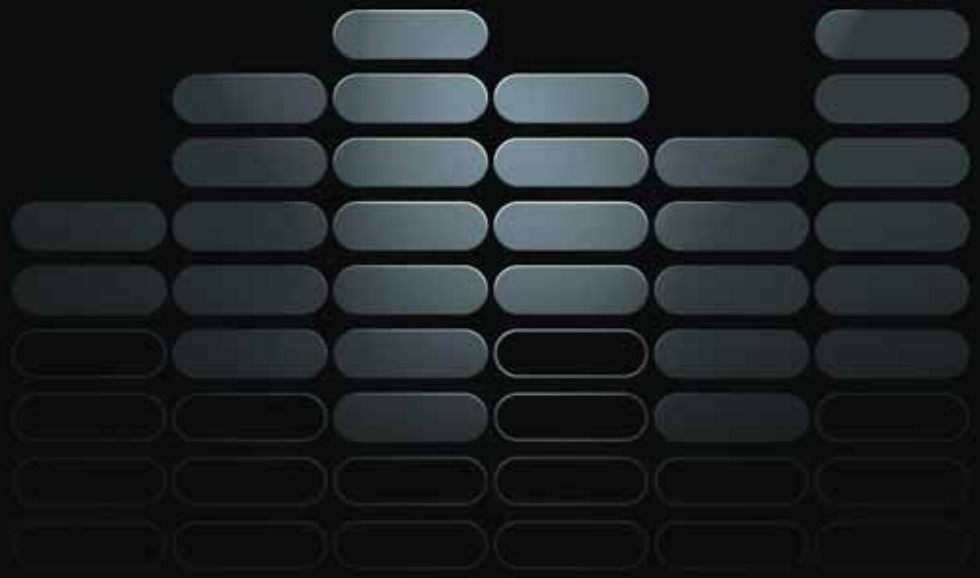
HIGH-DEFINITION SOUND™

A L L A B O U T S O U N D™

Paradigm®



Paradigm® rated #1 seventeen years in a row*!

Paradigm® is the only speaker company to be rated #1 in Price/Value for seventeen consecutive years by the distinguished publication **inside track**.*

**An annual independent nationwide survey of consumer electronics specialist retailers and custom installers.*

"Paradigm loudspeakers and the words 'high value' seem to go hand in hand—likely the result of the company carving out an enviable niche in the audioworld by designing, manufacturing, and selling relatively inexpensive speakers that offer quite an extraordinary level of performance."

Doug Schneider, SoundStage!

the ultimate in sound for music and home theater™

25 YEARS OF SONIC EXCELLENCE

For twenty-five years, Paradigm® has set the standard for sonic excellence in every product category we offer. And while we remain focused on what we consider the "absolutely essential" performance/value relationship, we continue to push the boundaries of speaker design. Breathtaking accuracy, a spacious soundstage, pinpoint localization, deep, powerful bass and thrilling dynamics are hallmarks of our advanced speaker designs.

Paradigm® Reference represents the ultimate in high-end sound for music and home theater. It takes a "cost-no-object" approach to speaker design, dedicated to producing the finest speaker systems available at any price. It is a stunning celebration of sound reproduction, embraced by those who insist on the absolute best in high-end sound and will accept nothing less.

Visit your local Paradigm® Dealer soon for a listen, because **it's all about sound™**.

lend us your ears

When evaluating speakers don't let what you see influence what you hear. For example:

Speaker Size
Is bigger better than smaller, or smaller better than bigger?

Driver Size
Are bigger drive units better than smaller ones?

Design Type
Which design type is better – bass reflex (ported) or acoustic-suspension (sealed)? Dynamic drivers or panels?

Price
Are exorbitantly priced speakers better than more affordable ones?

None of these factors is necessarily related to sound quality. When it comes to speakers, what counts most is how they sound!

