

# Trace Gas Analyzers

High performance CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O gas analyzers for the field and lab



LI-7810 CH<sub>4</sub>/CO<sub>2</sub>/H<sub>2</sub>O Trace Gas Analyzer

LI-7815 CO<sub>2</sub>/H<sub>2</sub>O Trace Gas Analyzer

LI-7820 N<sub>2</sub>O/H<sub>2</sub>O Trace Gas Analyzer

**LI-COR**<sup>®</sup>

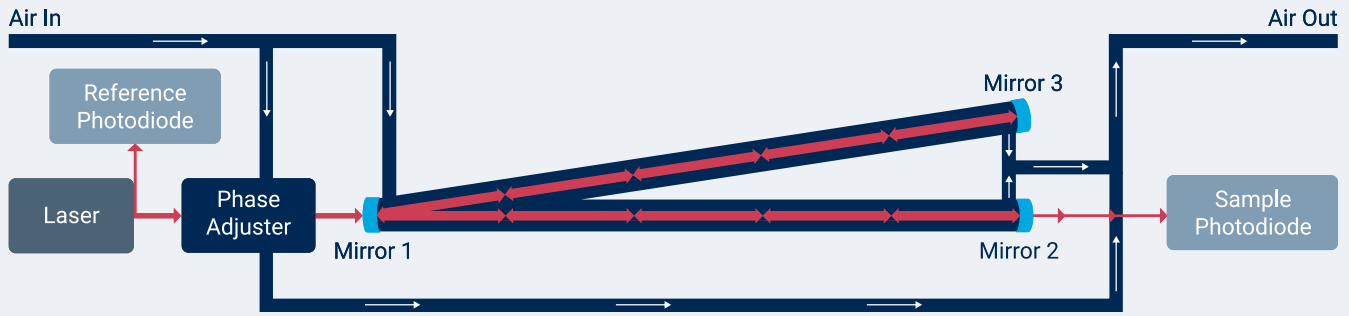
# The new standard in trace gas analysis

LI-COR Trace Gas Analyzers use laser-based spectroscopy to measure gases in air with high precision and accuracy. Optical Feedback-Cavity Enhanced Absorption Spectroscopy (OF-CEAS), in combination with numerous patented innovations,<sup>1</sup> has resulted in an exceptionally stable gas measurement platform that features a small form factor and low power requirements.

Combining these features, LI-COR Trace Gas Analyzers can serve the needs of a variety of research applications, including long-term atmospheric monitoring, climatology studies, mobile monitoring, soil gas flux measurements, and more. The compact form factor, low power requirements, and light weight make the instruments ideal for laboratory and field work alike.

1. U.S. patents 8659758, 8665442, 8885167, 9116047, 9194742, 9304080, 9581492, 9678003, 9759654, 9759655, 9989729, and 10060942. Additional patents pending in the U.S. and other countries.

