$\delta^{13}C$ Isotope and Carbon Dioxide and Methane Gas Concentration Analyzer

PICARRO

- Measure $\delta^{13}C$ in CO_2 at <0.1‰ precision
- Pair with peripherals to measure $\delta^{13}C$ from many sample types
- Simultaneously measure CO_2 and CH_4 gas concentrations
- Measure H_2O vapor and report dry mole fractions
- Outstanding pressure and temperature stability

The **Picarro G2131-*i* isotope and gas concentration analyzer** enables measurement flexibility for a wide variety of applications—from atmospheric and ocean science research to food and beverage origin and authenticity. First, it can measure $\delta^{13}C$ in carbon dioxide at better than 0.1‰ precision. Second, it can measure carbon dioxide (CO_2) and methane (CH_4) gas concentrations, simultaneously, at 200 and 50 parts-per-billion (ppb), respectively. And water (H_2O) vapor is measured in parts-per-million (ppm) precision to correct and report CO_2 and CH_4 in dry mole fractions.

$\delta^{13}C$ isotopes in carbon dioxide are utilized differentially by photosynthesis. Therefore, $\delta^{13}C$ isotopic signatures can be used directly as a source attribution for plants—such as place of origin and authenticity of plant-derived foods and beverages. $\delta^{13}C$ isotopic signatures can also be used indirectly for analysis of the diets of plant-eating animals. This enables an understanding of animal eating patterns as well as the authenticity of food of animal origin.

Carbon dioxide is the most significant long-lived greenhouse gas (GHG) in the Earth's atmosphere, and is a critical element in the carbon cycle. Methane has a shorter lifespan than carbon dioxide, but it bears an outsized impact on climate change with about 85 times the global warming potential over a 20-year period. Both gases occur naturally, but anthropogenic emissions have significantly increased the concentration of carbon dioxide and methane in the atmosphere. Therefore, precisely measuring both greenhouse gases is important to better understand the effect of human activity on the Earth's environment and climate.

The G2131-*i* analyzer can be paired with a variety of peripherals to measure $\delta^{13}C$ from a wide range of sample types, including:

- Dissolved inorganic carbon (DIC)
- Dissolved organic carbon (DOC)
- Carbonates
- Bulk materials
- Small volume gas samples
- Highly concentrated gas samples
- Closed systems

G2131-*i* Performance Specifications	
Precision, $\delta^{13}C$ in CO_2 (1-σ, 1 Hr window, 5 min)	<0.1‰ guaranteed precision at >380 ppm CO_2, <0.25‰ typical precision at 200 ppm CO_2, <0.05‰ typical precision at >1000 ppm CO_2
Max Drift at STP $\delta^{13}C$ in CO_2 (over 24 hrs, peak-to-peak, 1 hr interval average)	<0.5‰
Precision, CO_2 Concentration (30 sec, 1-σ)	200 ppb (^{12}C)/10 ppb (^{13}C)
Precision, CH_4 Concentration (30 sec, 1-σ)	50 ppb +0.05% of reading (^{12}C)
Precision, H_2O Concentration (30 sec, 1-σ)	100 ppm
CO_2 Dynamic Range	380–2000 ppm guaranteed specification range, 0.01–0.4% operational range Up to 100% pure CO_2 samples can be analyzed with the A0314 Small Sample Isotope Module 2 (SSIM2) peripheral, which includes dilution. Minimum sample volume per replicate with the SSIM2 is 10 µl of pure CO_2 (0.45 µmoles or 20 µg of CO_2) or the equivalent volume of CO_2 in air.
CH_4 Dynamic Range	0–500 ppm guaranteed specification range, 0–1000 ppm operational range
H_2O Dynamic Range	0–2.4 % guaranteed specification range, 0–5% operational range
Transient Response	Typical behavior <0.1‰ for a rate of 300 ppm CO_2/min
Ambient Temperature Dependence	Guaranteed <±0.06‰/°C, typical <±0.025‰/°C
Measurement Interval	~2 secs (includes periodic H_2O and CH_4 measurements)
Rise/Fall time (10–90%/90–10%)	Typical ~30s
Applications Considerations	Interference can occur for concentrations of H_2O, CO_2, and CH_4 well above normal ambient levels, as well as other organics, ammonia, ethane, ethylene, or sulfur containing compounds. Large changes in the isotopic ratio of H_2O can affect the results. Users should verify with prepared lab samples. Please contact us to discuss the experimental conditions.

G2131-*i* Analyzer Specifications	
Measurement Technique	Cavity Ring-Down Spectroscopy (CRDS)
Measurement Cell Temperature Control	±0.005°C
Measurement Cell Pressure Control	±0.0002 atm
Shock and Vibration Testing	Meet shock and vibration military MIL-STD 810F test standard.
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 17.5" d (43 x 18 x 45 cm) not incl. 0.5" feet External Pump: 5.6" w x 6.4" h x 11.9" d (14.3 x 16.3 x 30.3 cm)
Installation	Benchtop or 19" rack mount chassis
Weight	60.4 lbs (27.4 kg), includes external pump
Power Requirements	100–240 VAC, 47–63 Hz (auto-sensing), <260 W start-up (total); 125 W (analyzer), 80 W (pump) at steady state

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