Fritz Granular Engine

Operation Manual

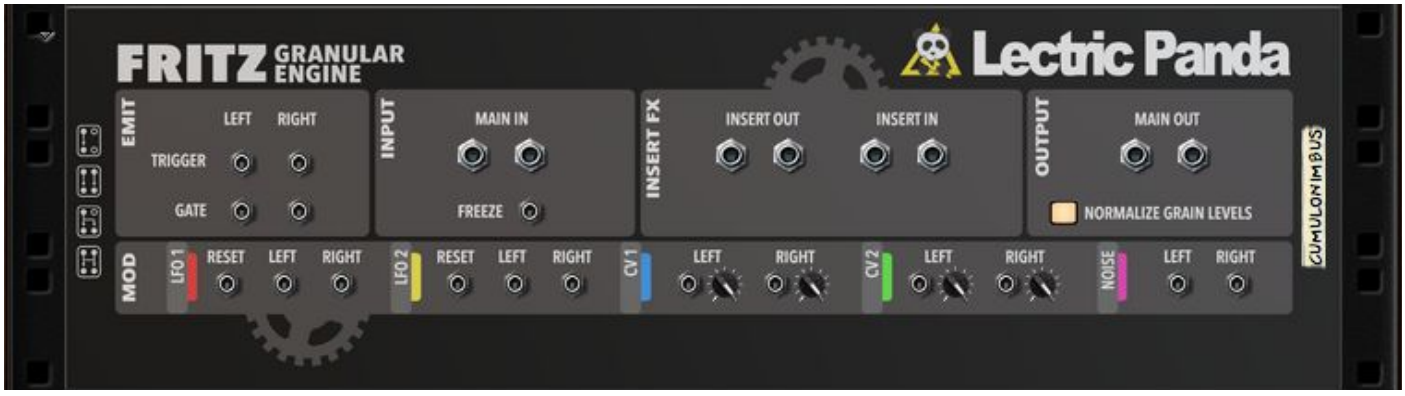
Version 1.0.0

Table of Contents

Introduction

Fritz is a granular effects device. Incoming audio is sampled and played back in small segments called grains. Many grains can play back at the same time, each with its own snapshot of parameters. This simple mechanism can create complex and psychedelic effects including pitch shifting, drone synthesis, stutters, glitches, reverbs, pitch smearing, time smearing, chord generation, texture clouds, sonic bursting, and many effects that are too strange to be named.

Front Panel



Back Panel

Random Patch Generation

Quite possibly the most important button on Fritz is the random patch generator. It is the icon of a die next to the patch loading and saving. Insert Fritz into your effects chain and keep clicking the die to come up with endless permutations of granular effects.

Grains

Many grains can be active and overlapping at the same time. When a grain is created, its parameters are locked in place. So while there can be constant parameter modulation, a single grain plays back with the snapshot of those parameters from when it was created.

Parameter Modulation

Modulation Amount Knob.

Modulation Source Selection.

Almost every parameter can be modulated. Each modulation knob () is shared by the five modulation sources.

The active modulation source is selected via the buttons () in the **MOD** section. The modulation knob will show the active modulation sources' respective color underneath the knob.

The current amount of modulation for each source is shown in the display next to the knob ().

Stereo Handling

Fritz has two separate granular systems running in parallel, one for each stereo channel. Almost all parameter modulation is also in stereo and can be adjusted with **L-R Phase Stereo** controls. Grains can fade over to the other channel using their **Pan** parameter. The **Stereo Spread** parameter adjusts the output stereo field width. Audio and CV Inputs on the back are normalized to function as mono when only the left is connected.

Bypass and Meter Section

Bypass and Meter Front Panel

In **Bypass** mode, the input signal passes through, unaffected, to the main outputs of the device. In **On** mode, the device outputs the processed signal. **Off** mode mutes the inputs and outputs.

The left stereo meter shows the input signal level.
The right stereo meter shows the output signal level.

