synthCube

Steiner Synthasystem
Quad VCO

module documents v1.0
October 2014

Available Formats

Euro format

Errata:

Background of 2014 Synthasystem Re-Release

The Steiner Parker Synthasystem was a well- known analog modular synthesizer system produced in the 1970s. David Ingebretsen, an engineer and self-proclaimed Synthasystem fan undertook a project to resurrect the original circuit designs, and with cooperation from Nyle Steiner, developed and tested PCBs and panels to allow the Synthasystem module designs to be made available again. Excerpted from David's documentation:

> "I was bitten by the synthesizer bug as a teen in the 70s. ELP, Yes, Rick Wakeman, Walter (Wendy) Carlos, etc. hooked me. I wanted a Moog, but clearly understood I could not afford even the most modest version and I wanted a big one.
>
> My father was an EE and taught me (and my brothers) how to stuff and solder a PCB, basic electronics, and instilled in me a desire to learn, experiment, and tinker with all things mechanical and electrical. So, as a teen, I could read a schematic, could figure out circuit basics, and thought I could tackle building one of these things if I could get designs.
>
> In comes Nyle Steiner. I don't remember how I got his name, but I did and it turned out he lived within an easy walk of my home. I cold called him one evening and he invited me down to his home. He welcomed me and took me downstairs to his workshop. There I got the personal demo of my life. He showed me his modular (a big Synthasystem), his recording equipment, gave me my first introduction into multi-track recording, and a demo of his developing EVI. I was overwhelmed. I asked for his help and over the next couple of meetings, walked away with schematics of most if not all of his current modules.
>
> I went to work and started to build a housing, laid out two huge sheets of aluminum which had been anodized black, and started drilling holes. I figured out a keyboard finally. I started by going down to a music store and begging some old piano keys which I mounted on a huge sheet of plywood. I abandoned that and got a Pratt-Read action. I built the keyboard circuit, and an oscillator, but I can't remember if I got anything more built. Nyle also offered me a summer job stuffing PCBs which was a lot of fun. So, if any of you have an early Synthasystem, I might have soldered your PCBs. You can tell because mine were soldered right :).
>
> Life happened, and the project slowed. I got stymied with the power supply, actually. I just couldn't figure out a good one that would power everything. For some reason I had it in my head that everything had to have a common power supply. So, my project stagnated. Eventually, while I was in France serving a church mission for the LDS church, I think (pretty sure actually) my brother cleaned out the basement and threw out all the synthesizer stuff. No, I'm not angry with him, nor was I at the time. Annoyed, but I understood in my heart I wasn't going to finish that project anytime soon. School, marriage, kids, career all got in the way.
>
> Zip ahead 35 years. I'm sitting in my chair, midlife crisis welling up inside me. I still think back to my modular and regret never building it. I had purchased a couple of keyboards over the years, but never loved them. I started looking on the net and what did I find? PAIA! I immediately ordered a 9700 system. In the weeks and months that followed I was completely sucked in. Blacet, CGS, Oakley, JH, the Bridechamber with all the suspects there, and on and on. I bought a Moog Voyager (well two actually, rack mount and keyboard), I pre-ordered a John Bowen Solaris; I started building til my eyes were weary and my brain hurt...
>
> I still felt like something was missing; my Synthasystem. But I knew the schematics were long gone. Both my brother and I looked. I started searching the net. I was floored, there was next to nothing out there for the Steiner modular. Moog, Buchla, Arp, etc. all sorts of information. Steiner, zip.
>
> I did find a copy of the Synthacon schematics and the owner's manual for the Synthasystem. Although the Synthacon "modules" didn't have all the features of the Synthasystem counterparts, I thought I could at least start here and build something like a Synthasystem. After all, these were still Nyle's designs.
>
> I kept looking and decided I needed to try to find Nyle. At the worst, he wouldn't be able to help. I had seen Nyle a couple of times over the years and had exchanged a couple of emails at the start of my mid-life crisis. But recent emails had gone unanswered.
>
> I managed to find someone who had better contact with Nyle and he acted as an intermediary and sent Nyle an email for

me. I got a reply and, a new email for Nyle. Nyle was still as nice, humble, intelligent, clever, and as good a guy as ever. I asked if he would be willing to share his designs with me again. His reply was simple, I'll help you with whatever you need. Wow...

Next thing I knew, I had scans of all his schematics.

Over the next month or two, Nyle and I spoke many times and caught up with life. He again invited me into his home, and I was able to finally reciprocate and have him in my home. I think he is about as excited with this project as I am. He gave me access to all his old archives. I took his original schematics and made very high resolution scans of all of them, and other important information and started capturing all the schematics and notes into Eagle.

So, motivation? I am now coming full circle. I will finally have that system I wanted as a young man, but done right. The first thing I made sure I did was the power supply :)

This project has some very deep and personal meaning and satisfaction for me. Renewing a friendship with a truly good man, trying to help him get more of the recognition and praise I think he deserves, and breathing life back into a very unique and cool analog modular synthesizer is an amazing experience.

It is my hope that those who come to these pages and build a module or two will come to appreciate the genius in "the man"; Nyle Steiner. He made some real contributions which deserve remembering by those who love synthesizers, especially the monster modulars.

Thanks and enjoy."

With that background, David has created a great set of PCBs and associated documentation for synth enthusiasts to re-create the Synthasystem.

Module Description

As you undertake the Synthasystem projects, keep in mind that the modules were designed in the early evolution of analog modular synthesizers and as such represent theoretically sound, and for the time, leading edge functionality. From David's documentation:

"This module produces an oscillating signal whose frequency is based on a voltage input. Typically, this is an audible tone, but this module can oscillate from well below hearing to well above. The control voltage input is typically tuned to a 1 volt/octave scale. Four waveforms are available, Sine, Triangle, Sawtooth, and Pulse. These four outputs are available at the same time. This module has a very wide useable frequency range from well below audible as a Low Frequency Oscillator to above hearing without re-tuning. Nyle really outdid himself on this module. Very unique and I will say I think it has the best sine wave I've heard.

From the Synthasystem manual (note some of the details don't apply to the re-issue module)

Each voltage controlled oscillator (V.C.O.) is identical except for the number of available waveforms that each produces. To avoid repetition we will describe the operation of the type A oscillator shown above, which produces all four waveforms. Each waveform is available at two parallel output jacks and each waveform and each waveform has a separate amplitude level pot. Example: Sine wave amplitude is controlled with control knob #2 (Figure #11) and is fed to two output jacks in parallel. Likewise for the triangle, sawtooth and pulse waveforms produced by this oscillator. The pulse waveform has an additional control for pulse width and an additional input jack for controlling pulse width. Either of these can control the width of the pulse coming out the output jacks. With the pulse width all the way CCW, and no input at the PWM jack, the pulse waveform is symmetrical and thus a square wave.

The frequency (or pitch) is controlled with the Frequency adjust knob from less than 1/10 Hz (cycles per second) to greater than 20KHz and can be fine adjusted with the Fine Frequency knob. Frequency is also controlled by feeding control voltages in the VC input jacks. Frequency modulation is accomplished by feeding an A.C. signal (such as the output from an oscillator) into one of these jacks instead of a D.C. voltage....

Each oscillator has an input jack called phase reset. Any signal with a fast negative going edge, for example a sawtooth, square wave, or pulse, will reset the output waveform to a precise point whenever the negative edge occurs as shown in figure #11A. usually the input signal at jack is lower in frequency than the oscillator, and the oscillator tends to take on a pitch sensation of the lower frequency with the timbre changing as the osc frequency is varied. This also makes it possible to have one oscillator track at a harmonic of another with no beating whatsoever

Inputs/Outputs

This module has three fundamental inputs and four outputs:

1. VC Inputs - These inputs accept a voltage input, typically between 0 and 10 volts. This can come from any source which provides a voltage output. VC3 Var Scale is an input which can be configured to respond to a different scale than the 1 volt/octave scale of the other two inputs.
2. VC Width - This input accepts a voltage which dynamically changes the width of the pulse on the Pulse Output.
3. Phase Reset - this input accepts a falling edge to reset the phase, or sync, the VCO output frequency to that of the signal at this input. A signal with a steep trailing edge works best, such as a pulse or a "ramp" type sawtooth wave.

1. Waveform Outputs - The top row of jacks provide the waveform outputs according to the legend on the panel. (synthCube note: location of the output jacks varies by module type)

Knobs

This module has 9 knobs; 4 for output levels, 1 frequency, 1 fine frequency, 1 pulse width, 1 v/Oct trim, 1 VC3 Scale.

1. Output level - These are attenuating controls to set the relative output levels of the 4 waveforms.
2. Frequency - This sets the base frequency of the oscillator.
3. Fine Frequency - This allows a fine adjustment of the base frequency.
4. Pulse Width - This sets a base pulse width which is combined with the VC Width input.
5. V/Oct trim - This front panel trimmer allows more convenient calibration of the V/Oct response. It is only used when re-calibration of this response is required. It may also be located on the PCB. (synthCube note: in the euro version of this module using the Clarke Robinson panel, the V/Oct trim is located on the PCB, not the panel)
6. VC 3 Scale - The third VC input can be configured to respond to a scale which is different than the scale of the other two inputs which is set with the V/Oct trimmer. This can be a regular potentiometer or a trimmer like the V/Oct trimmer depending on how the module is built and configured. It may be omitted or be on the PCB. (synthCube note: in the euro version of this module using the Clarke Robinson panel, the VC3 Scale trim is located on the PCB, not the panel)

Switches

There are no switches on this module.

General Connections

Hmmmmm, what good is a VCO in a synthesizer... Wow, hang on. I can think of something...

OK sorry for the bad sarcasm. VCOs are the main module for producing audio. A typical patch would connect a 1 volt per octave controller to one of the VC jacks like a keyboard. If you're Buchla, however, you won't use a keyboard :) Connect an output waveform to a filter, mixer, VCA, then to a speaker or headphones.

However, any varying voltage can be use as an input.

- Envelope Generator
- Ribbon Controller
- Amplified microphone
- Wrap some resistive wire around a wood dowel, connect the ends to a power source, (make sure you have a common ground) take a wire and drag it across the wire like a potentiometer.
- Use the VC2 or VC3 in for a frequency modulation input.

- An accelerometer connected to your hand.

It's only limited by your imagination.

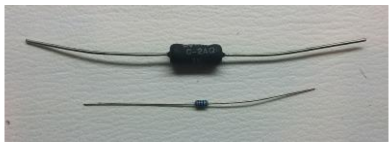
The frequency range of this VCO makes it very useful as an LFO (Low Frequency Oscillator). You can use the output of one VCO to modulate the other.

The Phase Reset is, in more common jargon, a sync input. Use the Saw or Pulse output of one VCO to force a second VCO to oscillate at the same frequency. This is a nice way to combine the outputs of two VCOs and have them stay in tune. However, one of the consequences is the second VCO may reset (probably will reset) before a full cycle of its wave. This will add harmonic content and will (hopefully) make the resulting output more interesting and rich. You can detune the second, third, fourth, etc. sync'd VCO intentionally to emphasize this extra harmonic content."

For those interested, the original David Ingebretsen documentation related to the Synthasystem project is here: http://user.xmission.com/~dingebre/Synthasystem.html

General Assembly Preparation

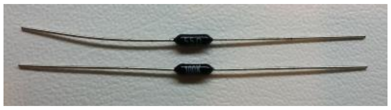
1) Check that the kit contains all of the parts noted in the BOM. Note that some parts may vary slightly from those depicted in this guide. Notify us of any quantity discrepancy using info@synthcube.com.
2) Gather additional materials and tools necessary for your build:
    a. Tools (soldering iron, pliers, wire cutters/stripper, etc)
    b. Solder of your choice
    c. Silicon grease or thermal compound
    d. Digital camera to document your progress
3) If the pots supplied with your kit have small metal tabs, break them off using needle nose pliers. Your pots may or may not have the nut and washer installed. If so, you may have an extra set of washers and nuts loose in your kit.
4) A note about resistors: kits come generally with a mix of 1% tolerance (blue body) and 5% tolerance (tan body) 1/4w resistors. In some cases, different tolerances are used and they are noted (for example, 0.1% tolerance, often black body). For purposes of these circuits there is no practical difference between the 1% and 5% tolerance resistors. In some cases, the build pictures may show one type of resistor while your kit provides another- there is no issue with using either 1%or 5% tolerance resistors.
5) A note about capacitors: kits generally come with different types of capacitors based on the requirement. Some are interchangeable, so if the capacitor in your kit does not match the picture, it is safe to assume that as long as the capacitance value is the same, it's been tested for interchangeability.
6) A note about tempco resistors: there are two different types of tempcos, the KRL/Bantry 1/4w 3500PPM, and the Ankaeohm 1/8w 3300PPM. Either may be part of your kit. They are interchangeable.

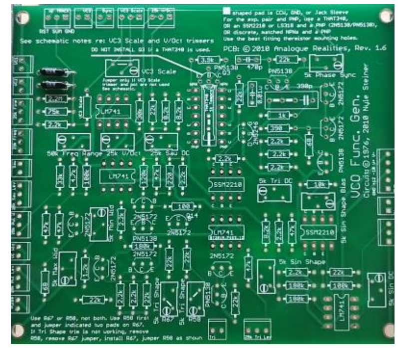


PCB Assembly Instructions

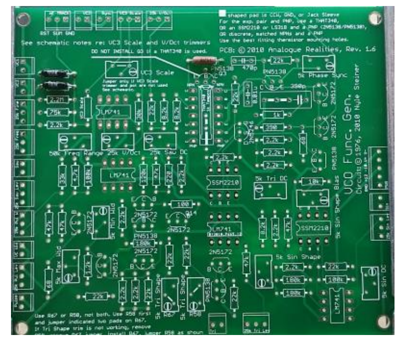
The Synthasystem VCO module consists of three PCBs—main PCB, HF Tracking PCB and Power PCB. First, we will build the Main PCB.

