# Product Data

## 1312 Photoacoustic Multi-gas Monitor

USES:

- ❍ Quantitative analysis of up to 5 components and water vapour in gas mixtures
- ❍ Occupational health and safety measurements
- ❍ Indoor air-quality and ventilation measurements
- ❍ Detection of accidental releases of gases/vapours
- ❍ Presentation of measurement data in spreadsheet, database and word processing programs

FEATURES:

- ❍ Selectively measures a wide range of gases/vapours
- ❍ Linear response over a wide dynamic range
- ❍ Extremely reliable due to self-testing procedures
- ❍ High stability (low drift) makes calibration only necessary about four times a year
- ❍ User-friendly procedures for calibrating the monitor, presenting and analysing measurement data via the PC user-interface
- ❍ Accurate — compensates for temperature fluctuations, water-vapour interference and interference from other known gases
- ❍ Seven *Sample Integration Times* to choose from — to optimize the measurement system, providing faster response times or lower detection limits
- ❍ Extremely low-volume flushing possible
- ❍ Operates immediately — no warm-up time necessary
- ❍ Collects samples from points up to 50m away
- ❍ Presents measurement data both in tabular and graphic formats – up to 6 gas concentration graphs displayed, simultaneously
- ❍ Uses Open Database Connectivity (ODBC) — enabling measurement data to be used in other programs
- ❍ Portable
- ❍ Operates also as stand-alone instrument
- ❍ Monitor can be used with one/two 1303 Multipoint Doser and Sampler units + additional PC software for ventilation efficiency measurements

