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The control window of the Waves C1 Compressor/Gate

Chapter 1 - About the C1

The Waves C1-Compressor/Gate is a studio-quality stereo dynamics processor and a "parametric compander". The C1 is also a fully featured dynamic filtering processor capable of many unique effects including sound sweetening, enhancement applications, and applications requiring correction of sound quality problems. For maximum flexibility and efficiency, the C1 breaks into smaller components, such as the C1comp and C1gate, or the C1c/sc (comp with sidechain). This lets you choose exactly the dynamic tool needed for the job you have. The C1comp and C1 gate (which don't have sidechain or lookahead) now can be used at 88.2/96kHz on some native platforms.

The C1 is designed for optimal subjective sound. While it is rich in features and functionality, and can do many things unavailable on any other dynamics processor (whether analog or digital) on the market, the design is based on features that sound good to the ear.

The C1 - in brief

The C1 consists of three independent stereo processing modules that can be used together in many different ways:

• Compressor/expander module
• Gate/expander module
• Filter/equalization module

The compressor/expander module (**Comp/Exp**) is capable of operating as a high-level compressor, a gentle high level expander, or as a mid-level compressor whose compression can be "tuned" at any user-chosen signal level. This module also has a unique cancellation dynamics mode for cancelling out very high-level sounds.

The gate/expander module (Gate/Exp) is capable of operating as a fully-featured expander or gate. It can also be used to take lower level signals and "compress them upwards".

The filter/equalization module (Filter) has a variety of filtering capabilities for many different kinds of processing, from conventional sidechain dynamics processing to a unique bandsplit dynamic EQ mode. This bandsplit configuration allows compression, expansion, or gating of any desired frequency band.

Each module can be set for different operating modes, plus various combinations can be used for efficient use of your processing power. For example, the Comp/Exp can perform wideband dynamic processing while the Gate/Exp module gates only the high frequencies (hiss gate). Another example would be using the compressor for bass compression while the Gate/Exp module gates rumble.

C1 Component plug-ins

On most host applications and platforms, you can select just the audio processing you need and use only the power necessary to do the job. The C1 has several plug-in components in the menu, and most have mono and stereo options.

Each has their own separate Factory Presets and User Presets. Information on each of the Factory presets will be in the C1 documents installed onto your hard disk. For more information about Component plug-ins, read the Component chapter in the WaveSystem Manual.

As of this printing, here are the current components; new ones may be added in future updates, and will be noted in the plug-in Read Me file. Some examples for each component are listed.

- **C1comp** — a wideband compressor/expander, no sidechain; *(voice or instrument, individual track compression, gentle soft-knee mastering, 'uncompression' by soft-knee upward expansion, soft-knee limiting)*

- **C1gate** — a wideband gate/downward expander, no sidechain; *(track gating, smooth voiceover downward expander, gate hold, low-level compression)*

- **C1c/sc** — compressor with sidechain or split-band compression; *(HF limiter, LF limiter, de-esser, de-popper, sidechain drum gate, any-Frequency limiter/compressor/expander, no-pump sidechain mastering compressor)*

- **C1comp/gate** — compressor and gate, wideband, when sidechain is not needed; *(voice or instrument, general "outboard" application, track insert)*

- **+C1c/g** — the "full" plug-in, with compressor, gate, sidechain EQ, and IDR; *(precision sidechain mastering dynamic tool, multi-band multi-function processor, wideband comp with HF gate, simultaneous compression and upward presence enhancer, any frequency-specific "compress up" tools*

- **C1c/g** — same as +C1c/g, except without IDR.

The Setup Library

For extensive control and fast setups, the C1 system includes an extensive Setup Library. It will take you directly to the essence of the C1. You can also use it as quick starting points in your work and as a tutorial for the features of C1. Waves strongly encourages you to try the Setup Library. A list of all setups in the library is included in Appendix A at the end of this User's Guide.

Included in this book is the C1 Setup Guide which consists of extensive documentation written by Michael Gerzon, including his highly insightful tips on every aspect of the C1. If the C1 seems a bit daunting, check the Setup Guide for a more application-specific approach.

Chapter 2 - About the compressor/expander

In the menu, you'll have a "C1comp" option, which is the Comp/Exp module by itself, with no sidechain control. The EQ Mode button is omitted when C1comp is used.

The Comp/Exp module is a soft knee variable-ratio processor which at maximum compression becomes a soft-knee limiter. The softness of the knee has been designed to reduce limiter gain about 3 dB at the limiting threshold.

The dynamic processor is unusual in two respects. First, for moderate compression ratios, the actual dynamic curve compresses over a range to about 20 or 30 dB above threshold, rather than extending the range indefinitely high. As explained below, this is much more flexible than a conventional compressor, while still allowing conventional use when working within 20 or 30 dB above threshold.

Second, an extended ratio control range permits (1) controlled high-level expansion by using ratios of between 0.5:1 and 1:1 and (2) a unique high-level "cancellation" mode beyond limiting, displayed as a *negative* compression ratio. Very high level signals well above threshold can be nearly cancelled out completely by using these *negative ratios.*
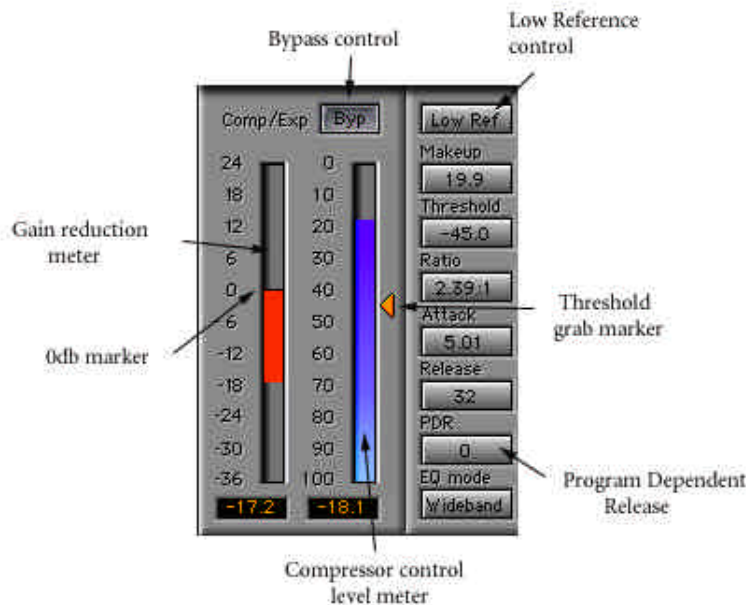
Bypass control

This switches the module's processing in and out. Shows **Bypass** when the module is out.

Level reference control

This has no effect on the sound but affects the output level and how the makeup control works:

LowRef mode [Low-level reference]. This is the conventional mode for compressors, in which the output drops as the threshold is lowered (and more gain reduction occurs).

PeakRef mode [Peak-level reference]. This permits easy adjustment of the Comp/Exp when you want to keep peak levels approximately the same. For example, when in PeakRef mode, as you lower the Comp/Exp threshold, the output gain increases, keeping the output level approximately the same.

Makeup gain

This is the traditional "output" level of the Comp/Exp module and is calibrated in dB, ranging from -40 dB to +40 dB.

Threshold

Calibrated in dB below 0dBFS (Full Scale digital). This is the input level above which the soft knee compression/ expansion starts acting to a significant degree. Adjust the **Threshold** by clicking and dragging on this Value Window, by dragging the triangle-shaped **grab marker** next to the Comp/Exp control level meter, or by dragging the upward-pointing **grab marker** under the input/output graph. (See illustration on next page.) You can change the Threshold by clicking and dragging on the Value Window, by direct numeric entry, or with the up/down arrow keys.

click and hold any Value Window, then drag up/down to change value
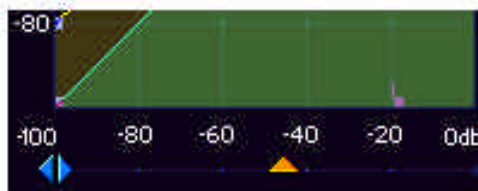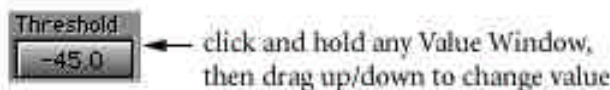
This grab marker is another way to control Threshold. Drag left or right.

Ratio

This control adjusts the compression (or expansion) ratio in the region above threshold. A ratio of 1:1 corresponds to no compression, whereas approaching 50:1 corresponds to a soft-knee limiter. Ratios between 0.5:1 and 1:1 give high-level expansion. Ratios in the control range above 50:1 are shown as negative values between -50:1 and -5:1. This mode is termed "cancellation" mode and is useful for cancelling out unwanted very loud signals while retaining quieter ones. Cancellation mode can result in dynamics that sound very odd, but it does have a number of uses explained later in the manual. You can also change the Ratio by clicking and dragging on the Value Window, by direct numeric entry, or with the up/down arrow keys.

Attack

Calibrated in msec. Adjusts the attack time of the Comp/Exp with time constants from 0.01 msec to 1 second. You can change the Attack by clicking and dragging on the Value Window, by direct numeric entry, or by the up/down arrow keys.

Release

Calibrated in msec. Adjusts the release time of the Comp/Exp with time constants from 1 msec to 10 seconds. You can change the Release by clicking and dragging on the Value Window, by direct numeric entry, or by the up/down arrow keys.

PDR (Program Dependent Release)

This control allows the release time to vary according to program content. When set to the lowest value, release time is fixed at the value shown in the release window. You can change the PDR by clicking and dragging on the Value Window, by direct numeric entry, or by the up/down arrow keys.

At higher settings, release time is shortened for short-duration transients; a slower release is used for longer duration signals.

The PDR calibration in milliseconds is a rough indication of the length of transients <u>below which release time will be shortened</u>. Thus for a PDR of 150ms, transients shorter than about 150ms will have a shortened release time. For transients longer than 150ms, the release time is the one specified by the **Release** control.

