Shattered Glass Audio

SGA1566

User Manual

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Introduction

SGA1566 preamplifier is loosely based on a single channel all tube vintage preamplifier. We have made some changes to the original schematic, added tone controls, and made it stereo. To achieve the most authentic analog sound, the whole circuit is simulated in real time using the high performance circuit simulator. This level of sound fidelity comes at a price of high CPU utilization. For cases where such a CPU hit is prohibitive, we have added a model that is significantly less CPU intensive but slightly less accurate than the circuit simulation.

Use SGA1566 preamp to add warmth to a track, as a saturation compressor, or to add "dirt" with tube overdrive.

Features:

- Authentic analog sound through real-time high-performance circuit simulation.
- Preamp featuring two 12AX7 voltage amplification stages.
- CPU friendly model of the circuit.
- Two-band active Baxandall EQ that can be placed either before or after the preamp.
- Up to 4x oversampling.
- Mono or stereo processing mode.

Signal Routing

There are two possible signal paths in SGA1566 depending on the position of the tone controls.

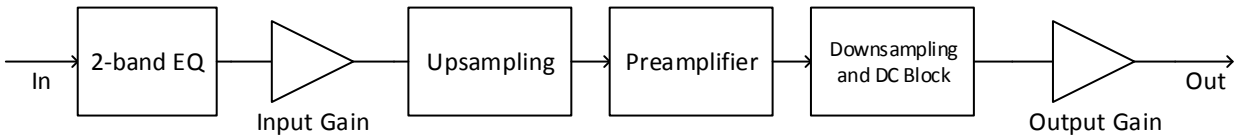

Figure 1. Signal routing with the EQ before the preamplifier.

Figure 1 shows signal routing with the EQ before the preamplifier. The signal first passes through the 2-band active Baxandall EQ. Input Gain block adjusts the strength of the signal going into the preamplifier. Output Gain adjusts the signal level leaving the plugin. This configuration can, depending on the signal strength, affect the level of overdrive that different frequencies experience because the tonal shaping happens before the preamplifier stage.

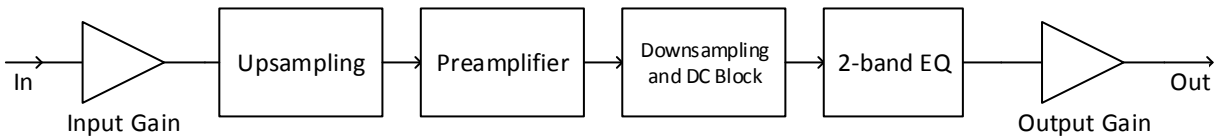

Figure 2. Signal routing with the EQ after the preamplifier

Figure 2 shows signal routing with the EQ after the preamplifier. Input Gain adjusts the signal strength entering the preamplifier. After the preamplifier the signal passes through the 2-band active Baxandall EQ. Output Gain adjusts strength of the signal leaving the plugin. Placing the EQ after the preamplifier allows for post amplification tonal shaping.

For computational efficiency only the preamplifier processes oversampled signal. The reason being is that the preamplifier is the only non-linear element in the signal chain, therefore the only element capable of creating additional harmonic content.

SGA1566 Circuit

SGA1566 uses a two stage triode preamplifier and a 2-band active Baxandall EQ for tonal manipulation.

Equalizer

The circuit schematic of the 2-band active Baxandall EQ is shown in Figure 3.