1. Install the resistors. First, identify and install the 0.1% tolerance 100K resistors for R37 and R38. Its good practice to install the resistors with the value label facing up for ease in troubleshooting.

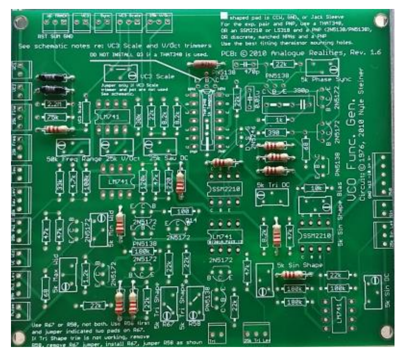




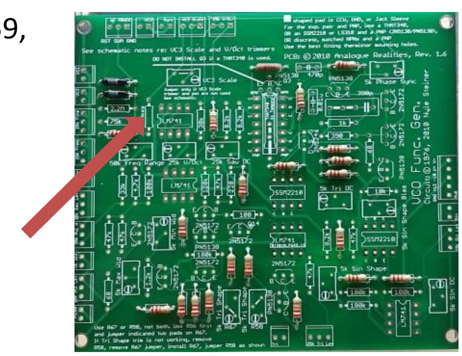
2. Install the 3.92K 0.1% tolerance resistor R3.



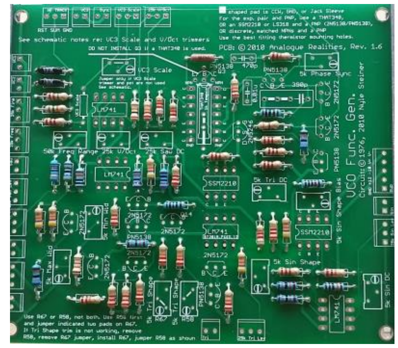
3. Install the eleven (11) 2K2 ohm resistors for R2, R4, R6, R9, R12, R16, R19, R30, R50, R68, R69. When installing color-banded resistors it is a good idea to orient them so they 'read' the same direction for easier troubleshooting.



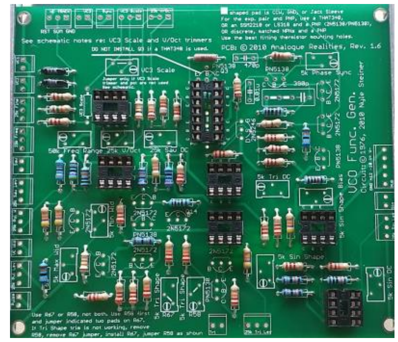
4. Install the nine (10) 22K ohm resistors for R1, R18, R29, R34, R41, R59, R60, R64, R72, R42. Note: R42 is labeled 'VC3 Scale' on the PCB



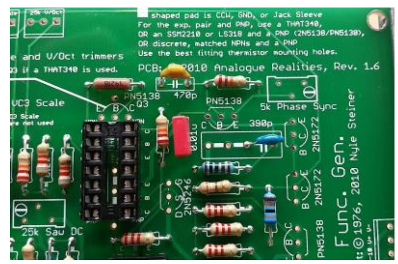
5. Install five (5) 47K ohm resistors R26, R27, R48, R57, R61; install three (3) 8K2 ohm resistors R8, R14, R56; install three (3) 180K ohm resistors R17, R62, R73; install two (2) 68 ohm resistors R7, R32; install two (2) 100K ohm resistors R22, R70
6. Install singlet resistors 390 ohm R10, 1K ohm R5, 100 ohm R15, 220 ohm R11, 120K ohm R49, 30K ohm R35, 2M2 ohm R46, 4K7 ohm R31, 1.2K ohm R24, 75K ohm R45, 33K ohm R21, 10K ohm R66.
7. If you are using water washable solder, it may be wise to stop now and wash the PCB.

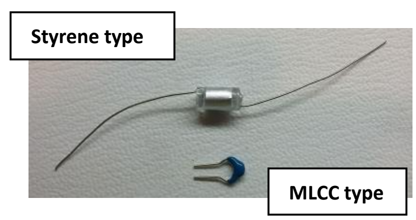


8. Install the six (6) eight-pin IC sockets and the one (1) 14-pin IC socket. Pay attention to the orientation of the indentation on the end of the socket, and align it with the silkscreen on the PCB. Reversing the socket and/or IC is one of the common issues when modules do not function. There are different ways to install the sockets but one method we find useful is to set the sockets in place, set a piece of cardboard over the sockets, and flip the assembly upside down so the cardboard holds the sockets in place. Solder one pin on each corner of each socket to hold them in place, then solder the remaining pins. DO NOT install the ICs at this time.

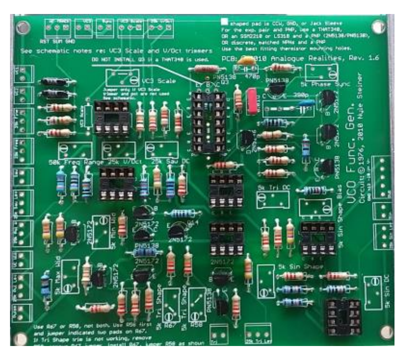


9. Install the capacitors 390pF C2, 0.01uF C1, and 470pF C3 (marked ‘471’). NOTE: your kit contains two different types of 390pF caps- the styrene version and the MLCC version. You need install only ONE in the C2 space. The styrene type is more temperature stable as specified in the BOM; however we have found them extremely sensitive3 to melting under solder heat and as a result generally use the MLCC type in its place. If you install the styrene version, and your module when completed does not deliver audio in any of the four waveforms, then the C2 cap is suspect. Note that when installing C2, the PCB layout allows for three different locations of one of the capacitor legs depending on the spacing. Be certain that one leg of your cap is installed on the right side of the double vertical lines in the silkscreen.

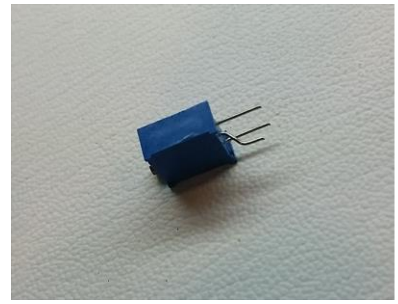




10. Install the thirteen (13) transistors. They are identified by the markings on the body. It’s helpful to slightly spread the pins out so they set in the PCB and the bottom of the case will sit just above the surface of the PCB. Be certain to orient the transistors to match the silkscreen outline; reversed transistors are a common error when modules do not function properly. Note: you will NOT install a transistor in the space marker ‘Q3’. This kit uses a THAT340 matched transistor IC which eliminates the need for Q3.



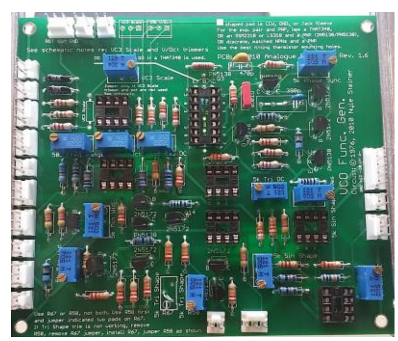
11. Install the thirteen (12) trimmer resistors. Yes, you will in fact have the opportunity to adjust each of them during calibration ☺ . Pay particular attention to the orientation of the trimmer vis a vis the silkscreen; the adjustment screw should sit atop the circle on the silkscreen. The trimmer marked ‘204’ is 200K and goes in the space marked ‘VC3 Scale’; the trimmer marked ‘503’ is 50K; the two trimmers marked ‘253’ are 25K and the remaining eight are 5K. Note: you will NOT install a trimmer in the space marked ‘R67 Tri Shape.’ Se below for the step to jumper this position. If your trimmers have the three legs in a straight line, bend the center leg as shown to fit in the pin spacing on the PCB. Like the IC sockets, we have found that setting the trimmers in place and using a flat piece of board to hold them while the PCB is flipped speeds assembly.



12. Since you did NOT install a trimmer in the space marked ‘R67 Tri Shape’ take a piece of scrap resistor lead wire and jumper R67 as shown on the PCB silkscreen.

13. For wiring the pots and jacks to the PCB, you have three choices:
    a. You can install white MTA headers and use the supplied Dupont ribbon wires and single pin black female connectors. This is the method illustrated in the pictures in this guide.
    b. You can install white MTA headers, use the supplied Dupont ribbon wires, cut off the black female connectors, and ‘punch down’ the wire ends to the supplied red MTA sockets using an MTA tool. Some believe this creates a better connection to the header than the black single-pin female connectors but requires additional work, and access to one of the MTA tools.
    c. You can wire the pots and jacks to the PCB directly. In this instance do NOT install any of the 2-pin or 3-pin MTA headers.

14. If you have decided on option 13a or 13b above, install the 2-pin and 3-pin headers. Note you will NOT install any headers in the spaces marked ‘VC3 Scale’ or ‘25K V/Oct’ because these calibration adjustments are made using the PCB trimmers, not pots. The easiest method for installing the headers is to use spring-loaded tweezers to hold the header in place while the pins are soldered.

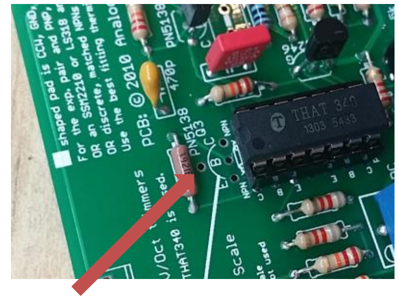


15. Next install the 5-pin 0.1 MTA header to the PCB. Note that the vertical piece of the header should be oriented to align with the double line on the PCB silkscreen. Note: if you prefer to wire the five power connections from the power PCB to the Main PCB directly, rather than using MTA headers and sockets, then do NOT install this header. If you plan to use the red MTA sockets and/or the Dupont ribbon wire female connectors for the power interconnection, then install the MTA header.

16. Wash the front and back of the PCB thoroughly if using washable solder.

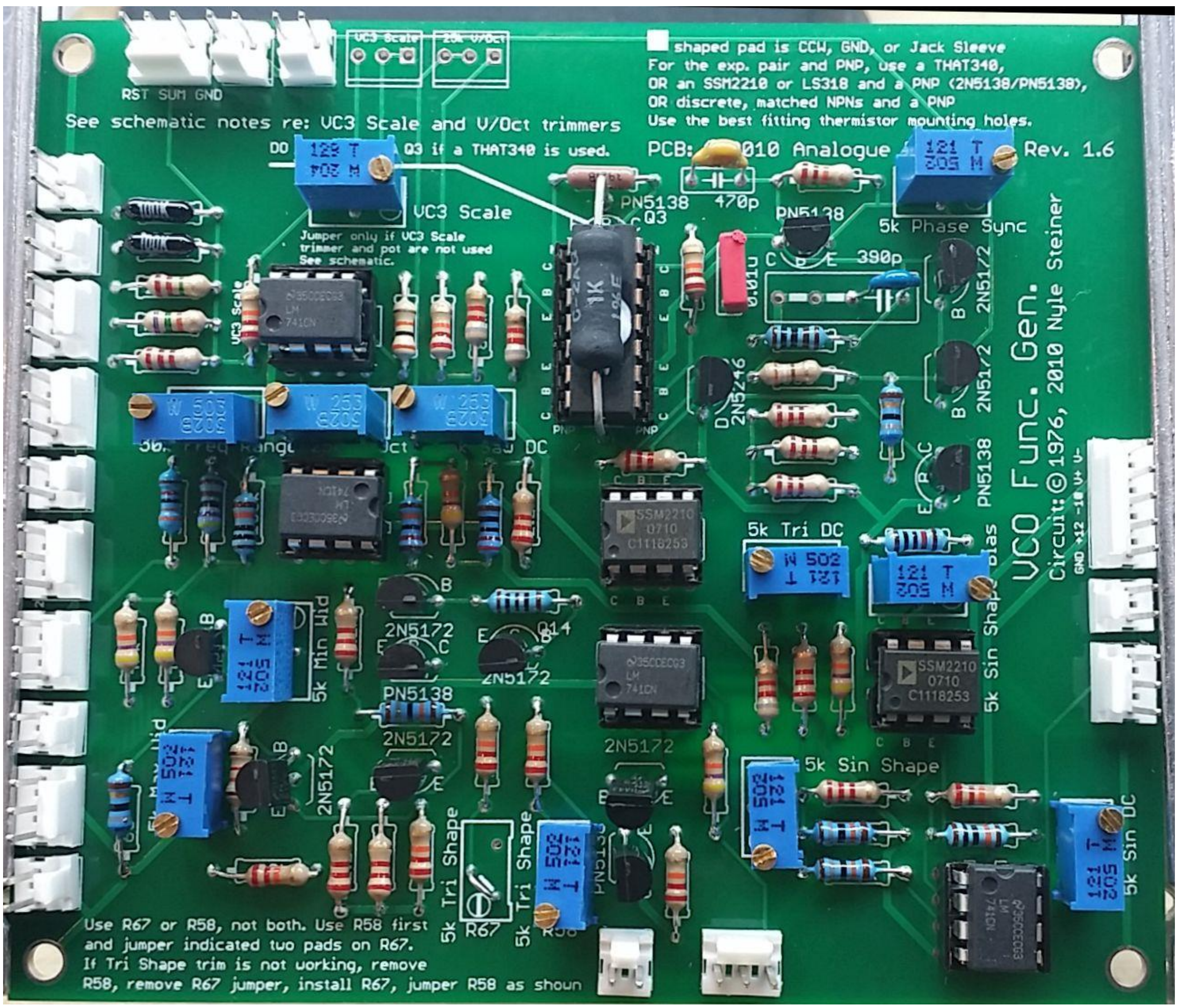
17. Insert the ICs in the sockets. Pay attention to the orientation of the IC vis a vis the socket. Use ESD protection if you have it available when handling ICs- wrist strap et al. Be especially cautious with the SSM2210- they are out of production, rare and costly.

