PLANTOWER
攀 藤 科 技

Product Specification

Product：	**Particulate Matter Sensor**
Product model：	PMS3003P
Specification No.：	PTQ3063-2015
Version：	V1.0

Writer	Verifier	Standardization	Approver
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Catalogue

Log Page

Version	Note	Date	Writer
V1.0	Newly-built	2021.1.26	

1. Main characteristics

- Zero false alarm rate
- Real-time response
- Correct data
- Minimum distinguishable particle diameter :0.3 micrometer

2. Overview

PMS3003P 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.

3. 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.

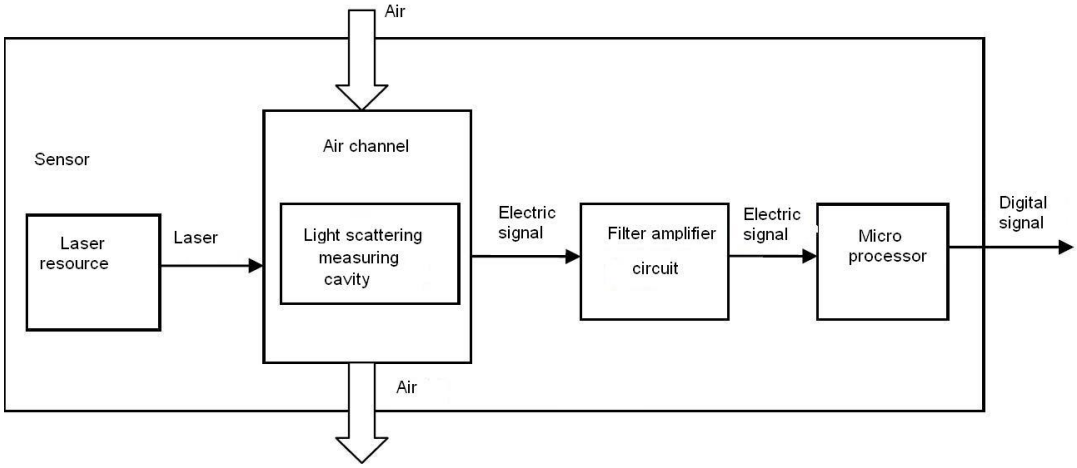


Figure 1 Functional block diagram of sensor

4. Technical Index

Parameter	Index	unit
Particle Range of measurement	0.3~1.0；1.0~2.5；2.5~10	Micrometer（μm）
Particle Counting Efficiency	50%@0.3μm 98%@>=0.5μm	
Particle Effective Range（PM2.5 standard）	0~1000	μg/m³
Particle Maximum Range（PM2.5 standard）*1	≥1000	μg/m³
Particle Resolution	1	μg/m³
Particle Maximum Consistency Error (PM2.5 standard data)	±10%@100~500μg/m³ ±10μg/m³@0~100μg/m³	
Particle Standard Volume	0.1	Litre（L）
Single Response Time	<1	Second（s）
Total Response Time	<10	Second（s）
DC Power Supply	Typ:5.0 Min:4.5 Max:5.5	Volt（V）
Active Current	≤100	Milliampere（mA）

Standby Current	≤2	Milliampere（mA）
Interface Level	L <0.8 @3.3 H >2.7@3.3	Volt（V）
Working Temperature Range	-10~+60	℃
Working Humidity Range	0~95%RH(no-condensing)	
Storage Temperature Range	-40~+85	℃
MTTF	≥5	Year
Physical Size	50×43×21	Millimeter（mm）

❖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%.

5. 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.

3） PWM output:PWM cycle is 1 second, and low level of time represents PM2.5 concentration (atmospheric encironment),each 1ms low level represents 1ug/m3.

For example, the low level time length is 210ms, means PM2.5 mass concentration(atmospheric environment) is 210ug/m3.

