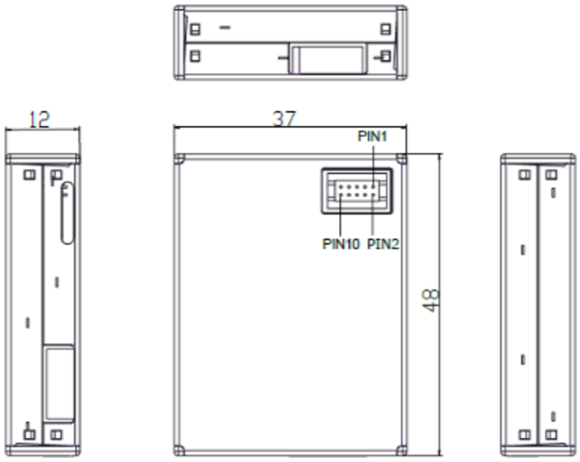
Plantower

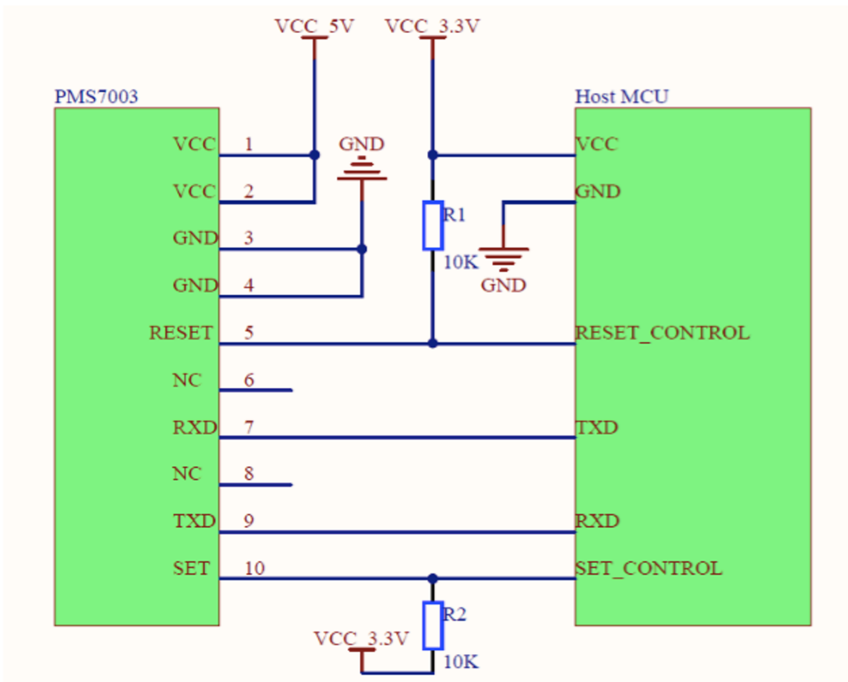
PMS-7003

Air Quality Sensor



Pin1----------VCC
Pin2----------VCC
Pin3----------GND
Pin4----------GND
Pin5----------Reset
Pin6----------N/C
Pin7----------RX
Pin8----------N/C
Pin9----------TX
Pin10---------Set

Measures:
0.3
0.5
1.0
2.5
5.0
10.0



Beijing Kondo Technology Co., Ltd. 2016 Product Data Handbook

DSENSOR

Digital Universal Particle Concentration Sensors

PMS7003 data sheet

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Review	Zheng Haoxin	Release date	2016-04-07

Key Features

- ◆ laser scattering principle to achieve accurate measurement
- ◆ zero error alarm rate
- ◆ real-time response and support continuous acquisition
- ◆ minimum resolution particle size 0.3μ m
- ◆ new patent structure, six full range of shielding, anti-jamming performance stronger
- ◆ The direction of the inlet and outlet can be selected, the scope of application is wide and the user does not need to design the air duct again
- ◆ ultra-thin design, only 12 mm, suitable for portable devices

Overview

PMS7003 is a digital versatile particle concentration sensor based on the principle of laser scattering, continuous mining

And calculate the number of suspended particles in different sizes of air in the unit volume, that is, the concentration distribution of particles,

And converted into mass concentration, and in the form of general digital interface output. The sensor can be embedded in a variety of air

Suspended particle concentration in the instrument or environmental improvement equipment, to provide timely and accurate concentration

according to.

working principle

The sensor uses the principle of laser scattering. Even if the laser irradiation in the air on the suspended particles to produce scattering,