Emit Section

Emit Section Front Panel

Emit Section Back Panel

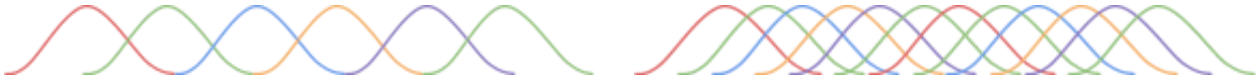
Rate

Sets the frequency at which grains are created. When tempo sync is disabled, the range is from 0Hz (Off) to 500Hz. When tempo sync is enabled, the available rates are: 32/4, 28/4, 24/4, 20/4, 16/4, 12/4, 8/4, 7/4, 6/4, 5/4, 4/4, 7/8, 3/4, 5/8, 2/4, 7/16, 5/8T, 3/8, 4/8T, 5/16, 1/4, 3/16, 2/8T, 1/8, 1/8T, 1/16, 1/16T, 1/32, 1/32T, 1/64, 1/128.

Rate Length Link

Enabling the **Rate Length Link** will cause the **Length** of grains to be inversely proportional to the emit **Rate**. If the emit **Rate** goes up, the **Length** of the grains decreases. If the emit **Rate** goes down, the grain **Length** increases. This helps create a steady number of active grains when the rate fluctuates.

Rate change with Link enabled. Rate increases cause length decreases.



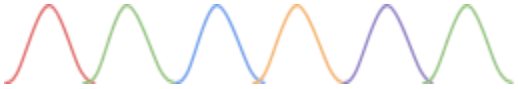
Rate change with Link disabled. Rate increases does not affect length.

Length

Sets the duration of the emitted grain. If **Rate Length Link** is disabled, the **Length** range is 0ms to 1sec. If **Rate Length Link** enabled, then the **Length** range is from 0% to 1000%. When it is set to 100%, the audio will be smooth and continuous as long as all other parameters are at their default state.

Link enabled. 200%

Link enabled. 100%



Link enabled. 50%

Link enabled. 25%

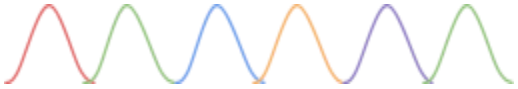
Noise modulated length

Gate

Gate determines whether the emitter is active or not. If **Gate** is off, no grains will be emitted. Turning the **Gate** off and then adding modulation can create rhythmic grain emissions. There is an additional CV input on the back for controlling the gate.

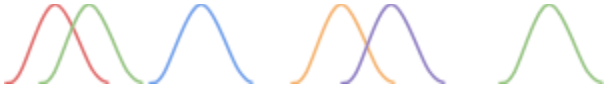
Jitter

Jitter is random noise added to the emitter clock timing. If the emit **Rate** is set at 10Hz, a grain will be emitted every 100ms. A **Jitter** of 100% would cause each grain's start to randomly be shifted 0ms to 100ms. **Jitter** does not affect **Length**, only emission time.



Jitter 0%

Jitter 50%



Jitter 100%

Trigger

Trigger CV Input will cause a single grain to be emitted. This overrides any current **Gate** value.

Input Section

Input Section Front Panel

Input Section Back Panel

Main Audio Input

Main stereo input. A single mono input on the left channel is copied to the right channel.

Freeze

Freeze will stop recording audio data into the input buffer, causing the audio data to be fixed and the grains to play from past captured audio.

Grains - Delay Section

Grain Delay Section

Delay

Delay determines the grain playback start position in the input buffer. If tempo sync is disabled, the values range from 10ms to 4sec. If tempo sync is enabled, the available rates are: 4/4, 7/8, 3/4, 5/8, 2/4, 7/16, 5/8T, 3/8, 4/8T, 5/16, 1/4, 3/16, 2/8T, 1/8, 1/8T, 1/16, 1/16T, 1/32, 1/32T, 1/64, 1/128.

Scale

Scale is a multiplier of the **Delay** parameter. This can also be thought of as a type of swing/shuffle.

