

PICARRO G2201-i CRDS Analyzer for Isotopic Carbon in CO₂ and CH₄

Simultaneous Insights Into Complex Carbon Source/Sink
Behavior of Two Species with One Analyzer



- World's only field-deployable analyzer capable of simultaneous $\delta^{13}\text{C}$ measurements for both CO₂ and CH₄
- Less hassle – Less calibration, less maintenance, no consumables
- Endures harsh environments – mountains, oceans, forests, and tundra
- Excellent precision at a fraction of the operating cost of IRMS
- Picarro analyzers are deployed by thousands of researchers, on all seven continents and in more than 60 countries

Respiration, fermentation. Oxidation, reduction. Source, sink. Carbon dioxide and methane are tightly intertwined in many biological and geological systems. If you know the behavior of only one of these species, you may only know half the story. With the new G2201-*i*, the isotopic carbon ratio in both CO₂ and CH₄ can be measured at the same time. This instrument combines the capabilities of Picarro's two carbon isotope instruments for CO₂ and CH₄ into a single instrument to gather the insights that stable isotope ratios offer. With this instrument, researchers can follow the carbon as it moves from source to sink.

The G2201-*i* operates in one of three modes: CO₂-only mode, CH₄-only mode, and combined CO₂/CH₄ mode. In the combined mode, the measurement of CO₂ and CH₄ are interleaved every few seconds to produce a sampling rate that is faster than the gas turn-over time in the cavity. The analyzer's combined precision is <0.16‰ for $\delta^{13}\text{C}$ -CO₂ and <1.15‰ for $\delta^{13}\text{C}$ -CH₄. The simultaneous measurement ability of the G2201-*i* is a technology unique to Picarro. When the analyzer is in CO₂-only mode or CH₄-only mode, the precision improves because more time is devoted to one molecule. For the CO₂-only mode, the $\delta^{13}\text{C}$ -CO₂ precision is <0.12‰, which is similar to the precision of our dedicated G2131-*i* $\delta^{13}\text{C}$ -CO₂ analyzer. For the CH₄-only mode, the $\delta^{13}\text{C}$ -CH₄ precision is <0.8‰, which is the same precision as our dedicated G2132-*i* $\delta^{13}\text{C}$ -CH₄ analyzer.

Methane concentrations vary widely in nature. Atmospheric methane is ~1.8ppm, but methane in the headspace of a water sample can be 1000ppm. To cover this large concentration range, the analyzer has two CH₄-only modes. The High Precision mode provides the best precision at ambient and near-ambient concentrations of CH₄ up to 12ppm, which is more than 6 times the ambient concentration. The High Range mode provides a dynamic range that goes from ambient concentration at 1.8ppm to 1000ppm. This allows one to select the best option for a given study.

The G2201-*i* brings simplicity to research. Its small size and robustness make it easy to transport to the field where getting immediate results allows researchers to change course on-the-fly to get the most from a critical field campaign. The G2201-*i* can be running within minutes out of the box, and can operate for months without user interaction. In all modes, the analyzer precisely measures CO₂, H₂O, and CH₄ concentration, which allows cross-influence of these species to be quantified and corrected, as well as eliminating the need for gas drying. Peripherals such as the Small Sample Isotope Module and the 16-Port Manifold extend the utility of the analyzer. Scientists using these systems have reported the highest quality data, day in and day out, with fewer calibrations than other spectral absorption-based instruments.

