

Technical Information

Raman Rxn5



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Function and system design

Analyzer technology

The Raman Rxn5 Analyzer is a turnkey laser-based Raman analyzer developed for applications in the petrochemical and gas treatment markets. In these applications, the Raman Rxn5 analyzer produces spectra that resemble--and can be analyzed like-- chromatograms, hence the designation as an “optical” chromatograph. However, these optical chromatograms do not require any valves, ovens, columns or use any carrier gas.

Fiber-optic probes (both gas and liquid style) are used to interface the Raman Rxn5 analyzer to the process sample. The Raman Rxn5 features four independent probes operating simultaneously obviating the need for mechanical stream switching. In addition, it allows for the application of four independent methods; in essence, it represents four analyzers in one unit.

The Raman Rxn5 is a multi-component analyzer and can measure gas mixtures containing several of the following components as low as 0.1 vol%: H₂, N₂, O₂, CO, CO₂, H₂S, CH₄, C₂H₄, C₂H₆, Cl₂, F₂, HF, BF₃, SO₂, CO₂ etc. In addition, the Raman Rxn5 can measure components at levels up to 100 vol%.

The Raman Rxn5 analyzer incorporates a flat screen, touch-sensitive display that is utilized for all user interactions. A simple tap with a finger is the equivalent of a mouse click.

Front view

The front of the Raman Rxn5 analyzer is shown below:

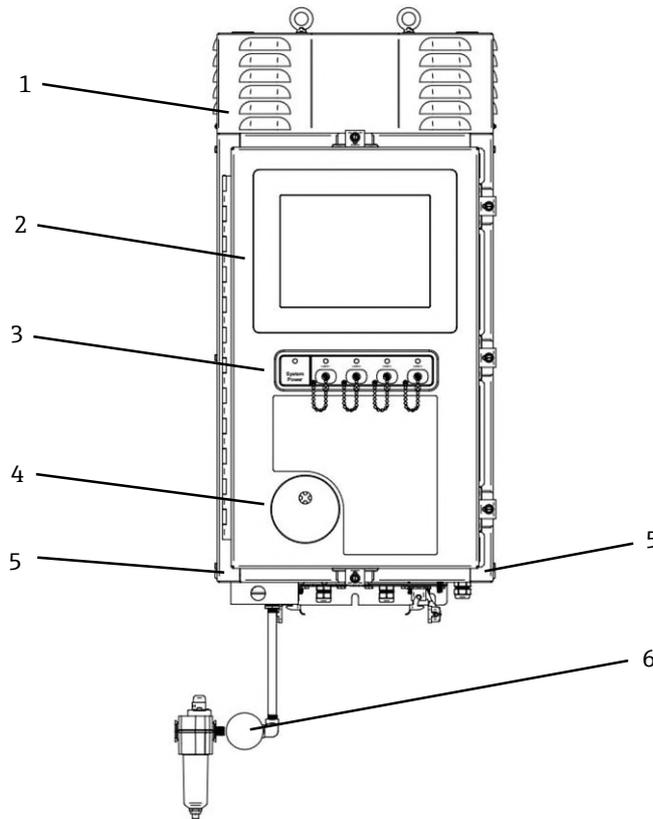


Figure 1. Raman Rxn5 analyzer front view

#	Name	Description
1	Cooling Exhaust Vent Shroud	Cooling air exhausts through the vents in this cover. Do not block.
2	Touchscreen Monitor	The built in Raman RunTime interface and touchscreen monitor.
3	Switch Indicator Panel and Laser On/Off Keys	<ul style="list-style-type: none"> • System power indicator. Green and steady indicates system is powered and operating normally. Red and fast flashing indicates system is powered, but internal temperature is too warm (take action). Red and slow flashing indicates that the system is too cold. Red and slow is normal upon startup in colder environments. • Laser on/off keys and indicators. Magnetically coupled switches control laser power for each channel. Switches are lockout/tagout compatible. Yellow indicators for each channel indicate if laser is on.
4	Purge Indicator	A Green indicator light that indicates that the pressure inside the enclosure is above 0.20" water column.
5	Cooling Air Inlet	Cooling air enters in this location in both sides of enclosure. Do not block.
6	Purge Valve and Purge Air Conditioning	The dilution and leakage compensation includes two modes: <ul style="list-style-type: none"> ▪ High Flow Dilution. The dial on the valve should be turned so the slot in the dial is horizontal and lined up with the "ON" position. This position is used to purge enclosure of potentially hazardous gases prior to power-up. Dilution time is >9.5 minutes. ▪ Leakage Compensation Mode. After manual dilution has been performed, the valve can be switched to this mode by turning the dial so the slot in the dial is vertical. This position is used to reduce purge air consumption after initial dilution.

