

# SPECIFICATION

[Preliminary Version]

Product Name: Integrated Air Quality Sensor Module

Item No.: AM1002

Version: V0.2

Date: June 08, 2023

# Revision

No.	Version	Content	Date
	V0.1	The first version	2020-09-17
	V0.2	Update specification and caution description	2023-06-08

# Integrated Air Quality Sensor Module

AM1002



## Applications

- Air purifier
- Air quality monitor
- Air conditioner
- Ventilation system
- Consumer electronic products

## Description

AM1002 is an integrated air quality sensor module with function of particle concentration, VOC concentration, temperature and relative humidity measurement. Particle concentration is measured by laser particle sensor which uses light scattering principle. It measures and calculates the suspended particle number exactly, and output particle mass concentration  $\mu\text{g}/\text{m}^3$  directly via mathematical algorithm and scientific calibration. VOC sensor is MOX type, which has extremely high sensitivity to various kinds of organic volatile gases such as formaldehyde, benzene, ethanol, formic acid, nicotine and some inorganic gas like carbon monoxide, ammonia, hydrogen.

## Features

- The smallest particle size of available measurement:  $0.3\mu\text{m}$
- Real-time output particle mass concentration in  $\mu\text{g}/\text{m}^3$  available
- High accuracy, high sensitive and quick response
- Temperature compensation algorithm
- Matrix calibration technology and optimized algorithm, for high accuracy and consistency
- Siloxane resistance of VOC sensor, for long lifespan and high stability
- Intelligent VOC auto-calibration strategy on site, maintenance-free
- Small size, compact structure, easy to install

## Working Principle

- The PM sensor integrated adopts laser scattering technology to detect particle mass concentration
- The VOC sensor is based on MOX technology
- The RH&T sensor integrated adopts capacitance resistance materials to detect indoor RH&T

