CHeNiLLe
BBD *Chorus Ensemble*

v2.0.0

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Additional redesign by esselfortium
Coding by Pitchblende Ltd for Jiggery-Pokery

AVAILABLE IN THE propellerhead shop

www.jiggery-pokery.com

Re Rack Extension

Chenille BBD Chorus Ensemble

Chenille is a Rack Extension dedicated to providing rich, "Bucket Brigade Delay" ensemble chorus sound, a favourite of guitarists, keyboard players and producers the world over. *Chenille* models the designs of Bucket Brigade Delay (BBD) chorus ensembles of the 1970s and 1980s, allowing you to create a wide range of chorus types, from the movement-free, subtle but spacious chorus effects similar to the Roland/Boss Dimension choruses, through to big ensemble choruses used in string synths, and BBD delays, while adding a level of parameter control not traditionally seen in such modules.

BBD Chorus

A BBD is a type of Integrated Circuit (IC) which is a Sample & Hold device with a fixed number of stages, known as a delay line; an audio input would be held as if it was a bucketful of water being passed along a line of people (hence, "bucket brigade"). External LFOs applied voltage adjusting the time between passing the water from one person to the next. For the SAD512D, think of it as if there were 512 people in the line. Other BBD ICs had differing lengths, up to 4096 stages.

The classic BBD ensembles utilised three BBD chips. A mono input was split and sent to each BBD, the delay time of each BBD was modulated by a pair of LFOs, then the outputs of each mixed to stereo; one to the left channel, one to the right channel, and one to both channels. It is important to note that there were two LFOs, each running at a different speed, and the mix was output to the first BBD; for modulating the other stages, the LFO signal was phase offset. This prevented the pumping and sweeping sounds endemic of simple dual chorus devices.

The lush sound created by using three stages became famous in the 1970s, and it was key to the string ensemble sounds. The Eminent 310U string ensemble, which later reappeared in the Eminent/ARP Solina, with its patented BBD chorus design took a dull, lifeless analog waveform and turned it into something spectacular. By the end of the 70s if you owned a keyboard company you had likely thrown at least one model of BBD-ensembled string machine at the market; joining Eminent and ARP were Crumar, Electronika, Elka, Farfisa, Logan, Moog, Powertran (the hobbyist kit-build offshoot of EMS), Korg, Roland. During this period a number of different BBD chips were available from different manufacturers, but most common was the Reticon SAD512, while Panasonic produced a variety of models, of which the MN3007 was arguably the most highly prized. BBD choruses soon broke out of the string synths and appeared in guitar pedals where they are still very sought-after.

As the 70s ended, more advanced BBD arrangements began to appear, such as the aforementioned and highly-regarded Dimension pedal and rackmount units, which used a long delay line with a slow modulation plus a duplicated but inverted and high-passed routing for a subtle, smooth chorus, and could be found in studios everywhere in the 1980s.

To celebrate the fantastic sound of the multi-BBD chorus, *Chenille* provides a massive six BBD ensemble, allowing you to create the setups of the Eminent (three 512-stage delay lines), Dimension (two 1,024-stage delay lines), and the CE-1 pedal with access to the rate and depth of twelve LFOs (one fast, one slow per BBD), along with feedback, phase switching and a 12-voice unison section.

Although *Chenille* is not designed to be a literal recreation of a specific BBD—they have different dynamic ranges, SNR and THD figures etc, not to mention sound differences caused purely by changes in operating temperature—or a particular chorus module, this super-BBD-ensemble-chorus-delay has been designed to give you the flexibility to sculpt your chorus by giving access to a breadth of parameters you would not normally be able to access: it can be as subtle or insane as you choose!

Controls

The **Mode** button allows you to chose between two chorus modes. Set to DDL, *Chenille* functions as a basic, common Digital Delay Line (**DDL**), modulating the delay length rather than the delay time. Use DDL mode if you want long delay times for your chorus but no aliasing. The BBD Setup section has no effect when set to DDL. For best results, leave set to **BBD**.

Buckets

The **BBD Setup** section sets the number of samples within each BBD and how fast the samples are accessed. Or, in other words, determines how many buckets are in the S&H delay line and the speed with which audio is passed from one bucket to the next.

The **Clock** value allows you to adjust the default clock rate of the BBD, from 1.5–100kHz. The default is 40kHz (0.2ms), which with 512 buckets gives a delay time of 6.4ms. Typical clock rates will be 10–40kHz.

