# Particle Sensor Module
## MDSM 501 Series

## 1. Features

- Detecting fine dust over 1$\mu$m
- Customized sensitivity for efficient control depending on application
- Excellent long term reliability and easy maintenance
- Compact size / MCU Control
- PWM Output
- Optimizing function



## 2. Applications

- **Air cleaners, Air conditioners**
- **Ventilation System, Fan Control**
- **IAQ Monitoring & Control**
- **Smoke Detectors**

## 3. Description

MDSM501 detects fine particle, house dust, pollen, germs, dust mites and cigarette smoke as small as 1$\mu$m and measures quantity of floating particles in a room space up to maximum 30m$^3$.

This sensor is ideal product for automatic room air monitoring system as an air purifier.
MDSM501's signal is converted to PWM output by internal circuit and MCU program.

Also, the sensor's filter circuit and MCU program could remove a noise for more stable sensing operation when the noise is inflowed in the signal, and **by operating optimization**, the sensor's detecting performance could maintain the similar condition with an initial state.

It has an effect on the recovery of the reduced detecting ability of sensor by long-term usage or pollution.
MDSM501 has advantage of both stable detecting ability and high production efficiency.
The sensor doesn't need additional control point for preventing malfunction from user's arbitrary modification.

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## 4. Product Specification

Ta = 25℃

| Parameter | Symbol | Min. | Typ | Max | Unit |
|---|---|---|---|---|---|
| Supply Voltage | $V_{CC}$ | 4.5 | 5.0 | 5.5 | V |
| Current Consumption(@ 5V) | $I_{CC}$ | | | 85 | mA |
| Storage Temperature Range | $T_{stg}$ | -20 | | 80 | ℃ |
| Operating Temperature Range | $T_a$ | -10 | | 65 | ℃ |
| Operating Humidity Range (Without dew condensation) | RH | | | 95 | %RH |
| Detectable Particle Size | | 1 | | | $\mu m$ |
| Detectable Range of Concentration | | 0 | | 15,000 | pcs/283㎖ |
| Output Signal | PWM (Pulse Width Modulation) | | | | |
| Weight | 25g | | | | |
| Size | (W) 59 mm x (H) 45 mm x (D) 17 mm | | | | |

## 5. Output Characteristics

Vcc = 5V, Ta = 25℃

| Parameter | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Vout 1, 2 at high [1] | Voh | No particle | - | Vcc | - | V |
| Vout 1, 2 at low [2] | Vol | Particle | - | - | 0.8 | V |
| Time for stabilization [3] | | | 1 | - | - | minute |

*1 : Vout 1 and Vout 2 are high state when particles are not detected. (=clean room)

*2 : Vout 1 and 2 go to low state when particles are detected.

*3 : After the power is turned on.
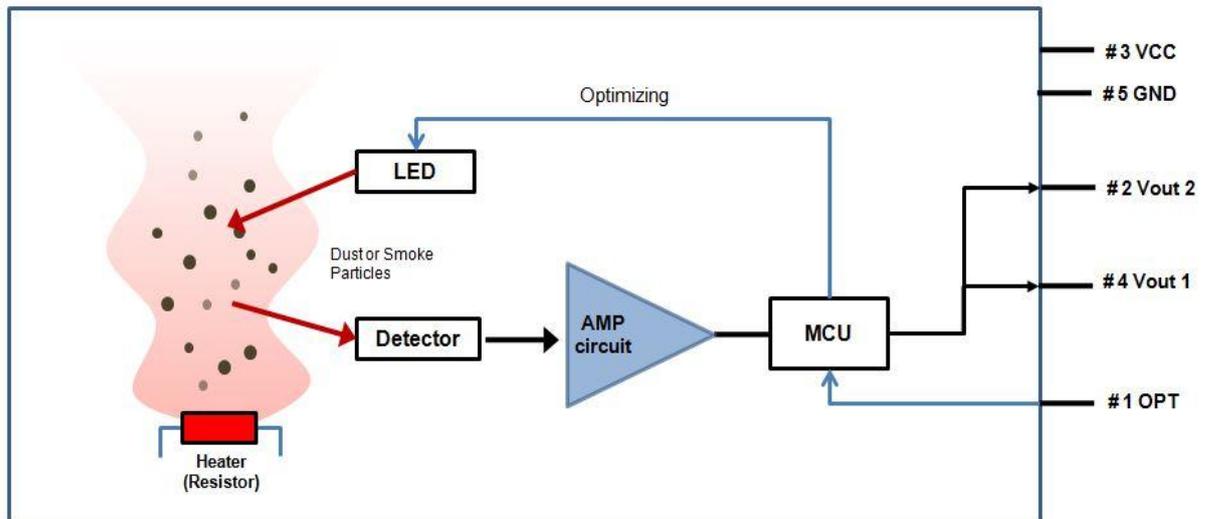
## 6. Block Diagram