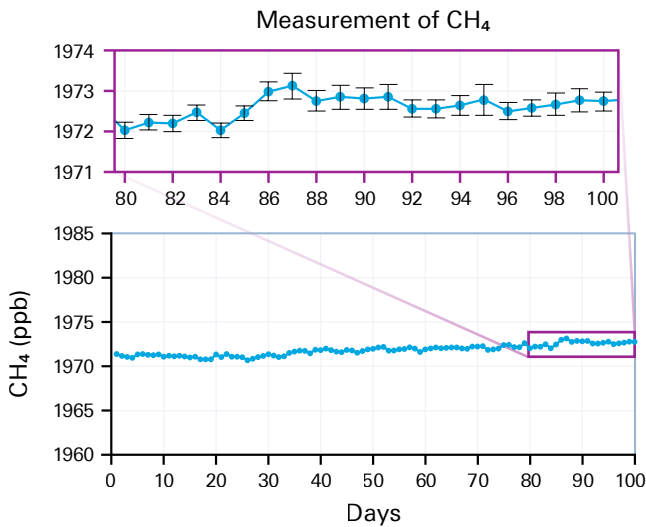




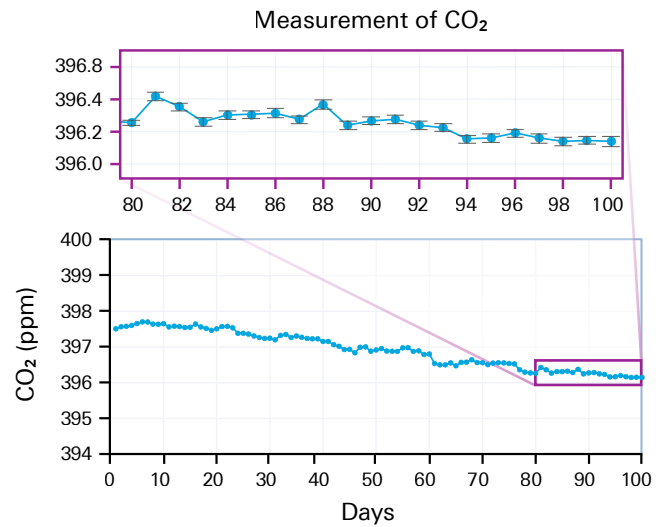
**Figure 1.** To measure gases in air, the laser is reflected within a high-finesse optical cavity, providing a long effective pathlength that creates many opportunities for absorption by the gases of interest. A dense grid of data points, created by the fixed cavity resonance modes, results in high-resolution absorption measurements with low uncertainty. Comparison between the measured absorption profile and a high-resolution dataset is used to compute gas density. The optical cell has a small volume, which is helpful for resolving rapid changes in concentrations.

## Precision, accuracy, and long-term stability

LI-COR Trace Gas Analyzers are optimized for precision, accuracy, and stability. Low uncertainty measurements ensure that the reported value is correct. Precise measurements ensure consistency from measurement to measurement. Stability over time means that reported measurements are dependable without regular calibration adjustments.



**Figure 2.** 100 days of methane stability data. Collected from an LI-7810 CH<sub>4</sub>/CO<sub>2</sub>/H<sub>2</sub>O Trace Gas Analyzer deployed in an enclosed shelter at an outdoor monitoring site in Lincoln, NE, USA.



**Figure 3.** 100 days of CO<sub>2</sub> stability data. Collected from an LI-7815 CO<sub>2</sub>/H<sub>2</sub>O Trace Gas Analyzer deployed in an enclosed shelter at an outdoor monitoring site in Lincoln, NE, USA.

## Versatile for many applications

With a durable, weather-resistant case and wide operating temperature range, LI-COR Trace Gas Analyzers can be deployed under a simple shelter in ambient temperature in many areas. Each analyzer can be used alone, or multiple analyzers can be plumbed in parallel for combined CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O measurements from a single source.



- Small form factor makes them ideal for a laboratory or instrument rack
- Low power requirements for off-grid deployments
- Hot-swappable batteries for uninterrupted long-term battery-powered operation
- External power adapter for operating from AC power and charging the batteries
- Small optical cavity for fast response to quickly changing concentrations
- Lightweight and easy to carry by hand or with the optional backpack kit





