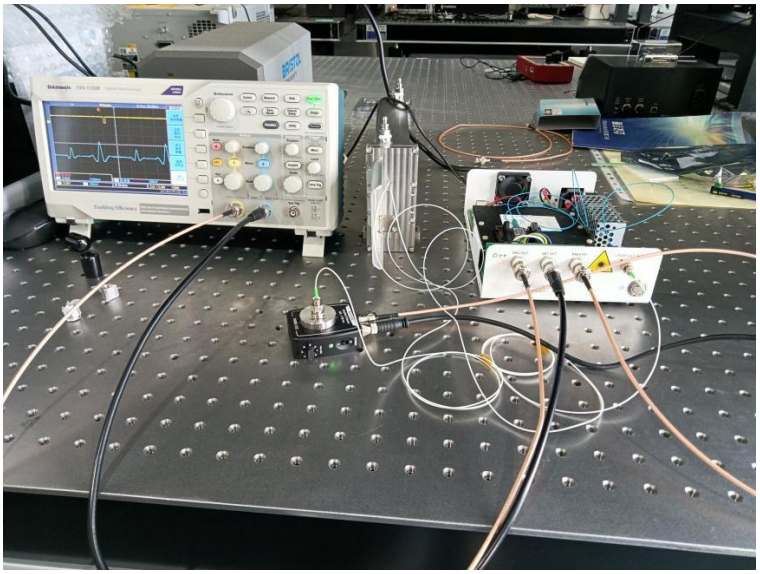
Near-infrared TDLAS (sulfur dioxide) C2H2 ppb level concentration analysis system



Product Description

TDLAS (Tunable Diode Laser Absorption Spectroscopy) is a new gas detection method developed on the basis of combining diode laser with long optical path absorption cell by modulating the wavelength of laser through the characteristic absorption area of the gas to be measured. The spectrum of the semiconductor laser light source used in TDLAS technology is much smaller than the broadening of the gas absorption spectrum, and a single-line absorption spectrum is obtained. Therefore, TDLAS technology is

a high-resolution absorption spectrum technology. Acetylene: C2H2, commonly known as wind coal or carbide gas, is the smallest member of the alkyne compounds and is mainly used for industrial purposes, especially in welding metals. Acetylene is a colorless, highly flammable gas at room temperature. Pure acetylene is odorless, but industrial acetylene has a garlic smell due to impurities such as hydrogen sulfide and phosphine.

- ## Product features

Tunable laser; All-fiber gas absorption cell; ppb-level detection accuracy; Integrated lock-in amplification and data acquisition; FC/APC fiber optic interface

- ## Part Number

MP-TDLAS-1520-C2H2-NIR

- ## Application area

Industrial acetylene leakage monitoring | Power transformer fault gas analysis | Petrochemical process control | Environmental trace gas detection | Research-grade spectroscopy experiments

- ## Core parameters

Output Power	Line Width
20mW	＜2MHZ

- **General Parameters**

Parameter

Theoretical basis:

1. Beer-Lambert law

When a laser beam passes through the measured gas with a concentration of C, when the wavelength of the laser is the same as the center frequency of a certain absorption spectrum line of the measured gas, the gas molecules will absorb photons and transition to a high energy level, which is manifested as the attenuation of the laser light intensity in the gas absorption band.

2. Wavelength modulation technology

A) Tuning characteristics of lasers

DFB lasers are widely used in gas detection because of their good monochromaticity, narrow linewidth and frequency tuning characteristics. DFB lasers can avoid cross-interference from other background gases and make the detection system have good measurement accuracy.

B) Harmonic detection theory

By adding a high-frequency sinusoidal voltage signal to the laser drive voltage, the current is changed, and the output frequency also changes according to the sinusoidal law. By adding a sawtooth voltage to the laser drive, the output wavelength is scanned on both sides of the gas absorption peak, and the

harmonic signal is modulated and demodulated using a phase-locked amplifier to measure the gas concentration.

