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GREEN 4: COMPRESSOR/LIMITER

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Green 4 Compressor/Limiter

Introduction

The Green 4 is a 2-channel compressor and limiter. Each channel can operate independently on two mono signals, or they can be combined to act as a single compressor and limiter on a stereo signal.

Compressors and limiters both act like automatic volume controls, turning down the volume of a signal if it gets too loud. The difference between the two is:

- A limiter sets an upper limit on the volume, and will not allow the signal to go above that volume.
- A compressor reduces changes in volume, so that the dynamic range of the compressed signal is lower than the dynamic range of the input signal.

The compressor reduces the dynamic range of a signal by automatically reducing the gain when it gets louder than a certain threshold. To understand a compressor, you must understand dynamic range – if you do not, you should read the section later about dynamic range.

Note that compression tends to even out a performance (particularly of stringed instruments such as guitar) since it stops the instrument getting very loud or very quiet in the mix. When compressing hard, it also reduces an instrument's attack (again, this is most noticeable with stringed instruments).

Dynamic Range

The dynamic range of a signal is the difference in volume between the quietest and loudest parts: for music, the dynamic range can be as wide as 120 dB.

Signals with wide dynamic range demand greater attention from the listener, and require listening conditions with low background noise. Consequently, in areas with high background noise, such as a restaurant, it is hard to listen to signals with a wide dynamic range – only the loud parts are heard, with the quiet parts being lost in the ambient noise. Compressing the signal reduces the dynamic range and so makes it easier to hear in such situations.

Similarly, the dynamic range of the signal can exceed that of the medium used to carry it:

- 16-bit digital recordings (such as DAT) have a theoretical maximum dynamic range of 96 dB. It is essential that you do not exceed this limit.

- Analogue tape has a dynamic range in the order of 60 dB (though noise reduction can add between 15 and 30 dB). It is not always necessary to limit dynamic range when recording onto analogue tape, as the tape saturates naturally when recording loud signals, which in some cases can be useful.
- FM radio has a dynamic range of 40 to 50 dB.
- AM radio has a dynamic range of 20 to 30 dB.

In all of these cases, you can use a compressor to restrict the dynamic range of the signal to that of the medium.

Getting to Know the Unit

The easiest way to get to know the unit, particularly if you are not familiar with using a compressor/limiter, is to try each control in turn, so that you can hear its effect. This section gives a checklist for working through the unit's controls in a logical sequence.

When you are getting to know the unit, use it on a track that you are familiar with (for example, you could run a favourite CD through the unit); working with a familiar track makes interpretation of the results easier. Note, however, that tracks are already compressed for CD, so you may find it hard to hear the results easily. If this is the case, try using samples instead (if you have access to them), or record your own track uncompressed and then play it back through the Green 4.

1. Before you start to use the unit, ensure that it is installed and set up correctly (see the Setup section).
2. Ensure that all the buttons, including Comp In, are out (not lit), and adjust the signal level into the unit so that the normal signal level registers at around 0 dB on the meter (though peaks can go higher).
3. Set the controls in the following starting positions:
 - Both compressor threshold and limiter threshold at maximum (controls fully clockwise).
 - Ratio on full (control fully clockwise).
 - Attack and release in their central positions.
 - Make up control at minimum (control fully anti-clockwise).
 - Filters off (low filter control fully anti-clockwise, high filter control fully clockwise).
 - Gain change button lit: the meter light shows 0 to indicate that there is no compression on the signal.

Voltage Select

The module will operate on a range of voltages. The two-position switch on the rear panel that should be set to the correct voltage:

115V

Set to this position if the module is to be used with voltages in the range 85V to 120V

230V

Set to this position if the module is to be used with voltages in the range 200V to 250V

To comply with the safety codes in some countries, modules may be supplied without a voltage selector. In this case, the module is preset to the local supply voltage, which is clearly marked on the rear of the module. Check that the voltage is set correctly.

The unit will work correctly from either 50 Hz or 60 Hz power supplies, and will draw approximately 35VA from the mains supply at highest load.

Audio Inputs and Outputs

All the audio signal connections are line level, and are made via standard XLR connectors or stereo jacks, depending on your model.

