

White Paper

Using PXI to Build a High-Performance MEMS Microphone Testing System

By Ming-Yen Wei
Measurement & Automation Product Segment
ADLINK Technology

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MEMS Microphones Are Taking the Market by Storm With High Performance Array-Based Noise Reduction and Compact Size

The demand for increasing microphone signal quality from handheld mobile devices has led to the development of microphone signal processing technologies such as: HD audio, noise cancellation, active noise cancellation, beam forming, directional reception, stereo sound field reconstruction, and speech recognition. As well, devices incorporating multiple microphones are becoming more and more popular. Several newly released smart phones now integrate multiple MEMS (Micro Electrical-Mechanical System) microphones for improved background noise cancellation. All flagship smart phone models in introduced in 2015 featured three or more MEMS microphones to support HD audio, ambient noise cancellation, noise filtering, directional reception and speech recognition. Popularity of MEMS microphones is expected to grow.



While the mobile device market is expected to multiply several fold, the growing popularity of speech recognition function has allowed MEMS microphones to gain significant ground in applications such as wearable electronics, smart homes, Industrial Automation, and Internet of Vehicles (IoV), based on which another wave of growth is expected. Smart home voice-controlled systems have even introduced configurations with 7 MEMS microphones, allowing voice commands for IoT and local control of audio-video applications to be issued from anywhere in the house.

MEMS Microphone High Acoustic Specifications and High-Output Testing Requirements

The growth of MEMS application allows smaller microphones with increasingly improved performance. MEMS microphones improve on conventional electret/condenser (ECM) microphone capabilities with lowered total harmonic distortion (THD), increased signal-to-noise ratio (SNR) and sensitivity, flattened frequency response, lowered power consumption, improved temperature tolerance, and ease of mounting and installation, while presenting thinner and lighter profiles. Performance verification for high-performance MEMS microphones, unlike conventionally established acoustic testing processes, is based on detailed and accurate measurement and qualification of these performance parameters as test indicators. Manufacturers are, more and more, seeking improved audio testing solutions.

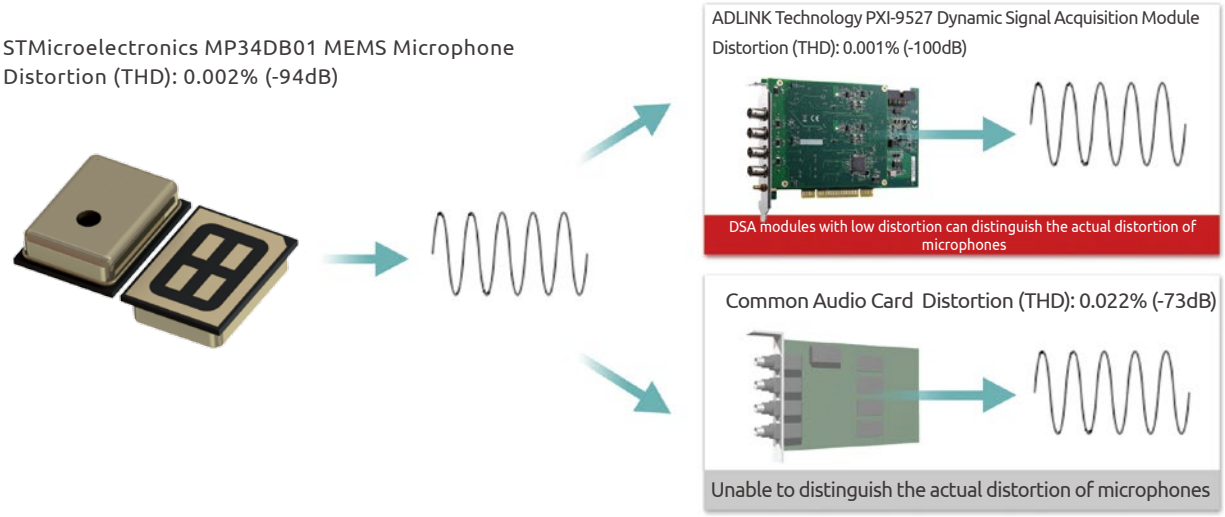
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MEMS Microphone Production Line Testing Performance Specifications and Challenges

When sound quality is an important determination of consumer electronics market position, manufacturers must not only enhance product functionality through advanced technology and system design, but further guarantee product quality through comprehensive performance testing.

