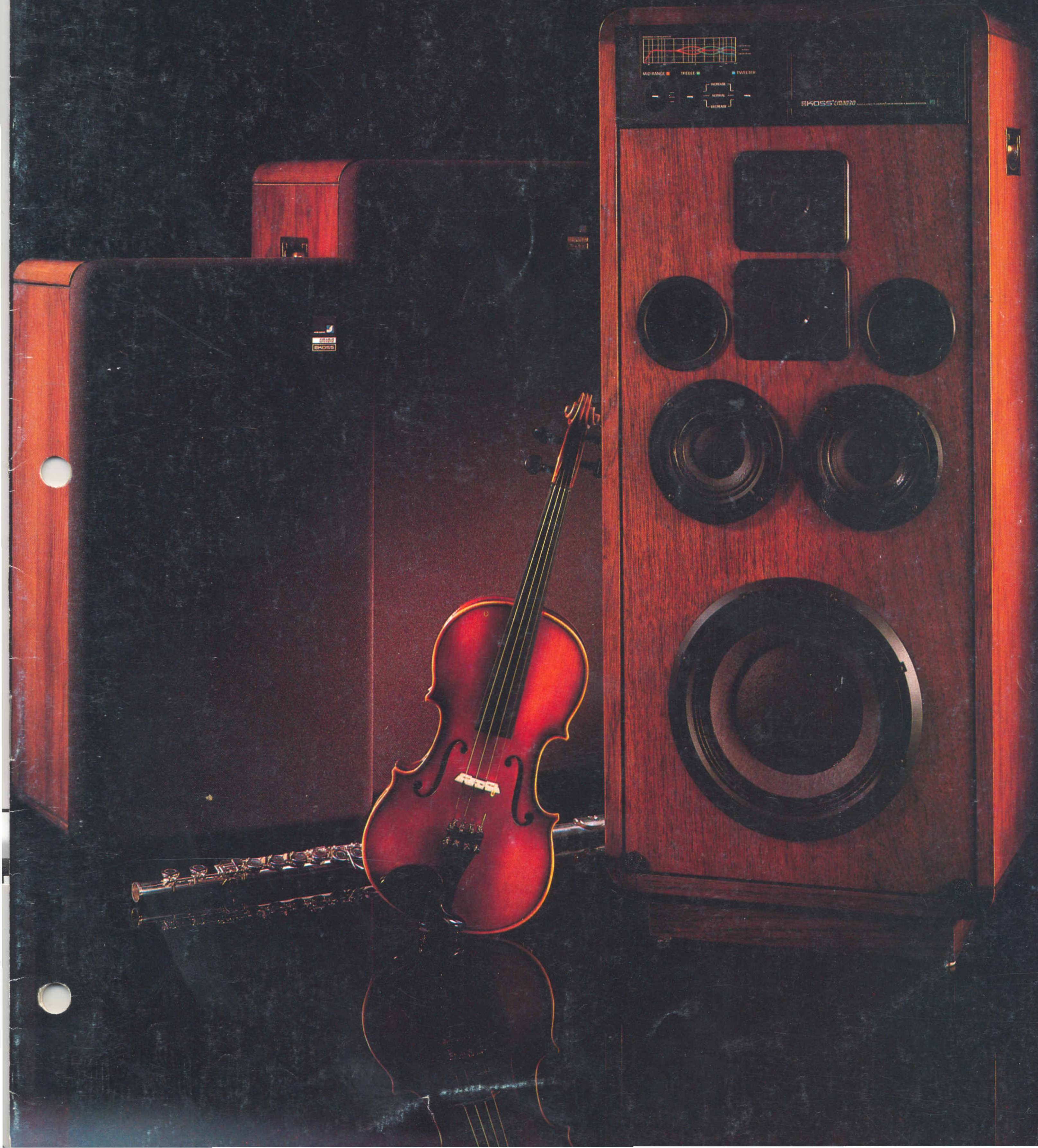
KOSS®

# CM/Loudspeakers



# The CM/1030 Loudspeaker System

The Koss CM/1030 represents the culmination of theory, technology and engineering experience in loudspeaker design. First, Koss engineers set the parameters for frequency response, efficiency and cabinet size. From these initial specifications, the Koss Theory developed specific design characteristics that include a 10-inch woofer, a mass aligned dual port system, a parallel midrange system, and both a tweeter and treble tweeter that feature a unique acoustic transformer. And to mesh the system into an unbelievably beautiful entity, the CM/1030 uses a quasi second-order crossover network. Once you've heard the Koss CM/1030, we think you'll agree that no 4 bandpass system available today even comes close in performance. Ask your audio dealer for a live demonstration, and hear the Koss Theory in action.

| | Bandpass Response (To typify the normal listening room situation) | Polar Response | Intermodulation Distortion Products | Reference Sensitivity | Recommended Amplified Power Rating (8 OHM) | Impedance | Input Power Overload Protection | Dimensions | Net Weight |
|---|---|---|---|---|---|---|---|---|---|
| **CM/1030** | Low frequency 3 dB down point ($f_3$) 29 Hz<br>High frequency 3 dB down point, 19 kHz<br>Overall system response for 6 dB down points 26 Hz to 19.5 kHz | −3 dB: 8 kHz<br>−6 dB: 10 kHz | Less than 0.1% | 94 dB SPL | 15 watts/channel—Min.<br>200 watts/channel—Max. | Nominal: 5 ohms<br>Minimum: 4 ohms | Fused 3 AG 3A | 16½" wide<br>14½" deep<br>38⅞" high | 74 lbs. |


