PLANTOWER
攀 藤 科 技

Product Specification

Product Name:	Particulate Matter Sensor
Product Model	PMS5303
Specification No.:	PTQ3068-2020
Version:	V1.2

Writer	Verifier	Standardization	Approver
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➢ Main Characteristics

- ◆ Laser scattering principle Correct data
- ◆ Zero false alarm rate
- ◆ Real-time response
- ◆ Minimum distinguishable particle diameter :0.3 micrometer
- ◆ High anti-interference performance because of the structure of six sides shielding

➢ Overview

PMS5303 is a kind of digital and universal particle concentration sensor,which can be used to obtain the number of suspended particles in the air,i.e.the concentration of particles, and output them in the form of digital interface. This sensor can be inserted into variable instruments related to the concentration of suspended particles in the air or other environmental improvement equipments to provide correct concentration data in time.

➢ Working principle

Laser scattering principle is used for such sensor, i.e. produce scattering by using laser to radiate suspending particles in the air, then collect scattering light in a certain degree, and finally obtain the curve of scattering light change with time. In the end, equivalent particle diameter and the number of particles with different diameter per unit volume can be calculated by microprocessor based on MIE theory. Please find the functional diagram of each part of sensor from Figure 1 as follows.

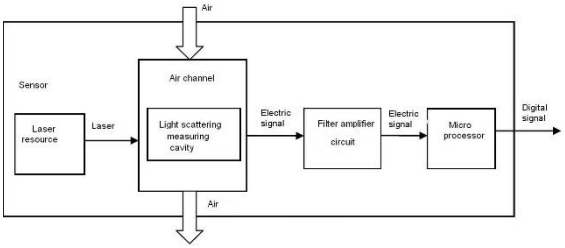


Figure 1 Functional block diagram of sensor

➢ Technical Index

Table 1 PMS5303 technical parameters

Parameter	Index
Particle Range of measurement	0.3～1.0μm; 1.0～2.5μm; 2.5～10μm
Particle Counting Efficiency	50%@0.3μm 98%@≥0.5μm
Particle Effective Range （PM2.5,PM10 standard）	0～500μg/m³
Particle Maximum Range （PM2.5 standard）*1	≥1000μg/m³
Particle Maximum Range （PM10 standard）	≥1500μg/m³
Particle Resolution	1μg/m³
Particle Maximum Consistency Error (PM2.5 standard data)*2	±10%@100～500μg/m³ ±10μg/m³@0～100μg/m³
Particle Maximum Consistency Error (PM10 standard data)	±15%@100～500μg/m³ ±15μg/m³@0～100μg/m³
Particle Standard Volume	0.1L
Single Response Time	<1s
Total Response Time	≤10s
DC Power Supply	Typ：5.0V Min:4.5V Max:5.5V
Active Current	≤100mA
Standby Current	≤2mA
Interface Level	L<0.8V @3.3V H>2.7V @3.3V
Working Temperature Range	-10 ～ +60℃
Working Humidity Range	0~95%(No condensation)
Storage Temperature Range	-40 ～ +85℃
Noise*3	≤29dB@0.05M
Fan Speed*4	4000~6000RPM
Fan Speed*5	4500~12000RPM
MTTF	≥5 Years
Physical Size	50mm×38mm×20.7mm

❖Note 1:Maximum range means that the highest output value of the PM2.5 standard data is not less than 1000.

❖Note 2: “PM2.5 standard data” is the “data2” in the appendix A.20℃,50%.

❖Note 3: Noise test conditions: the background noise is lower than 17dB and measured in indoor environment.

❖Note 4：Fan speed test conditions： 25℃.

❖Note 5：Fan speed test conditions： 70℃.

➢ PIN Definition

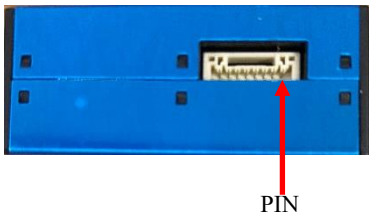


Figure 2 Connector Definition

Table 2 Digital interface pin definition

PIN1	**VCC**	Positive power 5V
PIN2	**GND**	Negative power
PIN3	**SET**	Set pin/TTL level @3.3V, high level or suspending is normal working status, while low level is sleeping mode.
PIN4	**RXD**	Serial port receiving pin/TTL level@3.3V
PIN5	**TXD**	Serial port sending pin/TTL level@3.3V
PIN6	**RESET**	Module reset signal/TTL level@3.3V, low reset
PIN7	**NC**	
PIN8	**NC**	