Table 1. Raman Rxn5 analyzer front view

Interior view

The interior of the Raman Rxn5 analyzer is shown below:

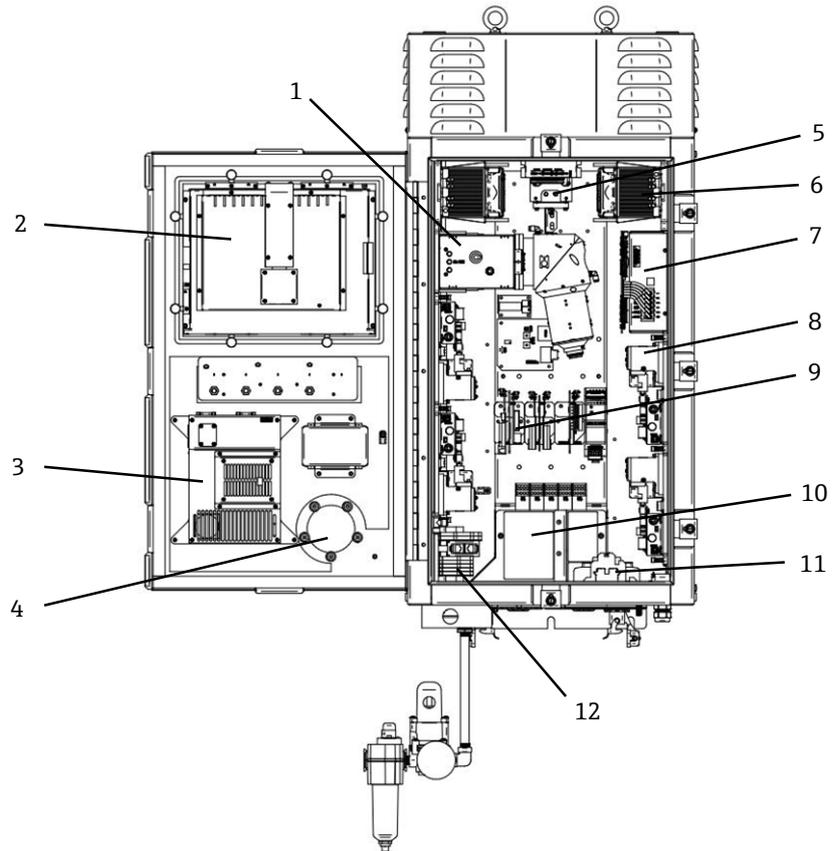


Figure 2. Raman Rxn5 analyzer interior view

#	Name	Description
1	Detection Module	The location where collected Raman scattered light from the sample is analyzed. There are four analysis channels in the detection module.
2	Touchscreen Monitor	Touchscreen monitor for Raman RunTime interface.
3	Embedded Controller	System controller with Raman RunTime.
4	Relief Valve	Monitors internal enclosure purge pressure and provides enclosure over-pressure relief valve. A Green indicator light that indicates that the pressure inside the enclosure is above 0.20" water column.
5	Motor Controller	A device that regulates the speed and direction of the cooling fan motor.
6	Coolers	Peltier cooling devices to remove waste heat from electronics inside the enclosure.
7	Power Supply	Main power supply which provides DC power for all electronics inside the enclosure.
8	Lasers (4)	The Rxn5 includes up to four lasers, depending on configuration ordered.
9	Control Electronics	Analyzer internal sensor signal conditioning and digitization electronics. Thermal control electronics and IS barrier power supply also reside here.
10	Intrinsically Safe IO Area	Probe fiber interlock and temperature/pressure sensor connection area.
11	AC Mains Distribution	Customer supplied mains power is connected here. Mains power is distributed to additional internal components via factory installed terminal blocks and wiring.
12	Non-IS Low Voltage IO Area	Connection area for: Qty 2 RS-485 Modbus RTU, Qty 2 TCP/IP for Modbus TCP and/or remote control, Qty 4 24VDC sampling valve driver.

Table 2. Raman Rxn5 analyzer interior view

Bottom view

The bottom view of the Raman Rxn5 is shown below. This is the location for all electro-optical and electrical input/output.

