The History and Legacy of JBL

By Don McRitchie and Steve Schell

Table of Contents

Preface

In the summer of 2005, Steve Schell and I were honored to receive an offer to develop a history of JBL for Stereo Sound Magazine. We had both become fascinated with the legacy of the company and its founder, which led us to develop the Lansing Heritage Website in May 2000. However, this assignment led me to reflect back to a fundamental question—how can one capture the significance of this legacy? Obviously, there is a factual record of specific accomplishments, and this forms the basis of the history article. While this record is long and storied, I wasn't certain that it communicated the overall impression and personal appeal of the company and its products—attributes that have garnered legions of fans around the world. I then realized that maybe my own experience is representative of this appeal.

My introduction to JBL was in the year 1973, at the age of 16. A friend of mine had just bought a JBL 030 system consisting of the D130 bass driver and 075 ring radiator housed in a custom built 13 cubic foot enclosure. Even in its day, this system was not the most accurate reproducer around, but the impact it imparted upon my first listening has never been equaled in the rest of my years. Up to that time, I never believed that such sonic realism could be obtained in one's home. The effect was palpable: bass notes thundered while vocals soared effortlessly into the room. It started me off on a decades-long search for sonic excellence that resulted in my dalliance with numerous brands of supposed high end audio gear. However varied that search became, I was always drawn back to the sound of JBL. While I purchased competing brands that were nuanced and detailed, they were all, in the end, lacking in one respect. What was missing was the special character of JBL speakers that drew me into this hobby in the first place—dynamic realism. I came to understand that the essence of music is its emotional appeal, and without dynamic impact, music becomes detached and uninvolving. By reconnecting with JBL, I reconnected with music itself.

There is a second aspect of JBL's subjective appeal that I think also resonates with its many fans and that is the quality of engineering inherent in JBL products. It holds special attraction for me, since I made my career in engineering—albeit civil engineering. I can distinctly remember the first time I saw a JBL driver outside of its enclosure. The massive magnetic motor, huge voice coil, fit, finish and attention to detail all left an indelible impression. This was the work of craftsmen—people who deeply cared about the goods they produced. It spoke to a level of excellence that had no equal in my experience.

Both Steve and I shared this personal admiration of JBL and it subsequently led us on a quest to seek out who and what was behind this remarkable company and its products. With the help of dozens of people (see the acknowledgments section), we started down a path of discovery on which we have yet to reach our final destination. It is doubtful that we will ever uncover the entire story, but as the cliché says, it is the journey that is the most rewarding. Our hope with this article is that others may share these benefits and gain a deeper understanding of the unparalleled record of accomplishment that is the legacy of James B. Lansing and JBL.

Donald McRitchie
February 2006

Greenridge Illinois 2005
© and Courtesy John Pikta

Greenridge, Illinois Circa 1910

The above photo shows Greenridge, Illinois circa 1910. It is a place that time has completely erased. However, for a few brief decades, it was a small, vital mining community that would mark the birthplace of James B. Lansing.

The town was founded in 1894 with the sinking of a mine shaft to tap the rich coal reserves in the area. At the time the Martini family lived there, it had a population of around 300 people. There were 65 houses, a post office, one store and a school. Most of the buildings were painted bright green and this gave rise to the name - Green Ridge

The mine struggled, even though the coal reserves were plentiful. Difficult financial times and corporate consolidations resulted in the closure of the mine in 1923. Over the next few years, the residents slowly drifted away until, by 1930, it was completely abandoned. Today, there is only one vacant farm house in the vicinity and the entire town site has been reclaimed by rows of tall corn.

Jim Lansing (1902-1949)

Early Life

The top left photograph illustrates a nondescript corn field in southwestern Illinois. Nobody lives there today, nor has anyone lived there in over 70 years. However, on January 2, 1902, the man who would become renowned as James B. Lansing was born in the small community that once occupied this field. He was the ninth of fourteen children born to Henry and Grace Erbs Martini. Henry was a coal mining engineer of Italian descent, and considering his occupation, he likely possessed an abundance of mechanical skills. James may have inherited his father's mechanical aptitude or developed an interest through exposure to his work. Life must have been hard for such a large family; at one point, James was sent to stay with a family by the name of Bullough in Litchfield, Illinois. James was so grateful for their kindness that he later adopted Bullough as his middle name.

Information about James's childhood is scarce, and much of what we do know was provided by his brother Bill. He demonstrated his interest in mechanics and electrical apparatus by age 10, when he built a Leyden jar, which he used to play tricks on his friends. Another interesting story: at age 12 James built a crystal radio receiver/transmitter that was powerful enough to disrupt nearby Naval communications. The authorities soon identified the set's location in the Martini home and insisted that it be dismantled. James graduated from eighth grade at Lawrence School, Litchfield, Illinois. He attended Springfield High School, Springfield, Illinois. He also studied at a private business college in Springfield. James found employment at the Leyland Lincoln automobile dealership in Springfield, and showed such aptitude that they paid for him to attend a school in Detroit to study automotive mechanics. It is also reported that he spent some time in Lansing, Michigan selling shoes, and also worked for a time as a telegrapher on oceangoing steamships.

James's mother died on November 1st, 1924; James was then 22 years of age. He apparently decided to head out west soon after. It is known that he arrived in Salt Lake City, Utah, by mid-1925. He applied for a job with the well-established Nathaniel Baldwin Company, a Salt Lake City manufacturer of radios, headphones and loudspeakers. Although he was interviewed by Mr. Baldwin, he was not hired. His luck soon improved however, as he obtained a job as engineer of a local radio station. A bit later he went to work for the Felt Auto Parts Company, where his automotive and machinery skills were likely of value. During this period, it was observed that he spent his spare time at his workbench experimenting with loudspeakers, constructing paper cones and attaching them to reed armature drive units made by Nathaniel Baldwin. Cone speakers were a new development at the time, and offered the possibility of much better sound than the gooseneck horns that were routinely used with home radios.

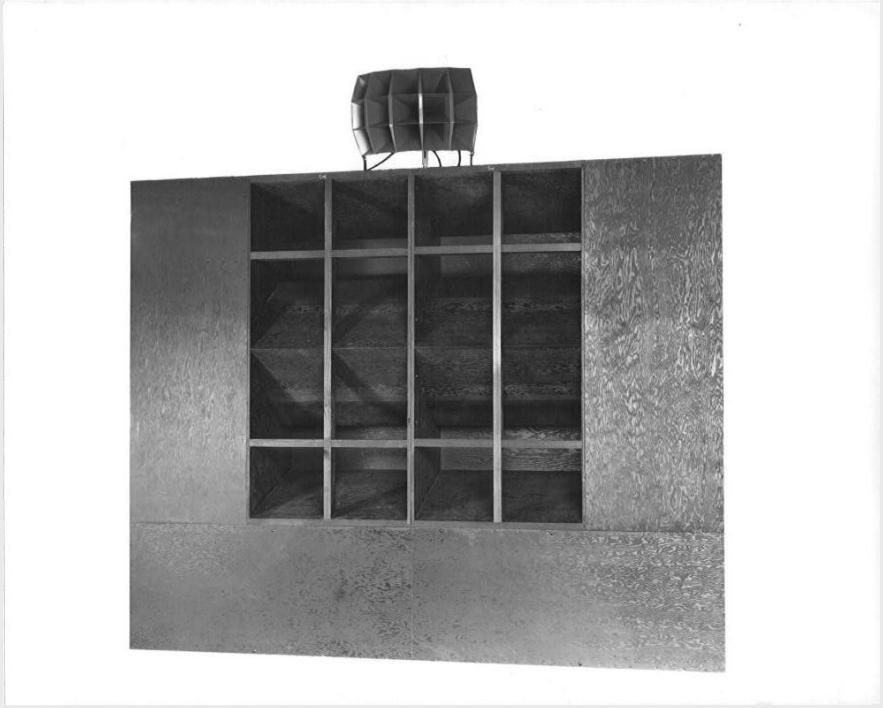
In the fall of 1925, James met Glenna Peterson, who was 21 years old. They began dating, and James became acquainted with her brother Fred. Through the Peterson family, James met Kenneth Decker, whose family had prospered in the jewelry business locally. James and Kenneth decided to form a partnership to manufacture loudspeakers for radio sets. Jim left his job at Felt Auto Parts and rented the basement of an office building in downtown Salt Lake City. Fred Peterson was hired as an employee. As Fred has recalled, Decker ran the business, James designed the speakers, and the two worked together building them. They had plenty of space to work, though they had to gain access to the basement via an elevator that was operated with a rope by hand power. Before long they began to enjoy some success—enough to attract Nathaniel Baldwin's attention. Mr. Baldwin paid a visit to the basement workshop, and offered to buy the company. This time it was James who said no.

Lansing Manufacturing Company

During the late 1920s, the radio manufacturing industry was growing exponentially, and Los Angeles, California, was becoming the most active area in the western United States. James and Kenneth realized that business opportunities would be much greater there than in Salt Lake City. They relocated their business to Los Angeles early in 1927, leasing a workplace on Santa Barbara Avenue. James legally changed his name to James Bullough Lansing about this time, and the Lansing Manufacturing Company was registered as a California corporation on March 9, 1927.

Cone speakers had almost completely obsoleted the gooseneck horn type at this point. They were generally sold separately from the radios, which had not yet evolved to contain an internal speaker. The Lansing product was typical of the era, consisting of a reed armature drive unit attached to a 10"-diameter paper cone, housed in a wooden enclosure, with ventilation grilles front and rear. By June 1928, Lansing Manufacturing Company was advertising their new Lansing Deluxe model in radio magazines. Heralded as "Surprisingly better," the Lansing models ranged in price from $20.00 to $42.50. By then, the company had moved to 6626 McKinley Avenue, Los Angeles, a location which provided more space for the growing operation as well as close proximity to the Jackson Bell Company, a prominent radio set manufacturer. The year 1928 would also see a milestone in Lansing's personal life. On November 29, James B. Lansing and Glenna Peterson were married in Los Angeles, and moved into a small home in a neighborhood close to the McKinley factory.

The moving coil loudspeaker had begun to quickly gain favor over the armature type, as much greater excursions of the cone were possible with this design. Bass response had always been very limited with the armature cone speakers because anything more than a tiny cone movement would cause the mechanism to rattle. Lansing Manufacturing Com-



Lansing Manufacturing 75W5 Shearer Horn Front

Lansing Manufacturing 75W5 Shearer Horn Back

pany began producing fine-quality moving coil speakers, utilizing a field-coil motor structure. The electromagnetic design was necessary, as permanent magnet materials of sufficient strength had not yet been developed.

By 1931 the Great Depression was beginning to limit most of the public's disposable income for luxuries such as radios, and a new, smaller style of radio called the cathedral was becoming very popular. This design contained a small loudspeaker within the cabinet. Lansing Manufacturing Company introduced 4", 6", and 8" models and began producing them in great numbers for the radio set manufacturers. By this time the company had grown to about 40 employees, including James Lansing's brothers Bill Martin and George Martin. In 1933 a strong earthquake knocked down the rear brick wall of the factory, and the company soon moved down the block to larger quarters at 6900 McKinley Avenue.

The Shearer Project

By the early 1930s the silent era in motion pictures had ended and virtually all movie theatres were showing sound features. Hollywood had become the center of the American film industry and was located within a few minutes' drive from Lansing Manufacturing Company. The Metro Goldwyn Mayer Studios was engaged in a thorough reevaluation of the equipment used for sound recording and playback. The rush to sound motion pictures had resulted in rapid development of the necessary equipment, and much of what was in use had been crudely designed. MGM's chief sound engineer, John Hilliard, determined that the recording amplifiers, which had been in use since 1925, suffered from as much as 1500 degrees of phase shift due to the poor quality of the transformers used. This caused distortion of speech and a loss of articulation. Hilliard's friend, Dr. John Blackburn, introduced him to James Lansing, who in turn assigned his transformer engineer Ercel Harrison to the task of designing improved transformers. Harrison was successful, and the new transformers built by Lansing Manufacturing Company reduced the phase shift in the MGM amplifiers to less than 360 degrees.

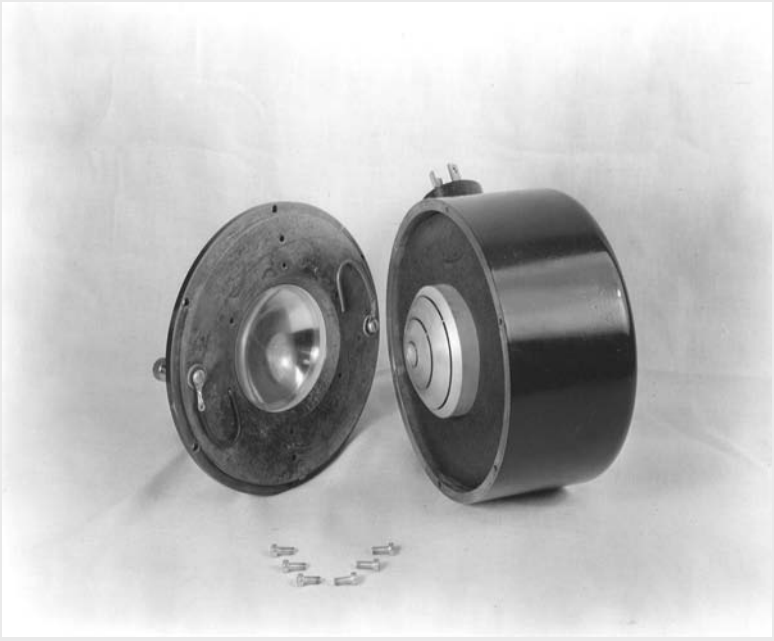
MGM controlled the Loews theatre chain, which operated 130 of the largest theatres in the U.S. MGM was not happy with the loudspeakers used in these theatres, most of which were the "Wide Range" systems built by Western Electric. These systems, which had been introduced in 1933, were of three-way design with separate low-frequency, midrange and high-frequency loudspeakers. The midrange units were large, curled "snail horns" driven by compression drivers, a legacy of Western Electric's "Voice of Action" single-way system dating back to 1927. The Wide Range system augmented the snail horns with cone woofers and horn tweeters mounted to a flat baffle at stage level. There was a twelve foot path length difference between the snail horns and the baffle mounted drivers, resulting in an echo when reproducing transient sounds. These systems were also limited in their ability to produce high volume with low distortion. This was a problem since many of the Loews theatres had between 2,000 and 5,000 seats.

Bell Telephone Laboratories engineers had developed a two-way horn system of state-of-the-art design for their Auditory Perspective series of experiments in early 1933. It was dubbed the "Fletcher Horn System" after the Bell Labs' project director, Harvey Fletcher. It was capable of very high output, wide bandwidth, and low distortion. After the experiments were concluded, an example of this system was made available to MGM for evaluation. Hilliard determined that this system, while excellent in most respects, had an eight foot path length difference between low and high-frequency sections, and retained much of the echo of the Wide Range System. He experimented by moving the high-frequency horn rearward in relation to the bass horn, and found that by the time the high-frequency horn was eight feet back the echo was gone. Moving the horn forward again, no problems became noticeable until it had moved more than one foot. So, his new goal for future design became an arrival time difference of no more than one foot, or one millisecond in time.

John Hilliard consulted with Douglas Shearer, his boss and head of the MGM sound department. It was obvious that a commercial version of this Fletcher Horn System was needed in the larger theatres. MGM informed the Electrical Research Products, Inc. branch of Western Electric that a contract for 150 such systems would be issued as soon as a prototype system could be demonstrated. In late 1934 a progress report was requested by MGM. ERPI responded that no action had been taken and that none was anticipated. It seemed that Western Electric was quite happy with their Wide Range installations and felt there was no need for them to develop a new theatre loudspeaker system.

Hilliard and Shearer consulted again and realized that if a new system based on the Fletcher design was to be developed, they would have to do it themselves. MGM studio chief Louis B. Mayer authorized the project and directed the head of Loews Theatres to assist by making theatres available for testing. Hilliard assembled a capable team to develop the system. James Lansing would build the loudspeaker units, assisted by Dr. John Blackburn in their design. Harry Kimball would engineer the dividing networks. Robert Stephens, a draftsman at MGM, was assigned the task of designing the multicellular high-frequency horns and supervising their construction in the MGM metal shop. When RCA was informed of the project, they sent their top engineers Harry Olson and John Volkmann out to California to assist. When ERPI found out that a serious design effort was underway, they pledged to do what they could to provide assistance.

The new system began to take shape. Olson suggested a folded "W" style bass horn of 50 Hz exponential flare. After several prototypes, a 15" paper-cone, field-coil woofer with a 2" voice coil was found to have good performance. Four of these Lansing model 15XS woofers were used in a configuration that consisted of two stacked bass horn enclosures that each contained two drivers.



284 Compression Driver

Lansing Manufacturing Iconic

Several prototype high-frequency compression drivers were built by James Lansing, all based on the driver used in the Fletcher System, but varying in diaphragm and exit size. The Fletcher driver, with its 4" diaphragm and 2" exit was thought to be too large and to suffer from "poor power performance." A driver with 2" diaphragm and 1" exit was also tried. Eventually a driver with a 2.84" diaphragm, three-section concentric-slit phasing plug and 1.5" exit was settled on, and the Lansing model 284 compression driver was born. Multicellular horns with various cell configurations were built to accommodate the needs of different theatres; 2x3, 2x4, 2x5, 2x6, 3x3, 3x4, and 3x5 horns were all constructed for testing.

Douglas Shearer and John Hilliard supervised the installation of a dozen of the new two-way horn systems in Loews theatres around the country in preparation for the premiere of "Romeo and Juliet," which starred Douglas's sister Norma Shearer. The systems were judged to be a great success, and MGM issued contracts for RCA and ERPI to each supply 75 of the new systems to the Loews theatres. This also represented a sizable amount of work for Lansing Manufacturing Company, which built the speaker units to be used in the RCA-supplied systems.

MGM was presented with an Academy Award in 1936 for excellence in sound technology for the Shearer Horn System.

Lansing Manufacturing in the Late 1930s

The Shearer Horn project had represented a major opportunity for James Lansing and his company. He evidently sensed that his destiny lay in providing fine quality loudspeakers to the motion picture industry from this point forward. Production of radio speakers was curtailed, and Lansing Manufacturing Company continued to serve their existing radio industry customers by distributing the distribution of speakers built by the Magnavox Company. All company resources were devoted to tooling up to produce a full line of loudspeaker equipment for motion picture theatres. By 1936, literature appeared which described a full line of compression drivers, multicellular horns, bass drivers, bass horn enclosures, field supplies and dividing networks. The brochure for the Lansing Shearer Horn states: "We unhesitatingly assert, without fear of refutation, that the Shearer Horn System, as made by Lansing Manufacturing Company is the finest sound system that you can obtain for your theatre."

The ERPI division of Western Electric was also in production of a new two-way horn system closely modeled on the Shearer Horn. It was called "Diphonic" and was supplied as part of their new "Mirrophonic" line of theatre sound equipment. They noted that the model 284 compression driver being built by Lansing was quite similar to their new 594A compression driver; indeed, both the 284 and 594A had been derived from the Fletcher System compression driver. Western Electric informed Lansing that he was infringing on Edward Wente's U.S. Patent #2,037,197, which described the Fletcher driver. Specifically they objected to Lansing's use of the concentric-slit phasing plug.

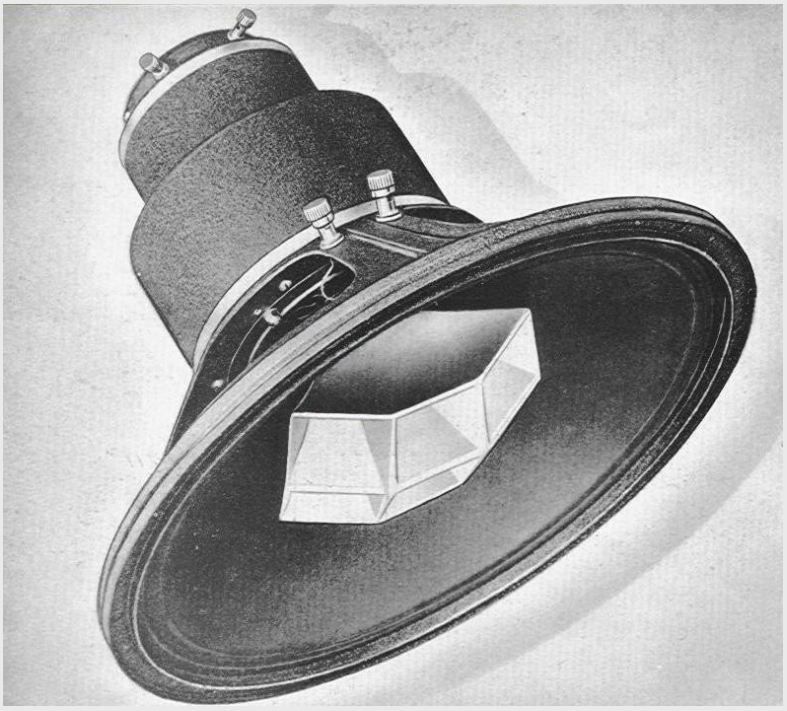
Dr. John Blackburn, who by this time was employed by Lansing Manufacturing Company, designed an innovative new radial-slit phasing plug that accomplished the same objectives as Wente's concentric-slit design but did not violate the existing patent. Dr. Blackburn applied for and received U.S. Patent # 2,183,528 on his new design. Lansing's compression driver was fitted with the new radial-slit phasing plug and was renamed the model 285.

Although the Lansing Shearer Horn systems set new standards of excellence in theatre sound, they were too large to be used for monitoring in the small confines of studio screening rooms and broadcast studios. Responding to requests for a smaller system that retained much of the quality of the Shearer systems, three models of the Lansing Monitor System were introduced in 1936. The 285 compression driver was joined to a 500 Hz. multicellular horn, and either one or two 15XS bass drivers was fitted to a reduced size W style bass horn. These systems proved quite popular with the Hollywood studios, and many units were supplied to the U.S. Armed Forces as well.

In 1937 Lansing Manufacturing Company introduced a landmark product, the Lansing Iconic two-way monitor speaker. Responding to the need for an even smaller system of high quality than the Lansing Monitors, the Iconic filled the need perfectly. Dr. Blackburn developed a new small-format compression driver called the 801; it featured a 1.75" diaphragm, two-section concentric-slit phasing plug, and 1" exit. It was used with a new 800 Hz eight-cell horn of compact dimensions. A single 15" bass driver was mounted in a six-cubic foot bass reflex enclosure. The system provided high output with low distortion, and covered the range from 40 Hz to 10 kHz in a small package and was an immediate success. A furniture cabinet version of the Iconic called the Salon was also introduced, for commercial and home installations where appearance was an important consideration.

John Blackburn researched the subject of phasing plug design and discovered that prior art for the concentric slit phasing plug existed in the realm of acoustical phonographs. He submitted this information to Western Electric, as it invalidated their claim that Wente's patent was enforceable. In 1938, Lansing Manufacturing Company introduced the new 284B driver, which returned to the use of the concentric-slit phasing plug. Another factor may have been that Western Electric was no longer supplying sound equipment to motion picture theatres, as they had signed a consent decree with the U.S. Government on September 1, 1937 to cease the supply and service of sound equipment to motion picture theatres in the United States. However, ERPI continued to manufacture and supply sound equipment for other applications. ERPI's theatre service branch was purchased by a group of former managers, forming Altec Service Corporation in the process. They continued to service the Western Electric sound systems in use, though they drew from a constantly dwindling supply of spare parts.

Kenneth Decker, 1918
© and Courtesy the Decker Family



Original Altec Lansing 604 Duplex
© Altec Lansing Technologies, Courtesy Dr. Bruce Edgar

In the late 1930s, Lansing Manufacturing Company struggled to develop the markets for their theatre loudspeakers. Components were supplied to International Projector Corporation in the United States and to the Raycophone Company in Australia. The company began to make and supply amplifiers and other electronic components, guided by the engineering expertise of Ercel Harrison. Despite these efforts, the company began to falter, as not enough equipment was being sold to keep the company profitable. About this time, Dr. John Blackburn left the company and accepted a job at the Massachusetts Institute of Technology to work on projects for the U.S. Government. A major blow occurred on December 10, 1939, when Kenneth Decker, the company's chief financial officer and Lansing's partner since the earliest days, was killed in an airplane crash. Decker had been a Lieutenant Colonel in the U.S. Army Reserve and a pilot for much of his life. The small plane he was piloting while on a routine training mission crashed into a residential backyard in the southern California community of La Crescenta, killing Decker and a passenger.

By early 1941 it was beginning to look like Lansing Manufacturing Company was going to have to close its doors. The workforce was now down to about nineteen. Altec Service Corporation was also approaching a crisis situation, as they were running out of critical replacement parts for their theatre equipment service work. John Hilliard, aware of the situation of both companies, suggested that the principals meet to discuss matters. This was done, and Altec Service Corporation purchased the Lansing Manufacturing Company on December 4, 1941 for $50,000 cash. The purchase price included all company equipment, inventory, and rights to manufacture the Lansing line of sound equipment, arguably the finest produced in the world at the time. The newly formed company was called Altec Lansing Corporation. The agreement included a non-competition clause, wherein Lansing agreed not to engage in the independent manufacture of loudspeakers for a five year period. He stayed on with the new company and was given the title of Vice President in charge of Manufacturing.

Altec Lansing Corporation

The company thrived under the new ownership. Altec Service Corporation was retained as a subsidiary, based from its offices in New York City, and maintained a large staff of service technicians across the country. When Pearl Harbor was attacked three days after the formation of the company, commercial manufacturing was interrupted for a time by the war effort. Sound products were supplied to the government, however, and the company received many contracts for transformers and other electrical products. When conditions permitted, the manufacture of the line of Lansing sound products resumed. The company featured the tag line "Loudspeakers by Lansing" on its literature, product identification tags, and the sign out front at the McKinley Avenue factory.

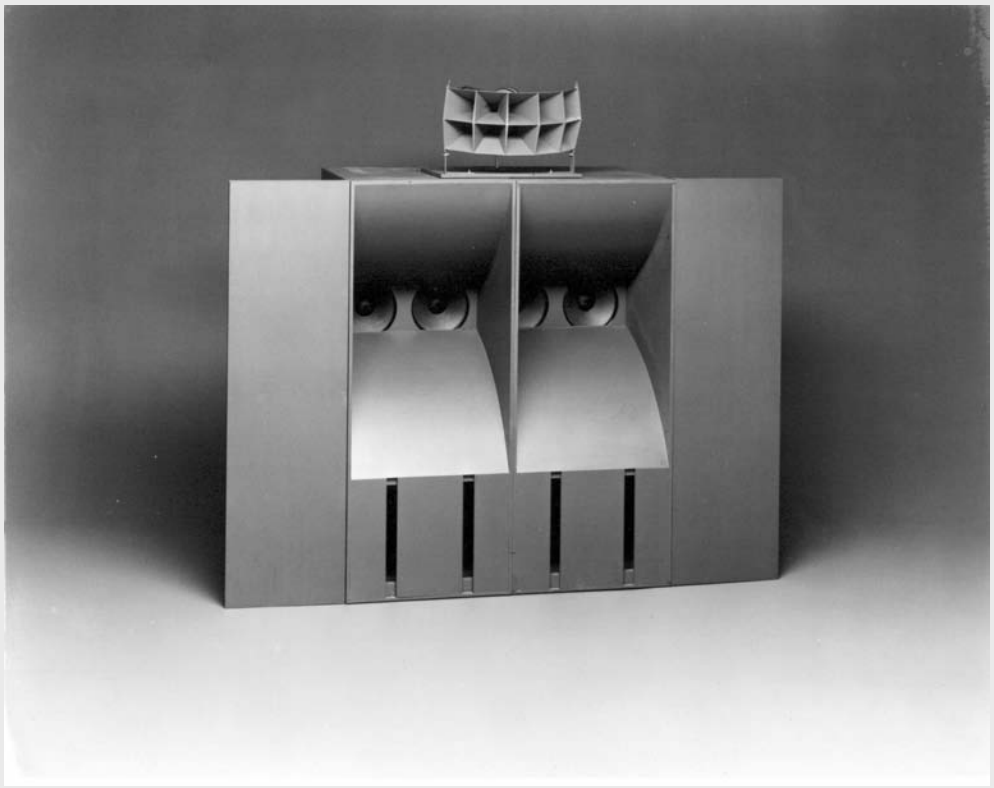
In 1941 Arthur Crawford, a local sound equipment retailer and Altec Lansing customer, suggested the concept of a new loudspeaker to the company. His idea was for a two-way coaxial loudspeaker unit, wherein the high-frequency driver would be mounted to the rear of the unit. The horn path for this added transducer would progress through the low-frequency magnet structure's center pole to a horn mounted in front of the low-frequency cone. Crawford may have been inspired by larger two-way coaxial loudspeakers that had been built by both Western Electric and RCA in the late 1930s. In any event, this was a brilliant idea, as it would permit a compact speaker unit to have high output over a very wide bandwidth. It would also provide a point source of sound, which would be very useful for monitoring purposes in close quarters. James Lansing developed the driver and the tooling necessary to produce it. He used the 801 high-frequency driver from the Iconic, combining it with a new 15" woofer fashioned from parts on hand and a new eight-cell, 1200 Hz horn. Both magnet assemblies utilized field coils. In 1943 the model 601 Duplex loudspeaker was introduced. It was typically housed in the model 612 utility bass reflex enclosure, which had served up to that time as the bass enclosure of the Lansing Iconic.

In 1943, John Hilliard, who had been working on radar development with Dr. Blackburn at M.I.T. since the previous year, was sent to Altec Lansing in Los Angeles to work on the Magnetic Airborne Detector project, a development effort for the U.S. Government to provide a practical radar system for military aircraft. This work involved use of newly developed magnetic materials, and the benefits of this research soon spilled over into loudspeaker developments at Altec.

Through 1943 and into 1944, Lansing and Hilliard collaborated on the design of what would become a new generation of motion picture theatre loudspeakers. The W-style bass horns of the Shearer system had proven to have poor performance in the midrange, as the higher frequencies were being lost in the horn folds. This led to poor intelligibility of speech, a critical flaw in a motion picture loudspeaker. Hilliard designed a new enclosure that combined a short exponential horn in front with a fully enclosed rear volume. This volume was utilized as a bass reflex, with vents in front augmenting the output below 100 Hz. The enclosure design also allowed for perfect alignment of high and low-frequency sections to eliminate any path length differences, a long-desired goal.

Utilizing the powerful new Alnico V magnet material, Lansing developed a new permanent magnet version of his large format compression driver. He also perfected the hydraulic forming of aluminum diaphragms, which allowed the use of a tangential outer compliance for improved performance. The voice coils were edgewound from aluminum wire, using a new process. As the permanent magnet design no longer allowed disassembly of the driver body for servicing, Lansing engineered an easily removable diaphragm assembly. The resulting new driver was called the Altec Lansing 288.

Lansing also developed a new 15" bass driver which incorporated many improvements over the older Lansing designs. Alnico V was used in the magnet assembly, and the voice



Altec Lansing A2

JBL D130

coil was increased from two inches to three inches in diameter. It was edge-wound from copper, using innovative winding techniques and equipment. The new low-frequency transducer was called the Altec Lansing 515.

Prototypes of the new system were built and tested in theatres in late 1944, as had been done a decade earlier with the Shearer System prototypes. This series of tests was judged to be very successful, and Altec Lansing began large scale production of the new systems. Dubbed the "Voice of the Theatre," installation in theatres began in early 1945.

The new permanent-magnet assemblies were also applied to the Duplex loudspeaker. The 801 compression driver from the Iconic was converted to an Alnico V permanent magnet, and a new easily-replaceable diaphragm with tangential compliance was designed. The resulting compression driver was combined with the 515 woofer to become the 604 Duplex Loudspeaker. The 601 field-coil Duplex was discontinued at that time. The new high-frequency driver would also soon be designated the 802, and would find application in smaller theatre systems beginning in 1947.

James Lansing persevered through his five years at Altec Lansing, but he became increasingly unhappy with his role with the company. Although given the title of Vice President, he felt that he was not allowed to have a guiding role in company decisions. "I'm just a name to them," he was known to say. As soon as the five-year period of his non-competition clause expired (in 1946), he left Altec Lansing. Company officials had expected that this would happen, and when he left they extended him their best wishes in his future endeavors.

