McIntosh

XR AND XRT ISOPLANAR LOUDSPEAKER SYSTEMS

McIntosh loudspeaker systems are now able to see through a newly discovered "design window" to a new acoustical vision of depth and spaciousness. McIntosh loudspeaker systems now offer a "Solid Stereo window" for complete stereo imaging.

McIntosh loudspeaker systems have again achieved a new step forward in performance.

McIntosh loudspeaker systems are on a new course toward a more closely approached reality, a more complete reproduction of the total solid detail of the original sound event. With these new loudspeaker systems, you will find that even your old stereo records have depth and space information which you may never have heard.

Not only do McIntosh loudspeaker systems have lower intermodulation distortion, better musical balance, better dispersion and broader frequency response, but now, these uniquely remarkable systems have achieved a new dimension in the depth and spaciousness of their stereo images.

The word STEREO is derived from the ancient Greek language. Its meaning is best translated into English with the single romance rooted word "solid." "SOLID" implies height and width and also depth. It is primarily the addition of depth imaging, to the left and right imaging, that the new generation of McIntosh speaker systems achieve for you.

Our acoustical researchers have discovered that there is, surprisingly, a design window through which the solid dimension of stereo imaging can be perceived. Other researchers, as well as we, have known for some time that all of the frequency elements of a radiated sound field should be coordinated in time. As with other variables in life however, many researchers have fallen into the common trap, that if a little time coordination is good, then more must always be better. Research is now showing that this may not always be true. It may well be that total time coordination can be achieved only at the expense of other important design requirements, such as smoothness of frequency response, efficiency and the right amount of dispersion. The correct optimizing of all of the variables, all of the elements in loudspeaker system design, constitutes and is the "design window" through which we hear the depth and spaciousness of the complete stereo image. The investment in engineering time and physical research facilities to pierce the veil of older technologies and discover the "Solid Stereo Window" was and is an impressive conjunction of physicists and their analytical methodologies.

Now here is the complete story of the theoretical basis of McIntosh Loudspeakers and Loudspeaker system design goals.

WHAT IS A LOUDSPEAKER?

A loudspeaker is a "sound imaging" device much the same as a stereo photograph is a "visual imaging" device. You measure the excellence of a photograph by judging the coincidence of the visual image with reality. You measure the excellence of a pair of loudspeakers by judging the coincidence of the sound image with reality. After considering both the reality and the sound image you make the ultimate judgement based on what you hear. The most important thing a loudspeaker can do for you is to sound right the *first time* you listen to it, the *next time* you listen to it and *every time* you listen to it.

THE McINTOSH PROMISE

A McIntosh Loudspeaker is a promise of a new psycho-acoustic experience - - - the experience of reality in your listening room - - - the experience of listening to an almost perfect sound image. From many man years of research McIntosh promises you that nearly perfect sound images will occur in your listening room - - - whatever the room is like! To say it differently - - - if the actual live or real sound would please you in your listening room then the McIntosh loudspeaker in your listening room will equally please you.

HOW IMPORTANT ARE LOUDSPEAKER SPECIFICATIONS?

To a research scientist who strives for perfection, specifications are the raw material of his trade. Through the analytical use of measurements a scientist sets his objectives, goals and direction. Specifications give him the ability to chart his progress, and most importantly tell him when his objectives have been achieved. But what do specifications mean to you? Specifications must be understood and interpreted correctly. Many loudspeakers are sold with no meaningful specifications and only a claim for perfection. Perhaps the most important single specification for a loudspeaker is its intermodulation distortion versus sound pressure level. Since most manufacturers do not give this information it is possible to judge their speakers only by listening to them. So to evaluate such speakers you must listen carefully to many types of music for some time and if possible right in your own home. The Total Listening Impression is most often the final criterion of value - - - the final judgment of reality. The massive investment and many man years of research at McIntosh were constantly directed to the one goal of Total Listening Impression. For though specifications may guide you, in the final analysis, the Total Listening Impression when correctly and carefully formed is the basis for the judgement of value.

MAKING A REAL SOUND IMAGE

When you look in a perfectly flat mirror you will see an accurate three dimensional image of yourself. If the mirror is bent then the accuracy of the image is altered. Mirrors can have other accuracy problems. They can be tinted so that the color coincidence of the object and the image is altered. In addition, the image may correspond in shape and size for one color but be out of shape or size for another color. Optical and sound imaging devices have analogous problems. Considering these facts it is possible to state the concept of image fidelity: the *image should coincide with the object in every detail. It should be no more nor no less.*

Applying the image fidelity concept to a sound system requires a statement like this: We should hear across the room the original sound from the loudspeaker -nothing subtracted - nothing added!

There are many links in the sound imaging chain. The microphone, the tape recorder, the disc recording, the many amplifiers and the loudspeaker all present possibilities for altering the sound image.

It's somewhat like the old parlor game of "gossip." That's the game where a group of people sit in a circle. One person whispers the details of a story to the person next to him. The story is whispered from person to person. As you would expect the story will not take many tellings and remain intact. In fact, the more details in the story the greater the likelihood that the story will be modified.

In the same way the more detail in the music, the richer the orchestration, the greater the range of contrast in tone, color and loudness, the greater is the demand on fidelity in the sound system chain.

Most of the links in the sound imaging chain have reached a high level of perfection. The loudspeaker has been the last link in need of a breakthrough to fidelity.

DESIGNING FOR LOUDSPEAKER FIDELITY

The reflection in a perfect mirror is a straight line relationship between the object and the image. Standing in front of the perfect mirror you will see yourself as you are. If your shoes are brown the mirror will reflect them as brown. Any change in color or shape is a departure from a straight-line relationship The sound image must, like the perfect mirror, be a faithful reflection of the original. Each link in the sound imaging chain must be capable of the same straight line relationship.

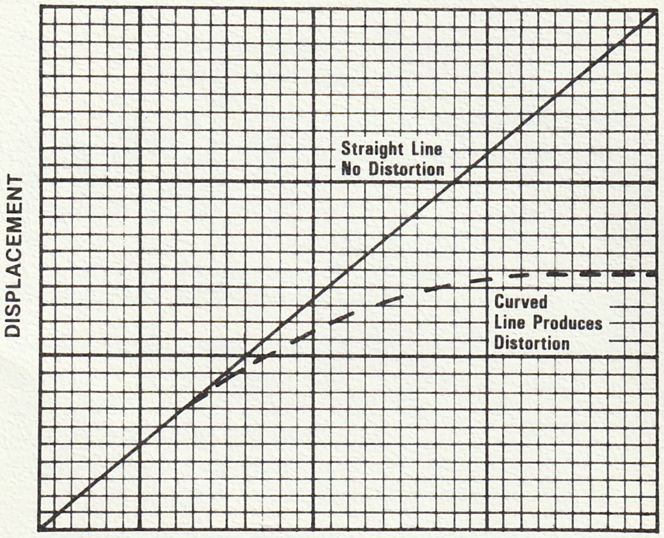


Figure 1 DRIVING FORCE

In loudspeakers, the relationship between the displacement of the cone and the driving force that moves the cone, must be a straight line to be able to produce a natural sound. For example - - - if 1 volt across the voice coil moves the cone one tenth of an inch, then 2 volts should move the cone 2 tenths, 3 volts, 3 tenths and so on to the limits of its travel (Figure 1). The graph of this action relating volts and displacement is a straight line.

However, if the line relating volts and displacement departs from a straight line the sound image will depart from reality. The greater the departure from a straight line relationship the less and less accurate the sound image. Then to make matters worse, if two sound images are reconstructed at the same time from the same cone--not only is each altered--but each image also blurrs the other. The name of this action is intermodulation distortion. Speakers developed from older technology have intermodulation distortion that can measure from 5 to 15 percent. The new technology that permitted the development of McIntosh speakers brought measured intermodulation distortion down to only 1/3 of 1 percent (Figure 2). That difference is a dramatic contrast! You hear reeds and strings as sharp, clear, well defined sounds with only 1/3 of 1 percent intermodulation distortion. On loudspeakers designed from older technology with several percent intermodulation distortion (Figure 3), these sounds are indistinct and unpleasant.