Balancing Testing Specifications and Output during Audio Testing for MEMS Microphones

One option for MEMS microphone testing is to use a professional audio analyzer providing a complete range of testing functions. Such a solution, however, imposes considerable costs to operations in which multiple production lines are employed to support mass production. An alternative, commonly-used approach is deployment of a standard sound card and PC, utilized together as a testing system. Maximum acoustic pressure, frequency response, and THD can all be measured, but test quality is limited by the class of the sound card. A MEMS microphone produced by STMicroelectronics, for example, uses THD -94 dB, SNR 61 dB (A-weighted at 1 kHz, 12 Pa) as testing specifications, according to which THD of the testing equipment must be very low with SNR that of the DUT in order to carry out effective performance testing. Such specifications are, however, beyond the capabilities of most standard sound cards.



Caption: The high dynamic range and electrical specifications of the PXI-9527/PXIe-9529 satisfy the performance testing requirements of MEMS microphones

Flatness of Frequency Response Detection

One of the key specifications for MEMS microphones is flatness of frequency response, measurement of which entails the sound source issuing a Frequency Sweep signal which changes during the testing process. A signal with a constantly changing frequency is also received on the receiver side. If the data acquisition equipment's own specifications and characteristics do not present sufficient signal flatness, repeatability and consistency of product testing results can be compromised.

Non-Synchronous Sampling on Capture Card Channels

Ordinary capture cards generally use Multiplexing Technology between channels for data acquisition. This means that signal sampling frequency is shared among all channels, and time difference is generated among signals from each channel, preventing actual synchronization. The shared sampling frequency increases the number of channels, leading to a hard limit in the high frequency zone. The time difference between multiple channels also produces increasingly severe time order errors as the number of test samples increases. Accordingly, considerable data processing is required to align the large amounts of data from each channel, taking a great deal of time and slowing testing output.

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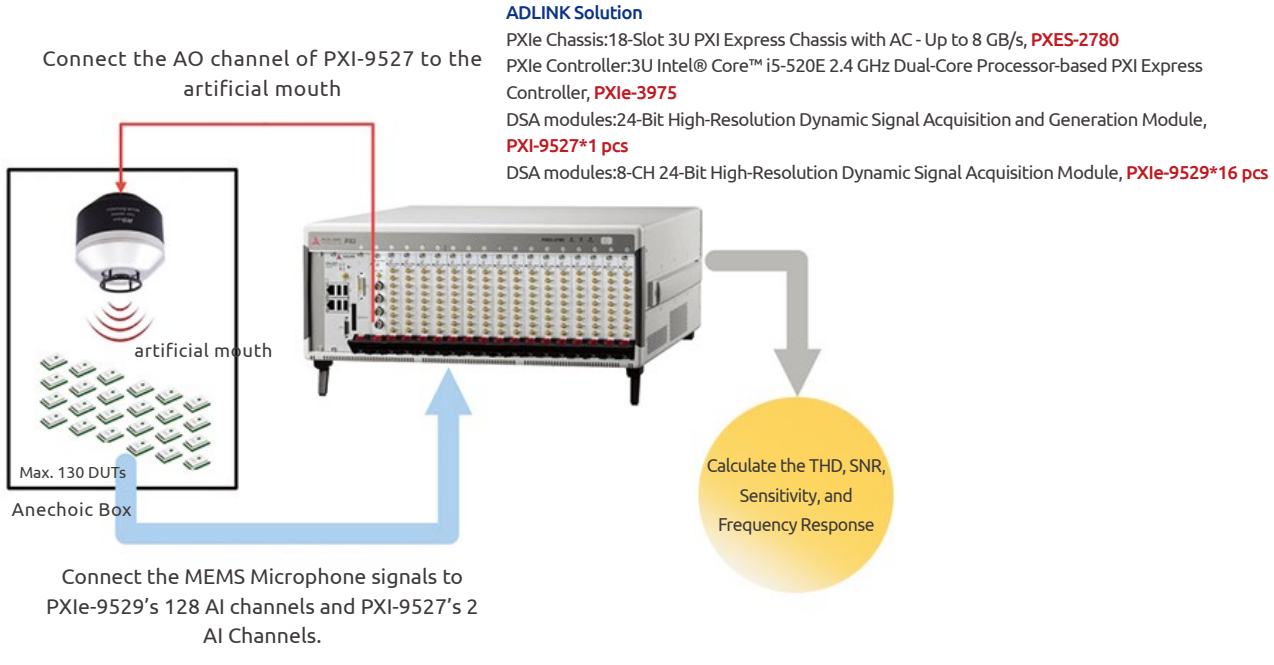
ADLINK's MEMS Microphone Production Line Testing Solution

