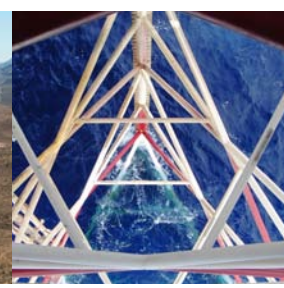




OMA Process Analyzers

Continuously measure the chemicals in a liquid or gas process stream using the future of industrial process analytics: the OMA.

APPLIED™ ANALYTICS

What is the OMA?

The OMA is an industrial device which measures a high-resolution absorbance spectrum in a continuously drawn sample from a liquid or gas process stream. Harvesting this rich data, the OMA provides real-time analytics for the process stream, including chemical concentrations, purity, and color.

» What is Absorbance Spectroscopy?

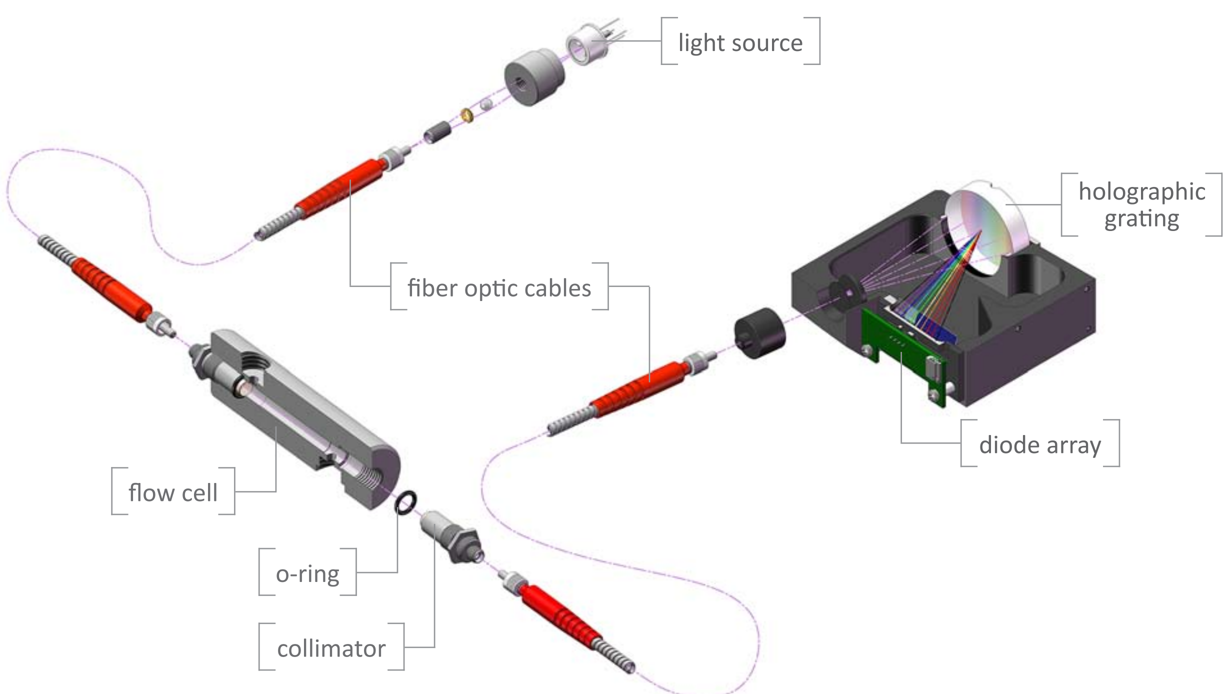
One of the ways in which light interacts with matter is ***absorption***: a molecule absorbs specific wavelengths of radiation as a function of its unique electronic and molecular structures. The energies (wavelengths) of radiation that are absorbed match the energy quanta that are required to move that molecule between two quantum mechanical states. This is why each molecule absorbs radiation in a unique, recognizable way.

Absorption is quantified as ***absorbance***, or the difference between intensity of the radiation entering the substance and the intensity of the radiation exiting the substance. Plotting the absorbance against wavelength creates an ***absorbance spectrum***, which allows us to observe the shape (curve) of the absorbance. Each chemical species has a natural identifier in its absorbance curve that can be detected like a fingerprint.

According to Beer-Lambert law, the absorbance of a chemical in a mixture is directly proportional to its concentration. By measuring the height of a chemical's absorbance curve, an instrument can determine that chemical's concentration.

» OMA Principle of Operation

The optical assembly of the OMA is depicted below, illustrating the complete path of the signal.

