The SpringTrap™

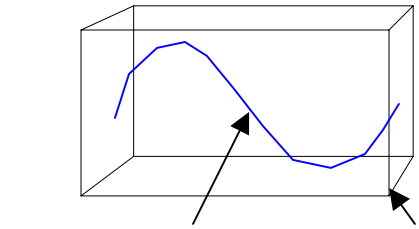
A Low-Frequency Bass Trap with Pistonic/Helmholtz Action

Introduction

This white paper presents the basic design and function of the StudioPanel® SpringTrap™, the reference standard in bass absorbers. Warning: this is a technical paper, and some material may not be suited for all audiences.

The Issues

Rooms invariably have standing wave resonances that muddy up the bass in the region between 30Hz and 100Hz. The standing wave pressures are the highest at the corners of the room where they add up on each other. Bass absorbers, often called "bass traps," are usually placed around the room to soak up the bass sounds and clean up the resonances. The problem is that many of these so-called bass traps only act on the mid bass frequencies (100Hz to 200Hz), or are very inefficient at low bass frequencies. Foam or fiberglass-based traps aren't really traps, but instead are deep "frictional absorbers" that act upon sound wave particles when they have movement. No movement equals no friction! Put a bunch of frictional material in a corner of a room where the pressure is the highest, and you may find little to no effect. That's simply because where there is pressure, there is no particle movement. That's a fundamental law of physics known as Bernoulli's principle (Yeah, that's why you should have listened in high school physics, rather than dream about that cool guitar amp you wanted to buy). Just think of being packed into an elevator with a whole bunch of suits at the end of a day. The pressure is high, because there's just no room to move!



The Solution

You need a pressure-sensitive absorber effective in the low bass to get rid of standing wave resonances. Now these have been around for a while. Helmholtz absorbers that look like oversized wine vats can work really well but are relatively inefficient. That means that you need lots of them around your room. Diaphragm absorbers that look like large flat square drums can also work OK, but they tend to be unreliable because they drift with temperature and humidity. Out of frustration with all the issues mentioned here, we decided to design a better mousetrap. Three years of research, countless prototypes built, and tons of money later, we invented the SpringTrap™; a spring-loaded, triple cavity, ported, pistonic-Helmholtz bass absorber (Try saying that five times fast!)

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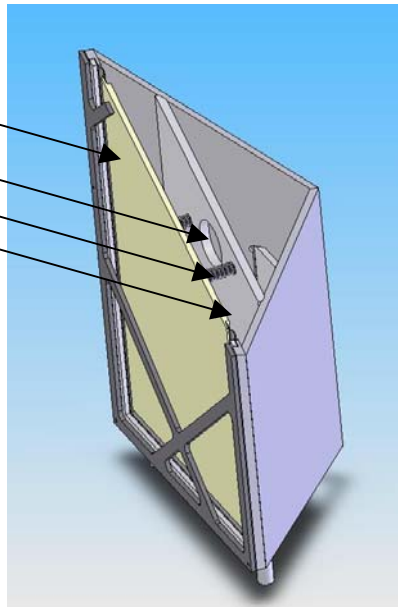
The SpringTrap is a wooden triangular box you place in the corner of a room. The front is a large grille cloth, like on a speaker. Behind the grille cloth is a large rigid diaphragm panel, suspended on six precision springs, and sealed with a rubber gasket, just like on a woofer. Inside the box are three cavities, each ported and tuned to the right frequencies to absorb sound energy over the band from 30Hz to 100Hz. The absorption process is, in fact, a combination of conversion of acoustic energy into heat through fluid friction of air particles against the internal ports, along with cavity resonator effects.

