



# SPECIFICATION

Product Name: Online Particle Counter

Item No.: OPC-6510DS

Version: v0.1

# Revision

No.	Version	Content	Date
1	V0.1		2022-12-27

## OPC-6510DS Particle Counter



### Applications

- Power battery manufacturing
- Chip manufacturing
- Medical and pharmaceutical
- Precision machining

### Description

The OPC-6510DS online particle counter adopts the principle of optical scattering, which can accurately detect and calculate the number of suspended particles of different particle sizes in the air per unit volume. It can output the particle count of 5 channels of 0.3 $\mu\text{m}$ , 0.5 $\mu\text{m}$ , 1.0 $\mu\text{m}$ , 5.0 $\mu\text{m}$  and 10 $\mu\text{m}$  at the same time (default unit is pcs/28.3L, available to switch unit to be pcs/m<sup>3</sup>).

### Features

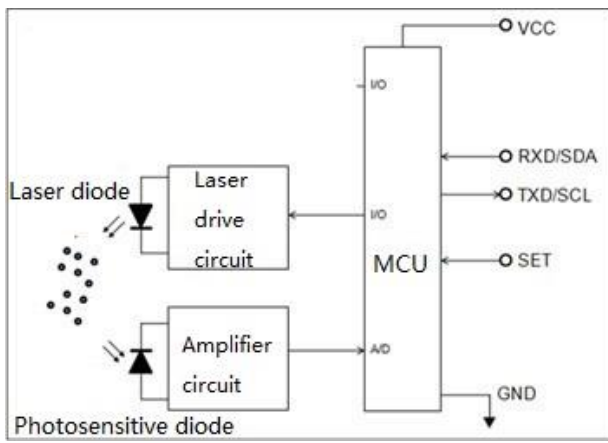
- Efficient particle recognition rate
- Industrial grade laser with high reliability
- Constant flow gas sampling system to ensure stable sampling
- Simultaneous output of 6 channels (0.3 $\mu\text{m}$ , 0.5 $\mu\text{m}$ , 1.0 $\mu\text{m}$ , 2.5 $\mu\text{m}$ , 5.0 $\mu\text{m}$ , 10 $\mu\text{m}$  particle number)
- Real-time display of the number of each particle size, display level, and alarm display, etc.
- Support for calibration of standard source coefficients
- Support TCP/IP MQTT protocol
- Support pcs/28.3L and pcs/m<sup>3</sup> unit switching
- Support switching between Chinese and English interface display

### Working Principle

Air sampling is carried out by a fan. When the particles in the sampled gas pass through a light source (laser) and other beams, light scattering occurs; the scattered light is converted into an electrical signal (pulse) through a photoelectric converter, and the larger the particle, the pulse signal is obtained. The larger the wave value (wave peak value), the number of particles with different particle sizes can be obtained through the wave peak value and the number of pulses at this time.

According to the block diagram on the right, the light source part of OPC-6510DS consists of a laser tube that emits light to detect particles and a drive circuit, the detection part consists of a photosensitive element that receives reflected light and an amplifier circuit, and the data processing and communication output are completed by a microprocessor.

The particle detection of OPC-6510DS is the gas flow generated by the operation of the fan, and the particles pass through the detection chamber. The light from the laser tube will be scattered by the particles and converted into electrical signals by the photosensitive device. After the electrical signal is processed by amplifying circuit, filtering and MCU, it will be converted into digital signal output.

