



# **tech overview**



# restart, reunite

If we've learned one thing from the COVID-19 pandemic, it's that being together matters. It matters for students and teachers, patients and doctors, and colleagues working collaboratively across a spectrum of industries. At Antrum, we understand that looking forward to a post-pandemic restart isn't just about getting back to business as usual. It's about coming out of isolation, connecting as a community, and working together in spaces designed to prioritize occupant health as efficiently as possible.

## know your air

AntrumX™ is a patented Indoor Air Quality (IAQ) monitoring technology that provides your Building Management System and facilities managers with the real-time data needed to ensure the healthiest air quality possible for your building's occupants—all while optimizing ventilation for increased energy savings.



# a centralized approach

AntrumX™ continuously monitors and reports Indoor Air Quality on up to 32 rooms from a single location, eliminating the need for expensive maintenance and calibration procedures.



**IAQ Monitoring:** CO<sub>2</sub>, TVOC, PM<sub>2.5</sub>, PM<sub>10</sub>, RH



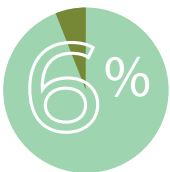
**Sustainable:** Zero moving parts means less maintenance. Sustainable for the life of the building.



**Single Point of Service:** Up to 32 rooms from a single location.



**AntrumEYE™:** Store, trend, analyze, and report.



**Scalable:** 6% of the sensors required in traditional systems. One sensor module for every 16 rooms.

## tested tech

Engineers at Grand Valley State University worked on the development of the technology for AntrumX for over a decade. In that time, it has monitored the IAQ of nearly 900 rooms and 600,000 square feet, creating demonstrably healthier environments for GVSU students and staff, and resulting in significant savings, both in energy usage and in installation/maintenance costs.





# how it works



1

All the room-occupant sees is AntrumX's discreet faceplate. Behind the scenes, quarter inch tubing transports air samples from the monitored space to the Sensor Pack.

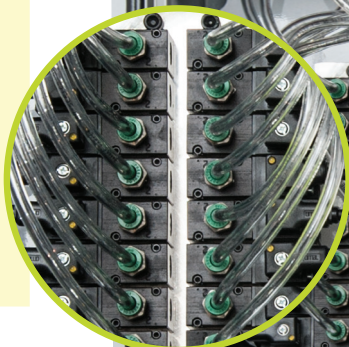
2

AntrumX's patented Air Accelerator uses building differential pressure to create a vacuum. Air is drawn from the faceplate in 32 unique spaces to the monitoring panel located in the mechanical closet.



3

Using three-way solenoids, air from the rooms is exhausted until it's time to be analyzed by the Sensor Pack. AntrumX sample time/room is user defined, but defaults to one room/minute.



AntrumX requires one 120V connection.

Sensors are calibrated annually and can be replaced at one easily accessible point of service.

AntrumX communicates IAQ data to the BMS over ANY protocol (BACnet, Modbus, N2, etc.).