The wiring arrangement is:

XLR version	Pin 1	Screen	chassis
	Pin 2	Live	audio 0°
	Pin 3	Return	audio 180°
Jack version	Tip	Live	audio 0°
	Ring	Return	audio 180°
	Shield	Screen	chassis

For all inputs and outputs, the screen is connected to the chassis earth point.

You can make either balanced or unbalanced connections to the inputs and outputs.

When the screen and earth wiring of the module is completed correctly, all modules which are marked with the European Community CE marking comply fully with the CE EMC regulations.

Input Operating Level

This switch sets the sensitivity of each input, and of its corresponding output, to either +4 dB or -10 dB:

- +4 dB is suitable for connection to professional equipment.
- -10 dB is suitable for connection to consumer equipment.

Note that in the +4 setting, the unit has high headroom, while in the -10 dB setting, the unit has less headroom but a very good signal to noise ratio, which is appropriate for consumer equipment.

Note that the switch does not affect the overall gain of the unit, but modifies the internal operating level. Therefore, with the switch out (+4 selected), an input level of +4 dB registers as 0 on the meter. Similarly, with the switch in (-10 selected), an input level of -10 dB registers as 0 on the meter.

Link

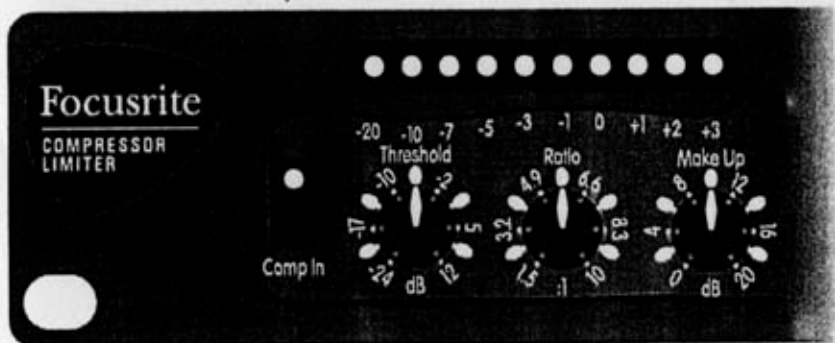
This is a stereo jack socket that you can use to connect two Green 4s.

The connection works in a similar way to the Link switch on the front panel (see later), in that the same compression is applied to separate signals. However, unlike the Link switch, there is no master/slave relationship, so the heaviest compression occurring in one of the channels is applied to all channels.

When you use a stereo jack to connect two units, the tip links channel 1, and the ring links channel 2. Do not use a mono jack, as this could damage the unit.

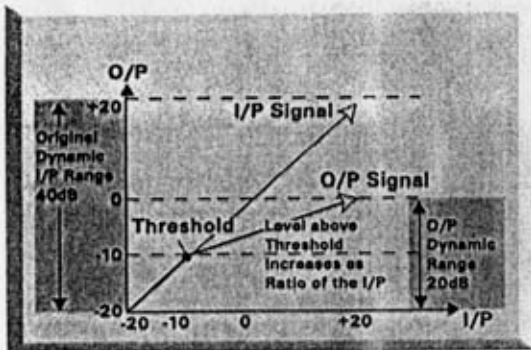
Compressor Controls

- The threshold and ratio controls set the amount of compression applied to the signal.
- The make up control sets the output volume of the compressed signal.
- The attack and release controls set the duration of the compression.



Threshold

The threshold determines when the compressor starts to compress the signal. By setting a threshold, you do not compress all of the input signal – instead, you compress the signal only when it is louder than the threshold, as shown in the following diagram:

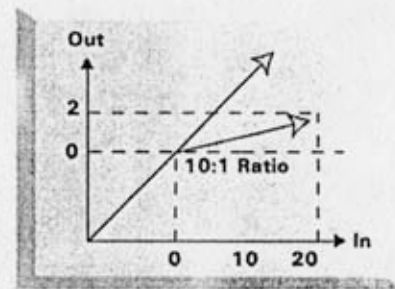


Setting the Threshold

By setting a threshold, you determine that quieter passages maintain their natural dynamic range, and only loud passages (that go above the threshold) are compressed.

