

Technical Note

Danger: Low Power

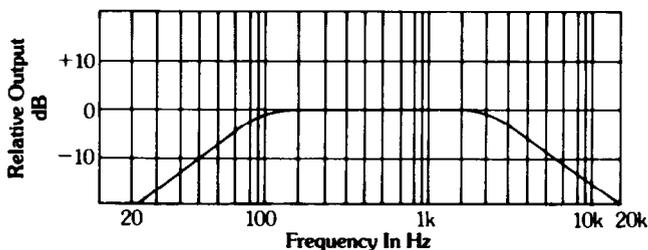
Too Little Amplifier Power Can Produce Too Much

We occasionally hear of JBL owners who damage the high frequency components of their loudspeaker systems using amplifiers that are rated at less—rather than more—power output than recommended. Understandably, they often find it difficult to comprehend how such an amplifier can actually burn out JBL components when they have been told, by our dealers and in our literature, that JBL loudspeakers can handle large amounts of power and will also deliver big sound with relatively little input power. These statements are true, provided the amplifier is not overdriven. To understand this more clearly, it is necessary to understand the nature of music as it relates to amplifier power and distortion.

First, The Nature Of Music

Not all musical notes are created equal. There is much more power in the lower registers of music than in the midrange and treble regions. If we examine the accompanying graph, we can see that the energy content of treble frequencies is typically 10 to 20 dB less than bass and midrange frequencies. Therefore, even if we allow for 10-dB peaks in high frequency program material, which is common, the high frequency driver of a system will be called upon to handle only about one-tenth the power that the low and mid frequency components must sustain.

This natural distribution of musical energy works to our advantage. It means, for example, that a loudspeaker system capable of handling 100 watts should have a high frequency unit capable of handling 10 watts. Thus, if the high frequency unit is designed to handle 20 watts of power (characteristic of many JBL systems), we are building a 100% safety factor into the high frequency unit. The result is that the capabilities of the components of a loudspeaker system parallel the natural energy distribution of music.



Energy distribution of typical recorded orchestral music. Rock and electronic music follow the same general contour.

Now, Let's Look At The Nature Of Amplifier Power

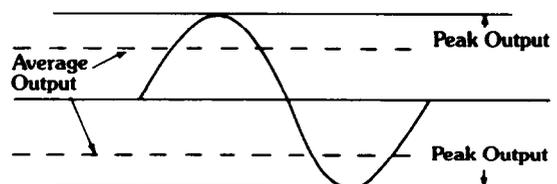
The power output specification of an amplifier is not absolute. Under certain operating conditions, such as when the volume control is set too high or when the input signal is too great, the amplifier can exceed its published output. The power output of an amplifier is rated with reference to a given level of total harmonic distortion (THD). If required to produce more power, the amplifier will do so, but at considerably greater distortion levels. For example, an amplifier rated at 10 watts (20 to 20,000 Hz into an 8-ohm load) at no more than 0.5% THD could be overdriven to produce 20 watts of output power to the loudspeakers. Under these same adverse conditions, an amplifier rated at 20 watts could deliver 40 watts to the loudspeakers; a 35-watt amplifier could deliver 70 watts and a 50-watt amplifier could be overdriven to deliver 100 watts. This distorted output could very well be in the treble region, as we shall soon see.

Here's The Killer: Distortion Generally Affects High Frequency Drivers

The additional power generated by overdriving the amplifier is rich in harmonics (distortion). These harmonics can be particularly dangerous to high frequency drivers. Harmonics are higher frequency multiples of the original signal; therefore, the high frequency component of a loudspeaker system must bear the brunt of the distortion—even though the original signal may have been generated by a bass guitar.

Here's What It Looks Like On A 'Scope

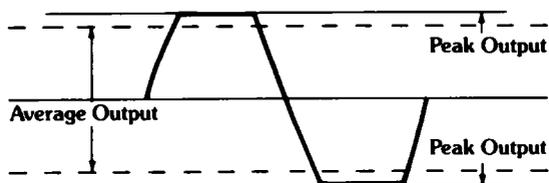
When a sine wave test signal (a signal consisting of a fundamental frequency without overtones or harmonics) is displayed on the screen of an oscilloscope, its top and bottom extremes will exhibit normally rounded contours. Average output power is one-half the peak output power. When an amplifier is overdriven, the contours are "clipped" off, producing a near square wave, having flat areas at the top and bottom limits, in which the average power approaches the



Typical Sine Wave

Peak Output 2 Times Average Output

peak power. When this occurs, up to twice the amplifier's rated output can be delivered to the high frequency driver, which may not be capable of handling the abnormal load. A higher powered amplifier, however, can generate the required power levels without clipping, allowing the loudspeaker system to receive program material containing a normal distribution of energy levels. Under these conditions, damage to the high frequency driver is most unlikely.



Typical Clipped Sine Wave
Average Output Approaches Peak Output



Artificially Generated Square Wave
Average Output Equals Peak Output

What Can The User Do?

There are no hard and fast rules. Very few amplifiers have meters that are capable of accurately indicating when an amplifier is being overdriven to the point that it could damage loudspeakers. Even the volume control position is not a clue – half rotation often produces considerably more or less than 50% of an amplifier's power. There are no absolutes. We wish there were.

However, we can offer a few guidelines:

1. *Purchase an amplifier that will provide more power than you will need.* Remember, a loudspeaker can require up to ten times the average power level for those instantaneous bursts of sonic power known as transients. If the amplifier has enough reserve power, transients will be clear and crisp. If not, the transients will be muddy or dull. When an amplifier runs out of undistorted power, it is forced to exceed its design capabilities, producing dangerous power levels rich in high frequency distortion.

2. *Do not drive the amplifier into clipping.* Clipping sounds something like a stylus mistracking, and generally occurs on loud passages when the system is played at loud volume levels. If clipping occurs regularly, turn down the volume level or install a larger amplifier that can deliver the required power without distortion.

3. *Do not make or break connections to the amplifier while it is operating.* Unplugging or inserting connectors into an amplifier, preamplifier or receiver while it is operating can produce momentary loud buzzes. Often, these buzzes occur at high power and can destroy loudspeaker voice coils very quickly.

4. *Practice audio precaution.* If your tape deck does not have tape lifters, it can produce squeals when in the fast-wind mode (either forward or backward) that can destroy high frequency drivers. Turning the volume down when fast-winding is a simple remedy. Also, turning down the volume whenever handling the phonograph tone arm is prudent. If a phonograph pickup is accidentally dropped on a record when the volume is turned up, the resulting thump could destroy the loudspeaker. Do not play the system loudly with excessive bass boost, which can easily cause the amplifier to be overdriven. Remember, a 3-dB increase in volume is just noticeable to the ear, but requires double the amplifier power, and many tone controls are capable of providing boost of 15 dB.

Summary

JBL loudspeaker systems are efficient; they will produce reasonable volume levels in a room of moderate size with very little amplifier power. However, if a small amplifier must be overdriven to obtain the desired volume levels in a listening room, thus generating high power and distortion levels, the user would be better advised to purchase a larger amplifier capable of producing the required power with negligible distortion. In any case, an amplifier should be selected with an output power rating that is greater than the maximum power that will be used. This margin of reserve power will ensure that the amplifier will not attempt to deliver more power than its design allows. The net result will be distortion-free sound reproduction and virtually unlimited loudspeaker life.