## Easy to use

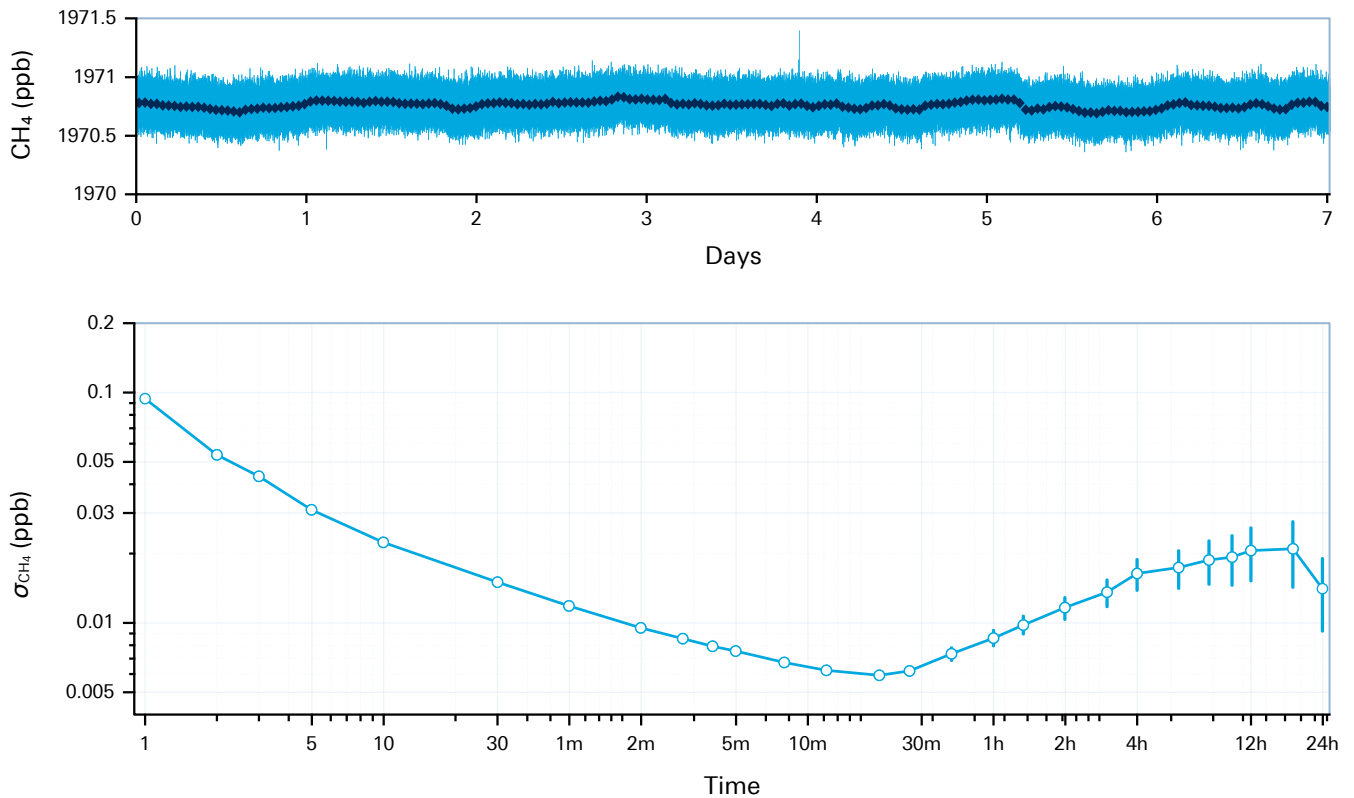
- Connect to the gas analyzer with a smartphone, tablet, or PC using the web browser—no apps or external programs needed
- Software designed for quick access to measurement data, status information, and configuration options
- Built-in storage to record three months of data
- Easily retrieve data as text files, either through the interface or with MQTT/TCP IP
- Support for direct connection to a PC or Ethernet-compatible datalogger for extended data transfer and storage options
- For soil flux measurements, easily integrates with the Smart Chamber and LI-8250 Multiplexer for survey and long-term soil gas flux measurements
- Ready to interface with GCWerks software for long-term monitoring systems



## LI-7810 CH<sub>4</sub>/CO<sub>2</sub>/H<sub>2</sub>O Trace Gas Analyzer

The LI-7810 delivers exceptionally stable and precise CH<sub>4</sub> measurements. The instrument is ideal for atmospheric CH<sub>4</sub> monitoring, combined CH<sub>4</sub>/CO<sub>2</sub> soil gas flux measurements, and high-precision methane measurement applications. With low power requirements and high precision measurements, the analyzer can be used for a wide range of applications and in a wide range of environments.

