

HPS-4000®

HIGH PERFORMANCE STEREO

Sound IS the Experience !™

SETTING SUBWOOFER LEVELS

BY

JOHN F. ALLEN

HIGH PERFORMANCE STEREO™



HPS-4000®

HIGH PERFORMANCE STEREO

FIRST IN DIGITAL STEREO

This article was written by John F. Allen and originally published in BOXOFFICE MAGAZINE. Unauthorized duplication or publication without the written consent of both John F. Allen and BOXOFFICE MAGAZINE is prohibited.

HIGH PERFORMANCE STEREO™

NEWTON, MA 02459 USA • TEL: 1-617-244-1757

HPS® and HPS-4000® are registered trademarks of John F. Allen

SETTING SUBWOOFER LEVELS

by
JOHN F. ALLEN

Although stereo motion picture sound systems have employed subwoofers for over two decades, a standard method for setting their playback levels has only recently been agreed to. This may seem surprising unless one remembers how standards and recommended practices are arrived at in the first place. Rather than an individual or group sitting around a table and dictating a standard or a specific practice that all must follow, standards committees typically recognize established industry practices and agree on how to describe them. The first use of many such practices often originates with various manufacturers. But not until it is acknowledged that such practices are in general use, or misuse as the case may be, are they considered by a standards committee.

The committee that oversees audio standards and practices for motion pictures is the Committee on Audio Recording and Reproduction Technology of the Society of Motion Picture and Television Engineers (SMPTE). For some years now, this group has been actively updating the various standards and recommended practices while discarding those that have become obsolete. (It's amazing how hard some of these things die.) There is no previous industry-wide practice regarding subwoofer levels to update, so a new recommended practice has been adopted. However, since DTS, Dolby and Sony have each specified a different method for setting subwoofer levels, it wasn't as simple as one might think.

The subwoofer channel was added to address the need for bass in movie theatres. In the mid 1970's, with the exception of the sensurround® process used for only four films, all the bass was delivered by the main full-range screen speakers. The largest screen speaker typically in use then was the Altec Lansing A-4. Large as it was, the A-4's woofer had a falling frequency response. The lower the bass frequency, the less the speaker's output. To a degree, this is true for every woofer ever made. In the case of most theatre speakers, the fall-off began anywhere from 80 to 200 hertz. With a few exceptions, this is pretty much the capability of the woofers in many of today's screen speakers. In addition, rooms as large as movie theatres (even small ones) simply must have more bass output from the sound system in order for the bass to be in balance with the middle and higher frequencies. This especially true for sound systems required to reproduce explosions.

Originally, Dolby Laboratories specified that the subwoofers be set at 89 to 91 dB in 70

MM theatres with pink noise playing and measured in the center of the theatre. It soon became apparent that this approach resulted in widely varying subwoofer levels from theatre to theatre when playing actual program material. This is due to many factors, such as room reverberation and size. Subwoofer systems in two different theatres could measure the same with pink noise, but be as much as 6 dB apart when a film played. Consequently, the only reliable way to set subwoofer levels was by ear, along with familiar material. Another measurement method was needed.

Dolby's answer was to use a Real-Time-Analyzer (RTA) rather than a sound pressure level meter to measure the subwoofer level. The idea was that the subwoofer frequencies should be set to appear 10 dB above those of the center channel, as seen on the analyzer. See Figure 2. Personally, I was skeptical about this approach. However, while I was unsure of this method, I did begin an extensive study to see if indeed the subwoofer's frequencies measured 10 dB above those of the center channel, when the subwoofer levels were correct and sounded the same in different theatres. Sure enough, they did. Yet the pink noise based subwoofer readings in these different theatres varied from 85 to 92 dB when measured with an SPL meter.

When DTS and Sony initially introduced their digital processors, they specified that their subwoofer levels should be measured and adjusted using an SPL meter, just as Dolby had originally done. Recently, both Sony and DTS have agreed with the Real-Time-Analyzer approach as they also found it to be more reliable. Consequently, the SMPTE has issued a recommended practice, RP200, described below.

