



August 2017

## Introducing the HPM Series Particle Sensor

**Honeywell**  
THE POWER OF **CONNECTED**



# Agenda

**1**

**Indoor Air Quality**

**2**

**Honeywell's HPM Series Particle Sensor**

**3**

**Potential Applications**

**4**

**Key Messages**

# Is Indoor Air Cleaner than Outdoor Air?

- Research shows that we spend nearly 90% of our time indoors<sup>1</sup>
- Indoor air is often considered to be cleaner than outdoor air; however, data shows that is not correct
- According to the U.S. Environmental Protection Agency (EPA), indoor air can have 2 to 5 times as many pollutants as outdoor air<sup>2</sup>



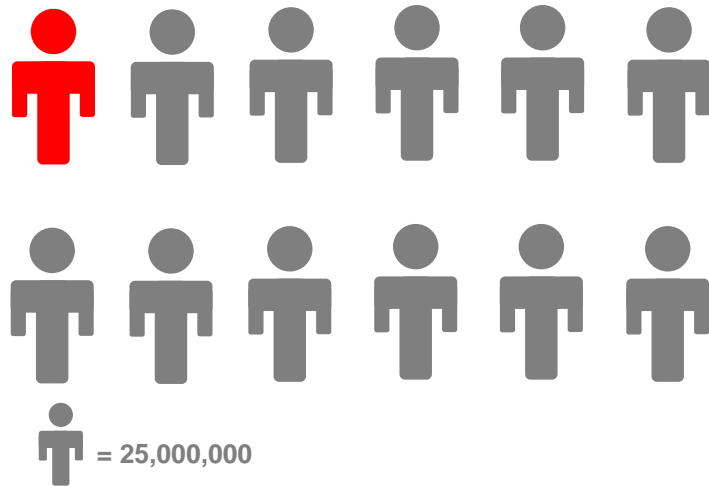
<sup>1</sup> Environmental Protection Agency – Importance of Indoor Air Quality

<sup>2</sup> Environmental Protection Agency – Volatile Organic Compounds' Impact on Indoor Air Quality

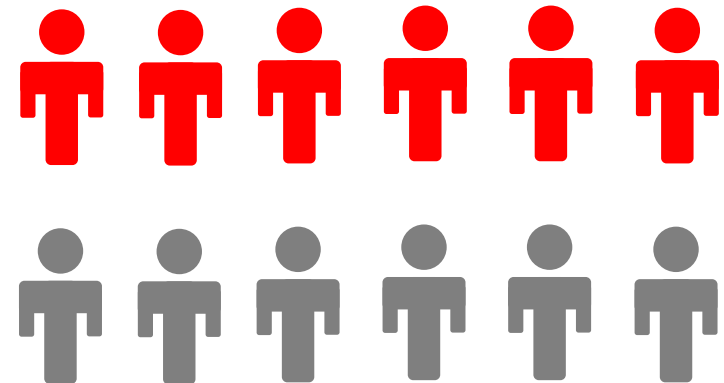
# Impact of Poor Air Quality on Health

- According to the U.S. Centers for Disease Control, poor indoor air quality can lead to respiratory infections and lung diseases, such as asthma

**25** 25 million Americans suffer from asthma—that is one in 12 people, or approximately 8% of the U.S. population<sup>3</sup>



**50** 50% of people who suffer from asthma had an asthma attack in 2008<sup>3</sup>



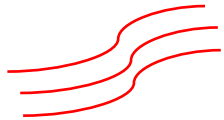
<sup>3</sup>American Academy of Allergy Asthma & Immunology – Asthma Statistics

# Other Aspects of Poor Indoor Air Quality

- Poor indoor air quality affects both our health and our productivity



## HEALTH



Common indoor air pollutants include mold, pollen, smoke, and gases from paints, building materials or machines<sup>4</sup>



Poor indoor air quality can lead to eye irritation, coughing, congestion, reduced lung function, or an irregular heartbeat<sup>4</sup>



## PRODUCTIVITY



Annual costs related to asthma have reached as high as \$3,300 per person<sup>4</sup>

