

Rosemount™ X-STREAM *Enhanced* XECLD

Chemiluminescence Continuous Gas Analyzer



Proven chemiluminescence technology with modern digital capabilities

The Rosemount X-STREAM *Enhanced* XECLD Gas Analyzer uses chemiluminescence technology to measure low and ultra-low nitrogen oxides (NO_x) concentration.

Designed for carefree maintenance and greater reliability, the Rosemount XECLD Gas Analyzer eliminates vacuum pumps, reducing a potential source of vibration, which can compromise equipment integrity and reliability or add maintenance requirements.

Overview

Combining the tried and true sensitivity and stability of the original CLD analyzer with the powerful, digital communication architecture of the Rosemount X-STREAM *Enhanced* gas analyzer series, the Rosemount XECLD Continuous Gas Analyzer delivers fast and accurate measurements of nitrogen oxide (NO/NO₂/NO_x) over a wide dynamic range from 0 to 5 ppm through 0 to 10,000 ppm. The Rosemount XECLD Continuous Gas Analyzer is built upon the time-proven chemiluminescence detection technology pioneered by Emerson's Beckman instruments, a technology that still reigns today as the industry's standard reference method for measuring nitrogen oxides (NO_x).

As part of the powerful Rosemount X-STREAM *Enhanced* Continuous Gas Analyzer series, the Rosemount XECLD Gas Analyzer is equipped with a solid-state detection technology and a full range of digital capabilities, including remote analyzer connectivity without installation of additional software. This simplifies access to analyzer health and actionable information that plant personnel can use to improve reliability, safety, and regulatory compliance in a variety of emissions monitoring and process gas analysis applications.

Designed for optimum reliability, the Rosemount XECLD Continuous Gas Analyzer uses next generation, thermoelectrically cooled chemiluminescence detector assembly, ensuring highly stable measurement performance and a longer operating life. The reliability and rapid response time of the Rosemount XECLD Continuous Gas Analyzer makes it particularly well-suited for vehicle and engine emissions certifications testing, as well as continuous emissions monitoring, combustion efficiency, and process control in purity measurement applications.

The analyzer houses the ozone generator, chemiluminescence reaction chamber, solid-state photodiode detector, and signal processing electronics. The reaction chamber operates at atmospheric pressure, eliminating the need for the bulky vacuum pump found in other chemiluminescence instruments.

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Principle of operation

The chemiluminescence reaction between ozone and nitric oxide is used to determine the presence of oxides of nitrogen (NO_x) in a sample gas.

The chemiluminescence measurement involves the following reactions:

1. **Reaction 1:** $\text{NO} + \text{O}_3 \rightarrow \text{NO}_2^* + \text{O}_2$

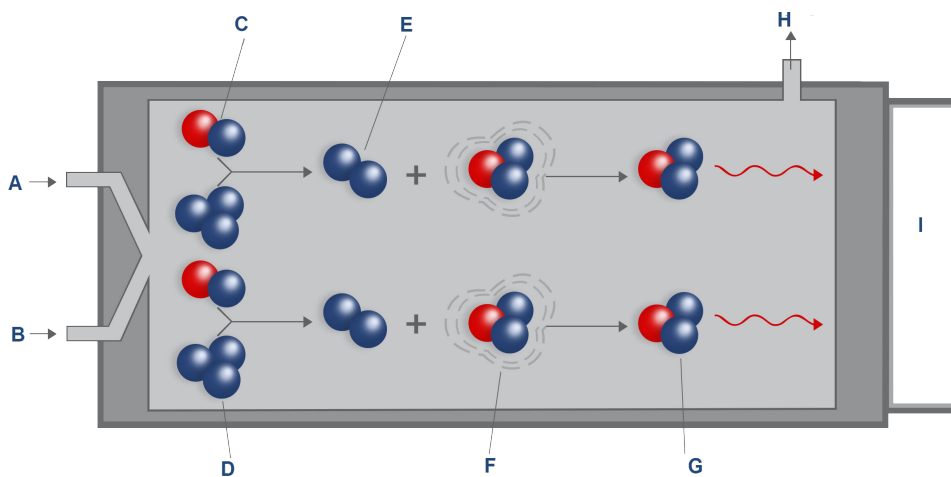
In Reaction 1, nitric oxide and ozone (O_3) readily react to form nitrogen dioxide in an electrically excited (NO_2^*) state.

2. **Reaction 2:** $\text{NO}_2^* \rightarrow \text{NO}_2 + h\nu$ (red light)

In Reaction 2, the excited NO_2^* immediately reverts to the ground state, emitting photons (red light).

The light intensity is measured by the photodiode detector. An integral proportional solenoid valve and capillary tube are used to maintain constant sample pressure and flow rate in the reaction chamber. Combining this controlled flow of sample gas with an excess of ozone ensures that the intensity of the resultant chemiluminescence reaction (2) is directly proportional to NO concentration in the sample.

