

Laser Gas Detection OEM Gas Sensing Solutions







Overview

Laser Gas Detection (LGD), based on Tunable Diode Laser Spectroscopy (TDLS), provides a solution to many gas analysis challenges process control, environmental monitoring, medical applications and research. The technology offers unique advantages like precise optical, contactless measurements, excellent target gas selectivity and sub ppm-level detectivity.

Axetris' Laser Gas Detection modules are stand-alone and ready-to-use OEM subsystems for selective detection and monitoring of gases. The sensor is based on a technology called "TDLS" – or Tunable Diode Laser Spectroscopy, which has proven its validity in high-end laboratory and process control applications. It's using a laser to scan the specific absorption lines of a target gas with an extremely high resolution, which enables a precise measurement of the gas concentration with a very high selectivity. Axetris' proprietary approach to TDLS leverages this technology to low-cost, high-volume gas detection and monitoring applications. The use of Axetris' own packaging technology of the laser diodes as light source, combined with the intellectual property of reference channel-free devices, reduces the gas sensor to a set of generic components and enables a low cost of ownership gas detection module for a wide range of applications.



LGD F200P2-H OEM Module, inside view



LGD Compact-A OEM Module

Table of contents

Technology Highlights & Applications	4
Our OEM Capabilities	5
Application Examples	6/7
Typical Specifications	7

Technology Highlights & Applications

Technology highlights

- Optical, contactless, accurate laser measurement
- High target gas selectivity
- Measurement of up to two gases simultaneously
- Fast response time
- Self-contained, easy to integrate
- Continuous sensor status monitoring
- Low cost-of-ownership
- Hot-gas measurement option up to 220 °C
- Compact solution for portable measurement

Applications

• Process control:

SCR in power generation & engine development, carbonitriding of steel, agriculture

• Environmental:

Continuous Emissions Monitoring (CEM), biogas, fugitive emissions, natural gas, leak detection

• Medical:

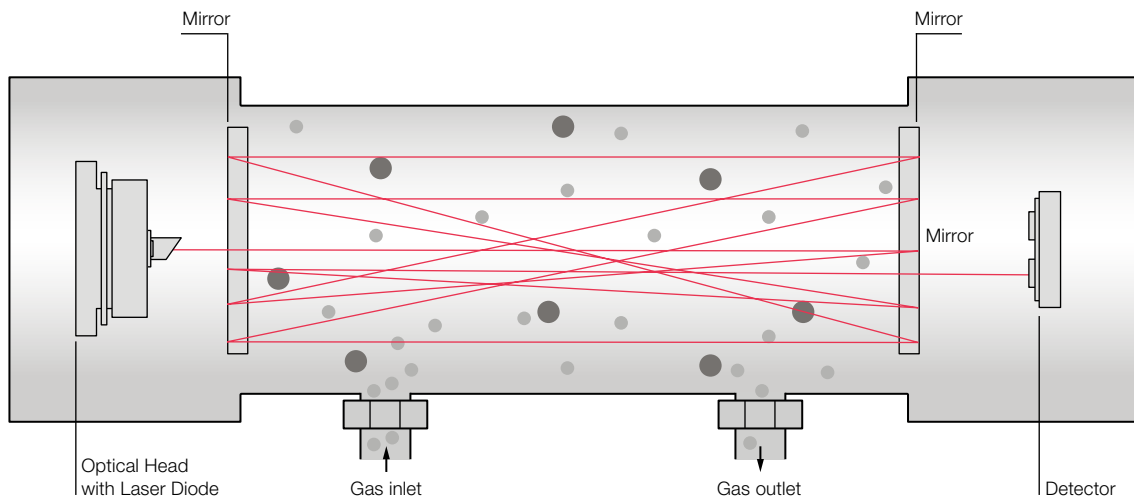
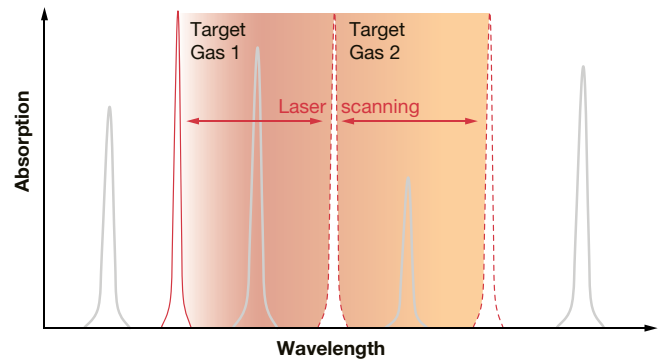
Breath gas analysis – Gas detection in Medical Diagnostics

