Aerodyne Mini-TILDAS CO₂ Isotope Monitor

Unprecedented precision and time response for $\delta^{13}$C and $\delta^{18}$O isotope ratios in a compact, transportable package.

Features:
- < 0.10‰ precision for $\delta^{13}$C, $\delta^{18}$O in 1 s
- < 0.03‰ precision for $\delta^{13}$C, $\delta^{18}$O in 100 s
- Fast time response (10 Hz)
- Direct measurement of CO₂ isotopes in air without sample processing
- Option for sample-reference valve-switching scheme for enhanced sensitivity with discrete samples
- Dual laser package allows simultaneous measurement of water isotopes or $^{12}$C$^{17}$O$^{16}$O or “clumped” CO₂: $^{13}$C$^{18}$O$^{16}$O.

Rugged, field-ready instruments

Direct absorption spectroscopy allows for highly specific and accurate gas detection

Mid-IR detection enables maximum measurement sensitivity

TILDAS Technology

Aerodyne instruments use tunable infrared laser direct absorption spectroscopy (TILDAS) at mid-IR wavelengths to probe molecules at their strongest “finger-print” transition frequencies. We further enhance sensitivity by employing a patented multi-pass broad-band absorption cell that provides optical path lengths up to 76 m. Direct absorption spectroscopy allows for fast (<1 sec) absolute trace gas concentrations without need for elaborate calibration procedures. Moreover, TILDAS instruments are free of measurement interference from other molecular species, enabling extremely specific detection.

Applications

- Determination of atmospheric sources, sinks, and transport through CO₂ isotopic ratios.
- Biosphere exchange.
- Laboratory measurements of discrete samples.
- Mobile measurements aboard aircraft, marine, and ground-based platforms.
- Carbon capture and sequestration monitoring.
- Breath analysis.

Aerodyne CO₂ Isotope Advantages

- Measurement precision comparable to much larger and more expensive IRMS instruments.
- Time response up to 10 Hz enables eddy covariance studies.
- Powerful TDLWintel software provides flexible instrument control, and real-time data analysis.
- Valve control capable of complex scheduling and automatic background and calibrations.
- 19” rack mountable for easy installation.
- Turn-key design allows unattended operation in remote field sites.
Performance Specifications:

Isotope ratio precision (1σ)

<table>
<thead>
<tr>
<th></th>
<th>1 sec</th>
<th>100 sec</th>
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<tbody>
<tr>
<td>δ¹³C</td>
<td>0.1 ‰</td>
<td>0.03 ‰</td>
</tr>
<tr>
<td>δ¹⁸O</td>
<td>0.1 ‰</td>
<td>0.03 ‰</td>
</tr>
<tr>
<td>δ¹⁷C</td>
<td>0.4 ‰</td>
<td>0.15 ‰</td>
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Species Precision (1σ @ 400 ppm CO₂)

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<tr>
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<th>1 sec</th>
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<tbody>
<tr>
<td>CO₂</td>
<td>25 ppb</td>
<td>10 ppb</td>
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Time Response

1-10 Hz data rate
0.05 s minimum Rise/Fall time (1/e)
(depending on vacuum pump)

Dynamic Range (air)

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<thead>
<tr>
<th></th>
<th>min</th>
<th>max</th>
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<tbody>
<tr>
<td>CO₂</td>
<td>0 ppm</td>
<td>5,000 ppm</td>
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Enhanced Measurement Options

16 channel valve control for complex sampling
Low volume multi-pass cell for limited sample size
Using the dual laser package:
Simultaneously measure the isotopologues of water (H¹⁶OH, H¹⁸OH, H¹⁶OD).
Simultaneously measure ¹²C¹⁷O¹⁶O and the "clumped" CO₂ isotopologue ¹³C¹⁸O¹⁶O.

Installation

19" rack mountable or benchtop

Instrument Operations

Operating temperature: 10 to 35 °C
Sample flow rate: 0 to 20 slpm

Instrument Components

Core instrument
Thermoelectric chiller
Keyboard, mouse, and monitor
Vacuum pump (customer specified)
Inlet sampling system (customizable)

Data Outputs

RS-232, USB drive, ethernet

Size, Weight, Power

Dimensions: 430mm x 660mm x 270mm
Weight: 35 kg (core instrument) + 15 kg (chiller) + pump weight
Max power: 125 W, 120/240 V, 50/60 Hz (core instrument) + 300 W (chiller) + pump power

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Aerodyne specializes in collaboration and custom design. Please contact us if you would like to discuss additional measurement options and applications.

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REFERENCES:

