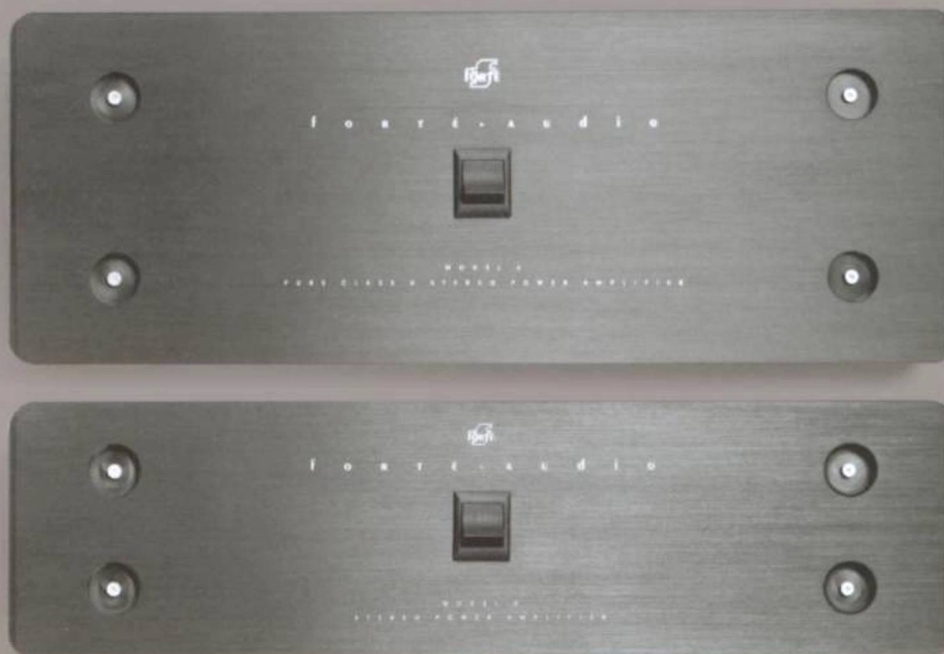
50 Watt + 50 Watt Pure Class A Stereo Power Amplifier Model **4**	100 Watt + 100 Watt Stereo Power Amplifier Model **5**	150 Watt + 150 Watt Stereo Power Amplifier Model **6**	75 Watt Pure Class A Monoblock Power Amplifier Model **7**

The first audio power amplifiers to employ insulated gate bi-polar technology with overall feedback-free operation.

Forté power amplifiers: High-end performance for your music system.
Critical music listeners agree that Forté components offer the performance of high-end "exotics" at a reasonable investment. Each Forté model is engineered for perfectionist accuracy and constructed to the highest quality standards. Individual performance verification assures state-of-the-art music reproduction in any home audio installation.



Ultra-linear performance from insulated gate bi-polar power devices with overall feedback-free operation.
These exciting Forté models are the first audio amplifiers to employ a new semiconductor development: insulated gate bi-polar transistors.

This latest technology is a new variety of semiconductor combining the best characteristics of bi-polar and MOSFET devices. They have the high input impedance of MOSFETs and tubes coupled with the low output impedance of bi-polars. Their high speed and linearity give Forté amplifiers an unsurpassed musical definition and eliminate the need for an overall corrective feedback loop around the amplifier. As a result, the anomalies associated with corrective loop systems are completely avoided. The output signal exhibits extraordinary purity under all conditions.

The output stage of each Forté model is designed with a dissipation capability many times greater than its actual power rating. This extended, safe operating envelope characterizes an output stage virtually impervious to stress, and allows unflinching operation into the most difficult loudspeaker load.

Advanced FET front-end design: Absolute signal purity during the most demanding music peaks.
Forté amplifiers use an advanced new front-end that is a single-ended pure class A design featuring low noise balanced and cascoded FET and bi-polar devices. This high speed gain stage is biased by active constant current sources which are doubly regulated and temperature compensated. Supply decoupling and high supply rejection remove the signal carrying circuits from power supply influence. This assures absolute signal purity even while the supply rails are reacting to heavy music demands.

