

## Feedback Controlled Electronic Bass Trap

Music sounds muddy or cloudy in a poorly treated listening/recording room. A primary reason for this is the tendency for rooms with small dimensions to have severe coloration in the bass or upper low-frequency region. Coloration is the result of standing waves in a room.

Unfortunately smaller rooms have dimensions that favor standing waves or resonance that are right in the fundamental range of voice and many musical instruments where our hearing is very sensitive and critical.

Considering the ineffectiveness of sound absorbing material at low frequencies, coloration problem has traditionally been addressed using large bass traps, e.g., Helmholtz resonators and other devices such as Tube Trap™ made by Acoustic Sciences Corporation (ASC). Figure 1 shows a typical arrangement of using Tube Traps in a room. These passive bass treatments, are large in size and like any other passive acoustic treatment difficult to retune.



Figure 1. ASC's Tube Trap™ installed in a listening room

**Electronic bass trap** is a *patent-pending*, feedback control scheme incorporated into an active subwoofer. This bass acoustic damping/absorption scheme is developed at DEICON, Inc. It abates the low-frequency coloration in listening rooms, home theaters, and recording/broadcasting studios. This product is tuned to the individual acoustics of customer's listening/recording environment. It can either be a stand-alone system used to add low-frequency absorption to the acoustics of a room, e.g. in a recording studio, or designed into the sound system's subwoofer, e.g. in a listening room. DEICON, Inc. has also developed an *innovative, internet-based approach to assist buyers tune the product to their particular listening/recording environments*.

In terms of required hardware, in addition to a powered subwoofer, the electronic bass trap needs only a low-cost microphone and an op-amp circuit or a micro-controller (which will house the control algorithm). The additional cost of incorporating the electronic bass trap into a subwoofer (for lowering the coloration due to the low-frequency standing waves) over a traditional powered subwoofer is minimal.

Electronic bass trap uses feedback control techniques for reducing the boominess of sound at frequencies corresponding to offending (coloring) standing waves of a room. These controllers can be tuned to a single (or multiple) resonant bass modes and abate sound coloration at those resonant frequencies. Figure 2 shows the acoustic frequency response of a small room with and without the electronic bass trap system. The room is rectangular shape with the longest dimension (length) of 172 inches, having a dominant coloration due to the 38 Hz standing wave that shapes up along the length of the room. Clear from Figure 2, the electronic bass trap, which was tuned to the frequency of the first standing wave, has effectively reduced the coloration due to that mode.

In addition to being *tunable*, the electronic bass trap is **highly reliable, robust, cost-effective** and **small in size** (practically the size of a subwoofer).

The key selling points of this product are: 1) smaller size than traditional passive bass traps, 2) customization of the product to an individual room and the ability to be re-customized to another room, and 3) the innovative internet based service to customize the product to an individual room.

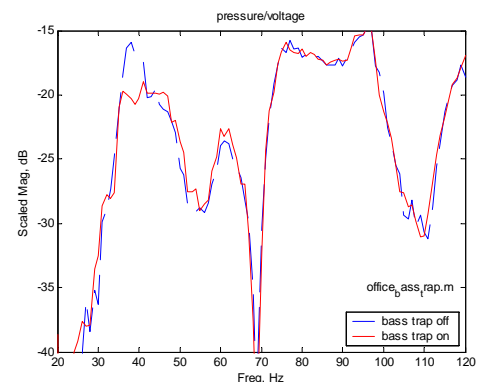


Figure 2. Frequency response functions with the controller on (solid line/red) and off (dashed line/blue)