

Waves – Linear-Phase MultiBand Software Audio Processor Users Guide



version 2 Dec. 27th

Chapter 1 – Introduction

Introducing Waves Linear-Phase MultiBand Processor.

The LinMB is an evolved version of the C4 MultiBand Parametric Processor. If you are familiar with C4 you will find the Linear Phase MultiBand very similar, adding some true breakthrough innovation and technology that yields superior and purer results.

The LinMB has -

- 5 discrete bands each with its own gain and dynamics for equalizing, compressing, expanding or limiting each band separately.
- Linear Phase crossovers allow true transparency when the split is active but idle. The only effect is pure delay with no coloration of any sort.
- LinMB is equipped with the options for Automatic Makeup and gain Trim.
- Adaptive threshold behavior achieves most effective and transparent multiband dynamics processing.
- LinMB has the visual interface of the award winning C4 with Waves' unique DynamicLine™ display showing the actual gain change as an EQ graph display.

Waves created the LinMB to answer to the most demanding and critical requirements when Mastering any sound and genre of music.

While the Waves Masters bundle is focused to provide purist quality tools for Mastering, there are many applications in which it may be very useful i.e. Vocal processing, Transmission processing, Noise reduction, Track Strip. The LinMB has a fixed amount of delay or fixed latency of about 70ms (3072 samples in 44.1-48kHz). Due to the intensive calculations required for the Linear Phase crossover it is quite an achievement to have this work in real-time in both TDM and Native. Much effort was put to optimize the performance for specific CPU's using Co processors such as AltiVec on MAC and SIMD on x86 type processors. Processing higher sample rate such as 96kHz will definitely require much more CPU then 48kHz.

MULTIBAND DYNAMICS

In MultiBand Dynamics processing we split the wide-band signal to discrete bands. Each band is sent to its dedicated dynamics processor to apply the desired dynamic gain adjustment or static gain. Splitting the signal has several major consequences as follows:

- Eliminates Inter Modulations between bands.
- Eliminates gain riding between different frequency bands.
- Allows setting each band's attack, release times scaled to the frequencies in that band.
- Allows setting different functionality (compression, Expansion, EQ) per each band.

For example, its possible to compress the low frequencies with longer attack release values, at the same time expand the mid range with shorter ones, DeEss hi-mids with much faster attack and release and boost the super hi frequencies without any dynamics.

MultiBand devices are especially handy when dealing with the dynamics of a full range mix. In a symphonic orchestra as well as in a Rock n Roll band different instruments dominate different frequency ranges. Many times the low range dominates the whole dynamic response while the higher frequencies are riding on top. While it is the mixer's or composer's job to reach a desired balance, mastering engineers often find they need to do something about the dynamics of the mixed source. It may be to complement it further or indeed improve its quality, or possibly just make it as loud as possible for competitive level, with as little degradation as possible.

LINEAR PHASE XOVERS

When the LinMB is active but is idle, it presents only a fixed amount of delay. The output is 24bit clean and true to the source.

When we use Xovers to split a signal we like to think that they are splitting the input signal to bands leaving everything else untouched. The truth is that any normal analog or digital Xover introduces different amount of phase shift or delay to different frequencies. Further dynamic gain changes will cause further modulation of the Phase shift introduced by the Xovers. This phenomenon was treated in C4's phase compensated Xovers but the initial phase shift caused by the Xovers is still apparent in C4 and in its output all frequencies are equal to the source in Amplitude but not in Phase.

When its important to achieve as much source integrity as possible the LinMB goes a long way and splits the signal to 5 bands maintaining a 24bit clean starting point for applying different dynamics processing to each of the bands.

Transients are the main sonic events that benefit from Linear Phase.

Transients contain a wide range of frequencies, and are highly "Localized" in time. A non-linear phase filter that shifts the phase differently for different frequencies will "smear" the transient over a longer period of time. The Linear Phase EQ will pass transients maintaining their full sharpness.

ADAPTIVE THRESHOLDS AND DE-MASKING

When a soft sound and a loud sound happen at the same time, the loud sound has some Masking effect over the softer sound. The research of Masking, articulated the Upward spread Masking, where loud low frequency sounds mask higher frequency sounds. The Linear MultiBand provides a way for each band to be sensitive to the energy in its "Masker" band. When the energy in the Masker band is high the band's threshold will rise to introduce less attenuation and compensate for the masking, letting the sound in each band come out as loud and as clear as possible. The Linear MultiBand is the first processor to introduce this de-masking behavior, of which you can read more in Chapter 3 of this guide.

Chapter 2 – Basic Operation.

THE WAVES LINEAR PHASE MULTIBAND'S CONTROL GROUPS –

THE CROSSOVER FREQUENCIES -



The 4 Xover frequencies are set directly under the graph by grabbing their graph marker or using the text button. These define the cutoff frequencies in which the WideBand signal will be split into the 5 discrete bands.

INDIVIDUAL BAND CONTROLS -



Each band of Waves LINMB has 5 adjustable dynamics settings. **Threshold, Gain, Range, Attack, Release, Solo** and **Bypass**. These function similarly in most dynamics processors but in this processor they affect the dynamics of one of the 5 bands. The **Range** may seem unfamiliar and basically it is in place of the well-known *Ratio*, but it defines both the intensity of gain adjustment and the limit of gain adjustment. Read more In the next chapter.

GLOBAL SETTINGS CONTROLS -



In the Global section you can find master controls, which are ganged controls for moving all the per band controls at once.



Other deal with the overall processor output – **Gain**, **Trim** and **Dither**.

The **Makeup** control allows selection between *manual* mode and *Auto* Makeup.

Finally there are 4 general compression behavior controls – **Adaptive** (Explained further in the next chapter), **Release** – Select between Waves ARC – Auto Release Control to a manually set release. **Behavior** – Opto or Electro modes affect the nature of the release. **Knee** - soft or hard knee or any value in between.

QUICKSTART

To start off, Waves provide a selection of factory presets. These can mostly serve as good starting points for applying MultiBand Dynamics. As this is not an effects processor the actual settings have to be program dependant and most mastering engineers would prefer to manually set the processor and not rely on ready made settings. The processor defaults and presets offer nice scaling of the Time Constants Attack, Release in relation to their Band's Wavelength providing slower settings to lower bands and faster values to higher. Other controls are set in the presets to provide some showcase of possible modes and different combinations.

