# Technical Information

# Raman Rxn4



Endress+Hauser

People for Process Automation

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# Function and system design

**Analyzer technology**

The Raman Rxn4 Raman analyzer is a for-purpose embedded system with built-in Raman RunTime control software. Raman spectroscopy provides the chemical specificity of mid-IR spectroscopy and the sampling simplicity of a near-IR analyzer. By operating in the visible spectral region, Raman spectroscopy allows vibrational spectra to be collected in situ, using fiber-coupled probeheads, without sample purging, and without the use of exotic sampling devices.

The Raman Rxn4 suite of analyzers are based on advanced and innovative technologies that provide distinct advantages over traditional instrumentation. The HoloPlex advantage, standard in all Raman Rxn4 analyzers, yields both full spectral coverage and high spectral resolution simultaneously for improved qualitative and quantitative analysis. Analysis is fast because the entire Raman spectrum is measured simultaneously, which translates into real-time data collection for reaction analysis and monitoring.

All Raman Rxn4 analyzers employ a unique self-monitoring system to ensure the validity of each analysis. The analyzer is capable of two-point self-calibration in extreme environments and utilizes self-diagnostics and spectral correction methods when system calibration is unnecessary. The analyzer's precision is essential for robust chemometric analyses and calibration transfer between instruments.

The Raman Rxn4 suite of analyzers allow for remote fiber-optic connections to probe sampling points for installation flexibility.

The Raman Rxn4 can be configured as a single channel, four channel, or Hybrid Raman analyzer. All are designed for use with the Endress+Hauser Raman fiber optic probe line.

**Front panel**

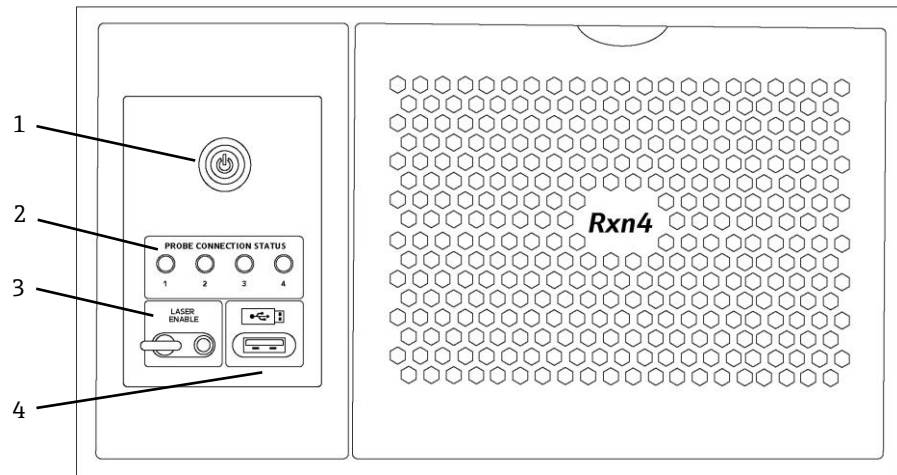The front panel of the Raman Rxn4 analyzer is shown below:



*Figure 1. Front panel of a Raman Rxn4 four channel analyzer*

| # | Name | Description |
|---|------|-------------|
| 1 | Main Power Switch | The main power switch turns the instrument on and off, which includes the laser regardless of the position of the laser key switch. The **Power** push button incorporates a **Blue** LED in the shape of a power symbol, which indicates the system power status (all components are powered when lit). The **Power** push button will communicate error conditions using blink codes when embedded software is not able to communicate them. To turn the instrument on, press and release the **Power** button once. To turn a responsive instrument off, shut down using Raman RunTime. If the instrument is unresponsive, it may be powered down using a long 10 second press and hold of the **Power** button. |
| 2 | Probe Connection Status Indicators | The bank of **Yellow** LED indicators above the laser key and USB 3.0 port indicates the physical connection status of each probe. The LED is lit when the corresponding probe is properly connected. While the Raman Rxn4 four channel analyzer front panel has four LED indicators, the front panel of the Raman Rxn4 Hybrid analyzer has only two LED indicators, and the front panel of the Raman Rxn4 single channel analyzer has only one LED indicator. |
| 3 | Laser Key Switch | The laser key switch turns the laser on and off. The **Red** LED indicator adjacent to the laser key switch indicates the laser power status. To activate the laser, turn the laser key switch to the **ON** position. The Red LED indicator should remain lit whenever the laser is ON. |
| 4 | USB 3.0 Port | The USB 3.0 port is intended to obtain diagnostic exports from the instrument using a USB flash drive. |