Base Delay	Scale	Final Delay
100ms	50%	50ms
1sec	200%	2sec
1/4	50%	1/8
1/4	125%	5/16
200ms	0%	0ms

Spray

Spray adds a random amount of time to the delay of each grain. At low values it can cause subtle time smearing of audio, at high values it can create erratic chopping and jumping.

The full range of the spray is twice the **Delay**. So for a **Delay** of 100ms, the random time added can range from -100ms to +100ms.

Spray is applied as an offset after **Delay** and **Scale**.

Base Delay	Scale	Spray	Final Delay Range
100ms	100%	100%	0ms - 200ms
100ms	200%	100%	100ms - 300ms
100ms	0%	100%	0ms - 100ms (~50% of grains @ 0ms)

Grains - Pitch Section

Grain Pitch Section

Pitch Probability

The **Pitch Probability** strip determines the pitch of a grain. Each box represents a semitone step in pitch shifting, 0 in the middle, +12 semitones at the top, and -12 semitones at the bottom. When a grain is emitted, a pitch offset is selected at random using probability weighting from the strip.

				
100% +0 Semitones	*50% +12 Semitones* *50% -12 Semitones*	*33.3% +7 Semitones* *33.3% +5 Semitones* *33.3% +0 Semitones*	*50% +5 Semitones* *50% -5 Semitones*	*25% +5 Semitones* *12.5% +2 Semitones* *12.5% +0 Semitones* *25% -5 Semitones* *25% -12 Semitones*

Examples of Pitch Probabilities for given weights.

Semitone

Semitone adjusts the pitch up to +/- 24 Semitones. This is applied in addition to the **Pitch Probability**.

Reverse

Reverse is the probability that a grain will play backwards (negative pitch). At 0%, all grains play forward. At 100%, all grains play backwards. At 50% reverse probability, half will play forwards randomly, the other half will play backwards randomly.

Grains - Envelope Section

Grain Envelope Section

Shape

Shape determines the amplitude envelope shape of a grain. At a **Shape** of 0%, the envelope is a cosine curve. At a **Shape** of 50%, a smooth trapezoid. At a **Shape** of 100%, a rectangle.

The Shape at values 0%, 50%, 100%.

Skew

Skew will shift the **Shape** of the envelope in either direction. At -100%, it creates a sharp attack like a ping or pluck sound. At 100%, it creates a reverse sounding grain.

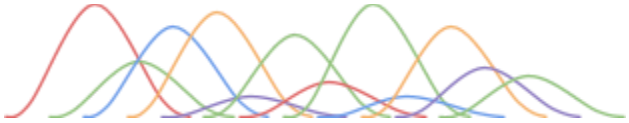
Skew values at -100%, 0%, 100%

Grains - Output Section

Grain Output Section

Level

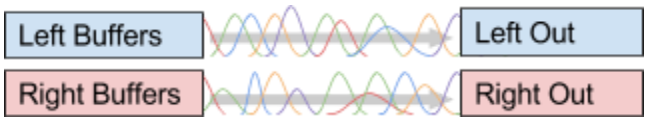
Level sets the amplitude of each grain. Modulating this parameter can give interesting pulsing effects.



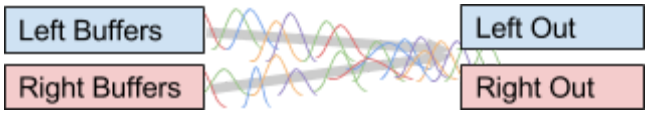
Grains with noise modulation on level.

Pan

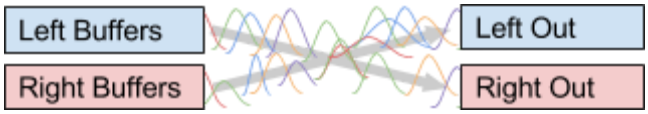
Fritz has two separate granular systems running in parallel, one for each stereo channel. Grains are always emitted from a single channel's input buffer. Grains can fade over to the other channel using their **Pan** parameter. At a **Pan** of 0%, grains will remain in their channel. At a **Pan** of 50%, grains will be mixed equally into both channels. At 100%, the grain will be written to the other channel. Modulation of **Pan** will spray the grains across the stereo field.



