Olson Systems LLC, Jan 2016

DJO-002 Woofer Distortion Testing

Seas, Scanspeak, HiVi, Dayton and Tang-Band

Results:

Driver	Diameter	Two Tone (dB) Closest, Highest Harmonic	T Decay -30dB, Current Drive	T Decay -30 dB Voltage Drive
RadioShack	6	-38		
Tang Band	6.5	-45 *		
ScanSpeak Illuminator	7	-42, -42	1.5 ms	0.8 ms
Seas W18EX001	7	-50,		1.2 ms
Dayton Ref	7	-48	0.8 ms	
Seas W22EX	8	-50, -42	1.5 ms	
Dayton Ref	8	-48	1.4 ms	
HiVi M8N	8	-38, -38	1.1 ms	

Table 1: Two Tone Harmonic Tone level and 800 Hz Tone burst decay times for Current output amplifier (I) and Voltage output amplifier.

* Higher SPL

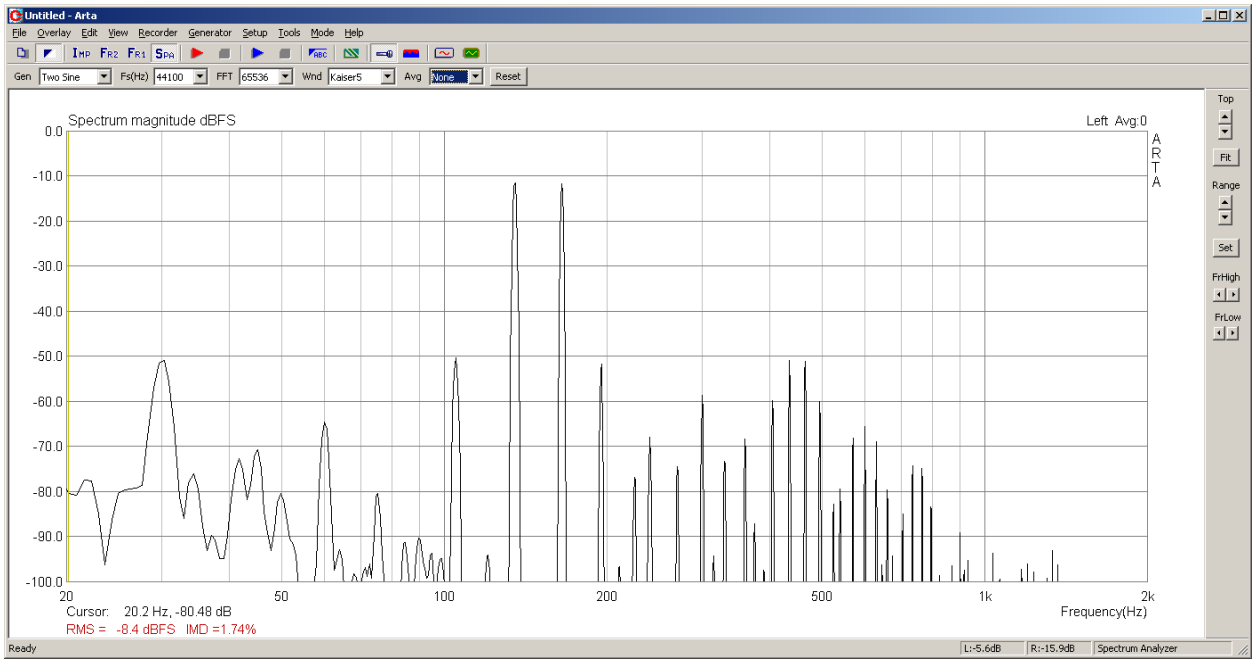
Introduction

Perform Linkwitz midrange linear and non-linear distortion tests

Go read the website for a clear understanding of what is about to happen here.
http://www.linkwitzlab.com/mid_dist.htm

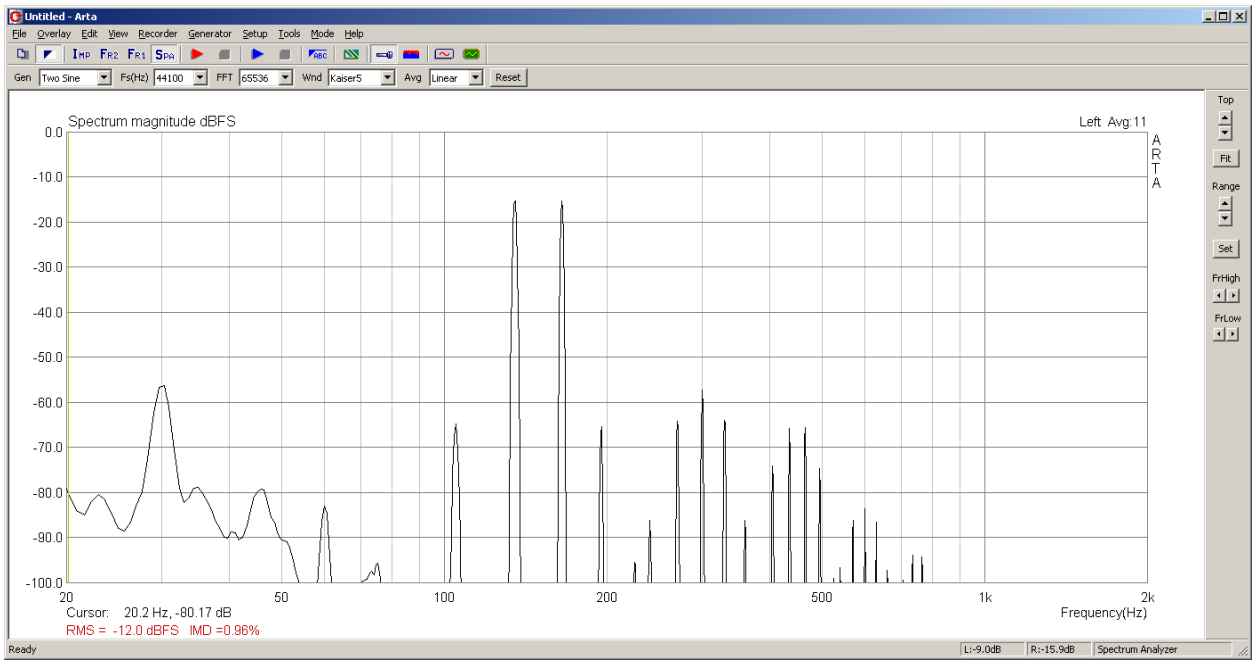
on reference woofer and selection of other candidates for design. 800 Hz Tone burst tests for linear energy storage related distortion. Steady two tone tests (135Hz and 165Hz) for Intermodulation distortion resulting from nonlinearities in the driver. Record the level of adjacent harmonic products in a table for comparison (table 1).

Non - Linear Distortion, Intermodulation, Two tone Test

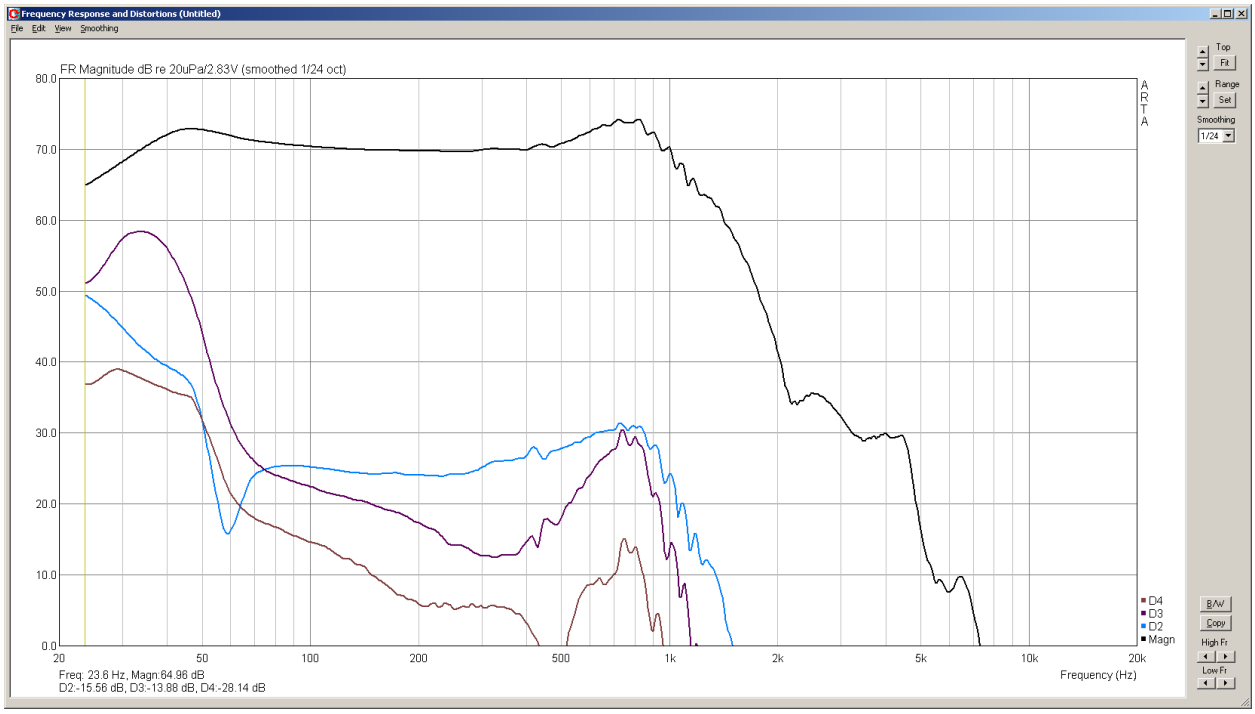


HiVi M8N 3.5 Volt (Radio Shack meter) Fundamental tones at -12dB. Current Drive -38 dB

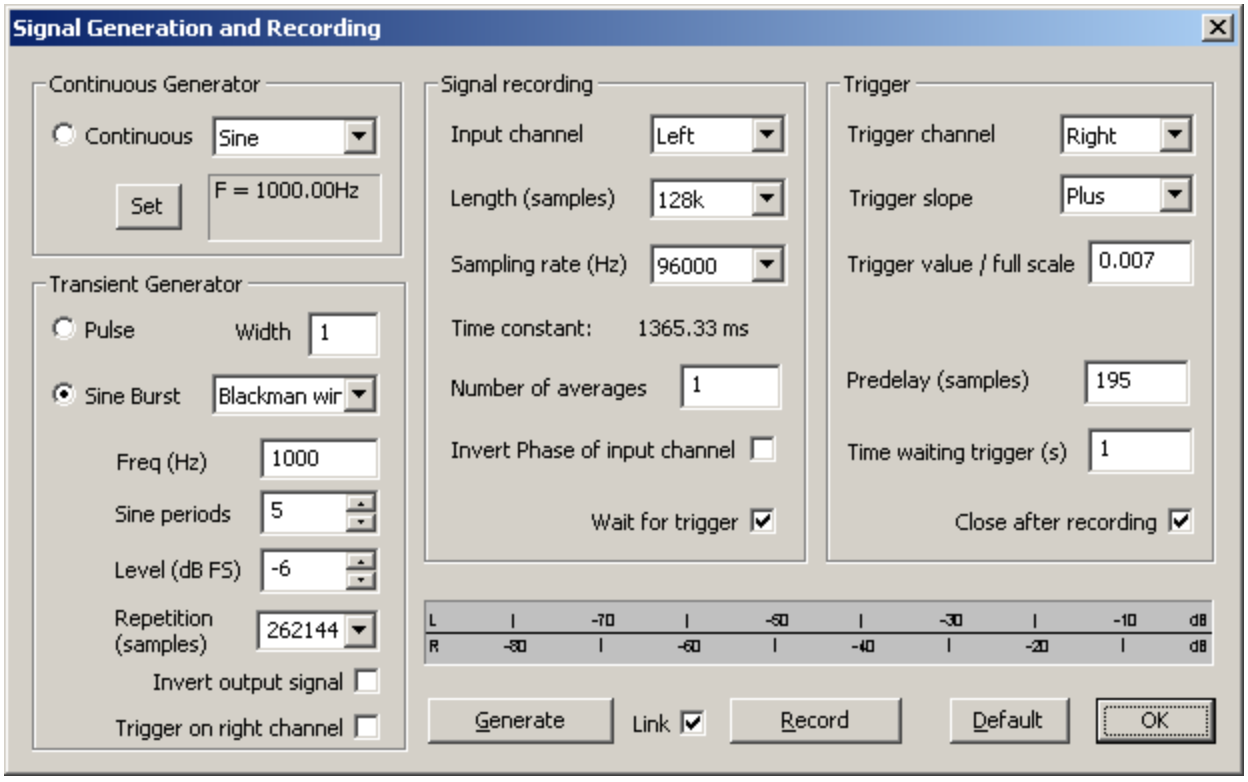
The plot above is the result for a two tone test. A perfect speaker would only have to peaks at 135 Hz and 165 Hz. All of the other peaks are a result of driver non-linearity.



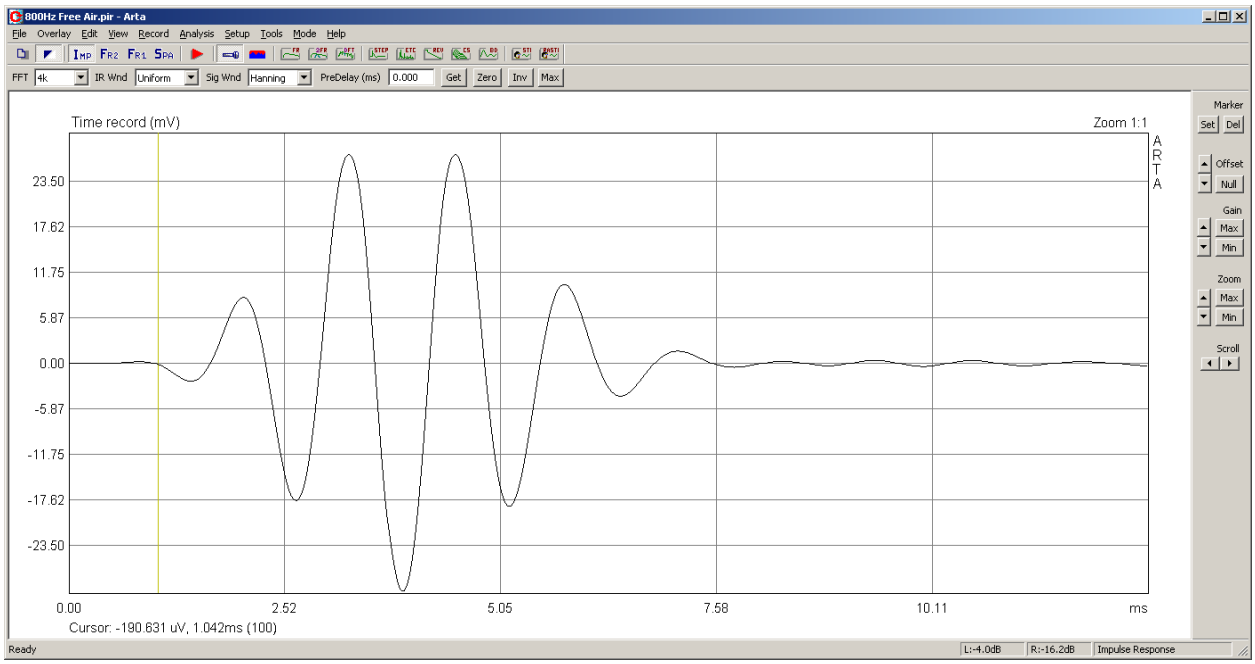
8" Seas Driver W22EX001 Same Current Drive as above. Fundamental tones at -16dB. -50 dB nearest lobe, -42dB highest lobe.



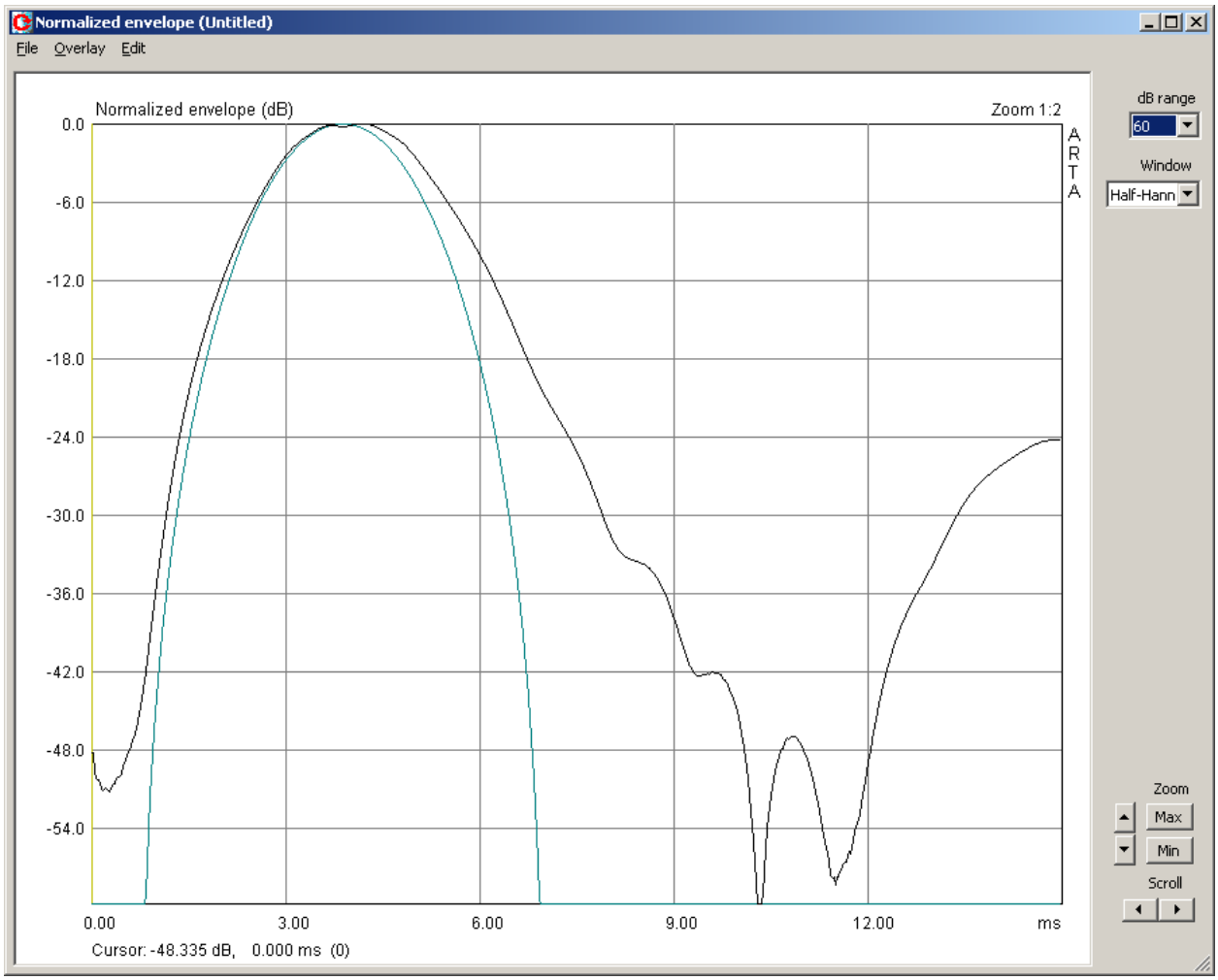
Seas 8” sweep, current Drive. Open air. Well damped at 45 Hz peak. Included 960Hz 4th order lowpass crossover. -45 dB 70 Hz - 800 Hz