6. Pin Definition

Figure 2 Connector Definition

Pin number	Pin name	Description
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	PWM	PWM output

7. Typical Circuit

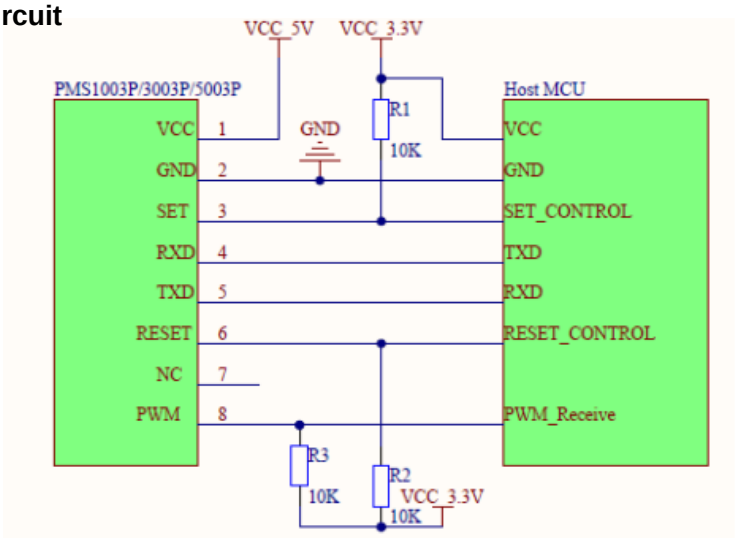


Figure 3 Typical circuit sensor

❖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 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.

