BOSE . . . The most highly reviewed speaker

The Complete Text of an unprecedented series of rave reviews of the BOSE 901 DIRECT/REFLECTING™ Speaker System

by
Equipment Reviewers
and
Music Critics

rsteller
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CAN YOU GUESS

WHICH FACTOR IS MOST RESPONSIBLE FOR THE LEADING POSITION OF THE BOSE 901 DIRECT/REFLECTING™ SPEAKER SYSTEM?

IS IT:

1 The Rave Reviews?
See the complete text of the nine rave reviews on the pages that follow.

2 The 12 Years of Research? — research that went beyond the collection of graphs and numerical data into the basic problems of correlating the perception of music with speaker design parameters. (Copies of the Audio Engineering Society paper 'ON THE DESIGN, MEASUREMENT AND EVALUATION OF LOUDSPEAKERS', by Dr. A. G. Bose, are available from BOSE Corp. for fifty cents.)

3 The Sound of Music Through the 901?
(Enjoy it at your nearest BOSE dealer or in the more comfortable surroundings of your friend's home.)

THE ANSWER:
(AS INDICATED BY CUSTOMER SURVEYS)

The research made it all possible and the rave reviews cause people to listen to the BOSE 901. BUT, the surveys show that the sound of the 901 is, by far, the major reason that owners of large and small speakers trade for the 901 and that newcomers to stereo select the 901. That's how it should be — you are not buying reviews or research the relevance of which rests completely upon the 901's ability to produce music with a fidelity that you will immediately recognize as superior. You are buying sound.

LISTEN TO THE BOSE 901 IN DIRECT COMPARISON WITH ANY OTHER SPEAKERS, REGARDLESS OF SIZE OR PRICE. YOU WILL ONLY APPRECIATE WHY WE MAKE THIS REQUEST AFTER YOU HAVE MADE THE EXPERIMENT.

Bose 901 DIRECT/REFLECTING™ Speaker System—$476 the Stereo Pair, including Active Equalizer. Slightly higher west and south. Walnut facing and pedestal base extra.

You can hear the difference now.

THE BOSE® CORP.
East Natick Industrial Park Natick, Massachusetts 01760

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HIGH FIDELITY

By Norman Eisenberg

A REPORT ON THE BOSE 901 SPEAKER SYSTEM

SURROUND and CONQUER

DESPITE THE PREVALENCE of look-alikes and sound-alikes in audio, every now and then the maverick spirit asserts itself and produces something that turns out to be as good from a performance standpoint as it is interesting from a design standpoint. So it is with the new Bose 901 speaker system, which—while an obvious departure from the familiar two-cubic-foot-walnut-box approach to speaker design—strikes us as one of the best sound reproducers we have ever heard.

Basically, the Bose 901 is a speaker system whose acoustic response is influenced by the electrical response of an equalizer unit inserted in the amplification chain. One equalizer serves to control two stereo channels. Each speaker system itself consists of nine specially designed four-inch drivers installed in a five-sided enclosure so that one driver faces into the listening room while the other eight radiate against a wall or other surface behind the enclosure. The nine speakers in each enclosure are identical, and no crossover network is used.

A question that immediately comes to mind is: can several small speakers match the bass performance of one large woofer? Let's see. It is apparent that the Bose system is based on certain specific design concepts, not all of which are completely accepted in audio circles. To wit: a relatively high amount of reflected sound, vis-à-vis direct radiated sound, is very desirable in playback; what one hears out of the speaker system is more important than what can be measured going into the system (the acoustic response should be flat even though the electrical signal itself is not); in creating a wide-range, high-quality speaker system the woofer-tweeter-with-crossover-network approach can be successfully ignored if suitable design steps are taken in the use of several identical drivers; nonparallel sides for an enclosure are more desirable than parallel sides; a speaker system ought to incorporate provisions—instead of or in addition to those normally found on an amplifier—for specific forms and degrees of tonal compensation related to input program material, speaker system characteristics, and loading to the acoustics of the listening room.

If all this sounds complex, it is. Briefly, here's how it works: the spatial presentation of sonic information, particularly germane to stereo, is accomplished by deliberately introducing a high ratio (eight-to-one, approximately) of indirect-to-direct sound. The sound reflecting off the walls blends with the sound from the lone driver in front to enhance the ambience and spatiality of the reproduction. At the same time the total area of speaker diaphragms improves the radiation resistance of the

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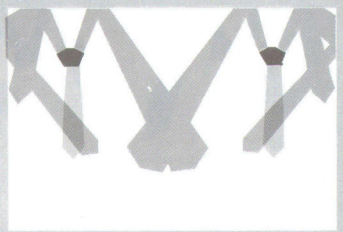
The Bose speaker system uses sound coming off the walls to help create superior stereo out front. First diagram shows normal amount of left and right channel sound with center mix. Next, angling speakers inward throws more sound to sides, emphasizes separation. Last sketch shows how more mix and less separation result when speakers are toed outward.



system in loading or transferring sound into the listening area. At low frequencies all nine speakers respond in phase to move fairly large amounts of air, thus radiating bass power. At high frequencies the small diaphragm of each speaker naturally behaves like a tweeter. Differences in individual resonances are overcome by the close internal coupling of the drivers, with the result that the response of the total array becomes fairly smooth, as compared to the characteristic response of any single driver.

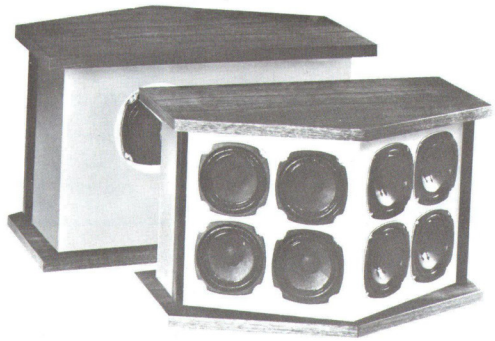
To extend the range of this smooth response and also to shape it to suit both program material and room acoustics, Bose employs an "active equalizer," a solid-state device that boosts the very low and very high ends of the spectrum. By using its controls, you can vary the degree of boost at either end (twenty frequency contours are available), but some lift always remains effective. The equalizer comes before the power amplification section of whatever equipment you're using; its connections permit you to patch it into a separate preamp and power amp, into an integrated amplifier, or into a receiver. Electronically speaking, the equalizer is a fairly sophisticated device—one of its functions, for instance, is to compensate for the acoustical character of the grille cloth over the speaker enclosure.

If this sounds like electronic hocus-pocus, consider that it is really no more so than the equalization (i.e., frequency gimmicking) used on records and tapes, which is compensated for by reciprocal circuits in every modern amplifier and receiver. Analysis of the Bose approach and—more important—many hours of listening to the system certainly justify and validate it in my opinion. Indeed, after comparing its various frequency contours, playing a number of recordings, I'd go so far as to say that you can use the Bose equalizer as a "trimmer" adjustment to further refine the existing RIAA characteristic during playback, thereby cleaning up both the very low and high ends of the audible response of many recordings. It also helps the tonal balance of FM broadcasts and of prerecorded tapes (though the latter generally strike me as better balanced to begin with) played through your system.

Because the equalization comes before the power amplifier, it can make demands of the latter that may exceed its capabilities. For this reason the Bose 901 is not recommended for use with puny amplifiers unless you're willing to settle for less than the full response capabilities of the system. Amplifiers (or amplifier sections of receivers) that can deliver at least 20 watts RMS power per channel into an 8-ohm load are recommended. At the same time, the power-handling ability of the combined nine drivers is prodigious, and permits using amplifiers that can deliver over 100 watts RMS per channel.

AWARE THAT MY verdict is in part subjective (and allowing too for the protean nature of the audio field, in which some future development may cause me to modify this opinion), I will say that as of now the Bose 901 strikes me as the best-sounding speaker system in its size and price class I have yet auditioned. Indeed, it rivals many systems built to larger dimensions and/or costing considerably more. In its midrange and highs—for clarity, full range, wide dispersion, open and natural sound—it is unsurpassed by anything I've heard. In its bass it is easily a match for the best of the air-suspension systems, and is outperformed only by the costliest and biggest of the top giants and horn systems. You actually have to think in terms of systems about double its cost, or more, to find speakers that surpass it at the low end—and then, they do so only by a few notes around the 20 Hz to 25 Hz region, or by what may be called an almost "subsonic feel" that is perceptible only on some program material. As for stereo spread and depth, no pair of speaker systems I've yet installed managed to create a more convincing and pleasing panorama of sound without the aid of center-fill or surround speakers to augment the presentation.

I did not attempt to push the 901 to its theoretical limit of 270 watts power-handling capacity (this figure is based on a 30-watt rating for each of the nine drivers in one enclosure), but I did run it from a 50-watt-per-channel amp. At louder than normal levels and with the equalizer contour set to deliver flat response, I found that the bass line held up firmly and cleanly to 40 Hz. Then—with some slight doubling that was considerably less than on most speaker systems and which did not increase as frequency was lowered—it continued strongly and with remarkable linearity to 26 Hz. By reducing the input level just slightly, to a more normal listening level, I found the 901 responded down to 23 Hz. The middles and highs were exceptionally smooth, clean, and strong, showing virtually no directional effects. A 10-kHz tone could be heard in another room; 13 kHz was audible fairly well off axis; 14 kHz was audible closer on axis; and from here the response sloped off towards inaudibility. White noise response was exceptionally smooth and well distributed throughout the listening area.

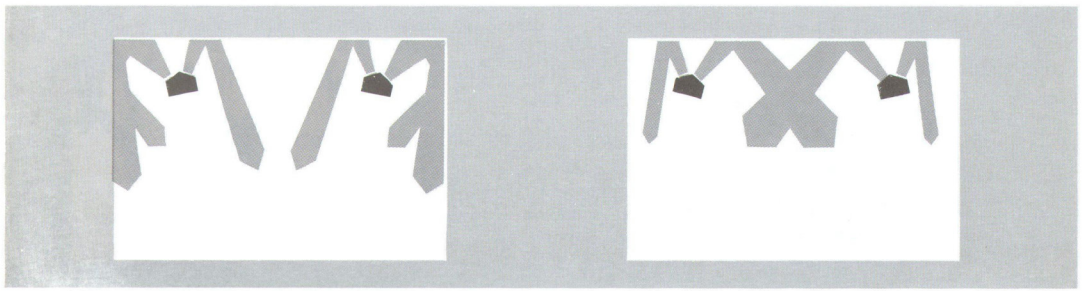


Behind the grille cloth, each reproducer in Bose 901 system has eight speakers on its angled rear panels, one on the front panel. Equalizer has controls for shaping contour of response, plus tape monitor substitute if patched into amplifier or receiver tape jacks.

To test the equalizer and Bose's claim that the 901 system responds with alacrity to differences in program sources, I played the same recordings with different pickups, and different recordings with the same pickup. Details of this extended listening occupied several of us for days; what it comes to is this: the equalizer not only serves generally to contour the amplifier response with respect to the 901 speakers, but it can (indeed, should, for the most accurate playback) also be used to vary this contour—subtly, but to critical ears effectively—at both the extreme high and low ends of a system's total response. In this way all the elements involved (program source, amplifier, room acoustics) can be brought into suitable or integrated acoustic focus. In this sense, the 901 system is the closest approach to the concept of "sound conditioning" of a listening room yet encountered in a commercially available, competitively priced product. And it is all the more commendable for its ease in use: the equalizer is a small walnut box that you can install next to or on top of your main control panel, whether it's part of a separate amplifier or a stereo receiver. After some experiment you will find the best positions for its controls for various recordings and/or different cartridges used in playing those recordings. For instance, using the Ortofon to play some Columbia records of the New York Philharmonic under Bernstein, I found it more agreeable to cut back on the high end a few steps; with the Shure V-15 II I cut back only one step. For Vanguard's recent Dolbyized releases I cut back one step with the Ortofon, but ran the system flat for the Shure. In discussing these adjustments with the manufacturer I was told that the exact degree of adjustment is bound to vary in different listening rooms but that the general pattern I had hit on seemed valid: recordings and pickups—even those that may be termed high quality—do vary in acoustic tone, and Bose's aim is to provide the keen-eared listener with a means (if he opts to use it) of compensating for those variations.

Yet another area of compensation—this one primarily with regard to individual room acoustics and relative location of the speakers—is offered by the 901 system. The accompanying diagrams illustrate this point, and again the effects represented are definitely audible. If you toe the speakers *inward*, more sound will come from the sides of the room; this effect increases the apparent stereo spread and may be desirable if the speakers have to be located fairly close to each other, say about three feet apart. If you toe the speakers *outward*, less sound will come from the sides and there will be more of a centre-fill effect—useful if the speakers are installed very far apart, say about fifteen feet from each other. In any location, you must leave about a foot of space behind the speaker and any amount of space at its side in order to allow the "bounce-and-reflect" effect to develop. Correctly installed along these lines, the pair of 901 systems provides full stereo from just about any listening position in the room. Combined with the sense of front-to-rear depth they project, the sound never seems to be emanating from boxes; rather you feel that the sound is "just there," and fairly well spread about you too. The acoustic perspective thus provided comes surprisingly close to simulating the sort of ambience you normally would get only by using "surround" and center-fill speakers in addition to the normal stereo pair.

Add to these virtues the utterly clean wide-range response of a 901, its neutral, well-balanced, transparent quality on all program material, and you feel you've made some sort of stereo discovery. And it doesn't pall, either: you can listen to this system for hours on end without getting listener fatigue—if your own response to it is like ours, you'll be reluctant to turn it off and go to bed.



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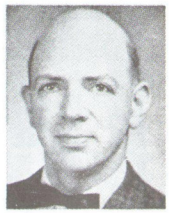
TECHNICAL TALK

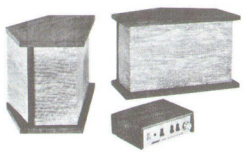


By JULIAN D. HIRSCH

EQUIPMENT TEST REPORTS

By Hirsch-Houck Laboratories

BOSE 901 STEREO SPEAKER SYSTEM



DEPENDING on one's viewpoint, the Bose 901 speaker system might be considered a revolutionary approach to sound reproduction, or simply a workable combination of well-established (and sometimes deprecated) techniques. The Bose 901 enclosures house nine small, specially designed drivers that have 4-inch cones and powerful magnetic structures. Eight of the drivers are angled to the rear, while the ninth is mounted on the front of the enclosure facing the listening area. This arrangement is intended to achieve approximately the same ratio of direct to reflected sound that exists in the concert hall.

The 901's cabinets are quite compact, measuring 12¾ inches high by 20$^{9}/_{16}$ inches wide when viewed from the front. Seen from the top, the rear of the enclosure forms a "V" of about 120 degrees. Basic to its operation is the requirement that it be mounted with the "V" facing the wall, the apex being about 12 inches from the wall. When a pair of 901's are so installed, the sound appears to be uniformly distributed across the wall between the speakers completely free of any "hole-in-the-middle" effect. Since only 11 per cent of the sound is radiated directly forward, it is almost impossible to localize the source.

An intrinsic part of the Bose 901 system is an active (ten-transistor) equalizer that handles both channels; it compensates for the high-frequency losses inherent in the reflecting process and also flattens out the bass response. (The uncompensated bass response is down because of the natural bass roll-off resulting from the very small volume of the enclosure.) Housed in a walnut cabinet 2$^{13}/_{16}$ inches high by 9¼ inches wide and 6¾ inches deep, this self-powered equalizer unit is connected either between the preamplifier and power amplifier or in the tape-monitoring signal path of the amplifier or receiver. In the latter case, the amplifier's tape-monitor switch is left set to TAPE. So that the tape-monitor function would not be lost, Bose has built it into the equalizer. A tape recorder can be connected to the equalizer and the usual monitoring switching performed through it.

There are five controls on the equalizer, four rocker switches and one five-position rotary control. One rocker serves as an on-off switch, another as the tape-monitor switch, and the third as a low-cut filter that primarily affects frequencies below 40 Hz. This is intended to reduce rumble or acoustic feedback. The fourth rocker switch interacts with a rotary five-position treble-contour control. When the rocker switch is set for NORMAL, the rotary switch provides a boost position, a flat position, and three positions of decreasing high-frequency response from the speakers. When the rocker switch is set for TREBLE DECREASE, it introduces a depression in the response between 2,000 and 6,000 Hz. The five switched contours then not only affect the very-high-frequency speaker performance, but also the frequencies between 500 and 2,000 Hz that are not affected with the rocker switch in its NORMAL position. In all, ten different high-frequency/mid-range response contours are available.

For those who have well-trained hearing and musical judgment—plus the urge to tinker—it is possible to correct for poor recordings to a remarkable degree with the equalizer controls. Most people will probably prefer to leave them in their NORMAL settings.

The active equalizer introduces no perceptible distortion. We measured its distortion at less than 0.13 per cent for any output under 3 volts, which is greater than would be required with any amplifier we know of. The output signal is of approximately the same level as the input signal.

In the August, 1968 *Technical Talk* column, I commented on the difficulty of describing speaker performance in purely objective terms. The Bose 901 is a perfect illustration of this problem. After a couple of months of living with a Bose 901 system, I am convinced that it ranks with a handful of the finest home speaker systems of all time. Because of its unconventional mode of operation, I rather doubted that any frequency-response measurements I could make would account for the remarkable realism of its sound. Difficult as it is to measure the output of a single direct radiator in a normal living room, it is well-nigh impossible to measure an almost perfectly dispersed sound pattern such as that of the 901 without strong influence from the effects of room acoustics. Nevertheless, a measurement was attempted.

We placed the speaker in the recommended position relative to the wall. We did not have the equalizer in the signal path for our frequency-response and tone-burst measurements, but measured the equalizer response separately and added it to the speaker response to obtain the final curve. Ten microphone positions were used, and their readings averaged. Harmonic distortion was measured at a 1-watt drive level with the equalizer installed.

It was no surprise to find that the final response curve was not as flat as some we have measured. There appeared to be a broad rise of about 5 or 6 dB in the 130- to 250-Hz region, although we could not detect its presence by ear. The output fell smoothly above 1,000 Hz to −7 dB at 6,000 Hz, then rose to the 1,000-Hz reference level between 10,000 and 15,000 Hz.

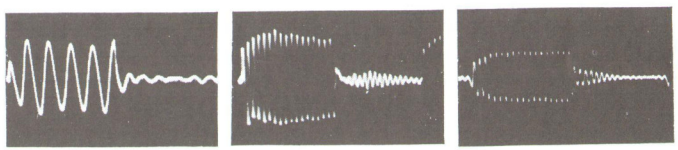
The low-frequency harmonic-distortion measurements were affected by the speaker and microphone placement. The distortion was 7 per cent at 20 Hz, and reached maximums of 12 per cent at 30 Hz and 10 per cent at 50 Hz. It was considerably lower at other frequencies in the bass range. (As a point of reference, the better acoustic-suspension speakers have about half as much measured distortion at similar drive levels.)

We listened to the Bose 901 in several listening rooms which ranged acoustically from extremely hard and bright to quite dull. It was compared in A-B tests with several of the better speaker systems at our disposal. The Bose 901 had an utterly clean, transparent, and effortless sound. Its clarity and definition when reproducing complex orchestral passages were, in the writer's opinion, unsurpassed by any other speaker he has heard. This impression was confirmed by its tone-burst response, which was uniformly excellent across the frequency spectrum. Its low-bass response was difficult to credit to such a compact system. It had all the room-filling potency of the best acoustic-suspension systems, combined with the tautness and clarity of a full-range electrostatic speaker. The spatial distribution, which brings an entire wall alive with sound, contributes greatly to the sense of realism.

There is, unfortunately, a serious obstacle to the universal acceptance of a speaker such as the Bose 901. The 12-inch gap necessary between the apex of the speaker and the wall places the front of the speaker about 30 inches from the wall. Bookshelf mounting is generally impractical, and it may be difficult to install the 901 in the correct location without disturbing room decor. Many potential users will be forced to decide between style and sound.

Electrically, the Bose 901 is rather inefficient, and the 18 dB of bass boost supplied by the equalizer requires huge reserves of amplifier power if loud low-frequency passages are to be played. To a lesser degree, the same problem exists at the very high frequencies. Bose recommends amplifier power ratings from 20 to 200 watts per channel, into 8 ohms. We have used it successfully with amplifiers at both ends of this range. Unlike most speakers, the 901 sounds as good at a whisper as it does at a roar, but if you are ever tempted to turn up the volume a bit, an amplifier with a continuous power rating of at least 60 watts per channel is strongly recommended. A possible compromise is to use the "below 40 Hz" roll-off in the equalizer, which reduces low-frequency peak-power requirements by 8 dB and has little audible effect. Incidentally, don't worry about overloading the 901. The individual drivers can each handle 30 watts without difficulty, and few of us are likely to be able to apply more than 270 watts to each channel.

In the final analysis, the judgment of a speaker must be subjective and personal in nature. I have, on occasion, warmly praised speakers that I considered to be outstanding performers. Everything I have said in the past is still valid. Nevertheless, at this moment, I must say that I have never heard a speaker system in my own home which could surpass, or even equal, the Bose 901 for overall "realism" of sound. My partner, Gladden Houck, concurs to the extent that he considers it a very fine system, certainly the equal of anything at or near its price. The Bose 901 system, consisting of two speaker units and the equalizer, is priced at $476.



The uniformly excellent tone-burst response of the Bose 901 is illustrated by the oscilloscope photos of tone-bursts at (left to right) 130, 1,000, and 9,500 Hz.

