RedWave Labs

Universal Platform

For Absorption Spectroscopy

2025

Overview

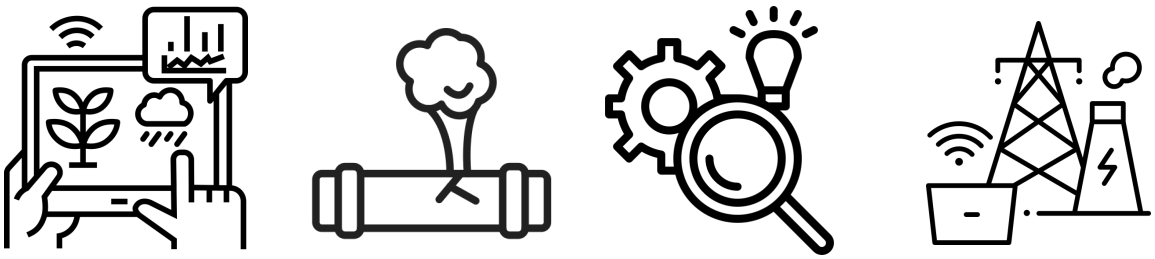
The Universal platform covers all the control electronics requirements for spectroscopic instruments, including power, data processing, signal acquisition and control, data storage and external communications.

For demonstrating purposes, methane was selected as the target gas due to its significance in various industries and environmental applications. As a primary component of natural gas, methane is widely used and transported, making its detection crucial for ensuring safety and efficiency. Moreover, methane is a potent greenhouse gas, contributing to global warming, and is often a key focus for environmental monitoring. Its relatively simple molecular structure and distinctive absorption characteristics make it an ideal candidate for demonstrating advanced gas sensing technologies.

This demonstration was part of the research carried out in the Q3MD project backed by funding from Innovate UK [10032014]. The custom TO packaging was carried out by Bay Photonics and QLM assisted with gas absorption modelling. We thank them for their contributions

Possible Applications:

1. **Environmental Monitoring:** Detecting methane emissions in controlled environments or industrial settings, contributing to efforts to reduce greenhouse gas emissions.
2. **Industrial Leak Detection:** Identifying leaks in pipelines or equipment where methane gas is used or stored.
3. **Research & Development:** A tool for developing advanced methane sensors and improving gas detection technologies.
4. **Energy Sector:** Monitoring methane levels in natural gas production or storage facilities for safety and efficiency improvements.



Technology Highlights & Applications

Redwave Labs' methane detection demonstrator is designed for **showcasing purposes**, which is why it measures methane in a **controlled cell with** a **high gas concentration** rather than in the atmosphere. This setup allows for easy observation and demonstration of the sensor's capabilities against the likes of existing sensors such as those using electroluminescence or chemiluminescence. Gas analysis by absorption spectroscopy has continuous, fast response times, no oxygen dependence, is non-destructive and resistance to many detrimental environmental conditions you might see in existing sensing techniques.

