



Temperature and Gas  
Sensing Solutions

# **GAS SENSING SOLUTIONS OVERVIEW**

[www.lumasenseinc.com](http://www.lumasenseinc.com)

[info@lumasenseinc.com](mailto:info@lumasenseinc.com)

## TECHNOLOGY OVERVIEW

# LUMASENSE SOLUTIONS FOR GAS SENSING

LumaSense delivers innovative gas sensing instruments for a number of markets, including global energy, industrial materials, and advanced technologies.

Our gas portfolio consists of gas modules and instruments that provide superior sensitivity over other gas detection techniques.

As the pioneer in trace and multi-gas analysis and monitoring solutions, LumaSense delivers a complete range

of Photoacoustic Spectroscopy (PAS) and Non-Dispersive Infrared (NDIR) based systems for all kinds of environments and applications. PAS and NDIR instruments are highly accurate, stable, and provide a direct measurement independent of background, and does not require carrier gases or consumables.



## NDIR

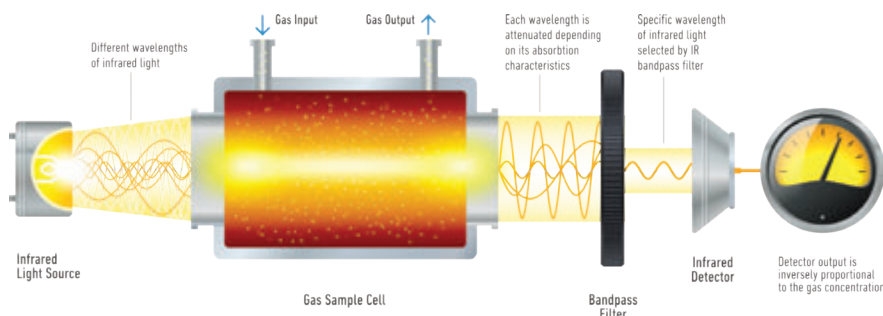
### NON-DISPERSIVE INFRARED GAS SPECTROSCOPY

Non-Dispersive Infrared (NDIR) quantifies known gases. While the technology has long existed, LumaSense Technologies' ANDROS® brand pioneered NDIR gas analysis for automotive emissions and patient monitoring. NDIR is the heart of our suite of SmartDGA products designed for Dissolved Gas Analysis (DGA) of transformers and load tap changers (LTCs). With ANDROS® NDIR modules, the cost of gas measurement is greatly reduced because our modules can measure multiple gases and field calibration is not needed using our unique single path approach.

The main components of NDIR gas sensors are: an infrared (IR) source (lamp), a gas sample chamber or light tube, an optical bandpass filter and the infrared detector. The gas is pumped or diffuses into the sample chamber and the gas concentration is measured optically by its absorption of a specific wavelength in the IR spectrum. The IR light is directed through the sample chamber towards the detector. The detector has an optical filter in front of it that eliminates all light except the wavelength that the selected gas molecules can absorb (see diagram).

The IR signal from the source is modulated so that thermal background signals can be offset from the desired signal. In some applications, it may be necessary to compensate for the presence of non-target gases which absorb in the same portion

of the IR spectrum. Our applications engineers and scientists work closely with customers to determine what is required for a precise and accurate gas measurement.

