

# N<sub>2</sub>O, CH<sub>4</sub>, CO<sub>2</sub>, NH<sub>3</sub> and H<sub>2</sub>O Greenhouse Gas Analyzer

# PICARRO



- Optimized flow path for fast ammonia response
- Wide CH<sub>4</sub> dynamic range up to 800 ppm
- Simultaneously measures five gases in air: N<sub>2</sub>O, CH<sub>4</sub>, CO<sub>2</sub>, NH<sub>3</sub>, and H<sub>2</sub>O
- Parts-per-billion (ppb) sensitivity brings excellent rate-of-rise quantification
- Rapid response time and continuous measurements provide data at high temporal resolution

The **Picarro G2509 gas concentration analyzer** was designed to provide simultaneous, precise measurement of N<sub>2</sub>O, CH<sub>4</sub>, CO<sub>2</sub>, NH<sub>3</sub>, and H<sub>2</sub>O in a rapidly evolving and dynamic ammonia environment with a high ambient methane concentration. The instrument provides a complete picture of greenhouse and reactive gas concentrations in challenging ambient environments. These might include such things as animal farming, manure processing, and fertilizer studies.

Concentrations of CH<sub>4</sub> can be characterized rapidly, up to 800 parts-per-million (ppm), and with ppb sensitivity. Faster measurement response of NH<sub>3</sub> is made possible with low-reactivity internal materials and high flow rate. The G2509 employs precise Cavity Ring-Down Spectroscopy (CRDS) technology to measure gas concentrations with up to ppb sensitivity and negligible drift. Unique Picarro algorithms provide automatic water correction of N<sub>2</sub>O, CH<sub>4</sub>, CO<sub>2</sub> and NH<sub>3</sub>.

G2509 Performance Specifications and Typical Performance in Air

Specification	N <sub>2</sub> O	CH <sub>4</sub>	CH <sub>4</sub> High Range	CO <sub>2</sub>	NH <sub>3</sub>	H <sub>2</sub> O
<b>Precision Raw (1σ)</b>	<25 ppb + 0.05% of reading Typical = 5.0 ppb*	<10 ppb + 0.05% of reading Typical = 0.3 ppb*	<100 ppb + 0.15% of reading Typical = 20 ppb*	<600 ppb + 0.05% of reading Typical = 240 ppb*	<5 ppb + 0.05% of reading Typical = 0.16 ppb*	<500 ppm
<b>Precision 1 min (1σ)</b>	<10 ppb + 0.05% of reading Typical = 1.1 ppb*	<7 ppb + 0.05% of reading Typical = 0.1 ppb*	<40 ppb + 0.15% of reading Typical = 7 ppb*	<300 ppb + 0.05% of reading Typical = 74 ppb*	<3 ppb + 0.05% of reading Typical = 0.07 ppb*	<250 ppm
<b>Precision 5 min (1σ)</b>	<5 ppb + 0.008% of reading Typical = 0.6 ppb*	<5 ppb + 0.02% of reading Typical = 0.1 ppb*	<20 ppb + 0.10% of reading Typical = 3 ppb*	<200 ppb + 0.05% of reading Typical = 38 ppb*	<1 ppb + 0.05% of reading Typical = 0.04 ppb*	<100 ppm
<b>Guaranteed Spec Range</b>	0.3–200 ppm***	1.5–12 ppm	0–800 ppm	380–5000 ppm	0–300 ppb	0–3 %
<b>Operating Range</b>	0–400 ppm***	0.5–15 ppm	0–800 ppm	0.02–2 %	0–10 ppm***	0–7 %
<b>Measurement Rate</b>	<8 secs	<8 secs	<8 secs	<8 secs	<8 secs	<8 secs
<b>Typical Gas Response (Rise-Fall 10-90%, 90-10%)</b>	~8 secs	~8 secs	~8 secs	~8 secs	<2 min**	~8 secs
<b>Report Dry Mole Fraction</b>	Yes	Yes	Yes	Yes	Yes	N/A

\* Typical performance is defined as the median of testing results from 50 sequentially built G250x analyzers, as measured in typical ambient concentrations.

