CELEBRATING THE 100 YEAR ANNIVERSARY

DANISH LOUDSPEAKERS

100 years

1915 – 2015

THE HISTORY OF THE DANISH LOUDSPEAKER INVENTION AND INDUSTRY

FOREWORD

Hearing is often considered as one of the most important of the traditional five human senses that allows us to communicate, understand, and navigate the world. The invention of the loudspeaker by the Dane Peter Laurits Jensen and Edwin S. Pridham in 1915 was groundbreaking. This enabled humans to communicate and experience sound from a distance, and further sparked the development of the 20th century's most important technology products such as radios, telephones, and public address systems. 100 years later, the loudspeaker is still a ubiquitous element of sound reproduction systems and used in almost all sound technology products.

Denmark was an early adapter of this new technology with the start-up of many companies as well as the introduction of university programs to support the technological development and constant flow of talented people. The present book covers important inventions, contributions, and amusing anecdotes from the 100 years of loudspeaker history, and not least, the flourishing of the Danish loudspeaker industry.

Understanding the history is essential in order to prepare for the future, but it also helps us to form a strong identity. It is a fact that the Danish sound sector has been, and still is, very healthy and has a strong identity and excellent reputation worldwide. In a way, the anniversary of the loudspeaker is also the anniversary for everyone who works hard every day to keep-on transforming the sector and maintaining competitiveness. This is of course not an easy task. The fact that we live in the digital age, where data is one of the core assets, also have consequences for the sound sector: The loudspeaker has become a commodity and should be integrated in smart and unique products and services ready for the digital economy and customizable to individual user's needs. I believe that Denmark has the positions of strength to take up that challenge in a multi-disciplinary collaboration.

In 100 years from now, the loudspeaker will surely be radically different. However, I am convinced that there is still a need for people to perceive and interact with sound from all over the universe. It is my hope that the Danish sound sector is taking part in fulfilling this need.

Enjoy the reading!

Jan Larsen
Director of the Danish Sound Innovation Network

DANISH SOUND

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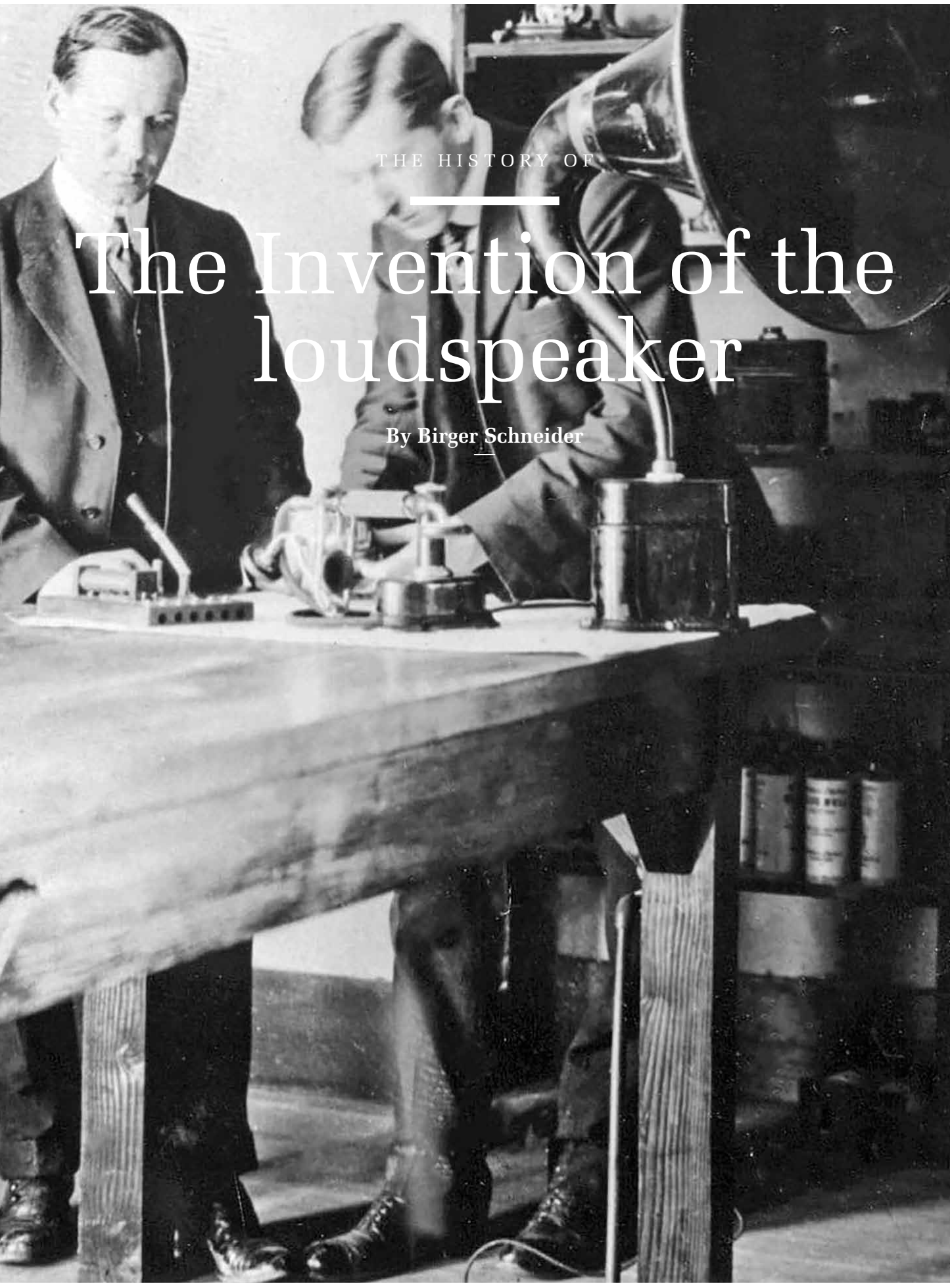

THE HISTORY OF

The Invention of the loudspeaker

By Birger Schneider

Peter Laurits Jensen, the charismatic inventor who changed the world of sound 100 years ago – and our lives today.

During the first two decades of the twentieth century, the world saw major breakthroughs in communication technologies, spearheaded by not least two Danish inventors, Valdemar Poulsen and Peter Laurits Jensen. In late 1903 Valdemar Poulsen (1869-1941) together with his assistant Peder Oluf Pedersen (1874-1941) had invented the 'Arc Generator', also known as 'Arc Transmitter', the solution that facilitated wireless transmission of telegraphy, and later on radio transmission of voice and music.

A few years later in 1915, Peter Laurits Jensen (1886-1961), a student of Valdemar Poulsen, invented the electronically amplified sound through his discovery, the loudspeaker. While the invention of the vacuum tube in a few years had made Valdemar Poulsen's great invention, the arc transmitter, obsolete and put an end to an industrial adventure that had lasted two decades, the vacuum tube in contrast was a decisive technology for rolling out the loudspeaker. It enabled a fast penetration of new sound technology to the entire world.

The vacuum tube in turn would be made redundant by another new technological achievement, the transistor after its invention in 1947. In contrast, Jensen's contribution to the world, electronically amplified sound through the use of a loudspeaker, has basically not changed to this day. Its widespread use is such an inherent part of our daily lives that we cannot fully grasp its full potential. An ordinary home of today possible has more than 50 loudspeakers in use in radios, TVs, cellphones, headsets, computers, bussers, audio systems in cars, warning systems, etc. However, until the end of 1915 this was still a completely unknown device to the public. Its invention was not predicted, as many inventions otherwise often are. In principle, it was a classic example of serendipity, i.e. the art of finding things unintentionally or by diversion.

When Peter L. Jensen and his colleague, Edwin Pridham (1881-1963), invented the loudspeaker, they had a different focus, that of developing an electro dynamically receiver to substitute the membrane receiver in use in telephone earpieces at the time.

Peter Jensen and Valdemar Poulsen were self-taught engineers

It is interesting to note that Peter L. Jensen as Valdemar Poulsen were self-taught engineers, and neither earned a degree but operated through practical engineering experience. Valdemar Poulsen, son of an assessor in the Danish High Court, had despite an early interest in science failed the entrance examination in mathematics at the Danish College of Advanced Technology (now Danish Technical University). After trying a university education in medicine, but lacking interest in the topic, he finally chose to become an apprentice as mechanics at the Frichs train factories in Aarhus, Denmark.

Later on he worked as a laboratory manager at the Copenhagen Telephone Company where he in 1898 invented the 'telegraphone', the world's first magnetic sound recorder. Following his success, Poulsen resigned from the Copenhagen Telephone Company to concentrate on his inventions and to improve his telegraphone for which he had registered patents in many countries. Poulsen handled his lack of mathematical knowledge by partnering with Peder Oluf Pedersen, P.O. Pedersen, a highly skilled engineer and physicist.

P.O. Pedersen is notable for his work on electro technology. In 1912 he became a professor of telegraphy, telephony and radio at the College of Advanced Technology (now Danish Technical University) where he in 1922 advanced to become Principal until his death in 1941. P.O. Pedersen should become a key person in developing and inspiring Danish audio industry in its infancy through his significant influence, e.g. through inspiring and educating young engineers. He also took the initiative to establish the Danish Academy of Technical Sciences in 1937. On January 1, 1941 he had initiated to set up the Acoustical Laboratory as an independent, foundation based institute under the auspices of the Danish Academy of Technical Sciences (ATV). It was the first of several such ATV institutes to be established in the years to follow. Today the Acoustical Laboratory is part of DELTA, Danish Electronics, Light and Acoustics.

It has been said that Valdemar Poulsen was the genius, and P.O. Pedersen was the bright mind. Together they complemented each other extremely well and "reached to the stars" of their time.

In 1903, Valdemar Poulsen, P.O. Pedersen and others were deeply engaged in improving the telegraphone, and also worked on other important inventions. Valdemar Poulsen was now known as the "Danish Edison". It was to this laboratory that Peter L. Jensen, the later to-be-inventor of the loudspeaker, arrived on January 1, 1903.

Learning shop culture engineering

Inspiring years at the Valdemar Poulsen Laboratory

From 1903 until 1907 Peter Jensen served as an apprentice at the Poulsen Laboratory, and was subsequently employed as a well-paid assistant until he entered his service as wireless operator in the Danish Navy in 1909 from March until October.

The salary was poor during the early period, 9 Danish Kroner per week. Jensen was poor and had to wear the clothes of his late father, although they did not fit him well. He often could not afford food, but friendly people now and then helped him. From a technical point of view, the job was highly inspiring. At the time it was referred to as a "shop culture" approach to engineering education.

The activity in the lab was to work with and refine Poulsen inventions, e.g. the 'telegraphone'. Late in 1903 Poulsen, with assistance of P.O. Pedersen, had even invented the 'Arc Transmitter' which would revolutionize wireless communications a few years later. In 1904 it was decided to split the laboratory in two to obtain sufficient focus on the new development. That proved a great opportunity for Peter Jensen. He was transferred to the arc laboratory, i.e. wireless communication lab, which was set up in new facilities across the street. The reason for including him, still only an apprentice, to the team of engineers at the time was that "he always knew were things were put".

Later on, he also proved valuable, since he was formidable in tuning the transmission circuits of the arc transmitter. Even keeping the arc alive required careful tuning, and Jensen mastered that to the full. He taught himself Morse code, and was the only one among the employees that could read and send Morse signals. The arc transmitter was superior to the Marconi transmitter since it featured tuning to specific frequencies thus avoiding interference between stations, whereas the Marconi approach would use the entire spectrum and only allow a single transmission. However, tuning could prove difficult and time consuming, and due to the low cost of labor, letting an apprentice do the job was

attractive, especially when the apprentice, as in the case of Jensen, was diligent and fast.

The first wireless transmission of a human voice

Many interesting developments and inventions became part of the life of Peter Jensen during his youth in Copenhagen. One incident of special merit, the first wireless communication of a human voice, is worth mentioning. Poulsen and his engineers had a clear vision that the continuous waves of the arc transmission system would somehow enable transmission of a human voice - not only Morse codes via the wireless transmissions. They just did not know how to make it work. In other places of the world, similar theories and experiments were in progress, but no breakthroughs had as yet been reported.

The Chief Engineer of the lab, Schou, had one day in 1906 brought in a small piece of crystal, galenite, to be use as detector. Connecting a thin wire to it, it would function, but often unstable, as a point-contact metal-semiconductor junction, forming a Schottky barrier diode. The arrangement is sometimes referred to as Cat's whisker detector. When connected in series with the so called "tikker" in the Poulsen system they discovered that the dots and dashes in the transmission would create tones, whereas if the crystal was not present only humming would sound in transmissions of dots and dashes. In lack of success, the project was put aside. However, Jensen was intrigued by the opportunity of human voice transmission, so one evening he went back to the lab with two of his friends, Axel and Olaf Vosbein-Jensen. Jensen had in the previous experiments realized that the combination of the tikker and the crystal was essential, since in the absence of a tikker the connection was completely silent.

That evening, Jensen placed one of the two brothers, Axel, in a shed with a microphone and he positioned himself about 100 meters apart with a receiver and a headset. He had asked Axel to count from 1 to 10 and keep repeating, but all that came through in the wireless communication was the tones that he and Chief Engineer Schou had already discovered in their previous experiments. After a long set of trials, but in vain, they were about to give up, when Jensen by mistake put his hand on the tikker and prevented it from operating. Suddenly in the headset he heard Axel's voice:" eight, nine ten, can you hear me?" It was so basic and yet not discovered in their previous experiments. The tikker and crystal had counteracted and the tikker should be removed. Next morning Jensen went into town to tell Valdemar Poulsen about the big discovery and more experienced engineers took over. Shortly after the news were spread about the breakthrough and Poulsen's wireless telephony. By pure luck Jensen had been assisting in discovering the essentials of the technology and became one of the first in the world, if not the first to hear a human voice being transmitted across a wireless connection.

Roaring California

America discovers Poulsen's arc transmitter

The success of Poulsen and his wireless transmitter, the arc generator, should turn into the opportunity of fame and breakthrough for Peter Jensen in the audio domain. The breakthrough of wireless communication, in direct competition with the successful landline based telephony was on, not least in a country like the USA with its vast distances.

Traditional telephony was costly due to its huge investments in cobber connections, poles, maintenance, etc. California, a rapid growing State far from the East Coast of the Continent, nurtured a culture of adventurers and gold diggers and with an influx of newcomers. A city like San Francisco had grown from about 1,000 people in 1848 to 415,000 in 1910, just 62 year later. People could become very rich from one day to the other. The devastating earth quake and fire in San Francisco in 1906 and its subsequent rebuilding added to an almost revolution in business activities creating a roaring environment. The city was rebuilt in just 4-5 years, and as often the case in such booms, entrepreneurial building tycoons, real estate developers, and fortune hunters played an important role and plenty of money was available.

A consortium of business people, bankers, and technical people, the latter closely connected to Leland Stanford's Stanford University in Palo Alto, was formed in 1908-09. A young engineer from the consortium, Cyril F. Elwell, was sent all the way to Copenhagen to assess the promising technology of Valdemar Poulsen's Arc Transmitter, which proved superior to a US development by Reginald Fessenden for the General Electric Company. Elwell had become familiar with Poulsen's work through the scientific literature, and he visited Poulsen in late 1908, as did many pioneers and business people from around the world to understand the new technology. However, Elwell had failed to strike a deal with Poulsen on behalf of the consortium and returned empty handed to California, traveling by train from Copenhagen to France, boat to the UK, train via London to Southampton, a 2 weeks sea journey across the Atlantic to New York and finally by train all the way across USA. In summer of 1909, he returned to Copenhagen and this time was successful in setting up an agreement, obtaining license for the Poulsen arc transmitter technology for the USA. License was transferred through Elwell and andhis partner John C. Coburn, to the investor who owned 'Poulsen Wireless Telephone and Telegraph Company' (PWTTC), in Palo Alto, California.

The Poulsen Wireless Company would be the first Tech company in Palo Alto, the heart of what would, a few decades later, be known as Silicon Valley.

The opportunity of a lifetime for Peter Jensen

After striking the deal with Poulsen, the challenge changed into that of practical matters. A mechanic from Chicago, Carl Albertus, was sent to Copenhagen for training, but a person familiar with operating the arc transmitter was badly needed. Peter L. Jensen was the optimal choice. He had left the Poulsen lab in Copenhagen on March 1, 1909, to enter his military service as a wireless operator in the Danish Navy and that ended in October the same year. Valdemar Poulsen sent Peter L. Jensen a letter offering him the assignment in California, now at a rather generous pay of 125 US$ a month, far better than the 9 Danish Kroner per week he received when he started back in 1903. It was a comfortable payment even in California. In addition, Jensen would have all his expenses covered. He gladly accepted the job offer, not least for the opportunity of seeing the world.

Jensen left Denmark on December 9, 1909, along with Carl Albertus, arrived in New York on December 21, and came to San Francisco around January 1 1910. Leaving a doll and gray Danish winter and arriving a few weeks later in California with its mild sub-tropical climate, tropical fruits, palm trees and sunny weather impressed a 23 year young man that had grown up in a remote rural area on the shores of the windy Baltic Sea. He soon came to learn that California was also a region of contrasts. Wealthy people and bounty hunters were common, but also a lot of extremely poor people struggling just to survive, facing a miserable life at a level far below what he knew from his native Denmark. As he wrote to his mother: "In America you find all the best and all the worst – mixed together!"

Business was very successful for Jensen and not least the PWTTC Company throughout 1910. Several transmitter stations were set up in San Francisco,

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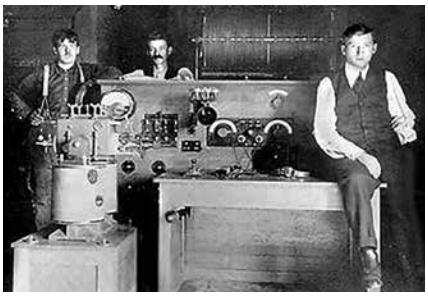

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01 The experimental radio station set-up by Valdemar Poulsen in Lyngby was an incredible playground for Peter Jensen. Often at night he would go to the lab and in his free-time transmit voice messages, music, or undertake various experiments on his own. Here he is listening to Morse communications, 1908-1909.

02 A young Peter L. Jensen, 1910, in setting up Poulsen arc transmitters for the Poulsen Wireless Company. Sitting right is Peter Jensen and center the mechanic, Carl Albertus, that followed Jensen from 1909 to 1925, when Albertus passed away.

Sacramento, Stockton, Los Angeles, and other places. It turned out that the Poulsen communication system using selected frequencies proved very robust against even deliberate attempts of jamming from competing wireless operators, e.g. United Wireless.

During this period, Peter Jensen developed a strong friendship with a 5 years older colleague, Edwin S. Pridham (1881-1963). The two respected each other very much, and 5 years later it would be the two that together invented the loudspeaker. Pridham was born at Downers Grove near Chicago and had managed to get an engineering degree at Stanford University. In that respect they complemented each other well, Jensen with his practical, creative and entrepreneurial approach and Pridham with a much stronger theoretical background in radio engineering obtained from the famous professor Ryan at Stanford University.

At the end of 1910, the PWTTC Company was split up in two due to new regulations of the US government demanding operators of wireless services, now Federal Telegraph Company, and the original Poulsen Wireless, supplier of system solutions. For Jensen it seemed time to go back to his native country, mission completed. However, he was now approached by Coburn, one of the founders of Poulsen Wireless.

When the PWTTC company was broken up, Coburn had made about 70.000 US$ from his sales of shares – a lot of money then, and income tax did not exist in California. At the same time there were a number of business people in San Francisco, who felt they had missed the great opportunity to make money on wireless investments. Coburn had in his typical style positioned himself centrally in forming a new consortium. Painting a picture of a worldwide radio cooperation for all communication outside the USA convinced investors. Part of the plan was he should go to Copenhagen and purchase all patents from Valdemar Poulsen for the arc transmitter for the entire world except the USA. That could follow later on. However, he needed a good inroad to Poulsen, and that was where he saw Peter Jensen, the 24 year old former assistant with Poulsen, as the ideal go-between.

Jensen was flattered when he learned about the list of investors and accepted to join Coburn to Copenhagen. However, he insisted that his good friend Edwin S. Pridham should be part of the deal. Peter Jensen was not unfamiliar with Coburn and his extravagant, intrusive and dominant style, e.g. having a personal automobile and driver and always using a gold knobbed cane, and he knew that it would make a good impression on Valdemar Poulsen.

So by the end of 1910 the three of them set off to Copenhagen. Unfortunately, Coburn, also an alcoholic, never made it to Copenhagen. He got trapped in Paris and London on the way and was drunk for weeks. Knowing his own weakness, he had hired a black servant to keep him from severe drinking, but even that failed.

So Jensen and Pridham had to proceed to Copenhagen on their own. Their mission, however, failed. Valdemar Poulsen had by then already sold basically all his rights to the arc transmission system. They tried to obtain a license for Ireland and Canada to facilitate wireless transmissions across the Atlantic. British authorities had originally suggested to them that the option would be available. However, later on it became apparent that the option for transmission systems had already been taken by a British syndicate under the British “king of armament” Lord Armstrong. In Copenhagen, they were respectfully received by Valdemar Poulsen and his colleague P.O. Pedersen, but opportunities for the Californian consortium had faded away. On departure, Poulsen gave hand to his former apprentice and now titillated him by:” Goodbye, Mr. Jensen!” As Jensen later recalled it: “Only a European could fully appreciate the full recognition in the few words of Valdemar Poulsen”.

Under the influence of Pridham, Peter Jensen decided to return to the USA and apply for US citizenship. On his way back he managed to pay his mother at the island of Falster a short visit. She felt sorry for his decision to finally leave Denmark. He should not see her again until 12 years later, and then only for a few days.

The two young men had made an appointment with Coburn to meet him in London. Once here they found Coburn in a state of excessive drunkenness, appearing like something the cat had just brought in, unable to enter into any sensible conversation. Lacking money for the return travel, they had the drunken Coburn dragged to a

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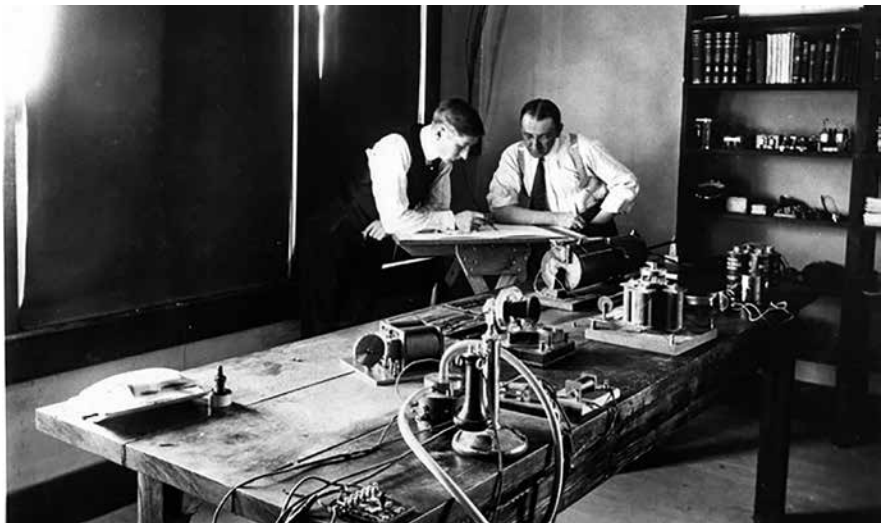

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01 Peter Jensen in the "lab", i.e. the parlor of the Bungalow in Napa. The Poulsen transmitter system can be seen in the right side of the lab.

02 The bungalow on F Street in Napa. The bungalow itself served as lab for the researchers. The building to the right is the mechanic workshop. That building is no longer there. The towers were used for wireless transmissions.

03 Jensen and a colleague in the lab in Napa. The Lab was set up in the parlor of the house.

04 The mechanic workshop in Napa. To the left Carl Albertus and Hugh N. Sym to the right.

05 "Foghorn Murphy" in San Francisco 1958 in front of the "Giants". The person in the picture may not be the original Foghorn Murphy of 1915, but he serves the same role.

Cooks travel agency for cashing in a traveler's check, and later on to a train at the very last minute to make it for the streamer 'Lusitania' back from Southampton to New York.

Setting up the Napa Valley R&D lab

They only had vague ideas of what to do when back in California, but Coburn connected them with investors of his consortium, first and foremost Richard O'Conner, a local soap and candle manufacturer. It should prove a fortunate act and lay the foundation for the development of the loudspeaker – although no one at the time understood that.

O'Connor and his business associates had been involved in the plans of acquiring the Valdemar Poulsen patents, which, however, had proven impossible to secure. They now formed the company 'Commercial Wireless and Development Company' and set up a research lab for Jensen and Pridham in remote Napa, in Napa Valley 55 kilometers north of San Francisco. At this small town, they established their R&D lab in small bungalow on February 22, 1911.

O'Connor felt an isolated setting away from the distractions of San Francisco would prove to be a more productive working environment for the inventors. Funny enough both young men ended up marrying young Napa women - Vivian Steves (Jensen) and Hazel Mauritson (Pridham) – and had children. The bungalow and associated land was acquired for US$ 2.500, and a small workshop was set up in a separate building on the premises. The parlor served as lab for the two engineers. The bungalow still exists today (1606 F Street, Napa) and can be found on Google Street View.

The aim of the activity was to develop new technology in the domain of wireless communication and improve telephone sound quality. Carl Albertus, who had worked with Peter Jensen since the days in Copenhagen, signed up as mechanic. Jensen and Pridham got some shares in the new company, and Coburn sold his share for 7.500 US$. Being an alcoholic, he later on lost control of his life, lost all money, automobile and driver, and his gold knobbed cane. He ended up as a tramp sleeping in the streets.

The invention of the dynamic speaker that was not an invention at all

During the first months they set up a Poulsen Arc transmitter and established a full radio transmitter station in Napa. Various experiments with even other items that had been sent over from Valdemar Poulsen in Denmark were made. They had been intrigued by a galvanometer based recorder that Poulsen had invented to record up to several hundred characters per minute during Morse signalling in telegrams. It consisted of a thin wire between magnet poles, and the wire would deflect and make markings on photographic paper that moved past, when currents were sent through the wire.

They realized that the speed of the unit was similar to ordinary speech. Substituting the thin wire in the galvanometer with a thicker one, and attaching the center of it to the center of a membrane, gluing an ordinary match between the two, they realized that they had a receiver for voice. Connecting it to a carbon microphone, they discovered they could transmit voice. The quality of the receiver had exceptionally strength and clarity. They called the invention an electro dynamically principle for sound reproduction. Mistakenly they assumed that they had made a serious new invention and applied for a US patent, after

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having studied if other patents on the topic already existed.

Needless to say, the team got extremely disappointed, when their patent application later on in 1911 was turned down, since the principle had already been discovered and patented years before. Ernst von Siemens, the 'German Edison', had as early as January 20, 1874 filed a patent on a "Magneto-electric apparatus" for "obtaining the mechanical movement of an electrical coil from electrical currents transmitted through it", and was granted U.S. patent No. 149,797 later on that year. In 1877 he had extended his patent to include a diaphragm of parchment. Oliver Lodge in the UK had a British patent, No. 9712 from 1898 on some additions. Anton Pollak received in 1908 a U.S. patent No. 939,625 on "improving moving-coil loudspeaker with a voice-coil centering spider". Patents by Dudley Field and others existed on somewhat similar topics. However, none of these inventors had managed to turn their patents into something viable for use in the real world.

In the year to follow, Jensen and Pridham continued to improve their "invention", but despite superior quality they could not get it down in price and weight to compete against the 700 gram receiver in existing telephones. Late in 1914 they travelled to New York to present their achievements to the American Telephone and Telegraphs Company (AT&T), a Bell telephone company. The dynamic receiver of Jensen and Pridham was analyzed carefully by AT&T for about 6 weeks, while the two stayed in New York. Finally, they received the verdict from AT&T. A short letter stating:" Sorry, we are not interested". No explanations or details given.

During their stay in New York they had visited Dr. Lee De Forest, a former colleague of their's from the days of the Poulsen Wireless Company in California. Now De Forest had invented the first vacuum tube, a 3 electrode "Audion" as he called it. He had sold the rights to AT&T for 140,000 US$. He would also later on be one of the fathers of sound in movies. However, De Forest was also a character balancing on the dark side of law and understanding the art of winning patent battles of inventions, he only originally had little part in. Selling rights, but not respecting the transfer of right, starting several "wild cat companies", luring investors from money was another merit of his. For Jensen and Pridham, however, the access to audion vacuum tubes would later on become essential in their developments of loudspeaker systems.

Upon return to California, the two researchers were on the verge of giving up. During their train journey back they had seriously discussed breaking up their partnership. Business prospects seemed to have evaporated, the financial backers pulled out after having spent more than 30,000 US$ on the R&D lab in Napa. However, again O'Connor should prove the guardian angel to them. Although the only financial supporter left, he asked them to continue work, although at a downsized budget.

Inventing the loudspeaker

The savior to their ideas and enterprise should come from a completely unexpected direction. Peter Jensen had gotten married. One day in January 1915 they received a visit by his wife's uncle, Ray Galbraith, a blacksmith of profession, probably mostly involved in shooing horses – and knowing absolutely nothing about radio communication and the likes. However, he was a practical man. "If you can't sell your solution to AT&T what chance do you then have? None! However, if you could get your device to speak a little louder, and put a horn to it like 'Foghorn Murphy', and you had a number of them, then it could be useful in the park during games, and we could understand what was said", he stated. 'Foghorn Murphy' was the famous, flamboyant and well known character in San Francisco opening baseball games and rodeos using a loud instrument, an old navy warning device, a fog horn, to get messages out to people. He would ride on horseback in front of the football team "the Giants" during parades and afterwards comment games.

The idea of adding a horn to their device so that sound could be heard not only in a head-set, but to more people in a room, immediately caught on, although it far from supported the lucrative telephone business they had imagined. Galbraith had also suggested the use of such a device at railway stations announcing train arrival and departure.

The same evening Jensen and Pridham started pursuing the opportunity. Using a gooseneck horn from an old Edison phonograph they had Carl Albertus connect the gooseneck horn to their receiver - a name for it was still not decided. During one of the following days they started the experiment that should prove so mind blowing at the time. In addition to the two researchers and Carl Albertus, another mechanic from the lab Hugh N. Sym was present, and so was the younger brother of Peter Jensen, Karl Jensen that had come to the USA as well.

The miracle of the great voice

They employed a set of microphones, which Jensen and Pridham had originally purchased in Germany on their travel to Denmark in 1910. Connecting the loudspeaker to a 12 V Accumulator and sending about 10 Amp of current through the microphone of the system, they essentially had a 25 W sound system. Completely lacking understanding of the consequences, they powered the system up in the bungalow's parlor, which served as their lab.
"A crack like the report from a gun came out of the horn, followed by a screaming howling noise which was ear-splitting and terrifying," Peter Jensen later on wrote. He continued: "Pridham shouted at the top of his voice: 'Disconnect the battery ...' At this point, the connection was broken, but Pridham was unaware of that, and he finished the sentence by hollering in a deadstill room '... before the house blows up!'"

What they had not anticipated was the feedback from a microphone-loudspeaker connection, when the two units are placed

too close to each other. Today that is common practice for everyone operating with microphone-loudspeaker systems, but not in those days, although the engineers knew about the effect, once they analyzed the situation. The noise was possibly a thousand times louder than anyone else in the world to that date had experienced. They tried again, now with the microphone and loudspeaker further apart, and they encountered a deafening noise, partly a thundering voice, partly still a lot of feedback noise.

Next step was then to move the loudspeaker and the microphone as far apart as possible. Placing the loudspeaker with its gooseneck horn on top of the roof facing northwest into the open land, Jensen's kid brother Karl was hanging on to the chimney, trying to prevent the loudspeaker from falling down as a result of the vibrations in the loudspeaker. A cable was connected from the loudspeaker down into the house, where Pridham sat talking into the connected microphone. Peter Jensen and mechanic Albertus was standing outside listening, and what they heard was "a voice not of this world". Jensen sensed it as the voice of a giant speaking.

Shortly after, Peter Jensen started to run across the fields followed by Albertus. Jensen, the younger of the two, sprinted along at a remarkable speed, Albertus lagging behind. After about 1 kilometer, the voice of Pridham was still very loud, and Jensen did not stop until he was about two kilometers away. Now the voice was starting to become unclear, and a cross-wind distorted the voice of Pridham.

A little further out, Jensen was stopped by a fence. Pridham later claimed that Jensen had set a personal record in running. When Albertus finally came along, they decided to go back. Jensen had already taken over the microphone and speaking, when Albertus made it back. Pridham, in the meantime, had mounted his bicycle and rode away to experience the miracle, while Karl, the younger Jensen, was still hanging on to the chimney.

The rest of the day was full of joy and celebration. No one before had heard a voice of that strength, so on this winter day in early 1915 (Jensen claims it was winter, other sources mention spring of 1915) they had finally invented something that no one else had ever done before. It was an invention that should change the world of sound forever – and the planet hasn't been quiet since!

However, as with most inventions they are of no value until they have been accepted and put to work in the real world, and on this day they were still far away from this – and they still only vaguely understood the potential of their finding. It should take another four years, before that condition was met.

Later on that day, they phoned O'Connor in San Francisco to tell him about their great achievement. He was highly skeptical but joked that the California state hospital for mentally disabled people was also located in Napa. Had they been influenced by that acquaintance? Next day O'Connor paid them a visit along with his friend, the famous attorney Matt. J Sullivan, who smilingly told them that "Dick (O'Connor) had called me yesterday about the history and I could not make head or tail on the story". Then O'Connor had sent his oldest son across to the office of Sullivan, but when he told that the researchers up in Napa had managed to hear a "telephone" one kilometer away from it, Sullivan was convinced that O'Connor had gone nuts.

The event immediately changed everything for Jensen and Pridham. From a situation, where their project and company were about to go bust, there was now no lack in finding investors to sponsor further work.

An immediate, but possibly trivial challenge was finding a useful name for the invention. Names like "tele megaphone", "Stentor" (Greek: meaning loud-voiced), "Magnavox" (Latin: the great voice") and others were discussed, but eventually the name "loudspeaker" picked up, although Jensen never liked that.

It is interesting to note that although most inventions are predicted and often debated in the press before the invention even takes place, this was not the situation for the loudspeaker. No one seems to have predicted the advent of the loudspeaker. In addition, it took a long time, before people understood the full potential of the invention.

Entertaining Napa at night

During the rest of 1915, Jensen and Pridham nurtured and refined the loudspeaker solution. With the Edison Gooseneck Horn connected to the membrane and galvanometer, the heart of the dynamic microphone, their solution had for the next several years obtained its appearance. They also connected a cylindrical Edison phonograph to their loudspeaker thus creating a musical system. At night they would frequently play music from a loudspeaker on top of the building, entertaining townspeople of Napa, a city of about 5,000 people.

During the summer of 1915 they extended the audible range of the loudspeaker to about 12 kilometer. At one event, Jensen was located on a hill, called "Cup and Saucer", quite distant from their laboratory, and he was to put up a bonfire, if he could hear the voice. Pridham was in the lab reading aloud. In lack of anything sensible to say, he used an imitation of their originally testing messages from the days of testing the Poulsen Wireless systems back in 1910. He stated over and over again: "Hello Sacramento, hello Sacramento, do you hear me? How is my voice coming through? Do you hear me loud and clear? If you can hear me, start your bonfire!" Jensen heard the voice and did as told. However, the townspeople of Napa also heard it, and for a long time rumors went around that Jensen and Pridham had been able to talk directly with Sacramento without any transmission system. Sacramento is located about 100 kilometers from Napa.

During the time they also managed to make new patents. For example they combined a wireless receiver in a box, with a turntable and a loudspeaker and patented the system. The system solution would for many years be a quite typical setup for many radio systems with integrated turntables.

Breakthrough – a 4 year journey

Three weeks that changed the world of reproduced sound

Eventually the invention of the loudspeaker would have to be presented to the public at large. In 1915, the Panama–Pacific International Exposition was a world fair held in San Francisco, between February 20 and December 4. The purpose was to celebrate the opening of the Panama Channel, but it was also a business opportunity to the world and a showcase for the rebuilt city after the earthquake 11 years earlier. It might have been an excellent opportunity for Jensen and Pridham to use the exhibition for disclosure of their invention, but they feared that others might steal their idea. Hidden in the center piece of the exhibition, the "Tower of Jewell", they had placed a loudspeaker. The loudspeaker played music that could be heard on the battleship "Oregon" at the Golden Gate bridge, nearly 2 kilometers away, where the seamen danced to the music. However, in general people did not really pay attention to the new invention.

December 10, 1915 should prove the first event, where the public really got news of the new invention. A demonstration was set up in Golden Gate Park to an invited audience. The next day, Edgar "Scoop" Gleason" published an enthusiastic article in "The San Francisco Bulletin" about the event of the previous night.

"Great invention made of Californians solve many problems. The slender tone of a single violin heard about one mile away.

01

01 The bungalow in Napa. On the roof is a tripod for support of loudspeakers. It was not there on the first experiment, when Karl Jensen was hanging on to the chimney holding the loudspeaker.

02 People on the balcony of San Francisco City Hall, December 25, 1915. To the far right is Edwin Pridham, hidden behind the gooseneck horn loudspeaker, and to the left of him Peter Jensen. Dick O'Conner is in front next to the phonograph facing the photographer. Mayor Rolph was also on the balcony.

03 The team in Napa. Karl Jensen to the far right, Peter Jensen in center, and Edwin Pridham to the right. In between is the two mechanics.

04 People are crowding in front of the new City Hall in San Francisco on December 25, 1915 to hear among other things the loudspeaker. At the centre of the building on the balcony above 'Stars & Stripes' is the loudspeaker.

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04

The sound of operatic Luisa Tetrazzini's voice reverberating throughout the stadium, and a piano solo resembling the chimes of Westminster Abbey played by Colossus of Rhodes".

And the article went on praising the achievements of Jensen and Pridham, mentioning also that Jensen was an immigrant from Denmark that had come to the USA to originally install the Poulsen arc transmitter and transfer the patents that was now in use by Federal Wireless Co.'s systems.

One of the demonstrations held for the "Bulletin's" journalist, took place on an evening with drizzling rain and winds up to 20 miles/hour. While the demonstration took place, two football teams were playing and shouting next to the event. Certainly not an ideal evening for an audio demonstration! The loudspeaker was situated at one end of the stadium and the listeners at the other end, about 750 meters away. However, in the rain they enjoyed the fascinating voice of Alma Gluck that filled the air, and later on a Hawaiian string quartet that sounded "like the harps of the cyclops". Surprisingly enough, the noise from the football game was not noticed by the listeners.

Christmas Day, 1915, Union Square, San Francisco

The demonstrations of the loudspeaker at Golden Gate Park had managed to stir up great interests, and "San Francisco Bulletin" wanted to capitalize on the achievement. Possibly, Richard O'Connor with his connections to the political system was active behind the scene. Every year at Christmas Day, December 25, the "Bulletin" held an annual holiday celebration inviting famous singers to entertain. An agreement was made with Jensen and Pridham (and O'Connor) to repeat the demonstrations of Golden Gate Park, but now for a much larger audience. A crowd estimated to be around 100,000 people attended the event that afternoon of Christmas Day at the Union Square in San Francisco. The Civic Hall had just been completed after 2 years of reconstruction following its complete devastating in the earthquake of 1906. So there were more reasons for people to come to Union Square on this sunny afternoon– not just the demonstration of the Magnavox, the "great voice" or the loudspeaker as we know it.

At the Balcony of the Civic Hall overlooking the crowd, Jensen and Pridham had set up a loudspeaker system concealed behind a Stars & Stripes flag. Several people in addition to Jensen and Pridham merged in on the balcony, including O'Connor. San Francisco mayor James Rolph, Jr. made a speech to the assembled crowd, and from a "Victrola" phonograph they played a prerecorded song by Tetrazzini – all magnified by the loudspeaker of Jensen and Pridham. 100,000 people shouted hurrah, and the newspaper next day floated over with appraisals like: "Every ear in this massive crowd of people, even people hundreds of meters away, heard every word the speakers said". It continued: "…Magnavox, an incredible invention that yesterday was put at test for the first time for the public".

What to use a loudspeaker for?

Although highly successful in bringing the message of the loudspeaker invention out to people, challenges still remained: What to use the new invention for? In hindsight it should have been a trivial matter - but not in 1915. The market was just not ready; e.g. people did not have radios in their homes. Use of the loudspeaker at train stations and sports events had been the inspiration of Galbraith, the blacksmith, but what else?

Jensen and Pridham started to experiment. One idea came from the Maare Island Naval Station in the San Francisco Bay not far from Napa. Commander George Cook Sweet had the idea that a loudspeaker system could be used to communicate from ground to a passing airplane (people in those days sat in open cockpits of biplanes), and the pilot in turn could use the system to communicate to ground. Reality proved the idea useless. The noise from the engines in an airplane was mixed up with speech of the pilot and amplified to a level, where nothing could be heard. The two engineers had more success in constructing a noise cancellation microphone. It had proven difficult to keep the

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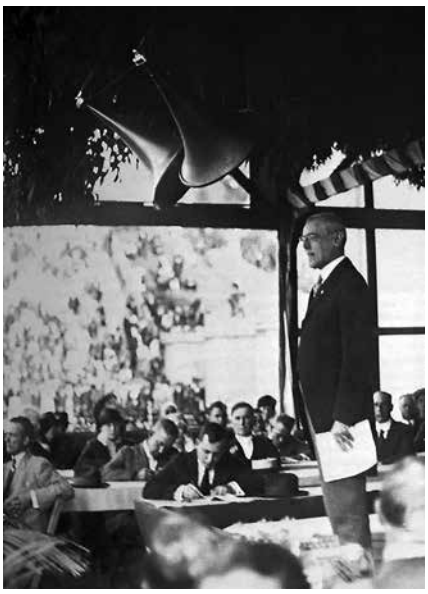


03

02

01 & 02 President Woodrow Wilson arriving at Balboa Stadium, San Diego, CA., on September 19, 1919 to deliver his address on promoting the ratification of the treaty of Versailles after World War I and membership in the Legion of Nations. 50,000 people were present to hear the president. The loudspeaker was essential in securing the success of the day.

03 Woodrow Wilson is delivering his speech at the stadium in San Diego on September 19, 1919. Above his head is the funnel shaped horns with microphones installed. That building is no longer there. The towers were used for wireless transmissions.

noise out from the microphone. Instead they opened the microphone so that noise could influence both sides of the membrane in the microphone simultaneously. That cancelled most of the noise and the speaker's voice, entering from one side and close to the membrane, could be heard clearly. The noise cancelling system was installed in airplanes with great success, e.g. in the Curtiss NC-4 flying boats, where crew member were located far apart.

In 1917 the R&D Company, The Commercial Wireless and Development Co., ceased to operate. Despite success in inventions they had failed to develop a useful business activity for the company, and investors now again faded off. Instead, they merged with Sonora Phonograph Corporation in San Francisco, a rather successful company in selling gramophones. The new company was renamed Magnavox, and the consolidated company started on August 3, 1917. O'Connor remained director and chairman of the board, while Frank M. Steers, the former president of Sonora, became CEO. Jensen and Pridham served jointly as "Chief Engineers", normally a hopeless parallel sharing of responsibilities, but the two close friends fared well with the setup.

Somehow their basic challenge was rather classical. Scientists and inventors of technology are not necessarily the right people for developing business. The art of business has its own set of conducts and practices that typically require a different breed of people. In the case of Jensen, he had to learn that dimension of life later on.

When the US entered World War I in 1917, developments related to the progress of a future loudspeaker market were put on hold. The Magnavox Company focused on the military market, primarily telephone production for use in naval ships and airplanes. It included flight communication systems, i.e. the noise-cancelling system and the dynamic receiver in headsets developed by Jensen and Pridham. The company delivered telephones for more than 250 destroyers.

Parallel to their new activities, Jensen and Pridham still fancied their old love, the loudspeaker, and were able to get hold of vacuum tubes to build amplifiers for the loudspeaker. It meant that now even small signals could be amplified and used in loudspeaker applications. They made their equipment available to local institutions, but hardly made any income from the equipment. Jensen judged that their invention was hardly known by any outside the borders of California.

The turning point for the loudspeaker

At the end of World War I, US President Woodrow Wilson had engaged himself deeply in setting up the treaty of Versailles, and not least forming the new League of Nations, the forerunner to United Nations. However, the US political system was against the ratification and not least entering the League of Nations. Wilson threw all his energy into convincing the Americans and travelled around the nation by train trying to establish pressure from the constituencies to senators and representatives in Congress. Cheering crowds would gather at the stations along the way, but Wilson suffered a failing health and adhered to his doctor's advice not to make rear-platform speeches. Sixteen days of travel and speeches had been very fatiguing and took a toll on Wilson. Prior to his speech in San Diego, California, his doctor warned him against talking out-of-doors and was about to cancel his planned address.

The event was planned for the City Stadium (later known as Balboa Stadium), and to protect the President it was decide to put up a glass cage of about 2 square meters in one end of the stadium. The cage was open in the front but it would be impossible for anyone to hear his address. A group of citizen approached Magnavox and asked for assistance in magnifying the speech and Magnavox agreed. Jensen was on a business trip to Washington to negotiate

contracts with the governments, so Pridham had to go to San Diego on his own.

It was thought "undignified" to ask the President to hold a microphone, and instead it was decided to put up two funnel shaped horns with a microphone installed in each above the head of the President. Pridham had the system set up, employing a three staged amplifier, two vacuum tubes in each stage. Before the arrival of the President, Pridham entertained the audience by playing some music through the loudspeaker system. The stadium was filled with about 50,000 people, an incredible number of people when realizing that the entire San Diego County at the time only counted about 74,000 people. Just as President Wilson's motorcade entered the stadium on September 19, 1919 late afternoon, Pridham was horrified when smoke started to emerge from the amplifier. Immediately he shut it off and pulled out the nearest of the vacuum tubes. It had collapsed. Putting a new vacuum tube in its place, he managed to get the system up and running again just as the President was entering the stairs to the platform with its glass cage.

Wilson delivered, what one reporter described as the "finest speech of the whole tour". Another reporter stated that all but a small portion of the crowd could hear "every word". Whatever the actual success of the experiment, it was, as the New York Times reported it next day, a "remarkable spectacle", one "seldom equaled in this country". In a sad aftermath, President Wilson 5 days later suffered a stroke, when he was in Pueblo, Colorado. He never really recovered and for the rest of his term as president, he was heavily incapacitated.

For Magnavox, and not least Pridham and Jensen, it was a magnificent success. The press all over the USA had the technical achievement of the loudspeaker system in its editorials the following days.

Magnavox successful in business

From this point on, the success of Magnavox was secured. In 1921, President Harding used the Magnavox loudspeaker system in his campaign for running for presidency and later on in his inauguration as President.

In 1922-23, the Magnavox Company made incredible profits, paying out dividends of 20 cents per share and additional extraordinary 15 cents. But now the "big companies" started to see the business opportunities in loudspeaker systems and AT&T entered the scene, and took over systems for big events. AT&T controlled the vacuum tube industry, which now was lifeblood for Magnavox, and could dictate terms. Magnavox instead focused on making radio systems with loudspeakers, the new entertainment item that every home started to need. O'Connor past away in 1924.The following year Jensen had enough of being controlled by aggressive business people and left Magnavox.