Figure 2
I.M. Distortion - McIntosh XR Loudspeaker System at 10 Watts Input

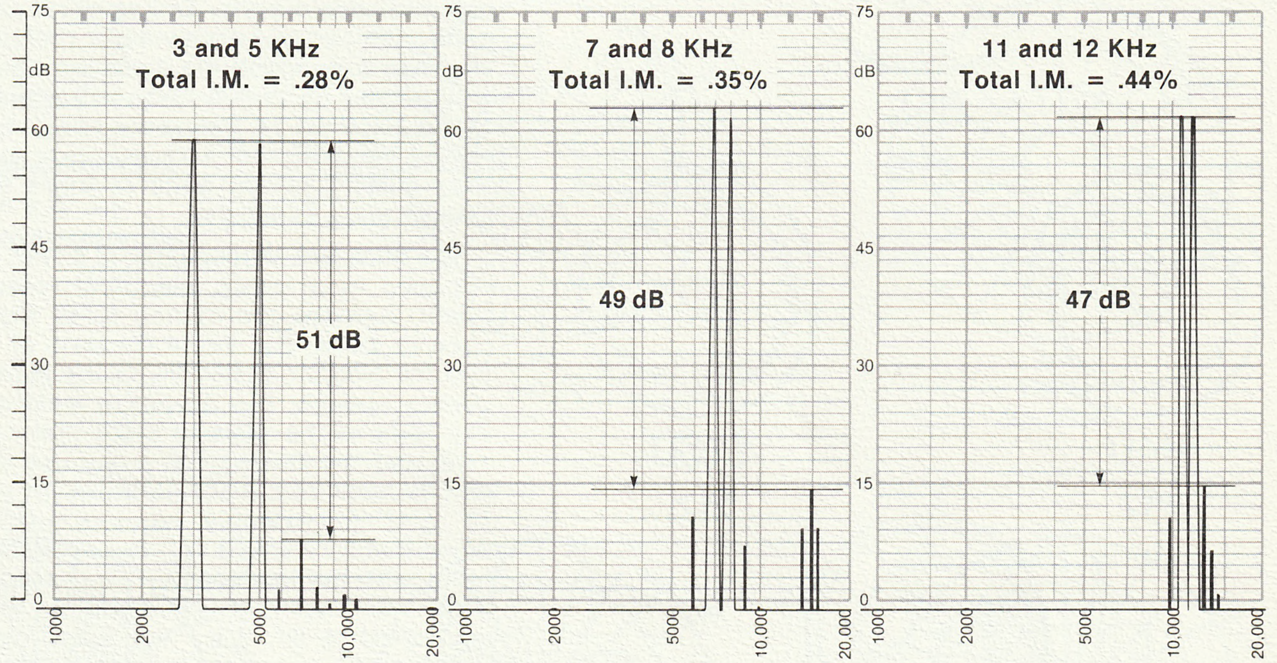
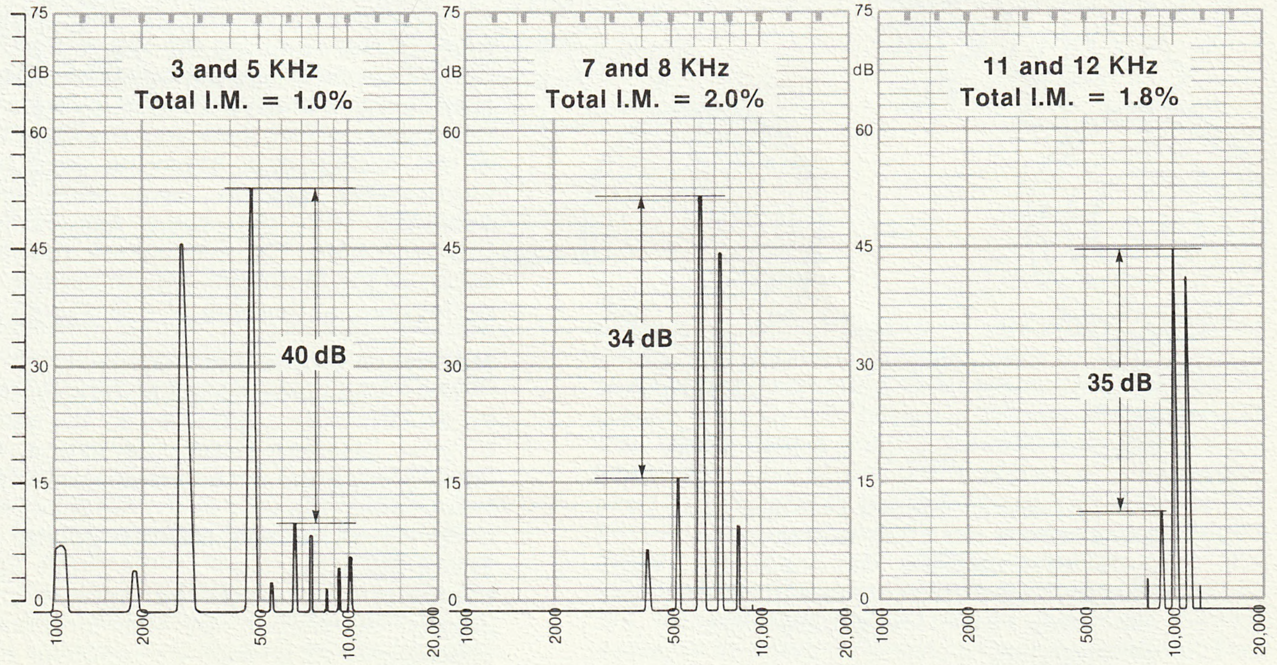


Figure 3
I.M. Distortion - Popular Loudspeaker Design Using Older Technology at 10 Watts Input



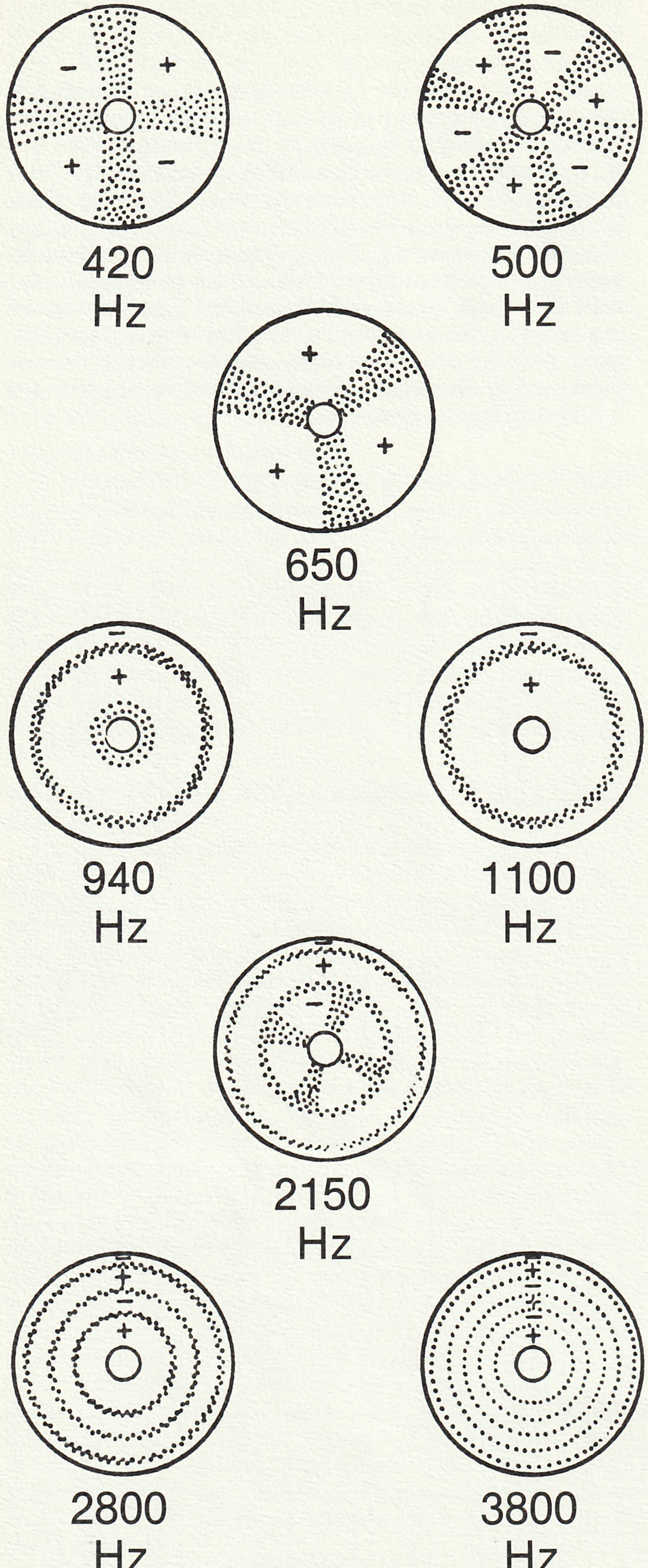


Figure 4

The (+) and (−) signs indicate regions where the cone is flexing in opposite directions, *i.e.,* opposite phases. These are examples of what can occur with inadequate cone construction.

To achieve the performance, needed to recreate reality, loudspeaker cones must move as near perfect pistons. The entire surface of the cone must move the same distance at the same time. If part of the cone should flex and so fail to move the same amount at the same time then an imperfect sound image occurs.

This condition is called "cone break-up" (Figure 4). It can be seen that when the cone breaks up, its motion no longer has a straight-line relation to the cone driving force. Again, any departure from a straight-line relationship is an increase in distortion.

Loudpeaker scientists have not been free to use the perfect piston cone because of its limitations. The perfect piston must be stiff to prevent cone break-up. Increase in stiffness usually requires increased cone weight. Among other characteristics, cone stiffness and cone weight, dictate the frequency range over which the cone can operate. As cone weight goes up usually cone stiffness increases, but at the expense of frequency range and efficiency. Hence the design of a loudspeaker system using a near perfect piston cone is more elaborate and usually more expensive.