18. The final step in assembling the main PCB is to install the tempco resistor. The tempco is installed to sit atop the THAT340IC. It must make physical contact with the IC. Use a small dab of silicon paste (thermal paste) to improve heat transfer. Note: IT IS EASY TO MISTAKE THE 'B' hole for Q3 with the correct hole for the tempco resistor. Be certain that you are installing the tempco to the correct location as shown.



19. DO NOT SKIP THIS STEP. Carefully look at each solder joint on the PCB. You are looking for joints that do not appear to be smooth, small cones- they could be cold or open solder joints which will cause trouble. Reflow any suspect joints.

20. This completes the assembly of the Main PCB. Reference photo below:



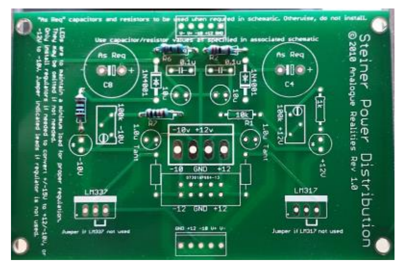
Next we will build the HF Tracking PCB.

1. Install the resistors- 8K2 ohm R2, 22K ohm R3. Install the diode D1- make certain that the black band on the diode aligns with the white stripe on the PCB silkscreen. Install the .01uF capacitor C1. Install the trimmer resistor, making sure to align the adjustment screw with the circle on the PCB silkscreen.

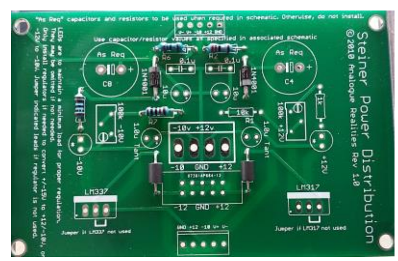
2. Wash the front and back of the PCB thoroughly if using washable solder.

3. DO NOT SKIP THIS STEP. Carefully look at each solder joint on the PCB. You are looking for joints that do not appear to be smooth, small cones- they could be cold or open solder joints which will cause trouble. Reflow any suspect joints.

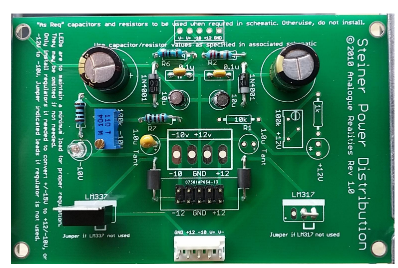
Next we will build the Power PCB.
Note: Many of the Synthasystem PCBs require the Power PCB, but the configuration can be different based on the needs of the circuit. Do NOT use these instructions for building the Power PCB for any Synthasystem module OTHER THAN the Quad VCO.
Note: Some of the components are not required and not installed for this version of the Power PCB. Pay particular attention to the location of the components per the diagrams and pictures.



1. Install the resistors. R2 and R6 are 22 ohm and are installed in the spaces marked ‘as req’ on the PCB. Install 10K ohm R7 and 1K ohm R8.



2. Install the ferrite beads and diodes. Do NOT confuse the parts- the ferrite beads have no markings on the black body, while the diodes have grey stripes. Install the diodes so the gray stripes align with the white stripe on the PCB silkscreen.



3. Install the LED. Note the orientation carefully. There is a flat spot on the LED plastic clear case that aligns with the PCB silkscreen. The long lead goes in the hole furthest away from the adjacent resistor (and next to the label ‘-10V’ on the PCB silkscreen)

4. Using a scrap piece of lead wire, jumper the location labelled ‘LM317’ on the PCB, where noted by the silkscreen ‘U’ notation.

5. Install the capacitors. C4 and C8 are the larger 105uF electrolytic caps. C2 and C6 are the 10uF electrolytic caps. Pay attention to the orientation of the ‘+’ symbol on the PCB- do NOT reverse the

polarity of the caps! Install C3 and C7, the 0.1uF MLCC caps. Install C5, the 1uF tantalum cap. Note this is a polarized cap- the ‘+’ sign on the cap has to align with the ‘+’ sign on the PCB silkscreen.

6. Install the 100K trimmer resistor. Align the adjustment screw with the circle on the silkscreen.

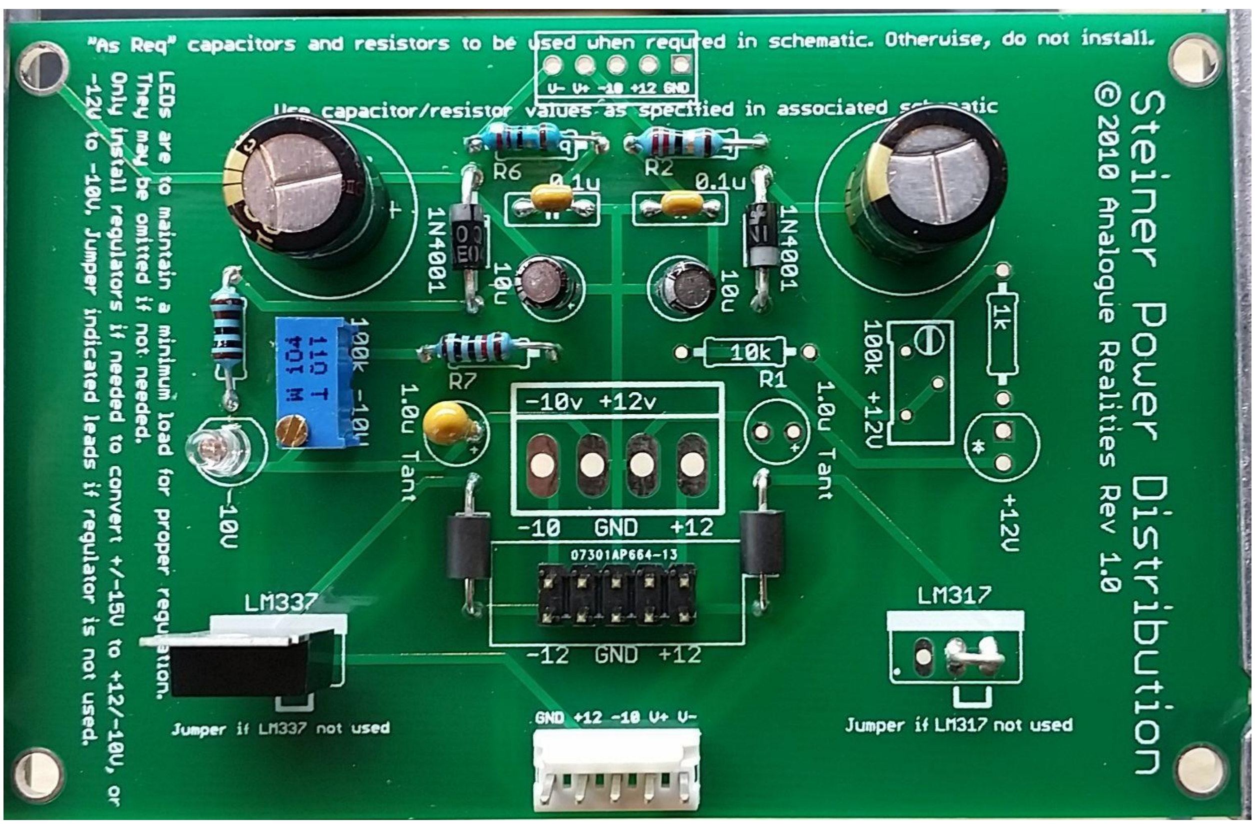
7. Install the ten-pin power header.

8. Install the five-pin power interconnect header. There are two possible locations; only one is required. We recommend using the location noted in the picture in order to use the MTA socket connector provided in the kit.

9. Install the LM337 voltage regulator. Align the heat sink (aluminum vertical panel) with the white stripe on the PCB silkscreen. You can choose to bend the regulator 90 degrees to parallel the PCB, and reduce the module depth.

10. Wash the front and back of the PCB thoroughly if using washable solder.

11. DO NOT SKIP THIS STEP. Carefully look at each solder joint on the PCB. You are looking for joints that do not appear to be smooth, small cones- they could be cold or open solder joints which will cause trouble. Reflow any suspect joints.



Euro Format Panel Assembly

1. Install the jacks to the panel. For ease in wiring, orient the jacks as shown on the Panel Diagram, with the two beveled corners pointing towards the left, when viewing the panel from the back, top up.

2. Install the pots. Orientation of the pots is a matter of preference—we like to line them up with solder lugs pointing generally in the direction of the header they are attached to, but others prefer to orient the lugs straight up or down. Peel the protective plastic cover off of the panel before installing pots and jacks. Use a soft cloth on your bench to reduce the possibility of scratching the panel.

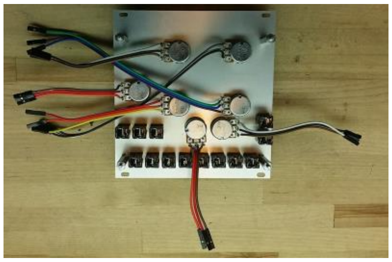
3. Install four (4) of the 1" standoffs to the panel using the black socket head screws.

4. Now we will prepare the wires for the jacks and pots. The module uses multi-color ribbon wire with DuPont connectors on each end. For each wire set, you are going to
    a. Peel the correct 2- or 3-color strip from the ribbon cable, in order of the below table
    b. Cut the 2- or 3- color strip to length
    c. Strip & tin the free ends of the 2- or 3- color strip (note: when stripping and tinning the wires for the output jacks, see the step below for instructions to strip and tin a longer-than-usual length)
    d. If you have chosen to use the red MTA sockets rather than the single-pin female connectors attached to the ribbon cable, you'll need to cut the Dupont female connectors off of the other end of the ribbon cables and punch them down to the MTA sockets in the proper orientation.
    e. Peel the ribbon wires in the order noted in the table; in this way you should use the individual wires in the color combinations noted.

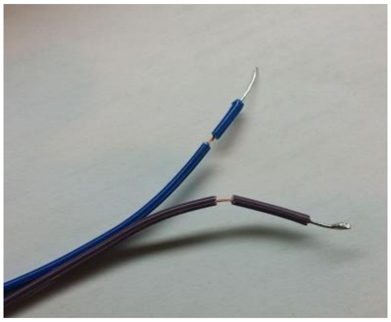
Function	**Colors**	**Length**
Pulse Width Pot	BLK/WH/GRY	7"
Saw Level Pot	PUR/BLU/GRN	7"
Pulse (Sq) Level Pot	YEL/OR/RED	5"
Frequency Pot	BRN/BLK/WH	4"
Sine Level Pot	BRN/BLK/WH	4" (other half of Freq Pot wire)
Fine Freq Pot	OR/RED/BRN	3"
Triangle Level Pot	OR/RED/BRN	3" (other half of Fine Freq pot wire)
n/a	GRAY	Single strand- spare
HF Track	PUR/BLU/GRN	Full length
Power	Y/OR/R/BRN/BLK	Full Length (see note 1 below)
Saw jack	W/GRY	7"
VC3	PUR/BLU	6"
Phs Reset Jack (Synch)	GRN/Y	7"
Pulse Width CV Jack	O/R	8"
Sin Jack	BRN/BLK	6"
VC1 Jack	WH/GRY	6"
VC2 Jack	PUR/BLU	5"
Pulse (Sq) Jack	PUR/BLU	4" (other half of VC2 Jack wire)
Triangle Jack	Y/GRN	4"

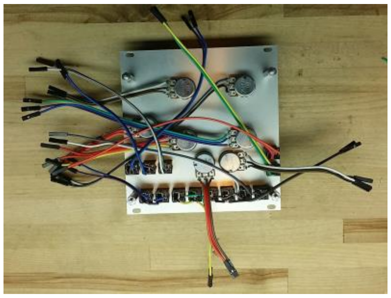
Note 1 – the Y/Or/R/Brn/Blk ribbon cable is provided in case you choose to connect the Power PCB to the Main PCB this way rather than the supplied MTA cable/socket assembly

5. Next we will solder the pot wires to the pots. For the pots, make a j-hook, attach the wire to the lug and solder.

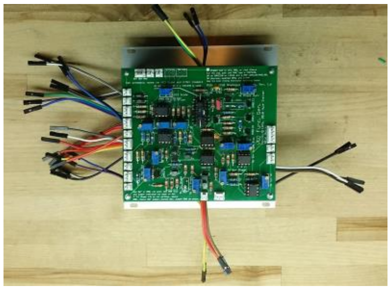


6. For the jacks associated with the audio outputs, you can create a special end to the wire in order to simplify the wiring of the two jacks associated with each output:
    a. Strip and tin the wires using a longer length at the stripped end of the wire than usual
    b. Using your wire stripper, cut through the insulation about ½" above where it ends
    c. With needle nose pliers carefully grip the clipped end of the insulation and slide it towards the end of the wire, exposing a short section of wire
    d. Tin this exposed section of wire
    e. When you solder these wires to the output jacks, the end of the wire will get soldered to one jack while the exposed section will get soldered to the second output jack for that waveform
    f. Alternate: if you would rather not strip the output jack wires in this way, you can solder one output jack lug to the other, then connect the output jack wire to one jack. The end result is the same—one output jack wire soldered to both output jacks.



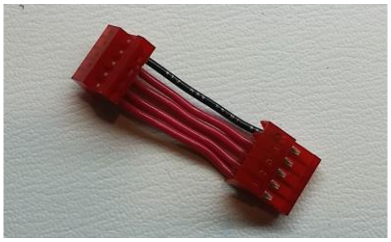


7. When all of the jack and pot wires are soldered, lay them out flat to the side towards where they will attach to the PCB. Set the Main PCB on the four standoffs and attach it using one #4 nut.



8. Attach the pot and jack wires to the headers on the Main PCB, Confirm that the colors match the diagram as a check against how the pots and jacks were wired. When you attach the female connectors to the headers, orient the connectors so the notch fits against the vertical latch on the header.