Ratio

The ratio control determines how much compression is applied to the signal. The ratio (such as 2:1) refers to the ratio of change in input level to the change in output level. So, a ratio of 2:1 means that for every 2 dB change in the input level, the output level changes by 1 dB, as shown in the following diagram:



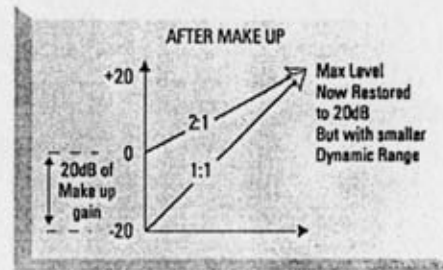
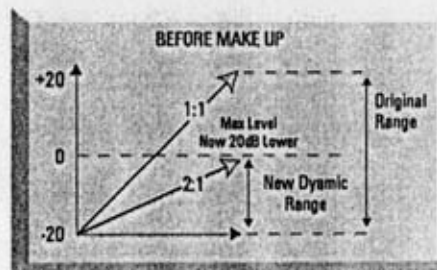
Setting the Ratio

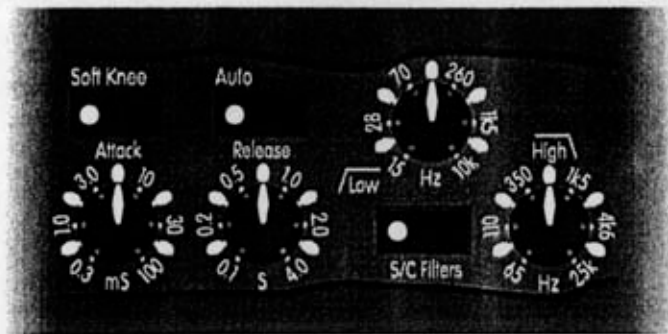
As you increase the ratio, the sound becomes tighter and the effect of the compression becomes more noticeable. A lower ratio has a softer slope, which preserves more of the original dynamic range, since an increase in input level still results in a significant increase in output level.

Make Up

The make up control adds gain to the compressed signal. Compressing a signal makes it quieter, so after you have set the compression on the signal, use the make up control to restore the signal's original volume.

In the diagram, the compressor reduces the signal by 20 dB, which reduces the dynamic range of the input and in so doing makes the signal quieter. Using the make up control restores the volume of the compressed signal.





Attack and Release

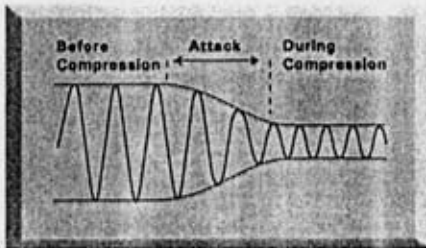
The attack and release controls determine how quickly the compressor switches on and off at the threshold. Without an attack control, full compression would be applied to the signal as soon as it got louder than the threshold. Similarly, without a release control, the compressor would switch off as soon as the signal got quieter than the threshold. While this is fine in some recording situations, in most it gives an unnatural sound to the signal, so you can use the attack and release controls to modify this.

Note that the optimum attack and release rates vary with the instrument being recorded, and with the performance. For example, when recording a snare drum, a fast attack and release are needed – a slow release over-compresses the signal, with all beats after the first dulled slightly because the compressor is still on.

Setting the Attack Rate

By slowing the attack rate, the compressor gradually comes to full compression, instead of compressing immediately. Transient response is less affected, so maintaining the presence of each note.

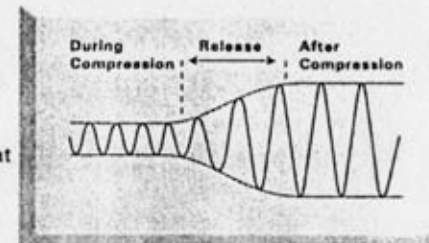
Attack times do not need to be very fast when recording onto analogue tape – you can use slower attack times of around 1 ms. The fastest transients are lost by saturation of the tape and become inaudible, and longer duration peaks can be controlled by the compressor, giving a more natural sound.