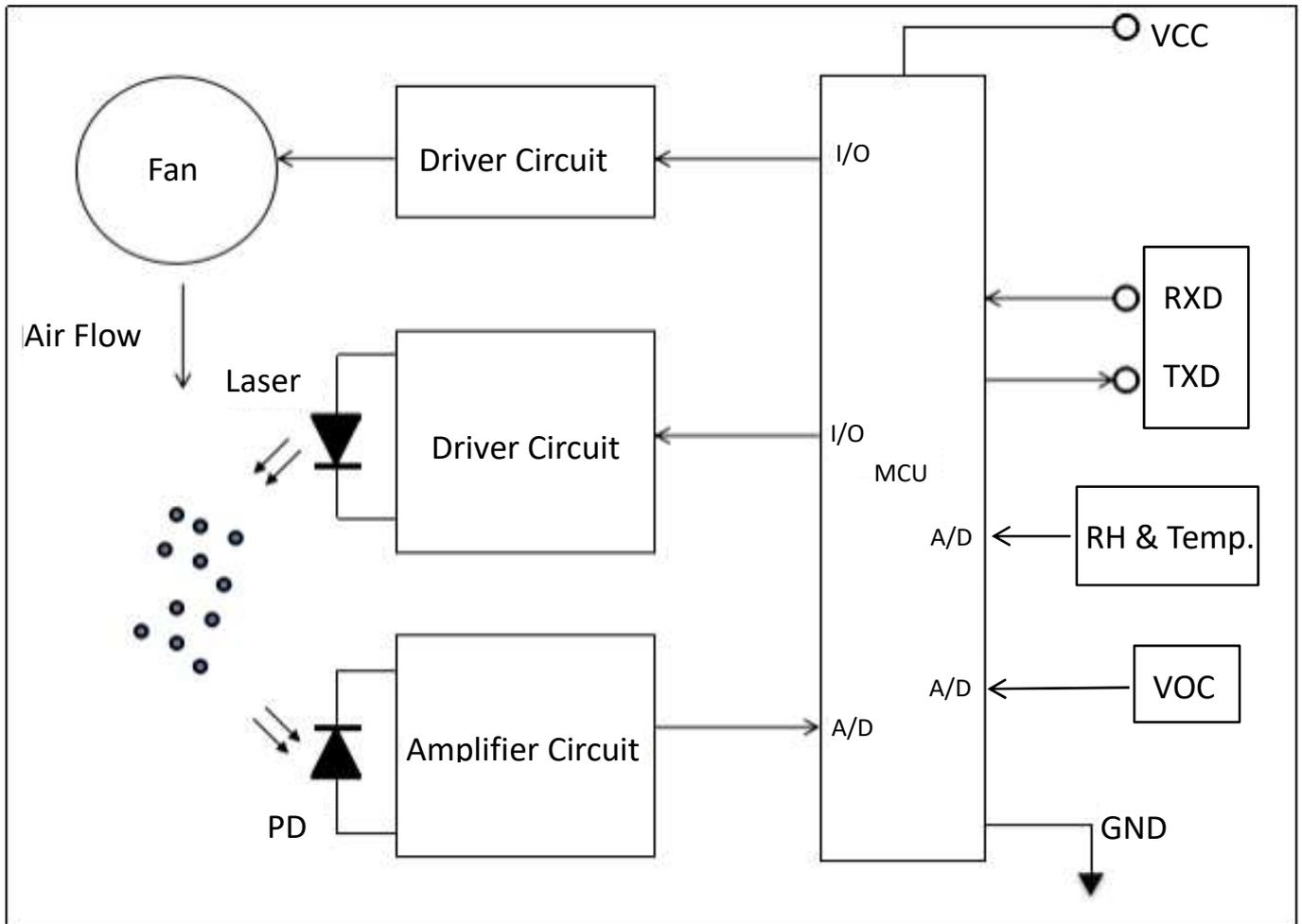
## Specifications

Integrated Indoor Air Quality Sensor Specification	
Operating principle	Laser scattering for particle measurement MOX for VOC measurement
Measurement range	Particle: 0~5,000 $\mu\text{g}/\text{m}^3$ VOC: 0~10ppm Temperature: -20-70 $^{\circ}\text{C}$ Humidity: 0-99%RH
Measured particle range	0.3 $\mu\text{m}$ ~10 $\mu\text{m}$
Particle output resolution	1 $\mu\text{g}/\text{m}^3$
VOC output resolution	1 ppb
Temperature output resolution	0.1 $^{\circ}\text{C}$
Humidity output resolution	0.1%
Working condition	-20 $^{\circ}\text{C}$ ~ 60 $^{\circ}\text{C}$ , 0-95%RH (non-condensing)
Storage condition	-40 $^{\circ}\text{C}$ ~ 80 $^{\circ}\text{C}$ , 0-95%RH (non-condensing)
Particle accuracy	PM1.0/PM2.5: 0~100 $\mu\text{g}/\text{m}^3$ : $\pm 10\mu\text{g}/\text{m}^3$ 101~500 $\mu\text{g}/\text{m}^3$ : $\pm 10\%$ reading  PM10: 0~100 $\mu\text{g}/\text{m}^3$ : $\pm 25\mu\text{g}/\text{m}^3$ 101~500 $\mu\text{g}/\text{m}^3$ : $\pm 25\%$ reading (GRIMM, 25 $\pm 2^{\circ}\text{C}$ , 50 $\pm 10\%$ RH)
Temperature accuracy <sup>1</sup>	0 $^{\circ}\text{C}$ ~ 40 $^{\circ}\text{C}$ : $\pm 1^{\circ}\text{C}$
Humidity accuracy <sup>2</sup>	Typical/Max: $\pm 5\%/\pm 8\%$ @5%-95%RH <sup>2</sup>
VOC Consistency	Typical/Max: 200ppb/250ppb OR 20%/25%, whichever is larger
Sampling interval	Particle sampling: 1s VOC, Temperature & Humidity: 1s
Time to first reliable reading	VOC: $\leq 180$ seconds; Particle: $\leq 8$ seconds; RH&T: $\leq 8$ seconds
Power supply	DC 5V $\pm 0.1\text{V}$ , ripple wave < 50mV
Working current	$\leq 130\text{mA}$
Standby current	$\leq 200\mu\text{A}$
Dimensions	W38*H35*D12 mm
Digital output	UART_TTL
Life time	$\geq 10$ years

Note 1: Temperature and humidity accuracy in the table are defined at stable environment

Note 2: Humidity accuracy is defined at temperature of 25 $\pm 2^{\circ}\text{C}$

## Internal Architecture Description



According to the above figure, the light source part of AM1002 is composed of a laser tube and a driving circuit. The detection part of the sensor is composed of light sensitive part which receives reflected light and amplifying circuit. Data processing and communication output are completed by microprocessor.

