

JJR ACOUSTICS, LLC

EXCELLENCE IN AUDIO

146th AES Dublin Ireland

W07 - Impact and Audibility of Distortion in
Automotive Audio Applications



www.jjracooustics.com



1. Costs and Distortion

- Speaker count
- Power levels
- Channel count

Acoustical

- *Small Vehicle*
 - *Speakers: 4-6*
 - *Speaker Acoustic Target: 82dB @ 2.83 Vrms*
 - *In-Vehicle Max SPL: 97-100dB*
- *Mid-Size Vehicle*
 - *Speakers: 6-10*
 - *Speaker Acoustic Target: 85dB @ 2.83 Vrms*
 - *In-Vehicle Max SPL: 100-103dB*
- *Large Vehicle*
 - *Speakers: 8-12*
 - *Speaker Acoustic Target: 88dB @ 2.83 Vrms*
 - *In-Vehicle Max SPL: 103-106dB*
- *Luxury Vehicle*
 - *Speakers: 10-19*
 - *Speaker Acoustic Target: 91dB @ 2.83 Vrms*
 - *In-Vehicle Max SPL: \geq 106dB*

Amplifier

- *Small Vehicle*
 - *Channels: 4-6*
 - *Class AB – 40W – $\leq 10\%$ THD – 14.4 VDC*
 - *DSP: 2nd Order HP/LP, Cut-Boost and Shelving Filters, Delay*
- *Mid-Size Vehicle*
 - *Channels: 6-10*
 - *Class AB – 50W – $\leq 10\%$ THD*
 - *DSP: 4th Order HP/LP, Cut-Boost and Shelving Filters, Delay, Dynamic Filters, Spatial Enhancement*
- *Large Vehicle*
 - *Channels: 8-12*
 - *Class AB or D – 50W – $\leq 10\%$ THD – 14.4 or 24 VDC*
 - *DSP: 4th Order HP/LP, Cut-Boost and Shelving Filters, Delay, Dynamic Filters, Spatial Enhancement, Surround*
- *Luxury Vehicle*
 - *Speakers: 10-14*
 - *Class AB (Discrete) or Class D – 50W – $\leq 1\%$ THD – 24 VDC*
 - *DSP: 4th Order HP/LP, Cut-Boost and Shelving Filters, Delay, Dynamic Filters, Spatial Enhancement, Surround*

2. Tuning for lower distortion

a. Gain limiting

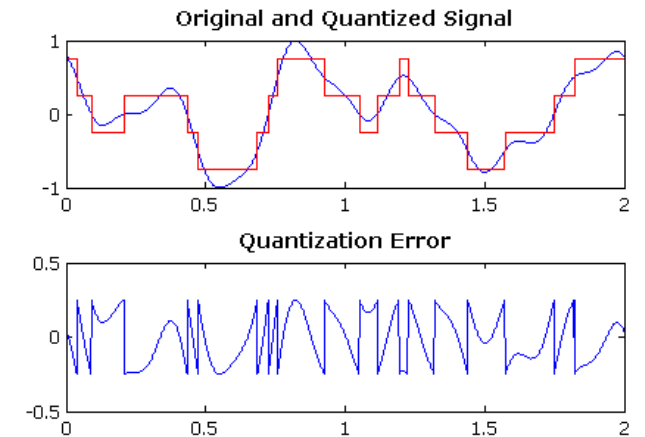
- a. Manual or Automatic – less than optima

b. Artifacts of compression

- Quantization noise and zero quantizer artifacts are often audible in compressed audio.
- Blind playback through common upmixers result in the unmasking of resultant artifacts
- Side (difference) channel artifacts may be crossed-masked in less than optimal spatial environments through parametric image re-parsing
- Bad opportunities for spatial “reassignment” of spectra to alternate portions of the image
- **Goal:** fix the source: mask codec artifacts and using adaptive architectures (re: different codecs)

c. **Adaptive, derivative based, equalization** - Adaptive equalization that eliminates downward adaptation of the human hearing system.

- **Benefits:** extending bass and brightness. Saves power, reduces transducer temp, saves/improves hearing.



3. Time and Phase Distortion

- Relative phase distortion is typically found to be inaudible in a controlled environment, but in a car it either becomes augmented or masked