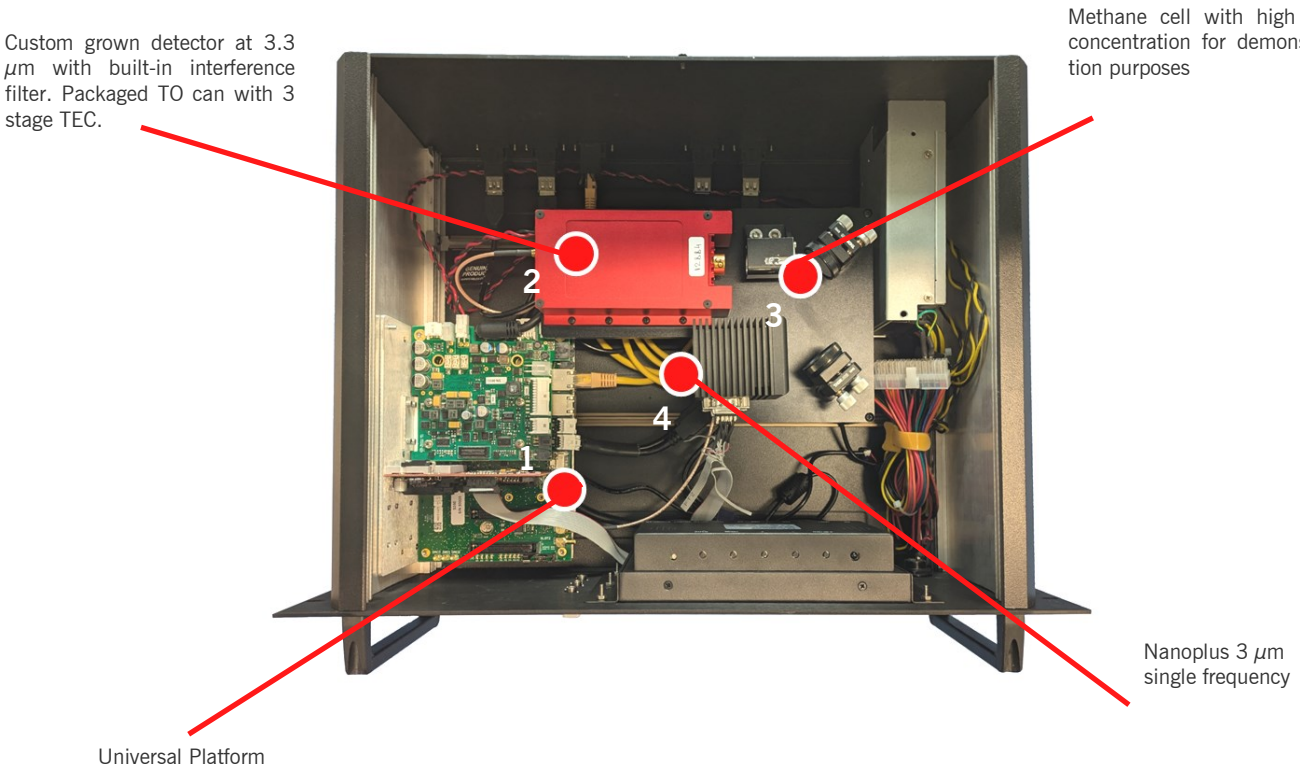
This methane sensing demonstrator operates by utilizing a single-frequency **3 μm laser** (https://nanoplus.com/products/distributed-feedback-laser/3240nm3270nm) to emit light that interacts with methane molecules. The **Nanoplus laser** is utilized for its high spectral purity, narrow linewidth, and excellent wavelength stability, making it ideal for precise gas sensing applications. Its ability to maintain stable single-mode operation ensures accurate detection of methane absorption lines while minimizing interference from other gases.

The **custom-grown detector at 3.3 μm**, equipped with an interference filter and a three-stage thermoelectric cooler (TEC), precisely measures the absorption of the laser light by methane. The system's **Universal Platform**, featuring an FPGA-driven high-speed ADC/DAC and an integrated pressure controller, ensures accurate data acquisition and real-time processing. Depending on the specific gas to be measured, the **controller can be swapped out** for a suitable one tailored to the exact laser and wavelength needed for the target gas detection.

The entire system runs on **Linux OS** with extensive libraries, enabling simple development of a **custom user interface**. Using our libraries, it's easy to integrate the system with OEM instruments, allowing for seamless control, monitoring, and analysis in real gas analysing applications.

Step-by-Step:

1. **Laser Emission:** The Nanoplus 3 μm laser emits a stable, narrow-band laser beam.
2. **Methane Interaction:** The laser beam passes through the methane cell, where it interacts with methane molecules. Some of the light is absorbed by the methane.
3. **Detection:** The custom-grown detector at 3.3 μm measures the absorption of the laser light. The detector is equipped with an interference filter to ensure only relevant wavelengths are detected, and a thermoelectric cooler (TEC) maintains a stable temperature for optimal performance.
4. **Data Acquisition:** The signal is processed by the FPGA-driven platform, which includes high-speed 16-bit DACs and 18-bit ADCs, as well as a 24-bit ADC for high-resolution measurement of temperature and pressure.
5. **Real-time Processing:** The processed data is used to calculate the methane concentration in the cell. The integrated pressure controller ensures stable environmental conditions, and all data is logged for further analysis.
6. **Display and Analysis:** The entire system is controlled by Linux OS, and users can easily create a custom user interface using our extensive libraries. This allows for real-time data visualization, control, and analysis, and can be integrated into real gas analyzer systems for various applications.