- Start off using the Processor defaults.
- Play Music through.
- For general MultiBand Compression first set the *Range* in all bands to – 6dB by dragging the Master Range control downwards. This will assure that the gain adjustment will be Attenuation or Compression and the maximal attenuation will not exceed a 6dB reduction.
- Now set your nominal per band thresholds. Use the peak energy in each band to set the nominal threshold to the peak value.
- Now you can drag down the master Threshold to set the general compression. You can choose to engage Auto Makeup after setting the nominal thresholds and this way further threshold manipulation will preserve relative loudness and you will hear the compression rather the change in loudness.
- Adjust the per band gains to satisfy or qualify with your idea of “flat” Equalization.
- Play the whole program, or at least the loudest passages and hit the Trim button to makeup the global output gain buy the its Margin to the full scale.

Note that this Quick Start routine is not the Golden recipe to mastering with the Linear MultiBand, it does however provide a general type practice that should let users new to MultiBand follow a recommended workflow. This example only scratches the surface of possibilities with the Linear MultiBand and there are more optional advanced features that may have implications on the workflow method. Read on in this guide to learn about some of the special advanced features.

Generally it's important to remember that while the process is applied to split discrete frequency bands, it affects the Whole WideBand sound. Soloing each band and applying its compression in solo and then listening to the whole may prove unrewarding as a workflow.

Frequency Analyzers can be used to get visual feedback to validate or articulate what you hear but its most important to use the ears and work in a good listening environment for critical reference.

Practice Makes Perfect!

This tool presents a lot of choice. Its not the Renaissance tools that help you save time for great results. It's a highly flexible, ultra professional, purist quality tool.

Chapter 3 – Specialties of the Chef

ADAPTIVE THRESHOLDS AND DE-MASKING.

The effect of louder sounds on softer sounds has been researched for decades. There are many classifications to masking and the most effective masking is considered forward in time and upward in frequency. Simply put loud lower frequencies affect the way we perceive higher softer frequencies. The loud low frequency mask the higher frequencies. In the LinMB we can consider each band to be the masker for the band above it, so when the sound in a certain band is very loud it will have some masking effect to the sound in the band above it. To address this we can introduce a little lift to the threshold of the masked band and as result it will get less attenuation and be a little louder or de-masked.

The Linear Phase MultiBand processor lets each band be sensitive to the energy in the band below it. The “Adaptive” control is a continuous scale of sensitivity to the Masker scaled in dB’s. $-\infty$. Adaptive = off, this means no sensitivity and the threshold is absolute regardless of what’s happening in the lower band. When increasing the value the band will become more and more sensitive to the energy in the band below it, The energy ranges from -80dB to $+12$. We call 0.0dB Fully Adaptive and values above it are Hyper Adaptive. When the energy in the Masker band is high the threshold will be lifted. When the energy in the lower band falls, the detail is revealed, threshold goes back down and the attenuation goes back to normal. Also there is a chain reaction that makes for subtle general looseness of compression to the higher bands whenever the low bands are with high energy.

Each band of the linear MultiBand has its own compression settings and the engineer may want to compress more when a band is exposed and less when its masked. In example a song starts with a solo vocal and then the Playback comes in and the picture changes. The “presence” frequencies of the voice become more significant then the lower “Warm” tones of the voice, so to regain warmth we would want to attenuate it less when the playback kicks in. This is a macro example that can easily be treated with a bit of automation but in concept masking happens on the micro scale throughout the program. For example a staccato bass line masks and exposes the higher band’s sound on a scale where manual riding isn’t practical. The adaptive behavior is the practical answer.

The Adaptive De-Masking behavior is new to almost all users, and some may think it’s unnecessary. It is however interesting, effective and worth a try. Others may find it useful but it may also call for some practice before you get comfortable with it. Optionally, it may change they way you work. As a first step, try to add adaptive behavior to ready made settings on material that you know very well. Set the Adaptive control to -0dB at this setting you will get very adaptive behavior. Do a bit of an A > B listening test. Try to pay special attention to passages that have different spectral dynamic nature and

hear how the adaptive behavior responds to them adding a more dynamic approach to dynamics. This example is somewhat extreme and it is recommended to try settings around -12 dB for subtle adaptive de-masking. It may also be interesting to lower the overall threshold of the top 4 “Adaptive” bands by Multi-selecting their thresholds and pulling them down to compensate for the added looseness, In any case when they are exposed they will be tighter and Looser when masked.

AUTO MAKEUP

When Applying compression adjusting the threshold reduces loudness. Indeed in most compressors we can hear the overall gain reduction and we can apply makeup gain to regain the lost loudness. In WideBand compressors we find auto makeup to be fairly straightforward. The auto makeup will boost by the reverse value of the Threshold, or sometimes have a threshold dependant makeup “range” that accounts for the knee and ratio too. In MultiBand there are other considerations. The bands energy is going to be summed with that of the other bands so it’s hard to predict the part of the discrete band’s energy on the summed WideBand signal.

The Auto Makeup in LinMB is somewhat similar in that it accounts for the Threshold, Range and Knee. In wide band we would use the headroom to boost the loudness further then was possible before compressing. In the MultiBand case It is designed to help maintain general level stability for better a/b comparing. While in a wideband compressor the overall level will be reduced in the LinMB only the gain of a certain band will be reduced in relation to the others. It is much easier to hear the lost loudness then the actual compression so working with Auto Makeup the bands level remains similar and you can focus better on the sound of the dynamics process for that band. You can choose to use Auto Makeup as a work mode to help get the per band compression to sound right, Then apply per band gain on top of it. When disengaging Auto Makeup its effect will be updated into the per band gains. It is recommended to first set nominal thresholds per band to the peak energy in each band. Then engage auto makeup and continue to adjust the desired dynamics.

Auto Makeup does not interfere with the per-band Gain control. Also it cannot be clipping proofed and the overall Output gain will serve to trim the margin between the peak and the full scale.

