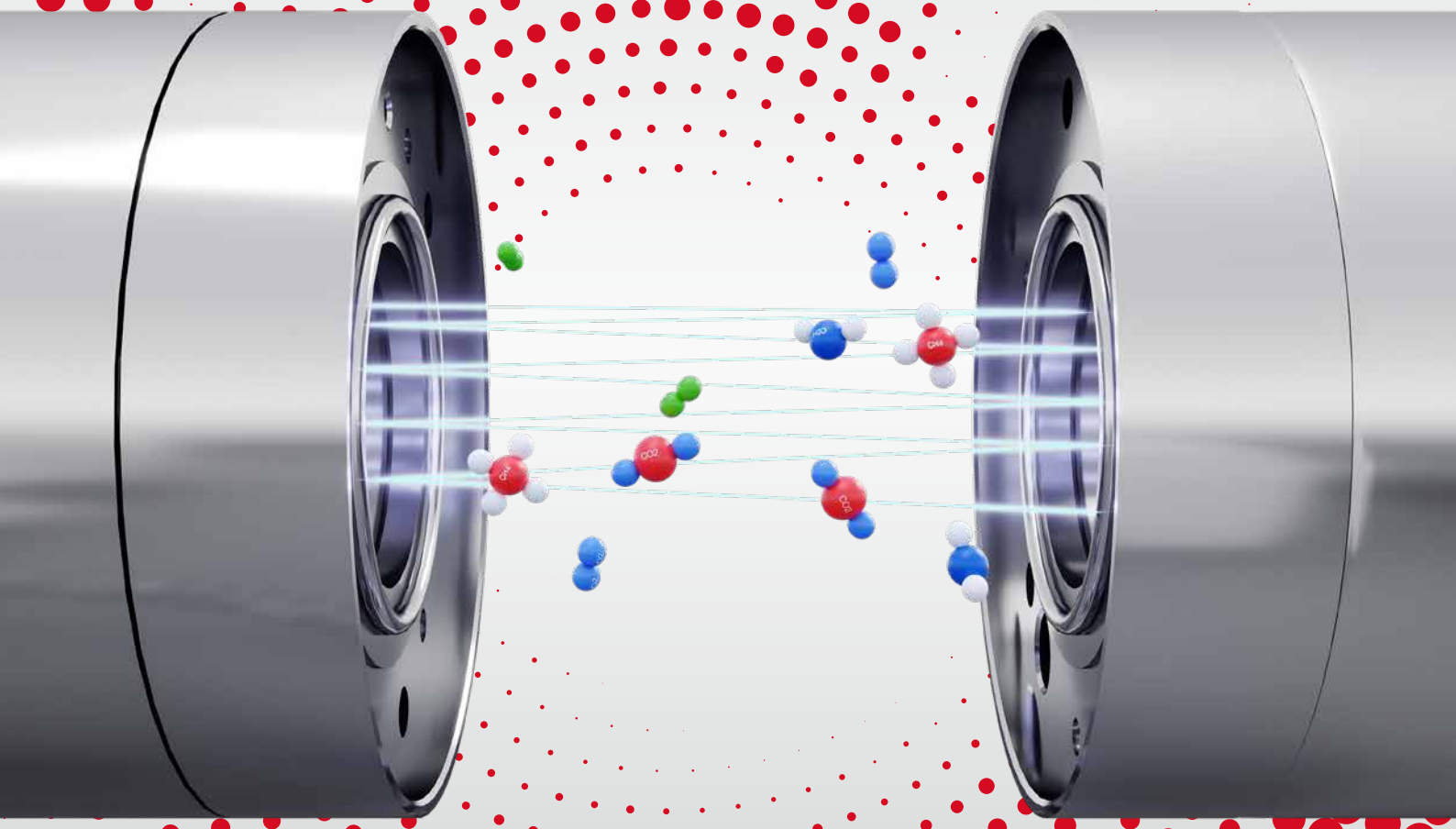
axetris

# Laser Gas Detection

## OEM Solutions



**Dedicated to precision.**

# Overview

**Although most gases are invisible to the human eye, we are constantly surrounded by them. Measurement technology allows us to determine, quantify and monitor gases. Be it for our safety or for process optimization; gas measurement technology adds value.**

Axetris Laser Gas Detection modules (LGD) provide solutions to many challenges in gas analysis. LGD modules are stand-alone, ready-to-use OEM subsystems for the selective detection and monitoring of gases. The sensors used in Axetris LGDs are based on so-called Tunable Diode Laser Spectroscopy – or TDLS for short. This technology has proven its validity in various areas of application, from high-end laboratory to process control. It uses a laser to scan the specific absorption lines of the target gas with an extremely high resolution. This enables the precise measurement of gas concentrations with a very high selectivity.

