

AEM1000 Data Sheet

Environmental monitoring box

- 5V DC power supply
- Digital signal output (RS485/UART)
- Customizable output signal mode
- Fast response and strong anti-interference
- Highly integrated, multiple signal data acquisition

Summary

AEM1000 is an environmental monitoring product, in which four sensors are integrated for the detection of temperature, humidity, VOC, CO₂ and PM2.5. The communication protocol is standard Modbus RTU.

Each product is fully calibrated and tested, and its performance is able to meet the application needs of customers.

Application

The products can be widely used in fields such as smart home, smart agriculture and smart classroom for the air quality monitoring at home, in smart greenhouse and in classroom.



Figure 1. AEM1000 Product reference drawing

1. Working principle

AEM1000 environmental monitoring box integrates four sensors, namely temperature and humidity, VOC, PM2.5 and CO₂ Sensor. As shown in Figure 2, the data of each sensor is acquired through the built-in MCU of AEM1000. Then, the data are transmitted to the host device through port of RS485 or UART based on the standard Modbus RTU communication protocol.

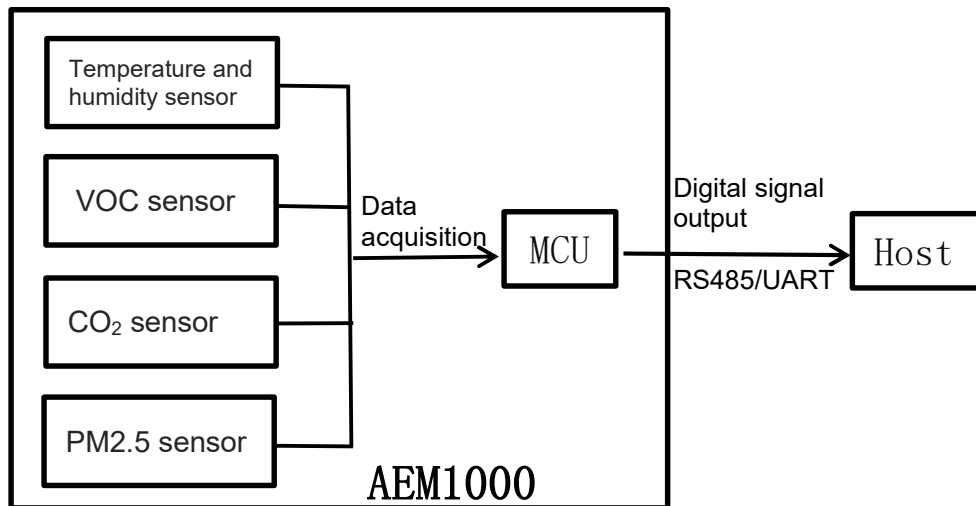


Figure 2. AEM1000 communication diagram

2. Technical specifications

2.1 Specification of sensors

Table 1. Specification of sensors

| Parameter | Temperature and humidity sensor | | PM2.5 sensor | CO ₂ sensor | VOC sensor |
|-------------------------------|---------------------------------|-------------|--|------------------------|---|
| | Humidity | Temperature | | | |
| Measurement range | 0~99.9%RH | -40~+80°C | 0~1000μg/m ³ | 400~5000ppm | 0~99.999ppm (Above 9.999ppm is extended range) |
| Resolution | 0.024%RH | 0.05°C | 2μg/m ³ | 1ppm | 2% of measured value |
| Accuracy | ±5%RH | ±0.5°C | ±20μg/m ³ (0~100) ±20%(100~1000) | ±(50ppm+5%M.V.) | 25%F.S |
| Response time (Typical value) | 8s | 8s | 3s | 90s | 10s |
| Long term drift | <1%RH/yr | <0.1°C/yr | / | / | / |

2.2 Electrical properties

Table 2. Electrical properties

| | |
|---------------------|--------------------------------|
| Working voltage | 5.0V DC |
| Working currents | 140mA@5V (Peak Value 264mA@5V) |
| Data update cycle | 2s |
| Output method | RS485/UART |
| Preheating time | $\geq 120s$ |
| Working temperature | 10~50°C |
| Working humidity | 5~80%RH |

