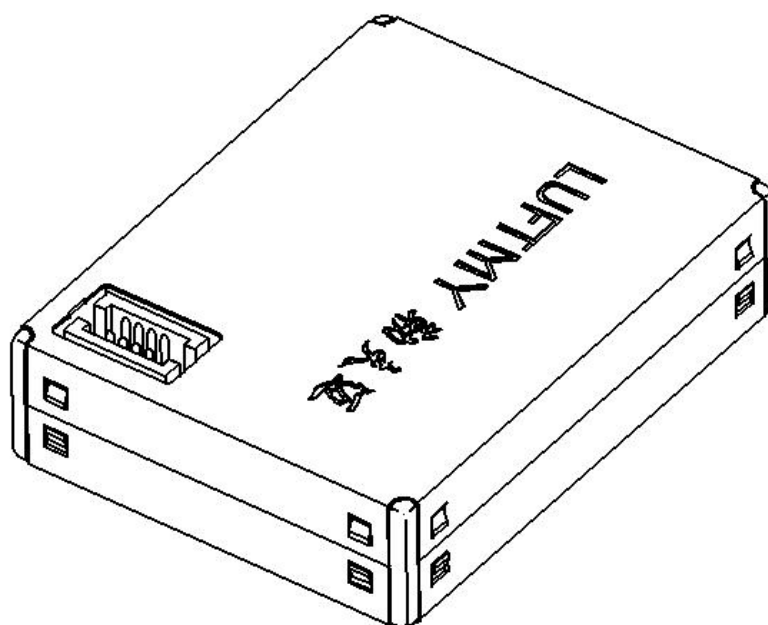


# Laser PM2.5 dust sensor Model # LD11

## Product Specification



# Catalogue

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## Product overview

LD11 is a high-precision particle sensor based on the theory of laser MIE scattering. It can continuously collect and calculate the number of suspended particles with different particle sizes in air per unit volume, that is the concentration distribution of particles, and then convert to mass concentration. And output in the form of universal digital interface.

The sensor can be embedded with various instruments related to the concentration of suspended particulates in the air or environmental improvement equipments to provide timely and accurate concentration data.

## Working principle

LD11 laser sensor adopts MIE spherical particle scattering principle, that is, laser sensor uses laser to irradiate suspended particulate matter in the air to produce light scattering, photoelectric detector collects scattering light intensity in a certain angle range, the scattering light intensity will be linearly converted to voltage, and then sent to data processing system, the data processing system take the principle of Michaelis scattering theory to deal with the datas, then the equivalent particle size and the number of particles with different particle sizes per unit volume are obtained.

## Main feature

- 1 High measure accuracy up to  $0.1\mu\text{m}$
- 2 Zero error alarm rate
- 3 Real-time response and support for continuous data collecting
- 4 Minimum resolution particle size  $0.1\mu\text{m}$
- 5 Electronic controlled devices lifetime  $> 8$  years, average working time  $> 5$  years.
- 6 Wide range of application, no need for air duct design, compatible with multi-protocol output
- 7 light and thin design, suitable for detectors, wearerable equipments, air purifiers, fresh air systems, etc.
- 8 Six-sided shielding combined the software anti-jamming algorithm, with higher anti-jamming performance

