Produced by Impact Soundworks in collaboration with OverClocked ReMix
Version 1.2.5 (April 11th, 2017)

Now Includes Super Audio Cart PC!

Introduction

Foreword from Impact Soundworks:

Super Audio Cart faithfully reproduces the sound of seven classic video game systems whose cultural legacy and influence has lasted far beyond their commercial lifespans. When the library was conceived, our goal was superb authenticity by deep-sampling every sound chip. But over time, we expanded our vision to shatter the limitations of the original systems and allow for near-infinite sound design possibilities.

The final version of Super Audio Cart is the culmination of 2+ years of intense research, development, and sound design. With a massive 5,500+ samples meticulously recorded, edited, and looped, we've thoroughly captured the raw capabilities of each game system. These sounds are loaded into a custom Kontakt Player engine packed with cutting-edge features, along with 1,000+ factory snapshots to inspire both chiptune music and modern genres.

To create this instrument, everyone involved needed a passion and deep connection to both video games and their music. That's why we collaborated with OverClocked ReMix, a website and community dedicated to the appreciation of game music. To us, Super Audio Cart represents the ultimate tribute to that art form, and we know that it will find a place in your music for many years to come!

Foreword from David Lloyd, founder of OverClocked ReMix:

Andrew and I actually had the original vision for Super Audio Cart way back in 2008 - a virtual instrument capable of accurately reproducing a broad range of the video game sounds & textures we know, love, and grew up with, but also of combining and manipulating those elements into totally new sounds.

It's taken a long while and a ton of work, but I'm very proud of the final product: Super Audio Cart makes these amazing sounds immediately convenient & accessible via a single interface that also offers profound sound-design capabilities… it's been amazing seeing what our team of preset designers have come up with, and I'm even more excited about the unexpected & creative ways artists are going to use this powerful tool!

Installation

Super Audio Cart requires a copy of Kontakt Player or the full version of Kontakt already installed on your computer. If you do not have Kontakt Player, you can download and install it **for free**:

https://www.native-instruments.com/en/products/komplete/samplers/kontakt-6-player/

1. Install the **Pulse** application if you don't already have it. **Pulse** is a cross-platform desktop app that lets you download and install your libraries with blazing speed! You'll need to create an account here, but once you do, you can access your purchases from *any* developers using **Pulse**, anytime, from any computer.

https://pulsedownloader.com/

2. Once **Pulse** is installed, open it and enter your **Super Audio Cart** product code. Follow the instructions to download and install the library.

3. Open Native Access, click "Add a Serial", and input the same product code to **activate** the library.

4. Once activated, click "View Products Not Installed". Find **Super Audio Cart** in this list. Click the "Add Library" button to the right, and select the folder where Pulse downloaded the library. This completes the installation process.

5. **Super Audio Cart PC**, which contains another 7 hardware systems (all classic computers), will be **installed automatically**. No extra registration or activation is needed to use Super Audio Cart PC. You'll see the SAC PC patches in the same folder as Super Audio Cart's NKIs.

Troubleshooting

PROBLEM: Kontakt says "No Library Found" when I try to add it.
Make sure you are selecting the Super Audio Cart folder that contains the file "Super Audio Cart.nicnt". This file is what Kontakt uses to connect the library. If you don't see that file at all, or if the library still will not activate, it's possible your download was not complete: double-check the size of your RAR files.

PROBLEM: Error message saying my Kontakt version is too old.
You can update Kontakt in Native Access. Run the update to get on version 5.5.2 and you'll be fine.

PROBLEM: The library takes a long time to load.
If you are using antivirus software, including Windows Defender installed by default on all PCs, make sure to add exclusions for the file types: NKX, NKC, WAV, and NCW. Load times can also be improved by moving the library to an internal hard drive - ideally a solid state drive - or to an external drive connected via USB3 or Thunderbolt.

Also, we recommend **updating your version of Kontakt** to the **latest version possible**. Native Instruments continues to improve the performance and stability of Kontakt.

PROBLEM: Sometimes I play notes and they don't trigger.
There is a bug with Kontakt's "Daft LP" filter on some systems. Check the layers Advanced pages (A-D tabs) to see if any of them are using this filter. If so, try changing it to Ladder LP2 or Ladder LP4 as a good alternative.

PROBLEM: I get pops and crackles during playback.
This can happen for several reasons. One would be that you are trying to run too many things (plugins & effects) at too low of a latency for your audio interface & CPU to handle. Disabling unnecessary FX plugins or increasing your audio buffer in your DAW/interface can help with this. However, there is also a bug in Kontakt's convolution reverb effect that affects some systems. Try disabling any reverbs in the FX racks to see if that helps.

Consoles

2600
The first mainstream home video game console, released in 1977. Though its graphics and audio are incredibly primitive by today's standards, it has an enduring dual legacy: it created the first video game market boom, as well as the first video game market crash, in 1982. Powered by a MOS 6507 CPU and Television Interface Adaptor (TIA) chip, the 2600 has only two oscillators available for audio. These oscillators can produce essentially only pulse waves and noise, with limited capacity for modulation of the output for slightly more complex sounds.

