Laser Particle Sensor Module

PM2009

Application

- ✧ Air purifier, air quality monitor
- ✧ Ventilation system, air conditioner with purifying function
- ✧ Auxiliary product of consumer electronic products
- ✧ Environmental monitoring
- ✧ Handheld air quality detector

Description

PM2009 laser particle sensor module use light scattering principle, to measure and calculate the suspending particle number which is within unit volume on the air exactly. Then output particle mass concentration by mathematical algorithm and scientific calibration.

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.

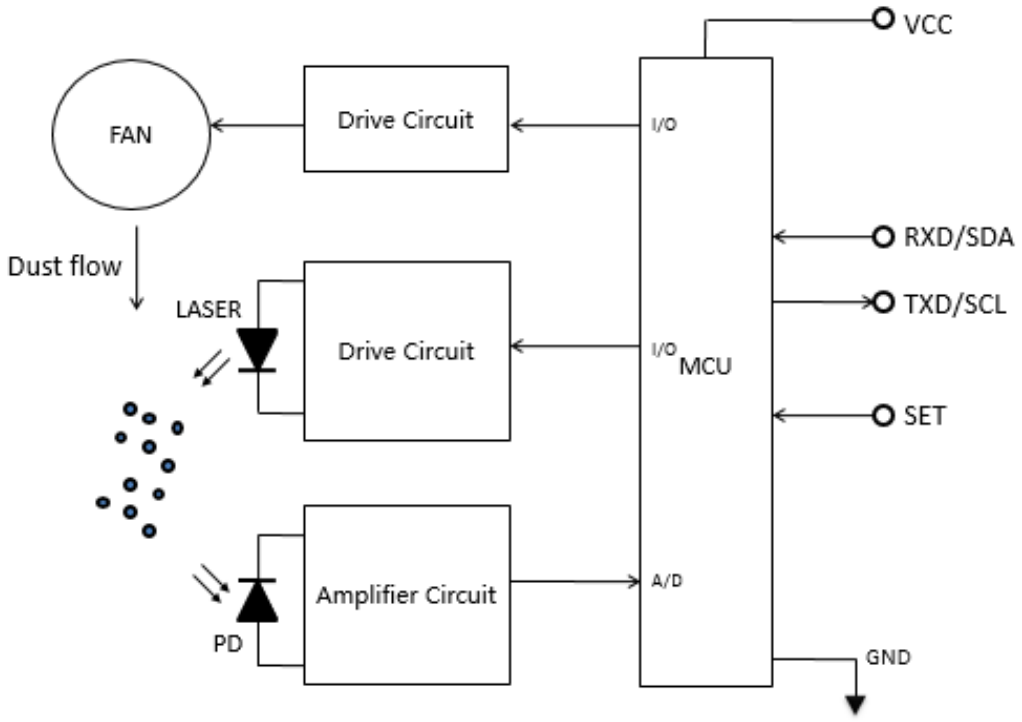
Main features

- ✧ The smallest size of available measurement: 0.3μm
- ✧ Three types of optional signal output
- ✧ Four types of optional measuring mode
- ✧ High sensitive and quick response
- ✧ Super slim design，light weight, easy for installing.

Cubic particle sensor module specification

Measuring particle range	0.3 ~ 10 μm
Measurement range	0-500μg/m³
Resolution	1μg/m³
Consistency Error for PM2.5	0~100μg/m³ ±15μg/m³ 101 ~500μg/m³ ±15% reading
Test dust	Cigarette
Data refresh frequency	1s
Preheating time	≤8 s
Working temperature	-10℃~ +60℃
Working humidity	0~95%RH （non-condensing）
Storage temperature	-20℃~+85℃
Nominal voltage	DC (5.0±0.1)V，ripple wave <50mV
Current	<100mA; Standby current <20mA
Signal output	1. UART_TTL(3.3V/5V, default) 2. I℃ (3.3V/5V, default) 3. PWM （Customized）
Output method	Data output is passive response, output interval is 1000ms
Dimension	50mm*38mm*21mm
MTTF	37297h (continuous turn on)