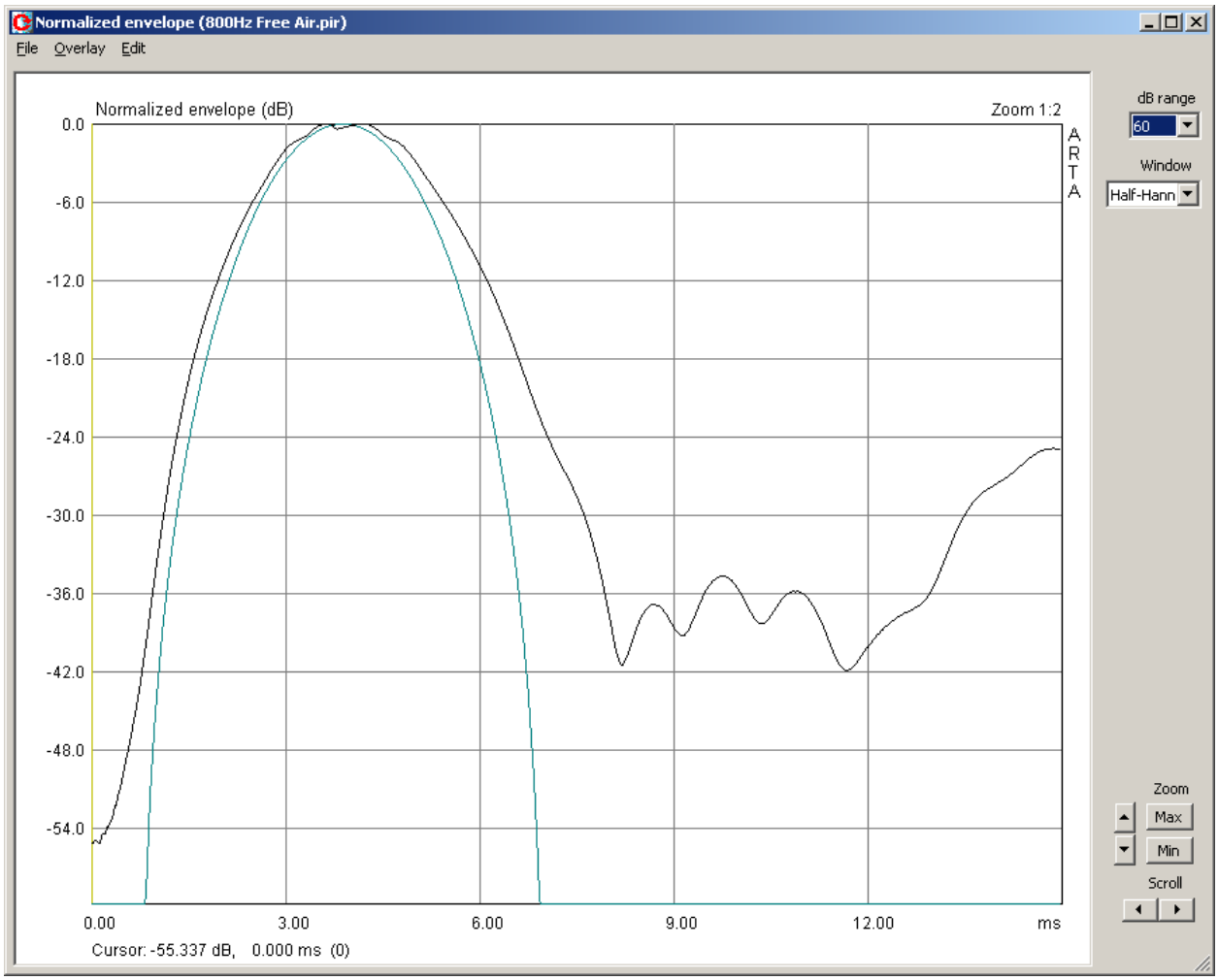
ARTA Software setup for the Tone Burst Setup. Windows Gain = 50%,



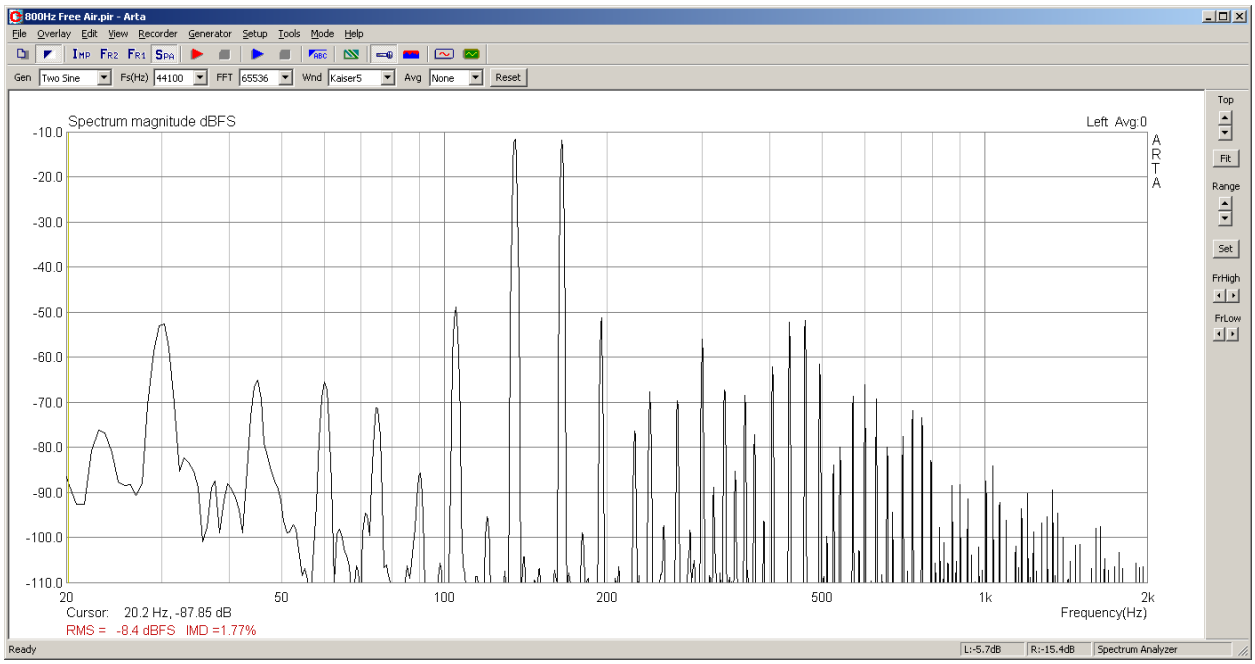
ETC Impulse Response. Seas W22EX001 8", 800 Hz tone burst. A clean tone burst response will have little or no response after 8 ms.



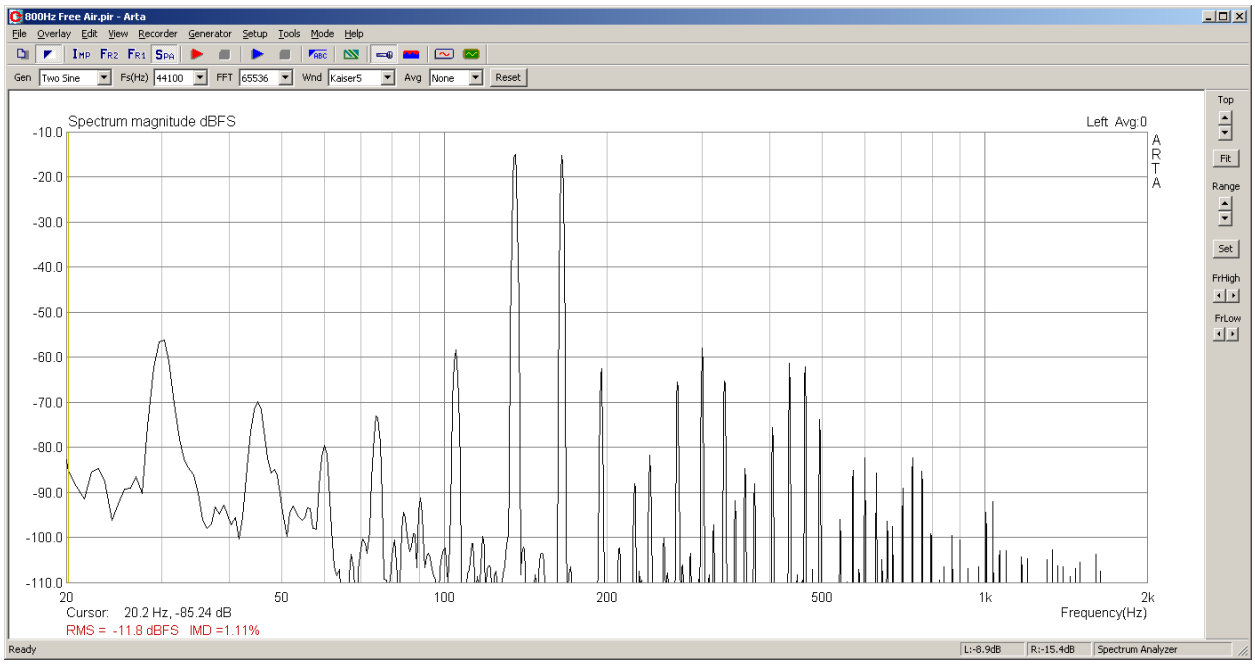
Seas W22EX001 Linear Distortion Test 800 Hz. Ceiling reflection starts at 12 ms. Grey line is perfect response, decaying immediately to -100dB. This is measured using loopback cable on the sound card. 1.5 ms to -30dB.



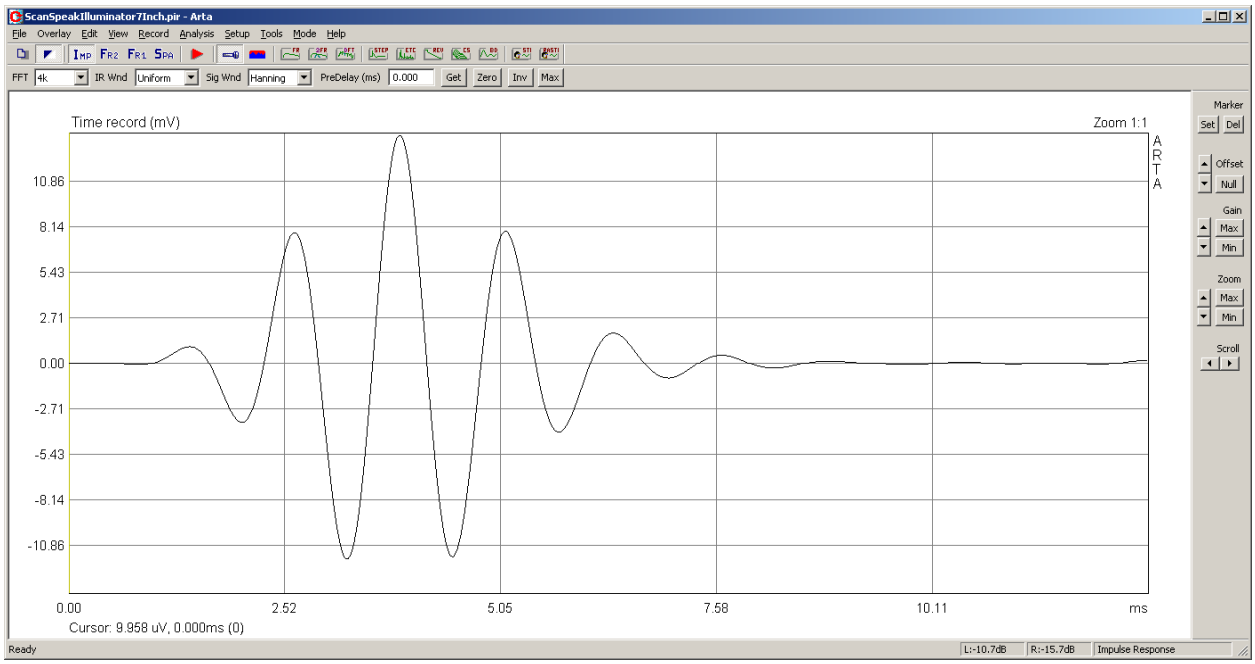
HiVi M8n 800 Hz, better initial drop, Higher between 8 and 12 ms. 1.3 ms to -30dB



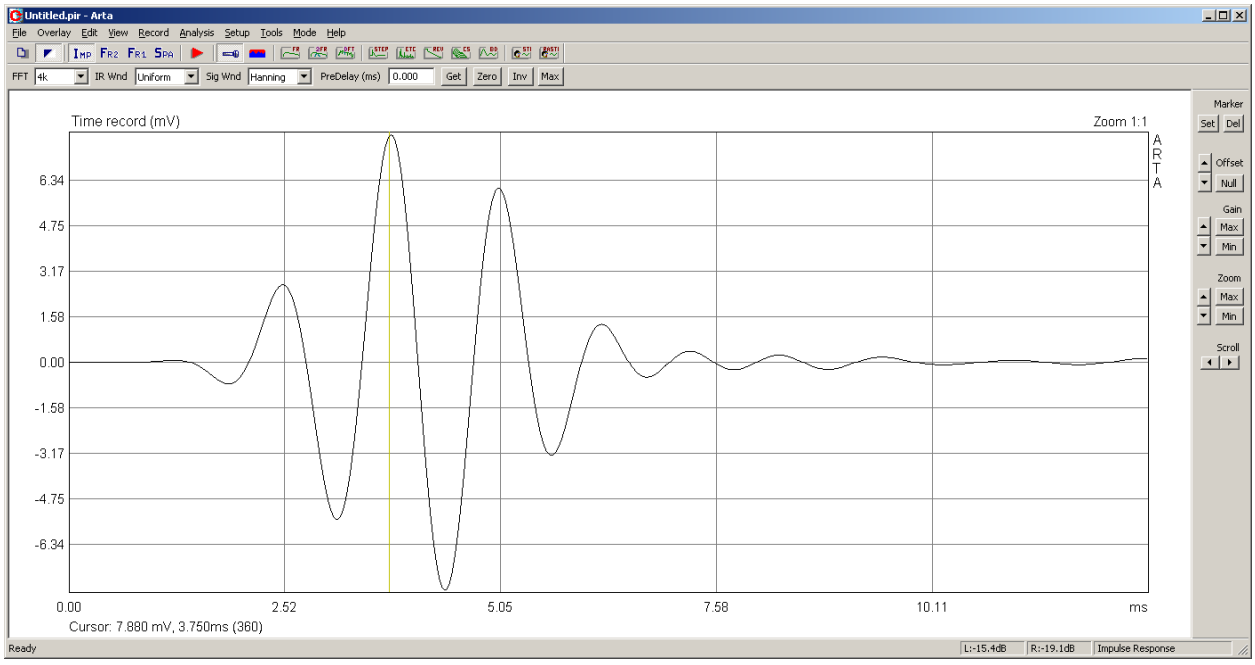
Scan Speak Illuminator 3.8 volt input. Fundamental tones at -12dB, Current Drive, -38 dB



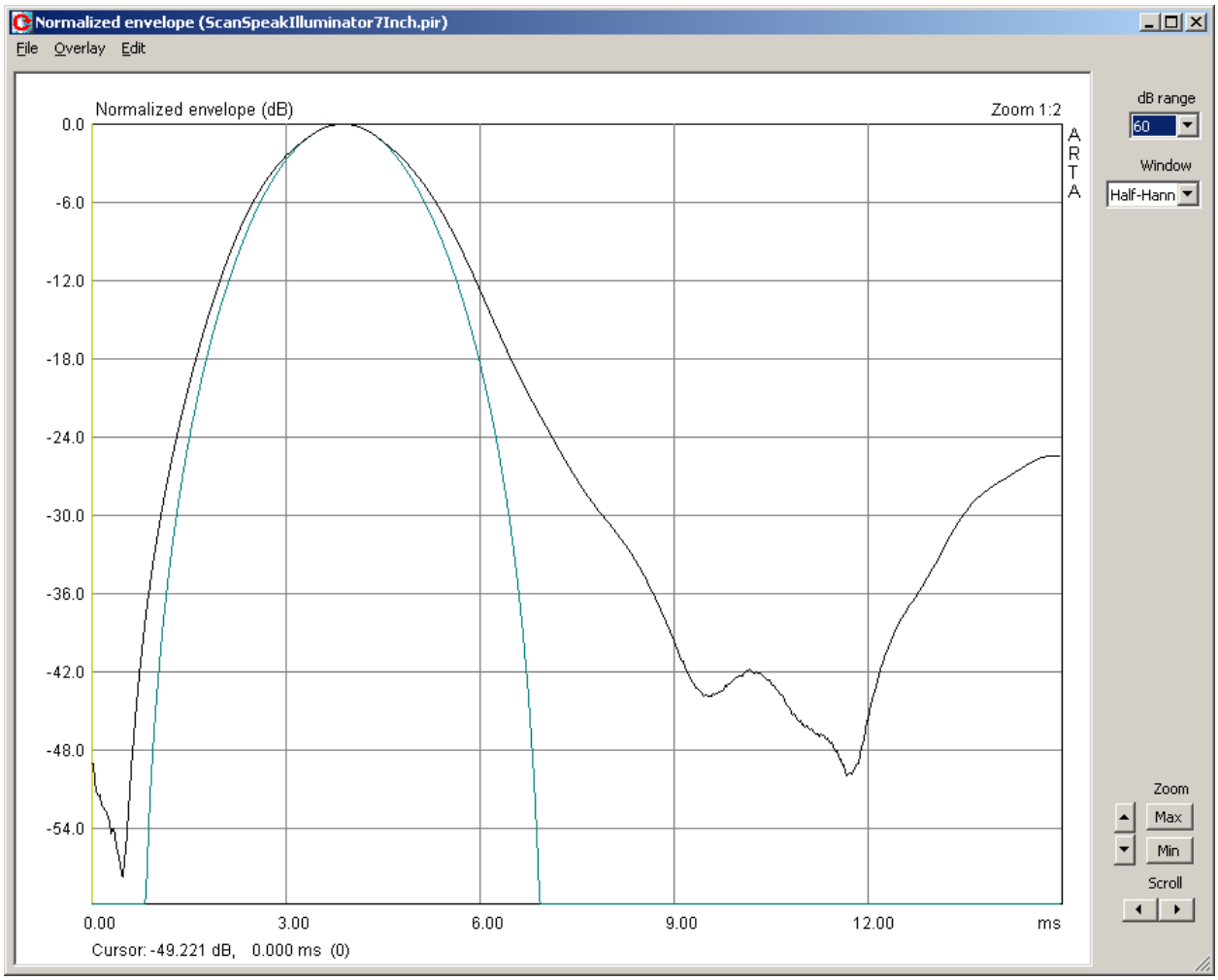
Scan Speak Illuminator 7 Inch. 2.4 Volt Current Drive fundamental tones at -16dB. -42 dB adjacent, -42 dB highest.



