Proton Particle Accelerator

Granular Synthesizer for Propellerhead Reason
Version 1.1

SOUNDLOVE

http://soundlove.se/

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Overview

Proton is a powerful, yet simple granular synthesizer with three different sound engines. It uses user-specified samples as the foundation for its sound, transforming them in various ways. Because Proton can load any sample, it is capable of creating a huge range of widely different sounds and timbres that are impossible to achieve with the Legacy devices in Reason.

Proton's sound engines have two main features: a *waveform buffer* (that contains a sample of your choice) and a *particle emitter*. When you play a note, each particle (or grain) produced by the emitter extracts and shapes a very short snippet of audio from the waveform buffer. The particles are then summed together and the result is sent through a filter pair, an amplifier, and a set of effects before it is passed on to the audio out sockets.

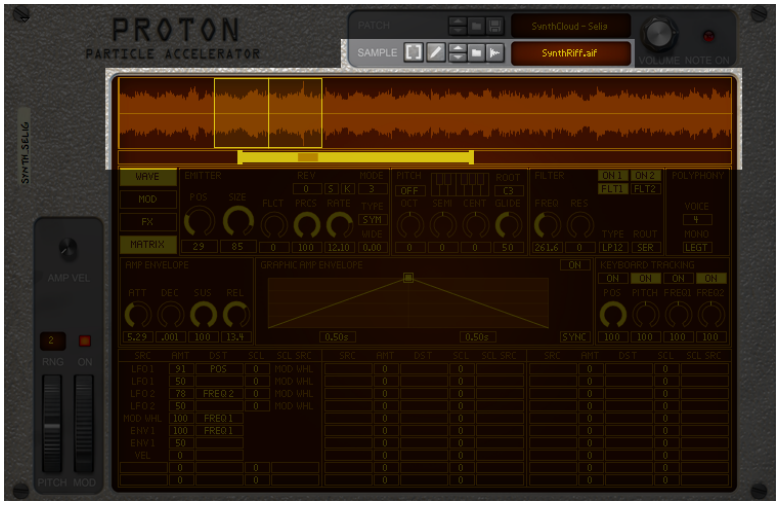
A note on CPU usage: Granular synthesis can be very CPU intensive! The reason is that each particle acts like a small oscillator, and Proton sums the signal from hundreds of particles simultaneously at its most extreme settings. In such situations, you may have to restrict the number of voices played by Proton to avoid the "Computer too slow" message from Reason. Work-arounds include reducing Reason's sample rate (unless it is already set to 44100), or to bounce voices to audio tracks.

General tip: Shift-drag knobs for more precise changes. Drag the number editor beneath the knobs for even more precise changes. Shift-drag the number editor beneath the knobs for very high precision changes.

General tip: Control-click (Windows) or Command-click (Mac) to reset a knob to its default value.

General tip: If you have trouble saving a patch due to self-contained samples, please refer to the section called "About Self-Contained Songs" in the Reason manual to learn more about the reason behind this problem (and how to solve it).

The Waveform Buffer



The waveform buffer holds a *waveform* (sample) of your choice. It is from this waveform the particles are created.

To load a sample, drag it onto Proton. Or browse to a sample by using the browse buttons:

To record a sample in Reason's sample recorder, click the sample record button:

To edit the sample in Reason's sample editor, click the sample edit button:

Reason's sample editor allows you to set the left and right loop points for the sample. If you like, you can choose to only include the sample frames between the loop points as the Proton waveform. The crop-to-loop button toggles this function on and off:

The crop-to-loop button will not change the sample, it will only affect which part of the sample that is used by Proton.

You can use the bright yellow scrollbar handle beneath the waveform to navigate the waveform. Drag in the middle of the handle to move it left and right. Drag the left and right edges of the handle to change its size (making the handle smaller means zooming in, and making it larger means zooming out). Click to the left or to the right of the handle to nudge it in that direction.

The darker rectangle in the scrollbar illustrates the position and size of the *emitter window* (more on this in the next section).

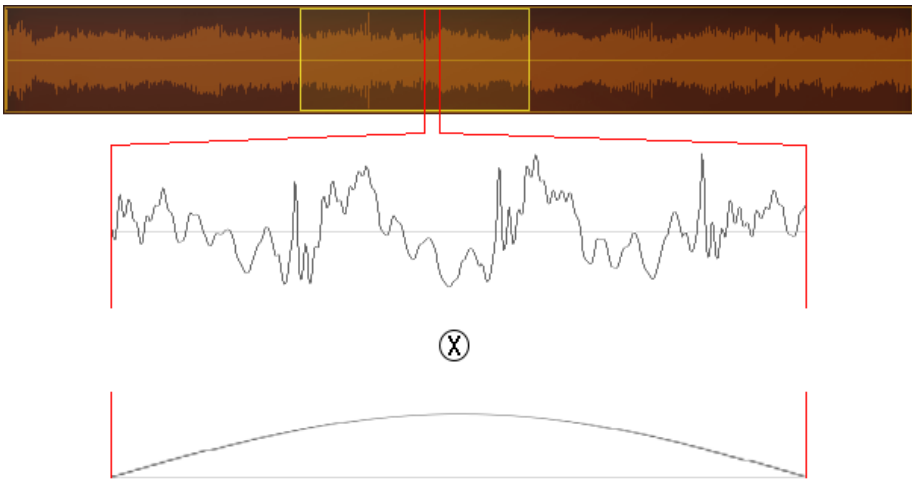
The Emitter

The particle emitter creates the particles (grains) that extract audio from the waveform. The emitter section allows you to configure how the emitter works.

Proton has three different *emitter engines*. To switch between the engines, use the MODE popup button in the top right corner of the emitter section:

All three engines have a *window position* (POS) and a *window size* (SIZE) setting. The window is shown in the waveform display as a bright yellow rectangle. You can drag in the waveform display to change the position of the window, and shift-drag to change its size. The window is used slightly differently by the three engines, but in general you can think of it as the waveform area from where audio frames for the particles are extracted.

A particle has two main features: its *lifetime* (or length) and its *envelope*. The image below illustrates how particles are created. First, a snippet of audio with the same length as the particle is extracted from the waveform. The audio frames are then multiplied by the envelope - in this case, the first half of a sine wave - to produce the final particle audio frames.



Engine 1

The first engine is a classic *grain cloud* engine. It creates its distinctive sound by playing a large number of very short (1-50 ms) particles simultaneously - which also makes it the most CPU-intensive engine in Proton. The start points of the particles are distributed randomly inside the emitter window. (This means that while particles always start inside the window, they can extend beyond its rightmost edge.) The particle envelope is an equal power crossfade function.

