

Tech Tip

Amplifier Clipping

When an input signal drives an amplifier beyond its output power capability, the result is signal clipping. This means the negative and positive peaks of the amplifier's output signal are clipped off. Since the amplifier's supply voltage determines its maximum peak output voltage, the signal will be clipped if the input signal level is too high.

With real-world music signals, the amplifier may also clip asymmetrically, meaning the positive side of the signal is clipped more than the negative, or vice versa. Either form of clipping will generate a direct-current (DC) component in the output signal, more so with the asymmetrical waveform.

Furthermore, clipping also generates unwanted low frequency or subsonic artifacts in the output signal. This energy has the capability to cause speaker distortion or driver damage.

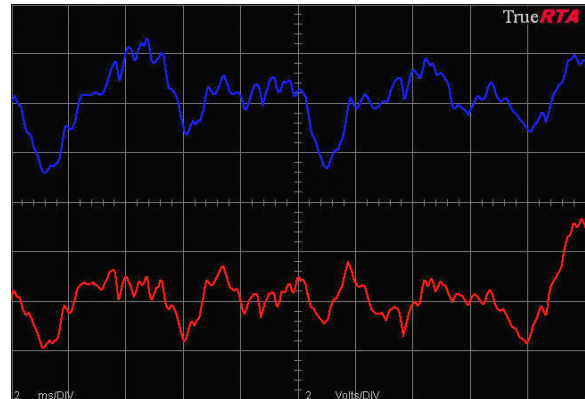


Figure 1: Normal audio waveforms

Clipping may or may not be audible. When it is, it can be heard as distortion. But whether you can hear it or not, clipping can damage audio components, including speaker selectors and volume controls.

Over time, the DC produced by clipping will eventually damage autoformer-based devices in the system. Such devices are designed for alternating current, not DC. Direct current passing through their low-resistance input coils will produce excessive heat. Resistor-based devices also will suffer damage from overheating caused by clipping, since resistors produce considerably more heat when driven with DC.

Some amplifiers and receivers have protection circuits that sense DC at the output and shut down the component to protect it. Because of this, these components may stop working when used with certain autoformer-based devices, such as speaker selectors. It may seem like the autoformers are at fault, but the real culprit is signal clipping, which changes the effective impedance seen by the amplifier or receiver.

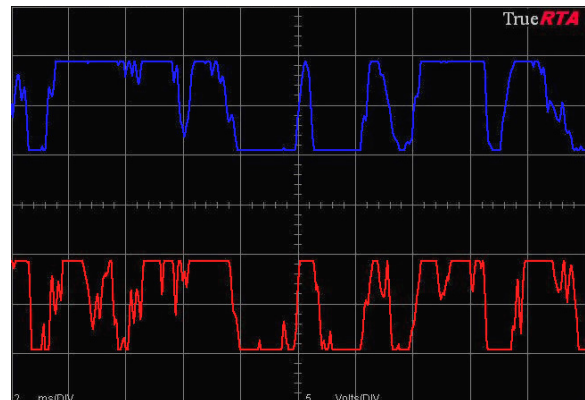


Figure 2: Severely clipped audio waveforms

Clipping is most often caused by overdriving the amplifier. This can happen with a receiver when its volume control is turned up too high (above 40 to 50 percent), especially when the receiver is driving more than one speaker per channel. It can also happen when the amplifier

doesn't have enough power for the speaker load. Generally, amplifiers with high-current designs are less likely to clip because they're capable of producing more current during peaks in the audio signal.

What you can do to prevent amplifier clipping:

- **Choose an appropriate amplifier for the speaker load.** Don't expect a multiroom AV receiver to drive multiple pairs of additional speakers. Instead, use an external amplifier connected to a fixed-level output on the receiver. We recommend at least 15 to 20 watts per speaker for moderate-level listening. Thus, if you have four pairs of speakers, you would need at least 60 to 80 watts per channel to drive them from the same stereo amplifier through an impedance-matching device. If you have many pairs of speakers, consider using a multichannel amplifier instead of a stereo amplifier. We also recommend using an amplifier with a high-current design. Keep in mind that it's generally safer to have more power available than not enough.
- **Set the levels properly.** Start with the amplifier's gain controls turned all the way down and the preamplifier (if there is one) turned all the way up. If there are volume controls connected to the amplifier's output, turn them up to their maximum setting. While playing music into the system, gradually increase the amplifier gain until the sound in the rooms is at the required level. The gain setting on the amplifier may be well below the maximum setting. This provides the optimal operating range for controlling the volume from the preamplifier or volume controls. **Note:** If you hear distorted sound from the speakers, the amplifier or speaker selector heats up rapidly, or the amplifier shuts down, turn the amplifier's gain controls down to the point where these symptoms cease. If this doesn't provide enough volume for the desired listening level, you will need a more powerful or additional amplifier.

To help protect the speaker selector, volume controls, and speakers from clipping damage, you can use a high-pass filter on the amplifier output. Russound's LFP-1.2 Low-Frequency Protection Module blocks subsonic frequencies and a major portion of any DC voltage that might be present. However, this will not prevent the amplifier from clipping or protect it from damage.

Note: Clipping damage is caused by an external source, not by the design or materials inherent in any Russound product. Using a Russound product not in accordance with its design can be considered abuse and thus will void the product warranty if so determined by a Russound service technician after inspecting the product.