Axetris LGD modules use this proven technology for low-cost, high-volume gas detection and monitoring applications. Axetris' expertise in reference channel-free devices combined with extensive experience in packaging technology of laser diodes results in a low maintenance gas detection module for a wide range of applications.

**Request a free expertise now**

# Product Overview

**The LGD F200 series is perfectly suited for the harsh process conditions in industrial environments. The heated gas cell allows hot and humid process gases to be extracted and measured without causing condensation on the optics.**

**Platform-specific benefits:**

- Hot-wet gas measurement up to 220°C
- Sub-ppm gas detection in a humid gas matrix
- High selectivity to target gas and H2O
- Dual gas measurement with fast T90
- Long-term stability due to robust design

**The LGD Compact series was developed specifically for the needs of extractive and mobile gas measurement under ambient conditions. The small volume gas cell provides a fast response time, while the small, lightweight casing allows for integration in almost any application.**

**Platform-specific benefits:**

- Suited for ambient gas measurement in portable instruments
- Sub-ppm gas detection for up to 2 gases
- Low power consumption for battery-powered applications
- Handy size and low-weight <600 g
- Low operation costs with no need for regular calibration

**The LGD Compact module is available in a basic and EMC-compliant version, as well as with different cable variants and gas connections.**

Contact your local sales partner or our application specialists to talk about the needs of your application.

# Fields of Application

## Environmental

Changing conditions are inherent in environmental measurement technology: Variable temperatures, humidity and dust particles are only a few challenges gas measurement faces. Optical measurement technology that delivers stable performance under changing conditions provides a critical advantage. Not only master Axetris LGD modules this challenge with ease, they are also highly selective, and therefore avoid cross-influence from other gases, while doing so.

## Industrial

Industrial applications are usually accompanied by demanding conditions for measuring gases. Optical gas measurement technology has the advantage of contactless measurement, which is why it is also suitable for aggressive or corrosive gases. The LGD modules are perfectly suited to this environment thanks to their robust design and long-term stability.

## Automotive

Exhaust fumes negatively affect air quality and the climate. The Axetris LGD features fast measurement frequencies and a small-volume gas cell, which makes it an ideal companion that allows for real-time measurement of exhaust gases on the test bench or on the road.

## Medical

Measurement technology used to measure respiratory gases in health care is faced with the most complex gas matrix imaginable. This makes selectivity and a low detection limit particularly important. LGD modules use a highly selective narrow-band diode laser that significantly reduces interference.

