

SPECIFICATION

Product Name: Laser Particle Sensor Module

Item No.: PM2008

Version: V0.2

Date: February 27, 2019

Writer	Audit	Approved
Mei Yang		

Revision

No.	Version	Content	Reviser	Date
1	V0.1	First Version	Mei yang	2019/2/27

Laser Particle Sensor Module

PM2008



Applications

- Air purifier
- Air quality monitor
- Air conditioner
- Ventilation system
- Consumer electronic products
- Environmental monitoring

Description

PM2008 laser particle sensor module is based on laser scattering technology, designed with all metal shielding, ultra-thin (12mm) which is used to detect particle concentration size between $0.3\mu\text{m}$ - $10\mu\text{m}$ exactly in the air and real-time output PM1.0, PM2.5, PM10 in $\mu\text{g}/\text{m}^3$ directly via mathematical algorithm and scientific calibration.

Features

- The smallest size of available measurement: $0.3\mu\text{m}$
- Real-time output PM1.0, PM2.5, PM10 in $\mu\text{g}/\text{m}^3$ available
- All metal shielding, strong anti-interference
- Smaller and thinner structure design, height only 12mm
- High accuracy, high sensitive and quick response ($\leq 8\text{s}$)
- Signal output optional: UART, I²C
- Four types of measuring mode for option: single/continuous/timing/dynamic
- RoHS and Reach compliant
- Air inlet and outlet on the same side

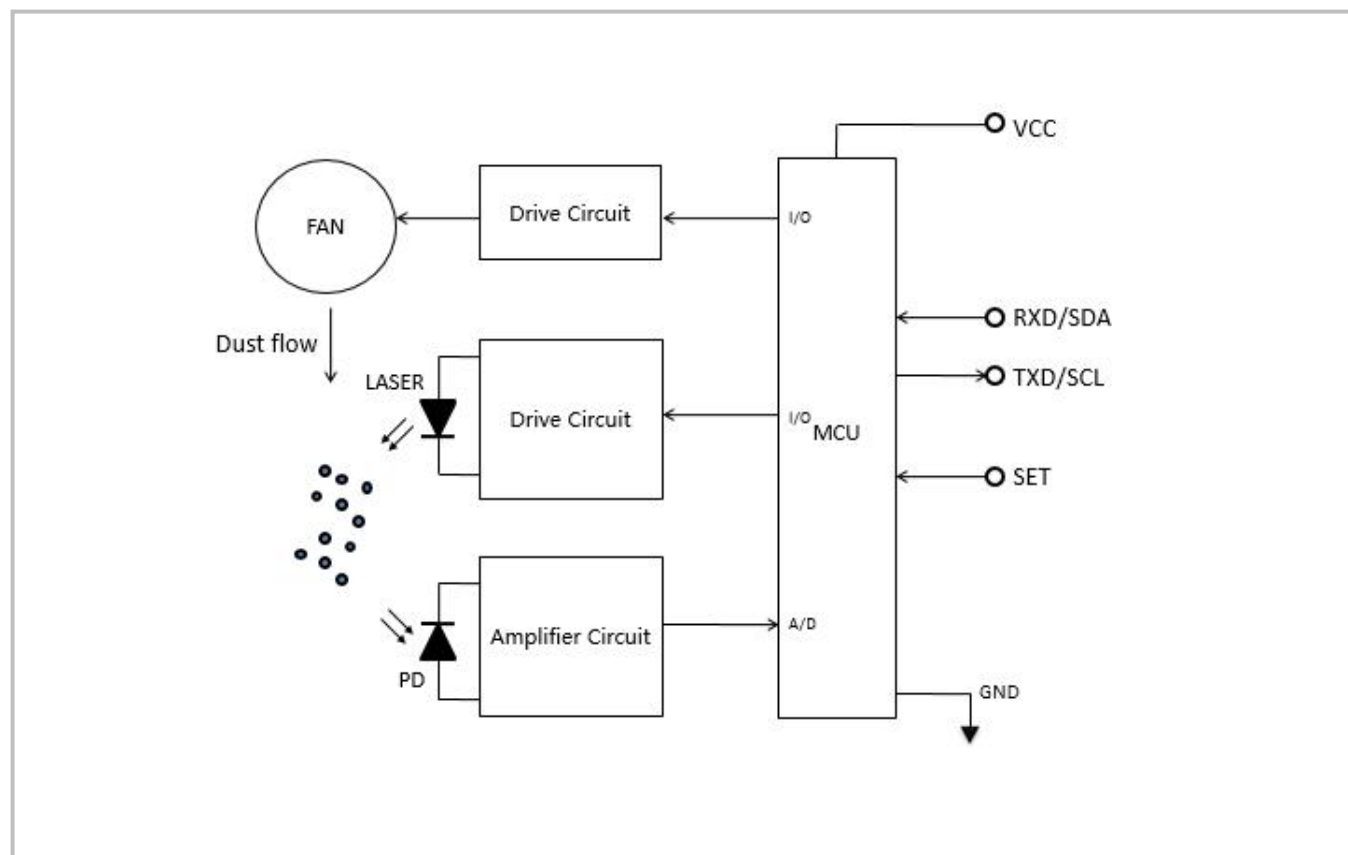
Working Principle

Sampling by the internal pressure which occurs by fan, when sampling particles pass through light beam (laser), there will be light scattering phenomenon. Scattered light will be converted into electrical signal (pulse) via photoelectric transformer. The bigger particles will obtain stronger pulse signal (peak value). Through peak value and pulse value quantity concentration of particles in each size can be calculate. Thus, real-time measured data is obtained through measuring quantity and strength of scattered light.