Setting the Release Rate

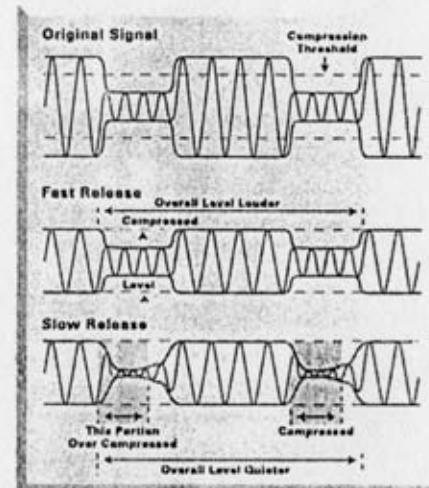
By slowing the release rate, the compressor recovers more slowly from compression, so it does not turn off completely when the signal returns below the threshold.

The release rate is probably the most important variable when recording rock music, since it controls loudness. Loudness is determined by the maintenance of high mean levels: compression increases the proportion of high-level signal content, and as the diagram shows, the faster the unit releases, the more low-level signal is brought to a higher level. Therefore, the faster the release rate, the higher the perceived loudness of the recording.



Auto

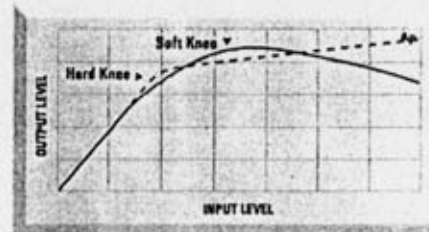
You do not have to set a permanent release time for the whole input signal; instead, you can use the Auto button. Auto reacts to the dynamic range of the input, so the higher the signal is above the threshold, the longer the release. This means that fast signals that aren't compressed hard have a fast release time, while longer signals release more slowly, which makes the compression in context with the signal.



Soft Knee

When the Soft knee control is used, the unit gives a more progressive kind of compression, similar to the units in the Red range.

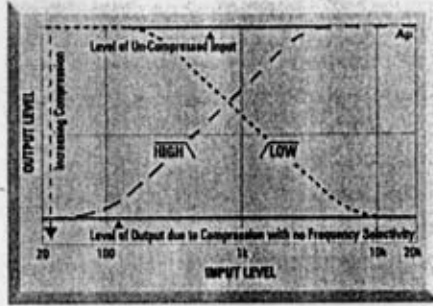
Since the soft knee gives a gentler type of compression it is actually possible to use more compression without the signal sounding very compressed.



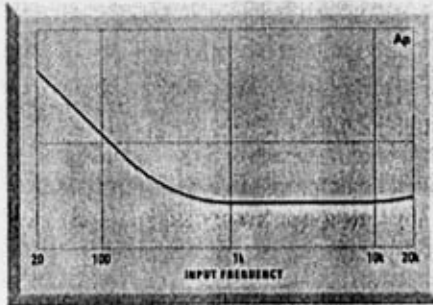
- Use standard compression when you want to do a specific, accurate job (for example, when mastering).
- Use the soft knee for a more creative effect, (for example when recording an individual instrument).

S/C Filters

The filters determine the frequencies that are sent to the compressor's side chain, and so affect how the signal is compressed. The low filter prevents low frequencies entering the side chain, and so stops the compressor reacting to those frequencies. Similarly, the high filter prevents high frequencies entering the side chain.



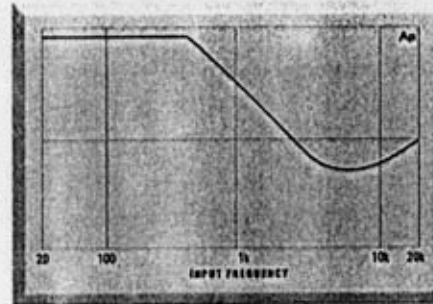
For example, one of the problems in compressing a mixed programme is that gain reduction tends to be controlled by one dominant instrument or sound. For more natural compression, you need to attenuate (reduce the volume of) the sound of the dominant instrument, but this is probably not acceptable since it would affect the mix. Therefore, you can use the filters to remove the frequencies affected by the dominant instrument, so the signal is compressed as if the dominant instrument had been attenuated.



Bass-Heavy Dance Mix Filtering

This technique can be very useful when compressing bass-heavy dance music. By attenuating the bass using the low filter, the bass in the original retains more of its dynamics.