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BEHIND THE SCENES

BERT WHYTE

WALK INTO the average hi-fi shop and what do you see? Walnut boxes. Dozens of them . . . most quite small, resembling breadboxes or whiskey cases. Some are even as big as *two* whiskey cases. These are loudspeakers . . . a ubiquitous breed, many imitative of each other's design. The claims for these speakers range from modest to monumental. No matter how clever their design, however, to *me* they have the common failing of sounding like a small point source. The music they reproduce sounds rather compressed and constricted, like it is being squeezed through a small window.

Am I prejudiced? You bet! For you see, I'm a "big speaker" man. Unabashed. Uncompromising.

You'll see the big ones in some of the better salons, interspersed among the walnut boxes, standing like some noble monoliths; speakers of massive proportion and imposing aspect. These are the sonic aristocrats . . . the "big speakers" . . . loathed by women and loved by men.

At the moment, this partiality is a bit of a problem since I find myself on a most uncomfortable spot. You see, I've been listening to a pair of small speakers that are reproducing music with a high-quality BIG speaker sound, something no small speakers have any right to do. This iconoclastic speaker is known as the Bose 901 . . . and thereby hangs a tale.

The 12-Year Quest

The speaker was designed by Dr. Amar G. Bose, a Professor of Electrical Engineering at the Massachusetts Institute of Technology. Among other things, Dr. Bose teaches acoustics, and for many years has been an avid music lover and hi-fi enthusiast. About 12 years ago, he began a research program to investigate loudspeakers, realizing the truth of the old axiom that the loudspeaker is the weakest link in the chain of music reproduction. A student of the violin in his younger days and a frequent visitor to concerts of the Boston Symphony Orchestra in nearby Symphony Hall, Dr. Bose could not equate what he heard in the concert hall with the reproduction of music through commercially available loudspeakers. This was especially true with his beloved strings, which the speakers reproduced as "interesting but far from realistic sounds." Preliminary investigations convinced him that a good part of the loudspeaker problems derived from the inadequacy of standard speaker measurement techniques, which relied mainly on anechoic chamber tests or free-field testing, and a lot of subjective listening.

Speaker design over the past thirty years has been part science, with anechoic chambers and chain-driven oscillators and oscilloscopes, and part art, which is "cut and try," "cone doping," "individual tuning," and still more subjective listening. There would seem to be little argument that empiricism plays a significant role in speaker development. It is also obvious that we don't listen to music in anechoic chambers, so that questions have been raised regarding the relevancy of chamber data to the home listening environment.

The task Dr. Bose set for himself was formidable indeed: to determine what kind of sound an ideally "perfect" speaker (theoretically a pulsating sphere) would make—if such a thing could be made; and to develop precise techniques of measuring this sound, all within the context of the home listening experience.

With the vast technical resources of MIT at hand, Dr. Bose's first consideration was the simulation of the ideal pulsating sphere, whose surface will emit pressure waves in all directions evenly over its entire circumference. It is important to note that a prime requirement was that the pulsating sphere be measured in a typical room, in the same fashion as a normally operating speaker. Thus the normal room nodes, standing waves, etc., would be included in the measurement. The ideal pulsating sphere turned out to be a high-voltage spark, which was discharged into a typical home-type room at a frequency rate of once per second. The sound of the spark discharge was picked up by a calibrated Western Electric 640-AA condenser microphone. The microphone reconverted the sound into an electrical signal which was fed into an accumulator in a special digital computer.

When 4000 discharges had been stored, the computer performed a computation known as digital convolution or superposition integration (which I assure you is quite beyond my ken) and the result was, in essence, a mathematical model of the ideal speaker. The signals on the computer tape are, of course, different from the original (reproduced by the ideal pulsating sphere/spark speaker) because of the characteristics of the "speaker" and the acoustical properties of the room. However, there is a mathematical relationship between the two signals. Once this is known it is possible to calculate how the "speaker" would reproduce any other recorded signals in that room, even something as complex as a symphony. The next step was to feed actual speech and music samples into the computer in the form of electrical signals. The computer produced a tape of this material as it would have been recorded in a living room if the samples were played through a hypothetical one-eighth of an ideal pulsating-sphere speaker placed in a corner. The same music and speech samples were also played in the same room through an approximation to the ideal sphere speaker, consisting of 22 four-inch speakers placed on an octant of a sphere of 20 inches radius, driven by a computer-derived electronic equalizing network.

The two tapes were subjectively compared. According to Dr. Bose, observers were unable (during an A-B test) to distinguish the computer-processed music and speech from the speaker-processed music and speech.

The mind boggles at the enormous computations necessary to produce these tapes. The need for a computer is obvious. Even so, when Dr. Bose started this experiment some years ago, it would have taken 20 *hours* of computer time to process 7 *seconds* of music! Today, this has been reduced to 3 to 6 minutes for the same 7-second processing.

The importance of the experiment was that it proved that with proper frequency equalization, the multiplicity of closely spaced small speakers on the spherical surface can produce music and speech signals in a *normal listening environment* that are *subjectively* indistinguishable from those that would be produced by an ideal pulsating sphere in the same environment having no resonances, phase shift, diffraction, or distortion of any kind. Thus Dr. Bose had a precise measurement technique, yet one that worked with the subjective factors in listening experience.

Another experiment was conducted to provide a measurement technique for speaker distortion. Distortion in speakers has usually been measured in an anechoic chamber, but this method of detecting distortion isn't meaningful to the listener in the environment in which the speaker normally operates—his living room. Most speakers exhibit various forms of distortion as their intensity of radiation increases, and have relatively negligible distortion at very small intensities. Dr. Bose's experiment made use of this fact to determine the level of intensity at which a speaker begins to generate audible distortion in music reproduction. Selections of music and speech were played a number of times through the speaker in a listening room at successively increasing intensity levels. Binaural recordings of each successive speaker playing were made at a constant, standard level. The various recordings were synchronized on parallel tracks of an eight-channel tape recorder. The listener subject was then given an A-B presentation of the sample that was recorded with the speaker playing at the lowest level and a sample representing a higher speaker output level. Naturally, both samples were presented at the same level to the listener, and he was asked only to try to detect a *difference*. The level of intensity produced by the loudspeaker for which a difference is first detected is then a measure of the performance of the loudspeaker. This measure is pertinent to the ultimate *subjective* evaluation, but it was obtained without introducing the problems of individual value judgment or prior notions of the sound of distortion. Essentially, this is a way of correlating objective measure with the subjective perception of sound. The subject was not asked whether he likes or dislikes a sound, but merely if he could detect a *difference* between sounds.

Armed with these unique measurement techniques, Dr. Bose continued his researches. As you can see from the foregoing, there has been considerable emphasis placed on the measurements as applied to the listening room environment. There have been many studies of concert halls made which show, conclusively, that an auditor at a concert, no matter where he may be seated, hears the orchestra at a certain ratio of direct-to-reflected sound. Dr. Bose expanded much of the original European data on concert hall measurement; his studies have shown that for virtually all seats in the average concert hall, the reverberant field is dominant. Even in a large hall such as Symphony Hall in Boston, the reverberant field equals the direct field only 19 ft. from the orchestra. It is important to note that in a reverberant field, sound energy arrives at any point via reflections from the surfaces of the room and that the angles of incidence of the arriving sound are widely distributed. This spatial property of the sound incident upon a listener, plus the frequency spectrum for the incident energy, are the important factors in the subjective appreciation of music.

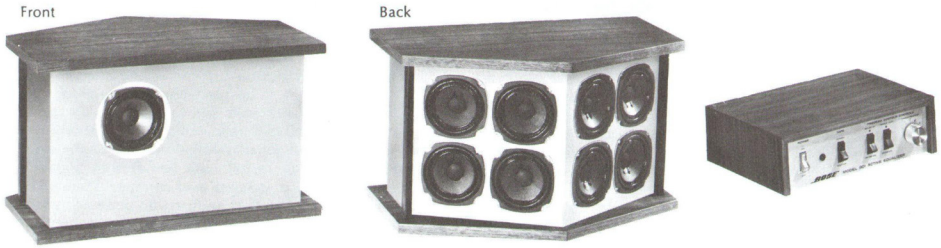
* * *

At first glance the Bose 901 is rather unprepossessing, but a closer look reveals that the unit is pentagonal in shape, with the two rear panels forming a "Vee" angled at about 30 degrees. As you can see from the illustration, four speakers are mounted on each of the rear panels (total of eight), while a single speaker is mounted on the front panel. All nine drivers are identical, specially designed, 4-in. units, with long-excursion voice coils. Each speaker has a power handling rating of 30 watts. Each is a full-range speaker, so there are no crossover networks. The sealed enclosure is densely packed with fiberglass. In this seemingly simple unit there are many sophisticated concepts derived from the research program.

The Bose Model 901 is sold as a stereophonic speaker *system*, with two of the units comprising the stereo channel, and both units controlled by a specially matched active equalizer. To function properly, the speakers must be placed in front of a wall with a minimum spacing from the wall of 6 inches, a maximum of 18 inches (optimum spacing is 12 inches).

Dr. Bose's concept, based on the concert hall measurements which showed the need for a dominant reverberant field, results in the 8 speakers on the two back panels radiating 89 per cent of the energy toward the wall, while the single speaker on the front panel radiates 11 per cent of the energy into the room. This is said to provide the necessary ratio of reverberant-to-direct sound. With the rear panels angled at 30 deg. to the wall, the wavefronts emerging from the first reflections from the back wall, together with the second reflections from the side walls, produce an effective source that is much larger than the actual enclosure; and that is well distributed across the wall in the

Fig. 1—A front and back view of the Bose 901 speaker system, with grille cloths removed, is shown below. (Note that the rear of the system has eight speakers, while the front panel has only one.) At right is the system's active equalizer, which has 10 transistors.



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same sense that an orchestra is distributed across a stage. Since the reflected sound affords a virtual central image, considerable flexibility is possible in regard to the separation of the speakers. Naturally there is a certain optimum placement in any given room, but if circumstance dictates, the speakers may be placed further apart and closer together than other types of speakers, while maintaining the desired balance of stereo separation or center fill (judicious angling of the speakers inwards or outwards in relation to the walls is necessary, of course).

The nine speakers in each enclosure are full-range units and, as you can see in the photo, are closely spaced. The resultant acoustic coupling causes the resonant frequencies of each speaker to be different from every other speaker. In much the same manner as i.f. cans are staggered to get a broad response, the resonances become inaudible; thus the sound of the total array of speakers is very smooth. With no crossover network, each speaker receives the same audio signal. At low frequencies, the nine drivers, operating in phase, move a great deal of air, which is a well-known principle. At higher frequencies the relatively small cones behave like tweeters, with the highest frequencies propagated by the speakers' dustcaps. The pentagonal shape of the enclosure ensures there are no sides parallel to any of the panels on which any of the nine drivers are mounted, which eliminates the problem of standing-wave resonance.

The Bose active equalizer is a solid-state device which influences the acoustic output of the two speaker units. Precise equalization is necessary for flat frequency response of the radiated sound. This involves considerable boost. In the case of flat response for the lowest frequencies, as much as *18 dB* boost is needed. By manipulating the controls of the unit in the proper manner, a total of 20 different frequency contours are available to compensate for variations in room acoustics, phono pickups, program material, and so on. Some of the contours available are unique. For example, midrange frequencies can be reduced, but without a drastic roll-off of high frequencies. There is also a "below-40-hertz" switch that can reduce turntable rumble and other low-frequency disturbances without adversely affecting response above 50 hertz. The equalization of the signal comes before the power amplifier. The unit can be conveniently patched into a preamp/amplifier setup, or an integrated amplifier or a receiver. In fact, the unit is treated as if it were a tape machine, utilizing the tape-in/tape-out jacks of your particular rig. Auxiliary tape input and output jacks are provided on the rear panel of the equalizer.

* * *

Having described the Bose 901 system and its revolutionary concepts, the question, quite naturally, is how does it sound? At this point we'll have to bring up the matter of power amplification. [Because the equalization comes before the power amplifier] when you are trying to reproduce the very lowest frequencies at substantial levels, the 18-dB boost mentioned earlier can place really heavy demands on amplifier power. Let's put it this way: for 99 per cent of the program material played by most people at better than "apartment house" levels, a good 30 to 40 watts *continuous* power per channel should suffice. But when you want to play that other 1 per cent of program material — the great pipe organs, with the really low pedal and, most especially, a sustained low frequency at thunderous levels — that's when you need all the amplifier power you can afford.

The speakers can handle high power, of course (each speaker in the Bose enclosures is rated at 30 watts, for a total of 270 watts per channel). You can lower your power requirements by activating the "below 40 Hz" switch, however. You gain about 6 dB this way. It is true you lose the frequencies below 40 Hz, but if you desire to play the system at house-shaking levels, and don't have sufficient amplifier power, this is the way it can be accomplished.

I've had good results driving the Bose with medium- and high-power amplifiers. I tried it with a University receiver and with a CM 911, for example. Also with the McIntosh 2105, which has the advantage of a power level meter. If you monitor the output of the Mac amplifier during the heaviest fortes of some grandiose symphony, and set the gain so that you don't exceed +3 (105 watts per channel), you won't hear any distortion. (I didn't.) You will also find it's pretty loud!

Lucky lad that I am, there is very little program material that I can't cope with; not when I have a pair of McIntosh 3500 amplifiers, each capable of a mere 350 continuous watts per channel! These 120-pound (each) brutes are quite magnificent when working with the Bose speaker systems. I put on an organ recording containing plenty of "low C" pedal, and at a level of 108 dB (measured on a sound-level meter) the visual evidence of a scope across the speaker terminals and the audible evidence indicated that the Bose and the Mac had just barely reached a point of mutual distortion.

In evaluating the sound of the Bose 901 system, I was constantly aware that I was listening to an entirely *different* kind of loudspeaker. In some ways, comparison of this speaker with conventional types isn't quite valid. Even without its other virtues, the overwhelming superiority of the Bose in terms of *spatial presentation* and *stereo effect* was immediately apparent. There is no question in my mind about the desirability of the direct/reflecting principle for home listening. With a symphonic recording, the illusion of an orchestra spread across the wall is uncanny. With the virtual image in the center you can sit well away from the traditional "stereo axis" and enjoy a very good stereo presentation. It is the closest thing I have heard to a true three-channel stereo recording. The overall sound is outstanding for its clarity, transparency, wide range, crisp clean transients . . . and just plain naturalness. Equally astonishing is the bass response. To hear a thunderous "low C" organ pedal from these small (approx. 20 x 12 x 12) speakers, or a clean, weighty impact of a large bass drum is truly impressive. The speakers are mercilessly revealing of the faults in all manner of program material. It is a comparatively rare recording that could be played with the equalizer set in the flat position. (There is obviously more high-frequency distortion around than I realized.) The Bose really comes into its own with top-quality tapes. I have some symphonic masters and some one-to-one copies of masters, and they were reproduced with a naturalness that is quite compelling.

With only kudos for the Bose's performance, there *are* some minor drawbacks, some of which have already been mentioned: Fairly high-power amplifiers are needed to realize the 901's *full* potential; if you use headphones, the equalizer should be switched off; priced close to $500 for the entire system (two speaker systems and the solid-state equalizer), they cannot be considered to be truly inexpensive; placement requirements (6 to 18 inches from the wall) can be a problem to some persons since "bookshelf" location is excluded. But the above are trifles, in my estimation, when balanced against the astonishingly realistic sound achievable at home with the Bose speakers.

There is no doubt that the much-abused and overworked term, "breakthrough," applies to the Bose 901 system and its bold new concepts. Æ

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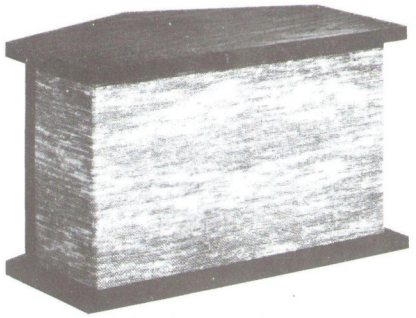
e/e HIGH-FIDELITY



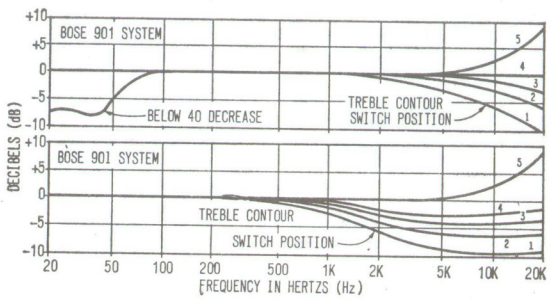
BOSE Model 901 Direct/Reflecting Speaker System

Audio engineers generally acknowledge that speaker systems are the weak link in the chain of components encompassing hi-fi reproducing systems. Amplifiers, preamps, recordings, have all benefited from state-of-the-art developments employing solid-state devices, but speaker design has followed the same basic concept since the introduction of the dynamic reproducer.

Many design engineers have attempted to overcome the inherent weaknesses of the moving coil reproducer. By novel applications of mechanical, electrical, and acoustical principles in combination they attempt to produce a speaker system that sounds like the original vocal, solo instrument, or orchestral rendition.

Hi-fi enthusiasts spend hours, even weeks or months in selecting a speaker system that pleases them. As a result, they are convinced that there really is little possibility that a new system will be developed that can provide cleaner, more realistic reproduction of sound. To correct for the deficiencies in speaker systems, amplifiers have been provided with unique compensating circuits that provide boost and/or cut at both high and low ends and sometimes in the mid-range of the audio spectrum. All of these circuits add to the cost of the amplifier.

Design Considerations. The recently introduced Bose 901 speaker system appears to have met the challenge. The Bose 901 is a product resulting from extensive research that disclosed many basic considerations to be taken in designing a speaker system. Among them are: a) correct balance between reflected and direct sound radiation: b) a means to overcome conflicts created by inherent resonances of speaker mechanisms and speaker housings; c) a new technique in the measurement of speakers, resulting in new standards for design, taking into account environmental conditions in which the speaker system will be operated; d) a new approach to the equalization of the signal driving the speaker to correct for deviations in frequency response created by



Curves supplied by manufacturer show various treble contours possible with Bose 901 speaker system and its equalizer. In upper graph, treble level switch is in normal position; in lower graph, switch is in decrease position.

e/e BOSE 901 SPEAKERS

mechanical design limitations; e) elimination of cross-over networks because of their inherent inability to effectively control amplitude and phase of the acoustic output in the crossover region, be they active or passive; f) a means to provide smooth, continuous acoustical blending of stereo channels without the necessity for a center speaker; and g) a means of eliminating standing waves that can affect frequency response.

Adapting Design Research. The Bose 901 system is comprised of two speaker enclosures, each pentagonal in shape, 12¾ x 20 9/16 x 12⅞-in. (HWD), and each containing nine 4-in. speakers. In addition, the system is furnished with an active equalizer that is inserted between the preamp and the power amp.

The form of the housing was developed for reasons other than to make a speaker having a different shape than those which are now popular. Two rear baffles are joined at an angle of 120° to establish a proper reflective angle off the wall of the room in which the speakers are operating. Because of this angular placement and the large ratio (8 to 1) of radiated sound, achieved by employing eight speakers on the rear angled baffles and one facing forward on the front baffle, there is uniform dispersion throughout the room without a "hole" in the center.

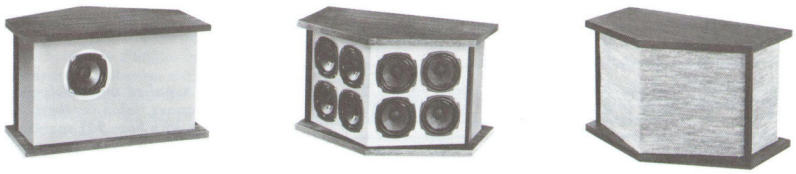
For listeners, this creates the illusion of being in a concert hall with a full orchestra spread across a stage. It removes completely the necessity of having the listener located directly on the axis of the speakers in order to enjoy the full high frequency response of the system. To create the concert hall illusion, the speaker housings must be placed 8 to 20-in. from the wall (12-in. is ideal average) to take advantage of the reflective wall surface that was calculated in the overall system design.

Also, the enclosures are shaped in pentagons to ensure that there are no surfaces parallel to the speakers, thus avoiding standing waves.

By placing eight speakers closely spaced on the rear baffles, acoustic coupling creates a resonant frequency for each speaker that will be different from that of every other speaker. The end result will be that each resonance becomes inaudible because it changes the output of just one of many speakers in the system. Thus, the distortion of sound that is caused by resonances in conventional systems is eliminated by using many speakers, each being driven by the same signal. This, in fact, is the principal reason for the improved clarity and definition of reproduction from the Bose 901, as compared to other speaker systems.

Excellent Bass Response. To solve the problem of wide response with good bass reproduction, designers have always used as large a speaker as possible for reproducing lows, along with smaller speakers to reproduce mid range and highs. In addition, they have employed a passive crossover network to route the appropriate frequency segment to a specific speaker. At best, these networks contribute appreciably to the overall distortion of the complete system. Despite the distortion effects of this combination on the response curve of such a speaker system, it appeared to be the only feasible method of covering the full audio range with dynamic speakers.

Bose, however, developed special techniques, requiring many hours of precision measurements of room characteristics along with computer analysis of taped performances, to prove that multiple small speakers can reproduce the same range as with single large speakers with no resonances or distortion. Bose employs a total of nine 4-in. special, long excursion, high compliance cone, wide range speakers in each pentagonal housing. Arranged in an in-phase array these can move large amounts of air, which, along with the special equalizer, accounts for the spectacular bass and clean mid and high range response of the 901 system.



