tech overview and guide

antrum™

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.
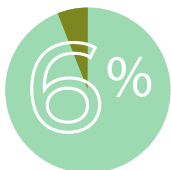
IAQ Monitoring: CO2, TVOC, PM2.5, PM10, RH

No Moving Parts: Ease of 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

6% of the sensors required: 1 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
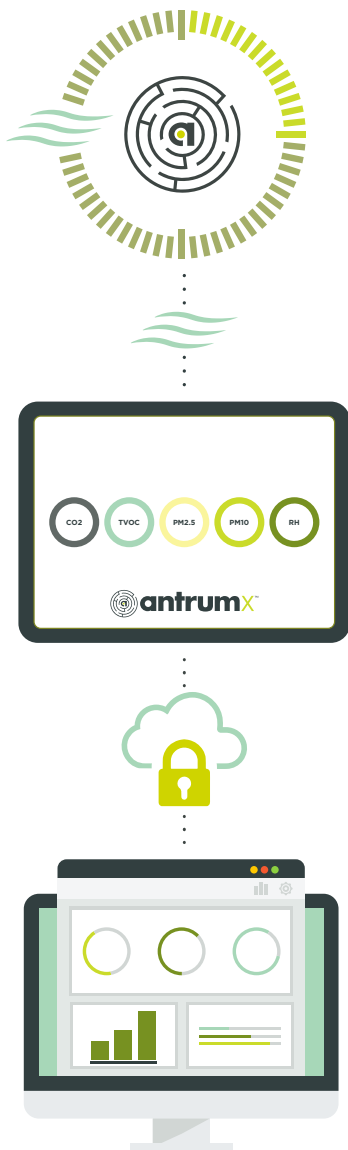
1

Using vacuum pressure, AntrumX continuously pulls air from each room to the main control panel.

CO2 TVOC PM2.5 PM10 RH

antrumx

2

The air from each room is sampled every 15 minutes by digital sensors, and then exhausted outside.
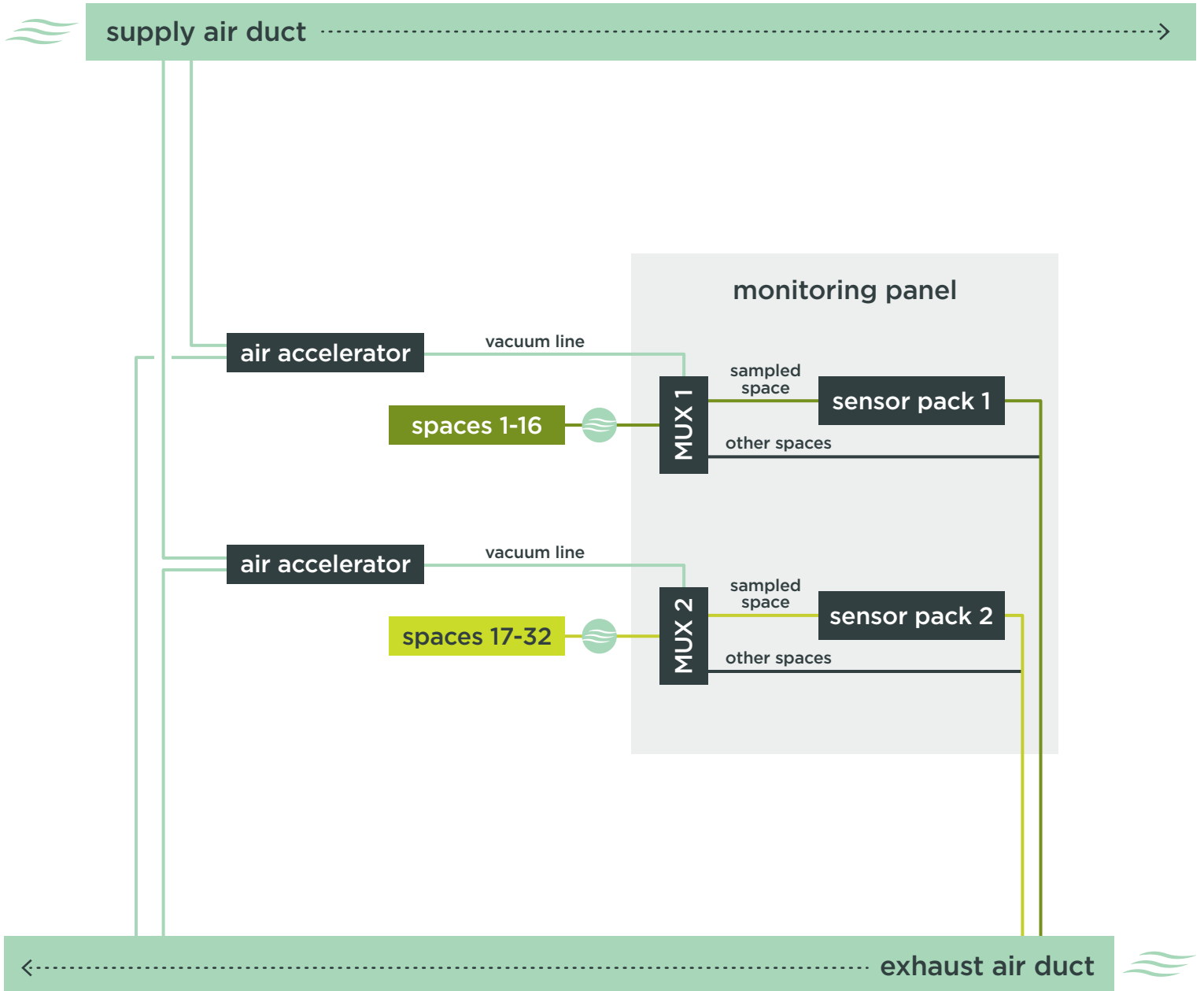
3