O'Connor, who had influenced the success of Jensen so much, and whom Jensen had respected sincerely, was no longer around to mediate. In 1927, Jensen founded the 'Jensen Radio Manufacturing Company' in Chicago. The product was "Jensen Speakers" and he operated under a license of Magnavox. In 1929, Jensen Company manufactured 60% of all speakers being made for independent radio producers. During these years, Jensen and his new Development Manager, Hugh Knowles, nurtured high fidelity audio. In 1942, Jensen presented the first commercial coaxial two-way loudspeaker. However, the following year he had enough of his shareholders reign, and he resigned from Jensen Manufacturing, just shortly after to set up his new company, Jensen Industries, which he ran until 1961, when he died of lung cancer - having been a heavy smoker for years.

Hugh Knowles left Jensen Manufacturing three years later when he founded Knowles Electronics, one of the world's major manufacturers of microphones, especially for medical applications.

Showing the Danes the art of loudspeakers

In 1922, Jensen visited Europe to develop business further. In Copenhagen, he agreed to give a showcase of the loudspeaker to a bemused public. A demonstration of his equipment took place from an office in an upper floor of the building of Danish newspaper "Politiken", sending sound from a loudspeaker to a crowd of people filling up the square at the Copenhagen City Hall.

A few days later, he visited his old mother, still living at the island of Falster. She lived in small house in the village of Moseby and had struggled hard since the death of Jensen's father back in 1902. She had been awarded a small pension and had worked hard in addition. Money that Jensen from time to time had send her, she had put in a savings bank. When he saw her, he hugged and kissed her, a habit he had developed in the USA, where he had learned to show his affections. "I hear you are famous", she said and continued: "now I only hope it will last".

In 1956 Peter Laurits Jensen received knighthood by the Danish King becoming "Knight of Dannebrog", which was a great honor to him.

A rare talent

Peter Jensen was a rare mix of talent, ingenuity, curiosity, sensitivity and an open mind garnered with a fair amount of luck. He operated in a time where technology was undergoing major changes, and he seized the opportunities as they presented themselves. Contributing to his success was the fact that a number of people close to him or crossing his way during childhood, youth and later in life took major decisions influencing his life, eventually guiding him to success. He had the fortune of entering a world hot-bed of opportunities, San Francisco, where capital was plenty. A quarter of a century later, similar opportunities paved the way for the birth of Silicon Valley, the area where the Poulsen Wireless Company was located, when Jensen first came to the USA.

It is interesting to note that in the book "Technology in America" edited by Caroll W Pursell, Jr., Peter Laurits Jensen is included as one of twenty very influential Americans in technology development along with people like Benjamin Franklin, Graham Bell, Thomas Alva Edison, Henry Ford, Charles A Lindberg, Enrico Fermi and others.

Today Jensen is forgotten by most people, but his major contribution to society, the loudspeaker, is as potent and alive as ever. ■

About the author

Birger Schneider is Vice President, Road Sensors, Optics & Light, at DELTA since July 2012. Education: BSc.EE in 1972, and employed at DELTA from 1973 until 1992, serving as Section Head, then Division Manager and from 1987 to 1992 Vice President, Technology.

Received the "Electro-Prize Award 1979" for outstanding contribution, dedication and performance in R&D (Danish Society of Engineers). In 1985 he initiated and led the activity of establishing a microelectronics R&D centre in Denmark, which was to be the Microelectronics Centre (now DTU Nanotech).

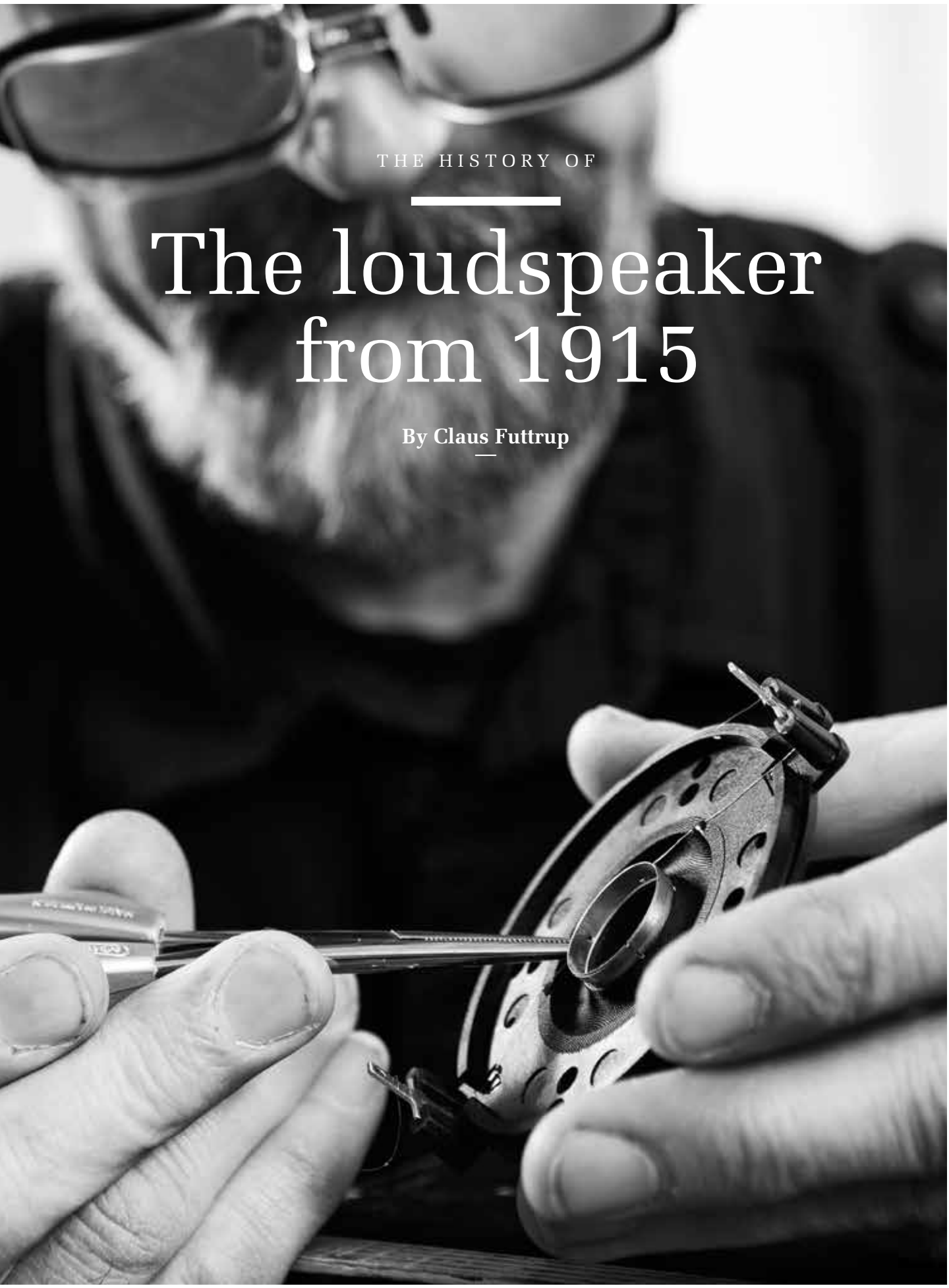
Operated his own company, microLEX Systems A/S, 1992-2008, with focus on test solutions for video and audio, delivering systems worldwide to companies such as Apple, Microsoft, Cisco, Oticon, GN-Resound, etc. Sold the company to National Instrument in 2008, and served in NI in R&D management and finally as Director for Global Business Development, Video & Audio test. In 2012 he rejoined DELTA.

Birger Schneider is a member of the Danish Academy of Technical Sciences (ATV), currently as Vice Chair for the domain of 'Electro & IT'. He also serves on the steering boards for the Danish Innovation Networks for 'Sound' and for 'Lighting' (Dansk Lys).

THE HISTORY OF

The loudspeaker from 1915

By Claus Futtrup



In 1915 the first loudspeaker was invented by Peter L. Jensen and Edwin Pridham. However, for the commercial success of loudspeakers in every home to be accomplished, several surrounding technologies had to be in place.

A puzzle of technologies takes form

First and foremost, electricity had found its way into normal households (in Denmark around the turn of the 20th century). Secondly, the triode vacuum tube had been invented in 1906 by Lee de Forest, making amplification of electrical signals possible.

Furthermore, the whole signal chain with a recording side and a playback side had to be established.

At the beginning the signal chain was a direct feed, but this was later simply extended with a direct transmission through radio waves. The concept of storing sound/data, such as speech or music on vinyl or reel-to-reel tape recorders evolved in parallel. The gramophone had been in use since the 19th century, but the electro-magnetic pick-up cartridge, suitable for electrical amplification and playback through loudspeakers, was not invented until 1925.

Like a puzzle, the pieces came together one-by-one, within a couple of decades.

On 9th October 1918, the two Danish engineers, Axel Petersen (1887–1971) and Arnold Poulsen (1889–1952) founded the Electrical Phono Film Company, later to become Ortofon. Their ambition was to synchronise picture and sound in movie theatres. On 12th October 1923 the first sound film recorded indoors was shown at the Palace Theatre in Copenhagen. Hollywood converted to sound film in the late 1920s. The release of "The Jazz Singer" in 1927 (by the Warner brothers) marked the breakthrough.

Microphones were initially of the carbon type. The electrodynamic (moving coil) microphone was invented in 1923 and gradually took over, the primary advantage being a significantly better signal to noise ratio.

Radio enters private homes

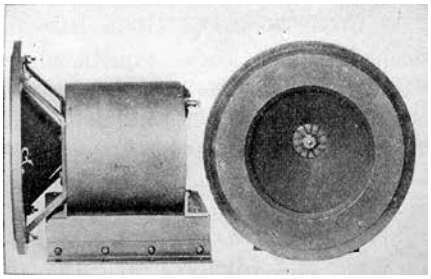
The first Danish radio broadcasts for the general public were transmitted in 1922 using AM (Amplitude Modulation). On 1st August 1926 daily news was broadcast. Up until 1951 there was only one Danish radio channel in Denmark. A second channel (P2) went on-air in 1951, and a third channel (P3) was added in 1963 with 100 % focus on popular music.

In mid-1920s, many companies emerged in Denmark focusing on manufacturing radios. One of these, Bang & Olufsen (B&O), still exists today, founded in 1925 by Peter Bang and Svend Olufsen.

In other words, applications for loudspeakers were rapidly developing. In the beginning, all speaker units in Denmark were either manufactured in-house (kitchen table style) or imported.

The direct radiator loudspeaker

The practical (modern style) dynamic speaker began with the Rice and Kellogg AIEE paper (1925) and the Radiola loudspeaker based on that paper (1926). This was a game changer, because what Kellogg and Rice discovered was a useful frequency range above the first mechanical resonance frequency of the speaker, where the frequency response flattens. Therefore the speaker was suitable for applications without horn-loading – a concept called direct-radiator loudspeaker.



The Rice-Kellogg speaker unit based on the AIEE paper (1925). Source: www.aes.org

The origins of the loudspeaker company Peerless date back to 1926 when Einar Skjold Petersen (a carpenter who was interested in radio) and his cousin, T.M. Larsen, formed the sales company Skjold Petersen & Co. Among others, the company represented an American loudspeaker brand named Peerless. The world crisis, following the Great Depression in 1929, put an end to these imports and the Danish company turned to repairing loudspeakers. It soon began to produce its own speakers and, as Peerless in the USA had closed down, Skjold Petersen & Co. took over the Peerless brand name. The company started on Amager (a Danish island near Copenhagen).

The Scandinavian countries were not affected by the Great Depression in the 1930s as much as certain other countries. In fact, the Danish economy experienced an increase in GDP during the time of the Great Depression, except for 1932.

A breakthrough was the invention and early manufacturing of AlNiCo (Aluminium-Nickel-Cobalt) magnets in 1930. Prior to this, electromagnetism had been widely used and permanent magnets only existed as some weak steel magnets. Being able to magnetize a permanent magnet and utilize this for signal transformation (from electricity to mechanical motion) required a lot less energy and overall was much easier to work with. AlNiCo magnets were developed further through the 1930s. They can be considered the first performance permanent magnets and they quickly replaced the magnetic steel-based ones. AlNiCo magnets were superior to previously available permanent magnets and dominated the loudspeaker market for the following 40 years. At some point during this period, Peerless started producing their magnets in-house.

Another breakthrough relevant for the loudspeakers was the invention of stereo in 1931. Initially named "binaural sound", the stereo was invented by an English electronics engineer named Alan Blumlein while he was working for EMI (the recording company) in the UK.

In 1930 Albert L. Thuras, working at Bell Labs, patented the bass reflex principle. This was incredibly early, considering that the principle would not theoretically be properly understood within the loudspeaker industry for another 40 years.

Danish loudspeaker industry in 1930s

During the 1930s, there were about 25 radio manufacturers in Denmark alone. The situation was similar in the neighbouring countries. Companies such as Bang & Olufsen, Linnet & Laursen, Eltra, Bravour, To-R, Arena, RTC, and Neutrofon, just to mention a few of the better known brands, grew up in a shelter of protective duty and tariff walls. Peerless was the main supplier of speakers for these production plants in Denmark and throughout the Scandinavian market.

The only domestic competitor to Peerless was Videbæk Højttalerfabrik, founded in 1933, which probably had the advantage of being located reasonably close to Bang

Tandberg loudspeaker unit with electromagnetic field coil, commonly used in the 1920s.

& Olufsen. Videbæk Højttalerfabrik A/S was founded by Niels Christian Madsen, and the products were initially named Hroswitha (an older spelling form of the geographical name of Videbæk). Later the company and its products were renamed SEAS (from about 1970), and then Vifa (from about 1981).

N.C. Madsen, started out as a wind- and mill-builder as well as a machinist, and was most likely also manufacturing electric motors for windmills and the farming industry in his home town, Hjerm by Holstebro.

N.C. Madsen settled in Videbæk, at the corner of Bredgade and Møllegade where he started a small automotive repair shop and a driving school. He sold stationary motors from old cars (with generators) to farmers in the area, who at this point did not have electricity yet. The Danish electronics industry was already up and running.

Bang & Olufsen, where two of N.C. Madsen's brothers worked, were in need of some speaker drivers for their speaker systems. Bang & Olufsen, who up until then purchased speaker drivers in France, attempted to purchase drivers at a local blacksmith in Struer. The blacksmith expressed that this task was beyond his business, but his brother in law, N. C. Madsen could take over the business. The Madsen family experimented during weekends and in 1933 they ended up with a functioning prototype of speaker drivers to be delivered to Bang & Olufsen.

Handmade

To begin with Videbæk's speaker drivers were handmade. The metal pieces for the speaker driver were made at N.C. Madsen's workshop, whereas cardboard for the cone was purchased at the local bookstore, and the suspension made of chamois leather came from the local grocery store. The voice coils were hand wound and the assembly was handled at the kitchen table by Mrs Madsen. Later on, a dedicated Videbæk factory was established in 1947.

During the 1930s a radio receiver was a box with a technical appearance and black buttons. The loudspeaker was built into the device, located either next to the buttons or on top of the device and the back was open - the so called "open baffle" design. In spite of the shortcomings, this concept reign supreme in the market. At this time the concept of a separate speaker box was considered poor design, and an attempt to launch such a product would possibly be considered "suicide" for the business.

In 1933 FM radio was invented by Edwin Armstrong and the radio media quickly became a huge success: about 8 years later approximately 50 radio stations were broadcasting globally. Belgium, Denmark, Germany, and the Netherlands were among the first countries in Europe to adopt FM on a widespread scale. Stereo capability was added in the early 1960s.

The first loudspeaker literature

The first book about the technologies of loudspeakers, "Loud Speakers", was written by McLachlan in 1934. Hereafter literature has developed at a steady pace, first Harry F. Olson's book "Elements of Acoustical Engineering (first edition 1940, second edition 1947), which eventually (1957) became "Acoustical Engineering" and then shortly after L. L. Beranek's book "Acoustics" from 1954. Both books are highly regarded even today.

Harry F. Olson, who documented his scientific work in his book, is in particular famous for his study of cabinet shapes and their influence on diffraction (and the resulting anomalies in the frequency response). Cabinet designs without parallel faces also reduce the need for internal damping, which reduces hysteresis and improves the dynamics. In this way Olson has inspired many loudspeaker engineers over the years to deviate from square/rectangular boxes.

Interestingly, the concept of electrical equivalent circuits, intended to simulate mechano-acoustical behaviour with electrical devices, was first applied by Bartholomew N. Lochanti in 1952. This concept was crucial for loudspeaker developers for the following 40 years, until more advanced computer simulators took over.

This all signifies that acoustics and loudspeaker technology started becoming a field of scientific study. In this process the Danish Technical University (DTU, but back then named Polyteknisk Læreanstalt) forms the acoustics laboratory (named Lydteknisk laboratorium) on 1st January 1941, on request from P. O. Pedersen, Principal of DTU. One of P. O. Pedersen' students, Fritz Ingerslev, became manager of the lab from 1945. All this happened during World War II, when Denmark was occupied by German forces (1940-1945). Fritz Ingerslev, who played a significant role within acoustics in Denmark until his retirement in 1982, wrote a Danish book for education in acoustics in 1949.

DTU as an educational institution deserves a lot of credits for the commercial success of Danish businesses within electronics and electro acoustics (microphones, loudspeakers, hearing aids). During recent years also Class D amplifiers, since both ICE Power as well as Toccata – later purchased by Texas Instruments, were founded out of PhD projects from DTU, thanks to Michael A. E. Andersen. The engineering schools in Denmark played a significant role in the Danish industries for decades. Today the electronics and electroacoustic

N.C. Madsen

business is the 4th largest export business of Denmark.

World War II had a huge impact on Danish businesses, who used the time afterwards to fully recover.

On a side note, 1946 was the year that Ortofon started making cutting heads for the vinyl recording industry, soon after followed by a pick-up cartridge (1948). Ortofon made their first Stereo Pick-Up (the SPU) in 1958. Robert Gudmandsen worked for Ortofon from 1941. He took a principal role in the development of the SPU pick-up cartridge and was later nicknamed Mr. SPU.

Loudspeaker cabinet production

Denmark is known for its wood based furniture production. One of these furniture companies, Tistrup Møbelsnedkeri, was founded in 1948. During the 1950s the company converted to making wood cabinets for radios and later on loudspeakers. The company still exists today and is run by the founder's sons, Kai and Preben. In general, you can say that wood furniture production and loudspeaker cabinet production are part of the recipe for the large production of loudspeakers in Denmark.

Since the 1950s Denmark has been known as the country where loudspeaker cabinets of high quality and complexity are built.

Hornslet Møbelfabrik A/S (later Hornslet Cabinets ApS), developed most of the Matrix technology for the B&W 800 series. Later on (in 1999) Hornslet developed the "HORNflex" technology, where a sheet of veneered MDF is manufactured in a particular way and lacquered while still flat, so that it can be bent, and afterwards glue is applied into the creases to retain the curved shape. Hornslet has had a couple of bumps on the road and last time it was active was in 2014.

Brdr. Ludvigsen was another prominent cabinet manufacturer, which emerged from the esteemed Danish furniture production. They were experts in form-pressed veneered wood, which can afterwards be machined with a 4-axis or 5-axis CNC machine (in the 1990s no one else had 5-axis machinery for wood work). Ludvigsen was, in 2000, able to form two shells, calculate the spring back and assemble them in a perfect 45 degree joint with the top panel. This technique was used, for example, in the Audiovector 6 loudspeakers.

Brdr. Ludvigsen and Hornslet were the two most important manufacturers of complex cabinets in the world in the 1990s and into the 2000s. Almost everything for B&W, KEF, Linn, Audio Physics, Audiovector, and System Audio, just to mention a few loudspeaker companies, were manufactured in Denmark.

Technical education

N.C. Madsen's son, Carl Christian Nørgaard Madsen studied engineering at the Aarhus Engineering School. After finishing his exam in 1948, he was headhunted to Norway by Jan Wessel to start making transducers and transformers for Wessel's radio production (Radionette) and in order to sell these components to other manufacturers.

Aarhus Engineering School (today named IAH and is part of AU, Aarhus University) is another institution in Denmark, which has a long tradition of educating some of the most important and influential engineers in the world, in particular within loudspeaker technology. One of these was the Norwegian, Ragnar Lian, who later made some significant loudspeaker inventions while working for SEAS and Scan-Speak.

Two Danish ways of speaker production

It is interesting to point out that two different ways of working with loudspeaker production have emerged: the Eastern Danish and the Western Danish way of producing loudspeakers. Mind you, Denmark is a small country, and the distance between Aarhus and Copenhagen is less than 200 km.

Peerless represents the Eastern Danish way of making loudspeakers in Denmark, whereas SEAS (Vifa), Scan-Speak, Dynaudio, AudioTechnology, DALI, and several other Danish loudspeaker companies represent the Western Danish way of producing speakers.

The Western Danish way means that transducer production is organized in cells. Down one side of the production the magnet systems are assembled and down the other side the soft parts are assembled. Sub-assemblies are typically stored in large carts on wheels, which mostly resemble book shelves. At some point the basket is joined with the magnet system. Then after curing, the soft parts are mounted into the basket/magnet system assembly. Proper curing of glue is assured between each step and precision of subassemblies assured with proper tools.

The Eastern Danish way means that transducer production is organized in a production line, often on a conveyor. Here it is required that speakers are assembled bottom-up, which means you start with the bottom-plate of the magnet system, then the magnet, then the top-plate, then the basket, then the voice coil is put in and the spider, then finally the cone/surround (which could be a pre-assembled part). The Eastern Danish method was in use in Denmark the 1960s, but was later adopted by Taiwanese manufacturers and is today known in the industry as the "Taiwanese way". The method is suitable for high-volume production and Peerless were experts.

In 1989 Peerless engineers made a woofer-line, which combined LEAN flow-production with very high flexibility so that it was possible to change between different products (also of different size) in a flow along the production line. In practice, when shifting from one model to the other, the stop-time would be a matter of minutes, while tools were changed and glue stations reconfigured. This puts high (specific) demands on the glues, which had to have very specific properties, and therefore employees at Peerless were also experts in mixing glue with other materials to adjust e.g. viscosity or curing time. The assembly of parts was made wet-in-wet. The adhesive was allowed to run down from the cone/coil assembly in to the spider/coil

Harry F. Olsen

Fritz Ingerslev

Carl Christian Nørgaard Madsen

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assembly. Finally the assembly was cured in an oven along the conveyor belt.

The establishment of SEAS

In 1949 Carl Christian Nørgaard Madsen was hired as the designer for the transducer business at Radionette. He grew up in a home where his father, N. C. Madsen, (and mother) manufactured loudspeakers at home, and just two years earlier (in 1947) an actual production site, Videbæk Højttalerfabrik, were set up. Nørgaard Madsen must have been an ideal match for Radionette's founder, Jan Wessel, to realize his vision of making transducers for Radionette's radio production.

Nørgaard Madsen was a professional engineer and a skilled business manager. In a very short time Wessel and Nørgaard Madsen needed to set up a separate production site and separate business, thus in 1950 SEAS (Skandinavisk Elektriske AS) was founded by Wessel and Nørgaard Madsen and in 1951 SEAS moved to Moss, Norway.

The quality of the SEAS products was higher than most of the competition, not least the business of Nørgaard Madsens own father, Videbæk Højttalerfabrik. The SEAS business enjoyed continuous growth, and ten years later, in 1960, they celebrated the production of speaker unit number one million. The same year Nørgaard Madsen's father retired and SEAS bought Videbæk Højttalerfabrik.

At the same time Radionette had a sister company in Copenhagen, named Radiovision, which had to be closed. Wessel asked Nørgaard Madsen if there was anybody among the Radiovision staff he could use and Magnus Nesdam-Madsen was hired to Videbæk Højttalerfabrik, first as Production Manager, later Factory Manager. Nesdam-Madsen remained to be a key figure in Videbæk for the following 35 years until he retired in 1995, and he was also the architect behind the separation of Videbæk Højttalerfabrik from its mother company, SEAS, in 1981 – an event I will return to later on.

Alongside these events, the stereo magnetic tape recording was demonstrated on standard 1/4-inch tape for the first time in 1952 – a cornerstone for the later development of stereo.

The introduction of TV

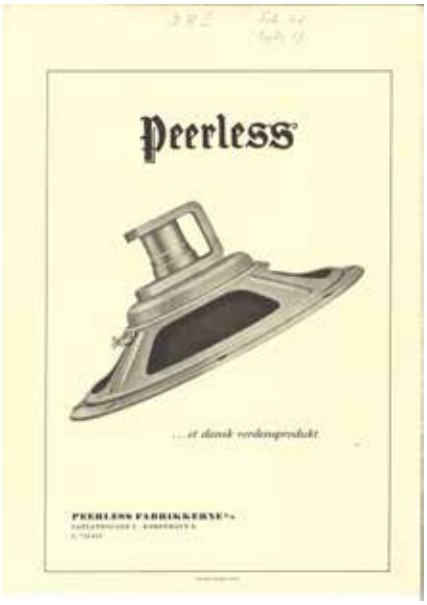
In the early 1950s, television was gradually showing up worldwide. The first trial broadcasts in Denmark were arranged by the newspaper Politiken in 1932. It became possible to pick up shows from the BBC around 1936-1939. The TV technology was publicly demonstrated around 1947-48 and Denmark's Radio (Statsradiofonien) had trial broadcasts in 1949-50, regular TV shows from 1951 and daily transmissions from 1954.

Magnavision (Eltra) was the first Danish manufacturer of TVs. Bang & Olufsen introduced their first TV in 1952, TV 508 S (nicknamed The Wheelbarrow) which was replaced by a nicer designed TV the following year. Around 1956, TV had its commercial breakthrough (among others at The Radio Exhibition in Berlin, IFA) and meant another application for loudspeakers. However, many Danish families did not have TV until well into the 1960s. At least some 25 manufacturers of TVs showed up in Denmark during this time period. Several of these were already making radios and saw TVs as a change to diversify (and stay in business). TVs extended the success with radios for another decade.

A highly respected figure

1956 was also the year that the Danish engineer, Knud Thorborg, a highly respected figure within the loudspeaker industry, started working at Peerless as R&D Engineer where he produced components for transducers. One of the first products designed by Knud Thorborg became one of Peerless' largest successes: the cone tweeter, MT20HFC, introduced in 1956 and later sold in millions.

For the 50th anniversary of Dansk Akustisk Selskab (D.A.S.), 2005, Knud



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01 The Eastern Danish production method is organized in a production line. Peerless woofer production 1973.

02 Peerless advertisement from 1952.

03 The Western Danish production method, where cell production is used. Proper curing of glue is assured between each step.

04 In the early 1950s, television gradually became more and more popular.

Thorborg wrote 12 pages about the loudspeaker industry and is quoted for saying the following about the R&D process at that time: “New models were developed in the way that firstly, the technicians made their chassis and designers made their cabinets. Then the loudspeaker manufacturer had to fill out the remaining space with the best and largest speaker. This led to a large demand for all kinds of possible - and some impossible - sizes and shapes of loudspeakers, typically round as well as oval shaped. Each new construction required a myriad of tools. Peerless produced by principle all components themselves, in addition to a number of necessary tools for their production. It took half a year to get all this ready, before the day arrived when the first speaker sample could be manufactured. The first test gave a good indication of whether the project would become successful - although of course you could refine and adjust afterwards.”

This way of working put great pressure on the loudspeaker engineers who had to come up with solutions with very specific constraints. Knud Thorborg mastered this discipline like no other and was able to deliver ingenious and surprising solutions when everyone else had given up on a project. Ole Klifoth of Audiovector recalls: “When the young engineers with their computers had given up, Knud browsed through his massive paper files, did a few calculations with pen and paper, and presented the perfect solution.”

Knud Thorborg generously shared his time and knowledge with fellow engineers in the loudspeaker industry, and taught more than a generation of Danish engineers how to make transducers and speakers, the Eastern Danish way. He continued to work for Peerless until 2009, when Peerless closed their facilities in Denmark. He then worked for Scan-Speak until his death (May 2015).

On a side note, 1956 was also the year that the US company, Acoustic Research, started marketing the AR-1 loudspeaker - the world’s first bookshelf speaker, utilizing a brand new acoustic suspension principle (the closed box loudspeaker), invented and patented by the American inventor, Edgar Villchur. This signifies the end of open-back loudspeakers, and is an early reminder that separate speakers and the concept of high fidelity (Hi-Fi) is coming soon. On the other hand, horn loudspeakers do hang on for some additional decades.

Bang & Olufsen released its first stereophonic loudspeaker, the Beovox ST606 in 1960. It was manufactured to complement its first stereo radio that year. The introduction of separate speaker boxes marks the start of the speaker box industry – and the triumphal of the Hi-Fi concept in Denmark.

The golden age

By far the most prosperous time post-war was a 15 year period 1957-1972, where Danish industry in general and the loudspeaker industry in particular blossomed.

Inventions

In 1961, the Australian engineer, Neville Thiele, presented a paper on vented box loudspeakers. The loudspeaker industry showed little interest, however. At Peerless the concept was tested, but the engineers concluded that it did not work. The concept headed into oblivion until the engineer and PhD student, Richard H. Small of California, arrived in Sydney to pursue his PhD thesis and expressed an interest in this work – publishing his findings in a number of papers during 1969-1974. The papers of Richard H. Small marked another turning point for loudspeaker designers, who were now capable of calculating performance of boxes in advance prior to building prototypes, and thus could predict the electro-acoustic outcome with good precision.

The soft (textile) dome was invented in the US by the audio industry pioneer, William Hecht, in 1964. Various types of domes existed prior to his patent, but Hecht was the one who really nailed it when he carefully described the non-rigid behaviour of the textile dome in his patent. This invention marks a turning point towards High Fidelity (Hi-Fi) in high frequency transducers; by the end of 1970s the soft textile dome completely outperformed the conventional paper cone tweeter design. Hecht had a US patent for the concept, but Europe was not restricted with a patent, which many European speaker companies utilised.

SEAS H87 tweeter

A German manufacturer of soft parts for loudspeakers, Dr. Kurt Müller, started manufacturing textile domes in the late 1960s and one of the first soft dome tweeters introduced to the market in 1968 was the SEAS H87 tweeter. This 38 mm (1½ inch) dome tweeter designed by the two SEAS engineers Ragnar Lian and Mogens Hvass became hugely successful and sold in more than 1.5 million units over the years 1968-1981. Mogens Hvass had worked for Nørgaard Madsen for 20 years, while Ragnar Lian started at SEAS in 1963.

Ragnar Lian explained to Fredrik C. Hildisch that while he worked for SEAS things in the loudspeaker industry changed: "From about 1965-66 Hi-Fi was starting to show up, and then the fun started. Then it was allowed to step outside the beaten paths."

While Ragnar Lian was at SEAS, he also developed the first woofers in Scandinavia with rubber surrounds (some of the world's first, 1968): the 8 inch 21 TV-EW and the 10 inch 25 TV-EW. The front-runners for these woofers were the KEF B139 (from 1963) and KEF B110 (from 1966) with neoprene rubber surrounds. No doubt they must have been a source of inspiration, but foam surround products were still developed in the 1970s and into the 1980s, not least because of their sound performance qualities. Hereafter loudspeakers with foam surrounds were no longer developed because rubber had a superior lifetime and the consumer market expected this.

Dynaco A-25 marks a time of prosperity

During such a time of prosperity, in particular the 1960s, many loudspeaker companies started up in Denmark. One of them was Audio Dyne, founded in 1965 by Peter Münster Hasselriis, who originally was a Sales Manager for Bang & Olufsen. The initial purpose of Audio Dyne was to import Dynaco products from America and sell them in Europe. In 1967 the Audio Dyne business was turned into Scandyna, partially funded by the American audio engineer, David Hafler, (founder of Dynaco) and together with SEAS engineers Scandyna developed speakers for Dynaco.

One of the most successful Hi-Fi loudspeakers of all time, the Dynaco A-25, was developed with help from SEAS engineer Ragnar Lian; featuring H87 textile dome tweeter, as well as rubber surround woofers. Several new technologies that were built into the Dynaco A-25, were forerunners for speakers of the future. More than 1 million Dynaco A-25 units were sold from 1968-1980 and the A-25 design went through several evolutions during that time.

As a side note, Dynaco (in the US) took care of paying all royalties to Hecht for the licensing required by his soft dome patent. The Dynaco A-25 products made by SEAS used Norwegian made transducers and they were assembled in Denmark. Assembly and shipping were managed from Videbæk Højttalerfabrik.

Skaaning enters the scene

In the late 1960s, David Hafler (Dynaco) and Peter Hasselriis (Scandyna) were on the lookout for a second-source for the Dynaco speakers to meet the high demand for the speakers, when they met Ejvind Skaaning around 1968.

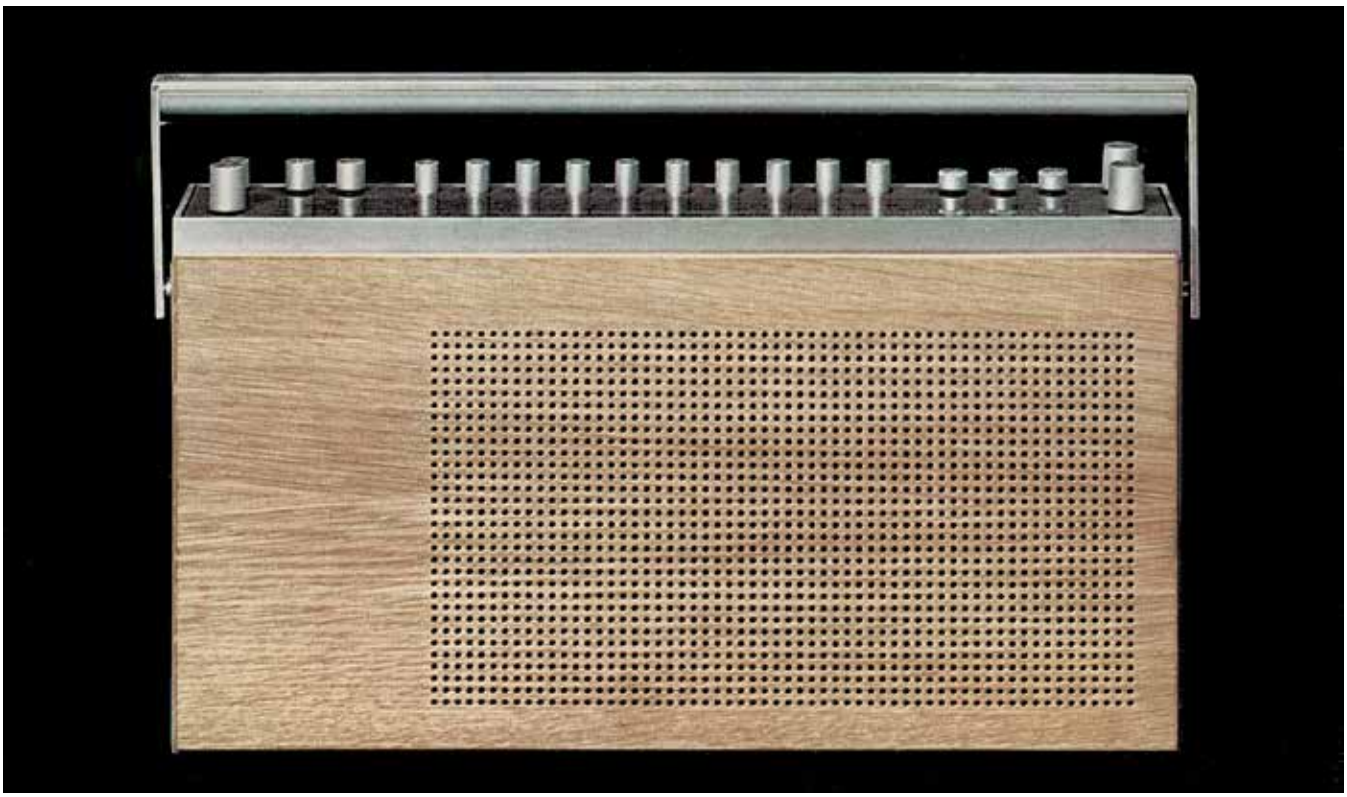
Ejvind Skaaning was originally a mechanic working at Ford Motor Company, and after establishing a successful scooter business in Aarhus in the mid-1960s, he sold the scooter company and started a record company called QSR, Quality Sound Recordings.

Skaaning became friends with Ragnar Lian while Lian was studying in Denmark at Aarhus Engineering School and they shared an interest for audio, recording and organ music. In the late 1960s QSR had turned

Ragnar Lian

Ejvind Skaaning

Magnus Nesdam-Madsen



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01 Beolit 1000 was launched in 1968 and it uses the first speaker unit with ferrite magnet system (by Ragnar Lian). The Beolit range of products continued to evolve.

02 The A-25 cabinet was solid and well dampened inside with stone wool. On the outside it was covered with real walnut veneer. The front grille was a frame covered with a light linen fabric (not unlike what AR used on their products). A speaker would cost 80 USD over the counter. It was not long before sales was well underway, and when the product received the tag "Best Buy" in Consumers Report, demand became enormous. After mounting the drive units and being tested, the cabinets were packed and stowed in large containers. In the most hectic period one container went to the United States every week. Overall, SEAS may have sent between 700,000 and 900,000 pieces of A-25 to Dynaco, i.e. an outstanding success, over a period of 12-13 years. Scan-Speak had a similar production volume, but over a shorter period of time (about 6 years). So in total well over 1 million A-25 units have been produced.

into a loudspeaker business.

After meeting with Hafler and Hasselriis in 1968, Skaaning built a prototype for Dynaco and eventually he was able to get the business for Dynaco A-25. The transducers Skaaning bought from SEAS.

The success of Dynaco A-25 was tremendous and both QSR and SEAS had a very successful business with Dynaco during 1968-69. Eventually, it came to a disagreement about sourcing SEAS transducers for QSR products, because SEAS regarded QSR as a competing supplier of Dynaco A-25s.

Skaaning made a bold move. In 1969 he hired Mogens Hvass who was fired from SEAS for cooperating with QSR. When fired from SEAS, he was asked to clear his desk and leave within 5 minutes. I get the sense that Mogens Hvass transferred knowledge about the SEAS H87 to QSR and this was likely the reason why he was fired from SEAS. Already in 1969 the first speaker unit, the D3806, was developed while the business was still named QSR. Skaaning then converted QSR into Scan-Speak (February 1970) and hired Ragnar Lian (March 1970).

Hvass and Lian, now working together again, developed transducers for Scan-Speak to replace the SEAS transducers and started producing Dynaco A-25s entirely with Scan-Speak parts.

Nesdams' vision

1970 was also the year that Videbæk Højttalerfabrik was re-named SEAS. At this production site lower-quality products were manufactured, whereas SEAS' high-quality products were made by SEAS in Moss, Norway.

The Danish site was managed by the notorious Nesdam. Magnus Nesdam-Madsen was born Magnus Madsen (in Vojens, 1929), but he changed his last name to Nesdam-Madsen in 1947. Yes, Nesdam is simply Madsen spelled backwards and no doubt this reflects his sense of humour. People normally just called him "Nesdam" and from here on we will do the same.

Nesdam clearly had a vision of raising the product quality from the Danish side, which he executed during the 1970s. In 1974 SEAS had around 450 employees.

The success of A-25 continues

Through the first half of the 1970s, SEAS and Scan-Speak competed on supplying A-25s to Dynaco. At the same time the Dynaco A-25 went through several evolutions, for example, at some point the speaker was equipped with an acoustic valve.

The acoustic valve is an opening in the otherwise closed box, with damping material, to release the pressure inside the box in a resistive way, by air flow friction through the damping material. When properly tuned, it dampens the fundamental resonance frequency in the box. The friction means that the system damping is increased (i.e. the total attenuation factor Qt is lowered). This principle had its hey-days when woofers were made with relatively small magnet systems due to cost considerations and therefore had a high Qt (resulting in an under-damped design). The principle is rarely used anymore.

In parallel with the Dynaco business, Peter Hasselriis sold Dynaco A-25 under his own brand name as Scandyna A-25 for the European market, manufactured by Skaaning (Scan-Speak). Scandyna also imported and sold various electronics.

Scandyna went through several critical phases and various bankruptcies during the next decades, but managed to stay afloat and in the hands of the Hasselriis family until around 2011. Today the brand is probably most famous for its Podspeakers, originally an iconic design by Simon Ghahary of B&W (early 1990s), which was handed over to Scandyna and further developed into a product line followed by several evolutions over the years. The Podspeakers were using drivers from Peerless of India and they were assembled at Tistrup Møbelsnedkeri.

Scan-Speak cabinets for Dynaco A-25 for the US market were made at Lem Sengefabrik (a woodshop that manufactured beds) in the 1970s. This factory later became Lydig, located in Ringkøbing, Denmark. In 1994 Lydig was merged into the American Harman group, named Harman Consumer Manufacturing A/S, and here they designed and manufactured Harman Kardon, JBL, and Infinity loudspeakers for many years, until Lydig closed down in 2003. Lydig also supplied cabinets to other manufacturers, e.g. Audiovector. Lydig's production line, which made cabinets of very high quality, was sold to Meiloon (Hong Kong).

The rise and fall of JAMO

Another Danish business which we must not forget, JAMO, is founded in 1968 by Preben Jacobsen and his brother in law, Julius Mortensen (JA-MO stems from the names Jacobsen and Mortensen). They built their first factory in 1970 and expanded year on year until 1994, when it had become the largest speaker manufacturer in Europe. JAMO made more than 10 million loudspeakers during their first 30 years.

In 1994, JAMO's market share in Denmark was around 40 %. Then times became tough and several poor management decisions were made. JAMO had tried to compete with the Asian market and although partially successful, not least through smart production setup and some automation, they eventually had to give up.

They closed the factory around 2004, when the majority of the production was transferred to China. In 2005 JAMO was sold to the American loudspeaker company, Klipsch, and hereafter they ceased to have much activity in Denmark.

Peerless in the 1960s & 1970s

In the 1960s Peerless launched a line of kits for the DIY market, which sat the standard for quality kits. SEAS picked up the idea and also launched a line of kits. This business area made Peerless and SEAS visible in the consumer market and was part of a successful branding strategy.

In 1966 Peerless faced a necessary and problematic change of generation when one of the founders, Einar Skjold Petersen retired. Peerless was a well-established and financially solid company. During this phase, Peerless' other founder, T.M. Larsen stayed with the company for a couple of years as General Manager and a 20 % shareholder (the remaining 80 % shares was purchased by American EAD). A couple of years later EAD purchased the shares of T.M. Larsen and became sole owner of Peerless. Peerless was able to recover.

In 1968 Per Staal became General Manager of Peerless and the company expanded heavily. Loudspeaker production was established in Boston (1973), USA (named PAL, Peerless Audio Leominster). Peerless also became a shareholder in KLH, Boston, USA.

In August 1971 the Peerless factory in Gladsaxe (Copenhagen) was expanded with 3500 m^2 of new buildings, with plans of expanding further over the next 5-6 years to 11,000 m^2. The factory was organized with raw materials entering one end (Peerless casted their own magnets, pressed their own steel chassis, wound their own voice coils and formed their own paper cones and textile spiders) and at the other end of the factory 250 meter down the road, out came the finished loudspeakers.

In Germany, Peerless purchased Mikrophonenbau (this became Peerless-MB), which manufactured loudspeakers, microphones and headphones. In the 1970s Peerless purchased the cabinet maker Unison in Horsens (Denmark) and a factory in Bretton (France) was purchased to jump into the French market.

At this point (1976) Peerless was one of the largest manufacturers of speakers in Europe, maybe one of the largest in the world when it came to Hi-Fi products, with a capacity to make 30,000 speakers per day. Danish (and Norwegian) transducers were - and in many people's opinion still are – leaders in the global market. If you were looking for a high quality driver at a good price (some would even say the best driver at any given price) you would buy it from the businesses in Denmark and Norway.

Peerless was among the first loudspeaker companies in the world to change the former (bobbin) of the voice coil from paper to aluminium. With its many advantages, aluminium remained a standard recipe for many speaker manufacturers all the way through the 1980s and well into the 1990s, when glassfiber and polyimide (Kapton) materials were explored as viable alternatives.

Peerless continued to expand internationally. In 1977 they entered a joint venture with capital from Denmark and India, and Peerless of India was founded in Bombay (today Mumbai), production started in 1978.

Peerless' facilities in Søborg (Copenhagen) were expanded several times. Worldwide Peerless had more than 1000 employees. The American mother company, EAD added system manufacturers like Infinity to the business portfolio. The entire loudspeaker division was managed from Søborg without much interception from the Americans.

Ferrite magnets

Early in the 1970s, ferrite magnets became increasingly popular in various speaker designs. The first SEAS loudspeaker with a ferrite magnet was designed by Ragnar Lian for the B&O Beolit 1000 (Type 1401) travel radio, launched in 1968. The primary reason to change from AlNiCo (Aluminium-Nickel-Cobalt) to ferrite was the content of cobalt, which was very expensive and dependent on sources from Africa (most notably Congo). Using ferrite resulted in a quality magnet at a much lower cost, but it required significant changes to the magnet system design, because the balance between magnetic reluctance and coercivity is completely different. Due to the heavier ferrite magnet systems, sometimes a new (stronger) basket would be required as well.

Oil crisis changes the business

In 1973, the first oil crisis sets in globally, quadrupling the cost of oil. This hit Denmark relatively hard. The Danes had to learn to save energy - turn off the lights at home, turn down the radiators, take showers instead of baths, every other street lamp was turned off, vehicle speed limit was lowered, and for a period of time it was not allowed to drive cars on Sundays, except for emergencies. The oil crisis resulted in financial instability following global recession, which led to a dramatic increase in unemployment in Denmark. At this point in time Denmark had just joined (in 1972) the European Union (back then named the European Economic Community), which meant that Denmark entered the Open Market in Europe with free trade across the European countries.

The Danish radio- and TV-production, which had boomed in the 1950s and 1960s, almost collapsed in the following decade, partially pushed by a saturated market, over-investments and the introduction of competition - due to being part of EU's Open Market - from foreign business into the Danish market (initially predominantly from German manufacturers, later not least from Japanese electronics giants). Only Bang & Olufsen and a few other larger competitors survived the first attach and later only Bang & Olufsen has survived. On the other hand, the loudspeaker industry continued to grow, although the business became less profitable than before.

Peter Larsen, a famous Danish transducer engineer, finished his education at Aalborg University (a completely new university at the time, established in northern Jutland, Denmark) and started working for SEAS in Videbæk in 1974. He later worked for Dynaudio, then JBL in Northridge (USA), to finally settle on an independent consulting business, Loudsoft. He is a consultant for several audio companies, including Peerless of India, for which he designed a product line that has many similarities to Vifa products.

Aalborg University is the second Danish university which educate Master's Degree engineers. Later Aalborg University becomes famous for work in Acoustics. Later on again, other engineering schools and universities were established in Denmark with specialty in acoustics and electro-acoustic technology (i.e. microphones and loudspeakers), for example SDU (South Danish University) which was founded in 1998 as a fusion between several institutions in the area – remarkable since Denmark is a small country with only about 5 million citizens.

To summarize, up until this time, Denmark had been more or less self-sufficient with electronics from about 1925 and well into the 1970s, nearly 50 years time span, where Denmark had high volume production of radios, gramophones, tape recorders, television, loudspeakers and combinations hereof.

Danish drive units in the forefront of technology

While Ragnar Lian worked for Scan-Speak, he invented the Symmetric Drive concept (1972), with a copper cap on the pole piece to make the voice coil inductance versus excursion Le(x) symmetric, which was patented US3935399 and he wrote an AES paper titled "Linear and Non-Linear Time Delay Distortion in Loudspeakers ". This paper describes the nature of linear and nonlinear time delay in loudspeakers. Remedies to reduce or remove this effect are described.

