

## The *Lightwise* Systems Ammonia Monitor

Tunable Diode Laser Absorption Spectroscopy (TDLAS) has a long history as a precision, scientific measurement technique.

The *Lightwise* is a TDLAS brought out of the laboratory and into the industrial plant - a system engineered and packaged to be a reliable, maintainable and easy to use device for monitoring and control of trace ammonia concentrations in an industrial environment.

Sensitivity	1 ppmv·m (concentration ·unit path length) Ammonia. Other species measureable are shown in Table 1. Other Detectable Species.
Selectivity	The high-resolution TDLAS technique guarantees ammonia detection with no interference from other flue species (see - <i>TDLAS, a Simplified Discussion</i> below).
Reference and Calibration	It is a dual beam system with its own internal calibration scheme. A reference gas cell automatically locks the laser frequency. (see Figure 1. Lightwise System Layout)
Configuration	<p>Optical layout can be optimized to facilitate:</p> <ul style="list-style-type: none"> <li>• point source extractive techniques,</li> <li>• cross stack/duct measurement – <i>and the unique probe design reduces the effects of soot particles and droplets.</i></li> <li>• long path, ambient monitoring.</li> </ul> <p>(Also see Figure 2. LightwiseConfigurations.)</p> <p>Fiber-optic coupling is used to keep the electronics remote from hazardous measurement areas. Also the instrument can be scanned over up to eight (8) fiber-optic coupled measurement sites in a multiplexed measurement configuration.</p>
Signals and storage	<ul style="list-style-type: none"> <li>• 4-20 ma and RS-232 standard (other outputs available on request).</li> <li>• update rate - user programmable .1 sec -1 hour.</li> <li>• on board data storage on a 2 GB hard drive and a 3.5" floppy drive.</li> <li>• user configured signal processing (averaging, thresholding, etc.).</li> </ul>

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## ***TDLAS, a Simplified Discussion***

*Gases (as well as other materials) absorb energy at wavelengths characteristic of their fundamental atomic and molecular structure. The resulting collection of absorption wavelengths and their corresponding absorption strengths, known as the "absorption spectrum", is unique to a gas.*

*In fact, a single, precisely measured absorption wavelength can be used to identify a particular gas. The reduction of intensity of a beam of light at that wavelength, when normalized over a specific distance, will absolutely determine the gas concentration over the measurement path.*

*In practice, most spectroscopic techniques use light probes that are much coarser than the spacing between absorption lines of species in the sample. Is the level of absorption in the light beam due to the concentration of ammonia, or is it due, in part, to a nearby water absorption line? These ambiguities are resolved using complex instruments to measure absorption over a large wavelength spectrum and then performing complex calculations to estimate the contribution to absorption of each gas species in the sample.*

*TDLAS uses lasers that can be tuned in wavelength, to scan and detect the targeted absorption feature. It's like using a scalpel instead of a meat cleaver to probe the fine features of the gas spectrum! Now the gas concentration can be determined directly and unambiguously.*

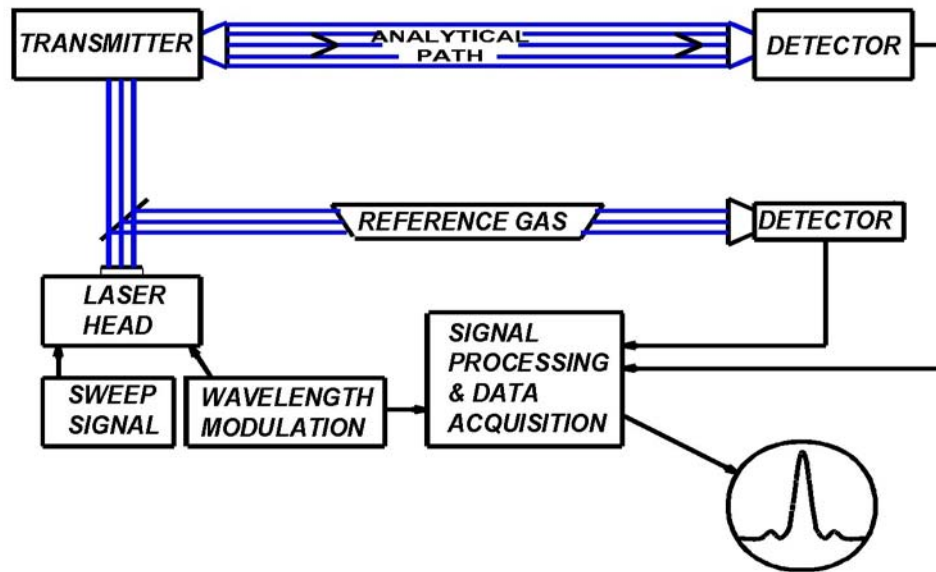
*The Lightwise System can also measure other trace gases such as **NO<sub>2</sub>, HF, HBr, H<sub>2</sub>O, HI, NH<sub>3</sub>, HCN, C<sub>2</sub>H<sub>2</sub>, H<sub>2</sub>S, CO, CO<sub>2</sub>, CH<sub>2</sub>CHCl, C<sub>2</sub>H<sub>4</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, HCl, NO, C<sub>3</sub>H<sub>8</sub>, HOD, D<sub>2</sub>O** as indicated in Table 1, below.*