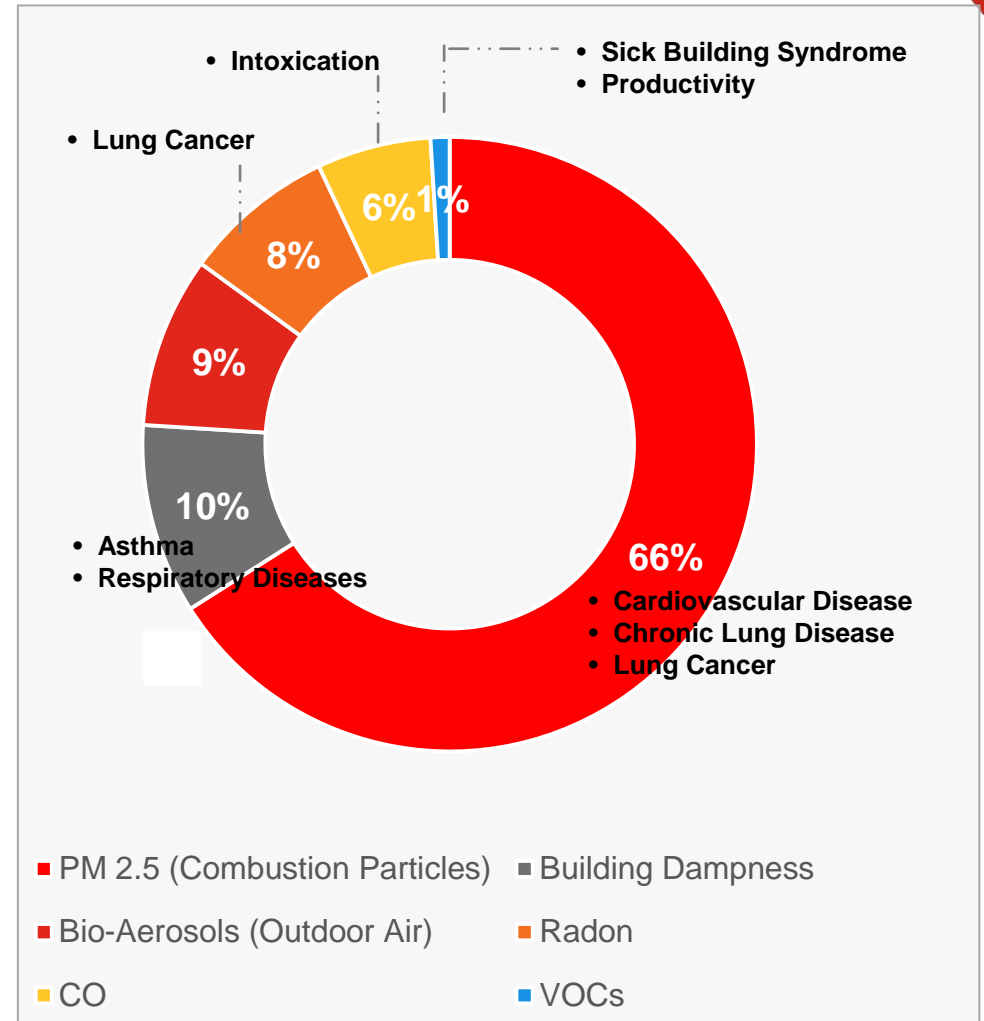


On average, children miss four days of school per year, and adults miss approximately five days of work per year, due to asthma-related illnesses<sup>4</sup>

<sup>4</sup>American Academy of Allergy Asthma & Immunology – Asthma Statistics

# Health Impact

- Airborne particulates are known to impact human health
- Particulates are much more likely to impact human health than other indoor air quality issues<sup>5</sup>
- The negative effects of poor indoor air quality go well beyond asthma-related issues, as shown graphically here



Source<sup>5</sup>

<sup>5</sup>Jantunen M., Oliveira Fernandes E., Carrer P., Kephelopoulos S., *Promoting actions for healthy indoor air (IAIAQ)*. (2011) European Commission Directorate General for Health and Consumers. Luxembourg.

