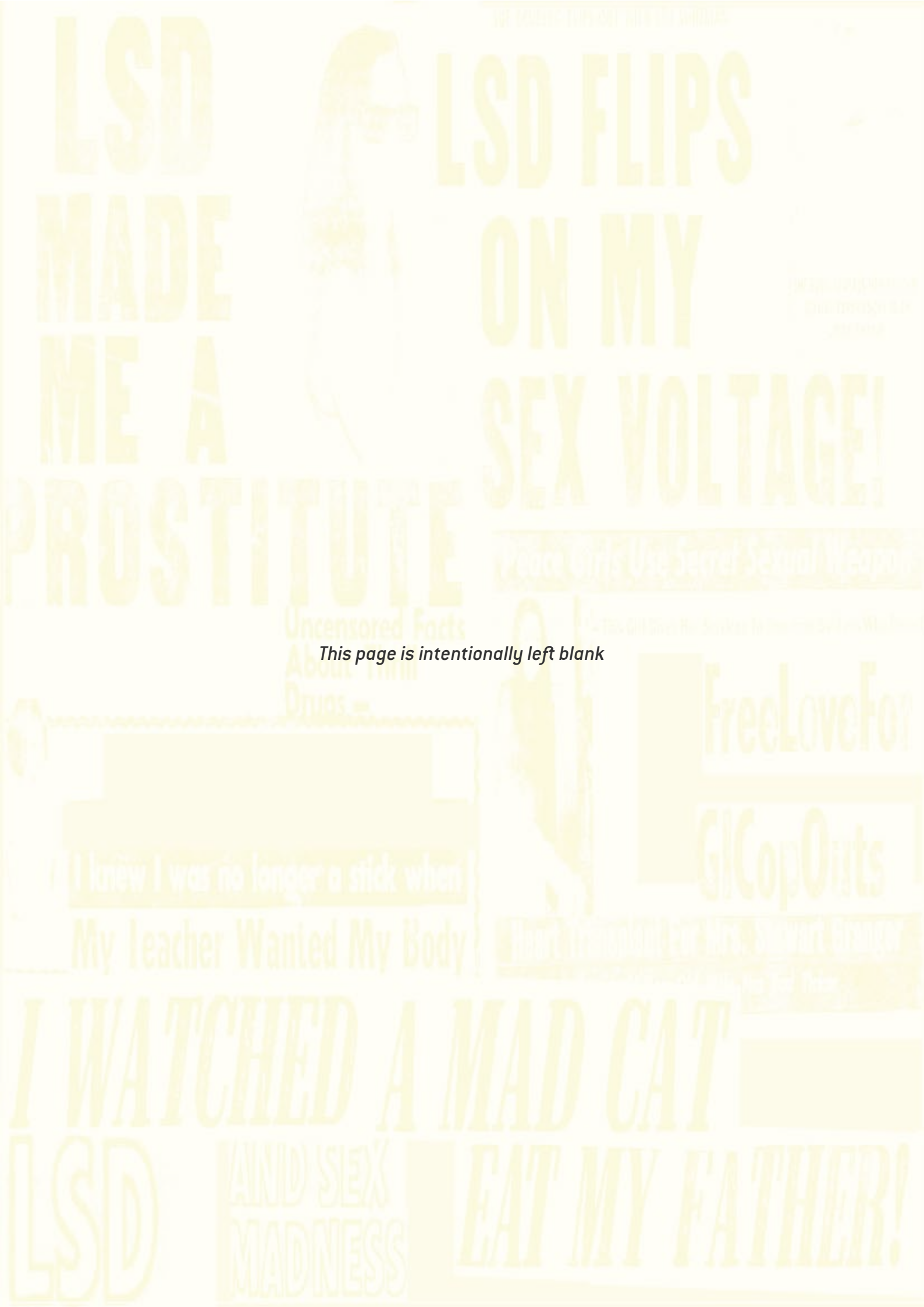
Endorphin.es

Furthrrrr Generator

Operator's manual
version 1.1



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We are proud to present you the Ɛndorphin.es!

