USER MANUAL

Laser Particle Sensor Module PM2005

---- fan series

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1. Brief introduction

PM2005 is one type of laser particle sensor module, which can measure the quantity (PCS/L) of different particle size (0.3μm to 10μm) in indoor air and it can be converted to μg/m^3 according to the mathematical algorithm.

2. Main features

- Smallest size of available measurement : 0.3μm
- Three types of optional signal output: PWM; UART-TTL; I^2C
- High sensitive and quick respond
- Small size, light weight, easy installation and maintenance

3. Application

- Air purifier; Air quality monitoring instrument
- Fresh air system; Air conditioning system
- Consumer electronics relevant products.

4. Principle of particle measurement

When sampling particles pass through light beam (laser), there will be light scattering phenomenon. And it will be converted into the electrical signal (pulse). The bigger particles will obtain stronger pulse single (peak value). Through peak value and pulse value can calculate quantity concentration of particles in each size. That is real-time data.

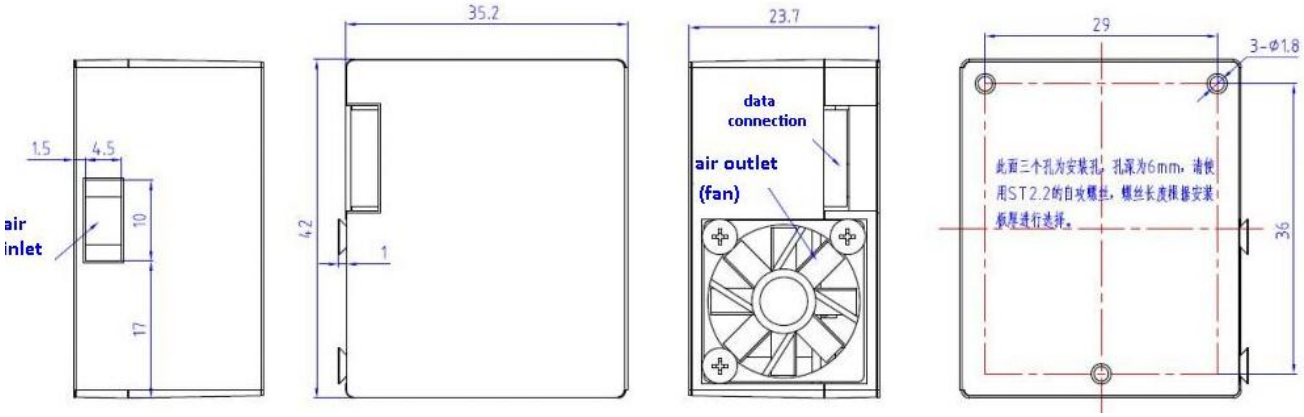
5. Specification

Measurement range	PM0.3/PM2.5/PM10 (0.3μm to 10μm)
Accuracy	±15% reading
Respond time	5 seconds
Working temperature	0… +45°C (full range of temperature correction)
Stable storage temperature	-20 … +60°C
Working humidity	0-95% RH non-condensing
Power supply	5.0 ±0.1 VDC ; < 100mA

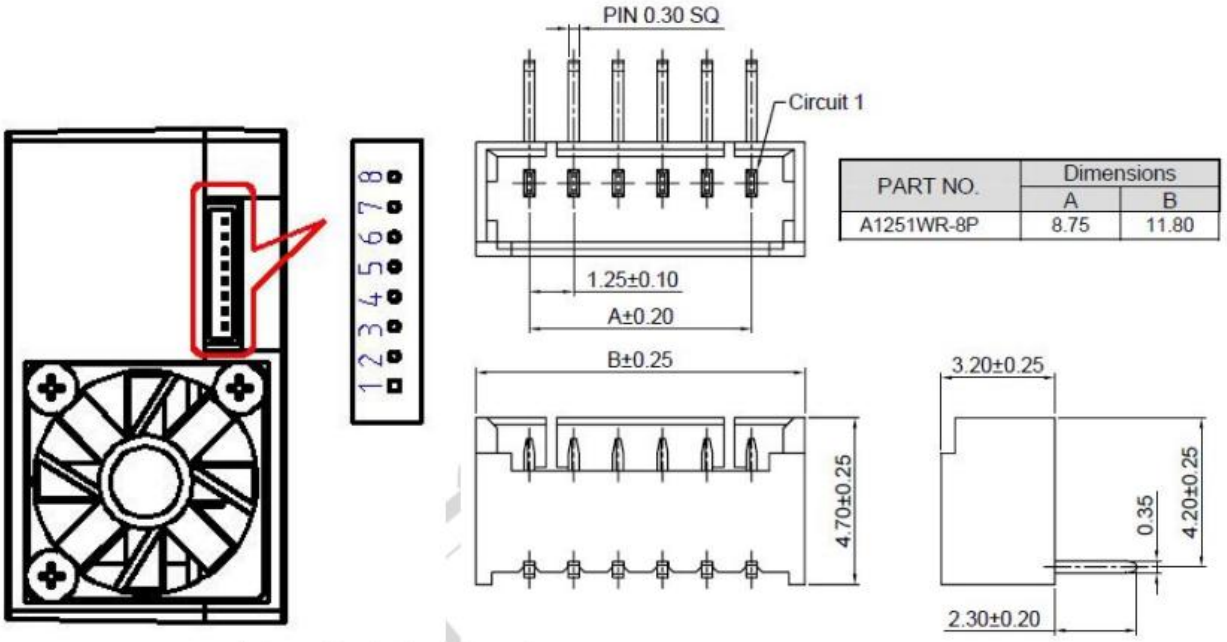
Signal outputs (option)	UART-TTL (0-3.3V interface) (default) Data bit: 8; Stop bit: 1; Check bit: null; Baud rate: 9600bps
	I^2C(0-3.3V interface) (default)
	PWM (customization)

