麦芽传感科技
Maiya Sensor Technology

Laser Particulate Matter Sensor

MST-PM07

User's Manual (Version No: 1.0)



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Declaration

Thank you for using our products.

Please read this manual carefully before use and use in accordance with the recommended method.

Please do not remove, disassemble or replace the internal components of the sensor without authorization. Otherwise the company will not bear the losses caused of this.

The color, style and size of the product you buy shall prevail in kind.

Every effort has been made to ensure the accuracy of this document at the time of printing. In accordance with the company's policy of continued product improvement, the company reserves the right to make product changes without notice. If the user finds something wrong please inform us, please contact us by Email at any moment.

Description

MST-PM07 is a general and miniaturized laser particulate matter sensor module, which can detect the dust particles in the air by using the MIE scattering principle. Through the professional algorithm and calibration process, the sensor has good consistency and stability. The sensor has both serial port output and PWM output capability, easy to use, small size, easy to integrate applications.



Features & Advantages

- Stability good consistency
- real-time response
- Measuring precision
- low power consumption
- The min resolved PM diameter is 0.3 μm

Typical Applications

- air purifier
- primary air system
- Portable instruments
- Air quality monitor
- air conditioner
- Consumer electronics and other equipment supporting

Table 1- Technical indicators

Model	MST-PM07
PM size	0.3-10 μm
Effective range	0-1000μg/m³
Signal interval	1s
PM2.5 accuracy	0-100 μg/m³ : ±10μg/m³ 101-1000 μg/m³ : ±10% value (Testing Conditions: 25±2℃, 50±10%RH, TSI8530, GBT18801-2015)
Warm-up period	30s
Output signal	UART_TTL (3.3V level, default)
	PWM (3.3V level, default)
Working voltage	5V±0.1V(DC)
Working current	＜100mA(5V power supply)
Saving mode current	＜200uA(5V power supply)
Response time	T90＜30s
Working Humidity	0~90％RH (No condensation)
Working temp.	－10~50℃
Storage temp.	－30~60℃
Size	48×38×12mm(L×W×H)
Weight	＜30g
MTTF	Continuous > 40000 h

Pin Information

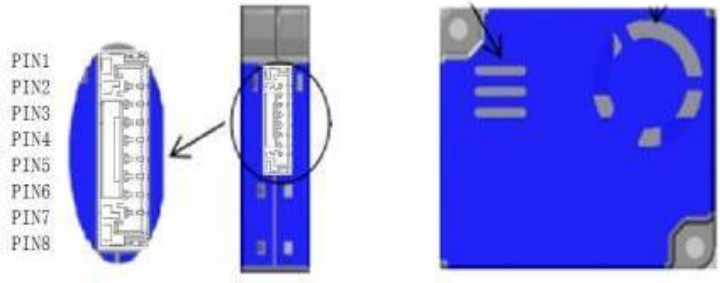


Figure 1- Pin No.

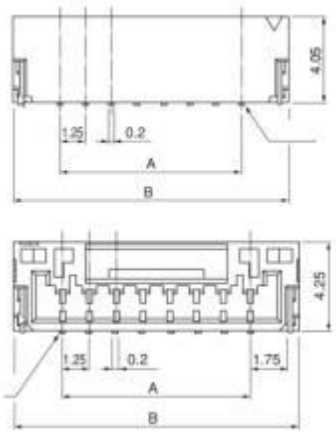


Figure 2- Terminal model (A=7x1.25, B=13.25)

Terminal Description: JST-SM08B-GHS-TB-8P connector

pin spacing: 1.25mm pins number: 8 pins

Pin Definitions

Table 2- Pin definitions

Item	Definition	Description
PIN1	VDD	DC +5V
PIN2	GND	GND
PIN3	SET	Power saving mode configuration (active low) Hover or high level (3.3V) works properly
PIN4	RXD/SDA	Serial port reception (TTL@3.3V)
PIN5	TXD/SCL	Serial port Send (TTL@3.3V)
PIN6	RESET	TTL@3.3V
PIN7	DAC	Analog voltage (default off)
PIN8	PWM	Analog voltage (default off)

