CLAIMS

The invention claimed is:

1. A system for enhancing the low frequency response of a loudspeaker for relatively low input level audio signals and protect the loudspeaker for relatively high input level audio signals, the system comprising:

a crossover network configured so as to separate an audio input signal into at least two frequency bands including a low frequency band; and

a signal compressor responsive to the energy level of the low frequency portion of an input audio signal in the low frequency band and configured to provide amplification gain on the low frequency portion of the input signal when the energy level of the low frequency portion of the input signal is relatively low so as to enhance the low frequency response of the loudspeaker, and provide attenuation of the low frequency portion of the input signal when the energy level of the low frequency portion of the input signal is relatively high so as to protect the loudspeaker from being overdriven.

2. A system according to claim 1, wherein the crossover network is configured to separate the audio signal into two frequency bands.

3. A system according to claim 1, wherein parameters of the system are configurable to optimize for a given speaker characteristic or listener preference.

4. A system according to claim 3, wherein the configurable parameters include one or more of the following: crossover frequency, compression ratio, maximum allowable gain, high pass filter cutoff frequency and target level.

5. A system according to claim 1 where the compressor includes an RMS based level detector for generating a signal representing the RMS energy level of the low frequency portion of the input audio signal.

6. A system according to claim 1, further including a summing block for providing a summed signal as a function of the compressed output of the signal compressor signal provided in each of any remaining frequency bands.

7. A system according to claim 6, further including a high frequency filter configured to respond to the summed signal and limit the lowest frequency energy applied to the loudspeaker.

8. A system according to claim 6, further including a peak limiter configured to respond to the summed signal and limit the maximum peak level of signal energy applied to loudspeaker

9. A system according to claim 6, further including a peak limiter configured, before the summing block, to respond to the compressed output of the signal compressor and limit the maximum peak level of signal energy in the low frequency band only.

10. A system according to claim 6, further including a static equalizer configured to respond to the summed signal and including a lower limit greater than or equal to the crossover frequency of the cross over network so that the static equalizer, when combined with the low band compressor, operates as a partially dynamic equalizer.

11. A system according to claim 1, wherein

the system is configured to enhance the low frequency response of at least two loudspeakers for left and right channel stereo play;

the crossover network is configured to separate each left and right channel audio input signals into at least two frequency bands including a low frequency band; and

the signal compressor is responsive to the energy level of the low frequency portion of each of the left and right audio input signals in the low frequency band and configured to provide amplification gain on the low frequency portion of each of the left and right channel audio input signals

when the energy level of the low frequency portion of each of the signals is relatively low so as to enhance the low frequency response of each of the loudspeakers, and provide attenuation of the low frequency portion of each of the left and right channel audio input signals when the energy level of the low frequency portion of each of the signals is relatively high so as to protect each loudspeaker from being overdriven.

12. A system according to claim 11, wherein further including a pair of summing blocks for providing a pair of summed signals as a function of the compressed output signal of the signal compressor of the left channel and the corresponding signals of remaining frequency bands of the left channel, and the compressed output signal of the signal compressor of the right channel and the corresponding signals of the remaining bands of the right channel.

13.. A system according to claim 11, wherein further a signal summer configured to provide a summed compressed signal representing the sum of the compressed output signals of the signal compressor of the left and right channels, and at least two summing blocks for providing left and right channel summed signals as a function of the summed compressed signal and the portion of each left and right channel signal provided in each remaining frequency band. .

14. A two-band compressor based architecture for use with a loudspeaker, architecture being configurable as a volume leveler, bass enhancer and speaker protection device.

15. A method of enhancing the low frequency response of a loudspeaker for relatively low input level audio signals and protect the loudspeaker for relatively high input level audio signals, the method comprising:

separating an audio input signal into at least two frequency bands including a low frequency band; and

compressing the low frequency portion of an input audio signal in the low frequency band so as to provide amplification gain on the low frequency portion of the input signal when the energy level of the low frequency portion of the input signal is relatively low so as to enhance the low frequency response of the loudspeaker, and provide attenuation of the low frequency portion of the input signal when the energy level of the low frequency portion of the input signal is relatively high so as to protect the loudspeaker from being overdriven.

16. A method according to claim 15, further including providing a pair of summed signals as a function of the compressed output signal of the signal compressor of the left channel and the corresponding signals of remaining frequency bands of the left channel, and the compressed output signal of the signal compressor of the right channel and the corresponding signals of the remaining bands of the right channel.

17.. A system according to claim 15, wherein further providing a summed compressed signal representing the sum of the compressed signals of the left and right channels, and providing left and right channel summed signals as a function of the summed compressed signal and the portion of each left and right channel signal provided in each remaining frequency band.

