# SPECIFICATION

Product Name: **Ultra-fine dust simple measurement module (IAQ/OAQ)**

Model: AM1036T-P-485

Version: V1.0

Date: Apr 15, 2020

# Revision

| No. | Version | Content | Reviser | Date |
|-----|---------|---------|---------|------|
| 1 | V1.0 | Revision | Kwon | 2020 – 4 - 15 |
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# Ultra-fine dust simple measurement module (IAQ/OAQ)

## AM1036-P-485T

### Applications

- Outdoor Air quality monitoring
- Emissions Monitoring
- Construction Site Monitoring
- Mining Site Monitoring
- Port and bulk handling terminals
- Fence line monitoring
- Brownfield developments

### Description

AM1036-P-485 Ultra-fine dust simple measurement module is based on laser scattering technology, which can accurately detect and calculate the number of suspended particles with different particle sizes in the air per unit volume. The built-in new patented technology intelligent identification of dust source can realize the accurate output of mass concentrations of $PM_{1.0}$, $PM_{2.5}$ and $PM_{10}$ in different environments.

### Features

- The built-in new patented technology intelligent identification of dust source
- Real-time output $PM_{1.0}$, $PM_{2.5}$, $PM_{10}$ in ug/m$^3$ available
- Meet the high temperature and low temperature working environment (-30°C ~ 70°C)
- High accuracy, high sensitivity and quick response (≤8sec)
- With voltage regulator design and EMC compliant, strong anti-static ability.
- Adopted "integrated temperature + humidity sensor" with low power monolithic CMOS sensor IC with excellent long-term stability.

### Working Principle

Sampling by the internal pressure which occurs by fan, when sampling 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.

Thus, real-time measured data is obtained through measuring quantity and strength of scattered light.

## Specifications

| Ultra-fine dust simple measurement module Specification | |
| --- | --- |
| Operating principle | Laser scattering |
| Measured particle range | 0.3um ~ 10um |
| Measurement range | PM: 0 ~ 1,000ug/m³ |
| Resolution | 1ug/m³ |
| Working condition | -30°C ~ 70°C, 0 ~ 95%RH (Non-condensing)<br>-40°C ~ 85°C working temperature sensor is also available. |
| Storage condition | -40°C ~ 85°C, 0 ~ 95%RH (Non-condensing) |
| Maximum consistency error for PM$_{1.0}$ & PM$_{2.5}$ | <35ug/m³: ±5ug/m³<br>35ug/m³ ~ 100ug/m³: ±10ug/m³<br>100 ~ 1,000ug/m³: ±10%<br>Condition: 25 ±2°C, 50 ±10%RH,<br> Reference instrument: Met-one BAM 1020 and GRIMM 11-A |
| Maximum consistency error for PM10 | 0 ~ 100ug/m³, ±15ug/m³<br>101 ~ 1,000ug/m³, ±15% of reading<br>Condition: 25 ±2°C, 50±10%RH,<br>Reference instrument: GRIMM11-A, Met-one BAM 1020 |
| Temperature accuracy | ±0.4°C (max), –10 ~ 85°C |
| Humidity accuracy | ± 4% RH (max), 0 ~ 80% RH,<br>± 6.5% RH (max), 80 ~ 100% RH |
| Response time | 1sec |
| Time to first reading | ≤ 8 seconds |
| Power supply | DC 5V ±0.1V / DC 9 ~ 36V ±0.5V, Ripple wave＜100 mV |
| Power supply | DC 5V ±0.1V / DC 9 ~ 36V ±0.5V, Ripple wave＜100 mV |
| Standby current | <30mA |
| Dimensions | W147mm × D191mm × H51mm |
| Digital interface | RS-485 / TTL 5V |
| Output method | Default by active output after powering on, sampling time interval should be over 1,000ms |
| Design Lifetime | ≥ 43,800Hrs. |