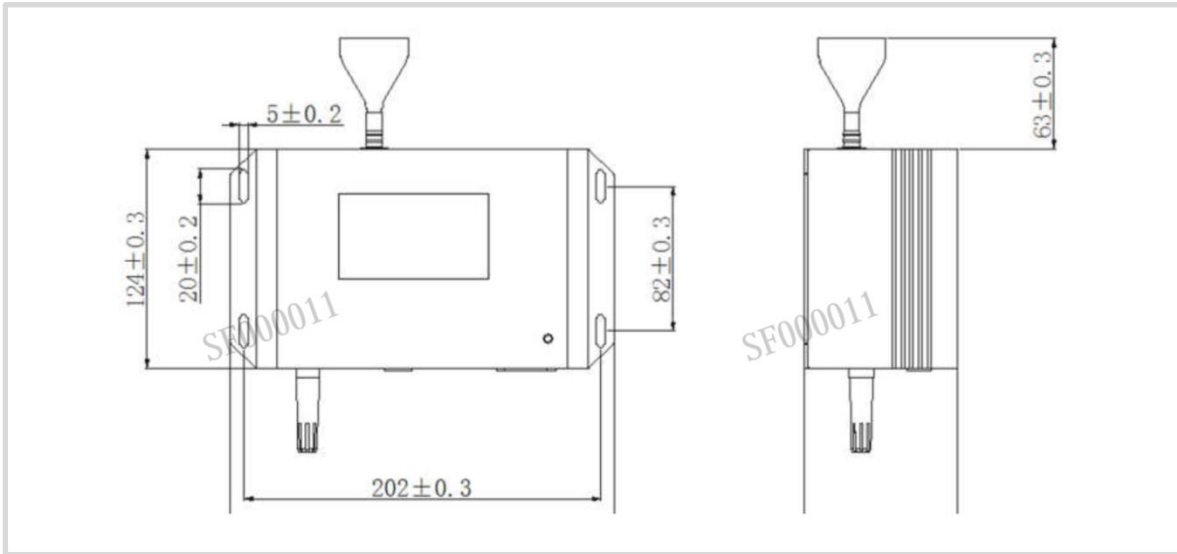


## Specification

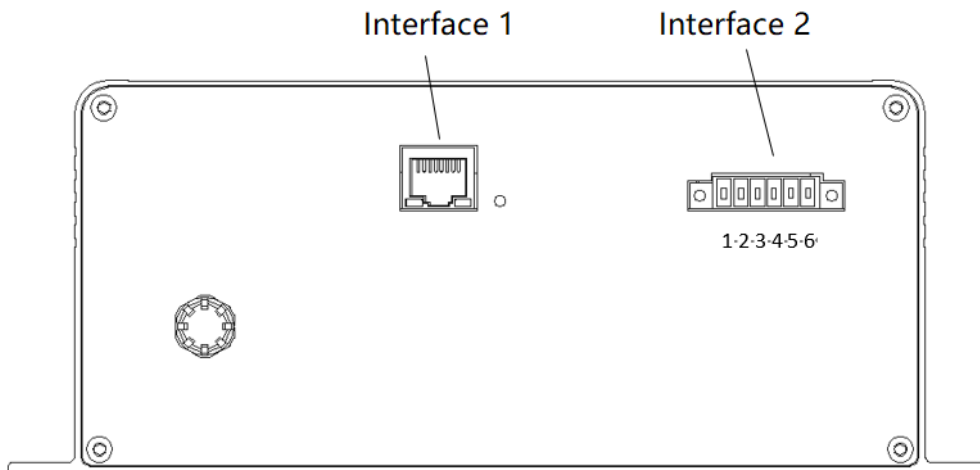
Principle	Light Scattering
Number of channels	5 channels (>0.3 $\mu$ m, >0.5 $\mu$ m, >1.0 $\mu$ m, >5.0 $\mu$ m, >10 $\mu$ m)
Counting efficiency	50%@0.3 $\mu$ m 100%@ $\geq$ 0.5 $\mu$ m (25 $\pm$ 2 $^{\circ}$ C, 50 $\pm$ 10%RH environmental conditions)
Detection range	0~1,000,000 pcs / 28.3L
Power-on stabilization time	$\leq$ 8s
Data refresh rate	1s
Working conditions	0 $^{\circ}$ C~45 $^{\circ}$ C; 0~95%RH (non-condensing)
Storage conditions	-20~60 $^{\circ}$ C, 0~95%RH (non-condensing)
Operating Voltage	DC 24V $\pm$ 15%
Average operating current	$\leq$ 3A
Communication Interface	RS485 interface (standard) RJ45 (standard)
Lifetime	$\geq$ 3 years (continuous working)
Sampling flow	28.3L/min
sampling head	Isokinetic Sampling Probe
External sampling tube	Inner diameter: $\phi$ 10mm Length: $\leq$ 3m
Operating mode	Adjustable (Default: Work 2min/Sleep 28min)
Display	3.5 inch color screen
Calibration	JJF 1190-2008

## Product appearance and pin definition function

### 1. Product dimensions (unit: mm, tolerance: ±2 mm)



### 2. Pin Definition Diagram



	No.	PIN	Description	Connector:
Interface 1	1	VCC	Power terminal (+24VDC)	KF2EDGRM-3.81-6P-14-curved needle
	2	GND	Power terminal (GND)	
	3	TB	Communication interface (RS485_TB)	Insertion: KF2EDGKM-3.81-6P-14
	4	TA	Communication interface (RS485_TA)	
	5	A2	original signal output	
	6	A3	original signal output	
Interface 2			<b>RJ45</b>	Connector: HR911105A (Fusida)

## Installation Instruction

When this product is installed and used in the system, the air flow of the air inlet and air outlet should be guaranteed to be smooth; in order to avoid the dust deposition on the surface of the sensitive device during use, which will affect the test accuracy of the sensor, it is recommended to install the sensor in the following way.

Recommended installation method:



## Precautions for Use

- ※ The instrument is forbidden to be used in environments with high dust concentration, environments containing moisture, oil and corrosive substances, and environments with high temperatures exceeding the allowable use.
- ※ Do not block the air inlet and outlet to avoid damage to the air pump.
- ※ The product is an integral part, users should not disassemble it to prevent irreversible damage.
- ※ Do not cause great vibration to the product, so as not to affect the internal air tightness.
- ※ The device cannot run continuously, which will shorten the service life of the product.

This product contains Class IIIB laser products, which contain laser radiation, avoid direct exposure to the eyes. Do not remove the case or cover. The warning signs are as following:





## Interface Note

The touch screen interface supports the counting display of particles in five channels of 0.3 $\mu$ m, 0.5 $\mu$ m, 1.0 $\mu$ m, 5.0 $\mu$ m and 10 $\mu$ m, as well as the determination of environmental grade.

Also, it shows Buzzer alarm and status display when exceeding the range of alarm thresholds. Synchronous support for uploading data to the server through MQTT protocol



Main interface:

- Display cleanliness class, according to ISO14644-1
- Display alarm status (normal in green; abnormal in red flashing)
- Display Internet connection status
- Display particle numbers of 0.3 $\mu$ m, 0.5 $\mu$ m, 1.0 $\mu$ m, 5.0 $\mu$ m, 10 $\mu$ m
- Display environmental temperature, humidity, sampling flow.



Login Interface:

Input default user login password to enter setting interface:

123456



Setting Interface:  
There are 9 Subfunction menu:

- MQTT setting
- Working time
- Channel display
- Alarm threshold values
- Correction factor
- Screen brightness
- Language setting
- Unit setting
- Device info



MQTT Interface:

This page allows the user to set the IP address and port number of the server to be connected

- Server IP address setting.
- Port Settings.



Working time interface:

- Device working time,

The default status is to work for 2min, and stop for 28min,

The limit is 2-10 minutes.

