Definitive Technology®
The Leader in High-Performance Loudspeakers®

Disappearing In-Wall Series Technical Brief

Product Goals – The promise of built-in speakers has been that the homeowner can get the great sound of quality free-standing speakers from speakers that are invisible. It's a worthy goal and one that consumers have enthusiastically embraced. But have built-in speakers really lived up to the promises? With the few exceptions of high priced units, built-in speakers have fallen short on the performance promise. And while they are certainly less visible than free-standing speakers only advertising copywriters could call typical built-in speakers "invisible." Our goals were to design a line of built-in speakers that were far less visible than prior art, had a much higher level of performance than competitive products and were easy to install in both pre and post-construction projects.

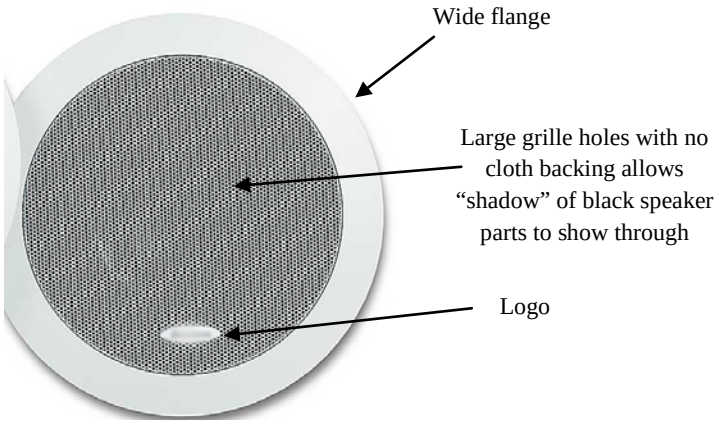
The Definitive DI Series speakers revolutionize the simple flange method of mounting by rendering the flanges invisible behind an unobtrusive grille. Unlike conventional products that use, either individually or in combination, wide visible flanges, protruding grilles, covered grilles, or completely embedding the speaker in the wall, the DI Series models do not compromise either acoustic performance or appearance.

The Art of Disappearing

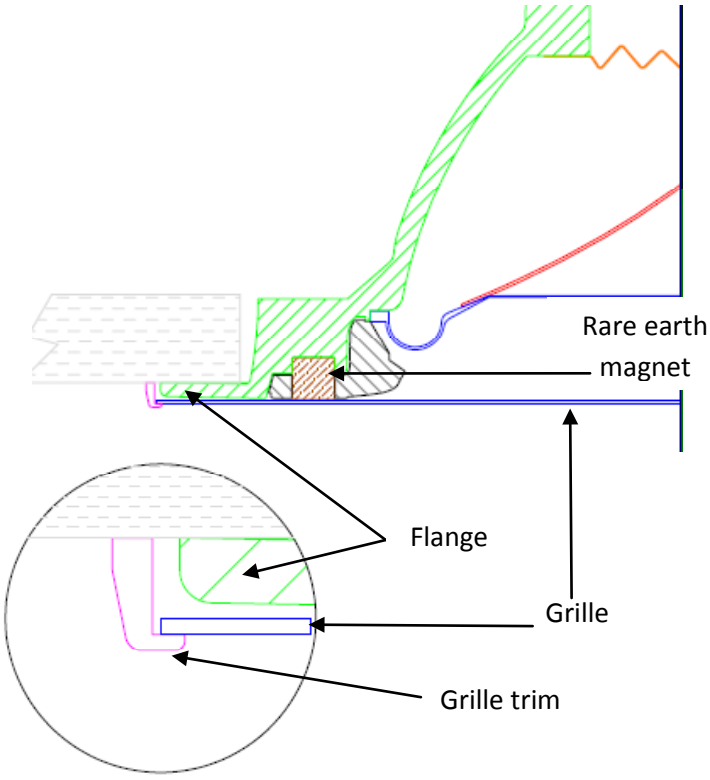
Some built-in speaker models exist whose grilles are truly flush with the wall, have no visible flange and come much closer to the invisible ideal than ever before. But such speakers are best installed on new construction jobs and require highly specialized, time consuming and expensive plastering skills to look good; fine for occasional cost-no-object installations but not at all practical for the vast majority of home installations.