Ɛndorphines & Associates is a company which specializes in modular synthesizers, engineering for sound design & contemporary art.

Utilizing the design philosophy of vintage *Buchla modular synthesizers* from the 60-80s we produce modules with a strong ***westcoast*** feeling in mind. These are not part-for-part clones but entirely new circuits & ideas created with modern electronic components.

The Endorphin.es are fully compatible with popular modern modular synthesizers like *Dœpfer, Tiptop Audio, Malekko, Cwejman, Metasonix, Analogue Systems* and others and implements accurate 1 or 1.2 v/oct standard.

The overall technical specifications are as follows:

- 3U eurorack format, modules depth: up to 1 inch
- audio signals and control voltages: -5v ... +5 volts (10 volts peak-to-peak)
- +/-12 volts operation via *Dœpfer A-100 bus* 16 pin power connector
- extensive usage of internal busses, in adherence to the established Dœpfer standard, thus allowing the routing of control voltages to modules along the bus-board (if supported).

Beginning from the date of each product purchase a 1-year warranty is guaranteed for each product in case of any manufacturing errors or other functional deficiencies during runtime.

The warranty dœs not apply in case of:

- damage caused by misuse
- mechanical damage arising from careless treatment (dropping, vigorous shaking, mishandling, etc.)
- damage caused by liquids or powders penetrating the device
- heat damage caused by overexposure to sunlight or heating
- electric damage caused by improper connecting.

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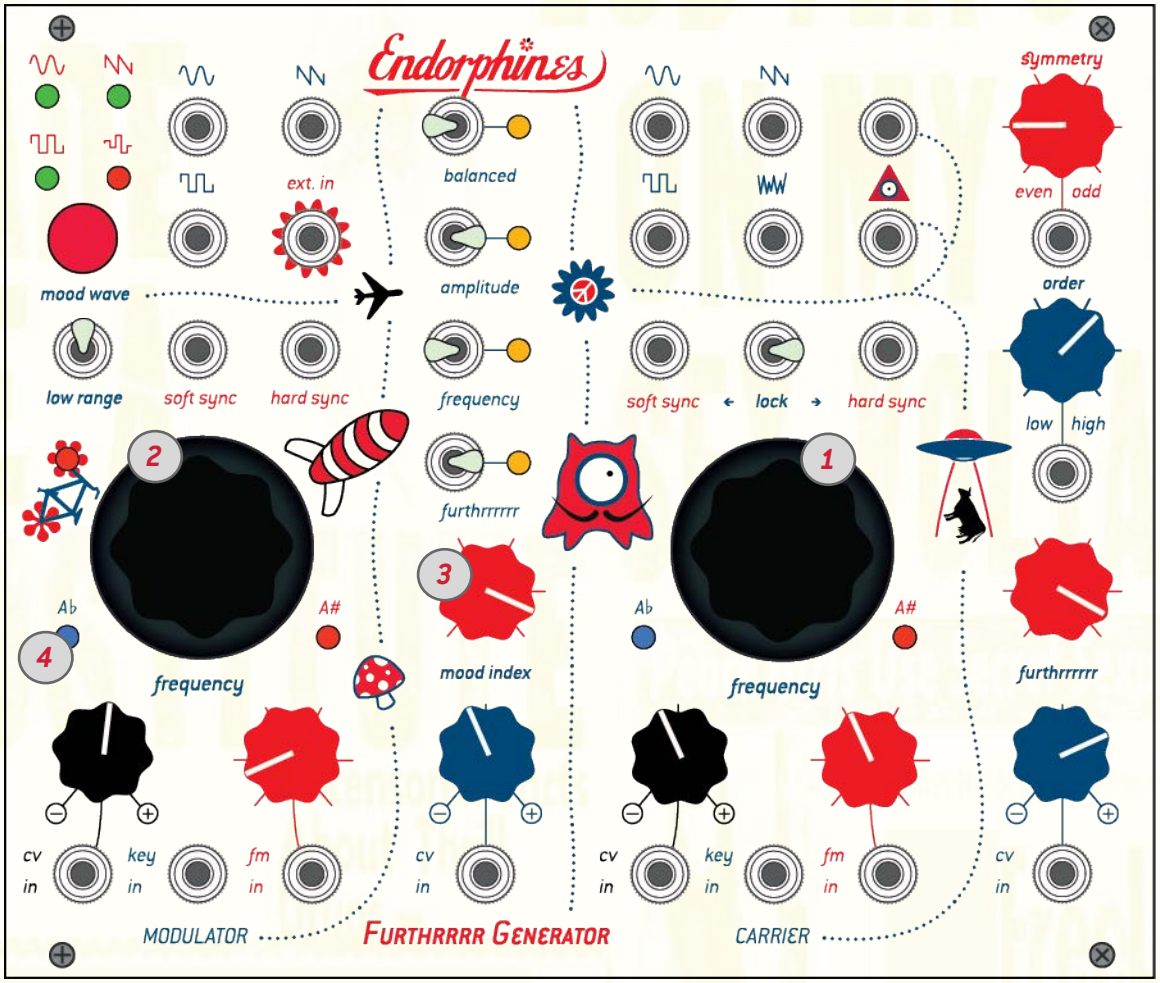
FURTHRRRR GENERATOR



