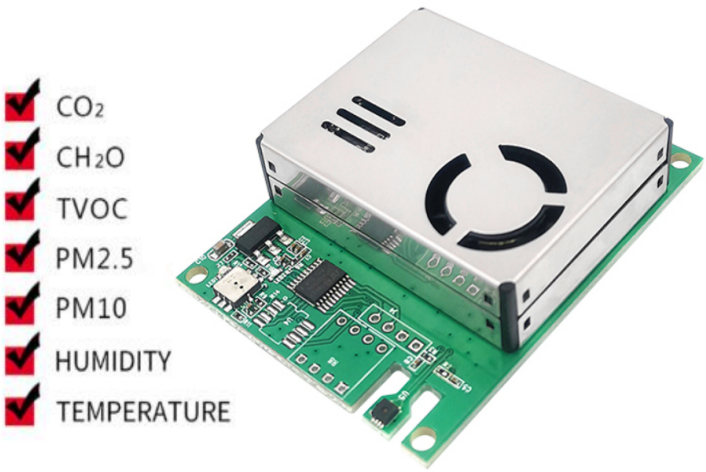
All-in-one Gas Sensor Module

(M702)

Product Specification



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All-in-one Gas Sensor Module (M702)

Overview

M702 is a multi-in-one gas sensor module that can measure various kinds of gas at the same time. The sensor module incorporates a laser particle sensor, and a VOC sensor. The sensor module also has a built-in temperature and humidity sensor chip. These parameters will be unified in the form of digital interface output. The sensor module by optimizing the internal structure, making the air inside the module path and the sensor sampling interface better combination, to reduce the size of the module, but also to the sensitivity of the sensor is guaranteed.

Main Characteristics

- Laser scattering principle measures the concentration of paricles
- Semiconductor principles measure TVOC、CO2 and formaldehyde
- Temperature and humidity output
- Unified air inlet Highly integrated
- UART output

Technical Index

Parameter	Measurement resolution	Range of measurement	Accuracy
CO2	1ppm	400ppm 5000ppm	±3%+50PPM or±10%
CH2O	1 g/m3	0 g 2000 g/m³	±10%
TVOC	1 g/m3	0 g~5000 g/m³	±25%
PM2.5	1 g/m3	0 g/m3 999 g/m³	±10% or±10
PM10	1 g/m3	o g/m3 1000 g/m³	±10% or±10
Temperature	0.1℃	-40℃～100℃	±1℃
Humidity	0.1%	0～100%	±3%RH
Physical interface	XH2.54		
output	UART		
Source Voltage	5.0±0.2VDC		
Current	500mA		
Warm-up time	2 minutes (TVOC needs to be warmed up)		
Operating Temperature	0℃～50℃		
Operating humidity (Non-Condensing)	95%RH		
Physical Size	62*49*15mm(L×W×H)		

Note: M702 series the CO2 and CH2O values output by the module are equivalent values of Tvoc