At the same time, the scattered light is collected at a certain angle to obtain the curve of the scattered light intensity with time.
And then microprocessing
Using the algorithm based on Mie (MIE) theory, the equivalent particle size and the volume per unit volume

Particle size of the number of particles. The functional block diagram of the sensor is shown in Fig air

sensor

Air channel

Digital signal

Laser source

laser

Light

Light scattering

Measuring the cavity

Generating component

Electrical signal filter amplification

Circuit

electric signal

microprocessor

air

Figure 1 sensor block diagram

Technical indicators

As shown in Table 1

Table 1 sensor technical indicators

parameter	index	unit
Particle measurement range	0.3 to 1.0; 1.0 to 2.5; 2.5 to 10	Micron (m)
Particle counting efficiency	50 %@0.3 microns 98% @> = 0.5 microns	
Particle mass concentration effective amount (PM2.5 standard)	0 ~ 500	Micrograms / cubic meter
Particle mass concentration		Micrograms / cubic meter
Particle mass concentration consistency (PM2.5 standard value) *	± 10% @ 100 ~ 500 micrograms / cubic meter ± 10 micrograms / cubic meter @ 0 ~ 100 micrograms / cubic meter	
Called quasi-volume	0.1	L (L)
Single response time	<1	Seconds (s)
Integrated response time	≤ 10	Seconds (s)
DC supply voltage	Typ: 5.0 Min: 4.5 Max: 5.5	Volts (V)
Working current	≤ 100	MA (mA)
Standby current	≤ 200	Microanism (μ A)

Data interface level	L <0.8 @ 3.3 H> 2.7@3.3	Volts (V)
Operating temperature range	-10 ~ + 60	Celsius (° C)
Operating humidity range	0 ~ 99%	
Storage temperature range	-40 ~ + 80	Celsius (° C)
Mean time between failures	≥3	Year (Y)
biggest size	48 × 37 × 12	Mm (mm)

Note: The basic data for obtaining the consistency of the particle concentration is the data of the communication protocol 2 (see Appendix A)

Environmental conditions of 20 °C, humidity 50%

Output the result

The main output is the mass per unit volume of particles and the number of particles, of which the number of particles per unit volume

For 0.1 liters, the mass concentration unit is: micrograms / cubic meter.

The output is divided into active and passive outputs. After the sensor is powered on, the default state is active output

The sensor sends the serial data to the host, the time interval is 200 ~ 800ms, the air concentration of particles

High, the shorter the time interval. Active output is divided into two modes: smooth mode and fast mode. in the air

Particle concentration changes less, the sensor output for the smooth mode, that is, every three times the same set of output values,

The actual data update period is approximately 2s.
When the concentration of particles in the air changes greatly, the sensor output automatically
Switch to fast mode, each output is a new value, the actual data update cycle of 200 ~ 800ms.

Shape structure and interface definition

Figure 2 shape and interface definition

Table 2 Digital Interface Pin Definitions

PIN1	VCC	Power supply is 5V
PIN2	VCC	Power supply is 5V
PIN3	GND	Negative power supply

PIN4	GND	Negative power supply
PIN5	RESET	Module reset signal / TTL level @ 3.3V, low reset
PIN6	NC	
PIN7	RX	Serial Receive Pin / TTL Level @ 3.3V
PIN8	NC	
PIN9	TX	Serial port pin / TTL level @ 3.3V
PIN10	SET	Set pin / TTL level @ 3.3V, high or floating for Normal working state, low level is dormant state

Typical circuit connection

Figure 3 Typical circuit connection diagram

Circuit design should be noted

1. PMS7003 requires 5V power supply, this is because the fan needs 5V drive. But other data communication and control Pins require 3.3V as a high level. So the host board with which the communication is connected should be powered by 3.3V. If the motherboard MCU is 5V power supply, then the communication line (RXD, TXD) and control line (SET, RESET) Should be added to the level conversion chip or circuit.
2. SET and RESET internal pull-up resistor, if not used, it should be vacant.

3. PIN6 and PIN8 for the program internal debugging, the application circuit should be vacant.
4. When applying the sleep function, note that the fan stops working when you sleep and the fan restart requires at least 30 Sec settling time, so to obtain accurate data, the sleep wake-up after the sensor working time should not be low In 30 seconds.

