SPECIFICATION

Product Name: Online Outdoor Air Quality Monitoring Device

Item No.: OPM-6303M

Version: V0.3

Date: November 03, 2020

Revision

No.	Version	Content	Date
1	V0.1	First version	2020.06.12
2	V0.2	Update communication protocol	2020.11.03

Online Outdoor Air Quality Monitoring Device

OPM-6303M

Applications

- Outdoor Air Quality Monitoring
- Meteorological Station
- City Raised Dust Monitoring
- Mining Field Dust Monitoring

Description

OPM-6303M online outdoor air quality monitoring device adopts a pump-suction sampling method and has a solid and reliable metal structure with a new intelligent auto particle identification (API) technology which enable the measurement to be accurate in different dust source scenarios. It can accurately and stably output PM1.0, PM2.5, PM10, TSP mass concentration. At the same time, it has a built-in pretreatment device and a flow monitoring sensor, so as to make the measurement suitable to be used for outdoor.

Features

- Patented API(automatic particle identification) technology to ensure accurate PM1.0,PM2.5, PM10, and TSP concentration measurement
- Built-in constant temperature pretreatment, suitable for high humidity environment
- Linear correlation with β rays $R^2 > 0.9$
- Real-time flow monitoring and constant flow sampling control
- Wider working temperature range

Working Principle

When sampled 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. Real-time measurement data is obtained through measuring quantity and strength of scattered light.

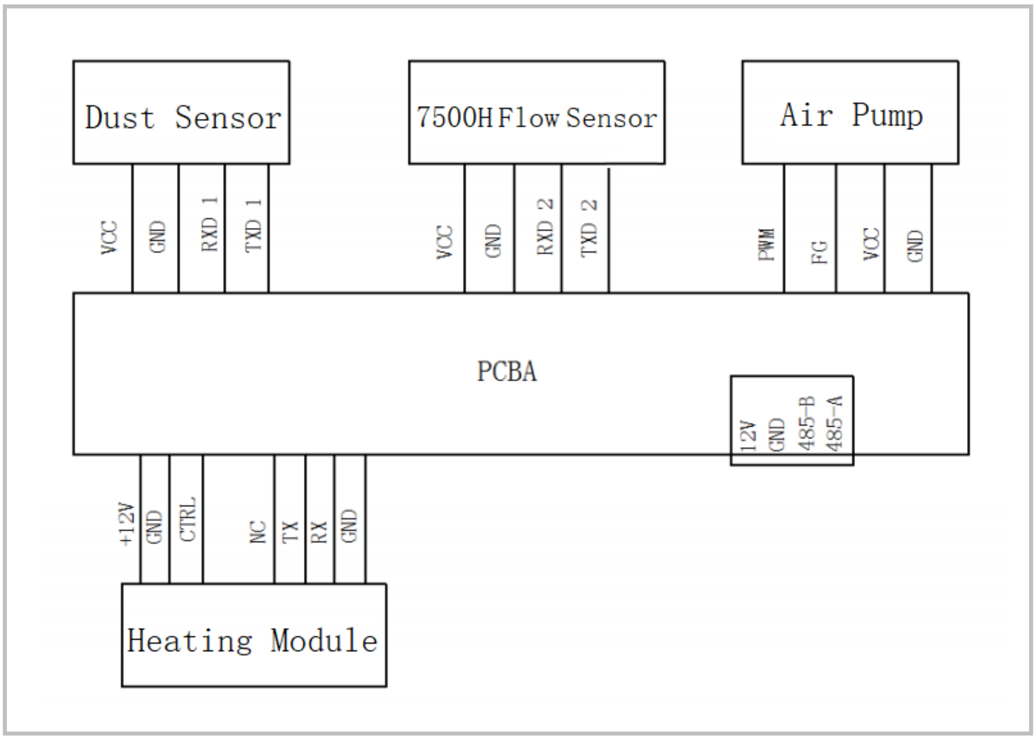
Specifications

Outdoor Online Outdoor Air Quality Monitoring Device OPM-6303M Specification	
Operating principle	Laser scattering
Measurement range	0~1,000μg/m³ Maximum display 30,000μg/m³
Accuracy of PM1.0/PM2.5	≤100μg/m³;±10μg/m³ 100~1000μg/m³：±10% of reading
Accuracy of PM10	≤100μg/m³;±15μg/m³ 100~1000μg/m³：±15% of reading
Accuracy of TSP①	≤100μg/m³;±20μg/m³ 100~1000μg/m³：±20% of reading
Time to first reading	≤ 8s
Data refresh cycle	1s
Working condition	-30°C ~ 70°C,0-95%RH (non-condensing)
Storage condition	-40°C ~ 85°C, 0-95%RH (non-condensing)
Power supply	DC 12V
Working current	≤4.5A
Communication	RS485
Dimensions	W202*H90*D125 (mm)
Lifetime	≥3 years
Sampling flow rate	1L/min