In 1973 Scan-Speak launched the D2008 tweeter, a 19 mm dome tweeter with a revolutionizing new idea, to drill a hole through the center of the magnet system and install a rear chamber at the back, with damping material. The end result was a tweeter with much lower resonance frequency and essentially this design could easily compete with traditional 1 inch dome tweeters in low-frequency extension, while at the same time have more output at the highest frequencies, better dispersion, etc. The D2008 was an instant success and became one of the most popular dome tweeters on the market. It was used by UK companies such as Naim, Linn, and still today is used by ProAc and Spendor.

The rear chamber was an idea that Ejvind Skaaning continued to use when he founded Dynaudio, and here it found its place in for example the D21 and D28 tweeters.

The rear chamber idea was not picked up by competitors until much later, for example SEAS (Norway) introduced their first tweeter with a rear chamber in 1986, the H400 alu-dome tweeter, which also became a highly regarded tweeter of its time (for more than a decade it was considered a reference-tweeter in the market). Today it is like an industry standard - almost all tweeters (as soon as it can be allowed for cost reasons) are made with a rear chamber.

Winds of change

Ejvind Skaaning and Scan-Speak ran into some serious trouble in mid-1970s, not least due Skaaning's business and financial involvement in the middle-east and in March 1974 the stocks are expanded with money from the former manager of Dynaco, David Hafler. When the civil war in Lebanon broke out in 1975, it led to a great loss for Skaaning. He had to sell his remaining shares in Scan-Speak to stay afloat. This made Hafler the primary owner of Scan-Speak, just as it was the case for Ortofon (1974), which essentially leaves Skaaning without influence in the company.

During this process, Ortofon changed Scan-Speak products into Ortofon branded loudspeakers. Unfortunately the mother-company, Fonofilm Industri AS (owned by Hafler – and Chanin, who was more involved in the electronics side, including ADCOM), like several other companies worldwide, struggled and in 1975 they decided to sell to Harman International.

Since Harman already had loudspeaker manufacturing in their portfolio, the Scan-Speak business did not match their strategy and Scan-Speak was brutally shut down (summer 1976). Liquidation papers show that 1.6 million kroner was removed from the company just days before it filed for bankruptcy. Scan-Speak ceased to exist for approx. 6 months, when eventually the pieces were picked up by Dantax (1977).

After leaving Scan-Speak, Ejvind Skaaning attempts at another business. This time with Gerhard Richter and Meir Mordechai, together founding RMS in 1975. RMS produced transducers and speakers in Israel, and was 1976 taken over by Mordechai and converted into Morel.

Skaaning then in 1976, again in cooperation with Gerhard Richter, started Dynaudio. From the very beginning, Dynaudio was a manufacturer of finished loudspeaker systems, separate transducers (not least to other OEM manufacturers), as well as kits.

Dantax

Dantax Radioindustri A/S was founded in 1971 by John Jensen. Through the 1980s Dantax had huge success, not least with their iconic designer loudspeaker, the TUBE, and they were the 3rd largest speaker manufacturer in Denmark (after Bang & Olufsen and JAMO). Later on Dantax sold Scan-Speak to Vifa, but kept the Scansonic brand, which today is revitalized with radios and loudspeakers.

Another brand under Dantax, Raidho, was founded by Michael Børresen in 2003. They started out by trying to manufacture and sell a ribbon tweeter, but it was never implemented into any specific product. I suppose Børresen was irritated by this fact and decided to make his own loudspeakers.

Later on (2009) Raidho became a subsidiary of Dantax with Michael Børresen as responsible for product development (today he is R&D Director).

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01 & 02 The Western Danish manufacturing method is traditionally labour intensive but as demands for high volume and/or uniformity has increased, production cells with more automatic equipment has been applied, in some cases with robots.

The pictures (1) and (2) illustrate to some extend the span in processes adopted for speaker driver assembly, which first and foremost is a gluing exercise.

Certain parts of the traditional Western Danish production methodology are difficult to automate and typically require craftsmanship, like for example the handling of delicate voice coil wires is often best in hands of skilled workers, illustrated in picture 02, while assembly processes by robots facilitate uniform, precise processes, illustrated in picture 01, here used for adhesive application onto a chassis in woofer production.

Ortofon

On a side note, Sidney Harman was appointed a political position under President Carter and had to sell his stocks. In 1976 Harman International Industries was sold to Beatrice Foods (yes, a food company). Sidney Harman returned to his business in 1979 and within a year he recovered JBL from Beatrice Foods, at a fraction of the sales price. Ortofon was spun off separately, sold to the Danish management.

As the CD media became popular in the late 1980s and 1990s and sales of vinyl decreased, Ortofon eventually went into a drought period, where no investments were made into the company. Ortofon remained in the vinyl business and only survived because DJ's were using a "scratching" technique, which requires vinyl, leaving Ortofon to become a major supplier of these special pick-up cartridges to DJs worldwide. Vinyl has later experienced a small revival and Ortofon's business seems to have stabilised. Today Ortofon thrives and they have expanded into other fields, including headphones.

In 1983, Ortofon expanded into the (loudspeaker and hearing aid) measurement equipment market when they launched the P400, an advanced analogue device with tracking filters and an advanced rub & buzz detection algorithm. This equipment became a cornerstone in the production testing of speakers in several Danish speaker companies.

Hiquphon

Oskar Wrønding worked at Scan-Speak from 1973 and continued with Scan-Speak at Dantax, where he became responsible for the Scan-Speak production. During 1978-83 there was almost no product development of Scan-Speak products as Dantax just manufactured and sold existing transducer and speaker designs.

In 1983 Wrønding quit Dantax to establish his own transducer business, Hiquphon, which still exist today. Initially the Hiquphon tweeter was remarkably similar to the Scan-Speak D2008, but eventually it was developed into a product line. All products from Hiquphon were 3/4 inch tweeters, all looking very similar to and clearly inspired by the Scan-Speak D2008 / D2010 products.

Changes within SEAS

SEAS were from the mid-1970s and onward faced with increasing competition and a stressed global economic situation. At the same time the company had an internal management crisis. Alcohol consumption

01

01 An anechoic chamber consists of a shell of concrete and Leca that rests on coil springs to dampen noise from vibration in the ground. The chamber is lined on the inside with meter-long sound absorbing wedges of damping material. The chamber is used for all kinds of free field measurements.

02 Beovox C40 and C75, Bang & Olufsen. The design is one of the master pieces by Jacob Jensen and the electro-acoustical engineering was made by Ragnar Lian. The C75 won the Danish "ID" (Industrial Design) Award and later it was shown at the Museum of Modern Art in New York. Even by today's standard, the speakers are small and lightweight with an impressive performance and would fit right into a modern home, e.g. in a bookshelf or mounted to a wall.

03 Audiovector's first product, the Trapez, was launched in 1979 and based on new Danish driver technology.

02

03

of Nørgaard Madsen was increasing, the internal battle between Nørgaard Madsen and Nesdam was maybe not actually the cause, but fuels the process further. In 1977 Nesdam became General Manager of SEAS. In a 4-year period he tried to improve the profitability at SEAS, Norway, and at the same time he orchestrated the transfer of technology from Norway to Denmark.

Jan Wessel died in 1980 and his son was not interested in the business. Eventually, it became official that Nesdam changed strategy from attempting to sell SEAS to closing the Norwegian part and move all production to Denmark.

However, exceptional national political work prevented this from happening and Nesdam instead planned to separate the Danish site from SEAS, Norway. This involved a loan of 1.3 million kroner with security in the Danish factory, which later was not paid back in time simply because Nesdam and Ringkjøbing Landbobank first required the loan paid back with short notice (day-to-day) and then agreed to turn off Ringkjøbing Landbobank's telex machine, so the transfer could not be verified. SEAS was able to raise the money, but facing technical problems, they defaulted on the loan. This was not completely legal, but it meant that the Danish site was dropped into the hands of Nesdam and Ringkjøbing Landbobank as the new owners in 1981.

The new company was named Vifa and the company with Nesdam as the manager recovered remarkably well and experienced successful growth for the next decade, whereas the recovery of SEAS, Norway, was a somewhat slower and harder process. Nørgaard Madsen, deeply alcoholic and with Alzheimer's, ended up in a sanatorium in Silkeborg (Denmark).

The middle management at Vifa were opposed to Nesdam's actions. After Nesdam had completed the departure from SEAS, he fired the entire middle management at Vifa except for one – Chief Engineer Peter Larsen. Nesdam knew that in order to raise Vifa from the ashes, he would need a lot of development, so Peter Larsen continued with Vifa until 1987, when he switched to Dynaudio. Until development of own tools was completed, Nesdam would visit suppliers and ask for supply of parts out of tools owned by SEAS.

The second oil crisis hit Denmark in

1979, when the price of oil increased quickly by a factor 2.8. It was another blow to the economy, on a global scale, and again shook the Danish loudspeaker industry, which hadn't completely recovered from the previous crisis and now facing harder competition from e.g. Japan and Taiwan.

A melting pot for loudspeakers

In 1979 Ole Klifoth founded F3/Lyd, later renamed Audiovector. His first product, the Trapez, was based on new Danish driver technology, using the brand new Dynaudio D28 tweeter (the one with a horn), a new SEAS paper midrange with coated paper (and with anti-resonant modifications), as well as a new Scan-Speak 25W/8561 with additional mass loading. The Trapez became an instant success and over 15 years sold more than 25,000 pcs.

In 1975 a mail-order business for audio was founded by the entrepreneur Peter Lyngdorf, who was considered a "pirate" by the established radio stores. This mail-order company was converted into AudioNord and a chain of Hi-Fi stores (named "Hi-Fi Klubben") emerged in Denmark. In 1983 Peter Lyngdorf started Danish Audiophile Loudspeaker Industry, manufacturing DALI loudspeakers. Initially to sell these high quality loudspeakers through his chain of stores, but over the years DALI separated and converted into a separate business with export to many countries.

Peter Lyngdorf once told me, if you were to set up a loudspeaker design and production in e.g. America, you would be hard pressed to find good engineers. In Denmark they're everywhere. Just send out a job posting and you can easily find highly skilled engineers, who can design and make real high-end loudspeakers. The concentration of qualified engineers is outstanding in Denmark.

TC electronic was founded in 1976 by two brothers, Kim and John Rishøj. They based their business on studio gear. They cooperated with Dynaudio on sales and marketing of Dynaudio Acoustics studio monitors, starting late 1990s. Later (2002) they turned it into a group of companies, among which the British speaker manufacturer, Tannoy, was included.

Ragnar Lian was faced with challenges when Scan-Speak closed in 1976. He founded Ragnar Elektroakustikk, yet soon after got a job at Bang & Olufsen as Development Engineer. Lian thrived at Bang & Olufsen and the Beovox C75 became one of the largest commercial successes in his career. Production was started late 1978 and in 1985 the product was updated to Beovox CX100. The exterior design by Jacob Jensen was unchanged. CX100 remained in production until 2003. Hence the product was on the market for no less than 25 years. The C75 was shown at the Museum of Modern Art in New York. He received Dansk Industriråds Pris (The Danish Industry Council Award) for the design. During the introduction in November and December 1978 alone, the speaker sold 30,000 units. Lian continued to work as a consultant for Peerless as well as Scan-Speak and others, and in later years also for SEAS (e.g. for the Exotic F8 fullrange, launched 2007). I believe the last product which Ragnar Lian developed for Scan-Speak was the famous D2905/9000 tweeter (launched in 1990).

The business at Peerless went fairly smooth through the 1970s, but during the 1980s, Peerless faces trouble. The company at this time was still a highly vertically integrated manufacturer of speakers, including for example the stamping of steel parts for magnet systems and sheet-steel frames. Vertical integration can be great, in particular if all divisions manage to progress and keep up with the state-of-art within each area.

Unfortunately for Peerless, the loudspeaker industry in Japan, Taiwan and China was very competitive and making parts in-house was not always a profitable solution. In such a situation, vertical integration can create a lack of flexibility and for example when cast magnesium (later cast aluminium) frames became more fashionable among customers, Peerless stayed with their sheet-steel frames. Peerless had to reduce their activities and close down factories. They moved to Karlslunde in 1983.

The same year, 1983, Knud Thorborg became the official R&D Manager at Peerless. He had already unofficially been in that role for more than a decade. Peerless of India became independent from the Danish company in 1983. For a while Peerless of India was actually the major shareholder of Peerless in Denmark (sold by the Americans), but they never managed to get control of the company due to some paperwork trouble. The employees at Peerless Denmark were not exactly helpful in this process.

Eventually Peerless Denmark ended up without a Board of Directors and the company was run by the middle management, led by Sales Manager, Olsen.

In 1986 Peerless was sold to JME (Jysk Murer Entreprise) and with financial support Peerless regained some of its strength (JME was a construction company – but a former manager of Peerless, Corny Petersen, was involved in JME). JME went bankrupt in 1990 and Peerless again had to find new investors, and after various owners ended up in the hands of Vifa-Speak.

System Audio was founded in 1984 by Ole Witthøft - a young entrepreneur only 19 years old. The products of System Audio follow a certain philosophy (sound character), the design is unobtrusive and easily installed in private homes, and the products are affordable.

In 1985, Gryphon Audio Designs was founded by Flemming E. Rasmussen. Initially the company made an MC pick-up preamp, expanding into amplifiers, etc., but in 2002 they introduced their first speaker, named Cantata. The interesting part is that Gryphon used some of the philosophies of late Steen Duelund, a Danish audio-maniac, who was also a mathematics teacher.

Steen Duelund is most famous for his own crossover for 3-way systems, named "The Synchronous Filter." Where normal crossovers (e.g. Butterworth) alignments are with a given steepness and Q, the Synchronous filter has different shapes, depending on the bandwidth of the midrange. The Synchronous filter is not really transient-perfect or time-aligned as such, but each speaker unit is in-phase with all other speaker units, not just in the passband but also in the stop band, i.e. the entire frequency range. The math for the crossover shows that it can be changed into a 2-way Linkwitz-Riley filter (by removing the midrange).

Beryllium, neodymium, and titanium

In 1975 the first Beryllium dome drivers showed up. The material, which was new in loudspeakers, was implemented into Yamaha speakers (for example the NS-1000 studio monitor). The material is classified as one of the best materials available today for hard dome tweeters and is experiencing a second chance since the material was made available to the general public, starting with the launch of the Scan-Speak D3004/664000 in 2009. Roughly 34 years after beryllium was introduced to the market by Yamaha, a large US company, Brush Wellman who specialised in materials, made beryllium available to the loudspeaker industry. Beryllium has very favourable properties, like low mass, high stiffness and also a fairly high damping coefficient.

Mid 1980s marks the earliest speaker products utilizing Neodymium magnets. For the following 20 years it became the new wonder material of magnet systems, by which small and powerful magnet systems can be designed. It has incredibly high remanence and coercivity, with only one property which the designer must take into consideration – it has limited temperature stability.

Voice coil bobbin from Titanium became the new big hit in loudspeakers in the late

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01 Scan-Speak manufactures speakers with copper in the magnet system. The original Symmetric Drive patent by Ragnar Lian ran out around 1993 and a new design was patented to replace the original. This design is named SD-1 and entails 3 copper rings in the magnet system, two located on the pole piece near the air gap, see picture (1), and a third ring near the bottom plate. World patent 1994027413 A1, valid from 1993 - 2013.

1990s; because it combines the best qualities of the aluminium former (stiffness) with low electrical conductivity (so you don't get undesirable electromagnetic damping) and it can be made even thinner than aluminium. It also has low heat conductivity, which you can see as either a positive or a negative feature. According to my source, the earliest requests for such former material came from Ingvar Öhman (a Swede) and Vifa forwarded this request to their suppliers. The suppliers became tired of the repeated requests and eventually they started to offer this option.

New horizons

In 1987 Skaaning was forced to leave Dynaudio. In 1990 Skaaning founded a new company, Audio Technology. This was the 5th loudspeaker company founded by Ejvind Skaaning, and the last one – co-founded with his son, Per Skaaning, who

runs the business today. Four of the five companies still exist today (only QSR, which was merged into Scan-Speak, doesn't exist anymore) – impressively all manufacturing transducers of the highest quality, and a testimony to the entrepreneurship of Ejvind Skaaning.

In 1998 TacT was founded by Peter Lyngdorf. The first product was the Millennium amplifier, a fully digital amplifier for the high-end audio market, based on Toccata "Equibit" technology (Toccata Technology is founded by Lars Risbo, following his PhD from Denmark's Technical University (DTU), later sold to Texas Instruments). TacT also developed some room correction hardware. This company was later converted into Lyngdorf Audio (2005), where electronics as well as speakers are made. In later years this was paralleled with Steinway-Lyngdorf (2007) with increased focus on loudspeakers and installation business.

Closing remarks

From here on, it is appropriate to let the companies tell their own stories, and I will not delve further down into much of what happened to e.g. Dantax, DALI, etc. We continue with companies that are no more, and with closing remarks on the others.

Scan-Speak was purchased by Vifa (from Dantax) and moved to Videbæk in 1991. Later the company changed its name to Vifa-Speak, but the speaker brands Vifa and Scan-Speak coexisted.

In 1991, Vifa was back to 200 employees, which is similar to the hey-days in the early 1970s. After that, Vifa ran into some years with minor trouble, where Vifa did not make that much money and one year Vifa had to write off a loss, and Nesdam was forced by the investors to retire in 1995. In retrospect, the loss was insignificant compared to what was coming later on.

In 2000 Danish Sound Technology (DST) was formed by Vifa-Speak taking over all stocks in Peerless. Peerless had not been profitable for 20 years and in retrospect this was a very bad decision by Vifa management. In 2000 a manufacturing facility was established in PanYu, China. To finance all this, Vifa was forced to sell their buildings and instead make a rental agreement with the new owners, which all-in-all destabilised the otherwise solid economy in Vifa (now DST).

DST was battling to finance the cost of their production sites and upkeep of the businesses. For one they sell their Vifa brand to Chinese investors (GGEC) and therefore GGEC were allowed to use the brand for business not related to transducers. DST was looking for investors, and in 2005 DST was sold to Tymphany. Hereafter Vifa and Peerless transducer products (and brands) were transferred to China.

The part of Vifa owned by GGEC is still active in Denmark under the company name Vifa Denmark A/S. The company is allowed to make system designs and they are today actively pursuing the design and production of post-Hi-Fi modern lifestyle products, like advanced radios and sound bars.

In 2008 Scan-Speak remained in Videbæk, while Tymphany China (incl. Peerless and Vifa) were sold to a group of managers situated in China. At this point in time Scan-Speak was part of the remaining Tymphany Denmark A/S. It was sold to the management in April 2009. Tymphany Denmark A/S filed for bankruptcy in the fall of 2009. Scan-Speak continues doing business, now based at the same facilities as Vifa was located since 1947.

As you can see from all the business surrounding loudspeakers in Denmark, financial instability and hard times cannot keep the industry down. The Danish nation, however small it may seem, is simply a melting pot for loudspeakers.

Danish electro acoustics

Although this chapter is focusing on the good-old loudspeaker industry in Denmark, as closing remarks, I cannot help but think electro-acoustic in general. I should mention that SONION in Horsens was originally Kirk Acoustics. Kirk was founded in 1892 by Emil Møller and it merged with Niels Geertsen's electromechanical factory in 1917. They were famous for their high-quality telephones and the speakers for the telephones were made in-house. During later years the production lines would be made in Horsens, Denmark, and then exported to China where they manufactured millions of small loudspeakers for cell phones. Some as low in cost as 0.01 EUR (one euro-cent).

I feel obligated to mention that Denmark is also famous for its microphones. Brüel & Kjær started with measurement microphones way back, development was pioneered by Gunnar Rasmussen. When he was asked to retire from B&K, he decided to start a new microphone business, GRAS, 1994, with his wife Hanna Hertz. Today the business is run by his two sons. As such we have not one, but two of the world leading manufacturers of measurement microphones, both located in the Greater Copenhagen area. Other microphone manufacturers exist in Denmark, for example DPA, they make e.g. recording microphones suitable for certain instruments and small body worn microphones.

Denmark is also known for hearing aids, which is a tiny loudspeaker. Due to space requirements it is not based on the moving coil principle, but the balanced armature principle. In fact, three of the top-6 companies in the world are located in the Greater Copenhagen area. These are Oticon (founded 1906), GN ReSound (founded 1943), and Widex (founded 1956). The other three major players on the market are Starkey (US based), Phonak (Swiss based) and Siemens (German based).

Although one should think that the loudspeaker, microphone, and hearing aid industries could benefit from synergies, they seem to live in completely separate bubbles.

The audio and electronics industry in general is the 4th largest exporting industry in Denmark. The top-3 is the oil and energy sector (e.g. windmills), farming, and the medical and pharmaceutical industry.

This history section represents the author's best effort in compiling a correct historical description/narrative. Errors, and not least omissions, may apply for which I am truly sorry. ■

About the author

Claus Futtrup was born in Herning, Denmark, in 1971. He received his M.Sc. in mechanical engineering in 1997 from Aalborg University. His special field is material science; steel and other metals, ceramics, rubber, plastics, and composites in regard to design parameters, process engineering, and chemical and environment issues.

During his career, he has worked for several loudspeaker companies. From 1997 to 2006, he worked at Dynaudio A/S first as an R&D Engineer, designing loudspeaker boxes and later as a System Engineer for automotive. From 2006 to 2008, he was employed as a Transducer Design Engineer at Tymphany Denmark and, in 2008-2013 he was R&D Manager at Scan-Speak. In 2013, he started working as Technical Sales Manager for SEAS, Norway, and in 2015 he was promoted to Chief Technical Officer.

Claus Futtrup has authored a number of AES papers, most of them published in the Journal (JAES), one was presented in London in May 2011. Due to his comprehensive technical and historical knowledge about loudspeakers he is often invited as a guest speaker at various events. In 2013 he was speaker at the Danish Electroacoustic Society (DEF)'s meeting. In October 2015 he held a speech at the Norwegian Acoustical Society's meeting in Trondheim. In January 2016 he is invited to give a speech at the AISE (ALMA International Symposium and Expo) in Las Vegas.

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DANISH LOUDSPEAKER COMPANYS

THE HISTORY OF

Artcoustic

Artcoustic was founded in 1998 by Danish Kim Donvig and Patricia Ljungberg. Their goal was to create a luxury speaker brand, which combines design aesthetics and sound quality, without sacrificing one to the other.

The history

The people behind Artcoustic, Kim Donvig and Patricia Ljungberg, moved to London in 2000 to establish Artcoustic Loudspeakers, with the thought: if it does not work here, it won't work anywhere.

This is now more than 15 years ago, and Artcoustic has become one of the most respected brands in the AV industry, winning several awards and in 2015 Artcoustic received the Best High End Speaker System award at the AV Tech Media Awards in the UK and The Best Loudspeaker award from Smart Building Awards.

Artcoustic has always worked towards combining high sound quality and design aesthetics, and they have achieved this mission. Artcoustic has become well respected in a very conservative UK market, with many good home brands. That is an achievement in itself and Artcoustic is now successfully selling to more than 35 markets around the world.

"Our aim has always been to create a high-quality, honest, and true sound and still achieve the aesthetic look of our products. We want to compliment, not conflict with, your home's aesthetics. We want our listeners to feel the music, to experience how a true live sound can be reproduced from Artcoustic loudspeakers," says Patricia Ljungberg.

The product

Artcoustic has transformed the way sound and speakers can enhance the atmosphere and interior. The company's loudspeakers have effectively erased the distinction between loudspeakers and furnishing yet remains true to the intended purpose: Superb reproduction of sound.

Artcoustic is now renowned worldwide for its range of high-end performance wall mounted speakers that feature interchangeable screens allowing one to choose any look to go with the interior. The superior product range has been awarded for its ground-breaking designs and is sold worldwide.

Iconic products

One of the most iconic products will without a doubt be the Artcoustic Multi LCR Sound-

Facts

Artcoustic™ Loudspeakers

Company name
Artcoustic Loudspeakers

Head office
Copenhagen, Denmark

Established in year
1998

Established by
Kim Donvig & Patricia Ljungberg

Main audio product types
Loudspeakers

Main markets
UK, EU, India, Asia

Number of employees
8

Spitfire series: Speaker model, Spitfire 16-8 and Spitfire Control 2 subwoofer mounted behind a perforated projection screen

Bar, the first left, centre, and right SoundBar in the World.

Artcoustic pioneered the concept of an all-in-one LCR (Left, Centre, and Right) Soundbar as far back as 2000, and the latest SL version is an evolution of this classic SoundBar.

Available in 4 standard versions, all feature clean discrete aesthetics with high output timbre matched performance.

The Multi SoundBar SL can be used as a single LCR loudspeaker, or for more powerful systems, used as a single mono centre channel. The standard sizes are designed to complement today's flat screens. Bespoke width options are also available.

The SL series

The SL range is the result of over 12 years research and development and utilises the very latest drive unit and crossover technology. The challenge was to create a loudspeaker capable of the dynamics and power of a horn-loaded design, but with the accuracy and quality of a hi-fi design.

The solution was to employ an array of world-class drive units to provide incredible efficiency, output, and accuracy, whilst also staying true to Artcoustic's signature design ethos.

The SL range is designed to be complimentary and flexible, allowing the correct model to be specified for the correct application. From small flat screen TV based systems to state-of-the-art private cinemas, as well as bars, restaurants, places of worship - in fact, anywhere where high performance sound is required.

With consistent timbre and sound qualities throughout the range, the correct model is the one that delivers the output levels desired together with aesthetics to suit the environment. Artcoustic's huge portfolio of more than 5,000 artworks and designs uniquely allows serious quality sound to be installed with no compromise to the interior design, and due to the large and expansive SL range, there is always a model to suit the application.

Performance is assured with a vast range of products and a trained installation network across the world, together with full design support from head office to guarantee the correct products are used for the correct application. The SL range is a revolution in loudspeaker design, delivering efficiency as high as 110 dB, with output up to 130 dB, and all in a range just 67 mm deep and stunning to look at.

Pioneering art and sound

The screens for your loudspeakers can be printed in any colour or with any digital image from Artcoustic's extensive portfolio, or with your own pictures or designs. You can also choose from over 1500 Pantone colours.

The Artcoustic gallery has been made to inspire and guide you to choose from a wide range of digitally printed artworks, created to match the Artcoustic loudspeakers.

Artcoustic hand-pick artists from around the world and invite them to create exclusive artworks for the Artcoustic Art Gallery. All speaker screens are interchangeable; meaning that you can choose your own personal collection of different prints and change the look of your unique Artcoustic loudspeakers, whenever you like.

Spitfire series for demanding home cinema application

The Spitfire series is designed for the finest dedicated home cinemas, with different configurations to suit almost any room size. Performance is crucially the same as the Artcoustic SL series, but are more cost effective due to more industrial aesthetics and a more robust finish, lending themselves perfectly to private cinemas where the speakers are hidden from view behind the projector screen.

Together with Artcoustic's signature slimline design, the Spitfire Serie deliver world-class cinema sound without taking up valuable space in the room.

Bass, bass, and more bass. The Impact SL series subwoofers

Nearly 20 years of subwoofer technology and acoustic evolution, has merged into the most advanced and powerful subwoofer series ever produced by Artcoustic. By mixing Artcoustic's early Pressure Control

Impact series: Speaker Impact 1

The Architect Series has been designed and engineered with same high specifications as all the other Artcoustic models.

technology and the later X2 bass system, the company has ended up with something truly unique.

This new technology and design addresses the issue of depth and power versus cabinet size, with an impressive F3 and F6 point due to multiple coupled 10” bass units, phase optimisation, and controlled frequency overlap.

This new design technology allows this performance to be possible in a cabinet much smaller than would otherwise be required, alongside higher sensitivity, better heat dispersion, and improved F3 and F6 points, operating all the way down to 15Hz.

Impact series: Speaker Impact 3

Future focus

Performance series and the future
Artcoustic is rapidly bridging further into the high sound pressure level market, such as large cinema complex, professional live audio, and the fast grooving club scene and this has been underlined with the 2015 launch of Artcoustic’s Performance series.

When starting out with the Performance series design brief and concept it was extremely important for Artcoustic not just to create yet another loud PA speaker, but instead to combine all the company’s knowledge from the existing award winning Spitfire and SL Series technology, and end up with something truly unique. Artcoustic understands the importance of sensitivity and high sound pressure levels, but has never been willing to sacrifice the true qualities typically enjoyed with lower sensitivity hi-fi speakers.

The Performance series is a unique cocktail, combining the award winning Artcoustic array technology, multi-coupled sub units and high sound pressure levels, all carefully aligned within well-ordered Danish design principals.

With Artcoustic’s unique multiple cone array technology, the company achieves a very flat audio response from 15Hz–20kHz, with extremely low distortion, guided directivity and all combined with very high sound pressure levels.

The future and active speakers, combined with wireless technology
Besides constantly improving its existing product line and expanding the art portfolio, colour options, and general choices for customisation, Artcoustic is also developing new products in the other end of the scale: Artcoustic is currently looking into active speaker technology, combined with possible wireless solutions, all in line with the high end Artcoustic design and engineering standards. ■

SL series: Speaker model, Target SL

Timeline

1998
The launch of the Artcoustic DF series on-wall and floor standing loudspeakers, including iconic products, such as the DF75-55, DFF120-43, all based on Artcoustic’s in-house designed Pressure Control Bass System and the typical flat form factor, matching the flat plasma screen technology.

2000
Artcoustic launch the world’s first ever left, right, and centre SoundBar, the iconic Artcoustic DF-Multi.

2006
The arrival of the X2 Series. This series was based on similar Pressure Control Bass System, as the previous series. The X2 series had a much improved mid and high frequency sensitivity, catering for the constantly more demanding home cinema market.

2012
As the plasma TV technology is slowly being replaced by the much slimmer LED technology, Artcoustic decide to revamp the entire range and the outcome of this, is the launch of the SL series. The SL series is the result of over 12 years research and development and utilizes the very latest drive unit and crossover technology.

Famous Swedish media company, 60 seater media room. Artcoustic Performance series speakers, mounted behind an acoustic transparent projection screen.

2013
The year of the Spitfire. The Spitfire series was designed for the finest dedicated home cinemas, with different configurations to suit almost any room size. Performance was crucially the same as the Artcoustic SL series, but more cost effective due to more industrial aesthetics and a more robust finish.

2014
Artcoustic goes in wall and in ceiling. The Architect series has been designed and engineered with same high specifications as all the other Artcoustic models, leaving no space for compromise on sound quality and build, but allowing the flexibility to install in ceilings or walls.

2015
Artcoustic launches its first stackable, array PA speaker system. The Performance series is a unique cocktail, combining the award winning Artcoustic array technology, multi coupled sub units and high sound pressure levels, all carefully aligned within well-ordered Danish design principals.

2015
After many years of research, Artcoustic has finally found the formula for printed speaker grille colours, which enable Artcoustic to produce an array of colours within well-known colour systems, such as Pantone, NCS, Farrow & Ball, and RAL but in order to keep things simple, Artcoustic has also made a functional colour swatch book.

THE HISTORY OF

Audio Technology

Audio Technology was founded by Ejvind and Per Skaaning in 1990 based on an idea of building small series of speaker drivers for customers that wanted to have some degree of influence regarding electrical and mechanical parameters, as well as appearance and design of the loudspeaker.

The history

In 1990, Ejvind and Per Skaaning founded Audio Technology. The basic idea behind Audio Technology was to build the drivers in a way that previous mistakes were avoided, such as problems with bottoming out and compression caused by ventilation problems. Only the finest raw-materials were to be used. Cone geometry should be refined to the best possible response.

This would naturally mean a product at a considerable price level, but this was of no concern. The people behind Audio Technology are enthusiasts and want only the best.

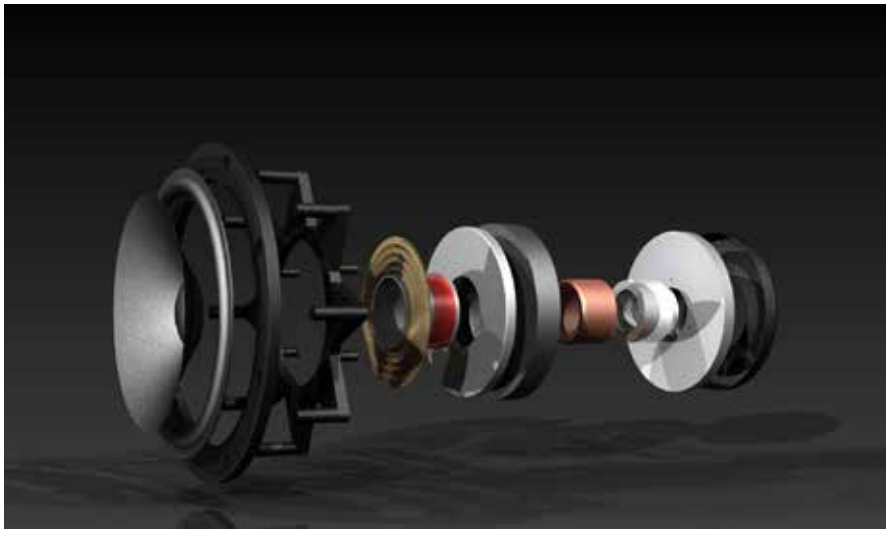
Iconic products

6" driver with 3" voice coil.
First driver developed by Audio Technology was the 6" driver. Audio Technology names its Flexunits drivers after the emissive cone diameter, because they operate with lots of different front ring diameters and shapes. Front rings can vary several centimeters, despite using the same cone diameter.

The physical shape of the drivers was quickly established and because it would not be limited by physical dimensions, like heights, etc. it was decided, the driver chassis should consist of two rings – a front ring and a middle ring, connected by spacers and bolted together. A very flexible construction, that led directly to the name – Flexunits.

6" Flexunits was finished with regards to the physical construction, but the shape

Flexunits with 3" voice coil.



of the cone was still to be developed. It was done according to the 'Trial and error' principle and went on for month. Lots of tests, measurements and discarded cones saw the day of light. Fortunately, this brought a lot of experience and the process of finding the right geometry of the cone got easier for the drivers to come.

6" Flexunits - Sonus Faber version

Sonus Faber (Italian speaker manufacturer) was already interested in such a driver, so turnover and sales was guaranteed from start.

The driver, used in Sonus Faber EXTREMA, was hereby the first commercially used driver of Audio Technology. It was produced with the Sonus Faber logo on the special shaped front as well as an individual designed cone by the ideas of Franco Serblin.

About 2000 Extrema mid-woofers have been produced, and the sales of these drivers, have contributed importantly to the ongoing foundation and development of Audio Technology.

Next newcomer was a 10" unit, also with 3" voice coil, but here development was somewhat faster. The physical design

Facts

Company name
Audio Technology ApS

Head office
Stilling, Denmark

Established in year
1990

Established by
Ejvind and Per Skaaning

Main audio product types
Midrange and woofer loudspeaker drivers

Main markets
All continents

Number of employees
6

was just a question of enlarging the existing parts, but the cone structure development proved yet again to be quite time consuming.

Then, a 4“ unit was planned and the need for a smaller voice coil occured. Like the 3“ voice coil winding tool, the 2” tool was made as an adjustable tool to produce coils with many possible winding heights. Voice coil former inserted into the tool can be changed by 5 millimeter intervals and winding heights to almost any given goal. Also, the impedance can be of your own choice.

The 4” Flexunits was constructed on the basis of the same ideas and from then cone building set to an ideal geometry went fast. Experience does matter…

Hereafter, the 5” Flexunits was made and it rapidly turned out to be a popular size driver. A not too big a driver, that is able to produce relatively large sound in a small cabinet. Many loudspeaker manufactures around the globe have become well-known for producing speakers with good sound, on the basis of this driver. Also the Danish Hi-Fi magazine Highfidelity, launched a DIY project ‘Speak & Abyss’ with the 5” Flexunits.

Due to the narrow structure of the 5” driver, it was necessary to change the construction of the basket. Instead of mounting the screws visibly from the front, a row of treats were hidden under the rubber-surround, allowing a somewhat smaller assembly. This step was quickly adopted into the other drivers. 4”, 5”, 6”, 8”, 10”, 12”, and 15” drivers were now available (1994) - some with 2” voice coil only – others with both 3” and 4” voice coils.

C-Quenze arrives

Until now, all drivers were constructed with the bolted together chassis, but in 2001 a new series comes around – the C-Quenze series. This series of drivers are in every aspect built from the same parts and material as the Flexunits, with exception of the frame. It is now a cast frame. This means the flexibility is reduced, but some parameters can still be changed. The cones are also changed as the energy is put into getting a slightly broader bandwidth. As this driver is a bit more cost-effective than the Flexunits, it becomes quite popular, but still, there are customers that want what they call ‘The real thing’.

15” drivers, with Rockport Technologies own Carbon Fiber Cone.

In 2009, the Sandwich Cones becomes available. It is made from two relatively thin carbon reinforced paper skins, which are glued together with expanding foam glue. The structure is light, but very stiff.

LR – magnet system

Last initiative is drivers with an aerodynamic magnet system – the LR system (2012).

The pole plates are rounded to an aerodynamic shape, avoiding aero noises and distortion from the driver. The LR system comes only with the 120 mm magnet so far.

Today, Audio Technology ApS is still owned by Per Skaaning and two of his brothers.

Ejvind Skaaning – Year 1999.

Timeline

1991
First commercial speaker system using Audio Technology drivers is tested in German Magazine Audio under the headline: “Nur fliegen ist schöner” meaning: “Only flying is Nicer”

1993
Guarneri Homage of Sonus Faber is introduced. The driver for this speaker is the biggest number of Flexunits produced. Copy No 001, is placed in the Violin Museum in Vicenza.

1994
The biggest Flexunits – 15” – is completed. The first Flexunits with 4” voice coil, meaning great power handling. Four pairs were sold to Ace of Base studios in Sweden.

1995
The Parcifal of Verity Audio in Canada is introduced. A very popular speaker that has been produced in more or less the same design for 20 years.

1999
The KA system sees the dawn of light. Full bodied bass at low levels, combined with good damping at X-max is possible.

2002
For the first time, Audio Technology drivers have the honor of being in “Speaker of the Year” in Stereophile Magazine represented by Rockport Technologies Antares.

Future focus

In the coming year, Audio Technology has plans of developing midrange drivers with smaller voice coils. The plan is to create drivers with a broader bandwidth, with special focus on the automotive industry. Also the overall size of the drivers will be downscaled to sizes not common for Audio Technology. ■

2007
Six speakers with Audio Technology drivers in "Recommended Components" of Stereophile Magazine. Speakers from Peak-Consult, Sonus Faber and Verity Audio are represented.

2008
The sandwich cone drivers are presented, giving the Audio Technology woofers an upgrade regarding low distortion and 'edge' in the overall sound experience.

2010
The Cutting Edge in The Absolute Sound: "…then I suspect that you will find that Verity's Lohengrin isn't cause for buyer's remorse but prolonged elation.", J. Heilbrunn TAS

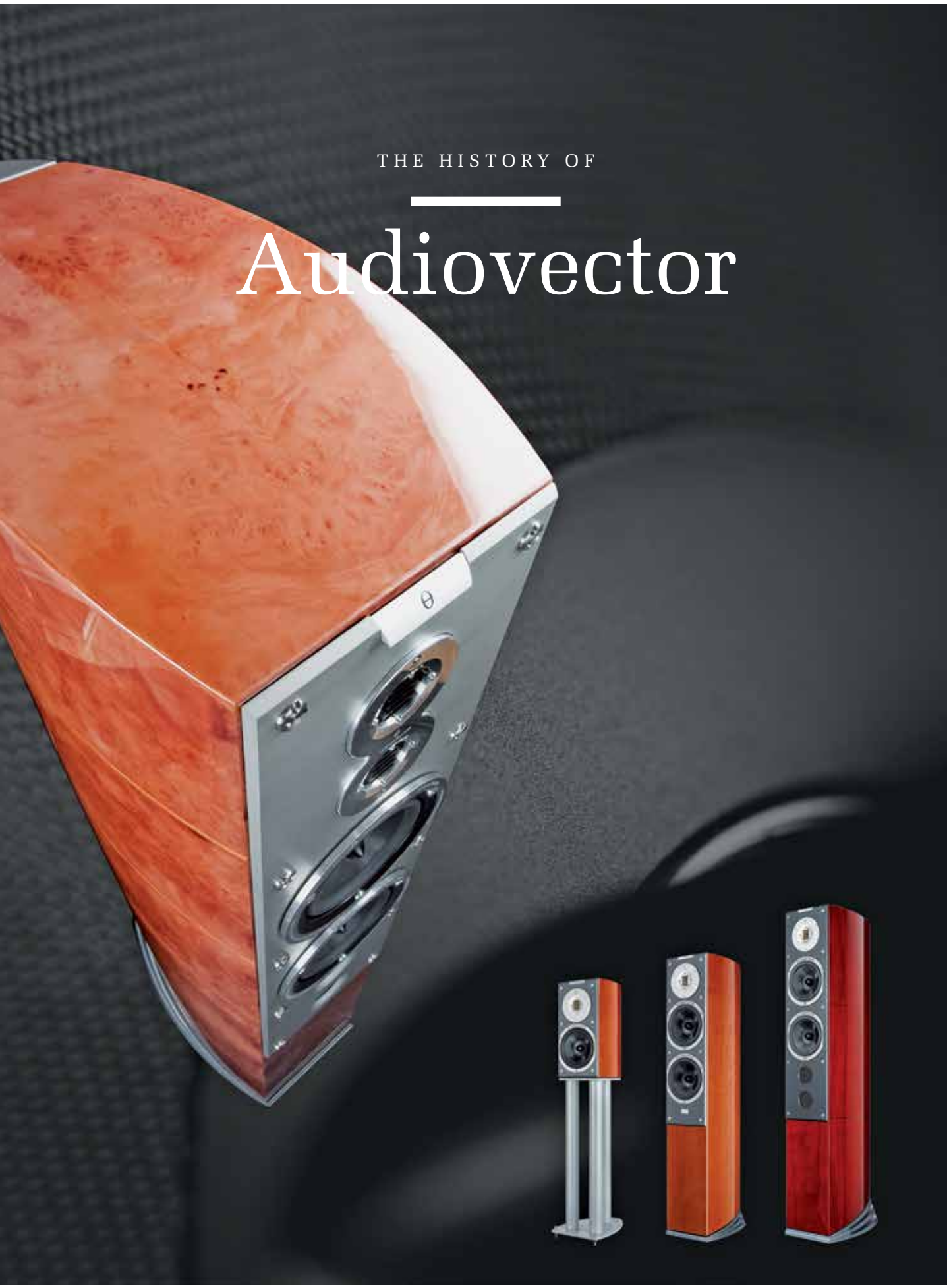
2011
The Rockport Technologies Altair Loudspeaker becomes "OVERALL Product of the Year", using 3 Audio Technology drivers – 15", 8" and a 5".

2012
$165K Arrakis from Rockport Technologies is tested by Robert Harley who says: "The best Stereo system I've ever heard". 6 Audio Technology drivers per speaker.

2015
November 1st Audio Technology celebrates their 25th Anniversary. 25 years of serving the best speaker builders around the globe.

THE HISTORY OF

Audiovector



Audiovector was founded in 1979 by Ole Klifoth - built on a vision to produce natural sounding loudspeakers for music lovers. The ideas of linear dynamics, linear phase, and low compression still form the backbone of Audiovector's design philosophy.

The history

In 1979, Ole Klifoth founded Audiovector and the vision for this new company was then, and still is, to produce natural sounding loudspeakers for music lovers. Ole Klifoth came from other parts of the hi-fi industry and started Audiovector, because as he says: "I could not find the speaker of my dreams, so I decided to build it myself."

As a new company, Audiovector enjoyed a successful start with the "Trapez" speaker, which was built according to Ole Klifoth's ideas about linear dynamics, linear phase and low compression. These ideas form the backbone of Audiovector's design philosophy. The history of Audiovector is described through its iconic products selection.

Iconic products

The list of iconic products from Audiovector is long. In the following, a few of the best and most forward pointing ones are highlighted.

The speaker, which started Audiovector, was the Trapez, which also stipulated the principles and dogmas, where after future Audiovector models have been engineered. In the Trapez, the Low Compression Concept was launched for the first time. This concept includes all areas, where compression and distortion needed to be dealt with: in tweeters, bass drivers, cabinets, cross-overs, and voice coils. The 6dB per octave linear phase cross-overs, pioneered in the Trapez - something other loudspeaker companies claimed would not work - is part of the LCC concept.

All the concepts used in Audiovector loudspeakers, have been developed in Denmark, the cradle of loudspeaker design.

The Trapez

In 1979 the Trapez - the brainchild of Chief Engineer Ole Klifoth - was first launched. For a long time he had been dreaming about the perfect speaker. A speaker with linear frequency response and linear phase response.

Three drivers (modified Scan-Speak and Dynaudio drivers from Denmark), were placed on a baffle sloping backwards in order to bring the acoustic centre of the drivers in phase, when the drivers were fed by a 6dB per octave cross over. The drivers themselves were all low compression types and the goal was to create a linear impulse response.

The exterior design of Trapez was designed by 5 times Danish award winning Industrial Designer, Lars Mathiesen, and sported all the modern Danish technologies of the golden age of Danish loudspeaker industry.

The Trapez sold more than 25,000 pairs during the next 10 years and was an instant success from day one.

The Audiovector 3

The need for slim and tall speakers inspired Ole Klifoth and Lars Mathiesen to develop the lop-sided Audiovector 3 model. Standing 1 metre tall and sporting two 6.5" drivers with polypropylene membranes and an aluminium version of Audiovector's 2406 low compression tweeter, they created the start of a very successful range of loudspeakers. Again, the focus was on low distortion, low compression, linear phase cross-overs and a minimum of standing waves. This had become the new Danish standard for loudspeakers.

The M-series

Introduced in 1996, the M-series was a truly modular series of speakers. One type of cabinets was used for several models. The series covered a total of five models before it was discontinued and followed by the S-series.

The M-series was also the first series to be upgradable. With the M-series Audiovector introduced the open back tweeter SEC system for the first time. The LCC concept, although originally invented in the days of Trapez, was expanded and put into system with the M-series.

The S 6/Si 6/SR 6 - Form Follows Function

Designed by Lars Mathiesen and Ole Klifoth with the goal of marrying function and modern Scandinavian/Danish design. The teardrop shaped cabinet allowed Audiovector to rethink the whole issue of internal damping.

Internal damping is often the source of huge production tolerances, which again is the source of poor product uniformity. Audiovector introduced new precision-cut foam materials, which was cut very thinly to fit into the teardrop shape that has no parallel sides and thus no internal standing waves. The company almost got rid of damping materials and their sound quality impairing consequence i.e. hysteresis distortion. "Fast as a reptile" was the headline of one magazine after testing the S 6 Avantgarde in 2001. The tweeter in this speaker was Audiovector's first Avantgarde AMT in an open SEC system.

The R 11 Arreté

In 2007, Ole Klifoth and designer Jacob Tryde decided to develop an Audiovector flagship speaker, which was intended to serve as Audiovector's in-house reference. Real music is of course the best reference, but the existence of an in-house faithful reference to benchmark all new Audiovector speakers against, was a long time wish of Audiovector's listening team.

Sporting two full midrange drivers on the front, a double Avantgarde AMT tweeter and eight long-throw bass drivers on the rear, the R 11 Arreté has the bass driver area of a 17-inch driver, but with a much faster response. In truth a grand speaker, able to reproduce the scale and drama of any musical genre, and doing this by using all the Danish technologies in Audiovector's toolbox. The first speakers to benefit from the new reference, were SR 6 models and later and recently SR 3/SR 1 models.

Facts

Company name
Audiovector

Head office
Copenhagen, Denmark

Established in year
1979

Established by
Ole Klifoth

Main audio product types
Passive and active loudspeakers for domestic use.