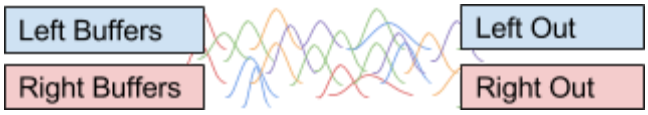
Grain Pan at 0%, Maintain Channel



Grain Pan at 50%, Mix Channels, Mono



Grain Pan at 100%, Swap Channel, (Ping Pong Style Delays)



Grain Pan at 50%, Modulated Pan, Stereo Spray

Grains - Modulation Section

Grain Modulation Section

Modulation Frequency

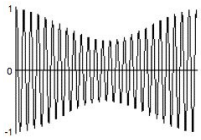
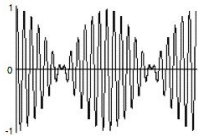
Sets the frequency for both FM and AM. The range is 0Hz to 5000Hz.

Modulation FM Amount

Sets the amount of frequency modulation applied to the grain.

Modulation AM / Ring Amount

Sets the amount of amplitude modulation / ring modulation applied to the grain.

Value	Effect
0	None
0.1-0.2	Vibrato 
0.5	Full AM 
1.0	Full RM 

Grains - Display

The grain display shows each active grain as a dot. Grains in the left channel are blue. Grains in the right channel are red.

The grain's location correspond to its playback position in the input buffer. Each major vertical tick mark represents a multiple of the **Delay** time.

A grain at the 0% bar is playing the input back in real-time, as it comes in. A grain at the 100% bar is playing the input back after the **Delay** time. A grain at the 200% bar is playing the input back after two times the **Delay**.

To see a clear example of this, right click on the Fritz device and issue a 'Reset Device' to get everything to its default value. Now, change the grain **Scale** amount from 0% to 200%, you will see the grains on the display move back and forth from the 0% bar to the 200%, corresponding to the **Scale**. Now, set **Scale** to 200% and set **Spray** to 50%, observe the grains randomly jumping around the 200% bar.

Output Section

Output Section Front Panel

Output Section Back Panel

Audio signal flows from left to right in the output section.

Main Audio Output

The main audio output for Fritz.

Normalize Grain Levels

The number of grains that can be simultaneously played back is variable from 0 to 64, depending on grain **Length** and emit **Rate**. Because of this, the output level of Fritz can vary wildly. Enabled by default, **Normalize Grain Levels** will attenuate grains based on how many are currently playing. This helps to keep the overall volume of Fritz at a useable level. This can be disabled if you wish to control the levels manually or with a limiter/compressor.

Insert Effects

External effects can be inserted into the signal path. These effects are inserted after the grains are mixed together and before the output diffuser section. See the **System Signal Path** section.

Diffuse

Diffuse applies a network of all pass filters to smear the audio in time. This paired with **Feedback** can create reverb like effects.

Feedback

The amount of signal that is fed back into the input for the grains to resample.

Spread

Stereo spreading of the output signal. 0% will mix both channels and create a mono output. 200% will invert some stereo signals and create a very wide stereo projection.

Dry/Wet

Controls the amount of input signal that gets mixed with the effect output.

Level

Master volume level of the device.

Patch Section

Patch Section Front Panel

Standard Patch loading and saving. Please see the **Random Patch Generation** section for more information about the die button.

Modulation - LFO Section

Modulation LFO Sections Front Panel

Modulation LFO Sections Back Panel

Reset

Reset will cause the LFO to move to its initial position set by **Phase**.