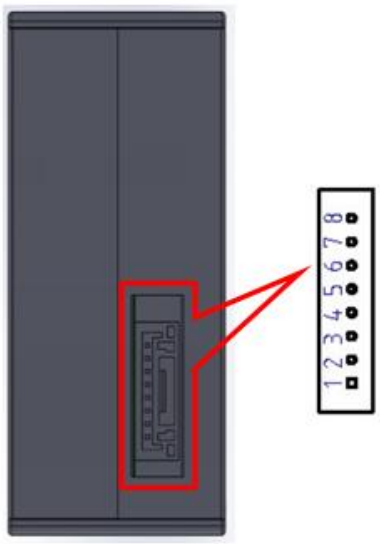
Internal architecture description

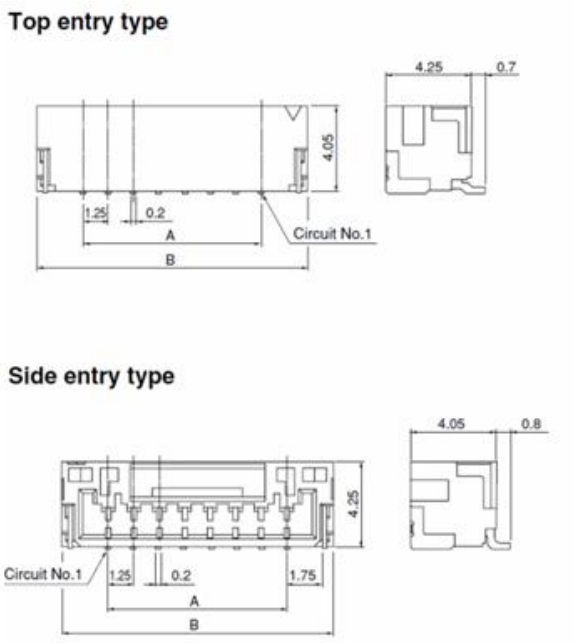


According to above Block Diagram, the air sampling of sensor is consist of fan and drive electric, the light source is consist of laser diode and drive electric, the detecting part is consist of light sensitive tube and amplifying circuit.

Air enter into the module by fan sampling, the light from laser diode will be scattered by particles and will be tell out by light sensitive equipment, then convert into electronic signal. Electronic signal is disposed by filter circuit and MCU, Then output particle mass concentration.

Configuration structure and I/O definitions





I/O definitions

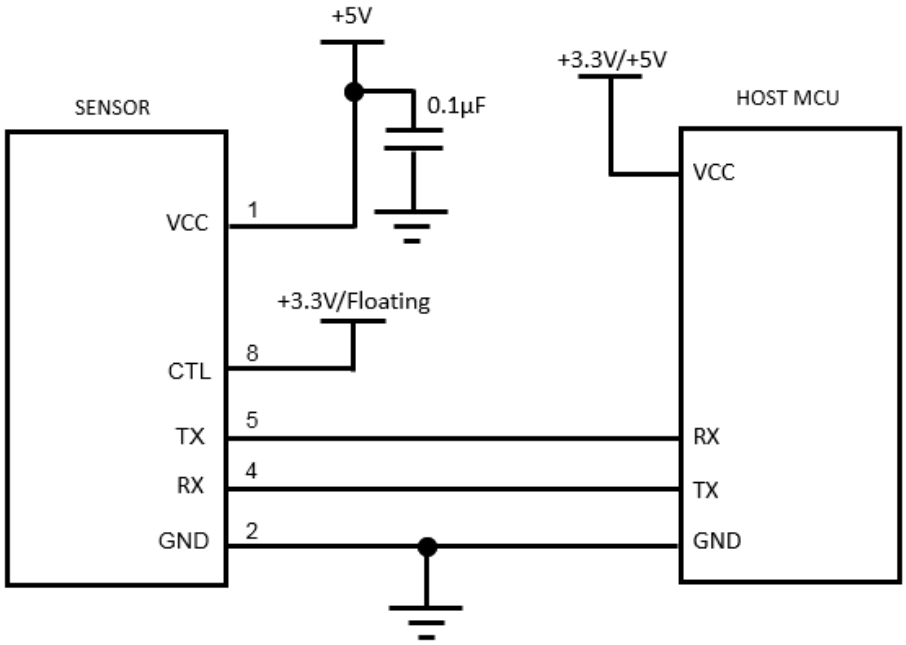
No.	PIN	Description
1	VCC	Power input（+5V）
2	GND	Power input (ground terminal)
3	SET	Set (TTL level @3.3V，high level or floating is normal working status, while low level is sleeping mode)
4	RX/SDA	UART-RX / I℃ SDA（TTL level @3.3V）,compatible with 5V communication
5	TX/SCL	UART-TX / I℃ SCL（TTL level @3.3V）,compatible with 5V communication
6	RESET	Reset/ TTL level @3.3V, low reset
7	NC	Impending（Do not connect）
8	CTL	Output mode exchange TTL level @3.3V High level or floating is UART communication mode, low level is I℃ communication mode