High capacity power supplies for unwavering energy.
Forté amplifiers employ custom manufactured toroidal power transformers capable of twice their continuous ratings for an extended period. The transformer output is routed through high current diode bridges and computer-grade electrolytic capacitors. The Forté philosophy of overdesign assures that there will always be a large energy reservoir available to the power circuits.

Superior components, individual assembly, and thorough testing.
Every Forté amplifier is individually constructed to the highest standards using the finest components. Circuit boards are military-grade glass-epoxy. Signal connectors are gold plated, and only precision resistors and capacitors are employed. Forté uses only discrete semiconductors, tested in-house and matched within each amplifier.

Every subassembly is checked prior to installation. Every completed amplifier is subjected to a "burn-in" period, and testing by both computer automation and an individual technician prior to shipment. The result is a level of musical accuracy coupled with reliability that places Forté in consideration for all high performance installations.

Every Forté amplifier is designed to afford serious music listeners state-of-the-art performance at an investment level consistent with the majority of home systems.

Heart of Forté amplifier feedback-free technology is the ***insulated gate bi-polar transistor.*** *A newly developed power semiconductor, it has the ideal combination of high input impedance and high speed (the best character istics of tubes and MOSFETs), and low output impedance and high current (the best characteristics of bi-polar transistors).*

50 Watt + 50 Watt Pure Class A Model 4

Advanced insulated gate bi-polar technology in the classic pure class A operating mode for the smaller ultra-performance system.

The exceptional performance of the Model 4 amplifier is based upon the highly linear characteristics of classic pure class A push-pull design — long recognized as the ideal operating mode for an amplifier reproducing music information. Combined with the newly developed insulated gate bi-polar semiconductors, this creates an output stage whose inherent linearity is realized without having to use a corrective feedback loop around the amplifier. This gives the Model 4 extraordinary musical accuracy with any source material and into any loudspeaker load.

The Model 4 provides superlative musical accuracy in any system having reasonable power demands. The class A character of the output stage delivers a musical performance subjectively more dynamic than conventional amplifiers having higher "bench" power ratings.

The Forté Model 4 offers music reproduction that sustains every subtlety carried by the recording media. Pure class A operation, overall feedback free design, and the most advanced semiconductor technology make the Model 4 ideal for moderately sized ultra-performance systems.

100 Watt + 100 Watt High-bias Class AB Model 5

Expanded output Wattage capability with insulated gate bi-polar technology and overall feedback free operation.

The superior music capabilities of the Forté Model 5 are derived from high-bias class AB operation, an advanced new front-end topology, and an insulated gate bi-polar power stage that operates without feedback correction. In combination, these allow an extremely high degree of signal accuracy at the higher dynamic levels demanded by loudspeaker systems of lesser efficiency. Placement of the Model 5 in any music system will assure that program material is recreated with all the subtlety and power that state-of-the-art recordings contain.

Since its inception, Forté has been recognized for components having state-of-the-art performance and reliability, while still suitable for consideration in any music lover's budget. The Model 5 continues this tradition by providing faultless music reproduction with a reasonable cost and space investment.

150 Watt + 150 Watt High-bias Class AB Model 6

Advanced insulated gate bi-polar design concepts and Forté's most powerful high-bias class AB output Wattage rating.

The Forté Model 6 utilizes insulated gate bi-polar technology, overall feedback free operation, and an advanced FET front end topology while it provides power reserves sufficient for the most demanding loudspeaker systems. Signal accuracy is significantly superior to conventionally engineered amplifiers, and allows the Model 6 to provide extraordinary musical definition.

All the characteristics that make Forté components unique in performance and value are intrinsic to the Model 6: Leading-edge circuit topologies, application of the latest semiconductor developments, and assembly procedures that guarantee every unit will conform to Forté's high standards.

The outstanding performance of the Model 6 assures impressive musical accuracy and uncompromised definition, without regard for loudspeaker efficiency or listening area size.

