TELEDYNE
MONITOR LABS
A Teledyne Technologies Company

SM8200

SO2/NO In Situ Multi-Gas Analyzer

The SM8200 combines state-of-the-art chemometric spectroscopic analysis software and second-derivative (d2) ultra violet (UV) technology with the proven features of the SM81XX series of analyzers to provide a rugged in situ analyzer.

The **SM8200** provides a unique innovative approach to monitoring SO2 and NO in utility and industrial process emission monitoring applications. This unique technology allows the **SM8200** to measure the absorption of UV energy by SO2 and NO molecules, with no interference from H2O, CO, O2 or CO2 as is common with other analytical techniques. Unlike extractive techniques, this method does not require gases for reference, sample conditioning, pumps, or other plumbing which can leak or cause sample degradation. With no continuously moving parts, the **SM8200** offers the ultimate in reliability. The **SM8200** transceiver includes a built-in keypad and display that enables the operator to configure, diagnose, calibrate, and operate the instrument while on the stack or duct. This allows basic maintenance and calibration procedures to be done by a single person without control room support. The on-stack equipment works in conjunction with Teledyne Monitor Labs' Enhanced Remote Panel (ERP), and can also handle an optional O2 or CO2 analyzer. The ERP provides a 14 line by 30 character display so that complete data can be simultaneously displayed for each analyzer. It further provides Ethernet access to all measurement and status information as well as digital contact closure and analog outputs. This measurement, control and reporting capability, when used with a Teledyne Monitor Labs RegPerfect Data Acquisition System (DAS) fully meets the requirements of U.S. EPA 40CFR75 as well as 40CFR part 60 for continuous emission monitoring systems (CEMS).

The **SM8200** features a choice of calibration cross-checks, including AUTOMATIC DYNAMIC CALIBRATION which enables the measurement accuracy to be verified with calibration gases measured at the same temperature and pressure as the flue gas being measured, and an alternate electro-optical calibration which uses an internal gas filled cell to verify the span stability of the instrument. Designed to operate with gases having high water vapor content, high particulate loading and high temperatures, the **SM8200** is ideally suited to a variety of combustion gas monitoring applications, including installation prior to particulate control equipment such as baghouses and Electro Static Precipitators (ESP) and after DeNOx emission control systems.

FEATURES

LOW MAINTENANCE

With a time-tested ceramic diffusion cell, rugged design, and proven measurement technique, six to twelve months of reliable, maintenance-free operation is typical. An innovation in lamp control techniques has considerably extended lamp life, compared to earlier UV in situ analyzers.

FLEXIBLE MEASUREMENT RANGES

Internal gains for each measurement channel can be independently adjusted to provide optimum accuracy for each gas of interest. Measurement cavities are selectable from less than one centimeter (cm) to 150 cm to accommodate an extensive range of gas concentrations from single digit to percent concentrations. The power of chemometrics also allows the **SM8200** to handle wider ratios of SO2 versus NO than was previously possible with the original d2 technology.

Chemometrics is the application of mathematical techniques to chemistry data, typically spectra of one type or another. There are many techniques, most of which look for correlations between the spectral and gas concentration data sets. We use Partial Least Squares (PLS) to develop the models used in the **SM8200.**

CALIBRATION VERIFICATION

Unequaled measurement accuracy is made possible through in situ dynamic gas calibrations for both zero and span. Zero gas can either be supplied via instrument air or a separate bottled gas.

VERSATILE

Selectable measurement cavities/ ranges and probe lengths that accommodate gas temperatures to 800° F make the **SM8200** ideally suited to a variety of combustion monitoring applications, including hot and dirty gases. Additionally, a variety of analog and digital inputs and outputs are available through the Analyzer Electronics Box (AEB) and ERP which can be made a part of the CEMS data records.

INEXPENSIVE AND EASY INSTALLATION

Major assemblies are easily handled by a single person. The **SM8200** mounts on a single port, with data transmitted from the stack to the ERP over a single pair of shielded wires using a field proven LONWORKS® network approach. This data link also incorporates electrical isolation for high data integrity in typical harsh industrial environments, and is largely immune to nearby lightning activity.

CYLINDER GAS AUDITS

Provide easy traceability to known standards, greatly reducing the effort and cost of U.S. EPA certification and periodic multigas quality assurance audits. Cylinder gas audits (CGA) can be automated with an optional CGA audit box.

OFF SITE ACCESS

Ethernet interface connectivity allows remote access to all major instrument diagnostic information. This eliminates the need to be at the installation site to observe what is going on with the analyzer.

