

SPECIFICATION

Product Name: Laser Particle Sensor Module

Item No.: PM2006MD

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

PM2006MD



Applications

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

Description

Designed with ultra-small structure, laser particle sensor module PM2006MD adopts laser scattering technology to detect particle concentration of indoor air and output particle mass concentration PM2.5 in $\mu\text{g}/\text{m}^3$ directly via mathematical algorithm and scientific calibration.

Features

- The smallest size of available measurement: $0.3\mu\text{m}$
- Real-time output PM2.5 in $\mu\text{g}/\text{m}^3$ available
- High accuracy, high sensitive and quick response ($\leq 8\text{s}$)
- Small size, compact structure, easy to install
- Four types of measuring mode for option: single/continuous/timing/dynamic
- RoHS and Reach compliant
- Air inlet and outlet on the same side

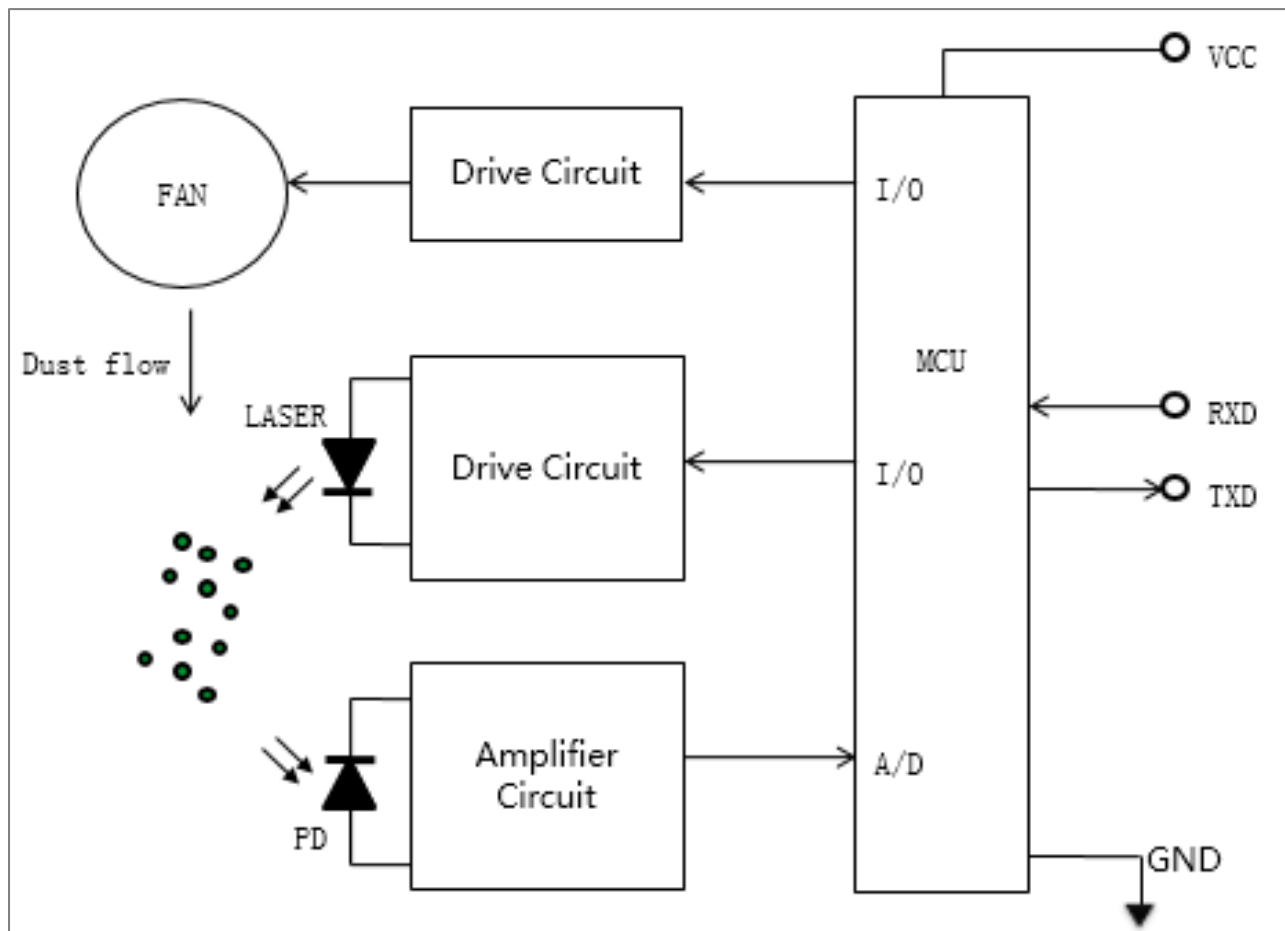
Working Principle