# The CM/1020 Loudspeaker System

Utilizing the Koss Theory of loudspeaker design and its computerized program, Koss engineers set out to design the optimum 3 bandpass loudspeaker. The result is a system that stands alone in delivering a high energy broadband response, a low distortion product, and a high efficiency level. The CM/1020 utilizes a dual port design to achieve proper cabinet tuning and greater structural stability. The specially-designed 10-inch woofer provides both a 3 dB gain in electrical efficiency as well as a flat response over the low bandpass. The 4½ inch midrange driver and 1-inch dome tweeter capture all the realism of your music without distortion. And to unite all these outstanding elements, Koss utilizes a unique, seamless crossover network. But no description can match the thrill of hearing the CM/1020 in a live demonstration.

| | Bandpass Response (To typify the normal listening room situation) | Polar Response | Intermodulation Distortion Products | Reference Sensitivity | Recommended Amplified Power Rating (8 OHM) | Impedance | Input Power Overload Protection | Dimensions | Net Weight |
|---|---|---|---|---|---|---|---|---|---|
| **CM/1020** | Low frequency 3 dB down point ($f_3$) 31 Hz<br>High frequency 3 dB down point, 18.5 kHz<br>Overall system response for 6 dB down points 27.5 Hz to 19 kHz | −3 dB: 8 kHz<br>−6 dB: 10 kHz | Less than 1.5% | 92 dB SPL | 15 watts/ channel—Min.<br>150 watts/ channel—Max. | Nominal: 5 ohms<br>Minimum: 4 ohms | Fused 3 AG 2½A | 15½" wide<br>13¾" deep<br>33" high | 60 lbs. |

# CM/1010 Loudspeaker System

No other 2 bandpass speaker system can match the CM/1010's extended bandwidth response, high efficiency and unbelievably low distortion performance. And that's true at any size and at any price range. Once you've heard the unequaled Sound of Koss in the CM/1010 you'll know for certain that our computerized Koss Theory helped to make the optimum 2 bandpass speaker a reality. The CM/1010's unique passive radiator enhances the lower two octaves of the bass and allows for the use of a specially-designed 8-inch woofer to reproduce the critical midrange. A high-energy 1-inch dome tweeter produces the highest energy output and lowest distortion of any tweeter currently available. And an exclusive crossover network adds the finishing touches to the finest 2 bandpass loudspeaker system available today.

| | Bandpass Response (To typify the normal listening room situation) | Polar Response | Intermodulation Distortion Products | Reference Sensitivity | Recommended Amplified Power Rating (8 OHM) | Impedance | Input Power Overload Protection | Dimensions | Net Weight |
|---|---|---|---|---|---|---|---|---|---|
| **CM/1010** | Low frequency 3 dB down point ($f_3$)<br>Alignment mass in: 35 Hz<br>Alignment mass out: 42 Hz<br>High frequency 3 dB down point, 17.5 kHz<br>Overall system response for 6 dB down points<br>32 Hz to 18.5 kHz mass in<br>39 Hz to 18.5 kHz mass out | −3 dB: 8 kHz<br>−6 dB: 10 kHz | Less than 2% | 90 dB SPL | 15 watts/ channel—Min.<br>100 watts/ channel—Max. | Nominal: 6 ohms<br>Minimum: 4 ohms | Fused 3 AG 2A | 15½" wide<br>11" deep<br>28" high | **44 lbs.** |

# CM/530 Loudspeaker System

The Koss CM/530 bookshelf loudspeaker sets an entirely new standard in its size and price range. Here is a small-sized speaker with an extended bandwidth response, high efficiency, low distortion, and perfect mirror-image sound. No matter how you place them on your bookshelf — horizontally or vertically — you get an incredible degree of dispersion and the beautiful Sound of Koss. To achieve the remarkable depth and clarity in the CM/530, Koss engineers used an 8-inch passive radiator to disperse the sound energy over the lower two octaves. This allowed them to use an 8-inch woofer to reproduce the critical midrange sounds. And the CM/530's 1-inch dome tweeter provides a unique combination of high energy output and unusually low distortion not found in competitive speakers. Listen to the CM/530 and you'll find it hard to believe the perfect mirror-image sound. But then, hearing is believing.

| | Bandpass Response (To typify the normal listening room situation) | Polar Response | Intermodulation Distortion Products | Reference Sensitivity | Recommended Amplified Power Rating (8 OHM) | Impedance | Input Power Overload Protection | Dimensions | Net Weight |
|---|---|---|---|---|---|---|---|---|---|
| CM/530 | Low frequency 3 dB down point ($f_3$), 36 Hz<br>High frequency 3 dB down point, 17 kHz<br>Overall system response for 6 dB down points 30 Hz to 20 kHz | −3 dB: 8 kHz<br>−6 dB: 10 kHz | Less than 2% | 88 dB SPL | 15 watts/ channel—Min.<br>75 watts/ channel—Max. | Nominal: 7 ohms<br>Minimum: 4 ohms | Fused 3 AG 2A | 13¾" wide<br>11¾" deep<br>24" high | 35 lbs. |

# The system that beats the systems.

Here, for the first time, is a loudspeaker theory that takes the gimmicks, the guesswork, and the trial and error out of loudspeaker design. From tweeter, mid-range and bass drivers to crossovers and cabinet size, it selects precisely all the parameters necessary to achieve a specific performance level in any desired loudspeaker system. Indeed, the new Koss Theory of loudspeaker design is so comprehensive that it has defined a whole new set of design specifications for individual speaker system components such as woofers, passive radiators, mid-ranges, tweeters and even for such design parameters as component alignment within the cabinet.