Main markets
Denmark, Russia, Sweden, Norway, Poland, Germany, Japan

Number of employees
9

Ole Klifoth, founder and owner of Audiovector has been engineering loudspeakers for more than 45 years. Audiovector is based on principles developed in Denmark by himself and others. In 2010 he launched the most expensive speaker from Denmark, his R 11 Arreté.

The S 3/Si/SR series
Inspired by the S 6-shape and the technology of the R 11 Arreté, the S 1's, and S 3's are scaled down versions using the same unique cabinet shape to create distortion-free dynamic performance. All the technologies from Ole Klifoth's Danish toolbox (6dB per octave cross-overs, low compression tweeters, SEC, SD-technology, resistive ports, 3-point fixing, no standing waves, etc.) are incorporated in these fine speakers.

The SR-series is Audiovector's best performing series of compact speakers to date. The SR 3 Avantgarde Arreté is a true example of an extremely compact high-end speaker. The SR-series was also the start of Audiovector's colour programme, which makes it possible to buy speakers in almost any colour.

Reviews
Through the years, all Audiovector models have received excellent reviews. These can be found on Audiovector's website.

Cutting-edge technology

This is Audiovector
As we know from the historical pages of this booklet, many of the important inventions in loudspeaker technology, have been developed in Denmark. Almost any loudspeaker today is using a double chamber treble driver in order to reduce compression and to obtain a linear impedance curve. This technology was invented and developed in Denmark. If we look at B&W's latest 800 series speakers, we will sees that its drivers are using SD technology. Invented in Denmark. And first order filters. Pioneered in Denmark.

The Audiovector speaker on the right is a very good example of a speaker loaded with Danish technology. Some of the technologies are invented by Audiovector, some by other Danish companies through the years. What they have in common, is that they are all Danish inventions. Space does not allow us to cover all the technical solutions, but the most important ones included in this Audiovector Jubilee model, and other models are:

- The double chamber treble driver was developed into an open back treble driver with even lower compression by Audiovecor in 1996 in tandem with the SEC system (Soundstage enhancement Concept) where intelligent use of the rear radiation from the membrane replaces the fight against ear radiation.
- In cooperation with Scan-Speak, Audiovector has pioneered the 3 layer sandwich membrane, which uses a combination of woven fibres and a light long fibre paper membrane.
- The Dynamic Feed Forward filter technology, which reduces coil resistance by a factor 2, was invented in 2004 by Audiovector in Denmark in order to get performance of the then new S-series closer to that of speakers with active electronic cross overs.
- The SD technology which reduces induction related distortion in speaker drivers, was invented in Denmark in the 1960'ties.
- The IUC upgrade concept, which is unique to Audiovector and which allows end users to upgrade their existing loudspeakers, is invented by Audiovector in 1996 in connection with the launch of the M-series modular speaker line.
- The NES concept, which reduces energy storage in the drivers of a loudspeaker, was introduced by Audiovecor in 2008 in connection with the launch of the Si-series speakers. Another Danish invention.
- The ARA room adaptation technology was developed in Denmark, too. ARA is a low-tech frequency domain solution to a complicated time domain problem.
- The Discreet Active technology, which is retrofittable in modern Audiovector speakers, or available as amplification for new active speakers, was developed for high end use in Denmark. It allows 24 bit/192 kHz transmission and upsampling.

Audiovector speakers build on an evolutionary process of ongoing improvements
The strategy of constant improvement of technologies and products, which are already notorious for their excellent sound quality and reliability, also serves to preserve the Audiovector sound–DNA. Something that characterizes all of Audiovector's loudspeakers from the smallest to the biggest one. From the very first product to the newest ones.

Many of the important inventions in loudspeaker technology, have been developed in Denmark

The speaker above the SR3 Avantgarde Arreté Jubilee 100 is celebrating the 100 years birthday of the loudspeaker as it was invented by Laurids Jensen. This speaker model is available in red and white, plus a couple of other color combinations and in limited numbers. 100 pairs, indiviually numbered, will be produced.

Home of the loudspeaker
Denmark is notorious for being a loudspeaker country. In the sixties and seventies, Danish companies manufactured more loudspeakers per capita than any other country in the world. The technologies invented in Denmark are numerous and many of these have since become industry standard.

Audiovector has developed and fine-tuned many of the technologies from the golden age of loudspeakers in the 1960s and added more technologies to improve loudspeaker performance. On the opposite page, there are descriptions of the technologies used on today's most advanced Audiovector models.

Precision tweeters
In 1984, Audiovector developed its own dome tweeter. The goal was to create a tweeter design with an excellent dynamic response, extremely low compression and very narrow production tolerances.

The result was the 2406 Low Compression dome tweeter launched in 1984.

Since 1984, Audiovector has built all its dome tweeters and Avantgarde Air Motion Transformers in-house.

Avantgarde tweeters
When Ole Klifoth discovered, that he could get a frequency response from 2 kHz-50 kHz from one of the same tweeters, it changed his view on treble performance. Before the Avantgarde tweeter - a carefully designed and tuned open back derivative of Dr. Oscar Heil's Air Motion Transformer - a dome tweeter was the best choice in performance and power handling. A tweeter for Audiovector's top-models was born and it was built in-house.

Proprietary bass/mid drivers incorporating the best of modern Danish technologies
In cooperation with Peerless and Scan-Speak a line of drivers with stunning dynamic performance was engineered, using a specially designed chassis with 3-point fixing to honour Audiovector's NES technology (No Energy Storage). Hysteresis distortion is avoided by using titanium voice coil formers and heat is efficiently lead away from the coils by black anodized pole pieces and diffusers. SD-copper caps keep inductance and distortion under control

The SEC system
The SEC (Soundstage Enhancement Concept) system is a treble system, which works together with open back, low compression tweeters. A rear firing port makes intelligent use of the rear radiation from the tweeter (instead of fighting it). The rear output is delayed and becomes a part of the room's reflections. It does not interfere with the direct sound from the tweeter.

SEC creates a much bigger soundstage and a better reproduction of detail with less distortion than conventional tweeter systems. This technology is subject to patent pending, and was first introduced in the Audiovector M-series in 1996.

The teardrop shaped cabinets
The teardrop shape combines beautiful design with a non-resonant environment inside the cabinet. This allows for a reduction in internal dampening materials to almost nothing. This means better dynamics, minimal loss, and very little hysteresis distortion. In short: a more immediate and dynamic performance.

The IUC upgrade concept
Audiovector is unique in offering a logical upgrade path of its speakers, as all its existing loudspeaker models can be upgraded to a higher level, e.g. from Signature to Avantgarde Arreté or from a passive Super to an active Discreet Avantgarde model.

The fact that these upgrades are offered, has led to several unique elements: Firstly, people can buy Audiovector loudspeakers with reassurance because the product does not change and lose value overnight. Secondly, the product has a more environmental friendly profile than the use-and-throw-away products. This inspires a pride of ownership. It is estimated that more than 65 % of all speakers made by Audiovector, are still out there in the service of music. People keep them, quite simply.

The Low Compression concept
The Low Compression concept is a universal concept, which is reducing all types of compression: in drivers, voice coils, treble systems, cabinets internally, and cables.

This concept allows the parts of a speaker to last almost forever, because the

Timeline

1979
The Trapez was Audiovector's first speaker model in which Ole Klifoth's pioneering technologies were introduced. It enjoyed an immediate success and received outstanding reviews from the start.

1985
The Audiovector 3 with its lopsided front was another successful design by Ole Klifoth and Lars Mathiesen. It was followed by scaled down versions, as Audiovector 1 and 2 followed the same design concept.

1996
The Audiovector M-series was the first truly modular series and it marked the introduction of the IUC upgrade concept. The M-series was also the introduction of the SEC treble system with No-Compression tweeters.

1996
The IUC upgrade concept is introduced. Any Audiovector from the M-series can be upgraded to a higher level. Later they were upgraded to Mi level and later again to Mi-SE level.

1998
The Avantgarde AMT open back tweeter is born. Perfect for the SEC concept and with a range from 2 kHz–50 kHz. It represented ultra-low distortion in combination with a very fast transient response.

2001
The S 6 marked the introduction of the famous teardrop shape, with its total lack of standing waves. A beautiful looking design combining form and function to perfection.

heat build-up is vastly reduced. It allows Audiovector's speakers to sound more free, more dynamic, and more powerful than many competing products.

NES – No Energy Storage
The mechanics of loudspeakers is often a neglected area. Audiovector has developed a 3-point fixing method, which isolates the drivers from the weight of the cabinet, thus creating less overhang and less coloration.

Discreet
Almost all Audiovector speakers are available in Discreet versions with no passive cross-over inside. Instead there are 3 digital amplifiers with an even harmonics distortion profile similar to that of tube amplifiers and Class A amplifiers.

A powerful (NASA engineered) DSP chip takes care of the linear phase electronic crossover, power distribution and distortion management. The signal is transmitted from a hub to the speakers in 24 bit/192 kHz quality. The hub accepts inputs from digital and analogue sources and has a built-in automatic subwoofer sensing cross-over.

The hub accepts wireless BT signals directly, Wi-Fi, hi-res, airplay signals (the three latter through an external port). It accepts optical and digital signals and has a built-in high quality A-D converter for analogue sources.

In other words, you can make a full-blown system, with a hub, a pair of Audiovector Discreet speakers, and the source of your choice.

Future focus

The future of Audiovector is in high–end luxury loudspeakers - passive as wells as active. An Audiovector speaker will also in the future be based on Audiovector's trusted acoustic and mechanical principles – which is subject to their constant process of evolutionary improvement based on scrupulous listening tests.

For Audiovector's passive and active Discreet speakers, the mechanical and acoustical basis is the most important part of the speaker.

Luxury high-end
Audiovector will continue to focus on producing luxury high-end products in either passive versions or active Discreet versions - using advanced acoustical shapes, specially designed and precision machined bolts and screws, high quality build, and attention to detail.

The ongoing evolution

It is the plan to keep on evolving Audiovector loudspeakers in order to achieve even better performance in the future. This is expected to happen using new and better materials, new technologies (some of which will be developed by Audiovector's own design and engineering team), new understandings of human perception of sound quality, and new discoveries in hearing psychology.

Passive and active
Audiovector believes that there always will be enthusiasts, who worship the best possible sound quality. People who want to partner their Audiovector speakers with the best amplifiers and sources.

It is also believes that many music lovers will choose active Discreet speakers, which they can stream to in any available format. Although it will be possible to stream in the highest available resolution at any given time, availability of music will be extremely important. This is why Audiovector embraces everything from Bluetooth to 24 bit 192 kHz hi-res.

Because of the active Discreet speakers which are fully active and digital (with an analogue sound), passive Audiovector speakers will be inspired by the low loss sound transmission in the active speakers with their electronic cross-overs and multiple amplifiers. Just as the active Discreet speakers have been inspired by their passive siblings there will be an ongoing cross–inspiration, which will result in constant improving speaker models.

Audiovector's in-house reference
The fact that any new speaker model from Audiovector are measured against and compared to the Audiovector R 11 Arreté, bodes well for the future. The real reference, of course is live music, which is why Audiovector's listening team are frequent concert attendants. The aim of Audiovector is to bring the concert hall into people's homes. ■

2004
The S-series is born out of inspiration from the S 6-shape. With floorstanders, stand-mounts, centre speakers, and subwoofers it is a complete range for both stereo and surround sound.

2008
The Avantgarde AMT tweeter is lifted to a higher level. Faster transient response, more linear frequency response, and lower distortion result in a cleaner yet clearer sound.

2010
The R 11 Arreté is released - the most expensive Danish loudspeaker to date. Initially intended to be used as an in-house reference, soon after the speaker catches the interest of music lovers.

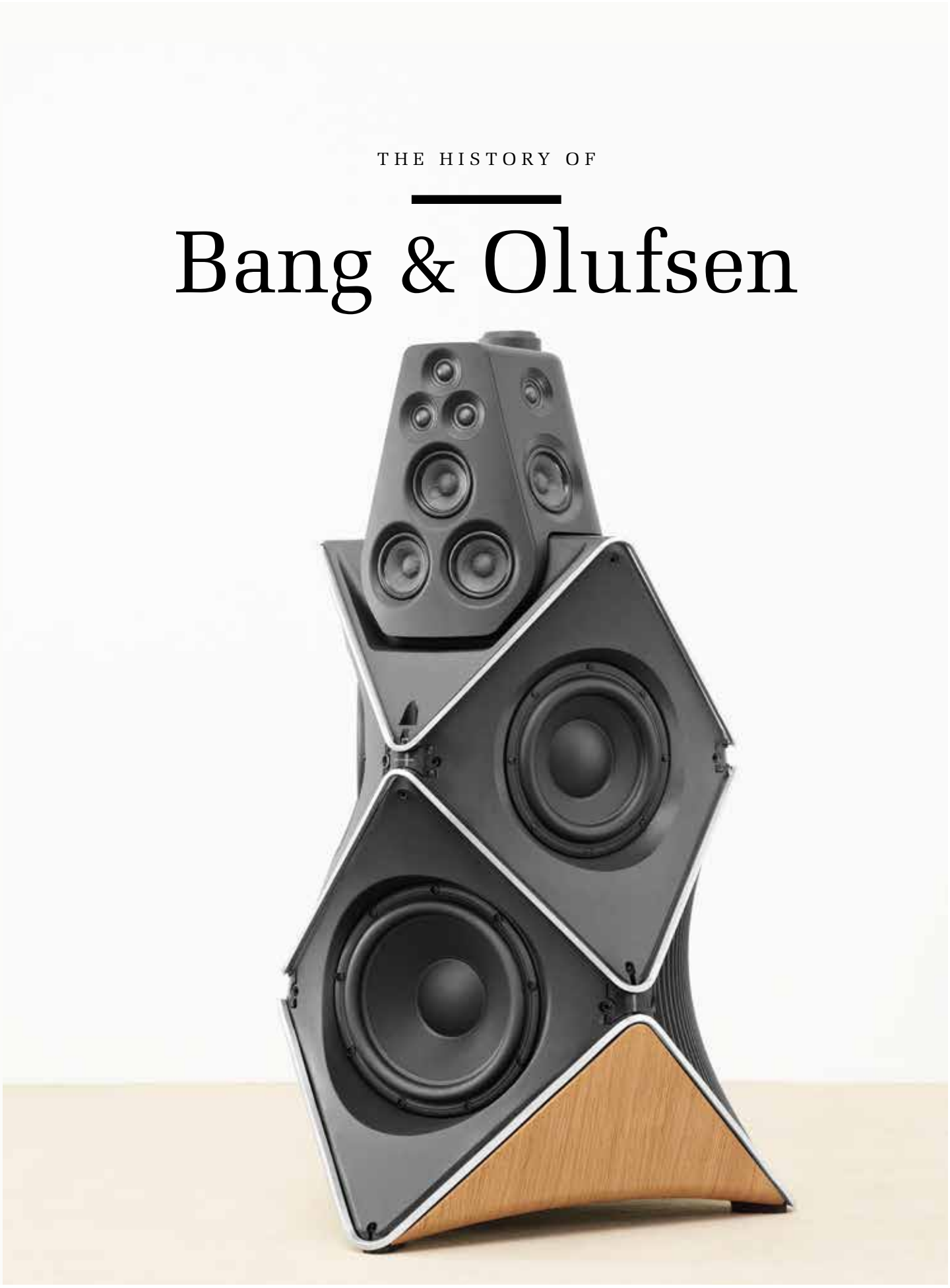
2011
The S 6 evolved into SR 6 (via Si 6). It was soon regarded as a true reference speaker. It has an isobaric bass system in combination with a 2.5 way upper bass/midrange/treble system.

2012
Audiovector active Discreet is introduced. Multiple "green" ultra-high damping factor PWM digital amplifiers with analogue sound driven by DSP derived "electronic" cross-overs with linear phase Bessel filters.

2014
The SR-series is introduced: Audiovector's best performing compact speaker to date. New treble drivers, low loss cross-overs, NES 3-point fixing and multiple colours, are just a few of the highlights.

THE HISTORY OF

Bang & Olufsen



Although B&O loudspeakers are renowned for the visual design, feats of engineering are needed to ensure a matching audio performance. Many challenges have been addressed over the years. Now, active directivity control is close to a reality due to advances in hardware and processing power.

The history

When the history of Bang & Olufsen (B&O) is told, one usually hears of the early days - of Peter Bang's progressive ideas such as his desire to make a device that would eliminate the problem of spilling acid on his clothes when coming home from re-charging the accumulators for his radio experiments - or of his more unique ideas like 'electro-fishing'. Or the story of how some of the company's initial funding came from the 'egg money' from the Olufsen's family farm - or how the young men's fathers insisted that their new radio factory, opened in 1927, to be designed to be convertible into a school as a 'backup plan', since, as was expressed in a newspaper in Copenhagen at the time: "Radio is a fashion trend, a phenomenon, which like spiritualism, jazz, and embezzlement is a consequence of progress."

If the stories are not written about the early history of the company, they are told of visual designers and the icons they have contributed to the company's portfolio. We hear of Henning Moldenhawer's Beomaster 900K radio, Jacob Jensen's 4000 turntable, Steve McGugan's Form 2 headphones, and David Lewis's Beolab 8000 loudspeakers.

Rarely, however, is the story told of Bang & Olufsen's long history of research into and developments in the acoustical behaviour of loudspeakers. Although often classified by audio enthusiasts as 'lifestyle' products (one of the most dismissive and pejorative words in their vocabulary), considerable engineering and experience is required to ensure that the audio performance of B&O loudspeakers are on par with their visual design and construction quality. Two of the largest challenges for the company's acoustical engineers have been the direct result of the size and shape of the loudspeakers.

In order to overcome the effects of a loudspeaker's size on its magnitude response, Bang & Olufsen acoustical engineers realised that the most effective solution was to move to building active loudspeakers with an individual filter and amplification channel for each loudspeaker driver in the system. This allowed them to achieve the maximum potential from the system by using active filtering to compensate for the natural response of a driver (particularly a woofer) in an undersized enclosure.

In order to protect the drivers from excessive excursion or the amplifiers and power supplies from clipping, B&O's Adaptive Bass Linearisation (or ABL) technology was concurrently developed. This custom-tuned dynamic equalisation system ensured that the product's various components stayed within their operating ranges. Of course, in the early models such as the Beosystem 2500, this processing was performed using analogue circuitry. However, this has been replaced by digital signal processing which is used in all current products.

While the constraints imposed by loudspeaker size can be addressed using signal processing (either analogue or digital), the relationship between a loudspeaker's shape and its directivity, power response, and effects associated with diffraction are more physical in nature. However, since the acoustical behaviour of a B&O loudspeaker is designed to meet the needs of a real-world customer rather than a listener with 'one chair and no friends', these aspects are of paramount importance, and have been a primary concern at Bang & Olufsen for more than 50 years.

By the 1950's, it was well-established that a loudspeaker driver's directivity was (at least partially) a function of its diameter and the frequency range in which it was used. Generally speaking, the higher the frequency, the more directional the driver. This 'beaming' resulted in at least two audible and undesirable problems in domestic loudspeakers. The first was the change in the loudspeaker's timbre (or tone colour) when moving off-axis to it. The second was a difference in the magnitude response of the direct sound and the early reflections off nearby surfaces.

Omnidirectional tweeters

In the late 1950s, Erik Rørbæk Madsen, B&O's acoustical engineer, was attempting to reduce the audible difference in dispersion between the low and high frequency bands by developing an omnidirectional tweeter whose dispersion would better-match that of the woofer.

In 1960, B&O released the 'Rondstraler' or 'Rundspreder' tweeter - a construction using two high frequency drivers aimed vertically (one upwards, the other downwards) at conical reflectors separating them. This tweeter was designed to either be placed directly on the main loudspeaker cabinet or to be hung from the ceiling. Rather than aiming the tweeters directly at the listener, the concept was that the primary sound came from the reflected signals which were dispersed in all horizontal directions equally.

Five years after production of the Rondstraler was discontinued, a new loudspeaker system was introduced based on the same intention. The Beovox 5000 loudspeaker could be upgraded with the Beovox 2500 Cube Tweeter, created by acoustical engineer Esben Kokholm, which was another early attempt to produce an omnidirectional high-frequency unit. This was a 95 mm cube with six 50 mm drivers that could, again, be mounted on a stand or hung from the ceiling.

The six drivers, each aimed in a different direction, were driven with the same signal. Although this high-frequency loudspeaker suffered from lobing effects caused by the multiple drivers operating in the same frequency band, the more

Facts

BANG & OLUFSEN

Company name
Bang & Olufsen A/S

Head office
Struer, Denmark

Established in year
1925

Established by
Peter Boas Bang and
Svend Andreas Grøn Olufsen

Main audio product types
Loudspeakers, Headphones, Audio players

Main markets
Worldwide

Number of employees
2000

omnidirectional high frequency dispersion provided an improvement over the Beovox 5000 loudspeakers they were designed to accompany. However, the introduction of wider-dispersion dome tweeters in later products made this concept unnecessary.

Uni-Phase loudspeakers

In May 1977, Erik Bækgaard, a Manager of Electronic Engineering at B&O, published a paper in the Journal of the Audio Engineering Society where he described a solution to one problem associated with second-order crossovers. In a typical (second-order Butterworth) two-way crossover, the two bands are 180º out of phase. To avoid complete cancellation at the crossover frequency where the two signals have identical magnitude, the polarity of the upper frequency band is typically inverted. However, this solution results in a total sum that has an allpass characteristic.

Bækgaard's solution to this problem was to insert a third section to fill in the missing phase component, linking the upper and lower frequency sections and avoiding the necessity for polarity inversion. This section has a first-order bandpass characteristic and was produced by a so-called 'phase link' driver. This corrected the phase response of the entire system and eliminated the allpass characteristic.

The result was an entire range of passive loudspeakers, dubbed the 'Uni-Phase' series, that was produced from 1976 to 1987. As is shown in Bækgaard's paper, his system improved the loudspeakers' responses in the time domain, not only on-axis, but also off-axis in the vertical plane.

Frequency or Power Response?

Since the 1980s, the typical development of a Bang & Olufsen loudspeaker, whether analogue- or DSP-based, has relied heavily on two primary measurements: the on-axis frequency response and the power response (an integration of many frequency response measurements made around a tessellated sphere surrounding the loudspeaker).

These measurements are performed by the project's acoustical engineer in 'The Cube', a 1800 cubic metre pseudo-anechoic chamber at the company's Acoustics Research and Development department in Struer. Two active filters are then created - one to flatten the on-axis response, the other to smooth the power response. These are the starting point for the sound designer who will choose one or the other, or some hybrid of the two, as the beginnings of the final tuning of the loudspeaker.

Through the development of many loudspeakers, both prototypes and commercially-available products, it was increasingly recognised in the Acoustics Department that the power response of a loudspeaker has a larger influence on its final sound design than its on-axis frequency response when intended for a domestic listening environment.

Indications of this were documented as early as 1972 in a research report by Rørbæk Madsen and Henrik Staffeldt - the result of the first Danish government-sponsored research project involving collaboration between industry and a university. This knowledge came to have increasing importance on future products, as is described below.

ARCHIMEDES

In 1983, work began on the development of the Beovox Penta passive loudspeaker. At the time, the literature indicated that a narrow vertical directivity was beneficial to the overall performance of a loudspeaker, however, the belief had not been proven scientifically. Based on this common knowledge, the Penta was designed with a goal to control vertical directivity and was released to market in 1986.

Around the same time, Søren Bech of the Technical University of Denmark (and later, B&O's Director of Research) contacted Villy Hansen at Bang & Olufsen and Laurie Fincham at KEF Electronics in the UK to propose that the three organisations collaborate on a EUREKA research project.

In 1987 the five-year project, nicknamed 'ARCHIMEDES' began, with a goal to evaluate "the influence of individual reflections on the timbre [and spatial aspects] of the sound field produced by a single loudspeaker positioned in a room the size of a normal living room." (Bech, S. (1996). Spatial aspects of reproduced sound in small rooms. Journal of the Acoustical Society of America 103(1), pp. 434-445.). The conclusions from this research showed that strong floor and ceiling reflections had a detrimental effect on the perceived timbre of a loudspeaker. In addition, the results led to well-defined criteria defining the desired vertical directivity of a loudspeaker.

Work then began on the development of a replacement for the Penta. This loudspeaker, internally named 'Højttaler 14' or 'HT14', was to have a vertical directivity that was both controlled and constant (meaning that the directivity should be the same at all frequencies).

The intention was that this would be a fully-active DSP-based loudspeaker using a vertical arrangement of nine loudspeaker drivers in a column-design. (The visual design of HT14 was later re-used for the Beolab 1.) The loudspeaker's vertical directivity was controlled using a symbiotic combination of driver directivity, placement of the loudspeaker drivers and appropriate filters in the DSP. However, this project never came to market as it was cancelled due to complexity and cost.

ALT: Acoustic Lens Technology

In 1996, before the HT14 project ended, Poul Præstgaard, Head of the Acoustics Department, had two important conversations less than a month apart. The first was a phone call from the visual designer, David Lewis, asking that the department start thinking about loudspeaker concepts that would prove to be more of a challenge to design. The second was with an American company called Sausalito Audio Works, whom the Danish acoustical engineer, Jan Voetmann suggested Præstgaard contact. They had developed a reflector called an 'Acoustic Lens' that appeared to offer a wide horizontal directivity with a narrow vertical dispersion.

The idea was to use a device with a vertical cross-section defined by a portion of an ellipse, with the acoustic centre of a vertically-aimed loudspeaker (typically a tweeter) at one focal point. Signals would therefore be reflected off the surface and pass through the second focal point. In order to distribute the signals in the horizontal plane, the shape was rotated to form a semicircular cross section.

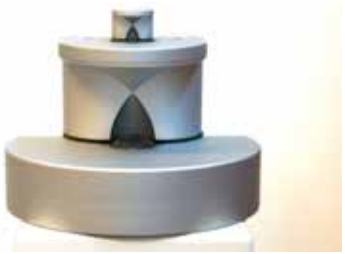


Fig. 1 The second prototype of the Acoustic Lens, which showed that a curved face was necessary to reduce comb filtering effects caused by edge diffraction.

After listening to a lens-equipped loudspeaker at a meeting in Los Angeles, it was decided that the idea had potential, and so development on this concept began with the acoustical engineers in Struer.

After years of simulation, analysis, and evolution of the technology, the result was incorporated into the Beolab 5 (2002-present). This loudspeaker delivered the desired constant directivity in the horizontal plane as can be seen in Figure 2, with a reduced

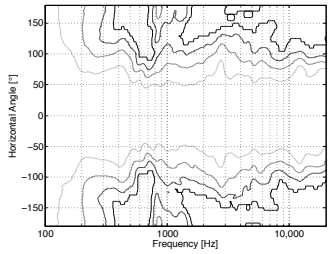


Fig. 2 Directivity of the BeoLab 5. Contours are in steps of 3 dB related to the on-axis response.

dispersion in the vertical plane.

In addition to the specific horizontal and vertical directivity characteristics, the Beolab 5 also proved to have a combination of a flatter on-axis magnitude response and smoother power response than was previously seen in B&O loudspeakers. As was mentioned above, the initial filters applied to a prototype loudspeaker under development are the direct result of acoustical measurements.

Following this, the loudspeaker undergoes an extensive sound design process where additional filters are applied based on listening to a wide range of recordings in various listening rooms. The final result is then measured once again in The Cube in order to define the master reference specification of the loudspeaker before the start of production.

The final on-axis magnitude and power responses of the Beolab 5, seen in Figure 3, show that a smooth power response proved to be more important than a flat on-axis response. This result did not come as a surprise to the development team, since it was a trend that was seen in the development and tuning of previous B&O loudspeakers.

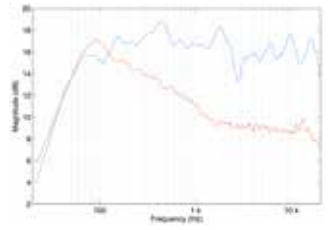


Fig. 3 On-axis frequency response (blue) and power response (red curve) of the BeoLab 5.

The 'Sharkfin' Experiment

At the end of the ARCHIMEDES project, Gert Munch (the acoustical engineer on the Beolab 5 project) had an idea of building an active loudspeaker capable of simultaneously delivering both a flat magnitude response on-axis and a smooth power response. The basic concept was (for example) that a 'classic' two-way loudspeaker construction be used with active filtering to deliver the desired on-axis response.

An additional dipole assembly aimed 90º away from the on-axis direction would then sit either on top of the loudspeaker (hence the nickname the 'Sharkfin') or horizontally-mounted on its back. Either positioning would place the null of the dipole in line with the front of the 'main' loudspeaker. The signal from this dipole could then be used to alter the power response of the system without having an influence on the on-axis response of the total system.

Fig. 4 The "Sharkfin" experimental loudspeaker with a top-mounted dipole made with back-to-back drivers.

This concept was finally built and tested in late 2012. Measurements in The Cube indicated that the concept performed as predicted in a free field, and so an extended listening session was undertaken. The outcome of this experiment indicated that (in a 2-channel stereo configuration), when changing the contribution of the dipoles, there was an audible effect - not only on the timbral impression of the loudspeakers but also on the spatial presentation of the recordings.

Phantom images changed both in perceived width and distance, and envelopment (when it existed in the recording) was also altered, particularly when the loudspeakers were closer to a reflecting surface. This was due to the fact that, although the dipole's null was aimed at the listening position, it provided an audible (but unwanted) contribution to the early reflections from sidewalls. This was particularly noticeable in a symmetrical stereo configuration when the dipoles faced in similar directions, increasing the phase difference of the lateral reflections, and therefore giving an artificial sense of spaciousness, even in monophonic recordings.

These artefacts led to abandoning the original 'pure' concept of the 'Sharkfin', but starting a new loudspeaker concept with a variable (or at least selectable) directivity that would give a customer the opportunity to determine the horizontal beam width and thus the balance of direct-to-reflected sound in the listening room.

By that time, Munch and Jakob Dyreby had already been collaborating on a research project with two graduate students at DTU, Martin Møller and Martin Olsen (both of whom started working at B&O after they graduated). They, together with Finn Agerkvist, an associate professor at DTU, presented a scientific paper at a convention of the Audio Engineering Society in 2010 called "Circular Loudspeaker Arrays with Controllable Directivity".

In this publication, they showed how a cylindrical enclosure containing 24 small loudspeaker drivers, each with its own amplifier and individualised DSP, could be used to steer a beam of sound in any direction in the horizontal plane with an arbitrary and controlled directivity, with the purpose of creating different individual 'sound zones' within a single listening area.

This study proved that it is possible to create a loudspeaker that could, using different filters in DSP, range from a narrow directivity (similar to commercially-available dipole- or cardioid-pattern loudspeakers) through to a full horizontal omnidirectional dispersion. Consequently, it was then used as the basis of development on a commercial product with similar capabilities.

Beolab 90: Beam Width Control

This first prototype of the new loudspeaker, internally code-named 'Speaker 40' or 'S40', was devised as a scaled-down version of the barrel loudspeaker used in Møller and Olsen's experiments. It had a hexagonal arrangement of tweeters and midranges and a square arrangement of woofers as can be seen in Figure 5. Each driver was to have its own amplification and DSP with customised filters to correct its time- and frequency-domain charac-

Fig. 5 S40: prototype 1

teristics, in addition to applying directivity control. Unfortunately, this version was not a success due to the fact that the drivers were simply too far apart to result in an acceptably constant directivity.

The aim of the second prototype, shown in Figure 6 was to abandon the steerable beam concept and concentrate on making an extremely narrow and constant horizontal directivity. The resulting loudspeaker was well-suited to solitary, active listening, as its spatial presentation of recordings was remarkable. However, it was decided that this would not make an appropriate product for Bang & Olufsen due to its focus on a single listening position.

Consequently, the aim for the third prototype was to create a hybrid between the first two - a loudspeaker with the capability of making forward-facing beam with an adjustable horizontal directivity (now called 'Beam Width Control'), but also the option to change the primary direction of the beam in a wider directivity to one of a small number of directions (or 'Beam Direction Control').

The result, shown in Figure 7, was a forward-facing cluster of 3 tweeters and 3 midranges, giving the possibility of creating a narrow horizontal directivity. In addition, the side, and rear-facing drivers from Prototype 1 were incorporated to be able to steer the sound beam in either of 4 directions.

The configuration of Prototype 3 was almost identical to the final production model. The only difference was that the single rear-facing midrange and tweeter were replaced by two of each, giving the possibility of a left-back and right-back Beam Direction.

The end result is a loudspeaker that can be different loudspeakers for different customers - or can fill different roles in one customer's home. In narrow-front mode, the Beolab 90 can meet the needs of the most demanding audiophile. However, its other modes (selectable using the included application or automated by audio sources) make the Beolab 90 an extremely adaptable loudspeaker. At the same time, it fulfils the targets set at B&O over 50 years ago - to make a full-range loudspeaker with a constant directivity that fits seamlessly into the customers' homes and lives.

Fig. 6 S40 prototype 2. The loudspeaker included one rear-facing midrange, tweeter and supertweeter.

Fig. 7 S40 prototype 3 and the first pre-production BeoLab 90.

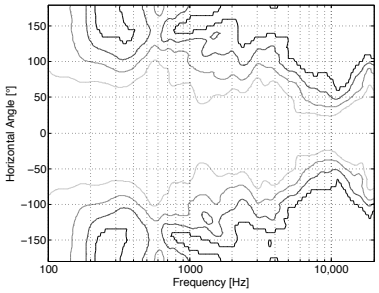


Fig. 8 Directivity of the BeoLab 90 with Beam Width Control disabled (only the front-centre woofer, midrange and tweeter operational). Contours are in steps of 3 dB related to the on-axis response.

Timeline

1925
Company created

1960 - 1962
The Rondstraler Tweeter (1960-1962) showing the two loudspeaker drivers and reflectors with the grille removed. The intention of this design was to provide an omnidirectional directivity in the horizontal plane to better match the behaviour of the low-frequency section.

1967 - 1971
Beovox 2500 Tweeter (1967-1971) - another attempt to deliver an omnidirectional high-frequency dispersion, this time in three dimensions. Each face of the cube contains a 50 mm tweeter, all six of which are driven with the same signal.

1976 - 1987
Beovox 120.2 (1983-1988) - one of the many 'Uni-Phase' loudspeakers with a woofer, tweeter and 'phase link' driver.

1978 - 2003
The Beovox CX-series passive loudspeaker. When sales of these ended in 2005, over 570,000 had been produced.

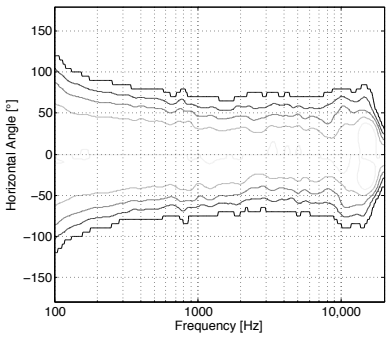


Fig. 9 Directivity of the BeoLab 90 in Narrow-Front mode. Contours are in steps of 3 dB related to the on-axis response.

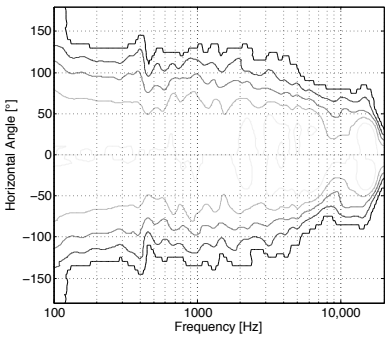
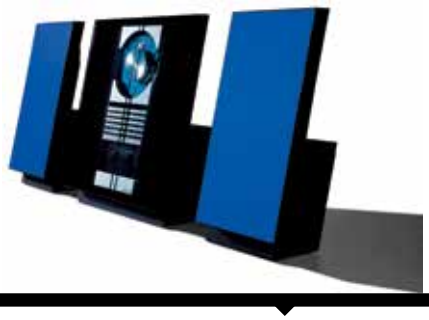


Fig. 10 Directivity of the BeoLab 90 in Wide-Front mode. Contours are in steps of 3 dB related to the on-axis response.

Future focus

Although Beolab 90 is the latest in Bang & Olufsen's quest to define the directivity of its loudspeakers, it is only the beginning of putting control of that directivity in the hands of the customers. It has been possible to personalise the tonal balance of sound systems for decades - even if only with simple controls such as Bass and Treble knobs. However, we are entering an era where the spatial behaviour of the loudspeaker can also be optimised to suit not only the listener's living space, but also his or her preferences and situations. The result will be loudspeakers that can not only adapt from space to space for different customers, but can be easily switched from performing as an 'audiophile' loudspeaker for active, critical listening by one person to a party loudspeaker, or anything in between. ■

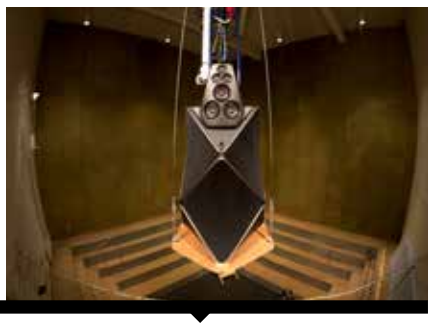


1986 - 1989
The Beolab Penta (1986-1989) was Bang & Olufsen's first loudspeaker with a built-in amplifier. However, it was not strictly speaking, an active loudspeaker, since the crossover was placed in the signal chain after the amplification stage.

1991 - 1993
The Beosystem 2500 with the Beolab 2500 loudspeakers - B&O's first fully-active loudspeakers. These loudspeakers marked a leap in sound quality for small enclosures due to the equalisation and ABL processing ahead of the amplification stages.

1992 - 2010
The Beolab 8000-series loudspeaker (1992-2010). One of Bang & Olufsen's visual design icons, echoed by its successor, the Beolab 18 (2013-present).

2002 - present
The Beolab 5 - Bang & Olufsen's flagship loudspeaker from 2002 until 2015. It was the first loudspeaker in the portfolio with the Acoustics Lens Technology and the ABC room compensation system.



2015
An early production sample of Beolab 90 undergoing acoustic measurements in The Cube.

THE HISTORY OF

Clint

The Clint brand is named after the famous Danish rock formation, Møns Klint – a type of rock formation which is very solid, but also pure and strong. From the very beginning, Clint's number one priority is to create innovative, well-designed and affordable audio products.

The history

The story of Clint goes back 21 years. It begins in 1994, when three friends and entrepreneurs (Jesper P. Christiansen, Preben Hansen and Brian Larsen) start the company HCL Europe A/S, importing consumer electronics from the Far East. The importing slowly evolves into OEM/ODM production, including a wide range of AV products, and a wide range of brands.

To start with, the main customers are Danish and Scandinavian supermarkets, AV resellers and chain stores. In the years that follow, sales expand to the Netherlands, Spain, Portugal and Germany as well. The product range includes various AV products, and each product is developed and produced to meet the demand for devices for the fast-growing digitisation of audio and video broadcasting.

The Clint brand is born

In the year 2008, the Clint brand is born. At this time the company is known as ViewMedia ApS, and it has just a few DAB radios in its portfolio, but the team behind the company has an amazing knowledge of the radio industry, as well as the different technologies used for radio production. All team members are well-established entrepreneurs in the field of digital audio and video, and they are among the pioneers of digital radio products (DAB/DAB+/Internet radios) in northern Europe.

The basis and key foundation of the Clint brand at this time, as it will remain to the present day, is to provide well-designed and well-engineered high quality products. At the outset, the company works mainly with OEM products from southeast Asia, but co-founder Brian Larsen and his colleagues want to change this. They want to start creating all their products from scratch, including design, development and manufacturing. The ambition is to handle all design and R&D functions in-house, with the manufacturing process closely monitored to ensure that the company's high quality standards are met.

And so the journey begins for the Clint brand. The brand is named after a very famous Danish rock formation, Møns Klint – a type of rock formation which is very solid, but also pure and strong. Exactly what the Clint brand, and the Clint products, should be associated with! Even the colour of the rock formation, chalky matt white, is used for all the white speakers in the Clint product range.

Production

One of the main priorities now is to find the right manufacturing partner. Since the company has been working with overseas manufacturers for more than a decade, this is expected to be an easy task. However, this is not entirely the case. Searching for a manufacturer to produce products that the company itself has developed and designed turns out to be a much more complicated task than just making OEM products. After a lot of hard work, and many factory visits and negotiations, the company finally finds the right manufacturing partner. An agreement is signed for the production of Clint products.

The technology

The team behind Clint have worked with radios and speakers, one way or another, for their entire professional lives. They know about the radio market, the technology that is used, and they have reliable and solid sales channels. Nonetheless, times change and the technology keeps developing. The team become aware of the new possibilities offered by music services. Apple introduces iTunes, and everybody can buy exactly the songs they like. Spotify launches a music streaming service, enabling people to listen to music via subscription. The radio media are very strong at this time, but CD distribution is slowing down massively, indicating a threat to a very large part of the existing Clint product line-up.

During the search for a manufacturing partner, the Clint team has discovered new technology concepts, based on products allowing users to play their purchased music from a smartphone, or other wireless device, to a personal speaker or a sound system. This is a very interesting discovery, and new technologies including wireless and streaming capabilities become an

Facts

Clint®

Company name
Clint Digital ApS

Head office
Ballerup, Denmark

Established in year
1994

Established by
Jesper P. Christiansen, Preben Hansen and Brian Larsen

Main audio product types
Streaming & Digital Audio

Main markets
Northern Europe

Number of employees
5-10

important part of the Clint product strategy. At this time, multi-room is also an upcoming new technology, so far only used by one other company in the world (an American company). But the Clint guys rapidly adopt the idea of developing the multi-room technology into a range of speakers.

The design vision
One of the most important brand features for Clint is "uniqueness". All Clint products have to be unique, easy to use, and, of course, good looking – preferably Scandinavian looking. Therefore, in 2012, the need for an in-house designer becomes evident. All employees are asked to reach out to their networks in the quest for the perfect candidate. One of the candidates is a young man named Phillip Bodum, who is working as an industrial designer in New York. He has a lot of experience with the design of furniture, interiors and graphics, but he has never designed electronic devices before. However, the Clint team decides that a partnership with Phillip is a good idea and, for the first time in the company's history, an in-house designer is hired. A decision which will soon prove to be just the right one.

A new beginning with EET Europarts
By 2013, ViewMedia ApS has developed a range of operator approved set-top boxes for the DVB TV market, together with a range of DAB/DAB+ radios, Internet radios and other products for the audio market. The company is also ready to launch a completely new line-up of streaming and multi-room products. However, the company needs an economic boost to move forward. So, at the beginning of 2013, ViewMedia ApS enters into a partnership with EET Europarts. The ViewMedia company is acquired by EET Europarts, and the ViewMedia activities are placed in a separate business entity, called Clint Digital. The acquisition provides the right springboard for launching the very exciting new Clint product range.

On the right track – and ready to introduce Asgard™
The new partnership provides the perfect economic and business environment, including a back-end organisation that allows the Clint team to concentrate on product development and the market launch of the latest Clint products – the all-new wireless and multi-room speaker range, dubbed Asgard™.

All the Asgard™ products are named after the Nordic gods, and they all have a special story to tell. Speakers and other electronic devices are part of people's everyday lives, and of their home décor, so the Clint team want to bring them to life.

Phillip Bodum is a graduate from Parsons School of Design in New York where he still lives and works. As his roots are from Denmark he has a strong dedication to details, materials and functionality.

The Asgard™ range, 2014
FREYA
The first product is FREYA. To begin with, FREYA is a simple, elegantly designed portable Bluetooth speaker. Small, easy to use, lightweight, and with good sound. FREYA is later upgraded to a Wi-Fi version, with full multi-room capabilities as well.

ODIN
The second product is the ODIN speaker. ODIN is a much larger speaker unit with more power. ODIN has the same characteristics as FREYA, with matching materials, colours and user-friendliness.

HEIMDALL
The third product is HEIMDALL. HEIMDALL packs a lot of features into one small unit, and is intended for customers with existing stereo systems. Using this small but powerful device enables the stereo system to harness all the new features, such as music streaming, multi-room functionality, Internet radio and streaming from local services. It simply upgrades the old hi-fi system to the new digital era.

THE CLINT APP: All of the products in the Asgard™ range connect to the same multi-room feature. To use this feature, the Clint app needs to be installed on a smart device. The app is available free of charge and gives customers a powerful tool to set up and control, via a smart device, all the speakers they have in their home or office. The Clint app is designed and developed in-house, just like the Clint audio products, so that users will experience the best possible performance with minimal hassle.

Digital convenience
Clint Digital focuses on the development of new products in the Asgard™ range, to meet all the needs of a digital home. Therefore, the team also designs and creates portable units which can be used both indoors and outdoors. The product line-up includes speakers of various sizes, to fill any room in a home or office with great music. Wall mounts and floor stands are also part of the range, to enhance the performance as well as add flexibility when it comes to placement of the speakers.

For Clint Digital, as an innovative and forward-thinking company, this is what matters most. The product range is focused on design and functionality.

Clint Digital thrives by creating products that include state-of-the-art technology, sophisticated design, a variety of colours and a high degree of user-friendliness. Furthermore, the products need to be affordable for everyone.

Clint Digital is a company with incredible potential. The team behind the Clint brand and products have been honoured with several international awards for design and functionality. Recognition like this is what drives the development of the company, the brand and the products.

Iconic products

New form factor

FREYA
FREYA is the first product launched in the Clint Asgard™ range in 2014. A small, portable speaker that can be placed anywhere. The design is spectacular with its cylindrical form factor and aluminium cabinet. When it is designed, it is one of the first speakers with a cylindrical form factor, since at this time all speakers are more or less square wooden or plastic boxes.

The FREYA speaker receives an IF design Award in 2015 as well as a RedDot Award in 2015.

ODIN
ODIN is the second product launched in the Asgard™ range. ODIN is a generously proportioned, powerful stereo speaker, best kept on the floor. ODIN also has an optional aluminium stand, which raises it 5 cm above the ground and angles it 8° for an optimal sound experience.

The ODIN speaker receives an IF design Award in 2015 as well as a RedDot Award in 2015.

Cutting-edge technology

World's first combined DAB+/Internet radio
The company behind the Clint brand is the first in the world to launch a combined DAB+/Internet radio. The radio is launched in 1997, and is called H1601. The H1601 model is the company's own design and it becomes a very successful product in Scandinavia.

In the UK, too, the company is the first to launch a radio with combined technologies such as traditional FM and the new DAB (Digital Audio Broadcasting) digital platform, plus Internet radio, giving access to more than 10,000 radio stations worldwide.

The company produces the H1601 as its own-brand model, and also launches various OEM versions for a range of customers around the world.

Top of the line all-in-one complete FM/DAB/Internet/CD/DVD/docking station for iPod/iPhone
In 2002 the company introduces its H1510 model. This is a large hi-fi system in a tall glossy wooden cabinet with external speakers. The system includes all the details and specifications needed for a high-end modern hi-fi system. It includes FM/DAB/Internet/CD/DVD as well as a docking station for iPod/iPhone, and offers great sound performance.

Brilliant adapter for upgrading existing hi-fi systems
The model named H2001 is introduced in 2006. The H2001 is an adapter for upgrading existing hi-fi systems to the latest digital audio and DLNA streaming. This model is successfully launched as an OEM product for multiple customers in Germany, the US and Scandinavia. This model continues to sell very successfully today, with minor design changes and with updated firmware – but the key features are still the same.

Very early adopter of music streaming technology
At a very early stage, Clint products feature music streaming technologies, including the implementation of streaming access from local devices and local servers. Later, the new and popular music services like Spotify, Tidal, Deezer, etc., are added to the products.

Advanced integration of multi-room technology
The Clint company is among the front-runners in the industry with regard to the spreading of multi-room technology. The company focuses especially on fine-tuning of the technology, making sure no delays occur in the music distribution from speaker to speaker, and making sure the handling of multi-room technology is smooth, easy and convenient, with a user-friendly, intuitive interface application to control the speakers.