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 calculate. 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	0.3 μ m~10 μ m
PM2.5 Measurement range	0~1000 μ g/m ³
Resolution	1 μ g/m ³
Working condition	-10°C ~ 50°C, 0-95%RH (non-condensing)
Storage condition	-20°C ~ 60°C, 0-95%RH (non-condensing)
PM2.5 Measurement accuracy	0~35 μ g/m ³ , \pm 5 μ g/m ³ >35 μ g/m ³ , \pm 15% of reading Condition: 25 \pm 2°C, 50 \pm 10%RH Reference instrument: TSI8530 Dust Source: Cigarette
Response time	1sec
Time to first reading	\leq 8 seconds
Power supply	DC 5V \pm 0.1V, ripple wave < 50mV
Working current	<70mA
Standby current	<10mA
Dimensions	45 \times 24.5 \times 16.5mm
Digital output 1 (default)	UART_TTL_3.3V
MTTF	37,297hrs

Internal Architecture Description

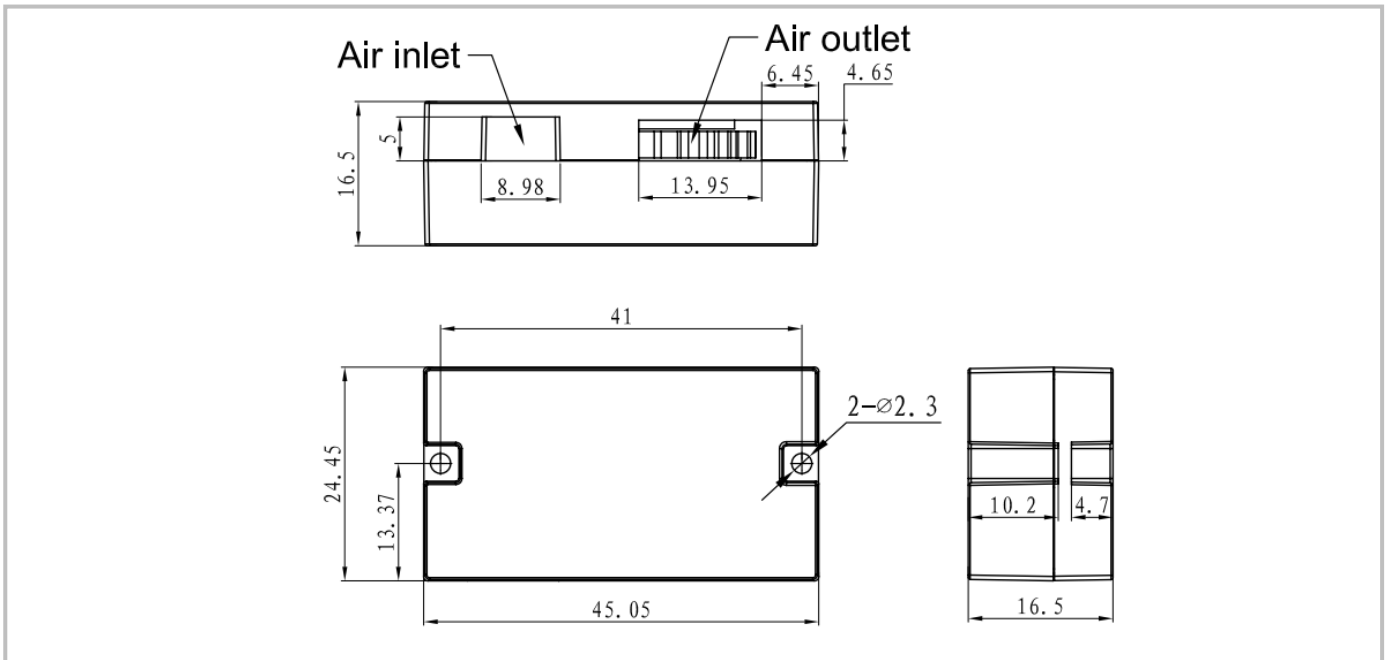


According to the above figure, the light source part is composed of a laser diode and a driving circuit. The detection part is composed of a photosensitive diode and an amplifying circuit. Value and communication output are finished by MPU.

