
Subject: Contemplation on combined Sensitivity(long)
Posted by [dbeardsl](#) on Wed, 17 Apr 2002 19:41:46 GMT
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seems like the people here are a bit more technical than those at other forums, so here ya go. I've always been a bit mystified about how putting two speakers in parallel actually increases their efficiency. How could you actually change how efficient a linear motor is by changing the input. Anyway, I thought about it the other day. Wayne or others, please correct me if I'm wrong. Here's how I think it goes, hooking up two motors in parallel does NOT increase the efficiency of the system itself. Example: One nominal 8 ohm driver being driven at 1 Watt. Solving this simple system of equations (ohms law) you get: $(W=VI) \quad 1 = 2.83 * .354 (V=IR) \quad 2.83 = .354 * 8$ 1 Watt, 2.83V, .354A. If you connect two drivers in parallel you now have a 4 ohm device. Solving this simple system of equations (ohms law) you get: $(W=VI) \quad 1 = 2 * .5 (V=IR) \quad 2 = .5 * 4$ 1 Watt, 2V, .5A. Now you have 1 Watt flowing through two parallel motors. Meaning they both experience the whole 2V, but each gets half the current (thus producing half the sound output each). Totaling to still... 1 Watt. The Reason we always say that two drivers in parallel doubles the efficiency (+3db) is simple. At a constant preamplifier level, if you connect a second 8 ohm device in parallel (total of 4 ohms), roughly twice as much wattage will flow through the system (depending on amplifier design), giving you twice the output SEEMING like the system is twice as efficient. Though each driver still has the same efficiency, your output is now over a greater area, moving away from a point source type configuration ($1/R^2$ falloff rate) and getting closer to a plane (no falloff) or a line ($1/R$ falloff rate). When standing back a bit, this may increase apparent efficiency even more. Am I making something more complex than need be? This seems right, but is it?

Subject: Re: Contemplation on combined Sensitivity(long)
Posted by [Adam](#) on Wed, 17 Apr 2002 20:07:59 GMT
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I am still a little mystified about this topic myself, I have had it explained to me several times but I wasn't able to completely grasp it. First off, I'm not sure where you get the numbers in your equations. Your first one uses 2.83 volts, the second one uses 2 volts. The two equations aren't identical on any levels, they should only change in the impedance category which means resistance is halved. In any event, I'll find the link where I asked a similar question and it was answered. Also, remember that we gain 3 db efficiency because the cone area doubles. Adam

Subject: but

Posted by [dbeardsl](#) on Wed, 17 Apr 2002 20:28:12 GMT

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The volts are different cause I'm calculating sensitivity at 1 Watt. thats why it doesn't look right.---the system of equations
$$\text{Watts} = \text{Current} * \text{Volts}$$
$$\text{Volts} = \text{Current} * \text{Resistance}$$
---expanded solutionso
$$\text{Watts} = \text{Current}^2 * \text{Resistance}$$
so
$$\text{Current}^2 = \text{Watts} / \text{Resistance}$$
so
$$\text{Current} = \sqrt{\text{Watts} / \text{Resistance}}$$
since
$$\text{Volts} = \text{Current} * \text{Resistance}$$
$$\text{Volts} = \sqrt{\text{Watts} / \text{Resistance}} * \text{Resistance}$$
so
$$\text{Volts} = \sqrt{\text{Watts} * \text{Resistance}}$$
so 2.83V = $\sqrt{1\text{W} * 8}$ for 8 ohms. 2V = $\sqrt{1\text{W} * 4}$ for 4 ohms. If you measure sensitivity at 2.82V/1M, then the Voltage will be the same and Wattage will be different.

Subject: Re: but

Posted by [Adam](#) on Wed, 17 Apr 2002 20:30:38 GMT

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Amplifiers are constant voltage sources, so you should be calculating with the voltage constant. Adam

Subject: Re: Contemplation on combined Sensitivity(long)

