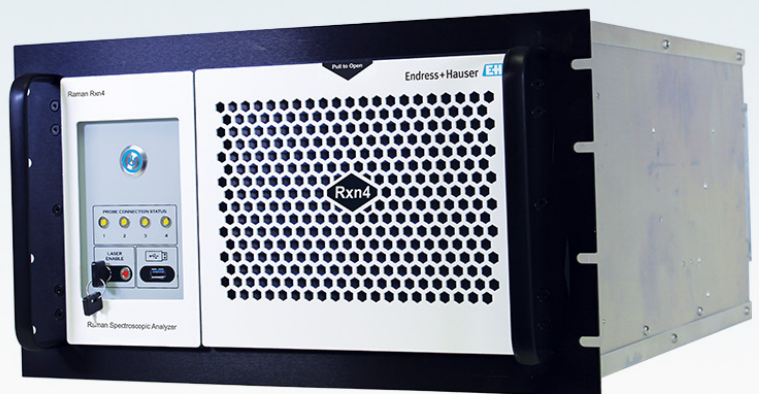


# Raman spectroscopic analyzers

## Robust optical measurement of chemical composition

### For lab-to-process optimization, scalability, quality, and safety

- Ability to measure up to four channels
- 532 nm, 785 nm, or 1000 nm excitation wavelength availability
- Robust and reliable in-line, on-line, or at-line measurement
- Increased process understanding, control, and monitoring of key quality parameters
- User-friendly embedded control software for 24/7 connectivity
- Streamlined calibration and verification procedures
- Unique self-monitoring and diagnostics
- Designed to pair seamlessly with our suite of Raman sampling probes
- Simplified process equipment and model transferability
- Faster processing time, reduced product loss, and higher yields
- Easier compliance with industry regulations



# Raman spectroscopic analyzers

## precise, powerful, proven

Endress+Hauser Raman analyzers, powered by Kaiser Raman technology, are the heart of your Raman system. They provide the strength and precise measurement data you need to maintain a continuous pulse on the safety and efficiency of your operations. Prized for their ability to perform chemical and composition analysis with unparalleled accuracy, our Raman analyzers deliver all the real-time, *in situ* measurements required for the laboratory, along with cost-effective scalability to the production environment.

Our Raman analyzer portfolio features highly intuitive, fully embedded Raman RunTime control software, and works in concert with a wide range of versatile Raman optimized sampling probes. With 24/7 process feedback at your fingertips, Raman technology opens the door to total process transparency and equips you with the knowledge necessary to tightly monitor and control your chemistries. In doing so, you gain the power to drive product quality, improve plant safety, and optimize process efficiencies across your entire lab-to-process enterprise.

**Real-time process data** Raise the bar on safety across your operation by improving your ability to monitor and control your processes. With continuous access to reliable measurement data, you can better predict and avoid safety incidents, as well as minimize personnel and environmental risk exposure.

**Smooth lab-to-process scalability** Whether you want to scale-up, scale-out, or just plain scale, the versatility of our Raman analyzers and probes allow for a seamless transition from the lab to the manufacturing floor. Enjoy higher volumes and speed your time to market.

**Top-notch product quality and higher yields** With 24/7 process automation, you can dramatically boost product quality, increase yields, and minimize product loss. As a bonus, you can also achieve higher profit margins with fewer regulatory compliance headaches.



### Process customization

- Up to four channels
- 532 nm, 785 nm, or 1000 nm wavelengths
- All phases of matter in any install environment
- Wide range of application suitability



### Proven accuracy & reliability

- In-line, on-line, or at-line measurements in real-time
- Continuous 24/7 & 365
- Compatibility with a suite of high-performing Raman sampling probes



### Lab-to-process scalability

- Simplified equipment
- Easy method transferability
- Self-alignment & calibration innovation



### Self-monitoring innovation

- Self-calibration
- Self-diagnostics
- Self-correction when system calibration is unnecessary



### Embedded Raman RunTime control software

- Intuitive touchscreen or remote interface
- Streamlined calibration and verification
- Simple integration into automation platforms
- Support for industry standard predictors
- Enhanced security design



### Industry standards/regulation compliance

- ATEX, North American, & IECEx hazardous area certification
- Enables cGMP
- ISO 9001:2015 certification



# Not all Raman analyzers are created equal

When reliability is a must, trust Endress+Hauser

For over 30 years, Endress+Hauser Raman systems have harnessed the powerful analytical information of Raman spectroscopy to help companies attain operational excellence through optical analysis. Our Raman analyzers provide reliable, continuous measurement of key process parameters for real-time monitoring, control, and optimization. They deliver precise measurement required for the laboratory, along with cost effective scalability to the production environment.