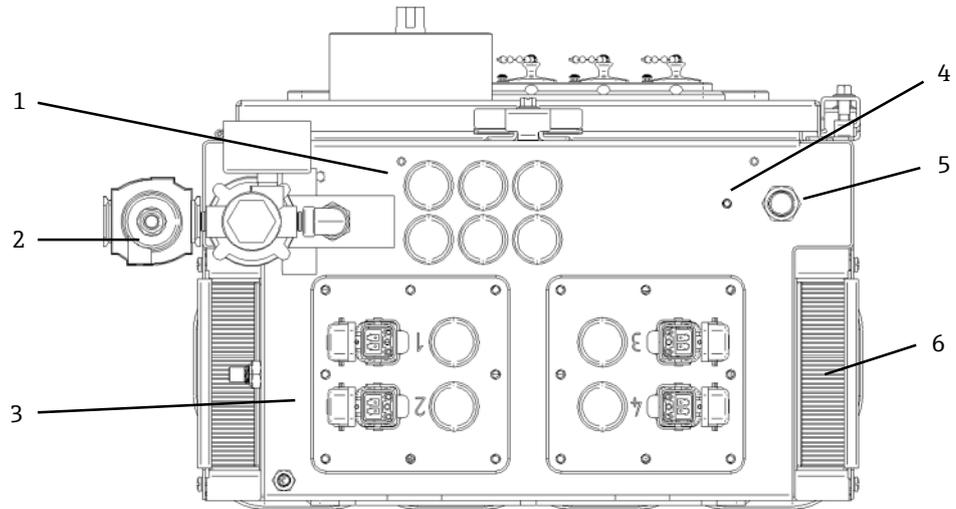


Figure 3. Raman Rxn5 analyzer bottom view

#	Name	Description
1	Low voltage IO location	Six holes for low voltage communications and process control wiring. Cord grips provided by customer and shall meet local electrical and hazardous area safety standards.
2	Purge air inlet	¼" NPT connection point for purge air supply.
3	Intrinsically safe IO location	IO panels include up to four electro-optical connectors for sampling probes and cord grips for sample environmental sensors.
4	Earth ground stud	¼"-20 x .75" enclosure earth ground stud.
5	AC mains inlet	Cord grip location for AC mains power connection.
6	Cooling air inlet	A cooling air inlet on each side of the enclosure. Do not block.

Table 3. Raman Rxn5 analyzer bottom view

Rear view

The rear view of the Raman Rxn5.

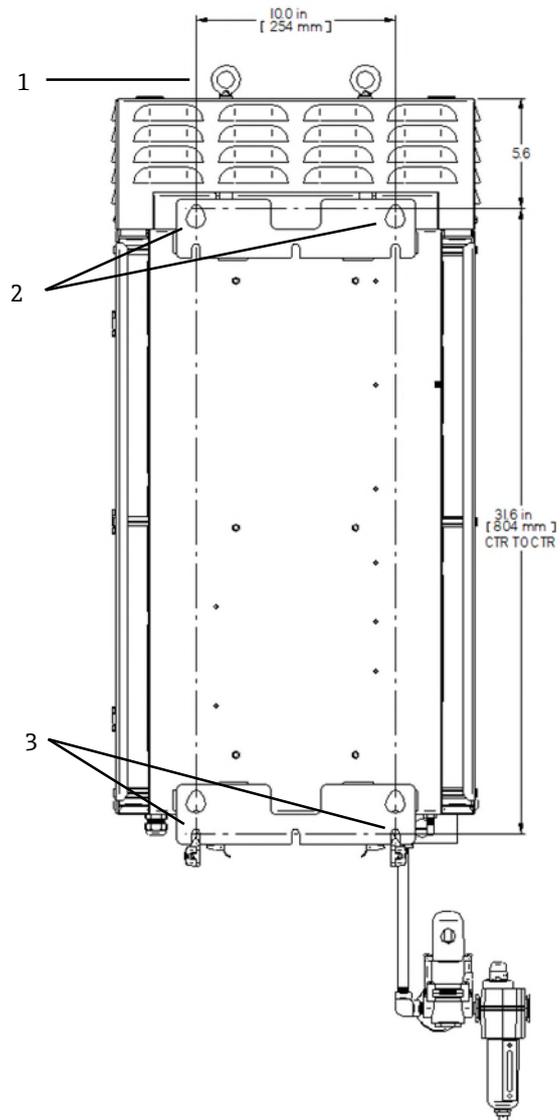


Figure 4. Raman Rxn5 analyzer rear view

#	Name	Description
1	Lifting rings	Two lifting rings for use when wall mounting the enclosure.
2	Upper mounting points	Two tear drop mounting points to hang the enclosure on supplied mounting bullets.
3	Lower mounting slots	Two slots to secure enclosure to wall using standard hardware.