# Poor Indoor Air Quality in the U.S.

- Some may think that poor indoor air quality is limited to developing countries; however, it also affects many areas of the U.S.



Smog – Los Angeles



Sand Storm - Phoenix



Pollen – Southeast



Industry

# Introducing the HPM Series Particle Sensor

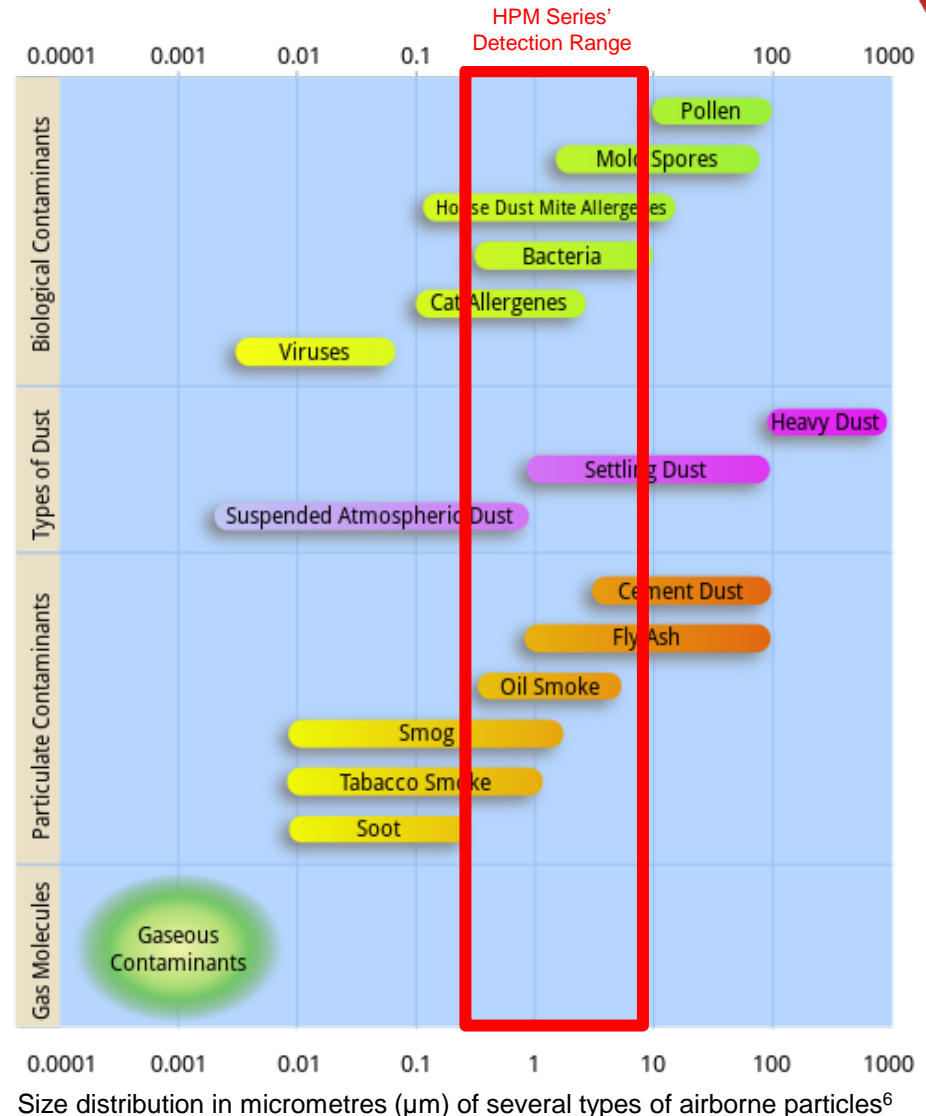
- Designed to maximize indoor air quality, the Honeywell HPM Series Particle Sensor provides more reliable and precise detection of indoor particulate concentrations of PM2.5 or PM10 with  $\pm 15\%$  accuracy
- Its 20,000 hour service life maximizes system life, minimizes downtime, and helps minimize costly service calls for future replacement





