Bipolar 8000 Series

White Paper

BIPOLAR SUPERTOWERS®

DEFINITIVE TECHNOLOGY®

The Most Technically Advanced Products in Definitive's History

Definitive Technology built its business on the success of the Bipolar Series. From one BP model (the BP10) introduced in 1990 the BP Series evolved and grew to a mighty line, including BP SuperTowers that combined bipolar arrays with built-in powered subwoofers. In the intervening years, Definitive grew to be the Leader in High-Performance Loudspeakers® and arguably the best selling line of premium speakers in the US.

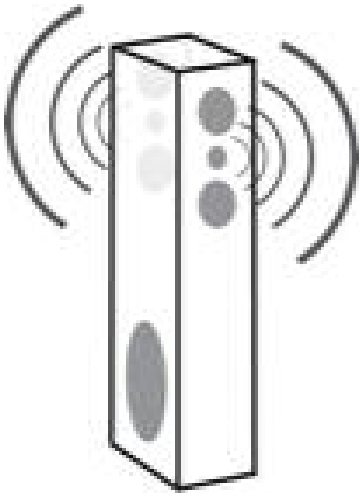
Twenty years after the beginning of the BP Series, we have completely redesigned from the ground up an entirely new generation of BP SuperTowers to meet the needs of today's listeners and living spaces. These four new towers and their matching center and surround speakers are the most technically advanced products in our history.

Bipolar Technologies

Bipolar speakers radiate sound from drivers placed on the front and rear panels of the speaker. Listeners and critics loved the way bipolar speakers projected a huge spacious soundstage that made the listening room sound as large as a concert hall. Best of all, people noticed that with bipolar speakers every listener in the room enjoyed the spectacular lifelike imaging. Listeners weren't tied to one narrow "sweet spot" to enjoy big, lush stereo sound.

Bipolar Sound for Today's Listeners

Definitive has been making great bipolar speakers for 20 years; now we wanted to make them better. How could we make bipolar sound even better and more relevant to our customers? By addressing how people use their speaker systems today. With today's thin TVs, people want to place their speakers closer to the wall behind them rather than out into the room. The original bipolar design radiated an equal amount of sound backward as forward and worked better when the speakers were positioned well away from the wall. Additionally, while everyone enjoyed bipolar speakers' huge soundfield, some listeners felt that on some types of music the sonic image of soloists and individual instruments could use more focus and localization to sound truly real. Lastly, today's listeners expect more vocal clarity from their speakers, but modern multichannel processing can add ambience to the recording that may reduce vocal clarity on a traditional bipolar speaker.



Forward-Focused Bipolar Array Technology

To address the issues mentioned on page 2, we decided to go back to the lab and do fundamental research into bipolar design. To start, we repeated a famous speaker directivity experiment but we added something new. We used identical pairs of speakers (Mythos XTR-50s), back to back, playing together, creating a "textbook" bipolar speaker. Using a mixing console, we were able to infinitely vary the ratio of the energy that was supplied to the front and back driver arrays. We found that when the rear sound output was reduced by 6dB, localization improved while retaining spaciousness, room "expansion" and sense of envelopment. As a bonus, the clarity of the vocals was enhanced compared to both textbook bipolar and direct forward-firing loudspeakers.

How can it be that adding reflected sound improves vocal clarity? There is a plethora of published scientific research on the beneficial effects of early reflections on speech intelligibility. Anyone who has been in an anechoic room (a room with no sound reflections) knows how unnatural those rooms sound and how difficult it is to have a normal conversation. Bipolar speakers use the room's acoustics (wall reflections) rather than fighting them to produce natural, highly intelligible sound.

In Definitive's patent-pending Forward-Focused Bipolar Array, the rear array output is exactly the same timbre (tonal balance) as the front speaker array but it is reduced in output by 6dB, exactly the amount our experiments showed to be the ideal ratio. Forward-focused bipolar technology optimizes a loudspeaker for maximum clarity, precise localization and sense of spaciousness beyond the room boundaries. This new groundbreaking technology combines the huge lifelike imaging benefits of bipolar design with improved pinpoint localization of soloists, greater placement flexibility, and superior intelligibility.

