

LAS 5000 EXPLORER: ULTRALIGHT GAS ANALYZER FOR ENVIRONMENTAL APPLICATIONS

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ABSTRACT

The LAS 5000 Explorer is an advanced gas analyzer designed for high-precision, real-time environmental monitoring of methane (CH_4), carbon dioxide (CO_2), and water vapor (H_2O). Developed to overcome the limitations of conventional gas detection technologies, the system combines high sensitivity, rapid response, and operational flexibility in a compact, lightweight form factor suitable for both ground-based and aerial deployment. It leverages Advanced Detection Laser Absorption Spectroscopy (ADLAS) with dual interband cascade laser (ICL) architecture, enabling selective, simultaneous multi-gas detection with detection limits in the ppb range for methane and sub-ppm for carbon dioxide. Enhanced by advanced signal processing, optimized optics, and high-speed electronics, the analyzer delivers robust performance under dynamic field conditions. The LAS 5000 demonstrate low measurement noise and high stability during airborne operations, confirming its suitability for site-wide emissions monitoring and leak detection. The system supports a wide range of applications, including regulatory compliance, environmental assessment, and industrial emissions quantification, representing a scalable solution for next-generation greenhouse gas monitoring.

INTRODUCTION

Environmental monitoring has become a central requirement for industrial operations, driven by increasingly stringent regulations and global efforts to mitigate climate change. Among greenhouse gases, methane (CH_4) and carbon dioxide (CO_2) are of particular concern due to their significant contributions to atmospheric warming and their impact on environmental health.

Accurate detection and quantification of these gases demand measurement systems that combine high precision with the ability to operate reliably in dynamic and complex environments. Conventional gas analyzers are often constrained by their size, slow response times, or reliance on laboratory-based sampling, limiting their effectiveness in real-world field conditions.

The LAS 5000 Explorer has been developed to overcome these limitations by delivering in-situ, real-time gas measurements with high sensitivity and rapid response. The system simultaneously detects methane (CH_4), carbon dioxide (CO_2), and water vapor (H_2O), the latter enabling environmental compensation and enhanced measurement accuracy.

A defining feature of the system is its dual-laser architecture, which enables selective and simultaneous multi-gas detection. Combined with its lightweight and compact design, the analyzer can be deployed across a wide range of platforms, including mobile and aerial systems, significantly expanding the scope and efficiency of environmental monitoring.



FIGURE 1. LAS 5000 Explorer



FIGURE 2. LAS 5000 Explorer mounted on a DJI M350 Drone

LIMITATIONS OF EXISTING TECHNOLOGIES

Conventional gas detection technologies, while widely used, exhibit several limitations that restrict their effectiveness in modern monitoring applications.

Catalytic sensors, although cost-effective, lack selectivity and are prone to cross-sensitivity. Gas chromatography systems offer high analytical accuracy but require complex sample preparation, skilled operators, and laboratory conditions, making them unsuitable for real-time field deployment.

Infrared-based analyzers are more adaptable to field use but often suffer from limited resolution and slower response times. Advanced techniques such as mass spectrometry provide excellent performance but are associated with high capital costs, operational complexity, and limited portability.

Moreover, many traditional systems are restricted to point-source measurements, capturing emissions only at specific locations. This limits their ability to detect diffuse or distributed sources and prevents comprehensive, site-level assessment.

These constraints highlight the need for a new generation of gas analyzers capable of combining accuracy, speed, and operational flexibility, capabilities embodied by the LAS 5000 Explorer.

TECHNOLOGY OVERVIEW: ADLAS

The LAS 5000 Explorer is based on Advanced Detection Laser Absorption Spectroscopy (ADLAS), a highly sensitive technique that detects gases through the interaction of laser light with molecular absorption features.

Each gas absorbs light at specific wavelengths characteristic of its molecular structure. By tuning the laser to these wavelengths, both the presence and concentration of the target gas can be determined with high precision.

The ADLAS approach enhances this principle through several key innovations:

- Interband Cascade Laser (ICL) technology: Operating in the mid-infrared region, where gas absorption is strongest, enabling higher sensitivity, improved selectivity, and detection limits in the parts-per-billion (ppb) range.
- Advanced signal processing: Proprietary algorithms reduce noise, compensate for environmental variability, and significantly improve the signal-to-noise ratio.
- High-speed electronics: Supporting rapid data acquisition (up to 24 measurements per second / 24Hz) with excellent long-term stability.
- Optimized optical design: Maximizing interaction between the laser beam and the gas sample to enhance sensitivity and measurement accuracy.

Through this integration, the LAS 5000 Explorer achieves ultra-high resolution, rapid response, and robust performance, even under challenging field conditions.

MULTI-PLATFORM DEPLOYMENT

A key strength of the LAS 5000 Explorer lies in its flexibility across multiple deployment platforms, enabling both localized and large-scale emissions monitoring.

At the source level, the analyzer can be deployed in close proximity to emission points using ground vehicles, portable handheld configurations, or robotic systems. This allows precise leak detection and quantification directly at the equipment level, enabling rapid maintenance and mitigation.

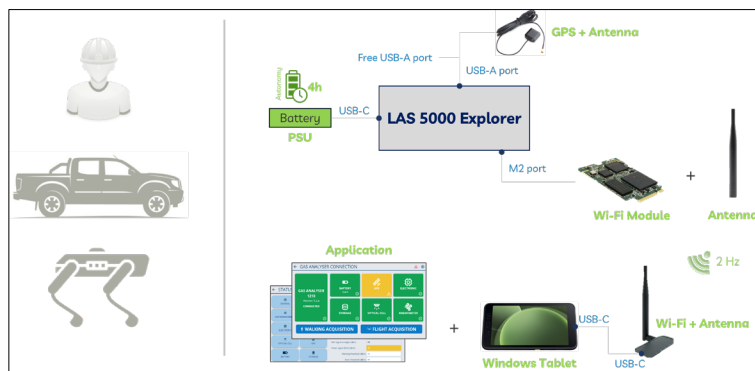


FIGURE 3. LAS 5000 Explorer - Source Level Configuration

At the site level, integration with aerial platforms such as drones enables coverage of large industrial areas, detection of emission plumes, and quantification of total site emissions.