LI-7810 7-Day CH<sub>4</sub> Precision with Allan Deviation Plot

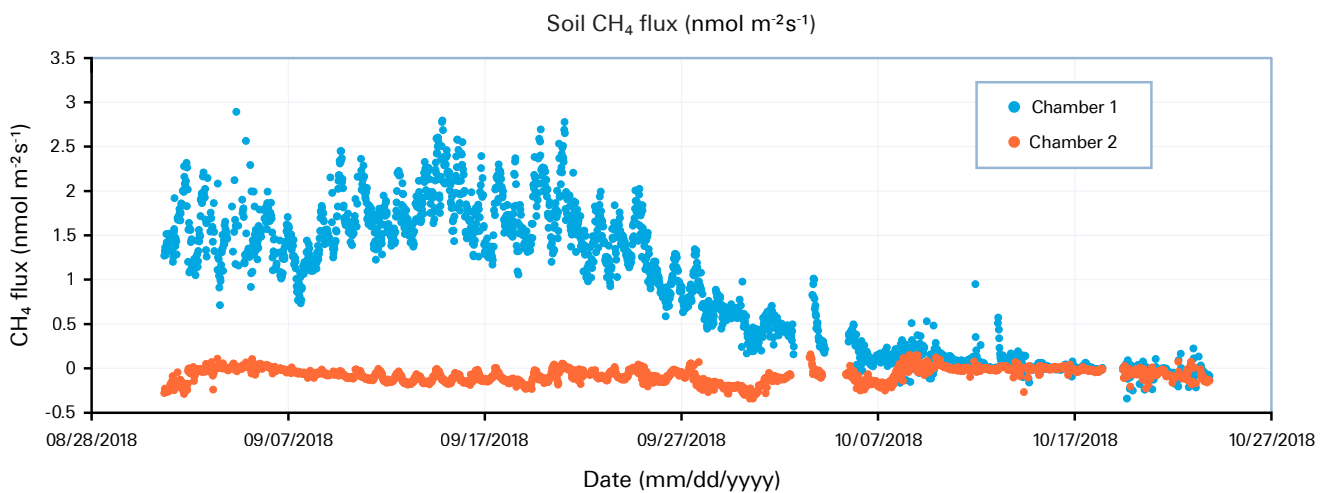


**Figure 4. CH<sub>4</sub> stability data from an LI-7810 as it measured continuously flowing tank gas (1970.7 ppb CH<sub>4</sub> and 387.5 ppm CO<sub>2</sub>) over a 7-day period.** The light blue line (top) is the 1-second CH<sub>4</sub> output; the dark blue line is the 50-minute block average. The Allan deviation plot (bottom) is CH<sub>4</sub> precision with 1-second averaging. Precision improves as averaging time increases. Error bars represent 68% ( $\pm 1\sigma$ ) confidence intervals based on number of averaged time series available at each  $\tau$ .

## Applications

The LI-7810 is ideal for a range of applications—from atmospheric CH<sub>4</sub> monitoring to mobile monitoring, to soil CH<sub>4</sub> and CO<sub>2</sub> flux measurements. It easily connects to the Smart Chamber or LI-8250 Multiplexer for survey or long-term soil CH<sub>4</sub>/CO<sub>2</sub> gas flux measurements.

- Atmospheric monitoring
- Soil gas flux measurements
- Mobile measurement systems
- Wetland and lake emissions
- Small volume injections
- Sampling from flasks
- Urban emissions monitoring
- pCH<sub>4</sub> measurement systems
- Sensor networks
- Large area emissions monitoring
- Fugitive emissions detection



**Figure 5. Seasonal soil CH<sub>4</sub> flux variations observed using the LI-7810 CH<sub>4</sub>/CO<sub>2</sub>/H<sub>2</sub>O Trace Gas Analyzer and the LI-8150 Multiplexer with 8100-104 Long-Term Chambers.** Chamber 1 site was a source of emissions up to 2.8 nmol m<sup>-2</sup>s<sup>-1</sup>—which was unexpected for grassland. By October, the site had become a sink. Chamber 2 site was typically a sink with rates ~-0.2 nmol m<sup>-2</sup>s<sup>-1</sup>. This was expected and consistent with published rates.

## Specifications

### CH<sub>4</sub> Measurements

Response Time (T<sub>10</sub>-T<sub>90</sub>): ≤ 2 seconds from 0 to 2 ppm

Range: 0 to 100 ppm

Precision (1σ):

0.60 ppb at 2 ppm with 1 second averaging

0.25 ppb at 2 ppm with 5 second averaging

Maximum Drift: < 1 ppb per 24-hour period

### CO<sub>2</sub> Measurements

Range: 0 to 10,000 ppm

Precision (1σ):

3.5 ppm at 400 ppm with 1 second averaging

1.5 ppm at 400 ppm with 5 second averaging

### H<sub>2</sub>O Measurements

Range: 0 to 60,000 ppm

Precision (1σ):