9. Attach the 5-pin MTA power cable assembly to the 5-pin header on the main PCB (or alternatively, use the 5-wide ribbon wire Y/OR/RED/BRN/BLK)

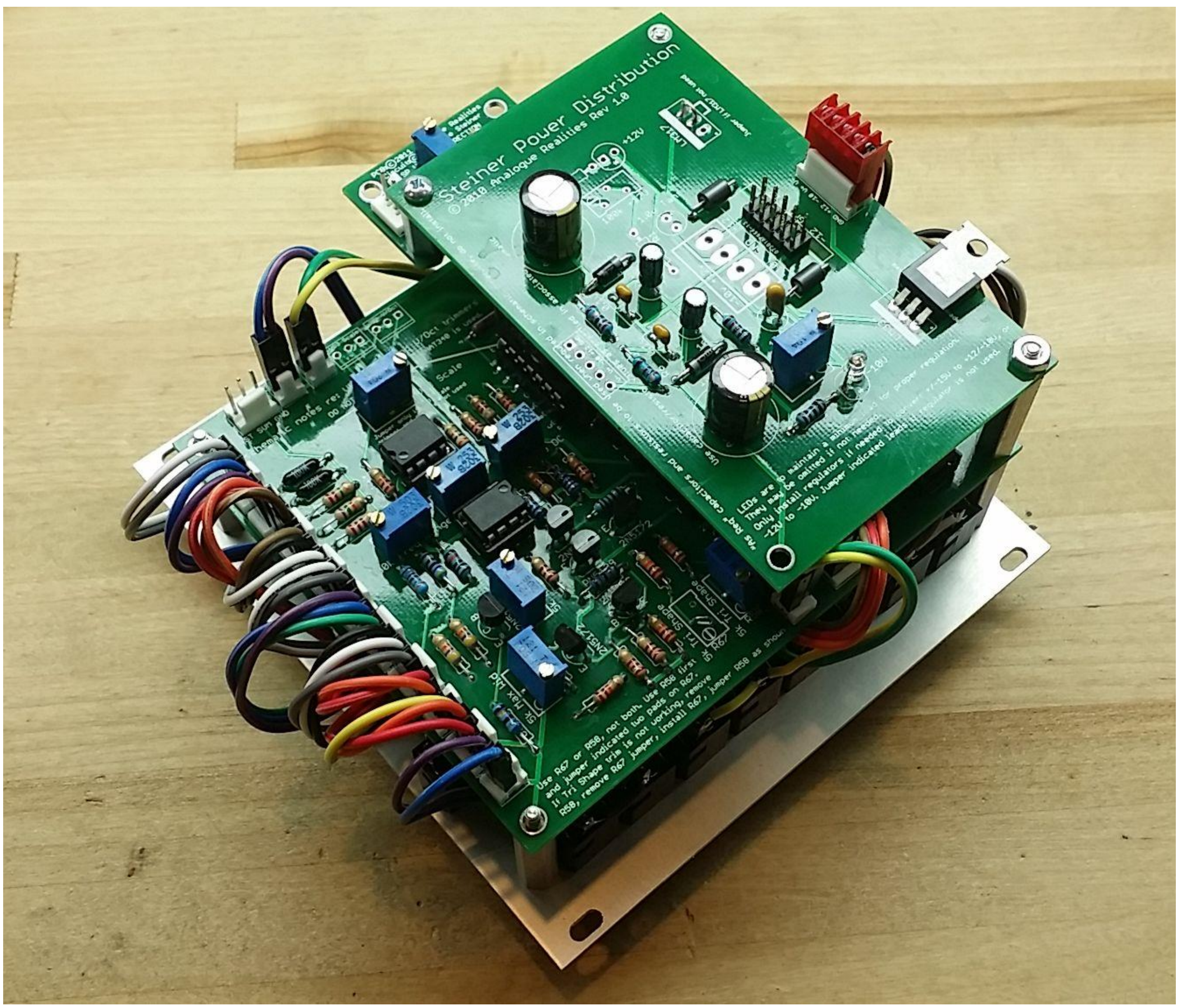


10. Install the remaining two 1" standoffs to the right side of the main PCB, when viewed from the back. This will be where the Power PCB is mounted.

11. Install the ½" standoff to one corner of the Power PCB as shown. Then attach the HF Corr PCB to this standoff as shown. Use the ½: standoff, one #4 nut and the #4 machine screw. Do not confuse the #4 machine screw with the M3 panel mounting screws.

12. Set the Power PCB on the two 1" standoffs. Connect the power interconnect assembly (or 5-ribbon wire) to the Power PCB. You should be able to lift it off of the standoffs and move it up and out of the way to reach the trimmers on the main PCB.

13. Connect the ribbon wire to the HF Corr PCB- Main PCB. Do not install the nuts to fully mount the Power PCB yet, as you will need access to all of the trimmers for calibration before the Power PCB is fully seated. Your module is now ready for power up testing and calibration.



Calibration

Take some time to review the calibration instructions. When you first power on the module, the blue LED should light. If you see or hear anything out of the ordinary turn off the power immediately. If all appears OK, adjust the trimmer on the Power PCB to deliver -10V exactly.

The original notes from David Ingebretsen re: calibration:

"There are a lot of trimmers on this PCB, and that is without apology. They aren't really difficult to setup, but it will take a little time. You will need a good voltmeter and an oscilloscope.
The Phase Sync, Sawtooth, Triangle, and Sine adjustments all interact and you may want to do them a couple of times until you get the desired results.

Phase Sync

1. First, set R52, Frequency Range, close to fully CW (clockwise) (if you don't hear a sound, turn R52 more CW until you hear something). Set R33 or R36, the V/Oct Trimmer (whichever you chose to use) to mid point.
2. Connect an oscilloscope to the saw output.
3. Adjust R52 until you hear/see an output. Something in the hundreds of Hertz will be fine for now.
4. Turn R39 Phase Sync clockwise (towards +12 volts) until the spike on the trailing edge disappears, then just a bit more. (you may also have to adjust R44 here to get the waveform into a useable range). This will also dramatically reduce or eliminate the little spike on the triangle wave, too. In practice, you should be able to eliminate this spike.

Sawtooth Offset

Next, adjust the sawtooth offset to balance the waveform around 0 VDC, R44.

Pulse Width Minimum/Maximum

Next, we will adjust the Pulse Width Minimum and Maximum.

1. Set R28 toward the counterclockwise side, not necessarily full.
2. Set R23 to mid point.
3. Connect an oscilloscope to the Pulse output.
4. Turn the Pulse Width knob fully counterclockwise. That is, ground the input. You want Q12 to be off. If you want, take a clip lead and short the base of Q12 to the emitter of Q12 to make sure it is off.
5. Looking at the scope, turn R28, Maximum Width, until you get a very narrow pulse. No specific width, just what you want.
6. Remove the clip lead on Q12 if you put it on.
7. Turn the Pulse Width knob fully clockwise. As a check, you should have about 5 volts or a little more on on the wiper.
8. Adjust R23 to get a small pulse on the output. If you want, you could adjust R23 to get a 50% duty cycle square wave.

If you are having trouble getting a narrow pulse with R23, you can vary the value of R21 to get at least 5 volts on the wiper at full clockwise rotation of the Pulse Width knob, R25.

You might also want to adjust these trimmers to give a 50% duty cycle at some particular spot on the PW control, too. Maybe use a pot with a detent in the middle and set these trimmers to give you a 50% duty cycle at the detent spot.

Triangle Shape

Lets move on to the triangle wave.

1. Connect a scope to the triangle output.
2. Turn the offset to mid point, or to where you can see the triangle wave. We'll come back to this trimmer.

3. You should have installed R58 to start with, and a jumper at R67.
4. Adjust R58 until the wave looks like a triangle with the two sides meeting at the top.
5. If you can't get the two sides to meet, uninstall R58 (disconnect the power first, really, do I need to say this :))
6. Uninstall the jumper at R67.
7. Install a 5K trimmer at R67 (maybe the one you uninstalled unless you ruined it like I've done a few times).
8. Install a jumper at R58 so that R59 connects to +12 VDC, pin 3, as indicated on the PCB.
9. Repeat the above calibration on R67 and it should work.

Triangle Offset

Easy one, turn R55, Triangle DC, to balance the Triangle wave around 0 volts. Remember to have your scope on DC coupled. Yes I have made this mistake, too :)

Sine Shaping

Nyle found that there are two spots where you will get a sine wave. One gives a very nice looking sine wave with an output of about 12 VPP give or take. The sine wave in the other spot is not as good. It has some weird distortion on the lower peak. The output is also closer to 19 VPP.

Here are Nyle's notes:

Funct. Gen. Sine can adj. in two modes, lousy waveform or good waveform.

1. *Start sine shape half way. Sine shape bias all was CCW*
2. *Put scope on sine output and adj. offset and fine tune sine shape.*

(Scope on collector and 47k Resistor)

(Here, Nyle is referring to teh 47k resistor to the left of the SSM2210 in the lower right corner of the PCB which makes up the NPN pair in the sine shape circuit. Put the scope on the top leg of the resistor).

Note: if sine shape bias pot is too far CW the sine wave can adjust in another mode with poor shape on teh bottom adn will be at 20 VPP.

When properly adjusted, sine on output (level pot fully CW) shoud be about 12 VPP.

Thank you Nyle.

Sine Bias

Connect a scope to the Sine output.

1. Adjust R71, Sine Shape Bias, until the sine wave is a little pointy on the bottom.

Sine Shape

This adjustment can be subjective to a point. If you want, you can just adjust R63, Sine Shape, until it just sounds good. If not, follow these instructions.

1. Connect a scope to the Sine output.
2. If you want to, set your scope to FFT mode.
3. Adjust R63 to get a smooth Sine wave, OR
4. Adjust R63 to minimize the harmonics in the FFT.

I've found in my calibration that often, I don't see anything on the Sine output to start. I found if I adjust the Since Shape Bias to about midpoint, adjust the offset to midpoint, and Sine Shape to CW then turn the Sine Shape trimmer CCW, I'll find the distorted sine wave. You will have to alternate between the DC Offset, Bias, and Shape to get the wave you want. Turning the Shape and Bias CW makes the sine wave more square. Turning them CCW makes the sine wave more of a triangle.

Sine Offset

Easy one again. Adjust R74, Sine DC, to get a balanced waveform around 0 volts.

Having done all this, I suggest you play with the Phase Sync, Triangle Shape, and Sine Shape til you get things sounding and looking the way you want. These controls all interact and it pays off in the end if you experiment with them.

V/Oct

The V/Oct calibration sets up the VCO to give a doubling in frequency for each change in CV of one volt. This is the current industry standard and has been for several decades. The saw core used in this VCO is similar to many if not most other VCO designs in use today. There is a common problem in this design in which the 1 V/Oct tracking becomes increasingly flat as the frequency of the oscillator core increases. Therefore, if this tracking error is objectionable, it needs to be corrected. Nyle proposed two different methods for his VCO. Both can be added, but the first way is least invasive as it only requires the addition of a few components and only requires the soldering of three wires to the original PCB. The second method uses fewer components, but requires cutting traces and so becomes more invasive to implement. Since method 2 has no inherent advantage over method 1, method 1 was implemented and is described here.

There are two schematic on this page which show the two methods and how they connect to the saw core.

First Step: SETUP

1. You need a control voltage source which will give you a selectable voltage output and a range comparable to that which you use to play the synthesizer.
2. Turn the HF correction trimmer fully counterclockwise. That is, to ground.
3. Connect this voltage source to a VC input (not usually VC 3)
4. Input a known voltage like 0 or 1 volt.
5. Set the pulse width to something like a 50% duty cycle.
6. Connect a frequency counter to the pulse output, or if you have a good ear, connect the output to headphones or a speaker.

Second Step: THE TUNING

1. Press a "low" key, a control voltage around 0 to 1 volt, and tune the Frequency and Fine Frequency knobs to a desired pitch. A good start is around 100 Hz.
2. Input a voltage twice or four times as great (following a 1 volt per octave scale). I suggest one or two octaves higher.
3. Adjust R36 (on the PCB if used) or R33 (on the panel if used) to get the proper tracking. Clockwise on R36 will increase the spread, CCW decreases it. That is, if your low frequency is 200 Hz and your high frequency is 796 Hz, turn R36 CW. Likewise, if your low frequency is 200 Hz and your high frequency is 807 Hz, turn R36 CCW. The oscillator frequency will change when you turn R36. Don't worry about it, this is normal.
4. Re-input the first voltage. Now, you can either a) reset the Frequency / Fine Frequency to get your original pitch and repeat, or b) just note the new low frequency and multiply it by 2 for one octave, 4 for two octaves, 8 for three octaves, etc. to get the new target pitch for the high end.
5. It should only take 4 or 5 repetitions or so to get pretty good tracking.

Third Step: HIGH FREQUENCY TRACKING

1. Now, hit the highest note on your voltage source and see how close you are to the proper frequency (4 or 5 octaves higher is pretty good). You will almost certainly be low. Turn the HF correction trimmer clockwise. About half way is a good start. This will probably overshoot your target frequency. Go back to step 1 in the "Second Step", then repeat steps 1 through 5 for the V/Oct trimming because adjusting the HF Correction trimmer will affect the V/Oct. When you get good low frequency tracking, 1 or 2 octaves at about 100 to 200 Hz, then re-do the "Third Step" section until you get the desired HF tracking.

Repeat the "Second Step" and the "Third Step" until you get good low and high end tracking.

Doing this, I was able to achieve excellent tracking over 5 octaves at least. I ended up setting the HF trimmer a little more than half way.

Frequency Range

This adjustment was not present in the original module and the original VCOs did not have a V/Oct adjustment. The tracking was set by a knob on the keyboard. This established the tuning for the master VCO. Other VCOs had a trimmer which changed the summing resistor value to match the tracking for the master VCO. Sort of what the VC VAR on the VC3 input can do.