Endress+Hauser Raman analyzers, powered by Kaiser Raman technology, are gold-standards trusted throughout the chemical, pharmaceutical, biopharmaceutical, oil & gas, and food & beverage industries. Our Raman analyzers are proven and reliable, which is precisely why they are selected above all other Raman alternatives when the measurement value is high. Quite simply, our Raman technology represents the state-of-the art in Raman instrumentation, with a long history of success in lab to manufacturing, including cGMP.

## Benefit Highlights

- Drive product quality and minimize product loss
- Optimize process performance and boost profitability
- Reduce personnel exposure and improve plant safety
- Speed time-to-market and maximize yields
- Institute in-line measurement to support industry initiatives such as PAT and QbD
- Scale-up and scale-out with analyzers for traditional and single-use bioreactors
- Realize 24/7 process automation from lab-to-process





## Raman Rxn2 analyzer: starter configuration

### Liquids or solids / laboratory analysis

The starter configuration of the Raman Rxn2 analyzer is the ideal system for those new to Raman spectroscopy or applications requiring lower spectral resolutions. The starter configuration of the Raman Rxn2 offers all the notable benefits that our Raman analyzers are known for - robustness, ruggedness, reliability, and ability to develop transferable models. It also features self-monitoring, diagnostics, and self-calibration capabilities to ensure the validity of each measurement.

The Raman Rxn2 starter system is perfect for cart-portable or benchtop uses such as material quality, reaction monitoring, basic science research, quality assurance, and unknowns identification. It is compatible with the Rxn-10 probe, fitted with non-contact or immersion accessory optics. The starter configuration for the Raman Rxn2 can be configured with up to four channels, and is available in a 785 nm excitation wavelength.

#### Field of application

- Food & Beverage: fermentation, food adulteration
- Chemical: reaction monitoring, blending, catalysis
- Polymer: polymerization reaction monitoring, extrusion monitoring, polymer blending

#### Technical highlights

- Laser wavelength: 785 nm
- Channels: single channel (standard), with optional four channel capability
- Sampling probe compatibility: Rxn-10 (with accessory optics)
- Hazardous area certification: ATEX, North American, IECEx
- Installation options: benchtop or mobile wheeled cart



#### Benefits at a glance

- Low cost entry into Raman
- Suitable for applications requiring lower spectral resolution
- Easy to install
- Minimal maintenance
- Operates sequentially, allowing both fast analysis per channel and programmable channel interrogation
- Accurately measures chemical composition and performs raw materials identification using acquired Raman spectra
- Easy-to-use embedded Raman RunTime software touchscreen interface
- Suitable for outputs into hazardous area/classified environments



## Raman Rxn2: base model configuration

Liquids, solids, or gases / lab to process analysis

The award-winning Raman Rxn2 analyzer adeptly harnesses the power of Raman spectroscopy while serving as an ideal bridge from lab-to-process. Designed for use in analytical laboratories with model transfer capabilities, the Raman Rxn2 is heavily relied on for routine sample identification, support of R&D projects, early process development, and scale-up settings for *in situ* analysis. Available for a benchtop or on a wheeled mobile cart, the Raman Rxn2 offers location convenience and portability for process development laboratories. With up to four probes per analyzer, measurement from different reactors or sampling points is possible with a single Raman Rxn2 system. Multi-channel capability means that Raman-based control methods can be achieved quickly with successful transfer to pilot and manufacturing environments.

Equipped with a unique self-monitoring system, the Raman Rxn2 ensures the validity of each measurement. It is capable of self-calibration and utilizes self-diagnostics and spectral correction methods when system calibration is unnecessary. With versatility in mind, the Raman Rxn2 is configurable with a 532 nm, 785 nm, or 1000 nm excitation wavelength. Like the rest of the Raman Rxn analyzer family, the Raman Rxn2 offers the benefit of having fully embedded, highly intuitive Raman RunTime software as its control platform.