C64
One of the most widely-used home computers of the 1980s, and in fact the most popular single computer model ever released. The C64 was ubiquitous particularly in Europe, with a huge

range of games and other software available. Its audio was driven by the famous MOS 6581 SID chip, capable of a wide range of tones. It featured three independent oscillators, four waveforms, volume envelopes, ring modulation, oscillator sync, and a multi-mode filter. Many of these capabilities were not to be found even in dedicated synthesizers of similar price.

SMS

An early attempt to break into the home console market, SMS ran on a Zilog Z80 processor and was designed as a more advanced machine than competitors' products, which proved difficult in the shadow of NES's market dominance and licensing practices. Although it did not sell well in North America and Japan, it gained a significant market share in Europe, and even now manages to sell comparably well in Brazil. The SMS is credited with contributing to later successes with the GEN console.

The SMS sound chip is a clone of Texas Instruments' SN76489 - used in many arcade games, other home consoles and home computers - and is integrated into the video display processor. The chip offers three tone generators producing square waves and a generator for white noise, each outputting sound at 16 attenuation levels. The noise channel generates at one of three fixed frequencies, or can utilize the full range of frequencies of the third tone channel (at the expense of sound output from that channel). For most music applications, it's done in order to emulate a hi-hat loop. The noise can also be programmed to generate periodically.

GB

A handheld game system that revolutionized the gaming industry upon its release in 1989, the GB was a monumental step forward from prior attempts at portable gaming. Its wide range of high-quality games like "Tetris" ensured it a place in the top three best-selling game systems of all time.

The sound chip, powered by a specialized 8-bit Sharp CPU, sports two pulse oscillators, a 4-bit PCM sample channel, and a noise generator. These four channels offer a surprising range of possible tones, particularly when the sample channel is used to load other synth waveforms. The GB is the first choice of many musicians in the chiptune music scene thanks to the "LSDJ" cartridge, allowing for direct access to the sound chip to create music.

NES

Where the 2600 was arguably responsible for the video game crash of the 80s, this system was undoubtedly the industry's savior. Released in North America in 1985, the NES was an immediate smash hit. Its library was home to genre-defining games like Super Mario Bros. and the Legend of Zelda, along with starting countless franchises that still exist today: Mega Man, Castlevania, Final Fantasy, Dragon Warrior, and many others. With some exceptions, the quality of NES games was a step above most other game consoles of the era, boasting better graphics, tighter gameplay, and better sound.

The NES is powered by a Ricoh 2A03 processor capable of outputting up to 5 channels of simultaneous audio: two pulse waves with variable width, a fixed-volume triangle wave, generated noise, and lo-fi DPCM (delta pulse-code modulation) sample playback. Compared to the hit console it succeeded - the 2600 - the NES offered audio designers of the time much more flexibility to create intricate music and sound effects.

GEN
Modeled after arcade hardware, originally released in 1988, and utilizing a Motorola 68000 processor for complex action and fast gameplay. The Z80 coprocessor managed the audio and allowed SMS games to be played via a converter. Its strengths in platformers, sports and arcade adaptations, along with its positioning as a clear gaming alternative, helped make its intense battle for market share with the SNES a catalyst for the exponential growth of the video game industry.

Sound was produced through a Yamaha YM2612 FM synthesizer and an integrated SN76489 PSG chip (same as in the SMS). The 2612 offered six channels of stereo FM sound, each using 4 sine wave operators, with 8-bit PCM sample playback available on one channel. The chip had fewer features compared to its arcade FM counterparts; most notably, a simplified sound mixer and built-in DAC created an unusual distortion at low output that some fans say gives the sound a special "character." One or both sound chips were controlled in hardware or software, which resulted, depending on the game requirements and the programming skill involved, in a diverse array of possible soundscapes.

Since FM synthesis allows for a nearly-infinite number of sonic possibilities, we focused on capturing over 120 multisampled sounds using the exact synth settings captured from the games themselves. In many cases the amplitude envelope of the sounds were untouched: the characteristic artifacts during the decay period is very important to preserve (As later GEN models replaced the discrete YM2612 with an integrated YM3438 that improved output and mostly eliminated the artifacts, samples were recorded using a Model 1 GEN with the original chip). Fans of classic GEN games will see our subtle nods to which games each sound came from! In addition to these multisampled synth patches, we also recorded a number of sound effects produced with the FM chip (using in-game sound tests) plus custom PCM drum samples recorded through the GEN's DAC.

SNES
The newest console featured in **Super Audio Cart**, and the most advanced. Released in 1990, the SNES was met with widespread acclaim for its 16-bit graphics and high-fidelity audio. Many enduring game franchises began on the SNES, or had installments still considered to be the best today. In Japan, it was abbreviated "SFC."