UART configuration

Table 3 - URAT configuration

Item	Description
Baud rate	9600
data bits	8
stop bit	1
parity	none

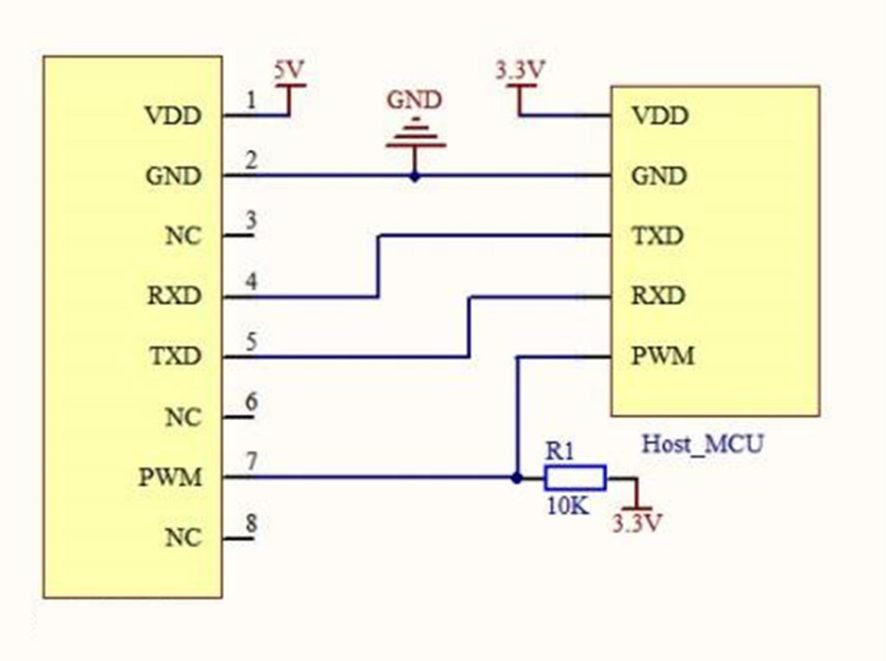
★ UART protocol refer to "MST-PM sesies Laser PM Sensor communication protocol"

Circuit connection schematic diagram

Typical Circuit (1)

Sensor power supply: 5V Interface level: 3.3V

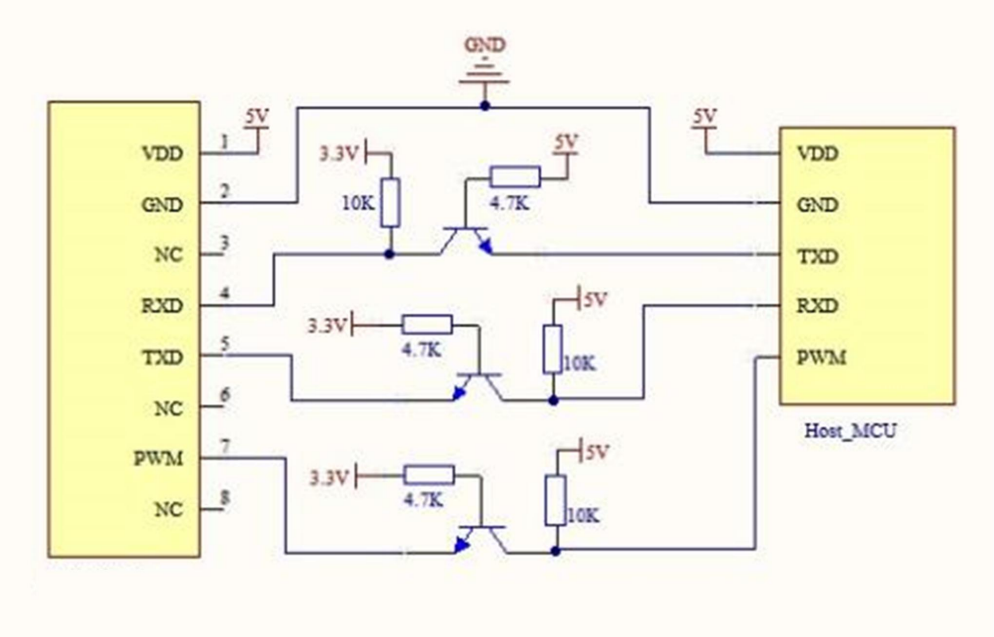
User MCU operating voltage: 3.3V Interface level: 3.3V