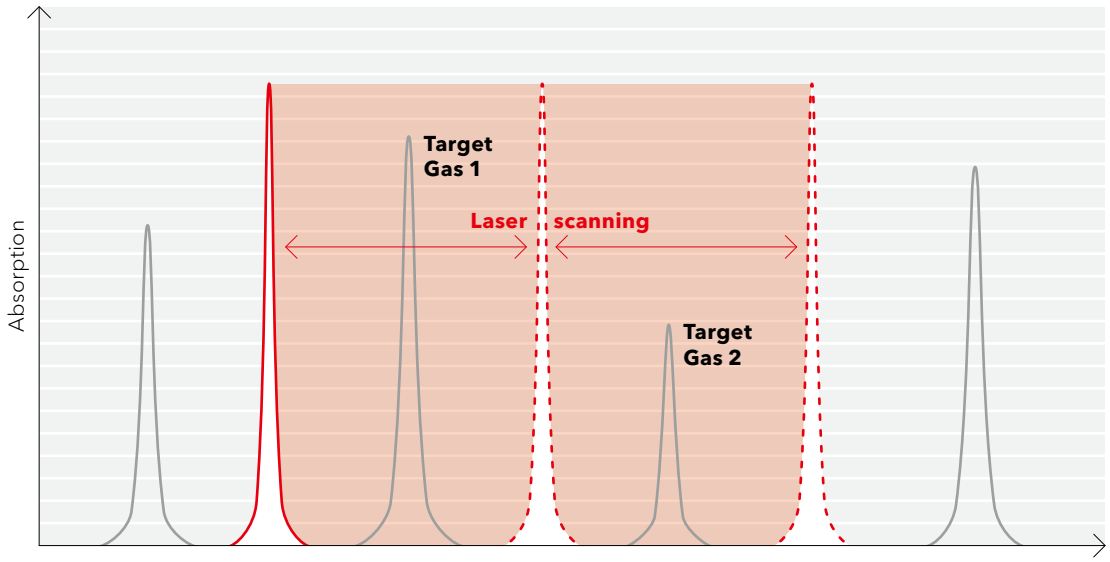
# TDLS Technology

**TDLS stands for Tunable Diode Laser Spectroscopy. This infrared spectroscopy technique makes use of the binding vibrational and rotational states of gas molecules. These are prompted by the absorption of photons. The absorption results in many organic and inorganic compounds exhibition absorption bands in the near and mid-infrared (IR) spectrum. The strongest absorption bands are usually found mid-IR. In near-IR we find so-called overtones. These are often strongly mitigated absorption bands of those in mid-IR.**

TDLS uses narrow-band semiconductor lasers. Their wavelength is tuned to the absorption line of the target gas. After absorbing some target gas photons, the remaining laser light hits a photodiode. Based on the Beer-Lambert law, this allows to calculate the absorption. The amount of absorption depends on the path length in the gas cell as well as the absorption coefficient of the target gas.

Electronic lock-in technology allows separating the gas absorption information from electro-optical system information, leading to a detection method that eliminates the need for a physical reference channel and offers continuous sensor status monitoring.

To increase the detection limit in this process, it is common to extend the path of the laser beam. State of the art multi pass cells, such as the Herriott Cell are used to reflect the laser beam multiple times between two mirrors before it hits the photodiode.




**In the defined infrared spectrum with the target gases, the diode laser can be tuned by means of temperature or current. This tuning causes the laser to scan over the corresponding absorption lines of the gases within a few nm.**

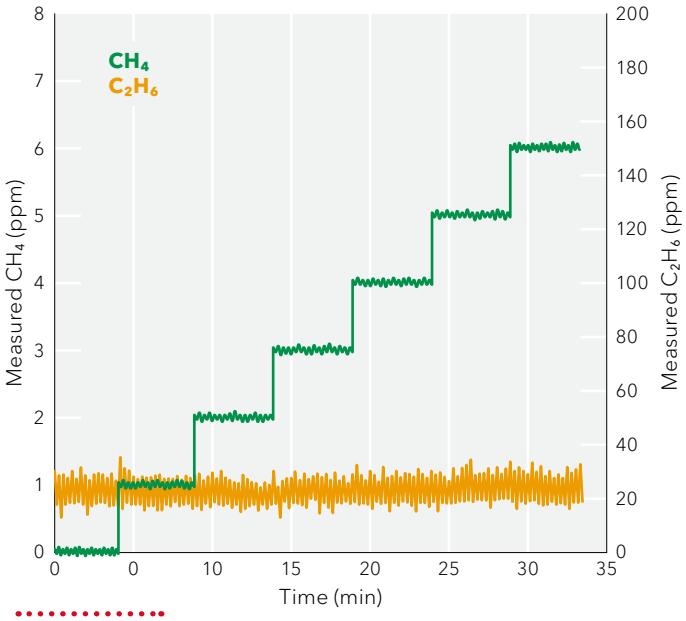
# TDLS Advantages

**TDLS is the most widely used laser-based gas measurement technology on the market today. Although the basic principle has been known for decades, it is constantly developed further.**