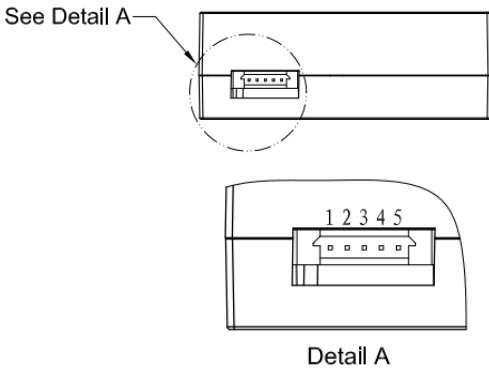
When the fan works, it will generate airflow. Particles will pass the detecting chamber. The light from laser diode will be scattered by particles and will be recognized by photosensitive device and converted into electronic signal. Electronic signal will be converted into digital signal output after dispose by amplifying circuit, filtering and MCU.

Dimensions and Connector

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



2. I/O Connector Pinout

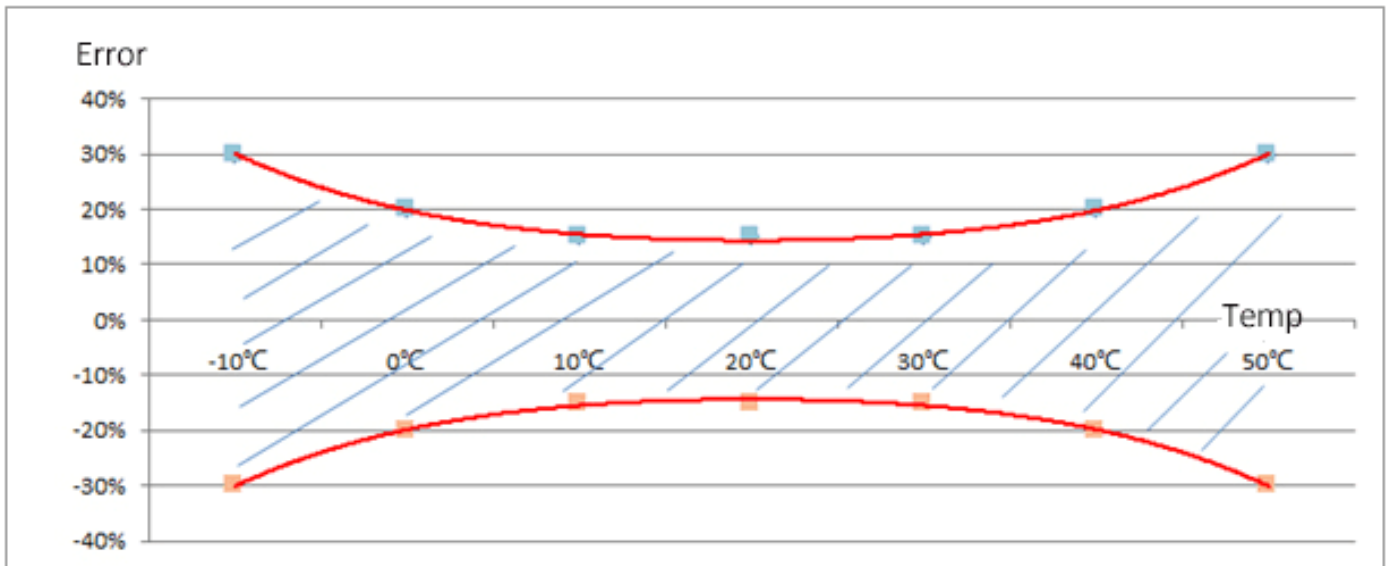


No.	Pin	Description
1	GND	Power input (ground terminal)
2	RX	UART (Receiving) (electrical level 3.3V)
3	TX	UART (Sending) (electrical level 3.3V)
4	5V	Power input (+5V)
5	3.3V	Power output (+3.3V/100mA)

The interface connector is located at the side of the sensor. Corresponding female plug part number is A1255WRA-S-5P from CJT. The pitch is 1.25mm.

The connection cable with female connector at both ends can also be customized.

Temperature Influence



Particle measured error: under $25 \pm 2^\circ\text{C}$, $0 \sim 1,000 \mu\text{g}/\text{m}^3$, consistency and accuracy of $\text{PM}_{2.5}$ is either $\pm 15\%$ reading or $\pm 15 \mu\text{g}/\text{m}^3$, the bigger one is considered.