Table 4. Raman Rxn5 analyzer rear view

Software

Raman RunTime

Raman RunTime embedded software is the control platform for its suite of Raman Rxn analyzers. Raman RunTime software is intended for easy integration with standard multivariate analysis and automation platforms to enable a real-time, in situ process monitoring and control solution. Raman RunTime presents an OPC and Modbus interface, which provides clients with analyzer data as well as analyzer control functions. Raman RunTime is fully embedded into Raman Rxn analyzers.

The main view of Raman RunTime displays four quadrants, one for each stream and a status bar (bottom) for a quick view of warnings and acquisition status. Stream details are accessed from each corresponding quadrant/stream window. To switch back and forth between the main view and stream detail views, click the Title Bar for each stream/quadrant. Views of current spectrum vs. process values (model results) can also be easily swapped by clicking on the Quadrant/stream window display. Additional features, such as system settings, calibration and diagnostics, are found under the Options section on the lower left corner of the screen.



Figure 5. Raman RunTime's main view in a Rxn5 four channel analyzer

User privilege levels

The Raman Runtime user levels are described below:

User Level	Action
User	<ul style="list-style-type: none"> ▪ Change subject (channel) display name ▪ View summary and detail of active stream acquisitions ▪ View calibration information ▪ View diagnostics ▪ Perform exports (Basic, Diagnostic, Full)
Operator	User level actions plus: <ul style="list-style-type: none"> ▪ View active stream acquisitions ▪ Perform calibration and view calibration information ▪ Perform verification and view verification results ▪ Enable/disable analysis ▪ Enable/disable methods ▪ Configure analysis parameters ▪ Configure sampling parameters (requires Raman RunTime 5.3.5+) ▪ Snapshot (requires Raman RunTime 5.3.5+) ▪ Ad hoc analysis (requires Raman RunTime 5.3.5+) ▪ Change system display name ▪ Configure date and time ▪ Restart
Admin	No Restrictions Operator level restrictions plus: <ul style="list-style-type: none"> ▪ Add/remove methods ▪ Configure methods (display name, enable/disable components & properties) ▪ Configure acquisition parameters ▪ Configure network ▪ Configure Open Platform Communications (OPC) (requires Raman RunTime 5.3.5+) ▪ Configure Modbus parameters ▪ Change security settings & manage users ▪ Apply embedded software updates

Table 5. User privileges

Software requirements

The client system software requirements are described below:

- Silverlight 5.0 or greater (for remote access)
- OPC UA client software (for OPC interface)
- OPC Classic client software (for OPC interface)
- Modbus client software (for Modbus interface)

Installation

Wall mounting

The Rxn5 is wall mounted and includes the special hardware required for mounting to 1-1/4" Unistrut metal framing. Typical mounting structure shown. Other mounting options are at the discretion of the installer.

