

MEASURING TWO ANALYTES IN GAS

5100HD Dual Laser TDLAS Analyzer

INTRODUCTION

AMETEK offers an extractive analyzer based on Tunable Diode Laser Absorption Spectroscopy (TDLAS), with dual lasers and a single sample cell (also available with dual sample cell). Two separate lasers are installed in the instrument, sharing a common optical path through the sample, enabling it to measure spectra at two different wavelengths. The dual laser platform can measure any two combinations of water vapor, carbon dioxide (CO₂), oxygen, carbon monoxide, hydrogen sulfide and others in process or flue gas. The actual concentration levels that can be measured are application-dependent.

A key feature of this instrument is the use of sealed reference cells, which contain known amounts of analyte

gases, for referencing the emission wavelengths of the lasers. Essentially, the use of reference cells enables both the ability to line-lock the laser and to continuously verify the instrument performance. The analyzer is also configured for field calibration or validation and users can challenge the analyzer response with a certified blend of cylinder gas. Industrial applications of the 5100HD dual laser analyzer include combustion monitoring and trace-species monitoring in process gas, in general. The dual laser configuration is suitable for hazardous area locations worldwide.

FEATURES

Dual laser configuration

A schematic representation of the dual laser implementation is shown in Figure 1. In this example, the measurement of water vapor is performed with an 1854 nm DFB laser, and the CO₂ measurement is performed with a 2004 nm DFB laser. The outputs of both lasers are coupled into single-mode fibers, which, in turn, are connected to fiber-optic splitters. The splitters are used to divide the optical power for use in the sample and reference measurements, respectively.

The "sample" outputs from both splitters are combined in a fiber-optic coupler, enabling a common sample cell to be used for both analytes. Gradient refractive index (GRIN) lenses are used to collimate the output of the single-mode fibers and direct the resulting beams through the sample and reference cells. The sample and reference cells each contain InGaAs-photodiode detectors, which are connected to separate input channels of the electronics unit.

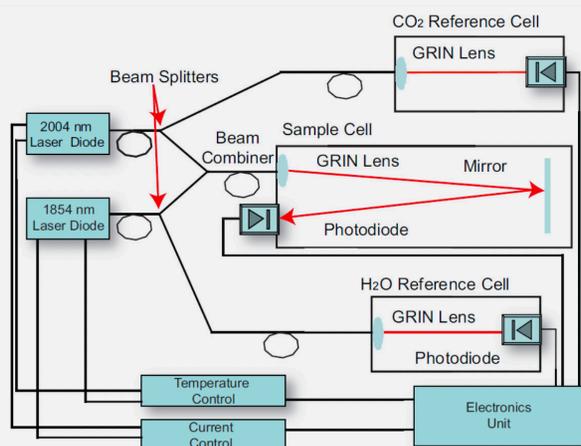


Figure 1. 5100HD schematic diagram

With this configuration, it is possible to make simultaneous measurements of unknown samples and known references. The reference information is used to lock the output wavelengths for both lasers.

The wavelength modulation spectroscopy (WMS) is implemented digitally to drive the tunable-DFB lasers. Further, signals produced by the detectors are digitized, prior to applying signal processing (e.g. phase-sensitive detection, averaging, etc.). Additionally, in contrast with the common practice of using second harmonic detection (2F) via an analog locking amplifier, the detection/demodulation in this instrument is performed at the laser-modulation frequency (i.e. "1F" detection). Using the 1F-detection scheme enables the instrument to normalize the spectra, without the need for a separate measurement of the laser power. Specifically, the magnitude of the power envelope of the laser output is contained in the spectra produced by 1F demodulation. After the 1F spectra are normalized, "2F" spectra are calculated from the digital data.

Built-in verification

Reference cells are used to lock the output wavelength of the laser diode. The sealed reference cells contain a known concentration of the analyte in a host gas, which has no absorbance in the spectral range of interest.

A block diagram wavelength-locking algorithm employed by the instrument is shown in Figure 2. Two nested levels of temperature control are employed to maintain the operation of the laser at the proper wavelength. The first level is a simpler PID control loop, which maintains the laser at a target temperature. In the second level, the outer control loop, the spectra of the analyte gases in the reference cells are monitored. Minor shifts in the observed peak positions are used as a feedback signal for the temperature set point of the inner control loop. Thus, the outer-control loop provides a fine adjustment for the inner-control loop.

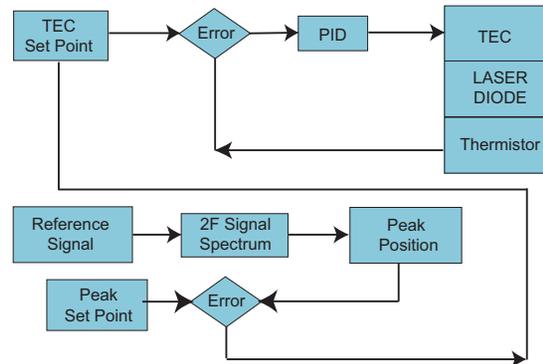


Figure 2. Laser wavelength-locking algorithm

SUMMARY

Two separate lasers, sharing a common optical path through the sample, enable simultaneous measurement of two separate analytes with the same analyzer. The digital signal-processing methods employed in this system allow the implementation of a multivariate calibration, to accurately measure two separate species with completely overlapped spectral responses. The dual laser configuration comes with built-in reference cells for performance verification and laser line locking functions for accurate and reliable performance. In the dual laser single cell configuration, two analytes can be measured simultaneously, resulting in significant cost savings.

SALES, SERVICE & MANUFACTURING

USA - Pennsylvania

150 Freeport Road
Pittsburgh PA 15238
Tel: +1 412 828 9040
Fax: +1 412 826 0399

USA - Delaware

455 Corporate Blvd.
Newark DE 19702
Tel: +1 302 456 4400
Fax: +1 302 456 4444

Canada - Alberta

2876 Sunridge Way NE
Calgary AB T1Y 7H9
Tel: +1 403 235 8400
Fax: +1 403 248 3550

WORLDWIDE SALES AND SERVICE LOCATIONS

USA

Tel: +1 713 466 4900
Fax: +1 713 849 1924

Brazil

Tel: +55 19 2107 4100

France

Tel: +33 1 30 68 89 20
Fax: +33 1 30 68 89 99

Germany

Tel: +49 2159 9136 0
Fax: +49 2159 9136 39

India

Tel: +91 80 6782 3200
Fax: +91 80 6780 3232

Singapore

Tel: +65 6484 2388
Fax: +65 6481 6588

China

Beijing
Tel: +86 10 8526 2111
Fax: +86 10 8526 2141
Chengdu
Tel: +86 28 8675 8111
Fax: +86 28 8675 8141
Shanghai
Tel: +86 21 5868 5111
Fax: +86 21 5866 0969



© 2019, by AMETEK, Inc. All rights reserved. Printed in the U.S.A. A-0266 Rev 8 (0219)
One of a family of innovative process analyzer solutions from AMETEK Process Instruments. Specifications subject to change without notice.



To find out more or request a quote visit our website

ametekpi.com