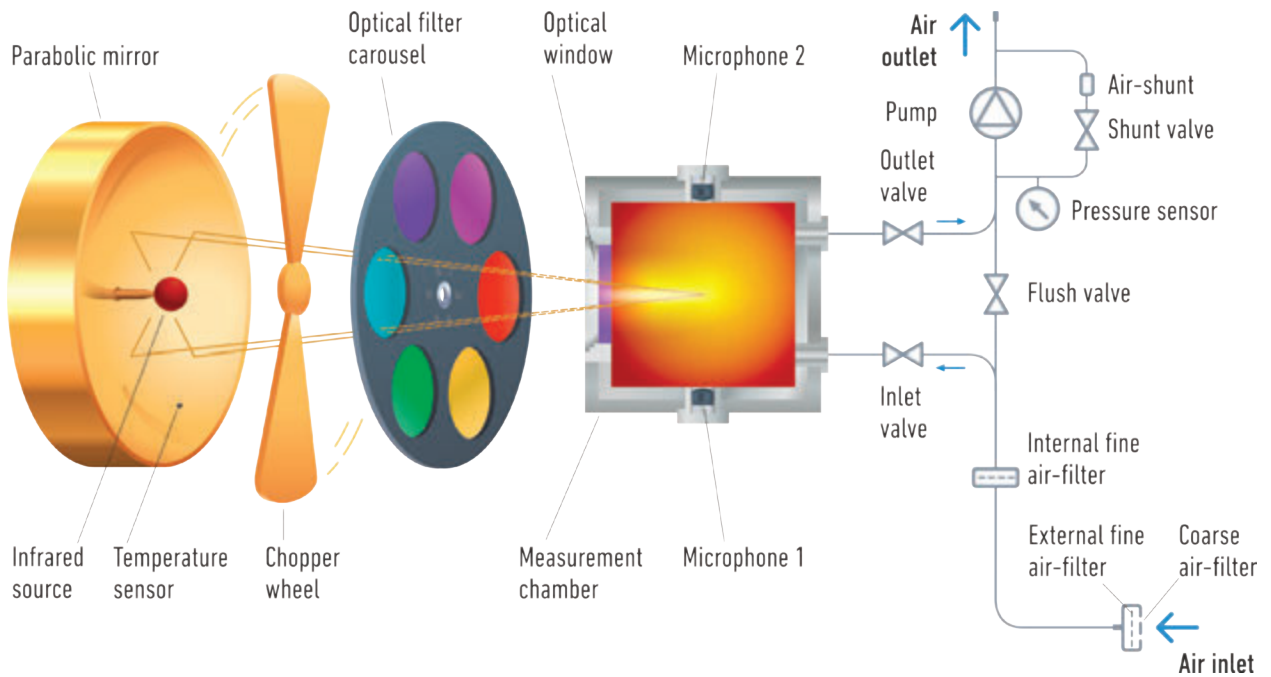


# PHOTOACOUSTIC SPECTROSCOPY

Photoacoustic Spectroscopy (PAS) gas instruments were pioneered and perfected by INNOVA™. With PAS, the absorption (proportional to the concentration) is measured directly and not relative to a background, making PAS highly accurate and stable. Furthermore, all gases and vapor in small volumes can be monitored sequentially in a single measurement chamber as it is possible to detect up to five substances and humidity to be monitored individually.

In a PAS instrument, the gas to be measured is irradiated by modulated infrared light of a pre-selected wavelength. The gas molecules absorb some of the light energy and convert it into an acoustic signal which is detected by microphones.

The IR-source is a spherical, heated black body. An ellipsoidal mirror focuses the light into a closed PAS cell through a window after it has passed the light chopper and the optical filter. The chopper rotates and effectively switches the light on and off. The optical filter is a narrow-band state of the art IR interference filter. If the frequency of the light coincides with an absorption band of the gas in the cell, the gas molecule will absorb part of the light. The higher the concentration of gas in the cell, the more light will be absorbed. As the gas absorbs energy, it is heated and therefore expands and causes a pressure rise. As the light is chopped, the pressure will alternately increase and decrease, thus generating an acoustic signal. The acoustic signal is detected by two microphones. The electrical output signals from the two microphones are added in an amplifier, before they are processed.



## Benefits of NDIR and PAS Technologies

### Accurately Measure

- Concentrations from ppb, ppm to percent range
- Compensated for temperature, pressure, and humidity interference

### Simplify Gas Detection

- Monitor up to 3 gases simultaneously with single NDIR sensor, up to 5 gases + water vapor for PAS instruments, and up to 9 gases simultaneously with SmartDGA
- Fast response time
- Easy set-up and remote control operations

### Protect Valuable Resources

- Detect harmful gases
- Reduce risk to human health and safety
- Preserve natural resources
- Comply with gas emission standards

GLOBAL ENERGY SECTOR

# SF<sub>6</sub> LEAK MEASUREMENT SOLUTION



**Sulfur Hexafluoride (SF<sub>6</sub>)** is one of the most potent greenhouse gases, with a Global Warming potential of more than 22,000 times than that of CO<sub>2</sub>. Over the past decades, manufacturers have replaced oil high-voltage switch gears with SF<sub>6</sub>-insulated units. Today, the power utility industry uses roughly 80% of all SF<sub>6</sub> produced worldwide.