First, I have a suggestion: Unless there is a very unlikely audible problem with the frequency response of a subwoofer, the subwoofer channel should not be equalized. The measurement systems used by theatre technicians are simply too unreliable to be equalizing a speaker playing only these lowest frequencies. Subwoofers do not need to be equalized, even though the measurement systems might seem to say that they do. Beyond limiting the bandwidth of the subwoofer channel to frequencies below 80 to 100 hertz, I have never found the need to equalize a subwoofer in twenty years.

Each of the DTS, Dolby and Sony cinema processors employ a different means for equalizing subwoofers. The best way I have found to set the subwoofer equalization with the various Dolby units is to use the adjustments to simply minimize the frequencies above 80 to 100 Hertz. The original Sony DFP-2000 processor as well as the DTS DTS-6 and DTS-6D players have fixed or selectable subwoofer filters that allow only the frequencies below around 80 Hertz to pass. The newer analog-digital processors from these companies employ optional subwoofer equalizers. In the Sony DFP-3000, for

instance, one can set the subwoofer filter at 100 Hertz (as is done with the DFP-2000) and leave the subwoofer equalization adjustments flat.

Rather than relying on a Sound Pressure Level meter, subwoofer levels should be established as follows:

1. After the screen channels are equalized and levels are set, play pink noise through the center channel. Observe the RTA display and note the level of the frequencies between 100 and 2000 Hertz. See Figure 1. This level becomes an imaginary reference line for setting both the optical and digital subwoofer levels. Turn off the center channel pink noise.

2. Turn on the pink noise in the subwoofer channel. Place the processor in the digital format. Adjust the digital subwoofer so that the subwoofer frequencies are 10 dB above the (imaginary) reference line. See Figure 2.

Note: For purposes of illustration only, I have included the “X” curve display shown in figure 1, in figures 2 and 3. Since the center channel is off when setting the subwoofer levels, the analyzer will obviously only show the frequencies of the subwoofer. The subwoofer frequencies are indicated by the blue-yellow bars.

3. Place the processor in the optical format. Now adjust the optical subwoofer level so that the subwoofer frequencies are even with the reference line established by the center channel. See Figure 3.

4. It should go without saying that listening tests should be done with familiar material, but not trailers. It may be necessary to reduce the optical subwoofer level if the three main screen speakers are providing enough bass (or almost enough) on their own.

For future reference, one may record the resulting subwoofer’s SPL meter readings in both formats. Only using these recorded levels as referenced to an analyzer, would an SPL meter be useful for checking subwoofer levels at some future time.

The RP200 recommended practice covers the adjustment of sound levels in all the channels of multi-channel motion picture sound systems. It specifies that the measurement microphone be located about 2/3 rds back from the screen and 1/3 rd the width of the theatre away from a side wall. In other words, off center. The argument goes that the microphone is in the far field and thus does not need to be in the center where it would be in a relatively symmetrical position between all the channels. Far-field? Maybe. But not far enough I think. In practice, I have found this to be erroneous, no matter what

kind of sound system is involved. For one thing, there is no such thing as a “far field” in a good surround array. The microphone should generally see a fairly flat near-field response when walked around the area bounded by the surround speakers. To place the measurement microphone off center could result in the two surround channels playing out of balance even though their measurements were equal. If one wants the surround channels to play in equal balance, they must be measured equally.

A symmetrical microphone placement is also beneficial for the screen speakers. So I would recommend that technicians set sound levels with the measurement microphone simply placed in the center of the seating area. Try it and see if the balance isn't better.

© Copyright 1999, John F. Allen. All Rights Reserved.

John F. Allen is the founder and president of High Performance Stereo in Newton, Mass. He is also the inventor of the HPS-4000® cinema sound system and in 1984 was the first to bring digital sound to the cinema. John Allen can be reached by E-mail at JohnFallen@aol.com.

