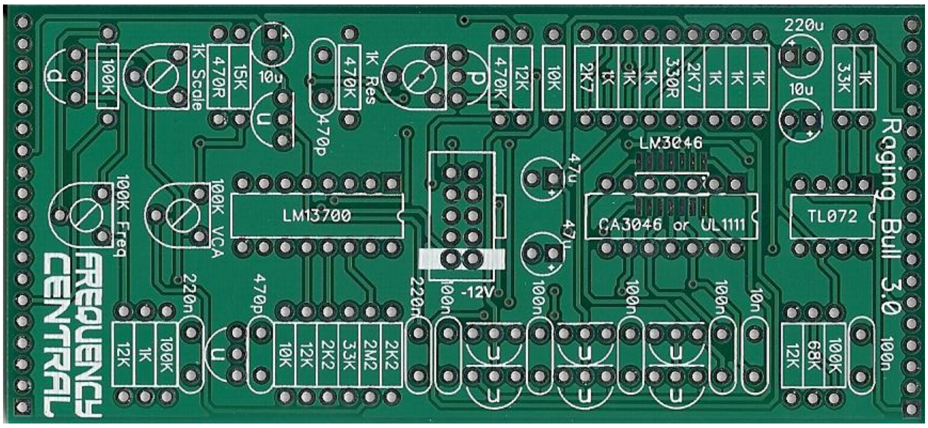


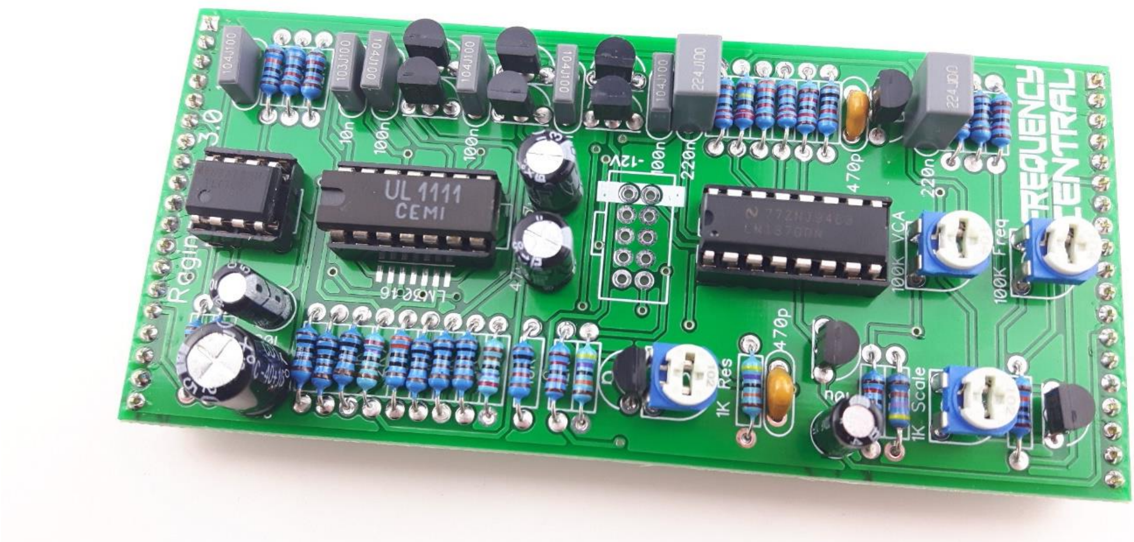


VCF/VCA PCB assembly

1. Solder all resistors.
   Tip #1 - don't mix up the 2K2 and 2M2
   Tip #2 - don't mix up the 470R and 470K
2. Solder all IC sockets
3. Solder all non-electrolytic capacitors
4. Solder all transistors
5. Solder all electrolytic capacitors
6. Cut male headers to size and solder them into place. Make sure that they stick out of the bottom of the PCB.

Note: there is no need to solder a power header on the this PCB, as power is distributed via the motherboard.

