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Subject: Hornsub shootout

Posted by [Wayne Parham](#) on Mon, 25 Jul 2005 01:22:54 GMT

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I'm putting together a hornsub shootout in a couple months and looking at venues right now. There hasn't been a prosound taste-testing like this for a while now, and there have been some new products released, both in the DIY and commercial markets. So I think it's a good time to have a get together and lots of people have indicated they are interested. Watch here for details.  
Prosound Shootout

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Subject: Ground Pounding Action, action, action!

Posted by [Wayne Parham](#) on Tue, 02 Aug 2005 08:25:01 GMT

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Well guys, we're in. Tulsa Raceway has agreed to allow us to host the event there. The date is Friday, October 14th, from 10:00am to 6:00pm. The price is \$10.00 for admission to the raceway, and for that, you can stay all day for the prosound event and through the evening for the racing event. After 6:00pm, the track will have car races. That night is test-n-tune, when racers are running and calibrating. You can even bring your car and run it if you want. There will be everything there from street cars to nitrous burning ground pounders. It will really be a lot of fun for the price, and you can come and go as you please through the day and evening. The racing complex has all the power we'll need, 110v, 220v even up to 480v three-phase. So we're set for power. The stadium seating on the north side of the track provides cover, so should we get rain, our equipment won't be exposed. I'm really looking forward to this. It should be a great time on several levels. We can test and examine our sound equipment all afternoon, and check out the cool cars all evening. Everyone is welcome, DIY and pros, so please come on out. If you need suggestions on hotels or anything else about the area, please contact me. Information is available on the website at [www.ProsoundShootout.com](http://www.ProsoundShootout.com). If you intend to be there and want to have your gear listed, please let me know and send some pics. I'll put it up so people can see who's coming. We'll also post photos and test results after the event.

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Subject: General test plan

Posted by [Wayne Parham](#) on Sun, 04 Sep 2005 04:45:36 GMT

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A general test plan is listed below. The specific details of the test plan are specific to the test platform, which is probably going to be Praxis or LMS. David Lee has graciously offered to provide these test platforms and other assistance. 1) Impedance sweep, cold. 2) Impulse response. 3) Frequency response w/SPL at 1W/1M, 10 Hz to 20 kHz (Measured at distance and corrected to 1M) 4) Frequency response (20 Hz - 200 Hz) w/SPL at 3dB increments to rated power

or physical limits. (This will show heat compression and max SPL)5) Distortion at 110dB (20 Hz - 200 Hz) and then at 3dB increments from there to rated power or physical limits. (This will indicate the practical limits of the system regarding usable maximum clean reproduction.)6) Run heat soak signal 15 minutes at 80% power, repeat steps 4 and 5.7) If required, processors can be applied and tests 2, 3, 4, 5 and 6 repeated. 8) Single horn tested first, pairs or groups tested next if desired.9) Subjective listening test using a selection of identical program material played at a referenced sound level.10) Subjective listening test using a selection of identical program material played at the maximum sound level of the loudspeakers. All measurement will be taken from the same place. To save time and insure the least variation, the microphone will be placed at ground level and not moved. All cabinets will be placed on the same mark at the same distance from the microphone.

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Subject: Re: General test plan

Posted by [Leland Crooks](#) on Mon, 05 Sep 2005 00:19:34 GMT

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Looks good to me. As one of the guinea pigs my main concern is for driver protection. I'm not a manufacturer who can sacrifice gear for test purposes I'll be relying on the much more experienced testers to monitor input power. I can hear distortion, but thermal problems concern me more. My hl10a's in my tuba 24's are rated @ 300w. I drive them with approx 450-500, but program material is not like a sine wave sweep or continuous pink noise. I'm really looking forward to this. Especially meeting you Wayne and seeing your thermal heat sink.

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Subject: Re: General test plan

Posted by [Wayne Parham](#) on Mon, 05 Sep 2005 08:14:28 GMT

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The test signal for response is actually an MLS (which sounds kind of like pink noise) or swept sine, depending on the measurement system. It is a relatively short burst, so these test signals won't heat up your voice coil very much at all. The thing to be concerned with is the heat soak signal, but even that isn't going to be run so long that it would likely hurt the voice coil, even at full rated RMS power. If we ran it an hour, then it might though. What we'll be doing is to run at 80% rated power, which in your case is 240Wrms. That will not heat the driver to damaging levels, so it will not harm your driver.

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Subject: Re: Hornsub shootout

Posted by [PG](#) on Thu, 08 Sep 2005 17:10:05 GMT

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I cant find any info on the JBL SR4720

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Subject: Re: Hornsub shootout  
Posted by [Wayne Parham](#) on Fri, 09 Sep 2005 06:27:40 GMT  
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It's just like the SR4719, but the woofers are 2242 instead of 2241.  
JBL SR Series

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Subject: Re: General test plan  
Posted by [Rory B.](#) on Wed, 14 Sep 2005 12:51:49 GMT  
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A friend of mine runs his single Tuba 24 at 600 watts with DJ program so whatever you're doing to yours shouldn't harm anything.

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Subject: Re: General test plan  
Posted by [Wayne Parham](#) on Thu, 15 Sep 2005 03:00:04 GMT  
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Speakers with LAB12 drivers should heat soak using 320 watts RMS (per driver) for 15 minutes. I think speakers running HL10's should heat soak with 240 watts for 15 minutes. These values are 80% of the manufacturer's ratings, and they're safe levels. Much more than that would probably let the smoke out.

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Subject: Re: General test plan  
Posted by [Leland Crooks](#) on Thu, 15 Sep 2005 12:21:17 GMT  
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Wayne, do you by chance have any of your heat sinks ready for HL10s? I find the whole idea interesting. I'm thinking of pulling a driver and taking some measurements to make a couple. The distance from the driver to the plate is pretty far in a tuba, so my plan is to radiate in the chamber, as the length would radiate most of it there anyway. Possibly turn a right angle to a sink mounted

in the horn path .