Connector description (Can be customized)

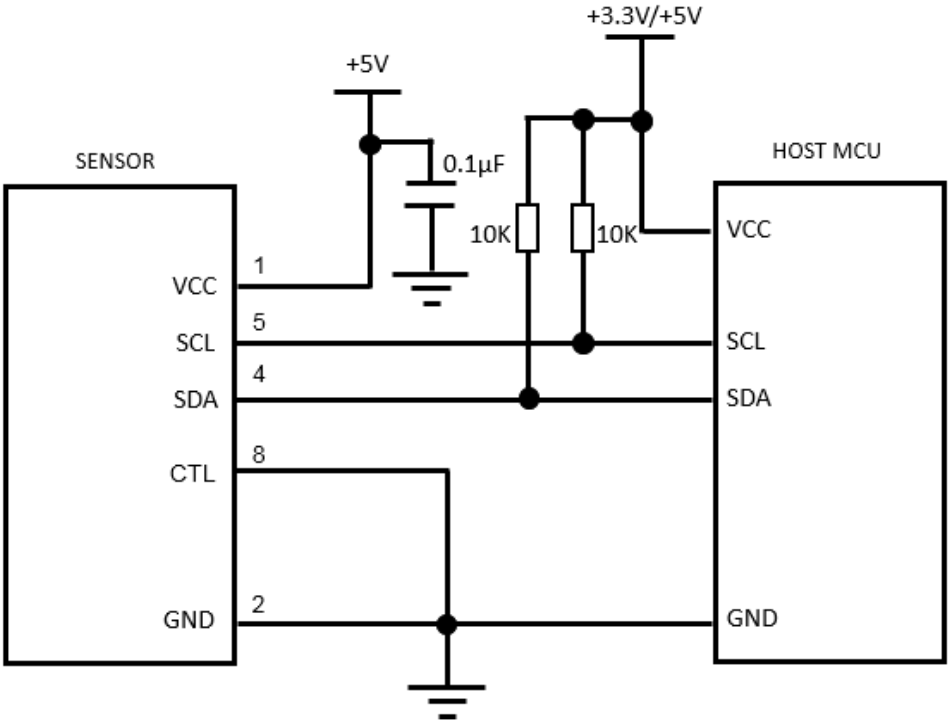
Item	Pin spacing	Brand
JST SM08B-GHS-TB	1.25 mm pitch	JST

Typical application circuit

Application 1：UART TTL 3.3V UART output



Application 2：I²C serial output



Note of circuit design：

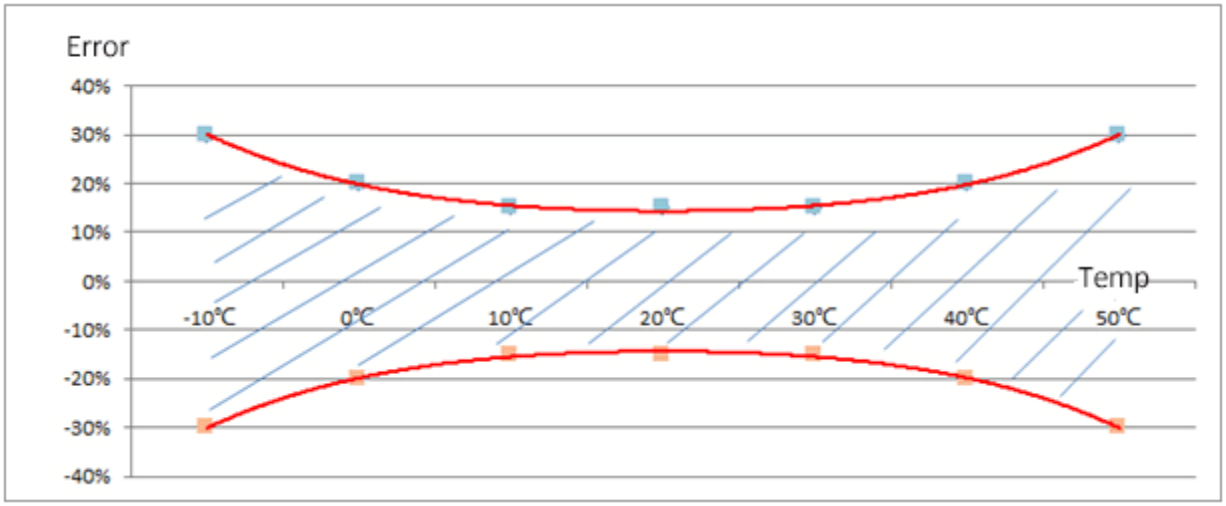
※ UART and I℃ communication is compatibility with 3.3V and 5V level.