Scan Speak Illuminator 800 Hz burst, Current Drive 7 Inch.

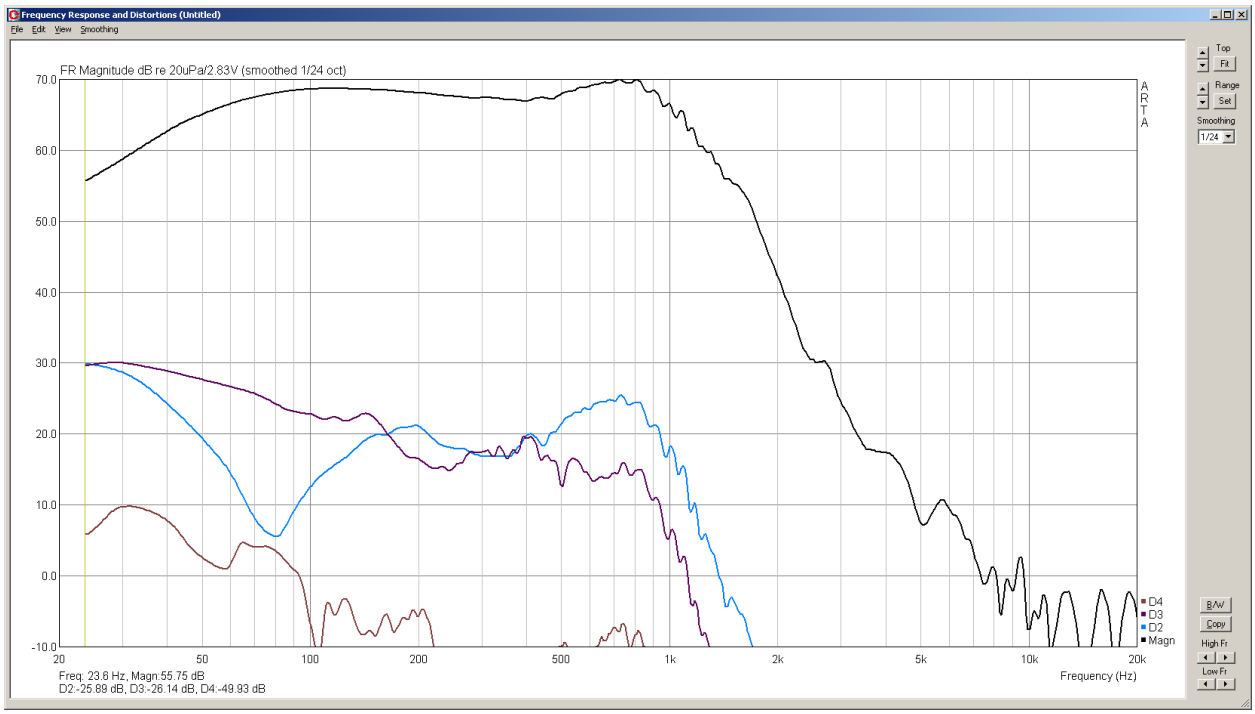


Seas W18EX001 7 Inch 800 Hz burst, Current Drive .

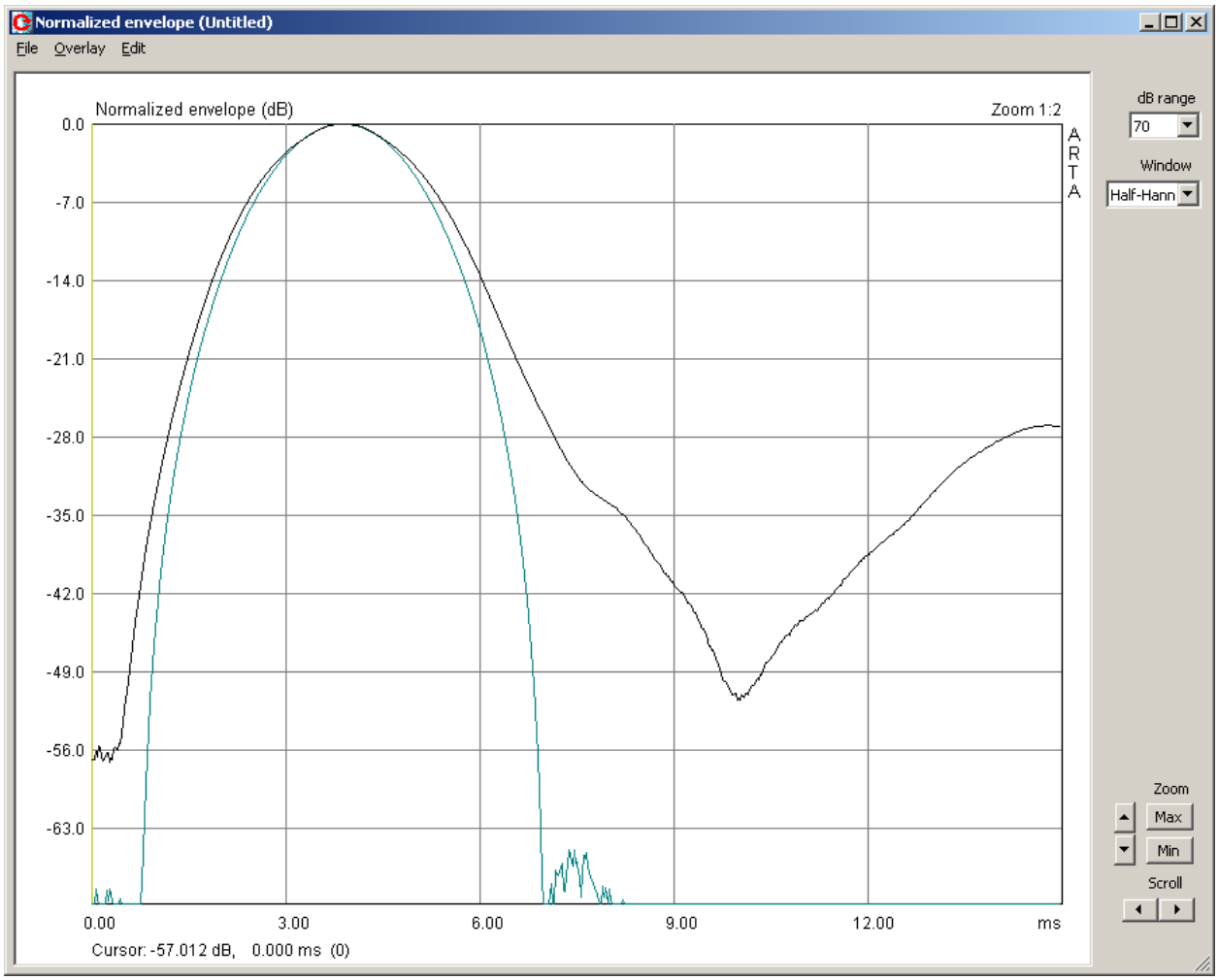


Scan Speak Illuminator 7 Inch 800 Hz burst, Current Drive . Ceiling echo at 12 ms

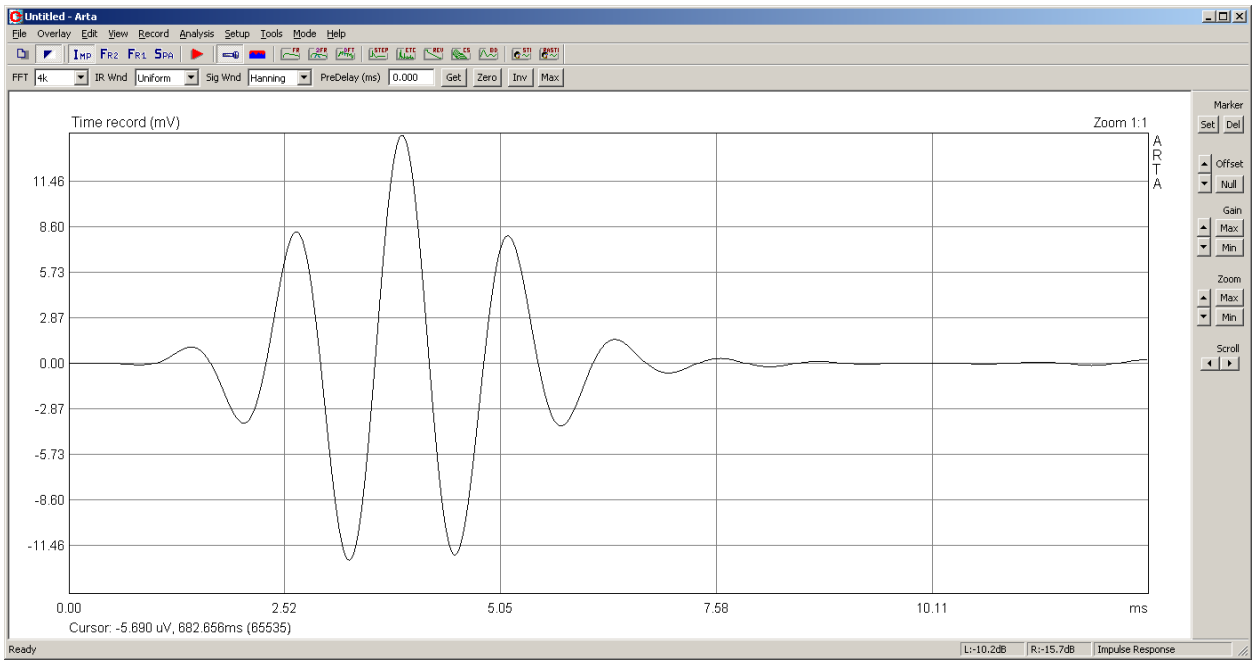
Illuminator test repeated with Voltage Drive



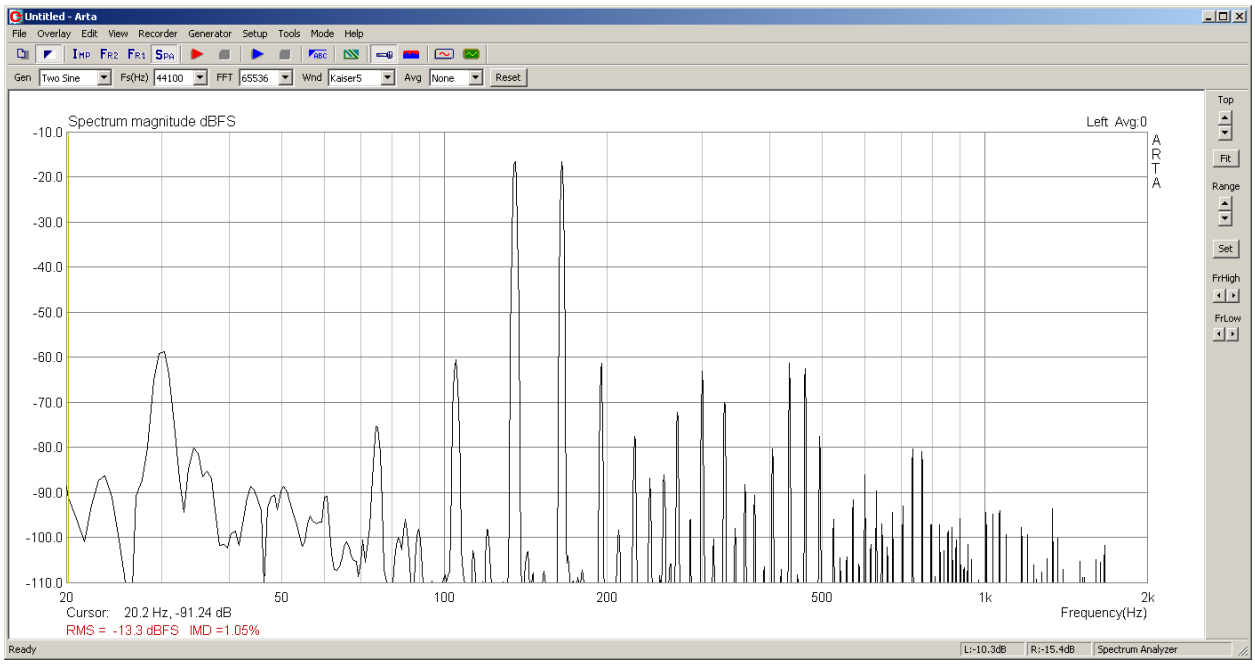
Illuminator, voltage drive -45 dB 100 Hz - 800 Hz



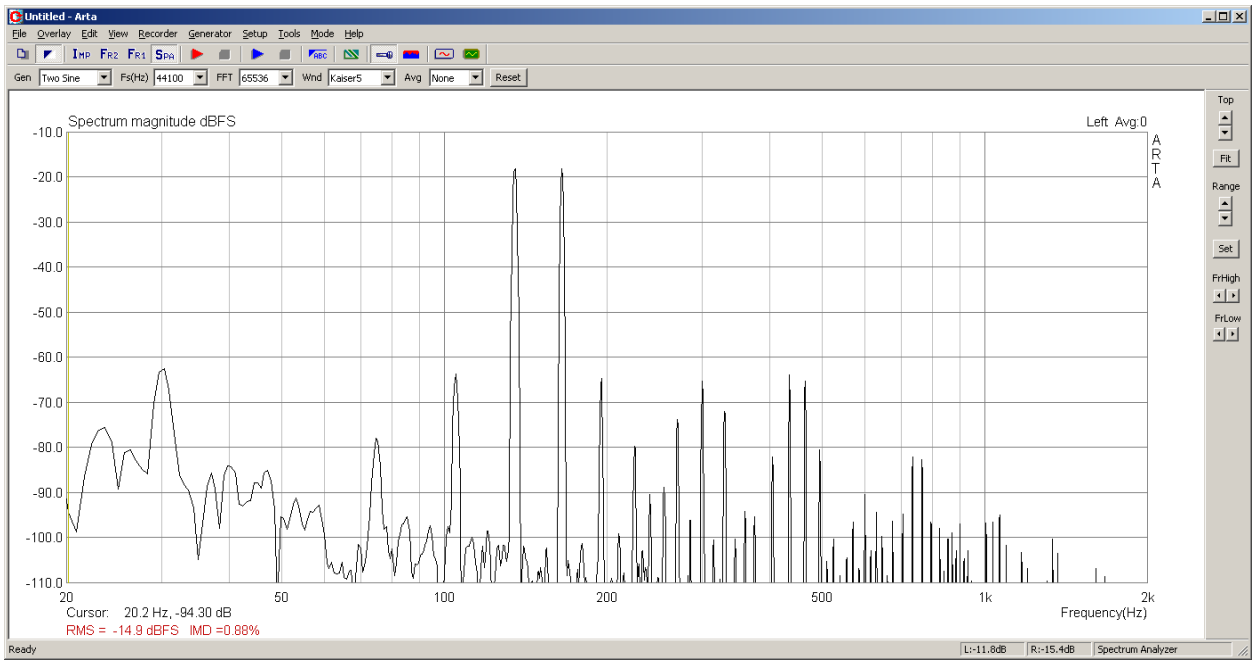
Illuminator Volt drive 0.8 ms to -30dB.



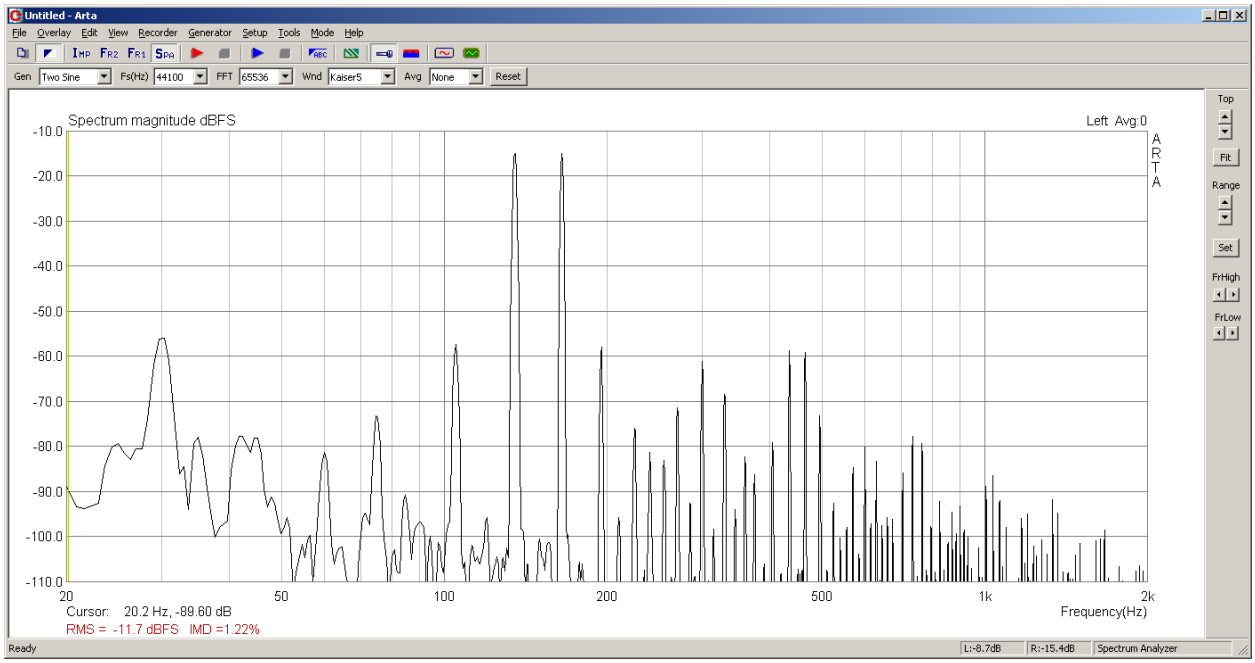
Illuminator voltage drive



Scan Speak Illuminator 7”, 135, 165 Hz two tone, Voltage Drive -45dB 3.0Volt fundamental tones at -17 dB.