Specifications

Laser Particle Sensor Specification	
Operating principle	Laser scattering
Measured particle range	0.3 μ m ~ 10 μ m
Measurement range	0~1,000 μ g/m ³
Resolution	1 μ g/m ³
Working condition	-10°C ~ 60°C, 0-95%RH (non-condensing)
Storage condition	-30°C ~ 70°C, 0-95%RH (non-condensing)
Maximum consistency error for PM1.0&PM2.5	0~35 μ g/m ³ , \pm 5 μ g/m ³ 35~500 μ g/m ³ , \pm 15% reading Condition: 25 \pm 2°C, 50 \pm 10%RH, Reference instrument: GRIMM Dust Source: Cigarette+Arizona A1
Maximum consistency error for PM10	0 ~100 μ g/m ³ , \pm 25 μ g/m ³ 101 ~ 500 μ g/m ³ , \pm 25% reading Condition: 25 \pm 2°C, 50 \pm 10%RH, Reference instrument: GRIMM Dust Source: Cigarette+Arizona A1
Response time	1sec
Time to first reading	\leq 8 seconds
Power supply	DC 5V \pm 0.1V, ripple wave<50mV
Working current	\leq 100mA
Standby current	\leq 200 μ A
Dimensions	47.8 \times 36.8 \times 11.7
Digital output 1 (default)	UART_TTL_3.3V(default); I ² C_3.3V/5V(default)
Digital output 2	PWM (customized)
Output method	Default by active output after powering on, sampling time interval should be over 1,000ms
MTTF	128,000 hrs (continuous turn on)

Internal Architecture Description

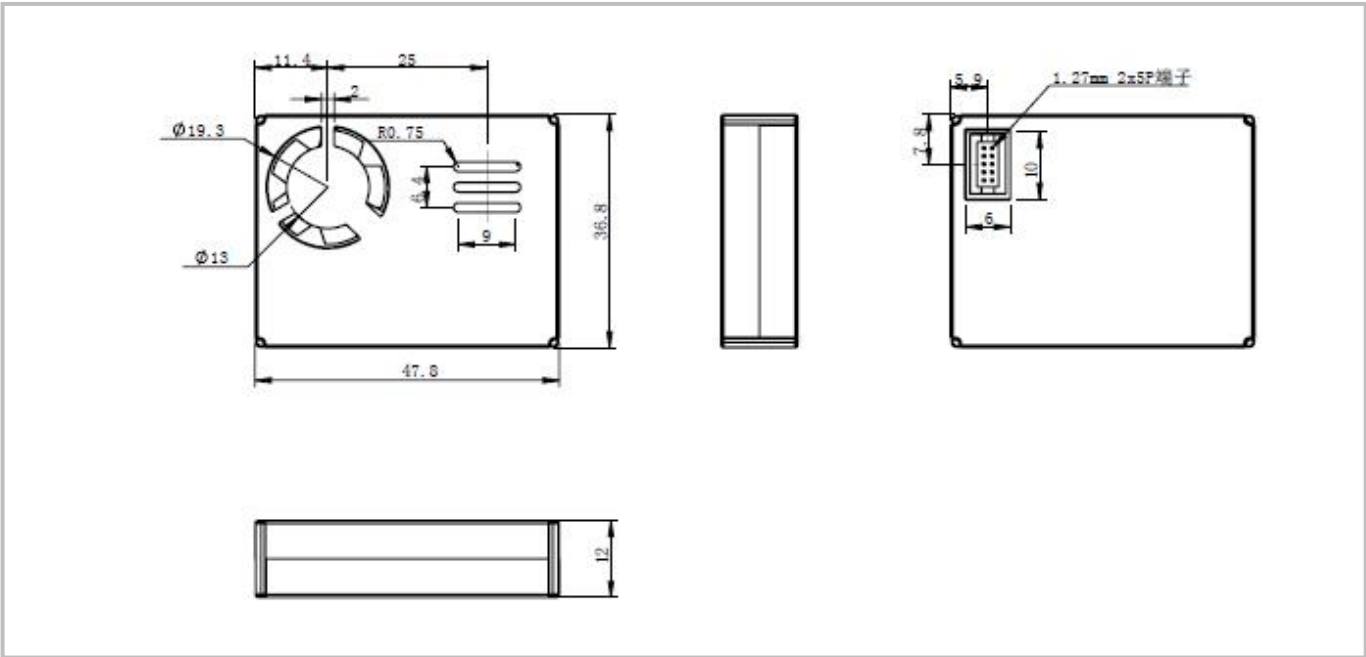


When the fan works, it will generate airflow. When the particles in the sampled gas pass through the beam of the light source (laser), a light scattering phenomenon occurs, and the scattered light is converted into an electrical signal (ie, a pulse) by the photoelectric converter. The larger the particle size, the larger the amplitude of the pulse signal output.

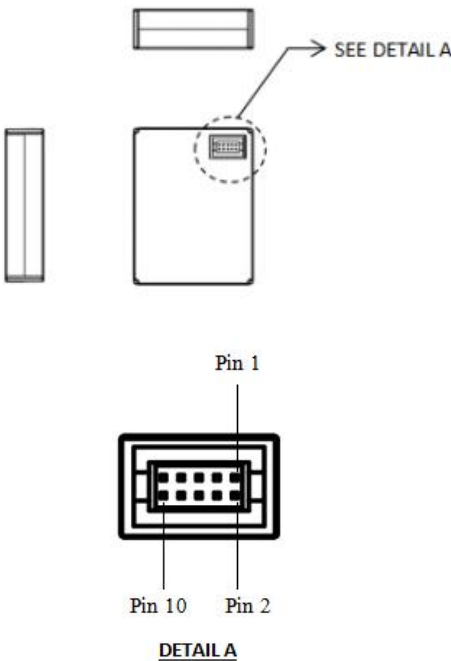
The number of particles of different sizes is calculated by comparing the peak value with the predetermined threshold value, and the mass concentration value is obtained by a professional algorithm. By testing the intensity of the scattered light, real-time test data is obtained.

Dimensions and Connector

1. Dimensions (Unit mm, tolerance ± 0.2 mm)



2. I/O Connector Pinout



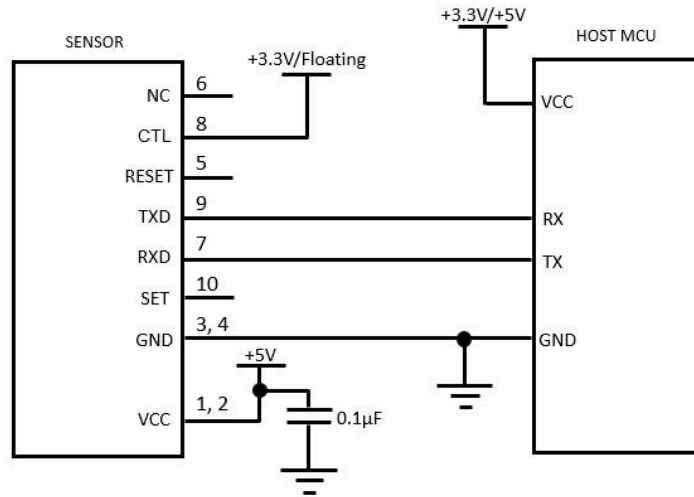
N	Pin	Description
1	VCC	Power input (+5V)
2	VCC	Power input (+5V)
3	GND	Power input (ground terminal)
4	GND	Power input (ground terminal)
5	Reset	Module reset signal (TTL level @3.3V, Low level signal)
6	NC	NC
7	RXD/SDA	UART-RX / I ² C SDA (TTL level @3.3V), compatible with 5V communication
8	CTL	Output mode exchange TTL level @3.3V High level or floating is UART communication mode, low level is I ² C communication mode
9	TXD/SCL	UART-TX / I ² C SCL(TTL level @3.3V), compatible with 5V communication
10	SET	Set (TTL level @3.3V/5V, high level or floating is normal working status, while low level is sleeping)

