LUMASENSE TECHNOLOGIES

INNOVA Multi-Gas Monitoring Instruments

Highly Accurate, Reliable, Stable, Quantitative, and Remote Controllable Gas Monitoring System

INNOVA 1412i

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- Selectively measures a wide range of gases/vapors
- Linear response over a wide dynamic range
- High Stability means a maximum of only two calibrations a year
- User-friendly: Easy calibration, configuration, and analysis of data on PC
- Accurate: Compensates for temperature and pressure fluctuations, water vapor interference, and interference from other known gases
- Extremely low-volume flushing possible
- Operates immediately: almost no warm-up time necessary
- Expandable up to 24 locations with 1409 Multipoint Sampler: the Gas Monitor can operate as the system controller for full standalone operation
- Remote control capability via TCP/IP network interface protocol

The Photoacoustic Gas Monitor – INNOVA 1412i is a highly accurate, reliable, stable, quantitative and remote controllable gas monitoring system. It uses a measurement system based on the photoacoustic infrared detection method and is capable of measuring almost any gas that absorbs infrared light.

Gas selectivity is achieved using optical filters. By installing up to five of these filters in the 1412i, it can measure the concentration of up to five component gases and water vapor in any air sample. Although the detection limit is gas dependent, it is typically in the ppb region. The accuracy of these measurements is ensured by the 1412i's ability to compensate for temperature and pressure fluctuations, water vapor interference, and interference from other gases known to be present. Reliability of measurement results is ensured by regular self tests, which the 1412i performs. By the nature of this measurement system, it requires no consumables and very little regular maintenance. For most applications, recalibration is only necessary one or two times a year.

The monitoring system is easily operated through either of the two user interfaces: the front panel, with its push buttons and display providing short explanatory texts, or the PC Software, with its graphical interface. Both interfaces enable the monitor to be set-up, a measurement sequence to be started, and the resulting concentration values of the specified gases to be viewed while monitoring.

The monitor is equipped with three standard interfaces: USB, Ethernet, and RS232. These enable the monitor to be integrated into automated process systems.

The 1412i has a built-in pump system that allows samples to be drawn from up to 50 m away.

Application areas:

- Occupational Health and Safety measurements – of possible production or accumulation of toxic/carcinogenic substances in working areas
- Monitoring of anesthetic agents in hospitals
- Emission monitoring of greenhouse gases from agricultural production
- Emission monitoring of exhaust from chemical processes
- Indoor Air Quality (IAQ) measurements
- Ventilation and air exchange using tracer gas

Selectivity

The gas selectivity of the 1412i is determined by the optical filters installed in its filter wheel. Because water is nearly always present in ambient air and absorbs infrared light at most wavelengths, it contributes to the total acoustic signal in the analysis cell. Therefore, the monitor is permanently fitted with a special filter that measures water vapor and enables the 1412i to compensate for water vapor interference. By selecting different filters, this technique can also be used to cross-compensate for known interferent gases.

Calibration

After the relevant optical filters are installed, the monitor must be calibrated. This is achieved through easy-to-use, menu-driven instructions. Thanks to its high stability, calibration of the 1412i is seldom necessary more than once a year. Calibration is performed using either the Calibration Software BZ7002 or directly from the front panel.