The Koss Theory of loudspeaker design represents the culmination of Koss' extensive experience in developing low distortion, highly efficient drivers for stereophones; the thorough understanding of a multitude of advanced loudspeaker theories developed by renowned researchers throughout the world; and the precise knowledge of modern computer science.

The result is a breakthrough in loudspeaker technology of such significance that it heralds the second major revolution in loudspeaker design technology.

We think you'll enjoy reading about why it happened, how it happened, and what it has created in terms of three new Koss loudspeaker systems.

### The Challenge

Without going into an in-depth discussion on the history of speaker systems, it's probably fair to say that the first revolution in speaker design came about with the development of the "acoustic suspension" system. Here, for the first time, speaker designers realized that the speaker cabinet and the bass driver had to be designed as a complete, integrated system.

But in spite of the popularity of acoustic suspension speakers, knowledgeable audio engineers remained convinced that the "vented box" type of speaker had superior potential.

The basic vented box concept utilizes the back waves of the bass driver at very low frequencies to reinforce the front waves over a range of about 1½ octaves. Hence, instead of wasting the acoustic energy in a sealed box by converting it to heat via damping material such as fiberglass, it's used to create a more efficient bass response by allowing it to supplement the bass driver. This is accomplished by providing a port or movable opening, such as a passive radiator, in the front of the speaker that allows the back waves to couple with the front waves.

However, the port or passive radiator affects another perhaps more important, loudspeaker operational feature, cone excursion. All drivers have a natural resonance . . . a frequency at which the moving system is most efficient and wants to move large distances. Unless this excursion is controlled, the driver at resonance can easily be driven into a high level of distortion. But since the range of linear motion for any driver is relatively small, it is necessary to limit as much as possible the excursion required to reproduce the low frequencies at the loudness levels desired, or suffer the consequences of high distortion.

In the vented box system, the port or passive radiator acts as an additional acoustical mass that resonates with the compliance (springiness) of the air in the cabinet and interacts with the natural driver resonance. The original speaker resonance is flattened out into two small damped resonances, one above and one below the original resonance. In this way, the driver's resonance is tightly controlled without the use of energy-wasting fiberglass or closed box damping.

The result is that the vented box woofer has the ability to produce very high acoustic energy output with very little cone motion. Although the potential of the vented box system has always been inherently very high, it's only now that all of the complex pieces of the vented box puzzle have been properly identified and refined so that the potential could be realized. Koss has achieved that potential, and offers performance levels at prices unimagined in previous loudspeaker systems.

### Use of sophisticated space-age technique called "network synthesis."

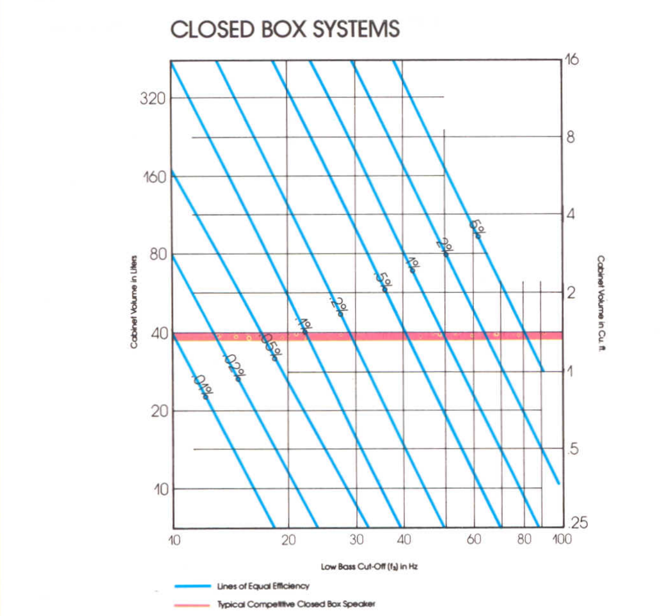
The complexity of the vented box puzzle and its eventual solution came into focus through the work of an Australian electronics engineer named A. N. Thiele. Thiele recognized that all loudspeaker systems, electrically speaking, are high-pass filters. And since the vented box system required mathematical treatment as a fourth-order differential equation, with a complex set of interlocking variables, vented box systems were too complex to be designed properly by trial and error engineering methods used in the simpler acoustic suspension systems. An Australian colleague of Thiele's, Dr. Richard Small, applied a sophisticated space age technique called network synthesis to Thiele's mathematical analysis, greatly enhancing its practical usability to the design engineer. Network synthesis techniques involve the use of computers to determine the exact cabinet and driver requirements needed to achieve a given level of performance in the final product. The beauty of this technique lies in the fact that the design engineer can ask the computer: "What happens if I change this or that?" and get a completely reliable answer, before a single screw is turned. The result is a highly refined level of performance-to-price ratio in the final product that is simply impossible to achieve otherwise.

