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Laser Particle Sensor Module

PM3015

Application

- ✧ Outdoor air quality monitor.
- ✧ Ventilation system, air conditioner with purifying function
- ✧ Auxiliary product of consumer electronic products
- ✧ Environmental Monitoring
- ✧ Outdoor portable air quality sensor

Description

The PM3015 is an outdoor laser particle sensor module. The sensor can accurately measure particle concentration PM 1.0μg/m³ and PM 2.5 μg/m³ through mathematical algorithms and scientific calibration.

Working principle

To draw air into closed interior space and then take air sampling in certain proportion. 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 the particles are, the stronger the pulse signal will be (peak value). Based on peak value and number of pulses, particle quantity concentration can be calculated. After calibrated with standard instrument, particle mass concentration is obtained.

Main features

- ✧ The smallest size of available measurement: 0.3μm
- ✧ Three types of optional signal output: UART_TTL, I²C, PWM
- ✧ Four types of measuring mode for option: single / continuous / timing / dynamic mode
- ✧ High sensitive and quick response
- ✧ It is with compacted structure, light weight and easy for installation and maintenance

Table 1: Cubic particle sensor module specification

Measured particle range	0.3μm ~ 10μm
Measurement range	PM1.0: 0 ~ 1,000μg/m³ PM2.5: 0 ~ 1,000μg/m³ PM10: 0 ~ 1,000μg/m³
Resolution	1 μg/m³
Working temperature	**-30°C ~ 70°C**
Storage temperature	-30°C ~ 80°C
Working humidity	0 ~ 95%RH(non-condensing)
Maximum Consistency Error for PM1.0 & PM2.5	0 ~ 100μg/m³, ±10μg/m³ 101 ~ 1,000μg/m³, ±10% reading
Maximum Consistency Error for PM10	0 ~ 100μg/m³, ±25μg/m³ 101 ~ 1,000μg/m³, ±25% reading
Respond time	1 sec
Time to first reading	≤ 8 sec
Power supply	DC 5V±0.1V, ripple wave＜50mV
Working current	<100mA
Standby current	<20mA
Dimensions	42mm×36mm×24mm
Digital output 1 (default)	UART_TTL_3.3V(default) I²C_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	37,297hr (continuous turn on)
Fan Waterproof grade	**IP42**

