



Pulsor 2 Reference Manual

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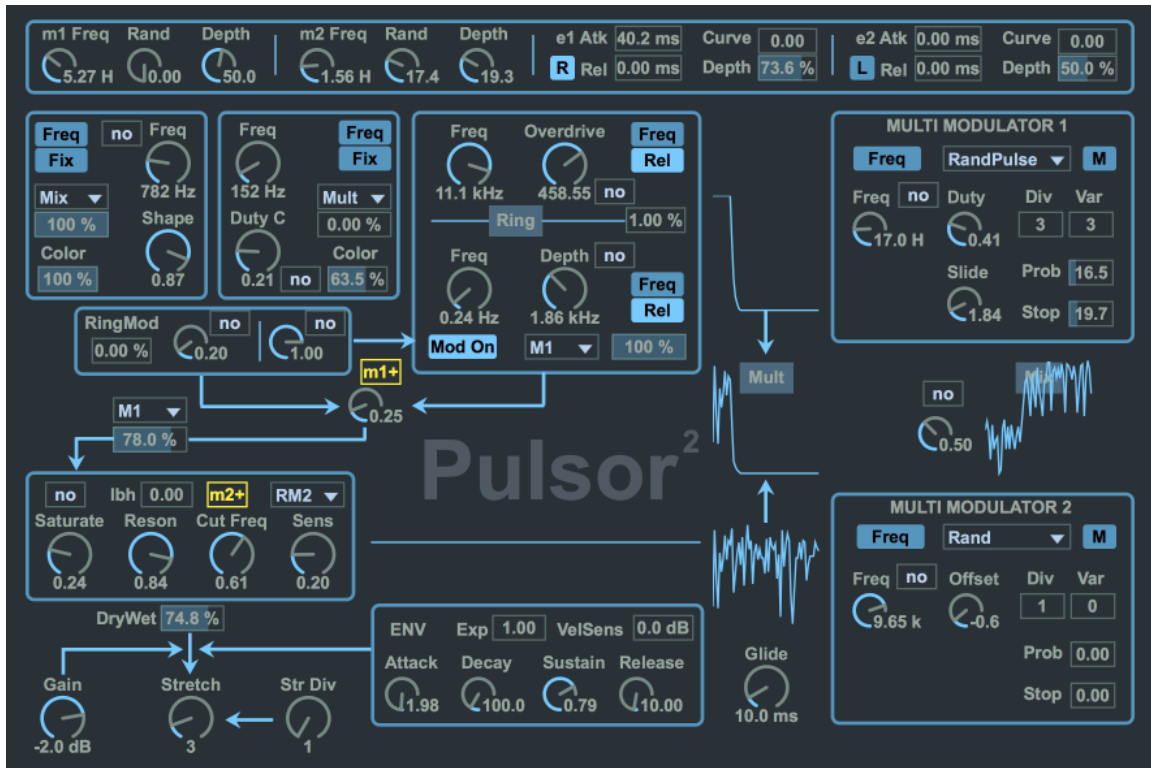
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Introduction



Pulsor 2 is the evolution of our Max for Live virtual instrument **Pulsor**. With **Pulsor 2** you can create amazing soundscapes, resonant lead synths, evolvable basses, unorthodox percussive sounds, rhythmic textures, distorted noises and endless variations of the weirdest and uncharted sounds you can imagine.

THE MAIN INTERFACE

The Main Interface is very simple:



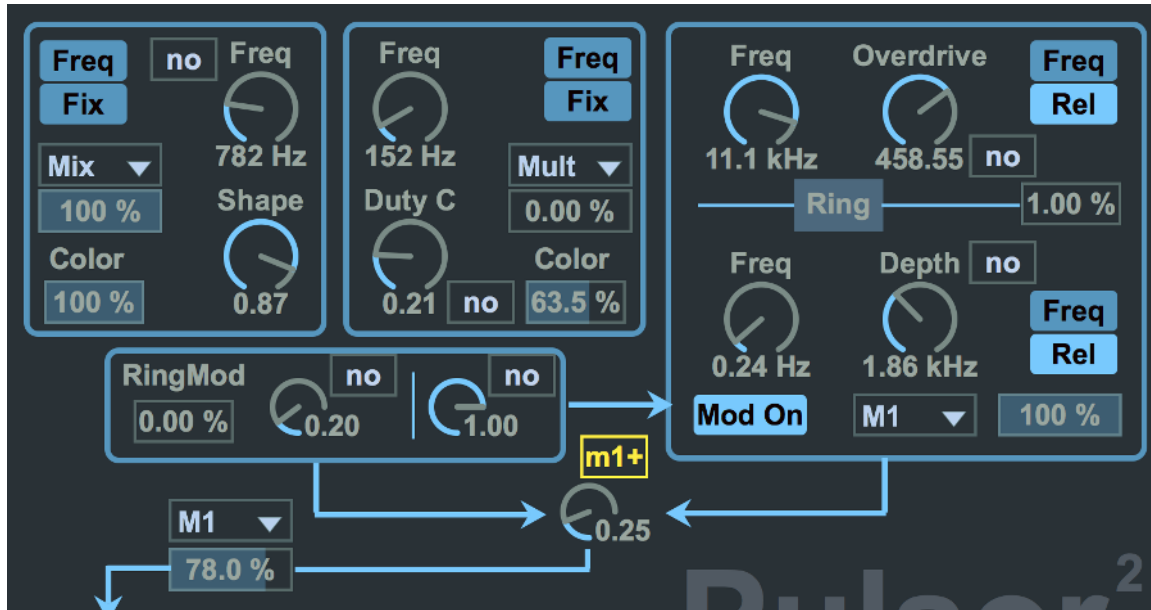
It has a "**Trigger**" checkbox to play and hold a note, a number box ("**Trig Note**") where you can choose the held note, and an "**EDIT**" button that let you open the synth **Floating Panel**.

You can play the synth with a MIDI keyboard or a MIDI clip, or by simply activating the "**Trigger**" checkbox: this will play a note while you edit the parameters in the **Floating Panel**.

THE FLOATING PANEL

The Floating Panel has more than 100 parameters to tweak your sound. Lets examine it section by section.

The Oscillators



Pulsor 2 has 4 oscillators; each oscillator has its own waveform and modulation/distortion algorithm.

All the oscillators have two buttons:

- **Freq/Pitch** Button to change between Frequency and Semitone values,
- **Fix/Rel** Button to change between fixed frequency/pitch and MIDI relative frequency/pitch.

In **Pitch** mode the dial is incremented in cents (1/100 of semitone) when dragged with the mouse. If you want a larger increment press the Command (Mac) or Control (Windows) key when dragging.

When in **Rel**(ative) mode, the frequencies are referred to the note C3: so, for instance if you set a frequency of 100 Hz for an oscillator, it will be 100 Hz when you play a C3 MIDI note, but it will be a 200 Hz frequency if you play a C4 MIDI note. If you always want the same frequency for all notes, switch to **Fix**(ed) mode.

There are two modulation sources for the oscillators: the **Multi Modulators** (more later) to modulate the amplitude and the **LFO/Envelopes** (more later) to modulate the timbre/distorsion parameter.

OSCILLATOR 1



The first oscillator parameters are located on the upper left of the Floating Panel.

The produced sound is a morphing triangular/sawtooth waveform: the **Shape** parameter (lower right) gradually transforms the triangular waveform (value 0) to a sawtooth one (value 1).

The **Color** parameter (lower left) sets the amount of harmonics produced by the oscillator. When this parameter is 0 the oscillator generates a sine wave.

On the upper right we have the **Freq/Pitch** parameter. The little box marked [no] near the **Freq** parameter is the **LFO/Envelopes chooser**: you can choose one of the two LFO or two Envelopes that you see on the upper part of the Floating Panel. You can use it to modulate the **Freq** parameter (i.e. to alter the frequency or pitch of the oscillator).

The **LFO/Envelopes** are explained later.

The menu you see on the left, the one with the "Mix" item selected, is the **Multi Modulator chooser**. The **Multi Modulator** is used to modulate the amplitude of the oscillator. The number box below the menu sets the amount of amplitude modulation.

The **Multi Modulators** are explained in detail below.

OSCILLATOR 2



The second oscillator parameters are located on the right of the first oscillator's.

The basic sound is a Square Wave: the **Duty C**(ycle) parameter sets the ratio between the positive and negative phase of the cycle: when it is 0.5 each phase take half a cycle. The little box marked [no] near the **Duty C** parameter is the **LFO/Envelopes chooser**: you can choose one of the two LFO or two Envelopes that you see on the upper part of the Floating Panel. You can use it to modulate the **Duty C** parameter.