Performance Specifications	CO ₂ Isotope-only mode		CH ₄ Isotope-only mode	Simultaneous mode
δ ¹³ C Precision (1-σ, 1 Hr window, 5 min. average)				
δ ¹³ C-CO ₂	< 0.12 ‰		-	< 0.16 ‰
δ ¹³ C-CH ₄	-		High Precision mode: < 0.8 ‰ High Dynamic Range mode: <0.4‰	High Precision mode: < 1.15 ‰ High Dynamic Range mode: < 0.55‰
δ ¹³ C Maximum Drift (peak-to-peak, 1 hr average interval average over 24 hrs at STP)				
δ ¹³ C-CO ₂	< 0.6 ‰		-	< 0.6 ‰
δ ¹³ C-CH ₄	-		High Precision and High Dynamic Range modes: < 1.5 ‰ at 10 ppm CH ₄	High Precision and High Dynamic Range modes: < 1.5 ‰ at 10 ppm CH ₄
Concentration Precision (1-σ, 30 sec. average)				
CO ₂	200 ppb + 0.05 % of reading (¹² C) 10 ppb + 0.05 % of reading (¹³ C)		1 ppm + 0.25 % of reading (¹² C)	200 ppb + 0.05 % of reading (¹² C) 10 ppb + 0.05 % of reading (¹³ C)
CH ₄	50 ppb + 0.05 % of reading (¹² C)		High Precision mode 5 ppb + 0.05 % of reading (¹² C) 1 ppb + 0.05 % of reading (¹³ C) High Dynamic Range mode: 50 ppb + 0.05 % of reading (¹² C) 10 ppb + 0.05 % of reading (¹³ C)	High Precision mode 5 ppb + 0.05 % of reading (¹² C) 1 ppb + 0.05 % of reading (¹³ C) High Dynamic Range mode: 50 ppb + 0.05 % of reading (¹² C) 10 ppb + 0.05 % of reading (¹³ C)
H ₂ O	100 ppm			
Dynamic Range				
CO ₂ Guaranteed Spec Range	380-2000 ppm		200-2000 ppm	380-2000 ppm
CO ₂ Operational Range	100-4000 ppm		0-4000 ppm	100-4000 ppm
CH ₄ Guaranteed Spec Range	1.8-500 ppm		High Precision mode:1.8-12 ppm High Dynamic Range mode: 10-1000 ppm	High Precision mode:1.8-12 ppm High Dynamic Range mode: 10-500 ppm
CH ₄ Operational Range	0-1000 ppm		High Precision mode:1.2-15 ppm High Dynamic Range mode: 1.8-1500 ppm	High Precision mode:1.2-15 ppm High Dynamic Range mode: 1.8-1500 ppm
H ₂ O Guaranteed Spec Range	0-2.4 %			
H ₂ O Operational Range	0-5 %			
Ambient Temperature Dependence	Guaranteed < ± 0.06 ‰ / °C, typical < ± 0.025 ‰ /°C			
Measurement Interval	~ 3 secs		~ 3 secs	~ 5 secs
Rise/Fall time (10-90 % / 90-10 %)	Typical ~ 30 sec			
Applications Considerations	Interference can occur for concentrations of H ₂ O and CO ₂ well outside of the defined dynamic range, as well as other organics, ammonia, ethane, ethylene, or sulfur containing compounds. Users should verify with prepared lab samples. Please contact us to discuss the experimental conditions. Pressure drops in the instrument’s gas path can draw external air when this system is used in recirculating applications.			

Analyzer Specifications	
Measurement Technique	CRDS
Measurement Cell Temp. Control	+/- 0.005 °C
Measurement Cell Pressure Control	+/- 0.0002 atm
Shock and Vibration Testing	Meets shock and vibration military MIL-STD 810F test standard and operates as specified afterward.
Sample Temperature	-10 to 45 °C
Sample Pressure	300 to 1000 Torr (40 to 133 kPa)
Sample Flow Rate	< 50 sccm (typical ~25 sccm) at 760 Torr, no filtration required
Sample Humidity	< 99 % RH non-condensing @ 40 °C, no drying required
Ambient Temperature Range	10 to 35 °C (operating) -10 to 50 °C (storage)
Ambient Humidity	< 99 % RH non-condensing
Accessories	Pump (external), keyboard, mouse, LCD monitor (optional)
Data Outputs	RS-232, Ethernet, USB, analog (optional) 0 – 10 V
Fittings	¼" Swagelok ®
Dimensions	Analyzer: 17" w x 7" h x 17.55" d (43.18 x 17.78 x 44.57 cm) not incl. 0.5" feet External Pump: 7.5" w x 4" h x 11" d (19 x 10.2 x 28 cm)
Installation	Benchtop or 19" rack mount chassis
Weight	56 lbs (25.4 kg), includes external pump
Power Requirements	100 - 240 VAC, 47 - 63 Hz (auto-sensing), < 260 W start-up (total); 125 W (analyzer), 35 W (pump) at steady state

This product is not optimized for vehicular deployment where there is a requirement for pin-pointing precise methane source locations while driving. As a result, we do not support this product's use for natural gas leak detection or other real-time methane emissions applications while driving. The Picarro Surveyor™ system is the optimal product for such studies.