## Typically Application

- (1) Particle monitor instruments
- (2) Environmental improvement equipments

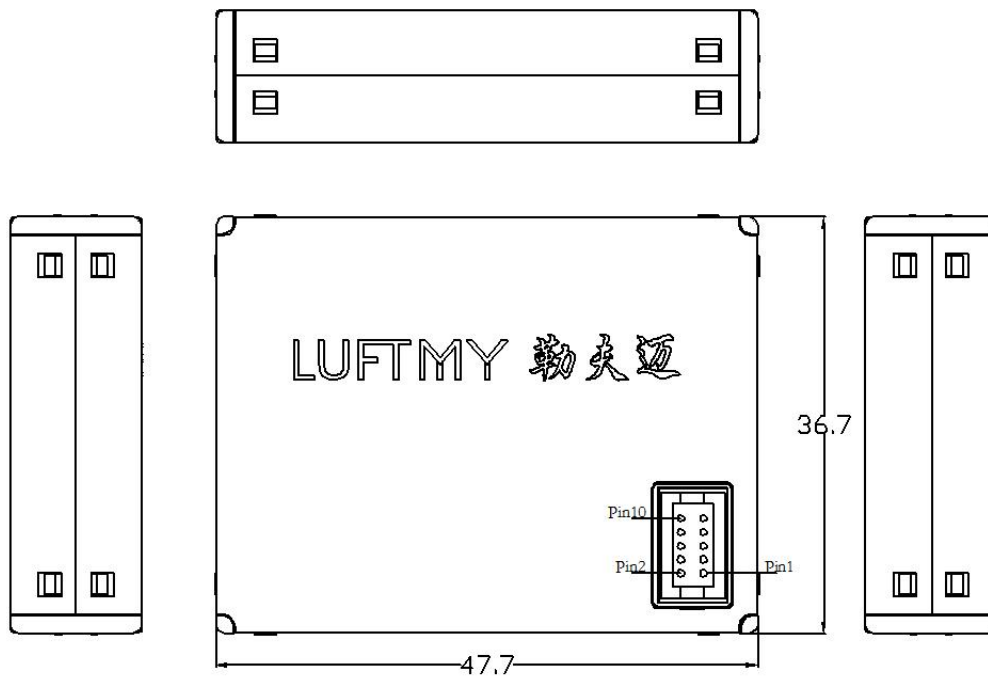
# Product Specification

Parameter	Value	Unit
Particle measure range	0.1 ~1.0 ; 1.0~2.5 ; 2.5~10	μm
Particle counting efficiency	35%@0.1 μ m 70%@0.3 μ m 99%@0.5 μm	
Max range of particulate mass concentration (PM2.5 standard)	0~500	μg/m <sup>3</sup>
Max range of particle concentration (PM2.5 standard)	≥1000	μg/m <sup>3</sup>
Particulate mass concentration resolution	1	μg/m <sup>3</sup>
Particle mass concentration consistency	100~500 ug/m3 Allowable max error ±8% ; <100 ug/m3 Allowable max error ±10 ug/m3	ug/m <sup>3</sup>
Standard volume	0.1	L
Single response time	< 1	S
Integrated response time	≤ 10	S
DC supply voltage	5V ± 5% ( Power ripple 50mv max )	V
Working current	≤ 60	mA
Standby current	≤0.5	mA
Data interface level	L <0.8 @3.3 H >2.7@3.3	V
Working temperature range	-10~+ 70	℃
Working humidity range	0~95% ( non-condensing )	RH
Storage temperature range	-40~+ 80	℃
Signal output	UART PWM	
Mean free error time	≥5	year
Max size	48×37×12	mm

**Note 1 :** Maximum range means that this sensor ensures that the maximum output value of pm2.5 standard value is not less than 1000 u g / m3. when the data is > 1000 u g / m3. pls take the actual measure value .

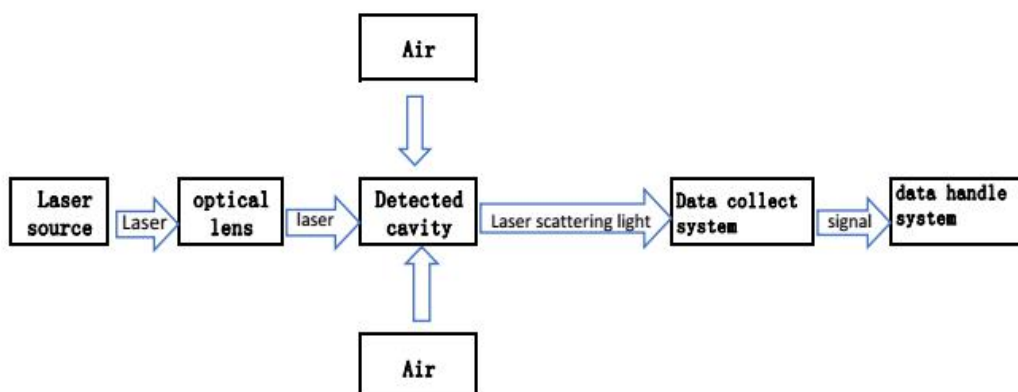
**Note 2 :** the consistency data of the particle concentration is the data in the appendix -Measuring temperature condition is 20℃,humidity condition is 50% .