The sonic benefits you hear are dramatic! This unique technology provides you with a lifelike balance of early-arrival sound from the front-facing drivers to convey focus, clarity and location data, and reflected attenuated and delayed sound from the rear drivers to convey the lush three-dimensional soundstage of a live music or cinematic performance. This combination creates a huge soundfield that is rich, warm, ultra-clear and vibrantly alive for every listener in your room. Most importantly, Definitive's forward-focused bipolar speakers make the walls of your room seem to disappear, transporting you into the sound space of the recorded event. They will literally bring your music and movies to life in your home. One listen and you can never go back to conventional speakers again!

Midrange and High-Frequency Technology

A Vastly Superior Midrange Driver

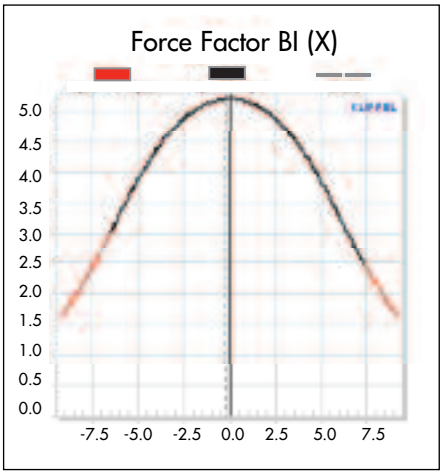
The midrange is where 90% of sound information exists. The quality and accuracy of the midrange driver is the single most critical factor in a speaker's overall performance and your long-term listening satisfaction. The best bass and highs in the world will do you little good without excellent midrange reproduction.

That's why Definitive engineers have always put extra care into the design and materials of our midrange drivers. While most brands use stamped steel baskets for the speaker's frame, Definitive has always used cast aluminum baskets. Cast aluminum baskets are more rigid and less prone to "ringing" (vibration of the basket material) that adds distortion and colors the sound. Steel baskets interfere with the magnetic field that controls the movement of the cone, while non-magnetic aluminum does not. All of the magnetic Gauss (strength) is focused in the voice coil gap instead of being wasted in magnetizing a steel basket. The benefit to you is a driver that plays louder, with lifelike dynamic impact and vanishingly low distortion.

Definitive's midrange drivers feature injection-molded butyl rubber surrounds instead of the cheap foam surrounds often seen in lesser brands of speakers. Butyl rubber lasts decades whereas foam surrounds stiffen (changing their sound) and eventually rot away. Definitive's drivers will sound consistently great over decades of use. But most of all, butyl rubber surrounds absorb cone resonance — for lower distortion, more natural midrange sound reproduction. Definitive's speakers have always been known for their clear, natural midrange — voices are full, perfectly intelligible and lifelike.

A More Linear Motor Means Better Sound

The figure to the right is a graph of the BL Product of the 5¼" driver used in the BP-8080ST. BL Product is the product of the motor's magnetic flux density times the length of voice coil in the gap. Put more simply, it is a measure of the motive force applied to the driver cone. The important thing isn't whether you have more or less BL Product, but whether the force is applied uniformly. In these graphs the center "0.0" vertical line represents the cone at the center "rest" position. To the left of center line is forward cone movement; to the right is backward cone movement. In this kind of graph, you're looking for a symmetrical curve, centered on the "0.0" line. You can see that the Definitive driver's BL Product is symmetrical and linear — the same amount of force is applied in both forward and backward travel. The net result is far less distortion for better inner detail and clarity.



The chart below compares the distortion of two 5¼" drivers, one Definitive and another from a well-respected speaker brand, both tested with high power signals (40V). The Definitive driver is clearly better in delivering high-output, low-distortion sound.