Here are some tips to help you evaluate speakers:

- **Make side-by-side comparisons.** Our acoustic memory is short. It's hard to remember the sound of speaker "A" if you have to go to a different room to compare it to speaker "B."
- **Listen at equal volume.** Even small variations in loudness can easily be mistaken for differences in sound quality.
- **Turn the video off.** Eliminating visual distraction will help you focus on sound, especially in a home-theater demonstration.
- **Listen for clarity.** Are the speakers clear, natural-sounding and intelligible with instruments and voice?
- **Listen for a "seamless" soundstage.** The speakers should present a broad, cohesive image of the original sound.
- **Listen to the bass.** Is it deep, tight and well-defined?
- **Sit up straight, then slouch.** If you hear distinct changes in sound quality the speakers may have a deficiency in their vertical dispersion.
- **Move around.** Good speakers disperse sound over a wide listening area. Move around the room to find out what people in different listening positions will hear.

Following these tips will help you control the variables and compare "apples to apples." Take your time and trust your ears.

Buyer Beware!

When you're ready to purchase, remember, you're also buying many hours of listening enjoyment. Keep these things in mind:

Check Them Out
Investigate the reputation of the brand name. Is it established and nationally advertised? What do reviewers say about the speakers?

Great Deals That Aren't
Discounts can be deceptive, especially if the speakers have an inflated list price. Never buy poor-sounding speakers just because of a discount.

Be Skeptical of "Design Breakthroughs"
All too often the latest "design breakthrough" is simply an old idea with a new name.

Buy Only From a Specialty Retailer
Only specialty retailers have the expertise and resources to properly demonstrate high-performance speakers—and to assemble a system that will save you time, frustration and money.

While auditioning speakers, listen for these common sound colorations:

Shrill or Dull
Overall sound is too sharp (shrill) or too muffled (dull).

Harsh
Resonances in the 2-kHz to 8-kHz region make high frequencies sound grating.

Nasal
Speak while pinching your nose. Resonance problems in the 1-kHz to 2-kHz range result in a "nasal-like" sound.

"Ahh" Sounding
Cup your hands and place them around your mouth. Say "ahh" and listen for this characteristic. It is caused by resonances in the 600-Hz to 1-kHz range.

Hollow
Form a cylinder with one hand. Place it to your mouth and speak. A speaker that sounds like this has resonance problems in the 200-Hz to 600-Hz range.

"Boxy"
These speakers are plagued by uncontrolled enclosure resonances in the 90-Hz to 200-Hz region. Upper bass lacks clarity and definition.

"Boomy"
In a "boomy" speaker, sound in the 60-Hz to 100-Hz range is overblown. Bass is "bloated" and poorly defined.

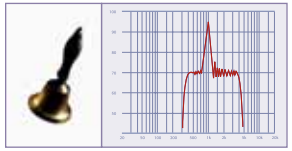
Paradigm's dedication to better design and superior quality control is clearly audible—you hear it in every speaker we make!

– Paradigm Design Team

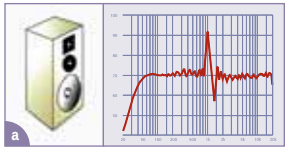
Every material resonates when struck or activated. This is how different materials, or for that matter musical instruments, make their identifiable sounds or tones.

Speakers should be neutral, having no identifiable sound of their own, but speakers are prone to resonances that color or alter the sound—these are unwanted and must be eliminated. In the same way the tint in a pair of sunglasses colors what you see, unwanted resonances color what you hear. They impose themselves on vocals and instrumental sounds being reproduced (see chart below).

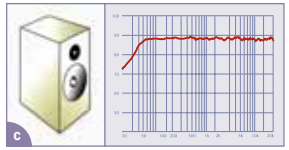
Coloration compromises fidelity and hampers imaging by blending sounds together. Speakers with low coloration are timbrally accurate—they faithfully represent the timbre or distinctive character of every sound they reproduce.



When a bell rings, its frequency response curve looks like this. Natural resonances created by musical instruments are heard as notes and tones.