45 ppm at 10,000 ppm with 1 second averaging

20 ppm at 10,000 ppm with 5 second averaging

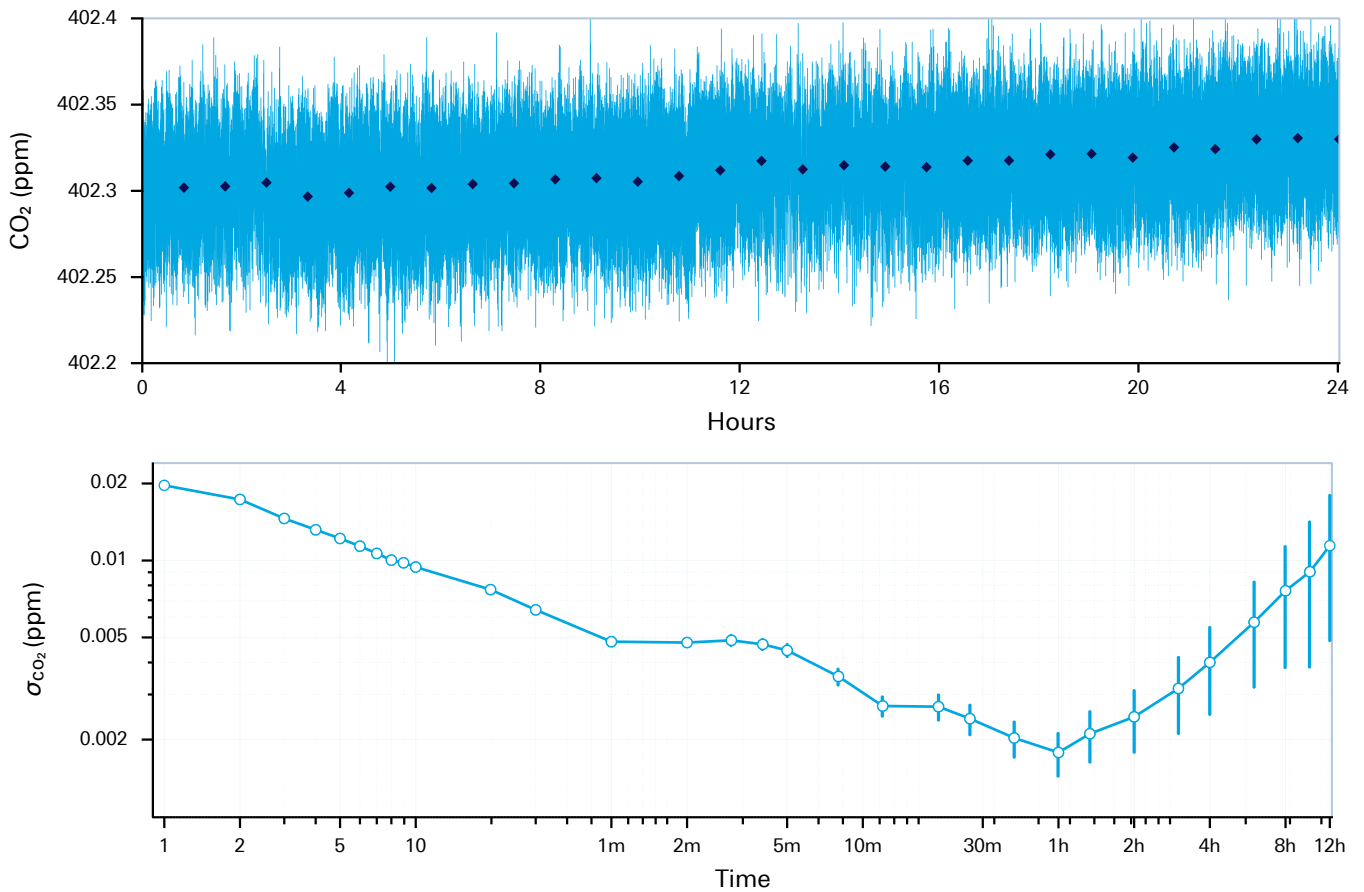
*Specifications subject to change without notice*

# LI-7815 CO<sub>2</sub>/H<sub>2</sub>O Trace Gas Analyzer

The LI-7815 is designed for long-term atmospheric CO<sub>2</sub> measurements. Combining precise, stable measurements with fast response times and portability, the LI-7815 is an ideal analyzer for mobile monitoring systems, emissions monitoring applications, and pCO<sub>2</sub> analysis systems. It delivers high precision in the field, on the move, or in the lab.