Establishment of Lansing Sound Incorporated

Before James Lansing left Altec Lansing, he had purchased an avocado and citrus ranch in San Marcos, California, located inland from Oceanside. He had long been interested in the breeding of fruit trees. Upon his departure from Altec Lansing, he told friends that he had had enough of the speaker business and planned to be a farmer from then on. Lansing was very proud of the three-pound avocados produced on his ranch. The problem, however, was that it was more difficult to sell them than the more common one-pound avocados.

It was soon noticed that metalworking machinery began to appear in the barn at the ranch. It seems that the loudspeaker business was in Lansing's blood, and he was unable to escape its grasp. Before long the barn had been converted to a small but complete precision machine shop.

James Lansing enlisted the aid of several old friends in the establishment of his new company. Lansing Sound Incorporated was registered as a California Corporation on October 1, 1946. The principals of the company were listed as James B. Lansing, Chauncy Snow, and Chester L. Noble. In the earliest sales literature the office location is listed as 510 South Spring Street, Los Angeles, which was Chester Noble's business address. The factory location was shown as San Marcos, California.

The first product of Lansing Sound was a 15" "general purpose" loudspeaker called the D-101. It bore a strong physical resemblance to the 515 woofer which Lansing had designed before leaving Altec Lansing. The D-101 differed in important ways though, as it used an edgewound 3" aluminum voice coil rather than copper, and was fitted with an aluminum foil center dome to further extend the high-frequency response of the driver. The D-101 was intended to function as a full-range speaker rather than the low-frequency portion of a two-way system like the 515. Lansing embellished the D-101 with a small round paper label that contained the word "Iconic" across its center.

The principals of Altec Lansing soon found out about James Lansing's new venture. They were upset about the use of "Lansing" in the name of the new company as well as the use of the term "Iconic", as they felt that both belonged to Altec Lansing. They contacted James Lansing, who agreed to drop the use of the term "Iconic", and also to change the name of his company to "James B. Lansing Sound, Incorporated." Altec Lansing was satisfied that the use of James Lansing's full name in his company's title would help to differentiate the names of the two companies in the mind of the public and avoid confusion.

An amazing period of creativity for James Lansing ensued through late 1946 and early 1947. In addition to the D-101, he began producing the D-130, a slim profile 15" high efficiency speaker for public address and music system use. It featured the first use of a 4" edgewound aluminum voice coil in a 15" speaker, built to tight tolerances never before seen in the industry. The D-130 continued the use of an aluminum foil center dome to extend the high-frequency response. The model D-130A was offered as a low-frequency variant of the D-130; it featured an edgewound copper voice coil and a paper center dome. The model D-131 was another D-130 variant, identical to the D-130 except for a 12" cone and basket. All of the cone drivers featured powerful magnet structures incorporating the Alnico V material.

Lansing also began to produce the D-175 high-frequency compression driver. It was quite similar in most respects to the Altec Lansing 802, which in turn owed its origins to the Lansing 801 driver of 1937. The D-175 featured a 1.75" diaphragm with tangential compliance, 1" exit, and a powerful Alnico V magnet structure. A new multicellular horn called the H-1000 was designed for use with the D-175. A new two-way loudspeaker system was introduced that included the D-175, H-1000, D-130A and a new 1200 Hz., 18 dB/octave dividing network called the N1000. These components were housed in a simple utility enclosure, and the complete system was called the D-1000. It was functionally very similar to the Lansing Iconic and was intended for use in the home and in small auditoriums.

JBL Factory 1948
Marquardt Building 3 in Van Nuys, California

Jim Lansing Gravesite
Englewood, California

James Lansing enlisted the aid of his friend Norman Neeley, who had recently established a marketing company, to represent his product line and establish channels of distribution. Neeley coined the term "A Jim Lansing Signature Speaker" to capitalize on Lansing's fine reputation in the industry. All of the products were given labels that bore this new identity.

By early 1947 it became obvious that the barn in San Marcos was too small to contain the growing operation. James Lansing spoke with his friend William H. Thomas, who was a founding partner and General Manager of the newly-formed Marquardt Aviation Company in Venice, California. A meeting was held between Roy Marquardt (co-founder and President of Maruqart Aviation), William Thomas and James Lansing. An arrangement was made whereby Lansing would be provided with a twenty foot by twenty foot workspace in the Marquardt plant and access to other Marquardt facilities in exchange for ten percent of net sales. It was also agreed that Marquardt Aviation would extend working capital to Lansing as needed, in amounts that would not be a burden to Marquardt.

James Lansing moved his operation to the Marquardt facility at 4221 Lincoln Boulevard, Venice, California. During this period Lansing had three employees. John Edwards ran the business office and delivered products to local dealers. Howard Weiser, who had worked earlier at Lansing Manufacturing Company, performed the precision operations of flattening wire and winding edgewound voice coils. Bud Fawcett had many duties, including the assembly of loudspeakers. John Edwards has recalled that "Jim, of course, could also do it all, including making the enclosures." During this period the model D-208 was added to the product line. It was an eight inch model with a 2" edgewound aluminum voice coil, and was similar in other respects to the D-130 and D-131.

The Desperate Battle for Success

James Lansing indicated in correspondence of the period that "…business has been deader than the proverbial skunk, but should be picking up shortly." As it happened, his company sank further into debt as time went on. Marquardt Aircraft Company was growing rapidly, and moved to a larger facility at 7801 Hayvenhurst Avenue, Van Nuys, California in late 1948. Lansing shifted his operation to the new location and resumed work. By this time the indebtedness to Marquardt had grown to almost $15,000, and it looked as though Lansing would have to sell his company to Marquardt and remain on as an employee. Lansing bought out the interests in his company that had been held by Chester Noble and Chauncy Snow so that he would be the sole spokesman for the company in negotiations with Marquardt. As it turned out, Roy Marquardt was dubious of the prospects for long term success of Lansing's venture, and he declined to purchase the company outright.

In early 1949, a controlling interest in the Marquardt Aircraft Company was purchased by the General Tire and Rubber Company. They were not interested in James B. Lansing Sound and Marquardt's shares in that firm were not included in the buyout. As a result, these shares became the personal property of Roy Marquardt and Bill Thomas. Subsequently, General Tire directed that James B. Lansing Sound vacate their newly acquired premises. A new location at 2439 Fletcher Drive, Los Angeles, California was found and General Tire paid the cost of moving Lansing's company to the new facility. This was the fourth location that the firm had occupied in less than three years.

In the summer of 1949, William Thomas and Roy Marquardt agreed that Thomas should leave the Marquardt Aircraft division of General Tire to head up James B. Lansing Sound, in order to protect and develop the investment that both of them had in Lansing's company. By this time James Lansing's ownership in the company had dwindled to about thirty percent. Loudspeaker production resumed at the new location, and several new employees were hired. Lansing's brother, George Martin, who had previously worked at Lansing Manufacturing Company, was among them.

It can be seen from this last series of events that operating James B. Lansing Sound must have taken a terrible toll on Jim Lansing. Despite his tireless work to build a successful company, it had largely slipped away from him just as had happened with Lansing Manufacturing Company years before. This downward spiral would reach a tragic conclusion on an autumn day in 1949. James Lansing would normally work in Los Angeles during the week and return to his ranch in San Marcos on weekends. He would often stop by to visit with his brother Bill Martin and enjoy pie and coffee before making the long drive. On Thursday, September 29 he made what would be the last such visit. Later that evening, he arrived at the ranch in San Marcos. Apparently despondent over his business affairs, he took his own life. So ended the unique career of a tremendously talented and driven man, who accomplished so much in his relatively short twenty-four year history in the loudspeaker business.

William Thomas

JBL and the Aeronautical Industry

Bill Thomas did not end his association with the aeronautical industry with his departure from Marquardt Aircraft in 1949. During his tenure as owner of JBL, he kept ownership and operation of Kittle-Muffler and established a new subsidiary, Kittle-Lacy Inc., which was instrumental in the development of jet engine silencers. Thomas bridged his involvement in both the aeronautical and loudspeaker industries with the establishment of a fully owned subsidiary of JBL called Transducers Inc. in the 1950s.

This subsidiary was primarily known for developing test facilities to simulate high intensity noise and vibration conditions for the design of missile components. The picture at left illustrates such a facility. The drivers shown are believed to be Transducers Inc. 375H compression drivers and 150H low-frequency drivers, designed and built by JBL. The 150H bore no relation to the 150-4C of 1953, or obviously, the 150-4H of 1985. It consisted of the chassis from a 130A with a cone derived from the LE15A. The heavier cone of the LE15A was essential in this application since the lighter cones of JBL's other 15" drivers would not have withstood the high power levels. The 375H was a modified version of the JBL 375 using a stainless steel diaphragm that was considerably heavier, but more rugged than the standard aluminum diaphragm.

JBL established numerous facilities similar to that pictured above throughout the aeronautical industry, some of which remained in operation as late as 2000.

The Thomas Era (1949 -1969)

The death of Jim Lansing could have easily marked the end of JBL. The firm was mired in debt, operations were unprofitable, and the man who represented both the public face and reputation of the company was now gone. However, what began as a tragedy marked a turning point from which JBL would begin its long march to become the pre-eminent loudspeaker firm in the industry. One person was responsible for this remarkable turnabout—Bill Thomas.

Background

Bill Thomas was born in Los Angeles, California, on November 28, 1912. His educational background was in physics, graduating from the University of California, Los Angeles in 1935 with a Bachelor of Science degree. In 1938, he was hired by the Kittle-Muffler company, which was primarily involved in engine silencing for the aeronautical industry. This gave him a background in acoustics which would subsequently lead to his interest in loudspeakers. Thomas rose quickly within the ranks of Kittle-Muffler, eventually achieving ownership of the company in 1945.

It was around this time that Thomas became associated with Jim Lansing. Bill Thomas had met Jim Lansing's associate, Chester Noble, through an acquaintanceship with Noble's son. Thomas first met Lansing in the early 1940s at a store on Wilshire Boulevard in Los Angeles called Gateway to Music. This store, which was owned by Alfred Leonard, sold records and custom radio phonographs.

When Lansing Sound Incorporated was formed in 1946, Thomas had no involvement with the enterprise. However, as previously described, he was responsible for forging a business relationship between Lansing Sound and Marquardt Aircraft Company, a firm he had co-founded with Roy Marquardt in 1945.

The sale of Marquardt to General Tire, and their desire to dissociate with Lansing Sound, resulted in Thomas moving over to the loudspeaker company as Vice President to protect the ownership interests that both he and Roy Marquardt held. Thomas soon developed an interest in the loudspeaker business and purchased Marquardt's share in Lansing Sound to become the majority owner with a 60% stake in the company. After Jim Lansing's untimely death on September 24, 1949, Thomas immediately assumed operational control of JBL and sought to consolidate ownership of the company. This would ultimately take a number of years to resolve, with the remaining 30% owned by the Lansing family purchased in 1957 for $30,000 and the 10% owned by Chester Noble, purchased some time later. Regardless, under Thomas's leadership, there began the nearly two decade ascendancy of JBL that would establish the company's reputation for excellence that remains to this day.

In a departure from Jim Lansing's previous management of JBL, Bill Thomas was goal-driven, focusing his attention on setting milestones while continually monitoring performance to ensure that his objectives were met. After assuming management of JBL, the initial goal was very straightforward—to ensure that JBL gained a viable and sustainable financial position. He initially made a personal capital investment of $10,000, which along with the $10,000 insurance payment on Jim Lansing's death, allowed Thomas to retire the corporate debt. However, the company was still losing money on operations. Thomas devised a three-year plan to reduce operational expenses by 30% while increasing sales by 300%. Through aggressive marketing and by streamlining manufacturing, Thomas met his goal by his target year, with annual sales rising from $60,000 in 1950 to $200,000 in 1952. While the operations were now sustainable, profits were negligible. This led Thomas to set a new five-year plan to further expand the company into a profitable venture.

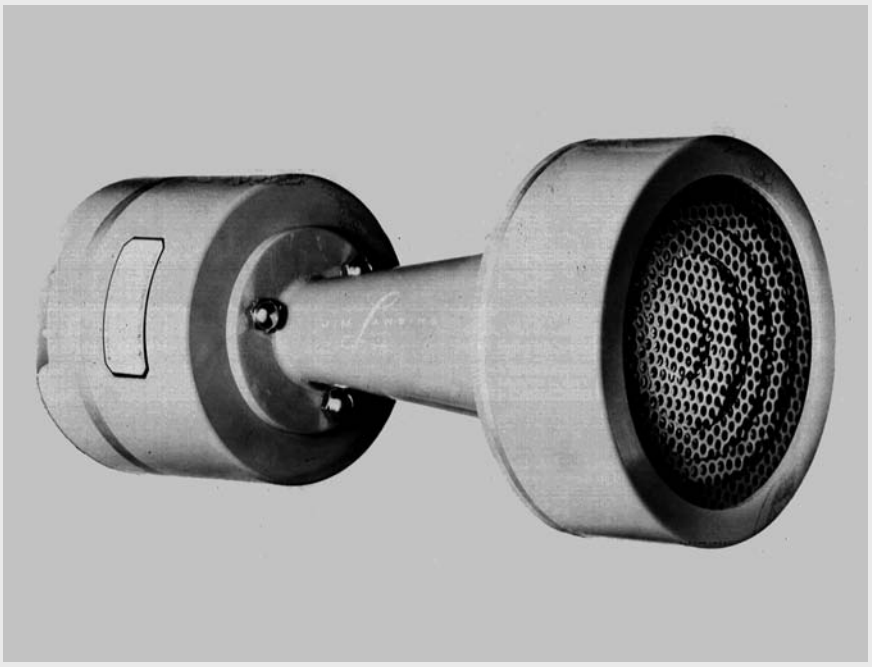
The Prestige Image

A core element of Bill Thomas's 1952 five-year plan was to establish JBL as a prestige company that embodied the highest levels of quality and desirability. Thomas was astute in assessing market directions. He realized that the professional cinema industry, which had been at the heart of Jim Lansing's earlier endeavors, was a mature field with limited opportunities for growth. He also recognized the near impossibility of competing with Altec Lansing, a much larger firm that held a near monopolistic position in that market. This perception resulted in Thomas making a very prescient decision to focus on home speaker products. He was one of the first to recognize that the hi-fi hobbyist phenomenon, which was just emerging in the early 1950s, had the potential for expansive growth into a broad-based market segment. Accordingly, this is where he concentrated his energies.

Thomas set about to differentiate JBL from the number of small companies then extant that catered to the hi-fi industry. His goal was to establish the JBL brand as the pre-eminent name in the home speaker industry. Three main principles were established to meet this goal:

1) Institutionalize aesthetics in all aspects of product and graphic design
2) Establish JBL at the forefront in technical excellence.
3) Develop a marketing strategy based on a prestige image.

The first objective was one of Thomas's most innovative ideas. As early as 1950, Thomas hired the noted graphic and industrial designer, Alvin Lustig, as a consultant to JBL. He was responsible for the first JBL catalog issued under Thomas's management. Its stunning graphics were a remarkable



175DLH

Bart Locanthi

Bartholomew Nicholas Locanthi II was born in White Plains, New York, in 1919. His educational background was in physics, having graduated with a B.Sc. from the California Institute of Technology in Pasadena in 1947. After graduation, he remained as a research associate involved with analog computer modeling. There, he became a protégé of Dr. John Frayne, who was affiliated with the Westrex Corporation. Locanthi collaborated with him in the development of Westrex theatre products, including the first practical implementations of acoustic lenses for high-frequency transducers. Dr. Frayne had an association with Jim Lansing that went back to his years at Altec Lansing and continued with JBL and Bill Thomas. Dr. Frayne became the connection that brought Locanthi to Bill Thomas's attention and resulted in his being hired as a consultant.

There has yet to be discovered definitive information on when Locanthi performed his first consulting work for JBL, but circumstantial evidence indicates that it was in 1952. That year, JBL introduced their first acoustic lens product, the 175DLH, which was certainly the work of Bart Locanthi.

Bart would remain as a consultant to JBL until 1960. That year, he was persuaded to join the company full time as Vice President of Engineering. During this period he had oversight of the design of some of the most famous and revered loudspeakers ever produced by JBL. He would remain in this capacity until 1970, when he left the company.

He would later work for Altec Lansing, Cetec Gauss, Pioneer America, and finally for his own consulting firm, BNL Associates, until his death in 1994. Outside of JBL, he gained his greatest renown in the loudspeaker industry for his development of the TAD line of loudspeaker components and systems for Pioneer.

Amongst Bart's greatest accomplishments within the audio engineering industry was his work with the Audio Engineering Society. He was President of the Society in 1986-1987 and was posthumously awarded their highest honor, the Gold Medal, in 1996.

Ray Pepe

The photo to the left is a classic illustration of Ray Pepe doing what he did best — promoting JBL with the aid of a Hollywood celebrity. Pepe is on the left and on the right is Richard Boone. At the time, Boone was a famous television actor noted for starring in the television western "Have Gun Will Travel."

To this day, Pepe remains somewhat of an enigma. Very little is known about his background other than that he originally hailed from the east coast and claimed, that prior to coming to JBL, he had been the comptroller for New York City under the administration of Mayor Fiorello LaGuardia. This has not been confirmed.

It is unknown what year he began working at JBL, but it had to be prior to 1954, the year of the introduction of the Hartsfield. This is because it is documented that Pepe was responsible for recruiting Bill Hartsfield to design his namesake speaker. Pepe remained at JBL in his capacity of Vice President until his death in 1966.

departure from the technically focused product literature of the past. More important, Lustig also applied his design skills to individual components. The hi-fi phenomenon was initially driven by hobbyists that usually built their own systems from individual components. Thomas was very shrewd to realize that the aesthetics of these otherwise industrially derived elements could influence a purchasing decision as much as the technical qualities.

Lustig was also responsible for establishing a signature image for JBL's enclosure designs in the early 1950s. The C34, C35 Fairfield, C36 Viscount, C37 Rhodes, C38 Baron, and the C40 Harkness were all Lustig's work, and which raised enclosure design from mere function to the level of contemporary art. It is no coincidence that these systems have become highly valued by collectors—many of whom have little or no interest in their function as loudspeakers, but who prize them as classic artifacts of interior design.

The second objective in gaining market pre-eminence was excellence in engineering. Aesthetics in loudspeakers are meaningless without performance levels to match. In this regard, Thomas drew directly from the legacy of Jim Lansing, whose initial products, the D130, D131, D175 and D208 had established an engineering reputation for JBL as second to none. However, Lansing's death created a huge void in technical capability within the company. Thomas himself partially filled that void by taking on design and engineering roles, being responsible for such products as the C40 Harkness and the original Theatre Sound System enclosure of 1953. Given Thomas's role as owner and manager of JBL, it was obvious that he could not meet all of the engineering demands by himself on any long-term basis. Therefore, early in his management, he brought on board an engineer who would have a lasting influence and impact on JBL. That engineer was Bart Locanthi.

Locanthi originally performed work for JBL as an independent consultant. The first product designed by Locanthi was the 1217-1290 horn/lens for the 175 driver, which is believed to be the first commercial example of this type of dispersion device. The concept would form the core technology behind JBL's horn products for the next 30 years. The acoustic lens was originally developed by Winston Kock and F.K. Harvey at Bell Labs in 1949, but was not commercialized at that time. Dr. John Frayne of Westrex (the former international division of Western Electric) worked with Bart Locanthi at the California Institute of Technology to further the development of AT&T's original work. They found a willing partner in JBL to commercialize their efforts and thus the JBL "Koustical" lens was introduced in 1952.

The next year, Locanthi worked on the development of three drivers that would mark the first significant enhancement of JBL's transducer offerings since the company was established. These products were the 275, 375 and 150-4C, which were originally developed for a proposed theatre system (described in more detail later in this article), but which initially gained notoriety in home speaker systems. As used in these systems, they would allow JBL to attain the highest accuracy of sonic reproduction yet attained in a domestic loudspeaker.

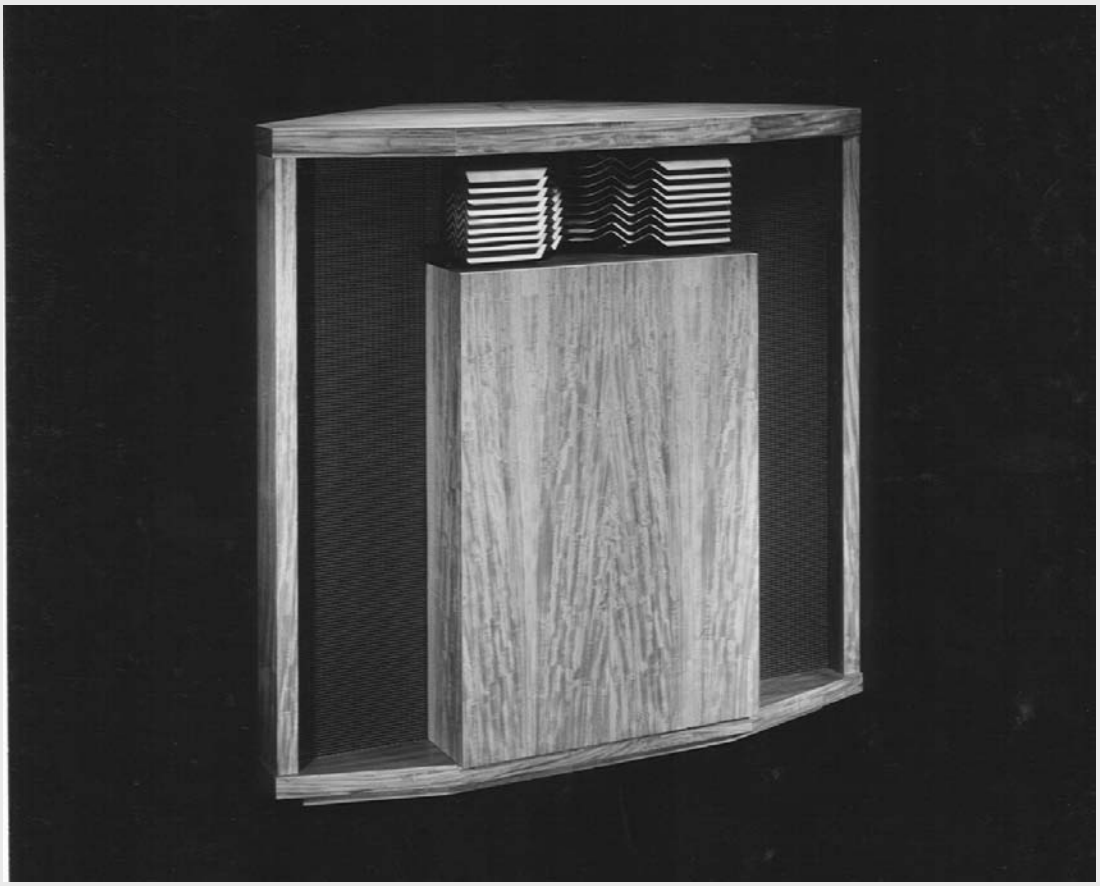
During this time, Locanthi was also responsible for a significant re-engineering of the magnet structures for all of JBL's drivers. Most loudspeakers of that era used an internal Alnico magnet that was encased in a pot structure consisting of an iron tube section and separate, welded back plate. This pot formed an integral component of the magnetic circuit by creating a flux return path to the outside of the voice coil gap. Locanthi replaced this welded pot with a single-piece sand casting. This provided a cost savings by eliminating the labor required to assemble the pot from discrete pieces. At the same time, the efficiency of the magnet circuit was significantly increased since the pot thickness could be optimized to mitigate magnetic losses.

The third objective of Thomas's five-year plan was a marketing strategy that created a prestige image for the JBL brand in the marketplace. Prior to Thomas's management, marketing had played a relatively small role within the company—having been limited mainly to presentations at trade shows and small advertisements in trade magazines. Thomas sought to have marketing take a much larger role within the company, but in a non-traditional manner. Rather than focusing on individual products, features, and specifications, much of the original JBL advertising under Thomas was institutional in nature. It was not uncommon for the sole graphic on a JBL advertisement to be a musical note or a musical instrument with no illustration of any specific product. The intent was to associate rare instruments and music itself with the brand, intending that the public would view JBL speakers as fine instruments in their own right and essential to the enjoyment of music at its highest level.

Thomas had a key aide in achieving this imaging objective: his Vice President of Marketing, Ray Pepe. Pepe had numerous connections in the media and in the local motion picture and recording industries, which he used to the company's great advantage. In particular, Pepe had established a friendship with A.C. Spectorsky, the associate publisher of Playboy magazine, and this resulted in numerous mentions and product placements in that publication over the years. Pepe also devised the tactic of making deals with agents of local celebrities whereby JBL products would be provided at no cost in exchange for permission to publicize the fact that these same celebrities used JBL systems in their homes. Frank Sinatra, Bing Crosby, and Mel Tormé were just a few of the personalities that took advantage of this opportunity.

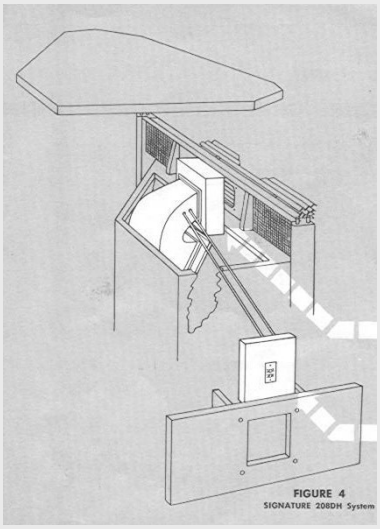
The First Project Speaker

With the three objectives of Thomas's prestige strategy falling into place, all that was needed was a showcase that would fully embody these elements and make a statement to the marketplace. That dramatic showcase would be the first of what has become known as JBL's Project Speakers—the Hartsfield of 1954.



D30085 Hartsfield

Variations on the Hartsfield



A little known fact about the Hartsfield is that there were originally two component kits that could be installed in the enclosure. Besides the standard 085 kit that included the 150-4C and 375, there was the D30208 system that used a single 8" D208 driver. The D208 was front-loaded by the acoustical horn/lens using the H208 horn extension, as illustrated above, while the main folded horn enclosure back loaded the driver. The intent was to offer a starter system at lower costs. The questionable logic behind buying a $300 enclosure to hold a $25 driver was answered by the marketplace. Virtually none were sold, and this option was discontinued after one year.

The Hartsfield evolved during its lifetime in both component configuration and horn design. In 1959, there was a complete redesign of the bass horn. The change was driven by two factors. The first was the complexity of the construction for the folded horn with consequent high manufacturing costs. Part of this complexity was due to the decision to accommodate the D208 starter kit. With the discontinuance of that option, a more conventional horn design could be employed. The second factor was a lack of deep bass extension in comparison to the Klipschorn that it was designed to compete against.

To address these factors, Bart Locanthi undertook a redesign that used a larger back chamber for the bass driver, a larger horn mouth area and a simplified horn path. While the redesign resulted in demonstrably deeper bass extension, it has sparked a debate that remains ongoing. That debate revolves around the question of which bass horn actually sounds best overall and followers have formed camps around each design. However, the initial design tends to command the highest price among collectors, mainly because it is the original Hartsfield.

The final evolution occurred in 1964 and was not at all controversial. It was the transformation of the Hartsfield into a three-way system with the addition of the 075 tweeter and N7000 network. The N500 crossover was also updated to the N400. The addition of the 075 ring radiator was a reflection of market reality, considering that numerous Hartsfield owners were customizing their systems by adding an 075 tweeter and N7000 crossover to address the high-frequency limitations of the 375. JBL simply decided to make this the standard configuration.

In a very late production change, the 150-4C was replaced with the LE15A. Internal testing at JBL had proven that the LE15A resulted in significantly lower distortion in the Hartsfield and thus it became the standard bass driver in its last year of production. The decision to end production in 1964 was a result of stereo finally displacing mono as the standard recording format. While it was fairly easy find one unobstructed corner in a home environment to place a Hartsfield for mono, it was much less common to find two for stereo. This greatly restricted the available market and led to the product's discontinuance.

The concept for the Hartsfield was originally developed to address demand from JBL's dealer network to offer a corner horn speaker. They were facing stiff competition from a number of loudspeaker companies offering this type of design. The originator of the folded corner horn was Paul Klipsch with his Klipschorn, introduced in 1949. The Klipschorn was a true innovation in home loudspeakers which, for the first time, combined the efficiency of a horn-loaded bass driver with low-frequency extension that had previously only been achieved with direct-radiator speakers. The problem with bass horns for home use was that they needed to be in the eight to twelve foot range in length to achieve effective low-frequency response. No reasonable home design could accommodate a straight horn of this size. Klipsch's innovation was to repeatedly fold the horn back on itself in a relatively compact package, with the horn mouth exiting into a room corner. The adjacent walls would act as the final flare of the bass horn, resulting in an effective horn length capable of extension to 35 Hz.

The Klipschorn was quickly recognized as a breakthrough, and soon there would be a number of loudspeaker firms either offering licensed copies or developing their own versions of the concept. Bowing to dealer demand, JBL decided to take the latter route.

It was Ray Pepe who recommended that Thomas consider hiring William Hartsfield as a consultant to design what would become his namesake speaker. Ray Pepe had known William Hartsfield when Pepe lived on the east coast and they both belonged to the same chapter of the Audio Engineering Society (AES). At the time he was engaged by JBL, William Hartsfield was employed by the Federal Bureau of Standards in Washington DC. He had developed a reputation amongst the local community of audio hobbyists for a home-built corner horn of his own design. Pepe was aware of this and thought he would be a natural fit to further develop his enclosure as part of a production JBL system.

JBL intended from the start that this would be a statement product. The Klipschorn, while considered a breakthrough, was not without its faults. It was widely perceived that the drivers used in the system were not up to the highest standards. In particular, the use of a small format (1" throat) compression driver with a low 400 Hz crossover point compromised the lower midrange response. Further, the enclosure was thought to be lacking in rigidity, which resulted in unwanted resonances. The Hartsfield would have none of these deficiencies. It would use what were arguably the finest components made by anyone at that time—JBL's 150-4C bass driver, 375 compression driver and N500 network. The large format 375, with its 4" diaphragm and 2" throat, would have no problems extending smoothly to the 500 Hz crossover. The enclosure would be built with heavy stock and thoroughly braced to minimize any resonance. Bart Locanthi was brought in to develop a unique folded lens mated to a new exponential horn that would have wide, even dispersion. The resulting 537-509 would remain in JBL's catalog for decades afterwards and was widely used in custom loudspeaker systems and monitors.

The Hartsfield gained immediate acclaim after its launch in the marketplace, culminating in two 1955 articles. The first, published in *High Fidelity* magazine, stated that "of all of the Klipsch derived family, one speaker, in my estimation, is noticeably superior—the Lansing Hartsfield." The second, and more influential, was a comprehensive article on the hi-fi industry by one of the most widely read magazines in the country—*Life* magazine. That publication named the Hartsfield as "the ultimate dream speaker," superior to anything else on the market.