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Subject: HL10 cooling plug and heat exchanger

Posted by [Wayne Parham](#) on Fri, 16 Sep 2005 11:20:34 GMT

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You can use the same cooling plug on the HL10A as is used on the LAB12. They have the same size cooling vent. You simply must try one of these - The cooling plug and heat exchanger really works.

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Subject: Scheduled date and bad weather date

Posted by [Wayne Parham](#) on Wed, 21 Sep 2005 18:21:31 GMT

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Just an FYI. The scheduled date is October 14, 2005. If the weather forecast predicts rain, we'll reschedule for a week later, October 21. This isn't something we can know earlier than Wednesday the 12th, so it is best to check back then. Try to make hotel arrangements that will allow a rescheduled date, just in case.

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Subject: Hotels

Posted by [Wayne Parham](#) on Wed, 21 Sep 2005 19:38:01 GMT

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I made a list of hotels that are right on highway 169, and I'll send it to anyone that asks. There is also a list of hotels at the Tulsa Raceway website. Tell 'em you're coming to the Prosound Shootout at the Tulsa Racetrack and they'll give you a discount rate.

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Subject: Facilities and Photos

Posted by [Wayne Parham](#) on Wed, 21 Sep 2005 21:17:12 GMT

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Yesterday, I went to the race track to make final arrangements, check power, etc. While I was there, I clicked a few photos so all the exhibitors could get a feel for the place.

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## Tulsa Raceway Entrance

Notice the two semi trucks in the background behind my car. A Pro Gas racer had rented the track for a private tuning session. He was running 8 second quarter mile times, making that wonderful smell.

## Staging area seen from inside the announcer's booth

The Tulsa track is nice, with a good launching pad and a perfectly straight and flat 1/4 mile run. If you look closely, you'll see the lanes begin a slight incline after the cars pass through the traps. That's because the fastest cars are going over 300 MPH at this point, and it helps 'em slow down. They go from zero to 300+ in less than 5 seconds in just a quarter mile, and then they have about 3/4 mile past that to get it shut down before hitting the sand trap. Most street cars turn off at the first or second exit, but the top fuelers need the whole road. The fastest cars these days are running the quarter mile in less than 4.5 seconds. That's quick! Most passenger cars don't cross an intersection from a stoplight that quickly.

We'll have the track all to ourselves until 6:00pm. After that, cars will begin to show up. So we will have a large quiet area for the day. Well, I don't know how quiet it will be, but I mean we won't have the rumble of race cars and dragsters during the day.

The complex is a mile long and about a half mile wide. So we have plenty of space and no noise constraints. Here you can see an aerial view of the entire track. The areas marked by the roads (white lines) mark a square mile. Tulsa is laid out on a grid with major roads every mile. There are North-South roads and East-West roads. The one shown on the left is Highway 169, which is parallel and very close to Garnett Road. The road at the bottom is Apache and the one at the right is 129 E. Ave. Just off the photo at the top is 36th Street North, which is the exit you take off Highway 169 to get to the track. You can see how the exit ramp takes you onto Garnett Road, which takes you to the track entrance. Each of these roads is a mile apart, forming a grid. Here's a map.

## Tulsa raceway, aerial view

Tulsa raceway, zoomed to show about 1/2 mile across

Tulsa raceway, zoomed to show about 1/4 mile across

## Spectator Seating, North Side

We will setup in the parking lot north of the track. The main power transformers and distribution area is under the spectator seats on the north side. All utilities are run underground, but we have access to them here.

## Power Distribution

Our main interconnect is a 70A line. There's a spool of wire to a utility box where we can connect. This will roll out to the parking lot and I'll terminate it with appropriate connectors prior to the Prosound Shootout. We'll have plenty of power, and I'll wire in a large connector for the main power amp and a barrier strip for the rest of the equipment.

## 70A line

Here's a view from the transformers out to the parking lot. This is under the spectator seats. We'll spool our lines out into the parking lot from here.

## Under the spectator seats on the north side

Below you'll see a view of the parking lot, looking northeast, showing the restroom building. The field extends much further to the north, basically a large flat expanse.

## Pit area and north parking lot

This is a photograph of the same area, but taken from the announcers booth, three stories up. The camera is pointed northeast. You can get a better idea of the layout here, showing the pit area, concession stand, restroom and the land beyond. The semis are for the racer that was there that day.

[img][http://prosoundshootout.com/Photos/ProsoundShootout\\_Pit\\_Area\\_from\\_Announcer\\_Booth.jpg](http://prosoundshootout.com/Photos/ProsoundShootout_Pit_Area_from_Announcer_Booth.jpg)

Pit area parking lot seen from the announcer's booth[/align]

Nothing but land, looking straight north from the announcer's booth:

## View straight north from the announcer's booth

Seen below is the view northwest from the announcer's booth. You can see the track entrance and the lanes where racers wait to be staged.

## Track entrance

## Ground level view of the track from the entrance

Ground level view of the pit area parking lot

Track viewed from above the announcer's booth

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Subject: Re: Scheduled date and bad weather date  
Posted by [jeffhtg](#) on Tue, 27 Sep 2005 23:00:19 GMT  
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Yeah.. So we're sitting here wondering if this event will be worth spending a good 1000\$ on airfair and hotels.. how many people are planning to go? I would really like to see some other familiar boxes in the show.. some punisher horns, labs, eaws, etc.. What is weather like in tulsa this time of year? Anyone in the area have events friday or saturday?

