User's Guide

for the

CRATE PRO AUDIO

SM4-CL

Studio Module

Stereo Compressor/Limiter

CRATE Pro Audio

CRATE Pro Audio SM4-CL   Stereo Compressor/Limiter

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Introduction:

Thank you for selecting the Crate SM4-CL Stereo Compressor/Limiter. This compact device has been designed with the audio professional in mind, providing accuracy, quality, ease of use and straightforward design. The SM4-CL is designed for use in live sound reinforcement, as well as recording studios, project studios, and on stage.

In order to achieve maximum performance from your SM4-CL and to better understand its applications, please read this user's guide prior to its use.

And "Thank You" from

Features

- • Two completely separate mono compressors – linkable for stereo applications
- • Gradual transition from soft to hard knee as compression ratio increases
- • Natural, transparent sound without unwanted coloration
- • -20dBu to +20dBu variable threshold adjustment
- • 2:1, 4:1, 8:1, 12:1 and 20:1 compression ratios
- • 20uS to 1mS variable attack time
- • 50mS to 1.1S variable release time
- • Fully balanced input and output jacks
- • Ten segment gain reduction and level meters
- • LED bar indicators switchable between left and right channels
- • Level meter switchable between input and output signal
- • Active switch for comparing compressed and uncompressed signals
- • 1/3 rack mount – three fit across one universal rack tray, one rack space high
- • Made in the U.S.A. by Crate, backed by Crate's Five-Year Warranty (U.S. only)

CRATE Pro Audio SM4-CL Stereo Compressor/Limiter

Designer's Notes:

Do not let the size nor price of this unit fool you. This is a serious compressor! And because there are so many products out these days that are not serious audio tools in this format, a brief explanation is in order to acquaint you with the advantages of this design.

The seed of this design was the classic 1176, a solid-state compressor put out by Urei in the early seventies that has long been prized by studios for its transparency and natural sound. Our goal was to use this concept as our starting point for further development.

What Makes Our Compressor Better!

Many compressors, as they reduce the gain, tend to color the sound giving it a distant character. This particular design doesn't introduce this or any unwanted coloration. Part of the reason that our compressor sounds natural is in the way it controls the level of the signal. One feature that you do not see on our unit that many modern compressors have is an RMS/PEAK switch. This changes the compressor such that it responds to either the peak value of the input signal or the RMS (Root Mean Square) value of the input signal. RMS is a method of deriving a number which represents the average level of a signal and has one important side effect. The RMS value is affected by the amount of harmonic complexity. Let me give you a quick example to illustrate: let us say that you are tracking a clean electric guitar for the verses of a song, but for the chorus you would like to kick in some heavy distortion. During the verses everything is fine, with a clean compressed sound. When we get to the chorus we kick in the distortion, which adds a huge array of harmonics to the sound (and let's assume, for the sake of argument, that the perceived volume of the sounds stays the same). The compressor interprets this increase in harmonic complexity as an increase in RMS level and thus turns the gain down! Needless to say, this is not a desirable feature.

This compressor is setup a little differently. What we have done (sorry about the math) is to take the log of the average instead of using RMS, in fact, this log/average process is a natural characteristic of this type of design and does not exhibit this sensitivity to harmonic content. RMS level detection is an attempt to re-create this characteristic with other types of compressor designs, but it doesn't quite get us there. PEAK detection, instead of responding to the average value of the signal, responds to the peak level. This is useful when using the compressor to limit more transient material, such as drums/percussion. On many compressors the detection/averaging circuitry and the ATTACK control circuitry are separate. Therefore, to make the compressor respond to peaks you need to change how it detects the signal level. On the SM4-CL the detection/averaging circuitry and ATTACK control circuitry are the same and therefore faster attack settings become more of a peak type detection while slower attacks give us more of an average type of detection. This is why our Attack Time goes down to 20uS. Basically instead of a switch, we have offered a continuously variable detection control. Again, this is a natural fallout of this design, which many manufacturers try to incorporate by adding an RMS/PEAK switch to their units.

