

LASERTRACETM

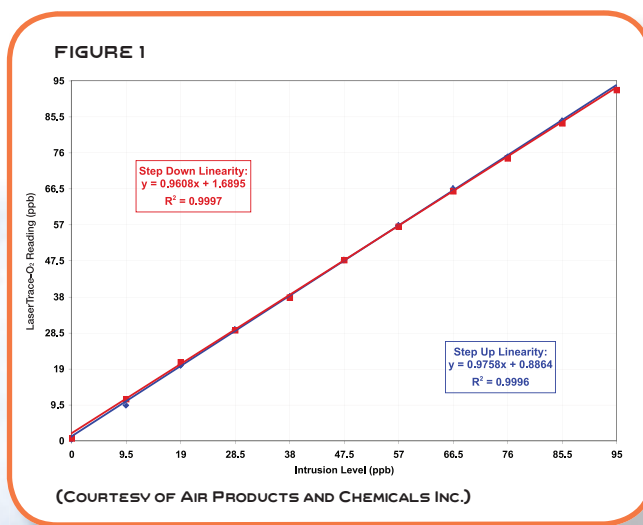


OXYGEN IN A NEW LIGHT

Electro-optic Trace Oxygen Analyzer for Ultra-High-Purity Gases

The standard for Cavity Ring-Down Spectroscopy, Tiger Optics raises the bar for oxygen detection in medical grade and ultra-high-purity gases. The LaserTrace O₂ is the world's first laser-based, trace oxygen analyzer, detecting parts-per-trillion (ppt) levels in ultra-high-purity gases. Based on our patented Continuous-Wave Cavity Ring-Down Spectroscopy (CRDS), the LaserTrace O₂ provides the same accuracy that makes the Tiger moisture analyzer a transfer standard at the world's leading national laboratories.

With its robust design, flexible software, and advanced sensing technology, the LaserTrace O₂ is the most versatile oxygen analyzer available. Designed by experienced instrument engineers, the LaserTrace O₂ addresses the stringent requirements of major semiconductor fabricators and their suppliers. A complete lab-in-a-box, it speeds throughput and reduces labor and operating costs by offering:



**LINEARITY PLOT OF FIELD
TEST STEP INTRUSION DATA**



- **Self-Verification:** The new standard for oxygen analysis, CRDS technology affords world-renowned accuracy and frees you from the need for dubious, time-consuming, and cumbersome zero/span calibrations. (Zeroing out an instrument with a drifting baseline can hide problems in the process or analyzer itself.) Since the signal generated relates directly to the oxygen concentration, there is no need for field calibration. In minutes and without going off-line, you can automatically verify your instrument's stability.
- **No more wet chemistry:** Measuring the absorption of light from compact and long-lasting continuous wave (CW) lasers, the LaserTrace O₂ does not employ toxic electrolytes. With no wet chemistry, there's no need to stabilize or to replenish your Tiger tool when you start up or go from point to point. It continues to monitor in real-time, without delay.
- **Minimal Maintenance:** The LaserTrace O₂ has no moving parts and a streamlined design that makes it wholly robust.
- **Multi-line monitoring with one unit:** One LaserTrace electronics module -- included with your first O₂ module -- controls up to four sample lines in an equivalent number of gases. Plus you can measure in a wide array of gases. (Please contact us regarding special applications.)
- **Multi-species monitoring with one unit:** Add up to four sensor modules for oxygen, moisture, methane, nitrous oxide, acetylene, ammonia, and more. (Separate devices for hydrogen detection are also available.) It's a space- and money-saving architecture that has already won acceptance at the world's leading semi fabs.
- **Elimination of oxygen shock:** No lost recovery time from a large upset. Your LaserTrace O₂ resumes operation the second the gas oxygen content is back in range, registering up to 2.5 parts-per-million (ppm).



PERFORMANCE IN A NEW LIGHT

Commercially available since 2001, Tiger's CRDS devices have transformed molecular analysis. Our CRDS-based tools provide speed of response and performance characteristics hitherto unavailable with conventional technology. Designed for both field and laboratory use, Tiger tools offer these unique advantages:

- **Quick response:** The LaserTrace O₂ provides response time at the "speed of light." In less than three minutes, you can register 90% of the actual change in oxygen levels.
- **Wide dynamic range:** The LaserTrace O₂ is highly linear, from 100 ppts to 2.5 ppms. Its wide range fully tracks excursions, yielding more knowledge and control of your process.
- **Rack-mount, portable, and modular configurations:** The LaserTrace O₂ fits into a standard 19" rack or cart and can be deployed up to 50 meters away from the LaserTrace electronics module. Built to sustain mechanical shocks, it is readily transportable.
- **Insensitivity to pressure and temperature changes:** While non-CRDS absorption spectroscopy must maintain the sample pressure with extreme accuracy for repeatable results, the Tiger tool requires no such effort.
- **No ambient effect:** Because the LaserTrace O₂ measures the time of light decay within the optical cell, the device is impervious to atmospheric conditions, unlike other laser-based techniques.