Fig.1 Block Diagram

According to the above Block Diagram, in the inside of sensor module, there are dust detection for infrared LED, Photo TR for scattered infrared signal by external dust, OP-Amp for signal amplification and MCU for optimizing function.

The principle of dust detection is that inflowed dust is passed by the measuring scope through upstream due to self-heating of heater, and lights from LED is spawned by dust and is realized as a signal at Detector.

The signal from detector is filtered by circuit and MCU and it is transferred as a PWM signals. The MCU has an optimizing function for making similar status about sensor's initial detecting ability. A User could use this operation when the sensor's detecting performance is slowdown through changes according to time or pollution by long-term using.

## 7. I / O Connector Specifications

| Pin number | Pin name | Description |
|:---:|:---:|:---:|
| 1 | Opt | Optimizing input |
| 2 | Vout 2 | Vout 2 output (PWM) |
| 3 | Vcc | DC 5 V Input |
| 4 | Vout 1 | Vout 1 output (PWM) |
| 5 | GND | Ground |

### 7-1. PIN Description

**Opt (Pin #1)**

This Pin is used for operating optimization function. And, it could be working as an active high(5V) signals through external control system or equipment.

When the optimizing function is stopped due to internal full down (10KΩ), this function's working time is Max. 15sec.

After completed an optimizing function, user should operate the sensor after reset (Power off → on).

For the function description, Please refer to '10. Description of Optimizing Function' in the 'Page.8'.

**Vout 2 (Pin #2)**

This Pin is used to transfer dust signals (over 1um) to PWM (Pulse Width Modulation) signal (Active Low).
Refer to the 'Page.6~7' or attached additional 'Application Note'

**Vcc (Pin #3)**

The Pin of DC 5V input Power.

For the stable operation, the power supply range adjust within ±10%, Ripple has to be 30mV.

**Vout 1 (Pin #4)**

This Pin is used to transferred dust signals (over 2.5um) to PWM (Pulse Width Modulation) signal(Active Low).
Refer to the 'Page.6~7' or attached additional 'Application Note' about the method of signal conditioning.

**GND (Pin #5)**

Pin #5 is used for Ground.

### 7-2. Connector Description

| Model name | Part No. | | Description | Connector's maker |
|---|---|---|---|---|
| MDSM501A | Wafer | 20010WR-05 | 2mm pitch | Yeonho Electronic |
| | Housing | 20010HS-05 | | |
| MDSM501B | Wafer | S 5B-EH | 2.5mm pitch | J.S.T. |
| | Housing | EHR-5 | | |