IAQ data is sent over a secure connection to the BMS and the cloud. Access readings and detailed reports on your computer or phone.

Let's talk about how AntrumX can work for you. Call 616.214.3155.

system architecture—airflow

supply air duct

monitoring panel

air accelerator — vacuum line

spaces 1-16 — MUX 1

sampled space — sensor pack 1

other spaces

air accelerator — vacuum line

spaces 17-32 — MUX 2

sampled space — sensor pack 2

other spaces

exhaust air duct

system architecture—dataflow

BACnet — BMS

cloud

monitoring panel 1

MUX 1 — sensor pack 1 — RS-485

gateway

MUX 2 — sensor pack 2 — RS-485

monitoring panels 2-9

MUX 1 — sensor pack 1 — RS-485

MUX 2 — sensor pack 2 — RS-485
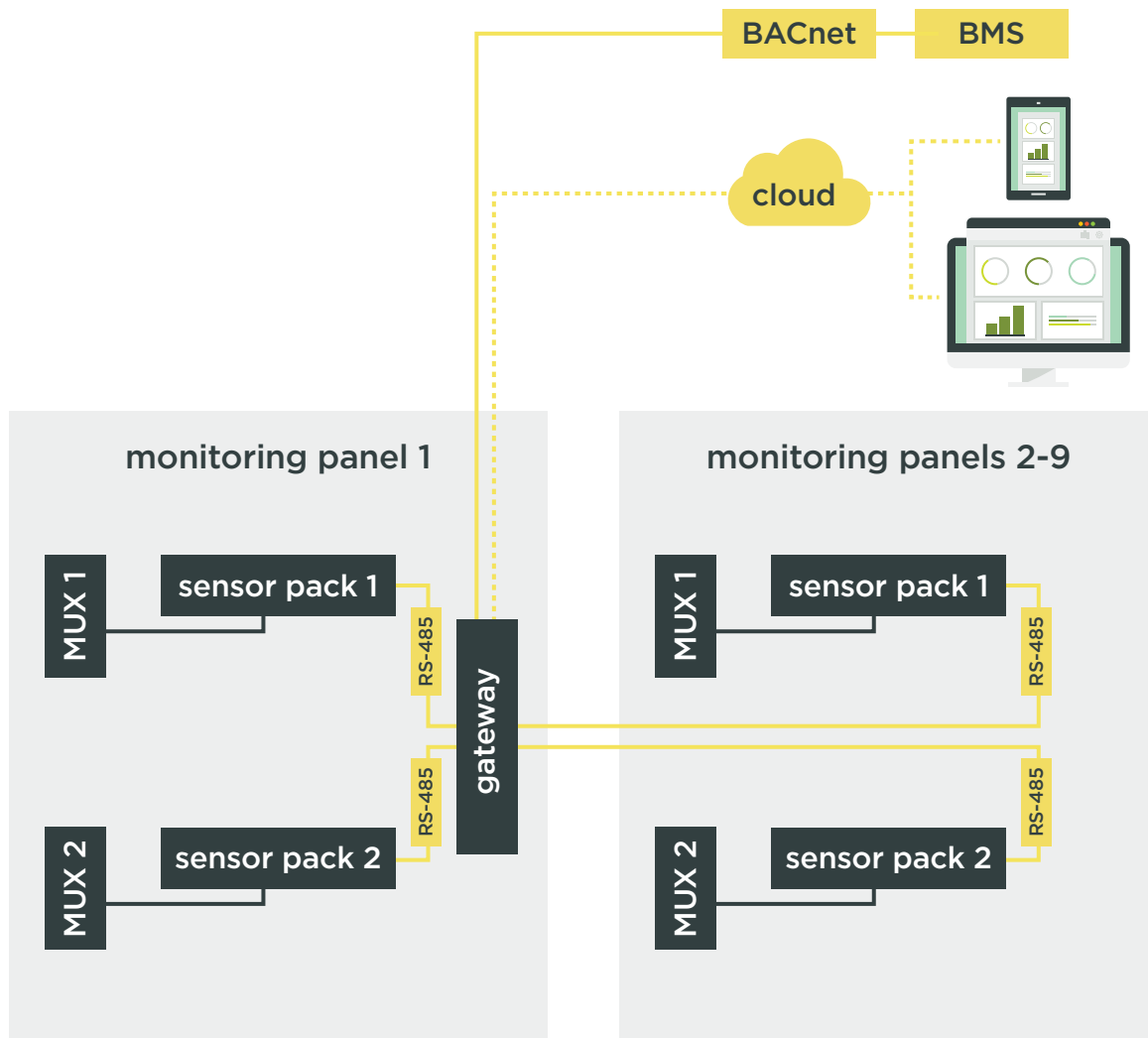