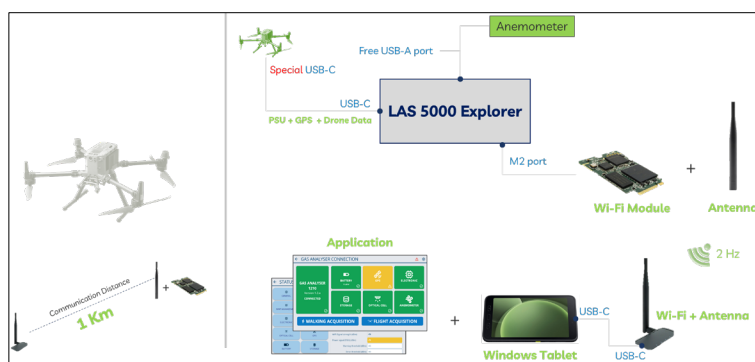


FIGURE 4. LAS 5000 Explorer - Site Level Configuration

This dual capability bridges the gap between localized measurements and full-site assessments, providing a comprehensive monitoring solution. It also supports a range of applications, including regulatory compliance verification, independent third-party validation, and environmental impact assessments.

QUALITY CONTROL AND PERFORMANCE

The performance of the LAS 5000 Explorer has been validated through controlled testing, demonstrating high accuracy and reliability for both methane and carbon dioxide measurements.

For methane (CH₄), the system achieves detection limits below 5 ppb, with a coefficient of determination (R²) close to 1, indicating excellent linearity between measured and reference concentrations.

For carbon dioxide (CO₂), detection limits are below 0.2 ppm, with similarly strong linearity and measurement consistency.

These results confirm high precision across a wide concentration range, strong repeatability, and minimal measurement bias, key requirements for regulatory and scientific applications.

TECHNICAL CHARACTERISTICS

Parameter	Value
CH ₄ Range	0–250 ppm
CO ₂ Range	0–2000 ppm
CH ₄ Resolution	<10 ppb
CO ₂ Resolution	<0.5 ppm
Response Time	42 ms
Measurement Frequency	24 Hz
Weight	1.9 kg

TABLE 1. Technical Characteristics

FIELD TRIAL RESULTS TO DETERMINE THE NOISE LEVEL

Field trials were conducted to evaluate system performance, especially noise level, under real operational conditions, including airborne deployment.

In one scenario, methane measurement noise was approximately 6.24 ppb and carbon dioxide noise was approximately 0.43 ppm, with measurements conducted at an altitude of 246 Ft. and a drone speed of 22 mph.

Under optimized conditions, methane noise decreased to 2.38 ppb and carbon dioxide noise to 0.20 ppm.

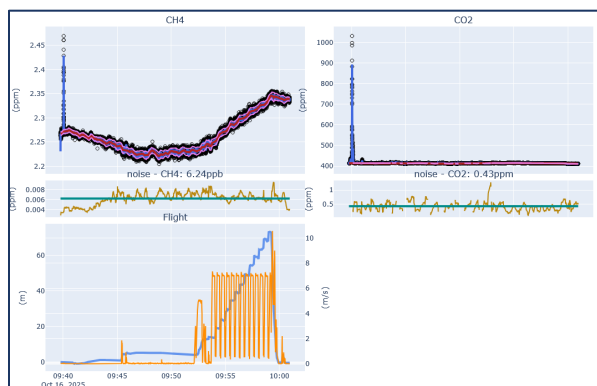


FIGURE 5. LAS 5000 Explorer - Field trials measurements – Set 1

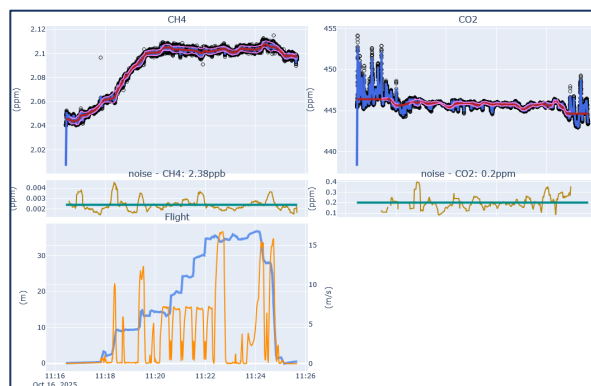


FIGURE 6. LAS 5000 Explorer - Field trials measurements – Set 2

These results, at 24 Hz, demonstrate that the analyzer maintains high sensitivity and stability in dynamic environments, where motion, altitude, and atmospheric variability can influence measurements. The low noise levels confirm their suitability for high-precision environmental monitoring and airborne emissions detection.

CONCLUSION

The LAS 5000 Explorer represents a significant advancement in gas analysis technology, combining high-performance spectroscopy with operational flexibility and mobility.

By leveraging ADLAS technology, the system delivers ultra-sensitive detection, rapid response times, and high measurement accuracy. Its multi-platform capability, spanning ground-based and aerial deployments, enables comprehensive monitoring strategies that are difficult to achieve with conventional technologies.

As environmental regulations continue to tighten and demand more accurate emissions reporting, the LAS 5000 Explorer provides a robust, scalable solution for industries seeking to monitor, quantify, and reduce their environmental impact.