

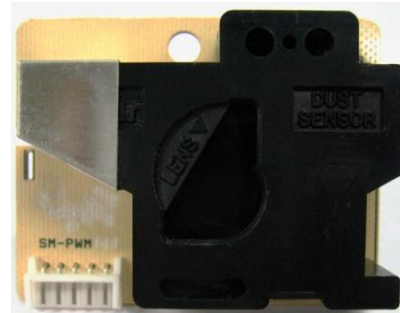
SPECIFICATION

Product Name: Dust Sensor

Model No. : SM-PWM-01A

SM-PWM-01A

SMART dust sensor for home appliance



■ Description

SM-PWM-01A is a dust sensor that detects the dust particle concentration in air by using optical sensing method. An infrared light emitting diode (IR LED) and a photo-sensor are optically arranged in this device. The photo-sensor detects the reflected IR LED light by dust particles in air. This dust sensor can detect the small particle like cigarette smoke and it can distinguish small particles like smoke from large house dust by pulse pattern of signal output.

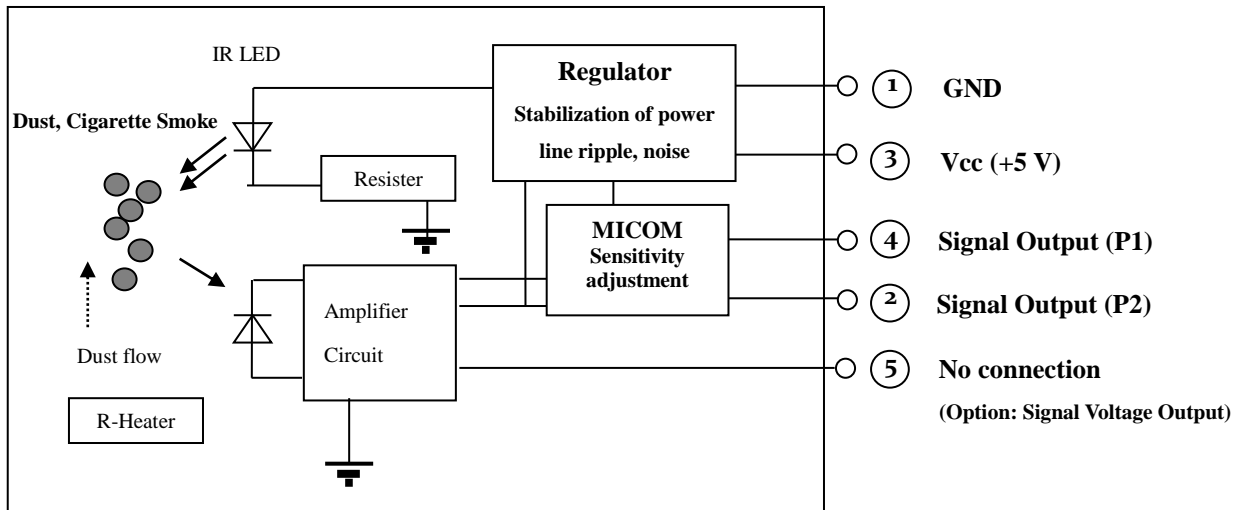
■ Features

- Compact size, light weight (W59x H45x D20 mm, ~ 35g)
- PWM (pulse width modulation) output (Low pulse output)
- Enable to distinguish small particle of cigarette smoke from large particle of house dust
- The Low pulse width is proportion to particle size and concentration.
- Constant forced air convection flow by heater resistor in dust sensor.
- Lead free and ROHS directive compliant

■ Application

- Detection of dust in the air, Indoor Air quality monitoring
- Air cleaner, Air purifier, Air conditioner
- Outdoor dust monitoring with the special mechanical design for customer
- Smoke type Fire alarm application by different sensor adjustments (customer option)

Internal schematic



P1: small particle(1~ 2 μm), P2: large particle(3 ~10 μm)

☞ SM-PWM-01 dust sensor can't count particles, not measure quantitatively, size is only for reference