THORETICAL "X" CURVE

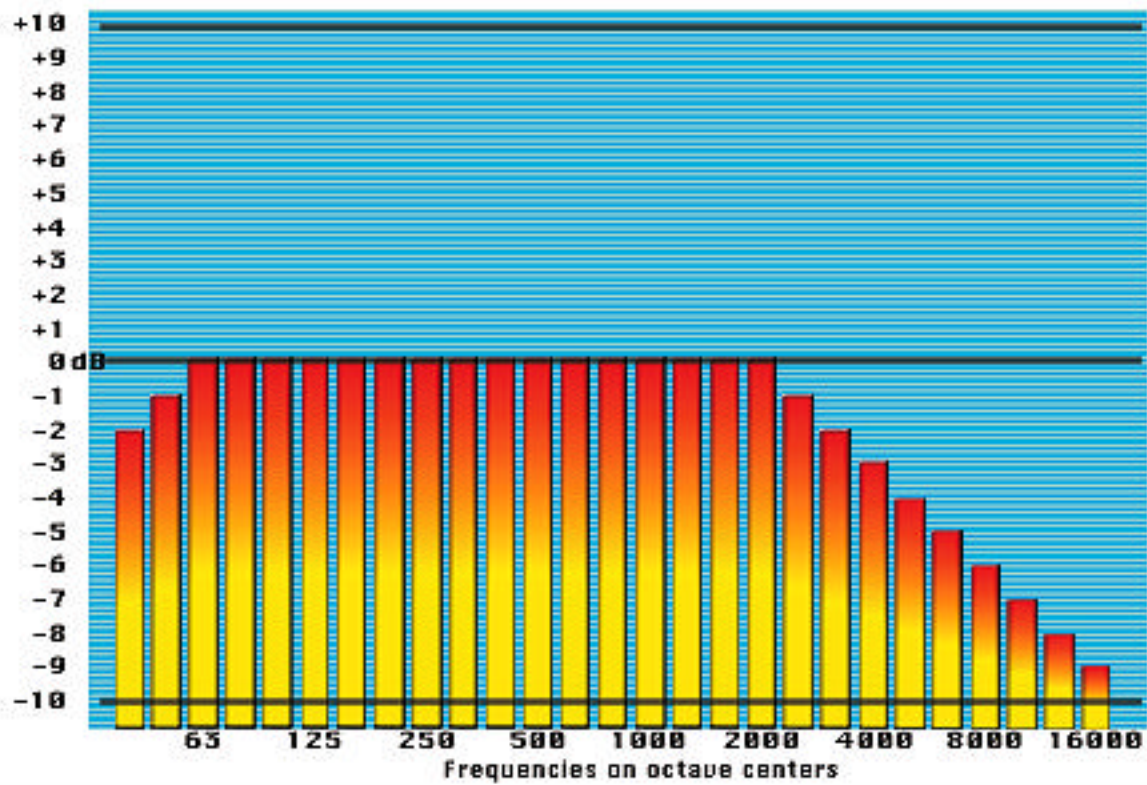


Figure 1

DIGITAL SUBWOOFER RESPONSE SUPERIMPOSED OVER THE THEORETICAL "K" CURVE

