UNDERSTANDING BASS MANAGEMENT IN PA SYSTEMS

A Guide for Performers

CERWIN-VEGA! PROFESSIONAL

3000 SW 42nd St. • Hollywood, FL 33312 • P 954.316.1501 • F 954.316.1590 • www.cerwin-vega.com

Table Of Content

Forward

Effective low frequency management can be the difference between a performance that has a great, tight low end with punch, or a disappointing murk. How many times have you been to a gig or have one of your gigs been turned into a sea of mud by out of control low end? It doesn't have to be that way and by using some basic techniques and applying them to any given situation, you can get the most out of your gear and results you may not have thought possible.

Where you put your subs, and how you use them makes all the difference. By learning the basics of how low frequencies behave and then implementing some basic means with which to deploy them, you'll be able to clean up your stage sound and provide clear, crisp sound with a bigger than life thump on the bottom end.

This information is relevant from the smallest coffee house stage to the arenas and theaters of the pros. Once you master the concepts and grasp the basics of the deployment techniques, no matter what size gig you or your band does, this information will go a long way to getting you and your band the quality sound you've been after.

Dave Stevens

Dave is a 20 year veteran sound mixer, specializing in large scale sound reinforcement, who has been involved in live mixing for Heart, Pearl Jam, Paul Rodgers, Al Jarreau, Everclear, David Sanborn, Neil Young, Nirvana, Kenny Loggins, Alan Persons, The Smithereens, Jefferson Starship, and Toad the Wet Sprocket.

Introduction

For many people, the most fun aspect of being a musician or DJ is the live performance. Let's face it, most people enjoy being recognized and appreciated. And what can be more enjoyable than performing your craft in front of a live crowd and hearing the applause of an audience that enjoys the show?

Of course to create a good performance you need a certain level of sound quality as well. It is this aspect of live performance that is frustrating for many people. From purchasing the correct products, to setting them up to sculpting the sound of the performance–this can be a daunting task even for experienced musicians.

Many people do not perform in live situations enough to acquire the skills needed for equipment set up and use. Also you are always under pressure to set up and be ready for show time.

This document is not an all encompassing guide to PA gear. It focuses on one of the toughest aspects of proper PA use and set up: bass frequencies. Who better to provide this information than Cerwin-Vega!? We are the industry leader in bass since the introduction of PA gear.

From the incorporation of wheels on bass cabinets to the use of our folded horns for the sound effects in the movie Earthquake, reliable, bullet proof, earth thumping bass is what we do.

Bass can be overpowering, non-existent, or many degrees in between. From a wide variety of bass cabinets to crossover settings to the sound space–all can induce variables that can make you sound like a wimpy act, a thumping, earthquake rumbling phenomenon, or a thick wall of mud that no one wants to listen to.

In this guide, we'll introduce you to several concepts that will help you get the sound you want—and that means a better performance for everyone. This is a challenge you will need to address if you want your PA to transfer your ideas accurately to the audience.

We hope you will find this document useful for your performances. We also hope you will consider Cerwin-Vega! products for your next PA system.

The Cerwin-Vega Team

Why Would I Need a Subwoofer?

You can gain many advantages by adding a subwoofer to your PA setup. A woofer in a full range PA speaker is asked to do numerous things. It must accurately reproduce the lowest frequencies at high volume, along with the low-mid and mid range material. By moving the lowest frequencies from your main PA speakers and directing them to a subwoofer, you eliminate a large amount of the excess work that your main top box was trying to reproduce. As a result, your main cabinets will run more efficiently and at higher volumes. In the process, you will also be sending those bass frequencies to a speaker that is specifically designed to handle them.

While the subject of bass management can be quite extensive, the goal of this guide is to provide you with the basics—a concise look at what you need to get the job done, why you need it, and a look at your available options. By grasping the concepts of bass management, we're confident you'll be headed down the right path to better sound.

What is Bass?