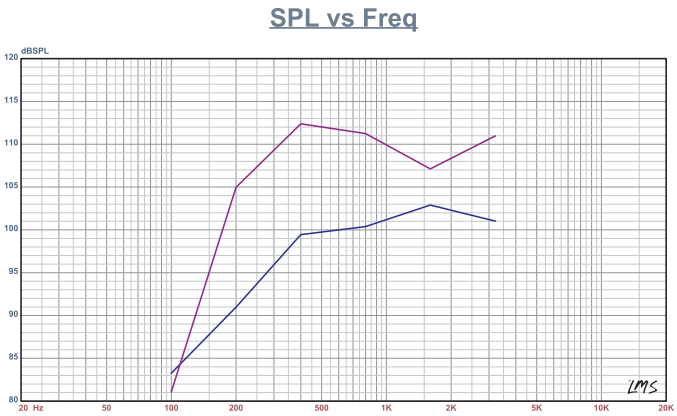
	Definitive Driver	Driver X
Db: distortion factors representing contribution of nonlinear force factor	0.5%	22.2%
DI: distortion factor representing contribution of nonlinear inductance	4.1%	7.2%
Dc: distortion factor representing contribution of nonlinear compliance	0.0%	16.4%

Patented BDSS Technology

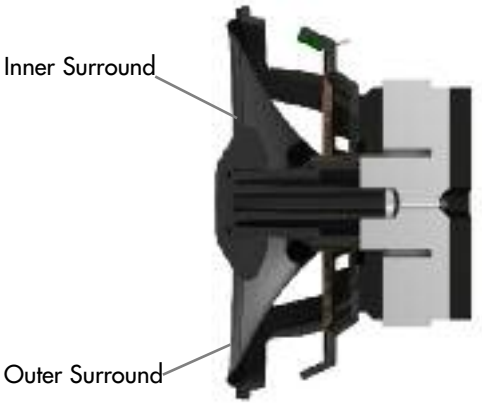
Definitive was awarded a U.S. patent for our innovative Balanced Double Surround System (BDSS) driver design. The original BDSS driver set new standards for wide-bandwidth accurate frequency response, broad dispersion, low distortion and maximum detail retrieval. In a BDSS driver, the cone is supported 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) with lower distortion.

Original BDSS

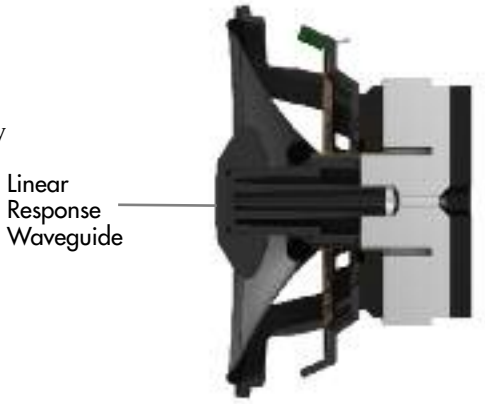
As output is a function of both a cone's diameter and excursion, the higher excursion BDSS system brings the benefit of higher output from smaller drivers. The 3½" driver used in several of the BP-8000 series models has the output and dynamic range of a typical 4½" driver, the 4½" driver has the output one would expect from a 5¼" driver and so on through the line: more sound, lower distortion, smaller size.



BDSS 5¼" driver (maroon) vs. non-BDSS 5¼" driver (blue) – measuring max output at 1% distortion



But now we've made this remarkable driver even better by improving the phase plug located at the center of the driver. What does a phase plug do? Higher frequencies radiate from the driver near the center of the cone. If the short high-frequency waves radiated from one side of the cone (Figure A) meet the same sound waves from the other side of the driver (and they will), those sound waves will interfere by canceling and reinforcing each other. The result is uneven frequency response and poor off-axis performance. The phase plug prevents those short high-frequency wavelengths from interfering with each other (Figure B). The benefit is flatter, smoother high-frequency response both on- and off-axis.



The new phase plug is called the Linear Response Waveguide™. It serves to smooth the driver's frequency response and improve off-axis response and dispersion as illustrated in the graphs below.