WAVES ARC™ - AUTO RELEASE CONTROL

Waves ARC was designed and debuted in the Waves Renaissance Compressor. This routine sets the optimal gain adjustment release time by being program sensitive. The Auto Release Control still refers to its band’s release time and optimizes it according to the actual attenuation assuring maximal transparency. Before ARC there was always a need to trade between grainy Distortion with short release times to Pumping when setting longer release times. ARC helps lower the extent of these artifacts. For best

results, you may set your release time for the best compromise between Distorting and Pumping and then apply ARC to get even better results with less artifacts. Alternatively you can just count on this technology, set your release value to the desired ballpark or stick with the release scaling from a preset and rely on ARC to get it right. ARC was so well accepted wherever we introduced it and in the LinMB it is ON by default.

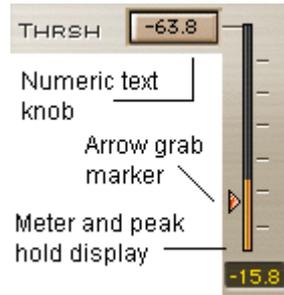
Chapter 4 – LinMB Controls and Displays.

CONTROLS

Individual Band Controls

THRESHOLD.

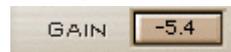
0- -80dB. Default – 0.0dB



Defines the point of reference for that band's energy. Whenever the energy in a certain band exceeds the threshold gain adjustment will be applied. For your convenience, each band has an energy meter for visual adjustment of the Threshold

GAIN.

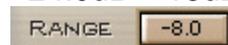
+/- 18dB. Default 0.0dB



Sets the overall output gain of the band or the bands makeup value. This Gain control can be use to adjust the gain of the band even without any dynamics like an EQ. It is also used to adjust gain of the band that's being compressed or expanded to make up for the headroom created buy the compressors attenuation, or make down to prevent clipping.

RANGE.

-24.0dB – 18dB. Default –6dB



Sets the possible range of the dynamic gain adjustment and also its intensity, replacing the classic "Ratio" control and adding a firm boundary to it. Negative Range means that when the energy exceeds the threshold a gain reduction will be applied, while positive Range means boosting it further. Read more about range in the next chapter.

ATTACK.

0.50 – 500ms. Defaults scaled for each band.



Defines the time it will take to apply the gain reduction from the moment the detected energy exceeds the threshold.

RELEASE.

5 – 5000ms. Defaults scaled for each band.



Defines the time it will take to release the applied gain adjustment from the moment the detected energy falls below the threshold.



SOLO.

Solo's the band to the main processors output for monitoring the band-pass by itself or along with other soloed bands.

BYPASS.

Bypasses all processing on the band and sends it to the main output the same way it was input. This allows to monitor the processed output vs. the source for each band by itself.

Crossovers – Xover



There are 4 Crossovers in the liner multiband. Each sets the cutoff frequency for the High Pass and Low Pass filters that cross each other.

For the calculation intensive nature of the Finite Impulse Response filters the Xover controls will sound a click when they are reset to a new position. When using the mouse to adjust the frequency or when grabbing the markers at the bottom of the Graph, the new filter will be set only when the mouse is released to avoid zipper noise. Using the arrow keys or control surface you can advance step by step to fine tune your Xover position. Smooth sweeps are impossible but the focus should be to set the Xover positions to the desired cutoff frequency.

Each of the four Crossovers has a unique range of frequencies as follows:

Low: 40Hz – 350Hz. Default – 92Hz.

Low Mid: 150Hz – 3kHz. Default – 545Hz.

Hi Mid: 1kHz – 8kHz. Default – 4000Hz.

Hi: 4kHz – 16kHz. Default – 11071Hz.

Output Section

GAIN –



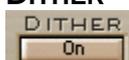
Sets the overall output gain. The double precision process assures no input or internal clipping so this gain is used at the output to prevent clipping.

TRIM –



The Auto Trim button updates the peak value and when clicked it adjusts the output gain control to trim the margin so that the peak will equal the full digital scale. For precise clip prevention let the program or at least its high gain parts pass through. When clipping occurs the clip light will light up and the Trim control box will update the peak value. Now click the Trim button to lower the gain by the peak value.

DITHER –



The double precision 48bit process can handle overflows. The result however comes out at 24bit back to the host application's audio buss. Some native Hosts may output 32 Floating point output to the mixer or to the next plug-in, this is the only case where we would recommend not to use the dither. The Dither control adds dithering back to the 24th bit rather than just rounding which will be the case when the Dither is off. The dither's noise and suspected quantization noise when with no dither, will be very low. The dither however can let your 24bit result virtually have a perceived 27bit resolution. Any introduced noise will be further boosted by Limiting the output (With L2 off course) so we did not want to commit the users to the dither noise and allow it to be turned off.

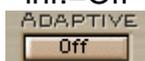
In any case, the noise may prove to be well beneath the program's floor and audible only at extreme monitoring levels, tucked within the noise floor of the reinforcement system. Normalizing dithered silence may boost the dither to terrible noise that is completely out of context. When analyzing non dithered silence it should remain quite silent, but this does not mean this mode is superior. The Dither is on by default and its use is recommended unless you know your host passes 32bit audio back to the host.

Global Behavior Settings

These settings will apply global dynamics process behavior which will influence the per band compression properties.

ADAPTIVE:

-inf.=Off – +12dB. Default – off.



The Adaptive control sets the sensitivity of a band to the energy in its Masker- the band below. The control uses a dB scale. The behavior will be that when there is high energy in a certain band the threshold will be lifted for the band above it to de-mask it. Read more about Adaptive Thresholds and de masking in chapter 3.

RELEASE:

ARC or Manual. Default – ARC.



The Auto release control sets an optimal release time in relation to the manual release time. When Manual release is selected then the release of the attenuation will be absolute as indicated, Adding ARC will make the release sensitive to the amount of attenuation and set the best release time to get more transparent results.

BEHAVIOR:

Opto or Electro. Default – Electro.



- *Opto* is a classic modeling of opto-coupled compressors which used light sensitive resistors to control the amount of compression (in the detector circuit). They have a characteristic release behavior of “putting on the brakes” as the gain reduction approaches zero. In other words, the closer the meter comes back to zero, the slower it moves. (This is once the gain reduction is 3dB or less). Above 3dB of gain reduction, the Opto mode actually has faster release times. In summary, Opto mode has fast release times at high gain reduction, slow release times as it approaches zero GR. This can be very beneficial for deeper compression applications.
- *Electro* is a compressor behavior invention by Waves, in that it is very much the inverse of the Opto mode. As the meter comes back to zero, the faster it moves. (This is once the gain reduction is 3dB or less). Above 3dB of gain reduction, the Electro mode actually has slower release times, much like a mini-leveler, which minimizes distortion and optimizes level. In summary, Electro mode has slow release times at high gain reduction, and progressively faster release as it approaches zero GR. This has very good benefits for moderate compression applications where maximum RMS (average) level and density is desired.

