

SEMTECH[®] - LASAR

Laser Absorption Spectroscopy with Amplified Resonance

On Board
Emissions
Analyzers

Test Cell
Emissions
Analyzers

Emissions
Testing
Services

Environmental
Applications



The SEMTECH[®] LASAR combines extremely high optical resolution optical feedback, cavity enhanced, scanning laser absorption spectrometry with very low pressure sampling for the measurement of emission gases over wide dynamic ranges. The use of a hyper-reflective gas cell in conjunction with laser light sources (TDL or QCL) enables kilometeric pathlength, delivering enhanced sensitivity. The wide spectral range scanning laser provides access, every 100 milliseconds, to up to 400 data-points spectra including information on several gases, real-time detection of interferences, and zero information for a no zero-drift response. Optical feedback enhances the purity of the laser beam injection in the gas cell by as much as 100x, enabling optical resolutions as low as 0.005 cm^{-1} . When combined with very low-pressure sampling, absorption bands are narrowed (no overlap); this results in zero-interference measurements. Very low pressure sampling and very low internal dead volume (e.g. 25 mL gas cell) enables faster system response times. In addition to the native 10 Hz electronic response rate, sample transfer speed in sampling can be as high as $4 \text{ m}\cdot\text{s}^{-1}$ and sweep time of the entire system of less than 1 second.

The SEMTECH[®] LASAR was designed with no moving parts, hygroscopic optics or liquid N_2 cooling requirements. It was integrated to maintain measurement integrity in presence of significant Electro-Magnetic Interference (EMI), vibration, and shock, enabling wide applicability. Sample conditioning is deported to the sampling point using a lightweight, low flow rate Dual Stage Heated Filter (DSHF) sampling assembly. Deporting the filtration unit to the sampling point increases sampling accuracy. Low flow rate requirements allows for small engine testing without slowing down rise/fall times.

The SEMTECH[®] LASAR is operated from a local host software including all customary analytical and diagnostic functions expected from an emissions gas analyzer. The system can also be connected to a remote host and operated from this host using familiar AK-commands.

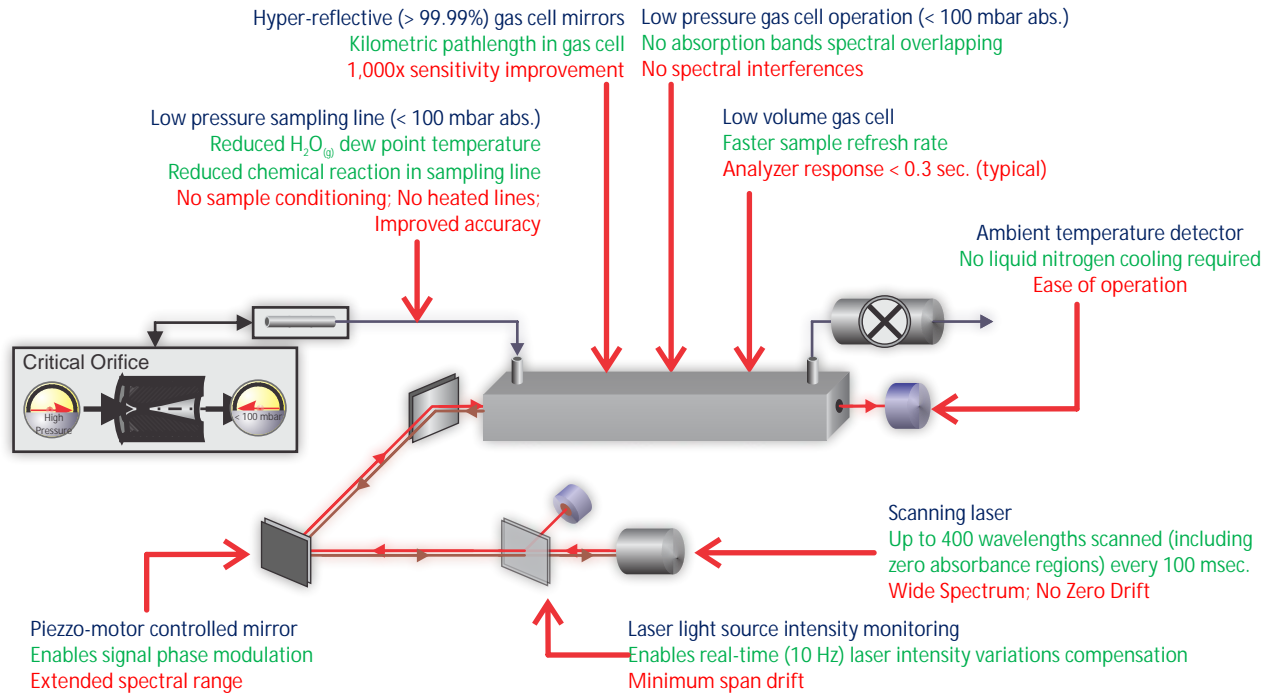
The SEMTECH[®] LASAR is 40 CFR part 1065 and Euro VI (draft) compliant for the gases regulated under these rules.