Traditional in-wall and in-ceiling speakers, use a wide variety of techniques with varying degrees of success to make the speakers “disappear.” In general there is a trade-off between the degree of performance and the obtrusiveness of the speaker. Prior-art "invisible" speakers have very compromised acoustic performance, and prior-art high performance speakers are quite visible. The DI Series design allows the realization of the highest levels of performance while simultaneously achieving a major step forward towards minimal visual impact.

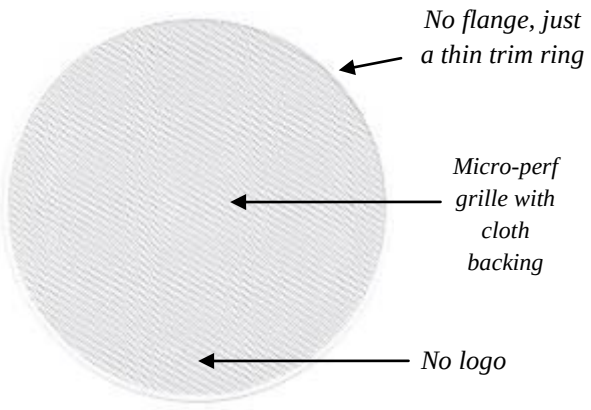
The photo below illustrates the invisibility impediments of traditional built-in speakers: a wide flange, large grille holes and sometimes a logo. In addition to the elements noted in the illustration, the grilles of some built-in speakers bulge, making them more obvious to the eye. In order to paint this style of speaker to help disguise it one must mask the speaker and paint the flange and grille separately—a time consuming process. Whether or not painted, installing the grille can be tricky as it has to be carefully fit into a narrow groove in the flange/baffle assembly. Installers are well familiar with the problems of bent and dimpled grilles.



Definitive’s solution has multiple inter-related design features and innovations. First the mounting flange thickness is no more than 2.5mm and is completely covered by the grille that stands a mere 3.5mm (approx 1/8 inch) proud of the wall surface. The grille is “micro perf” that while presenting an opaque appearance actually has more open area than typical perforated metal grilles allowing the sound to pass through with less interference and better fidelity. Behind the metal grille is an acoustically transparent cloth scrim that effectively blacks the dark “shadow” of the black speaker parts from showing through the grille.



Definitive's GaussGrip system securely holds the grille in place with powerful rare earth magnets. Simply lay the grille over the speaker and you're done. Taking off the grille is just as easy and fast; no special tools that can chip the grille paint are required. All you need are your fingers. Professional installers are astounded by how much time the GaussGrip system saves.



Definitive DI Series

Conventional

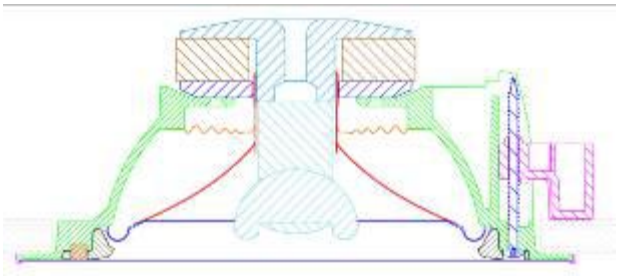
Size Matters

In the case of built-in speakers smaller is better; nothing disappears better than something small. These scale-drawings show that a Definitive DI Series speaker's total visual area is smaller than the competition

for the same size driver underneath. For the same visual area of a competitor's 6-1/2″ speaker Definitive gives you the extra bass output and dynamic range of an 8-inch driver.

The incredibly potent DI 3.5R

The secret of the DI models' small size is their integrated design. Similar to the monocoque construction of Formula One race cars, the mounting system towers basket and flange (green shaded areas) are cast as one piece, thereby increasing strength, conserving space and maximizing cone area.



The Right Size and Type for Every Application

Disappearing In-Wall models come in a wide variety of sizes from a barely visible 3-1/2″ to a surprisingly compact 8″ round. The 3-1/2″ round model (DI 3.5R) is particularly exciting because of its incredibly small size that helps it disappear and which is virtually the same as the mini recessed lighting fixtures that are so popular with lighting designers and homeowners today. The DI 3.5R and DI 4.5R are especially suited for use in multiple pairs to provide more uniform sound coverage in large rooms. *NOTE: When using multiple pairs of speakers on a single zone amplifier that is not rated to drive 2 – 4 Ohm loads, wire the speakers in series, not parallel.*

The DI 3.5R is about the size of mini recessed lighting fixtures

The DI 5.5S and DI 6.5S are square models mostly intended for in-wall use but may also be the perfect answer in ceilings where there are rectangular elements such as air registers, suspended ceiling grids and rectangular lighting fixtures. One interior designer was heard to quip "square is the new round."