Temperature influence coefficient: $0.5\%/^\circ\text{C} \sim 1\%/^\circ\text{C}$ or $0.5 \mu\text{g}/\text{m}^3/^\circ\text{C} \sim 1 \mu\text{g}/\text{m}^3/^\circ\text{C}$, the bigger one is considered.

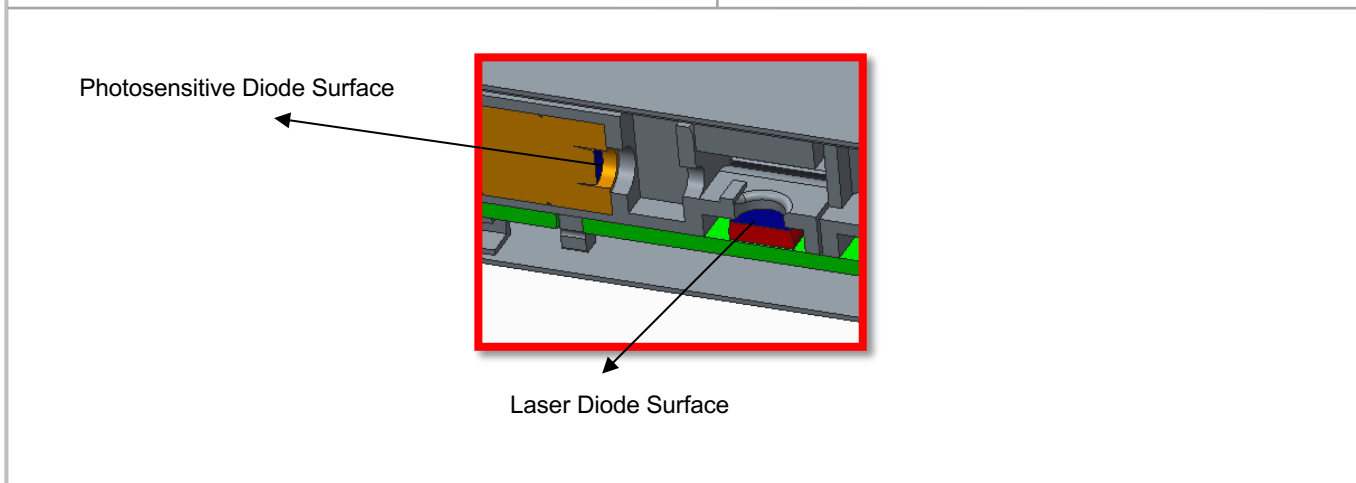
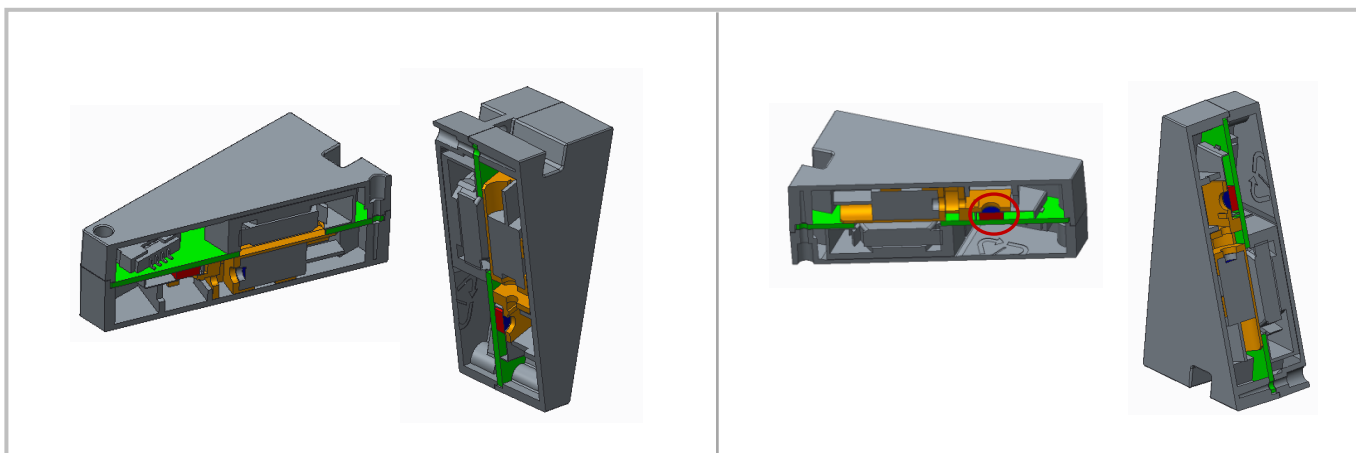
Product Installation

When install PM2006MD 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.

