Squeeze Me, Stretch Me: The DC 24 Users Guide

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INTRODUCTION

Compressors, expanders, and their cohorts – limiters and gates, are all in the business of automatically controlling the volume, or dynamics of sound. Lumped together they can be called dynamic controllers, which would also have to include your hand on the fader and the fat man dancing in front of the midrange cabinet.

Used wisely, often in conjunction with each other or with equalization or filtering, dynamic controllers can improve the intelligibility of voice and the subjective effect of music. But in the wrong hands they can sound terrible, and compressors are the worst offenders.

Our goal is to de-mystify dynamic controllers as best we can within the limitations of printed media. By understanding a given tool's strengths and weaknesses, you can put it to it's best use.

Roger Nichols - "I have used the DC 24 on every album project I have done since I've had it". He has had a DC 24 since 1988. Projects include mixdown on Riki Lee Jones *Flying Cowboys*, recording and mixdown on Donald Fagens *Kamakiriad*, and numerous others.

Walter Becker - "The DC 24 is great for bass and guitar. I suggest you check it out". Walter is a member of the popular group, *Steely Dan*.

DYNAMICS 101: A PRIMER

Let's start with what a dynamic controller actually does. No matter how you cut it, these are electronic volume controls. It is a hand on a control, turning the volume down and turning it up again. The hand is really quick and really accurate, but it's just turning a volume control.

SIGNAL CHAIN

Conceptually, dynamic controllers have two internal paths, the signal and the side chains. The signal chain is the path the main signal takes through the unit: through the input circuits, the gain control device and then through the output circuits. The signal chain goes through the "volume control" in the "hand on a control" analogy.

SIDE CHAIN

The side chain is the hand which turns the control. Side chain circuitry examines the input signal and issues a control voltage to adjust the amplification of the signal. There are a number of parameters governing side chain activity, but the four most commonly discussed are threshold, ratio (or slope), attack time and release time. Some dynamic controllers offer adjustment of each of these parameters, while others have one or more preset at an optimum setting for the application.

THRESHOLD

The threshold, like crossing through a doorway, is the point at which gain adjustment begins. When the input signal is below the threshold, a dynamic controller should be like a straight wire. Above, the side chain asserts itself and turns the volume down.

RATIO

Once the threshold is exceeded, just how far the volume goes down depends on the ratio (or slope) setting. An ordinary preamp or a straight wire has a ratio of 1:1, that is, the output level tracks the input level perfectly. A 2dB change at the input produces a 2dB change at the output. A severe ratio is perhaps 8:1 or 10:1. For a 10:1 ratio, a 10 dB blast at the input would rise only 1 dB at the output – *heavy* compression. Kinder, gentler ratios are in the 2:1 to 3:1 range.

ATTACK TIME

Attack time is the time which passes between the moment the input signal exceeds the threshold and the moment that the gain is actually reduced. Attack times generally range between 1ms and 30ms.

RELEASE TIME

Release time is the time which passes between the rnoment the input signal drops below the threshold and the moment that the gain is restored. Typical release times are between .1 seconds and 4 seconds.

Some of the oldest compressors were called levelers, which are becoming popular again.They had very slow attack times and very long release times to provide volume adjustment of overall program level for broadcast. If you shouted repeatedly, the level would slowly fall off for about 30 seconds, then it would take another minute or so to recover.

COMPRESSORS

A compressor, when the input signal reaches the level set by the Threshold control, begins turning down the signal by an amount set by the Ratio control. Most modern compressors make the loud signals quieter, but do not make the quiet parts louder. (However, by keeping the loud signals under control, you can turn up the output level which will make the quiet parts louder along with the rest of the signal.) Some compressor designs actually do raise quiet signals below the threshold. These designs might be called "upward expanders".

LIMITERS

A limiter is a special form of compressor set up especially to reduce peaks for overload protection. In other words, it is a compressor with a maximum ratio. A compressor is usually set up to change the dynamics for purposes of aesthetics, intelligibility, or recording or broadcast limitations. Once the threshold of a limiter is reached, no more signal is allowed through. A limiter has a relatively high threshold, very fast attack and release times and a very high ratio, approaching infinity:1.