Rate

Sets the cycle rate of the LFO. Free rates range from 0.0Hz to 50.0Hz. Available Synced Rates: 32/4, 28/4, 24/4, 20/4, 16/4, 12/4, 8/4, 7/4, 6/4, 5/4, 4/4, 7/8, 3/4, 5/8, 2/4, 7/16, 5/8T, 3/8, 4/8T, 5/16, 1/4, 3/16, 2/8T, 1/8, 1/8T, 1/16, 1/16T, 1/32, 1/32T, 1/64, 1/128.

Phase

Sets the **Phase** of the LFO waveform which is also the Initial phase on a reset.

Phase Stereo

Sets the phase difference between the LFOs feeding the Left and Right channels.

Waveform

Selects the waveform. Waveforms that show a (+) are unipolar. Waveforms that show a (O) are generated randomly and will not cycle.

Lag

Limits how fast the LFO value can change its output value.

Output

CV Output of each individual channels LFO.

Modulation - CV Section

Modulation CV Sections Front Panel

Modulation CV Sections Back Panel

This allows external CV control and modulation of parameters in Fritz. Inputs are normalized to function as mono when only the left is connected.

Modulation - Noise Section

Modulation Noise Section Front Panel

Modulation Noise Section Back Panel

Phase Stereo

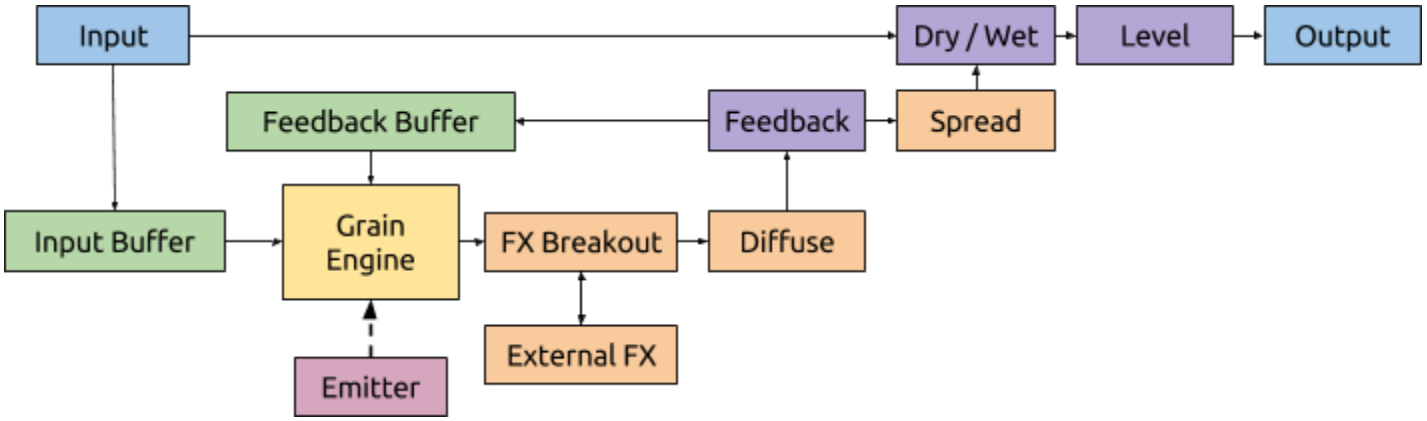
Sets the phase difference between the LFOs feeding the Left and Right channels.

Output

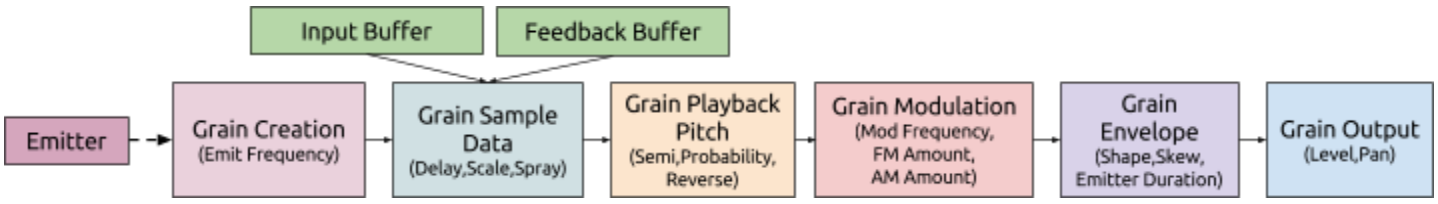
CV Output of each individual channel’s Noise.