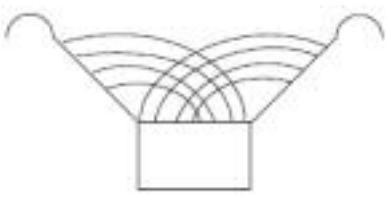


Figure A

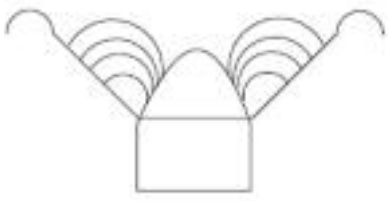
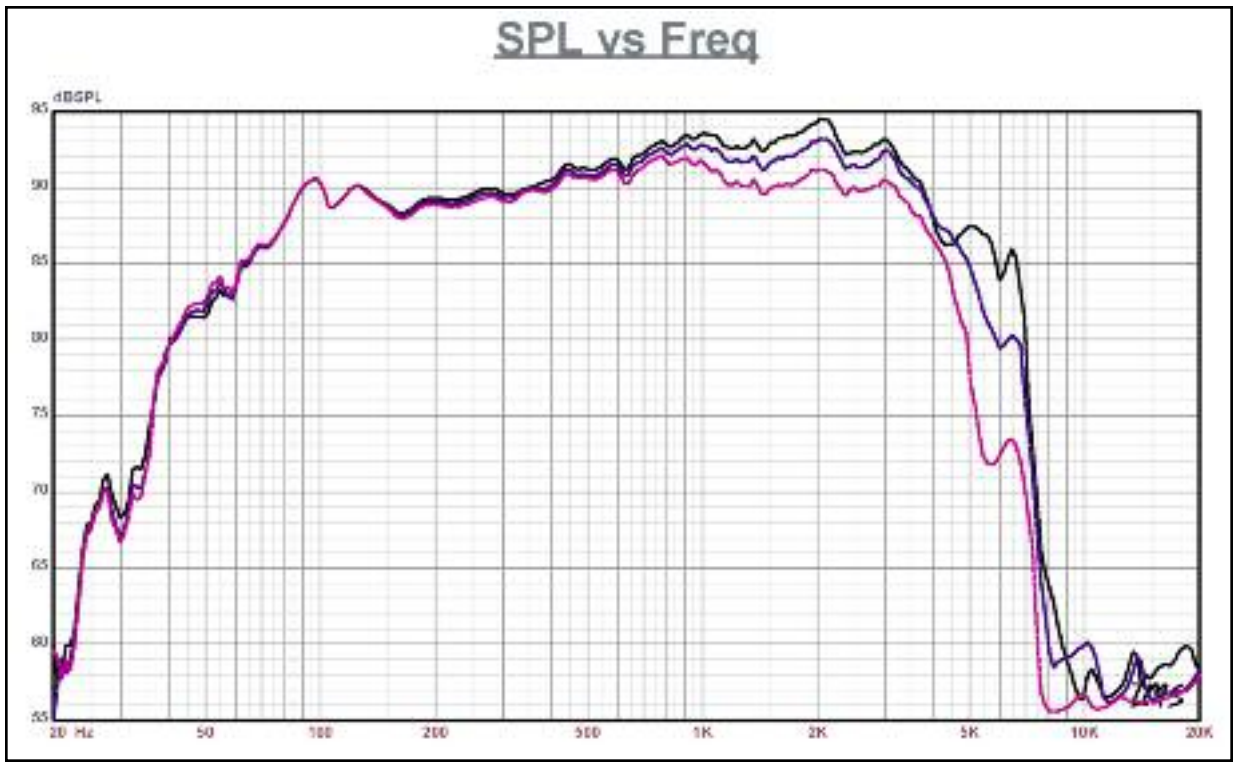


Figure B

Frequency response of driver with conventional phase plug: @ 0° (green), -15° (red) and -30° (yellow). Notice the severe high-frequency roll-off at 30 degrees off axis.



Frequency response of a BDSS driver with LRW phase plug: @ 0° (black), -15° (blue) and -30° (red). Even at 30 degrees off axis, the response is, at most, only 3dB down from the on-axis response.

Subwoofer Systems

The Case for Integrated Subwoofers

Besides eliminating the need for a floor-space-consuming separate subwoofer, integrated subwoofers offer dramatic performance benefits. First is the obvious benefit of having two subwoofers in the room instead of just one for simply more bass output. Most importantly, the subwoofers are perfectly integrated with the mid/high section. Audiophiles often spend dozens of hours moving and adjusting their subwoofers' crossover and phasing controls in pursuit of perfect subwoofer-to main-speaker "blending." With BP SuperTowers, the listener does not have to go through that kind of bother to get audio perfection. Definitive's engineers have perfectly adjusted the crossover and phase between the subwoofer and main speaker sections to achieve seamless blending and lifelike sound. All that is required of the listener is to set the bass volume to match the room and listener's taste, then sit back and enjoy audio perfection.

