



**PM Series
Integrated Sensor Module
Specification Sheet**

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1. Product Overview

The PM series is a comprehensive sensor module that integrates laser scattering sensors, temperature and humidity sensors, VOC sensors, CO2 sensors, and formaldehyde sensors. It is used to detect environmental parameters such as PM2.5, PM10, temperature, humidity, VOC, CO2, and formaldehyde. The external communication interface is a serial port (TTL).

Suitable for gas detectors, air conditioners, air quality detection systems, air purifiers, fresh air ventilation systems, smart homes, and other places.

2. Product Features

- ◆ Good linearity, low zero drift, excellent selectivity, high sensitivity;
- ◆ Long service life, low power consumption, and easy and quick connection to existing monitoring and control systems;
- ◆ Compact size, easy installation, low cost, convenient for customers' various applications;
- ◆ Highly adaptable, supports three communication formats, users can choose any format to use;

3. Specifications of integrated sensor module

Parameters		Numerical value	Unit
Measuring range		PM2.5, PM10, Temperature, Humidity	-----
Range	PM2.5	0~999	ug/m ³
	PM10	0~999	ug/m ³
	Temperature	-40~125	℃
	Humidity	0~100	%RH
	VOC	0-10000	ug/m ³
	CO2	400-5000	ppm
	HCHO	0-2000	ppb
Resolution	PM2.5	1	ug/m ³
	PM10	1	ug/m ³
	Temperature	0.01	℃
	Humidity	0.01	%RH
	VOC	1	ug/m ³
	CO2	1	ppm
	HCHO	1	ppb
Accuracy	PM2.5/PM10	± 10 (0~100)	ug/m ³
		± 10% (100~500)	-----
		± 15% (1>500)	-----
	Temperature	± 0.5 (<0 或 90~125)	℃
		± 0.3 (0~90)	℃
	Humidity	± 2.5 (0~90)	%RH
		± 3.5 (90~100)	%RH

warm-up time	≤3	min
Weight	60	g
Dimensions	71 * 62 * 16	mm

Table 1 Specifications of integrated sensors

4. Electrical specifications

Parameters	Value	Unit
Rated voltage	DC 5±0.3	V
Average current	120	mA
Maximum current	160	mA
Starting current	160	mA
Operating temperature	0~50	°C
Working humidity	0~95(Non-condensing)	%RH
Storage temperature	-20~60	°C
Storage humidity	0~60(Non-condensing)	%RH

Table 2 Electrical characteristics

5. Hardware Interface Definition

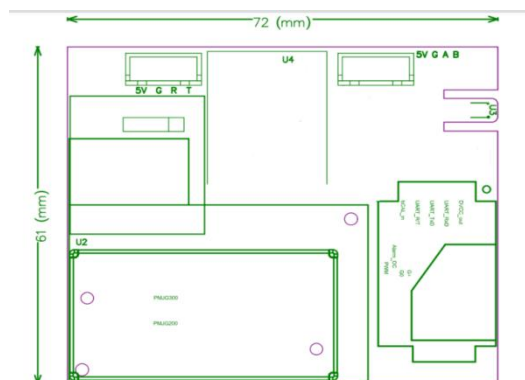


Figure 1 Hardware Interface

Pin	Name	Description	Note
1	5V	5V positive terminal	—
2	G	5V negative terminal	—
3	R	UART receive pin	3.3V
4	T	UART send pin	3.3V

Table 3 Hardware Interface Definitions

6. Communication protocol

UART parameters:

- baud rate: 9600
- data bit: 8
- check digit: None
- stop position: 1

Means of communication:

- TTL

Communication data format:

- Supports three communication data formats. Users can select the corresponding communication format based on their device. The factory default is the MODBUS protocol;
- Supports MODBUS protocol in any return mode;
- The communication protocol can be set to the return mode register via the MODBUS protocol (see example in 6.2.6.3);

6.1 Register

Restrictions:

1. Read-only registers and read-write registers are not allowed to overlap;
2. Bit addressing (coil and discrete inputs) cannot be implemented;
3. The total number of registers is limited. Currently, 32 input registers and 32 hold registers are supported;
4. The current version does not support the transfer of large files;
5. See Tables 4 and 5 for register details. All registers are 16-bit words, and the register address is the register number minus 1. Input registers, Table 4.

