Subject: 12pi push/pull benefits
Posted by Dustin Buegler on Sat, 24 Jan 2009 19:58:47 GMT
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What would you say are the audible differences of having push/pull in the 12pi basshorn sub? Horn loading makes distortion low so what is gained by going push/pull? I've read a lot about the cooling plug approach and that makes sense to me but haven't seen as much about push/pull woofers. I understand it is supposed to cancel distortion but what is the perceived difference in sound that you hear?Thanks in advance,Dustin

Subject: Re: 12pi push/pull benefits
Posted by Wayne Parham on Sat, 24 Jan 2009 22:18:04 GMT
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cooling plugs in each woofer that significantly increase power handling capacity and it uses push-pull drive which reduces distortion. Beyond that, it is a highly optimized alignment that provides smooth response than other hornsubs.

As to audible differences, the best way I can describe it is it just sounds cleaner, even while being pushed harder and louder. The bass is deep and full, yet it doesn't sound strained. This is true of

clean. Of course, I am understandably biased but I've heard these comments from others, truly everyone that has ever owned or used them for any length of time agrees.

There is one audible trait that clearly exposes the difference between a basshorn driven push/pull verses one that is not. When you send a conventional basshorn signals under cutoff, it distorts terribly. A similar push/pull basshorn does not. So this is a dead giveaway, send a tone that's deeper than the flare frequency. A conventional basshorn makes a sound even under cutoff but a push/pull basshorn is relatively quiet.

The reason is the push/pull basshorn cancels harmonics in the throat, so all that is present is the fundamental. If this fundamental is below cutoff, then the horn provides no benefit, no horn loading and relatively low output. A conventional basshorn amplifies the harmonics generated by the motor, and is therefore usually well over 100% distortion below cutoff. The fundamental isn't horn loaded but the harmonics are. Conventional basshorns are quite literally distortion amplifiers when driven below cutoff.

I really noticed this at the Prosound Shootouts in 2005, 2006 and 2007. Everyone did. We started sweeps below horn cutoff and ran them above the subwoofer range. So we could measure the effects of the entire band, as well as how they performed out of band. Most basshorns started off reasonably loud, even well below cutoff. Even 40Hz horns could be heard at 30Hz, sometimes even 20Hz. But the distortion level was off the chart, usually rising above the

notable exception, acting quite differently than all others. It was dead quiet until the sweep frequency rose to just below 30Hz, where the sound level rose quickly as horn loading started working.

Since the LMS system we used to measure the horns tracks the fundamental and rejects harmonics in the SPL sweep, the recorded sound level from most basshorns was well below the perceived loudness under cutoff. It looked like "magic" - SPL down in the basement, under the noise floor, yet you could clearly hear something coming from most horns. The answer was in the distortion sweep, which does the exact opposite of the SPL sweep. It rejects the funamental and tracks the harmonics. It showed where the magic sound was coming from. Conventional basshorns make a ton of distortion when driven below cutoff. That's what we were hearing from them.

A little history might be enlightening here.

were some discussions about home theater and hifi applications of hornsubs. My suggestion then, as now, was to forgo the massive basshorns and use direct radiating subs instead. I took some heat for those comments, but to me it is unreasonable to use a basshorn sub like this in home, if for nothing else to avoid the sheer size of the things. But even more importantly, you can easily tune a relatively small direct radiating sub to 20Hz and below. Such a subwoofer is useful for home theater, because it has plenty of extension and isn't very large. You can use more than one in a multi-sub configuration and still occupy less space than a single basshorn sub. The multi-sub solution offers much higher quality for home theater and hifi, and it is easier to work into the home decor.

There were some folks suggesting that their 30Hz basshorn could be used in home theater installations, and EQ provided to increase output below cutoff. The idea was that room gain would lift the bottom end somewhat and EQ could be used for the rest. My position was this was the wrong approach, that the 30Hz basshorn used below cutoff was nothing more than a direct radiator in a fancy box. The argument made by the other side was that horn loading doesn't completely go away, that there is some "partial horn loading" below cutoff.