Typical output characteristics

Asymmetric unit: μ g / m^3 (PM2.5 mass concentration standard value, Appendix A data 2) abscissa unit: times

Figure 4-1 Sensor room temperature consistency (20 °C)

Figure 4-2 High temperature consistency of the sensor (43 ° C)

Figure 4-3 Sensor Low Temperature Consistency (-5 ° C)

Figure 4-4 Long-term continuous operation of the sensor consistency (30 days)

The correspondence between temperature and consistency

The abscissa is the temperature, in ° C

Figure 5 The relationship between the absolute value of the maximum consistency deviation with temperature

Reliability test

Serial number	project	Test Methods	Judgement standard	N

1	Run for a long time	1, 10 ㎡ closed laboratory, temperature 20 ~ 25 °C, Humidity 30 ~ 70%, particulate matter generator to send smoke, Air purifier adjustment. 2, DC 5V power 3, continuous operation after 720 hours to detect consistency	Particle concentration 0 ~ 500 μ g / m³ of Set between 10 mining Sample	N = 30 C = 0
3	High temperature operation	1,10 ㎡ thermostat laboratory, temperature 43 °C, humidity 70%, particulate matter generator to send smoke, air purification Adjustment of the device. 2, DC 5V power test consistency	0 ~ 100 μ g / m³ Each test prototype and standard The maximum error between the quasi-machine Difference ± 15 μ g / m³ within;	N = 10 C = 0
4	Low temperature operation	1,10 ㎡ thermostat laboratory, temperature -5 °C, humidity 30%, particulate matter generator to send smoke, air purification Adjustment of the device. 2, DC 5V power test consistency	100 ~ 500 μ g / m³ Each test prototype and standard The maximum error between the quasi-machine Poor at ± 15% Inside;	N = 10 C = 0
2	vibration	1, 10 ㎡ closed laboratory, temperature 20 °C, humidity 50%, particulate matter generator to send smoke, air purification Adjustment of the device. 2, DC 5V power test consistency 3, vibration frequency: 50Hz. 4, Acceleration: 9.8 / S². 5, vibration direction: X, Y, Z direction. 6, amplitude (vertical): ± 2mm. 7, test time: X, Y, Z direction of 60 minutes.	Fan no obvious abnormal sound	N = 5 C = 0

5	High temperature and high humidity storage	1, constant temperature cabinet, temperature 70 °C, humidity 90 ~ 95% 2, placed 500 hours 3, after removal of DC 5V power test consistency	Particle concentration 0 ~ 500 μ g / m³ of Set between 10 mining Sample	N = 10 C = 0
6	Low temperature storage	1, constant temperature cabinet, temperature -30 °C, humidity 90 ~ 95% 2, placed 500 hours 3, after removal of DC 5V power test consistency	0 ~ 100 μ g / m³	N = 10 C = 0
7	Power fluctuation	1, 10 ㎡ closed laboratory, temperature 20 °C, humidity 50%, particulate matter generator to send smoke, air purification Adjustment of the device. 2, adjustable DC power supply, from 4.5V up to 5.5V, and then down to 4.5V, repeated cycle changes 2 hours, the voltage change speed of 0.1V / min. With When testing consistency	Each test prototype and standard The maximum error between the quasi-machine Difference ± 10 μ g / m³ within;	N = 5 C = 0
8	switch	1,10 ㎡ closed laboratory, temperature 20 °C, humidity 50%, particulate matter generator to send smoke, air purification Adjustment of the device. 2, DC 5V power supply, power switching frequency 0.5Hz, Lasted for 72 hours. After the end of the test consistency	100 ~ 500 μ g / m³ Each test prototype and standard The maximum error between the quasi-machine Poor at ± 10% Inside;	N = 10 C = 0
9	Sleep switch	1,10 ㎡ closed laboratory, temperature 20 °C, humidity 50%, particulate matter generator to send smoke, air purification Adjustment of the device. 2, DC 5V power supply, sleep control pin (SET) Level conversion frequency of 0.5Hz, for 72 hours. After the end of the test consistency	Fan no obvious abnormal sound	N = 10 C = 0
10	Laser switch	1,10 ㎡ closed laboratory, temperature 20 °C, humidity 50%, particulate matter generator to send smoke, air purification Adjustment of the device.		N = 10 C = 0

		2, the laser switching frequency 50HZ, for 240 hours, After the end of the test consistency		
11	Salt spray	Concentration of 5% industrial salt water, hydrolysis spray 100 hours, and Remove and wash with pure water for 48 hours	Metal parts without rust Discoloration	N = 1 C = 0

