Subject: Re: Choosing the right amp power
Posted by Wayne Parham on Thu, 18 Jan 2018 00:27:11 GMT
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It all depends on how big your room is and how much sound volume you require.

Assuming we're talking about the average home listening room, e.g. a few hundred square feet, then we can know that listeners won't be more than a few feet away from the speakers. That helps keep our power requirements reasonable.

Since speakers are generally rated at 1 meter (which is approximately 3 feet) and since the rate of sound decreases 6dB for every doubling of distance, you can expect the sound to be 6dB lower at 6 feet away, 12dB lower at 12 feet away, etc. And as power is increased, you can 6dB for every doubling of power. You gain 10dB for every ten-fold increase of power.

So if we have a speaker rated 90dB @ 1W/1M (which is 90dB over the threshold of hearing when driven with one watt RMS, measured 1 meter away), assuming it can handle 100 watts (and doesn't compress too much), then it can generate 110dB one meter away. If you move away from the speaker three meters (approximately 10 feet), it's around 100dB where you are.

A quick digression: When people talk about decibels in speakers, they are really talking about decibels above the threshold of hearing, the level where people can't hear a sound. This has been given a specific reference value of 20 micropascals, corresponding to a sound intensity of 0.98 pW/m2 at 1 atmosphere and 25 °C. It is approximately the quietest sound a young human with undamaged hearing can detect at 1,000 Hz.

Another thing to consider is the number of speakers in the room. Two speakers playing sound will be louder than one, and three or four will be louder than that. If you have two sound sources that are the same SPL and that sum together coherently, the two will be 6dB louder than one would be. But in practice, 6dB increase isn't achieved by a stereo pair of speakers for a variety of reasons. For one thing, they usually aren't playing the exact same material, i.e. monaural signal sent to both speakers. And for another thing, they're too far apart to sum coherently. Their interaction is complex due to reflections and what-not, so some frequencies sum, others cancel and most are somewhere in between. So you can use a rule of thumb that a pair of loudpeakers is approximately 3dB louder than a single one is when driven with the same source signal.

Having that basic understanding, we can start to figure out what we're dealing with. To know what sound pressure level (SPL) we can achieve, we need to know the sensitivity of each speaker, the number of speakers and the power levels we're driving them with. Or if we want to hit a target SPL, we work the math the other way. We can make the speaker sensitivity a constant, like 93dB @ 1W/1M and the desired SPL level a constant, like 115dB, and use that to calculate power requirements. We should allow some room for signal compression, because speakers become less able to convert power to sound as they get close to their maximum power rating.

If we want concert level volume levels, then we need to be able to hit 120dB. But most times, people are happy with 100dB to 110dB as a maximum volume level. The SPL level required for mains speakers to meet THX spec is 105dB, for example. They want subs to be able to hit 115dB

peaks.

So let's assume that we're going to make 115dB the requirement, and assume our listening position is ten feet away. That means the speaker has to be able to generate 125dB at 1 meter. That's actually a pretty tall order, since most speakers can't do that. But let's do the math anyway, because there are plenty of speakers that can. High-efficiency prosound speakers are able to meet this requirement.

We should assume that the speakers will compress 3dB to 5dB at this power level, so the 3dB we "gain" from having more than one speaker playing should be countered by the 3dB to 5dB loss from thermal compression. So we need to provide enough power to hit 125dB.

If a speaker is rated at 95dB @ 1W/1M, we need 30dB to hit 125dB. That's 1000 watts. If our speaker is rated at 85dB @ 1W/1M we would need 40dB. That would be 10kW. But if we had a speaker that inefficient, most of the power would be lost in heat. It wouldn't ever reach the target SPL, and would burn up before getting anywhere close.

A more realistic goal is the THX spec of 105dB. Now we can move all the numbers down by a factor of 10x. The speaker only needs to hit 115dB at 1 meter, which is not trivial performance, but more speakers can reach this level than can hit 125dB. Our 95dB speaker only needs 20dB to hit the goal, which is reached at 100 watts. A good high-efficiency prosound speaker is loafing at that level.

But an 85dB speaker still needs 1000 watts to hit 115dB, and that's only if it were able to do this without compression, which isn't realistic. In truth, it's never going to reach the goal. Low-efficiency speakers turn most electrical energy into heat rather than sound, and that heat tends to burn them up.

Might try a medium-efficiency speaker rated at say 90dB, because it can reach the 115dB goal with 316 watts. Provided the speaker is able to handle 500 watts, it might not burn up or compress too badly, so it might be able to reach the goal.