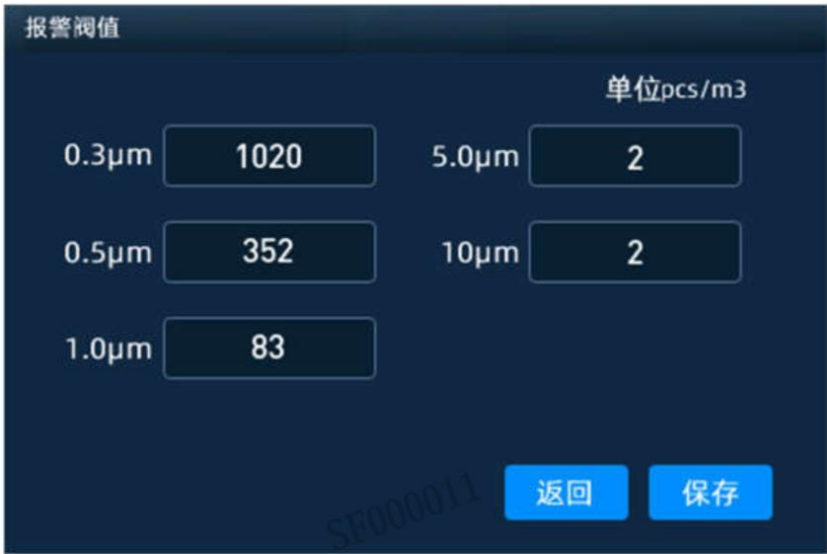
- Device stop time,

The value ranges from 2-1000 minutes



Display setting interface:

● The displayed particle channel can be set through this interface



Alarm threshold interface:

● Alarm threshold is default set based on CLASS 4, customer can set it according to the actual needs  
Alarm strategy:

1. The "Close Alarm" button will be added to the main interface.1
2. When the particle concentration exceeds the set alarm value, the status lamp will display abnormal and red light flashing, buzzer alarm, until the concentration is below the alarm valve for 2 minutes, the alarm status light and buzzer alarm will turn off, display normal and light will keep steady green.
3. When the "Close Alarm" is enabled, the buzzer will stop alarm for 5 minutes, the status light is still abnormal and the red light blinks, if the concentration still exceeds the



Correction Coefficient Interface:

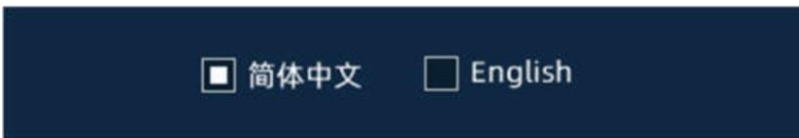
- Correction coefficient is used for customer site particle channel data parameter calibration and adjustment according to the standard equipment.



Other Settings:

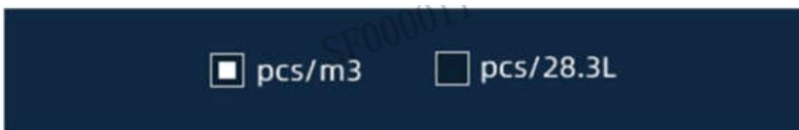
Screen brightness interface:

- It is used to adjust the brightness of the display in accordance with the environment



Language setting Interface:

Support Chinese and English switching display



Unit setting interface:

- Support unit PCS/m<sup>3</sup> and PCS/28.3L



Device information interface:

Info can be obtained from this interface:

Software version, product number, and manufacturer and contact information

### 1. Protocol overview

#### 1.1 Serial RS485 communication protocol

- 1) The data of this protocol are all hexadecimal data. For example, "46" is [70] in decimal.
- 2) [xx] is single-byte data (unsigned, 0-255); double-byte data high byte is in front and low byte is behind.
- 3) Baud rate: 9600b/s; data bits: 8 bits; stop bits: 1 bit; parity bit: none.

### 2. Communication protocol format

The device adopts the Modbus RTU communication protocol, and the requirements are as follows:

- 1) The device acts as a slave;
- 2) The Modbus 03 function code (Read Holding Registers) can be used to read the device status and data; the Modbus 06 function code (Preset Single Register) can be used to set the device status.
- 3) If the function code in the sent message does not meet the requirements, the device will reply the error code 01 (ILLEGAL FUNCTION) through the 81 function code message; if the request address in the sent message does not meet the requirements, the device will report the 81 function code. The text reply error code 02 (ILLEGAL DATA ADDRESS) notification.

### 3. Device factory default settings

- 1) The factory address is 01 by default.
- 2) The factory default is intermittent working mode.(Work 2min/Sleep 28 min)
- 3) The factory defaults all user coefficients are 1.0000.
- 4) The factory default setting control flow rate is 28.3 L/min (cannot be changed at will).

### 4. Check code

CRC-16 (Modbus), high byte first, low byte after.

### 5. Register address table

Restriction Description

- 1) Read-only registers and readable and writable registers are not allowed to overlap.
- 2) Only function of writing a single register is implemented, and writing multiple registers is not available.
- 3) The total number of registers is limited, currently 32 input registers and 32 holding registers are supported.
- 4) The current version does not support file transfer with a 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 number-1.

Table 1: Input Registers

Data No.	Address	Definition	Explanation
IR1	00H		Version No. (Enlarge 100)
IR2	01H		Reserve
IR3	02H		Reserve
IR4	03H	The number of particles >0.3 $\mu$ m	$\geq 0.3\mu\text{m}$ particle quantity high byte
IR5	04H	The number of particles >0.3 $\mu$ m	$\geq 0.3\mu\text{m}$ particle quantity low byte
IR6	05H	The number of particles >0.5 $\mu$ m	$\geq 0.5\mu\text{m}$ particle quantity high byte
IR7	06H	The number of particles >0.5 $\mu$ m	$\geq 0.5\mu\text{m}$ particle quantity low byte
IR8	07H	The number of particles >1.0 $\mu$ m	$\geq 1.0\mu\text{m}$ particle quantity high byte
IR9	08H	The number of particles >1.0 $\mu$ m	$\geq 1.0\mu\text{m}$ particle quantity low byte
IR10	09H		Reserve
IR11	0AH		Reserve
IR12	0BH	The number of particles >5.0 $\mu$ m	$\geq 5.0\mu\text{m}$ particle quantity high byte
IR13	0CH	The number of particles >5.0 $\mu$ m	$\geq 5.0\mu\text{m}$ particle quantity low byte
IR14	0DH	The number of particles >10 $\mu$ m	$\geq 10\mu\text{m}$ particle quantity high byte
IR15	0EH	The number of particles >10 $\mu$ m	$\geq 10\mu\text{m}$ particle quantity low byte
IR16	0FH		Reserve
IR17	10H		Reserve
IR18	11H		Reserve
IR19	12H		Reserve
IR20	13H		Reserve
IR21	14H		Reserve
IR22	15H		Reserve
IR23	16H		Reserve
IR24	17H	Gas flow value	Actual gas flow value multiplied by 100
IR25	18H	Temperature value	Actual temperature value multiplied by 100
IR26	19H	Humidity value	Actual humidity value multiplied by 100
IR27	1AH		Reserve
IR28	1BH		Reserve
IR29	1CH		Reserve
IR30	1DH		Reserve
IR31	1EH		Reserve
IR32	1FH		Reserve

