

What Makes Unprecedented Audio?

The partnership between Lexus and Mark Levinson was created with an unremitting goal: exceed the customer's expectations by creating a unique listening experience. This could only be accomplished by reconnecting listeners in an emotionally satisfying way with their favorite music or movie through truly unprecedented audio.



What makes unprecedented audio? In order to facilitate the listener's emotional connection, Mark Levinson acoustic engineers create the auditory illusion of the original performance. To do so, they emphasize specific sonic attributes that frame a wonderful audio experience. These attributes include stable three-dimensional imaging, high resolution, harmonic richness, natural dynamics, 360-degree spatial envelopment, and musicality.

Three-dimensional, stable imaging is a playback system's performance attribute that convincingly conveys the location of each performer across the "soundstage," both left to right and front to back. The perceived location of the performer should be fixed and consistent throughout the audio piece. The psychoacoustics, or perception of one's spatial auditory acuity, must seem natural and lifelike. Because directional cues principally come from higher frequencies, a key to creating stable imaging is equal, unobstructed path lengths between the tweeters and the listener's ears.

A system's ability to extract the smallest acoustic detail and nuance from a recorded musical or cinematic performance determines whether it exhibits **high resolution**. This "high-definition audio" reveals auditory cues such as the activation of the pedal during a piano concerto, a singer taking a breath, or the individual utterance of an audience member.

Harmonic richness allows for the full reproduction of an individual instrument's or vocal's particular harmonic structure or overtone. The richness is refined to such a degree that instead of hearing a piano or an acoustic guitar, a discerning listener could identify a Bosendorfer from a Steinway, or a Martin from a Gibson.

The contrast between the softest musical passages, or solo acoustic instruments, and the loudest orchestral crescendos describes **natural dynamics**. An essential characteristic in creating the illusion of a live musical performance or the full theatre movie experience, natural dynamics is the most identifiable attribute of live music while being the most difficult to

reproduce either in a home or an automobile. Cinematic special effects make the reproduction of natural dynamics even more challenging.

When a listener feels the sensation of being acoustically surrounded in a given space, as if at a live concert or movie theatre, they are experiencing **360-degree spatial envelopment**. This is a virtual creation of a live-performance venue or an engineer's control room where the passenger cabin is realistically filled with ambient sound or specific instrumentation in front of, to the sides of, and behind each of the listeners.

Musicality is the total measure of the playback system's ability to communicate the emotional essence of one's favorite music or cinematic storyline. It immerses the listener in the entertainment experience, transcending all considerations of the system entirely, while conveying the intent of the artist without coloring it. Musicality allows all of the other sonic attributes to blend together in recreating the sensation and emotion of the original auditory event.



Lexus and Mark Levinson accomplish the key sonic attributes of unprecedented audio via four cooperative steps that set the vision, define the execution, integrate the components into the Lexus vehicle, and that sets the stage for the Mark Levinson engineers to voice the system.

Setting the vision for a new Lexus model's sound system includes defining what the sound system should accomplish. This process is an inspired creative collaboration between the Lexus model's chief engineer and his staff along with the Mark Levinson acoustic engineers. For the all-new LS luxury sedan, the objective was the best OEM system on the market worthy of the "Reference" moniker, establishing a performance and sonic benchmark. To accomplish this, careful attention was paid to optimize every system detail, and performance targets had to be benchmarked and forecasted against the competitive set. The sonic attributes necessary in volume, bass, and a number of other targets had to be determined. Ultimately, the type of auditory experience that should be brought to the consumer had to be decided.

Once the vision for a new vehicle is established, the sound system is conceptually conceived and quantified. The research and development "roadmap" is reviewed to determine what technology is on the horizon and what state of the art tools will be available for the next generation system. The system's components and their specifications are decided upon in order to reach the performance targets. To achieve the desired performance, the needs of new technology invention or the evolution of existing technology are decided upon. On the new LS,

three-way system architecture in the front was required to create a magnificent front stage by providing stability and replication of natural dynamics. The 19-speaker total was determined not by a desire for numeric superiority but as a condition of attaining the system's "vision." Also, every speaker type in the LS, with the exception of the tweeters that were designed specifically for the 2006 GS sport sedans, was developed specifically for the vehicle.

At this point, the system starts to take shape and come to light, while the foundation for execution is decided. This collaborative development between Lexus engineers and the Mark Levinson design team determines the physical location of all the components in order to maximize the pre-voicing acoustic performance. Takeshi Yosida, the LS' executive chief engineer, had all the engineers responsible for designing the vehicle's packaging come listen to the sound system to understand why they would perhaps have to work twice or three times as hard in order to achieve strategic goal set for the sound system. The sound-system components are also optimized for size and weight, quality, ease of assembly during the auto's manufacturing process, and testing and validation. The optimization of space down to millimeters of angles is done in order to create the best "stage" for the system. Every motor, or magnet, in the new LS is made of neodymium, allowing them to be much smaller than standard ceramic magnets while still providing the necessary performance. Test specifications are also confirmed as well in areas of environment and lifecycle.