Figure 1: Chemiluminescence Reaction



- A. Nitric oxide (NO)
- B. Ozone (O_3)
- C. NO molecule
- D. Ozone molecule
- E. O_2 molecule
- F. NO_2 molecule (excited state)
- G. NO_2 molecule (emitting red light)
- H. Vent
- I. Photodiode

The technique for NO_x (NO/ NO_2) measurement is identical to that described above for NO except that before the sample gas is reacted with ozone, any NO_2 in the sample is converted to NO by a heated vitreous carbon bed. Any NO present in the sample passes through the converter unchanged before being routed to the reaction chamber.

Features

- Thermoelectrically-cooled solid-state detector (photodiode) ensures high stability and measurement performance
- Fast response, t90 within two seconds for reliable continuous monitoring
- Four user-selectable ranges from 0 to 10,000 ppm make the analyzer ideal for a wide variety of applications
- Automated ozonator shutoff on loss of air pressure prevents damage to the ozone generator
- Remote analyzer access and automatic calibration simplify operation and ensure reliable performance
- Online diagnostic capabilities enhance visibility to analyzer health and process conditions. This includes automated monitoring of reaction chamber pressure that provides maintenance messages if linearization and quenching are out of specification.
- Efficient, interference-free vitreous carbon NO₂ converter ensures measurement accuracy
- High voltage corona discharge ozone generation ensures full performance up to 10,000 ppm without pure oxygen
- Internal sample bypass flow eliminates additional tubing, maintenance requirements, and flow disturbance
- Atmospheric pressure operation eliminates the need for vacuum pumps and their maintenance requirements

Modern communication

Rosemount X-STREAM *Enhanced* Continuous Gas Analyzers offer a unique integrated web interface that features:

- Configuration and monitoring capabilities without the need to install additional software
- Email notification or daily reports of alarms and events

Rosemount X-STREAM *Enhanced* Continuous Gas Analyzers provide four status signal relay outputs (according to NAMUR NE 107), Modbus[®] TCP protocol over Ethernet (RJ45), and optional Modbus RTU over serial (RS-232/RS-485) communication. Onboard SD card, USB ports, and FTP client enable storage of:

- Measurement data, calibration, and event logger files
- Analyzer configuration files
- PLC and calculator programs

The analyzer can be easily upgraded with an additional In/Out (IO) board featuring nine digital outputs and seven digital inputs or an Analog Input board (AIN) with two inputs for integration of external measurements into the powerful digital X-STREAM *Enhanced* environment. Up to two analog outputs (according to NAMUR NE 43) are available.

Easy-to-use tools

The software of the Rosemount X-STREAM *Enhanced* Continuous Gas Analyzers provides several tools that make complex process analyzer systems easier and help eliminate additional expenses for third-party equipment:

- Time controlled routines for auto-calibration and auto-validation using external valves
- Automated valve assignment verification to avoid miscalibration
- Programmable Logic Controller (PLC) for things such as sample handling control/sample gas line switching or programming of customized alarms. (PLC can also switch between NO and NO_x mode.)
- Calculator for virtual measurements such as reference to certain oxygen content, heating value, etc.
- Limit alarms with reports for concentrations and secondary measurements, such as temperature and pressure
- Intuitive local operator interface featuring an LCD display that can be operated manually by only six keys

Applications

- NO/NO_x emissions Continuous Emission Monitoring Systems (CEMS) from combustion of fossil fuels in incinerators, boilers, gas appliances, and vehicle engine exhaust
- Turbine exhaust
- Nitric acid plant emissions
- Selective Catalytic Reduction (SCR) process control and efficiency monitoring
- Industrial and medical as well as food and beverage gas purity measurements

Specifications

Performance specifications

Range minimum/maximum	0-5 ppm / 0-10,000 ppm
Detection limit (4 σ) ⁽¹⁾⁽²⁾	≤ 1%
Linearity ⁽¹⁾⁽²⁾	≤ 1%
Zero point drift ⁽¹⁾⁽²⁾	≤ 0.5% per 24 h
Span (sensitivity) drift ⁽¹⁾⁽²⁾	≤ 1% per 24 h
Repeatability ⁽¹⁾⁽²⁾	≤ 0.5%
Response time (t ₉₀) from gas analyzer inlet	≤ 2 s (≤ 4 s for range < 25 ppm)
Sample flow rate	0.5 - 1.0 L/min
Inlet gas pressure	8.7 to 21.8 psig (0.6 to 1.5 Bar)
Permissible ambient temperature	41 to 104 °F (5 to 40 °C)
Warm-up time	60 min
Converter efficiency	> 95%; typical at 98%
Influence of temperature⁽¹⁾⁽³⁾	
On zero point	≤ 2% per 10 K
On span (sensitivity)	≤ 3 % per 10 K

(1) *Related to full scale*

(2) *Constant pressure and temperature*

(3) *Temperature variation < 10 K per h*

Requirements for sample gas supply and air supply to the ozonator

The sample gas into the analyzer must be conditioned by a sample handling system for standard and upset process conditions:

- Sample gas dew point is more than 5 °C below lowest ambient temperature.
- Air supply (ozonator) dew point is a maximum of -40 °F (-40 °C) and must be free from oil.
- To protect the analyzer from droplets, Emerson highly recommends a coalescence filter in front of the analyzer.
- Install a particulate filter with 2 μ m probe size for sample and air supply.
- Do not use the analyzer to measure explosive and flammable gases or gas mixtures.