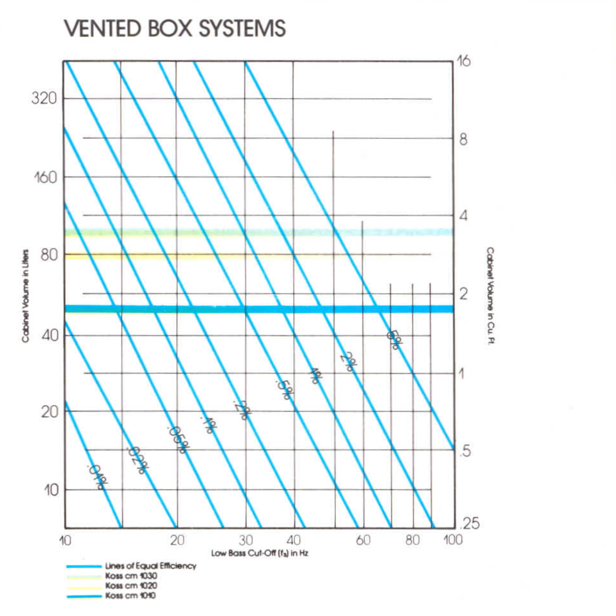
Now we have the theory. How do we achieve the theory in the real world of cones, magnets, spiders, crossovers and cabinets? Fortunately for Koss, the University of Colorado had on its staff a Professor of Electrical Engineering, Dr. J. Robert Ashley, who had conducted extensive research in the application of this new theory to real-world loudspeakers. An eminent worldwide leader and researcher in audio reproduction and engineering in his own right, Dr. Ashley had amassed the most extensive computer data bank of loudspeaker performance parameters in the world; and developed an advanced Fortran program for precisely measuring loudspeaker driver parameters based on Thiele and Small's theories. Now for the first time, with Dr. Ashley as part of the Koss engineering team, we had the necessary pieces to solve the vented box puzzle.

**Efficiency, bandwidth, and cabinet volume comparison between closed box and vented box systems.**

The most basic design decision needed to begin the network synthesis process is the correct acoustic alignment required for the low frequency system. Here, once again, we benefited from the pioneering efforts of Dr. Small. Dr. Small showed that the intelligent designer can make trade-offs between system efficiency, bandwidth and cabinet volume as he chooses.

As these two graphs illustrate, Small proved that the vented box is capable of lower bass reproduction ($f_3$) than the closed box system, given the same box volume and efficiency. Or to put it another way, holding the box volumes and the $f_3$ frequencies the same, the vented box is 3 dB more efficient (requires half the amplifier power) than the closed box for the same loudness level.

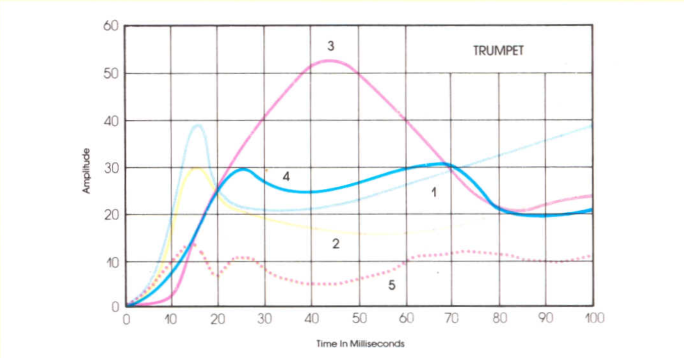



# What you've been missing...and why

Certain psychoacoustic and musical phenomena must be clearly understood before anyone can comprehend the incredible improvement in performance offered by the new Koss CM Speaker Systems over all current speakers, both vented and closed box designs.

Human hearing is characterized by two major descriptive qualities: the sense of spectrum (the perception of tonal color or timbre and of pitch) and the sense of loudness. Each acts both individually and conjointly as two dimensional acoustic phenomena in relation to a third acoustic dimension, time. Thus, through the spectral phenomena, the human ear perceives both the fundamental sound of each instrument and the various harmonics of that instrument as they evolve across a span of time. As the following chart shows, the fundamental (labeled 1) and the harmonics (2, 3, 4, 5) of each instrument actually evolve at remarkably different rates and amplitudes as time elapses. These short-term changes in the quality of sound and the way they are arranged are the essence of musical sound. We recognize musical instruments not only by the characteristic harmonic structure of their individual sounds, but also by the distribution or variation of that stucture as a function of time.