Future focus

From the very beginning, Clint Digital's number one priority is to create innovative, well-designed and affordable audio products. This remains the top priority for the company going forward.

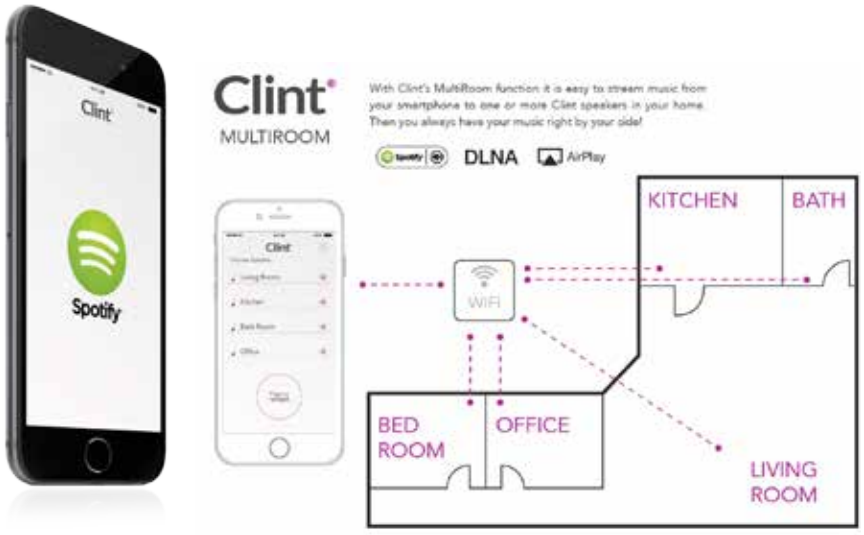
The Clint Asgard™ range will be further developed, and many new products within the Asgard™ multi-room concept will be brought onto the market in the near future. A multi-room setup means that customers have a wide variety of choices for installing a great sound system in their homes. Having specific speakers for specific rooms improves overall flexibility and the enjoyment of music.

The Asgard™ application will be further developed, with new features and a new design and interface, keeping in mind that ease-of-use in navigation and stability in use are some of the key issues for customers.

In the Clint radio line-up, new products will be launched – featuring new designs, new colours and new functionalities. Clint's employees are especially passionate about radios, since this product category is an important part of the company's heritage.

Clint is strongly focused on the digitisation of audio and video products, and in the future the company will focus on the development of products within the categories of wireless speakers, digital radios and streaming devices.

Emphasis will also be placed on product categories like in-car entertainment and the merging of SmartHouse and IoT systems. ■



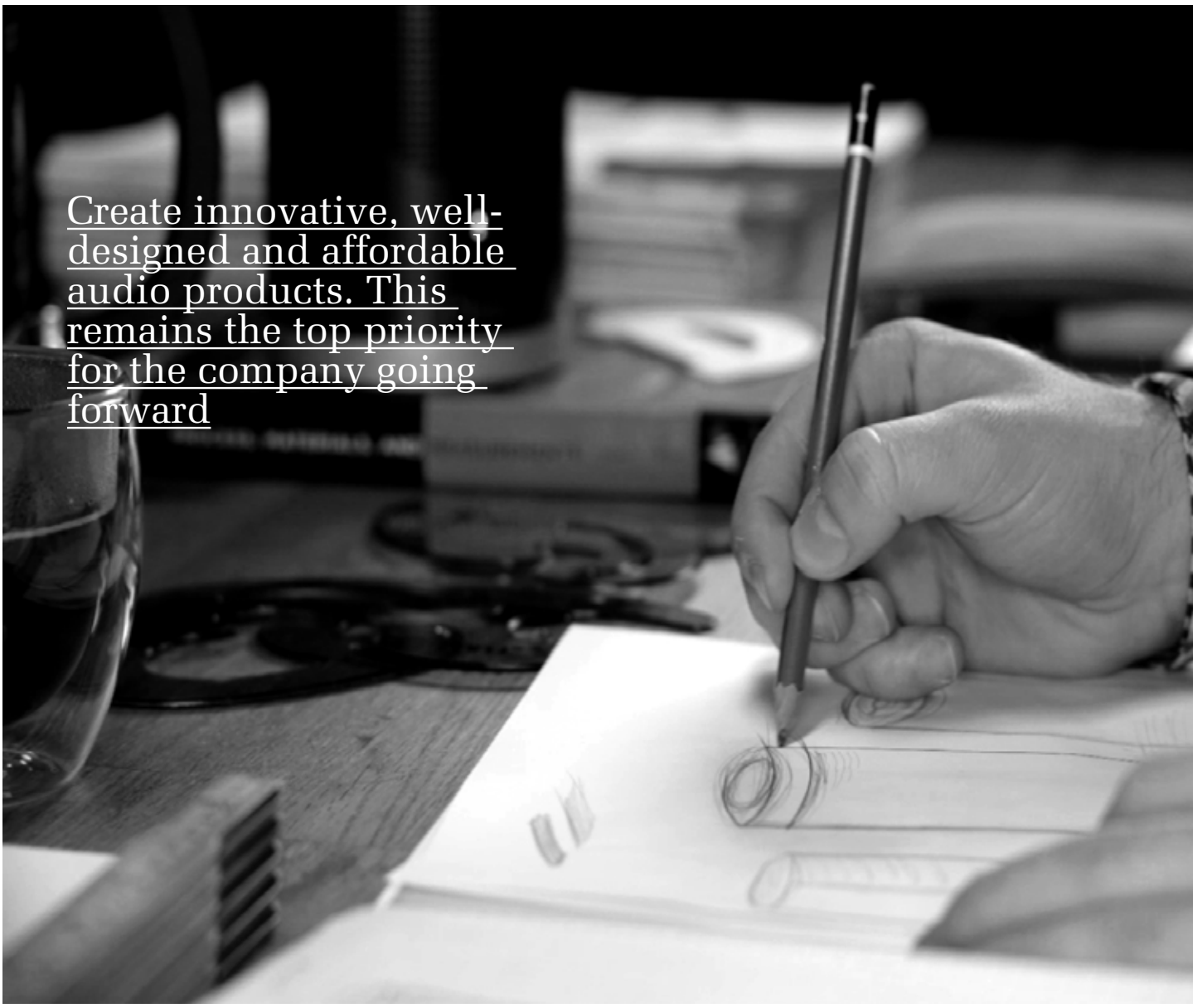
Timeline

1997
First tabletop combo radio with DAB/FM/Internet and DLNA. Hits the UK market first and then Germany and the Nordics.

1999
Upgraded stereo versions added to the product range.

2000
New portable product range.

2002
Combo stereo system including all known technologies enters the market with launch in the Netherlands to begin with.



Create innovative, well-designed and affordable audio products. This remains the top priority for the company going forward

2008
Upgraded compact stereo system is launched in Switzerland.

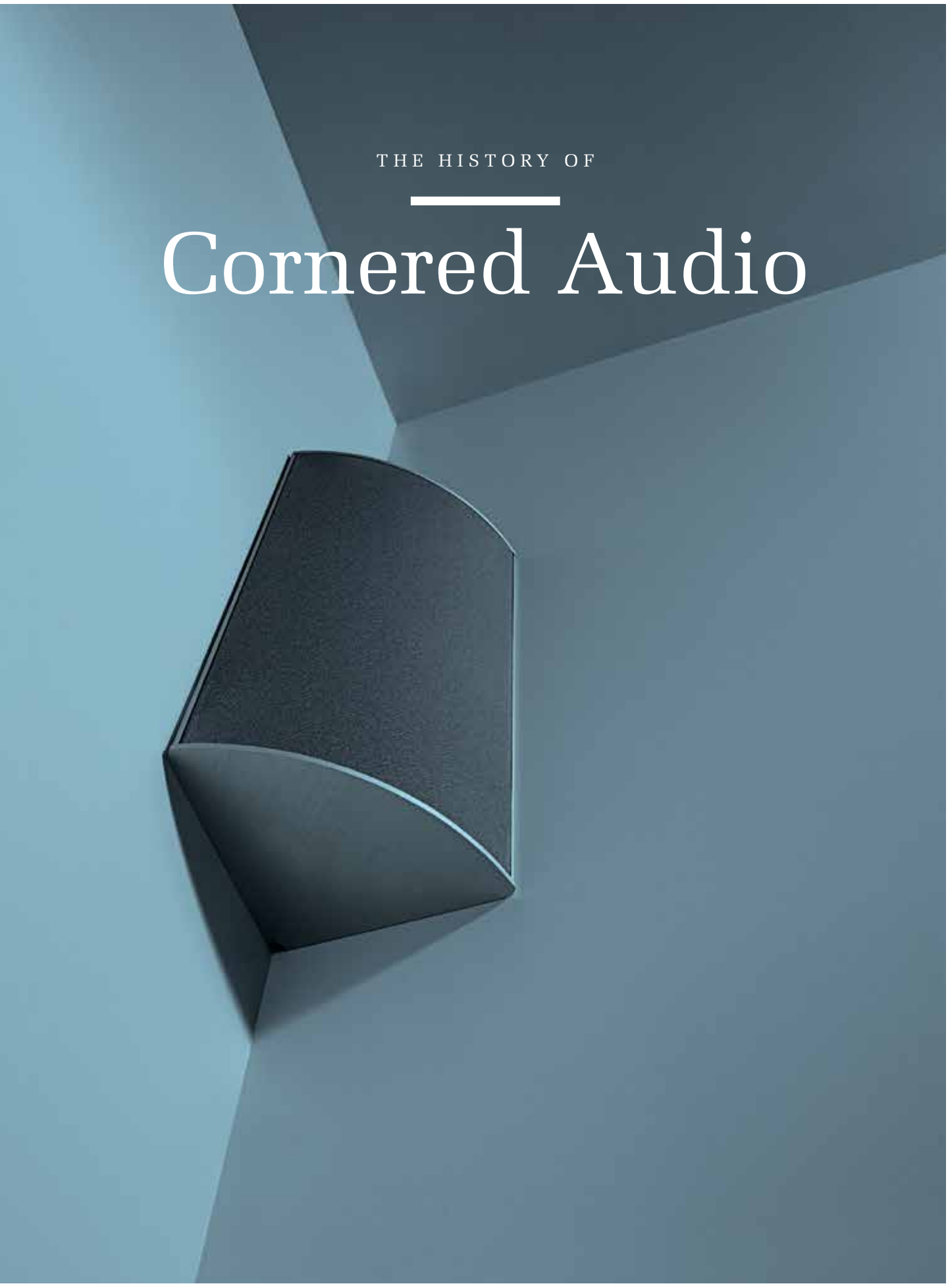
2013
First new Asgard™ speaker designed by Phillip Bodum comes to life. Speaker is named FREYA after the Nordic goddess.

2014
New FREYA WIFI speaker with full multi-room features and with battery support is launched.

2015
ODIN - the large wireless stereo speaker in the Asgard™ range is launched. And the hi-fi adapter HEIMDALL is introduced at the IFA show in Berlin.

THE HISTORY OF

Cornered Audio



Established in 2010, Cornered Audio ApS creates high performance loudspeakers for modern homes, commercial installations and entertainment venues.

The history

Founder Hans V. Madsen has more than 30 years of experience from the audio industry in both the consumer and professional segments.

"No matter where I went on the planet, customers asked for discreet loudspeakers. Tables, chairs, sofas, shelfs. Everything can be visible, but for some mysterious reason, speakers must be hidden away. One very late evening, listening to music and being in an almost meditative state, the Cornered design appeared for my inner eye. The next day I decided to stop working against the trend towards discrete speakers, but to work with it. I then formulated the Cornered Vision: 'To create a discreet loudspeaker system that would integrate well into homes and commercial installations while delivering unexcelled performance'," says Hans V. Madsen.

Vision

"The idea behind Cornered is simple and powerful; we design our speakers to be placed in corners or on walls and ceilings without steeling the picture. And we use the corner to increase output and create uniform coverage throughout the room. We brand ourselves by the term 'Aesthetic Sound' as our products are pleasing to the eyes as well as the ears," says Hans V. Madsen.

Design

The patented design is classic Danish and minimalistic, blending form and function. With a 90 degree triangular shape, the cabinets fit perfectly in corners – either vertically on the wall or horizontally below the ceiling. The front is slightly curved and the cloth covered grill mounts with neo magnets so it can easily be removed and allow access to cable terminal and mounting points. Mounting points are an integrated part of the design and allows the speakers to mount flush on wall and ceilings without brackets. The cable terminal is hidden behind the grill and cable is run from the rear of the cabinet through a port to the front baffle, so there is no visible cable no matter if the speaker is installed vertically or horizontally.

Two cabinets can be mounted together, working as a bi- or dipole speaker in home cinema applications. And in professional applications, two cabinets can be coupled

Facts

CORNERED AUDIO

Company name
Cornered Audio ApS

Head office
Albertslund, Denmark

Established in year
2010

Established by
Hans V. Madsen

Main audio product types
Loudspeaker systems

Main markets
Scandinavia, UK, France, Italy, China, Korea Australia, South Africa

Number of employees
4

together to widen coverage to 180 degree. Three cabinets can be coupled together to cover a 270 degree corner and four boxes can be coupled together and flown from the ceiling offering 360 degree dispersion.

With the discreet design, music and movie lovers are enabled to install a powerful multi-channel speaker system in their home without making the living room look like a sound studio. And professional installers can install serious sound systems in meeting rooms, shops, and lounges without getting in bad standing with architects and interior designers.

Iconic products

The iconic C5 model hit the market by summer 2010. It received excellent reviews. German AREA DVD called it 'outstanding', Hi-Fi Test gave it strong recommendation in the category 'oberklasse' and in Hungary, AV Online stated "…they acted almost like studio monitors".

In 2011 the C5 was installed in Danish rebel movie producer Zentropa's VIP Screening room in Berlin. And later same year, Zentropa's founder Peter Aalbæk installed a 5.1 C5 system in his home with the new C12PNC subwoofer from Cornered – a subwoofer designed as a puff appearing as a leather seat. In 2012, Cornered was established in 10 countries and exports exceeded 90 % of the turnover already in year one. Over the next years, the smaller C3 and C4 was introduced and Zentropa now also installed C4 in their VIP screening rooms in the Danish operation 'filmbyen'.

C4 back to back without grills at "Boards and Sports" in Istanbul, Turkey.

Later in 2012, the larger C6 and C6TRM models were introduced and shortly after, the largest Turkish television company Digiturk installed C6TRM and C12PNC's in all their VIP movie screening rooms. Today Cornered's speakers are sold in more than 40 countries. The customer list includes prestigious customers such as Louis Vuitton with five shop installations in France, the iconic five star Hotel D'Angleterre in Copenhagen, the five star Hotel W in Bangkok, Sunglass Hut in Mexico with 50 shop installed to mention just a few customers.

In 2013, Cornered Audio took out a design patent on a triangular speaker cable, designed as a support product for the triangular speakers. The cable is of course designed to run in the corner and is a great solution for places where it is not possible to run the cable in or behind the wall – or as a retro fit cable solution in existing installations where the cable is run on the wall.

In 2014 full polar plots were measured for all products and EASE data was made available for professional installers, enabling them to simulate sound pressure and coverage in any given room.

In 2015 the LS1 – an 'Aesthetic Line Source model' was launched at the ISE Show in Amsterdam. LS1 features closely spaced dual horn tweeters and is flown in a straight line with a maximum of six speakers. Such a configuration delivers 104 dB in 30 meters with hi-fi like clarity and very uniform coverage. There is no visible flying gear from the front and the solution is an aesthetic approach to professional sound reinforcement in high reverb venues.

Cutting-edge technology

Technically Cornered Audio takes pride in making a true audiophile product with excellent clarity, dynamics, and sound pressure. Designs feature the use of loudspeaker components from leading European brands and R&D is made by a pool of world-class Danish acoustic engineers. Air coils and polypropylene capacitors are used in the crossovers and to ensure ruggedness and exceptional reliability, everything is on the brink of being over-engineered.

An advanced slave woofer design is developed to adapt the bass response to the boost from the corner, so that the corner is used not to create a bass boost, but to increase the overall sensitivity and output of the speaker. So the speakers sound like 'normal' speakers, but can be neatly hidden away in the corners. All tweeters are designed with waveguides that optimise dispersion at the crossover point and creates seamless integration with the woofers.

Positioning the speakers in corners places high demands on the off-axis response from the speaker. To ensure that the off-axis response is uniform and controlled, full polar plots of all Cornered Audio speakers are measured – a process involving more than 10,000 computerised measurements per speaker. The data enables Cornered to offer EASE data to professional installers so that they can simulate sound pressure, coverage, and speech intelligibility in any given room.

An advanced slave woofer design is developed to adapt the bass response to the boost from the corner, so that the corner is used not to create a bass boost, but to increase the overall sensitivity and output of the speaker.

Room Integration
When controlling the off-axis response and optimizing the speaker acoustically for placement in corners, the speakers becomes surprisingly non-room dependent. The reason is that the first reflection – to which the ear is very sensitive – comes right after the sound leaves the speaker, so there is not enough time for the brain to enable it to perceive the first reflection. The second reflection comes very late as the sound has to travel through the entire room, so there is minimum negative influence from the second reflection.

In addition, as the speaker is angled 45 degrees away from the side walls, there is a minimum of comb filtering from the walls. The combined result is maximising the amount of direct sound in the listening position and minimising the amount of reflected sound. Because of that, Cornered speakers excel in clarity and are capable of reproducing a natural three-dimensional sound stage, filling the entire room with sound.

A combination of aluminium cabinets and MDF baffles makes the speakers compact while still sounding as a wooden cabinet. The triangular shape minimises standing waves from inside the cabinet, adding to the clarity of the sound. Strong focus is placed on low group delay, uniform phase, and frequency response as well as high minimum impedance to enable the speakers to get the most out of the amplifiers. The sound is forward and Cornered speakers engage the listener with dynamics, emotions, and great speech intelligibility – so you will actually be able to hear the lyrics.

The aluminium cabinet helps to cool the components so the speakers maintain perfect performance for hours even when pushed hard. In the TRM models, power compression is less than 1.5 dB after an 8 hour IEC power test.

Cornered speakers are not confined to corners. They also mount flush on walls and ceilings without brackets.

Future focus

The current product range offers products for smaller living rooms and shops up to large living rooms and medium SPL clubs and lounges. Cornered will widen the product range to include triangular installable subwoofers, wireless installable stand-alone models, and weatherproof models for outdoor use.

The brand name Cornered describes the core of the company: Designing speakers for corners. However, the speakers also mounts on walls or ceilings – so they are not confined to corners - and in the very near future, Cornered will evolve into the pro segment of the market with an aesthetic solution to large scale PA systems including in- and outdoor line array speakers and club solutions.

Cornered Audio gives customers yet another option to install speakers discreetly and aim at impressing customers and fellow music lovers with aesthetic sound. ■

Timeline

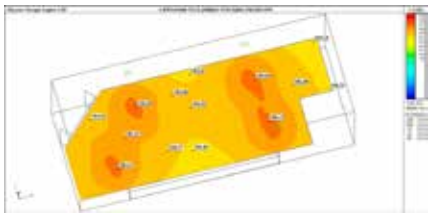
2010
Cornered Audio ApS is established and launches the iconic C5 model receiving excellent reviews from European AV magazines.

2011
The C12PNC subwoofer is launched – designed as a puff because there is never room for a subwoofer but always room for a seat.

2012
The smaller C3 and C4 models were launched and late in the 2012, the larger C6 and C6TRM models were introduced as well.

2012
Cornered C6TRM and C12 subs are installed in Digiturk's VIP screaning rooms.

The triangular shape minimises standing waves from inside the cabinet, adding to the clarity of the sound.



2013
First Louis Vuitton installation in Courchevel 1850 in the French Alps, followed by installations at LV Soings, Deauville and others.

2014
EASE Data provided for all models allowing professional installers to simulate sound pressure, coverage and speech intelligibility in any given room.

2014
Iconic 5 star hotel Hotel D'Angleterre choses C6TRM and C12 in their Champaign Bar Balthazar.

2015
Launch of the LS1 Line Source model launched at the ICE Show in Amsterdam.

THE HISTORY OF

DALI

In a low-density industrial neighbourhood in Nørager, close to Hobro in Northern Jutland, Denmark, lies the headquarters of one on the best-known loudspeaker brands worldwide, DALI.

The history

In the sprawling, squat buildings the design, manufacturing, and assembly of DALI speakers is carried out by a staff of 100 specialists from all trades. And they design nearly everything by themselves. Even the mounting screws for the speaker units.

DALI was officially instated 30 years ago, in 1985. But the actual beginning was two years earlier, in 1983. At that time the newly-founded chain of hi-fi stores 'Danmarks Hi-Fi Klub' (today just 'Hi-Fi Klubben') was having a huge success selling stereo components from NAD and Denon at affordable prices. But which speakers should they recommend to go along with the amplifiers, turntables and cassette players? The stores were already selling lots of Cerwin-Vega loudspeakers, but they were huge, costly and mostly suited for hard-hitting music genres.

Built NAD speakers in the boss' cellar

To fill the gap in the product range, Danmarks Hi-Fi Klub began designing and making NAD-branded loudspeakers. In spite of the name, it was purely a Danish product. NAD had never made loudspeakers, and the models were only made for the Danish market.

Product development and partly production initially took place in the cellar of Hi-Fi Klubben's founder Peter Lyngdorf's house. Later manufacturing facilities were rented in various places in the small towns of Skanderborg and Ry, close to where Peter Lyngdorf lived.

Speakers for pocket money

After two years of selling NAD speakers to customers, the brand DALI (Danish Audiophile Loudspeaker Industries) was founded, starting out with mostly compact two-way speakers, some of the models carried along from the NAD period. The smallest model, DALI 2, a 13-litre 6.5-inch compact, became an immediate success. If you were a young student setting up your first dwelling, you could put two of these in your bookshelf, next to an NAD 3020 amplifier, and you had high-quality sound at a hitherto unseen low price (less than a month's 'SU' educational grant in 1985).

In 1986 the demand had outgrown the rented production facilities (and besides that, the water was pouring through the roof when it was raining). Instead of finding a new space for rental, the whole facility was moved 100 kilometres north, to Nørager, where a new HQ would be built. A new factory was set up for the manufacturing of DALI loudspeakers.

Cerwin-Vega for all of Europe

But the factory was not only built for DALI. From the onset the biggest production at the Nørager facility was of Cerwin-Vega loudspeakers. Danmarks Hi-Fi Klub had from its earliest days been selling enormous numbers of the big, hard-hitting American loudspeakers, fuelling partiers and aggravating neighbours and parents. But in the mid-Eighties the Dollar exchange rate was close to 12 Danish Kroner for a Dollar, which, along with significant import duties, made American hi-fi products prohibitively expensive in Europe.

In order to cut costs on customs and freight (Cerwin-Vega loudspeakers were huge and heavy!) a Danish production was set up. And for more than 10 years DALI built the Cerwin-Vega speakers for not only the Danish market but for the rest of Europe as well on a licence basis. Germany was a particularly big market, and as strange as it may sound today, mainly due to the many American soldiers that was based in Germany during the Cold War. The production continued during the Nineties, until the Cerwin-Vega brand changed ownership. The last 'Danish' Cerwin-Vega was produced in 1999.

"Making Cerwin-Vega loudspeakers was essential to our initial growth, as it meant that we were able to build a much bigger factory and hire more people from the beginning than we could have done if we had only been building our own speakers," says Lars Worre, CEO of DALI.

Like cheese to the French

Denmark has a unique tradition for sound and for loudspeakers in particular," says Lars Worre, CEO of DALI. "Not only was the dynamic loudspeaker invented here, in 1915. Electromagnetism was a Danish discovery too, by H. C. Ørsted, nearly a hundred years before that, in the 1820s."

"This is, along with the very long dark winter evenings..., probably the reason why Denmark has always had such a big number of loudspeaker manufacturers. It is an indigenous product for the region. Like wine and cheese for France."

"For the Danes, however, this is natural to us. We do loudspeakers, and we are used to see our products around the world. But if you go to a hi-fi store in China, you will see many Danish flags, advertising that the products are from Denmark. Even though many of them have never been anywhere near Denmark. They tend to use the term 'Danish' in the broadest possible way, as the customers associate Danish heritage with quality and quality sound."

From house brand to brand name

DALI is one of very few brands that successfully have made the transition from being an in-house-series for a chain of hi-fi shops to being an independent and well-known player on a world-wide market.

DALI was originally created to accommodate the need for value-for-money speakers for the Hi-Fi Klubben chain stores. While the share majority is still owned by the original entrepreneurs, (later supplemented by management by-in), DALI

Facts

Company name
DALI

Head office
Nørager, Denmark

Established in year
1985

Established by
Peter Lyngdorf

Main audio product types
Loudspeakers

Main markets
Scandinavia, England, Germany, India

Number of employees
250 (100 in Nørager and 150 in Ningbo, China)

have come a long way from their humble beginnings. Today DALI has official distributors in 65 countries and is among the most well-known loudspeaker brands worldwide. The transition has not been an easy one, but it was necessary.

"Very few so-called house brands have managed to gain a foothold on other markets, but in order to keep developing the company we had to try," says CEO Lars Worre.

"It is not a question of expanding just for the sake of growth. Actually, we have always preferred to maintain the many advantages of being a small company, not least our passionate mentality and loyalty towards 'why are we here'. On the other hand making lots of speakers gives us a lot of advantages as well, cost-wise, technology-wise and in terms of making partnerships with major partners."

"The company spirit has gone through profound changes in the process. From the moment where we decided to become independent, to actually doing it, and further towards the day when we were able to make money on a worldwide market. Going all the way required some quantum leaps, not at least in the mind-set."

Independence means credibility

"Our wish in the process was to keep our position as one of the preferred brands in Hi-Fi Klubben, at the same time as gaining the strength of being measured and evaluated independently on the export markets. We have managed cut out a position for ourselves globally, and that is a strength – both for us and for Hi-Fi Klubben. We have gained credibility in the process," says Lars Worre.

As an in-house brand you stand a risk of having unrealistically high thoughts about yourself, since you have not really met the independent scale where international brands compete – far away from your home market

DALI's loudspeakers are now available in more than 65 countries, and more than 90 percent of the production is exported. Japanese and American audiophiles listen with respect to the top models, and DALI is getting rave reviews in critical hi-fi magazines worldwide. Even though the loudspeakers are often sold at price points somewhat over those at the Danish home market.

No outsourcing

Where many manufacturers are saving costs by having their speaker enclosures built by Asian sub-contractors, at DALI they have chosen another path, building all critical parts by themselves. And that includes designing every little part – from the smallest screw to the most complex components and structures. And, most importantly, in-house manufacturing of speaker units is considered the above-all critical process to master.

The reasons for taking the make-it-in-house-approach are speed, flexibility, and quality. The advantage of having every step in the production done in close proximity of the R&D engineers, is total control over every detail. And when problems begin to arise, it is easy to make quick adjustments and get back on track. Without having to wait for weeks for the next shipping crate to arrive by ship and conclusions to be postponed.

DALI used to design all speaker units and have them produced by other loudspeaker manufacturers. But even though the units were made according to DALI's own, strict specifications, they still had to choose from a palette of standard technologies and parts, like magnets, voice coils, soft parts, etc.

After DALI took over production of the speaker units, they have been able to implement new process- and material technology and experiment more freely, making small test runs and changing things much more target oriented and – faster!

A Danish factory in China

While DALI is at heart a Danish loudspeaker manufacturer, the entry level models are made at DALI's fully-owned factory in Ningbo, China. The Chinese factory also manufactures certain components and parts for several of the models that are built in at the Danish factory. The Ningbo factory was founded in 2007 and is in several ways an exact copy of the Danish factory in Nørager. The approx. 150 employees work under the same conditions as their Danish colleagues. The management is Danish as well, located on-site.

Manufacturing in China eventually comes down to cost and proximity to many of the sub-supply sources. But beside the cost of wages there are cultural differences. The Chinese DALI workers share the desire to work hard and to aim for results, but while being great specialists, their Danish colleagues tend to have a broader general knowledge.

Today DALI makes four complete 'classic performance' loudspeaker product lines, ZENSOR, OPTICON, RUBICON, and EPICON. Along with smaller ranges of specialist speakers, like the active KUBIK models, the shape/form oriented FAZON series, there is a dedicated range of subwoofers that can be used in conjunction with several models.

While the number of models is dazzling, there is a clear line from the smallest and most inexpensive model and up to the flagship high-end models. The sound – the

Loudspeaker drive manufacturing in-house was from the start a close cooporation between R&D and production engineers.

Denmark has a unique tradition for sound and for loudspeakers in particular

– LARS WORRE
CEO, DALI

voicing – is maintained throughout the model ranges.

"When you listen to a selection of our speakers, it is obvious that they are related. The qualities found in the more expensive models is to a certain degree found in the cheaper models as well," says Lars Worre.

Iconic products

Many DALI loudspeakers deserve the label 'iconic'. The first official speaker to carry the brand name, DALI 2, was a breakthrough in price. At only 525 kroner (in 1985), about half the price of similar loudspeakers, it opened the ears of many new listeners to hi-fi.

In the mid-Eighties the ingenious DALI 40 saw the light of day featuring the DALI-patented 'L-coupling' bass principle for complete cancellation of low frequency cabinet vibration, along with an innovative combination of extruded aluminium profiles and lavish veneered MDF, creating an almost resonance-free yet elegant twist of the classic box-design.

The 1990s saw the event of dipole speakers, a technique from the earliest days of loudspeaker construction. In the same period ribbon speakers became popular. DALI SKYLINE combined the two principles in a flat, triangular loudspeaker that still today is admired for its design. The open-backed speaker was equipped with a 15" woofer two 4" midrange units and a 40" ribbon tweeter of DALI's own design and manufacturing.

The one iconic product to literally tower them all was DALI MEGALINE. As the name suggests, it was a line source loudspeaker of pompous proportions. Standing 2.3 meters tall it just exactly fits into the height of most homes, while the bill fits only the wealthiest.

The MEGALINE was never intended to be a prestige product, but rather a one-off showcase product for hi-fi shows. "But then the orders began to arrive, so we figured that we had to begin manufacturing it," Lars Worre recalls.

Handling of the MEGALINE was 'fairly easy' – for a towering high-end loudspeaker, arriving on a 260 kilograms transport pallet. Each cabinet was divided into three identical subsections, stacked on top of each other. Twelve 6.5" woofers and three 30" ribbon tweeters per channel provided a uniform sound field from floor to ceiling, literally. Aside from forming an almost perfect line-source, the design was able to cancel out floor and ceiling reflections to a point where these room boundaries could be taken out of the equation entirely.

Cutting-edge technology

Agile motion and low distortion

The biggest challenge when building loudspeakers is neither obtaining a deep bass response, flat frequency range, nor high power handling. In fact, you rarely serve the listener well if ANY single discipline of loudspeaker performance is taken to the extreme. Having said that, there may be a holy grail of speaker design, according to DALI: to minimize distortion and non-linear losses in general. This goes through all aspects of the design from materials to the design of moving parts and a philosophy which prioritises the composition of agile, lightly damped moving parts rather than

heavy and heavy-damped moving parts.

"Of course we strive to avoid resonances and colourations, but you can easily go too far down that path. We did that on some models in our early years. If you play around with excessive mechanical damping, you risk ending up with a speaker that measures perfectly flat but has lifeless sound," says Lars Worre.

As an example of the low loss ideal, the woofer's diaphragms for DALI's bigger floor standing loudspeakers weighs only a few grams and are made of a pressed wood/cardboard pulp, chosen not for its lack of sound but in order to achieve ultra-fast response, wide bandwidth and a 'organic' resonance decay.

Great care is taken in the magnet and motor system to avoid non-linearity, and artefacts leading to dynamic attenuation of the signal. Magnetic oil for instance has been used for tweeters in decades, but unless the viscosity is kept at an absolute minimum, it tends to make the impulse response slower. And the quests for low compression ultimately lead to invention of a new kind of magnet system, banning the traditional excessive use of iron in the magnet assembly, in favour of a newly developed material, SMC (Soft Magnetic Compound).

The EPICON 8, the largest model in the EPICON series, introducing SMC in woofer and midrange magnet systems.

Out of the Iron Age

The most remarkable achievement reached is the material SMC (Soft Magnetic Compound). When pressed and heated into shape it has unique magnetic properties.

"Iron has been used for magnet systems for decades, and it works very well for transporting magnetic flux. Or so it seems," says Lars Worre. "The problem is that iron has a far from linear behaviour when exposed to a pulsating flux field. The resulting induction varies with both frequency and amplitude. At ultra-low frequencies the rules we learned from the books apply, but send a fast, strong signal into an iron magnet, and you get both compression and distortion. Unfortunately music consists of both fast and strong signals mixed in an ultra-complex and unpredictable cocktail."

For the EPICON high-end series a special magnet system based on the SMC material was developed and patented. The so-called Linear Drive Magnet System has reduced the distortion in the woofers with a magnitude of up to 20 decibels – that is a potential hundredfold decrease, bringing the odd-order distortion down to a level

Timeline

1983
DALI is founded as a manufacturer of loudspeakers for the stores of Danmarks Hi-Fi Klubben. The first speakers are sold under the NAD label. The brand name is changed to DALI in 1985.

1986
After starting up in founder Peter Lyngdorf's cellar and later at production at various locations, a new HQ and factory is built in Nørager, near Hobro, Denmark.

1980s
Not only DALI speakers are built in the new factory. In order to save cost on freight and customs, all Cerwin-Vega speakers for the European market are built in Denmark.

1990
DALI begins its expansion towards a worldwide market. After having been created as a shop-brand for the Danish stores, the first attempts at export are made.

1992
DALI Skyline 2000 dipole speaker included 15" woofer, two 4" midranges and 40" ribbon tweeter.

1996
DALI's state-of-the-art loudspeaker MEGALINE is introduced. Originally the gigantic line source speaker system was meant to be a one-off demonstration for a hi-fi show.

comparable with that of amplifiers.

Since the Linear Drive System and SMC was introduced, DALI has been able to trickle down to the technology to its more economical product lines, saving on materials while still retaining most of the advantages.

Hybrid tweeter module

Another DALI signature technology is their hybrid tweeter modules, combining a dome tweeter for a detailed treble reproduction and seamless midrange integration with a planar ribbon for constant dispersion and extra weightlessness in the extreme top. The hybrid tweeter configuration is today used in most of DALI's bigger loudspeakers. For the compact models a singular dome tweeter is used instead. Aiming for a small loudspeaker makes little sense if you end up making it half a metre high in order to fit in all the units.

Future focus

Cost-not-object not a challenge

The A i DALI stands for 'Audiophile' but Lars Worre does not see his company as a high-end company per se. The EPICON speakers are expensive, but far from the astronomical prices of the most esoteric high-end companies. Even though there is an unceasing challenge in improving things further, he has no ambitions of participating in the race for the most expensive speaker in the world. According to Lars Worre making a 200,000 dollars set of loudspeakers with a perfect reproduction and very little sales is not the interesting challenge. Making an achievable loudspeaker with a prefect reproduction is much more intriguing:

"We constantly strive to become better, and the cost-no-object statement models are not nearly as interesting. If you really want to demonstrate what you can do, show me your most inexpensive product and how much it can do for money. To make that great you have to be really ingenious!"

Into the music

Loudspeakers are for reproduction of sound, music, any music. But sometimes you want to get a little closer to the beat, to be part of the process. For the last two years DALI has been working symbiotically together with multiple platinum-winning musician Lukas Graham.

The cooperation means that Lukas Graham and his band are sometimes drawn upon when launching new products. In return new audiences and scenes around the world are opened up for the Danish ensemble. ■

Lukas Graham at DALI distributor event at restaurant Kadau in Copenhagen 2014.

2002
Launch of DALI EUPHONIA, introducing two important DALI technologies, present in all later ranges: Wood fibre woofer cone and the hybrid tweeter module.

2007
DALI's twin factory in Ningbo, China is set up. Staff of 150 employees builds the entry level series from DALI's range and produce parts for the Danish production.

2010
DALI begins in-house manufacturing of speaker units. The first model to use the units is DALI MENTOR 6 SE.

2011
Introduction of DALI FAZON F5, a genuine high-end hi-fi loudspeaker, build in aluminium and targeting a more design oriented audience.

2012
The research for the high-end EPICON series leads to the invention of a new magnetic design technology, using Soft Magnetic Composite with ultra-linear electro-magnetic properties.

2015
The OPTICON series utilising SMC-technology from the more expensive EPICON and RUBICON lines is launched at a musical event in London, being webcast to a worldwide audience.

THE HISTORY OF

Dynaudio

Dynaudio was founded in 1977 in Skanderborg, Denmark, by a group of engineers who shared a passion for music. The company has always been interested in exploring the dynamic response of loudspeakers and the company's founding objective was to create high performance loudspeakers that would exhibit no dynamic limitations.

The history

Contrary to what many would believe, the very first Dynaudio loudspeakers were based on OEM drivers sourced externally, with cabinets and crossovers designed and built in-house. Believing that the heart of any system is the driver, and being limited by the constraints of the quality of the OEM drivers available at the time, the company founders knew that the only means of achieving higher performance from a loudspeaker would be through improvements and innovations in driver design.

Realising that its vendors were unable to deliver satisfactory options, Dynaudio embarked on a project to develop and manufacture its own no-compromise driver designs, and only three years after the company's inception, all Dynaudio loudspeaker models featured the innovative new self-manufactured drivers. Shortly thereafter, the company also began marketing its raw drivers in addition to its finished loudspeaker systems.

Dynaudio has over the years evolved into a leading manufacturer of high performance loudspeaker systems, having established itself as one of the largest and most advanced high-end audio companies in the world.

Dynaudio's home audio loudspeaker products are renowned for their high-tech drivers that are designed, engineered and manufactured completely in-house, and for their handcrafted, furniture grade cabinetry. The company has consistently refined its core technologies while diversifying into other product categories to evolve into the leading loudspeaker specialist that Dynaudio is today.

Distributed in over 60 markets globally, Dynaudio produces a diverse range of dedicated audiophile grade loudspeaker models and drivers for Specialty Audio and Home Theater, Professional Studio, Car Audio and OEM applications.

To this day, the Dynaudio R&D team in Denmark relies on its own innovations for material selection, manufacturing processes, component matching, and quality control, with production still based in Skanderborg. Aside from manufacturing a wide range of award-winning audiophile home audio loudspeaker systems and supplying high-end audio companies with audiophile grade driver components, Dynaudio has become one of the leading professional audio companies by bringing its innovative loudspeaker technology into recording studios.

The world's most advanced studios are equipped with Dynaudio monitors, while Dynaudio loudspeakers have also been selected as the official reference loudspeaker of the venerable BBC Radio & Music (British Broadcasting Corporation), among others.

Dynaudio's aftermarket automotive loudspeaker models have brought the company's technology and performance to the car audio industry, perfectly evoking the high-end sound quality the company had become synonymous with. Dynaudio is also collaborating with automobile manufacturers Volkswagen and Bugatti to develop high-end factory fitted high fidelity loudspeaker systems for their models.

Each and every Dynaudio loudspeakers is subject to no less than 86 individual quality control tests before it is allowed to leave the factory in Denmark, and the company has achieved certifications validating the high levels of quality in the manufacture of its products.

Iconic products

Dynaudio 100

The Model 100 loudspeaker was introduced in 1978. This iconic loudspeaker was the first to incorporate all in-house developed and manufactured woofers and tweeters.

In order to accomplish this, Dynaudio had to develop a series of innovations such as the exceptional Center Magnet System technology, Symmetrical Magnet Design, MSP (Magnesium Silicate Polymer) cone material, Aluminium Wire Voice Coils, Aperiodic Bass Damping, Impedance linearisation, Ferrofluid damping, and other cutting-edge technologies. Many of the technologies listed have become integral innovations in Dynaudio's product portfolio and characterise Dynaudio both in the past and today by providing future products with a technological superior foundation.

One of the first reviews of the Model 100 was written by Electronic Sound in 1981 and stated: "The most special thing about this speaker is clearly the bass performance. Especially in the bass it achieves an impulse precision that to our knowledge is unsurpassed by any other product."

Evidence Master

The Evidence Master was launched in 1999 and represented a milestone in state-of-the-art loudspeaker technology at the time; establishing new standards in performance and product design.

The Evidence Master takes advantage of Dynaudio's most advanced driver design with four woofers, two midrange drivers, and two soft dome tweeters all of which are positioned in a vertically symmetric array. The highly sophisticated crossover balances these high performance drivers by utilising Dynaudio's DDC technology, which reduces room reflections and delivers an incredibly authentic music reproduction.

The loudspeaker comprises of three individual sections: the upper and lower sections are identical and house the bass drive units, while the middle section

Facts

DYNAUDIO

Company name
Dynaudio

Head office
Skanderborg, Denmark

Established in year
1977

Established by
Wilfried Ehrenholz, Gerhard Richter and Ejvind Skaaning

Main audio product types
Passive, active, active digital, wireless loudspeakers

Main markets
Germany, United States, Netherlands, United Kingdom, and China

Number of employees
250

contains the midrange and treble drive units as well as the crossover; the latter being further isolated within its own sub-compartment. The Evidence's construction offers a tremendous advantage, as it allows for each section to be optimised for the different requirements of precise bass, midrange, and high frequency reproduction. The Evidence Master's middle section features both Dynaudio MSP (Magnesium Silicate Polymer) cone midrange drivers, and two perfectly matched and meticulously selected Dynaudio coated soft dome tweeters.

The elegant design of the aluminium baffle is the direct result of geometric optimisation for absolutely perfect sound dispersion. The mechanical properties of aluminium and the mass of the middle section guarantee perfect resonance control – the reproduction of high frequencies remains completely uncoloured, so even the finest musical details are precisely produced.

This ensemble of high-end technology and design has been made possible by years of in-depth research and development, which makes the Evidence Master one of the absolutely finest Dynaudio loudspeakers ever produced.

Focus XD

Launched in 2014, the Focus 600 XD was a digital break-through, as it introduced high-end audio for completely lossless, digital 24bit/192kHz transmission from source to driver. The Focus 600 XD introduced the market for a progressive, new high-end audio system, as it is completely digital, fully active, and completely high-resolution. It was, and still is, a perfect symbiosis of floor-standing loudspeaker and high performance digital amplifier.

The two woofers feature extremely large and powerful magnets; each driven by its own power amplifier to ensure a low frequency output is always delivered at the highest level of bass precision. The Focus 600 XD utilises a quad-amp design: just as with the woofers; the midrange driver, and tweeter have their own individual power amplifier. These four drivers are harmonised through the highly sophisticated state-of-the-art DSP.

The Focus 600 XD's power outage of 600 W per channel offers a performance reserve capable of realistic playback of even the most demanding musical performance; faithfully recreating the feeling and scale of a live performance recording or the full impact, energy, and depth of modern electronic music.

The proprietary MSP cone material together with the renowned soft dome tweeter with Precision Coating ensure the tonal perfection and balanced sound characteristics of Dynaudio loudspeakers.

Cutting-edge technology

Coated soft dome tweeter

Dynaudio has relied on silk soft-dome tweeters for recreating high frequencies since the company was founded, continuously improving and perfecting the soft-dome principle over the years.

Dynaudio tweeter designs require a time-consuming, labour-intensive manufacturing process where the fine fabric diaphragm is shaped into a dome and is then treated with a specially formulated coating.

The Focus XD series introduced completely lossless, digital 24bit/192kHz transmission from source to speaker.

Dynaudio tweeters include a special damping chamber integrated into the rear of the construction, deadening any back-wave energy through an acoustic absorber. The advantages include extremely high power handling and unimpeded excursion.

The voice coil is positioned within the magnetic field of the tweeter magnet. When the loudspeaker reproduces sound, the voice coil, powered by the amplifier current, moves at a speed of up to 25,000 waves per second. To achieve a uniform movement, increase power handling while also improving the dome's excursion, ferrofluid is used around the voice coil. Due to the relatively high current and extremely fast movements, the voice coil is under constant thermal stress. The ferrofluid dissipates this heat, while also increasing power handling capabilities.

The frequency range of the Dynaudio tweeter can thus be expanded while the frequency response remains smooth and linear, delivering a high resolution and close to neutral sound reproduction. It is extremely difficult to produce a soft dome tweeter to such high levels of tolerance, which is a primary reason many companies chose another material. But Dynaudio has invested vast amounts of resources into the soft dome tweeter, and the company's tweeters are commonly regarded as perhaps the very best drivers in the world.

MSP (magnesium silicate polymer) driver membrane

The exclusive driver membrane is an immediately visible and characteristic feature of Dynaudio loudspeakers. For bass and midrange units, the company uses a proprietary composite of magnesium silicate polymer (MSP), a material that combines low mass, high rigidity, and ideal internal damping properties. Formed in a special manufacturing process, this membrane is a unique design with the distinctive, geometrically optimised form of the cone further enabling smooth sound dispersion.

Aluminium voice coils

A primary Dynaudio driver innovation is the use of pure aluminium wire for voice coils. In comparison to the more commonly used and much heavier copper alternative, aluminium allows for more windings and extraordinarily large diameter coils that remain extremely light. By using aluminium instead of copper for the coil in a bass driver, it is possible to effectively double the voice coil's diameter without increasing its mass. Due to the thermal properties of aluminium, cooling of the voice coil is dramatically improved as well.

In combination with the equally light

voice coil former and powerful magnet materials used in Dynaudio driver designs, cone excursion is much more controlled and the driver follows the music signal from the amplifier with a remarkable sense of dynamics and accuracy.

Center magnet system
By using lightweight aluminium voice coils in its drivers, Dynaudio can utilise the benefits of an extra-large coil positioned outside of the magnet (Dynaudio's Center Magnet System). The Dynaudio center magnet system yields a compact yet powerful driver system.

Its strong suit is the alignment: with the magnet positioned inside the voice coil, a larger and more homogenous magnetic field can be utilised, with less magnetic radiation from the inner magnet. This exceptional technology has the further benefit of symmetry, since the use of two magnet rings above each other enables a totally symmetrical pole piece design, making the driver coil induction constant in any voice coil position. This results in an extremely precise and symmetric voice coil movement for exact signal reproduction – even at higher volumes.

Vented magnet system
Dynaudio tweeters, mid-range and bass drivers benefit from venting of the otherwise nearly sealed compartments between the magnets and diaphragms. The Dynaudio center magnet system reduces the reflection surface behind the woofer cone, while the extremely rigid die-cast aluminium baskets are optimally shaped to further eliminate air turbulence and resonance.

Die-cast aluminium frame baskets
A loudspeaker driver consists of many different moving parts: a magnet powers a voice coil, which moves the diaphragm. The membrane is supported in a flexible assembly, surrounded by a supple rubber ring. In order to perform in a controlled manner, all of these parts must be housed together in a highly rigid frame: the driver basket.

Dynaudio primarily utilises low-resonance, highly warp-resistant baskets made of die-cast aluminium. Due to the stiffness of this non-magnetic material, the basket can be designed with aerodynamically formed ribs to reduce air compression behind the moving membrane. Another advantage is its long-term resistance against thermal, mechanical or other external influences.

For many years, Dynaudio was the only manufacturer to consider aerodynamic improvement of the driver basket. The extraordinary endurance and completely unvarying sound quality characteristics of the Dynaudio driver are also a result of the innovative and solid basket construction.

High quality 1st order crossovers
Dynaudio was a pioneer in terms of the effects of phase and transient response. Along these lines, another Dynaudio specialty would be 1st-order (6 dB per octave) crossover networks. Dynaudio's research showed that most drivers exhibit serious faults quite close to the crossover frequency for which they were designed, and that systems featuring the commonly-used very steep (2nd, 3rd and 4th order) crossover slopes yielded undesirable side effects on transient and phase response.