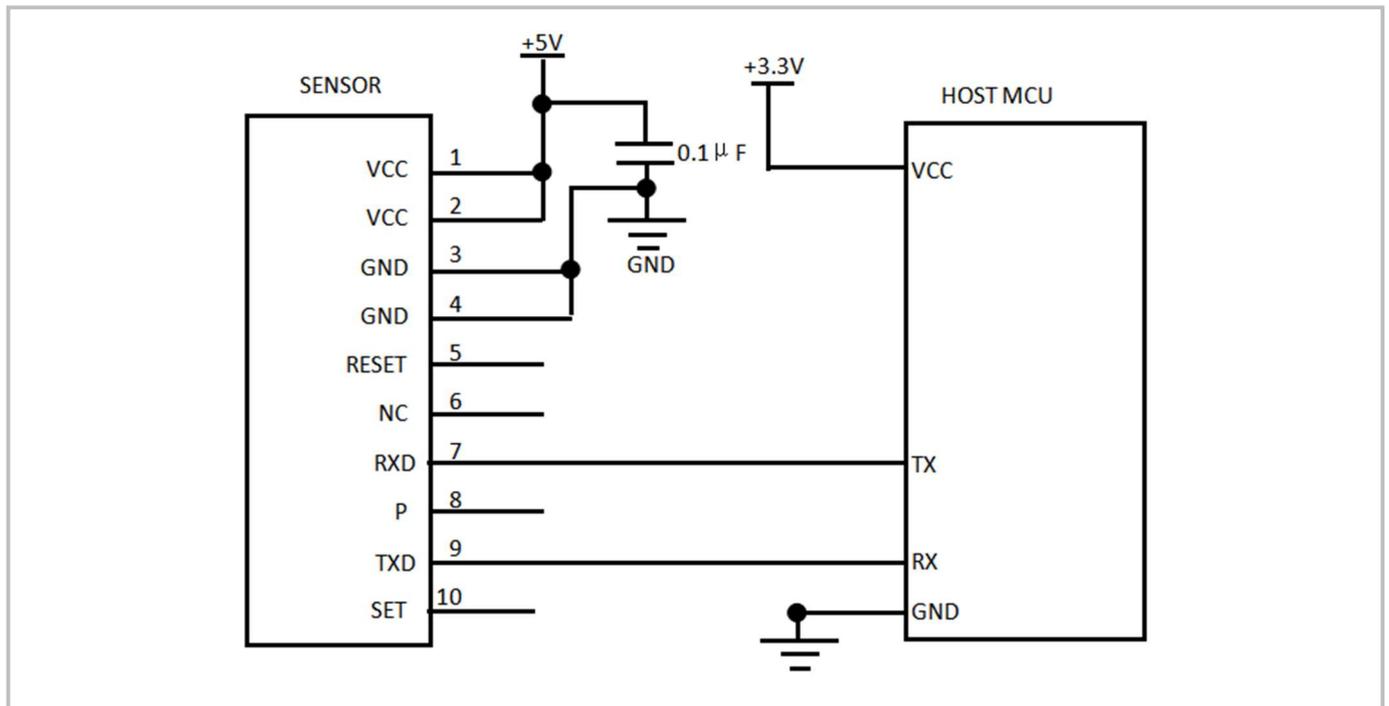
The gas flows into the module through the fan, when sampling particles pass through light beam (laser), there will be light scattering phenomenon, and scattered light will be converted into electrical signal (pulse) via light sensitive part. Electrical signal will be transformed into digital signals after amplifying circuit, smoothing and MCU processed.

Temperature and relative humidity is measured by sensor directly and data is transferred to MCU. MOX type VOC sensor is integrated, which has extremely high sensitivity to various kinds of organic volatile gases such as formaldehyde, benzene, ethanol, formic acid, nicotine and some inorganic gases like carbon monoxide, ammonia and hydrogen.



## Typical Application Circuit

### UART Application



# Communication Protocol

## 1. General Statement

- 1) The data in this protocol is all hexadecimal data. For example, "46" for decimal [70].
- 2) [xx] is for single-byte data (unsigned, 0-255); for double data, high byte is in front of low byte.
- 3) Baud rate: 9600; Data Bits: 8; Stop Bits: 1; Parity: No
- 4) It is default by continuously mode after powering on. Working mode will not be saved after powering off.