# PM2.5 and PM10

- Particulate matter, also known as PM, is comprised of solids and liquid droplets suspended in the air
- Particulates come in a variety of sizes and are typically divided into one of two categories;
  - PM2.5: Fine particles
  - PM10: Coarse dust particles
- The HPM Series is designed to detect particulates in this range, which includes:
  - Dust, dirt, soot, smoke, and liquid droplets



<sup>6</sup>Wikipedia

# PM2.5 and PM10 Output

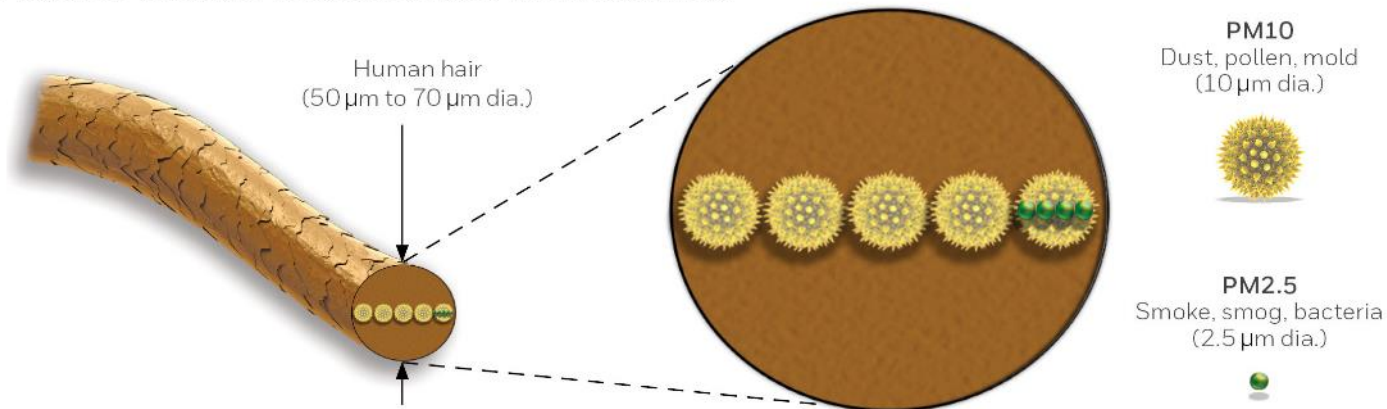


## Did You Know

Particulates less than 10 micrometers ( $\mu$ ) in size are smaller than the width of a human hair<sup>7</sup>

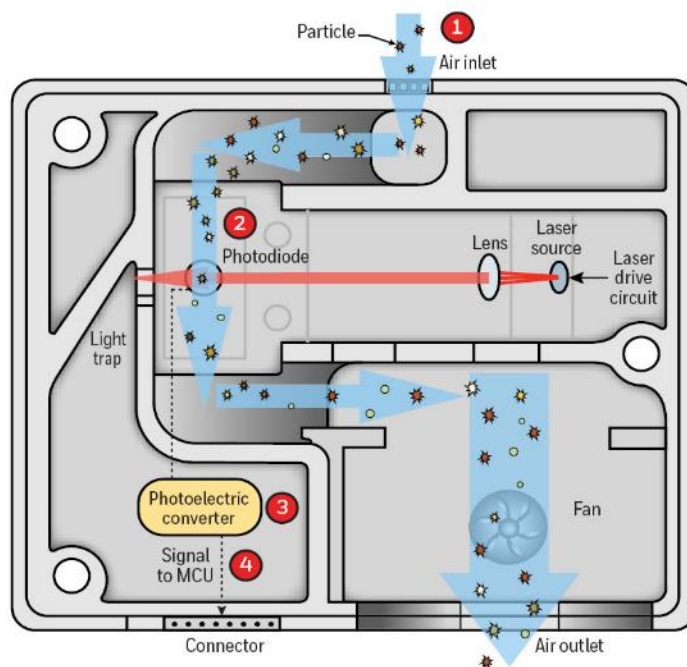
- Airborne contaminants smaller than  $0.10 \mu$  include mold spores, other bacteria, dust, and ash, all of which can enter the lungs
- Particles less than  $0.3 \mu$  include smog, fine dust particles, and liquid droplets, which can bypass the lungs and enter the blood stream
- Environmental contaminants in the PM2.5 and PM10 range can pose a health concern as they can cause a number of health issues