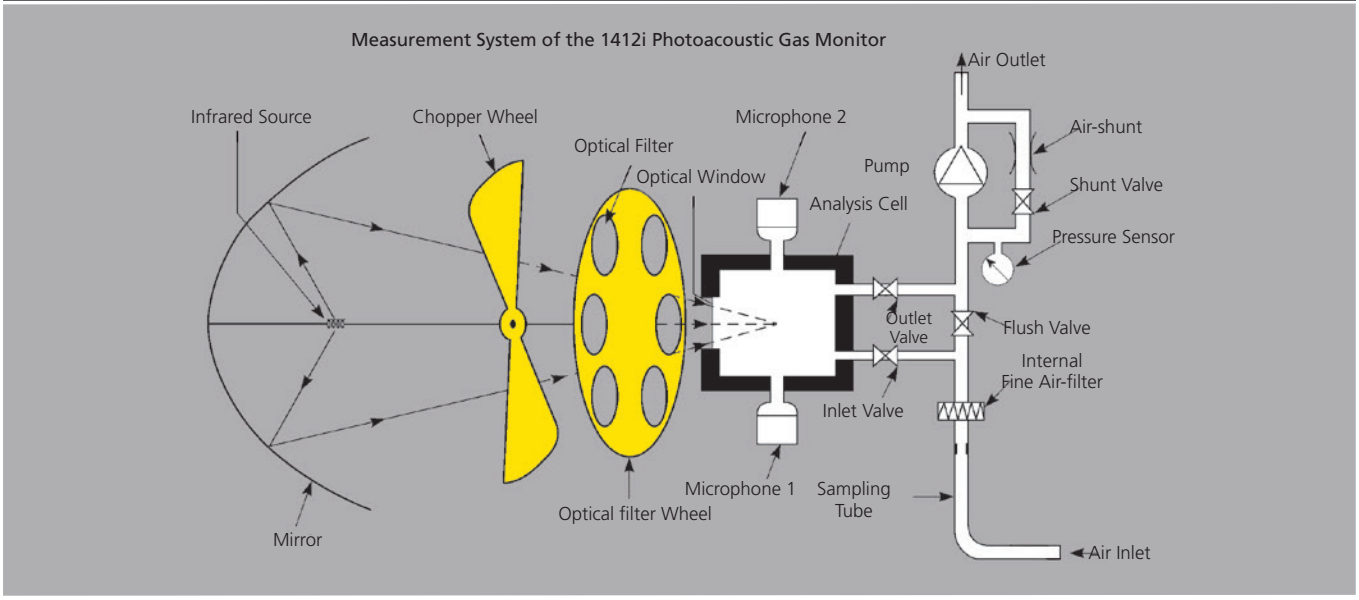
Operation

The 1412i monitoring system is easy to operate using either the application software LumaSoft™ Gas 7810 or 7870 or the front panel push-keys (which can be locked and accessed at three levels using passwords). The monitor can be operated as both an online and offline instrument (i.e. standalone operation). Using these user interfaces with their logical division of information, everything that needs to be defined is achieved prior to starting the monitoring task.

Setting up the Monitor

The set-up option enables all the parameters necessary to complete the monitoring task to be defined. Within this option, the Sample Integration Times (S.I.T.) is set – enabling measurement results to be weighted – sensitivity versus speed. When using the monitor as a system controller for multipoint monitoring, the same menu enables the setup of the INNOVA 1409's multipoint sampling tasks.

Measurement Cycle



1. The pump draws air from the sampling point through the air filter to flush out the "old" air in the measurement system and replace it with a "new" air sample. The pressure sensor is used to check that the pump sequence is elapsed successfully and to measure the actual air pressure.
2. The "new" air sample is hermetically sealed in the analyses cell by closing the inlet and outlet valves.
3. Light from an infrared light source is reflected off a mirror, passed through a mechanical chopper, which pulsates it, and then through one of the optical filters in the filter wheel.
4. The gas being monitored causes the temperature of the gas to increase selectively absorbs the light transmitted by the optical filter. Because the light is pulsating, the gas temperature increases and decreases, causing an equivalent increase and decrease in the pressure of the gas (an acoustic signal) in the closed cell.
5. Two microphones mounted in the cell wall measure this acoustic signal, which is directly proportional to the concentration of the monitored gas present in the cell.
6. The filter wheel turns so that light is transmitted through the next optical filter and the new signal is measured. The number of times this step is repeated is dependent on the number of gases being measured.
7. The response time is approximately 13 seconds for one gas or water vapor, or approximately 26 seconds if five gases and water vapor are measured.

Starting Measurements

Once the set-up parameters have been defined, measurements can be started immediately or later using a delayed start time. Once started, the monitoring task continues until it is stopped either manually or using a pre-defined stop time.

Alarms

Two Alarm trigger levels, which provide high alarm limits for each measured gas, can be defined. These can also be linked to audible alarms using the available relay outputs. In addition, the application software LumaSoft Gas 7810 or 7870 allows four alarm levels to be displayed.

Online Measurement Results

Using one or more of the monitor's standard interfaces, measurement results are transferred directly to a PC. Here they can be displayed on screen as real-time values in tables and graphs (see Fig. 1) or integrated into the process system.

In the LumaSoft Gas 7810 or the optional 7870 application software, graphs can be configured to display only the desired gases, defined concentration ranges, and results from statistical analyses. In addition, all measurement data is stored in a SQL Server 2005 database.