## SF<sub>6</sub> FILLED EQUIPMENT TESTING

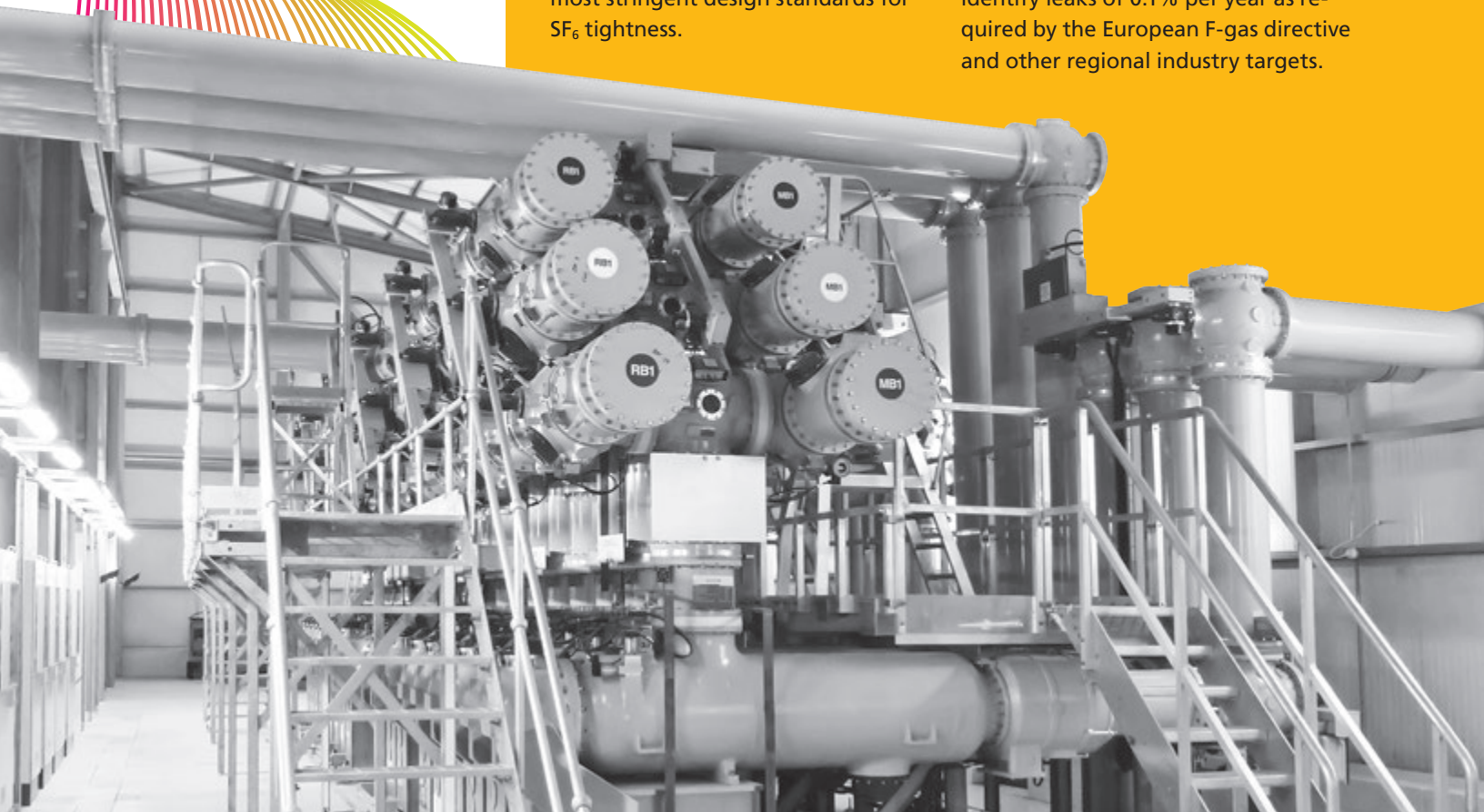
Photoacoustic infrared spectroscopy is actually listed as the state-of-the-art and most sensitive technique for quantitative tightness test by the reference document in the industry: SF<sub>6</sub> Tightness Guide, CIGRE Technical Brochure 430 – WG B3.18.

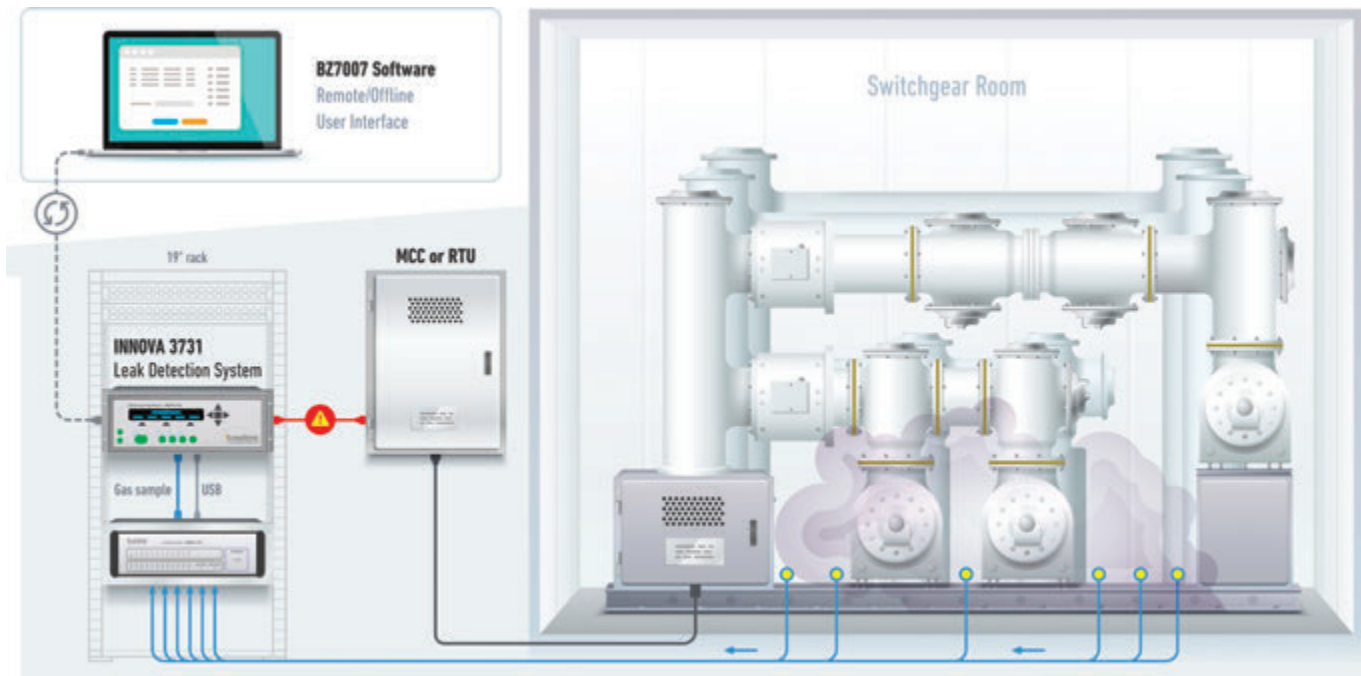
The low detection limit and high accuracy of our SF<sub>6</sub> Leak Detector enables manufacturers to complete their quality tests more efficiently, in a shorter time, and with great precision, while complying with the most stringent design standards for SF<sub>6</sub> tightness.