8. Typical Output Characteristic

Definition of axis Y: PM2.5 concentration, unit: μg/m³

Definition of axis X: number of samples, unit: time

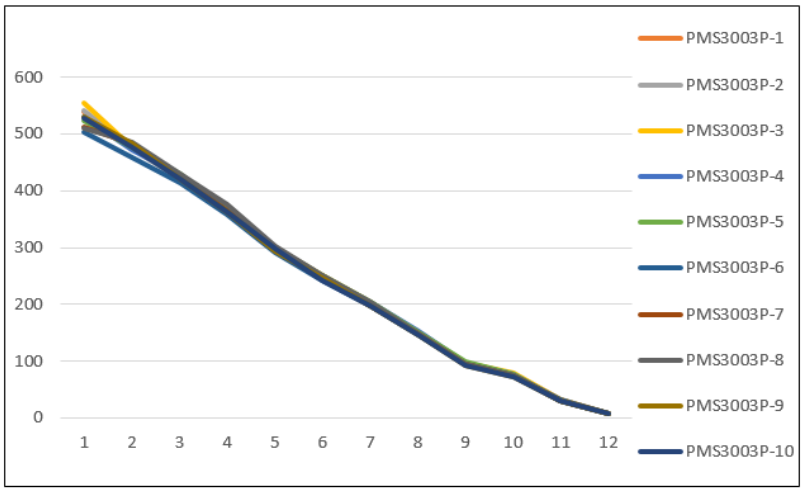


Figure 4-1 Consistency at 20℃

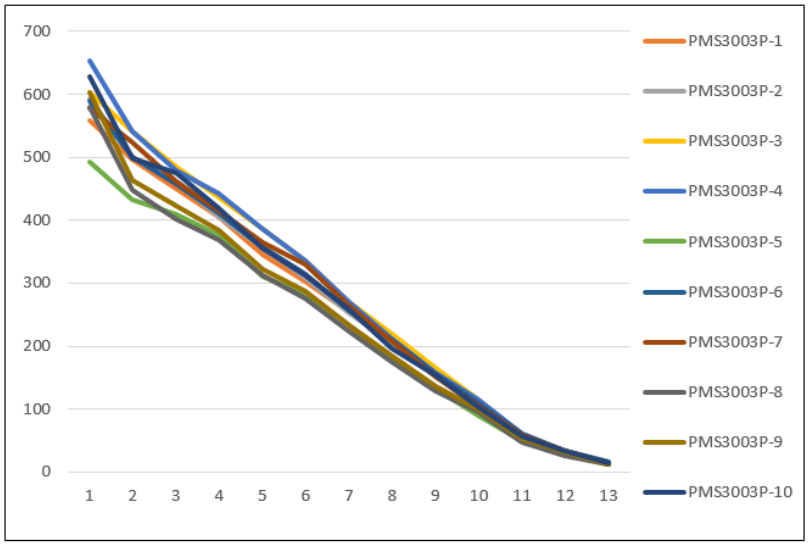


Figure 4-2 Consistency at 43℃

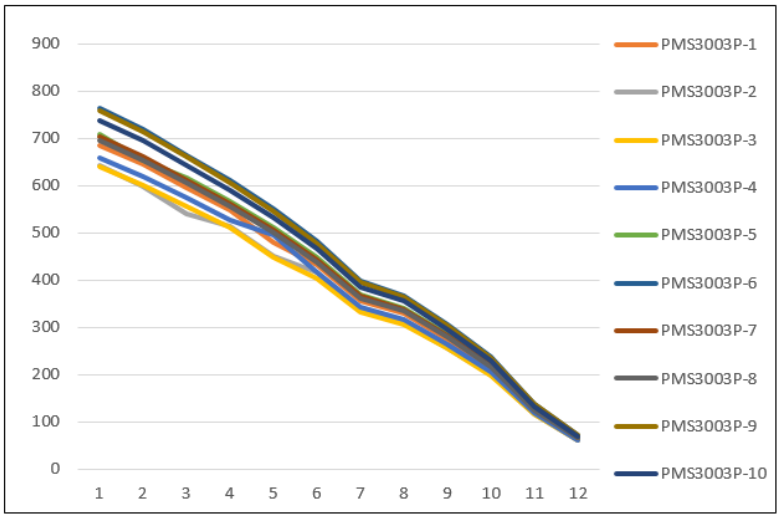


Figure 4-3 Consistency at -5℃

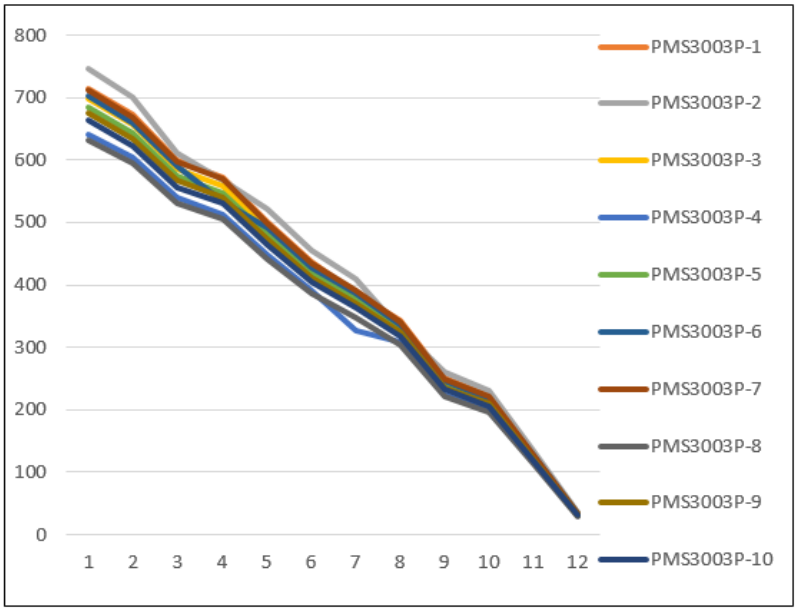


Figure 4-4 Consistency after 30 days running

Relationship of Temperature and Consistency

Definition of axis Y: Maximum Error Modulus(%)

Definition of axis X: Temperature(℃)