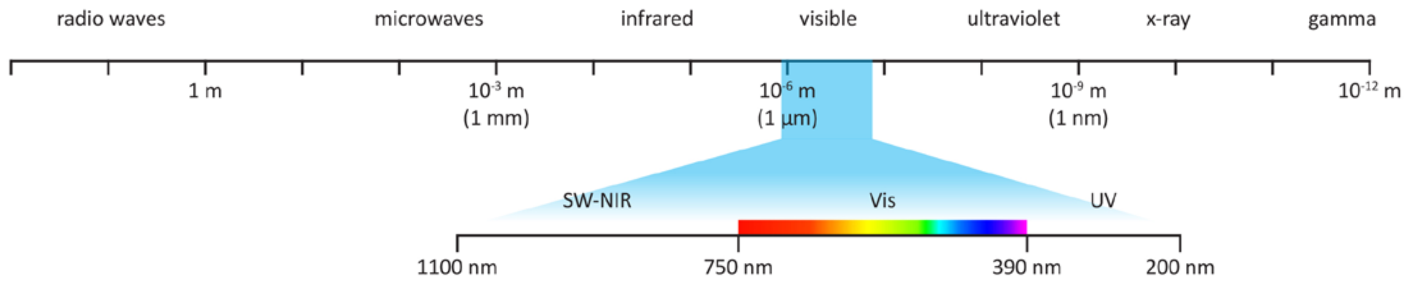


The signal originates in the light source and travels via fiber optic cable to the sample flow cell. Passing through the length of the flow cell, the signal picks up the absorbance imprint of the continuously drawn sample fluid.

Exiting the flow cell on the opposite end, the signal travels by fiber optic cable to the spectrophotometer, where a holographic grating separates the signal into its constituent wavelengths, focusing each wavelength onto a corresponding photodiode on a 1024-diode array. This is known as ***dispersive*** spectrophotometry.

» Spectral Range of the OMA

The OMA measures UV-Vis / SW-NIR (ultraviolet-visible / shortwave near infrared) absorbance. Depending on which range best suits the analytes, the OMA is configured to acquire either a 200-800 nm spectrum (using xenon light source) or 400-1100 nm spectrum (using deuterium light source).



Choose Your Measurements

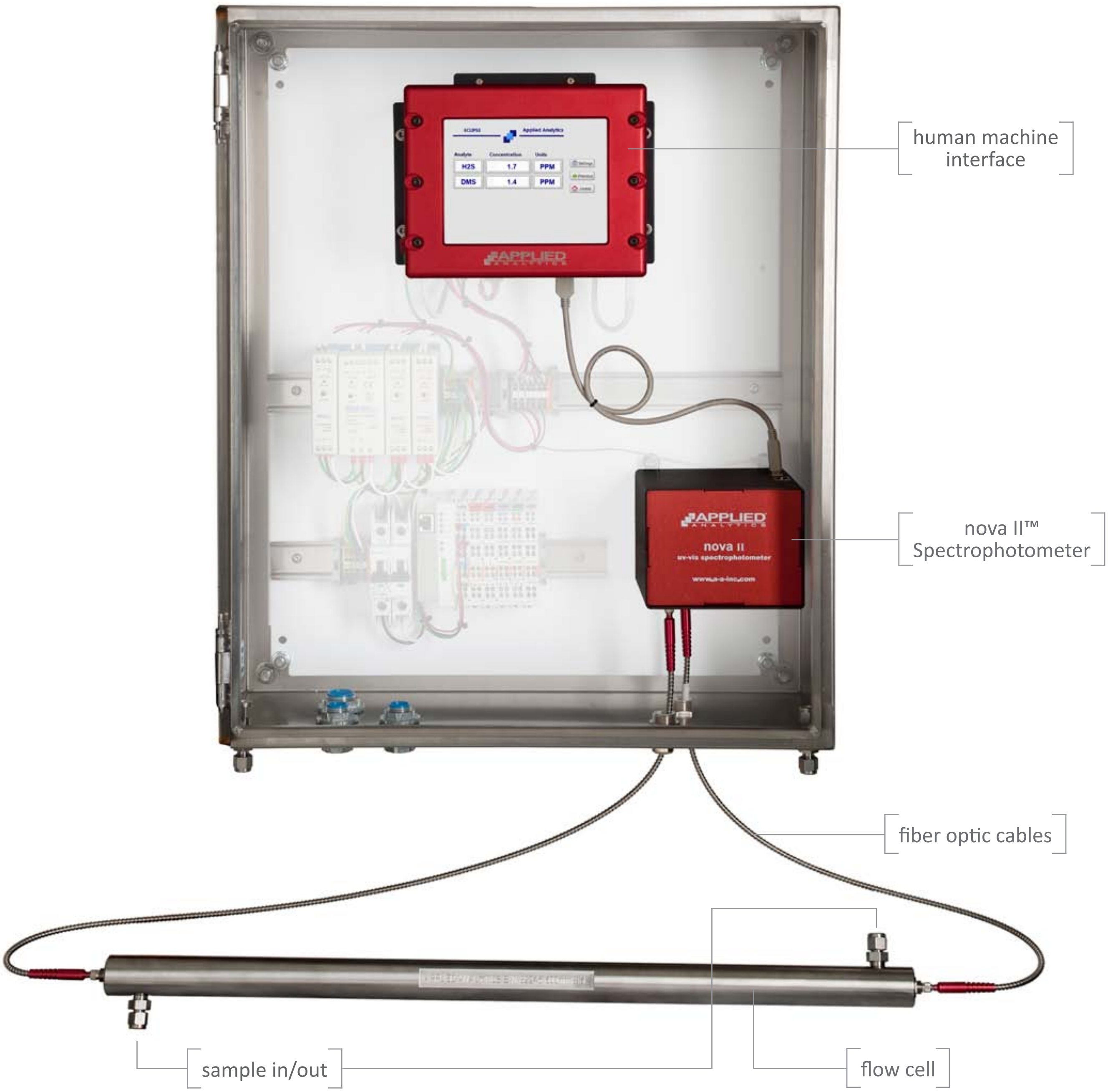
This system measures the concentration of any chemical that has an appreciable absorbance curve within the UV-Vis / SW-NIR spectral range, or any physical property that correlates to the measured absorbance spectrum.