The cone of a loudspeaker is driven by a linear, as opposed to a rotary, electrical motor. The linear motor supplies the driving force that causes the cone to move. The motor consists of the voice coil and the magnet assembly. In the McIntosh low frequency speaker this assembly weighs 9½ pounds. The laws of the physics state that as mass is accelerated the driving force required increases one unit for each unit of acceleration. An acceleration of 10 "g's," for example, requires a driving force 10 times that for a single "g." It can be shown that at 60 hertz, with the loudspeaker producing one acoustic watt, the maximum acceleration experienced is equivalent to 93 "g's." You can imagine that the loudspeaker scientists must consider any increase in moving mass very carefully.

The acceptance of these limitations and the use of multiple specialized radiators gives the loudspeaker scientist the key to low distortion and perfect sound image performance. The price paid for excellence is always totalled in terms of singleness of purpose, effort, care and attention to detail. Each of the loudspeaker elements used in a McIntosh loudspeaker system have been researced and designed with the same exhaustive, extensive, thorough care. The meticulous attention to minute detail is the McIntosh way to design for the nearly perfect sound imaging of a McIntosh loudspeaker.

MAKING A STEREO IMAGE

The human brain forms a stereo sound image based on information gathered by the ears. In the case of your listening room, the sound information is usually supplied by two loudspeakers. Differences in loudness intensity and differences in the time occurrence of sounds are recognized by the brain. These differences allow the brain to position the source of the sound. The intensity information, is greatly dependent on the directional radiation characteristics of each loudspeaker system.

Loudspeaker radiation patterns have been measured and plotted by several authorities. The means of designing for non-directional sound and widely dispersed sound are well known. It has been established, for example, that if the wavelength to be radiated is long in relation to the loudspeaker diameter then the intensity of sound at lower frequencies tends to be the same in any direction from the speaker, above it and below it, in front of it and behind it. With the knowledge that wavelength decreases from 56 feet at 20 hertz to about a half inch at 20,000 hertz the loudspeaker scientist can describe the dimensions of the reproducer to be used in the loudspeaker system. He can also describe the band of frequencies to which each loudspeaker must be limited to achieve widely dispersed radiation.

Widely dispersed radiation over the whole ten octaves of music makes for a well defined, stable stereo image. But the widely dispersed loudspeaker will not sound as loud as the highly directional loudspeaker. The designer must compensate by using expensive and heavy magnet structures to obtain equivalent loudness. He must limit the frequency bandwidth which the loudspeakers radiate so that the shortest wavelength is at least comparable to the loudspeaker diameter. Then he must exercise great care in mounting the speakers, in the design of crossover networks, the selection of grille structures and cloths as well as the actual construction of the basic loudspeaker mechanisms.

DIRECTIVITY vs. WAVELENGTH

To focus in a little more on this problem consider the chart of radiation patterns for a 12 inch diameter loudspeaker (Figure 5). Notice that as wavelength shortens the speaker becomes progressively more directional until it breaks up into major and minor lobes. The octave from 1500 hertz to 3000 hertz is particularly interesting. If an instrument were to increase pitch by this octave a listener 30 degrees off axis would hear a greatly reduced intensity. As we have seen, one of the prime pieces of information used by the brain to localize the stereo image is the intensity of the sound. If the intensity is changed merely by the pitch change radiated from the loudspeaker then the listener will be subjected to the incongruous image of the musician moving about as he plays different notes (Figure 6A and 6B). That's not an image of reality.

Measured directivity patterns for a typical 12-in. direct-radiator loudspeaker in a 27- by 20 - by 12-in. rectangular box.

