LumaSense™ TECHNOLOGIES

Photoacoustic Field Gas-Monitor – INNOVA 1412

Uses:

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

Features:

- Selectively measures a wide range of gases/vapors
- Linear response over a wide dynamic range
- High stability (low drift) makes calibration only necessary one – two times a year
- Extremely reliable due to self-testing procedures
- User-friendly procedures for calibrating the monitor, presenting and analyzing measurement data via the PC user interface
- 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
- Presents measurement data via connected PC both in tabular and graphic formats – up to five gas concentration and water vapor graphs displayed, simultaneously

Introduction

The Photoacoustic Field Gas-Monitor – INNOVA 1412 is a highly accurate, reliable and stable quantitative 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 through the use of optical filters. By installing up to five of these filters in the 1412, 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 1412'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 1412 performs. By the nature of this measurement system, it requires no consumables and very little regular maintenance, for example, for most applications recalibration is only necessary one – two times a year.

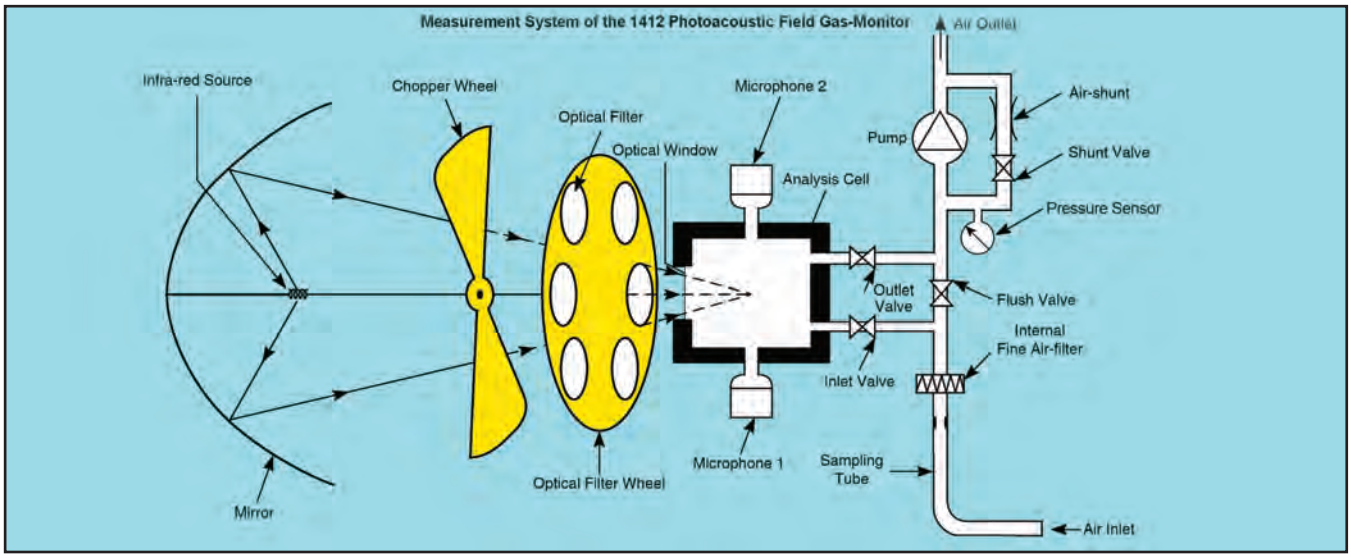
The monitoring system is easily operated through either of the two user interfaces: the front panel with its push buttons and display providing short explanatory texts, or the PC Software, with its graphical interface. Both interfaces enable the monitor to be set-up, a measurement sequence started and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

The monitor is equipped with two standard interfaces: IEEE-488 and RS-232 (optional JV 0901 converter RS-232 to USB. These enable the monitor to be integrated into automated process systems. The 1412 has a built-in pump system that allows samples to be drawn from up to 50 m away.

Selectivity

The gas selectivity of the 1412 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 analyses cell. Therefore, the monitor is permanently fitted with a special filter, which measures water vapor and enables the 1412 to compensate for water vapor's interference. By selecting different filters, this technique can also be used to cross-compensate for known interferent gases.

Photoacoustic Field Gas-Monitor – INNOVA 1412



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, causing 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 down to approx. 13 sec. for one gas or water vapor, or approx. 26 sec. if five gases and water vapor are measured.