EXPANDERS

An expander is a compressor running in reverse. *Above* the threshold, a compressor reduces the gain; *below* the threshold an expander reduces the gain. A compressor keeps the loud parts from getting too loud, an expander makes the quiet parts quieter.

GATES

A gate is an expander with the ratio turned up. With the proper settings (low threshold and a high ratio), a gate can be applied to remove noise between louder sounds, and is often called a noise gate for the way it can lock out background noise.

GATE / EXPANDERS

A low ratio acts as an expander that turns quieter signals down, while a high ratio acts as a gate that shuts signals off.

SIDE CHAIN EXTRA #1: SEND/RETURN

The gain control voltage is derived from the side chain audio. If you were to put a signal with treble boost into the side chain audio, it would not effect the treble in the main signal path, but it would cause the high frequencies to cross the threshold sooner or more often. Large peaks of treble could be set to cause heavy compression with virtually no compression at other times. What we've just designed here is the basic de-esser, a circuit to remove excess sibilance. With a bass boost you can make a de-thumper and with a midrange boost a de-nasaler. Most compressors have a send and return available in a side chain loop to patch in an equalizer for these purposes.

SIDE CHAIN EXTRA #2: SLAVE

Many compressors and expanders make the side chain control voltage available to connect to a neighboring unit, or to tie internal channels together. This is called slaving or linking the compressors, and it causes the units to compress

simultaneously when only one has an input over the threshold. This feature is normally used to preserve stable stereo imaging, or to preserve spectral balance when the compressors are used in the high and low frequency ranges of a mono signal.

THIS IS ALL VERY INTERESTING. SO WHAT'S THE PROBLEM?

The problem is that heavy compression (low threshold and a high ratio), almost always has nasty side effects. In the first place, the timbre of the sound itself changes; it becomes "hard" and "closed" and not nearly as sweet and open as the sounds you envisioned when you got into this business. Second, attack times optimized for pleasant compression will not track initial transients quickly enough, and many instruments audibly suffer. Third, heavy compression will usually be accompanied by "breathing," i.e., the background noise rises way out of proportion to the foreground sound as the compressor releases. Bottom line: it just doesn't sound good. Take anybody's compressor, run just about any sound through it, compress it severely and run the results on Family Feud: survey says, 89% of the audience won't like it.

SO WHAT'S THE SOLUTION?

Many designs have appeared throughout the years to produce gentle, smooth, natural-sounding compression. They include tubes, FETs, VCAs, soft-knee compressors, electro-optical attenuators, and self-adjusting attack and release times. Today, some digital workstations compress without snipping transients, by looking ahead into the digital future. Is that cheating or what? So what has Rane done to make its compressors sound so great?

An independent panel of judges has studied Rane's compressor designs and unanimously decided there has been no cheating. Rane has combined a number of perfectly even handed, meat-and-potatoes ideas to make its compressors so capable and transparent that we just *seem* like we're not being fair.

IDEA NUMBER ONE

Use self-adjusting attack and release times. The compressor and expander sections in the DC 24 change attack and release times automatically to suit the program material by using dedicated RMS-sensing ICs in the side chain. If the input is predominantly low-frequency, the times are made more gradual and slowed. If a quick transient comes flashing down the wires, the times are tightened to deal with it. Our experience has shown that attack and release controls, when present, are confusing and easy to misalign.

IDEA NUMBER TWO

Combine an expander/gate function with the compressor. The expander/gate, the compressor (and the limiter: see Idea Number Three) in the DC 24 can be used independently, but a big reason they are together is to share the work of clean compression. An expanded or gated source of sound exhibits less "breathing" when compressed. Instead of looking for another patch cord when you realize you need a bit of gating, you just turn a control.