• Research:

Climate control, environmental studies

Technology Brief

Axetris uses proprietary technology-enhanced TDLs for gas detection, where a 0.05 nm narrow bandwidth diode laser beam scans across an absorption band of the target gas, performing a high-resolution near-infrared absorption measurement. Electronic lock-in technology allows separating the gas absorption information from electro-optical system information, leading to a detection method eliminating the need for a physical reference channel and offering continuous sensor status monitoring. Thus, Axetris' LGDs present a clear alternative to current sub-optimal detection solutions and combine precise, contactless optical measurements with high target gas selectivity, calibration-free operation, low cost-of-ownership and easy OEM integration.





Your OEM Partner for Gas Sensing Solutions

Axetris AG is a designer and OEM manufacturer of Laser Gas Detection (LGD) solutions based on Tunable Diode Laser Spectroscopy (TDLS). The TDLS technology provides a valid solution to many gas detection challenges. We support our OEM customers with in-depth technology and application expertise from feasibilities until product launch. We collaborate with you in finding the right product design which best suits your needs in terms of performance and costs.

How Axetris enables its OEM customers to master gas measurement challenges?

Axetris provides easy-to-integrate sensor modules with Swiss Made quality and precision allowing you to reach new applications or simply to make your instruments better.

Understanding customer needs very well from the outset is essential to the development of an appropriate OEM product. This is where our core competencies come in: our customers trust in our TDLS technology expertise, practical application knowledge, and experience in the OEM business. On the basis of the jointly defined product requirements, we develop a solution and verify its feasibility at an early stage through initial laboratory tests as well as field tests. The test results help us optimize the product design which is then industrialized in order to reach market readiness. In doing so, we not only establish the performance expected of the future product; we also deal with the matter of cost in order to make it possible for our customers to get the OEM solution that best suits al their requirements.

As an OEM partner, we assist our customers with the integration at their side as well as with technical trainings. We have a competent Application Engineering Team for consulting in the fields of product integration and after-sales support. Our Repair & Service Center performs repairs, maintenance, and recalibration.

Our customers can count on Axetris even after the industrialization/market introduction. We maintain our OEM solutions with software updates and, on request, assist our customers with the further development or modernization of existing OEM product solutions.

TDLS compared to other Gas Sensing Technologies

	TDLS	NDIR	FTIR	E-Chem
Performance & Reliability				
High selectivity	+	=	+	-
High stability and reliability in the field	+	=	+	-
Cost				
Low initial investment	=	=	-	+
Low cost of ownership	+	=	=	=
Flexibility				
Hot gas measurement	+	=	+	-
Multigas Sensing	=	+	+	+



Application Examples

CH₄ leak detection from gas extraction over land or sub-sea transportation pipelines up to city-gas distribution leak search

Methane and other hydrocarbon emissions from extraction sites, gas treatment plants, from leakages in pipelines and city-gas networks are not only a safety hazard but also present a serious challenge in reducing overall greenhouse gas (GHG) emissions.

Fast reaction times due to minimized cell volume and rugged layout make the LGD Module an excellent instrument for CH₄-specific measurements. These characteristics are required for portable and vehicle mounted monitoring equipment used by utilities or their service providers in leak-search applications, or for shale-gas & oil extraction site surveillance.



Environmental studies of greenhouse & landfill gas

Methane (CH₄) is a potent greenhouse gas, about 25 times more effective than CO₂ at trapping heat in the atmosphere, which outgases from reservoirs, landfills and permafrost soils. Axetris Laser Gas Detection technology can reliably & selectively measure methane down to low ppm concentrations without the need for frequent recalibrations. Our sensors are suited for under-water or remote-site applications, e.g. in environmental research or for applications related to the commerce of CO₂ certificates.

NH₃ slip control in de-NO_x processes based on Selective Catalytic Reduction (SCR)

Gases like NO_x can cause significant long-term environmental affects. Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR) technologies for NO_x (Oxides of Nitrogen, NO + NO₂) controls have become the most popular means of NO_x reduction worldwide.

