



# Particles Sensor

(Model: ZPH02)

# Manual

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Zhengzhou Winsen Electronics Technology Co., Ltd

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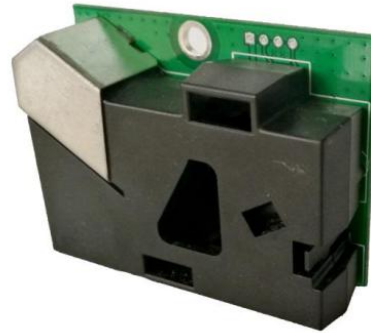
Zhengzhou Winsen Electronics Technology CO., LTD

## ZPH02 Particles Sensor

### Profile

This sensor integrates infrared PM2.5 detection technology, using particle counting principle to detect PM2.5 in the environment. It can detect the particles (diameter  $\geq 1\mu\text{m}$ ).

Before delivery, the sensor has been aged, debugged, calibrated and has good consistency and high sensitivity.



### Features

- \*Good stability for long time
- \*Interface output is multiple
- \*easy to install and use
- \*High sensitivity
- \*Good consistency

### Applications

- \*Air purifier
- \*Air refresher
- \*Portable instrumentation
- \*HVAC system
- \*Air conditioner
- \*Smoke alarm system

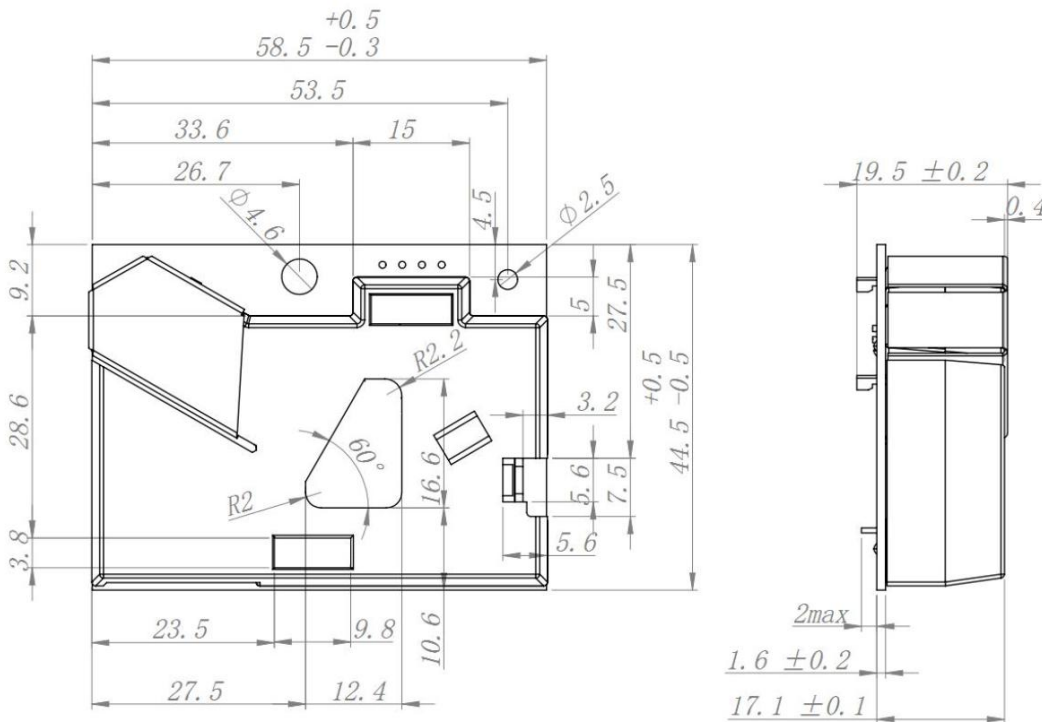
### Technical Parameters

Model		ZPH02
Working voltage range		5±0.2 V (DC)
Output way		Rate of low level%(recommending 30s)
Output signal voltage		5±0.2 V
Detection ability		smallest particles 1 $\mu\text{m}$ diameter
Warm-up time		$\leq 1\text{min}$ (device warming-up time)
Working current		$\leq 90\text{mA}$
Humidity range	Storage	$\leq 95\%RH$
	Working	$\leq 95\%RH$
Temperature range	Storage	-30°C ~ 50°C
	Working	0°C ~ 50°C
Size		59.5×44.5×20mm (L×W×H)
Physical interface		EH2.54-5P