▪ **If you use the measurement module for a long time in a high concentration dust environment, the life of the dust concentration measurement module cannot be guaranteed.**
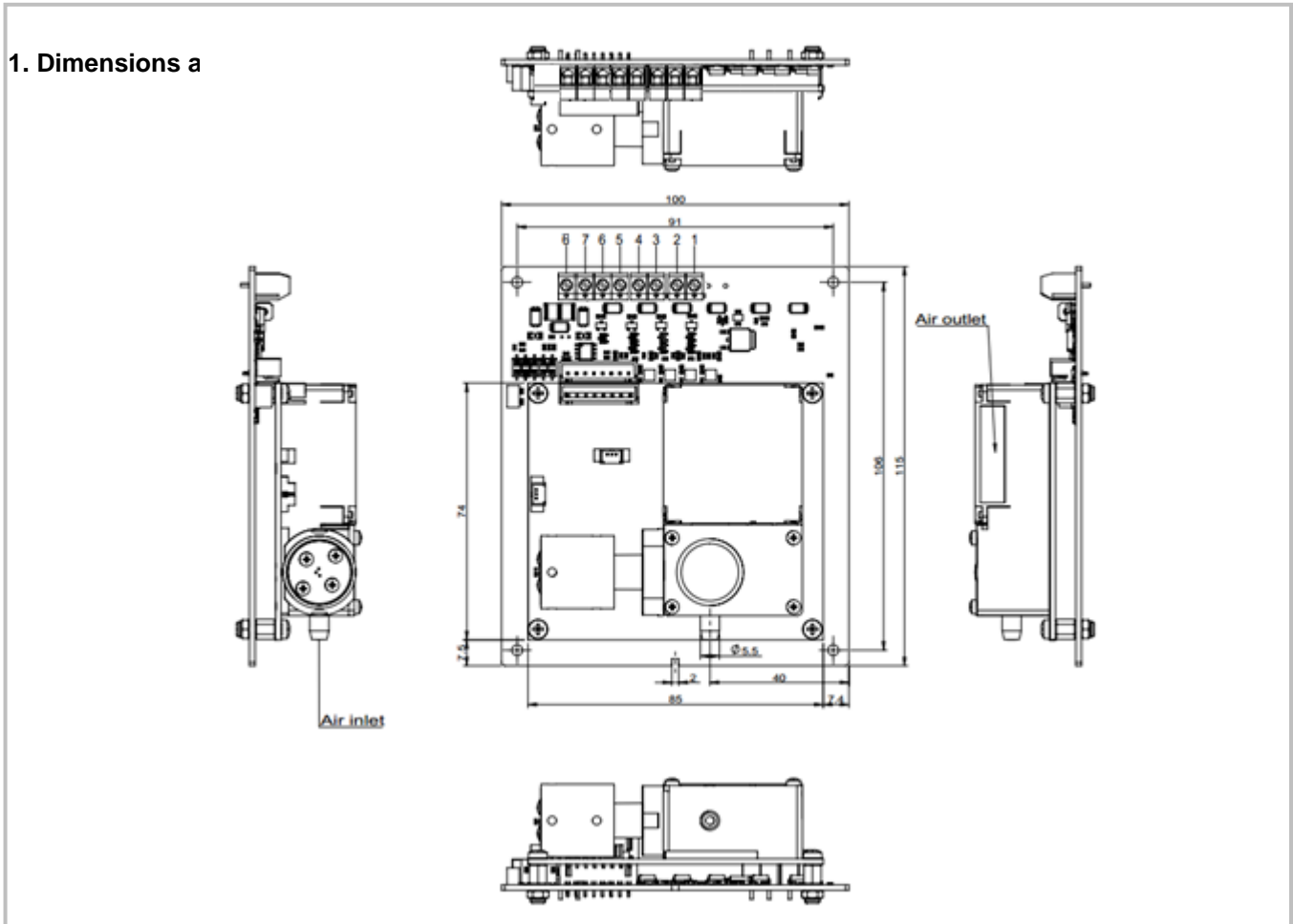
# Dimensions and Connector