## SF<sub>6</sub> LEAK MONITORING IN SUBSTATIONS

Leverage the same inherent measurement capabilities and benefit from the highly stable and low maintenance rate of the PAS instrument with the reliable SF<sub>6</sub> leak monitoring solutions for enclosed substations.

The ultra-sensitive SF<sub>6</sub> Leak Detector has a low detection limit of 0.006 ppm and is bundled with a multi-point sampler and monitors up to 24 different locations that can be distributed across the substation. This is the only solution sensitive enough to automatically identify leaks of 0.1% per year as required by the European F-gas directive and other regional industry targets.





## SF<sub>6</sub> Leak Detection System – 3731

- Stationary standalone multipoint monitoring for direct leak detection in large enclosed volume
- Ultra-sensitive, with a limit of detection at 6 ppb
- High reliability with self-test routines
- Available in 12 or 24 channels, with sampling lines that can extend to 75 m
- Exceptional accuracy with auto-compensation for temperature and pressure fluctuations, and for water vapor interference
- Measurements stored in internal memory, with easy export to remote PC via user-friendly BZ7007 software

## LumaSoft Gas Multi Point 7870

- Synchronizes the sampling functions of the sampler units to the measurement cycle of the Photoacoustic Gas-Monitors
- Displays measurement data in either a table or a graphical window; data can be displayed in a Channel or Gas view mode
- Alarm reporting for each gas at each measurement location
- Measurement data stored in SQL Server 2005 database
- Online access to the measurement data via built in OPC Server
- Login-secured access to measurement data



# DISSOLVED GAS ANALYSIS FOR TRANSFORMER MONITORING

LumaSense's online DGA solution is designed for easy installation, accurate performance, and helps utilities achieve fleet-wide usage on transformer and load tap changer (LTC) monitoring. Using our field proven Non-Dispersive Infrared (NDIR) solution, utilities can consistently measure the gas levels, rates, and ratios in real-time and get an accurate picture of transformer or LTC health.



## GAUGE

### 3 GAS + MOISTURE

The **SmartDGA Gauge™** is the industry's first dedicated online load tap changer (LTC) condition monitor. With the ability to monitor ethylene ( $C_2H_4$ ), acetylene ( $C_2H_2$ ), Methane ( $CH_4$ ), and moisture without maintenance and routine calibration, it offers the best value to assess LTC health.

## GUARD

### 4 GAS + MOISTURE

The **SmartDGA Guard™** provides reliable early warning diagnostics to prevent transformer failures. It measures and reports Hydrogen ( $H_2$ ), Carbon monoxide (CO), Carbon Dioxide ( $CO_2$ ), acetylene ( $C_2H_2$ ), and moisture for incipient fault detection without routine maintenance, calibration, or need for carrier gas.

## GUIDE

### 9 GAS + MOISTURE

The **SmartDGA Guide™** provides comprehensive online Dissolved Gas Analysis (DGA) monitoring and diagnostics to prevent transformer failures. It measures and reports all DGA gases at half the cost of other 9 gas DGA monitors. Furthermore, the Guide vastly reduces total cost of ownership due to its differentiated design and installation scheme.

Each SmartDGA instrument is connected to the **SmartDGA EZHub™**, which functions as the power supply and initial data storage location. For transformers with external LTCs a single EZHub can serve both SmartDGA Gauge on the LTC as well as a Guard or Guide on the main tank. The EZHub connects to a PC or *iCore* using RS485 or Ethernet which uses the DGA Viewer software for data visualization as well as additional data storage.



The **LumaSMART iCore™** optional device provides Smart grid ready advanced communications like IEC 61850, DNP3, MODBUS. It also provides high-powered computerized display for viewing, trending, and diagnostics; as well as long-term memory storage.



The **DGA Viewer™** software allows users to configure systems using various set-up tools and view data being captured by the SmartDGA® instrument. The software also enables easy commissioning and local display of online DGA results.





## COST OF OWNERSHIP

Most DGA monitors are too expensive to support wide-scale deployment, thus limiting the ability to realize a Smart Grid and true condition-based maintenance. SmartDGA is affordable - sometimes half the cost of other monitors with no consumables or scheduled maintenance.



## FLEXIBILITY

Our SmartDGA solution offers flexibility and the ability to accurately identify and mitigate faults by using IEEE and industry recommended guidelines for automated fault identification and alert.