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Subject: Re: Scheduled date and bad weather date  
Posted by [Wayne Parham](#) on Wed, 28 Sep 2005 01:36:14 GMT  
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The list of participants is on the Prosound Shootout website, so that will tell you what will be there. I believe we have a very good representation of systems, from those that are easy for one man to lift and carry to the big brutes. Everyone was invited, we made announcements here and on ProsoundWeb.com, so the regulars on both forums have had ample time to sign up. The weather in Tulsa is generally nice this time of year, between 70° and 85° average daily highs.  
Tulsa Weather

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Subject: Re: Scheduled date and bad weather date  
Posted by [jeffhtg](#) on Wed, 28 Sep 2005 06:43:39 GMT  
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yes yes.. i guess i'm kind of hoping for 1500 ppl to scream out 'ill be there and its going to rock' .. tulsa sure seems to be out there in the middle of nowhere as far as im concerned.. and it would suck to make arrangements to be there for nothing!

Subject: Re: Scheduled date and bad weather date  
Posted by [Wayne Parham](#) on Wed, 28 Sep 2005 16:57:26 GMT  
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Are you familiar with the last couple of horn shootouts like this? There was one in Michigan and another in NYC. These events are really testing and listening sessions, not rock concerts. The Tulsa Shootout will be similar, except ours will be held outdoors. That's the best way to test basshorns, and the Tulsa Raceway is perfect for it.

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Subject: Specific test plan  
Posted by [Wayne Parham](#) on Thu, 13 Oct 2005 22:56:45 GMT  
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The measurement system used is LMS 4.5 with the M51 calibrated precision microphone. Ground plane measurements will be performed, with the loudspeaker under test and the microphone placed on the ground. Both the loudspeaker and the microphone are placed 60 feet away from the nearest obstruction. The distance between loudspeaker and microphone is precisely measured for accurate SPL measurements, as described below.

1. Setup LMS presets for sweeps.
  - a. SPL: 10 - 1000Hz, 400 samples, both filters set as bandpass to track the sweep frequency (1.0) for maximum noise rejection. File - Save this Quickset preset as "SPL".
  - b. Distortion: 10 - 1000Hz, 400 samples, bandstop filter set to track the sweep frequency (1.0) to reject the fundamental, bandpass set to track harmonics (3.0). File - Save this preset as "Distortion".

Note: Distortion measurement can be done with bandpass set to isolate second harmonics by setting bandpass VCF tracking to 2.0. A second distortion measurement can be done to capture combined second and third harmonics by setting bandpass VCF tracking to 3.0. But the bandpass filter function is first-order, so there isn't much difference. For all practical purposes, the 3.0x setting can be considered a THD+N measurement. The bandstop filter rejects 40dB, so it does a pretty good job of eliminating the fundamental from the sweep. 40dB rejection sets the lower limit of our ability to measure distortion to 1%. We can tell when distortion rises above this, but cannot determine distortion levels below 1%.

2. Get noise floor baselines.
  - a. Connect microphone. Leave oscillator disconnected.
  - b. Run SPL sweep with amp disconnected and obtain SPL chart. Set Analyzer - Parameters - Data Curve. Choose an unused entry. Avoid accidentally recording over a previous dataset. Select Analyzer - Sweep to perform the measurement.
  - c. Run distortion sweep with amp disconnected and obtain SPL chart. Set Analyzer - Parameters - Data Curve. Choose an unused entry. Avoid accidentally recording over a previous dataset. Select Analyzer - Sweep to perform the measurement.



### 3. Measure impedance.

- a. Connect oscillator output to loudspeaker. File - Load Quickset file "Zimp2wire." Remember to set Analyzer - Parameters - Data Curve and choose an unused entry to avoid accidentally recording over a previous dataset. Then click Analyzer - Sweep.
- b. Determine impedance for the loudspeaker by examining the graph. This will determine power levels at various voltages.

Note: The same decibel value measured at 1W/1M will also be measured at 10 meters if power is increased by 100x or voltage increased by 10x. When finding 1W/1M values, scaling is useful for reducing horn path length error since most basshorns have path length greater than 2 meters. The SPL value measured at 10 meters is 20dB less than SPL at 1 meter. Our goal is to obtain measurements for values of 2.83V/1M and 1W/1M (using 28.28V/10M and 100W/10M), and then double power for each subsequent measurement, i.e. 200 watts, 400 watts, etc.

### 4. Measure amplitude response.

- a. Connect oscillator output to amplifier. Click Analyzer - Osc On. Set voltage for value required.
- b. File - Load Quickset file "SPL". Remember to set Analyzer - Parameters - Data Curve and choose an unused entry to avoid accidentally recording over a previous dataset. Then click Analyzer - Sweep.

5. Measure distortion. File - Load Quickset file "Distortion". Remember to set Analyzer - Parameters - Data Curve and choose an unused entry to avoid accidentally recording over a previous dataset. Then click Analyzer - Sweep.

Reminder: Distortion at 28.28v and 100 watts will be higher than at 2.83v and 1 watt levels.

6. Generate impulse response. Perform an inverse Fourier transform. Select "Processing - Inv Fast Fourier Transform". Choose the response curve generated in step 4 as the "Source Curve" and select two unused entries, one for impulse and the other for step. Label them accordingly and click "Execute".

Repeat steps 4 - 6 at 28.28v, 100 watts, 200 watts, 400 watts, etc.

7. Heat soak the speaker. Set "Analyzer - Parameters" Frequency to 40Hz. Then click "Osc On" or press F10. Set the voltage level to 80% maximum power and leave running for 15 minutes.

Repeat steps 4 - 6 at high power levels, comparing results with the measurements made at the same power levels prior to heat soaking the driver.

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Subject: Re: Hornsub shootout RESULTS  
Posted by [Wayne Parham](#) on Sat, 15 Oct 2005 16:02:43 GMT

We absolutely couldn't have picked a better day for the Prosound Shootout. The weather was clear, no wind, temperature about 65° when we arrived at the track, warmed to the low 80's in the afternoon. We all got some sun, that's for sure.