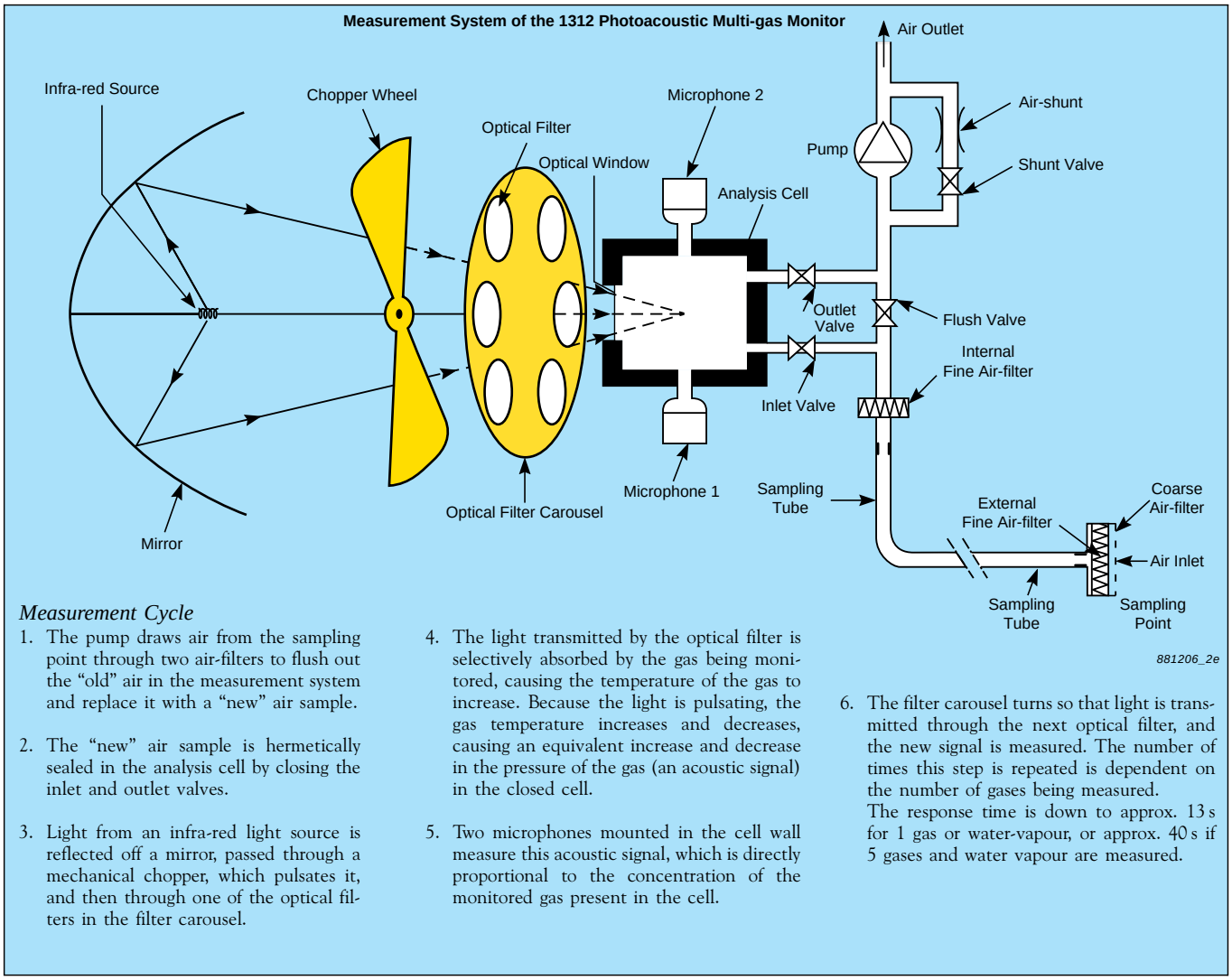
### Introduction

The 1312 Photoacoustic Multi-gas Monitor is a highly accurate, reliable and stable quantitative gas monitoring system. Its measurement principle is based on the photoacoustic infra-red detection method. This means that the 1312 can measure almost any gas which absorbs infra-red light. Appropriate optical filters (up to 5) are installed in the 1312's filter carousel so that it can selectively measure the concentration of up to 5 component gases and water vapour in any air sample. The 1312's detection limit is gas-dependent, but typically in the ppb region.

Reliability of measurement results can be ensured by regular self-tests which the 1312 performs. Accuracy is ensured by the 1312's ability to compensate any measurement for temperature fluctuations, water-vapour interference and interference from other gases known to be present.

The monitoring system is easily operated via a PC, or via the front-panel push-buttons when using a stand-alone instrument configuration. Short explanatory text guide the user through each operating procedure. Therefore, no special training is required to operate the 1312.


The 1312PC software enables the user to calibrate the monitor and load the user-defined measurement setups prior to monitoring. During a monitoring task, real-time measurement data is presented on screen as both graphs and tables, and the data is stored in named databases. When a monitoring task is completed, the 1312PC software can assist in analysing the data. The measurement data stored in the databases is easily accessible, and can be displayed on screen, printed out, and




*Measurement Cycle*

1. The pump draws air from the sampling point through two air-filters to flush out the "old" air in the measurement system and replace it with a "new" air sample.
2. The "new" air sample is hermetically sealed in the analysis cell by closing the inlet and outlet valves.
3. Light from an infra-red 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 carousel.
4. The light transmitted by the optical filter is selectively absorbed by the gas being monitored, causing the temperature of the gas to increase. 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 carousel 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.
   The response time is down to approx. 13 s for 1 gas or water-vapour, or approx. 40 s if 5 gases and water vapour are measured.

exported to other spreadsheet, database and word processor programs when required.

If a stand-alone configuration is required, the monitor can be operated using the front panel push-keys. The measurement results are stored in the monitor's memory, and can be uploaded to the PC or printed at a later stage.

The 1312 has a sturdy, dust-proof casing to protect its components. It is portable, and requires no warm-up time or re-calibration after moving — making it ideal for short-term monitoring of air samples drawn from its immediate environment. For long-term monitoring, the 1312 is placed indoors and collects air samples for analysis, via tubing, from points up to 50 m away.

## Selectivity

The selectivity of the 1312 is determined by the optical filters installed in it's filter carousel. A wide range of narrow-band optical filters is available from Innova AirTech Instruments. By studying the absorption spectra of the gases to be monitored, as well as those of any other gases which may be found in the ambient air in the same area, the most appropriate optical filters can be chosen. Please refer to the Gas Detection Limits chart for details.

Water vapour, which is nearly always present in ambient air, absorbs infra-red light at most wavelengths so that, irrespective of which optical filter is used, water vapour will contribute to the total acoustic signal in the analysis cell. The higher the concentration of water vapour in the cell, the more it contributes to the measured signal. However, a special optical filter is permanently installed in the filter carousel of the 1312, which allows water-vapour's contribution to be measured separately during each measurement cycle. The 1312 is thus able to compensate for water-vapour's interference.

Any other interferent gas, which is known to be present in the ambient air, can be compensated for in a similar fashion. By installing an optical filter to selectively measure the concentration of the interferent gas, the user can set-up the 1312 to compensate for the interferent gas's contribution.