KNEE:

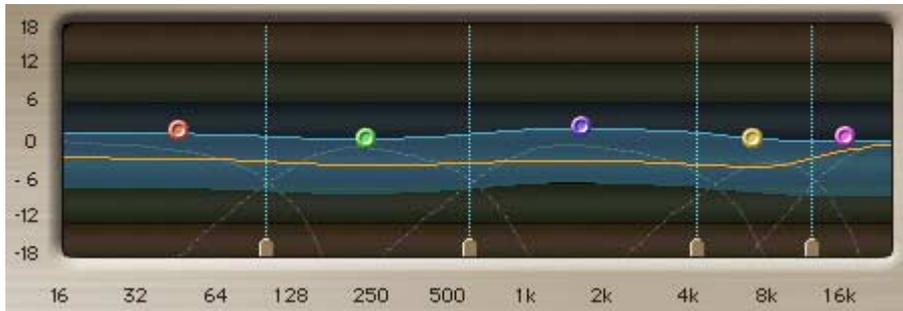
Soft =0 – Hard=100. Default - 50



This Master control affects all 4 bands' knee characteristics, ranging from softer (low values) to harder (higher values). At the maximum value, the Master Knee control tends to give the sound a harder edge, with a punchier overshoot-style character. Adjust to taste. The *KNEE* and *RANGE* together interact to give the equivalent of a ratio control. To achieve limiter-type behavior, use high *KNEE* settings.

DISPLAYS

THE MULTIBAND GRAPH:



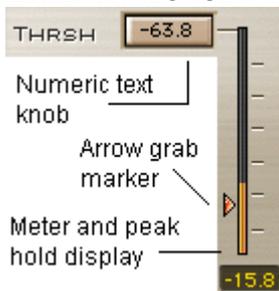
The MultiBand graph is like an EQ graph showing Amplitude in the Y-axis and Frequency in X-axis. In the Middle of the graph resides the DynamicLine™ that shows the per band gain adjustment as it happens within the Range, represented by the Bluish highlight. Beneath the graph there are the 4 Crossover frequency markers and on the graph there are 5 markers that allow you to set the gain of the band by dragging up and or down and the band's width by dragging sideways.

THE OUTPUT METERS:



The Output meters show the master output of the processor. Under each meter there is a peak hold indicator. The Trim control under the meters shows the current margin between the peak and the full scale. The holds and the Trim value are reset when clicking in the meters area.

BAND THRESHOLD METERS:



Each Band has its own meter showing the input energy in that band. Under the meter is a peak hold numeric indicator. When you want to set your nominal thresholds you can use the peak as reference and then continue to set them with the master threshold control.

Chapter 5 – Range and Threshold Concept

The concept of ‘Threshold’ and ‘Range’ instead of the traditional ‘Ratio’ control creates some very flexible and powerful uses for the LINMB. They include low-level compression and expansion, giving you multiband “upward compressors” and noise reducers.

OLD SCHOOL / ANOTHER SCHOOL

In the classic compressor approach, if you set a very low Threshold with any given Ratio, extreme amounts of gain reduction of high level signals may occur. For example, with a Ratio of 3:1 and Threshold of -60dB will result in a -40dB gain reduction for 0dBFS signals. Such a case is rarely desirable, and in general you would only set such a low Threshold in a typical compressor when the input level is also very low. In common practice, more than -18dB of gain reduction or $+12\text{dB}$ gain increase is rarely needed, especially in a multiband compressor.

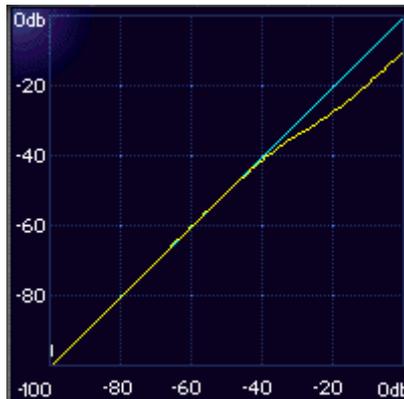
In the LINMB, the concept of ‘Range’ and ‘Threshold’ comes in very handy. It lets you first define the maximum amount of dynamic gain change using the ‘Range’ control, and then determine the level around which you want this gain change to take place using the ‘Threshold’. The actual values of these controls depend on the type of processing that you want.

If Range is negative; you’ll have downward gain change.

If Range is positive; you’ll have upward gain change.

The real flexible fun happens when you offset this dynamic Range with a fixed Gain value.

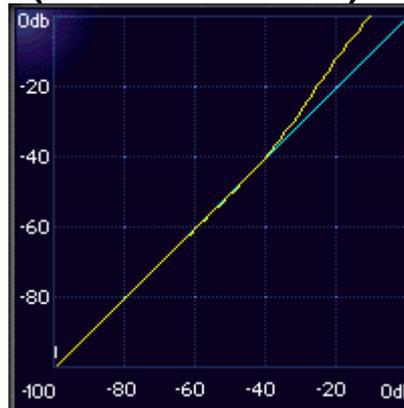
HIGH-LEVEL COMPRESSION



High-level compression in C1. Ratio is 1.5:1, Threshold is -35 . Equivalent LINMB setting would have Range set to about -9dB , with Gain set to 0.

If you are interested in conventional compression (termed here ‘high-level compression’ because the dynamics of the compression happens at high levels), simply set the Threshold to high values, between -24dB and 0dB , and the Range to a moderate negative value, between -3 and -9 . In this way the gain changes will take place at the upper part of input dynamics — just like a normal compressor will do.

HIGH-LEVEL EXPANSION (UPWARD EXPANDER)



An upward expander from the C1, with a ratio of 0.75:1, Threshold at -35. Equivalent LINMB setting would be a Range of +10 or so, quite a bit more than you'd probably ever need. Shown only for clear example.