Table 2: Holding Registers

Data No.	Address	Definition	Explanation
IR1	00H		Reserve
IR2	01H		Reserve
IR3	02H	Address setting register	Slave address (1-247)
IR4	03H		Reserve
IR5	04H		Reserve
IR6	05H		Reserve
IR7	06H		Reserve
IR8	07H		Reserve
IR9	08H		Reserve
IR10	09H		Reserve
IR11	0AH		Reserve
IR12	0BH		Reserve
IR13	0CH		Reserve
IR14	0DH	Device intermittent stop time	Set the device intermittent stop time (min)
IR15	0EH	Device control traffic size	Actual set gas flow value multiplied by 100
IR16	0FH	Device intermittent working time	Set the equipment intermittent working time (min)
IR17	10H		Reserve
IR18	11H		Reserve
IR19	12H		Reserve
IR20	13H		Reserve
IR21	14H		Reserve
IR22	15H		Reserve
IR23	16H		Reserve
IR24	17H		Reserve
IR25	18H		Reserve
IR26	19H		Reserve
IR27	1AH		Reserve
IR28	1BH		Reserve
IR29	1CH		Reserve
IR30	1DH		Reserve
IR31	1EH		Reserve
IR32	1FH		Reserve

## 6. Host communication protocol format

### Function code description

The OPC-6510DS supports the following function codes:

0x03: read holding register

0x04: read input register

0x06: write a single register

## 7. Command example

### Application conditions

- 1) Assuming a single sensor.
- 2) All data are hexadecimal data, and DFX needs to be converted to decimal when calculating data.
- 3) Symbol description:
  - ① IP is the device address.
  - ② CRC16 is MODBUSCRC16 two-byte check, the high byte is in the front and the low byte is in the back.
  - ③ CS is 0-ADD8 and check, the lowest byte of the previous data and +CS result is 0x00.
  - ④ DF1 DF2 DF3 DF4 represent uncertain data.

#### 7.1. Read >0.3μm, >0.5μm, >1.0μm, >5.0μm, >10μm of particles in each channel

##### 7.1.1 Read >0.3μm particle count:

Send: IP 04 00 03 00 02 CRC16

Answer: IP 04 04 DF1 DF2 DF3 DF4 CRC16

Description: >0.3μm particle count =  $DF1*256^3+DF2*256^2+DF3*256+DF4$  (pcs/28.3L)

##### 7.1.2 Read >0.5μm particle count:

Send: IP 04 00 05 00 02 CRC16

Answer: IP 04 04 DF1 DF2 DF3 DF4 CRC16

Description: >0.5μm particle count =  $DF1*256^3+DF2*256^2+DF3*256+DF4$  ( pcs/28.3L)

##### 7.1.3 Read >1.0μm particle count:

Send: IP 04 00 07 00 02 CRC16

Answer: IP 04 04 DF1 DF2 DF3 DF4 CRC16

Description: >1.0μm particle count =  $DF1*256^3+DF2*256^2+DF3*256+DF4$  ( pcs/28.3L)

##### 7.1.4 Read >5.0μm particle count:

Send: IP 04 00 0B 00 02 CRC16

Answer: IP 04 04 DF1 DF2 DF3 DF4 CRC16

Description: >5.0μm particle count =  $DF1*256^3+DF2*256^2+DF3*256+DF4$  ( pcs/28.3L)

##### 7.1.5 Read >10μm particle count: Send:

IP 04 00 0D 00 02 CRC16

Answer: IP 04 04 DF1 DF2 DF3 DF4 CRC16

Description: >10μm particle count =  $DF1*256^3+DF2*256^2+DF3*256+DF4$  ( pcs/28.3L)

#### 7.2. Read real-time gas flow value

Send: IP 04 00 17 00 01 CRC16

Answer: IP 04 02 DF1 DF2 CRC16



Description: Real-time gas flow value =  $(DF1*256+DF2)/100$  (L/min)

### 7.3. Read real-time temperature value

Send: IP 04 00 18 00 01 CRC16

Answer: IP 04 02 DF1 DF2 CRC16

Description: Real-time temperature value =  $(DF1*256+DF2)/100$ (°C)

### 7.4. Read real-time humidity value

Send: IP 04 00 19 00 01 CRC16

Answer: IP 04 02 DF1 DF2 CRC16

Description: real time humidity value =  $(DF1*256+DF2)/100$ (%)

### 7.5. Continuously read input register data

Send: IP 04 00 03 00 17 CRC16

Answer: IP 04 2E DF1~DF46 CRC16

Description:

>0.3µm particle count =  $DF1*256^3+DF2*256^2+DF3*256+DF4$  (pcs/28.3L)

>0.5µm particle count =  $DF5*256^3+DF6*256^2+DF7*256+DF8$  (pcs/28.3L)

>1.0µm particle count =  $DF9*256^3+DF10*256^2+DF11*256+DF12$  ( pcs/28.3L)