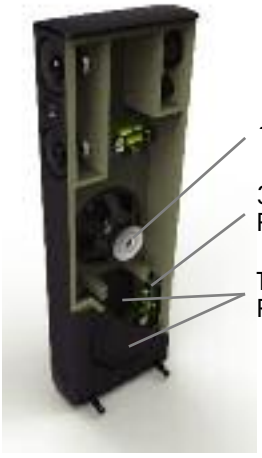
As if those benefits weren't enough, with BP-8000 series speakers, there are two woofers in the room which helps minimize the detrimental effects of room modes (standing waves), so you typically get more uniform bass response throughout the room than you would get with a single separate sub.

All New Pulse Width Modulated Amplifiers

The subwoofer sections of the BP-8080ST, BP-8060ST and BP-8040ST towers and the CS-8080HD feature brawny PWM (pulse width modulated) Class D amplifiers that are optimized for the power demands of the real world for low distortion and high output. As well as delivering high continuous power to cleanly reproduce sustained bass, the Definitive amps have a high crest factor to deliver considerably higher power during short, transient peaks such as bass drum kicks and on-screen artillery blasts. The PWM amplifiers have low output impedance for a high damping factor. Damping factor describes the ability of the amplifier to control movement of the driver near its resonant frequency, thereby promoting "tight" precise bass instead of loose, "boomy" bass. Definitive SuperTower bass is always detailed, tight and musical.

Computers in Your Speakers!

All of the PWM amplifiers have an integrated 56-bit digital signal processor (DSP) — in essence a mini-computer — that extends and shapes the bass response and provides a phase coherent crossover to perfectly blend the subwoofer system with the midrange arrays for seamless high performance. Multi-band digital protection systems tightly monitor and control the woofer system to prevent distortion and woofer damage at ultra-high volume levels with a minimum of audible artifacts. In contrast to simpler one-band compression/limiting circuits used in competing sub-woofer amp designs, the BP DSPs split the frequency range into multiple bands. If the DSP detects an overdrive condition in the upper bass range, it applies just the right amount of compression and limiting to prevent distortion to just that area, without compressing and/or limiting the low bass range, thereby vastly reducing the audible effects of compression and limiting. The bottom line is the BP-8000's bass is always tight, highly detailed and distortion free.



In way of proof, we offer the chart below that compares the BP-7004 and the BP-8060ST. Both models use 10" subwoofer drivers with twin 10" bass radiators and similar internal enclosure volume. Using the CEA 2010 method of measuring how low and how loud a subwoofer goes before audible distortion (the so-called Loud & Low measurement), the chart shows the BP-8060 clearly outperforms the 7004. Why? Better amplifier, better control.

	BP-7004	BP-8060ST	Improvement
Low bass range (20Hz – 32Hz)	108.8 dB	112.2 dB	3.4 dB
Upper bass range (40Hz – 63Hz)	135.8 dB	138.5 dB	2.7 dB

The Bass Radiator Advantage

The subwoofer section of the BP powered towers (with the exception of the BP-8020ST), as well as the CS-8080HD center channel, use low-bass radiators to deliver deep, tight, low-distortion bass. Here's how and why. In a bass radiator system, one driver is an active driver — that is, it has a voice coil and magnet and is connected to the amplifier. It is coupled via the air pressure in the sealed enclosure to two radiators that have all the parts of the active driver but not the magnet and voice coil. As the active driver moves, it pressurizes the air in the enclosure which in turn pushes the bass radiators. The radiators are carefully tuned so that they move only at very low frequencies. Naturally this system provides a huge amount of bass radiating surface area to move the air in the room. In fact a bass radiator system like the one in the BP-8080ST has 33% more surface area than a single 18" woofer but with better control, speed and detail than a single big woofer could ever deliver.