For quick selection and to allow precise value-setting, you can select from four preset ranges. Step through them with the red momentary selector button, or directly select the range by clicking the appropriate LED or LED label. With a range selected drag your mouse cursor up/down on the value display to set specific alternative sample values.

- **512** allows values of 2–512, default is 512
- **1024** allows values of 513–1024, default is 1024
- **2048** allows values of 1025–2048, default is 2048
- **Full** is the full-range option of 2–8,193, default is 4096. Use this to sweep the entire range of buckets

The default values are set to provide quick access to the main four BBD lengths typically available, and to allow for modulation within a Combinator to stay only within those values. It also enables easy selection for consecutive BBD setups. The SAD1048 could, for example, be set up to provide 2x512 in parallel as well as 1x1048; for ease of use *Chenille* keeps buckets parallel, as you can simply add a second Chenille for true consecutive setups.

While **Samples** can be modulated, it is recommended that this is left as a fixed value as results can be unpredictable.

Be aware that increasing values for **Stages** and decreasing values for **Clock** require slightly higher buffer memory sizes. The maximum delay time for *Chenille* is 2.7 seconds, that's 8,193 **Stages** with a **Clock** rate of 1.5kHz (0.6ms).

Stage Modulation

This section controls the clock rate modulation for the BBDs. First you must enable one or more Chorus channels by engaging the appropriate **Chorus Enable Buttons**. In this image Chorus 1, 3, 4 and 6 are operating. *To save CPU ensure you turn off BBDs you don't require!*

Chenille provides fine control to both the fast and slow LFO modulation rates and depth. BBD chorus devices typically used a highly filtered square wave, providing an approximate sine wave. In *Chenille* you can adjust the filter using the **Shape** controls from 0.00 (slightly filtered square) through 0.50 (triangle) to 1.00 (sine). Set the **Fast Shape** to its minimum value* to use the **Slow Shape** for both Fast and Slow.

* When requiring compatibility for songs created with v1.0, ensure Fast Shape is set to the full left position

Use the **Depth** controls to adjust the amount of the modulation, and the **Rate** controls to change the speed of the modulation. You'll notice that Chorus 1 controls are in orange rather than green. This is because when the **Sync** button is On the **Slow/Fast Rate** controls for Chorus 1 adjusts the LFO rates of *all* six Choruses: the subsequent five stages are slave-locked to this master rate. Note that Depth and Mix are still independent: only rate is effected by Sync lock. With **Sync** off, all twelve oscillators can have differing modulation rates by adjusting their respective Rate knobs. The available LFO rates are:

- **Slow** = 0.01–2.00 Hz, default = 1.00 Hz: to use *only* the Slow LFO **Rate**, set the respective BBD's *Fast* **Depth** to zero
- **Fast** = 2.00–10.00 Hz, default = 6.00 Hz: to use *only* the Fast LFO **Rate**, set the respective BBD's *Slow* **Depth** to zero

For each BBD these two LFOs are mixed to modulate the BBD clock rate. When the depth of both Fast and Slow LFO is greater than zero this ensures that the ensemble modulation isn't a simple sine or triangle waveform, and with at least three BBDs running, you are less likely to hear obvious repeat patterns and the type of flanging/phasing artefacts endemic to previous Reason choruses, such as the CF-101 Chorus/Flanger device. It's also for this reason that *Chenille* does not include tempo sync: since the idea of a chorus is that you *don't* hear the modulation, tempo synced choruses are like fitting rechargeable batteries and bluetooth into an ice cube*: it can be done but there's no practical purpose for it. So we decided to focus on having it sounding as good as possible as a free-running device, as was the case in the 70s and 80s!

