HM-3300/3600 Dust Sensor
Data Sheet

Version Number	**V2.1**
Prepared by	
Audit	
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Shenzhen *** Co., Ltd**

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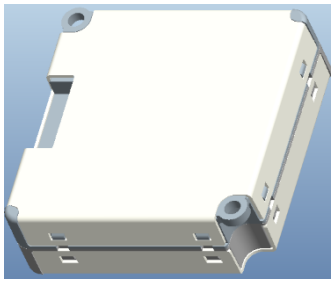
1. Overview

HM-3300/3600 is a new generation of laser dust detection sensor developed by our company, used for continuous and real-time detection of dust in the air.

Different from the pumping dust detection sensor, the HM-3300/3600 innovatively uses fan blades to drive air, and the air flowing through the detection chamber is used as a test sample to perform real-time and continuous test on dust of different particle sizes in the air.

HM-3300/3600 is suitable for dust detectors, intelligent air purifiers, intelligent air conditioners, intelligent ventilation fans, air quality testing, haze meters, environmental monitoring and relative products and applications.



2. Features and advantages

•Following standards of ISO 21501-4, ISO 14644-1 and FS209E.

• High sensitivity on dust particles of 0.3 μm or greater.

• Supports six-channel output of 0.3μm, 0.5μm, 1.0μm, 2.5μm, 5μm, 10μm.

• Directly output PM2.5, PM10 mass concentration with unit of μg/m3.

• Real-time & continuous detection of dust concentration in the air.

• Based on laser light scattering technology, readings are accurate, stable, and consistent.

• With humidity compensation, scalable for temperature and humidity sensor

• Ultra-low power consumption. Power consumption is less than 150uA in sleep mode, and less than 75mA during operation.

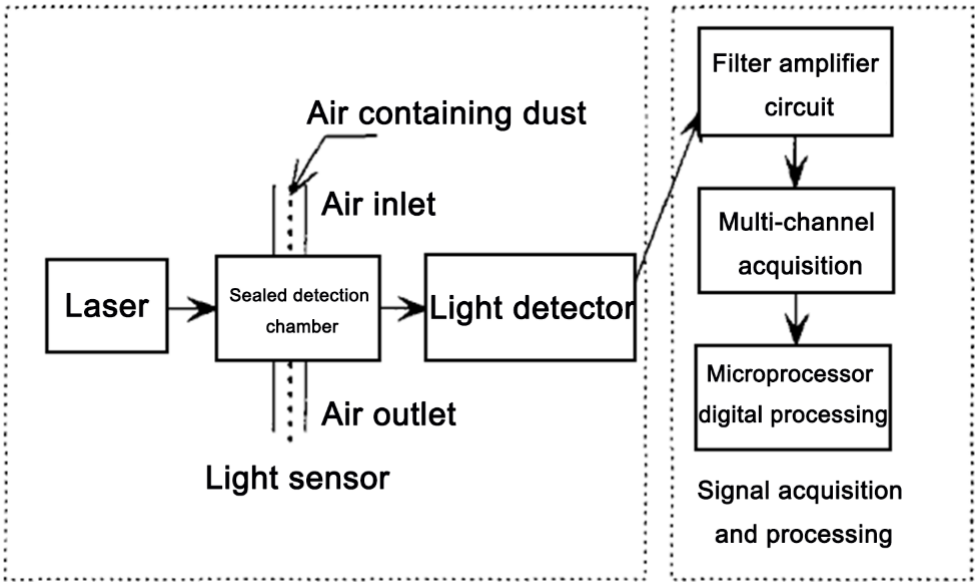
• Supports Communication modes of I2C and Uart interfaces for convenient secondary development and system integration.

• Low noise level, small size, light weight and easy installation.

3. Working principle

The HM-3300/3600 Dust Sensor is based on the advanced Mie scattering theory. When light passes through particles with quantity same as or larger than wavelength of the light, it will produce light scattering. The scattered light is concentrated to a highly sensitive photodiode, which is then amplified and analyzed by a circuit. With specific mathematical model and algorithm, the count concentration and mass concentration of the dust particles is obtained.