Dynaudio devoted a great deal of research into the smoothing of its drivers far outside the range for which they were actually developed, specifically designing them to remain clean and free of distortion for several octaves outside of the crossover frequency so that the advantages of gradual filters (maintaining the correct phase throughout the frequency range and not distorting the amplitude of transients) can be utilised.

Evidence Platinum, the culmination of Dynaudio's extensive research

Often in promotional literature, the impression is given that the use of filters with a high slope (12 to 24 dB per octave) is a quality feature of a loudspeaker system. This may have some validity when using drivers of standard construction and a narrow frequency range. Here, crossovers with a high slope may help to maintain a smooth frequency response. But on the other hand, the higher the slope of the filter, the worse the pulse response of the drive unit will be. Since music consists of dynamic signals with many pulses and few pure sine waves, reproduction suffers from filters with a high slope.

The ultra-linear frequency Dynaudio drivers enable the company to primarily employ first order filters. Even if this requires highly optimised drive units that are difficult and expensive to manufacture, the superior transient response and overall musicality confirm that it is worth the effort.

Only the highest quality components, selected for their sonic properties, are utilised in Dynaudio crossovers: carefully wound pure OFC (oxygen-free copper) air-coils, select capacitors, and temperature-stable ceramic resistors. Another Dynaudio area of expertise is impedance correction, making a perfect combination possible with virtually all amplifiers.

DDC: Dynaudio Directivity Control
The distinctive driver symmetry with two mirrored drive units is an unmistakable characteristic of the Dynaudio directivity control (DDC) technology.

After years of development experience with Dynaudio professional studio monitor loudspeakers, it became clear that many recordings are of superb quality but, due to listening room acoustics, the potential of these recordings could not be fully experienced. In particular, reflections from floor and ceiling boundaries interfere with a faithful, realistic sonic reproduction because of distortions and added time delays.

With DDC, Dynaudio has created a technology that effectively reduces these effects. The vertical symmetrical drive unit array and elaborate crossover topology reduce the energy dispersed to the floor and ceiling by approximately 75 per cent. The controlled vertical dispersion makes the loudspeaker far less dependent on the room and much less influenced by positioning as compared to conventional designs.

DDC is not simply arranging the drivers in a symmetrical array. For DDC to succeed, every single detail – from each drive unit to the crossover – must be individually tailored and optimised for this concept. With two

tweeters, two mid-range drivers and, depending on the model, two or four woofers, each drive unit complements its identical counterpart in frequency response and phase relationship in such a manner that a carefully defined dispersion characteristic is achieved.

This intricate matching is repeated once again for each loudspeaker pair to work together in tandem. DDC is an impressive example of the innovative Dynaudio methodology for loudspeaker design.

Dynaudio fine-tuning
It is not just technology that sets a Dynaudio loudspeaker apart from conventional offerings. It is also meticulous fine-tuning. Every Dynaudio model is fine-tuned in extensive, time consuming listening tests. Dynaudio even developed its own amplifier, the Arbiter, solely for this task, to ensure that they are not restricted by any one manufacturer's design.

Extraordinary power reserves, a frequency bandwidth at the edge of what is technically possible, the exacting use of absolutely sonically accurate components and circuits, and a unique power supply that remains completely free from mains noise are just a few qualities of Dynaudio's ultimate amplifier development.

The true sound quality of a loudspeaker can be judged using this virtually priceless reference amplifier. After a Dynaudio design has been fine-tuned, it is subjected to the Arbiter. Only after passing this most difficult test is it ensured that the authentic sound quality of a Dynaudio loudspeaker can be fully experienced.

Wireless
Dynaudio is the frontrunner in bringing wireless technology to high quality sound systems; effectively forcing high-end audio into the new millennium.

The Xeo and later Focus XD systems combine true high-end performance with the convenience of a multi-room, multi-source wireless delivery system. With a lossless transmission, the signal is delivered, from any type of input source to the speakers in full detail, without the need for running wires across the room. As the wireless transmission is latency-free, the system can be used with video sources without worrying about lip-sync issues or other artefacts. Dynaudio has pushed high-end audio to a completely new level of connectivity and convenience.

Digital
While Dynaudio is known for its many virtues in traditional speaker building, it is staying at the forefront of high-end audio thanks to major investments in digital processing. DSP based crossovers allow for advanced processing of the audio signal to maximise both the dynamic properties as well as the dispersion characteristics of the speaker.

Dynaudio takes this approach one step further, and utilises fully digital amplification in combination with DSP crossovers. This eliminates several of the components and conversions that traditionally have made up a high-end audio system, with greatly increased clarity and detail as a result. Because Dynaudio designs its own drivers, the digital processing can be optimised to utilise the full potential of each individual driver, and deliver a higher dynamic range from a given speaker size.

Active speakers
Dynaudio has many years of experience with active speaker systems, for both professional and home use. Most speakers incorporate a passive crossover filter, which separates the audio signal for each driver. In a passive system there is a significant loss of efficiency because of the loss in the crossover components.

With an active system the speaker includes a separate power amplifier for each individual driver, and the crossover takes place before the signal reaches the power amplification. This highly increases the efficiency and dynamic range, and keeps the clarity and detail of the signal intact. In combination with the advantages of digital processing the active system unleashes the full potential of each driver, with no filter between the amplification and the driver.

Extended Dynamic Range = 24 bit/192 kHz
With the Focus XD Dynaudio introduced a speaker system that is designed to fully utilise the potential of high-resolution audio: all the way up to 24 bit/192 kHz tracks. The digital signal processing of the Focus XD runs at full 24/192 resolution; all the

Timeline

1978
Dynaudio launched the Model 100, which is the first model with completely in-house developed and manufactured woofers and tweeters.

1983
In 1983, the original Dynaudio Consequence is introduced to the market. The Consequence eventually became one of the best-selling high-end loudspeakers to date – and it is still an icon.

1986
The Contour is possibly one of Dynaudio's most recognised loudspeaker series. The Contour established Dynaudio worldwide and included successful models like 1.3, 1.8, and 1.3 SE.

1989
In 1989, Dynaudio introduced Crafft, its first ultra high-end compact monitor and to this day, Crafft is a sought after classic. The success of Crafft helped found the Dynaudio Professional segment.

1991
For nearly two decades, the Confidence has been one of the most acclaimed high-end loudspeakers in the world. But most importantly, it introduced an unusual compound base and the legendary Esotar tweeter.

1999
The Evidence is the culmination of years of knowledge, research, and development that brought to life many innovative audio technologies.

Constantly questioning the status quo in the pursuit for perfection

way through the DSP crossover to the fully digital amplification circuits, without down sampling the signal to lower resolution. Due to the lossless nature of the crossover and amplification circuits, the Focus XD keeps more of the dynamics and detail of high-resolution sources intact compared to other systems.

Future focus

Innovation has always been part of Dynaudio's DNA; constantly questioning the status quo in the pursuit for perfection. This forward thinking has brought about innovative technologies that have propelled Dynaudio and its products into a leading position within the high fidelity audio industry. Many of these technologies and products remain the industry-standard to this day.

However, with a legacy that actively questions what has become the norm, the company continues its pursuit of creating the ultimate musical experience and the goal is simple: every new technology should leap into the future and revolutionise high fidelity audio; having produced the best products available will never become a reason to slow down. For Dynaudio, the next barrier to tear down is how to increase the convenience of high fidelity audio. This can be accomplished by producing simplistic audio systems that make the listener forget about everything other than the music experience, as products become wireless and connected.

However, for Dynaudio, increased convenience is not the only hurdle to overcome. The company strives to continue its legacy of revolutionising audio by faithfully recreating every note recorded. The dream is a digital input with lossless properties capable of reproducing the music at its highest resolution: to not create sound at all, but to reproduce the music, as it was recorded in the studio or concert hall. ■

2002
Dynaudio introduced the Confidence C2 and C4 with their innovative cabinet and front baffle design that featured the reflection reducing DDC technology.

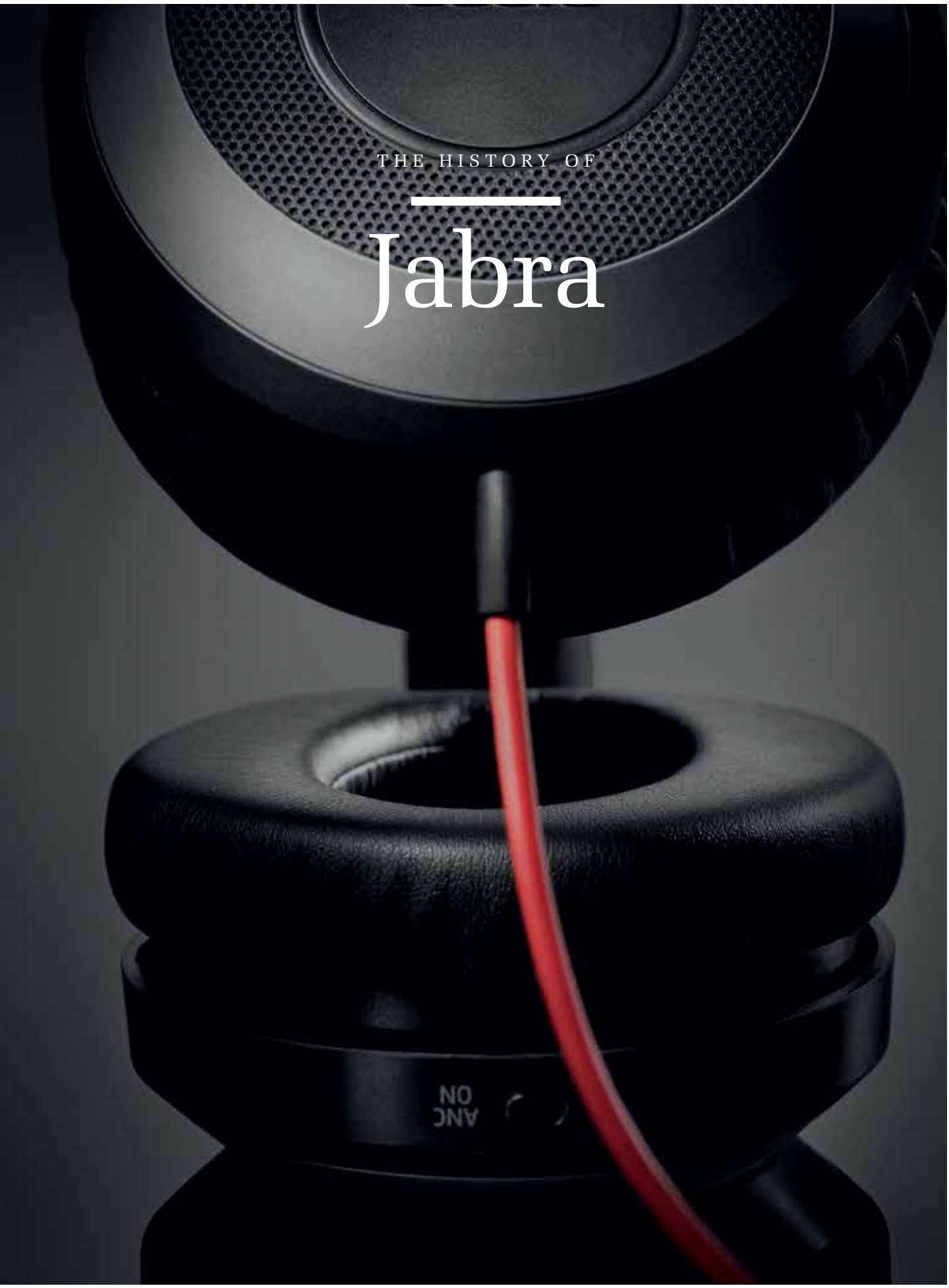
2002
The Special Twenty-Five incorporated the best technologies from the Evidence into a compact monitor design and marked Dynaudio's 25th anniversary.

2007
Sapphire marked Dynaudio's 30th anniversary with its characteristically 'sapphire' shaped cabinet and selected wood veneers.

2012
Xeo was the world's first wireless high-end loudspeaker, and it marked the beginning of a new era in high-end audio.

2014
The Limited Edition Contour continued a tradition filled with refined technology and selected wood veneers ensuring the legend lives on.

2014
With the Focus XD, Dynaudio brought about a digital revolution in high-end audio: fully active, fully digital, and specifically designed for high-resolution audio.



THE HISTORY OF

Jabra

Jabra's heritage in communication goes back to 1869. What started out as The Great Northern Telegraph Company is today a global leader in intelligent audio solutions from conversation to music.

It would be nearly impossible to imagine how Jabra could produce its products without using dynamic speakers. On a yearly basis, Jabra typically uses more than 15 million speaker units in the company's various products.

When engineers at Jabra talks about a '12' speaker, they are usually not referring to a speaker with a 12 inch diameter, but rather 12 mm. The reason behind this is that most speakers in Jabra products are used in a headset or a set of headphones where the typical speaker size is between 6mm-40mm. Apart from the apparent size difference compared to conventional loudspeakers, the design of the speaker unit and its enclosure is also inherently different.

A headset or a set of headphones are usually acoustically coupled to the ear using some form of ear cushion. As a result, the acoustic impedance load on the diaphragm of the speaker will often be dominated by the acoustic input impedance of the ear rather than the radiation impedance seen in loudspeakers. People also have different ear shapes and sizes, and a good headphone design needs to account for this variation in order to deliver a consistent sound across all types of ears. On top of this, various psychoacoustic effects are at play, which affects our perception of sound and music when using headphones. All these factors need to be taken into account when designing the speaker-transducer and its enclosure.

The history

Telegraph Lines - The Early Days 1869-1947

GN Store Nord started out as The Great Northern Telegraph Company in 1869. It was established on the initiative of C.F. Tietgen by merging three regional telegraph companies: The Danish-Norwegian-English Telegraph Company, The Danish-Russian Telegraph Company and the Norwegian-British Submarine Telegraph Company.

As a company, GN predates the invention of the dynamic loudspeaker, but the business of GN has always revolved around communication, and transmitting and receiving (sound) signals, so one could argue that this path was already set back then.

In 1870, the Great Northern Telegraph Company embarked on an era of pioneering, which would eventually establish a telegraphic connection between trade houses in the Far East (China and Japan) and the rest of the world. On October 20, 1870, the Telegraph Company landed the very first submarine cable in Hong Kong using the frigate Tordenskjold, placed at GN's disposal by the Danish government. Just a few years later, on January 1, 1872, GN opened the worlds' first telegraph connection from Northern Europe, via Siberia, to Japan and Hong Kong. This connection to the Far East remained at the core of the business well into the beginning of the 20th century, along with other networks in Europe.

The First World War would naturally have a large impact on the telegraph business. With the potential of another large scale war in 1939 and the uncertainty of GN's future, director Bent Suenson realized the need to change the company's business strategy. On his initiative the investment strategy went from saving the fortune in cash and national bonds, to investing in diversification. One of the initiatives was to acquire the Danish manufacturer of dry batteries A/S Hellesens, thereby taking the first step.

As predicted, World War II had an enormous impact on GN's telegraph business. After the war, many telegraph lines were destroyed and needed to be rebuilt. Even this posed a potentially dangerous task, with the ever-present risk of sea mines. The political landscape had also changed drastically. GN managed to reopen the connection to Russia and Japan in 1946-1947, but was unable to re-establish itself in China with the new political situation. With less income from the East Asian connection, it was once again time to consider new business areas.

Storno

In 1947, managing director Bent Suenson was approached by two young engineers; Erik Petersen and Svend Falck-Larsen. Their business concept was to adapt the new FM technology invented by the British Navy during WWII and use it for FM radio communication. In March 1948, the subsidiary STORNO (STORe NOrd) was established. By the 70's STORNO had by far outgrown the telegraph business in terms of turnover and counted 1,794 employees. Although more or less forgotten today, back then STORNO was up alongside brands like LM Ericsson, Nokia and Siemens. In 1976 STORNO was sold to General Electric, and the funds from the sale were reinvested in the Danish hearing aid company; Danavox. Danavox was the starting point of the two remaining subsidiaries in GN today: GN Resound and GN Netcom.

GN Danavox - The first headset and the birth of GN Netcom

The first headset developed in GN was the Stetomike 808, launched in 1980. It was developed using the knowledge and engineering expertise of micro loudspeakers and microphones used in Danavox. The Stetomike 808 would become a very successful product, launched at exactly the right time. The early eighties saw a rapid increase in the number of call-centers worldwide and with them came a rise in the demand for headsets. In 1986 the marketing and production of the Stetomike 808 was moved from Danavox to an individual company called GN Netcom.

Good comfort and high quality are key features for headsets that are worn for many hours or for a full working day. The properties of the dynamic loudspeaker can be exploited to aid in the design of headsets with low acoustic output impedance. This reduces the need for a tight seal between the headset and the ear, otherwise known in other products of that

Facts

Company name
GN Netcom, brand name: Jabra

Head office
Ballerup, Denmark

Established in year
1869 Great Northern Telegraph Company, 1986 GN Netcom

Established by
C.F. Tietgen

Main audio product types
Headsets, headphones, speakerphones & portable speakers

Main markets
Worldwide for both consumer and professional markets

Number of employees
950

time. Headsets like the GN Netcom Profile took advantage of this, and the result was a stable design with good sound quality and wearing comfort. This type of acoustic design has been carried on in the generations of headsets to follow.

Throughout the 80's and 90's, GN Netcom continued the development of headsets and communication devices aimed mainly at the professional markets; typically call-centers and offices. The hands-free communication offered by using a headset enabled users to freely use their hands during a telephone conversation and type on a computer during a call. As the market grew, the range of products was further diversified due to specific customer needs and the environments they were used in: monaural or binaural style (for listening with only one or both ears), open and acoustically transparent headsets (for awareness to the surrounding environment), or closed headsets (for shielding out noise and privacy). Wearing styles would also vary from the classic headbands to small ear hooks that would not interfere with the hairstyles of the user. Dynamic loudspeakers of different sizes and properties served them all.

Going wireless

In 1987 GN Netcom made an announcement to its shareholders. GN Netcom would invest in a development project called "Cordless Headsets". With the use of wireless technologies such as DECT, the wireless headsets would eventually become a reality with products like GN 9020 or GN 9120, but it would take some time. The first products were launched in the beginning of the 21st century. "Cutting the cord" extended the hands-free convenience and allowed the user to leave their desk and move around the office without interrupting the conversation.

The announcement of Bluetooth technology in the summer of 1998 triggered a new era for GN Netcom. Already in September 2000, GN Netcom presented the world's first Bluetooth headset approved to the Bluetooth standard – the GN Netcom 9010. It was launched approx. two months ahead of its competition.

Headsets for the increasingly popular mobile phone market opened a new potential for consumers, and in 2000 GN Netcom acquired one of the largest suppliers of hands-free devices for mobile phones in the US: Jabra Corporation.

The introduction of consumer products with the Jabra brand formed a fast growing range of products: headsets for mobile phones. First corded, and later cordless using Bluetooth. As mobile phones became more and more capable and started to incorporate music players, the boundary between the consumer headset for communication and a music headphone started to disappear. It led to products that supported both communication and music listening, and even consumer products primarily focused towards music.

The professional office headset has also been through a transformation in recent years. New ways of working in the office have changed the needs of the professional user, and what a headset should support. An office headset today will of course still need to support communication but also various other functions such as: listening to music, active noise cancellation, interfacing to an array of different devices; laptops, telephones and mobile devices. Some products are also used 'on the go' or when working from home.

After the acquisition of Jabra, consumer products were marketed using the Jabra brand, with professional headsets still branded as GN Netcom. As the overlap between the products offered to consumers and professionals increased, and in order to simplify market communication, the decision to market all products under the Jabra brand was made in 2009.

Iconic products

GN Profile

Speaker Design: Low Acoustic Output Impedance, 23mm Speaker.

The GN Profile was launched in 1988, and was the first headset from GN Netcom designed with low acoustic output impedance. This acoustic design had many advantages. It was leak tolerant, which means that the inevitable variation in the leak in the coupling between the ear and the cushion of the headset would have limited impact on the frequency response. As this leak typically varies from person to person, due to different ear shapes, a leak tolerant design will assure a consistent frequency response across different ears.

The GN Profile was the product that would establish GN Netcom as a headset brand known globally, and was deployed in many call centers around the world.

Jabra Speak 410

Speaker Design: Closed Back, 2" Speaker.

The Jabra Speak 410 was in many ways unique. It was the first time Jabra produced a loudspeaker for the office environment. Given the context it would probably be correct to refer to it with the term used in the telecom industry, 'speakerphone', rather than a loudspeaker. Although the product supported music playback over USB, it was primarily intended for use as a communication device for conference calls. As it only supported USB, it was designed for use with the various IP telephony platforms that emerged during the 00's. The follow-up version Jabra Speak 510 included a battery as well as Bluetooth connectivity, making it possible to connect the speakerphone to mobile devices as well.

Even though this was the first attempt from Jabra at making an office speakerphone, it became a very successful product. Within the personal speakerphone category, the Jabra Speak 410/510 have managed to hold a firm position in the global market, and more than one million units have been sold so far. It is a good example of a solution where premium sound quality, form, portability, functionality, and an intuitive user interface are united in a product.

Jabra Solemate

Speaker Design: Two 3/4" Soft Dome Tweeters, One 2" mid/woofer with passive radiator, 9 w amplifier.

The Jabra Solemate was introduced in 2012, and was a wireless speaker mainly aimed for playing music. It was the first time Jabra released a portable music speaker aimed at the consumer market. Compared to many earlier Jabra products, the Jabra Solemate sported an array of colorful variants and was mainly targeted at a younger audience. This is also apparent in the playful nature of the industrial design, inspired by something truly rugged and portable; the sneaker.

It is truly a portable speaker in the sense that it features a robust rubber

Compared to many earlier Jabra products, the Jabra Solemate sported an array of colorful variants and was mainly targeted at a younger audience. This is also apparent in the playful nature of the industrial design, inspired by something truly rugged and portable; the sneaker.

coated design and only weighs approx. 600 grams. The goal of the design was a product similar in size to the soft drink bottle. The Jabra Solemate was soon followed up by a smaller version (Jabra Solemate Mini) and a larger version (Jabra Solemate Max).

Jabra Evolve 80

Speaker Design: 40 mm speakers.

The Jabra Evolve series headset launched in 2014, introducing new technical features aimed towards supporting new ways of working in the open plan office. During the development of the Jabra Evolve series, a global study of thousands of office workers in various work situations was undertaken in order to find the right value proposition. The learnings resulted in an office headset that was different in many ways compared to previous headsets from Jabra.

It is the first Jabra headset with a circumaural fit, meaning a fit where the ear-cushion rested on the area around the ear rather than on the ear itself. It is only available in a stereo version, or what is typically called 'duo' in the telephony world. Stereo or two earpieces are necessary to get the full advantage of 'active noise cancellation' (ANC). ANC blocks out and cancels background noise, making it possible to fully concentrate and not be disturbed by noise and conversations in the surrounding environment.

Music listening is also supported in all aspects of the product. When listening to music there is no low-end compromise, and you can enjoy the whole frequency range (20 Hz-20 kHz). It also connects via both USB and 3.5mm jack, so it is possible to connect to various portable devices, as well as laptops with USB. Needless to say, it naturally supports two-way communication on both interfaces.

It also features a 'Busy Light' indication on the earpiece. If you are on a phone call, the light turns red, indicating to your surroundings that you are on a telephone call and not available to talk. The light can also be turned on manually to indicate that you are busy and do not want to be disturbed.

Jabra Sport Pulse

Speaker Design: 6mm speakers

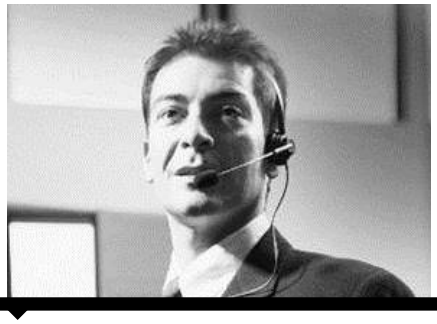
The Jabra Sport Pulse is part of Jabra's intelligent sports audio range. The Jabra Sport Pulse was released in 2014, and was the world's first wireless headset with a heart rate monitor. The ear is often not considered for pulse measurement, but research revealed that the thin skin layer and plenty of blood flow in the ear actually make it an ideal place. The Jabra Sport Pulse offers the combination of wireless music and smart features such as the biometric heart rate monitors that combined with the Jabra Sport Life app can be used for motivation to improve sports performance and workouts.

Future focus

At the core of Jabra lies communication and good audio quality, and this will also remain the focus in the future. Most of Jabra's products are "accessories" in the sense that they need to interface with other devices when used. This includes telephones, smartphones and other mobile devices, computers and laptops running various types of software as well as support of various wireless technologies.

Therefore, Jabra views its products as part of a solution, and the vision is to "be a leader in intelligent audio solutions, transforming people's lives through the power of sound". What this means, aside from making great audio and communication devices, is a focus on solutions that bring

Timeline



1869
GN Telegraph Company is established on the initiative of C.F. Tietgen. A few years later the first telegraph connection between Northern Europe and Japan/China is established.

1948
The subsidiary STORNO is established, and GN starts to produce hardware for FM radio communication.

1979
The first headset in GN is launched.

1986
GN Netcom is created as an independent entity that will focus on developing headsets for telecommunication.

1988
The GN profile is launced, using a low impedance speaker design.

2000
The worlds' first certified wireless Bluetooth headset is launched by GN Netcom. The US company Jabra Corporation is acquired into GN Netcom.

"The development of the world is dependent on communication"

– C.F. TIETGEN (1829-1901)
FOUNDER OF THE GREAT NORTHERN TELEGRAPH COMPANY

greater value to the users by enabling them to hear more, do more and be more. To successfully accomplish this Jabra needs to understand the customers' present situation, predict future needs, and identify how Jabra can incorporate and use new technology in the products to enhance the user experience of using the products.

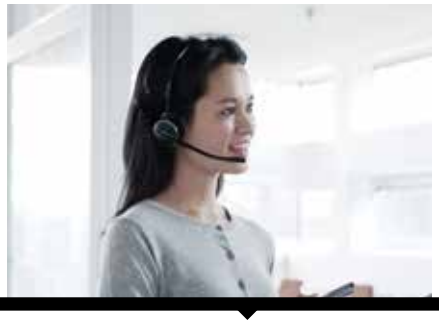
An example of this is the active noise cancellation (ANC) described earlier in the Jabra Evolve 80 headsets. One of the recent changes seen in many large corporations is the transition from smaller office rooms with a few people in them, to large open offices. In many cases, the change to the open office has resulted in an increase in noise levels. By developing a headphone that incorporates ANC, Jabra can provide a solution to the present open office noise challenge as part of our headset offering.

Another good example of enabling the user to do more is the Jabra sports audio portfolio. These products are developed specifically for runners and fitness lifestylers who want to listen to music while training. The Jabra Sport Pulse Wireless enhances the user's training experience beyond that of just listening to music with the Jabra Sport Life app running on a smartphone, it is possible to monitor training progress in real-time during a workout. When exercising, it is possible to be updated on distance, heartrate and pace and be motivated if you are slower than your target or your set training intervals, based on heart rate measurements. In the Jabra Sport Coach Wireless, accelerometers are used to count steps or repetitions. The product is optimized for cross-training, with coaching directly via the headset and the Jabra Sport Life app.

At the heart of everything Jabra does, there is a need for good speakers to deliver premium quality audio in Jabra products. ■

2004
Jabra launches its first Bluetooth in-car Speakerphone, the Jabra SP100.

2006
GN moves to the headquarter in Ballerup, and builds a 'state of the art' acoustic lab facility.



2009
All headset opertations are united and marketed under one brand: Jabra.

2009
The Jabra Pro 9400 is a professional wireless headset that can connect to the various phone types in the office; desk phone, mobile and softphone.

2014
Jabra Sport Pulse combines wireless music and smart features such as motion sensors, biometric heart rate monitors and the Jabra Sport Life app.

2015
The Jabra Eclipse is launched. It is the lightest headset ever produced from Jabra.

THE HISTORY OF

Libratone

Libratone has pioneered the wireless speaker market with an iconic line of speakers that give consumers the freedom to enjoy music the way they want it. Consumers can stream music however they like, via smartphone, PC or tablet – throughout different spaces in their homes or out in the world.

The history

The electromagnet part of the speaker was invented in the early 1860s. Although its invention was a technical triumph that replaced oversized horns, it took 40 more years to develop the knowledge of acoustics and materials that went into the modern speaker. Remarkably, little else has changed since that time. Speakers have remained relatively true to the original speaker design, with electromagnet coils that quiver the air and send sound waves in a certain direction.

Although the innovation has withstood a century, lifestyles have changed radically, especially in the way we listen to music. We no longer spend evenings tethered to the sofa in the sweet spot where two speakers are strategically aimed. We live for our music and want it to follow us wherever we go – from room to room, to back yard and beyond. We demand flexibility from a single speaker instead of a heavy, stationary fixed pair – and we want enough power to fill a room with rich, exquisite sound.

Liberators of sound

Founded in 2009 by three Danish entrepreneurs, Libratone has always existed to do one thing: fundamentally change the listener's relationship to sound by creating exceptional sound experiences. The founders knew right from the start that the only way to do this was to free the listener from the constraints of cables. At the same time, they imagined rescuing the speaker from the hidden corners of the room and making it the centrepiece of the home – both to improve the listening experience and to integrate the speaker elegantly in with the home's décor. Audiophiles in their own right, the founders were also staunchly dedicated to achieving the best possible acoustics with the richest, fullest sound. And they had faith that by focusing on creating great sound experiences, designing the right products would follow naturally.

These three entrepreneurs went on to pioneer the wireless speaker market with an iconic line of speakers that give consumers the freedom to enjoy music the way they want to. Consumers can stream music however they like, via smartphone, PC or tablet – throughout different spaces in their homes or out in the world. And they can do so stylishly – and without sacrificing sound quality.

The cornerstone: Creative intelligence

Kristian Krøyer, one of Libratone's original designers, says they achieved their original line of speakers by focusing on three distinct areas:

1. **Cutting-edge technology** – They created their signature FullRoom™ acoustic technology, which disperses sound waves in multiple directions giving listeners a fuller, richer listening experience wherever they are in the room;

2. **Smart Scandinavian design** – They revolutionised the form factor, transforming the traditional hard black box into a soft, curvy, living object of design;

3. **Exceptional user experience** – They created flexible, user-friendly wireless speakers that stream via almost any device and can be personalised according to 21st century listening habits and preferences.

Today the company still aspires to operate within the elusive area where technology, design, and user experience meet. They call it Creative Intelligence and they use it as a mantra for challenging conventions. "By combining all three domains and giving each its due importance we can take the audio industry into the future," says Krøyer.

The name Libratone is a combination of 'liberation' and 'tone' and according to Krøyer, it describes perfectly what the company is all about. "We are on a continued mission to liberate sound through the performance of our products. We don't only aim to provide listening experiences – we want to inspire you to create your own. With our speakers, we enable you to hear music however, wherever and whenever you want."

The Beat begins

In 2010, Libratone launched its first product, Beat, at IFA in Berlin. "The Beat had all the design and acoustic attributes we were going for, but it wasn't truly wireless," Krøyer admits. "Still, we were very excited because we had been working for a year perfecting our almost-wireless product, which was pushing the then-available technologies to the limit. And there was nothing else like it on the market. Unfortunately, two hours earlier, Apple launched AirPlay and suddenly the game had changed."

Krøyer and his tiny team spent the next year persuading Apple to allow them to integrate AirPlay into their products. By September 2012, the Libratone Live and Lounge, featuring Airplay, were launched to great fanfare, again at IFA.

"We were amazed by the attention we received with the launch of the Live and Lounge. Back then, we were still just 5 guys, and we had no marketing budget. But great design is in itself great advertising, and we quickly realised the products were marketing themselves."

By Christmas of 2012, Libratone had a double spread in Wallpaper, the iconic design, interiors and fashion magazine. Soon after, the company began raking in numerous awards and accolades for both technology and design, including multiple Red Dot and CES awards – and Apple became official partners.

Facts

LIBRATONE

Company name
Libratone

Head office
Herlev, Denmark

Established in year
2009

Main audio product types
Consumer based, HiFi & design speakers

Main markets
Global

Number of employees
100+

Distinct fabrics
One of Libratone's most important hallmarks is a distinctive fabric finish that gives the speakers a tactile craft quality, instead of a hard industrial look and feel. "The idea was to put a warm friendly touch to an electronics product and make it relate aesthetically more to interior design than to technology," adds Krøyer.

Classic Libratone products are covered in premium-quality organic Italian wool produced in an important textile and fashion centre of Tuscany, where they have been producing wool since the 12th century. In 2015, the company introduced its signature Cool Weave fabric, which is a technically complex, three-layer fabric that allows sound to penetrate it cleanly and beautifully.

"We chose the Cool Weave mesh fabric for its unique open structure and sound filtering properties," says Krøyer. "We like its trendy, breezy look and feel – and how it catches light in interesting ways and reflects colours so brilliantly. We think it's an excellent fabric to add to our collection."

Stunning colours
From the beginning, Libratone has always called on a rich universe of colours to amplify the design impact of the speakers. The fabric covers of all Libratone speakers are interchangeable and available in a wide palette of both fashion and décor colours. The design industry's most seasoned colour experts partner with Libratone to evolve their colour range.

"We rely on colour experts to help us sharpen our shade and fabric ranges, so that we can offer our customers the most confident and current colours," Krøyer explains. "It's a difficult process to interpret the past and present colour trends in order to forecast what will inspire consumers tomorrow. But we feel it's imperative that our colours reflect the changes in customer preferences, seasons, and trends."

SoundSpaces emerge
In 2015, Libratone launched its unique SoundSpaces concept. SoundSpaces inspires listeners to create their own SoundSpaces by streaming music, podcasts, movies and more in any space across their home with Libratone speakers. The concept is enabled by Libratone's SoundSpace Link which lets listeners connect and combine their speakers, via WiFi and Bluetooth, in any configuration and control them from anywhere with the Libratone App.

SoundSpaces offers users a friendly and flexible listening experience. Without any hassle, they can quickly link several speakers to share sound with a group, and they can just as easily unlink the speakers to play a single speaker and keep the sound contained to one room. With an entire ecosystem of speakers, the options are endless. It's very quick and seamless to create SoundSpaces perfectly suited to working, relaxing, and entertaining.

With the launch of SoundSpaces, Libratone is again pushing the limits of technology while quantifying and qualifying how people interact with sound. Taking multi-room audio to an entirely new portable level, SoundSpaces is designed to suit the elastic lifestyle of today's consumers.

The elastic lifestyle
"The elastic lifestyle" is a phrase coined by Scandinavian trend institute The PEJ Group. CEO Louise Byg Kongsholm explains: "Today our lives are less compartmentalised than they were just ten years ago. Work and leisure merge, house and garden merge, family life also involves adequate personal time, and the home's rooms flow together and are used for various purposes. The elastic lifestyle represents both the tangible and intangible ways our lives have become much more stretched and flexible to help us experience more – both inside and outside of our homes."

Kongholm explains that ubiquitous technology is driving and influencing the elastic lifestyle. "We have become accustomed to technology that makes life simpler. Out of this, we have developed a need for environments that can be twisted, expanded, and adjusted to different everyday situations. The elastic lifestyle requires that the elements in our home are functional, flexible, simple, and above all, they need to help us create the perfect mood for every situation."

Libratone CEO Jan McNair says SoundSpaces is a response to this important megatrend.

"As the elastic lifestyle illustrates, today's consumers expect their sound to be ever-present, portable and flexible – and stationary multi-room technology does not fulfil this. SoundSpaces is a flexible listening solution that lets you connect up to 6 speakers via WiFi and place them anywhere in any room and move them around as you wish. It's the most flexible listening experience on the audio market, and we are proud to provide it."

The next generation of ZIPP
Along with SoundSpaces, 2015 also saw the launch of the Libratone ZIPP and ZIPP Mini – two sleek redesigns of the iconic ZIPP Classic. Based on the same powerful, FullRoom™ acoustics and Scandinavian design, the next-generation ZIPPs can link together, so consumers can tap in-to the freedom and flexibility of SoundSpaces. Featuring both WiFi and Bluetooth connectivity, the new ZIPPs are ideal for streaming anywhere in the home – in the bedroom,

bathroom, back yard and beyond.

The next-generation Libratone ZIPP (100 W) and ZIPP Mini (60 W) speakers also feature Spotify Connect and Apple Music compatibility, an intuitive Touch interface, streaming and storage of up to five Internet stations directly on the speaker, speakerphone capability, 8-10 hours’ battery life and can be configured and controlled via the free Libratone App.

The ZIPP and ZIPP Mini are available in two versions: The standard edition combines a durable white base with the fresh and stylish Cool Weave fabric; The sophisticated Copenhagen edition combines a strong aluminium base with a soft Italian wool cover. Both feature interchangeable covers and are available in a range of fashion and décor colours.

With the next-generation ZIPPs, setup, streaming and sharing have become even easier. Libratone set out to liberate users from the typical maze of apps, downloads and non-compatibility issues – and they did just that. When friends come around, they can easily link their smartphones to a ZIPP ecosystem or customers can connect their ZIPPs together to create an impromptu sound system no matter where they are. The opportunities are endless.

“The ZIPP Classic has always been our best-selling product,” says CEO Jan McNair. “Nevertheless, we see the new ZIPP speakers as our most focused and refined achievement to date.”

Iconic products

The iconic ZIPP Classic

Over the course of its short history, Libratone received a multitude of prestigious awards. But no product was as well received as the Libratone ZIPP Classic, launched in 2013. It blew the competition away and received excellent reviews, from CNET, Wired and What Hi-Fi? among others, for its stylish design and superb sound quality.

The Libratone ZIPP was the first to offer a 360° speaker. Krøyer explains: “The ZIPP was designed to be the first true centrepiece speaker. We imagined it as a portable design piece that you could literally place on the table at a dinner party and it would be an integral part of the décor and the ambiance. At the same time, we wanted the sound to be rich and lush and enjoyed by everyone equally, no matter where in the room they were seated.”

The ZIPP Classic also served as inspiration for the follow-up products, the ZIPP and ZIPP Mini, released in 2015. Geared toward a younger, more global audience, the next-generation ZIPPs are designed for ultimate portability and flexibility.

Cutting-edge technology

Technology is the driver

Technology has always been the key driver to Libratone’s success. Although the sleek Scandinavian design is what initially catches the eye, Libratone’s patented FullRoom™ acoustic technology is what catches the ear and draws consumers in for a deeper, richer sound experience like no other.

Behind FullRoom™

Traditional stereo setups require multiple speakers, all arranged very precisely and aimed at one particular spot. With FullRoom™ technology, sound radiates from the source, disseminating, enveloping and encircling the listener. No longer are audiophiles tethered to the one spot where the dual speakers meet – now they can wander freely around their home enjoying the nuanced sound that follows them.

FullRoom™ disperses acoustic waves, at a full 360°, that reflect off the walls to evenly distribute the sound. High-end components for digital signal processing and digital amplification deliver crystal-clear highs that reach every corner of the room, creating a faithful reproduction of the recorded work. The acoustic quality that FullRoom™ delivers has shattered all notions of what wireless speakers are capable of. And the FullRoom™ experience can be customised with the Libratone APP, which matches the settings of the speaker to the specifications of the room.

The Libratone App and Touch interface

The Libratone App is designed to be the central control hub for all Libratone speakers. Users can simply download the app for free from App Store or Google Play and use it to configure and control their Libratone speakers. The Libratone App contains all the information consumers may need about their speakers, from setup and customisation to playback and volume control and even support. They can also communicate and interact with Libratone through the app.

In 2015, the Touch interface was launched on the ZIPP and ZIPP Mini. The Touch interface is the speaker's physical control panel and adds another quick and easy method of controlling the speaker without the need for a secondary device. Both the Libratone App and Touch interface are designed to enhance the customer experience by giving the customer multiple unique ways of interacting with their speaker.

SoundSpace Link

Libratone speakers allow listeners to create their own SoundSpaces™ – and listen however and wherever they want, with one or multiple speakers, inside or outside. SoundSpace Link is the feature on Libratone speakers that lets users create SoundSpaces with two or more speakers.

Introduced in 2015, Libratone's next-generation ZIPP products, including the ZIPP Mini, are enabled with SoundSpace Link. With two or more SoundSpace Link speakers and a WiFi router, users can create their own personal SoundSpace speaker group. With a single touch of the speaker's Touch interface, they can quickly and easily link their speakers. They can also link them using the Libratone App.

Future focus

A promising, dynamic future

Swimming against the current of most of the audio market, Libratone has identified and secured a unique market position that attracts consumers seeking superb sound quality, flexibility and portability. "Consumers demand the freedom of a portable speaker, but they don't want to compromise sound quality," says Libratone CEO Jan McNair. "We've managed to deliver innovative wireless speakers that tick all the boxes. Our ecosystem of portable wireless speakers, perfect for at home and on-the-go, are easily integrated, personalised and rearranged to suit all the unique moments of our customers' lives."

A significant brand shift

2015 marked a major milestone for Libratone. After significantly investing in a technological and aesthetic redesign, the next-generation ZIPPS were tailored and ready for a truly global audience. With the successful launch of the new ZIPPs, Libratone was ready to make the transition from a small Scandinavian niche brand to a leading global audio brand.

McNair explains, "Prior to 2015 we were a premium niche brand geared towards a sophisticated, affluent audience with minimalist design sensibilities. What we've become is a significant global brand with a younger, more diverse audience. We aim to be a leading audio brand in Asia and certainly in the top five in Europe and the US."

In order to make the next-generation ZIPPs more attainable for a younger audience, McNair says, it was important to make them more affordable. They were

Timeline

2010

As the first Libratone product on the market, The Libratone Beat launched the company's fundamental mission to combine exceptional user experience with superb acoustics and smart Scandinavian design. Built before the availability of AirPlay, the Beat was not truly wireless. After establishing a relationship with Apple, AirPlay was later integrated and the Beat evolved into the Libratone Live, launched in 2011.

2011

The Libratone Lounge was the company's first soundbar, designed to enhance the viewing experience through exceptional sound while acting as the central sound source for the room. As users can stream to the Lounge from virtually any device, no additional speakers are needed. With a distinguished look and feel, more like a piece of furniture than a piece of HiFi, the Lounge proved that soft Italian wool pairs perfectly with any flat screen TV and enhances the décor of any room.

2012

The Libratone Zipp was the company's first truly portable 360° wireless speaker, dispersing sound in all directions. The Zipp has continuously earned 'best-in-test' reviews and has won numerous awards for both design and technology, including the International CES Innovations Design and Engineering award, and multiple Red Dot awards.

able to do that with the help of their private investment partners in China. “With their help, we invested in our own technology platform, so we no longer need to rely on third-party ODMs (original design manufacturers). We’ve also secured larger-volume high-quality production in China.”

Libratone has also opened R&D facilities in Beijing to support and complement their R&D team in Denmark. The company’s headquarters remain in Denmark.

The road ahead

With the future of the audio industry looking very dynamic, McNair says it’s an exciting time to be leading a company like Libratone. “Although the smartphone is such an integral part of music streaming right now, I think in the future, consumers will prefer to keep their phone free and stream directly to their speaker. I also think wireless portability will be a growing trend and consumers will increasingly look for great sounding Bluetooth-enabled headphones and other portable speaker options. At the same time, music and other content sources will continue to multiply and consumers will want the freedom to stream from as many sources as possible.”

As Libratone heads into the future, armed with its intelligent streaming platform, FullRoom™ acoustic technology and iconic, fashionable design, the company intends to interact more with its global audience, grow that audience exponentially and become a significant audio force on the international market. ■

2013

An evolution on the 360° theme, the Libratone Loop took the company’s signature FullRoom™ sound, curved lines and soft fabrics and made them wall-mountable. A stylishly versatile form factor, the Loop can also stand on a shelf or table and makes an excellent accent to any décor.

2014

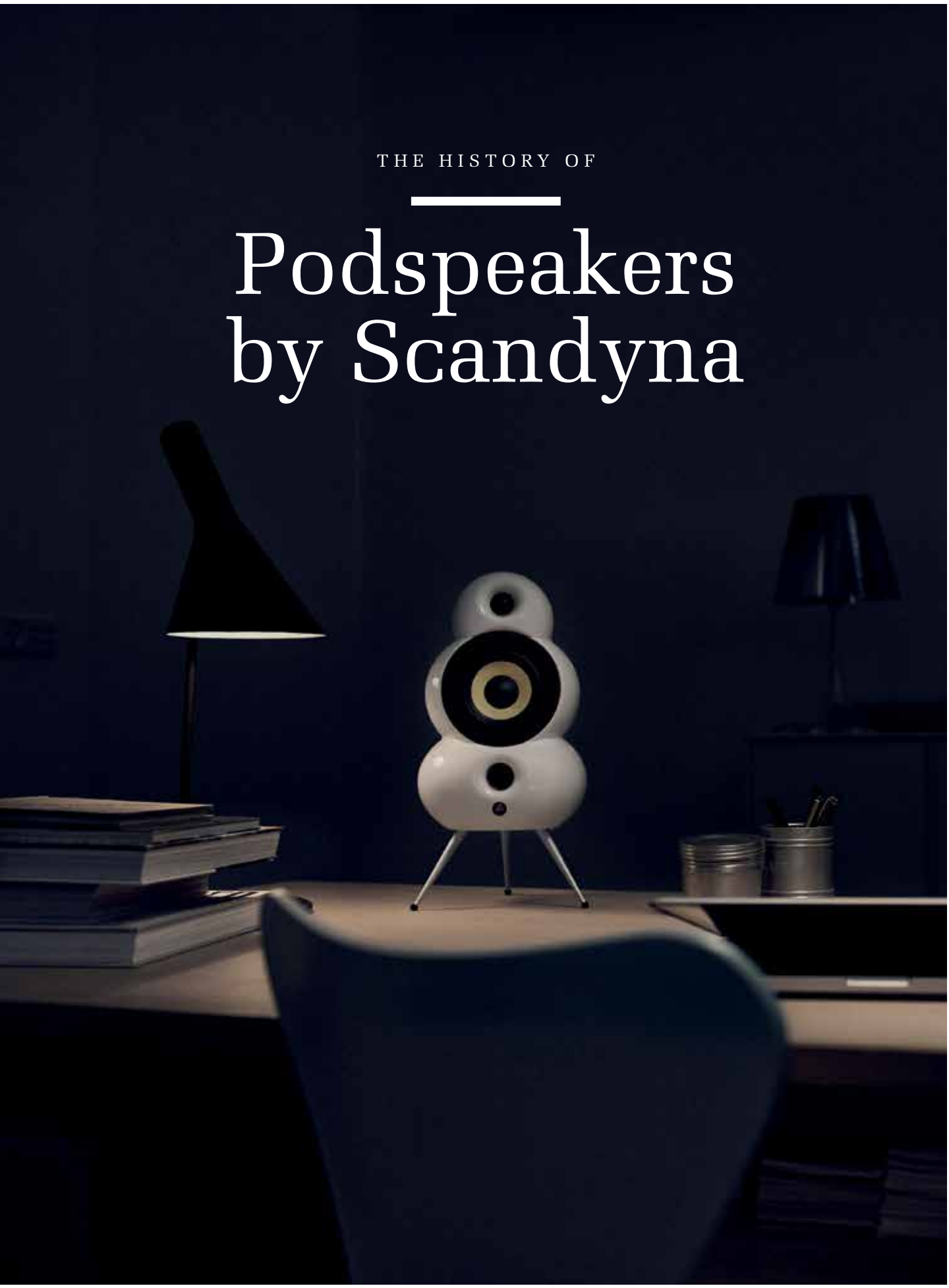
The Libratone Diva took the soundbar to a chic new level with a slimmer shape and curvier lines. Boasting extremely powerful FullRoom™ sound and seamless streaming, the Diva was the first Libratone product to integrate Bluetooth® technology. In 2014 the Zipp and Loop also became available with Bluetooth integrated.

