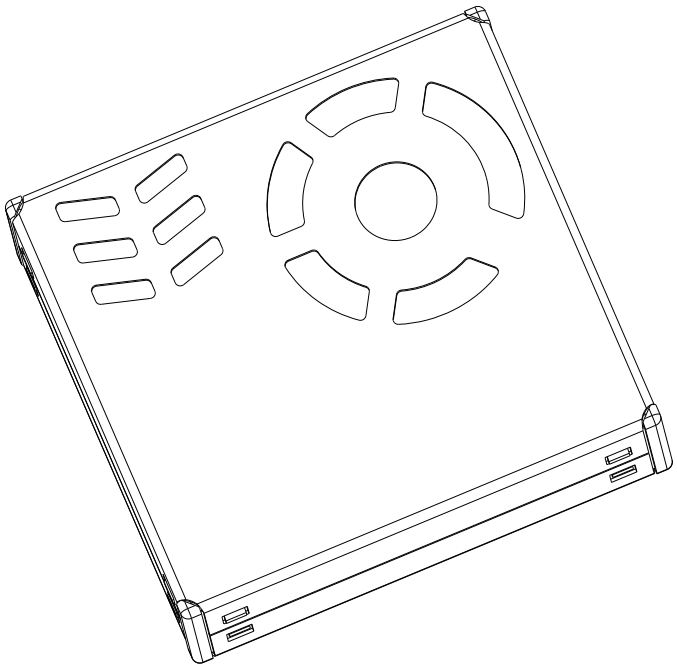
MPM10 series

Laser Particulate Matter Sensor



Product Datasheet

SPECIFICATION

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MPM10 series

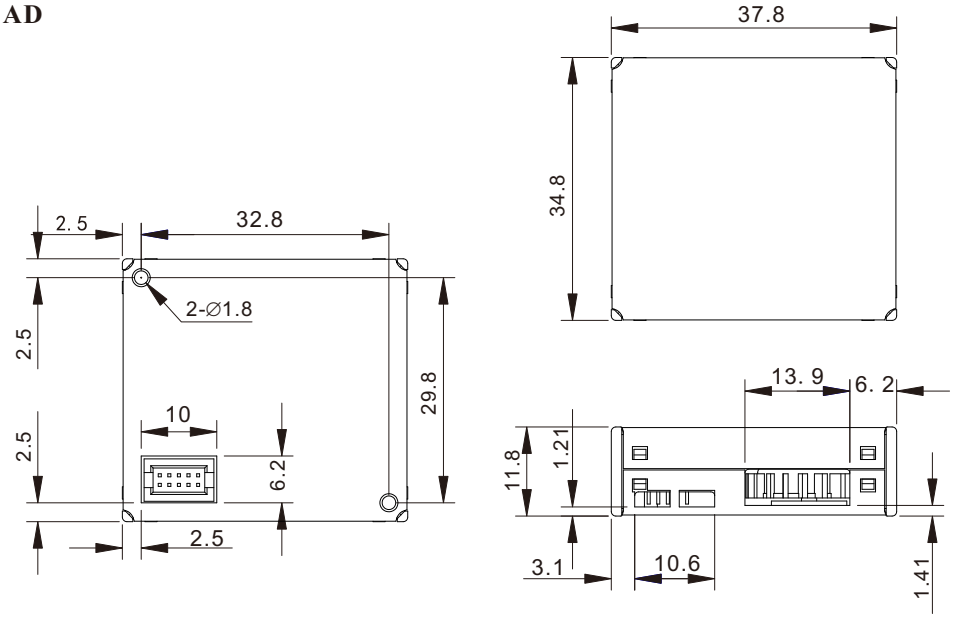
Laser Particulate Matter Sensor

◆ Product appearance

		