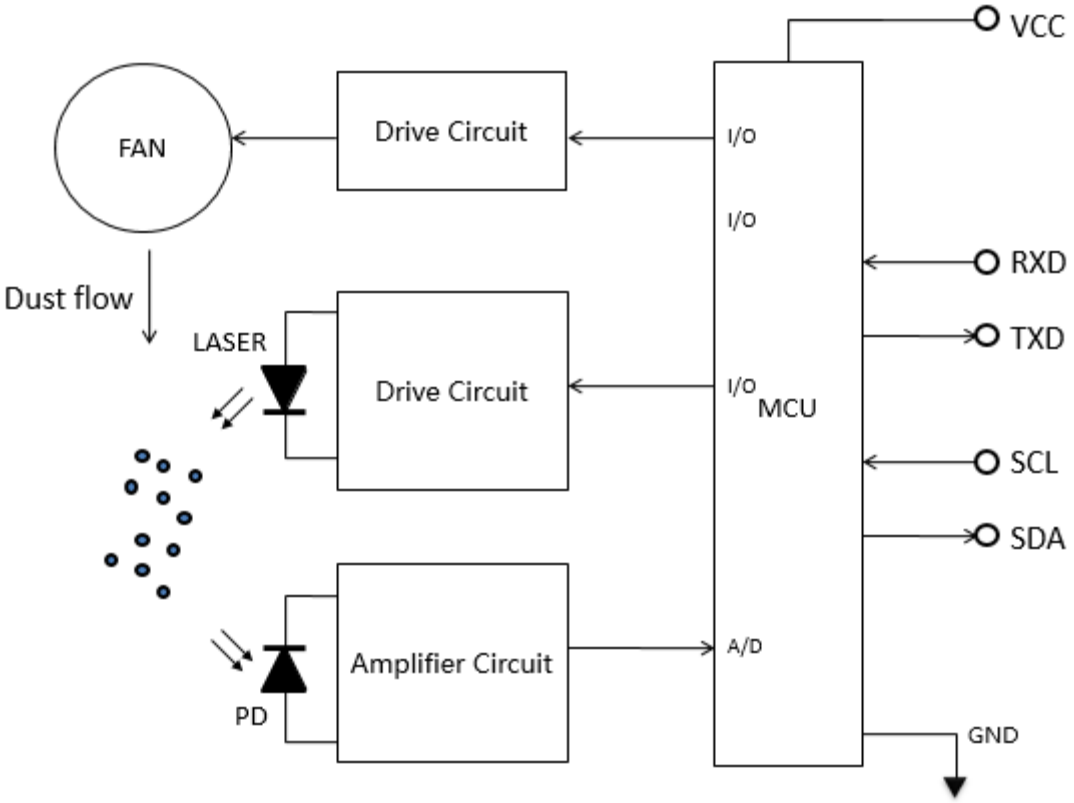


Figure 1. Internal configuration

The principle of particle detection is that while in-flowed particle is passing by the measuring scope through fan flow, the lights from laser diode is scattered by particle and is recognized as a signal at photo diode. The signal from photo diode is transformed into a UART/PWM/IIC signals by MCU

According to above Block Diagram, PM3015 is consist of fan for particle sampling, laser diode for particle detection, photodiode for scattered laser signal, Amp for signal amplification

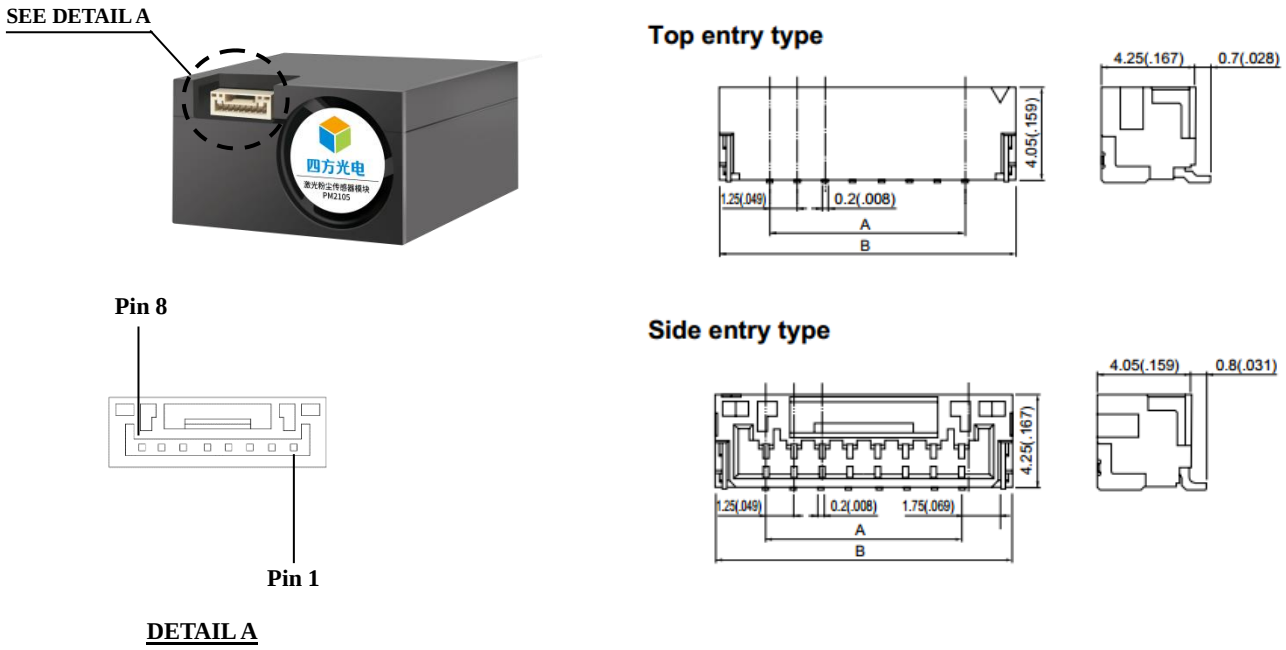


Figure 2. Connector Structure

Table 2: I/O Connector Specification

No.	Pin	Description
1	+3.3V	Power output (+3.3V/≤100mA)
2	5V	Power input (+5V)
3	SCL	I2C clock (TTL level @3.3V/5V)
4	SDA	I2C data (TTL level @3.3V/5V)
5	TEST	Suspend this pin without connecting
6	TXD	UART-TX (TTL level @3.3V)
7	RXD	UART-RX (TTL level @3.3V)
8	GND	Power input (ground terminal)