IDEA NUMBER THREE

Combine a peak limiter function with the compressor. Tracking with this idea of burden-sharing, Rane has put a peak limiter in the same path as the expander and the compressor in the DC 24. With a limiter right there, you won't be asking the compressor to clamp the wild excursions. The limiter, with auto-attack, auto-release and adjustable threshold optimized, will play level police while the compressor persuades more gently.

Rane designed a patented servo-locked limiting circuit, which places the limiter within a servo loop and effectively stops peaks from exceeding the threshold. The attack time varies with the source material, but is never allowed to produce diode-like hard clipping.

REALLY GREAT IDEA NUMBER FOUR, WHICH DESERVES ITS OWN SECTION

Here's the special twist in the DC 24: the two sections, fabulous as they are, can also be assigned to *different frequency ranges* of the same channel of sound. This is not a new idea, but it's a great idea. In the past, the difficulty has been that split-band compression has required a lot of equipment: at least two compressors and a set of bandpass filters per channel, or a very expensive difficult-to-set large unit. What the DC 24 offers is not just innovative engineering but a lot of powerful, interactive functions crammed into one rack space.

SPLIT-BAND DYNAMIC PROCESSING

We haven't talked much about split-band processing, but it's one of the easiest ways to compress transparently. Broadcast stations have used split-band compression for years, often dividing the spectrum into four or five bands. When it's done right, the radio station sounds great: loud, present, with no squashing or pumping at all.

The great Dolby noise reduction systems, from Dolby A all the way through B, C, S and SR, all use some variation on compression, expansion and band-splitting. Dolby's goal has always been maintenance of the purity of sound, with no artifacts of the processing. It works.

Split-band compression works well for several reasons: You can optimize each set of dynamic processors (the compressor, expander and limiter) to a particular range of audio. That is, the ratio and threshold controls can be suited to each part of the spectrum.

You can decide to process different ranges of an instrument differently. You could use no compression at all on the low end of a bass, with heavy compression on the top end to put the string slaps in balance with the bottom. Or you could tighten the boomy bottom up with compression but leave the top less controlled for that open feeling.

Any massive anomaly like a low frequency breath noise for example, only triggers gain reduction within its range, leaving the desired vocal unaltered. And the decidedly unmusical phenomenon of a popped 'P' sucking the overall level back 10 dB is a thing of the past.

