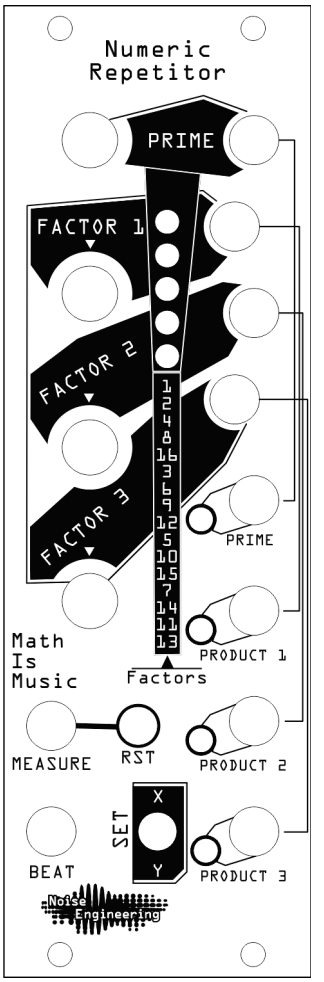
Noise Engineering

Numeric Repetitor

Dynamic Rythmic Generator



Overview

Type	Rhythm Generator
Size	8HP Eurorack
Depth	.8 Inches
Power	2x5 Eurorack
+12 mA	50
-12 mA	5

Numeric Repetitor is a rhythmic gate generator based on binary arithmetic. A core pattern forms the basis and variation is achieved by treating this pattern as a binary number and multiplying it by another.

This module contains 32 prime rhythms derived by examining all possible rhythms and weeding out bad ones via heuristic. Three of the outputs are variable by knob or CV. It requires only a beat clock to run.

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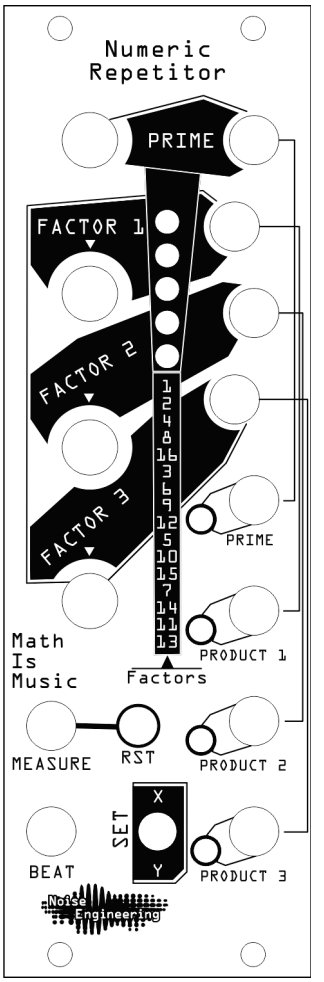

Patching Suggestions

The simplest way to get to know Numeric Repetitor is to simply patch a master clock into BEAT and connect each of the four outputs to the gate of four different percussion modules, envelopes or other gate triggered modules. You can get an idea of the patterns included by adjusting the PRIME knob and a feel for how the time offset works by playing with the FACTOR knobs.

The next step is to patch a CV. A CV sequencer or just a simple gate are both useful for controlling either the PRIME pattern or the FACTOR offset. These can be used to generate a wide variety of related rhythms and dynamic variations. A simple CV example is to take the beat clock being sent to Numeric Repetitor and divide it by 64. Send this divided beat in to one of the FACTOR inputs. Adjust the related FACTOR knob to control the amount of time offset that occurs to the FACTOR.

Many more complicated schemes are possible to dynamically vary the rhythms. Any slow control voltage or gate might produce an interesting variation!