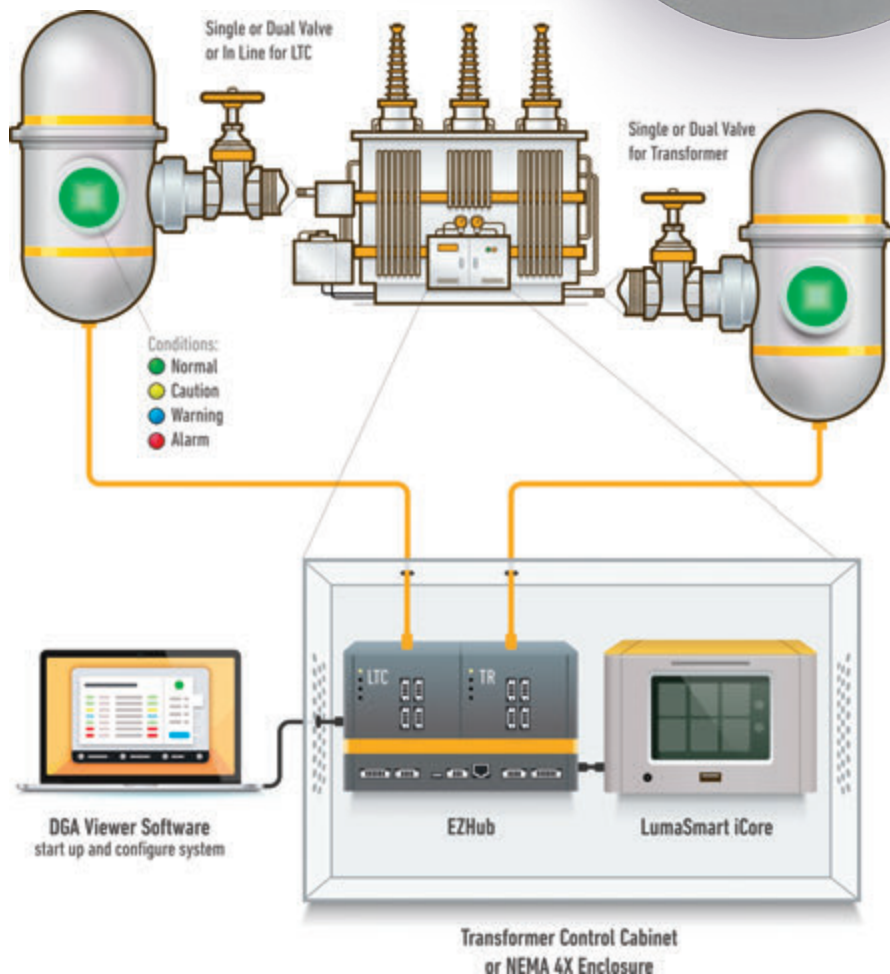
## EASE-OF-USE

Most monitoring technologies are cumbersome to install, maintain, and service, leading to a poor overall user experience. SmartDGA offers versatile monitoring configurations, including optional inline mounting.



## UP TO 9 GASES

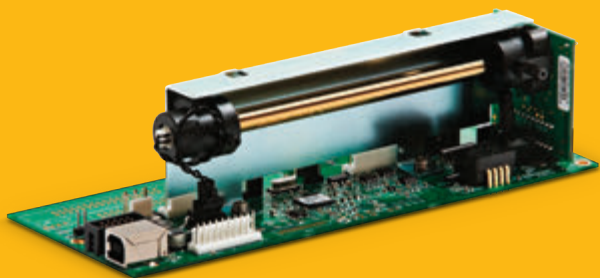
Comprehensive online Dissolved Gas Analysis monitoring and diagnostics to prevent transformer failures. Available with 3, 4, and 9 gas instruments to best match needs and budgets.



INDUSTRIAL MATERIALS SECTOR

# Industrial Combustion Monitoring

Industrial pollution can be mitigated monitoring waste gases such as carbon dioxide (CO<sub>2</sub>), Hydrocarbons (CH<sub>x</sub>) and oxides of nitrogen (NO<sub>x</sub>).



## ANDROS 6500 GAS MODULE

- Measures CO, CO<sub>2</sub>, and Hexane or Propane up to high concentrations with NDIR
- Measures O<sub>2</sub>, NO and NO<sub>2</sub> with chemical sensors

## MULTI-GAS MONITOR INNOVA 1316-1

- Measures CO, CO<sub>2</sub> and hydrocarbons (either hexane or propane)
- Measure O<sub>2</sub> and NO when combined with optional chemical sensors



The 1316 is a reliable and field-proven product that uses NDIR technology, which is particularly beneficial in harsh industrial environments because our instruments have no moving parts in the optical path, seldom require calibrations, and automatically compensate for drift while measurements are performed. NDIR gas instruments like the 1316 have been used for measuring fumes from industrial printing processes, monitoring filter break-through, and scrubber efficiency and analyzing exhaust from smoke stacks.