The **LFO/Envelopes** are explained later.

The **Color** parameter (lower left) sets the amount of harmonics produced by the oscillator. When this parameter is 0 the oscillator generates a sine wave.

The menu you see on the right, the one with the "Mult" item selected, is the **Multi Modulator chooser**. The **Multi Modulator** is used to modulate the amplitude of the oscillator. The number box below the menu sets the amount of amplitude modulation.

The **Multi Modulators** are explained in detail below.

OSCILLATORS 3 AND 4



Oscillators 3 and 4 are joined in a Ring Modulation circuit. Moreover the fourth oscillator is frequency modulated by the first two oscillators. The parameters are located on the right of the second oscillator's. In the upper side there are the third oscillator parameters, in the lower side the fourth's.

The basic sound of the third oscillator is a Sine Wave: the **Overdrive** parameter sets a sinusoidal waveshaping distortion. As usual the little box marked [no] near the **Overdrive** parameter is the **LFO/Envelopes chooser**: you can choose one of the two LFO or two Envelopes that you see on the upper part of the Floating Panel.

The basic sound of the fourth oscillator is also a Sine Wave: the **Depth** parameter sets the amount of frequency modulation performed by oscillators 1/2 (we will explain this in a moment). The little box marked [no] near the **Depth** parameter is the **LFO/Envelopes chooser**: you can choose one of the two LFO or two Envelopes that you see on the upper part of the Floating Panel.

How does the FM work on the fourth oscillator? If f.i. the **Freq** parameter is 500 Hz and the **Depth** parameter is 100 Hz, the fourth oscillator's frequency will oscillate between 400 (500-100) and 600 (500+100) Hz. The frequency of the fourth oscillator is modulated by a mix of the first two oscillators. How are the first two oscillators mixed? We will cover this in the next section.

The **Mod On/Off** button (bottom left) is used to activate or deactivate the frequency modulation.

As we said the Oscillators 3 and 4 are ring modulated between themselves: the **Mix/Ring** parameter on the middle right side is used to mix the two oscillator and set the amount of ring modulation. When the parameter's value is 0% we only hear the Oscillator 3, when it is 50% we hear the full ring modulation, when it is 100% we only hear the Oscillator 4. When this value is 0% and 50% we have a mix of the Oscillator 3 and the ring modulation, when the value is between 50% and 100% we have a mix of the ring modulation and the Oscillator 4.

The menu you see on the bottom, the one with the "M2" item selected, is the **Multi Modulator chooser**. The **Multi Modulator** is used to modulate the amplitude of the two oscillator. The number box on the right the menu sets the amount of amplitude modulation.

The **Multi Modulators** are explained in detail below.

The Mix Section



Below the 4 oscillators we can see the **Mix Section**.

There are 3 dials, from the upper left we will call them **Mix 1**, **Mix 2** and **Mix 3**: the two dials inside the rectangular frame (**Mix 1** and **Mix 2**) are used to mix Oscillators 1 and 2. The dial below the rectangular frame (**Mix 3**) is used to mix the previously mixed couples of oscillators 1/2 and 3/4.

Note that to the left of **Mix 1** there is a **RingMod** parameter: this is an additional mixing stage between a ringmodulation of oscillator 1 and 2 and **Mix 1**. In other words, when the **RingMod** parameter is 0%, only **M**

As you can see **Mix 1** signal is routed to **Mix 3**, which also receives a signal from the oscillators 3 and 4 frame. With these two dials you can carefully blend the sound of each oscillator.

Note that to the left of **Mix 1** there is a **RingMod** parameter: this is an additional mixing stage between a ring modulation of oscillator 1 and 2 and **Mix 1**. In other words, when the **RingMod** parameter is 0%, only **Mix 1** is sent to **Mix 3**, when the **RingMod** parameter is 100%, only the ring modulation is sent to **Mix 3**. Other values give a different mixing of the ring modulation and **Mix 1**.

Mix 2 signal is used to modulate the frequency of Oscillator 4 (see above): mixing the two possibly distorted waveforms of the first two oscillators you can create some complex frequency modulations. If you consider that you can modulate the amplitude of the two oscillators with the **Multi Modulators** and change the amount of distortion/modulation with the **LFO/Envelopes**, the possibilities are endless. And (if this is not enough) each **Mix** dial can be modulated by the **LFO/Envelopes**!