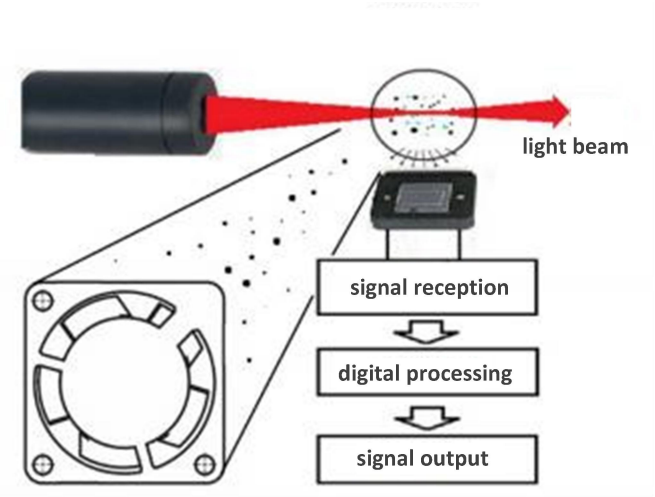
Typical Circuit (2)

Sensor power supply: 5V Interface level: 3.3V

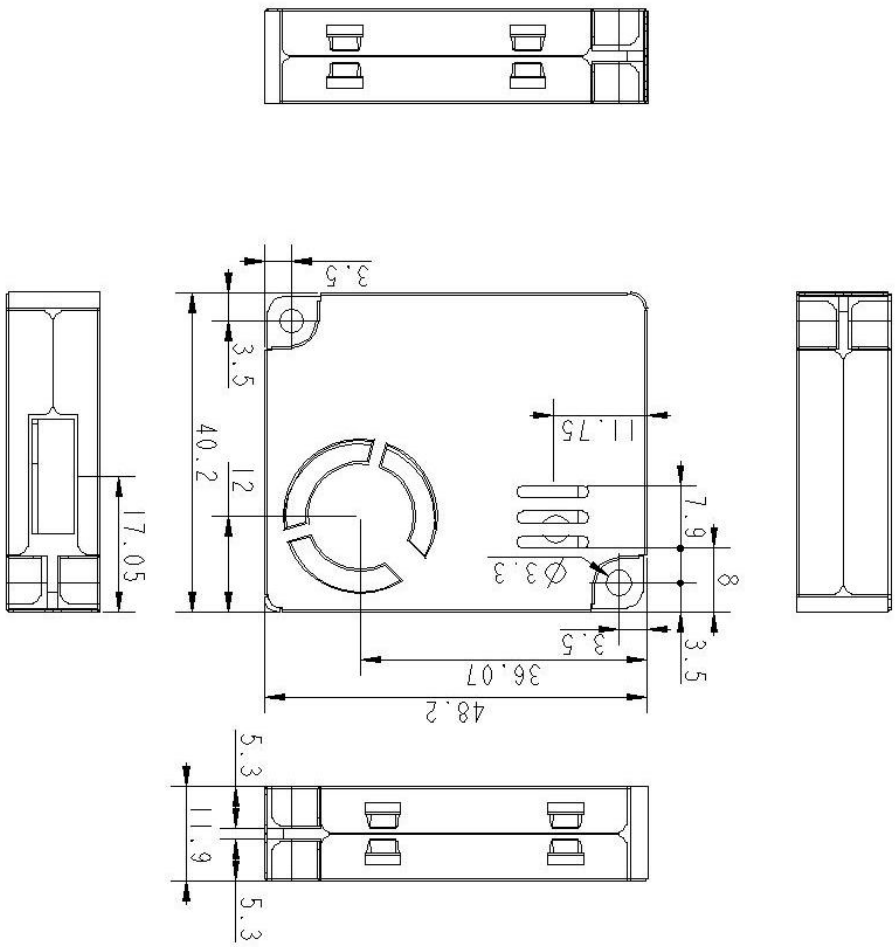
User MCU operating voltage: 5V Interface level: 5V