For the purpose of this guide, the bass we'll be discussing focuses on the low end of the audio spectrum dominated by bass guitar, kick drum, synthesizers, bass pedals, etc. When we're talking about bass, we mean low frequency sound waves. Sound waves? What are they?

Imagine dropping a pebble into a still pool of water. As the pebble hits the surface, it sends out ripples that have a high crest followed by a dip, or low point, in a familiar circular pattern of waves. Much like the waves produced by the impact of the pebble, a sound wave is an alternating pattern of high and low pressure areas that emanate from a sound source. When the speaker pushes out, it creates a high pressure area. When it pulls in, a low pressure area is created. Unlike the waves in the pond, however, sound travels much faster—at roughly 761 miles per hour at sea level.

When we listen, what we hear, in terms of high or low notes, is dependent upon how close together the successive high and low pressure areas are as they pass our ear. This is known as the frequency of the sound wave, and it is measured in cycles per second. A cycle consists of one high pressure zone followed by one low pressure zone, as indicated in Figure 1.

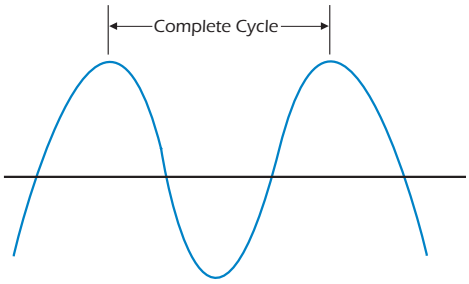

Figure 1. A Complete Sound Wave Cycle

Another measurement that can help you visualize this concept is wavelength. Wavelength is the actual distance between cycle peaks. In Figure 1, it is the distance denoted as one complete cycle. The longer the distance between peaks, the lower the frequency. For example, the high "E" string on a guitar is about 330 cycles per second. At the speed of sound, that would make the wave crests about 41.1 inches apart. For the low "B" string on a five string bass, the frequency is about 30.87 cycles per second, and the wavelength is 439 inches or 36.6 feet!

We measure frequency in Hertz, abbreviated Hz. A bass PA speaker, often called a subwoofer, is designed to reproduce frequencies from approximately 120 Hz and below, down to the lower limits of human hearing, which is approximately 20 Hz.

Sound waves do a few confusing things on their way to our ears. For example, their directionality varies with frequency. If you stand directly in front of a PA speaker and walk off to the side, you'll notice that the higher notes decrease in level. The farther you walk away from the front of the speaker, the more noticeable the loss of high frequency (HF) content, or sound, becomes. Why does this occur? The higher the frequency, the more directional its dispersion pattern—the area over which the speaker yields acoustic radiation (the sound). Hence, when you walk off to the side, you lose the highs.

Referring back to our description of the high "E" string on the guitar versus the low "B" string on a five string bass, the difference between wavelengths is not inches, but feet! Hence, low sounds just seem to "spread out" everywhere, while high sounds seem to easily disappear. This is precisely why people tend to complain about low, muddied sound with a lack of top end.

Mid/high frequency speakers will often have their dispersion pattern listed on the product's spec sheet, such as 60x40 degrees or 90x60 degrees. This is a measurement of the horn pattern of the HF drivers and is referred to as pattern control. A 90x60 degree horn will send the sound 45 degrees out to each side (45x2) and 30 degrees up and down (30x2) from its center point.

Unlike HF sounds, low frequency (LF) sounds spread out everywhere, so there is little you can do to control the directionality of bass. This is precisely why you continue to hear LF sounds as you walk away from, and off to the side of, the PA cabinet.

If your PA system uses more than one subwoofer grouped together, you will also gain the advantage of more bass as the individual cabinets "couple." As a result, adding more subwoofers to your system will increase the available SPL (sound pressure level), otherwise known as volume.

