Dwarf Star Synthesizer Quick Start Reference Manual

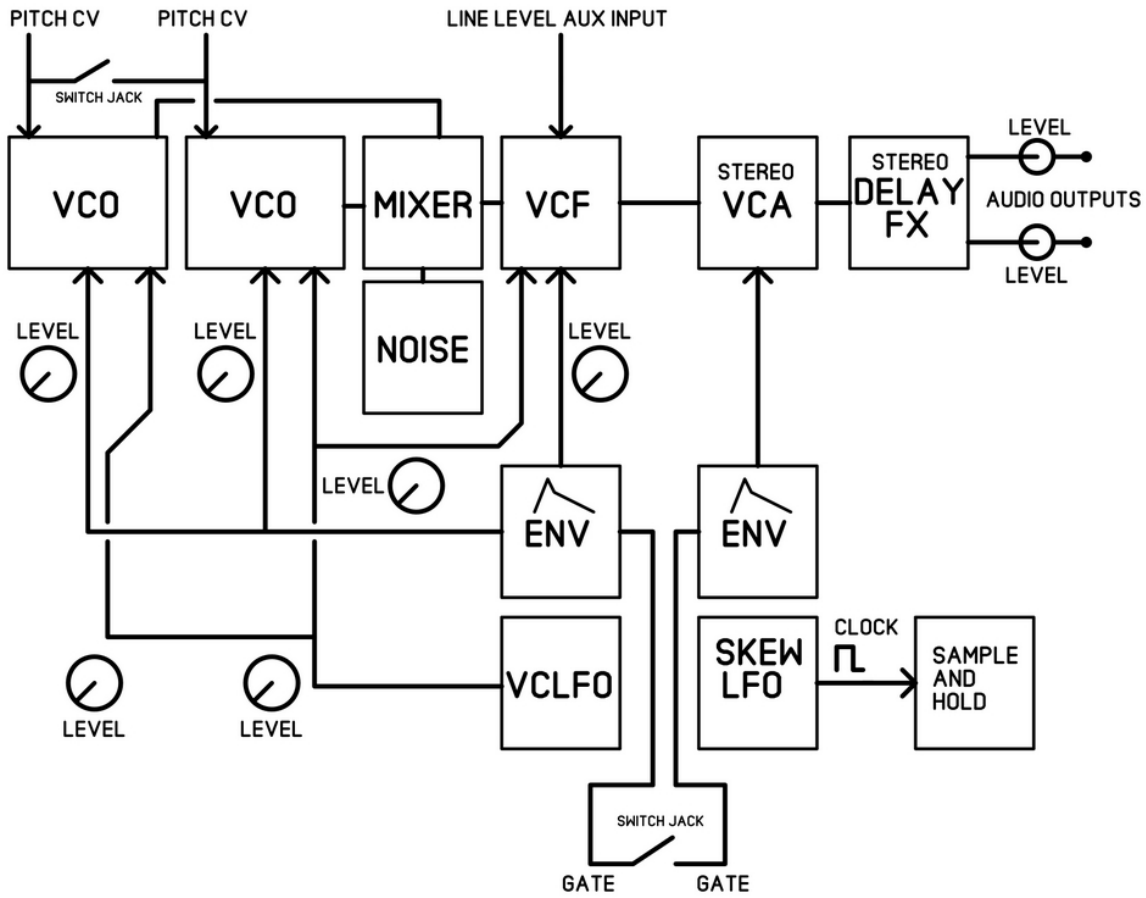
In these pages I will get you started and explain the various functions on the Dwarf Star Synthesizer.

The Dwarf Star Synthesizer has an all analog signal path. The last section duplicates the stereo signal and feeds it into a simulated vintage delay chip. That delay chip emulates old bucket brigade chips used in various guitar pedals and rack units from the 70's and 80's. The delay fx stereo outputs are mixed in with the original signal.

The Dwarf Star Synthesizer is a good investment for getting started with modular synthesis. It is also powerful enough to compliment your existing giant Doepfer based modular.

The Dwarf Star Synthesizer is Semi-modular. What that means is that the most common mono synth structure and signal path is already hardwired internally for you. With the help of this guide you will be able to get some sound, even with no patching. It might sound funny, but with a fully modular system it can take weeks, months, for some even a year to patch it correctly.

I will start you off with the signal path:



The synthesizer has some basic internal patching. The first envelope generator and vc-lfo are internally patched to the VCO's, and the VCF. I installed a dedicated 'Level' knob for each internal patch. Each level knob has either an on/off toggle switch or an invert switch.