NO.	Test Item	Test Conditions and requirement	Result
1	Specification	Dimension confirm; Electrical characteristics confirm; Internal resistance space confirm; Meet the drawing requirement, n=10	OK
2	Heat Shock 1	-40°C, 30min ←within 10s→80°C, 30min for 1 cycle; 10 cycles ①. appearance is not significantly abnormal; ②. electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=10	OK
3	Heat Shock 2	-25°C, 1H ←→70°C, 1H for 1 cycle, 100 cycles ①. appearance is not significantly abnormal; ②. electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=10	OK
4	High Temperature Humidity	60±5°C, 90±5%RH, 72H placement ①. appearance is not significantly abnormal; ②. electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=10;  60±5°C, 90±5%RH, DC5V 72H, continuous power-on ①. appearance is not significantly abnormal; ②. electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=10;	OK
5	Low Temperature	Low temperature placement: -30°C, 500H test once, 1000H test once, ①. appearance is not significantly abnormal; ②. electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=10;	OK
6	Soldering Heat Shock	-40°C 30m ←within 10s→80°C 30m for 1 cycle, confirmed at 200 cycles, 500 cycles, 1000 cycle, Reference: ST-E009, No cracking in the welded part, n=1	OK
7	Drop Test	Dropping from 100cm height on a hard board, 3times: ①. no damage and crack; ②. electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=10;	OK
8	Anti-static	200p F, 0Ω, ±200V electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=8;	OK
9	Vibration	Apply vibration of 10-55Hz frequency and 1G acceleration to each of 3 perpendicular directions for 1min ①. no damage and crack;	OK

		②. electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=10;	
10	Lead Strength	Room temperature~60°C, 1000H, Tin whisker needs to be below 50µm, n=1	OK
11	ON/OFF Test	45°C, 90-95%RH, power on/off 5min, 500H ①. appearance is not significantly abnormal; ②. electrical parameters meet below requirement: Low limit *0.7~ upper limit *1.3, n=10;	OK
12	Response Confirm	Stable time testing: After power on, stable time deviation needs to be less than 10%, n=20;	OK
13	Short-circuit Test	Short circuit or open circuit between electronic components, Inca power do not catch fire, combustion, No smoking allowed, n=5	OK
16	Leakage-resistance Tracking	0.2% ammonium chloride solution, 30S, 200 drops; No fire, burning, no smoking allowed, n=5;	OK