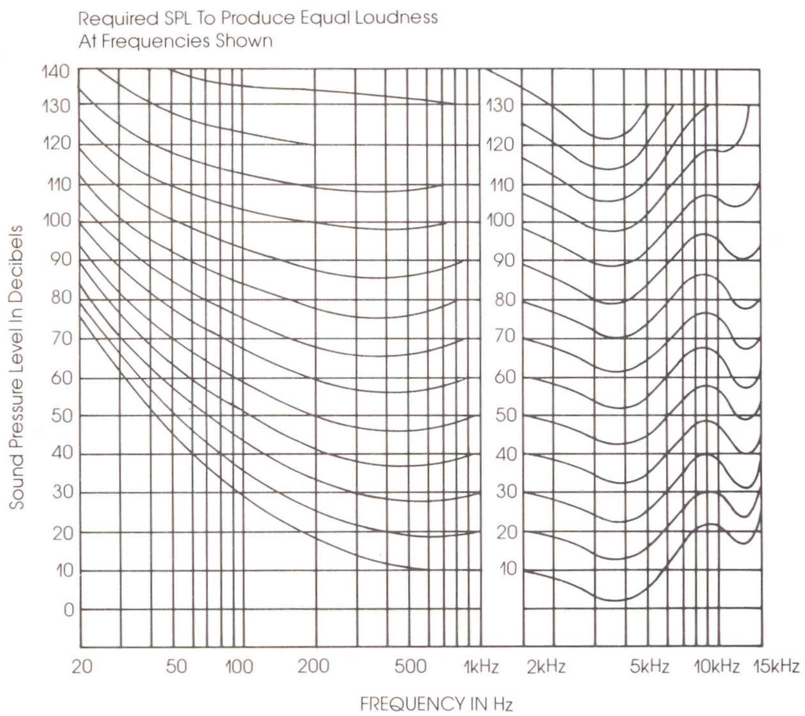



Today, modern technical analysis can explain why sounds from instruments evolved the way they did. And more importantly, why the energy requirements placed upon modern electrical and acoustical recording and reproduction equipment are so demanding if the total spectrum and dynamic range of live performance is to be recaptured with all its original excitement and impact.

often further reduced by the listener's own playback equipment.

### Understanding the added power phenomenon

Many audio component system enthusiasts are sur-




As you'll note in this subjective or equal-loudness chart, the bass end of the audio spectrum requires significantly more acoustic (and therefore, electrical) energy to sound as loud to the listener as higher frequencies. This hearing characteristic explains why the greatest acoustic energy produced by a rock band or orchestra lies in the lower frequency region — the ear simply requires more acoustic stimulation below 800 Hz to sound musically pleasing. Unfortunately, the bass frequencies introduce enormous problems both to the recording engineer and to the reproduction equipment designer. These problems are exaggerated by the dynamic range encountered in live music. The dynamic range (the difference between the loudest and softest passages in a musical performance) correlates strongly with the human ear's judgement of musical quality. Thus, the reproduction of the dynamic range in quality audio systems is of paramount importance, posing several problems. For instance, concert performances have a spread in acoustic sound pressure of 80 to 85 dB between the softest and loudest passages of music. On the other hand, today's finest tape recorders have a dynamic range of only 70 to 75 dB. Hence, if the maximum loudness of the concert music is kept within the overload limits of the tape, then the softest levels of the concert music will be lost in the tape noise. The alternative, of course, is to electronically reduce the music's dynamic range which in turn causes a significant reduction in the musical excitement and realism. And that reduction is all too

prised to discover that adding a larger power amplifier will create a startling improvement in the excitement level and realism of the sound even though the average loudness is kept the same between their old and new power amps. Understanding this phenomenon really requires going back and remembering that the fundamentals and harmonics of musical instruments evolve in a time capsule and that it requires a tremendous amount of energy to reproduce wide, dynamic sounds, particularly low bass, at equal loudness levels. For instance, assume that the average amplifier power requirement would be 5 watts to produce a normal listening level of 85 dB, given a set of today's acoustic suspension speakers operating in an average room. Now assume, too, that it could require 20 dB of transient peak power (headroom) to reproduce full spectrum dynamic peaks without "clipping" (distorting) the amplifier. Our power requirement now becomes 500 watts instead of the 5 watts we started with. The resulting peak radiated acoustic sound pressure level would be our original 85 dB plus 20 dB or a new level of 105 dB. If our amplifier has only 100 watts output power, then we will lose more than one-third of the dynamic range "headroom" needed to reproduce the music realistically. Since the ear delights in wide dynamic range, no wonder audio equipment enthusiasts expressed surprise and delight over their more powerful amps. After all, they were suddenly hearing the full fundamental and harmonic characteristics of all the instruments.

# The Sound and the Theory

From our previous discussions, it should be apparent that it's the broadband spectral and dynamic fidelity of a system that creates the highest level of musical excitement and drama for the listener. And it should also be apparent that both place extreme demands on the power capability of the audio system. The new vented box Koss CM loudspeaker systems offer dramatic advantages over acoustic suspension systems in both hi-energy and broadband spectral and dynamic fidelity. Indeed, never was "hearing is believing" so true as in side by side comparisons between Koss CM speaker systems and competitive speaker systems. Without getting into the specifics of each Koss CM loudspeaker system, here is the reason why.

**Koss doubles your acoustic output, doubles your pleasure.**

Go back and look again at the efficiency, bandwidth and cabinet size charts we looked at earlier. We know from their data and ours that a well-known acoustic suspension system has a 40 liter (1.4 cu. ft.) cabinet volume. And we also know that the $f_3$ for that system is around 40 Hz. As you can see from the chart, this puts them at a maximum efficiency of .5%. The comparable Koss system (CM/1010) has an efficiency 3 dB greater than that, with its $f_3$ set at 40 Hz. This 3 dB advantage in efficiency means that the acoustic suspension system requires twice the amplifier power to produce the same sound level as the Koss CM/1010. Or put another way, if your present amplifier is 50 watts per channel, with a Koss CM/1010 the acoustic output is equivalent to a 100 watt amplifier used with a closed box speaker. And with the new Koss CM/1020 and CM/1030, it becomes the equivalent of a 200 watt amplifier, when the same low frequency $f_3$ is achieved in the 1.4 cu. ft. acoustic suspension system. Of course, the important point here, is that you're not adding, by some strange magic, additional amplifier power. You're adding effective acoustic power that allows you to hear more of the dynamic range of the music you love.

