

A VARIABLE FREQUENCY LIMITER/COMPRESSOR/EXPANDER

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BY

LARRY BLAKELY
DBX, INCORPORATED
WALTHAM, MASSACHUSETTS

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A VARIABLE FREQUENCY LIMITER/COMPRESSOR/EXPANDER

By Larry Blakely
DBX, INCORPORATED

Abstract

There is often a need to modify signal dynamics in a selected portion of the audio spectrum, without affecting the remainder of the spectrum. Examples are FM signal transmission, disc cutting, modification of a solo in a master tape, or the addition of a percussive quality to a program.

The device described is a limiter/compressor/expander combined with a three-zone filter (20 Hz to 20 kHz) which permits a selectable high pass, bandpass or low pass signal to enter the limiter/compressor/expander. A special three-zone filter allows, for example, the bandpass to enter the limiter/compressor/expander, while the high pass and low pass segments of the spectrum go around the limiter/compressor/expander. The outputs of the limiter/compressor/expander, the high pass and low pass filters are summed together to give flat frequency response.

Discussion

The portion of the audio spectrum to be modified may be as little as an octave, or it may be several octaves. Furthermore, this band may be at the low, middle or high end of the spectrum.

A convenient format for ease of setting and good human engineering is a three-way splitting filter with two slide pot frequency controls operating in a single track, calibrated with a logarithmic frequency scale. (Figure 1)

The portion of the spectrum between 20 Hz and the lower control acts as a low pass filter. The portion of the spectrum between the two settings acts as a bandpass filter. The portion above the upper setting acts as a high pass filter. Thus, the settings in Figure 1. correspond to a low pass filter at 100 Hz, a bandpass filter at 100 Hz to 5 kHz, and a high pass filter at 5 kHz.

The high pass and low pass filters are voltage controlled state variable filters giving a 12 dB octave cutoff slope. As a consequence of the control characteristics of the voltage controlled amplifiers used, the filters have a logarithmic frequency-to-voltage response. (Figure 2) The bandpass function is derived from the high and low pass by subtracting them from the input signal. This gives a 6 dB/octave slope to the bandpass response and insures perfect summation on a frequency as well as time domain basis. (Figure 3)

The limiter/compressor/expander block diagram appears in Figure 4. The RMS detector response is made quite fast, and provisions made for separately variable attack and release times. The thresholds are set using operational amplifier gates in conjunction with a second slide pot with dual wipers. This arrangement facilitates setting of the transitions between limiter/compressor and compressor/expander by providing a direct visual indication of the inflection points versus the program dynamic level. In addition, LED's are activated corresponding to the zone in which the unit is operating. The meter is switchable to indicate gain change, input, or output level of the limiter/compressor/expander section. The limiter/compressor/expander is placed in operation in the system by a series of three push button switches which allow it to be inserted between any of the three filters and the summing circuit. (Figure 5) Each of the summing resistors is adjustable on the front panel to give a +20 dB range. This allows for the reduction or enhancement of the modified band. Alternatively, the filters may be used apart from the limiter/compressor/expander section as a three band, shelving type equalizer. Provision is made through front-panel jacks for inserting dynamic modifiers in each of the three bands simultaneously, thus allowing for program modification limited only by imagination.

Applications

Problems commonly encountered in recording and mixdown sessions such as the following are easily solved with this device:

Problem 1. A drum track has cymbals, snare drum, and bass drum mixed. The cymbals are splattering. Compression is applied to the high pass filter channel only, eliminating the excessive levels in this band.

Problem 2. A multitrack recording has one track with a female vocalist. We do not want the sound quality changed, but her high register is piercing and objectionable. The high frequency portion of her range is channeled through the bandpass filter and compressed to bring her voice into the desired balance.

Problem 3. A vocal was recorded on a track at too low a level, and hiss is bothersome at low levels. Downward expansion of high frequencies at low levels is used to reduce the hiss.

Problem 4. A bass drum is on a track with other instruments. More bass drum punch is desired. Heavy above threshold compression is applied to low frequencies only.