Unlike the other game consoles we sampled, the SNES does not have traditional synth oscillators. It instead uses two custom chips, the SPC700 and S-DSP, allowing for up to 8 simultaneous voices of 16-bit / 32kHz sampled audio sharing a whopping 64 kilobytes of RAM. Thanks to this flexibility, every SNES game could have a unique palette of sounds and DSP (panning, ADSR, echo, etc.)

Given its nature, it is not possible to sample the SNES per se, since the system itself has no synth oscillators. We thus created a custom bank of 400+ waveforms inspired by the soundtracks of the most classic SNES games, editing them to tiny sizes in the kilobyte range and using precision looping techniques. We then used lossy bit rate reduction (BRR) tools necessary to prepare the sounds for loading on to an actual SNES cartridge, with the end result being a bank of samples that could have been used in any actual SNES game release!

FC (New in Version 1.1)

The FC was the Japanese version of the NES, released almost two years earlier in 1983. The FC boasted a huge library of games, many of which were never released in North America or Europe, and offered some unique features that did not make it to the NES in the West. Besides a different visual aesthetic (red and white instead of grey), the FC was capable of expansion through several methods. One was the **FDS**, a hardware unit that attached to the FC and which loaded games from floppy disks instead of cartridges.

Even more relevant to our interests, the FDS included expanded sound capabilities. It used a primitive wavetable allowing for custom waveforms, separate from the default NES sound channels. As a result, FDS games often sounded richer than their NES counterparts.

Some FC games included special chips that could also be used to improve the FC's sound generation features. Some of these games were released in the West, but without the enhancement chips. One chip was the **VRC6**, which added two additional pulse channels (with more pulse width options) and a saw wave channel. The **VRC7** was an even rarer beast, featuring an entire FM synthesis chip derived from the Yamaha YM2413. The audio capabilities of the VRC7 were only used on a single game (Lagrange Point) which itself was released only in Japan. It included 15 hardcoded instruments plus the ability to output user-defined FM instruments.

User Interface (Main Page)

TIP: Clicking the Super Audio Cart logo will display the current version number. This is useful to make sure your version is up-to-date when future patches are released!

Layer Strip Controls

VOLUME: Controls the output level for this layer. This adjustment is applied **after** any Layer FX, but **before** the global FX.

SYSTEM: Shows the system the sound source was recorded from. Clicking this, or the sound source name, will open up the sound browser.

MUTE/SOLO: Mute disables the layer from being output without unloading it from RAM, while Solo excludes other layers from processing.

SOUND SOURCE: Shows the current sound source loaded into memory. This can be clicked to open the sound browser.

SOUND SOURCE UP/DOWN: These arrows cycle through available sound sources belonging to the selected system.

PAN: Controls panning for this layer.

PITCH: Controls coarse tuning for this layer. Each step of the knob is 1 semitone (half note). Note that this does not transpose MIDI input, but actually re-tunes the waveform entirely.

CUTOFF: Controls the filter cutoff for this layer. Will not do anything if the filter is not enabled.

ARP TOGGLE: Turns the arpeggiator/sequencer on or off.

RAW: Toggles RAW mode for this layer. In RAW mode, all FX are bypassed, and the playback range of the sound source is limited to the range of the recordings. The volume and pitch envelopes, along with the filter, will also be bypassed. This is the best way to get a truly, 100% authentic and unprocessed sound out of each source.

FX TOGGLE: Bypasses all FX for the layer.

OUTPUT: Selects the Kontakt audio output for the layer. This is useful if you want to route each layer to different stereo channels in your host mixer.

LAYER POWER: Toggles the entire layer on or off. When a layer is powered off, it is unloaded from memory (unless another layer is using the same samples!)

Global Controls

Control Link: When control link is enabled, making changes to a single layer (anything except FX) will affect other linked layers. For example, selecting layers A+B and enabling control link, then moving the cutoff on Layer A, will set Layer B's cutoff to the same value. However, if Layer C is not selected, then moving Layer C controls will not affect the other layers (and vice versa).

NOTE: Even with Control Link disabled, you can hold **alt** while dragging or clicking on any control to affect all layers simultaneously!

Global FX Toggle: When disabled, all global FX are bypassed (this does not affect layer FX).

Randomizers: Clicking any of the colored die will randomize parameters for either a single layer (with the dice colors corresponding with the layer strip colors), or all layers at once.

Undo Button: Resets the current patch to right before the last randomization.

Sound / FX / ARP: Toggles randomization of certain parameters.

Sound: Sound source / console selection will be randomized, along with volume ADSR and sample offset.

FX: All FX parameters will be randomized.

ARP: The arpeggiator will be enabled and a random arp, seq, or gate preset will be loaded**.**

XY Pad: This flexible controller can be mapped in the Mod Matrix (see later in the manual for more details). All snapshots have at least one routing for the X axis and one for the Y axis. You can MIDI learn each axis by right clicking on the white triangles to the immediate left and bottom of the XY Pad.

Layer Blend: When enabled, the XY Pad will crossfade between all layers. This happens in addition to any Mod Matrix functionality.