2.4 Volt fundamental tones at -18dB. - 48 dB



3.8 Volt fundamental tones at -16 dB. -42 dB

Sources of Distortion

Reproduced from Test Bench - Scan-Speak 10F/8414G10 Small 3.5” Full-Range Woofer
http://audioxpress.com/article/Test-Bench-Scan-Speak-10F-8414G10-Small-3-5-Full-Range-Woofer.html

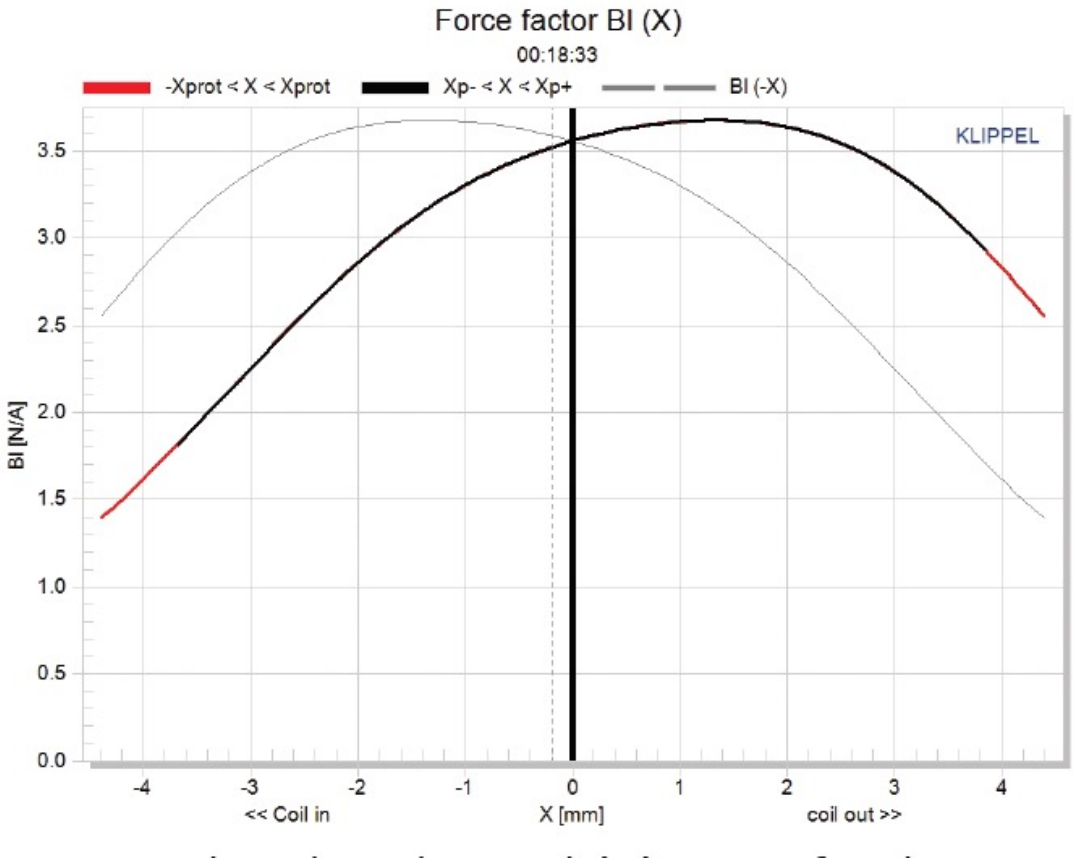
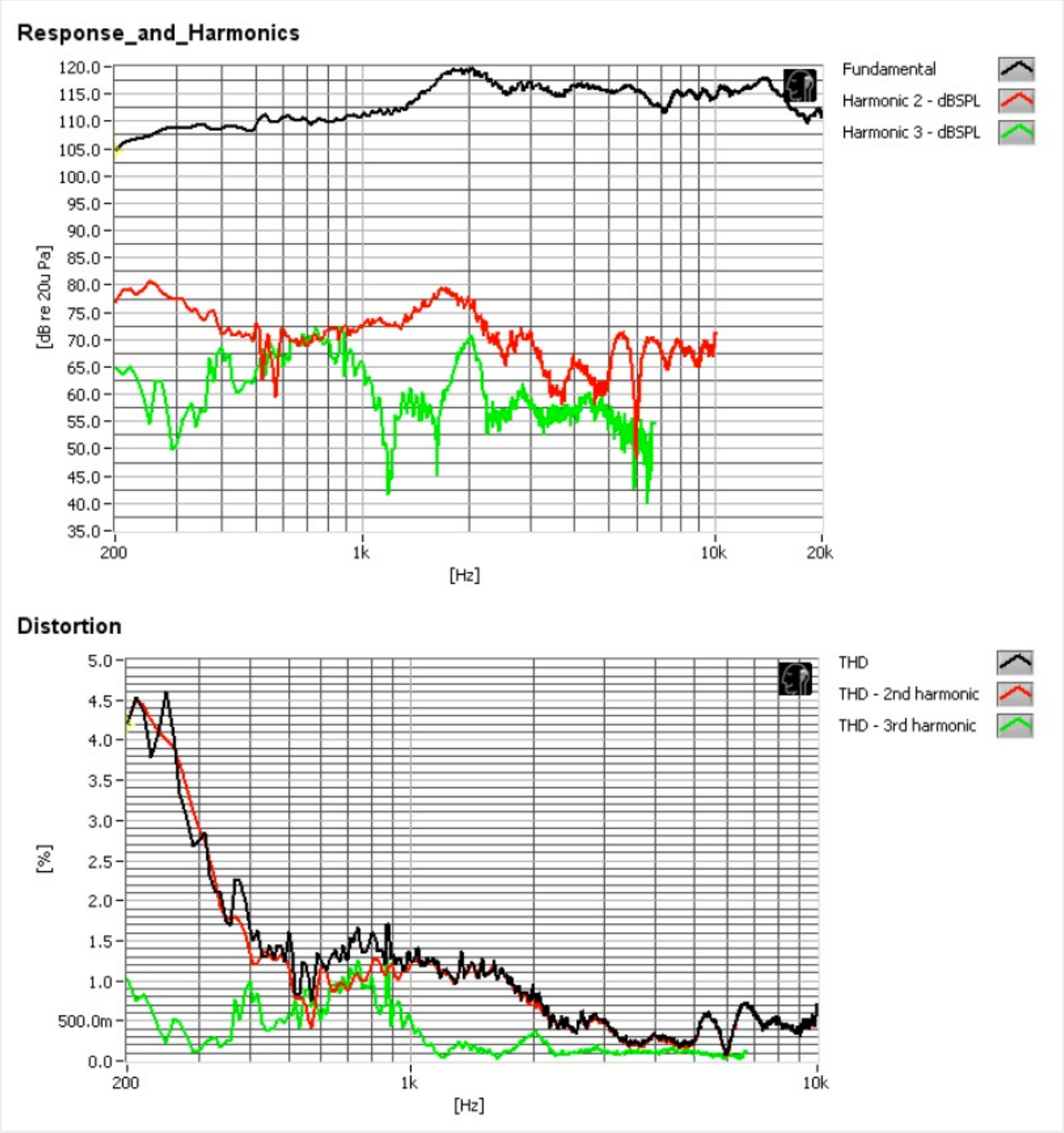


Figure 5: Klippel analyzer Bl (X) curve for the Scan-Speak 10F/8414G10.



A small offset (1.5 mm) of the spring center from the motor center causes Bl asymetry.

Solution:

1) A DC offset current could be applied to center the motor on the Bl symmetry position.
2) Gravity: Test facing up, down and sideways and compare. Compute cone sag.

3) Maintain constant pressure in sealed cabinet to position woofer.
4) Servo the spring mount position on the basket
5) Get a perfectly linear motor (ha ha ha)

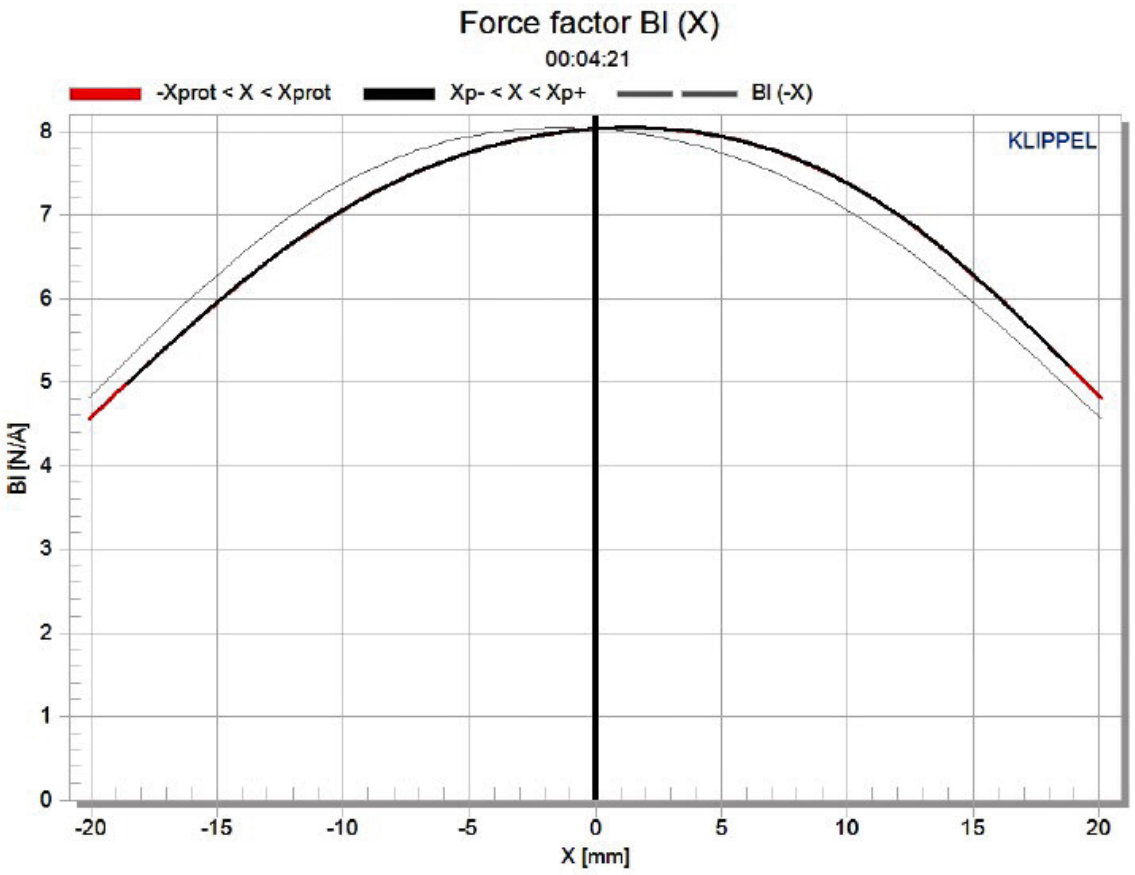
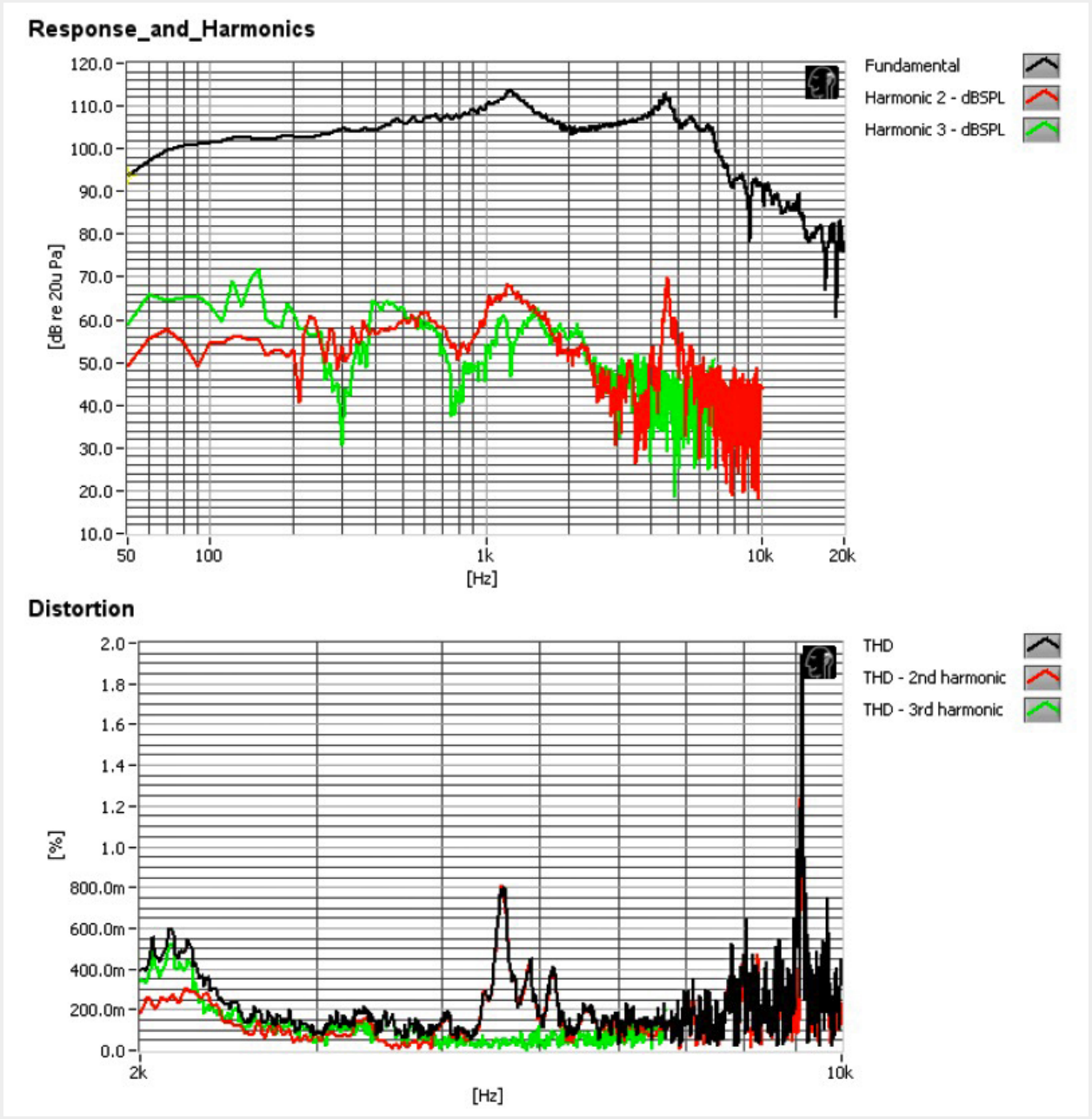


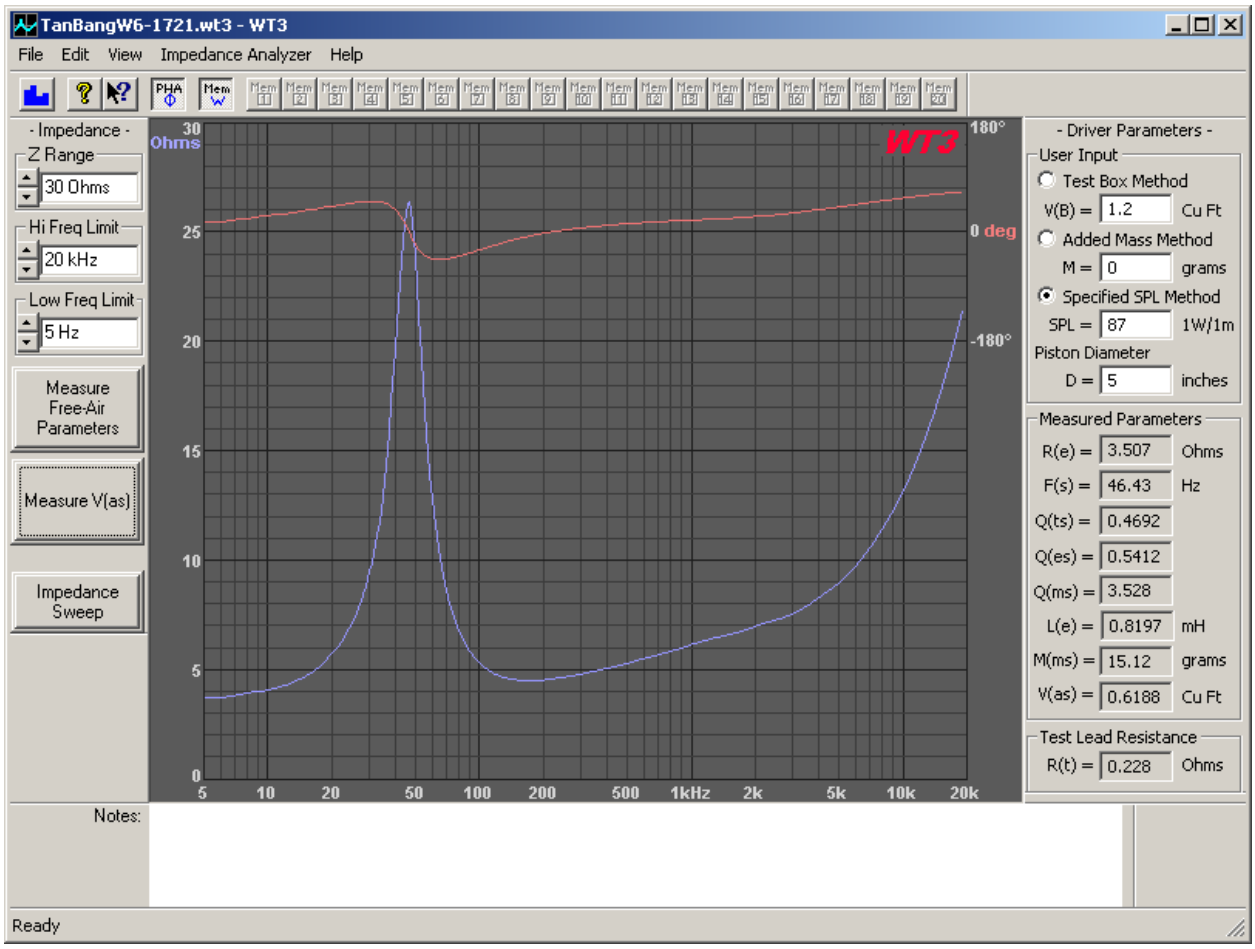
Figure 5: Klippel analyzer Bl(X) curve for the Dayton Audio ES140Ti-8.



Model the major sources and test with two tones.

