# SPECIFICATION

Product Name: Integrated Air Quality Sensor Module

Item No.: AM1002

Version: V0.1

Date: September 17, 2020
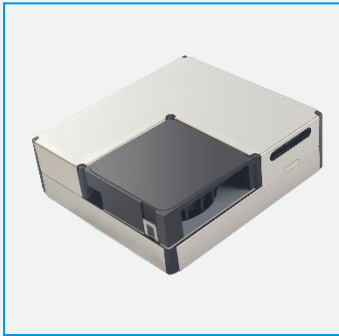
# Revision

| No. | Version | Content | Date |
|-----|---------|---------|------|
| | V0.1 | The first version | 2020-09-17 |

# Integrated Air Quality Sensor Module

## AM1002

## Applications

- Air purifier
- Air quality monitor
- Air conditioner
- Ventilation system
- Consumer electronic products

## Description

AM1002 is an integrated air quality sensor module with function of particle concentration, VOC concentration, temperature and relative humidity measurement. Particle concentration is measured by laser particle sensor which uses light scattering principle. It measures and calculates the suspended particle number exactly, and output particle mass concentration $\mu g/m^3$ directly via mathematical algorithm and scientific calibration. VOC sensor is MOX type, which has extremely high sensitivity to various kinds of organic volatile gases such as formaldehyde, benzene, ethanol, formic acid, nicotine and some inorganic gas like carbon monoxide, ammonia, hydrogen.

## Features

- The smallest particle size of available measurement: 0.3μm
- Real-time output particle mass concentration in μg/m3 available
- High accuracy, high sensitive and quick response
- Temperature compensation algorithm
- Matrix calibration technology and optimized algorithm, for high accuracy and consistency
- Siloxane resistance of VOC sensor, for long lifespan and high stability
- Intelligent VOC auto-calibration strategy on site, maintenance-free
- Small size, compact structure, easy to install

## Working Principle

- The PM sensor integrated adopts laser scattering technology to detect particle mass concentration
- The VOC sensor is based on MOX technology
- The RH&T sensor integrated adopts capacitance resistance materials to detect indoor RH&T

# Specifications

| Integrated Indoor Air Quality Sensor Specification | |
| --- | --- |
| Operating principle | Laser scattering for particle measurement<br>MOX for VOC measurement |
| Measurement range | Particle: 0~5,000µg/m³<br>VOC: 0~10ppm<br>Temperature: -20-70℃<br>Humidity: 0-99%RH |
| Measured particle range | 0.3µm~10µm |
| Particle output resolution | 1 µg/m³ |
| VOC output resolution | 1 ppb |
| Temperature output resolution | 0.1℃ |
| Humidity output resolution | 0.1% |
| Working condition | -20°C ~ 60°C, 0-95%RH (non-condensing) |
| Storage condition | -40°C ~ 80°C, 0-95%RH (non-condensing) |
| Particle accuracy | PM1.0/PM2.5:<br>0~100µg/m³: ±10µg/m³<br>101~500µg/m³: ±10% reading<br><br>PM10:<br>0~100µg/m³: ±25µg/m³<br>101~500µg/m³: ±25% reading<br>(GRIMM, 25±2℃, 50 ±10%RH） |
| Temperature accuracy[1] | 0°C ~ 40°C: ±1°C |
| Humidity accuracy[2] | 5%-95%RH: ±5%RH[2] |
| VOC Consistency | Typical/Max: 20%/25% |
| Sampling interval | Particle sampling: 1s<br>VOC, Temperature & Humidity: 10.5s |
| Response time | VOC: ≤ 180 seconds; Particle: ≤ 8 seconds; RH&T: ≤ 8 seconds |
| Power supply | DC 5V±0.1V, ripple wave＜50mV |
| Working current | ≤100mA |
| Standby current | ≤200µA |
| Dimensions | W38*H35*D12 mm |
| Digital output | UART_TTL |
| Life time | ≥10 years |

Note 1: Temperature and humidity accuracy in the table are defined at stable environment
Note 2: Humidity accuracy is defined at temperature of 25±2℃