EQ Mode switch

The EQ Mode switch is only available when sidechain is used and therefore is not seen in the "C1comp" component interface.

This has three modes: *Wideband, Sidechain* and *Split.*

In **Wideband** *mode*, the Comp/Exp operates as a conventional wideband compressor.

In **Sidechain** *mode*, the sidechain audio signal used to control the dynamics is first passed through the filters in the EQ module to make the dynamics respond only to a defined frequency band in the audio.
In **Split** *mode*, the sidechain audio signal is filtered, but the main signal is also split into two complementary bands: the

active band (whose frequency response is shown in red on the graph) and the *passive band* (shown in blue on the graph). Only the active band is subjected to the Comp/Exp, and the passive band is not dynamically processed in any way. By this means, a dynamic equalizer, whose action is confined to the active band, is obtained.
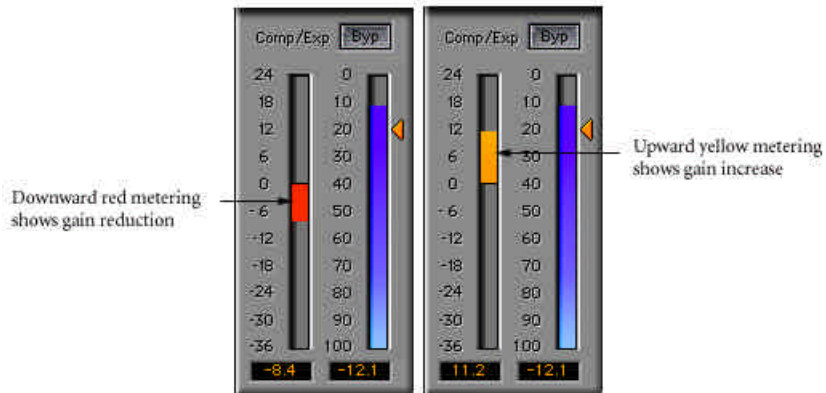
Gain reduction Meter

This shows the instantaneous gain reduction in dB (in red below 0 dB) or gain increase in dB (in yellow above 0 dB) of the Comp/Exp. The meter does not show the effect of makeup gain.

The value window above each meter in C1 shows the largest absolute peak since the last 'reset' of the meter. To reset any peak numeric meter, click directly on the peak value itself, or its meter bar.

> **Note:** When in PeakRef mode, the Gain reduction meter will show the *actual gain change for the signal*. This may be a bit confusing at first. For instance, if you are compressing a signal while in PeakRef mode, the peaks will be kept about the same if Makeup is set to 0.0dB. The Gain meter will show a *positive value*, indicating the amount of the gain increase necessary to keep the peaks about the same. Conversely, if you are expanding, then the meter will show how much the gain is reduced to keep the peaks about the same.

Comp/Exp control level meter

This blue meter shows the *sidechain* signal level that controls the Comp/Exp. The meter time constants match the Comp/Exp attack and release times. The threshold can be conveniently adjusted by dragging the small triangle **grab marker** beside this meter.

Chapter 3 - Gate/Expander module

About the Gate/expander

In the menu, you'll have a "C1gate" option, which is the Comp/Exp module by itself, with no sidechain control. The EQ Mode button is omitted when C1gate is used.

The Gate/Exp processor is operable in two modes: (1) as a soft-knee low-level expander for gentle reduction of low-level signals, or (2) as a gate including hold and hysteresis adjustments for well-behaved gating of low-level signals.

The Gate/Exp has a full range of adjustments which are independent of those in the Comp/Exp module, although, as explained later, some of the controls of the two modules may optionally be linked together for ease and speed of adjustment.

The extended floor control range is unique to this gate/expander. It permits not just a controlled degree of gain reduction below threshold, but even an increase in gain for low-level signals, which can create a low level compression effect when needed. This is the low-level compressor mode. In addition, Negative Floor values (indicated by a capital 'N' after the value) are for gate cancellation mode. This is useful in *split modes* for single-ended dynamic noise reduction, explained later in this manual, and even more extensively in the C1 Setup Guide.
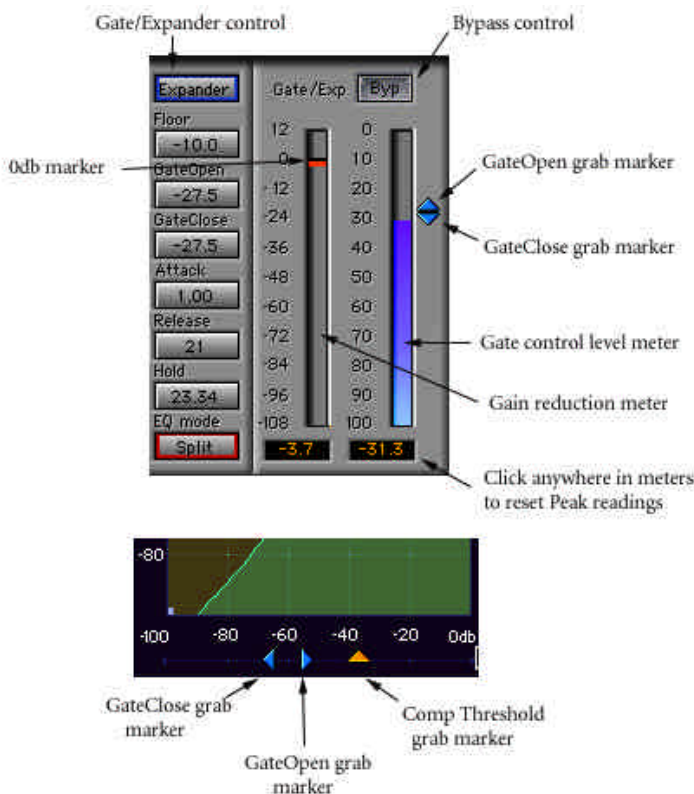
Bypass control

This switches the module's processing in and out. Shows **Bypass** when the module is out.

Gate/expander control

You can switch the mode of the Gate/Exp module to either *Gate* or *Expander.*

Floor

Calibrated in dB. **Floor** adjustment allows some signal to remain in order to avoid a complete signal cutoff. This adjusts the amount of residual signal gain at low levels when the gate is closed or the expander is at large gain reductions. When **Floor** is set to *-infinity dB*, essentially no signal is left at low levels. When set to 0 dB, the signal is unchanged at low levels. When set to positive gains, up to 12 dB, the signal level at low levels is actually increased, creating a low-level compression effect whereby quiet signals are increased in level. This low-level compression effect is particularly useful in the soft-knee expander mode.

In expander mode, the **Floor** control also goes beyond the *-infinity* setting to negative polarity settings (-100 N to -10 N). This is indicated by a negative number of dB followed by the letter N to indicate "negative polarity". This gives the expander a steeper expansion ratio below threshold, and of cancels sounds out completely when they are the indicated number of dB below GateOpen threshold.

Adjust **Floor** by clicking and dragging on the Value Window, by direct numeric entry, or with the up/down arrow keys.

Gate Thresholds

The two gate thresholds of the C1 allow you to adjust settings to minimize gate "chatter", the rapid opening and closing of the gate when signals are near the gate threshold.

GateOpen

Calibrated in dB below OdBFS. When in the *Gate mode*, **GateOpen** is the input threshold level above which the gate is opened to let the signal through. When in the *Expander mode,* **GateOpen** is the level at which soft knee expansion starts acting to a significant degree.

Adjust **GateOpen** threshold by dragging the upper equilateral triangle marker next to the Gate/Exp processor control level meter, or by dragging the right equilateral triangle marker under the input/output graph. You can also change **GateOpen** by clicking and dragging on the Value Window, by direct numeric entry, or with the up/down arrow keys.

GateClose

Calibrated in dB below OdBFS. In gate mode, **GateClose** controls the level below which gate is closed to stop signals from getting through. It is not used in expander mode. GateClose level is always equal to or less than GateOpen level.

Adjust **GateClose** by dragging the lower equilateral triangle marker next to the Gate/Exp control level meter, or by dragging the left equilateral triangle marker under the input/output graph. You can also change **GateClose** by clicking and dragging on the Value Window, by direct numeric entry, or with the up/down arrow keys.

> **Note:** In the expander mode of the Gate/Exp module, the **GateClose** and **Hold** controls have no effect, and the **GateOpen** control acts as a threshold control for the point where expansion action begins.

Attack

Calibrated in msec. Adjust the attack time of the expander/gate with time constants from 0.01 msec to 1 second. This adjustment is independent of the Attack time in the Comp/Exp module, although the two can be linked as described below. You can also change **Attack** by clicking and dragging on the Value Window, by direct numeric entry, or with the up/down arrow keys.

Release

Calibrated in msec. Adjust the release time of the expander/gate with time constants from 1 msec to 10 seconds. This adjustment is independent of the Release time in the Comp/Exp module, although the two can be linked as described below. You can also change **Release** by clicking and dragging on the Value Window, by direct numeric entry, or with the up/down arrow keys.

Hold

Calibrated in msec. This control adjusts the length of time during which the gate is guaranteed to be held open.

Hold is particularly useful in creative gating applications in order to allow a fixed duration of a gated sound to be heard. It should be set at a low value unless you wish to guarantee a minimum duration of unprocessed transient to be let through. Please note that when the Gate/Exp module is in expander mode, **GateClose** and **Hold** controls have no effect.

EQ Mode switch

The EQ Mode switch is only available when sidechain is used and therefore is not seen in the "C1gate" component interface.

This has three modes: *Wideband*, *Sidechain* and *Split.*
In **Wideband** *mode*, the Gate/Exp operates as a conventional wideband gate or expander.

In **Sidechain** *mode*, the sidechain audio signal used to control the dynamics is first passed through the filters in the EQ module to make the dynamics respond only to a defined frequency band in the audio.

