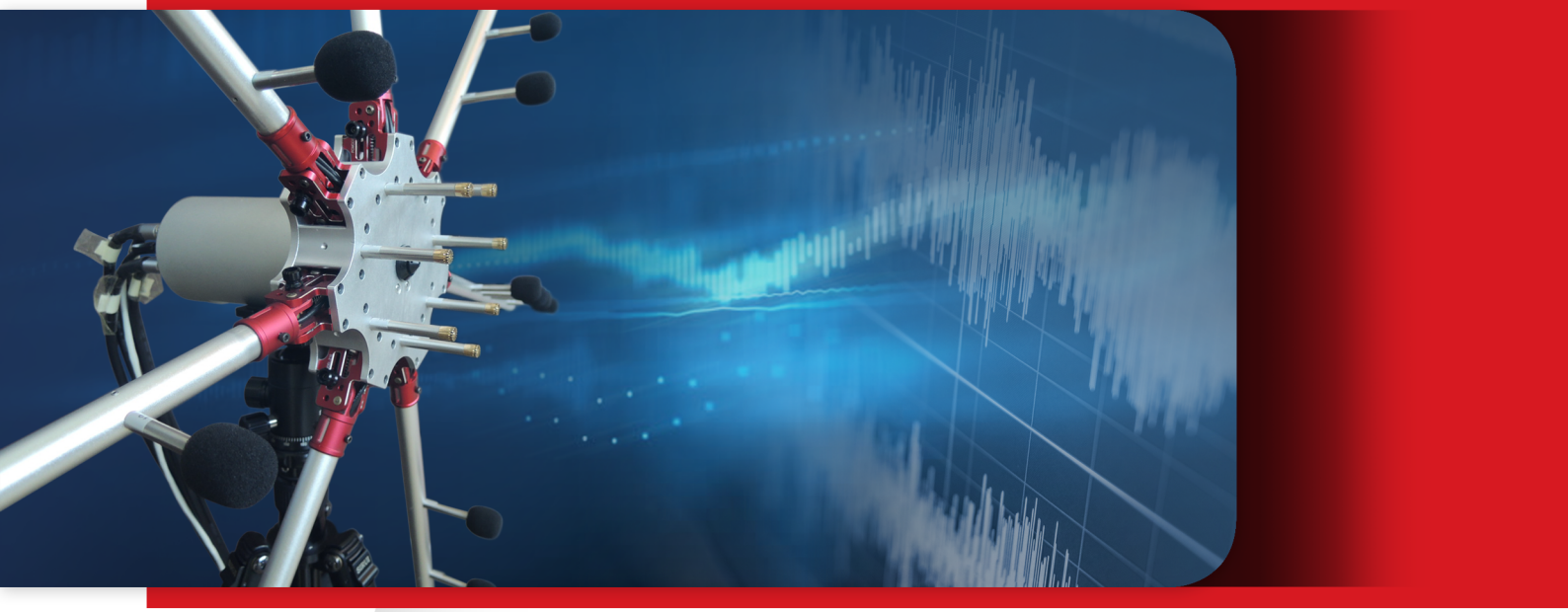
ADLINK
Leading EDGE COMPUTING



White Paper

Flexibility in Low-Cost Microphone Array Systems

Zake Lin, Test and Measurement Product Manager
Irene Chang, Senior Product Marketing Specialist

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With increasing concerns over environmental factors and their effects on quality of life, more and more attention is focused on over-exposure to detrimental levels of ambient noise. Global noise pollution has already been identified as a public wellness issue, according to the World Health Organization. Numerous local governments have enacted relevant regulations, including those requiring that all relevant devices comply with predefined standards. As a result, noise measurement has become a priority in product manufacturing.