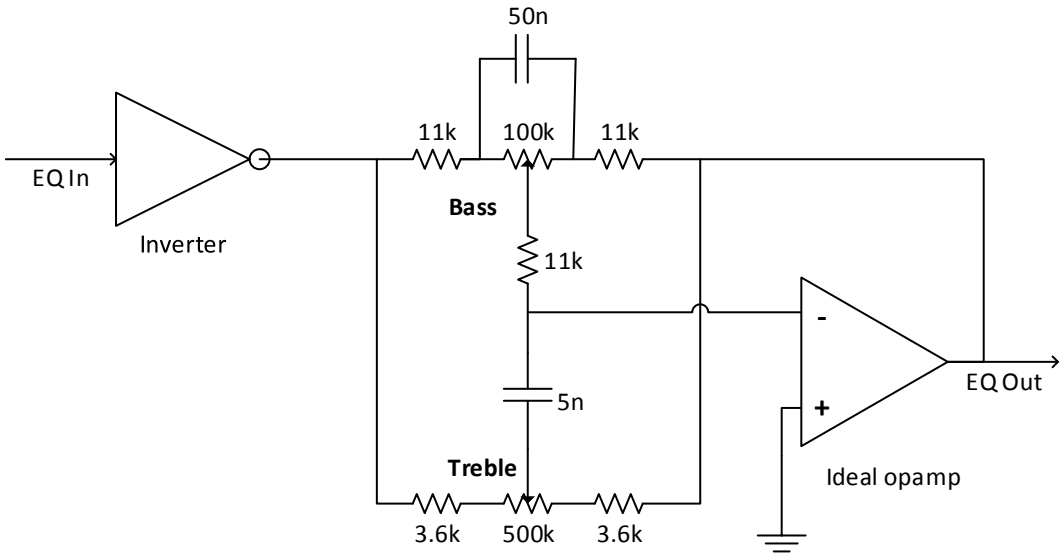

Figure 3. Two band active Baxandall equalizer.

The circuit is derived from the article “Designing A Pocket Equalizer For Headphone Listening” by Chu Moy (http://headwize.com/?page_id=741). Bass threshold frequency is approximately 300 Hz and the bass shelf frequency is approximately 30Hz. Treble threshold frequency is approximately 1 kHz whereas treble shelf frequency is approximately 10 kHz. Maximum gain and reduction of the circuit are +20dB and -20dB respectively.

Preamplifier

The circuit schematic of the preamplifier is shown in Figure 4.

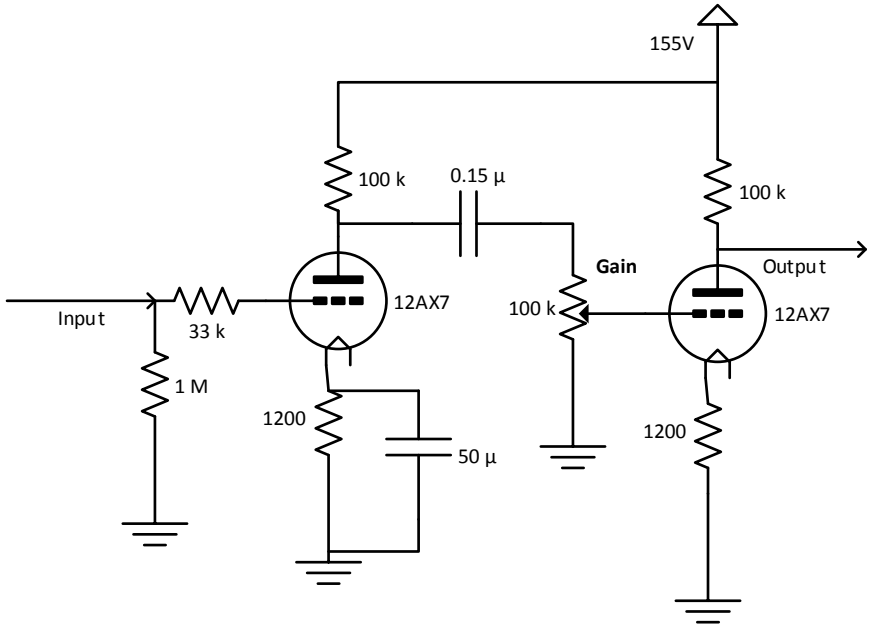

Figure 4. Schematic of the preamplifier circuit.

The preamp in SGA1566 is a two stage triode based amplifier. Each amplification stage is a 12AX7 based common cathode amplifier. Common cathode configuration is commonly used in (pre)amplifiers to amplify a weak signal to levels needed to drive a power amplifier.

There are couple of interesting things to note about this circuit:

- Supply voltage is 155V, which is substantially lower than the usual 200V+ voltage supply. The lower supply voltage translates into less clean headroom thereby making this preamp easy to overdrive.
- Gain potentiometer is 100kΩ, which is of the same order as the output impedance of the first stage. A consequence of this is the reduced gain of the first stage. Usually this potentiometer would have a value of 1MΩ so it does not affect the gain of the first stage.

Technology

Depending on the mode of operation SGA1566 uses either:

a) Real time circuit simulation to simulate both the preamplifier and the 2-band active Baxandall EQ.
b) Slightly less accurate hybrid model (combining elements of the circuit simulation with standard DSP elements) for the preamplifier simulation and the circuit simulation for the 2-band active Baxandall EQ.