Functional specifications

Gas connections	Inlet: ¼ in. or 6 mm Outlet: ⅜ in. or 10 mm
Rated voltage	100 to 240 V, approximately 50/60 Hz ±10%
Rated input current	2-1 A
Power input	IEC connector (C13)
Signal connection	Submin-D connectors or screw terminals (max. 0.1 in. ² /1.5 mm ²), RJ45
Enclosure	19-in. (482.6 mm) table top or rack mount
Enclosure protection	IP 20 acc. EN60529 for indoor installation, pollution degree 2, protected against direct sunlight
Humidity (non-condensing)	< 90% relative humidity at 68 °F (20 °C) < 70% relative humidity at 104 °F (40 °C)
Ambient temperature	Storage: -4 to 158 °F (-20 to 70 °C) Operation: 41 to 104 °F (5 to 40 °C) Allow 1 HU (1¼ in./44.5 mm) distance to other equipment in cabinet.
Elevation	0-6560 ft. (0-2000 m) above sea level
Weight	27.12 lb. (12.3 kg)

Signal inputs, outputs, and interfaces

Signal type	Description
Analog signal outputs	1 or 2, individually optically isolated 4 (0)–20 mA (RB ≤ 500 Ω) 1 as standard, 2nd as option NAMUR NE 43 and NE 44 compliance
Relay outputs	Four status relays acc. NAMUR NE 107 or e.g., concentration thresholds, valve status notification dry contacts: 1A, 30 V
Communication interface	Ethernet with Modbus® TCP RS-485 / RS-232C with Modbus RTU USB port
Optional I/O boards for extension slots	
Digital in/out (I/O)	Seven digital inputs (for remote control); max. 30 Vdc, 2.3 mA, common ground Nine additional relay outputs (e.g. concentration thresholds, valve status notification, flow alarm, range ID) dry contacts: 1A, 30 V
Analog signal inputs	Two analog inputs 0–1(10) V (R _{in} - 100 kΩ) or 4 (0)–20 mA (R _{in} - 50 Ω)

Note

All signal lines need appropriate shielding and grounding as described in the [Rosemount XECLD Reference Manual](#).

Approvals and certifications

General compliance certifications for Rosemount X-STREAM *Enhanced* XECLD Gas Analyzer

European Union/CE EMC 2014/30/EU: EN 61326-1, EN 55011 Class B
 LV 2014/35/EU: EN 61010-1
 ROHS 2011/65/EU: EN 50581

Canada/USA CSA US/C: according to 61010-1 for general purpose analyzer

Hazardous area compliance

Dimensional drawings

Figure 2: Front Panel View

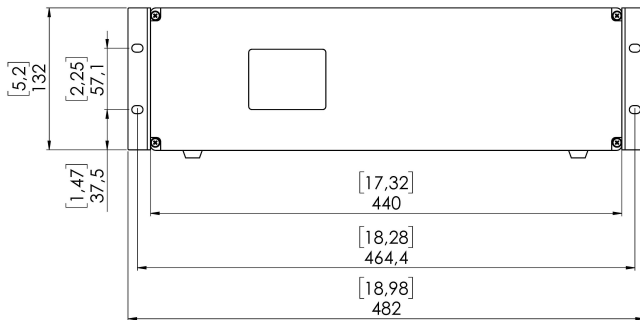


Figure 3: Back Panel View

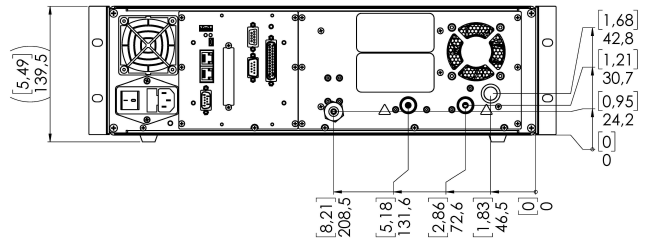
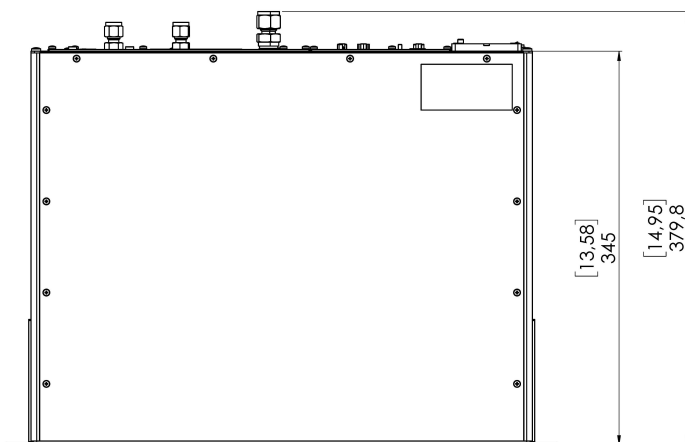


Figure 4: Top View



Note

Dimensions are in inches (mm).

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