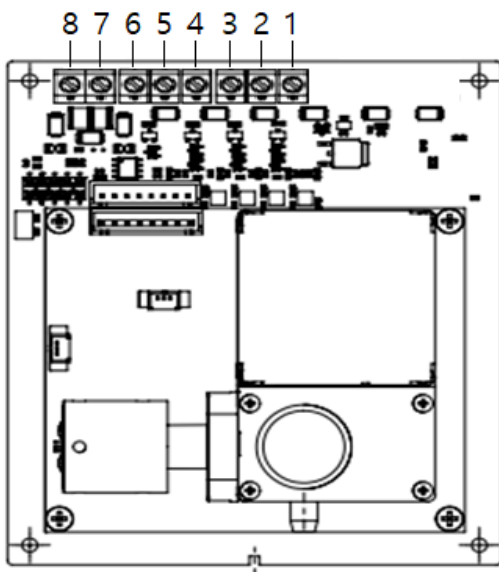## 1. Dimensions (Unit mm, tolerance ±0.2 mm)
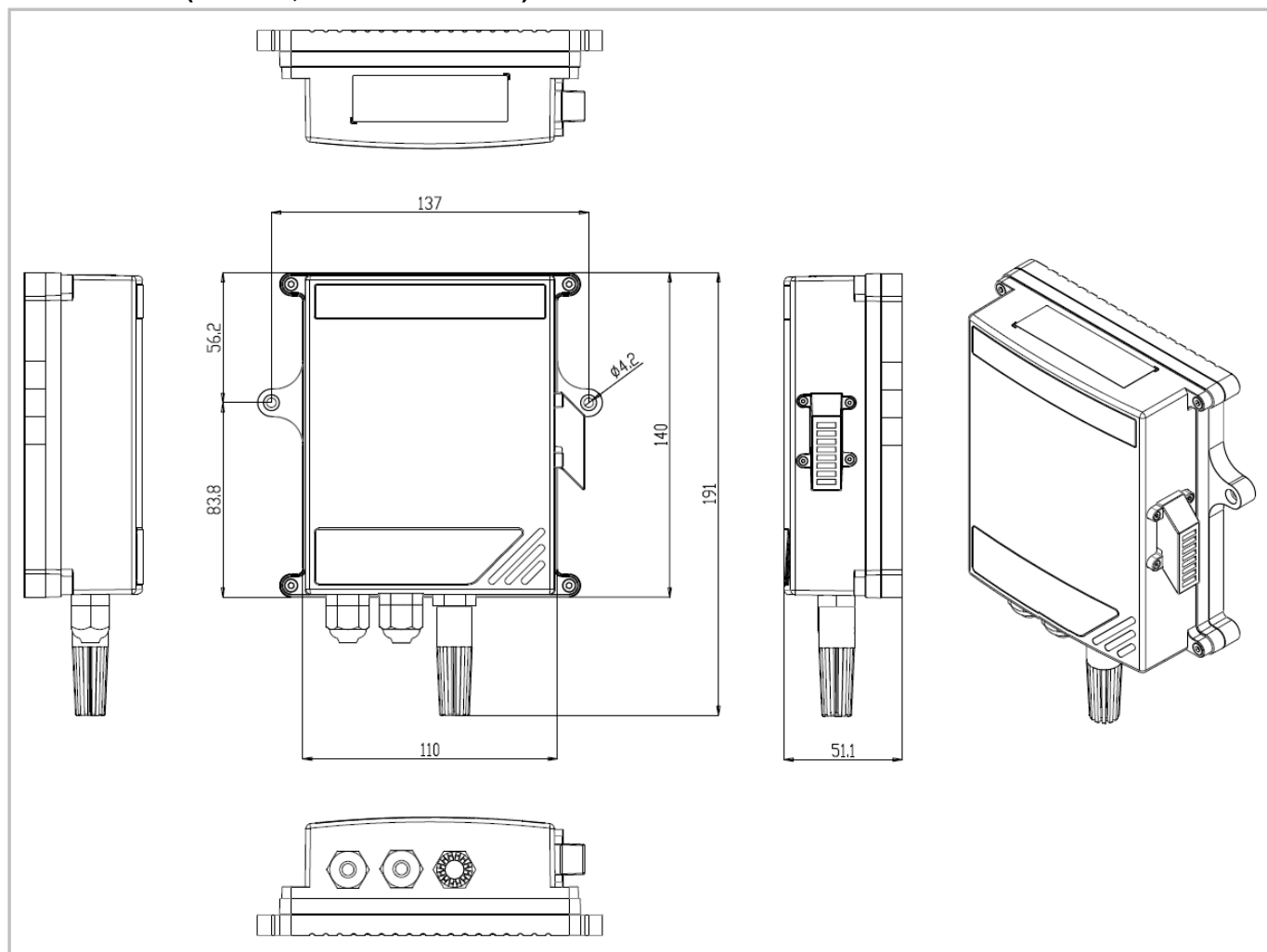
# Dimensions and Connector