Model definition

PMS 70 03

sensor type	Model version	Minimum resolution particle size
PMS-particles are concentrated Degree sensor		03-0.3 microns 05-0.5 microns 10-1.0 microns 25-2.5 microns

Product appearance size detail

Installation Precautions

1. The metal case is connected to the internal power source. Be careful not to connect with other external board groups or chassis.
2. The air inlet and outlet are located in the plane close to the user's machine wall and the outside of the pores for the best installation side Type, such as can not be achieved, then the outlet around 2cm without shelter. Between the air inlet and the outlet The structure isolates the airflow and prevents the airflow from flowing directly from the outlet to the air intake inside the user's machine.
3. The inner wall of the user's machine shall not be smaller than the size of the air inlet.
4. When used in purifier products, try to avoid placing the sensor directly in the purifier's own air duct, such as If you can not avoid, you should set up a separate structural space, place the sensor in it, make it Clean the purifier itself.
5. Application with the purifier or fixed detection equipment, the sensor position should be higher than the ground 20cm or more. otherwise There may be near the ground of large dust particles and even floc contamination caused by fan winding resistance.
6. Sensors used in outdoor fixed equipment, for dust storms, rain and snow and the protection of Yang Qiaoxu, Should be done by equipment.
7. The sensor is a unitary component, the user will not dismantle it, including metal shielding shell, to prevent the emergence of Reversible damage.

Annex **A: PMS7003** Transfer Protocol

Default baud rate: 9600bps Parity: None Stop bit: 1 bit
Total length of the protocol: 32 bytes

Starting character	0x42 (fixed)	
Start character 2	0x4d (fixed)	
Frame length is high octet	..	Frame length = 2x13 + 2 (data + check digit)
The frame length is eight bits long	..	
Data 1 high octet	...	* Data 1 indicates PM1.0 concentration (CF = 1, standard particles)
Data 1 low octet	...	Unit μ g / m3
Data 2 high octet	...	Data 2 indicates PM2.5 concentration (CF = 1, standard particulate matter)
Data 2 low octet	...	Unit μ g / m3
Data 3 high octet	...	Data 3 indicates PM10 concentration (CF = 1, standard particulate matter)
Data 3 low eight bits	...	Unit μ g / m3
Data 4 high octet	...	* Data 4 indicates PM1.0 concentration (in atmospheric environment)
Data 4 low octets	...	Unit μ g / m3
Data 5 high octet	...	Data 5 indicates PM2.5 concentration (in atmospheric environment)
Data 5 low octets	...	Unit μ g / m3
Data 6 high octet	...	Data 6 indicates PM10 concentration (in atmospheric environment)
Data 6 is low octet	...	Unit μ g / m3
Data 7 high octet	...	Data 7 indicates that 0.1 liter of air has a diameter above 0.3um
Data 7 is low octet	...	The number of particles
Data 8 high octet	...	Data 8 indicates that 0.1 liter of air has a diameter of 0.5um or more
Data 8 is low	...	The number of particles
Data 9 high octet	...	Data 9 indicates that 0.1 liter of air has a diameter of 1.0um or more
Data 9 is low octet	...	The number of particles
Data 10 high octet	...	Data 10 indicates that the diameter of 0.1 liter of air is above 2.5um
Data 10 low octets	...	The number of particles
Data 11 High octet	...	Data 11 indicates that 0.1 liter of air has a diameter of 5.0um or more
Data 11 is low octet	...	The number of particles

Data 12 high octet	...	Data 12 indicates that 0.1 liter of air has a diameter above 10um
Data 12 is low octet	...	The number of particles
Data 13 high octet	...	version number
Data 13 low octets	...	error code
Data and check high eight ...		Check code = start character 1 + start character 2 + ... + data 13 low
Data and check low eight ...		Eight

Note: The standard particle mass concentration value refers to the use of industrial metal particles as equivalent particles for density conversion

To the mass concentration value, suitable for industrial production workshop and other environments.
The mass concentration of atmospheric particulate matter is empty
The main pollutants in the gas are equivalent particles for density conversion, suitable for ordinary indoor and outdoor atmosphere.

B: Sensor Slave Extended Instruction Protocol

1. Host communication protocol format

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

2. Instruction and feature byte definition

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

3. Command response:

0xe2: Acknowledgment 32 bytes, with the sensor specification protocol.