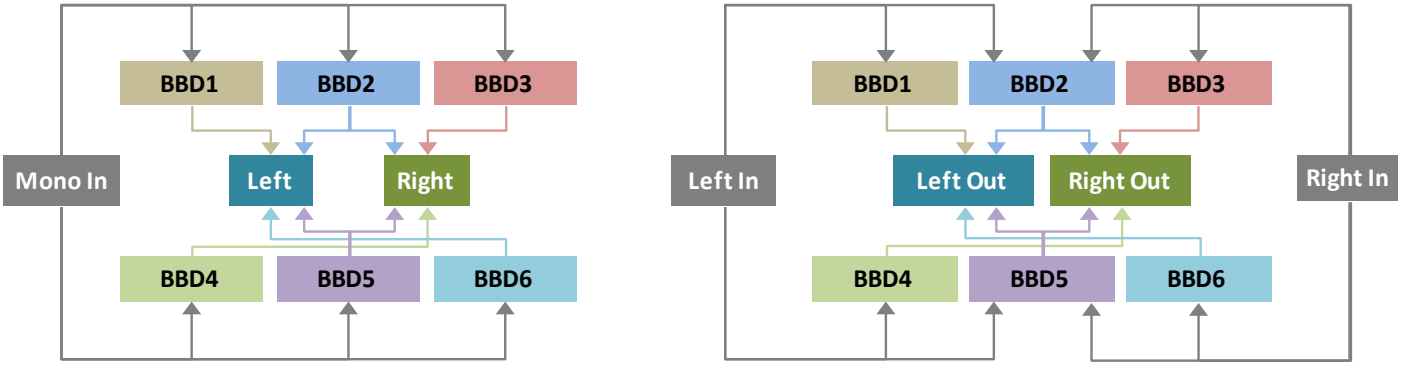
By default the phase offsets of the Chorus channels are multiples of 60°; Stages 2–3 are offset to degrees appropriate to typical 3-stage BBD implementations, while BBDs 4–6 are offset to intermediate positions. See **Chorus Mode** on page 6 for more details and how to change the phase setting.

Note that the Chorus channels can still use unison or delay feedback *without* requiring the delay to be modulated, so in that case ensure the two **Depth** controls of that Chorus are set to zero.

Mix

This section mixes the Chorus channels in a fixed stereo setup. Chorus 1 and 6 are sent to the left channel, Chorus 3 and 4 connect to the right channel, and Chorus 2 and 5 are sent to both. Note that left and right inputs are reversed and sent to right and left outputs respectively, for Chorus 4 and 6. This provides the channel inversion component of the Roland Dimension. With its **Mix Knob** centred that entire Chorus is effectively off. Turning the mixer knob to the right will add the Chorus output to the mix. Turn the mixer knob to the left and it will instead add a *high-pass filtered and phase inverted* Chorus output to the mix, again for behaviour similar to the Roland Dimension choruses. The high-pass filter on this phase inverted Chorus output is not adjustable.

Here is how the inputs and outputs are connected:



For a mono chorus output, only use the Chorus 2 and/or 5, which are summed left and right inputs that are sent to both left and right outputs. Don't forget you can effectively add a dry signal by increasing a Chorus Mix knob on a Chorus channel

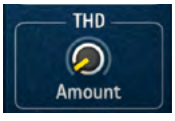
* Google "Martini Smart Cubes" for a laugh.

where the modulation itself is off; for example, only turn on Modulation Enable for Chorus 2 and Chorus 5 for a mono chorus, but add gain for Choruses 1, 3, 4 and 5. Now you'll have a chorus in the middle with dry "sides".

The **Chorus Gain** knob is an output gain for the entire Mixer. Use this to adjust the Wet level going in to the **Dry/Wet** control, which will ensure you can maintain an equal power curve if automating cross-fades between the Dry and Wet output. Chorus 2 alone, or Chorus 1 and Chorus 3 together, at +100% will be equal to the Dry level and so **Chorus Gain** can be left at "Off" (0dB gain); it is recommended that you *reduce* gain for each *additional* BBD active, and *increase* gain when raising the **HPF** frequency (up to around 250 Hz). You may also want to reduce the gain when adding voices with the Unison function and almost certainly want to reduce the gain when using high **Feedback**, particularly with high **THD**.

Chenille does not include per-Chorus pan controls (or individual LFO modulation phase control) as this may cause phase cancellation issues as you adjust them, thus would make the device needlessly complex and confusing. For chorus devices it is therefore preferable to simply have a fixed stereo output arrangement.

THD



Harmonic distortion is introduced by BBD circuits. The more stages in the BBD the more distortion is introduced. The **THD** knob controls the Total Harmonic Distortion produced. Typically you might expect approximately 1% of THD per 1,024 stages. In *Chenille* you can drive the THD from zero right up to 36% independently of the number of stages, although that 36% figure is fairly arbitrary: it's based on a sine wave of 80Hz at a particular input level, so the *actual* THD amount, as you would therefore expect, will not necessarily reflect what is set by this control.

The **THD** control also sets up complex harmonic interference when using the **Feedback** controls, and you will find that output level is attenuated the more you increase **THD** value. This is expected behaviour. The effect of this control will be most obvious on signals with less harmonics to begin with.