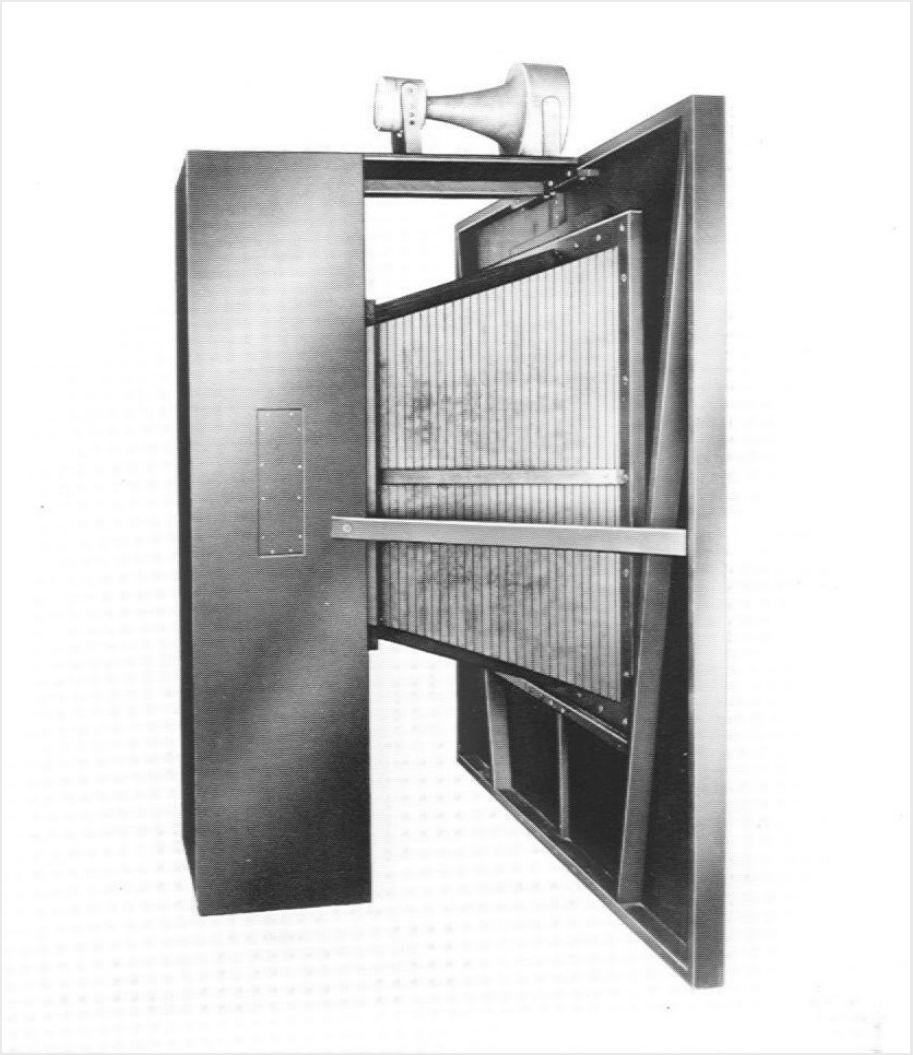
The impact of the Hartsfield's success on JBL cannot be overstated. According to Margaret Thomas, Bill Thomas's wife and a long-time JBL employee, the Hartsfield and the publicity generated by *Life* magazine "made" JBL. It was the product that gave the company national recognition. It was in large part responsible for sales increases that would average over 50% a year for the next three years. Only three years into Bill Thomas's five year plan, he had largely achieved his goal.

Initial Professional Endeavors

Earlier in this article, it was described how Bill Thomas made a strategic decision to focus on home speaker products in contrast to Jim Lansing's devotion to professional market. This doesn't paint a complete picture of the situation. The more detailed answer is that Bill Thomas saw risks in having his small company compete one-on-one with the entrenched Altec Lansing. However, if someone was willing to share the risk, Thomas would certainly consider the possibility. Two such opportunities presented themselves almost simultaneously in 1953. The first was with Westrex and the second occurred in conjunction with Ampex.

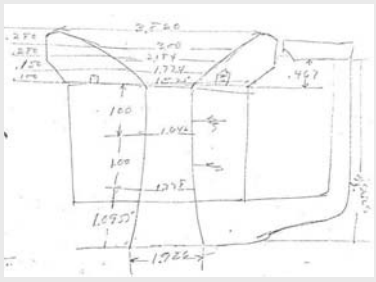
Westrex was the former export arm of Western Electric. It had been spun off as an independent company as a result of government mandated consent decrees that saw Western Electric exit the cinema market. The newly-independent Westrex wanted to re-enter the cinema loudspeaker market, but had no manufacturing capability for such products. Dr. John Frayne, having worked with Jim Lansing previously, met with Bill Thomas and Bart Locanthi for a discussion that would become legendary. Dr. Frayne brought along an example of the Western Electric 594A compression driver. He had a simple question: "Can JBL make a permanent magnet version of this driver?" The answer would result in the famous JBL 375.

The 594A had been out of production since shortly after Western Electric left the cinema market in 1938. Previously, it had been at the heart of Western Electric's large cinema loudspeakers. It was a field coil compression driver that was unique in its size and output, utilizing a 4" diaphragm, 2" throat exit and four-slit, circumferential phasing plug. Since discontinuance of the 594A, Altec's smaller 288 compression driver ruled as the standard high-power transducer for cinema systems. Westrex believed that a permanent magnet version of the 594A could offer a competitive advantage against the Altec 288 because of its greater output.



Westrex T501A

An Enigma



The drawing at left represents an ongoing enigma in documenting the accomplishments of Jim Lansing. It is a hand drawn sketch made by Jim in the late 1940's and is one of only a very few examples of his writing that exists to this day. The fact that this drawing represents the preliminary design of a 4"-diaphragm, 2"-throat compression driver is at the heart of this enigma. This is very similar to what would ultimately become the 375, but predates it by a number of years.

The existence of these sketches has been known for a long time, but it was always thought that they remained a design exercise and never made it to the prototype stage, let alone a production model. At the time that Lansing drew this illustration, the company was a very small operation and always undercapitalized. It was thought doubtful that Lansing would have the resources to undertake the necessary development work. This is supported by the fact that the subsequent 375 was only made possible by the funding of Westrex.

Recently, this speculation has been brought into question. Ross Snyder provided the following anecdote regarding the assembly of the first prototype of the Todd-AO sound system by Ampex. As stated elsewhere, this prototype required ten individual speaker systems, the larger of which used the newly developed 375 compression driver. Snyder recalls that Thomas was unable to provide all of the required 375 drivers within the deadline for completing the prototype. As an interim measure, Thomas included two models of a large format compression driver that he stated were "hand built by Jim Lansing." Thomas considered these drivers significant enough to JBL that he strongly stressed that they had to be returned to the company once JBL was able to deliver replacement drivers.

Unfortunately, nothing is known about what subsequently happened to those drivers. Ross Snyder remains doubtful that they were ever returned. Other than this anecdote and the above illustration, there is no documentation to confirm that Jim Lansing actually built a precursor to the 375 so its existence remains a tantalizing enigma.

Bill Thomas and Bart Locanthi agreed to take on the task of developing the 375 as part of an assignment to collaborate with Westrex in developing a complete line of cinema products. In addition to the 375, JBL developed three new horn/lens assemblies for this driver, two bass horn enclosures, a new 15" bass driver designed for horn loading, and a high-power crossover network. The intent was to come up with systems that could go head-to-head against Altec Lansing's A2 and A4 Voice of the Theatre (VOTT) systems.

The first two Westrex models that were developed would be known as the T501A and T502A. There would be other variations that differed in the number of high-frequency drivers and horn/lens models. The T502A was roughly analogous to the Altec A2 and used two 375 drivers attached to the newly-developed 537-500 horn/lens assemblies. The bass horn contained four newly developed 150-4 15" drivers. These drivers were a departure from previous JBL woofers in their use of steeply angled, straight-sided cones in a deep basket. This geometry gave the drivers additional rigidity to withstand horn loading.

The T501A was roughly analogous to the Altec A4, with only two 150-4 bass drivers, one 375 compression driver with the 537-500 horn/lens and N500 network. The bass horns were unique compared to the industry standard VOTT. They did not use bass reflex augmentation to extend the low-frequency response, since the rear of the enclosure was sealed. Instead, the design relied on a larger front horn to gain the needed extension. Both Westrex enclosures used a single bass horn to load all of the bass drivers in each system in contrast to the multiple bass horns of the larger VOTT series. It has been stated that the Westrex bass horns were personally designed by Bill Thomas. Supposedly, he drew on his background in high intensity sound simulation with his aeronautical company Kittle-Muffler to develop the concept.

Even though Westrex funded the development of these systems, they apparently did not gain exclusive rights to these designs. JBL marketed their versions of the T501 and T502 as the 5000 and 6000 series of the "Jim Lansing Theatre Sound System." It is doubtful that many, if any, of these Lansing-branded systems were sold, since the documented record that has been uncovered to date shows them available for only a one year period after their introduction.

Regardless, the fact that JBL maintained the design rights to these systems aided in their second professional collaboration; this time, with the Ampex Corporation. In 1952, Ampex decided to enter the theatre sound market. Specifically, they were involved with the Todd-AO Corporation in development of a competing cinema format to the newly introduced wide-screen, multi-channel Cinerama. Ampex undertook the development of the sound system for the Todd-AO project under the direction of Ross Snyder. Snyder was an acquaintance of Jim Lansing, and subsequently of Bill Thomas, after Thomas assumed control of JBL. Since Ampex had no prior experience in the design and manufacture of professional loudspeakers, Snyder sought out JBL to provide the necessary expertise.

The prototype Todd-AO sound system would consist of 10 individual loudspeaker systems. Locanthi and Thomas would design two new enclosures just for this system. These enclosures were two differently sized, back-loaded horns that would become mainstays of JBL's professional product line for nearly three decades. The larger was the C55, which held two 15" drivers and the smaller was the C43 that held a single 15" driver. Much later, they would be marketed as the JBL Professional models 4530 and 4520, but were probably more widely known by their nickname, the "Scoops," due to their appearance, which reminded some of huge sugar scoops. Both enclosures were loaded with 150-4 series bass drivers. The larger systems utilized the newly developed 375 driver and 537-500 horn/lens, while the smaller system utilized the 175DLH horn and driver combination.

The Todd-AO system met with a degree of initial success, though it was never able to achieve the level of acceptance enjoyed by the competing Cinerama system. However, it resulted in enough product demand that JBL was faced with a dilemma. The company's focus remained as a low-volume manufacturer of high profile home loudspeaker systems. Ramping up manufacturing to compete effectively in the professional cinema market carried a significant degree of risk. Thomas would likely have to go into debt to finance the necessary increase in manufacturing capacity. As always, the prospect of success in competing against the much larger and entrenched Altec Lansing was considered uncertain at best. Ultimately, Thomas came to a unique partnership with Ampex. He would license JBL's designs for both components and enclosures to that company which gave them the rights to undertake their own manufacturing. The two Westrex-developed systems were part of that deal, for which Ampex continued to use JBL's 6000 and 5000 series model designations. For the next decade, Ampex would produce their own versions of 375s, 150-4s and various other drivers and enclosures, which were labeled "Jim Lansing by Ampex."

Even with this arrangement, Thomas remained doubtful about the long term prospects for JBL, particularly in the professional markets. These doubts were strong enough that, for a pivotal moment in 1955, he came very close to selling the company. A recently unearthed Ampex memo, dated April 29, 1955, summarizes a nearly completed agreement to acquire JBL. According to the memo, Thomas was amenable to a buyout and negotiations had progressed to the point that his role as an employee within the Ampex organization was being discussed in detail. Obviously, this buyout was never consummated, as JBL remained an independent company until 1969. However, this event is an intriguing insight into Bill Thomas's uncertain view of JBL's position in the marketplace.

This uncertainty proved to be well founded in the professional market. While there was an initial increase in sales as result of the two previously described cinema projects, it was not sustained. Neither initiative resulted in any significant headway being made against Altec Lansing. Within a decade, both Ampex and Westrex withdrew entirely from the cinema industry.

DD44000 Paragon

© Harman International, Courtesy Arnold Wolf

Evolution of the Paragon

© Harman International, Courtesy Mark Gander and John Eargle

Illustrated at left is a photo of the industrial version of the Paragon that was introduced at the same time as the home version. This was a custom design for built-in installation that could be even further modified by JBL for a specific project. It utilized the same driver larray as the home model. Demand and sales remained low for this model and it was discontinued by 1960. However, a few exist to this day and show up occasionally on the collectors' market.

The original Paragon remained unchanged until 1960. That year, the new LE15 replaced the 150-4C bass driver. Around the same time, the enclosure material was changed. While the Paragon was initially constructed out of veneered plywood, later enclosures were built primarily with veneered particle board.

From 1960 to 1979, the basic Paragon configuration remained the same. In 1979, the LE15A was replaced by the ferrite magnet version LE15H. The next year, the 375 was replaced by the 376, which utilized a new diaphragm containing a diamond pattern surround.

Total production numbers are unknown, but it is thought that around 1000 Paragon systems were built. Production peaked in the mid 60s at around five systems per week. By the early 80s, production had dropped to one or two units per month. As a result of this drop, JBL's marketing department made the decision cease production in 1983. However, sufficient stock remained to continue selling systems in Japan. The last of this stock was sold in 1988 at which time the Paragon was dropped from the JBL catalog.

Arnold Wolf

© and Courtesy Arnold Wolf

Arnold Wolf has had a long, lasting influence on JBL that went beyond his role as an industrial designer. While the Paragon arguably represents his highest accomplishment in that field, it was only one of his many contributions to the legacy of JBL.

Arnold was born in San Francisco on April 30, 1927. His education included a B.A., majoring in theatre arts, from the University of California at Berkley. He initially sought work in that field, but quickly found that it was very difficult to find permanent employment. Eventually, he found work outside of his area of education in a local hi-fi shop where he became a jack of all trades. Contact with an early hi-fi electronics manufacturer, Sargent Rayment, led to consulting work in generating industrial designs for some of their products. His success in those endeavors caught the attention of Bill Thomas, and this resulted in his first assignment from JBL—the design of the Bel-Aire enclosure in 1956.

That product met with only limited market success, mainly due to cost and technical limitations. However, Thomas remained impressed with his work to the point that he sought him out for the Paragon design. The success of that project meant that Wolf became the primary industrial design resource to JBL for the next 13 years. Just a short list of his accomplishments during that time includes the now-famous orange JBL logo, the L100, the SE series amplifiers, the SA600 and the 4310/4320 professional monitors.

In 1970, Arnold Wolf's association with JBL took a significant turn. The company had just been acquired from Bill Thomas by Dr. Sidney Harman's Jervis Corporation. They were looking for new management and Wolf was approached with an offer to head their new acquisition. He accepted and in 1970, Wolf sold his consultancy, moved to Los Angeles, and took on his new responsibilities as President of JBL. For the next nine years, he played an instrumental role in leading the company through one of its most explosive periods of growth. He ultimately retired from JBL in 1979, and after a stint as Chairman of the Design Department at California State University, Long Beach, returned to the San Francisco area.

It is interesting to note that the 1955 Ampex memo contained Thomas's assessment of the home speaker market in which he is quoted as saying that JBL was "without competition" in this field. He also made the statement that he did not think that this situation would last much longer. Regardless, it is confirmation of JBL's success in becoming the pre-eminent home loudspeaker manufacturer of that time. That achievement allowed JBL to expand in 1957, when they left their plant and offices on Fletcher Drive to move into new quarters at 3249 Casitas Avenue in Los Angeles. The move was initiated by the State of California's expropriation of the Fletcher Drive properties to accommodate construction of a new freeway. However, Thomas took advantage of this development to consolidate operations in a larger and more efficient facility.

The Second Project Speaker

After declining the Ampex buyout offer, Thomas redoubled his efforts in the marketplace he knew best to ensure that JBL did not rest on its laurels. The first significant result of this renewed dedication would be the development of the second JBL Project Speaker—the Paragon.

The Paragon was intended to extend JBL's pre-eminence in home audio with the design of a statement system that showcased the newly-developed stereo sound technology. It relied on an unprecedented concept that utilized a curved dispersion panel to create a wide stereo soundstage, best described in the inventor's own words:

> *"The usual method of using two speaker systems separated eight feet or so means that the listeners must put their chairs in a line down the axis of this setup, much as if they were playing railroad, to get real stereo. This is because it is only along this axis of symmetry that the two speakers have consistently equal effect. As soon as the listener moves off axis, the speaker toward which he moves takes predominance. Sound intensity decreases rapidly with distance and the more distant speaker quickly loses out to the nearer.*
>
> *This can be avoided by projecting the sound from each speaker against a curved surface which acts as a convex lens for the sound and directs it more strongly to the side opposite the speaker than it does to its own side. The convex refractor eliminates the sharp axis of symmetry where the slightest movement of the listener is so disturbing."*

The developer was Richard Ranger, a noted electrical engineer and owner of the Rangertone Corporation. This firm was primarily known for its role in cinema sound, having developed products and technologies for film audio recording and reproduction. Ranger had previously used JBL components and speaker systems in this work, so an association existed between the two firms prior to the start of the Paragon project.

The best information indicates that Ranger approached JBL with his concept. His initial work was towards the development of a theatre sound system that used the curved panel diffraction concept. It is believed that Thomas convinced Ranger to develop the concept into a home speaker. In 1957, Ranger was hired by JBL to do the overall engineering for what would ultimately be introduced as the Paragon. Ranger was part of a team of consultants that undertook development of a prototype. One of the team members was William Hartsfield, who took on responsibility for the design of the bass horn. The other key team member was a relatively new consultant to JBL named Arnold Wolf, who was responsible for the industrial design.

An initial working prototype was constructed with surfaces of glossy black Micarta, and except for the curved diffraction panel, all of the enclosure walls consisted of right-angled planes. Arnold Wolf's task was to develop the design's aesthetics to a level that would match its unparalleled acoustic performance. This was an extremely difficult assignment. The vast majority of loudspeaker enclosures produced to date were some version of a box. In other words, the geometry was basic and generally not an issue in the industrial design. Conversely, the Paragon had very complex geometric requirements. Obviously the curved diffraction panel had a fixed shape that had to be integrated with the rest of the enclosure. The use of horn loading for the bass drivers resulted in another set of geometric constraints to ensure that the complex horn expansion requirements were met. However, the single most difficult challenge for the industrial design was the requirement that the midrange horns be mounted ahead of the diffraction panel and firing onto it. How could this be integrated in any kind of coherent and visually pleasing manner?

Arnold Wolf's design not only answered that question, but also became a landmark in industrial design that went beyond anything that had previously been achieved in the loudspeaker industry. In creating his design, Wolf originally relied on plan drawings and perspective renderings. However, he quickly realized these did not convey the overall visual impact. He then created a scale model of his proposed work. In particular, it illustrated his unique integration of the midrange horn mount with the legs that supported to entire enclosure. Wolf used this model as the sole presentation piece to JBL's management to gain their approval. Upon first sight, Thomas recognized the strength of its visual design and immediately authorized its development into a production model. With only minor variation to allow for enhanced constructability, the first production models were completed by late 1957.

The market introduction of the Paragon was facilitated with numerous public showings and listening sessions at venues throughout the country. They were met with universal acclaim from both attendees and the press. Notoriety for the

Edmond May

© and Courtesy Rich May

Edmond (Ed) May has to be considered the most influential design engineer at JBL during the seminal period of the mid 50's to the mid 70's. There is virtually no single JBL loudspeaker produced in that era for which he did not play a role or take the lead.

May was born in Eureka, Utah in 1910 and studied at the University of Utah, majoring in physics. While studying, he took a part time position as the night man at a local mortuary. The prospects for full-time employment resulted in May leaving university just prior to gaining a degree to work at the mortuary. Thus May, who would ultimately rise to become one of the most accomplished electro-acoustical engineers of his era, began a twenty year career as a mortician.

During that time, May was deeply involved in home audio as a hobby. He immersed himself its technical aspects to become a self taught expert. In 1953, he tired of the mortuary business and decided to sell the funeral home he then owned to make a completely new start in the audio field that was his passion.

May relocated to Dallas, Texas and soon established a partnership with Jack Frazier to form the Frazier- May loudspeaker company. This venture relied on drivers bought from third parties, and JBL became one of their suppliers. JBL quickly became impressed with May's technical proficiency to the point that they offered him a full-time position as a design engineer. Ed accepted this position and relocated to Los Angeles in 1956.

It is not possible to fully describe May's accomplishments at JBL, given the restrictions of this space. Just a short list includes the LE series of drivers, the passive radiator, the 4310 and 4320 monitors, the Sovereign and Olympus, the L100, the Decade series, the L65 and the L166.

May had a break in service with JBL from 1969 to 1972, during which he worked at Cetec Gauss to develop their line of professional loudspeakers. He returned to JBL in 1972, but permanently resigned in 1976. From that point on, he designed loudspeakers for Superscope Marantz until his death in 1980.

PL-100 Power Amplifiers

© and Courtesy Nils Sundquist

Paragon extended beyond the hi-fi market, as exemplified by the fact that it was displayed at the "Atomfair" International Exposition in Brussels (1958) and at the Brooklyn Museum (1967).

For the next 26 years, the Paragon would reign at the top of JBL's product line. To this day, it remains the most desirable loudspeaker system ever produced by JBL, commanding prices on the collectors' market that have exceeded the original selling price by an order of magnitude.

The LE Driver Series

JBL set about capitalizing on the success of the Paragon with the introduction of derivative products based on the Ranger concept, such as the Metregon. However, during this time, the first significant competitive threat to JBL in the home speaker market arose in the form of a new technology—acoustic suspension loudspeakers.

In 1954, Edgar Villchur devised a new integrated enclosure and driver design that he named acoustic suspension. Whereas most loudspeaker manufacturers used large bass reflex enclosures or horn loading of their bass drivers, Villchur designed his drivers to be mounted in a small, sealed enclosure. The air trapped in the enclosure acted as a spring that could be designed to work in conjunction with the suspension of the driver to produce deep bass response from a relatively small box. This concept had one significant disadvantage that restricted its initial acceptance. That was the low efficiency of the system, since considerable energy was lost in the compression of air inside the enclosure. However, the late 50s saw the onset of higher power amplifiers that largely mitigated this issue, resulting in a true marketing challenge for JBL. Villchur's Acoustic Research and other competitors were offering relatively small and inexpensive loudspeaker systems that sometimes exceeded the deep bass extension of JBL's much larger systems.

In 1959, Bill Thomas authorized the development of new line of drivers and enclosures that could compete with this new threat. Within JBL, the program had the working title of the "Low Efficiency Driver Project." The first two initials stuck as the prefix for the model designations of all the new drivers developed in this effort. The name was considered somewhat heretical, given JBL's past reputation for producing the industry's most efficient transducers. However, marketing would later step in and come up with the rather meaningless name "Linear Efficiency" for the LE prefix in the product literature.

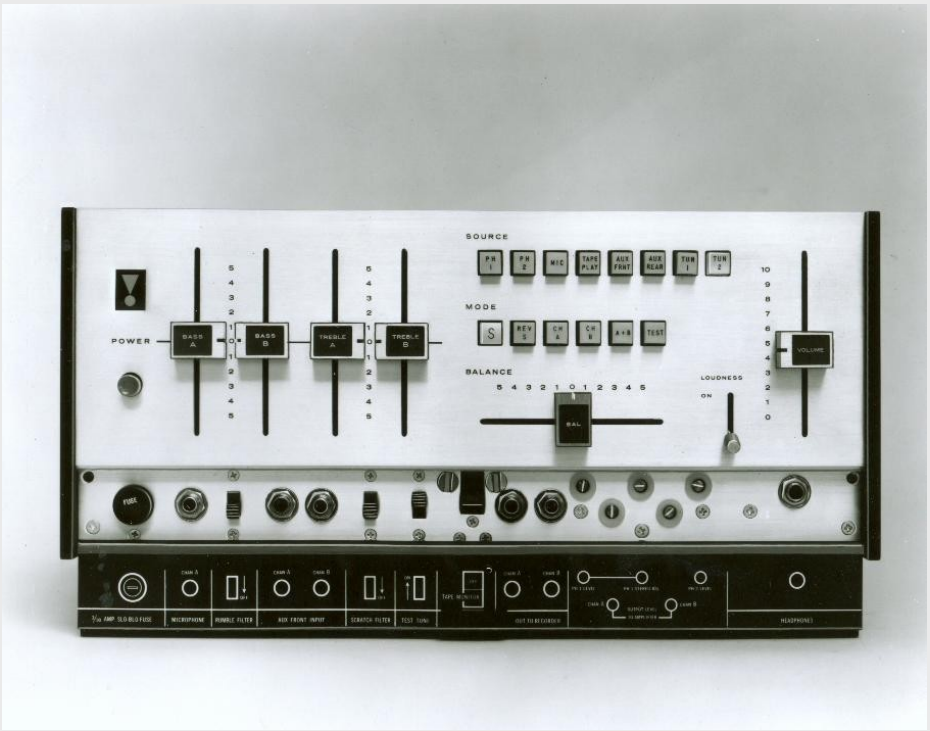
The series was developed under the direction of Bart Locanthi, who remained the primary technical consultant to JBL. However, most of the development work on the specific drivers was undertaken by an engineer named Edmond May, who had joined the company in 1956. He designed the 8" LE8 full-range loudspeaker and 10" LE10 bass driver. JBL's very first direct-radiator tweeter was developed by Harold Newton for this series and given the designation LE30. The line was filled out with the LX3 network and three small enclosures; the Minigon, the Dale, and the Madison.

One of the features of the LE8 and LE10 was the use of a half-roll surround made from a rubber compound that JBL named Lansaloy. In its development, it was discovered that even large drivers could benefit from the more linear response and damping that these surrounds provided. Thus, in 1960, the LE series was augmented with the 15" LE15 driver.

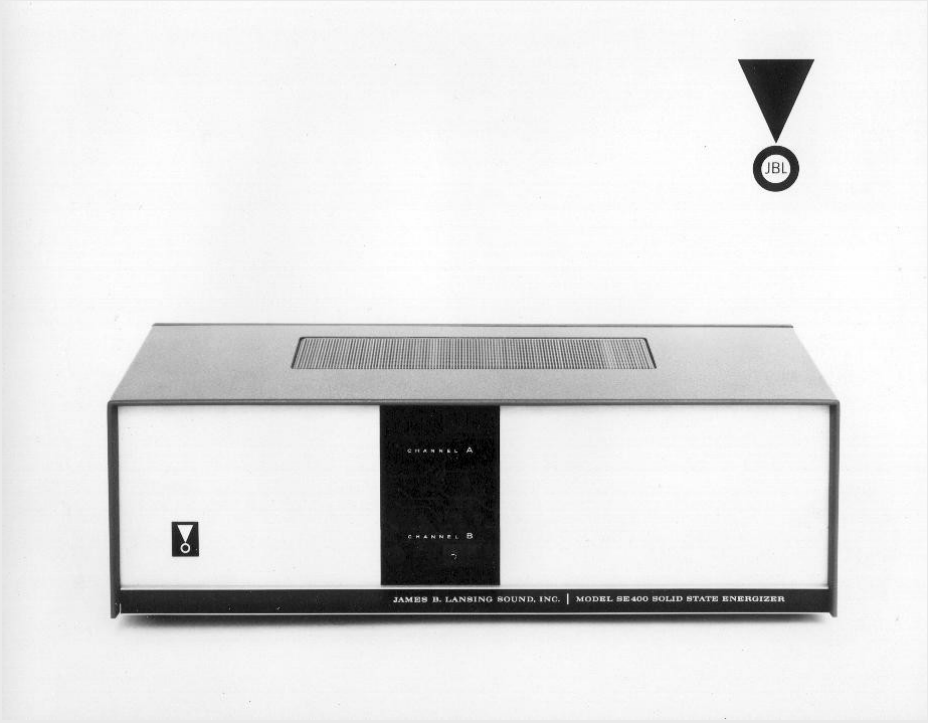
While the original intent was to develop drivers that could be used in sealed enclosures to compete with the new acoustic suspension loudspeakers entering the market, JBL determined that the larger drivers, in particular, could match the low-frequency extension of their competition by using heavier cones with lower resonant frequencies. Thus the later drivers such as the LE14A and LE15A were intended for use in both sealed and ported enclosures. To JBL, this allowed the best of both worlds. JBL's hallmark of unmatched dynamics could be maintained while augmenting low-frequency response. Even though the development of the LE series was predicated on lower-sensitivity drivers, the resulting products were certainly not what would be considered low-efficiency. While JBL's initial large bass drivers had sensitivities in the 100 dB range with a 1 watt input measured at 1m, the larger LE series drivers had sensitivities in the low- to mid-90 dB/W/m range. This was far higher than the nominal sensitivities of the acoustic suspension designs that tended to be in the mid-80dB/W/m range.

The LE driver project was originated to target lower-cost competition. However, the lineup would evolve to be positioned at the top of JBL's driver range. This was largely the work of Locanthi and May. By 1960 Locanthi had accepted full-time employment with JBL as their Vice President of Engineering. Prior to joining, he had developed a groundbreaking process of using analog computers to model loudspeaker response. This was the precursor to the Thiele-Small computer modeling that has become the industry standard for loudspeaker design. Locanthi applied this process to the design of the new drivers to result in the most accurate loudspeaker components that JBL had yet produced.

May saw this project as an opportunity to develop his take on the state-of-the-art in driver design. This is particularly represented by his work on the LE8 and LE15. Both of these drivers utilized what is known as underhung voice-coil geometry. With this motor topology, the voice coil is shorter than the gap so that it is fully immersed in a constant-strength magnetic field. This was not new and had been employed in a number of driver designs in the past. However, most of those speakers had limited voice-coil travel, and thus limited output, or their designer accepted a compromise whereby part of the coil would be allowed to travel outside of the gap at maximum excursion. Whenever any part of the coil is outside of the gap, it is exposed to an exponentially decreasing flux field, and this can lead to distortion. May designed these drivers to have significantly greater excursion than previous models but to still have their coils fully immersed in a constant-strength magnetic field.



SG520
© Harman International, Courtesy Arnold Wolf



SE400
© Harman International, Courtesy Arnold Wolf

To allow these drivers to have reasonable sensitivity, he designed motor structures with massive magnets to offset the magnetic energy that is lost to the coil for the portions of the deep gap that are not filled with wire. The final result was drivers with maximum linearity and high output—characteristics that were unmatched by the competition.

These new drivers became the starting point of a completely revamped loudspeaker line in the 1960s. The showcase system was the Olympus using the S7 component kit (LE15, LE85, LX5) which was specifically developed for that enclosure. Bart Locanthi undertook the system design with two goals in mind—flat amplitude response and flat power response. These two attributes would form the core of a design philosophy that remains in place at JBL to this day and therefore deserves elaboration.

Flat amplitude response regards the on-axis frequency response of a loudspeaker and the desire to ensure that there are minimal deviations in amplitude at any frequency within the system bandwidth. Power response refers to the sum of both the on-axis and off-axis response so that it regards the total acoustic power radiated into a space. A loudspeaker with flat power response would radiate the same total acoustic energy at any frequency within the system bandwidth.

The first attribute is important for timbral accuracy and has long been a goal of loudspeaker designers. The second attribute is important for even coverage and a controlled reverberant sound field. For many loudspeaker designs, these attributes are mutually exclusive. For example, most high-frequency drivers tend to become very directional at high frequencies. To preserve flat amplitude response in such a driver, the power response must necessarily drop. Locanthi addressed this dilemma through his design of the horn/lens for the LE85 that maintained a more uniform dispersion over a wider range of high frequencies. He then designed the LX5 network to provide an electrical signal with uniform power response to the high-frequency driver. The result was one of the first loudspeaker systems to have flat amplitude response with reasonably flat power response.

While the S7 component kit and Olympus were designed by Locanthi to meet his objectives for the highest levels of performance, the resulting system was not positioned at the top-of-the-line of the new LE driver based systems. That honor went to the S8 component kit that substituted the 375 for the LE85. It was developed at the insistence of Bill Thomas who wanted to ensure that JBL's statement high-frequency transducer, the 375, was employed in the new product line. The S8 was introduced as a two-way kit but could not match the bandwidth of the S7. Therefore, it was subsequently reconfigured as a three-way system with the addition of the 075 ring radiator and N7000 cross-over.

The Consumer Electronics Line

Possibly the most under-appreciated product line ever introduced by JBL was their consumer electronics series from the 1960s. It was in every sense as groundbreaking as JBL's most renowned loudspeakers, but due to marketing issues, would be short lived.

The consumer electronics line was the inspiration of Bill Thomas and Ray Pepe. They felt that JBL's continued growth was dependent upon expanding beyond their traditional loudspeaker market to encompass electronics as well. In the 1950s, JBL had established an informal association with McIntosh whereby each company had used the other's products in demonstrations and promotional activities. By 1960, that relationship was foundering as McIntosh sought to break the perception that their products were tied to any one loudspeaker company. JBL thus felt free to compete with the likes of Fisher, Marantz, and, of course, McIntosh.

Pictured above is the first consumer electronics product attempted by JBL—the PL-100. A JBL consultant named Henry Wolcott developed a stereo pair of tube amplifiers that was solely intended to be integrated into the Hartsfield enclosure. They were unique in that they consisted of two amplifier sections and an electronic crossover sharing a common chassis. The amplifiers used 6973 output tubes to develop 40 watts for the low-frequency section and 20 watts for the high-frequency section.

A number of prototypes were completed in 1960, but the amplifiers never went into production. The design would be very expensive to manufacture and the target market, restricted to Hartsfield owners, was considered too small. There was also a technology issue. The transistor was becoming a viable replacement for output tubes in higher power applications and it was felt that the PL-100 would soon be made obsolete. For all of these reasons, management decided to cancel this product and begin development on a new amplifier that would have a broader market appeal.