※ 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.

※ PIN7 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 details.

Temperature influence curve



Particle measured error: under 25±2℃，0~1000μg/m³, consistency and accuracy of PM2.5 is either ±15% reading or ±15μg/m³, use the biggest value

Temperature influence coefficient: 0.5%/℃~ 1%/℃ or 0.5μg/m³/℃~ 1μg/m³/℃，use the biggest value

Reliability test

Test Item	Test Condition	Standard	Sample qty: N Defective qty: C
Normal temperature performance	The temperature indoor should be: 25±2℃, and humidity is （50±10）%RH，Measuring in different particle environment after powering on	Consistency error： 0-100μg/m³:≤（±15μg/m³） 101-1000μg/m³ :≤（ ±15% of reading ）	n=10 c=0
Temperature influence	Operating the sensor in different temperature condition :-10±2℃, 0±2℃, 10±2℃, 20±2℃, 30±2℃, 40±2℃, 50±2℃ to measure the error of the sensor after powering on.	Measurement error satisfies the requirement of temperature curve	
Low temperature performance	The temperature indoor should be: -10±2℃. Measuring in different particle environment after powering on.	Measurement error satisfies the requirement of temperature curve	n=10 c=0
High temperature performance	The temperature indoor should be: 50±2℃，Measuring in different particle environment after powering on	Measurement error satisfies the requirement of temperature curve	
Low humidity performance	Operating the sensor in the ambient of 25±2℃,（30±5）%RH to measure the error of the sensor in different particle environment	PM2.5 Consistency error： 0-100μg/m³:≤（±15μg/m³） 101-1000μg/m³ :≤（ ±15% of reading ）	
High humidity performance	Operating the sensor in the ambient of 25±2℃,（80±5）%RH to measure the error of the sensor in different particle environment	PM2.5 Consistency error： 0-100μg/m³:≤（±15μg/m³） 101-1000μg/m³ :≤（ ±15% of reading ）	
Low temperature storage	Leave the sensor in the ambient of -20℃±2℃ for 500 hours after powering off. Then measuring the error of the senor in normal temperature	The sensor works normally after 2 hours in the ambient.	n=5 c=0
High temperature storage.	Leave the sensor in the ambient of 60℃±2℃，（50±10）%RH for 500 hours after powering off. Then measuring the error of the senor in normal temperature	The sensor works normally after 2 hours in the ambient.	n=5 c=0
Low temperature working	Leave the sensor in the ambient of -10±2℃, max voltage (within range of acceptable working voltage) for 500 hours. Then measuring the error of the senor in normal temperature	The sensor works normally after 2 hours in the ambient.	n=5 c=0
High temperature working	Leave the sensor in the ambient of 50±2℃, max voltage (within range of acceptable working voltage) for 500 hours. Then measuring the error of the senor in normal temperature	The sensor works normally after 2 hours in the ambient.	n=5 c=0
Thermal impact	Leave the sensor in ambient of -20℃ for 55 mins then move it to ambient of +60℃ within 5 mins for another 55 mins. Keep this cycle for 10 times. Powering off when testing.	The sensor works normally after 2 hours in the ambient.	n=5 c=0
High temperature and high humidity operation	Operating the sensor in the ambient of 50±2℃，80～85%RH，max voltage (within range of acceptable working voltage), for 500 hours.	The sensor works normally after 2 hours in the ambient.	n=5 c=0