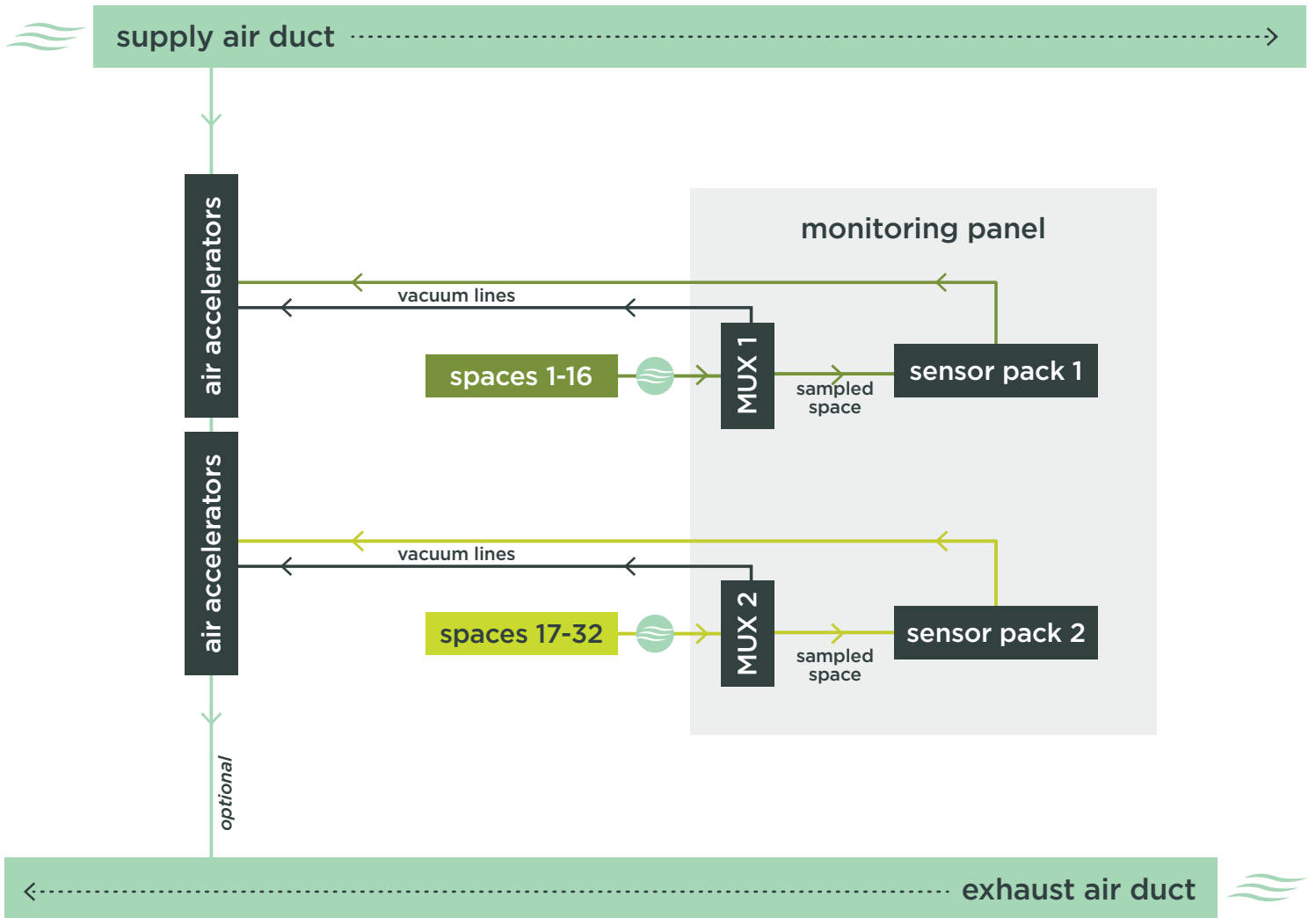


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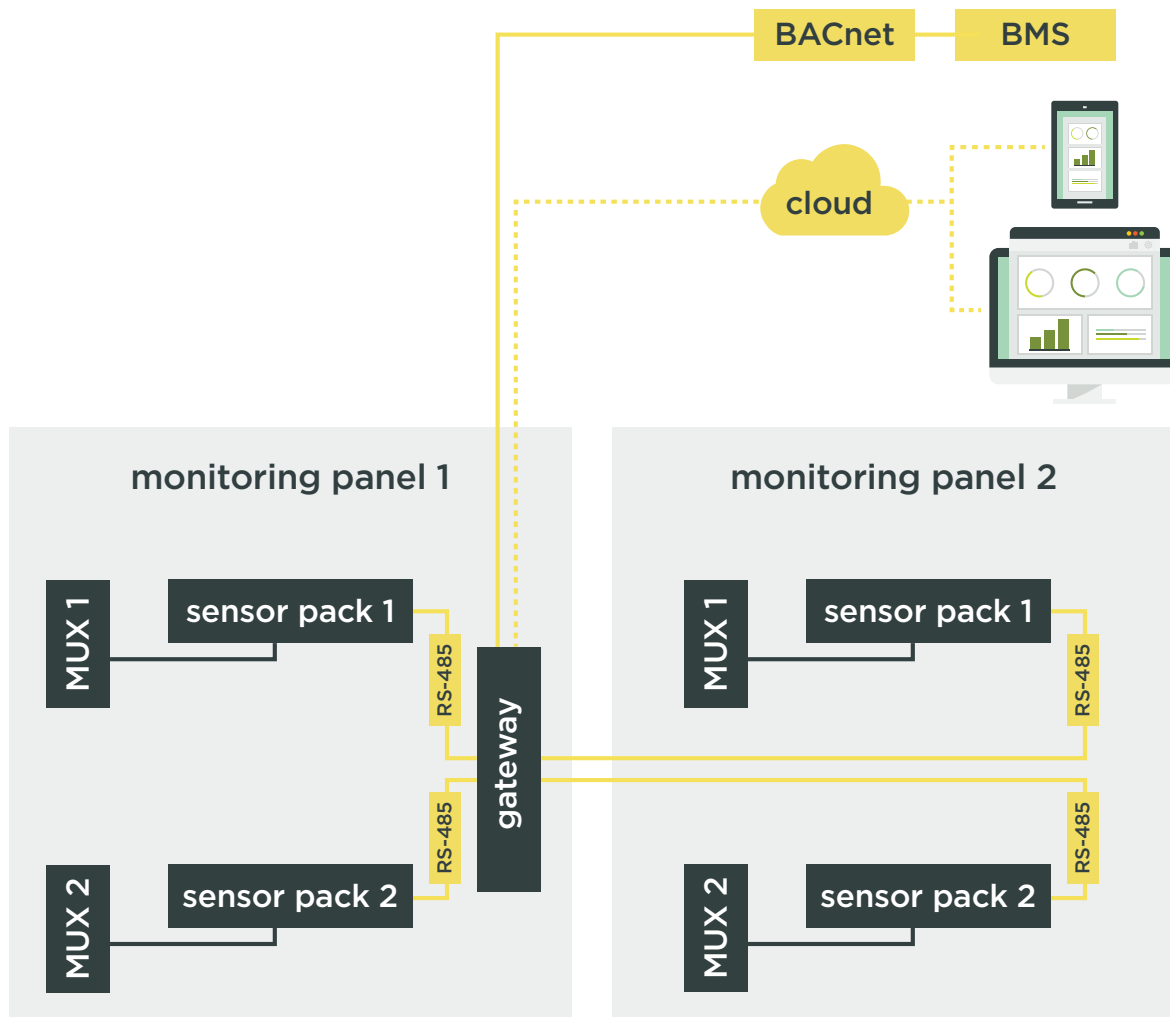
AntrumX communicates IAQ data to the cloud over a secure network and generates detailed reports. AntrumEYE provides a proactive deep-dive into your building's IAQ, sending push alerts and monthly reports available on a mobile platform.



# system architecture—airflow



# system architecture—dataflow





**This technical overview details how AntrumX™ delivers the real-time data you need to improve IAQ and optimize your building's ventilation in an easy-to-install, easy-to-maintain, and scalable system. Knowing your air means having confidence that your buildings and their occupants are healthy.**





# faceplate



**Includes:**

- 3500' of 1/4" OD polyethylene flame retardant tubing. Meets UL94V-2 and UL1820
- Push-to-connect tube fitting

**Ordering Guide:** AXFP0001

Antrum's faceplate, with its high-gloss finish and flush mounting, was designed to be simple and aesthetically pleasing. The faceplate collects air samples from each space and delivers them to the centrally located sensor pack through 1/4" flame-retardant polyethylene tubing. Antrum's patented Air Accelerator uses the differential pressure of the existing HVAC system to create a continuous vacuum between each faceplate and the sensor pack, allowing Antrum to continuously monitor the indoor air quality (IAQ) of multiple spaces on a multitude of environmental parameters.

## Faceplate Specifications

Materials	UL Listed Molded ABS
Color	Sno White
Connections	1/4" push-to-connect coupling; compatible with 1/4" tubing
Dimensions	3"W x 4.7"H x 1.5"D
Compliance	UL 94HB





# air accelerator



#### Includes:

- 50' of 2" and 100' of ½" ID Hose
- (4) Duct Couplers

**Ordering Guide:** AXAA0001

Antrum's patented Air Accelerator uses the building's supply duct static pressure to create a continuous vacuum in every room being serviced—the room being monitored as well as the idle rooms.