The HM-3300/3600 dust sensor is composed of main components such as a fan, an infrared laser source, a condensing mirror, a photosensitive tube, a signal amplifying circuit and a signal sorting circuit.



HM-3300/3600 Sensor structure diagram

4. Application field

The HM-3300/3600 can be used for cleanliness testing in clean room and performance testing of air purifiers and filter media to provide accurate dust particle mass concentration data, rather than vague grade data. It can be widely used in particle detection instruments, smart home appliances, indoor and outdoor air detection, clean room evaluation, etc.

Applications include but are not limited to the following products:

- Air purifier / air conditioner, etc.
- Air quality testing equipment
- Industrial PM value analysis
- Dust and smoke detection and analysis
- Real-time PM2.5, PM10, TSP detector
- Multichannel particle counter
- Environmental testing equipment

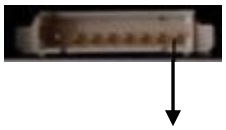
5. Technical Parameters

Item	Technical Parameters
Sensor Technology	Laser light scattering, electron cutting and particle counting
Range (PM2.5 standard value)	1~500μg/ m^3（ Effective range ）, 1000 μg/ m^3（Maximum range）
Particle size	Up to 6 channels：0.3μm、0.5μm、1.0μm、2.5μm、5μm、10μm
Output value	PM2.5, PM10, TSP Concentration（μg/ m^3）, Number of particles (one / 0.1L)
Resolution	Concentration: 1μg/ m^3, Counting concentration: 1s/0.1L
Consistency	0~100ug/ m^3: ±10ug/ m^3@25°，50%RH 100~500ug/ m^3: ±10% @25°，50%RH
stability time	30 seconds after power-on
Sensitivity	Refresh data once every 1 second
Supply voltage	DC5V±3%
Operating current	Average operating current <75mA, Peak current <120mA
Communication Interface	UART, I^2C optional (depending on model)
Conditions of Use	-10～60℃，10%～90％RH (non-condensing)

Life	Not less than 2 years @ indoor environment use
Follow the standard	ISO 14644-1, FS209E standard
Dimension	40（L）×38（W）×15（H）mm

6. Pin definition

The hardware interface of HM-3300/3600 adopts 1.25T-8P connector, which supports UART and IIC communication protocol, which is convenient for product development.

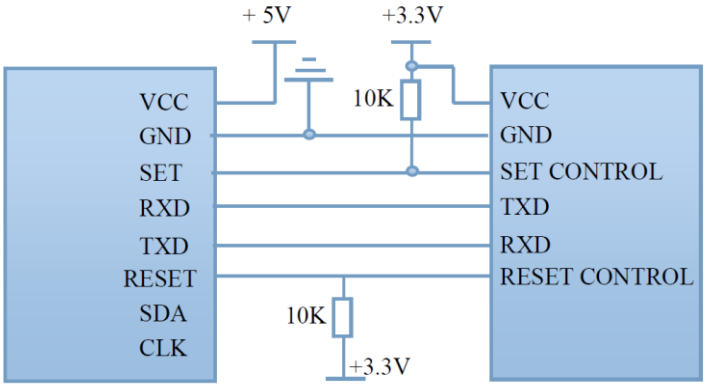


PIN1

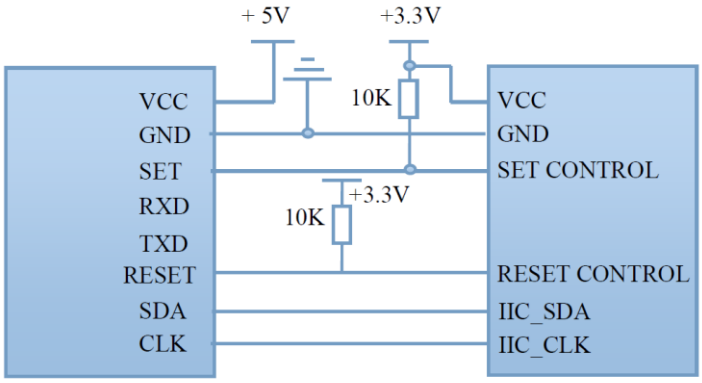
Pin number	Definition	Description
1	VCC	Power supply，DC5V
2	GND	Power ground
3	SET	Set the pin/TTL level @3.3V, high or floating for normal operation mode, low level for sleep mode
4	RXD	Serial Receiver Pin / TTL Level @3.3V
5	TXD	Serial port transmit pin / TTL level @3.3V
6	RESET	Module reset signal / TTL level @3.3V, low reset
7	IIC_SDA	IIC data signal level @3.3V
8	IIC_SCL	IIC clock signal level @3.3V

Please refer to the appendix of the manual for the communication protocol of HM-3300/3600.