3. Harmonic detection theory

When performing gas detection, the selection of absorption spectrum is very critical, and the following aspects should be considered

(1) The gas should have a strong absorption peak at the selected spectrum,

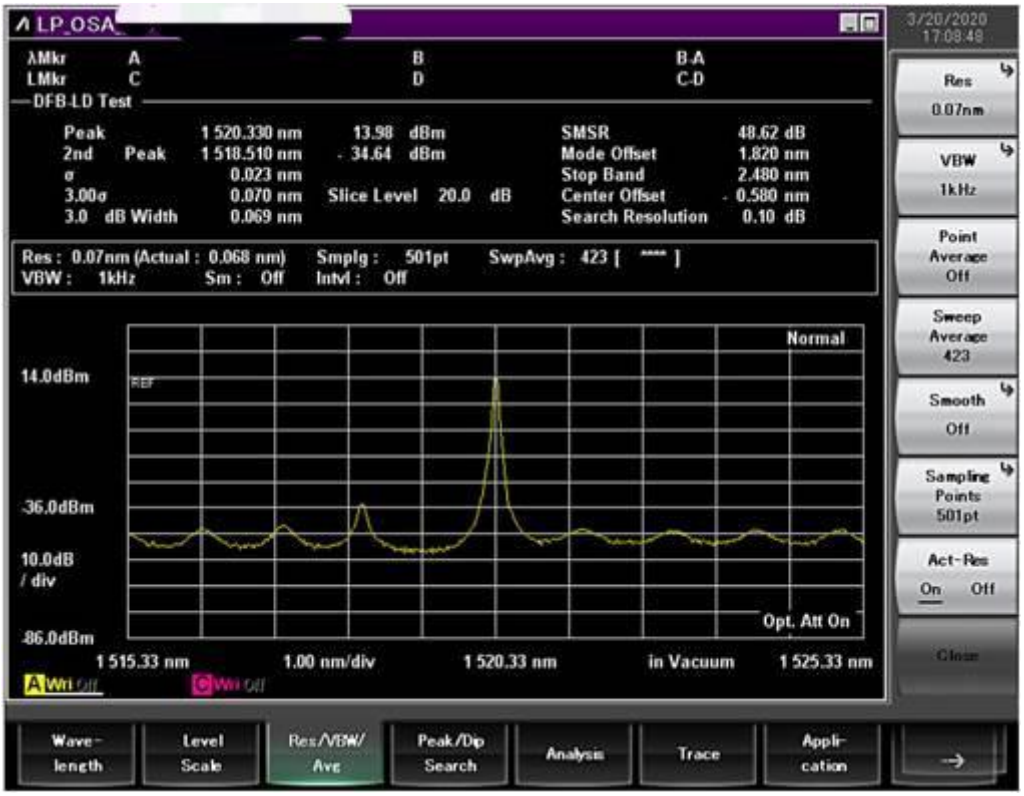
(2) The laser light source technology corresponding to the spectrum wavelength should be relatively mature

(3) There should be no interference from background gas absorption at the selected absorption spectrum, or the absorption is relatively weak and can be ignored

