# SPECIFICATION

Product Name: Online Particle Counter

Item No.: OPC-6510

Version: V2203111A-01

| Prepared By | Audit | Approve |
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# Revision

| No. | Version | Content | Date |
|---|---|---|---|
| 1 | V2203111A-01 | First Edition | 2022-3-24 |
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28.3 L

# Particle Counter

## Applications

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

## Description

The OPC-6510 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 6 channels of 0.3μm, 0.5μm, 1.0μm, 2.5μm, 5.0μm and 10μm at the same time (the default unit is pcs/28.3L).

## Features

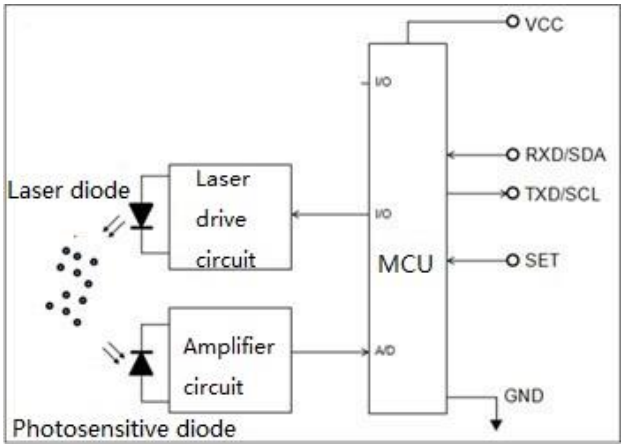
- Efficient particle recognition rate
- Industrial grade laser with high reliability
- Constant flow gas sampling system to ensure stable sampling
- Simultaneous output of 6 channels (0.3μm, 0.5μm, 1.0μm, 2.5μm, 5.0μm, 10μm particle number)
- Wide temperature operating range

## 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 OPC6510 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 OPC6510 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.

