

The Low-Down on your Sound System's Low-End

By Christopher Buttner

What is the most beautiful, detailed, expressive and dynamic acoustic musical instrument in your Church's musical group? The piano? How about the acoustic guitar? Flute? Consider this: When you praise the Lord in the most expressive musical manner, what instrument do you use? Right! You, the choir or worship team singers and the rest of the congregation use your voices.

Does your sound system reduce the beauty and majesty of the music from your praise and worship team to a hollow, artificial sound, more closely resembling a cheap A.M. pocket radio in a wastebasket instead of a live acoustic event? If so, read on as we discuss the importance of low-frequency extension in the musical experience.

We live in an atmosphere of pressure waves. Low-frequency sound pressure (bass) is an important element that completes and adds credibility to nearly every acoustic event. When low frequencies are removed from sound as it is amplified or reproduced, we are distracted by their absence. In fact, bass is often filtered out of voice or music in television or movies to cause you to believe you are hearing a telephone or a very old recording.

Reality is filled with detailed low-end sound pressure, from the sound of a refrigerator door slamming, to a book being dropped on the floor, to the percussive tone of a finger fretting a guitar string, to the whisper of your child's voice in your ear. Bass is truly a visceral thing, often a melding together of the body's powers of vibrational perception, the ear's power to hear and the mind's power to translate the two into emotion.

Power is inherent in bass energy: it's the feeling in your gut and the thump in your chest. Bass is a tactile sensation, like the wind on your face and in your hair. It's also a very primal, emotional, physical and instinctive sensation. You instinctively know when it's honest and you instinctively know when it's false. Let's use the example cited previously. Remember how the transistor A.M. radios from the 1960s and 1970s were notorious for their inherent lack of low end? When was the last time you liked, were drawn to, or trusted, music that sounded like it was coming from the one-inch speaker of a transistor radio? Instead, the tinny sound drives you to constantly tweak the knobs; to do anything you can to get some bass extension dialed in so the music will sound more realistic and natural. You know and trust true bass when you hear it. Effective low-end bass has the power to move both the musician and the congregation.

We're not talking volume here; we're talking control and extension. Volume is perceived really as an upper-bass phenomenon. You can't make low, low bass really loud. You can't even make it loud enough to hurt someone's ears. It's only the upper frequencies that can cause pain or fatigue. The fact is, the absence of one end of the audio spectrum is often perceived by the listener as too much

of the other. Take away the high frequencies and the listener will complain that the sound is muddy. Reduce the bass content and the congregation will describe the system as too bright, shrill, even screaming at them. By adding extended, accurate, low bass, it will actually make music less fatiguing and more soothing and relaxing to listen to. This cuts across all genres of music, from traditional hymns to contemporary worship and praise, as well as gospel, rock, classical, techno, punk, disco or jazz.

The most potent and effective sound system reproduces the real-life auditory experience of the event. At the foundation of a quality sound system are high-quality loudspeakers and subwoofers, mixer/pre-amplifiers, signal processing and power amplifiers. These components have to reflect reality and deliver the music's dynamic range accurately. Let's assume that a church (not your church), just invested in a quality sound system, but compromised on the subwoofers... as is often the case. To improve the overall system performance, let's talk about the low-end devices that deliver these frequencies: the subwoofers and the amps.

When considering and evaluating subwoofer systems, you have to listen to the transient response of the speaker. The transient response is the speed at which the speaker cone propagates the note to completion and returns back to its starting position, ready for another note. It's the speaker's 'Hit-it-and-Quit-it Factor'. A speaker system with the greatest 'Hit-it-and-Quit-it Factor' will not display as many perceptible intermodulation, decoupling, and/or distortion problems, and will recreate greater fidelity with more articulate, faithful musical nuances and subliminal cues.

Professional soundman Art Steele has over 22-years of live sound touring experience with the Grammy Award-winning a cappella Gospel group, 'Sweet Honey in the Rock'. Art offered the following advice about evaluating loudspeakers. "When I test out a large PA system's low-end response, I will drive the system with a quality high-fidelity amplifier with a matched power rating to the subwoofer. I use a well-recorded acoustic jazz ensemble with an upright bassist, bass guitar dominated music or music with an accurate and complex, yet detailed bass line. Since I also play bass guitar, I will many times plug an electric bass right into the PA system I am evaluating. The bass guitar is one of the most dynamic test instruments for a loudspeaker because it allows you to hear the speaker's transient response very quickly. As an example of the dynamic range of a bass guitar, listen to how fast the instrument can go into the high-frequencies of 12 kHz to 17.5 kHz, by tapping, popping, slapping, and harmonics, and then instantly dive to the very low frequencies of 30 to 40 Hz."