75 Watt Monoblock Pure Class A Model 7

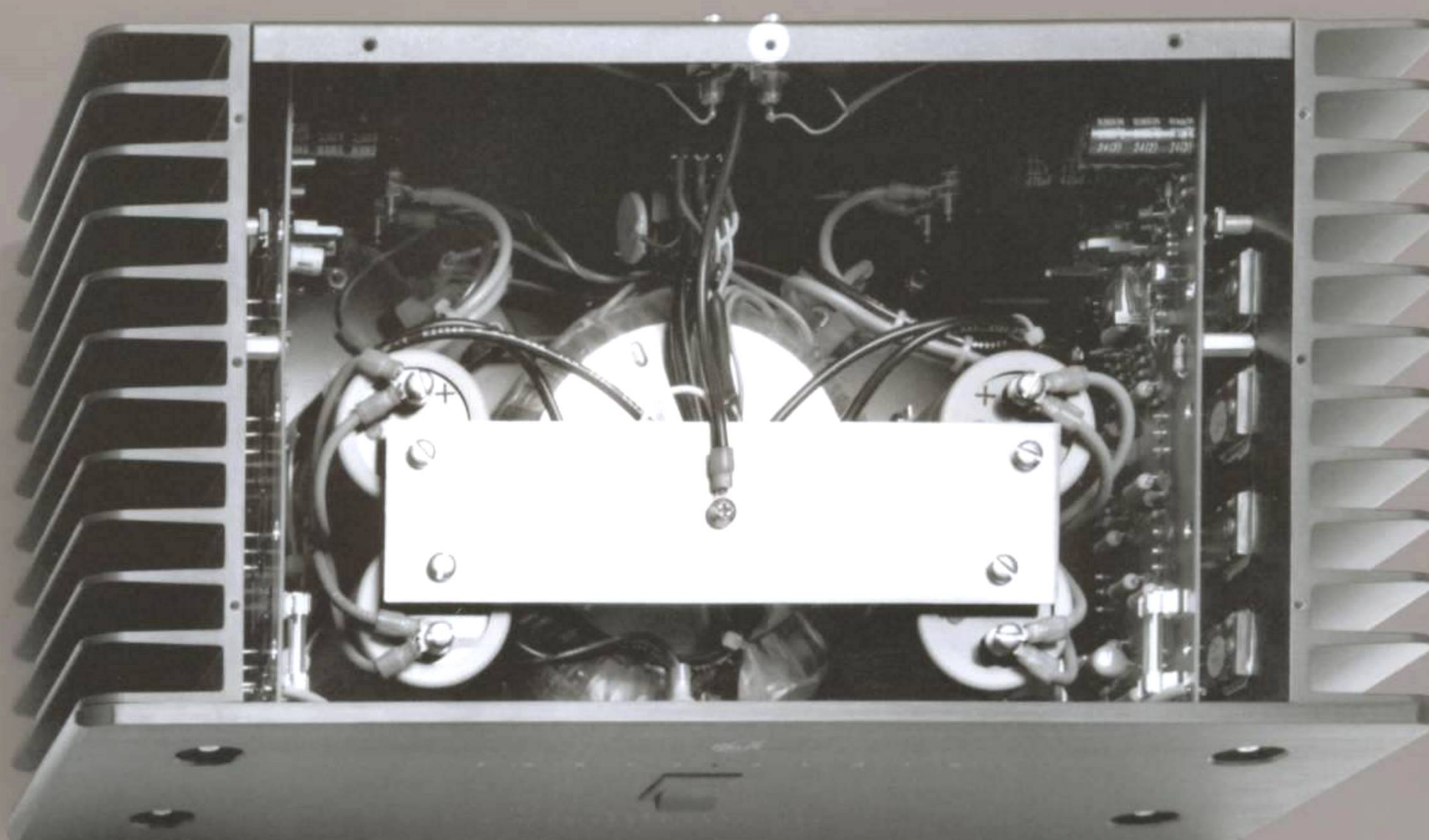
High pure class A power insulated gate bi-polar technology and dual mono operation enable flawless performance.

The Forté Model 7 brings true "exotic" class A and dual mono operation to larger installations where highest performance accuracy is the criteria.

The Model 7 is the only amplifier available offering insulated gate bi-polar technology, pure class A operation, advanced FET front-end topology, and monoblock construction. It provides the highest musical performance offered by any Forté amplifier and enables these recognized advantages to be enjoyed in systems previously restricted to conventional amplification.

In monoblock installations the power amplifiers for both channels are completely separate and do not share the same power supply or ground paths. This total independence between the stereo channels eliminates crosstalk and interchannel influence caused by the sharing of power supplies, chassis and ground paths. No activity of one channel can influence signal purity on the other channel through any circuit commonalty.

