

The ATC SM75-150S Midrange Driver

Review by Jeff Bagby



Introduction

The ATC SM75-150S midrange driver is a 3" fabric dome midrange developed by loudspeaker company ATC primarily for use as a midrange transducer in their own professional studio monitors, but it is also used by couple of other high-end professional loudspeaker companies as well.

I recently had the opportunity to work with this driver in a studio monitor I was commissioned to design. Since this driver has near-legendary status as a midrange I think the question- "Is it as good as they say it is?" Is a valid question, and one I will give my opinion on at the end of this review.

I do not know at this time if the "S" version is available to DIY'ers or what the cost may be. So, I apologize that this information is not included in this report. However, even if this driver is not readily available I still feel a review would be of interest to many DIY'ers just due to the nature and reputation of this driver.

General Description

There are two versions of the SM75-150, the standard model and the SM75-150S. The "S" stands for "Super". The main difference between these two versions is the size of the ferrite magnet used in the motor, and the resulting efficiency. The standard version has a 7 kg motor (15.5 lbs) and the "S" version has a 9 kg motor (19.8 lbs). Incidentally, for a good comparison the SM75-150S that I have been working with

weighs almost exactly the same as the Dayton UMM-12 12" Ultimax subwoofer driver. When you consider that the ATC is a 3" dome midrange, that's very impressive. The first thing anyone will notice about this driver is its sheer physical size. The SM75-150S is equipped with a motor massive enough to give a lot of woofers "magnet-envy" and some builders a hernia.

Note that this driver is designed to be mounted from inside the baffle because the magnet diameter is actually larger than the mounting flange of the driver. Since this is the intended mounting, the driver is designed so that a simple 6" diameter hole (154mm) in $\frac{3}{4}$ " baffle material (actually closer to 1" really) will result in a nice flush mounting of the short horn / wave guide accompanying the dome. This gives the dome a very clean appearance when mounted in a cabinet. Pictures below show the driver from behind and from in front on the baffle.

The shallow horn manages two nice accomplishments: First, it controls the directivity of the driver in its upper frequency range, and second, it minimizes the effects of edge diffraction by recessing the dome below the plane of the baffle. This excellent diffraction control will be seen in the frequency response plots later by the lack of diffraction effects shown.

One word of caution – Since you have to mount from the back of the baffle it works best to have a removable front baffle. But once you have mounted it, it makes the baffle difficult to lug around and attach to the cabinet due to that big hunk of metal hanging on the back of it. Watch out for your fingers....

Here are a few more pieces of technical information: The SM75-150S is designed similar to a dome tweeter but on a much larger scale. The voice coil is 75mm. It uses a short 3.5mm coil in a long gap that yields 6 mm P-P linear travel. The suspension is designed with dual spiders to minimize rocking of the dome which has been a problem with other large dome midranges and tweeters, and a source for distortion. The motor appears to be fairly conventional in design, and although I did not disassemble it, I was unable to find any reference to shorting rings in its construction.

ATC lists the F_s as 320 Hz (I actually measured it lower than that, as you will see below). The Sensitivity of the "S" version is listed at 94 dB/W/M. It is listed as having a usable frequency range of 300 – 5 kHz, with recommended crossover points of 380 – 3.8 kHz.

The manufacturer's literature lists nominal power handling at 75 Watts, maximum input power at 150 Watts, and maximum program material at 300 Watts. However, I am sure actual power handling is crossover dependent.

As stated above the cut-out for the driver is 154mm. The overall magnet diameter is 190mm. And the four M6 mounting holes lie on a circle 172mm in diameter.

Views from the back of the baffle. Note the size of the magnet. The woofer is the Acoustic Elegance TD12H for comparison:



An example of the ATC SM75-150S mounted in an ATC monitor:



Electro-mechanical Parameters

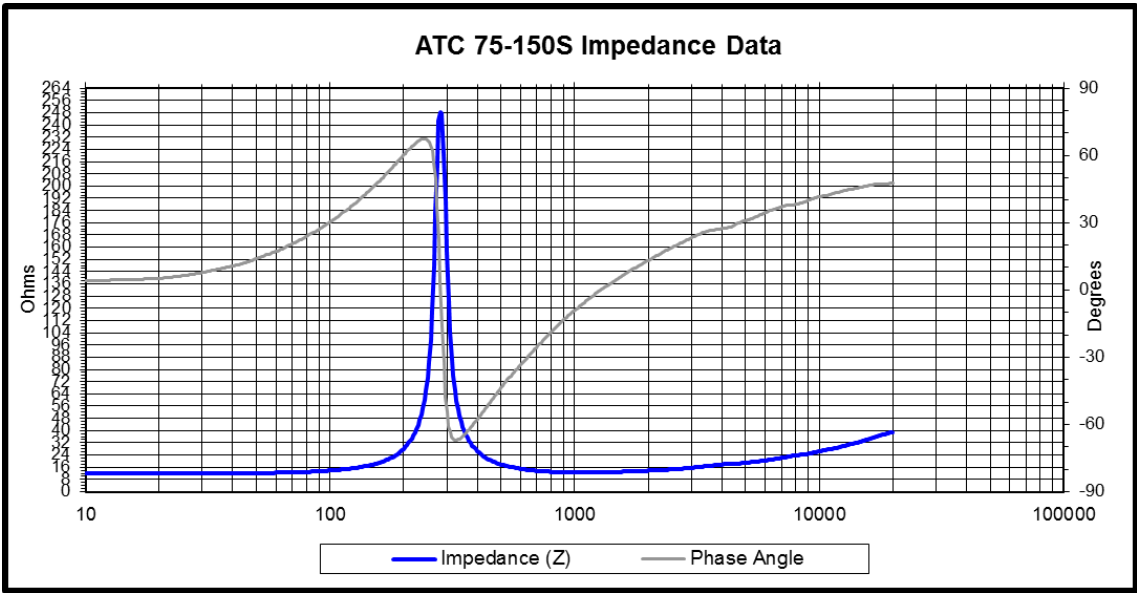
I measured the electro-mechanical parameters of the ATC SM75-150S driver. The sample submitted to me had a fairly high R_e of almost 11 Ohms, so it likely called a 16 ohm driver. (I believe a lower impedance 8 Ohm model is also available.)

The one parameter that stands out for this midrange is the very high Q_{ms} value of 13, which means there is very little mechanical damping of the driver's resonance (mechanical losses are very low). The high Q_{ms} results in an impedance peak at F_s of 248 Ohm. This would indicate that the driver is not suitable for a first order electrical filter, but use of a properly designed second order electrical filter, especially one with an L-Pad resistor network will easily compensate for this impedance peak. My sample had a measured F_s of 282 Hz and a Q_{ts} (actually a sealed Q_{tc}) of .577, for a nice well-damped second order roll-off.

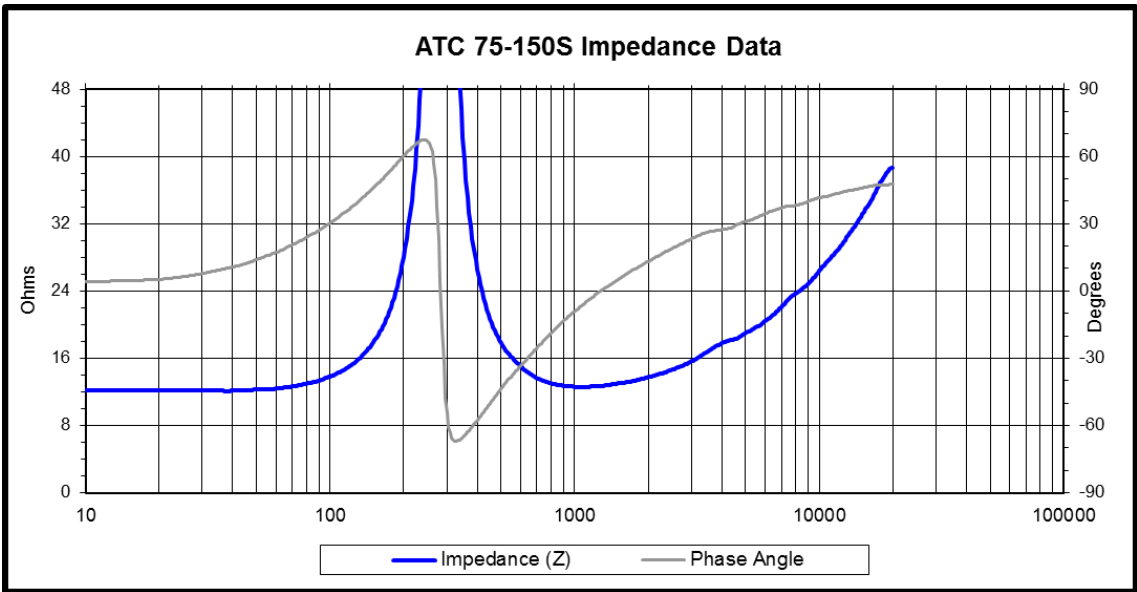
Here is a table of these parameters as measured:

| | | | |
|---------------|-------------|-------------------------|------------|
| Fs = | 282.583 Hz | Vas (L)= | 0.48 L |
| Re = | 10.898 ohm | Piston Diameter(Cm)= | 7.90 Cm |
| Qes = | 0.604 | Sd(cm^2)= | 49.02 Cm^2 |
| Qms = | 13.137 | SPL 1 W / Meter (dB)= | 94.47 dB |
| Qts= | 0.577 | SPL 2.83V / Meter (dB)= | 93.13 dB |
| Z @ Fs= | 248.118 ohm | Efficiency No= | 1.7253% |
| Z Min= | 12.109 ohm | Cms (mm/N)= | 0.14224 |
| Le @1kHz= | 1.008 mH | Mms (gm)= | 2.23 gm |
| Le @10kHz= | 0.383 mH | Rms (kg/s)= | 0.3014 |
| EBP (Fs/Qes)= | 468.20 | BL (kgm/sq)= | 8.46 |

Here is the full electrical impedance:

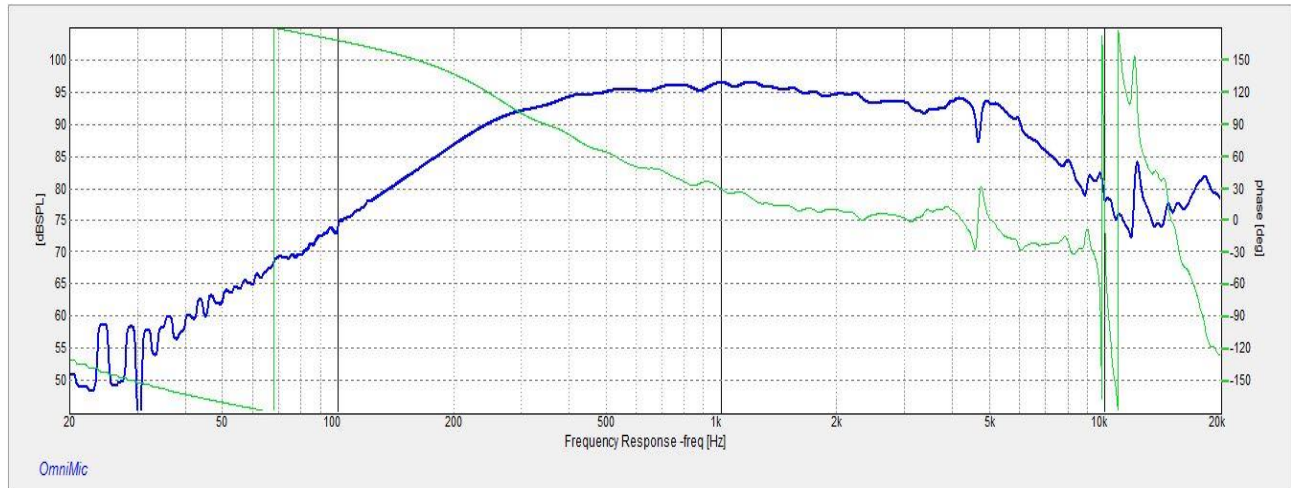


And here is the impedance curve on a smaller scale for better viewing:



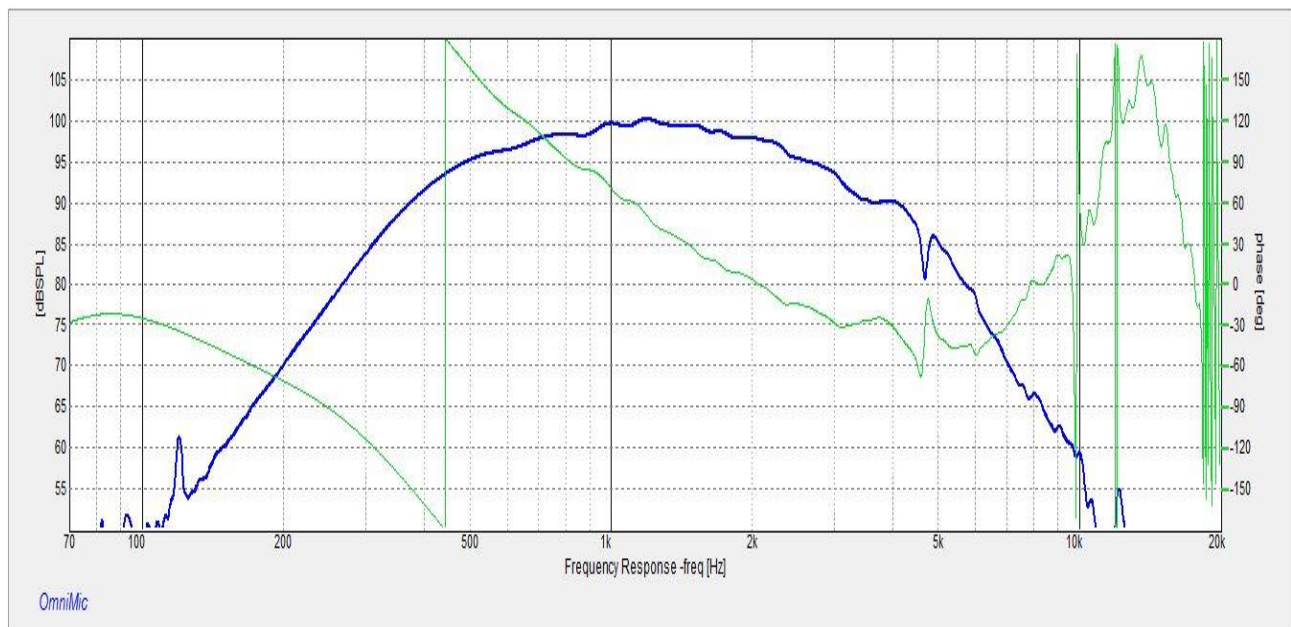
Frequency Response

Here I present my actual measured quasi-anechoic frequency response and measured phase of the ATC SM75-150S as mounted on the actual baffle used for the monitor I designed. This data was taken from about one foot away to reduce the effects of reflections. (The SPL level shown on these graphs is not normalized to any fixed distance and drive level). Smoothing is 1/48th octave.



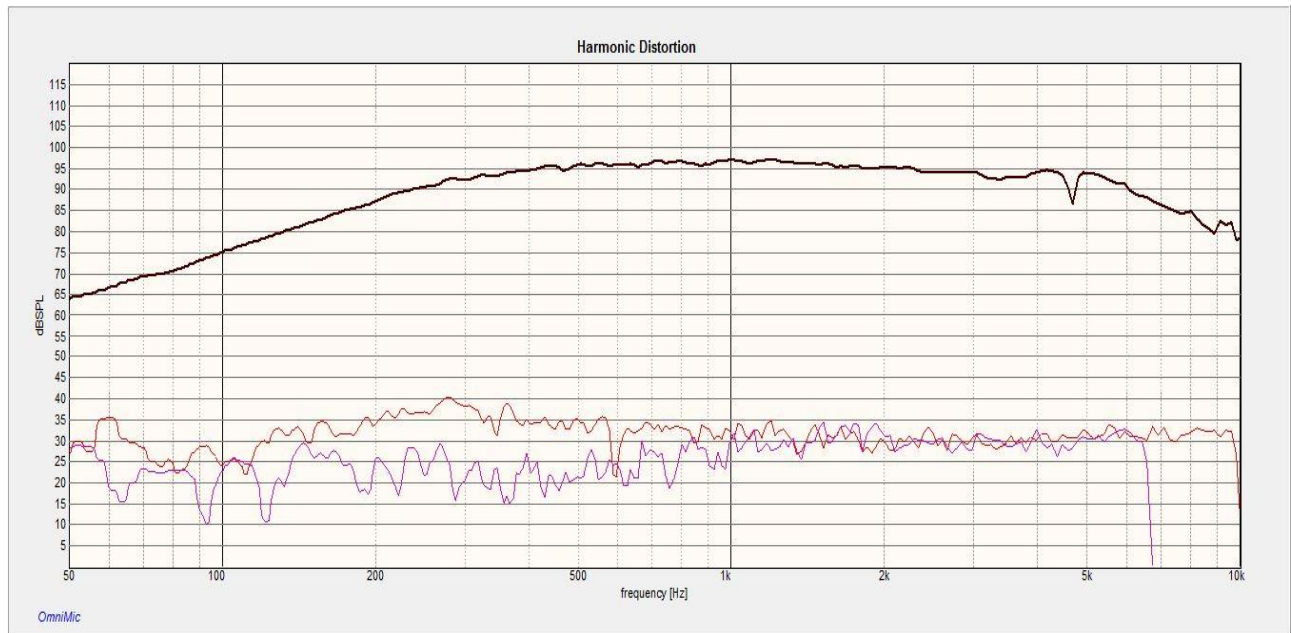
The frequency response for this driver is very smooth and the only abnormality, which shows up in all measurements is the narrow dip at 4.7 kHz. I do not know the source of this cancellation, it may be in the suspension of the dome. ATC recommends an upper crossover point of 3.8 kHz, so this dip should not be an issue for anyone. Otherwise, this driver is very well-behaved and very easy to work with.

Below is the response of the driver through my crossover which is comprised of a second order low pass and high pass along with a resistor network to adjust its level. The filter is designed to combine with the driver in such a way as to result in a 4th order Linkwitz-Riley response at both crossover points.



