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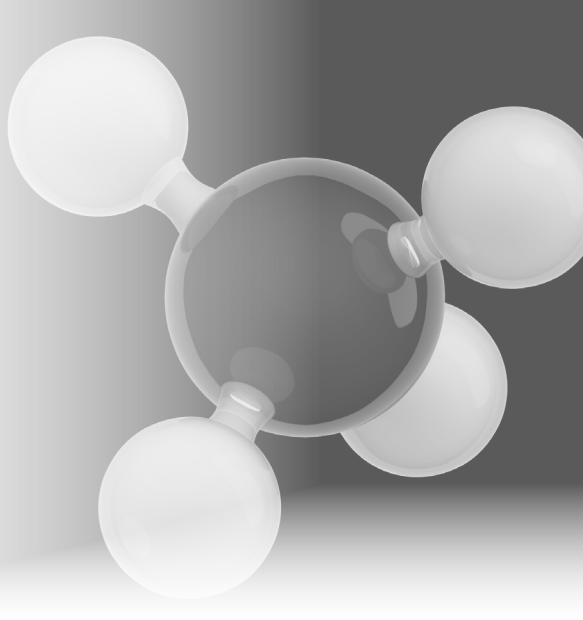


Turning data into insight: A decade of stable methane sensing

Methane (CH_4) has a short-term warming potential that is 80 times higher than carbon dioxide (CO_2)[1], a fact that has driven growing demand for reliable, real-world CH_4 measurements. However, achieving stable, sub-ppm detection in compact, field-ready systems is an engineering challenge. For over a decade, Axetris has delivered high-precision tunable diode laser absorption spectroscopy (TDLAS) modules designed to meet these requirements, supported by Hamamatsu Photonics' low-noise, highly stable InGaAs PIN photodiodes and early integration guidance.

CH_4 monitoring is gaining attention as governments, research institutes, and industry groups work to better understand and reduce greenhouse gas emissions. In the oil and gas sector, European Union has already established clear CH_4 reporting requirements, and several regulatory milestones have been implemented in recent years, each adding new expectations around measurement and reporting. Operators are now required to carry out real CH_4 measurements – not just estimates – and submit this data to authorities.[2] In the United States, recent deregulation has slowed mandatory CH_4 monitoring, although many leading operators continue voluntary measurements to manage leaks and maintain environmental performance. As a result, dependable leak detection and quantification tools are becoming increasingly important across the industry.

In the livestock sector, CH_4 monitoring is at an earlier stage. Formal regulation has not yet been introduced, but several European countries – particularly the Netherlands and Belgium – are funding long-term measurement programs to better quantify CH_4 emissions under real farm conditions. These initiatives aim to complement or refine the model-based emission factors currently used in national inventories, and are driving increased demand for sensing technologies that deliver stable, repeatable performance in challenging agricultural environments. Across both sectors, there is growing recognition that high-precision CH_4 sensing is essential, whether the driver is research, regulation or day-to-day operational needs.

Continuous CH_4 emission monitoring around barns (Axetris)

Engineering precision for real-world environments

Axetris, part of the Leister Group, is based in central Switzerland and focused on developing and manufacturing high-performance gas detection modules for CH_4, ammonia (NH_3), and CO_2. Its laser gas detection (LGD) product line is used across a wide range of

Axetris'integrated LGD Compact CH_4 for outdoor CH_4 monitoring

industries and applications, including oil and gas leak detection, fence-line monitoring, livestock emissions research, and medical breath analysis. These systems offer compact form factors, high sensitivity, and long-term stability, and are valued by research institutes, environmental scientists and system integrators who rely on precise, dependable data generation.

In Europe, Axetris has become a key contributor to livestock CH_4 research; universities and government-funded programs rely on the company's LGD systems for barn-based studies that investigate how diet, feeding schedules, animal behavior and housing conditions influence CH_4 emissions from cattle and other livestock. [3] These datasets are increasingly being used to improve understanding of livestock CH_4 emissions, which may help to inform future policy discussions, making the repeatability and stability of Axetris' technologies particularly important.