The Air Accelerator is connected to the multiplexer, which selects and routes one room every minute to the sensor pack, where the room air is sampled and indoor air quality (IAQ) parameters are measured and reported to the cloud and building management system (BMS). All other rooms serviced by the monitoring panel are routed through the multiplexer, but bypass the sensor pack and are exhausted out of the building.

The sensor pack continuously monitors the vacuum pressure in the system and performs a leak test every 24 hours. If the system loses vacuum, it will stop sampling and reporting, as is standard operating procedure when the air handling unit (AHU) status is 'off.' If a loss of vacuum is detected and the AHU status is on, the system will stop reporting and the BMS generates an alert.

There are no moving parts on the air accelerator and therefore no energy input to the system other than the negligible parasitic loss on the supply and exhaust fan motors in the AHU serving the rooms being sampled.

The Air Accelerator comes with built-in mounting holes to facilitate several mounting options.

#### Air Accelerator Specifications

Materials	TP 4056
Color	Black
Connections	(2) 2" hose barb connections (1) ½" hose barb connections
Dimensions	LxWxH: 11" x 2.06" x 3.07"
Weight	0.54lbs





# tubing

AntrumX™ tubing transports air samples from each designated space to the sensor pack located in the monitoring panel. The tubing is plenum-rated and specifically designed for pneumatic HVAC applications, utilizing push-to-connect fittings for ease of installation.

Featuring exceptional flame, spark, and stress-crack resistance, AntrumX tubing is ideally suited for industrial purposes, resulting in safe, successful system operation. The tubing provides a safe and stable medium for transporting samples of air from which carbon dioxide, volatile organic compounds, particulate matter, and relative humidity will be measured.

## Tubing Specifications

Compliance	NFPA90A UL1820 UL94V-2 ASTM D 1693A
Tube Inside Diameter	.17"
Minimum Bend Radius	¾"
Tube Outside Diameter	¼"
Application	Pneumatic Controls, Air Conditioning and Ventilation Systems
Tube Wall Thickness	0.040
Minimum Burst Pressure	500 psi
Minimum Operating Temperature	-65°C -85°F
Maximum Operating Temperature	66°C 150°F <i>For indoor use only</i>
Media	Air
Color	Black
Tube Material	Polyethylene
Coil	Length: 250' Weight: 15lbs
Master Pack	Length: 1000' Weight: 17lbs
Accessories	Straight Couplers Elbow Couplers

### Ordering Guide:

**250' Tubing:** AXPTC0001

**1000' Tubing:** AXPTM0001

**Straight Couplers:** AXPTSC0001

**Elbow Couplers:** AXPTec0001





# sensor pack



## Features:

- Currently offering (5) IAQ parameters
- Optional annual calibration
- Scalable architecture to facilitate future sensor technologies

Space-mounted sensors, primarily Carbon Dioxide (CO<sub>2</sub>) sensors, are often deployed in commercial buildings to obtain data that is used to automatically modulate rates of outdoor air supply. The goal is to keep ventilation rates at or above code requirements, and to save energy by avoiding over-ventilation relative to code requirements.

The widely dispersed nature of space-mounted sensors, however, presents a maintenance challenge. Sensors often go unmaintained, resulting in inaccurate readings, misguided ventilation strategies, and loss of potential energy savings.

AntrumX™ centralizes the sensors in its patented sensor pack, allowing multiple indoor air quality (IAQ) parameters to be measured and transmitted to the cloud and building management system (BMS) via the gateway from one central location, significantly decreasing maintenance costs.

The sensor pack is comprised of unique sensors with specific performance characteristics designed to facilitate demand-controlled ventilation or monitoring-only purposes. The ability to monitor a variety of IAQ parameters from a single location results in more accurate data, which leads to significant maintenance and energy savings, a better ventilation strategy, and an overall healthier building.