### Field of application

- Chemical: polymerization, extrusion monitoring, polymer blending, catalysis investigation
- Pharmaceutical: reaction chemistry, yield crystallization, polymorph, blending, drying, granulations
- Biopharmaceutical: bioprocess monitoring and control, PAT/QbD applications, cell culture, fermentation, downstream operations, cGLP/cGMP compatible
- Food & Beverage: zonal heterogeneity, fermentation

### Benefits at a glance

- Reliable real-time, *in situ* measurements
- Intuitive, embedded control software via touchscreen or remote interface
- Convenience of a single base unit supporting up to four probes
- Sequential operation for fast analysis per channel and programmable channel interrogation
- Converts acquired Raman spectra into process knowledge using built-in multivariate predictors
- Suitable for outputs into hazardous area/classified environments
- cGLP/cGMP compatible

### Technical highlights

- Laser wavelength: 532 nm, 785 nm, or 1000 nm
- Channels: single channel (standard), with optional four channel capability
- Probe compatibility: Rxn-10 (with accessory optics), Rxn-30, Rxn-40, Rxn-41, Rxn-45, Rxn-46
- Hazardous area certification: ATEX, North American, IECEx
- Installation options: benchtop or mobile wheeled cart





## Raman Rxn4 analyzer: base model configuration

Liquids, solids, or gases / process analysis

Designed for use in process and manufacturing settings, the rugged Raman Rxn4 analyzer is the optimal choice for manufacturing or process environments. Many companies move to the Raman Rxn4 after their processes have been successfully tested and proven in the laboratory and process development stages. Stackable in a standard 19" rack, the Raman Rxn4 saves valuable space on the production floor. It comes with fully embedded, user-friendly Raman RunTime control software which enables real-time, *in situ* process monitoring and control. Like its Raman Rxn2 counterpart, the Raman Rxn4 analyzer can be configured up to four channels with a 532 nm, 785 nm, or 1000 nm excitation wavelength, depending on your process needs. It also features unique self-monitoring, diagnostics and self-calibration capabilities to ensure the validity of each measurement.

The Raman Rxn4 is certified for output into hazardous areas, and it is offered with an optional stainless steel NEMA 4X enclosure.

### Benefits at a glance

- Robust, reliable, and highly accurate
- Easy installation and minimal maintenance/downtime
- 24/7 in-line, on-line, or at-line process measurement and monitoring
- Unified internal construction enables straightforward model transfer to support redundant analyzer systems
- Intuitive, fully embedded Raman RunTime control software via touchscreen or remote interface
- Robust data modeling
- Scale-up, scale-out, and cGMP/pilot-plant compatible
- Suitable for output into hazardous area/classified environments



### Field of application

- Chemical: reaction monitoring, blending, catalysis investigations
- Polymer: polymerization reaction monitoring, extrusion monitoring, polymer blending
- Pharmaceutical: API reaction monitoring, crystallization, polymorph
- Biopharmaceutical: bioprocess monitoring and control, PAT/QbD applications, cell culture, fermentation, downstream operations, cGLP/cGMP compatible
- Food & Beverage: mapping of meats and fish, fermentation, offgas, volatiles

### Technical highlights

- Laser Wavelength: 532 nm, 785 nm, or 1000 nm
- Channels: single channel (standard), with optional four channel capability
- Probe compatibility: Rxn-10 (with accessory optics), Rxn-30, Rxn-40, Rxn-41, Rxn-45, Rxn-46
- Hazardous area certification: ATEX, North American, IECEx
- Installation options: Designed for 19" rack installation; NEMA 4X enclosure on trolley or stand also available



## Raman Rxn2/4 analyzer: hybrid configuration

Solids or liquids / laboratory or process analysis

Raman Rxn2 and Rxn4 analyzers offer a hybrid configuration option for powerful solid phase analysis. Available with a 785 nm excitation wavelength, these bold two channel analyzers feature hybrid (micron and mm) probe capability, high spectral resolution, and easy calibration transfer between analyzers. When coupled with our Raman sampling probes, they adeptly perform both traditional small spot Raman sampling and wide area Raman sampling. Raman Rxn hybrid analyzer variants allow for quantitative monitoring and representative, non-destructive sampling of solids.