There were a couple of no-shows, and at first that kind of bummed me out. But after we got going, I realized that we would be pressed for time if everyone had showed. Even as it was, we had to leave out the heat soak part of the test. Those of you that run your equipment at high power levels longer than a couple hours know the results of heat soak, so it is an important metric to quantify. Speakers driven to high power levels have a life expectancy that's inversely proportional to both power and time. There is a sort of thermal de-rating that sets in over the duration of a high-power event. But measuring this and quantifying it takes time, and is probably better left to measure in another venue and not at an event like this.

The systems that were there were all winners. I was pretty amazed at the level of performance displayed. The Tuba 24 is tiny as horns go, measuring only 8 cubic feet (2'x2'x2') and it packed a punch. Leland Crooks was able to pick it up easily, and yet it still had useable response down to 40Hz and sounded very powerful. The Bassmaxx horn was incredibly flat. From 70Hz to 140Hz, the amplitude response was perfectly flat. It was amazing, basshorns don't have that kind of response. A straight diagonal line (easily EQ'ed) up to 70Hz, and then perfectly flat out to the upper cutoff point. David Lee was understandably pleased, and Johan Van Zyl will be proud

138dB at 1 meter. From this, I would expect a pair of horns to provide 144dB and four horns should produce 150dB.

So I've realized that the systems all were winners, with the Bassmaxx providing the flattest the most portable, great sound in a small package.

### Prosound Shootout Test Setup

The speakers were pulled out 60 feet from the stands, and the test computer and amplifiers were a few feet away. The test microphone was run 10 meters out and sat on a pad directly on the ground.

We had written a detailed test plan, and we stuck to it. That made the measurements go just like clockwork. The first thing we did was to measure the ambient sound, to get a baseline. The graph shown below is the noise floor for all tests. When the response curve dips below this line, the data becomes ambiguous. This is particularly true of the distortion test. We did a noise floor measurement for both filter setups used to measure SPL and distortion, but they are both fairly close. So the chart below is the noise floor for all of the datasets measured at the Prosound Shootout.

### Noise Floor

The next thing we did was to measure impedance for the loudspeaker under test. Not only was this information recorded, but we also used it to determine voltage levels needed to drive the speaker to specific power levels. This was one place where data interpretation was somewhat flexible, since impedance is not constant through the passband.

As an example, look at the Bassmaxx impedance curve. All horn loudspeakers have peaks, some larger than others. But the point is, you don't have a uniform impedance, and you don't even really have a good average value. Impedance through most of the passband is relatively low, with a few large peaks. I'm not sure it makes sense to consider impedance to be greater, although the average value most certainly is. At any rate, we would all be using the same metric, so we simply had to agree upon one and David Lee suggested using Zmin, and we all agreed.

### Bassmaxx Impedance Curve

#### Bassmax Horn Subwoofer

In each case, we measured at 28.28v. This generates 100 watts for 8 ohm loads, a little more for lower impedance loads and a little less for higher impedance loads. But it was the one absolute voltage level that we picked for all loudspeakers to be tested with. Since we measured 10 meters away, the SPL value obtained also corresponds to 2.83v/1m.

Using the Zmin value obtained from the impedance chart, we calculated voltage levels required to drive the speaker to 100 watts, 200 watts, 400 watts, and so on. We performed SPL and distortion measurements at each of these levels for every speaker, up to whatever power level the

to push it to the point of failure, and to determine whether its limits were due to mechanical or thermal failure. Others participants were more conservative.

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Posted by [Wayne Parham](#) on Sat, 15 Oct 2005 18:20:02 GMT

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uses a pair of LAB12 drivers connected in a push-pull configuration with a heat exchanger for each motor.

Specifications:

Weight: 230 lbs  
Dimensions: 45" x 45" x 28"  
Power handling: 1600wrms

Frequency range: 30Hz - 170Hz  
Sensitivity: 105dB/W/M  
Max Output: 137dB/M  
Distortion at 100 watts: <1%

23.2v for 200 watts, 32.8v for 400 watts, 46.5v for 800 watts and 65.7v for 1600 watts.

Next, we measured output at 28.28v. Since we measured 10 meters away, the values correspond to 2.83v/1M.

From this, we perform an inverse FFT to obtain impulse and step response:

[img][http://prosoundshootout.com/Measurements/12Pi\\_Step.gif](http://prosoundshootout.com/Measurements/12Pi_Step.gif)

Now to measure output at 100 watts. Since we measured 10 meters away, the values correspond to 1W/1M.

Measurement at 100 watts:

Output at 100 watts measured at 10 meters is about 106dB average between 60Hz and 160Hz, which is 126db at 1 meter. The blue line is SPL, and the violet line shows distortion. Average distortion is 40dB under the fundamental, which is about 1%.

Measurement at 200 watts:

Output at 200 watts measured at 10 meters is about 109dB average between 60Hz and 160Hz,

which is 129db at 1 meter.

Measurement at 400 watts:

Output at 400 watts measured at 10 meters is about 112dB average between 60Hz and 160Hz, which is 132db at 1 meter.

Measurement at 800 watts:

Output at 800 watts measured at 10 meters is about 115dB average between 60Hz and 160Hz, which is 135db at 1 meter.

Output at 1600 watts measured at 10 meters is about 117dB average between 60Hz and 160Hz, which is 137db at 1 meter.

You can see that compression has started to set in because the increase from 800 watts to 1600 watts was not 3dB, only 2dB. It has a peak at 120Hz, so maximum continuous output is 138dB/M at that frequency. But the point is that there is nothing more to be gained from increasing power above 1600 watts.

Notice that the distortion sweep was run from 10Hz. Even at 1600 watts, mechanical excursion is not excessive at 10Hz. There was no sign of mechanical interference or stress, and the distortion levels are quite low.

This is the limit of the loudspeaker, but I wanted to go further to see how it would act. Specifically, I wanted to see if a mechanical limit was reached before thermal failure. So I ran a test at 2000 watts.

