

It's all a power struggle

It seems we are all engrossed with power ratings in the audio game. Power ratings are generally the first specification bandied about when discussing amplifiers and/or loudspeakers. Be it a sales person selling you the latest high tech device, a group of guys gathered in the local McDonalds car park comparing “fully sick sub woofers”, or those annoying guys with pommy accents driving the white van that always seem to pull up next to you at traffic lights!



Part of a giant loudspeaker system used during the Korean War to blast propaganda across the demilitarised zone that is now the border between North & South Korea.

A very famous physicist once said, “you canna change the laws of physics” – or was that Scottie in Star Trek? Either way, contrary to what some marketing types may think, the ProAudio world does obey the laws of physics. One of my favourite laws of physics is the law of conservation of energy, which simply states that you cannot create or destroy energy, only change its state. This law also states that the useful output energy tends to be less than the total input. So how does this relate to power in audio systems? Stick with me and I’ll explain.

Power is actually a measure of the rate of transfer of energy (1 watt = 1 joule per second), thus the above law also applies to the transfer of power, and this is where we get back to audio systems.

The amplifier – loudspeaker interface is all about power transfer. The amplifier transforms power from the high voltage mains supply, to an alternating electrical current suitable for energising loudspeakers. The loudspeaker in turn converts this electrical current to acoustic energy (sound). This conversion is less than perfect. The resulting output power is always less than the input power. “But you said we cannot destroy energy, so what happened to the difference between input and output power?” I hear you say. The answer is heat. The “missing” power is converted to heat. The loudspeaker system must then safely dissipate this heat. Failure to do so will cause a build up of internal temperature, which if left unchecked will ultimately lead to failure of the loudspeaker system, but more on this later.

Input power is commonly listed on spec sheets as “Rated Power” or “Power Handling”. However output power, and or efficiency are rarely listed on spec sheets. Probably because even the most advanced, devices are notoriously inefficient. Typical cone transducers have an efficiency of around 10%, which means that around 90% of the input power is wasted as heat.

The rated power specification is commonly viewed as an indication of how loud a sound system will play. However, in reality it’s actually a measure of the devices ability to produce heat, not sound! Keep this in mind next time you are comparing specifications of loudspeaker systems. A high power rating does not necessarily equal high output. Basically comparing loudspeaker systems based on power ratings alone is equivalent to shopping for a new car based on fuel consumption figures, and selecting the one with the worst figure!

The automotive industry is constantly striving to produce more efficient vehicles. Modern vehicles are often powered by hi-tech, lightweight four cylinder engines that rival the heavy, fuel guzzling dinosaurs of the past. They key is minimise weight, and maximise engine efficiency.

The ProAudio industry is no different. Modern loudspeaker designs utilise new hi-tech materials and construction methods to produce light weight, high efficiency drivers (acoustic motors). JBL Pro’s patented NDD drivers are a great example of this.

JBL NDD Drivers utilise a combination of neodymium-iron-boron magnets (often abbreviated to neodymium for obvious reasons) a material that delivers the same magnetic strength as traditional materials, with around 1/3 of the weight, and a

unique dual magnet, twin voice coil motor structure which delivers significant improvements in driver efficiency. For further details on the inner workings of NDD please refer to JBL technical note, volume 1, Number 33; available at www.jblpro.com/pub/technote/JBL_TN%201-33%20rev3.pdf.

A better measure of loudspeaker efficiency is SENSITIVITY. Usually stated as SPL 1w/1m. i.e. the Sound Pressure output measured at one meter when the system is driven by 1 watt of input power. Remember that when dealing with quantities measured in decibels (dB), small numbers can equate to big changes, a 3dB change in sensitivity is equivalent to a doubling of power. For example, let's compare two loudspeaker systems.

System 1

Max Power = 800w

Sensitivity = 98dB SPL 1w/1m

System 2

Max Power = 600w

Sensitivity = 101dB SPL 1w/1m

At first glance you may assume that system 1 is the 'more powerful' system, and as such should produce a higher SPL than system 2. However this is not correct. System 2 is significantly more efficient than system 1. We can calculate maximum SPL based on sensitivity and power rating using the following equation;

$$\text{SPL}_{\text{max}} = 10 \times \text{LOG}(\text{P}_{\text{max}}) + \text{S}$$

Where Pmax = Maximum rated power and S = Sensitivity

Plugging the above number into this equation we get the following (rounded to 1dB);

System 1 Max SPL = 127dB

System 2 max SPL = 129dB

System 2 is capable of delivering MORE output than system 1, with LESS input power.

Now lets look at it another way. Let's re-arrange the equation to calculate required input power to hit a target SPL. Let's choose 127dB SPL as our target. We now get the following (rounded to 1w);

System 1 required input power = 794w (basically full power)

System 2 required input power = 398w

System 2 has 3dB greater sensitivity than system 1 which means it can produce the same SPL as system 1 utilising HALF the amplifier power. That's right, half the amplifier power. Think about the potential saving in amplifier cost, not to mention reduced amplifier rack weight, require mains draw etc. So next time you are shopping for a loud speaker system don't just look at the maximum power rating. Make sure you also check out sensitivity ratings to ensure to get maximum efficiency for your dollar.

OK. So if efficiency (sensitivity) is so important, why publish power ratings at all? Are they important? The answer is yes they are important, but hopefully I've demonstrated how they are often quoted out of context. Power ratings are intended to give you an indication of the maximum input power the loudspeaker system can absorb before it is unable to safely dissipate the waste energy. If you exceed this rating you run the risk of permanently damaging the device. However even this seemingly simple concept becomes much more complicated in real life, as the level of 'real' programme material (music, voice) varies greatly with time. Remember the above equation "1 watt = 1 joule per second"? Thus TIME is a critical component when considering power ratings.

Stay tuned for the next issue when we'll discuss how best to match your amplifier to your loudspeaker system, and tackle terms such as "Crest Factor", "Peak Power", "RMS" etc.

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