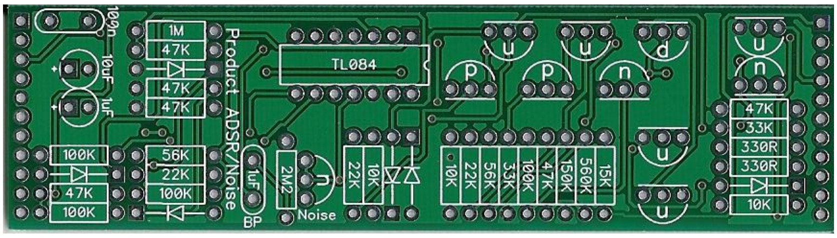


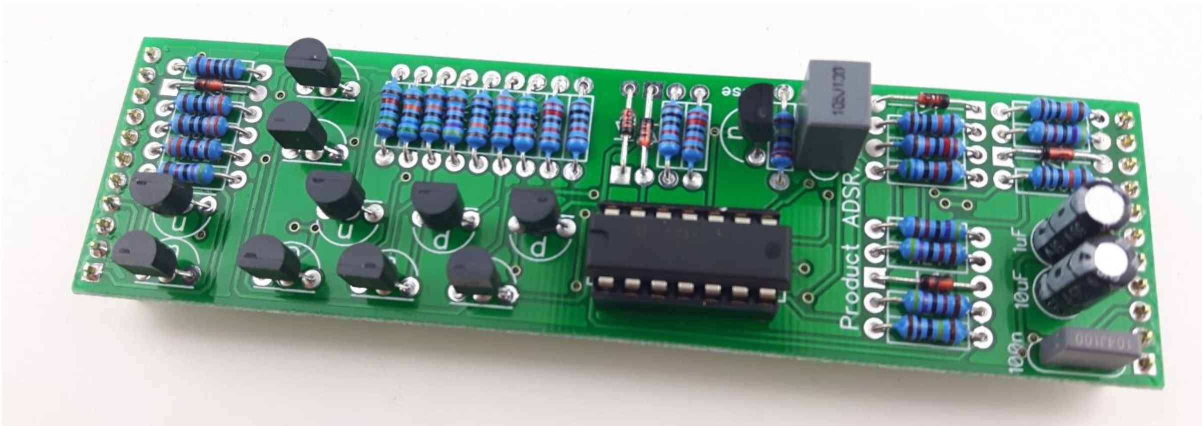


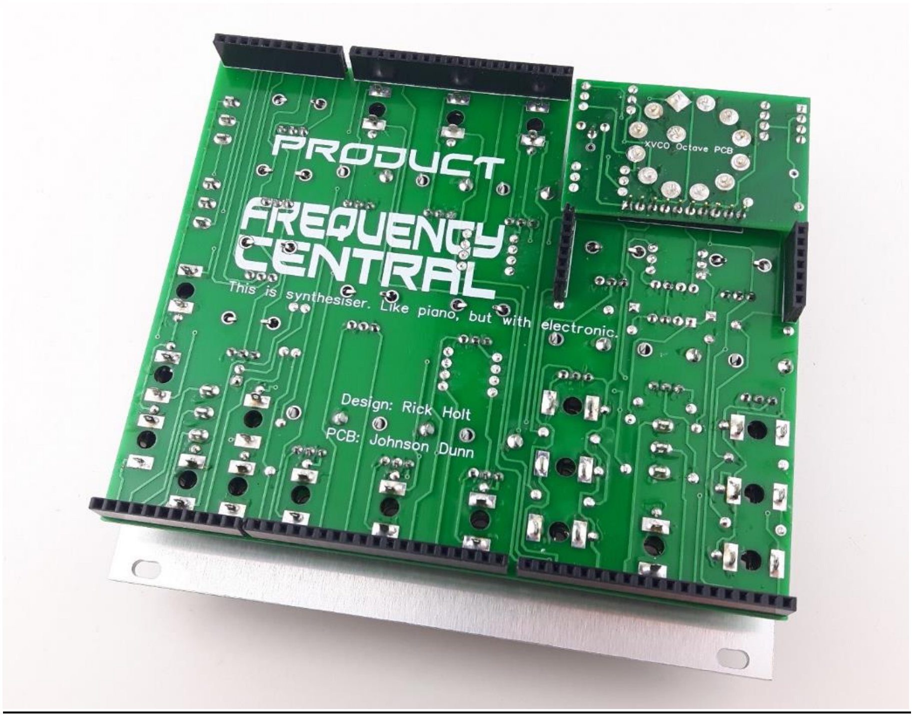
ADSR/Noise PCB assembly

1. Solder all diodes
2. Solder all resistors

3. Solder all IC sockets
4. Solder all non-electrolytic capacitors
5. Solder all transistors
6. Solder all electrolytic capacitors
7. Cut male headers to size and solder them into place. Make sure that they stick out of the bottom of the PCB







VCO PCB Calibration

- **1K Heat:** Power up the module and adjust this trimmer until you get a reading of 0.63V at **Test 1** next to the Duty trimmer.
- **4K7 Octave (on Rotary Switch PCB):** Set the octave switch to it's highest position and adjust trimmer until you get a reading of 7.5V at **Test 2** on the octave rotary switch daughter board.
- **10K Tri:** This sets up the triangle wave symmetry. As this VCO is sawcore, there is always going to be a very slight spike at the trough of the triangle, that's just science! However, you can use this trimmer to minimise the spike. Optimal position should be pretty close to the centre of the trimmer.
- **10K Duty:** 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.
- **2K2 Lin:** High end trim. There is a set-up procedure for this in the Roland service manual (pages 5 and 6 of this PDF). It requires the use of a 'scope and a precision reference oscillator. I've built a fair few of these by now, and I've found it tracks very well over 6-7 octaves even before using Roland's set-up procedure for high end trim – if you have a good ear and some patience.
- **50K Freq:** Sets up the initial frequency of the VCO. Optimal should be close to the mid position of the trimmer, but you may adjust to taste.
- **2K Scale:** 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!

VCF/VCA PCB Calibration

- **VCA trimmer:** 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.
- **Scale trimmer:** turn Emphasis all the way to self oscillation. 1V/oct is normalled into CV input 1, set the attenuator fully clockwise. Play octaves and adjust the Scale trimmer until they are spot on.
- **Freq trimmer:** you want to tweak this so that the filter is fully open when the Cutoff pot is fully clockwise.
- **Res trimmer:** you can adjust exactly where the Emphasis knob starts to self oscillate. If in doubt, leave this trimmer in it's mid position.

RDH 13/01/19

http://www.frequencycentral.co.uk/