Continuing, Art points out, "By playing complex, accurately recorded bass tracks through a PA loudspeaker and subwoofer system, you are able to listen to the way the air moves in the cabinet; you can hear how the ports are loading, and you hear the extension and transient response in a very functional, real and controlled way. You can hear how the bass unscrambles intermodulated sounds and how it deals with peaks and complex waveforms. Complex bass parts (a good bassist in your congregation can help you out in this department), allow you to reveal any potential flaws in all of the acoustic and auditory domains."

Steve Conrad, the Audio Manager of Dr. Robert Schuller's well-known and respected Crystal Cathedral, in Garden Grove, California, offers the following insight on evaluating PA loudspeakers. He states, "Evaluate loudspeakers made by a manufacturer who specializes in concert sound. Their livelihood is based upon making highly reverberant concert halls sound acoustically great in only a few hours. These sound systems undergo a tremendous amount of abuse and go in and out of massive concert halls day after day. A touring sound system gets moved into a stadium or large hall first thing in the morning, it's flown, the stage is set and a soundcheck is done by five or six p.m. For such applications, these speakers are designed to sound great in front of a paying crowd of 3,000, 15,000 or 20,000 people by a 7:30 p.m. showtime. I really can't think of better method for choosing a sound system for a church."

Knowing the directionality of frequencies is important when setting up a sound system. The shorter the wavelength - the higher frequencies - the more these frequencies tend to become focused or highly directional. Lower frequency wavelengths are much longer. The sound can bend and it becomes more omnidirectional. That's why if you stand behind a sound system, you hear more of the lower frequencies and very few of the highs.

The human voice produces midrange frequencies; therefore the human ear is designed to be a lot more sensitive to midrange frequencies. The range from about 2kHz through 6kHz is the critical range for vocal clarity and effective articulation for consonants. Partially because their energy is dispersed in all directions, subwoofers require much more power to keep up, or stay in balance with, directional midrange frequencies. When you find a 'smiley curve' on a sound system's EQ, the user is trying to boost the low and high frequencies to improve and increase fullness, clarity and

intelligibility.

Due to the very nature of low frequency sound, the output of subwoofers does not project forward, unless you have a wall behind the subwoofers to help reflect the sound out towards the audience. If the subwoofers cannot be placed in front of a wall to improve their forward output, then you're going to need a lot more power to achieve your goal. Translation: you're going to need more subwoofers and/or more power.

WHAT TO CONSIDER IN SUBWOOFER AMPS

An increase of 3 dB (decibels) SPL (sound pressure level) in the system output is the amount of change required for sound to begin to sound a little louder to the human ear. To get 3 dB more energy out to the audience, you need to double the power. To just perceive a volume increase, you need to go from 100 watts to 200 watts, and then 200 to 400, 400 to 800, etc. So, to really buy low-frequency headroom, you need some pretty dramatic increases in power.

In order to deliver a clean waveform, you require a lot of power to keep the cone stable. Because bass is a long waveform, the speaker cone moves slower than when it's reproducing higher frequencies. If the speaker cone loses control in these lower frequencies, you can hear more distortion. When a bass note distorts, you lose all definition in the lower frequencies and the note is reduced to slurred, non-musical resonance.

The power amp driving the subwoofer has to have enough on-board juice to reproduce fast and complicated musical events and passages. To keep the sound clean and undistorted, you want plenty of headroom and the amplifier has to be able to deliver the sound musically. Look for an amplifier with extended bandwidth that can deliver fast, instantaneous current. The power amplifier has to be honest, that is faithful to the original signal. In essence, the power amp must be transparent.

A subwoofer's contribution to the musical program material should never be reduced to 'wash tub' bass modalities, where the congregation winds up hearing only tangential changes on a one pitch 'thump'. An adequately powered, properly designed subwoofer system can add volumes to all that is said or sung.

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