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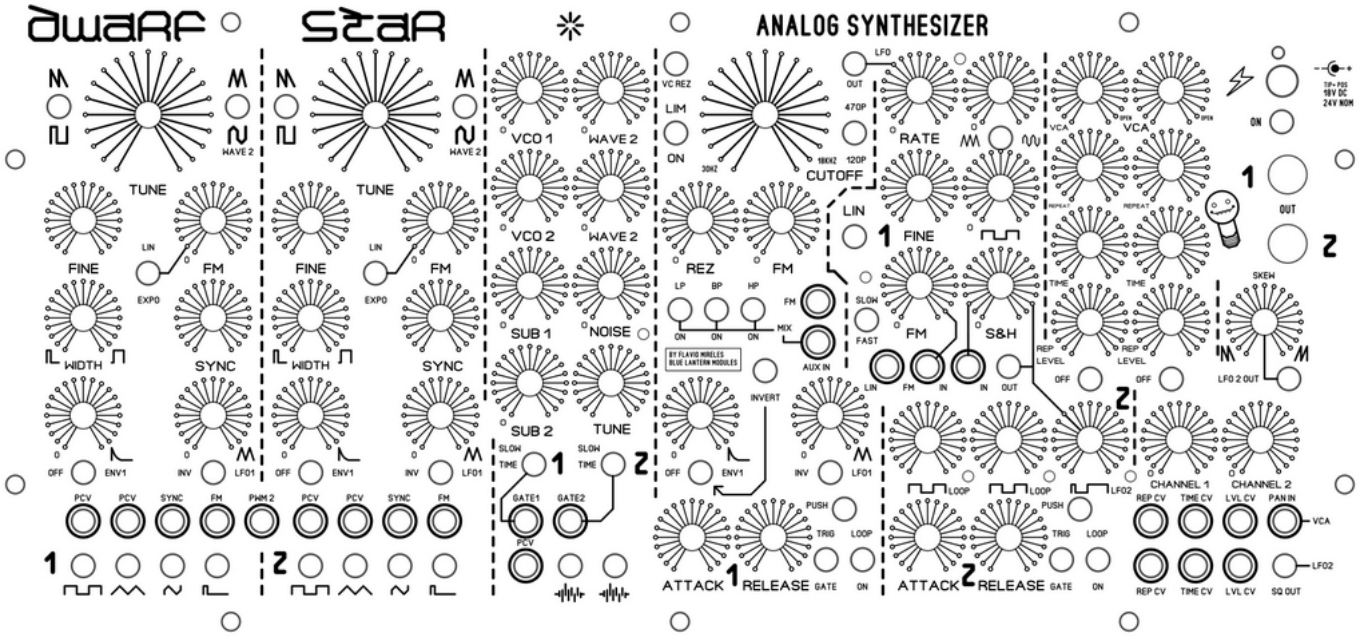
On the last page of the manual I have a synthesizer terminology page explaining what some of this jargon means.

I will explain each section of the flow chart and explain every function within the section. But first and foremost we have to make sure you set up the synthesizer in what I call the initial state. Otherwise you might not get sound, or have an uncontrollable synthesizer.

Here is a picture for quick reference:



Please do this to initiate the synth:

1. Have both level knobs for each VCO section set to ‘0’. One level knob has a picture of an envelope next to it, the other level knob has a triangle wave. They are located right above toggle switches, and those knobs are near the bottom.
2. On the mixer section have all the knobs set to ‘0’ or fully counter clockwise.
3. On the VCF or ‘filter’, have the level knobs on the bottom set to ‘0’. They look like the same ones you did for the vco’s.
4. For each attack and release, have the attack fully counter clockwise and the release set to middle position or 12’ o clock. Have the loop switches up for now this turns off the loop.
5. On the VCA section have the knobs fully clockwise or set to ‘open’. Have the ‘Rep’ level knob set to ‘0’ or fully counter clockwise. Have the toggle switches right below them set to ‘off’.
6. Have the Channel 1 and Channel 2 not set to ‘0’. You can have this set to middle position and you can turn it up to your liking once you confirm you can tame the dwarf star. These are the ar audio level output control knobs.

At this time you should have no sound, if you do have sound it is probably the filter resonance set fully clockwise and self resonating producing a sine wave.

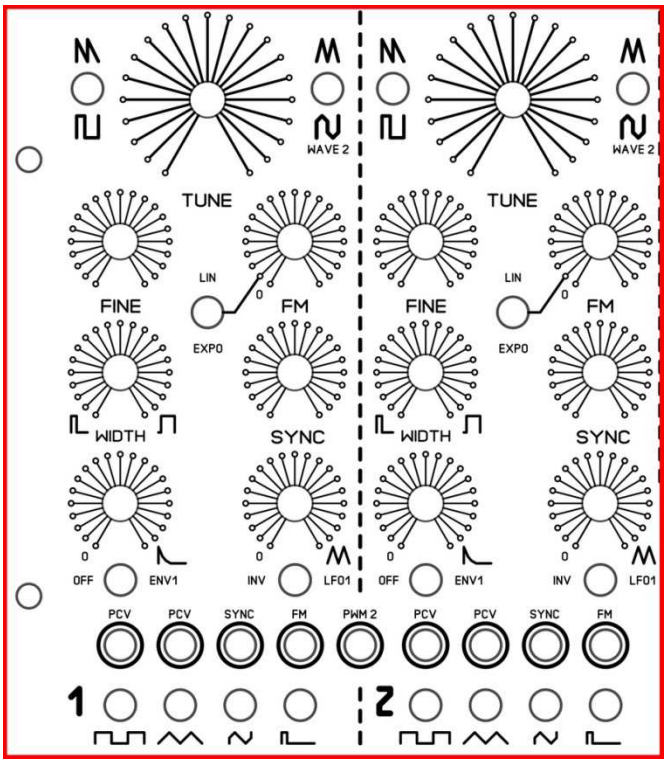
Time to tame the synth:

1. For each vco have the Tune, Fine, and width knobs set to the middle position. Have sync and fm knob set to '0' or fully counter clockwise. For the wave switches on the top decide on which one you would like to hear.
2. On the filter section have the cutoff knob fully clock wise. Have the Rez knob and fm knob set to '0' or fully counter clockwise. For now we will toggle the LP switch down to turn it on. Please have the BP and HP switch toggled up for 'off' for now.
3. On the mixer section turn up knob 'vco' 1.
4. On the second envelope on the bottom push the red button. You should hear some sound when you push the button. Press the button and turn vco 1's Tune knob to confirm you are controlling the pitch and the sound you hear is vco 1.
5. Now toggle envelope #2 loop switch to on. The middle rate knob above it with the word 'loop' and a square graphic controls the rate of the loop. If you would like to have the sound pass continuous or on auto 'hold', have the rate knob fully clockwise and the release knob fully clockwise. Otherwise you will hear a rhythmic loop dependant on the release knob and loop rate setting.
6. The twin VCA knobs determine how loud envelope 2 strikes them. Having them set close to 'open' means they will strike loud and add to getting a musical distortion sound, like clipping an amp.
7. Once you feel comfortable with having control over envelope 2 and the vca knobs you are ready to mix in vco 2, the noise generator, the sub harmonic generators, and sweep the filter.
8. You can now try out the other filter modes: bp, hp. Having only the lp and hp switch toggled on produces a phaser.
9. The Noise generator has it's own tune knob, you can sweep from white noise to an asteroid sound. When the noise generator is not in use it is best to have the tune knob set fully counter clockwise or set to slow rate. When not in use also have the mixer 'noise' knob also set to '0' or fully counter clockwise.
10. Envelope 1 is internally connected to the filter section, and used for modulation patches to the vco's. If you are comfortable with the loop control with envelope 2 it is the same thing with envelope 1. You need to turn up the 'level' knobs for each section to hear the effect from the envelope control. So for the filter slowly turn up the level knob and have the switch set to 'on' for its loop. Turn the filter cutoff knob at the top to hear it control the filter. Nice! Play with the rez knob to hear the reason why you like analog. You can now turn up the level knobs for each vco to have the envelope 1 control it's pitch. You should hear a zap or laser like effect. Look over the dwarf star's mixer section to see that vco's indeed have their sound fed into the filter section.
11. Wow you made it this far, last but not least you have earned the right to add some delay effect. To do this toggle the switch so that it does not point to 'off' for both channels. Turn up the 'REP'

level on both and start turning the other delay effect knobs. Because this is a stereo delay you might have to adjust them as a set, meaning turning two knobs at once. Explore the other delay knob parameters to hear the change in effect.

Now it is time to dig deeper into each section. I will follow the signal path and go in this order: vco, mixer, vcf, vca, delay fx, output. The separate modulation sources are vc-lfo, sample and hold, two envelopes, and skew lfo. There are two sections that are free floating, meaning that you have to patch them yourself to use them. They are: Sample and hold, and the Skew LFO.

VCO SECTION.



There are two vco's on the Dwarf Star synthesizer. Each are discrete transistor based with a modern 1v/octave exponential control circuit. They have their roots from an older Buchla complex vco. Yes, they have a triangle wave core. What that means is the triangle wave is the first wave generated by the vco, all the other wave shapes are produced separate from the core. Most other commercial synthesizers out on the market are saw wave core. For example Moog vco's are saw based core. The differences between the two types are found once you start frequency modulating them. The triangle core is known to have a better tone at extreme frequency modulation. The syncing of frequencies or 'sync' on a triangle core vco is also different. The reset of the wave happens at the tip of the triangle, as oppose to simply resetting

the saw or ramp producing a harsher tone. So to bluntly put it…the sync on the dwarf star is something different for your sound arsenal. I did not give you another boring Moog sync.

To use the sync function for each vco you are going to have to patch it yourself. For example, if you want to have VCO1 be a 'slave' and vco 2 be the 'master' you patch from one of the waves on vco 2 into 'sync' on the vco 1. Then you turn up the sync knob on vco 1. Sync knob on vco 2 with this patching configuration will have no effect. Turing the Tune knobs for each vco will give you some clue on the tones you can produce. The sync knob determines how hard or the 'magnet' strength of forcing the slave vco to reset it'core wave. The most common master wave used is the square wave, but you are free to use and try the other waves, each has a different color to it.

Note that input 3.5mm jacks have a ring graphic around them, and output jacks don't. So the simple rule for patching is you plug a patch cord first into something that has no ring (output) into something that has a ring (input).

To use the FM (frequency modulation) function for each vco you are going to have to patch it yourself. It is based on the same concept as patching the sync function: you chose a wave from the neighboring vco and patch it into the 'fm' jack. The FM function has a switch with Linear or Exponential response. Each one reacts different and produces different results. It also depends on the wave you decided to patch, each one also produces a color in tone. For example: a sine wave from vco 2 into vco 1's fm input produces: glassy, bell like tones at high rate frequency modulation. On the mixer section you would only have the vco 1 'wave 2' knob turned up to hear these results. The switch for vco 1's 'wave 2' has two waves, triangle or sine wave.

There are two internally patched modulation soures for each vco: Envelope 1 and VC-LFO.
To use the envelope 1 as a modulation source: turn on the toggle switch, turn up the level knob above the switch.
To use the vc-lfo as a modulation source: simple turn up the level knob, and decide with the switch right below it if you want the wave inverted (or flipped) or normal.
So no need to use a patch cable for these commonly used patches. This is great for cable free live use.

The pulse width is as normal as it gets compared to all the other synthesizers out there. You use the 'width' knob to narrow or move around the square wave. This can make it sound thin or fat.
Note*: Only vco2 has pulse width modulation. It is located at the bottom middle jack and labeled 'PWM'. You can patch the skew lfo to have it auto move the 'width' knob for you. VCO 1 does not have PWM.

PCV means Pitch Control Voltage. Staring from the label '1' at the bottom, the PCV jack right next to it is considered MAIN PCV. If you patch a midi converter or analog sequencer into that jack you will control both VCO1 and VCO 2. That jack is internally wired as a switch jack into vco

2's PCV jack located next to label '2'. To individually break that internal connection all you have to do is patch a cable into vco 2's PCV jack. I did this so that one cable is all you need to control both vco's, but also retain the option to cut the internal line.

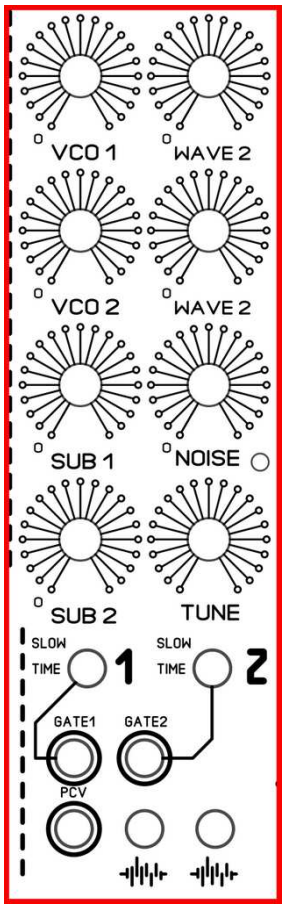
The second PCV jack is free floating and not paired like the 'Main PCV' set. So for each vco they are independent of each other.
Here are some notes about the wave outputs and how to use them.
Both vco's have most of those waves already internal patched into the mixer section. With the help of each vco's toggle switch (located near the top) you can quickly decide on which wave you want. On the Mixer section VCO 1 knob for example can either be saw or pulse wave, and the 'Wave' Knob next to it to the right can either be triangle or sine wave. You can mix both and come up with some 'complex' waves. The same concept is used for the vco 2 mixer section.

On the wave jacks you get a Pulse wave and a perfect Square wave. The perfect square wave is not connected to the mixer section because you can always build one using the width knob (when using the pulse wave).

So the wave jacks on the bottom of each vco were intended to use as 'voltage control' sources. Meaning, they are used for controlling other sections on the Dwarf Star synthesizer. The most common patches will be to use them to manipulate the vco neighboring it.
The wave signals are -5v/+5v output signals. This is compatible with the Euro Format Doepfer standard. Great News!

If you were to attempt to patch from a wave signal into a commercial desktop mixer, the audio will be continuous (non stoppable) and quite loud. Most audio line level signals are around -2v/+2v swing. So as you can see, it is a hot signal. I would say don't do it and no need to do it.

Mixer Section.



The VCO1 knob and wave 2 knob are considered a set. VCO2 and wave 2 knobs right below them are also a set.

Sub 1 and Sub 2 are Subharmonic Generators internally connected to the perfect square wave found on VCO1. So the Tune Knob on VCO1 determines the frequency of these also.

Noise Knob is the audio level of noise for the mixer.
Tune Knob on the mixer section only controls the rate of the noise cloud. You can sweep from an asteroid belt sounding effect, into a white noise sound. The circuit inside is using CMOS logic chips to produce it's sound. This is not a transistor based noise generator.

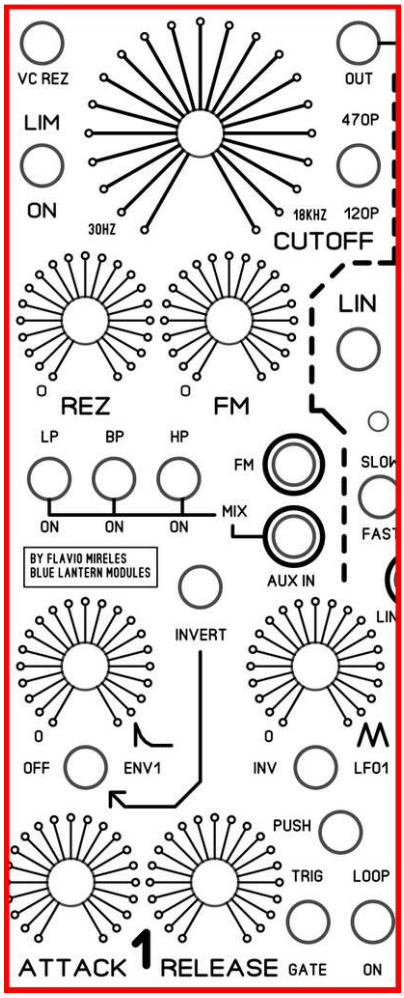
The Dwarf Star synthesizer was named after another product called the ‘Dwarf Star VC Noise’ which I still make for Euro Modular Format.

The Noise Generator has a PCV (Pitch Control Voltage) input, and two noise audio ouputs. Those Noise audio outputs are -5v/+5v swing. So they are also Euro Format compatible, and intended as a voltage control source when used on the Dwarf Star Synth.
So the same warning is applied on this output:
If you were to attempt to patch from this signal into a commercial desktop mixer, the audio will be continuous (non stoppable) and quite loud. Most audio line level signals are around -2v/+2v swing. So as you can see, it is a hot signal. I would say don’t do it and no need to do it.

The switches and the jacks labeled ‘Gates’ are not for the Mixer section. Those are for the Envelope Generators. Due to size and room, they were placed in the mixer section area. But they have nothing to do with the Mixer circuit itself.