THE ENDORPHIN.ES WILL MAKE YOU HAPPY:

- 30 HP/TE width, up to 1" in depth (super slim & therefore skiff friendly)
- All analog signal path inspired by & based upon famous westcoast synthesis — a module steeped in the tradition of harmonic generation based on additive synthesis theory
- 2 discrete OTA triangle-core VCOs both with hard- (resettable) and soft- (inverting) syncs
- Selectable tracking (1 or 1.2 v/oct) by setting a jumper
- Bolted potentiometers, wobble free for heavy duty
- Multi-turn frequency knobs sweep up to 10 octaves
- Oscillator tuners that simply always work
- Of course, RoHS & cat friendly ;)

1. Carrier (a.k.a. 'Principal' or 'Slave') Oscillator is the beginning of everything.

It features accurate 1 (or 1.2 User-selectable) volt per octave scaling, two types of synchronization, sine, saw (falling ramp), pulse outputs, white (flat) noise & finally – a dedicated *harmonic* section. This section is where the magic happens & involves a complex chain of waveshapers with wavefolder as well as modulation index with amplitude, balanced, frequency and *timbral* modulation. Every parameter is voltage controlled, interactive and depends on each other's position.

The whole scheme is a bit complicated; so don't get frustrated if you don't understand everything the first time around. A good way to approach the Furthrrrr Generator is to understand the following concept: ***forget about the waveforms!***

At first, some theory.

What is *harmonics*? They are voltages or currents at frequencies that are a multiple of the fundamental frequency.