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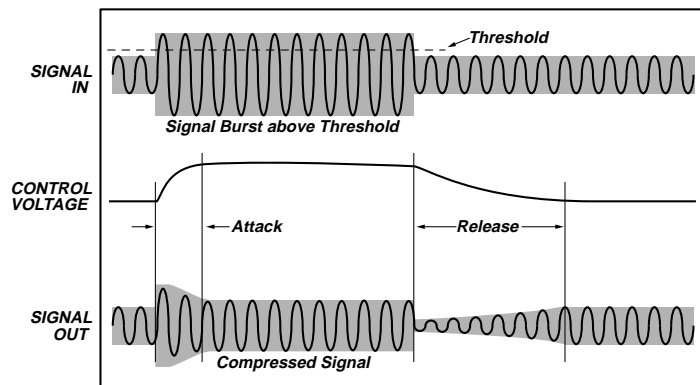# **CRATE** Pro Audio SM4-CL Stereo Compressor/Limiter

Another feature that is on many compressors today that we do not have is a HARD/SOFT knee switch. This changes the action of the compressor between immediately changing its gain curve after crossing the threshold (HARD) or slowly easing into it (SOFT). In general, a hard knee characteristic is going to be used more in limiting applications and soft knee more for general purpose compression. Our design gradually makes a transition from soft to hard as the compression ratio is changed from 2:1 to 20:1. A lot of other units on the market are trying to re-capture this classic character by providing additional circuitry to artificially create it. Again, this is a natural by-product of our design that takes some of the guess-work out of setting up your compressor.

You will also notice we do not have a sidechain jack on the SM4-CL. This particular feature cannot be implemented with this style of compressor. We felt that the gain in sonic character and transparency far outweighed the usefulness of this feature.

There are two features that we have added that most other compact compressors do not have. One is a LEFT/RIGHT switch allowing you to monitor the signals on either channel. The other is a DUAL MONO/STEREO switch: almost all small stereo compressors have a common control section that is shared by the left and right channels. We have designed this unit such that it has two completely independent compressors inside. Therefore, you can actually use it as two separate compressors. However, remember that the controls are shared and therefore the nature of the signal that you are compressing must be similar. (ie: two vocal mics, two toms, two guitars...)

A preview of things to come...

This figure illustrates how a compressor affects the signal passing through it. The "control voltage" curve represents the settings of the compressor. See pages 6 through 8 for more information.

SIGNAL IN — Threshold — Signal Burst above Threshold

CONTROL VOLTAGE — Attack — Release

SIGNAL OUT — Compressed Signal

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Compression: What, Why, Where and How:

WHAT? Very simply, compression is automated level control. Imagine setting the peak level for Celine Dion's vocal mic for her loudest part in the song. You'd never hear the soft whisper above the music track or band. On the other hand, if you set the peak level for the whispers, when she belted out the chorus, the levels would peg into distortion and possibly blow up some speakers in the process. A compressor makes soft sounds louder and loud sounds softer, thus reducing the dynamic range of the signal. Imagine someone at a mixing console with their hand on a fader listening to a channel and trying to keep the volume at a constant level. When used as a limiter the unit acts as a "watch dog" and tries to keep signals from going over a specified level, usually the point at which clipping occurs.

Compression is the key element to making your music sound more like the sounds you hear on hit recordings. You listen to compression all the time. Every record, tape or CD you buy, every radio broadcast, TV program or movie that you listen to uses compression/limiting to manage and automatically control the audio signal's level.

WHY? There are many reasons to use compressor/limiters. Below are just a few:
- During recording to prevent signal overload and improve the signal to noise ratio
- During mixdown: for the above reasons and because compression on the entire mix can impart a "produced sound" that is very common in both pop and rock styles
- Compressors are almost always used on vocals to keep a steady volume while the vocalist moves around the mic
- Compressors are almost always used on bass guitar for a tight, steady bass sound
- On any instrument to obtain a certain "sound" that compression can impart
- To raise the overall perceived volume of a signal without pasting the level meters

WHERE? Compressors are in-line devices, not parallel, meaning that they are inserted in the signal path – either via the insert on a mixer channel, between the mixer and the power amp, between a mic preamp and a mixer input, or between any line level output and input. They are not usually, however, used in Effects or Auxiliary loops with only a portion of the affected signal re-mixed with the original. (But as they saying goes, "Rules are made to be broken")

HOW? Is understanding how this works really necessary? Unfortunately, unlike other types of audio processing gear, to really use a compressor effectively you need to know how it does its job.