## Interface definition

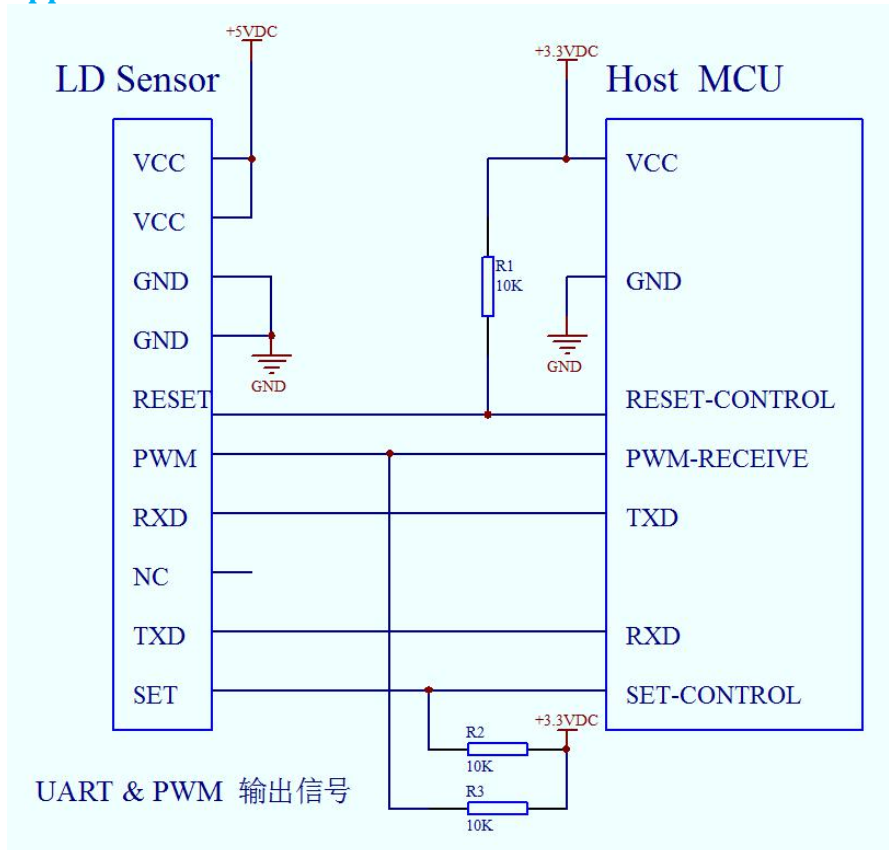


Pin1	VCC	Power positive pole 5V
Pin2	VCC	Power positive pole 5V
Pin3	GND	Power negative pole
Pin4	GND	Power negative pole
Pin5	Reset	Module reset signal / <a href="#">TTL@3.3V</a> , low reset
Pin6	PWM	PWM
Pin7	RXD	Serial receiving pin / <a href="#">TTL@3.3V</a>
Pin8	Reserved	NC
Pin9	TXD	Serial transmission pin / <a href="#">TTL@3.3V</a>
Pin10	PWM	Setting pin / <a href="#">TTL@3.3V</a> High level in shows normal working state; low level show dormant state

## Working principle display



## Application Circuit



Note : PWM or UART output is optional

## Output result

The main output is the mass and number of particles of various concentration in unit volume, in which the unit volume of the number of particles is 0.1L, and the mass concentration is  $\mu\text{g}/\text{m}^3$ . The output has 2 states : active output and passive output, the default state of sensor is active output when it power on, that is, the sensor sends serial data to host computer at a interval of 1 second.