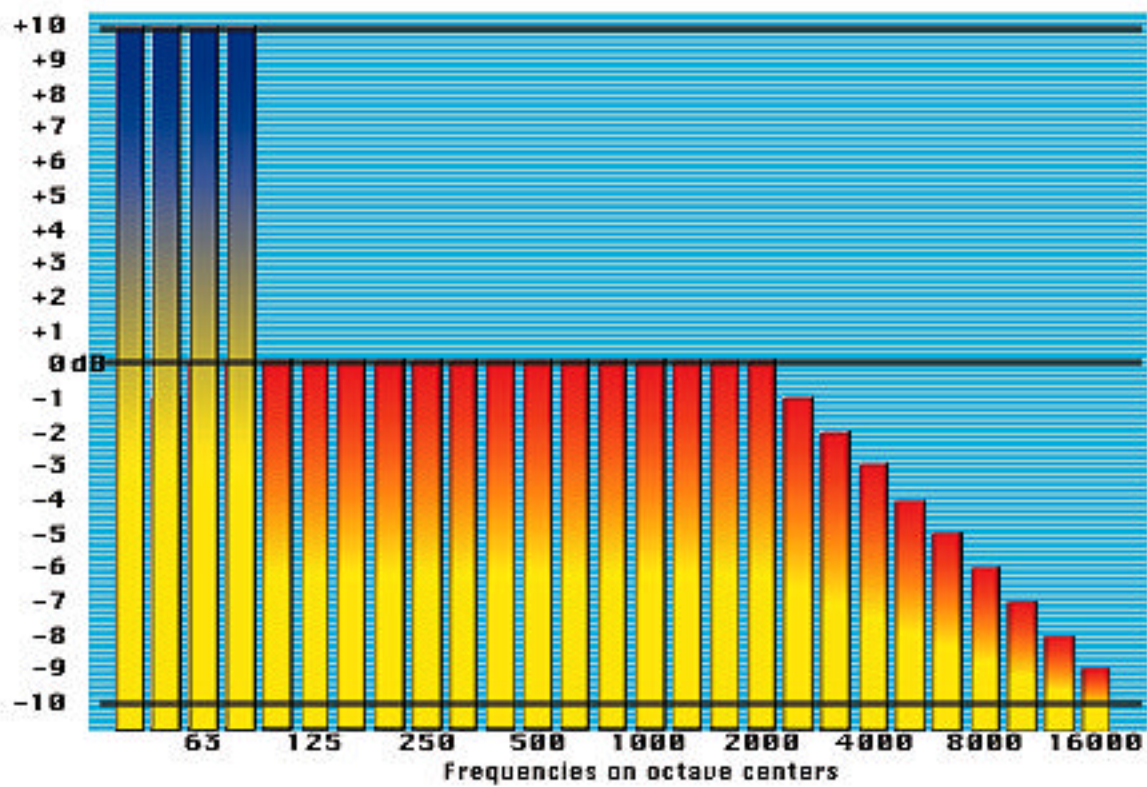


Figure 2

OPTICAL SUBWOOFER RESPONSE SUPERIMPOSED OVER THE THEORETICAL "K" CURVE

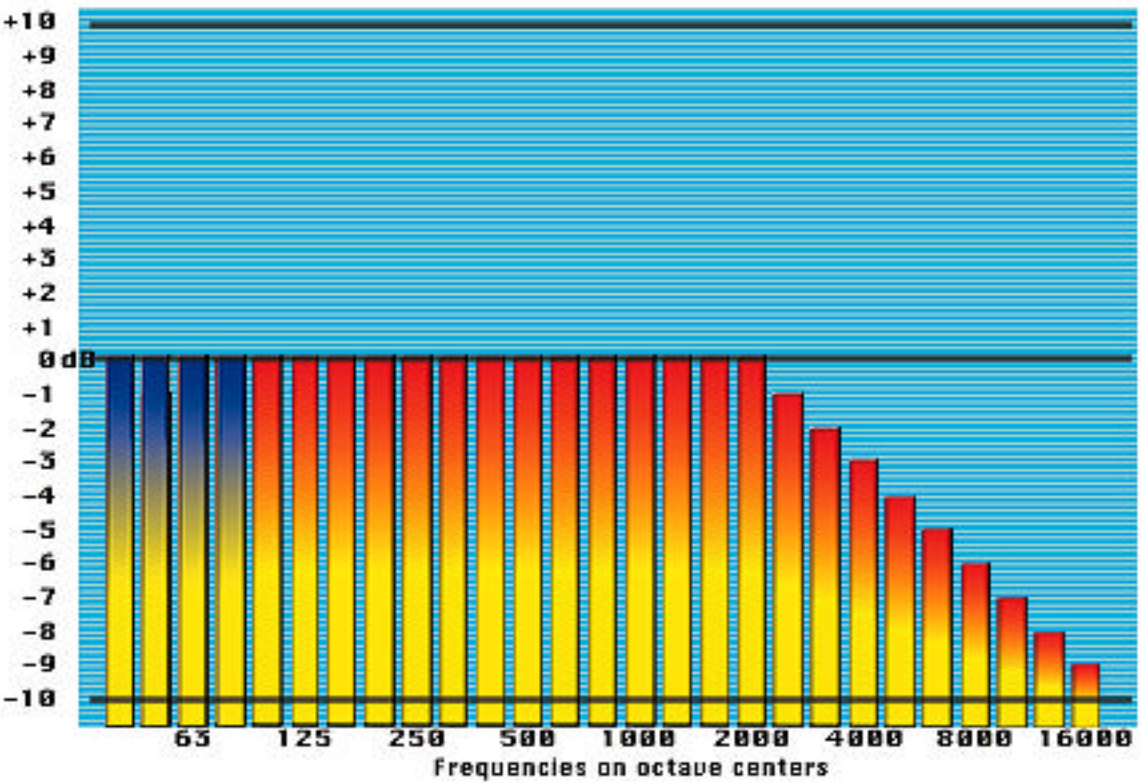


Figure 3