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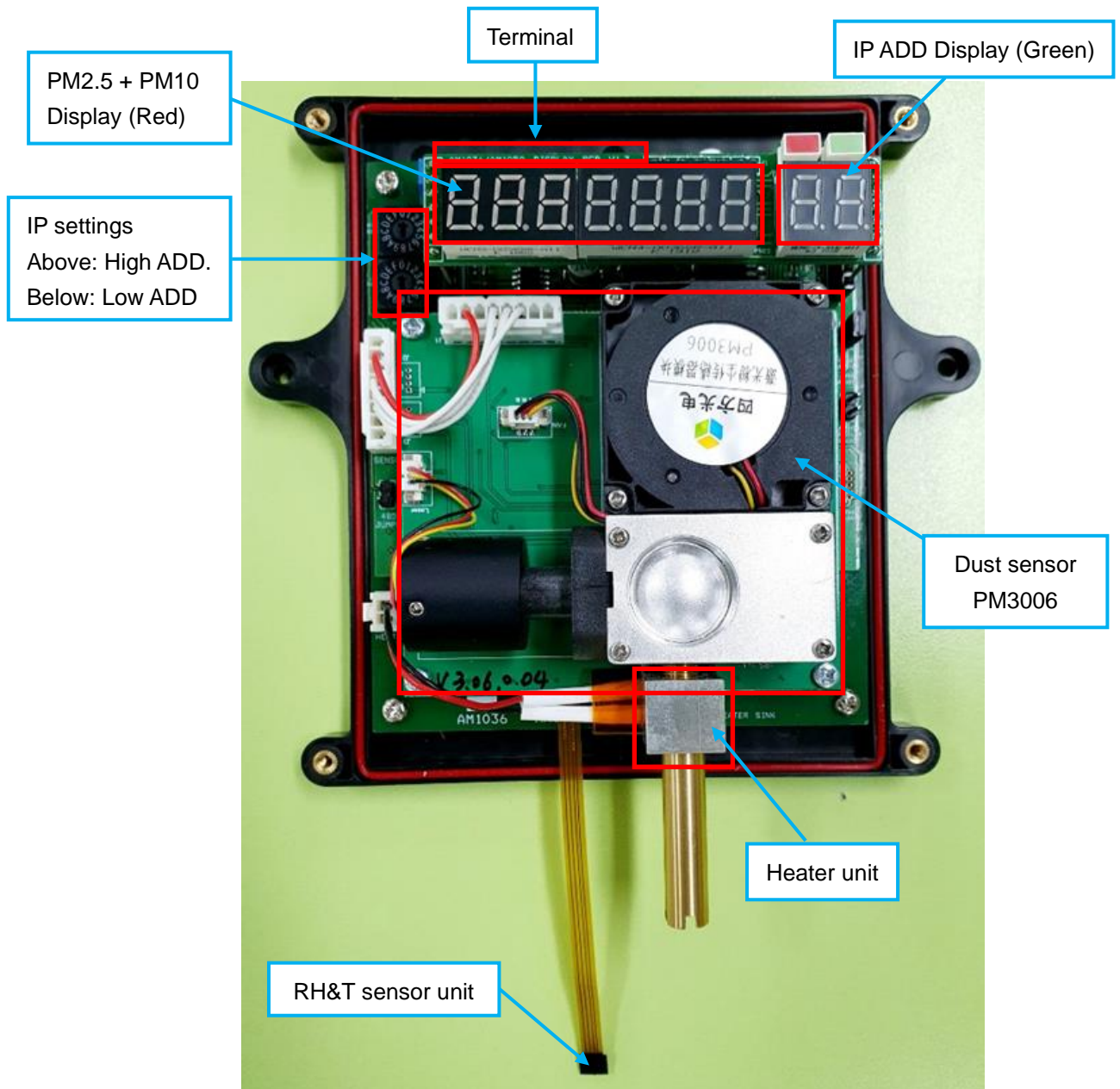
**1. Dimensions a**