Circuit Simulation

Analog-circuit simulators, the most well-known of which is SPICE, have been in use by engineers for decades. At the most basic level, circuit simulators take the circuit schematic, input signals, and simulation parameters as inputs and return voltages and optionally currents as outputs. To do that, circuit simulators turn the schematic into a set of differential equations that needs to be solved at each time step during transient analysis. If the circuit contains non-linear components (e.g. vacuum tubes, transistors, etc.) resulting set of non-linear differential equations needs to be solved iteratively at each time step during transient analysis. The circuit simulation provides the most accurate simulation of analog circuits at the expense of heavy CPU usage.

At the heart of the SGA1566 circuit simulation is the Shattered Glass Audio's high-performance circuit simulator. We, at Shattered Glass Audio, have created a circuit simulator using the same principles that SPICE is built on and optimized it for real time analysis. As a result of using circuit simulation to simulate the preamp and the EQ, SGA1566 delivers sound that possesses the genuine analog warmth associated with the vintage tube amplifiers.

Hybrid Model

Hybrid model was developed as a substitute for the circuit simulation in cases where the high CPU usage is unacceptable or where the real time circuit simulation is outright impossible. The hybrid model of the preamp combines elements of the circuit simulation with standard DSP elements. Such preamp model is significantly less computationally intensive than the circuit simulation of the preamp alone. The computational efficiency of the hybrid model comes at the price of a slightly reduced accuracy when compared to the circuit simulation, at the same sampling frequency. The difference between the two simulation modes is the most audible when the preamp is distorting the sound dominated by frequencies higher than approx. 5kHz. The accuracy of the hybrid model can be improved by increasing the sample rate or through the use of oversampling.

Using SGA1566

At low input signal levels and low Gain settings SGA1566 preamplifier simulates a clean tube preamp. When operated in such conditions SGA1566 can be used to enrich the original sound by adding "warmth" (additional harmonics) to it. The effect of adding warmth to the original sound is a direct consequence of the nonlinear nature of vacuum tubes.

At higher signal strengths and/or higher Gain settings SGA1566 simulates an overdriven tube preamp. A characteristic of overdriving a vacuum tube is soft clipping. Because of the soft clipping when driven into overdrive, SGA1566 can be used as a saturation compressor/limiter.

System Requirements

This plugin is available in both 32- and 64-bit VST and AU versions. AU version is available for Mac only.

Mac
OS X 10.7 or higher.

Windows
XP/7/8.

Controls
Settings controlled by knobs can be changed by clicking on them and dragging the mouse up and down. Settings controlled by switches can be changed by clicking on the appropriate switch or by clicking a switch and dragging the mouse.

Input
Controls the strength of the input signal to the preamplifier.

Gain
This control corresponds to the “Gain” potentiometer in Figure 4. Gain controls the signal level at the input to the second preamplifier stage.

Output
This control lets you adjust the output level of the whole plugin.

Bass
Sets the EQ bass level. Values less than 5 correspond to bass cut, whereas values greater than 5 correspond to bass boost. Value of 5 corresponds to neither cut nor boost.

Treble
Sets the EQ treble level. Values less than 5 correspond to treble cut, whereas values greater than 5 correspond to treble boost. Value of 5 corresponds to neither cut nor boost.

Oversampling
Select 1, 2, or 4 times the original sampling rate. When oversampling is set to 1x no oversampling is performed (i.e. the plugin operates at the original sampling frequency).

CPU
CPU control allows you to choose the circuit simulation type. The “HIGH” setting selects the full circuit simulation, which results in high CPU utilization. The “LOW” setting selects the hybrid circuit simulation model, which, compared to the HIGH selection, is easier on the CPU.

Position
Sets the position of the EQ in the signal path. To place the EQ before the preamp, as shown in Figure 1, set this switch to PRE. To place the EQ after the preamp, as shown in Figure 2, set this switch to POST.

Stereo

Stereo control lets you switch between mono and stereo processing. To set processing to mono, set the STEREO switch to OFF. Stereo processing nearly doubles the CPU load of the plug-in when compared to mono processing since in the stereo mode the plug-in needs to process two channels compared to one channel in the mono mode.

Tips

The following are tips for minimizing the CPU usage:

- Set the STEREO control to OFF if you are processing a mono track. Setting the STEREO control to OFF will half the CPU load. This is necessary since not all DAWs accurately, or at all, report whether a track is mono or stereo.
- Use the least amount of oversampling needed to avoid aliasing.
- Consider using the LOW CPU mode.