Square is the new round

The DI 5.5BPS is a rectangular model with two coincident array driver/tweeter sets in a bipolar arrangement. While it is mostly intended to be used as a dedicated surround channel in-wall or in-ceiling speaker, the 5.5BPS is perfect for any application that requires extremely broad sound dispersion.

Di 3.5R

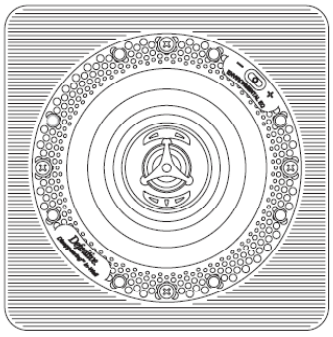
Di 4.5R

Di 5.5R

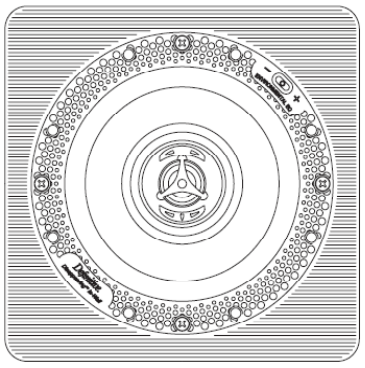
Di 6.5R

Di 6.5STR

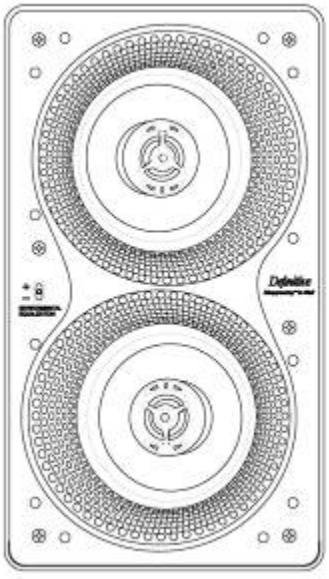
Di 8R



Di 5.5S



Di 6.5S



Easy to Paint

Painting flush mount speakers the same color as the wall/ceiling surface helps the speaker blend in and disappear. DI Series speakers are easy to paint but should never be painted with a paint brush or roller as those methods will clog the small holes of the grille and cloth scrim. A bright removable sticker on the grille is there to remind painting contractors to take care when painting. The DI Series micro-perf cloth-backed grilles can be spray painted without any loss of sound quality. Simply remove the grille from the speaker and place it on a drop cloth, newspaper or plastic sheet and spray paint it with canned spray paint that closely matches the desired finish/color or with indoor latex paint using a spray gun (the paint must be diluted to the paint manufacturer's specifications). There's no need to remove the backing cloth (scrim). Apply the paint in a series of thin coats sprayed at approximately 60 degrees from the grille surface, allowing each coat to fully cure before applying additional coats. To ensure that the paint distribution is evenly applied, each coat should be applied from at least 4 different directions to the grille (N, S, E, & W) to ensure an even coverage on the grille.

Since you don't have to mask the speaker itself, the painting goes remarkably quickly and can be done in any convenient location even after the speaker has been installed in the wall or ceiling.

The Art of Sound Quality

Sound Quality Matters!