MPM10-AD	MPM10-BD	MPM10-CD
		
MPM10-AS	MPM10-BS	MPM10-CS

◆ Product size

MPM10-AD



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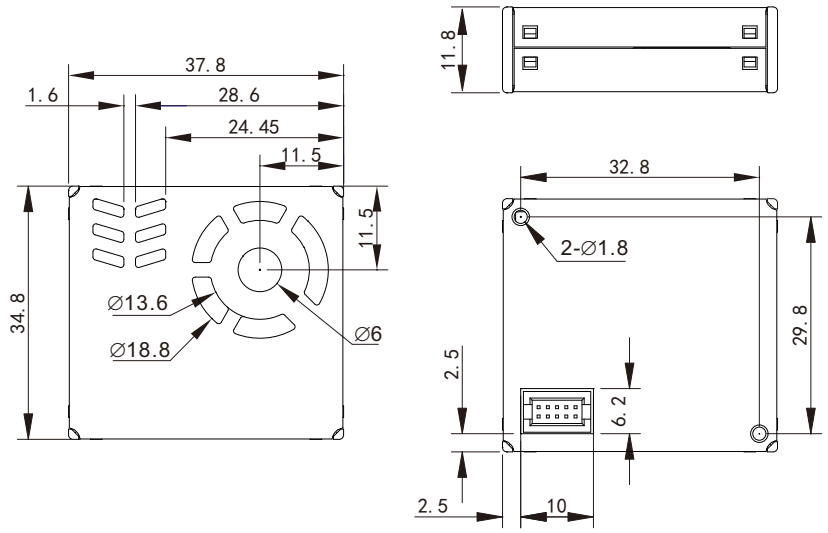
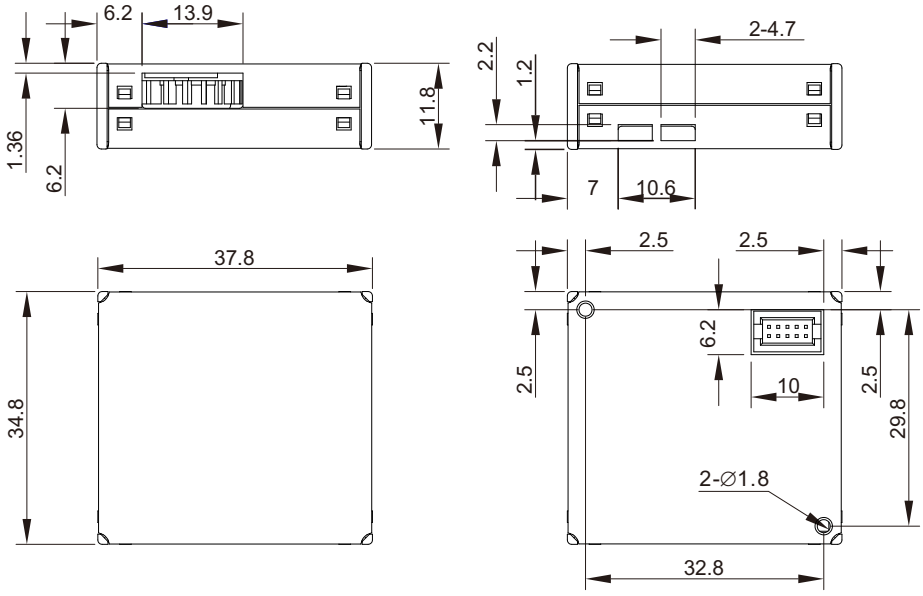
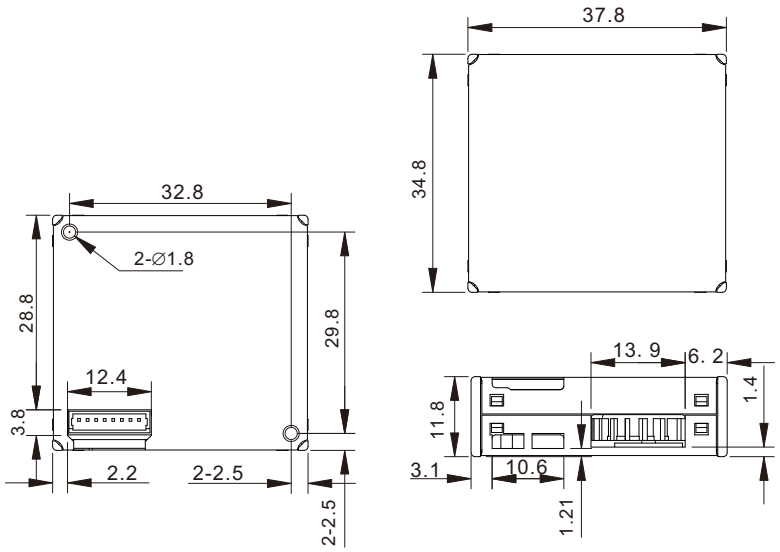
MPM10-BD



