

## Tip #37 That's a Gross Distortion

The term “distortion” is used pretty frequently in audio, but it’s not understood particularly well. There are different kinds of distortion, and some is more audibly bothersome than others.

By pure definition, if the output of an audio device differs in any way from the input, that difference is “distortion,” because theoretically, the device’s output should be a perfect mirror of the input signal. Nothing more, nothing less.

Well, unfortunately, this is the real world, and except for former Heavyweight Champion Rocky Marciano’s 49-0 record, nothing is perfect. Audio equipment produces distortion, and this distortion falls into two main categories—harmonic distortion and intermodulation distortion. We’ll explain both kinds (in simple terms, don’t worry!), and then you’ll know more than your friends.

### Harmonic Distortion

This distortion is defined as unintended signal products generated by an audio product that are whole number multiples of the original signal. For example, if an audio device is asked to reproduce a 40Hz signal, and instead produces 40Hz and a small amount of 80Hz + 120Hz + 160Hz + 200Hz, the 80Hz + 120Hz + 160Hz + 200Hz product is called harmonic distortion. Small amounts of distortion close in multiples to the original signal (“lower-order harmonics,” like 80Hz) are barely audible; larger amounts of distortion in greater multiples far away from the original signal (“upper-order harmonics,” like 200Hz) are grossly objectionable to the human ear. The sum total of all harmonic distortion products is expressed as a percentage of the original signal, or % Total Harmonic Distortion (% THD).

The human ear is most sensitive to midrange frequencies, so small amounts of distortion (less than 1%) in the 500-2000Hz range are clearly audible. We’re pretty insensitive to harmonic distortion in the bass range, so even 5-10% THD in the 20-60Hz region is usually not objectionable, as long as the device is not exhibiting other forms of audible misbehavior as well (mechanical scraping, buzzing, port ‘chuffing’, etc.). (See figure 1.)

### Intermodulation Distortion

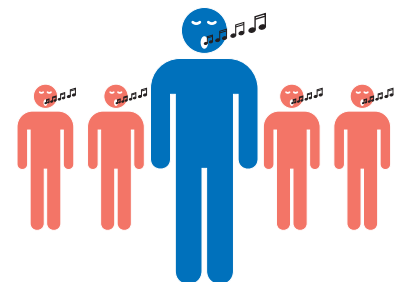
This is a bad one, because—unlike THD—it’s not harmonically-related to the original signal at all, so even very small amounts are audibly objectionable. IM distortion is when the distortion products occur at frequencies that are sums and differences of the original input signal. For example, if the input is 500 Hz and 2200 Hz, then the IM distortion products will occur at 1700 Hz and 2700 Hz. These frequencies have no musical relationship to the original frequencies at all, so the sound is very harsh and discordant. (See figure 2.)

Now when you read those THD and IM distortion specifications, you’ll know what they mean.

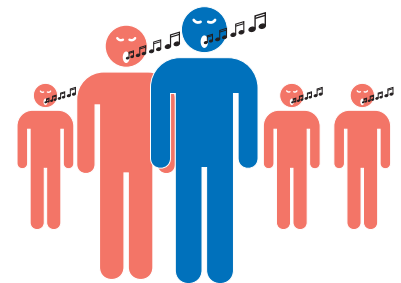
### Other Tech Tips:

- Tip 33: Surround Speakers – Explained!
- Tip 34: Why isn’t the 30 LCR an IWCB?
- Tip 35: New x400 Sats vs. x200 Sats?
- Tip 36: IWTS IP vs. non-IP versions

Figure 1 Low Harmonic Distortion is Good



*As long as the harmonics are small, the melody is good*



*When harmonics get too loud, the main melody is ruined*

Figure 2 IM Distortion Always Sounds Bad