# Internal Architecture Description
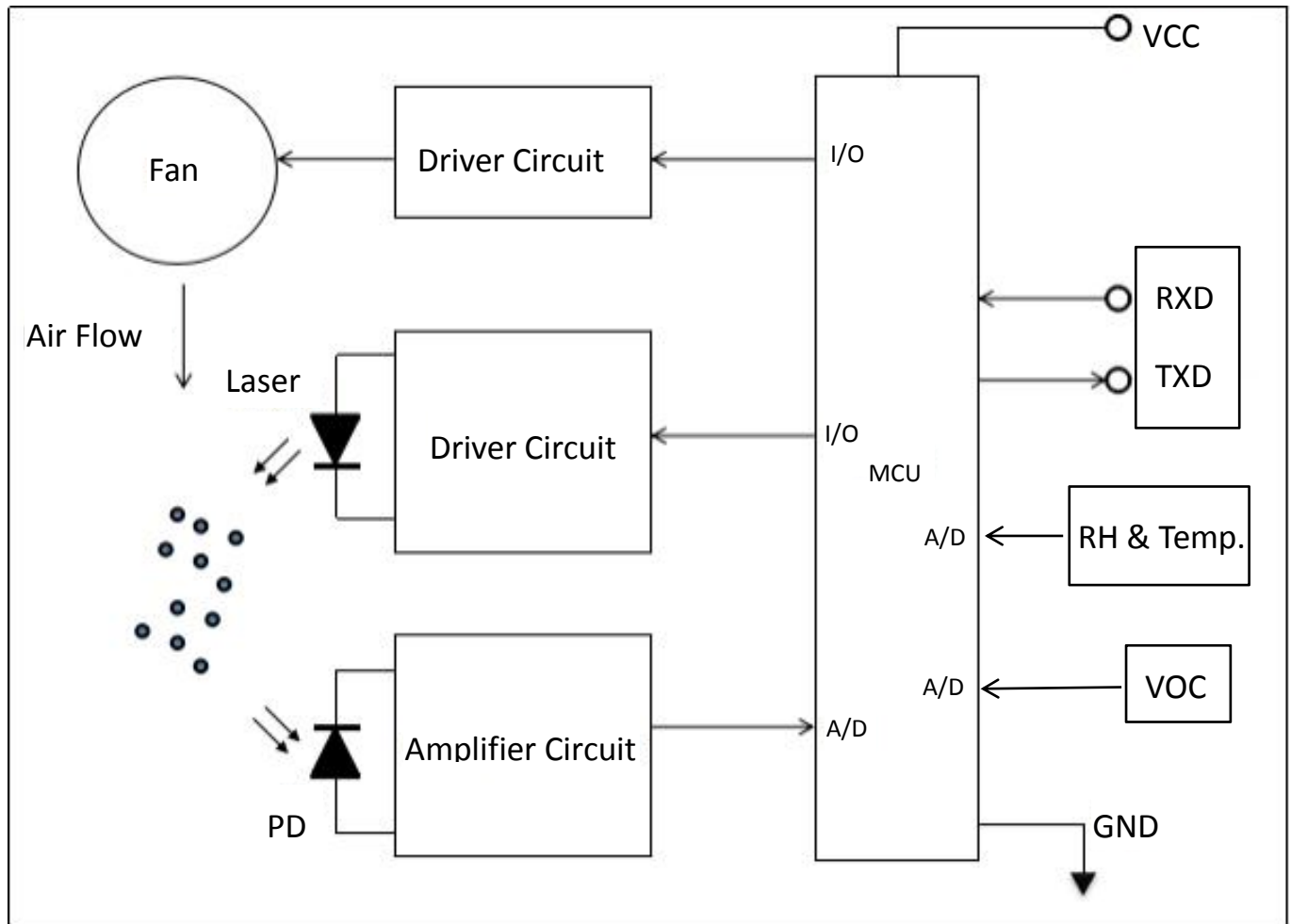


According to the above figure, the light source part of AM1002 is composed of a laser tube and a driving circuit. The detection part of the sensor is composed of light sensitive part which receives reflected light and amplifying circuit. Data processing and communication output are completed by microprocessor.

The gas flows into the module through the fan, when sampling particles pass through light beam (laser), there will be light scattering phenomenon, and scattered light will be converted into electrical signal (pulse) via light sensitive part. Electrical signal will be transformed into digital signals after amplifying circuit, smoothing and MCU processed.

Temperature and relative humidity is measured by sensor directly and data is transferred to MCU. MOX type VOC sensor is integrated, which has extremely high sensitivity to various kinds of organic volatile gases such as formaldehyde, benzene, ethanol, formic acid, nicotine and some inorganic gases like carbon monoxide, ammonia and hydrogen.

