DYNAMIC SIGNAL PROCESSORS

Compressors, Limiters & Expanders

Control of Dynamics
DYNAMICS

• A signal's dynamics is determined by the amount the signal level varies with time.

• A signal's dynamic range is simply the difference between the loudest and softest signal level. i.e.: lowest = -40 dbv & highest = -6 dbv gives 34 dbv of dynamic range.
DYNAMICS

Loud
100 db

Soft
40 db

dynamic range = \frac{100 db - 40 db}{60 db}

60 db
COMPRESSOR

- A device that reduces the level of a signal as the signal level increases thereby reducing the signals dynamic range.

- Often gain is added after compression, this allows the raising of low level sounds (below compression threshold).
LIKELY CONTROLS FOR A COMPRESSOR

- **Threshold**: Sets the level at which the compressor starts reducing level.

- **Compression Ratio**: Sets the amount of gain (level) reduction. The degree to which the dynamic range is reduced.

- **Attack**: Sets how quickly the compressor reduces the level after the threshold is reached.

- **Release**: Sets how quickly the compressor restores the level to the original amount when the signal falls below the threshold.

- **Key Input**: Input that allows one signal’s dynamics to control compression on another signal.
**LIMITER**

A compressor with a 10:1 or greater compression ratio.  (Often the threshold is set to a higher level)
SOME USES FOR A COMPRESSOR

- Control / reduce dynamics (sometimes aids mixing).
- Bring up low level sounds
- Increasing or decreasing the “attack” of the envelop of a waveform.
- Voice over mixing- using a key input the voice track reduces the level of a music track. Good for radio & television ads.
- De-Esser- Helps reduce sibilant vocals by using an equalizer in the key input to quickly reduce the level during a sibilant.
SOME USES FOR A LIMITER

- To protect a device (tape machine, radio transmitter, power amp) from overloading and distorting a signal.

- As an effect- Heavy compression (large compression ratios) will affect the envelope (level over time) of a sound causing it to sound different.

- Any time you need to stop the signal level from going beyond a set level.
POSSIBLE PROBLEMS

- Added noise & distortion.
- "Breathing & pumping" artifacts.
- Unnatural sound due to change in envelope.
EXPANDER

• A device which increases the level of a signal as the signal level increases thereby increasing the signal's dynamic range.

• Expanders have the same controls as compressors & some have key inputs.
USES FOR EXPANSION

- In a downward mode to reduce low level noise. The threshold controls at what level the begins being reduced.

- Restore dynamics of a compressed signal.
NOISE GATE

A device that provides attenuation of a signal until a threshold level is reached.
SOME USES FOR A NOISE GATE

- To reduce unwanted low level sound.
- Effects- Key input, for example, can allow one track to turn on and off another track.
COMPANDER

- A combination compressor & expander.
- When recording to analog tape compression is applied so that the lowest level signals can be recorded at a higher level further away from the tape hiss.
- On playback an expander restores the signals original dynamics and the tape noise (hiss) is reduced.
- Noise reduction systems such as Dolby, DBX use companders to reduce tape noise.
COMPANDER

Signal With Out Compander

Level

Distortion Level

Tape Noise

Signal’s soft levels in Tape Noise
COMPANDER

Compressed Encoded Signal

Distortion Level

Signals Lowest Level now away from Tape Noise

Tape Noise

Expanded Decoded Signal with restored dynamic Range
LOUDNESS NORMALIZATION

In an effort to control unwanted variations in loudness in different program material on TV the Calm act was voted into law. This created a standard for loudness called ITU-R BS.1770. In TV/Film the audio is normalized to -23 LUFS (Loudness Units relative to Full Scale). Which means the average level is -23 below the peak maximum.

YouTube uses -14 LUFS
Spotify uses -12 LUFS
iTunes uses -16 LUFS (if soundcheck is on)
see http://www.soundonsound.com/sos/feb14/articles/loudness-war.htm