CUBIC

SPECIFICATION

Product Name: Laser Particle Counting Sensor Module

Item No.: PM5000S

Version: V0.2

Date: 6th Sept, 2023

Revision

No.	Version	Content	Date
1	V0.1	First revision	2021.01.27
2	V0.2	Revise specification parameter	2023.09.06

Laser Particle Counting Sensor Module

PM5000S

Applications

- Clean Room
- Pharmaceuticals Industry
- Precision Machinery Industry
- Microbiological Industry

Description

PM5000S laser particle counting sensor module is based on laser scattering technology, which can accurately detect and calculate the number of suspended particles with different particle sizes in the air. The sensor can simultaneously output quantity of particles in 6 channels including 0.3um, 0.5um, 1.0um, 2.5um, 5.0um and 10um (PCS/L).

Features

- 6-channel (0.3um, 0.5um, 1.0um, 2.5um, 5.0um, 10um) simultaneous particle number output
- Constant current sampling structure, ensure the even sampling flow
- Better laser diode and strong fan with better performance.
- Wide working temperature range, more stability
- With voltage regulator design and EMC compatibility, strong antistatic ability
- Intelligent false alarm functions

Working Principle

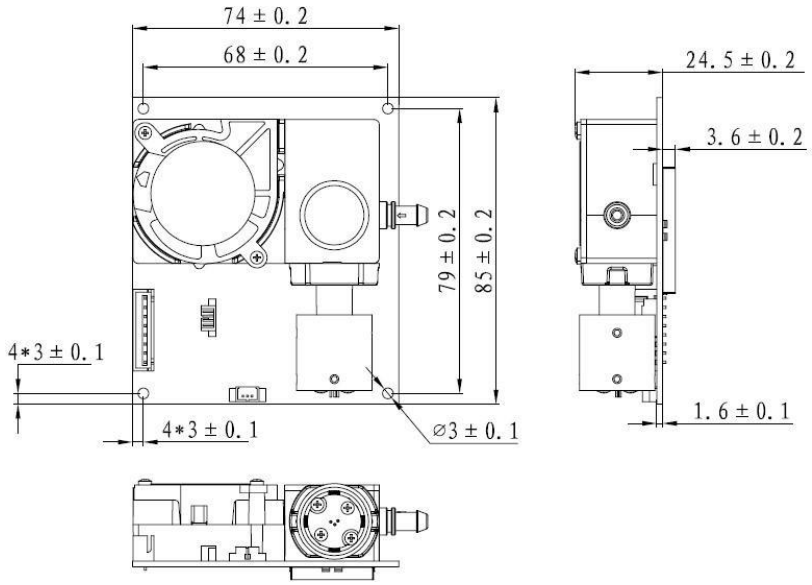
Sampling by the internal pressure which occurs by fan, when sampling particles pass through light beam (laser), there will be light scattering phenomenon. Scattered light will be converted into electrical signal (pulse) via photoelectric transformer. The bigger particles will obtain stronger pulse signal (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

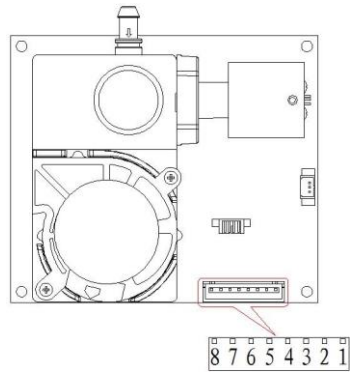
Laser Particle Counting Sensor Module PM5000S Specification	
Operating principle	Laser scattering
Output channels	>0.3μm, >0.5μm, >1.0μm, >2.5μm, >5.0μm, >10μm
Measurement range	0~10,000,000 pcs/L (1pcs/L=28.3pcs/cf)
Resolution	1 pcs/L
Working condition	-30°C ~ 70°C, 0-95%RH (non-condensing)
Storage condition	-40°C ~ 85°C, 0-95%RH (non-condensing)
Measurement error	<100pcs/l: ±30pcs/L >100pcs/L: ±30% of reading Condition: 0C ~ 40C,50+10%RH (0°C ~ 40°C, 50 ±10%RH. Reference instrument TSI 9306. TSI 9306 count efficiency 50% @ 0.3 μm and 100% for particles >0.45 μm)
Sampling interval	1s
Time to first reading	≤ 8s
Power supply	DC 5V±0.1V Ripple wave＜50mV
Working current	<250mA
Standby current	<25mA
Dimensions	W85*H74*D24.9 (mm)
Digital output	UART_TTL/IIC（3.3V/5V）
Lifetime	≥5 years(continuous working)