3. Connector and Cables (Connector can be customized)

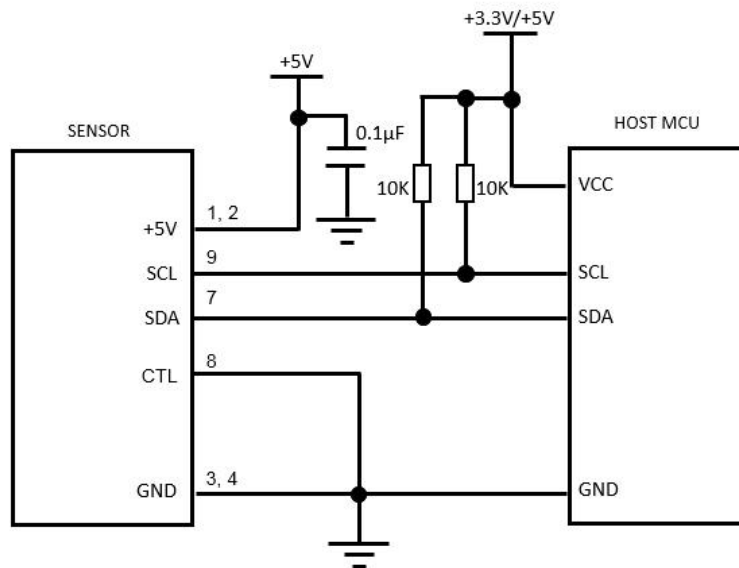
Item	Part Number	Pitch	Recommendation Manufacturer
Connector	JSD-BH-312-002	1.27 mm	Cubic

Typical Application Circuit

Case 1. UART Application



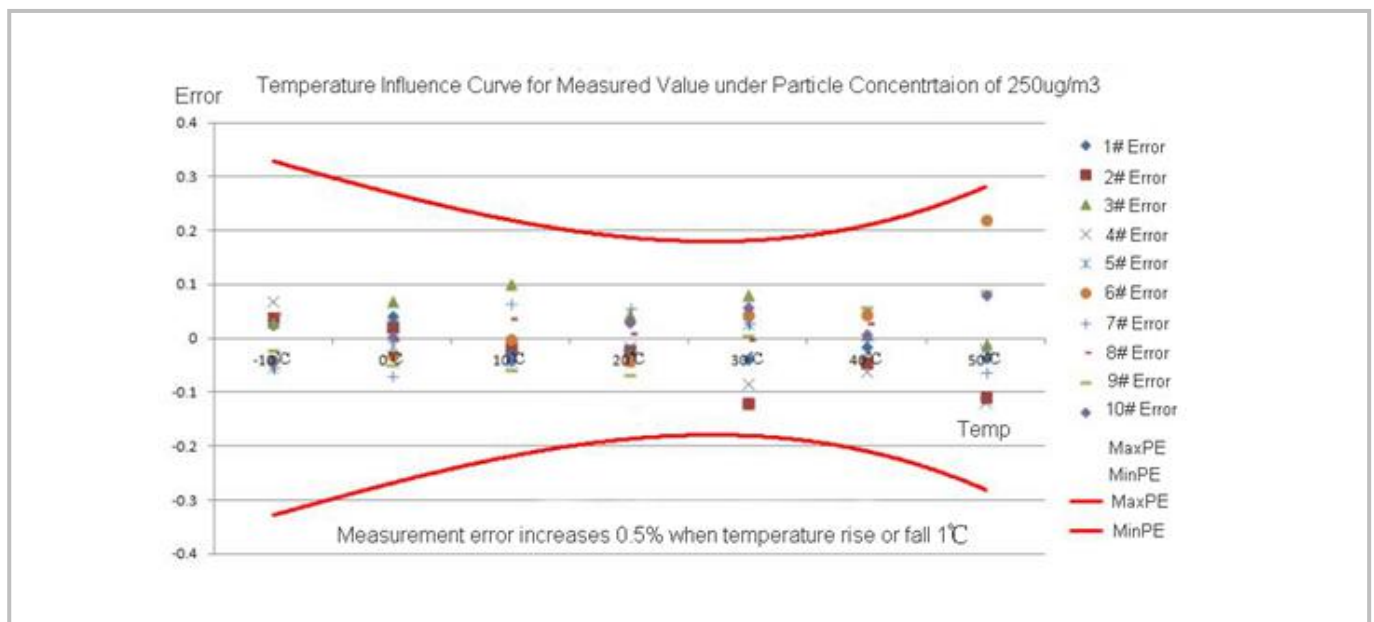
Case 2. I²C Application



Note of Circuit Design

- UART and I²C communication is compatibility with 3.3V and 5V level.
- There is pull-up resistor inside the SET and RESET. No matter there is signal input or not, these two pins will work normally. If they are not useful for you, keep it floating.
- PIN6 is the pin for manufacturer testing, you can keep it floating.
- The power supply of sensor should be 5V and low noise, please refer to table 1 for detail

Temperature Influence



Particle measured error: under $25 \pm 2^\circ\text{C}$, $0 \sim 1,000 \mu\text{g}/\text{m}^3$, consistency and accuracy of PM1.0/PM2.5 is either $\pm 15\%$ reading or $\pm 15 \mu\text{g}/\text{m}^3$, the bigger one is considered.