*Table 1. Front panel of Raman Rxn4*

**Rear panel**                          The rear panel of the Raman Rxn4 analyzer is shown below:
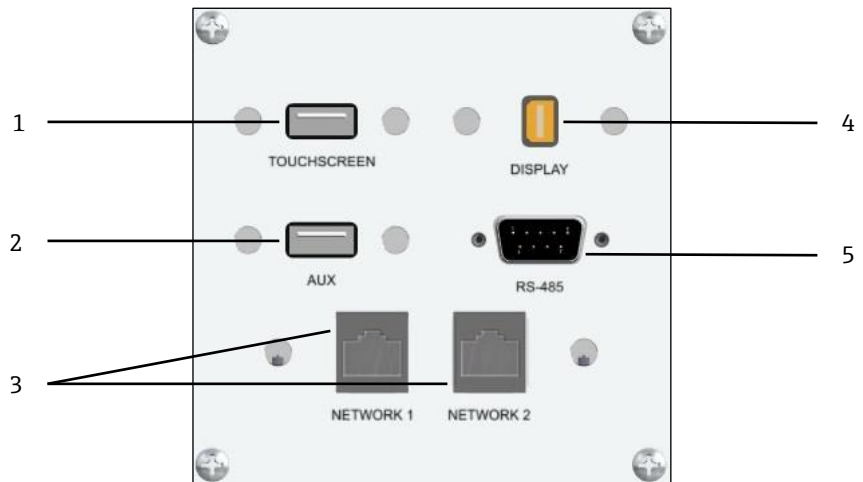


*Figure 2. Rear external circuit input/output panel of a Raman Rxn embedded analyzer*

| # | Label | Interface Format | Description |
|---|-------|------------------|-------------|
| 1 | TOUCHSCREEN | USB 2.0 Port | Input from touchscreen. |
| 2 | AUX | USB 2.0 Port | Reserved for future use. |
| 3 | NETWORK 1 and NETWORK 2 | Two 1GB TCP/IP Ethernet Ports | Ethernet connection for OPC and Modbus communication and automation. |
| 4 | DISPLAY | Mini DisplayPort | Video connection for optional touchscreen. |
| 5 | RS-485 | DB9 connector for 2-wire, half-duplex Modbus RTU interface. Pin 2 is Data+, Pin 3 is Data -, and Pin 5 is ground. | Modbus RTU interface connection. |