Electrical Characteristic

Absolute Maximum Ratings

($T_a=25\text{ }^\circ\text{C}$)

| Parameter | Symbol | Rating | Unit |
|-----------------------|-----------|-------------|------------------|
| Supply voltage | V_{cc} | -0.3 to + 7 | V |
| Operating temperature | T_{opr} | -10 to 65 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | -30 to 80 | $^\circ\text{C}$ |

Operating Supply Voltage and Signal Output

($T_a=25\text{ }^\circ\text{C}$)

| Parameter | Symbol | Rating | Unit |
|---------------------|----------|---|------|
| Supply voltage | V_{cc} | DC $5 \pm 5\%$, Ripple $< 30\text{mV}$ | V |
| Current Consumption | I_{cc} | $< 110 \pm 10\%$ *1 | mA |
| Signal output | P1,P2 | Hi : $> 4.5\text{V}$, Lo : $< 0.7\text{V}$, *2 Negative Logic Pulse output | |

*1 one minute is necessary to stabilize heater resister in dust sensor.

*2. Input impedance 200 $\text{k}\Omega$, Pull-Up 10 $\text{k}\Omega$, recommended 30sec moving average.

Connector

Standard connector(SM-PWM-01A)

| Connector Part No. | Symbol | Description | Maker |
|--------------------|------------|-------------|--|
| Male | SMAW250-05 | 2.5mm pitch | YeonHo Elec.(Korea) http://www.yeonso.com/ |
| Female | - | | |

☞ Y.H is standard for SM-PWM-01A.

☞ Custom requirement (model: SM-PWM-01A-J)

| Connector Part No. | Symbol | Description | Maker |
|--------------------|--------|-------------|---------------|
| Male | S5B-EH | 2.5mm pitch | J.S.T(Japan) |
| Female | EHR-5 | | |

☞ S5B-EH is option for customer requirement

Connector Pin Configuration

| Number | Symbol | Pin Description |
|--------|--------|---|
| 1 | GND | Ground, Connect with System ground |
| 2 | P2 | Low pulse Signal output(P2) of large particle |
| 3 | Vcc | Input Supply voltage |
| 4 | P1 | Low pulse Signal output(P1) of small particle |
| 5 | NC | Normally no connected, Voltage out by option |

☞ please refer the drawing for pin sequence.

■ Electro-Optical Characteristics

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|----------------------------|--------|------------|------|------|-----|-------------------|
| Sensitivity | S | *1*2*5 | 0.3 | 0.5 | 1.0 | mSec/μg |
| Low pulse output occupancy | Loo | *3*4 | 0 | 2 | 20 | % |
| Detection range | M | *4 | 0.01 | 0.05 | 2.0 | mg/m ³ |

*1 Sensitivity is specified by the amount of output low pulse width change when dust density changes by 100μg/m³ within 30 sec. The 30 second is the stabilization time of dust concentration in GE's test chamber.

*2 Sensitivity of dust sensor is shown in Fig.1

*3 Low pulse occupancy (%) = total sum of low pulse width (mSec)/30,000mSec * 100.

At each test concentration. (Reference particle size is one micrometer)

