



STRONG ZERO CORE

operated by

Endorphines
STRONG-ZERO



Manual installation guide v1.2

Hands up, or we will cross thru zero!



I'm your Furthrrrr

- Instant thru-zero linear fm in your Furthrrrr Generator
- 16-pin DIP IC chip – VCO Core replacement that works with any Furthrrrr Generator
- expands Furthrrrr Generator FM capabilities for obtaining new timbres – deeper, metallic timbres, entirely new sphere of sounds from light whistles to weird noises
- Band-limited 12 bit resolution 80 kHz samplerate output
- together with Terminal, create powerful 2-operator modular FM-synth
- 16 bit pitch CV and linear FM acquisition for proper microtuning and modulation operations
- Hard and soft sync without aliasing as may be expected from stock Furthrrrr VCO

We are proud to present you an unexpected but so awaited update to your Furthrrrr Generator.

The new digital STRONG ZERO Voltage Controlled Oscillator Core expands frequency modulation possibilities of the Furthrrrr Generator to an entirely new level.

What is an oscillator core?

Oscillator core is the heart of synthesizer's tone generator; the integrated circuit that generates primitive waveforms (in terms of Furthrrrr Generator – triangle and square waves) from which all the rest of the waveshapes are derived. It also ensures thermal stability of the oscillator's pitch – so the frequency will not alter to temperature drift (for example as the concert goes on and crowd breathe and smoke some weed, the temperature inside increases).

In most analog oscillators linear Frequency Modulation reacts only to positive Modulator signals – the ones that go above zero volts only. The voltages that go below zero usually don't affect the Carrier's pitch at all.

The new STRONG ZERO VCO Core offers bi-directional linear FM modulation – usually called in analog 'thru-zero' linear FM, with which negative modulator's part not only affects the modulation but creates a phase reversal of the Carrier (when Modulator crosses zero and at certain modulation index). Small difference, however as a result – deeper, metallic timbres, entirely new sphere of sounds from light whistles to weird noises.

In the Furthrrrr Generator typical workflow we have Carrier oscillator – used commonly as a tone signal generator, and Modulator – the one that shapes Carrier and carries control source. In terms of frequency modulation, they can be called 'operators' and the whole Furthrrrr Generator patch (incl. some relative modules in the patch) may be considered as a single voice.

In connection with Terminal, Furthrrrr Generator creates full synthesizer voice and with thru-zero linear FM capability it can be considered as 2-operator monophonic FM synthesizer.

Why linear FM is interesting into creating new timbres?

You all know that typical linear FM that produces bell-alike sounds. Its difference with exponential modulation is not only in typical timbre but the ability to allow the carrier to track pitch properly on a scale.

Bringing 'thru-zero' possibility allows to create much deeper, metallic, bell sounds as well as high frequency whistles and noises that are not obtainable with ordinary analog linear FM or other types of modulations. Despite ordinary linear FM, 'thru-zero' FM allows wider palette of sounds and even a small changes in pitch or index affect the timbre crucially.

What happens when modulator crosses from positive voltages thru zero into negative voltages? Most of analog oscillators incl. the stock ones in Furthrrrr Generator do not respond to negative linear FM voltages at all because of historical reasons design. Thru-zero linear FM behaves more or less like the famous DX synth's operator's modulation – i.e. going into so called negative frequencies. Negative means linear FM works bi-directionally and at some point when the Modulator crosses zero at moderate modulation index levels it will increase the frequency of Carrier same as in positive way at negative part of a Modulator and the phase of the Carrier reserves.

To make the timbre sound interesting, the depth of linear FM modulation (**Mood**-ulation index) should be dynamic – i.e. voltage or finger controlled in time. That principle creates entirely different palette of sounds, not obtainable with ordinary subtractive synthesis. It is convenient is to use one of the Airplane envelopes from the Terminal or other wave from any VCO or LFO for modulating the index. Don't forget that the Furthrrrr Generator includes internal VCAs that may be accessible via modulator's external input with Amplitude or Balanced modulation switched turned on. Needless to say that Balanced or so called Ring modulation is a thru-zero version of Amplitude modulation. Everything thru-zero indeed.

And of course, speaking in terms of frequency modulation the ratio in pitch between modulator and carrier is very important in generating harmonic content consciously.