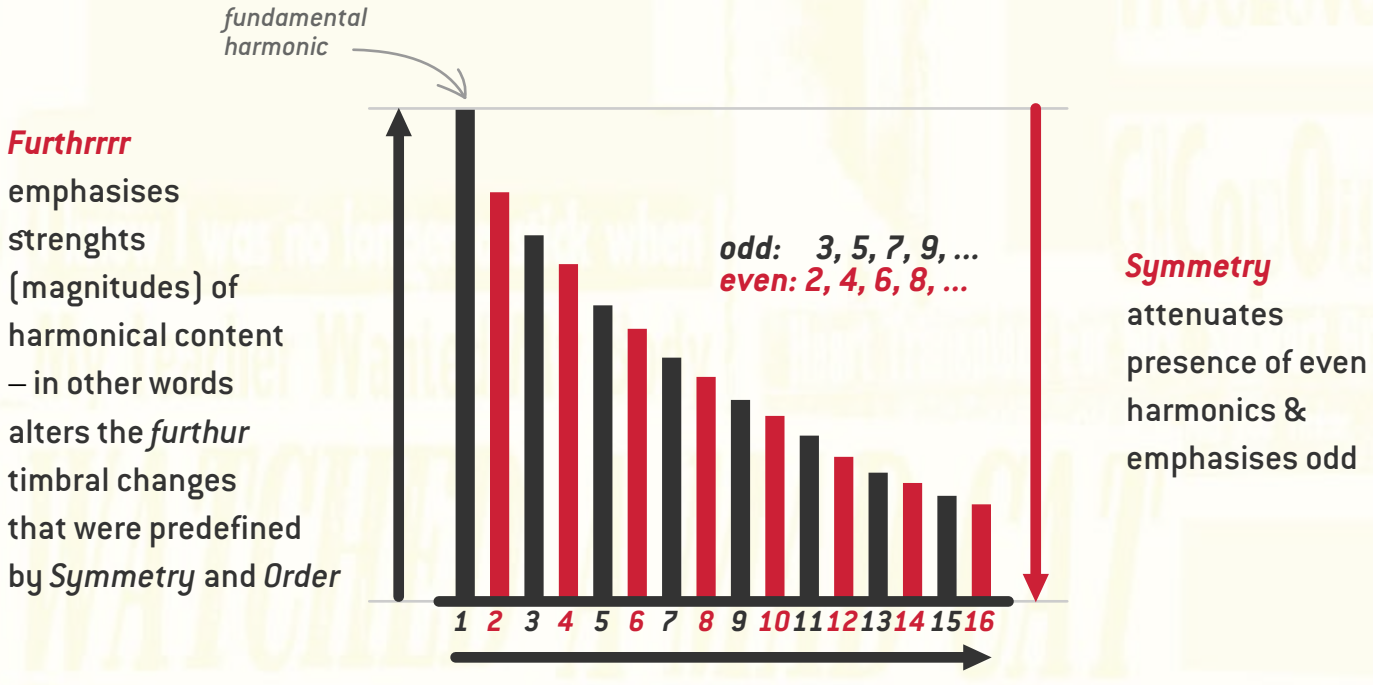
Pure *sine wave* contains only the one – *fundamental* harmonic.

Symmetric waves like a *square* and a *triangle* contain only ***odd*** harmonics – they are *symmetrical* above and below their horizontal centerlines.

Asymmetric waves like a *sawtooth* contain both ***even*** & ***odd*** harmonics.

The harmonic section operates with 3 knobs: ***Furthrrrr, Symmetry & Order***.

Here is kind of a starmap to imagine waveshaping scheme:



A pure square wave with *50% duty cycle* contains only odd harmonics. Altering its ***pulse-width*** will enrich it with even harmonics & make it sound more *musical*. The ***Symmetry*** knob also alters pulse-width of a square wave output of Carrier oscillator. In full clockwise (*odd*) position there will be a pure square with 50% of duty cycle from square jack output. However, when cranking ***Symmetry*** knob counter-clockwise (to *even*) the pulse duration of the square wave decreases and further in all the way to the left position it becomes a so called ***spike*** wave with very short almost 0% duty cycle.

In analog world the waveforms are not so perfect as in digital. In fact they don't need to pretend to it. Thus even a pure analog sine wave contains some minor amounts of even & odd harmonics and sometimes that is being considered as what brings uniqueness and feeling of living to analog sound.

Therefore tweaking the knobs of Carrier Oscillator's waveshapers will not give you *precise* settings of the harmonics amounts at the *Final output*, however they represent a cunning approximation of what's going on in the sound spectrum as upon additive synthesis.

2. Modulator (shaping, modulating, or 'Master') Oscillator produces sine, saw (falling ramp), and square waves. When the low-range switch is switched down, the oscillator acts as an ***Low Frequency Oscillator*** (LED blinks according to frequency in this mode & the tuner shuts off).

Both oscillators can produce a wide range of sounds: the lowest value is nearly 10 cycles per second & the highest up to 10 kHz equipped with only one multi-turn potentiometer that sweeps up to 10 octaves or approximately *1 octave per revolution* of the knob if you want to put it in that way. The higher / lower frequencies can be reached, of course, with CV, modulations & the low-range switch.

The heart of the oscillators is based around the *triangle core*. An ordinary comparator based voltage controlled relaxation oscillator in fact. This oscillator core is carefully made from scratch & then advanced with all the features sufficient for almost all modular tasks.

