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Siemens
Analytical products and solutions

Process Industries and Drives (PD) within the Siemens AG

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- Power and Gas
  - Dresser-Rand Unit
- Wind Power and Renewables
- Power Generation Services
- Energy Management
- Building Technologies
- Mobility
- Digital Factory
- **Process Industries and Drives**
- Healthcare (separately managed)
- Financial Services

Process Automation (PA)

Large Drives (LD)

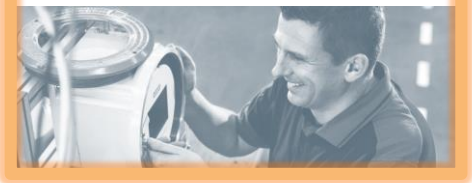
Mechanical Drives (MD)

Oil & Gas and Marine (OM)

Automation and Engineering

Process Instrumentation

Analytical Products and Solutions



Industrial Communication and Identification

Power Supply Products

Industries and Services

Source: ARC / IHS market reports

Process Automation product portfolio

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Process Automation

Engineering Management Level

COMOS
Plant engineering

SIMIT
Simulation

XHQ Operations
Intelligence

MES Solutions
Pharmaceuticals

Operation and Control Level

SIMATIC PCS 7
Process Control System

Power Supplies

SIMATIC HW Modules

SIMATIC
S7-400

Industrial
Communication

Field Level

Analytical
Products
and Solutions

Process Instrumentation

Industrial
Identification

- Chemical Industry
- Pharmaceutical Industry
- Water & Wastewater
- Glass & Solar
- Food & Beverage
- Fiber Industry
- Mining & Cement
- Oil & Gas
- Marine
- Energy
- Utilities
- Automotive
- Wind
- Other

Product Overview PD PA AP – Industrial gas analysis

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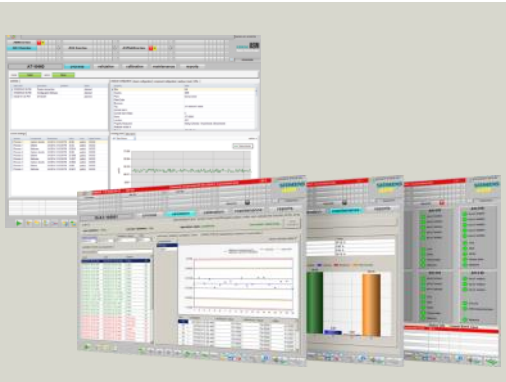
Continuous Gas Analyzer – Extractive

Continuous Gas Analyzer – In-Situ TDLS

Gas Chromatography

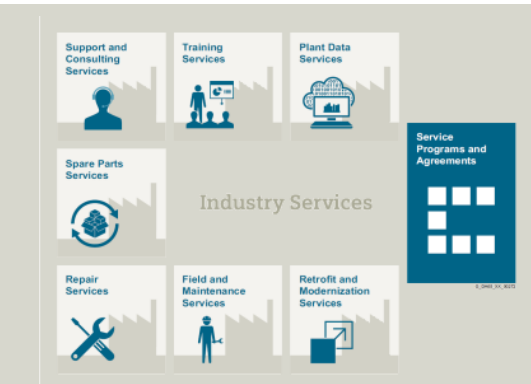
Software



Analytical Application Sets

System Integration

Service



- comprehensive portfolio for process and quality optimization
- including continuous gas analyzers & process gas chromatographs
- from single analysis devices to system solutions
- accompanied by individual service & support

Analytical Products and Solutions
Special expertise in 4 Key Process Industries

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Chemical Industry

- **Main applications**
  - Product quality measurement
  - Process control
  - Safety monitoring
- **Main analyzer products**
  - MAXUM, SIPROCESS GA700, Series 6, SITRANS SL

MAC / Metals

- **Main applications**
  - Emission monitoring
  - Combustion process control
- **Main analyzer products**
  - SIPROCESS GA700, Series 6, SITRANS SL, LDS 6

Oil & Gas

- **Main applications**
  - BTU measurement
  - LNG Process control
  - Refining / Blending
- **Main analyzer products**
  - MAXUM, SITRANS CV, MicroSAM

Power

- **Main applications**
  - Emission monitoring
  - Combustion process control
  - Generator gas monitoring
- **Main analyzer products**
  - SIPROCESS GA700, Series 6, SITRANS SL, LDS 6

Process Analytics for process and quality optimization in the process industry

Continuous Gas Analysis (CGA) – extractive

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Product range CGA extractive

ULTRAMAT 23

- Innovative multi component analyzer for various applications
- Auto calibration with ambient air
- cost efficient emission monitor

