logic

S F E
devices

INSTRUMENT · VERSION 1.1

WHAT IT DOES

logic is a drum machine made of sine waves and logic. Four clock sources make simple on and off patterns. Each of the four voices takes two of them, or the pattern of another voice, and combines them with a logic function: and, or, xor and their relatives. Where the result is true, the voice is struck.

The voices are struck sine waves: a second sine bends the first, the wave can be folded back on itself, the pitch falls from above at each hit, and a gate closes darker as the hit fades. The four oscillators can bend each other. At the end the sum runs through a drive stage with ten shapes and a stereo plate reverb.

Every pattern is a state per step, counted from one clock, so two sources never drift against each other.

The sound engine contains open source code under the MIT licence.

USING IT

Put logic on a MIDI track and start Live's transport. With sequencer on, the pattern runs with the transport. MIDI notes C1, C#1, D1 and D#1 strike kick, drum, bell and hi-hat, with velocity, whether the sequencer runs or not, so the voices can also be played from pads.

At the start the kick plays every quarter, the drum fills the gaps of a three step cycle, the bell plays the xor of a euclid pattern and a slow sine, and the hi-hat plays where the kick does not. drive mix and plate are at 0, the sum is clean and dry.

SOURCES

Four sources, a to d. Each has a cycle of steps and is on for part of it.

`type`	divide: on for the first steps of every cycle. euclid: hits spread as evenly as possible over the cycle. sine: on while a slow sine wave is above a threshold. random: a fixed random pattern that repeats.
`length`	The cycle in steps, 1 to 32. sine also uses the decimal, so 6.5 only lines up again after 13 steps.
`fill`	How much of the cycle is on. divide: how many steps in a row. euclid: how many hits. sine: the threshold. random: the density.
`shift`	Moves the pattern later by 0 to 31 steps. random: picks another fixed pattern.
`rate`	How long one step is: 1/8, 1/16, 1/32, 1/8t or 1/16t. Every source and every voice moves one step at a time.
`swing`	Delays every second step. At 100 % the late step sits on the third of a triplet.
`reset`	Starts every source from its first step again after 1, 2, 4, 8 or 16 bars. Off: the sources run on from the moment the transport starts.

LOGIC

One row per voice and one for the accent. Each row reads two inputs and combines them.

in a, in b	A source, a to d, or a voice. A voice above in the list is read in the same step; the voice itself, or a voice below it, is read in the step before. That way a voice can follow, avoid or answer another one.
logic	and: both. a not b: a, except where b. a: a alone. xor: one or the other but not both. or: either. nor: neither. not a: everywhere a is off. nand: everywhere except where both are on. The list runs from sparse to dense. a and not a ignore in b.
chance	How likely a hit of the voice really sounds. A voice that reads this voice reads what really sounded.
accent amount	The accent row has the same two inputs and logic as a voice. Where its result is true, all voices hit at full strength; accent amount sets how much quieter the hits off the accent are. At 0 every hit is equally strong.
sequencer	Runs the pattern with Live's transport. Off: the voices only play from MIDI notes C1 to D#1.

The grid to the right shows the last 16 steps of the four voices and the accent row; each column is written when its step plays. Below it, logic shows after how many bars all sources in use line up again. With chance below 100 % the voices vary inside that cycle.

VOICES

kick, drum, bell and hi-hat are built the same way and differ only in their settings. Each has six dials.

tune	The note the voice settles on, in semitones, from C-1 to C8 (C3 is middle C).
sweep	How many octaves above tune the voice starts and falls from at each hit, 0 to 4.
decay	How long a hit sounds, 5 ms to 2 s, until it has faded by about 40 dB. The gate closes darker as it fades.
timbre	Brightness. Up to 50 % a second sine bends the first one (frequency modulation), above 50 % the wave is also folded back on itself. Harder hits open brighter.
ratio	Pitch of the second sine, as a multiple of the first, 0.25 to 8. Whole numbers sound like skin and wood, numbers in between like metal.
volume	Level of the voice, from off to +6 dB.
cross fm	The four oscillators bend each other: every voice is frequency modulated by the sine oscillators of the other three, all the time, whether they sound or not; the gates only decide what you hear. Fine at the bottom, metallic at the top. At 0 they stay apart.

DRIVE

The sum of the four voices runs through a drive stage before master. It works inside the oversampled part of the voices, so it folds back very little and needs no oversampling of its own. drive mix blends the clean and the driven sum; at 0 the sum is untouched.

drive	How hard the sum is driven into the shape, through a soft overdrive input stage.
drive timbre	The parameter of the chosen shape: how hard it clips, how many times it folds, how wide the dead zone of diode is.
drive mix	Blend between the clean and the driven sum. The level of the driven sum is matched to the clean one, so the color changes more than the loudness.
drive model	The shape the sum is driven into, chosen in the menu model. Switching blends over 15 ms.
soft clip	Rounds off the peaks, gently.
overdrive	A warmer saturation that grows with drive.
fuzz	A hard saturation that also lifts the quiet parts: the tails of the hits get longer and denser.
sine fold	Folds the wave back on itself in round turns.
tri fold	Folds it in sharp turns.
signature	A bent curve with its own fixed color.
asymmetric	Leaves the upper half of the wave and squeezes the lower half, which adds even harmonics.
bi fold	A steep fold with many turns, bright and metallic.
diode	Only the louder part passes, the rest falls silent: decays break off and crackle.
octave	Rectifies the wave, which adds the octave above.

PLATE AND OUTPUT

plate	A stereo plate reverb after master. Blends between the dry sum and the reverb, at equal power. The send into the plate is high passed at 140 Hz, so the kick stays dry and the low end stays tight. At 0 the plate is off and, once its tail has died away, does not use any processing.
plate time	How long the plate rings.
master	Output level of all four voices, from off to +6 dB, before a soft ceiling just under full scale.

The display above master shows the waveform leaving the device. Without the plate both channels carry the same signal.