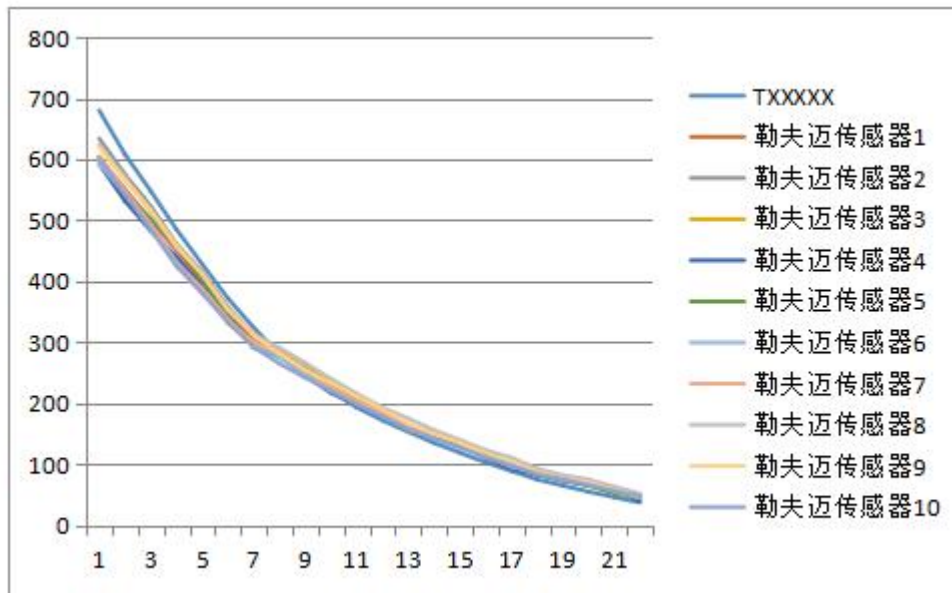
### Tips for circuits designing

- 1, LD11 sensor working current is 5V , data commnuicate and control pins need 3.3V as the high level ,mainboard MCU is 5V power supply , need to add level convert ships or circuits between the communication cables (RXD ,TXD ) and controls cables ( Set , RESET)
- 2, SET and RESET inside has pull-up resistor , it should be suspended when not use
- 3, Pin7 is to use for procedure internal debugging, it should be suspended when at the application circuits .
- 4, Be attention when it is in dormant states , the fans should stop working, it need at least 30s stable time to restart to get accurate datas , sensor working times should not less than 30s when the dormant state is waked up.