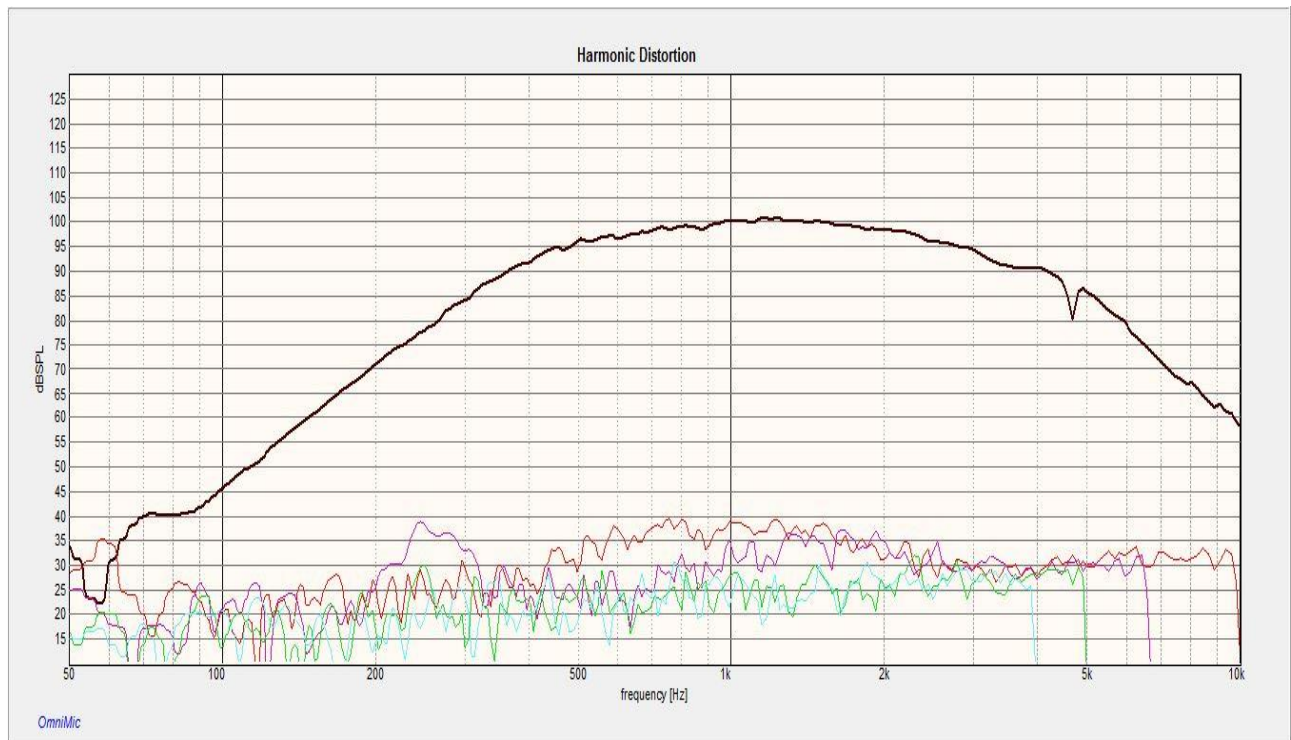
Nonlinear Distortion

Here is the measurement of nonlinear distortion for the driver. In the graph I only show the fundamental, the 2nd order, and the 3rd order harmonic distortions. The Red line is 2nd order and the Pink line is 3rd order:



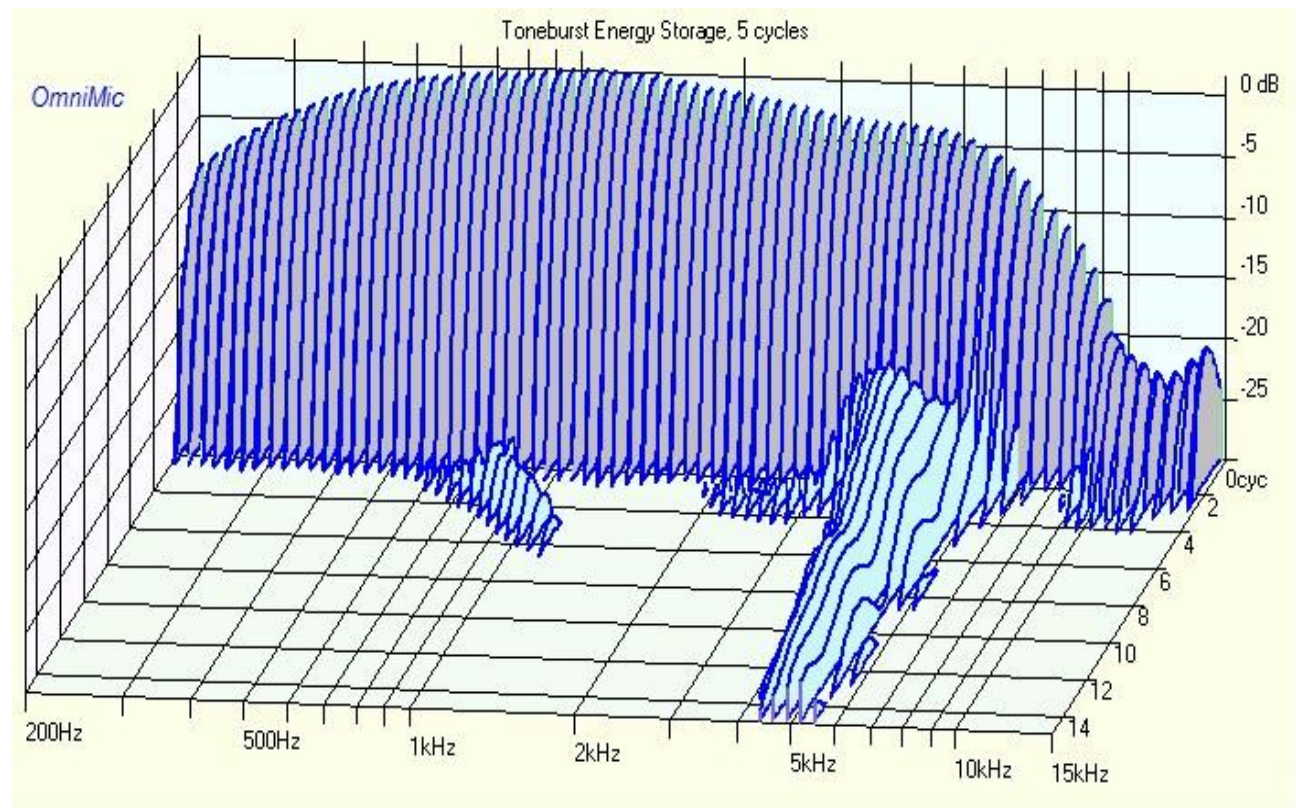
As you can see the nonlinear distortion is extremely low, with 3rd order in the neighborhood of -70dB at my low crossover point. These levels are very close to the noise floor in my room and I would consider this to be in the state-of-the-art range for midrange distortion.

The following chart shows distortion with the crossover network in place:



Energy Storage

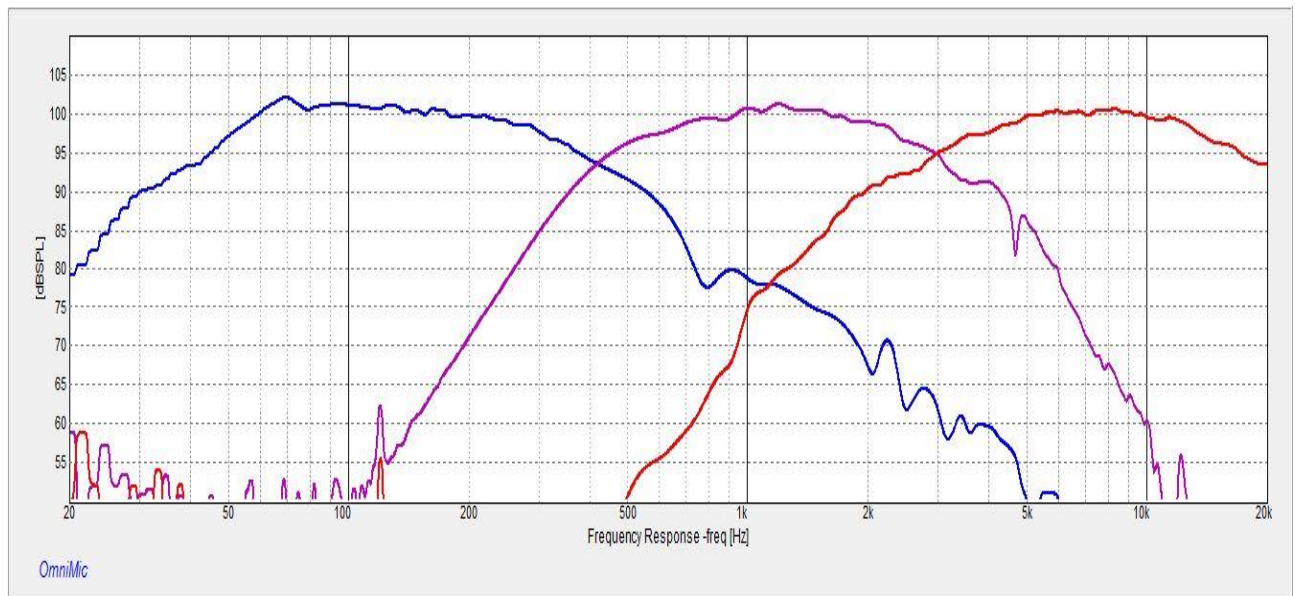
Below is the energy storage graph for the SM75-150S. The toneburst energy storage graph is actually more useful than the popular waterfall or cumulative spectral decay graph because it allows for you to easily differentiate between actual energy storage and reflections. Waterfall plots can make less audible issues stand out and highly audible ones barely visible:



In this type of graph “hash” or ridges that run diagonally crossing frequency lines are reflections. However, “hash” that runs parallel along frequency lines are due to energy storage and resonances. In this graph the energy that crosses 1 kHz is due to a reflection. Whereas, the ridge around 5 kHz is real and is associated with the narrow band notch in the frequency response we see at 4.7 kHz. However, apart from this, in the driver’s normal operating range this is a very clean driver with no other energy storage issues to contend with.

System Response

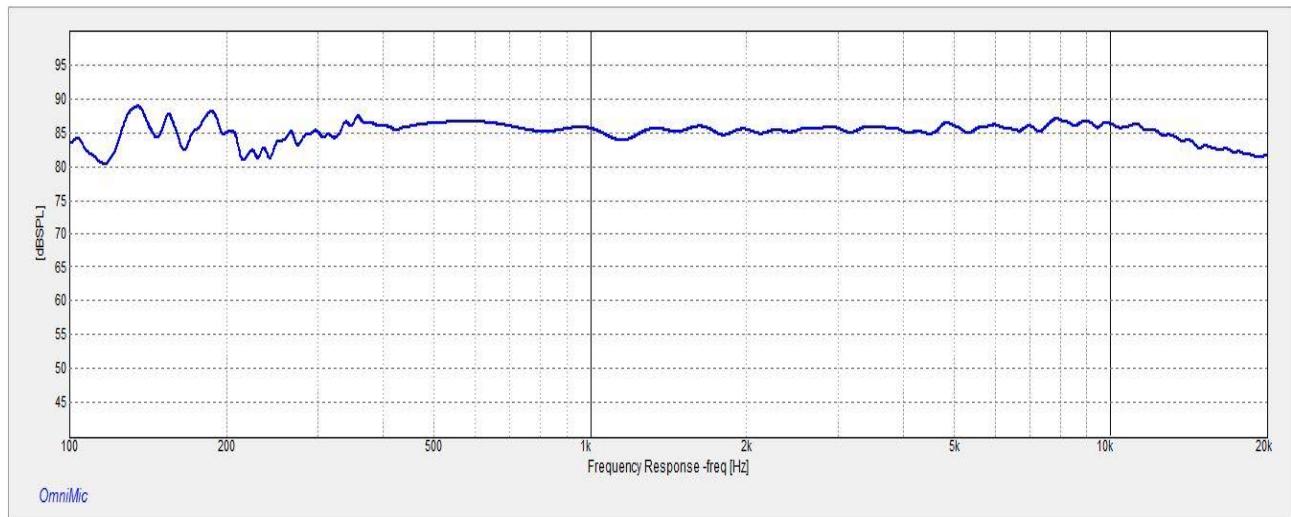
The design I am working on includes an Acoustic Elegance TD12H woofer and a RAAL 70-20XR ribbon tweeter. ATC recommends crossover points of 380 and 3.8 kHz for the SM75-150S and these are the crossover points they use in their systems. My results came out very similar, although my crossover is rather different than theirs. Working to optimize the summed response and phase alignment I arrived at a crossover of approximately 400 Hz between the TD12H and the SM75-150S, and in the following graph I show an acoustic crossover of 3 kHz between the SM75-150S and the RAAL Ribbon. These are the actual measured acoustic responses of each driver with its crossover with 1/48th octave smoothing:



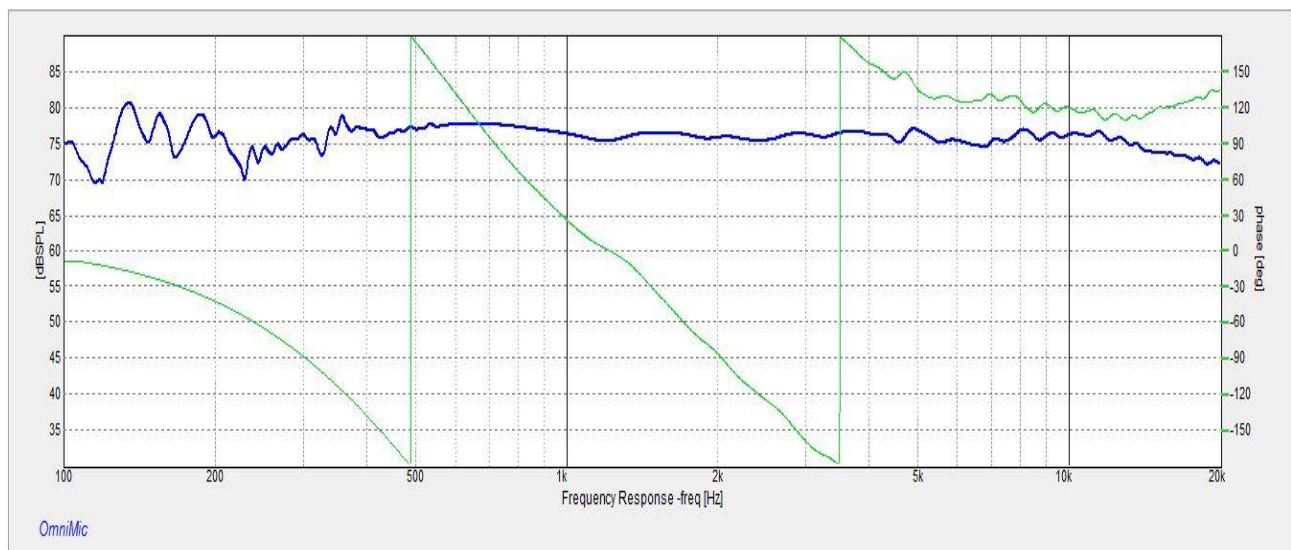
Here are the three drivers on the baffle as measured:



Summed response - at one meter in my listening room with 1/48th octave smoothing. I didn't plot below 100Hz because the room has taken over the response in this range.



System Phase Response – the following graph shows how the measured phase “wraps” at 180 degrees at or very near the crossover points. This, when combined with the flat summation in the same range, is a good indicator that the system's acoustic crossover response matches that of a 4th order Linkwitz Riley acoustic crossover with drivers in phase with each other at the crossover point.



Interpreting the Measurement Data

Before I move into my listening experience and give my thoughts on how this driver sounds I wanted to make a few comments about other measurements. I have noticed that there were some measurements of the SM75-150S posted on one forum several years ago that did not look very clean and the comments were highly critical of the driver. My measurements, on the other hand, did not match up to these at all.

Then I found that Zaph Audio (John Krutke's website) had also made measurements of the SM75-150S, but his measurements were essentially identical to mine and many of my comments will mirror Krutke's on this driver as well.

As shown in the frequency response data this driver has a very smooth and well controlled natural bandpass response. There are no serious issues in its response that would be a cause for concern. It is very easy to cross over and requires almost no response shaping to do an amazing job.

In the arena of distortion, this is where the driver really shines. Even though this is an older driver that has been around for years, and there is nothing particularly advanced in its motor design, its distortion is exceptionally low – pretty much at state of the art levels in the midrange band.

Final Thoughts on Listening

So what are my subjective thoughts on its sound? When commenting on midrange performance in a speaker like this you need to understand that the woofer's response will be a contributor to what we perceive. The AE TD12H is a very competent driver in the lower midrange and blends with the ATC exceptionally well. In the upper midrange and lower treble which is where the SM75-150S is actually doing the work the sound is clean, open, detailed, and almost three-dimensional. There is nothing about it that stands out or calls attention to the midrange, but when listening I can pick out nuances of detail that I have missed on other speakers. The midrange is so clean, undistorted, and natural sounding that vocals are almost life-like. Dynamics are clean and powerful. And the midrange hands off to the ribbon tweeter with exceptional finesse in a very natural way. I know of no cone midrange with distortion this low and dynamics on this level, or one with response this smooth.

So, is the driver as good as they say it is?

Well, if you take a midrange driver that has a very smooth linear bandpass response, extremely low non-linear distortion, no energy storage issues, relatively high sensitivity and dynamic range, and nice controlled directivity and power response, what more could you really ask for?

Yes, in my opinion, on an absolute basis, this is an exceptional driver and one of the finest midrange transducers I have ever listened to or measured. The SM75-150S may be difficult to find and may be very expensive when you do find it, so it may not be a good value in everyone's mind, but if you are looking for cost-no-object midrange performance then you may want to begin looking for a pair of ATC SM75-150S midrange drivers.

Jeff Bagby
4/30/2014

Some more beautiful examples of the SM75-150S in a few of ATC Professional Monitors