>5.0µm particle count =  $DF17*256^3+DF18*256^2+DF19*256+DF20$  ( pcs/28.3L)

>10µm particle count =  $DF21*256^3+DF22*256^2+DF23*256+DF24$  ( pcs/28.3L)

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

Real-time temperature value =  $(DF43*256+DF44)/100$ (°C)

Real time humidity value =  $(DF45*256+DF46)/100$ (%)

### 7.6. Read device address

Send: IP 03 00 02 00 01 CRC16

Answer: IP 03 02 00 DF1 CRC16

Description: Device address is DF1

### 7.7. Read the intermittent operation stop time of the device

Send: IP 03 00 0D 00 01 CRC16

Answer: IP 03 02 DF1 DF2 CRC16

Description: Equipment intermittent stop time =  $DF1*256+DF2$  (min)

### 7.8. Read the intermittent working time of the device

Send: IP 03 00 0F 00 01 CRC16

Answer: IP 03 02 DF1 DF2CRC16

Description: Equipment intermittent working time =  $DF1*256+DF2$  (min)

### 7.9. Read device setting flow size

Send: IP 03 00 0E 00 01 CRC16

Answer: IP 03 02 DF1 DF2 CRC16

Description: Device setting flow size= $(DF1*256+DF2)/100$  (L/min)

### 7.10. Modify the device address (the address range that can be set is 1-254)

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

Answer: IP 06 00 02 00 DF1 CRC16 (IP is the modified device address)

Description: DF1 is the device address that needs to be modified

### 7.11. Modify the equipment running stop time (the time range that can be set is 0-10000)

Send: IP 06 00 0D DF1 DF2 CRC16

Answer: IP 06 00 0D DF1 DF2 CRC16

Description:

1. Device stop time =  $DF1 * 256 + DF2$  (min)

2. When the intermittent stop time is set to 0, the device keeps running;

**7.12. Modify the operating time of the equipment (the time range that can be set is 1-10000)**

Send: IP 06 00 0F DF1 DF2 CRC16

Answer: IP 06 00 0F DF1 DF2 CRC16

Description: Equipment working time =  $DF1 * 256 + DF2$  (min), when the intermittent stop time is set to 0, the equipment will keep running, working time setting value is invalid.

**7.13. Modify the flow rate set by the control device (the flow rate can be set in the range of 15.0L/min – 35L/min)**

Send: IP 06 00 0E DF1 DF2 CRC16

Answer: IP 06 00 0E DF1 DF2 CRC16

Description: The modified flow rate =  $(DF1 * 256 + DF2) / 100$  (L/min)

**7.14. Query device address**

Send: 11 02 55 FF CS

Answer: 16 02 55 DF1 CS

Description: In the running mode, the query device address is DF1

**7.15. Query the software version number**

Send: 11 02 1E IP CS

Answer: 16 11 1E IP DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 DF11 DF12 DF13 DF14 DF15 CS

Description: The version number is DF1-DF15, the ASCII string is the software version number

**7.16. Query MQTT server IP and port number**

Send: 11 01 67 CS

Answer: 16 07 67 DF1 DF2 DF3 DF4 DF5 DF6 CS

Description: MQTT server IP and port number format: [IP1]:[IP2]:[IP3]:[IP4]:[PORT]

IP1=DF1, IP2=DF2, IP3=DF3, IP4=DF4, PORT=DF5\*256+DF6

**7.17. Modify MQTT server IP and port number**

Send: 11 07 66 DF1 DF2 DF3 DF4 DF5 DF6 CS

Answer: 16 01 66 83

Description: MQTT server IP and port number format: [IP1]:[IP2]:[IP3]:[IP4]:[PORT]

IP1=DF1, IP2=DF2, IP3=DF3, IP4=DF4, PORT=DF5\*256+DF6

## MQTT Communication Protocol

### 1. Protocol overview

- This device support DHCP protocol, can obtain the IP address automatically.
- Support the MQTT protocol version: MQTT V3.1.1.
- Using JSON data format.
- Support device calibration instructions.

### 2. Topic List

Directions	Topic	Description
Server->MCU	/product ID/device ID/function/invoke	Server sends the instant command(CMD-1~CMD-10)
MCU->Server	/product ID/device ID/function/invoke/reply	Reply to the server's sending command (ACK) : notifies the server of the received number According to (CMD-999)
MCU->Server	/product ID/device ID/properties/report	Device periodically reports data, cycle is intermittent operation cycle (configurable) (CMD-168) Response to data sent by the server (CMD-101 ~ CMD-110)

### 3. Authentication Definition

Product ID:opc-6510ds

deviceId :Device factory sn

secureId : sifanguangdian

secureKey: 123456

```
var clientId = deviceId(device SN)
```

```
var username = secureId+"|"+deviceId; // Concatenate user password
```

```
var password = md5(username+"|"+secureKey); // Use md5 to generate the abstract
```

### 4. Rule of Message

4.1. Messages are delivered in a uniform format where the inputs object is the content of the message.

All send instruction contents will be in inputs.