The bottom line is the BP SuperTowers' bass will rock your world like no other speakers anywhere near their size and price.

	Woofer/Bass Radiator Complement	Surface Area Compared to Single Woofer Cone
BP-8080ST	12½"/2 @ 12½"	33% greater than an 18"
BP-8060ST	10"/2 @ 10"	29% greater than a 15"
BP-8040ST	8"/2 @ 8"	30% greater than a 12"
CS-8080HD	5" x 10"/ 2 @ 5" x 10"	30% greater than a 12"

Enclosures

The BP enclosures were designed to maximize internal volume (for better bass) while minimizing the apparent bulk of the speaker. They use floor space efficiently and minimize sound wave diffraction and panel resonance for superior performance.

Size is Important

Before we describe the performance benefits of the BP-8000 series enclosure design, let's not forget that most people (maybe even you) care about how their home looks and how efficiently floor space is used. The narrow front face of the BP towers minimizes the apparent bulk of

the speaker. A BP-8080ST is a substantial 5,712 cubic inches (for better bass response) but it appears to be substantially smaller due to the narrow and tapered front baffle. Most of its mass is in its height, thus saving precious floor space. In fact the BP-8080ST occupies barely over 1 square foot.

	Area (including stabilizer feet)	Metric Area (including stabilizer feet)
BP-8080ST	1.4 sq. foot	1300 sq. cm
BP-8060ST	1.05 sq. foot	975 sq. cm
BP-8040ST	0.9 sq. foot	836 sq. cm

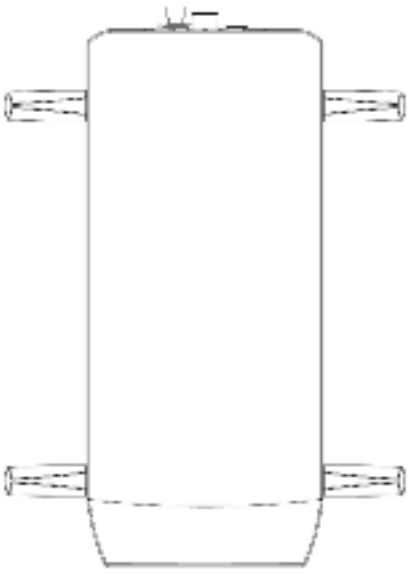
Decorative End Caps: Just for Looks

The removable caps on the BP towers and CS centers are decorative elements only — they are not part of the enclosure and acoustical system. That means the speakers sound the same whether the end caps are on or off, or made out of wood, Jello or solid gold. To borrow a punch line from Gary Larson's "The Far Side," they're like parsley, "just for looks." They're on the speakers to add a bit of glossy dash (bling if you prefer) and cover up the drawstring on the grille cloth sock. We chose to make the end caps out of injection-molded PolyStone because we could shape them in ways impossible to do in wood and we could ensure a more consistent, durable and high-quality gloss finish. And as an added bonus, the new end caps are more resistant to scratches.

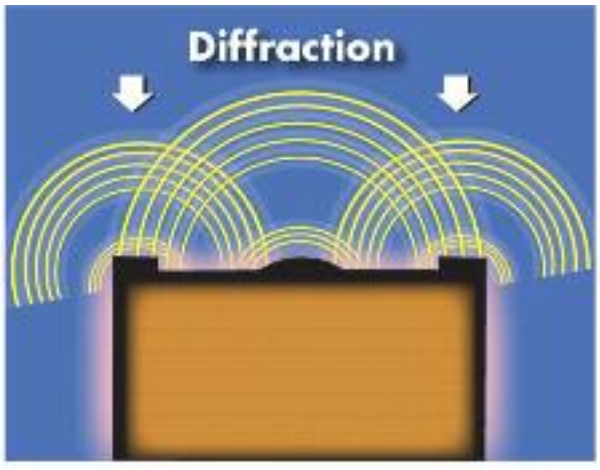
The Diffraction Dilemma

Sound radiates outward in a wave, not in a direct straight line. So it bumps into things on its way to your ears. Any discontinuity in the surface the sound wave travels across, such as a protruding grille frame or a hard 90° cabinet edge, causes bumping (the technical term is diffraction). Diffracting sound waves smear sound and create ghost images, much like white light diffracting through a prism splits into colors. The fewer things a sound wave bumps into, the less diffraction, and less diffraction means purer sound.

