



Photoacoustic Detector: **PA201**



Research photoacoustic detector for laser sources

PA201
PHOTOACOUSTIC
DETECTOR

Custom photoacoustic gas cell for laser sources

Laser photoacoustic spectroscopy (LPAS) is a highly attractive method for the trace gas analysis due to the **high sensitivity**, **linearity** and **low sample gas volume**. Tunable laser sources provide high selectivity and high measurement accuracy due to the zero background nature of the measurement principle.

The use of the novel **cantilever optical microphone** provides unmatched **sensitivity** and enables **measurements in low pressures** without compromising on the sensitivity. Narrower spectral lines at lower pressures provide additional benefit for selectivity compared to other tunable laser based systems operating at ambient pressure.

Gasera's PA201 research gas cell is designed for **laboratory measurements** and can be tailored for different types of light sources such as the near **infrared distributed feedback laser (DFB)**, the **quantum cascade laser (QCL)** and the **optical parametric oscillator (OPO)**.

Ultra-sensitive optical microphone

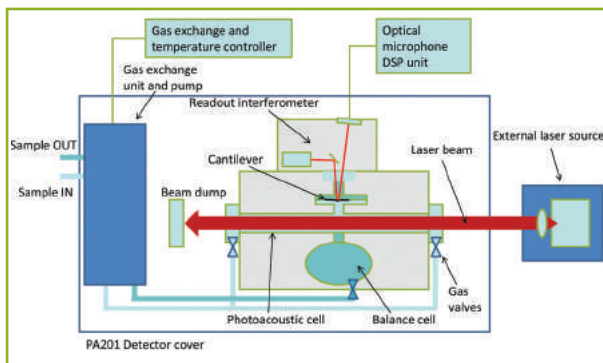
The heart of the system is the patented optical microphone comprising of a MEMS cantilever sensor coupled with a laser readout interferometer that can digitally measure microscopic movements of the cantilever sensor, having a dynamic range greater than any analog circuitry can ever obtain.

The cantilever-type pressure sensor is designed to significantly improve the sensitivity of PAS. An extremely thin cantilever portion moves like a flexible door due to the pressure variations in the surrounding gas. The movement of the free end of the cantilever can be about two orders of magnitude greater than the movement of the middle point of the tightened membrane under the same pressure variation. This is because the cantilever only bends and does not stretch.



The cantilever sensor is made out of silicon which is a highly stable material and this is why the sensor is practically immune to temperature and humidity variations. Also, the sensor is not exposed to wearing.

Pico-meter resolution of the cantilever displacement is achieved with novel optical readout based on laser interferometry.



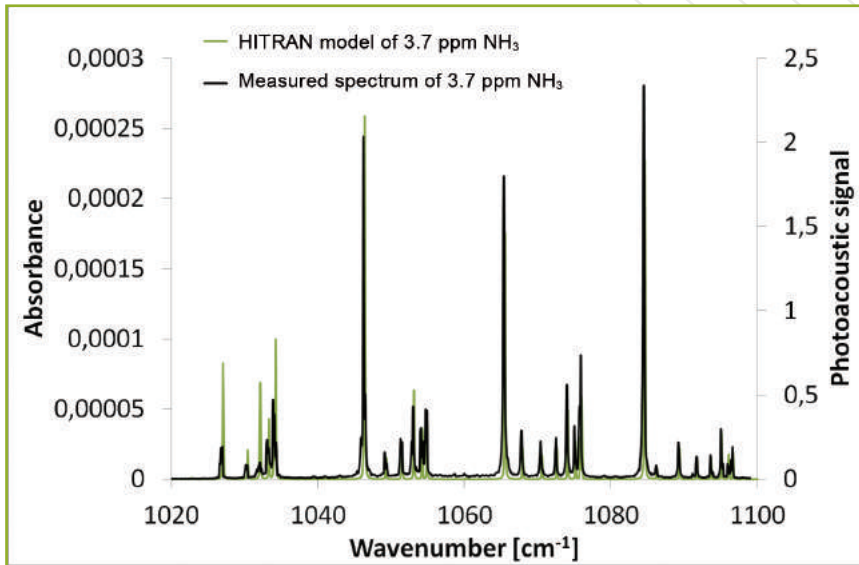
The PA201 detector includes automatic gas exchange system which can be controlled via separate controller unit.