Fig. 1 The graphical window shows up to seven graphs. The user selects the data plotted, the scaling, and the style and color of the lines and background to build the graphical window.

Offline Measurement Results

Gas measurement result data is displayed on the 1412i's screen (Display Memory) as soon as it is available, and is constantly updated. During a task, the 1412i runs statistical analyses of the measured gas concentrations, calculating a variety of values for each monitored gas.

This data in Display Memory can be copied to the Background Memory, which is a non-volatile storage area. The internal memory stores the measurement readings on a gas per gas basis, and when applicable, also across the sampling channel. Data stored in Background Memory can be recalled to Display Memory. From this memory, data can be uploaded to the Offline Software in either excel or text file format or alternatively printed out on a standard printer.

Reliability

The executive self-test check ensures that the software, data integrity, and the 1412i's components are functioning properly. If a fault is found, it is reported in the measurement results, so that the integrity of the results can be ensured.

If the power supply fails, the 1412i will automatically restart when power is restored. Measurement data stored in the monitor's memory is not affected by power loss.

Maintenance

The only maintenance tasks necessary are calibration and replacement of the air filter. Both tasks are easily performed. The frequency for changing the air filter depends on the individual applications.

Multiple Point Monitoring

The INNOVA 1412i can be integrated with the INNOVA 1409 Multipoint Sampler to form a monitoring system expandable to up to 24 channels sampled sequentially. The user can decide upon a full standalone operation (the gas monitor is the system controller) or a remote controlled operation from a PC with the LumaSoft 7870 for online monitoring.

Remote Control Option

LumaSense Technologies offers remote control capability through the user's local area network using the LumaSoft™ Gas Single Point 7810 or Multi Point 7870 software.

Ordering Information

Photoacoustic Gas Monitor —
INNOVA 1412i

Optical filters necessary for the user's monitoring task can be ordered together with the 1412i, and installed by LumaSense Technologies. The 1412i is then delivered zero-point and humidity interference calibrated.

Includes following accessories

AT 2177	4m PTFE tubing
DS0759	Particle Filter (25 pieces)
VF0102A	Fuse
BR6011	1412i Set-up tree
AS0001A	USB Cable
BZ7002	Calibration Software
BZ7003	Offline Software
7810	LumaSoft Gas Single Point monitoring software

Instruction Manual (USB flash drive)

Optional Accessories

The 1412i can be span-calibrated for certain gases — contact your local LumaSense Technologies representative for details of the gases for which this can be done.

27 Optical Filters

UA 0968 – UA 0989 and
UA 0936
UA 6008
UA 6009
UA 6010
UA 6016

Multiple Point Monitoring

1403	Multipoint Sampler and Doser
1409	Multipoint Sampler
7650	Basic Ventilation Software (included wih the 1403)
7651	Advanced Ventilation Software
7870	LumaSoft Gas Multipoint

Cables, Adapters, and Tubing

UD 5037	Nafion (copolymer of TFE& fluorosulphonyl monomer) tubing
UD 5046	Fittings
WL 0950-003	RS232 Interface cable 9pin–9pin null-modem
JP 0600	6-pin DIN plug (male) with locking collar for alarm relay
AF 0614	PTFE tubing
UA 1365	Genie Membrane separator (inline)

Calibrations

UA 0181	Automated Calibration
UA 0182	Complex Calibration
UA 0183	Advanced Calibration

Technical Specifications

Measurement Technique
Photoacoustic infrared spectroscopy.

Your LumaSense representative will assist in the selection of suitable optical filters. Details are provided in the Gas Detection Limits chart.

Response Time
Is dependent on the Sample Integration Time (S.I.T.) and the flushing time defined. Please see the examples below:

Measurement Specifications[1]

Monitor-Setup	Response Times
S.I.T.: „Normal" (5 s) Flushing: Auto, (tube: 1 m)	One gas: ~27 s 5 gases + water: ~60 s
S.I.T.: "Low Noise" (20 s) Flushing: Auto, (tube 1 m)	5 gases + water: ~150 s
S.I.T.: "Fast" (1 s) Flushing: Chamber 4s, Tube "OFF"	One gas: ~13 s 5 gases + water: ~26 s

Detection Limit: Gas-dependent, but typically in the ppb region. Using the Gas Detection Limits chart, the detection limit for a selected sample integration time (S.I.T.) can be calculated.

Dynamic Range: Typically 4 orders of magnitude (i.e. 10,000 times the detection limit at 5 S.I.T.). Using two span concentrations it can be expanded to 5 orders of magnitude.