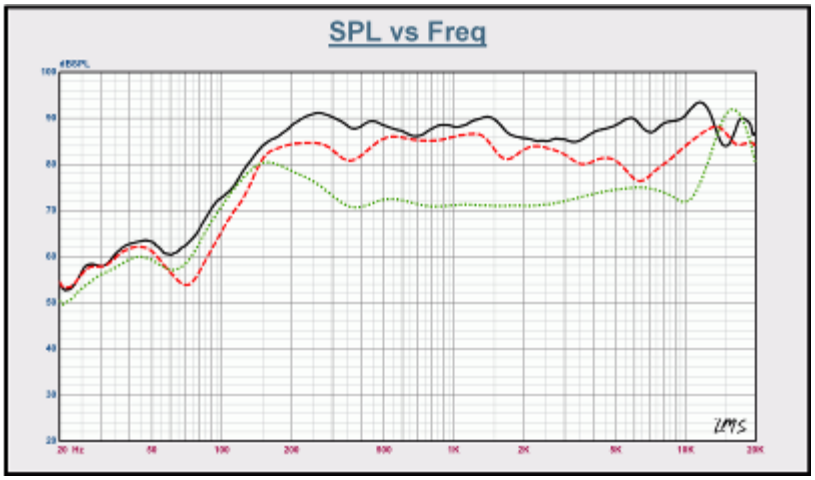
Definitive understands that delivering the very best sound quality is the best business policy for custom installation integrators, designers and retailers. Systems with sound quality that delights the end-user result in happier customers and more referrals. As a specialist speaker company with decades of experience in designing high-end, award-winning free-standing speakers, Definitive has a higher standard of performance for built-in loudspeakers. Our built-in speakers aim for the performance of free-standing speakers, not the "good enough, they can't hear the difference anyway" standard of many makers of built-in speakers. We've utilized our latest and most advanced technologies such as BDSS™ drivers, annealed pure Aluminum tweeter domes, inert PolyStone™ basket material as well as some new innovations to bring you an ideal combination of performance, style and value.

BDSS™ Drivers—Better Sound From Smaller Speakers

The mid/bass drivers used in the Disappearing In-wall series are essentially the same as those used in Definitive's Mythos ST and Mythos STS audiophile-grade free-standing speakers. Definitive's exclusive Balanced Double Surround System (BDSS) drivers are the most advanced in our history and set new standards for wide-bandwidth accurate frequency response, broad dispersion, low distortion and maximum detail retrieval. The BDSS driver's cone is supported by specially tuned soft rubber surrounds at both the outer and inner edges. The double surrounds allow the cone to have longer excursion (move farther) without distortion. As bass output is a function of both a cone's diameter and excursion, the higher excursion BDSS system brings the benefit of higher bass output from smaller drivers. The tiny DI 3.5R has the bass output and dynamic range of a typical 4-1/2″ driver, the DI 4.5R has the bass one would expect from a 5-1/4″ driver and so on through the line. More sound, smaller size.

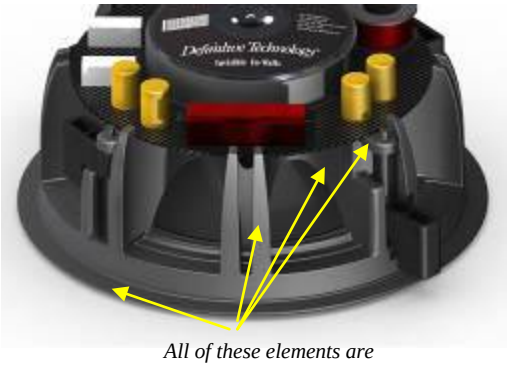
Balanced Double Surround System (BDSS) mid/woofer supports the cone at two points for better suppression of unwanted resonance and longer cone excursion for superior midrange clarity and bass performance.

To illustrate the superior output capability of the DI Series BDSS drivers, the graph shown here shows the output vs. frequency of the DI 3.5R (solid black line) and two competitive 3-1/2″ in-ceiling speakers. All three speakers have been fed the same 2.83Volt test signal. Notice that the DI 3.5R's output is consistently several dB higher than that of "Brand X" (dashed red line) and as many as an astounding 20dB higher than "Brand Y" (dotted green line). The Definitive BDSS driver simply performs like a larger speaker!



PolyStone™ and AeroRing™ Technologies

The driver basket, mounting flange, mounting system towers are one piece of cast PolyStone, Definitive's exclusive formulation of polymers and minerals that combine the rigidity and strength of metal with the resonance damping properties of plastics. Besides being more space efficient than multi-piece construction, it also contributes to the superior sound quality of the DI Series speakers.