**Dimensions:**

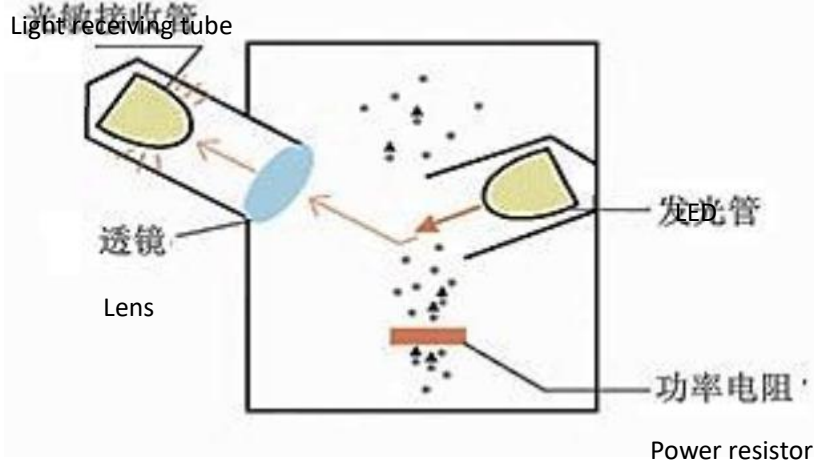


**figure 1**

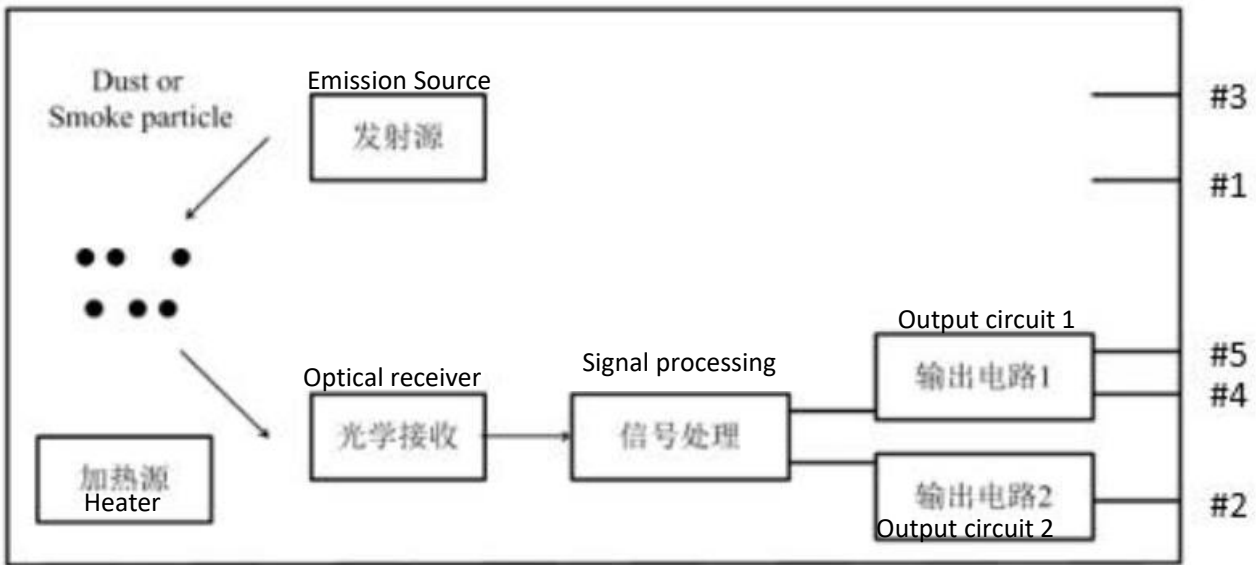
**Remarks:**

1.Connector(5-pin) part no. is HER-5; specific specifications please visit <http://www.jst.com/>

**Detection Principle**



**Fig 3. Principle schematic 1**

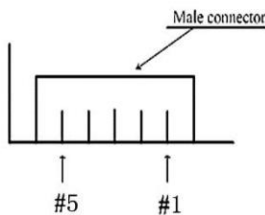


**Fig 4. Principle schematic 2**

**Remarks:**

ZPH02 dust sensor uses power resistors to heat the air, the hot air promotes the ambient gas (PM2.5) into the detection of light path, so as to detect. The optical structure determines the installation of the sensor has certain specification requirements, otherwise it will lead to abnormal detection data.

**Pins Definition**



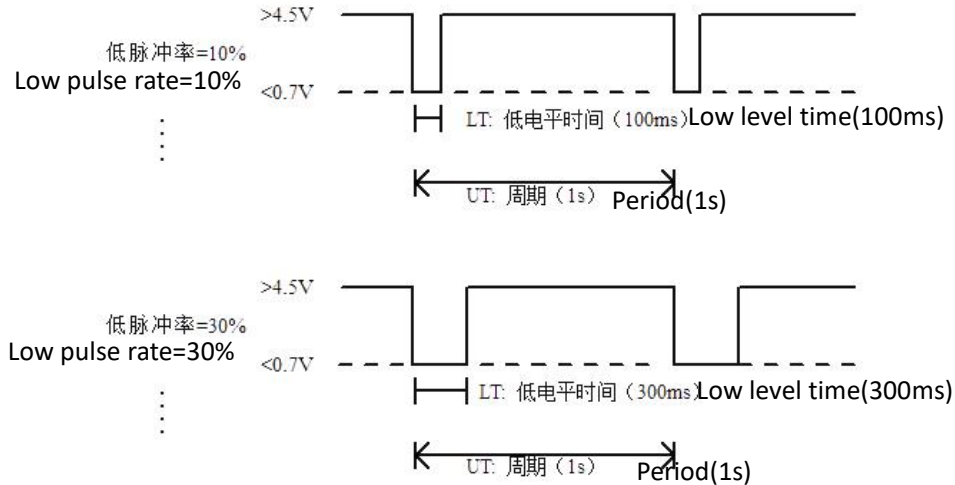
**Pins sketch**

PIN No.	PMW mode	UART mode
PIN1	GND	GND
PIN2	NC	TXD
PIN3	VCC	VCC
PIN4	PWM	NC
PIN5	NC	Connects to GND

**Remarks**

The ZPH02's two mode settings can only be performed before the sensor is normally powered on. Please make a hardware connection in advance. Pin5 can only be used as signal in UART mode and it does not assume the module power supply GND function, otherwise the power supply failure will cause the module to be irreparably damaged.