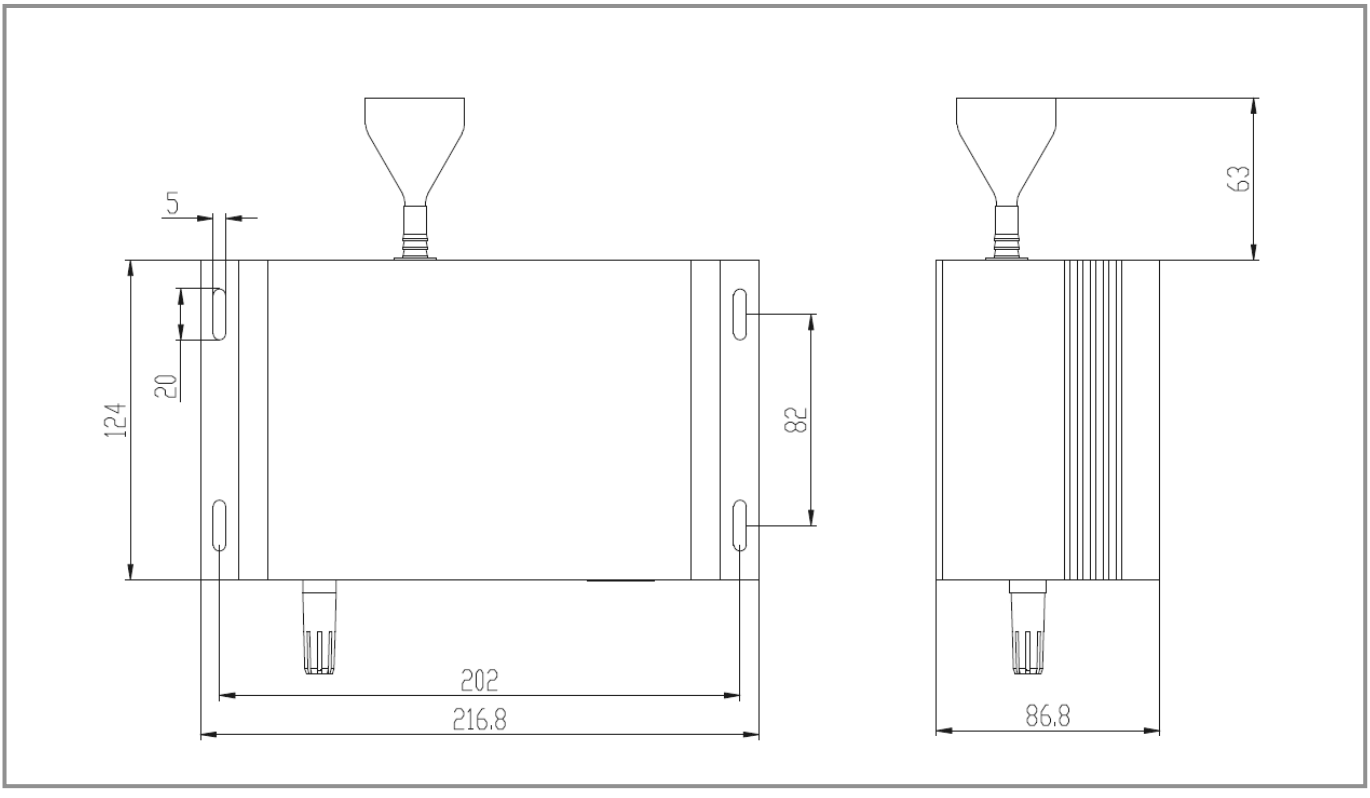

VCC
I/O
RXD/SDA
TXD/SCL
Laser diode
Laser
drive
circuit
I/O
MCU
SET
Amplifier
circuit
A/D
GND
Photosensitive diode

## Specification

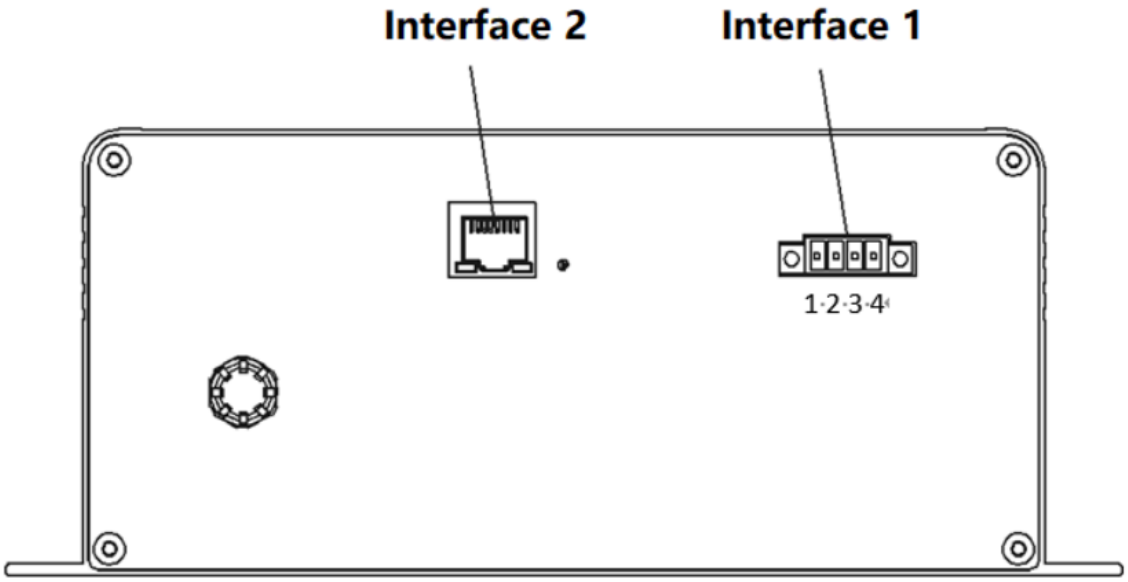
| Basic performance | |
|---|---|
| Principle | Light Scattering |
| Number of channels | 6 channels (>0.3μm, >0.5μm, >1.0μm, >2.5μm, >5.0μm, >10μm) |
| Counting efficiency | 50%@0.3μm<br>100%@≥0.5μm (25±2℃, 50±10%RH environmental conditions) |
| Detection range | 0~1,000,000 pcs / 28.3L |
| Power-on stabilization time | ≤8s |
| Data refresh rate | 1s |
| Working conditions | 0℃～45℃; 0～95%RH (non-condensing) |
| Storage conditions | -20~60℃, 0~95%RH (non-condensing) |
| Operating Voltage | DC 24V |
| Average operating current | ≤3A |
| Communication Interface | RS485 interface (standard)<br>RJ45 (optional) |
| Lifetime | ≥3 years (continuous working) |
| Sampling flow | 28.3L/min |