APPLICATIONS IN A NEW LIGHT

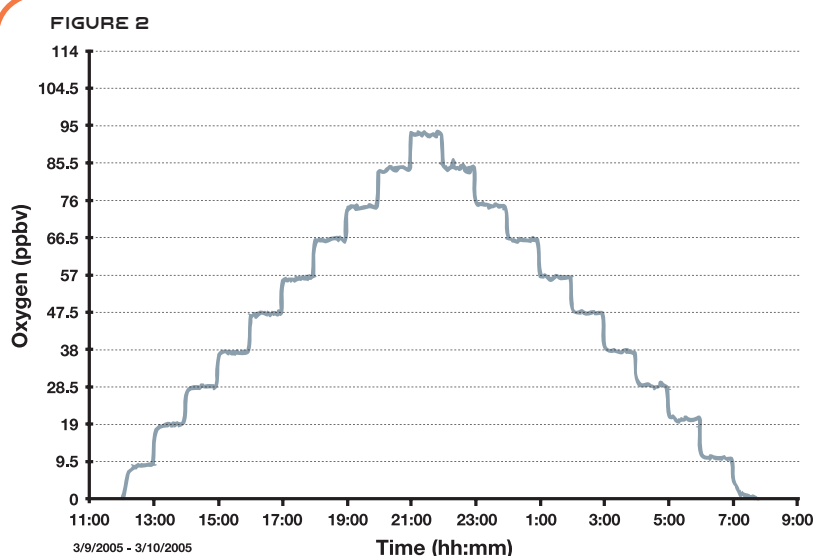
The LaserTrace O₂ lends itself to a multitude of applications where oxygen contamination indicates trouble or is of technical interest. These include:

- **Semiconductor fabrication.** As chip geometries continue to shrink and line-widths narrow, oxygen becomes a critical issue, given its negative impact on production yields. It can result in defects that promote polycrystalline rather than single crystal growth of subsequent layers. Such defects slow devices by occupying sites in the structure and limit the free flow of electrons. Thus, the requirement for superior gas quality has driven specifications to levels of 0.5 ppb and below.
- **Ultra-high-purity gas production.** UHP gas production requires reliable instruments to quickly and repeatedly measure trace levels of oxygen in production runs and cylinder transfills. Flawed specs can result from use of inadequate test equipment. Instruments should never operate at or beyond the outer range of their specifications.
- **Laboratory research and calibration.** Used as a transfer-standard, Tiger's CRDS-based tools provide accurate, repeatable, and linear performance. Stringent tests of thirteen different instruments conducted by Britain's National Physical Laboratory found Tiger's core technology by far the best on all counts for UHP applications. It is relied upon for the world's most advanced research – a practical tool for challenging endeavors.
- **Component and system testing.** With its accuracy, fast response, and four-line capability, the LaserTrace O₂ expedites qualification of systems, components, and tools. It verifies purifier performance, helps correlate oxygen content and product yield, and checks the validity of other instruments, such as APIMS and FTIRs.
- **Other applications.** Unique applications and circumstances can necessitate ppm to ppt oxygen analysis in various industries, including pharmaceuticals, electric power, refrigeration, aerospace, and chemicals and petrochemicals.