To make an upward expander (an "uncompressor") to restore overly quashed dynamics, simply reverse the Range setting. Make the Range be a positive value, say between +2 and +5. Now whenever the signal is around or above the Threshold, the output will be expanded upwards, with a maximum gain increase of the value of Range. In other words, if Range is +3, then the maximum expansion will be 3dB increase.

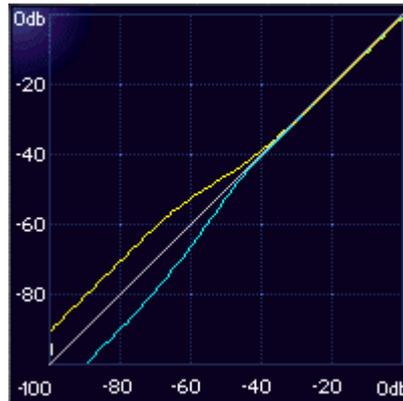
LOW-LEVEL COMPRESSION

The low-level processors are where we start to have even more fun. By using the fixed Gain control to offset the Range, you can affect only the lower-level signals.

If you are interested in increasing the level of soft passages, but leaving the louder passages untouched, (termed here 'low-level compression'), set the threshold to a low level (say -40 to -60dB). Set Range to a small negative value, such as -5dB, and set Gain to the opposite value (+5dB). The audio around and below the Threshold value will be "compressed upward" a maximum of 5dB, and the higher audio levels will be untouched, including their transients.

This will cause high levels signals (i.e. that are significantly above Threshold) to have no gain Change – since at high levels the Range and Gain controls are opposite values and together they equal unity gain. While around and below the Threshold, the Range is increasingly "inactive" and therefore approaches a zero-gain value. Gain is a fixed value, so the result is that the low level signal is increased by the Gain control, achieving the so-called "upward compression" concept.

This is very clear when you see this behavior on the LINMB display. Simply look at the yellow DynamicLine while the input signal is low or high, and see the resulting EQ curve. In a multiband compressor application, this low-level compression is very handy to create a dynamic 'Loudness Control' that could boost the LOW and HIGH bands only when their levels are low, as just one example.



Upper line shows Low-level compression (upward), achieved when Range is negative and Gain is equal but positive. Lower line shows Low-level expansion (downward), achieved when Range is positive and Gain is equal but negative. Graph is taken from C1 to help visualize the gain structures in the LinMB.

LOW-LEVEL EXPANSION (NOISE GATE)

If you are interested in a noise gate for a particular band or bands, set Range to a positive Value, Gain to the inverse of the Range, and Threshold to a low value (say -60dB). Similar to the above example, at high levels the full dynamic gain increase set by the Range is retained, and is fully compensated for by the Gain. While around and below the Threshold, the dynamically changing gain comes closer to 0dB, and the result is that the fixed negative Gain is applied to the low level signal — which is also known as gating (or downward expansion).

“UPSIDE DOWN” THINKING

These low-level examples may seem a little inverted to what you would expect. For instance, that a noise gate would have a *positive* Range. If you just remember that when the signal goes *around the Threshold*, then the Range becomes “active”, and that the Threshold is the halfway point of the Range. So whether Range is +12dB or -12dB, then audio 6dB above and 6dB below the Threshold is where the “knees” of the dynamic change will occur.

Positive Range

Then, if Range is positive and Gain is set to be the negative of Range (opposite but equal), then around and above the Threshold all audio will be a 0dB gain (unity). Below the Threshold, the Range is not active, so the Gain (which is negative) “takes over” and reduces that band’s gain. This is what gives the downward expansion.

Negative Range

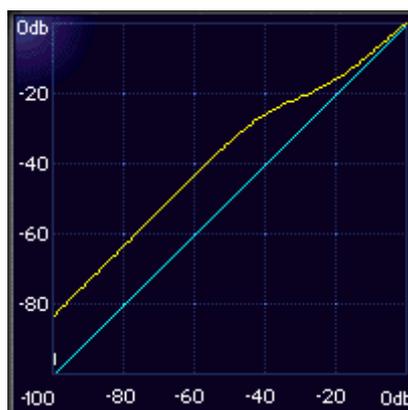
Another seeming example of the “upside down” concept is that low-level compression takes a *negative* Range. Again, remember that in the LINMB, whenever the audio is around the Threshold, the Range is active. So, if we set Range to negative, anything around or above the Threshold can be reduced in gain. However! Here’s the tricky part: if we set Gain to perfectly offset the Range value, then everything well above the Threshold has no effective gain

change at all, which means everything well below it gets “lifted up”. (If you take this just a bit further, you’ll figure that all audio exactly at the Threshold will have half of the Range’s value in positive gain).

ONE MORE WAY TO THINK ABOUT IT

Here is another bit of help so that you can really learn and use the power of the LinMB to its fullest capability. We’ll take another example from the Waves C1 Parametric Compressor, our one-band processor (it also does wideband and sidechain). It has a typical ratio and makeup gain control and has been widely used for upward compression (both wideband and split-band parametric usage).

The Linear MultiBand Parametric Processor has a very similar compressor law as the Waves C1 and the Waves Renaissance Compressor. This model allows the “compression line” to return to a 1:1 ratio line as the level continues to increase. In other words, there is no compression of the low signal, compression around the Threshold, and once the signal goes quite a bit past the Threshold, the compression tapers off back to a 1:1 line (no compression). In the graphic shown, you can see this exact type of line. The ratio is 2:1 and the Threshold is -40dB . The line is just curving a bit (-3dB down point) at the -40 input (the scale at the bottom). Output level is the scale on the right vertical edge, and you can see that at about -20dB , the line starts curving back to a 1:1 line.



So, very high-level audio peaks between 0 and -10dBFS are not touched at all, audio between -10 and -40 is compressed, and audio below -40 is not compressed, but is clearly louder at the output than at the input. This is low-level compression, or “upward compression”. Such a trick is very useful and has been implemented by classical recording engineers, mastering houses, and classical broadcasting. Low-level compression can “lift” soft sounds up gently and leave all the high-level peaks and transients completely untouched, reducing the dynamic range from the bottom upwards.