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Technology



The SEMTECH® LASAR relies on the combination of two patented technologies:

1. Optical Feedback Cavity Enhanced Absorption Spectroscopy (OFCEAS), a direct absorption measurement method using a ring resonator gas cell providing kilometric pathlength with little signal attenuation, thus enabling rapid (10 Hz) measurement of trace concentrations of gases. The technology can be used either with Tunable Diode Lasers (TDL's) or Quantum Cascade Lasers (QCL); however, 40 CFR part 1065 applications can all be successfully done using TDL's in association with that technology.
2. Low Pressure Sampling (LPS) technology, enabling operation of a sampling line at ambient temperature in test cells without risk of gas condensation. It also reduces chemical reaction rates in the sampling line and contributes to an overall improvement of measurement accuracy.

Sampling



Dual Stage Heated Filter (DSHF) Sampling Assembly for SEMTECH® LASAR.



DSHF sampling assy installed on engine dyno exhaust.
No heated lines required

For modal operation (test cells and on-board applications), the SEMTECH® LASAR is connected to a Dual Stage Heated Filter sampling assembly.

Deporting sample filtration system to the sampling point improves measurement accuracy by avoiding accumulation of soot in a heated sampling line (which will otherwise trap trace gases) and by reducing chemical reactions in the vacuum sampling line operated at room temperature.

Filters are rated at 99.999% filtration efficiency at 0.1 microns size PM and are very low volume, resulting in a sweep time of 0.5 second per filter. Sample flow requirement is only 6 LPM at the sampling point; vacuum line flow requirement is 340 CCM.

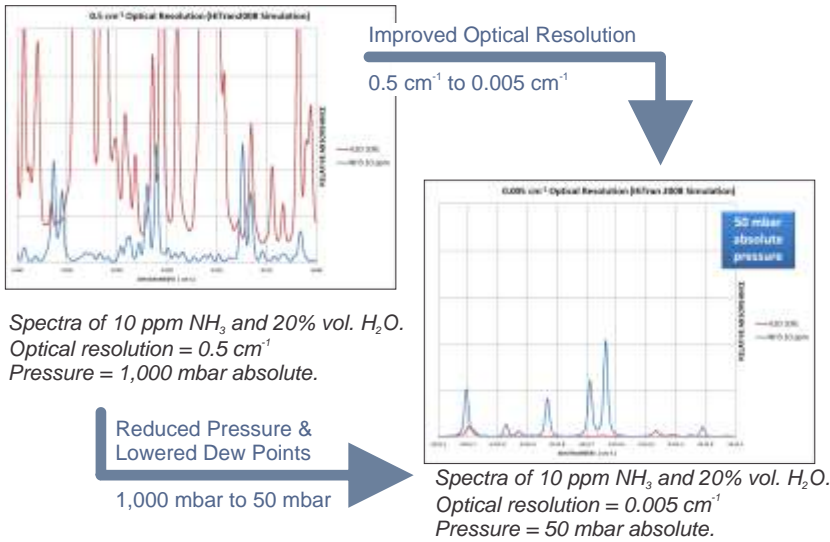
DSHF can be used with its own flow tube or without, enabling connection to existing gas sampling ports.