Left, view of front and (center) view of back of Bose 901 with grille cloth removed (note that unit has eight speakers in rear, only one in front). Right, view of rear of unit with grille cloth in place.

Bose Lab Check
Continued

High Power Capacity. Since each of the nine speakers individually can handle 30 watts of audio power, the complete system is capable of operating at very high power levels (upwards of 270 watts), that may be required to reproduce low frequencies of sufficient loudness. Bose recommends that amplifiers having a minimum of 20 watts power output be used. This is necessary to overcome the losses created by the equalizer and still have sufficient power output to recreate the dynamic range necessary to produce the illusion of natural reproduction.

The Active Filter. Regardless of the design of any speaker system, its overall performance can be improved somewhat by the application of correctly designed electronic networks that compensate for its variations from a uniform frequency response. Because it is impractical to equalize for variations created by resonances, speaker systems have suffered. However, since the Bose 901 speaker has been designed to be virtually free of resonance effects, the active equalizer that is part of this speaker system, produces uniformity of radiated power vs frequency not attainable in other commercially available speaker systems. This equalizer is a sophisticated, transistorized, active unit that accurately compensates stereo response for the effects of speaker characteristics, enclosure dimensions, radiation impedances and even the grille cloth covering the baffles. Equalization is accomplished without introducing distortion. This is achieved by equalizing the signal between the preamp and the power amplifier which, therefore, removes the necessity of employing the iron core inducers and capacitors capable of handling high power, that introduce distortion in passive filters. Further to this, it is possible to get a greater degree of accuracy in equalization by the use of more elements in an active filter than is practical in a passive one.

Tailoring Response. Besides affording the compensation required to produce flat acoustic response, this equalizer provides a selection of nineteen additional contours, selectable from the front panel of the equalizer. This flexibility of control of equalization permits the listener to tailor the response to meet his particular tastes in compensating for room characteristics, recording techniques, and other variables. A separate switch produces steep, uniform attenuation below 40 Hz to remove turntable rumble without affecting bass response from 50 Hz on.

Conclusion. The Bose 901 speaker system delivers the most natural stereo sound, creating the illusion of being in a concert hall, with a uniformity of frequency response and freedom from distortion that is unbelievable, particularly if the listener takes into account the physical size. Considering all its advantages, the price tag of just under $500.00 for the complete system, which includes two speaker assemblies and the active equalizer, is modest. It is our opinion that this is the speaker system to own, regardless of price, if one wants the ultimate in listening pleasure.

For further information and literature, write The Bose Corp., Dept. E, Natick, Mass. 01760 ■

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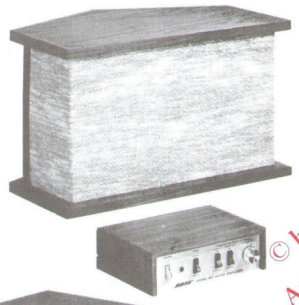
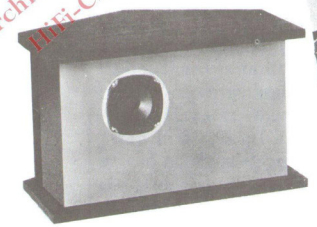
Hi-Fi BUYERS' GUIDE

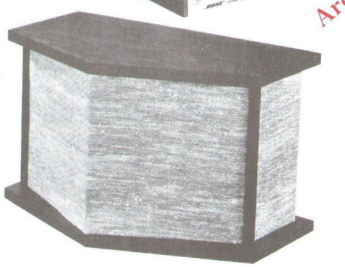
Speakers

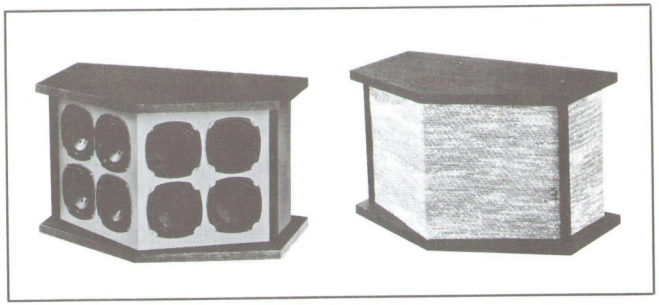
Foremost among current speakers tracing their lineage back to yesteryear is the Bose 901. Widely acclaimed by most anyone putting pen to paper, the 901 has been hailed again and again as a breakthrough in technology. Quite the contrary, there is no *new* technology in the 901; the true secret behind the 901 is that it is the first system to roll three oldish ideas—rear radiation, multiple speakers, equalization—into one. The sound? The 901 is very possibly the only speaker system to date to actually pour forth in true concert-hall fashion.

UN-TENABLE TRIO FROM YESTERYEAR









Utilizing a "new" approach to sound reproduction that incorporates at least three time-tested ideas, the Bose 901 is capable of delivering some of the most natural sound ever heard from a speaker system. Its midrange and highs are magnificently transparent, its lows neither smeared nor boomy, its over-all sound quality so clean that the listener is almost unaware of the electronics between him and the instruments. How does it succeed? Through use of reflected rather than direct radiation; multiple speakers rather than crossover networks; a special equalizer to contour response to suit room requirements.

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STEREO & HI-FI TIMES

Bose 901 Speaker System

There are a number of tried-and-true principles at work in this speaker, all of which combine to create one of the finest products it has been my pleasure to hear in some time.

The Bose 901 is a complete stereo speaker system. The package consists of two speaker containers and a control box. Each of the speaker boxes contains a total of nine drivers, all of them identical. This, in itself, is nothing new—multi-speaker systems have been with us for quite a while. Old-timers will remember the *Sweet Sixteen*, in which a number of low-cost speakers were combined to make what was supposed to be a high-quality speaker. It didn't quite work, partly because 16 times poor quality is still poor quality. Bose has used specially designed, high-grade, long-throw speakers. They are each four inches in diameter.

Eight of these speakers are facing the rear of the enclosure, with the ninth facing forward. The enclosures are not identical in the placement of that front-facing speaker. That is why they are specified as a *left* and *right* stereo pair. The principle of operation has all of the speakers functioning as a woofer to move a notable amount of air. Thus, excellent bass is realized from the system even though small speaker drivers are used. With eight of the drivers facing rearward, most of the sound you will hear will be reflected off the wall. Specifically, 89 percent of the sound is reflective and 11 percent is direct. According to the manufacturer, this is done to simulate the actual performance characteristics of instruments in a concert hall.

It is not new to speaker design to have such a multi-directional sound source. But some of the earlier attempts fell short of ideal on sonic qualities. This one does not.

A multi-directional speaker seems to have its sound escape from its box. The source of the sound becomes an area of space above and behind the actual enclosure. This is created beautifully by these speakers. A stereo pair fills the wall with stereo, yet each instrument has its prescribed space—and it stays there. You can spread these speakers much wider apart than conventional boxes without creating a "hole-in-the-middle" effect.

When 89 percent of the highs you are hearing are bounced off the wall, you are going to have an apparent loss of highs—depending on the absorption characteristics of the wall. (The man-

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The Bose 901 speaker system.

ual for the 901 specifies that the speakers must be 12 to 18 inches from the wall, with the V point of the enclosure pointing at the wall.)

In order to compensate for this characteristic, the Bose 901 comes with a special active-equalizer box. This control is connected between preamp and amplifier, usually via the tape monitor controls on your amplifier. (There is a tape-monitor control acting as a substitute on the equalizer panel if the monitor control connections on your amplifier are used.)

The equalizer serves to restore some of the lost highs that reflection creates. It also serves to slightly boost the extreme bass of the speakers. In short, the manufacturer recognizes that certain weaknesses exist in the basic speakers and he has taken this legitimate route to correction. The net result is that you can achieve a pretty nearly true flat sound from the speakers.

The equalizer does, additionally, permit you to tailor this sound somewhat. A total of 20 possibilities via three switches permit a wide range of subtly effective control. Most of this is on the treble end, with curves of presence, boost and cut available. These are not substitute amplifier tone controls—they function to control only the speaker *vis a vis* the particular room it is in—but they can do some effective correction of program defects as well. As an example, the Ortofon SL-15T cartridge reviewed elsewhere in this issue sounds much better with the right-hand switch activated. This puts a slight depression in the upper mid-band and rolls down the highs slightly, neatly compensating for the brightness of the Ortofon. Other cartridges I have need other compensation or can be used in the indicated flat positions on the equalizer.

All of this is very nice. But the proof of the pudding inevitably is sound. And it is here that the Bose 901 stands clearly away from the crowd. I've already commented on the directional characteristics—they are in no small measure responsible for the naturalness of the sound. But the bandwidth and transient characteristics of the speaker play an important part, as does the freedom from coloration.

I have spent a good deal of time listening to these speakers. They have been connected into a system that contains the finest componentry, including a high-power amplifier. There are only a few speakers I have ever come across that I can listen to for long periods. This is one of them.

The bandwidth is certainly there. The speaker goes down smoothly to 34 Hz and rolls off slowly below, according to frequency sweeps I made. There is still useful response at 25 Hz. That is certainly as deep as most music will go and, in any case, as deep as recordings will let you go.

At the high end, the speaker continues to go out, without audible peaks and valleys, to well beyond the upper limits of my hearing. As a check of the effectiveness of the directional characteristics, I put a 12 kHz signal on the speaker. There was no apparent change in level as I walked around the room. In any position there was a uniformity that bespoke the excellence of both the dispersion and the compensation of highs.

But we don't listen to sine waves, we listen to music. What a lovely sound these speakers produce!

On small groups the sound is clear and lifelike; with massive forces, the speaker simply expands to take up the slack. One of my favorite tests uses massed choral works. The dispersion characteristics take care of the stereo spread effectively. The sonic characteristics make the voices sound real. A massed chorus is an assembly of individual voices. A good speaker will sound just that way, a less-than-good speaker will homogenize the chorus into a confused mass. Listen to Columbia's *Carmina Burana* on this speaker and hear what a chorus should sound like!

Piano is always tough, but the Bose 901 makes it sound like it is. However, the hardest is male voice. Here the Bose system has a slight bass underline on the voice (as do so many speakers) but it *is* slight. and much better than most systems I hear.

All in all, the Bose 901 produces as well-balanced a musical sound as one could want. Sharp transients are followed faithfully. When a sound stops suddenly, so does the speaker. It does not produce bass when there is no bass in the music, but it does produce the deepest bass when it is there.

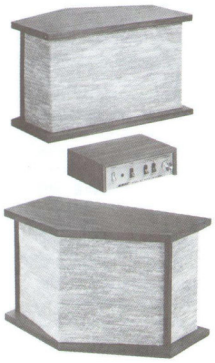
Each of the enclosures is 20½ by 12¾ by 12⅞ inches. They are compact in size, certainly. The complete system costs $476 (including the equalizer). It wants a lot of power—if you like to listen loudly, consider 50 watts per channel as a minimum. But these speakers provide a quality that is not to be matched.

the **AMERICAN**

record guide

SOUND IDEAS

An Equipment Review **By LARRY ZIDE**



Bose 901 Speaker System

THERE IS a great deal of advance interest in this report—and not without reason, as you will see.

Bose is a relatively new company, and the 901 is its one and only product. This is a "system" in every sense of the word, because the model number actually includes two speaker units plus an electronic control that goes between your preamp and amp. (It can also be hooked up to the tape monitoring circuits, and will provide switching for a tape recorder in addition to fulfilling its own primary functions. More about these presently.)

The two speaker enclosures are marked for left and right channels. At first glance you might think that they are meant for corner placement only, though this is hardly the case. They are not very large—only about 19" wide across the flat front and 13" deep.

Yet inside each box are nine small high-quality speakers! Eight face the rear, via the two faces of the pointed side. The ninth faces forward, in the upper left of the left speaker and upper right of the right speaker. The frequency spectrum and strength are divided among the speakers so that each gets fundamentally the same. The enclosure is intended to be free-standing, some distance from a wall. The eight rear speakers act as dispersers, serving mostly to reflect sound from the wall. Only the ninth or forward speaker localizes sound, in particular for the poorly-reflected highs. The net effect is intended to be an impression of wide sound dispersion over a broad plane (as in a concert hall) which nevertheless preserves the localizing information of stereo.

It works!

The Bose 901 is, indeed, one of the finest speaker systems it has ever been my pleasure to hear. I have lived with it now for several months, so that I am quite sure of what I say. I have long believed in the value of wide sound dispersion, and this system amply provides it.

Dispersion notwithstanding, it is the sound itself that remains paramount. The 901 is characteristically smooth. Everything is simply *there*. At high frequencies the ear indeed tells you that the frequency is there, but you do not have any "beaming" effect as with direct radiators. The bass is smooth down to my room's resonance at 34 Hz, with a smooth rolloff below. And there is useful output to about 25 Hz, which is plenty low enough.

In part the 901 achieves its excellent bass response by means of a boost circuit in the control box. This places an enormous strain on a power amplifier of marginal power. And 60 watts may prove to be marginal! I would say that to use the Bose 901 at its full potential demands an amplifier that can provide at least 50 or 60 watts *at 50 Hz and below*. Less than that will cause you to hear some audible bass distortion (caused by the amplifier clipping) *at very high listening levels in large rooms*. In any case I think that so fine a speaker would be simply wasted on amplifiers that can provide only 20-25 watts per channel.

The control box provides a useful degree of speaker *tuning*. It does serve to compensate the speaker against room acoustics, but it will do more. If you have a bright (or dull) cartridge and a tape recorder that is flat, they will not sound alike with equally good material. The high-frequency control can be used to (subtly) boost or cut highs in such a way as to equalize a bright cartridge. I have used this to compare more accurately the relative sound of cartridges, and it *is* effective.

But back to the sonic quality per se. I would have expected that all this reflected sound might have a bad effect on the sharpness of transients. Not so. The 901 is quite crisp in its attacks. When the music stops, so does the speaker.

But you really have to hear music from the best sources (such as master tapes) to appreciate all the virtues of this extraordinary system. True, at a price of $476.00 for the pair its virtues may not be for everyone. And perhaps I have failed (I suspect that I *have* failed) to give a clear picture of its special qualities. I urge that you listen for yourself. I think you will have to agree that Bose has, in a single giant step, produced one of the finest speaker systems ever made.

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Saturday Review

Irving Kolodin Reviews the BOSE 901

Cadillac Quality in Volkswagen Space

The long-standing contention that the bigger the speaker the better the sound has, in the last decade, been fighting a rear-guard action against the clear voice of reason embodied in the bookshelf types pioneered by Edgar Villchur in his AR revolution. But the heaviness of some, the less than fulfilling extremes of range of others, have left the musical optimumists vaguely or less than vaguely dissatisfied, according to their inclinations and expectations.

In the last year or so, however, aural extremists have been offered a new solution to their problems, and, after a time trial measured in months rather than weeks, this one can definitely proclaim that Bose is best, big or small, high or low. Like many top innovations, it is not the cheapest or the prettiest embodiment of its purpose, but it combines function with form in classical proportions of efficiency and compactness. For the furniture minded, the well-textured wood frame is available with a choice of four grill panel cloths.

The particular novelty of the MIT-derived design (Amar G. Bose did graduate and postgraduate work, and has held a professorship in acoustics at that institution) is the diffusion of sound from the rear of a small, cube-shaped hexagon, rather than from the front. A mere 20 5/16 inches wide, 12 3/4 inches high, and 12 7/8 inches deep, it uses the wall against which it is positioned as part of the sound-dispersing pattern. Two of them properly powered (my source is Marantz) can provide more sound than even an oversized studio room can absorb. An adapter network, housed in a less than book-sized enclosure, enables the speakers to be tuned to the specific space in which they are positioned.

As a basis of comparison, my listening ears have been attuned for more than a decade (since 1958, when stereo came in) to a pair of oversize KLHs (7s, measuring many feet of cubic content) extended in range through electrostatic mamama (high end) tweeters. Not only can I not detect any loss of response at the extremes of range in an A-B test of the Bose pair vs. the KLH-plus pair, but there is more solidity in the Bose midrange and equal smoothness through the transient response. The pair of Bose speakers list at $476, but the payoff is comparable to Cadillac quality in Volkswagen space. —I. K.

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down beat

A Report on Bose 901 Speakers

The weakest part of hi-fi systems has been the speaker, since technology caught up with amplifiers and tuners. The frustrated audiophile knows that the signal coming from his amplifier is miraculously close to that coming off the original recording microphone—but somehow it doesn't sound the way it did in the studio.

One fault in reproduction lies with the limitations of microphones. A microphone is no substitute for the human ear with respect to direction and differentiation of sound.

On todays multitrack recordings, the emphasis is on one sound or instrument per microphone for greatest separation on the recorded tracks. The greater the separation, the more freedom the recording engineer has concerning what instrument goes in which channel in a stereo mix-down of all the tracks. After the mix, records are mass-produced from the stereo tape master. Up to this point, the audio signal has not suffered any great loss but rather has been boosted and equalized by the engineers. The stereo amplifier and record changer in the average set is capable of doing a great job in reproduction.

But here is the second fault—the speakers. Even with the best equipment, the output of a microphone amplified through speakers will not sound the same as the original sound source.

Why? The directional microphone pulls in mostly sound from the voice or instrument. The human ear pulls in direct and reflected sounds and mixes them to arrive at a natural sound. A speaker must be able to compensate for the non-reflective sound of the recording microphone by adding an extra amount of reflected sound. Few speakers compensate in this way.

The speakers in a recording studio are conventional bass reflex or acoustic suspension design, designed to reproduce a flat response under acoustically controlled conditions. This tells the engineer exactly what the microphone is picking up and helps his trained ear compensate for scarcities of reflections produced in the listening area (equalization, echo, etc.).

At our studios, however, we have tried two stereo sets of Bose 901 speakers [142] with the active equalizers enclosed. The direct and reflected sound reproduced by the Bose speakers with the help of the 901 equalizer sounds amazingly natural and holds true to the sound the artist in the studio is hearing.

At first, we were skeptical about the Bose in physical comparison with acoustic suspension and bass reflex design but after testing, we found improvements we couldn't overlook: the nine speakers in the enclosure eliminated audible speaker resonances; there was no loss in the crossover or inaccurate crossover frequencies because the Bose has full-range speakers and does not require a crossover; the test tones we sent through our four Bose speakers proved that any point in our control room is a good listening point—i.e., there seems to be equal volume coming from each speaker, yet each of the four speakers is identifiable by test tone.

The one fault we found was in the response curve of the speakers without equalizers, but this is almost by design. Bose eliminated the problems conventional speakers only minimize. In doing so, they created a speaker with high coloration over the audible range. They then designed the 901 equalizer, which tapers the sound of the amplifier in each frequency range to fit the needs of the Bose. The efficiency of the equalizer showed us we could use the Bose consumer speakers in professional applications, and the high capacity of the Bose let us drive them with our studio amplifiers, at a whisper or wide-open, with clean and true sound. The Bose have replaced forever our bulky studio speakers with compact, handsome units. The only trouble is—our studio is beginning to look like a living room!

—Chuck Lishon

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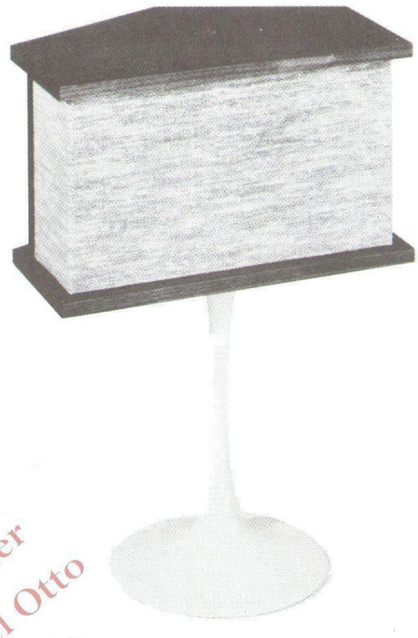
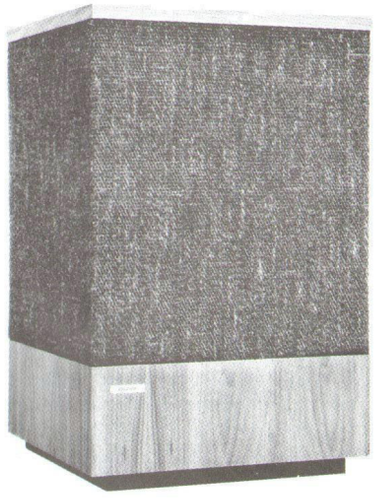
Out of the Research that Produced the 901—

BOSE brings you the Second DIRECT/REFLECTING™ Speaker System





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The BOSE 901

DIRECT/REFLECTING™ Speaker System

1 REVIEWERS SPEAK

The most highly reviewed speaker system regardless of size or price.

2 OWNERS SPEAK (Data from recent owner survey.)

a. Owners of the big speakers — costing up to $2400 — are trading for the 901.

b. People intending to spend only $130 per speaker buy the 901 once they hear it.

c. 32% of the people who purchase the 901 were not in the market for speakers until they heard the 901.

The BOSE 501

DIRECT/REFLECTING™ Speaker System

1 THE DESIGN GOAL

Our objective was to produce a speaker in the $125 price range that would audibly outperform all speakers costing less than the 901.

2 THE DESIGN APPROACH

We preserved as many of the features of the 901 as possible to produce a speaker that sells for $124.80.