In **Split** *mode*, the sidechain audio signal is filtered, but the main signal is also split into two complementary bands: the *active band* (whose frequency response is shown in red on the graph) and the *passive band* (shown in blue on the graph). Only the active band is subjected to the Gate/Exp, while the passive band is not dynamically processed in any way. By this means, a dynamic equalizer, whose action is confined to the active band, is obtained.

When using the full C1comp/gate with sidechain, the EQ mode of the Comp/Exp module and the Gate/Exp module may be chosen independently of one another. For example, you can combine a wideband compressor with a high-frequency gate.

Gain reduction Meter

This shows the instantaneous gain reduction in dB (in red below 0 dB) or gain increase in dB (in orange above 0 dB) of the Gate/Exp dynamic processor.

Gate/expander control level meter

This shows the level of the signal controlling the processor (wideband or sidechain EQ). The meter time constants match the Gate/Exp attack and release times. As you adjust the GateOpen level, this meter shows the Peaks of sidechain signal.

Linking controls in the two dynamics modules

Certain controls of the two dynamics modules can be operated simultaneously, for ease of adjustment, by clicking the button between them.

These pairs of controls include:
- Threshold/GateOpen
- Attacks
- Releases
- EQ Mode

For more information on changing multiple controls at the same time, see the **WaveSystem Manual**.

Chapter 4 - The filter module

About the filter module

The filter module is used in the full "C1 comp/gate" and "+C1" components. Future components may be added with more sidechain control. Details will be in the Read Me file of any updates.

The C1 filter module splits the audio band into two complementary bands, **active** and **passive**. A graphical display shows the frequency response of the active band (in red) and the passive band (in blue), except when both processors are in wideband mode (when the filter module is not used).

Adjust the characteristics of the active and passive band by changing the filter controls: **Frequency** and **Q** (bandwidth). The active band may be any of four types of filters: bandpass, lowpass, high-pass, or bandreject.

These filters have rapid crossover rates. For example, bandpass or bandreject sidechain filters crossover at at least 18 dB per octave, and low and high pass at 36 dB per octave.

When used to bandsplit the audio signal, these filters are restricted to a Q of 0.6 or less to avoid the audible colorations associated with higher Q's. However, with a unique Waves phase compensation technology, the filters achieve good interband separation. They completely avoid frequency-modulation of the audio when used in bandsplit mode in order to avoid "out of tune" pitch shifting effects.

> **Note**: The frequency response graph is that of the more moderate Audio band filter. The SideChain filter in sidechain mode is always 3/2 times steeper than the audio filter in split mode.

Active band is red   Passive band is blue
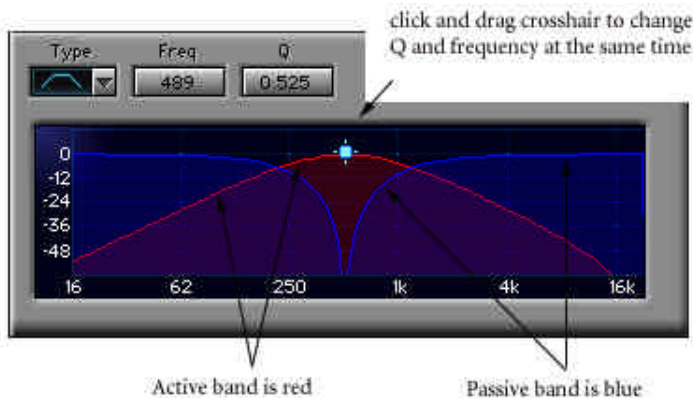
Type

This selects whether the active band is *bandpass, band reject, high pass,* or *low pass,* and the button itself displays a schematic picture of the active filter response. The passive filter is of complementary type, passing bands which the active filter rejects and rejecting bands which the active filter passes.
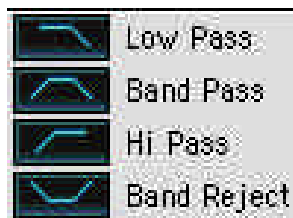
Frequency

Ranges from 16 Hz to 21 kHz. When *bandpass* or *bandreject* are selected, this is the center frequency of the respective pass or reject bands. When *low pass* or *high pass* types are selected, this is the crossover frequency between the two bands. Change the **Frequency** by clicking and dragging on the Value Window, by direct numeric entry, or by dragging the crosshair in the Filter graph to the left or right.

Q

Ranges from 0.1 to 0.6. In bandpass or bandreject filter types, **Q** controls the width of the band. The band is narrowest for highest Q. For low and high-pass filter types, **Q** determines the steepness of filter cut-offs. The cut-offs are steepest for the highest Q. Change the **Q** by clicking and dragging on the Value Window, by direct numeric entry, or by dragging the crosshair in the Filter graph up or down.

You can simultaneously control both **Q** and **Frequency** in the Filter graph by dragging the crosshair in the desired directions (left/right for Freq, up/down for Q).

> **Note:** The C1's **Q** calibration is the engineering textbook definition, which is different than the Q calibration found on normal audio parametric equalizers, such as the Waves Q10. Do not expect similar Q numbers for similar filtering in the C1 and Q10.

Chapter 5 - Other controls and I/O metering

About lookahead

Lookahead is not available in all C1 component plug-ins (which saves quite a bit of processing power). In this way, you use it only if you need it. It is included in any C1 component that has built-in sidechain support, that is to say, sidechain that is part of the plug-in itself, not part of the application, such as +C1, C1c/sc, etc.)

Lookahead processing is a method of delaying the audio signal with respect to control signals in order to minimize transient distortion caused by dynamic processing. It avoids premature cut-off of transients of gated signals, minimizes transient overshoot on compressed signals, and allows the use of longer attack times without unwanted side effects.
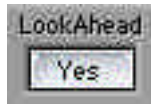
The *lookahead control* allows both dynamic processors to be operated with or without control signal lookahead. (The normal mode in most analog dynamic processors is without any control signal lookahead). **Lookahead** is a simple Yes/No switch with no other user controls. Lookahead time is automatically adjusted separately for the Comp/Exp and for the Gate/Exp module according to the attack times set up on each. At the 44.1 kHz audio sampling rate, the maximum lookahead time is approximately 7.5 milliseconds (the delay is exactly 340 samples, regardless of samping rate).

The use of lookahead generally means that longer attack times may be used without transient shape distortion becoming serious, even in gating applications. Such longer attack times result in lower nonlinear distortion and a cleaner sound. Note that lookahead processing does *not* affect the timing of signals from the start of a destructively processed sound file; therefore, you'd need to select at least a little before your audio to ensure the proper lookahead behavior. If the attack time is 14ms, extend your selection prior to the audio start by at least 14ms, etc.

Generally, you can use lookahead in all dynamic processing, unless you want the particular sound of modified transients obtained without lookahead. Sometimes, modified transients may be desired. For example, modified transients are effective when you want to gate an unwanted initial transient or to make the sound of sibilants bright when compressing speech.

But in compression applications, lookahead processing generally creates lower peak levels than nonlookahead processing, which makes lookahead processing the better choice when you want to maximize signal levels.

Limitations in available memory for lookahead mean that for longer attack times, especially above 15 or 20 msec, the lookahead mode is not as effective, although there is no reason not to use it.

About the input/output graph

This graph shows the relationship between input and output levels for both the Comp/Exp and Gate/Exp modules. Both input and output scales are calibrated in dB from 0 to -100 dBFS. Input level is the horizontal scale, and output level is the vertical scale.

The input/output graph is particularly useful for visualizing the effect of the processing on signal dynamics, and for adjusting the processing. It includes metering of control levels for the Comp/Exp and Gate/Exp processor, displayed on the curves to aid in processor setup.
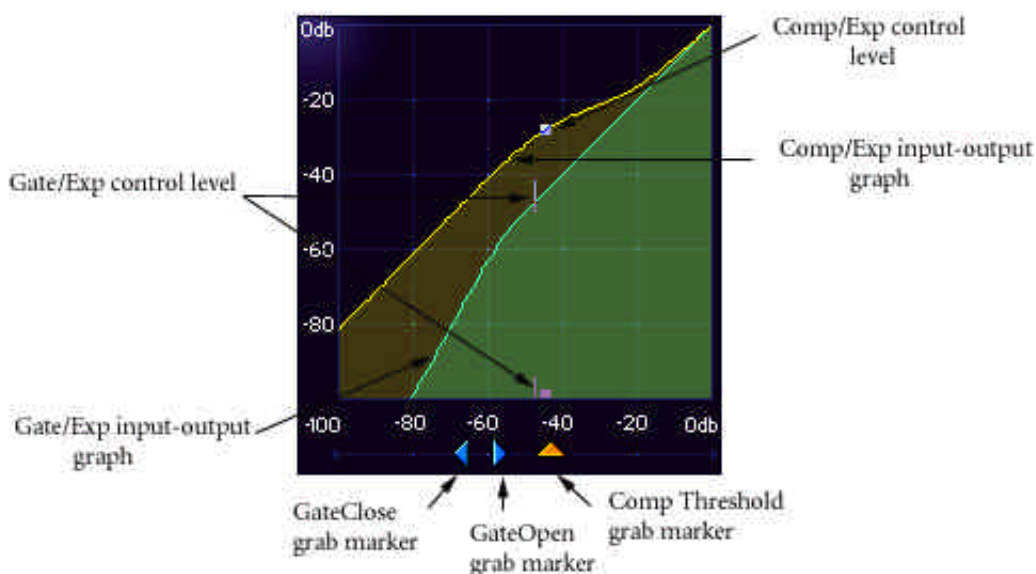
Comp/Exp display

Onscreen, the yellow curve shows Comp/Exp output level versus input level (depending on the EQ mode, this 'input level' will be the wideband or the sidechain level). Riding on the curve is a small square indicator showing the instantaneous level to which the Comp/Exp is responding. This provides an instant visual display of the actual effect on signal dynamics. To make adjustment of the threshold easier, a duplicate of the square moves along the lower edge of the I/O graph. Also on this lower edge is an upward-pointing yellow triangle. Drag it to adjust the threshold.

