SPECIFICATION

Product Name: Laser Particle Sensor Module

Item No.: PM2107

Version: V0.2

Date: December 29, 2018

Writer	Audit	Approved
Mei Yang		

Revision

No.	Version	Content	Reviser	Date
1	V0.2	The PM2.5 particle measurement accuracy is updated	Mei Yang	12.29
2	V0.2	UART protocol “Detail description on protocol format” is modified	Mei Yang	12.29
3	V0.2	In UART Protocol “General Statement”, deleting the previous content No. (4) and modifying content No. (5), the working mode is continuous mode by default	Mei Yang	12.29
4	V0.2	The information of the Mating Female Connector and the Connection cable is updated.	Mei Yang	12.29

Laser Particle Sensor Module

PM2107

Applications

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

Description

PM2107 is a laser particle sensor module for indoor use based on laser scattering technology. It has the similar structure and connector compared with the traditional LED dust sensor. It can measure particle concentration and output PM2.5 in μg/m^3 directly via mathematical algorithm and scientific calibration.

Features

- LED sensor replacement: similar structure compared with LED dust sensor
- The smallest size of available measurement: 0.3 μm
- Real-time output PM2.5 in μg/m^3 available
- High accuracy, high sensitive and quick response (≤8s)
- Signal output optional: UART, PWM, I^{2}C
- Four types of measuring mode for option: single/continuous/timing/dynamic
- RoHS and Reach compliant
- Air inlet and outlet on the same side

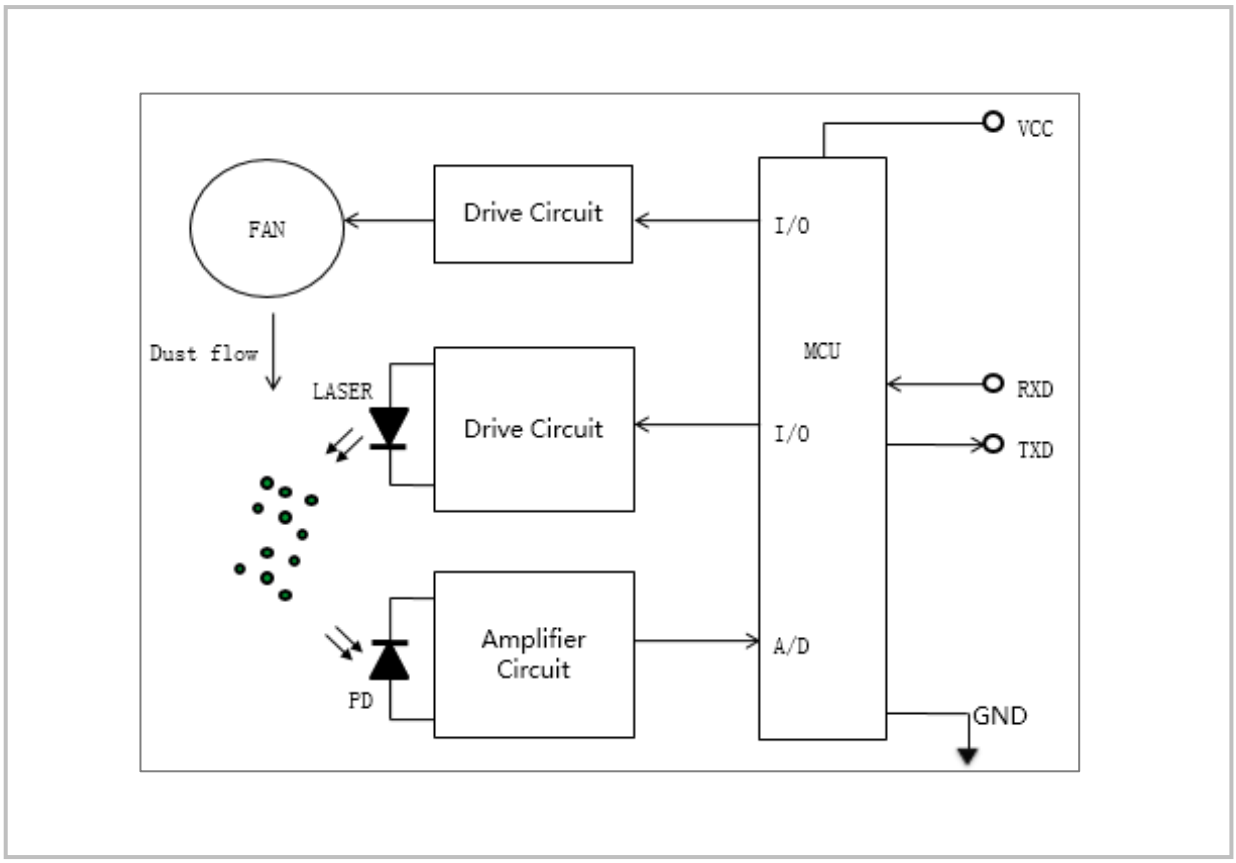
Working Principle

Sampling by the internal pressure which occurs by fan, when sampling particles pass through light beam (laser), there will be light scattering phenomenon. Scattered light will be converted into electrical signal (pulse) via photoelectric transformer. The bigger particles will obtain stronger pulse signal (peak value). Through peak value and pulse value quantity concentration of particles in each size can be calculated. Thus, real-time measured data is obtained through measuring quantity and strength of scattered light.