Principle description



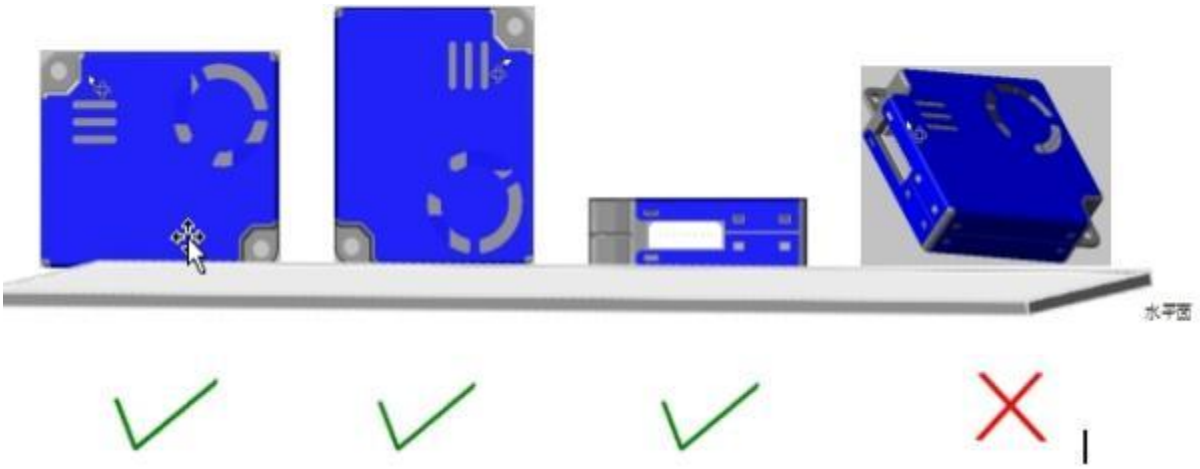
Dimension figure

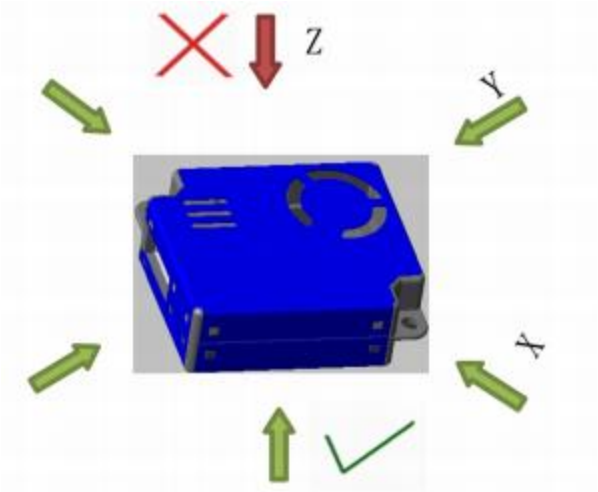


Installation

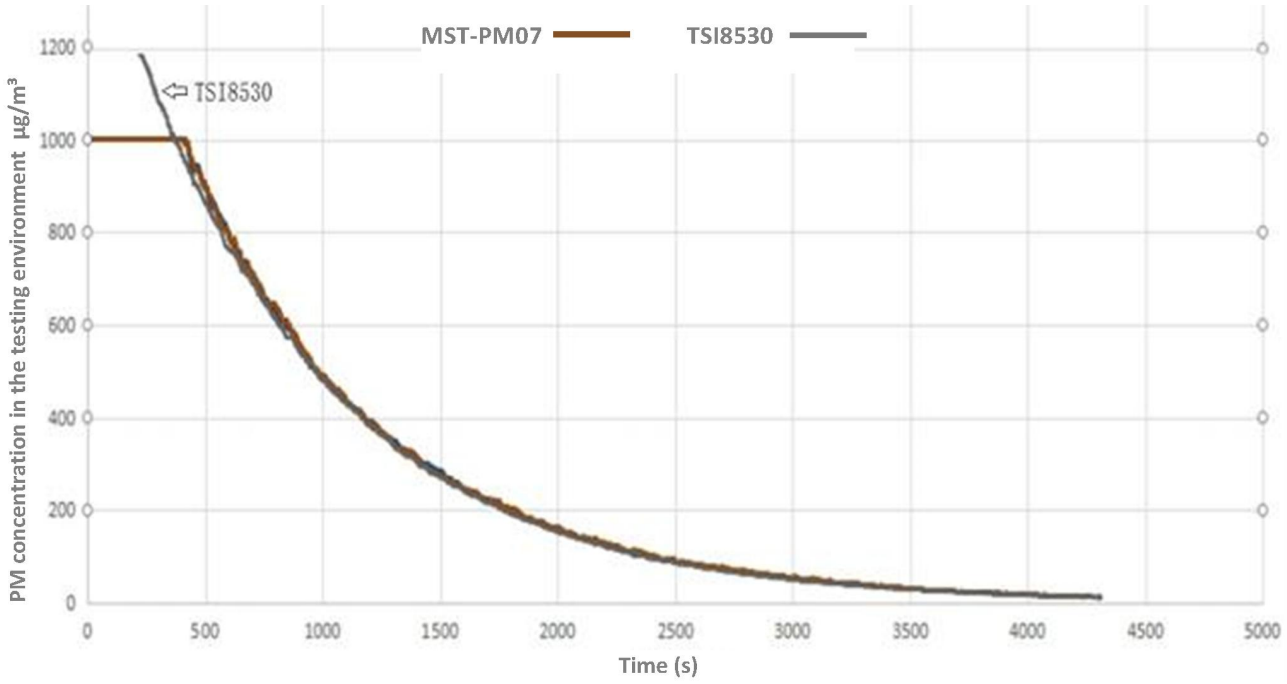
The dust collection hole is the air inlet inside the sensor, which needs to keep good contact with the outside air. The fan is installed at the air outlet inside the sensor. Avoid strong airflow interference around the sensor when using sensor, If it cannot be avoided, try to keep the external airflow direction perpendicular to the internal airflow direction of the sensor.

When using the sensor, ensure that the sampling gas path is unobstructed as much as possible. Air inlet and outlet impeded will seriously affect the measuring result.





Signal output curve



Explain:

The above figure shows the comparison of test results between the MST-PM07 sensor and the TSI8530 sensor in the same environment.

The abscissa represents: test time, unit (s) ;

Ordinate represents the concentration of particulate matter, based on TSI8530 data as reference, unit (μg/m^3).

Reliability testing

Table 4-Reliability Tests

No.	Item	Test method	Result requirements	number of test：n number of fail：c
1	Zero test	The experimental chamber meets the requirements of clean air (dust mass concentration does not exceed 5.0μg/m³). The sensor is powered on and the output value is recorded for 6 times.	Zero output range: < 15μg/m³	n=28 c=0