Gate/Exp display

The light blue curve shows the gate/expander processor output level versus input level (depending on the EQ mode of the processor, this 'input level' will be the wideband or the sidechain level). Riding on the curve is a small vertical line showing the instantaneous level to which the Gate/Exp is responding. This provides an instant visual display of the actual effect on signal dynamics. To make adjustment of the threshold easier, a duplicate of the line moves along the lower edge of the I/O graph.

Also on this lower edge, below the Gate/Exp's yellow threshold triangle, are two small blue triangles. Drag them to adjust the GateClose and GateOpen. As you drag the GateOpen, GateClose will follow it, maintaining the difference in dB you have set. For easy adjustment, click and drag GateOpen upward, pulling GateClose with it, until the gate opens the way you wish. Then, drag GateClose back down a few dB to create a hysteresis. This helps to avoid gate 'chatter'.

All three markers—Comp Threshold, GateOpen, and GateClose—may be adjusted up and down together by selecting all three and then dragging any one of them.

Keying mode

Stereo C1 components have keying modes, allowing one channel's energy to control the other's dynamics, or "key" it. Common applications are **ducking** and **gating**. **Ducking** reduces the gain of one signal when the other is above a threshold. It is normally used to make a background sound quieter when a foreground sound must be heard over the background. **Keyed gating** is essentially one signal controlling the gate of another. It is commonly used to gate a bass track with the kick, or to gate a continuous musical track with a percussion track in order to achieve a creative synchronized effect.

The Key button has three modes: Stereo (normal), L->R, and R->L. Click the button to cycle through the modes.

> **Note: In some platforms, to use the keying mode when processing destructively, you should select the channel you want Keyed, and that channel only.** In other words, do NOT select both Right and Left channels! When you Process in this mode, the channel you have selected will be Processed! If you have both channels selected, the 'keying' channel may be rewritten with silence. Therefore, if you still want to have the channel that is doing the Keying in the file after processing, make sure you have selected only the channel you want processed (the one being Keyed).

Stereo   **Left keys Right**   **Right keys Left**

Monitor switch

This allows audible monitoring of sidechain filtering and of the frequency processing. It controls what is heard at the output. Click the button to cycle through the three modes:

• Audio

Monitors the final output of the C1 dynamic processor and is the normal processing mode.

> *Note: When Key Mode is in L->R or R->L mode, only the keyed channel is heard.*

• Sidechain

If either processor is in split or sidechain mode, this allows you to monitor the equalized sidechain signal. (When both processors are in wideband mode, the wideband audio sidechain signal is heard.) This is very useful in de-essing or noise filtering applications in order to more easily tune the sidechain filtering for optimal processing. Note: When Key Mode is in L->R or R->L mode, only the keyed channel is heard.

• Passive (unprocessed)

If either processor is in split mode, this allows you to monitor the sound of the passive (unprocessed) band, so that the effect of the processing is heard when the dynamic processor is at maximum gain reduction. This is useful in de-essing or noise filtering applications in order to listen to the frequency effect from the maximally processed signal.

Input and Output Levels

Adjust the input levels of either stereo channel by clicking the Input Value Windows and dragging with the mouse, entering values directly from the keyboard, or tweaking with the up/down arrows.

Adjust the output level by dragging the Output fader with the mouse, entering values directly from the keyboard, or tweaking with the up/down arrows.

Chapter 6 - Basics of operation

Use what you need

Select the C1 component for the job; this saves processing power and processing time. If you need a vocal compressor, then the C1comp is probably all you need. For a "hiss gate", you'll have to have the Gate with Sidechain, such as in the full C1 comp/gate or the +C1.

Not all possibilities will be discussed in this chapter. Some of the examples assume you're working with the full C1, but the controls are still the same, and most examples will apply to smaller components.
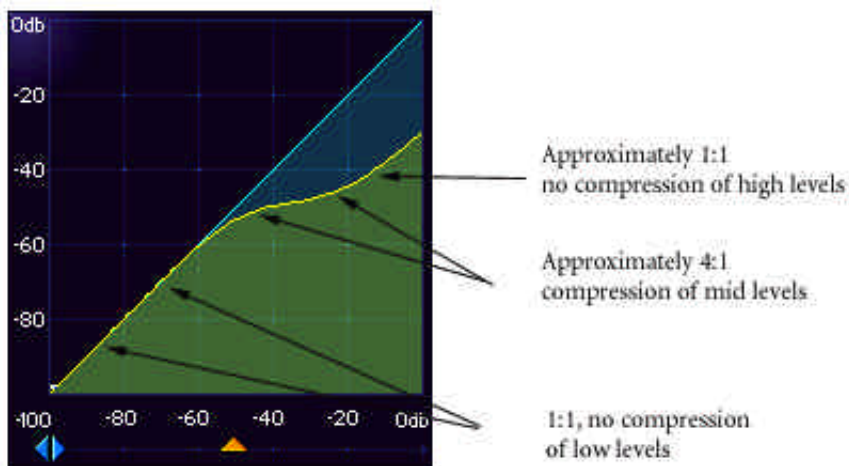
The Compressor module

To use only the basic compressor module, select the "C1comp" plug-in. If you're using the full C1 for this example, remember to set both **EQmode** switches to **Wideband** and the **Gate/Exp** bypass switch to **Bypass**. Make sure that the compressor module is not in Bypass mode.

Unless a special sound is desired, set the **Lookahead** switch to **Yes**.

Normally, set both input levels to maximum (0 dB), since this will never cause internal clipping problems in wideband mode. The input level adjustments are mainly useful for correcting channel imbalances (or intentionally creating them), since the output level fader can be used for overall level adjustments.

The C1 Comp/Exp module default settings are for basic compression. The ratio can be adjusted from 0.5:1 (expansion) to 50:1 (limiting). Beyond the 50:1 ratio are *negative ratios*, part of the unique *cancellation* mode of the Comp/Exp module.

Another distinctive aspect of this module is the **mid-level compression** that the compressor curve provides. To see this curve, set Ratio to about 4:1, and lower the Threshold to about -50dB. (See illustration on next page.)

Approximately 1:1
no compression of high levels

Approximately 4:1
compression of mid levels

1:1, no compression
of low levels

This **mid-level compression** allows you to increase loudness of a soundfile, or to make the sound more dense, *without overcompression of the peak dynamics*. Notice that the curve is not made of individual line segments but is a true soft-knee curve, providing smooth transition at all dynamic levels. This is ideal for post production, multimedia, and sweetening.

The Comp/Exp module is also capable of **negative ratios** (reverse compression). This occurs in the region beyond full limiting. Note how the level comes back down again over the threshold, and how, for more extreme reverse compression, it actually cancels out the signal completely at a level above threshold. This mode is also termed **cancellation mode** because of this property. It is useful if you wish to bring down high level input signals even further than would with a limiter.

Cancellation mode
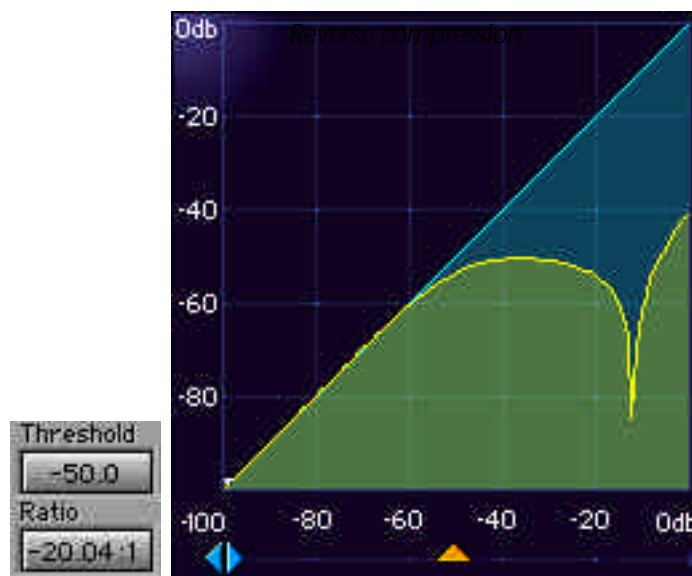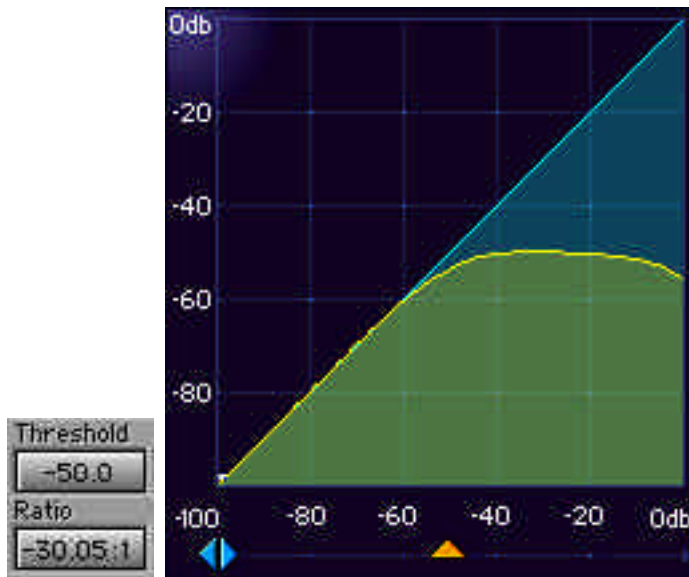
LowRef/PeakRef mode

There are two different ways of setting up the Comp/Exp output gain structure, using respectively LowRef and PeakRef adjustment modes. The adjustment mode may be selected with the LowRef/PeakRef reference level switch.
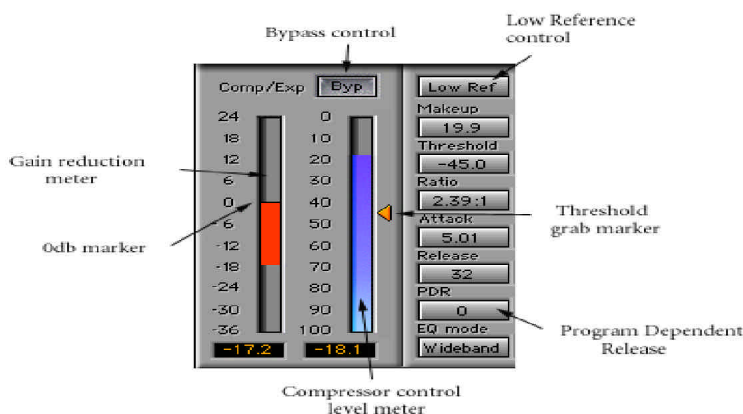
Which level reference mode should you use?

