

TABAQ[®]

Tang Band Quarter Wave

A Transmission Line designed and optimised for the Tang Band 3" full range drivers.



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Software by Martin J. King

www.quarter-wave.com

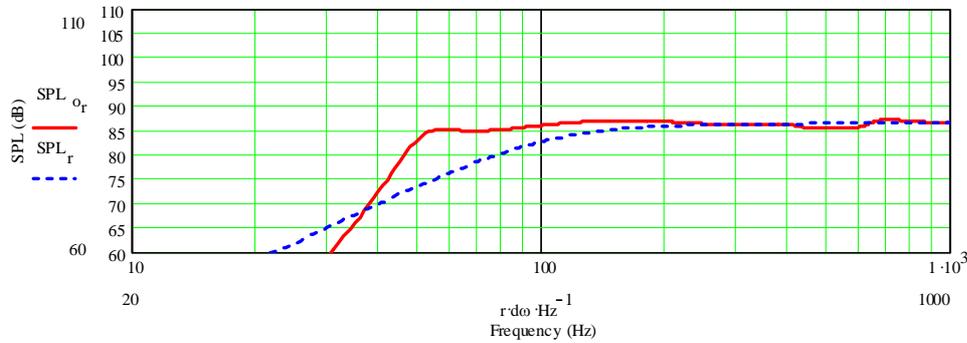
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Inspired from debates on Internet about quarter wave designs with Tang Band 3" full range drivers, I decided to design my own quarter wave loudspeakers with these nice drivers from Tang Band. They sure earned a better construction than those found on Internet.

The last couple of years, I have worked with the very useful simulation models from Martin J. King and designed and build a very successful TL sub (The HideAway) published in AudioXpress July 2006. Working with Martin's models is very educational, and feel confident about quarter wave (transmission line) design.

Please refer to my article "Martin J. King for Dummies" on <http://www.t-linespeakers.org/>

The TABAQ Sound Pressure Level (SPL) is impressive for such a small driver, with a very smooth and broad frequency response. The blue line is the Infinite Baffle (IB) response and the red line is the summed output from the driver and the opening:



The sound is open with no unwanted resonances, and the bass is relatively deep and clean. First time you listen this speaker, you will be impressed by the quality of the sound and performance of the bass. Bearing in mind the size of the driver and the lack of financial problems building it.

The problems with baffle step are corrected by a simple filter, which is balancing the SPL in the listening room.

The Tang Band Drivers

All the 3" drivers can be used in this construction. My first test was with W3-926S, which was replaced by W3-315SC.

The Tang Band drivers have a relatively high F_s and very high Q_t s. The high Q_t s means the roll off is more gentle than a low Q_t s driver, and it is therefore possible to design a quarter wave with useful output well below F_s . However, high Q_t s drivers can be difficult to control.

The whole idea with a quarter wave – or transmission line – is to extend the bass by the contribution from the opening. At the cabinet resonance, the output is adding to the driver output. However, there are some higher harmonics which are definitely unwanted as they are out of phase with the driver, causing uneven frequency response. These problems can be solved by different design parameters, which I have succeeded with the TABAQ design.

TABAQ Design thoughts

The tuning frequency of the cabinet alone should be set lower than the driver F_s . As the drivers all have a very high Q_t s, I started to see how low I could go, getting maximum bass performance out of the drivers without losing the overall frequency balance.

After hours of simulation with Martin's MathCad models I found the best compromise was 55 Hz, which is low for drivers with F_s of 100 or 110 Hz. But it works, because of the high Q_t s.

The tuning frequency is set by length of the pipe and the geometry. A tapered pipe is shorter than a straight pipe for the same tuning frequency. In TABAQ I have used the mass loading principle, where the last part of the pipe has a smaller area than the rest of the pipe. The air in this part of the pipe adds resistance to the driver (more mass – mass loading). Compared to a straight pipe, the length is shorter.

The problems with unwanted higher harmonics are solved by driver placement, stuffing and the geometry like the mass loading used in TABAQ.

The driver is one third down the pipe, a common and well known trick to attenuate the upper harmonics. However this is not enough, and damping of the cabinet is needed (as it is in every quarter wave).

The damping is high (1 lb per ft³) and is placed in the upper part of the pipe. The last third of the pipe is not stuffed. The stuffing will attenuate the output from the opening, so I solved this by increasing the volume of the cabinet.

Increasing the volume also increases the output from the opening, so this compensates for the high density stuffing. The area of the pipe is 4 times the area of the driver (S_d).

The TABAQ design is as follows:



Don't get confused, this is not a bass reflex enclosure. It is a quarter wave. Rob Brines has a good explanation on his site:

http://geocities.com/rbrines1/Pages/QWR_not_BR.html

TABAQ in your listening room

Until now, I have been in the world of theory. Real life is different, and I have to deal with the baffle step problem, which is general for all full range designs.