## INDUSTRIAL MATERIALS SECTOR

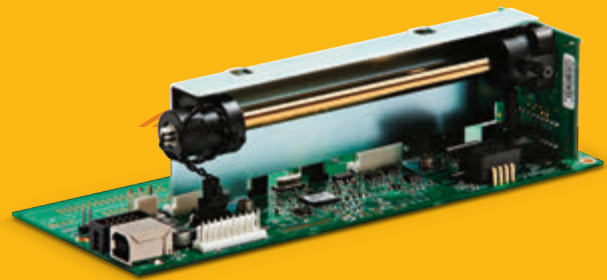
# Refrigerant gas leak detection

Refrigerant gas leak detection is becoming a high priority due to the risk to the environment, the increasing price of refrigerant gas, and the high price for repair of major leaks. The need for accurate refrigerant gas detection is also driven by tightening regulations such as the European F-Gas Directive and EN378 legislation.

## FOR SYSTEM INTEGRATORS

---

- The Andros 6552 NDIR gas module with two gas channels can be applied to any type or combination of refrigeration systems that may employ CFC, HFC, HCFCs and CO<sub>2</sub>.
- Low power consumption and low maintenance designed to meet or exceed EN 14624, performance of mobile leak detectors and of room controllers of halogenated refrigerants.



## FOR END USERS

---

- The INNOVA 1314i can address the needs of end users with a unique area monitoring system featuring ppb detection levels using photoacoustic technology.
- The trace gas detector INNOVA 1314i can be bundled with a multi-zone sampling systems with up to 24 channels.



## OTHER MARKETS

# Environmental Emission Monitoring

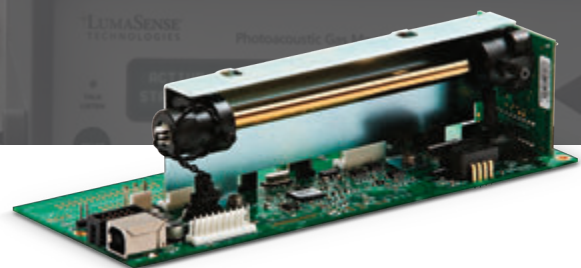
There is an expanding list of environmental and emission applications where gas sensing solutions are needed. Our INNOVA gas instruments have measured  $\text{NH}_3$  in swine and poultry stables,  $\text{CH}_4$  in cattle and poultry stables,  $\text{N}_2\text{O}$  from stables and fertilizer,  $\text{CH}_4$  from decomposing biomass, and in greenhouses and rice cropping.



## INNOVA 1412i

The INNOVA 1412i is a versatile gas monitor broadly used in research and development projects like:

- Agriculture emission reduction from soils, manure, and livestock housing
- Greenhouse gas emissions monitoring
- Remedial soil contamination system efficiency



## ANDROS 6511

ANDROS 6511: gas module is used for greenhouse gas and landfill methane monitoring:

- Continuous, real-time measurement of multiple components including methane and carbon dioxide
- Special version extremely stable (non zero request) compatible with Gas industry explosive environment



## OTHER MARKETS

# Fermentation Processes

Traditional means of gas measurement that require constant conditions are not well suited for fermentation metabolism. Exhaust gas measurement based on the ratio of CO<sub>2</sub> production and O<sub>2</sub> consumption (i.e. the Respiratory Quotient) is ideal. Exhaust gas analysis of fermentation process using NDIR technology is both accurate and cost-effective.



## INNOVA 1316-3

- The INNOVA 1316-3 is triple-gas monitor that can measure CO<sub>2</sub>, O<sub>2</sub> and Ethanol simultaneously from a single sampling point.
- The INNOVA 1316-3 has fast warm-up and response times. It is exceptionally easy to use and is scalable with the 7950 multi-point software.

## 7950 MULTI-POINT SOFTWARE



OTHER MARKETS

# Automotive Emissions Monitoring

LumaSense is the pioneer manufacturer of NDIR-based gas modules for the automotive testing industry with an installed base exceeding 450,000 units.

For vehicle exhaust gas and SHED evaporative testing, the INNOVA 3433 multi gas monitor offers highly accurate and reliable measurements. For vehicle diagnostic, inspection, and maintenance programs our ANDROS 6500 series gas module offers:

— Unparalleled accuracy and performance through simplicity of design and implementation.

— Easy integration and upgrade with flexible configuration thanks to the Andros operating system and development software.

— Low power consumption, low maintenance and cost of ownership.

Test setup at IPETRONIK (in Germany) with the INNOVA 1412i for monitoring emission values of R134a or HFO-1234yf.





SHED Chamber

Photoacoustic Gas Monitor  
**INNOVA 3433**



Embedded  
Sampling Pump

Data Acquisition System  
or LumaSoft Gas Software



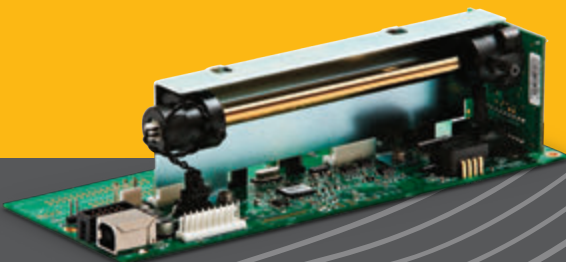
RS232

Modern automobiles are manufactured with sophisticated sensors, computer controls, and on board diagnostics (OBD). Even when all systems are operating correctly, engine emissions can be higher than the original regulatory standards. Many failures cannot be determined by OBD diagnostics alone, so the only way to know how well the engine is performing is to measure the tail pipe emissions using an NDIR based diagnostic instrument.