Note:

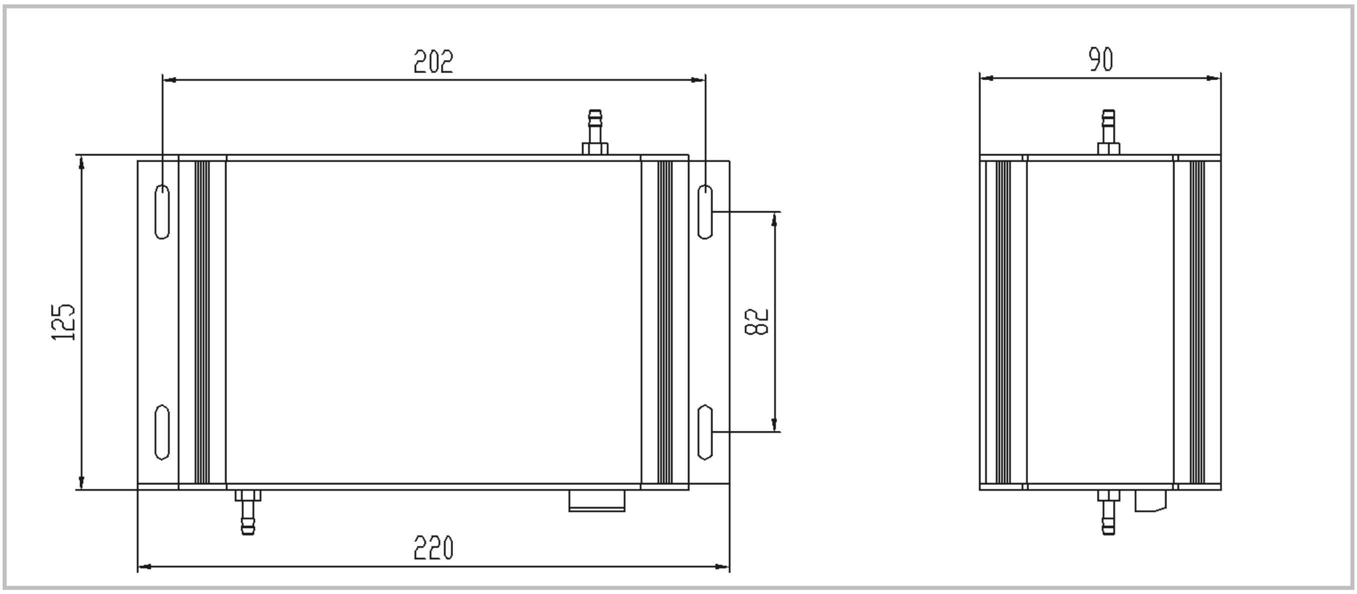
① Wuhan Station traceability system as benchmark. If there is measurement discrepancy in other regions, coefficient correction is needed based on the local dust particle distribution.

Internal Architecture Description



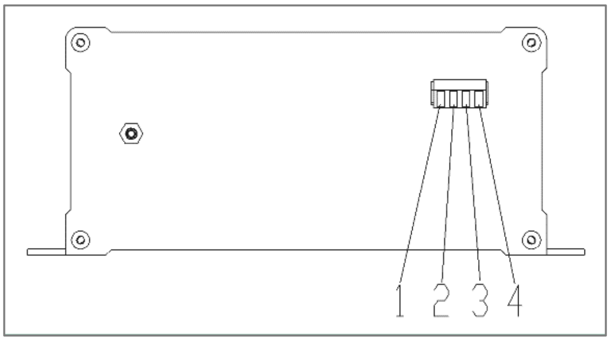
Internal Architecture Description

Structure and Pin Definition



OPM-6303M Structure (Unit: mm; Tolerance: ±2 mm)