## Product appearance and pin definition function

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



2. Pin Definition Diagram

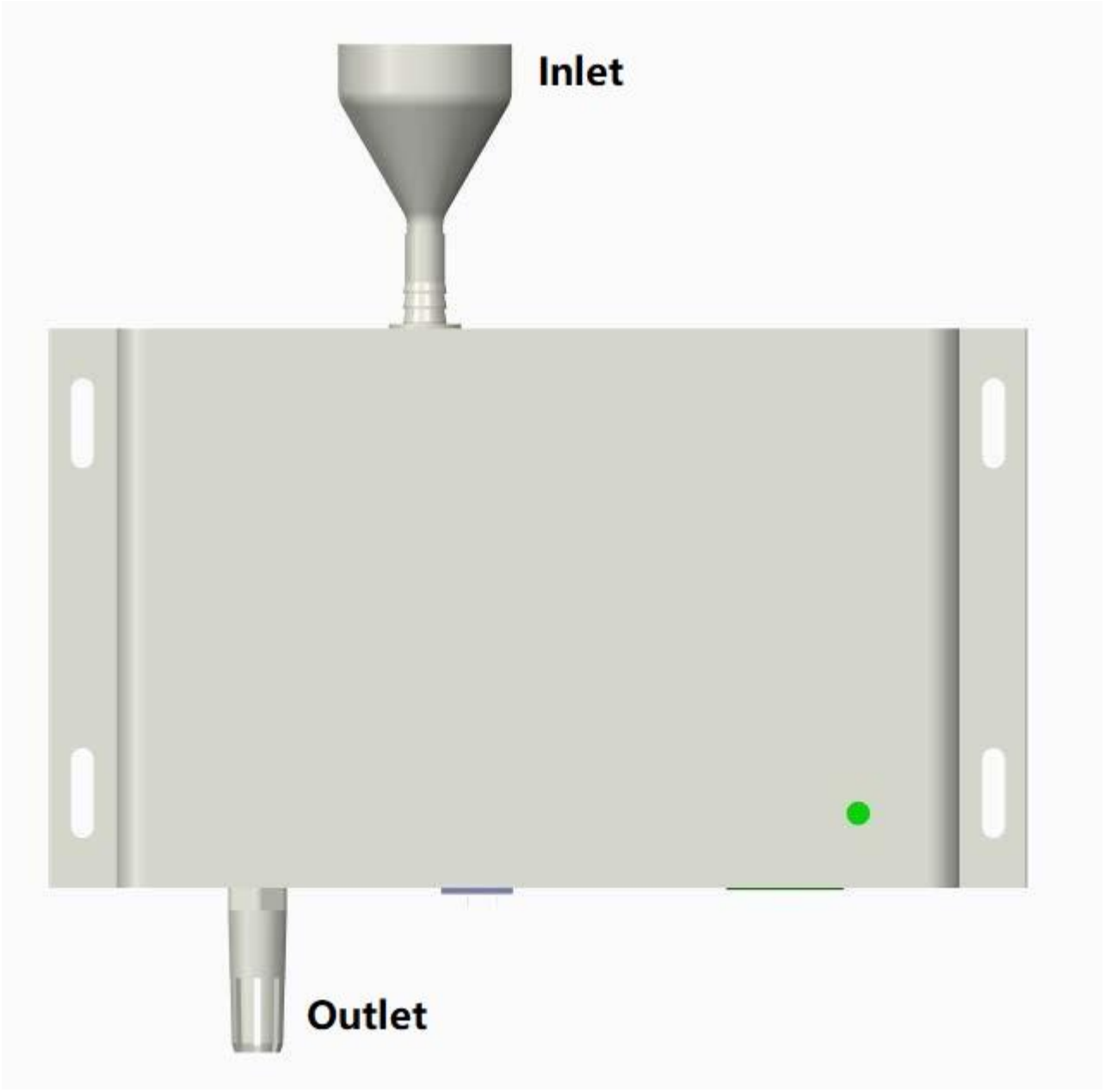



| | | | | |
|---|---|---|---|---|
| Interface 1 | No. | PIN | Description | Standard |
| | 1 | VCC | Power terminal (+24VDC) | |
| | 2 | GND | Power terminal (GND) | |
| | 3 | TB | Communication interface (RS485_TB) | |
| | 4 | TA | Communication interface (RS485_TA) | |

| | | |
|---|---|---|
| Interface 2 | **RJ45** | Optional |

## Installation method

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.