This process is extensively used in power plants and has found its way into emission control of large marine and fixed installed diesel engines.

The LGD Module is a perfect tool for OEM integrators because it offers a contactless low ppm-level measurement of NH₃ in a heated sample gas cell (220°C). Its extractive set-up allows for simple zero and span-gas calibrations.

NH₃ / HCl Continuous Emissions Monitoring (CEM)

Regulators worldwide dictate strict emissions limits for many atmospheric pollutants, including HCl (Hydrochloric Acid) and NH₃ (Ammonia). These emission limits require the emitting industries to monitor and report the level of the gas present in stack emissions and to ensure that steps are taken to guarantee that emissions fall below the specified limits. This may require the emitting industry to either refine their process, use cleaner fuels, or to add abatement apparatus downstream of the industrial process to reduce the emitted HCl or NH₃.

The Axetris LGD F200 integrated into an extractive set-up allows for simple zero and span-gas testing in compliance with legal regulations, e.g. in continuous monitoring of HCl in waste incinerators, cement & lime kilns, in steel production, etc. Typical applications for NH₃ monitoring are in stacks of power plants or chemical plants, as well as in fertilizer production prilling towers.



Industrial process control for surface treatment (steel surface hardening by gas nitriding)

Gas nitriding is a thermochemical process that diffuses nitrogen into the surface of a metal to create a case-hardened surface used to increase wear resistance, surface hardness and fatigue life.



In gas nitriding the donor is a nitrogen rich gas, usually ammonia (NH₃). When ammonia comes into contact with the heated work piece, it dissociates into nitrogen and hydrogen. The nitrogen then diffuses onto the surface of the material creating a nitride layer. The thickness and phase constitution of the resulting nitriding layers can be selected and the process optimized for the particular material properties required.

The Axetris OEM sensor LGD F200P2 NH₃ with its large linear measuring range from 0 – 500 ppm represents a reliable measuring solution for this application achieving a good control of the layer properties and thickness.

Detection of components in human breath for diagnostics

Breath tests represent already an effective way to investigate functional bloating, diarrhea, constipation, and suspected malabsorption, such as lactose and fructose. They are considered as a valid alternative to more invasive procedures. Approximately half the biomarkers identified in human breath air can be detected by laser spectroscopic techniques. TDLS is a robust and reliable technology able to sense many of these biomarkers such as methane (CH₄) and carbon dioxide (CO₂). The spectroscopic analysis of human breath can shorten the period needed to conduct tests from hours down to seconds and subsequently detect diseases early, prevent unnecessary hospitalization and reduce medical expenses considerably.



Typical Specifications

Target gas*		Lower detection limit **	Typical measuring ranges
NH ₃	Ammonia *** (hot-wet measurement)	0.2 ppm	0 – 15, 50, 100, (500) ppm
HCl	Hydrogen chloride *** (hot-wet measurement)	0.2 ppm	0 – 10, 50, 100, (500) ppm
H ₂ O	Humidity (hot-wet measurement)	0.2 vol %	0 – 30 vol %
CH ₄	Methane (ambient measurement)	0.4 ppm	0 – 100 (40'000) ppm
CO ₂	Carbon dioxide (ambient measurement)	4ppm	0 – 1'000 (300'000) ppm
C ₂ H ₆	Ethane (ambient measurement)	15 ppm	0 – 1'000 ppm
C ₂ H ₂	Acetylen (ambient measurement)	0.6 ppm	0 – 100 (500) ppm

* Other gases on request.

** Detection limits at constant system temperature, 20°C, 1013 hPa and 50 ± 1.5% r.H. Detection limits may change where system temperature changes occur significantly faster than concentration changes, and/or where a difficult gas matrix is present.

*** Detection limits degrade at higher temperatures due to spectroscopic reasons; e.g. NH₃ at 220°C.

About Axetris AG

Axetris serves OEM customers with micro-optical components, micro technology-based (MEMS) infrared light sources, mass flow meters and controllers, and laser gas detection modules used in industrial, telecom, environmental, medical, analytical and automotive applications.