The Forté Model 7 monoblock amplifiers deliver a musical experience that reveals every nuance and all the dynamics carried by the most advanced recording media. The Model 7 embodies uncompromised high-end performance intended for the most critical music listeners.



Specifications

Nominal output	***Model 4*** *50 Watts/channel into 8 Ohms.* ***Model 5*** *100 Watts/channel into 8 Ohms.* ***Model 6*** *150 Watts/channel into 8 Ohms.* ***Model 7*** *75 Watts into 8 Ohms.* *20Hz-20kHz both channels driven (where applicable) at no more than 0.1% THD.*
Bandwidth	*-3dB points @ 3Hz and 100kHz.*
Slew Rate	*50 volts per microsecond.*
Input impedance	*47,000 Ohms.*
Output impedance	***Models 4, 6, and 7*** *0.02 Ohm 7Hz-20kHz (equivalent damping factor 400).* ***Model 5*** *0.04 Ohm 7Hz-20kHz (equivalent damping factor 200).*
Current capability	***Models 4, 6, and 7*** *16 amperes continuous/50 amperes maximum peak into 0.1 Ohm.* ***Model 5*** *10 amperes continuous/30 amperes maximum peak into 0.1 Ohm.*
Output noise	*‹300 microvolts.*

As Forté is continuously evaluating new technologies and materials, the option is reserved to incorporate changes into ongoing production without notice or obligation. This literature does not constitute an offer or form any part of a contract written or implied.

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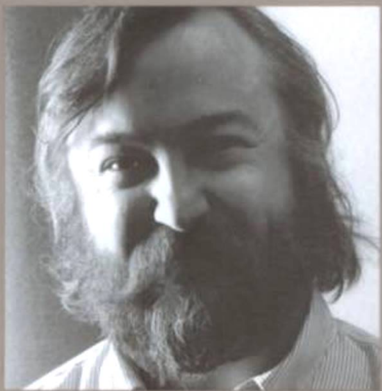
Phantom Acoustics: Active Low Frequency Acoustic Control



The control of low frequency room resonances through the application of active suppression means

Author: Nelson Pass
May 12, 1988

An introduction from Phantom Acoustics:

Although passive methods for treating room conditions are familiar, the Phantom Acoustics *Shadow* active low frequency trap is a new product and technology insofar as the audiophile community is concerned.

Over a year ago Phantom Acoustics realized that the most efficacious solution to room resonance problems encountered by the home music listener would have to be addressed by an active system.

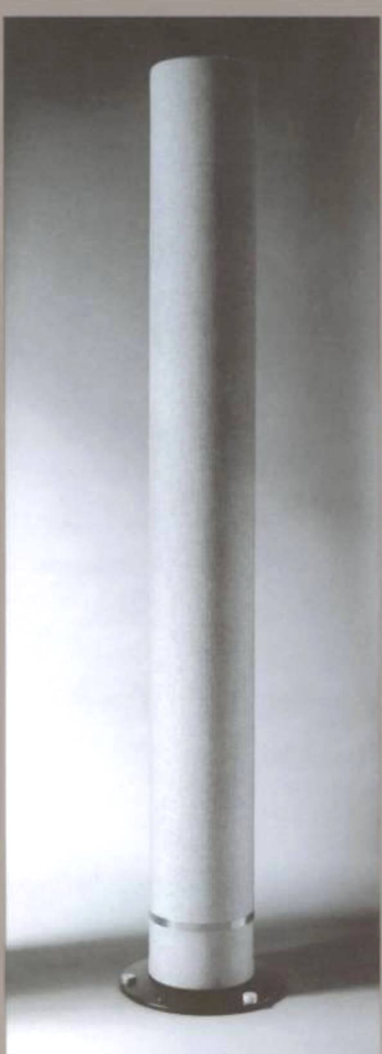
To develop such a home system Phantom Acoustics enlisted the consulting expertise of a design team under the direct supervision of Nelson Pass, physicist and acknowledged leader in innovative electronic design.

The following is a "white paper" of his authorship which will enable the interested audio enthusiast to appreciate room resonance problems and the solutions which may be applied.