In a very real sense, it's the same gain in dynamic range that we've been able to achieve through our world famous stereophones and their unmatched Sound of Koss. The advantage in high acoustic efficiency is increased dynamic fidelity and greater musical excitement.

**Koss low excursion, low distortion advantages.**

Another advantage of the new Koss CM loudspeaker system is the extremely low distortion products achieved because of the low woofer excursion required to produce high sound pressure levels. This is achieved through precise control over the Helmholtz resonance of the cabinet and the woofer resonance. The mass of the air in the port acting on the springiness of the air in the box, damps the woofer so that it barely moves over the octave centering on the Helmholtz resonance. Thus, the radiated power from the system is supplied mainly by the port or passive radiator. Hence, the woofer moves very little over the low bass octaves, where nonlinearities of driver suspension and magnetic nonlinearities multiply rapidly in conventional driver designs. Nonlinear driver motion causes large amounts of harmonic distortion, which cause bass sound to become heavy and dull or muddy; losing, for example, the delicate balance between the low impact and punch of a bass drum transient and the higher frequency "skin" sound that the drum has when heard live. But large excursions also cause a more "sophisticated" and perhaps more objectionable form of distortion. This distortion, called "modulation distortion", is the result of one driver simultaneously reproducing both low and high frequencies. There are two forms of this type of distortion, amplitude and frequency (or Doppler).

Amplitude modulation distortion is primarily produced in loudspeakers by the nonlinearities in the suspension and magnetic nonlinearities in the driver; and secondarily, at high frequencies by the lack of uniform cone movement.

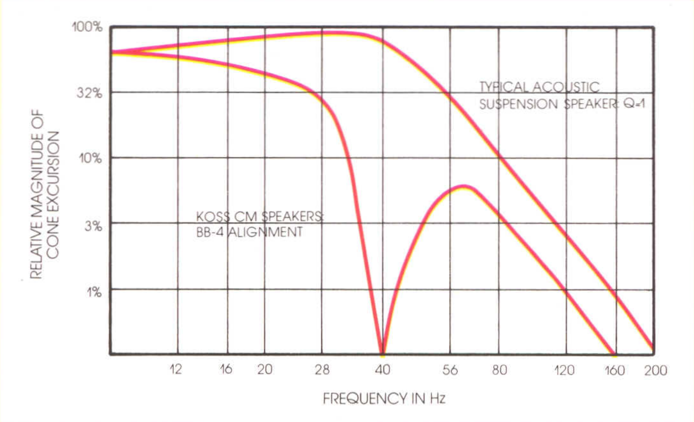
Frequency modulation distortion arises in a loudspeaker when cone motion at some low frequency produces a "warbling" effect on higher frequencies due to the Doppler effect. In loudspeakers, this distortion is caused by the simultaneous wide excursion of a woofer in reproducing low bass while also reproducing higher frequencies. The wider the woofer's excursion the greater its velocity and the more frequency modulation distortion that is produced.

The elegant solution to frequency modulation distortion is to produce loud low bass sounds with little cone motion. This presents a severe challenge to speaker manufacturers as the following discussion will illustrate.

Suppose that a 10 inch driver mounted in a closed box is driven to a sound pressure level (SPL) of 90 dB at 400 Hz, and that the cone travel (excursion) measures .02 inches in each direction. In order to maintain the same SPL at 40 Hz, the cone will have to excurte 1.28 inches. Obviously the excursion demands become outrageously large in the lower octaves compared to the rest of the spectrum. As the chart indicates, a point-by-point comparison of the excursion requirements typical of the Koss vented box system versus the typical acoustic suspension system shows the vast superiority of the Koss systems in minimizing low base cone excursion.

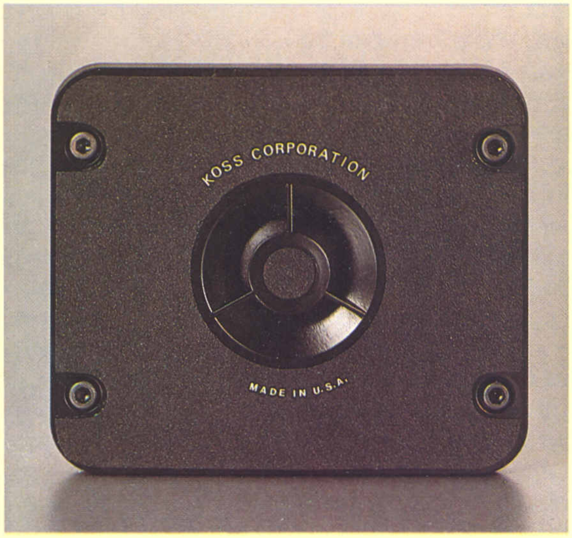
The vertical scale exhibits the excursion requirements of the vented box and the acoustic suspension systems as a percent of excursion required to produce a constant sound pressure level.