A SpringTrap. Notice the gasket-sealed diaphragm behind the removable grille. The diaphragm is made of nine-ply cabinet-grade poplar wood.
Dimensions: 18”x18”x46”

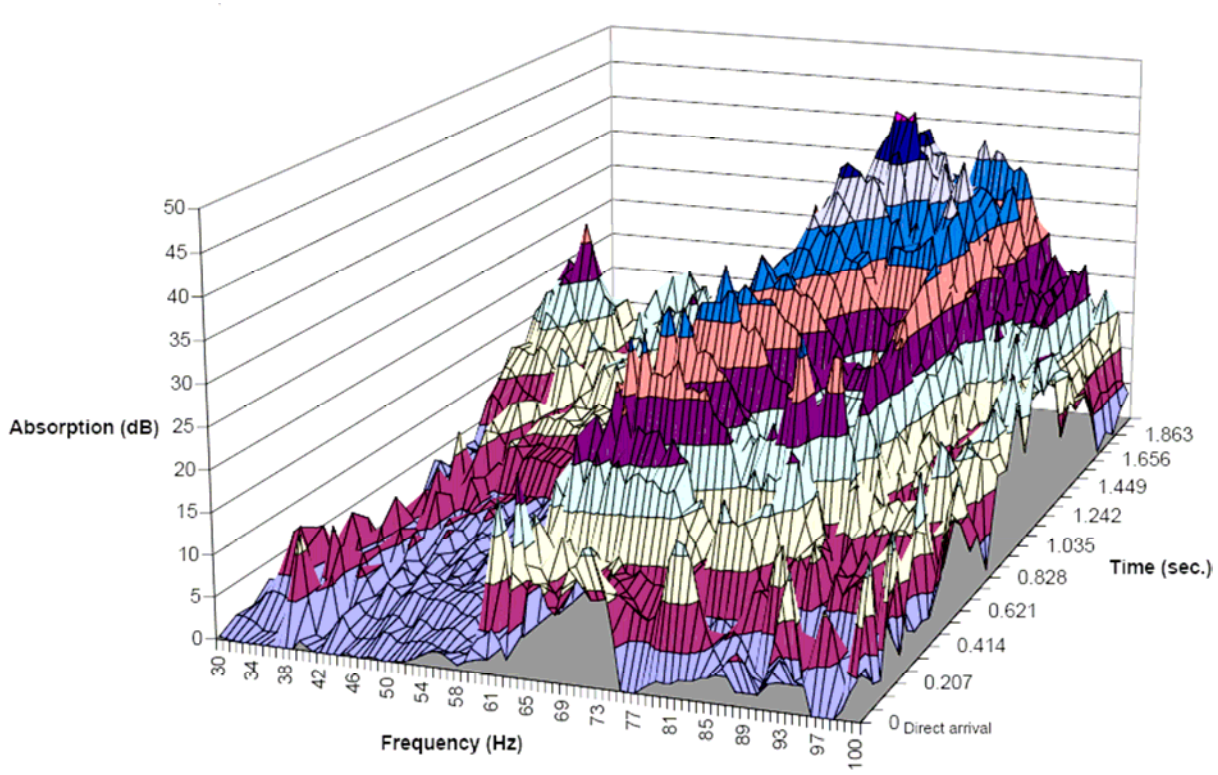
A cut-away view of the SpringTrap reveals the precision spring-loaded piston, the intermediate cavities, and the tuned ports. It’s all very complex and made of many CNC-routed parts; don’t try this at home!