Calibration

After the relevant optical filters are installed, the monitor must be calibrated. This is achieved through easy-to-use menu-driven instructions. With its high stability, calibration of the 1412 is seldom necessary more than once a year.

Calibration is performed using either the PC Software or directly from the front panel.

Operation

The 1412 monitoring system is easy to operate using either the PC Software 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 on-line and off-line instrument. 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.

Starting Measurements

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

Alarms

When measuring, two Alarm trigger levels, which provide high alarm limit one and two for each measured gas, can be defined. These can also be linked to audible alarms.

Measurement Results

On-line Measurements

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 PC Software, the graphs can be set up to display only the desired gases, defined concentration ranges and results from statistical analyses. Also, when using the PC Software, all measurement data is stored in user-defined databases in an MS-Access format.

Off-line Measurements

Gas-measurement result data is displayed on the 1412's screen (Display Memory) as soon as it is available, and is constantly updated. During a task, the 1412 performs running 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. Data stored in Background Memory can be recalled to Display Memory. From this memory, data can, if necessary, be uploaded to the PC Software and printed out in a list form

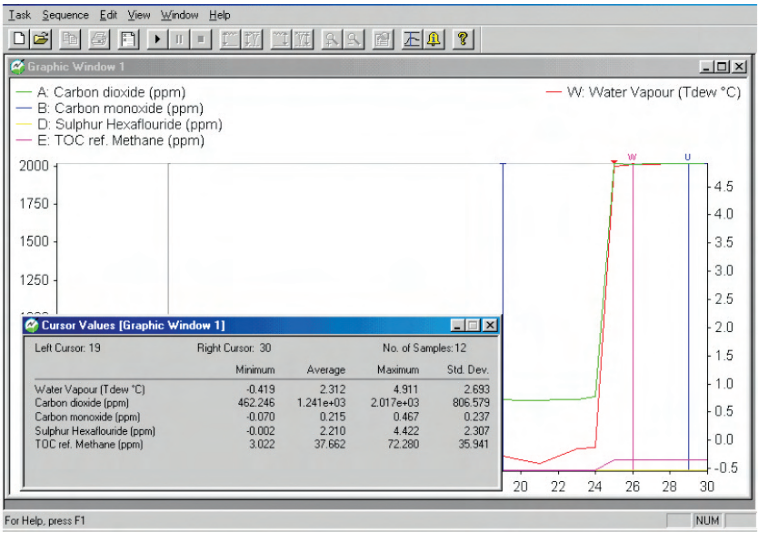


Fig. 1 Displaying detailed measurement data using the cursors in the graphic or table windows.

on any standard text printer via the 1412's IEEE and RS-232 interfaces.

Reliability

Executive self test check: software, data integrity, and the 1412's components to ensure that they function 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 1412 will automatically start up again when power is restored. Measurement data stored in the monitor's memory is not affected.

Maintenance

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

Remote Control Options

LumaSense Technologies offers two additional application software programs, the Application Software – INNOVA 7300 and the Application Software – INNOVA 7620.

Using 7300, a computer can remotely control a 1412 together with one Multipoint Sampler – INNOVA 1309 for sequentially monitoring air samples from up to 12 locations.

Using the 7620, a computer can control a 1412 together with up to two Multipoint Sampler and Doser – INNOVA 1303 units. This enables up to 12 locations to be dosed with a tracer gas and air samples to be drawn from each location for analyses by the 1412. The software uses the resultant measurements to calculate the air change or ventilation efficiency of each location.

Ordering Information

Photoacoustic Field Gas-Monitor – INNOVA 1412

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

Includes following accessories

AT 2177	PTFE tubing
Mains cable	
WL 0945	RS-232 Interface cable (9pin–25pin) null-modem included
DS0759B	Particle Filter (25 pieces)
BR6010	1412 Set-up tree
PC Software for Photoacoustic Field Gas-Monitor	
Instruction Manual (CD Rom)	
Field Guide	

Optional Accessories

The 1412 can be span-calibrated for certain gases (option UA1098) — contact your local LumaSense Technologies representative for details of the gases for which this can be done.