Common Applications

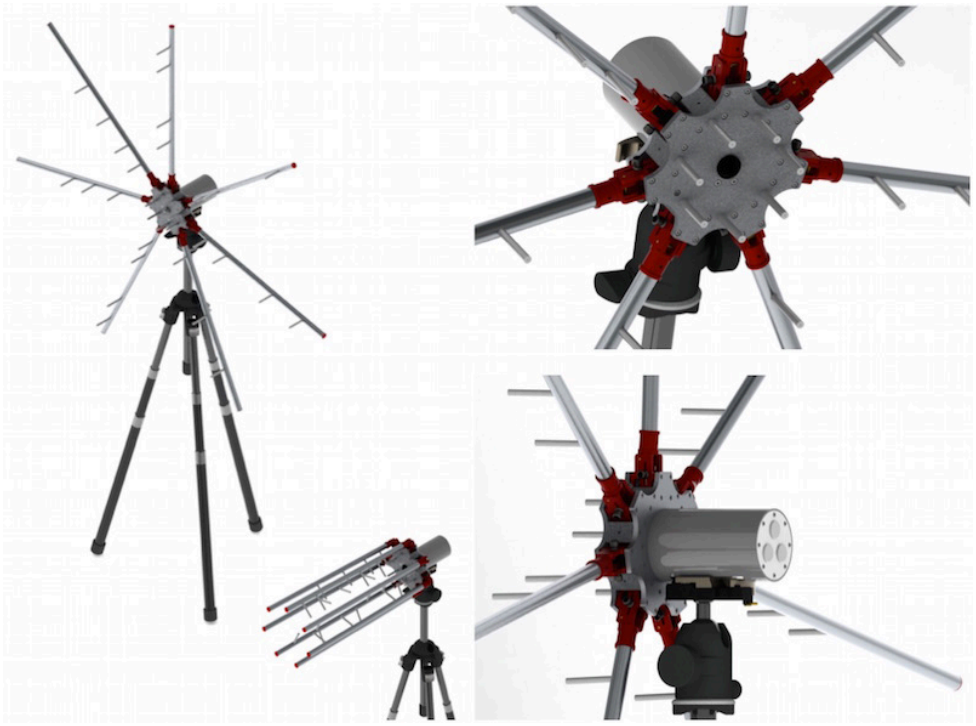
- NVH performance optimization for vehicles and home appliances
- Abnormal sound/noise identification for cars, home appliances, machine tools, injection molding machines, generating units, and others
- Sound source positioning or trajectory tracking identification such as unmanned aircraft early warning or payload delivery measurement, impact recording, projectile trajectory, and submarine targeting
- Door and window sealing test, pipe leak location
- Transportation noise imaging and positioning for car, train, and aircraft
- Speech enhancement, sound source orientation identification



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Comprehensive, Sophisticated Measurement

Product noise diagnosis can require uniquely complex measurement deployment when DUTs (Devices Under Test) generate sounds from multiple origins. Accurate sound source measurement requires sophisticated noise measurement. For vehicles, a microphone array collects data from multiple sources, acquiring a complete acoustic image for diagnosis of the noise source, utilizing color distribution.



Manufacturers have recently launched comprehensive and sophisticated measurement strategies, however, requiring not only more microphone sensors and higher image resolution, but also enhanced accuracy of time synchronization for acoustic imaging of the noise sources. The measurement system must be capable of dealing with these requirements to obtain accurate results. Currently utilized measurement solutions can provide dozens of channels, but to meet current requirements, manufacturers may demand cost-effective systems deploying more than 100 channels.

In aircraft manufacture, noise measurement also uses microphone arrays to collect data, but can require up to thousands of microphone sensors, with further possible restrictions requiring that all channels be precisely synchronized to handle wide ranges and high resolutions. In aviation manufacture, noise control can seriously impact market competitiveness, since exceeding airport noise limits can invite costly surcharges. With aircraft manufacturers actively developing new low-noise technologies, effective testing systems must provide flexible configuration and adjustment of highly accurate multi- measurement.