User Guide

1. Interface definition and communication protocol

1.1 Interface definition

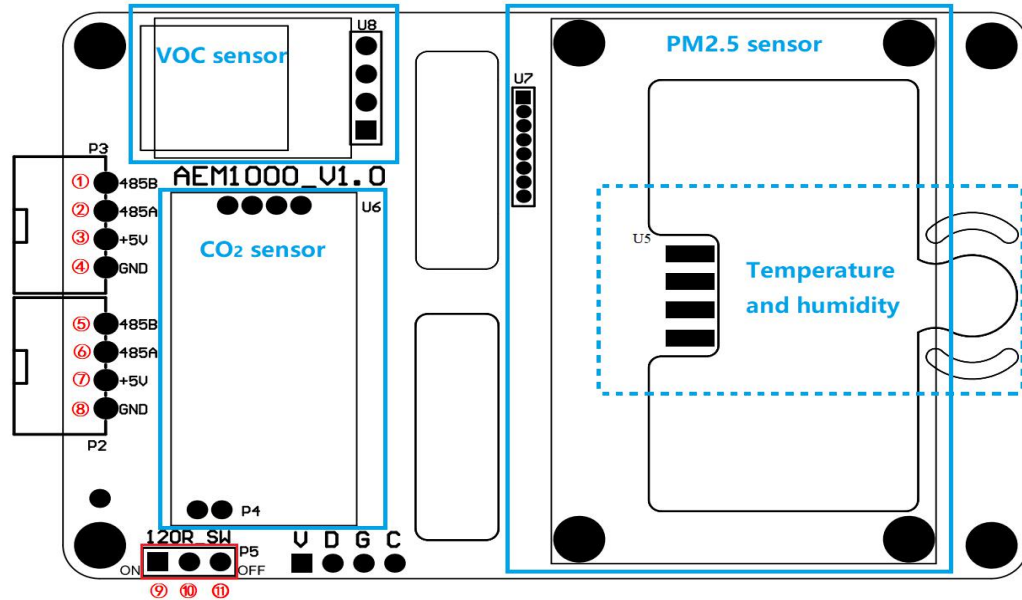


Figure 3. Port definition sketch of AEM1000

As shown in Figure 3, U5, U6, U7, U8 are the connection port for of temperature and humidity, CO₂, PM2.5 and VOC sensor, respectively. The mounting position of sensors are marked by 4 blue boxes, where the solid line box refers to mounting on the front side of the board and the dashed line box refers to mounting on the back of the board.

P2 and P3 are ports for host powering and communication, respectively. P5 is a port with 3 pins for jumper cap to provide RS485 long range communication. The name and description of pins in P2, P3 and P5 are listed in Table3.

Table 3. Pin definition

| Pin | Name | Description |
|-----|-----------|---|
| ① | RS485B | RS485 communication terminal B |
| ② | RS485A | RS485 communication terminal A |
| ③ | 5V | DC power supply |
| ④ | GND | Grounding |
| ⑤ | RS485B/TX | RS485 communication terminal B / UART communication transmitting terminal |
| ⑥ | RS485A/RX | RS485 communication terminal A / UART communication transmitting terminal |
| ⑦ | 5V | DC power supply |
| ⑧ | GND | Grounding |
| ⑨ | 120 Ω | Short-circuiting ⑨ and ⑩ : Connect in parallel with 120 Ω Short-circuiting ⑩ and ⑪: Cancel the connection to 120 Ω |
| ⑩ | RS485A | |
| ⑪ | None | |

Note: ⑤ and ⑥ are set to RS485b, RS485a by default. TX and RX can be customized based on needed of customers.