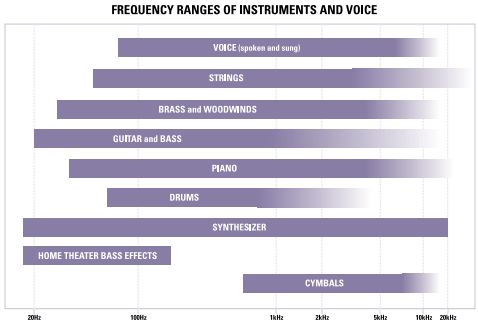


Inaccurate speakers have irregular frequency response curves because of resonance problems (a). Their uncontrolled resonances alter the original sound (b)—the peak now extends off the graph.



Accurate speakers are free from unwanted resonances and have smooth frequency response curves (c). They properly reproduce the original sound (d)—the bell's frequency response curve is reproduced accurately.

The chart (at right) shows frequency ranges of voice and instruments to help you see which sounds will be affected by various colorations.



Distortion

Coloration of a speaker's sound is caused by numerous problems: physical resonances in a speaker or its enclosure, frequency response imbalance, directivity, and harmonic distortion. Distortion is the creation of additional sounds resulting from unwanted tones or noise caused by the speaker's mechanical or electrical operation.

Two kinds of distortion are most common. The first, Harmonic Distortion, is heard as additional tones which are simple multiples of the original note played. If a speaker is supposed to reproduce a 40-Hz note, for example, it may also produce output at 80 Hz, 120 Hz, 160 Hz and so on, even though these tones are not part of the original sound. The second kind, Non-Harmonic Distortion, does not have a simple mathematical relationship with the original note—we typically hear this as a buzz, rattle or other "mechanical" noise.

the low-down on dispersion

"The value/performance of this brand is exceptional … performance for the dollar is their strong suit … and then, of course, the wide assortment they have … as Specialists we have to offer customers what we believe is the best value, and Paradigm reflects that … Paradigm is 'great across the board'."

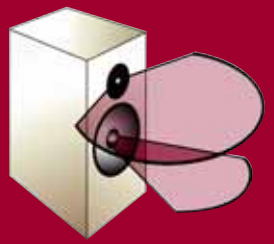
– **inside track**, *reprint of comments made by Independent Dealers during its Supplier Loyalty Test*

The fundamentals of natural sound travel uniformly in all directions—a piano, for example, distributes sound throughout a room.

Our hearing favors speakers that reproduce sound in the same way. Wide-dispersion speakers sound more real because they too fill the room. Limited-dispersion speakers sound less realistic because they beam, or project sound into only one area.

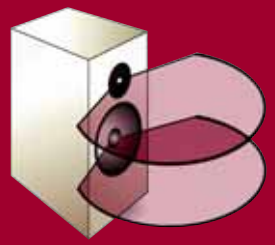
Wide dispersion throughout a speaker's bandwidth is difficult to achieve. Most high-frequency and bass/midrange drive units have good dispersion at the lower limits of their frequency range, but they naturally start to beam as they reach their upper-frequency limits. With high-performance high-frequency drivers, beaming occurs beyond audibility. Beaming from midrange drivers, however, occurs within the audible range. Speakers with beaming problems will not sound the same in all areas of a room. They may sound balanced in one area, but nasal, dull, or even harsh and shrill in other areas.

Midrange beaming can be reduced by lowering the crossover frequency. The high-frequency driver's lower range will then provide wider dispersion and the bass/midrange driver's output can be rolled off before its dispersion narrows. This is an effective approach but requires the use of high-frequency drivers that can handle the vast amounts of power it takes to reproduce these lower frequencies. This driver must be very robust and as a consequence, will be expensive to produce. Many speaker companies are unwilling to incur the cost of high-power high-frequency drivers, therefore not all speakers have uniformly wide dispersion.



A crossover is an electrical network that divides the audio signal into separate frequency bands and directs them to the individual speaker drivers. The frequency at which it does this is called the crossover frequency.

In order to protect a delicate high-frequency driver from damage, many speaker companies will set their crossovers quite high. Unfortunately, this encourages midrange beaming.



Paradigm speakers, with their more robust drivers and lower crossover points, do not suffer from beaming problems—they disperse sound uniformly and widely.

the science of imaging

When we hear sound only some of it reaches us directly. The rest we hear after it reflects off room surfaces.