## Calibration

After the relevant optical filters are installed, the monitor must be calibrated. Four types of calibration are available: zero-point, humidity-interference, humidity-span and gas calibration. Regardless of the calibration type, the 1312PC software makes it easy. Setting up the calibration is done via the familiar Windows®95 environment. The raw measurement data from the monitor is transferred to the PC where it is displayed graphically. Using the cursors in the graphic window, the best ranges can be defined. The raw data in these areas is used to produce the offset calculation values to enable humidity interference and cross-compensation. Only when you are satisfied with the result, are these calculation values downloaded to the monitor.

Due to the 1312's high stability (low drift), calibration is seldom necessary more than four times a year.

## Operation

The 1312 monitoring system is easy to operate, either directly via a PC or via the push-keys on the monitor's front panel. This enables the monitor to be operated as both an on-line and stand-alone instrument.

You define all the information necessary to start a monitoring task. The PC uses menu bars and "index-card" labelled windows to divide the procedures in to logical sections. The front panel push-buttons are supported by short explanatory texts, guiding the operator through the procedures.

**Setting-up the Monitor**

Each monitoring task is given a distinct name. Under this name, the setup option enables you to define all the parameters necessary for the monitoring task to be completed. The *Sample Integration Times* (S.I.T.) are defined here (see Fig. 2). This allows you to decide the measurement accuracy against the speed of the measurements. The monitor can be set to measure at one of seven different S.I.T.s (from 0.5 s to 50 s). The shortest S.I.T.s enable many measurements to be made quickly where the accuracy of the results are not crucial, while the longest S.I.T.s enable highly accurate results to be obtained. A separate S.I.T. can be selected for each filter.

This setup option also enables you to select if cross-compensation for known interferents and water vapour should occur, as well as decide on the sampling mode (continuous or fixed time interval). The flushing time is also set here. You decide whether only the measurement chamber is flushed, using a minimal gas sample, or whether the chamber and sampling tubing should be flushed and the length of time this should take. Alternatively, the monitor can be set to find the optimal flushing time, automatically.

Should some form of warning be necessary, the software enables the user to set minimum and maximum alarm trigger levels for each measured gas. It is also possible to define what action is taken when an alarm is triggered.

**Starting Measurements**

Once the setup parameters have been defined, measurements can be started immediately. Alternatively, a delayed start time can be defined. The PC and the monitor have synchronized clocks, so whether the monitor is operating on-line or stand-alone, the measurements will start at the correct time. The monitoring task will continue until it is stopped manually, or a stop time can be defined, enabling the system to run completely unattended.

**Memory Mode**

This option is available when the monitor is operating as a stand-alone instrument. During a monitoring task, all results are stored in a memory called *Display Memory*. While operating in Memory mode, data in this memory can be copied into the 1312's other memory (*Background Memory*) to prevent it being overwritten by results from the next task.

Data stored in *Background Memory* can be recalled to *Display Memory* and then can be uploaded to a PC.

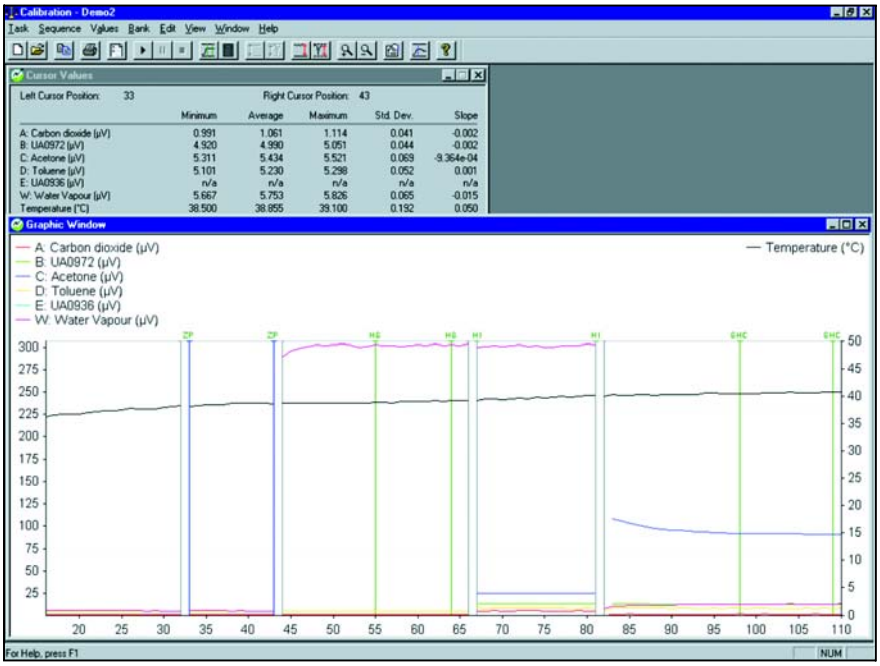



*Fig. 1 Calibration curves, including their cursors showing the regions used to calculate the calibration factors, which can be downloaded to the monitor*

**Alarms**

When on-line measurements are being made, the software enables the user to set trigger, minimum, and maximum alarm levels for each measured gas. It is also possible to define what action is taken when an alarm is triggered.