Here are some last words about the mixer section:
Internally the Op Amp gain is using x1.5. So it is not a perfect x1 amplification. What that tells you is that if you turn up the mixer level knobs past 12 o clock or middle position you are beginning to give the signal some gain. This will allow you to ‘drive’ or over amplify the filter section for more aggressive tones. So don’t just fully turn up levels on the mixer section clockwise, use your ears for tone sculpting. I used AC coupling capacitors on the signal path to smooth out wave peaks, and help reduce wave lock up. Wave lock up occurs when very close waves are beating against each other and instead of producing a nice phasing flanged effect, stick together and lock on to the same frequency. Even though I added these tricks of the trade wave lock up is not 100% gone. But I doubt you will notice.

VCF Section.



The Dwarf Star Synthesizer does not have a ‘cascaded transistor ‘ filter or Moog vcf. You have too much of those in your studio already. This design uses a cool audio v2164 quad vca to do low pass, band pass, and high pass. I internally connected those outputs to toggle switches, and then those internally mix into a hidden mixer section inside. Each filter flavor was internally amplified for proper levels. So no matter which toggle switch you use, the output will be seamless and mix nicely.

So your first troubleshoot in the event of hearing no audio: Check the Filter Toggle switches! You must have at least one toggled down for normal synth use.

When having all of them in use, that is known as an ALL PASS filter.
When using the LP and HP toggle switches, that is known as a NOTCH filter.

This filter will self resonate into a sine wave when the Rez knob is turned fully clockwise. You can use the toggle switch with the labels 470p and 120p to determine the amplitude of that sine wave. Those labels represent internal capacitor choices. Each changes the slope of the filter curve. So use those to shape your tone in conjunction with the cutoff knob and 'Limit' toggle switch. The Limit toggle switch uses an internal Diode limiter to brick wall some frequencies right around the resonate feed back path. It is a trick of the trade Blue Lantern Module feature. This filter is a refined version from a product called Cobalt Smelter Lab VCF. Also available in Euro Format.

The Rez knob can be voltage Controlled. Look for the jack all the way on the top.

The jack labeled 'out' on the top is for the VCLFO and not related to the filter section.

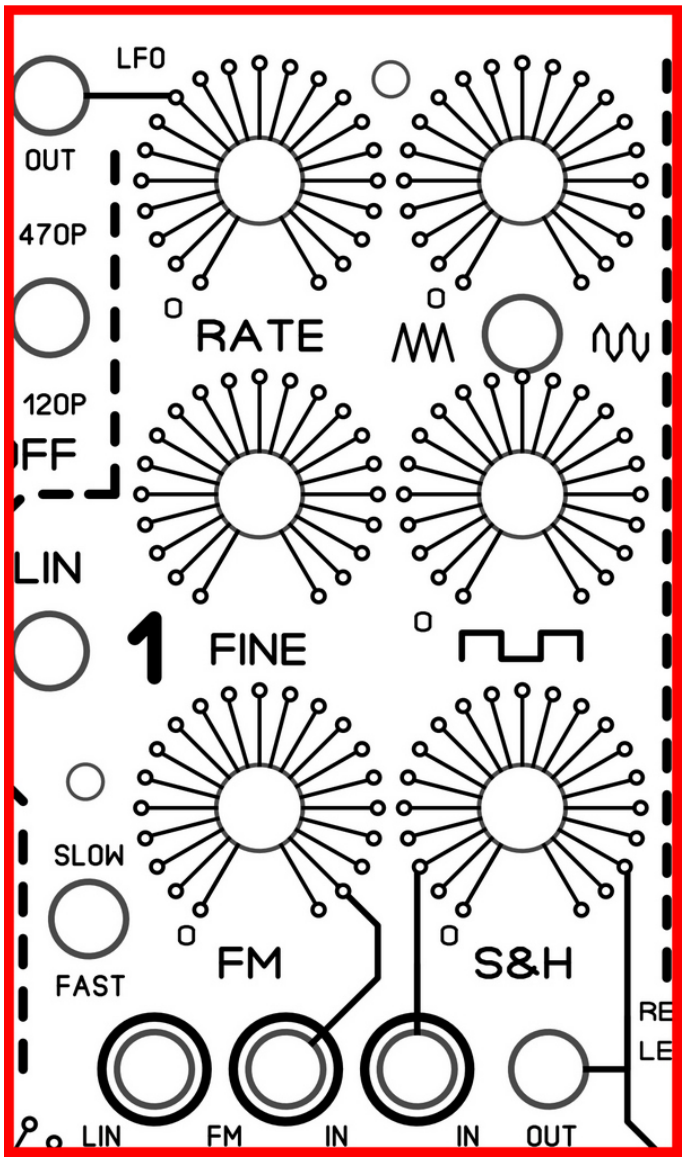
The envelope generator on the bottom is exclusively internally wired for the filter section and to modulate the vco section. To use this envelope you have to turn the Env Level knob clockwise. You also have the option to 'Invert' the envelope.

The FM knob is in conjunction with the FM jack. It must be patched for change or modulation to occur.

The lfo level control knob near the bottom is internally wired to the VC-LFO right next to it near the top. Use this to add some auto wah type control.

The Auxiliary jack is a line level tap point. You can use a 3.5mm to ¼" cable to connect a consumer line level source into the Filter section. This is a mono input. If you accidently patch a wave signal from the vco section it will amplify fairly large. You will not damage the circuit. Just know that using that technique will always produce a square wave.