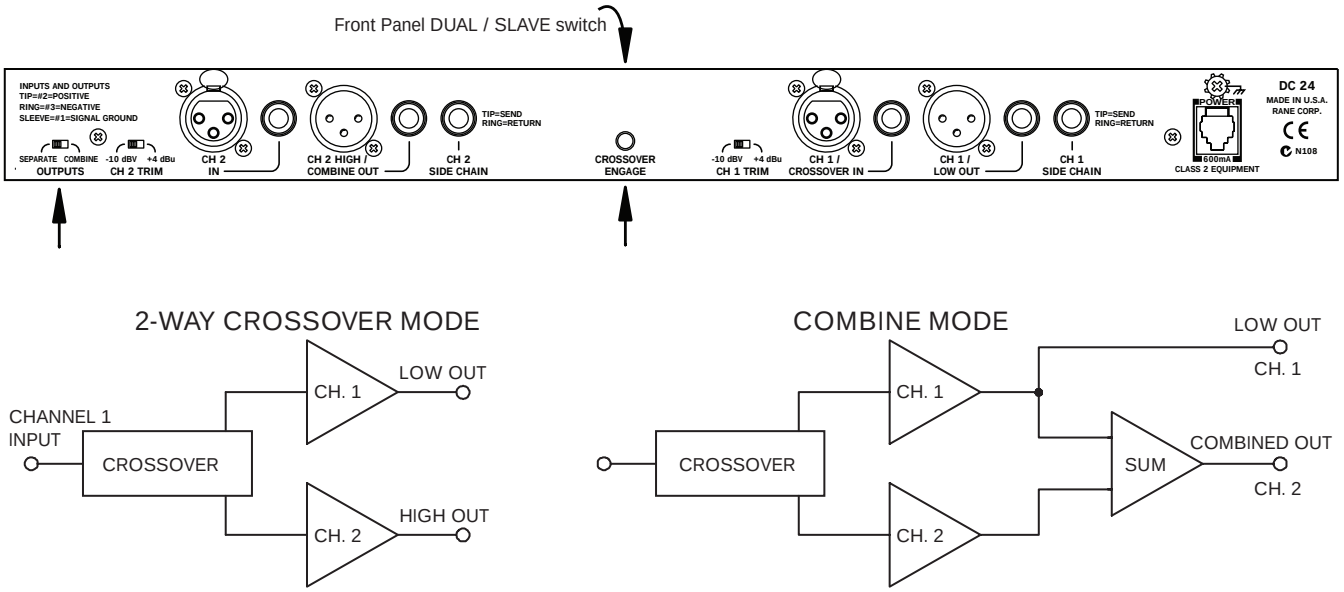


Figure 1. Results of the Separate / Combine and Dual switches in Crossover Mode.

VISUALIZING ALL THIS

Figure 1 shows a couple of different configurations, depending on the positions of the Crossover / Dual / Combine switches that truly make the DC 24 a multi-function unit. It can be a two way crossover, with independent processing on the low and high outputs. The outputs can be summed with the Separate/Combine switch, and the Crossover can be switched in (see rear panel above), so that processing the low and highs separately can take place in a mono or send/return application. Even though the outputs are summed at Channel 2's output, Channel 1 is still outputting the lows which might be valuable to a bass player running a full range along with a bass bin (see Figure 1).

Figure 2 shows how the gate/expander, compressor, and limiter all can work together on the same program material in a single channel. The vertical axis is the output level, and the horizontal axis is the input level. When all Ratios are set at 1:1, the input and output of the circuit are the same as illustrated by the straight diagonal line running at 45° across the graph. Each of the Threshold controls acts like a "hinge point", activating gain reduction only when the input signal reaches the level set by this control. The Ratio controls how much of an "angle" the hinge will bend, or more realistically how much gain reduction will occur once the threshold is reached. Graphically, the ratio can swing this hinge from 45° (no processing) to almost 90° (full ratio). It is also possible, by adjusting the Thresholds, to have each of these circuits overlap and interact with each other to develop a dynamic curve. The solid black line shows the curve produced when the controls are set as shown.

In this example, the gate/expander circuit works on the quiet parts, and the compressor and limiter work on the louder parts. The gate/expander can range from just turning down the quiet parts a little to a lot. The compressor and limiter are a lot more flexible when used separately at different thresholds, even though they have the same job of keeping the loud stuff under control. Got it?