OPERATION IN A NEW LIGHT

Tiger Optics pairs powerful CRDS technology with the ultimate in electronics. Our technical team understands your need for durable, reliable, and low maintenance equipment. That's why we engineered highly sensitive electro-optic technology that can withstand the hard knocks of instrument life. From its easy-to-use touch screen through its varied output and alarm options, the LaserTrace O₂ combines ease of use with flexibility. Consider its:

- **User interface:** Embedded in its electronics module, the LaserTrace O₂ has an intuitive, touch-screen interface. Its keypad and 10.4" backlit Color VGA display offer instant access to operating variables. No special skills are needed to start-up or to utilize its many features. Based on widely known Windows® operating systems, all front panel controls are readily understood. Using colors and large text to convey information, the instrument's performance and settings are easy to control and to gauge.
- **Advanced communication capabilities:** The LaserTrace O₂ has a fully integrated PC and Ethernet communications. Analysis results can be stored directly to network drives or remotely accessed from anywhere on your network. Built-in remote operation allows you to operate the LaserTrace from your desktop or other locations.
- **Self-verification capability:** The LaserTrace electronics has a built-in function to perform a zero check, free of purifiers and costly purified gas. In TWO MINUTES, the LaserTrace simply tunes the laser to a wavelength where no absorption occurs, making the oxygen "invisible." In this mode, the system characterizes all other sources of signal to serve as a baseline. The LaserTrace then deducts the baseline from the measurements taken when the laser returns to its absorption peak.
- **Service in real-time:** Tiger Optics offers built-in diagnostic tools for on-line service and maintenance. The LaserTrace constantly monitors all operating and measurement parameters. System events and faults are logged to the internal hard drive in the unit. Just provide Tiger Optics with access via the Internet OR email us your diagnostic files, and we'll check out your system from half-way around the world. Either way, you stay operational.
- **Dynamic diagnostics:** With a full-featured interface, diagnostic information can be displayed in graphic form. From trend analysis to observation of each individual ringdown, using our built-in virtual oscilloscope, determining system performance is easy and straightforward.
- **Alarms and other set points:** Each sample inlet has its own alarm and analog output. If you're monitoring multiple lines, there is no need to multiplex the outputs. You can independently configure each alarm relay, and analog output is user-selectable throughout the operating range of the LaserTrace. A system status alarm also ensures any faults are easily detected and corrected.



FIELD TEST STEP INTRUSION DATA

METHODOLOGY IN A NEW LIGHT

Oxygen detection is achieved through a unique new technology. Through quantitative catalysis, the system converts trace oxygen in the sample stream to water, which is analyzed by the Cavity Ring-Down spectrometer.

- This is achieved by first removing moisture background in the sample gas to <0.2 ppb, using a selective purifier (see Figure 3), which is designed not to interact with the target oxygen molecules.
- Downstream of the selective purifier, a very small flow of pure hydrogen at approximately 10 sccm (standard cubic centimeters per minute) mixes into the main sample flow of roughly 800 sccm to 1000 sccm. (Since the hydrogen constitutes ~1% of the total flow, its impact on the measurement accuracy is negligible.)
- The small stream of hydrogen is purified with a different purifier, which removes both moisture and oxygen. NOTE: Simple test procedures can be used to verify purifier performance.
- With the hydrogen addition, each oxygen molecule generates two water molecules detectable by a standard LaserTrace cell. The catalytic reactor, which is a small, all-metal, orientation-insensitive device, can reliably convert all oxygen into water in a very fast and linear fashion.

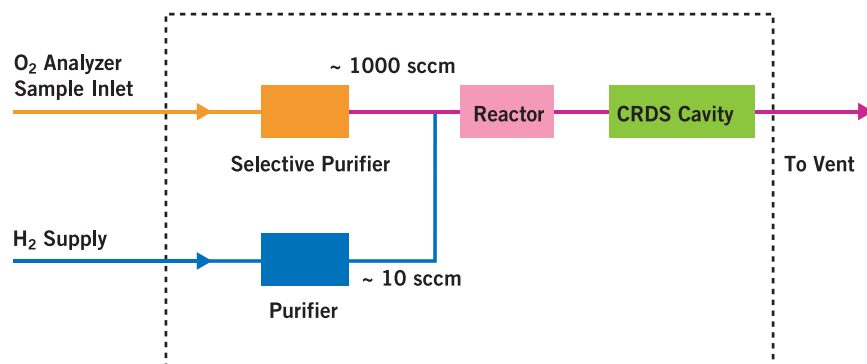
SERVICE IN A NEW LIGHT

Tiger Optics sets the standard for trace analysis, using our patented Continuous-Wave Cavity Ring-Down Spectroscopy. We have earned a reputation for cutting edge technology designed for field use. With sales and service support available worldwide, Tiger is ready to leap into action. Contact us -- or your local Tiger representative -- for more information on the LaserTrace O₂ today.

FIGURE 3

LASERTRACE TRACE O₂ ANALYZER

SIMPLE FLOW SCHEMATIC



LASERTRACE™

O₂

SAFETY ASSURED!