When the frequency ratio between Modulator and Carrier is 1:1 – i.e. they are at same pitch – then frequency

modulation will generate more even-like harmonics. When the ratio becomes 1:2 – i.e. Carrier is twice higher than the Modulator – then odd harmonics are generated. In general, when both Modulator to Carrier pitch ratios are integer, the obtainable timbre will have harmonically-related spectrum. And if either Carrier or Modulator's frequency is an irrational number, then the generated timbre will have in-harmonically related content but still may be perfectly used for bells, whistles and noise alike sounds.

Keep in mind the importance of Modulator to Carrier ratio to get the same harmonically timbres at different pitches – i.e. when playing notes with pitch CV from keyboard (generated from a Shuttle Control for example). In that case you have to track both Carrier and Modulator 1v/oct simultaneously.

Continuing speaking in terms of Frequency modulation, the operators can modulate each other (cross modulation) or by their own (by a feedback modulation itself). That's easy to do with a patch cables from any wave outputs into CV/FM/key inputs of current or modulateable oscillator (or using pre-patched feedback from Carrier's Final output into Modulator's linear or exponential FM inputs). So far, there are thousands of timbre variations depending on oscillators pitch rate to each other, their index and their patch combination with different modules environment. Explore!

In terms of harmonic content – frequency modulation produces additional frequencies called sidebands which form symmetrically around the original frequency of the Carrier. As the index increases, some of the harmonic energy of the Carrier frequency is being stolen (folded) to create these additional frequencies. Even simple linear sine by sine frequency modulation produces large amount of new harmonics and you can imagine what variety of results other or complex waveforms may do.

The STRONG-ZERO VCO Core can be used as a direct replacement of stock Furthrrrr Generator Carrier Oscillator's Core for instant thru-zero linear FM availability. STRONG-ZERO VCO Core can be replaced at Modulator as well, however no low-range mode will be available to Modulator (whenever the Lo-range switch position, the Modulator **will not go into Lo-range**). Also linear FM modulation will work only at Lo-range switch position turned UP).

Nearly all Furthrrrr Generators from all over the world are supported.

If your FG comes from the first dozen of early birds from 2012 year – there might be a few fixes you may contact us about.

The frequency range of STRONG ZERO VCO is 11 octaves (approximately 1 octave per less than one pitch knob revolution) – from approximately 8 Hz the lowest to approximately 13–14 kHz the highest.

Is my Furthrrrr Generator with stock VCO cores outdated or what?

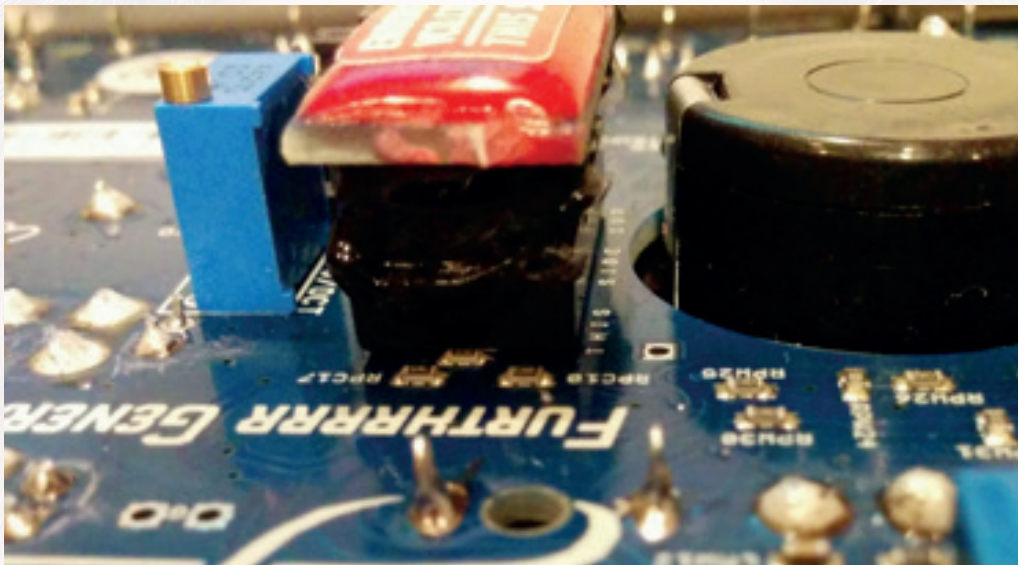
All Furthrrrr Generators are supported. We never forget about old customers. However the choice of a VCO Core is up to you. The stock analogue cores offer warm analog sound and all you can expect from an analogue oscillator. The digital STRONG ZERO Core adds harshness to the generated timbres and because of digital nature – small aliasing yet might occur at critical sharp edges like edgy slopes of phase-reversal at high frequencies with extreme mood index. Sometimes, without using the new linear FM you may even don't perceive the difference between in the timbre at all. The choice is up to you.