Voltage Controlled LFO Section



This lfo is using a triangle core design also. But this design is not a discrete transistor based core like the vco's. It is using an OTA LM13700 chip to form the triangle wave. I decided on this particular design because it uses a very unique Linear voltage control. This Linear control does not act the same when implemented on the VCO's for example. The linear control can sound Arpeggio like and very musical.

The fastest method to hear this effect is to patch from the other lfo, the skew lfo output into the jack 'LIN' on the vclfo's section. Use the small black knob next to fine knob to adjust the effect. You also use each lfo's rate knob to adjust the ratio. Then you can use VCLFO as a modulation source and turn up the level knob on one of the vco's (modulation level) for example to control the vco's pitch. To sum it up, this is a Linear control circuit.
To save on space I did not want you to have to patch or select a wave for the vclfo. Instead I decided to use a hidden mixer section specific for the lfo section. So the knob above the toggle switch with the triangle and sine wave is the first lfo wave you can mix. The knob right below it allows you to mix a Square wave. This also allows you to mix up both signals to make more complex waves.

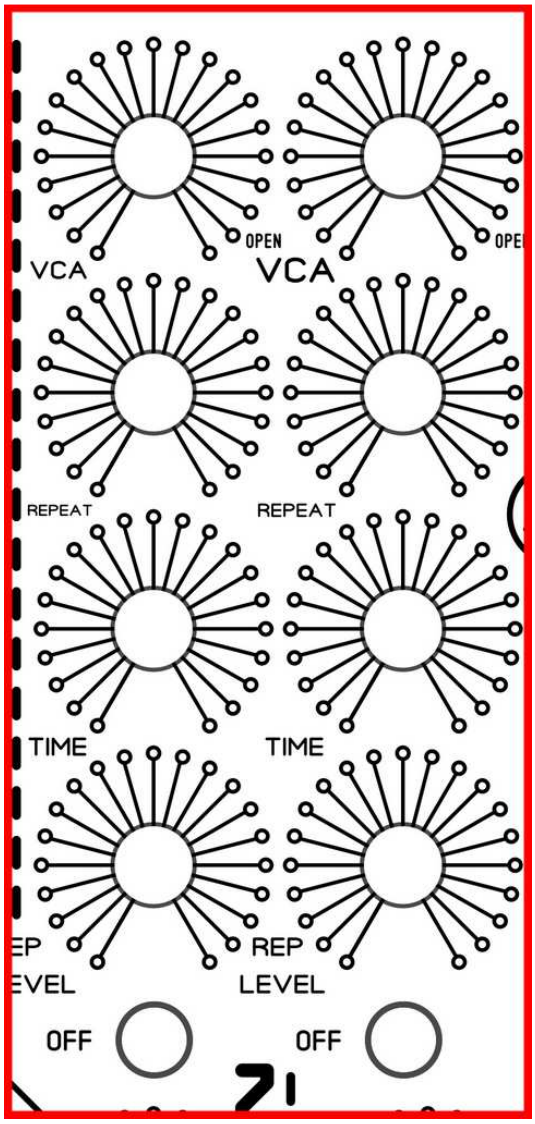
Here is your second troubleshoot: I can't hear any pitch modulation on the vco's. Even if I turn up the vco's modulation level.
Always check to see if the VCLFO's mixing area has at least one wave turned clockwise.

The FM knob and jack are free floating, you have to patch something into it to control the lfo. This is an exponential voltage control.

The sample and hold circuit is also free floating and not connected with the VCLFO. Instead the Sample and hold's internally rate clock is coming from the Skew LFO or LFO #2 on the bottom. I did add a graphic line to connect the S&H level knob with the 'Rate' knob below it. In order to use the Sample and hold you are going to have to patch a wave into it. You can patch from the vclfo 'out' jack near the top into this for example. Now patch from the S&H output jack into one of the various 'FM' jacks with it's dedicated FM knob. The S&H knob is a Level amount knob, not a S&H rate knob, remember the SKEW LFO is the S&H 'RATE' knob. You can also use the LFO skew knob to move around the Pulse width used for the sample and hold's clock source.

You also get a 'fast or slow' toggle switch for the vclfo section.

VCA and DELAY FX Section.

