

## OVERDRIVING A HEARING AID WITH MUSIC:

Music and speech are quite similar in many ways but an essential difference is that music is louder than speech. It is rare to have speech levels in excess of 80 decibels but even quiet music can have peaks that are far in excess of 90 decibels. While this wasn't as large of an issue in the "olden days" of analog hearing aids, modern digital hearing aids use an "analog-to-digital converter" also called an A/D converter. This converts all sound- music and speech- to digits so that the digital amplifiers can do their modern day magic. But with advances in technology comes its own problems. Many modern A/D converters, also known colloquially as the "front end" of the hearing aid can only transduce levels below about 90 or 95 decibels. Inputs to the hearing aid above this level- a common occurrence for music- will overdrive the front end and cause distortion. Once created, this distortion cannot be reduced. There is no hearing aid "programming" changes that can get rid of this distortion. This is a built-in hardware limitation of the hearing aid.

The maximum input level of modern digital hearing aids is sometimes referred to as the "peak input limiting level" and a hearing aid that won't be overdriven with ensuing distortion, would have a sufficiently high "peak input limiting level". Its best to think of this level as a bridge; if it's a low-hanging bridge nothing can get past it without significant distortion.

Many modern hearing aid manufacturers have resolved this problem, but not all. There have been some ingenious strategies by hearing aid design engineers to address this problem but this is a quickly changing aspect of current hearing aid technology.

To demonstrate this phenomenon, an "experimental" hearing aid was constructed (courtesy of Mead Killion, Russ Tomas, Norm Matzen, Mark Schmidt, and Steve Aiken) where the peak input limiting level, or front end, could be altered from an input level of 115 dB SPL which is near the limit of many modern day digital hearing aids, in steps, down to 90 dB SPL, which is the case of many low-end and poorly designed hearing aids.

In these files, all other hearing aid parameters such as gain, output, compression settings, and frequency response, have been kept the same. The only change is in the level of the peak input limiting level.

All files have the same presentation format: Peak input limiting level of 115 dB SPL, 105 dB SPL, 96 dB SPL, 92 dB SPL, and 115 dB SPL again.

The first audio file is for speech at 60 dB SPL input. Note that there is no real effect of peak input limiting level setting on the speech clarity since speech is a relatively quiet signal.

The second and third audio files are for music at 90 dB SPL and 100 dB SPL input levels respectively. With the normal playing and listening levels of music that are evident in our society, peak input limiting levels that are too low will cause an unresolvable distortion.

***All music is by one of my favorite groups, U2. If you like their (undistorted) sound, download some of their MP3s!***

[File 1: Combination 60 dB SPL](#)

[File 2: Combination 90 dB SPL](#)

[File 3: Combination 100 dB SPL](#)