INNOVA 3433i

Highly accurate, reliable, and stable quantitative gas monitoring system for automotive monitoring

The Innova® 3433i Photoacoustic Multi-Gas Monitor is a highly accurate, reliable, and stable quantitative gas monitoring system. Its measurement system, based on the photoacoustic infrared detection method, is capable of measuring almost any gas that absorbs infrared light.

PRODUCT HIGHLIGHTS

- Selectively measures a wide range of gases/vapors
- Linear response over a wide dynamic range
- Stable and Reliable: ensuring a maximum of only two calibrations a year
- User-friendly: easy calibration, configuration, and viewing/analyzing of data via PC
- Accurate: compensates for temperature and pressure fluctuations, water vapor interference, and interference from other known gases
- Operates immediately: virtually no warm-up time necessary
- Remote control capability via TCP/IP network interface protocol

TYPICAL APPLICATIONS

- Automotive monitoring - of alcohol content in vehicle exhausts and production of NH_3 and N_2O in diesel exhausts
- Automotive SHED evaporative emission testing

AT A GLANCE

Measurement Technique

Photoacoustic Infrared Spectroscopy

Filter Capacity

Up to 5 + water from 27 different filter options

Detection Limit

Gas dependent, but typically in the ppb region

Repeatability

1% of measured value

OVERVIEW

Gas selectivity for the Innova 3433i monitor is achieved through the use of optical filters. By installing up to five filters, the 3433i can measure the concentration of up to five component gases and water vapor in any air sample. The detection limit is gas-dependent, but is typically in the ppb region.

Reliability is ensured by a series of self tests performed by the monitor. The self tests check software, data integrity, and the 3433i'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.

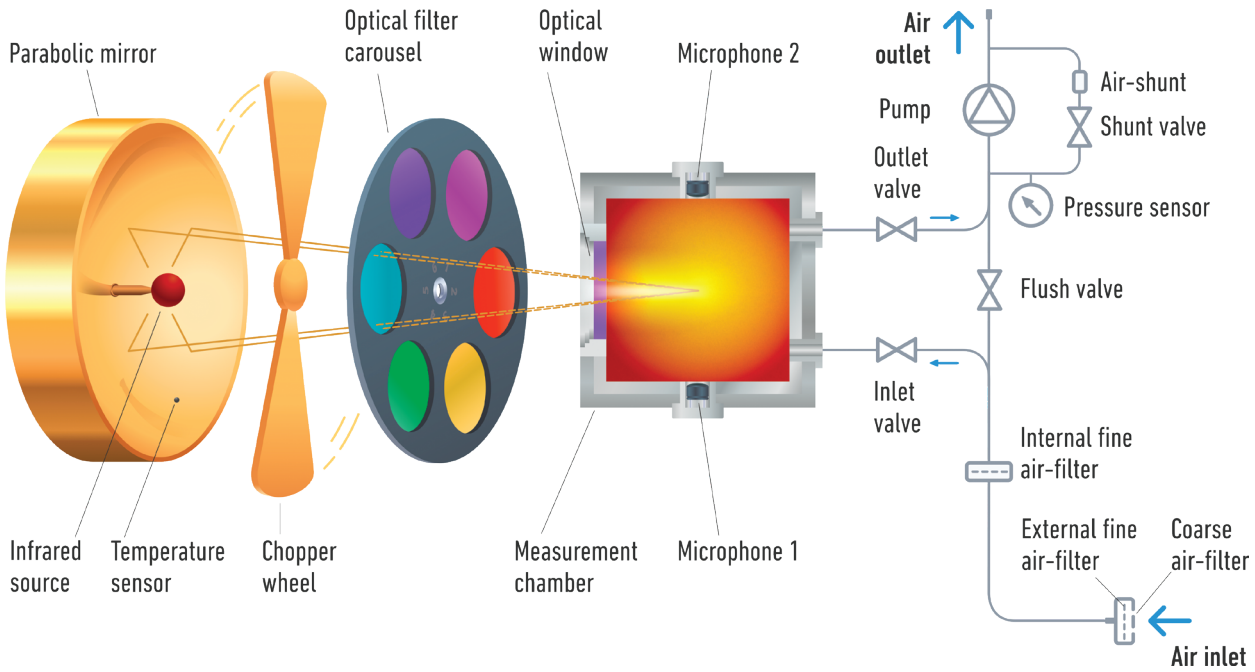
The 3433i measurement system requires no consumables and very little regular maintenance. For most applications, recalibration is only necessary one to two times a year.

The monitoring system is easily operated through either the front panel, with its push-buttons and display providing short explanatory texts, or through the PC software. Both methods allow the user to configure the monitor, start a measurement sequence, and view the resulting concentration values of specific gases.