## Measurement Results

**On-line Measurements**

Measurement results are transferred directly to the PC. Here they can be displayed on screen as real-time values in tables and graphs. The graphs can be set up to display only the desired gases, within defined concentration ranges and results from statistical analyses.

Regardless of what is displayed on screen, all measurement data is stored in user-defined databases, in an MS-Access® format. This makes results readily available to view at a later stage for further analyses, or for inclusion in other programs, for example, Excel™ or Word®. The 1312PC software, with its Open Database Connectivity (ODBC), enables result data to be utilized by any programs using this form of data exchange.

**Stand-alone Measurements**

Gas-measurement results are displayed on the 1312's screen as soon as they are available, and are constantly updated. During a task, the 1312 performs a running statistical analysis of measured gas concentrations, calculating for each monitored gas: the Mean Value; the Standard Deviation; and the Maximum and Minimum measured concentrations. The Mean Value is the same as the Time-Weighted Average (TWA) value during the total monitoring period.

The individual results stored in *Display Memory* can also be automatically averaged and presented on the display.

Measurement data stored in the 1312's *Display Memory* can be printed out in list form on any standard text-printer, via the IEEE 488 or RS-232 interfaces.

If any interesting or unusual event occurs during a monitoring task, the measurement being performed at this time can be "marked". This enables the user to assess the event's affect on the monitoring task.

When the monitor is once again connected to a PC, all the measurement results can be uploaded. These can then be viewed and used similar to the on-line gas measurement results.

**Exporting Data**

If measurement results need to be used by other instruments in the process, or by programs which can not use ODBC, data can be exported as semicolon delimited ASCII files.

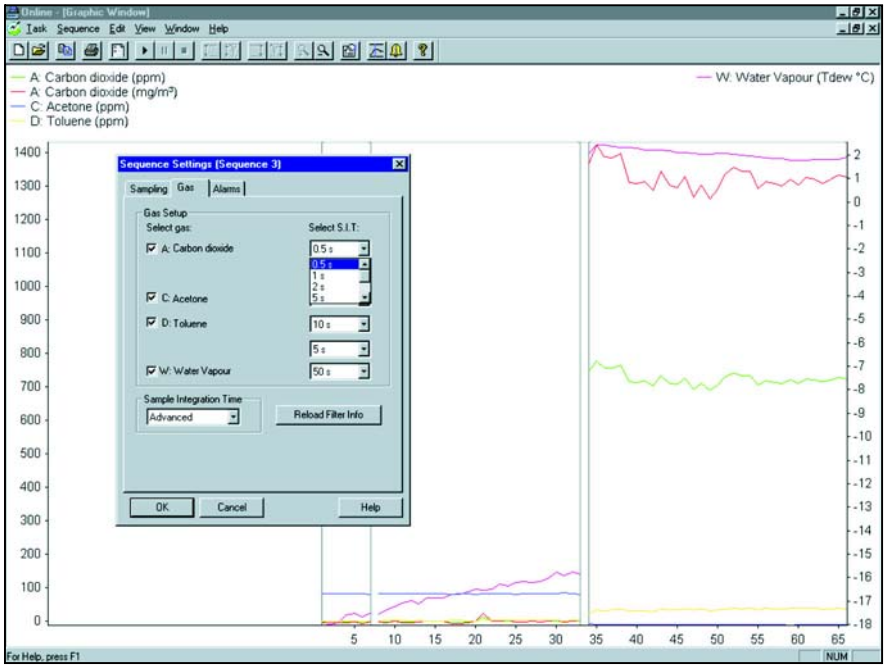



*Fig.2 Setting up the Sample Integration Times for the individual filters.*

## Reliability

Reliability can be ensured by a series of self-tests which the monitor can perform. The self-tests, which can be disabled if required, check software, data integrity, and the components of the 1312 to ensure that they function properly. If any fault is found, it is reported in the measurement results so that users can see what, if anything, has affected the accuracy of the measurement.