2	Consistency	The measurement values of the sensors were recorded at concentrations of 50, 130 and 260 μg/m³ for 6 times, a total of 18 times, and the maximum value was taken respectively.	Conforms to Table 1 "PM2.5 accuracy"	n=28 c=0
3	Stability	The sensor works continuously for 15 days, then measure zero signal and relative error.	Zero output range: < 15μg/m³ Relative error: ±15%	n=5 c=0
4	Response Time	After working in clean air for 1h, the sensor is placed in an environment of 500μg/m³ and the current time t0 is recorded. When the output value of the sensor reaches 450μg/m³ for the first time, the current time t1 is recorded. The response time t90=t1-t0 was calculated, and the average value was obtained by repeated measurement for 3 times.	Response time: T90 < 30s	n=8 c=0
5	Overrange impact	1.The sensor was powered on at 2000μg/m³ for 10min. 2.Measure sensor zeros and relative errors.	Zero output range: < 15μg/m³ Relative error: ±15%	n=2 c=0
6	Frequent power failure impact	1.The sensor was powered with DC5 ± 0.1V for 5min, then power off for 5min and cycle for 24h. 2.Measure sensor zeros and relative errors.	Zero output range: < 15μg/m³ Relative error: ±15%	n=2 c=0
7	Working noise	Keeping the ambient noise be less than 30dB (A), and the sensor work stably for 20min. The sensor and the sound-meter should be placed on the same horizontal surface 0.8m above the ground, with a distance of 1m. Each sensor should be measured for 3 times and take its maximum value.	Operating noise: ≤40dB (A)	n=2 c=0