### 7-3. Sample Schematics
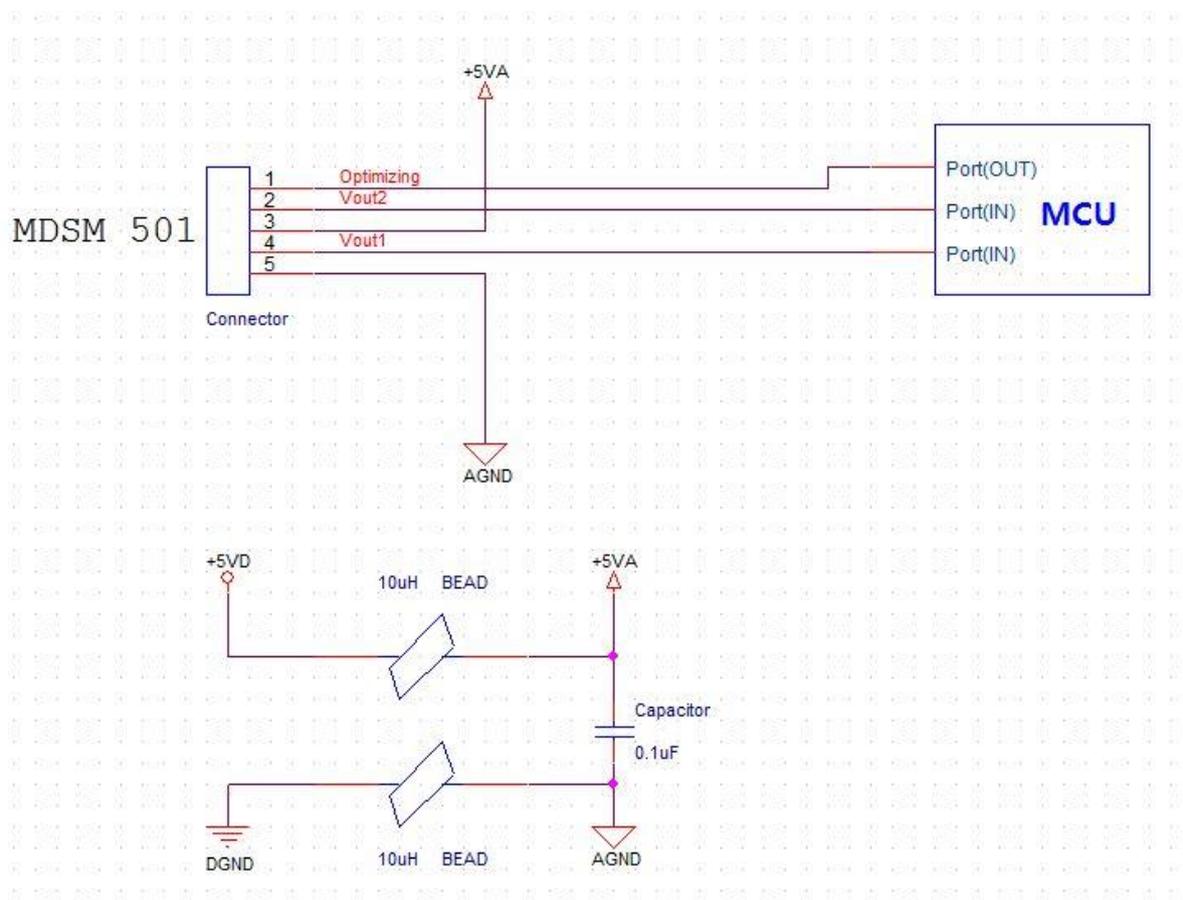


Fig.2 Sample Schematic

## 8. Detection Size Determination

Size of the signal from the sensor differs depending on the size of the particles detected; over 1um (Vout2) and over 2.5um (Vout1).
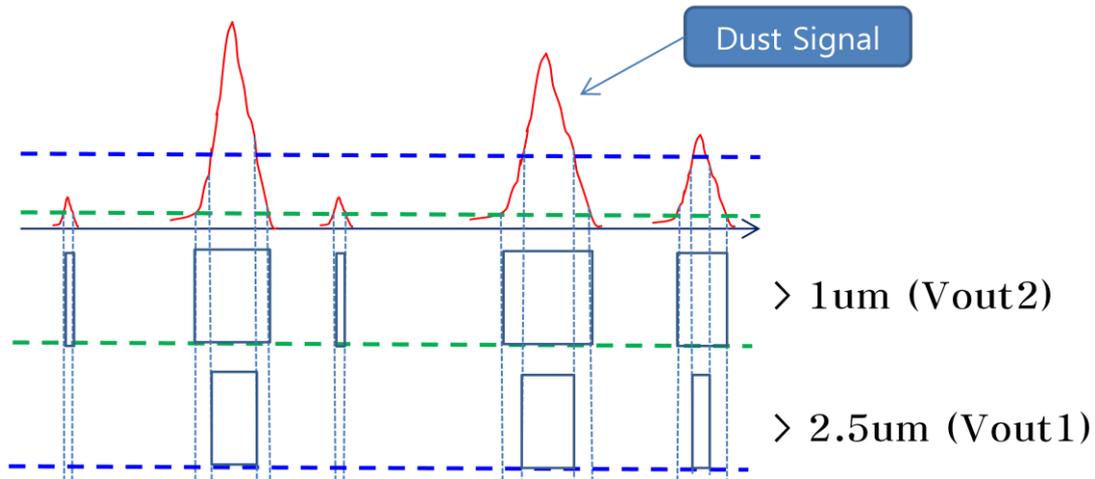