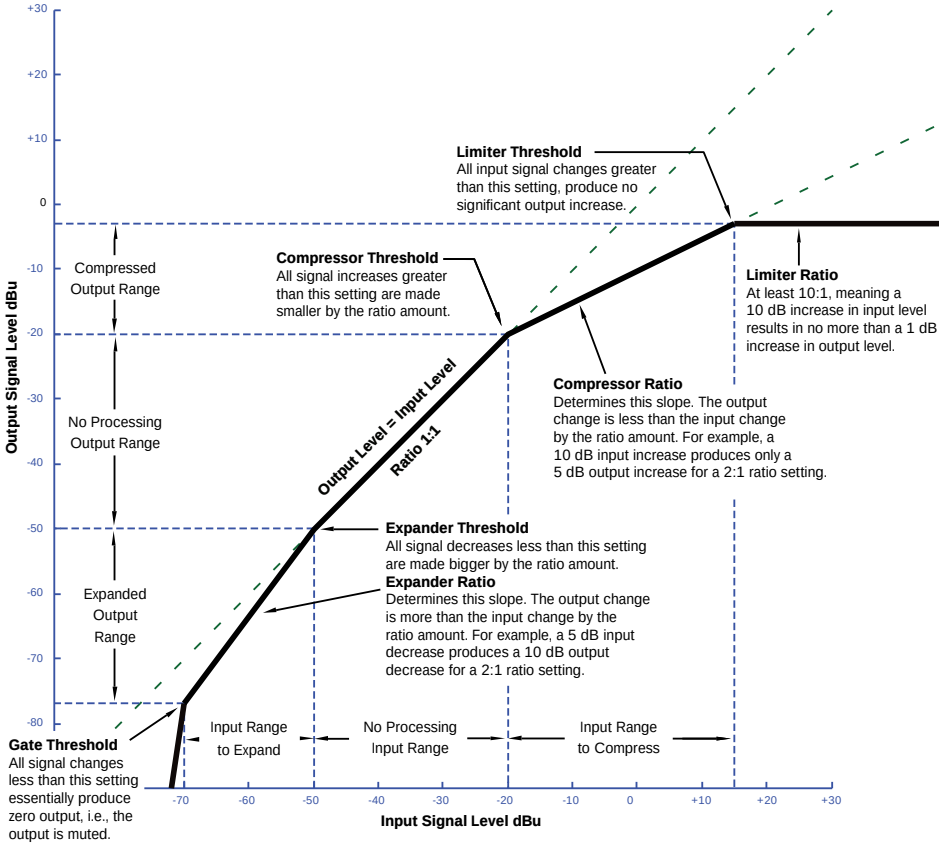


Figure 2. Compressor / Limiter / Gate Input to Output Graph

STARTING OUT

Sometimes it's neccessary to start from scratch. The panel above shows where the controls should be for *no* processing. Then you can adjust each section one at a time.

TWO CHANNEL COMPRESSOR/LIMITER

In this case, the audio path on channel 1 is completely separate from channel 2, allowing you to use it as a stereo unit or for doing two completely different processes to two completely different signals. For stereo use, the front panel has a “Dual/Slave” mode switch that allows you to slave channel 2 to channel 1. This assures that both signals are affected identically. In this application, the crossover is disengaged (this button is located in the middle of the rear panel.) The “Separate/Combine” switch on the rear panel should be in the “Separate” mode. Set the rear panel “-10/+4” switches accordingly, depending on whether you are running your system at -10 dBV or +4 dBu levels.

CROSSOVER WITH BUILT-IN LIMITING

Let’s say that you want to run a bi-amped system and process the low end a little differently than the high end. This is a handy way of saving your woofers from over-excursion. In this application the crossover is engaged and set at the recommended crossover point for your speakers, let’s just say 1.2k for the sake of example. In this instance the Separate/ Combine switch on the far left of the rear panel is set on Separate. Your input would connect to the Channel 1 input jack. This gives you a separate output on Channel 1 (signals below 1.2k, the “lows”) and everything from 1.2k and above on Channel 2 (the “highs”). This setup allows you to better contain the low end without unnecessarily limiting the high end. A crossover *and* a processor all in one rack space!

GUITAR

John Albani (Canadian Musician Magazine)- “By now, I’m sure that you have heard that a low stage volume is essential to your sound man getting a better house mix. Well, here are a few suggestions on how to achieve a lower volume without sounding like you’re playing out of a transistor radio.

“Marshalls and other 4 x 12 cabinets give a great ‘chunky’ sound, but it is also accompanied by an annoying ‘woofing’ on the lower end. This stereo compressor has the unique feature of becoming a two-way crossover with independent low end and high end compressors. With this I was able to achieve what was previously only possible with the dynamics section of the SSL console that was used for my guitar sounds on the Lee Aaron “Bodyrock” album. Take the preamp output of the loop into the DC 24 Channel 1 Input. The Channel 2 Output should return to the main amp input of the effects loop or the power amp (via your effects). Set the switches to Dual / Crossover / Combine. Now you can set a crossover point on the front panel (try around 400 Hz) and compress the bottom end at a 10:1 ratio. While chugging on a chord where you notice a lot of woofing, set the gain reduction with the Threshold control to read 6 dB. When you hit an open chord, there should be no gain reduction. If there is, back off on the Threshold, not on the Ratio. Now compress the top end between a 1.5:1 to 2:1 ratio, with 3 dB gain reduction when an open chord is hit, to give your sound a lot more attack. Also, no matter where you play on the neck, the bottom end of the sound will be even, without woofing, giving your overall tone punch and clarity.

