

# Subwoofer Bass Management Systems

The audio performance and benefits of placing four to 100 subwoofers in one room

by Brian Barr

Subwoofer bass management systems (SBMS) are perhaps the most awesome, noticeable and appreciated feature of home theaters and listening rooms for today's end-user—that is if they are correctly designed, engineered, manufactured, installed and calibrated on-site. Audio/video integration companies that successfully provide SBMS to their clients credit this aspect of their business as being a positive differentiator that places them above their competitors.

Even when armed with only four subwoofers, entry-level SBMS transform and significantly improve audio systems. With SBMS, the bass performance begins to approach that of state-of-the-art recording studio playback systems. Quick, accurate and evenly distributed bass is enjoyed by all family members (not just the audiophiles) at every listening position. Dialogue becomes far more coherent, and faster transients are achieved as SBMS approach the absolute transparency that the director intended originally.

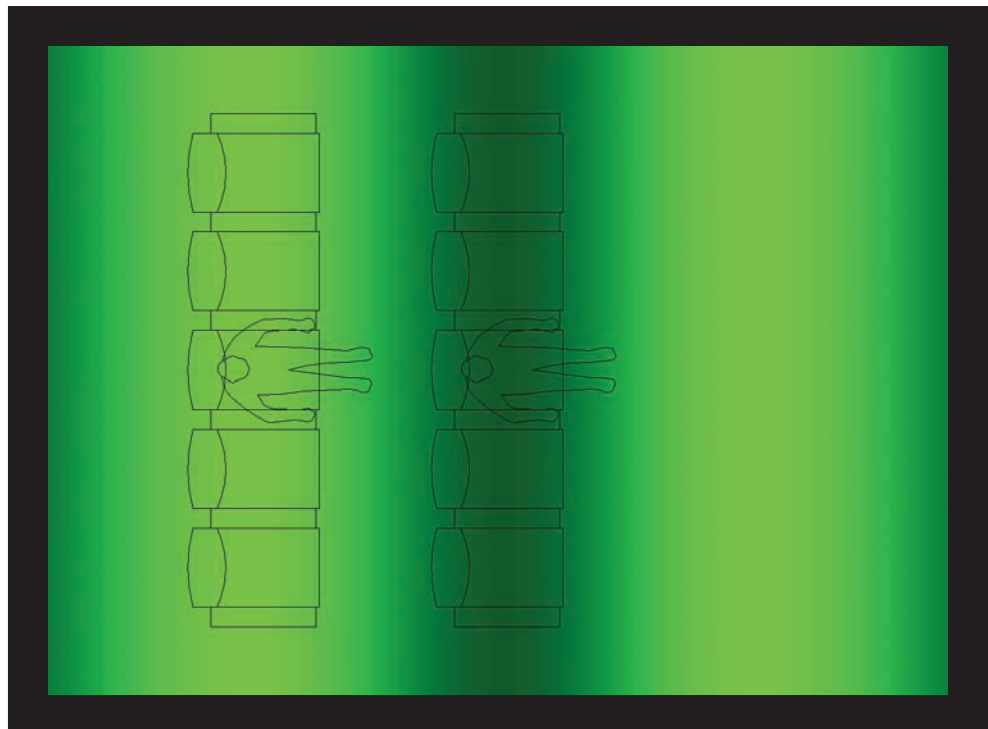
In general, users who are sensitive to listening fatigue don't enjoy the sloppy and inconsistent bass generated by single- and dual-subwoofer systems. Yet these same users cringe at the idea of adding even more subwoofers to their already "boomy" one- or two-subwoofer system. Although they require some education regarding the benefits of SBMS during the sales process, these same clients become the biggest SBMS fans fol-

lowing installation and calibration.

Women tend to be more sensitive to boomy bass than men. Single- and dual-subwoofer systems often cause slow, annoying and fatiguing bass that is very inconsistent throughout all listening positions. Without SBMS, as low-frequency standing waves add and cancel the signal at various bass frequencies and ampli-

tudes, one seating location may negatively experience far more than twice—and often five or six times—the perceived bass volume level of unwanted, fatiguing bass as another seating location at some frequencies.