IN SITU PROBE

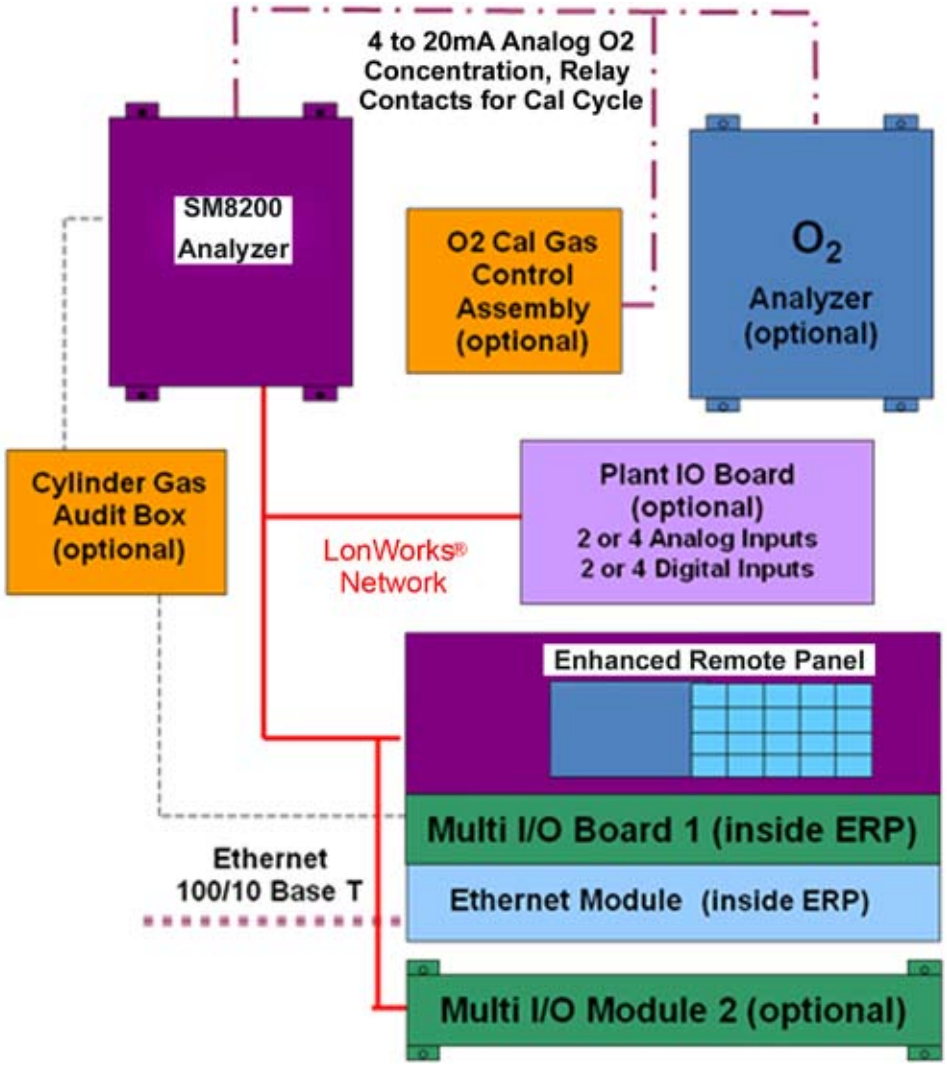
The proven probe design permits in situ gas measurement without any sample extraction, conditioning or transport. The stainless steel probe includes a Resistance Temperature Detector (RTD) gas temperature sensor and selectable gas measurement cavity.

It also incorporates a port for injecting calibration gas into the measurement cavity and a gas pressure sensing port which allows continuous correction for changes in gas pressure. The optical pathlength of the measurement cavity is precisely defined by a quartz window and retro-reflector assembly. As the stack gases diffuse through the ceramic filter and into the measurement cavity, the ultraviolet measurement beam is absorbed according to the unique absorption characteristics of the SO2 and NO in the stack gas.