Output at 2000 watts measured at 10 meters is about 118dB average between 60Hz and 160Hz, which is 138db at 1 meter. There has been almost no increase in output with the added power. Of course, the increase in power was less than 2dB, but you can see that the increase in sound output was less than that. The power level was well in excess of the speaker's thermal limits but had not exceeded its mechanical limits. It actually sounded powerful and strong, even at this extreme level. Distortion is still quite low. So I tried it at 2400 watts.

Output at 2400 watts measured at 10 meters is about 117dB average between 60Hz and 160Hz, which is 137db at 1 meter. The response curve looks good, but this is so far above the power limits of the driver that the voice coil fused near the end of the sweep. It did not exceed its mechanical limits at any frequency above 20Hz.

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Subject: Re: Hornsub shootout RESULTS - Bassmaxx Z5  
Posted by [Wayne Parham](#) on Sat, 15 Oct 2005 18:20:12 GMT  
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Bassmaxx Z5 basshorn sub

The Bassmaxx Z5 was next in line. It weighs in at about 180 lbs and measures 42" x 42" x 22.5". It uses a single 18" Merlin driver.

Specifications:

Weight: 180 lbs

Dimensions: 42" x 42" x 22.5"

Power handling: 1200wrms

Frequency range: 30Hz - 170Hz

Sensitivity: 105dB/W/M

Max Output: 133dB/M

Distortion at 100 watts: 2%

40v for 200 watts, 56.56v for 400 watts, 80v for 800 watts and 98v for 1200 watts. We joked that max power is just about right to run your home. Just plug these things into the wall socket.

Bassmaxx impedance

Next, we measured output at 28.28v. This generates 100 watts. Since we measured 10 meters away, the values correspond to both 2.83v/1M and 1W/1M.

The blue line is SPL, and the violet line shows distortion. Average distortion is 35dB under the fundamental, which is about 2%. Since measurement was taken at 10 meters, add 20dB to find SPL at 1 meter. With 100 watts input, the 10 meter measurement works out the same as 1 watt input measured at a distance of 1 meter.

Bassmaxx response at 10 meters with 28.28v input (2.83v/1M)

From this, we perform an inverse FFT to obtain impulse and step response:

Bassmaxx Impulse Response

[/b]Bassmaxx Step Response[/b]

Measurement at 200 watts:

Bassmaxx response at 10 meters with 40v (200w) input

Output at 200 watts measured at 10 meters is about 108dB average between 70Hz and 150Hz, which is 128db at 1 meter.

Measurement at 400 watts:

Bassmaxx response at 10 meters with 56.56v (400w) input

Output at 400 watts measured at 10 meters is about 110dB average between 70Hz and 150Hz, which is 130db at 1 meter.

Measurement at 800 watts:

Bassmaxx response at 10 meters with 80v (800w) input

Output at 800 watts measured at 10 meters is about 112dB average between 70Hz and 150Hz, which is 132db at 1 meter.

Bassmaxx response at 10 meters with 98v (1200w) input

Output at 1200 watts measured at 10 meters is about 113dB average between 70Hz and 150Hz, which is 133db at 1 meter.

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Subject: Re: Hornsub shootout RESULTS - Tuba 24  
Posted by [Wayne Parham](#) on Sat, 15 Oct 2005 18:20:16 GMT  
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## Tuba 24 basshorn sub

The Tuba 24 was the first to be tested. It weighs in at about 65 lbs and measures 24" x 24" x 24". It uses a single Eminence HL10A, although this one has a prototype HL10C driver. The difference is the C model is 4 ohms and has a smaller 0.75" cooling vent. Other than that, performance appears to be identical.

### Specifications:

Weight: 65lbs  
Dimensions: 24" x 24" x 24"  
Power handling: 300wrms

Frequency range: 40Hz - 200Hz  
Sensitivity: 102dB/W/M  
Max Output: 128dB/M  
Distortion at 100 watts: 5%

34.6v for 200 watts, 49v for 400 watts and 60v for 600 watts.

Next, we measured output at 28.28v. This is a little more than 100 watts. Since we measured 10 meters away, the values correspond to 2.83v/1M.

[align=center]

[b]Tuba 24 response at 10 meters with 28.28v input (2.83v/1M)

From this, we perform an inverse FFT to obtain impulse and step response:

Tuba 24 Impulse Response

Tuba 24 Step Response

Measurement at 100 watts:

Tuba 24 response at 10 meters with 24.5v (100w) input (1W/1M)

The blue line is SPL, and the violet line shows distortion. Average distortion is 25dB under the fundamental, which is about 5%. Since measurement was taken at 10 meters, add 20dB to find SPL at 1 meter. With 100 watts input, the 10 meter measurement works out the same as 1 watt input measured at a distance of 1 meter.

Measurement at 200 watts:



Tuba 24 response at 10 meters with 34.6v (200w) input

Output at 200 watts measured at 10 meters is about 105dB average between 70Hz and 170Hz, which is 125db at 1 meter.

Measurement at 400 watts:

Tuba 24 response at 10 meters with 49v (400w) input

Output at 400 watts measured at 10 meters is about 108dB average between 70Hz and 170Hz, which is 128db at 1 meter.

Measurement at 600 watts:

Tuba 24 response at 10 meters with 60v (600w) input

Increasing power from 400 watts to 600 watts results in little increased acoustic output.

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Wayne Parham](#) on Sat, 15 Oct 2005 18:36:25 GMT  
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Leland Crooks brought a pair of DR250 speakers that he hoped to test. So we had a little time at the end of the day and we ran a couple sweeps.

Specifications:

Weight: 40 lbs  
Dimensions: 22" x 22" x 22"  
Power handling: 150wrms

Frequency range: 100Hz - 16kHz  
Sensitivity: 105dB/W/M  
Max Output: 125dB/M  
Distortion at 100 watts: 5%

DR250 Impedance

correspond to both 2.83v/1M and 1W/1M.