LI-7815 24-Hour CO<sub>2</sub> Precision with Allan Deviation Plot



**Figure 6. CO<sub>2</sub> stability data from an LI-7815 as it measured continuously flowing tank gas (402.3 ppm CO<sub>2</sub>) for a 24-hour period.** The blue line (top) shows 1-second measurements; the diamond line shows a 50-minute block average. The Allan deviation plot (bottom) of CO<sub>2</sub> precision with 1-second signal averaging. Precision improves as averaging time increases. Error bars represent 68% ( $\pm 1\sigma$ ) confidence intervals based on number of averaged time series available at each  $\tau$ .



## Applications

The LI-7815 provides the high precision, accuracy, and stability required by leading atmospheric monitoring organizations.

- Atmospheric CO<sub>2</sub> monitoring, including integration with GCWerks software
- Sensor networks
- Urban emissions monitoring
- Mobile emissions monitoring
- pCO<sub>2</sub> measurement systems
- Large area emissions monitoring
- Fugitive emissions



Interested in seeing more case studies or references? Go to [www.licor.com/tracegas](http://www.licor.com/tracegas) for the latest research results and test reports.

## Specifications

### CO<sub>2</sub> Measurements

**Response Time (T<sub>10</sub>-T<sub>90</sub>):** ≤ 2 seconds from 0 to 400 ppm

**Range:** 0 to 10,000 ppm

**Precision (1σ):**

0.10 ppm at 400 ppm with 1 second averaging

0.04 ppm at 400 ppm with 5 second averaging

**Maximum Drift:** < 0.2 ppm per 24-hour period

### H<sub>2</sub>O Measurements

**Range:** 0 to 60,000 ppm

**Precision (1σ):**

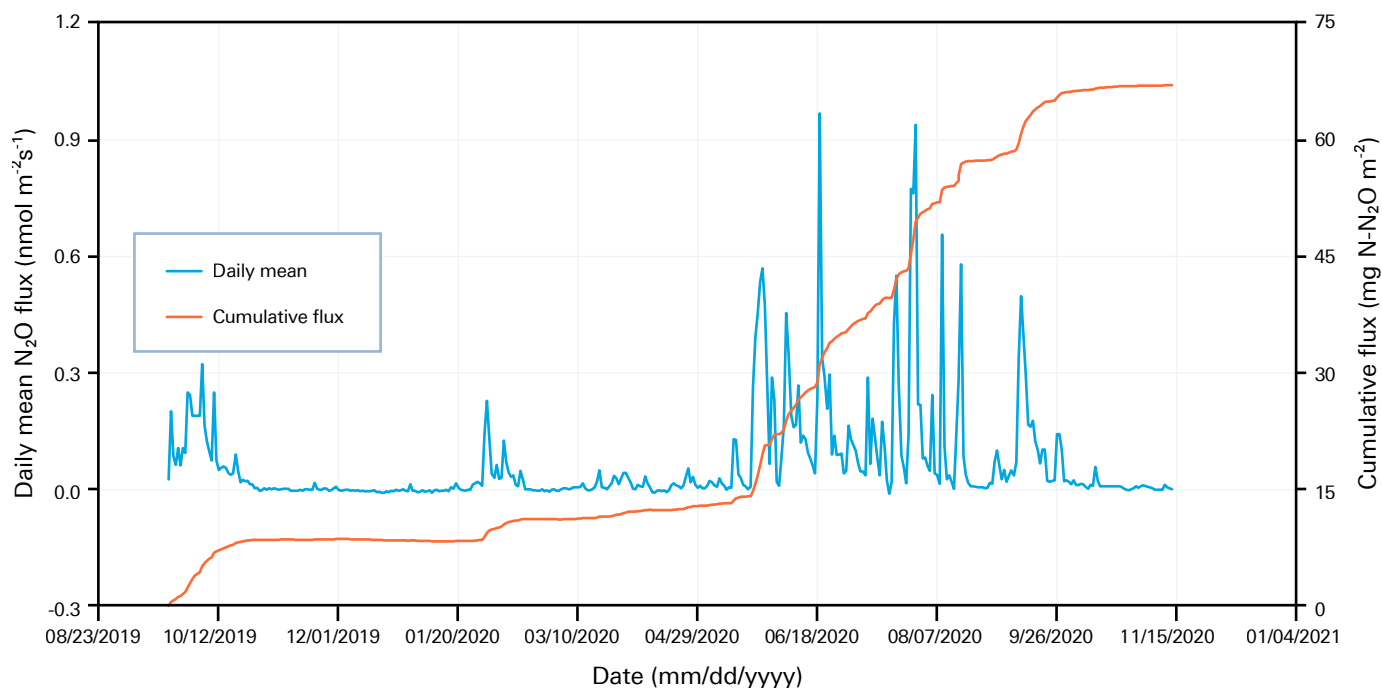
45 ppm at 10,000 ppm with 1 second averaging