In most loudspeakers there are two primary sources of diffraction — the edges of the box and the inner edge of the grille frame. On the BP towers we eliminated both of those sources of diffraction. First, there is no grille frame; the grille cloth sock is stretched over the entire cabinet rather than over a frame. Second, the narrow front baffle doesn't end in a hard 90° edge but in a tapered bevel to minimize cabinet diffraction. The result is open, boxless, and uncolored midrange that will seemingly put the performers right into your room across a broad and deep soundstage.

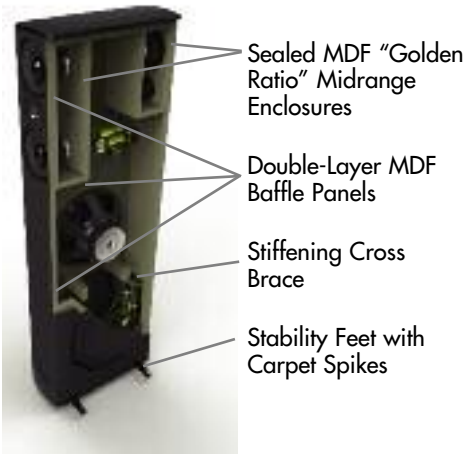


Top-Down View of BP SuperTower



Three Enclosures in One

Having a built-in subwoofer is a great idea but it has to be done right to work well. If a subwoofer system is in the same box as the midrange drivers, the back pressure waves from the sub will affect the movement of the midrange drivers, causing inter-modulation distortion. Each midrange and tweeter array has its own enclosure to isolate it from the subwoofer system. The dimensions of the midrange enclosures are based on Fibonacci "golden ratio" principles in order to minimize standing wave and organ pipe resonances inside the cabinet that would color and distort the sound. It's paying attention to little details like this that set Definitive's engineering and products apart from and above the competition.

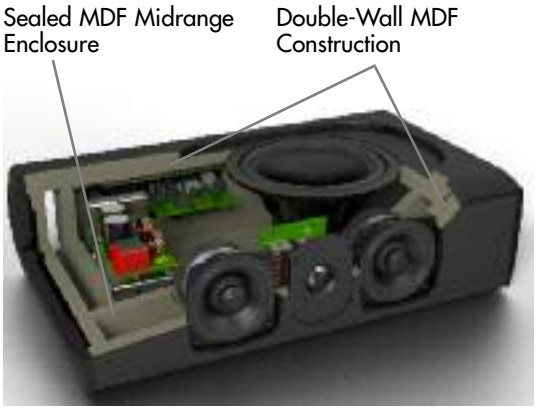


Resonance Control

Resonance is unwanted vibration that colors (distorts) the sound. In speakers you want the driver parts to move, not the enclosure. All BP Series enclosures are fabricated from MDF — a dense and low-resonance composite wood product. But large panels of any practical enclosure material will resonate unless braced in some way. In the BP and CS series speakers the internal midrange enclosures double as cross braces to suppress side-panel resonance. Additional cross braces are positioned above and below the active subwoofer, and double layers of MDF are used wherever a driver or bass radiator is attached. The result is a rock-solid, resonance-free enclosure and a speaker system that faithfully reproduces music and soundtracks.