This technical overview details how AntrumX™ delivers the real-time data you need to improve IAQ and optimize your building's ventilation in an easy-to-install, easy-to-maintain, and scalable system. Knowing your air means having confidence that your buildings and their occupants are healthy.

faceplate

Includes:

- 3500' of ¼" 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 ¼" 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.

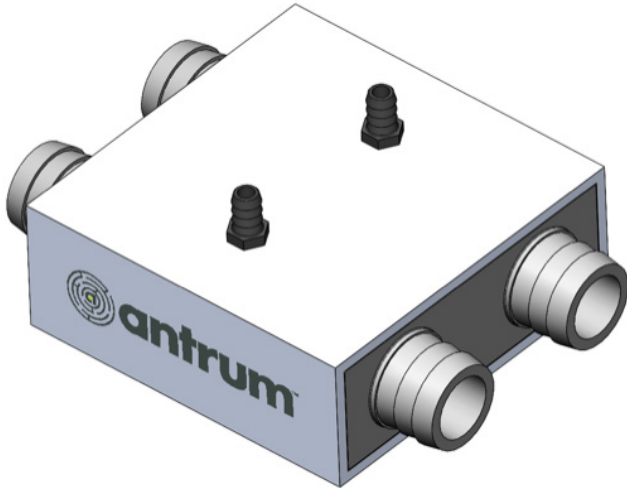**Faceplate Specifications**

Materials	UL Listed Molded ABS
Color	Sno White
Connections	3/8" to 1/4" push-to-connect tube fitting; compatible with 1/4" OD pneumatic tubing
Dimensions	3"W x 4.7"H x 1.5"D
Compliance	UL94HB

air accelerator

Includes:

- 50' of 2" and 100' of ½" ID Tubing
- (4) Tube-to-Duct Couplers

Ordering Guide: AXAA0001

Antrum's patented Air Accelerator uses the differential pressure of the existing HVAC system to create a continuous vacuum in every room being serviced—the room being sampled 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	Aluminum, UL Listed Molded H20H
Color	Aluminum
Connections	(4) 2" hose barb connections (2) ½" hose barb connections
Dimensions	LxWxH: 11" x 6" x 4.11"
Weight	5lbs
Compliance	UL94HB

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 *For indoor use only*
Media	Air
Color	Black
Tube Material	Polyethylene
Coil	Length: 250' Weight: 17lbs
Master Pack	Length: 1750' Weight: 30lbs
Accessories	Straight Couplers Elbow Couplers

Ordering Guide:

250' of Tubing: AXPTC0001
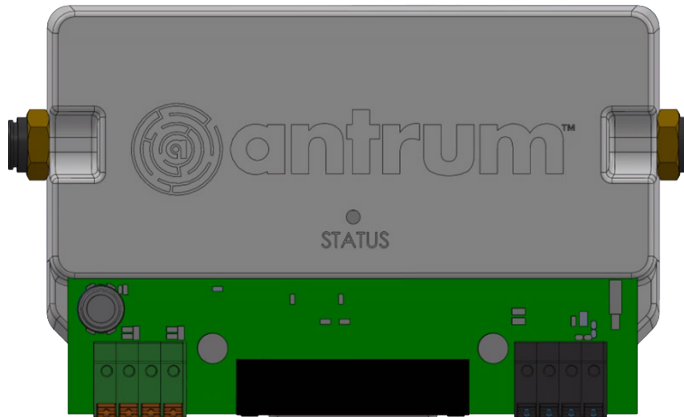
1750' Tubing: AXPTM0001

Straight Couplers: AXPTSC0001

Elbow Couplers: AXPTEC0001

sensor pack

Features:

- Digital from sensor to cloud
- Currently offering (5) IAQ parameters
- Annual calibration
- Scalable architecture to facilitate future sensor technologies

Space-mounted sensors, primarily Carbon Dioxide (CO_2) 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
Power Consumption	1A@5V, 0.5A@24V
Compliance	FCC

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_2), a colorless gas with a faint, sharp odor and a sour taste, is a key indicator of IAQ.

CO_2 is a byproduct of combustion, as well as a result of the metabolic process in living organisms. Because CO_2 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_2 levels are lower than those in indoor air; therefore, the more fresh air supplied to a space, the lower the concentration of CO_2.

Supplying the necessary volume of outdoor air to maintain appropriate CO_2 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_2 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_2 Sensor Specification

