After Later Audio nRings
User Manual

nRings is based on the *Rings* module designed by Emilie Gillet of Mutable Instruments (mutable-instruments.net)

Overview

nRings is a resonator, the essential ingredient at the core of several physical modelling techniques. It transforms an external, unpitched excitation audio signal (such as a click, a burst of noise, or whatever is captured by a contact microphone) into a full-bodied pitched sound. *nRings* is the bar, the tube or the bunch of strings you cause to vibrate with an external signal.

Installation

nRings is designed for Eurorack synthesizer systems.

Specs:

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+12 V: 120 mA
-12 V:   5 mA
Width:   8 HP
Depth:  25 mm
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Unlike most Eurorack modules, the red stripe of the ribbon cable can be oriented at either end of the power connector.

Resonator Types

Modal Resonator

Modal synthesis works by simulating the phenomena of resonance at play in vibrating structures, i.e. the way a string or plate will absorb some frequencies while accentuating, or "ringing" other frequencies called the modes. When we pluck a string, strike a drum or blow in a tube, that short burst of energy contains many frequencies. Some of these fall outside of the modes, and are absorbed while others excite the modes, producing a stable, pitched sound. Each mode corresponds to a harmonic or partial in the spectrum of the sound, and is modelled by a

band-pass filter. The Q factor of the filter determines how sustained the oscillations of the corresponding partial are. Various materials or structures are characterized by different relationships between the frequencies of their modes, which *nRings* recreates.

Sympathetic strings

Stringed instruments such as the sitar or sarod make use of strings that are not directly struck or plucked by the musician, but that simply respond to the vibration of the other strings, and add extra overtones or undertones to their sound.

nRings simulates this phenomenon with a bunch of virtual strings (synthesized with comb filters), allowing the addition of extra tones to an audio signal. The tuning ratio between these strings can be altered.

Non-linear/inharmonic strings

This last method is based on the extended Karplus-Strong method: the excitation signal is sent to a comb filter with an absorption filter, simulating the multiple reflections of a wave propagating on a string and being absorbed at its ends. However, to bring more variety to the sound, *nRings* adds three extra ingredients to this classic:

1. a delay-compensated all-pole absorption filter creating more drastic plucking effects,
2. delay time modulation emulating the sound of instruments with a curved bridge (like the sitar or tanpura),
3. and an all-pass filter in the delay loop, shifting the position of the partials and recreating the tension of piano string or completely bonkers inharmonic timbres.

Polyphony and "strumming"

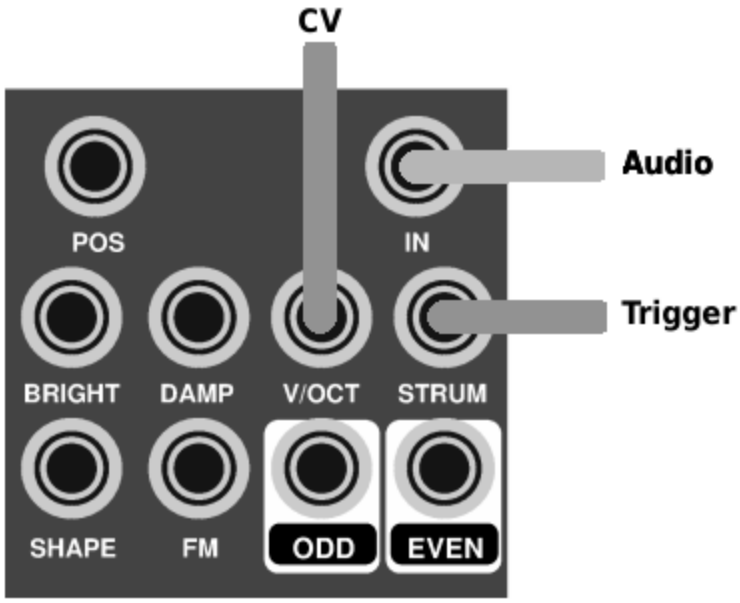
nRings' polyphony can be set to one, two, or four notes.

Enabling four-note polyphony doesn't mean that four CV input jacks will magically appear on the module, but simply that four notes played in sequence will nicely overlap without cutting each other's tails. To play chords, you will need to "strum" the module by playing a rapid sequence of notes.

Making the right connections

Ideally, *nRings* would need three input signals:

- A trigger signal in the **STRUM** input, to indicate when the currently playing note should fade away, and when a new note is starting.
- A CV signal in the **V/OCT** input, to control the note frequency.
- An audio signal in the **IN** input, which will hit, strike or caress the resonator.