“Warning: Do not over compress the top end or the pick attack will be slurred. If you want to hear more attack, turn up the top end Level of the DC 24 after setting the above-mentioned compression for the top end.

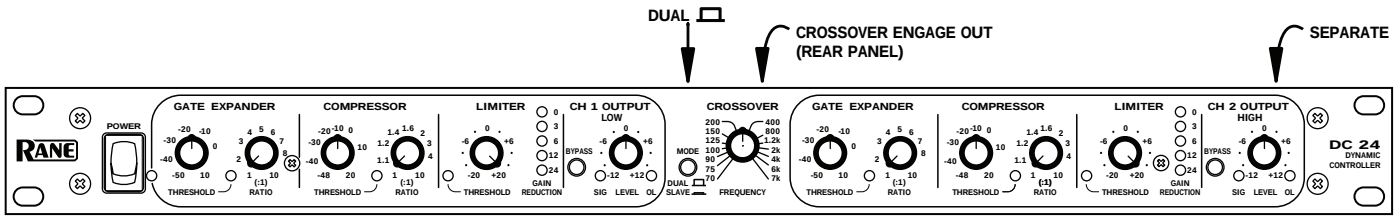
“Right now you are 99% on your way to retaining your sound or bettering it, without blasting everyone to Palookaville, or deafening your sound man.

“On stage you must work within the tonal range of your instrument. I hear guitarists with huge sounds that are great until the bass player fires up. He can’t hear because the bottom from the 4 x 12s is blurring out his bottom end. So you end up in a volume war, which puts you out of the front mix. Try this: Once you have the sound you like, back off on the bottom Level control of the DC 24. Your bass player is already operating in that tonal range and you won’t miss the sub lows when he’s playing with you anyway.”

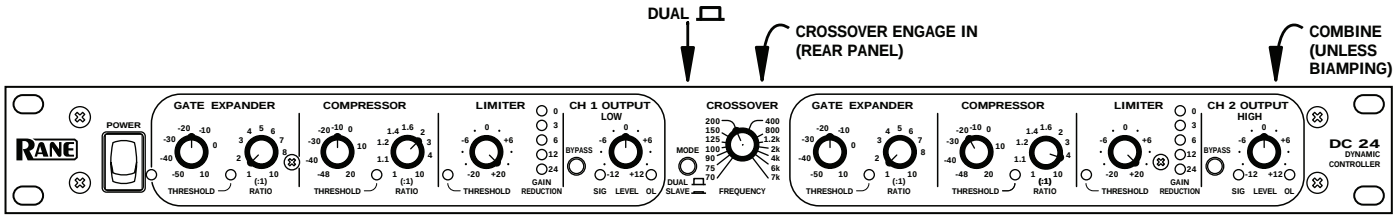
BASS

Now for you bass guitar players out there...How many times have you been yanked out of the mix by your soundman because you’re overdriving the system? You’d love to be able to keep the high-end attack without booming on the low end. Well, try this. Set the switches to Crossover *in,* Separate/Combine to Combine, and Dual Mode on the front panel. Now, plug into Channel 1 from your preamp output, and come out of Channel 2 into your amp. What you have done is split your mono signal, with a crossover point, then you’ve run it through separate processors and combined the signal back together on the Output of Channel 2.

Where does the unit go in the signal chain? Well, that depends on how you want it to function. If it’s a comp/limiter for the input signal, it would go after the bass (if the bass has a line-level output) and before the preamp. If it’s to function as a limiter to protect the speakers in the bass rig, it would go after the preamp and before the power amp. Another method



“Straight Wire” Setup



Bass Guitar Setup

is to insert the unit in the effect loop of the preamp. This allows the bass signal to be affected by the pre-amp first, then the comp/limiter, and then sent to the power amp. This can be desirable with tube pre-amps.

