TAPPING INTO THE POTENTIAL OF 70V SYSTEMS

Do longer wire runs, better sound 'sculpting' and more speakers per amplifier fit your audio design needs? Maybe you're ready to take a page from the commercial install playbook. ***BY WILLIAM KIELTYKA***

COMMERCIAL A/V integrators have long understood and enjoyed the benefits of high-voltage audio distribution systems. But many residential integrators think of 70V (70.7V to be precise) as "strictly commercial," equate it with poor sound, or don't understand it at all.

There are times when 70V can help a residential integrator overcome audio coverage problems that a traditional low-impedance amplifier/speaker system simply cannot solve. This is especially true for outdoor audio installations where uniform sound coverage is particularly difficult to achieve. A 70V system can be a lifesaver and deliver spectacular audio results if you know a little about it. This article will help dispel some myths and lead you to better audio installations.

COMPONENTS TO THE EQUATION

Let's start by explaining what a 70V system is and how it works. Technically these systems are "constant voltage audio distribution systems." Amplifiers for these systems output a constant high voltage, low current signal (although *audio* system voltage does not remain steady, we will assume that it does for this discussion). That is a lot like the power grid in your community — the power generating plant sends high voltage, low current AC down the lines and steps it down to household voltage at local transformers (you know, those things that occasionally explode during lightning storms). It's done that way to reduce power loss over hundreds of miles of wire.

On the Amplifier Side: Similarly in audio, amplifiers for these systems output constant 70 volts (typically 100V in Europe) of power output. Older amplifier designs use a step-up transformer placed before the speaker terminals to generate the constant voltage. Today's high-end 70V amplifiers are direct drive, high-voltage designs without step-up transformers, yielding better audio performance. And like power systems, 70V audio systems reduce current drop over long lengths of cable.

On the Speaker Side: Speakers in 70V systems need a step-down transformer to convert the high-voltage/low-current amplifier signal to the low voltage/high-current signal that speakers need. Some loudspeakers are available with the transformer already attached or built in, but any 8-ohm speaker can be converted to 70V operation by adding an aftermarket transformer. The primary side of the step-down transformer (the side that connects to the amplifier) has a number of connections (called taps) that select the peak power the speaker will draw from the amplifier.

A transformer may have taps for 2, 4, 8, 16 and 32 watts. The higher the wattage the louder the speaker will play relative to the other speakers connected to the same channel. For example, if you select the 16W tap for a given speaker you have set the *maximum* power going to the speaker to 16W. Another speaker on that same channel can be set to, say, 8W. That means that the 16W speaker will play 3dB louder than the 8W speaker regardless of how the volume control is set. In order to avoid distortion the total wattage of all the speakers on a given channel should not exceed 90 percent of the max output rating of the amplifier.

HEARING THE GOOD STUFF

OK, so what's the payoff for all of this high-voltage stuff? First, there's the low current-drop benefit. If you are faced with very long speaker wire runs and using 10- or 12-gauge wire isn't practical or affordable, a 70V system makes a lot of sense, as more power will get to the speakers over smaller gauge wire.

Next is the case of multiple speakers and system impedance. For very large rooms and especially for outdoor systems, multiple speakers are the ideal way to go. You get more even sound coverage with fewer "hot" and "dead" zones. Eight speakers playing at moderate volume will beat the daylights out of four speakers playing louder.

In low voltage/high current 8-ohm systems there are practical limits to how many speakers you can run in parallel on a given amp channel. Assuming nominal 8-ohm speakers and an amplifier with a minimum impedance limit of 4 ohms, you can only run two speakers per channel. Yes, some amps are

rated to 2 ohms, but because most speakers' impedance is lower than the nominal rating you have to be very fond of making service calls to risk running three speakers or more in parallel. You could wire in series/parallel to get to desired impedance, but that requires clumsy wiring paths and home runs... all a pain. What many residential integrators do is use one amplifier channel per two speakers — a fine, but expensive, solution.