Imagine listening to a saxophone in a club. **Direct sound** gives us the ability to locate that sax in the center of the stage, for example, in front of the drummer with a guitar on one side and a bass on the other.

Now imagine listening to a singer in a concert hall. **Reflected sound** provides us with information about the acoustic environment in which we hear the voice (for example, a large hall with a great deal of ambience).

Speakers have to recreate both direct and reflected sound. Direct sound provides **localization** cues—it helps us identify the location of individual instruments, voices and sound effects within the soundstage. Reflected sound provides **spaciousness**—a sense of the acoustic environment (or of the 'virtual' sonic environment created in a recording studio).

Moreover, the balance of direct and reflected sound is critically important. Too much direct output results in a narrow soundstage. An over-abundance of reflected sound makes it difficult to localize individual voices, instruments and effects. An accurate balance provides a sonic image so real it can make us forget we're listening to speakers.

Here are the general imaging characteristics of various types of front speakers (assuming typical "living room" acoustics). Keep in mind that speakers with higher levels of coloration will sound worse and image even more poorly.

Wide-Dispersion Speakers *(dynamic, multiple-driver "point-source" designs)*

Direct and reflected output can be balanced for relatively easy room placement.

Spaciousness: good to excellent.
Localization: good to excellent.

Highly Directional Speakers *(horns, rear-absorbed electrostatics, ribbon panels)*

With more direct than reflected sound, placement is usually easier. Electrostatics and ribbons with wider horizontal dispersion require greater care in placement.

Spaciousness: fair to good.
Localization: fair to excellent.

Multi-Directional Speakers *(bipolar, reflecting)*

Because there is more reflected sound than direct, room placement requires more care. Bipolar speakers must be placed well away from listening room walls.

Spaciousness: good to excellent.
Localization: fair to good.

Limited-Dispersion Dipole Speakers *(dynamic, planar or electrostatic dipoles)*

Room placement is critical. These speakers must be specifically positioned so that the reflected rear output does not cancel the front output.

Spaciousness: fair to good.
Localization: fair to excellent.

testing, testing, testing

NRC Research

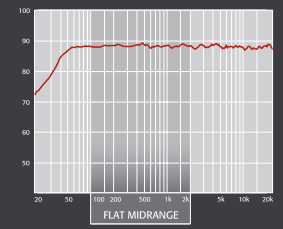
For more than two decades the National Research Council (NRC) in Ottawa, Canada, researched the nature of the relationship between how speakers sound and their measurable characteristics.

In hundreds of scientifically controlled double-blind tests with all different types of music, both novice listeners and experienced audiophiles were asked to grade speakers on their sound. Speakers were then grouped by listener preference and measured.

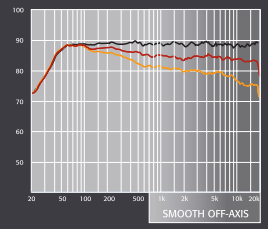
NRC researchers analyzed the results and concluded that there was a direct correlation between good sound and good measurements in three principal areas (see below). They further concluded that in order of priority, all listeners clearly favor:

1. **Flat Midrange** 2. **Smooth Total Energy Response** 3. **Low Distortion**

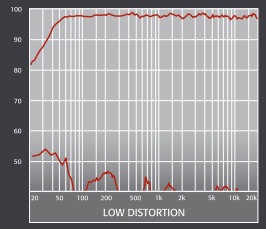
These landmark findings are the foundation upon which all Paradigm speaker design is based.



Flat Midrange: The highest-scoring speakers did not emphasize any one mid-range frequency —unwanted resonances were well controlled.



Smooth Total Energy Response: The best scoring speakers dispersed sound uniformly—on-axis and off-axis frequency response curves were similarly smooth.



Low Distortion: The speakers with the highest scores also exhibited very low levels of distortion.

"There is a direct correlation between what we hear and what we can measure. Applying the measurements that we know correlate, brings us into the arena of good sounding speakers."

– Bill VanderMarel in his interview with Audio Magazine

Getting It Right

Paradigm® speakers are internationally recognized for their exceptional sound. Quite simply, they are the best-sounding speakers in the world!