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FRONT PANEL CONTROLS: (see page 10 for an illustration of the following)

1. THRESHOLD: The setting of this control tells the compressor when to start doing its job (a reference level expressed in decibels). When the incoming signal gets above this level compression is applied. When the signal is below this level it passes through unaffected.

2. RATIO: This control determines how much compression will be applied to the signal after it crosses over the threshold. A ratio of 4:1 means that if the signal at the input increases by 4dB, the compressor will only let the output increase by 1dB. Limiting is performed when you have a high ratio (20:1) and the signal is almost not allowed to increase at all after crossing over the threshold.

3. ATTACK TIME: This controls how quickly, after the signal crosses the threshold, the full level of compression takes place. (Refer back to the figure on page 5.) There may be situations where a sound may have a sharp initial transient (slap bass), which you may not want to compress, but the rest of the signal needs to be more steady. You can increase the attack time to to allow that initial transient through, then have it kick in on the trailing part of the signal. On the other hand, if you have drums or percussion that you are limiting, you may want the attack time as fast as possible to grab a quick hold on the fast peaks that are coming in.

4. RELEASE TIME: This controls the amount of time it takes the compressor, after the signal drops below the threshold, to return to a state where it is no longer changing the signal. (Refer back to the figure on page 5.) This can be a very critical adjustment. Too short a release time can cause the signal to sound "pumpy" while too long a setting may not allow the compressor to recover in time to handle the next transient. A good rule of thumb is to set the release time so that it mimics the decay characteristics of the signal you are compressing. Use your ears to determine when you have it right.

5.OUTPUT LEVEL: After a signal has crossed the threshold the compressor begins to gradually turn down the volume in order to reduce it at a certain rate. Now that it has done this, your signal is going to be too low in level. This is where you need to adjust the OUTPUT LEVEL control.

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6. ACTIVE SWITCH: Once you have all of the other controls where you want them you can use the ACTIVE switch to listen to the signal with and without compression and adjust the OUTPUT LEVEL control until the overall volume of the compressed and uncompressed signals sounds the same.

7. DUAL MONO/STEREO SWITCH: This switch allows you to use the compressor as two separate mono compressors (with a common set of controls) or as one stereo compressor. The difference is that when using a compressor to process stereo sources the two channels need to be "linked" together so that if, for example, the left channel says to compress, the compression will be applied to both left and right channels equally. If this "linking" was not done (as if you used two separate mono compressors) the compression on either channel would be different and would cause the stereo image to be disturbed. Most small compressors are stereo only, therefore you can only use one side at a time for mono. The SM4-CL allows you to use both sides, however not totally independently due to the fact that you only have one set of controls. With this in mind, the two mono sources must be similar in nature, ie: two drum toms, two vocals, two guitars...

8. GAIN REDUCTION METER: This meter indicates how much the compressor is reducing the signal level at any given time and is therefore a visual indication of the compressor doing its job.

9. LEFT/RIGHT SWITCH: Allows you to monitor both the signal level and gain reduction for both the left and right channels.

10. LEVEL METER: This meter indicates the level of signal at either the left or right, input or output depending on the setting of the associated switches.

11. OUTPUT/INPUT SWITCH: Determines whether the Level Meter is monitoring the signal at the unit's input or output.

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Where Do I Start?

There *is* an art to using compressors effectively and this can only come from experience, therefore our intention here is to give you an outline of a process you can follow to get the sound you need as soon as possible. As you become familiar with the controls, visual indicators and sounds of compression, you'll develop your own methods of using these devices. Remember, there are no hard and fast rules.