Series 6: ULTRAMAT 6, OXYMAT 6/61/64, CALOMAT 6/62, FIDAMAT 6

- Innovative multi component analyzer for various applications

SIPROCESS UV600

- Multi component analyzer based on UV resonance absorption spectrometry, for lowest NO, NO_2, and SO_2 measurement ranges in continuous emission monitoring applications

SIPROCESS GA700

- Modular multi component analytical platform
  - ULTRAMAT 7
  - OXYMAT 7
  - CALOMAT 7
- Plug & Measure for simple service on site
- Uniform user interface

Continuous Gas Analysis (CGA) – in-situ

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Product Range CGA in-situ – Tunable Diode Laser Spectroscopy (TDLS)

In-situ measurement

- No sampling required, ideal for polar components as NH_3, H_2O, HCl, HF
- Short response time (from 1 second)
- Maintenance free

Application examples:

- Process control: DeNOx, combustion control
- Safety monitoring: O_2
- CEM: NH_3, HCl, H_2O

TDLS principle

- Based on tunable diode laser absorption spectroscopy, no moving parts
- Highly selective
- Simultaneous measurement of up to 2 components

Internal reference cell

- Process independent laser stabilization, no test gas required

LDS 6

- 19” central unit plus up to 3 CD 6 sensors for different measurement points

SITRANS SL

- Compact analyzer for single point measurements
- SIL 1

SITRANS TDL

- New TDL platform providing enhanced communication and diagnosis features

Process Gas Chromatography (GC)

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Product Range GC

MAXUM II Classic Oven

- World leading process gas chromatograph with broadest application capabilities for the chemical & petrochemical industries.
- Innovative analytical technologies like inter column detection & parallel chromatography allow to make even complex analytical solutions easier and more transparent.

MAXUM II Modular Oven

- The next step to simplify chromatography. The chromatographic system is built in oven modules, which can be mounted by simply fasten a screw.
- Repair time becomes a minimum. The gas chromatograph is back online in shortest time.

SITRANS CV / MicroSAM

- Compact field mount process gas chromatograph for energy industry with modular analytical system based on MEMS technology.
- Fast measurement, highest accuracy are key features.
- SITRANS CV is designed for fiscal metering applications of natural gas.

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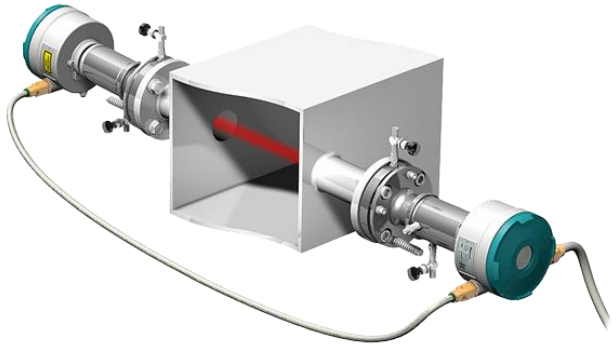
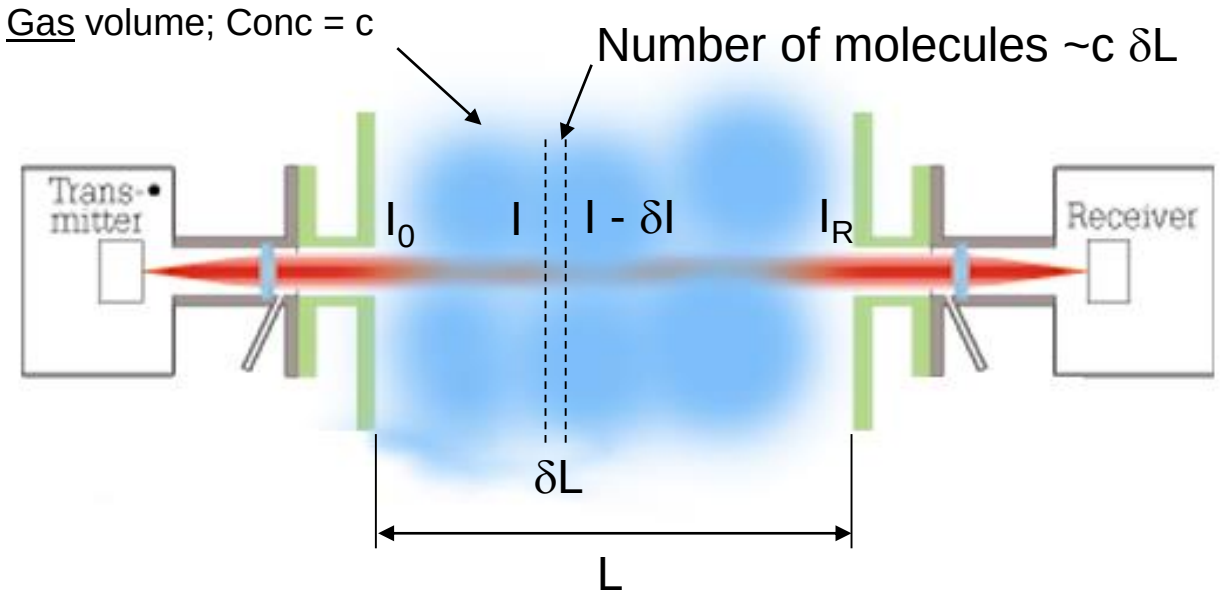
Principles of gas detection with laser spectroscopy