Data serial number	Address	Meaning	Explanation
IR1	0	retain	retain
IR2	1	PM2.5	0~999, ug/m ³
IR3	2	PM10	0~999, ug/m ³
IR4	3	temperature	-40~125℃; Data expanded 100 times
IR5	4	humidity	0~100%RH; Data expanded 100 times
IR6	5	VOC	0~10000; ug/m ³
IR7	6	CO2	0~4000; ppm
IR8	7	HCHO	0-2000; ppb
IR7	8	retain	retain
...	...	...	...
IR32	31	retain	retain

Table 4 Input registers

Keep the register, Table 5.

Data serial number	Address	Meaning	Explanation
IR1	0	device address	1-247
IR2	1	return address	Default communication protocol for integrated sensor modules 0: MODBUS agreement 1: Protocol 1 mode 2: Protocol 2 mode
IR3	2	retain	retain
...	...	...	...
IR32	31	retain	retain

Table 5 Retain Registers

6.2 MODBUS Communication protocol format

When the comprehensive sensor feedback mode is set to 0, the device defaults to this communication protocol format. The MODBUS protocol is used to read the corresponding parameter values of the module or to set the module's default feedback mode.

6.2.1 Agreement Description

The MODBUS protocol consists of four parts: address field, function code, data, and error check. The address field is used to indicate the address of the device receiving this signal; the function code is used to indicate that the device should perform a certain operation; the data has a different structure depending on the function code.

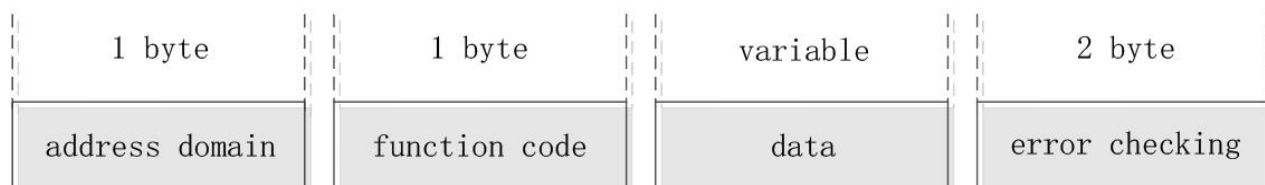


Figure 2 MODBUS Protocol Data Format

6.2.2 Address domain

The default factory address for the integrated sensor module is 0x01. To modify the device address, use the MODBUS protocol to write to the IR1 register.

Address	MODBUS	Integrated sensor module
0	Broadcast	Not supported at this time
1-247	Machine address	Factory default 1
248-255	Retain	Retain

Table 6 Address Domain Description

6.2.3 Function code

This device supports three MODBUS function codes, as shown in Table 7:

Function code	Function description	Corresponding function
0x03	Read hold register	Used to read back mode
0x04	Read input register	Used to read detection parameter values
0x06	Write a single hold register	Used to set the module feedback mode.

Table 7 Function Code Description

6.2.4 Data

The format of the data field varies depending on the function code. The protocol uses big-endian byte order. For the specific format, see Figure 3:

	1 byte	1 byte	variable	2 byte
	address domain	function code	data	error checking
Read hold register request	address domain	0X03	2 byte starting address	2 byte Number of reads N error checking
Read hold register response	address domain	0X03	1 byte Read byte count (2N)	2 byte*N Enter register value error checking
Read input register request	address domain	0X04	2 byte starting address	2 byte Number of reads N error checking
Read input register response	address domain	0X04	1 byte Read byte count (2N)	2 byte*N Enter register value error checking
Write a single hold register request	address domain	0X06	2 byte register address	2 byte Corresponding register value error checking
Write single hold register response	address domain	0X06	2 byte register address	2 byte Corresponding register value error checking

Figure 3 MODBUS Data Field Data Format

6.2.5 Error checking

MODBUS RTU dedicated CRC16 check method. Low byte first, high byte second.

6.2.6 Example

6.2.6.1 Read a single test parameter value

Example:

The default device address for the integrated sensor module is 1.