All of these elements are part of the single cast PolyStone structure

The dimpled AeroRing is soft Sanoprene rubber and serves several important functions. First it damps the basket/flange assembly nearest its thinnest part (the flange) to prevent resonance. Second it prevents the grille from rattling in the unlikely event that it makes contact with the speaker frame. It also provides a smooth transition for the waveform coming off the cone. When sound waves emanate from a speaker every change in surface they encounter (a bump, edge or ridge) causes the waveform to reflect and re-radiate— a form of acoustic distortion called "diffraction." Diffraction causes frequency response errors and other audible problems mostly in the midrange and high frequency areas that can make the speaker sound "boxy" and "nasal." Diffraction also has an adverse effect on broad, even dispersion. Similar to the dimples on a golf ball that reduce turbulence to aid in longer flight, the

dimples on the AeroRing promote smooth “laminar” air flow over the surface thereby reducing diffraction effects. DI Series speakers sound clear, natural and disperse their sound over a wide area.

Innovative Waveguide Tweeter Technology

Positioning a tweeter in front of a driver can be a bad thing to do. If you’re not careful you’ll wind up with diffraction and other interference effects that can ruin the sound of an otherwise good mid/woofer driver. One example of a bad tweeter implementation is to support the tweeter on a “bridge” that transverses the driver. The graph below shows the response curve of a prototype midrange driver with no obstructions (black solid line) and the same driver with a 1″ bridge across it (red dashed line). You can clearly see the negative effect the bridge has on the response.

But if you’re really clever you can use the tweeter assembly to actually *improve* the midrange performance.

Some high end midrange drivers like those used in the Mythos ST SuperTower have “phase plugs” or “waveguides” in the middle of the driver like the one pictured here. These waveguides block short wavelength (high) frequencies radiating from one side of the cone from meeting and interfering with the same frequencies radiating from the other side of the cone. Eliminating these cross-cone interference effects improves overall midrange sound quality and especially improves dispersion and off-axis response.

The DI series tweeters are post mounted instead of bridge mounted and the tweeter housing is specially smoothed and shaped to use it as an extremely effective low-diffraction waveguide.

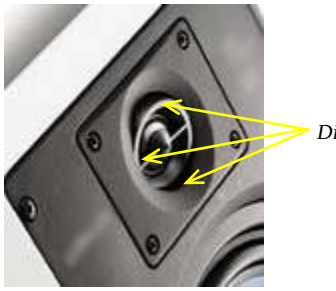
Definitive’s innovative Waveguide Tweeter improves dispersion and off-axis

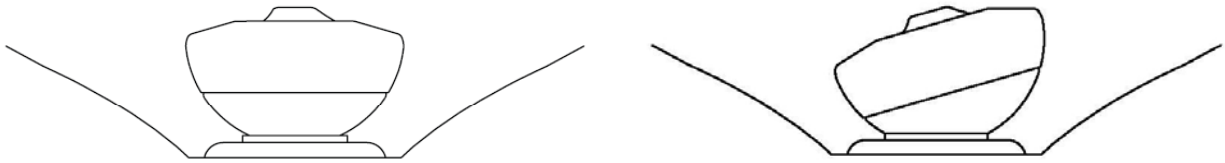
Latest Generation Tweeter Dome Technology

The DI Series use the same tweeter dome material as the Mythos ST and STS SuperTowers—our proprietary Ceramic coated annealed Aluminum dome. With a resonance point well above audibility this remarkable dome reveals all of the shimmer and detail in recordings without the hard, glassy and edgy character often found in metal dome tweeters.

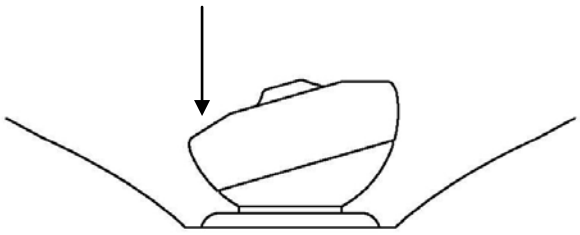
Aiming in a Better Way

In some installations the speakers must be positioned far from the main listening area resulting in a situation where the listeners will be very far off axis. In such cases it may be helpful to aim the tweeter toward the listening position for better high frequency balance. But tweeters that can tilt or aim often create other problems. When the tweeter pivots within a baffle as pictured here, the relationship of the tweeter to the objects around it changes. When this tweeter is pointed straight, the surfaces around it provide very little opportunity for diffraction to happen (that's a good thing) but when it is angled as shown in the photo, there are several hard edges that cause diffraction (that's a bad thing). The net result is that the speaker sounds one way when the tweeter is pointed straight out and sounds different (worse) when angled. In the DI Series products we eliminated this problem by allowing the entire tweeter housing to tilt. The speaker's sound quality does not change as the tweeter is tilted.