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 follows:

## Communication Protocol

### 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.

#### 1.2 Ethernet port RJ45 TCP/IP communication protocol

1) The device defaults to the local TCP Client mode, the default remote TCP Server IP is: 192.168.1.10, and the port number is: 4303;

2) Modify the IP and port number of the TCP Server by this device: web page; by default, set the computer IP to 192.168.1.10, connect the device with a network cable or connect the device through a switch, and enter 192.168.1.110 in the browser You can set the network parameter information of the device;

3) When the default IP address of the device is changed, you can press and hold the reset button on the device for 3 seconds to reset to the default network parameter configuration:

| Item | Parameter |
|---|---|
| Device IP | 192.168.1.110 |
| subnet mask | 255.255.255.0 |
| gateway | 192.168.1.1 |
| DNS | 114.114.114.114 |
| device port number | 4304 |
| Remote TCP Server IP | 192.168.1.10 |
| remote port number | 4303 |

4) The communication protocol is the same as the serial communication protocol.

### 2. UART serial 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 (one minute of work, 4 minutes of stop).

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 method

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 the function of writing a single register is implemented, and writing multiple registers is not supported yet.

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 >0.3μm | ≥0.3μm particle quantity high byte |
| IR5 | 04H | The number of particles >0.3μm | ≥0.3μm particle quantity low byte |
| IR6 | 05H | The number of particles >0.5μm | ≥0.5μm particle quantity high byte |
| IR7 | 06H | The number of particles >0.5μm | ≥0.5μm particle quantity low byte |
| IR8 | 07H | The number of particles >1.0μm | ≥1.0μm particle quantity high byte |
| IR9 | 08H | The number of particles >1.0μm | ≥1.0μm particle quantity low byte |
| IR10 | 09H | The number of particles >2.5μm | ≥2.5μm particle quantity high byte |
| IR11 | 0AH | The number of particles >2.5μm | ≥2.5μm particle quantity low byte |
| IR12 | 0BH | The number of particles >5.0μm | ≥5.0μm particle quantity high byte |
| IR13 | 0CH | The number of particles >5.0μm | ≥5.0μm particle quantity low byte |
| IR14 | 0DH | The number of particles >10μm | ≥10μm particle quantity high byte |
| IR15 | 0EH | The number of particles >10μm | ≥10μm 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 | Equipment intermittent stop time | Set the equipment intermittent stop time (min) |
| IR15 | 0EH | Device control traffic size | Actual set gas flow value multiplied by 100 |
| 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 | | 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-6510 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 >0.3um, >0.5um, >1.0um, >2.5um, >5.0um, >10um 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 >2.5μm particle count：

Send: IP 04 00 09 00 02 CRC16

Answer: IP 04 04 DF1 DF2 DF3 DF4 CRC16

Description: >2.5μm particle count = DF1*256^3+DF2*256^2+DF3*256+DF4 ( pcs/28.3L)

#### 7.1.5 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)

#### 7.1.6 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(℃)

### 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 DF2 DF3 DF4DF5 DF6 DF7 DF8DF9 DF10 DF11 DF12DF13 DF14 DF15 DF16DF17 DF18 DF19 DF20DF21 DF22 DF23 DF24 DF25 DF26 DF27 DF28 DF29 DF30 DF31 DF32 DF33 DF34 DF35 DF36 DF37 DF38 DF39 DF40 DF41 DF42 DF43 DF44 DF45 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)

>2.5μm particle count = DF13*256^3+DF14*256^2+DF15*256+DF16 ( 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(℃)

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 device setting traffic size

Send: IP 03 00 0E 00 01 CRC16

Answer: IP 03 02 DF1 DF2 CRC16

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

### 7.9. 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

### 7.10. 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: Equipment stop time = DF1*256+DF2 ( min)

### 7.11. Modify the flow rate set by the control device (the flow rate range that can be set is 15.0L/min – 35L/min)

Send: IP 06 00 0E DF1 DF2 CRC16

Answer: IP 06 00 0E DF1 DF2 CRC16

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

### 7.12. 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

### 7.13. Query the software version number

Send: 11 01 1E CS

Answer: 16 0E 1E DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 DF11 DF12 DF13 CS

Description: The version number is DF1-DF13, the ASCII string is the software version number


**After-sales service and consultation**

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