Connections

The two gas input channels are equipped with user changeable particle filters. The automatic gas exchange system can be programmed for gas monitoring from two different points. The measurement enclosure can be purged with nitrogen. The photoacoustic gas cell is mounted on a vibration-isolated support, which can be locked for transportation from the rear panel. The laser source is connected through the front panel. Direct fiber coupling to the photoacoustic cell is possible with a fiber connection socket.



Example



Spectrum of 3.7 ppm ammonia sample was measured using the PA201 combined with a continuous wave external cavity quantum cascade laser (CW EC QCL), which was tuned over the wavenumber range from 1020 cm^{-1} to 1100 cm^{-1} . Mechanical chopper was used for modulation and the maximum optical power of the laser was 62 mW.

Features

- Photoacoustic detector with cantilever enhanced optical microphone
- Virtual zero-background measurement principle
- Total gas volume of the system is low, approx. 30 ml
- The gas exchange procedure is user configurable by a simple user interface with display and buttons. The gas exchange can be started manually with a press of a button or the instrument can be programmed to do it automatically using timer or an external trigger.
- Three gas connections in the front. The sample gas has two connections, one for input and one for output. The input is equipped with a particle filter.
- Gas cell is stabilized to 50 °C temperature.
- Patented ultra-sensitive optical microphone based on a MEMS cantilever sensor coupled with a laser interferometer to measure microscopic movement of the cantilever sensor.
- Complies with the following standards or other standardization documents under the Low Voltage Directive 2006/95/EC and EMC Directive 2004/108/EC: EN 61326-1:2005, EN 61010-1:2001.
- 12 months warranty

Technical specifications

- Materials in contact with gas:
 - FPM (seals, solenoid valves)
 - NBR (solenoid valves, gas connectors)
 - PPA, PBT (solenoid valves, gas connectors)
 - PPS, EPDM (gas pump)
 - Stainless steel (solenoid valves, gas connectors)
 - IR-window of the cell: BaF₂, KBr, ZnSe etc.
 - Nickel (gas exchange unit block, gas connectors)
 - PTFE (tubes, particle filters)
 - PP (particle filters)
- Dimensions of the PA201 module: 17.2 cm W x 10.5 cm H x 34.9 cm D
- Weight: approx. 5 kg
- Total internal gas volume: 30 ml
- Operational conditions:
 - Temperature range: 15 °C – +35 °C
 - Humidity range: Below 90% RH, non-condensing
 - Pressure range: Ambient level
 - Dust/water resistance: IP20 (IEC 529)
 - Shock/vibration endurance: Strong vibrations can affect the measurement results.
 - Acoustical level: Loud sounds can affect to the measurement results

- Storage conditions:
 - Temperature range: 0 °C – +60 °C
- Sample gas conditions:
 - Temperature: Below the gas cell temperature and non-condensing
 - Pressure: 930 mbar – 1100 mbar
 - Moisture: Non-condensing at sample temperature
 - Gas flow with bypass flow: approx. 1 liters/minute
 - Particulates size < 1 µm
- Gas connections:
 - Tube fittings for 6/4 mm tubing
- Electrical connections:
 - Power supply unit:
 - Input voltage: 100 - 240 Vac, 50 - 60 Hz
 - Input power max: 30W
 - Analog outputs:
 - Output connectors: BNC or D9 connector
 - Output signal voltage span: ± 3.3 V
 - Output signal frequency band: Low pass filtered, 0-10kHz
 - Output load: >2k resistive
 - Trigger I/O:
 - CMOS compatible input
 - Open collector output
 - Triggering sequence programmable
- Measurement specifications:
 - Detection limit: Gas and light source dependent. Typically in the low ppb -region.
 - Optical path length: 100 mm at optical axis
 - Repeatability: < 1 % of measured value in operational conditions at the calibration concentration (source dependent)
 - Temperature stability: Ambient temperature change within the operational temperature range will not cause drift. The measurement pressure can be selected between 300 mbar - 1000 mbar.

Sales package content

- PA201 photoacoustic detector
- Optical microphone DSP module
- Gas exchange controller module
- Required cables and parts for connecting the modules
- Power supply units
- Measurement software for data acquisition via USB
- Connector socket for optical fiber
- User Manual
- Storage case

Gasera Ltd. reserves the right to change specifications without notice.