6. Dimension

6.1schematic diagram



6.2 I/O definitions

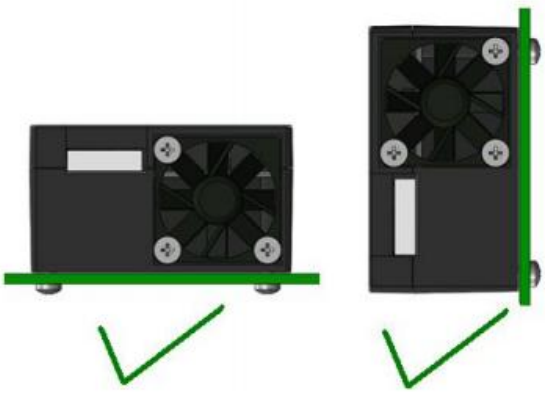


PART NO.	Dimensions	
	A	B
A1251WR-8P	8.75	11.80

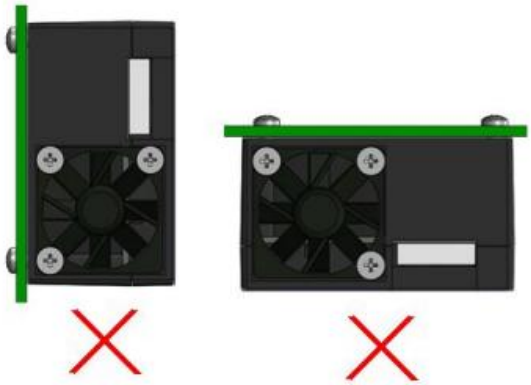
No.	Item	Description
1	+3.3V	Power output (+3.3V/100mA)
2	5V	Power input (5V)
3	SCL	I^2C Clock
4	SDA	I^2C Data
5	TEST	For testing
6	TX	UART-TX output (0-3.3V)
7	RX	UART-RX input (0-3.3V)
8	GND	Power input(ground terminal)

7. User attention

- PM2005 laser particle sensor module is for household electronics products, not suitable to medical, mining equipment etc. application;
- PM2005 adopts no static adsorption material like metal plate etc. Please do not use it in bad dusty environment. And please turn off sampling inlet when not working;
- When install PM2005 sensor module in your system or equipment, please make sure of unobstructed air-inlet and air-outlet. And there is no huge airflow faced to air-inlet and air-outlet. **Correct installation position as below for reference:**