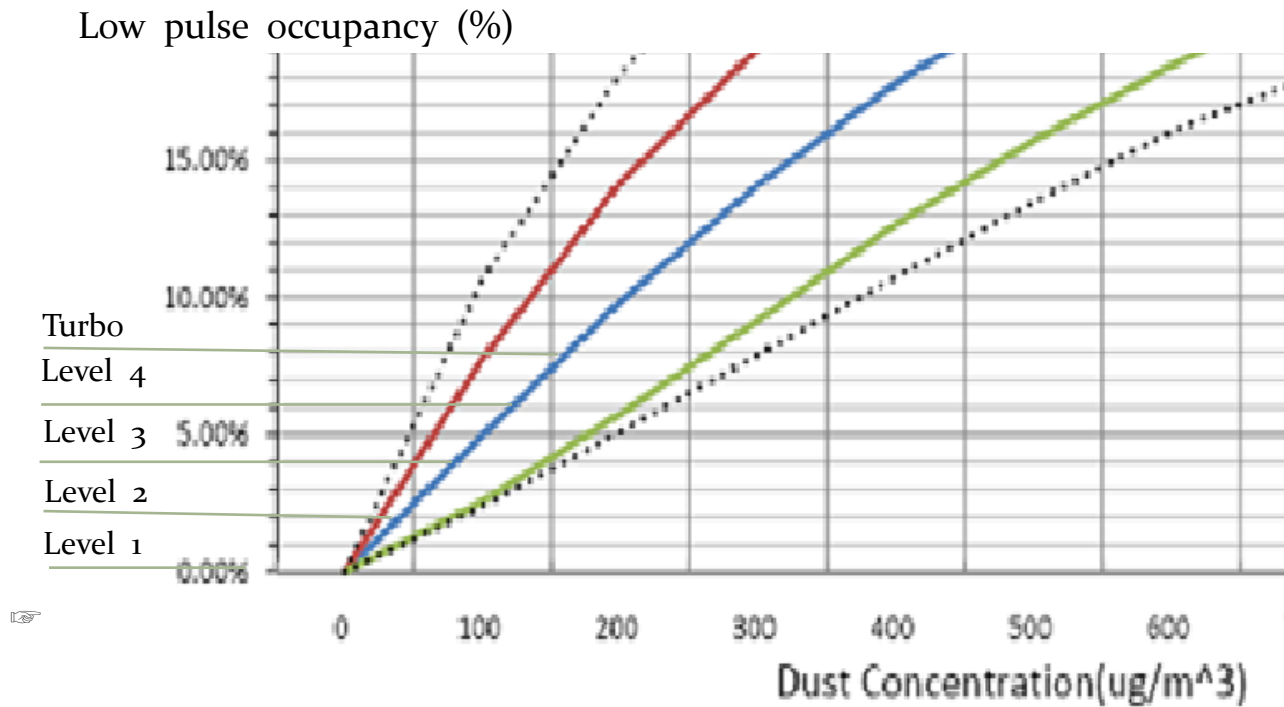
Moving average calculation method within absolute measuring operation time (Top) is using to decide the continuously contaminated level of air.

*4 Low pulse output is measured at the output signal of P1, connector pin number 4 in dust sensor.

Dust concentration : $2.0 \text{ mg/m}^3 \approx$ Cigarette of 1.5pieces in $10\text{m}^3 \approx 800,000$ pcs of $1\mu\text{m}$ smoke particle .

*5 the particle size and concentration is measured using LD3, GT331made by Shibata Japan and METONE USA. Linearity of SM-PWM-01A sensitivity will be kept up to 20 percent occupancy.

FIG.1 Low pulse Occupancy vs. Dust concentration



Level 1 to 4 means the display guideline to show the air contamination in air cleaner's LED display. But, this is only for reference and the level can be decided by the customer standard.