In addition to offering one channel dedicated to the Rxn-20 probe for solids analysis, Raman Rxn hybrid analyzer configurations also support one other alternate channel. This channel may be dedicated to liquids analysis, thereby enabling efficient measurement of two different applications or sample phases from the same analyzer. Whether you need cart-portable raw materials identification, bench-top methods development in a lab, reaction monitoring in a pilot plant, process control development in a manufacturing environment, or a dedicated quality control analyzer – a Raman Rxn hybrid analyzer provides an optimized sampling configuration.

### Benefits at a glance

- Reproducible solids measurements without needing to refocus probe or touch samples
- Sampling volume range: micron to mm
- Up to 6mm spot size measurement
- Elimination of subsampling concerns
- Suitable for outputs into hazardous area/classified environments

### Field of application

- Pharmaceutical: API reaction monitoring, crystallization, polymorph, blending, granulations, drying and other drug product unit operations, tablets, and capsules
- Chemical: polymerization, polymer blending, polymer pellets, fibers, plaques, or films, extrusion monitoring, catalysis investigations
- Food & Beverage: dairy solids, meat and fish composition



### Technical highlights

- Laser wavelength: 785 nm
- Probe compatibility: Rxn-20 probe and one alternate Endress+Hauser Raman probe
- Hazardous area certification: ATEX, North American, IECEx
- Installation options: similar to Raman Rxn2 and Raman Rxn4 analyzers



# Raman RunTime

## Embedded analyzer control software

The “brain” of every Raman Rxn analyzer is its powerful, intuitive, and fully embedded Raman RunTime software control platform. Accessed via a user-friendly touchscreen or remote interface, Raman RunTime integrates the spectrometer functions into the analyzer electronics, avoiding the need to run proprietary software using an entirely separate computer. This promotes productivity by offering a common, easy-to-use interface for use in the laboratory to process development and manufacturing.

Raman RunTime ensures reliability and seamless connectivity, allowing you to collect Raman spectra continuously for days, weeks, or even months. It is intended for easy integration with industry standard multivariate analysis and automation platforms to deliver real-time, *in situ* process monitoring and control. Raman RunTime conveys raw data and diagnostics using standard communication protocols to support data integrity assurance. Its embedded controller technology and interface was designed to be inherently secure. Combined with the capabilities of our Raman analyzers and probes, Raman RunTime software supports the needs of Industry 4.0.

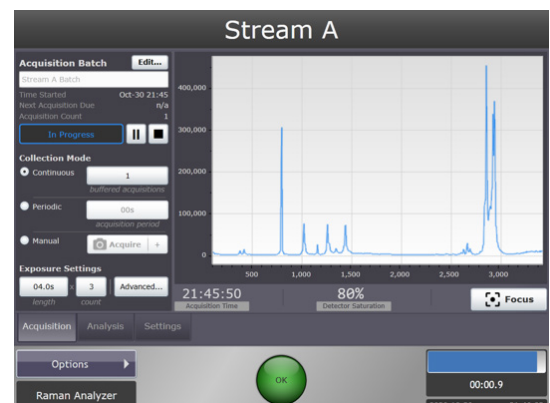
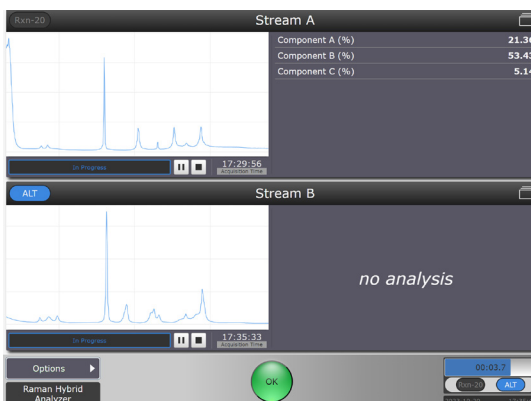


### Benefits at a glance

- Intuitive touchscreen Human Machine Interface or remote access
- Streamlined calibration and verification procedures
- Three collection modes: continuous, periodic, and manual
- Simple integration to PAT, MVA, and automation platforms
- Built in OPC, Modbus, and HTTPS communication protocols
- Support for embedded predictors
- Purposely designed to be inherently secure
- Supports IIoT/Industry 4.0 initiatives

### Security Highlights

- Proprietary, customized embedded controller that only accepts authenticated updates
- Fixed-purpose device operation to eliminate inadvertent or malicious user interaction
- No interaction with low level operating system, all control functions happen in the software user interface
- Password protection of privileged analyzer functionality
- User management for three different privilege levels: Administrator, Operator, User
- Real-time protection via built-in anti-virus software to eliminate potential malware points of entry





# Our Raman probes and accessories

## Boost the value of your Raman analyzer system

Our Raman probes and accessories allow you to measure with precision and customize your Raman analyzer to your unique operational needs for maximum return on investment.