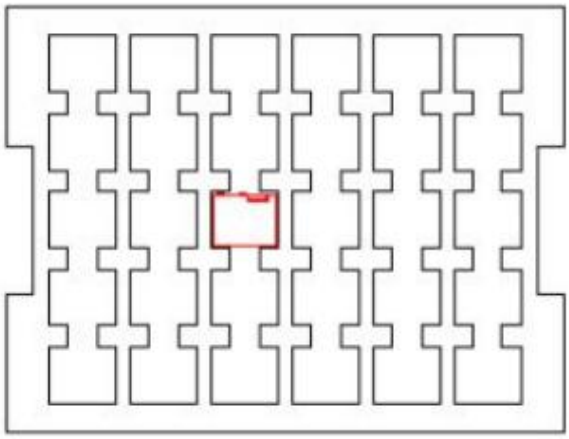
Correct installation

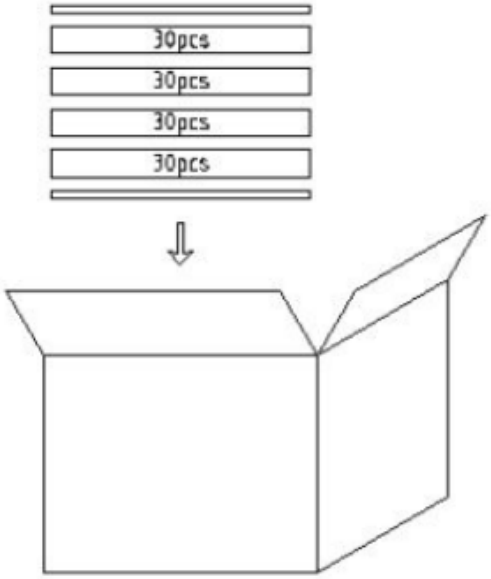


Wrong installation

8. Packing

Standard packing carton: 480*400*320mm
30PCS per EPE; 13 EPE per carton (Total 390PCS per Carton)





9. After-sales services and consultancy

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UART Communication Protocol (V0.08)

1 General Statement

1.The Data in this agreement are all hexadecimal data。Such as "46 for decimal [70]"
2.[xx] for single-byte data (unsigned, 0-255)； high byte of Double byte data is in the front, the low byte in the back。
3. PM2005 as subordinate module, will respond by 5ms delay after get command.

2 Communication Format

2.1 RS232 Protocol Format

Sending format:

Start	Length	Command	Data 1	……	Date n.	Check Sum
HEAD	LEN	CMD	DATA1	……	DATAn	CS
11H	XXH	XXH	XXH	……	XXH	XXH

Protocol format details description:

Protocol format	Description
Start	Command sending fixed [11H], the module respond fixed [16H]
Length	Frame bytes length = data length +1 (including CMD+DATA)
Command	Command
Data	Data of writing or reading, unfixed length
Check sum	Cumulative sum of data = 256- (HEAD+LEN+CMD+DATA)

3 Function

3.1 RS232 Protocol Function Sheet

Item No.	Function description	Command
1	Open/close particle measurement	0x0C
2	Read the measuring result	0x0B
3	Write user correction coefficient	0x1C
4	Set-up and read particle measurement time	0x0D
5	Set-up and read timing measurement mode	0x05
6	Set-up and read dynamic working mode	0x05

4. RS232 Protocol Detailed Description

4.1.1 Open/ close particle measurement

Send： 11 03 0C DF1 1E C2
Response: 16 02 0C DF1 CS
Function： Open/ close particle measurement
Information：

1、 When send the command, DF1=2 is opening measuring, DF1=1 is closing measuring, DF1=0, it will switch between open and close.
2、 When receive the command, DF1 means measuring status.DF1=2 means measuring open status. DF1=1 means measuring close status.
3、 When the sensor receives the command of measuring open, it starts pump into particle measuring status. The time is 36s. 36s later it stops automatically.

Send: 11 03 0C 02 1E C0 //open particle measurement
Respond: 16 02 0C 02 DA // the sensor module is under particle measurement open status

Send: 11 03 0C 01 1E C1 //open particle measurement
Respond: 16 02 0C 01 DB // the sensor module is under particle measurement close status

4.1.2 Read particle measuring results

Send： 11 01 0B E3
Response： 16 11 0B DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 DF11 DF12 DF13 DF14 DF15 DF16 [CS]
Function： Read particle measuring results (PCS/L)
Statement：
0.5 measuring data = DF1*256^3 + DF2*256^2 + DF3*256^1 + DF4
2.5 measuring data = DF5*256^3 + DF6*256^2 + DF7*256^1 + DF8
P10 measuring data = DF9*256^3 + DF10*256^2 + DF11*256^1 + DF12

DF13: working condition alarm of the sensor module

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit0
Alarm Def-inition	1：low electric current of laser diode	1: high electric current of laser diode	1: low sensitivity of sensor	1: high sensitivity of sensor	1: low working temp-erature	1: high working temp-erature	1: low revolving speed	1: high revolving speed

DF15: calibrated status alarm of the sensor module

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit0
Alarm Def-inition						1: uncalibrated status on high temperatue point	1:uncalibrated stauts on low temperature point	1: uncalibrated status on normal temperatue point

DF16: working status of the sensor module

DF16=3 : means the sensor is on measuring process

DF16 data	Description
3	The sensor module is on measuring process; The fan and laser diode is on working.
1	The sensor module is closed measuring. (closed by command) The fan and laser diode stop working.
128	The sensor module is closed measuring. This is automatically closed status for single measurement mode.

Send： 11 01 0B E3

Response： 16 11 0B **00 02 83 C9** **00 00 00 EC** **00 00 00 67** **00 00 00 00** 2D

0.5um **2.5um** **10um** **alarm**

0.5um measuring data = 0*256^3 + 2*256^2 + 0x83*256^1 + 0xC9 = 164809 (PCS/L)

2.5um measuring data = 0*256^3 + 0*256^2 + 0*256^1 + 0xEC = 236 (PCS/L)

10um measuring data = 0*256^3 + 0*256^2 + 0*256^1 + 0x67 = 103(PCS/L)

Send： 11 02 0B 01 E1 // read particle mass , the unit is ug/m^3 ，same response format as above.