In a 70V system the number of speakers that can be wired in parallel on an amp channel is a function of the total transformer power selections on all of the speakers and the maximum power of the amplifier. If you had a 300W amplifier, for instance, you could have up to eight speakers with the transformer set to 32W, or any combination that adds up to no more than 270W (it is always a good idea to leave at least 10 percent safety headroom). By the way, with today's high-sensitivity speakers, 32 watts plays very loudly.

THE BIG PAYOFF

What we most like about 70V systems is the ability to "sound sculpt." Imagine a scenario where adults are sitting and chatting around an outdoor dining table while at the same time teens are splashing about in the pool, and both areas are covered in an outdoor music system. The desired volume level for each of those zones is very different and needs to be planned for when designing the sound system.

With a 70V system you can select higher power for the pool area than for the dining area. Remember that for every doubling of power, sound output goes up 3dB. In this scenario I would start by setting the pool speakers at 3x the power of the dining area speakers for a 9dB differential in relative volume. Check out the chart A below for a sample system configuration.

BEATING A BAD RAP

Given all these advantages, where does prejudice against 70V systems come from? We think it partially comes from the fact that crummy-sounding paging and commercial audio systems are usually 70V, most often with low-cost, low-performance amps, speakers and transformers. Of course, poor system design and execution can also yield low-fi sound.

Transformers are made from lots of copper wire wrapped around a core of laminated steel. In reality, this massive winding creates very high resistances, hundreds and even thousands of ohms. Much like a voice coil, it presents a load to the amplifier. If this wire is extremely small gauge and the core is poorly designed, the transformer core will become saturated with signal, especially at low frequencies, resulting in poor bass, reduced dynamic range and higher distortion.

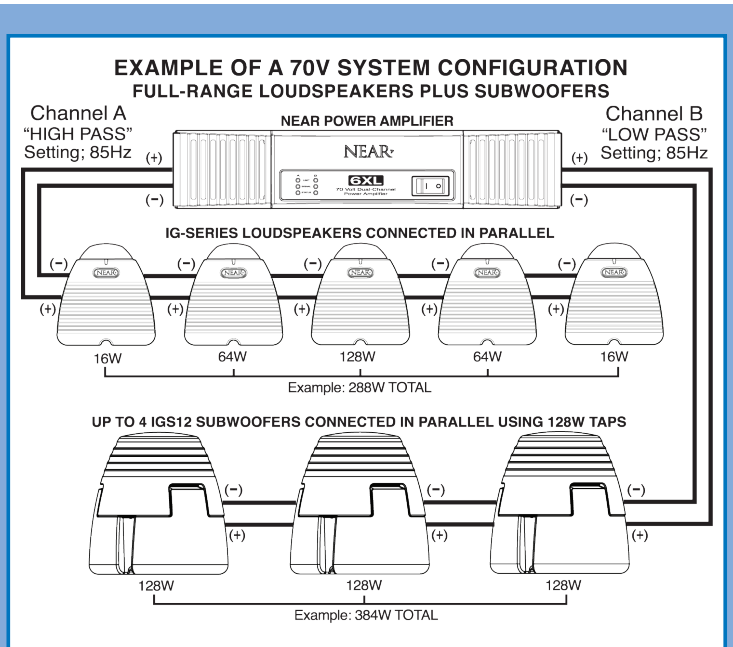
To minimize these kinds of problems, use transformers with large steel core and large wire gauge. How do you know what's appropriate? If you can't tell from the specs, let price guide you. The better ones typically cost more.