User Interface (Advanced)

Clicking any of the tabs labeled A-D along the bottom of the Main UI script will load the Advanced editing controls, which are further split into two tabs: Sound and Arp.

Sound Tab
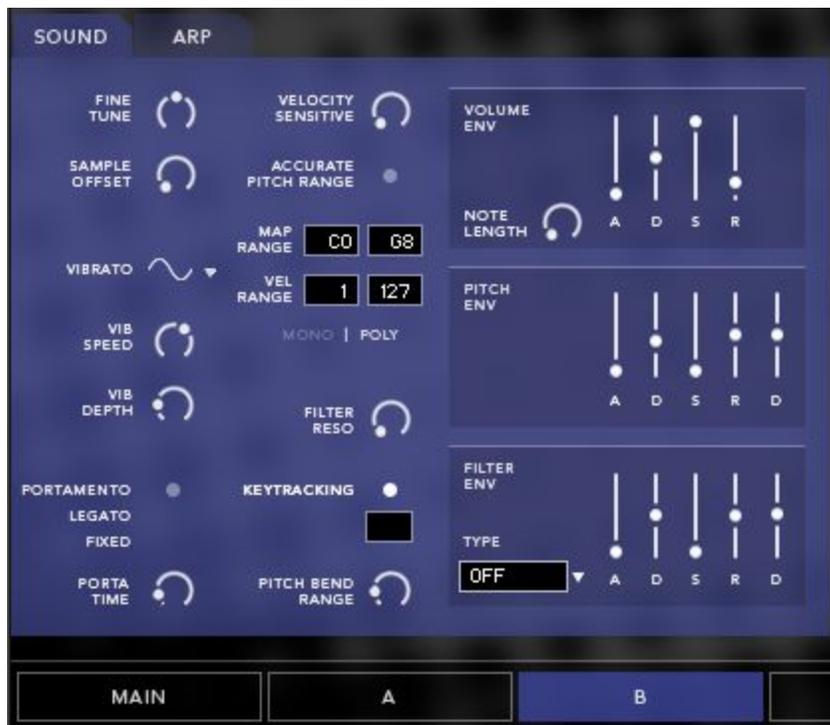
Fine Tune: Adjusts the layer's tuning +/- 200 cents (2 semitones).

Sample Offset: Sets the amount of sample playback offset; for example, with a value of 15ms, samples on this layer will be played back at a position of 15ms into the sample. This is very useful for 'cutting' transients out of a percussive sound, or making a slower sound more percussive. It can also be used to simulate free-running oscillators; see the "Tips & Techniques" section for more detail.

Velocity Sensitive: Controls the degree to which MIDI velocity affects layer volume. A value of 6dB for example means that there will be a 6dB difference between the volume level at velocity 1 vs. velocity 127. Note that this never **increases** the overall volume of the layer, it only scales the volume **down** at velocities lower than 127.

Accurate Pitch Range: When enabled, sound sources on this layer will play back at their naturally recorded range. Depending on the system and source, this can significantly reduce the playable range of the layer… but it IS more authentic this way!

Vibrato Waveform: Switches the waveform used for vibrato (pitch modulation).

Vibrato Speed: Sets the frequency of vibrato for this layer.

Vibrato Depth: Sets the maximum depth (intensity) of vibrato for this layer. Note that the **current** amount of vibrato can be mapped to anything in the Mod Matrix, with CC1 being a common choice for most snapshots. For example, if CC1 is mapped to vibrato amount, and CC1 is at 127, the total vibrato depth will be equal to this control. If CC1 is at 0, no vibrato will be heard.

Map Range: Sets the playable range of this layer. Limiting this range is useful for creating keyboard split patches, where different layers are mapped to different areas of the keyboard.

Vel Range: Sets the velocity range where this layer triggers. Notes played outside this velocity range will not trigger the layer. Using this feature, you can create 'multisampled' instruments with elements coming in at different velocities!

Mono | Poly Toggle: When monophonic mode is enabled, the layer will only play one voice at a time. If multiple keys are held, the most recently pressed note will be played and the previous note(s) will be quickly faded out.

Filter Reso: Controls the amount of resonance at the cutoff point of the filter, if a filter is enabled.

Portamento Toggle: Enables portamento (gliding) when two overlapping notes are played.

Legato: Softens the transition from note to note when Portamento is enabled.

Fixed: When enabled, the time it takes to glide from note to note is the same regardless of note distance. When disabled, greater distances will result in longer glide times.

Porta Time: Sets the speed modifier for portamento / glide.

Keytracking: When disabled, the pitch of the layer will not follow the MIDI note played. Instead, the fixed note (displayed underneath the Keytracking LED) will be played. This is particularly useful with drum kits, menus, and FX which have different samples for each key.

Pitch Bend Range: Sets the max amount of pitch bending processed when the pitch bend controller is used.

Volume Env: Controls the attack time, decay time, sustain level, and release time for the layer.

Note Length: For values above 0, this sets the total length, or hold time, of each note. Setting to "0" means the note will last as long as the key is held. This operates independently from the volume envelope. For example, with a note length of 100ms, the note will play for 100ms and cut out, regardless of what stage in the envelope the sound is in.