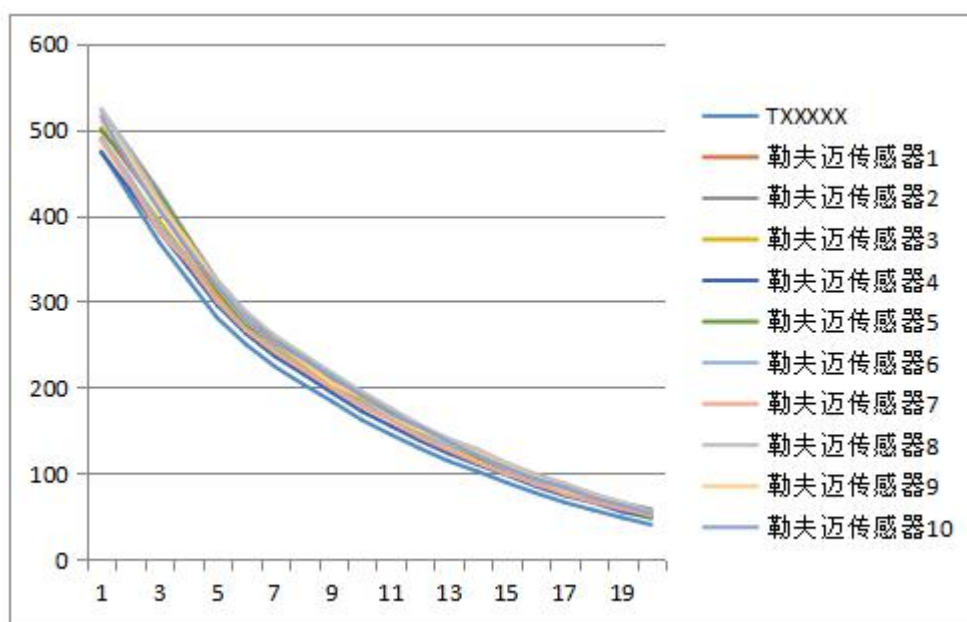
## Typical output feature

Vertical axis Unit : ug/m3

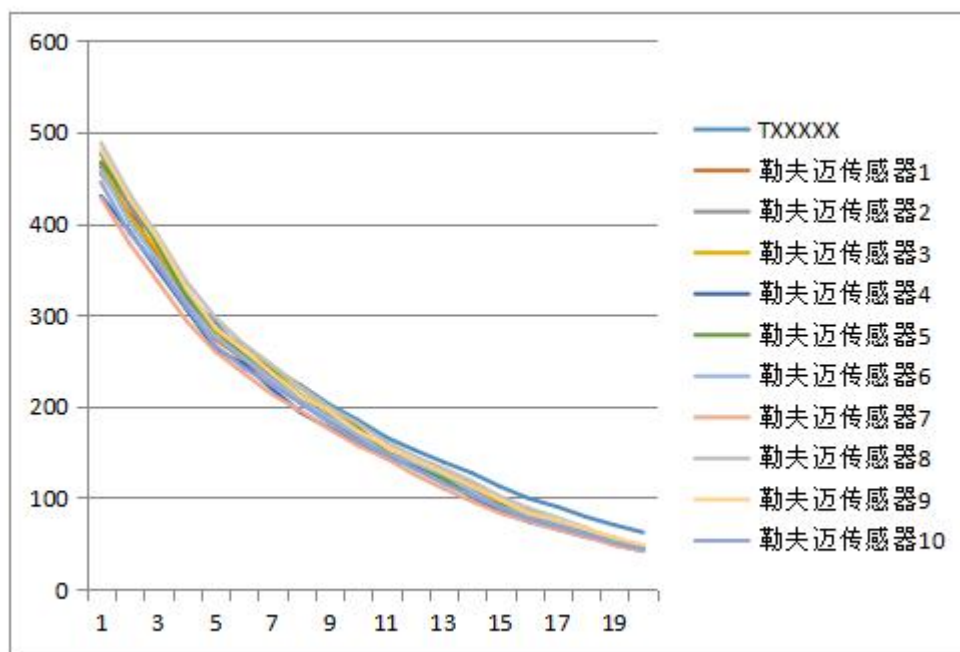
Horizontal axis- Times



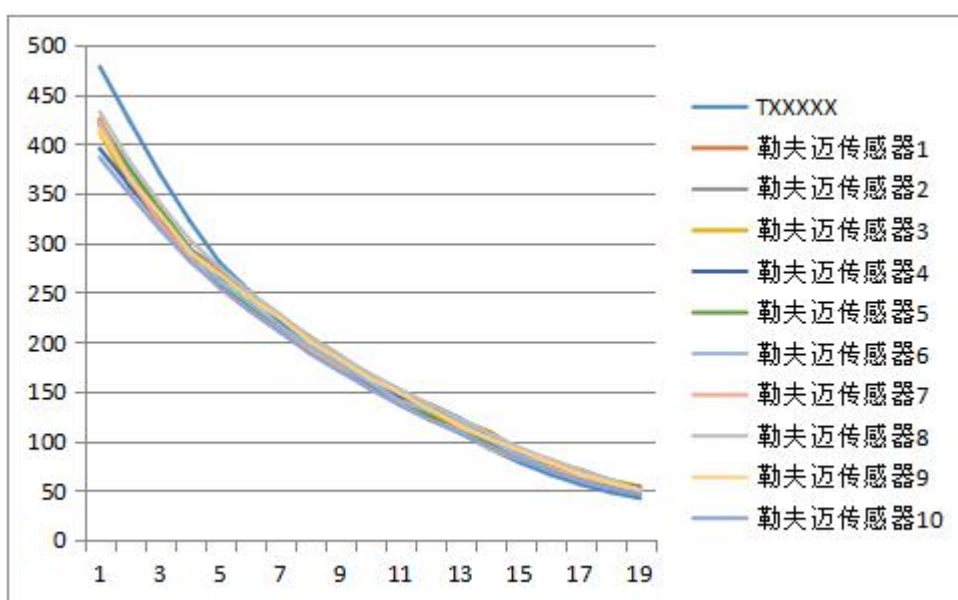
Picture1.1 Sensor consistency at normal temperature condition (25°C)



Picture 1.2 Sensor consistency at high temperature condition 45°C

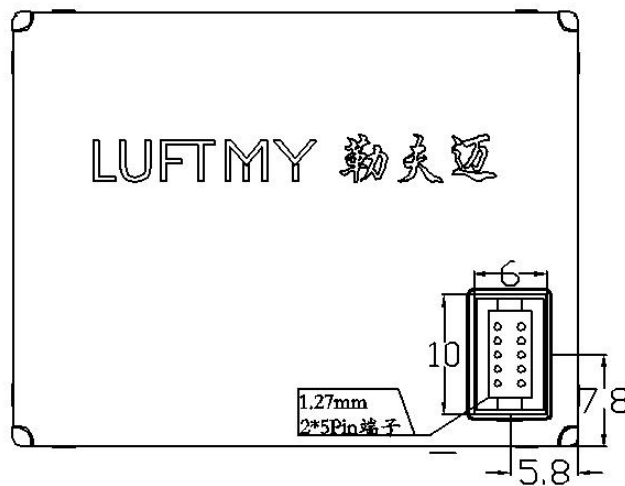


Picture 1.3 Sensor consistency at low temperature condition (  $-5^{\circ}\text{C}$  )



Picture 1.4 Sensor consistency at longtime operating condition (30 days )