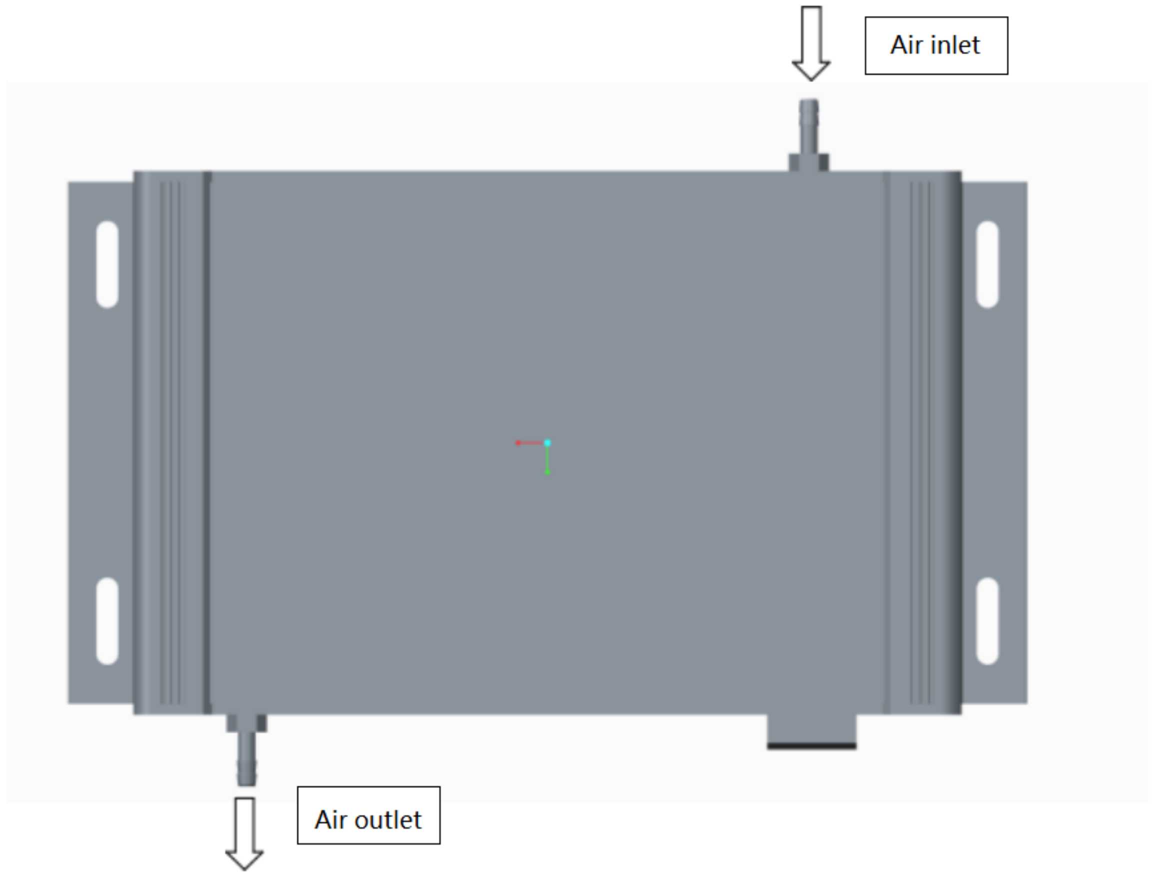
Connector Pin Definition



No.	Pin	Description
1	VCC	Power input (+12V)
2	GND	Power ground input
3	TB	Communication interface (RS485_TB)
4	TA	Communication interface (RS485_TA)

Product Installation

Please make sure that the sensor module’s air inlet is not blocked during installation and operation. To avoid the dust deposits on the surface of the sensitive sensor device which may impact the measurement accuracy, its recommended to install the sensor module in the following way.