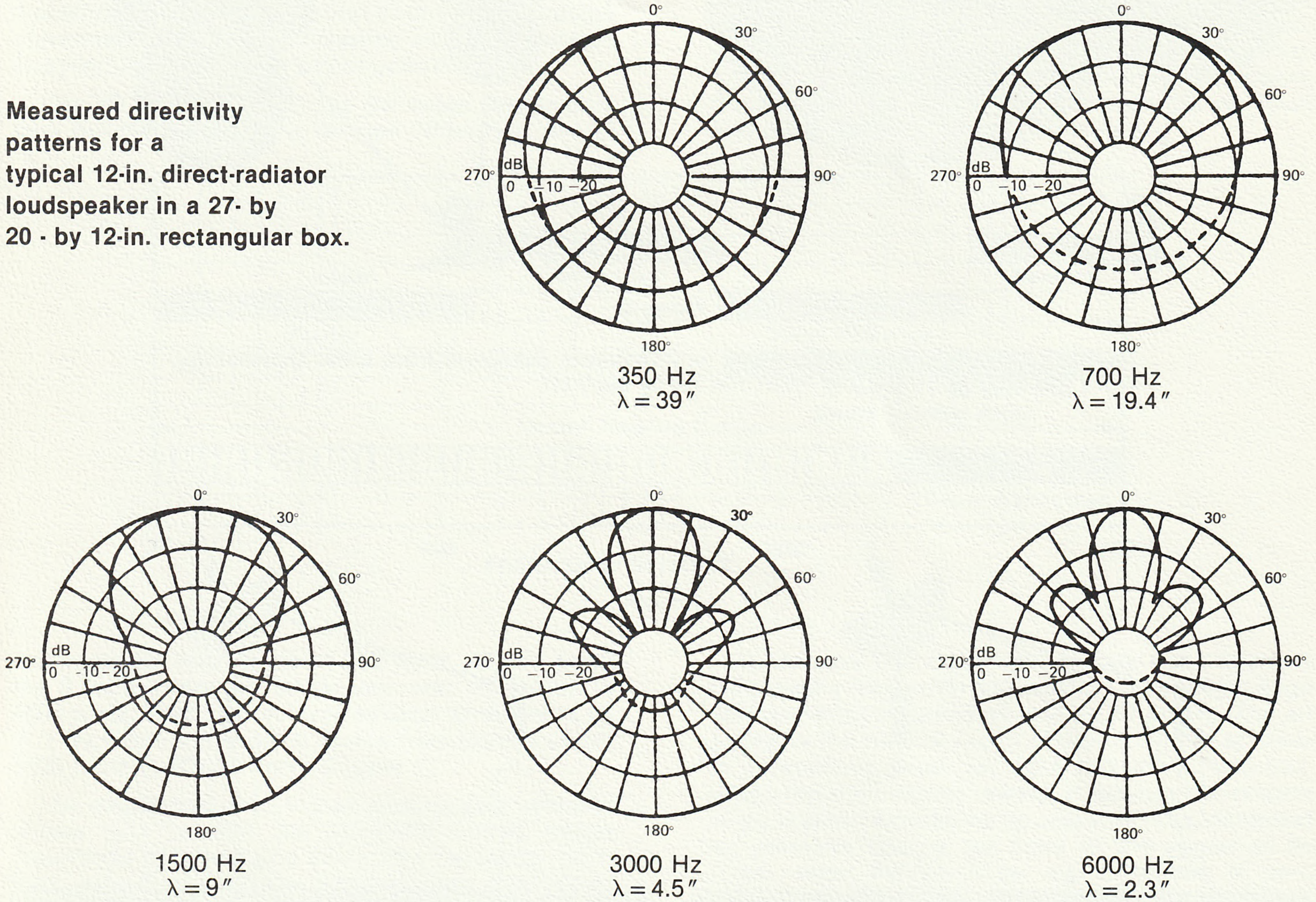


Figure 5

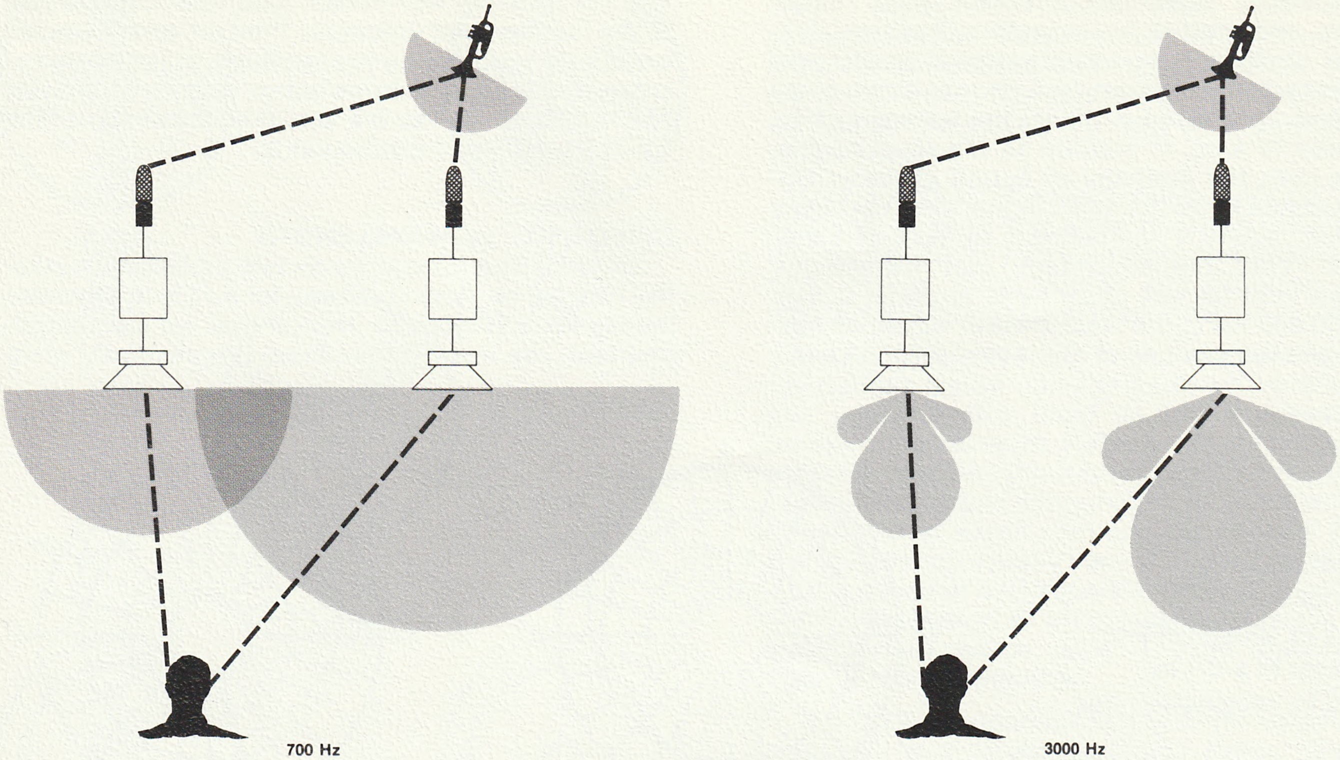


Figure 6A

Radiation patterns above typical of loudspeakers designed from older technology. Note the change in pattern from 700 Hz to 3000 Hz.

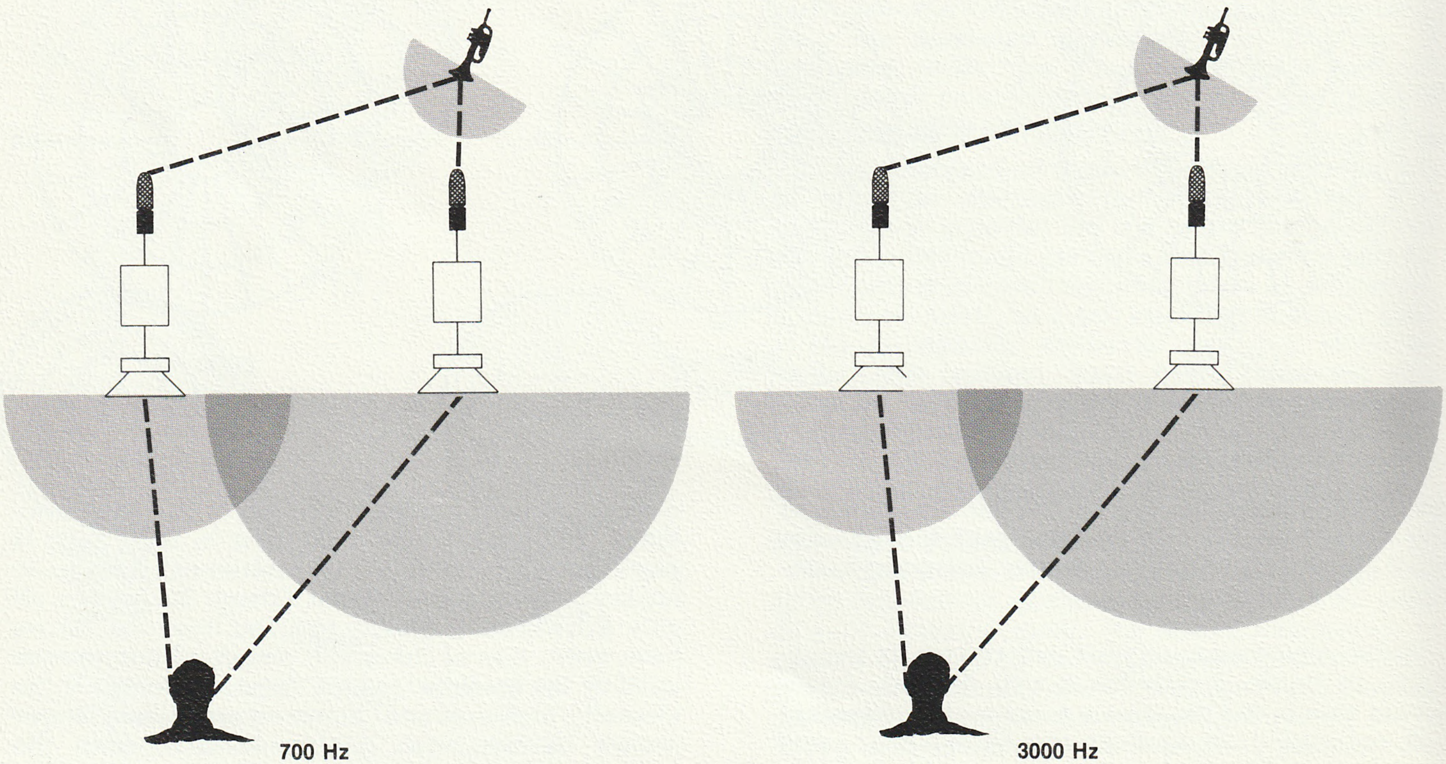


Figure 6B

Radiation pattern from McIntosh loudspeakers designed from new technology. Note the similarity from 700 Hz to 3000 Hz.

To avoid this problem right from the beginning our loudspeaker scientists used multiple loudspeakers with different diameters. For example with the XR 16 we limited the 12 inch woofer loudspeaker (10 inch effective cone diameter) to an upper frequency of 250 hertz, used a smaller 8 inch (6 inch effective cone diameter) diameter speaker to radiate to 1400 hertz, and then a still smaller 1½″ dome speaker to radiate to 7000 hertz, and then an even smaller 1″ dome speaker to radiate to 20,000 hertz. By this means the system dispersion is preserved and hence the stereo imaging preserved for all listening positions.

Limiting the frequency spectrum of each driver also allows designing with low intermodulation distortion. *It is interesting that both of these design objectives, better sound imaging and better stereo imaging, lead to similar construction.*

The XR 19 and XRT 20 use the same design concept but the spectrum is divided differently, the 12 inch woofers operate up to 250 hertz. At this point the 8 inch midrange takes over and continues to 1500 hertz. Then the multiple tweeter array made up of 1 inch dome speakers covers frequencies above 1500 hertz to 20,000 hertz. (Figure 7).

The dispersion of McIntosh loudspeaker systems allows you to hear the complete stereo image regardless of where you sit in your listening room. With wide dispersion the complete frequency spectrum is heard in all areas. Even in the extreme case of being directly in front of one loudspeaker system the complete program is heard from the other loudspeaker across the room. The *separation* of instruments in the *stereo image* and the *definition* of instruments in the *sound image* are a unique and valuable product of the McIntosh total technology approach to design.