Vibration test	10-55-10Hz/min, with amplitude of 1.5mm, vibrate in X,Y,Z direction, each direction for 2 hours.	1）The sensor works normally after 1 hours in the ambient. 2）Wire terminals without loss	n=5 c=0
Drop test	Drop the sensor from 1 m height down to the hard wooden board randomly for three time	The sensor works normally	n=5 c=0
Salt spray test	According to GB/T2423.17-2008, leave the sensor in the 35℃ salt-fog cabinet, spray it with 5% sodium chloride saltwater for 24 hours. Using water to clean the sensor after test.	No red rust on the sensor surface	n=5 c=0
Switch testing	In normal temperature , leave the sensor with powered-on for 5 mins and powered with 5 mins to test for 500 hours repeatedly	The sensor works normally	n=5 c=0
High level particle test	Operating the sensor continuously for 24 hours in the ambient of 10mg/m ^{3}	The sensor works normally after 1 hour in the ambient.	n=5 c=0
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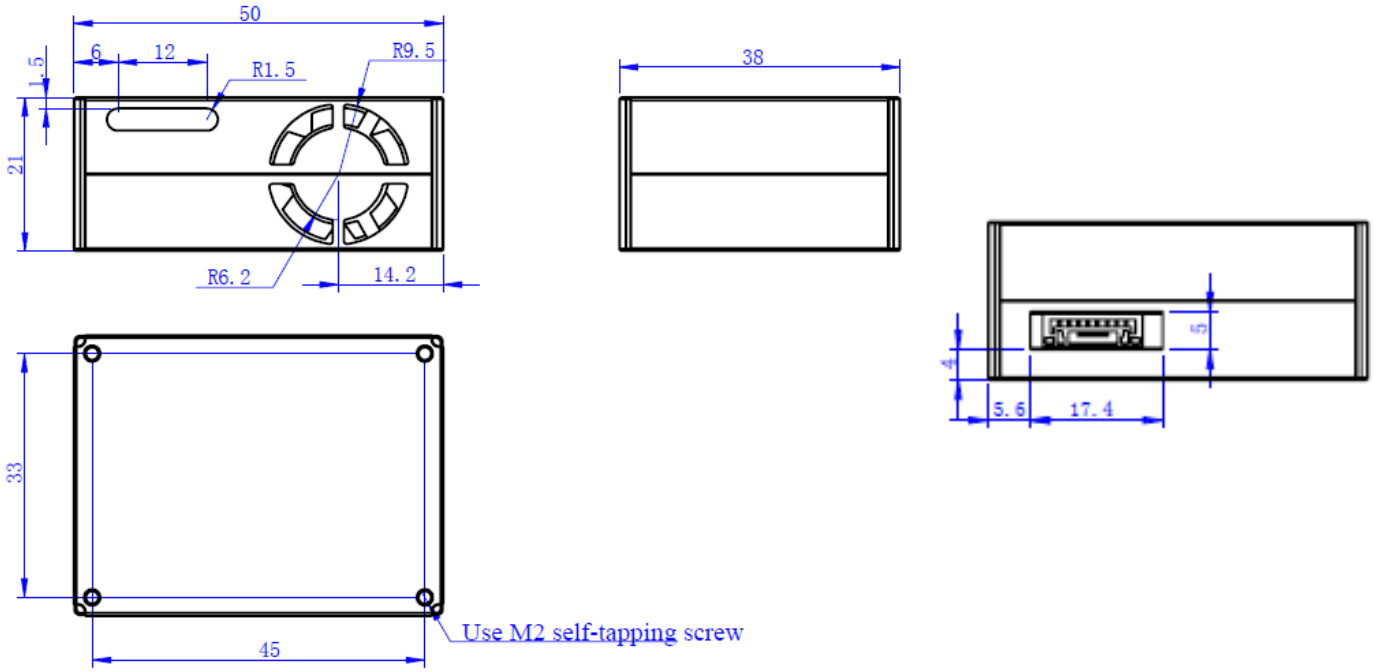
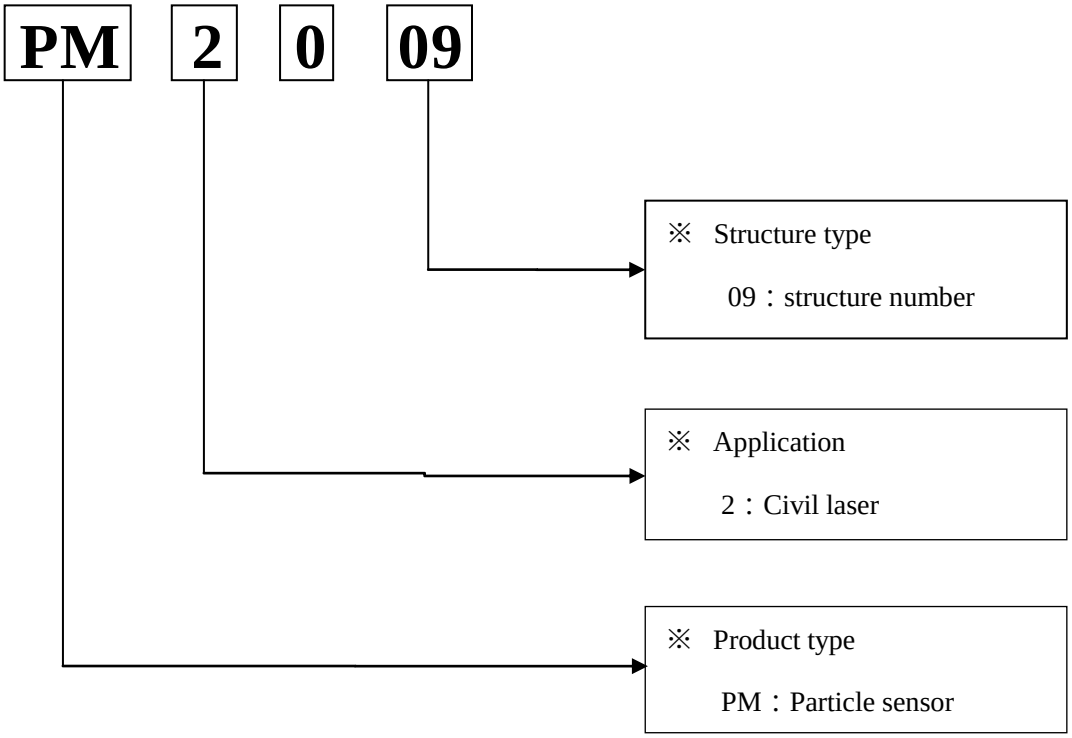
Sensor dimension