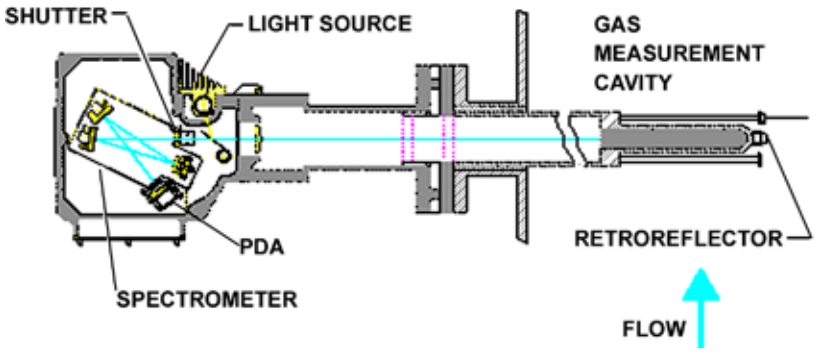
This porous diffuser concept has been tested in thousands of industrial installations and has proved to provide high reliability and very low maintenance.

Optical contamination is avoided by encasing the measurement cavity in a porous, nonreactive, ceramic diffuser. This element permits the gaseous components to diffuse into the measurement cavity, while blocking particulate matter. Clogging is prevented by an aerodynamic deflector that keeps particulate from accumulating on the sides of the diffuser.

SYSTEM COMPONENTS



TOP VIEW (HORIZONTAL FLOW)



TRANSCEIVER

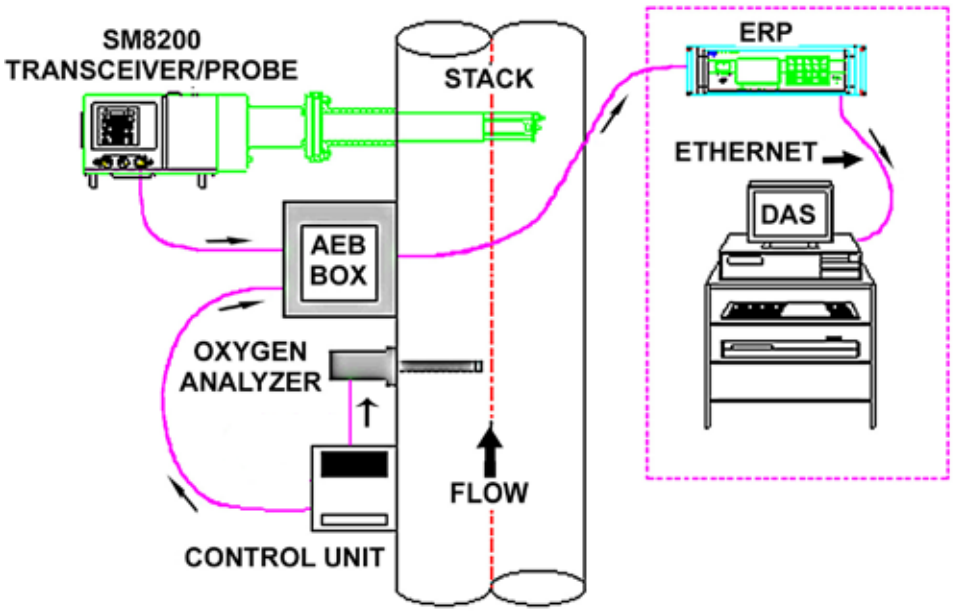
The transceiver contains the optical system which provides the spectral information that allows the second derivative based measurement values to be computed, with typical one-minute updates of SO2 and NO measurements. The measurement technique is also inherently compensated for changes in the light level which may occur as a result of lamp aging, gradual buildup of optical contamination on the exposed, but protected, retroreflector and window, and shifts in alignment due to temperature and mechanical stress. The optical system is temperature stabilized to minimize sensitivity to ambient temperature. It is easily removed from the probe and disconnected from the AEB for off-stack maintenance. The transceiver also contains a Local User Interface (LUI) which includes a display and keypad for monitoring and controlling the analyzer measurement, diagnostic, and configuration information. This allows for easy on-stack evaluation and/or correction of calibration and operational status.

ANALYZER ELECTRONIC BOX

Mounted beneath the transceiver, the Analyzer Electronic Box (AEB) assembly provides transceiver measurement information to the controller over an electrically isolated LONWORKS® network data link. The AEB, which is continuously purged with instrument air, contains a pressure regulator and gauges to regulate gas flow during calibrations and purge air. An optional pc board contains input/outputs to the O2 analyzer which is required for pound per million British Thermal Unit (BTU) calculations.

ENHANCED REMOTE PANEL

Typically mounted in the control room, the Enhanced Remote Panel (ERP) incorporates a display and keypad which provides for fault monitoring, emission alarms, measurement access, and automatic or manually timed calibration cycles. It further outputs measurement data in both analog and digital and provides Ethernet access.