The new amplifier was the model SE401, introduced in 1963. It was developed under the direction of Bart Locanthi and was one of the first in the industry to use transistors as output devices. As a result, it was a compact device whose size belied its 30 watt per channel output. As with the PL-100, it was intended to be mounted inside a loudspeaker enclosure to result in one of the first examples of an integrated, powered loudspeaker. However, where the PL-100 used two separate chassis in a stereo application, the SE401 was a stereo device that would be mounted in one enclosure of a stereo pair. However, what was truly revolutionary was the incorporation of replaceable equalization cards that allowed each amplifier to be custom-tailored to the specific loudspeaker it was intended to power. Thus, the SE401 was targeted at the broad JBL product line as opposed to just one specific speaker.

While Locanthi was responsible for directing the development of the consumer electronics line, the actual work was a team effort involving chief project engineer Lamont Seitz and his assistant George Noritake. They undertook the detailed design of the components and addressed the difficult issues of production engineering. One of the unique aspects of the design was the back plate for the SE401. Since this amplifier was intended to be mounted inside a loudspeaker

SA600
© Harman International, Courtesy Arnold Wolf

© Harman International, Courtesy Mark Gander and John Eargle

Birth of the Powered, Equalized Monitor

The image at left shows the first example of a powered, equalized studio monitor — the energized version of the D50SMS7 of 1963. It was an outgrowth of the JBL's consumer electronics line introduced that same year. The powered monitor has subsequently become the industry standard configuration. It allows loudspeaker performance to be optimized to an unprecedented level compared to a passive loudspeaker while easing integration into the complicated electronics environment of a typical studio. It would take industry nearly 30 years to catch up to this innovation.

enclosure, heat management would be difficult. They drew from the precedent set by the PL-100 to use the back plate as a combined heat sink and structural support for the attached electronic components. However, with input from Arnold Wolf, it was also designed to be to the aesthetic centerpiece of the design, since it would be the only visible component. Wolf styled this mounting plate with a simple elegance that could also serve as the back plate for the later free standing series of amplifiers.

Bill Thomas also directed the development of a pre-amplifier that could be partnered with the SE401. He came up with the concept for the SG520 pre-amplifier which was unique in its flexibility and ergonomic design. Arnold Wolf was responsible for detailing the ergonomics in the final production model and he paid particular attention to human factors in the selection and layout of the controls. The then-novel use of sliders for variable control was intuitive and provided visual confirmation of settings. Volume and tone sliders were vertically oriented so that a rising setting corresponded to increased output. Balance was controlled by a horizontal slider with left and right slider positions corresponding to output emphasis on the left or right speaker respectively.

Today, this layout seems obvious, since it has been so widely copied, but it was pioneering for the times. The push-button selectors were also pioneering in a consumer electronics component and visually evoked the modernity of the then nascent computer age. They unashamedly copied the illuminated plastic push buttons that were widely used on contemporary computer equipment. Applied to a pre-amplifier, it proved quite functional, allowing the direct selection of a desired setting without having to go through intermediate steps that would be unavoidable with the more common rotary dials. As with the sliders, the illuminated buttons provided visual confirmation of the settings. The SG520 was introduced in 1964 and immediately gained attention for both its performance and design. It received an Award of Excellence in the 1965 Western Electronic Show and Convention industrial design competition, and like the Paragon before it, was displayed at an exhibition at the Pasadena Art Museum.

In 1965, Bart Locanthi revised the power amplifier designs to incorporate a new output device of his invention called the T-Circuit. The analog computer methods he adapted to loudspeaker design also had application to electronic circuit design, and he had been experimenting with a new amplifier topology. Those experiments resulted in the T-Circuit, which was the very first example of a complementary output stage for an audio amplifier. It was subsequently widely copied to become an industry standard in amplifier design. At the time, it was unique in its minimal use of negative feedback and ability to handle a wide range of load conditions. It resulted in a series of exceptionally linear, low-distortion, and stable amplifiers. It was first introduced in the SA600 integrated amplifier and the updated SE series of power amplifiers which were designated with an "S" suffix.

Around this time, the first free-standing version of the SE power amplifiers was introduced as the SE400S. Since this amplifier would potentially be on display in a user's setup, it needed to be visually appealing from all sides. In particular, there was a desire to highlight the replaceable equalization cards. Arnold Wolf addressed this requirement with a translucent window on the front of the enclosure that would light up when powered and illuminate the label of the interior card.

The consumer electronics line was expanded in 1969 with the introduction of the higher-power SA660 integrated amplifier, rated at 60 watts per channel. The next year, the 60 watt per channel SE460 power amplifier was introduced along with the ST860 tuner. However, these would be the last JBL consumer electronic products. Ever since the 1969 takeover of JBL by Harman International, there was pressure by the parent corporation to discontinue this product line in deference to their sister company, Harman/Kardon's products. This pressure was compounded by the fact that the consumer electronics line was never the profit center it was hoped to be. It has been speculated that JBL lost as much as $50 on every electronic component sold. JBL's then-President, Arnold Wolf, resisted this pressure as long as he could but was ultimately forced to accede in 1971. Thus the revolutionary JBL consumer electronics line came to a premature end.

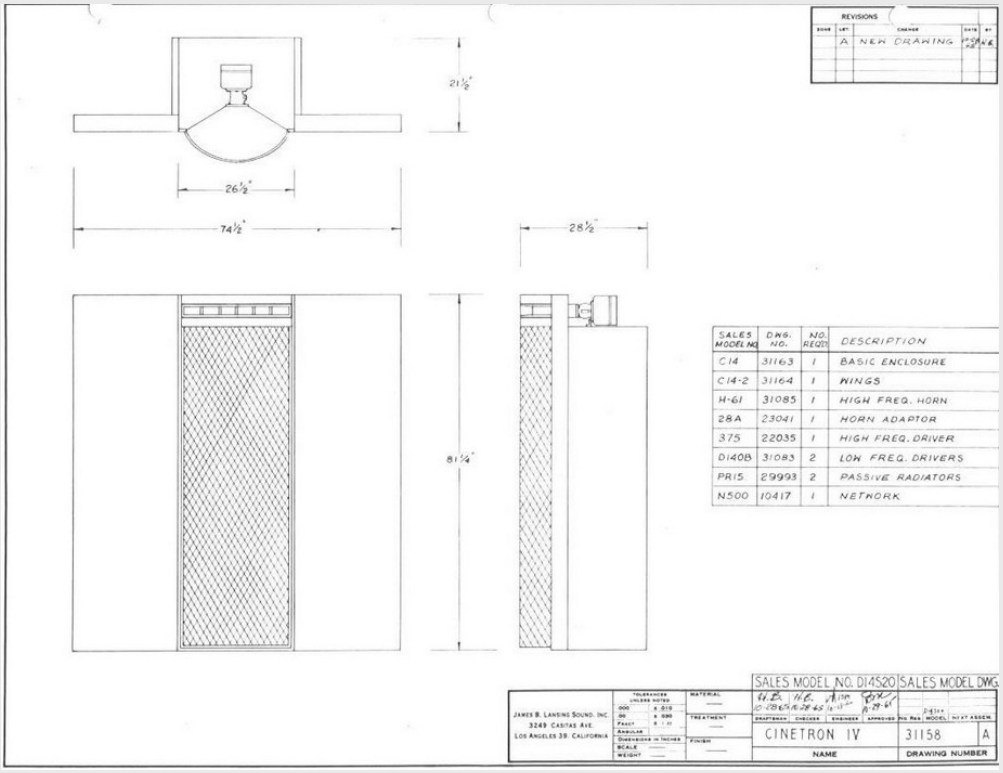
The 1960s Professional Endeavors

After limited success with their initial ventures into the cinema market, JBL began a second concerted effort to enter the professional field in the 1960s. It was led by George Augspurger, who had joined JBL as their Technical Service Manager in 1958. The first new professional opportunity would ultimately prove illusory, but it established the groundwork for what would ultimately become JBL Professional.

In 1960, Altec Lansing made a pivotal change in their marketing structure. Up until that time, Altec had relied on a single national distributor, Graybar, to be their point of sale to the professional sound contacting industry. That year, they decided to establish their own internal distribution network. This left Graybar with a massive hole in their product catalog. Representatives from Graybar contacted JBL with the offer of engaging them to develop a complete line of professional products that Graybar would subsequently market. JBL acted on this offer by developing a comprehensive product lineup. It included a series of amplifiers, transformers, and mixers, in addition to professional versions of their loudspeaker components. A new casting was created for the pot structures on all of the professional versions of the loudspeaker drivers to distinguish them from their home speaker counterparts. However, it should be noted that they were mechanically and electrically identical.

Product development was well underway and JBL made public announcements to the industry when the unthinkable happened. For reasons that remain unclear, the agreement

D140F



Sales Drawing for Cinetron IV (no photographs are known to exist)

between Graybar and JBL fell apart. As a result, the entire product line was scrapped before a single piece had been sold.

The second significant initiative in the professional field would have long-lasting ramifications. That was JBL's entry into the professional monitor field in 1962. JBL's arch-rival, Altec Lansing, made a critical error in judgment that gave JBL a foot in the door to a market segment they would later grow to dominate. As with the cinema market, Altec Lansing was the leader in the studio monitor business with their signature product, the 604 Duplex. New management at Altec embarked on a program to increase profit margins by reducing costs. A new version of the Duplex was developed called the 605 that used smaller magnets in its design. Rather than marketing this new driver as a lower-cost alternative to the 604, Altec introduced it as a "new and improved" version at the same retail price and discontinued its predecessor. The market quickly perceived this less than honest marketing ploy, and it resulted in an industry backlash. Sales of the new 605 were significantly down from the 604, and many Altec customers began to seek alternatives.

One of the customers seeking an alternative was Capitol Records. Staff at Capitol Records had established an acquaintanceship with JBL during the time that both companies had occupied facilities on Fletcher Drive. After the Altec 605 marketing incident, the chief engineer for Capitol's record production contacted Bart Locanthi to see if JBL would be interested in developing a studio monitor. JBL agreed, and Locanthi was responsible for producing their first dedicated studio monitor, the D50 series. The design work for the new monitor was pretty much limited to a new enclosure, the C50SM. This was a six cubic foot enclosure with an industrial finish that could hold either the S7 or S8 component kits that had originally been developed for JBL's home speaker product line. Capitol was impressed with these new monitors and soon standardized on JBL systems in all of their studios. These new monitors came to the attention of Capitol's parent company, EMI of the United Kingdom, and this eventually resulted in JBL becoming the standard monitor for EMI worldwide.

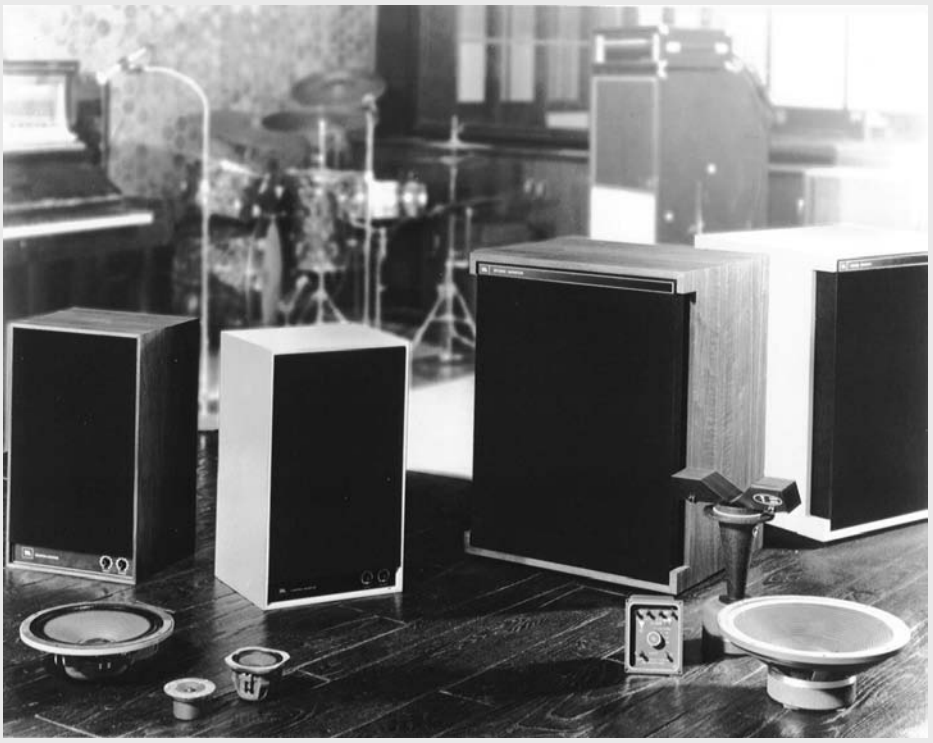
It should be noted that Altec Lansing eventually recognized the seriousness of their marketing blunder and subsequently reintroduced the 604 as the "E" version in the mid-sixties under the new moniker "Super Duplex." However, by that time, the damage had been done and Altec continued to lose market share to JBL in the studio business.

The next significant professional market opportunity for JBL came in 1963. That year, JBL introduced their first line of dedicated musical instrument loudspeakers known as the "F" series. JBL had a long history of supplying drivers for musical instruments, primarily for use in guitar amplifiers. As early as the 1940s, Les Paul, the inventor of the electric guitar, had established a personal relationship with Jim Lansing, and JBL was his preferred vendor for loudspeaker components. A similar relationship existed with Fender Musical Instruments, to which JBL supplied D130s and D131s for use as amplifier speakers.

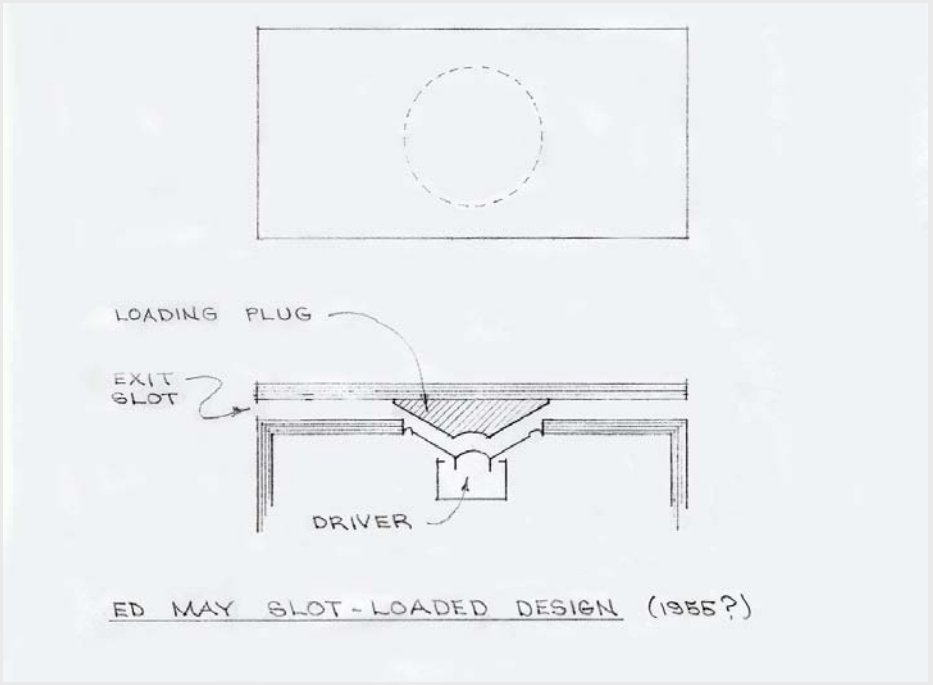
The rise of amplified music in the 1960s saw an explosion in the size of this market. At the same time, this new genre of music was placing new demands for output and reliability which exceeded the capabilities of most drivers of that era, including those from JBL. Harvey Gerst, one of JBL's technicians, noted the ever increasing number of drivers being sent in for repair from the musical instrument manufacturers. In 1963 he made a proposal to Bill Thomas to develop a series of ruggedized drivers to address the demand of this industry. Thomas agreed and Gerst set the parameters for JBL's transducer engineers to develop a dedicated line of musical instrument loudspeakers. The starting point was the D130 and D131, which were the favorites of JBL's musical instrument clients. These drivers were modified to use tougher suspensions to mitigate excessive excursion, treated paper surrounds to resist tearing, and slightly widened voice coil gaps to prevent rubbing as the coil former deformed under the stress of high power input. These drivers were labeled the D130F and D120F respectively. Additionally, the all-purpose 10" D110F and the 15" D140F intended for bass guitars were introduced as brand-new drivers. Gerst came up with the "F" designation in reference to Fender Musical Instruments, JBL's largest customer for these drivers. However, they were never intended to be solely provided to that company. Amplifier manufacturers, such as Sunn and Kustom, soon became major clients of JBL.

The mid 1960s saw JBL take one more run at Altec's stranglehold on the cinema market, and it resulted in the same resounding lack of success. The Altec Voice of the Theatre (VOTT) was an industry standard because it had become a reference and not because it represented the pinnacle of accuracy—which it did not. Sonic limitations such as the uneven response of its horn/reflex enclosure and restricted high-frequency extension were well-known in the industry. However, the Academy of Motion Picture Arts and Sciences had certified the VOTT as the standard for motion picture sound in 1953. Going against a standard set by such an important industry body was next to impossible. Nonetheless, JBL tried.

The loudspeaker product line introduced under this new initiative was the Cinetron system of 1965. As with JBL's previous cinema endeavors, it was instigated by a third party—Ampex, who decided to make another attempt at gaining a market position in the film sound industry. They approached JBL to design and manufacture the loudspeaker portion of an overall movie sound system that Ampex was developing. JBL developed three different-sized systems for use as main and fill loudspeakers. They all used direct-radiator bass enclosures with a high-frequency horn. The largest system introduced the 2397 "Smith" horn that had very wide dispersion, even at high-frequency extremes. In many ways, these loudspeakers were the precursor to what is now the industry standard for cinema speakers. However, they were considered too radical a departure from the VOTT. After extensive development work, Ampex sold exactly one installation. Altec's VOTT standard was as impenetrable as ever.



4310 (left) and 4320 (right)
© Harman International, Courtesy Mark Gander and John Eargle



Ed May Slot Loading Concept
© and Courtesy George Augspurger

It should be noted that this illustration shows the driver mounted vertically for clarity when in fact the actual system had the driver mounted horizontally with a vertically oriented panel.

The year 1968 saw two significant developments in the monitor product line. First, the D50S7SM was refined into the 4320 monitor. Ed May developed a new crossover that was dedicated to this system. It raised the crossover point to 800 Hz to provide better power handling and it more evenly matched the polar response of the low-frequency and high-frequency drivers through the cross-over region. This further enhanced the flat power response characteristic that had been an innovation with the S7 kit used in the original D50 monitor. It was an immediate success and further strengthened JBL's position in this marketplace. The second development would result in the most famous JBL studio monitor ever made and which would later have an even greater impact in the home speaker market. That monitor was the 4310.

The 4310 had a unique design goal: to mimic the sonic character of the well-reputed 604 in a small package. Even though JBL was making significant inroads in the monitor business, they could not fully displace the 604's reputation as an industry standard. What's interesting is that the 604 was anything but accurate. It had a pronounced midrange peak and a high-frequency response that is noticeably rolled off. However, because it had become ubiquitous in studios throughout the 40s and 50s, it became a reference that all studio engineers knew how to work with. This was arguably more important than accuracy, since it established a consistent basis of comparison.

Bob Fine, a prominent New York studio owner known to audiophiles as the original engineer of Mercury Living Presence recordings, set the original design objectives for the 4310. The need for a small package was the related to the introduction of eight-track recorders. Fine's first approach to using this technology was to install a monitor for each individual track. It was not practical to mount eight 604s in a control room, hence his request to JBL to develop a compact monitor. While this approach to monitoring would not last long, the small-package 4310 that resulted from this requirement soon found wide use in new studio applications.

The number of small independent studios increased markedly during the 1960s, and the 4310 was perfect for their smaller control rooms. The 4310 was also small enough to be mounted directly on the console bridge for near-field monitoring. This had the great benefit of minimizing the effects of room acoustics. The close proximity of the monitor meant that the engineer was exposed to a high proportion of direct sound from the monitor and to lower levels of sound reflected off of walls and ceilings—reflections that can greatly modify the sound of a loudspeaker.

There is an interesting anecdote about the development of the 4310 that speaks to the empirical nature of loudspeaker design during that era. Ed May was the JBL engineer responsible for the 4310. He took an existing two-way design, the L88, and added the LE5 driver to increase the midrange output to match the 604's peaked response. Corporate pride precluded acquiring a 604 to make a direct comparison. However, so well known was the 604 "sound" that Ed May had no trouble replicating its sonic character through subjective listening tests.

It should be noted that when the 4320 and 4310 were introduced, neither monitor used the model numbers for which they would become most widely known. The four digit numbering scheme that has become JBL's standard naming convention for professional products was not introduced until 1970. The 4320 was initially marketed under the D50 model name of its predecessor. The 4310, was simply introduced as the JBL Control Monitor.

A Noble Experiment

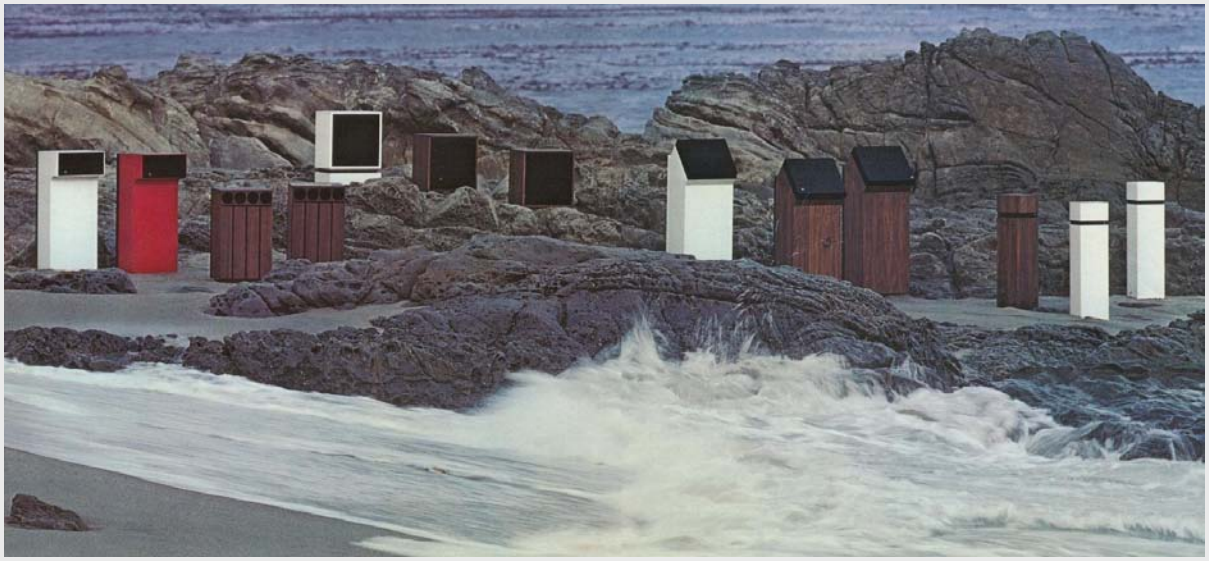
The close of the 1960s also saw a major new initiative on the home speaker front with the development of the Aquarius series of loudspeakers. That series was groundbreaking, yet its existence would be fleeting. It arrived in the marketplace after a flurry of development activity, but, with one exception, would disappear within two years. What follows is an insight into the risks and challenges of pushing the state-of-the-art.

The project was initiated in 1968 by Tom Jennings, who had recently joined JBL as Ray Pepe's replacement. As head of marketing, he was looking for an opportunity to refresh JBL's image with products that would stake out new ground in both style and technology. He devised an image and marketing concept that revolved around the "Age of Aquarius" pop culture phenomenon that had taken hold in the United States. The idea came to fruition as the Aquarius line of loudspeakers.

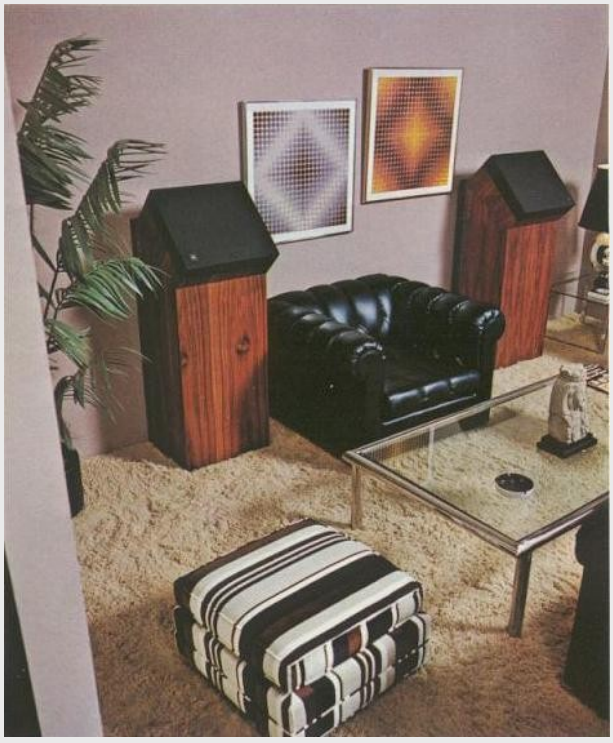
The new technology aspect came from Ed May. While he had been a partner at the Frazier-May company, he had developed a loudspeaker system that introduced the principle of slot loading. This concept had a panel and loading cap placed in front of a loudspeaker driver that left an air gap of approximately 1" into which the driver radiated. The gap extended to, and exited at, the sides of the enclosure so that sound radiated perpendicular to the axis between the loudspeaker and listener. May had tried to convince JBL to develop such a loudspeaker ever since joining the company. The Aquarius project gave him the opportunity he was looking for and Thomas granted approval to develop a complete line of systems based on this approach.

There would be five models in the Aquarius line, consisting of the 1, 2, 2A, 3, and 4. They all shared the design principle of slot loaded bass enclosures combined with a widely dispersed high-frequency propagation pattern. The acoustic goal was to result in loudspeakers that had few limitations in room placement while simultaneously providing a stereo soundfield that was largely independent of listener position. This desired result was similar to what JBL had pioneered with the Paragon system.

The first three models (1, 2 and 2A) were similar in design. They were all three-way systems that had the bass and midrange drivers slot loaded while the tweeters were unob-



Aquarius Series (left to right - 2A, 2, 1, 3, 4)



Aquarius 3

L120 Aquarius Q

structed and radiated directly along the axis to the listener. The Aquarius 3 was the top-of-the-line model using a two-way configuration with an LE14A and LE85. A unique horn was developed for the LE85 that had a petal shaped disk mounted in front of the driver throat exit to create the diffuse soundfield. The Aquarius 4 was the smallest system of the series, with the enclosure shaped as a column and containing an LE8T, and which was mounted vertically, firing into a loading cap and slot located above it. A rear-firing LE20 was added to the back of the enclosure that had its own circular slot loading to make it omnidirectional.

The Aquarius 1, 2, 2A, and 4 were introduced in 1970. Their unique styling and engineering generated significant buzz within the industry. However, this did not translate into sales. The Aquarius 2 and 2A were a particular disappointment. It quickly became apparent that their relatively high costs, both in development and production, would not be recouped. They were cancelled before the end of the year. The failure of these speakers led to the cancellation of the Aquarius 3 even before production could begin. Only four development pairs were ever produced before the program was terminated. The Aquarius 1 and 4 would soldier on into the 1971 production year. The Aquarius 1 was produced in a limited production run and was discontinued after this run sold out. Only the Aquarius 4 would continue in production for the next five years.

The relative success of the Aquarius 4 was interesting in light of the fact that it arguably had the most compromised performance of the series. However, in its favor were a compact form factor and timing. The extremely small footprint of the columnar design lent itself to great flexibility in placement in any number of home environments. The early seventies saw a short-lived technological development that accentuated this advantage. This was the introduction of quadraphonic sound. The need to accommodate four speakers for quadraphonic reproduction made the small footprint of the Aquarius 4 even more desirable. In fact, the relative success of this design led to a subsequently larger variant that was introduced in 1975. This was the three-way L120 Aquarius Q. However, by the mid seventies, the quadraphonic phenomenon was on the wane due to a lack of standards, which led to market segmentation. By 1977, all of the Aquarius series were discontinued.

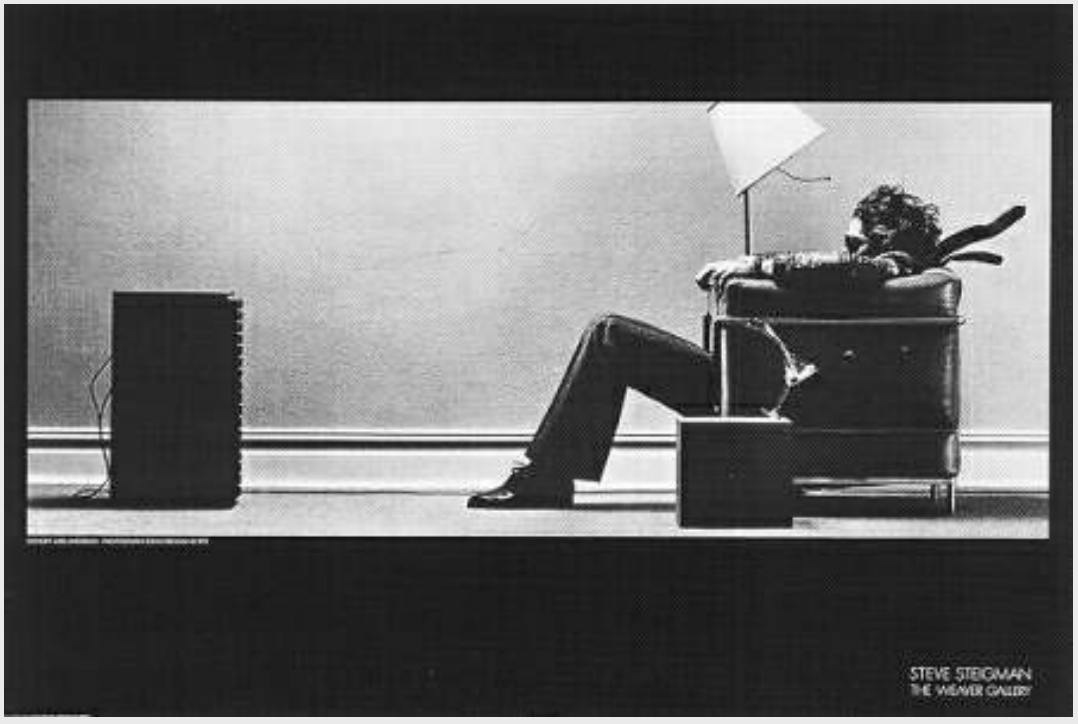
The disappointing sales of the Aquarius series were due to three primary factors. First, the design concept was arguably a technological step backwards. Rather than raising the level of sonic accuracy, it was meant to address shortcomings in the way that recordings were engineered which would ultimately be rectified as the industry matured. It must be remembered that this was the era of “ping pong” stereo. Instead of attempting to capture a three-dimensional soundfield, mixes were routinely engineered to simply place separate instrument tracks on separate channels. On these recordings, a widely distributed soundfield could artificially create a sense of space.

Second, there was insufficient time for development. This was compounded by the desire to introduce a whole family of unusual loudspeakers without allowing enough time to thoroughly engineer and test the systems. Given another six months, the sound quality of the Aquarius 2 and 4 could have been greatly improved.

Finally, there was a problem posed by the series radical departure in sound compared to previous JBL products. JBL was a successful high-end manufacturer with a reputation for a distinctive sonic personality, sometimes referred to as “presence”. The Aquarius series was considered by many to be too much of a deviation from this character. It therefore failed to find immediate acceptance in its proposed market segment. Further, the diffuse sound concept, contrary to the promotional claims, was difficult to set up in a typical listening room, and almost impossible to demonstrate effectively in a dealer’s showroom. This made development of a new market niche highly problematic.

The lack of market success was disappointing, but it was not disastrous for the company. At the time, JBL was a small, high-end company that operated without marketing studies or focus groups. A new design was sent to dealers and it either succeeded or failed. The fact that the Aquarius concept failed was unfortunate, but it was taken in stride. In fact, the introduction of the Aquarius series coincided with the introduction of the L100. That product emerge as the most successful loudspeaker ever produced by any manufacturer in its day.