The Beer-Lambert law





The relative intensity drop is proportional to the number of molecules in the path

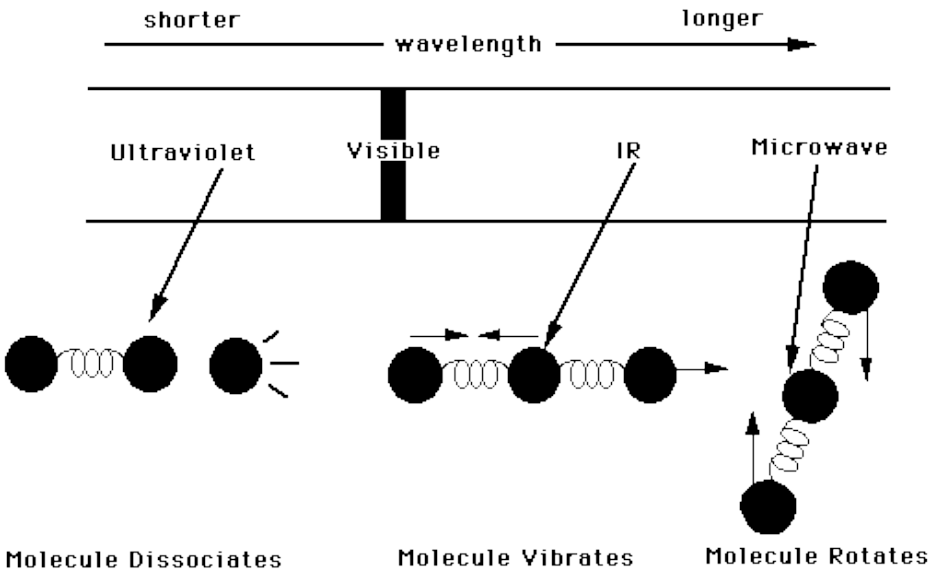
$$\frac{\delta I}{I} = -\alpha c\, \delta L$$

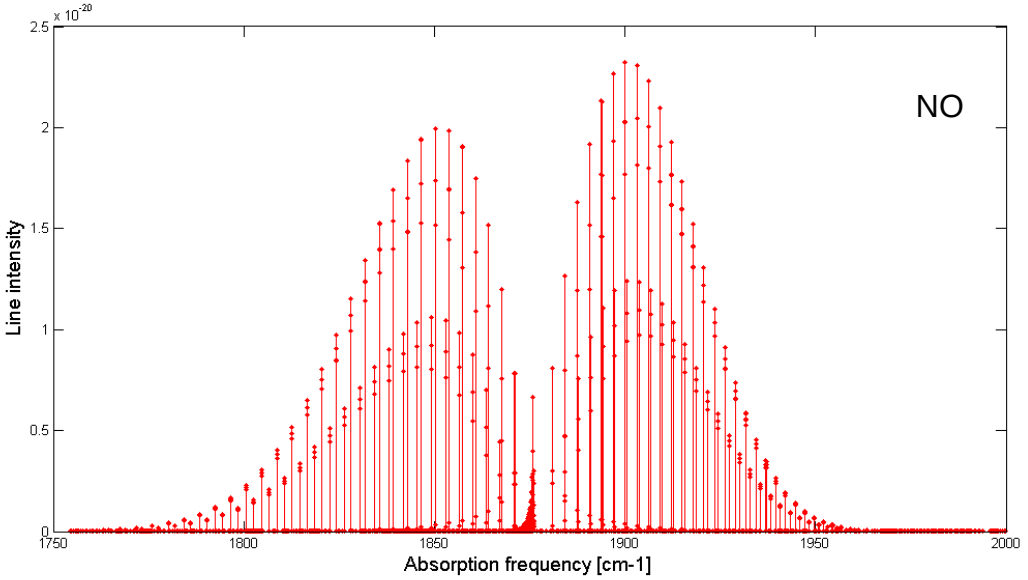
The total change in intensity over the path L is obtained by integration

$$\int_{I_0}^{I_R} \frac{\delta I}{I} = -\int_{0}^{L} \alpha c\, \delta L$$

$$\ln I_R - \ln I_0 = -\alpha c L \Rightarrow \boldsymbol{I_R = I_0 \exp[-\alpha c L]}$$