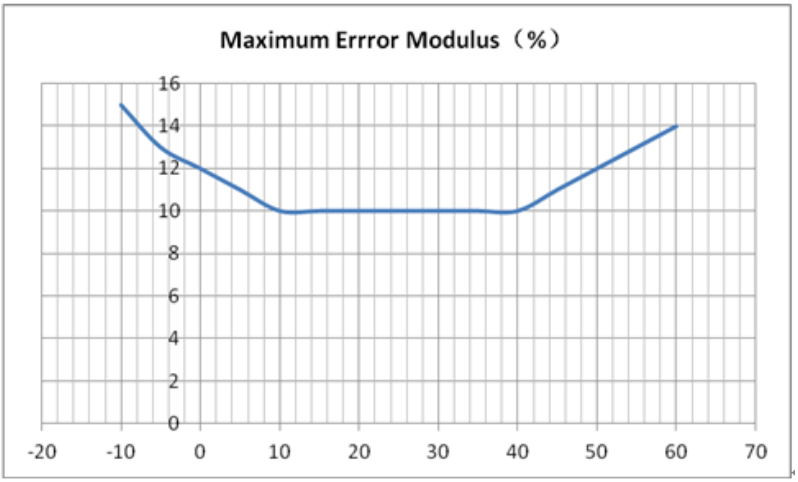


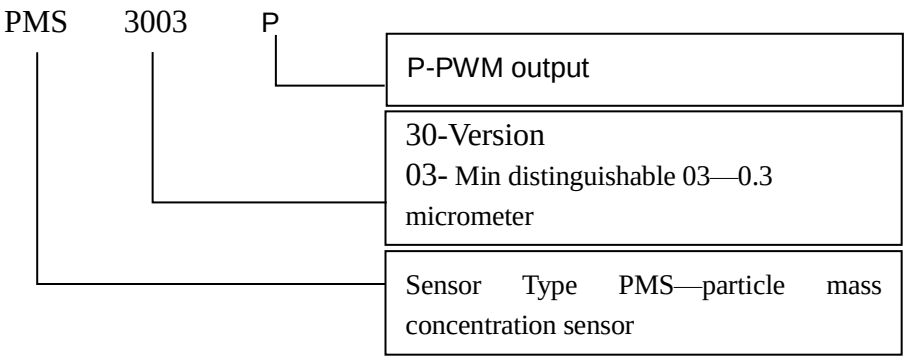
Figure 4-5 Consistency Vs Temperature

9. Endurance Characteristics

No	Item	Test Method	Characteristics	NC
1	Long Running	1. 30 m³ closed Lab,, 20~30℃, humidity 30%~70%, particle generator and air cleaner 2. DC 5V power supply 3. Check consistency after 720 hours' running	10 samples during 0~500μg/m³ 1. 0~100μg/m³ Maximum Error≤±15μg/m³	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	2. 100~500μg/m³ Maximum Error≤±15% 3. FAN does not screeched	N=5 C=0
3	High Temperature Operation	At 60℃, the sensor works continuously for 72 hours, and then returns to the normal temperature for 24 hours		N=10 C=0
4	Low Temperature Operation	At -10℃, the sensor works continuously for 72 hours, and then returns to the normal temperature for 24 hours		N=10 C=0
5	High Concentration Environmental Test	In the 3m³ closed 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	80℃±2℃,humidity 90%~95% , storage 100 hours, Check consistency after 24 hours' room temperature storage		N=10 C=0
7	Low Temperature Storage	-30℃±2℃, storage 100 hours, Check consistency after 24 hours' room temperature storage		N=10 C=0
8	Variation of Power Supply	1. 30m³ closed Lab, 20～30℃, humidity 40%~60%, particle		N=5 C=0

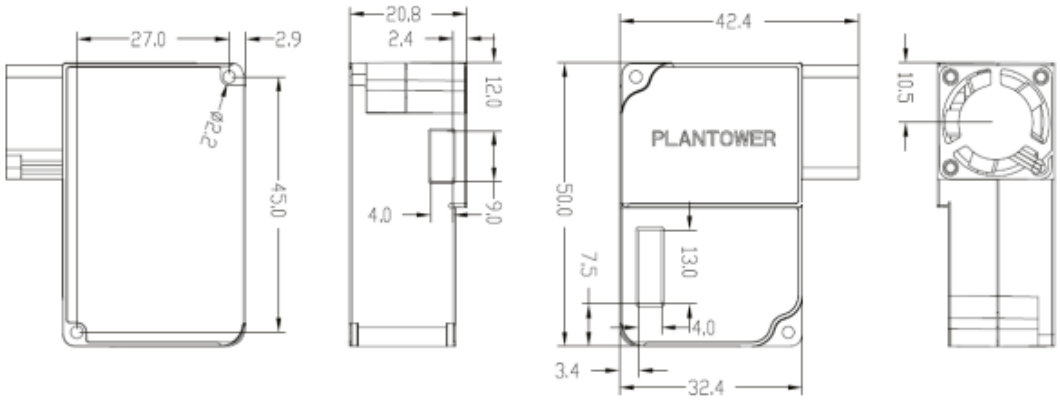
		generator and air cleaner 2. Power varies as the cycles of 4.5V to 5.5V ,then 5.5V to 4.5V with the pace of 0.1V/min for 2 hours. 3. Check consistency during Variation		
9	Power On-Off Cycle	DC 5V power supply，keep On-Off frequency 0.5Hz for 72 hours and check consistency		N=10 C=0
10	Laser On-Off Cycle	keep laser On-Off frequency 100Hz for 240 hours and check consistency		N=10 C=0
11	Salt Spray	5% industrial salt water, 35℃, Continuous spray for 8h and then dry for 16h. The salt spray settlement is 1-2ml (collected by 80cm square funnel).	No rust and discoloration of metal parts; consistency normal.	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	1. 30m^3 closed Lab,20~30℃，humidity 30%~70%, air cleaner to 0ug/m3 2. DC 4V power supply and check consistency	PM2.5 value less than 3ug/m3	N=10 C=0