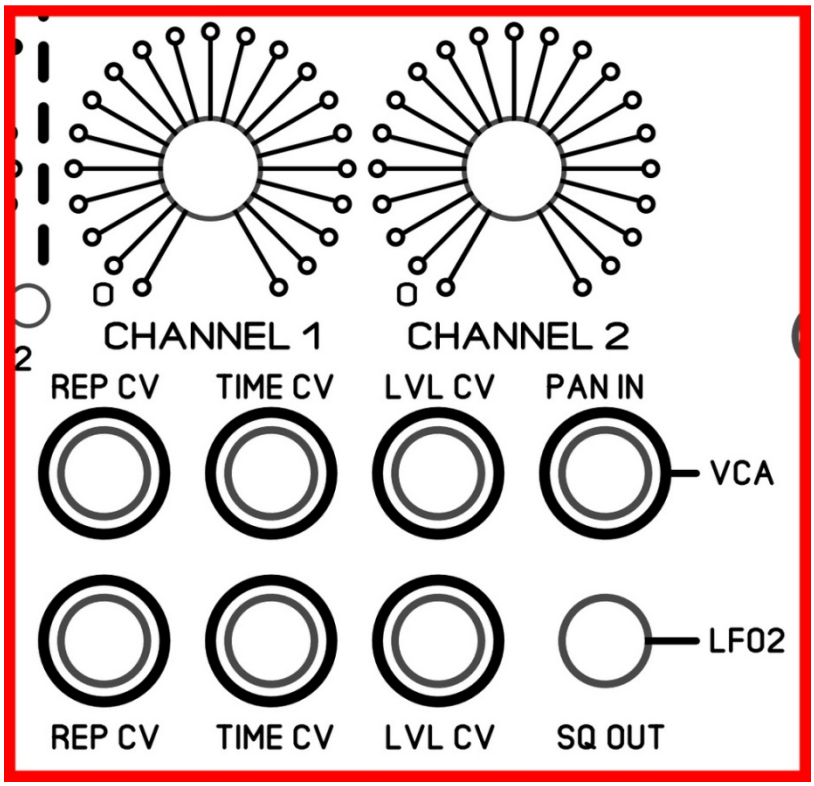


There are two VCA's for stereo action. After the VCA, the signal path is converted into line level. The signal is then duplicated or copied. This copy is done using a buffered multiple circuit. The copy is then feed into the Stereo Delay Section.

So on the final output the Delay FX section is mixed with the original all analog signal path. This gives you even more control over the FX.

The VCA knobs will give you a softer level when turned fully counter clockwise, and a louder/sustained response when turned clockwise.

Envelope #2 was internally wired to control those VCA knobs. You can independently adjust each channel's amp response.
Every knob for the Delay FX section is voltage controllable.



The top row of CV inputs for the Delay section is internally switch jack connected to the bottom row CV inputs. I did this so that you could control both delays with minimal patching. If your require independent cv control simply plug it in, it will break the switch jack connection.

The 'PAN IN' is used to give a stereo rotor effect to the VCA's.

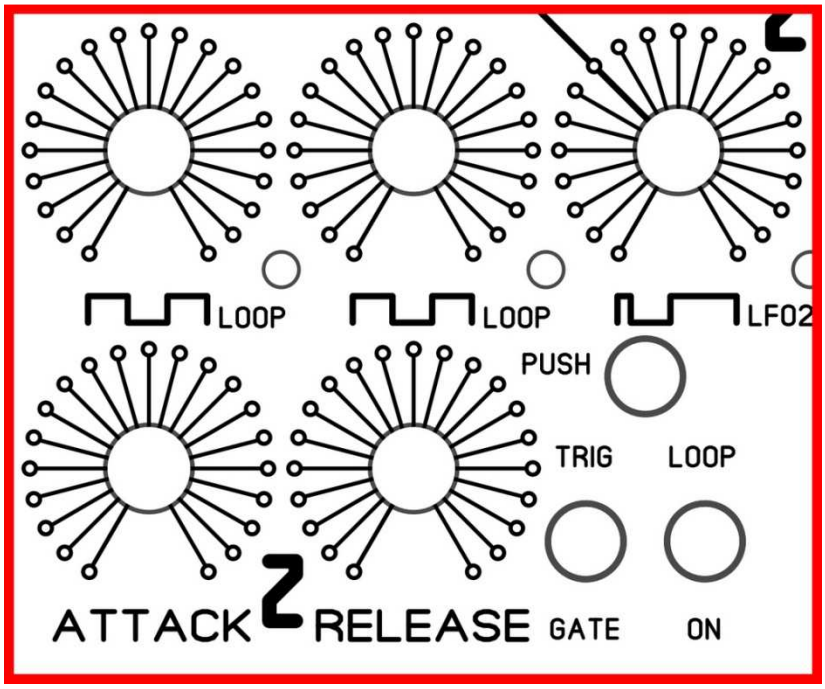
The Square out is not involved in the VCA-DELAY section. It is an output for a square wave from the Skew LFO.

The Channel 1 and 2 knobs are your final Master volume knobs from the ¼" Jacks.

On the Delay section the Time Knob is set up like the LFO rate knob. Fully counter clockwise is a slow rate, and fully clockwise is a fast rate or fast time. You might get confused at first because most guitar pedals have that knob response reversed.

The toggle switches with the label ‘off’ are for the Delay FX. They will turn off the fx. This will not mute the original ‘Dry’ signal path. If you must mute the original signal path and still leave some delayed trails, you can use the Filter section switches.

Looping section, and Envelope section.



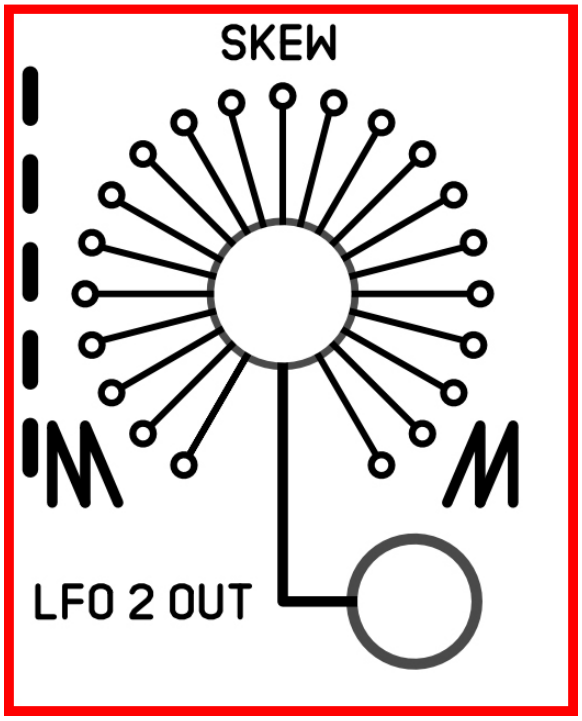
Each envelope generator is capable of internally looping and cycling. Each generator also has it’s own independent Loop rate control. In this particular diagram, middle loop knob is for envelope #2. You turn on the loop feature with the toggle switch.