20 ppm at 10,000 ppm with 5 second averaging

*Specifications subject to change without notice*

## LI-7820 N<sub>2</sub>O/H<sub>2</sub>O Trace Gas Analyzer

The LI-7820 provides precise N<sub>2</sub>O measurements that are ideal for chamber-based soil gas flux research and more. When coupled with LI-COR soil gas flux systems, it can measure short-term natural variations of N<sub>2</sub>O and large emission events. Capable of measuring flux rates as low as 0.05 nmol m<sup>-2</sup> s<sup>-1</sup> in a 2-minute measurement, the LI-7820 measures flux from soils in a fraction of the time required by traditional analyzers. With its compact form, low power requirements, and portable design, you can take the analyzer wherever you need to go.



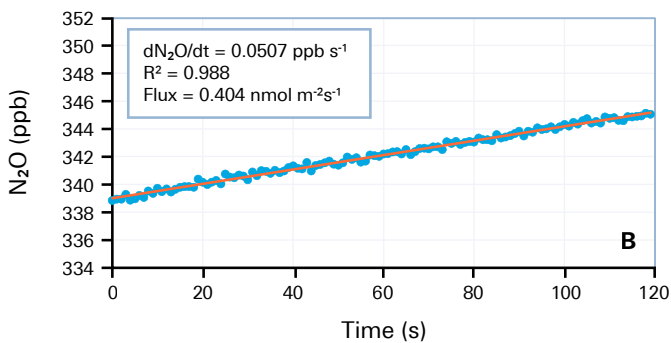
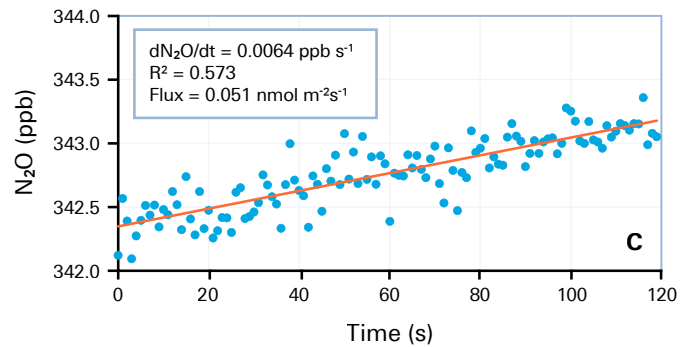
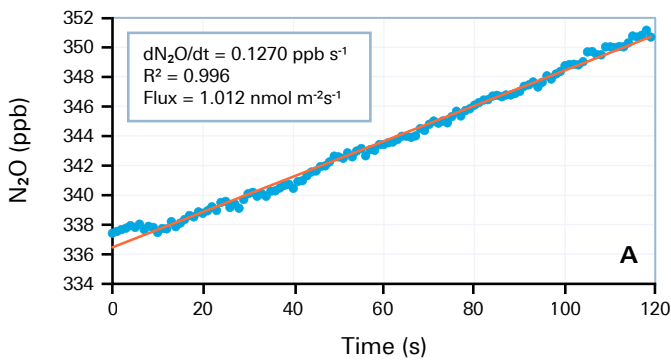
**Figure 7. Measurements of N<sub>2</sub>O flux from soils over a 14-month time period. Measured by the LI-7820 N<sub>2</sub>O/H<sub>2</sub>O Trace Gas Analyzer and an LI-8100A Automated Soil CO<sub>2</sub> Flux System.** Measurements were conducted over an urban lawn in Lincoln, NE, USA, and shows natural variations of N<sub>2</sub>O fluxes detected by the LI-7820. Results from Xu, et al., 2020.<sup>2</sup>

2. Xu., Liukang, Minish, K., Trutna, D. (2020). How do soil temperature and moisture regulate N<sub>2</sub>O flux from an urban lawn? Exhibited at AGU Annual Meeting 2020, December 1 - December 17, 2020.