Why? Extensive listener preference tests conducted by the National Research Council (NRC) give our design engineers a firm understanding of how we hear speakers and clearly establish what design parameters are most critical to "good" sound.

Using the NRC findings along with both measurement-based analysis and subjective double-blind testing, our engineers work to constantly improve Paradigm® speakers in these critical areas:

- **Flat Midrange:** Midrange response must be smooth and even with coloration reduced to the lowest level possible.
- **Smooth Total Energy Response:** On- and off-axis sound must be fundamentally similar. Dispersion must be wide and uniform, ensuring superior imaging and a wide listening area.
- **Low Distortion:** Distortion must be reduced to the lowest levels possible.

In addition, we concentrate on two other very significant performance areas:

- **Better Bass Response:** Bass must be tight, extended and well-defined.
- **Higher Power Handling:** To improve dynamic contrasts and thus sonic realism, power compression must be minimized.

Unyielding attention to all of these areas results in speakers that are both measurably and audibly superior. When it comes to high-performance audiophile sound, Paradigm gets it right!

Frequency response measurements clearly indicate the degree to which unwanted resonances and colorations have been brought under control. Thus, the ability to measure accurately is a fundamental part of building a better speaker.

At Paradigm, our concern with sonic accuracy led us to create research and development facilities that are among the most sophisticated and comprehensive in the world:

- Two controlled double-blind listening rooms for repeatable, accurate subjective speaker analysis (upper photo on left).
- 36,000-cu-ft (more than 1 million litres) high-resolution anechoic chamber (lower photo on left).
- Highly advanced digital data-acquisition measurement system operated with software developed and written by Paradigm researchers.
- PARC, the Paradigm Advanced Research Center, a facility dedicated to the design of state-of-the-art electronics, software and advanced technologies.

We also take advantage of a number of highly advanced tools for component design. One of the most useful is a process called Finite Element Analysis or FEA. FEA can be used to optimize drive units and enclosures, detect break-up distortion in cones and domes, monitor magnetic flow or heat dissipation, perform stress analysis and more.

We use FEA to help design a magnet structure. First, a simulation of the structure is fed into the FEA program. After assigning detailed sets of material properties (simulating steel or ceramic, for example) to each of its components, the entire structure is broken down into a mesh of connected points, or elements. Our engineers can then enact "What if?" scenarios, making "virtual" material substitutions or design changes and observing their effects on the magnet structure as a whole.

Using FEA and other such processes to optimize speakers, Paradigm engineers can develop prototype after prototype before actually building a single speaker. And since improving speakers is a continual experimental process, the ability to almost endlessly experiment helps us produce consistently better-sounding, more reliable speakers.

Why An Anechoic Chamber?

For speaker measurements to be meaningful they must be taken in a room that is completely free of echoes—an anechoic chamber.

Why? Measurements not made in an anechoic chamber cannot help but be tainted by reflections from room surfaces and outside noise—they will only represent a speaker's performance in the room in which they were taken.

Measurement systems such as Impulse Response, FFT, MLSSA, LMS and TEF can be made to simulate anechoic response and can be very inexpensive to implement. However, unless they are also used with a properly designed anechoic chamber they will be plagued by poor resolution and will give entirely inaccurate measurements at low frequencies.

Echo-free measurements can be taken outdoors, but hard-to-control noise and weather conditions make measuring outside unreliable and inaccurate.

Only a state-of-the-art anechoic chamber can provide truly accurate measurements. We recognized this and constructed the anechoic chamber (lower photo on left). Lined with 2.2-m (7-ft-4 in) sound-absorbing wedges on all walls, floor and ceiling, the chamber has an internal volume of over 36,000 cu ft (more than 1 million litres)—big enough to swallow up almost 50,000 Paradigm® Mini Monitor speakers!

the paradigm factory tour

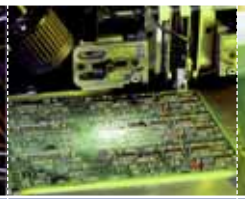
"What makes Paradigm different is the way they do things … in a world in which most speaker makers depend on other manufacturers for the drivers, electronics, and other components that go into their speakers, the Paradigm people insist on making most of their own parts—and the parts that make those parts. They also insist on selling through the kind of audio retailer who actually lets you sit down and listen to the music."