MPM10-CD



MPM10-AS



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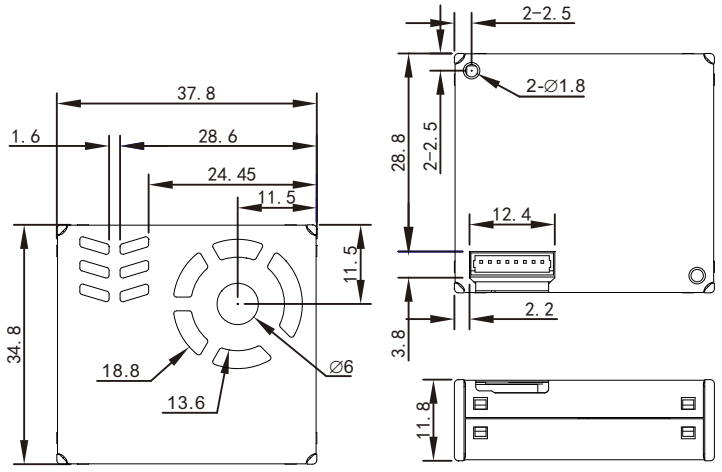
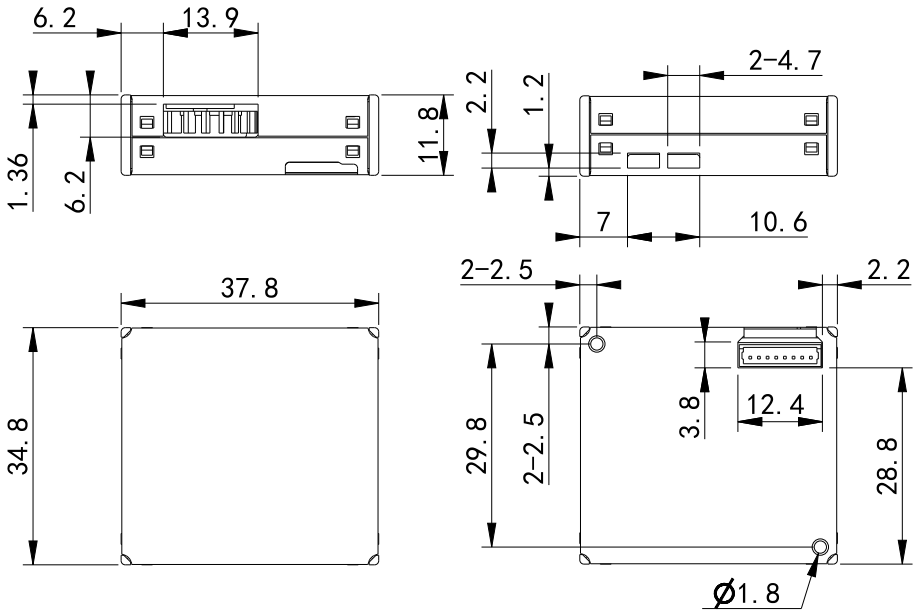
Laser Particulate Matter Sensor

MPM10-BS



MPM10-CS



◆ Product parameters

Parameters	Indexes	Unit
Particulate matter detection category	PM1.0, PM2.5, PM10	
Particle size range of particulate matter	0.3-10	um
Mass concentration range of particulate matter (PM2.5 standard value)	0~1000	μg/m^3
Resolution ratio of mass concentration of particulate matter	1	μg/m^3
Mass concentration consistency of particulate matter (PM2.5 standard value) * note	±10%(@100 ~ 500μg/m3) ±10μg/m3 (@ 0 ~100μg/m3)	
Single response time	≤1	s