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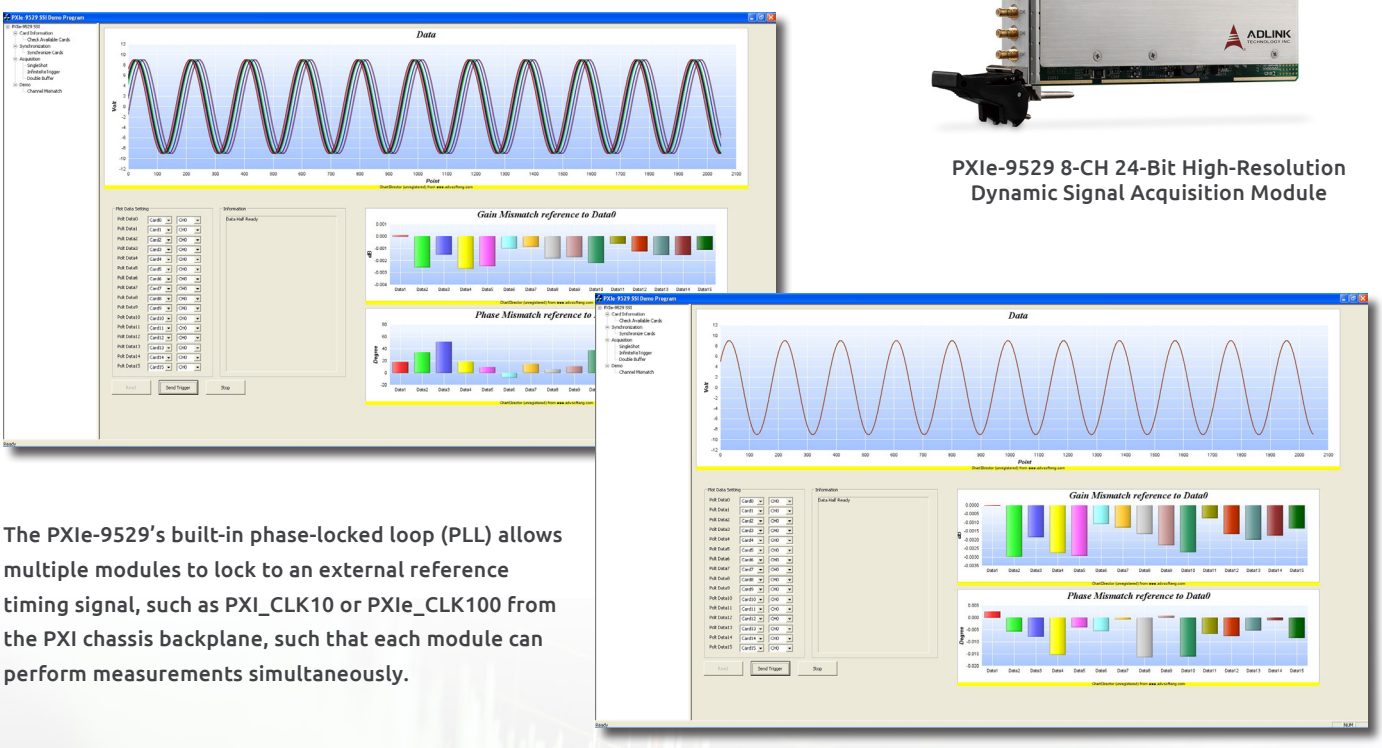
Integrated & Accurate Multi-Channel Solutions

In response to increasing requirements for larger numbers of microphone sensors, ADLINK presents full system solutions, combining high-performance PXIe controllers, multi-slot chassis, PXIe expansion cards, and high-density and -precision acquisition modules powered by professional acoustic imaging software, allowing manufacturers to evolve cost-effective measurement upgraded from partial to comprehensive measurement.

The PXIe-9529 dynamic signal acquisition module specializes in multi-channel noise measurement, offering support for eight simultaneously sampling analog input channels, up to 24-bit high resolution with a sampling rate of 192 kS/s, and 110 dB dynamic range at 90KHz bandwidth where a wide range of accurate noise source diagnosis is required. Accuracy of sound measurement is assured, with the PXIe-9529 in line with PXIe synchronous clock / trigger specifications to support 10MHz or 100MHz synchronous clock delivery from the PXIe system, while accepting synchronous triggering signals of trigger bus or star trigger, for complete accuracy in multi-card synchronized measurement.



