

UNDERSTANDING DAMPING FACTOR

Loudspeakers have a mind of their own. You send them a signal and they add their own twist to it. They keep on vibrating after the signal has stopped, due to inertia. That's called "ringing" or "time smearing."

In other words, the speaker produces sound waves that are not part of the original signal.

Suppose the incoming signal is a "tight" kick drum with a short attack and decay in its signal envelope. When the kick-drum signal stops, the speaker continues to vibrate. The cone bounces back and forth in its suspension. So that nice, snappy kick drum turns into a boomy throb.

Fortunately, a power amplifier can exert control over the loudspeaker and prevent ringing. Damping is the ability of a power amplifier to control loudspeaker motion. It's measured in Damping Factor, which is load impedance divided by amplifier output impedance. Let's explain.

If the speaker impedance is 8 ohms, and the amplifier output impedance is 0.01 ohms, the damping factor is 800. That's a simplification. Since the speaker impedance and amplifier output impedance vary with frequency, so does the damping factor. Also, the impedance of the speaker cable affects damping. Thick cables (with low AWG) allow more damping than thin cables with (high AWG).

The lower the amplifier's output impedance, the higher the damping factor, and the tighter the sound is. A damping factor of 1000 or greater is considered high. High damping factor equals tight bass.

How It Works

How does an amplifier control speaker motion? When the loudspeaker cone vibrates, it acts like a microphone, generating a signal from its voice coil. This signal generated by the speaker is called back EMF (back Electro Motive Force). It travels through the speaker cable back into the amplifier output, then returns to the speaker. Since back EMF is in opposite polarity with the speaker's motion, back EMF impedes or damps the speaker's ringing.

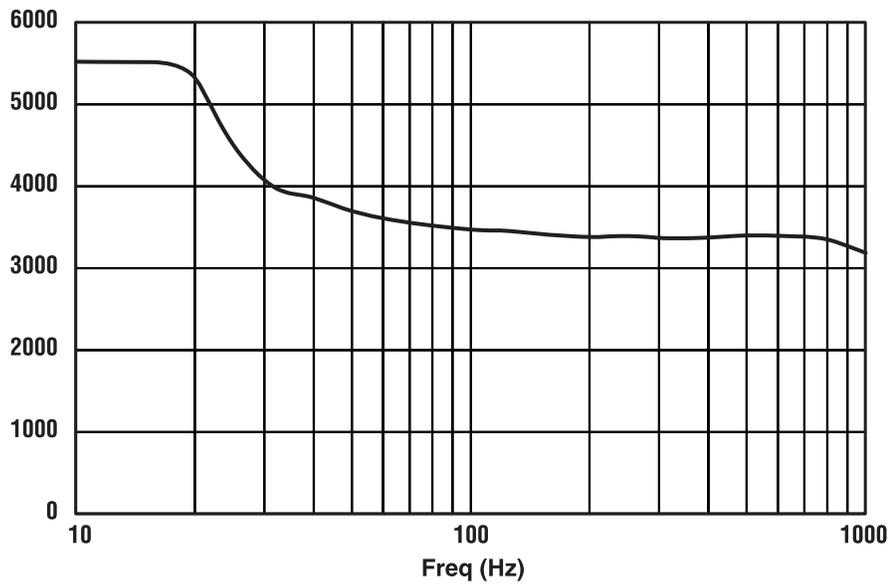
The smaller the amp's output impedance, the greater is the effect of back EMF on the speaker's motion. An amplifier with low output impedance does not impede the back EMF, so the back EMF drives the loudspeaker with a relatively strong signal that works against the speaker's motion. When the speaker cone moves out, the back EMF pulls the speaker in, and vice versa.

In short, the loudspeaker damps itself through the amplifier output circuitry. The lower the impedance of that output circuitry, the more the back EMF can control the speaker's ringing.

To prove it to yourself, take a woofer that is not connected to anything. Put your ear next to the cone and tap on it. You might hear a low-pitched "bongggg" if the speaker itself is poorly damped. Now short the speaker terminals and tap again. You should hear a tighter thump.

Damping factor varies with frequency. As you might suspect, damping factor is most important at low frequencies, say 10 Hz to 400 Hz. The chart on the next page shows typical damping factor vs. frequency of a Crown CTs 600/1200 power amplifier. It's well over 3000 from 10 Hz to 1 kHz.

All Crown amplifiers are designed to have high damping factor. That's why you can count on Crown amps to deliver clean, tight kick drum and bass.



Typical damping factor vs. frequency of a Crown CTs 600/1200 power amplifier.