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

To ensure easy placement of the 3433i, it is housed in a rugged box that fits in a standard 19" rack and has a built-in pump system that allows samples to be drawn from up to 50 meters away.

PHOTOACOUSTIC SPECTROSCOPY (PAS)



MEASURING DETAILS

Selectivity

The gas selectivity of the 3433i 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 3433i 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 3433i is seldom necessary more than once a year. Calibration is performed using either the Calibration Software BZ7002 or directly from the 3433i's front panel.

Operation

The 3433i monitoring system is easy to operate using either the application software or by using 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.

Configuring the Monitor

The set-up option enables all the parameters necessary to complete the monitoring task to be defined. This includes setting the Sample Integration Times (S.I.T.) option, which enables measurement results to be weighted - sensitivity against speed.

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 by using a defined stop time.

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 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.

Online Measurement Results

Using the monitor’s standard interface, measurement results are transferred directly to a PC or integrated into the process system.

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.

TECHNICAL DATA

Measurement Specifications[1]		
Measurement Technique	Photoacoustic infrared spectroscopy	
Response Times	S.I.T.: "Normal" (5 s) Flushing: Auto, (tube 1 m)	One gas: ~27 s
		Five gases + water: 60 s
	S.I.T.: "Low Noise" (20 s) Flushing: Auto, (tube 1 m)	Five gases + water: 150 s
	S.I.T.: "Fast" (1 s) Flushing: Chamber 4 s, (tube "OFF")	One gas: ~13 s
		Five 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 four 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 five orders of magnitude.	
Zero Drift	Typically ± Detection limit[1] per three months[2]	
	Influence of temperature[3]	±10% of detection limit[1]/°C
	Influence of pressure[4]	±0.5% of detection limit[1]/mbar
Repeatability	1% of measured value[2]	
Range Drift	±2.5 of measured value per three months[2]	
	Influence of temperature[3]	±0.3% of measured value/°C
	Influence of pressure[4]	-0.01% of measured value/mbar
Interference	The 3433i 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 3433i can cross compensate for the interferent.	
Acoustic Sensitivity	Not influenced by external sound	
Vibration Sensitivity	Strong vibrations @ 20 Hz can affect the detection limit	
Internal Data Storage Capacity	The total space available in display memory to store data is 131,072 measurement cycles. If a measurement cycle takes 15 sec, then the display memory space will be sufficient for a 22-day monitoring task.	

Environmental Specifications	
Operating Temperature	5 to 40°C (41 to 104°F)
Storage Temperature	-25 to 55°C (-13 to 131°F)
Humidity	Max relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity @ 40°C
Altitude	Up to 2000 m
Other Environment	UL 61010A-1: Environmental conditions
	Pollution Degree 2
	Installation Category II
	Indoor Use
Enclosure	IP 20
Dimensions (W x H x D)	483 mm x 175 mm x 375 mm (19" x 6.9" x 14.8")
Weight	14 kg (30.8 lb)

1 Detection limit is @ 5 s S.I.T.

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

3 Measured @ 1013 mbar and RH: 60%.

4 Measured @ 20°C and RH: 60%.

TECHNICAL DATA (CONTINUED)

Pumping System Specifications		
Pumping Rate	30 cm^3/s (flushing sampling tube)	
	5 cm^3/s (flushing measurement chamber)	
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	60 cm^3 (of the measurement system)	
Inlet and Outlet Fittings	6.34 mm (1/4")	

Electrical and Communication Specifications	
Power Requirement	100 to 240 VAC ±10%, 50 and 60 Hz
Power Consumption	~85 VA
Back-Up Battery	3 V lithium battery, lifetime 5 years. This protects data stored in memory and powers the internal clock.
Monitor Interface	Three interfaces: USB, Ethernet, and RS232, for data exchange and remote control of the instrument
Software Communication	Via USB, Ethernet, or RS232 interface
Computer Requirements	Hardware: Pentium processor 2 GHZ Quad-core or equivalent. Min 512 MB RAM. (4096 MB RAM on Windows 8). Min 500 MB space available on hard drive.
	Software (7820/BZ7002/BZ7003): Windows® 7, 8.1, and Windows® 10

Safety and Standards Specifications	
Safety	EN/IEC 61010-1 3rd Edition
	CAN/CSA C22.2 No. 61010-1-04
	UL 61010-1 3rd Edition
EMC	EN 61326-1:2013: Electrical equipment for measurement, control and laboratory use – EMC requirements; Part 1: General requirements
Standards Compliance	CE-mark indicates compliance with: EMC Directive and Low Voltage Directive
	NEMKO mark indicates compliance with: CSA and UL Standards

Warning

The Innova 3433i must not be placed in areas with flammable gases/vapors in explosive concentrations or be used to monitor explosive concentrations of these. Monitoring of certain aggressive gases or a very high concentration of water vapor may damage the 3433i. Contact your Advanced Energy sales representative for further information.