DR250response at 10 meters with 28.28v input (2.83v/1M)

The blue line is SPL, and the violet line shows distortion. Average distortion is 25dB under the fundamental, which is about 5%. Since measurement was taken at 10 meters, add 20dB to find SPL at 1 meter. With 100 watts input, the 10 meter measurement works out the same as 1 watt input measured at a distance of 1 meter.

DR250 impulse response

DR250 step response

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Leland Crooks](#) on Sat, 15 Oct 2005 23:48:05 GMT  
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I really regret that we didn't get a chance to play some music through these. They are an amazing speaker. I know David was skeptical of the piezos, which is everyone's first response. The second response when they hear them is Wow. Maybe next time. I'll have the new piezo 14 tweeter array in them by then. Thanks Wayne, it was fun and informative. I think it was shown that a guy with a tablesaw can compete. After all, that's where the majors came from originally.

---

Subject: Re: Hornsub shootout RESULTS  
Posted by [Mike.e](#) on Sun, 16 Oct 2005 03:50:57 GMT  
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Wayne : Excellent!Its great to see a friendly competition with some serious measurements!Did you have time for any music playback?Mike.e

---

Subject: Re: Hornsub shootout RESULTS  
Posted by [Wayne Parham](#) on Sun, 16 Oct 2005 09:09:13 GMT  
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Regrettably, we didn't have time for listening sessions, something we all looked forward to. We

also had to drop the heat soak cycle, which is something else we planned to do. But we got plenty of useful data and had an absolutely great time visiting with one other.

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Wayne Parham](#) on Sun, 16 Oct 2005 09:13:58 GMT  
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It was a great time. I'm already looking forward to the next event, and I think with David's ideas it will be even better.

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Subject: My impressions  
Posted by [akhilesh](#) on Sun, 16 Oct 2005 18:14:35 GMT  
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I attended for about 2 hours. I got a chance to hear the 12 Pi and Leland Crooks' tuba. I was very impressed! The main benefits of the 12 Pi are awesome SPL, and very low distortion. Wayne & Bill Wassilak pushed it to 2400 Watts! The combination of pushpull drivers and heat exchanger seem to create an awesome combination in terms of max SPL and very low distortion. I think we are talking less than 3 percent at 140 db levels, but check the graphs out for yourself. It was also the biggest box. Wayne mentioned it can be run indefinitely at 1600 Watts because of the heat exchanger. The tuba was smaller, very small, and seems very good for gigs in rooms/halls that can accommodate 100 or so people. Leland's system was the winner in terms of portability. I did not hear David Lee's bass max, but from what I heard others say, it had a very flat curve from about 50 hz to 150 hz. I did not get a chance to see the distortion numbers on it. It seemed capable of pretty high SPLs also, in the 130-140 range, at 1 meter. But I may be mistaken on that number (it may be more or less). The graphs may tell the story in these other posts. Overall, it was the middle in terms of size, and seemed to be a very solid all round performer. It was awesome to hear these huge sound transducers in an open field. Amazing! Great experience. Plus all the cool equipment brought by David Lee was cool, esp the 9000 Watt QSC amp that was the main testing power amp, plus the LMS software. It was cool to see realtime graphing of distortion & SPL! Very nice set up, and great event! The exact antithesis of the 2 watt SET mindset! -akhilesh

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Subject: Re: My impressions  
Posted by [Wayne Parham](#) on Sun, 16 Oct 2005 20:46:23 GMT  
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watts, continuous. That's also the point where compression sets in and power increases don't result in SPL increases. In testing, I ran at levels above 1600 watts and at frequencies well below horn cutoff specifically to test the mode of failure, to know whether it was mechanical or thermal. The failure mode is thermal, and that's why the heat exchanger is so important to the design.

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Posted by [cred\\_audio](#) on Mon, 17 Oct 2005 13:01:58 GMT

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What a great event!! Fantastic results and a great test gig!The only disappointment is that none brought in some LAB subs. That would have completed the best of the DIY Bass Bins out there, you guys who put in the sweat.

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Subject: Re: My impressions

Posted by [akhilesh](#) on Mon, 17 Oct 2005 13:35:44 GMT

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Makes sense Wayne.I could see the graphs, but since I have your ear, what SPLs did the Pi 12 reach (I saw 138 db at 1 meter, but did it go higher?) I thought the distortion numbers looked fantastic, is my guess of 3% or less at most frequencies upto 138 db at 1 meter correct? -akhilesh

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Subject: Re: My impressions

Posted by [Wayne Parham](#) on Mon, 17 Oct 2005 14:10:14 GMT

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up higher, but little additional output was generated. Up to 1600 watts, compression was negligible, with 2x power increases resulting in the expected 3dB SPL increases.

Measured response largely agrees with the computer model prediction. Compare the modeled response for one horn to the measured response of the prototype:

The accuracy of the model makes me comfortable that its prediction of a group of four horns is also accurate.

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Posted by [Wayne Parham](#) on Mon, 17 Oct 2005 14:14:27 GMT

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I wanted to see a LABsub there too. I had planned to allow one to try out the heat exchanger upgrade.

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Subject: Re: Hornsub shootout RESULTS - Bassmaxx Z5

Posted by [Wayne Parham](#) on Mon, 17 Oct 2005 15:10:40 GMT

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Did any of you notice how incredibly flat the Z5 response curve is? Amazing. And I think David was somewhat conservative in his choice to use 1200 watts as maximum power. I also want to say thanks to David for providing the LMS card for us to use.

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Subject: Re: My impressions

Posted by [freddy](#) on Tue, 18 Oct 2005 01:07:32 GMT

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hey Wayne - absolutely awesome!! musta been great fun and you smoked some heavy stuff! Best! Freddy

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Subject: Re: My impressions

Posted by [Wayne Parham](#) on Tue, 18 Oct 2005 02:16:06 GMT

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It was a lot of fun. The guys were great and their systems were awesome. The weather was wonderful too. We just couldn't have had a better day. I wish you could have been there though, I've seen you around online for a long time and it would have been cool to hang out with you.