Another way to add to the efficiency of your subwoofer cabinets is to "floor load" or "corner load" them. Let's revisit that pebble in the pool of water, only this time we'll drop the pebble into the water right against the edge of the pool. Because of the wall, all the energy of the impact would spread out in one direction. This same phenomenon occurs when you put a subwoofer on the floor. Since there is one less direction where the sound can travel, that acoustic energy gets channeled differently and, this time, more bass reaches the audience. Corner loading is the same idea, but with even less area for the sound waves to radiate. This will generally work better with smaller subwoofers, as larger cabinets may have too much reinforcement at select frequencies, resulting in too much "boom in the room".

To help minimize the loss of HF material during your performances, consider placing the subwoofer on the floor and positioning the mid/high enclosures on top of them—either directly, or on poles as shown in Figure 2. Positioning your mid/high cabinet in this manner can give you the advantage of having the high frequency horn above the head (ear) level of the crowd. This arrangement better enables the higher frequency sounds to reach the back of the room as opposed to being absorbed by the crowd.

The Boom in the Room

In an orchestra, there are instruments such as trumpets, that play higher notes and big horns, like the tuba, that play much lower notes. It takes a larger instrument to excite a column of air that will resonate at such low frequencies. The instrument's sound originates with a small mouthpiece-level sound, and that sound is amplified as the sound waves pass through the horn and out the bell. The driver in a loudspeaker system operates in much the same way.

Figure 2. CVA-118 with one top mounted CVA-28

Some History of Bass Reproduction

In the early days of sound reinforcement, the amplifiers of the period had relatively low output capability and were ridiculously expensive tube devices by today's standards. A 200 watt amp was a monster back then, with most amps being in the 45 to 90 watt range. Hence, the drivers of the day were made to be as efficient as possible. With such little power and great big venues that required sound systems, a solution was to build large wooden horn cabinets that acted like a tuba—taking the small "mouthpiece-like" driver level and boosting it to a more useable volume. Thus, the bass horn, also known as the folded horn, was born. There are still many folded horns in use today, though the newer designs are much different and are made to operate with modern, high powered amps and drivers. This original design is still very popular in many markets.

Cerwin-Vega! EL-36B Folded Horn

If you are a member of a local band or work as a DJ, you may not have the vehicle to haul around such a large design. Some of the original bass horns were as large as 8-feet wide. Enter the modern front loaded subwoofer. As speaker power handling capacity rose and the dollar per watt price of amplifiers dropped, front loaded cabinet designs became more common. You could get more speaker cone area in a smaller amount of truck space and apply plenty of watts to drive these types of subwoofers. Typically front loaded subwoofers don't provide the same level of SPL but the compact size is worth the compromise for many people.

There are a few other types of subwoofer designs you might see in use, such as the manifold cabinet, in which the driver faces into a tuned ported cavity. You hear sound directly from the back of the driver in addition to the sound that emanates out of the port. This type of enclosure design extends the frequency capability of the driver lower than it would reproduce by itself. Another common design is the band-pass subwoofer, where the drivers are completely hidden inside the box and all of the sound radiates from tuned ports. The band-pass subwoofer can extend the bass capabilities of the driver even further down the frequency spectrum, but at the cost of reduced efficiency. In other words, this type of subwoofer can provide extended frequency response at the cost of the "loudness" or SPL.

Common Subwoofer Types				
Type	**Ease of Movement**	**Throw**	**Pros**	**Cons**
Front loaded	Usually the most compact	Short to mid	Small size, relatively inexpensive, good definition, easy to time align	Not as efficient as other designs
Horn loaded (Folded horn)	Usually large	Mid to long	Most efficient design	Larger than other designs
Manifold loaded	Mid sized	Mid to long	Extends low frequencies	May not sound as good close up
Bandpass loaded	Mid sized	Short	Extends low frequencies, produces deep bass from a smaller driver	Usually heavy, doesn't throw well, and limited frequency range

Table 1. Common Subwoofer Types

Next, let's assess your situation. Are you purchasing a whole new speaker rig or just adding subwoofers to existing top cabinets? Will these be installed in a club or do they need to be transported? Can you fit them into the vehicles available to you? Must you be able to move them yourself or will there be help? Which type of subwoofer will best suit your music?