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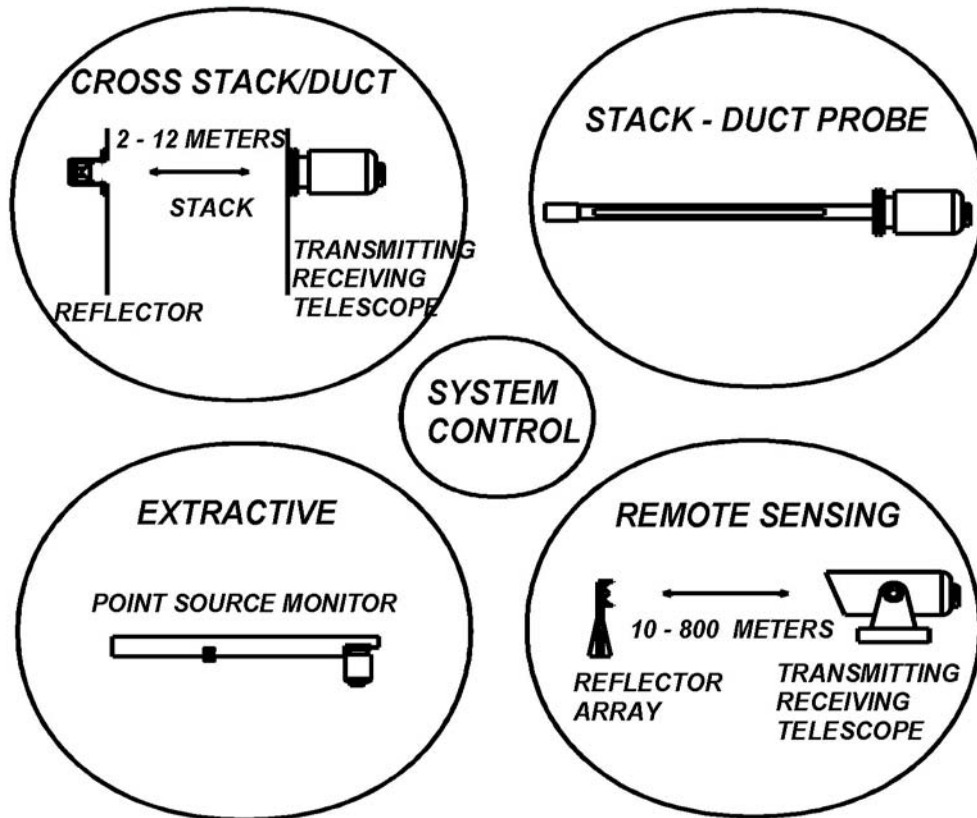
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**Fig. 1 Lightwise System Layout**



**Fig. 2 Lightwise Configuration**



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**Table 1. Lightwise™ Other Detectable Species**

SPECIES	DETECTION LIMIT (1 SEC)			
	$\lambda$	STACK/DUCT MONITOR	REMOTE SEPARATION	POINT MONITOR*
	Micrometer	(ppmv·meter)	Distance = 250 m ppbv	Cell length = 12 m ppmv
O <sub>2</sub>	0.760	200	8000	75
NO <sub>2</sub>	0.680, 0.800	25	50	0.5
HF	1.310	0.08	0.2	0.005
HBr	1.41, 1.960	50	100	1.0
H <sub>2</sub> O	1.390, 1.365	2	4.0	0.05
HCN	1.550	0.15	0.3	0.03
HI	1.541	2.5	5.0	0.05
NH <sub>3</sub>	1.510, 1.544	1.0	10	0.1
C <sub>2</sub> H <sub>2</sub>	1.520, 1.550	5.0	10	0.1
H <sub>2</sub> S	1.570, 1.578	20	40	0.25
CO	1.570	50	100	1.0
CO <sub>2</sub>	1.579, 1.960	50	100	1.0
CH <sub>2</sub> CHCl	1.612	2.0	4.0	0.05
C <sub>2</sub> H <sub>4</sub>	1.620	20	40	0.5
CH <sub>4</sub>	1.651	2.0	4.0	0.05
C <sub>2</sub> H <sub>6</sub>	1.640	50	100	1.0
HCl	1.747, 1.790	0.3	0.6	0.006
NO	1.800	50	100	1.0
C <sub>3</sub> H <sub>8</sub>	2.430	10	20	0.2
PH <sub>3</sub>	2.150	78		

\* Reduced pressure operation

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