Table 3: Connector Description (Connector can be customized)

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

Case 1. UART application

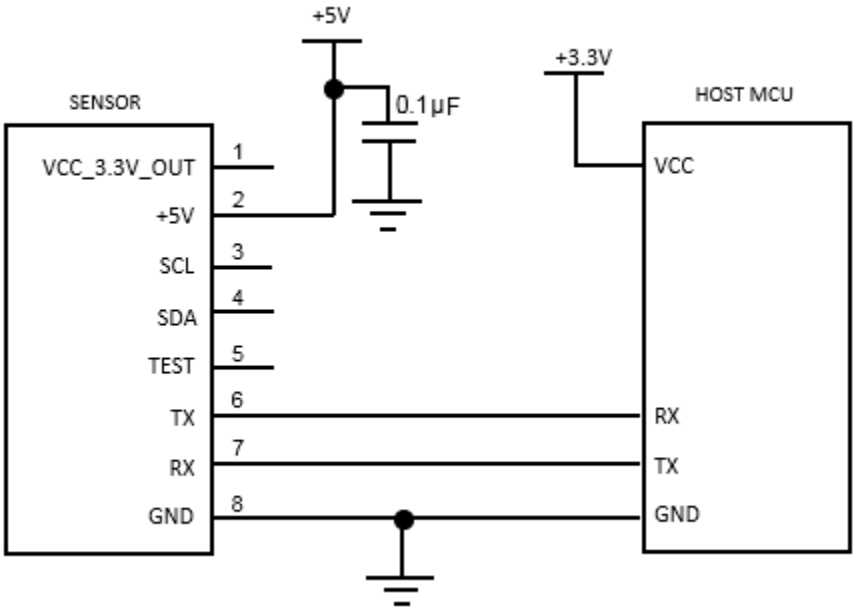


Figure 3. **UART** application circuit

Case 2. I²C application

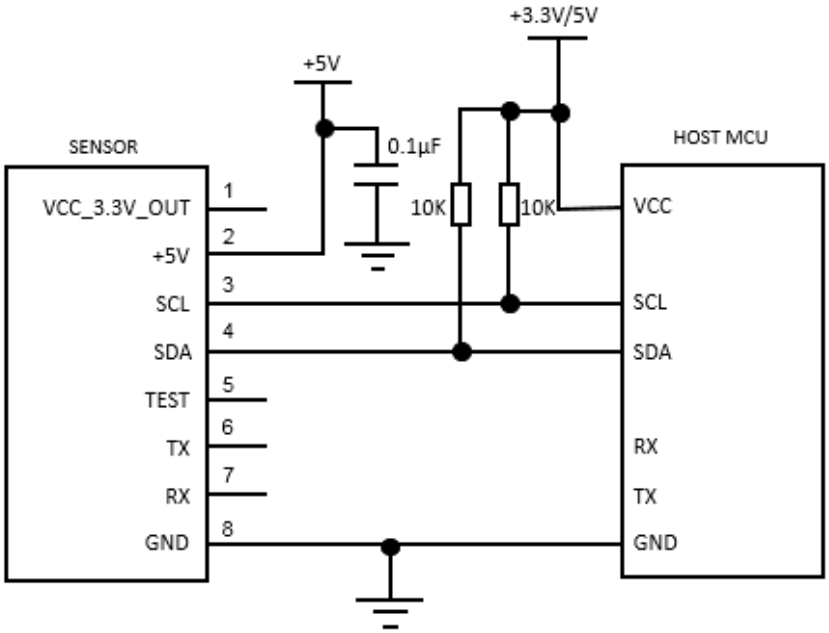