### Tips for product installation

- 1, Metal case and internal power should be in conduction ,do not connect it with other external plate resistance circuits or chassis shells .
- 2, The best installation way is when the plane of air inlet and air outlet is close to the air hole of the user's inner wall and external connection,if it can't be realized ,there will be no occlusion within 2 cm of the air outlet . it should has a structure between the plane of air inlet and air outlet to isolate the airflow,so that to avoid direct backflow of air from the air outlet to the air inlet inside the user,
- 3, The size of air hole for air inlet plane in the user inner wall should not smaller than that of air inlet plane .
- 4, When used for some products such as purifier,do not directly put the sensor into the purifier itself air duct ,otherwise it should separately set up a structure space to put the sensor inside of it , so that isolate itself air duct with the purifier's air duct.
- 5, When it used for purifier or fixed detection equipments , the position of purifier should be higher 20cm above the ground,otherwise it may be polluted by lager dust particle and even the floccules near the ground ,cause the fans twine and resist to return.
- 6, Sensor is a whole element, the user do not disassemble it ,including the metal shield ,in case bring irreversible damages .

### Other notes

- 1,The sensor data shall ensure the consistency between the ex-factory individuals and shall not be compared with third-party testing instruments or data. If the user wants the final measurement results to be consistent with a third party testing equipment, the user can perform data fitting according to the actual collected results.
- 2, This sensor is applicable to common indoor environment. If the user equipment is used in the following actual environment, corresponding protective measures shall be added to the sensor; otherwise, the data consistency may be reduced due to excessive dust accumulation, oil accumulation and water inflow.  
Some place of where its dust concentration is above 300 micro grams/cubic meter for more than 50% time of the year, or above 500 micrograms/cubic meter for more than 20% time of the year, such as smoking room, Lampblack environments- kitchens; High water mist environment, - hot spring, bathroom; outdoor.

## Appendix : Communication protocol

### Protocol A (default) :

1, URAT communication :  
 Default baud rate : 9600bps  
 Bit data : 8 Bit  
 Parity bit : no  
 Stop : 1 bit

### 2, Host communication portocol format

Attribute byte 1	Attribute byte 2	Instruction byte	Status byte 1	Status byte 2	Check byte 1	Check byte 2
0x42	0x4D	CMD	DATAH	DATAL	LRCH	LRCL

### 3, Instruction and feature byte definitions

CMD	DATAH	DATAL	Explain
0xE2	X	X	Passive reading
0xE1	X	00H- passive 01H- active	Status switching
0xE4	X	00H-standby mode 01H-normal mode	Standby control

### 4. Instruction reply:

0xE2: reply 32 bytes, same as sample data type protocol.

### 5 .Check word generation

The sum of all bytes starting from the characteristic word

### 4. Total length of sampling data type: 32 bytes

Start character 1	0x42 (fixed )
Start character 2	0x4D (fixed)
Frame length is eight bits high	.....
Frame length is eight digits lower	.....
Data 1 is eight digits high	.....
Data 1 is eight digits Lower	.....
Data 2 is eight digits high	.....
Data 2 is eight digits lower	.....
Data 3 is eight digits high	.....
Data 3 is eight digits lower	.....
Data 4 is eight digits high	.....
Data 4 is eight digits lower	.....
Data 5 is eight digits high	.....
Data 5 is eight digits lower	.....
Data 6 is eight digits high	.....
Data 6 is eight digits lower	.....
Data 7 is eight digits high	.....
Data 7 is eight digits lower	.....
Data 8 is eight digits high	.....
Data 8 is eight digits lower	.....
Data 9 is eight digits high	.....

Data 9 is eight digits lower	.....	1.0 um in 0.1 L of air
Data 10 is eight digits high	.....	Data 10 means the number of particle with diameter of above 2.5 um in 0.1 L of air
Data 10 is eight digits lower	.....	
Data 11 is eight digits high	.....	Data 11 means number of particle with diameter of above 5.0 um in 0.1 L of air
Data 11 is eight digits lower	.....	
Data 12 is eight digits high	.....	Data 12 means the number of particle with diameter of above 10 um in 0.1 L of air
Data 12 is eight digits lower	.....	
Data 13 is eight digits high	.....	Version number
Data 13 is eight digits lower	.....	Error code
Data and check high eight digits	.....	Check code = start character 1+ start character 2+ .. + data 13 low eight
Data and check low eight digits	.....	