Don't be discouraged – compressors *do* require some tweaking to get where you need to be. We feel that the SM4-CL is more forgiving than most and will get you there with a minimal amount of tweaking.

1. First, begin by patching in the compressor where you need it, ie: the mixing console insert.

2. Start with medium Attack and Release settings, Ratio at 4:1, Output at "0" and Threshold high.

3. Apply the source signal you wish to compress.

4. Now lower the threshold and you should eventually see activity on the Gain Reduction meter. To start, lower the threshold till the Gain Reduction meter barely shows activity for the quietest sections of the sound.

5. Now adjust the Attack control. Listen to the front part of each sound and note what it does. You need to make some decisions now. Does the sound have a sharp attack that you don't want to squash? Or maybe that *is* the sound you're after. Does the sound not have a very strong attack and therefore the Attack control doesn't come into play as much? If you're still not sure, a good rule of thumb is to adjust the attack time until it's fast enough for the compressor to do its job and no faster. In other words, try to let some of the initial attack come through without chopping it off. This helps to keep the act of compression sounding natural since alot of a sounds character is in its attack transient.

6. Next, try different Release settings. Generally you will want the release setting to mimic the decay of the sound you're compressing. Adjust it till its slow enough to sound natural, but not so slow that the compressor cannot react to the next transient.

7. Now its time to listen to what the compressor is doing for you. Take the compressor out by pressing the Active switch and comparing the volumes of the compressed and uncompressed signals. Adjust the Output level until the perceived volume is the same.

8. If you are compressing too much, you can either raise the Threshold or use a lower Ratio setting. This is where you really need to use your ears and only experience with these two controls will get you there. The idea is to get the amount of compression you need, but without being able to hear the action of the compressor. As you change these settings be sure to always compare the compressed and uncompressed signals and adjust the Output level so that they sound equal in volume.

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The Front Panel:
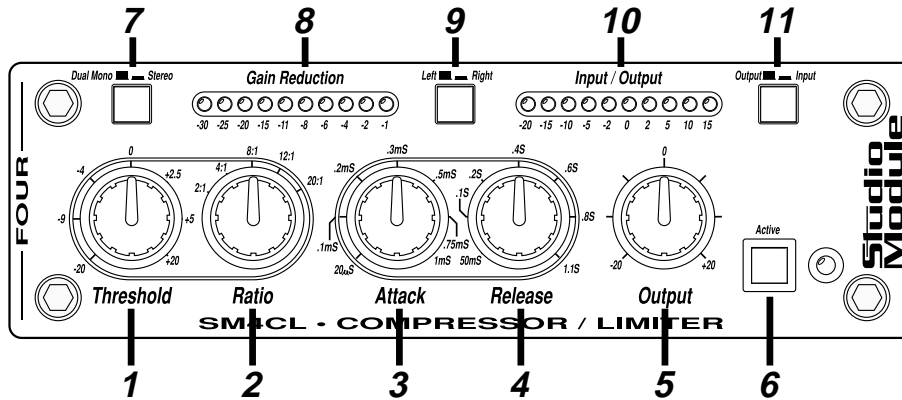
1. THRESHOLD CONTROL: Determines the level above which compression takes place.

2. RATIO SWITCH: Determines how much compression will take place.

3. ATTACK CONTROL: Determines how quickly the compressor takes full effect after crossing the threshold.

4. RELEASE CONTROL: Determines how long it takes the compressor to return to a passive state after the signal has dropped below the threshold.

5. OUTPUT CONTROL: Controls addition of output gain in order to make up for level loss during compression.

6. ACTIVE SWITCH: Allows comparison of the compressed signal with the original. Switch in is active (LED green), switch out is bypassed (LED red).