Mark Fleischmann, Home Theater

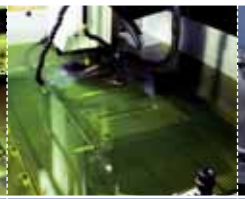
In the speaker-building chain, manufacturing is just as important a link as research and design. At Paradigm, we design and build drive units, crossover networks, electronics, amplifiers, plastics and enclosures—and even our own tooling, production and testing equipment—to ensure greater precision and superior quality control.

Advanced robotics help ensure strict quality standards. This assembly glues dust caps and holds them in place until the adhesive sets.

Our injection-molding machines use molds we design and produce. Look closely at this one and you can see a bass/midrange cone "hot off the press"!



Auto-insertion machines attach components to circuit boards, ensuring greater accuracy and reliability.



Our electronic discharge machine (EDM) creates component molds like the one shown in the next photo. The EDM uses an electrical charge to "carve out" metal at the molecular level to a tolerance of ±0.005 mm (±0.0002 in)!

With the EDM we can attain a level of detail that would otherwise be impossible. Note the intricacies in this high-performance AMS-100R chassis.

Quality Control

Our dedication to better design and superior quality control is clearly audible, you can hear it in every speaker we make!

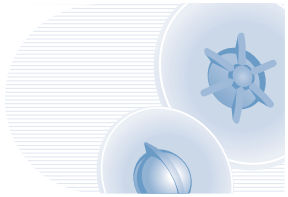
Some companies pair-match their speakers as a means of quality control but we go one step further. To ensure superior sonic uniformity we match every speaker to within +/- 1/2 dB or better of its production reference!

How? By ensuring a higher level of precision at every stage of production. Here are just a few examples:

- We wind our voice coils to an unheard of +/- 0 turns, so impedance can not vary and cause response inconsistencies.
- The magnetic gaps in our magnet structures have tolerances of +/- 0.025 mm (+/- 0.001 in) to ensure higher unit-to-unit consistency.
- Cone material is batch-purchased to eliminate run-to-run variations.
- Our inductors are wound to +/- 1/2 turn. The industry standard is typically +/- 3 turns.
- Paradigm film capacitors are +/- 5% tolerance.
- We use precision components in our amplifiers to ensure consistency and reliability. All of our amplifier circuit boards are made to military specifications (FR4-rated).
- Every circuit board is pre-tested (with software we designed and coded) on a "bed of nails"—a contact system that tests multiple connections at once—to ensure that it meets specifications.
- Every amplifier is operated with a test load before it leaves the factory to ensure reliability.

Greater Than The Sum of Their Parts …

Advanced engineering, superior materials and precision component parts ensure exceptional performance and make Paradigm® speakers truly greater than the sum of their parts.

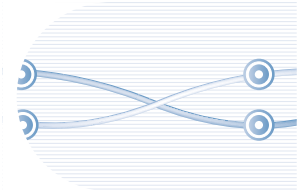


High-Frequency Drivers

High-frequency drive units provide outstanding extended frequency response while proprietary WaveGuide™ faceplates and sound-grilles ensure exceptionally uniform high-frequency response throughout a wide listening window. High-temperature voice coils, aluminum formers, ferro-fluid cooling and powerful oversized magnets ensure high thermal capacity and power handling, and permit the use of lower crossover points for superior off-axis response, lower distortion and longer service life.

Bass/Midrange Drivers

Bass/midrange drive units deliver remarkably coloration-free response. High-pressure die-cast aluminum or injection-molded chassis eliminate ringing and flexing, and function as heatsinks. Advanced cone materials ensure smooth, uniform response. High-hysteresis butyl suspensions eliminate "edge-hole" distortion. High-temperature, multi-layer voice coils and high-quality formers ensure sonic accuracy and improve long-term reliability. Focused-field magnet assemblies ensure low distortion and consistent frequency response, even at high output levels.