3 THE PERFORMANCE

You are the judge. If we have succeeded in our design goals, the result will be obvious to you when you A-B the 501 with any speaker selling for less than the 901.

"You can hear the difference now."

THE BOSE® CORP.

Natick, Massachusetts 01760

verfügbaren Systemen. Der Bose 901 klang ausgesprochen sauber, transparent und frei. Seine Klarheit und Klangdefinition wurde besonders bei orchestraler Wiedergabe von keinem Lautsprecher übertroffen. Dieser Eindruck bestätigte sich auch bei Impulsmessungen, die über den ganzen Bereich ausgezeichnet waren. Die Wiedergabe im untersten Baßbereich hätte man einem solch kompakten System nicht zugetraut. Er hatte alle raumfüllenden Eigenschaften der besten akustisch geschlossenen Systeme und darüber hinaus die Präsenz und Klarheit eines Breitbandelektrostaten. Seine räumliche Klangverteilung, durch die eine ganze Wand förmlich zum Leben erweckt wird, ist der wesentliche Grund für das realistische Klangbild. Ich muß gestehen, daß ich nie ein Lautsprechersystem in meiner Wohnung hatte, das den Bose 901 übertroffen oder ihm auch nur nahe gekommen wäre in bezug auf seine allumfassende Klangtreue.

Hirsch-Houck Laboratories
Hi-Fi/Stereo Review

Einmaliges Hörerlebnis.

Durch die acht nach hinten gerichteten Lautsprecher stammt der Hauptanteil des Schalls von der Reflexion an der Wand. Genau genommen sind es 89 % Reflexion und 11 % Direktschall. Nach Angaben des Herstellers stand die Überlegung dahinter, daß nur so eine echte Simulierung der Gegebenheiten im Konzertsaal zu erreichen ist.

Das Prinzip der *multidirectional* Klangquelle ist nicht neu im Lautsprecherbau. Aber viele frühere Versuche sind durch den Mangel an Qualität fallen gelassen worden. Dieser Versuch schlug nicht fehl.

Beim *multidirectional* Lautsprecher scheint sich der Schall von der Box zu lösen. Rings um die Schallquelle breitet sich ein geräumiges Klangbild aus, das hier auf wunderbare Weise realisiert wird. Ein Stereopaar macht die Basis stereophon, wobei jedes Instrument seinen festen Platz hat, den es auch behält. Sie können diesen Lautsprecher weiter als die herkömmlichen voneinander entfernt aufstellen, ohne befürchten zu müssen, daß ein Loch in der Mitte entsteht.

Der schlagenste Beweis ist zweifellos der Klang. Hier läßt der Bose 901 die anderen weit hinter sich. Die Richtungscharakteristik habe ich schon erwähnt. Sie ist für die Natürlichkeit des Klangbildes weitgehend verantwortlich. Bandbreite und Impulstreue spielen dabei die gleiche wichtige Rolle wie die Verfärbungsfreiheit. Ich habe viel Zeit mit diesem Lautsprecher verbracht. Die Übertragungskette bestand aus lauter hochwertigen Komponenten, einschließlich eines Hochleistungsverstärkers. Nur wenigen Lautsprechern kann ich stundenlang zuhören. Dies ist einer!

Die Bandbreite ist bestechend. Nach meinen Frequenzgangmessungen geht der Lautsprecher linear bis 34 Hz und fällt darunter sehr langsam ab. Die Wiedergabe ist selbst bei 25 Hz brauchbar. Dies ist sicher der tiefste Punkt, der von Musikprogrammen zuweilen erreicht wird, an den normale Aufnahmen jedoch selten herankommen.

Zum oberen Ende hin verläuft der Frequenzgang ohne hörbare Spitzen und Einbrüche und zwar weit über meine Gehörgrenze hinaus. Zur Bestimmung der Effizienz seines Dispersionsgrades habe ich ein 12-kHz-Signal verwendet. Es war keine Pegelabweichung beim Herumgehen im Raum hörbar. In jeder Position empfand man eine Gleichmäßigkeit, die die exzellente Dispersion und den Höhenausgleich nur bestätigte.

. . .

Wir hören jedoch keine Sinuswellen sondern Musik. Und wie schön sie klingt aus diesen Lautsprechern! Bei kleinen Gruppen ist der Klang offen und lebensnah; große Klangmassen werden unverzögert verarbeitet. Einer meiner beliebtesten Tests enthält massive Chormusik. Die Dispersionscharakteristik läßt den Stereoeffekt sehr gut zur Geltung kommen. Die Klangcharakteristik läßt die Stimmen als sehr real erscheinen. Ein Chor stellt einen großen Verband einzelner Stimmen dar. Ein guter Lautsprecher wird dies eben genau so reproduzieren, ein weniger guter wird den Chor zu einem homogenen Klangkörper zusammenschmelzen. Hören Sie sich die Carmina Burana (Columbia) aus diesem Lautsprecher an und Sie werden feststellen, wie ein Chor klingen sollte.

Klavierwiedergabe galt schon immer als besonders kritisch, der Bose 901 bringt sie wie sie ist.

Alles in allem erzeugt der Bose 901 ein ausgewogenes Klangbild, wie Sie es sich besser nicht wünschen könnten. Kurzen Impulsen folgt er exakt. Stoppt der Schall plötzlich, so ist der Lautsprecher ebenso schnell in Ruhe. Wenn die Musik keine Bässe enthält, wird auch im Lautsprecher keiner übertragen. Existieren aber welche, so werden auch die tiefsten wiedergegeben. Sie benötigen viel Leistung bei lautem Hören, mindestens 50 Watt pro Kanal. Dafür ermöglichen sie eine Qualität, die nicht so leicht ihresgleichen finden dürfte.

Stereo & Hi-Fi Times
Spring 1970

Ein neuer Weg.

Der Bose 901 ist in der Lage, den natürlichen Klang, den man je von einem Lautsprechersystem gehört hat, zu erzeugen. Seine Mitten und Höhen sind von hervorragender Transparenz, die Tiefen weder verschwommen noch bumsig. Die Gesamtklangqualität ist so klar, daß sich der Hörer der Elektronik zwischen sich und den Instrumenten gar nicht bewußt wird.

Der Klang? Der 901 ist zur Zeit wahrscheinlich das einzige Lautsprechersystem, das eine echte Konzertsaalqualität erzeugt.

Hi-Fi Buyers Guide
Fall/Winter 1969 Issue

Weitere hervorragende Testberichte sind veröffentlicht in Hi-Fi Stereophonie, Deutschland (Karl Breh); Fono Forum, Deutschland (Stratos Tsobanoglou); Revue du Son, Frankreich (J. M. Marcel, P. Lucarain); Technique, Frankreich (Gilles Nardeau); Revue du Son, Frankreich (Jaques Dewèvre).

Das deutsche Nachrichtenmagazin »Der Spiegel« berichtet über Bose (Nr. 22/71). Fragen Sie nach den Sonderdrucken.

PRESSE KOMMENTARE

THE **BOSE** 901®
DIRECT/REFLECTING™
SYSTEM

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Hi-Fi INTERAUDIO
INTERAUDIO
6 Frankfurt/M., Schumannstr. 34a
Tel. 0611/749404

Die zwölfjährige Entwicklungsgeschichte.

Der 901-Lautsprecher wurde von Dr. Amar G. Bose, Professor der Elektrotechnik am Massachusetts Institute of Technology, entwickelt. Dr. Bose lehrt neben anderem Elektroakustik und ist seit jeher ein ausgesprochener Musikliebhaber und Hi-Fi-Enthusiast. Vor ca. 12 Jahren stellte er ein Forschungsprogramm zur Untersuchung von Lautsprechern auf. Er erkannte, wie richtig die alte Erfahrung ist, daß der Lautsprecher das schwächste Glied in der akustischen Übertragungskette darstellt. Als junger Violinstudent und ständiger Gast bei den Konzerten des Boston Symphony Orchestra in der nahegelegenen Symphony Hall war es Dr. Bose nicht möglich, dem Höreindruck im Konzertsaal etwas Vergleichbares mit Hilfe im Handel erhältlicher Lautsprechern gegenüberzustellen. Dies betraf in erster Linie die von ihm besonders geschätzten Streichinstrumente, die zwar recht interessant, aber doch sehr wirklichkeitsfremd klangen. Die Voruntersuchungen bestätigten, daß die wesentlichen Lautsprecherprobleme aus der Inadäquanz der Standardmeßtechniken, die sich hauptsächlich auf Tests im schalltoten oder freien Raum sowie subjektive Hörtests stützten.

In den vergangenen 30 Jahren wurde die Lautsprecherentwicklung zu einem Teil exakt wissenschaftlich (mit Hilfe schalltoter Räume und in Reihe betriebener Tongeneratoren und Oszillographen), zum andern handwerklich empirisch betrieben, d. h. durch „Basteln und Probieren", „Membrandoping", individuelles Abstimmen und darüber hinaus immer wieder in Form subjektiver Hörversuche. Es scheint für diese Art von Lautsprecherforschung wenig Argumente zu geben; Musik wird nun einmal nicht im schalltoten Raum gehört. So erhob sich die Frage nach dem Aussagewert von Messungen im schalltoten Raum gegenüber dem gewöhnlichen Hörmilieu.

Dr. Boses Aufgabe war in der Tat äußerst schwierig: die Parameter für den Klang des idealen Lautsprechers (theoretisch eine pulsierende Kugelsphäre), falls überhaupt realisierbar, herauszufinden und präzise, diesem Klangbild adäquate Meßtechniken zu entwickeln, und zwar immer unter Berücksichtigung der Hörbedingungen im Wohnbereich.

Mit Hilfe der enormen technischen Ausrüstung des M.I.T. widmete sich Dr. Bose in seinen ersten Untersuchungen der Simulierung der idealen, pulsierenden Kugelsphäre, deren Oberfläche Druckwellen in allen Richtungen gleichmäßig abstrahlen sollte. Herauszustellen ist die Tatsache, daß es für sehr wichtig gehalten wurde, die pulsierende Kugelsphäre genau in einem solchen Raumtypus auszumessen, wie er den normalen Betriebsbedingungen eines Lautsprechers entspricht. So mußten die Schwingungsknoten, die stehenden Wellen usw. in die Messungen miteingehen. Eine ideale, pulsierende Kugelsphäre, die kurze, hochfrequente Impulse erzeugt, kann durch eine Hochspannungsfunkenentladung, die in einem typischen Wohnraum einmal pro Sekunde ausgelöst wurde, simuliert werden. Der Schall dieser Entladung wurde mit einem kalibrierten Western Electric 640-AA Kondensatormikrofon aufgenommen. Das Mikrofon wandelte das Schall-Signal in ein elektrisches um, womit der Akkumulator eines speziellen Digitalcomputers gespeist wurde.

Mit 4000 gespeicherten Entladungen führte der Computer eine Rechenoperation durch, bekannt als Digitalabgriff oder Überlagerungsintegration (ich kann Ihnen versichern, daß dies jenseits meiner Kenntnisse liegt).

Das Resultat war ein mathematisches Modell des idealen Lautsprechers. Die Signale des Computer-Magnetbandes unterscheiden sich selbstverständlich vom Original (erzeugt von der idealen, pulsierenden Kugelsphäre/„Funkenlautsprecher") in bezug auf die Charakteristik des „Lautsprechers" und die akustischen Eigenschaften des Raumes. Trotzdem ergibt sich eine mathematische Beziehung zwischen den beiden Signalen. Ist diese einmal bekannt, so ist es auch möglich, rechnerisch den akustischen Sollwert des „Lautsprechers" zu ermitteln — gültig für jedes andere aufgenommene Signal in diesem Raum, sogar für das komplexe Schallereignis eines Orchesters. Als nächstes fütterte man den Computer mit Sprach- und Musikmustern in Form elektrischer Signale. Der Computer produzierte ein Band dieses Materials, wie es bei der Aufnahme in einem Wohnraum zustande gekommen wäre, als ob es von einem, in einer Ecke des Raumes befindlichen, hypothetischen achten Teil des idealen, kugelsphärischen Lautsprechers mit 22.4-Inch-Systemen auf einem Oktanten mit dem Radius von 20 Inches. Die Steuerung erfolgte über ein Ausgleichsnetzwerk, dessen Daten aus einer Computerberechnung hervorgingen.

Die beiden Bänder wurden dem Subjektivtest unterworfen. Nach Dr. Bose waren die Testpersonen außerstande, innerhalb eines A-B-Vergleichs die Sprach- und Musikbeispiele der Computer-Simulation von der Lautsprecherdarstellung zu unterscheiden.

Mit normalem Denkvermögen kann man den außerordentlichen Rechenaufwand, der zur Herstellung dieser Bänder notwendig war, nicht nachvollziehen. Die Unerläßlichkeit eines Computers ist einleuchtend. Selbst dann, wenn Dr. Bose seine Experimente einige Jahre später vorgenommen hätte, wären 20 Stunden Rechenzeit erforderlich gewesen, um 7 Sekunden Musik zu erstellen! Heute würde sich diese Zeit auf 3-6 Minuten reduzieren.

Die Bedeutung des Experiments wurde dadurch unterstrichen, daß mit Hilfe eines exakten Frequenzausgleichs die auf der sphärischen Oberfläche dicht plazierten, kleinen Lautsprecher in der Lage sind, unter normalen Hörbedingungen Musik und Sprache zu reproduzieren, die sich subjektiv nicht von denen unterscheidet, welche eine ideale, pulsierende Kugelsphäre in der gleichen Umgebung reproduzieren würde — ohne Resonanzen, Phasenverschiebungen, Brechungen und Verzerrungen jeglicher Art. Dr. Bose verfügte somit über eine Meßtechnik, die ihre Gültigkeit durch Einbeziehung subjektiver Hörfaktoren noch unterstrich.

Ein anderes Experiment wurde zur Ermittlung eines Meßverfahrens zur Bestimmung von Lautsprecherklirrgraden vorgenommen. Bislang waren Verzerrungen immer im schalltoten Raum bestimmt worden. Diese Methode ist jedoch wenig verbindlich für einen Hörer, der seinen Lautsprecher normalerweise in einem Wohnraum betreibt. In den meisten Fällen treten bei zunehmender Abstrahlintensität verschiedene Verzerrungen auf. Bei geringer Lautstärke sind sie hingegen vernachlässigbar klein. Dr. Bose berief sich auf diesen Tatbestand, indem er denjenigen Pegel bestimmte, bei dem hörbare Verzerrungen auftraten. In einem Wohnraum wurden Musik- und Sprachbeispiele wiederholt mit sukzessiv steigender Abstrahlenergie wiedergegeben. Die Testperson befragte man ausschließlich nach einem erfaßbaren Unterschied. Derjenige Abstrahlpegel, bei dem zuerst eine Abweichung wahrgenommen werden konnte, bezeichnete den Grad der Leistungsfähigkeit des Lautsprechers. Dieses Maß unterliegt zwar letztlich subjektiver Bewertung, wurde aber erhalten, ohne auf individuelle Höranalysen oder die bekannten Verzerrungskriterien zurückgreifen zu müssen. Genau genommen handelt es sich hierbei um ein Verfahren, das eine objektive, physikalische Messung mit der subjektiven Aussage über ein Schallereignis koppelt. Die Testperson wurde nicht nach der Gefälligkeit des Klangbildes sondern nur nach Klangdifferenzen befragt.

Dr. Bose konnte seine Studien nun mit Hilfe der neu entwickelten Meßmethoden fortsetzen. Wie den obigen Ausführungen zu entnehmen ist, hat man den Messungen unter normalen Hörbedingungen größte Aufmerksamkeit geschenkt. Viele Studien zur Konzertsaalakustik haben bestechend demonstriert, daß der Hörer, unabhängig davon, wo er sich gerade befindet, das Orchester als ein Schallereignis wahrnimmt, bei dem direkte und reflektierte Komponenten in einem für jeden Saal charakteristischen Verhältnis zueinander stehen. Dr. Bose verwertete auch akustische Daten aus europäischen Konzertsälen. Dabei ergab sich, daß der Anteil des reflektierten Schalls auf nahezu allen Plätzen überwog. Sogar in einem äußerst großen Saal wie der Boston Symphony Hall dominierte der indirekte Schall bereits in 6,5 m Entfernung vom Orchester. Es ist sehr wichtig zu berücksichtigen, daß im Reflexionsfeld die Schallenergie auf dem Reflexionsweg an jedem Punkt der Raumoberfläche erscheint und die Einfallswinkel der Schallsignale sehr weit gestreut sind. Diese Raumwirkung des einfallenden Schalls und ihr Frequenzspektrum sind die maßgeblichen Faktoren des Höreindrucks.

. . .

Bei der klanglichen Beurteilung des Bose 901 Systems war ich mir darüber im klaren, daß ich es mit einem völlig neuen Lautsprechertyp zu tun hatte. In mancher Beziehung ist dieser Lautsprecher mit konventionellen Typen nicht zu vergleichen. Ohne seine anderen Vorteile zu berücksichtigen, sind schon allein seine räumliche Wirkung und der Stereoeffekt von ganz bestechender Überlegenheit.

Kein Zweifel, das *Direct/Reflecting*-Prinzip ist für die Musikwiedergabe im Wohnraum unbedingt gerechtfertigt. Bei sinfonischen Darbietungen ist die Illusion eines räumlich anwesenden Orchesters komplett. In der Mitte gewinnt man den Eindruck eines perfekten, virtuellen Bildes. Aber auch jenseits der herkömmlichen Stereoachse ist das Klangbild erstaunlich stereophon. Es kommt meines Erachtens dem einer authentischen Dreikanalstereoaufnahme am nächsten. Das ganze Klangbild zeichnet sich durch seine Klarheit, Transparenz, Breitbandigkeit, kristallklare Impulstreue . . . und extreme Natürlichkeit aus. Gleichermaßen erstaunlich ist die Baßwiedergabe. Die Übertragung des donnernden Kontra C eines Orgelpedals mit einer von den Maßen her (20 x 12 x 12) so zierlichen Box oder der saubere Anschlag einer großen Baßtrommel ist ein überwältigendes Ereignis. Die Lautsprecher decken erbarmungslos alle Schwächen der Reproduktion auf. Nur selten trifft man eine Aufnahme an, die in linearer Stellung des *equalizers* abgespielt werden kann. (Es gibt offenbar mehr hochfrequente Verzerrungen als ich es je geahnt hätte.) Der Bose kommt erst richtig zur Geltung, wenn er mit Programmen hochwertiger Bänder ausgesteuert wird. Ich besitze mehrere sinfonische Mutterbänder sowie Originalkopien, deren Wiedergabe von einer bezwingenden Naturtreue waren.

Zweifellos kann man dem Bose 901 mit seinem neuen, wegweisenden Prinzip den abgenutzten Begriff eines „Revolutionärs" zuerkennen.

Bert Whyte
Audio — Dezember 1968

Gedanken zum Klang.

Der Bose 901 ist in der Tat eines der vollkommensten Systeme, dem ich zuzuhören je das Vergnügen hatte. Ich glaube dies mit Sicherheit sagen zu können, weil ich nun schon seit mehreren Monaten mit ihm lebe. Seit jeher hielt ich die Schalldispersion für ein wegweisendes Prinzip, das hier konsequent verwirklicht wurde.
Abstrakter gesagt, der Klang ist einfach großartig. Der 901 zeichnet sich durch seine Klangneutralität aus. Es ist einfach alles da.

Larry Zide
The American Record Guide

Resumée.

Das Bose 901 Lautsprechersystem erzeugt den natürlichsten Stereoklang, der die Illusion des Konzertsaales erweckt, mit einer Gleichmäßigkeit des Frequenzganges und einer unglaublichen Verzerrungsfreiheit — besonders in Anbetracht seiner Größe. Unter Berücksichtigung all dieser Vorteile muß man ihn einfach besitzen, wenn man auf höchsten Hörgenuß Wert legt.

Elementary Electronics, Sept. 69

Schall erobert den Raum.

Bei richtiger Aufstellung des 901 Systems ist es möglich, an jedem Punkt des Raumes den vollen Stereoeffekt zu erreichen. Gemeinsam mit der enormen Tiefenwirkung wird ganz der Eindruck erweckt, als rührte der Schall gar nicht von Lautsprechern. Die akustische Perspektive nähert sich gerade zu frappierend demjenigen Klangerlebnis, das man gewöhnlich nur durch Hinzunahme eines dritten Lautsprechers, der das Loch in der Mitte füllt, erreicht.
Fügen Sie diesen Werten die außerordentliche Breitbandigkeit des 901, seine neutrale, ausgewogene Transparenz bei jedem Programmaterial hinzu, und Sie werden sich fühlen, als hätten Sie eine Art Stereoentdeckung gemacht. Darüber hinaus können Sie diesem System stundenlang ohne Unterbrechung zuhören — sollte Ihre Reaktion ähnlich ausfallen, so schalten Sie auch nur mit Widerwillen ab.

Norman Eisenberg
High Fidelity

Equipment Test Reports.

Wir hörten uns den Bose 901 in verschiedenen akustischen Milieus an: vom extrem harten und strahlenden bis zum stark bedämpften. Wir verglichen ihn dann in A-B-Tests mit den besten uns

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verfügbaren Systemen. Der Bose 901 klang ausgesprochen sauber, transparent und frei. Seine Klarheit und Klangdefinition wurde besonders bei orchestraler Wiedergabe von keinem Lautsprecher übertroffen. Dieser Eindruck bestätigte sich auch bei Impulsmessungen, die über den ganzen Bereich ausgezeichnet waren. Die Wiedergabe im untersten Baßbereich hätte man einem solch kompakten System nicht zugetraut. Er hatte alle raumfüllenden Eigenschaften der besten akustisch geschlossenen Systeme und darüber hinaus die Präsenz und Klarheit eines Breitbandelektrostaten. Seine räumliche Klangverteilung, durch die eine ganze Wand förmlich zum Leben erweckt wird, ist der wesentliche Grund für das realistische Klangbild. Ich muß gestehen, daß ich nie ein Lautsprechersystem in meiner Wohnung hatte, das den Bose 901 übertroffen oder ihm auch nur nahe gekommen wäre in bezug auf seine allumfassende Klangtreue.