Zero Drift: Typically ± Detection limit[4] per 3 months[1].

Influence of temperature[2]: +/- 10 % of detection limit[4]/°C.

Influence of Pressure[3]: +/-0.5 % of detection limit[4]/mbar.

Repeatability: 1 % of measured value[1].

Range Drift: +/- 2.5 % of measured value per 3 months[1].

Influence of temperature[2]: +/- 0.3 % of measured value/°C.

Influence of pressure[3]: -0.01 % of measured value/mbar.

Reference Conditions:

[1] Measured at 20 °C , 1013 mbar, and relative humidity (RH): 60%. (A concentration of 100x detection limit[4] was used in determining these specifications.)

[2] Measured at 1013 mbar, and RH: 60 %.

[3] Measured at 20 °C and RH: 60 %.

[4] Detection limit is @5 s S.I.T.

Interference:
The 1412i automatically compensates for temperature and pressure fluctuations in its analysis cell and can compensate for water vapor in the air sample. If an optical filter is installed to measure a known interferent, the 1412i can cross compensate for the interferent.

Acoustic Sensitivity: not influenced by external sound.

Vibration Sensitivity: strong vibrations at 20 Hz can affect the detection limit.

Internal Data Storage Capacity
The total space available in Display Memory to store data ia 131072 measurement cycles. If a measurement cycle takes 15 sec, then the display Memory space will be sufficient for a 22-day monitoring task.

General
Pumping Rate: 30 cm^3/s (flushing sampling tube) and 5 cm^3/s (flushing measurement chamber).

Power Requirement: 100-240 VAC +/- 10%, 50-60 Hz.

Power Consumption: ~85 VA.

Air Volume per sample:

Flushing Settings	Volume of Air
Auto: Tube Length: 1 m	140 cm^3/sample
Fixed time: Chamber 2 s, Tube 3 s	100 cm^3/sample
Fixed time: Chamber 2 s, Tube "OFF"	10 cm^3/sample

Total Internal Volume: The total Internal Volume of the measurement system: 60 cm^3.

Alarm Relay Socket: for connection to one or two alarm relays (visual/audio). Alarm levels for each gas are user-defined. System On/Running status available. Max. 25 VDC, max.100 mA.

Back-up Battery: 3 V lithium battery, lifetime 5 years. This protects data stored in memory, and powers the internal clock.

Dimensions:
Height: 175 mm (6.9 in).
Width: 395 mm (15.6 in).
Depth: 300 mm (11.8 in).
Weight: 9 kg (19.8 lbs).

Communication
The monitor has three interfaces, USB, Ethernet, and RS232, for data exchange and remote control of the 1412i. The PC software communicates using the USB, Ethernet, or RS232 interface.

Computer Requirements
Hardware:
Intel dual core i3 or compatible.
Min. 4096 MB RAM.
Min. 500 MB space available on hard-disk.
Software:
7810/7870/BZ7002/BZ7003/7650/7651:
Windows® 7, 8.1 and
Windows® 10.

WARNING: The 1412i must not be placed in areas with flammable gases/vapors in explosive concentrations or be used to monitor explosive concentrations of these. Also, monitoring of certain aggressive gases or a very high concentration of water vapor may damage the 1412i. Contact your LumaSense representative for further information.

CE Nemko	**COMPLIANCE WITH STANDARDS:** CE-mark indicates compliance with: EMC Directive and Low Voltage Directive. NEMKO mark indicates compliance with: CSA and UL Standards.	
Safety	EN/IEC 61010-1 3rd Edition	Safety Requirements for electrical equipment for measurement, control and laboratory use.
	CAN/CSA C22.2 No. 61010-1-04	Safety Requirements for electrical equipment for measurement, control and laboratory use.
	UL 61010-1 3rd Edition	Safety Requirements for electrical equipment for measurement, control and laboratory use.
EMC	EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use – EMC requirements; Part 1:General requirements
Environment	UL 61010A-1: Environmental conditions. Altitude up to 2000 m Operating Temperature: +5 °C to +40 °C Storage Temperature: –25 °C to +55 °C Humidity: Maximum relative humidity 80% for temperatures up to 31 °C decreasing linearly to 50% relative humidity at 40 °C Pollution Degree 2 Installation category II Indoor Use	
Enclosure	IP20	

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