Fig.3 Detection Size Determination

## 9. Sensor Characteristics vs Low ratio

### 9-1. Dust sensor Characteristics
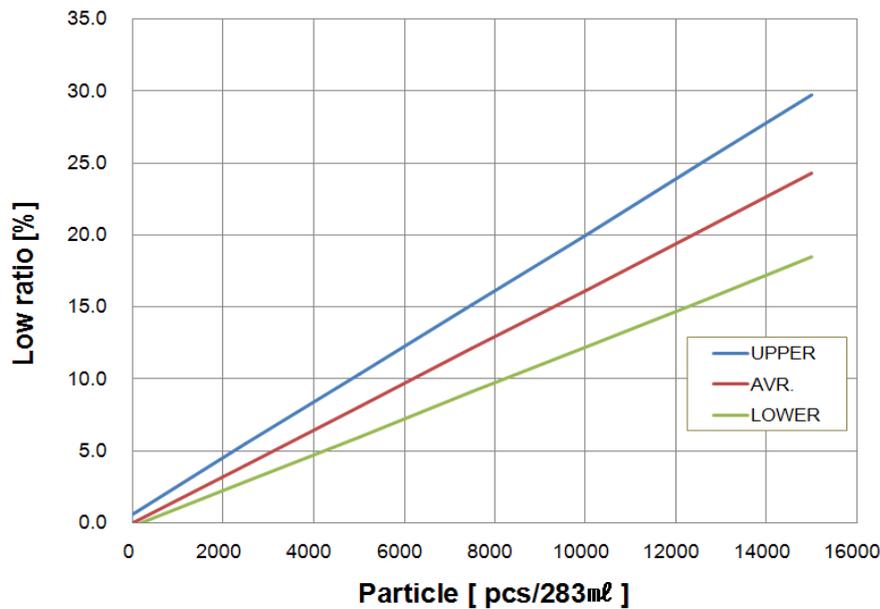


Fig.4 Sensitivity Characteristics of Dust sensor

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### 9-2. Low Ratio Calculation
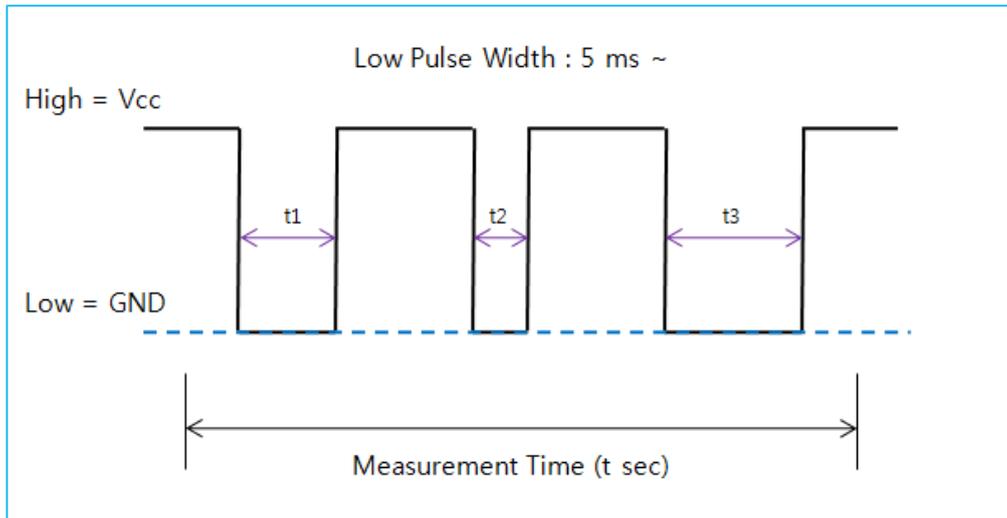


Fig.5 Dust sensor Low Ratio

Low Ratio (%) = (t1 + t2 + t3) / t x 100
(Measurement Time is calculated by a percentage of sum of Low signals occurred within t(5~30) seconds)

## 10. Description of Optimizing Function

The optimizing function can recover the detecting ability as an initial status when it decreases due to long-term using and polluted lens. User can operate an optimizing function when the detecting ability is slowdown rapidly.