Specifications

Laser Particle Sensor Specification	
Operating principle	Laser scattering
Measured particle range	0.3μm ~ 10μm
Measurement range	0~1000μg/m³
Resolution	1μg/m³
Working condition	-10°C ~ 50°C, 0-95%RH (non-condensing)
Storage condition	-30°C ~ 60°C, 0-95%RH (non-condensing)
PM2.5 measurement accuracy	0~35μg/m³, ±5μg/m³ >35μg/m³, ±15% of reading Condition: 25±2℃, 50±10%RH, Reference instrument: TSI8530 Dust Source: Cigarette
Data refresh frequency	1sec
Time to first reading	≤ 8 seconds
Power supply	DC 5V±0.1V, ripple wave < 50mV
Working current	⩽100mA
Standby current	<20mA
Dimensions	58.7×45×13.9mm
Digital output 1	UART_TTL_3.3V (default)
Digital output 2	PWM (5V default, 3.3V reserved)
Digital output 3	I²C
MTTF	16910 hrs(continuous turn on)

Internal Architecture Description

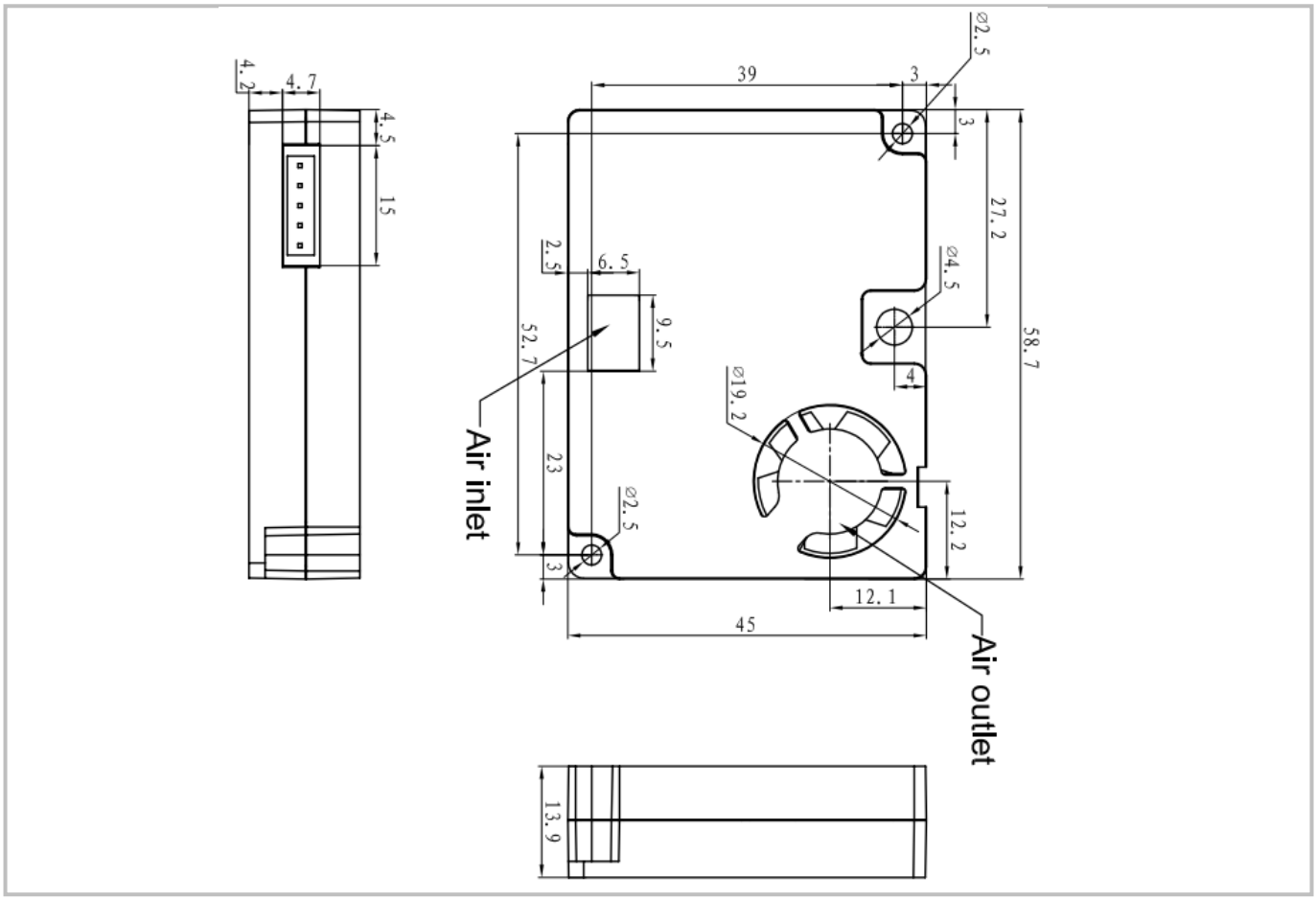


When the fan works, it will generate airflow. When the particles in the sampled gas pass through the beam of the light source (laser), a light scattering phenomenon occurs, and the scattered light is converted into an electrical signal (ie, a pulse) by the photoelectric converter. The larger the particle size, the larger the amplitude of the pulse signal output.