The *fluctuation* (FLCT) setting introduces random delays between particles (that increase with the knob value).

The *lifetime* (LIFE) setting controls the length of the particles.

Tip: You can use the particle pan modulation destination (see the modulation section below) to control the stereo pan position of the particles.

Engine 2

The second engine is inspired by an Ableton Live instrument called *Granulator*. The engine plays two particles that are offset in phase: the second particle begins playing as the first particle reaches the center of its envelope, and vice versa. Proton visualizes the location of the particles in the waveform display by drawing low-intensity vertical lines.

The lifetime (as well as the waveform location) of the two particles are the same as the window. In other words, as the window size decreases, the particles become shorter and their apparent rate increases. This also means that the lifetime and apparent “particle rate” increases with the MIDI note pitch, and decreases as the MIDI note pitch decreases. When the window becomes very small, the particle envelope (and aliasing introduced by the interpolation scheme used to fetch samples from the waveform) creates an amplitude modulation effect that adds harmonics and pitch shift to the sound. Sweeping the window in different directions at short lengths will also shift the pitch of the sound.

The *fluctuation* setting (FLCT) introduces a random delay before the next particle is triggered. The larger the setting, the larger the maximum delay.

The *precision* (PRCS) setting randomizes the actual location of the particles in the waveform as an offset from the current window position. Higher settings increases the range of the randomized offset.

The *particle type* (TYPE) setting allows you to select which envelope to use when the particles are computed. The *symmetric* (SYM) setting uses an equal power crossfade function, which keeps the particles “smooth”. The *fade-in* (IN) setting uses the fade-in part of an equal power crossfade function. The *fade out* (OUT) setting uses the fade-out part of an

equal power crossfade. The *smooth fade in* (IN-S) and *smooth fade out* (OUT-S) are similar to the fade in and fade out envelopes, but have been lowpass filtered.

The *stereo width* (WIDE) setting offsets the pitch of the left and the right channel by up to 10 cents, which (in most situations) gives an impression of a wider stereo field.

Tip: You can use the particle pan modulation destination (see the modulation section below) to control the stereo pan position of the particles.

Engine 3

The third engine is inspired by a VST instrument called *The Mangle*. In this engine, the particles originate from the center of the window and can play both forwards and backwards. Proton visualizes where the current particle playback is at in the waveform display by drawing low-intensity vertical lines. **Note:** Proton can play more particles than it has time to draw, so some particles might be missing in the display.

The lifetime of the particles are defined by the window size, and can be between 10 ms and 2 seconds. A particle's "playing time" does not vary with its pitch in engine 3, which means that a higher-pitched particle will "travel" a larger distance through the waveform than a lower-pitched particle. (This is one of the fundamental differences between engine 2 and 3; the "travel distance" of all particles are the same - regardless of pitch - in engine 2.)

The *position* (POS) and *size* (SIZE) settings configures the emitter window.

The *precision* (PRCS) setting randomizes the actual location of the particles in the waveform as an offset from the current window position. Higher settings increases the range of the randomized offset.

The *rate* (RATE) parameter determines the rate at which particles are emitted. The *tempo sync* (S) toggle button above the rate knob determines whether particle emission is synchronized with the transport play position or not. The *keyboard sync* (K) toggle button, also above the rate knob, determines whether the particle creation should be synchronized across all MIDI keyboard notes or not. **Note:** Keyboard sync only has an effect when tempo sync is disabled.

The *fluctuation* (FLCT) parameter introduces a random drift in the particle emitter rate. The higher the setting, the larger the variation. **Note:** Fluctuation only has an effect when tempo sync is disabled.

The *reverse percentage* (REV) setting specifies what percentage of the particles that should play backwards through the waveform.

The *particle type* (TYPE) setting allows you to select which envelope to use when the particles are computed. The *symmetric* (SYM) setting uses an equal power crossfade function, which keeps the particles "smooth". The *fade-in* (IN) setting uses the fade-in part of an equal power crossfade function. The *fade out* (OUT) setting uses the fade-out part of an equal power crossfade. The *smooth fade in* (IN-S) and *smooth fade out* (OUT-S) are similar to the fade in and fade out envelopes, but have been lowpass filtered.

The *stereo width* (WIDE) setting offsets the pitch of the left and the right channel by up to 10 cents, which (in most situations) gives an impression of a wider stereo field.

Tip: You can use the particle pan modulation destination (see the modulation section below) to control the stereo pan position of the particles.

Particle Tuning

The pitch section allows you to change the tuning of the particles. The *octave* (OCT), *semitones* (SEMI), and *cents* (CENT) knobs work just like the tuning knobs in Legacy Reason synthesizers.

The *root note* (ROOT) number editor shows the MIDI root note of the currently loaded sample (or C3 if the sample does not contain that information). If you use a tuned sample that does not contain root note information, you can offset the root note by dragging inside this box.

The *glide/portamento* (GLIDE) knob specifies the speed at which the pitch glides between successive or held notes. **Note:** This setting only has an effect when Proton is set to use a single voice (see below).

The small keyboard and the selector above the tuning knobs can be used to constrain particle semitone modulation to a scale of your choice. This feature will be described in detail in the modulation section below.

The pitch bend wheel (in the lower left corner of Proton's front panel) works just like the pitch bend wheel in Legacy Reason synthesizers. Drag the value in the *pitch bend range display* (RNG) above the wheel to change the range (in semitones) of the pitch bend.

Filters

Proton's two filters are configured in the filter section of the front panel.

The *filter 1* (FLT1) and *filter 2* (FLT2) radio buttons are used to select which filter to edit.

The *on/off 1* (ON 1) and *on/off 2* (ON 2) toggle buttons turns the filters on or off.

The *frequency* (FREQ) control sets the frequency of the currently selected filter, in Hz.

The *resonance* (RES) control sets the resonance of the currently selected filter.

The *filter type* pop-up button allows you to choose the type of the currently selected filter. Proton has five filter types: a 24 dB/octave lowpass filter, a 12 dB/octave lowpass filter, a 12 dB/octave highpass filter, a 12 dB/octave bandpass filter, and a comb filter.

The *routing* (ROUTE) pop-up button allows you to select whether the filters are applied in series or in parallel.

Amplifier Envelope and Amplifier Velocity

The amplifier envelope section allows you to set the *attack* (ATT), *decay* (DEC), *sustain* (SUS), and *release* (REL) of Proton's voices. The controls work the same way as in all other Reason Legacy synthesizers.

Proton also has an alternative, multi-section graphic amplifier envelope that you can use instead of the standard ADSR envelope. It is configured in the graphic amp envelope section. The *on/off* (ON) toggle button in the upper right corner specifies whether the graphic amp envelope should be enabled or not. **Note:** When the graphic amp envelope is active, the ordinary ADSR envelope is not used, and vice versa.

