fircomp 2 user manual

https://jonvaudio.com

Introduction

Fircomp 2 is a peak compressor / limiter which combines ideas from classic peak compressors, alongside a new digital peak detection method which reduces amplitude modulation by a significant amount.

This results in a compressor which can be pushed to the extremes without falling apart, with zero / low latency, and low CPU use. Very fast (or zero-sample) attack times can be used without sounding "clicky". In addition, the release stage can be highly history-dependent, making Fircomp 2 suitable for busses or "invisible" compression.

There is no phase shift or filtering of the audible signal, regardless of the settings chosen. By default Fircomp 2 operates in zero latency mode, which has much lower distortion than a standard compressor implementation with similar timings would have. But Fircomp 2 also has a "lookahead" mode which lowers distortion even further, at the cost of a small amount of latency. This is implemented via a FIR filter in the sidechain (not in the audible path).

Fircomp 2 vs Fircomp 1

Fircomp 2 is a new plugin that can be installed and used alongside Fircomp 1. Fircomp 2 is much more flexible and has many more features.

By default, Fircomp 2 has the same attack and release behaviour as Fircomp 1. However it does not null with Fircomp 1 due to improvements in the methods used to reduce distortion.

Features

Presets

- A / B / C / D buckets for settings comparison, with the ability to copy / initialize buckets.
- Preset system with quick load menu based on the preset folder hierarchy, with a settable default preset. Presets are XML files that can be easily shared.

GUI

- Resizable vector-based GUI.
- Theme system with modifiable colours, overall colour adjustments, and optional background image. Themes are XML files that can be easily modified or shared.
- Peak and LUFS-SL metering of gain reduction, dry, and compressed signals.
- Gain reduction meter with adjustable range.

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- Optional big horizontal gain reduction meter.
- All GUI settings saved automatically when the window is closed.

Sidechain
- Intuitive stereo options with L/R or mid/side modes, adjustable stereo link, adjustable detector balance, and auto makeup / makeup balance.
- Sidechain hipass filter, bandpass filter, or hipass plus k-shelf filter.
- Sidechain listen and compression delta listen controls.
- External sidechain option.

Compression
- Ratio adjustable from 1.01 to 30, or special infinity setting which detects the max of both channels for hard limiting.
- Knee adjustable from 0 to 60 dB
- Attack time adjustable from 0 samples to 50 ms.
- Release time adjustable from 5 ms to 3 seconds.
- Release shape control, with the default setting matching Fircomp 1
- Release history / program dependence control from Fircomp 1.
- Max compression range control.
- Optional lookahead mode from Fircomp 1.
- Regardless of mode, there is no phase shift or filtering of any kind applied to the audible signal.

Output
- Convenient "Limit" button / menu which can change / examine other settings to use Fircomp 2 as a limiter.
- Auto makeup and auto makeup balance "snap" controls based on the past 3 seconds of perceived loudness.
- Soft bypass control which preserves latency if necessary.
- Wet / dry mix control.

Additional post-launch features
- Sidechain bandpass filter
- Additional peak detection (not to be confused with peak/topology modes) options. (The peak detector operates in all topology modes modes). This includes the Fircomp 1 mode, a "naive" / aliasing mode, and varying levels of Fircomp 2 "grit" modes that are in-between "naive" and Fircomp 2.
- VCA mode topology.
- Coupled peak mode topology (which slightly changes the attack/release topology in the original peak mode).

Formats

Fircomp 2 supports the following platforms / formats:

- 64-bit AU "universal binary" which runs natively on Intel-based macs and M1 based macs
- 64-bit VST3 "universal binary" for macs
- 64-bit VST3 for Intel-based Windows PCs

Please ensure that Fircomp 2 works correctly on your system using the free demo version, **before** purchasing.

Sample rate support

Fircomp 2 officially supports all standard sample rates from 8 kHz up to 384 kHz. Sample rates outside of this range may work, but the sound quality may degrade slightly. If using a host that allows you to oversample a plugin, restrict your oversampling to a multiplier that does not exceed the maximum supported sample rate of 384 kHz.

Installing Fircomp 2

Installation simply involves downloading and unzipping the Win or OSX version as needed, running the `RUN_ME_FIRST.command` file if you are on OSX, then copying the plugin file / bundle into the correct folder / directory for your system. Depending on your DAW or host software, you may then need to "rescan" your plugin folder. The folders / directories suggested below.

Windows VST3: Copy the `FirComp2.vst3` file to the `C:\Program Files\Common Files\VST3` folder.

Max OSX

Extract the zip file, then run the `RUN_ME_FIRST.command` file to remove the "quarantine" attribute from both versions of the plugin. **Warning:** failure to run this command **before** copying the plugin file to the destination, may mean that you have to clear your DAW's plugin cache (**not** just re-scan) and restart your machine. Please use the support email (below) if you encounter any issues while installing. Then:

Mac OSX VST3: Copy the `FirComp2.vst3` file to the `/Library/Audio/Plug-Ins/VST3` folder. If this folder is not visible, then from the finder you can click on `Go -> Go to folder` to navigate to it. Note: be careful not to confuse this system folder with your local library in your home folder (`~/Library`) as this may not work in some hosts.

Mac OSX AU2: Copy the `FirComp2.component` file to the `/Library/Audio/Plug-Ins/Components` folder. If this folder is not visible, then from the finder you can click on `Go -> Go to folder` to navigate to it.