The following is a typical circuit when the HM-3300/3600 uses UART communication:



The following is a typical circuit when the HM-3300/3600 uses IIC communication:



Please pay attention to below points when designing circuit:

1） The HM-3300/3600 is powered by DC 5V, but the communication level of other data communication and control pins is 3.3V.

2） There is a pull-up resistor inside SET and RESET, if it is not used, it should be left floating.

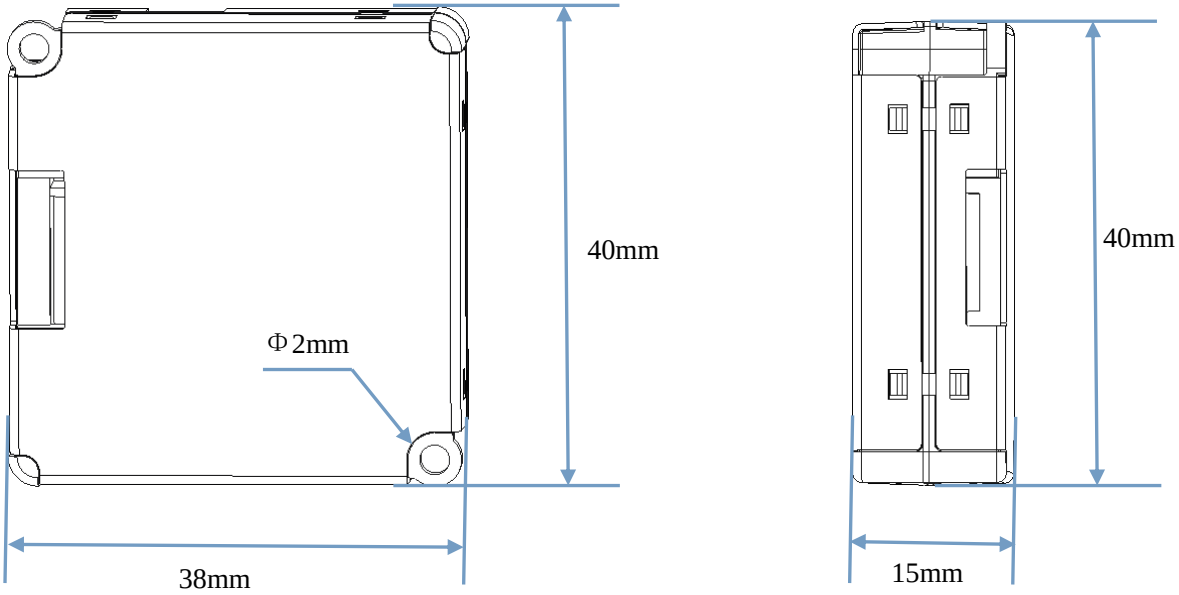
3）It is forbidden to use both UART and IIC interfaces.

4）When using IIC communication, the clock frequency is 100kHZ to 400kHZ.

5）In sleep mode, the fan stops working. It takes at least 30 seconds for stabilize when restart the fan. To obtain accurate measurement data, it is recommended that the sensor work time should not be less than 30 seconds after wake-up.

7. Installation and precautions

Dimension:



Precautions:

1) The sensor metal case is electrically connected to the internal power ground. Do not short-circuit it with other external boards or product covers.

2) The best installation method is: the air inlet and the air outlet are stayed close to the air hole of the inner wall of the product and the outside. If it is not possible, ensure no obstruction near the air outlet. It is recommended that there is a structure between the air inlet and the air outlet to isolate the airflow. 3) The vent hole opened on the inner wall of the user product for the air inlet should not be smaller than the size of the air inlet.