The global signal **Mix 3** is sent to a **Multi Modulator** for further amplitude modulation and then to a Filter Distortion section.

The Filter Distortion Section



In this section the signal is first distorted using an algorithm not used in the oscillators distortion (parameter **Distort**), then sent to a 24 dB "analog-morphing" filter (the filter is different from the one in Pulsor 1, it is a zero-delay feedback nonlinear SVF). Note that the **Distortion** parameter can be modulated by the **LFO/Envelopes** modulators.

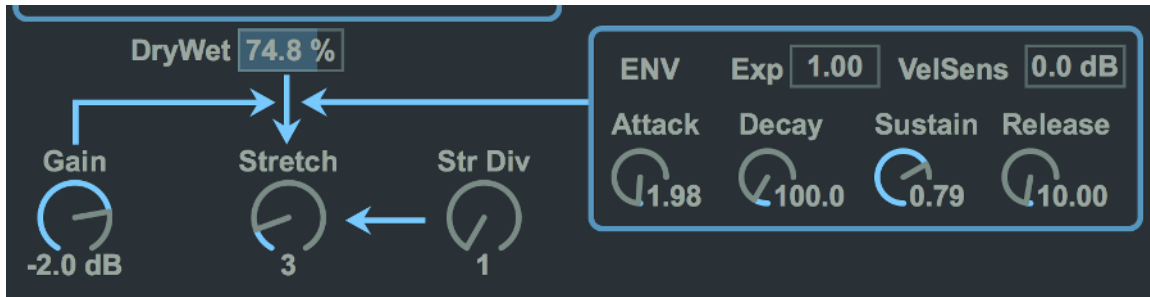
The filter has a parameter, **lbh**, to morph its characteristics from low-pass (value 0), band-pass (value 0.5) and high-pass (value 1).

The **Cut Freq** parameter is relative to the MIDI note played and can be modulated by the **LFO/Envelopes** modulators.

The **Sens**(itivity) parameter is used to further modulate the cut off frequency by means of the Amplitude Envelope (see below) or of a **Multi Modulator**.

Below the Distortion Filter frame there is a **DryWet** parameter to mix the unfiltered and filtered signals.

The Output Section



After the filtering the signal is shaped by an **Amplitude Envelope** (the frame on the right) which has an **Exp** parameter (to get exponential segments) and a **VelSens** (Velocity Sensitivity) parameter expressed in dB.

Before being sent out the signal spectrum can be “stretched” using the **Stretch** and **Str Div** parameters. The **Stretch** parameter is a multiplication factor of the distance between the harmonics of the oscillators. For instance, if the oscillator fundamental is 100 Hz, and the **Stretch** factor is 3, the spectrum would be 100, 400, 700, 1000 Hz and so on. The **Str Div** parameter is a division factor: for instance, if the oscillator fundamental is 100 Hz, and the **Str Div** factor is 3, the spectrum would be 100, 133.3, 166.6, 200 Hz and so on. You can set both parameters and have a stretching factor, for instance, of 5/4 (**Stretch**: 5 and **Str Div**: 4). Nota that the stretching factor is calculated on the MIDI note you send to the synth: so if the actual frequency of the signal doesn’t correspond to that of the MIDI note, the result could be unpredictable (and this is not a bad thing!).

The signal is then rescaled by the **Gain** parameter on the left.

The Multi Modulators

The screenshot displays the control interface for two Multi Modulators. At the top, a waveform shows a signal that has just decayed from a high level. Below this, a central waveform labeled 'Mult' shows a complex, irregular signal. To the right, another waveform labeled 'Mix' shows a high-frequency, irregular signal. Below the 'Mult' waveform, a 'Glide' control is set to 10.0 ms. The interface is divided into two main control panels:

MULTI MODULATOR 1

- Mode: **Freq** (selected)
- Waveform: **RandPulse** (dropdown menu)
- Parameter: **M** (checkbox)
- Freq: **no** (checkbox), value: 17.0 H (knob)
- Duty: 0.41 (knob)
- Div: 3 (input box)
- Var: 3 (input box)
- Slide: 1.84 (knob)
- Prob: 16.5 (input box)
- Stop: 19.7 (input box)