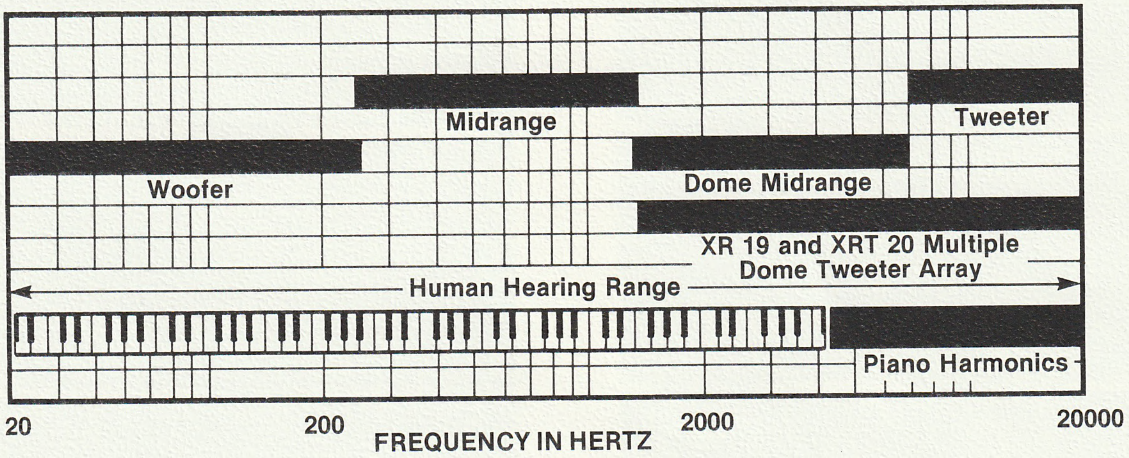


Figure 7

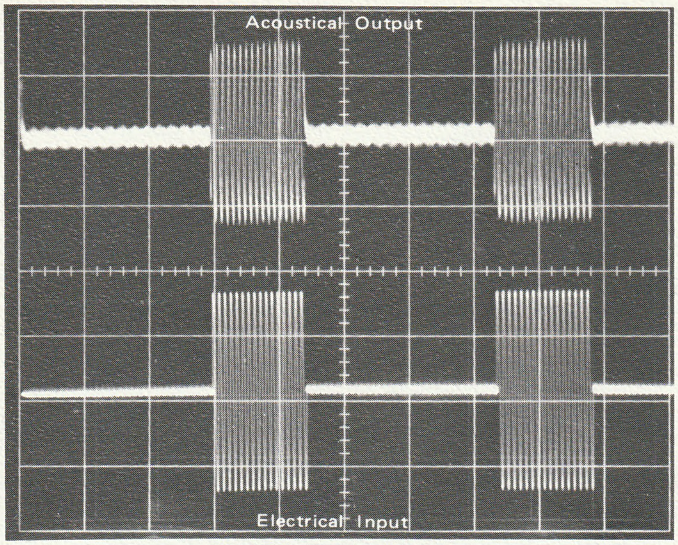
DESIGNING FOR NATURAL BASS

Research programs have one common advantage for the alert scientist and engineer. The thousands of hours of effort, analysis, conjecture, and synthesis uncover opportunities to make meaningful contributions. Most of these opportunities were discovered just where lesser men saw only problems. One of the great opportunities that the McIntosh acoustics research team uncovered was a new design for natural sound of bass instruments.

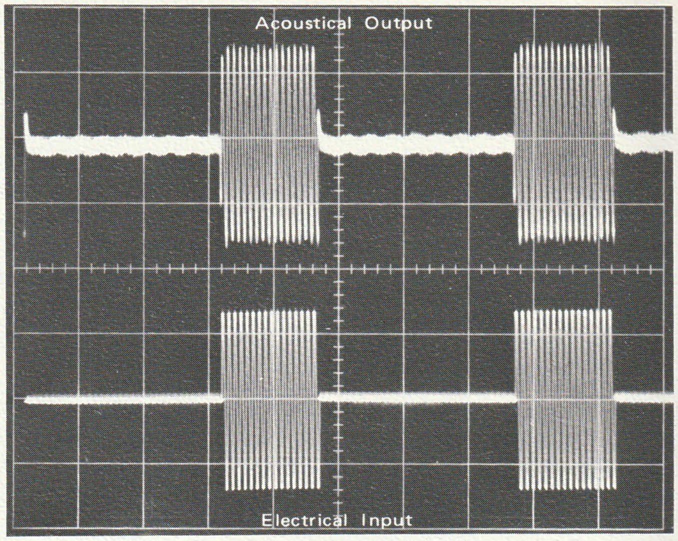
To understand more of this design consider what happens when a bass drum is struck, and the motion of the diaphram pumps a large volume of air. The reproduction of such a sound image requires the motion of the same volume of air or, at least, a significant fraction of it. Because the other design objectives of low intermodulation distortion and widely dispersed radiation dictated a maximum effective cone diameter of 10 inches, the low frequency loudspeaker had to be designed with large excursion, back and forth movement, to achieve the volume velocity necessary. Our design objective was the development of a low frequency loudspeaker with one half inch peak to peak cone excursion. Remember that, even with this large excursion, the straight line relationship between driving force and movement had to be maintained.

To achieve this linear relationship our engineers employed a long voice coil winding, a very light edge and centering suspension and an air spring. The air spring is the natural result of mounting the speaker in a relatively small air tight extremely rigid box. When the cone moves inward, it reduces the volume of air thereby increasing its pressure. The increased air pressure returns the cone to the center of its travel when the electrical signal returns to zero value. When the cone moves outward, the volume of air increases reducing the air pressure in the box. Now the air pressure in the room can restore the cone to its center position when the electrical signal again reaches zero. One of the properties of an air spring is an almost perfectly straight line relation between volume and pressure for such small changes in volume. This insures a low level of distortion at low frequencies and also a low level of intermodulation distortion.

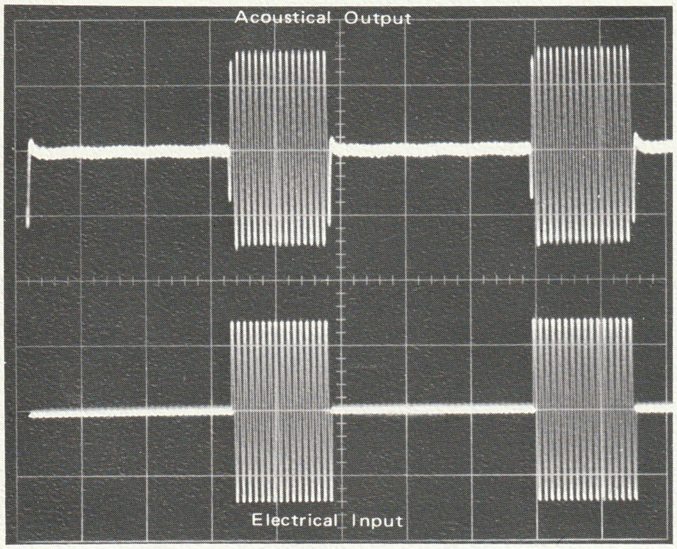
It was at this point that a really new and patented development occurred. We found that if we combined the linear air spring with a stiff cone, long voice coil and a very large and massive magnet structure we could achieve the most accurate control of the cone motion for bass frequencies.



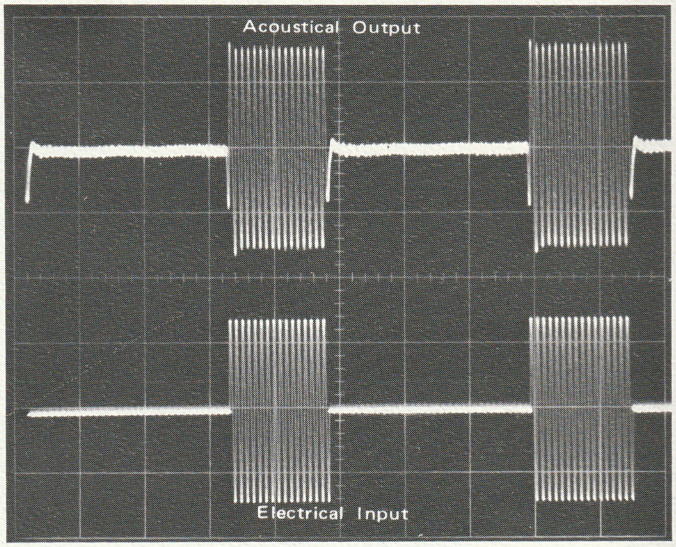
20 HERTZ TONEBURST
Figure 8A



50 HERTZ TONEBURST
Figure 8B



100 HERTZ TONEBURST
Figure 8C



150 HERTZ TONEBURST
Figure 8D

The above oscillograms show the degree of accuracy with which the system reproduces tone bursts at 20 hertz (Figure 8A), 50 hertz (Figure 8B), 100 hertz (Figure 8C), and 150 hertz (Figure 8D).

The use of a massive magnet structure to obtain this degree of control produces what is called a critically damped speaker. Such a speaker produces the most accurate cone control, but it has another characteristic that has bothered designers for many years.

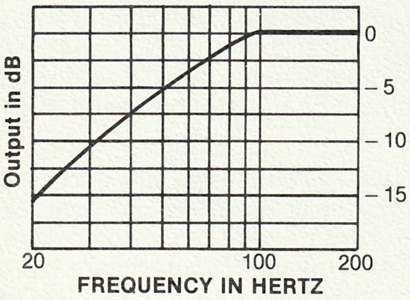


Figure 9

The response of the speaker rises as frequency increases from 20 hertz to about 100 hertz. The rise in response is on the order of 15 decibels, a power ratio of 32 to 1. See Figure 9.

There are two ways to obtain a flat response over this frequency range. In the older technological approach to loudspeaker system design, flat frequency response was obtained by using mechanical resonances in the speaker and its enclosure but this compromised control of the cone motion and system efficiency. This has been the traditional solution with its emphasis on cost reduction rather than reproduction accuracy.

Then there is the new approach. To restore the system to a flat frequency response while maintaining control of the cone motion, an electrical signal is supplied having a complementary curve to the curve of the rising speaker response. (Figure 9) Supplying this electrical signal introduces an equalizer into the system. The combination of the loudspeaker system and equalizer produces both a flat response and excellent motional control of the woofer cone, down to 20 Hz. This is the subject of three patents #3,715,501, 3,721,861, and 3,803,359 all assigned to McIntosh Laboratory, Inc.

This advantage brings another potential improvement to the system. The location in the room in which the loudspeaker is placed can substantially alter its sound balance. The equalizer can be designed to compensate for different positions of the loudspeakers in any room.