With the DI Series tweeter design the acoustic environment around the tweeter is the same whether the tweeter is pointing straight forward or angled.

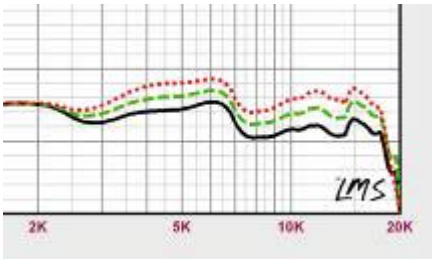


To aim the DI Series tweeter, rotate the arrow on the tweeter housing to the desired direction and push down to aim.

Crossover and Environmental EQ

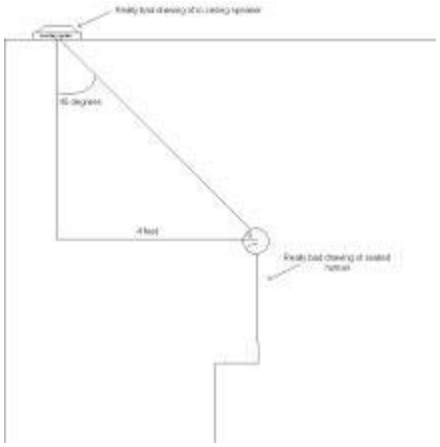
Even the best drivers and tweeters would perform poorly if not blended together perfectly. Definitive's engineers lavished as much attention on the crossover network in the DI Series as any other part of the system. Its second order (12dB/octave) Linkwitz-Riley topology offers a smooth frequency and phase transition from driver to tweeter for natural midrange response and excellent off-axis performance. A Zobel network flattens the Impedance curve of the system making it easier for today's digital amplifiers to drive the speakers. Custom tight-tolerance (+/- 5%) components are used throughout the crossover for superb unit-to-unit performance consistency. Superior metal film capacitors are used in the high-pass section and the Zobel network for extended high frequency response. Over size inductors (coils) avoid saturation thereby maintaining the wide dynamic range capabilities of the driver and tweeter.

The Environmental EQ switch (on all models except the DI 3.5R and DI 4.5R) provides a 1dB broad bandwidth tweeter output lift or cut to compensate for highly absorptive or reflective acoustic environments. The green dashed line in this graph it the center (normal) position on the switch, the black solid line is the cut (-) and the red dot line is the lift (+) switch position.