## 2. I/O Connector Pin Map



| No. | Pin | Description |
|---|---|---|
| 1 | +9 ~ 36V | Power supply input ( +9 ~ 36V ) |
| 2 | GND | Power supply input (GND) |
| 3 | +5V | Power supply input (+5V) |
| 4 | RS485_B | 485 B Terminal |
| 5 | RS485_A | 485 A Terminal |
| 6 | GND | GND (Signal) |
| 7 | RESET | Hardware Power on Reset |
| 8 | Error | Notification of device failure |

PM2.5 + PM10
Display (Red)

Terminal

IP ADD Display (Green)

IP settings
Above: High ADD.
Below: Low ADD

Dust sensor
PM3006
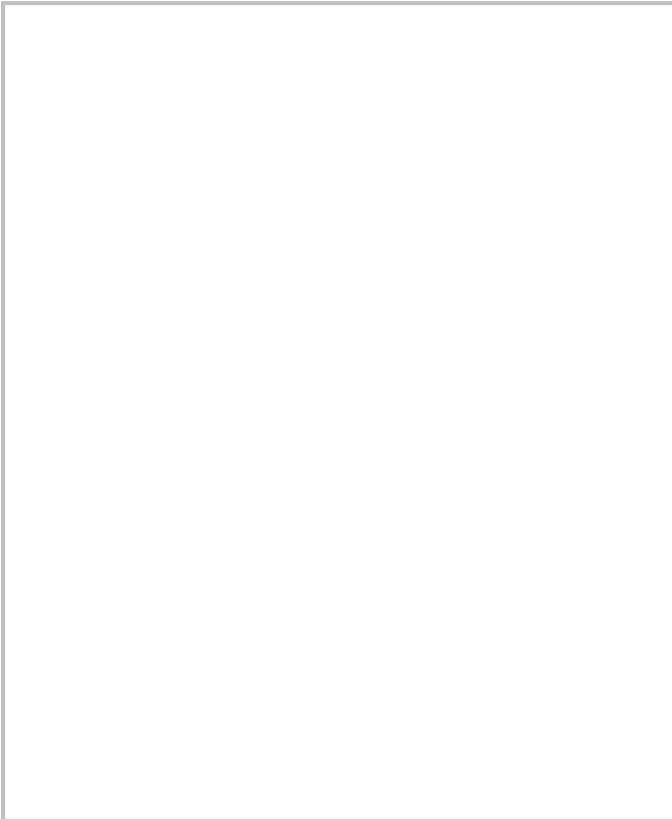
Heater unit

RH&T sensor unit

AM1036-P-485 board (PM3006+Display board: PM2.5, PM10, IP ADD)

## Product Installation

- In order to avoid dust deposition on the surface of sensitive component (laser diode and photosensitive diode), which may affect the measurement accuracy of the sensor.
- The appropriate installation ways are recommended as below.

| Recommended Installation | Non-Recommended Installation |
|---|---|
|  |  |

## User attention

- The best installation way is to make the surface of air inlet and outlet of the sensor clings to the air vent in the inner wall of the user device that communicates with the outside. If it's not possible, then an air isolation structure between air inlet and air outlet is necessary to avoid the air back flow in the user's device.

- Sensor is a complete unit. Disassembling metal shielding cover may cause irreversible damage.

- Avoid using the sensor under the condition with strong magnetic, such as situation close to stereo speaker, microwave oven, induction cooking.

- It is defined as 3R laser product according to 【GB7247.1-2012 laser product safety with laser radiation inside】.

- Please avoid direct exposure to your eyes. Warning sign as below.

# RS-485 Communication Protocol

## 1. General Statement

1) The data in this protocol is 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: 9,600; Data Bits: 8; Stop Bits: 1; Parity: No

4) Please make sure to consult with the seller or technical support before using the product.