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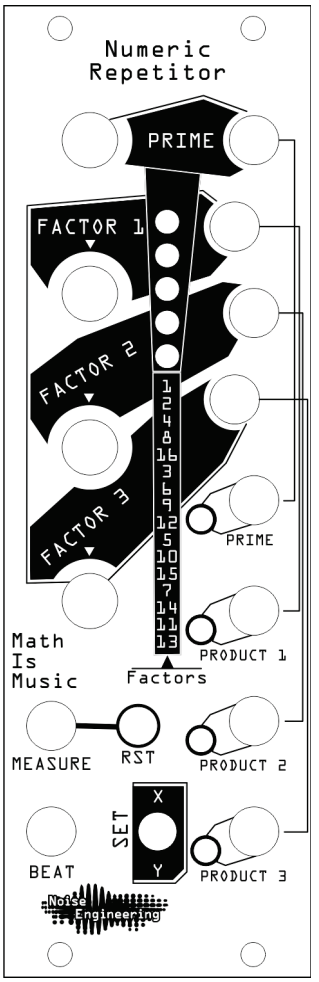

Design Notes

Numeric Repetitor started as a somewhat crazy idea: if rhythms can be represented as binary numbers what basic operations will produce human-meaningful variations?

A simple example: 1000. One downbeat every four units. If we multiply this by three (11 in binary) we get: 11000. Treating the measure as a circle then gives the rhythm: 1001. This is a human significant variation as it gives us an upbeat before the down. Other small number give interesting variations as well. Any power of two (2,4,8,16) perform offsets in time (1000 becomes 0010 with 4 for example). Odd numbers will always keep the down beat (1000 becomes 1100 multiplied by 9).

Once I had worked through many of these sorts of examples on paper I became convinced that this variation technique was worth putting into hardware. The format of the Zularic Repeitior was nearly identical to what was needed for the Numeric so it became the platform for development.

To determine which PRIME rhythms would be included a program was written to determine the best possible set of PRIME rhythms given the following criteria:

1. Rhythm must be 16 units long
2. Rhythm must have a beat on the first unit
3. Rhythm must not be rotationally equivalent to any other rhythm in the set
5. Rhythm must not have two beats in a row
6. Rhythm must not have a gap between beats of more than 6 units
7. Rhythm must have more than 3 beats per measure
8. Rhythm must have less than 8 beats per measure.
9. Rhythm must not have more than 2 beats in the first half of the measure than in the second half for all rotations

These criteria produce exactly 32 rhythms from the 65536 possible 16 unit rhythms. They are ordered by numeric value with “four on the floor” being set 1 pattern 0.

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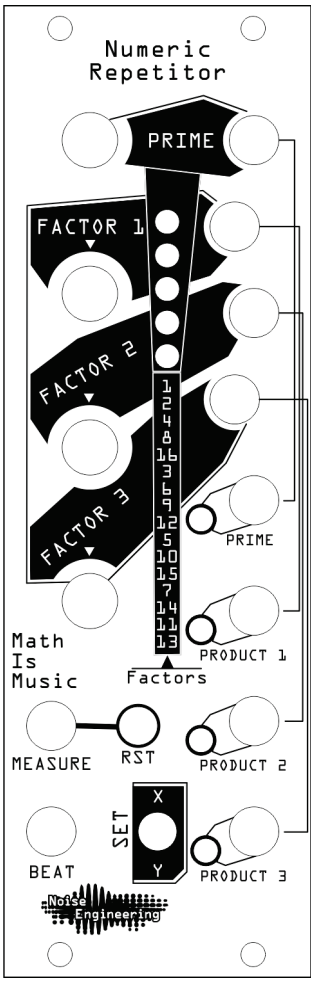

Interface

PRIME (knob)

The PRIME knob selects the pattern set that is output. The PRIME knob acts as a scalar for the PRIME CV. The current patch is displayed on the LEDs near the center top. A key to the patterns is included later in the manual.

FACTOR 1-3 (knob, input CV)

The FACTOR knobs control the variation factor applied to the PRODUCT outputs. The rhythm variation is a based on the angle of the prime knob. This angle selects the product (these are the numbers listed on the panel) which is multiplied by the PRIME pattern to produce the PRODUCT rhythm. FACTOR 2 and 3 additionally modify the rhythm by performing a binary-and between the prime rhythm and the values 0x0F0F and 0xF003 respectively before the multiplication variation.

SET

The SET switch selects which bank of patterns to use. The status of the BANK switch is indicated by the orange LED.

BEAT

The BEAT input is a clock input that advances the time on the rising edge and returns any active gates to zero on the falling edge.

MEASURE

The MEASURE input resets the beat to the start of the measure on a rising edge.

RST

The RST button will pause the advancement of time while depressed and when released reset the time back to the start of the measure.