7. DUAL MONO/STEREO SWITCH: Determines if the SM4-CL works as two separate mono compressors or as one stereo compressor.

8. GAIN REDUCTION METER: Shows how much compression is taking place.

9. LEFT/RIGHT SWITCH: Determines which channel is monitored by the meters.
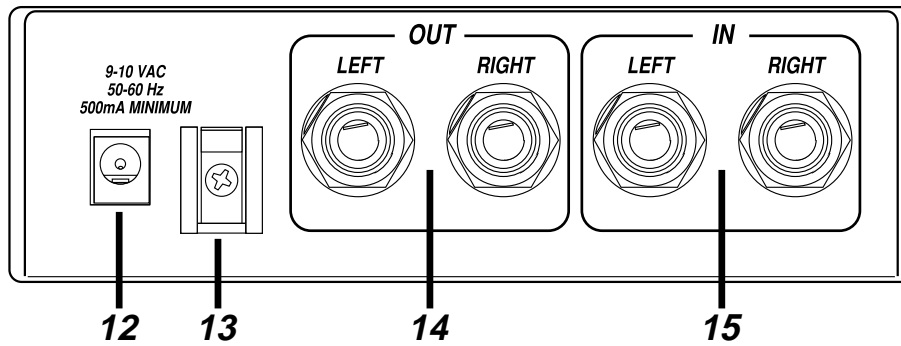
10. INPUT/OUTPUT METER: Shows the level of the signal being monitored – right or left, depending on the setting of switch #9; input or output, depending on the setting of switch #11.

11. OUTPUT/INPUT SWITCH: Determines which signal (input or output) is monitored by the Input /Output Meter (#10).

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The Rear Panel:

12. POWER SUPPLY JACK: Plug the small metal barrel connector of the AC power adapter here.

13. CORD CINCH: Use this clip to secure the cable of the power pack to the chassis of the SM4-CL.
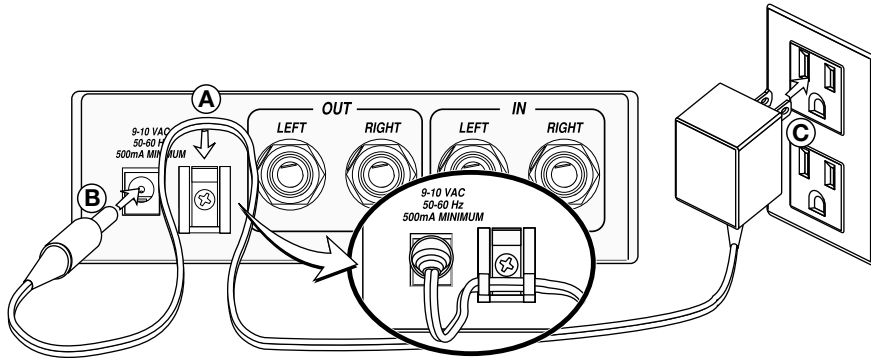
14. OUTPUT JACKS: These balanced 1/4″ jacks* carry the output signal from the SM4-CL to its destination.

15. INPUT JACKS: These balanced 1/4″ jacks* receive the input signal from the source into the SM4-CL.

*tip = signal +, ring = signal –, sleeve = ground

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Connecting the AC Power Adapter:

A) Slide the power adapter cable into the cord cinch as shown above, leaving a few inches of cable between the cinch and the cable's small metal barrel connector.

B) Plug the barrel connector into the power supply jack.

C) After all other connections are made, plug the power pack into a suitable source of AC line voltage. (See the sticker on the power adapter for voltage requirements.)

NOTE: Since the SM4-CL is "always on" when the power pack is plugged in to a live outlet, it is advised that you unplug the power pack (or turn off the AC source) when not using the unit for extended time periods.
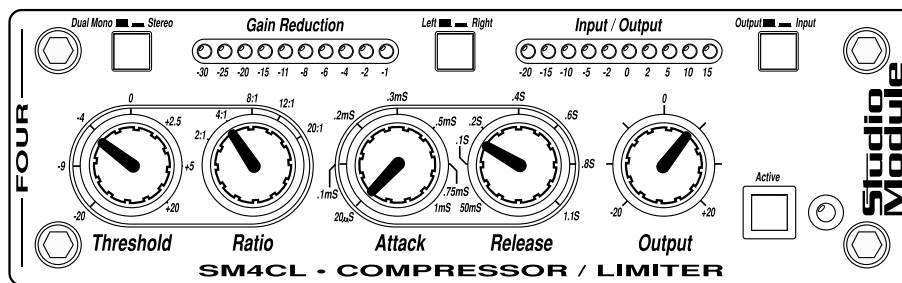
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Recommended Initial Settings:

1) Patch the SM4-CL into the signal path. (For example, into the insert jack of a mixing board, between a mic preamp and mixer input, between a mixer and power amp, or between a line level output and a line level input.)