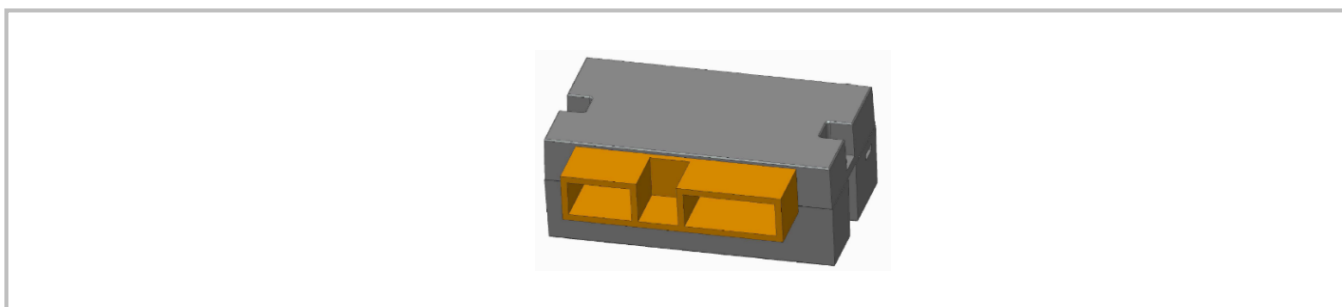
In order to avoid dust deposition on the surface of sensitive component (laser diode and photosensitive diode) which may affect the measurement accuracy, the appropriate installation ways are recommended as below.

Recommended Installation

Non Recommended Installation

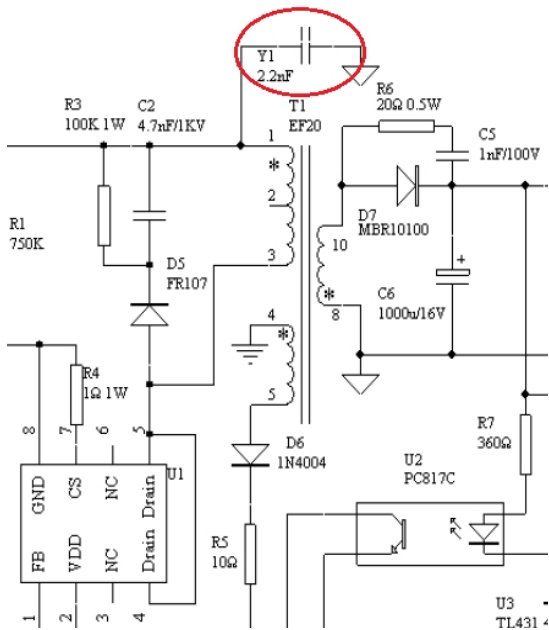


The best installation way is to make the surface of air inlet and outlet of the sensor clings to the air vent on the inner wall of the user device that communicate with outside. If it's not possible, there should be air isolation structure between inlet and outlet to avoid the air back flow in the user's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



User Attention

- 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, the sensor should be installed above 20 cm 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.
- 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 withstand voltage reaches to 3KV.



- The sensor itself is safe to use. What you should be cautious is the safety of power supply and structure design on the sensor.
- 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. The warning label is as 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.

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 Protocol

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 (ug/m³)

Note:

PM2.5 measurement value = DF1*256³ + DF2*256² + DF3*256¹ + DF4

Data bit: 16 11 0B 00 00 00 C9 00 00 00 00 00 00 00 00 00 00 00 00 05
 PM_{2.5} 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 definition						1: Non-calibrated	1: Non-calibrated	1: Non-calibrated

DF16: Reserved

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 sending command, DF1=02 means opening measurement, DF1=01 means closing measurement;
2. When receiving response, DF1=02 means measuring opened, DF1=01 means measuring closed;
3. When the sensor receives the command of opening measurement, it will be in default continuous testing mode.

Example:

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

The factory measurement time of the module is set to 65530, that is, after receiving the dust measurement command, it is measured until the stop command is received or the power is reapplied.