If there is an AC mains power-supply failure, the 1312 will automatically start-up again when power is restored. Measurement data is stored in the monitor's memory and can be uploaded to the PC when the software has been restarted.

## Maintenance

The only maintenance tasks necessary are calibration and changing the filters in the internal and external air-filtration units of the 1312. Both tasks are easily performed, and are typically necessary only four times a year.

## Other Remote Control Options

Innova AirTech Instruments also offers two additional application software programs, the 7300 Application Software and the 7620 Application Software.

Using the 7300, a computer can remotely control a 1312 together with one 1309 Multipoint Sampler for sequentially monitoring air-samples from up to 12 locations.

Using the 7620, a computer can control a 1312 together with up to two 1303 Multipoint Sampler and Doser Units. This enables up to 12 locations to be dosed with a tracer-gas and air-samples to be drawn from each location for analysis by the 1312. The software uses the resultant measurements to calculate the air-change or ventilation efficiency of each location.

# Specifications 1312

**WARNING!** *The 1312 must not be placed in areas with flammable gases/vapours 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 vapour, could damage the 1312. Ask your local Innova representative for further information.*

All terms relating to gas analysis are in accordance with the definitions set out in the ISO International Standard 8158.
Your local Innova representative will assist in the selection of suitable optical filters. Details are provided in the "Optical Filters" Product Data Sheet and the Gas Detection Limits wall-chart.

**MEASUREMENT TECHNIQUE:**
Photoacoustic infra-red spectroscopy.

**RESPONSE TIME:**
(including chamber flushing) is dependent on the sample integration time (S.I.T.) and the flushing time defined. The fastest response time for one gas is 13 s and for 5 gases and water vapour 40 s, but see the examples below:

| Monitor Setup | Response Times |
|---|---|
| S.I.T.: "Normal" (5s)<br>Flushing:<br>Auto, (Tube 1m) | One gas: ~25s<br>5 gases + water: ~75s |
| S.I.T.: "Fast" (1s)<br>Flushing: Tube "OFF"<br>Chamber 4s | One gas: ~15s<br>5 gases + water: ~45s |

**MEASUREMENT RANGE:●**
**Detection Limit:** gas-dependent, but using the "Gas Detection Limits" wall-chart, the limits can be calculated using the following multiplication factors:

| S.I.T. | 0.5 | 1 | 2 | 5 | 10 | 20 | 50 |
|---|---|---|---|---|---|---|---|
| Factor | 3 | 2.2 | 1.6 | 1 | 0.7 | 0.5 | 0.3 |
| Note: an individual S.I.T. can be selected for each filter | | | | | | | |

**Dynamic Range:** five orders of magnitude (i.e. upper limit = 100000 times the detection limit). To measure over this wide dynamic range, span-calibration must be performed with two different gas concentrations.

**MEASUREMENT UNITS: (1312PC)**
$mg/m^3$, $g/m^3$, $\mu/m^3$
ppm, vol%, ppb

**ACCURACY:**
**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.
A concentration of 100× detection limit♣ was used in determining these specifications:
**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%.
♦ Measured at 1013 mbar, and RH: 60%.
♥ Measured at 20°C and RH: 60%.
♣ Measured detection limit is @5s S.I.T.

**INTERFERENCE:**
The 1312 automatically compensates for temperature fluctuations in its analysis cell, and can compensate for water vapour in the air sample. If an optical filter is installed to measure a known interferent, the 1312 can cross-compensate for the interferent.

**DATA STORAGE CAPACITY:** (for stand-alone)
Dependent on the number of gases being measured. Sufficient for a 12-day monitoring task, monitoring 5 gases and water vapour every 10 min.

**GENERAL:**
**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).
**Maximum Pumping Rate:** 30 $cm^3/s$ (flushing sampling tube) and 5 $cm^3/s$ (flushing measurement chamber).
**Minimum Volume of Air required per sample:**
**Power Requirement:** 100 – 127 V and 200 – 240 V (50 – 400 Hz) ±10% AC. Complies with IEC 536 Class 1 Safety Standards.
**Power Consumption:** ~100 VA.

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

**Alarm Relay Socket:** for connection to one or two alarm relays (visual/audio). Alarm levels for each gas are user-defined.
**Acoustic Sensitivity:** not influenced by external sound.
**Vibration Sensitivity:** complies with IEC 682-6. Strong vibrations at 20 Hz can affect the detection limit.
**Back-up Battery:** 3V lithium battery, life-time 5 years. This protects data stored in memory, and powers the internal clock.