FIGURE 1. PM10 AND PM2.5 COMPARISON WITH HUMAN HAIR



<sup>7</sup> Environmental Protection Agency – Particulate Matter Basics

# How Does the Particle Sensor Work?



- 1** Fan draws sample environment through Air Inlet
- 2** Environment passes through laser, which is projected through lens and captured by Photodiode
- 3** Photodiode passes information to Photoelectric Converter, which processes size and frequency of particles
- 4** Information is sent to Micro Control Unit (MCU), where an algorithm processes the data

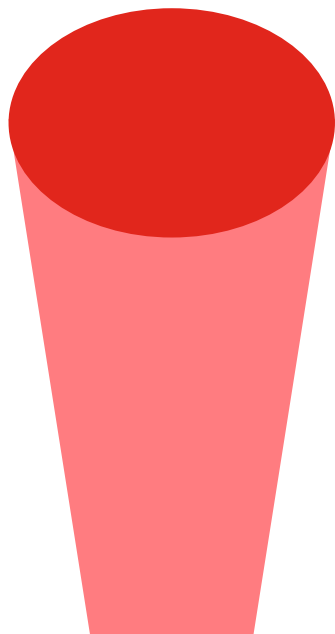
# Laser vs. LED Detection



The HPM Series Particle Sensor employs laser technology, which allows it to provide accuracy levels of  $\pm 15\%$

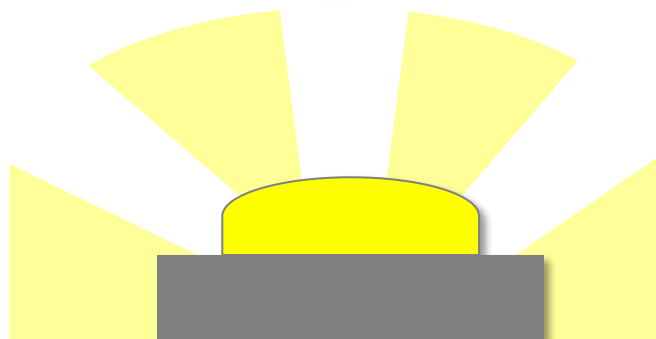
## Laser Monitoring

A laser produces a single, dense column of light, which allows the HPM Series to more precisely detect particulates and more accurately relay real-time conditions to the control device.



## LED Monitoring

Some sensors using LED (Light Emitting Diode) technology are significantly less accurate than laser monitoring. Some LED designs broadly distribute light within the device's chamber. This scattering can negatively impact the device's ability to detect particles.



# HPM Series vs. LED Competitor

- When comparing the HPM Series to competitive LED solutions, the Honeywell solution is the clear winner:
  - ✓ Enhanced accuracy of  $\pm 15\%$
  - ✓ Faster response time
  - ✓ Longer operating life
  - ✓ Smaller overall dimensions

	<b>Laser Light Scattering</b> <i>(Honeywell's Particle Sensor uses)</i>	<b>LED Light Scattering</b> <i>(Many competitors use)</i>
Detection range	PM2.5, PM10	<1 $\mu\text{m}$
Concentration range (max)	0 $\mu\text{g}$ to 1000 $\mu\text{g}/\text{m}^3$	0 $\mu\text{g}$ ~ 800 $\mu\text{g}/\text{m}^3$
Accuracy	max ( $\pm 15 \mu\text{g}/\text{m}^3$ , $\pm 15\%$ ) (T=20°C)	max ( $\pm 20 \mu\text{g}/\text{m}^3$ , $\pm 35\%$ ) to max ( $\pm 60 \mu\text{g}/\text{m}^3$ , $\pm 30\%$ )
Self-calibration	factory calibrated	not applicable
Response time	<6 s	<30 s
Supply voltage	5 V $\pm$ 0.2 V	5 V $\pm$ 0.5 V, (ripple < 30 mV)
Standby current	<20 mA	not applicable
Supply current	<80 mA	90 mA
Operating humidity	0–95 %RH	<95 %RH (non-condensing)
Output data	PM2.5 (default); PM10 (optional)	none or analog voltage
Output protocol	UART (default); I <sup>2</sup> C (option)	UART or PWM
Operating life	20,000 hours continuous or 60,000+ based on duty cycle	from undisclosed to >7years
Dimensions	43mm x 36mm x 23.7mm [1.7in x 1.4in x 0.93 in]	59mm x 45mm x 22mm [2.3in x 1.8in x 0.87in]