Hirsch-Houck Laboratories
Hi-Fi/Stereo Review

Einmaliges Hörerlebnis

Durch die acht nach hinten gerichteten Lautsprecher stammt der Hauptanteil des Schalls von der Reflexion an der Wand. Genau genommen sind es 89 % Reflexion und 11 % Direktschall. Nach Angaben des Herstellers stand die Überlegung dahinter, daß nur so eine echte Simulierung der Gegebenheiten im Konzertsaal zu erreichen ist.

Das Prinzip der *multidirectional* Klangquelle ist nicht neu im Lautsprecherbau. Aber viele frühere Versuche sind durch den Mangel an Qualität fallen gelassen worden. Dieser Versuch schlug nicht fehl.

Beim *multidirectional* Lautsprecher scheint sich der Schall von der Box zu lösen. Rings um die Schallquelle breitet sich ein geräumiges Klangbild aus, das hier auf wunderbare Weise realisiert wird. Ein Stereopaar macht die Basis stereophon, wobei jedes Instrument seinen festen Platz hat, den es auch behält. Sie können diesen Lautsprecher weiter als die herkömmlichen voneinander entfernt aufstellen, ohne befürchten zu müssen, daß ein Loch in der Mitte entsteht.

Der schlagenste Beweis ist zweifellos der Klang. Hier läßt der Bose 901 die anderen weit hinter sich. Die Richtungscharakteristik habe ich schon erwähnt. Sie ist für die Natürlichkeit des Klangbildes weitgehend verantwortlich. Bandbreite und Impulstreue spielen dabei die gleiche wichtige Rolle wie die Verfärbungsfreiheit. Ich habe viel Zeit mit diesem Lautsprecher verbracht. Die Übertragungskette bestand aus lauter hochwertigen Komponenten, einschließlich eines Hochleistungsverstärkers. Nur wenigen Lautsprechern kann ich stundenlang zuhören. Dies ist einer!

Die Bandbreite ist bestechend. Nach meinen Frequenzgangmessungen geht der Lautsprecher linear bis 34 Hz und fällt darunter sehr langsam ab. Die Wiedergabe ist selbst bei 25 Hz brauchbar. Dies ist sicher der tiefste Punkt, der von Musikprogrammen zuweilen erreicht wird, an den normale Aufnahmen jedoch selten herankommen.

Zum oberen Ende hin verläuft der Frequenzgang ohne hörbare Spitzen und Einbrüche und zwar weit über meine Gehörgrenze hinaus. Zur Bestimmung der Effizienz seines Dispersionsgrades habe ich ein 12-kHz-Signal verwendet. Es war keine Pegelabweichung beim Herumgehen im Raum hörbar. In jeder Position empfand man eine Gleichmäßigkeit, die die exzellente Dispersion und den Höhenausgleich nur bestätigte.

. . .

Wir hören jedoch keine Sinuswellen sondern Musik. Und wie schön sie klingt aus diesen Lautsprechern! Bei kleinen Gruppen ist der Klang offen und lebensnah; große Klangmassen werden unverzögert verarbeitet. Einer meiner beliebtesten Tests enthält massive Chormusik. Die Dispersionscharakteristik läßt den Stereoeffekt sehr gut zur Geltung kommen. Die Klangcharakteristik läßt die Stimmen als sehr real erscheinen. Ein Chor stellt einen großen Verband einzelner Stimmen dar. Ein guter Lautsprecher wird dies eben genau so reproduzieren, ein weniger guter wird den Chor zu einem homogenen Klangkörper zusammenschmelzen. Hören Sie sich die Carmina Burana (Columbia) aus diesem Lautsprecher an und Sie werden feststellen, wie ein Chor klingen sollte.

Klavierwiedergabe galt schon immer als besonders kritisch, der Bose 901 bringt sie wie sie ist.

Alles in allem erzeugt der Bose 901 ein ausgewogenes Klangbild, wie Sie es sich besser nicht wünschen könnten. Kurzen Impulsen folgt er exakt. Stoppt der Schall plötzlich, so ist der Lautsprecher ebenso schnell in Ruhe. Wenn die Musik keine Bässe enthält, wird auch im Lautsprecher keiner übertragen. Existieren aber welche, so werden auch die tiefsten wiedergegeben. Sie benötigen viel Leistung bei lautem Hören, mindestens 50 Watt pro Kanal. Dafür ermöglichen sie eine Qualität, die nicht so leicht ihresgleichen finden dürfte.

Stereo & Hi-Fi Times
Spring 1970

Ein neuer Weg

Der Bose 901 ist in der Lage, den natürlichen Klang, den man je von einem Lautsprechersystem gehört hat, zu erzeugen. Seine Mitten und Höhen sind von hervorragender Transparenz, die Tiefen weder verschwommen noch bumsig. Die Gesamtklangqualität ist so klar, daß sich der Hörer der Elektronik zwischen sich und den Instrumenten gar nicht bewußt wird.

Der Klang? Der 901 ist zur Zeit wahrscheinlich das einzige Lautsprechersystem, das eine echte Konzertsaalqualität erzeugt.

Hi-Fi Buyers Guide
Fall/Winter 1969 Issue

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PRESSE KOMMENTARE

„Nie zuvor
hat ein Hi-Fi-Produkt
so einhellig gute Kritiken
in der amerikanischen
Fachpresse erhalten"

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Bose 901, Direct/Reflecting ™ loudspeaker system

THE BOSE® CORP.

Die zwölfjährige Entwicklungsgeschichte.

Der 901-Lautsprecher wurde von Dr. Amar G. Bose, Professor der Elektrotechnik am Massachusetts Institute of Technology, entwickelt. Dr. Bose lehrt neben anderem Elektroakustik und ist seit jeher ein ausgesprochener Musikliebhaber und Hi-Fi-Enthusiast. Vor ca. 12 Jahren stellte er ein Forschungsprogramm zur Untersuchung von Lautsprechern auf. Er erkannte, wie richtig die alte Erfahrung ist, daß der Lautsprecher das schwächste Glied in der akustischen Übertragungskette darstellt. Als junger Violinstudent und ständiger Gast bei den Konzerten des Boston Symphony Orchestra in der nahegelegenen Symphony Hall war es Dr. Bose nicht möglich, dem Höreindruck im Konzertsaal etwas Vergleichbares mit Hilfe im Handel erhältlicher Lautsprecher gegenüberzustellen. Dies betraf in erster Linie die von ihm besonders geschätzten Streichinstrumente, die zwar recht interessant, aber doch sehr wirklichkeitsfremd klangen. Die Voruntersuchungen bestätigten, daß die wesentlichen Lautsprecherprobleme aus der Inadäquanz der Standardmeßtechniken, die sich hauptsächlich auf Tests im schalltoten oder freien Raum sowie subjektive Hörtests stützten.

In den vergangenen 30 Jahren wurde die Lautsprecherentwicklung zu einem Teil exakt wissenschaftlich (mit Hilfe schalltoter Räume und in Reihe betriebener Tongeneratoren und Oszillographen), zum andern handwerklich empirisch betrieben, d. h. durch „Basteln und Probieren", „Membran doping", individuelles Abstimmen und darüber hinaus immer wieder in Form subjektiver Hörversuche. Es scheint für diese Art von Lautsprecherforschung wenig Argumente zu geben; Musik wird nun einmal nicht im schalltoten Raum gehört. So erhob sich die Frage nach dem Aussagewert von Messungen im schalltoten Raum gegenüber dem gewöhnlichen Hörmilieu.

Dr. Boses Aufgabe war in der Tat äußerst schwierig: die Parameter für den Klang des idealen Lautsprechers (theoretisch eine pulsierende Kugelsphäre), falls überhaupt realisierbar, herauszufinden und präzise, diesem Klangbild adäquate Meßtechniken zu entwickeln, und zwar immer unter Berücksichtigung der Hörbedingungen im Wohnbereich.

Mit Hilfe der enormen technischen Ausrüstung des M.I.T. widmete sich Dr. Bose in seinen ersten Untersuchungen der Simulierung der idealen, pulsierenden Kugelsphäre, deren Oberfläche Druckwellen in allen Richtungen gleichmäßig abstrahlen sollte. Herauszustellen ist die Tatsache, daß es für sehr wichtig gehalten wurde, die pulsierende Kugelsphäre genau in einem solchen Raumtypus auszumessen, wie er den normalen Betriebsbedingungen eines Lautsprechers entspricht. So mußten die Schwingungsknoten, die stehenden Wellen usw. in die Messungen miteingehen. Eine ideale, pulsierende Kugelsphäre, die kurze, hochfrequente Impulse erzeugt, kann durch eine Hochspannungsfunkenentladung, die in einem typischen Wohnraum einmal pro Sekunde ausgelöst wurde, simuliert werden. Der Schall dieser Entladung wurde mit einem kalibrierten Western Electric 640-AA Kondensatormikrofon aufgenommen. Das Mikrofon wandelte das Schall-Signal in ein elektrisches um, womit der Akkumulator eines speziellen Digitalcomputers gespeist wurde.

Mit 4000 gespeicherten Entladungen führte der Computer eine Rechenoperation durch, bekannt als Digitalabgriff oder Überlagerungsintegration (ich kann Ihnen versichern, daß dies jenseits meiner Kenntnisse liegt).

Das Resultat war ein mathematisches Modell des idealen Lautsprechers. Die Signale des Computer-Magnetbandes unterscheiden sich selbstverständlich vom Original (erzeugt von der idealen, pulsierenden Kugelsphäre/„Funkenlautsprecher") in bezug auf die Charakteristik des „Lautsprechers" und die akustischen Eigenschaften des Raumes. Trotzdem ergibt sich eine mathematische Beziehung zwischen den beiden Signalen. Ist diese einmal bekannt, so ist es auch möglich, rechnerisch den akustischen Sollwert des „Lautsprechers" zu ermitteln — gültig für jedes andere aufgenommene Signal in diesem Raum, sogar für das komplexe Schallereignis eines Orchesters. Als nächstes fütterte man den Computer mit Sprach- und Musikmustern in Form elektrischer Signale. Der Computer produzierte ein Band dieses Materials, wie es bei der Aufnahme in einem Wohnraum zustande gekommen wäre, als ob es von einem, in einer Ecke des Raumes befindlichen, hypothetischen achten Teil des idealen, kugelsphärischen Lautsprechers mit 22.4-Inch-Systemen auf einem Oktanten mit dem Radius von 20 Inches. Die Steuerung erfolgte über ein Ausgleichsnetzwerk, dessen Daten aus einer Computerberechnung hervorgingen.

Die beiden Bänder wurden dem Subjektivtest unterworfen. Nach Dr. Bose waren die Testpersonen außerstande, innerhalb eines A-B-Vergleichs die Sprach- und Musikbeispiele der Computer-Simulation von der Lautsprecherdarstellung zu unterscheiden.

Mit normalem Denkvermögen kann man den außerordentlichen Rechenaufwand, der zur Herstellung dieser Bänder notwendig war, nicht nachvollziehen. Die Unerläßlichkeit eines Computers ist einleuchtend. Selbst dann, wenn Dr. Bose seine Experimente einige Jahre später vorgenommen hätte, wären 20 Stunden Rechenzeit erforderlich gewesen, um 7 Sekunden Musik zu erstellen! Heute würde sich diese Zeit auf 3-6 Minuten reduzieren.

Die Bedeutung des Experiments wurde dadurch unterstrichen, daß mit Hilfe eines exakten Frequenzausgleichs die auf der sphärischen Oberfläche dicht plazierten, kleinen Lautsprecher in der Lage sind, unter normalen Hörbedingungen Musik und Sprache zu reproduzieren, die sich subjektiv nicht von denen unterscheidet, welche eine ideale, pulsierende Kugelsphäre in der gleichen Umgebung reproduzieren würde — ohne Resonanzen, Phasenverschiebungen, Brechungen und Verzerrungen jeglicher Art. Dr. Bose verfügte somit über eine Meßtechnik, die ihre Gültigkeit durch Einbeziehung subjektiver Hörfaktoren noch unterstrich.

Ein anderes Experiment wurde zur Ermittlung eines Meßverfahrens zur Bestimmung von Lautsprecherklirrgraden vorgenommen. Bislang waren Verzerrungen immer im schalltoten Raum bestimmt worden. Diese Methode ist jedoch wenig verbindlich für einen Hörer, der seinen Lautsprecher normalerweise in einem Wohnraum betreibt. In den meisten Fällen treten bei zunehmender Abstrahlintensität verschiedene Verzerrungen auf. Bei geringer Lautstärke sind sie hingegen vernachlässigbar klein. Dr. Bose berief sich auf diesen Tatbestand, indem er denjenigen Pegel bestimmte, bei dem hörbare Verzerrungen auftraten. In einem Wohnraum wurden Musik- und Sprachbeispiele wiederholt mit sukzessiv steigender Abstrahlenergie wiedergegeben. Die Testperson befragte man ausschließlich nach einem erfaßbaren Unterschied. Derjenige Abstrahlpegel, bei dem zuerst eine Abweichung wahrgenommen werden konnte, bezeichnete den Grad der Leistungsfähigkeit des Lautsprechers. Dieses Maß unterliegt zwar letztlich subjektiver Bewertung, wurde aber erhalten, ohne auf individuelle Höranalysen oder die bekannten Verzerrungskriterien zurückgreifen zu müssen. Genau genommen handelt es sich hierbei um ein Verfahren, das eine objektive, physikalische Messung mit der subjektiven Aussage über ein Schallereignis koppelt. Die Testperson wurde nicht nach der Gefälligkeit des Klangbildes sondern nur nach Klangdifferenzen befragt.

Dr. Bose konnte seine Studien nun mit Hilfe der neu entwickelten Meßmethoden fortsetzen. Wie den obigen Ausführungen zu entnehmen ist, hat man den Messungen unter normalen Hörbedingungen größte Aufmerksamkeit geschenkt. Viele Studien zur Konzertsaalakustik haben bestechend demonstriert, daß der Hörer, unabhängig davon, wo er sich gerade befindet, das Orchester als ein Schallereignis wahrnimmt, bei dem direkte und reflektierte Komponenten in einem für jeden Saal charakteristischen Verhältnis zueinander stehen. Dr. Bose verwertete auch akustische Daten aus europäischen Konzertsälen. Dabei ergab sich, daß der Anteil des reflektierten Schalls auf nahezu allen Plätzen überwog. Sogar in einem äußerst großen Saal wie der Boston Symphony Hall dominierte der indirekte Schall bereits in 6,5 m Entfernung vom Orchester. Es ist sehr wichtig zu berücksichtigen, daß im Reflexionsfeld die Schallenergie auf dem Reflexionsweg an jedem Punkt der Raumoberfläche erscheint und die Einfallswinkel der Schallsignale sehr weit gestreut sind. Diese Raumwirkung des einfallenden Schalls und ihr Frequenzspektrum sind die maßgeblichen Faktoren des Höreindrucks.

. . .

Bei der klanglichen Beurteilung des Bose 901 Systems war ich mir darüber im klaren, daß ich es mit einem völlig neuen Lautsprechertyp zu tun hatte. In mancher Beziehung ist dieser Lautsprecher mit konventionellen Typen nicht zu vergleichen. Ohne seine anderen Vorteile zu berücksichtigen, sind schon allein seine räumliche Wirkung und der Stereoeffekt von ganz bestechender Überlegenheit.

Kein Zweifel, das *Direct/Reflecting*-Prinzip ist für die Musikwiedergabe im Wohnraum unbedingt gerechtfertigt. Bei sinfonischen Darbietungen ist die Illusion eines räumlich anwesenden Orchesters komplett. In der Mitte gewinnt man den Eindruck eines perfekten, virtuellen Bildes. Aber auch jenseits der herkömmlichen Stereoachse ist das Klangbild erstaunlich stereophon. Es kommt meines Erachtens dem einer authentischen Dreikanalstereoaufnahme am nächsten. Das ganze Klangbild zeichnet sich durch seine Klarheit, Transparenz, Breitbandigkeit, kristallklare Impulstreue . . . und extreme Natürlichkeit aus. Gleichermaßen erstaunlich ist die Baßwiedergabe. Die Übertragung des donnernden Kontra C eines Orgelpedals mit einer von den Maßen her (20 x 12 x 12) so zierlichen Box oder der saubere Anschlag einer großen Baßtrommel ist ein überwältigendes Ereignis. Die Lautsprecher decken erbarmungslos alle Schwächen der Reproduktion auf. Nur selten trifft man eine Aufnahme an, die in linearer Stellung des *equalizers* abgespielt werden kann. (Es gibt offenbar mehr hochfrequente Verzerrungen als ich es je geahnt hätte.) Der Bose kommt erst richtig zur Geltung, wenn er mit Programmen hochwertiger Bänder ausgesteuert wird. Ich besitze mehrere sinfonische Mutterbänder sowie Originalkopien, deren Wiedergabe von einer bezwingenden Naturtreue waren.

Zweifellos kann man dem Bose 901 mit seinem neuen, wegweisenden Prinzip den abgenutzten Begriff eines „Revolutionärs" zuerkennen.

Bert Whyte
Audio — Dezember 1968

Gedanken zum Klang

Der Bose 901 ist in der Tat eines der vollkommensten Systeme, dem ich zuzuhören je das Vergnügen hatte. Ich glaube dies mit Sicherheit sagen zu können, weil ich nun schon seit mehreren Monaten mit ihm lebe. Seit jeher hielt ich die Schalldispersion für ein wegweisendes Prinzip, das hier konsequent verwirklicht wurde.
Abstrakter gesagt, der Klang ist einfach großartig. Der 901 zeichnet sich durch seine Klangneutralität aus. Es ist einfach alles da.

Larry Zide
The American Record Guide

Resumée

Das Bose 901 Lautsprechersystem erzeugt den natürlichsten Stereoklang, der die Illusion des Konzertsaales erweckt, mit einer Gleichmäßigkeit des Frequenzganges und einer unglaublichen Verzerrungsfreiheit — besonders in Anbetracht seiner Größe. Unter Berücksichtigung all dieser Vorteile muß man ihn einfach besitzen, wenn man auf höchsten Hörgenuß Wert legt.

Elementary Electronics, Sept. 69

Schall erobert den Raum

Bei richtiger Aufstellung des 901 Systems ist es möglich, an jedem Punkt des Raumes den vollen Stereoeffekt zu erreichen. Gemeinsam mit der enormen Tiefenwirkung wird ganz der Eindruck erweckt, als rührte der Schall gar nicht von Lautsprechern. Die akustische Perspektive nähert sich geradezu frappierend demjenigen Klangerlebnis, das man gewöhnlich nur durch Hinzunahme eines dritten Lautsprechers, der das Loch in der Mitte füllt, erreicht.
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Equipment Test Reports

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out of the research that produced the 901 . . .

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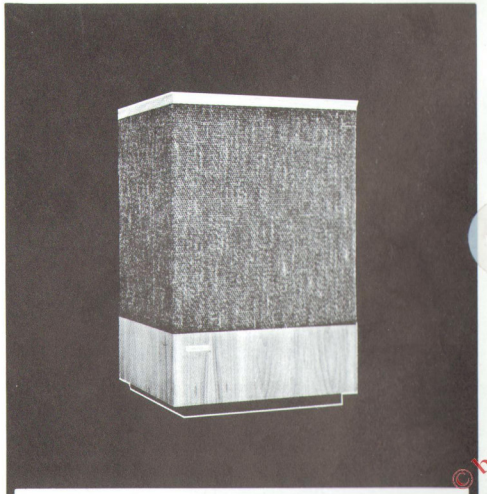

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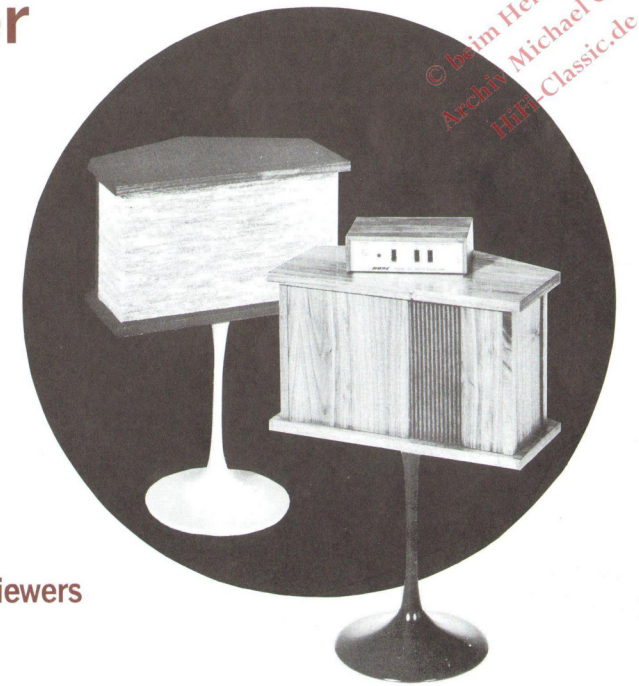

by
Equipment Reviewers
and
Music Critics

RECORDINGS · BOOKS · MOVIES

Saturday Review

June 27, 1970 50¢

THE U.N. AT 25

by Lester B. Pearson

Irving Kolodin, Dean of American Music Critics, Reviews the BOSE 901.