Typical Application	IAQ Monitoring, Demand Control Ventilation (DCV)
Technology	NDIR
Signal	Digital
Range	400 – 10,000 ppm
Accuracy	+/-30 up to 10,000 ppm
Repeatability	+/- 10 ppm
Temp. Stability	2.5 ppm (0-50C)
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
Signal	Digital
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
Signal	Digital
Range	-40–70°C
Accuracy	+/-.5°C (0–50°C)
Repeatability	+/-.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
Signal	Digital
Range*	*Calibrated* .3 – 30 ppm *Maximum* 0 – 1,000 ppm
Accuracy	Greater of: <50 or <10% of reading ppb
Repeatability	+/- 5 ppm
Drift Stability	+/- 15 ppm
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.
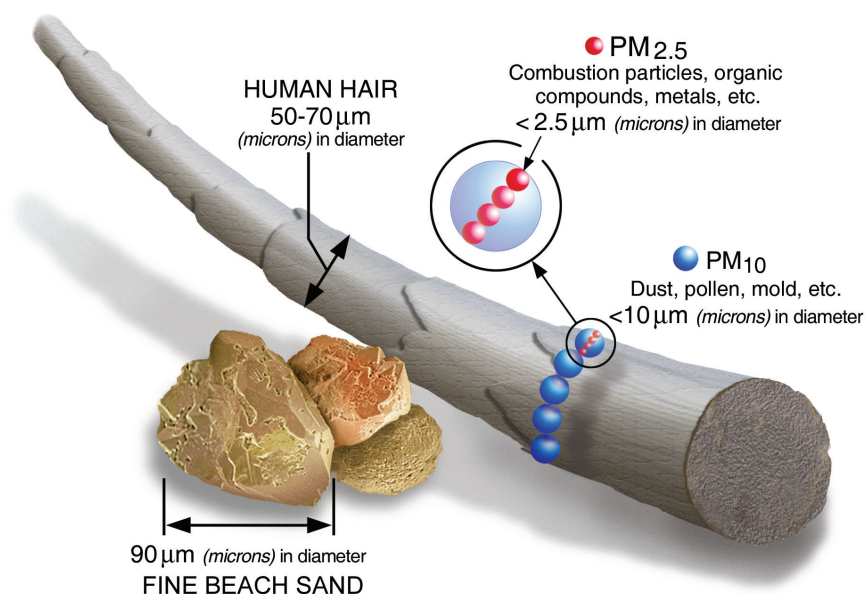
Particles in air are either:

• 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.

PM2.5
Combustion particles, organic compounds, metals, etc.
<2.5 μm *(microns)* in diameter

HUMAN HAIR
50-70 μm
(microns) in diameter

PM10
Dust, pollen, mold, etc.
<10 μm *(microns)* in diameter

90 μm *(microns)* in diameter
FINE BEACH SAND

Source: EPA Website, Particulate Matter Basics

particulate matter sensor

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 (PM2.5) 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
Signal	Digital
Mass Concentration Range	0 – 1,000 µg/m^3
Mass Concentration Resolution	1 µg/m^3
Mass Concentration Accuracy	+/- 10 @ 0 - 100 µg/m^3 +/- 10% @ 100 - 1,000 µg/m^3
Particle Detection Size Range	*Mass Concentration* PM1.0, PM2.5, PM4, PM10 ppm *Number Concentration* PM0.5, PM1.0, PM2.5, PM4, PM10 ppm
Lower Limit Detection	0.3 µm
Response	20s
Sample Time	2s

gateway enclosure

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 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

I/O Ports	2x micro-HDMI, 2x USB 3.0 Ports, 2x USB 2.0 Ports
Ethernet Ports	1 Gigabit Ethernet Port
Environmental Conditions	Operating Temp: 0–50°C Operating Humidity: 5-95% RH non-condensing
Power Consumption	2A@5V
Connections	Between Monitoring Panels: RS-485 To BMS: BACnet MSTP, BACnet over IP Speed: 19.2k baud Facility Interface: Gigabit Ethernet
Compliance	BTL, FCC

antrumEYE

AntrumEYE™ is a mobile subscription service available on iOS and Android platforms for AntrumX™. While any registered customer who has AntrumX installed in their building can visit antrumeye.com to see real-time indoor air quality (IAQ) data space-by-space throughout their building or campus, only subscribers have access to the mobile platform.

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

AntrumX and AntrumEYE Features	AntrumX	AntrumEYE
Real-time IAQ data	✓	✓
Industry-leading, near-real-time IoT data connectivity	✓	✓
Online anytime, anywhere	✓	✓
Export Sensor Data	✓	✓
Web Browser Support	✓	✓
Mobile (IoS & Android)		✓
Machine learning		✓
Smart analytics		✓
Push-alerts		✓
Error priorities		✓
Monthly analysis of the monitored spaces		✓

antrum™