Unison

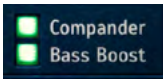
Add 2 additional voices per Chorus with the **Unison Level** control, and increase the amount of detune between them with the **Detune** control. The unison module for each Chorus is slightly offset in terms of latency and detune amount. You can apply unison detune even if the channel modulation is off, for up to 12 voices.

Filters

Because BBDs used Sample & Hold, a low-pass filter must be applied to both the input (the anti-alias filter) and output (the reconstruction filter) signal to prevent aliasing. This has the natural side-effect of cutting upper frequencies. The ensemble circuits on the Eminent 310U, for example, cut as low as 6 kHz, longer delays might be as low as 1kHz! *Chenille* uses a 48dB/octave low pass shelf for these filters, and luckily you have the possibility to adjust the cutoff frequency from 1–28kHz using the **LPF** control as you see fit. *Please remember when operating in* **BBD Mode** *the audio* ***will*** *audibly alias if the Low Pass Filter is set too high: this may be the effect you want for glitchy noises, hence why we allow it to occur, but for typical BBD chorus purposes the more Samples you have selected in the BBD Setup, and the lower the clock rate is, the lower the LPF frequency needs to be. If in doubt, use a preset, or turn* **BBD Mode** off *to use the non-aliasing* ***DDL Mode****!*

A 48dB/octave high-pass filter is available after the Ensemble Mix section to cut all low frequencies up to 1kHz. This is useful on bass synths and bass guitars, where you can use the **HPF** control to prevent the chorus swamping the low end of your mix, by only adding the chorus to higher frequencies. Because of the steep filter you'll probably want the cutoff frequency much lower than you might expect: a setting as low as 130Hz, for example, you may find enough for bass guitar. Cutting higher may require additional volume gain of the wet signal using the **Chorus Gain**, or if using *Chenille* as an SSL Send effect, you can also add gain there. This control does *not* affect the HPF frequency of the phase-nverted mixer levels.

Compander

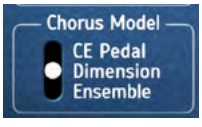


This button enables the compressor/expander which are sometimes used in BBD-based devices. Companders were typically used to reduce internal noise by effectively boosting the SNR (signal-to-noise ratio). As *Chenille* is a noise-free software device, you can normally leave this off, as they were more prevalent in delay devices. It is included in *Chenille* for patches that experiment with delay where you may like to model more accurate response, that is quite aggressive on transients. This compander uses a 16:1 compression ratio with a 40ms attack and a half-second release.

Bass Boost

Based on similar behaviour found on the Roland Dimension chorus unit, turn this on for a low shelf boost. It is enabled by default on the "Dimension" patches, and can add some low-end "warmth". The dB gain is slightly higher than the Dimension D and only affects the wet signal, not the dry as well. Note that this boost will be removed entirely if you increase the **HPF** above 200 Hz!

Chorus Mode



This three-mode switch adjusts the phase offsets of Choruses 2–6 when in Osc Sync mode, which is particularly important in relation to the phase offset of Chorus 3, the right channel, relative to Chorus 1 and the type of chorus you wish emulate.

"Ensemble" mode provides the correct 3-phase settings, left, right and centre, for traditional ensemble choruses, while "Dimension" and "CE Pedal" modes provide the correct setting for those models.

- **"CE Pedal":** **BBD2** = 180° **BBD3** = 90° **BBD4** = 120° **BBD5** = 45° **BBD6** = 240°
- **"Dimension":** **BBD2** = 90° **BBD3** = 180° **BBD4** = 0° **BBD5** = 120° **BBD6** = 180°
- **"Ensemble":** **BBD2** = 120° **BBD3** = 240° **BBD4** = 60° **BBD5** = 180° **BBD6** = 300°

The BBDs not required for each mode are set to alternative positions to provide a degree of experimentation. Using three BBDs or more it's less likely you'll notice the difference between modes.

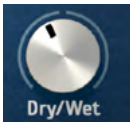
Feedback

Whether using *Chenille* as a chorus or a delay device, experiment with adding feedback. The **L Feedback** encoder sends the outputs of BBD1 and BBD6 back into themselves, and the **R Feedback** encoder does likewise for BBD3 and BBD4. Both **L** and **R Feedback** values are averaged to get a feedback amount for BBD2 and BBD5.