The horizontal scale shows the frequency at which the cone is moving to produce the constant sound pressure level. There is no doubt that the Koss vented box systems have a very substantial advantage over the acoustic suspension systems. In the example




shown, the typical Koss system requires an average excursion of less than 15% of that required by the acoustic suspension system over a range of 2½ octaves in the low bass spectrum.

This tremendous reduction in excursion requirement reduces the harmonic and modulation distortion products of the Koss CM speakers to levels previously unattainable by dynamic speakers.




**The unique Koss high bandpass driver system.**

Although, as we've shown, the low bandpass area is devilishly complex, there is nothing simple about the high bandpass requirements and solutions. However, the unique Koss tweeter and special acoustic transformer have created a major breakthrough in handling the high bandpass energy requirements.

The demands put upon a tweeter depend on the bandpass over which it must operate. At the low end of the tweeter's range, there is a substantial excursion demand on the driver at even minimal acoustic energy levels. These demands increase significantly as the tweeter is required to play louder and louder. Therefore, a well designed tweeter must be able to provide the necessary acoustic energy level without excessive excursion. This can be accomplished either by a single large driver or by a multiplicity of small drivers. Unfortunately, either solution creates a problem in dispersion.

If the radiating driver is too large, the acoustic energy begins to be bunched together at some points around the radiating surface and thinned out at other points. This results in unevenness and beaming of certain sounds. The larger the driver's radiating dimensions become, relative to the acoustic wavelengths, the more the beaming increases.

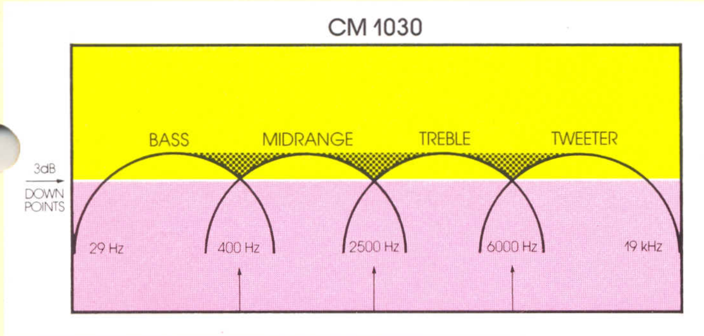
Just how important is it to have uniform wide dispersion? Psychoacoustical studies have shown that uniform power response (total integrated room response) within a 3 dB envelope out to 15 kHz is readily perceived by the listener as being more alive and more real sounding. When the uniform power response was within 3 dB only out to 10 kHz, the listeners sensed a striking loss of dimensionality and aliveness. If we choose to select 12 kHz as the 3 dB uniform power response target, our driver must be no larger than 1 inch in diameter. While this satisfies the higher frequency uniform power response requirement, it plays havoc with the larger radiating surface area requirement for a single driver at the lower end of the bandpass. Using multiples of small diaphragm drivers is an old practice, but this also results in poor power response uniformity because of inter-driver phasing problems which result in a very disturbing "fingering-effect" of high frequency dispersion.

Another major problem which a good tweeter must overcome relates to what is called "dynamic spectral shift". This is the tendency of most tweeters to produce different frequency responses at low drive levels than at high drive levels. Live sound regularly has very high levels of peak energy, as during a sudden cymbal clash. Piano attacks, in particular, produce extraordinarily high peak sound pressure levels for periods of a fraction of a second. Under these conditions most tweeters will exhibit dynamic spectral shift, that is, the tweeter will not reproduce all of the sounds fed into it with their proper loudness relationship. Dynamic spectral shift results in the alteration of the normal relationship between the fundamental tone and the harmonic structure of instrumental sounds. In this case, the high frequencies (harmonics) of the sound become diminished relative to the fundamental, resulting in a marked absence of punch and authority on musical crescendos and sharp percussive sounds. To overcome this the tweeter must be designed with sufficient reserve headroom to reproduce the original sounds accurately at all drive levels.

The Koss CM tweeters are fitted with a unique acoustic transformer design that acts as an acoustical impedance matching network, and results in a 6 dB improvement in the acoustical energy transfer characteristics of the driver. The improved bandwidth energy of this design ensures that the Koss CM high bandpass driver will reproduce today's superior recordings with little or no measurable dynamic spectural shift.

But that's not all. The 6 dB gain in bandwidth energy greatly improves the high bandpass driver's performance in the critical area of diaphragm acceleration. Consider the situation when playing modern recordings at realistic playback levels. Computer analysis of small tweeter drivers has shown that under these conditions the acceleration rate of the diaphragm would exceed 6,000 G's! There is no known material on earth which is capable of being accelerated at this rate without undergoing significant structural distortion! However, the more acoustic energy that is produced by a given increment of diaphragm motion, the less the diaphragm will have to travel to produce a given SPL. The less the diaphragm is required to travel, the lower the acceleration rate and the lower the distortion level produced.

The high bandpass driver system used in all Koss CM speakers produces the highest broadband energy figure of merit of any 1" direct radiator system we know about. Direct comparisons between this driver system and all major competitive units, using a sophisticated Hewlett-Packard Spectrum Analyzer, show the Koss CM driver to be demonstrably lower in distortion at all input drive levels. This unique combination of high energy output and low distortion makes the Koss CM high bandpass driver system the most unique 1" direct radiator tweeter currently available.