Notes : The mass concentration value of standard particulate refers to the mass concentration value obtained by density conversion of industrial metal particles as equivalent particles, which is applicable to industrial production workshops and other environments. The mass concentration value of particulate matter in atmospheric environment is calculated by taking the main pollutants in air as equivalent particles

## Protocol B ( Default )

1, URAT communication :  
 Default baud rate : 9600bps  
 Bit data : 8 Bit  
 Parity bit : no  
 Stop : 1 bit

## 2, Host communication portocol format

Start character	length	Command number	Data 1	.....	Data n	Check sum
HEAD	LEN	CMD	DATA1	.....	DATAn	CS
0x11	0xXX	0xXX	0xXX	0xXX	0xXX	0xXX

## 3, Protocol details

### 3.1 Start/stop the dust measurement

Sending : 0x11 0x03 0x0C 0

Protocol format explain

Protocol format	Explain
Start character	The upper computer sending is fixed at 0x11 and the module answering is fixed at 0x16
Length	Data length (including CMD+ DATA)
Command number	Command number
Data	Reading or writing data with variable length
Check sum	Single - byte summation, = 256 - (HEAD+ LEN+ CMD+ DATA)

## Command protocol table

Number	Function	Command Number	Function description
1	start/stop the dust measurement	0x0C	
2	Read the dust measurement results	0x0B	

xXX 0x1E [CS]

Answering : 0x16 0x02 0x0C 0xXX [CS]

Explain : At the sending command, 0xXX=2 is to start measure, 0xXX=1 is to stop measure  
At the answering command, 0xXX=2 is to start measure, 0xXX=1 is to stop measure ,  
when the sensor is powered on ,it 's default to start measure.

### 3.2 Reading the Dust concentration

Sending : 0x11 0x02 0x0B 0x01 0xE1

Answering : 0x16 0x11 0x0b DATA1... DATA16

4., position detail

Position		data	Explain
DATA1		0xXX	PM2.5 concentration data
DATA 2		0xXX	PM2.5 concentration data
DATA3		0xXX	PM2.5 concentration data
DATA4		0xXX	PM2.5 concentration data
DATA5		0x00	Reserved
DATA6		0x00	Reserved
DATA7		0x00	Reserved
DATA8		0x00	Reserved
DATA9		0x00	Reserved
DATA10		0x00	Reserved
DATA11		0x00	Reserved
DATA12		0x00	Reserved
DATA13		0x00	Reserved
DATA14		0x00	Reserved
DATA15		0x00	Reserved
DATA16		0x00	Reserved

PM2.5 calculation method :  $\text{Data1} \times 256^3 + \text{Data 2} \times 256^2 + \text{Data 3} \times 256^1 + \text{Data 4}$

## About luftmy



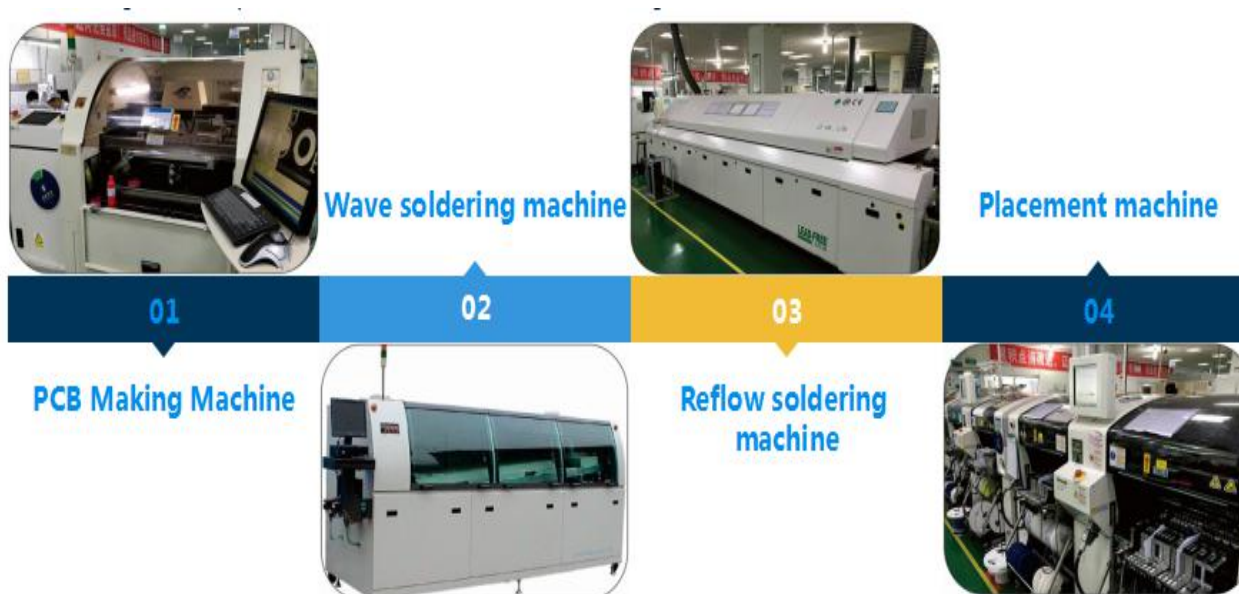
In the year of 2012 Guangzhou Luftmy Intelligence Technology Co.Ltd was jointly founded by the Institute of automation of Chinese academy of sciences and German Aachen University of Technology , it is a professional high-tech enterprise that is engaged in the air quality sensor's researching and developing production and sales.