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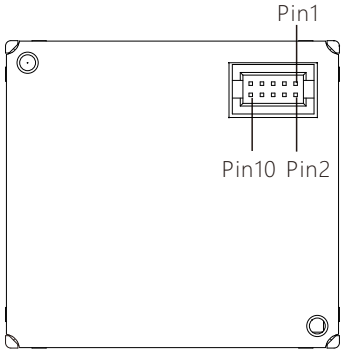
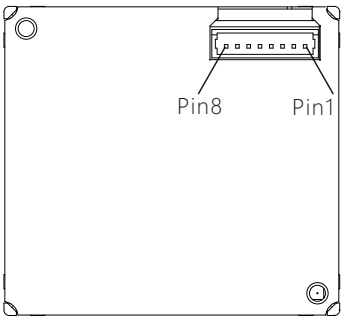
Comprehensive response time	≤10	s
DC supply voltage	5.0	V
Working current	≤85	mA
Standby current	≤45	μA
Output mode	UART / IIC / PWM	
Storage temperature	-30~+70	℃
Operating temperature range	-10~+60	℃
Operating humidity range	0-95% RH (without condensation)	
Mean free error time	≥3	Y
Boundary dimension	37 . 8*34 . 8*11.8mm(L×W×H)	mm

Notes: Concentration consistency data of particulate matter are the data 2 in communication protocol (test condition: 25±2℃ and 50±10%RH).

◆ Pin icon



MPM10-AD / MPM10-BD / MPM10-CD



MPM10-AS / MPM10-BS / MPM10-CS

Pin No. MPM10-AD MPM10-BD MPM10-CD	Pin No. MPM10-AS MPM10-BS MPM10-CS	Pin name definition	Pin function description	Electrical characteristics of pin
Pin 1	Pin 1	VCC	Power supply positive (+5V)	No reverse connection protection
Pin 2	–	VCC	Power supply negative (+5V)	
Pin 3	Pin 2	GND	Power supply negative	No reverse connection protection
Pin 4	–	GND	Power supply negative	
Pin 5	Pin 6	Reset	Module resetting signal input pin Low-level resetting; Suspension in case of non-use	TTL electrical level @3.3V; Input pin, equipped with internal pull-up resistor
Pin6	Pin8	N/C	This pin suspends in midair	
Pin7	Pin4	RXD/SDA	The RX of module UART interface or the SDA of IIC interface often connects to the TX of UART interface of customer MCU or the SDA of IIC interface.	TTL electrical level @3.3V It is necessary to connect pull-up resistor in case of IIC function.

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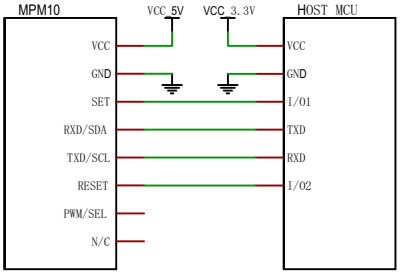
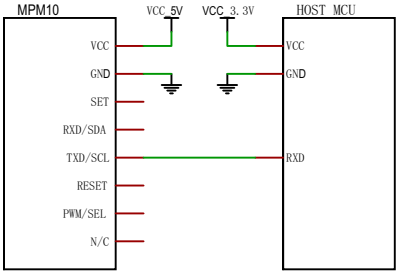
Pin 8	Pin 7	PWM/SEL	PWM output pin (effective for low level) is also the selection pin of UART or IIC communication interface. The module detects the level status of the pin within 1 second after power-on: The status is high level (pin connects the pull-up resistor or hangs in midair): The pin is used as the PWM signal output pin, and the UART interface function (IIC interface is not available) of RXD/SDA and TXD/SCL pins are enabled. The status is low level (pin connects GND): This pin doesn't have the PWM output function, and the IIC interface function (UART interface is not available) of RXD/SDA and TXD/SCL pins are enabled.	TTL electrical level @3.3V; Push-pull output mode in case of PWM output pin
Pin 9	Pin5	TXD/SCL	The TX of module UART interface or the SCL of IIC interface often connects to the RX of UART interface of customer MCU or the SCL of IIC interface.	TTL electrical level @3.3V; It is necessary to connect pull-up resistor in case of IIC function.
Pin 10	Pin3	SET	Module is set to work normally or to be dormant. High level or suspension: Module works normally, with low level: Module is dormant	TTL electrical level @3.3V; Input pin, equipped with internal pull-up resistor