When building this new release, I knew that with modern controllers, there needed to be a way to tune each oscillator to a standard, not to each other. Nyle helped decide on the V/Oct tuning method and values and I decided there needed to be an adjustment for the frequency range to allow the user to set a useable frequency span. I really hated making these changes, because I didn't want to change a thing on Nyle's designs. But, since Nyle was very involved in testing and tweaking these new releases, I was placated and I'm very happy with the result.

If these modules were only going in my own system, I don't think I would have changed a thing. But since I wanted these to get out to the community and Nyle was very supportive of that idea, it was clear some modifications needed to be made.

On with the last trimmer!

1. Input the lowest voltage you will use with the VCO. Typically 0 volts but it can be a negative voltage, too.
2. Connect a frequency counter, scope, or some other indicator (I used my Blacet bar graph)
3. Turn the Frequency fully counterclockwise.
4. Turn the Fine Frequency to mid point.
5. Adjust R52 to output the lowest pitch you want to use.
6. Input the highest voltage you will use.
7. Turn the Frequency knob fully clockwise.
8. Listen to or look at the output pitch and make sure you can output the highest pitch you will want.

Turning R52 CW will increase the lowest and highest frequency you can use and CCW lowers it. You can also play around with the value of R50. Increasing it will shift the adjustable range higher and lowering it will shift it lower.

You should be able to go from fractions of a Hz, to above hearing. Understand you may not have the voltage span on your controller to get this whole range without changing the Frequency control's setting. The utility is that the VCO can be used for LFO applications and/or regular audio settings, or for annoying the neighbor's dog at the really high frequencies :) (C'mon, it's a joke...)”

Additional notes from synthCube re: calibration

1) It’s important to set all the trimmers to a ‘standard initial setting’ in order to hear audio when the module is initially powered on. We set trimmers roughly this way to start:
    a. HF Trimmer- Full CCW
    b. Freq Range- Full CW
    c. V/Oct Tracking- halfway between CW and CCW
    d. Saw Offset- halfway between CW and CCW
    e. Pulse Width Max- full clockwise less ten turns
    f. Pulse Width Min- halfway between CW and CCW
    g. Tri Shape- halfway between CW and CCW
    h. Tri Offset- halfway between CW and CCW
    i. Sine Offset- halfway between CW and CCW
    j. Sine Shape Bias- halfway between CW and CCW

k. Sine Shape- halfway between CW and CCW
l. V3 Adj- halfway between CW and CCW

If the trimmers are set out of range, the module can be silent, so if you power up the module the first time and hear nothing, don't panic. It may be a combination of trimmer settings that need to be adjusted.

There is a lot of interaction between the synch (phase reset) and pulse width min/max trimmers. If you find that the pulse width pot has limited effect towards the CW position, try moving the phase reset trimmer further CW. We have found that the phase reset, pulse width max, and pulse width min have to be adjusted at the same time for optimal results.

Common trouble spots in PCB assembly:

- Make sure your trimmers are oriented the right way. Its easy to reverse them.
- Make sure your transistors are oriented the right way.
- Doublecheck the orientation of your IC sockets and ICs.
- It is easy to solder one end of the tempco resistor into the 'Base' pad for Q3 rather than the tempco pad. Watch for this.
- C2 (390pf cap) is a difficult value to locate. If you use a styrene cap, be extra careful when soldering- it melts easily. If your module is silent upon powering up, and all the voltages check OK at the ICs, its possibly a bad C2 causing the issue. We changed from styrene to MLCC caps in assembled modules and kits as a result of this difficulty.

Final Module Assembly

Once the module is calibrated and tuned, you are ready to complete the assembly. Place the Power PCB back on the two 1" standoffs. Attach the Power PCB to the standoffs using two of the #4 nuts, and attach the Main PCB to the other standoffs using the remaining #4 nuts. If you like, straighten your wire runs and use cable ties to clean up the assembly. Attach the knobs to the pots, and the power cable to the power header.

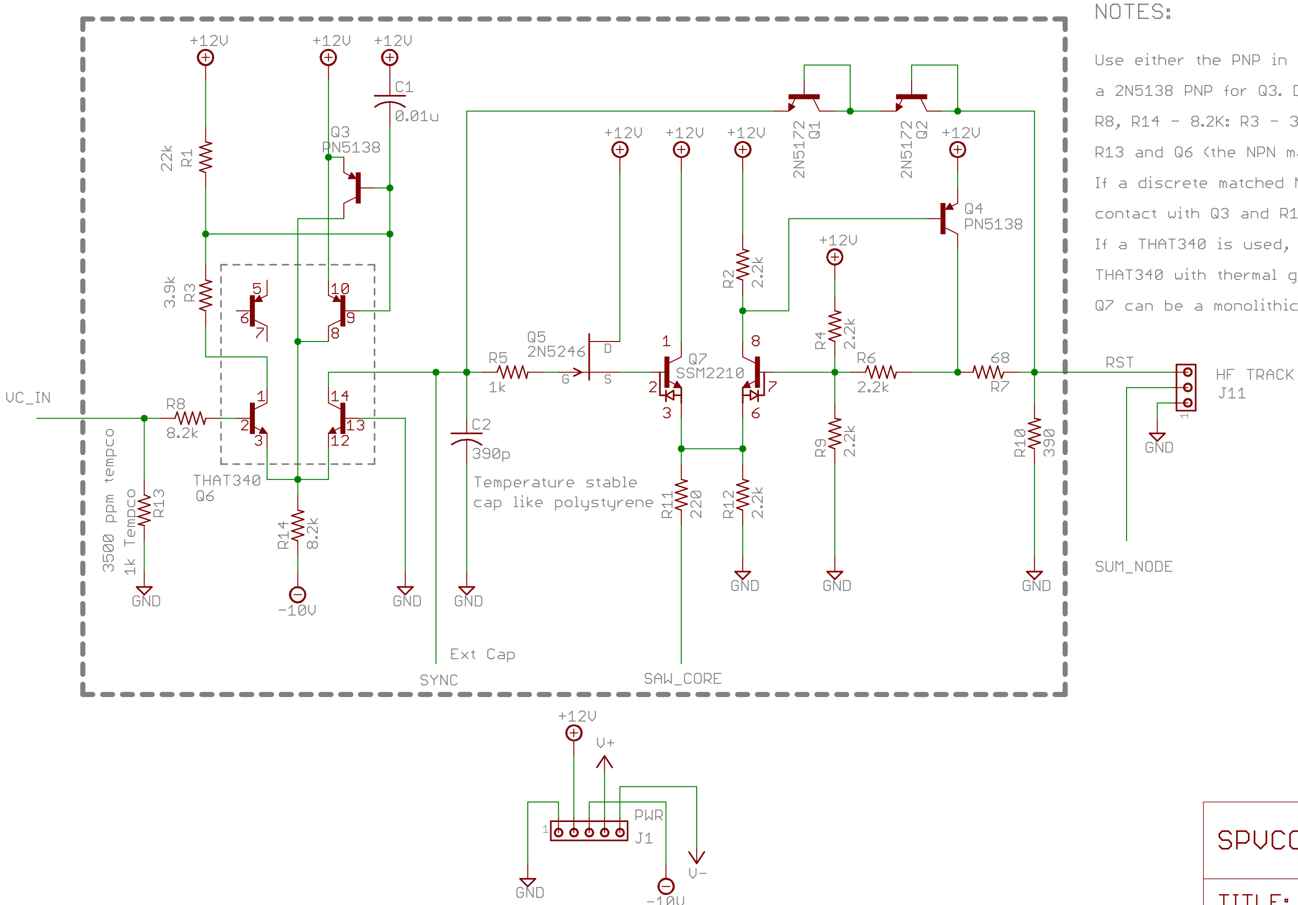
Synthasystem Quad VCO- Main PCB					
Short Description	**Value**	**Unit**	**Quant**	**Part Notes**	**Ref Designator**
Multilayer Ceramic Cap .01uF	0.01	uF	1		C1
Styrene Cap 390pF	390	pF	1	higher temp stability but sensitive to solder heat	C2
MLCC Cap 390pF	390	pF	1	can be used in place of styrene cap	C2 alternate
Multilayer Ceramic Cap 470pF	470	pF	1		C3
LM741 Op Amp			4		IC1, IC2, IC3, IC4
SSM2210 Supermatched Transistor IC			2		Q7, Q17
8 Pin IC Socket			6	socket	
2N5172 NPN Transistor			8		Q1, Q2, Q9, Q10, Q11, Q12, Q14, Q16
PN5138 PNP Transistor			4	Q3 omitted due to THAT340	Q4, Q8, Q13, Q15
2N5246 JFET Transistor			1		Q5
THAT340 Transistor Array			1		Q6
14 Pin IC Socket			1	socket	
Metal Film Resistor 3.92Kohm 0.1%	3.92	kOhm	1		R3
Metal Film Resistor 22Kohm 1%	22	kOhm	9		R1, R18, R29, R34, R41, R59, R60, R64, R72, R42
Metal Film Resistor 2.2Kohm 1%	2.2	kOhm	11		R2, R4, R6, R9, R12, R16, R19, R30, R50, R68, R69
Metal Film Resistor 1Kohm 1%	1	kOhm	1		R5
Metal Film Resistor 68ohm 1%	68	Ohm	2		R7, R32
Metal Film Resistor 8.2Kohm 1%	8.2	kOhm	3		R8, R14, R56
Metal Film Resistor 390ohm 1%	390	Ohm	1		R10
Metal Film Resistor 220ohm 1%	220	Ohm	1		R11
Metal Film Resistor 100ohm 1%	100	Ohm	1		R15

Synthasystem Quad VCO- Main PCB					
Metal Film Resistor 180Kohm 1%	180	kOhm	3		R17, R62, R73
Metal Film Resistor 33Kohm 1%	33	kOhm	1		R21
Metal Film Resistor 100Kohm 1%	100	kOhm	2		R22, R70
Metal Film Resistor 100Kohm 0.1%	100	kOhm	2		R37, R38
Metal Film Resistor 1.2Kohm 1%	1.2	kOhm	1		R24
Metal Film Resistor 47Kohm 1%	47	kOhm	5		R26, R27, R48, R57, R61
Metal Film Resistor 4.7Kohm 1%	4.7	kOhm	1		R31
Metal Film Resistor 10Kohm 1%	10	kOhm	1		R66
Metal Film Resistor 30Kohm 1%	30	kOhm	1		R35
Metal Film Resistor 75Kohm 1%	75	kOhm	1		R45
Metal Film Resistor 2.2Mohm 1%	2.2	mOhm	1		R46
Metal Film Resistor 120Kohm 1%	120	kOhm	1		R49
Trimmer Vert Adj 50K	50K		1		R52
Trimmer Vert Adj 25K	25K		2	v/oct	R44, R36
Trimmer Vert Adj 5K	5K		8		R23, R28, R39, R55, (R58 OR R67), R63, R71, R74
Trimmer Vert Adj 200K	200K		1	vc3 scale	R40
0.1 Header 2P Friction Lock	2		9		
0.1 Header Socket 2P Red	2		9		
0.1 Header 3P Friction Lock	3		8		
0.1 Header Socket 3P Red	3		8		
0.1 Header Socket 5P Red	5		2	power cable	
0.1 Header 5P Friction Lock	5		1	power header on PCB	
1K Tempco Resistor			1		R13
PCB			1		

Synthasystem Quad VCO : HFC PCB					
Short Description	**Value**	**Unit**	**Quant**	**Part Notes**	**Ref Designator**
Multilayer Ceramic Cap .01uF	0.01	uF	1		C1
Metal Film Resistor 22Kohm 1%	22	kOhm	1		R3
Metal Film Resistor 8.2Kohm 1%	8.2	kOhm	1		R2
1N4148 Signal Diode			1		D1
Trimmer Vert Adj 25K	25K		1		R1
0.1 Header 3P Friction Lock	3		1		J1
0.1 Header Socket 3P Red	3		1		J1
PCB			1		

Synthasystem Quad VCO- Power PCB					
Short Description	**Value**	**Unit**	**Quant**	**Part Notes**	**Ref Designator**
Tantalum Cap 1uF	1	uF	1		C5
Electrolytic Cap 10uF	10	uF	2		C2, C6
Electrolytic Cap 150uF	150	uF	2		C4, C8
Multilayer Ceramic Cap .1uF	0.1	uF	2		C3, C7
1N4001 Rect Diode			2		D2, D4
3mm Short Lens Blue LED			1		D3
Linear Regulators -1.5A Neg Adj Vol Reg			1		IC2
VERT BRKAWAY HDR 10P dual row tin			1		J2
0.1 Header 5P Friction Lock	5		1		J3, J4
EMI Filter Beads, Chokes & Arrays			2		L1, L2
Metal Film Resistor 10Kohm 1%	10	kOhm	1		R7
Metal Film Resistor 1Kohm 1%	1	kOhm	1		R8
Metal Film Resistor 22 ohm 1%	22	Ohm	2		R2, R6
Trimmer Sealed Multi Turn 100K	100K		1		R5
PCB			1		

Synthasystem Quad VCO- Panel Parts				
Short Description	**Value**	**Quant**	**Part Notes**	**Ref Designator**
16mm pots 25K linear solder lug, solid shaft	25	7		
3.5mm jack	JACK	13		
Knob- large 33.3mm	KNOB	2		
Knob- small 13mm	KNOB	4		
Knob- med 19.8mm	KNOB	1		
Panel- clarke68	PAN	1		
Panel Screws M3X.5X6mm Pan	HDWR	4		
1" aluminum standoffs	HDWR	6		
1/2" aluminum standoffs	HDWR	1		
Ribbon Cable (40)		1		
4-40 x 1/4 Socket Head Cap Screw Stainless Steel Black Oxide	HDWR	4		
#4-40 Nuts- standoffs	HDWR	7		
10-16 power cable, euro	PWR	1		



NOTES:

Use either the PNP in the THAT340 or matched NPNs for Q6 and a 2N5138 PNP for Q3. DO NOT INSTALL Q3 IF A THAT340 IS USED!