## Sensor Pack Specifications

Environmental Conditions	Operating Temp: 10–40°C
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# carbon dioxide sensor

AntrumX™ centralizes sensors in a patented sensor pack, allowing multiple indoor air quality (IAQ) parameters to be measured simultaneously from one central location. AntrumX continuously draws air samples from each faceplate/space to the sensor pack located in the monitoring panel, where it measures and reports data to the building management system (BMS) and the cloud for further analysis.

Carbon Dioxide (CO<sub>2</sub>), a colorless gas with a faint, sharp odor and a sour taste, is a key indicator of IAQ.

CO<sub>2</sub> is a byproduct of combustion, as well as a result of the metabolic process in living organisms. Because CO<sub>2</sub> is a result of human metabolism, concentrations within a building are often used to indicate occupancy levels, and to determine whether fresh air is being adequately supplied to the space.

Under typical conditions, outdoor CO<sub>2</sub> levels are lower than those in indoor air; therefore, the more fresh air supplied to a space, the lower the concentration of CO<sub>2</sub>.

Supplying the necessary volume of outdoor air to maintain appropriate CO<sub>2</sub> concentration is essential to the overall health of your building. Additionally, optimized ventilation dilutes the concentration of airborne contaminants, improves occupant comfort and efficiency, and decreases energy usage and cost.

The CO<sub>2</sub> sensor employs patented CMOS technology for precision, reliability, and functionality. Weak analog sensor signals are amplified and digitized where they are generated, thereby making them resistant to interference. CMOS paired with NDIR measurement technology is the foundation of Antrum's world-class sensor accuracy.

## CO<sub>2</sub> Sensor Specification

Typical Application	IAQ Monitoring, Demand Control Ventilation (DCV)
Technology	NDIR
Range	400 - 10,000 ppm
Accuracy	+/-30 ppm
Repeatability	+/- 10 ppm
Temp. Stability	+/- 2.5 ppm/°C
Response	20s
Sample Time	2s





# relative humidity sensor

Relative humidity (RH) is the amount of water vapor present in the air expressed as a percentage of the amount needed for saturation at the same temperature.

RH is an indication of the amount of moisture in a given space. Environments with higher moisture content are susceptible to mold growth; therefore, controlling RH is essential to the health of your building. ASHRAE recommends maintaining 65% RH or below, whereas the EPA recommends maintaining 30% - 60% RH. While the World Health Organization does not make a recommendation, there is growing evidence of the crucial role RH plays in the prevention of virus transmission and in the effectiveness of the respiratory immune system.

RH and air sample temperature are measured to calculate dewpoint. Using the dewpoint and reading the dry bulb temperature of the space from the BMS allows Antrum to calculate the relative humidity of the space.

The RH and Temperature sensors employ patented CMOS sensor technology for accuracy and long-term stability. These robust digital sensors operate with precision in the most challenging environments.

## Relative Humidity Sensor Specification

Typical Application	IAQ Monitoring, Demand Control Ventilation (DCV)
Technology	CMOS
Range	0 - 100% RH
Accuracy	+/- 1.8% RH typ +/- 3.5% RH max
Repeatability	0.08 - 0.25% RH
Resolution	0.01% RH
Response	10s
Sample Time	2s

## Temperature Sensor Specification

Typical Application	IAQ Monitoring, Demand Control Ventilation (DCV)
Technology	CMOS
Range	0-60
Accuracy	+/- .4°C
Repeatability	0.04-0.1°C
Response	10s
Sample Time	2s



# volatile organic compound sensor

Volatile organic compounds (VOCs) are emitted as gases from certain solids and liquids. VOCs include a variety of chemicals emitted by a wide array of everyday products (e.g., paint, disinfectants, clothing, building materials, and office equipment). VOC concentrations are consistently higher—up to ten times—indoors than they are outdoors, which can result in adverse short- and long-term health effects like eye, nose, and throat irritation, headaches, and nausea.

Supplying adequate outdoor air and maintaining appropriate ventilation are critical to reducing VOC exposure inside commercial buildings. Optimized ventilation dilutes airborne concentrations of indoor contaminants, improving occupant comfort and efficiency, and ultimately ensuring an overall healthier building.

The VOC sensor utilizes patented CMOS technology and metal oxide-based sensing for long-term stability. The biggest advantage of a metal oxide sensor is its high sensitivity to a variety of target gases, such as VOCs and hydrogen.