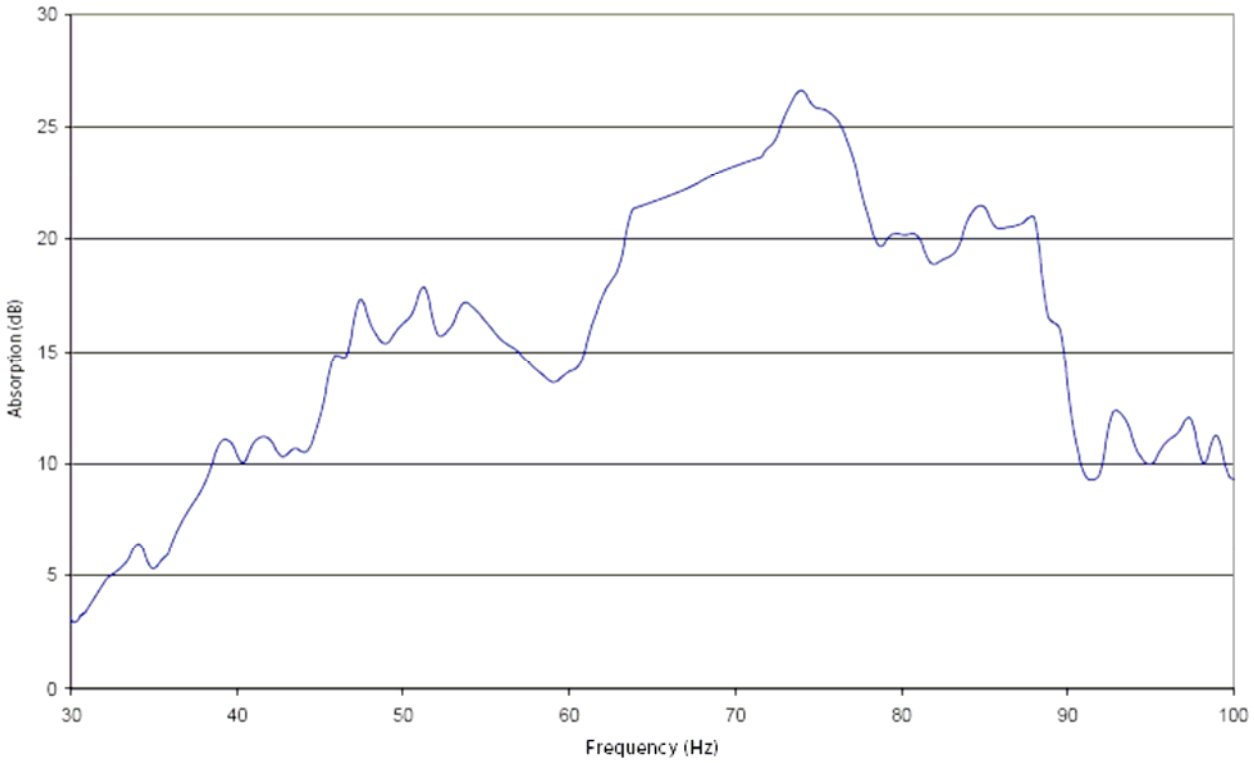
SpringTrap bottom revealing the primary port

So how well does all this work? Here's some data and an anecdote:

First, the propeller-head science: Below are two charts showing the absorption effect of the box. These were measured by comparing the bass response in a bare room, to the same room equipped with a SpringTrap. The top chart shows the difference over two seconds of time. Each line in the chart represents a slice of time. The taller the line, the more bass resonance was absorbed. As you can see, the effects are very visible over time, which is effectively the way a resonance works.



The next chart shows the results of averaging all the above time slices into one curve. This curve represents the absorption effectiveness over two seconds of time. As you can see, the SpringTrap eliminated up to 25dB of the resonance issues. Now, that's effective!



As for anecdotes, we sent a unit to a journalist for review. At first he thought that SpringTrap had completely eliminated all of his bass. Upon removal of the SpringTrap and further listening, he realized that he had been listening to bloated bass all this time. The SpringTrap went back in, and the journalist bought the review sample. What an endorsement!

Conclusion

The StudioPanel SpringTrap is a super-efficient and novel bass absorber that fully qualifies as a "bass trap". Bass waves that go in get caught and converted into heat energy. Anything else sounds fishy!

To find out more about the science behind SpringTrap, pick up preprint number 5760 presented at the 114th AES Convention, March 23, Amsterdam, Holland. www.aes.org.