L100
© Harman International, Courtesy Mark Gander and John Eargle



Blown Away Poster Featuring L100
© Hitachi Maxell

The Initial Harman Era (1969-1977)

Background

The year 1969 saw the most momentous corporate change to JBL since the death of Jim Lansing. That year, Bill Thomas sold JBL to the Jervis Corporation and so ended its 23 year run as an independent company. Thomas was going through a divorce, and its settlement required that he liquidate his assets. Tom Jennings, Thomas's Vice President of Marketing, was tasked with finding a buyer. He was aware that Dr. Sidney Harman, as head of the Jervis Corporation, was interested in expanding the company's presence in the audio market beyond their traditional field of electronics. Jennings arranged for the two parties to meet and a sale was negotiated. Jervis assumed 100% ownership of JBL and complete control of its operation. Thomas did not totally end his involvement with JBL, as he took a position on Jervis's board of directors and assumed the title of Honorary Chairman of JBL.

JBL came under the overall direction of Dr. Harman as a subsidiary of Jervis. With the exception of a three-year break from 1977-1980, Dr. Harman has provided direction for JBL from the date of its initial acquisition to the time of this writing. This means that Dr. Harman has had a longer lasting influence on the company than anyone else. Therefore, it is important to understand his background in order to put JBL's accomplishments during his management tenure in their proper context.

Dr. Harman is one of the pioneers of the hi-fi industry. He was born in 1918 in Montreal, Canada and raised in New York City. He studied science at City College of New York and graduated with a degree in business from Baruch College. Much later, he would obtain a Ph.D. in education from the Union Institute and University.

Dr. Harman began his career in the audio industry immediately after obtaining his undergraduate degree in 1939, when he was hired by the David Bogen Company to work in their engineering department. He took a two year leave from the company to serve in the army during World War II and then returned to his original employer in 1946. While working there, he formed a friendship with a fellow engineer named Bernard Kardon. In 1953, both Harman and Kardon left Bogen to start their own company, focusing on their field of interest—high fidelity electronics. Not surprisingly, the new firm was named Harman/Kardon, and their first products consisted of a line of amplifiers and tuners.

Through a combination of Kardon's engineering innovations and Dr. Harman's marketing skills, the company thrived. They probably gained their greatest recognition as the inventors of the hi-fi receiver, combining the previously separate preamplifier, amplifier, and tuner components in one chassis. In 1956, even as the company continued to grow, Bernard Kardon made the surprise announcement of his desire to retire. Dr. Harman took Harman/Kardon public as a means to raise the capital necessary to buy out Kardon's share of the company. Dr. Harman headed this newly-public company until 1962, when he accepted a purchase offer from Jerrold Electronics and became President of that corporation. His association with Jerrold did not last long, as he eventually had a falling out with the chairman of the company which led to a buyout of Dr. Harman's shares.

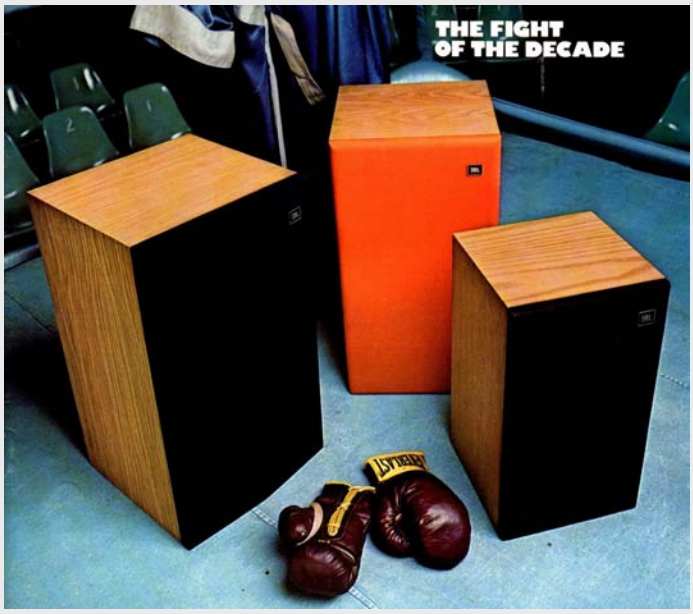
Dr. Harman invested the proceeds from this transaction in a small, multi-business, public company called the Jervis Corporation. Over time, he increased his holdings to the extent that he gained effective control of the firm. At that point, he expanded the company's activities into the audio industry that had always remained his primary field of interest. He initially reacquired Harman/Kardon from Jerrold and then sought to establish a leadership role in the audio market. It was at that time that the opportunity arose to purchase JBL. Dr. Harman immediately recognized that this company's stellar reputation for quality and performance would be a perfect fit with his objectives.

JBL Becomes a Household Name

Shortly after the JBL acquisition, Jervis Corporation was renamed Harman International. As previously mentioned, Harman recruited JBL's longtime industrial design consultant, Arnold Wolf, to head the new JBL subsidiary. Joining Wolf as part of the new management team was Irving Stern (Vice President, Marketing), Sterling Sander (Vice President, Operations), and Albert Schwartz (Vice President, Manufacturing) .

Whereas JBL under Thomas was primarily a niche manufacturer, focused on the high end of the home loudspeaker business, Dr. Harman was interested in establishing the brand at all levels of the marketplace. The wedge product that opened up the mass market to JBL was the L100.

Technically, the L100 was not a groundbreaking speaker. It was essentially a consumer repackaging of the very successful 4310 monitor. The key to its success was the strategy behind its marketing and, quite frankly, timing. Larry Phillips, then JBL's head of domestic marketing, devised a promotional plan that proved so insightful that it remains a cornerstone of JBL's current marketing activities. That plan was to leverage JBL's success in the professional realm to establish its desirability in the home market. Phillips astutely realized that there could be no stronger recommendation for a loudspeaker than that of professionals whose very livelihood depended on the sonic quality of that same product. By 1970, the 4310 had become so successful that it had established itself as a standard throughout the studio industry. Philips devised a marketing campaign that stressed the L100 as being the choice of professionals. It proved to be a very compelling approach.



Decade Series

1971 Professional Loudspeakers

The timing aspect of the L100's success involved a shift in demographics in the high fidelity marketplace. The appeal of hi-fi initially skewed toward an older demographic. This was because the hobby was relatively expensive, and not until individuals were well established in a career would they likely have the disposable income to actively pursue it. This changed dramatically in the 70s. Popular music reached out to an ever-younger audience, and the members of that audience were more affluent than those of any previous generation. The L100 was unique in the attributes that appealed to this younger constituency. Sonically, the L100 was known for a punchy, dynamic sound that proved a perfect fit for the rock music that defined the youth culture. Visually, the L100 stood apart from the majority of the competition that was still focused on styling loudspeakers as traditional furniture. In particular, the sculpted foam grill, designed by Arnold Wolf, gave the system a contemporary look that was so successful that it ultimately became an icon. This status was dramatically confirmed by the use of an L100 as the centerpiece of one of the most famous photographs from the 1970s, "Blown Away," which originated as a Hitachi Maxell advertising campaign.

The L100 proved to be the single most successful loudspeaker ever marketed to that time. More L100s were sold in the 1970s than any other hi-fi loudspeaker from any manufacturer. Dealers were clamoring to gain the JBL product line, which greatly expanded JBL's presence in the marketplace. This laid the foundation for the success of JBL's first true mass-market products: the Decade series.

While the L100 proved to be extraordinarily successful, it could not be called inexpensive. While less costly than the traditional JBL high-end offerings, it was still out of reach for a large portion of the market. JBL chose to address this segment with the Decade series. This series proved to be a challenge. In many ways, it is more difficult to design a mass-market product than a state-of-the-art product, due to the many constraints imposed by a lower price point. In JBL's case, they had a reputation for quality and performance to maintain while targeting a cost structure lower than any product line they had previously produced. Ed May was given overall responsibility for the development of the series. He devised three systems, the L16, L26, and L36. The first was a two-way system utilizing an 8" bass driver, the second substituted a 10" driver for the 8" driver, while the third system was a three-way adaptation of the L26 with the addition of an LE-5 midrange driver.

For the first time, JBL used ferrite magnet drivers for the midranges and high-frequency components of these systems to reduce costs. While they did allow lower price points, they were not compromised in sonic performance. In particular, the ferrite LE5-6 used in the L36 was later modified for use in the much more expensive L65. This was not because of its reduced cost, but because it worked better in that system than the Alnico alternative.

The Decade series was successful in its intended goal. It filled out the JBL product line to cover the entire scope of he marketplace. As a result, by the mid-70s, JBL truly became a household name.

Market Dominance of JBL Studio Monitors

If one looks carefully at the fisheye photograph at bottom left, one can spot a huge, unique loudspeaker system containing two 15" bass drivers mounted along a vertical axis, with a top section containing a 12" driver, horn/lens and slot radiator. This was a seminal prototype that laid the foundation for JBL's rise to market dominance in the studio monitor industry by the mid 70s.

The prototype was the brainchild of Walter Dick, the head of JBL's Transducer Engineering Department. This department title was a bit of a misnomer, since it had responsibility for engineering all aspects of loudspeaker systems, both professional and consumer, including transducers, networks, enclosures, and overall system parameters. In 1971, Walter decided that JBL needed a showcase to present at the upcoming Audio Engineering Society (AES) convention. He set the parameters for a professional loudspeaker with an unparalleled combination of output and accuracy.

The system illustrated above utilized two 2216 bass drivers, which were the professional equivalents of the LE15B developed for the L200. The mid-bass unit was a 2130, while the mid- and high-frequency drivers were the 2440 and 2405, respectively. The system was bi-amplified with separate amplifiers for the bass section and mid/high module and was affectionately nicknamed the "Texas Bookshelf."

As intended, the system generated a high level of attention at the AES convention. Walter Dick recognized that there was enough interest to develop the prototype into a production model. While the prototype was not targeted at any specific market, he realized that a studio monitor developed from that concept made the most sense. As previously mentioned, rock music was at the center of the popular culture in the 1970s. This genre placed ever increasing demands on playback levels for which the still widely-used Altec 604, and even the JBL 4320, were inadequate.

Dick placed responsibility for the development of what would eventually become the 4350 in the hands of a recently hired engineer named Pat Everidge. Ed May would be responsible for the development of a brand-new bass driver for this system, the 2230. This was JBL's first 15" driver to utilize a cone damping treatment that JBL named Aquaplas to lower the driver's resonant frequency and extend deep bass response. Ed also developed a new 12" driver, the 2202, specifically for application as the mid-bass transducer for this system. The pre-existing 2440 and 2405 filled out the driver lineup.

The resulting system was a four-way configuration that was unprecedented in the monitor industry. The vast majority of studio monitors produced to that date had been two-way designs. The four-way concept had two significant advantages—increased accuracy and increased output. By splitting

4350

4343, 4333A, 4331A

the audio spectrum into four segments, each driver operated within a narrower bandwidth that could be chosen to coincide with the transducer's window of maximum linearity. Since each driver only handled a fraction of the input, the total power handling of the system rose significantly to increase dynamic range and maximum output.

The downside of this concept was the greatly increased complexity in the network and system design. The need to deal with these refinements resulted in a marked change in design approach. In the past, with notable exceptions like the Paragon, JBL's systems had largely been designed around the components they utilized. The prevailing philosophy had been that system quality would be an intrinsic outcome of engineering the highest quality transducers. This was too narrow an approach for a monitor as advanced as the 4350. As a consequence, the development of this system institutionalized a holistic, integrated approach to system design that remains the core design philosophy at JBL to this day.

The heart of the system design was the network configuration. The 4350 utilized a hybrid of passive and active networks to maximize the accuracy of the system response and make the most use of the impressive power handling. The 4350 was the first JBL monitor that required an active crossover so that the twin bass drivers would be powered by their own dedicated amplifier. A new electronic crossover was developed that allowed the insertion of customized cards to set the crossover parameters for different systems. Such a card was specifically developed for the 4350 that set the crossover frequency between the bass drivers and the mid/high passive network at 250 Hz. Pat Everidge devised the passive crossover network that was used for the mid-bass, midrange, and high-frequency drivers. This network was advanced in comparison to the more generic crossovers that had been in JBL's product line for years. It comprehensively optimized response of the 4350's three specific drivers within the unique parameters of the overall system.

The system was introduced in 1973 to widespread acclaim. As an example, The Who would ultimately install twelve 4350 monitors in their personal studio. Dick recognized that an entire monitor line could be developed around the concepts of wide bandwidth and high power handling that formed the basis of the 4350 design. Consequently, in 1973-1974, he oversaw the development of four-way, three-way, and two-way versions of what were known as large-format monitors. That term generally refers to monitors with 15" bass drivers that are intended to be placed in a far-field environment; that is, at least 8' away from the listener. The monitors that resulted were the 4340/4341, the 4332/4333 and the 4330/4331. The twin numbers assigned to each model had to do with whether they were configured for biamplification or whether they used only passive networks (the lower numbers referred to the biamplified versions).

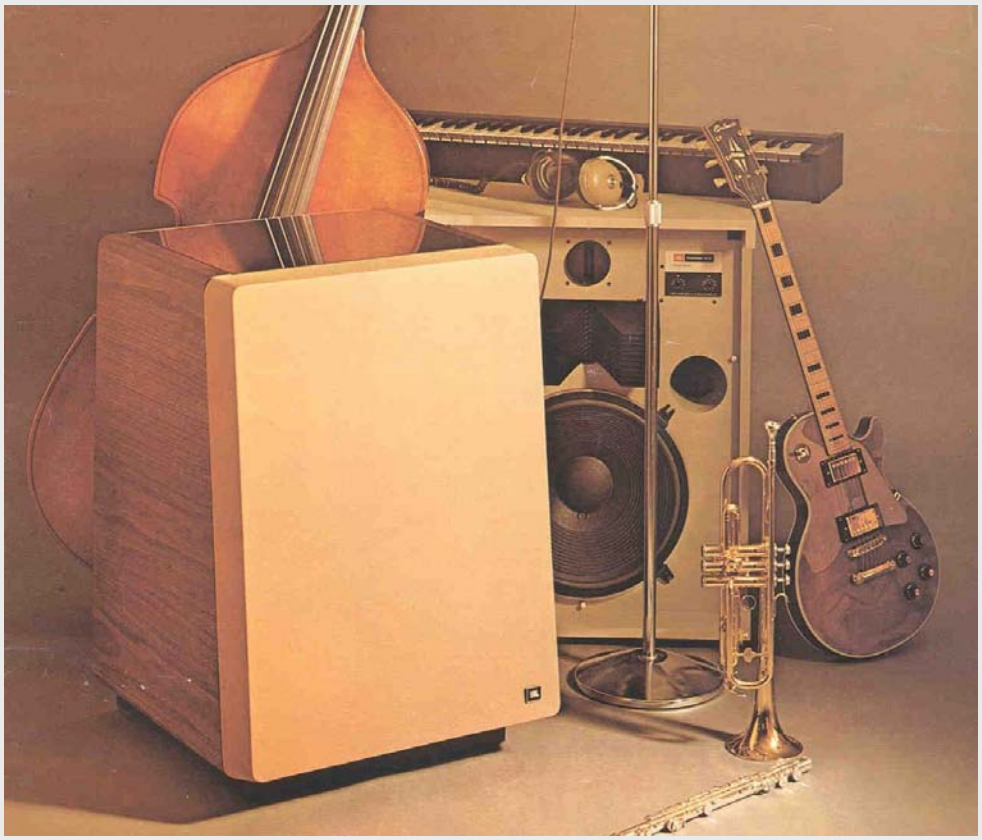
The development of these systems was made possible by Ed May's design for a new bass driver which would evolve to become the standard for JBL's large format monitors for the next two decades. This driver was the 2231, with its consumer counterpart designated as the 136A. Prior to the development of the 4350, JBL's standard 15" driver for both monitors and home speakers was the 2215/LE15A. This transducer had an outstanding reputation for accurate response, but was limited in power handling. The 2230 that Ed May developed for the 4350 was the first JBL driver to use a very long coil, short gap topology. The longer coil handled more power and dissipated heat more effectively. It also allowed for greater cone excursion which increased dynamic range and output.

As previously stated, the 2230 was coated with Aquaplas to enhance its low-frequency extension. While this worked very effectively in the 4350 with its low 250-Hz crossover, it was found to be problematic with the higher crossover points needed for two- and three-way designs. The heavy, damped cone proved to have an uneven and falling response in the upper mid-bass region. To address this, Ed May came up with the unique solution of a mass control ring. This was a metal ring affixed at the junction of the cone and the coil former. It provided the mass needed for low-frequency extension while permitting the use of a stiff, lighter cone for extended mid-bass response. This revised transducer would be employed in all of JBL's new 15"-driver monitors, including an updated version of the 4350. Its domestic counterpart, the 136A, would find its way into the L200B and L300.

To fill out the monitor lineup, Pat Everidge took on the design of the 4340/41 in 1973. This was a scaled down version of the 4-way concept introduced with the 4350 that employed a single 2230 (later replaced with the 2231) with smaller mid-bass and compression drivers. This design had the wide, linear bandwidth of the 4350 with only a small reduction in maximum acoustic levels. It proved to be a very popular monitor and, in updated versions, would gain unexpected demand as a home speaker, particularly in the Japanese market.

Dick brought in another new employee to undertake the design of the two-way 4330/4331 and three-way 4332/4333. That person was Greg Timbers, who would go on to become the engineering focal point for state-of-the-art system designs at JBL—a role that he continues to play. These systems were an updating of the traditional JBL monitor that had its roots in the D50 series of the early 1960s. As with the 4350, the innovation behind these new systems was the holistic, integrated approach to their design. New networks were devised for each system which comprehensively optimized their overall response. The 4333 became noteworthy for its full bandwidth and flat power response obtained from a relatively compact enclosure. It would become the single most popular of JBL's large format monitors.

The revamped 4300 series monitor lineup was completed with a unique mid-field monitor that became seminal in the design of later JBL home speakers. That monitor was the 4315, which achieved the same extended bandwidth of the 4350 in a much smaller package which could be used in a large variety of environments. Obviously, such a system could not match the output of its larger brothers, but given



L300

The L400

The photograph at left is an excerpt from JBL's 1975 catalog illustrating a mystery speaker cloaked in a sheet. The only description says, "Coming soon. The L400, with the promise that it will be the most exciting fusion of art and technology yet presented by JBL." It never came.

Originally, the speaker was planned to be a domestic conversion of the 4341 monitor, similar to the conversion of the 4333 into the L300 home speaker. It would be a four-way speaker using a 15" low-frequency driver, 10" mid-bass, 1"-throat compression driver midrange and slot tweeter. The main development work in converting this speaker for domestic use centered on network design changes, a revised midrange horn and aesthetics suitable for a home environment.

There were three separate attempts to bring this speaker to market. All failed before a final decision was made to cancel the project. The primary difficulty was developing a system that could be sold at an acceptable cost. However, there were also technical issues, and no one was satisfied with the ultimate sound of the prototypes.

the market trend towards small, independent studios, it had a ready field of application. The 4315 utilized the 4350's same four-way concept but was built around a new 12" low-frequency driver (2203) developed specifically for that system. A new 8" mid-bass driver (2108), utilizing a 3" diameter coil, was also designed for this new monitor. The pre-existing 2105 midrange and 2405 ring radiator filled out the design.

With this last system design in place, 1974 brought the introduction of the full range of JBL monitors. The significance of this complete product line cannot be overstated. Within three years, JBL would dominate the studio monitor industry. The change in market acceptance was tracked by two *Billboard* magazine surveys. In 1973, the magazine published the results of a survey that stated Altec Lansing monitors were used by more recording studios than all competing brands combined. This information would form the basis of an Altec Lansing marketing campaign for both their home and professional products. However, when *Billboard* published their 1977 survey, it documented a complete reversal of the market data and put a quick end to Altec's campaign. According to that survey, JBL had completely displaced Altec from their leadership position, commanding a 70% market share—more than double that of Altec.

The 4300 series monitor lineup had significance well beyond its penetration of the monitor market. It can be fairly stated that these products established JBL in a position of leadership within the professional marketplace as a whole. The same monitors allowed JBL entry into the commercial installed sound industry. In the mid- to late 1970s, JBL monitors could be found in discotheques, hotel ballrooms, convention halls and many other commercial venues as primary sound reinforcement systems. Prior to the 4300 monitor introduction, JBL was relegated to only limited niches in the professional market by the seemingly impenetrable monopoly held by Altec Lansing. The 4300 series breached that position and displaced Altec Lansing from one of their core markets. It also raised the profile of JBL to that of a broad-based supplier in all aspects of the professional sound industry.

The Legacy of Excellence Continues

In addition to the company's expansion into the mass market, the 1970s brought continued enlargement of JBL's high end home speaker lineup. Initially, JBL developed a version of their standard large-format monitor for home use. The L200 was introduced in 1971 and was a domestic packaging of the 4325 monitor. What was distinctive about that system was its striking visual design, which, while understated, exuded power. This design was produced by Douglas Warner, who was Arnold Wolf's former assistant in his consulting firm. When Arnold accepted the presidency of JBL, he sold his firm to Warner, who renamed the offices as Warner and Associates. This firm would remain the primary industrial design resource to JBL until the mid 1980s.

The home speaker lineup soon benefited from the previous updating of the monitor line. Greg Timbers carried on from his development role in that series to become responsible for engineering their home counterparts. In 1975, the L200 was updated to the L200B when it inherited the components from the 4331. That same year saw the introduction of what would become one of the most desirable large JBL systems ever produced—the L300. That system used the 4333 monitor as its starting point. Warner developed the industrial design around the form factor of his previous L200. However, while the L200 had a more traditional look, the L300 took on a clean, modern appearance with rounded edges, glass top, flush baffle and grill assembly that fit as an extension to the sides of the enclosure. The design has a timeless quality with an appeal that has been little diminished since its introduction 30 years ago.

The next major high-end product would mark a turning point in technology from JBL and prove to be the precursor to some of the most highly-regarded systems they ever produced. That system was the L212 of 1976, and while it was a significant technical achievement, it was not a market success. This contradiction of technical excellence, yet limited market acceptance, is worth examining in some detail.

The concept for the L212 was to be the most accurate, widest frequency response loudspeaker ever produced by JBL for the home market. Greg Timbers was given overall responsibility for the engineering with assistance from Steve Lyle and direction by product manager Lorr Kramer. The system was unique in that it was the first example of a subwoofer/satellite speaker system using a powered subwoofer. The separate subwoofer was the key to the extended bass response that was flat to 25 Hz. It utilized a custom-developed bass driver that was an evolution of the 2203 developed for the 4315 monitor. A 75-watt amplifier was integrated into the subwoofer enclosure so that external amplification was only applied to the individual left and right satellite loudspeaker systems.

The L212 also drew from the 4315 in its use of a domestic version of the 2108 mid-bass driver. That driver had exceptional linearity and control due to its unique use of a 3" voice coil in an 8" driver. A customized version of the LE5 was adapted for this system, and high-frequency response was handled by the 066 soft-dome tweeter that had previously been introduced in the L166. The three drivers in each satellite system were packed into a tight array that resulted in exceptional coherency. The satellites were also unique in being the first JBL speakers to have their components time aligned, which resulted in pinpoint imaging. The overall system more than met its goal of providing the highest level of performance yet achieved by a JBL loudspeaker.

However, the L212 was not the success that was hoped. It met with limited sales and was discontinued by 1979. The precedent-setting nature of its design was part of the reason for this disappointment. JBL had become stereotyped by the success of its large, horn-based systems, so that an all-direct-radiator system seemed heretical for JBL's top-of-the-line. The L212 also had an Achilles heel that went to the heart of

L212

Northridge Plant and Headquarters circa 1980

JBL's reputation. In hindsight, the subwoofer was too small and underpowered to match the brand's hallmark of unparalleled dynamic range. None of this diminishes the L212's place in the JBL's legacy of excellence. The legendary L250 and very recent Performance Series draw a direct line to the concept and technologies embodied in the L212.

The last significant event of the first Harman era was JBL's sixth and final move of their corporate headquarters and plant. The Casitas Ave facility, JBL's headquarters since 1957, had long been outgrown as a consolidated facility for all of their operations. By the mid-1970s, the furniture shop had been relocated to a former aircraft hangar at the old Glendale airport, while transducer, network, and electronics operations had been relocated to a building near the Burbank airport. This geographically dispersed setup was creating inefficiencies, and in 1976, a search was begun for a new site that could house all of JBL's operations.

Suitable property was discovered in Northridge that was then owned by RCA as a facility for research and manufacture of marine electronics. RCA was in the process of abandoning this line of business so that the property became available. In addition to a number of existing buildings, there was a large section of undeveloped property on a site that totaled 44 acres (17 hectares) in size. In 1976, JBL leased a portion of the facility, with an option to buy the entire site. The management, engineering, accounting and communications offices were immediately moved into the leased portion. An agreement was subsequently reached to purchase the entire site and plans were drawn up for the development of a 420,000 square foot (42,000 square meter) manufacturing and warehousing space. Construction began in March 1976 and was completed in November 1978. At that time, JBL consolidated all of their operations into the new facility on Balboa Boulevard and which has remained the corporate headquarters to this day.

Conglomerates and the Audio Industry

When audiophiles first discover that JBL was once owned by Beatrice Food Corporation, it usually leads to the question: "What possible interest could a food company have in JBL?" The answer lies in an American business phenomenon that arose in the late 1950s and culminated in the 1970s. That phenomenon was the growth of the multinational conglomerate. This was a corporation that was made up of a number of seemingly unrelated companies, that operated independently, but under the umbrella of a controlling interest. The philosophy behind the conglomerate phenomenon was the belief that diversification would lead to greater opportunities for growth, and for firms that competed in cyclical markets, would lessen the impact of market fluctuations.

This philosophy gained hold with Beatrice management in the 1960s. Prior to that period, the company had been founded and operated solely within the food processing industry. This was a mature market with low profit margins and little opportunity for growth. Over the next two decades, the company went on a buying spree, picking up such disparate brands as Avis car rentals, Samsonite luggage, Airstream trailers, and of course, JBL.

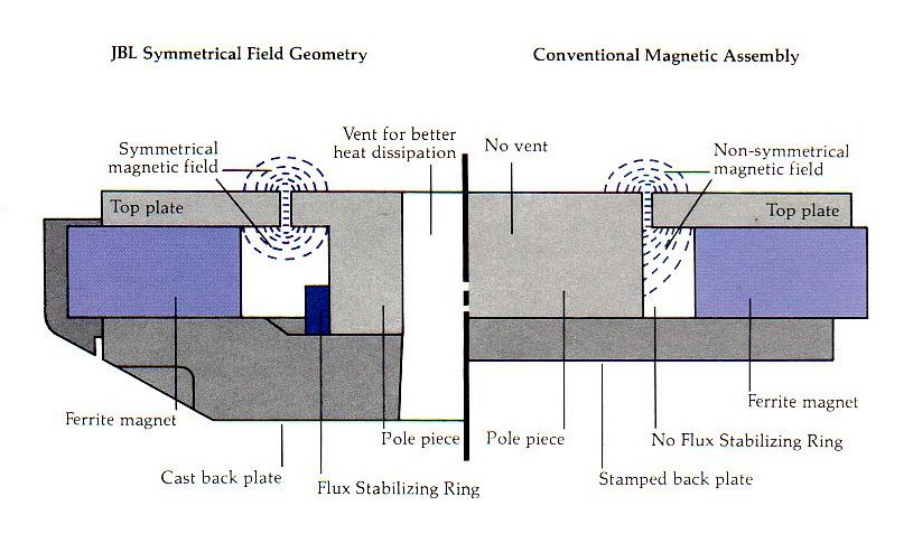
While conglomerates continue to exist, the phenomenon fell into disrepute in the 1980s, with many falling by the wayside. The great weakness of conglomerates was that their expansion was usually financed by borrowing, which resulted in massive debt loads. Running dozens of disparate companies proved difficult for any one management team, so that the expected growth in profits often did not materialize. This left conglomerates vulnerable to another business phenomenon — the leveraged buyout. This befell Beatrice when they were taken over by Kohlberg Kravis Roberts & Co in 1987 with the sole intent of dismantling the company in hopes that the individual parts could be sold off for more than the cost of acquisition for the parent company. By 1994, this dismantling was complete and Beatrice ceased to exist.

JBL was not the only audio company to fall victim to the conglomerate phenomenon. JBL's time under Beatrice's control was relatively short, and it eventually re-emerged as part of the reformed Harman International family of audio companies without significant long term damage. The same cannot be said of their arch-rival Altec Lansing.

Altec was taken over by a conglomerate named Ling Temco Vought (LTV) in 1959. LTV had a reputation of wringing profits from their acquisitions by reducing costs, while minimizing investments in research and development. This had the effect of increasing short-term profits at the expense of long-term growth. LTV recognized the short-term nature of this approach and made it part of their strategy to divest themselves of such companies in public share offerings just before they reached the point of unprofitability.

This is the fate that befell Altec Lansing. In 1972, LTV spun off that company and saddled Altec with considerable debt that they had no hand in making, as a means of improving the parent company's bottom line. At a time when the audio industry was experiencing explosive growth, Altec was financially handcuffed, unable to make the investments necessary to expand and enter new markets. It became a significant factor in their inability to fend off JBL as they inexorably encroached on the traditional markets that had once been the monopoly of Altec Lansing.

Symmetric Field Geometry (SFG) Motor



The Great Alinico Ferrite Debate

Within the audiophile community, a number of myths have developed over the circumstances behind the industry's conversion from Alnico to ferrite magnets. Most regard a cost cutting conspiracy with the belief that acoustic quality was sacrificed strictly to cost concerns. JBL's own marketing was complicit in establishing these myths, since they had spent decades touting the superiority of their Alnico magnets in comparison to the competition's use of ferrite. When JBL converted all of their bass drivers to ferrite in 1979 without a clear explanation of the root cause, it was widely perceived to be strictly an economic issue. This was reinforced by the fact that the world economy was in the midst of an extended period of high inflation causing numerous companies to reduce product quality in an effort to stem rising prices.

One of the more enduring myths was that the new ferrite drivers lacked the magnetic energy of their Alnico counterparts. This was certainly not the case in JBL's product line. To be able to continue production of the speaker systems in their catalogs, the ferrite bass drivers had to be the exact sonic equivalents of the Alnico drivers they replaced. Otherwise, the entire systems would have to be re-engineered and there was no time to do this, given the supply crisis. For example, the L300 Summit, both before and after the ferrite bass driver conversion, used the exact same Alnico tweeter, Alnico compression driver, enclosure and network. The only change was that the 136A driver had its Alnico motor replaced with ferrite to become the 136H. The basket, cone and suspension remained identical. The only way this could work was if the ferrite motor had the exact same magnetic energy as the Alnico structure.

As previously stated, Alnico as a magnetic material has intrinsic advantages in heat stability and resistance to flux modulation compared to ferrite. This doesn't mean that products using ferrite are inherently inferior. It is possible to engineer out these deficiencies and this is exactly what JBL did with their SFG topology and use of shorting rings. The resulting drivers were measurably superior to their Alnico predecessors.

However, it was and remains difficult to convince true believers of Alnico loudspeakers' superiority that equivalent or better results can be had with ferrite drivers. This is best illustrated by an interesting anecdote that occurred during the introduction of JBL's ferrite products. JBL arranged demonstrations to industry and press representatives where an existing Alnico system would have its bass driver replaced with a new ferrite version. In one such demonstration, a noticeable sonic difference was detected. The Alnico driver was measured and found to be partially demagnetized. This resulted in a 1-2 dB drop in output in the midbass region. Deep bass was unaffected since system response in those frequencies was more dependent on enclosure tuning than driver characteristics. Those who preferred the Alnico drivers were found, after investigation, to prefer a partially degaussed Alnico unit's frequency response to that of an equivalent ferrite or original-spec Alnico transducer.

Alnico driver demagnetization was the dirty little industry secret of the time. Due to Alnico's low coercivity, it is very easy to demagnetize. The power-on "whomph" of older amplifiers was often enough to result in some degree of demagnetization after only one occurrence. Because the chances of momentarily overpowering an Alnico driver are near impossible to avoid over any extended period, just about any vintage Alnico loudspeaker can be expected to have some degree of demagnetization. This deficiency in Alnico transducers would remain until addressed very recently by JBL with their 1500AL bass driver.

The Beatrice Era (1977 -1980)

Background

The year 1977 saw another momentous corporate change at JBL when Harman International was sold to Beatrice Foods Co.