The envelope has a gate and trigger mode. On gate mode, the envelope will not release it’s cycle until the gate signal or +5v is finished. On trigger mode no matter if the 5v gate signal is held, the envelope will finish it’s cycle and return back to wait for another gate signal or ping.

I can describe it as: use trig for rapid percussive response, and gate for keyboard player/note response.

The knob labeled ‘LFO 2’ is the rate control for the skew lfo.

Skew LFO, or LFO #2

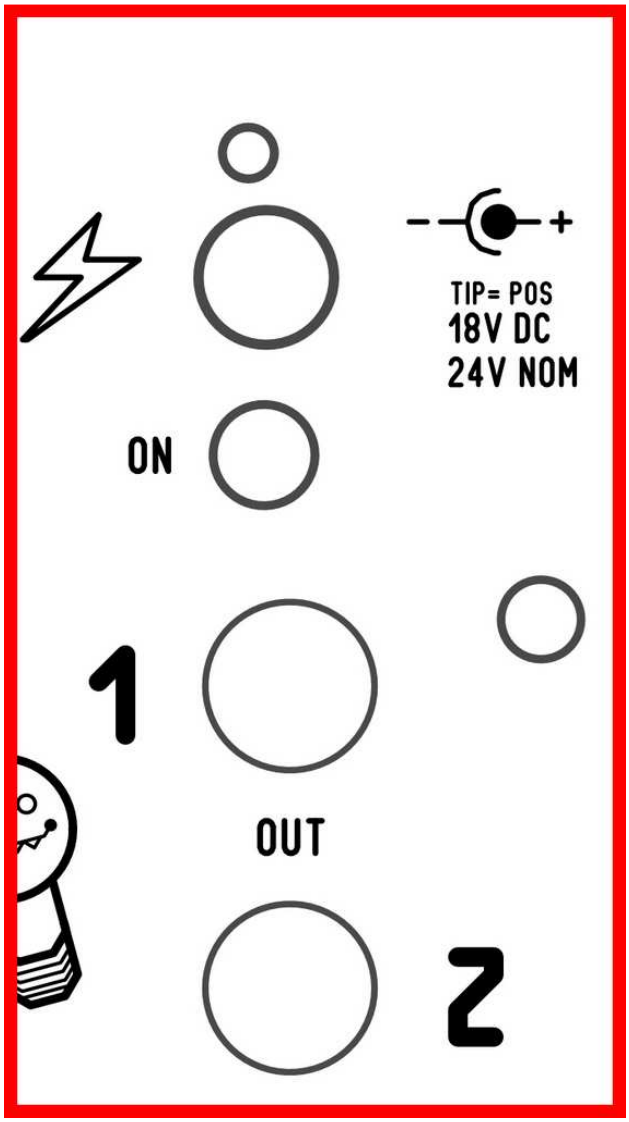


This knob above is found near the Channel Knobs, on the far right of the synth. Because of space I could not have the rate and slew knobs next to each other.

So these both are used to control the skew LFO. This particular skew lfo can sweep from a triangle, to a saw or ramp wave. The triangle wave is when the knob is in the middle position.

The jack in the diagram is the output for this 'triangular' wave.
The lfo also has a Square output near the bottom of the synth. It is one of the last jacks near the far right. You can also use the Skew knob to change the Square shape, or pulse width.

Power Section, and Line Level Outputs.



The Dwarf Star synthesizer is using a DC to DC converter. The requirement needed for the converter to do it's magic is to input a 18v to 24v DC adapter rated at minimum 3A. 2 Amps might work, but I supply and use 3 amps. I like to supply more current then needed. The total amperage is shared by the rails. So the synth might use 1.5A for +12v and 1.5A -12v.

The tip of the adapter must be positive polarity! There is reverse protection inside but it is best not to challenge the protection or use the power supply incorrectly.

I like to use 24v DC because the datasheet for the dc to dc converter states that for optimal use it requires 24v.
The synthesizer will not power on at anything below 18V DC.

Never plug or use a 12v -24v AC adapter. This synth is DC only!! You will damage the power supply.

The ¼" output jacks are Tip and Ring type. Hot and Ground. They are not balanced outputs.

The Audio Frequency Spectrum for this synthesizer is 20HZ – to over 50Khz.

Synthesizer Words. Join in on the talk.

VCO – Voltage Controlled Oscillator, these are your sections that produce audio at normal use.

VCF – Voltage Controlled Filter. This is a one knob equalizer to go from light to dark tones on the fly.

OSC – Oscillator

LFO – Low Frequency Oscillator

HP – High Pass Filter

LP –Low Pass Filter

BP – Band Pass Filter

VCA –Voltage Controlled Amplifier.

Rez – Ghetto way to say resonance

FOLD – to run a wave through usually diodes and ‘fold’ the shape of the wave.

LAG – a time based circuit that will delay something.

Boat – the metal box used on the Dwarf Star Synth, and found on Serge Synthesizers, and other 4U DIY systems.

The Rails – the bi-polar power used to power up synthesizers. It can be -12v/+12v or -15v/+15v.

The power strip – in modulars this is the internal power strip used to connect the individual modulars.

Skiff – shallow ‘boat’ like box for desktop synth use.

Sync – to force a timing capacitor to reset and become a slave to another frequency. This is usually done on VCO’s and LFO’s.