4) When applied to purifiers, try to avoid placing the sensor directly in the purifier's own air duct. If it is unavoidable, set up a separate structural space, and place the sensor in it to isolate it from the purifier's own air duct.

5) When applied to purifiers or fixed detection equipment, the sensor position should be more than 20cm above the ground. Otherwise, it may be contaminated by

large dust particles or even flocs near the ground, causing the fan to wrap.

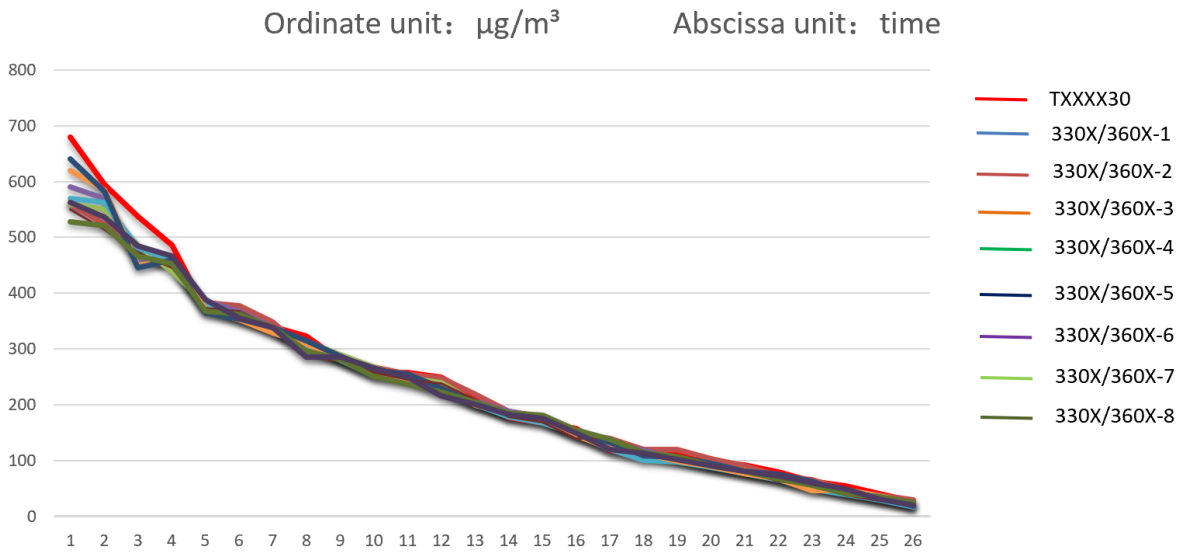
6）When the sensor is applied outdoors, the protection against dust storms, rain and snow, and the willow floc should be completed by the product.

7）The sensor is a precision device, please do not disassemble it, otherwise sensor might be damaged.

8）The bottom of the sensor is designed with two positioning holes, which are fixed with M2.5 screws.