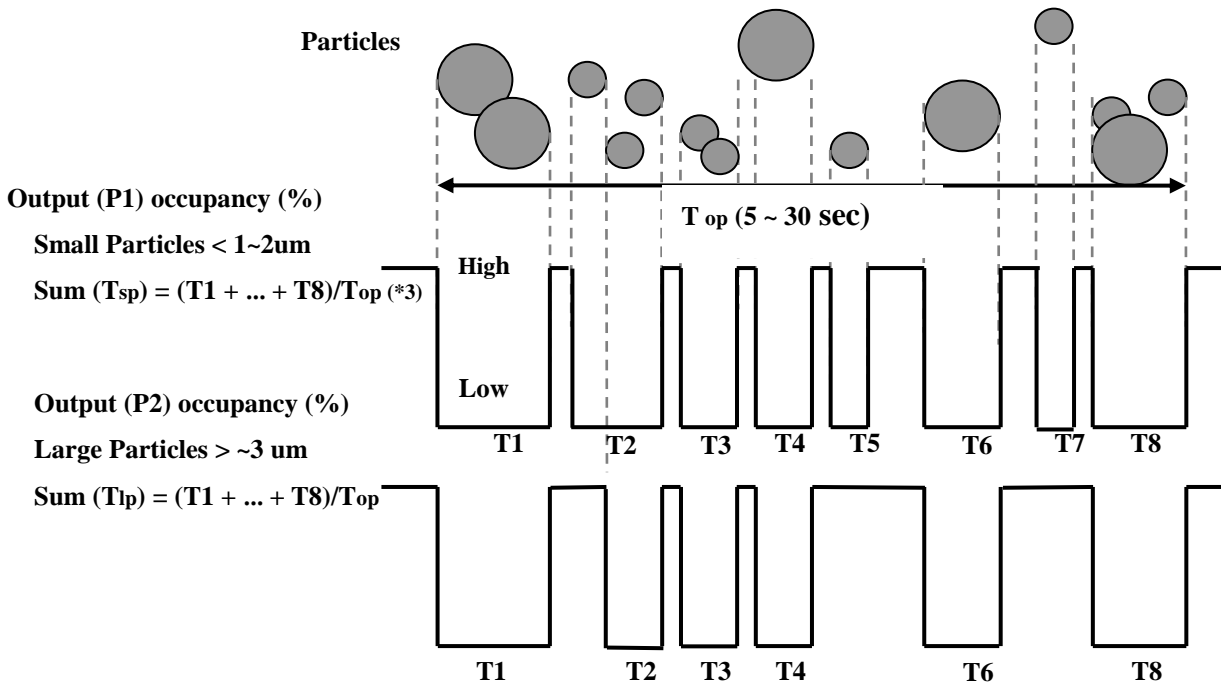
■ Distinguishing Method between small cigarette smoke and large house dust

As on the below Fig.2, the output of small cigarette smoke shows narrow pulse or overlapped pulse shape continuously. But the output of large dust shows wide pulse and not overlapped. Therefore, by reading a transition of output pulse during a certain time period using system MICOM, the system can distinguish

(a)Kind of dust (b) Large particle (c) Small particle.

And the system can also detect how and how much air polluted.

Fig. 2



■ Low pulse width vs. Dust size distribution

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|--|----------|-----------------------|-----|-----|-----|------|
| Low pulse width of a small particle (P1) | T_{sp} | *1 Cigarette smoke | 1 | 5 | 100 | mSec |
| Low pulse width of a large particle(P2) | T_{lp} | *2 House dust | 50 | 100 | 200 | mSec |

*1. Low pulse width is decided by dust size and concentration. In not heavily contaminated condition, 100~200 $\mu\text{g}/\text{m}^3$ of cigarette smoke, output pulse width of P1 pin is the average detection result of average one micrometer size of particles based on cigarette smoke during certain period.

*2. Low pulse width of a big house dust is bigger than cigarette smoke particle. The particle size is normally 5 to 20 μm and more.

*3. Top is the continuous operating time for particle detection. It is normally from 5 to 10 second for air cleaner application for fast feeling.