1 Background

We are striving to achieve the most realistic audio reproduction possible. We want the sound impinging on our ears to be a perfectly faithful copy of that experienced at the original event, and we are willing to go to a lot of trouble to obtain that performance. Every link in the chain carries the full responsibility for the integrity of the information, and we scrutinize each component for flawed handling of the sonic experience. The listening environment is a major component in this chain and is one of the worst offenders against realism.

Of all the varieties of distortion, let's consider just the amplitude and phase response. With modern recording and playback equipment it is not difficult to deliver a signal from microphone through the recording/playback process to the output of the amplifier with less than 2 dB of amplitude variation over the audio band.



Prototype of the *Shadow*.

Loudspeakers display considerably less accuracy, but several still manage to deliver less than 5 dB variation at all but the lowest frequencies. A reasonably live rectangular room, however, is easily capable of amplitude variations of 20 dB, corresponding to an energy error of 10,000%.[1]

These resonant modes destroy the original amplitude and phase relations of the music and cause overhang and "boominess" in somewhat the same way as a poorly designed speaker enclosure driven by an amplifier with a very low damping factor—only worse.

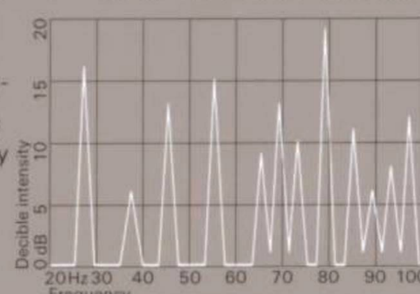
It is worth noting that loudspeaker performance is commonly evaluated in anechoic chambers because normal room contributions make it nearly impossible to evaluate the steady state phase and amplitude response. Sophisticated technical approaches have allowed measurement of loudspeaker response at higher frequencies by separating actual speaker output and room acoustics for millisecond durations, but this has not improved the lot of audiophiles whose ears are not so equipped.

A number of efforts have involved completely lining the room with absorbant foam, fiberglass, or cloth to eliminate reflected sound, but this is not effective at the lower frequencies where the worst of the room contributions exist. Even if we could create a completely non-reflective environment, it would not solve our problem. Anyone who has ever listened to audio in an anechoic chamber will tell you that it is an interesting but not very satisfying experience.

Everyone in the field has long recognized the need for serious improvement in the listening environment, and there is a small but growing industry offering solutions to these acoustic problems.

2 The physics of room resonances

We know that a totally absorbant acoustic environment is unsatisfying just as a totally reflective environment is. The upper 7 octaves of the audio band are fairly easy to control with judicious use of absorptive materials mixed with reflective



1
Typical resonant peaks for 20′ x 15′ room with 8′ ceiling. See text: 2, The physics of room resonances.

surfaces to reduce the decay time and diffuse the standing wave patterns. The wavelengths of sound at these higher frequencies are short enough (6 feet or less) that the reflective patterns are diffuse and common absorbant materials are effective.

At frequencies below 200 Hz, the average listening room begins to behave more like a classic rectangular chamber and exhibits large response variations due to standing waves. Standing waves develop between opposing corners and parallel surfaces where pressure can build up. In a rectangular room an entire series of resonances occurs according to the formula:

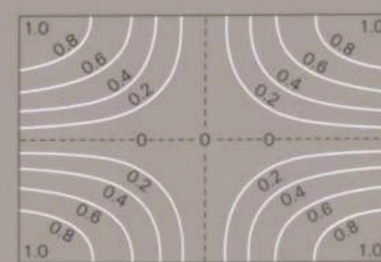
$$\text{Frequency} = 563 \times \sqrt{\left(\frac{P^2}{L^2} + \frac{Q^2}{W^2} + \frac{R^2}{H^2}\right)}$$

Where L is the length, W is the width, and H is the height in feet and where P, Q, and R are independent integer values from 1 to infinity.

The gravest of these resonances corresponds to the longest dimension of the room. In this resonance, an acoustic standing wave develops high cumulative energy with high pressure in the corners and high air velocity in the center of the room.

Figure 1 shows a potential resonant response curve for a rectangular room with a length of 20 feet, a width of 15 feet, and a height of 8 feet. It shows resonance for a mix of values of P, Q, and R from 0 to 2 and only reflects frequencies below 100 Hz.