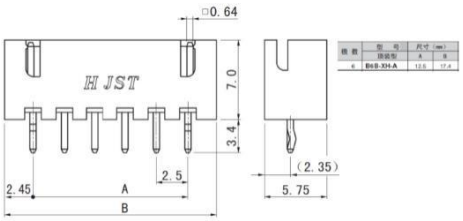
Dimensions and Connector

1. Dimensions (Unit mm)



2. I/O Connector Definition





No.	Pin	Description
1	VCC	Power input (+5V)
2	VCC	Power input (+5V)
3	GND	Power input (GND)
4	GND	Power input (GND)
5	TXD /SCL	UART sending (TTL level @3.3V~5V)/IIC clock
6	RXD/SDA	UART receiving (TTL level @3.3V~5V)/IIC data
7	CTR	Output mode exchange TTL level @3.3V high level or floating is UART communication mode, low level is I²C communication mode
8	BT	NC

3. Connector Description

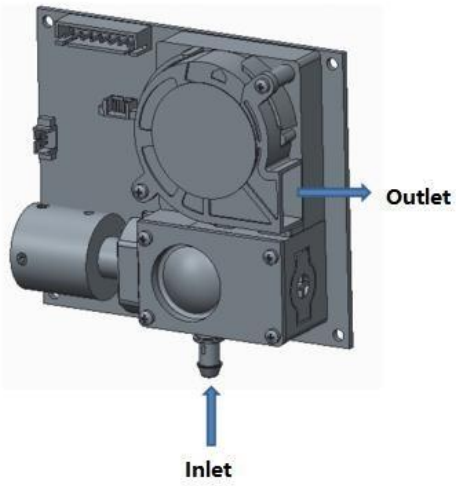
The interface connector of Sensor is A2501WV-8P. The pitch is 2.5mm.

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

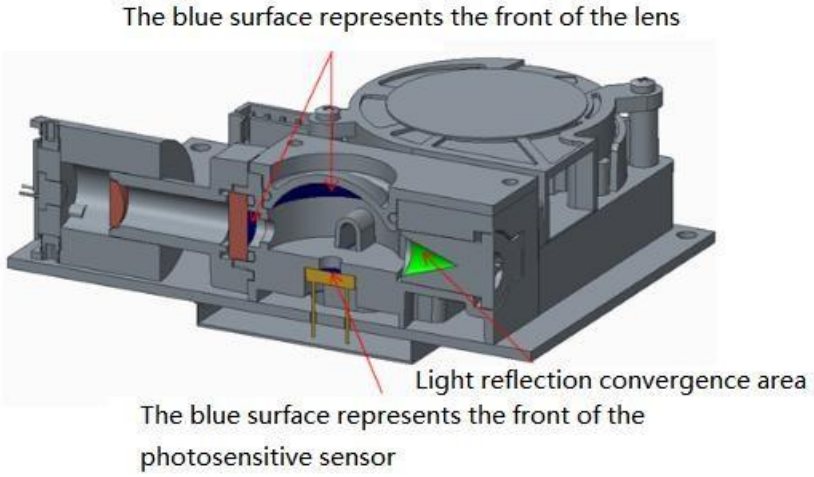
Product Installation

The surface of air inlet and air outlet closing to inner wall of user machine, this is the best installing method. If cannot do like this, there should be air isolation structure between inlet and outlet, thus to avoid the air flow return in the machine. The appropriate installation ways are recommended as below.

Recommended installation



Internal profile



User Attentions

※ When install the product in your system or equipment, please make sure of unobstructed air-inlet and air-outlet. And make sure that there is no huge airflow faced to air-inlet and air-outlet. Please follow the recommended installation to avoid dust deposit on the sensitive elements surface.

※ The inside diameter of user equipment's air inlet should not be smaller than the product's air inlet diameter.

※ When applying to air purifier, the product should be avoid being installed directly in the air duct. Or there should be a structure room to isolate the product in the air duct.

※The product installation position should be over 20cm above the ground.

※ The product is an integral unit that shall not be disassembled to avoid any irreversible damages.