## 2. Format of Serial Communication Protocol

Sending format of software:

| Start Symbol | Length | Command | Data 1 | …… | Data n. | Check Sum |
|---|---|---|---|---|---|---|
| HEAD | LEN | CMD | DATA1 | …… | DATAn | CS |
| 11H | XXH | XXH | XXH | …… | XXH | XXH |

Detail description on protocol format:

| Protocol Format | Description |
|---|---|
| Start symbol | Sending by software is fixed as [11H], module respond is fixed as [16H] |
| Length | Length of frame bytes= data length +1 (including CMD+DATA) |
| Command | Command |
| Address | Controller case address (0 ~ 254, default is 254, 255 is address of broadcast) |
| Data | Data of writing or reading, length is not fixed |
| Check sum | Cumulative sum of data= 256 - (HEAD+LEN+CMD+DATA) |

## 3. Command Table of Serial Protocol

| Item No. | Function Description | Command |
|---|---|---|
| 1 | Read measurement result | 0x0B |
| 2 | Read controller IP | 0xAC |
| 3 | Set controller IP | 0xAB |
| 4 | Read controller software version number | 0x1E |
| 5 | Read serial number | 0x1F |
| 6 | Software Power on Reset | 0x55 |
| 7 | Set up and Read Particle Calibrated Coefficient | 0x07 |

## 4. Detail Description Protocol

[ADD] is slave address, initialize IP is **0**.

Please make sure to consult with the seller or technical support before using the product.

### 4.1 Read Measurement Result

**Send**: 11 02 0B [ADD] [CS]

**Response**:

16 15 0B [ADD] [DF1 ~ DF4] [DF5 ~ DF8] [DF9 ~ DF12] [DF13 ~ DF14] [DF15 ~ DF16] [DF17 ~ DF18] [DF19] [CS]

**Function:** to read ADD, $PM_{1.0}$, $PM_{2.5}$, $PM_{10}$, [Reserve], Humidity, Temperature, Alarm [CS]

Statement:

Response data bit:

16 15 0B <u>00</u>    <u>00 00 00 00</u>    <u>00 00 00 00</u>    <u>00 00 00 00</u>    <u>00 00</u>    <u>00 00</u>    <u>00 00</u>    <u>00</u>    <u>XX</u>

        ADD     $PM_{1.0}$       $PM_{2.5}$       $PM_{10}$   Reserve  Humidity  Temp  Al.  [CS]

| Item | Data byte | Decimal Effective Value Range | Corresponding Value | Multiple | Unit |
|---|---|---|---|---|---|
| $PM_{1.0}$ | DF1 ~ DF4 | 0 ~ 1,000 | 0 ~ 1,000 | 1 | ug/m³ |
| $PM_{2.5}$ | DF5 ~ DF8 | 0 ~ 1,000 | 0 ~ 1,000 | 1 | ug/m³ |
| $PM_{10}$ | DF9 ~ DF12 | 0 ~ 1,000 | 0 ~ 1,000 | 1 | ug/m³ |
| Reserve | DF13 ~ DF14 | | | | |
| Humidity | DF15 ~ DF16 | 50 ~ 990 | 5 ~ 99.0 % | 10 | % |
| Temperature | DF17 ~ DF18 | 100 ~ 1,350 | -40 ~ 85 | 10 | °C |
| Alarm definition | DF19 | Alarm of sensor module working condition. (See the description below.) | | | |

**Note:**

1. Temperature data is added 500 upon practical measurement result.

For example, -20°C is corresponding to value 300. Temperature value= (DF17 * 256 + DF18 - 500) / 10.

2. The measurement result comes out with two data bytes, the high byte is on the head, and the low byte is after then.

Measurement result= $DF_n$ * 256 + $DF_{n+1}$  or Measuring result= ($DF_n$ × 16,777,215) + ($DF_{n+1}$ × 65,535) + ($DF_{n+2}$ × 256) + $DF_{n+3}$  **or**  ($DF_n$ × 0xFFFFFF) + ($DF_{n+1}$ × 0XFFFF) + ($DF_{n+2}$ × 0XFF) + $DF_{n+3}$

DF19: Alarm of sensor module working condition:

| Bit | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|---|---|
| Alarm definition | | | | | | 1.Sensor Comm. Error | 1: Fan at low revolving speed | 1: Fan at high revolving speed |

## 4.2 Read controller IP

**Send**: 11 02 AC FF 42

**Response**: 16 02 AC [ADD] [CS]

**Function:** Read controller IP address.

**Note:** 0XFF refers to broadcast address, this is used for checking IP when you do not know the IP.

   **[ Be sure to connect only one device and check the IP. ]**


## 4.3 Set controller IP

**Send**: 11 03 AB FF [ADD] [CS]

**Response**: 16 02 AB [ADD] [CS]

**Function:** Set controller IP address.

**Note:** [ADD] Controller's IP should be set.


## 4.4 Read controller software version number

**Send**: 11 02 1E [ADD] [CS]

**Response**: 16 0F 1E [ADD] DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 DF11 DF12 DF13 [CS]

**Function:** Read controller software version number

Note: DF1 ~ DF13: Characters of software version number.