Dimension description of sensor

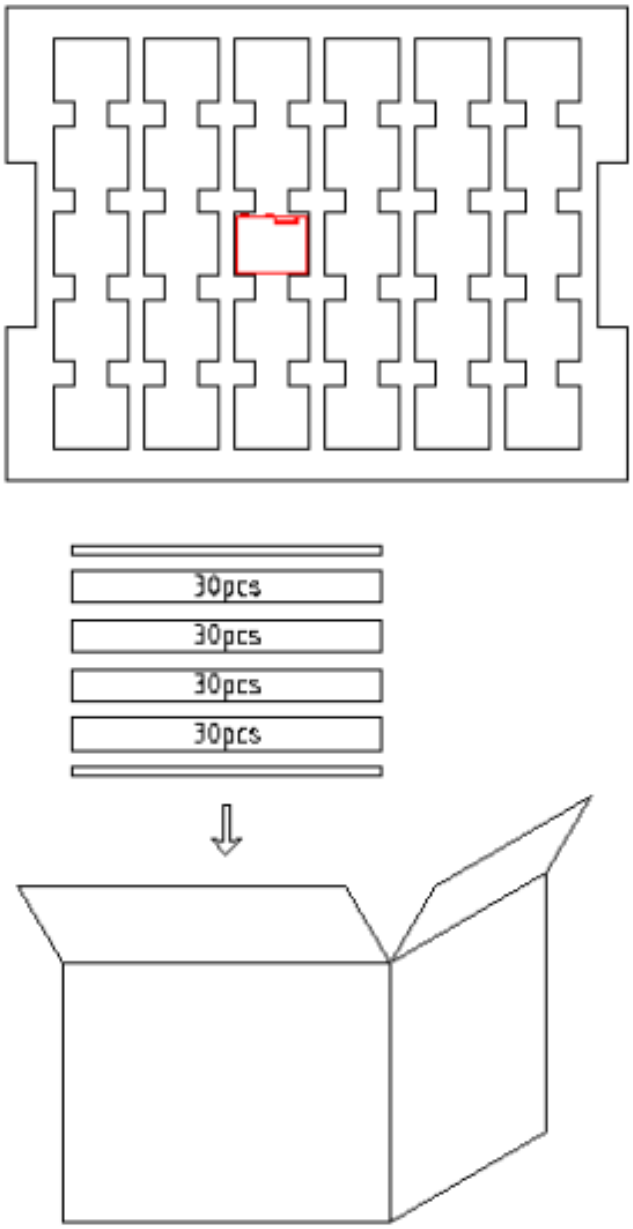
Unit: mm



Ordering Information



Packing information

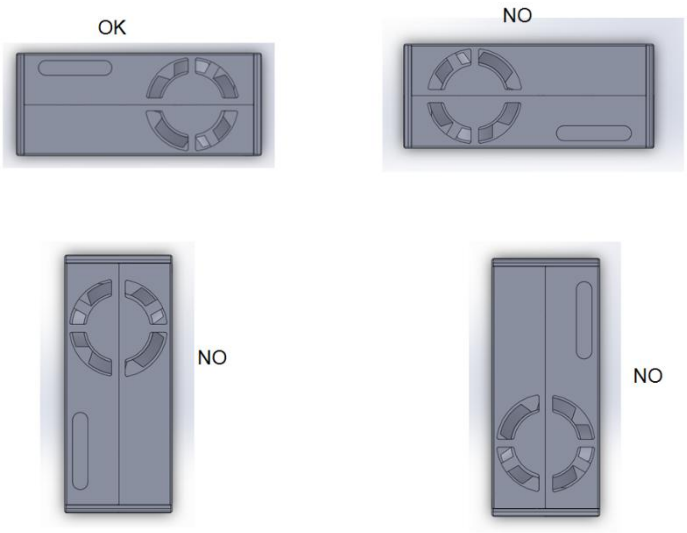


Packing method

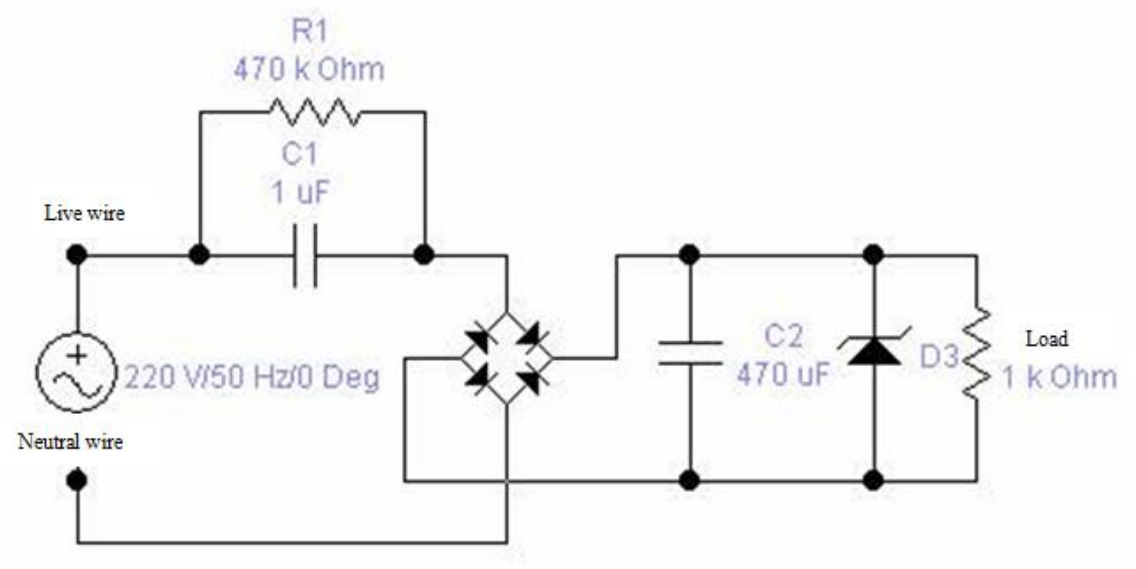
Per layer qty	Layers	Packing qty	Carton dimensions	Packaging material
30pcs	13 layers	390	W395 * L310 * H480 mm	Red pearl cotton (ESD)

User attention

- PM2009 laser particle sensor module is for household electronics products. For application of medical, mining, disaster preparedness, which need high security and high dependence, this sensor is not suitable.
- Please do not use it in bad dusty environment.
- Avoid using the sensor under situation with strong magnetic, such as situation close to stereo speaker, microwave oven, induction cooking.
- When install PM2009 sensor module in your system or equipment, please make sure of unobstructed air-inlet and air-outlet. And there is no huge airflow faced to air-inlet and air-outlet. **Correct installation position as below for reference:**