When researching the many enclosure choices available, what should you look for? What specifications are important for you to know? Begin by starting with a budget. Determine how much you can realistically spend on the entire bass system, including all the system components you'll need in addition to the subwoofers themselves. How much speaker cable is required? If you need an amp or multiple amps, what is your budget? How much rack space do you have available? Will you need a crossover or speaker management device? These things add up fast! From there, determine what you (or your entire band) can carry—carefully considering size and weight.

Once you've arrived at a decision about what's most important for your particular requirements, it's time to move to design. How many people will be in your average audience? Will your most common venue be indoors or out? If you will be performing outdoors, you'll need a design with the ability to project the sound a greater distance. The issue of sound projection is referred to as the enclosure's ability to "throw" the sound. If you're mainly working in small clubs, you want minimal throw, as the bass will be reflecting off of the back wall. Be advised, this situation could make your sound muddy or boomy.

What type of program (material) will the sound system be reinforcing? The type of subwoofer chosen for a country band may be quite different from that used for a rap or reggae act. Different subwoofer designs emphasize different bass frequencies in real world use. When auditioning a subwoofer enclosure (or any loudspeaker enclosure for that matter), listen with program material that is familiar to you. This is critically important. If you aren't familiar with the music, you place yourself at a disadvantage in terms of being able to evaluate an enclosure's performance.

Next, how many subwoofers do you need? If you're currently playing 300 seat clubs with a pair of pole mounted enclosures like the many available models that use a 15-inch LF driver combined with a horn for the HF, adding a single driver, front loaded sub underneath each will work nicely. Many of these subwoofers have what is known as a "pole cup" on top of them, so the mid high cabinet can be mounted right on top (see Figure 2).

By reviewing the Typical System Configurations chart (Table 2), you should be able to get a good idea of where your performance requirements lie in relation to the type of system most suitable for your application. If you have a much bigger club rig in mind, you may want to consider a subwoofer with two or more drivers—and, perhaps, even multiples of those. If you need to cover large audiences outdoors, you may be looking at a modern folded horn cabinet.

Typical System Configurations		
PA Configuration	**Venue Size**	**Type of Music**
Small System: 2 pole mounted mid/highs and 2 small subwoofers, 15-inch or 18-inch driver.	Small club up to 300 people	Jazz, Acoustic, Country, Soft Rock
Small High Power System: 2 high power mid/highs with 15-inch woofers and large horn; two high power subwoofers with one or two 18-inch drivers each. Front or manifold loaded.	Small club up to 500 people	All types
Mid Size System: 4 larger multi-woofer mid/highs with 4 subwoofers–either front loaded, manifold loaded, or folded horn.	Large clubs over 500 people, small festivals, fairs	All types
Large System: Multiple mid/high cabinets possibly flown in the air, and a like number of subwoofers–either front loaded, manifold, or folded horn.	Large venues over 1000 people, larger festivals	All types

Table 2. Typical System Configurations

Here's another important consideration. Will your subwoofer cabinets be active, meaning the amplifier is built in, or passive, requiring an external amplifier? While they are more expensive, the advantage of self-powered, active speakers is that the system is pre-matched—optimizing the combination of amplifier and loudspeaker in the process. The active system might even include an active crossover (more on that later). By contrast, a passive (non-powered) system enables you to replace the amps later if you want to, but also results in more equipment to haul around. For now, let's focus on non-powered subwoofers.

Setting Up Your System with a Non-Powered Subwoofer

Once you've decided on the best subwoofer choice for your situation, you need to consider your amplification, and this is where understanding a loudspeaker's specifications becomes important.

For starters, you'll need to determine the efficiency of the subwoofer(s) you are considering purchasing. Usually, this is expressed as XX db @ 1 watt/1 meter, where XX is a number of decibels (a unit of sound pressure). This is accomplished by placing a measurement microphone 1 meter from the front of the speaker, and powering it with 1 watt of signal—a process performed and documented by most loudspeaker manufacturers as a means of helping customers compare models. The higher the resulting number, the more sound you'll get out per watt applied. Hence, a speaker with an efficiency of 95db @ 1 watt/1 meter will be louder than a subwoofer rated at 85 db @ 1 watt/1 meter, while using the same power.