Figure 4. I²C application circuit

Case 3：5V-3.3V Level Shift

RX, TX Level Shift

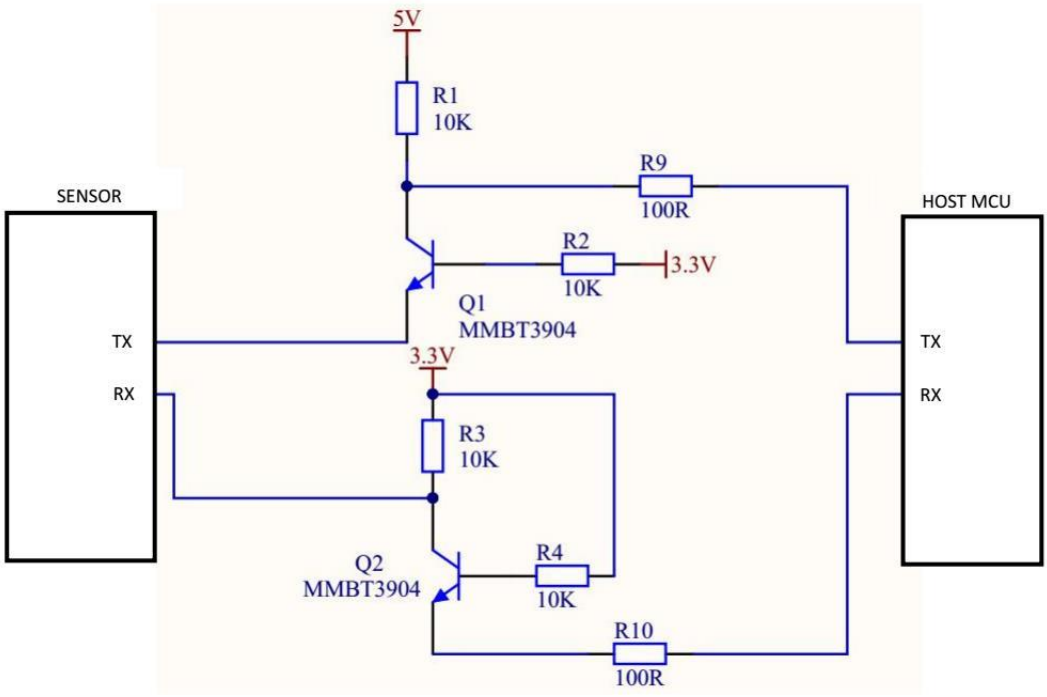


Figure 5. RX, TX Level Shift (3.3V-5V) Diagram

Dimension

Unit: mm, tolerances: ±0.2mm

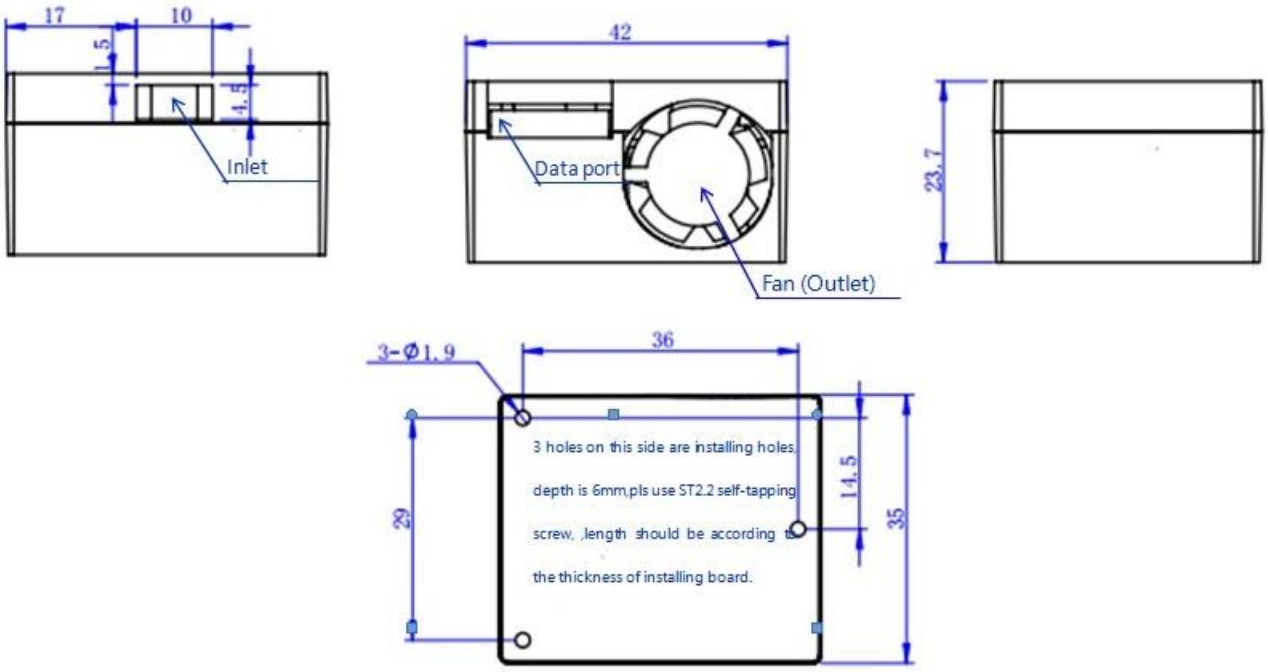


Figure 7. Dimension