Communication Protocol

General Statement

1) The data in this protocol are 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

Format of Serial Communication Protocol

The equipment adopts MODBUS RTU communication protocol, and the requirements are as follows:

1. Equipment as slave.

2. MODBUS 03 function code (read holding registers) can be used to read device status and data; MODBUS 06 function code (preset single register) can be used to set the device status;

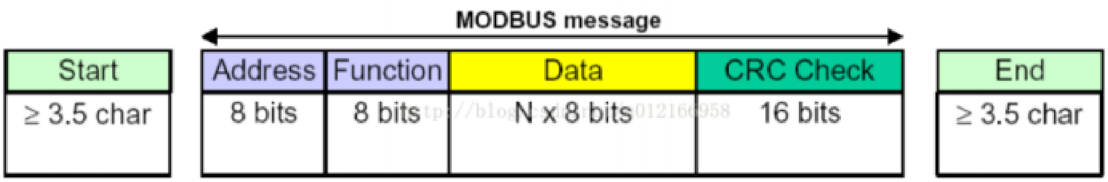
3. If the function code in the sending message does not meet the requirements, the device will reply error code 01(illegal function) through 81 function code message.

If the request address in the sending message does not meet the requirements, the device will reply the error code 02 (illegal data address) through 81 function code message.

Each MODBUS frame includes address domain, function domain, data domain and error detection domain.
MODBUS RTU operation mode

Address	Function Code	Data Quantity	Data 1	…	Data n	CRC High Byte	CRC Low Byte
Address Domain	Function Domain	Data Domain				Error Detection Domain	

Frame delimitation: In Modbus RTU mode, the sending/receiving time interval between each two characters cannot exceed 1.5 times of the character transmission time. If the time interval between two characters exceeds 3.5 times of the character transmission time, it is considered that one frame of data has been received and a new frame of data transmission begins.



Factory Default Setting:

- The factory address of the instrument is 01 as default.
- The mode of the instrument is intermittent operation (working for one minute, stopping for four minutes) as default.
- The user coefficient of the instrument is 1.0000 as default.
- The factory default setting of the instrument is 1.0 L / min (cannot be changed at will).

Calibration Method:

- CRC-16(Modbus), high byte is in front of low byte

Communication Protocol

Register Address Table:

Restrictions:

1. Read-only register and read-write register are not allowed to overlap;
2. Only the function of writing single register is realized, and writing multiple registers is not supported;
3. The total number of registers is limited. At present, it supports 32 input registers and 32 holding registers;
4. The current version does not support file transfer with large amount of data;
5. See Table 1 and table 2 for register details. All registers are 16-bit words, and the register address is register serial number-1.

Table 2: Input registers

Data	Address	Meaning
IR1	0	Version number (enlarge by 100 times)
IR2	1	Reserved
IR3	2	Reserved
IR4	3	Reserved
IR5	4	Reserved
IR6	5	TSP high level of measurement value (μg/m³)
IR7	6	TSP low level of measurement value (μg/m³)
IR8	7	PM1.0 high level of measurement value (μg/m³)
IR9	8	PM1.0 low level of measurement value (μg/m³)
IR10	9	PM2.5 high level of measurement value (μg/m³)
IR11	10	PM2.5 low level of measurement value (μg/m³)
IR12	11	Reserved
IR13	12	Reserved
IR14	13	PM10 high level of measurement value (μg/m³)
IR15	14	PM10 low level of measurement value (μg/m³)
IR16	15	Reserved
IR17	16	Reserved
IR18	17	Reserved
IR19	18	Reserved
IR20	19	Reserved
IR21	20	Reserved
IR22	21	Reserved
IR23	22	Reserved
IR24	23	Actual gas flow value multiplied by 100
IR25	24	Reserved
IR26	25	Reserved
IR27	26	Reserved
IR28	27	Reserved
IR29	28	Reserved
IR30	29	Reserved
IR31	30	Reserved
IR32	31	Reserved

Table 3: Holding Register

Data	Address	Definition	Meaning
IR1	0		Reserved
IR2	1		Reserved
IR3	2	Address setting register	Slave address (1-247)
IR4	3		Reserved
IR5	4		Reserved
IR6	5		Reserved
IR7	6		Reserved
IR8	7	TSP user calibration coefficient	User calculation coefficient multiplied by 10000
IR9	8	PM1.0 user calibration coefficient	User calculation coefficient multiplied by 10000
IR10	9	PM2.5 user calibration coefficient	User calculation coefficient multiplied by 10000
IR11	10		Reserved
IR12	11	PM10 user calibration coefficient	User calculation coefficient multiplied by 10000
IR13	12		Reserved
IR14	13	Set the intermittent stop time of the device	Set the intermittent stop time of the device（min）
IR15	14	Set device and control flow	Actual setting gas flow value multiplied by 100
IR16	15		Reserved
IR17	16		Reserved
IR18	17		Reserved
IR19	18		Reserved
IR20	19		Reserved
IR21	20		Reserved
IR22	21		Reserved
IR23	22		Reserved
IR24	23		Reserved
IR25	24		Reserved
IR26	25		Reserved
IR27	26		Reserved
IR28	27		Reserved
IR29	28		Reserved
IR30	29		Reserved
IR31	30		Reserved
IR32	31		Reserved