### Raman Rxn2 mobile wheeled cart

Convenient location/transport packaging option for the Raman Rxn2 analyzer

- Industrial-grade construction with all powder-coated aluminum/steel
- Large 5" lockable, dual-wheel swivel casters
- Probe and sample chamber mounting, plus additional storage
- Convenient single power connection and ethernet jack



### Raman Rxn4 NEMA 4X enclosure

Rugged stainless-steel enclosure location/packaging option for the Raman Rxn4 analyzer

- Stainless steel construction
- NEMA, washdown compatible



### Raman sampling probes

Suite of phase-optimized sampling probes designed to seamlessly pair with our Raman analyzers

- Rxn-10 probe - laboratory analysis of liquids and solids
- Rxn-20 probe - laboratory and process analysis of solids
- Rxn-30 probe - laboratory and process analysis of gases
- Rxn-40 probe - laboratory and process analysis of liquids
- Rxn-41 probe - process analysis of liquids
- Rxn-45 probe - process analysis of liquids for bioprocessing
- Rxn-46 probe - lab and process analysis of liquids for bioprocessing



### Raman probe accessory optics

Robust immersion and non-contact optics accepted by our Raman probes to heighten accuracy and sampling flexibility

- Non-contact optic
- Immersion optic
- bIO-Optic
- Raman optic system for single use



### Calibration accessory

Fast, simple, and accurate wavelength and intensity calibration

- Robust calibration protocol
- Unparalleled system accuracy and instrument precision
- Minimal technical support



### Enclosed sample compartment

Flexible sampling accessory compatible with our Raman non-contact optics

- Accommodates a variety of sample forms
- May be used in either a horizontal or vertical orientation
- Cart mountable for a convenient and transportable analytical chamber



# Technical specifications: Raman Rxn2 lab-to-process analyzer series

Configuration	Raman Rxn2: starter	Raman Rxn2: base model	Raman Rxn2: hybrid
Laser wavelength	785 nm	532 nm, 785 nm, 1000 nm	785 nm
Spectral coverage	300-3300 $\text{cm}^{-1}$ (785 nm)	150-4350 $\text{cm}^{-1}$ (532 nm) 150-3425 $\text{cm}^{-1}$ (785 nm) 200-2400 $\text{cm}^{-1}$ (1000 nm)	175-1890 $\text{cm}^{-1}$ (785 nm)
Spectral resolution	10 $\text{cm}^{-1}$ average	5 $\text{cm}^{-1}$ (532 nm); 4 $\text{cm}^{-1}$ (785 nm); 5 $\text{cm}^{-1}$ (1000 nm) average	4 $\text{cm}^{-1}$ (785 nm) average
Temperature / % relative humidity	Operating temp: 15 °C to 30 °C Storage temp: -15 °C to 50 °C Relative humidity: 20-80%, non-condensing	Operating temp: 15 °C to 30 °C Storage temp: -15 °C to 50 °C Relative humidity: 20-80%, non-condensing	Operating temp: 15 °C to 30 °C Storage temp: -15 °C to 50 °C Relative humidity: 20-80%, non-condensing
Input voltage	100-240 V, 50-60 Hz, $\pm 10\%$	100-240 V, 50-60 Hz, $\pm 10\%$	100-240 V, 50-60 Hz, $\pm 10\%$
Power consumption	400 W (max) 250 W (typical start-up) 120 W (typical running)	400 W (max) 250 W (typical start-up) 120 W (typical running)	400 W (max) 250 W (typical start-up) 120 W (typical running)
Warm-up time	120 minutes	120 minutes	120 minutes
Unit dimensions (width x height x depth)	<b>Benchtop model:</b> 279 x 483 x 592 mm <b>Cart model:</b> 685 x 1022 (to tabletop) x 753 mm	<b>Benchtop model:</b> 279 x 483 x 592 mm <b>Cart model:</b> 685 x 1022 (to tabletop) x 753 mm	<b>Benchtop model:</b> 279 x 483 x 592 mm <b>Cart model:</b> 685 x 1022 (to tabletop) x 753 mm
Weight	<b>Base model:</b> 32 kg <b>Cart model:</b> 93 kg	<b>Base model:</b> 32 kg <b>Cart model:</b> 93 kg	<b>Base model:</b> 32 kg <b>Cart model:</b> 93 kg
Sampling probe compatibility	Rxn-10 (with accessory optics)	Rxn-10, Rxn-30, Rxn-40, Rxn-41, Rxn-45, and Rxn-46	Rxn-20 (with accessory optics) and one alternate Raman probe
Hazardous area certifications	ATEX, North American, IECEx	ATEX, North American, IECEx	ATEX, North American, IECEx
Connection interface	OPC, Modbus, and HTTPS (contact Sales for other options)	OPC, Modbus, and HTTPS (contact Sales for other options)	OPC, Modbus, and HTTPS (contact Sales for other options)
Installation options	Benchtop (standard) or mobile wheeled cart	Benchtop (standard) or mobile wheeled cart	Benchtop (standard) or mobile wheeled cart