Pitch Env: When "D" (depth) is set above 0, the pitch envelope applies changes in pitch every time a note is pressed. The ADSR parameters control the shape of this pitch change.

Filter Env: When a filter is enabled and "D" (depth) is set above 0, this envelope controls modulation of the filter cutoff each time a note is pressed.

Filter Type (Menu): Selects the desired filter type for the layer. "LP" filters are Lowpass, removing high frequencies. "HP" are highpass, removing low frequencies. "BP" are bandpass, removing both high and low frequencies. "Notch" are inverted bandpass filters, removing a narrow range of frequencies. Each filter type offers a different sound - try them out to see which works best for you!

Arp Tab
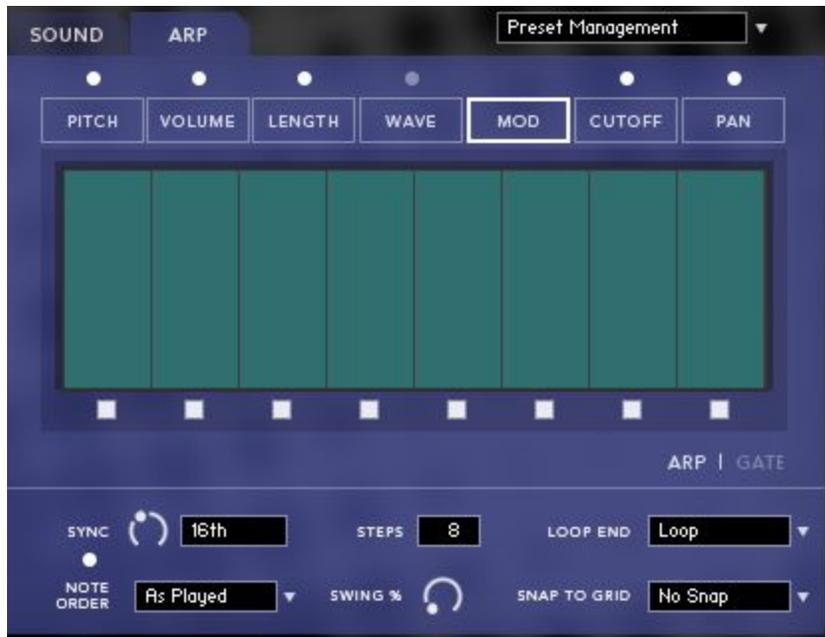
Super Audio Cart features a very powerful poly-arpeggiator, sequencer and gate per layer. Almost all controls per layer are totally independent, with the exception of **Sync** and **Snap to Grid**. In version **1.2**, multiple new features were added to make this rhythm section even more powerful.

Pitch, Volume, Length, Wave, Cutoff, Pan LEDs: The lights above each arp table enable or disable the respective table - see below for what they do!

Pitch Table: When **enabled**, the arpeggiator becomes a sequencer. Each note pressed will create a sequence of pitches, which can be drawn in this table. When the pitch table is **disabled**, the arpeggiator will cycle through all currently held notes.

Volume Table: When **enabled**, the volume of each step of the arp is modified by the values in the table. When **disabled**, the volume of the arp steps is based on the velocity of the notes played.

Length Table: When **enabled**, the length of each step in the arp is modified by the table - the maximum value is 100% length (i.e. at 16th note sync, each note sustains for a 16th note). Length does not do anything in **Gate** mode.

Wave Table: When **enabled**, the waveform selected for the layer will cycle based on the values in the table. This only works if the layer console is NOT SNES or Genesis, and is set to either a noise waveform or tonal waveform. It does not work on percussion or menus. Also, the wave table does not do anything in **Gate** mode, or when the **Pitch** table is disabled.

Mod Table: This table is always enabled. Each step of the table sends a modulation value to the **modulation matrix**. Each layer has its own unique mod table, making a total of four unique modulators (Mod Table A, B, C, and D).

Cutoff Table: When **enabled**, the cutoff of the layer is changed for each step in the arp. This operates independently of other modulation that may be assigned to the layer's filter cutoff.

Pan Table: When **enabled**, the panning of the layer output is changed for each step in the arp.

Arp | Gate Toggle: In **Arp** mode, new notes are triggered for each step of the arpeggiator. In **Gate** mode, the tables modify notes currently being held. For example, if Gate mode is enabled and the **Volume** table is also enabled, each step of the table will change the volume of all currently held notes.

Hold Step Buttons: Each layer has its own set of hold buttons beneath each step of the arp. When a button is disabled, that step will not trigger; instead, the previous step will be held. For example, turning off every other step in a 16th sync arp will effectively create an 8th sync.

Sync Knob: Sets the length of each step in the arpeggiator. This is synced with the host BPM if the **Sync LED** directly below this knob is enabled. If the LED is disabled, the sync time is set to a millisecond value independent of host BPM.