You already know that a speaker placed in the middle of the room has a weaker bass than placed against the wall. The same thing is happening for the middle and high tones, which get extra help from the front of the cabinet. The result is a speaker that sounds bright with a focused middle tone. This “analytical” sound will be irritating after some time.

Therefore a baffle step compensation circuit is needed to attenuate the higher frequencies. Does it sound complicated? It is not. It is just a resistor and an inductor in parallel and placed in the + cable to the driver.

Martin King's latest MathCad models now include calculations needed for baffle step compensation. The values for the TABAQ are a resistor of 3.9 Ohm and an inductor of 1.0 mH. This is 4 db attenuation at 700 Hz. If your cabinet is more than 1 meter from the wall – or your personal choice would prefer more attenuation of the higher frequencies, 6 db attenuation is accomplished by using 6.8 ohm and 1.5 mH instead of.

I have tested TABAQ with different kinds of music and placed the cabinet in the middle of the room, at the wall and in the corner. The speaker is easy to place in the listening room, and the bass is well controlled.

I have even listened to organ music. Of course, it is not like being in the church, but I was impressed by the lack of distortion.

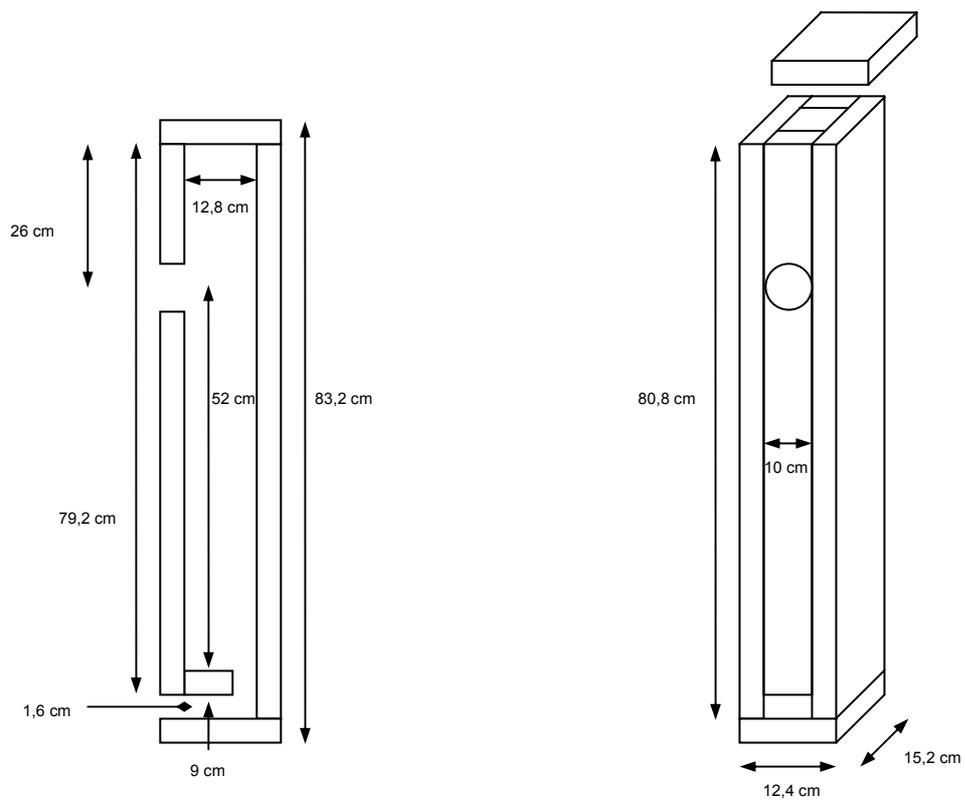
To build TABAQ

You need 12 mm MDF pieces in the following sizes:

12.4 cm x 15.2 cm	2 pcs	Top and Bottom
79.2 cm x 10.0 cm	1 pcs	Front
80.8 cm x 10.0 cm	1 pcs	Back
9.0 cm x 10.0 cm	1 pcs	Opening
80.8 cm x 15.2 cm	2 pcs	Side

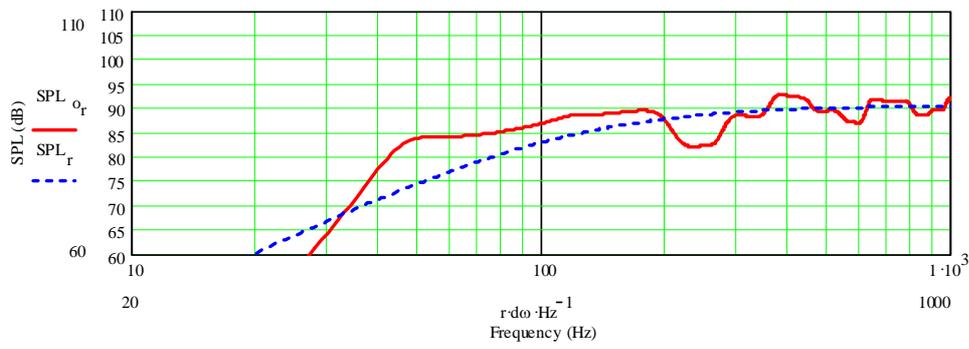
Stuffing: 100 gram (0.23 lb) in the upper $\frac{2}{3}$ of the cabinet