JV 0901	Converter RS-232 to USB
27 optical filters:	
UA 0968 – UA 0989 and	
UA 0936	Optical Filters
UA 6008	Optical Filter
UA 6009	Optical Filter
UA 6010	Optical Filter
UA 6016	Optical Filter
UA 1098	Span Calibration

UD 5037	Nafion (copolymer of TFE & fluorosuphonyl monomer) tubing
UD 5046	Fittings
AO 0265	IEEE–IEEE Interface cable
WL 0946	RS-232 Interface cable 25pin–25pin) null-modem included
JP 0600	6-pin DIN plug (male) with locking collar for alarm relay
AF 0614	PTFE tubing
UA 1365	Genie Membrane separator (inline)
1303	Multipoint Sampler and Doser
1309	Multipoint Sampler
7300	Application Software
7620	Application Software
BE 6011	Instruction Manual (Printed)

Specifications – INNOVA 1412

MEASUREMENT TECHNIQUE:
Photoacoustic infrared spectroscopy.

Your local LumaSense Technologies 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:●

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

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® per 3 months●.
Influence of temperature©: ±10% of detection limit®/°C.
Influence of pressure™: ±0.5% of detection limit®/mbar.
Repeatability: 1% of measured value●
Range Drift: ±2.5% of measured value per 3 months●.
Influence of temperature©: 0.3% of measured value/°C.
Influence of pressure™: -0.01% of measured value/mbar.
Reference conditions:

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

© Measured at 1013 mbar, and RH: 60%.
™ Measured at 20°C and RH: 60%.
® Detection limit is @5s S.I.T.

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

Acoustic Sensitivity: not influenced by external sound.
Vibration Sensitivity: strong vibrations at 20Hz can affect the detection limit.

INTERNAL DATA STORAGE CAPACITY:
Dependent on the number of gases being measured. Sufficient for a 12-day monitoring task, monitoring 5 gases and water vapor every 10 min.

GENERAL:
Pumping Rate: 30cm^3/s (flushing sampling tube) and 5cm^3/s (flushing measurement chamber).
Power Requirement: 100-240VAC, 50-60Hz.
Power Consumption: ~120VA.

Air Volume per sample:

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

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

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

Back-up Battery: 3V 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 (19.8lbs).

COMMUNICATION:
The monitor has 2 interfaces, IEEE 488 and RS-232. These are used for data exchange and remote control of the 1412. The PC Software communicates using the RS-232 interface.

PC SOFTWARE REQUIREMENTS:
Hardware:
A Pentium (166MHz) processor or better. Min. 64MB of RAM (depending on Op Sys.). Min. 40MB of space available on the hard disk. One RS–232 port.
Software:
Windows 2000 (min. SP1), NT4.0 (min. SP4), XP (min. SP1).

WARNING!
The 1412 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 could damage the 1412. Ask your local LumaSense Technologies representative for further information.

CE UL ULR	**COMPLIANCE WITH STANDARDS:** CE-mark indicates compliance with: EMC Directive and Low Voltage Directive. UL-mark indicates compliance with: UL Standards. Cabinet UL recognized in accordance with UL746.
Safety	EN/IEC 61010–1, 2nd (2001): Safety requirements for electrical equipment for measurement, control and laboratory use. UL61010A-1 first edition (2002): Electrical Equipment For Laboratory Use; Part 1. General Requirements. CAN/CSA–C22.2 No. 1010.1–92: Safety requirements for equipment for measurement, control and laboratory use.
EMC	EN 61000-3-2:1995 + A1/A2:98 + A14:00 Harmonic Currents EN 61000-3-3:1995 Voltage Fluctuations EN 55022:1994 + A1:95 + A2:97/EN 55022:1998 Radio disturbance char. – IT equipment EN 55024 : 1998 Immunity Standard – IT equipment EN 61000-4-2:95 Electrostatic Discharge Requirements EN 61000-4-3:96 Radiated Radio-frequency EM Field EN 61000-4-4:95 Electrical Fast Transient/burst Requirements EN 61000-4-5:95 Surge Immunity Test EN 61000-4-6:96 Conducted Disturbances induced by RF Fields EN 61000-4-8:93 Power Frequency Magnetic Field Immunity EN 61000-4-11:94 Voltage dips, Interruptions and Variations
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 linerly to 50% relative humidity at 40°C Pollution Degree II
Enclosure	IP20

LumaSense Technologies reserves the right to change specifications and accessories without notice.

LUMASENSE™ TECHNOLOGIES

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