Problem 5. Sound effects from a phonograph record have too much rumble. Low frequencies are important at high levels, but the background noise is excessive in quieter portions. Low frequency downward expansion below a selected threshold is used to gate out the rumble.

Problem 6. A vocal track has too much print through. Downward expansion of the 1 kHz region eliminates the majority of the audible signal without loss of overtones and sibilants.

Summary

This device allows compression, limiting, or expansion in any selected frequency range 20 to 20 kHz. Those ranges not being signal processed are bypassed and summed at the output, thereby allowing a portion of the frequency spectrum to be processed without affecting the balance of the spectrum. This device allows dynamic modifications of problem recordings after the fact, or even problem live recordings that, in the past, had no means of being corrected.

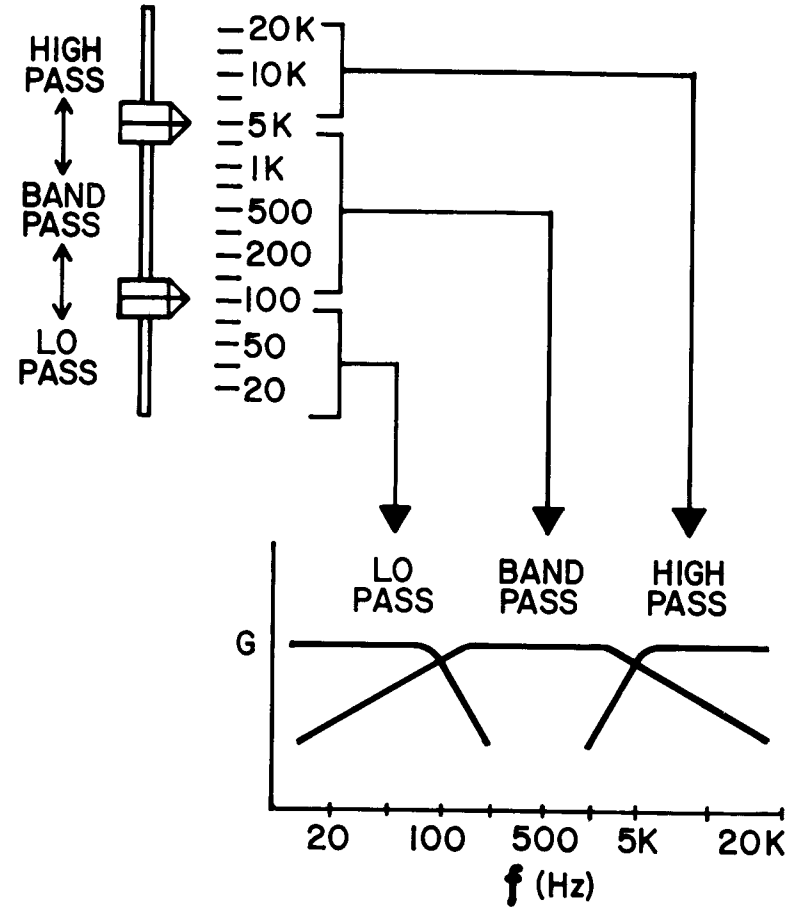


FIGURE 1.
DUAL SLIDER BAND SPLITTING CONTROL

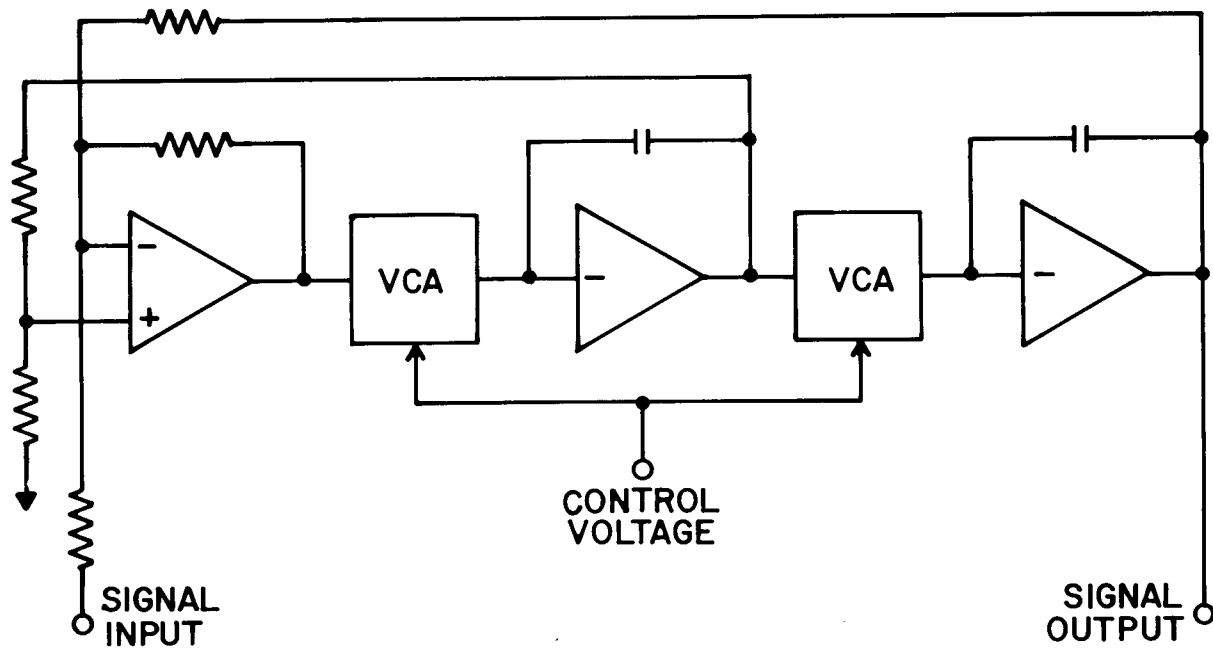


FIGURE 2.
