Perseverance and Innovation Leads to Success

An Interview with Steve Temme, President of Listen, Inc.

By
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Steve Temme founded Listen, Inc., in 1995 after teaching himself LabVIEW programming and working long hours to develop the coding for his company's flagship product, SoundCheck.

Listen, Inc. is a world leader in audio and electroacoustic test and measurement. Founded in 1995, when its flagship product SoundCheck was launched, the company has pioneered electroacoustic measurement techniques for more than 20 years. Listen has set the standard in the marketplace with powerful, innovative test methods and algorithms, and fast, flexible testing.

SHANNON BECKER: Tell us a little about your background.

STEVE TEMME: I have been fascinated with audio since the day that my father brought home a "close and play" record player when I was a child. The sound quality was terrible but it was better than nothing. After hearing some of my friends' high-end stereos, I quickly realized that there were better audio systems out there, and resolved to buy one myself to replace the "close and play" at home. My interest in audio continued in my teenage years, including going to Boston Symphony Hall with my father to listen to orchestral music and eventually I went to Tufts University to study Mechanical Engineering. While I was there, I started a business selling stereo equipment on campus, which financed my own audio equipment purchases as well as helping to pay my way through college.

SHANNON: How did you become interested in audio and electroacoustic test and measurement?

STEVE: Like many people in this industry, my real audio education began at Brüel & Kjær. Straight after college I began working there as a customer support engineer where I answered customer support phone calls and followed up with typed letters (actual hard copy—there was no email back then!). Eventually I moved into sales and then was offered a job at one of my loudspeaker manufacturing customers as they needed someone who knew how to operate the dual-channel Fast Fourier Transform (FFT) audio analyzer that I was trying to sell them. At Apogee acoustics,

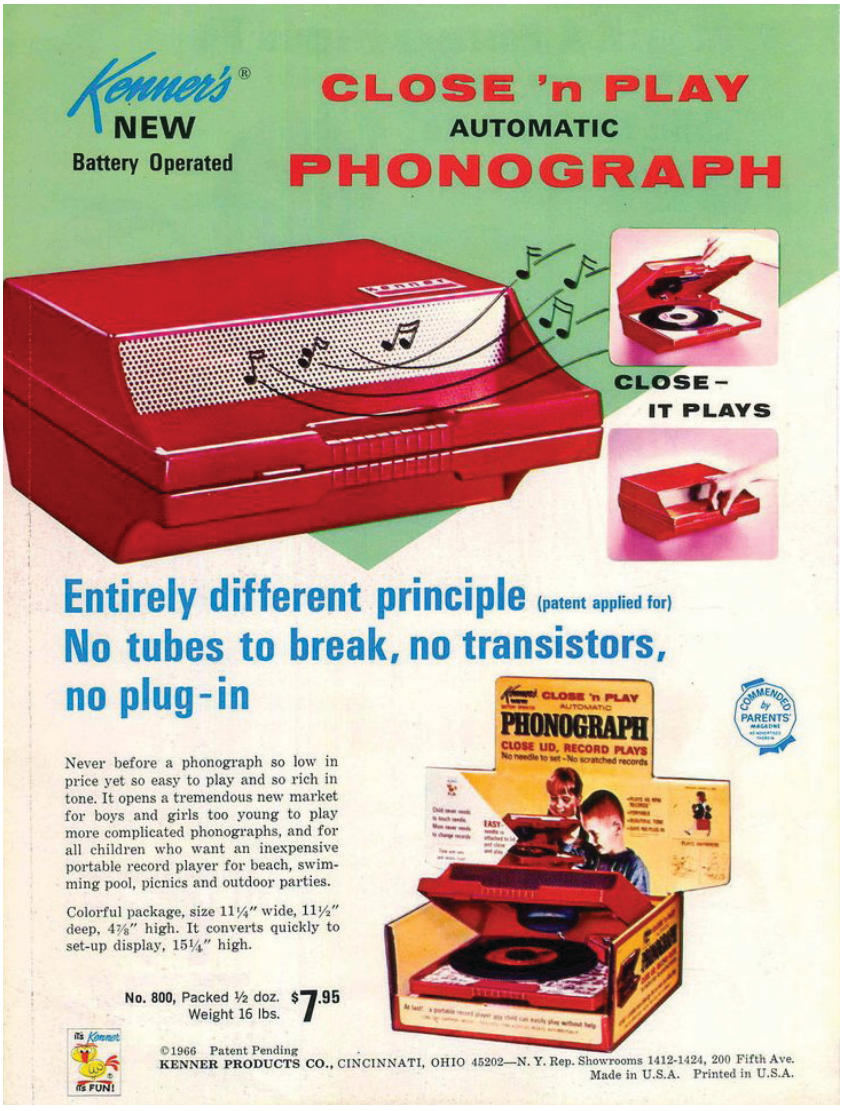
in addition to audio test, I was involved in the design of their first active crossover for their flagship Diva loudspeakers, which I still own and regularly use at home. My time there cemented my love for high-end audio equipment, which has remained to this day. After that I moved to Denmark to again work for Brüel & Kjær, this time as applications engineer to make a sales video for the new 2012, one of the most famous acoustic analyzers of all time. It was here that I acquired a deep understanding of all things related to acoustic test and started writing Audio Engineering Society (AES) and other technical papers on the subject. I also started to think there must be a better and less expensive way of making audio measurements, and the idea for Listen, Inc. was born.