Temperature influence curve

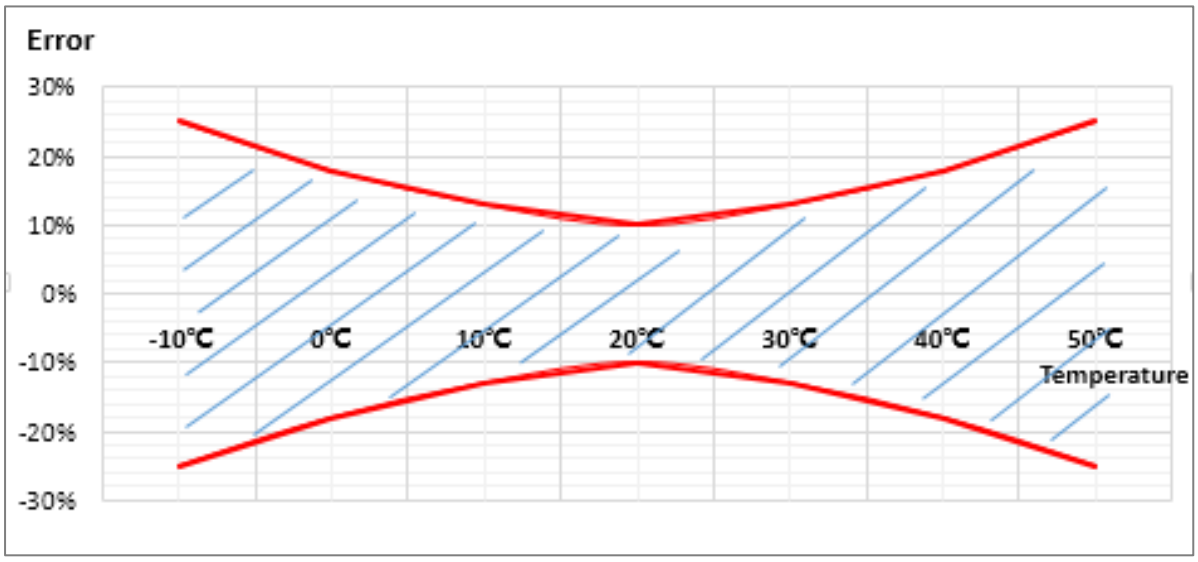


Figure 8. Temperature Influence Curve

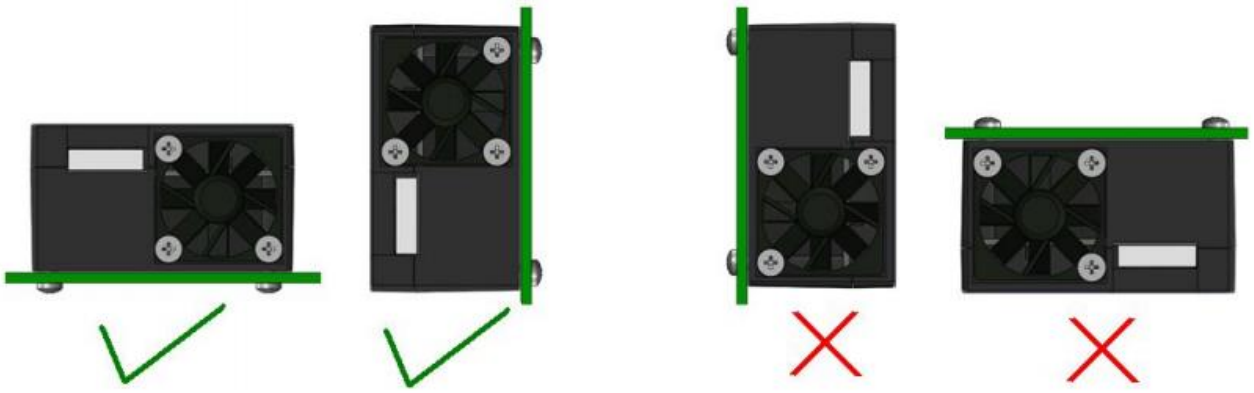
Particle measured error: under 25±2℃, 0~1,000μg/m³, consistency and accuracy of PM2.5 is either ±10% reading or ±10μg/m³, the bigger one is taken.