Because it might not always be possible to get these three signals from your system, *nRings* makes the following assumptions:

(1) If no patch cable is inserted in the **IN** audio input, the module will synthesize its own excitation signal whenever a note is strummed. This excitation signal is either a low-pass filtered pulse, or a burst of noise depending on the resonator type.

(2) If no patch cable is inserted in the **STRUM** audio input, the module will determine that a new string should be strummed either by:

- Detecting note changes on the **V/OCT** input. Or:
- Detecting sharp transients of the **IN** audio signal when nothing is patched in the **V/OCT input.**

As a result...

You can play nRings *with just the note CV signal taken from a sequencer or stepped random module. The module will produce a suitable excitation signal internally, and will switch strings for every new note.*

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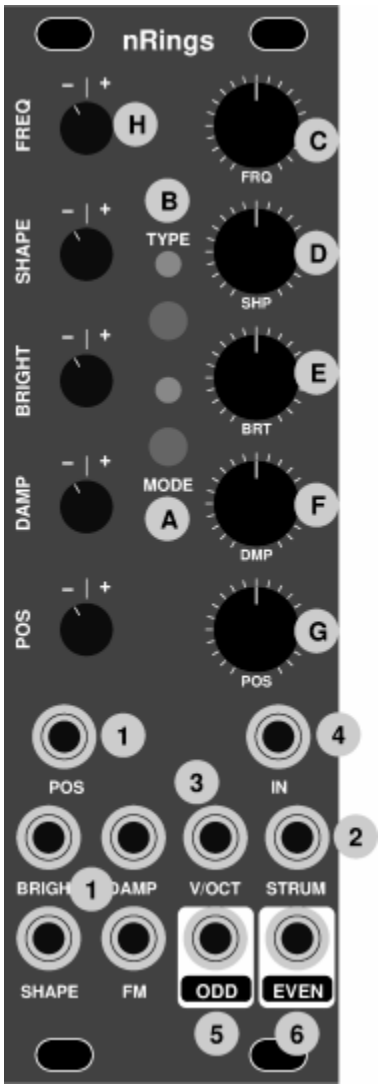
Front panel



Controls

A. Polyphony **MODE**. Selects between monophonic, duophonic or quadraphonic operation.

B. Resonator **TYPE**. Modal, sympathetic strings or non-linear/inharmonic string.

C. Coarse **FREQ**. Quantized in semitones when a cable is patched in the **V/OCT** (3) input.

D. Harmonic **SHAPE**. Frequency ratio between the partials of the modal resonator, detuning of the sympathetic strings, or non-linearity/inharmonicity of the string.

E. BRIGHT. Adjusts the level of higher harmonics in the signal, by the simultaneous action of a low-pass filter on the exciter signal (closed at 8 o'clock, fully open at 12 o'clock), and of the damping filter (or Q factor of the higher modes) on the rest of the course of the potentiometer.

F. DAMP. Controls the decay time of the sound.

G. Excitation **POS**. Controls on which point of the string/surface the excitation is applied. This setting will remind you of the PWM control of a square oscillator or of the comb-filtering effect of a phaser.

H. Attenuverters for the CV inputs.

Inputs and outputs

1. Resonator parameters CV inputs. Note that the frequency CV (**FM**) input is normalized to a small constant voltage, allowing its attenuverter to be used as a fine frequency control when no patch cable is inserted.

2. STRUM trigger input, for polyphonic operation. Whenever a trigger is received on this input, the module freezes the currently playing voice, lets it decay, and starts a note on the next voice. This input is normalized to a step detector on the **V/OCT** input and a transient detector on the **IN** input.

3. V/OCT CV input. Controls the main frequency of the resonator.

4. Audio **IN** for the excitation signal. Modular levels are expected! This input is normalized to a pulse/burst generator that reacts to note changes on the **V/OCT** CV input or triggers on the **STRUM** input.

5, 6. ODD and **EVEN** audio outputs. In *monophonic* mode, these two outputs carry two complementary components of the sound (odd and even numbered partials with the modal resonator, dephased components due to picking position and pickup placement with the string resonators).

In *polyphonic* mode, they split the signal into odd and even numbered strings/plates.

Note that you need to plug a cable in the **EVEN** (6) output to actually split the two signals otherwise they will be mixed together and sent to **ODD** (5).