The next item for consideration is the maximum output—also expressed as a decibel number. This is the measurement of how loud a speaker will get with the same measurement microphone at 1 meter, when supplied with the full rated power. Thus, a speaker rated at 114db @ 1 meter will have the capability of being louder than one rated at 104db @ 1 meter. Also included among a loudspeaker's specifications are the continuous output number and a peak output number. These relate to the duration of the signal. Most music doesn't use full power for more than a few seconds at a time, so the driver can produce much louder "peaks" in level that are short in duration. Since product specifications only tell part of the story, you should make every effort to conduct careful A-B comparisons of your system choices at the dealer—with program material that you are familiar with.

Time to Choose an Amplifier

It is much more detrimental to a loudspeaker driver to under-power it than it is to overpower it. Amplifier clipping is a common killer of subwoofer speakers, as the abrupt action of the clip interrupts the cooling action in the loudspeaker motor. What is clipping? Let's begin by grasping the concept of "headroom."

If you were to walk through a submarine, you would find yourself ducking to fit through the hatches between rooms—or your head would smack into a bulkhead! In similar fashion, this is what happens to your audio signal as it smacks up against the power limits of an underpowered amplifier. It clips the top of your waveform off, which may be great for rock guitar, but is very bad in a system that is supposed to accurately reproduce the signal from your band. This type of distortion is known as clipping, since the wave shape is distorted from its original shape.

Imagine walking through a ballroom. Is there much chance of you hitting your head on the ceiling? Highly unlikely. You could probably jump on a trampoline and not hit the ceiling. Think of this "protective margin" as headroom. Your audio signal—particularly with live music—is dynamic, meaning it has loud and quiet passages. Preferably, you want your amplifier to have enough headroom to accommodate even the highest spikes in your program material. If in doubt, go for the bigger power amplifier—you can always back it off a bit.

If we use the example of 100 watts into 8 Ohms, we can expect the amplifier to be able to output sinusoidal waveforms with an RMS (continuous power output as opposed to peak or transient power) voltage up to 28 Volts, with peak voltages up to ±40 Volts. Any attempt to produce a larger output fails as illustrated in Figure 3.

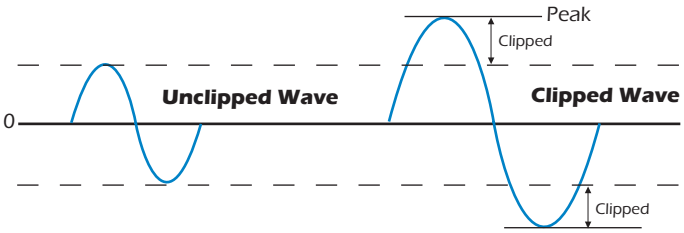

Figure 3. Example of Sinewave Clipping

Ideally, you want to choose an amplifier that is big enough to power your subwoofer in a manner that is conducive to obtaining the best possible sound. In terms of maintaining a "safe" margin, it's good practice to use an amplifier with an RMS wattage rating equal to, or higher, than the "peak" or "music power" rating of the subwoofer.

A brief note about RMS: The RMS power rating for an amplifier is the actual full time, or continuous, power level it can reproduce without distortion. The peak or "music power rating" is much higher because the amplifier can reproduce much higher power levels without distortion for a short time, usually a fraction of a second.

What if I Want More Than One Subwoofer on an Amp Channel?

Accomplishing this safely depends on a variety of factors. First, there's the Ohm rating—better known as the impedance of the subwoofer. Impedance is the amount of resistance, in Ohms, a speaker introduces to an audio signal passing through its voice coil. You must match the subwoofer's system impedance to the power rating of your amplifier at that impedance.