DOWNSIDES TO 70V

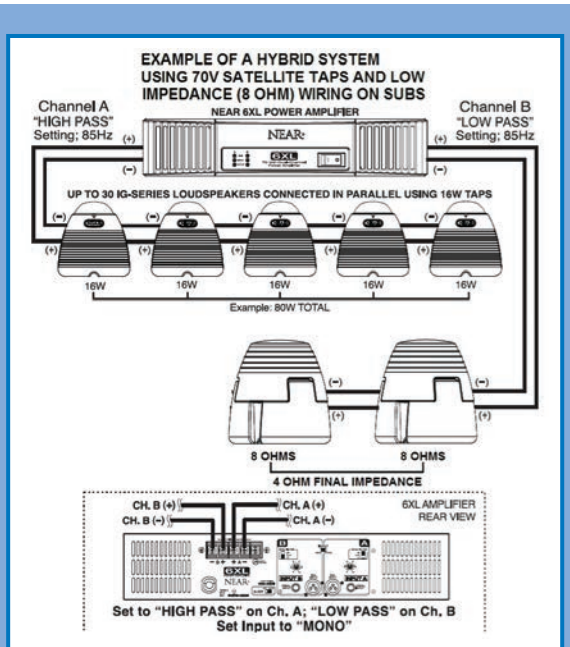
In fairness, there are downsides of 70V systems. In a direct comparison of an 8-ohm system with a 70V equivalent where the speaker wire runs are short, the 8-ohm system will sound a little better at the extreme frequencies. Even the best transformers will roll off the extreme low and high frequencies. But these tradeoffs could be the lesser evils compared to the current drop and impedance problems associated with 8-ohm systems. The attenuated frequency ranges we're talking about here are not musically significant, especially in areas where the listening is casual instead of the main activity.

Figure 1 shows the bass response of a speaker with a high-quality built-in transformer. You can see a couple of dB of low frequency loss with 70V operation below 30 Hz. This level of loss would be undetectable to almost every listener. Figure 2 shows the high frequency response of the same speaker with a high frequency loss of 5dB but only in the final octave (above 10kHz), which would be perceived as a reduction in "air,"

A



B



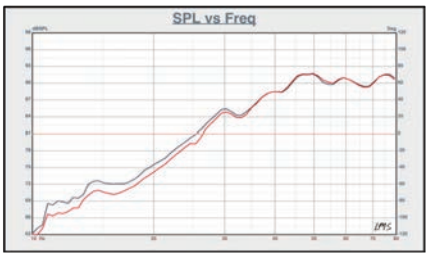


Figure 1- A speaker with a built-in transformer in 8-ohm (blue) vs. 70V (red) shows small low frequency loss.

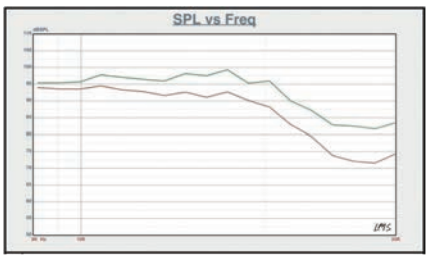


Figure 2 - A speaker with a built-in transformer in 8-ohm (green) vs. 70V (red) shows 5dB loss above 10kHz.

but not tonal balance or clarity. These effects would be much greater and more audible with lower quality transformers.

CONSIDER A HYBRID SOLUTION

One option to think about is a hybrid system where the subwoofer is run in 8-ohm mode and the mid/high satellite speakers are used in 70V mode. Usually only one or two subs are used in a system, so impedance is less of an issue. Running the sub in 8-ohm minimizes transformer saturation and distortion that are more likely to occur in the bass. Most systems require multiple mid/high speakers so 70V operation is ideal as it avoids impedance problems. See chart B for a sample hybrid system design.

WHICH SYSTEM WORKS FOR YOU

For a quick recap, here are the main benefits and downsides to 70V implementation:

70V Pros

- Allows longer speaker wire runs
- Allows use of smaller gauge speaker wire
- Allows many speakers to be run off of each amplifier channel without endangering system reliability
- Allows "sound sculpting," implementing different volume for each speaker

70V Cons

- Higher distortion (with low-quality transformers or when even high-quality transformers are over-driven)
- Low frequency roll off
- High frequency roll off (with low-quality transformers)
- Variability (low-quality transformers)

Now that you have a newfound appreciate for what's involved with 70V systems and their possibilities, is a 70V system right for your next audio system installation? That depends on several variables and the unique needs of your customers. If you can check off more of the Pros on the aforementioned list than Cons, a 70V system solution may be your best option, especially for outdoor audio. CE Pro

BILL KIELTYKA ***is the founder and division general manager of Maine-based NEAR, a division of Bogen Communications.***