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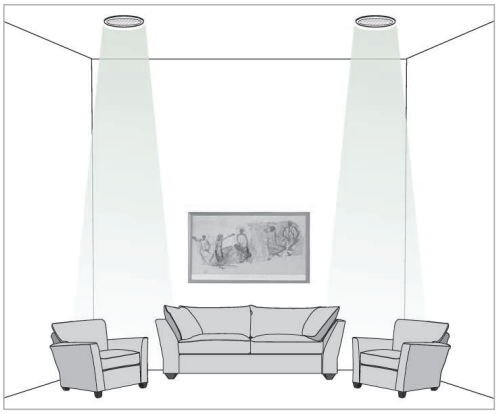
THE ULTIMATE IN SOUND FOR MUSIC AND HOME THEATER™
PARADIGM REFERENCE
The Paradigm Group
205 Annagem Blvd.
Mississauga, ON L5T 2V1

PIVOTING DRIVERS FOR IN-WALL/IN-CEILING SPEAKERS

"For more than 20 years, Paradigm has offered high-quality products that have defined their market segment. A visit to their Mississauga headquarters in Ontario makes it easy to see why. Research and development are at the center of Paradigm's philosophy. They pay little attention to fads, gimmicks, or assertions that are not backed up by scientific fact; their on-site anechoic chamber stands as a symbol of Paradigm's commitment to science and empirical research."

– Anthony DiMarco, Home Theater & Sound

When it comes to in-wall/in-ceiling speakers there is no substitute for good design built on years of experience producing the best sounding speakers in the world! Although some brands would have you believe otherwise, the same design criteria that makes for the best sounding bookshelf and floorstanding speakers also applies to in-wall/in-ceiling speakers.



Buyer Beware!

Typical in-wall/in-ceiling speakers use inexpensive low-performance drivers. They may even be dressed up with impressive looking cones or domes to make you think they are engineered designs, but nothing could be further from the truth. These speakers not only have poor fidelity, they also have poor dispersion resulting in sonic hot spots — too much sound in one part of the room and not enough in another.

How Can You Identify a Good Brand?

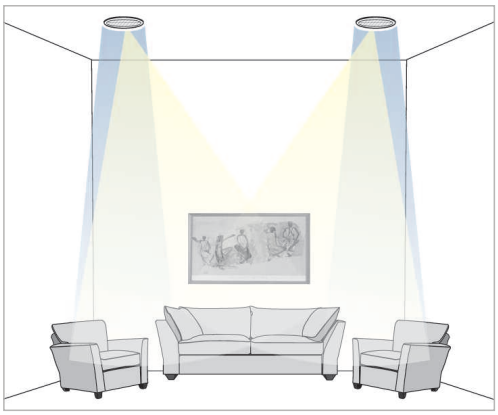
Does the brand have a history of good reviews? Has it won awards for the performance of its speakers? Does it have significant acoustic R&D facilities? If the answer to these questions is no, then perhaps the brand is actually about marketing programs, not performance.

Dispersion through the Midrange-Tweeter is Critical

Good sounding speakers require a smooth transition of sound between drivers. This not only means accurate transition of frequency response, it also means matching, as closely as possible, the dispersion patterns of adjacent drivers in order to prevent: 1) Inferior Sound Off-Axis and 2) Sonic Hot Spots.

Inferior Sound Off-Axis: Here's a visual way to understand how mismatched dispersion results in inferior sound. Take a blue spotlight (midrange) and match it to a yellow floodlight (tweeter). If you sit outside of the spotlight's beam but within the floodlight you will see yellow but not blue — sonically you will hear the tweeter but not the midrange.

Sonic Hot Spots: With poor dispersion designs, to see both blue and yellow you must sit within the beam of the blue (midrange) spotlight — sonically this is a hot spot. In a listening room those sitting in the hot spot will hear more than those sitting outside of it. This creates a volume imbalance: too loud for those in the hot spot and not loud enough for those outside of it.



Pivoting Tweeters

If matching the dispersion patterns of adjacent drivers has been achieved then pivoting the tweeter will only degrade sonic performance. Why?

To accommodate the pivoting mechanism a small low-power plastic encapsulated tweeter is required, which in turn necessitates a higher crossover to prevent thermal failure. Pivoting the tweeter, however, only degrades sound quality. The tweeter will typically be pointed toward the main listening area. Those listeners will be on the tweeter axis, but off the axis of the bass/midrange driver — the all-important midrange will not reach them. The result is a progressively "sucked-out" midrange and a bright, screechy tweeter … and the more "pivot" you dial in, the worse it gets.