Pic. 1 Demonstrator 1. Scheme

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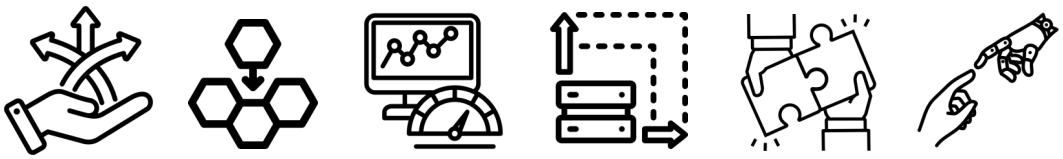
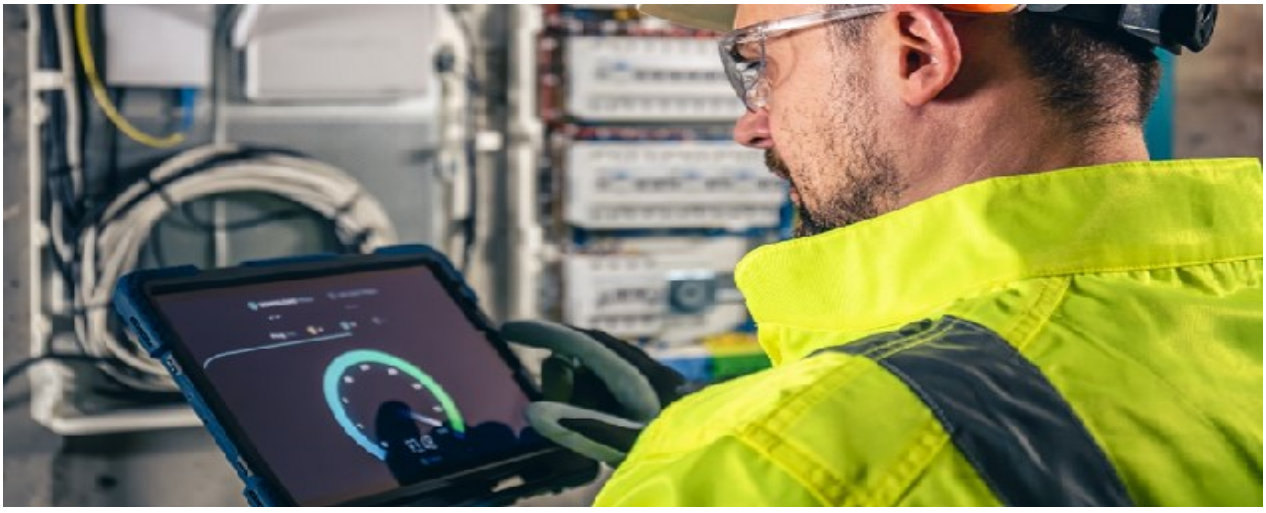
Why Redwave Labs' Universal Platform is the best solution for building gas analyzers:

1. **Versatility**: Supports various laser configurations for different gases, making it adaptable to a wide range of applications. RedWave's family of low-noise, precise laser drivers can support various laser architectures including DFB and QCL.
2. **Modular Design**: Easily customizable to meet specific needs by swapping components like laser controllers or measurement systems.
3. **High Performance**: Equipped with high-speed DACs, ADCs, and precise pressure control for accurate and reliable gas detection.
4. **Scalability**: Can be easily expanded or modified to accommodate new technologies or gases as needs evolve.
5. **Quick Integration**: The Linux OS and pre-integrated components reduce development time, allowing faster deployment of gas analyzers.
6. **Future-Proof**: Offers flexibility for future upgrades, ensuring long-term viability and adaptability in the field of gas sensing.



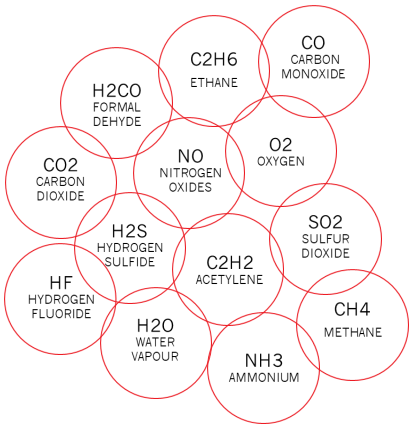


Link: https://gtr.ukri.org/projects?ref=10032014

Nanoplus

Why Nanoplus laser is best choice for gas sensing:

1. **High Spectral Purity**: Provides clean, precise wavelengths with minimal spectral noise, ideal for accurate gas absorption measurements.
2. **Narrow Linewidth**: Enables precise detection of narrow gas absorption lines, improving sensitivity and accuracy.
3. **Excellent Wavelength Stability**: Ensures consistent performance over time, reducing the risk of drift and ensuring reliable readings.
4. **Stable Single-Mode Operation**: Minimizes interference from other gases, ensuring accurate detection of target gases.
5. **Customizable for Different Gases**: Available in a range of wavelengths, making them suitable for detecting various gases by simply changing the laser.
6. **Proven Reliability**: Trusted in a wide range of industrial and environmental applications, ensuring high-quality performance in demanding conditions.



Link: https://nanoplus.com/applications/applications-by-gas

Contact Us

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