

# ECHOBODE

*Frequency  
Shifter  
Delay*



SONICCHARGE

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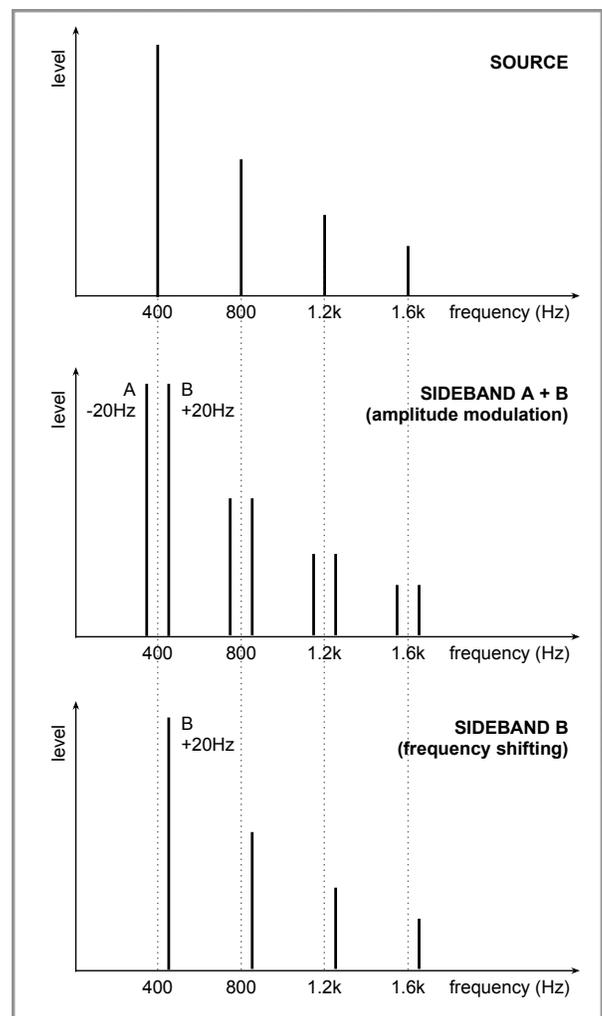
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## INTRODUCTION

**Echobode** is a delay effect with a frequency shifter placed inside the feedback loop. The frequency shifter algorithm is inspired by the classic Bode Frequency Shifter (*named after its inventor Harald Bode*). The difference between a frequency shifter and a pitch shifter is that it shifts the audio spectrum linearly. E.g. an overtone series of 100, 200, 300 Hz can be shifted by 50 Hz to 150, 250, 350 Hz, making the overtones inharmonic. This effect in itself is great for creating metallic bell timbres, but putting it inside a delayed feedback loop opens up many other possibilities.

When a frequency shifter processes audio, two "sidebands" are generated, one that is shifted upwards and one that is shifted downwards. The challenge in creating a good frequency shifter lies in suppressing one of these sidebands (*otherwise the effect sounds like a regular amplitude modulator*). We are proud to say that **Echobode** features excellent suppression over the range of 40 Hz to 20 kHz. If you want less suppression there is a "sideband mix" parameter that you can adjust, allowing you to create amplitude and ring modulation effects.

**Echobode** features a unique "anti-reflection" stage that removes "negative" frequencies (*frequencies that are shifted down beyond 0 Hz and would otherwise*



bounce back into the audible spectrum).

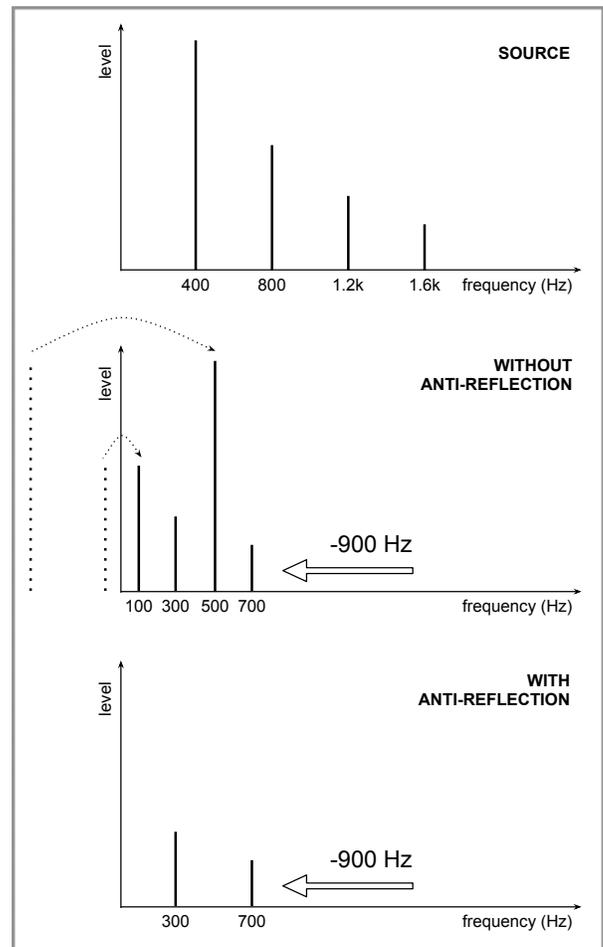
This stage also eliminates frequencies that are shifted up over half the sample-rate ("nyquist").