Through the use of our own integrated circuit technology & then producing proprietary chips we achieved great results regarding the oscillators' tracking & stage-ready temperature compensation as well. This includes accurate 1 or 1.2 volt per octave standard, well-known musical sounding frequency modulation & both types of oscillator synchronization or reset; *soft* & *hard*.

How synchronization works. Synchronization is sometimes needed in order to eliminate *beating* (discrepancies in pitch) between two oscillators. Sometimes it is used intentionally to enrich the synchronized oscillators with harmonics (*overtones*).

The ***hard sync*** fully restarts the oscillator's cycle & delivers the results one would expect from a hard-synched oscillator; namely a tearing & ripping harmonic sound. In fact, it enriches all output waveforms with even & odd harmonics in amounts *akin* to a sawtooth waveform.

When ***soft sync*** is applied, it dœs not restart the waveform's cycle but changes (inverts) its direction (up to the next half-cycle) & gives a much more complex harmonic saturation as a result. By applying an audio signal to the ***soft sync input*** of an oscillator wherein the soft synched oscillator (the one receiving the audio signal from the other oscillator) is higher in pitch than the incoming signal, the result will be that the receiving oscillator's square wave output will be *pulse-width modulated* (***PWM***) in some way.

Both types of synchronization can function independently thereby obtaining far more interesting results. Do keep in mind that applying the same synchronization signal to both soft- & hard-syncs inputs simultaneously will result in hard sync.

3. Mood Index allows one to simultaneously modulate different parts of the Carrier (right side) Oscillator. The amount of modulation is voltage controlled & the Mood Index can be considered to be a smooth *wet/dry* (or amount) control for how much modulation is being sent to the appropriate destination as selected by the 4 toggle switches located above the red ***Mood Index*** knob. All modulation is bypassed when the Mood Index knob is fully counter-clockwise (all the way to the left).

The choice as to what kind of waveshape should modulate the Mood Index bus is selected with the ***Mood Wave*** button at the top-left. This features an additional random ***Sample & Hold*** source the rate of which is clocked by the Modulator (left) Oscillator).

An ***External Mood Input*** is also available so that you can inject any signal that you want (even from the Carrier oscillator so that it can FM itself!) This powerful option is activated when a jack is inserted into the ***ext. in*** (the one with the *flower*) jack. This will replace the sample & hold signal.

The following is a list of destinations of the Mood Index bus with additional information as to what is going on & how they work. The Modulation Oscillator can simultaneously or separately modulate the Carrier Oscillator. A destination will receive the modulation from the Mood Index bus if its corresponding LED is illuminated.

Balanced Modulation – This is the multiplying of the Carrier & Modulation Oscillators. Sometimes this is referred to as *ring modulation*. The Mood Index control dictates the amount of Balanced Modulation being driven to the carrier oscillator.

Balanced Modulation produces the sum & difference of the frequencies (harmonics) present in each waveform & new harmonics (*intermodulations*) are obtained.

Amplitude Modulation – The Modulation Oscillator controls the amplitude of the Carrier Oscillator at its outputs. Audio rate A.M. will result in artifacts that somewhat resemble Balanced Modulation. Sub-audio rate A.M. results in tremolo at the Carrier's Final Outputs.

Frequency Modulation – This defines the level of modulation of the Carrier Oscillator's pitch. This is often referred to by its initials; ***F.M***. This can be viewed as *analog two-operator fm-synthesis*. Frequency Modulation can be switched to ***linear*** or ***exponential*** via a jumper on the back of the PCB (see the last chapter of that manual). Sub-audio rate F.M. results in vibrato at the Carrier Oscillator's Outputs.

There is pre-routed connection from Carrier Final output into Modulator's ***fm in*** normalled input jack for producing quick ***cross-modulation*** without use of extra patch cables. When Modulator's ***fm in*** knob is fully counter-clockwise, then no modulation gœs from Carrier. That connection breaks when any plug is inserted into *fm in* jack.

Furthrrrr Modulation – Ah, the good stuff! This produces the modulation of the ***Furthrrrr*** control. This will result in either more or less *Furthrrrr waveshaping*. The harmonics added by this process are among the richest & most dramatic *timbral variations* in synthesis.