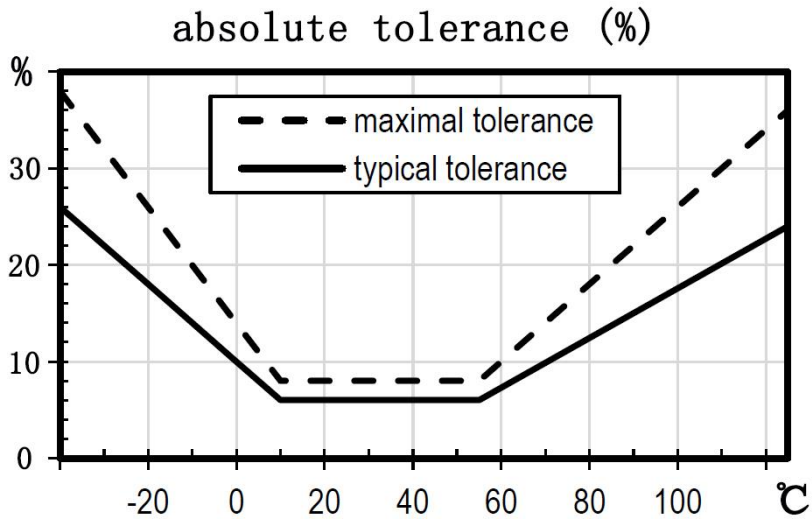
8. Testing data

1）Consistency test



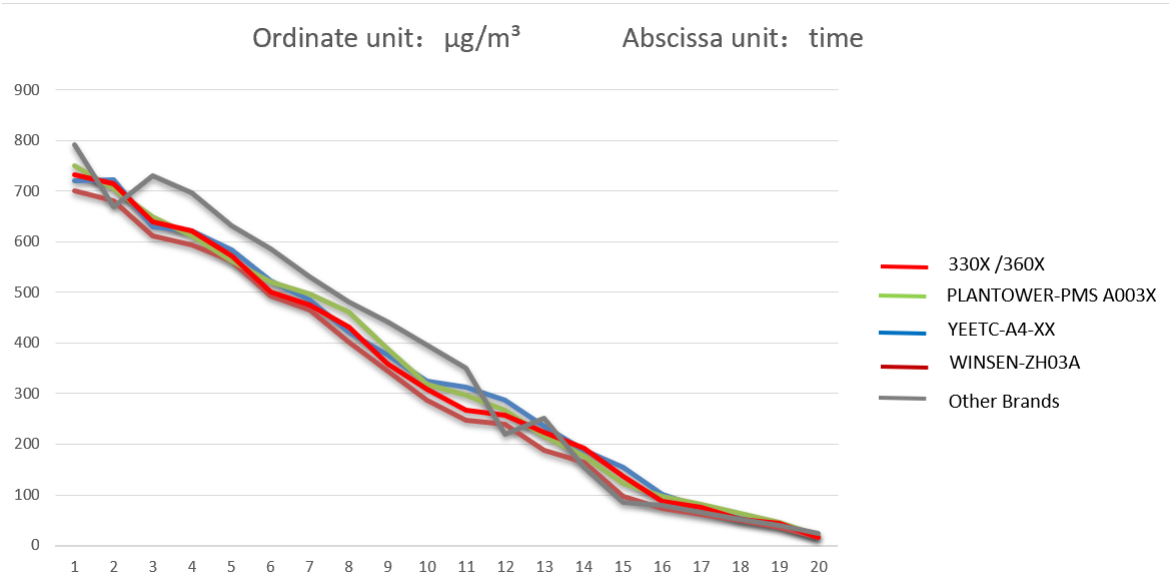
Sensor consistency test chart at 20 ° C @ 50% RH

Correspondence between temperature and consistency:



The relationship between the absolute value of consistency deviation and temperature

2）Contrast test with dust sensors of other major brands



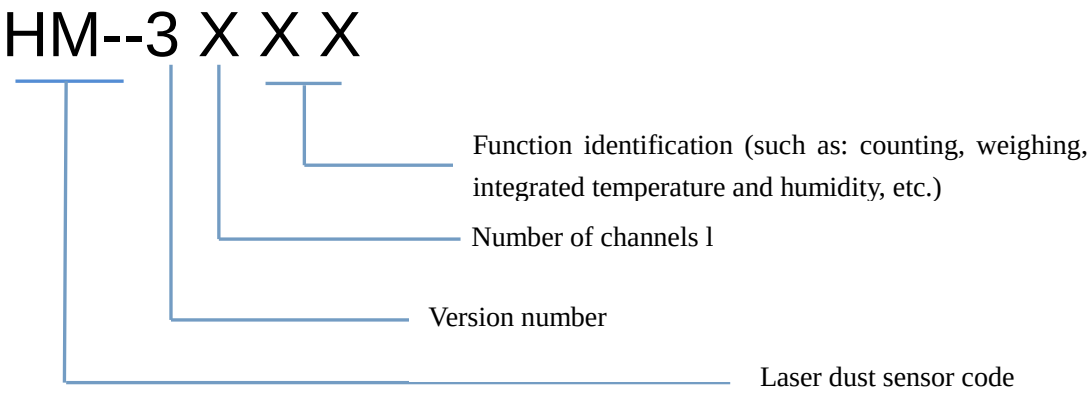
Contrast test with dust sensors of other major brands