Temperature influence coefficient: 0.5%/℃ ~ 1%/℃ or 0.5μg/m³/℃ ~ 1μg/m³/℃, the bigger one is taken.

Reliability test

No.	Test List	Test Condition	Standard	Sample qty: N Defective qty: C
1	High temperature and high humidity operation	Operating the sensor in the ambient of 70±2℃, 90-95%RH, max voltage (within range of acceptable working voltage), for 24 hours.	The sensor works normally after 2 hours in the ambient.	N=5, C=0
2	High temperature storage.	Leave the sensor in the ambient of 80±2℃, (50±10) %RH for 96 hours without power on.	The sensor works normally after 2 hours in the ambient.	N=5, C=0
3	Low temperature storage.	Leave the sensor in the ambient of -30±2℃, (50±10) %RH for 96 hours without power on.	The sensor works normally after 2 hours in the ambient.	N=5, C=0
4	High temperature working	Leave the sensor in the ambient of 70±2℃, powered with nominal voltage for 96hours.	The sensor works normally after 2 hours in the ambient.	N=5, C=0
5	Low temperature working	Leave the sensor in the ambient of -30±2℃, powered with max voltage (within range of acceptable working voltage) for 96hours.	The sensor works normally after 2 hours in the ambient.	N=5, C=0
6	Thermal cycle	Leave the sensor in ambient of -30℃for 55mins then move it to ambient of +70℃ for 55mins. Keep this cycle for 10 times. No control in temperature, and the sensor is power off.	The sensor works normally after 2 hours in the ambient.	N=5, C=0
7	Vibration test	10-55-10Hz/min, with amplitude of 1.5mm, vibrate in X, Y, Z direction, each direction for 2 hours.	The sensor works normally after 1 hour in the ambient.	N=5, C=0
8	Drop test	Drop the sensor from 70cm height down to the hard-wooden board randomly for three times.	No damage, no breaking, no failure on electrical characteristics.	N=5, C=0
9	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. Clean the sensor after test.	No red rust on the sensor surface.	N=5, C=0
10	ON-OFF test	Leave the sensor in normal ambient, power on for 5min then power off for 5min. Keep the cycle for 500 hours.	The sensor can work normally.	N=5, C=0
11	High dust concentration test	Operate the sensor in ambient of **100mg/m³dust** concentration continuously for 24 hours.	The sensor works normally after 1 hour in the ambient.	N=5, C=0

- PM3015 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 PM3015 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:**



Correct installation **Wrong installation**

Figure 9. Installation Display

- Because the metal shell of the sensor relates to the DC ground of interior circuit board, it's dangerous to touch the sensor's DC ground. So please install the sensor somewhere human body cannot touch directly. Cut off the power before touching the sensor.
- When RC is used to reduce voltage, be cautious that the metal shell will relate to either 220VAC live wire or the neutral wire.