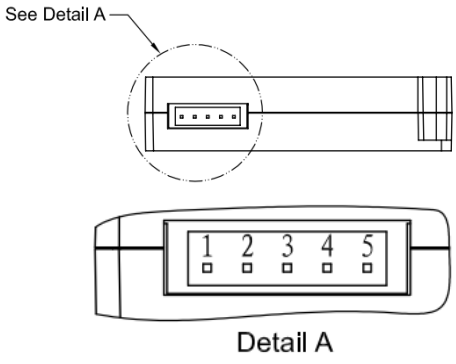
The number of particles of different sizes is calculated by comparing the peak value with the predetermined threshold value, and the mass concentration value is obtained by a professional algorithm. By testing the intensity of the scattered light, real-time test data is obtained.

Dimensions and Connector

1. Dimensions (Unit mm, tolerance ±0.2 mm)



2. I/O Connector Pin Map

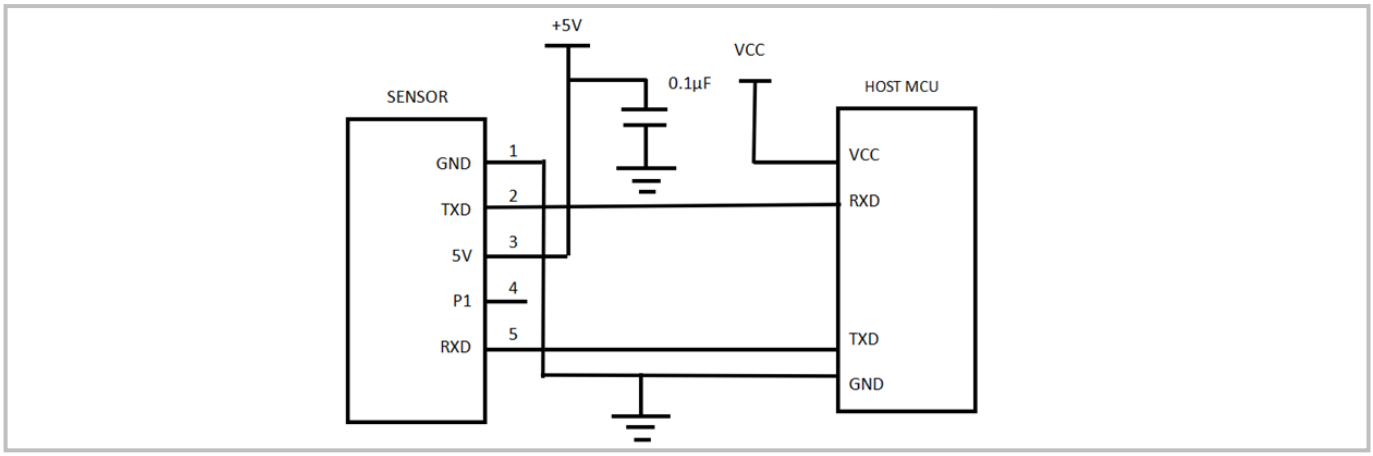


No.	Pin	Description
1	GND	Power input (Ground terminal)
2	TXD/SCL	UART-TX(Sending)/ I²C clock
3	5V	Power input (+5V)
4	P1	PWM output
5	RXD/SDA	UART-RX(Receiving)/ I²C data