### 10-1. To inputting signal to Optimization Function Pin (Opt. Pin No. 1)

To connect active high (5V) signal to Opt (Pin.1) input signal pin.
After inputting signal to sensor, the optimizing function is operating.
On that time, the active high (5V) signal should be keep more than Min. 1ms.

### 10-2. Waiting for Optimizing Function

The optimizing function time is taken approximately Max. 15sec, and during the operating, Please keep away the any external impact, vibration or scattering lights to the sensor.
Furthermore, Please do not turn off the power during operating optimization because new values are automatically inputted to the EEPROM of MCU.

### 10-3. Resetting after completed Optimizing function

After completed the optimizing function, Please turn off the power and restart for stable sensor operation.

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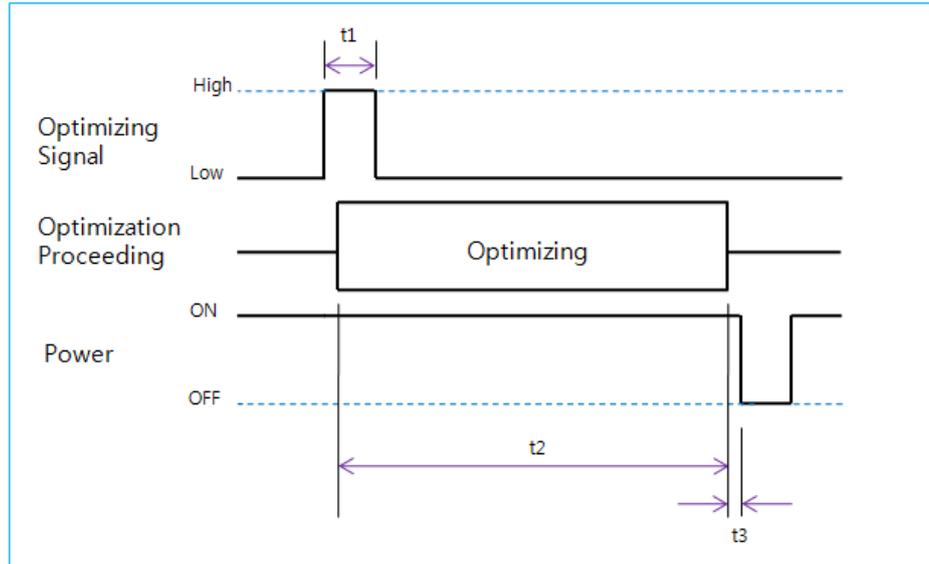
| Parameter | Description | Min | Max | Unit |
|-----------|-------------|-----|-----|------|
| t1 | Optimizing Signal Input Time | 1 | | ms |
| t2 | Optimization Proceeding Time | | 15 | sec |
| t3 | Switch Off after Optimization | 0.1 | | ms |

Fig.6 Handling Optimization

## 11. Dimension

(Unit : mm)