C'est la 'Raison d'être' de notre belle bête!

4. Looney Tuners are visible via two LEDs on either side of the 10-turn frequency knobs of each oscillator. They are *digital* tuners which continuously scan the frequency of each oscillator & compare it with the frequency multiples of the ***A-notes*** within the range or hearing & even lower: 13.75 Hz, 27.5 Hz, 55 Hz,... , 440 Hz and up to 14,080 Hz.

When the oscillator's frequency is lower than the *nearest* A-note then left LED lights.

When it's higher than the nearest A-note, the right LED lights. When the frequency *lands* exactly upon any A-note, both LEDs will light. Now what could possibly be simpler & more performance-friendly than that?!

The tuners only represent a visual pitch reference point & do not affect pitch or the audio path in any way.

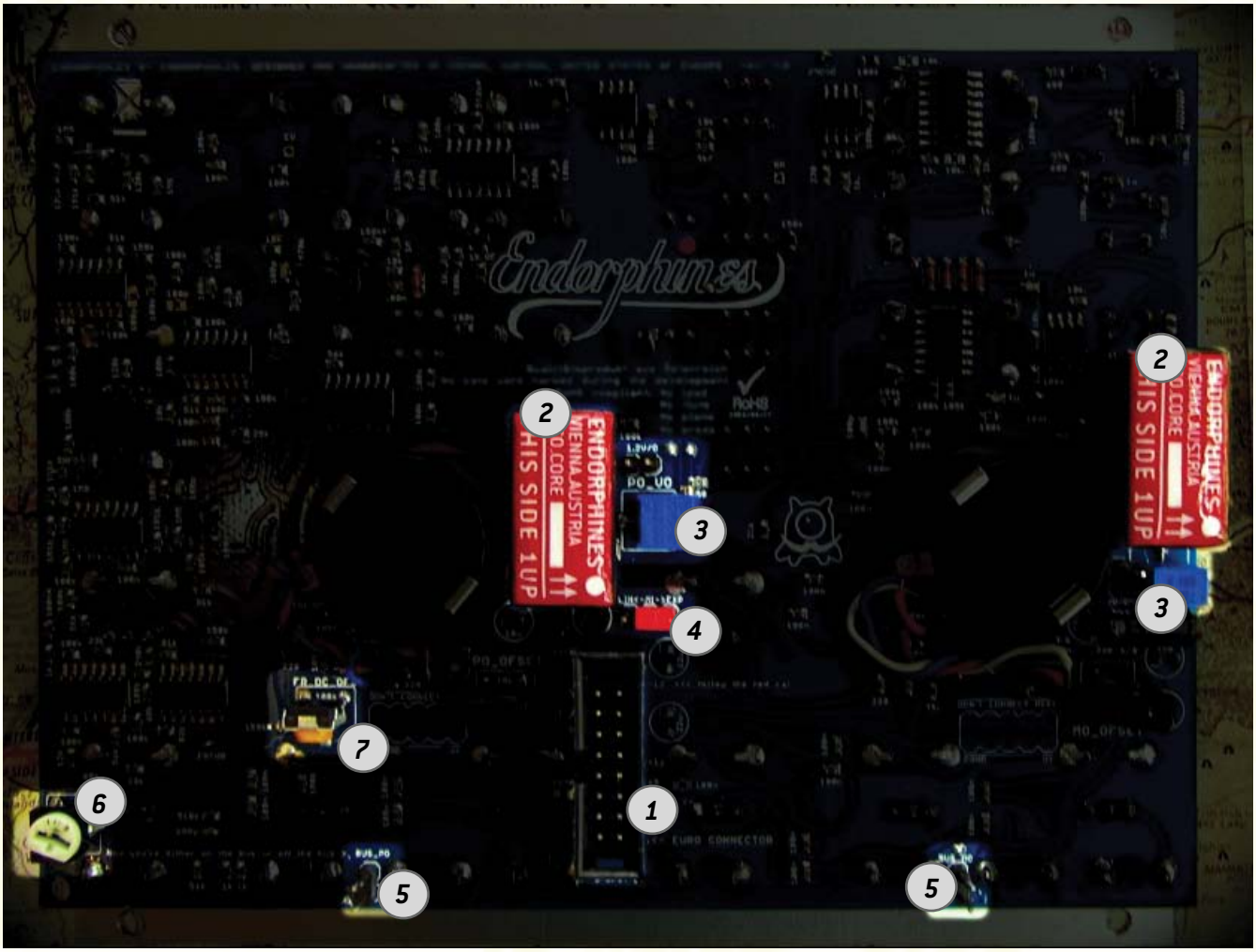
Tuning is now fun & dœs not require any live monitoring or listening at all — you can tune your oscillators before or during the performance very quickly & without any sound fed to the speakers & your audience.