➢ Typical Circuit

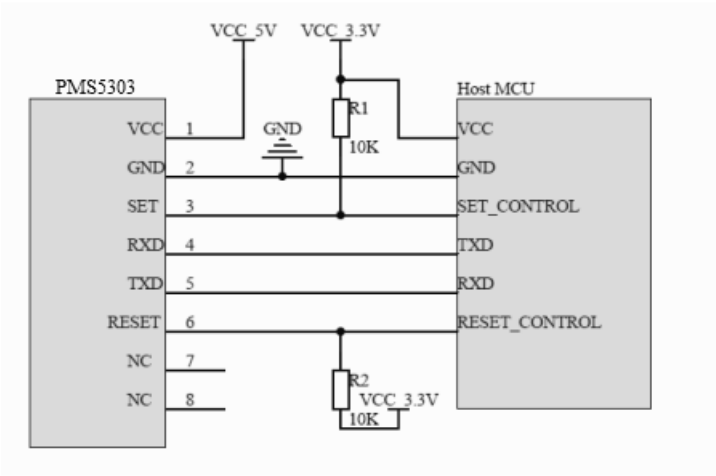


Figure 3 Typical Circuit

❖ **Circuit Attentions**

1) **DC 5V power supply is needed because the FAN should be driven by 5V. But the high level of data pin is 3.3V. Level conversion unit should be used if the power of host MCU is 5V.**
2) **The SET and RESET pins are pulled up inside so they should not be connected if without usage.**
3) **PIN7 and PIN8 should not be connected.**
4) **Stable data should be got at least 30 seconds after the sensor wakeup from the sleep mode because of the fan's performance.**

➢ Output Result

1. Mainly output as the quality and number of each particles with different size per unit volume, the unit volume of particle number is 0.1L and the unit of mass concentration is μg/m³.
2. There are two options for digital output: passive and active. Default mode is active after power up. In this mode sensor would send serial data to the host automatically. The active mode is divided into two sub-modes:stable mode and fast mode. If the concentration change is small the sensor would run at stable mode with the real interval of 2s.And if the change is big the sensor would be changed to fast mode automatically with the interval of 200~800ms, the higher of the concentration, the shorter of the interval.

➢ Typical Output Characteristic

PM2.5 Concentration (Data 2 in Appendix A)