The graphic amp envelope consists of a user-specified number of *curve segments*. The length of each segment can be specified by dragging in the corresponding number editor beneath the curve. The *tempo sync* (SYNC) toggle button controls whether the segment lengths are measured in seconds or in time signature units (like 1/4th notes or 1/8th notes).

The overall shape of a segment can be changed by dragging the square *control points* up or down. You can also modify the *curvature* of a segment by dragging inside the segment. To reset the curvature of a segment back to a straight line, hold control (Win) or command (Mac) and click inside the segment.

To add a new section to the envelope, hold shift and click inside the region where you want to add the new segment. To remove a section, hold shift+control (Win) or shift+command (Mac) and click on the section's control point.

You can also select a *sustain point* for the graphic amp envelope. When you play a MIDI note, Proton will follow the amp envelope until it reaches the sustain point and hold there

until you release the MIDI note. It will then follow the rest of the curve until it ends. To select which of the control points that act as the sustain point, hold control (Win) or command (Mac) and click the control point. **Note:** If you release the MIDI note before playback has reached the sustain point, Proton will move the envelope playback position to the sustain point (via a quick fade) and continue from there.

The *amplifier velocity modulation knob* (AMP VEL), which sits above the pitch and modulation wheels, controls to what extent MIDI keyboard velocity should map to voice amplifier velocity. If it is set to zero, all voices will have the same volume. If it is set to 100%, then the full range of MIDI key velocity is used to control the volume of each voice.

Polyphony

The polyphony section controls how Proton manages voices.

The *voice count* (VOICE) popup button selects the number of voices that Proton can play at the same time.

The *mono* (MONO) pop-up button allows you to choose how voices are triggered in monophonic (= 1-voice) mode. In *retrigger* (RTRG) mode, each new MIDI keyboard note triggers the amplifier envelope. In *legato* (LEGT) mode, the amplifier envelope is not triggered if MIDI keyboard notes overlap.

Note: When Proton is in monophonic mode, the *glide/portamento* (GLIDE) knob in the pitch section (see above) specifies the speed at which the pitch glides between successive or held notes.

Tip: keeping the voice count to a minimum can be an effective way to limit Proton's CPU usage, especially when emitter engine 1 (see above) is active.

Keyboard Tracking

The controls in the keyboard tracking area allow you to choose how the MIDI note you play affect various settings in Proton.

The *emitter position tracking* (POS) knob can be used to change the emitter's position offset based on the MIDI note. The position offset is zero at MIDI note 36 (C1). When the knob is set to +100, the emitter moves from full left to full right over the two MIDI octaves above note 36. Conversely, the emitter moves from full left to full right over the two MIDI octaves below note 36. The *on/off* (ON) toggle button above the knob enables or disables the tracking.

The *particle pitch tracking* (PITCH) knob modifies the engine's pitch based on the MIDI note played. By default it's set to 100, which means that notes are tracked in the normal, expected way. At zero (or when particle pitch tracking is turned off), the MIDI note you play does not affect the pitch at all: every particle is played at note 60 (C3). The *on/off* (ON) toggle button above the knob enables or disables the tracking.

The two *filter frequency tracking* (FREQ1 and FREQ2) knobs allows you to modify the filter frequency with the MIDI note. When turned on, the default setting of 100 means that the filter frequency will track 1-to-1 with the MIDI note. At zero, the MIDI note does not affect the filter frequency at all. The *on/off* (ON) toggle buttons above the knobs enables or disables the tracking.

TIP: Use the filter frequency tracking to allow the comb filter to “stay in tune” as you play different MIDI notes! This allows you to add harmonic content to noisy, non-harmonic timbres.

Modulation Matrix

The key to creating interesting sounds in Proton is to use its extensive *modulation facilities*. Modulation, in a nutshell, means that you add or subtract a *modulation source* signal (like a low-frequency sawtooth wave or random noise, for example) to one or several of Proton's parameters, or *modulation destinations*. This allows you to create timbres and sounds that evolve and change over time.

Proton 1.1 expands on the modulation capabilities introduced in version 1.0 by introducing a generic *modulation matrix*. Version 1.1 also adds a substantial number of modulation sources and a large amount of modulation destinations. In fact, almost all of Proton's parameters can now be selected as destinations!

The modulation matrix is the large area at the bottom of Proton's GUI. The matrix contains 30 *modulation slots*. A modulation slot consists of a *modulation source*, a *modulation destination*, a *modulation amount*, a *modulation scaling source*, and a *modulation scaling amount*. **Note:** The first eight modulation slots have hard-coded modulation sources and scaling that correspond to the fixed modulation routings in Proton 1.0. These routings cannot be changed because doing so would break patch compatibility.

To select a destination, source, or scaling source, click and hold in the corresponding box. This will bring up a pop-up menu with the available choices. To change the amount and scaling amount, drag in the corresponding number editor box.

As mentioned above, the source signal is added to or (subtracted from) the destination parameter value. The modulation amount (which can be both positive or negative) defines how large the modulation should be. Conceptually, modulation is computed like this:

modulated destination value = current parameter value + source signal x amount

In addition, the scaling source and scaling amount can be used to introduce a *secondary modulation*: scaling modulates the amount. Conceptually, scaled modulation is computed like this:

scaled amount = amount value + scaling source x scaling amount

modulated destination value = current parameter value + source signal x scaled amount

As an example, imagine that we want to set up a basic vibrato. One way to do this is to select particle pitch as the modulation destination and a low-frequency oscillator (LFO) as the source (see below for more info on LFOs). As we increase the modulation amount from zero to +100, the vibrato becomes more intense. But what if we want the mod wheel to control the intensity? This is where scaling comes in: we set the modulation amount to zero, select the mod wheel as the scaling source, and set the scaling amount to +100. Now, when we push the mod wheel, the basic modulation amount will increase, and so will the vibrato!

Modulation sources

This section describes the modulation source signals that you can use in the modulation matrix.

Low-frequency oscillators (LFOs)

Proton has two LFOs with configurable triangle/sawtooth waveforms. When you play MIDI notes, Proton will show the current position of the LFOs by drawing a dark square (one per active voice) in the LFO displays.

To tweak the waveform of an LFO, simply drag it in the display.

The *tempo synchronization* (SYNC) toggle button specifies whether the LFO rate should be synchronized to Reason's transport tempo, or if the LFO should be free-running.

The *key synchronization* (KEY) toggle button specifies whether or not the LFO should be restarted when a new voice is triggered. **Note:** Key sync has no effect when tempo sync is active and the transport is playing.