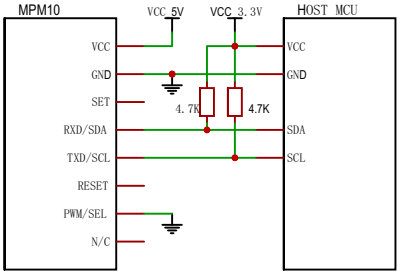
◆ Electric circuit connection



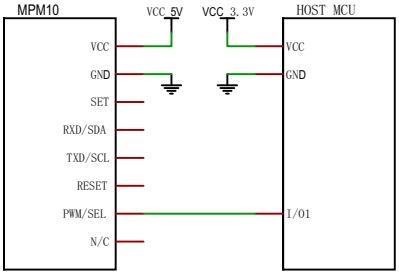
Typical circuit connection of UART



The simplest circuit connection of UART



Electrical connection of IIC interface



Electrical connection of PWM output

Circuit design and application notes:

1. Module's power supply voltage is 5V, and the data communication and control pin adopt 3.3V as high level. Therefore, the mainboard MCU connecting to it for communication shall be 3.3V power supply. If the mainboard MCU is 5Vpower supply, the level conversion chip or electric circuit shall be added to the communication line (RXD/SDA and TXD/SCL) and control line (SET and RESET).
2. There is pull-up resistor in SET and RESET. It shall suspend in midair in case of non-use.
3. The following aspects shall be noted upon application of dormancy function: Fan stops running upon dormancy, and restarts needs after 30 seconds for stabilization. Therefore, to obtain accurate date, the module's working hour shall not be lower than 30 seconds after dormancy rouses.

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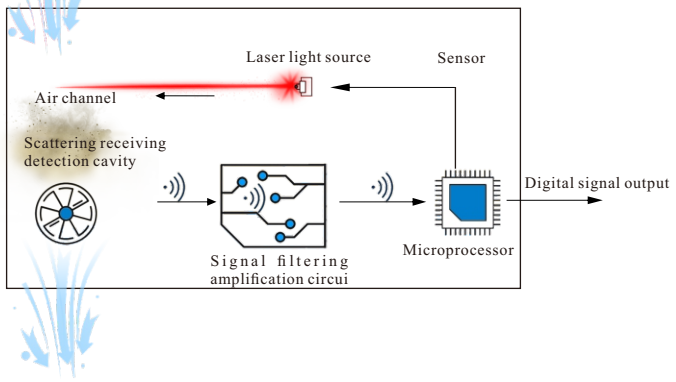
Operating principle

As per the laser scattering principle, the laser beam generates scattering when irradiating on the suspended particulate matters in the air. The laser's photoelectric receiver is put at certain specific location to collect the scattered light, then the curve about the change of scattered light intensity with time is obtained. The electrical signal of acceptor is collected in real time through micro programming. The equivalent grain size of particulate matter and the quantity of particulate matters with different particle sizes in unit volume. Functional block diagram of sensor is shown in the following figure.



Communication protocol

Serial port communication:

Serial port setting	Baud rate	Data bit	Stop bit	Parity bit	Interface level
	9600bps	8 bit	1 bit	None	3.3V

The serial port output of module is divided into the automatic output mode and passive output mode. The module is defaulted as automatic output mode after power-on, that is, the module proactively sends the serial data to the host (data format is shown in Table 3), with the sending interval of 1 second. The host MCU can send directive so that module transforms into the passive output mode. For the passive output, the host MCU sends the query directive, and responds to and outputs data one time after query of module one time.

Table 3. Format of Module Serial Port Output Data (32 Bytes):

S/N	Field	Value	Description
1	Frame header byte 1	0x42	(fixed value)
2	Frame header byte 2	0x4d	(fixed value)
3	Frame length high byte	**	Frame length
4	Frame length low byte	**	
5	High byte of data 1	**	PM1.0 concentration value (standard particulate matter), unit: μg/m^3*
6	Low byte of data 1	**	
7	High byte of data 2	**	PM2.5 concentration value (standard particulate matter), unit: μg/m^3*
8	Low byte of data 2	**	
9	High byte of data 3	**	Pm10 concentration value (standard particulate matter), unit: μg/m^3*
10	Low byte of data 3	**	
11	High byte of data 4	**	PM1.0 concentration value (atmospheric environment), unit: μg/m^3*
12	Low byte of data 4	**	
13	High byte of data 5	**	PM2.5 concentration value (atmospheric environment), unit: μg/m^3*
14	Low byte of data 5	**	
15	High byte of data 6	**	Pm10 concentration value (atmospheric environment), unit: μg/m^3*
16	Low byte of data 6	**	