MULTI MODULATOR 2

- Mode: **Freq** (selected)
- Waveform: **Rand** (dropdown menu)
- Parameter: **M** (checkbox)
- Freq: **no** (checkbox), value: 9.65 k (knob)
- Offset: -0.6 (knob)
- Div: 1 (input box)
- Var: 0 (input box)
- Prob: 0.00 (input box)
- Stop: 0.00 (input box)

There are two **Multi Modulators**, which are a series of different *unipolar* (i.e. only positive) oscillators with parameters to change their shape. The waveforms for each modulator (selectable with the top menu) are:

Sine, Triangle, Pulse, Rand (a random noise generator), RandCurve (a smooth random noise generator), Samp&Hold (a stepped random noise generator), and RandPulse (pulse generator with random pulse width).

The frequency ranges from 0 to 15000 Hz, and can be modulated by the **LFO/Envelopes** modulators. When in **Sync** mode the frequency is expressed in beat subdivision: quarter, eight and so on.

Depending on the waveform there are these additional parameters:

Offset (a sort of exponential DC offset: try it to see how it works)

Exp (exponential shaping: again, try it to see how it works)

Duty (duty factor for pulse waveform)

Slide (this parameter smooths the pulse edges)

Trisaw (for triangle waveform only, morph between sawtooth and triangle shape).

The **Div** and **Var** parameters (on the right of the **Multi Modulator** frame) are used for a stuttering effect: f.i. a **Var** of 3 means that the waveform cycle is divided into 3 faster cycles. The **Var** parameter sets a random variation of the subdivision: f.i. with **Div** = 5 and **Var** = 2 the possible subdivisions are 3, 4, 5, 6 and 7 (two slower than 5 and two faster). The **Prob** parameter below sets the probability that the stutter actually occur. The **Stop** parameter sets the probability that the modulator stops for a cycle.

Between the two **Multi Modulators** there is a **Mix** dial to mix the signal of the modulators: note that this parameter can be modulated by the **LFO/Envelopes** modulators.

Moreover the two modulators are multiplied, so we have 4 sources of modulation:

Mod 1, Mod 2, Mult and **Mix**.

Now take a look at the **Multi Modulator chooser** in the Oscillators parameter: this menu contains 9 items

None (no modulation)

M1 (first modulator)

M2 (second modulator)

Mult

Mix

RM1 (reversed first modulator)

RM2 (reversed second modulator)

RMult (reversed multiplication)

RMix (reversed mix)

The LFO/Envelopes modulators



These modulators are on the top of the **Floating Panel**: there are 2 LFOs and 2 Envelopes.

The **LFO** parameters are Frequency, Random factor and Modulation Depth.

There are actually two LFO modes

- "normal" mode: the Random factor represents a frequency deviation of the sine wave LFO.

- "interpolate" mode: the Random factor represents an interpolation between a sine wave and a random wave.

The **Envelope** parameters are Attack and Release times, Curve (exponential) factor, Depth and Legato/Retrigger switch.

To see how they work let's take a look at one of the many **LFO/Envelopes choosers** we find in the Oscillators parameters. The list of items is the following:

no (no modulation)

m1+ (first LFO in normal mode)

m1- (reversed first LFO in normal mode)

m1i (first LFO in interpolate mode)

m2+, m2-, m2i (see above)

e1+ (first envelope)

e1- (first envelope reversed)

e2+, e2- (see above)

The **Depth** factor for the **LFOs** depends on the nearest limit of the modulated parameter.

F.i. if the modulated parameter range is 0-10, and the actual, unmodulated, value is 8, the maximum possible depth is 2, so the value can oscillate between 6 (i.e 8-2) and 10 (i.e. 8+2). In this case if the Depth is 100% (the maximum) the value oscillates between 6 and 10, if it is 50% it oscillates between 7 and 9 and so on.

For the **Envelopes** the **Depth** parameter is always related to the lowest limit. So if the value is 8 and the depth is 100% the envelope goes from 0 to 8, if the depth is 50% the envelope goes from 4 to 8 and so on. The *reversed* envelope goes from 8 to 0, from 8 to 4 and so on.

CREDITS

A big “thank you” to our friends at Surreal Machines (<http://www.surrealmachines.com>) who gave us permission to use their zero-delay feedback nonlinear SV filter in our device.