(1) Read PM2.5 parameter values

PM2.5 concentration is 0x2D (actual value is 45ug/m³)

Send	0x01 0x04 0x00 0x01 0x00 0x01 0x60 0x0a
Response	0x01 0x04 0x02 0x00 0x2d 0x79 0x2d

(2) Read PM10 parameter values

(3) PM10 concentration is 0x2D (actual value is 45ug/m³)

Send	0x01 0x04 0x00 0x02 0x00 0x01 0 0x90 0x0a
Response	0x01 0x04 0x02 0x00 0x2d 0x79 0x2d

(4) Read temperature parameter values

The temperature is 0x09CA (actual value is 25.06° C).

Send	0x01 0x04 0x00 0x03 0x00 0x01 0xc1 0xca
Response	0x01 0x04 0x02 0x09 0xca 0x3f 0x37

(5) Read humidity parameter values

Humidity is 0x1450 (actual value is 52.00% RH)

Send	0x01 0x04 0x00 0x04 0x00 0x01 0x70 0x0b
Response	0x01 0x04 0x02 0x14 0x50 0xb6 0x0c

(6) Read VOC parameter values

VOC value is 0x00c8 (actual value is 200)

Send	0x01 0x04 0x00 0x05 0x00 0x01 0x21 0xcb
Response	0x01 0x04 0x02 0x00 0xc8 0xb8 0xa6

(7) Read CO2 parameter values

CO2 concentration is 0x072C (actual value is 1836 ppm)

Send	0x01 0x04 0x00 0x06 0x00 0x01 0xd1 0xcb
Response	0x01 0x04 0x02 0x07 0x2c 0xba 0xdd

(8) Read the formaldehyde parameter value

Formaldehyde value is 0x40 (actual value is 64 ppb)

Send	0x01 0x04 0x00 0x07 0x00 0x01 0x80 0x0b
Response	0x01 0x04 0x02 0x00 0x40 0xb8 0xc0

6.2.6.2 Read multiple detection parameter values

Example:

The default device address for the integrated sensor module is 1.

PM2.5 concentration is 0x08 (actual value is 8 ug/m3)

PM10 concentration is 0x09 (actual value is 9 ug/m3)

The temperature is 0x09CA (actual value is 25.06° C)

Humidity is 0x1450 (actual value is 52.00% RH)

VOC is 0x00c8 (actual value is 200 ug/m3)

CO2 concentration is 0x072C (actual value is 1836 ppm)

Formaldehyde value is 0x40 (actual value is 64 ppb)

Send	0x01 0x04 0x00 0x01 0x00 0x07 0xe0 0x08
Response	0x01 0x04 0x0e 0x00 0x08 0x00 0x09 0x09 0xca 0x14 0x50 0x00 0xc8 0x07 0x2c 0x00 0x40 0x12 0x1e

6.2.6.3 Read-back mode

Example:

The default device address for the integrated sensor module is 1.

The return mode is 0x01 (communication protocol is protocol 1).

Send	0x01 0x03 0x00 0x01 0x00 0x01 0xd5 0xca
Response	0x01 0x03 0x02 0x00 0x01 0x79 0x84

6.2.6.4 Set module feedback mode

Example:

Set the default communication format of the integrated sensor module to Protocol 1.

Send	0x01 0x06 0x00 0x01 0x00 0x01 0x19 0xca
Response	0x01 0x06 0x00 0x01 0x00 0x01 0x19 0xca

6.3 Protocol 1 Communication Protocol Format

When the comprehensive sensor feedback mode is set to 1, the device defaults to this communication protocol format. In this mode, serial port 1 automatically uploads data at a 1-second interval.

6.3.1 Agreement Description

Protocol 1 is structured as shown in Figure 4 and includes the following fields: frame header, CO2 data, formaldehyde data, VOC data, PM2.5 data, PM10 data, temperature data, humidity data, and checksum. For detailed specifications, see Table8.