PRIME (output)

PRIME outputs a 6v low impedance gate suitable for controlling most any gate driven device.

PRODUCT 1-3 (output)

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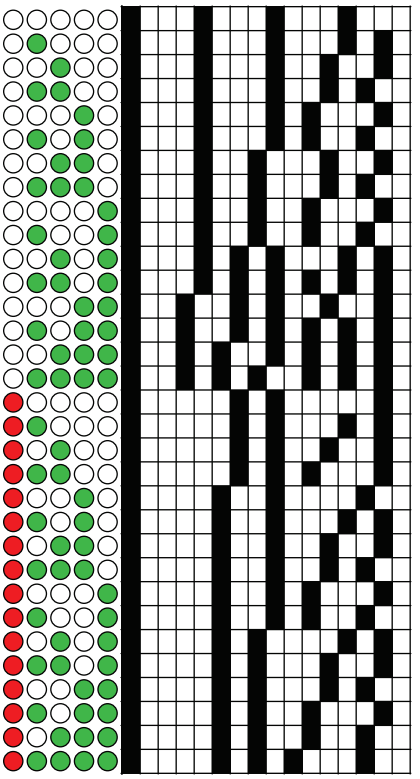
Prime Patterns

Prime & 1



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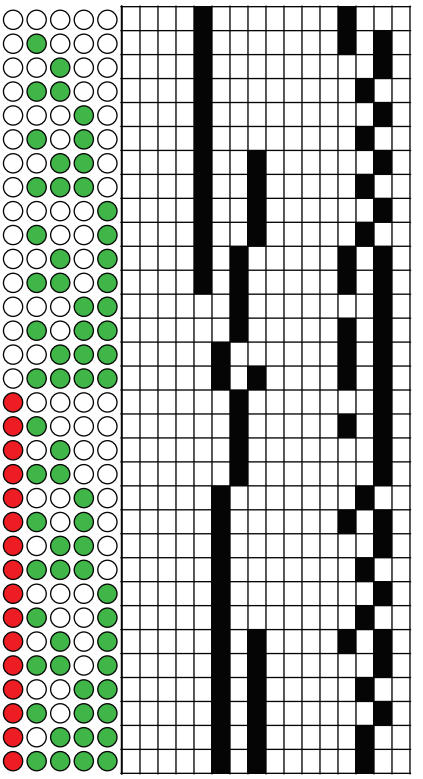

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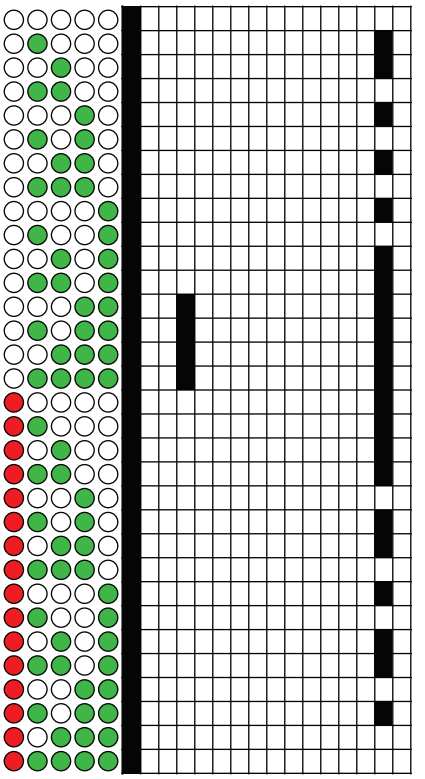

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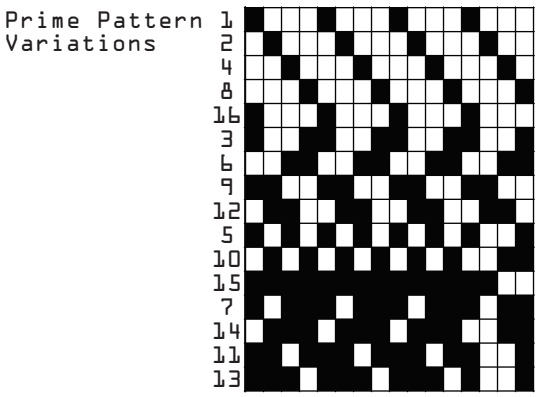
Example Variations



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