Another application of this technique is in de-essing. When de-essing, you want sibilants in a voice to be heavily compressed. To achieve this, set a high level of compression, but use the filters to remove frequencies that are not affected by sibilance (as a starting point, set the low filter at 2 kHz and the high filter at 10 kHz, and adjust accordingly). This causes only the sibilants to be heavily compressed.



De-Essing

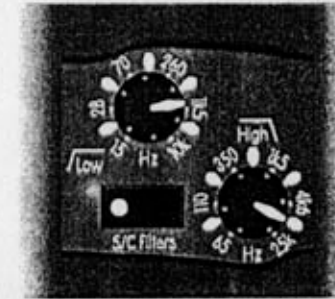
Note that, because of the range of the filters, it is possible to set them so that there is no compression at all. Since only the frequencies between the two filter settings are compressed, be careful not to set the frequency of the high filter below that of the low filter: if you do, no frequencies reach the compressor side chain, so no compression is applied to the signal.

Example of Filter Control Settings:

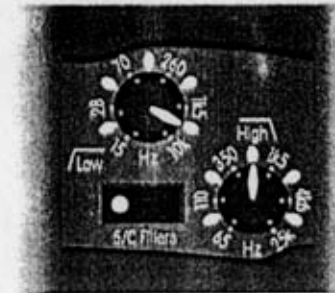
BASS DANCE MIX



DE-ESSING



NO COMPRESSION



Limiter Controls



- The threshold control sets a maximum volume for the compressed signal.
- The release control sets the duration of limiting.
- The look-ahead button causes the limiter to react more quickly.

When the limiter is working, the limit light comes on.

To turn the limiter off, set its threshold fully clockwise to +26.

Threshold

The threshold determines the absolute threshold for the signal volume after compression, and does not allow the volume to go above that threshold.

Note that the threshold for the limiter is independent of the threshold for the compressor (the dB value of the limiter's threshold is an absolute value, not a relative value above the compressor's threshold). Therefore, it is possible to set the threshold for the limiter below the threshold for the compressor – if you do this, the compressor will not work.

Release

The release functions in the same way as the release control on the compressor, and prevents the limiter turning off immediately when a loud audio signal returns below the threshold.

Normally, the limiter should have a fast release time. However, you may want a slower release if you are recording a very loud signal that remains near the limiting threshold for some time. On such a signal, you may hear the limiter coming in and out, as the signal moves above and below the threshold. To compensate for this, set a slower release: the limiter now recovers more slowly from limiting, so although it limits more it sounds less obvious.

Look-ahead

The look-ahead function is primarily intended for use when recording to a digital medium (such as hard disk), and allows the limiter to react more quickly to transients in the signal.

Even without using the look-ahead, the limiter reacts very quickly to transient peaks in the audio signal; however, it is still possible for a very fast transient to get through before the limiter cuts in. This is not normally a problem with an analogue medium (such as tape), but it can cause undesirable digital distortion in digital recording. The look-ahead delays the audio signal into the compressor, but not into the limiter, thus effectively giving the limiter a "head start" and allowing it to react before the transients exit the compressor.

In normal circumstances, you probably will not need to use the look-ahead, since you can reduce the threshold of the limiter instead – this allows the limiter to react before the transients actually get too loud. You only need to use the limiter when you want to maximise the signal level into the digital medium, so are recording at high volume near the limit of the medium, but do not want to overshoot it.

Bear in mind that the look-ahead actually adds another piece of circuitry into the audio path, and band limits the unit to around 35 kHz, so do not use it if you recording in an environment where the ultimate signal quality is of prime importance.

Display and Linking Controls



Gain Change

This modifies what the meter displays. When the switch is out, the meter displays the level of the input signal. When the switch is in, the meter displays the amount of compression. Since compression reduces the volume of the signal, the meter drops as compression is applied. For example, a 3 dB drop shows as -3 VU on the meter.

Link

This links the left and right channels for recording a stereo signal.

Normally the two channels of the Green 4 run independently in mono. Controlling a stereo signal using two independent channels is very difficult, since it is almost impossible to set the controls for both channels identically. If the channels are not compressed identically, you will compress one channel more than the other, thus shifting the stereo position to the left or the right. To avoid this problem, use the Link button, which disables the main controls for the right-hand channel: the left-hand channel's controls determine the compression applied to both channels.