*Table 2. Raman Rxn4 ports*

**Interior of the Raman Rxn4**          The interior of the Raman Rxn4 with the cover removed is shown below. The internal components are common among all configurations.
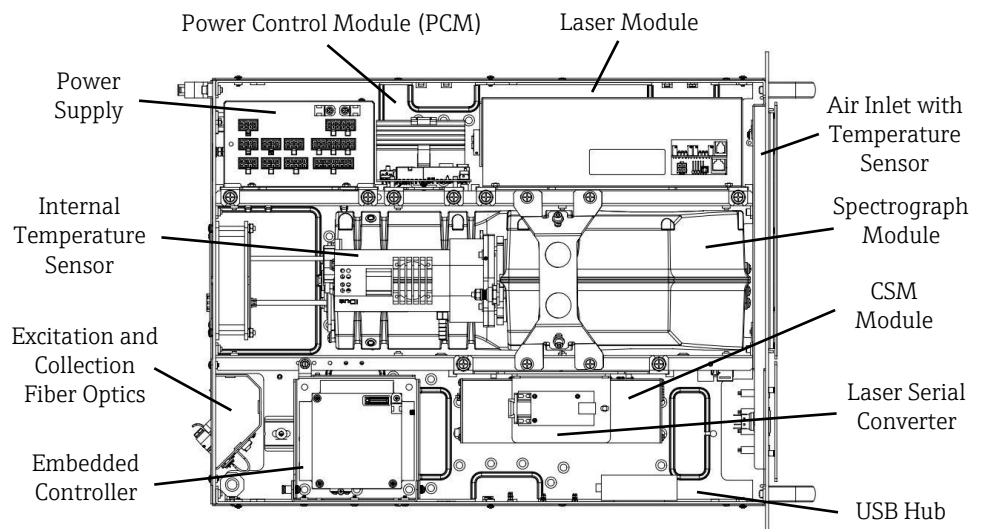


*Figure 3. The interior of the Raman Rxn4 analyzer*

**Port connections**          The port connections for the Raman Rxn4 analyzer are shown below:
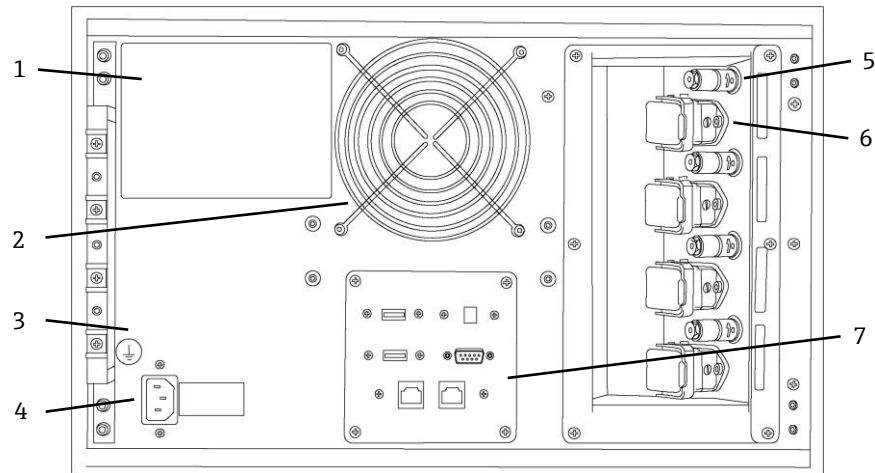


*Figure 4. Rear panel of Raman Rxn4*

| # | Name | Description |
|---|------|-------------|
| 1 | CDRH Product Label | Product information about the Raman Rxn4 analyzer. |
| 2 | Air Exhaust | Air exhaust fan and outlet. |
| 3 | Strain Relief | EO fiber cable strain relief mounting location. |
| 4 | AC Inlet 100-240 VAC 50/60 Hz | Power socket outlet that AC power to the base unit. Ground pin on this connector serves as the Protective Conductor Terminal. |
| 5 | Remote Interlock Connectors | Safety feature. To interrupt the laser, remove the black plug. |
| 6 | EO Fiber Connector | Provides fiber optic laser radiation output, fiber optic Raman collection and electrical laser interlock loop for each instrument channel. The electrical laser interlock loop is intrinsically safe and is governed by Endress+Hauser drawing 4002396.<br>Match 3 prongs on probe to 3 plugs on EO. Pull latch down to secure probe in place.<br>Laser radiation may NOT exit a channel whose EO fiber connector is removed because removing the EO connector also interrupts the laser interlock loop for that channel. |
| 7 | Analyzer Ports | Touchscreen USB Port, USB Port, Ethernet Ports, RS-485 Serial Port, and Touchscreen Video Port. |