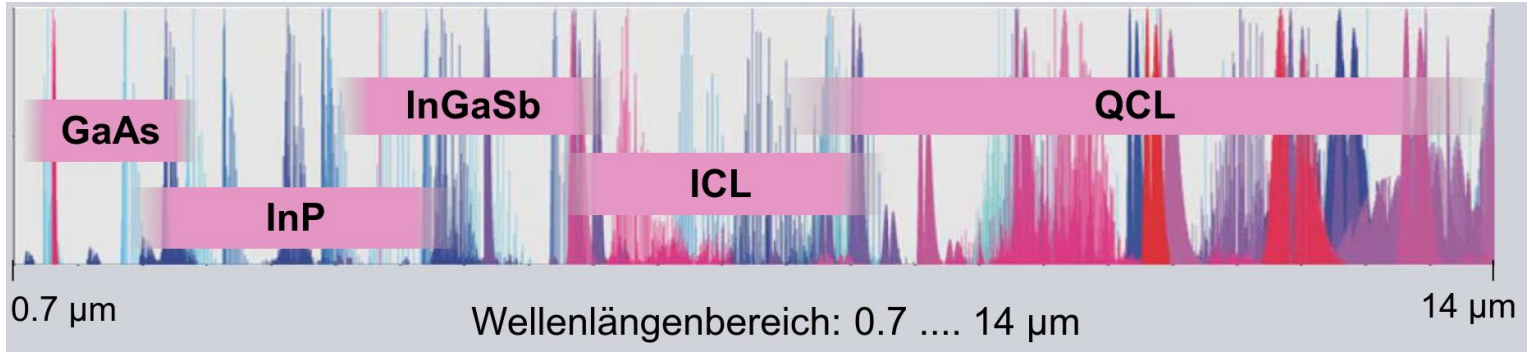
Molecular absorption spectra

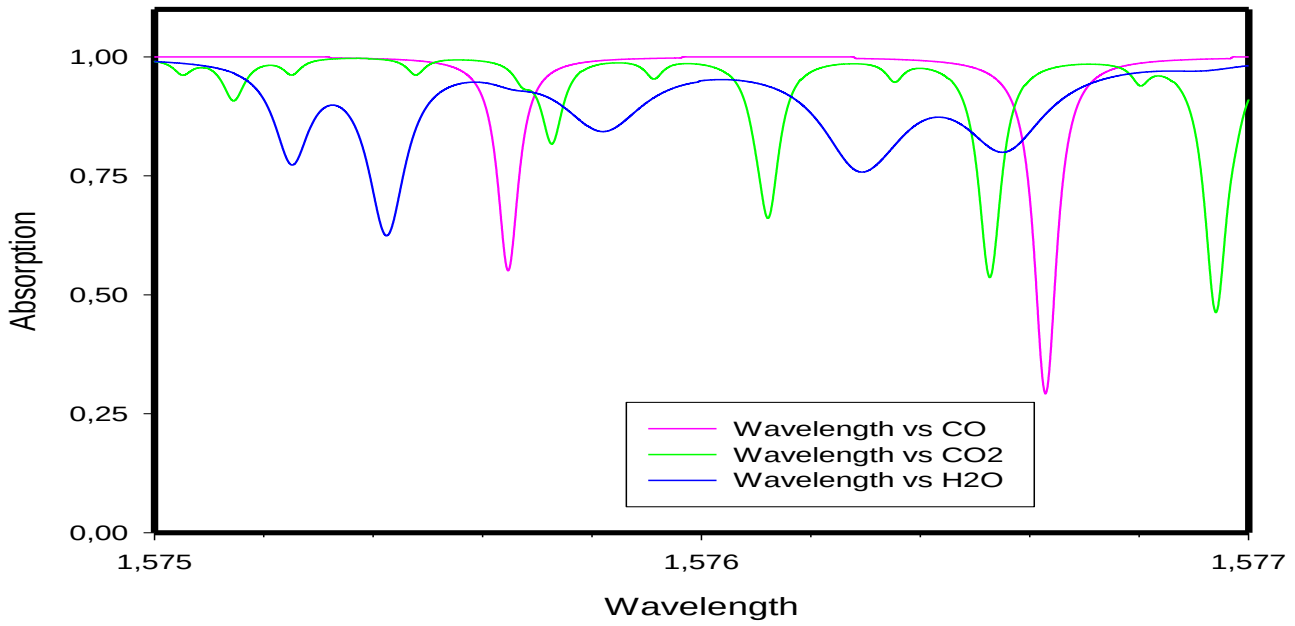




Nature (quantum mechanics) allows only molecular excitations with **distinct** excitation energies
→ discrete spectral lines

Spectra of gas mixtures





Choice of spectral line depends on

- Concentration of measurement gas
- Presence / concentration of cross gases
- Temperature
- Pressure
- Path length
- Required measurement performance
- …