Host Communication Protocol Format

Function code description

The function code of OPM-6303M is as follow:

03: read holding register

04: read input register

06: write single register

Command Example

Application conditions:

(1) Assume it is a single sensor.

(2) All data are hexadecimal data, DFX must be converted to decimal when calculating data.

(3) Symbol description:

IP is the device address.

CRC16 is a two-byte check of MODBUS CRC16, high byte is in front of low byte.

CS is 0-ADD8 sum check, the minimum byte of result for head +sending data + CS is 0x00.

DF1 DF2 DF3 DF4 … DFN represent uncertain data.

1 Read PM1.0, PM2.5, PM10, TSP measurement value

Read PM1.0 measurement value:

Send: IP 04 00 07 00 02 CRC16

Respond: IP 04 04 DF1 DF2 DF3 DF4 CRC16

PM1.0 measurement value: DF1*256^3+ DF2*256^2+ DF3*256+DF4 (ug/m3)

Read PM2.5 measurement value:

Send: IP 04 00 09 00 02 CRC16

Respond: IP 04 04 DF1 DF2 DF3 DF4 CRC16

PM2.5 measurement value: DF1*256^3+ DF2*256^2+ DF3*256+DF4 (ug/m3)

Read PM10 measurement value:

Send: IP 04 00 0D 00 02 CRC16

Respond: IP 04 04 DF1 DF2 DF3 DF4 CRC16

PM10 measurement value: DF1*256^3+ DF2*256^2+ DF3*256+DF4 (ug/m3)

Read TSP measurement value:

Send: IP 04 00 05 00 02 CRC16

Respond: IP 04 04 DF1 DF2 DF3 DF4 CRC16

TSP measurement value: DF1*256^3+ DF2*256^2+ DF3*256+DF4 (ug/m3)

2 Read real time gas flow value

Read real time gas flow value: (DF1*256+DF2)/100(L/min）

Send: IP 04 00 17 00 01 CRC16

Respond: IP 04 02 DF1 DF2 CRC16

3 Read input register data continuously

Send: IP 04 00 03 00 19 CRC16

Respond: IP 04 2A DF1~DF42 CRC16

PM1.0 measurement value: DF9*256^3+ DF10*256^2+ DF11*256+DF12 (ug/m3)

PM2.5 measurement value: DF13*256^3+ DF14*256^2+ DF15*256+DF16(ug/m3)

PM10 measurement value: DF17*256^3+ DF18*256^2+ DF19*256+DF20 (ug/m3)

TSP measurement value: DF5*256^3+ DF6*256^2+ DF7*256+DF8(ug/m3)

Real time gas flow value: (DF41*256+DF42)/100(L/min）

4 Read PM1.0, PM2.5, PM10, TSP measurement value user calibration coefficient

Read PM1.0 user calibration coefficient:

Send: IP 03 00 08 00 01 CRC16

Respond: IP 03 02 DF1 DF2 CRC16

PM1.0 user calibration coefficient： (DF1*256+DF2)/10000

Read PM2.5 user calibration coefficient:

Send: IP 03 00 09 00 01 CRC16

Respond: IP 03 02 DF1 DF2 CRC16

PM2.5 user calibration coefficient： (DF1*256+DF2)/10000

Read PM10 user calibration coefficient:

Send: IP 03 00 0B 00 01 CRC16

Respond: IP 03 02 DF1 DF2 CRC16

PM10 user calibration coefficient： (DF1*256+DF2)/10000

Read TSP user calibration coefficient:

Send: IP 03 00 07 00 01 CRC16

Respond: IP 03 02 DF1 DF2 CRC16

TSP user calibration coefficient： (DF1*256+DF2)/10000

5 Read device address

Read device address: device address is DF1

Send: IP 03 00 02 00 01 CRC16

Respond: IP 03 02 00 DF1CRC16

6 Read device stop time

Read device stop running time, running time: DF1*256+DF2 (min)