System Diagrams

System Signal Path



Grain Path



Remote Items

Name	Type	Min	Max
"Cv 1 To Delay Scale"	Number	-100.0	100.0
"Cv 1 To Delay Spray"	Number	-100.0	100.0
"Cv 1 To Diffuse"	Number	-100.0	100.0
"Cv 1 To Dry Wet"	Number	-100.0	100.0
"Cv 1 To Emit Gate"	Number	-100.0	100.0
"Cv 1 To Emit Jitter"	Number	-100.0	100.0
"Cv 1 To Emit Length"	Number	-100.0	100.0
"Cv 1 To Emit Rate"	Number	-100.0	100.0
"Cv 1 To Feedback"	Number	-100.0	100.0
"Cv 1 To Grain Level"	Number	-100.0	100.0
"Cv 1 To Grain Shape"	Number	-100.0	100.0
"Cv 1 To Grain Skew"	Number	-100.0	100.0
"Cv 1 To Grain Spread"	Number	-100.0	100.0
"Cv 1 To Input Freeze"	Number	-100.0	100.0
"Cv 1 To Master Level"	Number	-100.0	100.0
"Cv 1 To Mod Am Amount"	Number	-100.0	100.0
"Cv 1 To Mod Fm Amount"	Number	-100.0	100.0
"Cv 1 To Mod Frequency"	Number	-100.0	100.0
"Cv 1 To Pitch Reverse"	Number	-100.0	100.0
"Cv 1 To Pitch Semitone"	Number	-100.0	100.0
"Cv 1 To Spread"	Number	-100.0	100.0
"Cv 1 To Stereo Width"	Number	-100.0	100.0
"Cv 2 To Delay Scale"	Number	-100.0	100.0
"Cv 2 To Delay Spray"	Number	-100.0	100.0
"Cv 2 To Diffuse"	Number	-100.0	100.0
"Cv 2 To Dry Wet"	Number	-100.0	100.0
"Cv 2 To Emit Gate"	Number	-100.0	100.0
"Cv 2 To Emit Jitter"	Number	-100.0	100.0
"Cv 2 To Emit Length"	Number	-100.0	100.0
"Cv 2 To Emit Rate"	Number	-100.0	100.0
"Cv 2 To Feedback"	Number	-100.0	100.0
"Cv 2 To Grain Level"	Number	-100.0	100.0
"Cv 2 To Grain Shape"	Number	-100.0	100.0
"Cv 2 To Grain Skew"	Number	-100.0	100.0
"Cv 2 To Grain Spread"	Number	-100.0	100.0
"Cv 2 To Input Freeze"	Number	-100.0	100.0
"Cv 2 To Master Level"	Number	-100.0	100.0
"Cv 2 To Mod Am Amount"	Number	-100.0	100.0
"Cv 2 To Mod Fm Amount"	Number	-100.0	100.0
"Cv 2 To Mod Frequency"	Number	-100.0	100.0
"Cv 2 To Pitch Reverse"	Number	-100.0	100.0
"Cv 2 To Pitch Semitone"	Number	-100.0	100.0
"Cv 2 To Spread"	Number	-100.0	100.0
"Cv 2 To Stereo Width"	Number	-100.0	100.0
"Delay Scale"	Number	0.0	200.0
"Delay Spray"	Number	0.0	100.0
"Delay Tempo Sync"	Int	0	1
"Delay Time Free"	Number	0	127
"Delay Time Sync"	Int	0	18
"Diffuse"	Number	0.0	100.0
"Dry Wet"	Number	0.0	100.0
"Emit Gate"	Int	0	1
"Emit Jitter"	Number	0.0	100.0
"Emit Length Free"	Number	0	127
"Emit Length Scale"	Number	0	127
"Emit Rate Free"	Number	0	127
"Emit Rate Length Link"	Boolean	0	1
"Emit Rate Sync"	Int	0	30
"Emit Tempo Sync"	Int	0	1
"Feedback"	Number	0.0	100.0
"Grain Level"	Number	0	127
"Grain Shape"	Number	0.0	100.0
"Grain Skew"	Number	-100.0	100.0
"Grain Pan"	Number	0.0	100.0
"Input Freeze"	Int	0	1
"Lfo 1 Lag"	Number	0	127
"Lfo 1 Phase"	Number	0	127
"Lfo 1 Phase Stereo"	Number	0	127
"Lfo 1 Rate Free"	Number	0	127
"Lfo 1 Rate Sync"	Int	0	30
"Lfo 1 Reset"	Boolean	0	1
"Lfo 1 Tempo Sync"	Boolean	0	1
"Lfo 1 To Delay Scale"	Number	-100.0	100.0
"Lfo 1 To Delay Spray"	Number	-100.0	100.0
"Lfo 1 To Diffuse"	Number	-100.0	100.0
"Lfo 1 To Dry Wet"	Number	-100.0	100.0
"Lfo 1 To Emit Gate"	Number	-100.0	100.0