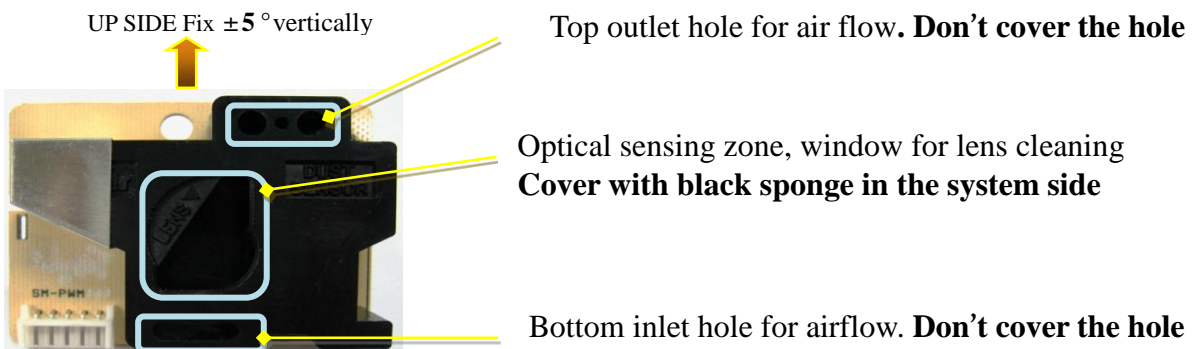
■ Notes for application

1. EMI and Power line noise protection and malfunction

The plastic cover case is conductive polymer material or has same function by treatment. Top metal shield case and plastic cover case is connected with GND in sensor. The photo sensor signal is weak for EMI. To protect EMI affection of photo sensor signal from motor and high voltage source, another bottom metal shield case could be soldered on electronic PCB's ground by customer requirements. Normally, top shield case is enough to protect EMI from outer electronic goods. However, to prevent EMI from high voltage negative ion generator and power line noise from electric dust collector, please install the high voltage generator in the opposite side from dust sensor also pay attention to prevent power line noise by using noise filter. The malfunction of dust sensor can be observed by taping all holes of dust sensor completely not to penetrate dust into open holes of dust sensor. After making clean the dust sensor chamber and taping all holes not to come any dusts into optical zone of sensor and operate the sensor. In this experiment dust sensor has not to show any low pulse output. If it is interrupted by EMI and line noise, many Low pulse output signals will be showed up. In this case, please consult to GE's technical team.

2. Dust Sensor install Method

When customer install the dust sensor in air cleaner, dust sensor must be installed vertically in the place that is not affected by air flow caused by motor fan rotation. We recommend to install dust sensor in the front panel side. The dust sensor can detect the water vapor as dust. Please do not use dust sensor in vaporizing place like bathroom or at near air humidifier. Dust sensor use IR wavelength LED and the visible cutoff photo sensor, but the irradiation by lamp light of optical zone will cause malfunction of dust sensor. Please cover the center hole shaped triangle by using black sponge not to irradiate dust sensor optics. Please do not cover the bottom and top hole for air flow to measure the dust. The center hole of PCB is for screwing bolt to system. Please use screw PH 3 pie for fixing. Please pay attention not to damage and touch sensor case.



The heater resistor is installed inside of dust sensor for inducing the forced air convection and the heated air flows from bottom side to top side direction. So, vertical positioning of dust sensor is important for air flow direction and speed in optical zone. The air flow direction and flow speed can affect the signal output of dust sensor. Please keep ± 5 degree position vertically.

3. Cleaning

Cigarette tar on the lens should affect the sensitivity of dust sensor. Wet swab with alcohol and rub softly the lens and dry. Normally wet cleaning is not recommended; because there is a case this device is not satisfied with its characteristics by wet cleaning. If large particle such as home dust are accumulate in the dust sensor optics parts, please consider the maintenance such as vacuuming or blowing off the dust by air.

4. Sensitivity adjustment, customized low pulse output data control by MICOM programming

SM-PWM-01A is the dust sensor that sensitivity is adjusted by MICOM program. Customer can't change the sensitivity by changing volume resistor. MICOM send the low pulse output data proportional with dust concentration. Also MICOM can be programmed to send the communication code with system MICOM like code for LED level or code for monitoring sensor life. If customer wants to use dust sensor to special purpose like fire detection, MICOM program can be changed to send low pulse data for fire alarm level warning. Please contact to GE technical team for more information.

5. Responsibility

This product shall not contain the following materials banned in RoHS Directive. (2002/95/EC)

- Pb, Hg, Cd, Cr+6, PBB, PBDE

GE takes no responsibility for any problems related to any intellectual property right of a third party resulting from the use of GE's device. GE takes no responsibility for damage caused by improper use of the device which does not meet the condition of absolute maximum ratings to be specified in relevant specification sheet nor meet the condition of the extremely high level of reliability and safety such as safety device, clean room monitoring, fire alarm, life support equipment, etc. This publication is the proprietary product of GE and is copyright with all rights reserved. Under the copyright laws, no part of this publication may be reproduced or transmitted

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Please contact with a GE representative if there are any questions for this publication.