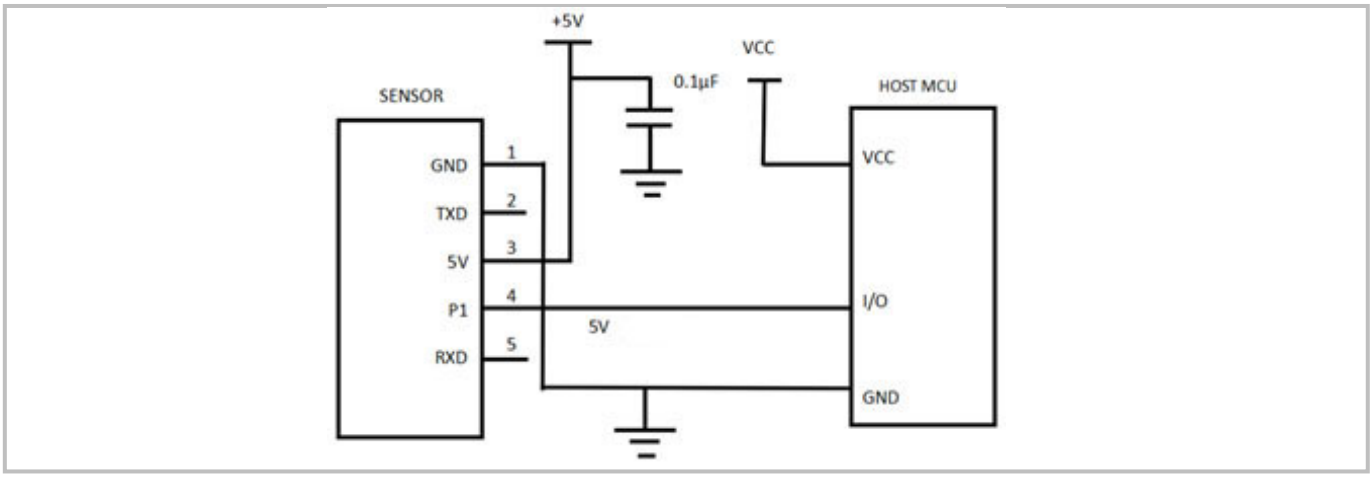
The interface connector is located at the side of the sensor. Corresponding female plug part number is EH-5 from JST. The pitch is 2.5mm.
The connection cable with female connector at both ends can also be customized.