SHANNON: Tell us more about the start of your company, Listen, Inc.?

STEVE: In 1994, I returned to the US after living in Europe for four years. Having been a serial entrepreneur through my teenage and college years, I was determined to start my own business and was evaluating several ideas. At this point, Windows 95 had just been released, bringing with it the option to use multimedia sound cards. With my strong background in audio test and measurement, I realized that the flexibility offered by software, personal computers and sound cards could replace conventional hardware-based audio analyzers, offering less expensive, faster, more powerful and more flexible audio analysis. While I spent my evenings developing a business plan for a lower-cost PC-based audio test system, I was also working several audio consulting jobs in order to pay the bills.

SHANNON: How did SoundCheck come to be?

STEVE: The turning point for me came on a visit to Sonetronics, one of my consulting clients, and a manufacturer of military headsets. Sonetronics had purchased several 2012 analyzers from Brüel & Kjær for production line testing, and had hired me to assist with developing the tests and getting the systems installed on the production line. The first time that I met Sonetronics President Gary Kuskin, he asked me if their measurements could be done with a PC and a sound card, as the hardware systems were expensive, slow, and he would need additional systems to meet his production testing needs. I replied that yes, it was definitely possible. Although I couldn't persuade Gary to pay me to develop the systems, he quickly agreed to buy several systems at a negotiated price if I could deliver them quickly.



The Close 'n Play record player inspired Steve Temme's lifelong mission to improve audio quality.

Hoping that I could build the system and make money from it, I began developing the first version of the product that would become SoundCheck. I had already decided that the main weakness of most measurement systems on the market was that the operator needed to understand programming in order to configure tests, so I decided to build SoundCheck on the National Instruments (NI) LabVIEW platform. This enabled tests to be built by selecting from a range of pre-configured steps using a point and click interface which hugely simplified test setup as no programming knowledge was required

Next, I looked for a programmer to partner with to develop the system. However, with no money to pay anyone, I was looking for a consultant who would write the code in exchange for a share of the profits when the system was sold. Unsurprisingly, no one

The original SoundCheck system is pictured in use at Sonetronics (circa 1995).

was willing to work on this basis, but I was advised that LabVIEW was not difficult to learn, and my best option would be to teach myself. Armed with a book and some knowledge from a few NI users, I taught myself LabVIEW programming and started coding SoundCheck.

For six months I programmed day and night, upwards of 60 hours a week. In addition to programming LabVIEW, I also needed to learn a lot about testing to military specifications, which necessitated weekly 10 hour round trips to work with engineers at Sonetronics. The return trip by car was always done in a day, as hotels and flights were way out of my budget!