❖ Definition of axis Y:unit μg/m³

❖ Definition of axis X:unit times

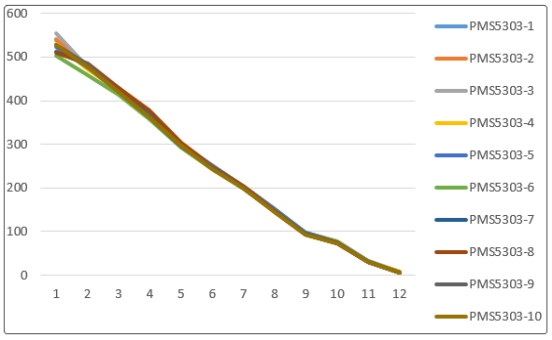


Figure 4-1 Consistency at 20℃

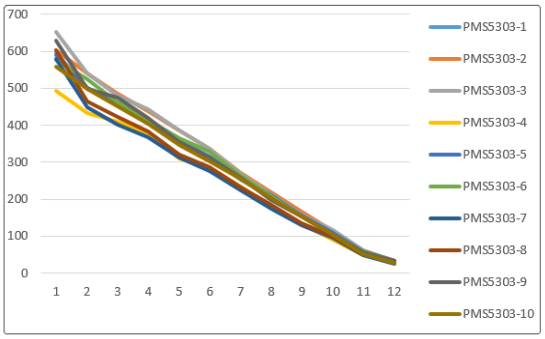


Figure 4-2 Consistency at 43℃

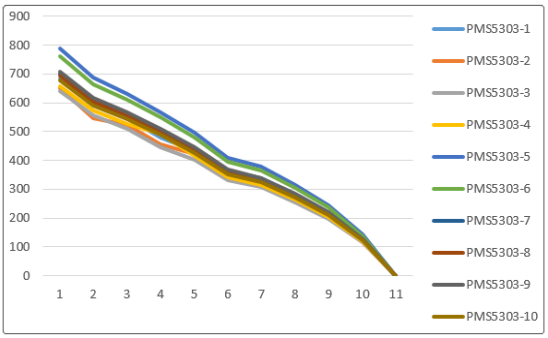


Figure 4-3 Consistency at -5℃

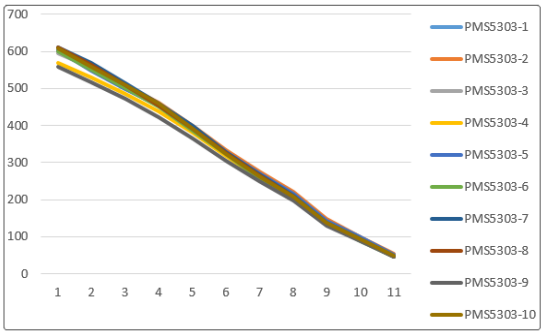


Figure 4-4 Consistency after 30 days running

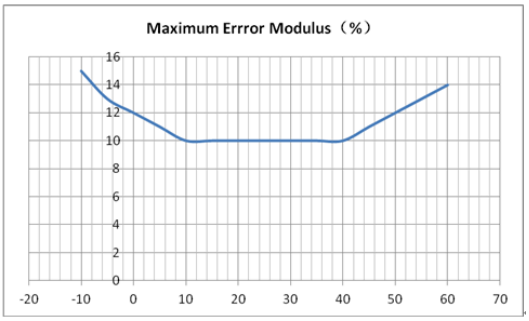


Figure 4-5 Consistency Vs Temperature

Endurance Characteristics

No.	Item	Test Method	Characteristics	Sample No.：N Defective：C
1	Long Running	30 m³ closed Lab,20~30℃，humidity 30%~70%，particle generator and air cleaner Check consistency after 720 hours' running	10 samples during 0~500μg/m³ 1) 0~100μg/m³ Maximum Error≤±10μg/m³ 2)100~500μ g/m³ Maximum Error≤±10%; 3)FAN does not screeched	N=10，C=0
2	Vibration	1. DC 5V power supply and check consistency 2. Frequency：50Hz。 3. acceleration：9.8/ S²。 4. Direction：X、Y、Z 5. Vibration Amplitude：±2mm。 6. Time：X、Y、Z –way, Per 1 hour		N=5，C=0
3	High Temperature Operation	At 70℃, the sensor works continuously for 72 hours, and then returns to the normal temperature25±5℃ for 2 hours		N=10，C=0
4	Low Temperature Operation	At -10℃, the sensor works continuously for 72 hours, and then returns to the normal temperature25±5℃ for 2hours		N=10，C=0
5	High Concentration Environmental Test	In the 3m³closed laboratory chamber, PM2.5 concentration remained stable above 1000ug, and the consistency was detected after the sensor was placed in the laboratory chamber for 240 hours		N=10，C=0
6	High Temperature and Humidity Storage	60℃±2℃,humidity 90%~95% , storage 48 hours, Check consistency after 2hours' room temperature25±5℃ storage		N=10，C=0
7	Low Temperature Storage	-20℃±2℃, storage 72 hours, Check consistency after 2 hours room temperature25±5℃ storage		N=10，C=0
8	Variation of Power Supply	30m³closed Lab, 20～30℃, humidity 40%~60%, particle generator and air cleaner Power varies as the cycles of 4.5V to 5.5V ,then 5.5V to 4.5V with the pace of 0.1V/min for 2 hours. Check consistency during Variation		N=5，C=0
9	Power On-Off Cycle	DC 5V power supply，keep On-Off frequency 0.5Hz for 72 hours and check consistency		N=10，C=0
10	Laser On-Off Cycle	keep laser On-Off frequency 100Hz for 240 hours and check consistency	Laser and sensor work normally.	N=10，C=0
11	Salt Spray	5% industrial salt water, the pH value was 6.5-7.2, The salt spray settlement is 1-2ml (collected by 80cm square funnel), at 35℃Continuous spray for 96h and then washed with pure water and blown away the water droplets , placed at room temperature for 1h for inspection and determination .	No red rust, white spots, rust spots and other corrosion area is less than 0.5%.	N=2，C=0
12	Shell shielding	Switch the multimeter to the resistance, and the two meter tips are placed on the shielding housing on both sides of the sensor	The shielding shells on both sides shall be connected	N=10，C=0
13	The zeroTest	30m3 closed Lab,20~30℃，humidity 40%~60%, air cleaner to 0ug/m3 DC 5V power supply and check consistency	PM2.5 value less than 3ug/m3	N=10，C=0

➢ Part Number Definition

PMS 53 03

- 03 — Min distinguishable 0.3μm
- 53 — Version code
- PMS — Sensor type：PMS- Particulate Matter Sensor