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No Interference



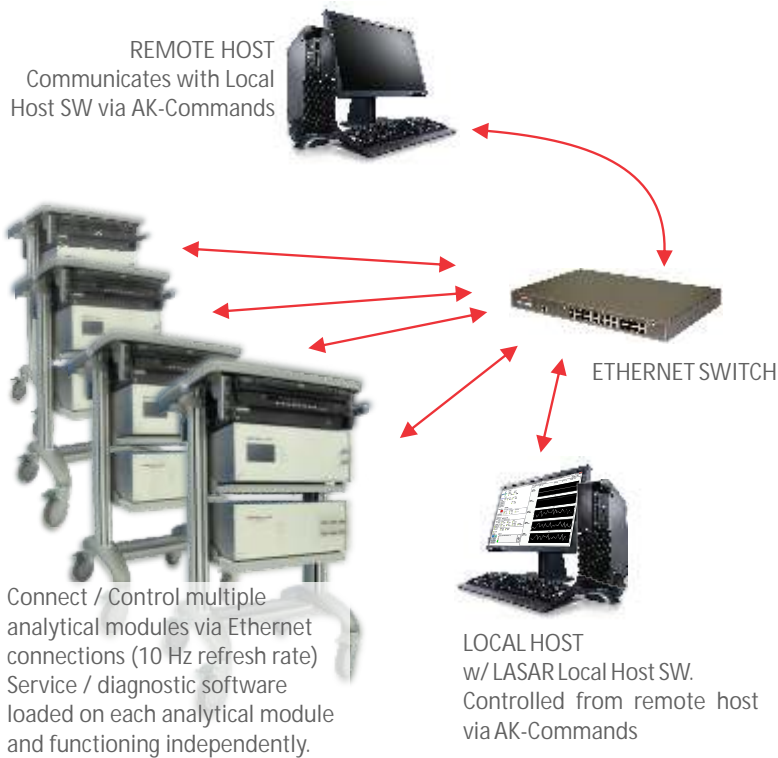
The SEMTECH® LASAR enables measurement of trace gases without interference from other gases due to the combination of extreme optical resolution and very low pressure operation.

OFCEAS technology allows collection of spectra with spectral resolution as low as 0.005 cm^{-1} . This 100X improvement in optical resolution allows observing very fine spectral features of trace concentration gases in a complex mixture.

Operating the gas cell at very low absolute pressure narrows the absorption bands bandwidth to the point where they do not spectrally overlap anymore.

As shown to the left, (spectra of 10 ppm NH_3 and 20% vol. H_2O at 50 mbar absolute pressure over the same spectral range than the spectra of the same gases measured at atmospheric pressure), absorption bands bandwidth is reduced to the point where spectral regions without any spectral overlapping can be identified. Extremely fine optical resolution allows the device to still record these very narrow features. The combination of both enables interference-free measurement of trace gases.

Data Transmission Architecture / Software



All SEMTECH® LASAR analytical modules are designed as internet-enabled appliances. They can be connected to the LASAR host software either using a dedicated local area network or via an existing local area network.

The LASAR local host software polls data, diagnostics and spectra (including calibration spectra and interference detection spectra) from up to 4 analytical modules at 10 Hz, applying all necessary post-processing calculations and displaying results, diagnostics and spectra in real-time.

The LASAR local host software can be controlled by (and send data back to) a remote host using TCP-IP protocols and AK-commands.

The LASAR local host software is intuitive and contains built-in, in-context help menus. Data, diagnostics, spectra and error logs can be recorded at the push of a button, saving all data in standard .CSV format for ease of retrieval and use.

Lastly, all data, diagnostics and spectra are saved in a binary encrypted format for full and tamper-proof archiving enabling full traceability of results.



User Support

As with all SEMTECH® products, the SEMTECH® LASAR comes with a wide range of customer support, including WebEx and a customer portal with tips, forum and more.