While 100% feedback is effectively "always on" as you would expect, depending on other settings in the Modulation section and **THD** amount, be aware the sound may still decay in **BBD Mode**, due to the destructive interference caused by any modulation on each feedback loop. So for scenarios where you want to modulate but don't want the sound to decay, to DDL Mode instead. High **Feedback** can create very loud output, so watch your levels!

High feedback setting on very long delay lines with a fast clock rate—e.g. 4096+ buckets and a 50+ Hz clock—Chenille makes an effective BBD reverb device.

Dry/Wet



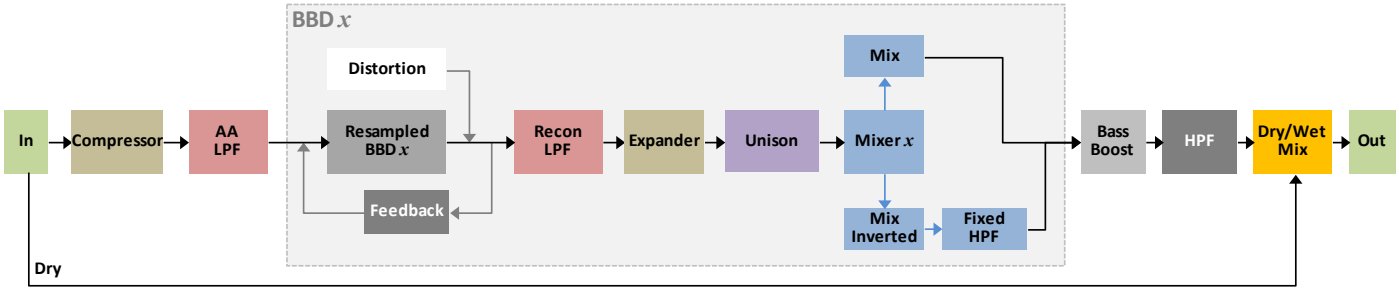
Chenille's **Dry/Wet** control is equal power, so in theory you can fade Dry and Wet signals with no loss of gain. However, since the total Wet volume is ultimately determined by the Mixer values, so you may find 100% wet significantly lower than 100% Dry, so don't forget to set the **Chorus Gain** to an appropriate level to allow the equal power Dry/Wet control to be effective. Some presets, such as the 310U patches, you may find preferable 100% wet. The Dimension-type patches, however, work best at just 20–40% wet, providing a subtle, "movement-free"

chorus. Indeed, sometimes it's so subtle you might not even be aware the chorus is on! But turn it off and the lack of effect quickly becomes apparent!

Back panel

The back panel provides mono/stereo in to stereo or dual-mono out, depending on the settings of the Mixer. A set of CV modulation inputs are provided, while all front-panel parameters can be modulated via the Combinator TS8450 programmer.

Signal flow



Patches

Reset Device and "A True Init Patch"

The root folder contains 45 easily accessed and useful presets, covering choruses, ensembles and unison.

For a clean sheet from to create from scratch, use the "A True Init Patch" preset; everything is zero'd except Buckets (512) and Clock Rate (40kHz).

The right-click "Reset Device" setup is a version of the Ensemble 310U patch.

"Chenille Favourites Inserts" and "Chenille Favourites Sends" folder

These are patches created a starter guide to specific uses, such as guitar and vocals. Feel free however try to any of them on anything! Use the Chenille Favourites Inserts folder if adding to the FX chain of an instrument or audio track; use the Chenille Favourites Sends folder if adding to a Reason Mixer Sends channel, as the Dry/Wet is pre-set to 100% wet.

"Chenille Inserts" and "Chenille Sends" folders

For ease of browsing Chenille includes the same patches set up as both Send (all patches preset to 100% wet) for use as a send effect via the Reason Main Mixer, where the wet volume can be controlled via the channel send mixer, and as an Insert (dry/wet mix), for inserting directly after a sound source in the rack. Some inserts may still be set to 100% Wet where this may be the preferable setting, such as the ensembles, but mostly inserts will be between 20–80% Wet. For subtle, sweep-free chorus to add body to an instrument or especially a voice, don't use more than 50% wet; 30% may be enough in most circumstances! Beyond that level the chorus modulation effect may become too obvious.

"Combinator Effects" and "Combinator Instruments" folders

A hearty selection of demo Combinators are available for your enjoyment.