Send: IP 03 00 02 00 01 CRC16

Respond: IP 03 02 DF1 DF2 CRC16

7 Read the setting flow of the control device

Read the setting flow of the control device: (DF1*256+DF2)/100 (L/min)

Send: IP 03 00 0E 00 01 CRC16

Respond: IP 03 02 DF1 DF2 CRC16

8 Read reading holding register data continuously

Device address: DF2

PM1.0 user calibration coefficient: (DF13*256+DF14)/10000

PM2.5 user calibration coefficient: (DF15*256+DF16)/10000

PM10 user calibration coefficient: (DF19*256+DF20)/10000

TSP user calibration coefficient: (DF11*256+DF12)/10000

Device stop running time, running time: DF23*256+DF24(min)

The setting flow of the control device：(DF25*256+DF26)/100 (L/min)

Send: IP 03 00 02 00 0A CRC16

Respond: IP 03 14 DF1~DF26 CRC16

9 Modify PM1.0, PM2.5, PM10, TSP measurement value user calibration coefficient (The coefficient range that can be set is 0.1 - 6.5)

Modify PM1.0 user calibration coefficient:

Send: IP 06 00 08 DF1 DF2 CRC16

Respond: IP 06 00 08 DF1 DF2 CRC16

PM1.0 user calibration coefficient: (DF1*256+DF2)/10000

Modify PM2.5 user calibration coefficient:

Send: IP 06 00 09 DF1 DF2 CRC16

Respond: IP 06 00 09 DF1 DF2 CRC16

PM2.5 user calibration coefficient: (DF1*256+DF2)/10000

Modify PM10 user calibration coefficient:

Send: IP 06 00 0B DF1 DF2 CRC16

Respond: IP 06 00 0B DF1 DF2 CRC16

PM10 user calibration coefficient: (DF1*256+DF2)/10000

Modify TSP user calibration coefficient:

Send: IP 06 00 07 DF1 DF2 CRC16

Respond: IP 06 00 07 DF1 DF2 CRC16

TSP user calibration coefficient: (DF1*256+DF2)/10000

10 Modify device address (The address range that can be set is 1- 254)

Modify device address: DF1 is device address need to be modified

Send: IP 06 00 02 00 DF1 CRC16 (IP is device address before modified)

Respond: IP 06 00 02 00 DF1 CRC16 (IP is device address after modified)

11 Modify device stop running time (The time range that can be set is 0 – 10000)

Modify device stop running time: stop running time is DF1*256+DF2 min

Send: IP 06 00 0D DF1 DF2 CRC16

Respond: IP 06 00 0D DF1 DF2 CRC16

12 Modify the setting flow of the control device (The flow range that can be set is 0.8L/min – 1.2L/min)

Modify the setting flow of the control device: the setting flow is (DF1*256+DF2)/100L/min

Send: IP 06 00 0E DF1 DF2 CRC16

Respond: IP 06 00 0E DF1 DF2 CRC16

13 Query device address

Query device address in running mode: device address is DF1

Send: 11 02 55 FF CRC16

Respond: 16 02 55 DF1 CRC16

14 Query the software version number

The reply should be corresponding to the software version number:DF1-DF13 form ASCII character string is the software version number

Send: 11 01 1E CRC16

Respond: 16 0E 1E DF1~DF13 CRC16

User Attention

※ It is forbidden to use the product in the environment with high concentration dust, containing water vapor, oil and corrosive substances, and in the high temperature environment exceeding the working temperature.
※ Do not block the air inlet and outlet, so as not to damage the air pump.
※ When use the product, it is recommended to add a 50-60 mesh protective filter to the sensor's air inlet to prevent flocs, hair, etc. from affecting the sensor's detection.
※ This product is an integral unit. Users should not disassemble it to avoid irreversible damage.
※ In order to not to affect the internal air tightness of the product, do not cause great vibration to the product.
This product contains 3R laser products inside, which has laser radiation, please avoid direct illumination on the eye. Pease do not remove the enclosure or cover. The warning signs are as follows:

After-Sales Services and Consultancy

Cubic Sensor and Instrument Co., Ltd
Add: Fenghuang No.3 Road, Fenghuang Industrial Park, Eastlake Hi-tech Development Zone, Wuhan 430205, China
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