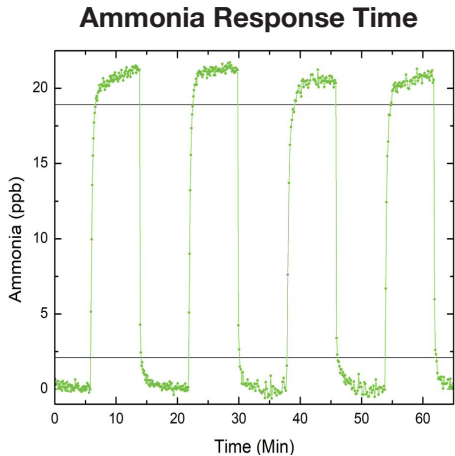
\*\* The response of H<sub>2</sub>O and NH<sub>3</sub> are limited by the adsorption of these species to the surfaces of the experimental apparatus. To ensure ammonia measurement accuracy, the G2509 features a high flow rate and low reactivity internal materials (e.g. SilcoNert and Teflon) to reduce adsorption effects and accelerate the response time.

\*\*\* At NH<sub>3</sub> concentration above 2 ppm, regular mode, expect reduction in accuracy of +/- 0.003 ppm per ppm of NH<sub>3</sub> in the N<sub>2</sub>O measurement

**Analyzer specificity:** Picarro's CRDS technology utilizes extremely narrow spectral regions, which greatly reduces the likelihood of interference from other gas species when compared to other spectral measurement techniques. However, in real-world samples, interferences can happen. Picarro has included interference detection software and has tested and characterized the effects of the following species for this analyzer:

G2509 Trace Gases	N <sub>2</sub> O Sensitivity
Carbon Dioxide	None - Automated correction good to 20,000 ppm CO <sub>2</sub>
Methane	Automated correction over the operating range for the given mode
Ammonia	None - Automated correction good to 2 ppm NH <sub>3</sub>
Ethane	0.2 ppb N <sub>2</sub> O/ppm C <sub>2</sub> H <sub>6</sub> tested up to 120 ppm
Ethylene	0.5 ppb N <sub>2</sub> O/ppm C <sub>2</sub> H <sub>4</sub> tested up to 16 ppm
Acetylene	Not for use with acetylene experiments
Background Gas	Designed for use in ambient air, not for use with highly varying or enriched N <sub>2</sub> , O <sub>2</sub> , H <sub>2</sub> , or He

G2509 System Operation Parameters	Specifications
Ambient Temperature	10 to 35°C
Ambient Humidity	<85% RH, non-condensing
Sample Pressure	300 to 1,000 Torr (40 to 133 kPa)
Sample Flow Rate	~1.3 slpm
Sample Humidity	<99% RH, non-condensing, water correction tested to 25°C dew point
Sample Temperature	-10 to 45°C
Cavity Temperature Control	±0.005°C
Cavity Pressure Control	±0.0002 atm
Closed-loop/Recirculation Capability	Not compatible with Picarro Closed System Pump
Inlet Fittings	¼" Swagelok® PFA fittings
Dimensions	Analyzer: 17" w x 7" h x 17.5" d (43.2 x 17.9 x 44.6 cm), not including 0.5" feet External Pump: 6.1" w x 8.7" h x 13.6" d (15.5 x 22 x 34.5 cm)
Weight	Analyzer: 47.0 lbs (21.3 kg) External Pump: 14.3 lbs (6.5 kg)
Power Requirements	100–240 VAC; 47– 63 Hz (auto-sensing); < 375 W at start-up (total). Steady-state operation: 120 W (analyzer), 150 W (pump).
Installation	Benchtop (standard) or 19" rack mount chassis (optional)
Accessories	Included: Vacuum pump, keyboard, mouse. Optional: LCD monitor



Typical response time for a 10-90% and 90-10% 20 ppb ammonia challenge.