No.	Item	Test condition	Compliance requirements	number of test：n number of fail：c
8	Low temperature storage	The sensor was not energized and placed at -30 ± 2 ° C for 16h, and then placed at room temperature for 2h. 2.Measure sensor zeros and relative errors.	There is no obvious dent, scratch, crack, deformation and other defects on the surface of the sensor. The coating are free of bubbles, cracking and falling off. The connectors or parts are free of loosening and falling off. Zero output range: < 15μg/m³ Relative error: ±15%	n=2 c=0
9	High temperature storage test	The sensor was not energized and placed at 70 ± 2 ° C for 16h, and then placed at room temperature for 2h. 2.Measure sensor zeros and relative errors.		
10	Work at high temperatures	The sensor is powered on and placed at 50 ± 2 ℃ to measure sensor zeros for 2 hours, then take its maximum value.	There is no obvious dent, scratch, crack, deformation and other defects on the surface of the sensor. The coating are free of bubbles, cracking and falling off. The connectors or parts are free of loosening and falling off. Zero output range: < 15μg/m³ Relative error: ±15%	n=2 c=0
11	Work in low temperatures	The sensor is powered on and placed at -10 ± 2 ℃ to measure sensor zeros for 2 hours, then take its maximum value.		n=2 c=0
12	Shaker test	1.The sensor is exposed and not powered on, place on vibrator. Frequency range: (10~150)Hz; Sinusoidal amplitude: 1.5mm; x, y, z 3 axes, each axis frequency sweep 15 times. 2.Measure sensor zeros and relative errors.	There is no obvious dent, scratch, crack, deformation and other defects on the surface of the sensor. The coating are free of bubbles, cracking and falling off. The connectors or parts are free of loosening and falling off. Zero output range: < 15μg/m³ Relative error: ±15%	n=2 c=0
13	Fall-down	1.The packed sensor is dropped from a height of 1m onto a concrete or smooth rigid surface. Each of the 6 different sides falls once. 2.Measure sensor zeros and relative errors.		n=2 c=0
14	Static interference	When the sensor is energized, discharge 8 times with 2000eV on the surface of the metal shell of the sensor, and discharge 2 times on the ground plate 10cm around the sample. The time interval of each discharge is at least 1s. 2.Measure sensor zeros and relative errors.	Zero output range: < 15μg/m³ Relative error: ±15%	n=2 c=0

UART data definition	
Start character 1	0x42(fixed)
Start character 2	0x4d(fixed)
Frame length High 8 + low 8	Frame length=2×13+2(Data + check bit)
Date01 High 8 + low 8	PM1.0 Value(CF=1,Standard particulate, unit: μg /m³)
Date02 High 8 + low 8	PM2.5 Value(CF=1,Standard particulate, unit: μg /m³)
Date03 High 8 + low 8	PM10 Value(CF=1,Standard particulate, unit: μg /m³)
Date04 High 8 + low 8	PM1.0 Value(Atmospheric, unit:μg /m³)
Date05 High 8 + low 8	PM2.5 Value(Atmospheric, unit: μg /m³)
Date06 High 8 + low 8	PM10 Value(Atmospheric, unit: μg /m³)
Date07 High 8 + low 8	0.1 L in air particles number, D>0.3 μm
Date08 High 8 + low 8	0.1 L in air particles number, D>0.5μm
Date09 High 8 + low 8	0.1 L in air particles number, D>1.0 μm
Date10 High 8 + low 8	0.1 L in air particles number, D>2.5 μm
Date11 High 8 + low 8	0.1 L in air particles number, D>5.0 μm
Date12 High 8 + low 8	0.1 L in air particles number, D>10.0μm
Date13 High 8 + low 8	Reserved
Data sum check High 8 + low 8	Check code = Start character 1+ Start character 2+..... + Data 13 lower 8 digits