1 byte	1 byte	2 byte	2 byte	2 byte	2 byte	2 byte	1 byte	1 byte	1 byte	1 byte	1 byte
Frame header 0x3C	Frame header 0x02	CO2	HCHO	VOC	PM2.5	PM10	Integer part of temperature	Temperature decimal part	Humidity integer part	Humidity integer part	Checksum

Figure 4 Protocol 1 Data Format

Field	Length (bytes)	Explanation
frame header	2	0x3C 0x02
CO2	2	0~4000; ppm
HCHO	2	0~2000; ppb
VOC	2	Unit: ug/m3, big-endian byte order
PM2.5	2	PM2.5 mass concentration, unit ug/m3, big-endian byte order
PM10	2	PM10 mass concentration, unit ug/m3, big-endian byte order
integer part of temperature	1	The integer part of the temperature is in degrees Celsius, and the most significant bit is the sign bit for the data. For example, 0x9B represents an integer part of -27° C.
temperature decimal part	1	Humidity decimal part, multiplied by 100
Humidity integer	1	Humidity integer part, unit %RH

part		
Humidity decimal part	1	Humidity decimal part, multiplied by 100
checksum	1	First 16 bytes and lower 8 bits

Table 8 Protocol 1 Field Descriptions

6.3.2 Example

CO2 concentration is 0x072C (actual value is 1836 ppm)

Formaldehyde concentration is 0x00E0 (actual value is 224 ppb)

PM2.5 concentration is 0x0C (actual value is 38ug/m³)

PM10 concentration is 0x11 (actual value is 64 ug/m³)

The temperature is 0x1C41 (actual value is 28.65°C)

Humidity is 0x3A3D (actual value is 58.61% RH)

VOC is 0x0000 (actual value is 0 ug/m³)

proactive reporting	0x3C 0x02 0x07 0x2C 0x00 0xE0 0x00 0x00 0x00 0x0C 0x00 0x11 0x1C 0x41 0x3A 0x3D 0x42
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6.4 Protocol 2 Communication Protocol Format

When the comprehensive sensor feedback mode is set to 2, the device defaults to this communication protocol format. In this mode, once a query command is sent and a response is received, the device will upload data once per second. There is no need to resend the query command before powering off and restarting the device.

6.4.1 Agreement Description

The data format of Protocol 2 is shown in Figure 5, which includes a frame header, length, command number, data, and checksum fields. For detailed explanations, see Table 9.



Figure 5 Protocol 2 Data Format

Field	Length (bytes)	Explanation
Frame header	1	Send request: 0x11 Response: 0x16
Length	1	Does not include frame header (frame length - 1)
Command number	1	Function Name 0x01: Read Measurement Results
Data	Variable	See Figure 6.
checksum	1	(Take the inverse (byte 1 + byte 2 + byte 3 + ... + byte n)) + 1

Table 9 Protocol 2 Field Descriptions

6.4.2 Data

The data format varies depending on the sender, as shown in Figure 6. The request content is fixed, and the response contains parameter data, as specified in Table 10.

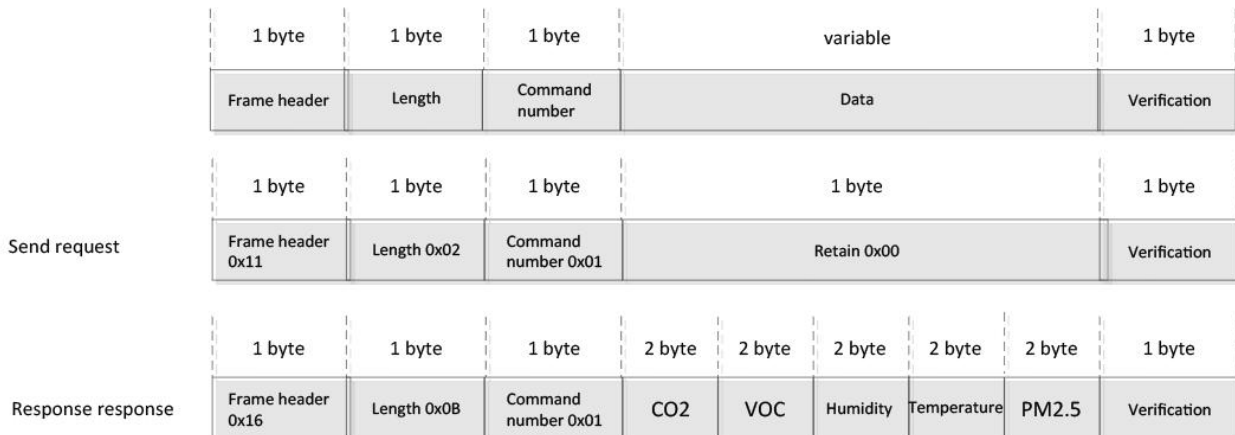


Figure 6 Protocol 2 Data Field Format

Field	Length (bytes)	Explanation
CO2	2	0 to 4000; unit ppm
VOC	2	Pollution level, 0-100, big-endian byte order
Humidity	2	Humidity, big-endian byte order, multiplied by 10, unit %RH
Temperature	2	Big-endian byte order, unit ° C, actual value = (corresponding value - 500) / 10, i.e. the actual value corresponding to 0 ° C is 500.
PM2.5	2	PM2.5 mass concentration, big-endian byte order, unit ug/m3