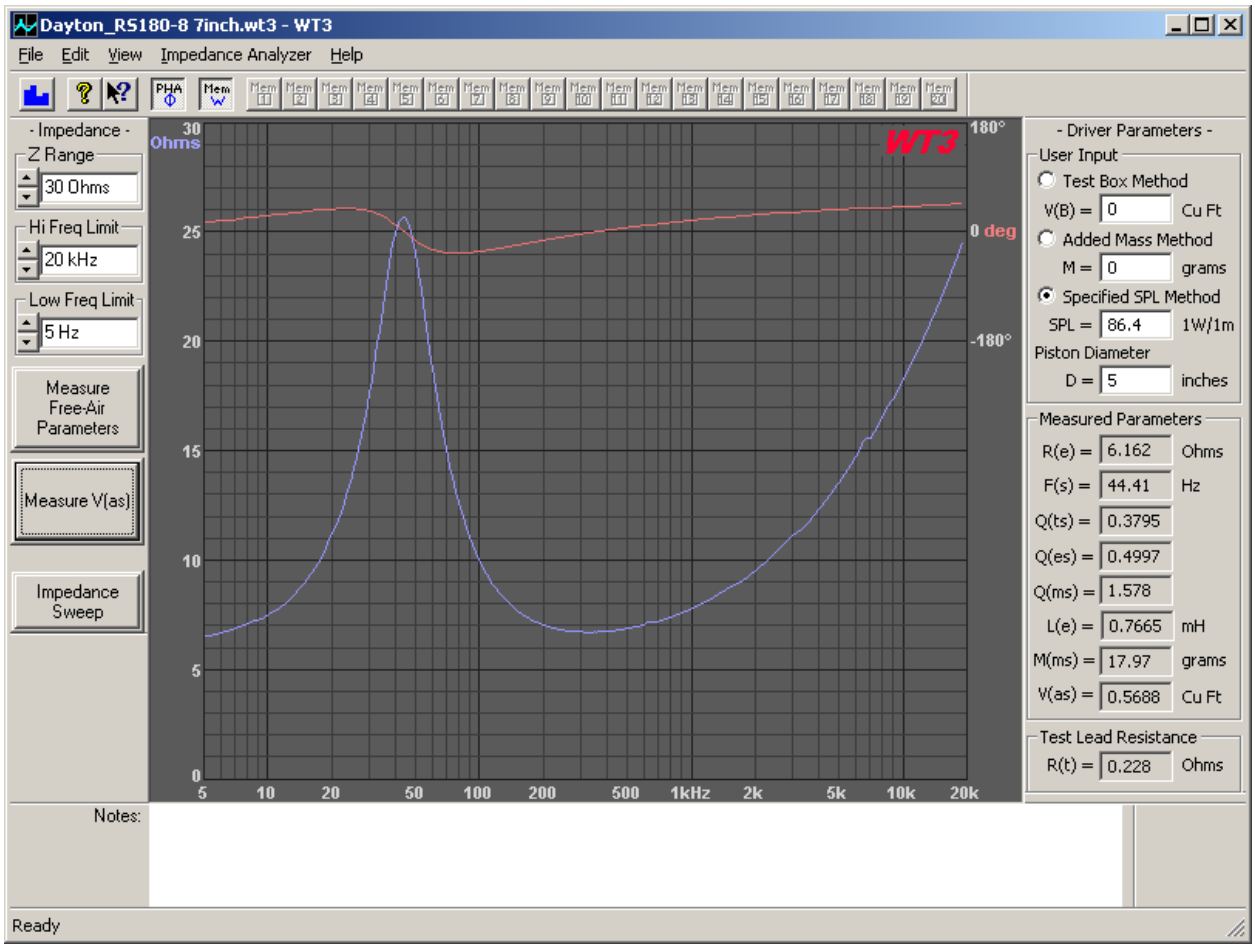
Measured Parameters

Tan Bang W6-1721



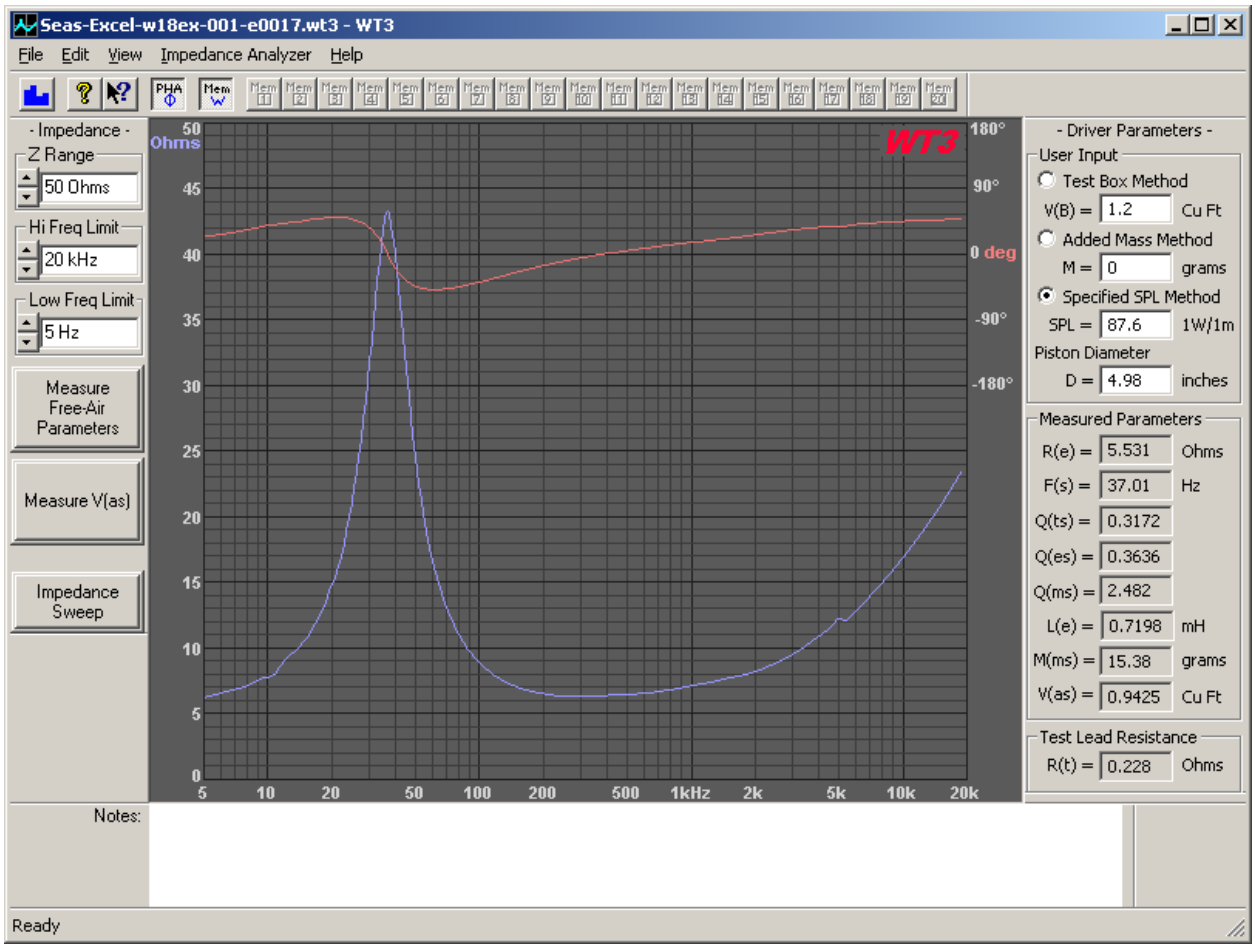
Measured Parameters, Windows Audio volume set to 10%. Adjusted SPL until calculated mass matched spec.

Le is not 87. mH as shown in data sheet, it was probably spec'd at .87, so this is good. The impedance plot is smooth.

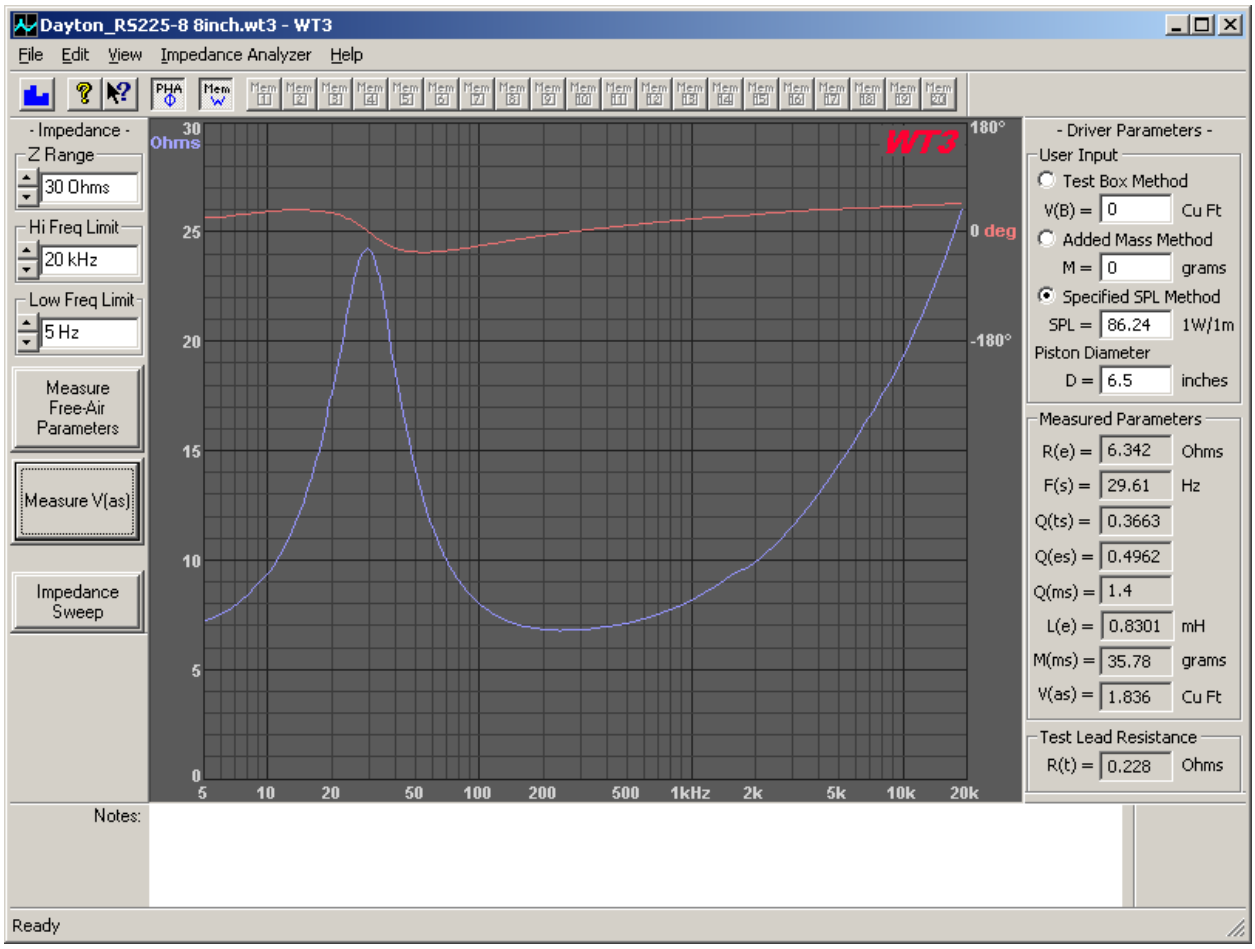


Dayton Reference RS180-8 “7 inch” driver Measures a 5” cone, so it is really a 6.5” driver, exactly the same diameter as TangBand.

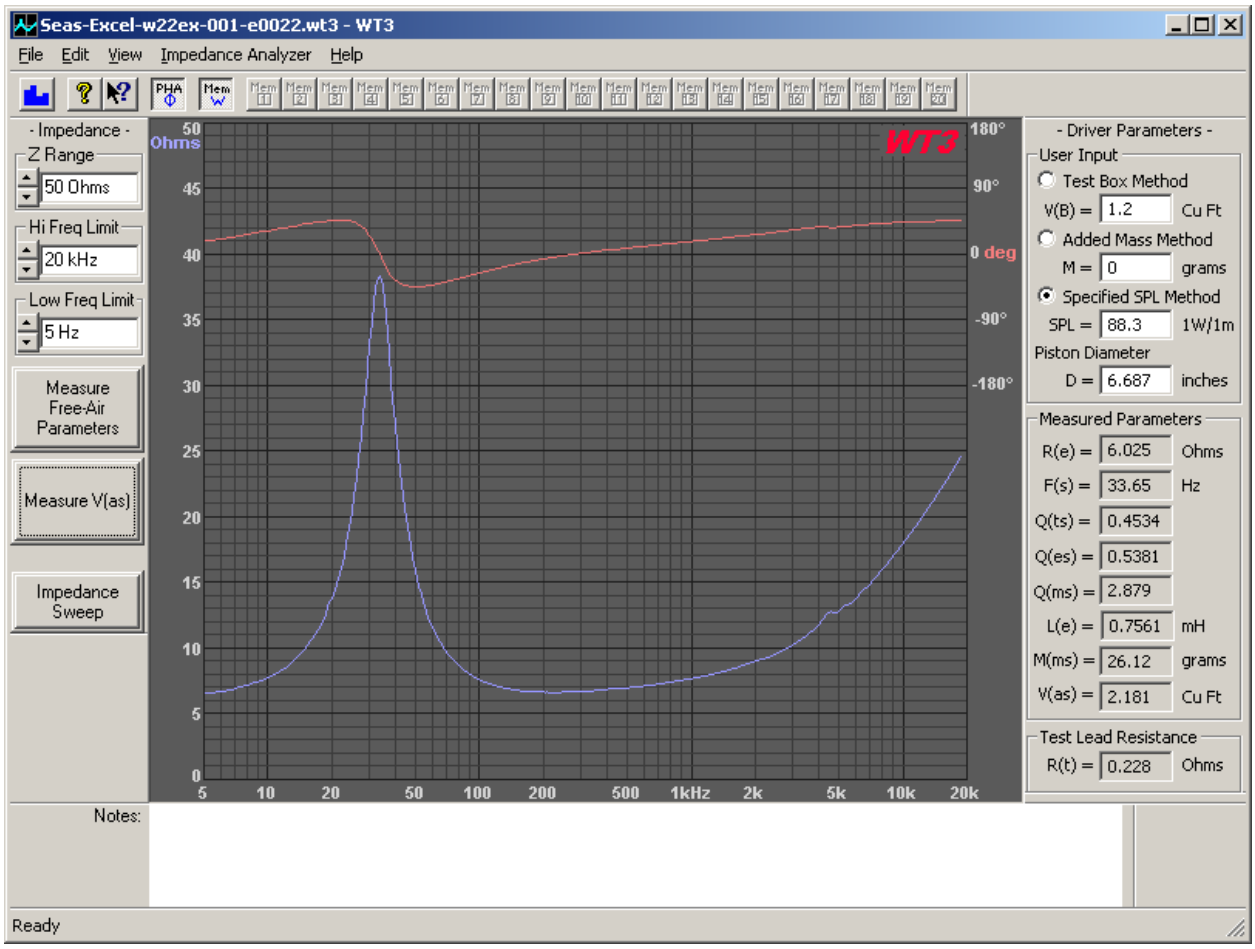
Low Qms of 1.58.



Seas w18ex-001-e0017 7 Inch driver. Qms 2.48, Fs high at 37 Hz



Dayton Ref RS225-8, 8 inch driver. Qms is actually lower than spec'd 1.46. Fs is very close to spec of 28.3 Hz Adjusted SPL to match Mms. Fs is good at 29 Hz



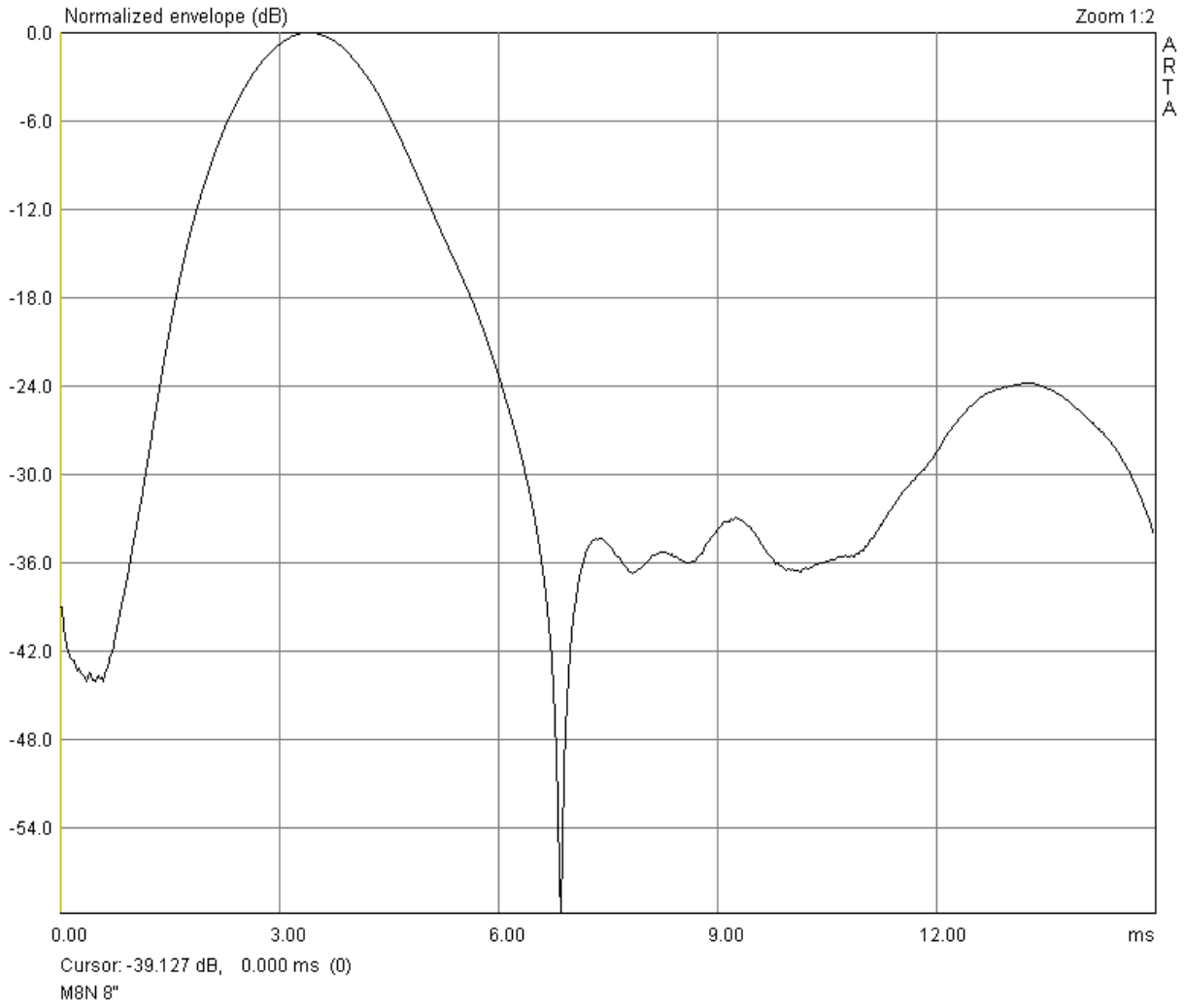
Seas Excel W22ex-001 E0022 8” driver. Qms a bit high at 2.88, SPL 2 dB higher than Dayton drivers.