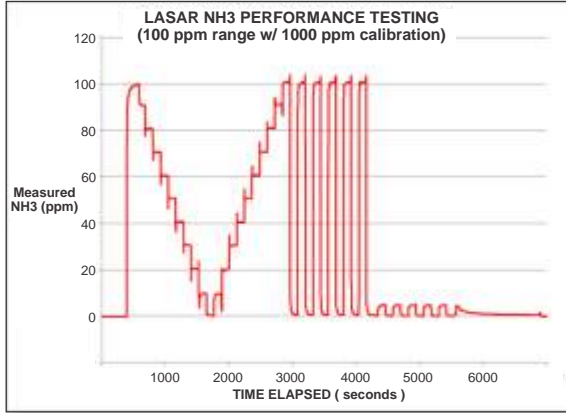




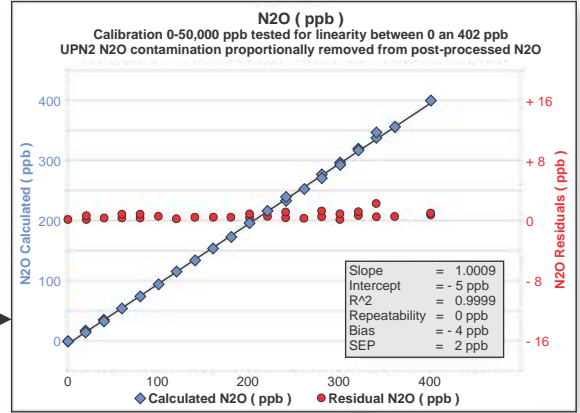
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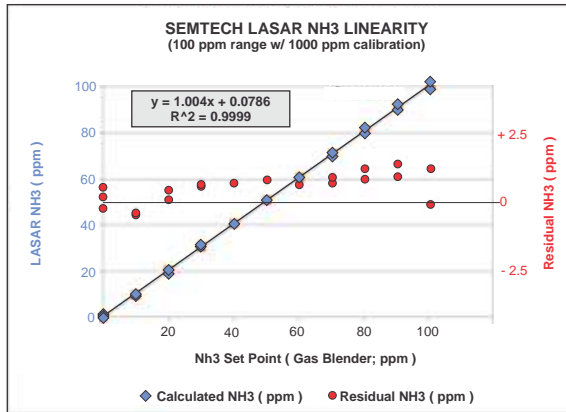
Performance Illustrations



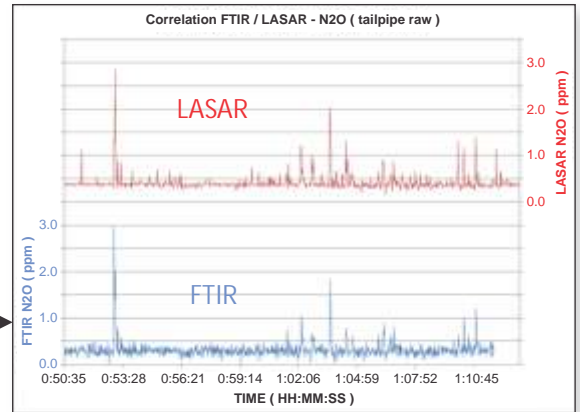
SEMTECH LASAR NH₃ Performance Qualification.
Gas Blender Test Profile



SEMTECH LASAR N₂O Performance Qualification.
Linearity @ 402 ppb using a 50 ppm calibration



SEMTECH LASAR NH₃ Performance Qualification.
Linearity @ 100 ppm using a 1000 ppm calibration



SEMTECH LASAR N₂O Performance Qualification.
Correlation with FTIR
LASAR flow rate = 350 CCM;
FTIR flow rate = 15 LPM

SEMTECH® LASAR Analytical Modules Configuration



MODULE	GASES MEASURED / SPAN
NH ₃	NH ₃ (1000 ppm) - CO ₂ (30 %) - H ₂ O (30 %)
N ₂ O	N ₂ O (50 ppm) - NH ₃ (100 ppm) - CH ₄ (200 ppm)
NO	NO (800 ppm) - CO ₂ (20 %) - H ₂ O (20 %)
NO ₂	NO ₂ (800 ppm) - CO ₂ (20 %) - CH ₄ (10 %)

For all modules / calibrations: LoD @ 1 sec. < 0.10% of span
LoD @ 30 sec. < 0.02% of span

Other Modules Available:

CO (measures H₂, CO₂, CH₄)
O₂ (measures O₂)

Alternative Fuels -----
H₂ (measures H₂, CO₂, CH₄)

High Sulfur Diesels -----
H₂S (measures H₂S, CO₂, CH₄)
SO₂ (measures SO₂)
SO₃ (measures SO₃)

NOTE: Specifications are subject to change without notice. While due caution has been exercised in the production of this document, possible errors and omissions may occur.