Additional info on the "run me first" command file on OSX

The `RUN_ME_FIRST.command` file included with the OSX versions of the plugin simply removes the "quarantine" attribute from the downloaded plugin files, and has no other effect on your system. It does this using a script that calls the `xattr` program, which is part of OSX. To close Terminal after this process has completed, simply go to `Terminal -> Quit Terminal`, or press `Cmd-Q` while the terminal window is selected.

Support / feedback / bugs

Please send support requests / feedback / bug reports to: `fircomp@jonvaudio.com`

If asking for support or help, please provide:
- The exact operating system versions(s) you are using.
- If on OSX, whether you have an Intel or M1 based mac.
- If on OSX, whether you are using the VST3 or AU versions, or both.
- The exact version of Fircomp 2 you are using (you can find this by clicking on `Save / Options..` then `License / About..`).
- The exact DAW version(s) you are using.
- If possible, please also provide screenshots and / or videos demonstrating your issue, as this can be very helpful.

Fircomp 2 controls

Buckets, quickload, and the save / options menu
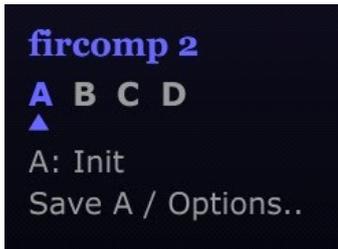
Buckets, and the bucket popup menu
Fircomp 2 can remember 4 different sets of settings, so that you can easily compare different compression settings, amounts, or mixes. These are labelled **A**, **B**, **C**, and **D**, and you can switch between them by clicking on them. However, clicking on the currently active bucket shows the bucket popup menu, with the following options:

- **Init ALL:** Initialize all buckets to the default bucket (either the user-saved default preset, or the hard coded defaults if no default preset file exists).
- **Init [current bucket]:** Initializes just the currently selected bucket.
- **Copy [current bucket] to ALL:** copies the current bucket's settings to all other buckets.
- **Copy [current bucket] to [other bucket]:** Copies settings from the current bucket to one other bucket.
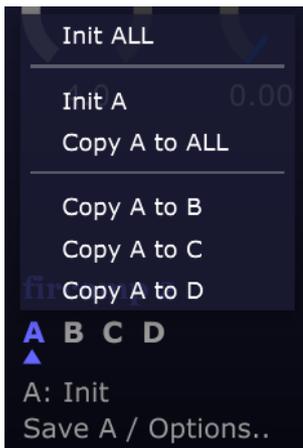
[Current bucket]: [preset name] *(quick load preset popup menu)*
Clicking on the currently loaded preset name, or "Init" if no preset has been loaded, shows the "quick load" preset popup menu. This allows you to quickly load a preset into the **current bucket only**. All other buckets will be unaffected. If the preset name ends in *, it means it has been modified after loading.

The structure of this popup menu mirrors the directory structure of the presets folder, but is limited to 5 levels deep and 100 entries per level. *(See below for how to open the presets folder in Windows Explorer or the Finder).*
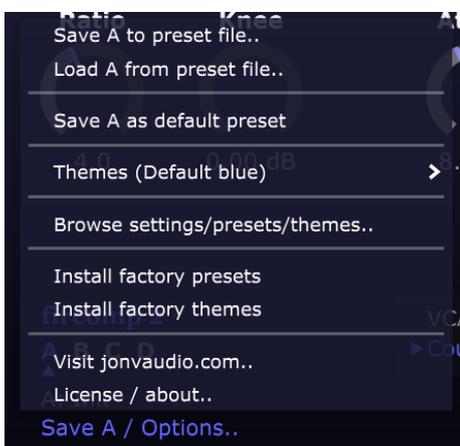
Save [current bucket] / Options.. *popup menu*
- **Save [current bucket] to preset file..:** Saves only the current bucket as a preset file (XML). The preset file can be saved anywhere, but it is recommended that you save it in the presets folder if you want to access it from the quick load preset menu.
- **Load [current bucket] from preset file..:** Works exactly the same as the quick load preset menu, but allows you to browse for any XML preset file on your computer.
- **Save [current bucket] as default preset:** Saves the current bucket as the default preset for when the plugin is loaded or buckets are initialized. (If no default preset exists when initializing, hard coded defaults are used). To delete your default preset, delete the `fircomp2_init_preset.xml` file from the settings folder (see below on how to access the settings folder).

- **Themes ([theme name]):** Load a visual theme from the themes folder. Themes are stored as XML files. You can open them in your favourite text editor to modify them or create themes of your own. The factory themes XML files contain text comments with instructions on how to make new themes.
- **Browse settings/presets/themes..:** Open a Windows Explorer or Finder window showing the folder where settings, presets, and themes are stored.
- **Install factory presets *and* Install factory themes:** These two options allow you to re-install the factory presets and themes. **Warning:** any existing presets or themes with the same file names as the factory themes or presets will be overwritten when you choose this option (but any existing presets or themes with differing file names in the same folder(s) will be left in place). Therefore, it is recommended that you make a copy of any factory preset or factory theme you wish to modify, before modifying it.
- **Visit jonvaudio.com..:** Launches your default web browser and visits this URL.
- **License / about..:** Shows a popup dialog box with information on the version of Fircomp 2.