The *rate* (RATE) knob sets the rate of the LFO. When tempo sync is active, the rate unit is beats (e.g., 1/4^{ths}, 1/8^{ths}). When tempo sync is inactive, the rate unit is Hz.

The *randomization* (RND) knob can be used to introduce random drift into the LFO signal. When the knob is at zero, there is no randomization at all. When the knob is at 100, the LFO signal is completely random.

By default, an LFO begin playing at the leftmost point in the graph in the LFO display. To change the start point offset, drag the small arrow above the LFO display.

Modulation Envelopes

Proton has two *modulation envelopes* that allow you to construct your own LFO waveforms. To select which envelope to edit, use the ENV1 and ENV2 radio buttons.

Both modulation envelopes are triggered when you play a MIDI note. Proton will show the current position of the currently selected envelope by drawing a dark square (one per active voice) in the mod envelope display.

The length of the envelope can be configured by dragging in the number editor box beneath the curve. The *tempo sync* (SYNC) toggle button selects whether the envelope length is defined in transport tempo units (e.g., 1/4^{ths}, 1/8^{ths}) or in seconds.

A modulation envelope waveform consists of a number of *curve segments* that pass through *control points*. To move a control point, just drag it in the curve display. To add a new control point, hold shift and click where you want to add the point. To remove a control point, hold shift + control (Win) or shift + command (Mac) and click the point you want to remove.

To change the *curvature* of each segment, simply drag the segment. To restore the curvature to a straight line, hold control (Win) or command (Mac) and click on the segment.

You can also select an optional *sustain point* for the modulation envelope. When you play a MIDI note, Proton will follow the envelope until it reaches the sustain point and hold there until you release the MIDI note. It will then continue through the rest of the envelope (as long as the voice remains active). To select which of the control points that act as the sustain point, hold control (Win) or command (Mac) and click the control point. To disable the sustain point, hold control (Win) or command (Mac) and click it again.

Random noise

The random noise modulation source can generate three kinds of noise with slightly different character: *uniform noise*, *Gaussian noise*, and *exponential noise*. The *probability density function* (PDF) pop-up menu selects which of the three noise functions to use. The small graph to the left of the PDF selector shows an example of what the noise looks like. The length of the signal shown in the graph is one second. **Note:** The graph is just an example - it does not display the actual current output of the noise generator.

The uniform probability density function is commonly referred to as *white noise*. Its output can assume any value in the range, with equal probability. The output from the noise generator is passed through a lowpass filter before it is used by Proton. Use the *lowpass filter cutoff* (LPF) knob to configure the filter.

The Gaussian probability density function allows you to control the range and offset of the output. The *mean* (MEAN) knob controls the "offset" of the output: a large mean will make it more likely that the noise generator outputs high values, whereas a small mean will make it more likely that the generator outputs small values. The *variance* (VAR) knob controls the "spread" of the output: a large variance will cause the noise generator to include more of the full range of possible output values, whereas a small variance will cause the noise generator to include values close to the mean. The output from the noise generator is passed through a lowpass filter before it is used by Proton. Use the *lowpass filter cutoff* (LPF) knob to configure the filter.

The exponential probability density function is similar to a Gaussian function with the mean set to zero, but with a slightly different character. The *variance* (VAR) knob controls the "spread" of the output: a large variance will case the noise generator to include more of the full range of possible output values. The output from the noise generator is passed through a lowpass filter before it is used by Proton. Use the *lowpass filter cutoff* (LPF) knob to configure the filter.

Mod wheel

The modulation wheel is probably the simplest way to give the user control of modulation effects. The modulation wheel signal is zero when the wheel is at the bottom position and at the positive max when the wheel is at the top position.

You can enable and disable the modulation wheel by using the button above the wheel.

Velocity, Aftertouch, Expression, and Sustain Pedal

Key velocity, key aftertouch, expression, and sustain pedal are four other classic modulation sources.

The key velocity source outputs a larger value when the user strikes the MIDI keys harder (or, in fact, faster).

The aftertouch source outputs a larger value when the user presses down on a MIDI key that's already held (this functionality may not be available on all MIDI keyboards).

The expression source is a generic modulation source in the MIDI standard. Many musicians use a pedal for inputting expression values, but other kinds of controllers (like breath controllers) are can also be used.

The sustain pedal is used to hold notes in Proton, but its value can also be used as a modulation source.

Amplifier Envelope and Graphic Amplifier Envelope

The amplifier envelope modulation source outputs the same attack-decay-sustain-release envelope that Proton uses to control the volume of a voice (see above).

The graphic amplifier envelope modulation source outputs the optional graphic amp envelope curve.

Note: Both modulation sources will output a signal, regardless of whether the voice volume is controlled by the standard ADSR envelope or by the graphic envelope.

CV Inputs

Proton 1.1 has four generic CV inputs on the back panel that can be used as modulation sources. These are useful, for example, when creating Combinators.

Pitch quantization

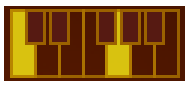
When particle semitone pitch is used as the modulation destination, you can constrain the pitch to a set notes of your choice by using the *pitch quantizer*.

Note: There are two semitone modulation destinations; one bipolar (which ranges from -1 to +1 octave) and one unipolar (which ranges from 0 to +1 octave). In the description the follows, we will assume that you are using the unipolar destination, but the principle is the same for the bipolar destination.

The pitch quantize controls are in the PITCH area on the WAVE page of the main display:

The pitch quantizer can be in one of three modes: *off*, *closest note*, and *equal distance*. You select the mode by clicking and holding the button on the left. The keyboard keys on the right is the *quantization scale*. Clicking on a note in the quantization scale will enable it (which means that it is included among the notes that the pitch quantizer is allowed to choose from). If no quantization scale notes are enabled, the pitch quantizer has no effect.

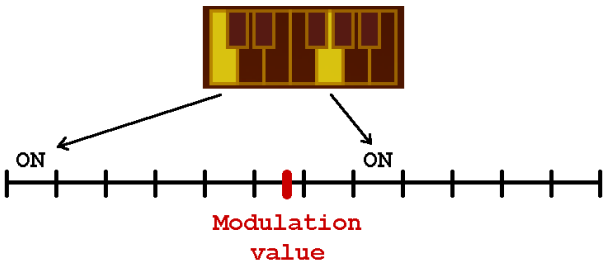
Note: The quantization scale "starts" at the MIDI note you play. So, for example, let's assume you have set the quantization scale to this:



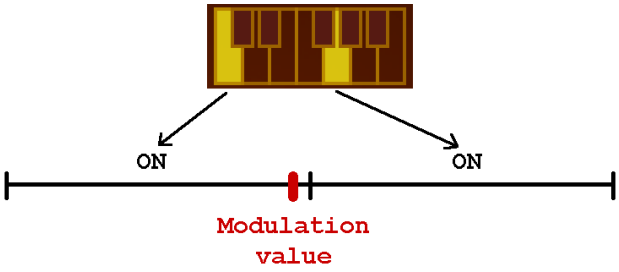
When you play a C, the pitch quantizer will output C and G notes. If you play a C#, the pitch quantizer will output C# and G# notes, and so on.