It depends on what you want to do with the compressor. Waves has provided the two modes to make it easier to set up for different applications. While no absolute rules can be given, and everyone has their own preferred ways of working, the following is a rough guide.

LowRef mode is the classic compressor mode with which most people are familiar. Since this involves no relearning of standard methods of operation, this may be preferred by many users experienced in using audio compression.

LowRef mode is typically used if the threshold is not too "deep" (that is, if a majority of the signal dynamics is well below the threshold setting). It is also recommended if large compression ratios such as 4:1 and higher are being used. This is especially the case when the compressor is in split mode.

PeakRef mode would typically be used if you have very low threshold settings (below -30 dB). This will be the case if you wish to compress (or expand) mainly the lower-middle or middle levels of the input dynamic range, leaving both very low and high levels uncompressed (i.e. "mid-level" compression applications). Typically in these applications, the ratio will lie between about 0.65:1 (expansion) and 3:1 (compression).
Usually, in these applications, the threshold setting will be low, somewhere in the middle or low-middle of the signal's dynamic range.
You can see the relative setting of threshold and input signal level by comparing the threshold marker with the control level meter indication, or by comparing the threshold marker with the level indicated by the square indicator on the I/O graph.

Adjustment of the compressor in LowRef mode

This is the traditional mode for a dynamics processor. When the Comp/Exp module is used as a compressor, as you lower the threshold, the output goes down. Adjust the Makeup gain value to compensate for the gain reduction.

Adjustment of the compressor in PeakRef mode

In PeakRef mode, first adjust the Makeup gain value so that it reads 0 dB or slightly less, such as -3dB. This ensures that output peak levels are roughly the same as input peaks.

When the Comp/Exp module is used as a compressor, as you lower the threshold, the output gain will increase to approximately compensate for the gain reduction.

After compressor adjustment, some additional trimming of the Makeup gain may be needed to prevent output peak clipping. (The Makeup gain controls the output of the Comp/Exp module.)

How to adjust PDR

In general, fixed release times are best for a somewhat small range of dynamic action. In reality, a release time that automatically adjusts to the sound material is sometimes desirable. You will find that the *Program Dependent Release* feature of the C1 allows for a controllable automatic release time.

When **PDR** is at its lowest value (0), it is disabled, and the **Release** time of the Comp/Exp module is fixed.

Set the **Release** time to the longest time desired, then set **PDR** for the compressor action that gives the desired effect.

The actual Comp/Exp release time is shortened whenever a transient occurs that is <u>shorter</u> than the **PDR value** (calibrated in millseconds). As the value of PDR gets larger, it takes longer sustained energy to get PDR to work. For example, if your soundfile has a sudden sustained, high-level area followed quickly by a very quiet area, then you would set PDR longer to avoid 'hole-punching'. Of course, if you want to have creative 'pumping', now you can control it with careful adjustment of PDR.

If you are using a long release time but have sounds with short transients (typically, a few milliseconds) such as speech sibilants and 'plosives' or drumstick attack sounds, the short transients will reduce gain for a long time without PDR. You can set the PDR just long enough (perhaps 10 or 20 msec) to allow rapid recovery of gain after these to prevent them from reducing level too much.

In applications where very long release times are used, you may wish to use PDR times as long as perhaps 300 msec so that the release time is short for all individual sounds having a limited duration of up to a fraction of a second, with the fixed **Release** time acting only after sustained periods of high-level sound. As an example, this would help to prevent reverberation from being over-exaggerated by the use of compression.

You will find that on recordings in very reverberant acoustics (e.g. classical music), PDR can allow significant compression without the reverb tails being brought up too rapidly.

Chapter 7 - The Gate/Expander module

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To use only the basic Gate/Exp module, select the "C1gate" plug-in. If you're using the full C1 for this example, set both **EQmode** switches to **Wideband** and the **Compressor** bypass switch to **Bypass**. Make sure that the Gate/Exp module is not in Bypass mode.

For best results, unless a special sound is required, the **Lookahead** switch should be set to **Yes**.

Normally, set both input levels to maximum (0 dB), since this will never cause internal clipping problems in Wideband mode. The input level adjustments are mainly useful for correcting channel imbalances (or intentionally creating them), since the output level fader can be used for overall level adjustments.

To use as a Wideband Gate

Set the **Gate/Exp** mode to *Gate.*
Set **EQ mode** to *Wideband.*
Set **Floor** to *-infinity.*
Then drag the **GateOpen** threshold up to a moderate level so that the Gate opens the way you want.
Set the **Attack** and **Release** times for the desired gate action.

To minimize gate "chatter" (or rapid opening and closing of the gate when the signal is near **GateClose**), lower the **GateClose** value a few dB below the GateOpen value, (for instance, -3dB lower). This will close the gate at a slightly lower level than the level necessary to open the gate, allowing the sound to die out a bit more before closing.

In the following illustration, the **GateOpen** and **GateClose** are both set to -41.7dB. Note that the Gate/Exp line in the Transfer Graph shows the Gate clearly, and all signals below -41.7 are gated.

To set the **Hold** time, adjust the Hold value (calibrated in mS) by clicking and dragging on the Value Window, by direct numeric entry, or with the up/down arrows. The Gate will stay open for this time period before the Release time occurs. In other words, once the level goes above the GateOpen threshold, the gate will remain open for the Hold time specified, then the Release time will begin. The Hold time is essentially a 'delay before release', such as the "S" part of an "ADSR" device.
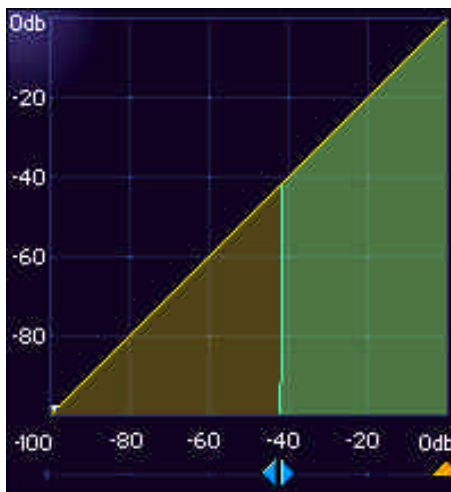
To use as a Wideband Expander

Simply set the **Gate/Exp** mode to *Expander* and leave all other settings the same. The only difference is that now the module is a *downward expander*, with a ratio of 1:2. A downward expander will give you a more subtle, less abrupt alteration of the dynamics as the signal level drops.

In the following illustration, note the sloping Gate/Exp line showing the 1:2 expansion.
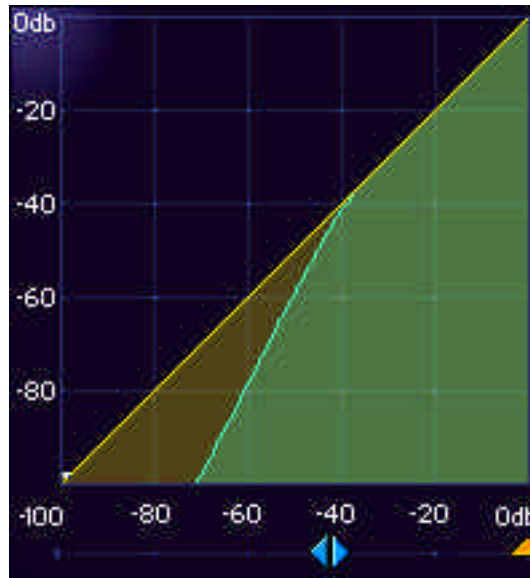
To use the Floor control

Floor (calibrated in dB) controls the lowest level a sound will be taken to when Gated or Expanded. The default is (-infinity), which means that the level can be taken down to digital silence. However, many times it is desirable to leave a little background noise "room tone" instead of completely gating all sound. This is when you can use the **Floor** control.

To adjust **Floor**, just click and drag on the Value Window, enter numeric values directly, or use the up/down arrows.

In gate mode, the **Floor** control ranges from -infinity to +12dB. To retain a little "room tone", set the Floor value to about -30, as in the following illustration. It is also possible to *increase* the level below the GateOpen threshold by setting Floor to positive values. This will be discussed in the chapter **Putting it all together.**

In expander mode, the **Floor** control also goes beyond the *-infinity* setting to *negative polarity settings* (-10 N to -100 N). This gives the expander a steeper expansion ratio below threshold. The expander will cancel sounds out completely when they are the indicated number of dB below GateOpen threshold.
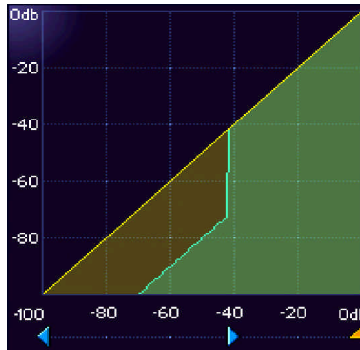
The Filter module

The great power of the C1 comes from its **Filter** module, which can be used for Sidechain EQ or the unique *bandsplit modes.* For example, this bandsplit configuration allows you to compress just the bass while gating wideband, or compress wideband while de-essing. These are just two of many possible *combination setups.* The C1 Setup Library presents a wide array of dynamic tools based on this *bandsplit mode.* You will most likely find this library and its documentation very usable. We strongly suggest you take the time to explore it.