"Lfo 1 To Emit Jitter"	Number	-100.0	100.0
"Lfo 1 To Emit Length"	Number	-100.0	100.0
"Lfo 1 To Emit Rate"	Number	-100.0	100.0
"Lfo 1 To Feedback"	Number	-100.0	100.0
"Lfo 1 To Grain Level"	Number	-100.0	100.0
"Lfo 1 To Grain Shape"	Number	-100.0	100.0
"Lfo 1 To Grain Skew"	Number	-100.0	100.0
"Lfo 1 To Grain Spread"	Number	-100.0	100.0
"Lfo 1 To Input Freeze"	Number	-100.0	100.0
"Lfo 1 To Master Level"	Number	-100.0	100.0
"Lfo 1 To Mod Am Amount"	Number	-100.0	100.0
"Lfo 1 To Mod Fm Amount"	Number	-100.0	100.0
"Lfo 1 To Mod Frequency"	Number	-100.0	100.0
"Lfo 1 To Pitch Reverse"	Number	-100.0	100.0
"Lfo 1 To Pitch Semitone"	Number	-100.0	100.0
"Lfo 1 To Spread"	Number	-100.0	100.0
"Lfo 1 To Stereo Width"	Number	-100.0	100.0
"Lfo 1 Waveform"	Int	0	198
"Lfo 2 Lag"	Number	0	127
"Lfo 2 Phase"	Number	0	127
"Lfo 2 Phase Stereo"	Number	0	127
"Lfo 2 Rate Free"	Number	0	127
"Lfo 2 Rate Sync"	Int	0	30
"Lfo 2 Reset"	Boolean	0	1
"Lfo 2 Tempo Sync"	Boolean	0	1
"Lfo 2 To Delay Scale"	Number	-100.0	100.0
"Lfo 2 To Delay Spray"	Number	-100.0	100.0
"Lfo 2 To Diffuse"	Number	-100.0	100.0
"Lfo 2 To Dry Wet"	Number	-100.0	100.0
"Lfo 2 To Emit Gate"	Number	-100.0	100.0
"Lfo 2 To Emit Jitter"	Number	-100.0	100.0
"Lfo 2 To Emit Length"	Number	-100.0	100.0
"Lfo 2 To Emit Rate"	Number	-100.0	100.0
"Lfo 2 To Feedback"	Number	-100.0	100.0
"Lfo 2 To Grain Level"	Number	-100.0	100.0
"Lfo 2 To Grain Shape"	Number	-100.0	100.0
"Lfo 2 To Grain Skew"	Number	-100.0	100.0
"Lfo 2 To Grain Spread"	Number	-100.0	100.0
"Lfo 2 To Input Freeze"	Number	-100.0	100.0
"Lfo 2 To Master Level"	Number	-100.0	100.0
"Lfo 2 To Mod Am Amount"	Number	-100.0	100.0
"Lfo 2 To Mod Fm Amount"	Number	-100.0	100.0
"Lfo 2 To Mod Frequency"	Number	-100.0	100.0
"Lfo 2 To Pitch Reverse"	Number	-100.0	100.0
"Lfo 2 To Pitch Semitone"	Number	-100.0	100.0
"Lfo 2 To Spread"	Number	-100.0	100.0
"Lfo 2 To Stereo Width"	Number	-100.0	100.0
"Lfo 2 Waveform"	Int	0	198
"Master Level"	Number	0	127
"Mod Am Amount"	Number	0.0	100.0
"Mod Fm Amount"	Number	0.0	100.0
"Mod Frequency"	Number	0	127
"Noise Phase Stereo"	Number	0	127