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Subject: Re: My impressions

Posted by [freddy](#) on Tue, 18 Oct 2005 12:44:25 GMT

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finally got prostatitis on top of other stuff - won't go away yet - maybe never (?) - ain't much fun - guys watch diet and include something to offset this possibility!! did Tuba 30 not show? You're doing a fab job!!!!!! Best!!!

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Subject: Re: My impressions

Posted by [Wayne Parham](#) on Tue, 18 Oct 2005 14:06:46 GMT

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I'm very sorry to hear about your health. I sincerely hope your treatments go well. I was bummed that the larger Tubas didn't show. But the Tuba 24 did well, especially when you consider that it is rather small and was tested alone rather than in a group. We had hoped to test a pair but ran out of time. We also wanted to test the effects of heat soaking, and how the speakers acted after being heated for a lengthy period of time with a powerful signal. But we didn't have time to do that either. We did obtain some very good information though. Prior events weren't done outdoors, so this was a first. We were able to perform a battery of tests that was consistent, getting true half-space anechoic measurements at various power levels. But most of all, we just had an absolutely wonderful time. What could be better than messing around with powerful sound gear at a race track, followed by cool cars coming in to race. It was just an awesome day, and I'm already anxious for next year! Did you see the response of the Bassmaxx hornsub? Perfectly flat, amazing. I'd like to see what it does in groups, if the deep bass level rises and what that does to the rest of the response curve. Next time, that is something I hope to see.

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Subject: Re: My impressions

Posted by [freddy](#) on Tue, 18 Oct 2005 15:06:55 GMT

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(treatments=got none-lol - maybe a few more course of antibiotics) yeah - looked at bassmaxx. Tuba 24 @65lb is a winner for band guys who have to lug stuff w/o help how fast does your heatsink get hot? - do you think its significantly reducing heat of entire voice-coil? did W-version of

---

pi sub get completely scratched?does harmonic distortion on sine ever correlate well with music  
trax?

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Subject: Re: My impressions

Posted by [Wayne Parham](#) on Tue, 18 Oct 2005 17:00:20 GMT

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The Tuba 24 is definitely a lightweight that packs a heavyweight punch. Small bands can have a

It dissipates heat as fast as it sinks it. It feels warm to the touch, but at full power it's only 130°. Without the heat exchanger, motor temperature rises to 195° under the same conditions. At that temperature, the pole piece re-radiates heat back into the voice coil, literally baking it. The glue burns and becomes brittle, and fails to hold the voice coil. When the voice coil comes undone, the speaker begins to buzz as the winding vibrates against the pole piece in the gap. Eventually, the voice coil breaks and the speaker fails entirely. The use of a heat exchanger prevents this. Power levels can be substantially increased, and the motor stays nice and cool so the voice coil glue never fails. I don't know if you've seen the tests I did on the heat exchanger, but I did a series of temperature measurements. I measured the pole piece at various power levels, with and without the heat exchanger installed. So that kind of lets you know what to expect in terms of longevity. LAB12 destructive test LAB12 test with heat exchanger installed As for compression due to voice coil heating, the acoustic measurements at the Prosound Shootout shed some light. The sweeps were actually pretty long duration, not gated MLS signals. So they probably heated the voice coil pretty well at high power levels. Compression can be seen as less than 3dB increases between measurements where power was doubled. Each speaker rises 3dB between measurements until it reaches a certain point, where SPL doesn't increase much anymore because compression has set in. We had planned to do another series of tests that included a lengthy heat soak period, but we simply ran out of time. That would tell us what the speakers acted like after the magnets were very hot. The heat exchanger is really of most benefit in that situation, because it prevents the magnet from getting so hot that it re-radiates heat and bakes the voice coil.

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Subject: Re: My impressions

Posted by [freddy](#) on Tue, 18 Oct 2005 17:30:11 GMT

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missed all that - every little bit of heat reduction should help. - accidently smoked an Eminence 15 w. 3" coil (9.1mm xmax overhang) with clipped sine and a tiny Servo 260 Samson in a couple of minutes at 20Hz with a tranform EQ box - didn't lock nor open but aroma pouring out of pole-piece then into vent to room smelt pretty nasty - lol

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Subject: Re: My impressions  
Posted by [Wayne Parham](#) on Tue, 18 Oct 2005 17:46:26 GMT  
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I know that smell.

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Subject: Tuba30  
Posted by [PG](#) on Tue, 18 Oct 2005 23:17:49 GMT  
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My Tuba30 didnt make it unfortunately. I wanted to get some measurements, I guess I will have to do them myself. I am thinking of Praxis, any thoughts?

---

Subject: Usage of Zmin  
Posted by [Mike.e](#) on Thu, 20 Oct 2005 00:52:05 GMT  
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Hi wayne.Why us Zmin used and not some sort of average Z over used bandwidth?Which is more accurate?

---

Subject: Re: Usage of Zmin  
Posted by [Wayne Parham](#) on Thu, 20 Oct 2005 13:33:50 GMT  
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The method of impedance determination was one of the things we discussed at the Prosound Shootout. I rarely describe the impedance of a horn being a fixed value because it is too peaky. Instead, I think it's better to look at the impedance curve. So when I wrote the test plan for the shootout, I left final interpretation for each of the participants to agree upon. We made a decision prior to measuring anything, and used the same method consistently for each speaker. We could use any value as long as it was consistent for all speakers tested and we all agreed. But it's nice to choose a figure that is easy to repeat in other tests and appropriate for comparison with other measured datasets. We didn't have time to accurately determine average impedance using the calculated area under the curve but we could have examined each chart and estimated an average over the 20-100Hz range. We considered using  $(\min + \max / 2)$ , but this would have given an artificially inflated figure. And we considered using Zmin, which is the most conservative method of all. In the end, we chose Zmin. It was the most consistent and least subject to interpretation. Of course, using Zmin as the value to determine RMS voltage for test gave the



lowest power and SPL. If we had used some sort of average impedance value, the levels would have obviously been higher. It appears to me that using Zmin resulted in choosing voltage levels that correlated very well with expected SPL values. Zmin was David Lee's suggestion, and I think I agree with him that it is probably the best value to use when testing and when considering subwoofer setups, amplifier choices, etc.