Using rotary controls

Fircomp 2 has two types of controls: clickable buttons which either toggle a setting or pop up a menu, and rotary controls, which adjust some value.

Rotary controls work as follows:
- **Left click and drag vertically:** Adjust the value.
- **Ctrl+ left click and drag vertically:** (or Cmd on OSX): Fine adjust value.
- **Double left click:** Reset to the hard-coded default value (not affected by the Init preset).
- **Left click on the number / text below a rotary control:** Type in a new value, then press enter / return to apply that new value. Some entry boxes have "special" values that can be typed in, and these are described below.

The stereo controls
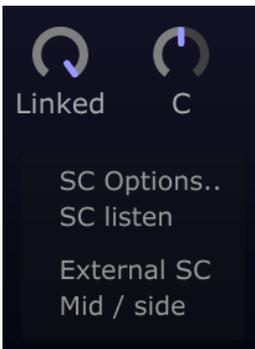
Internally, Fircomp 2 is a dual mono compressor. The stereo channels are linked or unlinked "on the way in" at the detection stage, instead of when gain reduction is applied. The stereo controls are discussed together here, as they relate to each other.

Mid / side

This button enables the mid / side mode. An explanation of mid / side processing is beyond the scope of this manual. When this is disabled, Fircomp 2 operates as a standard left / right compressor. When mid / side is enabled, Fircomp 2 handles all the details of mid side processing for you, including encoding and decoding to and from left / right. The input, output, and gain reduction meters will also be switched to mid / side mode. But you should still feed Fircomp 2 with a left / right input signal! And it will give you a left / right output signal.
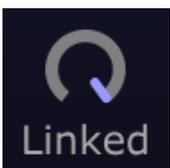
SC Link %

This is the overall "stereo link" control. This controls the amount of detector linking of the left / right, or mid / side, channels. At "Unlinked" (0%) Fircomp 2 behaves like a dual mono compressor, where the two channels have no knowledge of each other and do not interact. At "Linked" (100%) Fircomp 2 behaves like a standard stereo compressor with a mono sidechain. With any non-zero link percentage and standard ratios, the sidechain will detect the average of both channels post-rectification, but with the ratio set to infinity it will take the maximum of both channels.

A note on SC Link % implementation: linking is implemented post-rectification in the log (dB) domain, by feeding various amounts of one channel into the other, and then appropriately scaling the result. It is implemented "on the way in" (instead of at the end, via gain reduction linking), so that 100% linked behaves the same as a mono sidechain with better stereo image.

SC Link % text entry shortcuts: `u`, `l`, for unlinked, linked, respectively.

SC balance
This control effectively allows you to adjust the relative compression threshold for the left / right (or mid / side) channels, by balancing the input. In left / right mode, turning this control to the left reduces the amount of compression applied to the right channel (but the amount of compression applied to the left channel is unaffected), and vice versa.

A note on SC balance implementation: Like SC Link %, this is implemented post-rectification in the log (dB) domain. Which is why neither of these controls have an effect on what you hear when "SC listen" is enabled, which simply lets you hear the output of the SC filtering.

SC balance text entry shortcuts: `l`, `m`, `r`, `s`, `c` for left / mid, right / side, or centre, respectively.

An important note on how SC balance and SC Link % interact
SC balance can intelligently override SC Link %. The actual implementation of this is beyond the scope of this manual, but "just works". Let's say that you set SC Link % to Linked (100%), but then adjust the SC balance slightly to the left (to compress the right channel less). You will notice the appearance of the SC Link % control change. This is because, although the amount of L being fed into the R detector stays the same (a 50/50 split), the amount of R being fed into the L detector has been overridden to be slightly less, (all while intelligently preserving levels), to match the fact that we are compressing the R channel less. If we then set SC balance to L (all the way to the left), we end up with 0% stereo linking, even if SC Link % is set to 100% ("Linked").

Sound confusing? Don't worry about it - it has all been implemented to "just work" and not do anything unexpected. Simply choose the SC Link % and compression balance that you want!
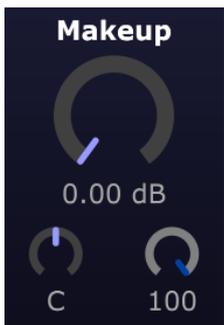
MU balance *("makeup balance", to the bottom left of the makeup gain control)*
We a jumping around here slightly, as this control is on the opposite side of the GUI to the stereo controls. But with good reason, as it is towards the end of the signal chain. The other makeup controls (makeup gain, wet %) are discussed later, but we explain makeup balance here.

MU balance is a "pan" / balance control, but **only for the additional gain added by the "Makeup" control**. If there is no makeup gain, **MU balance has no effect**. This is an intentional design decision as it allows the perceived gain reduction metering to estimate the correct output balance. If it were a simple balance control, you would have to constantly adjust it after changing the makeup gain / compression threshold, and it would become difficult if you wanted makeup gain on one channel only.

The displayed angular meter position for MU balance is Fircomp 2's estimation, based on the perceived loudness of the gain reduction. It aims to **preserve** the same output balance as the input signal. It does **not** attempt to centre or balance the output signal, only match what it originally was, so you may want to completely ignore the suggested value!

When MU balance is set to C, the makeup gain is applied equally to both channels. When it is set to L / M, the makeup gain will **only** apply to the left / mid channel, and vice versa.