Mixing a slightly shifted signal with the source signal creates phaser-like "beatings" and applying feedback (*with a very short delay time*) emphasizes this sound. The sideband suppression technology introduces additional "phase shifting" that adds further to this effect.

The delay time can be synchronized to tempo and it can be modulated to create chorus type effects. The delay uses an "all-pass interpolation" technique that is low on aliasing and will preserve all the high-frequency energy of your source signal (*even when time is being modulated*). Even with no frequency shifting taking place, **Echobode** is useful as a high quality echo effect with subtle phase smearing properties.

A built-in sine LFO can be routed to modulate the frequency shifting amount, the phase shift or the delay time. The LFO can be tempo synchronized and put into stereo mode to generate inverse modulation for the right audio channel. Even in synchronized mode, rate changes are smooth and will not cause sudden jumps.

**Echobode** has no latency and has a consistent sound on all supported sample rates. It is CPU friendly and automatically "suspends" itself, taking 0% CPU when its inputs and outputs are silent. You will find lots of CV inputs on the backside and separate outputs for the two sidebands. Bundled with the product are many patches, combinator and song files that will demonstrate the many different identities that this deceptively simple looking effect can assume.



# User Interface Front



## RANGE

Defines the behavior of the **FREQUENCY** knob (*aka The Big Knob*).

**FINE** frequency shifting amount range from -200 Hz to 200 Hz

**WIDE** frequency shifting amount range from -20 kHz to 20 kHz

**SYNC** frequency shifting amount is synchronized to host tempo. This mode is useful when creating AM or phaser effects with short feedback delays. **FREQUENCY** knob lets you choose the synchronized rate with which a full cycle completes. (Use **SIDE BAND A** for upwards sweeping effects and **SIDE BAND B** for downwards sweeping.)

Because of how Rack Extensions work internally the **FREQUENCY** knob will move if you change the **RANGE** mode. There are actually three separate frequency shift parameters which you will also notice if you automate the knob or make MIDI controller assignments. Among other things, this is necessary to provide the correct tooltip hint depending on **RANGE** mode.

## FREQUENCY (shift amount)

The big center knob around which everything revolves: the amount of frequency shifting. Notice that turning the knob clockwise shifts the frequencies up for **SIDE BAND B**, but down for **SIDE BAND A**. Even with zero frequency shifting the "phases" of the input signal frequencies will be distorted (as you will notice if you mix **Echobode** with the source signal).

## PHASE

When the frequency shifter is at 0 Hz or synchronized to the beat, this knob is useful to adjust the phase distortion in a precise manner. You can use it to tune the spectral "notches" and "peaks" that are produced when using **MIX** and / or **FEEDBACK**.

## SIDE BAND

Lets you blend the two frequency shifted sidebands. At extreme settings you will have the cleanest frequency shifting. In between you will obtain a more or less attenuate

tremolo / amplitude modulation effect. There are also separate outputs on the backside for the two bands.

### **ANTI REFL**(ection)

Enable the **ANTI REFLECTION** stage to eliminate harmonics that are shifted down below 0 Hz or beyond half the sample rate. Otherwise these frequencies will bounce back into the audible spectrum. The anti-reflection is implemented with a proprietary technology by **Sonic Charge** and has the same excellent quality as the sideband suppression. It introduces additional phase distortion that can affect the timbre of tight feedback loops.

### **DELAY**

Lets you adjust the delay time between 0.02 ms and 1 second when delay **SYNC** is off or 1/128 to 1/2 measures when delay **SYNC** is on. Changes to the delay time is smooth like on analog delays. The delay is implemented with a proprietary "all-pass interpolation" filter that preserves all the high-frequency energy of the source signal. Modulate the delay with the **LFO** to create flangers, choruses or outer space madness.

### **SYNC** (delay)

Turn this on to make the delay time follow the song tempo.

### **FILTER**

This controls the cutoff frequency of the lowpass filter that is applied just before the frequency shifting. Goes from 100 Hz to 40 kHz (*yes, that is not a typo*).

### **CROSS**

This switch swaps the left and right input channel (*before the output and feedback*). Depending on the **Echobode** settings and audio source this can have a dramatic effect on the audio or no effect at all. E.g. an echo effect on a source that is hard-panned to the left will result in the echoes bouncing back and forth between the speakers. The same effect on a mono signal and **CROSS** will make no difference at all. (*Having said that, the CROSS setting can affect the sound also on monophonic sources if the LFO is used to generate a stereo effect internally.*)

### **FEEDBACK**

Apply **FEEDBACK** to send some of **Echobode**'s output back to its input. With very short delays (*up to a few ms*) and little or no frequency shifting you will achieve a distinct phasing effect. If you turn up the delay time the effect turns into a comb-filter (*flanger*) and eventually you will start hearing distinct echoes.