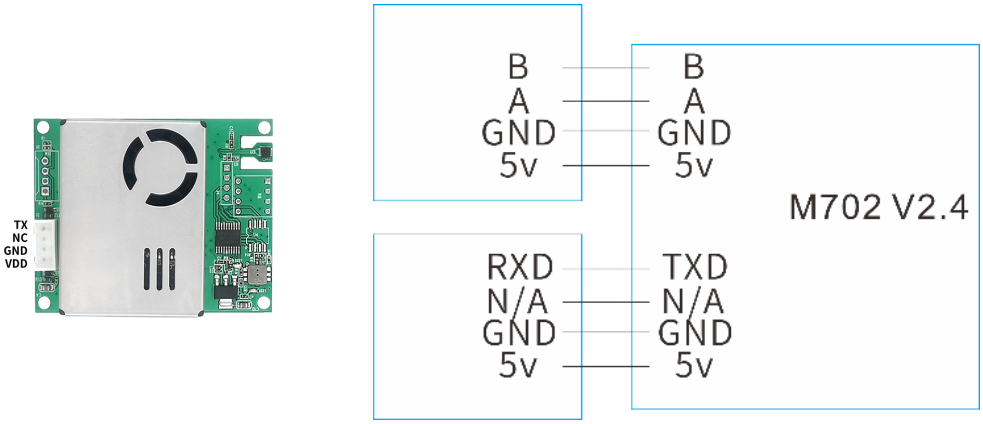
Definition of Interface

Fiture 2 Connector Definition

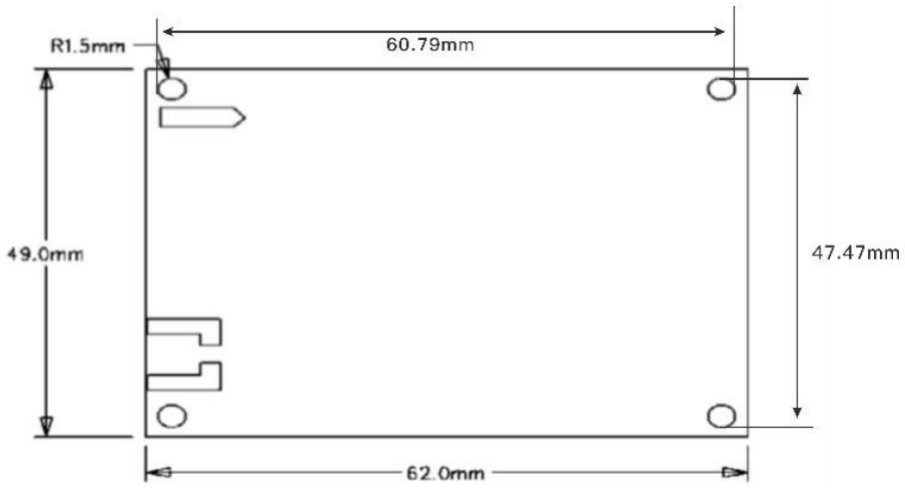
Pin Number	Function	Description
PIN1	VCC	Positive Power（+5V）
PIN2	GND	Negative Power
PIN3	NC	
PIN4	TXD	UART output

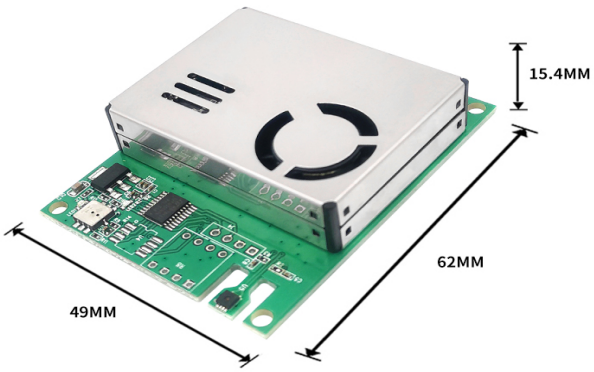
The interface level of TXD is TTL (3.3V)

Connection Schematic :



Physical Size（Height 15mm）





Attentions

1) The best way of install is making the plane of inlet and outlet closely to the plane of the host. Or some shield should be placed between inlet and outlet in order to prevent the air flow from inner loop.

2) The blowhole in the shell of the host should not be smaller than the inlet.

3) The sensor should not be installed in the air flow way of the air cleaner or should be shielded by some structure.

4) The sensor should be installed at least 20cm higher than the grand in order to prevent it from blocking by the flock dust.

5) When the sensor is used to outdoor fixed equipment, the equipment should be completed for the protection of sandstorm,rain,snow,etc.

6) Do not break up the sensor.