Note: frequency modulation applied to the oscillator will alter its tune correspondingly & the resulting pitch will be *varying in time*. In that case tuners will go mad.

We advise you to trust your ears & enjoy your Endorphin.es!

Special thanks go to ***Marko Ciciliani*** (www.ciciliani.com) and ***Kent Iverson*** for invaluable contribution and sincere help.

5. Trimming & servicing. The module comes factory tuned to *1 v/oct scale* and is trimmed before shipping. However, sometimes you may want to make some calibrations.
On the picture below you can see the backside of the module with the following controls:



1. ***Dœpfer A-100 bus IDC-connector.*** We advise that you use the supplied 16-pin ribbon cable. Please ensure that the ***red stripe*** of the cable (the top pair of pins/wires) is connected to ***negative -12V*** rail when plugging the cable to your power distribution board. If the ribbon cable is connected backwards, the module might be destroyed. Please ensure twice before connecting since this is not covered under warranty.

2. ***VCO cores of oscillators.*** In the picture above, the left core is the Carrier oscillator & the right is the Modulator. Please don't remove them as this can harm the unit due to mishandling. This is *also* not covered under warranty.

3. ***Volt per octave scale trimmers & jumpers for 1.2 v/oct. scaling.*** If you need 1.2v/oct scaling – just install the jumper to appropriate oscillator. If you stay with 1v/oct scaling – don't do anything. However the scaling might be trimmed in both cases after changing the tracking mode.

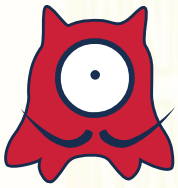
   Volt per octave trimming procedure *never was so easy as now. Just play an infinite looping sequence of two consequent same notes from 4-5 different octaves & use the tuners to determine whether the subsequent pitches are deviating from the preceding lower notes. With ordinary flat screwdriver make small turns in clockwise or counter-clockwise directions and observe the tuners. The tracking considered as trimmed when you obtain up to 5 octaves of stable tune.*

4. ***Type of frequency modulation at Mood index.*** The jumper defines whether it will be ***linear*** (or just called *ordinary f.m.*, AC-coupled) or ***exponential*** (*c.v. / pitch*, DC-coupled) frequency modulation.

5. ***On-the-Bus & Off-the-Bus jumpers.*** When appropriate jumper is installed, the CV from the 13/14th pins of the Dœpfer A-100 system bus (Bus CV) gœs directly to the exponental CV input (***key in***) of the appropriate oscillator. However, the connection is conveniently temporarily *broken* when a plug is inserted into the appropriate ***key in*** jack of the module.

6. ***Initial sensivity of Furthrrrr control.*** When *Symmetry, Order & Furthrrrr* knobs are fully counter-clockwise and no modulation is applied to waveshaper, there should be a sine wave at the *Final outputs* of the module. If necessarily, adjust a little this trimmer so that the sine wave will have the maximum amplitude (approx. up to 10Vpp) without *distortion / folding*. Use your ears if you don't have an oscilloscope.

7. ***Furthrrrr control DC-symmetry offset.*** Adjust carefully only when the sine wave at Final outputs of Carrier Oscillator begins to *distort / fold* non-symmetrically when cranking Furthrrrr control while Symmetry & Order controls are fully counter-clockwise.



Enjoy your Furthrrrr and never forget
The Endorphin.es will make you happy!