Description of particle mass reading ：

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

PM10 measuring data = DF5*256^3 + DF6*256^2 + DF7*256^1 + DF8

Alarm bit is same as above.

4.1.3 Set-up and write user correction coefficient

Send: 11 01 1C D2 // read correction coefficient

Send: 11 04 1C [PMx] DF1 DF2 [CS] // set-up user correction coefficient

Respond: 16 07 1C DF1 DF2 DF3 DF4 DF5 DF6 [CS]

Description:

1. Send command PM x parameters means：

   PM x=0 stands for 0.5um particle correction coefficient

   PM x=1 stand for 2.5um particle correction coefficient

   PM x=2 stand for 10um particle correction coefficient

2. Send command coefficient is DF1*256+ DF2
3. Available coefficient range for set-up is 1 to 10000
4. Default coefficient value and base are 100 (100 stand for measuring values are not amplified. 200 stands for measuring values * 2 times. 10 stands for measuring values * 0.1 times)
5. Response command parameter meaning ：

Remark	Data Bits	Multiple
0.5 coefficient	[DF1][DF2]	100
2.5 coefficient	[DF3][DF4]	100
10 coefficient	[DF5][DF6]	100

Send： 11 04 1C 00 01 A0 2E
Response： 16 07 1C 01 A0 01 B8 01 CC A0

4.1.3 Set-up and read particle measuring time

Send： 11 03 0D DF1 DF2 [CS] // set-up particle measuring time
Send： 11 01 0D E1 // read particle measuring time
Respond： 16 03 0D DF1 DF2 [CS]
Function： to read particle measuring time
Description:

1. Particle measuring time = DF1*256+DF2, unit is second. Minimum measuring time is 36 seconds. Factory default set-up time is 36 seconds. Available time range for set-up is 36-65500 seconds.
2. When measuring time is 65531, it means under continuous measuring mode. It will not stop measuring until sending stop command.

Send：**11 03 0D 00 64 7B** // set up particle measuring time is 100 seconds
Respond：**16 03 0D 00 64 76** // measuring time set-up successfully

4.1.5 Set-up and read particle measuring mode

Send： 11 03 05 DF1 DF2 [CS] // set up particle measuring mode
Send： 11 01 05 E9 // read particle measuring mode
Respond： 16 03 05 DF1 DF2 [CS]
Function: to read particle measuring time
Description:

1、 Particle measuring mode value X = DF1*256+DF2， the unit is second;
2、 When X<300, it means single measuring mode. Under this mode, the sensor module will open measurement one time by command, and need to send command once again for second measurement. Default mode is single type.

3、 When X ≥ 300, it mean timing measuring mode. The sensor module will open measurement one time by timing measuring cycle X seconds. Meanwhile, it is also able to work by command. When under this mode, measuring data is the latest one after close measurement.

4、 Set-up range of X data is 300-3600*18. It means that, the shortest timing cycle is 5 minutes; and longest one is 18 hours.

Send：**11 03 05 02 05 E0** // Set up as timing measuring mode, and timing cycleis 517seconds.
Respond：**16 03 05 02 05 DB** // Set up successfully

Send：**11 03 05 00 00 E7** //Set up as single measuring mode
Respond：**16 03 05 00 00 E2** // Set up successfully

4.1.6 Set-up and read dynamic measuring mode

Send： 11 03 06 DF1 [CS] // Set up dynamic particle measuring mode
Send： 11 01 06 E8 // Read dynamic particle measuring mode
Respond： 16 03 05 DF1 [CS]
Function： Read/set up particle dynamic measuring mode
Description：

1、 Particle dynamic measuring mode data DF1;

2、 DF1=0 means, closing dynamic measuring mode. DF1=1 means, opening dynamic measuring mode.

Analysis of dynamic mode:

1、 When open dynamic mode, there will be the first single measurement for completed 36 seconds;

2、 After the first single measurement, it will open measurement each minute. And if the measurement data of initial 6 seconds is 15% less than data from the first completed 36 seconds, then the sensor will be stopped. And, latest measurement data will keep the first 36 seconds result. Otherwise, the sensor will go ahead for the second completed 36 seconds measurement and update the latest measurement data accordingly.

Send：**11 02 06 01 E6** //Set up open dynamic measurement mode
Respond：**16 02 06 01 E1** // Set up successfully

Send：**11 02 06 00 E7** // Set up close dynamic measurement mode
Respond：**16 02 06 00 E2** //Set up successfully