<sup>9</sup> See slide 17 for additional information.

# Response Time

# 5X

## Faster response time

The HPM Series offers a response time of <6 seconds, making it 5 times faster<sup>8</sup> than many competitive sensors available today



## Faster processing time

The HPM Series processes information faster and more accurately than other sensors, allowing it to respond to conditions in real-time with minimal lag time

<sup>8</sup> Honeywell analysis based on information sourced from competitors' datasheets which are publicly available on their websites. See slide 17 for additional information.

# Service Life



The HPM Series provides a service life of 20,000 hours, which is longer than many competitive devices



- 20,000 hours equates to seven years of service life when used 8 hours per day
- Provides enhanced reliability for the customer while also eliminating costly return visits for service and repairs

# Potential Applications

- **HVAC equipment**
  - Heating and cooling systems
  - Indoor air monitors
  - Air ventilation systems
  - Air purification equipment
- **Consumer products**
  - Portable air purifiers
  - Automotive cabin filtration
  - Handheld air quality detectors
  - Kitchen ventilation



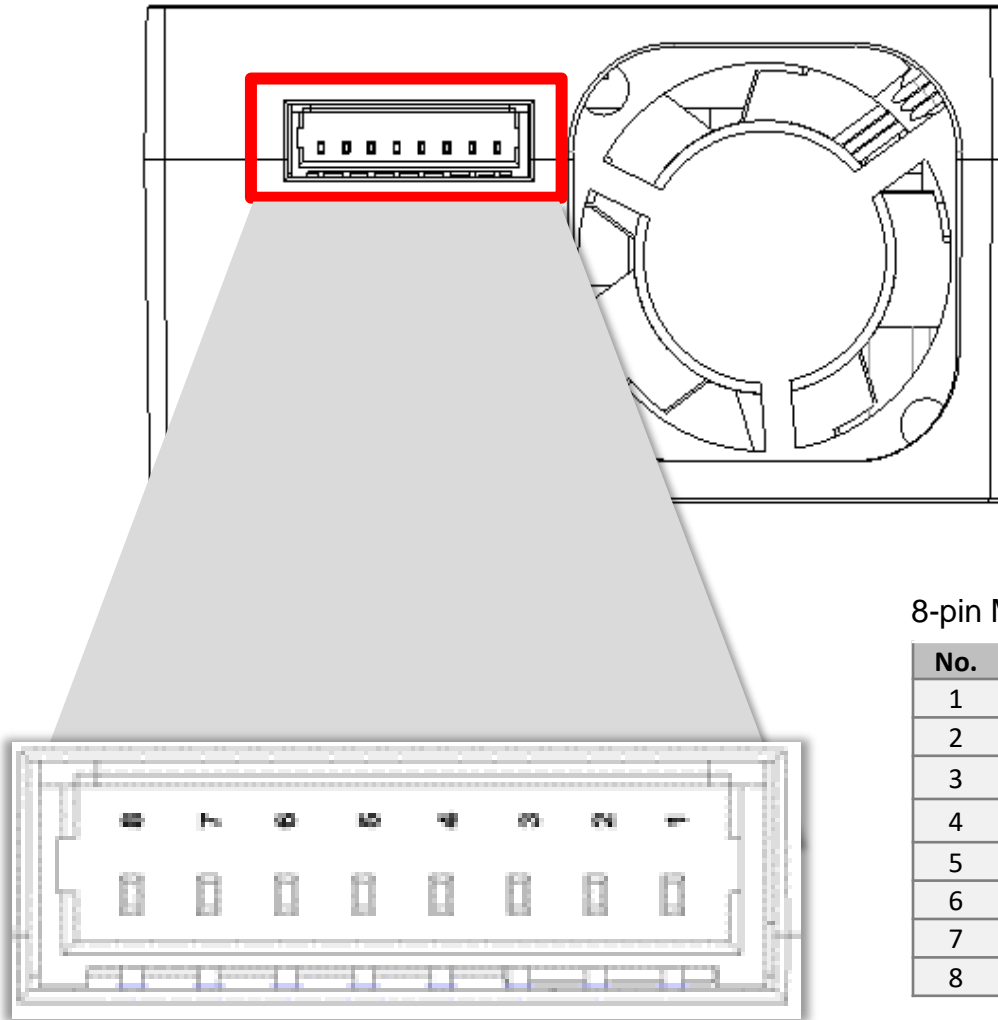


# HPM Series Particle Sensor Specifications

SPECIFICATIONS	
Working principle	Laser-based light scattering
Detect range	2.5 $\mu\text{m}$ , 10 $\mu\text{m}$ (PM2.5, PM10 optional)
Measurement range	0~1000 $\mu\text{g}/\text{m}^3$
Concentration range(max)	<1000 $\mu\text{g}/\text{m}^3$
Concentration range(linearity)	50~300 $\mu\text{g}/\text{m}^3$
Accuracy (consistency at 20°C)	>100 $\mu\text{g}/\text{m}^3$ , ( $\pm 15\%$ ), <100 $\mu\text{g}/\text{m}^3$ , ( $\pm 15 \mu\text{g}/\text{m}^3$ )
Response time	<6 s
Supply voltage	5 V $\pm 0.2$ V