Our multi-disciplinary and highly skilled engineering and manufacturing teams combine broad experience in design, manufacturing and metrology from MEMS components to advanced optical and electronic sensor modules. Axetris supports its customers with in-depth application know-how. Customers benefit from excellent product value, consistent high product quality and outstanding customer support. OEMs rely on Axetris worldwide as a competent partner for customer-specific solutions from concept to volume production. Axetris is ISO 9001:2015 certified and operates its own 6-inch to 8-inch wafer MEMS foundry for its own products and contract manufacturing for external customers. A wafer back end, a sensor assembly and calibration facility under clean room conditions completes the manufacturing infrastructure of Axetris.



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Gas Detection With The New LGD Compact

Precision meets small footprint

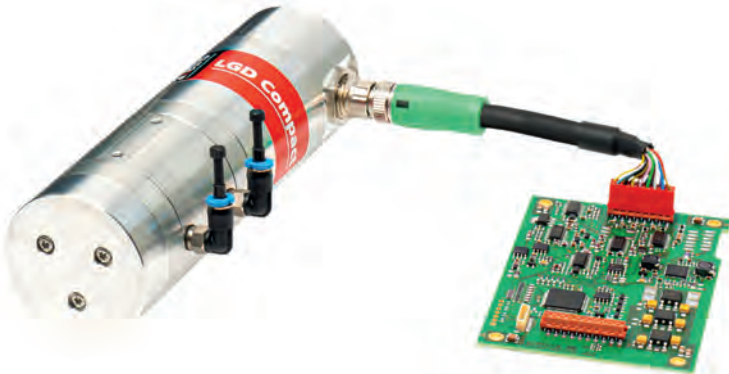


Figure 1: The new LGD Compact sensor module with attached electronics



The Danish Company Explicit testing UAV Leak Detection by a drone with an integrated LGD Compact from Axetris

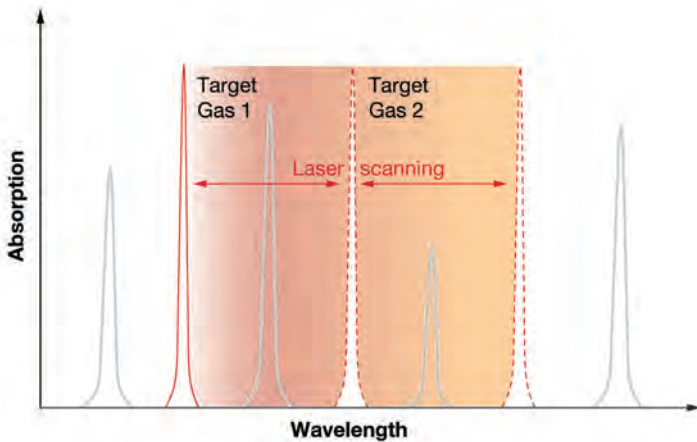


Figure 2: Detection of up to two target gases due to the wide tunability range of the laser

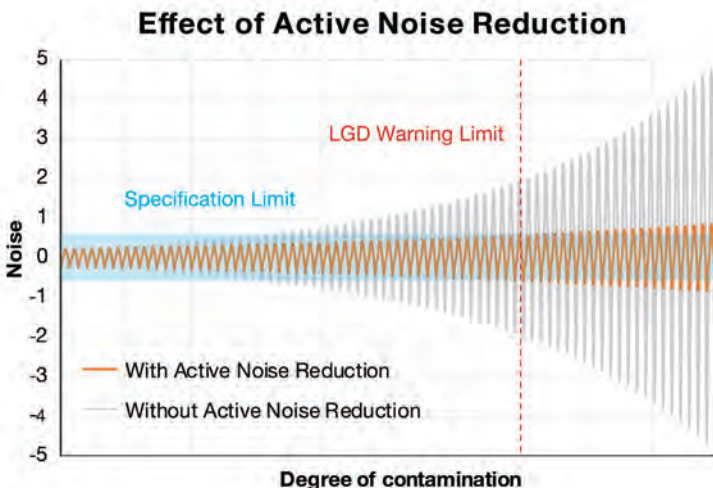


Figure 3: Effect of Active Noise Reduction in the new LGD Compact at increasing gas cell contamination

The new LGD Compact fits in almost every application – not just due to its size

Many applications in gas measurement technology today are continuously pushing the limits to have manufactures design and produce ever-smaller devices while increasing the performance. These smaller devices are able to make a variety of portable applications possible. At the same time, the demands on measurement performance and long-term stability are growing. Axetris AG introduces the new LGD Compact, an elegant solution that brings a combination of compact size and measurement performance one-step closer to ideal. With the new LGD Compact, engineers no longer have to make any compromises to meet the requirements of your measurement task (Figure 1).