Dry/Wet crossfading and Chorus Gain

For consistency, we have endeavoured to set the patches up to provide an equal power gain wherever feasible, based on a C3 major chord with a -12dB input, but is impossible to set patches up to work out of the box for all possible crossfade scenarios. Adjust the **Chorus Gain** knob to ensure that the output level in the Mixer when 100% Wet into the mixer is the same when 0% Wet (fully Dry!). For example, both result in 0dB VU, or -12dB Peak. Note that increasing **HPF** in *Chenille* will result in *significantly* reduced Wet output level for notes with fundamentals below the set frequency**.** Also be aware that some patches, may create loud harmonics on certain notes; you may want to add an MClass Maximiser afterwards.

Experiment!

The same patch can sound quite different from one instrument to another.

As a general rule of thumb you can assume the following:

- **Dimension** style patches are excellent on vocals, but keep the wet level below 50%. It fattens thin vocals in a very subtle way, with no noticable modulation
- **CE** style patches are great on guitar, and create a sparkly shimmer that's not too rich but creates a nice movement
- **Ensemble** style patches are great on synths and organs for a big, rich sound. If you listen closely you can might discern the modulation, but with three channels it's quite well disguised, even more so if you don't hold a note for too long.

We hope you enjoy the beautiful, magical sound of the *Chenille BBD Chorus Ensemble*!

Version history

2.0.0

- **Beautiful new design by esselfortium**
- **Chorus Mode, Bass Boost and Compander controls are now available on the front panel, and automatable/Remote™-able.**
- **Depth/Rate paging has been removed, providing full access to both Depth and Rate (see Note below)**
- **Root folder preset list revised and expanded with a fantastic set of useful go-to chorus and ensemble patches**
- **The device default patch has been changed to Dimension D Mode 6 Chorus**

[Note: The Rate Edit Mode button to control the paging in Chenille 1.x has been deprecated from the GUI panel, but is still present in automation function to maintain backwards compatibility, but it no longer does anything]

1.1.0

- **Added Fast Modulation Shape**
- **A few extra patches**

1.0.0

- **Initial release**

BBD Delay Times

Clock Rate kHz	BBD Stages								
	2	10	50	256	512	1024	2048	4096	8193
	ms	ms	ms	ms	ms	ms	ms	ms	ms
1.5	0.6667	3.333	16.667	85.3	170.7	341.3	682.7	1,365.3	2,731.0
2	0.5000	2.500	12.500	64.0	128.0	256.0	512.0	1,024.0	2,048.3
3	0.3333	1.667	8.333	42.7	85.3	170.7	341.3	682.7	1,365.5
4	0.2500	1.250	6.250	32.0	64.0	128.0	256.0	512.0	1,024.1
5	0.2000	1.000	5.000	25.6	51.2	102.4	204.8	409.6	819.3
6	0.1667	0.833	4.167	21.3	42.7	85.3	170.7	341.3	682.8
7	0.1429	0.714	3.571	18.3	36.6	73.1	146.3	292.6	585.2
8	0.1250	0.625	3.125	16.0	32.0	64.0	128.0	256.0	512.1
9	0.1111	0.556	2.778	14.2	28.4	56.9	113.8	227.6	455.2
10	0.1000	0.500	2.500	12.8	**25.6**	51.2	102.4	204.8	409.7
11	0.0909	0.455	2.273	11.6	23.3	46.5	93.1	186.2	372.4
12	0.0833	0.417	2.083	10.7	21.3	42.7	85.3	170.7	341.4
13	0.0769	0.385	1.923	9.8	19.7	39.4	78.8	157.5	315.1
14	0.0714	0.357	1.786	9.1	18.3	36.6	73.1	146.3	292.6
15	0.0667	0.333	1.667	8.5	17.1	34.1	68.3	136.5	273.1
16	0.0625	0.313	1.563	8.0	16.0	32.0	64.0	128.0	256.0
17	0.0588	0.294	1.471	7.5	15.1	30.1	60.2	120.5	241.0
18	0.0556	0.278	1.389	7.1	14.2	28.4	56.9	113.8	227.6
19	0.0526	0.263	1.316	6.7	13.5	26.9	53.9	107.8	215.6
20	0.0500	0.250	1.250	6.4	12.8	25.6	51.2	102.4	204.8
25	0.0400	0.200	1.000	5.1	10.2	20.5	41.0	81.9	163.9
30	0.0333	0.167	0.833	4.3	8.5	17.1	34.1	68.3	136.6
35	0.0286	0.143	0.714	3.7	7.3	14.6	29.3	58.5	117.0
40	0.0250	0.125	0.625	3.2	**6.4**	12.8	25.6	51.2	102.4
45	0.0222	0.111	0.556	2.8	5.7	11.4	22.8	45.5	91.0
50	0.0200	0.100	0.500	2.6	5.1	10.2	20.5	41.0	81.9
55	0.0182	0.091	0.455	2.3	4.7	9.3	18.6	37.2	74.5
60	0.0167	0.083	0.417	2.1	4.3	8.5	17.1	34.1	68.3
65	0.0154	0.077	0.385	2.0	3.9	7.9	15.8	31.5	63.0
70	0.0143	0.071	0.357	1.8	3.7	7.3	14.6	29.3	58.5
75	0.0133	0.067	0.333	1.7	3.4	6.8	13.7	27.3	54.6
80	0.0125	0.063	0.313	1.6	3.2	6.4	12.8	25.6	51.2
95	0.0105	0.053	0.263	1.3	2.7	5.4	10.8	21.6	43.1
96	0.0104	0.052	0.260	1.3	2.7	5.3	10.7	21.3	42.7
100	0.0100	0.050	0.250	1.3	2.6	5.1	10.2	20.5	41.0