Key value	Types	Description
cmd	String	Command number
inputs	Object	Downlink message content
desired	Object	Uplink message content
messageId	Otring	Message Id

Note: All descending instructions must contain the "messageId" and "inputs" fields; and the "inputs" field must begin with cmd field. messageId of the uplink ACK = messageId of the downlink ACK

## 4.2. Command List

MCU->Server (Downlink)

Command	Description
CMD-1	Read particle count
CMD-2	Read the real-time gas flow value
CMD-3	Read the real-time temperature and humidity values
CMD-4	Read the particle quantity coefficient
CMD-5	Read the alarm threshold
CMD-6	Read the intermittent operation stop time of the device
CMD-7	Query the SN code and firmware version
CMD-8	Modify device parameters

MCU->Server (Uplink)

Command	Description
CMD-101	Upload the particle count
CMD-102	Upload Real-time gas flow value
CMD-103	Upload the real-time temperature and humidity values
CMD-104	Upload the particle quantity coefficient
CMD-105	Upload the alarm threshold
CMD-106	Upload the intermittent operation stop time of the device
CMD-107	Upload SN code and firmware version
CMD-108	Modify the device parameter response
CMD-168	Periodically report the data automatically
CMD-999	Uplink ACK(Acknowledgement message of receiving the instruction, which informs the server that the instruction was received )

## 5. Instruction specification

### 5.1 Read particle count CMD-1

Description: Read >0.3um, >0.5um, >1.0um, >5.0um, >10um of particles count in each channel

Downlink command:

Parameter	Type	Description
-	-	-

Example:

topic : /prodcutID/deviceID/function/invoke

```
{
  "messageId": "1574326733176995841",
  "deviceId" : "173072083110001",
  "timestamp": 1664183717422,
  "functionId": "CMD1",
  "messageType": "INVOKE_FUNCTION",
  "inputs": [{"cmd": "CMD-1"}]
}
```

Uplink ACK (Acknowledgement message of receiving the instruction, which informs the server that the instruction was received):

TOPIC: /prodcutID/deviceID/function/invoke/reply

```
{
  "messageId": "1574326733176995841",
  "cmd": "CMD-999",
  "output": "success"
}
```

Uplink data:

Parameter	Type	Description
particles_0.3um	Number	>0.3µm particle count
particles_0.5um	Number	>0.5µm particle count
particles_1.0um	Number	>1.0µm particle count
particles_5.0um	Number	>5.0µm particle count
particles_10um	Number	>10µm particle count
Unit	String	Unit (pcs/m3 or pcs/28.3L)

topic : /prodcutID/deviceID/properties/report

```
{
  "cmd": "CMD-101",
  "desired":{
    ;"particles_0.3um" : 123,
    "particles_0.5um" : 123,
    "particles_1.0um" : 123,
    "particles_5.0um" : 123,
    "particles_10um" : 123,
    "unit":"pcs/28.3L "
  }
}
```

### 5.2 Read the real-time gas flow value CMD-2

Description: Read the real-time gas flow value,Unit is (L/min)

Downlink command:

Parameter	Type	Description
-	-	-

topic : /prodcutID/deviceID/function/invoke

```
{
  "messageId":"1574326733176995841",
  "deviceId":"173072083110001",
  "timestamp":1664183717422,
  "functionId":"CMD2",
  "messageType":"INVOKE_FUNCTION",
  "inputs":[{"cmd":"CMD-2"}]
}
```

Uplink ACK (Acknowledgement message of receiving the instruction, which informs the server that the instruction was received):

TOPIC: /prodcutID/deviceID/function/invoke/reply

```
{
  "messageId":"1574326733176995841",
  "cmd": "CMD-999",
  "output":"success"
}
```

Uplink data:

Parameter	Type	Description
gas_flow	Number(Floating-point value)	real-time gas flow value (Unit: L/min)

topic :/prodcutID/deviceID/properties/report

```
{
  "cmd": "CMD-102",
  "desired":{
    "gas_flow" : 28.3
  }
}
```

### 5.3 Read the real-time temperature and humidity values CMD-3

Description: Read real-time temperature and humidity. The temperature is divided into ambient temperature and cavity temperature

Downlink command:

Parameter	Type	Description
-	-	-

topic : /prodcutID/deviceID/function/invoke

```
{
  "messageId": "1574326733176995841",
  "deviceId": "173072083110001",
  "timestamp": 1664183717422,
  "functionId": "CMD3",
  "messageType": "INVOKE_FUNCTION",
  "inputs": [{"cmd": "CMD-3"}]
}
```

Uplink ACK (Acknowledgement message of receiving the instruction, which informs the server that the instruction was received):

TOPIC: /prodcutID/deviceID/function/invoke/reply

```
{
  "messageId": "1574326733176995841",
  "cmd": "CMD-999",
  "output": "success"
}
```

Uplink data:

Parameter	Type	Description
temperature	Number- Floating-point value	ambient temperature / °C
humidity	Number- Floating-point value	ambient humidity / RH%

topic : /prodcutID/deviceID/properties/report

```
{
  "cmd": "CMD-103",
  "desired": {
    "temperature": 25.6,
    "humidity": 45.7,
  }
}
```

### 5.4 Read the particle quantity coefficient CMD-4

Description: Read the particle quantity coefficient

Downlink command:

Parameter	Type	Description
-	-	-

topic : /prodcutID/deviceID/function/invoke

```
{
  "messageId": "1574326733176995841",
  "deviceId": "173072083110001",
  "timestamp": 1664183717422,
  "functionId": "CMD4",
  "messageType": "INVOKE_FUNCTION",
  "inputs": [{"cmd": "CMD-4"}]
}
```

Uplink ACK (Acknowledgement message of receiving the instruction, which informs the server that the instruction was received):

TOPIC: /prodcutID/deviceID/function/invoke/reply

```
{
  "messageId": "1574326733176995841",
  "cmd": "CMD-999",
}
```

"output": "success"

} Uplink data:

Parameter	Type	Description
particles_coef_0.3um	Number-integer number	>0.3µm particle count user oefficient,10000 times larger
particles_coef_0.5um	Number- integer number	>0.5µm particle count user oefficient,10000 times larger
particles_coef_1.0um	Number- integer number	>1.0µm particle count user oefficient,10000 times larger
particles_coef_5.0um	Number- integer number	>5.0µm particle count user oefficient,10000 times larger
particles_coef_10um	Number- integer number	>10µm particle count user oefficient,10000 times larger

topic : /prodcutID/deviceID/properties/report

```
{
  "cmd": "CMD-104",
  "desired":{
    "particles_coef_0.3um" : 123,
    "particles_coef_0.5um" : 123,
    "particles_coef_1.0um" : 123,
    "particles_coef_5.0um" : 123,
    "particles_coef_10um" : 123
  }
}
```