3） Reliability test

No.	Test items	Test Methods	Test Results	Test sample and number of failures （N/C）
1	fall	The simulated product fell from a height of 1m to the wooden floor, three times	No cracking, normal function	N=6，C=0
2	vibration	Placed on the vibrating table for sinusoidal and random vibration, X/Y/Z direction, vibration frequency 10~50Hz, lasting 1 hour	Stable performance	N=6，C=0
3	Running at high temperatures	Placed in an oven set at 45 ° C for 800 hours of continuous operation	0~500ug/m3 Sampling 12 points and taking the average. 0~100ug/m3 In contrast to standard instruments, the deviation does not exceed 10 ug/m3. 100ug/m3 or more, compared with standard instruments, the deviation does not exceed 10%.	N=10，C=0
4	Running at low temperatures	Placed in a constant temperature chamber set at -5 ° C for 600 hours of continuous operation		N=10，C=0
5	High temperature and high humidity storage	Placed in a constant temperature and humidity chamber set to 70 ° C, 95% humidity for 720 hours		N=10，C=0
6	Low temperature storage	Placed in an incubator set at -20 ° C for 720 hours		N=10，C=0
7	Power fluctuation	It is powered by DC adjustable power supply, and the voltage is adjusted between 4.5V and 5.5V. The rate of change is 0.1V/min.		N=2，C=0
8	On/off test	Powered by DV 5V, the test environment is set to 20 °C, 50% RH, and the ON/OFF state of the power supply is switched every minute.		N=3，C=0

9	Low power consumption	Set the Sleep pin to low level	<150uA	N=2，C=0
10	noise	Place the product in a quiet room and measure with a sound level meter 1 meter from the sensor	<45dB	N=1，C=0
11	Salt spray	Placed in a salt spray test chamber, continuously sprayed with a 5% NaCl for 24 hours and then placed for 48 hours.	Metal shield without obvious rust	N=3，C=0
12	Static Protection	According to IEC61000-4-2 standard, the storage capacity is 150pF, the discharge resistance is 330Ω, and the test voltage is Level 1 (±2kV). Level 2 (±4kV), Level 3 (±8kV), discharge in air	Normal work	N=1，C=0

9. Product model



Selection guide:

Model	HM-3301	HM-3302	HM-3601	HM-3602
Number of channels	3 channels	3 channels	8 channels	6 channels
Export	Weighting mode	Counting, weighing mode	Weighting mode	Counting, weighing mode
Range	0~500μg/ m^3	0~500μg/ m^3	0~1000μg/ m^3	0~1000μg/ m^3
Consistency	±10μg/ m3@(0～100)μg/m^3, ±10%@(100～500)μg/m^3			
Temperature and Humidity	-	Optional	-	Optional
Communication protocols	UART/IIC	UART/IIC	UART/IIC	UART/IIC

Appendix 1: Serial UART Protocol

The communication parameters are: 9600, n, 8, 1, and the CRC code is the sum of all the previous bytes.

1. **Module number reading and modification**

The number of the module is the address with which the master station communicates. The number must be correct. Otherwise, URT communication cannot be performed. When multiple modules are connected in parallel, they must be with different numbers.

1.1 Module number reading

Primary station sending:

Head byte	function code	Module query number (4 bytes)	CRC code H	CRC code L
45	40	AA AA AA AA	03	2D

Module response:

Head byte	function code	Data length (number of bytes)	Reserved (2 bytes)	Current number (2 bytes)	Default (4 bytes)	CRC code H	CRC code L
45	40	8	XX XX	XX XX	00 00 00 00	XX	XX

Message example:

TX: 45 40 AA AA AA AA 03 2D

RX:45 40 08 00 00 00 02 00 00 00 00 00 90

The current module number is 0002.

1.2 Number modification

Primary station sending:

Head byte	function code	Default (2 bytes)	Module number (2 bytes)	Default (2 bytes)	New module number (2 bytes)	default (4 bytes)	CRC code H	CRC code L

45	60	00 00	XX XX	00 00	XX XX	00 00 00 00	XX	XX

Module response: The module modifies the number to a new number after receiving the command.

