

## How Much Power for My Speakers

*By Don Boomer, Product Manager, Sound Reinforcement Div*

It seems like one of the most frequent questions asked in Pro Audio forums and in music stores is "how big of an amp should I be using for my speakers?" It also seems to have the biggest number of confusing answers ... 1X – 1.5x - 2X RMS?, program?, peak? ... augggh!

The simple answer? Well, it all depends on what you *really* mean. If the question is to answer how much power you can add without fear of speaker burnout, the answer is probably different than is the question is to determine the size of an amplifier that can offer the maximum potential in sound quality and absolute volume.

Let's explore how to correctly match speakers with power amps and why.

First ... let's stop the spread of a big myth. *You cannot burn out a speaker by using too little power.* If that were the case, then anybody turning down their system would be frying their drivers.

Speakers are burned for these reasons:

- By applying too much power and exceeding the thermal (heat) rating of the speaker, or

- By applying too much power at too low a frequency (excursion rating), thereby mechanically ripping the driver apart.

The mistake people make is they don't realize how much power their amplifier is actually creating when it clips. An amp under hard clipping conditions has the potential to almost double the amount of power that it puts out at its full continuous (RMS) rating. That is to say that an amp with a 200W continuous rating can put out (the duty cycle equivalent of) 400W during hard clipping. So if you burned up your 300W speaker with a 200W amp, it was not because you were underpowered ... it's because the 400W generated by your amp when you weren't looking exceeded your speaker's rating.

**Thermal power rating:** A speaker has a thermal or heat related rating. Most of all the specs that users try to match up are thermal specs. Make sure you understand that 500W for Brand X speaker system probably doesn't equal 500W for Brand Y speaker system (see our white paper titled "The Loudspeaker Spec Sheet Game"). There is a certain amount of power that can be applied for a specified length of time before you simply cook the speaker. You might melt the voice coil wire, melt the glue or blister the insulation off of the VC wire, causing

the coil to short out. The speaker doesn't really care whether the waveform is a sine wave, a complex music signal or a square wave. When the amount of power exceeds the speaker's capabilities (usually over time) it simply burns out.

**Excursion Limits:** There is a point in each speaker where applying too much power at too low of a frequency will cause the speaker to tear itself apart or smash the VC down to the bottom plate. This is the excursion or mechanical limit of a speaker. It could also cause the speaker to move so far that it begins to distort the shape of the round voice coil so that it scrapes the side of the gap it sits—which will cause a short. For this reason it is very important to limit the amount of power at very low frequencies delivered to the system. A "high-pass" (also known as a low-cut) filter should be applied to the signal before it reaches the power amp or in the amp itself. As a general rule, the power delivered to the speaker below its box tuning frequency should be  $1/4^{\text{th}}$  at one octave beneath. So, a speaker that can safely handle 500W at the tuning frequency (let's say 50Hz, for example) should not receive more than 125W at 25Hz. If it does it is likely to fail.

It has been our experience at Peavey that most woofer failures are caused by exceeding excursion limits, while tweeters usually fail due to thermal problems.

### **So how much power do I need?**

For maximum performance we recommend you use an amplifier that is capable of delivering the same number of RMS/continuous watts as the "program" rating of the speaker. So a speaker like an SP™ 5 (whose rating is 400W continuous/800W program/1600W peak) would be fine with a CS® 4000 (800 W at 8 ohms continuous). *Now before you run off ... read the rest of this!* This does not grant you permission to mic a kick drum into this speaker with this power level available without taking other precautions. If you go for maximum performance you must provide optimal operating conditions. You must limit the amount of low frequency energy being sent to the system with a high-pass filter. You must ensure that you are not clipping the mixer or any processing gear ahead of the amplifier. And the lack of seeing a flashing clip LED does not necessarily ensure that!

If you are looking for a recommendation so that you would be relatively free of blowing up the speaker under almost any real world condition, you should pick an amplifier that can deliver the continuous rating of the speaker or a little less. In this case, 400W continuous at 8 ohms (such as a CS® 1400) or a little less ... remembering that it is always possible to be struck by lightning, even though not likely.

## **Why do speakers really blow up?**

The number one reason ... operator malfunction. Amplifiers don't kill speakers, people kill speakers (see our white paper titled "Top 10 Ways To 'TOAST' Speakers and Diaphragms"). Inexperienced operators often try to use a system that just doesn't have enough power (speakers and amps and AC power) to do the job properly, not the power of the speakers themselves. This results in pushing the system way too hard and making failures more common. Learn the capabilities of your equipment and practice a little restraint. If you start hearing distortion, the system is asking for your help ... and don't bury the clip lights. If they are on more than briefly (with the beat of the music), trouble is just around the corner.