4. Check word generation

All bytes are summed from the feature word

```
//------------------------------------------------------------------
------------
//  PM sensor PMS7003 (fine dust)

/*

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limitations under the License.

*/

//------------------------------------------------------------------
------------

#include <SoftwareSerial.h>

SoftwareSerial Serial1(10, 11); // serial ports RX, TX

// input byte variables
int inputHigh = 0;
int inputLow = 0;
// variable to caclulate checksum input variables
uint16_t inputChecksum = 0;
// sensor variables
uint16_t concPM1_0_CF1;
uint16_t concPM2_5_CF1;
uint16_t concPM10_0_CF1;
uint16_t concPM1_0_amb;
uint16_t concPM2_5_amb;
uint16_t concPM10_0_amb;
uint16_t rawGt0_3um;
uint16_t rawGt0_5um;
uint16_t rawGt1_0um;
uint16_t rawGt2_5um;
uint16_t rawGt5_0um;
uint16_t rawGt10_0um;
uint8_t  version;
uint8_t  errorCode;
uint16_t checksum;

void setup() {
```

```
    Serial.begin(9600);
    while (!Serial) {
    }
    Serial.println("Serial port ready");
    Serial1.begin(9600);
    while (!Serial1) {
    }
    while (Serial1.read()!=-1) {};  //clear buffer
    Serial.println("Sensor port ready");
}

bool pms7003ReadData() {

//    while (Serial1.read()!=-1) {};  //clear buffer

    if (Serial1.available() < 32) {
      if (Serial1.available() == 0) {
        delay(150);
        return;
      };
      if (Serial1.available() > 16) {
        delay(10);
        return;
      };
      if (Serial1.available() > 0) {
        delay(30);
        return;
      };
      delay(100);
      return;
    }
    if (Serial1.read() != 0x42) return;
    if (Serial1.read() != 0x4D) return;

    inputChecksum = 0x42 + 0x4D;

    inputHigh = Serial1.read();
    inputLow = Serial1.read();
    inputChecksum += inputHigh + inputLow;
    if (inputHigh != 0x00) return;
    if (inputLow != 0x1c) return;

    inputHigh = Serial1.read();
    inputLow = Serial1.read();
    inputChecksum += inputHigh + inputLow;
    concPM1_0_CF1 = inputLow+(inputHigh<<8);

    inputHigh = Serial1.read();
    inputLow = Serial1.read();
    inputChecksum += inputHigh + inputLow;
    concPM2_5_CF1 = inputLow+(inputHigh<<8);

    inputHigh = Serial1.read();
    inputLow = Serial1.read();
```

```
inputChecksum += inputHigh + inputLow;
concPM10_0_CF1 = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
concPM1_0_amb = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
concPM2_5_amb = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
concPM10_0_amb = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
rawGt0_3um = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
rawGt0_5um = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
rawGt1_0um = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
rawGt2_5um = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
rawGt5_0um = inputLow+(inputHigh<<8);

inputHigh = Serial1.read();
inputLow = Serial1.read();
inputChecksum += inputHigh + inputLow;
rawGt10_0um = inputLow+(inputHigh<<8);

inputLow = Serial1.read();
inputChecksum += inputLow;
version = inputLow;

inputLow = Serial1.read();
inputChecksum += inputLow;
```

```
    errorCode = inputLow;

    Serial.print("PMS7003;");
    Serial.print(concPM1_0_CF1);
    Serial.print(';');
    Serial.print(concPM2_5_CF1);
    Serial.print(';');
    Serial.print(concPM10_0_CF1);
    Serial.print(';');
    Serial.print(concPM1_0_amb);
    Serial.print(';');
    Serial.print(concPM2_5_amb);
    Serial.print(';');
    Serial.print(concPM10_0_amb);
    Serial.print(';');
    Serial.print(rawGt0_3um);
    Serial.print(';');
    Serial.print(rawGt0_5um);
    Serial.print(';');
    Serial.print(rawGt1_0um);
    Serial.print(';');
    Serial.print(rawGt2_5um);
    Serial.print(';');
    Serial.print(rawGt5_0um);
    Serial.print(';');
    Serial.print(rawGt10_0um);
    Serial.print(';');
    Serial.print(version);
    Serial.print(';');
    Serial.print(errorCode);

    inputHigh = Serial1.read();
    inputLow = Serial1.read();
    checksum = inputLow+(inputHigh<<8);
    if (checksum != inputChecksum) {
      Serial.print(';');
      Serial.print(checksum);
      Serial.print(';');
      Serial.print(inputChecksum);
    }
    Serial.print('\n');

    delay(700);  // higher will get you checksum errors

    return;
}


void loop () {
    pms7003ReadData();
}
```