We did say that the LinMB was “very similar” to the C1, but different in a significant way: the Threshold defines the midpoint of the Range. Therefore, to achieve the same curve in the LinMB as shown here, the Threshold on the LinMB would actually be about -25 with a Range setting of $+15.5\text{dB}$. Now this is a very large amount! The example shown here was merely to make it obvious; we picked the 2:1 line only because it is easier to see on the page. In reality, low-level compression that lifts the softer audio up 5dB is equivalent to an approximate ratio of 1.24:1. Lifting the low-level up about 5dB is a good

example for several reasons. It is (1) a very realistic setting that could be equal to what is being done by the previously mentioned engineers; (2) only raising the noise floor by an acceptable amount for many applications; (3) easy to hear on nearly any type of audio, not only classical. In the Load menu of the LinMB are a few factory presets with names beginning “Upward Comp...” that are good points to learn more about this concept. More presets are in the LinMB Setup Library.

In the next chapter there are more specific examples of using low-level processing (compression, expansion) that are very good starting points as well as models for learning.

Chapter 6 – Examples of use

PRACTICE OF MULTIBAND AND MASTERING

Upon a time the mediums just couldn't handle the same dynamic range that an orchestra can produce or a Microphone transduce, so for the lower passages not to be too low and the peaks not too high, compression and peak limiting was used. In broadcasting AM signals, the hotter the signal was the further it would reach. Since heavy wide-band compression causes modulation distortions these industries used EQ Xover filters to split the signal and feed it into separate compressors and then mix back. Today's mediums for both transmission and local music playback have a dynamic range that is quite fit to carry extreme dynamics, yet compressors are still heavily used in most cases and in some to an extreme extent.

We find that nowadays the Mastering stage is where broadband signals are processed with compression for best translation from the low noise professionally equipped mixing environment to the hi fi home systems, personal headphone players or car reproduction systems. At this stage it is an art of subtlety to complement a ready-made mix while effectively taking advantage of the target media properties and the typical target reproduction properties to reach a certain optimum.

The master will be the carrier of the so-called "Flat" response of the program material. This "Flat" response may well be further processed at the listener's side for boosting or cutting frequency ranges according to taste driven preferences. While we can reach relative flatness with EQ devices, it may sometimes be complementary and perhaps necessary to add some frequency range dependant push or pull to fit even better. It's like putting the mix on vitamins, making it as potent as possible in all frequency ranges to cut through best at any given playback scenario.

It is recommended to apply MultiBand dynamics as a first generation of mastering compression before applying another stage of wide band limiting. This way more transparency will be maintained for a similar amount of loudness gained. The MultiBand stage will serve to optimize the dynamics of the broadband signal for that final stage. As indicated before it is a subtle trade. The taste and experience of the mastering engineer will determine the result and the Linear MultiBand may serve as a purist level tool offering total transparency when splitting the signal to 5 discrete bands for the engineer to do he's thing.

That aside, we recommend trying the **Multiband Opto Mastering** preset, or the **Basic multi** preset. Either one will give you reasonable compression and increased density of your mix.

To enhance low-level signals (a great way to boost level without squashing dynamics), try the **Upward Comp +5**, or **+3** version of the preset. This is great for adding level without losing punch.

TO FIX A MIX

Most of the time, you want to use relatively equivalent Gain and Range settings across the bands so to not change the spectral balance too much. However, it's not a perfect world, and many mixes are not perfect either. So let's say you have a mix that has too much kick, the right amount of bass guitar, and needs a little "cymbal control" and de-essing.

Load the BassComp/De-Esser preset.

- Adjust the bass Threshold, band 1, until you have some compression.
- Adjusting the band 1 Attack control will let through more or less of the kick itself.
- Adjusting the band 1 Gain control lets you set the overall level of the kick and bass. If the compression pulls the bass guitar down too much, you might increase the Gain until the bass is right, then adjust the Attack value to control the kick drum punch until it has a better balance.
- Faster attack times will let less kick through; slower times will let more of it be heard. In fact, with too long of a setting, you may actually *increase* the dynamic range between the loud kick and bass guitar, which isn't what the example was all about.

LINMB AS A "DYNAMIC EQUALIZER"

Because of the RANGE and THRESHOLD concept explained in Chapter 5, it's easy to think of the Waves LinMB as a dynamic equalizer which allows you to set 2 different EQ curves (low level EQ and high level EQ), then set the *transition point* between them. The transition is the Threshold control, which sits at the halfway point of the Range value. Of course, it is not a "morphing EQ" but it most certainly is a *dynamic process* that moves between two different EQ settings.

Here's an example. Load the Low-level Enhancer factory preset from the Load menu. You can see the purple range has 2 distinctly different "curves", the lower edge and the upper edge. The lower edge is flat, the upper edge has an obvious "loudness boost" to it. Now remember that this is set as a compressor, so when the signal is *low*, the upper edge of the purple band will be the EQ; when the signal is high (and compressed) the lower edge of the band will be the EQ. So for this example, with no compression (low-level sounds) there will be a loudness boost (more highs and lows); with compression, the sound will have a "flat EQ".

- Play some audio thru the Low level Enhancer setup.

You'll see that the audio is compressed downward toward the flat line, so that as more compression occurs, the effective EQ curve (although dynamic) is flat.

- Now reduce the input level to the LinMB, or play a quiet section of music so that there is little or no compression.

You'll see that the audio is not compressed very much at all, so the DynamicLine "sticks" to the upper edge more. By setting the Gain control of each band, you control the low level EQ of the processor; by setting the Range control of each band, you control the high level EQ.

How to create your own dynamic EQ setting (for low-level enhancement):

1. Set the Range to the amount of gain reduction desired in each band; this also sets the “EQ” of the compressed signal.
2. Set the Gain of each band so that the desired low-level EQ is seen. For instance, you may want a song to have a little more bass when it is soft, so set the bass band(s) so that their gain values are higher than the other bands.
3. Attack and release values should be appropriate for the frequency band. (This is why it is generally easier to work from a preset, then tweak it for what you need).
4. Set Threshold for the desired behavior. What you want is for the high levels of the song to be compressed closer to the lower edge of the purple area (to get the EQ for the high-level); therefore, the Range values should not be very big. Otherwise you'll be compressing a great deal, which is probably not what you want for most applications.

LINMB AS A VOCAL PROCESSOR

Voiceover or singing both have similar needs in compression and de-essing, and a multiband device can be quite good for this. In fact, the LinMB also lets you work as an EQ as well, as previously mentioned.