PRINCIPLE OF OPERATION

The **SM8200** multi-gas analyzer enhances the d2 techniques developed in the SM81XX series of gas analyzers, and proven in thousands of installations, by adding the vast mathematical power of chemometric techniques. Chemometrics, as we use it, is the application of mathematical techniques to chemistry data, typically spectra of one type or another. There are many techniques, most of which look for correlations between the spectral and gas concentration data sets. We use Partial Least Squares (PLS) to develop the models used in the SM8200.

The analyzer measures the UV response of SO2, NO, and other gases, using a 512 element photo diode array (PDA) in association with a dispersive element (diffraction grating) to establish 512 individual pixel, or wavelength, measurements of a gas stream. At the factory we apply a variety of gas mixtures, known as the “training set”, which are analyzed using a unique combination of partial least squares techniques, statistical smoothing and derivatizing algorithms, and matrix mathematical operations. These routines, along with measurement of the PDA dark current, the sample cell clear path, and the spectra of the gas sample, are used to create a calibration matrix that allow the analyzer to calculate the unique combination of gases in the stack sample that are in the observed spectra of that sample. Additionally, the spectra are analyzed to allow us to just use that portion that provides the most unique information of interest, further reducing the potential for interference from other gases. The data is also corrected for temperature and pressure, which are measured along with each spectra.

The result is a simplified optical system without any continuously moving parts, high voltage power supplies, or photo multiplier tubes. We end up with a very accurate, rugged, and durable software based analyzer which surpasses previous analytical techniques, and which is easily adapted to a great variety of applications, which may include hot and dirty gases with deNOx emission control systems.

Specifications

MEASUREMENT RANGES	SO2 and NO	Minimum 0 to 50 ppm; Maximum 0 to 10,000ppm
	SO2/NO Range Ratio	Minimum 0.125; Maximum 8
	Stack Temperature Measurement	Range: 0 to 800°F (-17.8°C to 426.7°C)
GAS MEASUREMENTS LOWER DETECTABLE LIMITS	(LDL'S defined as standard deviation of 15 successive one-minute measurements) (valid from 75°F to 400°F (23.9°C to 204.4 °C)	
	SO2	1% of nominal full scale, or 1.5 ppm, whichever is greater
	NO	1% of nominal full scale, or 1 ppm, whichever is greater
GAS MEASUREMENT CHARACTERISTICS COMMON TO ALL GASES	Response Time	Adjustable to a minimum of 200 seconds to 95% of value
	Measurement Principle	2nd Derivative UV Absorption Spectroscopy with Chemometrics
	Environmental Regulatory Compliance	USEPA 40CFR60 OR USEPA 40CFR75, dependent on instrument configuration and options
	Calibration Drift, Zero & Span	± 2.5% of range, or 5 ppm for range <200 ppm, whichever is greater
	Linearity	±5% of Reference Value from 20 to 100% of range (valid from 75°F to 400°F (23.9°C to 204.4°C)
POWER & INSTRUMENT AIR REQUIREMENTS	Analyzer Electronics Box	115 VAC 575 VA Maximum 230 VAC, 590 VA Maximum 47-63Hz, Single Phase, Factory Wired
	Analyzer Instrument Air	Analyzer requires 0.1 CFM to 0.706 CFM (2.8 to 20 LPM) of clean, oil-free dry air or N2 at 69.6 PSI to 101.5 PSI (480 to 700KPa) gauge
	Calibration Gas Heater (Part 75 only)	115/230 VAC 300 VA Maximum
	Enhanced Remote Panel Power	85-245 VAC, 47-63Hz, Single Phase, 30 VA Maximum Fuses 2 Amp Time Delay, 250V, 5x20mm
	Multi I/O Module Power (optional)	85-245 VAC, 47-63Hz, Single Phase, 25 VA Maximum Fuses 2 Amp Time Delay, 250V, 5x20mm
	Plant I/O Module Power (optional)	85-245 VAC, 47-63Hz, Single Phase, 25 VA Maximum Fuses 2 Amp Time Delay, 250V, 5x20mm
AMBIENT OPERATING CONDITIONS	Analyzer Electronics Box and Transceiver	Temperature Range: -30 to +130°F (-34.4 to 54.4°C). Relative Humidity Range: 0 to 100% condensing. Barometric Pressure Range: 18 to 32"Hg (61.1 to 108.6 KPa). Enclosure Rating: NEMA4
	Enhanced Remote Panel & (Optional) Multi I/O Module	Temperature Range: +32 to +104°F(0 to +40°C) Relative Humidity Range: 0-95% non-condensing
MEASUREMENT MEDIUM CONDITIONS FOR GAS MEASUREMENT	Static Pressure Range for Valid Measurement	±20" H2O (±4.98 KPa) Gauge
	Maximum Particulate Concentration	4.37 grains/SCF (10,000 mg/Nm3)
	Humidity	Non-condensing.
	Temperature Range for Valid Measurement	75 to 800°F (23.9 to +426.7°C)
WIRING REQUIREMENTS, ANALYZER TO ENHANCED REMOTE PANEL	Network Transceiver Type	Free Topology Transceiver (FTT10A)
	Cable Type	2 conductor shielded twisted pair, 16 AWG (Alpha 5610B1601 or equivalent)
	Termination Style	Jumper Selectable Double Termination (Internal)
	Maximum Distance Between Analyzer & Enhanced Remote Panel	3281 feet (1000 meters) [must be Double Terminated]
	Maximum Total Network Length	3281 feet (1000 meters) [must be Double Terminated]
ENHANCED REMOTE PANEL I/O	2 Serial Ports	1-RS232C, 1-RS422 or RS485 (selectable)
	1 Ethernet Port	10/100 Base T
	4 Analog Outputs	4-20 mA*
	8 Digital Inputs	Dry, Isolated or Non-Isolated*
	8 Relay Outputs	Single Pole Single Throw, Normally Open*
	*Note: Optional Multi I/O Board will Double these above outputs.	