Currently , the researching team of Luftmy was composed of more than 50 technical elites from overseas and domestic , among them with 6 doctors , 13 masters , under the leadership of enterprises culture “The craftsman dream weavers” , the team has obtained more than 30 PCT international patent for invention , 19 software works patents and many utility models and appearance patents

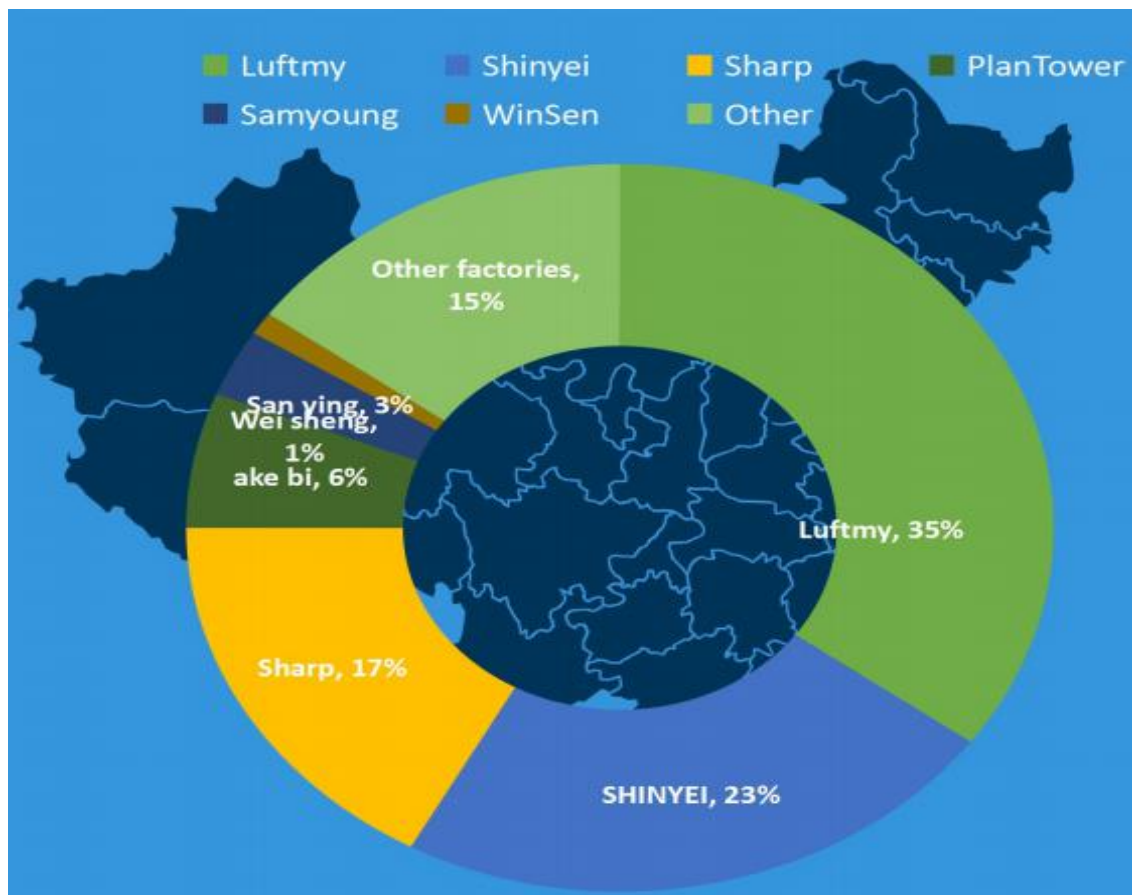
1, Some hot-sale products



2, Our produce equipments



### 3, Our market share in the dust sensor field



### 4, Parts of successful cases