- Load the Voiceover preset from the Load menu.
 - Any of the bands can be bypassed! If you don't need de-popping, just bypass band 1, for example.
 - Band 1 is for de-popping, without affecting the deep bass.
 - Band 2 is set rather wide, to perform most of the work.
 - Band 3 is a de-esser, with a 1dB boost (note that the Gain is 1dB higher than bands 1 and 2).
 - Band 4 is just the “air” of the voice, just a tad of compression and boost of 2dB above bands 1 and 2.
 - *Optionally*, you can set Band 1 GAIN to -10, with RANGE set to zero, and the Low Crossover set to 65Hz. This can low-cut any pops or thumps but may remove some low stuff that is important; do it only if there are real problems.
- Now, while playing voiceover or vocals through the LinMB, solo each band to hear what it will affect. Band 2 certainly has all the “meat” of the voice, and by using Band 1 set to a low crossover, any loud pops or rumble will be isolated. Adjust the Thresholds of each band so that you have reasonable compression on band 2, with relatively strong de-essing on band 5. Then adjust the Gain controls to balance the tonality of the voice.

The Q and Knee controls are set very high in this preset (created primarily for voiceover), and can certainly be softened for a singing voice. Try lower Q and Knee values with smaller Range settings for more gentle compression, while still giving you powerful de-essing and “air limiting”.

AS AN UN-COMPRESSOR

Sometimes you might get a track or recording that has been previously processed, and possibly not in a very flattering way. In other words, someone might have seriously over compressed the track.

To some degree using upward expansion, which is the exact opposite of compression, can restore the squashed dynamics. As the signal goes around

or above the Threshold, the signal is increased in gain. Upward expansion takes more time to adjust because you must try to find the subjectively equal settings of what was done to the sound, and even if you know the “numbers” on the original processor, the numbers really don’t relate from one processor to the next very well.

- Load the **Uncompressor** preset.
- Notice that all Ranges are set to *positive values* so that the gains will be increased when the signal goes around or above the Threshold.
- Adjust the Master Threshold for some reasonable expansion.

Now it is important to point out that the attack and release times are absolutely critical to the way the expansion works. In most cases of over compressed material, the peaks and punch have been mightily squashed down, so a fast attack time will help restore these peaks. Longer release times help bring the presence and sustain back into the material.

However, let’s go one step further and suppose that you have a mix that has “hole-punching” or “pumping”. These are tricky, but can be restored to a degree. In the case of hole-punching, this is when a compressor has overshoot of the gain reduction, that is, it over-reacts to a peak signal and applies too much gain reduction to the signal. Many times the peak itself was never compressed, just the audio after the peak, so you would want to use a slower attack time to avoid expanding the peak even higher, and carefully adjust the release time to “fill in the hole”. It’s tricky enough to do this on a wideband expander such as the C1, and even more so on a multiband.

Best thing to do in this case is to try to determine if you should use a wideband expander (such as the C1 or Renaissance Compressor). Using a multiband upward expander would be best for situations where specific frequency ranges had been over compressed, such as a mix with too much compression on the bass. Another example would be too much compression on a drum submix and you need to restore the attack of the drums but not the low frequencies, so you could use a mid- and high- frequency upward expander and ignore the lower frequencies.

You can load the Uncompressor and simply Bypass any band you don’t need. Here’s another tip: to bypass a band but still have it available as “EQ”, simply set the Range control to zero and use the Gain control to set the EQ level in that band.

Chapter 7 – Factory Presets.

GENERAL TIPS!

Here is a recommended order for adjusting a preset, even if you have no intention of “using presets”. They are merely good places to start. Create your own library by using our User Preset command in the Save Menu.

- The first step should be to adjust the nominal threshold for each band according to the energy in that band. Set the threshold arrow to the top of the metered energy, then select Auto makeup and adjust the master threshold control downward.
- Adjust the **Master Range** control for more or less dynamic processing (changes ratio and amount of processing simultaneously).
- Next, adjust each of the band's **Thresholds** to get the desired amount of processing in each band.
- Next, fine-tune the **Attack** and **Release** controls. Longer attacks may mean you have to adjust the Threshold downward to maintain the action you want (and shorter ones may mean you need to raise it).
- Next, if needed, adjust the **Gain** of each band to rebalance the compressed outputs.

THE FACTORY PRESETS

Factory presets are designed to provide nice starting points for different applications. As the thresholds are really program related the default will have all thresholds at 0dB and it is for the user to adjust the nominal thresholds. The Factory presets when loaded will maintain the user defined thresholds and load all other parameters according to the preset.

Full Reset

This is also the default setting that LinMB opens with when you first insert it on the TDM bus. It is a easily adjustable setup with moderate Range. The Gain is set to zero so that it is essentially unity gain for low-level sounds. Band 1 is set for low bass, to eliminate modulation distortion.

Band 2 does the Low-mids.

Band 3 does the Hi-mids.

Band 4 is in a de-esser.

Band 5 is the air band limiter.

Although the Threshold is not yet set, a little bit of attenuation may already be apparent if the energy in any of the bands is high enough the soft knee will apply attenuation to signals -3dB and above.

Basic multi

Based on the default setting above, this setup uses deeper thresholds, plus it has a positive Gain of +4, so it is closer to a unity gain when bypassing for most mixed pop material with peaks between -6 and -2dBFS .

Hard basic

Master Range is bigger, so the ratio is higher and there is more compression. However, the attack times are slower than in Basic Multi, so the transients are still quite present and untouched. A punchy preset.

Deeper

Not a “flat” preset, by any means, this has deeper Ranges on the high end, which means the signal will be bassier as it gets louder, and more compressed in the high end as it gets louder. Attack and release times are faster, so the compressor grabs more.

Low-level Enhancer

A classic loudness enhancer as described in Chapter 4 in the Low-Level Compression section. As the sound gets louder, it approaches “flat compression”, but all low-level sounds will have the bass and treble boosted, as seen by the upper edge of the purple Range band.

This is not a particularly subtle preset. To reduce the boost, simply lower the Gain of Bands 1 and 4 (they are preset to 4.9, which is 3dB above the middle two bands). Try only 1dB (set them both to 2.9) and then you have a very nice subtle low-level enhancement setup.

Upward Comp +3dB

A gentle upward compressor with flat response. It lifts the low-level sounds by 3dB at the average Threshold of -35dB.