Cadillac Quality in Volkswagen Space

The long-standing contention that the bigger the speaker the better the sound has, in the last decade, been fighting a rear-guard action against the clear voice of reason embodied in the bookshelf types pioneered by Edgar Villchur in his AR revolution. But the heaviness of some, the less than fulfilling extremes of range of others, have left the musical optimumists vaguely or less than vaguely dissatisfied, according to their inclinations and expectations.

In the last year or so, however, aural extremists have been offered a new solution to their problems, and, after a time trial measured in months rather than weeks, this one can definitely proclaim that Bose is best, big or small, high or low. Like many top innovations, it is not the cheapest or the prettiest embodiment of its purpose, but it combines function with form in classical proportions of efficiency and compactness. For the furniture minded, the well-textured wood frame is available with a choice of four grill panel cloths.

The particular novelty of the MIT-derived design (Amar G. Bose did graduate and postgraduate work, and has held a professorship in acoustics at that institution) is the diffusion of sound from the rear of a small, cube-shaped hexagon, rather than from the front. A mere 20 5/16 inches wide, 12 3/4 inches high, and 12 7/8 inches deep, it uses the wall against which it is positioned as part of the sound-dispersing pattern. Two of them properly powered (my source is Marantz) can provide more sound than even an oversized studio room can absorb. An adapter network, housed in a less than book-sized enclosure, enables the speakers to be tuned to the specific space in which they are positioned.

As a basis of comparison, my listening ears have been attuned for more than a decade (since 1958, when stereo came in) to a pair of oversize KLHs (7s, measuring many feet of cubic content) extended in range through electrostatic (high end) tweeters. Not only can I not detect any loss of response at the extremes of range in an A-B test of the Bose pair vs. the KLH-plus pair, but there is more solidity in the Bose midrange and equal smoothness through the transient response. The pair of Bose speakers list at $476, but the payoff is comparable to Cadillac quality in Volkswagen space.

—I.K.

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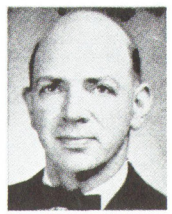
Stereo Review

TECHNICAL TALK

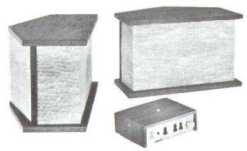


By JULIAN D. HIRSCH

EQUIPMENT TEST REPORTS

By Hirsch-Houck Laboratories

BOSE 901 STEREO SPEAKER SYSTEM



● DEPENDING on one's viewpoint, the Bose 901 speaker system might be considered a revolutionary approach to sound reproduction, or simply a workable combination of well-established (and sometimes deprecated) techniques. The Bose 901 enclosures house nine small, specially designed drivers that have 4-inch cones and powerful magnetic structures. Eight of the drivers are angled to the rear, while the ninth is mounted on the front of the enclosure facing the listening area. This arrangement is intended to achieve approximately the same ratio of direct to reflected sound that exists in the concert hall.

The 901's cabinets are quite compact, measuring 12¾ inches high by 20$^{9}/_{16}$ inches wide when viewed from the front. Seen from the top, the rear of the enclosure forms a "V" of about 120 degrees. Basic to its operation is the requirement that it be mounted with the "V" facing the wall, the apex being about 12 inches from the wall. When a pair of 901's are so installed, the sound appears to be uniformly distributed across the wall between the speakers completely free of any "hole-in-the-middle" effect. Since only 11 per cent of the sound is radiated directly forward, it is almost impossible to localize the source.

An intrinsic part of the Bose 901 system is an active (ten-transistor) equalizer that handles both channels; it compensates for the high-frequency losses inherent in the reflecting process and also flattens out the bass response. (The uncompensated bass response is down because of the natural bass roll-off resulting from the very small volume of the enclosure.) Housed in a walnut cabinet 2$^{13}/_{16}$ inches high by 9¼ inches wide and 6¾ inches deep, this self-powered equalizer unit is connected either between the preamplifier and power amplifier or in the tape-monitoring signal path of the amplifier or receiver. In the latter case, the amplifier's tape-monitor switch is left set to TAPE. So that the tape-monitor function would not be lost, Bose has built it into the equalizer. A tape recorder can be connected to the equalizer and the usual monitoring switching performed through it.

There are five controls on the equalizer, four rocker switches and one five-position rotary control. One rocker serves as an on-off switch, another as the tape-monitor switch, and the third as a low-cut filter that primarily affects frequencies below 40 Hz. This is intended to reduce rumble or acoustic feedback. The fourth rocker switch interacts with a rotary five-position treble-contour control. When the rocker switch is set for NORMAL, the rotary switch provides a boost position, a flat position, and three positions of decreasing high-frequency response from the speakers. When the rocker switch is set for TREBLE DECREASE, it introduces a depression in the response between 2,000 and 6,000 Hz. The five switched contours then not only affect the very-high-frequency speaker performance, but also the frequencies between 500 and 2,000 Hz that are not affected with the rocker switch in its NORMAL position. In all, ten different high-frequency/mid-range response contours are available.

For those who have well-trained hearing and musical judgment—plus the urge to tinker—it is possible to correct for poor recordings to a remarkable degree with the equalizer controls. Most people will probably prefer to leave them in their NORMAL settings.

The active equalizer introduces no perceptible distortion. We measured its distortion at less than 0.13 per cent for any output under 3 volts, which is greater than would be required with any amplifier we know of. The output signal is of approximately the same level as the input signal.

In the August, 1968 *Technical Talk* column, I commented on the difficulty of describing speaker performance in purely objective terms. The Bose 901 is a perfect illustration of this problem. After a couple of months of living with a Bose 901 system, I am convinced that it ranks with a handful of the finest home speaker systems of all time. Because of its unconventional mode of operation, I rather doubted that any frequency-response measurements I could make would account for the remarkable realism of its sound. Difficult as it is to measure the output of a single direct radiator in a normal living room, it is well-nigh impossible to measure an almost perfectly dispersed sound pattern such as that of the 901 without strong influence

from the effects of room acoustics. Nevertheless, a measurement was attempted.

We placed the speaker in the recommended position relative to the wall. We did not have the equalizer in the signal path for our frequency-response and tone-burst measurements, but measured the equalizer response separately and added it to the speaker response to obtain the final curve. Ten microphone positions were used, and their readings averaged. Harmonic distortion was measured at a 1-watt drive level with the equalizer installed.

It was no surprise to find that the final response curve was not as flat as some we have measured. There appeared to be a broad rise of about 5 or 6 dB in the 130- to 250-Hz region, although we could not detect its presence by ear. The output fell smoothly above 1,000 Hz to −7 dB at 6,000 Hz, then rose to the 1,000-Hz reference level between 10,000 and 15,000 Hz.

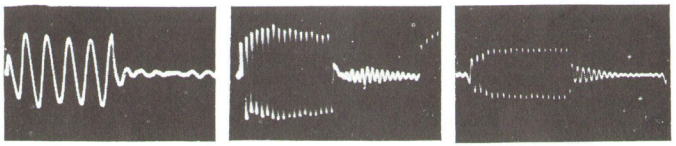
The low-frequency harmonic-distortion measurements were affected by the speaker and microphone placement. The distortion was 7 per cent at 20 Hz, and reached maximums of 12 per cent at 30 Hz and 10 per cent at 50 Hz. It was considerably lower at other frequencies in the bass range. (As a point of reference, the better acoustic-suspension speakers have about half as much measured distortion at similar drive levels.)

We listened to the Bose 901 in several listening rooms which ranged acoustically from extremely hard and bright to quite dull. It was compared in A-B tests with several of the better speaker systems at our disposal. The Bose 901 had an utterly clean, transparent, and effortless sound. Its clarity and definition when reproducing complex orchestral passages were, in the writer's opinion, unsurpassed by any other speaker he has heard. This impression was confirmed by its tone-burst response, which was uniformly excellent across the frequency spectrum. Its low-bass response was difficult to credit to such a compact system. It had all the room-filling potency of the best acoustic-suspension systems, combined with the tautness and clarity of a full-range electrostatic speaker. The spatial distribution, which brings an entire wall alive with sound, contributes greatly to the sense of realism.

There is, unfortunately, a serious obstacle to the universal acceptance of a speaker such as the Bose 901. The 12-inch gap necessary between the apex of the speaker and the wall places the front of the speaker about 30 inches from the wall. Bookshelf mounting is generally impractical, and it may be difficult to install the 901 in the correct location without disturbing room decor. Many potential users will be forced to decide between style and sound.

Electrically, the Bose 901 is rather inefficient, and the 18 dB of bass boost supplied by the equalizer requires huge reserves of amplifier power if loud low-frequency passages are to be played. To a lesser degree, the same problem exists at the very high frequencies. Bose recommends amplifier power ratings from 20 to 200 watts per channel, into 8 ohms. We have used it successfully with amplifiers at both ends of this range. Unlike most speakers, the 901 sounds as good at a whisper as it does at a roar, but if you are ever tempted to turn up the volume a bit, an amplifier with a continuous power rating of at least 60 watts per channel is strongly recommended. A possible compromise is to use the "below 40 Hz" roll-off in the equalizer, which reduces low-frequency peak-power requirements by 8 dB and has little audible effect. Incidentally, don't worry about overloading the 901. The individual drivers can each handle 30 watts without difficulty, and few of us are likely to be able to apply more than 270 watts to each channel.

In the final analysis, the judgment of a speaker must be subjective and personal in nature. I have, on occasion, warmly praised speakers that I considered to be outstanding performers. Everything I have said in the past is still valid. Nevertheless, at this moment, I must say that I have never heard a speaker system in my own home which could surpass, or even equal, the Bose 901 for overall "realism" of sound. My partner, Gladden Houck, concurs to the extent that he considers it a very fine system, certainly the equal of anything at or near its price. The Bose 901 system, consisting of two speaker units and the equalizer, is priced at $476.



The uniformly excellent tone-burst response of the Bose 901 is illustrated by the oscilloscope photos of tone-bursts at (left to right) 130, 1,000, and 9,500 Hz.

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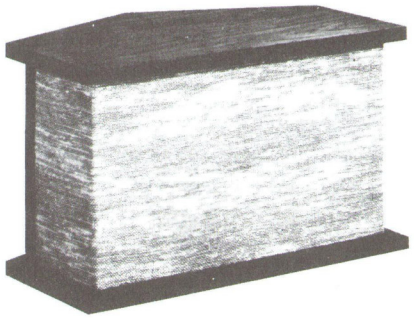
e/e HIGH-FIDELITY



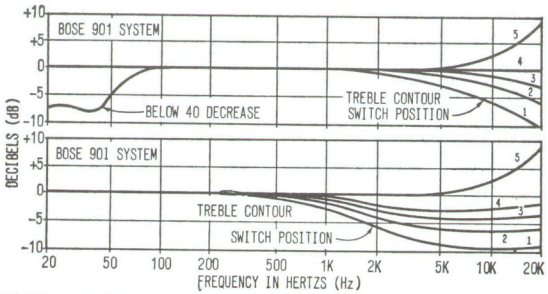
BOSE Model 901 Direct/Reflecting Speaker System

Audio engineers generally acknowledge that speaker systems are the weak link in the chain of components encompassing hi-fi reproducing systems. Amplifiers, preamps, recordings, have all benefited from state-of-the-art developments employing solid-state devices, but speaker design has followed the same basic concept since the introduction of the dynamic reproducer.

Many design engineers have attempted to overcome the inherent weaknesses of the moving coil reproducer. By novel applications of mechanical, electrical, and acoustical principles in combination they attempt to produce a speaker system that sounds like the original vocal, solo instrument, or orchestral rendition.

Hi-fi enthusiasts spend hours, even weeks or months in selecting a speaker system that pleases them. As a result, they are convinced that there really is little possibility that a new system will be developed that can provide cleaner, more realistic reproduction of sound. To correct for the deficiencies in speaker systems, amplifiers have been provided with unique compensating circuits that provide boost and/or cut at both high and low ends and sometimes in the mid-range of the audio spectrum. All of these circuits add to the cost of the amplifier.

Design Considerations. The recently introduced Bose 901 speaker system appears to have met the challenge. The Bose 901 is a product resulting from extensive research that disclosed many basic considerations to be taken in designing a speaker system. Among them are: a) correct balance between reflected and direct sound radiation: b) a means to overcome conflicts created by inherent resonances of speaker mechanisms and speaker housings; c) a new technique in the measurement of speakers, resulting in new standards for design, taking into account environmental conditions in which the speaker system will be operated; d) a new approach to the equalization of the signal driving the speaker to correct for deviations in frequency response created by



Curves supplied by manufacturer show various treble contours possible with Bose 901 speaker system and its equalizer. In upper graph, treble level switch is in normal position; in lower graph, switch is in decrease position.

e/e BOSE 901 SPEAKERS

mechanical design limitations; e) elimination of cross-over networks because of their inherent inability to effectively control amplitude and phase of the acoustic output in the crossover region, be they active or passive; f) a means to provide smooth, continuous acoustical blending of stereo channels without the necessity for a center speaker; and g) a means of eliminating standing waves that can affect frequency response.

Adapting Design Research. The Bose 901 system is comprised of two speaker enclosures, each pentagonal in shape, 12¾ x 20 9/16 x 12⅞-in. (HWD), and each containing nine 4-in. speakers. In addition, the system is furnished with an active equalizer that is inserted between the preamp and the power amp.

The form of the housing was developed for reasons other than to make a speaker having a different shape than those which are now popular. Two rear baffles are joined at an angle of 120° to establish a proper reflective angle off the wall of the room in which the speakers are operating. Because of this angular placement and the large ratio (8 to 1) of radiated sound, achieved by employing eight speakers on the rear angled baffles and one facing forward on the front baffle, there is uniform dispersion throughout the room without a "hole" in the center.

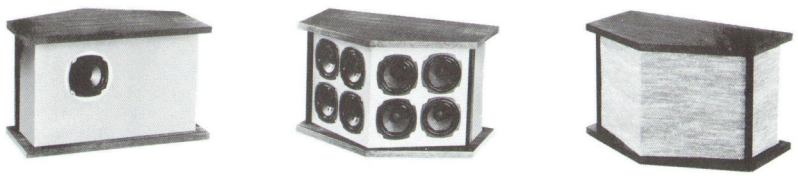
For listeners, this creates the illusion of being in a concert hall with a full orchestra spread across a stage. It removes completely the necessity of having the listener located directly on the axis of the speakers in order to enjoy the full high frequency response of the system. To create the concert hall illusion, the speaker housings must be placed 8 to 20-in. from the wall (12-in. is ideal average) to take advantage of the reflective wall surface that was calculated in the overall system design.

Also, the enclosures are shaped in pentagons to ensure that there are no surfaces parallel to the speakers, thus avoiding standing waves.

By placing eight speakers closely spaced on the rear baffles, acoustic coupling creates a resonant frequency for each speaker that will be different from that of every other speaker. The end result will be that each resonance becomes inaudible because it changes the output of just one of many speakers in the system. Thus, the distortion of sound that is caused by resonances in conventional systems is eliminated by using many speakers, each being driven by the same signal. This, in fact, is the principal reason for the improved clarity and definition of reproduction from the Bose 901, as compared to other speaker systems.

Excellent Bass Response. To solve the problem of wide response with good bass reproduction, designers have always used as large a speaker as possible for reproducing lows, along with smaller speakers to reproduce mid range and highs. In addition, they have employed a passive crossover network to route the appropriate frequency segment to a specific speaker. At best, these networks contribute appreciably to the overall distortion of the complete system. Despite the distortion effects of this combination on the response curve of such a speaker system, it appeared to be the only feasible method of covering the full audio range with dynamic speakers.

Bose, however, developed special techniques, requiring many hours of precision measurements of room characteristics along with computer analysis of taped performances, to prove that multiple small speakers can reproduce the same range as with single large speakers with no resonances or distortion. Bose employs a total of nine 4-in. special, long excursion, high compliance cone, wide range speakers in each pentagonal housing. Arranged in an in-phase array these can move large amounts of air, which, along with the special equalizer, accounts for the spectacular bass and clean mid and high range response of the 901 system.



Left, view of front and (center) view of back of Bose 901 with grille cloth removed (note that unit has eight speakers in rear, only one in front). Right, view of rear of unit with grille cloth in place.

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Bose Lab Check

Continued

High Power Capacity. Since each of the nine speakers individually can handle 30 watts of audio power, the complete system is capable of operating at very high power levels (upwards of 270 watts), that may be required to reproduce low frequencies of sufficient loudness. Bose recommends that amplifiers having a minimum of 20 watts power output be used. This is necessary to overcome the losses created by the equalizer and still have sufficient power output to recreate the dynamic range necessary to produce the illusion of natural reproduction.

The Active Filter. Regardless of the design of any speaker system, its overall performance can be improved somewhat by the application of correctly designed electronic networks that compensate for its variations from a uniform frequency response. Because it is impractical to equalize for variations created by resonances, speaker systems have suffered. However, since the Bose 901 speaker has been designed to be virtually free of resonance effects, the active equalizer that is part of this speaker system, produces uniformity of radiated power vs frequency not attainable in other commercially available speaker systems. This equalizer is a sophisticated, transistorized, active unit that accurately compensates stereo response for the effects of speaker characteristics, enclosure dimensions, radiation impedances and even the grille cloth covering the baffles. Equalization is accomplished without introducing distortion. This is achieved by equalizing the signal between the preamp and the power amplifier which, therefore, removes the necessity of employing the iron core inducers and capacitors capable of handling high power, that introduce distortion in passive filters. Further to this, it is possible to get a greater degree of accuracy in equalization by the use of more elements in an active filter than is practical in a passive one.

Tailoring Response. Besides affording the compensation required to produce flat acoustic response, this equalizer provides a selection of nineteen additional contours, selectable from the front panel of the equalizer. This flexibility of control of equalization permits the listener to tailor the response to meet his particular tastes in compensating for room characteristics, recording techniques, and other variables. A separate switch produces steep, uniform attenuation below 40 Hz to remove turntable rumble without affecting bass response from 50 Hz on.

Conclusion. The Bose 901 speaker system delivers the most natural stereo sound, creating the illusion of being in a concert hall, with a uniformity of frequency response and freedom from distortion that is unbelievable, particularly if the listener takes into account the physical size. Considering all its advantages, the price tag of just under $500.00 for the complete system, which includes two speaker assemblies and the active equalizer, is modest. It is our opinion that this is the speaker system to own, regardless of price, if one wants the ultimate in listening pleasure.

For further information and literature, write The Bose Corp., Dept. E, Natick, Mass. 01760 ■

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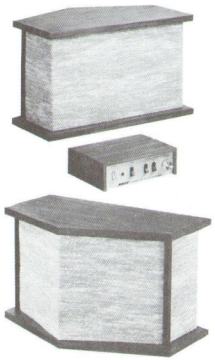
the AMERICAN

record guide

SOUND IDEAS

An Equipment Review By LARRY ZIDE



Bose 901 Speaker System

THERE IS a great deal of advance interest in this report—and not without reason, as you will see.

Bose is a relatively new company, and the 901 is its one and only product. This is a "system" in every sense of the word, because the model number actually includes two speaker units plus an electronic control that goes between your preamp and amp. (It can also be hooked up to the tape monitoring circuits, and will provide switching for a tape recorder in addition to fulfilling its own primary functions. More about these presently.)

The two speaker enclosures are marked for left and right channels. At first glance you might think that they are meant for corner placement only, though this is hardly the case. They are not very large—only about 19" wide across the flat front and 13" deep.

Yet inside each box are nine small high-quality speakers! Eight face the rear, via the two faces of the pointed side. The ninth faces forward, in the upper left of the left speaker and upper right of the right speaker. The frequency spectrum and strength are divided among the speakers so that each gets fundamentally the same. The enclosure is intended to be free-standing, some distance from a wall. The eight rear speakers act as dispersers, serving mostly to reflect sound from the wall. Only the ninth or forward speaker localizes sound, in particular for the poorly-reflected highs. The net effect is intended to be an impression of wide sound dispersion over a broad plane (as in a concert hall) which nevertheless preserves the localizing information of stereo.

It works!

The Bose 901 is, indeed, one of the finest speaker systems it has ever been my pleasure to hear. I have lived with it now for several months, so that I am quite sure of what I say. I have long believed in the value of wide sound dispersion, and this system amply provides it.

Dispersion notwithstanding, it is the sound itself that remains paramount. The 901 is characteristically smooth. Everything is simply *there*. At high frequencies the ear indeed tells you that the frequency is there, but you do not have any "beaming" effect as with direct radiators. The bass is smooth down to my room's resonance at 34 Hz, with a smooth rolloff below. And there is useful output to about 25 Hz, which is plenty low enough.

In part the 901 achieves its excellent bass response by means of a boost circuit in the control box. This places an enormous strain on a power amplifier of marginal power. And 60 watts may prove to be marginal! I would say that to use the Bose 901 at its full potential demands an amplifier that can provide at least 50 or 60 watts *at 50 Hz and below*. Less than that will cause you to hear some audible bass distortion (caused by the amplifier clipping) *at very high listening levels in large rooms*. In any case I think that so fine a speaker would be simply wasted on amplifiers that can provide only 20-25 watts per channel.