For example, a single 18-inch subwoofer typically has an impedance of 8 Ohms. Let's say this subwoofer has a maximum music power rating of 600 watts and has two parallel input jacks for cascading, or "daisy chaining" the signal from one enclosure to another. If you were to add a second, identical subwoofer to the same amplifier channel by cascading the two cabinets together, the system impedance would drop to 4 Ohms, and each speaker would share 50% of the available power—effectively making the amplifier work twice as hard. The system would now want to see a power source of 1,200 watts RMS at 4 Ohms.

If you added a third such subwoofer to the chain, the system impedance would drop to approximately 2.8 Ohms. Hence, this new system would require a power amplifier capable of delivering 1,800 watts into 2 Ohms. You should know that you won't find an amp rated at 2.7 Ohms. Power amplifiers carry 8-, 4-, and 2-Ohm ratings. If you add a fourth 8-Ohm subwoofer, your amplifier would then see a 2-Ohm load. The subwoofer system would then require an amplifier capable of producing 2,400 watts at 2 Ohms. This is a reasonable lower limit for professional audio amplifiers.

It should be noted that, by the time a setup reaches three subwoofers per side, we're talking about a pretty good-sized rig with a lot of power. While this isn't necessarily uncommon, it is probably more system than many club bands and mobile DJs are likely to need. However, understanding the basics of Ohms Law is critical if you are to properly configure your sound system.

8 ohms + 8 ohms wired in parallel = 4 ohms
4 ohms + 4 ohms wired in parallel = 2 ohms

Cables and Connectors

While we're discussing impedance, it's important to gain an understanding of how the speaker wire you use to connect your amp and speakers impacts your system's performance. The longer the cable run, the more impedance, or resistance, is added to the system rating—cutting efficiency in the process. Similarly, thinner wire translates to more impedance. Wire thickness is measured by the gauge of the wire—typically identified as the AWG (American Wire Gauge) rating. The lower the number, the thicker the conductors. For short subwoofer cables, 14-gauge wire will work, but for longer runs of 25-feet or more, you are better off using at least 12-gauge wire (12 AWG). Never use an instrument cable for a speaker cable, as the conductors are way too thin!

It's also important to know the type of connectors that are on the subwoofer. The two most common connector types are the quarter-inch phone jack, and the Speakon™ connector. Some older designs may have the red and black binding posts that accept banana plugs, but these are usually found on home stereo equipment or products designed for permanent installations. The quarter-inch phone jack is commonly used to patch guitars to amplifiers and other low power level duties. These connectors were originally designed for telephone company switchboards—not for the power levels of today's high powered audio equipment. Now let's take a look at the Speakon ™ connector.

The Speakon ™ connector was designed expressly for audio speaker connections. They are made in three configurations: the NL2, NL4, and NL8. The NL4 is most widely used on subwoofers. It has four separate connections labeled 1+, 1- and 2+, 2-. This connector is capable of connecting two completely different systems, such as a subwoofer cabinet and a mid/high cabinet. This can be accomplished by wiring the subwoofer up to 1+ and 1- and your mid/high cabinet to 2+ and 2-. You simply connect your top cabinet to the second NL4 jack on your subwoofer with only the 2+ and 2- connections used. Check with your speaker manufacturer for the pin configurations on your subwoofer if they are not located on the jack panel of your subwoofer cabinet.

Standard Quarter-inch Phone Plug Neutrik NL Speakon™ Connector Assemblies

Figure 4. Connector Types

Understanding the Crossover

Thus far, you've made your best choice of type, size, and cost of a subwoofer. You also have the amplifier and speaker cables sorted out. All that's left is getting the bass to the amplifier, and the midrange and high frequencies to their appropriate drivers in the system. This is accomplished with a frequency dividing network, commonly called a crossover. A crossover is used to divide the signal—effectively sending separate frequency bands to the appropriate amplifier or driver. At this point, we are still referring to a non-powered subwoofer (an external amp is required).