Typical Application Circuit

Case 1. UART_TTL 3.3V Output

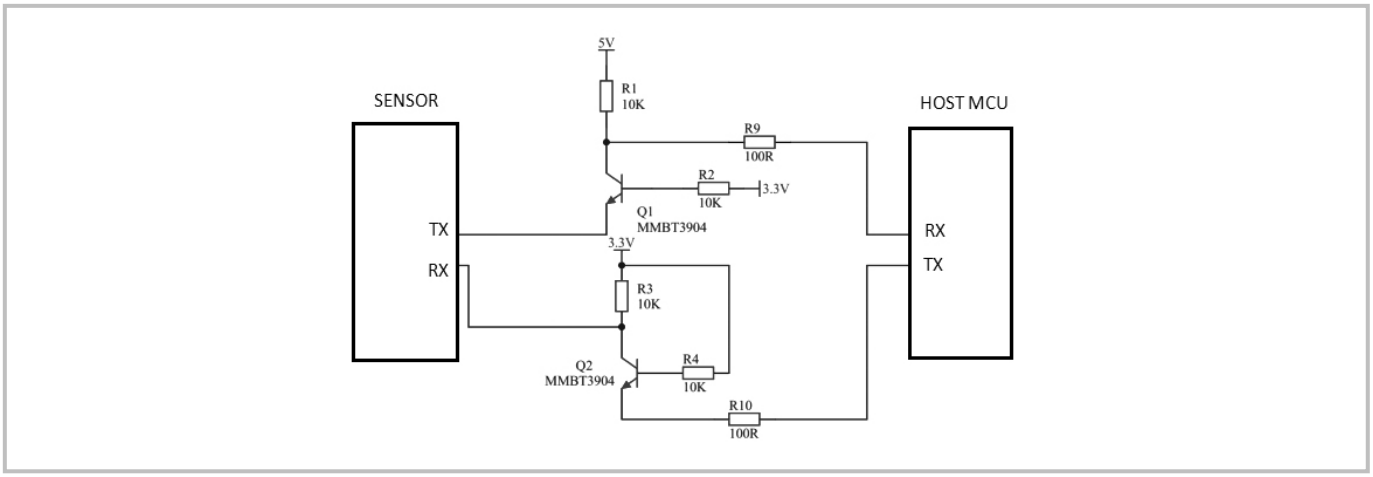


Case 2. PWM Output

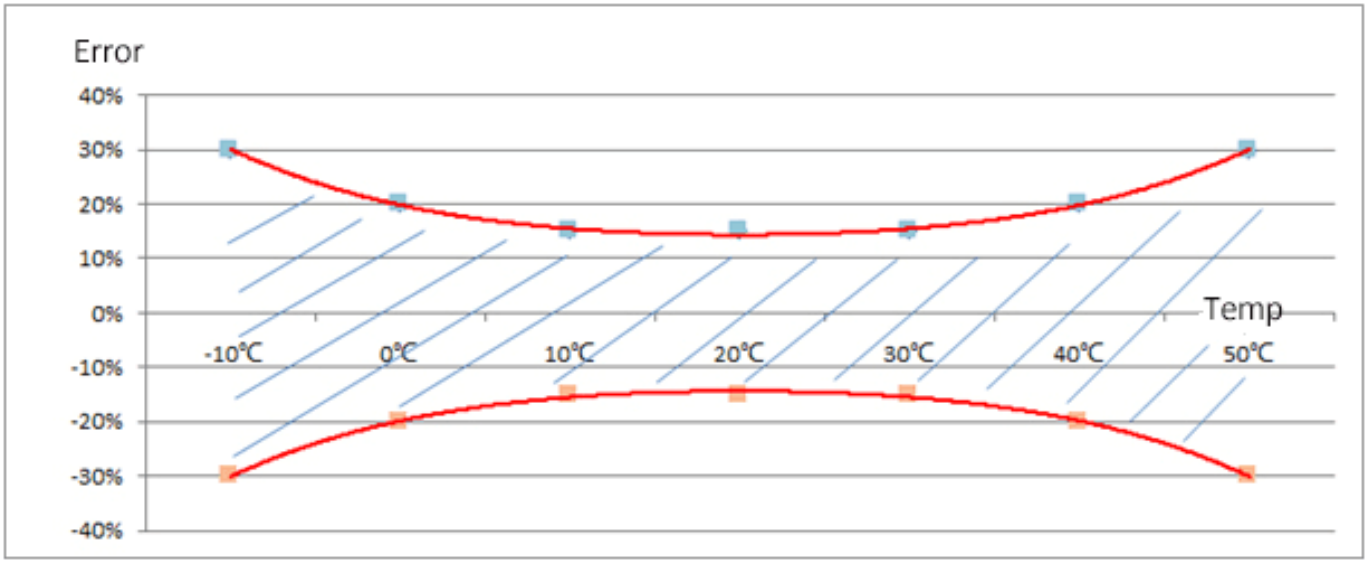


Case 3. 5V Level and 3.3V Level Conversion Circuit

If the communication level of the MCU is 5V, then the communication interface RXD and TXD should be connected with conversion chip or circuit to transfer 5V level to 3.3V level. Below diagram application is only for reference.



Temperature Influence Curve



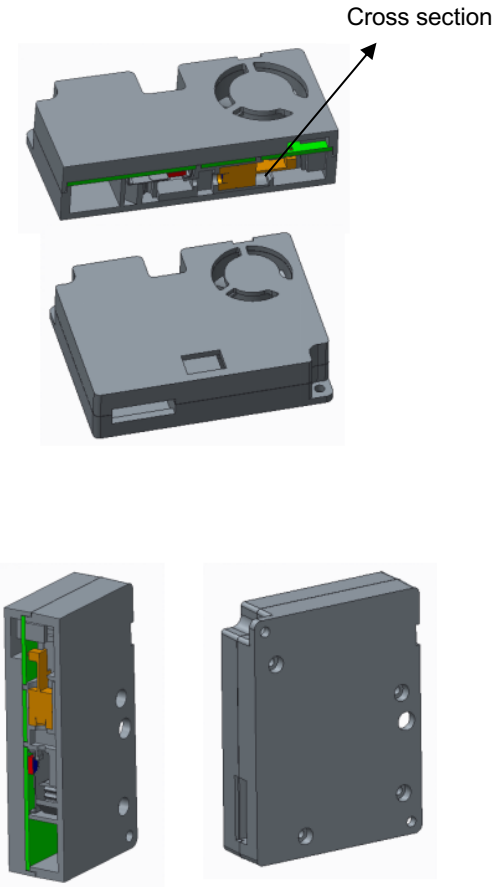
Particle measured error: under 25±2℃, 0~1,000μg/m³, consistency and accuracy of PM2.5 is either ±15% reading or ±15μg/m³, the bigger one is considered.

Temperature influence coefficient: 0.5%/℃ ~ 1%/℃ or 0.5μg/m³/℃ ~ 1μg/m³/℃, the bigger one is considered.