➢ Physical Size

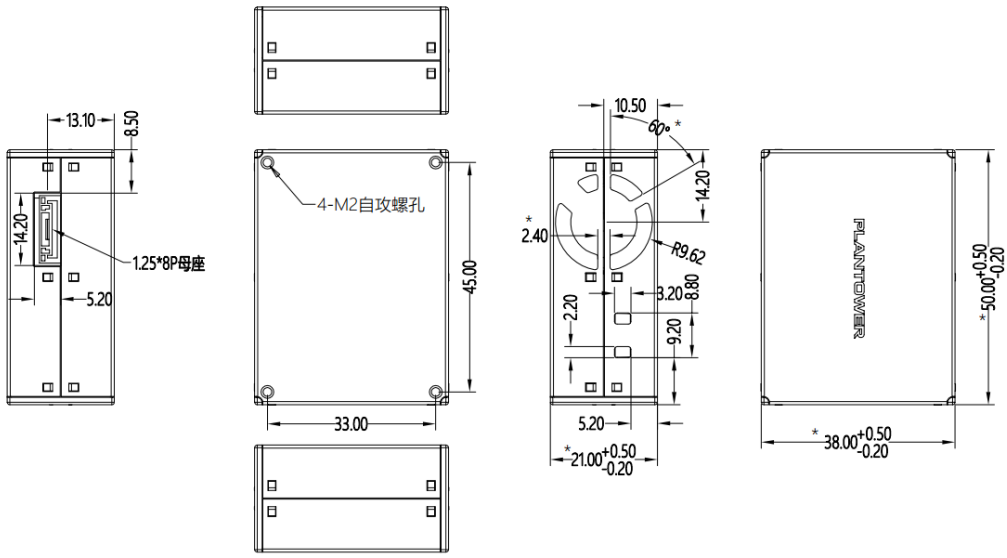
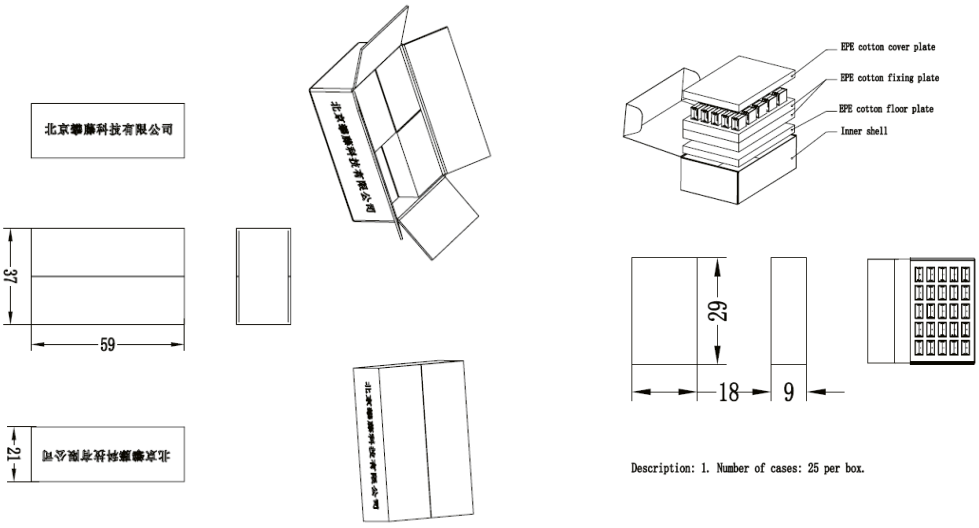


Figure 5 Physical size(Unit:mm)

➢ Packaging Information



- **Installation Attentions**

a) Metal shell is connected to the GND so be careful not to let it shorted with the other parts of circuit except GND.

b) The best way of install is making the plane of inlet and outlet closely to the plane of the host. Or some shield should be placed between inlet and outlet in order to prevent the air flow from inner loop.

c) The blowhole in the shell of the host should not be smaller than the inlet.

d) The sensor should not be installed in the air flow way of the air cleaner or should be shielded by some structure.

e) The sensor should be installed at least 20cm higher than the grand in order to prevent it from blocking by the flock dust.

f) When the sensor is used to outdoor fixed equipment, the equipment should be completed for the protection of sandstorm,rain,snow,etc.

g) Do not break up the sensor.