7） The sensor is usually used in the common indoor environment. So some protection must be added if using in the conditions as followed:

a) The time of concentration ≥300μg/m³ is longer than 50% of the whole year or concentration≥500μg/m³ is longer than20% of the whole year.

b) Kitchen

c) Water mist condition such as bathroom or hot spring

d) Local temperature is too high or direct sunlight

e) Outdoor

Appendix A:UART Transport Protocol

Serial data format:

Baud rate	9600bps
Value bits	8 bits
Check code bits	No
Stop bits	1 bits

Byte number	Value	Instruction
B1	Fixed byte 1	Fixed value 3Ch
B2	Fixed byte 2	Fixed value 02h
B3	value	eCO2 high 8 bits
B4	value	eCO2 low 8 bits
B5	value	eCH2O high 8 bits
B6	value	eCH2O low 8 bits
B7	value	TVOC high 8 bits
B8	value	TVOC low 8 bits
B9	value	PM2.5 high 8 bits
B10	value	PM2.5 low 8 bits
B11	value	PM10 high 8 bits
B12	value	PM10 low 8 bits
B13	value	Temperature Integer part
B14	value	Temperature decimal part
B15	value	Humidity Integer part
B16	value	Humidity decimal part
B17	Check code	Check code=B1+B2+B3+B4+・・・・・+B16, low 8 bits

When the temperature data B13 bit7=1, it means negative temperature, when B13 bit7=0, it means positive temperature. For example, when B13=9Bh, bit7=1 at this time, it means negative temperature, and the temperature is -27℃; if B13=1Bh, bit7=0, it means positive temperature, and the actual temperature is 27℃.

Appendix A: RS485 Transport Protocol

Ver2.0

When the temperature data B13 bit7=1, it means negative temperature, when B13 bit7=0, it means positive temperature. For example, when B13=9Bh, bit7=1 at this time, it means negative temperature, and the temperature is -27℃; if B13=1Bh, bit7=0, it means positive temperature, and the actual temperature is 27℃.

Byte number	Value	Instruction
B1	Fixed byte 1	Fixed value 3Ch
B2	Fixed byte 2	Fixed value 02h
B3	value	eCO2 high 8 bits
B4	value	eCO2 low 8 bits
B5	value	eCH2O high 8 bits
B6	value	eCH2O low 8 bits
B7	value	TVOC high 8 bits
B8	value	TVOC low 8 bits
B9	value	PM2.5 high 8 bits
B10	value	PM2.5 low 8 bits
B11	value	PM10 high 8 bits
B12	value	PM10 low 8 bits
B13	value	Temperature Integer part
B14	value	Temperature decimal part
B15	value	Humidity Integer part
B16	value	Humidity decimal part
B17	Check code	Check code=B1+B2+B3+B4+・・・・・+B16, low 8 bits

1、Physical interface：Adopt standard serial RS-485 communication port

Baud rate	9600bps
Value bits	8 bits
Check code bits	No
Stop bits	1 bits

2.1 M701 communication protocol detail

1） All loop communication shall follow the master/slave mode.In this way, information and data are passed between a single master and slave station (monitoring device).

2） Broadcast mode is not supported.

3）Cannot start communication from a slave station.

4） If a package containing an unknown command is received by the master station or any slave station, the package will be ignored and the receiving station will not respond.

2．2 Returns a description of the data frame structure

Each data frame is composed as follows：（RTUmodel）

Address

Function code

Number of data

data1

...

Data n

CRC 16 Check code

3、The transmission format

(1)Format of command message

Host sends read data command:

Address	Function code	Data starting address high	Data starting address low	Data length(2byte)	CRC 16 bit Check code
xx	03	00	02	00 07	Low in the first

At present, only reading all data is supported, starting from address 0002, reading 7 data values), only 7 data, corresponding to 7 addresses, their high address and high data level, are not processed in the module. Defdefault is 0, host data start high and data each high, it is recommended to send 0X00

Internal message information

start address	Number of data	Explain
Can only be as follows:		
0x0002	1	CO2 value
0x0004	1	Formaldehyde value
0x0006	1	TVOC value
0x0008	1	PM2.5 value
0x000A	1	PM10 value
0x000C	1	Temperature value
0x000E	1	Humidity value

The starting address can only use the addresses in the above list, otherwise you do not respond. If the number of data exceeds, it will not respond. For example, if the starting address is 0X000C, the number of data you can return can only be 1 or 2, and if you want to return 3 data, you will not respond. Similarly, at the address 0X000E, the number of returned data can only be 1. The number of returned data is 0, and it does not respond.