Remote Mapping

```
/Remote Map template for  Effects          Jiggery-Pokery Sound: Chenille BBD Chorus Ensemble
Scope     Jiggery Pokery  com.jiggerypokery.Chenille
//        Control Surface Item        Key     Remotable Item      Scale     Mode
Map       _control_       BBD Delay Samples
Map       _control_       BBD512
Map       _control_       BBD1024
Map       _control_       BBD2048
Map       _control_       BBD Full Range
Map       _control_       BBD Clock Rate
Map       _control_       BBD Mode
Map       _control_       Chorus Model

Map       _control_       Modulation Shape
Map       _control_       Fast Modulation Shape

Map       _control_       Oscillator Sync

Map       _control_       BBD1 Enable
Map       _control_       BBD2 Enable
Map       _control_       BBD3 Enable
Map       _control_       BBD4 Enable
Map       _control_       BBD5 Enable
Map       _control_       BBD6 Enable

Map       _control_       BBD1 Slow LFO Rate
Map       _control_       BBD2 Slow LFO Rate
Map       _control_       BBD3 Slow LFO Rate
Map       _control_       BBD4 Slow LFO Rate
Map       _control_       BBD5 Slow LFO Rate
Map       _control_       BBD6 Slow LFO Rate

Map       _control_       BBD1 Fast LFO Rate
Map       _control_       BBD2 Fast LFO Rate
Map       _control_       BBD3 Fast LFO Rate
Map       _control_       BBD4 Fast LFO Rate
Map       _control_       BBD5 Fast LFO Rate
Map       _control_       BBD6 Fast LFO Rate

Map       _control_       BBD1 Slow LFO Depth
Map       _control_       BBD2 Slow LFO Depth
Map       _control_       BBD3 Slow LFO Depth
Map       _control_       BBD4 Slow LFO Depth
Map       _control_       BBD5 Slow LFO Depth
Map       _control_       BBD6 Slow LFO Depth

Map       _control_       BBD1 Fast LFO Depth
Map       _control_       BBD2 Fast LFO Depth
Map       _control_       BBD3 Fast LFO Depth
Map       _control_       BBD4 Fast LFO Depth
Map       _control_       BBD5 Fast LFO Depth
Map       _control_       BBD6 Fast LFO Depth

Map       _control_       BBD1 Amp Mix
Map       _control_       BBD2 Amp Mix
Map       _control_       BBD3 Amp Mix
Map       _control_       BBD4 Amp Mix
Map       _control_       BBD5 Amp Mix
Map       _control_       BBD6 Amp Mix

Map       _control_       BBD Mixer Gain
//GUI now labelled "Chorus Gain"

Map       _control_       Unison Level
Map       _control_       Unison Detune
Map       _control_       HPF Frequency
Map       _control_       LPF Frequency

Map       _control_       Dry/Wet
Map       _control_       Feedback Left
Map       _control_       Feedback Right

Map       _control_       THD Amount
Map       _control_       Compander
Map       _control_       Bass Boost

Map       _control_       Rate Edit Mode
//Rate Edit Mode deprecated from v2.0.0
```

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Chenille BBD Chorus Ensemble was designed and assembled by Jiggery-Pokery Sound, of London, England; DSP coding by Pitchblende Ltd, of Middle Earth.