The technology is **safe** to operate. The **LaserTrace O₂** has an internal purifier for H₂ gas, so you can use 5.0 grade (99.999%) cylinders H₂ or H₂ from a generator. The recommended small, laboratory hydrogen generator includes added built-in safety features. If the gas line suddenly opens to atmosphere, it senses the resultant pressure drop and immediately shuts off.

Even under extreme emergency conditions, the hydrogen generator poses no hazard to personnel or your operation. Approved without additional safety sensors by the world's leading chip makers, it features an automatic shut-off in the event of power failure and performs well within accepted safety parameters. Specifically:

- If H₂ were accidentally vented from a 90 sccm generator into a 10'x10'x 8' sealed room with no air exchange, it would take ~3 days to reach one half the H₂ flammability limit in air!
- The O₂ module orifice restricts H₂ flow to ~10 sccm, approximately 1% of sample gas flow.
- The O₂ module catalytic converter operates at a temperature of only 140° C vs. the minimum auto-ignition temperature for H₂ of 570° C.

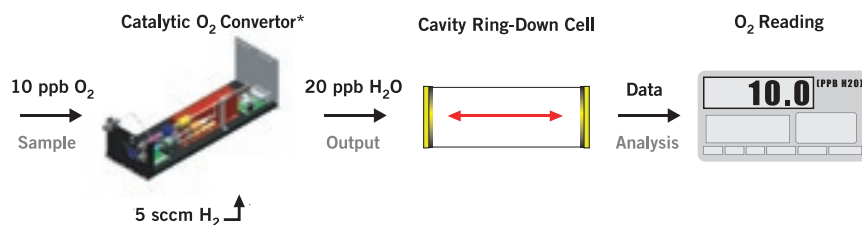


FIGURE 4

CATALYTIC CONVERSION EXPANDS CAPABILITIES

O₂ REACTION AND DETECTION

FAST, QUANTITATIVE CONVERSION OF TRACE OXYGEN TO WATER



*US patent pending 10/387,911

LASERTRACE™



O₂ SPECIFICATIONS

A. GAS SAMPLE CONDITIONS

Sample Inlet Pressure:	10- 125 psig (1.7 - 9.6 bar)
Flow Rate:	0.5 – 0.8 slm per inlet (depending on gas type)
Sample Gases:	Most inert and passive
Sample Line Temperature:	up to 60° C

B. GAS FLOW SYSTEM

Materials of Construction:	316L stainless steel, copper lined reactor
Wetted Components:	10 Ra surface finish
Gas Connection:	Sample inlets & outlets - 1/4" VCR
Leak Rate:	<2x10 ⁻⁸ mbar • l/sec

C. ELECTRICAL

Alarm Indicators:	User-programmable alarm setpoints
Power Requirements:	90-240 VAC 50/60 Hz
Power Consumption:	300 Watts max. per channel
Output Signals:	• Recorder -- 0-5 VDC, isolated 0-20 or 4-20 mA output • Alarm -- Form-C relay per sample inlet
User Interface:	0.4" color VGA display with touch screen, PS2 Mouse and Keyboard connection, 10BaseT Ethernet, USB

D. DIMENSIONS

Mounting:	H x W x D [inches (mm)]
• Control Unit:	13.97 x 19 x 14.15 (additional 1.58" for handle) (353.5 X 482.6 X 359.3)
• Sensor Unit:	8.735 x 19 x 27.61 (221.9 X 482.6 X 701.4)
Weight:	
• Control Unit:	32 lbs.(14.5 kg)
• Sensor Module Unit:	50 lbs (22.7 kg) per channel

PERFORMANCE

Lowest Detection Limit:	100 ppt
Sensitivity:	100 ppt
Accuracy (greater of):	5% of reading or ± 0.1 ppb
Speed of Response (typical):	95% of value <3 min.
Operating Range:	0 – 2500 ppb
Environmental Conditions:	10° to 40° C
Storage Temperature:	-10° to 50° C

TECHNOLOGY

Method:	Cavity Ring-Down Spectroscopy, Quantitative Catalytic Conversion
Patents:	U.S. Patent # 5,528,040 U.S. and foreign patents pending



When Measurement is a Matter of Survival

Founded in 2001, Tiger Optics brings you cutting-edge technology designed for field use. With sales and service support available worldwide, Tiger is ready to spring into action. For more information on the **LaserTrace O₂**, please call us, or your local representative.

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