There are two main types of crossovers used in speaker cabinets today. The first type of crossover is called passive. This crossover uses a series of capacitors and coils to divide the frequencies. This is the crossover type most commonly used in home stereo speakers to send bass to the woofer and highs to the tweeter. It may include a level control for the tweeter as well, usually on the speaker jack plate. This type of crossover can also be used in higher power systems to divide the mid and high frequencies. Some low powered subwoofers found in music stores may also include a passive crossover, but for high powered subwoofer duty, a passive crossover would be very large, heavy, and inefficient.

Because of the size and weight limitations of passive crossovers, there is another type of crossover called the electronic or active crossover. These crossovers are placed before the power amplifiers in a system where the signal is still at line level. They are matched to the system by the number of bands they divide the signal into. As an example, if you are using a subwoofer with a mid/high cabinet, you would, at least, require a 2-way crossover. Your mid/high cabinet may already have a passive type crossover built in that handles the mid/high dividing duties. You may see a switch on your mid/high cabinet marked "full range" and "bi-amp" that can bypass the internal passive crossover. In the "bi-amp" position, your system would need a 3-way crossover—a channel for low frequency, mid frequency, and high frequency—wired to a separate amplifier channel for each frequency band.

The manufacturer's recommended settings from your owner's manual should be followed when setting up your electronic crossover. These settings will include the frequencies to define the crossover point, and may include a slope specification. The slope value determines how much of the frequency range is used for the crossover implementation. A higher value (such as 24dB/octave) means a steep crossover slope over a minimal frequency range. A lower value (such as 12dB/octave) means a wider frequency range is used for the crossover function. These specifications are frequently listed in decibels per octave, usually in multiples of 6 such as 12dB/octave or 18db/octave.

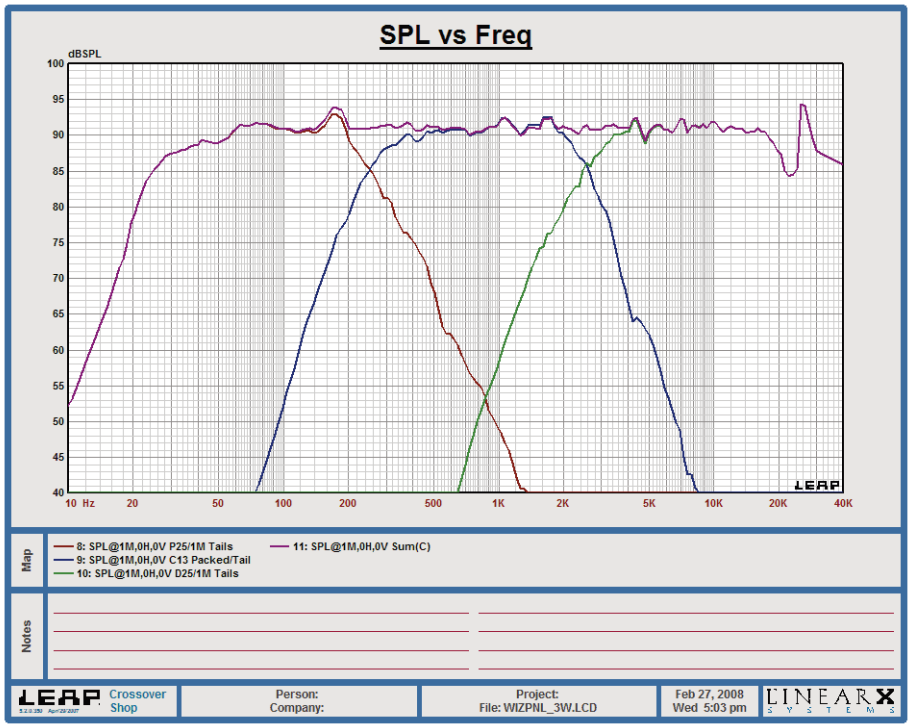

Figure 5. A Typical 3-Way Crossover Response

You should also understand there are two main groups of electronic crossovers—known as analog and digital crossovers. The analog crossover is a simple device that, for the most part, divides frequencies only. In addition to frequency division, the digital crossover may offer several other functions such as equalization, limiting, and time delay. These additional features can replace many outboard signal processors in an equipment rack.