# Dimensions and Connector

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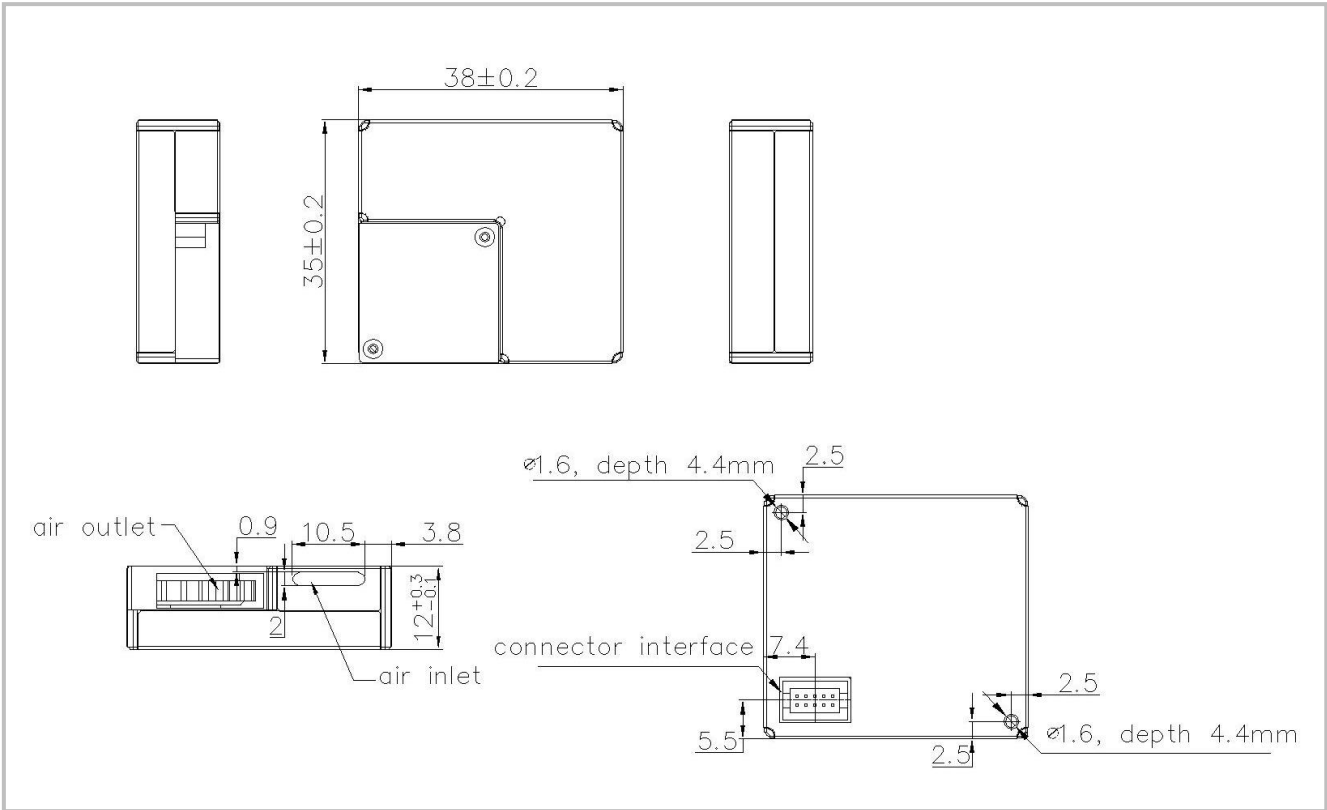


## 2. I/O Connector Pin out
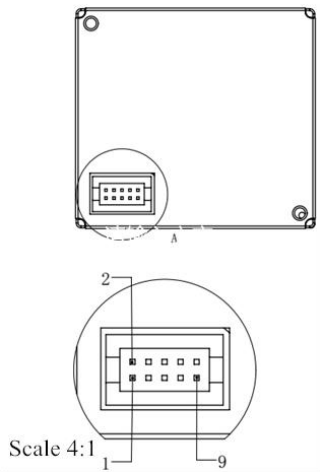


| No. | Pin | Description |
|---|---|---|
| 1 | VCC | Power input (+5V) |
| 2 | VCC | Power input (+5V) |
| 3 | GND | Power input (ground terminal) |
| 4 | GND | Power input (ground terminal) |
| 5 | Reset | Reset (Low level is reset, floating is default) |
| 6 | NC | NC |
| 7 | TXD | UART sending |
| 8 | NC | Keep floating |
| 9 | RXD | UART receiving |
| 10 | Set | Set (TTL level @3.3V, high level or floating is normal working status, while low level is sleeping mode） |

| Item | Part Number | Pitch |
|---|---|---|
| Connector | JSD-BH-312-002 | 1.25 mm |