DESIGNING FOR DIFFERENT SPEAKER POSITIONS

The intensity of sound delivered to the room from a bass speaker at very low frequencies varies over an 8 to 1 range (9 decibels) depending on where the speaker is positioned in the room.

For example if the loudspeaker enclosure is suspended in the center of a large, sound absorbing room, a 20 hertz signal will radiate equally in all directions from the loudspeaker. It will be radiating into a sphere.

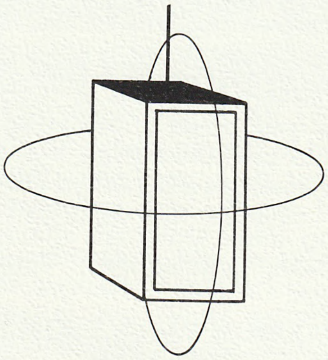


Figure 10

If the loudspeaker enclosure is then placed against a wall of the room it would be radiating into a hemisphere. The signal striking the wall would be reflected outward and in effect double the intensity delivered to the room.

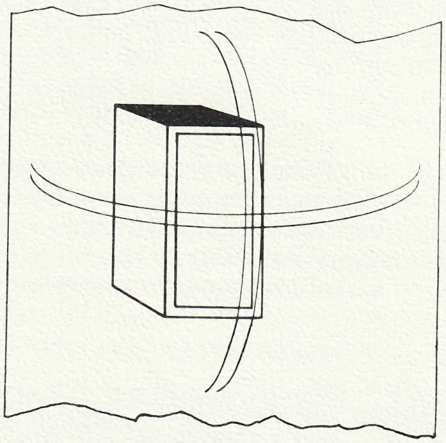


Figure 11

If the loudspeaker is then moved down the wall to the floor the intensity will double again. The loudspeaker is then radiating into one quarter of a sphere.

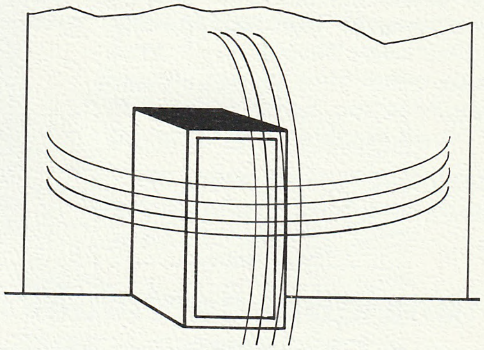


Figure 12

Then by moving the loudspeaker into a corner of the room the radiation is concentrated into one eighth sphere with another apparent doubling in intensity.

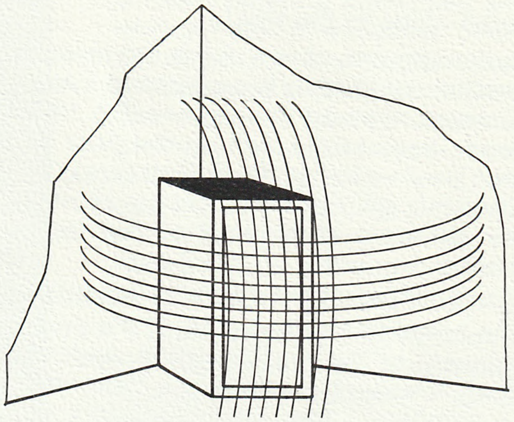


Figure 13

The effect of the position of a loudspeaker system in a room can be summarized graphically as in Fig. 14.

Comparative Effect of Room Gain
with Changes in Loudspeaker Placement.

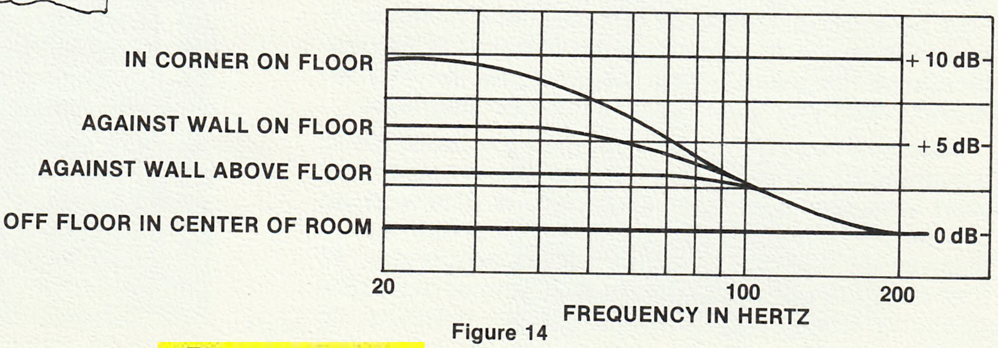


Figure 14

The equalizer that was required for natural bass reproduction can now provide an additional advantage. The electrical equalizer response can be varied in accordance with the upper curves shown in Figure 15. The lower group of curves show the net acoustic effect of the environmental equalizer in combination with the loudspeaker system when

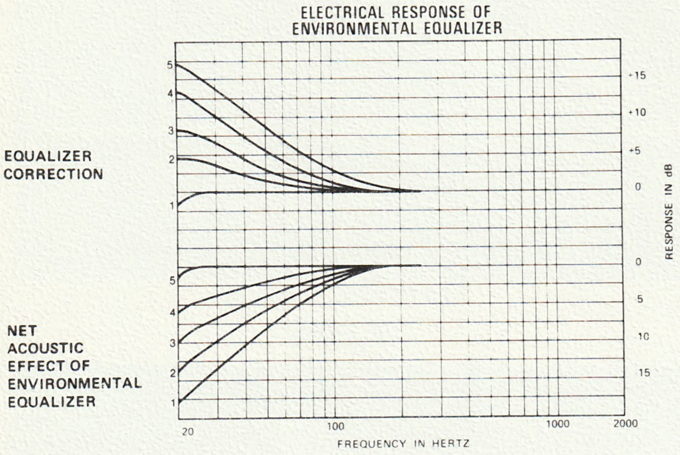


Figure 15

measured close to the woofer.

By selecting one of five curvature rates in the environmental equalizer it is possible to make a speaker radiate as it would in a corner (Fig 13) when it's positioned against the wall on the floor (Fig 12), or mounted on a wall (Fig 11), or vice versa. For stereo, individual left and right controls are provided to correct for different placement of the loudspeakers in the room.

DESIGNING FOR DEPTH AND SPACIOUSNESS

In the preceding description of the evolution and development of the low distortion, wide dispersion McIntosh speakers you will see that each system uses a number of specialized radiators of different diameters to achieve the system's design goals. Different radiators have different acoustical time centers. Smaller diameter radiators often have time centers which lead time centers of larger diameter radiators. Dome radiators have time centers that are in front of, or lead, those of the same diameter cone radiators. How to bring these varying time centers into alignment in real time is a problem that has been and still is challenging the ingenuity of designers.

One fairly obvious solution is to back-space those radiators which have leading acoustical time centers. This solution is limited in effectiveness however. It operates in space only along the line that is perpendicular to the plane of the radiators. As the listener moves off of this line time coordination degrades.

Research quickly shows that if all the radiators in a system are mounted in a vertical line in one plane, then whatever degree of alignment is achieved on the perpendicular, that alignment is preserved in front of the radiators and off the perpendicular. At first it appeared that while this was a most desirable goal, its attainment would never be practical. It seemed to be literally impossible to bring the system radiators into exact time alignment while they were mounted in the same plane. At this point we reviewed the research into the degree of time alignment that is required for stereo depth perception. Here is what we found.

The dynamics of the pychoacoustic stereo image allows a tolerance within which further time coordination is not necessary for stereo depth perception. As long as the time centers of the radiators are within a time envelope such that there is a smooth time curve from one to the other and response amplitude is also made smooth, then the system stereo depth image is not impaired. In fact, research has shown that if a system is designed for a tight time tolerance without regard for response then the discontinuities in response offset the benefit of time alignment. Thus there is evolving the critical elements of a "Design Window" whose requirements are to a degree mutually excluding and whose boundaries must be respected to achieve subjectively significant depth and space imaging.

The new XR 14, XR 16, XR 19 and XRT 20 systems are all designed to the requirements of the "Design Window" so that they can "see" through to new dimensions of depth and spaciousness, while retaining all the other McIntosh characteristics of clarity, definition, preciseness, dispersion and musical balance.

OBTAINING MAXIMUM VALUE FROM THE WORLD'S BEST LOUDSPEAKER

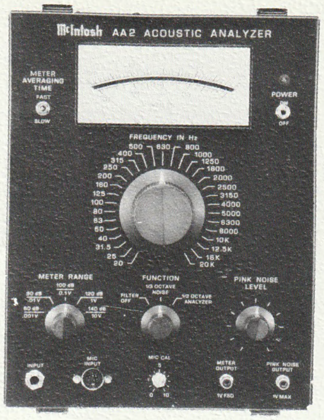
Regardless of what room you use them in McIntosh speakers will always sound better than any other speaker. Whether they are used with an equalizer or not the superiority of the McIntosh speaker is always apparent. The clarity, the naturalness of sound, the balance, the accurate transient response are all superior qualities that are always with you.