ORDERING INFORMATION

Optical filters necessary for the user's monitoring task can be ordered together with the 3433i and installed by Advanced Energy. The 3433i is then delivered zero-point and humidity interference calibrated.

The 3433i is typically configured with two different sets of optical filters, depending on the type of application.

Included Accessories

- Fuse (VF0102A)
- Mains cable
- USB cable (AS0001A)
- LumaSoft single point monitoring software (7820)
- Set-up tree (BR6022)
- Calibration software (BZ7002)
- Offline software (BZ7003)
- Instruction manual

Automotive Exhaust Emissions	
Filter PN	**Gas Detected**
UA0976	Ammonia
UA0985	Nitrous Oxide
UA0974	Ethanol
UA0983	Carbon Dioxide
UA0984	Carbon Monoxide

SHED Evaporative Emissions	
Filter PN	**Gas Detected**
UA0936	Methanol
UA0974	Ethanol
UA0981	Toluene
UA0983	Carbon Dioxide
UA0971	Freon R134A

OPTIONS AND ACCESSORIES

Calibrations	
UA0181	Automated Calibration
UA0182	Complex Calibration
UA0183	Advanced Calibration

Additional Optical Filters	
UA0968 to UA0989	UA6009
UA0936	UA6010
UA6008	UA6016
DS0806 Particle filters	

Cables, Adapters, and Tubings	
WL0950-003	RS232 Interface cable (9pin–9pin) null modem
JP0600	6-pin DIN plug (male) with locking collar for alarm relay
AF0614	PTFE tubing
UA1365	Genie membrane separator (inline)
UA1374	Analog/relay interface module
JZ0102	37-pin Sub-d to 37-pin screw terminal (for analog relay)
AO1431	I/O cable one meter (for analog relay)
AO1432	I/O cable three meters (for analog relay)

Additional Option

The 3433i can be span-calibrated for certain gases – contact your local Advanced Energy representative for details of the gases for which this can be done.

STANDARD MODULES

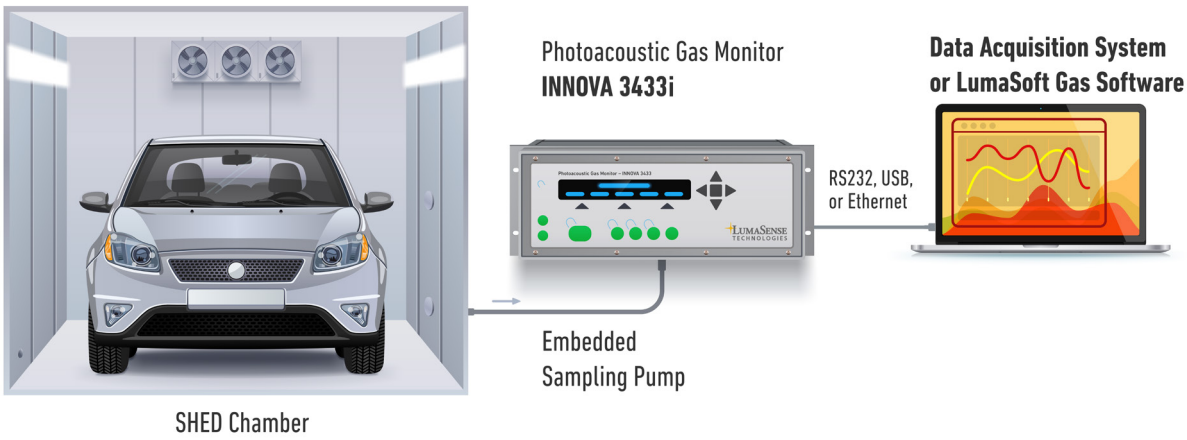
Cushion Pump Module

The 3433i is fitted with a cushion pump modules which reduce the noise from the pump when the 3433i is operated in the continuously pumping sequence mode. This module includes stainless steel tubing from the gas inlet to the measurement chamber.

Purge Module

The 3433i is fitted with a”sealed box” which ensures that the measurement system inside the 3433i can be purged using an inert gas. The Purge Inlet is fitted with a ¼” tube fitting.

MONITORING SYSTEM SET-UP



ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

AE's power solutions enable customer innovation in complex semiconductor and industrial thin film plasma manufacturing processes, demanding high and low voltage applications, and temperature-critical thermal processes.

With deep applications know-how and responsive service and support across the globe, AE builds collaborative partnerships to meet rapid technological developments, propel growth for its customers and power the future of technology.

PRECISION | POWER | PERFORMANCE

For international contact information, visit advancedenergy.com.

sales.support@aei.com
+1 970 221 0108

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