### 5.5 Read alarm threshold value CMD-5

Description: Read alarm threshold value

Downlink command:

Parameter	Type	Description
-	-	-

topic : /prodcutID/deviceID/function/invoke

```
{
  "messageId": "1574326733176995841",
  "deviceId": "173072083110001",
  "timestamp": 1664183717422,
  "functionId": "CMD5",
  "messageType": "INVOKE_FUNCTION",
  "inputs": [{"cmd": "CMD-5"}]
}
```

Uplink ACK (Acknowledgement message of receiving the instruction, which informs the server that the instruction was received):

TOPIC: /prodcutID/deviceID/function/invoke/reply

```
{
  "messageId": "1574326733176995841",
  "cmd": "CMD-999",
  "output": "success"
}
```

} Uplink data:

Parameter	Type	Description
alarm_threshold_0.3um	Number	>0.3µm particle alarm threshold value
alarm_threshold_0.5um	Number	>0.3µm particle alarm threshold value
alarm_threshold_1.0um	Number	>0.3µm particle alarm threshold value
alarm_threshold_5.0um	Number	>0.3µm particle alarm threshold value
alarm_threshold_10um	Number	>0.3µm particle alarm threshold value
Unit	String	Unit (pcs/m3 or pcs/28.3L)

topic : /prodcutID/deviceID/properties/report

```
{
  "cmd": "CMD-105",
  "desired":{
```

```

        "alarm_threshold_0.3um": 123,
"alarm_threshold_0.5um"      : 123,
"alarm_threshold_0.3um"      : 123,
"alarm_threshold_0.5um"      : 123,
"alarm_threshold_0.3um"      : 123,
"Unit": "pcs/m3"
    }
}

```

### 5.6 Read the intermittent operation stop time of the device CMD-6

Description: Read the intermittent operation stop time of the device

Downlink command:

Parameter	Type	Description
-	-	-

topic : /prodcutID/deviceID/function/invoke

```

{
"messageId": "1574326733176995841",
"deviceId": "173072083110001",
"timestamp": 1664183717422,
"functionId": "CMD6",
"messageType": "INVOKE_FUNCTION",
"inputs": [{"cmd": "CMD-6"}]
}

```

Uplink ACK (Acknowledgement message of receiving the instruction, which informs the server that the instruction was received):

TOPIC: /prodcutID/deviceID/function/invoke/reply

```

{
"messageId": "1574326733176995841",
"cmd": "CMD-999",
"output": "success"
} Uplink data:

```

Parameter	Type	Description
work_stop_time	Number-Shaping number	Device stop time /min cannot be 0, otherwise the setting value is invalid.
Work_run_time	Number- Shaping number	Device intermittent operation time /min cannot be 0, otherwise the setting value is invalid. Actively upload MQTT data once the run time is over

topic : /prodcutID/deviceID/properties/report

```

{
  "cmd": "CMD-106",
  "desired": {
    "work_stop_time" : 10,
"work_run_time" : 2
  }
}

```

### 5.7 Query the SN code and firmware version CMD-7

Description: Query the SN code and firmware version

Downlink command:

Parameter	Type	Description
-	-	-

topic : /prodcutID/deviceID/function/invoke

```

{
"messageId": "1574326733176995841",
"deviceId": "173072083110001",
"timestamp": 1664183717422,
"functionId": "CMD7",

```



```
"messageType": "INVOKE_FUNCTION",
"inputs": [{"cmd": "CMD-7"}]
}
```

Uplink ACK (Acknowledgement message of receiving the instruction, which informs the server that the instruction was received):

TOPIC: /prodcutID/deviceID/function/invoke/reply

```
{
"messageId": "1574326733176995841",
"cmd": "CMD-999",
"output": "success"
}
```

Uplink data:

Parameter	Type	Description
sn	String	Device sn
sw_version	String	sw version

topic : /prodcutID/deviceID/properties/report

```
{
"cmd": "CMD-107",
"desired": {
"sn" : "123456789",
"sw_version" : "xxx"
}
}
```

### 5.8 Modify device parameters CMD-8

Description: Modify device parameters

Downlink command:

Parameter	Type	Description
particles_coef_0.3um	Number	>0.3µm particle count user coefficient, range 1000~65000,10000 times larger, actual coefficient is 0.1~6.5
particles_coef_0.5um	Number	>0.5µm particle count user coefficient, range 1000~65000,10000 times larger, actual coefficient is 0.1~6.5
particles_coef_1.0um	Number	>1.0µm particle count user coefficient, range 1000~65000,10000 times larger, actual coefficient is 0.1~6.5
particles_coef_5.0um	Number	>5.0µm particle count user coefficient, range 1000~65000,10000 times larger, actual coefficient is 0.1~6.5
particles_coef_10um	Number	>10µm particle count user coefficient, range 1000~65000,10000 times larger, actual coefficient is 0.1~6.5
work_stop_time	Number	Device stop time
work_run_time	Number	Device operation time
alarm_threshold_0.3um	Number	>0.3µm particle alarm threshold value
alarm_threshold_0.5um	Number	>0.3µm particle alarm threshold value
alarm_threshold_1.0um	Number	>0.3µm particle alarm threshold value
alarm_threshold_5.0um	Number	>0.3µm particle alarm threshold value
alarm_threshold_10um	Number	>0.3µm particle alarm threshold value

Note:

1. Before modifying alarm\_threshold\_\*\*, the unit of the current device particle number must be clear. The alarm threshold received by the device is set based on the unit of the current particle number.

topic : /prodcutID/deviceID/function/invoke

```
{
"messageId": "1574326733176995841",
"deviceId": "173072083110001",
"timestamp": 1664183717422,
"functionId": "CMD8",
"messageType": "INVOKE_FUNCTION",
"inputs": [
{"cmd": "CMD-8"},
{"particles_coef_1.0um": 12345},