ADLINK's high resolution dynamic range signal acquisition module series delivers a much more efficient solution for the various challenges to production line testing of MEMS microphones. The ADLINK PXIe-9529 is a 24-bit high precision signal acquisition module with a dynamic range of up to 110dB and 8 input channels. each of the 8 channels utilizes its own independent analog-to-digital converter (ADC) and an internal clock makes light work of multichannel synchronous sampling. The result is a dramatically increased total channel count for each PXI unit.

MEMS microphone testing requires a sound source and signal frequency sweeping, control of must also be synchronized. The PXI-9527 offers 24-bit high dynamic range signal output with a synchronous rate of up to 216 kS/s, and THD and SNR specifications meet or exceed output requirements for audio device testing, allowing it to serve as an effective test signal source. The PXI-9527 also offers synchronous sampling up to 432 kS/s and AC/DC coupling for more sensitive measurements. An integrated anti-aliasing filter and 4 mA bias current support compatibility with integrated electronic piezo-electric (IEPE) microphone sensors. High resolution and high dynamic range signal sources also easily fulfill testing requirements for audio and acoustic frequency sweeping measurement. The PXI-9527 seamlessly cooperates with the PXIe-9529, with no requirement for separate signal source integration. As well, system self-testing is easily implemented to simplify production line troubleshooting.

ADLINK's high-performance data acquisition modules support Visual C++/C#, VB.NET, LabVIEW, and MATLAB development toolkits, allowing rapid development of dedicated in-house testing systems, further reducing testing cycles and improving efficiency, speeding time to market to fully advantage market opportunities.

Finally, ADLINK also recently also unveiled Audio Analyzer, a data acquisition and analysis utility providing complete management of audio testing for smart phones and components. When co-deployed with the PXI-9527 and PXIe-9529 data acquisition modules, measurement and analysis of THD, SNR and other parameter is trouble-free, precise, and powerful. Audio Analyzer serves not only be as a tool for rapid and accurate verification of device performance, built-in serial testing function empowers development of dedicated automated production testing systems with no need to repurpose new testing software for C/C++ or LabVIEW. This translates into shorter system development cycles, improved testing efficiency, and lower costs. The Audio Analyzer is provided free when purchasing the ADLINK PXI DSA module.



Caption: ADLINK MEMS Microphone Production Line Testing Solution System Architecture

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About ADLINK

ADLINK Technology is enabling the Internet of Things (IoT) with innovative embedded computing solutions for edge devices, intelligent gateways and cloud services. ADLINK's products are application-ready for industrial automation, communications, medical, defense, transportation, and infotainment industries. Our product range includes motherboards, blades, chassis, modules, and systems based on industry standard form factors, as well as an extensive line of test & measurement products and smart touch computers, displays and handhelds that support the global transition to always connected systems. Many products are Extreme Rugged™, supporting extended temperature ranges, shock and vibration.

ADLINK is a Premier Member of the Intel® Internet of Things Solutions Alliance and is active in several standards organizations, including PCI Industrial Computer Manufacturers Group (PICMG), PXI Systems Alliance (PXISA), and Standardization Group for Embedded Technologies (SGeT).

ADLINK is a global company with headquarters in Taiwan and manufacturing in Taiwan and China; R&D and integration in Taiwan, China, the US, and Germany; and an extensive network of worldwide sales and support offices. ADLINK is ISO-9001, ISO-14001, ISO-13485 and TL9000 certified and is publicly traded on the TAIEX Taiwan Stock Exchange (stock code: 6166).

About the Intel® Internet of Things Solutions Alliance

From modular components to market-ready systems, Intel and the 250+ global member companies of the Intel® Internet of Things Solutions Alliance provide scalable, interoperable solutions that accelerate deployment of intelligent devices and end-to-end analytics. Close collaboration with Intel and each other enables Alliance members to innovate with the latest technologies, helping developers deliver first-in-market solutions.

ADLINK

Tel: +886-2-8226-5877
Fax: +886-2-8226-5717
Email: service@adlinktech.com
www.adlinktech.com

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