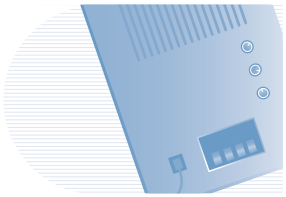


Crossover Networks

Multi-element frequency- and phase-coherent crossover networks are purpose-designed for each model. High-power close-tolerance components are hand-selected for greater accuracy. Some models can be bi-wired or bi-amplified.

Enclosures

Paradigm® speaker enclosures use acoustically inert high-density or medium density hardboard and strategically located radial braces as needed to limit unwanted resonances, increase enclosure stiffness and prevent "ballooning" effects. Acoustic damping material eliminates internal standing waves. Low-diffraction grilles minimize interference from enclosure edges. High-velocity low-noise ports allow maximum bass efficiency with minimum turbulence distortion.



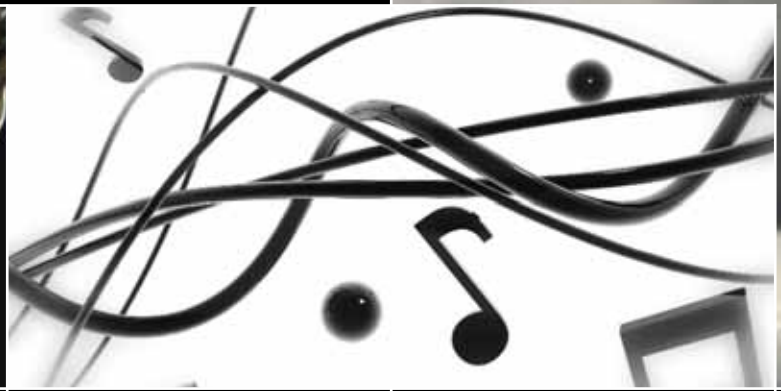
Subwoofer Amplifiers

Patented, high-power, high-current subwoofer amplifiers, including leading-edge digital designs boasting superior efficiency, ensure full power delivery at all times. Precision-engineered components and dual-sided, multi-layered military-spec (FR4-rated) glass-epoxy circuit boards with plated through-holes ensure superior performance and realiablity.

For more in-depth details on any of the above, visit our website at **www.paradigm.com**

"Paradigm quality extends from the most affordable products to the top of their line—unquestionable value at every price point."