PXIe-9529 8-CH 24-Bit High-Resolution Dynamic Signal Acquisition Module

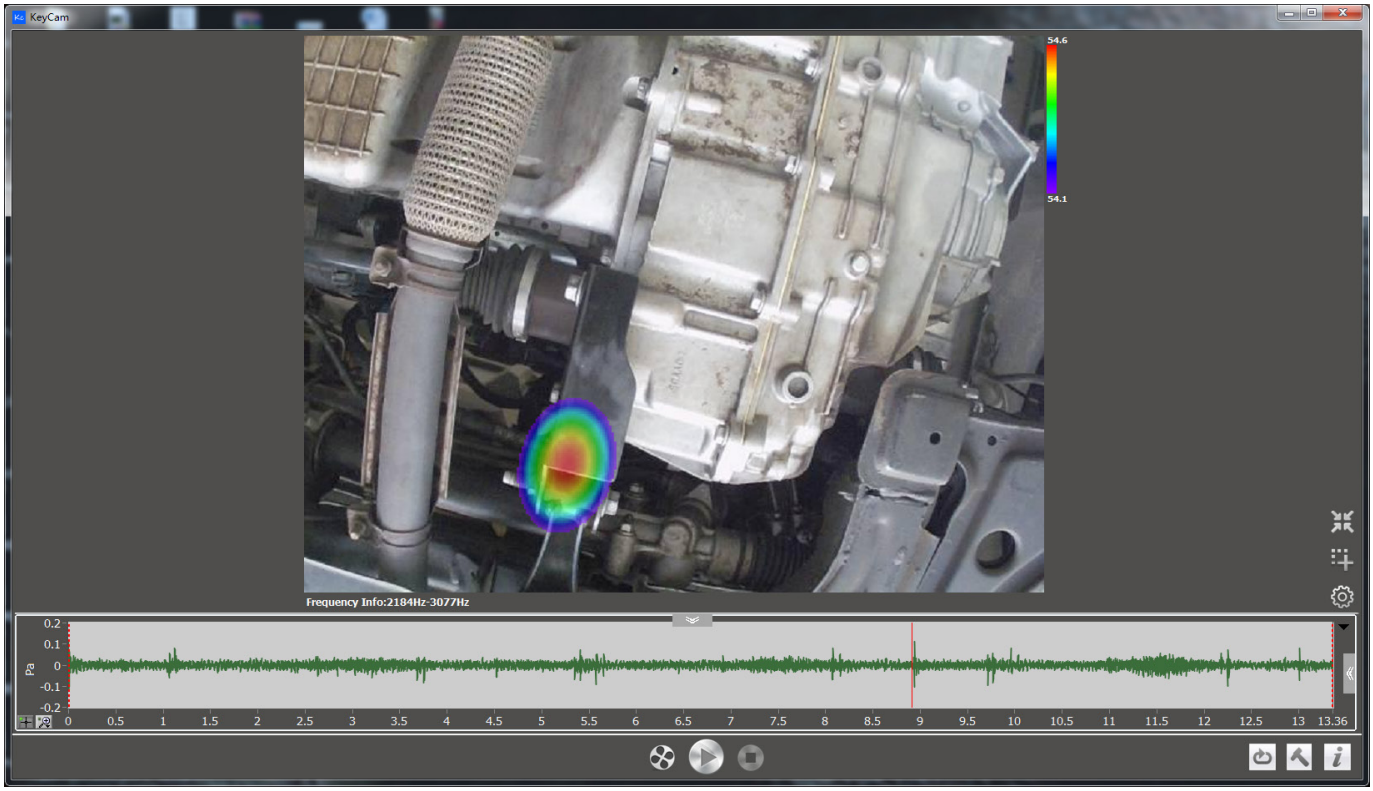


The PXIe-9529's built-in phase-locked loop (PLL) allows multiple modules to lock to an external reference timing signal, such as PXI_CLK10 or PXIe_CLK100 from the PXI chassis backplane, such that each module can perform measurements simultaneously.

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The PXIe-9529 further provides a flexible input channel configuration setting that supports DC or AC coupling, differential or pseudo-differential input channel configurations, and different voltage input range settings for a wide range of measurement applications. For microphone array measurement, the PXIe-9529 can be set at ± 1V AC coupling and pseudo-differential input mode to fully meet sensor measurement demands. Built-in signal conditioning can directly connect to standard Integrated electronic piezoelectric (IEPE) sensors with no need for additional installation and wiring of a power supply.

ADLINK also provides fast and easy-to-use-development tools, allowing system developers and users to design tests and applications in their choice of development environments, such as C++/.NET/C# and LabVIEW, enabling easy completion of program design while shortening system verification and speeding time to market.