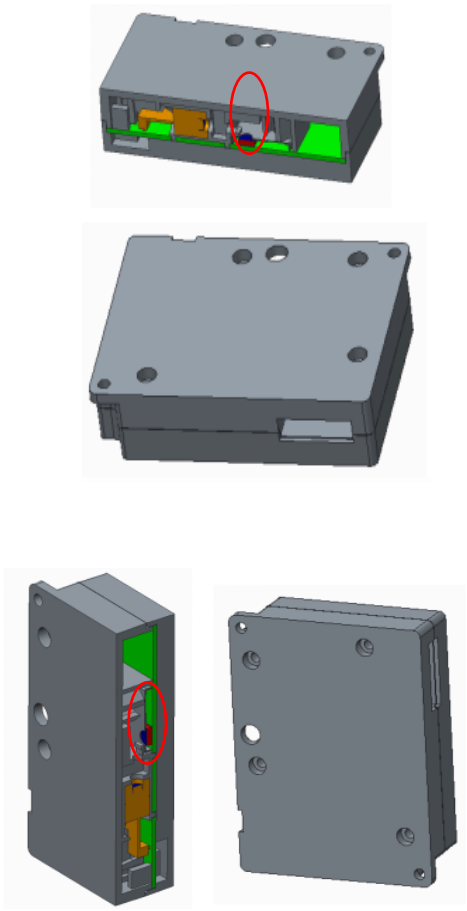
Product Installation

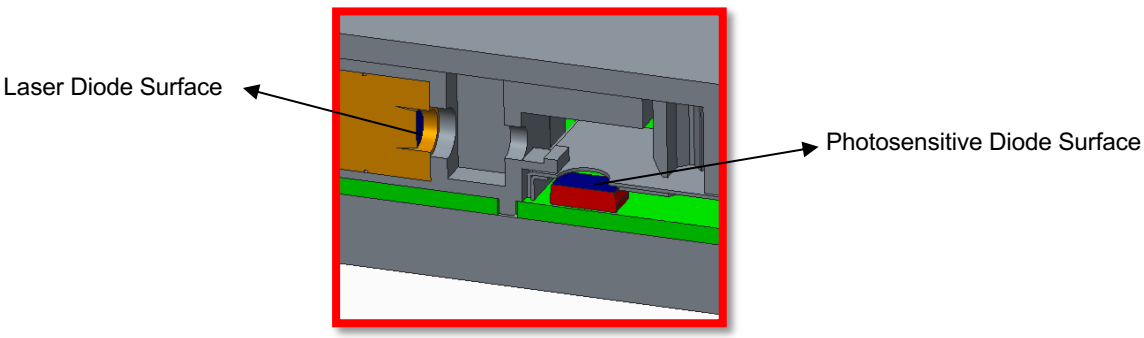
When install PM2107 sensor module in your system or equipment, please make sure that the air inlet and air outlet are unobstructed. And there is no huge airflow face to air inlet and air outlet. In order to avoid dust deposition on the surface of sensitive component (laser diode and photosensitive diode), which may affect the measurement accuracy of the sensor, the appropriate installation ways are recommended as below.

Recommended Installation



Non Recommended Installation





User Attention

▪The best installation way is to make the surface of air inlet and outlet of the sensor clings to the air vent in the inner wall of the user device that communicate with the outside. If it's not possible, then an air isolation structure between air inlet and air outlet is necessary to avoid the air back flow in the user's device.

▪ Air vent on the internal wall of user's device for airflow should be bigger than the size of air inlet of the sensor.

▪For purification products, sensor cannot be installed in the purifying air duct. If it's not possible, it's necessary to design a separate structure for sensor installation to isolate the sensor from air purifier duct.

▪For purifier and detector device, sensor should be installed above 20cm higher than floor to avoid contamination of large dust particles or even flocs near the ground entering the sensor, which influences the measurement.

▪Sensor should be prohibited from using for outdoor inspection equipment. Dust storms, rain, snow, and willow flocs can have a significant impact on unprotected sensors.

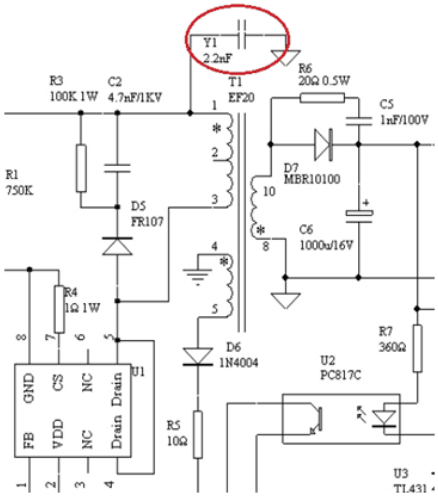
▪ Sensor is a complete unit. Disassembling the cover may cause irreversible damage.

▪It is for household electronics products. For application of medical, mining, disaster preparedness, which needs high security and high dependence, this sensor is not suitable.

▪Avoid using the sensor under the condition with strong magnetic, such as situation close to stereo speaker, microwave oven, induction cooking.

▪There is no high pressure transient protection circuit of the sensor. The power supply of the sensor should be stable and low noise. Please refer to the working voltage in specification table.

▪If isolated switch power supply is adopted to obtain DC power, please control the capacitance between the DC ground and the AC ground below 2.2nF and stand voltage reaches to 3KV.



▪This product is defined as 3R laser product according to《GB7247.1-2012 laser product safety》with laser radiation inside. Please avoid direct exposure to your eyes. Warning sign is as shown above.

UART 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 continuous mode after powering on. Working mode will not be saved after powering off.
5) Module can support I²C or UART communication.

If module do not receive any UART commands during the first 5 seconds, it will exchange to I²C communication.
If module receive UART commands during the first 5 seconds, it will keep UART communication.

2. Format of Serial Communication Protocol

Sending format of software:

Start Symbol	Length	Command	Data 1	……	Data n.	Check Sum
HEAD	LEN	CMD	DATA1	……	DATAn	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

Item No.	Function description	Command
1	Read particle measurement result	0x0B
2	Open/close particle measurement	0x0C
3	Read software version number	0x1E
4	Read serial number	0x1F

4. Detail Description of RS232 Protocol

4.1 Read Particle Measurement Result

Send: 11 02 0B 01 E1

Response: 16 11 0B DF1- DF4 DF5- DF8 DF9- DF12 DF13 DF14 DF15 DF16 [CS]

Function: Read particle concentration

Note:

PM2.5 measurement data= = DF1*256^3 + DF2*256^2 + DF3*256^1 + DF4

Data bit: 16 11 0B 00 00 00 C9 00 00 00 00 00 00 00 00 00 00 00 00 05

PM2.5 Reserved Reserved Reserved

DF13: Alarm of sensor module working condition:

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Alarm definition					1:low working temperature	1: high working temperature	1:Fan at low revolving speed	1: Fan at high revolving speed

DF14: Reserved

DF15: Alarm of sensor module calibrated status

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Alarm						1: Non-calibrated	1: Non-calibrated	1: Non-calibrated

DF16: Reserved

Note: Part of reserved bit is used for our internal testing. The data changeable of reserved bit is nothing related to function.