1.2 Communication protocol

Table 4. Modbus RTU communication register definition

| Register address | Value range | Read write properties | Multiple | Register information | Remarks |
|------------------|---|-----------------------|----------|---|--|
| 0x0000 | -400~+800 | Read-only | 10 | Temperature (°C) | - |
| 0x0001 | 0~999 | Read-only | 10 | Humidity (%RH) | - |
| 0x0002 | 0~99999 (Above 9999 is extended range) | Read-only | 1000 | VOC (ppm) | formula is: $\mu\text{g}/\text{m}^3 = \text{ppm} * 2290$ |
| 0x0003 | 400~5000 | Read-only | 1 | CO ₂ (ppm) | - |
| 0x0004 | 0~1000 | Read-only | 1 | PM2.5 ($\mu\text{g}/\text{m}^3$) | - |
| 0x0005 | 30000~120000 | Read-only | 1 | Air pressure [31:16] (Pa) | Reserved |
| 0x0006 | | | | Air pressure [15:0] (Pa) | Reserved |
| 0x0007 | 0~ 9999 | Read-only | 100 | O ₂ (%) | Reserved |
| 0x000A | 1~255 | Read-write | 1 | Slave address | Default factory slave address: 0x01 |
| 0x000B | 0~2 | Read-only | 1 | Temperature and humidity sensor status | 0: Working 1: Error 2: Sensor is not connected |
| 0x000C | 0~2 | Read-only | 1 | VOC sensor status | |
| 0x000D | 0~2 | Read-only | 1 | CO ₂ sensor status | |
| 0x000E | 0~2 | Read-only | 1 | PM2.5 sensor status | |
| 0x000F | 0~2 | Read-only | 1 | Pressure sensor status | |
| 0x0010 | 0~2 | Read-only | 1 | O ₂ sensor status | (Reserved) |
| 0x0020 | 0~2 | Write-only | 1 | CO ₂ sensor calibration | 0: Manual 1: Automatic 2: Reset |
| 0x0021 | 400~5000 | Write-only | 1 | Parameters for CO ₂ sensor calibration | Switch to manual calibration mode |
| 0x0022 | 0~2 | Write-only | 1 | O ₂ sensor calibration | 0: zero calibration (Short-circuiting of the working and counter electrodes) 1: Calibration at 1 atm (Oxygen sensor exposed in air) 2: Reset |

The digital output signal of the AEM1000 environmental monitoring box is transmitted by default two RS485 communications or customized to be one RS485 and one UART. RS485 or UART is required to set the baud rate to 9600, data frame to 8 bits, one start and one stop bit.

The communication protocol is the standard Modbus RTU. The host can be a computer, RS485 receiver or MCU controller. AEM1000 has a default address of 0x01 and the address can be modified. Host can have access to connect to arrays of AEM1000.

The Modbus RTU communication register definition for AEM1000 is shown in Table4.

When the host reads the data of PM2.5 from AEM1000 with default address of 0x01, the host sends commands to AEM1000 in the data format as shown in Table 5.

Table 5. Data format of host sending read register command

| Host Send Information | Number of bytes | Examples of sending information (Hex) | Information meaning description |
|--------------------------|-----------------|---------------------------------------|--|
| Slave address | 1 | 01 | Slave address |
| Function code | 1 | 03 | Read multiplex register |
| Register start address | 2 | 0004 | Register 0x0004 stores the data of PM2.5 |
| Number of read registers | 2 | 0001 | Read 1 register |
| CRC code | 2 | C5CB | CRC code is used for verification |

The format of returned data from AEM1000 to the host is shown in Table 6.

Table 6. Format for returned data from AEM1000

| Sending information from slave | Number of bytes | Example of receiving information (Hex) | Information meaning description | According to the above example, the meaning of the data sent and received by the host |
|----------------------------------|-----------------|--|--|---|
| Slave address | 1 | 01 | Slave address | - |
| Function code | 1 | 03 | Read multiplex register | - |
| Number of bytes of received data | 1 | 02 | Number of bytes of received data = Number of read registers×2 | - |
| Register data | 2 | 0014 | 1 register read | 0x14 convert decimal to 20 The value of PM2.5 is 20 $\mu\text{g}/\text{m}^3$ |
| CRC code | 2 | B84B | CRC code is used for verification | - |

};

```

unsigned int CRC_Compute(unsigned char * pushMsg,unsigned char usDataLen)
{
    unsigned char uchCRCHi = 0xff;
    unsigned char uchCRCLo = 0xff;
    unsigned char uIndex;
    while(usDataLen--)
    {
        uIndex = uchCRCHi^ *pushMsg++;
        uchCRCHi = uchCRCLo^ uchCRCHi[uIndex];
        uchCRCLo = uchCRCLo[uIndex];
    }
    return (uchCRCHi << 8 | uchCRCLo);
}