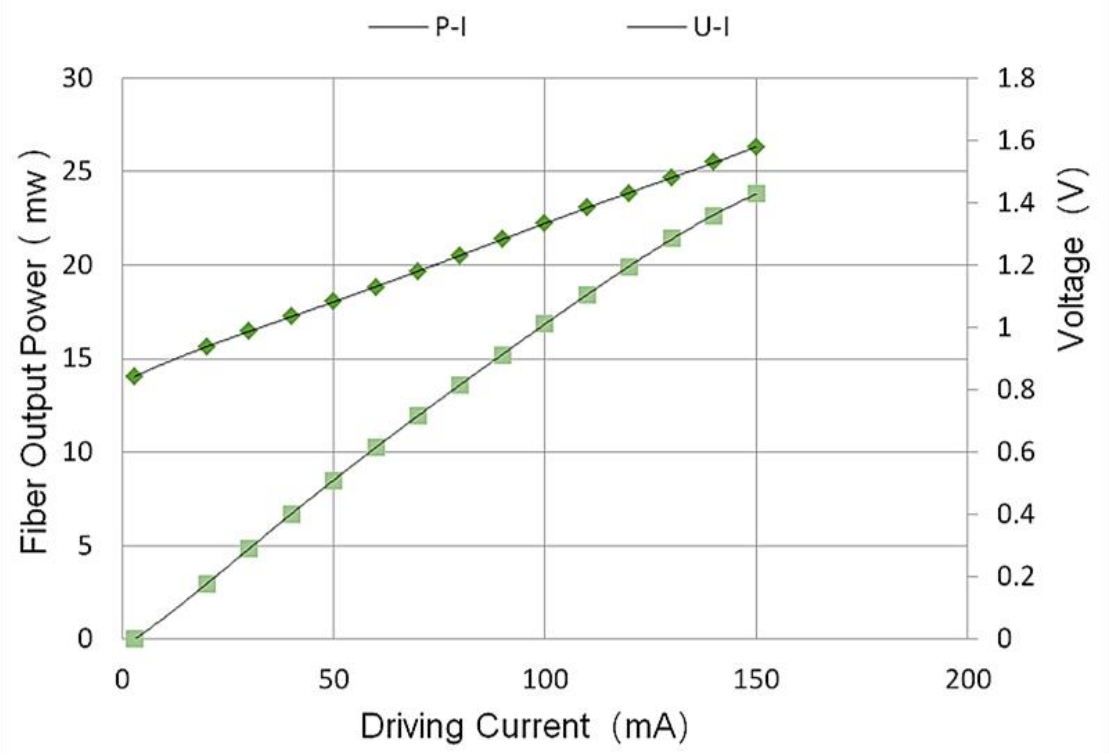
Experimental instruments

1. 1520nm Laser

Features: good wavelength stability, narrow line width, single longitudinal mode tunable, 14-pin package



spectral



Power Curve

2. TDLADS laser gas detection integrated control box

This product is a control module for tunable semiconductor laser absorption spectroscopy technology (tunable semiconductor laser absorption spectroscopy technology (TDLAS)). The main functions include: generating digital laser drive with superposition of sine wave and triangle wave, adjustable gain, adjustable gain amplifier, 1f/2f digital lock-in amplifier, analog output temperature control unit. The operating parameters and waveforms can be controlled and read by the computer.

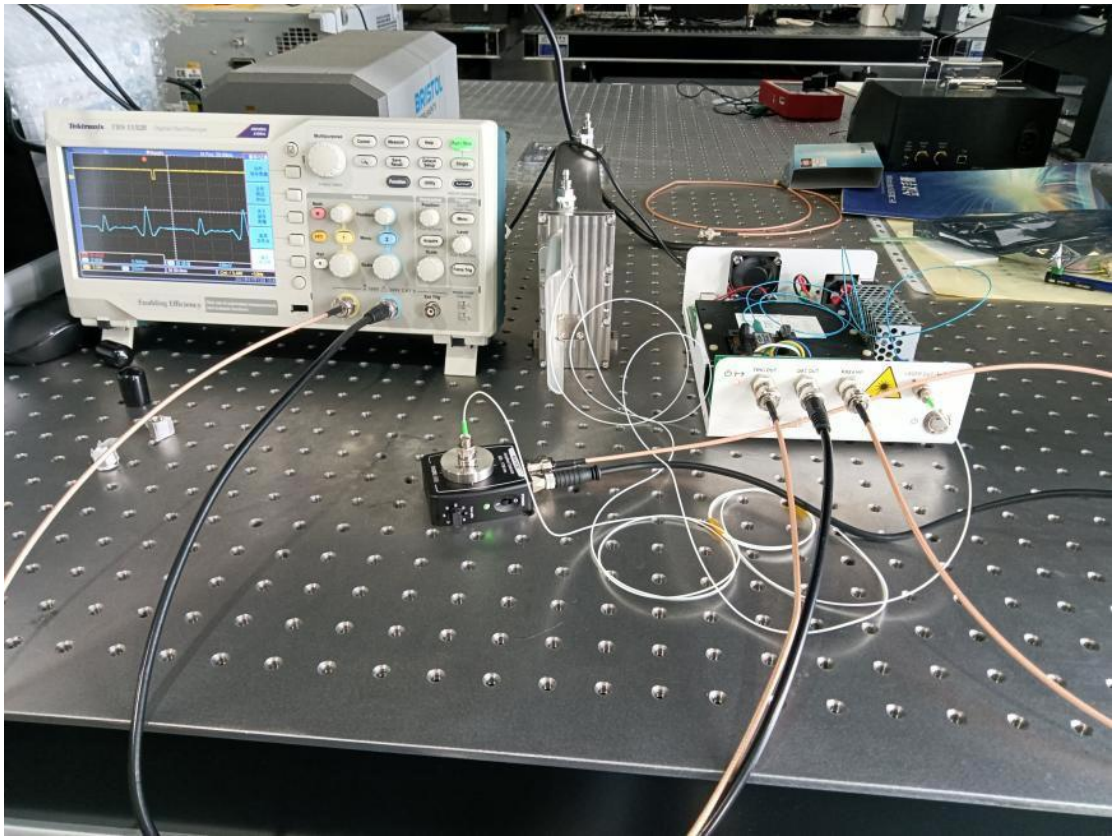
3. 40m long optical path gas absorption cell