*Table 3. Port connection*

# 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 for four channel analyzers, one for each probe and a status bar (bottom) for a quick view of warnings and acquisition status. Single channel analyzers display only one main channel/probe window, while Hybrid analyzers display two channel/probe windows, one for the PhAT probe channel and one for the non-PhAT probe ALT. Batch details are accessed and edited from each corresponding quadrant/probe window. To switch back and forth between the main view and batch detail views, click the Title Bar for each probe/quadrant. Views of current spectrum vs. process values (model results) can also be easily swapped with by clicking on the Quadrant/Probe 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 Raman Rxn four channel analyzer*

**User privilege levels**

The Raman Runtime user levels are described below:

| User Level | Action |
|---|---|
| User | <ul><li>Change subject (channel) display name</li><li>View summary and detail of active batch acquisitions</li><li>View calibration of information</li><li>View diagnostics</li><li>Perform exports (Basic, Diagnostic, Full)</li></ul> |
| Operator | User level actions plus:<ul><li>View active batch acquisitions</li><li>Perform calibration and view calibrations information</li><li>Perform verification and view verification results</li><li>Start/stop batch acquisitions</li><li>Focus</li><li>Snapshot</li><li>Ad hoc analysis</li><li>Change system display name</li><li>Configure date and time</li><li>Restart</li></ul> |
| Admin | No Restrictions<br>Operator level restrictions plus:<ul><li>Add/remove models</li><li>Configure models (display name, enable/disable components & properties)</li><li>Configure network</li><li>Configure Open Platform Communications (OPC)</li><li>Change security settings & manage users</li><li>Apply embedded software updates</li></ul> |

*Table 4. 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

**Mounting location**

It is recommended that the Raman Rxn4 analyzer be located in a standard 19-inch wide equipment rack with at least 30 inches of depth using the included slide rails, mounting brackets, and cable carriers. Alternately, the analyzer can be located on a level surface such as a laboratory benchtop or an equipment cart. In addition, the location selected should be:

- Free of moisture, dust, and corrosive vapors
- Isolated from excess vibrations

**Ventilation**

The location selected should allow for adequate ventilation to both the front and rear of the base unit. A space of not less than 6 inches (155 mm) must be provided in both the front and rear of the base unit for proper inlet and outlet air movement.

If the unit is to be mounted in a user-provided 19-inch wide equipment rack, the rack must allow for adequate airflow and temperature transfer (see Section 2.4 Temperature). Rack depth must be at least 30 inches.

**Air filter**

The Raman Rxn4 incorporates a tacked polyester spun air filter element to reduce dust intake into the base unit. The air filter is accessed by a magnetically secured access panel on the front of the instrument (4). The air filter should be cleaned with compressed air once every month or if the embedded software is reporting an internal over-temperature error (if ambient temperature is within specification). In extremely dusty conditions, the air filter should be cleaned more often. The air filter has a **Blue** tacky side which should be oriented toward the outside of the base unit.