**COMMUNICATION:**
The monitor has an IEEE 488 and an RS-232 interface, for data exchange and remote control of the 1312. The 1312PC communicates using the RS-232.

**1312PC SOFTWARE**
Supplied on 3.5 inch disks.
**Computer Requirements:**
**Hardware:**
A 486 (50MHz) processor or better.
Min. 16Mbytes of RAM.
Min. 40Mbytes of space available on the hard disk.
VGA monitor or better.
One RS–232 port.
Mouse.

**Software:**
Windows®95.

**COMPLIANCE WITH STANDARDS:**

| | |
|---|---|
| CE | CE-mark indicates compliance with: EMC Directive and Low Voltage Directive. |
| **Safety** | EN 61010–1 (1993) & IEC 1010–1 (1990): Safety requirements for electrical equipment for measurement, control and laboratory use. |
| **EMC Emission** | EN 50081–1 (1992): Generic emission standard. Part 1: Residential, commercial and light industry.<br>EN 50081–2 (1993): Generic emission standard. Part 2: Industrial environment.<br>CISPR 22 (1993): Limits and methods of radio disturbance characteristics of information technology equipment. Class B Limits.<br>FCC Class B limits. |
| **EMC Immunity** | EN 50082–1 (1992): Generic immunity standard. Part 1: Residential, commercial and light industry.<br>RF immunity implies that gas concentration indications greater than 150 times the detection limit will be affected by no more than ±5%@5s S.I.T.<br>EN 50082–2 (1995): Generic immunity standard. Part 2: Industrial environment.<br>RF immunity implies that gas concentration indications greater than 500 times the detection limit will be affected by no more than ±5%@5s S.I.T.<br>**Note:** The above is guaranteed using accessories listed in this Product Data sheet only. |
| **Temperature** | IEC 68–2–1 & IEC 68–2–2: Environmental Testing. Cold and Dry Heat.<br>Operating Temperature: +5°C to +40°C (+41°F to +104°F).<br>Storage Temperature: –25 to +55 °C (–13°F to +131°F). |
| **Humidity** | IEC 68–2–3: 90% RH (non-condensing at 30°C). |
| **Enclosure** | IEC 529: IP 20. |
| **Mechanical** | IEC 68–2–6: Vibration: 0.3 mm, 20 $m/s^2$, 10–500 Hz.<br>IEC 68–2–27: Shock: 1000 $m/s^2$.<br>IEC 68–2–29: Bump: 3000 bumps at 250 $m/s^2$. |

# Ordering Information

1312 Photoacoustic Multi-gas Monitor

The 1312 is delivered zero-point and humidity-interference calibrated. Optical filters necessary for the user's monitoring task can be ordered together with the 1312, and installed by *INNOVA*.

**Includes following accessories**

| | |
|---|---|
| 8 × DL 3322 | Optical filter locking springs |
| UD 5023 | External air-filter unit |
| DS 0759 | Filters (25) for air-filter unit |
| QA 0164 | Tweezers |
| QA 0170 | Tool for locking spring |
| Calibration Kit | comprising: |
| UD 5001 | Y-piece |
| 2 × YM 0652 | Threaded Nuts |
| AT 2177 | PTFE tubing |
| UD 5037 | ®Nafion (copolymer of TFE & fluorosuphonyl monomer) tubing |
| 2 × UD 5046 | Fittings for tubing |
| BR 6000 | Quick Set-up Guide |
| Mains cable | |
| WL 0945 | RS-232 Interface cable (9pin–25pin) null-modem included |
| 1312PC software | |
| Instruction Manual | |
| Field Guide | |

## Optional Accessories

The 1312 can be span-calibrated for certain gases (option UA 1098) — contact your local *INNOVA* representative for details of the gases for which this can be done.

| | |
|---|---|
| **UA 0968 – UA 0988** | and |
| **UA 0936** | Optical Filters (22) |
| **EB 6009** | Optical Filter |
| **EB 6010** | Optical Filter |
| **UA 1098** | Span Calibration |
| **AO 0265** | IEEE–IEEE Interface cable |
| **AO 0264** | IEEE–IEC 625 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 |
| **WQ 0943** | Battery Back-pack |
| **WQ 0916** | Water-trap Filter |
| **WQ 1106** | Filter cartridges (3) for use with WQ 0916 |
| **EA 6001** | Closed-loop Calibration Kit |
| 1303 Multipoint Sampler and Doser Unit | |
| 1309 Multipoint Sampler | |
| 7300 Application Software | |
| 7620 Application Software | |



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