Steps: Sets the number of steps across all tables for this layer. After the maximum number of steps is reached, the **Loop End** behavior will trigger. In "Loop" mode, the arp will loop back to the first step. "Hold" will sustain the last step of the table, and "Stop" will simply stop the layer until a new note is pressed.

Swing %: Sets the amount of swing (offset of every other step) in the arp.

Snap to Grid: When enabled, the arp/seq will activate only when the host transport (playback position) reaches the selected subdivision. For example, if "Bar" is selected, the arp will not begin until the playback hits a new bar line, even if the note is pressed before then.

FX Rack

Super Audio Cart includes five custom FX racks: one for each layer, and one for the global insert bus, which all layers are routed to by default. Each of these racks is completely independent: you can enable an EQ on Layer A with different settings than Layer B, or enable a Delay on Layer C but not on the Global rack, and so forth.

Note: While the FX controls can be MIDI learned from the Kontakt interface, these MIDI connections affect only the currently selected rack (or last viewed rack, if the FX tab is closed).

It is recommended that you instead **use the mod matrix** to create custom MIDI CC links to specific FX on specific layers.

Preset Management: Allows you to initialize the current rack (clear all settings), save, and load custom FX rack presets.

FX Rack Lock: When enabled, the current FX rack settings will not change when changing snapshots.
EQ: A four-band, analog-modeled parametric EQ. All four bands have controls for gain (+/- 20dB) and frequency range. The low-mid frequency band (LMF) and high-mid (HMF) also have controls for the width (or "Q") of each band. A lower Q value means the band is narrower and affects a

smaller range of frequencies, while higher Q values can affect multiple octaves worth of frequency content.

COMPRESSOR: An analog-modeled, SSL-style compressor that can be used for both subtle and extreme processing. All controls are standard to compressors; the Mix knob can be used for phase-accurate blending of the dry (uncompressed) and wet (compressed) signals.

BITCRUSHER: A key effect that can reduce the bit depth and sampling rate of the audio output in real time. Great for adding even more grit and crunch to any sound. The Noise knob introduces *constant* line noise, while Noise Color filters this noise.

SCREAM: A distortion unit based on the 'Tube Screamer' guitar pedal. Tone filters the high frequencies out of the signal, while Drive boosts the distortion effect. Bass and Bright push more low or high frequencies, while Mix blends the dry & wet processing; do note that even at 0%, this effect does still have a mild impact on the sound.

DELAY: An all-purpose, tempo-synced delay unit. For Layers A-D, the MIX knob blends between the dry and wet (echoes) signals. However, on the Global FX bus, the MIX knob is additive - it does not affect the Dry signal. Damping, when turned up, dampens (lowpasses) the high frequencies from the echoes. Pan increases the amount of 'ping pong' L/R in the echoes.

On the Global FX bus, the Mod Matrix can be used to modulate the delay SEND amount, as opposed to the delay mix. For example, if you want an echo to ring out but turn off the delay for subsequent notes, the SEND should be modulated and not the MIX.

SNESVERB: Modeled after the echo of the S-DSP chip in the SNES, this is essentially a very short delay that is not tempo synced. It can be used to add width and space to a sound without using true reverb, and is particularly useful when emulating SNES soundtracks.

REVERB: A convolution reverb with a large collection of custom impulse responses (IR) created by Impact Soundworks. HPF and LPF filter the reverb signal, while Size changes the length of the IR. Note that this effect is somewhat CPU-intensive and, on some older computers, may not be suitable for real-time use. Also note that the HPF, LPF, and Size knobs are not processed in real-time and thus are not automatable. As with Delay, the Reverb SEND can be modulated using the Mod Matrix.

LIMITER: A simple brickwall limiter. Good for taming unruly patches and FX blends with minimal CPU usage.

Mod Matrix

Overview

The mod matrix allows for highly flexible routing of modulators, such as generated LFOs and MIDI CCs, to almost any control in Super Audio Cart. Mod matrix setups can be easily saved and loaded from the built-in Preset Management menu, or cleared with the **Initialize** function within that menu.

All modulation within the matrix uses the **base value** of controls throughout the interface. The **base value** can be changed anytime by moving the knob or slider to be modulated. This might seem obvious, but active modulation will visibly change the value of the control. The displayed value of the control when it is being modulated is **not** the base value, but the **modulated** value.

In short: even if a knob is currently being modulated (for example, by an LFO) you can always click on it and move it to the desired base value. After a brief pause, the visible modulation will continue.

Modulators

To create a modulation routing, first click the dropdown menu on the left side (set to [none] by default) and select a **modulator**.

Note that all modulators have a **Mod Depth** parameter which controls the intensity of the modulation. A depth of 0% means no modulation will occur. 100% depth means the modulation will span the entire range of the control: for example, if the destination control is Filter Cutoff and that control is set to 0 (minimum), a 100% modulation depth means the modulation will push up to maximum value.

Conversely, a negative modulation depth reacts inversely to the value of the modulator. For example, if the **Velocity** modulator normally increases the control at higher velocities, a negative modulation depth will **decrease** the control at higher velocities.