Tone Bursts

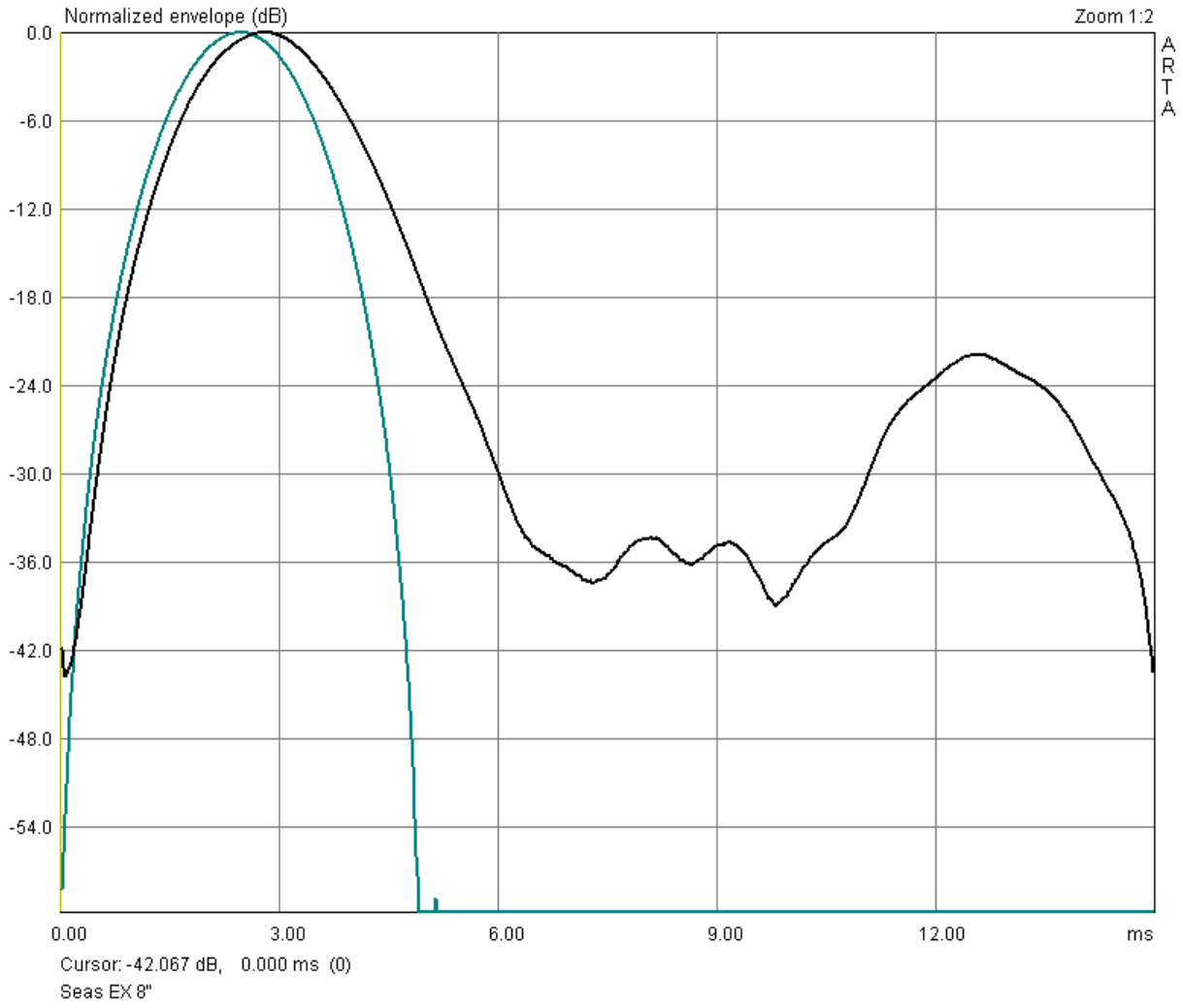
Setup:

Windows Level 25%

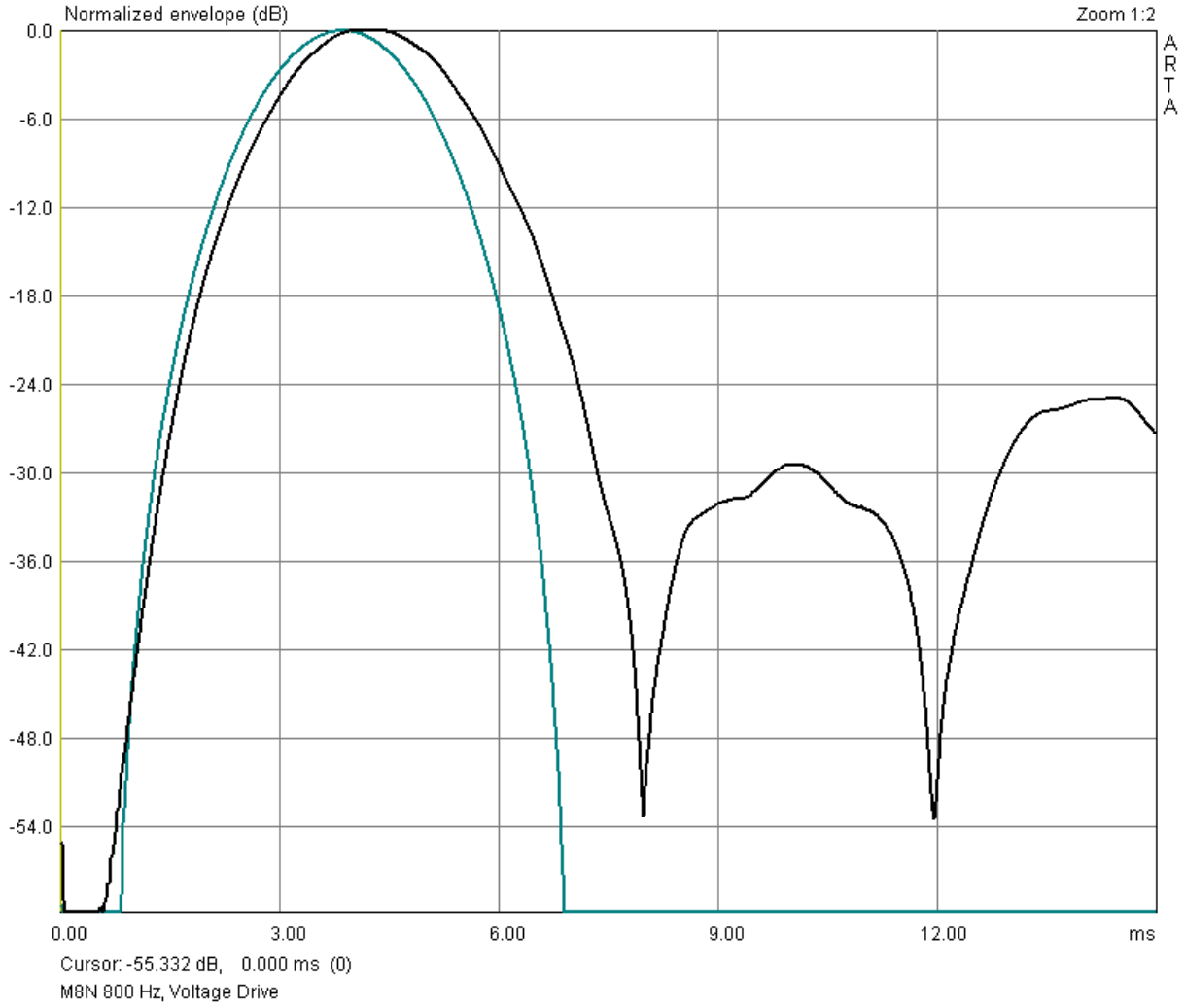
Voltage Amplifier

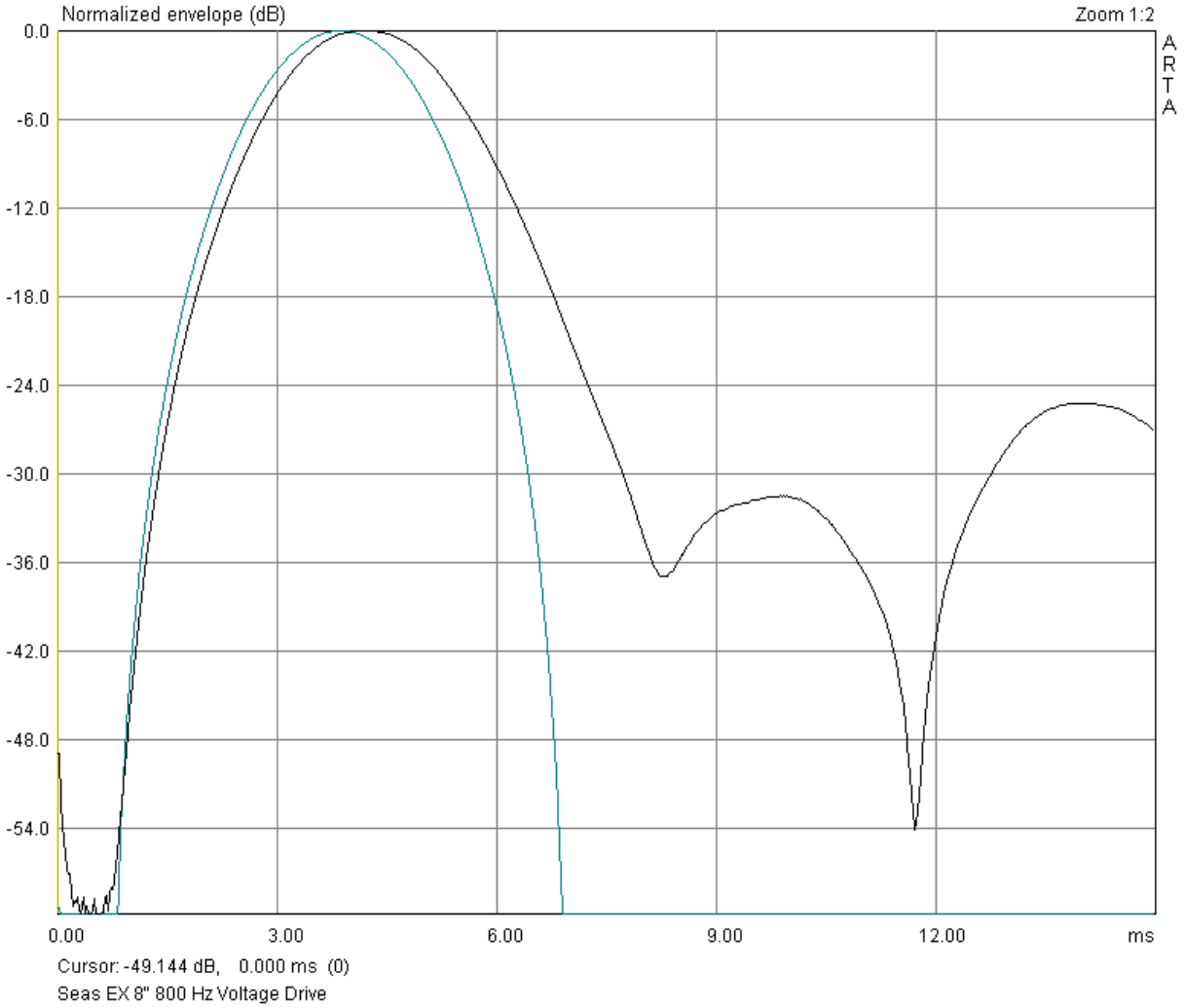


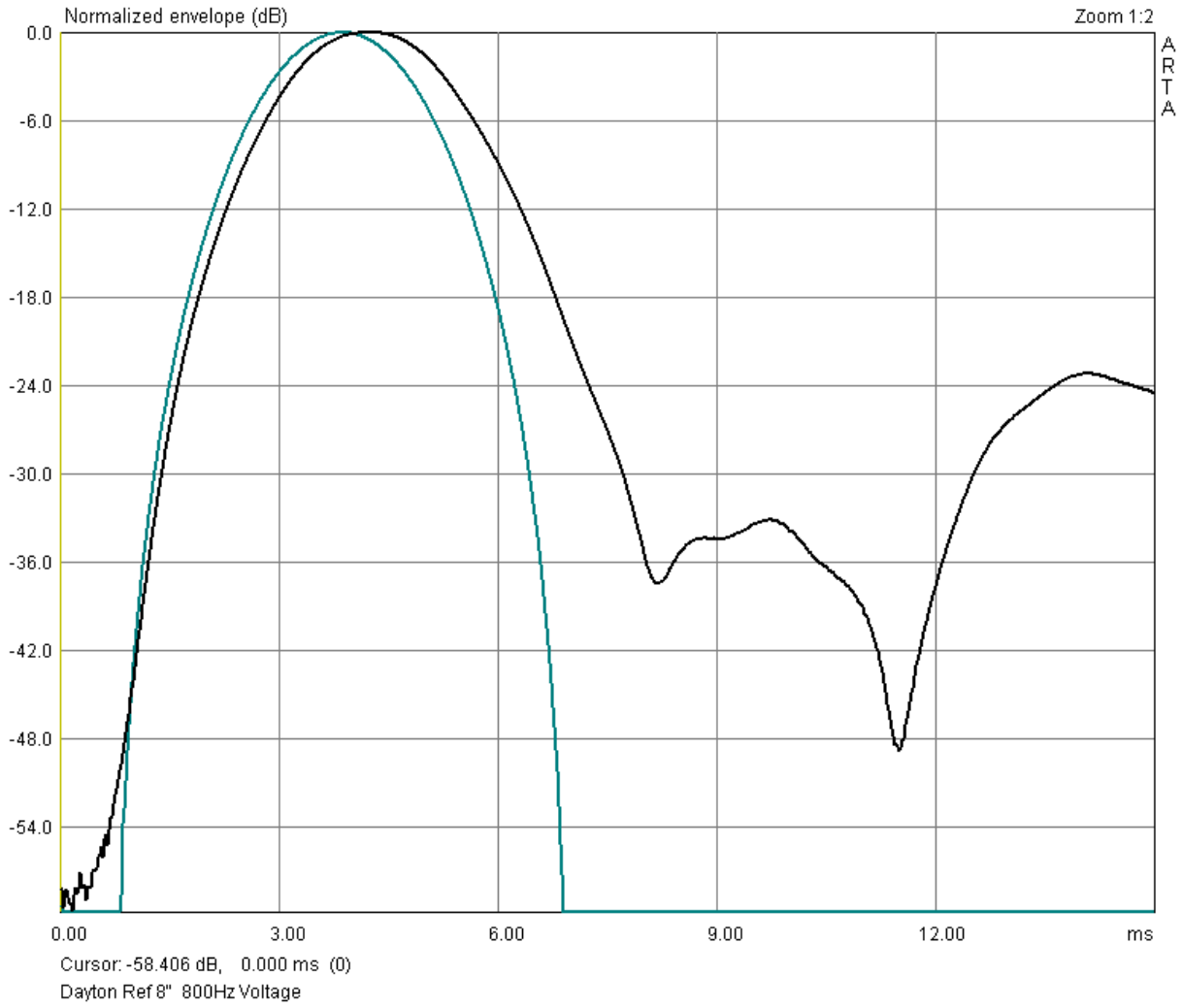
1000 Hz, Note that rise around 12 ms is from room reflections.


Normalized envelope (dB)
Zoom 1:2
ARTA
0.0
-6.0
-12.0
-18.0
-24.0
-30.0
-36.0
-42.0
-48.0
-54.0
0.00
3.00
6.00
9.00
12.00
ms
Cursor: -42.067 dB, 0.000 ms (0)
Seas EX 8"