2) Set the controls of the SM4-CL as shown in each example. Use the Active switch to compare the level of the compressed signal with the original and adjust the Output control as needed.
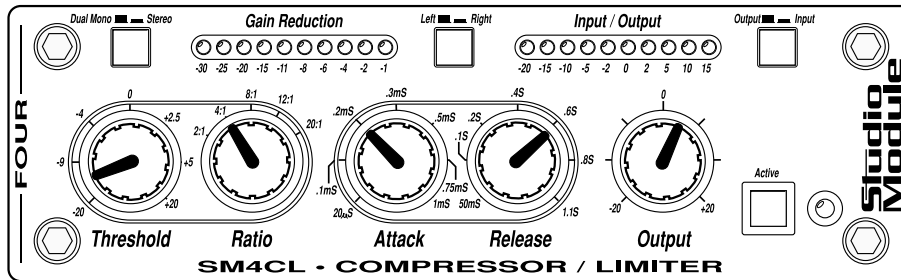
Vocals:

- *To get more breath sound between words use a higher ratio*

- *For group vocals a higher ratio usually yields a thicker sound*

- *Change to a ratio of 2:1 if a more subtle compression is needed*

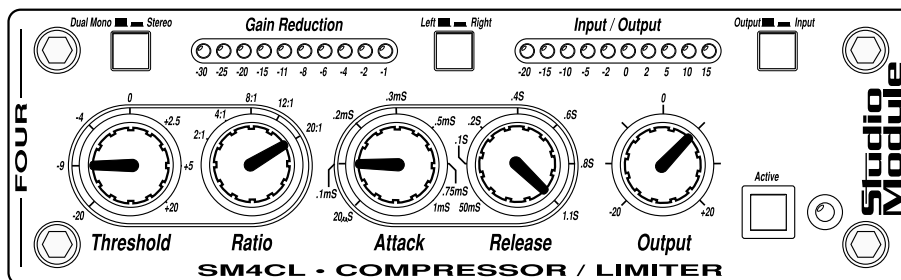# CRATE Pro Audio   SM4-CL   Stereo Compressor/Limiter

Recommended Initial Settings:

Acoustic Guitar:

> • *Try to keep your gain reduction no more than 8dB to maintain a natural sound*
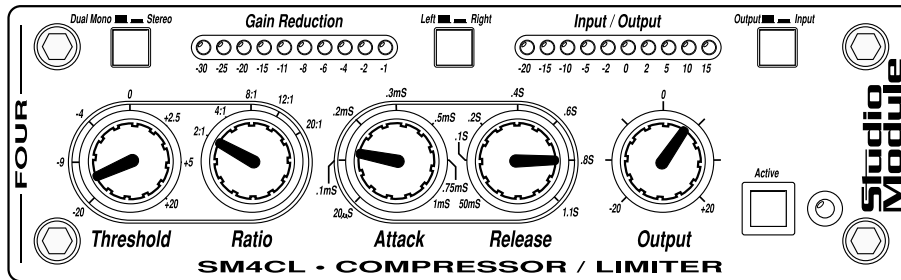
Electric Guitar:

> • *Anything is possible with electric guitars. but generally a cleaner sound will require less compression*