This unit can also be used for biamp rigs. For this, it is placed in the signal chain after the preamp and before the power amps. The output from the preamp is the signal that is processed and split at the selected crossover point. For biamp purposes, the Combine/Separate switch should be in the Separate position. Channel 1 processes the lows and channel 2 processes the highs. The low and high outputs are independent and correspond to Channels 1 and 2.

The DC 24 has two great advantages over other compressors–the crossover and the dual channels. It gives you complete control of the signal and processing of it. This is something that wasn't available before in a single unit. One stereo or two mono comp/limiters and one crossover would be required to do what the DC 24 does in a single rack space. This unit solves many compressor blues. For more attack, you can turn up the Level on the top end. Notice that when you stop playing, that amp buzz and hiss goes away. Nice, huh?

Dave Freeman (Bassics Magazine)- "I tested this unit in the combine mode with the crossover set at 200 Hz. I used my 4 string Music Man bass, famous for its ear splitting high end, as test in different channel settings. I set Channel 1 (low end) for mild compression at 2:1 with the Threshold at -10 dB. I set Channel 2 (high end) for heavy compression at 6:1, and the Threshold at -20 dB. I turned the volume and the treble controls on the bass on full, and slapped and popped like a madman. So what happened? Well, the high end was compressed down to the low end level. The sound was balanced and didn't have a compressed tone. I could slap away 'til my fingers went numb without having the comp/limiter clamp down on the entire signal. Impressive results!

"I then tested the unit with my 5 string Ken Smith bass. I set the lows for mild compression at 2:1 at -20 dB Threshold. I set the high end for the same compression but with the Threshold at -10 dB. I wanted just a bit on the bottom for the low B string and less processing on the highs. I slapped and popped on all the strings including the low B. The result was slight processing on the lows which tightened the bottom, but didn't make it *sound* controlled or processed. The highs had subtle compression that sounded natural, unlike others that 'breathe' when compressing."

RECORDING

Use it on bass guitar, piano, drums, vocals–anywhere you've used a compressor/limiter before. The DC 24 gives you more control and a less tortured sound. In fact, split-band processing works so well that a DC 24 sounds good compressing an entire mix (two required for stereo in split-band mode).

Of special interest are instruments which have large level differences in their different tonal ranges. String pops on a bass are one, but flute is another. The higher tones require more breath and are much louder than the lower. Another good application would be a drum mix or submix. A split-band compressor does a better job of smoothing the performance out.

Roger Nichols (Engineer)- He uses the DC 24 primarily on bass and guitar. He sets the Crossover at 100 Hz, the Gates and Compressors to 1:1, and engages the Combine and Dual Mode switches. This gives him separate Limiters to control the high and low peaks separately on a mono signal.

Brent Hurtig (EQ Magazine)- "In the studio, the crossover has some different applications. With Combine selected and the Crossover engaged, a signal entering Channel 1 is split into two bands. These two bands again may receive separate processing. What's different here, though, is that the two bands' signals are merged at the Channel 2 Output. This little exercise allows you to apply different amounts of compression and limiting to the low and high ends of a piano. Or let's say the saxophonist sounds great, but every time she hits the high C she pins the meters: Just the high end of the sax could be limited. Very clever.

"You also can use the Separate mode in the studio. With this setting, the crossover acts like a low pass filter to signals in Channel 1, and like a high pass filter to signals in Channel 2. We found some great sounding guitar, vocal, and keyboard tones using the DC 24 in this equalizer-like manner."

Digital Recording: Use it to compress an extremely wide dynamic range into a signal that won't go into digital overload, i.e. clipping. The limiter is the primary circuit here to keep things under control, but a little compression with its threshold set just under the limiter threshold setting will help keep the limiting even more subtle. Also, the gate can be set just above the noise floor with a low threshold and high ratio to remove mixer or tape hiss between cuts. To control a stereo mix, set the switches to Normal / Separate / Slave.