When the pitch quantizer is in the *closest note* mode, the modulation interval is divided into 12 segments, corresponding to the notes in the quantization scale. The pitch quantizer chooses the enabled segment closest to the modulation value as the output note. The figure below illustrates how this works. In this example, the quantization scale has two enabled notes (the first and the eighth) and the current modulation value (the red line) is close to the

midpoint. The eighth step is the closest enabled note to the modulation value, so this will be the output note.



When the pitch quantizer is in the *equal steps* mode, the modulation interval is divided into the same number of intervals as there are enabled notes in the quantization scale. The pitch quantizer selects the segment that the modulation value is inside, and outputs the corresponding note. The figure below illustrates how this works. The quantization scale has two enabled notes (the first and the eighth), so the modulation value range is divided into two intervals. The current modulation value (the red line) is in the first interval, so the first scale step will be the output note.



Effects

Proton contains a number of useful effects that can be used to add additional interest to its sound. This section contains descriptions of the effects.

Graphic Equalizer

Proton's graphic equalizer works similarly to Reason's MClass equalizer. To enable the equalizer, use the *on/off* (ON) toggle button in the top right corner.

The equalizer consists of four filters: a *low-shelf filter* that is intended for boosting or cutting low frequencies, a *high-shelf filter* that is intended for boosting or cutting high frequencies, and two *parametric filters* that can be used to pinpoint specific frequency ranges to boost or cut.

To enable a filter, use the corresponding *filter enable* (LS / HS / P1 / P2) toggle button. When a filter is enabled, a square will appear in the graph. Drag it to change the frequency and gain of the filter. Hold shift and drag the square to fixate the frequency while changing gain. Hold Alt and drag the square to change the Q (or quality factor) of the filter. Increasing the Q will reduce the bandwidth of the filters, but will also cause a larger gain boost or cut. Hold Control (Win) or Command (Mac) and click a square to reset the filter to its default settings.

Phaser

The phaser is a classic effect that uses all-pass filters (that let through all frequencies but introduces a short delay that varies with frequency) to create a sweeping/swooshing effect. Adding a small amount of phasing often adds interest to “noisy” timbres. Use the *on/off* (ON) toggle button in the upper right corner to enable the phaser.

Use the *tempo synchronization* (SYNC) toggle button to select if the phaser's sweep should be tempo-synchronized with Reason's transport.

The *rate* (RATE) knob sets the rate of the phaser sweep. When tempo sync is active, the rate unit is beats (e.g., 1/4^{ths}, 1/8^{ths}). When tempo sync is inactive, the rate unit is Hz.

The *tuning* (TUNE) knob sets the center frequency (in Hz) around which the phaser sweeps.

The *depth* (DEPTH) knob specifies how far off the center frequency that the sweep reaches. The sweep range is zero at the minimum setting, while it is +/- 64 semitones at the maximum setting.

The *resonance* (RES) knob increases feedback in the phaser, strengthening its effect.

The *stereo offset* (OFFS) knob offsets the phase of the right channel of the phaser and can be used to increase the apparent stereo width of the sound or to create “ping-pong” effects.

The *mix* (MIX) knob sets the amount of dry signal to the amount of wet signal.

Delay

The delay is similar to Reason's DDL-1 and The Echo devices. The *on/off* toggle button turns it on or off.

The *tempo synchronization* (SYNC) button selects if the delay length should be synchronized with Reason's tempo or not.

The *delay* (DELAY) knob sets the length of the delay. In tempo sync mode, the length is in beats (e.g., 1/4^{ths}, 1/8^{ths}). In free-running mode, the length is in seconds.

The *right channel delay offset* (OFFS) knob offsets the delay length for the right channel. In tempo sync mode, the length is in beats (e.g., 1/4^{ths}, 1/8^{ths}). In free-running mode, the length is in seconds.

The *feedback* (FB) knob selects the amount of feedback for the delay.

If the *ping-pong* (PING PONG) toggle button is enabled, the right channel output from the delay is fed back to the left channel and vice versa.

The delay feedback loop contains an optional 12dB-per-octave low-pass filter that can be used to “color” the sound of the delay. Use the *low-pass filter on/off* (ON) toggle button to enable it. The *filter resonance* (RES) knob can be used to tweak the resonance of the filter.

The *mix* (MIX) knob sets the amount of dry signal to the amount of wet signal.

Reverb

Proton's reverb can be used to add ambience and stereo width. The *on/off* toggle button turns it on or off.

The *size* (SIZE) knob selects the apparent size of the room.

The *damping* (DAMP) knob allows you to filter out higher frequencies from the reverb tail.

The *stereo width* (WIDTH) knob sets the apparent stereo width of the reverb.

The *mix* (MIX) knob sets the amount of dry signal to the amount of wet signal.

Back panel

Proton's back panel has two standard L/R audio output sockets. It also has the standard Gate/Note CV inputs (which allow you to play Proton through CV utilities like Matrix or RPG-8; please refer to the Reason manual for details).

The back panel also contains CV input sockets that you can use to modulate various parameters in Proton's sound engines.

Note: All CV input signals are converted internally by Proton into a unipolar range before they are used; any input signal value smaller than zero is clamped to zero.

The first row of CV input sockets can be used to modulate the particle engines. The sockets modulate the following parameters (left-to-right): emitter position (POS), emitter size (SIZE), emitter fluctuation (FLCT), particle pitch (PITCH), particle lifetime (LIFE; engine 1 only), emitter precision (PRCS), stereo width (WIDE; engine 2 and 3 only), and particle emission rate (RATE; engine 3 only).

Below the particle engine sockets there are CV inputs for modulating the two filters: the sockets modulate the cutoff frequency (FREQ) and resonance (RES).

The last row of CV inputs are generic modulation inputs; you use the modulation matrix to select which parameter to modulate.

Acknowledgements

Proton's signal processing code was programmed by LoveOne Consulting AB.
http://soundlove.se/

Many of Proton's audio features, and parts of its user interface were designed by Selig Audio.
http://www.seligaudio.com/

Proton's reverb is based on the STK version of FreeVerb.
https://ccrma.stanford.edu/software/stk

Proton's 24 dB/oct lowpass filter is based on code made available by Paul Kellett.
http://www.musicdsp.org/

Proton's mode 2 grain engine is inspired by Granulator II for Ableton Live.
http://monolake.de/technology/granulator.html

Proton's mode 3 grain engine is inspired by The Mangle VST instrument.
http://sound-guru.com/software/mangle/

A huge thank you to all our testers and patch makers!