```

```

{"work_run_time": 45}
]
}

```

Uplink ACK (Acknowledgement message of receiving the instruction, which informs the server that the instruction was received):

TOPIC: /prodcutID/deviceID/function/invoke/reply

```

{
"messageId": "1574326733176995841",
"cmd": "CMD-999",
"output": "success"
}

```

Uplink data:

Parameter	Type	Description
result	String	success or failed

topic : /prodcutID/deviceID/properties/report

```

{
"sn" : "123456789",
"cmd": "CMD-108",
"desired":{
"result" : "success"
}
}

```

### 5.9 Automatically report the data periodically CMD-168

The device will automatically reports data periodically without the server sending request data packets

The automatic report period is the intermittent operation period (set by CMD-8). After one working period is complete, the automatic report is uploaded once

Uplink data list:

Parameter	Type	Description
particles_0.3um	Number	>0.3µm particle count
particles_0.5um	Number	>0.5µm particle count
particles_1.0um	Number	>1.0µm particle count
particles_5.0um	Number	>5.0µm particle count
particles_10um	Number	>10µm particle count
Unit	String	Unit (pcs/m3 or pcs/28.3L)
temperature	Number- Floating-point value	Ambient temperature / °C
humidity	Number- Floating-point value	Ambient humidity / RH%


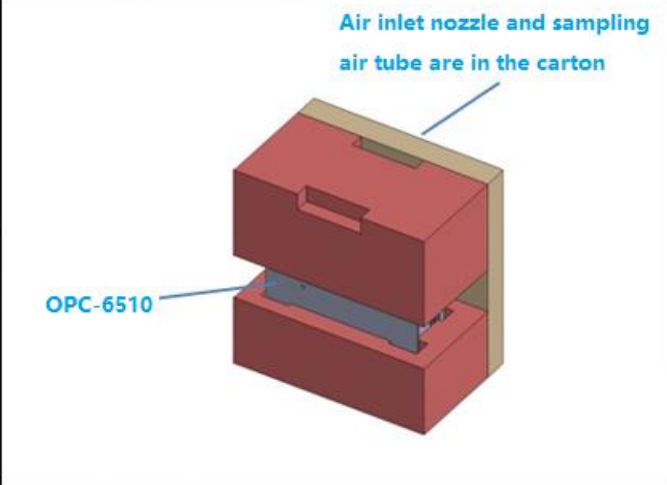
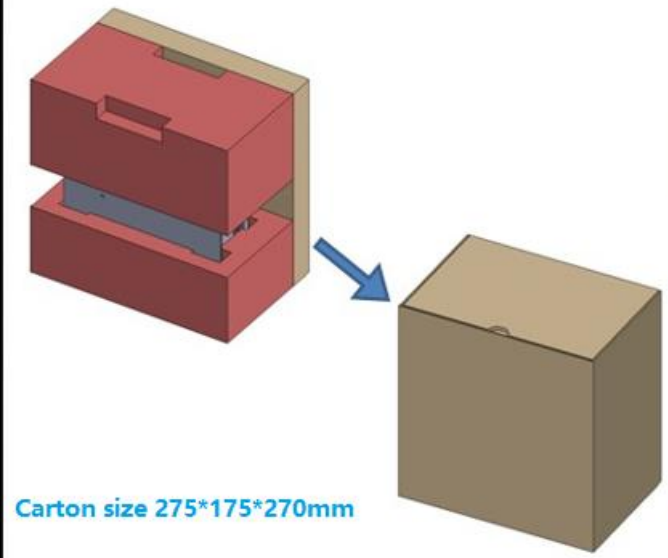
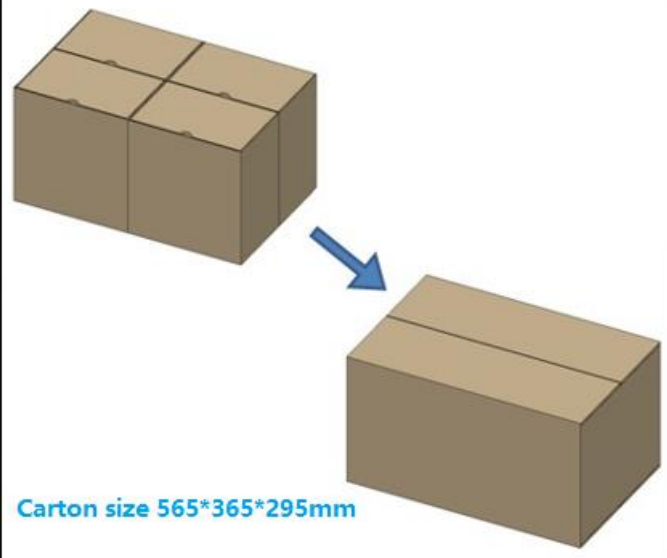
topic : /prodcutID/deviceID/properties/report

```

{
"cmd": "CMD-168",
"desired":{
"particles_0.3um" : 123,
"particles_0.5um" : 123,
"particles_1.0um" : 123,
"particles_5.0um" : 123,
"particles_10um" : 123,
"unit": "pcs/m3",
"temperature" : 25.6,
"humidity" : 45.7,
}
}

```

## Packing Information

(1) Components in the package	(2) Schematic diagram of inner packaging
 <p>1. OPC-6510</p> <p>2. Air inlet nozzle</p> <p>3. Sampling tube (length 3 meters)</p>	 <p>Air inlet nozzle and sampling air tube are in the carton</p> <p>OPC-6510</p>
(3) Schematic diagram of single packaging	(4) Schematic diagram of secondary packaging
 <p>Carton size 275*175*270mm</p>	 <p>Carton size 565*365*295mm</p>

### After-sales service and consultation

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