Temperature influence coefficient: $0.5\%/^\circ\text{C} \sim 1\%/^\circ\text{C}$ or $0.5 \mu\text{g}/\text{m}^3/^\circ\text{C} \sim 1 \mu\text{g}/\text{m}^3/^\circ\text{C}$, the bigger one is considered.

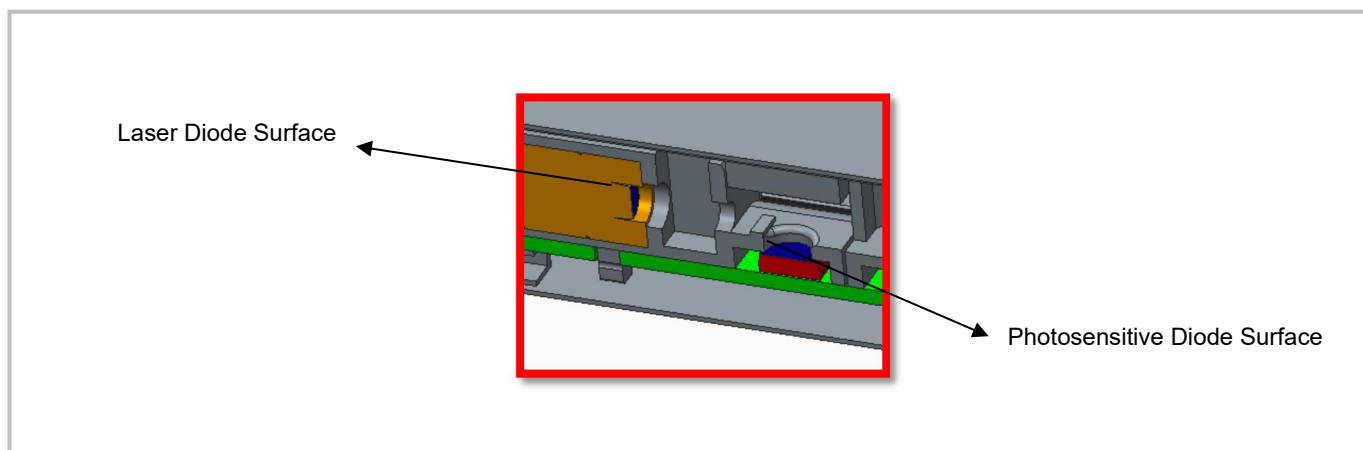
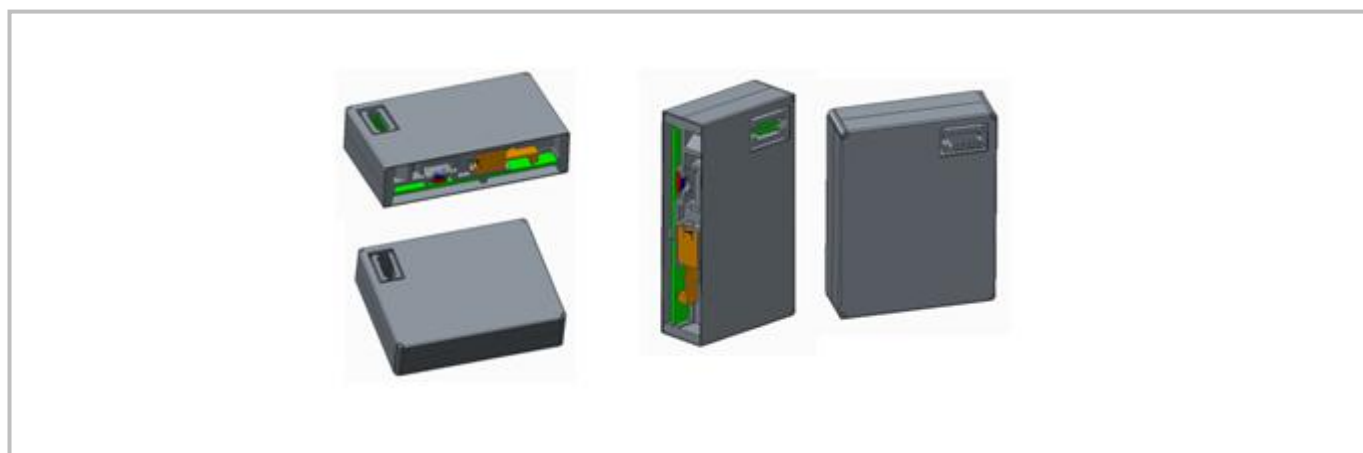
Product Installation

When install PM2008 sensor module in your system or equipment, please make sure that the air inlet and air outlet are unobstructed. And there is no huge airflow face to air inlet and air outlet. In order to avoid dust deposition on the surface of sensitive component (laser diode and photosensitive diode) which may affect the measurement accuracy, the appropriate installation ways are recommended as below.