MU balance text entry shortcuts: l, m, r, s, c, for left / mid, right / side, or centre.

Simplified step-by-step process for Fircomp 2's stereo system

1) Click on Mid / side if you want mid / side processing, otherwise leave off for standard left / right processing.

2) Decide on the stereo link percentage.

3) Listen to see if one channel should be compressed more than the other, and set SC balance accordingly. Or set SC balance to its min / max value if you only want to compress one channel.

4) Set MU balance accordingly if you need makeup gain, using the estimation meter to match the input balance, or your own ears if you want to have a different balance. If you are only compressing one channel, then you should set MU balance to its min / max value so that makeup is only applied to that corresponding channel.


Compression controls
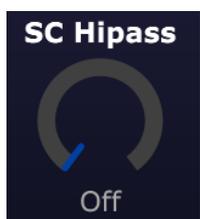
SC Hipass *(or* **SC Bandpass** *when switched)*
This controls the cutoff frequency for the hipass (or corner frequency of the bandpass) filter in the sidechain. For those not familiar with sidechain filtering: This filter is **not** applied to the audible signal, and since Fircomp 2 is a wideband compressor, it does **not** affect the frequency response of the output, and does **not** affect which frequencies get compressed. It simply filters the signal that Fircomp 2 "responds" or "listens" to.

The **Off** setting is a true bypass, and also disables the K shelf boost if selected (see below).

SC Hipass text entry shortcuts
- n for "natural" (200 Hz), h for "de-harsh" (1.5 kHz), s for "de-ess" (7 kHz). These are the values from Fircomp 1.
- For matching a K-weighted filter, enable the K shelf (see below) and then enter k for 38 Hz.
- Entering a numerical value smaller than 10 will give kHz, eg 7 gives 7 kHz.
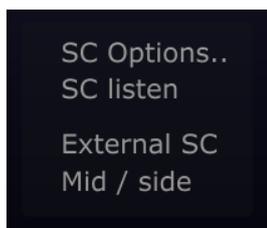
SC listen
Pressing this button will toggle the "sidechain listen" control. Note that this is really a "post-sidechain-filter" listen - it is completely unaffected by mid/side balance, sidechain linking, or sidechain balance. If you enable "Delta listen" (see below) this control will be disabled, and vice versa.

External SC
This button allows you to trigger / key the compressor's sidechain using an external source (from another track, or from a different part of the signal chain, depending on your DAW's routing options). Note that if you do not use your DAW to route an external signal into Fircomp 2's sidechain input, this control may have no effect or may disable compression!

Any sidechain filtering / link / balance will also be applied to the external sidechain input if it is used.
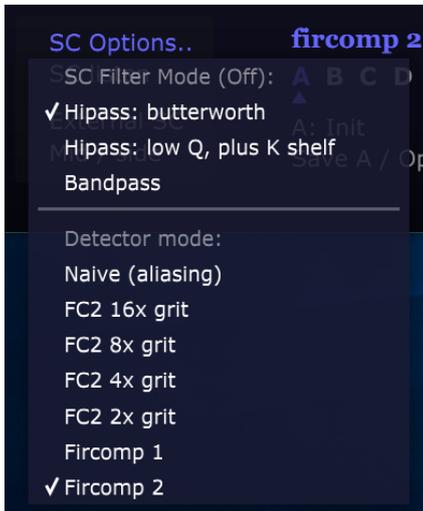
The SC Options.. menu

The sidechain options menu is split into two parts. The first concerns the SC filtering options, and the second controls peak detection.

SC Options: Filter modes

Hipass: butterworth: This is the default Hipass filter option, a 12 dB/octave Butterworth hipass filter.

Hipass: low Q, plus K shelf: This combines a very low Q 12 dB/octave hipass filter, with an upper mid range shelf boost.
If you type k into the SC Hipass frequency text entry box, you will get 38 Hz, which will match the K weighted filtering used for perceived loudness monitoring.
Note that if you set the SC Hipass rotary control to "Off", the K shelf will be disabled and all sidechain filtering will be bypassed.

Note: in previous versions of Fircomp 2, this mode was called "Crush". This was renamed as some users assumed it meant distortion, when in fact it refers to "crushing" the perceived loudness to that it always sounds the exact same volume.

Bandpass: This changes the hipass filter to a 2-pole bandpass filter. Note that this may affect timings when fast attack times are used.

SC Options: Detector modes

Fircomp 2's main defining feature is the advanced peak detection method it uses. The peak detector occurs in the sidechain immediately after rectification. The peak detector is active in all modes (even in VCA mode which is not a "peak compressor") and should **not** be confused with the different topology modes (VCA, coupled peak) which are unrelated. It serves to lower the distortion, particularly with fast attack times. The peak detector smooths peaks, but the output from the peak detector is always at least as high as the input. This is achieved using techniques that are only possible in the digital domain.

Fircomp 2 allows you to change the peak detector mode, and they are listed from most distorted at the top, to cleanest at the bottom (with "Fircomp 2" being the default, cleanest mode).

Note: When lookahead is enabled, the peak detector mode is overridden to be Fircomp 2.

Naive (aliasing): The simplest possible peak detector mode, simply the absolute value of the input (rectification).

FC2 16x grit ... FC2 2x grit: These operate in the same way as the full Fircomp 2 detector mode, but with changing some internal values to get more or less distortion. 16x has the most distortion, and 2x has the least (but still more than the Fircomp 1 or Fircomp 2 modes).