```

2. Dimensions

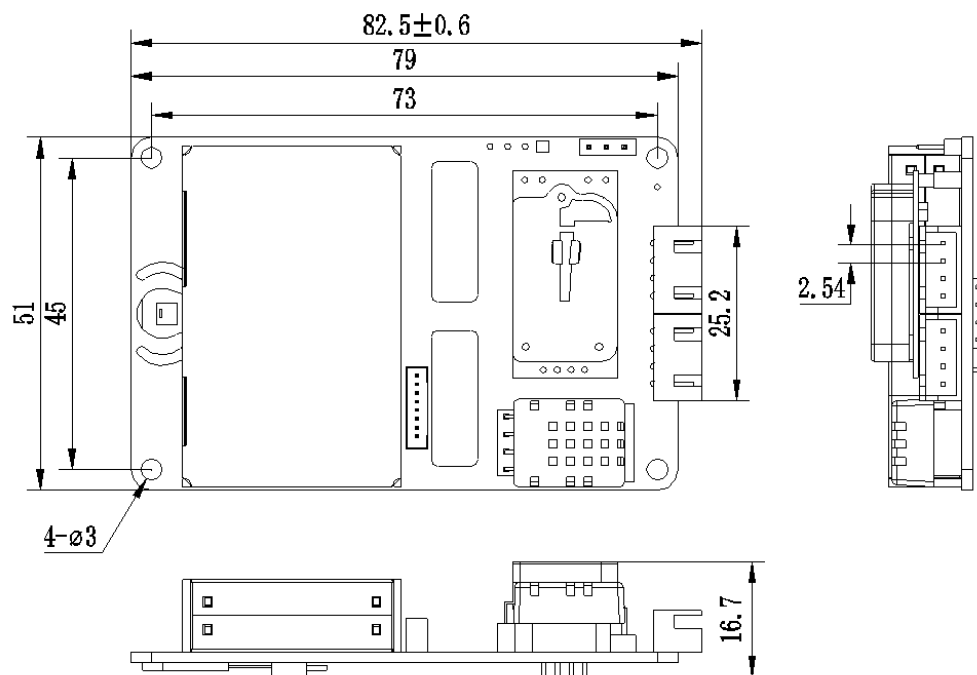


Figure 4. AEM1000 dimension drawing (Unit: mm)

3. Storage and power

In order to achieve the best working status and to reach the accuracy of the product, it is recommended to consider the following suggestion:

When AEM1000 is stored for a long time without power-on, the VOC sensor will have reversible drift, which is related to the storage environment. To stabilize the AEM1000 after long-term storage, a long time power-on of sensor is required. Storage time and corresponding power-on time are recommended as shown in Table 8.

Table 8. Storage and energization meter

| Storage time | Recommended power-on time |
|--------------------|---------------------------|
| Less than 1 week | > 12 hours |
| 1 ~ 6 months | > 72 hours |
| More than 6 months | > 96 hours |

The installation position of AEM1000 environmental monitoring box must be away from the external heat source to prevent the affecting on working status and accuracy of the monitoring box. It shall be used in an open and ventilated environment.

4.Warning and Personal Injury

Do not apply this product to safety protection devices or emergency stop equipment, and any other applications that may cause personal injury due to the product's failure. Do not use this product unless there is a special purpose or use authorization. Refer to the product data sheet and application guide before installing, handling, using or maintaining the product. Failure to follow this recommendation may result in death and serious personal injury. Aosong will not be liable for all compensation for personal injury and death arising therefrom, and relieve any possible claims against Aosong's managers, employees, affiliated subsidiaries and agents, distributors, etc., including: various costs, compensation fees, attorney fees and so on.

5.Quality Assurance

Guangzhou Aosong Electronics Co., Ltd. offers warranty as shown in Table 9 to the direct buyers (warranty takes effect after the date of delivery), quality standard ref to the technical specifications in the datasheet of the sensor products published by Aosong Electronics. If within the warranty period, the product is confirmed to be defective, Aosong will provide repair or replacement for free.

Table 9. Warranty Description

| Product | Warranty |
|--------------------------------------|-----------|
| AEM1000 environmental monitoring box | 12 months |

Aosong is only responsible for the application of the product in accordance with the technical conditions of the product caused by defects of the product. Aosong does not make any guarantee for the application of the product in special scenarios that are not recommended. At the same time, Aosong does not make any commitment to the reliability of the products applied to other products or circuits that are not Aosong's supporting products.

This manual may be changed at any time without notice.

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