– Mike Quinn, Jazz Times



Surrounds That Surround You

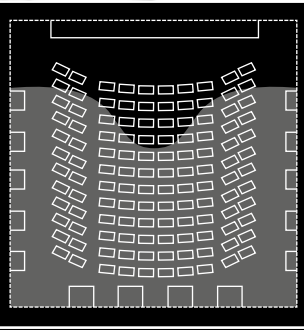


Fig. 1 Movie Theater Surrounds

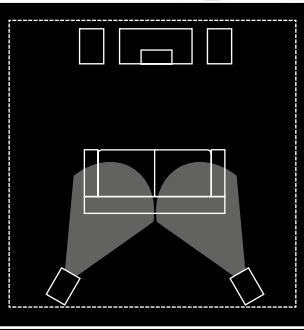


Fig. 2 Forward-Radiating Surrounds

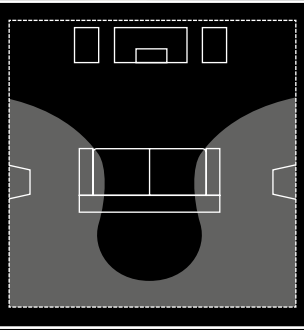


Fig. 3 Reverberant Surrounds for 5.1 Configuration

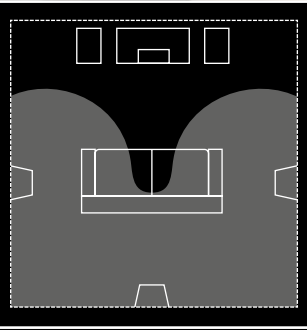


Fig. 4 Reverberant Surrounds and Rear for 6.1 Configuration

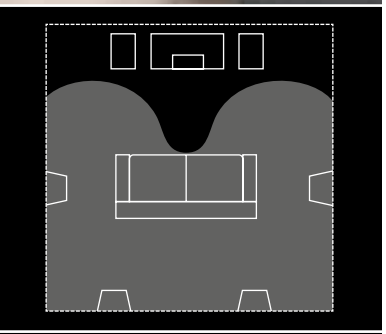
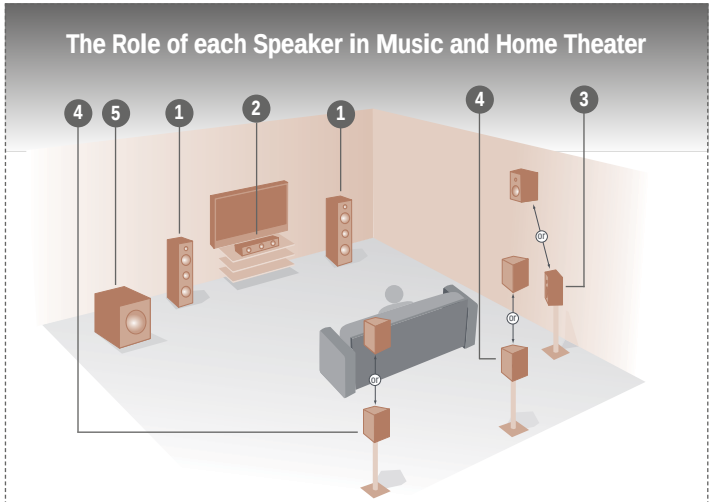


Fig. 5 Reverberant Surrounds and Rears for 7.1 Configuration

sound that paints a thousand pictures



Front Speakers (1) reproduce dialog, sound effects and much of the music.

Center Speaker (2) reproduces dialog, sound effects and music. It can be placed on top of a TV (or behind a perforated screen in a front-projection system). If used with a direct-view TV this speaker must be magnetically shielded to prevent picture interference.

Surround Speakers (3) reproduce ambience and sound effects critical to the full dimension of multichannel music and movies. Surround speakers with a uniform reverberant soundfield and accurate full-bandwidth bass work best.

Rear Speakers (4) contribute dimensional size and realism. Here also speakers with a uniform reverberant soundfield and accurate full-bandwidth bass work best.

Subwoofer (5) handles deep bass, giving dynamic power to low-frequency effects in movies and the bass content in music.

Why Paradigm ADP™ Speakers Work Best for Music and Home Theater
No discussion about sound is complete without a mention of surround speakers, and in particular, Paradigm's ADP™ (Adapted DiPole*) reverberant surround/rear speakers …

When it comes to home theater, although the size and quality of the video picture are important, it takes an accurate high-performance speaker system to really bring movies to life! And not just movies. An increasing number of artists are releasing music in multichannel DVD-Audio and SACD. When recorded and engineered aesthetically, multichannel music accurately reproduces the full dimension of the original acoustic space with a realism that could never be achieved with conventional two-channel recordings.

Movie theaters use multiple arrays of surround speakers to keep viewers from being distracted by the sound of any single one (Fig. 1, opposite page). Conventional forward-radiating speakers cannot reproduce movie theater surround sound in your home. If they are loud enough for their sound to blend with the front speakers they draw attention to themselves. Turn them down so they don't distract you and they won't blend with the fronts (Fig. 2, opposite page). So how can you hear all of the glorious surround sound you're supposed to? With Paradigm's ADP™ reverberant soundfield surround/rear speakers placed to the sides and rear of the listener (Figs. 3, 4 & 5, opposite page).

Like movie theater surround speakers, *reverberant* surround/rear speakers envelop you in sound without drawing your attention away from the movie you're watching. They add size and dimension to the soundstage and ensure a seamless transition when sound and effects move from the front and center to side and rear speakers. And they're just as important for multichannel music. Because of their ability to create a large non-localized soundfield, they contribute multidimensional realism to the reproduction of the original recording's acoustic space.

The diffuse sound of Paradigm's ADP™ reverberant soundfield surround/rear speakers turns your listening into a magical experience—they put the "theater" in home theater and make music sound "live"!

*For more information on our ADP™ technology visit **www.paradigm.com**

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