R8, R14 - 8.2K: R3 - 3.9K: R1 - 22K use RN55E, 0.1% if desired.

R13 and Q6 (the NPN matched pairs) and Q3 should be in thermal contact.

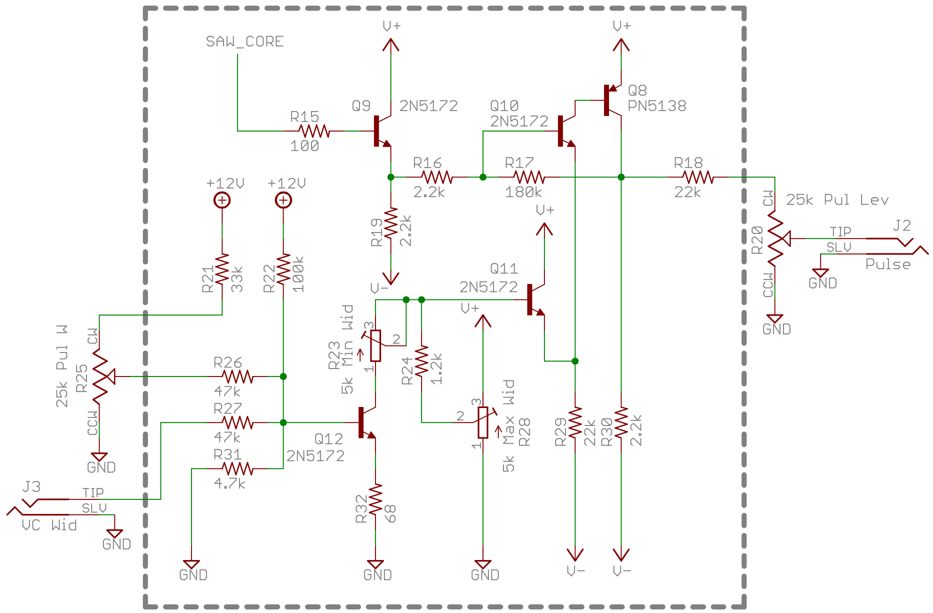
If a discrete matched NPN pair is used, be sure the pair is in physical and thermal contact with Q3 and R13.

If a THAT340 is used, Q3 is not installed and mount R13 over the top of the THAT340 with thermal grease.

Q7 can be a monolithic pair like SSM2210 or matched/unmatched NPNs

The VCO uses all the power connections. Use 150u electrolytics and 22 ohm resistors on the Power PCB as noted.

SPVCO_A_1.6	
TITLE: Voltage Controlled Oscillator	
Document Number:	REV:
Date: 3/22/2011 12:58:53 AM	Sheet: 1/4



Set min/max wid:

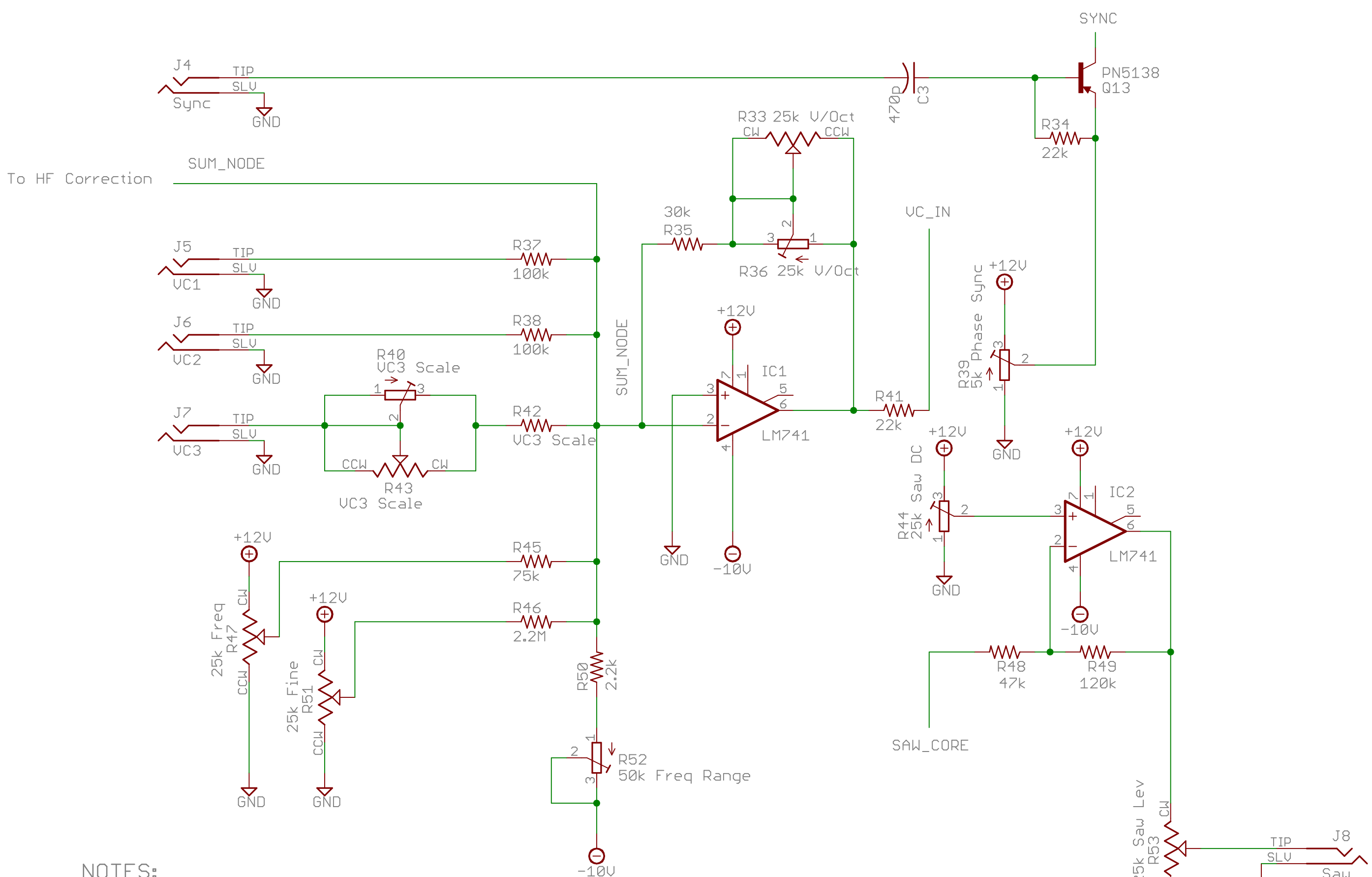
1. Turn PW full CCW. (Make sure Q12 is off. Short base to emitter if you want to be sure).

2. Adjust R28 towards the positive supply (CW) until a minimum pulse width is achieved

3. PW knob full CW, (unshort Q12 if needed). Adjust R23 for minimum width

Changed R21 from 68k to 33k to put 5 Volts on wiper when full CW.

SPVCO_A_1.6	
TITLE: Voltage Controlled Oscillator	
Document Number:	REV:
Date: 3/22/2011 12:58:53 AM	Sheet: 2/4



NOTES:

All 100K input resistors should be matched to 0.1% or better to match the V/Oct response for all inputs

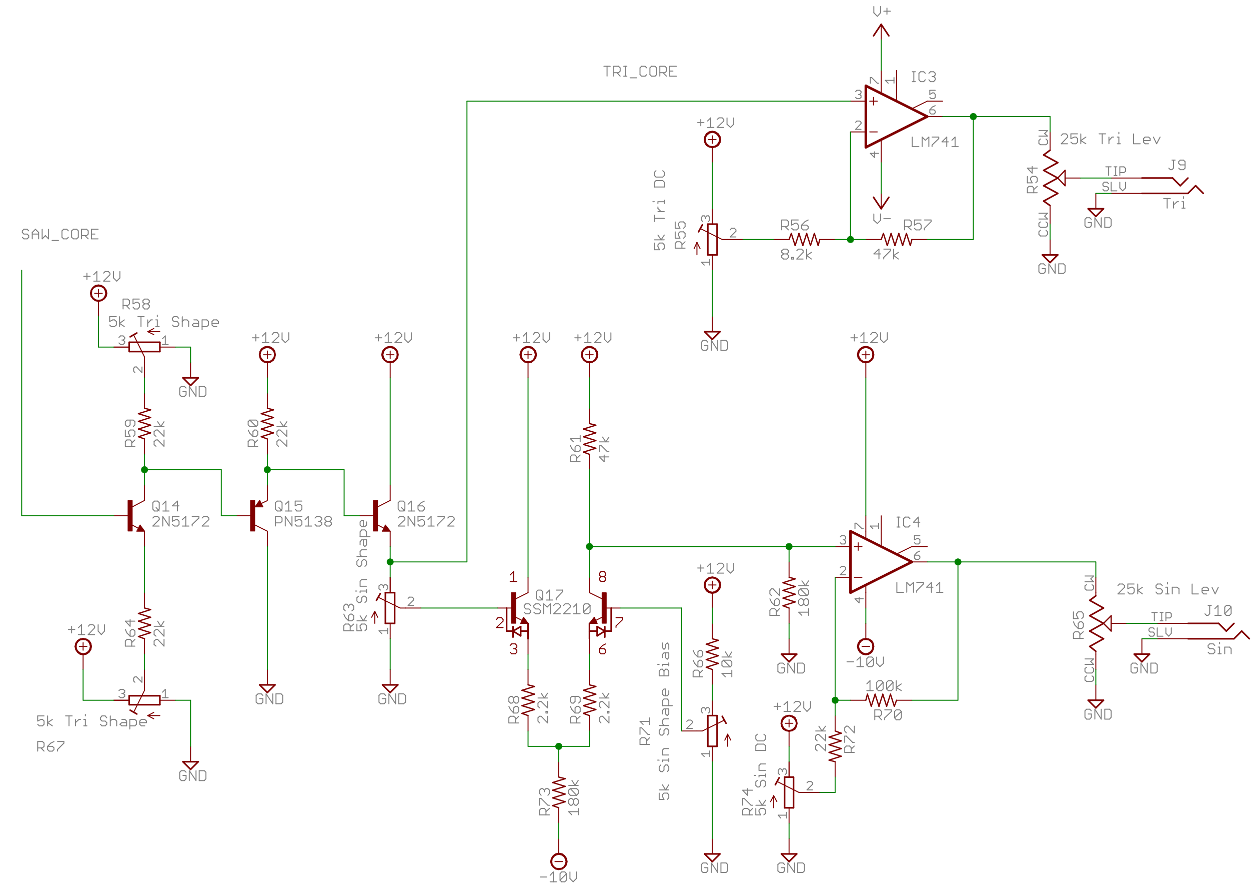
Install either R33 or R36, not both. R33 is for a panel mount trimmer. R36 is if you want the trimmer on the PCB.

Install either R40 or R43, not both. R43 is for a panel mount trimmer. R40 is if you want the trimmer on the PCB.

R40 or R43, and R42 are selected as wanted. R42=22k and R40 or R43 = 200k are a starting point. Choose these values to allow this input to tune to the desired scale with respect to the other two inputs.

If you don't want a variable scale on VC3, install a matched 100k resistor in R42 and jumper either R40 or R43.

SPVCO_A_1.6	
TITLE: Voltage Controlled Oscillator	
Document Number:	REV:
Date: 3/22/2011 12:58:53 AM	Sheet: 3/4



For normal building, install R58 and do not install R67 (trimmers). Install a jumper between pins 1 and 2 on R67's footprint.

That is, R64 should connect to ground in a normal build.

If triangle shape can't be adjusted with R58, uninstall R58 and install a jumper between pins 2 and 3.

That is, R59 should connect to +12V

Uninstall the jumper at R67 and install R67 instead. Adjust the triangle shape with R67.