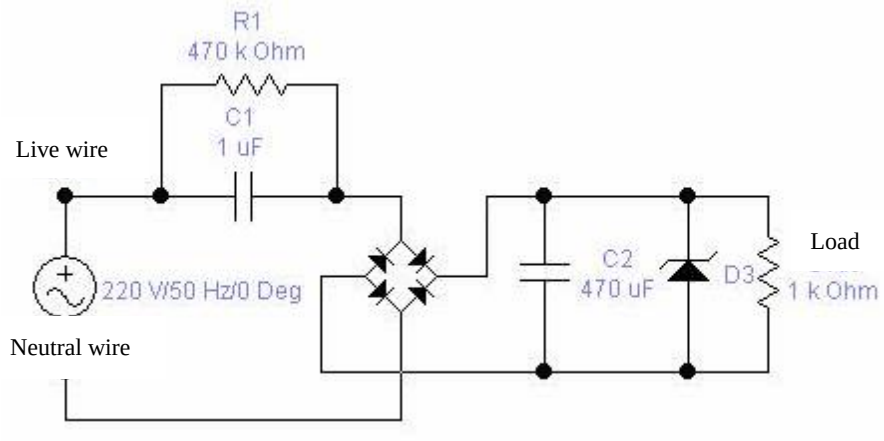
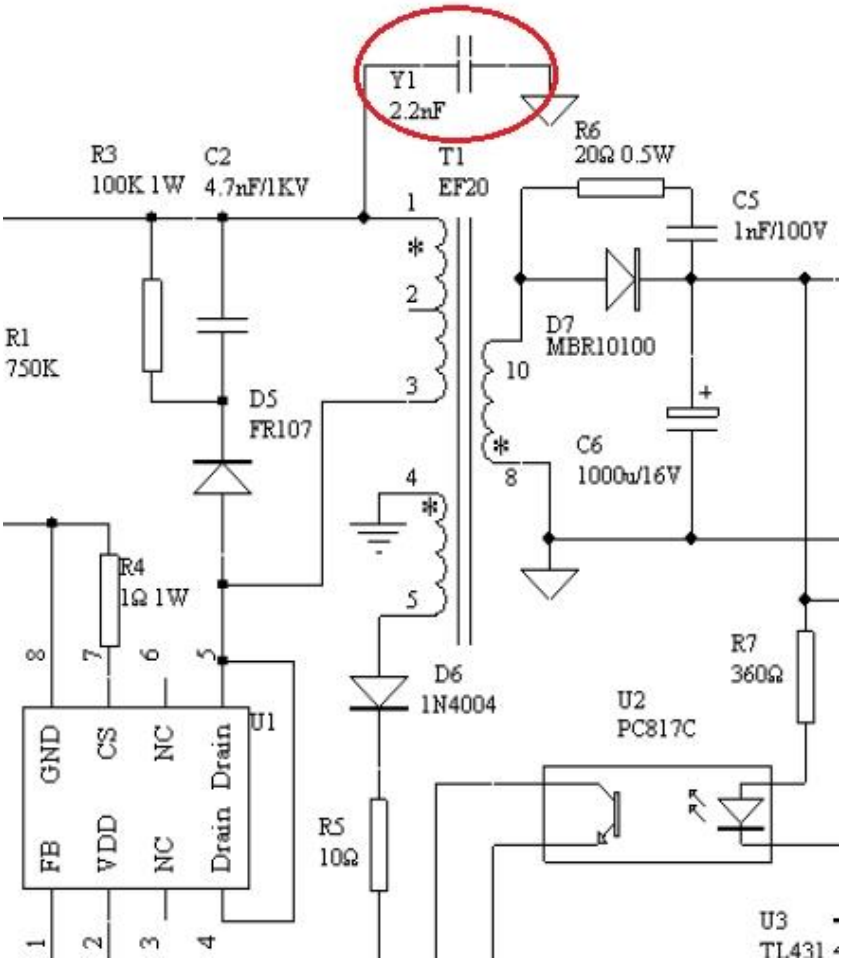


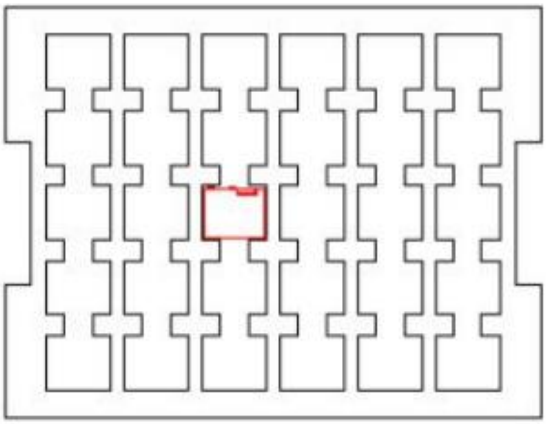
Figure 10. 220VAC Live Wire and Neutral Wire Diagram