## 2. Format of Serial Communication Protocol

Sending format of software:

Start Symbol	Length	Command	Data 1	.....	Data n.	Check Sum
HEAD	LEN	CMD	DATA1	.....	DATA <sub>n</sub>	CS
11H	XXH	XXH	XXH	.....	XXH	XXH

Detail description on protocol format:

Protocol Format	Description
Start symbol	Sending by software is fixed as [11H], module respond is fixed as [16H]
Length	Length of frame bytes= data length + 1 (including CMD+DATA)
Command	Command
Data	Data of writing or reading, length is not fixed
Check sum	Cumulative sum of data = 256- (HEAD+LEN+CMD+DATA)

## 3. Command Table of Serial Protocol

Item No.	Function Description	Command
1	Read measurement result	0x16
2	Read software version number	0x1E
3	Read serial number	0x1F

## 4. Detail Description of Protocol

### 4.1 Read Measurement Result

Send: 11 01 16 D8

Response: 16 13 16 DF1~DF18 [CS]

Response description:

1. DF1-DF2: TVOC concentration = DF1\*256<sup>1</sup> + DF2, unit: ppb
2. DF3-DF4: reserved
3. DF5-DF6: PM1.0=DF5\*256<sup>1</sup> + DF6, unit: µg/m<sup>3</sup>
4. DF7-DF8: PM2.5= DF7\*256<sup>1</sup> + DF8, unit: µg/m<sup>3</sup>

5. DF9-DF10: PM10+  $DF9 \times 256 + DF10$ , unit:  $\mu\text{g}/\text{m}^3$
6. DF11-DF12: Temperature=  $DF11 \times 256 + DF12$ , unit:  $^{\circ}\text{C}$  (real temperature  $= ((DF11 \times 256 + DF12) - 500) / 10$ )
7. DF13-DF14: humidity= $DF13 \times 256 + DF14$ , unit: 1% (real relative humidity  $= ((DF13 \times 256 + DF14) / 10)$ )
8. DF15-DF16: reserved
9. DF17-DF18: reserved

#### 4.2 Read Software Version Number

**Send:** 11 01 1E D0

**Response:** 16 0E 1E DF1~DF13 [CS]

**Function:** Read software version

**Note:**

Software version="DF1~DF13"

Should change the HEX code to ASCII code.

**Example:**

HEX code: 16 0E 1E 50 4D 20 56 31 2E 32 36 2E 35 2E 32 38 E9

ASCII code: PM V1.26.5.28

#### 4.3 Read Serial Number

**Send:** 11 01 1F CF

**Response:** 16 0B 1F DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 CS

**Function:** Read serial number

**Note:**

Serial number =  $(DF1 \times 256 + DF2)$ ,  $(DF3 \times 256 + DF4)$ ,  $(DF5 \times 256 + DF6)$ ,  $(DF7 \times 256 + DF8)$ ,  $(DF9 \times 256 + DF10)$

**Example:**

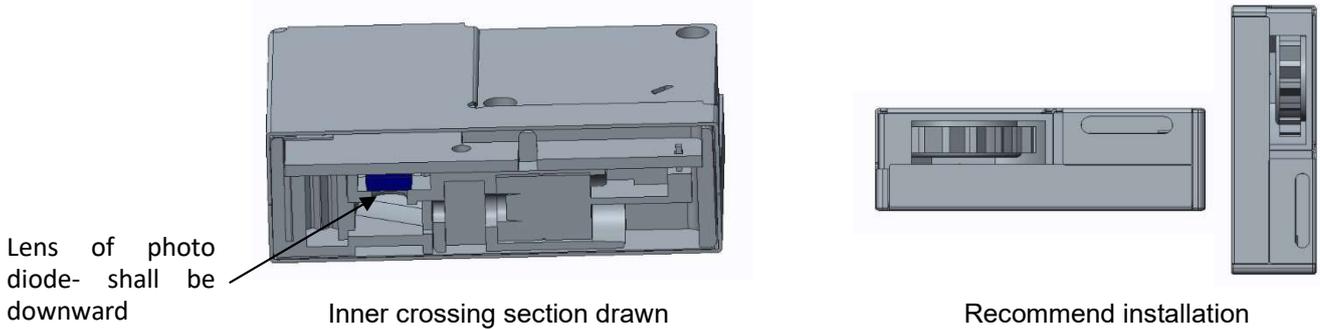
Response: 16 0B 1F 00 00 00 7E 09 07 07 0E 0D 72 9E