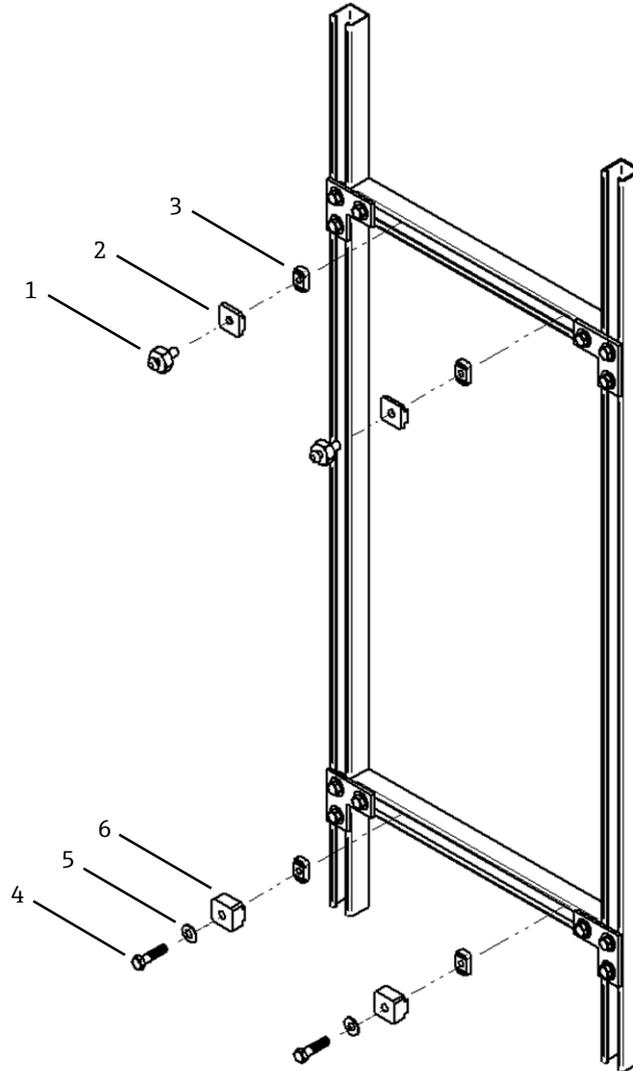


Figure 6. Wall mounting

#	Name	Description
1	Upper mounting bolt	3/8-16 threaded, custom upper mounting bolt (qty 2). Provided with the Raman Rxn5.
2	Upper mounting plate	Upper mounting plate for 1-1/4" Unistrut metal framing (qty 2). Provided with the Raman Rxn5.
3	Channel nut	3/8-16 threaded channel nut for Unistrut metal framing. Shown as an example. Provided by the installer.
4	Lower mounting screw	3/8-16 hex cap screw. Shown as an example. Provided by the installer.
5	Lower mounting washer	3/8 flat washer. Shown as an example. Provided by the installer.
6	Lower mounting plate	Lower mounting plate for 1-1/4" Unistrut metal framing (qty 2). Provided with the Raman Rxn5.

Table 6. Wall mounting

Sampling probe connection	<p>Two I/O panels on the Raman Rxn5 each provide sampling probe connections for two of the four channels available. The gray locking connector is the hybrid fiber optic connector that contains both the excitation and collection fiber optics as well as the electrical laser interlock. Exercise appropriate care when making these connections to ensure clean fiber optic connections.</p> <p>Endress+Hauser offers an <i>Raman Rxn5 Optical Service Kit (p/n 2013270)</i>, which is intended for diagnosing and servicing the major field-serviceable optical paths and components of the Raman Rxn5 system. It is also intended to diagnose and identify components that may require replacement or factory service.</p>
Temperature and pressure sensors	<p>In certain applications, each sampling probe is complemented with two environmental sensors—sample temperature and pressure sensors. These sensors are installed into the sampling system adjacent to each sampling probe. The sensors have 4 – 20 mA outputs and their ranges are configured to order.</p> <p>The sensors are interfaced to the analyzer by four IS barriers—one per channel. One IS barrier interfaces to a temperature sensor and a pressure sensor. The IS barriers are installed on the lower DIN rail to the right of the electrical laser interlock IS barrier. The left most IS barrier is for channel 1's sensors with 2, 3, and 4 following from left to right. The electrical cables are installed through the appropriate cable gland.</p>
Solenoid valve driver	<p>The Raman Rxn5 is configured with an optional solenoid driver to drive up to four solenoids at the sampling system. One solenoid per stream can be driven, the timing of which is configurable in RunTime. Each output provides 24 VDC at 0.5A max (12 W max). The maximum wire size the terminal blocks will accept is 18 American Wire Gauge (AWG). The channel number and polarity are labeled on the terminal blocks. It is the installer's responsibility to route solenoid power cables from the terminal blocks to the sampling solenoid valves through approved glands.</p> <p>These outputs are not intrinsically safe and shall terminate in non-hazardous areas.</p>
COM ports	<p>The Raman Rxn5 system can communicate with the customer's Distributed Control System (DCS) via Modbus RTU over RS-485. Endress+Hauser will provide the Modbus map. It is the installer's responsibility to route the communications cable from the internal IO din rail to the DCS interface through an approved gland. The pinout for the Raman Rxn5 RS-485 COM port is labeled on the terminal blocks and referenced on the IS shield label.</p> <p>These outputs are not intrinsically safe and shall terminate in non-hazardous areas.</p>
Ethernet ports	<p>Two Ethernet ports are provided. The Raman Rxn5 can also communicate with the customer's DCS via Modbus over TCP/IP or OPC (UA or Classic). Two RJ-45 connectors are provided on the terminal block DIN rail.</p> <p>These outputs are not intrinsically safe and shall terminate in non-hazardous areas.</p>
Purge alarm	<p>A dry contact purge alarm is provided to indicate positive pressure in the enclosure. There are two connections on back of the purge indicator.</p> <p>This output is not intrinsically safe and shall terminate in non-hazardous areas.</p>

Purge indicator and valve system The purge indicator installed on the Raman Rxn5 analyzer is of the Z-Purge variety from Purge Solutions, Inc. The indicator is certified for use in Division 2/Zone 2 hazardous areas. The Z-purge indicator has a **Green** indicator light that indicates that the pressure inside the enclosure is above 0.20" water column. The indicator provides a dry contact alarm relay for a remote alarm if needed; it is the installer's and/or customer's responsibility to interface to the alarm contacts.

The Z-Purge indicator is paired with a Purge Solutions manual leakage compensation valve. There are two modes of operation for the valve—dilution and leakage compensation. For a high flow dilution, the dial on the valve should be turned so the slot in the dial is horizontal and lined up with the "ON" position. Once the manual dilution has been performed for the specified time, the valve may be switched to the leakage compensation mode by turning the dial so the slot in the dial is vertical. Leakage compensation mode allows the enclosure to remain pressurized with a much smaller usage of purge air after the manual dilution has occurred.

Minimum purge time prior to power application is 9.5 minutes at 2.0 – 2.5 psi as indicated on included pressure gauge.

Thermal control

Heat removal is a challenge in all devices that consume electrical power. The major power consuming and heat producing components in the Raman Rxn5 are conductively cooled through their heat sinks into plenums on either side of the analyzer into the external ambient environment. The external fan pulls air through each plenum and over all heat sinks. This design maximizes heat removal from the devices and minimizes reliance on active devices to remove heat from the enclosure.

Maintain 18 inches below the analyzer to allow for proper airflow into the cooling plenums and for access to fiber optic probe connections.

Electric power control

The Raman Rxn5's thermal control system controls power application to modules that may be temperature sensitive. The thermal control system has control over the electrical power of the following components: lasers, detection module and touch screen monitor. The computer/hard drive, Universal Serial Bus (USB) hub, purge indicator, calibration board, and all other miscellaneous electronic devices are always on if the systems is powered. The HVAC modules are controlled by the temperature control servo loop and can be turned on or off at any time by the control loop.

Specifications

Dimensions

The height, width, and length of the Raman Rxn5 are shown below:

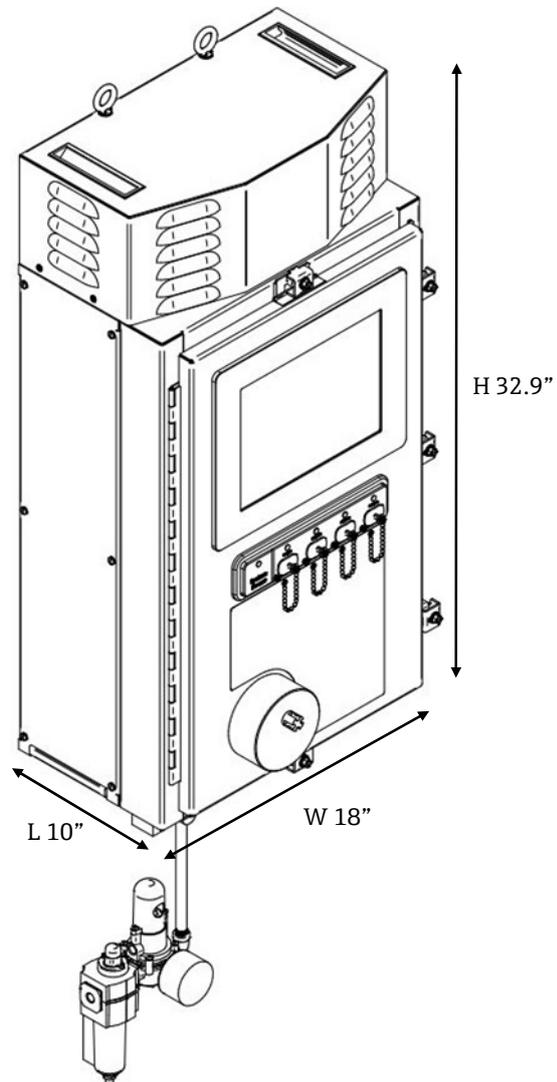


Figure 7. Raman Rxn5 analyzer dimensions

Name	Description
Height	32.9 in (83.6 cm)
Width	18.0 in (45.7 cm)
Length	10.0 in (25.4 cm)