First, the basics about the filter/equalization module. The Filter has bandpass, bandreject, highpass and lowpass filter types. The Filter's Graphic Display shows the filter and status of the active/passive bands. In the following illustration, the Filter is in *Bandpass* mode, with a center **Freq**uency of 489Hz and a **Q** (bandwidth) of 0.525.

Click on the **Type** control to cycle through the 4 filter types. The **Freq** and **Q** controls can be adjusted by the usual methods: clicking and dragging on the Value Window, entering values numerically, or using the up/down arrow keys.

> **Note**: You may also adjust the **Q** and **Freq** simultaneously by dragging the crosshair, as shown in the illustration. Move the mouse vertically to adjust the **Q**, horizontally to adjust the **Freq**.
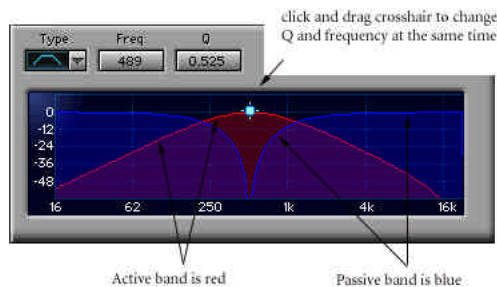
Chapter 8 - Sidechain Tutorial

To really start putting it together, first we'll present a classic wideband compressor and gate. Here are the steps for this basic setup:

Select the full C1 comp/gate with sidechain (you can use +C1).
Set both modules' **EQ mode** to *Wideband.*
Set both modules so they are <u>not</u> Bypassed.
Set the desired **Ratio**.
Drag the Comp/Exp **Threshold** to obtain the desired gain reduction.
Now drag the Gate/Exp **GateOpen** to obtain the desired gating action.
Adjust the **Attacks** and **Releases** to appropriate settings for the file.

It's this simple.

Next step

Now we'll bring the **Filter** into the configuration.

First, here's how a single dynamic module and the **Filter** combine for sidechain. This is the traditional sidechain compression technique used for de-essing.

- Put the Gate/Exp in *Bypass.*
- Set the compressor for traditional compression *(ratio 2:1, attack 5ms, release 30ms)*
- Set the Comp/Exp **EQ mode** to *Sidechain.*

Now the Comp/Exp module will compress according to the amount of energy in the filtered signal. You can adjust the filter to 'tune in' on the level of energy to which you want to make the compressor sensitive.
Listen to the sidechain filter output by clicking the Monitor button once so that it says *Sidechain.*

Watch the blue Comp/Exp Control Level VU meter. Adjust the Threshold grab marker (the triangle) and drag it so that the VU meter reading moves above and below the marker. The red Comp/Exp Gain Reduction meter will show gain reduction whenever the Control Level goes above the Threshold. With this interface, you can set the sidechain filter and adjust the threshold very quickly.

Now set the **Monitor** mode back to *Audio* by clicking the button to hear the de-essing process.

Better (bandsplit) de-esser

Second, here's another simple de-esser, but this time in *bandsplit mode.* The settings are all exactly the same, but instead, you will compress only the 'ess' part of the band, instead of the entire wideband signal.

- Put the Comp/Exp module in *Split mode* by clicking the **Eq mode** button until *Split* is shown on the button.
- Now adjust the module for desired de-essing action.

This is not necessarily the optimum de-esser! It's just an example. Check the "Better De-esser" Factory Preset.

This Preset can be easily made into a **De-Popper** by changing the sidechain Freq to 120!

You can combine the **Filter** with the Gate/Expander module in the same way. If you have a soundfile that has lots of low end energy that keeps triggering the Gate at the wrong times, use the **Filter** in the *Highpass* mode to help prevent these low frequencies from triggering the Gate.

An ideal application is to have a sidechain gate to clean up drum tracks. Use a Highpass filter to isolate the snare, a Bandpass filter for toms, and lowpass to gate the kick.

Chapter 9 - Intro to Combination setups

Combination setups are for use with both modules plus the Filter module.

Using both dynamic modules with one module in Sidechain or Split mode offer the most flexible possibilities. There is only one Filter, but the two dynamic modules can perform separate processing while using the Filter in very different ways.

For instance, with the Filter in Highpass mode, you can have the Comp/Exp module in sidechain mode as a de-esser, and have the Gate/Exp module in split mode as a de-hisser. Both modules would be controlled by the energy measured in the highpass band. The difference is that the compressor would be acting on the wideband signal, the gate only affecting the highpass band.

Combining the three modules of the C1 will give you considerable flexibility—in fact, so much flexibility that it is fastest to start with the Setup Library for many applications, then tweak the settings for your work. To introduce you to this complex aspect of C1, the examples in the following section use setups from the C1 Setup Library.

Classic Combinations

High-level Compressor + De-Hisser

The first two combination examples were for de-essing. Now, here's the third, but this combination is designed as a "de-hisser". It uses both dynamic modules and the Filter. This time, the Gate/Expander will be the de-esser, while the compressor will remain a classic wideband compressor. In this setup, the real essence of the C1 is demonstrated: two independent effects which may be set up, optimized, and controlled independently or together.
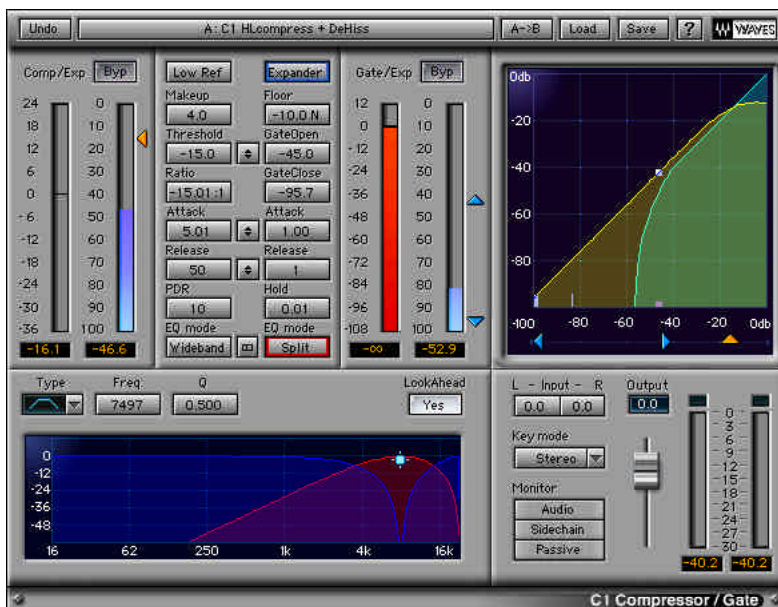
The Comp/Exp module is set up as a wideband compressor. Note that the compression Ratio is set to a negative value to bring down peaks a little further. This is very effective when any cancellation nulls lie beyond 0 dB. Of course, you can have traditional compression with a more traditional Ratio (for example, 3:1).

Note that the Makeup gain is +4.0dB. However, the use of compression with this Makeup gain will bring up any background hiss. The **Gate/Exp** module is set up as a de-hisser to minimize this background hiss with the least effect on the sound. It is a low-level expander whose action is confined to a carefully-tuned frequency band centered around 7 kHz.

In this setup, the **GateOpen** threshold setting is the critical adjustment for de-hissing. Adjust it up and down until you find the highest setting that has no significant unwanted effect on tonal quality. This is the optimum de-hiss setting. The setting is a trade-off between loss of treble and hiss reduction. On most speech and popular music, there is usually a good setting that has a subjective hiss reduction of 6 dB or more but with little tonal effect . The filters chosen here for de-hissing are generally suitable for hiss with a white, pink or blue spectrum, requiring only perhaps a kHz up or down tuning of frequency. The tonal effect of maximum hiss reduction can be heard by setting the **Monitor** to *passive* mode. The **Q** setting turns out to be fairly critical — lower Q (wider bandwidth) will filter out more hiss — but modulation noise (variations of the hiss up and down with the wanted signal) will become more audible. A **Q** of 0.5 is generally the best compromise, but up to 0.6 can be used. The optimum filter settings usually end up close to those in the setup.

Main controls for Compressor + De-Hisser:
Comp/Exp *set to high-level compression.*
  • **Makeup** as needed
  • **Threshold** -20 to 0
  • **Ratio** -50 to -5 as needed
  • **Attack**, **Release**, **PDR**: As needed

Gate/Exp *module set to de-hissing*
  • **GateOpen** threshold. -25 to -80. Set by ear to leave signal treble balance unaltered while diminishing hiss.

Other controls:
  • **Frequency**: In range 5500 to 9000 Hz for lowest perceived hiss
  • **Q**: In range 0.45 to 0.6 for best trade-off of modulation noise versus hiss reduction
  • **Output Level**: (has same function in this setup as makeup)

Compress + De-reverb

From the Setup Library, load the file **Compress+De-reverb**. Try this with a voiceover with too much room reverberation. This setup uses the compressor for mid-level wideband compression in order to increase loudness and density of a voice. However, this brings up lower level sounds, including reverberation. For post and multimedia applications, setting the Gate/Exp module for *splitband downward expansion* enables you to remove some of this reverb.

This means that you can reduce the volume of the lower frequencies — the ones responsible for the 'cloudy' sound of compressed reverb — by expanding their dynamics downward. Note that the **Filter** is set for a crossover frequency of 400Hz.

Main controls for Compress+De-reverb:

Comp/Exp *set to mid-level compression.*
* **Makeup as needed**
* **Threshold -70 to -20.**
* **Ratio 1:1 to 3:1**
* **Attack, Release, PDR: As needed**

Gate/Exp *set to bass de-reverberation*
* **GateOpen threshold:** -40 to -15 set by ear to leave signal bass balance unaltered while diminishing reverb bass
* **Attack, Release, Hold:** As needed - usually Attack not too short (to avoid distortion of the bass frequencies) and Release and Hold not too long (to allow quick response to low level in the bass)

Other controls:
* **Frequency:** In range 200 to 600 Hz for best sound
* **Output Level** (has same function in this setup as makeup)
* **Lookahead**

GateOpen/GateClose

By dragging GateOpen, you may vary the two settings up and down together with a constant dB difference between them. You can also adjust them together by dragging the upward-pointing grab marker (GateOpen) on the Gate/Exp control level meter, **or** by dragging the right-pointing arrow under the I/O graph (see illustration on facing page).