Figure 2 shows a normalized horizontal pressure distribution for the (P=1, Q=1, R=0) mode at 47 Hz



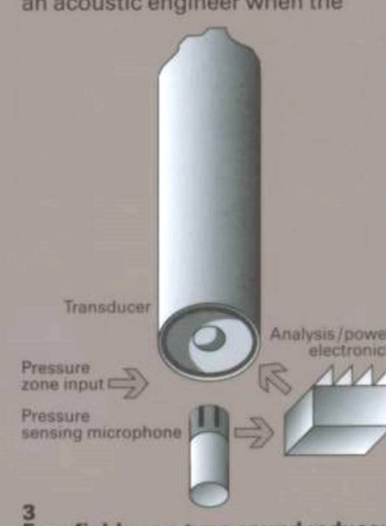
2
Room pressure distribution at 47 Hz as seen from above. Note buildup in corners. See text: 2, The physics of room resonances.

as seen from above.[2] Air cannot flow through the walls, and pressure builds up in the corners much as it does in the throat of a horn.

Not having a rectangular room does not mean that resonant peaks do not develop; they simply correspond to a different mathematical series.

3 The solutions

There are several things that can be done to minimize room resonance. If your architect works with an acoustic engineer when the



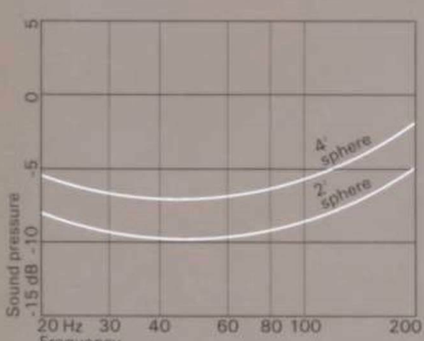
3
Free field zone type sound reducer
An active technique for pressure reduction. See text: 3, The solutions.

room is first designed, significant improvements can be made in its shape to help avoid the worst of the resonant modes.

If you don't have that luxury you can consider the use of mostly ineffective absorptive surface treatments. You can place very large diffusing objects and shapes in the room to break up the geometry of standing waves. Or you can install passive bass traps to help soak up the unwanted energy.[3]

There is yet another possibility. Observing that the room resonance depends on high pressure buildup, particularly in the corners, we can conclude that it is possible to pull the rug out from under resonance by reducing the pressure in the corners. One way to do this is with the ever popular chain saw. Simply slice away the offending corner and expose the room to the unbounded environment outside. This does not eliminate every possible mode of resonance but will take much of the wind out of them.

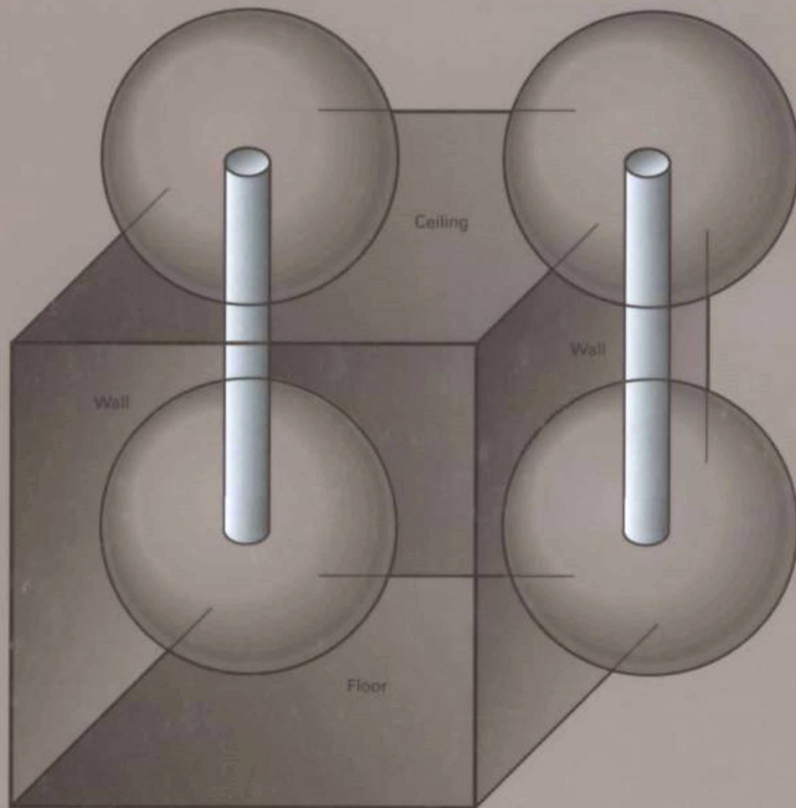
As a practical matter, though, it is not desirable or necessary to carve up the room. If we could postulate a virtual sonic "black hole," a device which creates an acoustic region where the pressure is greatly reduced, we could place it in the corners and achieve roughly the same result.