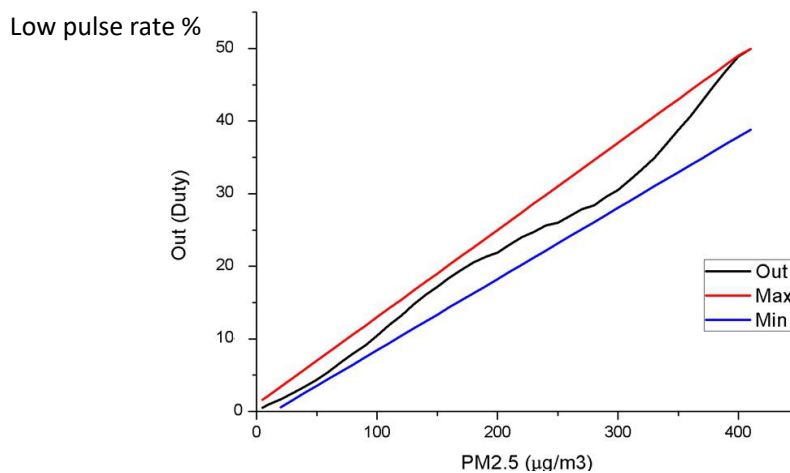
**PM2.5 output wave in PWM mode**



**Fig6.PM2.5 output wave in PWM mode**

- Remarks: 1.LT is the pulse width of low level in one period.(5-500Ms)  
2.UT is the pulse width of one period(1s)  
3.Low pulse rate RT:  $RT=LT/UT \times 100\%$  range(0.5%-50%)

**The relationship between low pulse rate of output and particle concentration**



**Fig7.The relationship of PM2.5 low pulse rate of output and particle concentration**

Remark: People usually use different levels (best, good, bad, worst) to describe the air quality condition.

Recommended solution: Best: 0.00%-4.00%

Good: 4.00%-8.00%

Bad: 8.00%-12.00%

Worst: &gt;12.00%

This suggestion is just a reference, please set according to users' real demand.

## Communication protocol

### 1.General Settings

**Stable 3.**

Baud rate	9600
Interface level	5±0.2 V (TTL)
Data byte	8 byte
Stop byte	1 byte
Check byte	no

### 2.Communication command

Module sends the concentration value every other one second. Only send, no receive. Command as follow:

0	1	2	3	4	5	6	7	8
Start byte	Detection type name code	Unit (Low pulse rate)	Integer part of low pulse rate	Decimals part of low pulse rate	Reservation	Reservation	Reservation	Check value
0xFF	0x18	0x00	0x00-0x63	0x00-0x63	0x00	0x00	0x00	0x00-0xFF

**Stable 4.**

#### Remarks:

1. Conversion of duty ratio:

Eg: sensor sends one frame data, the third byte is 0x12 and the forth byte is 0x13. It means the duty ration of sensor's output is 18.19%.

2. Conversion of PM2.5

$K * 18.19\% = \text{PM2.5 concentration}$ . K is a proportionality coefficient, as experience,  $K=1000$ .

### 3.Check and calculation

```

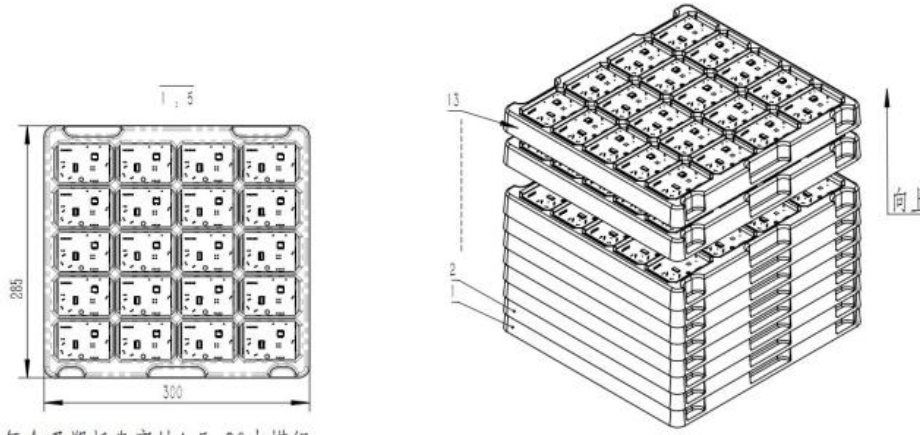
/*****
* Funtion name: ucharFucChecksum(uchar *i,uchar ln)
* Funtion description:Sum check(Negate the sum of send and receive protocol 1/2/3/4/5/6/7
and +1 )
*****/
unsigned char FucChecksum(unsigned char *i,unsigned char ln)
{
    unsigned char j,tempq=0;
    i+=1;
    for(j=0;j<(ln-2);j++)
    {
        tempq+=*i;
        i++;
    }
}