» Common OMA Measurements

acrylonitrile
ammonia
ammonium
aromatic hydrocarbons
arsenic
benzene
bisphenol A
bromine
BTX
1,3-butadeine
caffeine
carbon disulfide
carbonyl sulfide
chlorine
chlorine dioxide
chromium ions
cobalt ions
color
copper ions
diesel
dimethyl sulfide
ethanol
ethylene glycol (MEG)
ethyl mercaptan (EtSH)
ferric chloride
ferrous sulfate
fluorine
hydrogen peroxide
hydrogen sulfide
hypochlorite
iron ions
hydroquinone monomethyl ether
mercury
metallocenes
methanol
methyl mercaptan (MeSH)
nitric oxide
nitrogen dioxide
nitrogen trichloride
NOx
odorants
olefins
ozone
phenol
pitch
styrene
sulfur
sulfur dioxide
4-tert-Butylcatechol (TBC)
titanium tetrachloride
transmittance
toluene
vanadium
vanadium oxytrichloride
xylene

System Overview

Each version of the OMA uses the same basic components. These components are indicated below inside the model OMA-300 (door removed):



» **nova II™ Spectrophotometer**

The heart of the OMA is the diode array spectrophotometer. This device contains the light source as well as the detector which measures the absorbance spectrum.

A highly evolved device, the nova II has several distinctive features which allow it to excel in demanding OMA applications:

- Solid state build with excellent wavelength stability
- CMOS analog circuitry reduces noise and power consumption
- 1024-element diode array with ~1nm resolution
- Strong light throughput in low UV region
- Very low stray light due to design without mirrors or filters
- Ethernet interface for remote access

» **Human Machine Interface**

The HMI controlling the spectrophotometer and communication provides a simple, touch-screen visual interface. Running our proprietary ECLIPSE software, the HMI offers the user several display choices (e.g. standard numeric display, trendgraph, bar graph).

From this interface, the user can quickly adjust settings like how frequently the Auto Zero is performed, the unit of concentration for each measurement, the analog output range, and much more.

» **Flow Cell**

The sample (gas or liquid) from the process stream continuously cycles through the flow cell via 1/4" Swagelok tube fittings. The standard flow cell is rated up to 3,000 psi / 150 °C and made from stainless steel 316L for corrosion-proof durability.

The path length of the flow cell is specified by our engineers to optimize the measurement for the expected concentration ranges of your analytes.

2 mm path

600 mm path

» **Fiber Optic Cables**

Our fibers are all manufactured in-house to ensure spectroscopic-grade quality. The stainless steel cladding provides proven durability in the field. Before shipment, each fiber is tested to ensure it meets transmission benchmarks, Exceptional UV light transmission is achieved through our presolarization technique.

The fibers connect to the flow cell through rugged steel collimators, and are thus not wetted to the sample fluid. Optional cooling extensions provide further protection from hot samples.

Choose Your Form Factor

The OMA Process Analyzer is available in three different models:

MODEL OMA-300 WALL-MOUNTED ANALYZER

Available in a variety of enclosure materials.

MODEL OMA-206P PORTABLE ANALYZER

A rugged copolymer suitcase enclosure.

MODEL OMA-406R RACKMOUNT ANALYZER

Designed for a standard 19”rack.

Customize Your OMA

» **Explosion-Proof Your OMA**

The OMA-300 is available in two explosion-proof formats:

Ex p Purged Enclosure (X/Z Purge)

Ex d Cast-Aluminum NEMA 4X Enclosure

» **Integration Options**

The OMA can be also be provided within a cabinet or freestanding structure for turnkey implementation:

» **Integrated Measurements**

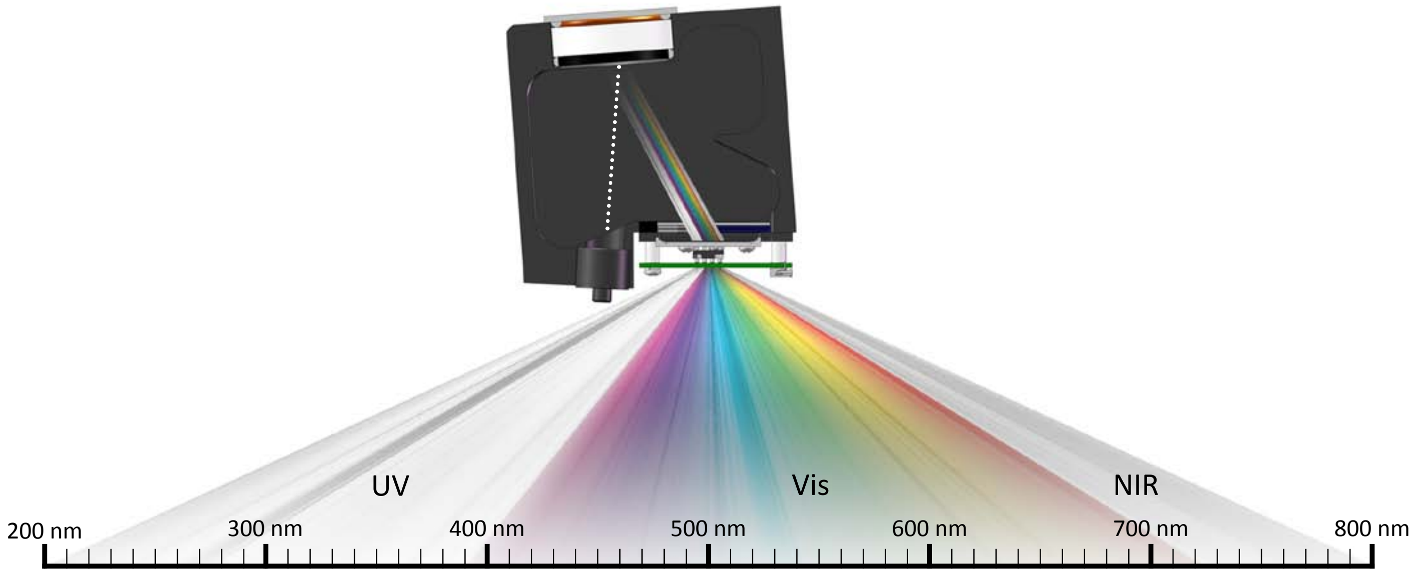
Some chemicals cannot be measured in the OMA's spectral range. However, these measurements can easily be implemented using MicroSpec modules, which integrate seamlessly into the OMA.

- carbon dioxide
- carbon monoxide
- ethylene
- methane
- water

Full-Spectrum Analysis

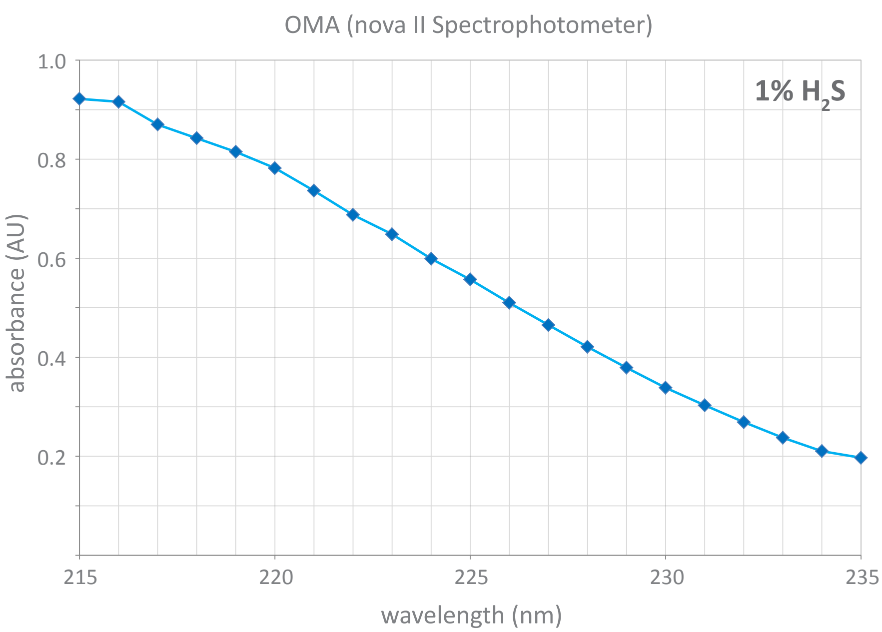
A conventional 'multi-wave' photometer measures a chemical's absorbance at one pre-selected wavelength with one photodiode. This 'non-dispersive' technique uses an optical filter or line source lamp to remove all wavelengths but the pre-selected measurement wavelength.

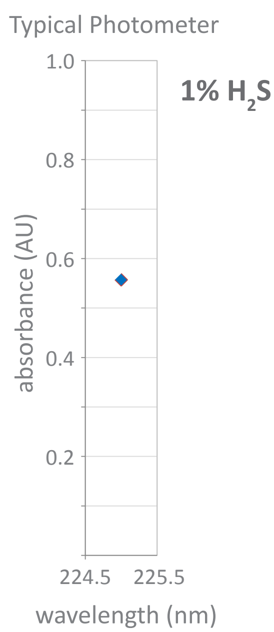
By contrast, the OMA uses a dispersive spectrophotometer to acquire a full, high-resolution spectrum. Each integer wavelength in the spectral range is individually measured by a dedicated photodiode.