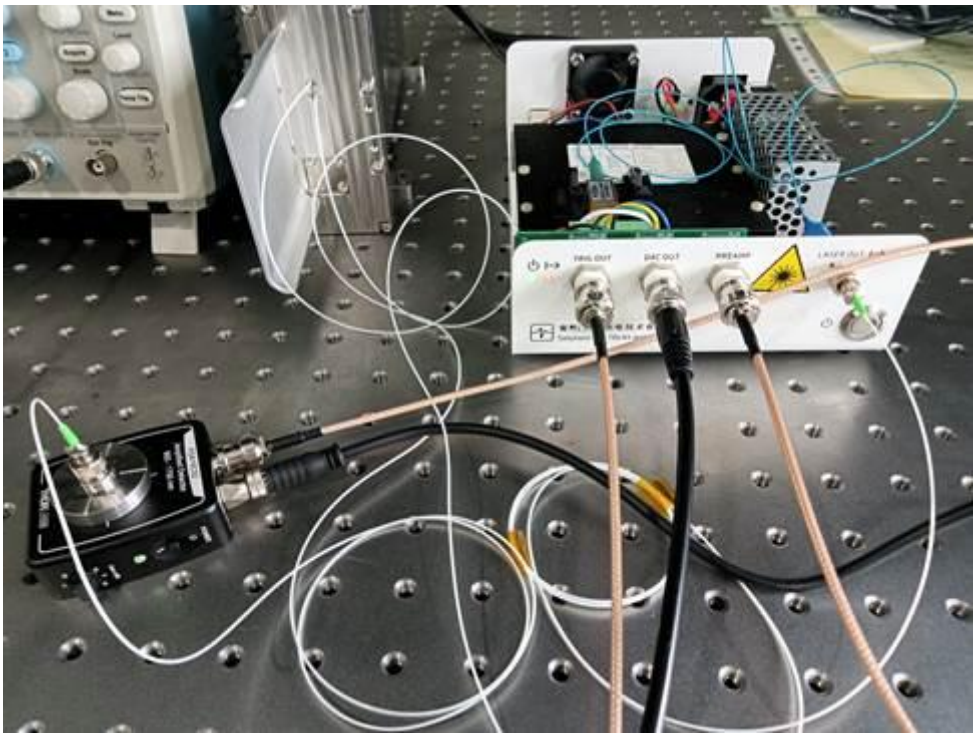
Idealphotonics' 40-meter long optical path gas absorption cell adopts an all-fiber structure design. The fiber input and fiber output units are used for spectral analysis and detection of various gases. The optical structure of the gas absorption cell adopts an independent technically approved design, with excellent optical stability, auxiliary and high-stability optical packaging structure, mainly composed of gas cavity, reflector, standard fiber connector, gas inlet and outlet, shockproof seat, etc. The unique suspended optical path design has excellent vibration and temperature stability, can work stably in a variety of complex environments, and is very suitable for online real-time detection of various gases. The system has low noise and can be used for trace gas analysis.