MIDI CC Chart

[5]	Glide
[7]	Main Volume
[12]	Amp Envelope Sustain
[13]	Amp Envelope Decay
[18]	Delay Length (Free)
[19]	Delay Length (Sync)
[21]	Tuning Octaves
[22]	Tuning Semitones
[23]	Tuning Cents
[25]	Delay Feedback
[26]	LFO 1 Rate (Free)
[27]	LFO 1 Depth 1
[28]	LFO 1 Wave Shape
[29]	LFO 1 Destination 1
[30]	LFO 1 Key Sync
[31]	LFO 1 Tempo Sync
[39]	Pitch Bend Range
[44]	LFO 1 Depth 2
[45]	LFO 1 Destination 2
[46]	LFO 1 Randomization
[48]	Delay On
[49]	Delay Right Channel Time Offset (Free)
[50]	Delay Right Channel Time Offset (Sync)
[51]	Delay Ping Pong
[52]	Delay Tempo Sync
[53]	Delay Mix
[54]	Delay Filter On
[55]	Delay Filter Cutoff
[56]	Delay Filter Resonance
[71]	Filter 1 Resonance
[72]	Amp Envelope Release
[73]	Amp Envelope Attack
[74]	Filter 1 Cutoff
[75]	Filter 1 On
[76]	Filter 1 Type
[77]	Filter 2 Resonance
[78]	Filter 2 Cutoff
[79]	Filter 2 On
[80]	Filter 2 Type
[81]	Filter Route
[82]	Mod Matrix Slot 8 Source
[83]	Mod Matrix Slot 8 Amount
[84]	Mod Matrix Slot 8 Destination
[85]	Mod Matrix Slot 8 Scaling
[86]	Mod Matrix Slot 8 Scaling Source
[87]	Mod Matrix Slot 9 Source
[88]	Mod Matrix Slot 9 Amount
[89]	Mod Matrix Slot 9 Destination
[90]	Mod Matrix Slot 9 Scaling
[91]	Mod Matrix Slot 9 Scaling Source
[109]	LFO 1 Rate (Sync)
[110]	LFO 2 Rate (Free)
[111]	LFO 2 Rate (Sync)
[112]	LFO 2 Depth 1
[113]	LFO 2 Wave Shape
[114]	LFO 2 Destination 1
[115]	LFO 2 Key Sync
[116]	LFO 2 Tempo Sync
[117]	LFO 2 Depth 2
[118]	LFO 2 Destination 2
[119]	LFO 2 Randomization
[128]	Mod Wheel On
[129]	Mod Wheel Depth
[130]	Mod Wheel Destination
[131]	Mod Wheel LFO 1 Depth Modulation
[132]	Mod Wheel LFO 2 Depth Modulation
[135]	Phaser On
[136]	Phaser Rate (Free)
[137]	Phaser Rate (Sync)
[138]	Phaser Tuning
[139]	Phaser Depth
[140]	Phaser Resonance
[141]	Phaser Stereo Width
[142]	Phaser Tempo Sync
[143]	Phaser Mix
[150]	Reverb On
[151]	Reverb Size
[152]	Reverb Damping
[153]	Reverb Stereo Width
[154]	Reverb Mix
[160]	Emitter Position
[161]	Emitter Size
[162]	Emitter Fluctuation
[163]	Particle Lifetime
[164]	Emitter Precision
[165]	Particle Type
[170]	Emitter Position Keyboard Tracking On
[171]	Emitter Position Keyboard Tracking
[172]	Tuning Keyboard Tracking On
[173]	Tuning Keyboard Tracking
[174]	Filter 1 Cutoff Keyboard Tracking On
[175]	Filter 1 Cutoff Keyboard Tracking
[176]	Filter 2 Cutoff Keyboard Tracking On
[177]	Filter 2 Cutoff Keyboard Tracking
[178]	Mod Envelope Length Free
[179]	Mod Envelope Length Sync
[180]	Mod Envelope Sync
[181]	Mod Envelope Loop
[182]	Mod Envelope Depth 1
[183]	Mod Envelope Destination 1
[184]	Mod Envelope Depth 2
[185]	Mod Envelope Destination 2
[186]	Amplifier Velocity
[187]	Velocity Depth
[188]	Velocity Destination
[189]	LFO 1 Phase Offset
[190]	LFO 2 Phase Offset
[191]	Emitter Stereo Width
[192]	Emitter Rate (Free)
[193]	Emitter Rate (Sync)
[194]	Emitter Tempo Sync
[195]	Emitter Key Sync
[196]	Emitter Reverse %
[200]	EQ On
[201]	EQ Low Shelf On
[202]	EQ Low Shelf Frequency
[203]	EQ Low Shelf Q
[204]	EQ Low Shelf Gain
[205]	EQ Param 1 On
[206]	EQ Param 1 Frequency
[207]	EQ Param 1 Q
[208]	EQ Param 1 Gain
[209]	EQ Param 2 On
[210]	EQ Param 2 Frequency
[211]	EQ Param 2 Q
[212]	EQ Param 2 Gain
[213]	EQ High Shelf On
[214]	EQ High Shelf Frequency
[215]	EQ High Shelf Q
[216]	EQ High Shelf Gain
[217]	Mod Envelope 2 Length Free
[218]	Mod Envelope 2 Length Sync
[219]	Mod Envelope 2 Sync
[220]	Mod Envelope Sustain Point
[221]	Mod Envelope 2 Sustain Point
[222]	Random Noise Type
[223]	Random Noise Mean
[224]	Random Noise Variance
[225]	Random Noise Filter Cutoff
[226]	Pitch Quantize
[227]	Pitch Quantize Scale C
[228]	Pitch Quantize Scale C#
[229]	Pitch Quantize Scale D
[230]	Pitch Quantize Scale D#
[231]	Pitch Quantize Scale E
[232]	Pitch Quantize Scale F
[233]	Pitch Quantize Scale F#
[234]	Pitch Quantize Scale G
[235]	Pitch Quantize Scale G#
[236]	Pitch Quantize Scale A
[237]	Pitch Quantize Scale A#
[238]	Pitch Quantize Scale B