Fig.7 Dimension

## 12. Ordering Information



| M | DSM | 5 | 01 | X |
|---|---|---|---|---|

※ Connector
 A : 20010WR-05
 B : S5B-EH

※ Particles Minimum size
 01 : 1um

※ Input Voltage
 5 : 5 Volt

※ Series
 DSM : Dust Sensor Module

※ MCU Type
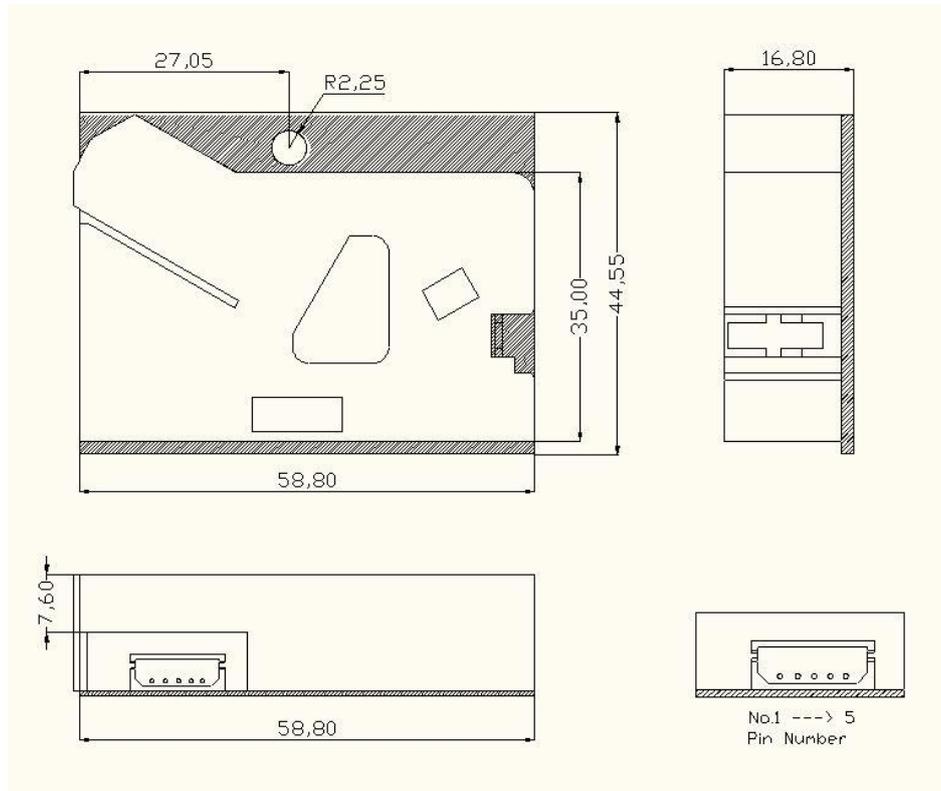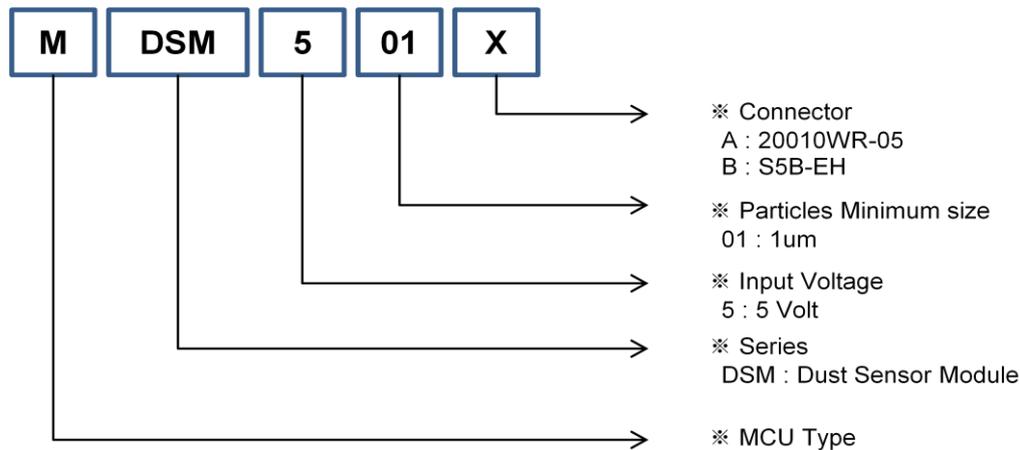
Fig.8 Ordering Information

## 13. Packaging Information

### 13-1. Marking

| Model no. | MDSM501A   or   MDSM501B |
|---|---|
| Qt'y | 00   pcs |

### 13-2. Packaging Details

Module dimensions : W59 x H45 x D17 mm

Weight : Approx. 25g / ea

Tray : modules of 25pcs.(5x5) per tray

Outer box : 10 trays per box (module 250pcs)

Outer Box Dimensions : W380 x H255 x D320mm

Weight : Max. 7.5Kg per outer box

### Caution for Use

Please do not disassemble the device. If the device is reassembled, it may not satisfy the specification.

For using the products normally and stably, please refer to additional 'Application Note'.

Please **never use** this device for **Emergency** or **Fire alarm** application.