17	High byte of data 7	**	The number of particulate matters with diameter of over 0.3um in 0.1L air
18	Low byte of data 7	**	
19	High byte of data 8	**	The number of particulate matters with diameter of over 0.1um in 0.5L air
20	Low byte of data 8	**	
21	High byte of data 9	**	The number of particulate matters with diameter of over 0.1um in 1.0L air
22	Low byte of data 9	**	
23	High byte of data 10	**	The number of particulate matters with diameter of over 0.1um in 2.5L air
24	Low byte of data 10	**	
25	High byte of data 11	**	The number of particulate matters with diameter of over 0.1um in 5.0L air
26	Low byte of data 11	**	
27	High byte of data 12	**	The number of particulate matters with diameter of over 0.1um in 10um air
28	Low byte of data 12	**	
29	High byte of data 13	**	Reserved
30	Low byte of data 13	**	Reserved
31	Data and check of high byte	**	Check code = frame header byte 1+ frame header byte 2+……+ low byte of data 13
32	Data and check of low byte	**	

Notes: The mass concentration value of standard particulate matter refers to the mass concentration value obtained through density conversion of industrial metal particles as equivalent particles, and is suitable for the industrial production workshop, etc. The mass concentration value of particulate matter in atmospheric environment is based on the density conversion of main pollutants in air as equivalent particles, and is suitable for common outdoor and indoor atmospheric environment.

Communication directive format:

Frame header byte 1	Frame header byte 2	Directive byte	Data byte 1	Data byte 2	Check byte 1	Check byte 2
0x42	0x4d	CMD	DATAH	DATAL	SUMH	SUML

The check byte is the sum of all bytes by starting from frame header byte.

Definition of directives sent by host and data byte:

CMD	DATAH	DATAL	Description
0xE2	X	X	The host sends the directive to read the module data upon passive output mode. The format of module output data is shown in table 3.
0xE1	X	0x00	Module switches to the passive output mode.
		0x01	Module switches to the automatic output mode.
0xE4	X	00H	Module enters the standby mode.
		01H	Module enters the normal working mode.

The x indicates any numeral value

Application example of serial port communication:

1. Switch to the passive mode directive:

Host sends: 42 4D E1 00 00 01 70

Module response: No response; Module switches to passive output mode, and doesn't automatically output number.

2. Passive reading directive:

Host sends: 42 4D E2 00 00 01 71

Module response: 42 4D 00 1C 00 26 00 38 00 44 00 1C 00 2A 00 36 1E 1F 05 B2 01 3D 00 2D 00 11 00 0A 00 00 03 43

Response data converts to the measured value:

PM1 .0 measured value is: PM1 .0 = 0x00 * 256 + 0x1C = 28(ug/m^3)

PM2 . 5 measured value is: PM2 . 5 = 0x00 * 256 + 0x2A = 42(ug/m^3)

PM10 measured value is: PM10 = 0x00 * 256 + 0x36 = 54(ug/m^3)

3. Switch to the standby mode directive:

Host sends: 42 4D E4 00 00 01 73

Module response: No response; Module enters the standby mode.

◆ IIC communication protocol

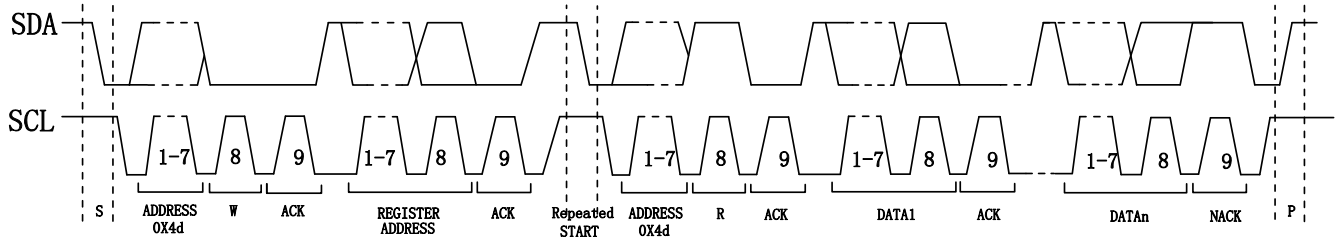
Module works in the slave mode of IIC and can connect the external MCU. The communication line shall connect the pull-up resistor.