VCO Core Replacement procedure – how to?

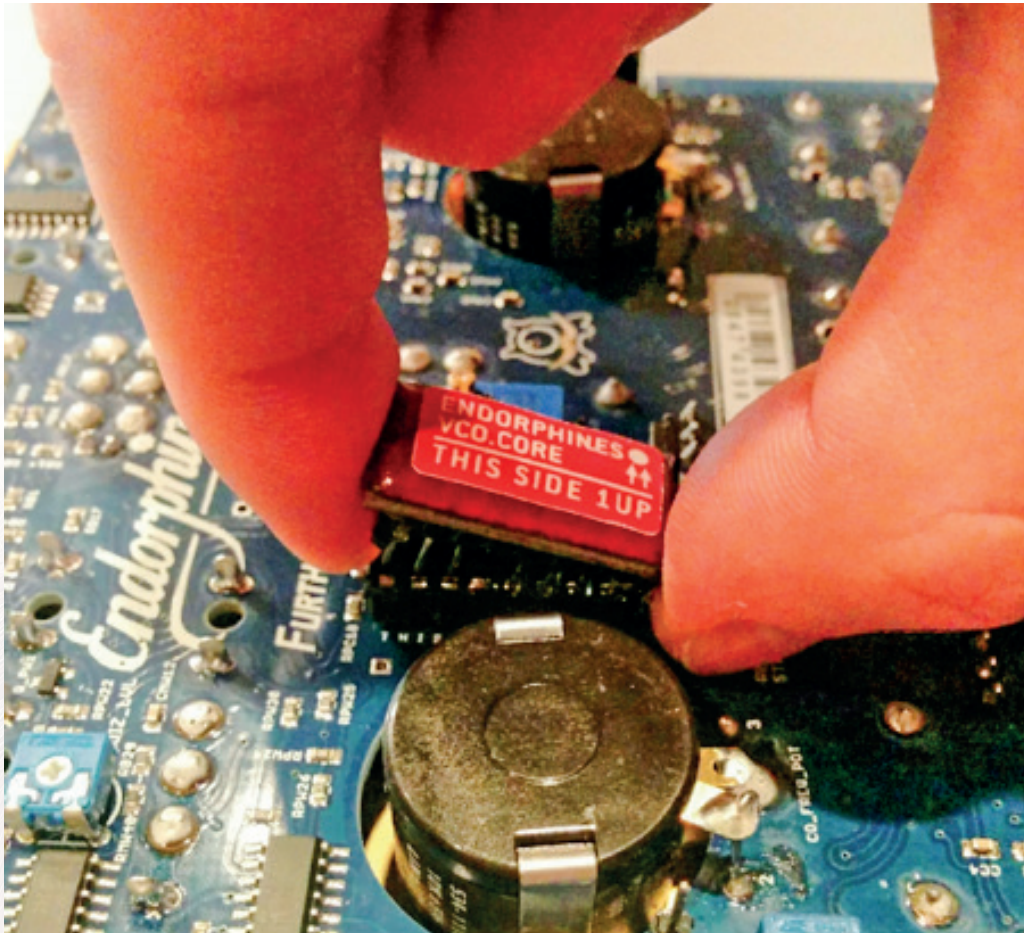


Stock VCO Cores of Furthrrrr Generators are inserted into 16-pin DIP sockets and secured with hot glue blobs in the edges so the VCO will not fall off the socket when the modular system is shaking at transportation.