10. Part Number Definition



11. Technical Drawings

Pysical size:(Unit:mm)



12. Attentions

12.1 Installation Attentions

1) Metal shell is connected to the GND so be careful not to let it shorted with the other parts of circuit except GND.
2) 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.
3) The blowhole in the shell of the host should not be smaller than the inlet.
4) The sensor should not be installed in the air flow way of the air cleaner or should be shielded by some structure.
5) The sensor should be installed at least 20cm higher than the grand in order to prevent it from blocking by the flock dust.
6) When the sensor is used to outdoor fixed equipment, the equipment should be completed for the protection of sandstorm,rain,snow,etc.
7) Do not break up the sensor.

12.2 Other Attentions

1) 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.

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

   a) 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.

   b) Kitchen

   c) Water mist condition such as bathroom or hot spring.

   d) Outdoor

13. UART Protocol

The following UART settings have to be used:

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

13.1 UART Function Description

The Universal Asynchronous Receiver/Transmitter (UART) protocol is an asynchronous serial interface. The UART transmit and receive interfaces consists of 2 signals:

TX – Transmitter
RX – Receiver

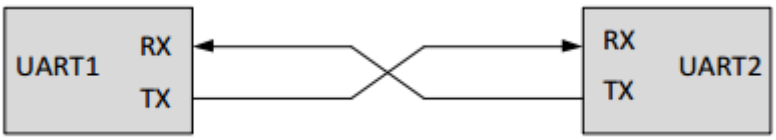


Figure 5 UART module

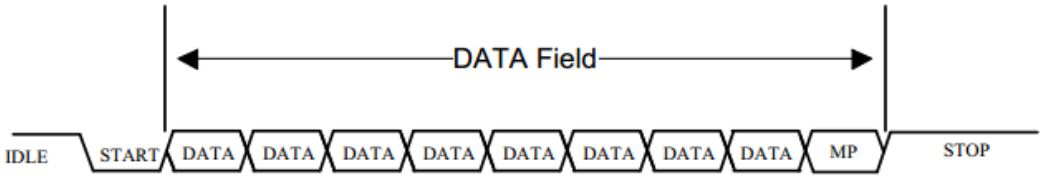


Figure 6 Transmitted byte

13.2 UART Commands

Start Byte 1	Start Byte 2	Command	Data 1	Data 2	Verify Byte 1	Verify Byte 2
0x42	0x4D	CMD	DATAH	DATAL	LRCH	LRCL

CMD	DATAH	DATAL	Note
0xE1	X	0x00-passive 0x01-active	Change mode
0xE2	X	X	Read in passive mode
0xE4	X	0x00H-sleep 0x01H-wakeup	Sleep set
0x52	X	0x01-default 0x02-TSI CF=0.38 0x03-TSI CF=1	Set data standards

13.2.1 Change work mode:0xE1

Answer protocal

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

Change passive mode

Host	0x42 0x4D 0xE1 0x00 0x00 0x01 0x70
Device	0x42 0x4D 0x00 0x04 0xE1 0x00 0x01 0x74

Change active mode

Host	0x42 0x4D 0xE1 0x00 0x01 0x01 0x71
Device	0x42 0x4D 0x00 0x04 0xE1 0x01 0x01 0x75

13.2.2 Adjust fan speed:0xE2

Passive mode reading(Invalid in active mode)

Host	0x42 0x4D 0xE2 0x00 0x00 0x01 0x71
Device	32 byte data

13.2.3 Change sleep/work mode:0xE4

Answer protocal

Start Byte 1	Start Byte 2	Frame length1	Frame length2	Command	Data	Verify Byte 1	Verify Byte 2
0x42	0x4d	0x00	0x04	0xE4	work	LRCH	LRCL

Change sleep mode

Host	0x42 0x4D 0xE4 0x00 0x00 0x01 0x73
Device	0x42 0x4D 0x00 0x04 0xE4 0x00 0x01 0x77