## Technical specifications: Raman Rxn4 process analyzer series

Configuration	Raman Rxn4: base model	Raman Rxn4: with enclosure	Raman Rxn4: hybrid
Laser wavelength	532 nm, 785 nm, 1000 nm	532 nm, 785 nm, 1000 nm	785 nm
Spectral coverage	150-4350 $\text{cm}^{-1}$ (532 nm) 150-3425 $\text{cm}^{-1}$ (785 nm) 200-2400 $\text{cm}^{-1}$ (1000 nm)	150-4350 $\text{cm}^{-1}$ (532 nm) 150-3425 $\text{cm}^{-1}$ (785 nm) 200-2400 $\text{cm}^{-1}$ (1000 nm)	175-1890 $\text{cm}^{-1}$ (785 nm)
Spectral resolution	5 $\text{cm}^{-1}$ (532 nm); 4 $\text{cm}^{-1}$ (785 nm); 5 $\text{cm}^{-1}$ (1000 nm) average	5 $\text{cm}^{-1}$ (532 nm); 4 $\text{cm}^{-1}$ (785 nm); 5 $\text{cm}^{-1}$ (1000 nm) average	4 $\text{cm}^{-1}$ average
Temperature / % relative humidity	Operating temp: 5 °C to 35 °C (532 nm, 785 nm); 5 °C to 30 °C (1000 nm) Storage temp: -15 °C to 50 °C Relative humidity: 20-80%, non-condensing	Operating temp: 5 °C to 50 °C (all wavelengths) Storage temp: -15 °C to 50 °C Relative humidity: 20-80%, non-condensing	Operating temp: 5 °C to 35 °C Storage temp: -15 °C to 50 °C Relative humidity: 20-80%, non-condensing
Input voltage	100-240 V, 50-60 Hz, $\pm 10\%$	115 V $\pm 10\%$ , 60 Hz OR 230 V $\pm 10\%$ , 50/60 Hz	100-240 V, 50-60 Hz, $\pm 10\%$
Power consumption	400 W (max) 250 W (typical start-up) 120 W (typical running)	1560 W (max) 1560 W (typical start-up) 750 W (typical running)	400 W (max) 250 W (typical start-up) 120 W (typical running)
Warm-up time	120 minutes	240 minutes	120 minutes
Unit dimensions (width x height x depth)	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	Rxn-10, Rxn-30, Rxn-40, Rxn-41, Rxn-45, Rxn-46	Rxn-10, Rxn-30, Rxn-40, Rxn-41, Rxn-45, Rxn-46	Rxn-20 (with accessory optics) and one alternate Raman probe
Hazardous area certifications	ATEX, North American, IECEx	Call Support for options	ATEX, North American, IECEx
Connection interface	OPC, Modbus, and HTTPS (contact Sales for other options)	OPC, Modbus, and HTTPS (contact Sales for other options)	OPC, Modbus, and HTTPS (contact Sales for other options)
Installation options	19-inch rack package	NEMA 4X enclosure; wall-mountable, mobile trolley, or fixed stand	19-inch rack package



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