Standby current	<20 mA
Supply current	<120 mA (100 mA)
Operate temp and humidity	-10~50 °C, 0~80 %RH
Storage temp and humidity	-30~65 °C, 0~95 %RH
Output data	PM2.5 (default), PM10 (optional), concentration ( $\mu\text{g}/\text{m}^3$ )
Output protocol	UART(default), I2C (optional at request)
Operate life	continuous mode: 20,000 hours
	intermittent mode: Depends on duty cycle
Dimensions	43mm x 36mm x 23.7mm (1.7in x 1.4in x 0.93in)
EMC	yes
ESD	$\pm 4$ kV contact, $\pm 8$ kV air per IEC 61000-4-2
Radiated Immunity	1 V/m (80 MHz to 1000 MHz) per IEC 61000-4-3
Fast transient burst	$\pm 0.5$ kV per IEC61000-4-4
Immunity to conducted disturbances	3 V per IEC61000-4-6
Radiated emissions	40 dB 30 MHz to 230 MHz; 47 dB 230 MHz to 1000 MHz per CISPR 14
Conducted emissions	0.15 M to 30M in compliance with CISPR 14
Self-calibration	yes
Vibration	5~55~5Hz/1min, 2hrs per X/Y/Z, amplitude 2 mm
Thermal cycle	N=100
MTBF	>7 years, laser diode >10,000 hours



# Interface Simplifies Integration



8-pin Molex Connector P/N: Molex 51021-0800

No.	Item	Description
1	+3.3V	Power output (+3.3v/100 mA)
2	5V	Power input (5 V)
3	N/A	N/A
4	N/A	N/A
5	TEST	Used for Testing (N/A)
6	TX	UART-TX output (0 to 3.3 V)
7	RX	UART-RX input (0 to 3.3 V)
8	GND	Power input (ground terminal)

# Resources

- The following materials are available to provide you with more information about the HPM Series Particle Sensor:
  - [Product webpage](#)
  - [Datasheet](#)
  - [Installation instructions](#)
  - [Press release](#)

# Key Messages

- Making every particle count
- $\pm 15\%$  accuracy
- <6 second response time
- 20,000 hour service life



# About Honeywell's Products

- For more information about all of Honeywell Sensing and Internet of Things' sensor and switch products, visit [sensing.honeywell.com](https://sensing.honeywell.com)