4. Detector

InGaAs detector, amplified, adjustable gain, 900 - 1700 nm, bandwidth 13 MHz

Experimental testing





Operation steps:

1. Connect the TDLAS control box to the power supply and USB cable;

2. Connect one end of the optical fiber of the 40-meter long optical path gas absorption cell to the output end of the laser, and the other end of the optical fiber to the input interface of the detector;

3. Use a BNC to BNC cable to connect the detector and the PERAMP preamplifier end of the TDLAS control box;

4. Use a BNC to BNC cable to connect the TRIG OUT of the TDLAS control box and the channel 1 of the oscilloscope as a trigger;

5. Use a BNC to BNC cable to connect the DAC OUT of the TDLAS control box and the channel 2 of the oscilloscope as an output;

6. Turn on the laser and turn on the detector switch;

7. Introduce an appropriate amount of 2ppm C_2H_2 into the gas chamber, adjust the software parameters, and observe the second harmonic signal amplitude information on the oscilloscope.

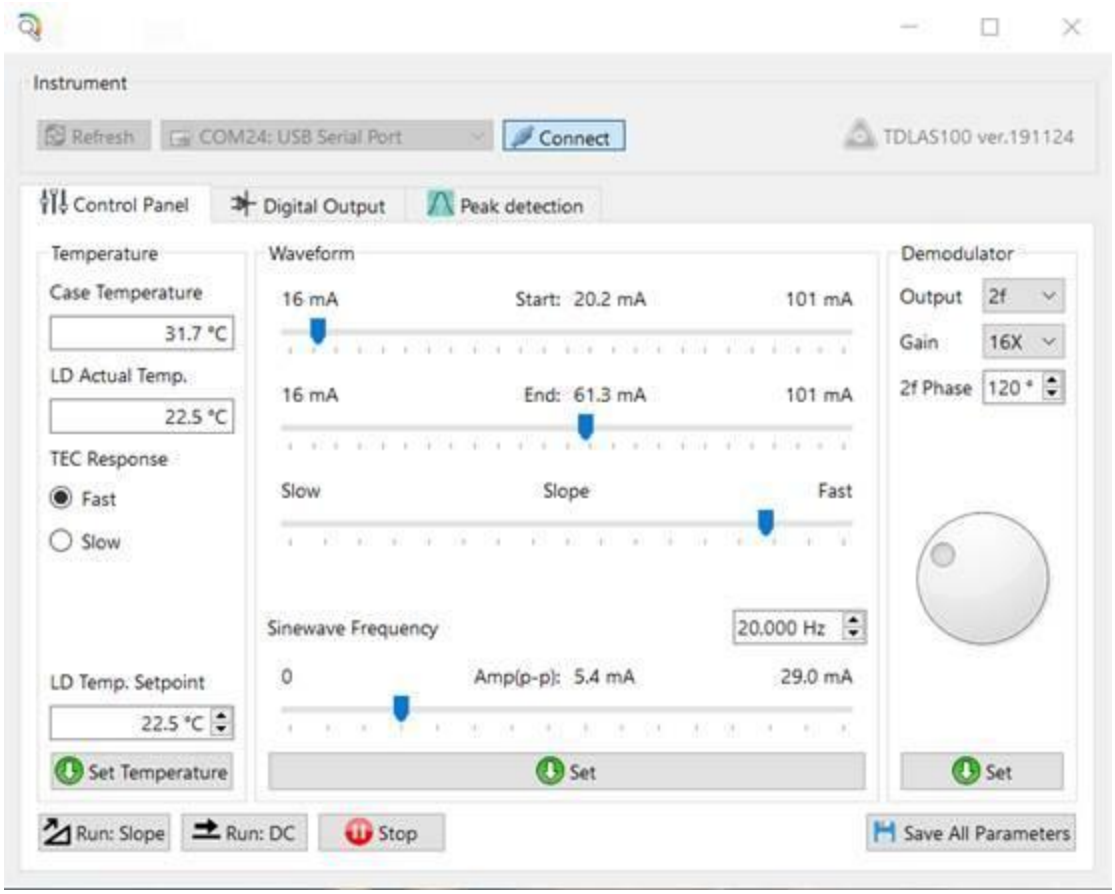
Process Analysis:

The control software on the computer is used to adjust the current and temperature to tune the wavelength, so that the laser can scan a certain wavelength range and the output wavelength covers the absorption peak of the gas. The phase-locked amplifier provides a high-frequency sinusoidal modulation signal, so that the laser output frequency is sinusoidally modulated. The light emitted by the laser passes through the gas absorption cell and enters the preamplifier circuit at the PREAMP end through the detector. It is then modulated and demodulated by the phase-locked amplifier and sent to the oscilloscope channel 2 through the DAC OUT analog output end to display the second harmonic signal. During the whole process, we adjusted various parameters in the software and observed the output waveform at the same time to optimize the output waveform.

A) Test results

1. The second harmonic waveform and modulation parameters are as follows:

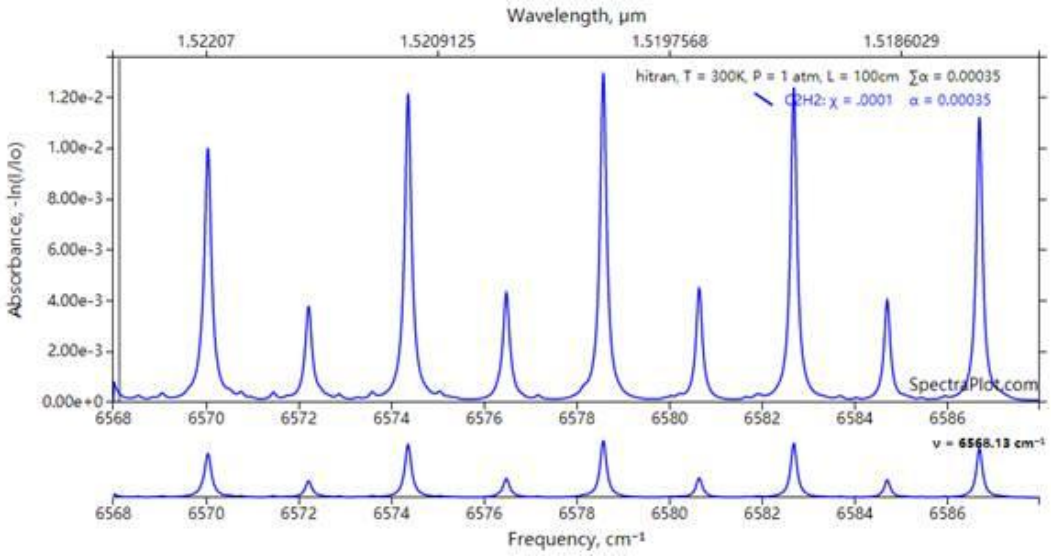
SecondHarmonic



Software modulation parameters

Verification analysis:

By querying the Hitran database, the absorption lines in the wave number range of 6568cm-1-6588cm-1 are as follows:



We compared the second harmonic amplitude information with the database and found that it was consistent with the database, thus verifying that it was C_2H_2 gas.

Experimental Conclusion

Through testing, we found that when the C_2H_2 concentration is 2ppm, the second harmonic amplitude can reach 512mV. This shows that our TDLAS analysis system has extremely high testing accuracy, which can reach the ppb level.

Ordering Information

Product model: TDLAS-1520-C_2H_2-NIR

Product name: Near infrared TDLAS C_2H_2 ppb level concentration analysis system

SN#	Name	Describe	Number
1	TDLAS integrated control host	The host includes laser drive, phase-locked amplifier, and data acquisition functions	1
2	1520nm DFB laser diode	2nm adjustable, output power 20mw, line width<2MHz, 14-pin butterfly package, compatible with controller	1
3	40m long optical path gas absorption cell	Optical path: 40m all-fiber, fiber in and fiber out, FC/APC connector	1
4	Detector	Indium gallium arsenide detector, with amplification, adjustable gain, 900 - 1700 nm, bandwidth 13 MHz	1
5	USB flash drive	Including operating software, product operation manual	1