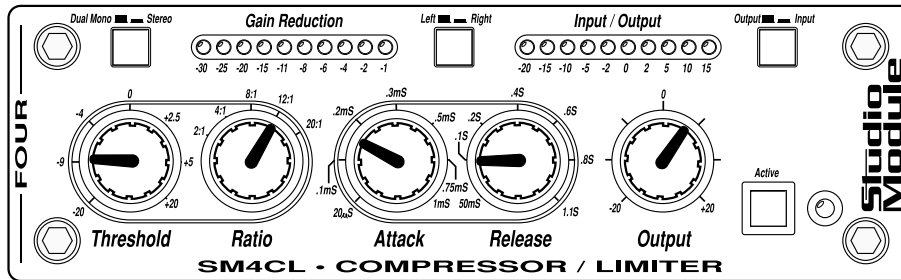# CRATE Pro Audio SM4-CL Stereo Compressor/Limiter

Recommended Initial Settings:

Bass Guitar:

> • *A more dynamic style may require a higher ratio, but be careful: too much compression can bring up fret noise*
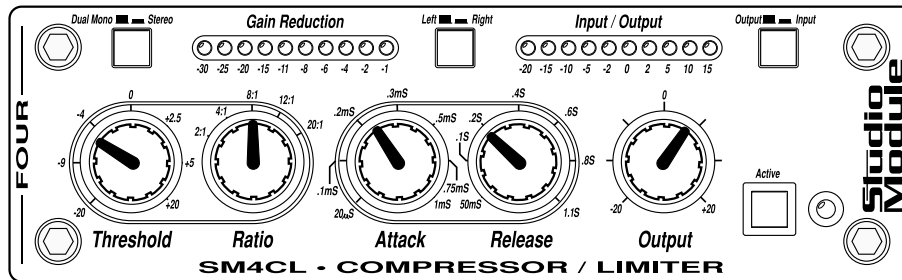
Slap Bass:

> • *Dial in the attack until you get just enough of the initial "pop" and no more.*
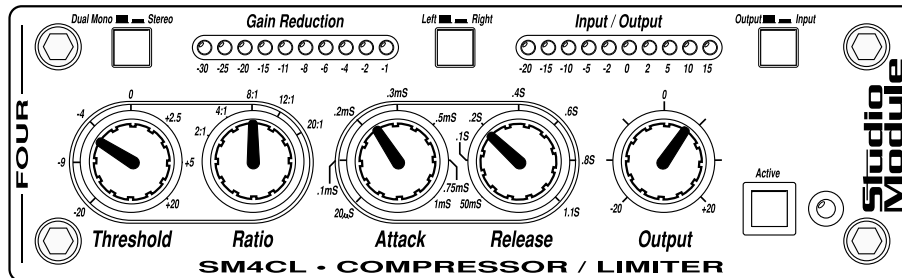
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Recommended Initial Settings:

Kick Drum:

- *To reduce boom and add punch to the sound use a higher ratio and lower threshold*

- *Faster release times can curb some of the ringing*
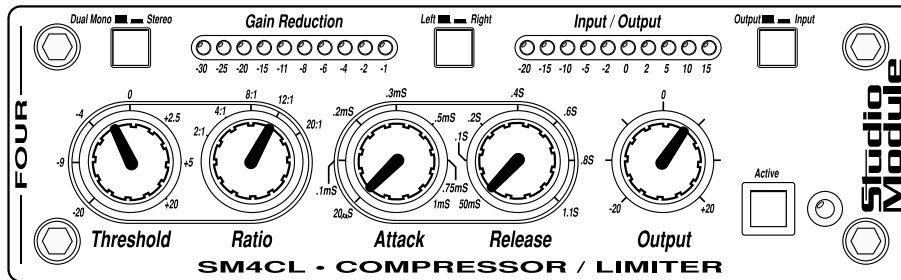
Snare Drum:

- *To get more stick sound use a slower attack*
- *Slower release times tend to fatten up the sound*