CLAIMS:

1. A system for enhancing the low frequency response of a loudspeaker for relatively low input level audio signals and protecting the loudspeaker for relatively high input level audio signals, the system comprising:

a crossover network configured so as to separate an audio input signal into at least two frequency bands including a low frequency band; and

a signal compressor responsive to the energy level of the low frequency portion of an input audio signal in the low frequency band and configured to provide amplification gain on the low frequency portion of the input signal when the energy level of the low frequency portion of the input signal is relatively low so as to enhance the low frequency response of the loudspeaker, and provide attenuation of the low frequency portion of the input signal when the energy level of the low frequency portion of the input signal is relatively high so as to protect the loudspeaker from being overdriven;

wherein the system is configured to enhance the low frequency response of at least two loudspeakers for left and right channel stereo play;

the crossover network is configured to separate each of a left and right channel audio input signals into at least two frequency bands including a low frequency band; and

the signal compressor is responsive to the energy level of the low frequency portion of each of the left and right audio input signals in the low frequency band and configured to provide amplification gain on the low frequency portion of each of the left and right channel audio input signals when the energy level of the low frequency portion of each of the signals is relatively low so as to enhance the low frequency response of each of the loudspeakers, and provide attenuation of the low frequency portion of each of the left and right channel audio input signals when the energy level of the low frequency portion of each of the signals is relatively high so as to protect each loudspeaker from being overdriven;

wherein the system further comprises a signal summer configured to provide a summed compressed signal representing the sum of the compressed output signals of

the signal compressor of the left and right channels, and at least two summing blocks for providing left and right channel summed signals as a function of the summed compressed signal and the portion of each left and right channel signal provided in each remaining frequency band.

2. A system according to claim 1, wherein the crossover network is configured to separate the audio signal into two frequency bands.

3. A system according to claim 1, wherein parameters of the system are configurable to optimize for a given speaker characteristic or listener preference.

4. A system according to claim 3, wherein the configurable parameters include one or more of the following: crossover frequency, compression ratio, maximum allowable gain, high pass filter cutoff frequency and target level.

5. A system according to claim 1 where the compressor includes an RMS based level detector for generating a signal representing the RMS energy level of the low frequency portion of the input audio signal.

6. A system according to claim 1, further including a summing block for providing a summed signal as a function of the compressed output of the signal compressor and the signal provided in each of any remaining frequency bands.

7. A system according to claim 6, further including a high frequency filter configured to respond to the summed signal and limit the lowest frequency energy applied to the loudspeaker.

8. A system according to claim 6, further including a peak limiter configured to respond to the summed signal and limit the maximum peak level of signal energy applied to loudspeaker.

9. A system according to claim 6, further including a peak limiter configured, before the summing block, to respond to the compressed output of the signal compressor and limit the maximum peak level of signal energy in the low frequency band only.

10. A system according to claim 6, further including a static equalizer (38, 40) configured to respond to the summed signal and including a lower limit greater than or equal to the crossover frequency of the crossover network so that the static equalizer, when combined with the low band compressor, operates as a partially dynamic equalizer.

11. A system according to claim 1, further including a pair of summing blocks for providing a pair of summed signals as a function of the compressed output signal of the signal compressor of the left channel and the corresponding signals of remaining frequency bands of the left channel, and the compressed output signal of the signal compressor of the right channel and the corresponding signals of the remaining bands of the right channel.

12. A method of enhancing the low frequency response of at least two loudspeakers for relatively low input level audio signals and protecting the loudspeakers for relatively high input level audio signals, the method comprising:

separating each of a right and a left audio input signal into at least two frequency bands including a low frequency band;

compressing the low frequency portion of each of the right and the left input audio signals in the low frequency band so as to provide amplification gain on the low frequency portion of each of the right and the left input signals when the energy level of the low frequency portion of each of the right and the left input signals is relatively low so as to enhance the low frequency response of each of the loudspeakers, and provide attenuation of the low frequency portion of each of the right and the left input signals when the energy level of the low frequency portion of each of the right and the left input signals is relatively high so as to protect each of the loudspeakers from being overdriven; and

providing a summed compressed signal representing the sum of the compressed low frequency portions of the left and right signals, and providing left and right channel summed signals as a function of the summed compressed signal and the portion of each left and right input signal provided in each remaining frequency band.

13. A method according to claim 12, further including providing a pair of summed signals as a function of the compressed output signal of the signal compressor of the left input signal and the corresponding signals of remaining frequency bands of the left input signal, and the compressed output signal of the signal compressor of the right input signal and the corresponding signals of the remaining bands of the right input signal.