Dr. Harman had established a reputation for success and innovation in his management of Harman International that came to the attention of President-elect Jimmy Carter. Carter approached Dr. Harman with an offer to join his administration as Deputy Secretary of Commerce, which was accepted. This government position would have responsibility in regulating industry; potentially impacting Dr. Harman's personal financial interests as represented by his majority shares in Harman International. The President-elect's counsel indicated that the potential for perceived, if not real, conflict of interest would require him to divest his business holdings as a condition of joining Carter's administration. Dr. Harman accepted this requirement and began to seek out a buyer for his equity position.

The year previous to Dr. Harman accepting a position in government, he had been approached by Beatrice on a number of occasions with offers to buy Harman International which he had refused. In 1977, Dr. Harman contacted Beatrice with the news of his change in circumstance to see if they remained interested in acquiring his holdings. A sale was negotiated and all of the companies formerly owned by Harman International became subsidiaries to the Beatrice conglomerate.

Beatrice installed management staff at JBL to represent the interests of their corporate headquarters. They all had backgrounds that were outside of the loudspeaker industry, and this inexperience led to some degree of conflict with remaining members of the previous management team. New management's primary focus was on expanding market share, particularly in the mass market. However, before significant change occurred in the product mix, world events overtook the new owner's business goals resulting in an unexpected and serious problem.

The Alnico Crisis

From the very founding of company, the motor technology used in the vast majority of JBL transducers was based on Alnico V magnets. This material has a high energy-to-weight ratio, very good heat stability and high resistance to flux modulation. However, it has one significant disadvantage that was little publicized at the time: the susceptibility to permanent partial demagnetization when exposed to high current. At the time, the advantages of using Alnico V outweighed this shortcoming. Circumstances would change in 1978 when, for a period of time, Alnico V became commercially unavailable. JBL was faced with the prospect of being unable to manufacture any products if they did not change their motor technology.

The problem developed as a result of a civil war that broke out in the Democratic Republic of the Congo, then known as Zaire. Alnico V utilizes cobalt as one of its primary ingredients. At the time, Zaire accounted for over 60% of the world's production of cobalt. Rebels invaded that country from Angola, and in May, 1978, the cobalt mines in the Kolwezi region were taken and flooded. Zaire's cobalt production was effectively shut down. Considering that most of the remaining cobalt producers were either behind the Iron Curtain or tied up by the defense industry, the net effect was that cobalt was largely eliminated from the commercial market.

The simplest answer to this situation was to substitute the widely available ferrite magnet material in place of Alnico V. This required a new motor topology. Because of Alnico's high energy-to-weight ratio, the magnets could be small enough to be housed internally in the motor, underneath the pole piece. The lower energy-to-weight ratio ferrite magnets needed much more material to achieve the same total flux of their Alnico counterparts. The resulting motor used an external magnet topology in conjunction with a massive iron pole piece that connected directly to the back plate.

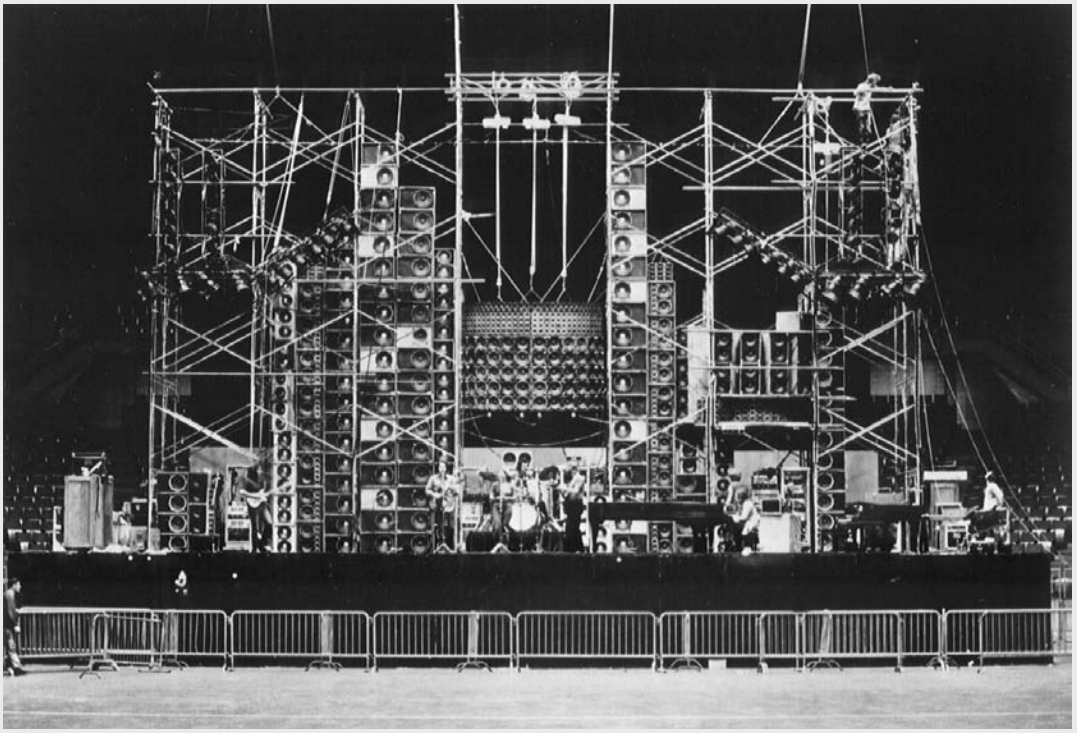
A number of prototype ferrite bass drivers were developed by JBL's engineering department that were meant to be exact replacements for existing Alnico drivers. These were placed in sample production speaker systems and subjected to listening tests. The results of the listening tests were unambiguous. The new ferrite drivers were audibly different and the consensus was that they sounded worse. A team of JBL engineers led by an Terry Sorensen, and including Mark Gander, was given the task of investigating these new drivers to determine the technical reasons for this deterioration in performance.

The team discovered two factors that were causing distortion in the new drivers. Both were related to the new external magnet geometry and its use of a massive iron pole piece. The first had to do with unsymmetrical flux fields above and below the voice coil gap. Transducers which use voice coils longer than the gap depth (as in the majority of JBL's bass drivers at that time) are exposed to fringe flux fields that radiate above and below the gap. Due to the influence of the pole piece, the fringe field below the gap was much stronger than that above the gap. This created second-order harmonic distortion at large excursions, which was addressed by undercutting the pole piece so that it was removed far enough from the gap to no longer influence the fringe field. This technology was trademarked by JBL as Symmetrical Field Geometry (SFG), a technology that continues to be employed in JBL's ferrite drivers.

The second factor that Sorensen and Gander discovered had to do with the magnetic permeability of the massive iron pole piece. It allowed the magnetic field from the coil to

L220

© Harman International, Courtesy Mark Gander and John Eargle



Grateful Dead "Wall of Sound" using JBL Speakers

© and Courtesy Richard Pechner (For Usage Contact: rpechner@comcast.net)

couple back into the magnetic structure, which also resulted in second-order harmonic distortion. This was solved by installing an aluminum ring at the base of the pole piece, which shorted out the induced field. With this last modification, the converted transducers generated lower distortion than their Alnico predecessors at all operating frequencies.

With the technical problems behind them, JBL introduced a complete line of ferrite bass drivers in 1979. The conversion effort had initially focused on bass drivers since they represented the largest consumption of magnets. By the time that part of the conversion was complete, France, Belgium and the USA had interceded in the civil war and the cobalt mines were back in production—albeit at reduced output. Alnico magnets became available again at higher cost. JBL decided to continue the manufacture of Alnico compression drivers for the time being to avoid the costs of conversion. This continued until 1982, when it was decided that the long-term economies of switching to ferrite could no longer be ignored. Ferrite versions of JBL's complete line of compression drivers were introduced that year, although an Alnico version of the 2441 would continue to be produced until 1991 for those willing to pay the high price.

Home Speaker Endeavors

As previously stated, the Beatrice era focus was mainly on expanding the mass market presence. However, there were a couple of significant developments in the higher end products. To begin with, the Beatrice years marked a turning point in engineering. Whereas loudspeaker design by all manufacturers prior to the 1970s took a largely empirical approach, the end of the 70s saw JBL's engineering efforts firmly in the realm of science and engineering. 1977 saw the introduction of the JBL's first speakers developed using Thiele-Small parametric design. A new engineer named Mark Gander (the current Vice President of Marketing for JBL Professional) was instrumental in introducing this and other technological advances. It resulted in such superlative designs as the L110.

At the highest end, JBL introduced the L150 and L220. Both systems were large tower designs using passive radiators to augment deep-bass response. The L150 was a version of JBL's 3-way bookshelf monitor with the addition of a 12" passive radiator. The L220 was unique in its introduction of a new ring radiator, the 076. This device used the chassis common to all JBL ring radiators, but added a long, oval exit horn. The main parameter for designing this horn was its length, since it allowed the driver to be set back far enough into the enclosure to be time aligned with the rest of the system drivers. The L220 was also unique in the use of an acoustic lens over a variant of the LE5 midrange to control its dispersion. The low frequencies were covered by an LE14H mated to a 15" passive radiator.

Professional Market Expansion

The Beatrice era marked a turning point in JBL's endeavors in the professional market. In 1979, Ron Means was hired from Altec Lansing to head JBL's professional division, and over the next 16 years, he would lead an unprecedented expansion. Even though JBL had made significant headway in this field, it was still considered a niche in comparison to the home speaker business that had been at the forefront of JBL's success since its founding. This would change in the coming decade as Means expanded JBL's share of the professional market to the point that it rivaled the home speaker business.

This expansion began with Means's restructuring of the professional division. He put in place new staff that was committed to this line of business and began organizing operations around the concept of vertical markets. Instead of treating the professional industry as one field, he ultimately organized JBL around five separate segments that had dedicated staff for marketing and product development, but utilized common engineering resources. These vertical markets were Cinema, Installed Sound, Portable Sound, Recording & Broadcast and Tour Sound. Over his 16 year tenure, sales at JBL Professional increased tenfold.

Means had a solid footing to begin his expansion. As previously described, JBL dominated the studio monitor field and was using these same products to stake out a major presence in the installed sound market. At the same time, JBL was building upon a legacy of products for musicians that had started with the "F" series of drivers in the 1960s, to expand into two what became two of the new vertical markets—tour sound and portable sound. While related, the two fields are distinct with the first regarding complex mobile sound systems for very large audiences in very large venues, and the latter regarding individual musical instrument loudspeakers and individual public address (PA) systems for small venues. The target market for tour sound systems tend to be tour operators and sound contractors while portable sound products are primarily aimed at the retail level.

Tour sound was the older of the two fields, having evolved from the 1960s. However, it was the 70s that saw it rapidly expand into a significant market segment, during which time JBL realized an opportunity to become the premier supplier. This period saw popular acts (rock musicians in particular) move out of theatres and into arenas, stadiums and even larger facilities so that greater audiences could be accommodated during tours. This placed immense demands on sound reinforcement to provide a large and distant audience with a satisfying sonic experience. Initially, tour operators turned to the cinema sound vendors because those manufacturers were the only ones with experience in high output sound reproduction. Since Altec Lansing was the premier cinema sound supplier, their products were often used to meet the requirements of the early tour sound market. Altec's 604 Duplexes, A2, A4 and A7 Voice of the Theatre systems all found their way into the emerging tour sound companies' inventories.

However, Altec did little to encourage this market. Their products were never designed for the high output levels used in rock tours, and which exceeded the levels required in the cinema market from which they originated. As a result, Al-

Mark Gander

© Don McRitchie

Mark Gander has been instrumental in establishing and maintaining JBL Professional's position as the premier sound manufacturer in the industry. His background gave him a unique insight into the requirements of the professional sound user that he drew upon in his initial work at JBL. However, it is his continual efforts to understand the needs of JBL's customers and the relationships that he has established with them that have become his greatest asset.

Gander joined JBL in 1976 with a unique education and work background. He obtained a Bachelor of Science and a Masters of Science in Electrical Engineering from Syracuse University and the Georgia Institute of Technology respectively. Both institutions allowed wide latitude in Gander's coursework and he undertook a multidisciplinary study program that included acoustics, audiology, engineering, science and music. While at Syracuse, he pursued an avocation in professional sound by spending considerable time with the university radio station and concert board (responsible for campus concerts). More important to his subsequent career, Gander spent the two year period between his undergraduate and graduate studies as a full time sound engineer, working with artists such as Muddy Waters, Orleans and Garry Burton.

After joining JBL, Gander initially worked as a transducer and systems engineer. He was heavily involved in the Alnico/Ferrite conversion, with primary responsibility for developing the "E" series of musical instrument speakers. On the systems engineering side, he was responsible for such loudspeakers as the L40, L50 and L220. In 1980, he switched positions to become the applications engineer for the newly restructured Professional Division where he provided advice and expertise to JBL's professional customers. In 1981, he accepted a new role as the sole product manager for professional products, becoming the architect for the surge in Pro product development throughout the ensuing decade and beyond,

In 1984, JBL Professional was restructured into an independent corporate entity within Harman International and Gander became its first Vice President of Marketing. Particularly in this position, Mark used his background, understanding and contacts in the industry to establish relationships with JBL's customers. This resulted in numerous partnerships whereby JBL became the primary supplier of components to major clients that developed systems under their own corporate name. Moreover, Gander's deep understanding of the industry has resulted in product and marketing direction that has anticipated the industry's changing needs, often long before the competition. The EON® and VerTec® series are just two recent examples of groundbreaking products that have resulted from this understanding.

Finally, Gander has an unofficial role at JBL that is very significant to the readers of this article. Gander, along with John Eargle, have become the "keepers of the flame" in maintaining the company's history. Gander single-handedly developed and maintained JBL's historical archive. Both Gander and Eargle were the initial contacts at JBL for the Lansing Heritage founders and became mentors in the development of that website.

Promotional Photograph of Cabaret Series Illustrating (left to right) 4602, 4680 and 4622

© Harman International and Courtesy Mark Gander

tec was being inundated with repairs on drivers that had failed due to being overdriven. Since their profit margin on repairs was low, they resisted expanding into tour sound, believing it was not worth the headaches that would result from trying to service that demanding application.

It was at this time that the new industry discovered JBL. As previously described, JBL had developed the ruggedized "F" series of drivers for the musical instrument field and these transducers proved ideally suited to tour sound requirements. Further, JBL had an intrinsic advantage in their use of 4" diameter voice coils on all of their large drivers in contrast to Altec's standard 3" voice coil diameter. The larger coils could carry more current and dissipate heat more effectively due to their greater surface area.

JBL made a major effort to foster this growing industry and worked to solve its problems. Phenolic diaphragm versions of their compression drivers were developed to increase their power handling and output. Huge rock festivals, starting with the famous Woodstock event and continuing with Watkins Glen and Cal Jam, assembled massive, unparalleled sound systems utilizing JBL components. Existing JBL enclosures such as the 4520 and 4530 "Scoops" found widespread acceptance in tour sound application. In the 1970s, JBL went on to market new enclosures specifically designed for that industry in what proved to be an interesting reversal of Altec's experience. Where Altec cinema products initially found their way into the tour sound industry, JBL developed tour sound enclosures like the 4550 and 4560, which later gave JBL an entry into the cinema venues.

The Beatrice era marked a milestone when JBL consolidated their position as the premier tour sound supplier. They were shrewd in not going head-to-head in competition with the existing firms that built tour sound systems. Over the coming years, Mark Gander led the establishment of partnerships with theses companies, providing sound system components and expertise, while allowing these third parties to build complete systems and market them under their brands. This collaborative approach resulted in JBL greatly expanding their sales and market position.

Portable sound was the second market segment into which JBL expanded during the Beatrice era, and this expansion marked one of the most significant developments in the evolution of JBL Professional. It was unique in that it was an application that they largely established and defined. More important, it has subsequently grown to become the largest of JBL's five vertical markets.

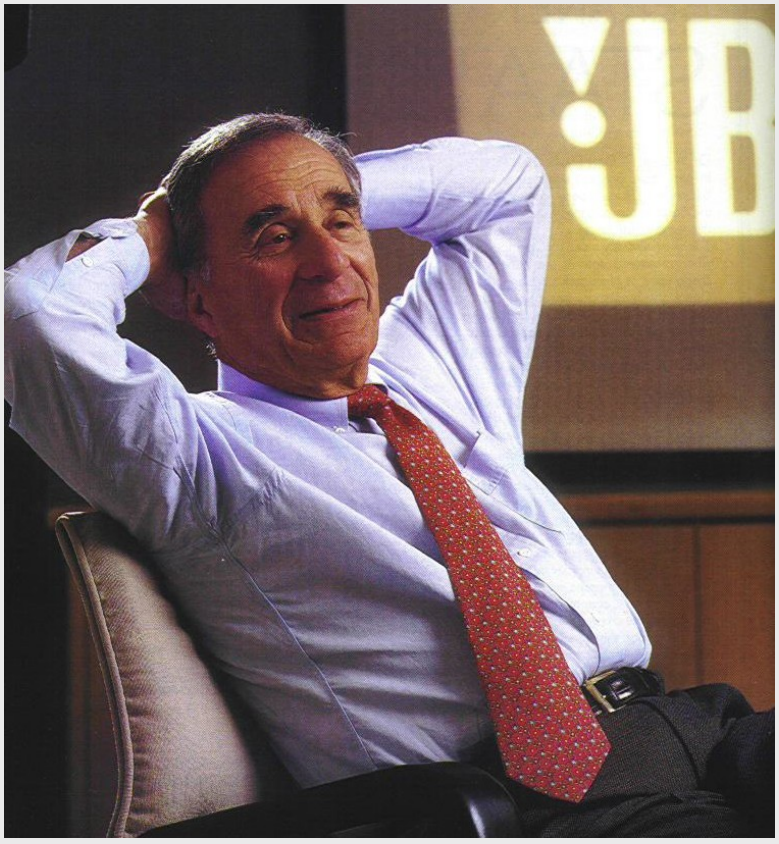
The development and expansion of this market segment was a direct result of JBL's introduction of the Cabaret Series of loudspeakers in 1978. This series is widely credited with being the first full line of portable PA systems for the musician and music store market. Prior to their introduction, musicians were reliant on sound companies that built custom loudspeaker systems using third party components, or they used loudspeakers from other applications in this field. For example, modified versions of Altec's A7 cinema loudspeaker became a mainstay PA system for musicians that performed in small venues.

Mark Gander took the lead role in the development of this series and engineering the individual loudspeaker systems. In the mid seventies, there had been a number of product requests made by the marketing department for portable loudspeaker systems for musicians' use that had never been acted upon. Given Gander's background in the music and sound industries, he recognized the significance of this potential market and championed the development of a new product line. In 1978, he developed a feasibility study for what became the Cabaret series and subsequently received management approval for production. One unique aspect of this study was the involvement of Doug Warner in developing preliminary design renderings. JBL had long recognized the significance of industrial design in enhancing the desirability of their home loudspeakers and studio monitors. However, products for the musicians' market were usually considered utilitarian, with little attention given to aesthetics. The incorporation of industrial design as a key aspect of the Cabaret series was innovative and a factor in its ultimate success.

The series launched in 1979 with three products: the 4680 line array for PA use (four K110s and two 2402s), the 4622 guitar cabinet (two K120s), and the 4602 floor monitor (K120-8 and 2402). These products gained immediate acceptance, since they were directly designed for the touring musician and not a compromised adaptation of an existing loudspeaker. For example, in comparison to the widely used Altec A7 PA system, the 4680 was much more compact, and therefore, much easier to transport and set up. Unique features included optional covers, corner mounts for stacking, integral recessed handles and spring loaded caps for the phone connectors. Sonically, these speakers were a marked step up from their competition. It is especially worth noting that the line array concept pioneered in the 4680 is now an industry standard.

The success of the initial three products led to an expansion of the Cabaret series into a wide range of loudspeakers with specialized designs for keyboard and drum reinforcement in addition to guitar and PA applications. The modular nature of these systems was also stressed so that users could start small and build up larger sound systems in a building block manner as their needs expanded. As with the studio monitor series, it became apparent that these products had application to the installed sound field and aesthetically appropriate versions were developed for permanent installation in churches, ballrooms and clubs.

While conceived and launched during the Beatrice era, the Cabaret series became a mainstay product for JBL for over a decade. In addition to defining the portable sound market segment, they helped JBL consolidate their leading position in professional sound in general. They would not be replaced until 1991, with the introduction of the SR and MR series, and paved the way for the current wildly-successful EON product line.



Dr. Sidney Harman

JBL Installation at the Academy of Motion Picture Arts and Sciences
Samuel Goldwyn Theatre

The Second Harman Era (1980—Present)

Background

Dr. Harman's service in the Carter administration ended in late 1978. He returned to private industry with the intent of re-entering the audio market. By that time, it was apparent that Beatrice was having a difficult time in the audio industry. Their total lack of experience in that field, combined with the fact that the audio companies played a relatively small role within the large conglomerate, meant that the former Harman International firms were subjected to uninformed management. It resulted in a number of marketing and product decisions that ended up hurting their profitability. Therefore, when Dr. Harman approached Beatrice about the possibility of reacquiring his holdings, they were more than willing to negotiate.

The major brands under the Harman International banner at the time of the original Beatrice acquisition had been Harman Kardon, JBL, Ortofon and Tannoy. In 1980, an agreement was reached whereby Dr. Harman would purchase only JBL back from Beatrice. Harman/Kardon had previously been sold to Shin-Shirasuna, the Japanese company that was Harman/Kardon's OEM supplier, while Tannoy and Ortofon were spun off separately. Due to the prior divestiture of these subsidiaries, and the deteriorated financial condition of JBL, Dr. Harman was able to re-acquire it for a fraction of the sum that Harman International had brought when it was sold to Beatrice only three years before. Dr. Harman reestablished Harman International with JBL at the forefront and worked to restore and expand their market presence. He also set out to ensure that Harman International regained its presence in the wider audio market through the acquisition of a number of corporations representing different sectors of the industry. The company he co-founded, Harman/Kardon, was one of the first of these new acquisitions.

The Last Altec Bastion Falls

As has been related throughout this article, JBL continually went up against Altec Lansing in the professional field; and over time, gradually wrested away market share with product innovations and astute reactions to market changes. By 1980, there remained one field of endeavor that had stubbornly resisted 30 years of JBL's efforts to gain entry: the cinema sound industry. Ever since the 1945 introduction of the Altec Lansing Voice of the Theatre (VOTT) loudspeakers, those systems had established an industry standard that was seemingly immovable. It would take a convergence of five disparate developments, one of which was a change in standards, before JBL would successfully challenge Altec in this market segment.

The first development was JBL's introduction of the Bi-Radial® horn series. These products were JBL's version of a class of horns known within the industry as constant directivity, or CD horns. The CD horn was invented by Don Keele in 1973 when he was employed by Electro-Voice. Up until that time, the vast majority of horns were of the exponential type, which had first been mathematically defined by Bell Labs in the 1920s. However, all horns of this type suffer from narrowing dispersion as frequency increases, to the point where high-frequency reproduction is confined to a narrow beam. This dispersion pattern is actually complementary to the physics of compression drivers. Their use of large metal diaphragms results in the phenomenon of mass rolloff, whereby the weight of the diaphragm constrains output as frequency increases. Exponential horns act to equalize this response on-axis at the expense of uniform dispersion.

Don Keele's solution was to use a diffraction slot built into the horn throat which maintained constant acoustic energy, regardless of frequency, in one plane (usually horizontal) and complex sidewall contours to maintain constant output in the remaining plane (usually vertical). Don Keele subsequently became an employee at JBL, and in 1980, refined his CD concept into the Bi-Radial® design. The biggest advance in the JBL version was that Keele was able to develop a more accurate mathematical model for the required horn contours so that the resulting Bi-Radial® horn removed response discontinuities that had been present in the earlier designs. While solving the dispersion issue, these horns did not address the frequency roll-off limitation of compression drivers. However, this issue was easily dealt with through equalization in either the network or amplification.

The second development was a seminal paper that was presented by JBL's John Eargle and Mark Engebretson of Advanced Technology Designs Corporation at the 1981 spring Audio Engineering Society (AES) convention. This paper, titled "State-of-the-Art Cinema Sound Reproduction Systems: Technology Advances and System Design Considerations," delineated the severe limitations in existing cinema loudspeaker performance and described innovative technologies that had the potential to overcome them. One of the central approaches was Don Keele's Bi-Radial® horn design.

In conjunction with the presentation of this paper, a demonstration of the available new technologies was arranged at the Academy of Motion Picture Arts and Sciences theatre in Los Angeles. JBL assembled a prototype loudspeaker system consisting of bass modules utilizing the 4508 enclosure with two 2225 drivers and a high-frequency section consisting of the 2441 compression driver and 2360 Bi-Radial® horn. These loudspeakers were used in conjunction with four newly-developed 2245 18" subwoofers.

The demonstration was a resounding success, with many audience members expressing astonishment at the level of performance. The industry standard VOTT systems had nowhere near the bandwidth of the JBL prototype. Further,

The Decline of Altec Lansing

© Altec Lansing Technologies

The photo at left is an aerial view of the longtime home of Altec Lansing Corporation in Anaheim, California. It was the closure of this plant in 1983 that signaled the long-protracted decline of the company. It was located immediately adjacent to Disneyland, whose success had driven up local property values. Altec's management decided to sell the property to realize that appreciation. Operations were then consolidated at their University Sound plant in Oklahoma City. As part of this reorganization, Altec's home speaker division was shut down and the brand rights were licensed to Sparkomatic, which would later be renamed Altec Lansing Technologies.

Altec Lansing entered into voluntary bankruptcy that same year, from which they re-emerged in 1984. The next year, they were purchased by Gulton Industries, which had previously purchased Electro-Voice. Gulton itself was absorbed by Mark IV Industries in 1986. In 1997, the Mark IV audio companies, including Altec, were sold to an investment company called Greenwich Street Capital Partner and merged into a subsidiary with Electro-Voice called EVI. In 1998, EVI shut down the Oklahoma City plant and thus ended Altec's half century run as both a pioneer and leader in the sound industry.

However, this was not the end of the Altec Lansing brand. In 2000, EVI sold the remaining brand name rights to Altec Lansing Technologies, which was then focused on the PC speaker market. In 2002, they opened a new professional division staffed by former EVI management. This division has reintroduced many of the classic Altec designs including the 604 Duplex, 515 and 288. In 2003, the company reintroduced the classic A7 Voice of the Theatre to the home market and that loudspeaker system remains in production as of this writing. They have subsequently introduced a number of new products and technologies as they pursue the difficult task of restoring the Altec Lansing brand to the professional marketplace.

UREI Background

© Harman International, Courtesy Mark Gander

UREI stands for United Recording Electronics Industries. It was founded by Bill Putnam in the 1960's as Universal Audio, a small manufacturing arm of his larger recording studio business — Universal Recording Company (later United Recording and United Western). Bill was one of the most respected recording engineers in the business. He was Frank Sinatra's favorite engineer and worked on many of the singer's most renowned recordings.

Putnam was instrumental in developing many of the technological innovations that have become standards in the recording industry. Word of Putnam's innovations in developing home-built equipment for his studio spread throughout the industry and resulted in demand for him to manufacture and sell his products. This was the genesis of what would ultimately become UREI. One of Putnam's home-built products that gained significant word-of-mouth was a customized monitor that was the prototype for the 813.

The original prototype was an evolution of the Big Red monitor developed by Sherwood Sax of Mastering Lab and manufactured by Audio Techniques of Stamford, Connecticut. It was based on the Altec 604. The major innovation of the Big Red was to replace the standard crossover with a customized design that tamed the ragged midrange response characteristic of all 604/605's of that era. It resulted in a much smoother response that refuted the long-standing reputation of the 604 as being a "fatiguing" monitor.

Bill Putnam worked with Dean Austin, Ed Long and Dennis Fink of UREI to further improve the 604. The multi-cell horn of that driver had relatively poor directional control and poor loading at crossover, which contributed to the harsh and ragged response. The 813 was developed with a customized, flared horn that had tighter pattern control. It also used a revised crossover designed by Ed Long, which introduced the patented Time Align® concept that allowed the 604 to operate as a time-coherent point source.

The original 813 was installed in Putnam's own United Western (now Ocean Way) recording studios in the mid-70s. Outside mixers and engineers who booked time in these studios were very impressed with this new monitor and pressured Putnam to manufacture and sell the 813. In 1976, UREI expanded its field of operations and entered into the monitor business.

The original 813 used a modified 604-8G along with an Eminence helper woofer and Ed Long's Time Align crossover. Interestingly, the main purpose of the Eminence woofer was not to extend bass response but rather to increase overall output. The 604 was prone to failure at high output levels. The additional woofer allowed UREI to increase the power handling of the 813. To this day, unless flush mounted in a wall and equalized, the 813 has a reputation of being somewhat bass shy. The 815 was also introduced at this time: a monster monitor that contained two Eminence helper woofers for a total of three 15" drivers. The line was rounded out by the 811, the UREI-modified 604 in a compact cabinet without the supplemental woofer.

In 1979, Altec introduced the 604-8K as the ferrite replacement for the Alnico 604-8H. The new driver was found to sound quite different, mainly due to changes in horn throat geometry, leading Putnam and Dean Austin to make further revisions to the 813. A new horn was introduced that added foam padding to the interior of the horn and a foam extender on the horn mouth to soften the cutoff frequency characteristics. Putnam also included small Helmholtz resonators on the internal side walls of the horn to trap a persistent 3 kHz spike in the 604 response. The network was redesigned to accommodate the driver changes and the new system became the 813A; The 811 and 815 were similarly redesigned and became the 811A and 815A.

During the late 70's and into the early 80's, Altec was experiencing significant quality control problems. At the time, Altec was headed towards bankruptcy and the eventual closure of the Anaheim facility. It resulted in such poor product consistency that UREI was rejecting as much as 95% of the incoming Altec drivers. UREI became an authorized Altec repair center just to ensure they would have enough stock on hand to build the 813. It led UREI to ultimately seek a replacement for the 604.

UREI initially considered Tannoy, Emilar, and Gauss products, but none would meet their requirements. Ultimately, they became interested in PAS, which had a unique 15" bass driver that could accept a high-frequency compression driver of the user's choice. UREI was favorably impressed with JBL's 2425 compression driver and mated it to a customized PAS transducer. This became the basis of the 813B, introduced in 1983. Again, an Eminence helper woofer was employed. This was a very successful design and led to a healthy upgrade business for UREI in converting 813A's to 813B's.

In 1982, Bill Putnam's wife died and he began to lose enthusiasm in the business. Harman International expressed interest in the firm, and UREI was sold in mid-1983 to become a division of JBL Professional. Dean Austin moved over to JBL and became responsible for the ongoing design of UREI monitors. In 1984, the 813C was introduced as an all-JBL product. It replaced the PAS/JBL driver with the 801C, a coaxial mounting of JBL's E145 and 2425H drivers. It also replaced the Eminence helper woofer with the 2215H (the pro equivalent of the LE15H). This was the most successful 813 yet. Dean went on to design the very successful 12" 809, which remained in production until Harman International discontinued the brand in the mid-1990's.

the hybrid horn/reflex enclosures, which were at the heart of the VOTT, had an inherent uneven response in the midbass region that was eliminated in the direct-radiator JBL prototype. Finally, the even coverage of the Bi-Radial® horn was far superior to the uneven dispersion of the multicellular horns that were the staple of the VOTT.

This demonstration directly led to the third and fourth developments on the path to JBL's dominance in the cinema market. In the audience for that demonstration was Dan Ross, head of operations for the Academy of Motion Picture Arts and Sciences. In 1983, under Ross's direction, the Academy undertook a complete renovation of their theatre, including the replacement of their sound system. Ross's favorable impression from the AES demonstration led him to contract with JBL to provide a state-of-the-art loudspeaker system based on their cinema prototype. It resulted in a prestige installation that became a showcase and advertising focal point for JBL's cinema endeavors.

Around this same time, Tomlinson Holman of Lucasfilm began development of what would become the THX standard. This is a standard and certification process for motion picture recording and playback designed to ensure consistency in moviegoers' listening experiences. Holman had heard about the AES demonstration and its overwhelmingly positive response. He asked JBL to provide samples of their drivers and systems for use in developing the playback portion of the standard. As a result, JBL gained bragging rights in that the THX standard had been developed on the basis of their products, along with the fact that their speakers were the first to gain THX certification.