Chenille BBD Chorus Ensemble v2 was redesigned by esselfortium.

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From the maker of ...

Rack Extensions

- **Ammo 100LA Modulation Oscillator** - Portable single-channel oscillator for audio and CV rate synthesis and LFOs, featuring 128 waveforms
- **Ammo 400R Modulation Oscillators** - 4-channel LFO generator with audio output, featuring 136 waveforms and advanced modulation mixing
- **Ammo 1200BR Modulation Synthesizer** - Advanced 4-channel LFO generator and audio synthesizer adds S&H, Comparator and Electro-Switch
- **Anansi Mid/Side Mastering Router** - Mid/side audio router with mono compatibility check, 3-in merger and 3-out splitter
- **Charlotte Envelope Generator** - 9-stage EG with time, level, curve and velocity control per stage, and a priority-selectable MIDI-to-cv-pitch splitter
- **Chenille BBD Chorus Ensemble** - Realistic BBD chorus device, based on the 70s string synth ensembles and the classic Roland Dimension D rack unit
- **Combo 310 Unique Organ** - The legendary Dutch electronic home/church organ, best known as the "Jarre" organ of Oxygene and Equinoxe.
- **Combo B3T Organ** - The famous American tonewheel organ and Leslie combo in highly tweak-able and addictive Rack Extension format
- **Combo Compact Organ** - The classic Italian transistor organ now in a brilliant, easy to use and equally compact Rack Extension format. Bags o' fun!
- **Combo Continental Organ** - The classic British transistor organ in a fantastic Rack Extension for that instant 60s feel!
- **Combo Electric Harpsichord** - A rare example of a lovely 60s curio, the Baldwin Solid Body, aka Electric, Harpsichord!
- **Combo X~705 Space Organ** - An inspirational Frankensynth monster: an all-in-one Hammond clone, synthesizer and Rhapsody 610 string ensemble!
- **Itsy Stereo/Phase Inverter** - L/R channel flip, cv-controllable 180˚ stereo inverting width adjust, stereo phase inverters and phase correlation metering
- **JPS Harmonic Synthesizer** - Vintage additive synthesizer emulation, based on the ultra-rare RMI keyboard
- **Lolth CV Delay Splitter** - 4x4 channel cv splitter with independently adjustable gain and inversion controls, channel delay, and mirroring
- **Miranda CV Delay Merger** - 4x4 channel cv merger with independently adjustable gain and inversion controls, channel delay, and mirroring
- **Mordred Audio Bypass Merger** - 4 x 5 channel stereo audio merger with independently switch-able outputs and auto-fade control
- **Shelob Audio Bypass Splitter** - 4 x 5 channel stereo audio splitter with independently switch-able outputs, mirroring, and auto-fade control
- **Steerpike BBD Delay Ensemble** - Vintage style 6-tap BBD device, with multiple delay modes including parallel, serial, and reverse
- **Titus BBD Delay Line** - A lightweight 1U delay device featuring a single Steerpike delay line, with reverse

ReFills

- **Guitars vol.1+2: Stratocaster & Telecaster** - Multi-sampled guitars with slides, mutes, signature L6 effects and key-switching
- **Elements²: Vector Synthesis Workstation** - Massive patch collection featuring Korg Wavestation/MS2000, Waldorf Blofeld and Roland SC-8850
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- **Hammond Novachord*** - the near-antique pre-WW2 monster polyphonic valve synthesizer
- **Retrospective: 40 years of Synthesizer History*** - Over 1Gb of vintage samples from synths and electronic keyboards from the Hollow Sun archive

FreeFills

- **Additives** - demo version of Additions: the fantastic Additives tracks from PUF Challenge #2 can be found at **http://soundcloud.com/groups/additives**
- **8-BIT Magic**: The ZX Spectrum ReFill
- **Classic Drum Machine Collection v1.1**
- **Eminent 310 Strings** v3** - a very old set of samples of miscellaneous quality, so you don't need this anymore. You've got this lovely Combo 310 Unique Organ for your Rack now, with every note recorded in 24-bit at 96kHz, so it's much better!
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- **Moog Taurus Bass Synthesizer** v1.1**

For more information on these products and for direct downloads of these latest versions, plus a wide range of great Combinator skins, please visit **www.jiggery-pokery.com**

* Includes samples licensed from HollowSun.com
** demo ReFills for Retrospective