```



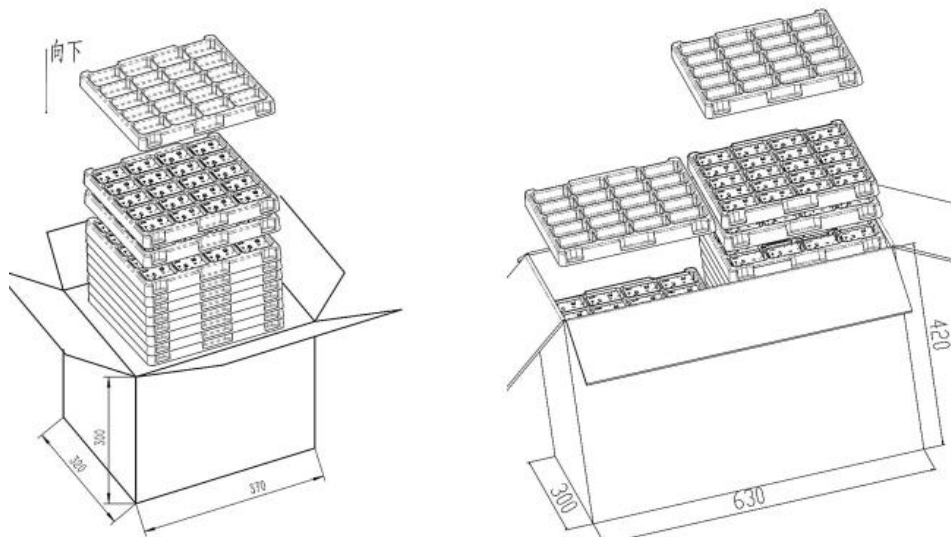
```
tempq=(~tempq)+1;
return(tempq);
}
```

**Standard Package**



每个吸塑托盘容纳4\*5=20支模组

**图8: 吸塑托盘容纳传感器**



**图9: 不同规格包装箱容纳传感器**

Carton Size:

355x310x285cm, 260 pcs/carton

630x280x405mm, 760 pcs/carton

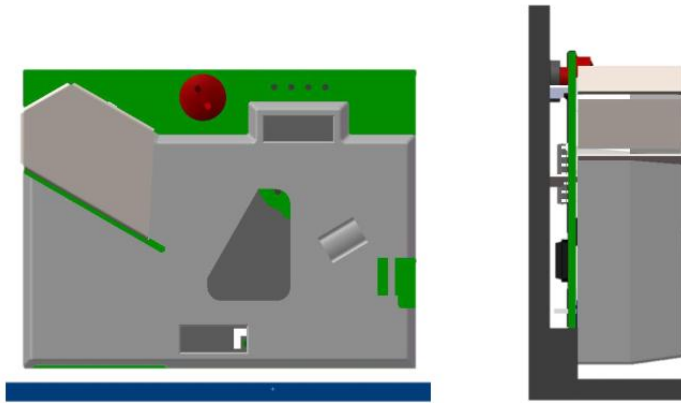
**Cautions**

**1.Terms of Use**

1. Installation requirements: The sensor must be installed vertically to ensure that the gas path is smooth and avoid contact with organic solvents.

1.1. Installation must be vertically. As shown in Figure 3, the power resistance of the air heating, hot air to promote the external gas into the optical path and promptly removed, the wrong

way to install the sensor will read abnormal.



1.2. To ensure smooth detection of gas flow outside the air flow can smoothly into the sensor optical cavity and timely discharge. When applied to the air refresher, the fan inlet and outlet air flow can not affect the stability of the sensor detection gas path, can be installed on the side of the body

1.3. To avoid light. Dust sensor uses a specific wavelength light LED and visible light cut off the photoelectric sensor to detect dust particles, external light radiation will affect the dust sensor optical signal, it is recommended to use the sponge cover dust sensor center triangle hole (shown in Figure 1), do not block Sensor inlet and outlet.

2. Power supply requirements: Module metal shield and circuit GND connection, should prevent the GND pin access to higher than the human body safe voltage system, should not be applied to the system involving personal safety.

3. Clean the lens: the lens needs to be cleaned according to the use of the environment, once about 6 months. When cleaning, use a cotton swab to rinse the surface of the lens, and then wipe the water with another head in time. Do not wipe the lens with organic solvents such as alcohol.

## 2.To avoid bad interference

To avoid exposure to water vapor away from the bathroom or air humidifier, the water mist will PM2.5 data abnormal fluctuations; splashing water or immersed in water will cause the sensor sensitive characteristics

## 3.Transport & storage

1. Avoid vibration: Frequent transport and assembly process, excessive vibration will lead to optical device dislocation affect the original calibration data

2. Long-term storage: Sealed bags sealed to avoid contact with corrosive gas damage to circuit boards and optics.

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