Table 7. Raman Rxn5 analyzer dimensions

Sample interface

The specifications for the sample interface are listed below:

Item	Description
Process Interface (Raman Rxn-30 probe)	NPT to sample or transfer line, NeSSI platform
Fiber-optic Probe Temperature	Up to 150 °C Temp (gas-phase)
Fiber-optic Probe Pressure	Up to 1000 psig (7000KPa, gas-phase)
Sample Flow Rate	Compatible with stop/flow measurement

Table 8. Sample Interface

Electrical and communications

The specifications for electrical and communications are listed below:

Item	Description
Input Voltage	90 – 264 VAC, 47 – 63 Hz
Communications	Serial: RS485 . Modbus TCP/IP; OPC Optional
User Interface	Touch-screen color LCD display
Max Power	<300 Watts max (startup), 200 watts typical
Sound Level (from operator’s perspective)	60.1 dB Max, A-weighted

Table 9. Electrical and communications

Physical

The physical specifications are listed below:

Item	Description
Enclosure Type	Painted steel or optional 316 Stainless Steel, NEMA4 (or IP56)
IEC 60529 rating (ingress protection)	IP56
Dimensions	18.0” wide x 32.9” high x 10.00” deep
Weight	~ 135 lbs
Number of Probes	Up to four (simultaneous operation)
Wetted materials (gas probe)	SS316, Teflon and sapphire (window to process), other metals optional
Operating Temperature (base unit)	-20 to +50 °C
Operating Temperature (cable and connector)	-40 to +80 °C
Operating Humidity	95% RH Non-condensing

Table 10. Physical

Purge air supply

The purge air supply specifications are listed below:

Item	Description
Purge Air Maximum Temperature	40 °C
Purge Air Dewpoint	-40 °C
Purge Air Pressure Range	20-120 psi
Inlet Fitting	1/4-18 FNPT
Maximum Particle Size	5 micron
Max Flow Rate During Purge	2.0 SCFM
Max Flow Rate for Steady-State Operation	.75 CFM

Table 11. Purge air supply

Area classification and ratings The area classification and rating specifications are listed below:

Item	Description
Environmental Temp Range	-20 °C to +50 °C (solid state cooling – no vortex or external cooling)

Table 12. Area classification and ratings

AC mains wiring The main power connection specifications are listed below:

Item	Description
Supply voltage range	90-264 VAC
Supply frequency range	47-63 Hz
Max inrush current	30 Amps
Max steady-state current	7.0 Amps
Cable jacket diameter	6-12 mm
Conductor gauge range	22-10 AWG
Conductor stripping length	9 mm
Max cable service loop (internal to Raman Rxn5)	12 inches

Table 13. Main power connection specifications

Low voltage I/O connections The available connections are listed below:

Labels	Description	Signal Levels
R3+, R3-, R3 GND	RS-485 Comm to DCS	-7 VDC to +12 VDC
R4+, R4-, R4 GND	RS-485 Comm to DCS	-7 VDC to +12 VDC
No Labels	RJ45 (Qty 2) Optional TCP/IP to	+/- 2.5 VDC per Twisted Pair
A+, A-	Purge Alarm	30 VDC, 150 mA Max
1+, 1-	Sampling Output 1	24 VDC, 0.5 A Max
2+, 2-	Sampling Output 2	24 VDC, 0.5 A Max
3+, 3-	Sampling Output 3	24 VDC, 0.5 A Max
4+, 4-	Sampling Output 4	24 VDC, 0.5 A Max

Table 14. Connections and points of termination

Certificates and approvals

Certifications

The certificate and approval information are listed below:

Item	Description
<u>IEC Ex Certificate Number:</u> IECEX ITS 14.0014X	<u>Hazardous Area Marking Code:</u> Ex ec ic [ia Ga] [op sh Gb] pzc IIC T4 Gc Ta -20°C to +50°C
<u>ATEX Certificate Number:</u> ITS 11ATEX 17307X	<u>Hazardous Area Marking Code:</u> Ex ec ic [ia Ga] [op sh Gb] pzc IIC T4 Gc Ta -20°C to +50°C CE 0035  II 3/(2)/(1) G
<u>CSA Certificate Number:</u> 2438730	<u>Hazardous Area Marking Code:</u>  Class I, Division 2, Groups B, C, or D, T4 c _{us} Class I, Zone 2, IIB + H ₂ , T4