"Noise To Delay Scale"	Number	-100.0	100.0
"Noise To Delay Spray"	Number	-100.0	100.0
"Noise To Diffuse"	Number	-100.0	100.0
"Noise To Dry Wet"	Number	-100.0	100.0
"Noise To Emit Gate"	Number	-100.0	100.0
"Noise To Emit Jitter"	Number	-100.0	100.0
"Noise To Emit Length"	Number	-100.0	100.0
"Noise To Emit Rate"	Number	-100.0	100.0
"Noise To Feedback"	Number	-100.0	100.0
"Noise To Grain Level"	Number	-100.0	100.0
"Noise To Grain Shape"	Number	-100.0	100.0
"Noise To Grain Skew"	Number	-100.0	100.0
"Noise To Grain Spread"	Number	-100.0	100.0
"Noise To Input Freeze"	Number	-100.0	100.0
"Noise To Master Level"	Number	-100.0	100.0
"Noise To Mod Am Amount"	Number	-100.0	100.0
"Noise To Mod Fm Amount"	Number	-100.0	100.0
"Noise To Mod Frequency"	Number	-100.0	100.0
"Noise To Pitch Reverse"	Number	-100.0	100.0
"Noise To Pitch Semitone"	Number	-100.0	100.0
"Noise To Spread"	Number	-100.0	100.0
"Noise To Stereo Width"	Number	-100.0	100.0
"Pitch Probability 0"	Number	0.0	100.0
"Pitch Probability M 1"	Number	0.0	100.0
"Pitch Probability M 10"	Number	0.0	100.0
"Pitch Probability M 11"	Number	0.0	100.0
"Pitch Probability M 12"	Number	0.0	100.0
"Pitch Probability M 2"	Number	0.0	100.0
"Pitch Probability M 3"	Number	0.0	100.0
"Pitch Probability M 4"	Number	0.0	100.0
"Pitch Probability M 5"	Number	0.0	100.0
"Pitch Probability M 6"	Number	0.0	100.0
"Pitch Probability M 7"	Number	0.0	100.0
"Pitch Probability M 8"	Number	0.0	100.0

"Pitch Probability M 9"	Number	0.0	100.0
"Pitch Probability P 1"	Number	0.0	100.0
"Pitch Probability P 10"	Number	0.0	100.0
"Pitch Probability P 11"	Number	0.0	100.0
"Pitch Probability P 12"	Number	0.0	100.0
"Pitch Probability P 2"	Number	0.0	100.0
"Pitch Probability P 3"	Number	0.0	100.0
"Pitch Probability P 4"	Number	0.0	100.0
"Pitch Probability P 5"	Number	0.0	100.0
"Pitch Probability P 6"	Number	0.0	100.0
"Pitch Probability P 7"	Number	0.0	100.0
"Pitch Probability P 8"	Number	0.0	100.0
"Pitch Probability P 9"	Number	0.0	100.0
"Pitch Reverse"	Number	0.0	100.0
"Pitch Semitone"	Int	-24	24
"Stereo Spread"	Number	0.0	200.0