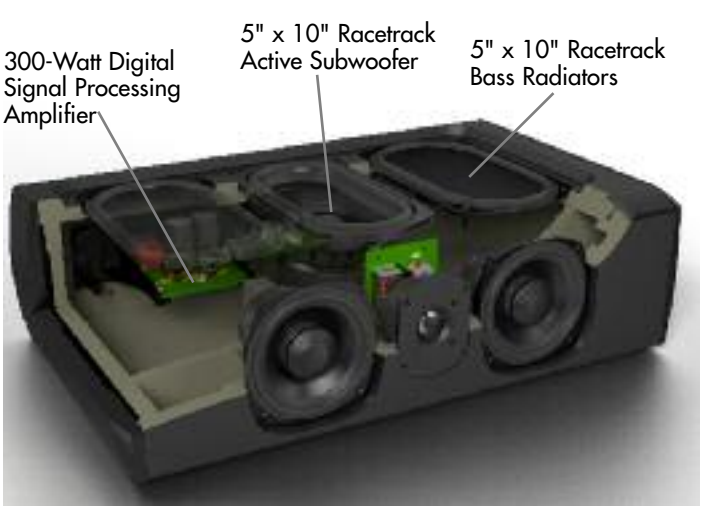
Centers, Surrounds and Systems

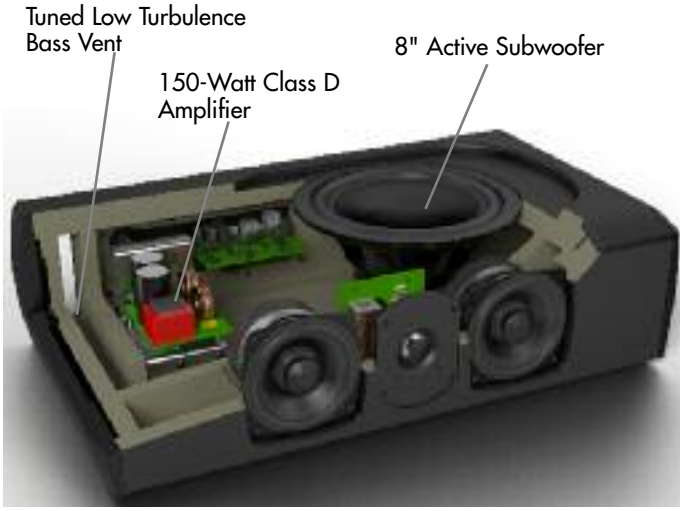
Just about everything that can be said about the BP-8000 series SuperTowers can also be said about the matching CS series centers and SR series surround speakers. They have the exact same midrange drivers and tweeters, the same robust construction and fanatical attention to detail that make the 8000 SuperTowers such marvels of engineering and performance.



Centers with Powered Subs

Two of the CS centers also feature built-in powered subwoofers. Most audio experts agree that the ideal surround speaker system would have five identical truly full-range speakers at every position. But most rooms and setups can't accommodate five identical large speakers. So we engineered the next best thing: truly full-range center speakers that fit on a shelf.





The CS-8080HD features a 5" x 10" racetrack subwoofer driver powered by a 300-Watt digital amplifier. The active driver is pressure-coupled to two racetrack-shaped low-bass radiators for a total bass radiating area considerably greater than a 12" round woofer. The CS-8060HD features an 8" subwoofer driver vented via a wide cross-sectional area bass port. A 150-Watt amplifier powers and tightly monitors and controls the woofer system to prevent distortion and woofer damage at high-volume levels. The upward-firing woofer systems only requires 1" (25mm) of clearance, so they work perfectly, whether mounted free-air or in cabinets. Both CS powered models outperform any similarly sized and priced center speakers by a wide margin so you can fully realize the performance potential of the center channel program material as the movie director intended it to be heard.

SR Bipolar Surrounds

Definitive's SR series surrounds are true bipolar designs containing two complete full-range speaker systems, one on each side of the cabinet. Bipolar technology is superior for surround speakers because it combines the performance advantages of direct radiating (imaging, focus, localization and specificity) and dipolar speakers (spacious, all-enveloping ambience) into one ideal system which is perfect for all multichannel formats. The SR-8000 series models are full-range, low-distortion systems which are timbre-matched to blend perfectly with all Definitive BP series speakers as well as other high-quality speaker systems. Their tremendous dynamic range as well as true high-definition sound quality combined with bipolar radiation pattern results in total immersion in the soundfield.

Systems

Because the centers and surrounds share the same driver components with the towers, getting perfect timbre-matched seamless surround sound is easy. Here are the best pairings of front, center and surround speakers:

> BP-8080ST
CS-8080HD
SR-8080BP

> BP-8060ST
CS-8060HD
SR-8080BP

> BP-8040ST
CS-8040HD
SR-8040BP

> BP-8020ST
CS-8040HD
SR-8040BP

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