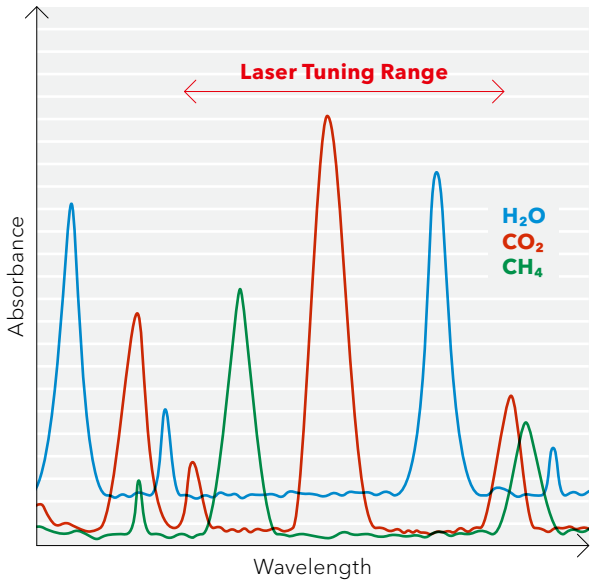
**High selectivity**
Probably the greatest advantage in laser-based spectroscopy is selectivity. The use of narrow-band diode lasers allows the direct scanning of individual gas absorption lines. Interference through other gases can be avoided – as shown in diagram on the left below. This is an advantage over broadband light-sources as used in NDIR (non-dispersive infrared spectroscopy). The Axetris LGD can reliably detect trace gases in sub-ppm ranges – even in complex gas matrices.

**Measuring up to two gases**
In TDLS radiation is generated with tunable laser diodes. Their emission frequency can be changed through temperature or changes in the current. Like this it is possible to scan a small spectral range of a few nm using TDLS – as shown in the diagram on the right below. Should other relevant gases be present in this spectral range, they can be measured simultaneously with the target gas.

**Optical and contactless measurement**
TDLS measurements are made without contact between the laser and the gas matrix. Therefore, aggressive and corrosive gases can be measured without any damage to the laser source. Only the gas cell is directly exposed to the sample gas. Materials can be optimized based on the chosen application to ensure a continuously stable operation.




**Thanks to the narrow-band diode lasers, the gas peaks can be detected separately. Interference with other gases in the matrix is thus avoided, as shown here for the example of methane and ethane. A step-wise increase of the methane concentration shows no influence on the measured ethane.**

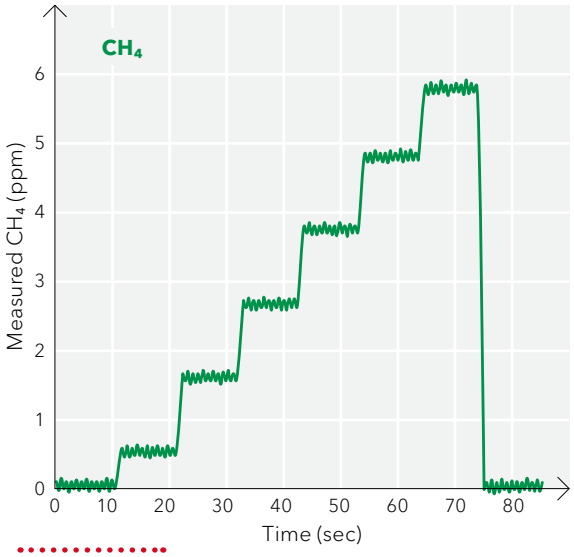



**If more than one target gas in the spectrum is within the laser tuning range, they can often be measured together. The additional measurement usually does not result in a loss of time, so a real-time measurement is also possible with two gases.**

# Axetris LGD Benefits

## 1 Temperature stability

The maxima of the gas absorption lines change with temperature. This can lead to deviating measured values during temperature fluctuations. To minimize this effect, the LGD modules are equipped with a heated gas cell (LGD F200) or a temperature sensor (LGD Compact). With this, the temperature of the gas cell is kept constant or measured and consequently compensated. As a result, the measured values remain stable and reliable even if the ambient temperature changes.




**Thanks to their small volume gas cells, all Axetris LGD modules can detect even smallest concentration changes below 1 ppm in real time. There is no settling time and the measured signal remains stable.**