2015

A technological and aesthetic redesign of the classic Zipp, the Libratone Zipp and Zipp Mini introduced the company’s signature Cool Weave fabric and SoundSpace Link. SoundSpace Link links together more than one Zipp, so users can create their own SoundSpaces by streaming music, podcasts, movies and more in any space across their home with Libratone speakers.

THE HISTORY OF

Podspeakers by Scandyna



The story of Scandyna spans five decades. The company is founded in 1965 by Peter Hasselriis. Over the next five decades Scandyna is dedicated to producing high-quality speakers with natural sound reproduction for a discerning audience.

The history

Scandyna – the beginning
In the first decade, Scandyna produces the DYNACO A-25 shelf speaker, and the Scandyna 3000 and 4000. In the mid-1990s, the company introduces the iconic MiniPod design loudspeaker to a wider audience of audio and design enthusiasts. The MiniPod is well on its way to becoming a modern classic with its 20th anniversary this year (2015), loved for its futuristic, still relevant design and its natural sound quality.

History and highlights
In 1965 Peter Hasselriis establishes Scandyna. Prior to this he has been an Export Manager at B&O. The Scandyna company starts by importing products from the US, but soon the business is turned around, and instead of importing from the US, the company starts to export from Denmark to the US. The first products are the DYNACO A-25 speakers.

In 1969 the company has 200 employees. The AV receiver named Scandyna 3000 is developed. Right after it comes the A-45 speaker, providing the company with a complete product range. The DYNACO A-25 speaker is voted "Best Speaker" in the US, and sales go sky high.

In 1970 the company establishes Scan-Speak speaker production at Hørning (in Jutland, Denmark) with expected sales of 200,000 units per year. Between 1970 and 1975, Scandyna has a market share of 20% in Denmark, with over 50,000 receivers sold, and amazing sales of more than 1.7 million of the popular DYNACO A-25 model.

In 1990 Peter Hasselriis begins selling speakers and speaker components to two major British speaker manufacturers, Bowers & Wilkins and KEF. This leads to a long-term relationship with Bowers & Wilkins and some of their key staff members.

The Podspeaker era – from square boxes to shaping sound
After spending a number of years as a successful component supplier to manufacturers KEF and Bowers & Wilkins, Scandyna enters the market with the highly acclaimed MiniPod, designed by Simon Ghahary and Lawrence Dickie – both of whom play a significant role in the development of the world-famous Nautilus series at English speaker producer B&W. At this point, the parallel stories of Scandyna and the Podspeakers emerge and take their first steps together into history and out into the world.

Simon Ghahary is an English born artist, brand architect and lifestyle engineer from the United Kingdom known primarily for his unconventional speaker designs.

Simon Ghahary and shaping sound
Simon Ghahary (born in England on 12 May 1972) lives close to the B&W manufacturing plant. Simon approaches audio product design as an art in itself, inspired by nature, technology and art.

"The shape of sound inspires me. I first began to visualize sound as being alive. My desire was to create forms that embody this concept. For me, the speaker is not only playing a technical function. It was more like an instrument. As an instrument that was as capable as all musical instruments. Like a window granting access to the outside world, speakers are a voice for our own musical choices."
– Simon Ghahary

Facts

PODSPEAKERS
Shaping Sound

Company name
Scandyna/EET Group A/S

Head office
Birkerød, Denmark

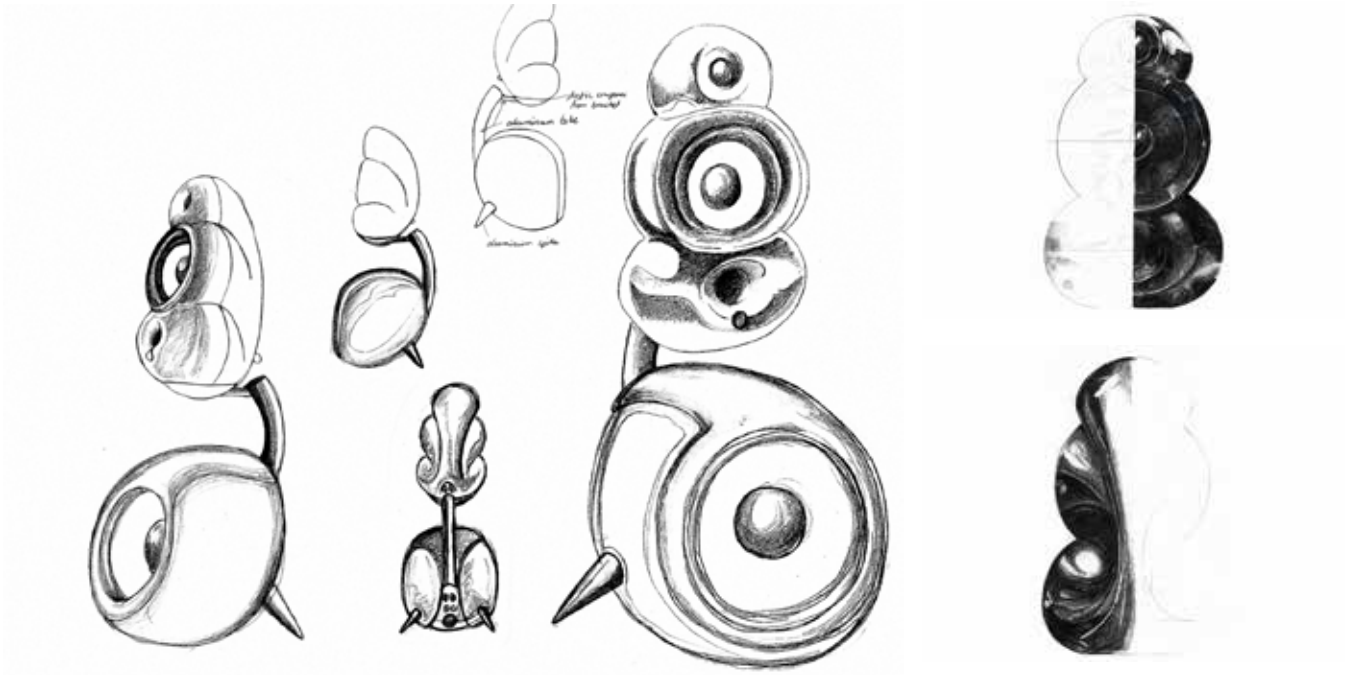
Established in year
1965

Established by
Peter Hasselsriis

Main audio product types
Loudspeakers

Main markets
Scandinavia, Europe

Number of employees
5-9



The Pod's design seeks to create a speaker capable of achieving perfect sound quality while at the same time challenging the traditional, square standard that dominates loudspeakers at this time. Convinced that the ideal way of transmitting sound waves naturally is via round cabinets without flat surfaces and sharp edges, the Pod range is an antidote to the convention of square, box-type enclosures.

In 1991 Simon Ghahary designs the Podspeaker (initially called the HousePod) based on the idea that loudspeakers perform better in a rounded form than in a square box. A chance encounter and subsequent friendship with Bowers & Wilkins engineer Laurence Dickie (who pioneered the Nautilus speaker) leads to the 1993 release of his first Podspeaker range. Ghahary manages to design the entire seminal Pod range, which includes the MiniPod, Bass Station, CinePod and MicroPod.

In 1992 Ghahary founds Blue Room Loudspeakers, which is then integrated into B&W Loudspeakers, championed by Robert Trunz. This move makes the global release of Ghahary's Pod designs possible.

The HousePod wins the European Image and Sound Association (EISA) Award 1995–96 for audio design, which Simon Ghahary accepts on behalf of Blue Room in Berlin. This is a magnificent start for B&W Loudspeakers and secures cult status for changing the face of the domestic hi-fi market. The Pods have really become an antidote to the convention of square, box-type enclosures. They spearhead a revolution in audio design, the effects of which can still be seen today.

In 1995 the first MiniPod is born. The first MiniPod cabinets produced are moulded in-house in the workshop facility at B&W Loudspeakers. The expense and time involved does not allow the potential of mass production, and so the original MiniPod begins its life as a relatively exclusive product. Only 4,000 units are made, at a price of DKK 12,000 each.

From fibreglass to ABS plastic

In the first instance, at B&W, the Pods are made from fibreglass. They are very expensive and are mainly sold (under the Blue Room logo) to a few audio and design enthusiasts who are willing to pay the price (approximately DKK 12,000). When Scandyna takes over the production in 1998, the Pods are manufactured in ABS plastic and some improvements are made. This makes it possible to reach a lower price of approximately DKK 4,000, which people in general who are interested in music and design can afford.

Jaguar Racing Green, Apple, Friends and Madonna

When Scandyna takes over the production, it becomes possible to produce the MiniPod in different colours at a reasonable price. For a while, the MiniPod turns Jaguar Racing Green – the Jaguar importer in the Netherlands orders 190 MiniPods. Later on, even a limited-edition transparent plastic MiniPod is made, which is very popular in combination with Apple Mac computers at this time.

Imagining two MiniPods joined together is the starting point from which Simon sculptures the form.

In 1996, Blue Room Loudspeakers separates from B&W, and it becomes an independent entity in 1997. The MiniPod is reborn after production is moved to Scandyna in Denmark – using high-stiffness, recyclable ABS plastic. A number of improvements are made to the general functionality, and the new MiniPod model becomes a reality. The Sputnik spikes fixing mechanism, the wall bracket, and experimentation with a spectrum of colours and finishes, including transparent plastics, are now possible.

In 1998 the Bass Station is born. With the prospect of competing in a cinema set-up, it is apparent that the MiniPod needs some extra bass extension, and therefore a new design is called for. The ancient form of a percussionist's drum inspires the Bass Station. The sub bass driver sits horizontally on top and vibrates like a drum skin, conducting sound through the cylindrical body of the subwoofer cabinet to the bass-port horn positioned underneath.

Over the years, the Podspeakers are sold on the Scandinavian market through Hi-Fi Klubben's chain of shops. Hi-Fi Klubben starts selling the HousePod in 1995. When Podspeakers are reintroduced to the Scandinavian market in the year 2000, 16 MiniPods are sold in Denmark in the first month. This marks the beginning of a partnership between Hi-Fi Klubben and Scandyna.

In 1999–2001, the CinePod joins the Pod range. Simon Ghahary once again works closely with acoustic engineer Laurence Dickie. Imagining two MiniPods joined together is the starting point from which Simon sculptures the form. The MicroPod is born in 2001 and is originally conceived as a complete home cinema audio solution. The initial ideas are based around the shape of the MiniPod.

During the 1990s, Scandyna gains a lot of attention from the MiniPod being shown in the television sitcom "Friends" and is also gifted a lucky break with UK band The Grid (Richard Norris and Dave Ball) with multiple white Pods filmed for a music video, "Swamp Thing". It happens like this: Simon Ghahary receives a call from Think, the London-based design and PR company, requesting he put together as many white Pods as he can fit in a truck. David Roberts and Simon Ghahary split a shipment destined for export and race to London with everything they have. The Pods are scattered throughout the studio and filming begins. It is shot in a day and they travel back to Brighton late in the evening.

Released in June 1994, "Swamp Thing" by The Grid is a monster of a tune. It reaches number three in the UK charts and is in the Top Ten for eight weeks. Pods also appear on both of The Grid's album covers. The video plays everywhere, and the exposure is priceless.

At this time the original roster of colours is just black, white and blue, so Simon starts to experiment. Through a team-up with Erisbian Garbs of Brighton, a duo of eccentric and highly talented designers of fashionable leather products, a project is born to create a unique pair of HousePods covered with leather, intended as a gift for Madonna. Unfortunately these speakers go missing during a film shoot in Denmark and never make it to the Queen of Pop.

When the Apple MP3 iPod and iPod Mini are selling very well in 2005, Apple takes Scandyna to court because of the use of the term "MiniPod". However, the court rules that Scandyna is allowed to sell products under the "MiniPod" name as long as the company does not launch an amplifier under this name.

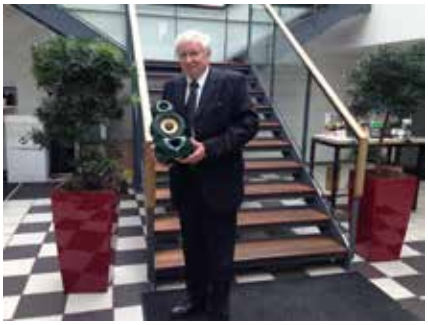
When Scandyna celebrates its 40th anniversary in September 2007, the company has produced more than 100,000 MiniPods.

In the years that follow, the Drop (2007, designed by Graham Allen), the BigPod (2012), the SmallPod (2012, Bluetooth 2011, Airplay 2013) and the MiniPod BT (2013) are added to the Podspeaker range.

As of 2011, Peter Hasselriis is no longer involved in Scandyna. Bent Hovendahl (former owner of Eltax and the Tangent brands) and Halberg Capital take over the company. In this period, the audio business is shifting from analogue (passive) loudspeakers to almost exclusively active loudspeakers, and so the company incorporates amplifiers and focuses on updating the technology to streaming technology with Bluetooth and Airplay. Also, the production moves from Denmark to China.

From the 90s until today, the Podspeakers are featured in several films and in many lifestyle and design magazines.

In June 2015, Scandyna is acquired by the Danish distribution company EET Europarts. The company's ambition is to further expand the success of the Podspeakers throughout Europe and worldwide via EET Europarts' wide distribution network. Peter Hasselriis is pictured here visiting the EET Europarts headquarters in Ballerup, Denmark, in the summer of 2015. He is holding a Racing Green MiniPod.



Iconic products

MiniPod MKIII
The MiniPod MKIII is a stylish speaker for both stereo and surround sound. A true design icon, and the "Pod model" that starts it all. The MiniPod is one of the world's best-recognised loudspeakers. Since its launch in the early 1990s, the MiniPod has set a benchmark for what can be achieved when moving away from conventional box designs.

Its high performance and its unique and sculptural design make the MiniPod one of the world's most exceptional speaker icons. The MiniPod comes with Sputnik spikes.

The MiniPod range receives the Plus X Award for design in 2005.

In 2015, the MiniPod MKIII receives the distinguished Diapason D'Or 2015 Award in France. Diapason is one of the finest French awards for Hi-Fi products: the Minipod MKIII gets 6 out of 6 stars and wins the Diapason D'Or Award 2015.

Diapason says: "Designed by the same engineers as the famous B&W Nautilus, with which it shares the same bold design and internal load, this speaker boasts advanced technology. The third-generation MiniPod benefits from improved speaker drivers and crossover. The bass is taken care of by a 6-inch Kevlar membrane, treble by a 1-inch soft dome tweeter. It stands on aluminium feet. Their light weight could cause concern, but it is not a problem. The MKIII MiniPod wins with evidence. Phase, depth and width are of staggering precision.

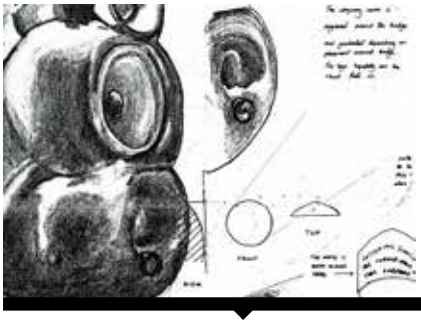
Similarly, the timbre does not suffer from the use of plastic, while the bass is natural and generous. With its speed and responsiveness, this speaker shows undeniable dynamic qualities."

CinePod
CinePod is a stylish centre speaker for surround sound. Designed to be used in expanding or creating a multi-channel audio system, the CinePod is the voice box of the Scandyna family. The most important loudspeaker in a home theatre system, the centre channel is responsible for around 70% of any movie soundtrack, so it needs to be capable, agile and responsive.

In 2005 the CinePod is honoured with a Plus X Award for design.

The Drop
The Drop is a drop-shaped speaker for both stereo and surround sound. It features the same design principles as the other "Pods", yet in a different form. The Drop's rigid cabinet offers different mounting options, making it one of the most versatile loudspeakers on the market. As well as conventional desk-top or book shelf mounting, the Drop's unique "hanging" bracket

Timeline



1965
Peter Hasselriis establishes the company Scandyna.

1970
Scandyna establishes Scan-Speak speaker production in Hørning.

1991
Simon Ghahary designs the Podspeaker (initially called the House Pod).

1995
The first MiniPod is born, and Hi-Fi Klubben introduces Podspeakers to the Scandinavian market.

1998
The BassStation is born.

2000
Hi-Fi Klubben re-introduces the Podspeakers in Denmark, Norway, Sweden and The Netherlands.

makes it ideal for those who want the same Scandyna sound performance but from a product that can be suspended from the ceiling. The Drop is ideal for those who wish to make a statement in both appearance and performance.

BassStation
The BassStation is a subwoofer for both stereo and surround sound. The BassStation is emotive and always underpins any sound system. The BassStation with its 150 watt class D amplifier and 250 mm long throw drive unit creates more emotions than most. It reproduces deep, clear notes that can be both subtle, as part of a symphony, or impressive, as part of a movie soundtrack. As a perfect companion for any of the Scandyna loudspeakers, the BassStation will integrate into any space and enhance the sound performance for a truly compelling listening experience.

The BassStation is honoured with a Plus X Award for design in 2005.

MicroPod SE
Scandyna MicroPod SE speakers are compact speakers for stereo and surround. They are suitable for both two channel stereo and home theatre surround sound applications. The MicroPods are full-range speakers and can be used on their own. They can also easily be matched with a subwoofer for added bass presence. MicroPod SE speakers come with aluminium "Sputnik" spikes or can be wall mounted using the optional wall bracket.

In 2006 the MicroPod SE receives a Plus X Award for design.

Future focus

Podspeakers for the modern generation
Even though Danish company Scandyna's history goes back to 1965 and includes the overwhelming success and iconic status of the Podspeaker range in the 1990s, Podspeakers continue to impress hi-fi enthusiasts with their unique design and impressive sound. What surprises most people is the fact that Podspeakers were designed back in the 1990s. The goal then was to develop high-quality speakers with a unique design that people could afford to buy. The mission has been accomplished, and the results are still astonishing.

The company behind the Podspeaker brand today, EET Europarts, will continue to breathe new life into the Podspeaker range, and to ensure that the speakers match the needs of the modern generation. The digital audio era for streaming services is growing, as are the new concepts of multi-room and interoperability between brands and platforms. The Podspeakers' functionality and performance will change accordingly and will follow this trend, but the core focus on iconic design with great sound will stay the same.

EET Europarts hopes to bring the brand and history of Scandyna and Podspeakers great success in the years to come. EET Europarts believes that the design is significant enough to remain iconic as a modern classic that will continue to be relevant to a lifestyle and design oriented global audience. ■

2001
The MicroPod is born.

2007
The Drop is designed by Graham Allen.

2011
Peter Hasselriis leaves the company and Bent Hovendahl and Halberg Capital takes over the ownership of Scandyna.

2012
The BigPod and the SmallPod BT 2012 are launched.

2013
The SmallPod Airplay and the MiniPod BT are launched.

2015
Scandyna is acquired by EET Europarts and MiniPod MKIII receives the distinguished Diapason D'OR 2015 Award.

THE HISTORY OF

PointSource Acoustics

In 2009 PointSource Acoustics was founded by engineer and R&D loudspeaker expert, Carsten Tinggaard. Since then, PointSource Acoustics has taken huge steps towards being the world´s most accurate and fastest sample production lab for loudspeakers.

The history

PointSource Acoustics owner, Carsten Tinggaard, has 17 years of experience in loudspeaker research and development. This includes High-End tweeters, midrange drivers, complex woofer designs and platforms from the small 1.5" mini full-range drivers to the larger 15" subwoofers.

The founder of PointSource Acoustics
Carsten Tinggaard studied Engineering at the University of Southern Denmark (SDU) and later at the Technical University of Denmark (DTU) between 1992-2000. In 1998 he finished his Bachelor of Acoustic Engineering at SDU, and thereafter he applied for a job in Mexico with the intensions of becoming an underwater acoustic engineer. Life turned out differently and instead he travelled to Spain where he worked with speakers and acoustics solutions. In 1999 he returned to Denmark and took the 8 Master´s degree courses in acoustics available at DTU while working as a freelance acoustic consultant.

Education and theories alone are not sufficient knowledge to generate great sound solutions, so between 2000 and 2009 Carsten Tinggaard gained the practical core expertise that forms the basis of PointSource Acoustics' expertise today.

In 2000, he landed a job at Peerless in Karlslunde, Denmark working as an Acoustic Engineer. Those were the great years, when the factory used its own tools, treated the raw materials, and manufactured all speaker parts in-house including the final assembled drivers. Numerous acoustical experiments were carried out by Carsten Tinggaard, leading to hard-core theoretical discussions with the very experienced grand old man within in the loudspeaker industry, Knud Thorborg.

In 2003 Carsten Tinggaard became the Peerless' Product Manager under Danish Sound Technology (DST) where he teamed up with Gert Christensen, today Product Manager at M&K Sound. Together Knud Thorborg, Carsten Tinggaard, and Gert Christensen designed many drivers for the audio industry. All three played an important role in the Danish loudspeaker industry throughout those years.

In 2005, the company changed ownership and name to Tymphany and between 2005 and 2009 it endured more changes. The factory in Karlslunde was shut down. Production was moved partially to Jutland and the rest to China where Tymphany built a state-of-the-art manufacturing site in Panyu, Guangdong. A new R&D site was also established in Taastrup (20 km from Karlslunde) where Carsten Tinggaard became Chief Engineer, responsible for the development of all three Danish loudspeaker brands: Peerless DK, Vifa DK, and Scan-Speak.

The R&D site in Taastrup had grown to include a strong team of more than 20 people, covering R&D, QA, and Sales. But due to the global financial crisis end 2008, Tymphany decided to shut down the R&D site early 2009.

Gert Christensen (left), Knud Thorborg (middle), Carsten Tinggaard (right) - Copyright © Brüel & Kjær

PointSource Acoustics - a new beginning
The shut-down of the Taastrup site came very unexpectedly but it opened up a new opportunity for Carsten Tinggaard to start his own company named PointSource Acoustics. The vision was clear: PointSource Acoustics should help clients by filling the huge gap between the conception and product realization. Often, potential clients asked: "How fast can you make a sample matching the specification?" It thus became a mission for PointSource Acoustics to build and develop the world´s most accurate and fastest sample lab.

It is indeed a good start to have great ideas, know fundamental theory, simulate for best results, and create 3D CAD models to visualize what words cannot cover. However, without fast execution in converting

Facts

Company name
PointSource Acoustics

Head office
Roskilde, Denmark

Established in year
2009

Established by
Carsten Tinggaard

Main audio product types
Loudspeaker driver designs. Acoustical, mechanical and electromagnetic measurements.

Main markets
Europe and USA

Number of employees
6

ideas, simulations, and CAD drawings into a producible and playing loudspeaker, no one can sit down, relax and enjoy the music.

The name "PointSource Acoustics"
During the start-up years of 2009-2011 it was very important to develop a robust business model that could grow the company even in tough financial times. It was important the company name was not limited to Hi-Fi, Home Entertainment, in-wall, lifestyle, PA, automotive, etc. A "point source" in the theoretical world is identified as an ideal sound source (a point in space). Any calculated wave propagation in air begins with an ideal point source. Such a concept intended to include all kind of industries needing ideal acoustics solutions. With this thought in mind, the company name was born "PointSource Acoustics" (PSA).

Long term strategy and robustness
The first years (2009-2011) were very challenging: cash flow was low; projects were few and with no lab facilities, the consultancy service was limited. But the long term mission and strategy remained clear - to build up a world-leading sample lab with the most sophisticated measurement equipment that could objectively quantify and evaluate all kind of transducer performance in the most precise and accurate way.

The home garage of 20 m^2 was quickly remodeled into an office space. A generous company, System Audio in the nearby town of Roskilde lent out an extra 20 m^2 where Carsten Tinggaard could build his first anechoic chamber.

As projects were few, his focus concentrated on creating a robust process. Robustness, where the business would be less affected by global and individual markets' ups and downs, then became part of the company's business strategy. The first years were therefore dedicated to developing a consultancy service, covering the core expertise of PointSource Acoustics by making internal procedures and universal templates.

With this setup, the focused strategy soon began to produce results, resulting in an increase in consultancy work. This covered varied industries and areas of the acoustic field and with very different applications. Even though the tasks and applications were completely different, the company's core expertise elements could respond to the challenges.

The Cooperation with Montana Møbler
Then a question came to mind: why focus solely on the traditional loudspeaker industry? Why not create a link with a company from a completely different industry? Carsten Tinggaard set himself high standards: it had to be a Danish company and it had to have the similar degree of recognition in its own industry. In other words, it had to have "the Danish label" and have solid marketing and sales functions. Such a partnership would allow PointSource Acoustics to focus on the R&D side and the development of its specialised core competence.

The Danish furniture industry was an ideal match and a new working relationship bloomed between PointSource Acoustics and Montana Møbler A/S. This marked the beginning of the creation of a new series of loudspeakers whose goal was to be elegantly concealed within the Montana furniture and out of sight.

The invisible integration of high quality audio, a clean look, and no visible cables - all the essential ingredients to win the approval of having a powerful sound system in a modern household.

Due to increased Montana production there was a pressing need for more space, so PointSource Acoustics rented a further 100 m^2 in Carsten Tinggaard's home village.

It was the first step in the direction of what became possible for PointSource Acoustics in the 21st century: to re-establish loudspeaker assembly production in Denmark. To complete the Montana loudspeaker assembly in Denmark it was essential for PointSource Acoustics to ensure high speaker quality and to guarantee 100 % outgoing quality control.

Unique combination of research, accuracy, practical diagnostics, and operational know-how
PointSource Acoustics aims to constantly improve the sound quality of loudspeakers. There is a drive to run new research projects, not for the sake of research itself but to go beyond the complexity of the loudspeaker and to better understand how to convert research into practical improvements. Such improvements should enhance the beauty and joy of listening to reproduced sound. This can only be achieved through cutting edge research and highly accurate measurement equipment to identify and quantify the subjective sound improvements.

In 2011 PointSource Acoustics invested in the Klippel analyser to be able to measure the large signal non-linear behaviour of the speakers and the different distortions as harmonic, difference tone and multi tone. A highly accurate laser was selected and integrated to measure the driver parameters. Having the Klippel analyser, objective measurements of large signal non-linear

Production of 4x6 middle loudspeaker PointSource Acoustic.

behaviour could now be supported and combined with the distortion measurements from the 2pi anechoic chamber facilities.

A huge step

In 2013 space became an issue for the company again and with three different locations it was time to make an important decision. In September 2013 PointSource Acoustics moved into a new laboratory facility of total 304 m^2 in Roskilde. The location was one big room but within a month new walls were set up to create office space, conference room, glue lab facilities, sample lab facilities, new 2pi anechoic measurement chamber, workshop, assembly and power test facilities including nice stock and packing facilities. The new environment was a catalyst to keep the momentum around developing more accurate measurement methods and investigate the root causes of complex behaviour in loudspeakers.

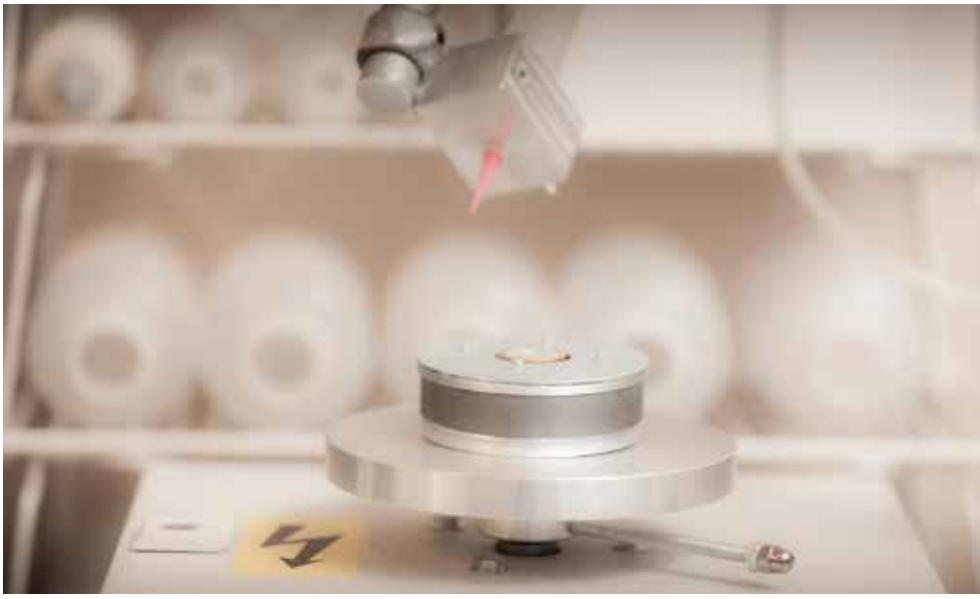
In 2014 this led PointSource Acoustics to design and construct a velocity driven Force Factor measurement equipment to measure, verify, and control all kinds of magnet systems and their non-linearities. It became possible to gain knowledge about the flux modulation based on measurements. Morten Halvorsen, a student from the DTU, decided to do his Master thesis in cooperation with PointSource Acoustics and the results were presented on AES convention 138 in Warsaw in spring 2015. In August 2014 Morten Halvorsen finished his Master in Acoustics and was hired by PointSource Acoustics.

It turned out to be a powerful measurement tool that supported the other measurements in the lab, such as an advanced curve fitting method to fit measurements to the loudspeaker model at higher frequencies. This method was developed in close collaboration with Knud Thorborg who frequently visited the PointSource Acoustics lab until the age of 86 years.

With the above described measurement tools it became possible to separate a loudspeaker's three fundamental elements: the electromagnetic, the mechanical moving structure, and the vibro-acoustics of the loudspeaker. The practical hands-on experience together with separating the elements has proved to be an outstanding combination, leading to accurate driver diagnostic of the root cause and fast problem solving.

Loudspeaker prototype and sample build

To achieve a healthy knowledge bank of loudspeaker simulations, it is necessary to match simulations with the actual built driver. It is a self-feeding closed loop that can be compared with adaptive signal processing where the input and output are constantly been compared. PointSource Acoustics has an internal database where measurement data of approximately 1200 built samples has been collected over the years. The data is statistically managed and the results are constantly compared with actual simulations to be able to predict the loudspeaker parameters within a 2-5 % deviation from the real built sample. It has become another powerful and efficient tool in the design phase when clients need to speed up the time-to-market timeframe.



A fully-automated glue machine designed and constructed to fulfil the high requirements for a sample build.

To ensure correct data from the sample build is transferred back into the database, it is important to control the assembly process. Here again, much attention is given to structured procedures, precision, accurate glue amount and placement, practical experience and know-how about the individual parts and their strengths and weaknesses.

At the time, a fully automated glue machine suitable for the requirements of PointSource Acoustics was not available on the market. Without it, the reproducibility, precision and accuracy of the sample build was not possible.

Consequently, in 2012 PointSource Acoustics designed and constructed their own glue machine with the accuracy needed to assemble loudspeakers with high accuracy and high reproducibility. It worked fine but went through several upgrades to improve flexibility and faster operation. In May 2015, the glue machine was finally completed and today it is an integral part of the loudspeaker build procedure. The sample build and the measurement results are so accurate that the loudspeaker measurements in the data bank are now used with great success to simulate and estimate the new loudspeaker parameters that match the client specification. Since its foundation in 2009 PointSource Acoustics had made many steps in order to build up a robust company. Investments in highly advanced measurement and simulation equipment, developing and creating its own glue machine and Force Factor measurement machine, and continuously improving the internal procedures and templates. Thus, PointSource Acoustics has taken a huge step towards being the world´s most accurate and fastest sample production lab.

Iconic products

Montana by PointSource

The brand name 'Montana by PointSource' is a unique outcome of two well-known Danish industries that un-traditionally have teamed up: the Danish furniture industry and the Danish loudspeaker industry. Both industries are famous for their expertise, design, and high levels of quality. Together they created the Montana Sound concept.

The Montana Sound modules have been designed for storing Hi-Fi systems and electronic equipment. PointSource Acoustics has developed three different loudspeaker sizes and one Montana Sound Unit amplifier - all specifically designed to complement the Montana modules. The stable foam pads between speaker and

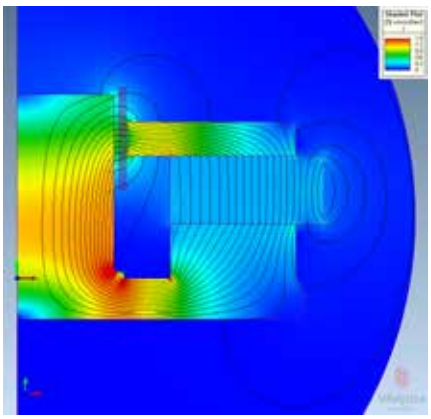
furniture ensure no mechanical contact; the top and bottom mounting plates work as a vibration killer of box resonances and the 10mm gap at the bottom is part of an acoustic-optimized resonator for extending bass response. Here there are no compromises. Superb sound quality, perfect integration with Montana´s shelving systems, and compatibility with various types of wireless streaming.

In 2010, the first loudspeaker (4x6 mid-size) was launched. Shortly after came the smaller size 2x4 speaker and in 2013 together with the launch of the Montana Sound Unit came the big and powerful 6x8 loudspeaker. In parallel with the consultancy services, the Montana by PointSource speakers and the Montana Sound Unit (MSU), there is another branch of PointSource Acoustics: a long-term investment basis closely related with the strategy of building up a robust and solid company.

Cutting-edge technology

Since the foundation of PointSource Acoustics in 2009, one of the key visions of the company is to be a global leader in motor design simulation and relating that to the real loudspeakers. In order to achieve this vision, PointSource Acoustics made its first investment in a highly advanced 2D Static and Transient license for Infolytica´s FEA simulation tool MagNet. This enabled PointSource Acoustics to simulate force factor non-linear curves and optimise the working point for the magnet and electrical impedance curve, before building a prototype driver.

In the last couple of years, PointSource Acoustics has invested additional resources to increase the knowledge of the many complex phenomena in motor systems such as saturation, eddy currents, stray fields, and flux modulation. This includes investment in motion solvers and 3D solvers for MagNet and the acquisition of a dedicated FEA super computer, optimized to run highly complex FEA simulation scenarios. This includes 2D simulation with symmetrical axis speakers or with any shaped driver in 3D, fixed voice coil positions with any given signal and even simulations of voice coil dynamic motion.



Flux lines and B field simulated in MagNet.

To obtain a result as close as possible to the real world, PointSource Acoustics imports mechanical parameters such as mass, damping, and non-linear compliance curves into the simulation. The company is now in a position to simulate excursion, harmonic distortion, intermodulation distortion, and multi-tone response long before a physical sample is built.

From the very beginning PointSource Acoustics has been working closely with the Technical University of Denmark, DTU. PointSource Acoustics has been invited to give guest lectures, to supervise student projects and participate in technical discussions with PHDs and professors about drivers, system design, and acoustics in general.

In spring 2014, PointSource Acoustic supervised a Master´s thesis on the topic of 'Flux Modulation in the Electrodynamic Loudspeaker'. The thesis covered simulations and a measurement study of the voice coil generated flux modulation. The simulations were carried out on the FEA super computer, where the generated flux was simulated, both with the voice coil fixed in position and moving dynamically. The simulations showed how the eddy currents and the skin effect caused phase shifts and amplitude changes of the flux modulation and how the generated flux modulation travelled into the iron parts of the speaker like a wave propagation, thus demonstrating that the motor system has a memory and depends on previous states.

Timeline

2009
At the very beginning, education, experience, knowhow and networks were all there but with zero lab facilities. We started building our first 2Pi anechoic chamber at System Audio.

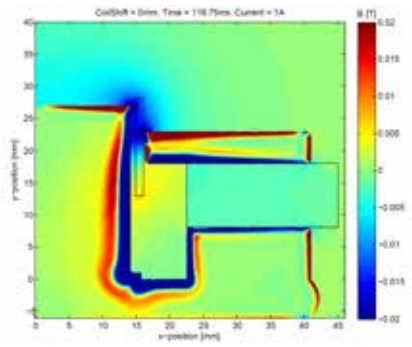
2009
End of 2009, the FEA magnet simulation tool MagNet from Infolytica was implemented. It was to simulate static and dynamic response with the transient solver incl. THD, 2nd and 3rd har.

2010
January 2010, PointSource Acoustics officially created the relationship with the furniture company Montana Møbler A/S. The first products were launched at the Koelnmesse 2010

2010
April 2010, PointSource Acoustics expanded it's production facilities area to 100m^2. The new facilities were mainly for speaker assembly and testing the Montana Sound speakers.

2011
January 2011, PointSource Acoustics invested in the Klippel analyser to add advanced measurement tools to the consultant-driven research and development side of the company.

2011
With both the Klippel analyser and more traditional ways of measuring the driver parameters, it was possible to investigate driver problems from different measurement angles.



Simulated AC changes of the B-field.

To verify the simulations, PointSource Acoustics modified its own, internally developed Force Factor measurement machine to measure the generated flux from the voice coil under blocked voice coil conditions. Comparing the measurements and the simulations showed a good consistency in the flux modulation. This thesis work has given PointSource Acoustics a deeper understanding of the complex electromagnetic behaviour of the electrodynamic driver. New student projects in collaboration with the DTU and PointSource Acoustics are underway to get even deeper into the understanding of flux modulation and its effect on motor system performance.

Future focus

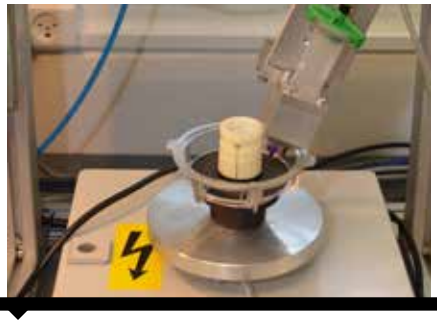
PointSource Acoustics team will continue to optimize and improve its skills and knowledge to become the fastest and most accurate sample lab. A solid fundament is established and essential equipment ensuring accuracy and efficient execution will be implemented with constant focus on improving procedures and templates. In this way our clients will see their new product ideas accelerate though the complete speaker development phase and reduce time-to-market.

September 2015, the company invested in a 3D printer. This enables the team to build prototypes rapidly. The machine fitted in to PointSouces Acoustics' goal of acting quickly, enabling the team to design and build the clients' driver samples and print parts for internal investigations.

The future focus of PointSouce Acoustics is to:

- Continue to develop the already strong relationship with universities, especially the Technical University of Denmark and its acoustics department. Help students maintain the intensity of studies and support in making their Master thesis or PhD in collaboration with PointSource Acoustics.
- Continue to improve its core expertise in 2D and 3D transient magnet simulations using Infolytica tools to do any type of advanced motional magnet simulation.
- Continue to build a strong bridge between simulations and actual driver measurements in order to more intelligently determine the driver specification, T/S parameters, and non-linearity before building the sample. This also includes improving loudspeaker models to fit the real world loudspeaker behaviour more precisely.
- Expand with focus on new material research. Develop its own measurement methods and build the necessary measurement equipment to ensure highly accurate material properties.
- Expand the company's prototype facilities with advanced production tools, fixtures, and gauges that will enable the team to make small pilot production runs and maintain the close relationship between research, development, and production.
- Focus on developing new Montana by PointSource brand products in collaboration with Montana Møbler A/S to continuously expanding the public knowledge about Montana Sound.

Finally, in expanding its R&D, sample lab and production facilities, PointSource Acoustics hopes to create more Danish jobs. ■



2012
With the accurate and advanced simulation facilities, followed the demand for a more accurate sample build. An in-house automated glue station was designed and constructed.

2012
The measurement facilities were expanded with the Klippel vacuum test chamber for micro speakers and Pascal Audio 2400W amplifiers for high-powered power test.

2013
In May 2013 a new Montana Sound speaker named "6x8 Big" and a Montana Sound Unit were developed. A new quality audio brand was born: "Montana by PointSource".

2013
PointSource Acoustics moved into new R&D facilities with office space, conference room, sample lab, 2pi anechoic chamber, assembly line, power test, workshop and storage.

2014
A Static BL(x) measurement equipment based on constant velocity was constructed. It was designed to measure, verify and control all kind of non-linearities in magnet systems.

2014
The next big step was to invest in a highly advanced 3D MagNet Simulation tool from Infolytica and a super computer to support the heavy processing capability needed.

THE HISTORY OF

Quali-Fi

Quali-Fi is a small Danish company specialized in producing full-range loudspeakers in advanced cabinets made out of sustainable materials and with high quality craftman ship. The listener's experience of music is unique in its detail, nuance and three-dimensional perspective. The beauty of the cabinets provides a similar visual experience.

The history

The history of Quali-Fi is rather long and winding, an attempt to explain it will be made in the following paragraphs. Suffice to say, Quali-Fi's focus has always been on providing the customers and listeners with an extraordinary experience of music at an affordable price. Today this is primarily reflected in Quali-Fi's line of loudspeakers built with full-range drivers and beautiful non-resonant cabinets made in sustainable bamboo. The beginning however was much more colourful.

Early days

Quali-Fi was founded by Ole Brøndum i 1963 – almost by coincidence. From his early childhood Ole had a passion for classical music. Inspired by his father – a radio amateur and inventor – he ventured into experiments with tube amplifiers and loudspeakers with significantly better performance and reproduction of the coveted music, than the equipment on the market in the day.

Somewhat later after being stationed in the USA by the Danish Navy, the American Hi-Fi equipment had made a lasting impression and raised the bar for reproduction of especially opera and heavier orchestral works.

During his studies as an electrical engineer and with a wife equally hooked on musical perfection, Ole conducted constant listening sessions and experiments with amplifiers, loudspeakers, and turntables.

One lodger – Gormsen, an architect and designer – introduced the then revolutionary pick up arm SME being presented in Copenhagen in 1963 at an exhibition for British design. SME were seeking distributors, Ole and Gormsen decided to try for it. As company name they chose Quali-Fi - a combination of quality and Hi-Fi. SME answered later that Quali-Fi had been chosen and they were very proud of that. A year later they learned that they had been the only applicant.

This was the foundation: SME tonearms were the first products on board. But more was needed to become a high end Hi-Fi supplier. Turntables were evaluated and Garrad 301 was chosen and then Shure pick ups. Gormsen designed high end plinths and through SME they got in contact with Radford and consequently also had a top end amplifier in the program. Quali-Fi also managed to get an agreement with the upcoming Dolby company. This noise reduction technology spread like wildfire in all the Scandinavian recording studios.

Later Quali-Fi got JBL loudspeakers through a contact Ole had acquired in the USA and the product lineup was pretty complete and business became serious. And this connection with JBL proved to be the most important one with regards to loudspeakers. The JBL loudspeakers were already well established in the professional sound field as the stage sound systems for the leading bands.

After a while Quali-Fi got permission to build cabinets locally in Denmark and assemble the speakers here - the products were the JBL S99 Athena, JBL Lancer 99, and Lancer 101. Under the strict supervision of JBL quality control the manufacturing of cabinets for these models was approved - all in Danish design looks and finish. This immediately gave a boost to the Hi-Fi sales.

Sales increased further when several performing musicals such as Hair and Jesus Christ Superstar and groups such as The Savage Rose were equipped with Quali-Fi gear. Later Quali-Fi supplied a large part of the European market with JBL speakers.

Quali-Fi almost became synonymous with high-end Hi-Fi in the seventies, supplying installations to many Nordic recording studios, large concert halls staging large productions such as musicals.

When the public was exposed to such an experience of sound, they started asking for more. This led to major discotheques investing in Quali-Fi systems with JBL speakers, and eventually consumers started to flock around.

In 1973 JBL was sold to Harmon Kardon, and business relations deteriorated. In the end Ole Brøndum left the company to pursue other avenues and Quali-Fi descended into more ordinary consumer product, but that – as they say – is another story.

Fast Forward

Ole Brøndum and Kurt Nielsen met in the early 2000's around other business initiatives, and discovered a common interest if not passion for good musical experiences.

Kurt Nielsen – an engineer in electronics and acoustics – had since the early seventies built loudspeakers, mostly with various full range units and using various horn designs, which was the craze of the day. 30 years later he had picked up the interest again with a vision of recreating some of the original simplicity in design and clarity of sound as in the great speakers of earlier times.

Kurt became aware of some important facts:

- Recent theoretical models and developments in loudspeaker design including new computer software that could simulate loudspeaker cabinet designs with unprecedented precision.
- Through a project in the third world

Facts

Company name
Quali-Fi

Head office
Egtved, Denmark

Established in year
1963

Established by
Ole Brøndum

Main audio product types
Full-range loudspeakers in bamboo cabinets

Main markets
Europe

Number of employees
4

the many qualities of bamboo became apparent. Cross-ply bamboo material exhibit very little resonance, which makes it an ideal acoustic material for loudspeaker cabinets.

- Markaudio from Hong Kong were discovered. They had developed completely new ways of making both suspension and cone design of loudspeaker units. Design and construction of speaker units have taken a quantum leap forward in terms of achievable frequency area, propagation of sound and, reduction of distortion.

Kurt built the first prototypes of the Bach loudspeaker with the now legendary Alpair 7 full range unit from Markaudio and brought it to Ole, who was amazed at the detail and the sound stage these little units could produce. In early 2009 the ideas organized into a shared vision of creating a series of loudspeakers with sustainable design and uncompromising sound quality. Quali-Fi was re-born.

All Quali-Fi speakers are designed based on the same consistent principles:

- **Clarity and detail are priorities** – Quali-Fi designs are with full-range units to avoid compromises in filters. Cabinets are produced in rigid, non-resonant, sustainable bamboo for minimum coloration of sound.

- **Simplicity and sustainability are priorities** – no-nonsense visually appealing designs that can be produced easily, at affordable prices with as little negative impact on the environment as possible. The simple and clean lines of the cabinets are combined with full-range drivers of the highest quality.

- **Music lovers above all others** – The purpose is to bring the original recording venue as close as possible to the listener. That includes great impulse handling, no phase distortions and a sophisticated three-dimensional sound. Lovers of music have somewhat been left orphaned in the current MP3 audio and home cinema market. Quali-Fi is here to provide an alternative.

The philosophy behind Quali-Fi designs is a mixture of old principles, developed by sound pioneers in the first half of the 20th century and the latest technology in software, simulation, speaker, and cabinet design with a touch of sustainability added.

Iconic products

Quali-Fi is a small company and has developed a relationship with suppliers, staff and distributors that allow the company to move very quickly and produce new designs in small series at reasonable prices. Here is a list of landmarks in the product line:

Bach – reaches to the sky
The Bach loudspeaker is a special, rediscovered design. As in so many other aspects of life, the secret is actually simplicity. The Bach cabinet is a special variant of a TQWT (Tapered Quarter Wave Tube). It consists of a long conical horn with a fold at the bottom and the horn opening facing upwards. The speaker unit is placed at a precise distance from the closed end of the horn to reduce resonances.

This cabinet has some very special qualities that make some listeners hold this one as their favorite. The sound fills the room in a very special way, and the bass is extraordinarily open and very precise. Many people have compared the sound from this type of cabinet with the sound coming from a so called Open Baffle, which has a large fan base among music appreciators, because of its open and seemingly effortless sound image.

The Bach cabinet uses the listening room actively – in order to get the best result Bach must be placed in a corner or up against a back wall. The corner or the back wall works as the continuation of the horn. It excites the room's vertical resonance in a very different way.