Table 10 Response Field Descriptions

6.4.3 Example

Read measurement results

CO2 concentration is 0x072F (actual value is 1839ppm)

PM2.5 concentration is 0x0C (actual value is 12 ug/m³)

The temperature is 0x0312 (actual value is 28.6°C)

Humidity is 0x0248 (actual value is 58.4% RH)

VOC is 0x0 (actual value is 0 ug/m³)

Send	0x11 0x02 0x01 0x00 0xec
Response	0x16 0x0B 0x01 0x07 0x2F 0x00 0x00 0x02 0x48 0x03 0x12 0x00 0x0C 0x5F

7. Product dimension diagram

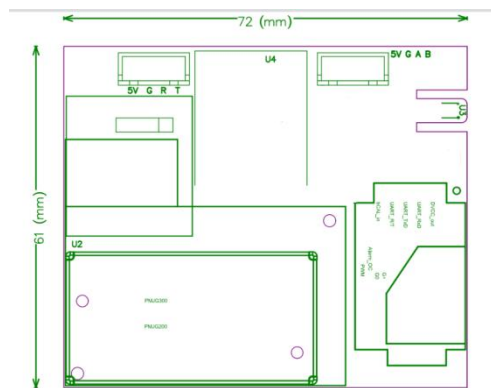


Figure 7 Dimensions of the integrated sensor module

8. Installation and usage precautions

8.1 Important notes

- 1) This product is manufactured for use with household appliances. Do not use it for medical, mining, disaster prevention, or other applications that require high safety and reliability.
- 2) This product uses metal and other non-static adsorption materials to avoid working in harsh environments with large amounts of dust. After using the sensor, it is recommended to close the sampling port.
- 3) The metal parts of this product's casing are connected to the DC ground of the internal circuit board. If a person directly touches the DC ground of the entire device, it could pose a safety hazard. Therefore, the sensor must be installed in a location that cannot be directly touched by humans, and it can only be touched after the power has been turned off.

8.2 Installation method

When installing and using this product in a system, ensure that the air inlets and outlets are unobstructed and that there is no strong airflow directly facing the air inlets and outlets. In addition, two sides of the product (as shown in Figure 8) must not be placed facing downwards during installation to prevent dust from accumulating on the surface of sensitive components over extended periods of use, which could affect the accuracy of sensor testing.

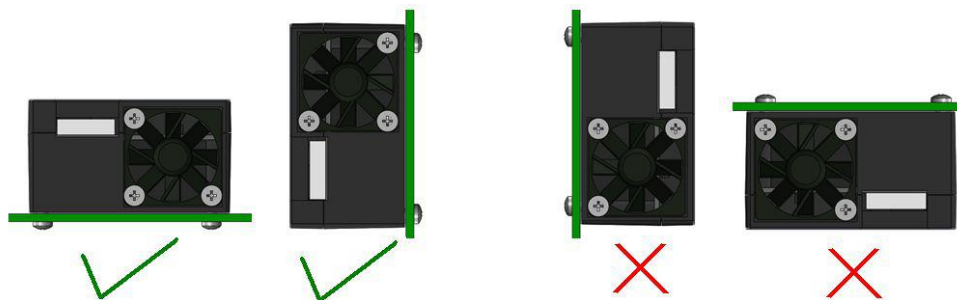


Figure 8 Installation diagram

Temtop, U.S.:

Address: 2528 Qume Dr, Ste 2 San Jose, CA 95131 USA

Sales: sales@temtopus.com Tel: (+1) 408-898-2866

Website: www.temtopus.com

Temtop, Shanghai:

Address: 555 Pudong Avenue, Pudong New Area, Shanghai

Sales: sales@temtopus.com.cn Tel: (+86)400-996-0916