» The Accuracy Advantage of Collateral Data

A single photodiode is susceptible to noise and signal clipping. As accepted in the lab community for decades, the only way to eradicate this source of error is to use many photodiodes measuring at many wavelengths. Compiling the data from all these photodiodes produces an absorbance spectrum instead of a single data point:

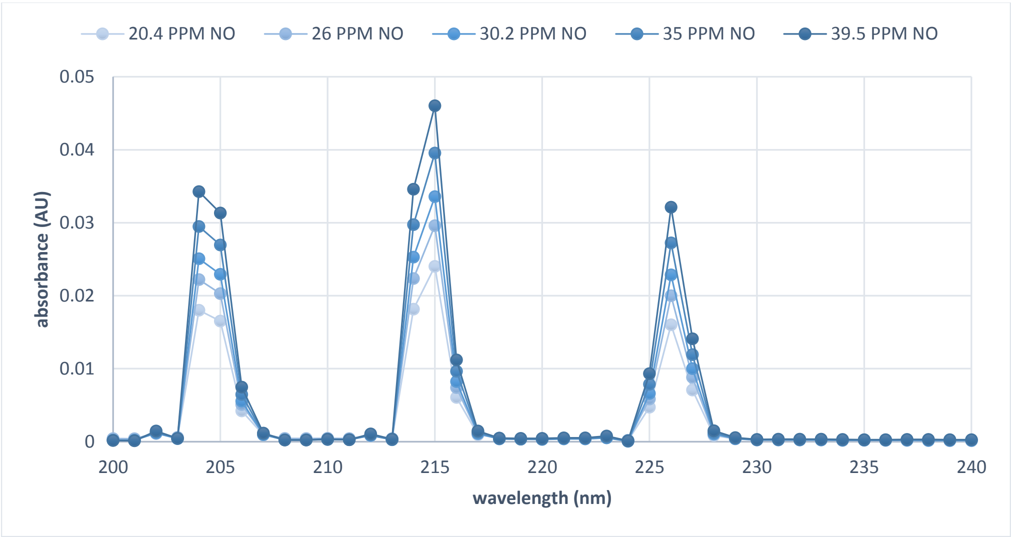




While the single-wavelength photometer has only one data point and no contextual curve with which to verify the accuracy of that data point, the OMA uses statistical averaging of all the data points along the curve to immediately detect and ignore erroneous data from a single photodiode. By detecting the actual structure of the curve instead of peak absorbance, the OMA avoids false positives and provides superior accuracy.

» Visualizing Absorbance Curves

In calibration, the OMA 'learns' the absorbance curve of each measured analyte and how to isolate this curve from the total sample absorbance spectrum. Technically, the calibration procedure stores molar absorption coefficients for each wavelength while running a calibration standard (mixture of known concentration) through the flow cell.

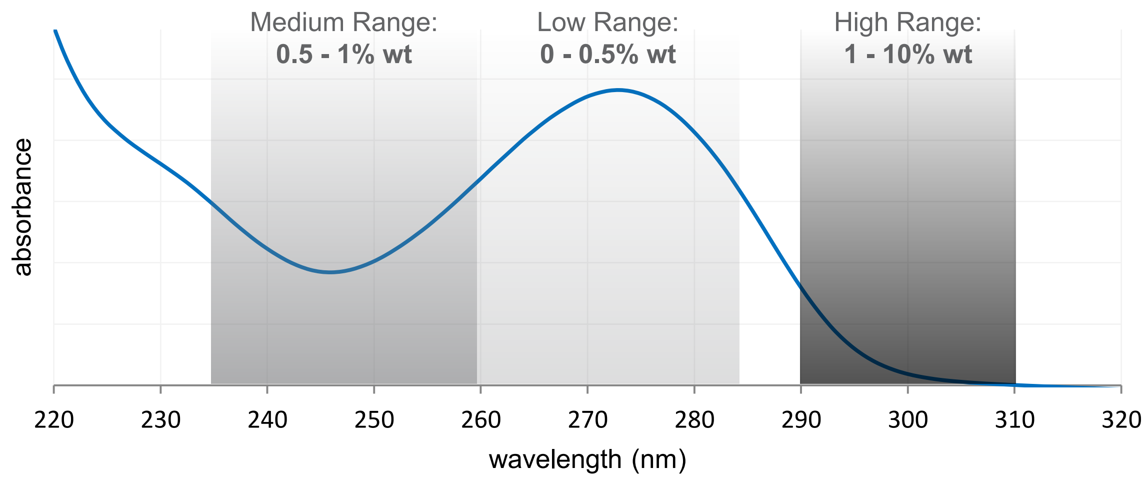


» Massive Dynamic Range

The reason that most photometers measure a limited concentration range is because the signal gets clipped when absorbance gets too low (indistinguishable from noise) or too high (zero light detected).