■ Reliability

| | | | | |
|---|--------------------------------|--|---|------------|
| 1 | Drop | Drop it unintentionally from 100cm height down to the hard wooden board three times at random direction. | No damage, No breakage, NO failure on electrical characteristics | n=2 C=0 |
| 2 | High temp, humidity Storage | Leave in the atmosphere 85°C 95%RH for 500 hours | Output <UpperX1.3 LowerX0.7 <Output (Within ±30% of the original value) | n=4 C=0 |
| 3 | Low temp. storage | Leave in the atmosphere -30°C for 500 hour | | |
| 4 | Thermal Cycle | Repeat 10 times in the following cycle. After leaving in the atmosphere of - 25°C for 30minutes, move it into the atmosphere of + 70°C within 10 seconds. Further, return to the atmosphere of - 25°C after 30minutes. | | |
| 5 | Thermal Shock | Repeat 10 times in the following cycle. After soaking in the liquid of 5°C for 30 minutes, move to the liquid of + 70°C within 10 seconds. Further, return to the liquid of 5°C after 30minutes. | | |
| 6 | High Temp., Humidity Operation | Operating it in the atmosphere of 60°C 90~95%RH for 1000 hours | | |
| 7 | Low Temp Operation | Operating it in the atmosphere of -10°C for 1000 hours | | |
| 9 | ON-OFF | Apply the power on-off test for 500 hours in the atmosphere of 45°C 90~95%RH. On time : 5 minutes / Off time : 5 minutes | | |

| | | | | |
|----|------------------|--|----------------------|------------|
| 10 | Mechanical shock | 10~55~10Hz/1minute, overall amplitude 1.5 mm, X,Y,Z direction for 2 hours | | n=1 C=0 |
| 11 | Open-Short | Keep the mutual terminals of electric parts in short circuit, or keep the terminals opened, and supply the electric current to it. | Not to cause failure | n=1 C=0 |
| 12 | Salt spray | 200 times drops of the 5% solution of saltwater on the printed board for 30 seconds interval. | | |

*1. After test measurement shall be done after leaving under normal temperature and humidity for 2 hours.
And there is no contamination on lens and sensor PCB.

■ Lifetime of LED

Lifetime of LED: 7 years for continuous operation

■ Standard of sensor

The first standard is the calibrated particle counter and mass counter that are certificated.

The second standard is the master dust sensor and the master dust sensor is used for the process quality control of production.

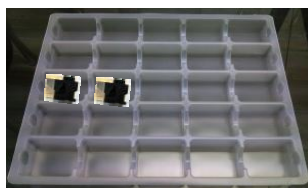
This master dust sensor is compared with the customer master sensor once every six month.

■ Packaging Specification

Packaging details

Outer Box Dimension: W400 x H400 x D400 [mm]