## Examples of air pollutants and their sources

- Harmful gases**
  - **Acetone** (paints, glues)
  - **Toluene** (furniture, mattresses, building products)
- Odors**
  - **Hydrogen sulfide, volatile sulfuric compounds** (rotten food, farts)
  - **Ammonia, amines** (pet pee)
- Other gases**
  - **Ethanol** (alcohol, cleaner, perfume)
- Smoke**
  - **Benzene, nitrosamines** (cigarette smoke)

## Volatile Organic Compound Sensor Specification

Typical Application	IAQ Monitoring, Demand Control Ventilation (DCV)
Technology	CMOS, MOx
Range*	<i>Calibrated</i> .3 - 30 ppm <i>Maximum</i> 0 - 1,000 ppm
Accuracy	Greater of: <50 or <10% of reading ppb
Repeatability	± 5 index points
Drift Stability	± 15 index points
Response	10s
Sample Time	2s

\*ethanol equivalents



# particulate matter sensor

Particulate matter (PM) is the term representing the sum of all solid and liquid particles suspended in air, many of which are hazardous. This complex mixture includes both organic and inorganic particles, such as dust, pollen, soot, smoke, and liquid droplets. These particles vary greatly in size, composition, and origin.

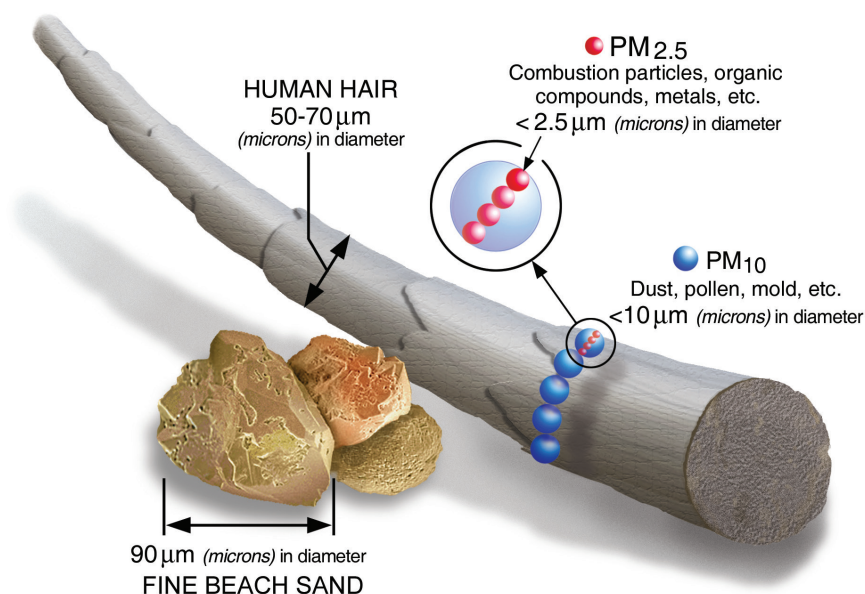
**Particles in air are either:**

- Directly emitted, for instance, when fuel is burnt and when dust is carried by wind, or
- Indirectly formed, when gaseous pollutants previously emitted into the air turn into particulate matter

**Particle pollution includes:**

- PM10: inhalable particles, with diameters that are generally 10 microns and smaller
- PM2.5: fine inhalable particles, with diameters that are generally 2.5 microns and smaller

*How small is 2.5 micrometers? For reference, the average human hair is about 70 micrometers in diameter—making it 30 times larger than the largest fine particle.*



Source: EPA Website, Particulate Matter Basics



# particulate matter sensor

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Besides the potential harmful effects particulate matter can have on the environment, such as reduced visibility and depletion of nutrients in the soil, exposure to these dangerous microscopic solids and liquids can adversely affect human health. Exposure to such particles can affect both your lungs and heart, with fine particles (PM<sub>2.5</sub>) being the most dangerous.

Supplying adequate outdoor air and maintaining appropriate ventilation are critical to reducing exposure to harmful particulate matter inside commercial buildings. Optimized ventilation dilutes airborne concentrations of indoor contaminants, improving occupant comfort and efficiency, and ultimately ensuring an overall healthier building.