※ The product is defined as 3R laser product according to GB7247.1-2012 Laser Product Safety with laser radiation inside. Please avoid direct exposure to the eyes.

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 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	……	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	Set up and read particle calibration coefficient	0x07
4	Read software version number	0x1E
5	Read serial number	0x1F

4. Detail Description of UART Protocol

4.1 Read Particle Measurement Result

Send: 11 02 0B 07 DB

Response: 16 35 0B DF1- DF52 [CS]

Function: Read measurement result.

Note: Read particles number (pcs/L).

Data	Description
DF1~DF4	Reserved
DF5~DF8	Reserved
DF9~DF12	Reserved
DF13~DF16	Reserved
DF17~DF20	Reserved
DF21~DF24	Reserved
DF25~DF28	>0.3μm, particles number, unit: pcs/L
DF29~DF32	>0.5μm, particles number, unit: pcs/L
DF33~DF36	>1.0μm, particles number, unit: pcs/L
DF37~DF40	>2.5μm, particles number, unit: pcs/L
DF41~DF44	>5.0μm, particles number, unit: pcs/L
DF45~DF48	>10μm, particles number, unit: pcs/L
DF49	Alarm
DF50~DF52	Reserved

>0.3μm, particles number = DF25*256^3 + DF26*256^2 + DF27*256^1 + DF28
>0.5μm, particles number = DF29*256^3 + DF30*256^2 + DF31*256^1 + DF32
>1.0μm, particles number = DF33*256^3 + DF34*256^2 + DF35*256^1 + DF36
>2.5μm, particles number = DF37*256^3 + DF38*256^2 + DF39*256^1 + DF40
>5.0μm, particles number = DF41*256^3 + DF42*256^2 + DF43*256^1 + DF44
>10μm, particles number = DF45*256^3 + DF46*256^2 + DF47*256^1 + DF48

DF49: 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: Laser tube failure alarm	1: Fan failure alarm	1: Fouling alarm	1: Low temperature alarm	1: High temperature alarm	1: Fan at low revolving speed	1: Fan at high revolving speed

DF50, DF51, DF52: 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 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

4.3 Set up and Read Particle calibration coefficient

Send: 11 02 07 DF1 CS // Set up particle calibrated coefficient

Send: 11 01 07 E7 // Read particle calibrated coefficient

Response: 16 02 07 DF1 CS

Function: Read/set up particle calibration coefficient

Note:

Calibration coefficient =DF1/100

Calibration coefficient setting valid range：0.1~2.5.

4.4 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

4.5 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: 0000 0126 2311 1806 3442

1. Brief Introduction

a. This is an I²C protocol for PM5000S. 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 measurement: 2
P4	Data 2, high byte	Reserved (0*00 0*00)
P5	Data 2, low byte	
P6	Data 3	Reserved (0*00)
P7	Data check code	Check code= (P1^P2^……^P6)

3.1.1 Close Particle Measurement

Send: 16 07 01 00 00 00 10

Function: Close particle measurement

3.1.2 Open Particle Measurement

Send: 16 07 02 00 00 00 13

Function: Open particle measureme

3.2 Read Data Command

Send by main controlled board:

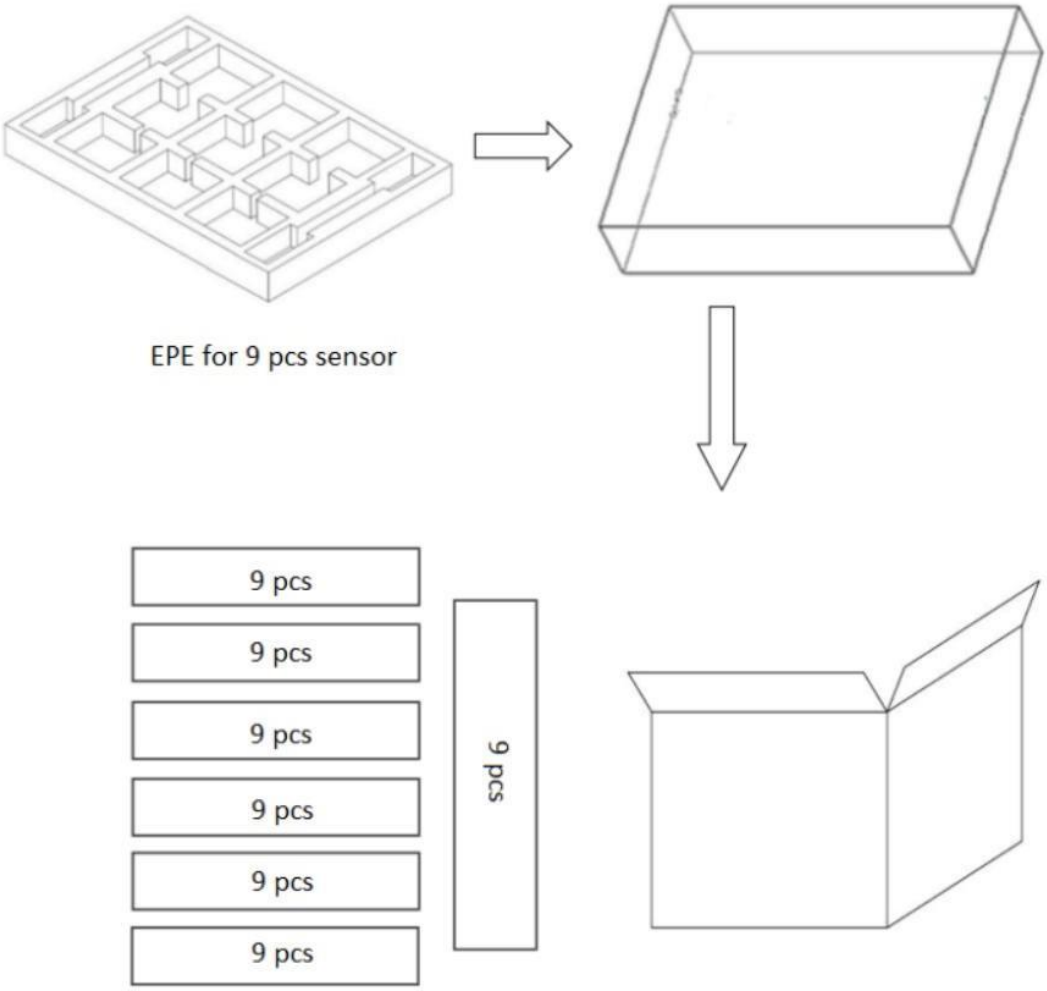
START+READ+ACK+P1+ACK+P2+ACK+……+P32+NACK+STOP

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 (from P1 to P32, 32 bytes in total)
P3	Sensor status	Status “1” means sensor is closing. Status “2” means sensor is under measuring. Status “7” means the faulty, temperature is too high or too low, or fan speed is too high or too low. Status “0x80” means measuring data is stable (only for dynamic or timing measuring mode)
P4	Data 1	Reserved
P5	Data 2	Alarm
P6	Data 3	Reserved
P7	Data 4	Calibration coefficient (range from 10 to 250, which corresponds to 0.1 to 2.5 coefficient)
P8	Data 5, high byte	>0.3μm, particles number, unit: pcs/L
P9	Data 5, high byte	
P10	Data 5, low byte	
P11	Data 5, low byte	
P12	Data 6, high byte	>0.5μm, particles number, unit: pcs/L
P13	Data 6, high byte	
P14	Data 6, low byte	
P15	Data 6, low byte	
P16	Data 7, high byte	>1.0μm, particles number, unit: pcs/L
P17	Data 7, high byte	
P18	Data 7, low byte	
P19	Data 7, low byte	
P20	Data 8, high byte	>2.5μm, particles number, unit: pcs/L
P21	Data 8, high byte	
P22	Data 8, low byte	
P23	Data 8, low byte	
P24	Data 9, high byte	>5.0μm, particles number, unit: pcs/L
P25	Data 9, high byte	
P26	Data 9, low byte	
P27	Data 9, low byte	
P28	Data 10, high byte	>10μm, particles number, unit: pcs/L
P29	Data 10, high byte	
P30	Data 10, low byte	
P31	Data 10, low byte	
P32	Data check code	Check code = (P1^P2^……^P31)

Accessories

Accessories PN	Picture	Description	Function
Gasboard-7500H-OPC		Ultrasonic Flow Meter	To measure air flow rate, measurement range is 0~5L/min

Package Information



Sensor per Tray	Tray Qty	Sensor per Carton	Carton Dimensions	Packing Material
9 pcs	7 layers	63 pcs	395*310*330 mm	Red anti-static EPE

After-Sales Services and Consultancy

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