The control box provides a useful degree of speaker *tuning*. It does serve to compensate the speaker against room acoustics, but it will do more. If you have a bright (or dull) cartridge and a tape recorder that is flat, they will not sound alike with equally good material. The high-frequency control can be used to (subtly) boost or cut highs in such a way as to equalize a bright cartridge. I have used this to compare more accurately the relative sound of cartridges, and it *is* effective.

But back to the sonic quality per se. I would have expected that all this reflected sound might have a bad effect on the sharpness of transients. Not so. The 901 is quite crisp in its attacks. When the music stops, so does the speaker.

But you really have to hear music from the best sources (such as master tapes) to appreciate all the virtues of this extraordinary system. True, at a price of $476.00 for the pair its virtues may not be for everyone. And perhaps I have failed (I suspect that I *have* failed) to give a clear picture of its special qualities. I urge that you listen for yourself. I think you will have to agree that Bose has, in a single giant step, produced one of the finest speaker systems ever made.

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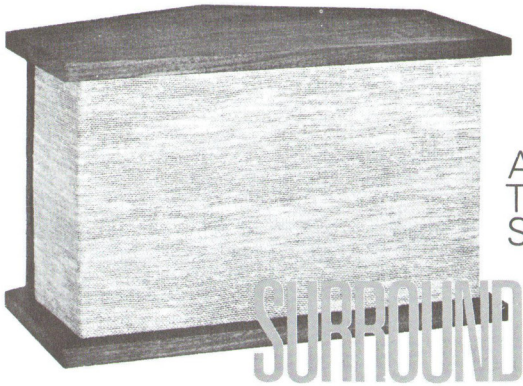
HIGH FIDELITY

By Norman Eisenberg



A REPORT ON THE BOSE 901 SPEAKER SYSTEM

SURROUND and CONQUER

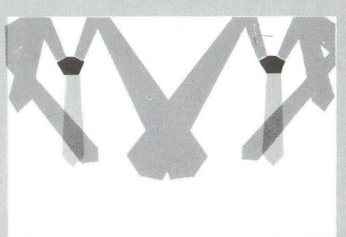
DESPITE THE PREVALENCE of look-alikes and sound-alikes in audio, every now and then the maverick spirit asserts itself and produces something that turns out to be as good from a performance standpoint as it is interesting from a design standpoint. So it is with the new Bose 901 speaker system, which—while an obvious departure from the familiar two-cubic-foot-walnut-box approach to speaker design—strikes us as one of the best sound reproducers we have ever heard.

Basically, the Bose 901 is a speaker system whose acoustic response is influenced by the electrical response of an equalizer unit inserted in the amplification chain. One equalizer serves to control two stereo channels. Each speaker system itself consists of nine specially designed four-inch drivers installed in a five-sided enclosure so that one driver faces into the listening room while the other eight radiate against a wall or other surface behind the enclosure. The nine speakers in each enclosure are identical, and no crossover network is used.

A question that immediately comes to mind is: can several small speakers match the bass performance of one large woofer? Let's see. It is apparent that the Bose system is based on certain specific design concepts, not all of which are completely accepted in audio circles. To wit: a relatively high amount of reflected sound, vis-à-vis direct radiated sound, is very desirable in playback; what one hears out of the speaker system is more important than what can be measured going into the system (the acoustic response should be flat even though the electrical signal itself is not); in creating a wide-range, high-quality speaker system the woofer-tweeter-with-crossover-network approach can be successfully ignored if suitable design steps are taken in the use of several identical drivers; nonparallel sides for an enclosure are more desirable than parallel sides; a speaker system ought to incorporate provisions—instead of or in addition to those normally found on an amplifier—for specific forms and degrees of tonal compensation related to input program material, speaker system characteristics, and loading to the acoustics of the listening room.

If all this sounds complex, it is. Briefly, here's how it works: the spatial presentation of sonic information, particularly germane to stereo, is accomplished by deliberately introducing a high ratio (eight-to-one, approximately) of indirect-to-direct sound. The sound reflecting off the walls blends with the sound from the lone driver in front to enhance the ambience and spatiality of the reproduction. At the same time the total area of speaker diaphragms improves the radiation resistance of the

The Bose speaker system uses sound coming off the walls to help create superior stereo out front. First diagram shows normal amount of left and right channel sound with center mix. Next, angling speakers inward throws more sound to sides, emphasizes separation. Last sketch shows how more mix and less separation result when speakers are toed outward.



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system in loading or transferring sound into the listening area. At low frequencies all nine speakers respond in phase to move fairly large amounts of air, thus radiating bass power. At high frequencies the small diaphragm of each speaker naturally behaves like a tweeter. Differences in individual resonances are overcome by the close internal coupling of the drivers, with the result that the response of the total array becomes fairly smooth, as compared to the characteristic response of any single driver.

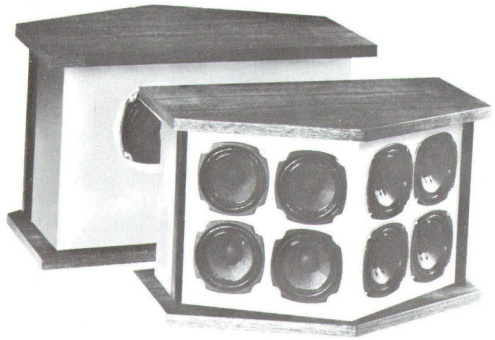
To extend the range of this smooth response and also to shape it to suit both program material and room acoustics, Bose employs an "active equalizer," a solid-state device that boosts the very low and very high ends of the spectrum. By using its controls, you can vary the degree of boost at either end (twenty frequency contours are available), but some lift always remains effective. The equalizer comes before the power amplification section of whatever equipment you're using; its connections permit you to patch it into a separate preamp and power amp, into an integrated amplifier, or into a receiver. Electronically speaking, the equalizer is a fairly sophisticated device—one of its functions, for instance, is to compensate for the acoustical character of the grille cloth over the speaker enclosure.

If this sounds like electronic hocus-pocus, consider that it is really no more so than the equalization (i.e., frequency gimmicking) used on records and tapes, which is compensated for by reciprocal circuits in every modern amplifier and receiver. Analysis of the Bose approach and—more important—many hours of listening to the system certainly justify and validate it in my opinion. Indeed, after comparing its various frequency contours, playing a number of recordings, I'd go so far as to say that you can use the Bose equalizer as a "trimmer" adjustment to further refine the existing RIAA characteristic during playback, thereby cleaning up both the very low and high ends of the audible response of many recordings. It also helps the tonal balance of FM broadcasts and of prerecorded tapes (though the latter generally strike me as better balanced to begin with) played through your system.

Because the equalization comes before the power amplifier, it can make demands of the latter that may exceed its capabilities. For this reason the Bose 901 is not recommended for use with puny amplifiers unless you're willing to settle for less than the full response capabilities of the system. Amplifiers (or amplifier sections of receivers) that can deliver at least 20 watts RMS power per channel into an 8-ohm load are recommended. At the same time, the power-handling ability of the combined nine drivers is prodigious, and permits using amplifiers that can deliver over 100 watts RMS per channel.

AWARE THAT MY verdict is in part subjective (and allowing too for the protean nature of the audio field, in which some future development may cause me to modify this opinion), I will say that as of now the Bose 901 strikes me as the best-sounding speaker system in its size and price class I have yet auditioned. Indeed, it rivals many systems built to larger dimensions and/or costing considerably more. In its midrange and highs—for clarity, full range, wide dispersion, open and natural sound—it is unsurpassed by anything I've heard. In its bass it is easily a match for the best of the air-suspension systems, and is outperformed only by the costliest and biggest of the top giants and horn systems. You actually have to think in terms of systems about double its cost, or more, to find speakers that surpass it at the low end—and then, they do so only by a few notes around the 20 Hz to 25 Hz region, or by what may be called an almost "subsonic feel" that is perceptible only on some program material. As for stereo spread and depth, no pair of speaker systems I've yet installed managed to create a more convincing and pleasing panorama of sound without the aid of center-fill or surround speakers to augment the presentation.

I did not attempt to push the 901 to its theoretical limit of 270 watts power-handling capacity (this figure is based on a 30-watt rating for each of the nine drivers in one enclosure), but I did run it from a 50-watt-per-channel amp. At louder than normal levels and with the equalizer contour set to deliver flat response, I found that the bass line held up firmly and cleanly to 40 Hz. Then—with some slight doubling that was considerably less than on most speaker systems and which did not increase as frequency was lowered—it continued strongly and with remarkable linearity to 26 Hz. By reducing the input level just slightly, to a more normal listening level, I found the 901 responded down to 23 Hz. The middles and highs were exceptionally smooth, clean, and strong, showing virtually no directional effects. A 10-kHz tone could be heard in another room; 13 kHz was audible fairly well off axis; 14 kHz was audible closer on axis; and from here the response sloped off towards inaudibility. White noise response was exceptionally smooth and well distributed throughout the listening area.

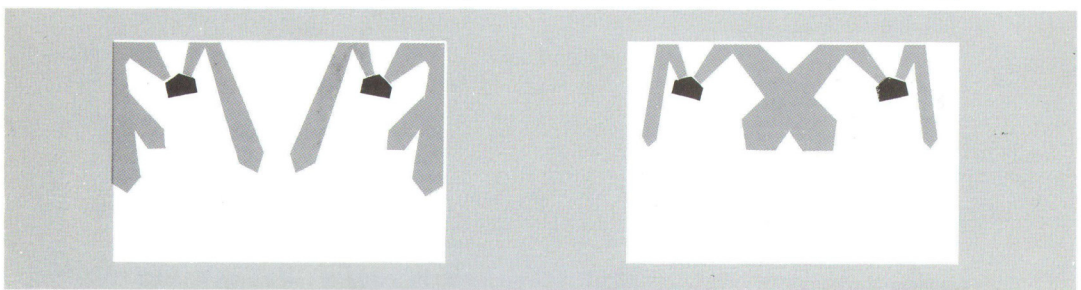


Behind the grille cloth, each reproducer in Bose 901 system has eight speakers on its angled rear panels, one on the front panel. Equalizer has controls for shaping contour of response, plus tape monitor substitute if patched into amplifier or receiver tape jacks.

To test the equalizer and Bose's claim that the 901 system responds with alacrity to differences in program sources, I played the same recordings with different pickups, and different recordings with the same pickup. Details of this extended listening occupied several of us for days; what it comes to is this: the equalizer not only serves generally to contour the amplifier response with respect to the 901 speakers, but it can (indeed, should, for the most accurate playback) also be used to vary this contour—subtly, but to critical ears effectively—at both the extreme high and low ends of a system's total response. In this way all the elements involved (program source, amplifier, room acoustics) can be brought into suitable or integrated acoustic focus. In this sense, the 901 system is the closest approach to the concept of "sound conditioning" of a listening room yet encountered in a commercially available, competitively priced product. And it is all the more commendable for its ease in use: the equalizer is a small walnut box that you can install next to or on top of your main control panel, whether it's part of a separate amplifier or a stereo receiver. After some experiment you will find the best positions for its controls for various recordings and/or different cartridges used in playing those recordings. For instance, using the Ortofon to play some Columbia records of the New York Philharmonic under Bernstein, I found it more agreeable to cut back on the high end a few steps; with the Shure V-15 II I cut back only one step. For Vanguard's recent Dolbyized releases I cut back one step with the Ortofon, but ran the system flat for the Shure. In discussing these adjustments with the manufacturer I was told that the exact degree of adjustment is bound to vary in different listening rooms but that the general pattern I had hit on seemed valid: recordings and pickups—even those that may be termed high quality—do vary in acoustic tone, and Bose's aim is to provide the keen-eared listener with a means (if he opts to use it) of compensating for those variations.

Yet another area of compensation—this one primarily with regard to individual room acoustics and relative location of the speakers—is offered by the 901 system. The accompanying diagrams illustrate this point, and again the effects represented are definitely audible. If you toe the speakers *inward*, more sound will come from the sides of the room; this effect increases the apparent stereo spread and may be desirable if the speakers have to be located fairly close to each other, say about three feet apart. If you toe the speakers *outward*, less sound will come from the sides and there will be more of a centre-fill effect—useful if the speakers are installed very far apart, say about fifteen feet from each other. In any location, you must leave about a foot of space behind the speaker and any amount of space at its side in order to allow the "bounce-and-reflect" effect to develop. Correctly installed along these lines, the pair of 901 systems provides full stereo from just about any listening position in the room. Combined with the sense of front-to-rear depth they project, the sound never seems to be emanating from boxes; rather you feel that the sound is "just there," and fairly well spread about you too. The acoustic perspective thus provided comes surprisingly close to simulating the sort of ambience you normally would get only by using "surround" and center-fill speakers in addition to the normal stereo pair.

Add to these virtues the utterly clean wide-range response of a 901, its neutral, well-balanced, transparent quality on all program material, and you feel you've made some sort of stereo discovery. And it doesn't pall, either: you can listen to this system for hours on end without getting listener fatigue—if your own response to it is like ours, you'll be reluctant to turn it off and go to bed.



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down beat

A Report on Bose 901 Speakers

The weakest part of hi-fi systems has been the speaker, since technology caught up with amplifiers and tuners. The frustrated audiophile knows that the signal coming from his amplifier is miraculously close to that coming off the original recording microphone—but somehow it doesn't sound the way it did in the studio.

One fault in reproduction lies with the limitations of microphones. A microphone is no substitute for the human ear with respect to direction and differentiation of sound.

On todays multitrack recordings, the emphasis is on one sound or instrument per microphone for greatest separation on the recorded tracks. The greater the separation, the more freedom the recording engineer has concerning what instrument goes in which channel in a stereo mix-down of all the tracks. After the mix, records are mass-produced from the stereo tape master. Up to this point, the audio signal has not suffered any great loss but rather has been boosted and equalized by the engineers. The stereo amplifier and record changer in the average set is capable of doing a great job in reproduction.

But here is the second fault—the speakers. Even with the best equipment, the output of a microphone amplified through speakers will not sound the same as the original sound source.

Why? The directional microphone pulls in mostly sound from the voice or instrument. The human ear pulls in direct and reflected sounds and mixes them to arrive at a natural sound. A speaker must be able to compensate for the non-reflective sound of the recording microphone by adding an extra amount of reflected sound. Few speakers compensate in this way.

The speakers in a recording studio are conventional bass reflex or acoustic suspension design, designed to reproduce a flat response under acoustically controlled conditions. This tells the engineer exactly what the microphone is picking up and helps his trained ear compensate for scarcities of reflections produced in the listening area (equalization, echo, etc.).

At our studios, however, we have tried two stereo sets of Bose 901 speakers [142] with the active equalizers enclosed. The direct and reflected sound reproduced by the Bose speakers with the help of the 901 equalizer sounds amazingly natural and holds true to the sound the artist in the studio is hearing.

At first, we were skeptical about the Bose in physical comparison with acoustic suspension and bass reflex design but after testing, we found improvements we couldn't overlook: the nine speakers in the enclosure eliminated audible speaker resonances; there was no loss in the crossover or inaccurate crossover frequencies because the Bose has full-range speakers and does not require a crossover; the test tones we sent through our four Bose speakers proved that any point in our control room is a good listening point—i.e., there seems to be equal volume coming from each speaker, yet each of the four speakers is identifiable by test tone.

The one fault we found was in the response curve of the speakers without equalizers, but this is almost by design. Bose eliminated the problems conventional speakers only minimize. In doing so, they created a speaker with high coloration over the audible range. They then designed the 901 equalizer, which tapers the sound of the amplifier in each frequency range to fit the needs of the Bose. The efficiency of the equalizer showed us we could use the Bose consumer speakers in professional applications, and the high capacity of the Bose let us drive them with our studio amplifiers, at a whisper or wide-open, with clean and true sound. The Bose have replaced forever our bulky studio speakers with compact, handsome units. The only trouble is—our studio is beginning to look like a living room!

—Chuck Lishon

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STEREO & HI-FI TIMES

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Bose 901 Speaker System

There are a number of tried-and-true principles at work in this speaker, all of which combine to create one of the finest products it has been my pleasure to hear in some time.

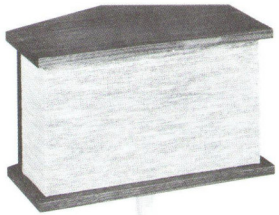
The Bose 901 is a complete stereo speaker system. The package consists of two speaker containers and a control box. Each of the speaker boxes contains a total of nine drivers, all of them identical. This, in itself, is nothing new—multi-speaker systems have been with us for quite a while. Old-timers will remember the *Sweet Sixteen*, in which a number of low-cost speakers were combined to make what was supposed to be a high-quality speaker. It didn't quite work, partly because 16 times poor quality is still poor quality. Bose has used specially designed, high-grade, long-throw speakers. They are each four inches in diameter.

Eight of these speakers are facing the rear of the enclosure, with the ninth facing forward. The enclosures are not identical in the placement of that front-facing speaker. That is why they are specified as a *left* and *right* stereo pair. The principle of operation has all of the speakers functioning as a woofer to move a notable amount of air. Thus, excellent bass is realized from the system even though small speaker drivers are used. With eight of the drivers facing rearward, most of the sound you will hear will be reflected off the wall. Specifically, 89 percent of the sound is reflective and 11 percent is direct. According to the manufacturer, this is done to simulate the actual performance characteristics of instruments in a concert hall.

It is not new to speaker design to have such a multi-directional sound source. But some of the earlier attempts fell short of ideal on sonic qualities. This one does not.

A multi-directional speaker seems to have its sound escape from its box. The source of the sound becomes an area of space above and behind the actual enclosure. This is created beautifully by these speakers. A stereo pair fills the wall with stereo, yet each instrument has its prescribed space—and it stays there. You can spread these speakers much wider apart than conventional boxes without creating a "hole-in-the-middle" effect.

When 89 percent of the highs you are hearing are bounced off the wall, you are going to have an apparent loss of highs—depending on the absorption characteristics of the wall. (The man-



The Bose 901 speaker system.

ual for the 901 specifies that the speakers must be 12 to 18 inches from the wall, with the V point of the enclosure pointing at the wall.)

In order to compensate for this characteristic, the Bose 901 comes with a special active-equalizer box. This control is connected between preamp and amplifier, usually via the tape monitor controls on your amplifier. (There is a tape-monitor control acting as a substitute on the equalizer panel if the monitor control connections on your amplifier are used.)

The equalizer serves to restore some of the lost highs that reflection creates. It also serves to slightly boost the extreme bass of the speakers. In short, the manufacturer recognizes that certain weaknesses exist in the basic speakers and he has taken this legitimate route to correction. The net result is that you can achieve a pretty nearly true flat sound from the speakers.

The equalizer does, additionally, permit you to tailor this sound somewhat. A total of 20 possibilities via three switches permit a wide range of subtly effective control. Most of this is on the treble end, with curves of presence, boost and cut available. These are not substitute amplifier tone controls—they function to control only the speaker *vis a vis* the particular room it is in—but they can do some effective correction of program defects as well. As an example, the Ortofon SL-15T cartridge reviewed elsewhere in this issue sounds much better with the right-hand switch activated. This puts a slight depression in the upper mid-band and rolls down the highs slightly, neatly compensating for the brightness of the Ortofon. Other cartridges I have need other compensation or can be used in the indicated flat positions on the equalizer.

All of this is very nice. But the proof of the pudding inevitably is sound. And it is here that the Bose 901 stands clearly away from the crowd. I've already commented on the directional characteristics—they are in no small measure responsible for the naturalness of the sound. But the bandwidth and transient characteristics of the speaker play an important part, as does the freedom from coloration.

I have spent a good deal of time listening to these speakers. They have been connected into a system that contains the finest componentry, including a high-power amplifier. There are only a few speakers I have ever come across that I can listen to for long periods. This is one of them.

The bandwidth is certainly there. The speaker goes down smoothly to 34 Hz and rolls off slowly below, according to frequency sweeps I made. There is still useful response at 25 Hz. That is certainly as deep as most music will go and, in any case, as deep as recordings will let you go.

At the high end, the speaker continues to go out, without audible peaks and valleys, to well beyond the upper limits of my hearing. As a check of the effectiveness of the directional characteristics, I put a 12 kHz signal on the speaker. There was no apparent change in level as I walked around the room. In any position there was a uniformity that bespoke the excellence of both the dispersion and the compensation of highs.

But we don't listen to sine waves, we listen to music. What a lovely sound these speakers produce!

On small groups the sound is clear and lifelike; with massive forces, the speaker simply expands to take up the slack. One of my favorite tests uses massed choral works. The dispersion characteristics take care of the stereo spread effectively. The sonic characteristics make the voices sound real. A massed chorus is an assembly of individual voices. A good speaker will sound just that way, a less-than-good speaker will homogenize the chorus into a confused mass. Listen to Columbia's *Carmina Burana* on this speaker and hear what a chorus should sound like!

Piano is always tough, but the Bose 901 makes it sound like it is. However, the hardest is male voice. Here the Bose system has a slight bass underline on the voice (as do so many speakers) but it *is* slight, and much better than most systems I hear.

All in all, the Bose 901 produces as well-balanced a musical sound as one could want. Sharp transients are followed faithfully. When a sound stops suddenly, so does the speaker. It does not produce bass when there is no bass in the music, but it does produce the deepest bass when it is there.

Each of the enclosures is 20½ by 12¾ by 12⅞ inches. They are compact in size, certainly. The complete system costs $476 (including the equalizer). It wants a lot of power—if you like to listen loudly, consider 50 watts per channel as a minimum. But these speakers provide a quality that is not to be matched.