Six months after starting the project, I had a prototype ready for evaluation. For the most part, the system performed as expected, showing the same results as the more costly hardware system, and the customer was happy. Some minor tweaking and refining ensued, and the customer agreed to purchase the system. The system was named SoundCheck, Listen was formed, and I was in business!

SHANNON: What were some of the greatest challenges in creating SoundCheck?

STEVE: While there were many technical challenges, most of these were fun to overcome, as I was doing something I enjoyed. Perhaps the greatest technical challenge in the early days was developing the "Stweep" test signal and the corresponding HarmonicTrak algorithms. Most test systems back then (and even today), used stepped-sine sweeps followed by a tracking filter. When stepping from one frequency to the next, there was an audible transient caused by a phase discontinuity transitioning from the old to the new sine frequency. With the help of some former work colleagues, we came up with a phase continuous transition and a smart FFT that allowed us to play the "Stweep" in one go and analyze afterward, using an auto-delay algorithm to align the FFT with each frequency. This saved considerable time and captured all the harmonics simultaneously. The PC processors were getting so fast that the total test time was approaching the "Stweep" time.

More significant than the technical challenge was doing most of it alone, as it was hard to find partners who were willing or able to take a chance on investing a lot of time in a project with no guaranteed financial return. At the same time as spending long hours writing code, I was also continuing my consulting work to keep paying the bills, and managing huge amounts of credit card debt, moving it from one card to another every time the initial interest free period expired. Juggling all that, while working on a product for which I still had to find customers, rather than taking home a paycheck was probably the hardest part of all!

SHANNON: What made SoundCheck so different from the others on the market?

STEVE: This has changed over the years. In the beginning, it was a truly revolutionary idea using a high-end pro-audio sound card as the audio interface rather than an expensive hardware box or data acquisition card. We also designed our own measurement microphone power supply since existing ones were so expensive. This brought the cost of automated testing down to less than half its previous cost, making it a financially viable option for production lines. The early days also saw a focus on creating fast tests to meet the needs of high-throughput production line testing. I invested heavily in developing specialist algorithms which offer faster and more accurate measurements. In fact the STWEEP and Harmonictrak algorithms that I programmed into the first version of SoundCheck are still in use today.

Innovation has been a key selling point through Listen's 22-year history. We were the first company to implement the Farina sweep (Log TSR) in 2001 just months after his landmark paper on the subject—something that other companies have only introduced in the past 5 to 10 years. It helped that I was already considering it because of its speed

SoundCheck is being used for driver testing on a production line in China.

benefits before the paper was presented! We were the first to offer algorithms for robust Rub & Buzz detection algorithm using higher order harmonics, loose particle detection, perceptual Rub & Buzz, non-coherent distortion measurement with music, and more.

I think the big advantage I had coming to it in 1995 was that with the latest technology and no legacy system, I was in a position to build a system for the computer age. This turned out to be hugely beneficial because, as devices have become more sophisticated and interfaces have changed, there has been no need to change the underlying architecture of the system. This means that with the evolution of the algorithms contained in the software, plus some additional low-cost interfaces, measurements that back in 1995 were made on a simple speaker driver can now be made on an internet-connected smart speaker, Bluetooth headphone or any other device.

SHANNON: Can you tell us, which of your products you feel have had the greatest impact on the industry.

STEVE: Without a doubt, out of all of our products, SoundCheck has had the biggest impact on the industry. I believe SoundCheck was largely responsible for the shift from human listeners to automated end of line production testing throughout the 2000's. Back in the beginning I used to have to try to convince people to invest in automated end-of-line testing because it was more reliable and cost-effective than human listeners. Now others have entered this marketplace and there is no doubt that automated systems are needed for any new production line - the question is 'which brand?' With the wide adoption of SoundCheck in recent years, and most of the Fortune 500 consumer electronics companies using SoundCheck, I think it's fair to say that most people own at least one product—probably more—that is tested (or its components tested) with SoundCheck.

SHANNON: How have your products evolved over the past 20 plus years?