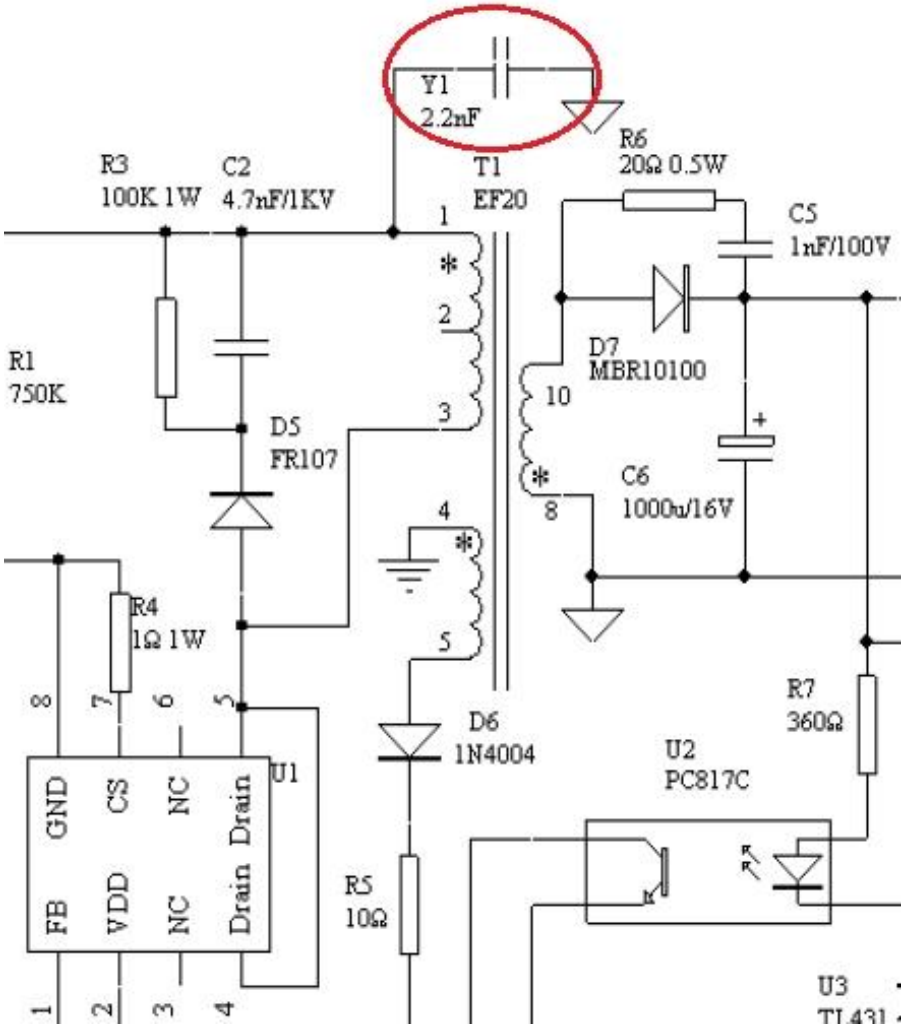


- There is no high voltage transient protection circuit, the power supply should be 5V with stable and low noise. Please reference to table 1
- The power supply for the sensor is 5 V because that the fan should be drove under 5V. But it is 3.3 V communication to work as high level electricity for other data communication interface and pin. So the main board MCU is 3.3V communication level. If main board MCU is 5V communication level, then should add an external 5V switch to 3.3V level on the communication pi n (RX,TX) and controlled pin (RESET), to switch components and circuit. Please reference to table 2.
- When RC is used to reduce voltage, be cautious that the metal shell will be connected with either 220VAC live wire or the neutral wire.



Note

- 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.



The sensor itself is safe to use, what you should be cautious is the safety of power supply and structure design on the sensor.

After-sales services and consultancy

Wuhan Cubic Optoelectronics Co., Ltd
ADD: Fenghuang No.3 Road, Fenghuang Industrial Park, Eastlake Hi-tech Development Zone, Wuhan 430205, China
TEL: 86-27-81628827
FAX: 86-27-87401159
Http://www.gassensor.com.cn
E-mail: info@gassensor.com.cn