Change work mode

Host	0x42 0x4D 0xE4 0x00 0x01 0x01 0x74
Device	0x42 0x4D 0x00 0x04 0xE4 0x01 0x01 0x78

13.2.4 Set data standards:0x52

Answer protocal

Start Byte 1	Start Byte 2	Frame length1	Frame length2	Command	Data	Verify Byte 1	Verify Byte 2
0x42	0x4d	0x00	0x04	0x52	standard	LRCH	LRCL

Change original standard

Host	0x42 0x4D 0x52 0x00 0x01 0x00 0xE2
Device	0x42 0x4D 0x00 0x04 0x52 0x01 0x00 0xE6

Change TSI standard(CF=0.38)

Host	0x42 0x4D 0x52 0x00 0x02 0x00 0xE3
Device	0x42 0x4D 0x00 0x04 0x52 0x02 0x00 0xE7

Change TSI standard(CF=1)

Host	0x42 0x4D 0x52 0x00 0x03 0x00 0xE4
Device	0x42 0x4D 0x00 0x04 0x52 0x03 0x00 0xE8

13.2.5 Active mode protocol

Start character 1	0x42 (Fixed)	
Start character2	0x4d (Fixed)	
Frame length high 8 bits	……	Frame length=2x9+2(data+check bytes)
Frame length low 8 bits	……	
Data 1 high 8 bits	……	Data1 refers to PM1.0 concentration unit μg/m3（CF=1，standard particle）*
Data 1 low 8 bits	……	
Data2 high 8 bits	……	Data2 refers to PM2.5 concentration unit μg/m3

Data2 low 8 bits	……	（CF=1，standard particle）
Data3 high 8 bits	……	Data3 refers to PM10 concentration unit μg/m3（CF=1，standard particle）
Data3 low 8 bits	……	
Data4 high 8 bits	……	Data4 refers to PM1.0 concentration unit *μg/m3（under atmospheric environment）
Data4 low 8 bits	……	
Data5 high 8 bits	……	Data 5 refers to PM2.5 concentration unit μg/m3（under atmospheric environment）
Data5 low 8 bits	……	
Data6 high 8 bits	…….	Data 6 refers to PM10 concentration unit μg/m3 (under atmospheric environment)
Data6 low 8 bits	……	
Data7 high 8 bits	……	Reserve
Data7 low 8 bits	……	
Data8 high 8 bits	……	Reserve
Data8 low 8 bits	……	
Data9 high 8 bits	……	Version
Data9 low 8 bits	……	error code
Data and check high 8 bits	……	Check code=Start character1+ Start character 2+……..+data9 low 8 bits
Data and check low 8 bits	……	

❖Note: Error code

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
X	X	X	X	Fan	X	Fan	Fan

Fan: If the fan error these bit would be set 1.Normal would be set 0.

Eg: 0x42 0x4D 0x00 0X1C 0x00 0x5C 0x00 0x86 0x00 0xAE 0x00 0x42 0x00 0x60 0x00 0x86 0x0F 0xC6 0x04 0x1E 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x00 0x97 0x0A 0x04 0xFB

Error code : 0AH=0000 1010 Fan error

04FBH=42H+4DH+00H+1CH+00H+5CH+00H+86H+00H+AEH+00H+42H+00H+60H+00H+86H+0FH+C6H+04H+1EH+00H+00H+00H+00h+00H+00H+00H+00H+97H+0A

13.2.6 Sample code

```
uint8 check_package(uint8 *buffer,uint16 size)
{
  uint16 i,sum=0;
  if(buffer[0]!=0x42 ||buffer[1]!=0x4D)return 0;
  for(i=0;i<(size-2);i++)
  {          sum+=buffer[i];
  }
  if(sum!=(buffer[size-2]*256+buffer[size-1]))
  {
      return 0;
  }
  return 1;
}

// PM2.5 data
uint16 readPM2_5(void)
{
  uint8 txBuffer[7]={0x42,0x4D,0xE2,0x00,0x00,0x01,0x71};
  //passive mode reading
  UARTx_SendData(&senserUART,txBuffer,7);
  //wait data
  while(flag_package==0);
  flag_package=0;
  //check LRC
  if(check_package(rxBuffer，rxNum))
  {
      return buffer[12]*256+buffer[13];
  }else{
      return 0;
  }
}
```