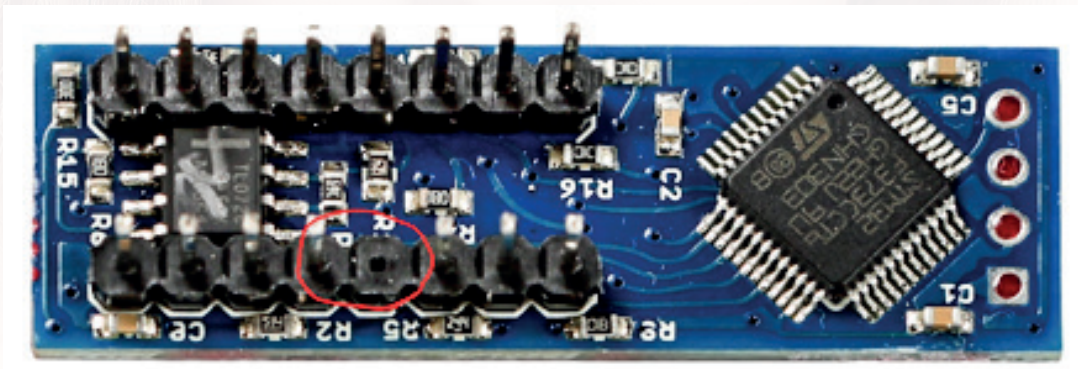


The replacement procedure is pretty straightforward. First, ensure that the power of your modular system is turned off. Unscrew your Furthrrrr Generator from the rack and plug the rainbow power cable off. Navigate to the VCO Core you are going to replace. It's recommended to replace Carrier's core. The Modulator's replacement isn't as necessary as the Carrier is considered as main tone generator. Also keep in mind you will lose the Lo-range mode in the Modulator with the new STRONG-ZERO VCO Core. Lo-range means frequencies from 0.1–0.5 Hz to 10 Hz to use Modulator as an LFO. Also, keep in mind if you need some really long LFO – you may use Terminals envelopes that go up to 10 seconds per rise or fall stages (up to 20 seconds in total) or Shuttle Control LFO generators that go up to 1 minute per cycle.

Carefully pull the stock VCO core off. After pulling, it may still have some remains of hot glue on the chip and its socket. Carefully tear them off with tweezers or a paper knife. Be careful not to damage the PCB where the socket is soldered into.



Each VCO Core has white round pin at one of its edges that defines the first pin and its orientation. Moreover, there is one pin of the Core missing and one pin in the socket is covered with soldering acting together as a key, so it is literally impossible to plug the Core in the wrong way backwards.



Install the new Core in the socket and press on it with thumbs of both hands tightly to ensure it is installed fully. There still should be like 3mm pitch between the socket and plastic housing of the Core pins.



It is recommended to secure the new core, so it will not fall off the socket when the module is shaking at transportation. Take a stick of hot glue and put it on an open fire of a match, light or a candle for up to 10 seconds but before the stick will become to melt and drip. Afterwards immediately touch with that side of the stick to one of the edges of the newly installed Core in the place where its pins are inserted into the socket. Repeat the procedure with heating hot glue for securing opposite side of the Core. Now yours newly installed Core is secured. You may put the hot glue stick aside now to calm it down. Attention – it may be hot and sticky as hell for a while.

The last thing you have to check is ensure MOOD INDEX FM jumper is put to the LIN side of pins, so the linear FM will be applied thru the voltage controlled Mood-ulation index.

Plug your Furthrrrr Generator back into rack minding the polarity (red pin on the side of rainbow cable means -12V and should be connected to that side in the socket on the PCB of the Furthrrrr Generator and in your power bus board with same polarity.

Before screwing the Furthrrrr Generator back into rack, turn on your modular system to ensure the new core works (the tuners blink when you crank the pitch knob or a certain VCO or blink when you apply FM modulation to it).

The final step is to ensure the proper 1v/oct tracking for your new core. By default, it should track exact same as stock cores, however if you may want to bring some fine trimming, check clause 3 of part 5 of Furthrrrr Generator manual to trim the oscillator to a proper tuning.

***Now you may screw your Furthrrrr Generator in the rack.
It's trimmed and ready for drop out.***

The characteristics of the product described are subject to change without notice.