When listening to SBMS for the first time, most people say it's the best audio/video technology they have ever experi-



Low-frequency sound pressure variances arise as a result of standing waves at a given frequency. Shown above: a typical two-subwoofer system without a subwoofer bass management system (SBMS).

enced. Women and men, who used to hate their one- or two-subwoofer systems, now thoroughly enjoy their new SBMS—even though it contains substantially more subwoofers (at least four and usually dozens). In an attempt to praise SBMS, non-industry people often refer to it inaccurately as “subwoofer noise cancellation systems.” Nonetheless, these users also are more than pleased with the accurate bass response that SBMS provide at all listening positions.

In addition to significantly increasing overall audio performance, audio systems that are armed with an An SBMS can be turned up louder and for longer, while causing less listening fatigue than audio systems without it. SBMS brings accuracy, a “wow” factor and fun to the top recording studios and home theaters.

For example, sound emanating from the speedy snap of the drum hits the listener, then quickly disappears so that every detail of the singer’s voice, and the other accompanying instruments, can be heard. Explosions throw the audience back in their seats, but vanish so the audience can enjoy the realism of bullet casings hitting the ground. A two-hour movie or concert can be enjoyed by all members of the family, at low- or high-volume levels—without anyone having to experience negative listening fatigue.

### THE PLACEMENT’S THE THING

Most rooms require a minimum of four—and often dozens—of correctly placed subwoofers to gain the minimal desired benefits of SBMS. An acoustician must correctly place each of the four to 100 SBMS subwoofers using precise acoustic calculations to ensure proper placement. But be aware: There is no standard formula that works for all room sizes. Only a properly trained acoustician can gather and implement all the necessary information to correctly place all the subwoofers in an SBMS.

To avoid the necessity of hiring a properly trained acoustician, as well as purchasing all the necessary calibration equipment and digital signal processors (DSPs), many dealers have been trained unfortunately to place subwoofers in the four corners of a room. Others have been taught over-simplified schemes, which have little relevance in actual application (e.g. dividing the room into thirds and placing the subwoofers in one-third of each sidewall, etc.). Interestingly, many of those who currently follow some of the aforementioned theories are the same



This CAT project, installed 20 years ago, displays the placement of the system’s front stage delivery subwoofers (FSDS) and the dedicated channel subwoofers (DCS).

people who, 20 years ago, preached that only one subwoofer was necessary. Ten years later, they preached that only two subwoofers were necessary.

To achieve the minimum desired performance results, SBMS systems require a minimum of four correctly placed subwoofers. Each of these four subwoofers should have a dedicated DSP channel and a dedicated amplifier channel. This formula doesn’t change as you increase the number of subwoofers: An eight-subwoofer SBMS setup will require eight DSP channels and eight amplifier channels. In SBMS, the subwoofer (LFE) output of the audio/video processor is wired to the input of the DSP processor(s). Next, each DSP output is wired to each amplifier input. For example, Symetrix manufactures an award-winning DSP exclusively for CAT, which boasts eight XLR inputs and outputs (optional Euro-

block inputs and outputs are available, as well).

When designing SMBS, the more subwoofers that an acoustician has at her/his disposal, the better. Twenty years ago, CAT engineers designed, manufactured and calibrated on site an SBMS system that incorporated 20 subwoofers. In 2008, CAT engineers provided a high-end client with an SBMS system that incorporated approximately 100 subwoofers! (CAT 8x8 DSP XLR’s can be added together to DSP over 1,000 audio channels, if necessary.)

Car audio specialists often install two, three and even four dozen subwoofers, each controlled with a separate DSP channel that’s driven by a separate amplifier channel, and calibrated on site in their award-winning competition vehicles. Yet surprisingly, most elite home audio/video installation companies, who fancy themselves as experts, have never calibrated a DSP, or ever offered SBMS to their clients. Instead, they simply place one or two subwoofers in their home-theater installations. Humorously, the luxury car the client drives to a dealer’s showroom is often armed with more DSP horsepower than the home theater that they’re about to purchase.

### SHARING THE WORKLOAD

Please do not confuse SBMS- dedicated subwoofers with other subwoofers in the system. Again, all subwoofers in an SBMS receive their signal from a DSP that receives its original information from the LFE (low-frequency output) of the audio/video processor. Typically, some of the SBMS subwoofers are acoustically placed in the front of the room. CAT engineers call these Front Stage Delivery Subwoofers (FSDS).