Fircomp 1: The peak detector mode from Fircomp 1

Fircomp 2: The default peak detector mode, and the cleanest, with least distortion.

Ratio

This is a standard compression ratio control from 1.01 to 30, or Infinity. However, ratio also affects the detection mode. When set to "Infinity", the detector takes the max of the two input channels when linked. When set to any other ratio, the detector takes the average of the input channels when linked, for a nicer stereo image.

Knee

This is a standard compressor knee control, from 0.0 dB (no knee whatsoever) up to an extremely soft 60 dB. The knee extends half above, and half below, the threshold, eg a threshold of -20 dBFS and a knee of 10 dB means that compression can start on signals that reach -25 dBFS.

Compression timings

In most digital and analogue compressors, attack and release times are not really "times". Nor are they "rates of change". Instead, they are "time constants" that control the behaviour of something that is very similar to a lowpass filter, but acting on the gain reduction itself instead of the audible signal (so don't worry, there is no lowpass filter applied to what you hear!)

Attack and release timings may not match across different compressors. But most of the time, they act like a spring would: speeding up when the target is further away (stretched), and slowing down when the target gets closer.
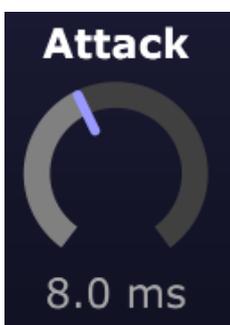
Attack

This is a standard attack time control. The fastest time is 0 samples (true zero / same-sample attack time) to 50 ms. (Note that if the bandpass filter is enabled in the sidechain, the same-sample attack time may be delayed). Faster attack times mean that Fircomp 2 reduces the gain more quickly when the input level goes over the compression threshold.

The attack behaviour is the same as Fircomp 1, and is capable of being extremely fast with high levels of compression without sounding "clicky".
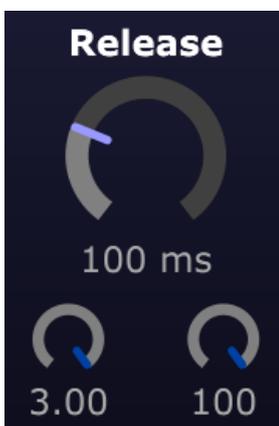
Release

This is an overall release time control. The fastest time is 5 ms, and the slowest is 3 seconds. The actual release behaviour is also influenced by the R shape / Env shape control (bottom left), and the Prog dep % / Feedback % control (bottom right). Faster release times mean that Fircomp 2 returns the gain to normal more quickly after the input level falls below the compression threshold.

When typed into the text entry box, values smaller than 4 are interpreted as seconds instead of milliseconds (eg 2.5 gives 2.5 seconds).

The release behaviour is the same as Fircomp 1, but only when the R shape control is in its default position of 3.

R shape *(Env shape in VCA mode)*
This is the control below the Release control and to the left. The release stage of Fircomp 2 is a release-to-target design, but the R shape control allows you to speed up the beginning of the release stage. The default (and Fircomp 1 behaviour) is 3.0, which means that the beginning of the release stage can be 3x faster, but then becomes unboundedly slow as it reaches its target. The minimum value is 1.0, which means that the beginning of the release stage is much more linear (almost constant dB/s), but still slows down as it reaches its target.

Musically, higher numbers mean that you will hear more background detail, and lower numbers mean slightly more noticeable or "pumping" compression.

In VCA mode, the R shape control operates differently, explained below.

Prog dep % *(Feedback % in VCA mode)*
This is the control below the Release control and to the right. This works identically to the corresponding control in Fircomp 1. It affects the extent to which the release time depends on the recent history of gain reduction.

With "PD Off" (0%), the release stage is still "program dependent" in the standard way, but only depends on both the current instantaneous gain reduction, and the target gain reduction, with no regard for history of gain reduction (although both of those are affected by history).

With this control set to anything other than 0%, the release time is re-calculated every audio sample, depending on the recent history of gain reduction compared to the current gain reduction (where "recent history" is approximately equal to 3x the chosen release time).

So for example, if Fircomp 2 is currently doing a lot of gain reduction, but has done very little gain reduction in the recent past, the release time may be sped up by quite a lot. However, if Fircomp 2 has been doing a lot of gain reduction in the recent past, but is currently doing much less, then the release time may be slowed down significantly.

At 100%, Fircomp 2 is very transparent, especially if R shape is set to 3.0. But the release time control may not have enough of an influence, so turn down the Prog dep % to have more control over the release time.

Note: In VCA mode, this control becomes the Feedback % control, explained below. Program dependence works differently in VCA mode and there is no equivalent "Prog dep %" control. Instead, the "Env shape" control has much more of an influence over program dependence, unlike in the standard modes where it only affects the shape of the release curve.

Topology controls

VCA mode
Coupled peak mode

The "topology" buttons are below the attack and release controls. By default, they are both disabled, and Fircomp 2 uses the decoupled peak topology, which is the same as in Fircomp 1.