## Applications

The LI-7820 is ideal for soil gas exchange measurements and general-purpose monitoring. It easily connects to the Smart Chamber or LI-8250 Multiplexer for survey or long-term soil N<sub>2</sub>O flux measurements.

- Soil gas flux measurements
- Atmospheric monitoring
- Large area emissions monitoring
- Animal agriculture N<sub>2</sub>O flux measurements
- Urban emissions monitoring
- Mobile emissions monitoring
- N<sub>2</sub>O measurements in sensor networks



**Figure 8. Soil N<sub>2</sub>O flux measurements with the LI-7820.** The LI-7820 precision allows fluxes to be resolved within 2 minutes, for both high fluxes (linear regression coefficients higher than 0.9 when N<sub>2</sub>O flux was higher than 0.1 nmol m<sup>-2</sup>s<sup>-1</sup>, figures A and B), as well as when fluxes from natural emissions occur that can be extremely low. The LI-7820 is capable of measuring flux rates as low as 0.05 nmol m<sup>-2</sup>s<sup>-1</sup> in 2 minutes under these conditions (C).

Learn more about using the LI-7820 with the Smart Chamber or LI-8250 Multiplexer at [www.licor.com/soil](http://www.licor.com/soil)



## Specifications

### N<sub>2</sub>O Measurements

**Response Time (T<sub>10</sub>-T<sub>90</sub>):** ≤ 2 seconds from 0 to 330 ppb

**Range:** 0 to 100 ppb

**Precision (1σ):**

0.40 ppb at 330 ppb with 1 second averaging

0.20 ppb at 330 ppb with 5 second averaging

**Maximum Drift:** < 1 ppb per 24-hour period

### H<sub>2</sub>O Measurements

**Range:** 0 to 60,000 ppm

**Precision (1σ):**

45 ppm at 10,000 ppm with 1 second averaging

20 ppm at 10,000 ppm with 5 second averaging

*Specifications subject to change without notice*

# General specifications

These general specifications apply to all analyzers. See individual analyzers for measurement specifications.

**Measurement Technique:** OF-CEAS (Optical Feedback-Cavity Enhanced Absorption Spectroscopy)

**Measurement Rate:** 1 sample per second (1 Hz)

**Optical Cavity Volume:** 6.41 cm<sup>3</sup>

**Flow Rate:** 250 sccm nominally; 70 sccm with reduced flow rate kit

**Total Weight:** 10.5 kg (including batteries)

**Case Dimensions:** 51 cm x 33 cm x 18 cm (L x W x H)

**Operating Temperature Range:** -25 °C to 45 °C (without solar load, under normal operating conditions)

**Operating Humidity Range:** 0 to 85% RH (non-condensing, without solar load, under normal operating conditions)

**Sample Line Humidity Range:** 0 to 99.9% non-condensing

**Operating Pressure Range:** 70 to 110 kPa

**Connectivity:** Ethernet, Wi-Fi (not available in some countries)

**Wi-Fi Compatibility:** 2.4 GHz, 802.11 a/b/g/n/ac

## Power Consumption:

**Steady State Operation:** 22 W at 25 °C without batteries charging

**Warm up:** Up to 65 W without batteries charging; up to 100 W with batteries charging

**Off:** Up to 2.3 W when powered from pins 3 and 4 without batteries charging; up to 0.2 W when powered from pins 1 and 5 without batteries charging

## Power Supply Requirements

**Pins 1 and 5 (24 VDC Input):** Minimum 6 A at 24 V

**Pins 3 and 4 (10.5 to 33 VDC Input):** Minimum 14 A at 10.5 VDC; 6 A at 24 VDC

**Power Supply:** Universal Power Adapter (Input: 100 to 240 VAC, 50-60 Hz; Output: 24 VDC)

**Battery Life:** 8 hours typical with 2 batteries

**Pollution Degree:** 2

**Over-voltage Category:** II

**Class 1 Laser Product**

*Specifications subject to change without notice*



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The LI-COR board of directors would like to take this opportunity to return thanks to God for His merciful providence in allowing LI-COR to develop and commercialize products, through the collective effort of dedicated employees, that enable the examination of the wonders of His works.

"Trust in the LORD with all your heart and do not lean on your own understanding. In all your ways acknowledge Him, and He will make your paths straight."

— Proverbs 3:5,6

ISO 9001:2015 certified

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