If a replacement air filter is needed, please contact at support.kosi@endress.com.
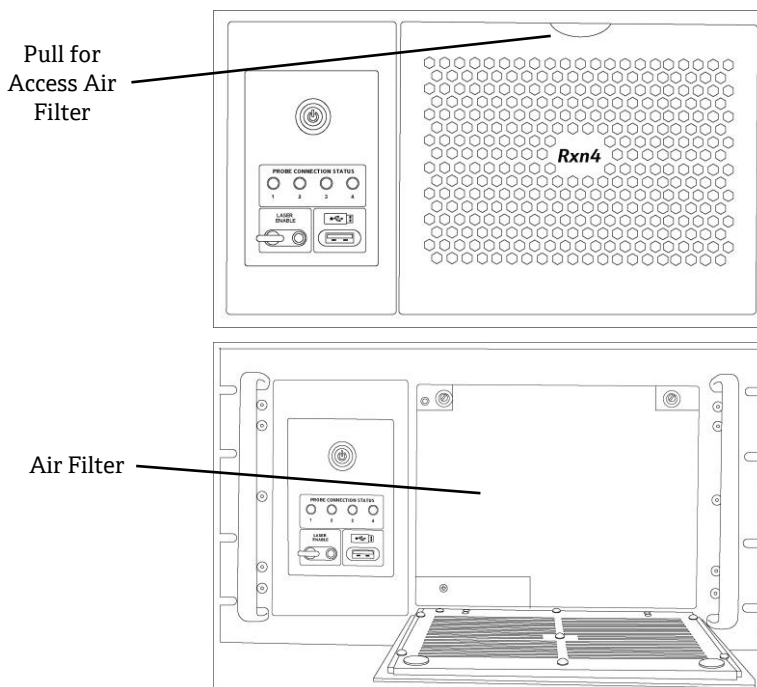


*Figure 6. Filter access*

# Specifications

**Dimensions**                    The height, width, and length of the Raman Rxn4 are shown below:
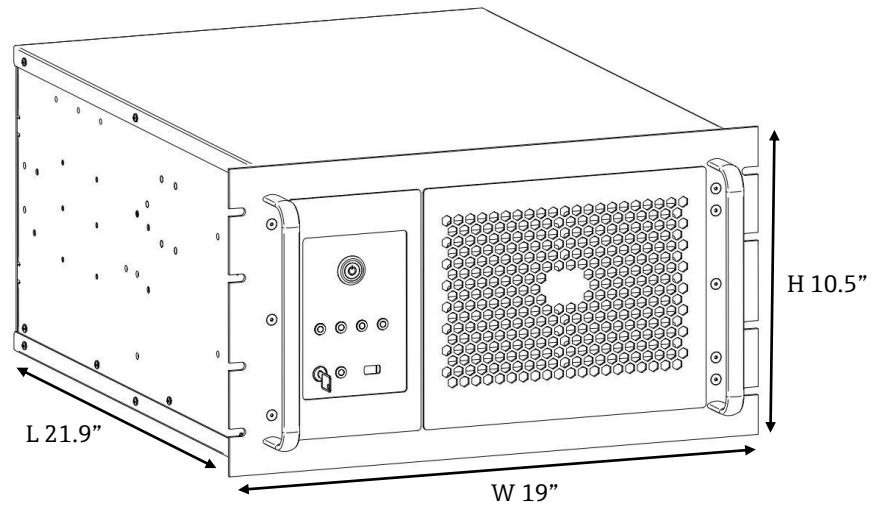


*Figure 7. Raman Rxn4 dimensions*

| Name | Description |
|------|-------------|
| Height | 10.5 in (26.7 cm) |
| Width | 19 in (48.3 cm) |
| Length | 21.9 in (55.6 cm) |

*Table 5. Ranan Rxn4 analyzer dimensions*

**Analyzers**

The specifications for the three types of Raman Rxn4 analyzers are listed below:

| Category | Raman Rxn4 | Raman Rxn4 w/Enclosure | Raman Rxn4 Hybrid |
|---|---|---|---|
| Laser Wavelength | 532 nm<br>785 nm<br>1000 nm | 532 nm<br>785 nm<br>1000 nm | 785 nm |
| Spectral Coverage | 150-4350 cm$^{-1}$ (532 nm)<br>150-3425 cm$^{-1}$ (785 nm)<br>200-2400 cm$^{-1}$ (1000 nm) | 150-4350 cm$^{-1}$ (532 nm)<br>150-3425 cm$^{-1}$ (785 nm)<br>200-2400 cm$^{-1}$ (1000 nm) | 175-1890 cm$^{-1}$ (785 nm) |
| Spectral Resolution | 5 cm$^{-1}$ (532 nm)<br>4 cm$^{-1}$ (785 nm)<br>5 cm$^{-1}$ (1000 nm) average | 5 cm$^{-1}$ (532 nm)<br>4 cm$^{-1}$ (785 nm)<br>5 cm$^{-1}$ (1000 nm) average | 4 cm$^{-1}$ (785 nm) average |
| Temperature / % Relativity Humidity | *Ops Temp:* 5℃ to 35℃ (532 nm, 785 nm); 5℃ to 30℃ (1000 nm)<br>*Stg Temp:* −15℃ to 50℃<br>*Relative Humidity:* 20–80%, non-condensing | *Ops Temp:* +5 ℃ to +50 ℃<br>*Stg Temp:* −15℃ to 50℃<br>*Relative Humidity:* Up to 80% for temperature range +5 ℃ to +31 ℃, decreasing linearly to 20% at 50 ℃ | *Ops Temp:* 15℃ to 30℃<br>*Stg Temp:* −15℃ to 50℃<br>*Relative Humidity:* 20–80%, non-condensing |
| Input Voltage | 100–240 V<br>50–60 Hz<br>±10% | 120 V ± 10%<br>60 Hz OR 230 V<br>± 10%<br>50/60 Hz | 100–240 V<br>50–60 Hz<br>±10% |
| Power Consumption | 400 W (max)<br>250 W (typical start-up)<br>120 W (typical running) | 1560 W (max)<br>1560 W (typical start-up)<br>750 W (typical running) | 400 W (max)<br>250 W (typical start-up)<br>120 W (typical running) |
| Warm-up Time | 120 minutes | 120 minutes | 120 minutes |
| Unit Dimensions | 483 x 267 x 556 mm | 1175 x 1480 x 826 mm (with optional trolley) | 483 x 267 x 556 mm |
| Weight | 28.5 kg | 185.5 kg (with optional trolley) | 28.5 kg |
| Sampling Probe Compatibility | RamanRxn (with optics), bIOPRO (standard and KS model), WetHead, Pilot-E, and AirHead | RamanRxn (with optics), bIOPRO (standard and KS model), WetHead, Pilot-E, and AirHead | PhAT (with optics) and one alternate non-PhAT Endress+Hauser Raman probe |
| Hazardous Area Certifications | ATEX, North American, IECEx | Pending | ATEX, North American, IECEx |
| Connection Interface | OPC, Modbus (contact Endress & Hauser for other options) | OPC, Modbus (contact Endress & Hauser for other options) | OPC, Modbus (contact Endress & Hauser for other options) |
| Installation Options | 19-inch rack package | NEMA 4X enclosure; wall-mountable, mobile trolley, or fixed stand | 19-inch rack package |

*Table 6. Analyzer Specifications*

**Laser**

The specifications for the laser are listed below:

| Item | Description |
|---|---|
| **532 nm**<br>Excitation wavelength<br>Maximum power output<br>Warranty | <br>532 nm<br>120 mW<br>unlimited hours for 1 year |
| **785 nm**<br>Excitation wavelength<br>Maximum power output<br>Warranty | <br>785 nm<br>400 mW<br>unlimited hours for 1 year |
| **1000 nm**<br>Excitation wavelength<br>Maximum power output<br>Warranty | <br>993 nm<br>400 mW<br>unlimited hours for 1 year |

*Table 7. Laser*

**Probes**

The specifications for the probes are listed below:

| Item | Description |
|---|---|
| Raman Rxn4 (single channel and four channel) | Compatible with:<br>RamanRxn probehead equipped with immersion or non-contact optics<br>Endress+Hauser gas and liquid phase Raman probe<br>Endress+Hauser bioprocessing Raman probes |
| Raman Rxn4 Hybrid | Compatible with:<br>P$^h$AT probe and<br>One other ALT probe including:<br>RamanRxn probehead equipped with immersion or non-contact optics<br>Endress+Hauser gas and liquid phase Raman probe<br>Endress+Hauser bioprocessing Raman probes |