Drag either of these grab markers (GateOpen) to change GateOpen and GateClose at the same time
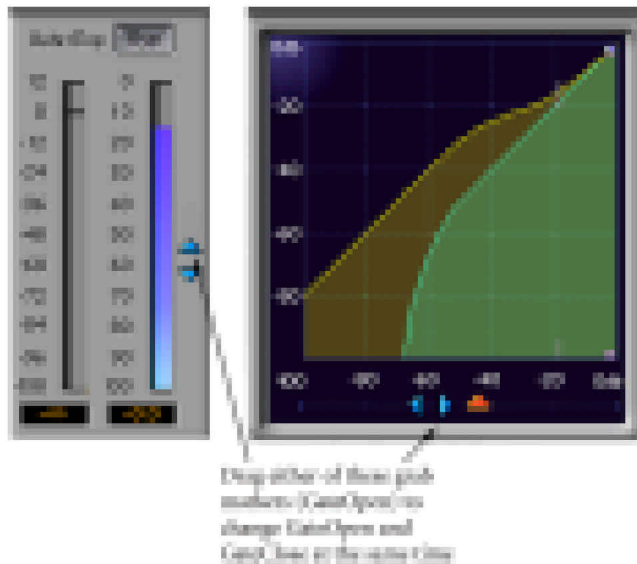
Please see the WaveSystem Manual for complete details of these and other control features.

Chapter 10 - Setup Library listing

Simple Setups

C1 Multimedia Speech 1
C1 Multimedia Speech 2
C1 EQ + Gate
C1 EQ + LLexpander
C1 EQ + LLcompressor
C1 Compressor + EQ

Compression

C1 Speech Compress/Expand 1
C1 Compressor + De-Reverb
C1 HLcompress + DeHiss

Noise Reduction

C1 Noise Reducer
C1 Noise Reducer 2
C1 Gate Noise Reducer
C1 Rumble Reducer
C1 High-pass filter

De-Essers

C1 Compressor + DeEsser 1
C1 De-Ess + De-Hiss 1
C1 De-Ess + LLcompress
C1 De-Ess + EQ + De-Hiss 2
C1 De-Hiss + EQ + De-Ess 3
C1 De-Hiss + EQ + De-Ess 4

Enhancers

C1 Speech Enhancer
C1 Treble Enhancer
C1 Bass Enhancer
C1 Bass/Treble Enhancer
C1 CheapSystem Enhancer

Keying Setups

C1 Ducking 1
C1 Ducking 2
C1 Ducked EQ 1
C1 Ducked EQ 2
C1 Keyed Gate
C1 Keyed Expander
C1 Keyed EQ Expander

Chapter 11 - Conceptual block diagrams of all EQ mode options
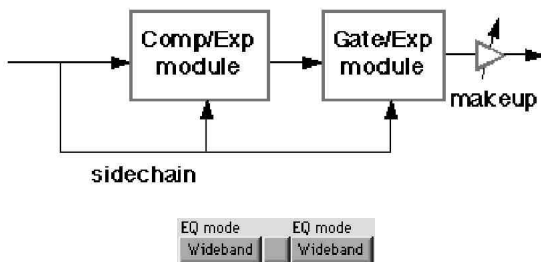
Both modules in Wideband mode.
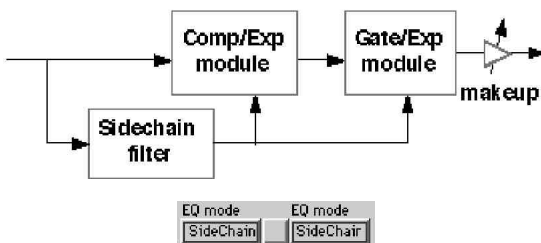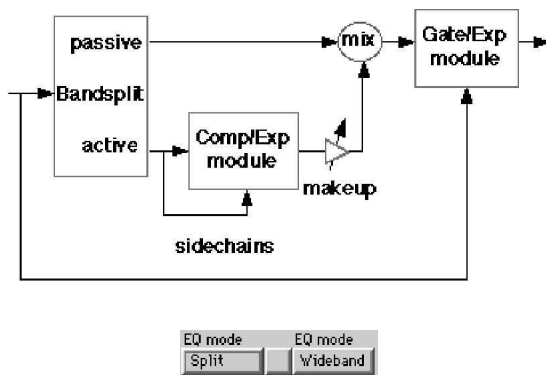

Both modules in Sidechain mode.
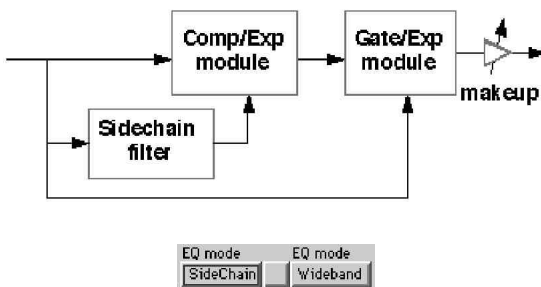
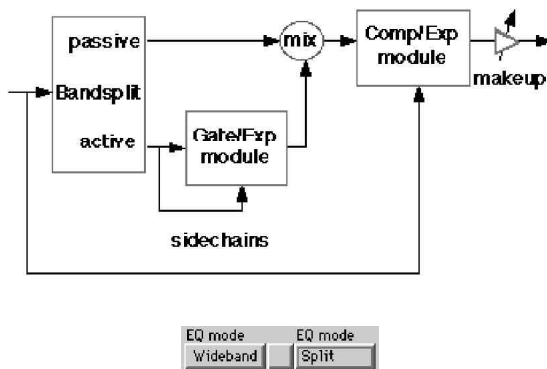*Comp/Exp module in Sidechain mode, Gate/Exp in Wideband.*
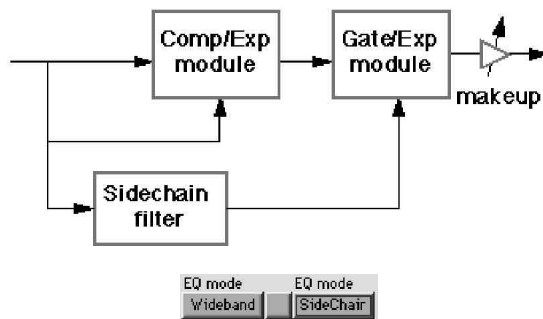
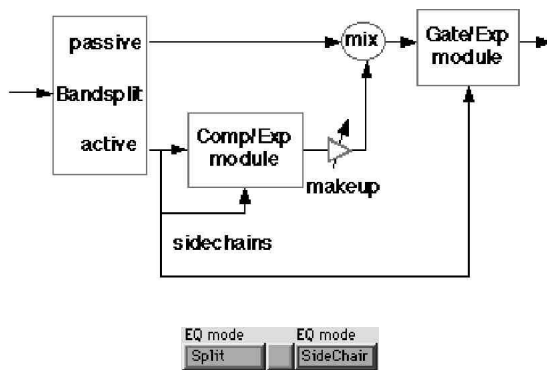*Gate/Exp module in sidechain mode, Comp/Exp module wideband.*
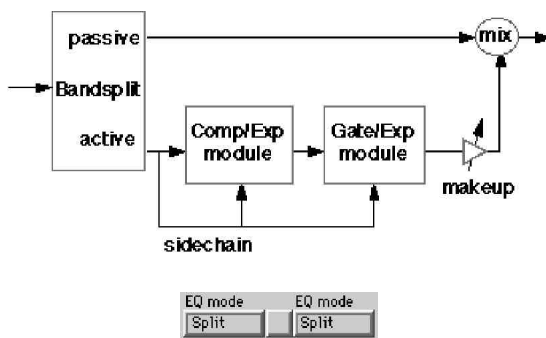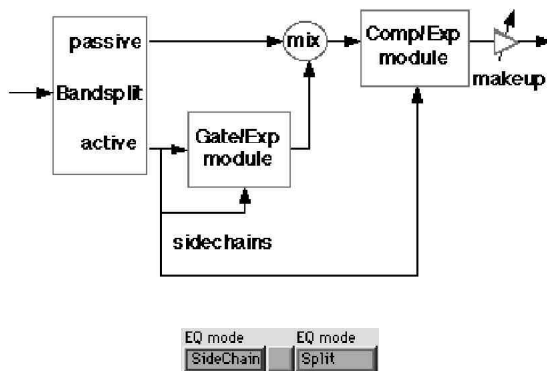

Both modules in bandsplit mode.

Bandsplit Comp/Exp module, with wideband Gate/Exp module.