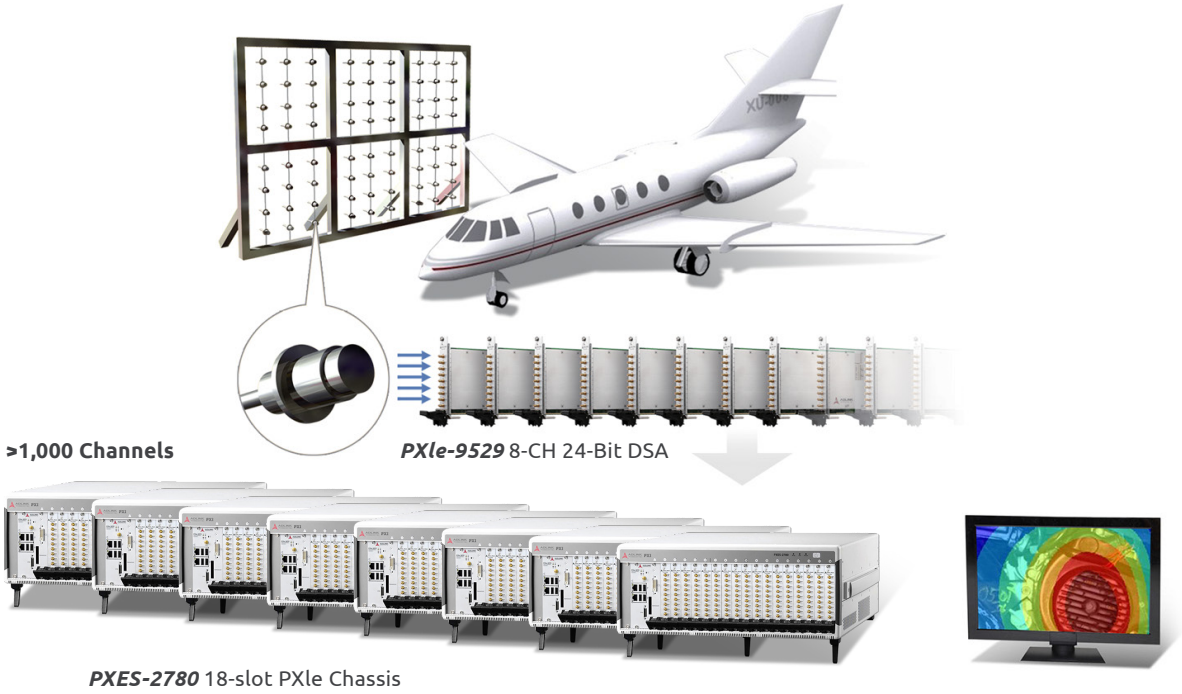


Real-time algorithm for acoustic imaging with a microphone array.

Automobile and Aircraft Noise Measurement

For automotive noise measurement, which can require hundreds of channels or even more, ADLINK's solution combines multiple PXIe-9529 signal acquisition modules, high-end PXIe-3985 embedded controller with a built-in Intel® Core ™ i7-4700EQ 2.4 GHz quad-core processor, and PXES-2780 chassis with 18 PXI Express slots. With this combination, the chassis accommodates 17 eight-channel PXIe-9529s, bringing the total number of channels to 136. The ADLINK PXIe controller's fourth generation processor provides superior computing performance, guaranteeing that even with large volumes of data, the system can accurately and smoothly perform synchronous measurement. With aircraft noise measurement, over one thousand microphone sensors are needed to adequately cover the fuselage surface in its entirety. Multiple ADLINK 136-channel measurement systems can be coupled with the PXIe-8638 expansion kit, for seamless, fully accurate deployment of the requisite measurement channels.

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Where smaller DUTs or only partial noise measurement are employed, ADLINK's PXIe-9529 signal acquisition module, with the PXES-2301 chassis providing 6 PXI Express slots can provide 40-channel simultaneous sampling.

Compared with standard measurement systems providing only fixed hardware specifications, ADLINK's modular solutions support adjustment of dynamic signal acquisition module quantities according to actual required channel counts, and selection or upgrade of embedded controller or expansion cards based on system performance requirements. Accordingly, limitations normally associated with fixed measurement equipment (which is often scrapped when channels, speed, or performance are insufficient) are eliminated. ADLINK allows trouble-free adjustment of system board configurations without the expense of replacing equipment and re-building new test systems, enabling the measurement system to stay current with conditions and developments in testing technology.



PXES-2301 6 All-Hybrid Slot 3U PXIe Chassis

Minimizing Costs, Maximizing Specifications

With increasing market competition, manufacturing industry success is increasingly the result of developing the best possible performance for the least expenditure. As more and more production items are required to comply with a variety of environmental standards, noise control is increasingly key to successful market placement. Effective control of testing costs is equally as critical as deployment of the systems themselves.
ADLINK's PXIe hardware/software integration platform for multi-channel microphone array-based noise measurement delivers low-distortion, low noise, and 24-bit resolution for thoroughly accurate synchronized sampling. The fully modular solution provides flexible configuration based on actual demand, while substantially reducing implementation costs, for highly efficient and precise measurement with minimal investment.

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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).

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ADLINK® Leading EDGE COMPUTING

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

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