In the default "decoupled" mode (neither option selected), the gain reduction is computed immediately after the instantaneous peak signal *(but, as with all topologies, this is after it has been "smoothed" by the intelligent peak detector to reduce distortion, without adding lag or lowering any of the detected peaks)*. After the gain reduction has been computed, it is smoothed by the attack stage, and then by the separate program-dependent release stage. As these are two separate stages in series (and the attack stage has its own "release" equal to the attack time), it means that the release time behaves as

if the attack time is added on to it. (But, nowhere is the attack time directly added to the release time: it's an implicit side effect).

Coupled peak mode

Coupled peak mode is very similar to the default decoupled mode, except that the attack and release stages are a now joined into a single stage with "switching" behaviour, and there is no dedicated attack stage. This means that the release time may feel slightly shorter, or like it begins earlier. This is similar to what you might find on some more "classic" peak compressors. (But as Fircomp 2 is not an analogue emulation, it will not match in behaviour).

VCA mode

VCA mode is the newest mode added to Fircomp 2. This mode re-orders the topology, so that the attack and release controls affect the signal going into the gain reduction computer. This makes for a more "punchy" sound. VCA mode changes the interpretation/meaning of two controls:

R shape *("release shape")* becomes the **Env shape** control, and
**Prog dep %** becomes the **Feedback %** control.

Env shape *(VCA mode only, R Shape in other modes)*

In VCA mode, the attack & release timings control the behaviour of an envelope follower which happens *before* the gain reduction computer. This envelope follower actually consists of two envelope followers in parallel, and the Env shape parameter dictates the relative speed of the faster of the two. In simple terms, Env shape is the "program dependence" control for VCA mode (with higher values being more program dependent), although it works in a completely different way to the program dependence in either of the standard peak modes.

Feedback % *(VCA mode only, Prog dep % in other modes)*

In VCA mode, Feedback % controls the amount of log-domain (dB) gain reduction fed back into to the input of the VCA envelope (attack / release) follower. In the latest versions of Fircomp 2, Feedback % has no effect on the compression ratio, and in some circumstances (ie with high ratios) this control will represent the proportion of the feedback required to achieve the desired ratio (as feedback itself is a method of changing the ratio), and the real ratio and feedback are tweaked behind the scenes to achieve this. Don't worry if this is confusing, as it will give you your intended result!

If a ratio of infinity is chosen in VCA mode, Feedback % has no effect as it is not possible to have an infinite ratio with any amount of feedback, in any compressor design.
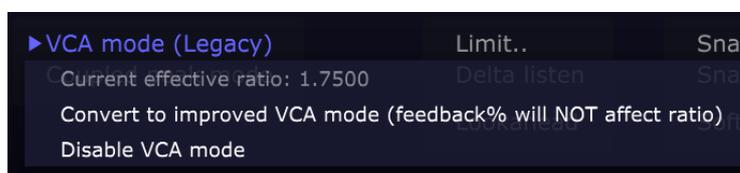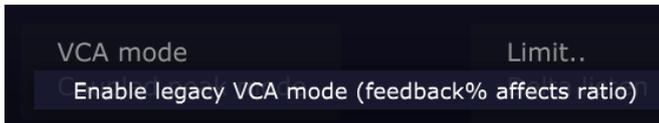
A note on the "Legacy" VCA mode
In the original VCA mode, changing the Feedback % **would** affect the true or "effective" compression ratio that you would end up with. This is not necessarily wrong, as in older, analogue designs, the ratio was often changed by adjusting the amount of feedback. But, for improved workflow, this was changed in version 2.1 of Fircomp 2. Presets, projects, or settings that used this original VCA mode will now load in "VCA mode (Legacy)". Left clicking on the "VCA mode (Legacy)" button will provide a menu with three entries:

- **Current effective ratio** will display the calculated "true" ratio that you will have in effect in the legacy mode, given the selected ratio and feedback you have chosen.
- **Convert to improved VCA mode** will convert your settings to the closest possible settings in the new mode. **Note that the settings may not be identical, and may not null**, but should sound very close.
- **Disable VCA mode** keeps your chosen settings, but disables any kind of VCA mode.

Should you wish, you can **enable** the legacy VCA mode by **right** clicking on the VCA mode button when it is **not** enabled. However, there is no advantage to doing so, as the new mode uses an identical topology and design to the legacy mode, but with intelligent selection of true feedback and ratio behind the scenes.
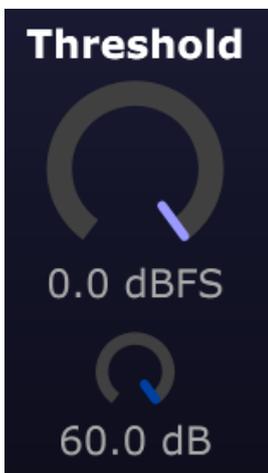
Threshold

This is a standard compression threshold control in dBFS. The threshold rotary control also displays an angular meter for convenience: this is a peak meter depicting the signal level going into the gain computer. In the standard peak modes, this is a peak meter, but in VCA mode the level of this meter is more of an average (depending on attack and release times), due to the difference in VCA topology. (It is also **not** the same as the input peak meter on the right hand side, as it is post SC filtering and linking, and post attack-release in VCA mode, and displays the max of both channels). If the sidechain signal is external, it will show the external signal.

Max compr *(below Threshold)*

This control limits the amount of gain reduction that takes place. The angular peak meter shows the maximum of both channels' gain reduction currently taking place. Note that this does **not** "scale" the gain reduction, it is simply a hard cap. (If you are looking to scale the gain reduction, use the Wet % control instead, which is mathematically equivalent).