Filter: 1 resistor 3.9 Ω and 1 inductor 1.0 mH. These are in parallel and in in seria with the + driver terminal.

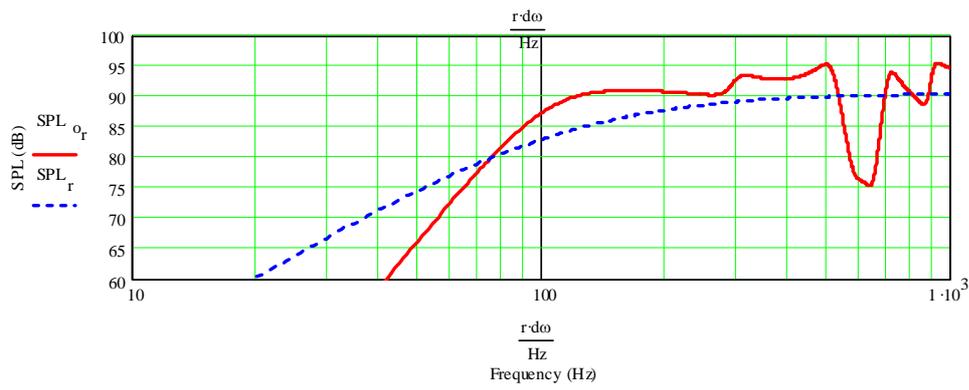


TABAQ compared to other designs

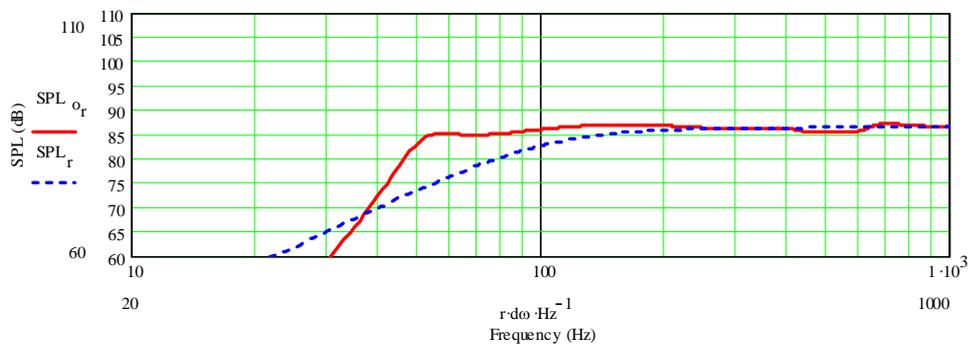
Cyburgs Needle



Long Tail



TABAQ



Building TABAQ



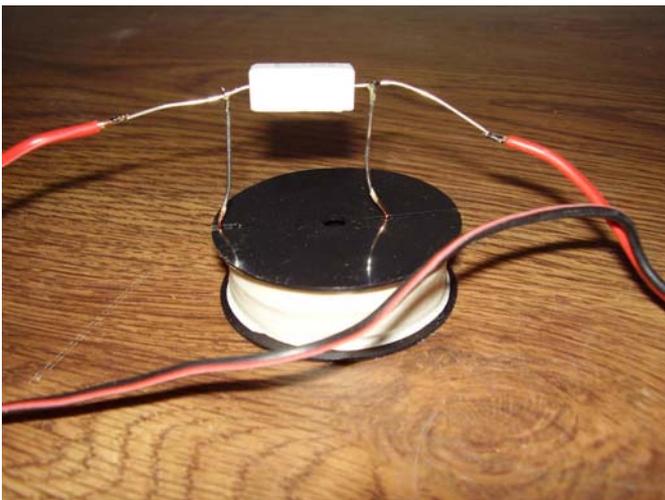
The stuffing is in the upper two third of the pipe and has a relatively high density.



Even the opening is small; half the area of the driver S_d , there is no air turbulence (chuffing).



Please note, the beer is non-alcoholic.



The baffle step correction circuit is attenuating the middle- and high tones with 4 db. The sound is then balanced in your listening room.

The resistor is in parallel with the inductor and then placed in the + cable to the driver.

Build it – enjoy it! Pleasant building from Bjørn Johannesen, Denmark. May 28th 2006