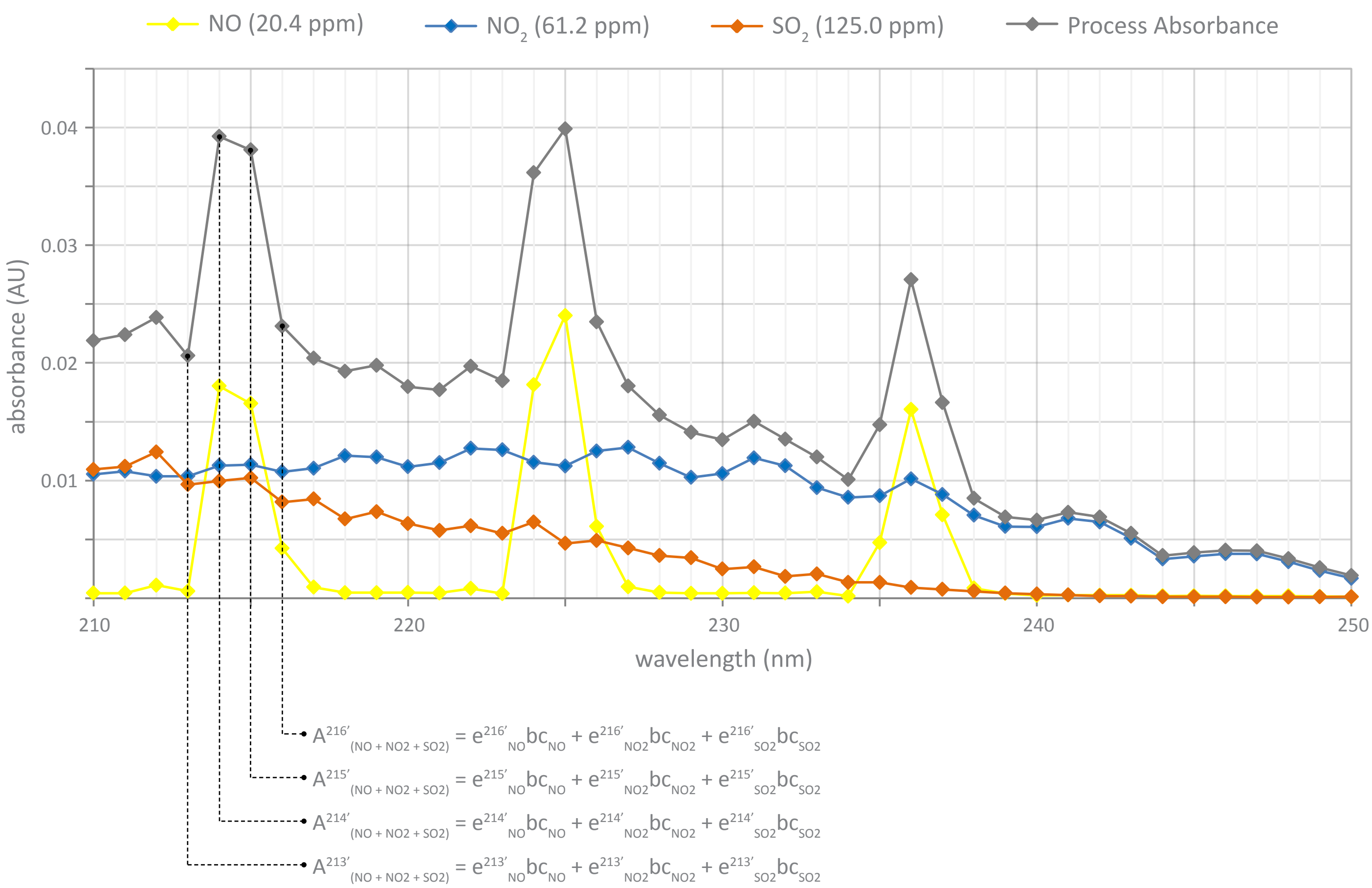
Through full-spectrum acquisition, the OMA has access to many measurement wavelengths. In order to constantly optimize the signal, the OMA runs parallel analysis models, each differentiated by their wavelength range and each suited for a specific concentration range.

The caffeine absorbance curve below demonstrates this capacity for expansive dynamic range:



Multi-Component Analysis

The ECLIPSE software is capable of measuring up to 5 chemical species simultaneously by de-convoluting the absorbance curve of each analyte from the total sample absorbance structure.



As illustrated above, each measurement wavelength contributes an equation to a matrix which is continuously solved by the ECLIPSE multi-component algorithm. Due to the resolution of the spectrophotometer, this procedure isolates the absorbance curves of the analytes with very high accuracy and is not susceptible to cross-interference.

Photometers that offer multi-component analysis will often use crude techniques like rotating “chopper” filter wheels or a group of line source lamps. These solutions implement moving parts that are prone to malfunction and multiple light sources that all require replacement, while delivering inferior accuracy.

Through the power of rich data, the OMA provides robust multi-species measurement using a solid state design and a single light source.