Once the sound-system has been fully integrated into the vehicle, the voicing process is completed. This fine-tuning is where art meets science and the sonic attributes are confirmed. Objective listening is conducted with output test measurements by a six-microphone array, which is strategically placed at different times in all seats in the vehicle. Additionally, Mark Levinson acoustic engineers perform subjective listening, bringing their extensive auditory experience to balance the objective sound. Testing is made with both mock vehicles in a laboratory setting and out on common roads and test tracks to evaluate how the system performs in real-world conditions like road and wind noise. Final performance benchmarking is also done on late pre-production vehicles.

The surround sound system in the new Lexus LS 460 and LS 600h L luxury sedans, and recently the LX 570 luxury utility vehicle, was the first to match the "reference product" tradition established by the Mark Levinson home products,. It was a system that built upon a

continually evolving partnership between Lexus and Mark Levinson that ceaselessly recreates itself to achieve an unprecedented audio experience. A relationship that makes one of the quietest, non-resonate vehicles on the market into the one of the best “listening rooms” on wheels.

Lexus Mark Levinson® Reference Surround

Did you know ...?

- All speakers (except the tweeters) in the LS were custom designed specifically for the LS. The tweeters were first custom designed for the all new 2006 GS.
- Mark Levinson Surround (MLS) allows every seat in the LS to become a targeted "sweet spot."
- The amplifier's daughter board in the LS has a heart of gold: its printed circuit board traces are gold-plated.
- Every motor, or magnet, in the new LS is made of neodymium, allowing them to be much smaller than standard ceramic magnets while still providing top performance.
- From concept vehicle to the final production models, approximately 4,000 man hours were spent by Mark Levinson systems personnel voicing Reference Surround for the all-new LS.
- A greater percentage of people listen to music in the car than in the home.
- The retail cost equivalent for a home audio system on par with the LS' Mark Levinson Reference Surround is over \$200,000.
- The Mark Levinson/Lexus line is the only customer-dedicated assembly line in all of Harman/Becker Automotive Group.
- The Mark Levinson brand is dedicated to Lexus and no one else, a partnership based on a gentleman's agreement rather than a legal document.
- The first vehicle to offer Mark Levinson premium audio was the 2001 Lexus LS 430.
- Every one of the eight Lexus vehicles offers a Mark Levinson sound system.
- Three levels of Mark Levinson systems exist in the market place today: Premium Sound, Premium Surround and Reference Surround.
- Conceiving a vehicle's sound system often means working with Lexus 5+ years in advance of vehicle launch.
- Mark Levinson is the only other brand on Lexus vehicles besides tires.

- The Mark Levinson assembly line incorporates Lexus culture by integrating both poka yoke and kaizen philosophies in order to achieve the most error-free and continually improving processes.
- In the first executive meeting between Lexus and Mark Levinson, it was recognized that both entities shared incredibly similar philosophies in their respective pursuit of the "best of the best."

Home vs. Automotive Audio

	Automotive	Home
P R O	<p>Space Compact listening space (volume) requires less power to fill with music</p> <p>Location Location of the listeners is fixed/ constant</p> <p>Acoustics Acoustics of the listener room (cabin) is known and remains constant</p> <p>Mass Production/Customization Fixed listener locations/acoustic environment, with the consistent repeatability of mass production, allow for expert voicing of the entertainment system, optimizing the sonic performance exclusively for that vehicle model</p>	<p>Environment Offers a quiet environment with a low ambient noise level and minimal vibration</p> <p>Capacity Capacity is generally available to accommodate larger music/movie system components</p> <p>“Sweet Spot” Distance to speakers and average room dimensions generate a large listener “sweet spot”</p>
C O N	<p>Environment Road, tire, traffic, wind noise create high/variable ambient noise levels in the passenger cabin (except in a Lexus)</p> <p>Vehicle BSR (buzz, squeak and rattle) adds unpredictable and annoying ambient noises (except in a Lexus)</p> <p>Capacity Small cabin size and immense packaging constraints (size, weight, current consumption) in direct conflict with component performance</p> <p>Acoustics Seat backs create acoustic “enclosures” for each seating row. Close proximity of each listener to all speakers and specifically a single channel or transducer</p> <p>“Sweet Spot” The small size of the listening room (cabin) creates a small “sweet spot”</p>	<p>Space Large listening space (volume) requires more power to fill with music</p> <p>Location Listener can be in multiple places (couch, floor, chair, etc)</p> <p>Acoustics Acoustics of the room are unknown and can change (carpeting, curtains, moved furniture); system components are often EQ’d (equalized) “flat”</p> <p>Mass Production/Customization Custom engineered components and room equalization is extremely expensive</p>