Modulator Types

LFO: An inaudible, low frequency oscillator that changes the destination control continuously according to the selected waveform. LFOs are **bipolar**. This means the modulation goes both above the base control value and below it.

LFOs have a number of unique parameters:

LFO Shape: Switches the LFO waveform between sine, cosine, triangle, square, saw, and random shapes. Note that for the **Saw** waveform, the ramp moves **upward** when   mod depth is **positive**, and **downward** when mod depth is **negative**.

LFO Freq: Sets the frequency of the LFO. For example, a value of 1Hz means that the LFO waveform will complete its cycle every second (1 Hz = 1 second).

Tempo Sync: When enabled, the LFO Freq knob changes to LFO Sync, which corresponds to the host tempo.

Trigger Free|Note: In **Free** mode, the LFO is 'free running', meaning that each time a note is pressed the phase of the LFO will be different. In **Note** mode, the phase of the LFO resets each time a note is pressed, as long as there are no currently active voices.

LFO Unipolar: Functions much like bipolar LFOs, but the modulation only happens in one direction (positive if the modulation depth is above 0%, or negative if the depth is below 0%).

CC: Links the value of MIDI CC to the destination control. Creating a CC modulator will prompt you to select which MIDI CC will be assigned as the modulator.

Velocity: Changes the destination control based on the velocity of the last MIDI note pressed. For positive mod depth values, higher velocities will result in higher modulation values.

Key: Changes the destination control based on the note # of the last MIDI note pressed. For positive mod depth values, higher MIDI notes will result in higher modulation values.

Pitch Bend: Links the value of the pitch bend MIDI controller to the destination control. This is separate from the CC modulator, as the pitch bend controller is not technically a MIDI CC.

Mono AT: Changes the destination control based on the last aftertouch value pressed. Note that not all MIDI controllers support aftertouch, so this will not be useful unless your controller has support for it. Also, this control is strictly based on mono aftertouch - keyboards that send poly aftertouch will only be read as single aftertouch values.

Mod X/Y: Changes the destination control based on the positions of the X or Y axes in the X/Y pad on the Main page of the UI.

Random Uni/Bi: Generates a random value every time a note is pressed and uses this value to modulate the destination control. Unipolar will only generate positive values, while bipolar will generate both positive and negative values.

Constant: Sends a constant value to the destination control. This value is simply the position of the Mod Depth knob.

ADSR Env: Acts just like the previously described Volume, Filter, and Pitch ADSR envelopes, except it can be routed to any destination control. All 4 values (Attack, Decay, Sustain, and Release) can be defined. The **Trigger** LED, when enabled, will re-trigger the envelope each time a new note is pressed.

Keyswitch: Sets a keyswitch note to toggle the destination control. You can select both the **Keyswitch Note** and whether it should **Latch** or not. In **Latch** mode, pressing the keyswitch will toggle the control regardless of whether you continue holding the keyswitch note. When **Latch** mode is off, you must hold the note.

   NOTE: Keyswitches will only modulate certain 'binary' destinations (controls with ON/OFF or ENABLED/DISABLED as possible values).

CC Range: Toggles the destination control based on current MIDI CC values. You can specify the MIDI CC to use, and what value range that CC must be for the toggle. As with the Keyswitch modulator, this can only be used for certain binary destinations.

Vel Range: Toggles the destination control based on the most recently played velocity value. You can specify the velocity range. As with CC Range, this can only be used for certain binary destinations.

Key Range: Toggles the destination control based on the most recently played MIDI note. You can specify the key range. As with CC & Vel Range, this can only be used for certain binary destinations.

Mod Table A-D: Sends modulation values for each step of the arpeggiator in layers A-D (respectively). Note that the arp must be turned on for the given layer in order for this modulator to work!

Destinations

The mod matrix operates "one-to-many", meaning the same modulator (like CC1) can be used to modulate multiple destinations. However, it does not operate "many-to-one", meaning once a destination control is being modulated, that control cannot be modulated by any other modulators.

A, B, C, D, Global: Selects which layer the modulator will process. If global is selected, the same modulation will be sent to all 4 layers - or in the case of Global FX, to the global FX rack instead of the individual layer FX racks.

Destination Categories

Most controls are self-explanatory: notes are provided below for less intuitive destinations.

General
Tune [Fine]: Fine tuning (+/- 200 cents) of the layer(s).
Tune [Ext.]: Coarse tuning (+/- 36 semitones) of the layer(s). Doesn't affect Pitch knob.
Offset: Sample offset of the layer(s).
Vibrato Amount: Current vibrato amount (as % of max vibrato depth) of the layer(s).
Pitch [Coarse]: Coarse tuning (+/- 36 semitones) of layer(s), affecting the Pitch knob.

XY: This destination category appears only for the Global destination. This is a particularly powerful routing: you can assign X/Y as modulators themselves, and then modulate them with something else, like an LFO. However, you cannot modulate X/Y with themselves.

Filter: The Attack, Decay, Sustain, Release, and Depth controls refer to the filter envelope. If there is no filter active, these will not do anything.