Placing two or more subwoofers in the front of the room (the more the better) significantly reduces the low- frequency attack and decay time compared to one subwoofer. For example, one subwoofer

takes significantly more time than numerous subwoofers since it has to travel substantially farther to achieve the same displacement. The remaining SBMS subwoofers are acoustically placed in other locations of the space in question—the side and rear walls, floors, columns, cabinetry and ceilings. CAT engineers call these SBMS subwoofers Room Balancing Subwoofers (RBS).

But there are other subwoofers in a world-class sound system that are not part of the SBMS and do not receive LFE information. CAT engineers call these Dedicated Channel Subwoofers (DCS). To accurately produce true low-frequency bass information beneath 20 Hz in each channel of the system, CAT engineers place one, two or six or more subwoofers with each loudspeaker in the system—front left, center, right, left-side rear, left rear, right rear, and right-side rear. The top CAT MBX systems incorporate front left, center, right and a dozen side and rear loudspeakers (each armed with additional DCS subwoofers), in addition to the 20 to 100 subwoofers in the SBMS.

### THE SALES PROBLEM

Smart audio/video business owners offer the services of engineers, acousticians and on-site audio calibration in a manner similar to the way they offer top video projectors and on-site video calibration to their customers (e.g. ISF and DCI calibration). But these dealers are more the exception than the rule. In many cases today, subwoofers are the most misused loudspeakers in home theaters and listening rooms. Lack of proper acoustic engineering knowledge, calibration equipment, subwoofer placement, and a lack of understanding and implementation of digital signal processors (DSPs), are some of the primary reasons for the present shortage of correctly installed and on-site calibrated SBMS. In fact, most audio/video installers have never attempted to provide their clients with SBMS.



Shown above is the same CAT project with room balancing subwoofers (RBS); the project is also equipped with an SBMS.

The sales and marketing departments of large audio corporations are to blame, as well. When the home theater revolution arrived approximately 20 years ago, large corporations—which were more interested in the quick profit that lesser performance systems offered—marketed the incorrect concept that a single subwoofer was more than adequate to accurately and evenly reproduce all necessary low “bass” frequencies at every listening position in a given room.

Equally detrimental, this single subwoofer was placed in a corner under a desk or in a cabinet. End-users began to refer to this lonely subwoofer as a “boom box”—the same derogatory term already given to those plastic music boxes that create noise pollution in public spaces.

Before this trend, most stereo loudspeakers were at least the size of a small refrigerator or filing cabinet, and were housed an 8- or 10-inch subwoofer—and sometimes in 12-, 15- or 18-inch subwoofers. As a positive result, their stereo speakers *rocked*. Unfortunately, early Dolby surround processing systems only sent full range 20Hz to 20 KHz signals to the front-left and -right speakers. The center and surround channels were rolled off at 80Hz. Thus, very small center speakers and surround “satellite” speakers became en vogue since they didn’t need to reproduce any frequencies below 80Hz.

However, present surround technologies do, in fact, send true, full-range 20Hz to 20KHz information to all channels (front left, center, right and surrounds).

Thus, properly designed audio/video systems should place a true 8- or 10-inch—or preferably larger 12-, 15-, 18- or 22-inch—woofer(s) on all channels, in addition to SBMS subwoofers.

Audio/video businesses that incorporate SBMS into their repertoire provide superior performance and increased visceral impact to their clients, while positively differentiating themselves from their competitors.

However, as with all technical offerings, high-end A/V dealers must make certain to properly prepare their businesses to offer this superior SBMS technology. Similar to selling, installing and calibrating ultra-high-end projectors, SBMS requires substantial off-site acoustic engineering knowledge and practice, as well as state-of-the-art calibration equipment and on-site calibration by trained acoustic engineers. Proper calibration of a four- to 100-woofer SBMS takes more calibration equipment and substantially more time than a single projector setup. Whereas a projector takes less than a day to calibrate, an SBMS takes from one to several work days to calibrate on site. But in the end, all the time and investment reward both the dealer and the client substantially. ●



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