The fifth and final development that sealed Altec's fate started with the rapid adoption of the THX standard. First published in 1983, the next year saw a dramatic increase in demand for cinema loudspeakers as theatre owners rushed to upgrade their sound systems to gain THX certification. In contrast, by 1984, Altec Lansing was in disarray. As a means of raising badly needed capital, Altec had sold off their longstanding Anaheim, California headquarters and plant and was in the process of consolidating operations in the Oklahoma City facility of their University Sound subsidiary. For a period of many months, Altec was unable to ship any products as their manufacturing equipment was being disassembled in Anaheim and reassembled in Oklahoma City. JBL found themselves in the position of being the only available supplier of cinema sound systems at a time when demand was spiking.

This proved to be a fatal blow to Altec Lansing from which they never really recovered. They would be absorbed by Gulton Industries in the first of a long line of ownership changes that ultimately resulted in Altec Lansing Technologies gaining the brand rights. While currently known principally for their computer speakers, they are working to re-establish the Altec Lansing brand in the wider audio market.

The technical achievement behind JBL's 1980s theatre speakers represented an historic milestone. This is best illustrated by the fact that their designers, John Eargle, Mark Engebretson, and Don Keele, received a 2001 Academy Award for Scientific and Technical Achievement for "*the concept, design and engineering of the modern constant-directivity, direct-radiator style motion picture loudspeaker systems."* This was only the second Academy of Motion Pictures Arts and Sciences award ever given for loudspeaker technology. Not coincidentally, the first such recognition also involved a Lansing company. That was the 1936 award for the Shearer loudspeaker system in which Jim Lansing's original firm, Lansing Manufacturing Company, played a significant role.

Evolution of the Monitor Line

By 1980, JBL's success with the high-output, wide-bandwidth 4300 series of monitors was threatened with unexpected competition from a small, independent studio equipment manufacturer named UREI. Starting in the late 70s, the UREI 811 and 813 monitors were gaining widespread acceptance in the studio market at the expense of JBL's large format monitors. The greatest innovation behind these systems was the use of a patented, time-aligned network in conjunction with a highly modified Altec Lansing 604 Duplex, resulting in a monitor that could act as a point source with pinpoint imaging. JBL's monitors were at a disadvantage in this regard. The four-way concept used in the largest monitors was not time-aligned. Overcoming this deficiency would prove very difficult, due to the lateral displacement of the individual drivers needed to accommodate horn loading. Further, the multiple drivers meant that these monitors could not match the soundfield coherency of a coaxial transducer in listening distances less than around eight feet, which restricted their placement and thus the potential market. While the drivers could be electronically time aligned (as with the UREI monitors) the result would be a very complex design requiring the alignment of four drivers at three crossover points, and this still would not address the coherency issue.

In the time since the 4300 series was introduced, JBL had made significant advances in transducer power handling. In particular, the use of high-temperature adhesives, Kapton voice-coil formers, and rugged suspension elements had more than doubled the power handling of their bass drivers. Further advances in cone materials and JBL's innovative mass controlling ring, meant the bass drivers could have both deep bass response and an extended bandwidth that allowed a higher crossover point. This in turn relieved the excursion requirements for a compression driver diaphragm, greatly increasing its power handling and output over a narrower bandwidth.

All of this was pointing JBL back to their traditional monitor configuration of a two-way design. It resulted in the specification for a new large format monitor series that would be time aligned, have the same high output and wide bandwidth of the previous 4300 series, yet in a two-way package. The high-frequency horn would be tightly arrayed with the bass drivers to ensure coherency at close listening positions. The series consisted of two models—the high-

4430 and 4435

L250

output, twin-woofer 4435 and the lower-output, single-woofer 4430.

A further attribute was specified that would distinguish the initial 4400 series from its predecessors and its competition—uniform power response across very wide listening angles. This was something that the UREI monitors could not match. The requirement dictated the use of JBL's newly-developed Bi-Radial® horn technology. A JBL engineer named David Smith was given responsibility for designing 2 monitors based on Keele's new horn. The horn, given the model name 2344, was specified to have wide 100º dispersion in both the horizontal and vertical planes.

A very different crossover topology was required to deal with the inherently different response of the Bi-Radial® horns, and to give traditional midrange and treble controls in a 2-way design. As previously described, network equalization of the high-frequency driver was essential to address diaphragm mass roll-off (because the Bi-Radial® horn lacked the inherent on-axis equalization of older radial-horn systems). The initial systems used the 2421A compression driver in conjunction with the new horn. This driver was an update of the Alnico 2420 with a new aluminum diaphragm which introduced the diamond pattern surround. The surround enhanced the high-frequency response by moving the secondary resonance frequency above 16k Hz.

Two new bass drivers were developed for this system: the 2234H and 2235H. The 2235H was an updating of the 2231A, which was initially developed for the 4300 series monitors. This new driver utilized recent developments in power handling to double the rating of its predecessor. It also addressed a long known, but little publicized issue called dynamic offset. At low frequencies, the plane around which the back and forth coil excursion is centered can shift from the center of the coil gap. In extreme cases, this offset point can move completely outside of the gap, resulting in audible distortion and restricted output. Mark Gander devised a progressive suspension that provided an increased restoring force with increased excursion. This eliminated dynamic offset and became a core technology of the 2235H and the contemporary 2225H sound reinforcement and cinema woofer.

A single 2235H was used in the 4430, while two 2234Hs were used in the 4435. The 2234H was simply a 2235H without the mass ring. While this would normally result in reduced low-frequency extension, it was employed in a novel configuration in the 4435 that took advantage of the higher efficiency of the lower-mass driver while providing even greater low-frequency extension than the 4430. This was accomplished by utilizing the two 2234H transducers in identical sub-enclosures, but limiting the bandwidth of one of the drivers to 100 Hz at the high end. Thus, the limited-bandwidth woofer augmented the low-frequency response of the full-bandwidth driver in the 27-100 Hz range, which coincided with the range of falling response of a single 2234H. This resulted in a system response that was flat down to 30 Hz, yet remained 3 dB more efficient than the smaller 4430.

The systems were introduced in 1981 and achieved their intended goal of setting a new standard in large-format monitor performance. In 1983, the initial two Bi-Radial® monitors were joined by a smaller mid-field monitor called the 4425. This system was designed by Dean Rivera and utilized a new 12" bass driver combined with the smaller 2342/2416H Bi-Radial® horn/driver combination. This series would be a staple of JBL's monitor line for nearly two decades, with the last model being discontinued in 2000.

There is one other monitor development from this era that deserves note; namely, the 4312 of 1982. This monitor traces its roots back to the seminal 4310 of 1968 but marks a distinct turning point. As described previously, the 4310 was designed to imitate the competing standard of its day, the Altec Lansing 604 Duplex. As a result, absolute accuracy was not a consideration. This philosophy carried on into the design of the 4311 that replaced it. However, JBL had made accurate response a core requirement of their subsequent monitor designs, particularly with the revamped 4300 series of the mid 70s.

It was now time to apply this philosophy to the venerable 4311. The result was the 4312, which replaced the minimal crossover network of its predecessor with a comprehensively engineered network designed to optimize overall system performance without markedly changing the 4311's sonic character. The resulting system has become somewhat of a legend, particularly in Japan. Not only did it find favor in its intended studio market, but it also gained widespread acceptance as a home speaker, both domestically and overseas. It resulted in numerous variants being developed over the years—all carrying the 4312 model name. There are almost too many to count, with such versions as the 4312B, 4312BMKII, 4312M, 4312SX and on and on. The most recent 4312D uses advanced JBL loudspeaker technologies such as the neodymium Differential Drive®.

L250 and the Ti Speaker Series

The L250 was a landmark speaker system that firmly placed JBL at the highest levels of achievement in home loudspeakers. It was the first new high-end loudspeaker initiative undertaken by JBL after the Harman International reacquisition and was the starting point of a series of loudspeakers that re-established the JBL brand for quality and innovation after the less-than-stellar Beatrice era.

The L250 was the brainchild of JBL engineer Greg Timbers and it had a unique genesis. Instead of being a product defined by a marketing requirement, it was the result of Timbers's avocation. He developed the prototype as a hobby on his own time to meet his personal high standards for a home system. Timbers had previously been responsible for the 4315 and had involvement with the seminal L212. Both systems reinforced his opinion that a four-way system had great merits in ensuring maximum linearity and dynamic response. He addressed the known limitation of the L212's restricted bass dynamics by employing a 14" LE14 in each enclosure. He designed the enclosure to have a pyramid

Greg Timbers

© Don McRitchie

Greg Timbers has continued the legacy of excellence in engineering that was set by Bart Locanthi and Ed May in the first decades of JBL. He has been involved with virtually every significant loudspeaker system developed by JBL in the past three decades. In the majority of cases, he held the lead engineering role. Just a short list includes the 4331, 4333, 4344 and 4345 monitors, the L200B, L300, L212, L250, Ti series, XPL series, Everest and K2 series home loudspeakers.

Timbers's expertise extends beyond system design. He is also a proficient transducer engineer, being responsible for the development of the 2245 subwoofer. This driver was partially responsible for setting off the do-it-yourself subwoofer phenomenon that continues to this day. A seminal article he co-wrote on employing this driver was published by Audio Magazine in the mid 80s. It generated significant interest in home-built subwoofers and helped define this loudspeaker genre.

The center of Timbers's art has to be considered network design. He has the uncanny ability to subtly tune drivers and system response through network engineering to achieve superlative performance. He was responsible for inventing the charged-coupled network that has become the preferred network topology on JBL's statement loudspeakers.

As of this writing, Timbers has been with JBL for 33 years, having started on August 1, 1972. He joined JBL after obtaining a B.Sc in electrical engineering and an M.Sc. in acoustics from UCLA. He was hired by Walter Dick, then head of JBL's engineering department, and trained under Ed May and Pat Everidge. He quickly rose to become a senior engineer who had responsibility for overall system designs. His current title is Chief Development Engineer for Harman Consumer, where he has responsibility for designing all of JBL's high-end loudspeakers.

Original Ti Series

© Harman International, Courtesy Mark Gander and John Eargle

shape that tapered at the top. This was functional in that it eliminated internal standing waves and minimized the baffle area around the midrange and tweeter to mitigate high-frequency diffraction. The network was designed using a first-order topology that allowed the system to be time and phase aligned. It also provided subtle tuning of the individual drivers to result in superlative linearity.

Timbers auditioned this system for anyone he could convince to listen to it. Eventually, he received a positive response from JBL management, which then authorized development of a production system. The main work was translating the design from what Timbers described an "an engineer's system" into a home speaker with aesthetics that would match its acoustic level of performance. Doug Warner was called in to undertake the industrial design. The working prototype had the functional, but less than desirable appearance of a very large metronome. Warner came up with the enclosure geometry of the production system, consisting of mirror-imaged trapezoids for the left and right speakers. This preserved the functional requirement of a tapered enclosure while resulting in an elegant, understated appearance.

Whereas Timbers had used off-the-shelf transducers for the construction of his prototype, customized drivers were developed for the production system. The initial version of the L250 would use a driver complement consisting of the LE14H-1 bass driver, the 108H mid-bass, LE5-11 midrange and 044-1 aluminum-coated phenolic tweeter.

There was another related transducer developed as part of the L250 rollout. That was the 18" 2245 subwoofer for which Timbers was responsible. This was only the second 18" driver produced by JBL (being predated by the 1970s musical instrument K151). It was also their second true subwoofer, the first being the ill-fated bass module for the L212. This subwoofer would have none of the constraints of that used in the L212. Its maximum excursion of 1" and immense cone area resulted in unparalleled output at the lowest frequencies. A dedicated 8 cubic foot enclosure called the B460 was developed solely for that driver. The optimal enclosure volume for the 2245 was approximately 12 cubic feet, which was too large for a consumer product. Consequently, the B460 was designed to be used with a special crossover network, the BX63, an innovative active/passive design that combined the very low-frequency portions of the left and right channels and added equalization to flatten the system response to the mid-20 Hz region. With room coupling, this would extend response to below the limits of audibility at 20 Hz. Styling for the B460 was also the responsibility of Doug Warner, who developed a design that was complementary to the L250 and marketed as its ultimate accessory. The need for this subwoofer was not essential, given that the L250 had a flat in-room response that extended solidly to 30 Hz. However, the addition of the B460 provided JBL with the first system with a bandwidth that exceeded the limits of human hearing.

The L250 would undergo a number of updates over the years. The most significant was a new driver lineup in the 250Ti, which is described in more detail below. Most subsequent models, such as the Limited Edition, Classic and Jubilee, involved network revisions and different enclosure finishes. The final version, the 250Ti Jubilee, was issued in 1996 in celebration of JBL's 50th anniversary and marked the use of the charge-coupled network that resulted from the K2 project of early 1990s. It would remain in production until 1999, when the last 250 model rolled off the production line.

The 250Ti warrants special attention, because it launched an entire line of speakers whose progeny continue in production to this day. The "Ti" in the name refers to titanium, and this product marked JBL's first use of titanium diaphragms in a home speaker. The majority of JBL's current speaker line use some form of a titanium tweeter an innovation pioneered in the 250Ti.

The use of titanium as a high-frequency diaphragm material actually came out of JBL's Professional Division. JBL had traditionally used aluminum diaphragms in their compression drivers. By 1980, these drivers were being used in ever more demanding high-power applications for which they were never envisaged. This resulted in unacceptable failure rates and a development program was undertaken by a JBL engineer named Fancher Murray to solve this problem. Murray had a background in the aerospace industry prior to joining JBL and used his knowledge of materials technology to develop the first titanium diaphragm.

While stress brought on the diaphragm failures, the underlying cause was determined to be metal fatigue. This is a condition whereby the repeated and cyclical application of stress causes a metal to fail below its ultimate strength. The repeated stress has to be beyond a specific minimum value before it results in fatigue failure. For most loudspeaker applications, the stresses would be below a level that which would induce fatigue. However, the ever increasing output demands placed on professional loudspeakers meant that, more and more often, JBL compression drivers were being used under conditions that exceeded the fatigue threshold.

Titanium is a metal that has an order of magnitude greater resistance to fatigue than aluminum. It weighs more by volume than aluminum, but this is offset by greater stiffness and strength. When suitably engineered, it was found to be an ideal material for high-frequency diaphragms, with the result that all of JBL's compression drivers were converted to titanium.

With this new diaphragm material firmly established in JBL's professional products, it was decided to investigate the application of titanium to JBL's home speakers. At that time, most higher-end JBL tweeters used a soft phenolic dome that was aluminum-coated. These had good, uniform response, but relied on controlled decoupling to gain high-frequency extension. It was discovered that a titanium dome tweeter could be engineered to be totally pistonic (i.e. to operate in the manner of an inflexible piston) throughout its bandwidth, which resulted in lowered distortion. JBL decided to design an entire line of loudspeaker systems around

DD55000 Everest

Everest Componets

this new tweeter, the 044Ti, that started with a conversion of the L250 to the 250Ti.

At the same time, a new midrange was developed for this series that utilized a polypropylene cone. At the time, polypropylene cones had become somewhat of a fad in home loudspeakers, particularly for use in woofers, because of the material's good damping properties. JBL resisted this trend, and for good reason. Large cones made of this material lack stiffness and, therefore, are prone to breakup. However, JBL discovered that the small-diameter cones needed for a midrange driver could be made of a stiffened polypropylene and still behave pistonically. Consequently, a midrange transducer using this material could take advantage of its excellent damping properties while not suffering increased distortion due to breakup. The result was the 104H midrange driver which was first introduced in the new 250Ti.

The new Ti series premiered in 1984. In addition to the flagship 250Ti, there was the 240Ti, 120Ti and 18Ti. The 240Ti was basically a 250Ti without the midbass driver and using a more traditional rectangular enclosure. The 120Ti was a version of the traditional JBL 3-way bookshelf speaker using a 12" bass driver with the new midrange and tweeter. Finally, the 18Ti was a small two-way unit using a 6.5" bass driver in conjunction with the 044Ti tweeter. The Ti series was the starting point for a number of product lines that became the staple of JBL's catalog for the remainder of the decade.

The Third Project Speaker

The development of the third project speaker came about after the discontinuance of the Paragon in 1983. At that time, Japan had been the largest market for this unique product. Bruce Scrogin, then President of JBL International, wanted to have a system that would appeal to that market and could fill the recently-created gap at the highest end of JBL's product line. He developed the concept for a new statement speaker around two factors—a wide, stable stereo image and high efficiency.

The first factor harkened back to the Paragon. That system had been unique in the use of a curved diffraction panel to create a wide stereo soundfield that was little diminished as a listener moved off axis. Scrogin recognized that an existing JBL Professional horn technology could be employed in a home loudspeaker to a similar effect. That technology was the asymmetrical horn. Don Keele had developed the 2346 horn for the 4660 ceiling speaker. That horn's asymmetric geometry allowed even coverage, front to back, even though the front listening distance was considerably shorter than the back distance. Scrogin's inspiration was to rotate the horn 90º. For a stereo pair, the effect was to direct increasing output towards the opposite loudspeaker, counteracting the tendency of the nearer speaker to dominate the stereo image as a listener moved off axis. The result was a stereo image that was stable and uniform at virtually any lateral position between the speakers.

The second goal, high efficiency, also harkened back to JBL's early legacy. Up until the LE series of drivers, all large JBL transducers were known for their very high sensitivity. They had an effortless, dynamic character that many audiophiles prized. Therefore, the new project speaker was projected to have a target sensitivity of 100 dB/W/m.

The new system was given the name Everest and the model number DD55000 as a reference to the DD44000 Paragon that it replaced. Greg Timbers was ultimately given overall responsibility for engineering. A number of different approaches were tried before a three-way configuration was settled upon. Pre-existing drivers were selected for the system instead of custom units, because existing drivers tested in the prototype were found to meet the design parameters and purpose-built transducers were deemed unnecessary.

The bass driver selected was the E145 from JBL's musical instrument line. It should be noted that most musical instrument transducers have a distinctive sonic character that is purposely not meant to be accurate. The E145 was the exception to this rule. It was intended for bass guitar and electronic keyboard amplification, where accuracy is preferred. The E145 utilized the motor from the LE15H with its underhung coil topology. This was the most linear motor in JBL's product line. The cone was very similar in configuation to the 150-4C with a deep-profile, steeply-angled, straight-sided cone. This geometry provided added strength to minimize the potential for breakup. When used in the Everest, this driver was relabeled as the 150-4H in homage to the 150 -4C, from which it could rightly be said to have descended. The midrange driver was the 2425H, the driver used on the same 2346 horn in the 4660. The venerable 2405 was added to give high-frequency extension to the limits of audibility.

As usual, Timbers worked his magic in system tuning and network design. He was able to meet the high efficiency target, achieve the unique imaging requirement, and provide smooth frequency and power response. The resulting system was sonically worthy of the Everest name. It had unparalleled dynamics but could also resolve subtle detail. The only remaining problem was the physical size.

The prototype was simply immense. To gain the necessary extension for the 150-4H driver, an 8 cu. ft. interior volume was called for. However, this space had to be dedicated to that driver alone. An initial thought of salvaging volume from behind the massive horn proved impractical since the horn was not stiff enough to damp the resonating air mass. The volume for the horn and its enclosure would therefore be over and above the 8 cu. ft. volume needed for the bass driver. As a result, one of the most challenging aspects of the design was the styling for such a large system. The loudspeaker had the form factor of a refrigerator and it would be very difficult to place in a home environment without it being visually overbearing.

A new industrial design consultant named Dan Ashcraft was brought in to tackle this problem. His ingenious solution came about as a result of addressing the location of the 2405 tweeter. The enclosure was already tall due to the midrange

K2-S9500

Power Compression

If there is any one factor that is at the heart of JBL's sound, it is arguably freedom from power compression—the phenomenon whereby output from a driver does not increase linearly with increased input. The major culprit is heat. As more power is applied to a driver, more heat is generated, which represents wasted energy. More important, the heat increases the impedance of the voice coil so that it draws less power from the amplifier. Heat also temporarily reduces the strength of the permanent magnetic field and, therefore, sensitivity. If not dealt with, it robs dynamic range by compressing high power transients and inducing changes to the overall sonic character of a loudspeaker (depending on the listening volume).

Freedom from power compression has been a trait of JBL loudspeakers from the very beginning. JBL pioneered the use of 4"-diameter coils in their large bass drivers and compression drivers. These coils have a significantly larger exposed area than their competition, which means that they can radiate heat more effectively. JBL also standardized their coil designs on single windings of flat ribbon wire with large cross-sectional areas that had less resistance, and therefore less heat generation, than the commonly used multiple windings of small-diameter wire.

JBL has continued to build on this position of technological leadership in power compression mitigation. They were the first to employ convection cooling of voice coils through their Vented Gap Cooling® (VGC) motors. These motors use cone motion to force air trapped behind the dustcap into the voice coil gap and around the coil to remove heat. The 1400nd was one of JBL's first drivers to use this innovation, and it is partly responsible for the exemplary performance of the K2-S9500

The Super Vented Gap Cooling (SVG) motors were a refinement of the VGC technology that extended the pole piece above and below the top plate to provide even greater heat sinking of the coil, while providing greater uniformity to the magnetic field. This would be employed in the subsequent S3100 and 4344MKII loudspeaker systems.

JBL's latest motor innovation, the Differential Drive® (described later) provides the highest levels of freedom from power compression of any driver yet built, and is increasingly finding its way into JBL's product line, both consumer and professional.

The net result of all of these technologies means that JBL loudspeakers demonstrate a dynamic character that is unmatched in the industry. For years, JBL used to advertise that "Steep waveforms of explosive loudness are reproduced effortlessly by the precision engineered 4-inch edgewound-ribbon voice coil…" It was no exaggeration then and not today. JBL speakers are unparalleled in their ability to capture the dynamics, and thus, the emotional impact of music.

horn height and placement requirement, so that locating the 2405 on the vertical axis above the horn seemed out of the question. This dictated placement of the 2405 to one side, which required that the driver be angled for proper coverage. The use of an angled baffle for this driver proved to be the key to the overall design and set the product architecture. Other angles were introduced on the front baffle for the low-frequency driver and on edge chamfers. These changes broke up the monolithic proportions of the previous box design. They also provided a visual tie to the angular, asymmetric midrange horn that was the heart of the system from both an engineering and design perspective.

The result was a visually striking design that belied the huge dimensions of the overall system. Placing the low-frequency driver on an angled baffle that departed from the plane of the massive very large midrange horn resulted in two distinctive visual elements instead of one massive shape. The final system architecture became a remarkable visual statement.

The Everest was an immediate success. It garnered Stereo Sound's "Product of the Year" award for 1985. There was no predetermined production run, but it is thought that around 500 pairs were produced. It continued in regular production until the introduction of the K2 in 1989. However, it was still possible to special order the Everest for the next couple of years. They were marketed exclusively by the International Division, with the vast majority going to Japan.

The Fourth Project Speaker

The K2-S9500 came quickly on the heels of its predecessor. The relatively short time between Project systems was not a reflection of any technical or marketing failing, but was instead evidence of Everest's remarkable success on both fronts. That system was so well received that JBL management felt there was an opportunity to further enhance the corporate image with a statement system that exceeded even the Everest's high standards.

Work on the K2-S9500 began in 1989 and was again based on a concept developed by Bruce Scrogin. That concept was a two-way system utilizing twin woofers that were arranged vertically above and below a high-frequency horn. This symmetrical driver placement was designed to act as a point source for exceptional imaging. However, the most noteworthy aspect of the K2-S9500 was its transducers. JBL had always been known for the quality of its individual transducers and this was arguably the greatest legacy of the company's founder, James B. Lansing. The K2-S9500 would be a showcase for JBL's transducer engineering, utilizing drivers designed specifically for this product and to represent the highest expression of JBL's state-of-the-art.

The driver complement would consist of two examples of a brand-new 14" bass driver and a new 4"-diaphragm compression driver. The introduction of these transducers marked the first commercial use of neodymium magnets for compression drivers and woofers. Neodymium magnets (short for neodymium-iron-boron magnets) were a relatively new development, becoming commercially available in the mid-1980s. Their great asset is the fact that they have the highest energy to weight ratio of any permanent magnet material. On average, they have four times the energy by weight of Alnico and ten times that of ferrite. Yet they are not without their disadvantages. Neodymium magnets are susceptible to permanent, partial demagnetization from heat at levels much lower than either Alnico or ferrite. They are also highly susceptible to corrosion.

The corrosion issue was dealt with by coating the magnets with nickel, but the heat resistance problem would prove to be much more challenging, particularly for the high-power bass drivers. Doug Button, a transducer engineer (currently JBL Professional's Vice President of Research and Development), undertook the challenge of designing the new low-frequency driver. He had been instrumental in developing JBL's Vented Gap Cooling® motor technology, and he adapted it to the new 1400nd to provide unprecedented cooling capacity. This allowed the driver to operate at temperatures well within the limits of the magnet material, even at continuous power levels as high as 600 watts (in the later sound reinforcement version).

The 1400nd was also unique in Button's use of a high-excursion, underhung motor topology. As has been stated earlier, underhung motors are the most linear design, since the voice coil is always immersed in a constant-strength magnetic field at all points of travel. In the past, most drivers of this type had limited coil depths and limited travel, which restricted power handling and output. This problem arises from the limitations inherent in a deep gap design. Such gaps require a massive top plate and pole piece, if, as in past practice, these parts are fabricated metal plates of uniform thickness. Button's innovation was to use finite element analysis to map the necessary geometry for these parts to ensure that they had sufficient flux carrying capacity while minimizing the material requirements. The use of a very-high-energy neodymium magnet helped in this concept, since it allowed for a very compact magnet that minimized the consequent size of the return structure.

The resulting design had a very deep gap that was more than double that of JBL's earlier underhung LE15 series. However, the finite element analysis had shown that substantial material could be carved out of the pole piece and pot structure without affecting the flux carrying capacity. This use of this variable depth geometry yielded significant weight savings, and in conjunction with the lighter magnet, resulted in a motor weight that was less than half that of a typical 15" JBL driver with similar total magnetic energy. The 1400nd emerged a compact, high-excursion, high-linearity driver that demonstrated exemplary dynamic range and accuracy.

Fancher Murray was responsible for the new compression driver. This product employed a 4" diaphragm and a 2" throat exit were derived directly from the 375. The new driver was given the model name 475nd in deference to this legacy. As with the 1400nd, it was designed from a clean

K2-S7500

XPL Series

sheet of paper and would be the first compression driver to utilize a neodymium magnet. Another unique feature of this driver was the introduction of JBL's Coherent Wave phase plug. This phasing device used a curvilinear geometry for the annular slits to ensure that the output from each slit was combined exactly in phase at the throat. In contrast, previous phase plugs, such as that employed in the 375, had path lengths that were closely matched, but not exactly the same. A unique titanium diaphragm was also developed that used a thin coating of Aquaplas to damp spurious resonances. The resulting driver exhibits a smooth, extended response with vanishingly low levels of distortion.

As with Everest, Greg Timbers undertook the overall system and network design with additional responsibility for the unique Bi-Radial® horn. Timbers specified a Bessel transformation tuning for the low-frequency drivers that minimized phase shift to achieve unparalleled low-frequency transient speed. A ten-sided enclosure was also specified for each bass driver to minimize standing waves and panel radiation. Further, the enclosure was made of medium density fiberboard (MDF) bonded to a shell of reaction molded foam to result in a solid, non-resonant cabinet.

The industrial design was the responsibility of Brian Lusty, Product Development Manager for JBL International, and consultant Dan Ashcraft. Ashcraft developed the overall theme that would become the basis of the architecture for K2-S9500—a system defined as the sum of its parts. Whereas Everest emphasized the enclosure, K2-S9500 would be about discrete, individual components interacting to create an acoustical unit. This was a direct reflection of the seminal role played by the state-of-the-art transducers developed for the system. For this reason, Ashcraft was also involved in the visual design of the individual drivers.

The component theme resulted in the K2-S9500 being broken down into four primary subsystems. Each bass driver would be installed in a separate enclosure. The horn would be designed as a monolithic acrylic molding that would physically separate the two bass enclosures. Finally, the whole system would be set on a massive, independent concrete base. The inspiration for this was the observation that many Japanese audio enthusiasts mounted their speakers on cinder blocks to raise them to ear level.

Whereas all previous Project speakers had been one-off designs, K2 was unique in that it launched with two separate speaker systems. The component nature of the original K2-S9500 concept allowed the development of a scaled back version at a lower cost by eliminating one of the bass enclosures. Thus, the smaller K2-S7500 was born. Both were introduced to the press and reviewers in 1989. That year, the K2-S9500 received Stereo Sound magazine's Component of the Year (COTY) award. It went into regular production in 1990 and was a marketing success even with a price tag of over $30,000/pair. However, the K2-S7500 did not receive the same market acceptance. In hindsight, its price point was too close to the K2-S9500, and those who could afford the K2-S7500 could likely also afford the marginally more expensive flagship speaker. Therefore, few opted for the K2-S7500 and it was discontinued after a couple of years.

JBL used the success of the K2-S9500 as the starting point for a series of derivative K2 branded systems. The first was the K2-S5500 in 1993. It used two 12" bass drivers and a small-format compression driver in the same configuration as the original K2-S9500. That system pioneered an original crossover design developed by Greg Timbers. It is referred to as the "Charge-Coupled Linear Definition Dividing Network." This concept utilized a biasing voltage in the crossover network to keep the music signal from crossing the dielectric zero-point of the capacitors. The result is more linear operation of the network with a significant improvement in sonic performance. It has formed the basis for most network designs for JBL's high-end loudspeakers

The K2-S5500 also introduced a new enclosure tuning referred to as "Imaginary Equivalent Tuning" (IET). The intent was to combine the fast transient response of Bessel tuning with the more extended response of Butterworth tuning. Greg Timbers developed this design that is based on twin bass enclosures of different sizes above and below the high-frequency horn with the drivers and ports of each enclosure are tuned to different frequencies. The combined energy from all four sources provides deeper extension than the Bessel tuning while maintaining transient speed.

These two technologies were later applied to the original K2-S9500 design to produce the M9500 of 1993. The M9500 used the same components in a larger, industrial enclosure. The IET tuning allows deeper and more linear bass output than the K2-S9500, with room response flat to 25 Hz. This system was intended as a professional monitor and did find its way into a number of studios. It was a very good reference loudspeaker but was too big for soffit mounting, and this limited its application. As a result, it was much more successful in the consumer market and received Stereo Sound's 1993 COTY award.

1990s Home Speaker Endeavors

The 1990s saw the development of a number of noteworthy home loudspeaker systems. The XPL series was introduced at the start of the decade and contained two technological innovations. The first was the introduction of the 093Ti midrange driver. This consisted of a 3" titanium dome used as a direct radiating driver. It operated pistonically within its bandwidth with no breakup, and was therefore an extremely accurate device. The dome geometry resulted in a wide, even dispersion pattern that gave the loudspeaker excellent off-axis response.

The second innovation was the use of a composite baffle consisting of a wood substrate covered with a heavy rubber compound. This allowed for the molding of tapered edges and a stepped profile that permitted time alignment of the drivers and mitigated driver refraction.

© and Courtesy Greg Timbers

XPL250 Prototype

After the premature discontinuance of the XPL line, an effort was made to develop a new high end speaker that merged the technology of that series with the 250Ti. Significant work went into development, which got as far as the prototype stage before the project was cancelled. The development system went under the name XPL250 and used a configuration very similar to the 250Ti. The significant differences were the replacement of the 104-H with the 093Ti midrange, use of a composite wood and rubber compound enclosure, and the development of a new network.

Three functioning prototype stereo pairs were developed by 1994, when the project was cancelled as result of a marketing decision. Only one pair exists today, in the hands of the system's designer, Greg Timbers. He, and the other engineers involved with the project, consider it the highest evolution of the 250 concept ever developed and lament the fact that it never made it into production.

Century Gold

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The XPL series represented the highest technical achievement for JBL in a family of loudspeakers that covered the full market range. However, the series was less successful than had been hoped. Changing market conditions resulted in the premature discontinuance of the line in 1992. Still, for its designer Greg Timbers, it remains one of his proudest accomplishments. The collectors' market has justified this opinion. Today, whenever rare examples of the XPL series do make it to the used market, they command prices higher than any other full range of loudspeakers produced by JBL in the last three decades.

The next significant home speakers introduced by JBL were the Signature series of 1995, consisting of the S3100 and S2600. These were an adaptation of the asymmetrical horn concept used in the Everest. They were both two-way designs that used a smaller version of the Everest horn, called the H2600, which was driven by a 2426H compression driver. The systems were differentiated by enclosure and bass driver sizes. The larger S3100 used the ME150HS 15" driver while the S2600 used the ME120HS driver

The ME150HS bass driver was the most unique feature of this series. It was the first domestic application of JBL's SVG motor technology, resulting in the greatest freedom from dynamic compression yet achieved in a JBL home speaker.

