

ULTRASONE Development History **(S-Logic, safer-hearing, ULE technology)**

In 1979 D.Sc. Florian M. Koenig (founder and chief technical officer of ULTRASONE AG) started recording synthesizer music with his brother in a small, self-made, home recording studio. The tone productions were monitored exclusively with supra-aural and circum-aural headphones. These headphones caused too much pressure on the ears and irregular closing effects, were too soft, created too much bass reproduction and provided zero high-frequency listening.

These “normal” headphone sound impressions and the annoying localization of auditory events in the head motivated F. Koenig to take practical training courses on professional audio techniques and hi-fidelity acoustic labour as a student in the College of Electrical Engineering at the University of Applied Sciences in Munich, Germany. There he researched and presented a thesis on “computer-supported, diffuse-field, transmission frequency response determinations of headphones.”

After graduation, the research continued at SZV central laboratory (Munich) and he wrote a number of expert reports for companies like Hama, Lufthansa, Market & Technik, Vivanco, Sony and Sennheiser.

In 1989, during a meeting with Mr. Gresser (the inventor of the “open-headphone type” at Sennheiser), the inspiration arose to begin experiments to create a new process for frontal auditory effects in headphones. These experiments helped develop the base technology for S-Logic™ Natural Surround Sound. The first patent application was for the de-centric driver placement that is found in all ULTRASONE headphone ear cups. The near-field sound source produces head-related transfer function (HRTF) effects that are commonly found with frontal hearing and through directional filtering by anatomic influences. The human ear construction realizes the HRTF to create a 3-dimensional hearing image.

In 1990 ULTRASONE Electroacoustics GmbH (Ltd.) was formed to take the new invention to market with a new line of headphone products. At the same time, the S-Logic patent was pushed for worldwide approval with the tagline: “This is what the whole audio industry is searching for!”

As the business grew, research continued in such areas as room acoustics, psycho-acoustics, hearing acoustics and the electro-magnetic effects of headphones. These studies led to the development of the tone-neutral, head-related re-enforcement situation for the reproduction of surround sounds (the technology for Dolby Pro-Logic/AC3/Dolby Digital).

In all, the research has led to more than 60 patents worldwide and the findings have appeared in more than 50 top scientific publication. During this time, he also finished a PhD in “Audio Spectrum Analysis of Natural Alternating Fields in the Atmosphere.” This research led to the development of headphones with a natural surround sound, the technology behind the S-Logic, based on the following principles:

- 1) For circum-aural headphones, the speaker needs to be placed at an angle of 30 to 40 degree de-centric (lower/frontally based on the ear channel). The bufferboard should be acoustically hard (reflect for low frequencies) and damp (for higher frequencies). The upper area of the speaker is to close or damp at about 30 percent of the diaphragm-reflecting zone to optimise the de-centric placement optionally.
- 2) For supra-aural headphones, the speaker needs to be positioned near centric or slightly lower on the ear channel. The bufferboard should be acoustically hard for the total frequency range. The upper area of the speaker is to close at about 50 percent of the diaphragm-reflecting zone, creating a de-centric placed sound source in front of the ear channel.
- 3) The ear pad needs to be chosen to ensure tone with maximum emphasis free of colorations. For open headphones, a velvet or cloth surface is preferred. For closed headphones, the ear pad should be genuine or synthetic leather.
- 4) The speaker should be a gold or titanium-mylar diaphragm and developed for an extremely hard burst response (THD spectral delay time at frequencies greater than 1 kHz about 0,9 ms). The drivers allow for very low frequency tone signals (<40 Hz) without phase-masking effects and without the perception of the real tone signal (not the THD) first (transmission frequency could be offered up to 35 kHz). These tone-neutral aspects are important in the reproduction of the clearest and cleanest natural spatial sound, effects as lateral wall reflections, phases as a function of high dynamic audio signals (>100 dB).

The development of new headphones is a permanently growing process led, in part, by new technology and market desires, but the metamorphosis of steps from mono to stereo to S-Logic (natural surround sound) has had to proceed sequentially to fully understand the effects of each on future technology. A documentation of the results of the past makes it possible for bi-directional observations of the acoustics effects.

In studying the past, it is clear that S-Logic is the only way to influence stereo or channel tone signals to produce a 3-dimensional auditory event without any digital, binaural processing, apart from the mean human HRTF of a dummy-head (hint: recordings with a more ambient feeling, but the old well-known above in the head localization). The human outer ear (pinna) fluctuates more than 15 dB at frequencies less than 1 kHz (standard deviation 6 kHz=7 dB!). These individual hearing realities cannot be served with only one headphone. HRFT is the only logical consequence. And, since the tone recordings offer no 3-directional information regarding common pan-pot stereophonic recording techniques, the only solution is S-Logic.

S-Logic utilizes decentralized transducer positioning to reflect sound off the listener's pinna, or outer ear, creating a natural 3-dimensional sensation without the use of processing. Whereas standard headphones create the impression of a stereo image within the listeners' head, S-Logic produces a stereophonic surround sound field that is perceived to be broad, detached, and located in front of the listener. ULTRASONE is the only headphone manufacturer to directly address the physiology of the ear rather than use electronics to generate a stereophonic sound field.

Moreover, since the headphone transducers are not aimed directly at the auditory canal, listeners perceive the same volume with up to 40 percent lower sound pressure levels. This may significantly reduce the risk of hearing damage (safer hearing) while ensuring hours of fatigue-free listening – an absolute must if you spend a lot of time in headphones.

Finally the ULE technology for professionals as they do spend half of their lives in headphones. Most headphone drivers today convert an electric signal into an acoustical signal, producing low-frequency magnetic fields. Medical research shows that these emissions can be hazardous to our health. In response, ULTRASONE developed special MU Metal shielding to reduce the radiation by up to 98 percent compared to current headphones. The patented ULE (ultra low emission=ULE) technology has stood the test of international review and is recommended by technical surveillance organisations.

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