Remote™ names

AEON	Amp Envelope On
AESN	Amp Envelope Sync
AM0	Mod Matrix Slot 0 Amount
AM1	Mod Matrix Slot 1 Amount
AM10	Mod Matrix Slot 10 Amount
AM11	Mod Matrix Slot 11 Amount
AM12	Mod Matrix Slot 12 Amount
AM13	Mod Matrix Slot 13 Amount
AM14	Mod Matrix Slot 14 Amount
AM15	Mod Matrix Slot 15 Amount
AM16	Mod Matrix Slot 16 Amount
AM17	Mod Matrix Slot 17 Amount
AM18	Mod Matrix Slot 18 Amount
AM19	Mod Matrix Slot 19 Amount
AM2	Mod Matrix Slot 2 Amount
AM20	Mod Matrix Slot 20 Amount
AM21	Mod Matrix Slot 21 Amount
AM22	Mod Matrix Slot 22 Amount
AM23	Mod Matrix Slot 23 Amount
AM24	Mod Matrix Slot 24 Amount
AM25	Mod Matrix Slot 25 Amount
AM26	Mod Matrix Slot 26 Amount
AM27	Mod Matrix Slot 27 Amount
AM28	Mod Matrix Slot 28 Amount
AM29	Mod Matrix Slot 29 Amount
AM3	Mod Matrix Slot 3 Amount
AM4	Mod Matrix Slot 4 Amount
AM5	Mod Matrix Slot 5 Amount
AM6	Mod Matrix Slot 6 Amount
AM7	Mod Matrix Slot 7 Amount
AM8	Mod Matrix Slot 8 Amount
AM9	Mod Matrix Slot 9 Amount
AMPV	Amplifier Velocity
ATT	Amp Envelope Attack
CENT	Tuning Cents
DEC	Amp Envelope Decay
DLAY	Delay On
DLF	Delay Filter On
DLFB	Delay Feedback
DLFF	Delay Filter Cutoff
DLFR	Delay Filter Resonance
DLLF	Delay Length (Free)
DLLS	Delay Length (Sync)
DLMX	Delay Mix
DLOF	Delay Right Channel Time Offset (Free)
DLOS	Delay Right Channel Time Offset (Sync)
DLPP	Delay Ping Pong
DLTS	Delay Tempo Sync
DS0	Mod Matrix Slot 0 Destination
DS1	Mod Matrix Slot 1 Destination
DS10	Mod Matrix Slot 10 Destination
DS11	Mod Matrix Slot 11 Destination
DS12	Mod Matrix Slot 12 Destination
DS13	Mod Matrix Slot 13 Destination
DS14	Mod Matrix Slot 14 Destination
DS15	Mod Matrix Slot 15 Destination
DS16	Mod Matrix Slot 16 Destination
DS17	Mod Matrix Slot 17 Destination
DS18	Mod Matrix Slot 18 Destination
DS19	Mod Matrix Slot 19 Destination
DS2	Mod Matrix Slot 2 Destination
DS20	Mod Matrix Slot 20 Destination
DS21	Mod Matrix Slot 21 Destination
DS22	Mod Matrix Slot 22 Destination
DS23	Mod Matrix Slot 23 Destination
DS24	Mod Matrix Slot 24 Destination
DS25	Mod Matrix Slot 25 Destination
DS26	Mod Matrix Slot 26 Destination
DS27	Mod Matrix Slot 27 Destination
DS28	Mod Matrix Slot 28 Destination
DS29	Mod Matrix Slot 29 Destination
DS3	Mod Matrix Slot 3 Destination
DS4	Mod Matrix Slot 4 Destination
DS5	Mod Matrix Slot 5 Destination
DS6	Mod Matrix Slot 6 Destination
DS7	Mod Matrix Slot 7 Destination
DS8	Mod Matrix Slot 8 Destination
DS9	Mod Matrix Slot 9 Destination
EQ	EQ On
EQ1F	EQ Param 1 Frequency
EQ1G	EQ Param 1 Gain
EQ1O	EQ Param 1 On
EQ1Q	EQ Param 1 Q
EQ2F	EQ Param 2 Frequency
EQ2G	EQ Param 2 Gain
EQ2O	EQ Param 2 On
EQ2Q	EQ Param 2 Q
EQHF	EQ High Shelf Frequency
EQHG	EQ High Shelf Gain
EQHO	EQ High Shelf On
EQHQ	EQ High Shelf Q
EQLF	EQ Low Shelf Frequency
EQLG	EQ Low Shelf Gain
EQLO	EQ Low Shelf On
EQLQ	EQ Low Shelf Q
EREV	Emitter Reverse %
ERKS	Emitter Key Sync
ERTF	Emitter Rate (Free)
ERTS	Emitter Rate (Sync)
ERTS	Emitter Tempo Sync
F1FR	Filter 1 Cutoff
F1MD	Filter 1 Type
F1ON	Filter 1 On
F1RE	Filter 1 Resonance
F2FR	Filter 2 Cutoff
F2MD	Filter 2 Type
F2ON	Filter 2 On
F2RE	Filter 2 Resonance
FLCT	Emitter Fluctuation
FROU	Filter Route
KEYM	Key Mode
KF1O	Filter 1 Cutoff Keyboard Tracking On
KF2O	Filter 2 Cutoff Keyboard Tracking On
KF2T	Filter 1 Cutoff Keyboard Tracking
KF2T	Filter 2 Cutoff Keyboard Tracking
KTP	Emitter Position Keyboard Tracking
KTPO	Emitter Position Keyboard Tracking On
KTT	Tuning Keyboard Tracking
KTTO	Tuning Keyboard Tracking On
L1D1	LFO 1 Depth 1
L1D2	LFO 1 Depth 2
L1KS	LFO 1 Key Sync
L1PO	LFO 1 Phase Offset
L1RF	LFO 1 Rate (Free)
L1RN	LFO 1 Randomization
L1RS	LFO 1 Rate (Sync)
L1T1	LFO 1 Destination 1
L1T2	LFO 1 Destination 2
L1TS	LFO 1 Tempo Sync
L1WS	LFO 1 Wave Shape
L2D1	LFO 2 Depth 1
L2D2	LFO 2 Depth 2
L2KS	LFO 2 Key Sync
L2PO	LFO 2 Phase Offset
L2RF	LFO 2 Rate (Free)
L2RN	LFO 2 Randomization
L2RS	LFO 2 Rate (Sync)
L2T1	LFO 2 Destination 1
L2T2	LFO 2 Destination 2
L2TS	LFO 2 Tempo Sync
L2WS	LFO 2 Wave Shape
LIFE	Particle Lifetime
M2LF	Mod Envelope 2 Length Free
M2LP	Mod Envelope 2 Loop
M2LS	Mod Envelope 2 Length Sync
M2SP	Mod Envelope 2 Sustain Point
M2SY	Mod Envelope 2 Sync
MED1	Mod Envelope Depth 1
MED2	Mod Envelope Depth 2
MELF	Mod Envelope Length Free
MELP	Mod Envelope Loop
MELS	Mod Envelope Length Sync
MESL	Mod Envelope Select
MESP	Mod Envelope Sustain Point
MESY	Mod Envelope Sync
MET1	Mod Envelope Destination 1
MET2	Mod Envelope Destination 2
MLF1	Mod Wheel LFO 1 Depth Modulation
MLF2	Mod Wheel LFO 2 Depth Modulation
MODD	Mod Wheel Depth
MODE	Emitter Mode
MODM	Show Mod Matrix
MODT	Mod Wheel Destination
MODW	Mod Wheel On
OCT	Tuning Octaves
PAGE	Page
PHDP	Phaser Depth
PHMX	Phaser Mix
PHRF	Phaser Rate (Free)
PHRS	Phaser Rate (Sync)
PHRS	Phaser Resonance
PHSR	Phaser On
PHSY	Phaser Tempo Sync
PHTN	Phaser Tuning
PHWI	Phaser Stereo Width
POLY	Polyphony Voices
PORT	Glide
POS	Emitter Position
PRCS	Emitter Precision
PTQT	Pitch Quantize
RBDM	Reverb Damping
RBMX	Reverb Mix
RBSW	Reverb Stereo Width
RBSZ	Reverb Size
REL	Amp Envelope Release
REVB	Reverb On
RNDF	Random Noise Filter Cutoff
RNDM	Random Noise Mean
RNDT	Random Noise Type
RNDV	Random Noise Variance
ROOT	Root Note
SC0	Mod Matrix Slot 0 Scaling