Pivoting the Woofer and Tweeter

Pivoting the woofer and tweeter in different directions will result in different listeners hearing drastically different frequency responses — it is impossible to have accurate sound with drivers aimed in different directions.

Pivoting the woofer and tweeter in the same direction doesn't solve the problem either.

First, these systems beam the critical midrange to sonic hot spots (like a spotlight). Pivoting the woofer and tweeter in tandem will only result in moving the sonic hot spot to another area of the room.

Second, the geometry of swiveling the woofer and tweeter in a flush-mounted system requires the drivers to be recessed. As they pivot, one side becomes more recessed while the other comes closer to flush. This results in:

a. Frequency response that will change with the amount of swivel, both on and off axis.
b. An overall dispersion that becomes progressively more asymmetrical making "non-sweet" spots progressively worse.

Pivoting Drivers Cannot be Optimized

Since the speaker designer has no control over the actual amount of pivot used, optimizing designs with variable pivoting drivers is fundamentally impossible. There are many good reasons why high performance bookshelf and floorstanding speakers do not use pivoting tweeters, not the least of which is that **you cannot optimize a design for best sound when you don't know which direction the tweeter or bass/midrange driver will be pointing**. The same holds true when it comes to in-wall/in-ceiling speaker design — you cannot optimize for best sound when you don't know which direction the drivers will be aimed. Even in the best possible design, pivoting drivers degrade performance.

Multiple Problems with Pivoting Drivers

Poor Fidelity: Pivoting tweeters result in a progressively "sucked-out" midrange and bright, screechy top end — the more "pivot" you dial in, the worse it gets. Pivoting the woofer and tweeter in tandem only moves sonic hot spots from one area of the room to another.

Can't Balance Volume: Pivoting drivers beam sound. Adjust the volume for the person sitting within the beam and it becomes too quiet for those sitting outside of the beam. Turn it up, and sound will be too loud for the person sitting within the beam (a common problem in restaurants that use poor quality speakers).

Poor Stereo Imaging: Imaging is the re-creation of the music's soundstage and is fundamental to the enjoyment of music. Imaging requires us to hear sound from both left and right speakers. Pivoting drivers beam sound. If you are within the beam of the left speaker but outside the beam of the right the music will simply not image into a coherent soundstage. You will hear more of a "mono" (single-channel) presentation.

Poor Home Theater Soundstage: Pivoting driver designs beam sound, and that doesn't work well for home theater either.

- **Center Channel**: If you happen to be sitting in a chair outside of the sonic beam the "sucked-out" midrange and screechy top end will make dialog sound muffled, fuzzy and unclear.
- **Left/Right Fronts**: The same imaging problems will occur as outlined in stereo imaging above.
- **Surrounds/Rears**: Sound effects will beam and distract you from the front screen (theaters use multiple wide-dispersion surround speakers specifically to prevent sound effects from beaming to the audience).

The bottom line? Pivoting drivers are essentially a gimmick, one which never overcomes the deficiencies which made it seem necessary in the first place.

The Solution? Coherent Wide-Dispersion Design

Paradigm® in-wall/in-ceiling speakers use superior high-performance high-power drivers. Where applicable, we even use heat sinks on our high-frequency drivers for higher power handling. This allows us to use lower crossover points and ensure coherent wide dispersion through the critical midrange-tweeter interface. Sonic hot spots are eliminated —every listener hears superb imaging at volume levels that are equal throughout the room.

Vastly Superior Sound: We apply the same design principles for in-wall/in-ceiling speakers as we use for all our designs. This ensures that Paradigm® in-wall/in-ceiling speakers sound accurate throughout their wide dispersion range.

Better Volume Control: Everyone in the room will hear sound equally well. Adjusting the volume results in sound that is at the same level for everyone.

Better Stereo Imaging: You hear both the left and right speakers, even if you are closer to one than the other. The result is much better imaging — the soundstage remains intact throughout the room.

Better Home Theater Imaging: Center-channel information is clear throughout the room. Imaging stays intact, even when you are sitting off to one side. Surround/Rear effects are better integrated into the soundstage with less distraction from the front screen.

When it comes to the best sounding in-wall/in-ceiling speakers, pivoting drivers simply do not work, in fact they degrade performance. Paradigm's focus on design excellence that produces the finest bookshelf and floorstanding speakers also produces the best sounding in-wall and in-ceiling speakers.