Posted by [DanF](#) on Wed, 17 Apr 2002 20:39:52 GMT

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I look at it like this...If you are talking "efficiency" then that would be the acoustic power vs. the electrical power applied to the driver(s) and would probably best be expressed as a percentage - generally less (way less?) than 10% I think. "Sensitivity" would be the Sound Pressure Level (SPL) generated by a particular input voltage. Most speakers are actually rated for sensitivity such as 98db @ 2.83v rms @ 1 meter. Of course the 2.83v level is used because it corresponds to an actual 1 watt when driving an 8 ohm load; it just makes a nice standard. The amplifier puts out a _voltage_ signal identical to the input except multiplied by some factor - a constant voltage source like Adam said. Adding another driver (hopefully) doesn't change this. Since each driver is now seeing the 2.83v, each driver is drawing 1w and the amp is delivering 2w total. We doubled the power being delivered and therefore added 3db to the sensitivity of the system. So we arrived at basically the same conclusion up to this point. We also doubled the radiating surface

area. That is... our 2w is not moving one driver with x square inches of surface area but two drivers - 2x surface area. So we are moving twice as much air - right? That means that we are delivering twice as much acoustical power into the room (as compared to putting 2w into one driver). Twice the power being delivered into the room - add 3db again. So adding one more driver adds 6db to the "sensitivity" of the system at the cost of dropping the impedance to half of what it was before. So nominal 8 ohm speakers with a 4 ohm minimum become 4 ohm speakers with a 2 ohm minimum. (And my decrepit receiver then emits a wonderful aroma into the room... Doh!) Did that help? I'm sure if I were a slow typist I could have fit this into fewer words. Ha. Dan Ferguson

Subject: (epiphany)

Posted by [dbeardsl](#) on Wed, 17 Apr 2002 21:01:06 GMT

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Yeah you're right, I know... I mentioned that at the bottom. but if we want to calculate max SPL, amps are rated at a certain Wattage RMS at a certain Ohm resistance. If we have a typical amp that puts out 100W at 4 ohms and 50 W at 8. 100W into 4 ohms is 5 amps and 20V. 50W into 8 ohms is 2.5 and 20V. wow... well crap. the voltage is the same even at max output with different impedances, never thought about that. hmm... and at 20V the two parallel drivers are each using 50W... giving twice the efficiency.. don't I feel sheepish, I never really thought about how amps are limited. I feel a little bit better that this doesn't defy any laws of physics, the speakers aren't anymore efficient in terms of pure power per output, but they make use of the amp circuitry more efficiently. Thanks bud, Danny

Subject: 104 pages of answers

Posted by [Wayne Parham](#) on Wed, 17 Apr 2002 21:21:29 GMT

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Grab a copy of the JBL Professional Sound System Design Manual. It illustrates this (on page 86 or "7-8") and a lot of other important issues including diffraction, phase, directivity and directional control, reflected and direct energies, room interactions, room mode calculations, treatments, etc. It's a really good non-technical general text for all those interested in building high efficiency loudspeakers and horns.

Subject: Re: (epiphany)

Posted by [Adam](#) on Wed, 17 Apr 2002 21:37:46 GMT

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Hehe, no problem.Adam

Subject: Re: Contemplation on combined Sensitivity(long)

Posted by [Hodel](#) on Wed, 17 Apr 2002 22:04:51 GMT

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When you connect 2 eight ohm loads in parallel, the solid state amplifier now has a 4 ohm load and delivers twice the current at the same voltage giving +3db more SPL, and double the power, with the same output voltage across the speakers. That's why when you see 4 ohm speaker efficiencies, you need to make sure they're measuring with 1 watt thru the speaker to get the SPL measurement. Otherwise, with the 2.83 Volts across the 4 ohm speaker, you're actually putting 2 Watts thru the speaker not 1 Watt. However, solid state amps usually put out 65% more power into a 4 ohm load than an 8 ohm load, so it's probably all moot point anyway!!!

Subject: Re: Contemplation on combined Sensitivity(long)

Posted by [mikebake](#) on Thu, 18 Apr 2002 00:22:39 GMT

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I have only glanced through this thread (after my usual 1.5 beers) but if I recall according to JBL, we can (also?) get an increase in SPL when we double the boxes (if they are close coupled), whether driven by the same amp or different amps.....from the link below (because I happened to have a pair of 4662A's and was researching them one time) JBL's info sez....."Compact, powerful

reinforcement systems, the 4662A and 4663A offer high efficiency, vivid, natural sound (even at very high levels), and a controlled dispersion pattern for indoor or outdoor reinforcement applications. These systems are capable of high acoustic output, can handle large amounts of power, and are designed for reliability and durability. Outdoors, with no support from room acoustics, either system will produce an impressive 117 dB at 3 m (10 ft) when driven at its rated power of 150 watts continuous pink noise. Where higher sound pressure levels are desired, systems may be paired to produce up to 6 dB more SPL than a single unit, with consequent improvement in peak power capability". The "close coupled" phrase is from a similar blurb on their site.....