## 2 Fast response time

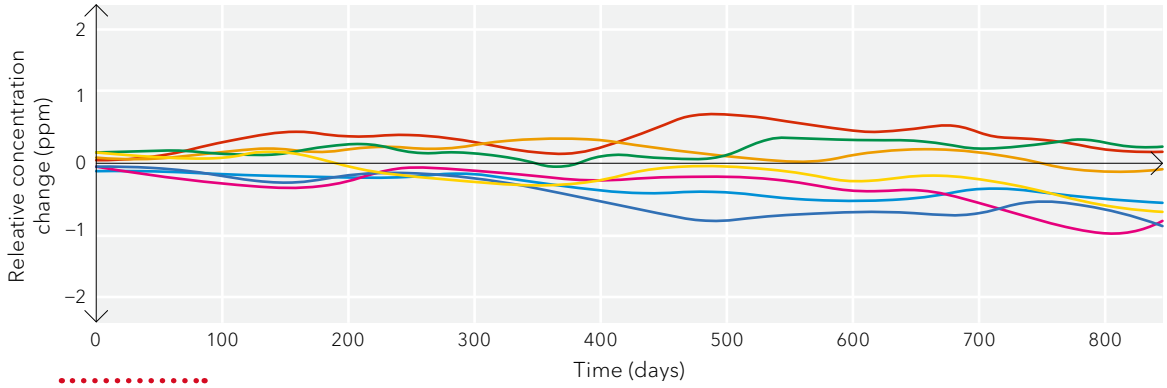
Axetris LGD modules feature small volume gas cells of only a few ml. Real-time gas measurement relies on sample gas being exchanged fast and gas cells being purged and released from sample gas quickly. Axetris LGD modules are designed to deliver fast response times and are an ideal choice for real-time measurements.

## 3 Long-term stability

Optical light sources usually require regular calibrations due to naturally occurring drift during long-term operation. The Axetris LGD software algorithm, however, is able to correct regular occurring drift automatically. When operated permanently, the software checks the measurement positions of the target gases at specified intervals and adjusts the measurement parameters accordingly.

On top of this, the LGD tracks the target gas or a gas present in the gas matrix constantly, even if the target gas is not present. To do so some LGD modules are equipped with reference gas in the optical path.

These clever features prevent age-related drift and loss of measurement position which in turn eliminates the need for regular calibration. As a result, Axetris LGD modules are unrivaled when it comes to cost of ownership in gas measurement technology.




**Even with a prolonged operating time of several years, the drift and the associated change in concentration remain very low. Therefore regular calibration of Axetris LGD modules are not necessary.**

## 4 Self-contained, easy to integrate

Axetris LGD modules come (depending on the configuration) already equipped with communication electronics. Both digital and analog signals sent by the LGD module can be received via a standard RS232 interface. All application-specific parameters can be changed directly through the interface or using the free LGD Frontend software.

The compact design of the LGD modules ensures easy integration for almost any application. Based on our many years of experience, we are also happy to advise on suitable equipment, such as filters or hose materials, for optimal integration.

## 5 Active noise reduction

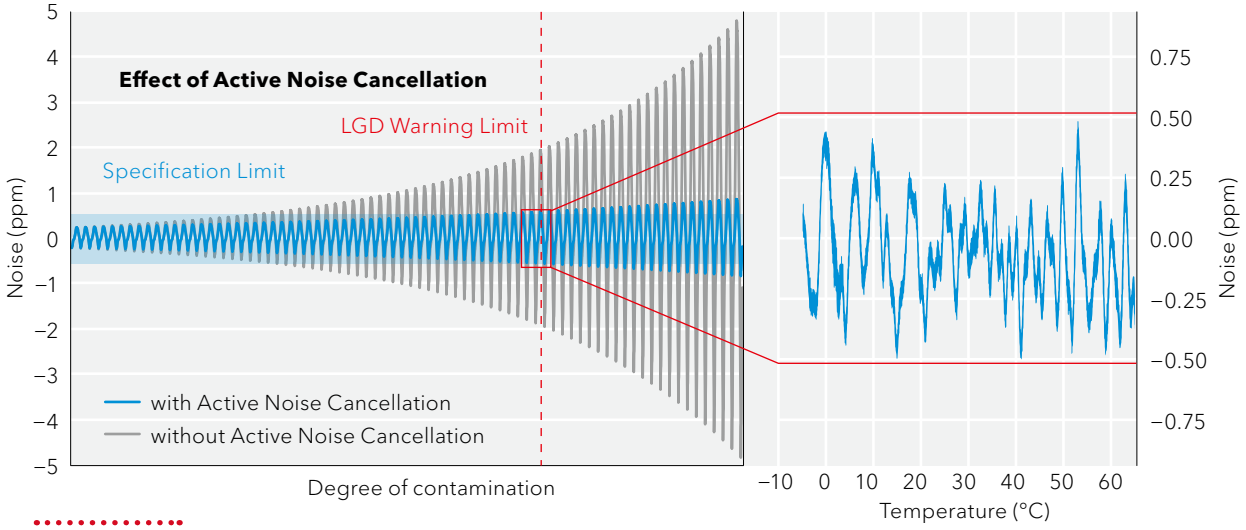
TDLS technology measures changes in a signal compared to a large noise backdrop. Any noise caused by the built-in light source or optical system reduces detectability. Especially in industrial environments, harsh conditions often prevail and the optics of the device can easily become contaminated.