- The ANDROS 6500 Auto Emissions gas module is manufactured and tested to meet the limits defined in any of the worldwide requirements to ensure the OEM is receiving the highest measurement performance capability.
- The ANDROS 6500 is designed to meet and exceed ISO 3930/OIML R99, Class 0 and BAR 97 specifications.

For vehicle testing and engine design validation, several gases ( $\text{NH}_3$ , EtOH, and  $\text{N}_2\text{O}$ ) need to be measured. LumaSense's INNOVA 3433 Multi Gas monitor is used to measure evaporation emissions (SHED) and vehicle exhaust gas (Constant Volume Samples CVS) approved by EPA and CARB. The INNOVA 1412i can also be used for measurements of Mobile Air Conditioner emissions R134a and HFO-1234yf.

## ANDROS 6500



## INNOVA 3433

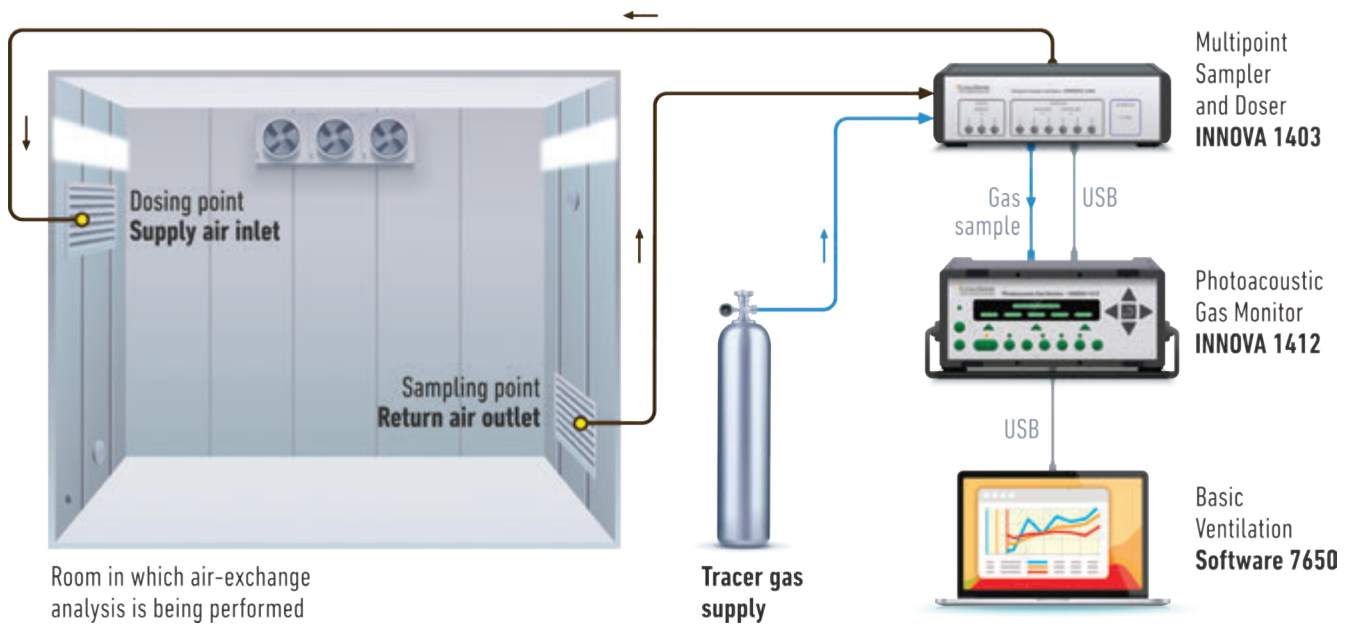


OTHER MARKETS

# Ventilation Performance

LumaSense's Tracer Gas Solutions help designers, commissioning engineers, and specialized consultants (eg. forensic) to analyze and characterize with superior accuracy the key characteristics of complex ventilation systems: high-quality standard buildings, critical duty, passenger cabins, etc.

A typical air-exchange analysis system shown with an application example. The aim of the analysis is to determine the size of the air-exchange in the mechanically ventilated room. The diagram shows only the dosing and one sampling point for clarity. All functions of the system is controlled by the Application Software 7650.



## INNOVA 1412i



## INNOVA 1403



## OTHER MARKETS

# Sorbet Gas Filter Testing

With higher and higher concerns around indoor environment quality, in particular concerning airborne pollutants like ammonia, carbonyls, or other volatile organic compounds (VOC), air purification and air cleaning solutions are gaining importance and a regulatory frame exists with design and test standards applying to the qualification of air purification media.

LumaSense's Gas Solutions are trusted by multiple advanced filtration materials and respiratory equipment manufacturers worldwide, which rely on their exceptional performances to characterize and test the critical specifications of their products.

- The Photoacoustic Multi-Gas Monitor INNOVA 1412i is an analytical solution to support the characterization of breakthrough time for air purification materials based on sorption.
- Capable of monitoring any gas that absorbs in the mid-IR spectrum, with detection limit usually in the ppb range. The gas selectivity is achieved by the choice of appropriate optical filters among the 27 filters available in our portfolio.