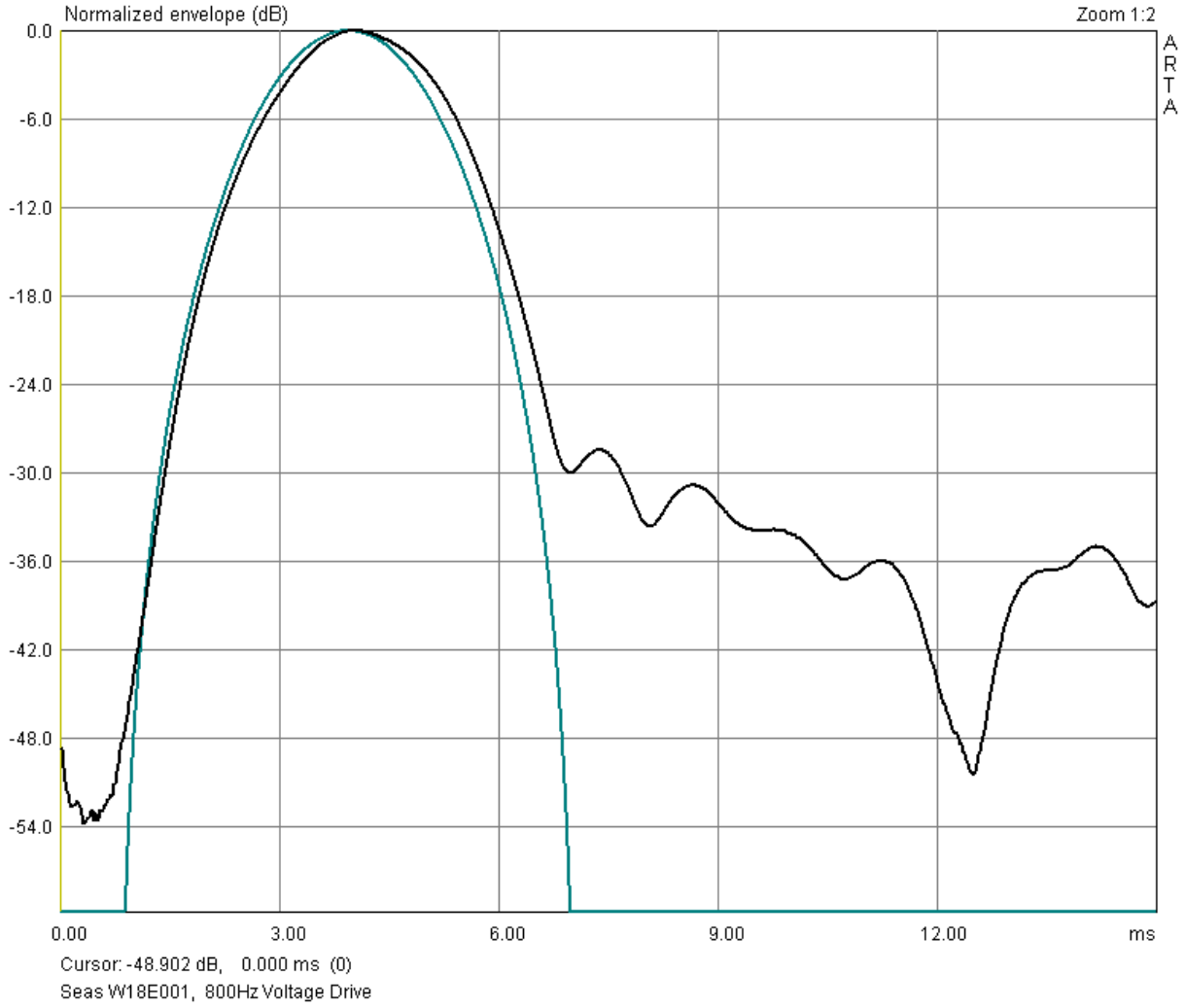
1000 Hz

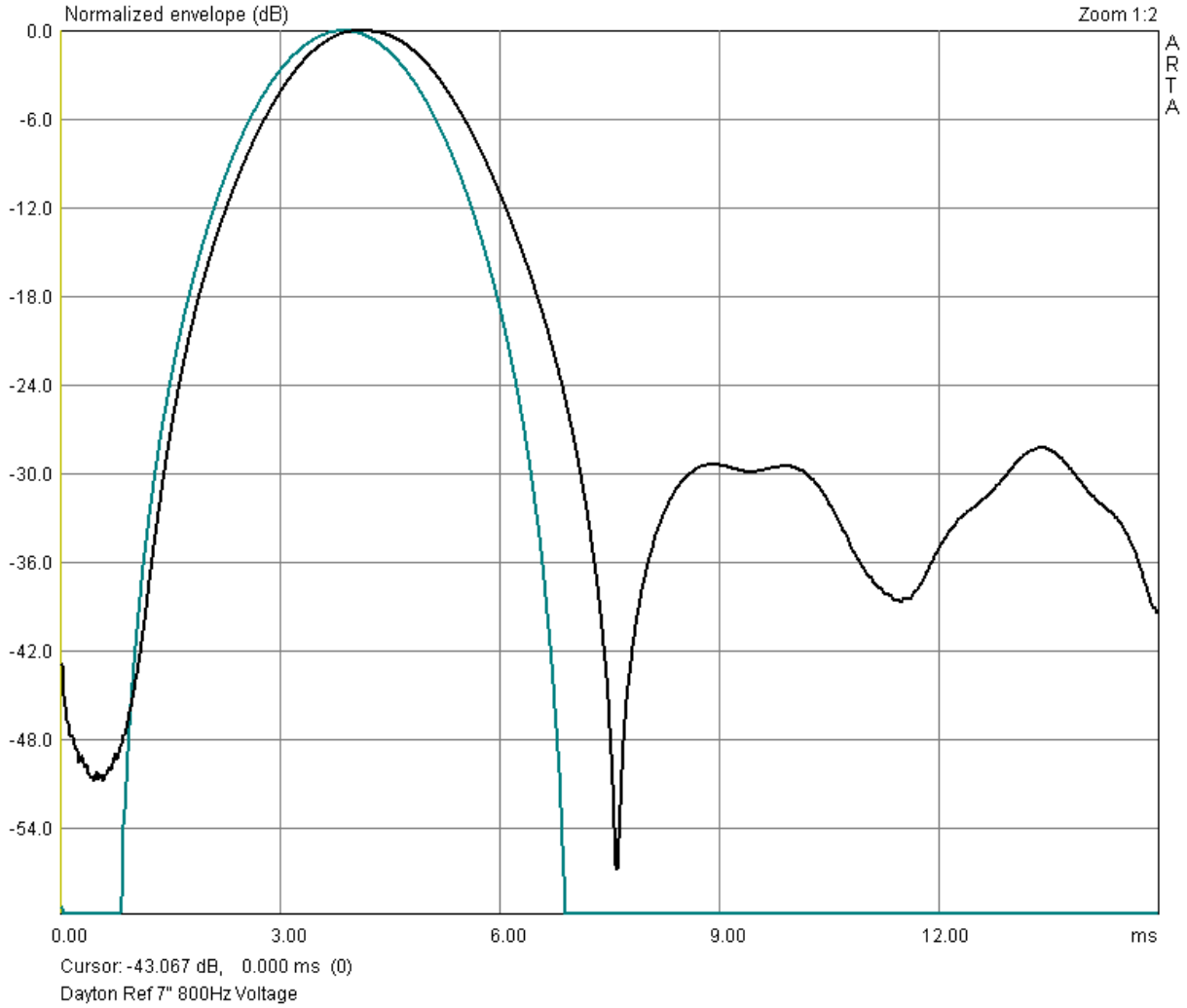

Normalized envelope (dB)
Zoom 1:2
ARTA
0.0
-6.0
-12.0
-18.0
-24.0
-30.0
-36.0
-42.0
-48.0
-54.0
0.00
3.00
6.00
9.00
12.00
ms
Cursor: -55.332 dB, 0.000 ms (0)
M8N 800 Hz, Voltage Drive


Normalized envelope (dB)
Zoom 1:2
ARTA
0.0
-6.0
-12.0
-18.0
-24.0
-30.0
-36.0
-42.0
-48.0
-54.0
0.00
3.00
6.00
9.00
12.00
ms
Cursor: -49.144 dB, 0.000 ms (0)
Seas EX 8" 800 Hz Voltage Drive

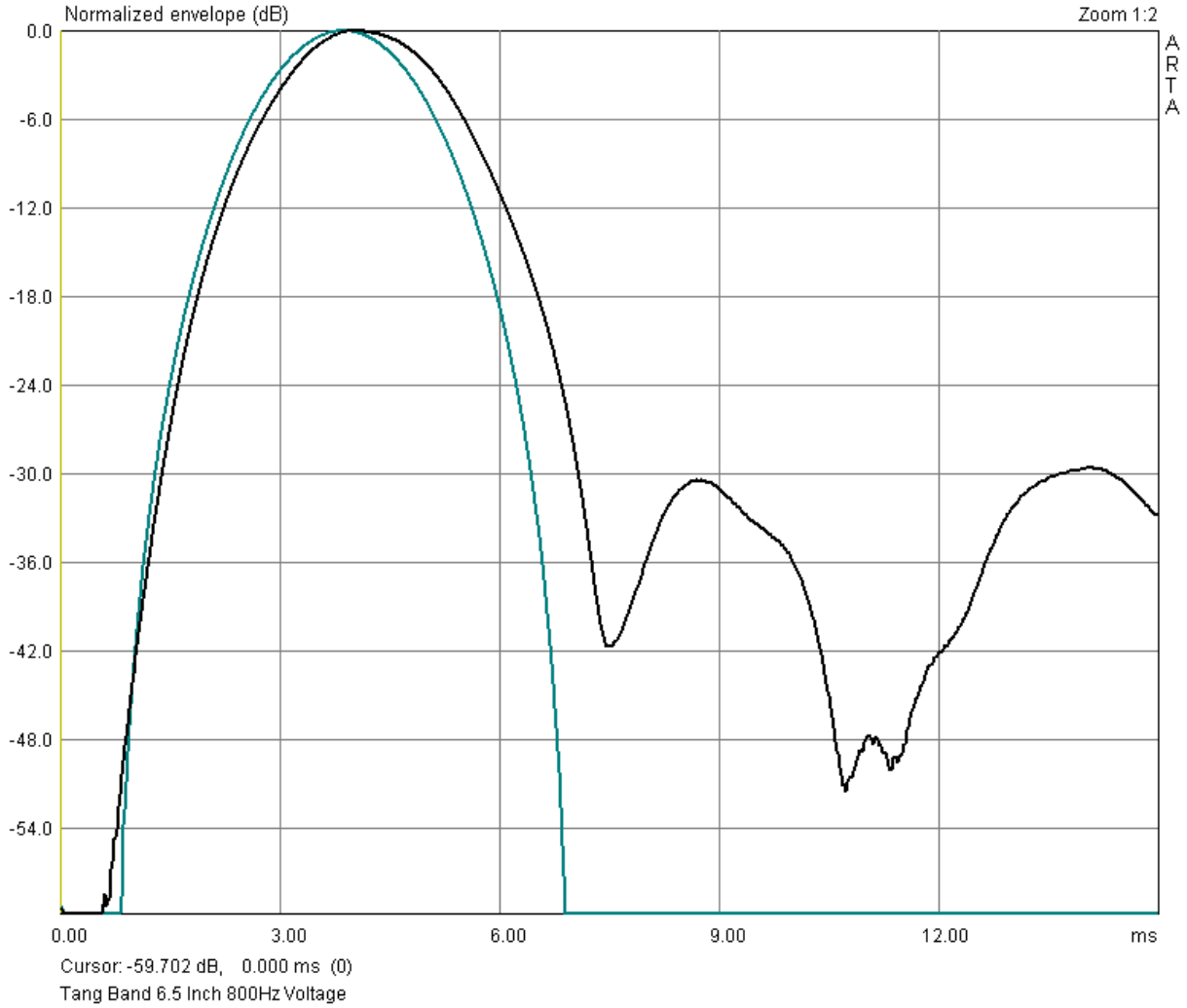


Dayton Ref 8”, Nearly Identical to Seas Driver, slightly better at 9 ms.


Normalized envelope (dB)
Zoom 1:2
ARTA
0.0
-6.0
-12.0
-18.0
-24.0
-30.0
-36.0
-42.0
-48.0
-54.0
0.00
3.00
6.00
9.00
12.00
ms
Cursor: -48.902 dB, 0.000 ms (0)
Seas W18E001, 800Hz Voltage Drive

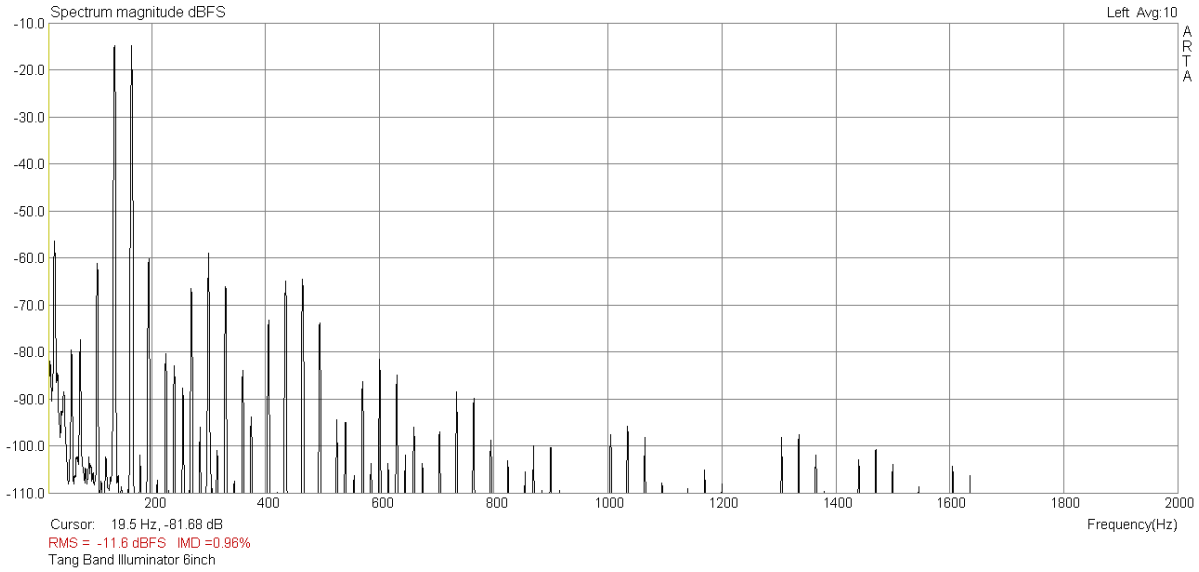


Dayton 7” (6.5) Driver. Faster Initial Decay than 8” drivers, bumps up to -30 at 9ms.

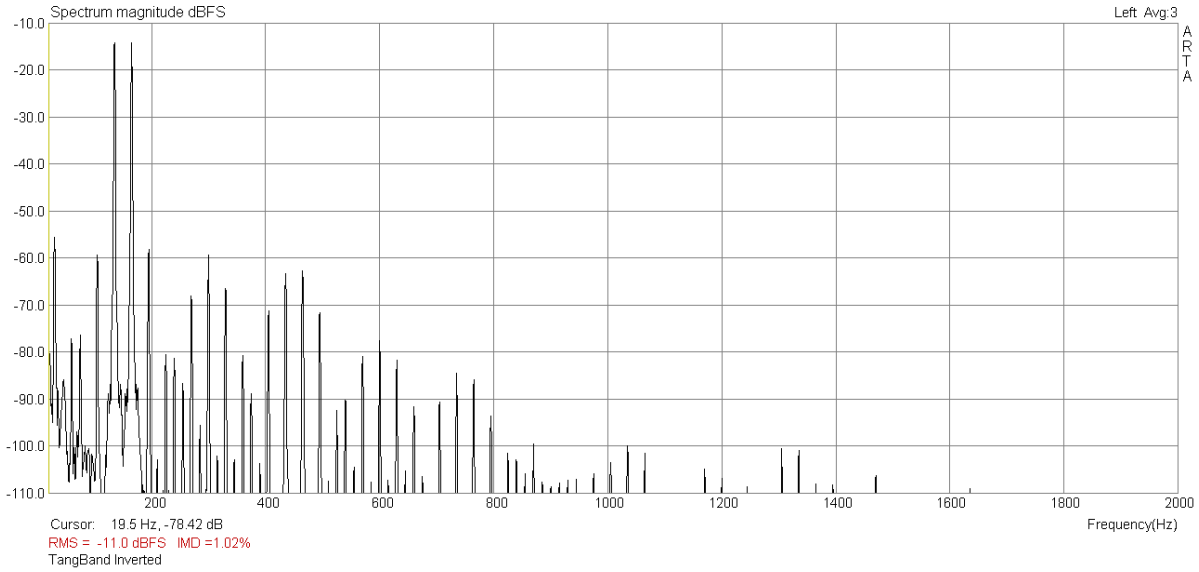


Tang Band "Illuminator copy" A bit faster than Dayton 7"