Axetris LGD modules use a patented algorithm to actively suppress the noise level. Even with slightly contaminated optics, the LGD delivers stable measurements. Long-term gas detection in the sub-ppm range is therefore possible with only minimal maintenance.

## 6 Easy span and offset adjustment

Axetris LGD modules are designed to operate continuously for several years and do not usually require regular factory calibration. If needed, Axetris LGD modules can easily be adjusted with a simple span and offset correction. This requires nothing more than nitrogen for the zero point adjustment and the corresponding target gas in the desired concentration.

The LGD Frontend software allows users to change the span and offset values – so does the data package through th RS232 interface. This makes the span and offset adjustment easy to implement even outside the lab.




**Optical measuring instruments often suffer from contamination under harsh conditions. This may result in increased noise levels, which can significantly disturb the measurement quality. In Axetris LGD mdoules, a patentet technology for active noise reduction ensures stable values within specifications – even with increasing contamination.**

# LGD Frontend Software

**Axetris offers open-source frontend software for all LGD products on www.axetris.com. The .exe file can conveniently be run on any device without the need to install a program. Neither does it require an internet connection. Perfectly suited to be used in the field.**

The LGD-Frontend start page shows the current measurement of the target gas as well as their temporal course. Parameters, such as integration time or span and offset values can easily be changed in settings.

The menu item "Diagnostic Data" also provides the user with valuable information about the status of the LGD. The "Power on Photodiode" shows how much of the laser light is reaching the detector and whether there could be any contamination. And the "Linelocking_Status" provides information about whether the LGD is tracking to the correct measurement peak. All information from the "Diagnostic Data" can also be continuously retrieved as a data package via the digital RS232 interface.

Statistical data can be generated from measured values of target gases. To do so, the user simply marks the corresponding area in the adjacent diagram. Values such as the mean value, minimum, maximum and standard deviation are then displayed in the table as shown below.

Like this the performance of measured values can be checked quickly and easily.

To integrate the software into a software landscape, sent and received data packages can simply be logged in the frontend. This gives the user real-time feedback on commands.

There are different service levels. For extended service needs, Axetris support can access the module remotely and issues can be resolved quickly.


**Axetris LGD frontend software lets users analyze and depict additional parameters.**

# Your Trustworthy OEM Partner

## Technical customer support and application/integration know-how

Do you have a technical issue or a complaint about the LGD you received? Are you looking for the right product for your measurement task? Do you have different specification requirements or do you need help integrating our measurement technology?

Our team of engineers has broad application knowledge and supports you in finding the right product for your needs.

## Repairs and recalibration

We at Axetris are a partner to our worldwide OEM customers. Our technical support team takes care of your concerns, whether it is remote support or off-site repairs.

All Axetris OEM sensor components are low maintenance and can be operated for a long time without the need for re-calibration. If a new calibration is necessary, which is often driven by external regulations, we can perform it at any time under clean room conditions in our production facility.

## Product training

As you are already an integration specialist for our products, would you also like to take care of maintenance and repairs yourself? We offer technical training on various levels for our entire product range. This will render you an expert for our products and you can perform re-calibrations and repairs on your own.

Our training and our product software are scaled for different needs and levels of expertise. Depending on your wishes and needs, we will find the right training on-site or at Axetris.

# About Us

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

At Axetris a highly qualified team of engineers and manufacturers combine their broad experience in design, manufacturing and metrology from MEMS components to advanced optical and electronic sensor modules. Axetris supports customers with in-depth application know-how. Customers benefit from excellent product-value, consistently high product quality and outstanding customer support. OEMs rely on Axetris as a competent partner for customer-specific solutions from concept to volume production.

Axetris is ISO 9001:2015 certified and operates a 6- to 8-inch wafer MEMS foundry for Axetris products and contract manufacturing for external customers. A wafer back end, a sensor assembly and calibration facility operating in clean room conditions complete the manufacturing infrastructure of Axetris.

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Axetris is ISO 9001:2015 certified.