The PM sensor uses a proprietary contamination-resistance technology coupled with optical sensors utilizing a laser-based scattering principle. This innovative technology enables long-lasting, highly accurate measurements.

The sensor is equipped with advanced algorithms providing superior precision for different PM types and advanced particle-size binning through calibrated digital output.

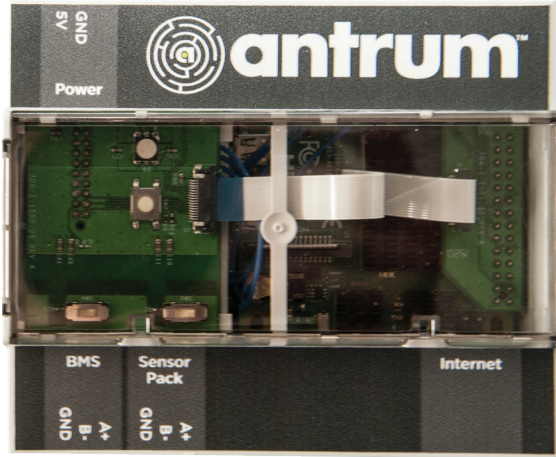
## Particulate Matter Sensor Specification

Typical Application	IAQ Monitoring, Demand Control Ventilation (DCV)
Technology	Proprietary Contamination Resistance
Mass Concentration Range	0 - 1,000 µg/m <sup>3</sup>
Mass Concentration Resolution	1 µg/m <sup>3</sup>
Mass Concentration Accuracy	± 10 @ 0 - 100 µg/m <sup>3</sup> ± 10% @ 100 - 1,000 µg/m <sup>3</sup>
Particle Detection Size Range	PM <sub>2.5</sub> : 0.3 - 2.5 µm PM <sub>10</sub> : 0.3 - 10.0 µm
Lower Limit Detection	0.3 µm
Response	20s
Sample Time	2s



# gateway

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The core of the AntrumX™ technology platform is the gateway, a controller located in the monitoring panel that integrates the sensor pack, building management system (BMS), and the cloud.

The gateway receives data from the sensor pack and uploads the data to the cloud for further analysis. This data is available on [antrumeye.com](http://antrumeye.com) and the AntrumEYE™ mobile app (subscription required). This data is also communicated to the BMS to allow for better overall space-level control.

## Security Summary

AntrumX uses an on-board secure element to store encrypted certificates for communicating with AntrumEYE APIs over HTTPS using TLS. AntrumX utilizes X.509 certificate for identity, a minimum 2048 bit RSA key, and asymmetric cryptography to ensure that customer data is encrypted end to end.

## Gateway Specifications

Connections	Monitoring Panels: RS-485 BMS: BACnet MS/TP Internet: 10/100/1000 Ethernet
Compliance	BTL Listed







# antrumEYE



AntrumEYE™ is a multi-level subscription service for the AntrumX product offering that provides facility managers with real-time IAQ data. You can access readings and detailed reports on your computer or mobile device.

AntrumEYE provides the data you need to improve your air, optimize ventilation, and breathe easy. Through smart analytics, push-alerts, and a monthly analysis of the monitored spaces, AntrumEYE provides critical IAQ data anytime, anywhere.

<b>AntrumEYE Subscription Tiers</b> Providing varying levels of data access and online/mobile tools			
	<b>Bronze</b>	<b>Silver</b>	<b>Gold</b>
<b>Campus Level IAQ Data</b>	✓	✓	✓
<b>Building Manager Tool</b>	✓	✓	✓
<b>Organizational and User Management Tool</b>	✓	✓	✓
<b>Room-Level IAQ Data</b>		✓	✓
<b>Charts, Reports, and Alerts</b>		✓	✓
<b>Annual</b> <ul style="list-style-type: none"><li>• Panel PM</li><li>• Sensor Pack Calibration*</li><li>• Associated Inspection Report</li></ul>			✓

\*Sensor Pack needs to be replaced every 5 years. Replacement cost is included with Gold subscription only.



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**antrum**<sup>™</sup>