Table 15. Certifications

Hazard area drawing

The hazard area installation drawing is shown below:

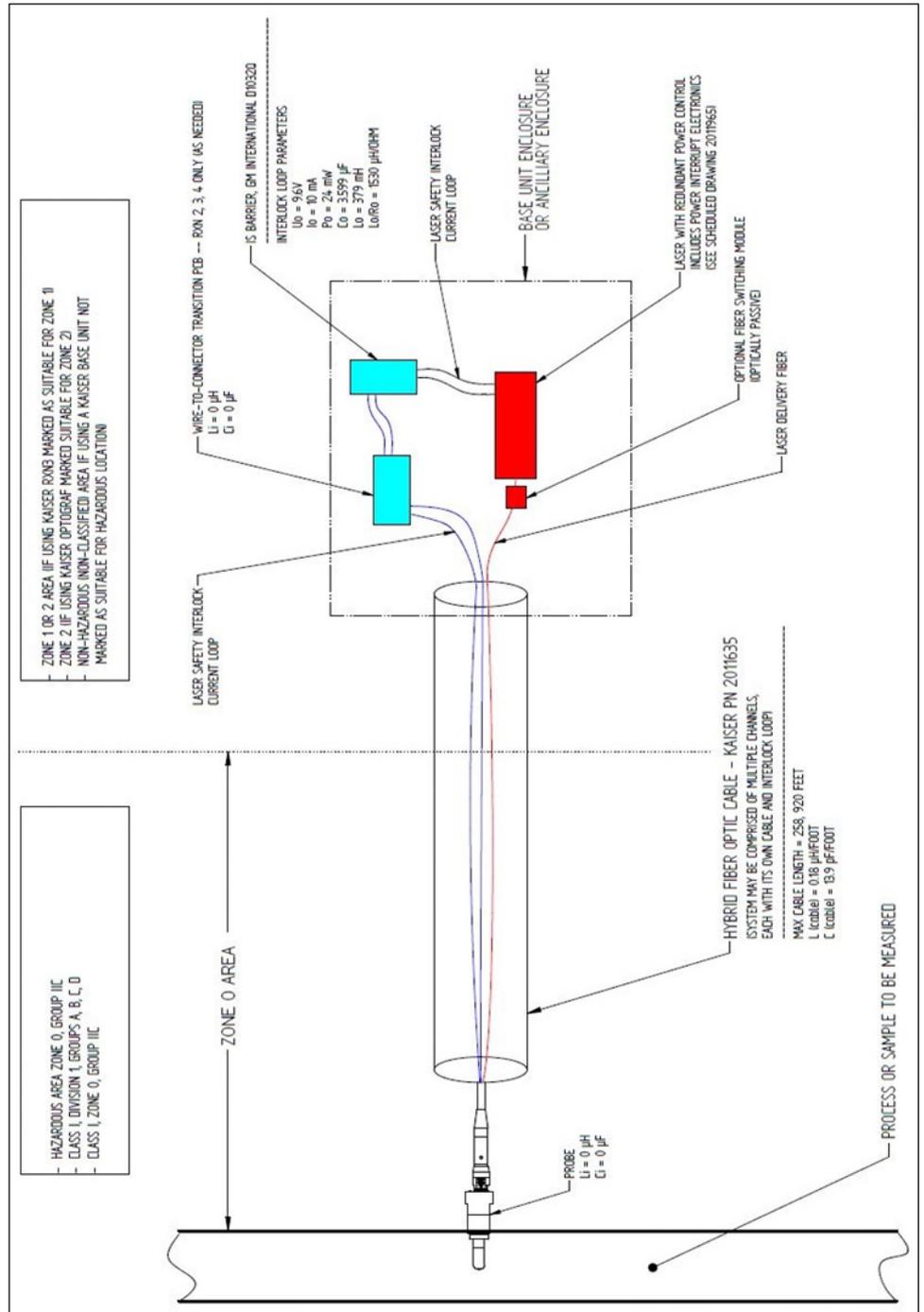


Figure 8. Hazardous area installation

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