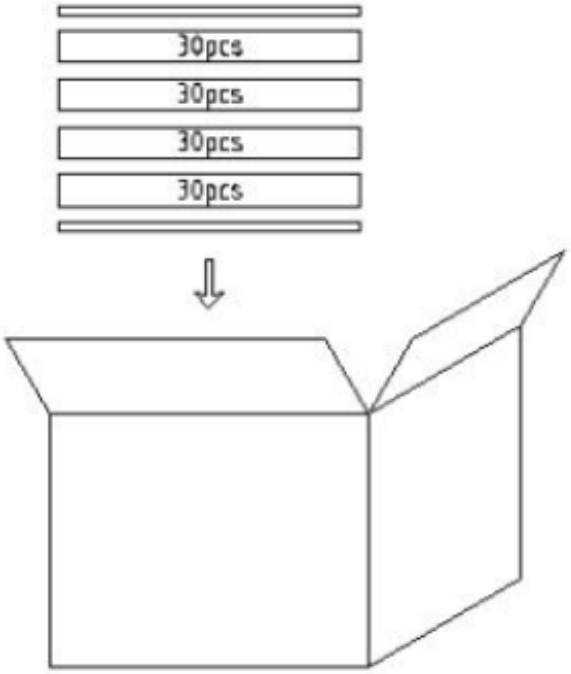
- If isolated switch power supply is adopted to obtain DC power, please control the capacitance between the DC ground and the AC ground below 2.2nF and withstand voltage reaches to 3KV.



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

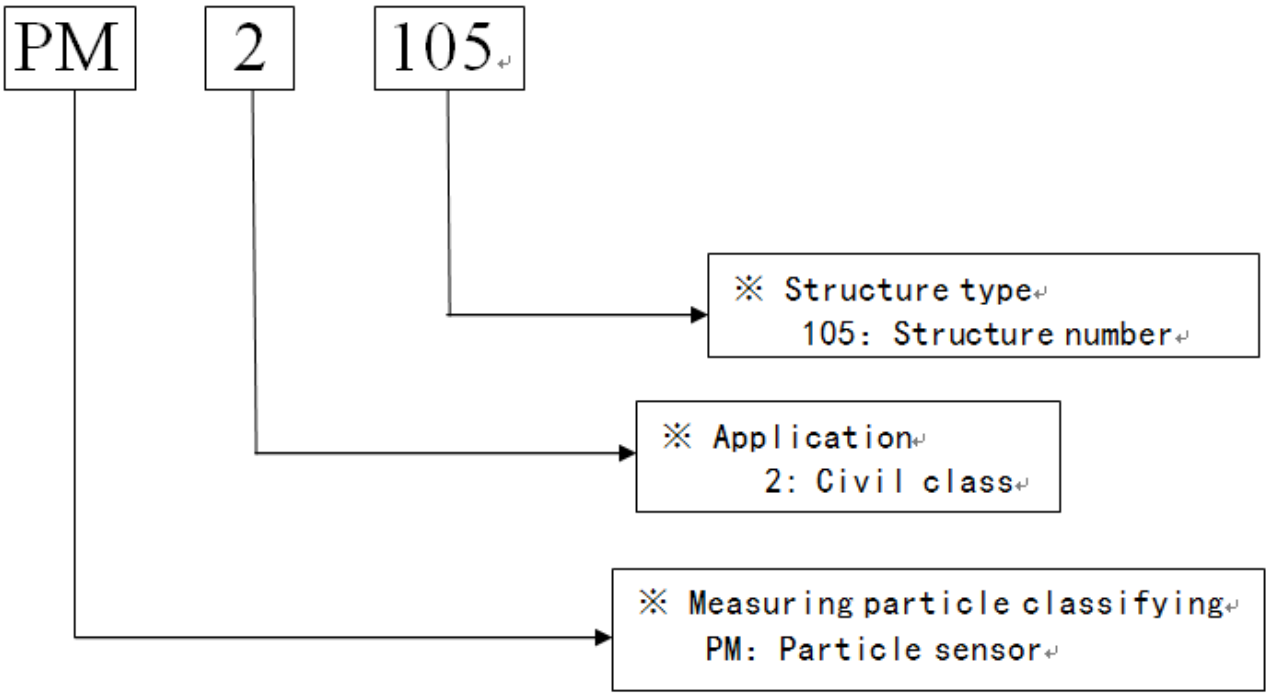
Packaging information





Packing description

Qty per layer	Layer	Carton	Carton dimensions	Packing material
30pcs	13 layers	390pcs	W480 * L400 * H320 mm	Red pearl cotton (ESD)



After-sales services and consultancy

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