Note that the Link button does not disable the look-ahead and filter controls for the right-hand channel (since they are in the signal path it is impractical without degrading the audio quality). When linking, therefore, ensure that you set them manually to match the settings of the left-hand channel.

How to Use Compression

- Using an input signal with wide dynamic range, set the controls in the following starting positions:
 - Ratio in the middle (around 5:1).
 - Threshold at maximum (+12).
 - Attack and release at their fastest.
 - Make up control at minimum.
 - Switch the meter to show gain change, so that you can monitor the effect of compression.
- Reduce the threshold, and monitor the effect this has on the sound:
 - Listen to the reduction in the dynamic range.
 - Watch the meter to see the amount of gain reduction.
- When you are close to the dynamic range you want, you need to adjust all the controls to achieve the quality of sound that you are looking for:
 - Adjust the ratio to compress softer or harder.
 - Adjust the threshold to compress sooner or later.

As you reduce the threshold, increase the make up control to restore the level of the signal.

The combination of ratio and threshold determines the maximum level of the loudest sections:

- Adjust the attack to dampen the sound or to restore transients.
- Adjust the release to even out compression between the loud and quiet sections.

The release determines the level of the quietest signal. The combination of ratio, threshold and release determines the overall dynamic range.

When to Use Compression

Compress hard:

- To stop dropping in and out (particularly vocals – compress quite hard so they sit above the mix).
- When recording bass (for example) – if there is a lot of bass energy that can easily get out of control.
- When recording snare.
- Anything you want to maintain a continuous presence in the mix.

Compress more softly:

- When the attack is an important characteristic of the sound.

When compressing softly, set the limiter to the maximum input level of the next stage in the signal chain. This lets you compress softly without the risk of overloading the next stage.

When to Use Limiting

Set the limiter when it is important not to exceed a certain output level from the unit. The limiter sets a maximum output level for the Green 4, so you can prevent it overloading equipment later in the signal chain. For example, overloading a digital device gives unpleasant digital distortion, so set the limiter to prevent peaks in the signal that could cause an overload.

Non-Operation

If the unit does not appear to be operating correctly, perform these simple checks before assuming that it needs repair.

None of the LEDs light

Check the mains supply:

1. Is the module connected to the mains supply?
2. Is the socket switched off?
3. Is the voltage select switch on the back of the unit in the correct position?
4. If the supply is okay and the module turned on but no LEDs light, then a fuse has probably blown. See the section on changing a fuse.

LEDs light, but the compressor does not appear to work properly

Check that the unit is set as you expect:

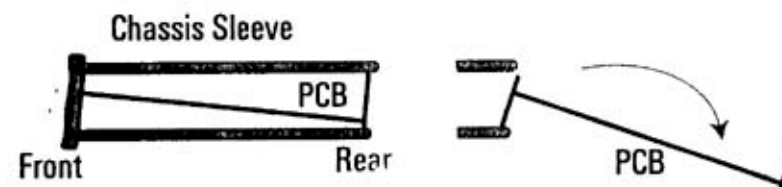
1. Is the Comp In button lit?
2. Is the compressor threshold set below the loudest signal level?
3. Is the S/C Filters button lit? If so, are the filters set correctly? (Remember that you must not set the frequency of the high filter below that of the low filter.)
4. Is the limiter threshold set to a value lower than the compressor threshold?

Changing a Fuse

We strongly recommend that you do NOT attempt to change fuses unless you are absolutely certain that you know exactly what you are doing. If you are in any doubt whatsoever, contact your dealer or the factory before you open the module.

To change a fuse, if you are certain of your technical ability:

1. Disconnect the mains cable.
2. Viewing the module from the back, remove the screws that secure the back panel.
3. Carefully slide out the inside of the unit (see diagram).



4. The fuse is in a holder close to the transformer. To remove the fuse, pull off the top of the fuse holder, which holds the fuse.
5. Replace the fuse with a 250 mA anti-surge type.
6. When you have replaced the fuse, slide the inside of the unit back into the outer cover.
7. Replace the screws in the back panel.