Recommended installation

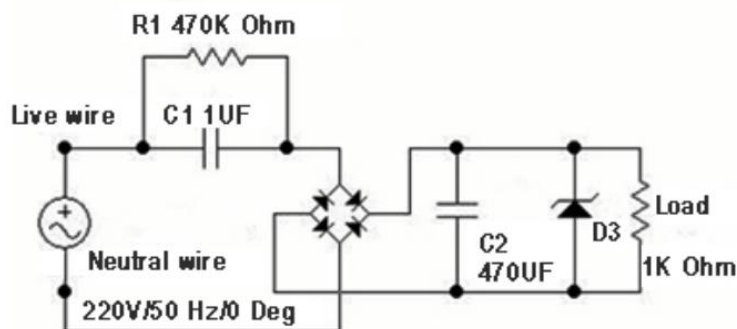


Non-Recommended installation

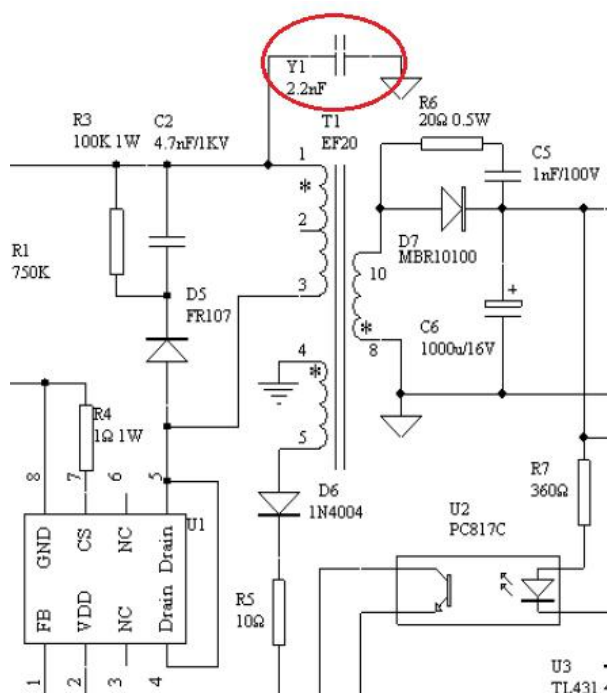


User Attention

- Metal case conducts with GND of internal power supply. Don't short-circuit with other external circuit or shell.
- The best installation way is to make the surface of air inlet and outlet of the sensor clings to the air vent in the inner wall of the user device that communicates with the outside. If it's not possible, then an air isolation structure between air inlet and air outlet is necessary to avoid the air back flow in the user's device.
- Air vent on the internal wall of user's device for airflow should be bigger than the size of air inlet of the sensor.
- For purification products, sensor cannot be installed in the purifying air duct. If it's not possible, it's necessary to design a separate structure for sensor installation to isolate the sensor from air purifier duct.
- For purifier and detector device, the sensor should be installed above 20cm higher than floor to avoid contamination of large dust particles or even flocs near the ground entering the sensor, which influences the measurement.
- Sensor should be prohibited from using for outdoor inspection equipment. Dust storms, rain, snow, and willow flocs can have a significant impact on unprotected sensors.
- Sensor is a complete unit. Disassembling metal shielding cover may cause irreversible damage.
- It is for household electronics products. For application of medical, mining, disaster preparedness, which needs high security and high dependence, this sensor is not suitable.
- Avoid using the sensor under the condition with strong magnetic, such as situation close to stereo speaker, microwave oven, induction cooking.
- There is no high pressure transient protection circuit of the sensor. The power supply of the sensor should be stable and low noise. Please refer to the working voltage in specification table.
- When RC is used to reduce voltage, be cautious that the metal shell should be connected with either 220VAC live wire or the neutral wire.



▪If isolated switch power supply is adopted to obtain DC power, please control the capacitance between the DC ground and the AC ground below 2.2nF and withstand voltage reaches to 3KV.



▪It is defined as 3R laser product according to 《GB7247.1-2012 laser product safety with laser radiation inside》. Please avoid direct exposure to your eyes. Warning sign as below.



UART Communication Protocol

1. General Statement

- 1) The data in this protocol is all hexadecimal data. For example, "46" for decimal [70].
- 2) [xx] is for single-byte data (unsigned, 0-255); for double data, high byte is in front of low byte.
- 3) Baud rate: 9600; Data Bits: 8; Stop Bits: 1; Parity: No
- 4) It is default by continuously mode after powering on. Working mode will not be saved after powering off.

2. Format of Serial Communication Protocol

Sending format of software:

Start Symbol	Length	Command	Data 1	Data n.	Check Sum
HEAD	LEN	CMD	DATA1	DATAn	CS
11H	XXH	XXH	XXH	XXH	XXH

Detail description on protocol format:

Protocol Format	Description
Start symbol	Sending by software is fixed as [11H], module respond is fixed as [16H]
Length	Length of frame bytes= data length +1 (including CMD+DATA)
Command	Command
Data	Data of writing or reading, length is not fixed
Check sum	Cumulative sum of data = 256- (HEAD+LEN+CMD+DATA)

3. Command Table of Serial Protocol

Item No.	Function Description	Command
1	Read particle measurement result	0x0B
2	Open/close particle measurement	0x0C
3	Set up and read particle measurement time	0x0D
4	Set up and read timing measurement mode	0x05
5	Set up and read dynamic working mode	0x06
6	Set up and read particle calibrated coefficient	0x07
7	Close/open laser diode	0x08
8	Read software version number	0x1E
9	Read serial number	0x1F

4. Detail Description of RS232 Protocol

4.1 Read Particle Measurement Result

Send: 11 02 0B 07 DB

Response: 16 35 0B DF1- DF52 [CS]

Function: Read concentration of particle and particles number.

Note: Read particle concentration (ug/m3) and particles number (pcs/0.1L)

PM1.0 GRIMM mass concentration = $DF1 \times 256^3 + DF2 \times 256^2 + DF3 \times 256^1 + DF4$

PM2.5 GRIMM mass concentration = $DF5 \times 256^3 + DF6 \times 256^2 + DF7 \times 256^1 + DF8$

PM10 GRIMM mass concentration = $DF9 \times 256^3 + DF10 \times 256^2 + DF11 \times 256^1 + DF12$

PM1.0 TSI mass concentration = $DF13 \times 256^3 + DF14 \times 256^2 + DF15 \times 256^1 + DF16$

PM2.5 TSI mass concentration = $DF17 \times 256^3 + DF18 \times 256^2 + DF19 \times 256^1 + DF20$

PM10 TSI mass concentration = $DF21 \times 256^3 + DF22 \times 256^2 + DF23 \times 256^1 + DF24$

Particles number >0.3um = $DF25 \times 256^3 + DF26 \times 256^2 + DF27 \times 256^1 + DF28$

Particles number >0.5um = $DF29 \times 256^3 + DF30 \times 256^2 + DF31 \times 256^1 + DF32$

Particles number >1.0um = $DF33 \times 256^3 + DF34 \times 256^2 + DF35 \times 256^1 + DF36$

Particles number >2.5um = $DF37 \times 256^3 + DF38 \times 256^2 + DF39 \times 256^1 + DF40$

Particles number >5.0um = $DF41 \times 256^3 + DF42 \times 256^2 + DF43 \times 256^1 + DF44$

Particles number >10um = $DF45 \times 256^3 + DF46 \times 256^2 + DF47 \times 256^1 + DF48$

DF49: Alarm of sensor module working condition:

Bit	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Alarm definition					1: low working temperature	1: high working temperature	1: Fan at low revolving speed	1: Fan at high revolving speed

DF50, DF51, DF52: Reserved

Note: Part of reserved bit is used for our internal testing. The data changeable of reserved bit is nothing related to function.