Serial number: 126 2311 1806 3442

## User Attention

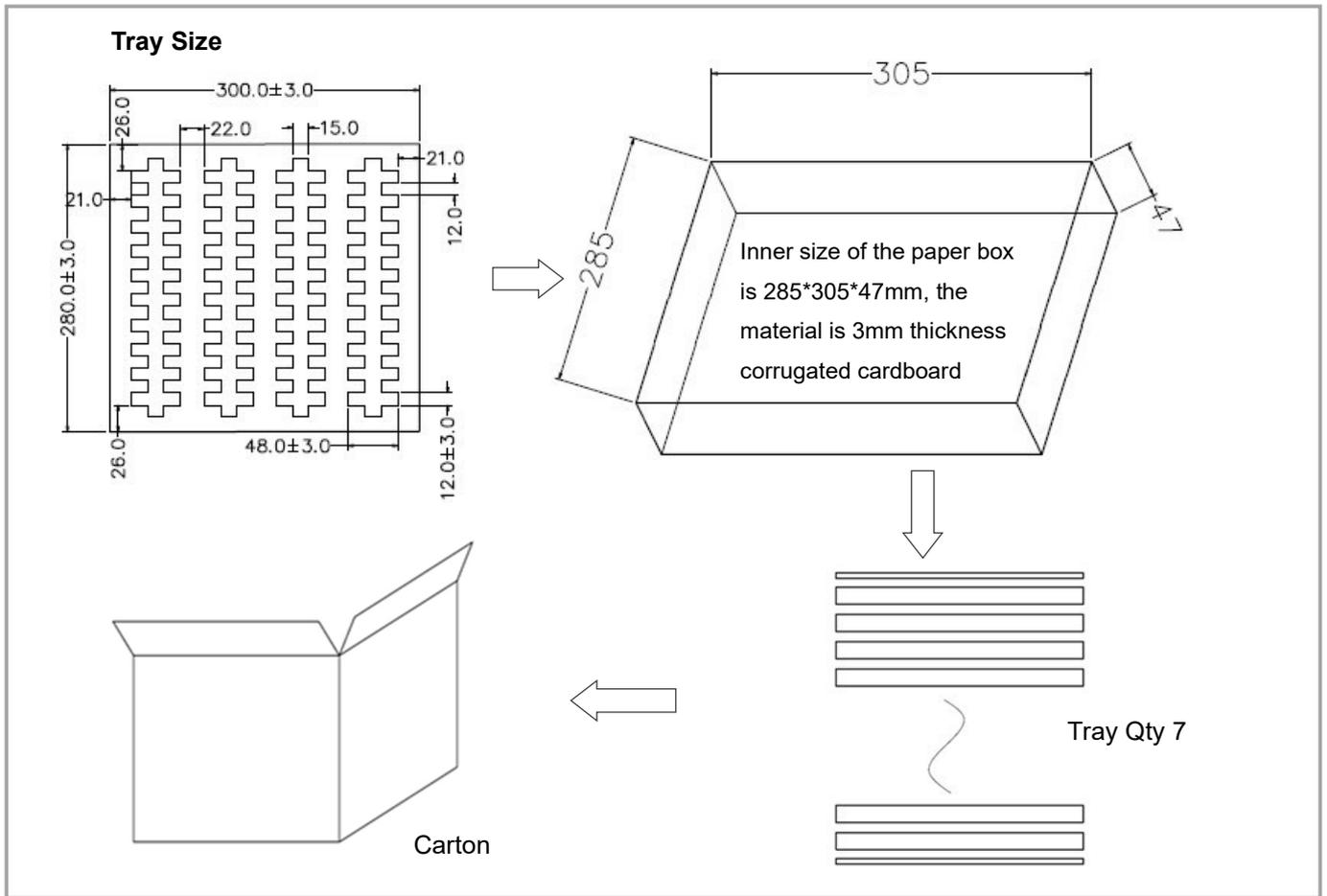
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- The sensor is for household electronics products. For application of medical, mining, disaster preparedness, which needs high security and high dependence, this sensor is not suitable.
- Please do not use it in bad dusty environment and close sampling port.
- Avoid using the sensor under situation with strong magnetic, such as situation close to stereo speaker, microwave oven, induction cooking.
- When install the sensor, make sure the inlet and outlet is unobstructed, and cannot be fronted onto large air stream. There are two sides cannot be put downwards (As below pictures), In case of dust deposition on the surface of sensitive device, dust deposition will affect accuracy of sensor.



- The metal case of sensor connects with the DC ground of inner circuit directly, which will cause safety problem if touching with DC ground. To avoid this problem, Sensor should be internally installed and no permit for touching sensor before power off.
- There is no high pressure transient protection circuit of the sensor. The power supply of the sensor should be stable 5V and low noise. Please refer to the working current in specification table.
- This product is defined as 3R laser product according to 《GB7247.1-2012 laser product safety》 with laser radiation inside. Please avoid direct illumination on the eye.

## Package Information



Sensor per Tray	Tray Qty	Sensor per	Carton Dimensions	Packing Material
40 pcs	7 layers	280 pcs	395*310*330 mm	Red Anti-static EPE

## After-Sales Services and Consultancy

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