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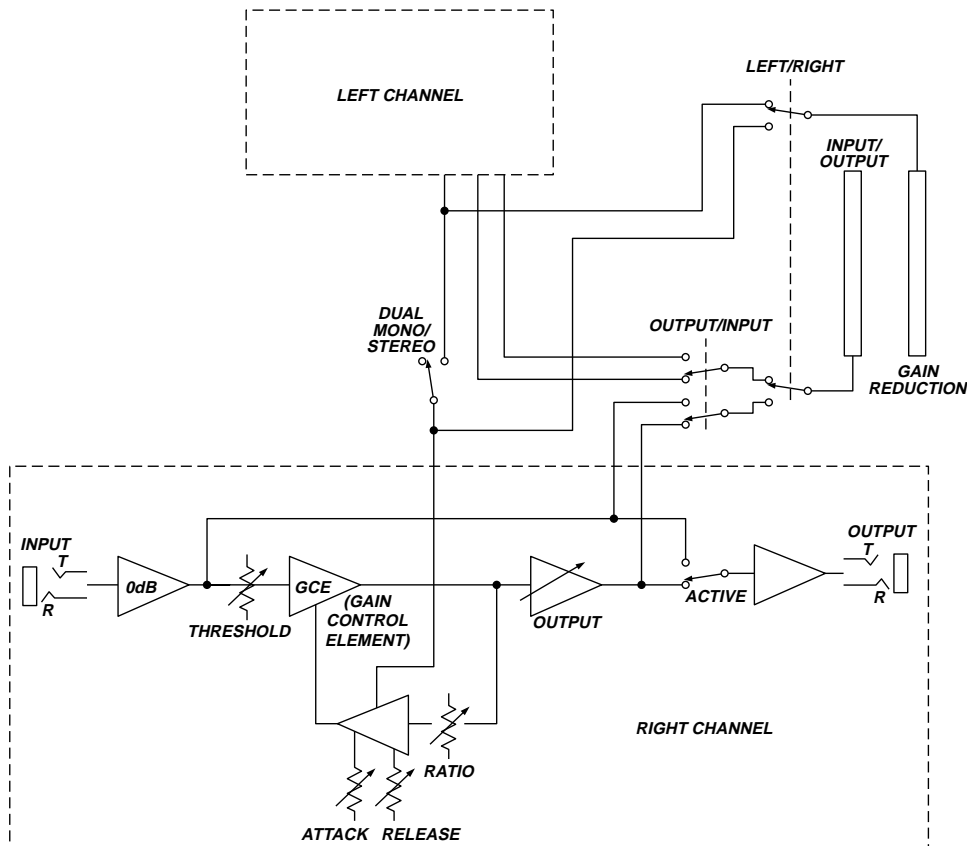
Recommended Initial Settings:

Percussion:

• Adjust the release control based on the rhythm of the source

NOTE: You can record your own settings using the templates provided on page 19!

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System Block Diagram:

SM4-CL   Stereo Compressor/Limiter

User's Settings: *(You may copy this page to record even more settings as needed.)*

Threshold	Ratio	Attack	Release	Output

Threshold	Ratio	Attack	Release	Output

Threshold	Ratio	Attack	Release	Output

Threshold	Ratio	Attack	Release	Output

Threshold	Ratio	Attack	Release	Output

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Technical Specifications:

Frequency Response	7Hz – 95kHz (measured w/10dB gain reduction)
Maximum Input Level	+21dBu
Maximum Output Level	+21dBu
Input Impedance	10k ohms
Output Impedance	1.8k ohms
Distortion	<.5% THD @ 1kHz
Crosstalk	<90dB from max output (10dB of gain reduction, output @ unity)
Attack Time	20uS – 1mS, adjustable for 100% recovery
Release Time	50mS – 1.1S, adjustable for 63% recovery
Threshold Control (rotary pot)	-20dBu to +20dBu
Ratio Control (5 position switch)	2:1, 4:1, 8:1, 12:1, 20:1
Output Control (rotary pot)	-20dB to +20dB
Active Switch/Bi-Color LED	Active/Green LED (in); Bypass/Red LED (out)
Gain Reduction Meter	10 segment LED, switchable for left or right channel
Input/Output Meter	10 segment LED, switchable for input or output level and left or right channel
Input/Output jacks	1/4" balanced T/R/S
Power Supply Requirements	10 VAC @ 500mA
Size and Weight	1.6" H x 5.6" W x 5.5" D; 1.5 lbs (without power adapter)

Specifications subject to change without notice.

Studio Module

CRATE Pro Audio

www.crateamps.com

recyclable