4.2 Open/Close Particle Measurement

Send: 11 03 0C DF1 1E CS

Response: 16 02 0C DF1 CS

Function: Open/ close particle measurement

Note:

1. When sensor is power-on, it starts continuous measuring.
2. When sending command, DF1=02 means opening measurement, DF1=01 means closing measurement;
3. When receiving response, DF1=02 means measuring opened, DF1=01 means measuring closed;
4. When the sensor receives the command of opening measurement, it will be in default continuous testing mode.

Continuously working mode:

When continuously measuring mode is set, sensor situation is 2 . When PM1.0 is less than $5 \mu\text{g}/\text{m}^3$, then measuring is close (situation changes to 0x80, only the laser diode turns off for 5 seconds) and

outputs the last value in standby mode. After 5 seconds, the PM sensor resumes the measurement for 4 seconds, If PM1.0 measuring data within the 4s is less than $5 \mu\text{g}/\text{m}^3$, then measuring is close (situation changes to 0x80, only the laser diode turns off for 5 seconds). Otherwise, the sensor will go ahead testing until the PM1.0 measuring data is less than $5 \mu\text{g}/\text{m}^3$.

Example:

Send: 11 03 0C 02 1E C0 //open particle measurement

Response: 16 02 0C 02 DA//module is under particle measurement open status

Send: 11 03 0C 01 1E C1 //close particle measurement

Response: 16 02 0C 01 DB// module is under particle measurement closed status

4.3 Set up and Read Particle Measuring Time

Send: 11 03 0D DF1 DF2 [CS] // set up particle measuring time

Send: 11 01 0D E1 // read particle measuring time

Response: 16 03 0D DF1 DF2 [CS]

Function: Read particle measuring time

Note:

1. Particle measuring time = $\text{DF1} \times 256 + \text{DF2}$, unit is second. Minimum measuring time is 36 seconds. Time range is 36-65535 seconds. After setting up successfully, the sensor will stop working first, then you can send "Open" command to start single xx seconds measuring.
2. When measuring time is ≥ 65531 , it means module will be in continuous measuring mode once powered on. It will not stop until stop command is sent.

Example:

Send: 11 03 0D 00 24 BB // set up single measuring mode; measuring time is 36s

Response: 16 03 0D 00 24 B6// measuring time is set up successfully

Send: 11 03 0D FF FF E1 // set up continuous measuring mode (Repowering on means to start measuring status)

Response: 16 03 0D FF FF DC//continuous measuring mode is set up successfully

Send: 11 01 0D E1// read particle measuring mode

Response: 16 03 0D 00 24 B6 // read single measuring mode successfully

4.4 Set up Timing Measuring Mode

Send: 11 03 05 DF1 DF2 [CS] // set up particle measuring mode

Send: 11 01 05 E9 // read particle measuring mode

Response: 16 03 05 DF1 DF2 [CS]

Function: Read particle measuring time

Note:

1. Particle measuring mode value $X = DF1 \times 256 + DF2$, unit is second;
2. When $X \geq 180$, it means module is under timing measuring mode. Measurement timing cycle is X seconds. The sensor module will start measurement every X seconds. Default measuring time is 36 seconds.
3. Range for X is $180 - 3600 \times 18$, minimum timing period is 3 minutes, maximum timing period is 18 hours.

Send: 11 03 05 02 05 E0 // Set up as timing measuring mode, and timing cycle is 517seconds.

Response: 16 03 05 02 05 DB // Set up successfully

4.5 Set up Dynamic Measuring Mode

Send: 11 02 06 DF1 [CS] // Set up dynamic particle measuring mode

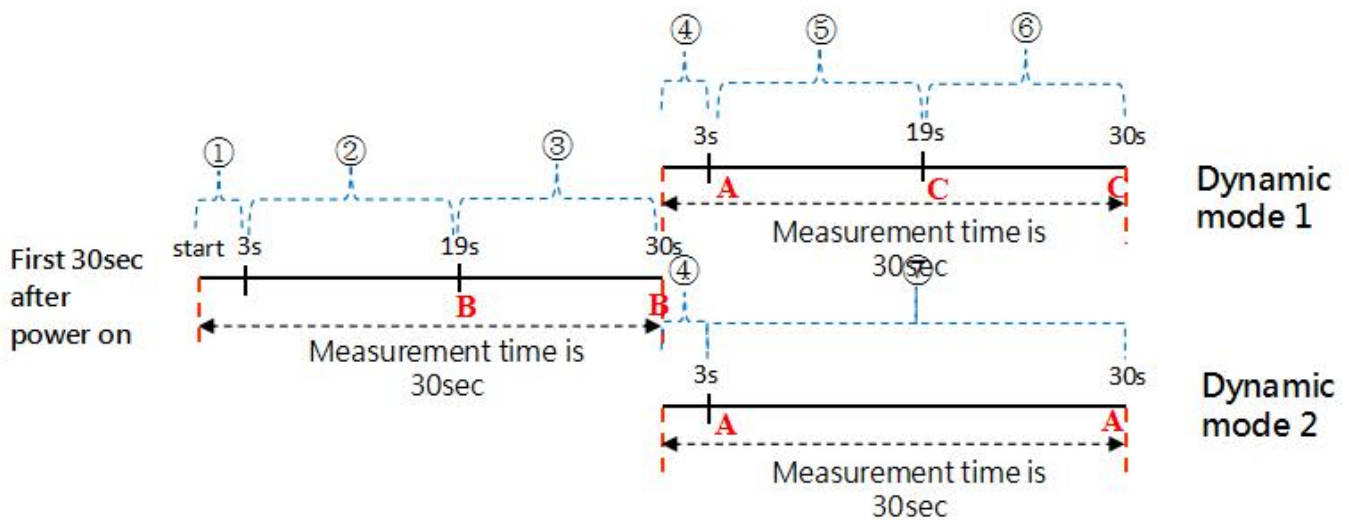
Send: 11 01 06 E8 // Read dynamic particle measuring mode

Response: 16 02 06 DF1 [CS]

Function: Read/set up particle dynamic measuring mode

Note:

1. Particle dynamic measuring mode result DF1.
2. When $DF1=00$, close dynamic measuring mode. When $DF1=01$, start dynamic measuring mode.

Dynamic Working Mode Description:

After sensors are in dynamic working mode, start measuring every 30s. The sensor starts the measurement for the first 3 seconds.

After 3 seconds of measurement, the sensor starts measuring again continuously for 16 seconds and outputs the B value.

The laser diode turns off for 11 seconds, enters the standby state, and outputs the B value.