*Table 8. Probes*

**Sound levels**

The specifications for the sound levels are listed below:

| Analyzer / Accessory | Sound Level from Operator's Position |
|---|---|
| Raman Rxn4 | 58.2 dB |

*Table 9. Sound levels*

**Network configuration**

The table below summarizes the ports relevant to specific Raman Runtime features. Ports for OPC Classic are assigned dynamically in the indicated range; fixed-port behavior is only available for OPC UA. It's only necessary to open firewall ports for the features intended to use. Ports in bold should be regarded as mandatory for the associated protocol; other ports are recommended for full functionality (e.g. discovery services).

| Protocol | Ports |
|---|---|
| OPC UA | TCP 4840, 4843, 52601, and **62886** |
| OPC Classic | TCP **135** and **49152**-**65535** |
| Modbus | TCP **502** |
| File Sharing | TCP **139** and 445 |
| Remote Access | TCP **943**, **3593**, **4525**, and 5674; User Datagram Protocol (UDP) 3702 |

*Table 10. Raman RunTime network configuration*

# Certificates and approvals

**Hazard area rating**     The hazard area rating details are listed below:

| Item | Description |
|---|---|
| Pilot-E and WetHead series probes can be classified to: | **ATEX**<br>⟨Ex⟩ II 2/1 G Ex ia op is IIA or IIB or IIB+H2 or IIC T3 or T4 or T6 Ga -20℃ ≤ TA ≤ +60℃<br><br>**IECEx**<br>IECEX ITS 14.0015X<br><br>**North American**<br>Ex ia IIC T4<br>Class I Zone 0 AEx ia IIC T4<br>Class I Division 1 Groups A, B, C, & D T4 |
| AirHead series probes can be classified to: | **ATEX**<br>⟨Ex⟩ II 2/1 G Ex ia op is IIA or IIB or IIB+H2 or IIC T3 or T4 or T6 Ga -20℃ ≤ TA ≤ +60℃<br><br>**IECEx**<br>IECEX ITS 14.0015X<br><br>**North American**<br>Ex ia IIB+H2 T4<br>Class I Zone 0 AEx ia IIB+H2 T4<br>Class I Division 1 Groups B, C, & D T4 |
| P$^h$AT series probes can be classified to: | **ATEX**<br>⟨Ex⟩ II 2/1 G Ex ia op is IIA or IIB or IIB+H2 or IIC T4 or T3 or T6 Ga -20℃ ≤ TA ≤ +60℃<br><br>**IECEx**<br>IECEX ITS 14.0015X<br><br>**North American**<br>Ex ia op is IIA or IIB or IIB + H2 or IIC T3 or T4 or T6 Ga<br>Class I, Division 1, Groups A, B, C, D T3/T4/T6<br>Class I, Zone 0 AEx ia op is IIA or IIB or IIB + H2 or IIC T3 or T4 or T6 Ga |
| RamanRxn Probe | None |
| bIO-PRO Probe | None |

*Table 11. Hazardous area rating*

**Hazard area certification**     The hazard area certification details are listed below:

| Item | Description |
|---|---|
| Certification – Base Unit (fiber optic and interlock outputs only) | **ATEX**<br>⟨Ex⟩ II (2)(1) G Ex [ia Ga] [op sh Gb] IIC<br>CE 0035 ⟨Ex⟩ II (2)(1) G<br><br>**IECEx**<br>Ex [ia Ga] [op sh Gb] IIC<br><br>**North American**<br>Intrinsically Safe output for probe and sensors used in Class I, Division 1, Groups A, B, C, and D.<br>Ambient Temperature Range: +5℃ ≤ Tamb ≤ 35℃ |