Proprietary TDLS gas detection technology

Laser Gas Detection (LGD), based on Tunable Diode Laser Spectrometry (TDLS), provides a solution to many gas detection challenges in emission monitoring and process control. The technology offers unique advantages like precise optical, contact-less measurements, excellent target gas selectivity and sub ppm-level detectivity.

Axetris uses proprietary technology-enhanced TDLS for gas detection, where a 0.05 nm narrow bandwidth diode laser beam is scanned across an absorption band of the target gas (Figure 2), performing a high-resolution near-infrared absorption measurement. Electronic lock-in technology allows separating the gas absorption information from electro-optical system information, leading to a detection method eliminating the need for a physical reference channel and offering continuous sensor status monitoring.

Several advantages integrated into the LGD Compact

The new LGD compact combines TDLS technology with a small and lightweight designed multipass cell and a modulation-based active noise reduction (Figure 3) thanks to the unique optical laser package. Therefore, it is a perfect match for a wide range of portable instruments where performance and compact size matters. Its over-all size of less than a can with a weight of 600 g allows for an easy integration. Due to the high selectivity, second gases can be measured at the same time without interferences or confusion between the target gases (Figure 2). Thanks to the robust design and the active noise reduction technique a stable performance can be achieved even with increasing contamination of the gas cell. Axetris' technical support can remotely access relevant functions in the product interface through the extended features in the product software and support the customer as needed.

Natural gas detection in a compact way

Leak detection of methane – a major component of natural gas – along gas distribution networks is growing in importance. Methane emissions from gas pipelines are a major safety hazard, as Spectroscopy (TDLS) is fast becoming a very popular method to detect methane due to key advantages such as quick response time, exceptional accuracy and lower cost of ownership than traditional NDIR (Non-dispersive Infrared Spectroscopy) or FID (Flame Ionization Detector) which is often combined with gas chromatography.

The high selectivity of methane detection rules out any false alarms due to the presence of other gases or hydrocarbons (Figure 5). The technology can measure over a wide dynamic range – from sub ppm detection up to % level, thereby eliminating the need to install multiple sensors.

Finally, the size of the LGD Compact for the smaller measuring devices in portable applications is an enormous advantage (Figure 4). Thanks to the low-power consumption of the sensor, it is best suited for battery-powered operation that can last an entire working day.

Breathtaking progress in medicine

Breath analysis represents an effective way to investigate flatulence, diarrhea, constipation and suspected malabsorption, such as lactose and fructose. It is an alternative method to invasive diagnostics (Figure 6). Approximately half the biomarkers identified in human breath can be detected by laser spectroscopy. The spectroscopic analysis of human breath can shorten the period needed to conduct tests from hours down to seconds and subsequently detect diseases early, prevent unnecessary hospitalization and reduce medical expenses considerably.

The diagnosis of various gastrointestinal diseases, e.g. food intolerances, is a good example where the new LGD Compact is able to measure both methane and carbon dioxide simultaneously. This makes it particularly suited for medical applications where several components in the human breath provide information about the patient's state of health. The high selectivity and the ability to measure at sub-ppm levels are specific strengths of TDLS technology.

Axetris – A true OEM partner

Besides its standard LGD modules for OEMs, Axetris also offers customized solutions for specific gas detection applications. For this, the team of Axetris development engineers and integration specialists support OEMs with in-depth knowledge of technology and applications, from prototyping up to mass production.

About Axetris AG, Switzerland

Axetris is a company of the Leister Group and serves OEM customers with micro-optical components, micro technology-based (MEMS) infrared light sources, mass flow meters and controllers, and laser gas detection modules used in industrial, telecom, environmental, medical, analytical and automotive applications.

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Figure 6: Detection of diseases with breath analysis is also possible for the youngest patients



Figure 4: The LGD Compact integrated in a drone for portable UAV Leak Detection by the Danish Company Explicit



Figure 5: Even very low CH4 concentrations can be detected by scanning a biogas plant area with a drone



Figure 7: Axetris headquarter located in central Switzerland