The time delay function is especially useful when using folded horn subwoofer cabinets, since the sound in the horn has a much longer path to travel than the sound coming from the mid/high portion of the audio. By delaying the mid/high a few milliseconds, you can get both the bass and the mid/high sound to arrive at your ears more or less simultaneously. To properly define your delay settings, you should refer to the speaker manufacturer's specifications. If you are uncertain how to use time delay, then you should avoid adding it to your system, as this can cause serious phasing problems.

Crossover Point Selection for Subwoofers

When adjusting the low pass filter for subwoofers, the crossover point will range approximately between 60–150 Hz, depending on the type of music played and frequency response of the full range/mid-high cabinets that are being used in the system.

If the sound is muddy or the lower frequencies of the vocals start coming through your subwoofer, increase the slope value (12, 18 or 24dB/octave) of the crossover, or lower the crossover point.

A lower crossover point can be used with a shallower slope like 12 or 6 dB/octave for a smoother transition between the sub and full range/mid-high cabinets as well. At first, it may take some time to find what works best. Always adjust it to what sounds best to your ear as that is your best tool. After all, that's what you are setting it up for.

Subsonic Filters

The subsonic filter is used to protect the woofer from over-excursion caused by reproducing frequencies below the box tuning. A properly set subsonic filter will protect the woofer from bottoming out and allow the subwoofer to handle more power and have increased output. By blocking frequencies below the box tuning, the amplifier has more power available for the usable frequency range of the subwoofer. Determining what frequency to set the subsonic filter at can sometimes seem difficult. Normally, the subsonic filter is set close to, or at, the enclosure port tuning or the low end limit of the subwoofer. For example, for a direct fire ported enclosure with a port tuning of 37 Hz, the filter would be set at the same frequency (37 Hz). For a folded horn, the filter would be set at the bottom limit of the frequency range. Therefore, for example, a folded horn with a frequency range of 30–200 Hz would require the filter to be set at 30 Hz. The sharper the slope the greater the protection. Remember you can always set this by ear. If you hear the woofer bottoming out at high volume, adjust the subsonic filter higher and/or increase the slope, i.e. increase from 12dB to 18dB/octave or higher.

The Active Subwoofer

Finally, a few words about active, or self-powered, subwoofers. The active subwoofer is a self-contained bass system, usually consisting of the crossover network, a power amplifier, and the drivers. Many manufacturers sell these systems to match with a mid/high cabinet they they also make. By integrating everything into a system package, all components are pre-matched and the manufacturer optimizes the performance for you. Other advantages include ease of use, no amplifier racks to be concerned with, and no extra speaker cables.

Some active subs will also have inputs for both left and right channels from a stereo mix. The system will combine the two signals, enabling you to use just one subwoofer for small gigs. If you are using active mid/high cabinets as well, your subwoofer may have high pass outputs for them, and these signals are derived after the internal crossover. Hence, the mid/high signals come from the subwoofer below it. Please reference the manufacturer's specifications when setting the subwoofer crossover points for a specific active mid/high cabinet. After you have your active subwoofer mid/high system up and running, be certain to fine tune the volume levels between the system components. There will be level controls on the subwoofer for this.

There are disadvantages to this approach however. Among them, you'll find added weight, as the entire system is in one box, and not being able to choose individual system components that you might prefer. Further, this may be a more expensive investment.

In Conclusion

By now, you should have a much clearer understanding of the challenges every musician, mobile DJ, or sound reinforcement professional faces when shopping for a new sound system. By grasping the concepts presented in this guide, you should now be in a much better position to make an informed decision when purchasing sound reinforcement equipment. So what are you waiting for? Go forth and put some bass in your place!

Acknowledgements

Cerwin-Vega! would like to thank William Koehler for his contributions to this document and Roger Maycock for his editing expertise.