To set active upload, run the following command line format:							
Control Command	Header Code		CMD			Check Code	
	1	2	3	4	5	6	7
Passive reporting mode	0x43	0x4d	0xe1	0x00	0x00	0x01	0x71
Active reporting mode	0x43	0x4d	0xe1	0x00	0x01	0x01	0x72
Host read data	0x43	0x4d	0xe2	0x00	0x00	0x01	0x72
Sensor startup	0x43	0x4d	0xe3	0x00	0x01	0x01	0x75
Sensor standby	0x43	0x4d	0xe4	0x00	0x00	0x01	0x74
The passive mode is reported only when the data is read, and the active mode is reported once for 0.5s							

Example of check value calculation of the active upload data frame:

Data Frame：42 4D 00 1C 00 54 00 6E 00 7C 00 54 00 6E 00 7C
00 00 00 00 00 00 00 00 00 00 00 00 00 00 03 27

Check Code
=0x42+0x4D+0x00+0x1C+0x00+0x54+0x00+0x6E+0x00+0x7C
+0x00+0x54+0x00+0x6E+0x00+0x7C+0x00+0x00+0x00+0x00
+0x00+0x00+0x00+0x00+0x00+0x00+0x00+0x00+0x00+0x00 = 0x0327

Check Code
High 8bits 0x03 in the the data frame 31 byte
Low 8bits 0x27 in the the data frame 32 byte

UART QA mode/Check algorithm

Sample data returned by sensor in QA mode“FF 86 00 47 00 C7 03 0F 5A” Check Value = 0x86 + 0x00 + 0x47 + 0x00 + 0xC7 + 0x03 + 0x0F
= 0xA6（reserved lower 8 bits ）
= 0x59（INV）
= 0x5A（+ 1）

Sample code：

```
/*****************************************************************************
* Funcname: unsigned char FucCheckSum(unsigned char *i, unsigned char ln)
* Function description: sum check（Take the sum of 1\2\3\4\5\6\7 of the transmit and receive protocols and invert +1）
* Function description: Add the array elements 1- the second to last element and take the inverse +1 (the number of elements must be greater than 2)
 *****************************************************************/
unsigned char FucCheckSum(unsigned char *i, unsigned char ln)
{
unsigned char
j,tempq=0; i+=1;
for(j=0;j<(ln-
2);j++) {
tempq+=*i;
i++;
}
tempq=(~t
empq)+1;
return(te
mp
```

Notice

1. Do not remove the sensor. Removing the sensor shield will cause the sensor to become less resistant to jamming. The metal shield of the sensor shall avoid contact with other external circuits to prevent interference from external signals.

2. Strong impact or vibration will affect the accuracy and life of the sensor, so it should be avoided when the sensor is in use.

3. The sensor is suitable for the detection of dust particles in the conventional environment, need to avoid lampblack, large dust particles, high humidity and other conditions, such as: kitchen, bathroom, smoking room, sand factory, etc. If user want to use the sensor in the above environment, it need to add some filtering protection to the sensor.

4. Keep the air inlet and the air outlet unimpeded, and there can be no shielding object within 2cm around the air outlet to avoid the air outlet and the air inlet exchange.

5. Under normal temperature and pressure, the sensor can work continuously for more than 10000 hours. The service life of the sensor can be improved by setting the power saving mode of the sensor and increasing the signal set interval. The maximum working life of the sensor can be more than 3 years. Please contact us by email if you encounter any problem when using the sensor.

Packing, transportation and store:

- Wrap the product in soft foam and place in a carton.
- The sensor should be stored in a dry environment at room temperature and pressure.
- Do not weigh down the sensor with heavy weights.