» **Benefit Summary**

- Measure up to 5 chemical species simultaneously with a single OMA
- Add or remove analytes at any time
- Full subtraction of background absorbance (for avoidance of false positives)

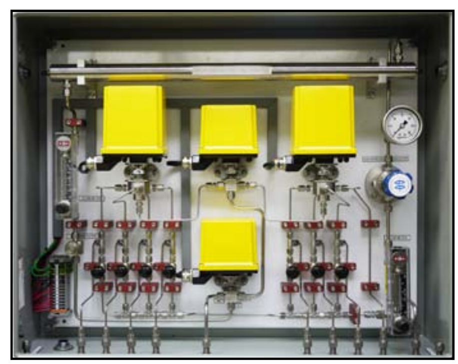
Sample Conditioning & Integration

OMA systems use flow cells rated for extreme temperature and pressure, while moisture is transparent to the UV signal. This allows us to build far simpler, more elegant sample conditioning systems that retain high sample integrity and optimal response time.

In our experience, applications can be similar but rarely identical. That is why we always work from the process realities to the drawing board, building custom sample conditioning for each project.

Our core competencies in sampling design include headspace sampling for opaque process streams, close-coupled systems for stack gas analysis, corrosion-proof systems, in situ probes, and stream multiplexing.

Headspace SCS
0-100 ppm H_2S in crude oil



Multiplexed SCS
0-20 ppm H_2S in 7 streams

Ultra-Corrosive Sample SCS
0-50% Cl_2 and 0-30% NCl_3

User Experience

The OMA only requires a one-time calibration during installation. Designed for long-term unattended operation, the system depends on Auto Zero to maintain measurement stability. Spanning is not required to meet performance specifications, but Auto Span is offered as an optional feature.

» Auto Zero

The OMA is self-maintained by periodically normalizing the spectrophotometer on a zero-absorbance fluid (e.g. nitrogen, air) in order to “zero” (i.e. blank) the analyzer. The ECLIPSE Auto Zero function automates this task by operating the SCS valves via relays to purge the flow cell with zero fluid and save a new zero spectrum. Auto Zero can be run on-demand or at a scheduled frequency.

runtime display

Auto Zero

In a typical usage profile, Auto Zero is set to run every 8 hours. The task requires approximately 120 seconds during which the measurement output is frozen. Under these settings, the OMA can provide *greater than 99.5% analyzer uptime*.

Evolution of OMA

The OMA process analyzer design was developed and first manufactured in 1993 with the conviction that dispersive UV-Vis spectroscopy was an ideal technology for online analysis of liquid/gas process streams.

Since then, the OMA series has been deployed for a vast array of applications across various industries. Due to the benefits of accurate multi-component analysis, wide dynamic range, and solid state reliability, this technology has steadily replaced the simple photometers of the past.


original OMA-300 design in 1993

APPLIED
ANALYTICS
OMA300
Applied Analytics, Inc.
Sample Conditioning System
WARNING
PANEL
ENERGIZED
SAMPLE CONDITIONING SYSTEM

Technical Specifications

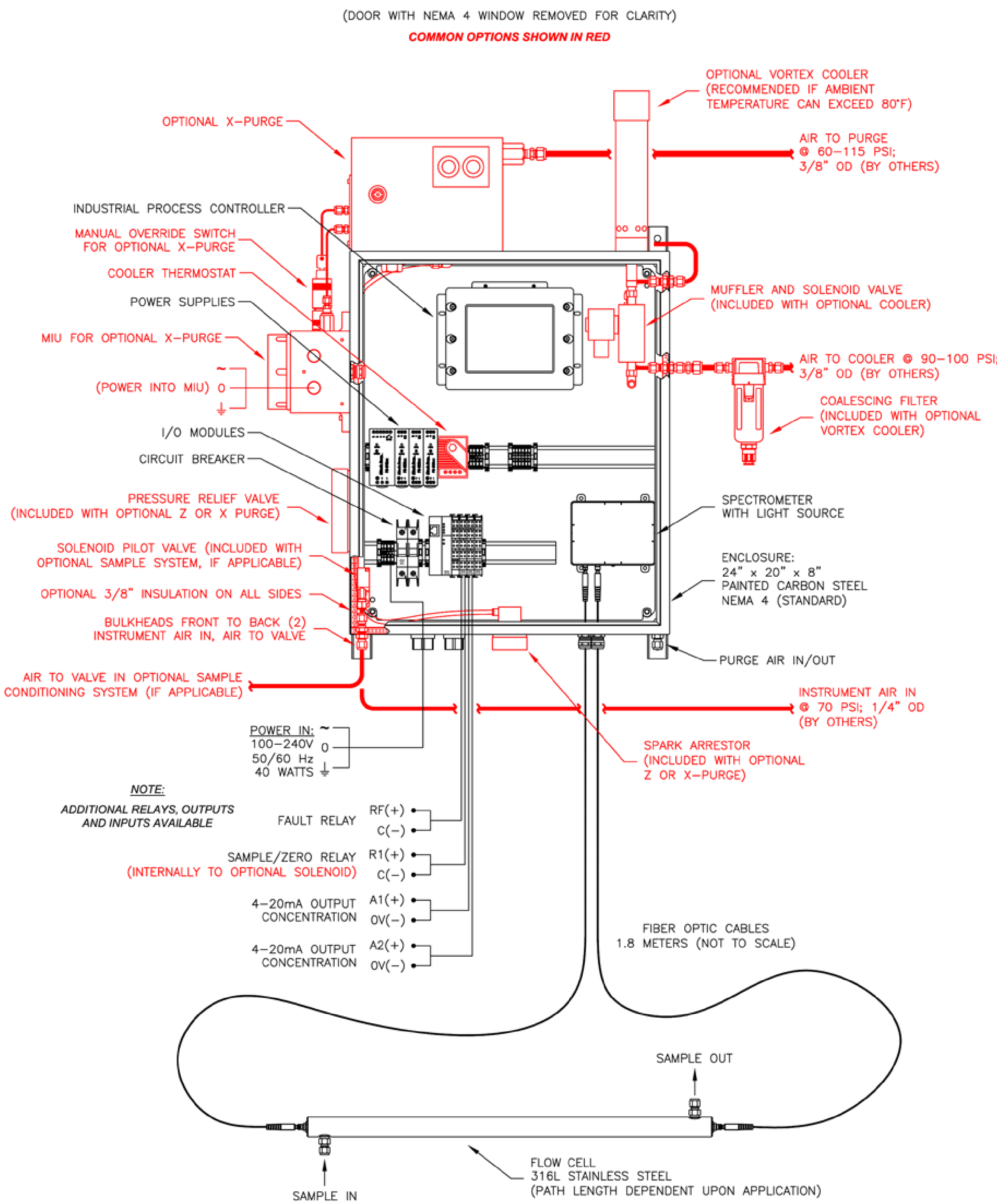
Note: All performance specifications are subject to the assumption that the sample conditioning system and unit installation are approved by Applied Analytics. For any other arrangement, please inquire directly with Sales.