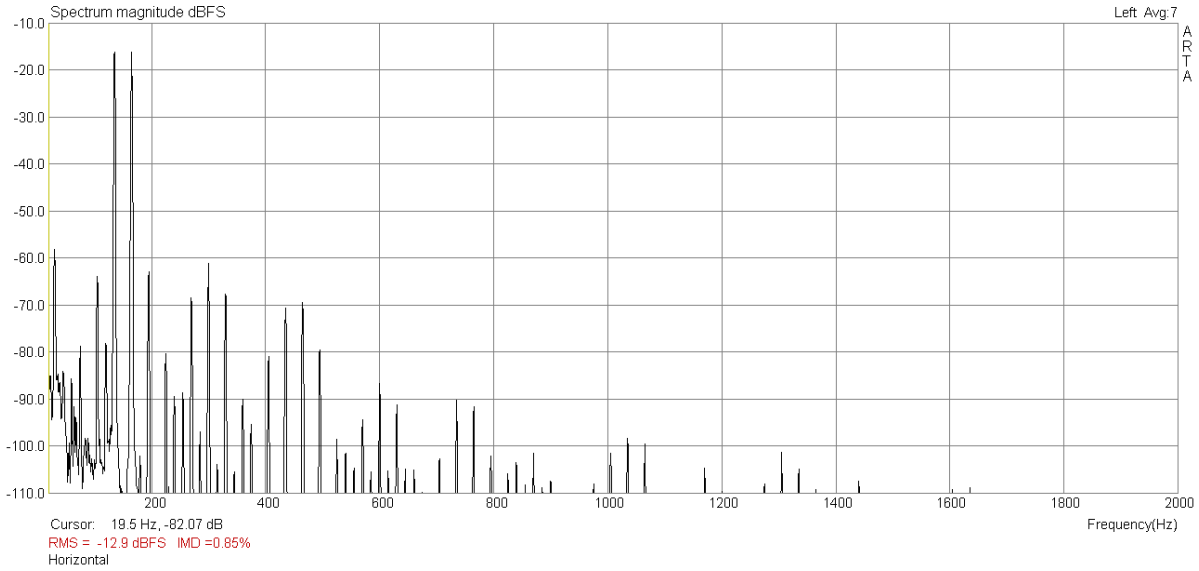
Non-linear Distortion, Two Tone Testing



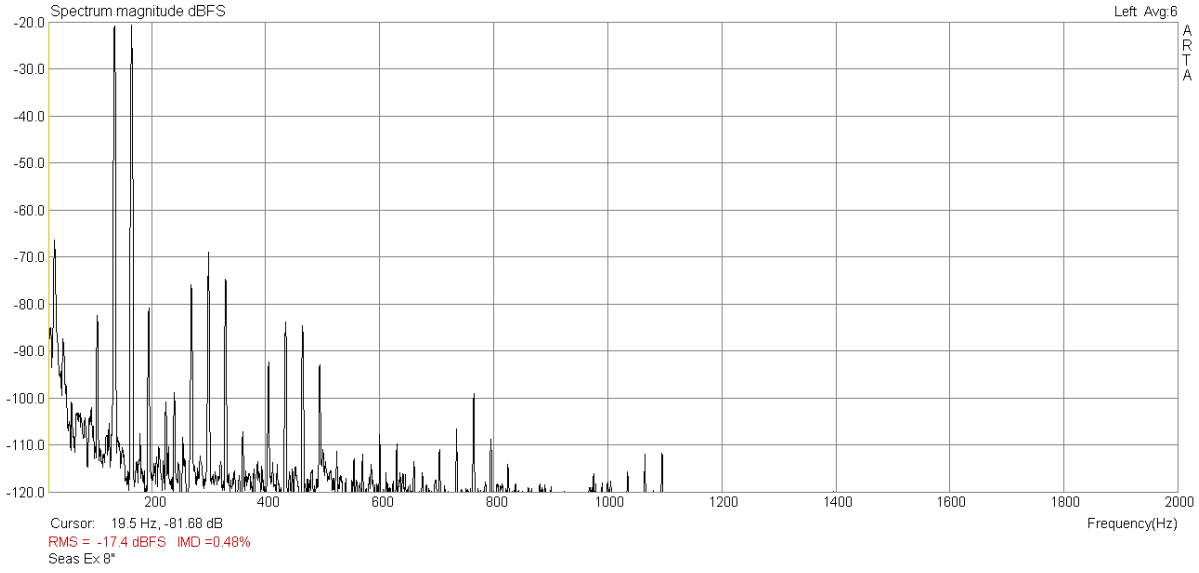
Tang Band -45 dB, Facing Ceiling



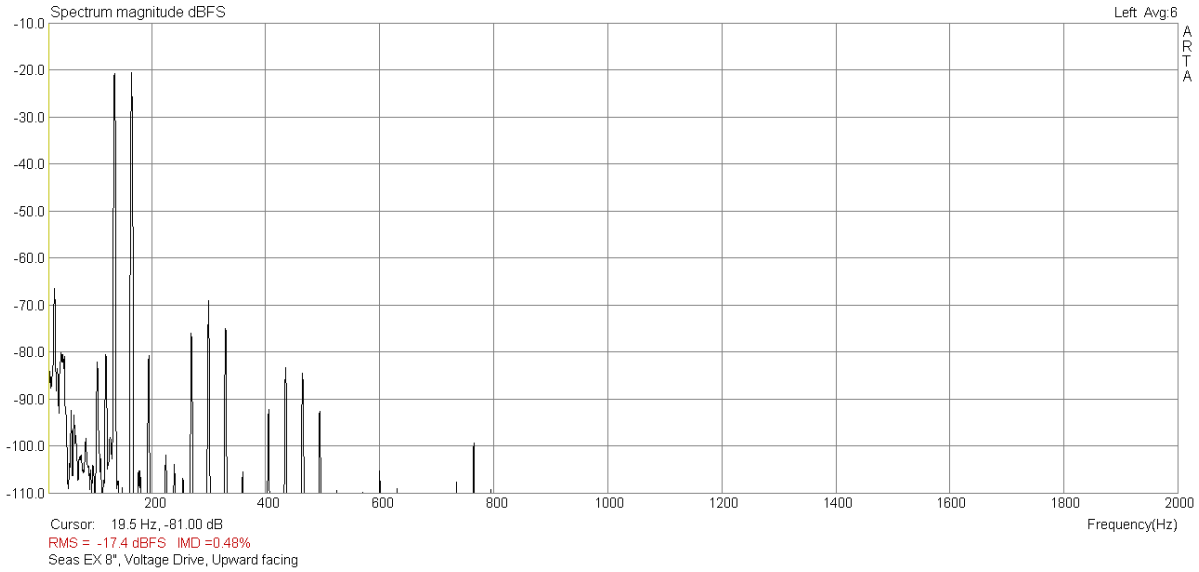
Tang Band Facing Floor



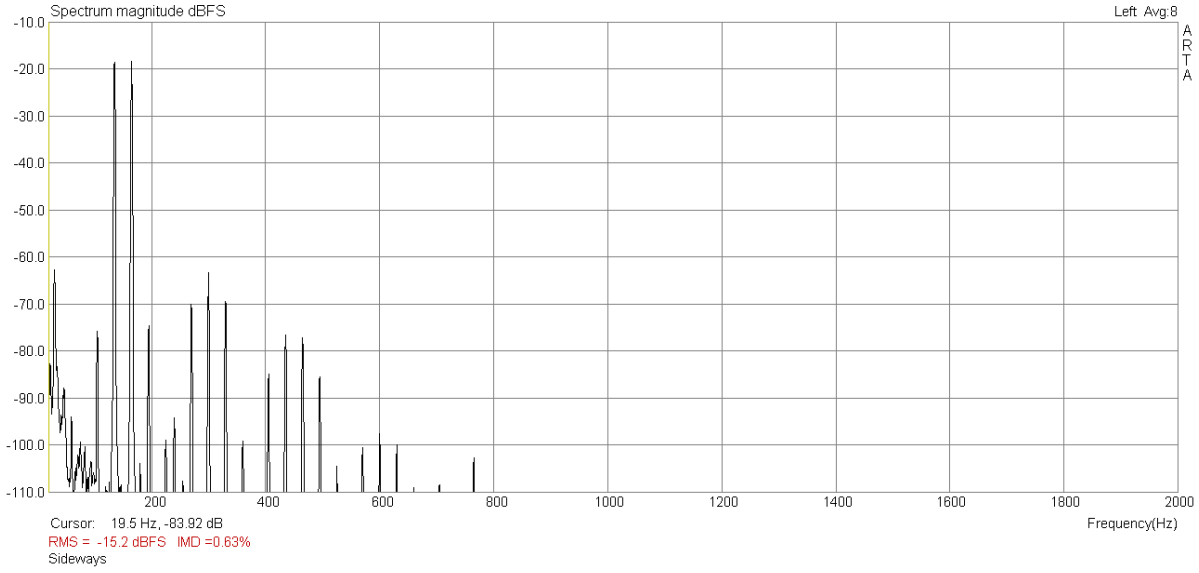
Tang Ban Horizontal.

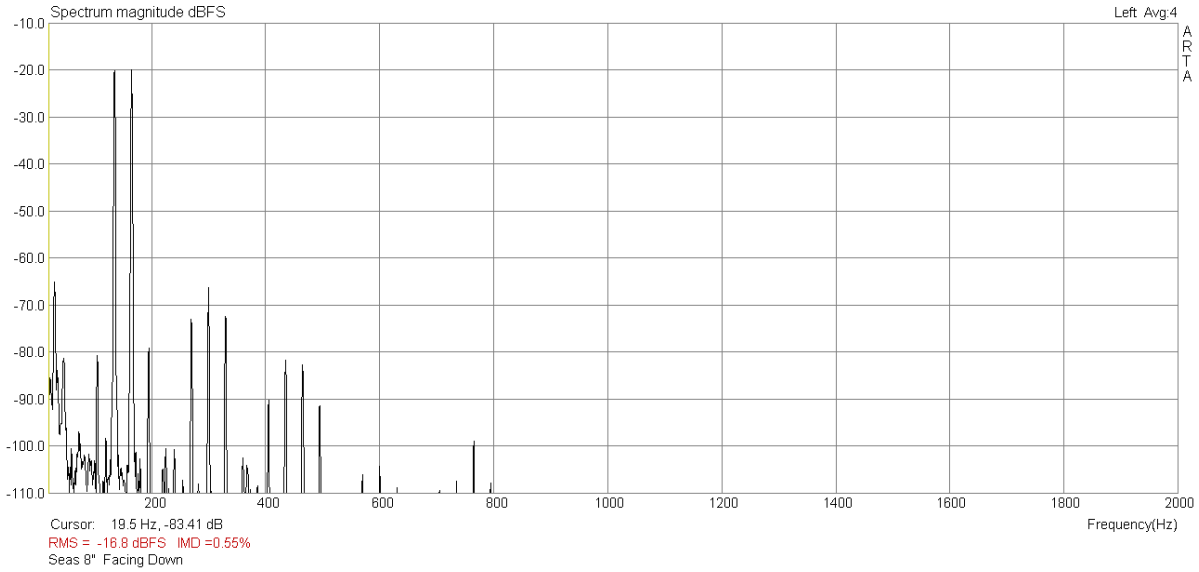


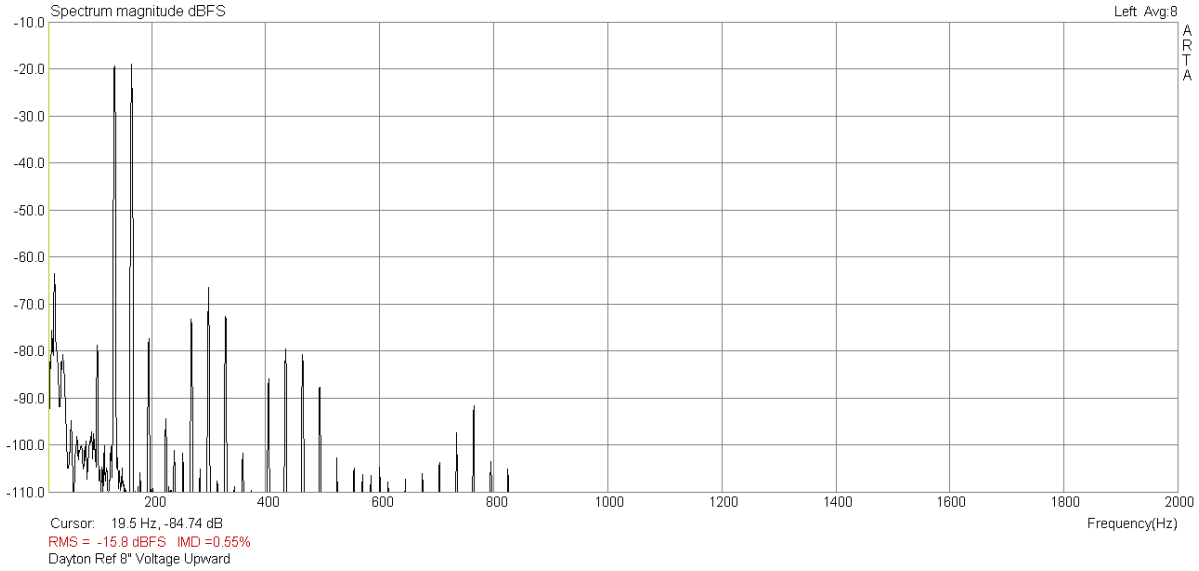
Seas Ex 8” Upward, -48 dB -60 adjacent - 45 lower



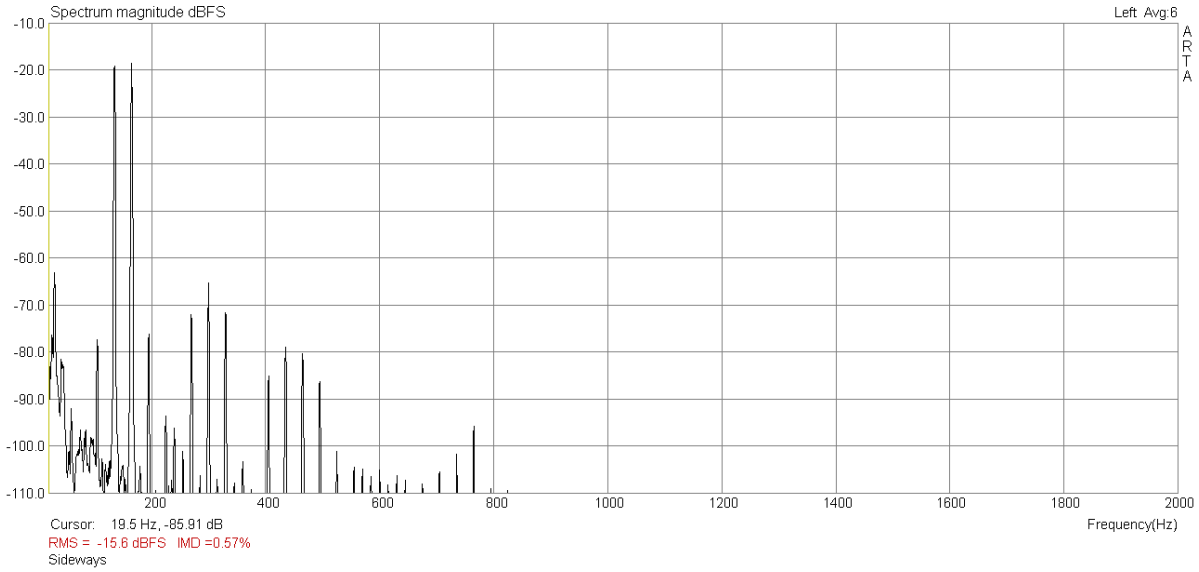
Seas Ex 8” Upward, expanded scale. -48 upper harmonics, -60 adjacent, -45 lower.



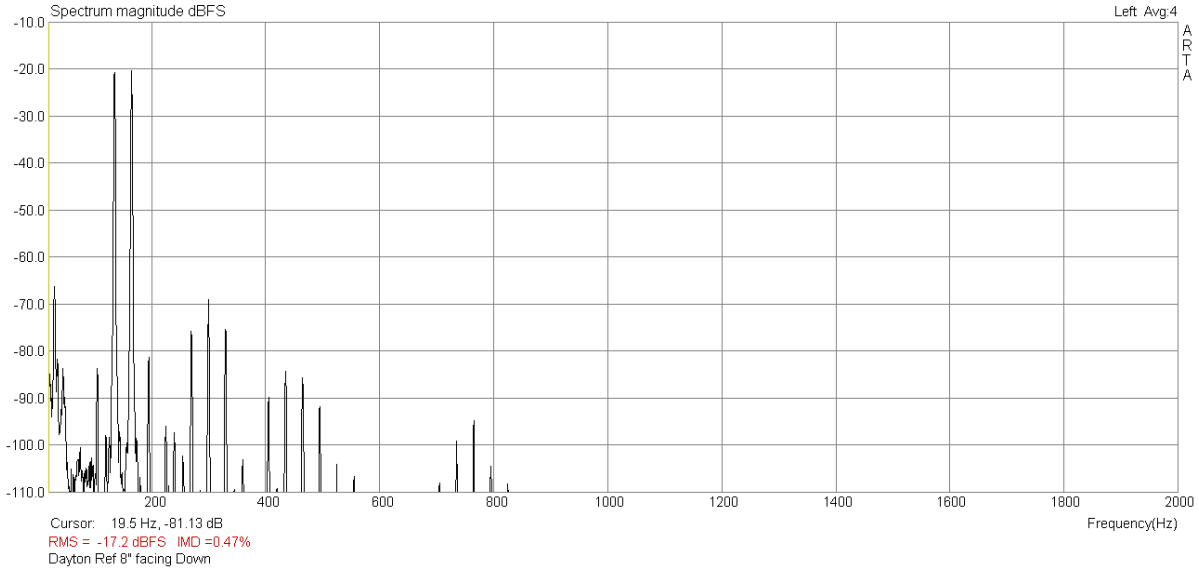




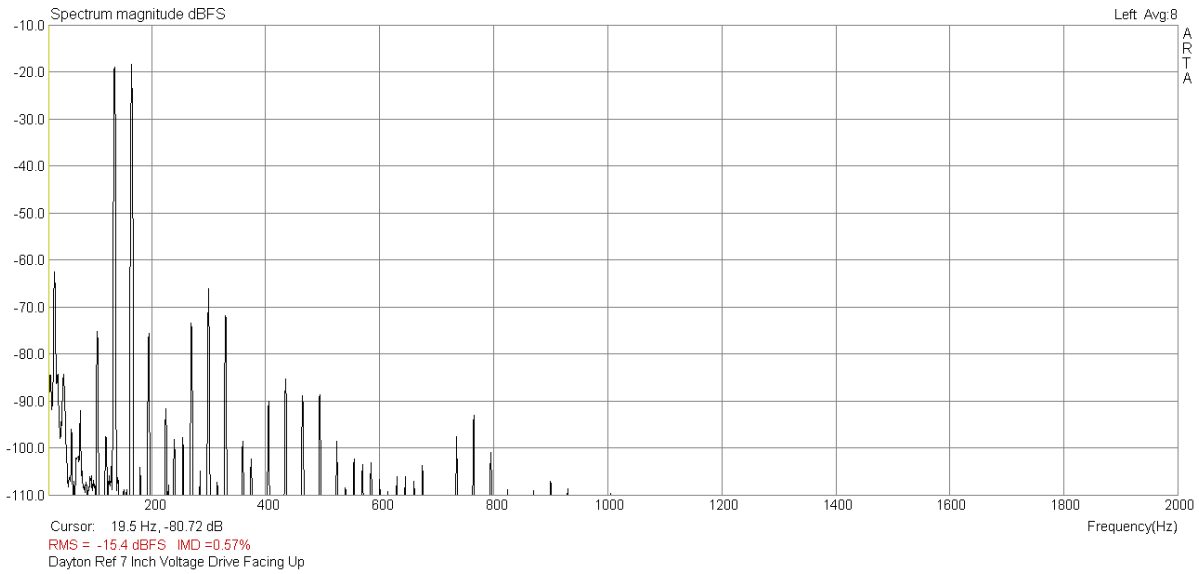
Dayton Upward Fundamental tones -19dB. -48 upper, -58 adjacent, -45 lower.



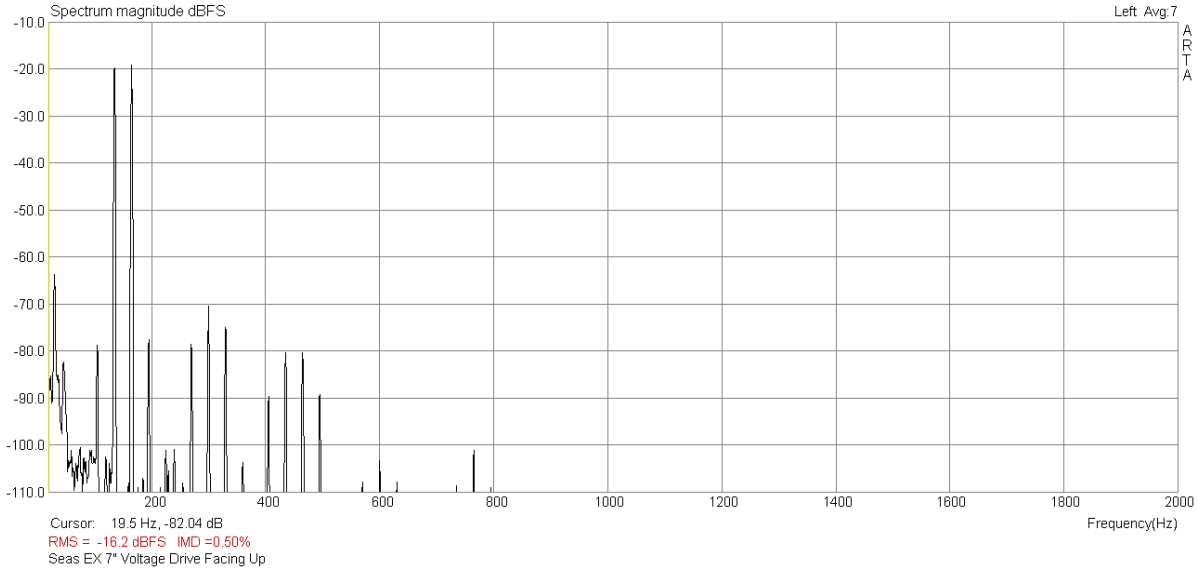
Dayton 8”



Dayton 8” Down



Dayton Ref 7”, -48 dB upper -58 adjacent, -43 lower



Seas EX 7” -50 dB upper (300 Hz) -58 adjacent (180Hz), -43 lower harmonic (30 Hz?)

Conclusion:

If you want the best, spend $275 and get the Seas. If you have room, use two Dayton drivers, and save $200. Scan Speak has great transient response, but seems to have some non-linearity.