Returns the value from the machine sensor:

From the machine address	FC	Number of data	data N	CRC
XX	03	xx	xx	xxxx

N0	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10	N11	N12	N13
CO2 High	CO2 LOW	CH2O High	CH20 LOW	TVOC High	TVOC LOW	PM2.5 High	PM2.5 LOW	PM10 High	PM10 LOW	Temh	TemLOW	Humh	HumLOW

Byte length refers to the data length only

The Host sends a read address command:

Address	FC	High data start address	Low data start address	Numbers of data High	Numbers of data Low	CRC 16 Bit checksum
00	02	00	00	00	02	Xxxx Low in the front

Return Address:

Address	FC	Byte length	Low data start address	numbers of data High	CRC 16 Bit checksum
00	02	02	00	xx	Xxxx Low in the front

4. Host data sampling frequency:

When reading the temperature and humidity sensor data, the interval time of the upper computer to read the data is not less than 500ms, and the recommended value is 1s.

5, FC

03: reading data

02: Read the address

6. Command, for example:

Serial port setting: asynchronous communication, start 1 bit, data bit 8 bit, no check, stop 1 bit 1 bit

Data transmission rate default is: 9,600 b / s

Upper computer send: 01 03 00 02 00 07 CRCL, CRCH (read 7 data of address 01 from 00 02, do not check the inspection code from the machine)

M701 return:0x01,0x01,0x07, CO2 H, CO2 L, CH2O H, CH2O L, TVOC H,TVOC L,PM2.5 H,PM2.5 L, PM10 H, PM10 L, Temperature H, Temperature L, Humidity H, Humidity L, CRCL, CRCH

Example 1:

TX: 01 03 00 02 00 07 CRCL，CRCH

RX: 01 03 07 01 E2 00 05 00 24 00 2D 00 00 FF 03 11 CRCL，CRCH

CO2 value= CO2H x 256 + CO2L PPM (BYTE3 x256 + BYTE4)

CH2O value = CH2O H x256 + CH2O L ug (BYTE5 x256 + BYTE6)

TVOC value = TVOCH x256 + TVOCL ug (BYTE7 x256 + BYTE8)

PM2.5 value = PM2.5H X256 + PM2.5L ug (BYTE9 x256 + BYTE10)

PM10 value = PM10H X256 + PM10L ug (BYTE11 x256 + BYTE12)

Temperature = （(BYTE13)X256 + (BYTE14)）% 10

Humidity= （(BYTE15)X256 + (BYTE16)）% 10

the above CO2=482,CH2O=5,TVOC=36,PM2.5=45,PM10=56,TEM=30.5,HUM=64.6

Example 2:

TX:01 03 00 0C 00 02 CRCL，CRCH (10:43:52:001) (Read 2 data starting at address 01 starting from 00 0C)

Two data starting from 0x00 0C, corresponding to temperature and humidity.

RX:01 03 02 01 27 02 45 03 57 (10:43:52:159)

The return temperature value of 0X0127 corresponds to a 10 decimal system of 295, indicating the temperature of 29.5℃

The return humidity value of 0X0245 corresponds to a 10 decimal system of 581, indicating the humidity of 58.1%RH

Attention :

The temperature and humidity data returned from the machine are represented by two bytes, the high before and the low in the back

Return the data range-32768- - -32767, the actual temperature and humidity data need to divide the return value by 10

Example：

Return the humidity 16 decimal data: 0X0311, corresponding to the decimal 785, indicating that the humidity is 78.5%RH

Return a temperature of 16 decimal data: 0X00FF, corresponding to a decimal system of 255, indicating a temperature of 25.5℃