Q17 can be a monolithic pair like SSM2210 or matched/unmatched NPNs

SPVCO_A_1.6	
TITLE: Voltage Controlled Oscillator	
Document Number:	REV:
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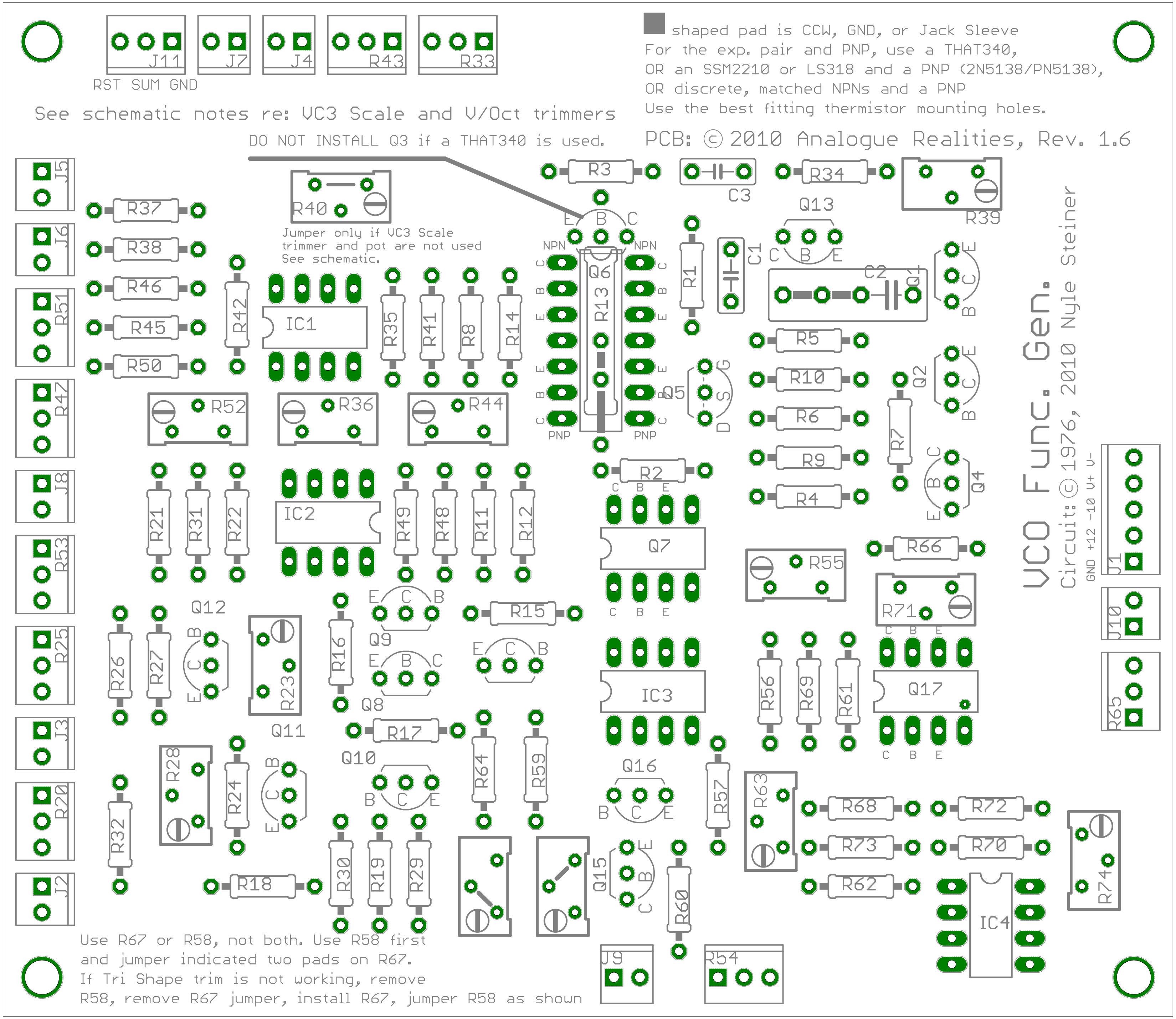
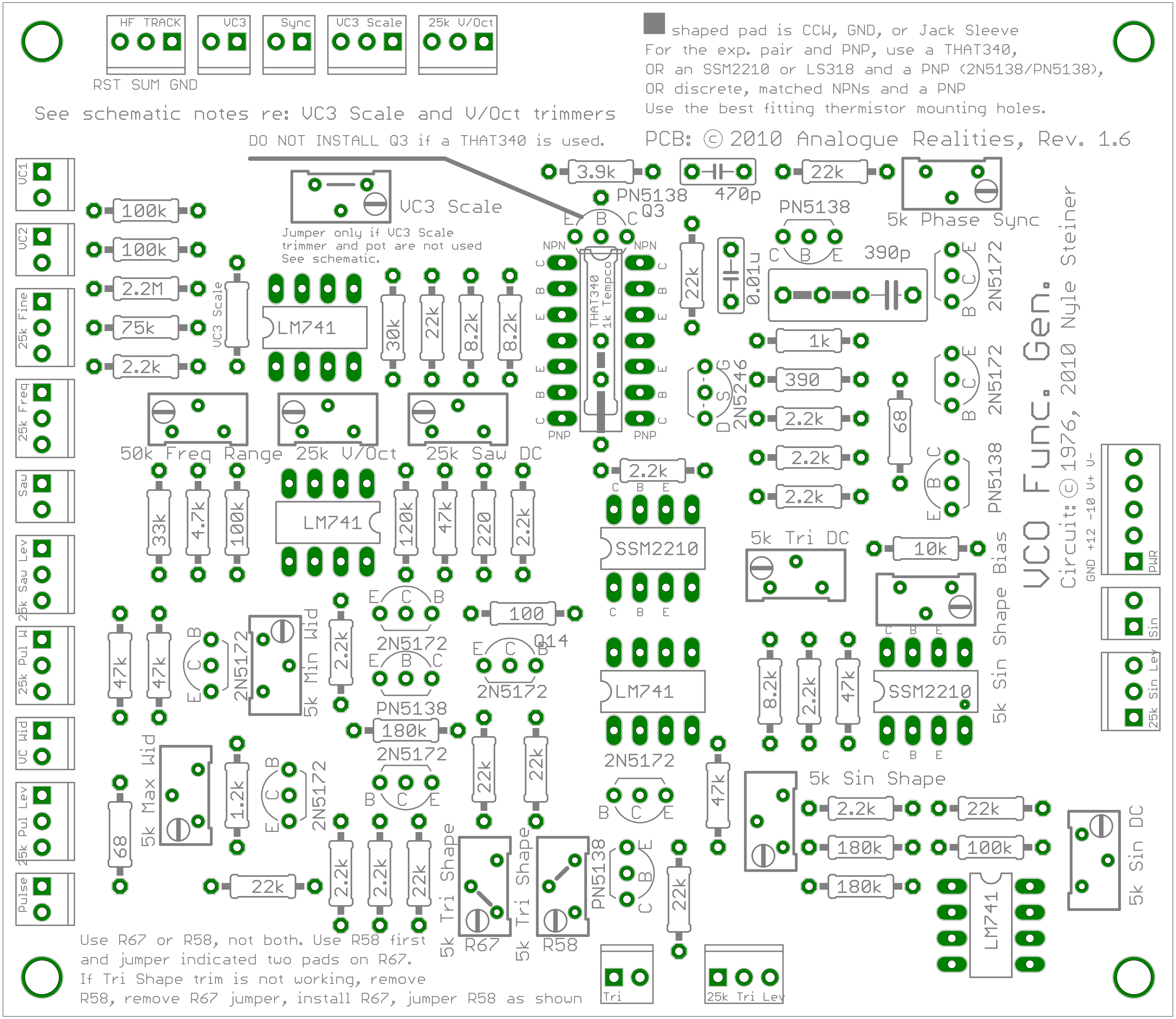

RST SUM GND
See schematic notes re: VC3 Scale and V/Oct trimmers
DO NOT INSTALL Q3 if a THAT340 is used.
shaped pad is CCW, GND, or Jack Sleeve
For the exp. pair and PNP, use a THAT340,
OR an SSM2210 or LS318 and a PNP (2N5138/PN5138),
OR discrete, matched NPNs and a PNP
Use the best fitting thermistor mounting holes.
PCB: © 2010 Analogue Realities, Rev. 1.6
Jumper only if VC3 Scale
trimmer and pot are not used
See schematic.
VCO Func. Gen.
Circuit: © 1976, 2010 Nyle Steiner
GND +12 -10 V+ V-
Use R67 or R58, not both. Use R58 first
and jumper indicated two pads on R67.
If Tri Shape trim is not working, remove
R58, remove R67 jumper, install R67, jumper R58 as shown

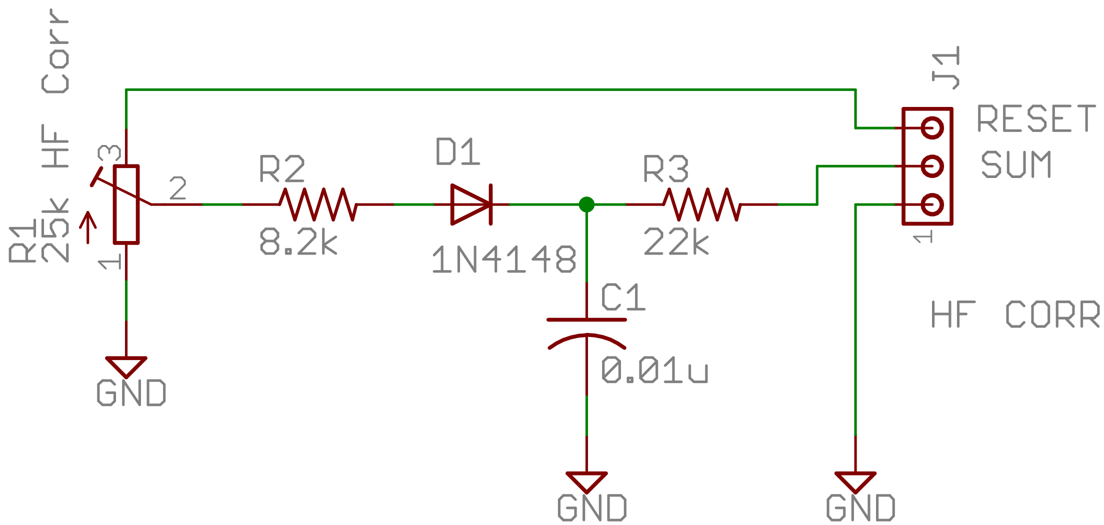

HF TRACK
RST SUM GND
VC3
Sync
VC3 Scale
25k V/Oct
shaped pad is CCW, GND, or Jack Sleeve
For the exp. pair and PNP, use a THAT340,
OR an SSM2210 or LS318 and a PNP (2N5138/PN5138),
OR discrete, matched NPNs and a PNP
Use the best fitting thermistor mounting holes.
See schematic notes re: VC3 Scale and V/Oct trimmers
DO NOT INSTALL Q3 if a THAT340 is used.
PCB: © 2010 Analogue Realities, Rev. 1.6
VCO Func. Gen.
Circuit: © 1976, 2010 Nyle Steiner
Jumper only if VC3 Scale
trimmer and pot are not used
See schematic.
VC3 Scale
5k Phase Sync
50k Freq Range
25k V/Oct
25k Saw DC
5k Tri DC
5k Sin Shape Bias
5k Sin Shape
5k Sin DC
5k Min Wid
5k Max Wid
5k Tri Shape R67
5k Tri Shape R58
THAT340 1k Tempco
VC1
VC2
25k Fine
25k Freq
Saw
25k Saw Lev
25k Pul W
VC Wid
25k Pul Lev
Pulse
GND +12 -10 V+ V-
PWR
Sin
25k Sin Lev
Tri
25k Tri Lev
LM741
SSM2210
PN5138
2N5172
2N5246
Use R67 or R58, not both. Use R58 first
and jumper indicated two pads on R67.
If Tri Shape trim is not working, remove
R58, remove R67 jumper, install R67, jumper R58 as shown

RESET is the input. It connects to the junction of R7, R10, and Q2.

SUMMING NODE is the output and connects to the summing node on the VCO.

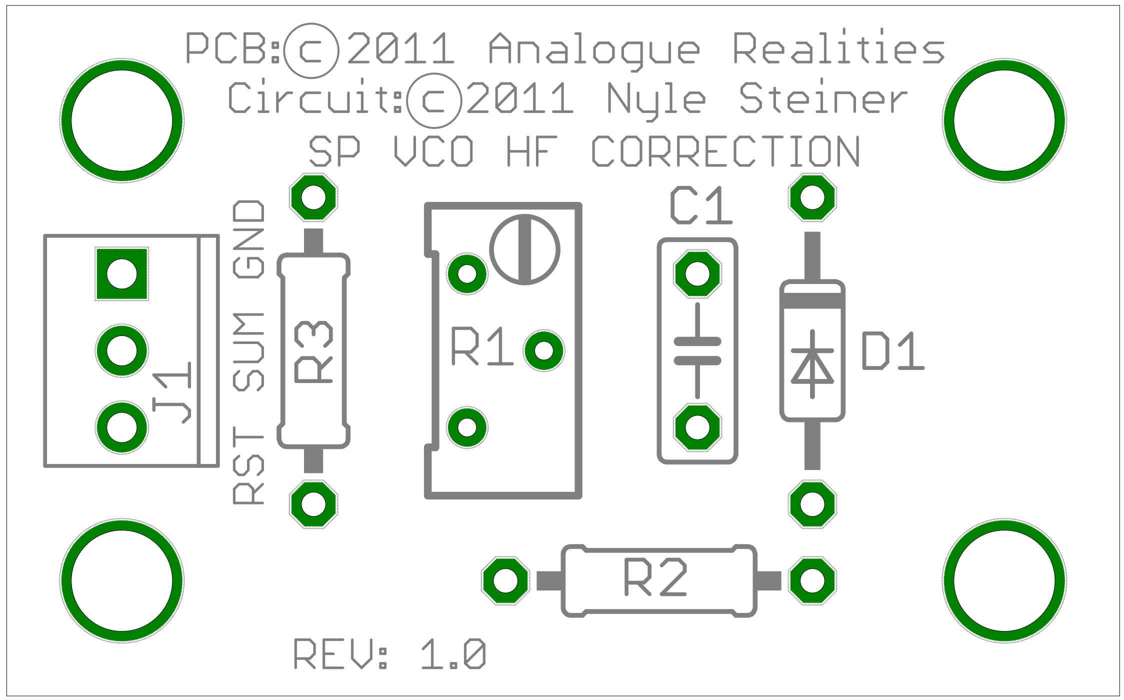
Make this wire as short as reasonably possible.

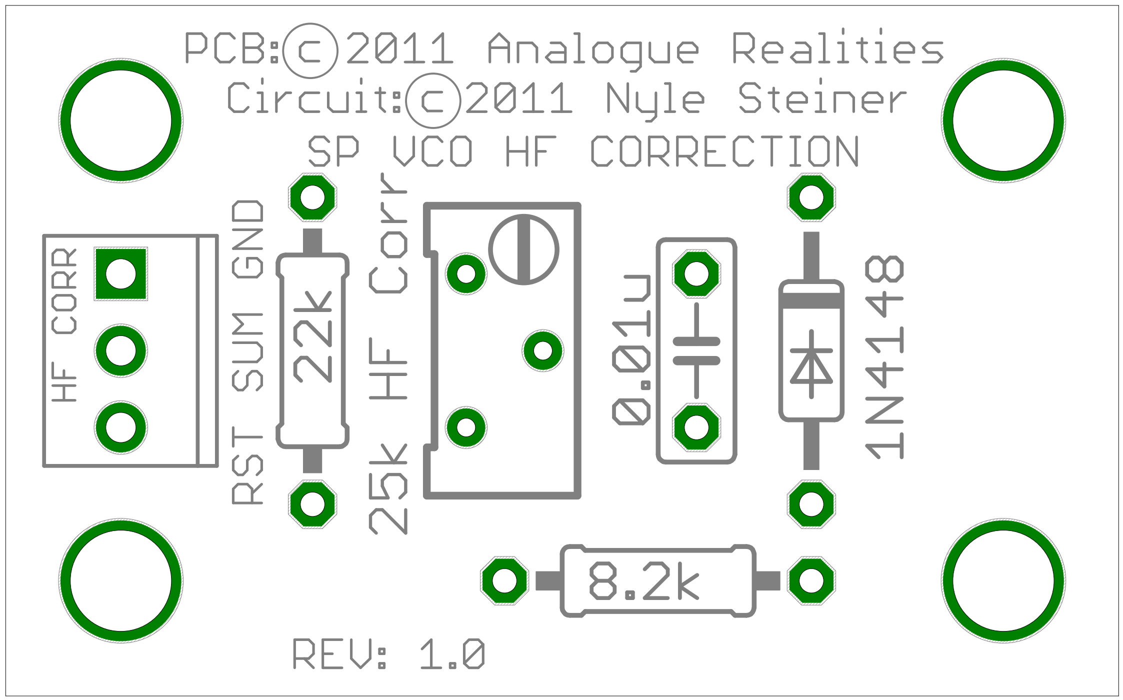
Connect the GND pin to a ground on the Power/Regulation or VCO PCB.