Every room affects the balance of the sound in that room. Millions of dollars have been spent trying to establish correct balance for symphony orchestras in concert halls. As live music is affected by a room so is the sound of a speaker. There are several ways in which this happens.

- The position of the speakers in the room.
- The dimensions of the room.
- The wall, floor and ceiling covering.
- The stiffness or flexibility of the room surfaces.
- Radiation from furnishings or substructures in the room.

Any or all of these factors can alter the sound balance. What you can do about this depends of course on what you want to do. Some people simply live with incorrect musical balance because it's not important enough to them. Sometimes very simple measures, such as changing the location of speakers, will produce adequate musical balance. After going to over 300 rooms where people live and listen we have found that most systems can be dramatically improved by acoustically analyzing the room and then from this position of knowledge specific remedial action is easy to apply. Whether it is a simple action such as relocation of speakers or whether it involves electrical compensation for otherwise unavoidable imbalance, simply knowing at what frequency to apply correction and how much correction is valuable in itself. When each speaker's response to the listeners ears is smooth and uniform and in balance the sudden A/B comparison of improved clarity, stereo imaging and overall listening impression is dramatically satisfactory.

McIntosh has developed an acoustical analyzer which your franchised dealer can bring to your home. In a matter of one to three hours you can have an accurate point by point 1/3



octave response analysis of your speakers in your home. You can experience the A/B comparison of correct balance and smooth uniform sound from each loudspeaker. You can know that your system is right for your home and for your own ears. Even if you should need to move from your home, or only move your speakers in your home, correct balance can be restored in a short time.

An investment in McIntosh sound is truly one of the safest investments you can make.

To protect your investment each McIntosh Isoplanar Loudspeaker System is given a wide variety of tests.

Tests range from time coordination to intermodulation distortion, to power response. These tests required the purchase of some very expensive and sophisticated test equipment and facilities. Too often manufacturers bypass the expense and time required to perform this important research.

McIntosh Laboratory has recently expanded its acoustical laboratory to make it one of the finest private acoustic laboratories in the world. Here is a description of some of our equipment and its use.

Response measurements are made in a matter of seconds with a Bruel & Kjaer Real Time Analyzer, (fig. 1). We can see the output of all the 1/3 oc tave bands simultaneously. This screen display shows the output of a pink noise generator that is used to make response measurements. By driving a speaker system with pink noise and automatically switching the output of many Bruel & Kjaer condenser microphones located at various points around the system, we quickly find the average response radiated over various solid angles. This way we can design with a degree of confidence not only in the measurements, but also in the loudspeaker system performance. To do the same test by measuring each

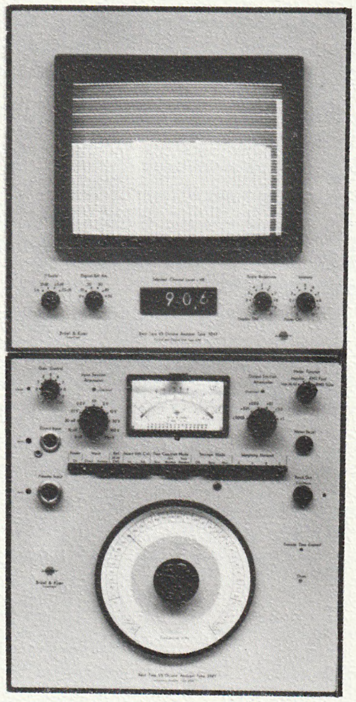


Figure 1

of 30 individual frequency bands at each of many points in space and then calculating the average response would literally take days. If improvements were then to be made in developing the system, these tests would have to be done over again many times.

McIntosh's new anechoic room (fig. 2) is used for some of our speaker tests where a controlled acoustic environment is essential. The surfaces of this room reflect less than 0.1% of the sound striking them. Distortion and response can be easily and repeatedly measured under these conditions without any false readings caused by reflecting surfaces. This non-reflecting environment also allows accurate measurement of speaker system time coordination.

The reverberant room tests (fig. 3) are equivalent to measuring and averaging an infinite number of points around the speaker system. This enables us to rapidly find the total acoustic power radiated from the speaker in all directions. Smooth acoustic power is essential in good speaker design. Calibration and environmental control devices are shown as well as Bruel & Kjaer condenser microphone and McIntosh XR Isoplanar Loudspeaker system.

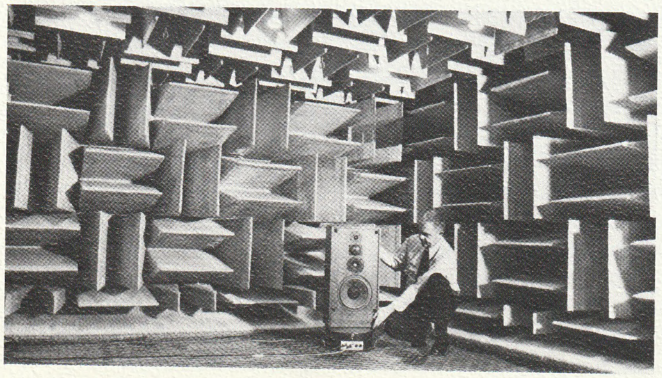


Figure 2

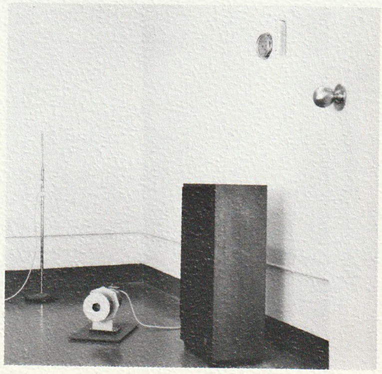


Figure 3

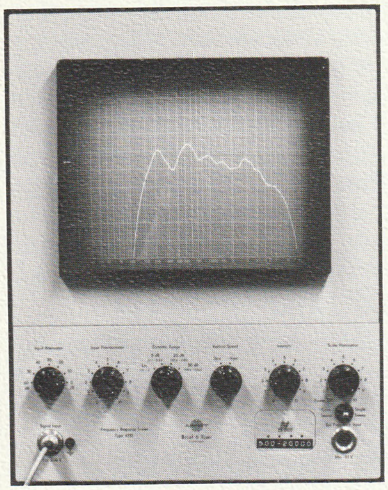
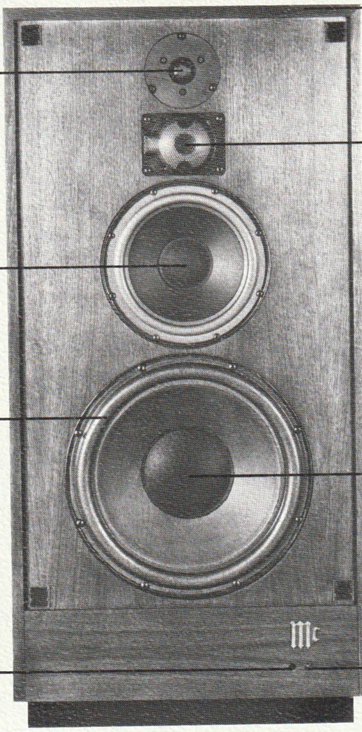


Figure 4

This Bruel & Kjaer Response Tracer (fig. 4) is used to test speaker elements in production before they are used in the system. This insures maximum quality control and uniformity between systems.

Figure 5

This Bruel & Kjaer test equipment (fig. 5) is used for measuring response and impedance as well as harmonic and IM distortion. This equipment automatically plots a continuous curve of total harmonic distortion or resolves individual curves for 2nd, 3rd, 4th, and higher components. Higher harmonics are more easily heard than lower ones. If you were to measure a power amplifier for distortion you might measure at 20 Hz, 1 kHz, and 20 kHz. If it is low at these frequencies, you could infer all other frequencies are as low and you probably would be right. With loudspeakers, however, any frequency could be bad and not show up at other frequencies. A continuous measurement is the only way to be sure.