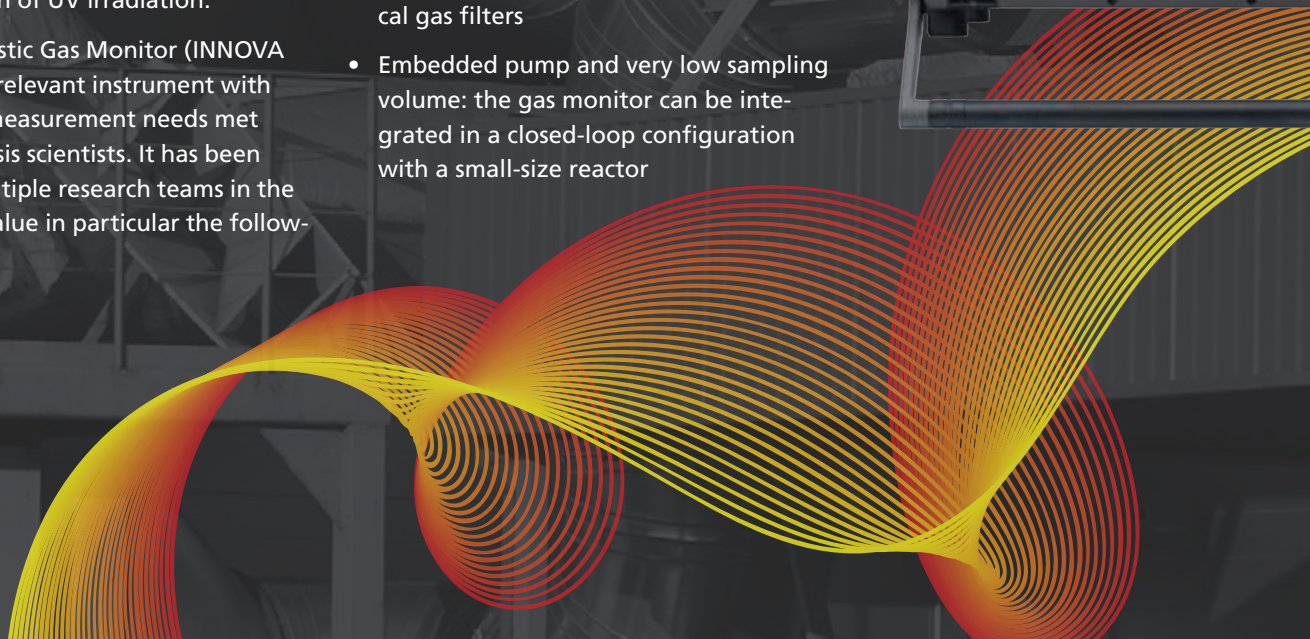
## OTHER MARKETS

# Photocatalytic Material Testing

Photocatalytic materials have multiple applications which consist for the majority in catalyzing value-added physico-chemical processes. These processes usually involve a gas reaction, catalyzed on a solid substrate, and which is activated by daylight and, typically, absorption of UV irradiation.

Our Photoacoustic Gas Monitor (INNOVA 1412i) is a very relevant instrument with regard to the measurement needs met by photocatalysis scientists. It has been selected by multiple research teams in the world, which value in particular the following features:

- Multi-gas instrument enabling the monitoring of reactants and products with a unique instrument
- High versatility and easy customization: the selection of gases of interest is made simply by choosing the appropriate optical gas filters
- Embedded pump and very low sampling volume: the gas monitor can be integrated in a closed-loop configuration with a small-size reactor



**Americas, Australia, & Asia**

Headquarters Sales & Service  
Santa Clara, CA  
Phone +1 408 727 1600  
Phone +1 800 631 0176 US TOLL-FREE  
Fax: +1 408 727 1677

**Europe, Middle East, Africa**

Sales & Service  
Frankfurt, Germany  
Ph: +49 69 97373 0  
Fax: +49 69 97373 167

**Denmark**

Innova Sales & Support Center  
Ballerup, Denmark  
Ph: +45 44 2001 00  
Fax: +45 44 2001 01



**France**

Sales & Support Center  
Erstein, France  
Ph: +33 3 8898 9801  
Fax: +33 3 8898 9732

**India**

Sales & Support Center  
Mumbai, India  
Ph: +91 22 67419203  
Fax: +91 22 67419201

**China**

Sales & Support Center  
Shanghai, China  
Ph: +86 133 1182 7766  
Ph: +86 21 5877 2383

[www.lumasenseinc.com](http://www.lumasenseinc.com)  
[info@lumasenseinc.com](mailto:info@lumasenseinc.com)

© 2017 LumaSense Technologies, Inc. All Rights Reserved.  
LumaSense, Mikron, IMPAC, INNOVA, SmartDGA, Andros, Fluoroptic are trademarks of  
LumaSense Technologies, Inc. All information contained herein is provided for information  
only and is subject to change without notice.  
Gas Sensing Solutions Overview Brochure-Letter-EN Rev. 10/02/2017