WEIGHT: max 12kg



5 ea 5ea x 2 tray= 50 ea
25 ea/tray



Electrostatic bag, 50ea/2 tray/bag

50ea x 8bag=400 EA
8 bag/box

■ Marking Information

SM-PWM-01

A B

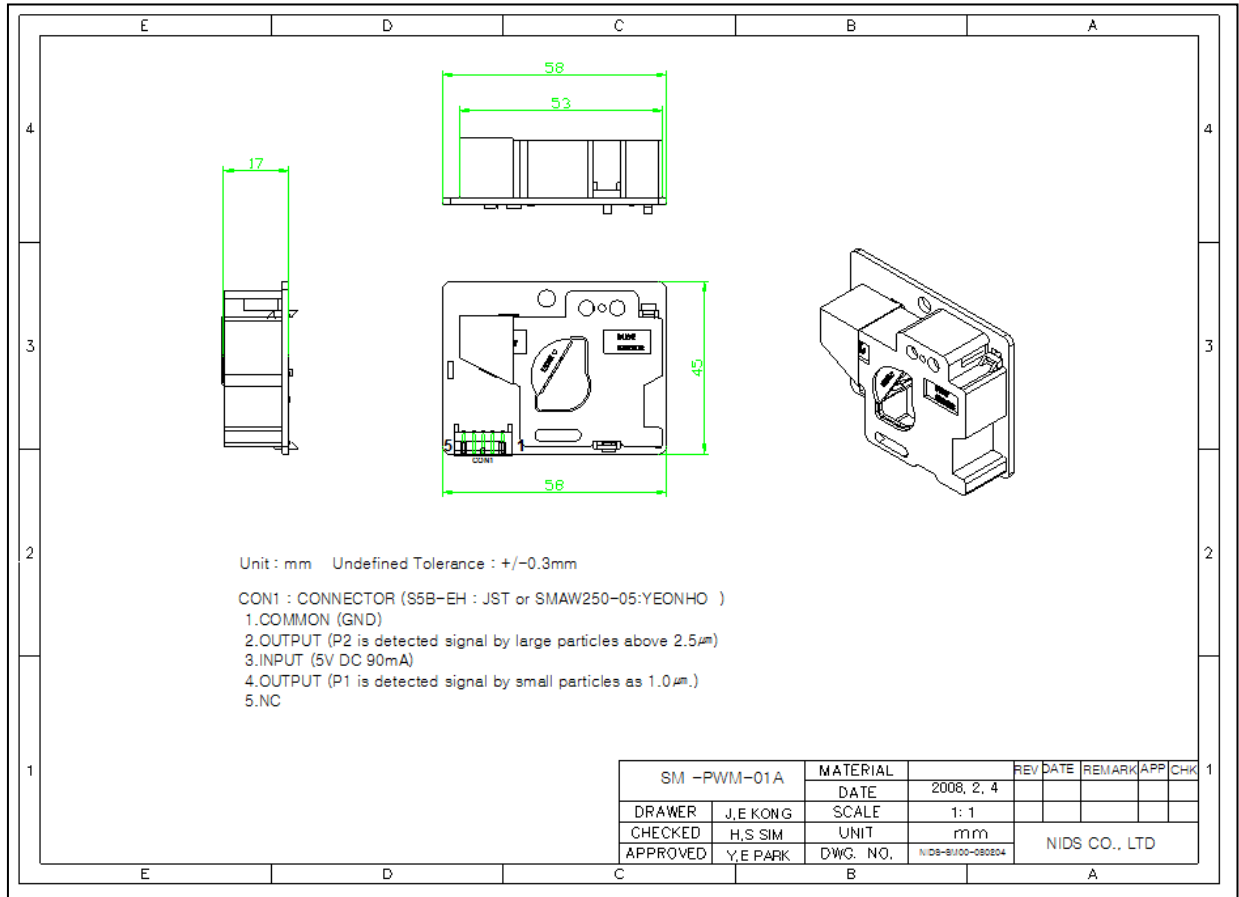
A, B: Date code (2digit). Stamp marking

| 1 st digit | | 2 nd digit | |
|-----------------------|------|-----------------------|------|
| Year of production | | Month of production | |
| A.D | Mark | Month | Mark |
| 2010 | 0 | 1 | 1 |
| 2011 | 1 | 2 | 2 |
| 2012 | 2 | 3 | 3 |
| 2013 | 3 | 4 | 4 |
| 2014 | 4 | 5 | 5 |
| 2015 | 5 | 6 | 6 |
| 2016 | 6 | 7 | 7 |
| 2017 | 7 | 8 | 8 |
| 2018 | 8 | 9 | 9 |
| 2019 | 9 | 10 | X |
| 2020 | 0 | 11 | Y |
| : | : | 12 | Z |

Repeat in a ten year cycle

Country of origin: Korea

■ Outline Dimension



Notice: The content of data sheet is subject to change without prior notice.