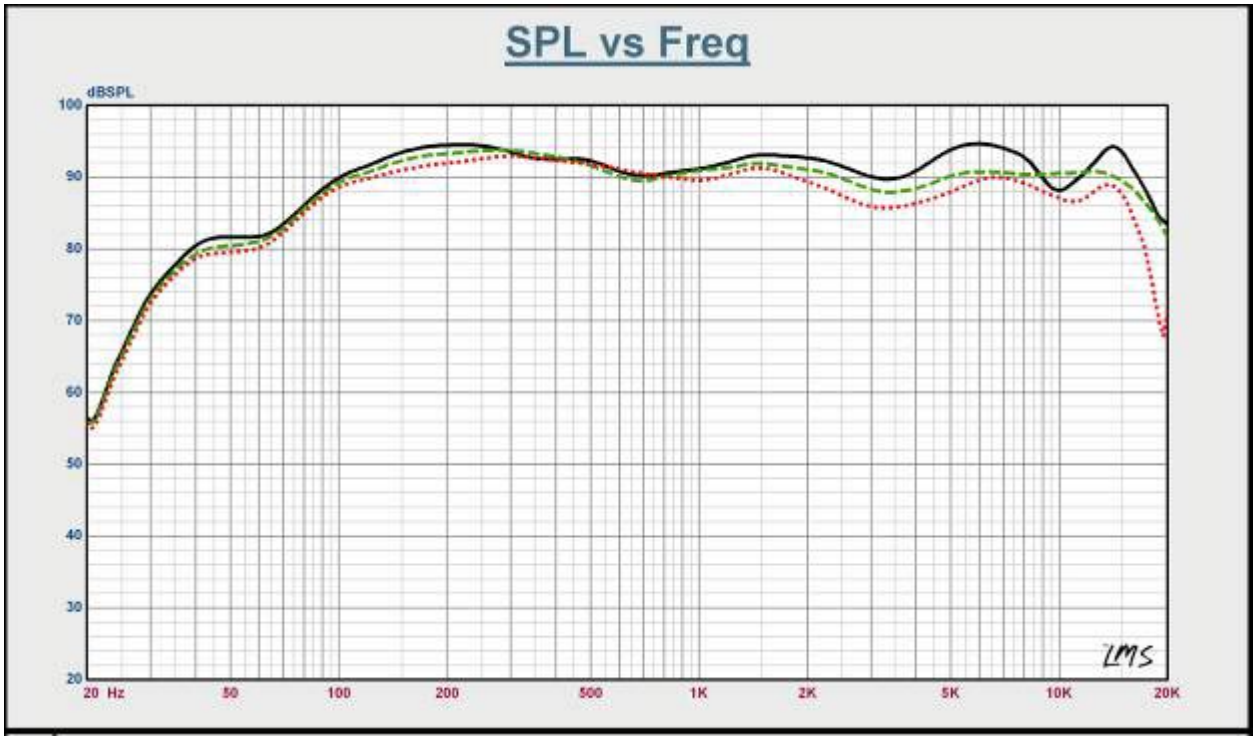


Off-Axis Performance and Ceiling Speakers

Throughout this document we've emphasized the effect of the technology or feature on dispersion and off-axis response because listeners are rarely sitting on-axis with an in-ceiling speaker. Someone sitting 4 feet away from a speaker installed in an 8-foot ceiling is 45 degrees off-axis from the speaker.



Definitive DI Series speakers are optimized for smooth, accurate off-axis sound quality. Definitive's BDSS driver, tilting WaveGuide tweeter, Linkwitz-Riley crossover and AeroRing technologies all contribute to the superior off-axis sound quality of the Disappearing In-Wall speakers. This graph show the on-axis response of the DI 6.5R (black solid line) and the same speaker 30 degrees off-axis (green dashed line) and 45 degrees off-axis (red dotted line) with the tweeter tilted toward the measurement microphone. The 30° off-axis response is actually flatter (better) than the on-axis response and the 45° response is still smooth with strong output at 15kHz.



Installation and Accessories

Installing DI Series speakers is as easy as can be. Simply cut the hole, connect the speaker wire, insert the speaker in the hole, turn the front screws until the “dogs’ or rotating clamps engage the back of the wall and finally cover the speaker with the grille. Ta da; you’re done.

Cutting the Hole

All DI Series models come with a cardboard that may be tacked to the mounting surface and traced around the edge. In the case of most models cutting the hole in sheetrock is best accomplished with a sheetrock saw. In the case of the DI 3.5R and DI 4.5R models you may find it more convenient and certainly more precise to use hole saws. The DI 3.5R hole may be cut with a 3-3/4″ (95mm) hole saw (Rigid catalog #5950-95, Milwaukee 49-56-0203) and the DI 4.5R with a 4-1/2″ (114mm) hole saw (Rigid catalog #52980-114, Milwaukee 49-56-0233).

Pre-Construction (Rough-In) Brackets

The optional DI Series pre-construction rough-in brackets are arguably the nicest in the industry. The center rings are fabricated from heavy duty stamped steel that's been painted. There are no ultra-sharp metal edges to cut an installer's hands and they're ultra rigid so that when drywall is laid over the brackets will not bend or break. The two 12″ wings are painted perforated metal that snap on to the center ring in a variety of positions to cover any installation eventuality. The wings can be attached with nails, stables or screws, can be bent and easily trimmed with tin snips. The wire tie loop easily breaks away when the speaker is installed. DI Rough-in Brackets are packaged two to a carton.

Fire-rated Enclosures

In most locales a fire rate back box is required by law for speaker installations in multi-family dwellings and commercial properties. We offer UL-standard steel back boxes for all DI Series models. Overstuffed with spun ceramic batting the enclosures also provide X dB of sound isolation and are perfect solutions in single family homes when the goal is reduction of sound leakage into adjacent rooms.