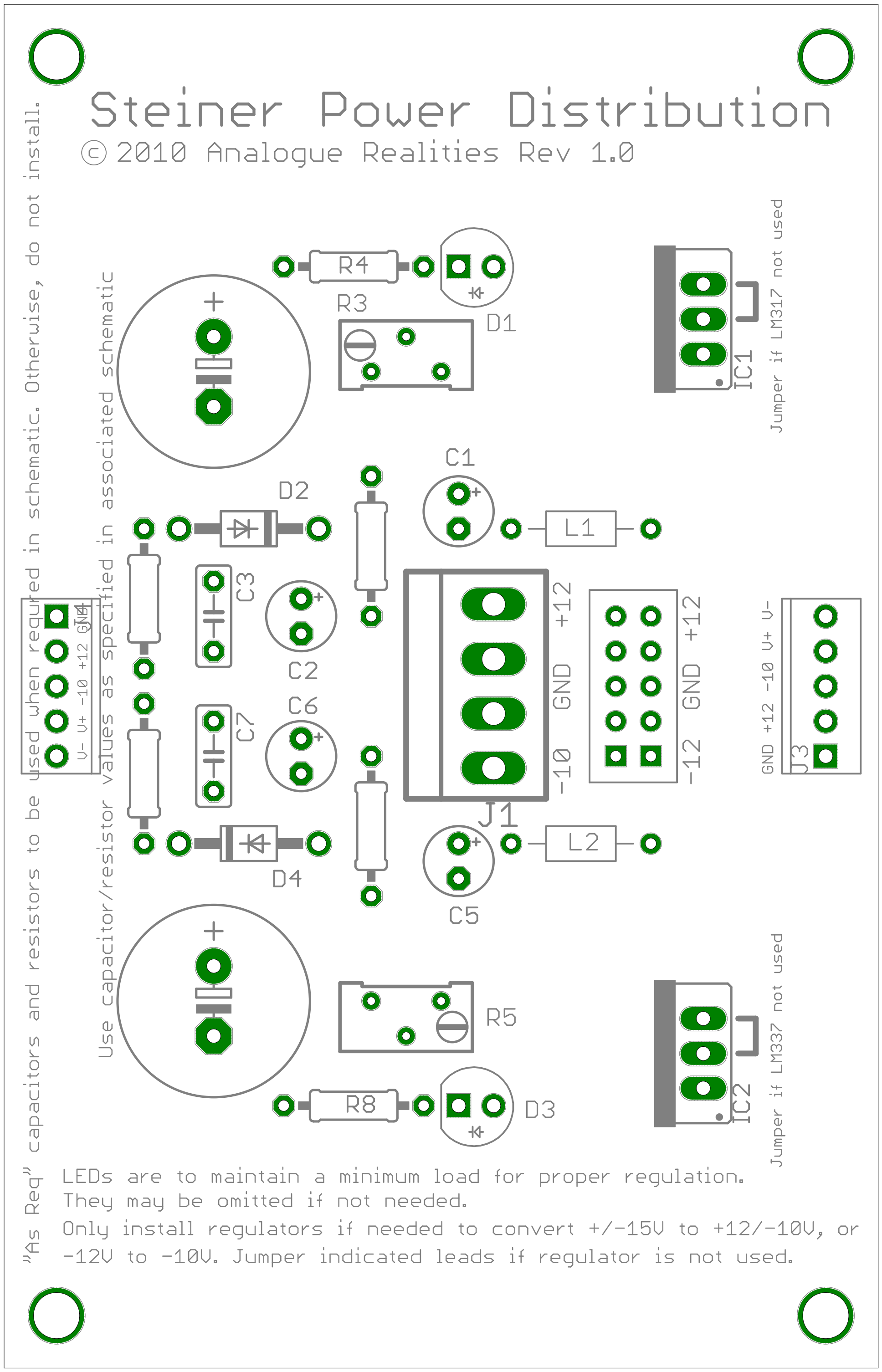


SP_HF_Corr_1.0
TITLE:

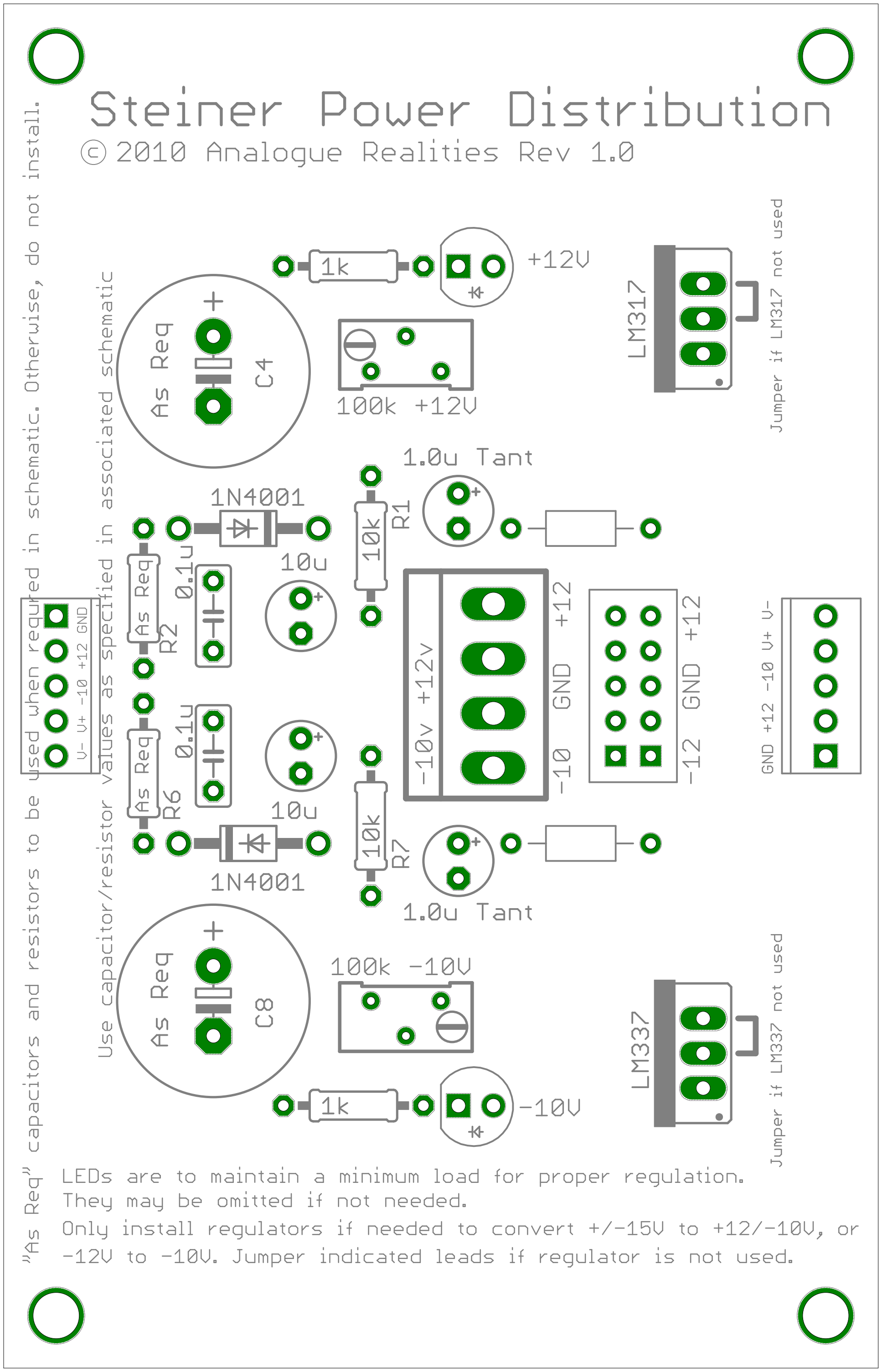
Document Number:	REV:
Date: 2/14/2011 11:50:05 PM	Sheet: 1/1

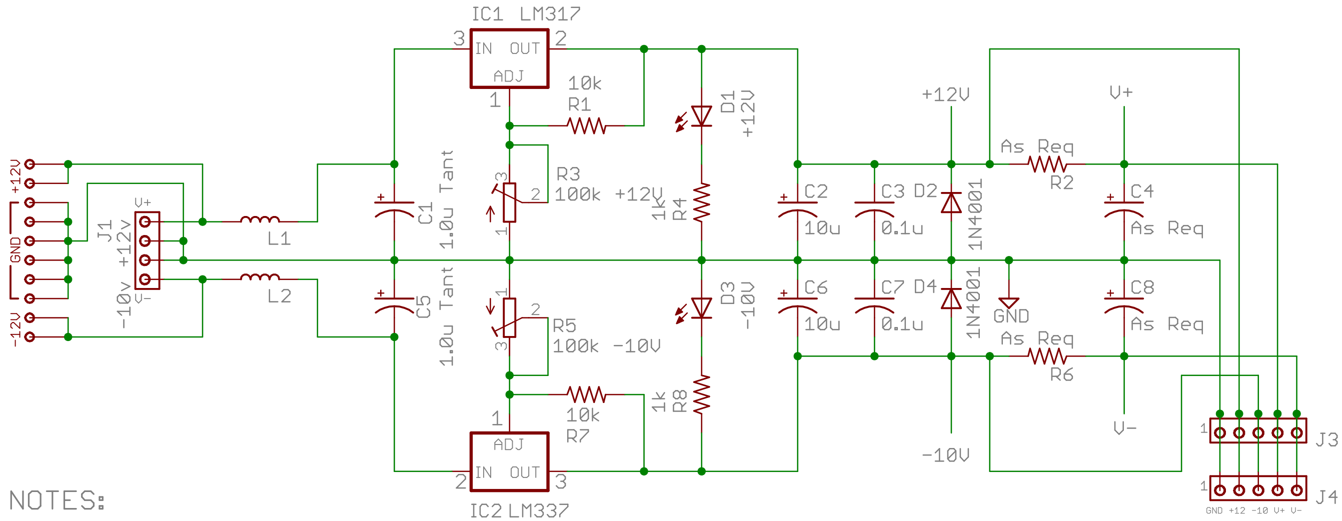

PCB:©2011 Analogue Realities
Circuit:©2011 Nyle Steiner
SP VCO HF CORRECTION
C1
RST SUM GND
J1
R3
R1
D1
R2
REV: 1.0


PCB:©2011 Analogue Realities
Circuit:©2011 Nyle Steiner
SP VCO HF CORRECTION
HF CORR
RST SUM GND
22k
25k HF Corr
0.01u
1N4148
8.2k
REV: 1.0



Steiner Power Distribution
© 2010 Analogue Realities Rev 1.0
R4
D1
R3
IC1
Jumper if LM317 not used
C1
D2
L1
C3
C2
C6
C7
J1
+12
GND
-10
-12
J3
GND +12 -10 U+ U-
J4
U- U+ -10 +12 GND
L2
D4
C5
R5
R8
D3
IC2
Jumper if LM337 not used
Use capacitor/resistor values as specified in associated schematic
"As Req" capacitors and resistors to be used when required in schematic. Otherwise, do not install.
LEDs are to maintain a minimum load for proper regulation.
They may be omitted if not needed.
Only install regulators if needed to convert +/-15V to +12/-10V, or
-12V to -10V. Jumper indicated leads if regulator is not used.


Steiner Power Distribution
© 2010 Analogue Realities Rev 1.0
"As Req" capacitors and resistors to be used when required in schematic. Otherwise, do not install.
Use capacitor/resistor values as specified in associated schematic
1k
+12V
LM317
Jumper if LM317 not used
As Req
C4
100k +12V
1.0u Tant
1N4001
R1
10k
10u
0.1u
R2
V- V+ -10 +12 GND
-10v +12v
GND
+12
-10
-12
GND U+ -10 U+ U-
0.1u
R6
10u
10k
R7
1N4001
1.0u Tant
As Req
C8
100k -10V
LM337
Jumper if LM337 not used
1k
-10V
LEDs are to maintain a minimum load for proper regulation.
They may be omitted if not needed.
Only install regulators if needed to convert +/-15V to +12/-10V, or
-12V to -10V. Jumper indicated leads if regulator is not used.



NOTES:

If regulators are not needed/used, do not install the associated components such as C1, R1, R3, R4, and D1 for the LM317, and C5, R5, R7, R8, and D3 for the LM337.

Solder a jumper between the IN and OUT pins respectively in place of the unused regulator, pins 2 and 3 in each case.

The LEDs and respective current limiting resistor only need to be installed if the circuit load is insufficient for the respective regulator.

See the LM317 and LM337 data sheet for minimum load specifications.

TITLE: SPPwrReg_1.0

Document Number: REV:

Date: 12/24/2010 10:20:39 AM Sheet: 1/1