**The seamless crossover challenge and the new, quasi second-order Koss crossover network.**

While the new Koss Theory of loudspeaker design set the design parameters of all the important speaker facets such as cabinet size, woofer, midrange, tweeter and radiator or port construction, there was still one vital part of the Koss Theory that had to be developed: the crossover network.

In any speaker system, no matter how well designed the drivers are, unless they are capable of working with each other as one unified system, the system is next to worthless. Thus the development of a superior crossover or filtering network is of paramount importance.

Through the process of network synthesis, Koss engineers were able to develop the precise filter system characteristics required for a linear phase uniform power response. Indeed, the specially designed, quasi second-order crossover network used in all three Koss CM loudspeaker systems represents the ultimate in a seamless passive filter network.

Inherent in any crossover design is the proper division of incoming audio signals into the bandpasses required by each driver. But there is more to achieving proper crossover systems than merely the selection of specific bandpass crossover points. Attention must be paid to the coupling impedance versus frequency and inductance characteristics of the terminated driver. In the Koss quasi second-order passive filter network, the resistance of the crossover is included in the driver parameters right from the start of the total system formulation.

In addition, the new Koss crossover network provides for a smooth, constant phase slope over the system's operating range. Either on-axis or off-axis, the acoustic output of this system exhibits very smooth phase and frequency response, resulting in a seamless blending of each driver's acoustic output with the other, making the crossover acoustically invisible.

**Computer Maximization**

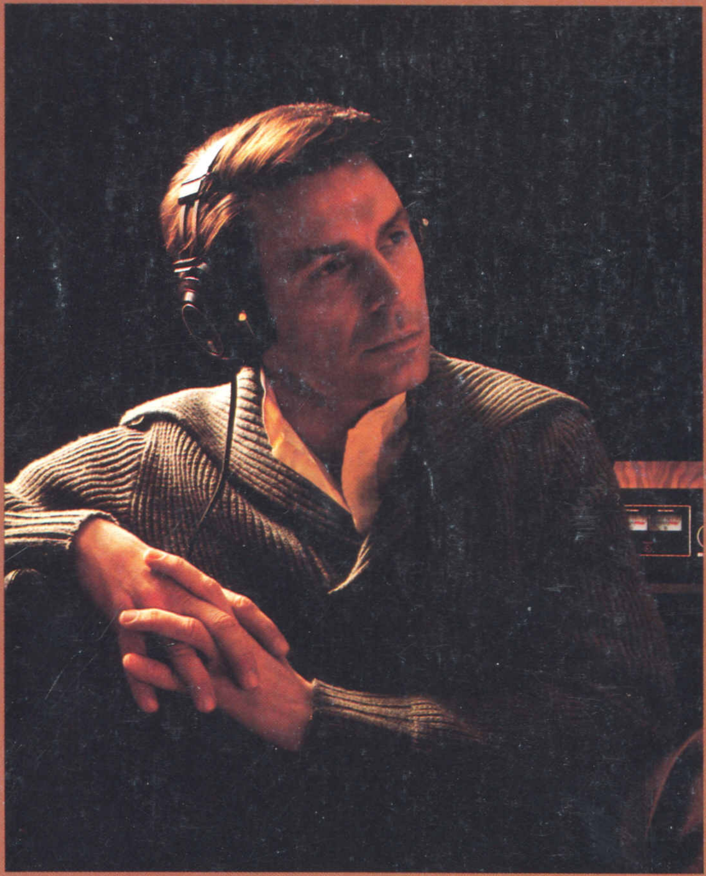
Although much has been attributed to the speed and efficiency of the modern computer, there is little that any computer can accomplish without first having the specific scientific equations and data necessary to achieve specified goals. In the case of the new Koss CM loudspeaker systems, the modern computer allowed Koss engineers to perform the massive and complex audio engineering calculations required in using network synthesis to establish the engineering parameters for all three systems.

Nevertheless, whereas the computer may have simplified the workload, it was still the genius of electrical and audio engineers and even, in the case of the cabinet designs, the brilliance of structural engineers, that made this remarkable new generation of loudspeaker systems possible.

**Perfect Mirror-Image Sound**

The Koss CM/1010, CM/1020, and CM/1030 loudspeakers were designed for perfect mirror-image sound when placed in the vertical position. This means that you will always hear a perfectly balanced, full-width sound whether walking around the room or sitting in your favorite chair. In developing the Koss CM/530 bookshelf speakers, however, Koss engineers realized that available space might be a problem. So they designed the CM/530 in matched pairs with the tweeters at a 45-degree angle from the passive radiator and the woofer. This configuration allows the listener to place the CM/530 speakers either horizontally or vertically without losing the perfect right to left or left to right imaging. The sound from both the left and right speakers comes to the listener with the same musical balance. You enjoy an incredible degree of dispersion and the beautiful Sound of Koss.

**hearing is believing®**



In addition to our CM Loudspeaker series, Koss invites you to experience the world of private listening through Koss stereophones. You'll be amazed at the levels of brilliance and depth Koss stereophones bring out in your favorite music. It's the result of a long-standing tradition of innovation and engineering achievement we've carried on since the introduction of the SP/3 Stereophone back in 1958.

Today, Koss is the world's leading manufacturer of stereophones, with models suited to every listener's needs and budget. Stop by your audio dealer and hear the Sound of Koss for yourself. When you do, we think you'll agree: "hearing is believing."

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