STEVE: Some things stay the same and some things evolve! SoundCheck is still SoundCheck (and still costs the same as back in 1995), yet it is a very different product. It has hugely increased functionality, is equally popular for both R&D and production, and has expanded in line with new developments in the audio industry. For example, since its early days an equation editor was added which enabled calculation of Thiele-Small parameters, or any user-defined mathematical calculation, making it as suitable for the R&D lab as the production line. Many new algorithms have been added, for example, Perceptual Rub & Buzz measurement, Time-frequency analysis, and algorithms to implement the post-processing frequency shifts necessary to test Bluetooth devices and cloud-connected devices such as smart speakers. Additional hardware integration options have been added so that the hardware necessary to measure today's devices, such as Bluetooth, MEMS microphones, etc. can be controlled from within SoundCheck. While the sequence editor and noise immunity have always made it a great option for production line measurements, today SoundCheck also features the ability to incorporate it as part of a wider factory automation system with control via Python and TCP/IP and various saving to database options. It has also expanded from a two-channel system to a system that can simultaneously acquire and process as many channels as the audio interface could handle—we have customers successfully testing up to 64 channels simultaneously.

Hardware has also been an area of great innovation over the years. Although Listen was initially a software company, I realized fairly early on that although our software would work with any hardware, there was an advantage to creating our own designed specifically for audio measurement purposes. We first started creating hardware in 1997 with the SoundConnect microphone power supply. In more recent years, we launched the hugely-popular AmpConnect all-in-one audio interface which significantly streamlines the test setup, and products such as AudioConnect (audio interface with built-in microphone power supply), SoundConnect 2 (a two-channel microphone power supply), and SCAMP (an amplifier specifically designed for audio testing).

Through our partnership with Portland Tool and Die, we also now offer dedicated interfaces for MEMS microphone testing, Bluetooth testing, and more.

My personal area of interest is distortion measurement, and we have always been on the cutting-edge of this area of electroacoustic test. We have launched many innovative distortion measurement methodologies over the years including the first robust Rub & Buzz detection algorithm using higher order harmonics, loose particle detection, non-coherent distortion measurement with music, and most significantly, Perceptual Rub & Buzz. We continue to innovate in this area and will have some additional developments soon.

SHANNON: Can you share your personal views on market trends and where you see the audio industry headed in the next couple years?

STEVE: In the next couple of years, I believe mobile audio will continue to grow but I think the biggest explosion in growth will come from voice-controlled devices—in the home, in the car and mobile. The lines between different kinds of devices are becoming blurred as new virtual/augmented reality devices are launched, consumer electronics companies start manufacturing cars, televisions become voice-controlled, smart speakers become speakerphones, earphones double as 'hearables' and Amazon's Alexa becomes omnipresent in our lives. This presents some new and exciting challenges for audio testing, both in terms of what to measure as well as how to measure it, as audio signals transmit via the cloud as well as Bluetooth, USB, mini-USB, lightning and other interfaces. One of the real advantages about the flexible architecture of SoundCheck is that since we have been testing a wide variety of products since the early days of the company, we are already familiar with the test methodology used in these different areas, and with the addition of the algorithms that compensate for latency caused by various wireless interfaces, it's actually pretty straightforward for us to test most wireless and cloud based devices to the same standards as their wired counterparts.

SHANNON: What's next for Listen, Inc.?

STEVE: In terms of product and market development, we are continuing to develop our testing capabilities for voice control and smart speakers (and other IoT devices). In fact this year we are touring with our smart speaker testing seminar where we demonstrate how to measure smart speakers and other voice-controlled devices such as robots, thermostats, and more. We continue to add to the functionality of the software with new and improved algorithms, additional display options, and tighter software-hardware integration. We are also developing some exciting new products (which I am not ready to reveal yet) that will be launched early in 2019. From a business standpoint, this year, we plan to recruit additional staff in sales, software development, DSP, and business management to meet our increasing business needs.

SoundCheck is used for headphone testing at Reviewed.com, a review website that objectively measures and compares hundreds of headphones.