VOLTAGE CONTROLLED STATE VARIABLE FILTER

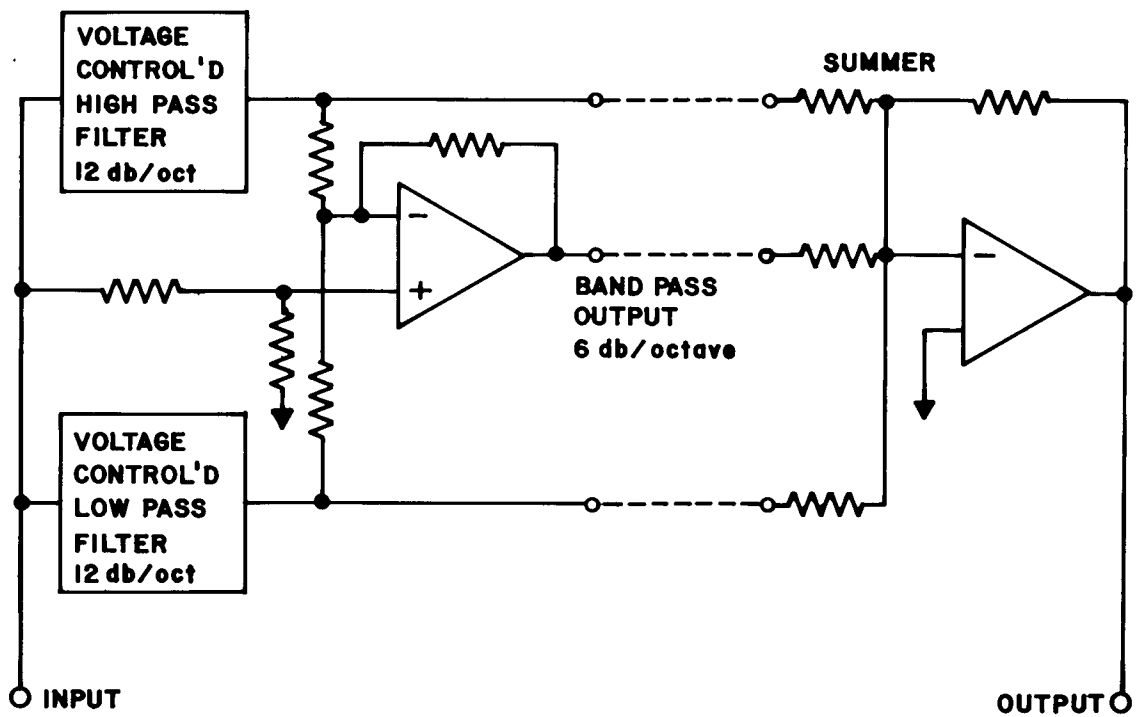


FIGURE 3.
FREQUENCY SPLITTING FILTER WITH DERIVED BANDPASS FUNCTION

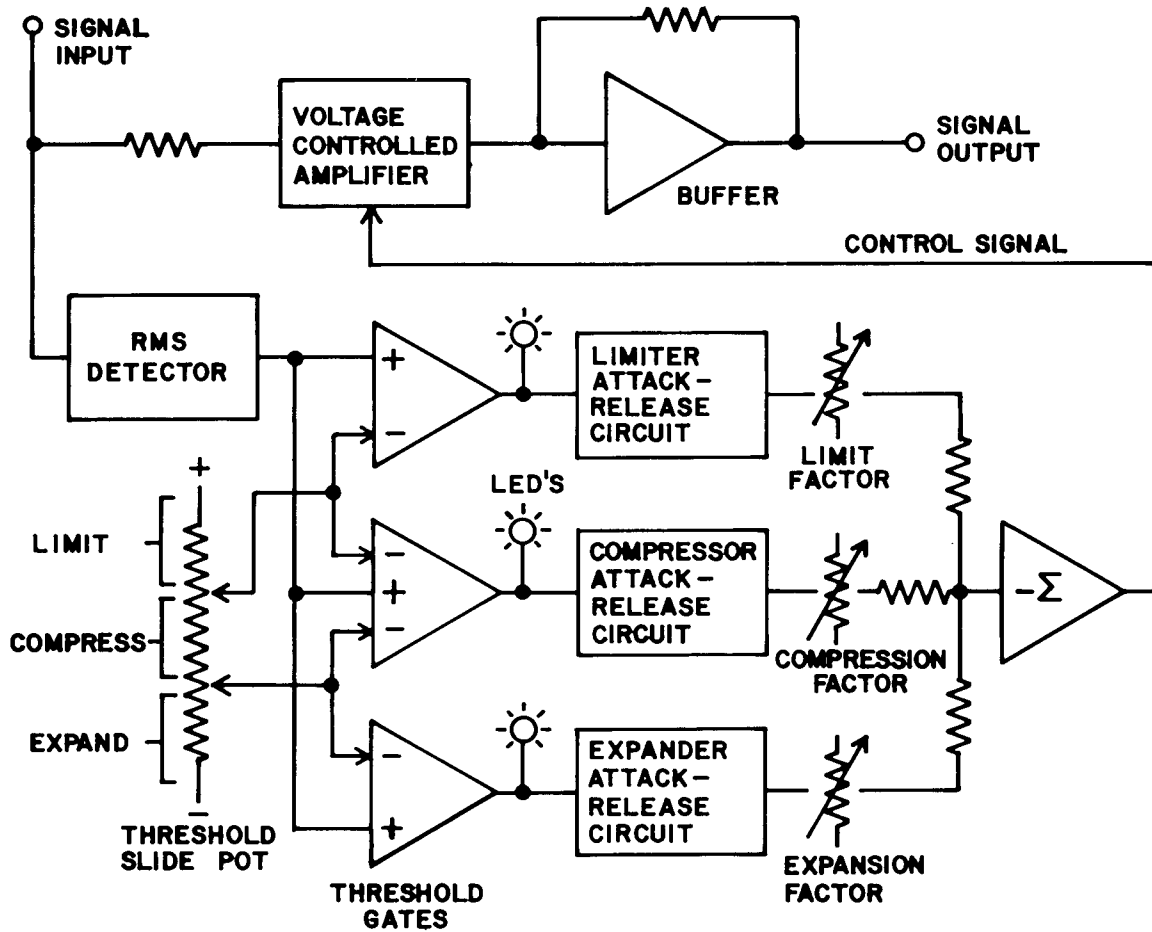


FIGURE 4. COMPRESSOR EXPANDER BLOCK DIAGRAM

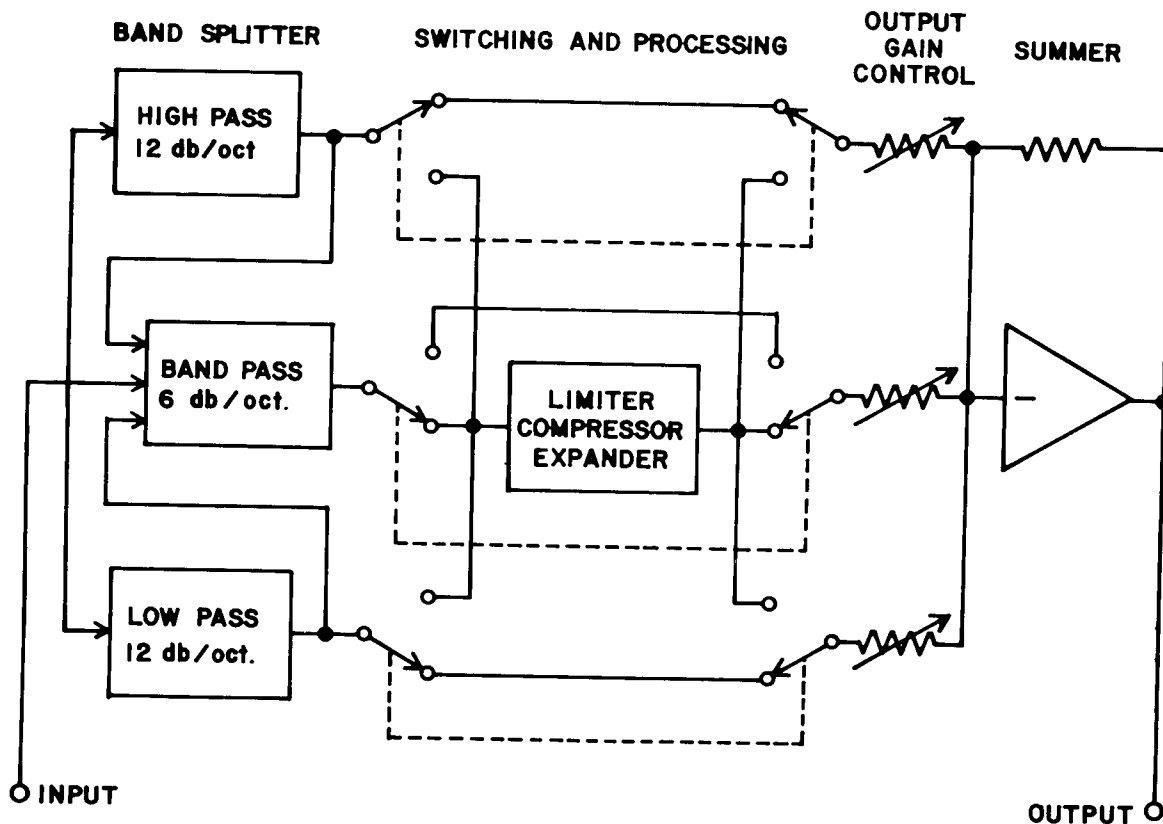


FIGURE 5.
BLOCK DIAGRAM OF MODEL 169 LIMITER COMPRESSOR EXPANDER