The challenge of achieving stable sub-ppm detection

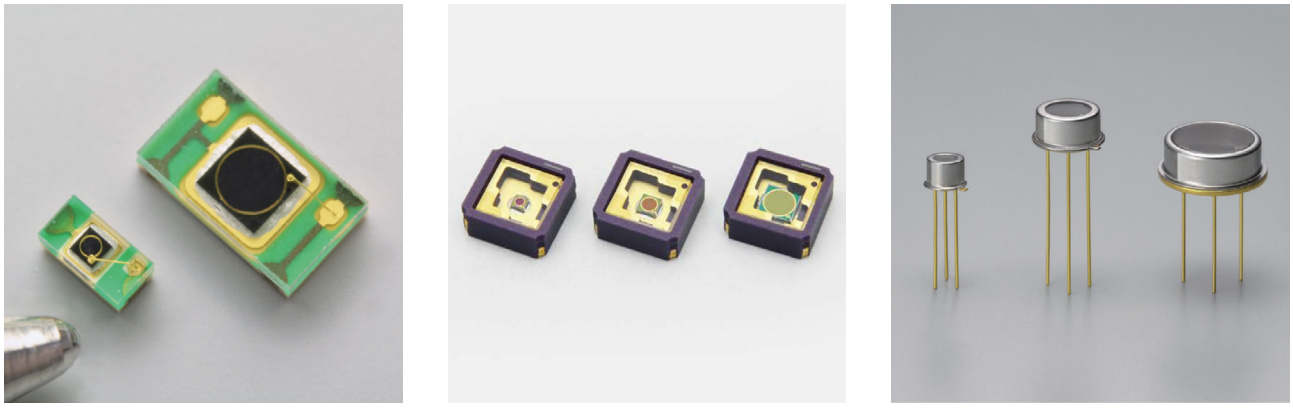
Developing a compact, field-ready CH_4 sensor brings several engineering challenges. CH_4 absorption in the near-infrared (NIR) region – around 1.6 µm – is relatively weak, making it challenging for compact TDLAS systems to detect the very small changes in optical transmission required for sub-ppm measurements. Although CH_4 absorbs more strongly at 3.3 µm, the 1.6 µm region is preferred as it is covered by mature, stable, and compact telecom-grade lasers and detectors suitable for field applications.

The optical path for these sensors is limited by the small form factor, meaning that drift, vibration, and environmental noise have a greater impact on the signal, while fluctuations in polarization can introduce additional measurement error. To compensate for these limitations, the optical components must work well together to preserve signal quality. The laser needs to maintain consistent beam alignment and wavelength stability, while the photodiode must deliver very low noise, low dark current, and strong responsivity at the relevant wavelength.

Axetris selected Hamamatsu Photonics' InGaAs PIN photodiode to form the core detection element in its CH_4 sensing systems more than 15 years ago, and it has since been the detector of choice. Low noise and dark current allow the photodiode to meet Axetris' sub-ppm detection requirements, while the large active area helps to preserve alignment if the beam shifts due to temperature fluctuations or mechanical stresses. The low polarization dependence loss (PDL) design of the photodiode further reduces signal fluctuations caused by polarization changes, improving overall stability in compact TDLAS modules.

"Hamamatsu Photonics has been rock solid in terms of delivery, performance, and field reliability. The detector just works, and that's exactly what you need in this kind of system."

— Baz Matvichuk
Head of Sales & Product Management, Axetris



Hamamatsu Photonics offers various InGaAs photodiode packaging option, from left to right: CAN package, surface mount chip-on-board (COB) package and surface mount ceramic package.

This long-running relationship has involved more than supplying components; Hamamatsu Photonics has provided practical guidance and technical support from the initial integration through to later optimization work, helping Axetris to refine how the detector performed within the compact TDLAS architecture. Rui Protasio, Product Manager at Axetris, explained: "When we first integrated the photodiode, we had support from Hamamatsu Photonics on how to package it – things like the cap, anti-reflection coatings and some custom options not shown on the website. That helped us to optimize the detector for our compact design. We have a very small optical path, so every source of noise becomes a problem, and the low-PDL photodiode really allowed us to reach the performance we needed without having to increase the form factor."

The detector has proven consistent, reliable, and robust for more than a decade, helping Axetris to deliver stable, repeatable measurements in both research and industrial settings. Baz Matvichuk, Head of Sales & Product Management, noted: "Hamamatsu Photonics has been rock solid in terms of delivery, performance, and field reliability. The detector just works, and that's exactly what you need in this kind of system."

Summary

The shift towards measured, rather than estimated, CH_4 emissions is driving demand for sensing technologies that perform reliably in varied environments. Axetris' experience illustrates the engineering considerations behind achieving sub-ppm performance in compact systems, where optical alignment, detector behavior, and long-term stability directly influence data quality. Hamamatsu Photonics' InGaAs PIN photodiodes have provided the consistency required for these measurements, supported by a collaborative relationship that included early technical guidance and component-level optimization. The result is a sensing approach that supports repeatable, real-world measurements, which are increasingly important for research programs, regulatory reporting, and operational monitoring in applications like livestock management and the oil and gas sector.

For more information on reliable detection solutions, please visit www.hamamatsu.com or contact us at info@hamamatsu.eu

About Axetris

Axetris AG, part of the Leister Group, develops and manufactures high-performance components for gas measurement and micro-optical applications. Founded in 1998 and based in Switzerland, the company specializes in TDLAS solutions for precise and stable gas sensing. Axetris' technologies are used globally in emissions monitoring, industrial process control, safety, and environmental research. All core manufacturing, assembly, and calibration processes are carried out in Swiss cleanroom facilities to ensure consistent quality and long-term reliability.

References

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