After the first 30 second period, the sensor starts a new 3 second measurement and outputs the A value.

① If $|A-B| > 10 \mu\text{g} / \text{m}^3$ or $|A-B| / B > 10\%$, the sensor selects Dynamic mode 1. The sensor measures continuously for 16 seconds and outputs the C value.

The laser diode turns off for 11 seconds, enters the standby state, and outputs the C value.

② If $|A-B| < 10 \mu\text{g} / \text{m}^3$ or $|A-B| / B < 10\%$, the sensor selects Dynamic mode 2 and stores A value, then enters standby state for 27 seconds and outputs A value.

Remark: A, B, C value is related to PM1.0 Grimm mass concentration

Regardless of the dynamic mode A or B, the sensor starts a new 30 second measurement cycle by starting the initial 3 second measurement. Compare the measured value with the previously stored value for the initial 3 seconds and select Dynamic mode 1 or 2 again.

Send: 11 02 06 01 E6 // Set up opening dynamic particle measuring mode

Response: 16 02 06 01 E1 // Set up successfully

Send: 11 02 06 00 E7 // Set up closing dynamic particle measuring mode

Response: 16 02 06 00 E2 // Set up successfully

Remark:

The module can support 4 kinds of working mode (Single+Continuous+Timing+Dynamic). It can be switched between these 4 kinds of working mode. It is continuous working mode by default after leaving factory. These 4 kinds of working mode can be switched by sending commands, as following:

1. Send: 11 03 0D 00 24 BB // Single measuring mode, time is 36s. After setting up successfully, the sensor will stop working first, then you can send "Open" command to start single 36s measuring.
2. Send: 11 03 0D FF FF E1 // Continuously measuring mode
3. Send: 11 03 05 02 05 E0 // Timing measuring mode, interval time is 517 seconds
4. Send: 11 02 06 01 E6 // Dynamic measuring mode

4.6 Set up and Read Particle Calibrated Coefficient

Send: 11 02 07 DF1 [CS] // Set up particle calibrated coefficient

Send: 11 01 07 E7 // Read particle calibrated coefficient

Response: 16 02 06 DF1 [CS]

Function: Read/set up particle calibrated coefficient

Note:

1. Range 70~150 Corresponding coefficient: 0.7~1.5

Description:

1. When there is difference between standard device, calibrated coefficient can be set to correct the final value.
2. When calibrated coefficient is set, the value of PM1.0, PM2.5, and PM10 will be all corrected by this coefficient.

4.7 Close/Open Laser Diode

Send: 11 02 08 04 E1// Close laser diode

Send: 11 01 08 E6 // Read status

Response: 16 02 08 04 DC

Note:

When laser diode is closed, the sensor will stop measuring but the FAN will stay working. The measuring data will keep the same with the last time measured data. If to open the laser diode again, you can use "Open/ close particle measurement' command.

4.8 Read Software Version Number

Send: 11 01 1E D0

Response: 16 0E 1E DF1~DF13 [CS]

Function: Read software version

Note:

Software version="DF1~DF13"

Should change the HEX code to ASCII code.

Example:

HEX code: 16 0E 1E 50 4D 20 56 31 2E 32 36 2E 35 2E 32 38 E9

ASCII code: PM V1.26.5.28

4.9 Read Serial Number

Send: 11 01 1F CF

Response: 16 0B 1F DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 CS

Function: Read serial number

Note:

Serial number

$= (DF1 * 256 + DF2), (DF3 * 256 + DF4), (DF5 * 256 + DF6), (DF7 * 256 + DF8), (DF9 * 256 + DF10)$

Example:

Response: 16 0B 1F 00 00 00 7E 09 07 07 0E 0D 72 9E

Serial number: 126 2311 1806 3442

I²C Communication Protocol

1. Brief Introduction

- This is an I²C protocol for PM2008-API. The sensor module is lower computer, which is not able to initiate communication automatically. Communication is initiated via main controlled board, which reads data and sends control commands.
- Communication clock frequency $\leq 100\text{Khz}$

2. Communication Common Command

START: start signal, send by main controlled board;

STOP: stop signal, send by main controlled board;

ACK: acknowledge signal, send by the sensor module if in bold; otherwise, send by main controlled board;

NACK: non-acknowledge signal, send by the sensor module if in bold; otherwise, send by main controlled board;

Px: receive and send data; send by the sensor module if in bold; otherwise, send by main controlled board.

3. Protocol Detailed Description

3.1 Send Command Data

Send by main controlled board:

START+WRITE+ACK+P1+ACK+P2+ACK+..... +P7+ACK+STOP

Data	Byte content	Description
Device address	Sensor address and read/write command	This byte is 0x50 when write data
P1	0x16	Frame header
P2	Frame length	Number of byte, not including length of device address (From P1 to P7, 7 bytes in total)
P3	Data 1	Control command of the sensor as: Close measurement: 1 Open single measurement: 2 Set up continuously measurement : 3 (default mode) Set up timing measurement: 4 Set up dynamic measurement: 5 Set up calibration coefficient:6
P4	Data 2, high byte	Measuring time: (range: 180~64800) unit: second. It should be 0xFF 0xFF when setting up continuously measurement here. Calibration coefficient:(Range: 70~150, Corresponding: 0.7~1.5)
P5	Data 2, low byte	
P6	Data 3	Reserved
P7	Data check code	Check code= (P1^P2^.....^P6)

3.2 Read Data Command

Send by main controlled board:

START+READ+ACK+P1+ACK+P2+ACK+.....+P32+NACK+STOP

Data	Byte content	Description
Device address	Sensor address and read/write command	This byte is 0x51 when read data
P1	0x16	Frame header
P2	Frame length	Number of byte, not including length of device address (from P1 to P32, 32 bytes in total)
P3	Sensor status	Close: 1; Alarm: 7; Testing: 2; Data stable: 0x80 Other data is invalid.(Check 3.3 detailed introduction for every kinds of sensor status)
P4	Data 1, high byte	The measuring mode of sensor as: Single measuring mode: 2; Continuous measuring mode: 3 Dynamic measuring mode: 5; Timing measuring mode: >= 180 (means measuring time)
P5	Data 1, low byte	
P6	Data 2, high byte	
P7	Data 2, low byte	Calibration coefficient: (Range: 70~150, Corresponding: 0.7~1.5)
P8	Data 3, high byte	PM1.0 concentration , unit: $\mu\text{g}/\text{m}^3$, GRIMM
P9	Data 3, low byte	
P10	Data 4, high byte	PM2.5 concentration , unit: $\mu\text{g}/\text{m}^3$, GRIMM
P11	Data 4, low byte	
P12	Data 5, high byte	PM10 concentration , unit: $\mu\text{g}/\text{m}^3$, GRIMM
P13	Data 5, low byte	
P14	Data 6, high byte	PM1.0 concentration , unit: $\mu\text{g}/\text{m}^3$, TSI
P15	Data 6, low byte	
P16	Data 7, high byte	PM2.5 concentration , unit: $\mu\text{g}/\text{m}^3$, TSI
P17	Data 7, low byte	
P18	Data 8, high byte	PM10 concentration , unit: $\mu\text{g}/\text{m}^3$, TSI
P19	Data 8, low byte	
P20	Data 9, high byte	Number of PM0.3, unit: pcs/0.1L
P21	Data 9, low byte	
P22	Data 10, high byte	Number of PM0.5, unit: pcs/0.1L
P23	Data 10, low byte	
P24	Data 11, high byte	Number of PM1.0, unit: pcs/0.1L
P25	Data 11, low byte	
P26	Data 12, high byte	Number of PM2.5, unit: pcs/0.1L
P27	Data 12, low byte	
P28	Data 13, high byte	Number of PM5.0, unit: pcs/0.1L
P29	Data 13, low byte	
P30	Data 14, high byte	Number of PM10, unit: pcs/0.1L
P31	Data 14, low byte	
P32	Data check code	Check code = $(P1 \wedge P2 \wedge \dots \wedge P31)$

3.3 Description of sensor status

1. Status "1"

Means sensor is closing.

2. Status "2"

Means sensor is under measuring.

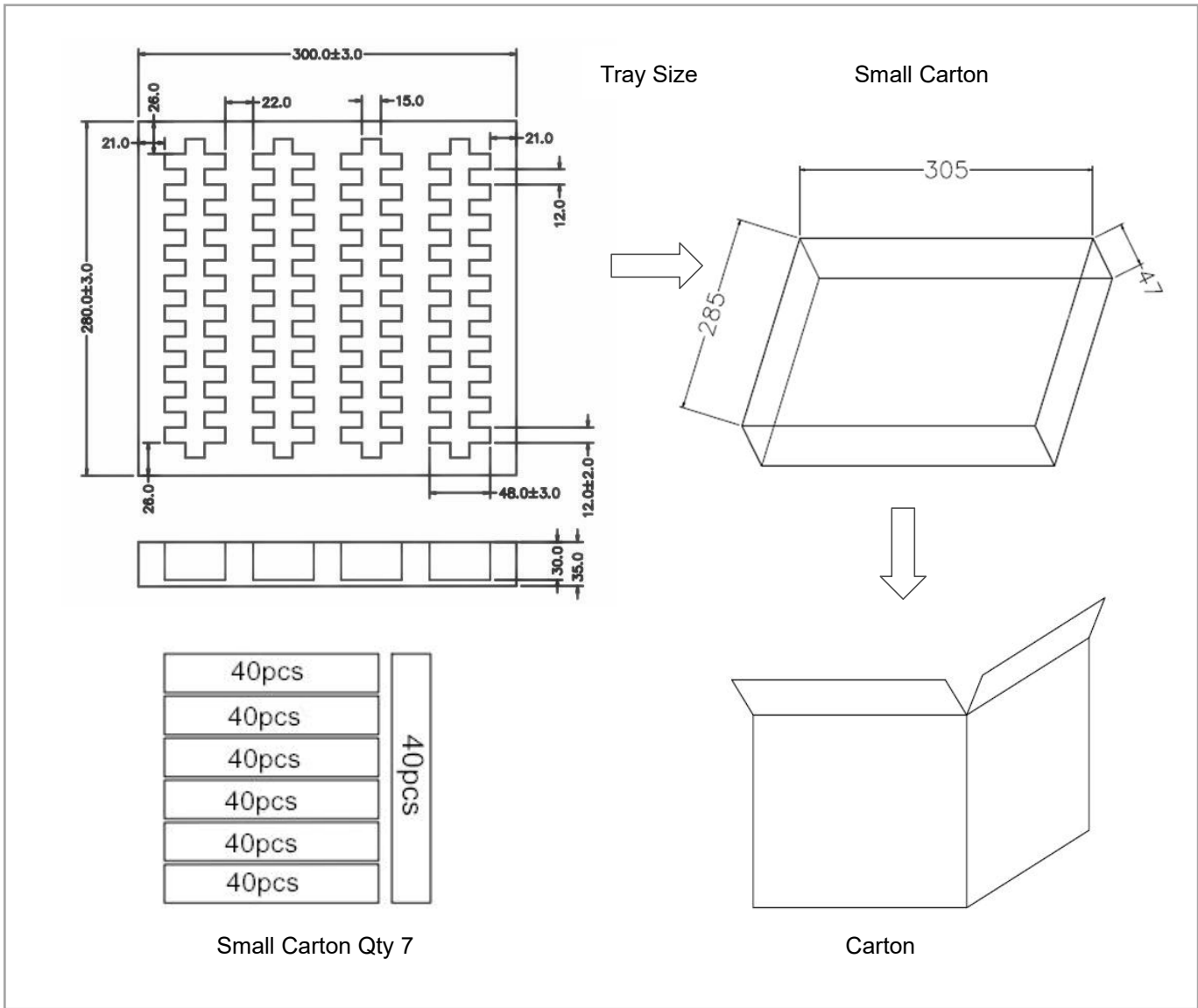
3. Status "7"

Means the temperature is too high or too low, or fan speed is too high or too low.

4. Status "0x80"

Means measuring data is stable.

Package Information



Sensor per Tray	Tray Qty	Sensor per Carton	Carton Dimensions	Packing Material
40 pcs	7 layers	280 pcs	395*310*330 mm	Red anti-static EPE

After-Sales Services and Consultancy

Cubic Sensor and Instrument Co.,Ltd
Tel: +86 (0)27 81628827 Fax: +86 (0)27 81628821
Add: Fenghuang No.3 Road, Fenghuang Industrial Park, Eastlake Hi-tech
Development Zone, Wuhan 430205, China
E-mail: info@gassensor.com.cn