That is completely false. Below cutoff, there is no "partial horn loading." What there is, is loading of the harmonics. A conventional basshorn like they were promoting does make sound when pushed below cutoff, and it can be pretty loud if the harmonics it generates are high. But that's the point. Why would anyone want such a thing? The rear chamber is so small that it is like an undersized sealed cabinet that limits output below 30Hz. The whole system is optimized for use above 30Hz, and below 30Hz it becomes a distortion amplifier. I said it then and I'll say it again, basshorn subwoofers are not the way to go for home hifi. Better to use a direct radiating subwoofer tuned lower, use several and go with a multi-sub setup.

The company that was pushing that hornsub back then and its supporters attacked me on that point, and several other semi-related points, for that matter. One of the things they did during their attacks was to ask me what I would do differently, if I were to design a basshorn similar to the one they were pushing. Actually, the one they were talking about at the time was a sort of open source thing that later was tweaked a bit to become a commercial product, sold specifically

to be put near room corners in home theater applications. It was designed to be used with boundary reinforcement, but was otherwise similar. Naturally, they did not like what I was saying about using direct radiating subs tuned lower. They wanted to divert the conversation away from that, I expect because they realized the distortion below cutoff issue was real, and their position couldn't be defended very well. So they wanted to derail the conversation and make it about something else. They asked what I would do if I were to make a basshorn subwoofer. Forget about home hifi, they said, what would I do if I wanted to make a hornsub for use outdoors, in the way a hornsub should be used.

very large spaces. That's where a hornsub makes sense. So I set about designing the horn, optimizing it as best I could. After some work in the initial design, I decided to use the same LAB12 woofers they had. I optimized the front and rear chambers for better response, and layed out the folding to accomodate push/pull drive. To me, that was a useful way to reduce distortion using two identical woofers. Since horn loading reduces excursion, the pumping action is limited, preventing the cooling vents from being as effective as they would be in free air. Horn loading increases efficiency, but there is still plenty of heat to dissipate and the cooling vents can't carry that heat away effectively. Adding the cooling plugs greatly improves thermal transfer, and the

"what would you do if asked to build a 30Hz basshorn subwoofer." I still wouldn't recommend it

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Subject: Re: 12pi push/pull benefits
Posted by Dustin Buegler on Wed, 28 Jan 2009 19:31:57 GMT
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Can you expound on that just a little Just kidding. That's very useful information. You put it in a way that makes it easy to understand what the benefit is and how to listen for it.

Thanks again,
Dustin

Subject: Re: 12pi push/pull benefits
Posted by BtHarris on Wed, 28 Jan 2009 20:50:22 GMT
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Did you notice Danley's latest SPUD sub uses push pull woofers?
http://forums.audioholics.com/forums/showpost.php?p=497823&postcount=60

Subject: Re: 12pi push/pull benefits
Posted by Wayne Parham on Wed, 28 Jan 2009 21:56:52 GMT
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Interesting. Tom Danley was a very vocal opponent of push-pull drive a few years back when I

Apparently now he's changed his mind. Maybe we'll see cooling plugs in his speakers someday soon too.

Subject: Re: 12pi push/pull benefits
Posted by BtHarris on Wed, 28 Jan 2009 22:25:03 GMT
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Didn't you apply for patent on the cooling plug? Are you saying you would license this technology to Danley?

Subject: Re: 12pi push/pull benefits
Posted by Wayne Parham on Wed, 28 Jan 2009 23:19:41 GMT
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Yes, I did file a patent on the cooling plug and no, I probably wouldn't license it to Danley Sound Labs.Let's don't turn this into a Danley bashing thing though. I purposely didn't bring his name into this at first, because even though he was initially critical of push-pull drive, I think it is better to leave the water under the bridge. I applaud his choice to start using it now.

Subject: Patent issued
Posted by Wayne Parham on Tue, 28 Sep 2010 19:05:54 GMT
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Patent 7,804,976More information about the cooling plug approach:
Loudspeaker motor cooling methods