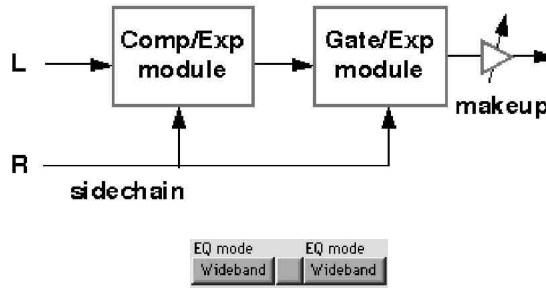*Bandsplit Gate/Exp module with wideband Comp/Exp module.*

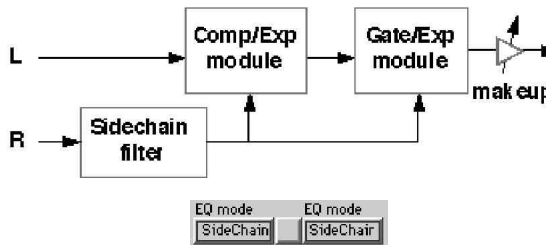*Comp/Exp module in bandsplit mode, Gate/Exp module in sidechain mode.*

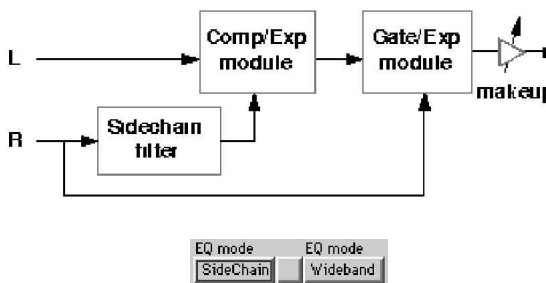*Gate/Exp module in bandsplit mode, Comp/Exp module in sidechain mode.*

Key modes

The following show "R keys L" modes. The "L keys R" modes simply interchange the L and the R inputs.
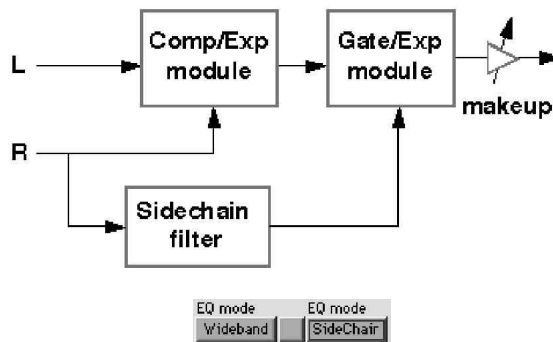

Both processors in wideband mode. R keys L.

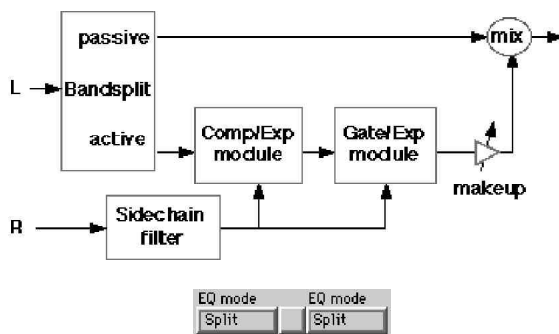*Both processors in sidechain mode. R keys L.*

Comp/Exp module in sidechain mode.
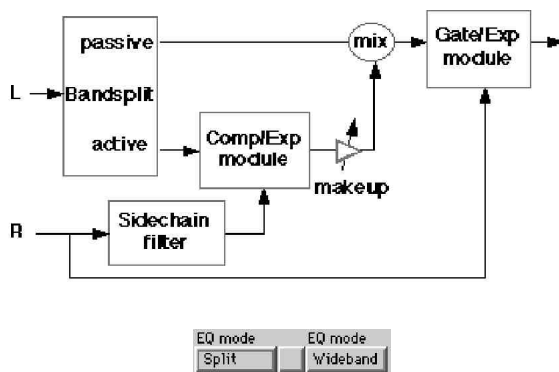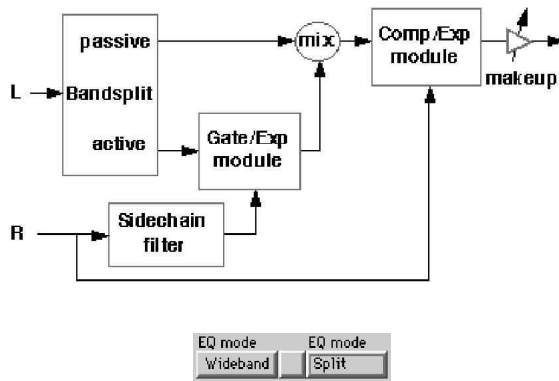*Gate/Exp module in wideband mode. R keys L.*

Comp/Exp module in wideband mode.
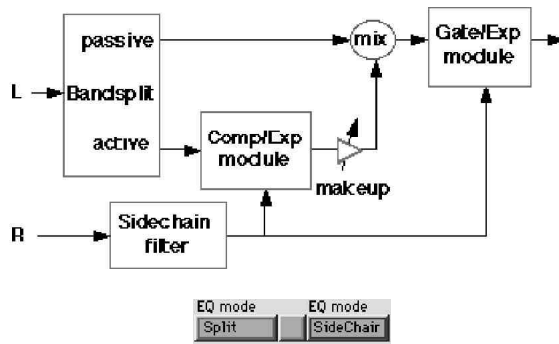*Gate/Exp module in sidechain mode. R keys L.*

Comp/Exp module and Gate/Exp module both in Bandsplit mode. R keys L.

Comp/Exp module in Bandsplit mode.
Gate/Exp module in wideband mode. R keys L.

passive

L → Bandsplit

active

R

Sidechain filter

Gate/Exp module

mix

Comp/Exp module

makeup

EQ mode
Wideband

EQ mode
Split

Gate/Exp module in Bandsplit mode. Comp/Exp module in wideband. R keys L.

passive

L → Bandsplit

active

R

Sidechain filter

Comp/Exp module

makeup

mix

Gate/Exp module

EQ mode
Split

EQ mode
SideChain

Comp/Exp module in Bandsplit mode. Gate/Exp module in sidechain. R keys L.

passive

L → Bandsplit

active

R

Sidechain filter

Gate/Exp module

mix

Comp/Exp module

makeup

EQ mode
SideChain

EQ mode
Split
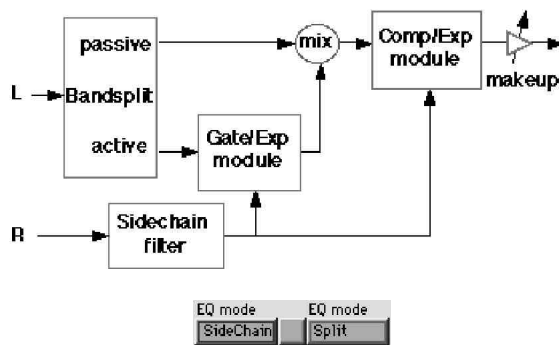
Gate/Exp module in Bandsplit mode. Comp/Exp module in sidechain. R keys L.

Chapter 12 - C1 Technical Specifications

Digital operating resolution.

Internal computations: 24 bits. Bandsplit filters incorporate internal noise shaping. Control signals are computed to 24 bit accuracy every sample to eliminate zipper and quantization noise.
Input signal: 16 or 24 bits.
Output signal: 16, 20 or 24 bits, plus additional 2 bit perceived improvement using IDR technology (+C1 component only).
Digital Resolution enhancement: IDR normal type 1 noise shaped dithered quantization, at 16 or 20 bits, plus unmodified 24 bit output.

Primary sampling rates: 44.1 or 48 kHz, but supports other rates. C1comp and C1gate (without sidechain and lookahead) now support 88.2 and 96kHz rates in native applications.

Compressor/Expander module

Type: Soft knee with gain reduction 3 dB at threshold for limiting mode. Compression occurs over about 30 dB range above threshold, then ratio reverts to 1:1.
Ratio: 0.5 expansion to full limiting plus negative ratio settings.
Threshold: 0dBFS (full scale) to -100 dB in 0.1 dB steps.
Attack time: 0.01 to 1000 msec logarithmic scaling.
Release time: 1 to 10000 msec logarithmic scaling.
PDR time (length of transients for which release time is shortened): 1 to 1000 msec.
Makeup gain: -40 dB to + 40 dB.
Gain reference modes: Low-level referenced or peak-level referenced.
Lookahead: optional, linked to attack time.
EQ operating modes: Wideband, Sidechain EQ, Bandsplit mode.
Compressor Bypass switch: yes.
Metering: Sidechain input levels (100 dB range), inc. maximum reading, Gain reduction/increase, inc. maximum reading.
Graphical displays: Input/Output curve over 100 dB, with on-curve level metering. Sidechain/bandsplit frequency responses.

Gate/Expander Processor

Operational modes: Gate or 2:1 soft-knee expander.
Floor gain level: -infinity dB to +12 dB and (for expander only) negative polarity floor gains from -10N to -100N dB.
Expander/GateOpen threshold: 0dBFS (full scale) to -100 dB in 0.1 dB steps.
GateClose threshold: 0dBFS (full scale) to -100 dB in 0.1 dB steps with time-related hysteresis (gate only).
Attack time: 0.01 to 1000 msec logarithmic scaling.
Release time: 1 to 10000 msec logarithmic scaling.
Hold time: 0.01 to 5000 msec logarithmic scaling (gate only).
Lookahead: optional, linked to attack time.

EQ operating modes: Wideband, Sidechain EQ, Bandsplit mode.

Gate/Exp processing Bypass switch: yes.

Metering: Sidechain input levels (100 dB range), inc, maximum reading, Gain reduction/increase, inc. maximum reading.

Graphical displays: Input/Output curve over 100 dB, with on-curve level metering. Sidechain/bandsplit frequency responses.

EQ Section

Filter types: Bandpass, bandreject, High-pass, Low-pass

Q: 0.1 to 0.6.

Frequency: 16 Hz to 21 kHz logarithmically scaled.

Bandsplit filter type: IIR phase compensated bandsplit internally noise shaped.

Sidechain filter type: 6th order IIR.

Graphical display: Sidechain/bandsplit frequency responses.

Audio Monitoring: Processed sound, sidechain signal, "passive band" signal.

Other

Lookahead processing latency (only in components with the lookahead button): 340 samples (7.7 msec at 44.1 kHz sampling rate, 7.08 msec at 48). Processed files in native applications (non-DSP) may show latency.

Keying modes: Ordinary linked stereo, Left keys right, Right keys left.

Output metering: stereo peak-reading bar meters 0 to -30 dB, also indicating maximum level and number of clips (in +C1).

Input level: Separate left and right gains 0 to -24 dB in 0.1 dB steps.

Output level: slider gain +18 to -40 dB in 0.1 dB steps.

Overall bypass mode: Yes, with gain adjustment +12 to -24 dB for A/B comparisons.

Number of setups available: Currently loaded: Two. In memory: unlimited.

Real-time preview mode at 44.1 and 48 kHz sampling rates.

Features and specifications subject to change without notice.