Specifications, Round Models

	DI 3.5R	**DI 4.5R**	**DI 5.5R**	**DI 6.5R**	**DI 6.5STR**	**DI 8R**
Grille Diameter	4-9/16" (11.6 cm)	5-3/8" (13.55 cm)	7-3/8" (18.62 cm)	8-5/16" (21.04 cm)	8-5/16" (21.04 cm)	9-3/4" (24.76 cm)
Cutout Diameter	3-3/4" (9.55 cm)	4-1/2" (11.5 cm)	6-5/16" (16 cm)	7-1/4" (18.4 cm)	7-1/4" (18.4 cm)	8-3/4" (22.2 cm)
Total Depth *	3" (7.55 cm)	3-3/8" (8.64 cm)	3-5/8" (9.04 cm)	3-5/8" (9.07cm)	3-5/8" (9.07cm)	3-7/8" (9.77cm)
Mounting Depth In-Wall **	2-1/2" (6.3 cm)	2-7/8" (7.4 cm)	3-1/16" (7.8 cm)	3-1/16" (7.8 cm)	3-1/16" (7.8 cm)	3-3/8" (8.5 cm)
Woofer Nominal Diameter	3-1/2" (8.9 cm)	4-1/2" (11.4 cm)	5-1/4" (13.3 cm)	6-1/2" (16.5 cm)	6-1/2" (16.5 cm)	8" (20 cm)
Tweeter Diameter	3/4" (20 mm)	3/4" (20 mm)	1" (25 mm)	1" (25 mm)	2@3/4" (20 mm)	1" (25 mm)
Product Weight	1.9 lb. (0.85 kg)	2.6 lb. (1.16 kg)	3.7 lb. (1.67 kg)	3.8 lb. (1.73 kg)	4.4 lb. (2.14 kg)	4.8 lb. (2.14 kg)
Frequency Response	40 Hz – 30 kHz	35 Hz – 30 kHz	28 Hz – 30 kHz	26 Hz – 30 kHz	26 Hz – 30 kHz	26 Hz – 30 kHz
Sensitivity	87 dB	88 dB	89 dB	90 dB	90 dB	90 dB
Impedance	4 – 8 Ohms	4 – 8 Ohms	4 – 8 Ohms	4 – 8 Ohms	4 – 8 Ohms	4 – 8 Ohms
Min/Max Recommended Power (Watts/Channel)	10/125	10/150	10/175	10/200	10/125	10/225

* From back of mounting flange to deepest part of product
** Total depth when product installed in 1/2" (12.7mm) thick material

Specifications, Rectangular Models

	DI 5.5S	**DI 6.5S**	**DI 5.5BPS**
Grille Width	7-3/8" (18.61 cm)	8-5/16" (21.01 cm)	7-3/4" (19.74 cm)
Grille Length	7-3/8" (18.61 cm)	8-5/16" (21.01 cm)	13-5/8" (34.6 cm)
Cutout Width	6-5/16" (16 cm)	7-1/4" (18.4 cm)	6-13/16" (17.4 cm)
Cutout Length	6-5/16" (16 cm)	7-1/4" (18.4 cm)	12-5/8" (32.2 cm)
Total Depth *	3-5/8" (9.04 cm)	3-7/8" (9.70 cm)	3-7/8" (9.7 cm)
Mounting Depth In-Wall **	3-1/16" (7.8 cm)	3-1/16" (7.8 cm)	3-3/8" (8.42 cm)
Woofer Nominal Diameter	5-1/4" (13.3 cm)	6-1/2" (16.5 cm)	2 @ 5-1/4" (13.3 cm
Tweeter Diameter	1" (25 mm)	1" (25 mm)	2 @ 1" (25 mm)
Product Weight	3.8 lb. (1.73 kg)	4 lb. (1.79 kg)	8.4 lb. (3.76 kg)
Frequency Response	28 Hz – 30 kHz	26 Hz – 30 kHz	28 Hz – 30 kHz
Sensitivity	89 dB	90 dB	89 dB
Impedance	4 – 8 Ohms	4 – 8 Ohms	4 – 8 Ohms
Min/Max Recommended Power (Watts/Channel)	10/175	10/200	10 – 225

* From back of mounting flange to deepest part of product
** Total depth when product installed in 1/2" (12.7mm) thick material