SC1	Mod Matrix Slot 1 Scaling
SC10	Mod Matrix Slot 10 Scaling
SC11	Mod Matrix Slot 11 Scaling
SC12	Mod Matrix Slot 12 Scaling
SC13	Mod Matrix Slot 13 Scaling
SC14	Mod Matrix Slot 14 Scaling
SC15	Mod Matrix Slot 15 Scaling
SC16	Mod Matrix Slot 16 Scaling
SC17	Mod Matrix Slot 17 Scaling
SC18	Mod Matrix Slot 18 Scaling
SC19	Mod Matrix Slot 19 Scaling
SC2	Mod Matrix Slot 2 Scaling
SC20	Mod Matrix Slot 20 Scaling
SC21	Mod Matrix Slot 21 Scaling
SC22	Mod Matrix Slot 22 Scaling
SC23	Mod Matrix Slot 23 Scaling
SC24	Mod Matrix Slot 24 Scaling
SC25	Mod Matrix Slot 25 Scaling
SC26	Mod Matrix Slot 26 Scaling
SC27	Mod Matrix Slot 27 Scaling
SC28	Mod Matrix Slot 28 Scaling
SC29	Mod Matrix Slot 29 Scaling
SC3	Mod Matrix Slot 3 Scaling
SC4	Mod Matrix Slot 4 Scaling
SC5	Mod Matrix Slot 5 Scaling
SC6	Mod Matrix Slot 6 Scaling
SC7	Mod Matrix Slot 7 Scaling
SC8	Mod Matrix Slot 8 Scaling
SC9	Mod Matrix Slot 9 Scaling
SEMI	Tuning Semitones
SIZE	Emitter Size
SR0	Mod Matrix Slot 0 Source
SR1	Mod Matrix Slot 1 Source
SR10	Mod Matrix Slot 10 Source
SR11	Mod Matrix Slot 11 Source
SR12	Mod Matrix Slot 12 Source
SR13	Mod Matrix Slot 13 Source
SR14	Mod Matrix Slot 14 Source
SR15	Mod Matrix Slot 15 Source
SR16	Mod Matrix Slot 16 Source
SR17	Mod Matrix Slot 17 Source
SR18	Mod Matrix Slot 18 Source
SR19	Mod Matrix Slot 19 Source
SR2	Mod Matrix Slot 2 Source
SR20	Mod Matrix Slot 20 Source
SR21	Mod Matrix Slot 21 Source
SR22	Mod Matrix Slot 22 Source
SR23	Mod Matrix Slot 23 Source
SR24	Mod Matrix Slot 24 Source
SR25	Mod Matrix Slot 25 Source
SR26	Mod Matrix Slot 26 Source
SR27	Mod Matrix Slot 27 Source
SR28	Mod Matrix Slot 28 Source
SR29	Mod Matrix Slot 29 Source
SR3	Mod Matrix Slot 3 Source
SR4	Mod Matrix Slot 4 Source
SR5	Mod Matrix Slot 5 Source
SR6	Mod Matrix Slot 6 Source
SR7	Mod Matrix Slot 7 Source
SR8	Mod Matrix Slot 8 Source
SR9	Mod Matrix Slot 9 Source
SS0	Mod Matrix Slot 0 Scaling Source
SS1	Mod Matrix Slot 1 Scaling Source
SS10	Mod Matrix Slot 10 Scaling Source
SS11	Mod Matrix Slot 11 Scaling Source
SS12	Mod Matrix Slot 12 Scaling Source
SS13	Mod Matrix Slot 13 Scaling Source
SS14	Mod Matrix Slot 14 Scaling Source
SS15	Mod Matrix Slot 15 Scaling Source
SS16	Mod Matrix Slot 16 Scaling Source
SS17	Mod Matrix Slot 17 Scaling Source
SS18	Mod Matrix Slot 18 Scaling Source
SS19	Mod Matrix Slot 19 Scaling Source
SS2	Mod Matrix Slot 2 Scaling Source
SS20	Mod Matrix Slot 20 Scaling Source
SS21	Mod Matrix Slot 21 Scaling Source
SS22	Mod Matrix Slot 22 Scaling Source
SS23	Mod Matrix Slot 23 Scaling Source
SS24	Mod Matrix Slot 24 Scaling Source
SS25	Mod Matrix Slot 25 Scaling Source
SS26	Mod Matrix Slot 26 Scaling Source
SS27	Mod Matrix Slot 27 Scaling Source
SS28	Mod Matrix Slot 28 Scaling Source
SS29	Mod Matrix Slot 29 Scaling Source
SS3	Mod Matrix Slot 3 Scaling Source
SS4	Mod Matrix Slot 4 Scaling Source
SS5	Mod Matrix Slot 5 Scaling Source
SS6	Mod Matrix Slot 6 Scaling Source
SS7	Mod Matrix Slot 7 Scaling Source
SS8	Mod Matrix Slot 8 Scaling Source
SS9	Mod Matrix Slot 9 Scaling Source
SUS	Amp Envelope Sustain
TYPE	Particle Type
VELD	Velocity Depth
VELT	Velocity Destination
VOL	Main Volume
WIDE	Emitter Stereo Width