Tech Talk: Power Handling – Mechanical vs Thermal

November 30, 2017 | 0 Comments | 1522 Views

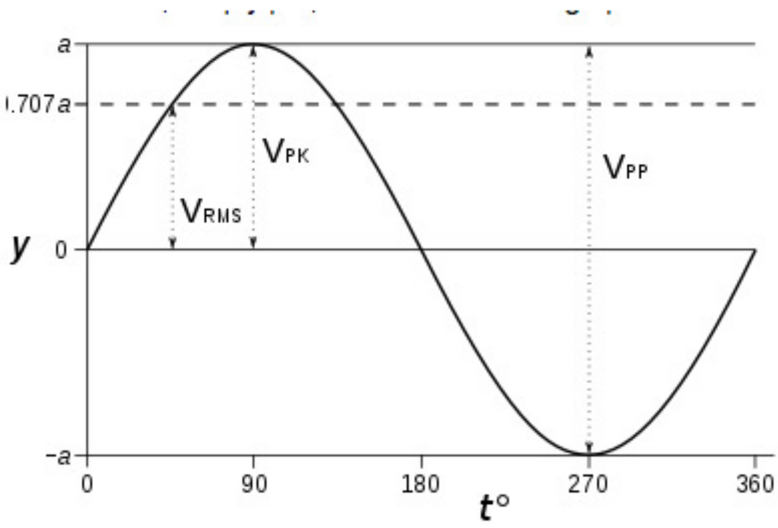
Tech Talk | WRITTEN BY AARON TRIMBLE | November 2017

Ever seen a broken speaker? They come in two flavors, right? The roasty toasty kind and the shredded kind. These speakers fall into two categories and manufacturers give us numbers that outline when you'll see broken speakers. Manufacturers provide us with power handling numbers. They are RMS or continuous, and peak or max. If we break them down further, they are thermal power handling and mechanical or excursion limited power handling. These are some of the fundamentals of speakers.

What is RMS though?

RMS stands for Root Mean Square. You're probably saying that knowing what the acronym means doesn't exactly clear anything up. Alternating Current or AC power is not a static value. Many times a second (depending on how many

Hertz we're talking about) an AC signal is a positive voltage a negative voltage and no voltage. In order to express this in a more digestible format RMS was developed. RMS is the AC heating equivalent of DC power. 50 watts of DC power and 50 watts of RMS power will produce the same amount of heat through a resistor of a given value. RMS, simply put, is .707 of the voltage peak of a sinewave.



Source: https://en.wikipedia.org/wiki/Root_mean_square

So when we talk about RMS rating of a speaker we're talking about a type of average power. Be careful though, electrical Nazi's will hunt you down if you call RMS "average" in the technical sense. True average would actually be less power, but that's an article for another month! RMS is generally stated over more than a single sinewave, especially when we're talking about dynamic signals like music. Equipment like your Digital MultiMeter (DMM), if it does True RMS, will count voltage thousands of times a second and then equate out the square **R**oot of the **M**ean value of the **S**quares of all those counts to give you the reading on the display a couple times a second. That previous sentence is a bit of a mouthful, so I've included the equation below to try and help out.

$$RMS_{Total} = \sqrt{\frac{RMS_1{}^2 + RMS_2{}^2 + \ldots + RMS_n{}^2}{\text{number of counts}}}$$

RMS Power Handling

Power handling used to be calculated widely through the use of crest factor on pink noise. Crest factor describes the relationship between Peak power and RMS power measured in dB. A crest factor of 3dB would be a peak value that is double the RMS. A crest factor of 6 dB would be a peak value that is 4 times greater than the RMS value. Each additional 3 dB doubles the power. Pink noise on the other hand is a selected bandwidth (ie 20-20k Hz, 50-500 Hz, etc) where all frequencies are played at the same time and at equal power levels per octave. Adding crest factor to pink noise allows the frequencies being played to increase or decrease in output depending on how much crest factor is allowed while maintaining the RMS power. Pink noise is the best way to make an unbiased test track; no one has to decide which song is THE test song.

This method of testing speakers on pink noise was common practice by various organizations like the Audio Engineering Society (AES) and the International Electrotechnical Commision (IEC). AES's now obsolete standard (AES2-1984) says that a speaker would be subjected to pink noise from the speakers low frequency limit to 10 times (one decade) that value with a crest factor of 6 dB (peak values reaching 4 times that of RMS). Speakers would be subjected to the pink noise in 2 hour increments of increasing power levels until the speaker could no longer reach a thermal equilibrium. AES also stated that this would be done without an enclosure for the speaker, which presents a problem for modern day high power speakers. A speaker that is capable of handling 2000 watts RMS would be subjected to peak power values as high as 8000 watts. 8000 watts of power free air on any commercially available car audio speaker, will likely result in a voice coil creating a hole in your ceiling when it shoots out of the magnet like a bullet when attempting to play 25-30 Hz. Even though some organizations, including AES have updated their testing procedures, many car audio manufacturers have turned to algorithms that can be modeled to determine their RMS values.

Mechanical Power Handling

Peak Power numbers mean nothing. Yes, it's true. Peak or MAX power, as it may be, are generally meant as guidelines for mechanical power handling, but there is no universal way to determine how much power a woofer in a given environment can use before failing from breakage. Peak power is measured in bursts, so we’re not concerned with if the voice coil of the woofer will turn into a slinky in the bottom of the motor from long term heat exposure. If we look at it in terms of our pink noise example, we’re not concerned with the RMS power, but the height of the crest factor. The speaker in question only has to survive the peak, not maintain it. The challenge here is that mechanical power handling varies with enclosure and frequency, and in most cases with how the woofer loads in the listening environment. All these factors prevent us from actually determining what a fair peak power for a woofer is. Speakers must move more to play lower frequencies at the same volume. So if a speaker must move ¼” to play 60 Hz at 90 dB, it must move 1” to play 30 Hz at the same 90 dB. A speaker must move 4 times as much to play one octave below a reference frequency. This changes when we put the speaker in a vented enclosure as the airspace of the enclosure and the port damp the speaker. Frequencies most heavily affected by the vent of the enclosure will require considerably less power to match the output of a higher frequency. Frequencies below the tuning of the vent will require much more power to create the same reference volume. However, since the enclosure will damp a woofer less and less as the frequencies drop, the speaker will reach a point where the peak power of the speaker at those frequencies is actually lower than the RMS power in most cases. This is precisely why Subsonic filters are employed. Subsonic filters attenuate low frequency play to prevent over-excursion.

99.9% of users will never have a time when peak power is actually a relevant figure. The only people who need concern themselves with this are those who choose to compete in SPL. For the rest of us, simply setting our crossover filters and matching amps to speakers correctly should alleviate situations where over-excursion is possible. For the 0.1% who are SPL competitors, Peak power is something which must be discovered through testing. A competitor will usually tune their enclosure near the peak resonance of their vehicle so that the enclosure is damping the speaker the strongest. This allows the user to apply more power to the speaker for short bursts to increase their SPL score.