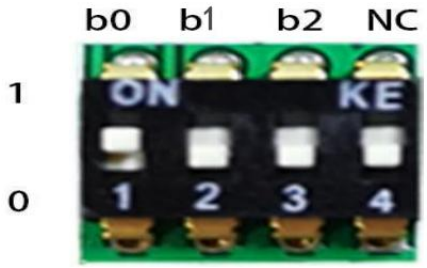
Return a temperature of 16 decimal data: 0X8064, the highest bit of 1 indicates the negative number, corresponding to the decimal-100, indicating a temperature of-10.0℃

Read address value:

On the machine to send：00 02 00 00 00 01 CRCL，CRCH

The transmitter returns： 00 02 02 00，Address L ，CRCL，CRCH

Address Setup Description：



The dial switch is 4 bits, uses 3 bits, the fourth is negligible, and the single chip does not read.

The 1,2,3 feet, corresponding to b0, b1, b2. As shown in the figure above, up code (ON direction), corresponding to high and lower code is low.

Address code = (b0 | b1 <<1 | b2 <<2) (Do not use 00 as possible)

The address code used by the module may differ from the address code read by issuing the command. Is the address used by the module only read once, and if the address code used by the module will not change. It needs to be repowered to change;

Sending a command to read an address code is a real-time response to the current dial switch. If the address is not changed after the power is turned on, the address used by the module is the same as that when the command is read, and if changed, the address is changed when the command is read. The module uses the address when the power is on.

Address list:

b2	b1	b0	ADDR
0	0	0	0x00
0	0	1	0x01
0	1	0	0x02
0	1	1	0x03
1	0	0	0x04
1	0	1	0x05
1	1	0	0x06
1	1	1	0x07

CRC calibration reference:

CRC High byte value table： static char auchCRCHi[] = {0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80,

CRC Low byte value table： static char auchCRCLo[] = {0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7, 0x05, 0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E, 0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09, 0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9, 0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC, 0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3, 0x11, 0xD1, 0xD0, 0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32, 0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C, 0xFC, 0xFD, 0x3D, 0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38, 0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF, 0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26, 0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1, 0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4, 0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB, 0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA, 0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5, 0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0, 0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97, 0x55, 0x95, 0x94, 0x54, 0x9C, 0x5C, 0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E, 0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98, 0x88, 0x48, 0x49, 0x89, 0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C, 0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83, 0x41, 0x81, 0x80, 0x40};

CRC function calculation method:

1. preset 116-bit register as hexadecimal FFFF (i. e. all 1); call this register a CRC register;
2. Change the first 8-bit binary data (the first byte of the communication information frame) from the low 8-bit of the 16-bit CRC register and put the results on the CRC register;
3. Move the content of the CRC register to one right (low) to fill the highest bit with 0, and check the displacement after moving right;
4. If the shift is 0: repeat step 3 (right one again); if the displacement is 1: CRC register and

polynomial A001 (1010000000000000001);

5. Repeat steps 3 and 4 until moving right eight times so that the entire 8-bit data is processed;

6. Repeat steps 2 to steps 5 to process the next byte of the communication information frame;

7. After all the bytes of the communication information frame are calculated in the above steps, the high and low bytes of the resulting 16-bit CRC register are exchanged;

8. The final CRC register content is: CRC code.

CRC function routine: / / * pushMsgis the array pointer variable to be checked, and usDataLen is the number of data variable to be checked

```
void CRC16(char *pushMsg,unsigned short usDataLen) {

    char uchCRCHi=0xFF;          //High CRC bytes are initialized
    char uchCRCLo=0xFF;          //Low CRC bytes are initialized
                                                              1(

unsigned int uIndex;          //CRC Index in the loop
while(usDataLen--)            //CRC Check table check function
        {
uIndex=uchCRCHi^*pushMsg++;//calculate CRC
uchCRCHi=uchCRCLo^auchCRCHi[uIndex];
 uchCRCLo=auchCRCLo[uIndex];
      }
 *pushMsg++=uchCRCHi;         //Check data High in the back
  *pushMsg=uchCRCLo;          //Check data High in the back
}
```

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