XR 16

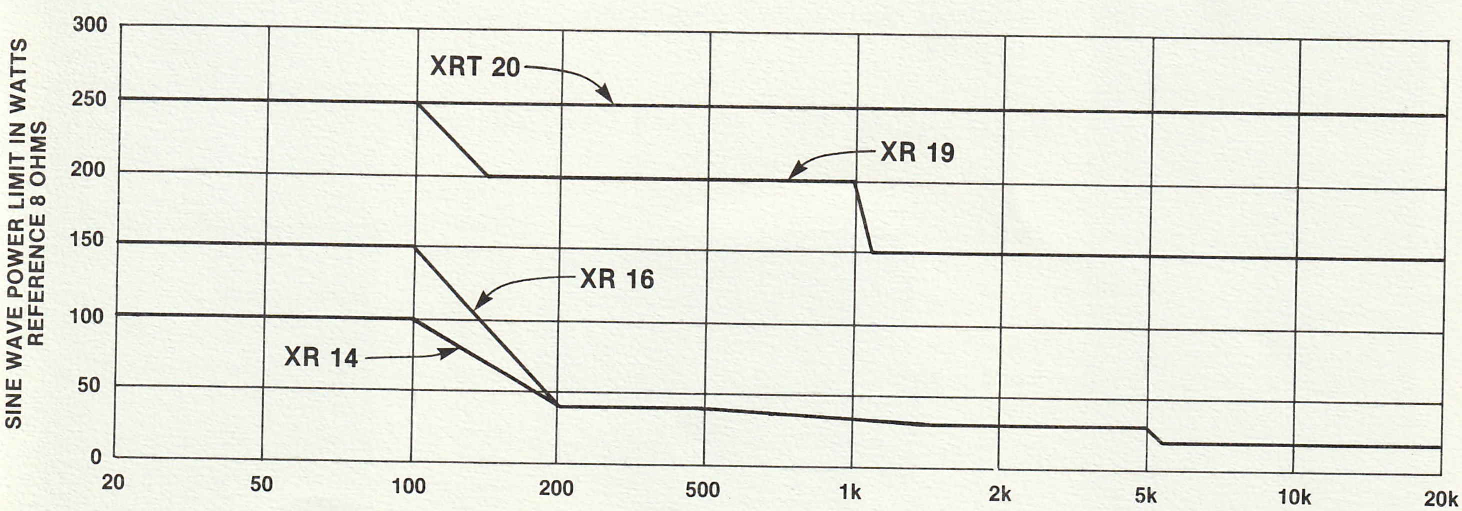
The XR Isoplanar loudspeaker systems are the result of extensive and thorough research and development. We make the XR systems to give you the best performance and best value.

Special attention is paid to the crossover network. Low loss metalized capacitors are used in all critical circuits. Selected low loss electrolytics are used in less critical areas. Both air core and iron core inductors are used. The iron cores operate in the completely linear region even at the maximum recommended power levels for the system. The circuits and components in the network of each speaker element are carefully adjusted for optimum system performance with maximum phase continuity which presents an improved coherent sound source to the listener over a wide listening area. This causes the stereo image between the speakers to remain steady in solid stereo space without changing apparent location with various frequencies.

Finally we listen to our loudspeakers. We listen over a wide range of program material and in a variety of rooms. When we listen to a speaker that appears to sound smooth, we need to know why it sounds smooth. We need to measure it to know how smooth, in what frequency range, and where it might need improvement. Achieving the design goals of low distortion, smooth power response, wide frequency range, minimum phase interference, wide dispersion, high power handling, optimum sensation of depth and spaciousness, etc., is a challenge that can only be met by extensive use of adequate test equipment coupled with years of listening, designing and manufacturing experience.

ISOPLANAR RADIATOR LOUDSPEAKER SPECIFICATIONS

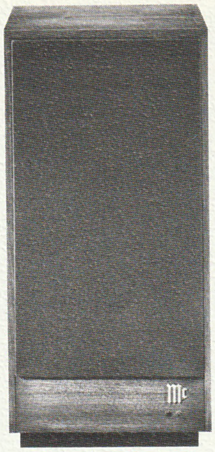
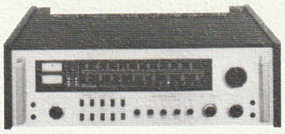
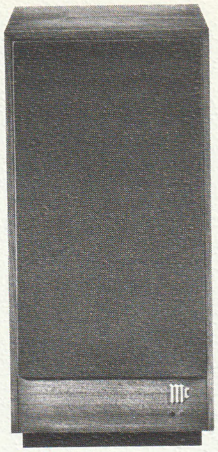
SPECIFICATIONS	XR 14	XR 16	XR 19	XRT 20
Impedance	All Models: 8 Ohms Nominal			
Crossover Frequencies	700 Hz, 1.4 and 7 kHz	250 Hz, 1.4 kHz, 7 kHz	100 Hz, 250 Hz, 1.5 kHz	250 Hz, 1.5 kHz
Program Power Rating (Maximum Power Provided Amplifier Is Not Driven Into Clipping)	100 Watts	150 Watts	200 Watts	250 Watts
Sine Wave Power Rating	See Graph Below			
Speaker Sizes (Diameter) Woofer, Frame Size Radiator Size	 10" (25.4 cm) 7¾" (19.7 cm)	 12" (30.5 cm) 9½" (24.1 cm)	 Two 12" (30.5 cm) Two 9½" (24.1 cm)	 Two 12" (30.5 cm) Two 9½" (24.1 cm)
Low Mid-Range, Frame Size Radiator Size	 5" (12.7 cm) 3⅛" (7.9 cm)	 8" (20.3 cm) 6" (15.2 cm)	 8" (20.3 cm) 6" (15.2 cm)	 8" (20.3 cm) 6" (15.2 cm)
Upper Mid-Range, Radiator Size	1½" (3.8 cm) Dome	1½" (3.8 cm) Dome		
Tweeter(s) Radiator Size	1" (2.54 cm) Dome Super Radiator	1" (2.54 cm) Dome Super Radiator	Twelve 1" (2.54 cm) Dome Super Radiators	Twenty-Four 1" (2.54 cm) Dome Super Radiators
Burn-Out Protection	All models have individual system and high frequency fuses with warning and blown fuse indicator lights			
Cabinet Size Height Width Depth	 30$\frac{3}{16}$" (76.7 cm) 14¾" (37.5 cm) 10" (25.4 cm)	 35⅝" (90.5 cm) 17½" (44.5 cm) 11¾" (29.8 cm)	 45¾" (116.2 cm) 25⅞" (65.7 cm) 12⅞" (32.7 cm)	Bass Cabinet / H.F. Column 39¼" (99.7 cm) / 77⅞" (195.9 cm) 25½" (64.8 cm) / 10¾" (27.3 cm) 12$\frac{11}{16}$" (32.2 cm) / 1$\frac{13}{16}$" (4.6 cm)
Construction	XR 14, XR 16, XR 19 and XRT 20 bass cabinets constructed of ¾" thick 45 pound density partical board covered with genuine walnut veneer. Hardwood internal bracing and airtight glueing of all seams and joints assures a strong and rigid enclosure. XRT 20 H.F. column is constructed of aluminum extrusions with genuine walnut veneer.			
Finish	All models have genuine walnut veneer with a low sheen lacquer finish			
Weight Net Shipping	 54 lbs. (24.5 kg) 74 lbs. (33.6 kg)	 75 lbs. (34.0 kg) 102 lbs. (46.3 kg)	 151 lbs. (68.5 kg) 167 lbs. (75.7 kg)	 164 lbs. (74.4 kg) 186 lbs. (84.4 kg)



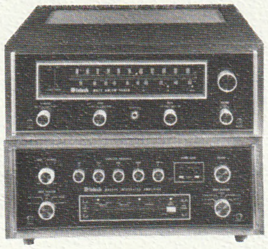
NOTE: THIS CURVE DOES NOT REPRESENT THE SPEAKER FREQUENCY RESPONSE

Ceretti

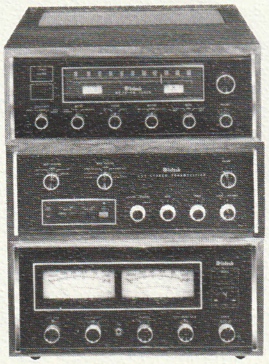
XR 14 Loudspeakers are shown with a MAC 4100 AM/FM Stereo Receiver.

XR 16 Loudspeakers are shown with a MR 75 AM/FM Stereo Tuner, and a MA 6200 Stereo Preamp Amplifier.


XR 19 Loudspeakers are shown with a MR 78 FM/FM Stereo Tuner, C 27 Stereo Preamplifier and a MC 2255 Stereo Power Amplifier.


XRT 20 Loudspeakers are shown with a MR 80 Digital FM/FM Stereo Tuner, C 32 Stereo Preamplifier and a MC 2500 Stereo Power Amplifier.

OBTAINING MAXIMUM VALUE FROM THE WORLDS BEST LOUDSPEAKER

McIntosh has developed 2 exciting new products that can quickly and scientifically remedy most room-speaker interface problems. Often, a fine speaker can sound very poor in your listening room because of the effect of the room acoustics or loudspeaker placement. The McIntosh AA2 Acoustic Analyzer will measure your speaker room response so that you can determine the interaction of the room and your loudspeakers. The McIntosh MQ 104 custom Environmental Equalizer can be tailored to significantly improve your sound quality. The use of a McIntosh Environmental Equalizer with the XR speaker systems allows extra design advantages that would not otherwise be possible. You get extended response down to 20 Hz, complete control of the woofer cone motion particularly at system resonance, and compensation for different speaker locations in the room to maintain the same low frequency output for different room gains. For maximum quality of sound your room needs to be equalized.

MQ 104

The continuous improvement of its products is the policy of McIntosh Laboratory Incorporated, who reserves the right to improve design without notice.

McIntosh

2 CHAMBERS ST., BINGHAMTON, N.Y. 13903
607-723-3512

Printed in U.S.A.

039214