## 4.5 Read controller serial number

**Send**: 11 02 1F [ADD] [CS]

**Response**: 16 0C 1F [ADD] DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 [CS]

**Function:** Read controller serial number

**Note:** "DF1 ~ DF10" Controller serial number.


## 4.6 Software Power-on Reset

**Send:** 11 02 55 [ADD] [CS]

**Response:** 16 02 55 [ADD] [CS]

**Note:** After the sensor is powered off for one second, restart the communication PCB.

After that, it operates the same as when power is supplied to the unit.


## 4.7 Hardware Power-on Reset

**How to RESET:** Send a high signal to the reset terminal for at least **1 second**.

(Maximum signal voltage is **DC 20V**. Minimum signal voltage is **DC 3V**.)

**Note:** After the sensor is powered off for one second, restart the communication PCB.

After that, it operates the same as when power is supplied to the unit.


## 4.8 Set up and Read Particle Calibrated Coefficient

**Send:** 11 05 07 [ADD] DF1 DF2 DF3 [CS] // Set up particle calibrated coefficient

**Send:** 11 03 07 [ADD] DF1 [CS]    // Read particle calibrated coefficient

**Response:** 16 05 07 [ADD] DF1 DF2 DF3 [CS]

**Function:** Read / set up particle calibrated coefficient

**Note:**

1. Range 50 to 999, correction factor: 0.50 ~ 9.99. (DF2 * 256 + DF3) / 100

2. DF1: 01($PM_{1.0}$), 02($PM_{2.5}$), 03($PM_{10}$)

## 4.9 Error Signal output.

If the PM sensor and the communication board are disconnected for more than 30 seconds, or if the master board and communication board are disconnected for more than 30 seconds, the signal output level of the error signal output terminal is changed from High Level to Low Level.

This feature can be used to easily identify device status at a remote location and to facilitate subsequent processing.

Error signal output terminal Output method: **Open Collector.**

Vs (max): **DC 20Volt**

Ic (max): **50mA**

R (max): **10kΩ**
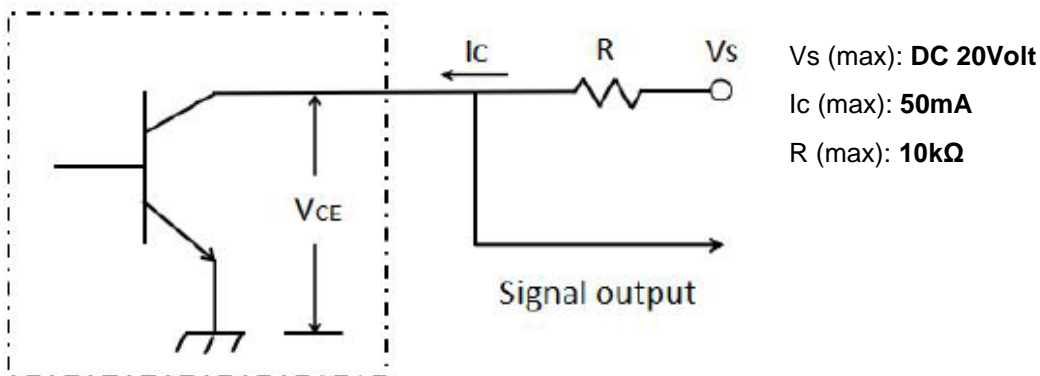
## 4.10 How to disable error signal output.

If communication with the sensor is interrupted, either the "**software power-on reset**" or the "**hardware power-on reset**" method must disable the error signal output or power cycle the device.

If the communication with the master is resumed after the communication between this unit and the master is interrupted, the error signal output function is automatically canceled.