Pitch: These destinations refer to the pitch envelope.

Delay & Reverb:
Send: Appears only for the Global destination and controls the **Send** amount of the delay or reverb effect, whereas **Mix** controls the output volume of the effect. The difference is relevant if, for example, you want to turn off delay for a few notes without muting previous echoes (this would be done with **Send**, not **Mix**).

Binary Destinations: Some destinations are only available when binary modulators (Keyswitch, CC Range, Vel Range, Key Range) are used. These destinations have only ON and OFF values.

For example, Vel Range is selected as modulator, and set to velocities 100-127. The destination is Arp Layer A, set to Enabled. With this setup, playing at 100-127 will **enable** the Arp on Layer A.

Tips & Techniques

"Free Running" Oscillators
Since the waveforms in Super Audio Cart are sampled, they will always play back from the same position each time. If you move the "Sample Offset" knob on the Advanced UI page, you can change this playback position - great for sound design purposes, as it can remove the attack / transient portion of a sound.

However, when trying to achieve a unison / ensemble sound with multiple layers it may be desirable to have random start points to simulate "free running" oscillators (random phase). To do this in Super Audio Cart, create **four Random Unipolar modulators** in the mod matrix. Assign each one to a separate layer - NOT global - ensuring the **mod depth is turned all the way up**. Then set the target for GENERAL > OFFSET.

Now, every time you hit a key, the sample offset for each layer will be changed independently!

Creating Drum Patterns
By turning off Keytracking for a layer with drum sounds, that layer will play back the same fixed pitch every time a note is pressed. **MIDI note 36 (C1)** is the starting point for our "Drumkit" patches.

With Keytracking OFF, the Arpeggiator ON, and the Pitch table ON, the pitch table becomes a great tool for creating custom drum patterns. For this, you'll actually want to set the fixed note to **48**. This way, the minimum pitch in the table (-24 semitones) will hit the lowest pitch of the kit (36 - kick drum, typically) and up to two octaves above that. This way, you can create drum patterns using the arpeggiator, and even do different patterns for each layer.

Widening Your Sounds
Most samples in Super Audio Cart are mono, since most sound chips sampled were themselves mono. However, there are a few easy ways of getting a wide stereo sound.

1. Load the same sound source on two layers, then pan each layer opposite each other. Change the fine tuning on these two layers by a small amount, for example -4 cents for one layer and +4 for the other. Also try introducing a mild sample offset to one layer, but not the other. This makes each channel (left/right) different enough to be perceived a wide stereo image.

2. Use the SNESVERB effect, turning down the mix and sync/time to make it sound almost like a very short-tail reverb as opposed to the 'slapback' effect common on the SNES. Make sure to turn up the PAN knob of course! This can also be done with the Delay effect, but it's a little easier with SNESVERB.
   In the mod matrix, set an LFO (not unipolar) to the layer of your choice with at least 50% depth, and set the destination to Pan. Change the speed as desired. If you want to do this on multiple layers, be sure to use different waveforms or frequencies for each LFO.

Transposition
The Pitch knob on each layer does not actually transpose incoming MIDI, but instead re-tunes the sound up to 3600 cents (36 semitones) in either direction. This is useful for some purposes, but may introduce artifacts to some waveforms (like the NES triangle) at high values. In these cases, you may want to transpose the sound instead.

A quick and dirty way to transpose a sound is enable the arpeggiator for the Layers you want to edit. Then, reduce the # of steps to 1, turn ON the Pitch table, and turn OFF the other tables. Set the loop end mode to HOLD and set the first (and only) step of the table to the desired transposition amount. Boom, you're done!

Simulate Velocity Layers
Although you already have the "velocity sensitivity" knob at your disposal, you can also simulate a softness or hardness to a sound at varying velocities. This is especially useful if you design a preset using organic sound sources like pianos or mallet instruments.

Route the Velocity parameter in the mod matrix to a particular layer, choose the FILTER > CUTOFF mod destination, and put a positive mod depth. Don't forget to turn on the filter for each layer you want to affect! Let's say you pick the Sv LP4 filter model (though other LPF models are also suitable).

Lower the cutoff frequency for each layer to, say, 40~60% (adjust accordingly, based on the sound source you are working with). This will be your initial cutoff at velocity 0. Adding on the mod depth will give you the maximum cutoff at velocity 127.

As a result, your lower velocities will generate softer notes, and vice versa - for the more organic sound sources, this can approximate actual softer/harder playing. Or, even better - combining this trick with "free running" oscillators can additionally simulate 'round robins' via the phase differences.

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Troubleshooting and Feedback

Have you used **Super Audio Cart** in a project recently? Got an awesome track you'd like to share? Drop us a line (admin@impactsoundworks.com) and we might post it on our website! Or, tell the world at our Facebook page here: http://www.facebook.com/ImpactSoundworks

We encourage all our users to share and promote their work. Word of mouth is the #1 way people find our samples, so it also helps us to produce more great libraries for you!

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