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AUDIO

BEHIND THE SCENES

BERT WHYTE

WALK INTO the average hi-fi shop and what do you see? Walnut boxes. Dozens of them . . . most quite small, resembling breadboxes or whiskey cases. Some are even as big as *two* whiskey cases. These are loudspeakers . . . a ubiquitous breed, many imitative of each other's design. The claims for these speakers range from modest to monumental. No matter how clever their design, however, to *me* they have the common failing of sounding like a small point source. The music they reproduce sounds rather compressed and constricted, like it is being squeezed through a small window.

Am I prejudiced? You bet! For you see, I'm a "big speaker" man. Unabashed. Uncompromising.

You'll see the big ones in some of the better salons, interspersed among the walnut boxes, standing like some noble monoliths; speakers of massive proportion and imposing aspect. These are the sonic aristocrats . . . the "big speakers" . . . loathed by women and loved by men.

At the moment, this partiality is a bit of a problem since I find myself on a most uncomfortable spot. You see, I've been listening to a pair of small speakers that are reproducing music with a high-quality BIG speaker sound, something no small speakers have any right to do. This iconoclastic speaker is known as the Bose 901 . . . and thereby hangs a tale.

The 12-Year Quest

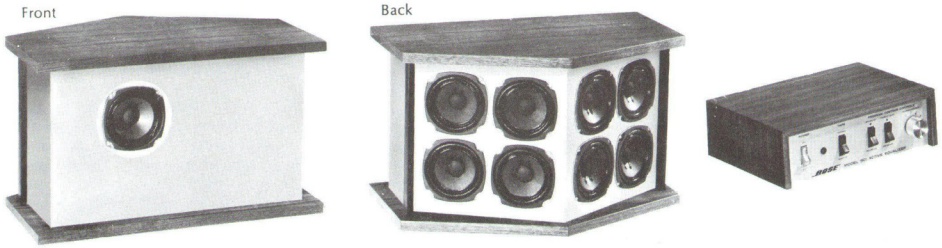
The speaker was designed by Dr. Amar G. Bose, a Professor of Electrical Engineering at the Massachusetts Institute of Technology. Among other things, Dr. Bose teaches acoustics, and for many years has been an avid music lover and hi-fi enthusiast. About 12 years ago, he began a research program to investigate loudspeakers, realizing the truth of the old axiom that the loudspeaker is the weakest link in the chain of music reproduction. A student of the violin in his younger days and a frequent visitor to concerts of the Boston Symphony Orchestra in nearby Symphony Hall, Dr. Bose could not equate what he heard in the concert hall with the reproduction of music through commercially available loudspeakers. This was especially true with his beloved strings, which the speakers reproduced as "interesting but far from realistic sounds." Preliminary investigations convinced him that a good part of the loudspeaker problems derived from the inadequacy of standard speaker measurement techniques, which relied mainly on anechoic chamber tests or free-field testing, and a lot of subjective listening.

Speaker design over the past thirty years has been part science, with anechoic chambers and chain-driven oscillators and oscilloscopes, and part art, which is "cut and try," "cone doping," "individual tuning," and still more subjective listening. There would seem to be little argument that empiricism plays a significant role in speaker development. It is also obvious that we don't listen to music in anechoic chambers, so that questions have been raised regarding the relevancy of chamber data to the home listening environment.

The task Dr. Bose set for himself was formidable indeed: to determine what kind of sound an ideally "perfect" speaker (theoretically a pulsating sphere) would make—if such a thing could be made; and to develop precise techniques of measuring this sound, all within the context of the home listening experience.

With the vast technical resources of MIT at hand, Dr. Bose's first consideration was the simulation of the ideal pulsating sphere, whose surface will emit pressure waves in all directions evenly over its entire circumference. It is important to note that a prime requirement was that the pulsating sphere be measured in a typical room, in the same fashion as a normally operating speaker. Thus the normal room nodes, standing waves, etc., would be included in the measurement. The ideal pulsating sphere turned out to be a high-voltage spark, which was discharged into a typical home-type room at a frequency rate of once per second. The sound of the spark discharge was picked up by a calibrated Western Electric 640-AA condenser microphone. The microphone reconverted the sound into an electrical signal

Fig. 1–A front and back view of the Bose 901 speaker system, with grille cloths removed, is shown below. (Note that the rear of the system has eight speakers, while the front panel has only one.) At right is the system's active equalizer, which has 10 transistors.



which was fed into an accumulator in a special digital computer.

When 4000 discharges had been stored, the computer performed a computation known as digital convolution or superposition integration (which I assure you is quite beyond my ken) and the result was, in essence, a mathematical model of the ideal speaker. The signals on the computer tape are, of course, different from the original (reproduced by the ideal pulsating sphere/spark speaker) because of the characteristics of the "speaker" and the acoustical properties of the room. However, there is a mathematical relationship between the two signals. Once this is known it is possible to calculate how the "speaker" would reproduce any other recorded signals in that room, even something as complex as a symphony. The next step was to feed actual speech and music samples into the computer in the form of electrical signals. The computer produced a tape of this material as it would have been recorded in a living room if the samples were played through a hypothetical one-eighth of an ideal pulsating-sphere speaker placed in a corner. The same music and speech samples were also played in the same room through an approximation to the ideal sphere speaker, consisting of 22 four-inch speakers placed on an octant of a sphere of 20 inches radius, driven by a computer-derived electronic equalizing network.

The two tapes were subjectively compared. According to Dr. Bose, observers were unable (during an A-B test) to distinguish the computer-processed music and speech from the speaker-processed music and speech.

The mind boggles at the enormous computations necessary to produce these tapes. The need for a computer is obvious. Even so, when Dr. Bose started this experiment some years ago, it would have taken 20 *hours* of computer time to process 7 *seconds* of music! Today, this has been reduced to 3 to 6 minutes for the same 7-second processing.

The importance of the experiment was that it proved that with proper frequency equalization, the multiplicity of closely spaced small speakers on the spherical surface can produce music and speech signals in a *normal listening environment* that are *subjectively* indistinguishable from those that would be produced by an ideal pulsating sphere in the same environment having no resonances, phase shift, diffraction, or distortion of any kind. Thus Dr. Bose had a precise measurement technique, yet one that worked with the subjective factors in listening experience.

Another experiment was conducted to provide a measurement technique for speaker distortion. Distortion in speakers has usually been measured in an anechoic chamber, but this method of detecting distortion isn't meaningful to the listener in the environment in which the speaker normally operates—his living room. Most speakers exhibit various forms of distortion as their intensity of radiation increases, and have relatively negligible distortion at very small intensities. Dr. Bose's experiment made use of this fact to determine the level of intensity at which a speaker begins to generate audible distortion in music reproduction. Selections of music and speech were played a number of times through the speaker in a listening room at successively increasing intensity levels. Binaural recordings of each successive speaker playing were made at a constant, standard level. The various recordings were synchronized on parallel tracks of an eight-channel tape recorder. The listener subject was then given an A-B presentation of the sample that was recorded with the speaker playing at the lowest level and a sample representing a higher speaker output level. Naturally, both samples were presented at the same level to the listener, and he was asked only to try to detect a *difference*. The level of intensity produced by the loudspeaker for which a difference is first detected is then a measure of the performance of the loudspeaker. This measure is pertinent to the ultimate *subjective* evaluation, but it was obtained without introducing the problems of individual value judgment or prior notions of the sound of distortion. Essentially, this is a way of correlating objective measure with the subjective perception of sound. The subject was not asked whether he likes or dislikes a sound, but merely if he could detect a *difference* between sounds.

Armed with these unique measurement techniques, Dr. Bose continued his researches. As you can see from the foregoing, there has been considerable emphasis placed on the measurements as applied to the listening room environment. There have been many studies of concert halls made which show, conclusively, that an auditor at a concert, no matter where he may be seated, hears the orchestra at a certain ratio of direct-to-reflected sound. Dr. Bose expanded much of the original European data on concert hall measurement; his studies have shown that for virtually all seats in the average concert hall, the reverberant field is dominant. Even in a large hall such as Symphony Hall in Boston, the reverberant field equals the direct field only 19 ft. from the orchestra. It is important to note that in a reverberant field, sound energy arrives at any point via reflections from the surfaces of the room and that the angles of incidence of the arriving sound are widely distributed. This spatial property of the sound incident upon a listener, plus the frequency spectrum for the incident energy, are the important factors in the subjective appreciation of music.

* * *

At first glance the Bose 901 is rather unprepossessing, but a closer look reveals that the unit is pentagonal in shape, with the two rear panels forming a "Vee" angled at about 30 degrees. As you can see from the illustration, four speakers are mounted on each of the rear panels (total of eight), while a single speaker is mounted on the front panel. All nine drivers are identical, specially designed, 4-in. units, with long-excursion voice coils. Each speaker has a power handling rating of 30 watts. Each is a full-range speaker, so there are no crossover networks. The sealed enclosure is densely packed with fiberglass. In this seemingly simple unit there are many sophisticated concepts derived from the research program.

The Bose Model 901 is sold as a stereophonic speaker *system*, with two of the units comprising the stereo channel, and both units controlled by a specially matched active equalizer. To function properly, the speakers must be placed in front of a wall with a minimum spacing from the wall of 6 inches, a maximum of 18 inches (optimum spacing is 12 inches).

Dr. Bose's concept, based on the concert hall measurements which showed the need for a dominant reverberant field, results in the 8 speakers on the two back panels radiating 89 per cent of the energy toward the wall, while the single speaker on the front panel radiates 11 per cent of the energy into the room. This is said to provide the necessary ratio of reverberant-to-direct sound. With the rear panels angled at 30 deg. to the wall, the wavefronts emerging from the first reflections from the back wall, together with the second reflections from the side walls, produce an effective source that is much larger than the actual enclosure; and that is well distributed across the wall in the same sense that an orchestra is distributed across a stage. Since the reflected sound affords a virtual central image, considerable flexibility is possible in regard to the separation of the speakers. Naturally there is a certain optimum placement in any given room, but if circumstance dictates, the speakers may be placed further apart and closer together than other types of speakers, while maintaining the desired balance of stereo separation or center fill (judicious angling of the speakers inwards or outwards in relation to the walls is necessary, of course).

The nine speakers in each enclosure are full-range units and, as you can see in the photo, are closely spaced. The resultant acoustic coupling causes the resonant frequencies of each speaker to be different from every other speaker. In much the same manner as i.f. cans are staggered to get a broad response, the resonances become inaudible; thus the sound of the total array of speakers is very smooth. With no crossover network, each speaker receives the same audio signal. At low frequencies, the nine drivers, operating in phase, move a great deal of air, which is a well-known principle. At higher frequencies the relatively small cones behave like tweeters, with the highest frequencies propagated by the speakers' dustcaps. The pentagonal shape of the enclosure ensures there are no sides parallel to any of the panels on which any of the nine drivers are mounted, which eliminates the problem of standing-wave resonance.

The Bose active equalizer is a solid-state device which influences the acoustic output of the two speaker units. Precise equalization is necessary for flat frequency response of the radiated sound. This involves considerable boost. In the case of flat response for the lowest frequencies, as much as *18 dB* boost is needed. By manipulating the controls of the unit in the proper manner, a total of 20 different frequency contours are available to compensate for variations in room acoustics, phono pickups, program material, and so on. Some of the contours available are unique. For example, midrange frequencies can be reduced, but without a drastic roll-off of high frequencies. There is also a "below-40-hertz" switch that can reduce turntable rumble and other low-frequency disturbances without adversely affecting response above 50 hertz. The equalization of the signal comes before the power amplifier. The unit can be conveniently patched into a preamp/amplifier setup, or an integrated amplifier or a receiver. In fact, the unit is treated as if it were a tape machine, utilizing the tape-in/tape-out jacks of your particular rig. Auxiliary tape input and output jacks are provided on the rear panel of the equalizer.

* * *

Having described the Bose 901 system and its revolutionary concepts, the question, quite naturally, is how does it sound? At this point we'll have to bring up the matter of power amplification. [Because the equalization comes before the power amplifier] when you are trying to reproduce the very lowest frequencies at substantial levels, the 18-dB boost mentioned earlier can place really heavy demands on amplifier power. Let's put it this way: for 99 per cent of the program material played by most people at better than "apartment house" levels, a good 30 to 40 watts *continuous* power per channel should suffice. But when you want to play that other 1 per cent of program material — the great pipe organs, with the really low pedal and, most especially, a sustained low frequency at thunderous levels — that's when you need all the amplifier power you can afford.

The speakers can handle high power, of course (each speaker in the Bose enclosures is rated at 30 watts, for a total of 270 watts per channel). You can lower your power requirements by activating the "below 40 Hz" switch, however. You gain about 6 dB this way. It is true you lose the frequencies below 40 Hz, but if you desire to play the system at house-shaking levels, and don't have sufficient amplifier power, this is the way it can be accomplished.

I've had good results driving the Bose with medium- and high-power amplifiers. I tried it with a University receiver and with a CM 911, for example. Also with the McIntosh 2105, which has the advantage of a power level meter. If you monitor the output of the Mac amplifier during the heaviest fortes of some grandiose symphony, and set the gain so that you don't exceed +3 (105 watts per channel), you won't hear any distortion. (I didn't.) You will also find it's pretty loud!

Lucky lad that I am, there is very little program material that I can't cope with; not when I have a pair of McIntosh 3500 amplifiers, each capable of a mere 350 continuous watts per channel! These 120-pound (each) brutes are quite magnificent when working with the Bose speaker systems. I put on an organ recording containing plenty of "low C" pedal, and at a level of 108 dB (measured on a sound-level meter) the visual evidence of a scope across the speaker terminals and the audible evidence indicated that the Bose and the Mac had just barely reached a point of mutual distortion.

In evaluating the sound of the Bose 901 system, I was constantly aware that I was listening to an entirely *different* kind of loudspeaker. In some ways, comparison of this speaker with conventional types isn't quite valid. Even without its other virtues, the overwhelming superiority of the Bose in terms of *spatial presentation* and *stereo effect* was immediately apparent. There is no question in my mind about the desirability of the direct/reflecting principle for home listening. With a symphonic recording, the illusion of an orchestra spread across the wall is uncanny. With the virtual image in the center you can sit well away from the traditional "stereo axis" and enjoy a very good stereo presentation. It is the closest thing I have heard to a true three-channel stereo recording. The overall sound is outstanding for its clarity, transparency, wide range, crisp clean transients . . . and just plain naturalness. Equally astonishing is the bass response. To hear a thunderous "low C" organ pedal from these small (approx. 20 x 12 x 12) speakers, or a clean, weighty impact of a large bass drum is truly impressive. The speakers are mercilessly revealing of the faults in all manner of program material. It is a comparatively rare recording that could be played with the equalizer set in the flat position. (There is obviously more high-frequency distortion around than I realized.) The Bose really comes into its own with top-quality tapes. I have some symphonic masters and some one-to-one copies of masters, and they were reproduced with a naturalness that is quite compelling.

With only kudos for the Bose's performance, there *are* some minor drawbacks, some of which have already been mentioned: Fairly high-power amplifiers are needed to realize the 901's *full* potential; if you use headphones, the equalizer should be switched off; priced close to $500 for the entire system (two speaker systems and the solid-state equalizer), they cannot be considered to be truly inexpensive; placement requirements (6 to 18 inches from the wall) can be a problem to some persons since "bookshelf" location is excluded. But the above are trifles, in my estimation, when balanced against the astonishingly realistic sound achievable at home with the Bose speakers.

There is no doubt that the much-abused and overworked term, "breakthrough," applies to the Bose 901 system and its bold new concepts. Æ

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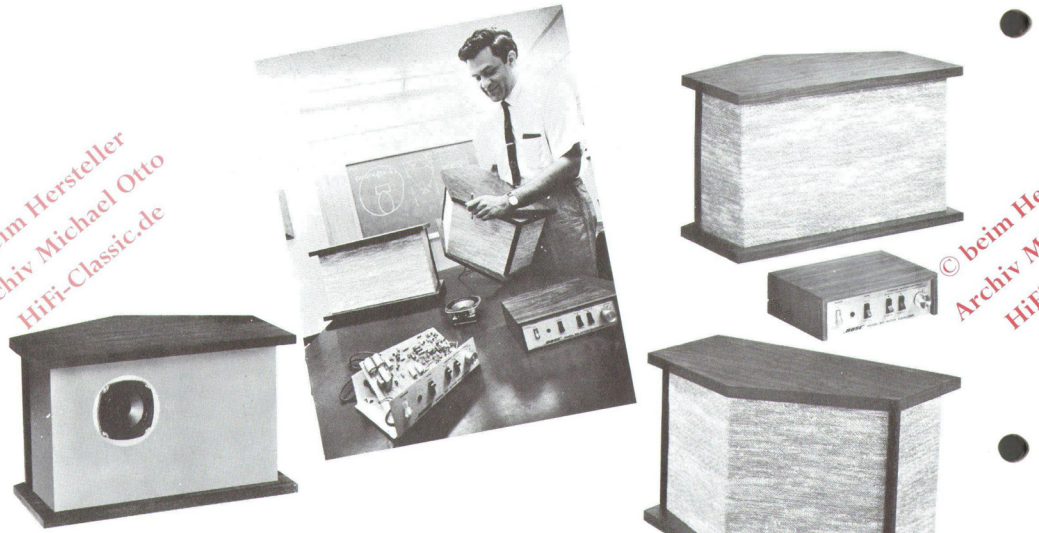
Hi-Fi BUYERS' GUIDE

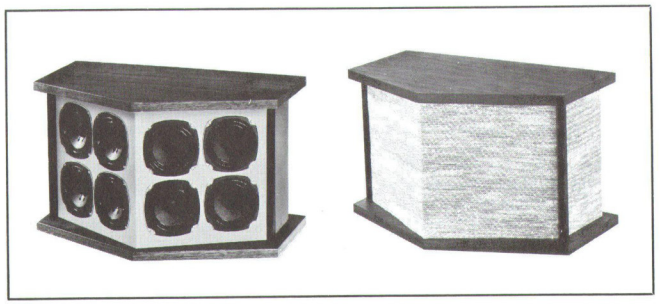
Speakers

UN-TENABLE TRIO FROM YESTERYEAR

Foremost among current speakers tracing their lineage back to yesteryear is the Bose 901. Widely acclaimed by most anyone putting pen to paper, the 901 has been hailed again and again as a breakthrough in technology. Quite the contrary, there is no *new* technology in the 901; the true secret behind the 901 is that it is the first system to roll three oldish ideas—rear radiation, multiple speakers, equalization—into one. The sound? The 901 is very possibly the only speaker system to date to actually pour forth in true concert-hall fashion.



Utilizing a "new" approach to sound reproduction that incorporates at least three time-tested ideas, the Bose 901 is capable of delivering some of the most natural sound ever heard from a speaker system. Its midrange and highs are magnificently transparent, its lows neither smeared nor boomy, its over-all sound quality so clean that the listener is almost unaware of the electronics between him and the instruments. How does it succeed? Through use of reflected rather than direct radiation; multiple speakers rather than crossover networks; a special equalizer to contour response to suit room requirements.



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You can now read THE ULTIMATE REVIEW by the owners themselves

You have read the unprecedented series of rave reviews that the BOSE 901 Direct/Reflecting® Speaker System has received from the leading music and equipment critics and, if you are interested in the background of the 901, you have probably read the Audio Engineering Society paper by Dr. A. G. Bose.

HOWEVER, the relevance of the research and the value of the reviews rest solely upon your ultimate appreciation of the product. Every day we receive letters and comments from owners expressing an appreciation that goes far beyond the expected reaction to just another good product.

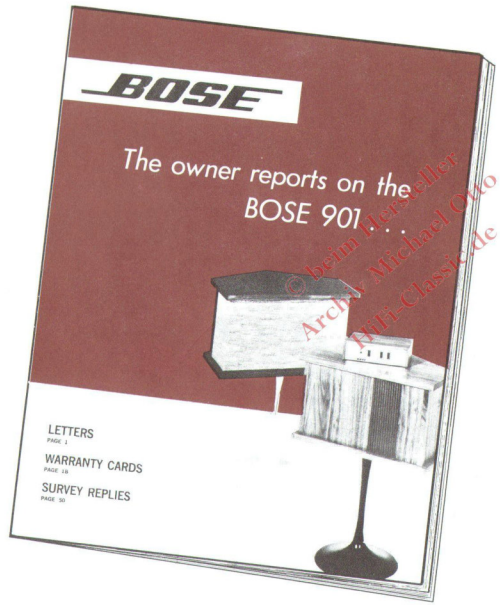
We decided to share these owner observations with you in a 72 page booklet that we believe makes some of the most fascinating reading in the field of high fidelity. It is entitled "The Owner Reports on the Bose 901". Included are letters from owners, warranty cards, and survey replies.

In it you can read the words of the owners on:

1. How different owners describe the esthetic experience of music and the sound of the 901.
2. What equipment owners use with the 901.
3. What equipment owners traded to buy the 901.
4. What happened when a customer tried to buy the 901 from a dealer that was not franchised.
5. What owners would like us to develop next.
6. What owners would like to see improved about the 901.
7. The influence owners have in selling the 901.
8. Candid remarks on many topics by people who, just like you, are searching for the best in stereo.

If your reaction is similar to the response of those who have already seen the booklet, you will read every page before putting it down.

And when you finish, you will know why we get much more satisfaction from our work than could ever be derived from profits alone.



Copies of "The Owner Reports" are available from BOSE Corporation for one dollar.

You can hear the difference now . . .

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