The year 1996 was the 50th anniversary of JBL and it marked the introduction of two significant systems—the Century Gold and 4344MKII. The Century Gold was specifically developed in celebration of JBL's milestone anniversary. It was meant to be the highest performing bookshelf speaker they ever produced. It was inspired by the legacy of the L100 Century and used a similar three-way configuration consisting of a 12" bass driver, 5" midrange and 1" tweeter.

All of the components were purpose designed to maximize performance of the overall system. The low-frequency driver utilized JBL's VGC technology for outstanding bass response. The midrange driver marked JBL's first use of a Kevlar diaphragm, which provided excellent damping and very low distortion. The tweeter utilized a gold plated titanium dome with flat response and smooth dispersion. Greg Timbers undertook the system design and incorporated a network utilizing the charge-coupled topology he invented for the K2-S5500.

The system was very well received by both the press and the market. Though intended as a limited edition anniversary product, unexpected demand resulted in its being in production for the next four years.

The 4344MKII was an updating of one of the most popular large format monitors ever produced by JBL. The 4344 had been out of production for over a decade, yet interest, particularly in Japan, remained high, with active trading on the used market. While initially designed as a professional monitor, it found its way into more homes in the Asian market than in any professional application. The updated 4344MKII would be designed by JBL's Consumer Division specifically for the home market even though it kept the visual design of a professional monitor. The most innovative aspect of the revised design was its drivers. The 4344MKII employed the ME150HS that had originally been designed for the S3100. The compression driver was the neodymium 275nd that had originally been developed for the K2-S5500. Greg Timbers again employed a charge-coupled network of unique design. It married the output of the four disparate drivers into a seamless system response that embodied all of JBL's hallmarks for accuracy and dynamics. The resulting product proved very popular in the intended Asian market and remained in production for 8 years, until being replaced by the 4348 in 2003.

The close of the decade brought the introduction of JBL's SVA series of loudspeakers. This group was unique in its utilization of horn-loaded dome drivers. All models in the series employed a two-way configuration similar to the K2-S9500, with twin woofers surrounding the high-frequency horn and driver. The largest model, the SVA2100, utilized twin 10" drivers sharing a common enclosure volume, and a Bi-Radial® horn equipped with a 1" dome driver. A variant of the SVA speakers remains in production as part of JBL's home theatre product line.

The Fifth Project Speaker

Work on the K2-S9800 started in 1999 under the direction of Greg Timbers and was given the development name "M1 Millennium." It was meant to mark the turn of the century with the latest statement of JBL's state-of-the-art. It didn't quite make its target introduction date, being delayed until the fall of 2001, but it did meet the engineering target of being the highest-performing loudspeaker ever developed by JBL for home use.

As with the previous Project speaker, the heart of the K2-S9800 concept was its incorporation of transducers that were uncompromised in their performance. The most unusual of these drivers was the 15" 1500AL, which reintroduced a JBL Alnico motor for the first time in over 20 years.

Much has been made in this article on how JBL engineered ferrite drivers to outperform their previous Alnico models, even though ferrite has a number of inherent disadvantages. This led to an interesting design question. What would happen if JBL applied the same level of engineering that they employed to address ferrite magnet shortcomings to fully exploit the intrinsic advantages of an Alnico motor? As previously described, Alnico has some performance characteristics, particularly resistance to heat and flux modulation, that are superior to any other magnet material. The answer to this question would be the highest performing bass driver ever produced by JBL, and arguably, by any other manufacturer to date—the 1500AL.

The concept for the 1500AL was developed by Doug Button, while the final design was the work of Jerry Moro. Button's starting point was to address the single greatest weak-

K2-S9800
© Harman Japan, Courtesy Tim Wada

1500AL, 435, 045
© Harman Japan, Courtesy Tim Wada

ness in Alnico loudspeaker motors—the susceptibility to permanent partial demagnetization when subjected to excessive power. This phenomenon is a result of variability in strength of the permanent magnetic field caused by interference from the voice coil's electromagnetic field. This is referred to as flux modulation and is a leading cause of mid-band distortion in any dynamic loudspeaker. The electromagnetic field generated in the coil pushes against the global magnetic field set up by the permanent magnet and return circuit, causing it to "bend." Under normal operating conditions, Alnico magnets actually resist this bending better than most other magnet materials. However, should this shift become large enough, it will exceed the coercivity of Alnico and cause it to partially demagnetize.

Doug Button realized that the flux stabilization technology, originally developed for ferrite motors, could be applied to control flux modulation in an Alnico motor to such a degree that the coercivity of its magnet would never be exceeded. He specified a huge copper shorting ring that would resist any changes in the global field that was induced by the voice coil signal. The result was that the major drawback of using Alnico for a loudspeaker magnet could be completely eliminated.

As with his previous 1400nd design, Button specified a large, underhung coil motor. However, the geometry for the motor in the 1500AL was much more extreme, with a gap that was nearly twice as deep as that of the 1400nd. This unique design exacerbated a little-documented phenomenon with underhung motors. The deep gap fosters the development of eddy currents which act as the secondary in a transformer to effectively short out the coil circuit, leading to a loss in voltage drive. The net result is a "swayback" response curve through the mid-band, with about a 2-dB drop in output. While this can be dealt with in network compensation, the purist in Button wanted to keep that energy. He addressed this by specifying a laminated insert of alternating steel and copper rings that would be applied to the outside diameter of the coil gap. This broke up the eddy currents and had the benefit of further stabilizing the local field within the gap.

With this final attribute, the conceptual design for the 1500AL was in place. Jerry Moro, Senior Transducer Engineer for JBL Consumer Products, then took on the formidable task of developing a production driver. He specified a maximum excursion capability of over 1" to accommodate the wide dynamic range inherent in the latest digital technology. This necessitated an unprecedented gap depth of 1.6" with a 0.8" deep coil. The magnetic energy requirement to provide a reasonable flux density in such a deep gap was enormous. The answer was an Alnico magnet of massive proportions. An Alnico slug weighing over 5 pounds became the core of the motor structure and he overall structure motor structure weighed over 30 lbs.

The large excursion requirement presented unique suspension demands. Normally, the surround and spider are designed to act together to provide a restoring force and damping for the cone movement. However, with these large excursions, the difference in construction between the surround and spider would result in non-symmetric response to deflections and, therefore, distortion. Moro addressed this by designing a mirror-imaged pair of spiders that acted symmetrically and thus allowed the surround to be optimized for linearity. Mirror-imaging the spiders resulted in any distortion components being cancelled out.

A major focus of Moro's design for the 1500AL was to embody JBL's hallmark attribute of freedom from power compression. He adapted JBL's VCG technology by embedding three channels in the pole piece and magnet along their outer circumference. Air trapped behind the dustcap was forced past the coil and out these channels to convectively cool the coil. Next, an aluminum motor cap was developed that completely surrounded the magnetic return structure. A series of ribs drew heat away from the iron pot to the cap, which acted as a large heat sink. Finally, there was an air gap between the cap and the pot structure that was vented in the rear. The motion of the spiders pumped air into this gap to provide further convective cooling.

The net result is a woofer that arguably has lower levels of power compression than any other loudspeaker of its size. It can sustain maximum output levels of 118 dB with minimal distortion. Testing at a 110 dB output level revealed mid-band distortion to be down 50 dB, or around 0.3%

The 435Be midrange driver developed for the K2-S9800 was equally groundbreaking. It was the first JBL compression driver to provide extended response without breakup. Ideally, a dynamic loudspeaker diaphragm should act as a piston, with all points in uniform motion. However, since diaphragms are not infinitely rigid, there will be a point at which the forces acting upon them can cause oscillating deflections, resulting in different points on the surface moving in different directions. Under this condition, the diaphragm is said to be in breakup, and there is an attendant increase in distortion. Both aluminum and titanium compression driver diaphragms are in breakup for much of their response, partly due to their large size. For smaller diameter transducers, like direct radiating tweeters, aluminum and titanium diaphragms can remain pistonic to the limits of audibility. However, on a 4"-diaphragm compression driver, the breakup modes for both aluminum and titanium can be as low as 4000 Hz.

In 1999, Doug Button began development on a new series of compression drivers that led to the 435Be. Button wanted to address both the bandwidth and output requirements with minimal distortion. The goal was to have a driver that was pistonic throughout its bandwidth and have extension that did not rely on resonance. The solution was in a different diaphragm material—beryllium. The use of beryllium in compression drivers was not new. The TAD Division of Pioneer had been producing such drivers for many years. However, the approach and design objectives set for the 435Be were unique.

To ensure pistonic response, Button specified a smaller 3" diameter diaphragm. A beryllium diaphragm of this size

4348
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Dr. Floyd Toole

©Don McRitchie

Dr. Floyd Toole has to be considered the most influential scientist working in the loudspeaker industry. His work has been widely adopted by both standards-setting bodies and manufacturers.

Dr. Toole's initial education was at the University of New Brunswick in Canada, where he received a B.Sc. in electrical engineering. He later received a Ph.D. from the Imperial College of Science and Technology, University of London. He returned to Canada in 1965 and was offered a position at the National Research Council in Ottawa in their Acoustics and Signal Processing Group.

Initially, Dr. Toole was involved in pure research. However, in 1969, he was presented with a unique opportunity. He was approached by a Canadian audio magazine with an offer to conduct objective measurements of loudspeakers to be printed with their reviews. It meant that Dr. Toole would have access to numerous loudspeakers that he could use for research purposes. He thus began a twenty-year program of directed research to correlate loudspeaker performance, room acoustics and listener perception.

This work was groundbreaking. It was the first time that anyone had attempted such a correlation in a comprehensive and objective manner. The result of this research was no less than the establishment of a Canadian loudspeaker industry. There are currently two dozen Canadian manufacturers producing loudspeakers for the world market, which were founded on Dr. Toole's research. Numerous foreign companies were also quick to adopt his approach to loudspeaker development and measurement.

In recognition of his accomplishments, Dr. Sidney Harman approached Dr. Toole in 1991 with an offer to join Harman International in one of their most senior positions. Dr. Toole accepted and was assigned oversight and direction for acoustic engineering for all of the Harman International companies. The current design and development work at JBL, both for home speakers and professional products, is based upon principles and processes that he established.

ensured that breakup modes would be above 15.5k Hz. A thin layer of Aquaplas was applied to the back of the diaphragm to damp spurious resonance. The diaphragm was also light enough for extension to that frequency without relying on resonance. Total moving mass was only 1 gram, with the diaphragm less than 0.5 grams. This was less than a third the weight of previous materials.

While the switch to beryllium solved the distortion and extension issues, it did not meet the requirement for high output, since a surround formed out of this same material has much less fatigue resistance than the titanium it replaced. Button addressed this in a very innovative way, with a unique composite design. He specified a Kapton surround that would be immune to fatigue failure. However, previous composite designs always proved problematic due to the need to have the diaphragm, voice coil former and surround all attach at the same point. Button resolved this problem by having the Kapton surround formed into a deep well just before the point where it attaches to the diaphragm. The voice coil was dropped into this well, which eliminated the need for a former. Since only the surround had to be fastened to the diaphragm, the result was a very robust design with reduced moving mass.

Another unique feature of the driver is that it does not have a traditional throat. The phase plug terminates at the driver exit, providing an effective flare rate of 550 Hz. Previously, virtually every compression driver made had a 180 Hz flare rate, the origin of which dates back to the original Bell Labs designs from the 1920s. This low rate was necessary to accommodate the low crossover points used in early two-way loudspeakers. However, this low rate compromised high-frequency performance. Given that there was no need for such low-frequency output for the 435Be, the flare rate could be optimized to provide a 6 dB drop in second harmonic distortion.

The final result was the highest-performing high-frequency driver ever produced by JBL. The stiff, light beryllium diaphragm has such excellent transient response that its sonic character is closer to an electrostatic design than previous compression drivers. Distortion was reduced to levels never attained previously at JBL. All of this was accomplished with a driver whose output, and associated dynamic range were fully in keeping with the hallmarks of the JBL brand.

The third transducer used in the K2-S9800, the 045Be ultra-high-frequency driver, was also groundbreaking in its combination of extreme extension, high output, low distortion and wide coverage. Its development was related to recent advances in recording media. Traditional recording media (CDs in particular) restrict high-frequency information to approximately 20k Hz. The new high-resolution formats can record information to 50k Hz and beyond. It was decided during the development of the K2-S9800 that this system should have the capability of reproducing this ultra-high-frequency information. However, no one had ever attempted such frequency extension in a high-efficiency, high-output device. The 045Be was developed as a pioneering design to address these expanded requirements.

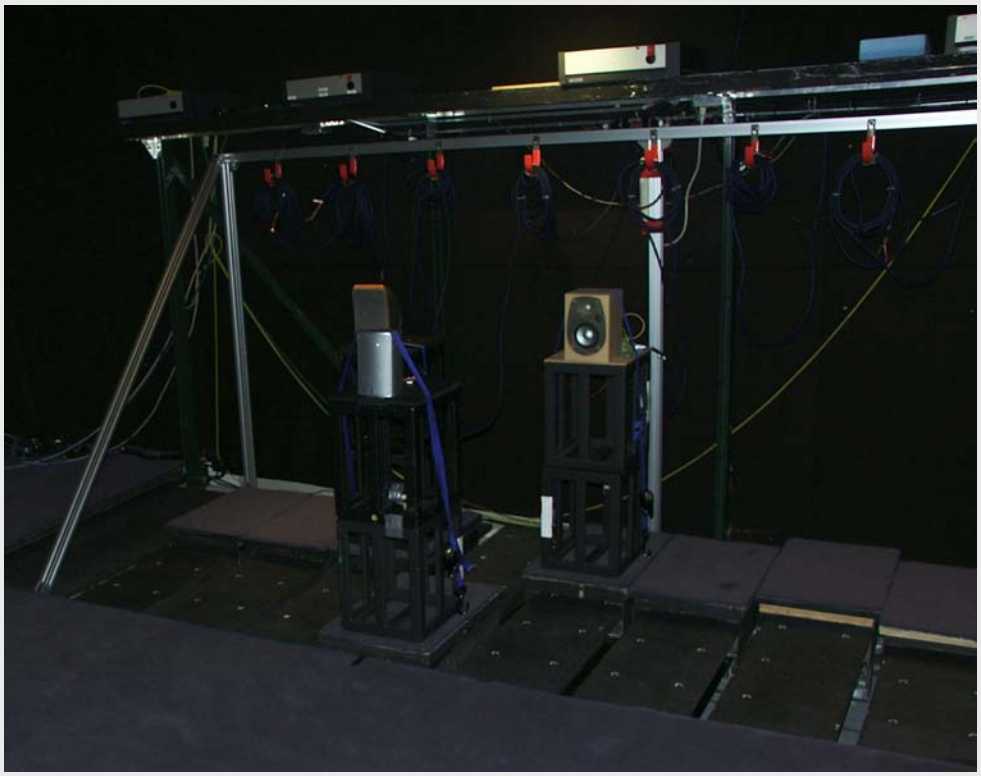
Design of the 045Be was the responsibility of Tim Prenta, the Director of JBL Consumer Engineering. The need for high output and efficiency dictated a compression driver device. However, to achieve the required extension, an extremely small and light diaphragm would be required. As with the 435Be, beryllium proved to be the most suitable material. Prenta specified a 1" diaphragm that has a weight of only 0.1 grams. To keep the total moving mass low, the coil is attached directly to the diaphragm without a former. The complete assembly weighs only 0.3 grams. High efficiency was accomplished with an extremely powerful but small neodymium magnet that provides a flux density of 20 Tesla in the gap.

The small diaphragm and need for extreme extension dictated the need for an inordinately precise phase plug. The only process that proved capable of meeting the tight tolerances was stereo lithography. Normally, this technology is only applied to the development of prototypes due to the high costs involved. However, every production phase plug made for this driver is produced using this technique since no other suitable means could be found. The result was a driver with minimal distortion levels and a frequency response that is essentially flat from 10k Hz to 48k Hz. It had extraordinary output, capable of sustained levels over 110 dB. All of this was accomplished in a package that weighs less than 1lb.

With the driver complement in place, Greg Timbers undertook the network design and system tuning. Timbers concept for the system was an extended two-way design. In other words, the 1500AL and the 435Be would function very similarly to a traditional JBL two-way system whose bandwidth covered the majority of musical information. The 045Be would only act as a super-tweeter, providing extension to the 50k Hz cutoff. This dictated a relatively high crossover point of 10k Hz for that driver. Timbers utilized his charge-coupled network topology with steep 24-dB slopes to minimize both distortion at the crossover points and overlap between drivers.

Timbers was also responsible for the two Bi-Radial® horns and enclosure design. The midrange horn was configured for uniform dispersion over 100º horizontal and 60º vertical coverage angles. The ultra-high-frequency horn had horizontal and vertical coverage angles of 60º and 30º respectively. The enclosure was built using heavy 1"-thick MDF stock and was comprehensively braced. A six-sided cross-section was employed to eliminate the propagation of standing waves inside the enclosure. A separate sub-enclosure at the base of the system was designed to house the crossover and isolate it from the vibrations induced in the main enclosure volume.

As with the previous two Project speakers, Dan Ashcraft was brought in at the start of the project to undertake the industrial design. In keeping with Timbers's design concept, Ashcraft felt that the system should take on the look of the classic two-way JBL monitor that focused on the 15" woofer and midrange compression driver/horn. The addition of the super tweeter as a separate unit would define the product



Multi-Channel Listening Lab (Shuffle Room)
@ Don McRitchie

Doug Button

©Don McRitchie

Doug Button, currently JBL's Vice President of Research and Development, has been instrumental in maintaining JBL's position of technological leadership for nearly 20 years. His university education began with a B.Sc. in electrical engineering that he obtained from Iowa State University in 1982. He started his career in loudspeaker engineering at Electro-Voice in 1984, where he was responsible for the design of a number of bass transducers and compression drivers which remain in their catalog to this day. In 1987 Button joined JBL in their transducer engineering department and immediately established a reputation for innovation with his development of the VGC series of bass drivers.

As has been documented elsewhere in this article, Button has subsequently been responsible for a long line of "firsts" in transducer engineering at JBL. However, this doesn't capture what is arguably his greatest asset — his ability to approach design from a holistic perspective. Rather than concentrating on design issues in isolation, he is unique in his ability to visualize the larger engineering framework in which these issues exist. This approach results in solutions that address the overall goal of a product's design and not just the smaller objectives of discrete components.

There can be no greater example of this than the EON® series of portable sound products that he developed in 1995. The goal was for a simple, compact sound reinforcement system for touring musicians. The need for simplicity resulted in the decision to integrate amplification with the loudspeaker system. This was nothing new, as JBL had produced integrated systems for years. However, Button's approach to the design was unprecedented. He designed a front baffle as a single-piece, aluminum casting that integrated the bass driver chassis, horn, enclosure construction and amplifier mounting. It also acted as a heat sink for the attached drivers and amplifiers. In addition, convective cooling of the entire system was accomplished with the placement of heat sinking fins in the enclosure ports that were attached to the baffle. The result was a high output system in a very small form factor, with exceptional control of power compression. All of this was achieved in a system that was very cost effective due to its unparalleled level of integration.

This holistic approach has been carried on in such innovative products as the EVO series of installed sound products. In that case, the integration extended to digital signal processing and control that includes active room and power compression correction. It is representative of technological leadership that leaves JBL well positioned for future endeavors.

architecture. The design would highlight the super tweeter by making its housing visually distinct from the overall enclosure.

The main enclosure proved challenging. Engineering considerations demanded that the midrange horn extend beyond the front baffle. The grill over the woofer was used to tie the horn back into the same curved plane of the overall enclosure, while allowing a recessed, flat, front baffle to mount the 15" woofer. The final design for K2-S9800 was fully in keeping with its status as a statement of the JBL product philosophy.

The K2-S9800 continued JBL's unbroken string of successes for its Project speakers. It was widely praised in the press, with one noted reviewer stating that it was the finest loudspeaker he had ever heard. It was equally successful in the marketplace and remains in production at this time. Whereas the previous two Project speakers were mainly intended for the Asian market, the K2-S9800 has found acceptance in all major markets, including Europe and North America. It has led the way for a number of follow-on products including the K2-S5800, S4800 and monitor series 4338, 4348 and 4428. All of these products used technology derived from the K2-S9800.

Technological Leadership

JBL's success has, in many ways, been defined by its position of technological leadership that traces its roots to Jim Lansing himself. As JBL enters its seventh decade, this leadership is stronger and more remarkable than at any previous time. The pace of technological change has never been greater and the ability to stay in front has never been more difficult. Yet JBL continues to push the state-of-the-art.

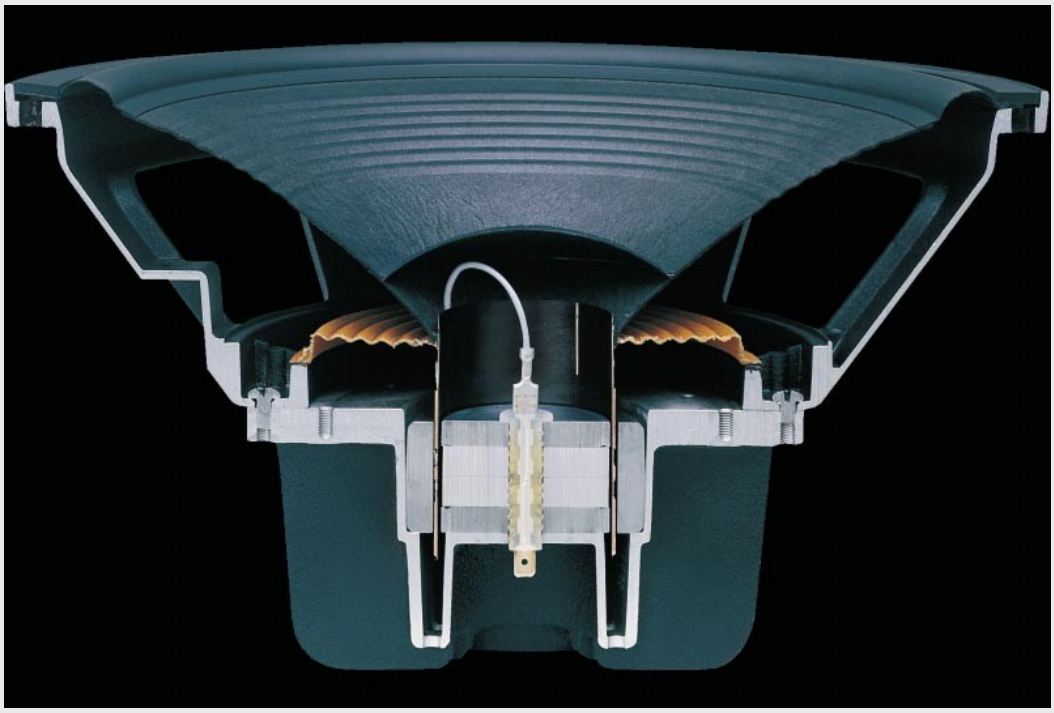
One of the people most responsible for maintaining this culture of technological leadership at JBL is Harman International's Senior Vice President of Acoustical Engineering—Dr. Floyd Toole. Dr. Toole is the audio industry's recognized leader in research and development for the field of loudspeaker/room/listener interaction. He has instilled a design philosophy at JBL that represents the culmination of a technological progression started by Jim Lansing. Lansing was first and foremost a transducer engineer. He established the reputation for excellence in driver engineering that remains undiminished to this day. In the 1970s, numerous JBL engineers were responsible for expanding that tradition of excellence into system design. Instead of transducers being the starting point, ultimate system performance defined the overall goal for which components were optimized. Dr. Toole has further expanded this engineering philosophy so that the listener's experience forms the basis of design. This was possible only though his pioneering work in relating loudspeaker performance to the listening environment and auditory perception.

Dr. Toole joined Harman International in 1991. One of his first accomplishments at Harman was the construction of a multi-million dollar acoustic laboratory in the Northridge campus that remains the most advanced facility of its kind in the private sector. The facilities include three separate anechoic chambers and a unique multi-channel listening lab nicknamed "the Shuffle Room," designed for blind evaluations. Dr. Toole discovered that perceptual issues like a speaker's styling, brand name, price or relative position to other speakers in a room can all influence a listener's preference. Blind testing removes these variables, and the Shuffle Room became an essential tool in achieving this goal.

The Shuffle Room uses movable platforms that are pneumatically operated to position any one of four loudspeakers into an optimal location for auditioning. Different speakers can be silently moved in and out of position in no more than three seconds. The speaker under audition is always behind an acoustically transparent, but optically opaque, screen. The listener has full control over which anonymous speaker is auditioned and the length of time for each audition. The result has been a wealth of information that has been used to comprehensively and objectively measure loudspeaker performance and listener perception. It has provided the technical underpinnings upon which all JBL speakers are currently designed.

It is interesting to note that Dr. Toole's analysis has confirmed the importance of two longstanding design tenets at JBL—uniform amplitude response and uniform power response. Dr. Toole documented that listeners prefer neutral loudspeakers that do not artificially emphasize portions of the frequency spectrum. He has also documented that uniform, off-axis radiated power within a controlled dispersion pattern correlates with listener preference. JBL's studio monitors have been designed with these traits since the pioneering D50, as have home speakers for the past three decades.

One of the most noteworthy series of speakers to result from Dr. Toole's design philosophy has been the LSR line of studio monitors. Instead of using a limited set of industry standard measurements, these speakers were designed on the basis of measurements that contained thousands of data points which were correlated to listener perceptions. The first of the series were designed to have a very controlled response that would minimize the impact of room interaction to allow uniform sound under a wide range of placement conditions. More recently, the LSR series has been



252G Differential Drive ® Woofer from LSR32

JBL Synthesis 3

enhanced to include room correction software and hardware to actively compensate for room interaction, which results in even more flexibility in placement. Technology from the LSR series, such as the Elliptical Oblate Spheroidal (EOS) tweeter waveguide has found its way into numerous JBL home speakers.

Even with the greatly expanded range of design concerns posed by speaker-room-listener interaction, the importance of transducer engineering has not been diminished at JBL. It simply has been brought into a much larger context. Doug Button can be considered the current heir of Jim Lansing's legacy in transducer technology leadership. Over the past 18 years, he has overseen the development of numerous technological firsts in driver design. Just a short list includes neodymium motors, VGC and SVG motor topologies and composite beryllium diaphragms. All of these technologies have been previously described in this article. However, one of his most significant driver breakthroughs, Differential Drive®, deserves elaboration.

The Differential Drive® uses two voice coils and two magnetic gaps in the motor design. Button's work in developing the neodymium motor resulted in magnetic structures that were greatly reduced in size. In particular, the depth of these motors was considerably less than previous Alnico or ferrite versions. It allowed Button to extend the voice coil former through the back plate which was pierced to create a second magnetic gap in the circuit and allow the placement of a second, separate voice coil. The shallower depth meant that the extended former was short enough to mitigate mechanical control issues associated with keeping a long coil former centered in two separate gaps. It also meant that the additional moving mass of the extended former would be minimal.

On first examination, it may appear that two gaps and two coils should double the sensitivity of the driver. However, this is not the case. The total magnetic energy of the driver has not been changed, and therefore efficiency is not increased. However, power handling and freedom from power compression are significantly raised. This is because two coils and two gaps allow for greatly increased heat management. Heat buildup in the coils is halved and the separate coils can be heat-sinked independently to greatly reduce operating temperatures. Since heat is the main culprit in limiting output and robbing dynamics, the resulting drivers have unparalleled output and the lowest levels of dynamic compression of any drivers currently made. While initially developed for sound reinforcement applications, Differential Drive® technology now has found its way into JBL's studio monitors, automotive speaker line, and such home speakers as the 4312D.

The pace of technological change at JBL remains unabated, and foundations for future advances are well in place. While it is always a fool's game to predict future technology, certain trends are apparent that may well play an ever-increasing role at JBL. The most significant is the marriage of electronics, data processing and loudspeakers. As previously described, the LSR studio monitor series has pioneered active room correction through a combination of hardware and software. JBL Professional's HiQnet technology allows networked integration for control and monitoring of numerous loudspeakers and associated electronics. JBL's Synthesis® home theatre line consists of loudspeakers integrated with amplification and signal processing. Over time, it is likely that such integration will extend to all aspects of JBL's product development.

DD44000 Paragon
© Harman International, Courtesy John Edwards

JBL VerTec® Installation at Radio City Music Hall
© Harman International, Courtesy Mark Gander and John Eargle

Summary

Excellence in Engineering and Art

This article has tracked a sixty-year progression of achievement. The company that has emerged appears to bear little resemblance to the family operation founded on a ranch in 1946. However, looks can be deceiving. JBL remains intrinsically tied to the principles of its founder, James B. Lansing. Jim Lansing's overriding ambition was to engineer the finest loudspeakers he was capable of producing. His work embodied an attention to detail that was unsurpassed in the field. His eagerness to understand and adapt new technologies ensured that his work was at the forefront of the industry.

These principles are reflected in both the philosophy that guides that people of JBL and the products they create. A special attribute of the company is that its search for technical excellence has always been pursued with one goal in mind—the accurate reproduction of music. In many ways, the technology has become inseparable for the larger esthetic implications—both sonic and visual—of loudspeaker design. From the elegance of products like the Paragon, to the striking appearance of otherwise utilitarian components, JBL has tried to transform every functional object into a work of art.

Jim Lansing's legacy can rightly stated as no less than the genesis of the loudspeaker industry. The companies he was involved with were the first to broadly commercialize loudspeakers in both domestic and professional applications. JBL carries on this inheritance as the pre-eminent loudspeaker manufacturer in the industry. Whether it be at home, in the car, at a theatre, a live music performance, or in one's place of work, there is a greater chance that you will be listening to a JBL loudspeaker than that of any other company. There can be no greater legacy than this.

Clockwise From Top Left: John Eargle, George Augspurger, Mark Gander, John Edwards, Rich May, Greg Timbers, Garry Margolis, Drew Daniels, Dr. Bruce Edgar

Acknowledgements

This article has only been made possible with the input and assistance of numerous people and agencies. First and foremost, we would like to acknowledge Harman International, without whose assistance this article would not have been possible. We would be remiss if we did not acknowledge the previous work upon which this article has been built. That is John Eargle's "A Brief History of James B. Lansing and James B. Lansing Sound Inc." that he developed in 1981 when he was JBL's Vice President of Market Planning. John has been instrumental in guiding the development of this article and our website endeavors. Mark Gander, Vice President of Marketing for JBL Professional, has been our mentor at JBL in developing a historical record of the company and its founder. Koji Onodera, the Editor-in-Chief of Stereo Sound Magazine, has shared with us the meticulous record of JBL's product development that they have compiled over many years. Finally, the following individuals have been generous in sharing their knowledge of the events that define the legacy of JBL.

Dan Ashcraft	-	Principal of Ashcraft Design, the primary industrial design consultant to JBL Consumer.
George Augspurger	-	Former senior JBL employee from 1958 to 1970 and currently an internationally known studio designer.
Doug Button	-	Current Vice President of Research and Development for JBL Professional.
Hal Cox	-	Original JBL dealer and personal acquaintance of Jim Lansing.
Drew Daniels	-	Former Applications Engineer at JBL Professional from 1984 to 1989.
Walter Dick	-	Former head of JBL's Transducer Engineering Department.
Dr. Bruce Edgar	-	Horn design expert and historian on the development of horn loudspeakers.
John Edwards	-	JBL's fourth employee and subsequently JBL's first Vice President of Finance.
Lorr Kramer	-	Former Product Manager for JBL in the 1970s and 1980s
Lansing Family	-	Lois O'Neil, Glenna Garrett, Richard Lansing and James Kent Lansing.
Bartholomew Locanthi III	-	Son of Bart Locanthi, JBL's first Vice President of Engineering.
Garry Margolis	-	Former Vice President, Marketing for JBL International and former Director of Marketing for UREI
Richard May	-	Son of Edmond May and a former longtime JBL employee
Jerry Moro	-	Current Senior Transducer Engineer for JBL Consumer
Fred Peterson	-	Lansing Manufacturing's first employee in 1926.
Tim Prenta	-	Current Vice President of Engineering for JBL Consumer
Greg Timbers	-	Current Chief Development Engineer at Harman Consumer.
Dr. Floyd Toole	-	Current Harman International Senior Vice President of Acoustical Engineering.
Arnold Wolf	-	Former President and Chairman of JBL and former industrial design consultant to JBL.