DYNAMIC GAS CALIBRATION

The gas calibration technique can be activated either automatically at predetermined intervals, manually from the ERP or LUI, or via digital command. When the instrument enters the automatic gas calibration cycle, zero gas is first flowed into the measurement cavity to establish a true zero concentration baseline. Then, a high level calibration gas of known concentration is injected into the measurement cavity where it is measured at the same temperature and pressure as the stack gas. Purge and averaging times are menu selectable, and calibration values are output from the Enhanced Remote Panel. Automatic selectable correction for calibration drift is applied after the calibration check is completed. When the calibration gas is injected into the measurement cavity through the port provided on the mounting flange, it provides a complete check of the measurement system, including all components used in measuring the normal stack gas concentrations. Gas measurements are continuously corrected for the effects of variable gas temperature and pressure.

SPAN CELL CALIBRATION CHECKS

The instrument includes an internal span cell containing both SO2 and NO gases which can be solenoid activated. When this electro-optical mode of calibration is selected, the calibration cycle consists of a zero calibration based on flowing zero calibration gas into the measurement cavity, and then an upscale check based on inserting the span cell into the light beam. This calibration check does not provide for automatic span correction, but does provide a simple method of verifying instrument operation and stability without consuming calibration gases. This method can also be selected either automatically, manually, or by command from an external DAS.

The **SM8200** is inherently linear, but adjustments have been provided to match the measurements to 40CFR75 specified calibration gases. An adjustable linearizer is provided to allow trimming the output for low, mid, and high level measurements.

APPLICATIONS

The **SM8200** is ideally suited for industrial emission monitoring applications. It is designed for a wide range of stack gas conditions, and can be applied in extremely dirty gas applications such as encountered before ESPs or baghouses. It can be used in conjunction with an O2 or CO2 analyzer to provide SO2 and NO, in pounds per million British Thermal Unit (BTU), or pounds per hour with appropriate flow measurements. The **SM8200** can be used for tuning low NOx burners as well as complete CEMS applications. Gas concentrations are available in either parts per million by volume wet basis (v/v wb) or milligrams/normal meter cubed (mg/Nm3) and stack temperature is available in degrees C or F. Measurement averages are selectable up to about 60 minutes. As a result, the **SM8200** is easily integrated into a CEMS for compliance applications, or a process control system. A full range of TML services are available to support the instrument from startup, training, and certification, through on-call or periodic contract maintenance.

OPTIONS

Multi I/O Module: The Multi I/O module provides additional outputs from the SM8200. The module connects to the analyzers LONWORKS® network and can be located either with the ERP or remotely from the Transceiver. The unit doubles the available Analog Outputs, Digital Inputs, and Relay Outputs from the SM8200.

Plant I/O Module: The Plant I/O Module provides a means to bring external plant operating data (such as Unit Up/Down, Fuel Flows, Fuel Type, etc.) into the SM8200 which can then be transmitted into the DAS System. The module connects to the analyzers LONWORKS® network and can be located with the ERP either remotely or from the Transceiver.

Cylinder Gas Audit Box: This box provides the valves and control necessary to automate the CGA procedure.

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