# Typical Application Circuit

## UART Application
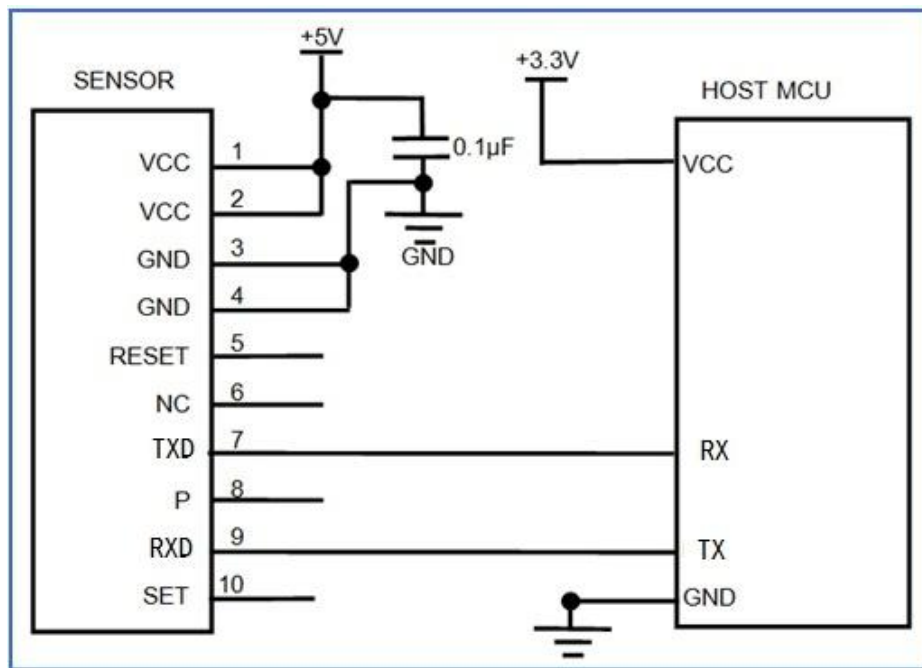
# Communication Protocol

## 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: 9600; Data Bits: 8; Stop Bits: 1; Parity: No

4) It is default by continuously mode after powering on. Working mode will not be saved after powering off.

## 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 |
| 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 | 0x16 |
| 2 | Read software version number | 0x1E |
| 3 | Read serial number | 0x1F |

## 4. Detail Description of Protocol

### 4.1 Read Measurement Result

Send：11 01 16 D8

Response：16 13 16 DF1~DF18 [CS]

Response description：

1. DF1-DF2: TVOC concentration = DF1*256^1 + DF2, unit: ppb

2. DF3-DF4: reserved

3. DF5-DF6: PM1.0=DF5*256^1 + DF6, unit: μg/m3

4. DF7-DF8: PM2.5= DF7*256^1 + DF8, unit: μg/m3

5. DF9-DF10: PM10+ DF9*256^1 + DF10, unit: μg/m3

6. DF11-DF12: Temperate= DF11*256^1 + DF12, unit:℃ (real temperature((DF11*256^1 + DF12)-500）/ 10)

7. DF13-DF14: humidity=DF13*256^1 + DF14, unit:1% (real relative humidity =((DF13*256^1 + DF14) / 10)

8. DF15-DF16: reserved

9. DF17-DF18: reserved

## 4.2 Read Software Version Number

**Send:** 11 01 1E D0

**Response:** 16 0E 1E DF1~DF13 [CS]

**Function:** Read software version

**Note:**

Software version="DF1~DF13"

Should change the HEX code to ASCII code.