Lower the Master Threshold for more subtlety, raise it for more pronounced effect. Note the crossover settings are different from the +5 setup. Band 1 is set to 65Hz for the very low bass; Band 2 is the next octave and primarily deals with the fundamental of the bass guitar and meat of the kick; Band 3 is very broad, from 130Hz to 12kHz; doing most of the work; and Band 4 is the air compressor. These points give greater control over the bass (dividing it into 2 bands), but have no “ess-band” range. If upward compression provides too much of a boost in the highs (a common result due to the lower overall energy of HF), then simply lower the Threshold in the high band.

Upward Comp +5dB

Similar to the previous setup, but with different crossover points, for different flexibilities. This one is more similar to the Basic Multi, with crossovers at 75, 5576, and 12249, so that you have bands for Low Bass, Low-Mid, High-Mid, “Ess” or presence band, and the Air. These points give greater control over the high end (2 bands). This is a more aggressive setting, the main difference being the crossover points, which changes the Thresholds significantly from the +3 setup. Easily made more or less aggressive by changing the Master Gain setting. If upward compression provides too much of a boost in the highs (a common result due to the lower overall energy of HF), then simply lower the Threshold in the high bands.

Multi Opto Mastering

Now we are going into areas that haven’t actually existed yet, other than in C4. A multiband opto-coupled device!

This is a rather transparent setting for mastering and pre-mastering. Even though ours is virtual, the gentle release times that become ever slower as they come back to zero gain reduction really have the sound and behavior of opto's, just as the Renaissance Compressor does. The longish attack and release times of this setup let the processor gently increase lower levels while having the classic setup of a high-level compressor. Changing the Master Release and making the release times significantly faster will still preserve transients and markedly increase the average level.

Multi Electro Mastering

The other end of the spectrum, insofar as the mastering goes, with much more aggressive settings throughout than the Opto setting described previously. With fast attacks and releases, deep Range, steeper slopes, ARC system, Electro release behavior, and hard knee, this one is starting to be a little dangerous if you push it (although certainly not over the top). With this setup and the **Multi Opto Mastering** preset as bookends, there are many levels in between to provide varying levels and behaviors. Working with both of these presets defines a very broad range of high-level compression settings to create. (We'll leave that to you!).

Adaptive Multi Electro Mastering

The same as above but with -12dB sensitivity in the Adaptive control. This will let you see how the adaptive behavior loosens the attenuation for a band when there is higher energy in the band below. Try toggling between the Multi Electro and Adaptive Multi Electro to audition the de-masking that the adaptive control makes. You can try to further raise or lower the adaptive control and if you raise to 0dB or higher for hyper adaptive behavior you may want to lower the thresholds for the top 4 bands and see how they become more dynamic and hyper sensitive.

UNcompressor

Since there has been so much work done in the direction of multiband compression and limiting, it seemed only fair that a preset that tried to go in the other direction would be added. Admittedly, there is most likely a bigger challenge in undoing an over-compressed signal than in the original mistake! Wideband upward expansion is probably the first method you should try (with the Waves C1 or Renaissance Compressor), unless you can positively identify a mix that has already had some multiband or DeEssing (parametric) type of compression misprocessing. Otherwise, trying to use a multiband upward expander to fix a mix that had wideband over-compression is not advisable, as the gain changes applied in the first place would have been across the entire band. However, as flexible as the Linear Phase Multiband Parametric is in the other areas discussed in this manual, it certainly is equally capable of producing amazing UN-compression in the multiband arena. Keep in mind that the attack times are what create the transients, and if you've already got good transients in the mix but the audio *after the transients* is what is over-compressed, make your Uncompressor Attack time longer, to avoid making even bigger transients. Soloing each band and adjusting its Attack and Release times so that the transients are natural, the

compression is relieved and the audio sounds more relaxed and open is the trick.

The preset has not attempted to set attack and release times, as this is so highly dependant on the source material, we simply set all 4 bands to attack times which are moderate for the frequency band, and equivalent release times across all 4 bands.

BassComp/De-Esser

A common problem with small studio mixes is the low end, due to near-field monitors, improper room low-frequency absorption, beer, and demanding clients. Another common problem is the lack of enough de-essers to go around, and furthermore, the insistence of drummers bringing their full-size, heavy cymbals into the studio. The result is often a mix with a low end that is too loud, and/or an improper balance between the bass guitar and the kick drum, plus a high-end that might need de-essing and “de-cymbaling”. The most challenging of these situations has very bright guitars and cymbals and dull vocals. Of course, the best way to solve these issues is to de-ess in the mix, use very light cymbals, and, well, better engineering on the low end! This preset uses only 2 bands (the most common application of multiple C1’s), for bass compression/control, and de-essing.

Band 1 is set to 180Hz which covers the main part of the kick drum and almost all fundamental notes of the bass guitar or other bass line. Band 2 is a bandpass de-esser centered at 8kHz. Attack and Release controls are the critical controls. With a faster attack on Band 1, the kick can be controlled separately from the bass line with reasonable precision. Soloing the band will help in setting the Release time so that distortion is minimized (too fast a Release will cause the compressor to follow the bass wave itself, a form of modulation distortion that even multibands are susceptible to). It’s the same for Band 4; the Attack time (at 12ms) allows enough transients of the snare and consonants of the singer that there is not too much dulling of the sound, but the sustained high-frequency material, such as esses and cymbals, may be controlled quite well. Bands 2 and 4 can be used as EQ, as the Range is set to zero.

BassComp/HiFreqLimit

A variation on the previous setup, except that instead of a bandpass de-esser, the entire high frequency is a shelving compressor/limiter. Sometimes quite useful if there has been too much “air EQ” applied in the source material.

Too Much Limiting

Now what exactly should we say about this preset?

You can call it *instant radio* if you wish, as it does represent the type of processing that is applied by some radio stations in order to be as loud as possible, and they do so to recordings that have already been processed to be as loud as possible! Great for loops and remixes.

Setup with Auto-Makeup

If you haven’t tried auto makeup yet, go right ahead, grab a threshold for a band and listen to the compression rather than hear the drop in level. Try some more to see if this seems like a good way for you to work, rather than

chasing overall level all the time, the auto makeup will not totally preserve overall level but it will focus you on the dynamics setting rather than the separate levels.