## MIX

Mixes the wet and dry signal to your liking. Because of the phase distortion of **Echo-bode**, even a frequency shifting of 0 Hz will affect the sound although it is extremely subtle if you do not mix it with the dry signal. If you mix it you will hear the typical spectral "notches" and "phases" that you associate with a phaser effect.

## LFO Section

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### TARGET

The built-in **LFO** can affect **FREQUENCY** shift amount, **PHASE** adjustment or **DELAY** time. Just like the **RANGE** dial, changing **LFO TARGET** will make the **AMOUNT** knob jump. The **LFO** waveform is always a smooth sine shape.

### RATE

The rate of the **LFO**, from 0 to 100 Hz if **SYNC** is off and 8 measures to 1/64 if **SYNC** is on. A rate of 0 Hz is actually useful as it will reset the **LFO** output to a high constant level. With the **STEREO** switch you can then use **AMOUNT** to separate the left and right setting of the designated **TARGET**. E.g. having different amount of frequency shifting on the left and right audio channels.

### SYNC

Turn this on to synchronize the **LFO** to song position and tempo. The **LFO** will follow the song position when the sequencer is running so that things will sound the same every time (*as common among Reason devices*). However if you change the synchronized rate when playing, the **LFO** is still adjusted smoothly and it will never jump abruptly. There is a CV output for the **LFO** signal on the backside (*this is the signal before it is scaled by the AMOUNT*).

### AMOUNT

Sets the amount of **LFO** modulation on the designated target. As said above, changing the **TARGET** can make the **AMOUNT** knob jump. Also to repeat, with a 0 Hz **LFO** rate and **STEREO** enabled, the **AMOUNT** knob can be used to set the designated **TARGET** parameter of the left and right channel independently.

### STEREO

Enable **STEREO** to invert the modulation of the right audio channel (*meaning it will go down when the left channel goes up and vice versa*). If you have enabled **CROSS** and a lot of **FEEDBACK** this stereo separation will be less prominent but will still affect the stereo image.

## User Interface Back



Most of the inputs and outputs on the **Echobode** backside are straight forward and self-explanatory. The main exception is the **FREQUENCY SHIFTER NOTE** input. When you connect the **NOTE** input, **Echobode** will enter a CV pitch following mode where the frequency shift will follow the frequency of the CV note value you send to **Echobode**. With this feature you can do harmonic shifting on monophonic sounds (*"monophonic" as in "non-polyphonic"*). If you do not have a CV source for your notes you can use the built-in RPG-8 arpeggiator to convert notes to CV. The "SC Stroem Picher" combinator is an example of such a patch.

Also notice that the separate **SIDE BAND** outputs do not feature **ANTI REFLECTION** (*see above*) as this takes place after the **SIDE BAND** mix.

## MIDI Controller and Remote Mapping Chart

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MIDI CC	Remote Item Name	Description
-	Enabled	<i>effect bypass switch</i>
-	Select Previous Patch	
-	Select Next Patch	
20	Frequency Shift Range	<i>fine / wide / sync selector</i>
21	Frequency Shift Fine	<i>frequency knob for fine range</i>
22	Frequency Shift Wide	<i>frequency knob for wide range</i>
23	Frequency Shift Synced	<i>frequency knob for synced range</i>
24	Phase Shift	
25	Anti Reflection	
26	Sideband Mix	
27	Delay Sync	<i>sync on / off for delay</i>
28	Delay Time	<i>delay knob for sync off</i>
29	Delay Time Synced	<i>delay knob for sync on</i>
30	Filter Cutoff Frequency	
31	Cross Channels	
32	Feedback Amount	
33	Wet Mix	
34	LFO Target	<i>freq / phase / delay selector</i>
35	LFO Sync	<i>sync on / off for LFO Rate</i>
36	LFO Stereo	
37	LFO Rate	<i>rate knob for sync off</i>
38	LFO Rate Synced	<i>rate knob for sync on</i>
39	LFO Amount Frequency	<i>amount knob for "freq" LFO Target</i>
40	LFO Amount Phase	<i>amount knob for "phase" LFO Target</i>
41	LFO Amount Delay	<i>amount knob for "delay" LFO Target</i>

## Credits and Contacts

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**Echobode** v1.0.0 (2012)

Created by:

**Magnus Lidström**

Graphical design and additional development:

**Fredrik Lidström**

Sound design:

**AF** Adam Fielding

<http://www.adamfielding.com>

**eX** eXode (Daniel Thiel)

<http://soundcloud.com/exodesound>

**KD** Koshdukai (Marco C.)

<http://KoshdukaiMusicReason.blogspot.com>

**LW** Linus Wileryd

<http://www.cutup.se>

**SC** Sonic Charge

**TA** TONAL AXiS (Richard Hider)

<http://tonalaxis.wordpress.com>

**TP** Tom Pritchard

<http://tompritchardsounddesign.com>

**Sonic Charge** website:

<http://soniccharge.com>

Thanks to our fabulous beta-testers and special thanks to Andrew Simper (<http://cytomic.com>) for the brilliant parameter smoothing algorithm.

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The contractor / manufacturer for **Echobode** is:

Magnus Lidström

Mosebacke Torg 16 A

S-116 20 Stockholm

Sweden