Message example:

TX: 45 60 00 00 00 01 00 00 00 02 00 00 00 00 00 A8

Change the module number from 1 to 2.

2、Mode setting

The command direction is the host computer -> sensor, the frame format is as follows:

Feature byte 1	Feature byte 2	Instruction byte	Status byte 1	Status byte 2	Check byte 1	Check byte 2
0x42	0x4d	CMD	DATAH	DATAL	LRCH	LRCL

Instruction and status byte definition:

CMD	DATAH	DATAL	Description
0xe2	00	00	Passive reading
0xe1	00	00H-passive 01H-active	State switching
0xe4	00	00H-standby mode 01H-normal mode	Standby control

3、Upload data format

The command direction is sensor -> host computer, the frame format is as follows (high byte first, low byte last):

start character 1	0x42 (fixed)	
start character 2	0x4d（active mode）,0x4e（Polling mode）	
Frame length	2 bytes	Frame length=2x13+2(data+ Check Digit)
Data 1	2 bytes	PM1.0 concentration（CF=1，Standard particulate） unit μg/ m^3

Data 2	2 bytes	PM2.5 concentration（CF=1，Standard particulate） unit μg/ m^3
Data 3	2 bytes	PM10 concentration（CF=1，Standard particulate） Unit μg/ m^3
Data 4	2 bytes	PM1.0 concentration（Atmospheric environment） Unit μg/ m^3
Data 5	2 bytes	PM2.5 concentration（Atmospheric environment） Unit μg/ m^3
Data 6	2 bytes	PM10 concentration（Atmospheric environment） Unit μg/ m^3
Data 7	2 bytes	the number of particles with diameter 0.3um or above in 1 liter of air
Data 8	2 bytes	the number of particles with diameter 0.5um or above in 1 liter of air
Data 9	2 bytes	the number of particles with diameter 1.0um or above in 1 liter of air
Data 10	2 bytes	the number of particles with diameter 2.5um or above in 1 liter of air
Data 11	2 bytes	the number of particles with diameter 5um or above in 1 liter of air
Data 12	2 bytes	the number of particles with diameter 10um or above in 1 liter of air
Data 13	High eight	Module number
Data 13	Low eight	Module number
Data 14	High eight	Check code = start character 1 + start character 2+..... + data 13 low eight
Data 14	Low eight	

Appendix 2: IIC Communication Protocol

In I2C standard mode (100kHz), the sensor acts as a slave device to the IIC at address 0x80。

The control instruction format is as follows：

Start	Address write	Answer	command	answer	end
Start	0x80	ACK	0X88	ACK	Stop

Use IIC communication, turn off UART communication. The module is defaulted to UART communication when it power-on, and actively upload data. When using IIC, you need to send this command to turn off the UART, otherwise the data is wrong.

The data frame format is as follows：

Start	Address read	Answer	data	answer	data…	answer	end
Start	0x81	ACK	Data1	ACK	Data…n	ACK	Stop

Data format：

Data1~Data2	reserved
Data3~Data4	Sensor number
Data5~Data6	PM1.0 concentration（CF=1 ， Standard particulate）unit μg/ m^3
Data7~Data8	PM2.5 concentration（CF=1 ， Standard particulate）unit μg/ m^3
Data9~Data10	PM10 concentration（CF=1 ， Standard particulate）unit μg/ m^3
Data11~Data12	PM1.0 concentration （Atmospheric environment）unit μg/ m^3
Data13~Data14	PM2.5 concentration （Atmospheric environment）unit μg/ m^3
Data15~Data16	PM10 concentration （Atmospheric environment）unit μg/ m^3
Data17~Data18	the number of particles with diameter 0.3um or above in 1 liter of air
Data19~Data20	the number of particles with diameter 0.5um or above in 1 liter of air
Data21~Data22	the number of particles with diameter 1.0um or above in 1 liter of air
Data23~Data24	the number of particles with diameter 2.5um or above in 1 liter of air
Data25~Data26	the number of particles with diameter 5.0um or above in 1 liter of air
Data27~Data28	the number of particles with diameter 10um or above in 1 liter of air
Data29	Data0~Data28 Checksum