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Timebomb](#) on Sat, 29 Oct 2005 23:09:02 GMT  
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Hi Wayne, Thanks for posting the graphs, what driver do you use in your DR250? The sensitivity is a little lower than the graph on Bills site, i was just wondering if you used a different driver? Thanks. James

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Wayne Parham](#) on Sun, 30 Oct 2005 15:54:56 GMT  
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You'll have to ask Leland Crooks because those speakers were his. Perhaps he'll chime in on this thread.

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Leland Crooks](#) on Mon, 31 Oct 2005 13:54:52 GMT  
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I think Bill's figures are with an MCM driver. Mine are with a beta 10. Also my tweeter configuration is not optimal. I have too much spacing between the drivers, leading to comb filtering. (Bill's been getting on me about it since I built them ) That accounts for the spikiness in the upper end. The original plans called for 10, which I built from, but closer together. Since then it has been figured out you can go to 14 piezos in the face, which I plan to do pronto. Will smooth all of that out, increase efficiency, and look cool as hell. When I get it done I'll run some tests with my primitive gear and post it. I don't have a \$2k rig like we had at the shootout, but should at least give an indication. It's an amazing box. Sound guys look askance at it until I fire it up. The sound quality from a \$40 woofer and \$10 worth of piezos is insane. Along with the volume from only a couple hundred watts. Not an easy build.

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Timebomb](#) on Tue, 08 Nov 2005 19:41:58 GMT  
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Cheers, would be interested in a seeing a graph with the different tweeter array. Ive built a pair myself with 12 piezos crossfiring and im genrally happy with the sound, though the upper mid could doo with more level i feel.James

---

Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Leland Crooks](#) on Tue, 08 Nov 2005 22:27:06 GMT  
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Just bought a new toy. When I get my tweeter array changed I'll post one. Not quite as sophisticated as the LMS system , but it will give us an idea. Eq the upper mids. That's what I do. With a 31 band you can smooth these puppies to silk. It takes almost no amp power in those upper ranges.

---

Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Timebomb](#) on Tue, 08 Nov 2005 22:40:14 GMT  
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Cool, ill look foward to seeing that, ive orderd a spl meter and im assuming if play a test tone cd with 1/3 octave interval tones and take mesurements with the meter ill have a fairly accurate graph. I thought boosting the mid on the graphic eq gave you less headroom on the amp? As its turning the signal up the mids would clip more easily, so a 6db boost would mean 6dbs less head room on the amp, meaning you could only give the speakers 1/4 of the power you could otherwise. Ime not 100% sure on this though, ive asked bill over on his forum.

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Leland Crooks](#) on Tue, 08 Nov 2005 23:46:29 GMT  
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Depends on where you define mids. Upper part of the register costs very little in amplifier power. Your'e right that power consumption doubles every 3db, but most of the effort (amperage)lies in the bass. Doesn't take a lot of current to drive a 3k signal.

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Subject: Re: Hornsub shootout RESULTS - DR250  
Posted by [Timebomb](#) on Wed, 09 Nov 2005 00:21:14 GMT  
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Im with you, so it shouldnt make my amp clip far sooner if i have a 6db boost at 2-3khz? Ill try it tomorrow and see, and ill do some plots as soon as my spl meter arrives and i have some spare time.Cheers.James

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Posted by [Josh Billings](#) on Mon, 05 Mar 2007 18:32:09 GMT  
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I just wanted to double check this. Is this power per cabinet (like 2 6 ohms drivers in parralel being 3 ohms) or is this 2400 watts PER driver in the cabinet?-Josh Billings

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Posted by [Wayne Parham](#) on Mon, 05 Mar 2007 19:02:00 GMT  
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All power levels at the 2005 Prosound Shootout were per cabinet, not per driver. The impedance was measured and used to calculate voltage to set power level. This drive level was then used

watts RMS. I've also tested without cooling plugs and found that the LAB12 driver cannot withstand this same test beyond 400 watts, or 800 watts for a pair.The LAB12 meets its published power specification of 400 watts RMS. It cannot handle sustained power levels beyond 400 watts

basshorn, you can run 1600 watts continuously. Naturally, peak power levels are increased as well.The LAB12 driver can withstand peaks in excess of 400 watts, as shown in the "music program" rating of 800 watts. This is a different way of describing how the speaker handles power, and should be compared with other "music power" specification ratings. A LAB12 driver with a cooling plug can handle 1600 watts "music power". When a pair of drivers is used in a basshorn, then "music power" rating is 1600 watts without cooling plugs and 3200 watts when cooling plugs are used.

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Posted by [Josh Billings](#) on Mon, 09 Apr 2007 06:28:45 GMT  
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I'm curious how long these sweeps were? Were they like 10 seconds long or like a minute? Just curious cuz i'm trying to gauge max power when there are some low heavy sweeps in teh dance music we play at the club some time.-Josh Billings

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Posted by [Wayne Parham](#) on Mon, 09 Apr 2007 07:06:15 GMT

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shootout. I did destructive tests without cooling plugs installed and then compared them with performance after cooling plugs were inserted. The drivers failed after 1.5 hours at 400 watts continuous power without the cooling plugs installed. When cooling plugs were used, they reached sustained power levels of 840 watts without failure for several hours of use. This is per driver, so with two drivers the numbers are 800 watts for an unprotected basshorn or 1680 watts for one with a cooling plug. These figures reflect performance at sustained, continuous power

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