**Example:**

HEX code: 16 0E 1E 50 4D 20 56 31 2E 32 36 2E 35 2E 32 38 E9

ASCII code: PM V1.26.5.28

## 4.3 Read Serial Number

**Send:** 11 01 1F CF

**Response:** 16 0B 1F DF1 DF2 DF3 DF4 DF5 DF6 DF7 DF8 DF9 DF10 CS

**Function:** Read serial number

**Note:**

Serial number = (DF1*256+DF2), (DF3*256+DF4), (DF5*256+DF6), (DF7*256+DF8), (DF9*256+DF10)
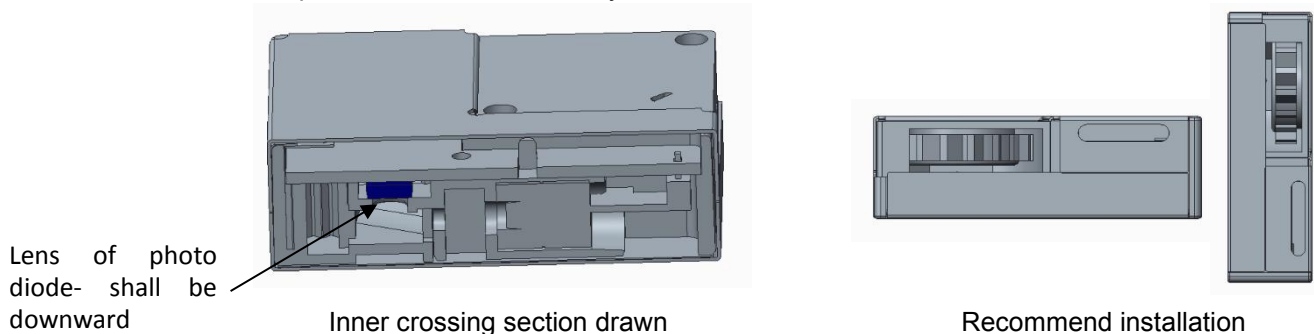
**Example:**

Response: 16 0B 1F 00 00 00 7E 09 07 07 0E 0D 72 9E

Serial number: 126 2311 1806 3442

# User Attention

▪The sensor is for household electronics products. For application of medical, mining, disaster preparedness, which needs high security and high dependence, this sensor is not suitable.

▪ Please do not use it in bad dusty environment and close sampling port.

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

▪When install the sensor, make sure the inlet and outlet is unobstructed, and cannot be fronted onto large air stream. There are two sides cannot be put downwards (As below pictures), In case of dust deposition on the surface of sensitive device, dust deposition will affect accuracy of sensor.



Lens of photo diode- shall be downward

Inner crossing section drawn                    Recommend installation

▪The metal case of sensor connects with the DC ground of inner circuit directly, which will cause safety problem if touching with DC ground. To avoid this problem, Sensor should be internally installed and no permit for touching sensor before power off.

▪There is no high pressure transient protection circuit of the sensor. The power supply of the sensor should be stable 5V and low noise. Please refer to the working current in specification table.