4.2 Open/Close Particle Measurement

Send: 11 03 0C DF1 1E CS

Response: 16 02 0C DF1 CS

Function: Open/ close particle measurement

Note:

1. When sensor is power-on, it starts continuous measuring.
2. When sending command, DF1=02 means opening measurement, DF1=01 means closing measurement;
3. When receiving response, DF1=02 means measuring opened, DF1=01 means measuring closed;
4. When the sensor receives the command of opening measurement, it will be in default continuous testing mode. Pls check as below:

Send: 11 03 0C 02 1E C0 //open particle measurement

Response: 16 02 0C 02 DA//module is under particle measurement open status

Send: 11 03 0C 01 1E C1 //close particle measurement

Response: 16 02 0C 01 DB// module is under particle measurement closed status

4.3 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

4.4 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*256+DF2), (DF3*256+DF4), (DF5*256+DF6), (DF7*256+DF8), (DF9*256+DF10)

Example:
Response: 16 0B 1F 00 00 00 7E 09 07 07 0E 0D 72 9E
Serial number: 126 2311 1806 3442

I²C Communication Protocol

1. Brief Introduction

a. This is an I²C protocol for PM2107. The sensor module is lower computer, which is not able to initiate communication automatically. Communication is initiated via main controlled board, which reads data and sends control commands.

b. Communication clock frequency <=100Khz

2. Communication Common

START: start signal, send by main controlled board;

STOP: stop signal, send by main controlled board;

ACK: acknowledge signal, send by the sensor module if in bold; otherwise, send by main controlled board;

NACK: non-acknowledge signal, send by the sensor module if in bold; otherwise, send by main controlled board;

Px: receive and send data; send by the sensor module if in bold; otherwise, send by main controlled board.

3. Protocol Detailed Description

3.1 Send Command Data

Send by main controlled board:

START+WRITE+ACK+P1+ACK+P2+ACK…… +P7+ACK+STOP

Data	Byte Content	Description
Device address	Sensor address and read/write command	This byte is 0x50 when write data
P1	0x16	Frame header
P2	Frame length	Number of byte, not including length of device address (From P1 to P7, 7 bytes in total)
P3	Data 1	Control command of the sensor as: Close measurement: 1 Open single measurement: 2 Set up continuously measurement: 3(default mode) Set up timing measurement: 4 Set up dynamic measurement: 5 Others: invalid
P4	Data 2, high byte	Timing measuring cycle: (range: 180-64800) Unit: second (set to 0xFF 0xFF for continuous mode)
P5	Data 2, low byte	
P6	Reserved	
P7	Data check code	Check code= (P1^P2^……^P6)

3.2 Read Data Command

Send by main controlled board:

START+READ+ACK+P1+ACK+P2+ACK+……+P32+NACK+STOP

Data	Byte Content	Description
Device address	Sensor address and read/write command	This byte is 0x51 when read data
P1	0x16	Frame header
P2	Frame length	Number of byte, not including length of device address(P1 to P22, 22 bytes total)
P3	Sensor status	Close: 1 Alarm: 2 Testing: 3 Testing finished: 0x80 Other data is invalid
P4	Data 1, high byte	Reserved
P5	Data 1, low byte	
P6	Data 2, high byte	PM2.5 concentration , unit ug/m^3
P7	Data 2, low byte	
P8	Data 3, high byte	Reserved
P9	Data 3, low byte	
P10	Data 4, high byte	The measuring mode of sensor as: Single measuring mode: 2 Continuous measuring mode: 3 Dynamic measuring mode: 5 Timing measuring mode: >= 180 (means measuring time)
P11	Data 4, low byte	
P12	Data 5, high byte	Reserved, default value is 0
P13	Data 5, low byte	
P14	Data 6, high byte	Reserved, default value is 0
P15	Data 6, low byte	
P16	Data 7, high byte	Reserved, default value is 0
P17	Data 7, low byte	
P18	Data 8, high byte	Reserved, default value is 0
P19	Data 8, low byte	
P20	Data 9, high byte	Reserved, default value is 0
P21	Data 9, low byte	
P22	Data check code	Check code = (P1^P2^……^P21)

3.3 Description of Four Kinds of Work Mode

1. Single Measuring Mode

The sensor will start measuring particles after receiving command of opening measuring, sensor status is 3. After preheating for 6 seconds, measured value of last measurement will be output automatically. Measurement will finish in 36s, and sensors situation change to 0x80, it means data is stable, and measurement will be closed automatically.

2. Continuous Measuring

Continuous measuring mode, sensor situation is always 3 after powering on or turning to continuous measuring mode.

3. Dynamic Measuring Mode

After sensors are in dynamic measuring mode, measuring cycle is 1 minute.