4
Sound pressure reduction for low frequencies. See text: 3, The solutions.

The concept for such a device has been around since at least 1953 when Olson and May described what is referred to as a "free field zone type sound reducer." It consisted of a simple circuit of microphone, amplifier, and loudspeaker, set in a loop so as to define an acoustic region of low pressure. They went on to describe mounting such a device in the corners of a room so as to maximize its effect by presenting it with the large acoustic load experienced there.[4]

In one of the few cases where he did not precede actual science, science fiction author Arthur C. Clarke humorously described such a device in his 1954 short story "Silence Please" wherein its hapless inventor is killed by exploding capacitors (which had absorbed the sound energy) after the device had been employed in a concert hall to silence an opera performance.[5]



5
Pressure reduction zones (equivalent to removal of room boundaries within zones) created by a pair of Phantom Acoustic Shadows in a typical 8' ceiling room. See text: 3, The solutions.

Such a circuit is depicted in figure 3, where you can see the simplified topology. A microphone is used to sense the pressure in a particular zone and sends its signal to an amplifier which amplifies this signal and drives a transducer in such a way so as to cancel the pressure sensed by the microphone. The loop that is created depends mostly on the quality of the microphone, as any distortion produced by the amplifier and transducer are reduced by the feedback of the system.

Beyond the simplified schematic, the electronics for an actual unit must contain circuitry to compensate for the amplitude and phase response of the transducer so as to assure loop stability, and a power supply for a high quality condenser microphone.

The effect on a roughly spherical zone around both transducers is depicted in figure 4, where the approximate pressure reduction is shown over the range of bass frequencies for a spherical volume 2 feet in diameter and 4 feet in diameter.

A working copy of this device was under development in 1987 and was demonstrated co-incidentally with the Winter Consumer Electronics Show in Las Vegas, January, 1988. It is in current production by Phantom Acoustics. The *Shadow,* its consumer embodiment, consists of two so-called "black hole" modules, one at each end of an internally damped 7 foot tube which places them within 6 inches of the 3 sided surface intersection at the corners of an average 8 foot ceiling room. A pair of *Shadows* operate so as to create four acoustic zones of low pressure (figure 5) which operate from below 20 Hz to approximately 200 Hz. In so doing they simulate openings to an outside unbounded area and break up the high pressure corner patterns which support room resonance.

They can be placed effectively anywhere in a room, although they are most effective in corners when used with conventional loudspeakers. Interestingly, they have a significant benefit for bipolar types of loudspeakers such as electrostatic or other panels which radiate front and back. Such loudspeakers have an inherent problem in reproducing low frequencies because the rear wave is out of phase with the front wave, and at low frequencies the two reach around the sides of the loudspeaker and cancel each other. By placing a "black hole" module behind a bipolar panel, you can cancel much of the rear wave and extend the perceived low frequency performance of the panel considerably.

The particular devices produced by Phantom Acoustics are capable of absorbing high sound pressure levels. We can place a high efficiency woofer (JBL LE-15A) within the zone and drive it at full power (160 Watts continuous sine wave) without exceeding the capacity of the circuit or observing transducer distortion.

The Phantom Acoustics *Shadow* active low frequency absorber is a superior alternative to passive techniques for suppressing the pressure buildups that support resonance characteristics in the room. When used with proper loudspeaker/listener placement and the moderate use of passive absorption in lesser pressure zones it can greatly enhance the reality of the listening experience. In an industry that will expend large efforts for small improvements, it is a very cost effective approach.

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3 Olson, US patent 2,502,020. Bedell et all, US patent 2,160,638.
4 Olson, H.F. and May, JASA, vol. 25, no. 6, p. 1130, 1953.
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