The Limit button / menu

In versions of Fircomp 2 prior to 2.1, the Limit button was a switchable meta-parameter, which when clicked would immediately change other Fircomp 2 parameters so that the compressor would operate as a hard limiter.

If clicked again it would return to the last known non-limiting settings, but these settings would be immediately forgotten if anything else was changed.
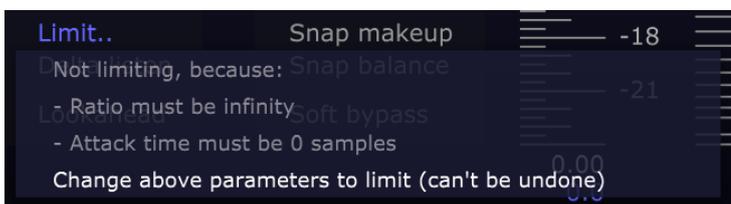
In versions 2.1 and newer, the Limit button / menu has been updated as it was causing confusion. The limit button will still light up if you set all of the other parameters yourself to be hard limiting. But otherwise, clicking on the limit button (when not limiting) will now show a list of parameters that need to be changed in order to hard limit. You can then either change these parameters yourself, or click on "Change above parameters..." to have them automatically changed for you.
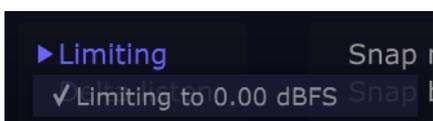
When the parameters *are* set to limiting, the button text will be highlighted and change to the word "Limiting". If you click on this button, it will tell you the value that samples are limited to (which depends on threshold and makeup).

Note that Fircomp 2 is designed as a CPU efficient low-latency track plugin, and does **not** detect inter-sample peaks, otherwise known as true peaks. Limiting only guarantees that sample values do not exceed the threshold. Fircomp 2 is primarily designed as a compressor, but its peak detection design made it easy to add basic limiting functionality.

What if I want to quickly compare limiting / not limiting, as I could in older versions?
In older versions of Fircomp 2, you could quickly compare limiting / not limiting settings by repeatedly clicking the Limit button. This has now been removed for confusion, but instead if you would like to be able to do this, the suggested method is via the A B C D buckets (see above).
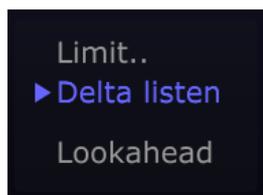
Delta listen
When enabled, this allows you to hear the *difference* between the dry and compressed (before makeup & MU balance) signals. This is useful for de-essing etc.

If you enable "SC listen" this control will be disabled. If you are in mid / side mode, the delta you hear will still give you the difference between dry L/R and compressed L/R after mid/side compression has taken place.
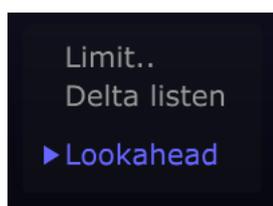
Lookahead
This control enables lookahead, which has a very similar lookahead implementation to Fircomp 1. This incurs a small amount of latency which is reported to your host. For most situations lookahead is not necessary - but you should enable it when you start to hear any distortion or artefacts that you don't like.

What is Lookahead and how is it implemented in Fircomp 2 (and 1)?
The term "lookahead" is actually a poor description of what actually happens behind the scenes for correctly implemented lookahead in a digital compressor. The objective of digital lookahead is to reduce distortion which occurs from very fast amplitude modulation. Low-order smoothing filters used for attack and release behaviour (in almost all compressors) give the most natural sounding attack and release timings, but even at slow settings they do only an "ok" job at smoothing out amplitude modulation in the gain reduction signal. So we apply a steeper, linear phase filter to the gain reduction itself, at the very end of the sidechain signal, in the linear domain, right before multiplication. We also have to do some clever stuff near the beginning of the sidechain to prevent the release starting too early, and add a delay to the audible path to match the latency of the lookahead filter. This lookahead filter is **not** applied in the audible path and you cannot hear it at all (in fact, it would sound quite bad if you could hear it in the audio, as the lookahead filter is implemented differently to a linear phase EQ filter). Instead, all you hear is less distortion when compressing aggressively, and possibly also that some transients may become less punchy or clicky under some circumstances.

In any digital compressor, how do I know if lookahead is implemented well?
For any compressor plugin (or digital hardware compressor), simply compress a test signal with fast time constants (ideally the fastest possible attack and release) and measure the difference in distortion when lookahead is enabled vs when lookahead is disabled. There should be significantly less distortion when lookahead is enabled. This can be done either with a 1kHz sine wave, or if you have the software tools, a full sweep analysing THD and / or IMD.
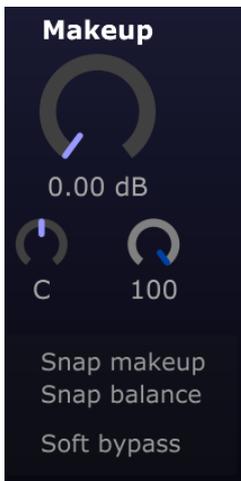
Makeup

This is the makeup gain control in dB. It is only applied to the compressed signal: the dry signal (when using dry / wet mix) is not affected by makeup gain. The angular meter on the makeup rotary control shows the max of the two channels' perceived loudness gain reduction estimation over approximately the past 3 seconds. (This value is also used to calculate the MU balance suggested value, to match the balance of the input and compressed signals). Note that if you are using very short attack times, this makeup estimate may be too high. You can always check whether it sounds right by toggling the "Soft bypass" button.