Subject to modifications. Specified product characteristics and technical data do not serve as guarantee declarations.

General			
Measurement Principle	Dispersive UV-Vis / SW-NIR absorbance spectrophotometry		
Detector	nova II™ diode array spectrophotometer		
Spectral Range	200-800 nm or 400-1100 nm		
Light Source	Standard: pulsed xenon lamp (average 5 year lifespan)		
Signal Transmission	Standard: 600 µm core 1.8 meter fiber optic cables		
Sample Phase	Gas or liquid		
Sample Introduction	Standard: stainless steel 316L flow cell with application-dependent path length		
Sample Conditioning	Custom design if needed		
Analyzer Calibration	If possible, analyzer is factory calibrated with certified calibration fluids; no re-calibration required after initial calibration; measurement normalized by Auto Zero		
Reading Verification	Simple verification with samples or neutral density filters		
Human Machine Interface	Industrial controller with touch-screen LCD display running ECLIPSE™ Software		
Data Storage	32GB Solid State Drive		
Available Certifications	CSA Class I, Division 1; CSA Class I, Division 2; ATEX Exp II 2(2) GD *Please inquire for other certifications.*		
Measuring Parameters			
Repeatability	±0.5% of scale		
Photometric Accuracy	±0.004 AU		
Spectral Resolution	~1 nm		
Sample Conditions			
Sample Temperature	Using immersion probe: -20 to 150 °C (-4 to 302 °F) Using standard flow cell: -20 to 150 °C (-4 to 302 °F) Using optional sample cooling: up to 1000 °C (1832 °F)		
Sample Pressure (max)	Using immersion probe: 100 bar (1470 psig) Using standard flow cell: 206 bar (3000 psi)		
Ambient Conditions			
Analyzer Environment	Indoor/Outdoor (no shelter required)		
Ambient Temperature	Standard: 0 to 35 °C (32 to 95 °F) With optional temperature control: -20 to 55 °C (-4 to 131 °F) *To avoid radiational heating, use of a sunshade is recommended for systems installed in direct sunlight.*		
Utility Requirements			
Electrical	85 to 264 VAC 47 to 63 Hz		
Power Consumption	45 watts		
Outputs/Communication			
1x galvanically isolated 4-20mA analog output per measured analyte (up to 3; additional available by upgrade) 2x digital outputs for fault and SCS control Optional: Modbus TCP/IP; RS-232; RS-485; Fieldbus; Profibus; HART; more			
Physical Specifications			
	Model OMA-300	**Model OMA-206P**	**Model OMA-406R**
Analyzer Enclosure	Standard: wall-mounted, carbon steel NEMA 4 enclosure	Ultra High Impact structural copolymer suitcase	Steel rackmount enclosure for standard 19″ rack
Analyzer Dimensions	24″ H x 20″ W x 8″ D (610 x 508 x 203 mm)	16.87″ H x 20.62″ W x 8.12″ D (428 x 524 x 206 mm)	8.75″ H x 19″ W x 11.46″ D (222 x 483 x 291 mm)
Analyzer Weight	32 lbs. (15 kg)	25 lbs. (11 kg)	30 lbs. (14 kg)
Wetted Materials	Standard: K7 glass, Viton, stainless steel 316L		

Model OMA-300 Technical Drawing

See data sheets for drawings of OMA-206P and OMA-406R.



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