- **Other Attentions**

a) Only the consistency of all the PM sensors of PLANTOWER is promised and ensured. And the sensor should not be checked with any third party equipment.

b) The sensor is usually used in the common indoor environment. So some protection must be added if using in the conditions as followed:

i. The time of concentration ≥300μg/m³ is longer than 50% of the whole year or concentration≥500μg/m³ is longer than20% of the whole year.

ii. Kitchen

iii. Water mist condition such as bathroom or hot spring.

iv. Outdoor

Appendix A：Active Transport Protocol

Baud Rate: 9600 bit/s Data Bits:8 Parity:None Stop Bit:1

Total protocol length:32 byte

Definition	Note	
Start character 1	0x42	
Start character 2	0x4d	
Frame length high 8 bits	……	Frame length=2x13+2(data+check bytes)
Frame length low 8 bits	……	
Data 1 high 8 bits	……	Data 1 refers to PM1.0 concentration unit μg/m3（CF=1，standard particle）*
Data 1 low 8 bits	……	
Data 2 high 8 bits	……	Data 2 refers to PM2.5 concentration unit μg/m3（CF=1，standard particle）
Data 2 low 8 bits	……	
Data 3 high 8 bits	……	Data 3 refers to PM10 concentration unit μg/m3（CF=1，standard particle）
Data 3 low 8 bits	……	
Data 4 high 8 bits	……	Data 4 refers to PM1.0 concentration unit μg/m3（under atmospheric environment）
Data 4 low 8 bits	……	
Data 5 high 8 bits	……	Data 5 refers to PM2.5 concentration unit μg/m3（under atmospheric environment）
Data 5 low 8 bits	……	
Data 6 high 8 bits	……	Data 6 refers to PM10 concentration unit μg/m3 (under atmospheric environment)
Data 6 low 8 bits	……	
Data 7 high 8 bits	……	Data 7 indicates the number of particles with diameter beyond 0.3 um in 0.1 L of air.
Data 7 low 8 bits	……	
Data 8 high 8 bits	……	Data 8 indicates the number of particles with diameter beyond 0.5 um in 0.1 L of air.
Data 8 low 8 bits	……	
Data 9 high 8 bits	……	Data 9 indicates the number of particles with diameter beyond 1.0 um in 0.1 L of air.
Data 9 low 8 bits	……	
Data 10 high 8 bits	……	Data 10 indicates the number of particles with diameter beyond 2.5 um in 0.1 L of air.
Data 10 low 8 bits	……	
Data 11 high 8 bits	……	Data 11 indicates the number of particles with diameter beyond 5 um in 0.1 L of air.
Data 11 low 8 bits	……	
Data 12 high 8 bits	……	Data 12 indicates the number of particles with diameter beyond 10 um in 0.1 L of air.
Data 12 low 8 bits	……	
Data 13 high 8 bits	……	Version
Data 13 low 8 bits	……	error code
Data and check high 8 bits	……	Check code=Start character 1+ Start character 2+……..+data 13 low 8 bits
Data and check low 8 bits	……	

❖ Note1: CF=1 should be used in the factory environment

Appendix B：Passive Transport Protocol

Baud Rate: 9600 bit/s Data Bits:8 Parity:None Stop Bit:1

1. Host protocol

Start Byte 1	Start Byte 2	Command	Data 1	Data 2	Verify Byte 1	Verify Byte 2
0x42	0x4d	CMD	DATAH	DATAL	LRCH	LRCL

2. Command Definition

CMD	DATAH	DATAL	Note
0xe2	X	X	Read in passive mode
0xe1	X	00H-passive,01H-active	Change mode
0xe4	X	00H-sleep,01H-wakeup	Sleep set

3. Answer

a) 0xe2: 32bytes , same as appendix A

b) 0xe1:

Start Byte 1	Start Byte 2	Frame length1	Frame length2	Command	Data	Verify Byte 1	Verify Byte 2
0x42	0x4d	0x00	0x04	0xe1	work	LRCH	LRCL

c) 0xe4:

Start Byte 1	Start Byte 2	Frame length1	Frame length2	Command	Data	Verify Byte 1	Verify Byte 2
0x42	0x4d	0x00	0x04	0xe4	sleep	LRCH	LRCL

4. Verify Bytes:

Add of all the bytes except verify bytes.

Modification History Form

Version	Date	Page	Item	Modification Content
1.0	2020/4/20	--	Newly-built	--
1.1	2020/12/8	2	Technique Index	Add Fan speed range
		6	Physical Size	Update Physical Size picture
1.2	2021/7/6	3	Pin Definition	Update Pin Definition picture
			Typical Circuit	Update Typical Circuit
		6	Packaging Information	Add Packaging Information