The **Snap makeup** button below the makeup gain control changes the makeup gain to the perceived gain reduction amount over the past 3 seconds. You should click on this after compression has been taking place for a short while and has "stabilised". As always, this is just an estimate and you can check whether it sounds right with the "soft bypass" button.

The **Snap balance** snaps the balance of only the additional makeup gain added, in order to match the balance of the input signal, using the same perceived gain reduction method as for the meter on the makeup gain control. See **The stereo controls** section above for more details on this.

Wet % *(Bottom right of Makeup control)*

The default of 100% on this rotary control gives you only the compressed signal, as you would expect. Turning this down allows you to mix in some of the dry signal (makeup gain and makeup balance have no effect on the dry signal). A common use example would be to over-compress by an extreme amount, apply makeup gain so that the dry and compressed signals have the same perceived loudness, and then mix in a small amount of the wet signal. But you can try whatever you like!

Soft bypass

This bypasses the entire plugin, but preserves the same latency (if lookahead is enabled) and still shows the gain reduction meters as if the plugin was enabled (ie, the compression algorithm is still running, but bypassed).

Meters, and the meters popup menu
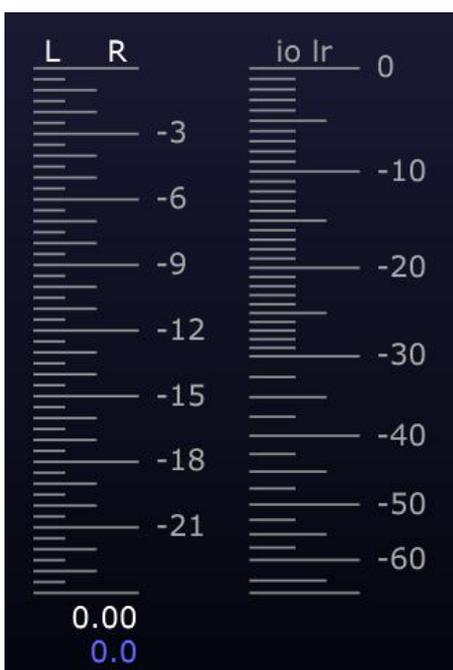
By default, Fircomp 2 shows a vertical **gain reduction** meter, alongside dry, and compressed-plus-makeup meters. The meter types are peak, peak hold, and k-weighted LUFS-SL. The meter calculations are carried out in the audio / DSP thread, but are disabled when the GUI is closed. Therefore, when the GUI is open, your DAW's CPU / DSP meter will show slightly higher usage, even though DAW CPU / DSP meters do not show GUI CPU use.

The **"io lr"** or **"io ms"** meters show the dry signal on the left hand side, and compressed-plus-makeup signal on the right hand side. In mid / side mode, these are mid / side meters. This has the advantage of allowing you to match input and output levels visually, but the slight disadvantage of not being able to see standard left & right output levels in mid / side mode. The peak value readouts (same colour as the peak bar in your theme) show max(L, R) or max(mid, side) for the either input or output, depending on the "readouts" menu setting (see below). The output levels are calculated using the compressed signal **before** makeup gain is

applied, but then makeup gain and makeup balance are added instantly to the result, so that these calculations can be reused for perceived gain reduction. This has the slightly unusual side effect of meaning that adjusting the makeup gain control will change the output meter readouts immediately, but makes it quicker and easier to visually match levels.

The **gain reduction** meter shows the peak gain reduction amounts, alongside the perceived gain reduction amounts calculated using the values from the input & output meters. The perceived gain reduction amount meter may sometimes "wobble", as it measures the difference between two longer-running average levels which become less meaningful as the input signal starts to decrease in volume. The perceived gain reduction meter is **not** a reflection of the actual gain reduction (which is shown by the peak meters), but aids in suggesting makeup gain amounts. The gain reduction meter also changes depending on whether mid/side is enabled: it matches the stereo mode. Both the peak and perceived gain reduction value readouts display max(L, R) or max(mid, side).

Clicking on any of the level meters brings up the meter popup menu:
- **Big GR meter / Small GR meter:** Toggle between the standard vertical gain reduction meter, and the big horizontal gain reduction meter. When the big horizontal gain reduction meter is enabled, the vertical gain reduction meter is hidden and the dry and compressed-plus-makeup meters take their place. (The plugin window becomes narrower and taller).
- **GR right to left / GR left to right:** Only makes a difference when the big horizontal gain reduction meter is enabled. Affects whether the meter travels from right to left or from left to right.
- **Range:** Set the range of the gain reduction meter. Affects both the horizontal and vertical modes.
- **Input level readouts / Output level readouts:** Changes the numerical value readouts at the bottom of the "io lr" or "io ms" meters to either give the input (dry) values, or the output (compressed-plus-makeup) values.

Thanks and acknowledgement

Fircomp 2 uses the juce framework for the GUI and cross-platform support:
https://juce.com/

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bManic
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Rojh
Nantho
Nil
Vas
Lesha
Kirke
David
Heath
Richard

...plus thanks to everyone else who gave valuable feedback on Fircomp v1!