▪If use RC to decrease voltage, metal case will contact with 220V phase line or null line, special protection is needed.
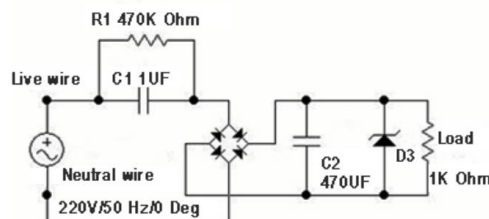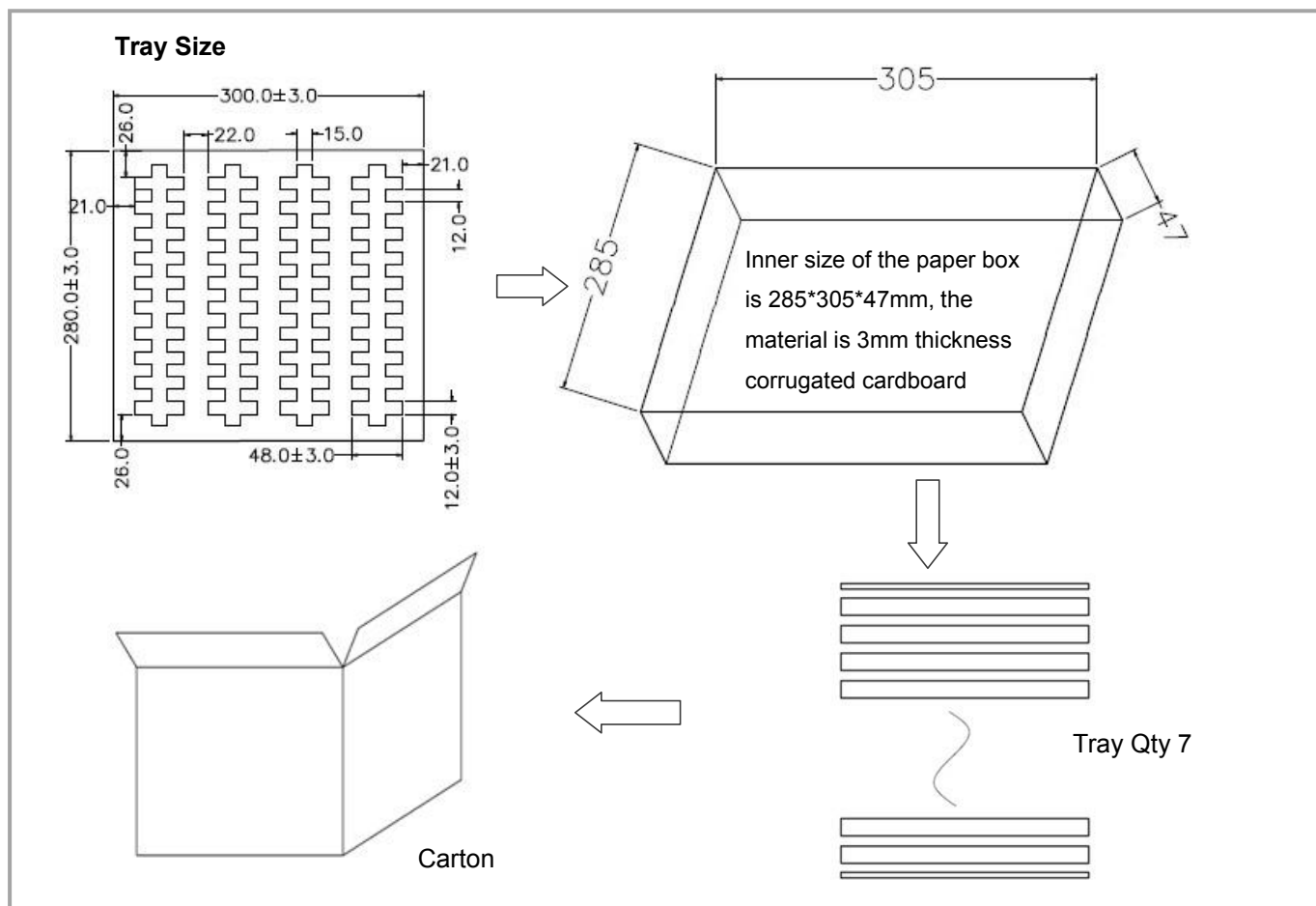


▪If isolated switch power supply is adopted to obtain DC power, then capacitance between the DC ground and the AC ground shall be ≤2.2nF and voltage withstand≥3kV.
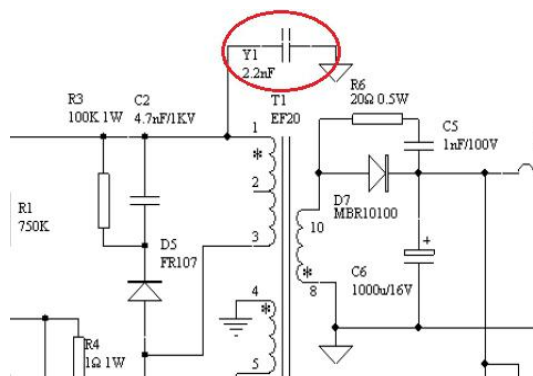


▪This product is defined as 3R laser product according to 《GB7247.1-2012 laser product safety》 with laser radiation inside. Please avoid direct illumination on the eye.

## Package Information

**Tray Size**



Inner size of the paper box is 285*305*47mm, the material is 3mm thickness corrugated cardboard

Tray Qty 7

Carton

| Sensor per Tray | Tray Qty | Sensor per Carton | Carton Dimensions | Packing Material |
|---|---|---|---|---|
| 40 pcs | 7 layers | 280 pcs | 395*310*330 mm | Red Anti-static EPE |

## After-Sales Services and Consultancy

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