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

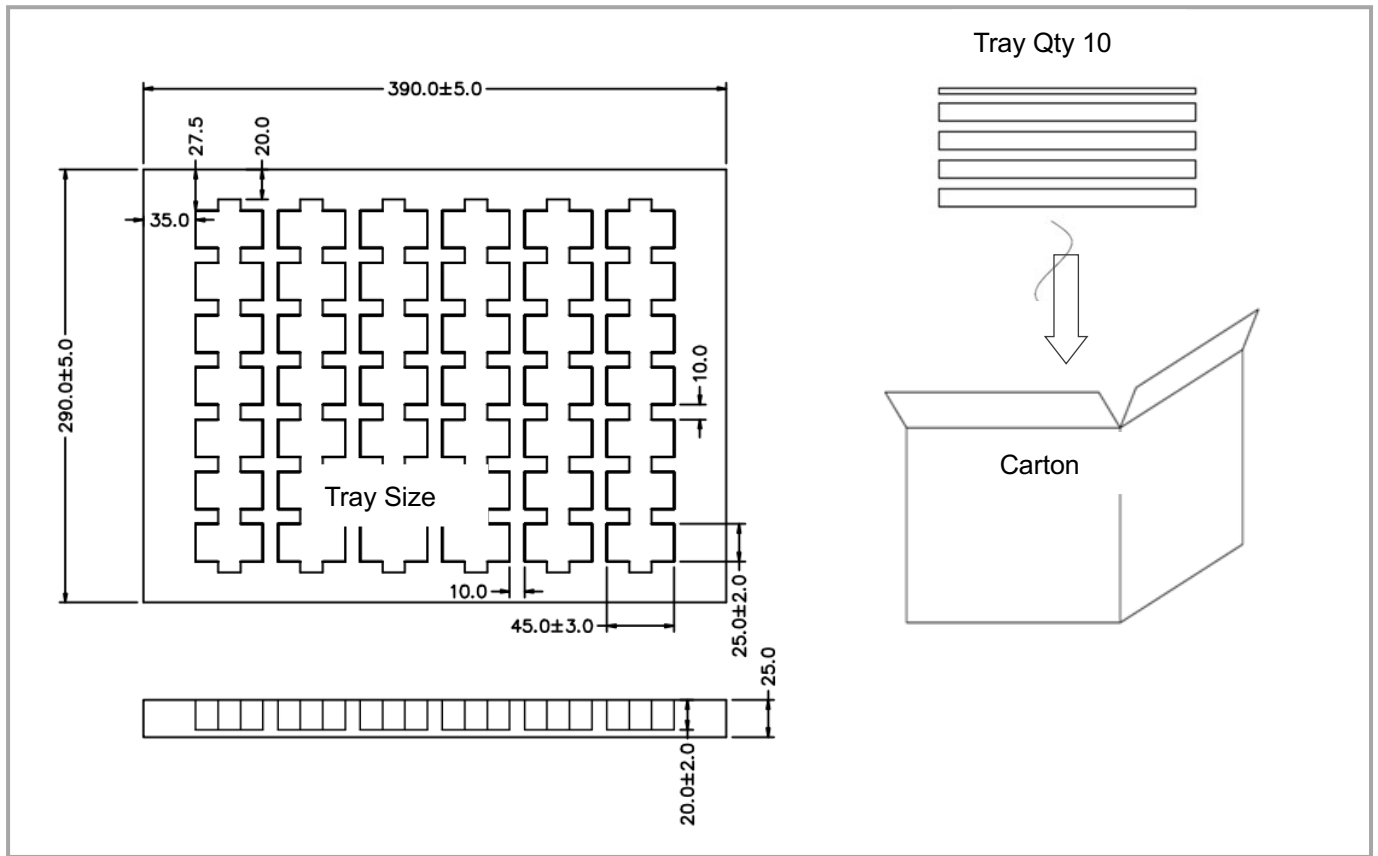
$=(\text{DF1} \times 256 + \text{DF2}), (\text{DF3} \times 256 + \text{DF4}), (\text{DF5} \times 256 + \text{DF6}), (\text{DF7} \times 256 + \text{DF8}), (\text{DF9} \times 256 + \text{DF10})$

Example:

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

Serial number: 126 2311 1806 3442

Package Information



Sensor per Tray	Tray Qty	Sensor per Carton	Carton Dimensions	Packing Material
60 pcs	18 layers	1080 pcs	395*310*480 mm	Red anti-static EPE

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