*Table 12. Hazardous area certification*

**Hazard area drawing**   The hazard area installation drawing is shown below:



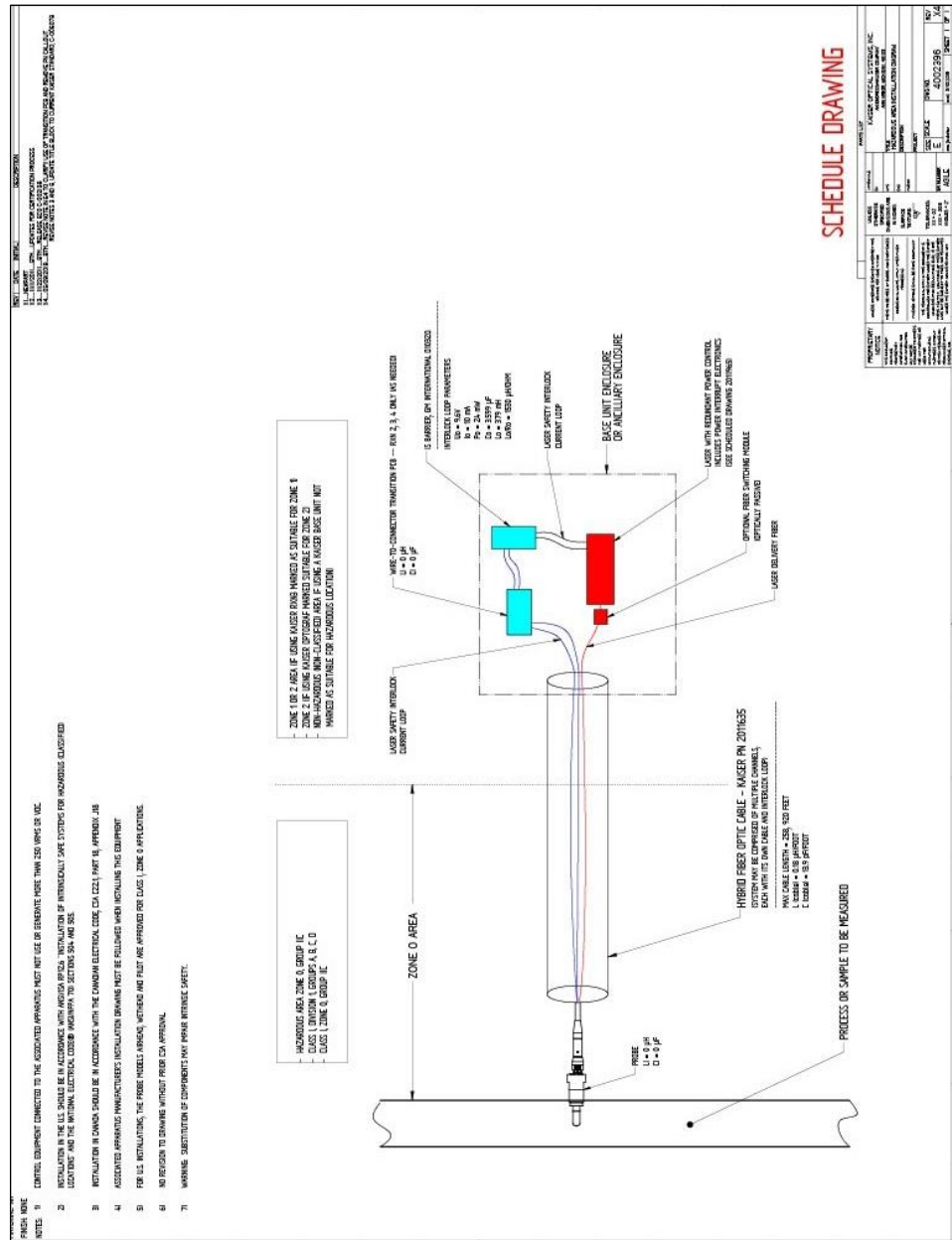*Figure 8. Hazardous area certification*

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