The design was rediscovered in 2005 by Terry Cain, a cabinetmaker from the United States with an interest in speaker designs. This cabinet soon got its nickname BIB (Bigger is Better). Quali-Fi changed some parameters through computer simulations to reduce standing resonances in the horn.

Mozart – slim and discrete
The Mozart loudspeaker is a throw-back to the seventies where the company Epicure Products Inc. ("EPI") had great success with their Micro Towers. Being impressed by the Markaudio Alpair 7 unit's three-dimensional sound stage Quali-Fi wanted to create a beautiful product that took up less space than the Bach speaker.

The result was Mozart. With its tall, slender appearance it blends into the room in an elegant way and become a piece of furniture or even art in its own right. Mozart is wider than it is deep, unlike most modern speakers. It is possible for it to be placed up against a wall taking up a minimum amount of space.

The design is a so called "end-loaded TL"; a transmission line that ends in a port. The port is built the port into the cabinet itself, first of all because it looks better than a traditional round plastic port and secondly, because this type of port provides a higher acoustic resistive component in the port, which produces a more dry bass than a traditional round port.

The front of Mozart is chamfered at a 45 degree angle. Aesthetically this presents a unique expression that exposes the refined structure of the bamboo. However, there is also an acoustic reason for softening the edge: it diminishes the diffraction of the mid range and Alpair 7's excellent three-dimensional qualities are demonstrated at their very best.

Mozart is as good as Bach at providing nuances in the mid range area. The bass is dry and precise and percussion instruments are exact and well-defined. There is a good balance between form and function with Mozart, and the sculptural effect of the tall, slim cabinet is appreciated by most. Mozart was designed in collaboration with David Dlugos from Planet10 Hi-Fi in Canada; he had the original idea for construction; Quali-FI adapted it to the Alpair 7 and the bamboo design.

Chopin – the chubby little brother
Chopin is a Mozart with a different form factor. Quali-Fi was asked for a design that could be placed in a more traditional way, in a bookshelf or on a speaker stand. The result was the Chopin.

Wagner – drama for all your money
Every company needs to have an outrageous product. For Quali-Fi it is the Wagner - a double-mouth horn of around 200 liters. It measures 180 centimeter in height and is driven by Markaudio's Alpair 12P - an 8" unit with extreme dynamic range and detail.

Scott Lindgren from Woden Design in England designed this large double-mouth horn after the Olson-Nagaoka principle, where the horn consists of a series of rectangular chambers from the speaker unit to the horn opening. Scott put all his experience and creativity into this design, and Quali-Fi worked long and hard on chamber sizes and damping the horn in just the right way to get a natural sound image.

The design with two horn openings gives a very unique sound image. We are talking seriously grand music here; this loudspeaker requires a room of 30-40 m^2 and a listening distance of four to five meters in order to sense its full potential. In a room like that, there is nothing that compares to it – independent of price. Nuance and sound stage is extraordinary - the listener senses the original room's acoustic properties in great detail.

The Händel Family
Modern simulation software provides opportunities to the cabinet designer that previous generations did not have, for example combining a transmission line and a horn. It has been tried before, in the fifties, by Electro Voice with their Aristocrat.

The Händel family of speakers is developed from scratch by Quali-Fi. The idea came from listening to older transmission line speakers and noticing the precision and clarity of the bass. Much of the experience of the lower octaves of musical reproduction depends on the impulse characteristics of the speaker. The listener's experience is not just about the frequency response but just as much about how the pressure wave develops in the first 10 to 20 milliseconds.

After some computer simulations it became evident that the Markaudio speaker units are ideal for variations of transmission line speakers. The speakers are easy to get a decent bass out of and the TL cabinet provides the well behaved impulse characteristics.

The Händel family comes in a floor standing version called Händel Horns with Alpair 6, 7, 10 and 12 units and for the smaller Alpair 6 speaker a small stand mount cabinet called the Händel Compact.

The Händel Horn is a slim floor stander, a transmission line horn hybrid with exceptional bass reproduction. Drums and contra bass have a serious attack that brings the music to life in an extraordinary manner. The Händel Horn is suited as the main speaker in a stereo setup or as the front speaker in a home cinema installation. It is ideally placed at some distance from the rear and side walls. The rear firing horn mouth should not be backed completely up against a wall.

The Händel Compact is a small, slim transmission line speaker with an up-firing port. It is suited for wall mounting or as a book-shelf speaker. Händel Compacts are also available in high-gloss black lacquer.

The Hayden family
Some customers wanted deeper bass than the Händel Horn 12 can provide, and Wagner is for many people out of the question for obvious reasons. Through simulations it was discovered that extra bass extension and amplification could be extracted from the Alpair 12P with a special mass-loaded semi-conical horn.

The Haydn family was born. So far it only has one member, the Haydn 12 Horn. It outperforms the Händel Horn in bass reproduction in volume - the jury is still out on the question as to which one provides the better impulse characteristics. Inherent in the Haydn design is also a reduction of mid-range resonances that make voices slightly clearer and closer to the original recording.

Cutting-edge technology

Most of Quali-Fi's technologies are plain old common sense. However, a couple of approaches set them apart and deserves an explanation.

The best full rangers
Quali-Fi started by picking the best possible full range units to be found at an affordable price, the Markaudio product range. Then all of the attention was directed towards the construction of the cabinets. Quali-Fi have looked back in history where engineers did not have all the electronics and all the power that are available today. How did they build their cabinets? People like Paul Voigt, Harry Olson, and Paul Wilbur Klipsch have been great inspiration.

Simulation and experimentation
Several good software packages allow very precise simulation of cabinets. Quali-Fi learned to master a few of them. The Markaudio speakers have very tight production tolerances, therefore the designs can be pushed to the limit It is not necessary to make bland cabinets that will sound OK with anything. It is amazing to see how little it sometimes takes to tweak a design to produce extra bass or remove an irritating standing wave.

The simulation leads to experimentation, committing to saw dust. With experience you know how to re-enforce cabinets if necessary to prevent resonances. The last stage is typically a listening session with various levels of damping tried out. Regularly, Quali-Fi invites people with critical ears to review new products.

After that, the product is being prepared for production. The skilled craftsmen at Kirkegaard Design in Billund, Denmark, work with Quali-Fi in streamlining designs to minimise labor costs in production. Production of loudspeaker cabinets in Denmark has nearly disappeared, but with care it is still possible to be commercially competitive. Close collaboration between everybody involved is crucial for commercially viable production of small batches.

The fabulous bamboo
The story about bamboo deserves its own section. The basic material in Quali-Fi cabinets is bamboo.

Bamboo is the fastest growing plant in the world with qualities that are similar to hardwood. There are more than 1.000 different bamboo species that can survive under most different growth conditions. The plant is fully grown within three to five years, which makes it ideal for replanting in exhausted forest areas.

Some species can grow very large with poles that are over 40 meters high and almost 30 centimeters thick. Bamboo has a tensile strength that is higher than steel and can - unlike the exotic hardwoods - be harvested without harming the living plant.

The bamboo boards that Quali-Fi use for cabinets are produced of many small bamboo strips glued together in several layers. This together with the built in strength and sturdiness of bamboo assures superb stability and resistance against resonance. This is the first prerequisite for

Bamboo is a near perfect acoustic material without resonances. It is also aesthetically very pleasing with a warm glow and silky smooth surface when treated with bee's-wax.

Timeline

1963
Quali-Fi is started by Ole Brøndum. Many high-end products are distributed to the professional market, gradually consumers flock to Quali-Fi.

1970
Quali-Fi is at its peak in the market. JBL Cabinets are produced for the European market. Large stage productions like Hair and Jesus Christ Superstar use Quali-Fi equipment.

1973-2009
The dark ages. Quali-Fi decends into consumer products. Kurt Nielsen experiments with horns and full-range units at a small scale. Everest is produced in limited numbers.

2009
Quali-Fi is reborn by Kurt Nielsen. A relationship established with Markaudio and bamboo cabinet construction developed, Bach is created.

building excellent speaker cabinets. Several independent measurements have proven that bamboo really provide extraordinary qualities in this area compared even with the much revered birch plywood.

The natural warm color and structure of the bamboo fits well with the slightly retro taste at the present time after a time of sterile black-and-white being in fashion. Quali-Fi always uses carbonised bamboo; this means that the bamboo has been heated. The natural sugar in the bamboo has now become brown, caramelised.

It takes experience and care to work with bamboo boards; the saw blades have to be ultra-sharp as not to fray the edges; the same goes for the router. Bamboo is a grass with long fibers and not a tree. The finishing is not that hard; it is easy to sand the bamboo boards and it creates a silky smooth surface – but it has to be done with care in order to get a uniform look.

All Quali-Fi cabinets are given a finishing treatment with organic beeswax that protects the surface and brings out the bamboo's natural warm colours and beautiful structure. Based on this, Quali-Fi made bamboo the characteristic of its product line.

Future focus

Quali-Fi's focus is right now on expanding its presence in more countries, reaching more music lovers. There is a lot more market potential for the products than is currently exploited.

The new Alpair 7P and 10P are some of the most detailed speakers available, independent of price. With great source material expect extraordinary musical bliss.

Quali-FI is expanding the latest Haydn family with coverage for smaller Markaudio units, starting with the Alpair 7P and a new version of the Wagner is on the drawing board. But other than that it will mostly be incremental improvement of existing designs.

Quali-Fi have had several sub-woofer products and discontinued them being dissatisfied with musical performance. They are fine in home cinema solutions for reproducing earthquakes and jet-fighters, but don't do much good for delivering the lower octaves of music. Currently, open baffle designs are work-in-progress. These speakers produce extraordinary dynamic impulse characteristics and are not available as commercial products in the market. A series of products based on this principle will be launched, once again with focus on the music lover - in this case whoever wants to sense the punch of the upright bass or the bass drum like in live performances. ■

2010
Mozart, Chopin are created with the help of international experts, they become the bread and butter products of Quali-Fi . Sales start internationally.

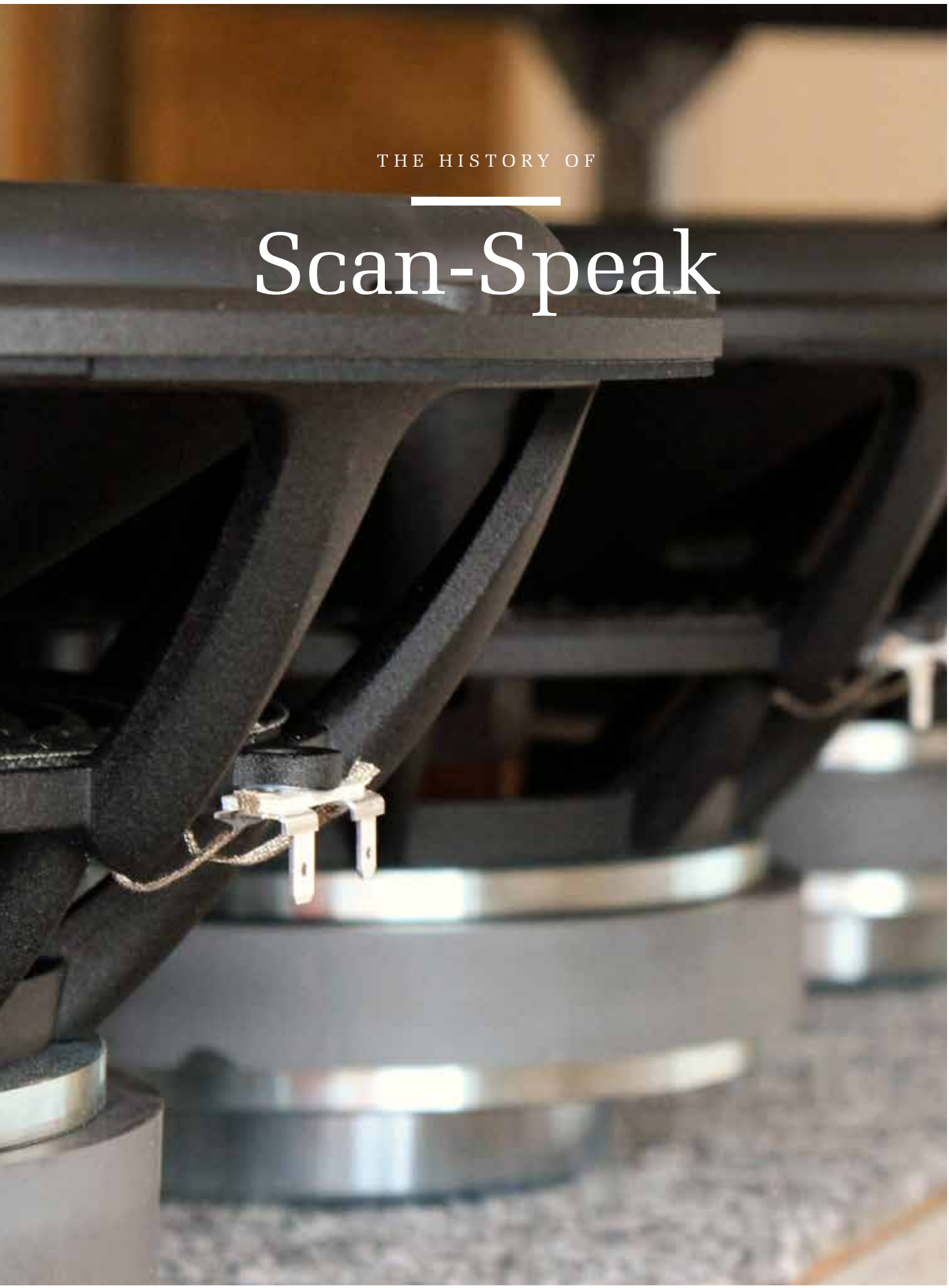
2011
Wagner is developed. And sales pick up in Sweden. Different solutions for woofers are evaluated, but mostly they are disappointing.

2012
The Händel family is created completely from scratch by Quali-Fi. Some cabinets are produced in MDF, but abandoned as bamboo is far superior. A Markaudio drivers are supported.

2015
Markaudio has introduced paper based units, and they are slightly different. The Haydn family is introduced in response, they provide superior bass experience.

THE HISTORY OF

Scan-Speak



Scan-Speak's history links into the long and proud Danish loudspeaker development and manufacturing tradition.

The history

Before day one
The foundation of Scan-Speak was laid in the 1960's when Ragnar Lian, a Norwegian student at Århus Teknikum (Aarhus Engineering School) and Ejvind Skaaning, a local machinist and scooter dealer, joined up around a business called Quality Sound Research (QSR).

QSR's and Skaaning's reputation led to a groundbreaking relationship with Scan-Dyna and Dynaco. This ultimately led to a large quantity of speakers being ordered that became the famous Dynaco/Scan-Dyna A-25. Skaaning's striving towards perfection drove him towards in-house driver development and manufacturing to be able to customize the drivers to exactly the needed specifications instead of accepting compromised solutions with off-the-shelf drivers from external manufacturers.

Kick-off
February 1st, 1970 Skaaning founded Scan-Speak with the purpose of manufacturing drivers for the Dynaco/Scan-Dyna loudspeakers. Ragnar Lian and the Dane, Mogens Hvass, were hired to develop and start driver manufacturing at Scan-Speak, first for the A-25 and later for other loudspeakers. The business was successful and grew fast and by 1972 already had 40 employees.

Creating a product line
In addition to the 1½" D3806 tweeter and the 8" woofer that had already been designed to fit the Dynaco/Scan-Dyna A-25 speaker the team of Skaaning, Lian, and Hvass develop a 4½" midrange, a 10" woofer, and the ¾" dome tweeter D2008 in the period of 1971 to 1974. Both tweeters - in slightly modified versions - continue in Scan-Speak's current product range.

The Symmetrical Drive
During 1973 Ragnar Lian invented and patented the Symmetric Drive (SD) motor, which consists of placement of copper caps on the polar part in order to minimize the currents of Foucault (eddy currents). The copper is positioned and dimensioned so that the inductance variation of the driver coil motion becomes symmetric. The Symmetrical Drive was an important discovery as it controlled the eddy currents and reduced inductance in the speaker driver, resulting in lower distortion and it allowed for easier design of good crossovers for drivers due to the flatter impedance curve.

Fast expansion
In the early 1970s Scan-Speak registered brand names that it used for its own line of speaker systems. Due to the sales success of its own product range and the A-25 speakers Scan-Speak grew quickly and by 1973 it employed 200 people at its facility in Hørning south of Aarhus.

The rapid growth of Scan-Speak required additional funding and resulted in a change of ownership. The primary owner of Scan-Speak became David Hafler who also was a majority owner of Ortofon. The mutual ownership led Ortofon into selling Scan-Speak built speaker systems branded Ortofon in parallel with its famous pick-up cartridges.

In May 1975, Scan-Speak's shares were taken over by Fonofilm Industri A/S, the parent company of Ortofon. Although the production was running well, and with a good margin, this change seemed to draw a lot of money out of Scan-Speak and the company went into bankruptcy.

The liquidation of Scan-Speak caused the end of Skaaning's involvement in Scan-Speak who up until this point had been in charge of product development together with Ragnar Lian and Mogens Hvass.

Moving north
In early 1977 Dantax in Pandrup acquired the remains of Scan-Speak.

Scan-Speak's production equipment and inventory was moved from Hørning to Pandrup in northern Jutland. Oskar Wrønding who started at Scan-Speak in Hørning in 1973 as a Quality Engineer was hired by Dantax and put in charge of moving and re-establishing Scan-Speak at Dantax's facility in Pandrup. After the transition Wrønding continued as Head of Product Design, Development and Production and later on he was Technical Manager. Scan-Speak's sales and administration were integrated into the Dantax organization.

The inclusion of the much bigger Scan-Speak into Dantax led to a very large expansion of Dantax's business.

Iconic products

During the period 1978 to 1984 several new models were developed including the now famous 18W woofer with paper cone.

In 1985 a new tweeter, the D2010, was born. This was an improved version of the D2008 which now had been on the market for almost 15 years and needed a successor. The new and old versions appeal to different customers and both models continue in Scan-Speak's current product line.

The market demanded products with new technology and a different visual appearance and in 1987 Scan-Speak launched new versions of the 18W and the 21W woofers with membranes in semi-transparent Polypropylene that had a milky white appearance. These products were popular for many years and continued in production until the new millennium.

Burned down to the ground – and then again
After the Scan-Speak Hørning factory burned down in the mid 1970's no one

Facts

SCANSPEAK

Company name
Scan-Speak A/S

Head office
Videbæk, Denmark

Established in year
1970

Established by
Ejvind Skaaning

Main audio product types
Loudspeaker transducers as tweeters, midranges, woofers and subwoofers.

Main markets
Europe, North America, and Asia

Number of employees
45

thought that such a thing would occur again, but after more than a decade in Pandrup, it happened again.

In 1987 the factory burned down to the ground. The fire took everything; the entire building, all manufacturing equipment, inventory and technical instructions, etc.

New machinery was purchased and a new suitable location was found in Aabybro in northern Jutland. To Scan-Speak's credit only 2 months later speaker models were delivered to customers and after only 5 months, all existing products were again in stock.

Kevlar cones

In 1988 Scan-Speak launched a line of drivers with an in-house manufactured Kevlar membrane. The major benefit of using Kevlar as material is the 'low distortion' due to its high stiffness and good inner damping.

The line of drivers became popular fast and many customized versions were made for several of Scan-Speak's high-end customers. Several of these 'Kevlar woofers' are still produced today for various OEM customers.

Acquired by Vifa

In the 1980s Videbæk Højttalerfabrik A/S (Vifa) under Magnus Nesdam's management was very successful and a strong driving force in the Danish audio industry.

Nesdam envisioned a great synergy between the Vifa brand and the more high-end Scan-Speak products and in 1989 Scan-Speak was acquired by Vifa.

In 1991 Scan-Speak moved to Videbæk and even though Scan-Speak did not move in with Vifa there was a certain amount of integration and many of Vifa's more industrialized ways of doing things were adopted, especially regarding documentation, production line setup and administration.

Lian's final effort

In 1990 the D2905/9000 tweeter was launched as the last Scan-Speak product designed by Ragnar Lian. It was a 28mm dome tweeter that with its characteristic sticky dome filled an important gap in Scan-Speak's product range as the company until then had not had a dome tweeter in the popular 1" size. This tweeter became one the best tweeters of its time and laid the groundwork for many tweeter designs that still are in Scan-Speak's current product offerings.

New product development

In 1992 a young creative Engineer, Lars Goller, started as R&D Engineer at Scan-Speak after holding positions at DALI and Vifa. From the start it was clear that Goller often saw things in a different way and often challenged the traditional ways of making loudspeakers. In his first year Goller invented and patented the second generation Symmetrical Drive, consisting of 3 copper rings placed in specific positions in the magnet system.

In the early to mid-1990s a range of tweeters based on Lian's D2905/9000 were developed.

A top version featuring SD-2 Symmetrical Drive and a large waveguide faceplate was launched in 1995 and became the iconic -9900 Revelator tweeter that at its time was regarded as the best tweeter available. These tweeters continue to be offered in Scan-Speak's product line.

Goller invented the linear spider that is a key element in Scan-Speak's Low-Loss-Linear Suspension which became one of the prime features in most of Scan-Speak's woofers. This technology enables the suspension to have the same tension during the entire cone excursion allowing the woofers to have the same sound characteristics at low volume as at high volume.

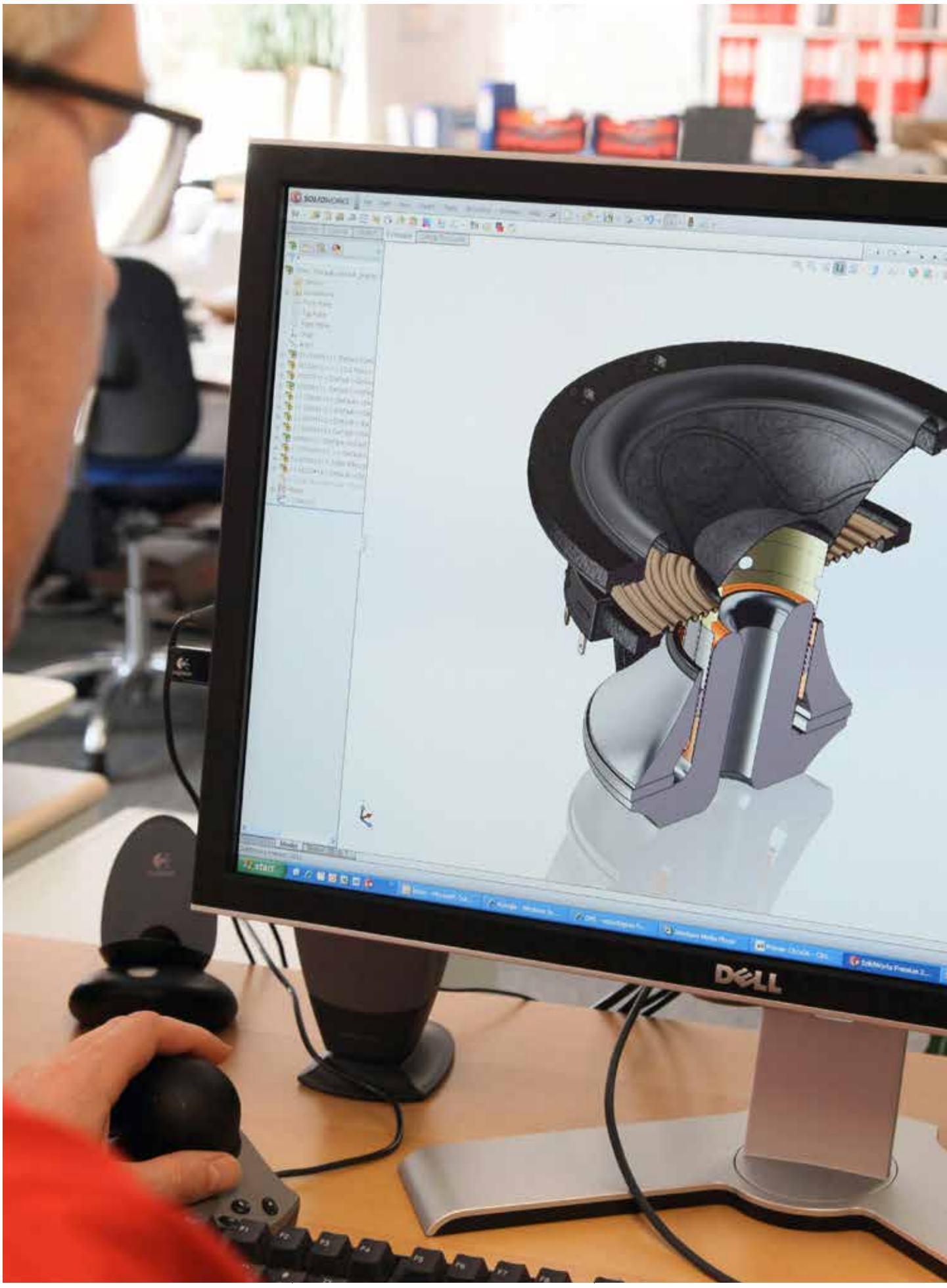
In 1997, based on another Goller idea, the first Revelator mid-woofer with sliced cone was introduced. Cutting a number of slices of uneven length and angle through the cone paper and then applying glue to the slices eliminated cone breakup modes which meant a huge improvement in sound quality.

The next development was Ring Radiator tweeter technology which was co-developed with Vifa and resulted in Scan-Speak's R2904/700000 tweeter that took high frequency reproduction to a whole new level and once again made a Scan-Speak tweeter famous for being the best available at the time.

Moving in with Vifa

In the late 1990s the company's name was changed to Vifa/Scan-Speak to signal the mutual ownership and close relationship between the two brands.

In 2000 Peerless was acquired and merged into Vifa/Scan-Speak. The resulting combined company changed its name to Danish Sound Technology (D-S-T). That same year Scan-Speak moved from its own location into a new extension of the Vifa factory making the merger complete.


DELL

American adventure
In 2005 D-S-T was acquired by the Silicon Valley start-up company Tymphany, which had invented a special type of subwoofer. Tymphany was in need of manufacturing facilities and an established customer base.

During this time Scan-Speak operated as an autonomous division within Tymphany.

Later, as the years went by Tymphany's business grew and its own manufacturing was moved out of Videbæk to China.

Illuminator line
For many years Scan-Speak's research engineers had worked on developing a new under-hung motor design that showed promising results. It was decided to use this design, Symmetrical Drive magnet system SD-3, for a new product line that was launched in 2008/2009. This Illuminator line became Scan-Speak's new top product line.

The Illuminator woofers offered a unique construction and its design differed greatly from how woofers traditionally had been build. In addition to the SD-3 the design included several new technologies including a special lightweight paper sandwich cone that with its stiffness and inner damping provided a very precise and distortion free sound reproduction.

The 2008 financial crisis was hard on the loudspeaker industry and Tymphany's operations suffered dramatically. As a result Scan-Speak was split off and sold to the local Danish management in April 2009. At this time Scan-Speak had 35 employees and had spread its activities to a larger part of the old factory where the Tymphany manufacturing previously had been done.

Discovery line
Also in 2009, shortly after the management buyout, Scan-Speak launched a new line called Discovery which targeted a more volume based segment of the high-end audio market. From the start the Discovery line included a full range of drivers from 1" tweeters up to 12" subwoofers.

Beryllium diaphragms
Since its start Scan-Speak has always preferred tweeters with a soft diaphragm, with only a few exceptions like the -9800 aluminium dome tweeter from the late 1990s. A market survey in 2009 showed that a significant part of the market preferred hard diaphragms and nothing could convince them to use a soft dome tweeter.

With this in mind it was soon decided to develop a new tweeter with a hard diaphragm and in line with Scan-Speak's legacy it had to be the best hard dome tweeter that could currently be built. Samples of all kinds of hard diaphragms in different materials were acquired; tweeter samples built, tested and evaluated; one material stood out from the crowd and showed excellent results in every aspect; it was the beryllium diaphragm! Tweeters with beryllium diaphragm had a wider frequency range extending significantly above 50 kHz, had very low distortion and had outstanding sound; detailed, precise, transparent, and a pleasant listening experience.

The beryllium diaphragm was very expensive and required special precautions during manufacturing adding even further to the costs, which was a concern before launch. In 2010 when the D3004/664000 beryllium tweeter was launched all concerns were proven wrong when it sold 10 times as many as the most optimistic predictions within its first year. It has become among the top 3 selling Scan-Speak tweeters.

Large woofers
It had long been Scan-Speak's desire to make larger woofers in very high quality, and in 2010 Scan-Speak moved forward with a new larger woofer platform that became the 32W 13" Revelator woofer, featuring a patented foam filled sandwich cone, a large and powerful Symmetrical Drive motor system with a 3" voice coil.

The 32W was so much bigger and different from any previous Scan-Speak product that it not only required development of the product itself, it also needed a

Timeline

1970
February 1st Ejvind Skaaning establishes Scan-Speak in Hørning. Two products are launched the first year, an 8" woofer and the 1½" tweeter D3806.

1973
The groundbreaking motor design - Symmetrical Drive - is invented and patented by Ragnar Lian.
The ¾" dome tweeter D2008 is launched.

1977
Dantax acquires the production equipment, patents and rights to the Scan-Speak brand and moves the production from Hørning to Pandrup in northern Jutland.

1988
Scan-Speak launches a line of drivers with in-house manufactured Kevlar membranes. This product line became very popular.

1990
Scan-Speak moves into new facilities in Videbæk after being acquired by Videbæk Højttalerfabrik A/S (Vifa) the year before.

1995
The highly regarded 'Revelator' tweeter D2905/990000 was launched and broke the ground for what later became Scan-Speak's largest and most successful product line.

completely new production setup.

After 2 years of development the 32W/4878 was launched in 2012 and it immediately got a lot of attention with several high-end speaker brands having a need for this product and immediately they started designing products to include it. Today Scan-Speak's woofers are used as the deep bass unit in some of the most exclusive home audio speakers.

Cutting-edge technology

Several of Scan-Speak's technologies were cutting-edge when launched, including:

- Symmetrical Drive magnet system
- Kevlar woofer and midrange cones
- Low-Loss-Linear Suspension
- Sliced woofer cone
- Ring Radiator tweeter
- AirCirc Magnet system
- Beryllium dome tweeter

Future focus

Current ownership

April 1st, 2014 Scan-Speak was acquired by Eastern Asia Technology (HK) Limited which is a fully owned subsidiary of Eastern Technologies Holding Limited (KYET). KYET was established in 2011 as a group of companies listed on the Taiwan Stock Exchange (TSE stock code: 5225) and is an offshoot of an original group of companies that were formed in 1971.

Scan-Speak operates as an independent company in the KYET Group under local Danish management continuing its more than 40 years history of Danish development and manufacturing.

Future focus

Over the years many audiophiles have also used Scan-Speak loudspeakers for custom built audio systems in their cars and a growing interest led in 2010 to the launch of a few speaker systems designed for car use. Scan-Speak will be expanding its range of aftermarket auto loudspeakers in the coming years.

Since its inception Scan-Speak has focused on high-end loudspeaker transducers for home audio loudspeaker systems for demanding audiophiles. The Scan-Speak products have been used by most high-end brands worldwide as well as Scan-Speak's products have and still are the preferred brand for many DIY speaker builders around the globe.

Scan-Speak will continue with its focus on high-end loudspeakers for discerning audiophile customers within the home and car audio segments and its commitment to constantly delivering products of the highest quality level. Scan-Speak's constant search in making the best loudspeaker drivers available will carry on within the frames of the company's core values; Customer focus, Quality, Co-operation, and Flexibility and Scan-Speak's manufacturing will proudly continue in western Jutland. ■

1997
The unique sliced woofer cone is invented and first implemented in the 5½" Revelator woofer that also includes the second generation Symmetrical Drive.

2000
Scan-Speak moves to its current location in Videbæk, getting more space and direct access to one of the industry's best equipped R&D facilities which includes 2 large anechoic chambers.

2005
Launch of the AirCirc tweeter with a new style of motor system featuring 6 neodymium magnets and an open motor structure.

2008
After several years' research and development the revolutionary Illuminator line is launched, taking midbass drivers to a new level with its astonishing design and technology.

2010
Continuing on the AirCirc design and a new exotic Beryllium diaphragm the D3004/664000 tweeter is launched, and soon became one of the best selling Scan-Speak tweeters.

2013
Launch of Scan-Speak's largest and most powerful product; the 13" Revelator subwoofer featuring a patented sandwich cone, 3" voice coil and Symmetrical Drive.

THE HISTORY OF

System Audio

System Audio is the only loudspeaker brand founded by a musician. Ole Witthøft played in a band and was surprised that ordinary speakers did not sound natural. So he decided to build his own.

The history

The year is 1984. Here System Audio is launching its first speaker. An amazed press write that "this loudspeaker sets new standards", but the speaker was not only created through a fascination with technology. It was created through a love for the music. Today about 20,000 SA speakers are manufactured every year and there are 25 different speaker models in the range. They are exported to 41 countries and are aimed at people who appreciate design, art, experiences, and, of course, music.

Ole Witthøft's background as a musician means that System Audio works in a different way than other loudspeaker companies. The sound experience comes ahead of all other properties and SA are among the only brands that have a sonic brand: a sound that is characteristic for all the brand's speakers.

System Audio is also known for its design. The philosophy is that the speaker is a piece of furniture that should be beautiful enough to deserve a central place in the user's living room. This is also where it will sound the best.

The company's name contains the word "system" because in 1984 Ole Witthøft discovered that good speakers must be designed in accordance with a variety of meaningful concepts that relate together. A system.

Concepts with meaning

The system giving its name to System Audio consists of elements that are essential for a good loudspeaker. All SA speakers are therefore created from the same basic principles. You can call the system a design handbook.

There are a total of 25 elements in the system. These are divided into three general categories:

- **Sound.** The sound should bring the listener closer to the artist
- **Integration.** Products should work in the home, from an acoustic, electrical, and design perspective
- **Quality.** The solutions must be long-lasting

Ole Witthøft is the first musician who founded a loudspeaker brand.

Each of the 3 categories contains 6-9 elements that an SA loudspeaker must be designed in accordance with. It is about such things as the durability of the products, the materials in relation to the environment, manufacturing tolerances and of course: the sound.

Among the most important is assessing the "musicality" in the speakers

When Ole Witthøft began to be interested in speakers in the 1980s, it was because as a musician he could not find any speakers that gave him the sound experience he knew from live music. All speakers can create sound, but it is certainly not all kinds of sound that grabs the listener and holds their interest in enjoying the music.

In fact, it can be a relief to turn it down.

Ole was among the first to use the word "musicality" in connection with the sound of speakers. This was to find a term that describes the speaker's ability to entertain the listener with a living sound quality. The idea of assessing speakers from the musicality of the sound elevates the user experience to the most important thing in the product. The user experience comes before the speaker technology. And working with speaker design is therefore more than just developing technology.

Facts

Company name
System Audio A/S

Head office
Roskilde, Denmark

Established in year
1984

Established by
Ole Witthøft

Main audio product types
Active and passive loudspeakers

Main markets
Europe, Asia

Number of employees
13

Important DNA arose by chance
In the early 1980s Ole Witthøft built his speakers in his parents' basement. The recipe was simplicity in both the technical architecture and the design. There are major challenges to building speakers when it comes to the development process, but also from the craftsmanship.

In the beginning, System Audio sold about 1,000 speakers each year. They were all built in the basement of his parents' villa in a suburb of Copenhagen. Some of the first speakers had a design, which simply had fabric all the way around the cabinet and with a smooth acrylic plate on top. The design was originally conceived as an inventive way to solve the craftsmanship challenges in providing the speakers with a sufficiently neat finish, but the simple design actually became an iconic symbol of simplicity. And so design became part of the DNA of System Audio. But greater challenges lay ahead.

Committed users are vital for product development
With the sound as the focal point, it is not enough to use measuring equipment to ensure that the products are good. Measurements of acoustics are of course essential, but there is no way that human experiences such as musicality, presence, atmosphere, and nerve can be captured by measuring equipment. These have to be experienced. So System Audio started to test the speakers on real people.

Quite early in the lifetime of the company, users were engaged to contribute to product development by acting as test pilots. Input from users helps to answer some of the questions that arise in a development process where a given technology is to be employed. Reviews from test pilots can help to determine if the technology is perceived as valuable to the user, or if it is actually only worth something on paper.

Iconic products

The first speaker that put System Audio on the international map was the tiny 905 model. It is not much bigger than a shoebox, and visually does not attract too much attention. But the tiny 905 loudspeaker sounds much bigger than it is. In just six days at an exhibition in London, the company signed export contracts with 20 countries and System Audio's international adventure began. The small 905 model was part of the 900 series, which was the first family of speakers to win international recognition with good test results worldwide.

In the early 1990s, the 900 series was not a genuine technological innovation, but its captivating sound quality made reviewers everywhere prick up their ears. In the annual CES in Las Vegas it was awarded the "Best Sound at the Show" and the 905 became a success. It was the first family of speakers from Audio System where each model had a number explaining where it belonged in the program. A model name ending in 5 or 10 is a small compact model, while loudspeakers ending in 30 or 50 are floor-standing models.

SA talent. It is the first speaker to use storytelling in the design.

Controversial speaker with expensive cables
The 905 was a great success in Germany and the discerning German market demanded a compact speaker where there is no restriction on cost, but instead used the maximum creativity in every detail of the product. The result was the System Audio 5010 signature. The first speaker that System Audio built in real wood. The loudspeaker employed specially developed speaker units in an almost solid cabinet, and the small speaker is complemented by internal connections with expensive cables from the American brand Nordost.

Ole Witthøft designed a speaker stand especially for the 5010 signature. It raises the speaker to an ideal listening height and at the same time exhibits the speaker as a visible object in the room. Work on the 5010 signature helped to expand System Audio's expertise in how to create a big sound from a relatively small speaker.

The company concentrates on sound
In the years leading up to the millennium, System Audio found its identity as a company. The future required flexibility and focus on the product characteristics that make a real difference to the user, and so production of less essential components was outsourced to specialist companies. Electronic assembly was outsourced along with a number of less important functions, and previous thoughts about such things as producing one's own speaker units or cabinets were set aside in favour of qualities that make a real difference to the user. Development work was now prioritized, and all resources were given over to building up expertise about the sound. And this gave results.

Computers are used to simulate and develop sound
One of the first tasks was to find out whether there is an acoustic connection between speakers that we like the sound of. To put it another way: Is it possible to find certain characteristics of good speakers? Can these characteristics be used in the development of future speakers?

Using a mass of data from the speakers, you get a list of the important properties and so-called targets can be prepared for the sound. This was the birth of a sonic

SA saxo. The financial crisis creates a new family of loudspeakers.

brand. The database was gradually built up as more experiences were put into the system. You can say that the personal taste of hundreds of test pilots is as a guide in the search for the best sound. There was also an investigation into which sound characteristics of the speaker can make people tap their foot to the music. This is behaviour that is closely related to the feeling of being involved in the music.

A bold move against the tide

In 1996 the floor-standing speaker System Audio 1070 was crowned Product of the Year and this marked the beginning of a new era. This was the first computer-aided loudspeaker created with sound characteristics that the tests pilots like.

But the project was not easy.

Studies showed that loudspeakers with a controlled sound radiation are perceived as being more true to life, in comparison to speakers where no work was done on the sound radiation. Therefore there was a lot of work done on sound radiation on the 1070 model, which can be seen in such details as the special construction where the tweeter is located between two woofers.

The challenge is that commercially it does not make sense to work with sound radiation when it comes to the technical specifications. This is because loudspeaker manufacturers are not obliged to provide information about the speaker's sound radiation. Only few consumers will discover the speaker's particular strength. So it came as a great help that 1070 was named Product of the Year. The model has since been the basis of many new generations of speakers from System Audio.

Iconic loudspeaker to mark the new millennium

System Audio launched into the new millennium with the new SA2K, a compact speaker with a number of innovations. The vision with the speaker was to demonstrate that it is possible to create big high-quality sound from a relatively small speaker. It took 5 years to develop SA2K and it ended up being called a "Masterpiece" and "World-class" in the international test magazines.

New name in 2003

In 2003 the launch of four new loudspeaker families (the 500, 1500, 700 and 1700 series) marked the transition to the SA name. Until then the speakers were called System Audio, but now the brand name was changed to the simpler SA. The path to the new name was a long one with many internal reflections, but one day it dawned on the people at System Audio that for years they had been calling their own products SA, so why not just make the name official? The four new speaker families launched along with the new name were a complete collection of all the experiences from the SA house and at the same time a new and important step was taken.

SA talent. A provocation to the established industry

In 2005 SA talent was launched. It was the first speaker with a real name and it was put into the world with a mission. It was to show that consumers interested in design also wanted to buy good speakers. Design people had been neglected for years and only had clumsy-looking loudspeakers to choose from. At that time a wall-mounted speaker was not at all interesting for a so-called serious Hi-Fi enthusiast. There were stories circulating that it was acoustically unwise to hang a speaker on the wall and it was not accepted for serious Hi-Fi enthusiasts to have wall-mounted speakers.

In the real world, SA talent was a success. Thousands of design-interested music lovers took to the speaker and it became the longest-living product in SA's portfolio with sales in line with Danish design classics. The sound has been upgraded three times, but the design has not changed since its launch in 2005.

It is the first speaker to use storytelling in the design. Seen from the front, the speaker depicts a typical Danish sunset. The open skies. The calm sea. The SA brand is the sun.

Two floor-standing speakers create history

Two of the most ambitious floor-standing speakers saw the light of day in 2007. The SA ranger and SA explorer were built of specially developed parts and designed using extensive computer power to simulate and perfect the sound. Many test pilots tested the speakers during the development phase and know-how about sound radiation

and wave guides was used in the most advanced form. Both speakers used knowledge from the millennium speaker SA2K and the product names tell in their own way that there is something special going on here. SA ranger shows its confidence by being shaped like an exclamation mark. Both models were successful in all markets and SA explorer was crowned Speaker of the Year.

The financial crisis creates a new family of loudspeakers

Towards the end of the 2000s, several international markets were affected by the financial crisis, resulting in declining sales. System Audio decided to prepare itself for hard times. Therefore they launched the speaker family SA saxo. The speakers are a study in efficiency and manufacturing technology. The goal was to create a series of speakers for the economically minded music lover, without compromising the values that are the basis of the System Audio brand.

The name of the saxo family includes an ambiguity. For Saxo referred to the abbreviation System Audio X-over with the meaning "to cross over the crisis", but the person Saxo is also known as a historical personage in Denmark. He was the first to write down the history of Denmark. SA saxo was given a tremendously warm reception and took up all available capacity at System Audio. In fact, there was a failure to communicate the fact that the saxo family's success was partly due to a further development of the wave guide.

Mantra. The recipe for successful development

The four speaker families that were launched in 2003 were due a replacement in 2010. The replacement had been a long time coming, and for 7 years Ole Witthøft had gathered ideas for new speakers in a desk drawer. Now the drawer was full.

The essence of the development process is evolution. The idea is to build on ideas that work. A speaker such as the SA mantra 50, for example, borrows technology for the woofers from its more expensive predecessor, SA ranger. The structure that controls the sound radiation is an eighth-generation evolution of the design that has roots back in the other speaker models that also bore the number 50 (for example, SA 1250, 1550, 1750 and 2050). The Mantra models subsequently won six stars, and were the Test Winner, Best for Price and Best in Test in a number of tests all around the world.

The world's first loudspeaker to be developed in an open forum

In 2012 Ole Witthøft opened the doors and invited readers of Denmark's largest science magazine The Engineer to an open development process that should end with a compact world-class loudspeaker. The goal was to spend one year developing the speaker in an open forum. It had to surpass SA2K, which in total took 5 years in the making in a traditional closed development process.

The project was set up as a blog with the name Speaker Q113 and engineers in

The SA mantra family uses reduction as a design philosophy both internally and visually on the loudspeaker. Simplification of details is thought to optimize the user's experience.

Timeline

1984
Ole Witthøft founds System Audio with the idea that good speakers should be based on a number of concepts. A system.

1989
Design is part of System Audio speakers as it is the design that gives the speaker the opportunity to be placed on a visible location in the room, where it will also sound the best.

1993
The loudspeaker model 905 puts System Audio on the international map and begin exporting to 20 markets.

1995
The development of System Audio as a sonic brand takes off. Test pilots are used to test the speakers to identify how people experience good sound.

1996
The speaker 1070 is selected as Product of the Year. This is a great achievement as it is created with sound at the centre.

2000
A completely different loudspeaker sees the light. SA2K is an innovation that provides inspiration for many upcoming speakers.

acoustics, mechanics, electronics, etc., could voluntarily participate in the project and make new discoveries. 110 engineers participated and the project tasks and results were shared in full transparency on the blog. The first result was the speaker SA pandion 2, which was placed in the category “Absolute Spitzenklasse” in a German test magazine.

SA pandion 30. Named after the osprey
Pandion is the Latin name for osprey. The loudspeakers from the open development project bear this beautiful name because they (like the bird) find nourishment from many different directions. SA pandion 30 is no exception. It was developed by Danish engineers in a community that openly shared the knowledge that arose in the project. The open collaboration led to several new discoveries and SA pandion 30 is among the first speakers developed with the help of trained testers from DELTA SenseLab. Almost all of the speaker parts are produced by specialist Danish companies and the design appears simple, functional and original.

Wireless speakers named Loudspeaker of the Year
In 2013 the first wireless speaker from SA was unveiled. It had been 4 years in the making and the electronic part of the speaker was developed in close cooperation between System Audio and a major international electronics manufacturer. Wireless music playback is growing at a tremendous rate, but instead of quickly launching a lot of inexpensive loudspeaker products, Ole Witthøft and the SA team decided to go the opposite way. That is, spending time on creating a simple but also relatively expensive speaker product.

The philosophy works. The first wireless SA speaker was crowned Loudspeaker of the Year and was honoured (among other things) for its sound quality and high standard. Thus System Audio found a winning formula, and just one year later launched yet another wireless speaker, which was crowned Loudspeaker of the Year in 2015.

Cutting-edge technology

The wave guide. Simplification towards better sound
Having learnt from experience about the great importance of sound radiation for the perceived sound, at the beginning of the new millennium System Audio took a new step. This was the so-called wave guides, a bowl-shaped ring that fits around the tweeter diaphragm. It aims to control the sound radiation, so the user experiences the sound as cleaner and more nuanced. It was of great significance for System Audio to build its experience with wave guides, which became clear a few years later. First the established industry had to be provoked a little.

DXT. A further development of the wave guide
Diffraction eXpansion Technology is the name of the patented technology which found its way into the SA saxo loudspeakers. DXT is a kind of wave guide which uses three so-called diffraction rings to give the loudspeaker better sound radiation. It is well recognized through proven research that the sound radiation is essential for the sound quality. DXT is a technology that helps speakers fill the room with sound. It has a Danish patent.

Future focus

System Audio is the only speaker brand founded by a musician. This means that the sound is central to the business and not just something that is measured and calculated. It is a valuable experience for the users. In the future there will be a greater use of mobile speakers, but there is also a need for the content and authenticity that only really good speakers can provide. SA will set the standard in both areas. ■

2007
SA ranger is launched and together with the SA explorer it is the first SA speaker that uses wave guides as well as a design that controls the sound radiation.

2009
The wave guide is further developed and given the name DXT.

2010
The speaker families’ aura and mantra are presented as the best examples so far.

2012
The world’s first open development project (Speaker Q113) is started by Ole Witthøft in the news magazine The Engineer and after three months wins the Bording Prize for Digital Media.

2013
SA presents its first active speaker, the wireless SA saxo 1 active. It is subsequently crowned Loudspeaker of the Year.

2015
SA pandion 30 is launched. This is a floor-standing speaker from the open development project, with 110 volunteer engineers taking part in the development work.