Tunable Diode Laser Absorption Spectroscopy (TDLAS)

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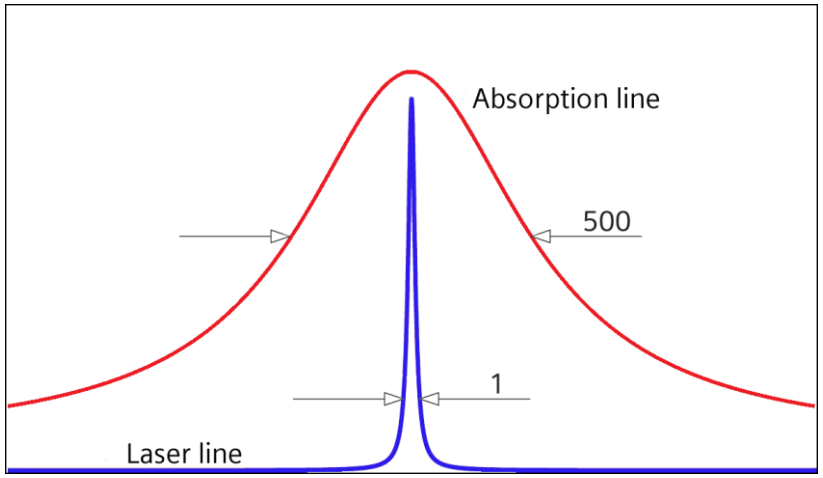
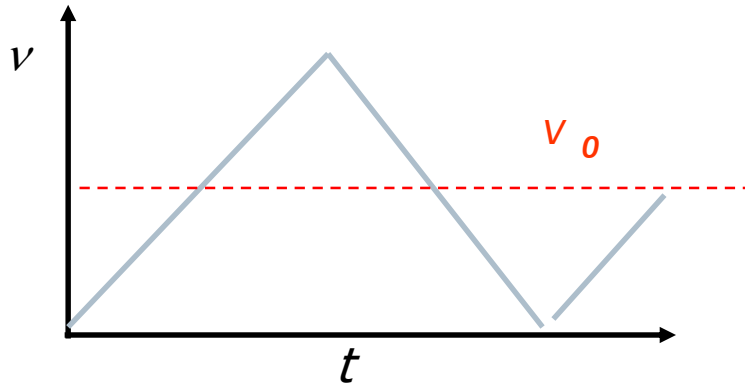
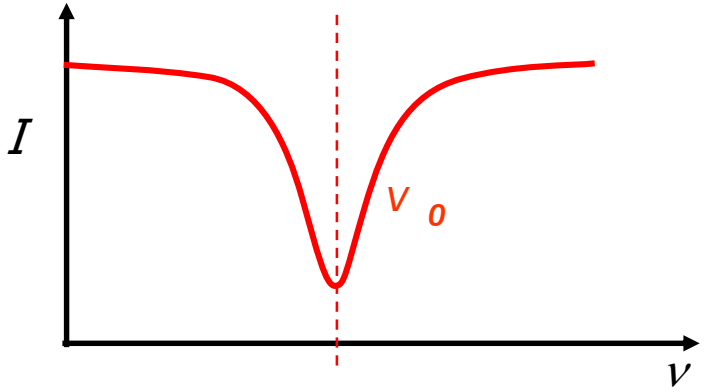


Laser light source



Detected spectrum (in transmission)



Parameter		Unit	Example
Wavelength	λ	nm / µm	
Wavenumber	υ = 1/ λ	cm^{-1}	
Line width	Δυ	cm^{-1} / GHz	Laser line width < 0.5 GHz Spectral line ~ 10 GHz (typ. for NH_3)