The sensor starts the measurement for the first 6 seconds. If measuring result within 6 seconds compared with the last time measured result meets situation ①, the sensor will go on testing for another 30s, then measurement is closed for 24s(laser diode and fan both off) until next new 60s measuring cycle.

① Change range is > ±10μg/m³ or > ±10%

If measuring result within 6 seconds compared with the last time measured result meets situation ②, the measurement is closed for 54s until next new 60s measurement cycle starts.

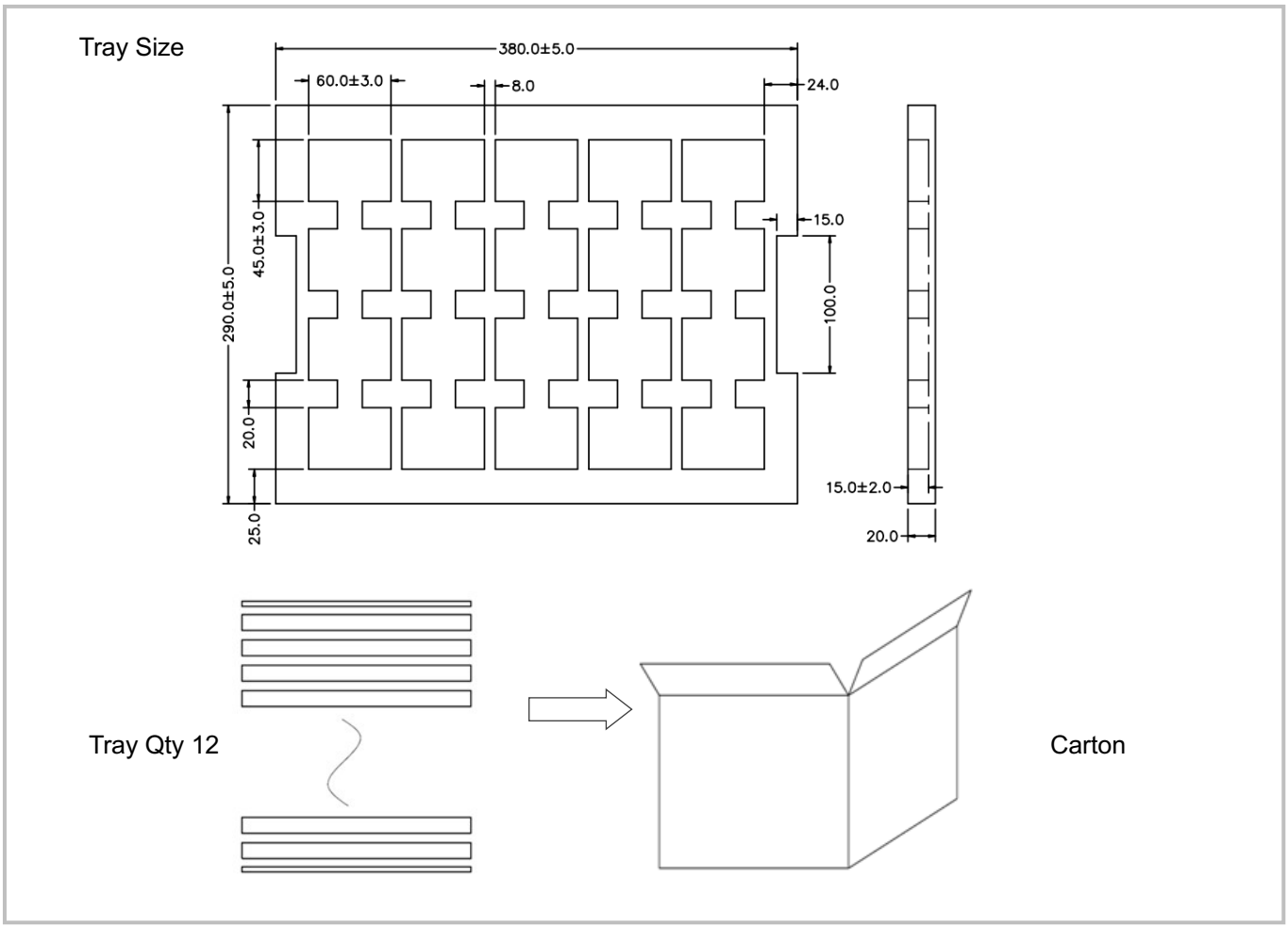
② Change range is < ±10 μg / m³ or < ±10%

4. Timing Measuring Mode

When start timing measurement mode, the sensor will open 36 seconds' measurement in timing XX seconds. The sensor situation is 3 during measuring process. After 36 seconds' measurement, the sensor situation will be 0x80.

No matter under what kinds of measuring mode, the sensor will close measurement when get related command. The sensor situation will change into 1.

Packing Information



Sensor per Tray	Tray Qty	Sensor per Carton	Carton Dimensions	Packing Material
20 pcs	12 layers	240 pcs	395*310*330 mm	Red anti-static EPE

After-Sales Services and Consultancy

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