SUPER AUDIO CART

Rack Extension Version

Produced by Impact Soundworks in collaboration with OverClocked ReMix

Version 1.0.0

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 greatly expanded 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 Rack Extension with slick sound design tools 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!

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
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

A: Console Selection

Click on the console picture to switch between any of the 8 included consoles.

B: Sound Source Selection

This dropdown menu contains all sounds for the selected console. For some consoles, like SNES and GEN, the sound sources are subdivided into folders.

C: Note Control

The **Mono** toggle, when enabled, limits the instrument to one note at a time (monophonic).

The **Length** knob, if turned above 0, sets a specific length for every note played regardless of how long the MIDI note is. This is useful for drum sounds.

The **Offset** knob plays the samples at an offset, truncating the attack or transient.

D: Pitch Control

This section controls basic tuning parameters such as **Tune** (fine tuning), **Semi** (coarse tuning in semitones), and **Portamento** (gliding).

If the **Pitch Tracking** toggle is disabled, all notes will play at a fixed pitch, selected by the **dropdown** menu. This is useful for drum sounds and special FX.

The **Vibrato** subsection allows you to select vibrato waveform and vibrato speed.

E: Filter Control

A **Filter** can be enabled by clicking the toggle LED. The dropdown allows you to select from multiple filter types and models, with adjustable **Cutoff** and **Resonance** as you would expect.

F: Amp (Volume) Control

The **Pan** and **Volume** knobs modify the RE's output (self-explanatory!) while **Velo Sens** controls how much MIDI **velocity** affects **volume**. When at 0, velocity has no impact on volume at all.

G: Envelopes

There are three envelopes available: **Pitch**, **Filter**, and **Volume**, which work as you would expect. The Pitch and Filter envelopes will not have an effect unless the **Depth** (D) slider is changed, while the Volume envelope is always active.

H: Performance Controls

The **dropdown menu** here controls **pitch bend range**, which is appropriately controlled by the pitch bend knob immediately to the right.

The second large knob is the **modwheel**, which can be set to modify any (or all) of three parameters: **vibrato depth**, **filter cutoff**, and **filter envelope** depth. Cutoff and filter envelope are bipolar: they can be set from -100% to 100%.

I: Sequencer Toggles

The powerful arpeggiator of Super Audio Cart is enabled by clicking the master toggle (next to the letter "I" in the screenshot). Then, it controls up to 5 parameters, each of which can be individually enabled or disabled: **Pitch, Volume, Length, Cutoff**, and **Panning**.

J: Sequencer Table

Here you can write notes and values on a per-step basis. Just click and hold with the mouse on each bar to control the value for that step. Each of the five tables (pitch, volume, etc.) have **unique values**.

Control+Click: Resets the step to default value

Shift+Click+Drag: Changes the value by a smaller increment.

The **boxes** below each step represent whether that step will be triggered in the sequence. If it is not triggered, the previous note will be held.

K: Arpeggio Controls

The **Sync** toggle, when enabled, syncs the arp to the host BPM. This is not always desired, for example if you're doing extremely fast old-school arps!

The **Rate** menu (or knob, if **Sync** is disabled) controls the speed of the seq/arp.

The **Order** menu controls how the arp/seq orders notes that you play. For example, in "ascending" mode, the notes are always arpeggiated from lowest to highest.

Mode toggles between mono, poly, and gate modes. In **mono** mode, the seq/arp behaves like a traditional **arpeggiator** that switches between the notes played (determined by **order**). In **poly** mode, each key press generates a **sequence** of notes. In **gate** mode, notes are not retriggered at all, but modified with each step.

Steps controls the number of steps in the sequence.

Snap allows you to snap the beginning of the sequence to host transport. For example, if this is set to "bar" and you play a note right before the bar line, it will not begin until the exact downbeat of the bar.

Swing controls the amount of swing, of course!

Loop End controls the behavior at the end of the sequence. In "Loop" mode it repeats as long as MIDI note(s) are held. In "Stop" mode, it simply stops with no hold/tail, while "Hold" sustains the last note subject to amp envelope.)

CV Controls

By pressing **tab** you'll see the available controls on the rear of this extension. The knobs next to each control the depth of the modulation.

Credits and Acknowledgements

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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!

For any technical support issues regarding the library, don't hesitate to email support@impactsoundworks.com.

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