Slave address of module component is: 0x4d (7-bit address)

Writing operation address of module is: 0x9a

Reading operation address of module is: 0x9b

When the MPM10 - BD register data are read through IIC interface, the communication temporal waveform is shown in the following figure:



Host sends the time series:

1: Host sends the IIC inception signal.

2: Send the module device address 0x4d(7 bits)+W(writing).

3: Send module data register address (send the address of register where reading starts).

4: Send repeated IIC inception signal (notes: there is no stop signal).

5: Send the module device address 0x4d(7 bits)+R(reading).

6: Host receives the data n byte output by module (host shall send the ACK signal bit to module when receiving data. If host doesn't send the ACK signal bit, the module stops data transmission).

7: Host sends the IIC stop signal.

IIC register address and data format

Register address	Data	Description
0x20	High byte of data 1	PM1.0 concentration value (standard particulate matter), unit: μg/m^3*
0x21	Low byte of data 1	
0x22	High byte of data 2	PM2.5 concentration value (standard particulate matter), unit: μg/m^3*
0x23	Low byte of data 2	
0x24	High byte of data 3	Pm10 concentration value (standard particulate matter), unit: μg/m^3*
0x25	Low byte of data 3	

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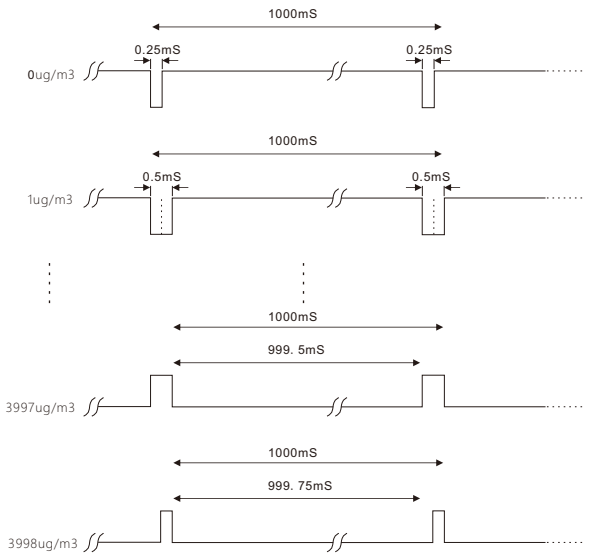
0x26	High byte of data 4	PM1.0 concentration value (atmospheric environment), unit: μg/m^3*
0x27	Low byte of data 4	
0x28	High byte of data 5	PM2.5 concentration value (atmospheric environment), unit: μg/m^3*
0x29	Low byte of data 5	
0x2A	High byte of data 6	Pm10 concentration value (atmospheric environment), unit: μg/m^3*
0x2B	Low byte of data 6	
0x2C	High byte of data 7	The number of particulate matters with diameter of over 0.1um in 0.3L air
0x2D	Low byte of data 7	
0x2E	High byte of data 8	The number of particulate matters with diameter of over 0.1um in 0.5L air
0x2F	Low byte of data 8	
0x30	High byte of data 9	The number of particulate matters with diameter of over 0.1um in 1.0L air
0x31	Low byte of data 9	
0x32	High byte of data 10	The number of particulate matters with diameter of over 0.1um in 2.5L air
0x33	Low byte of data 10	
0x34	High byte of data 11	The number of particulate matters with diameter of over 0.1um in 5.0L air
0x35	Low byte of data 11	
0x36	High byte of data 12	The number of particulate matters with diameter of over 0.1um in 10um air
0x37	Low byte of data 12	

*Note: The mass concentration value of standard particulate matter in the table refers to the mass concentration value obtained through density conversion of industrial metal particles as equivalent particles, and is suitable for the industrial production workshop, etc. The mass concentration value of particulate matter in atmospheric environment is based on the density conversion of main pollutants in air as equivalent particles, and is suitable for common outdoor and indoor atmospheric environment.

◆ PWM output mode

PWM's cycle is 1000ms
Low-level output of 0.25ms at initial period
Middle cycle: 999.5ms
High-level output of 0.25ms at end period
Calculation formula of obtaining current PM2.5 concentration value through PWM:
PM2.5 = 4000 * (TL -0 .25ms)/(TH+TL)
PM2.5 is the PM2.5 mass concentration value obtained through calculation, with unit of ug/m^3.
TH refers to the high-level output time in output cycle.
TH refers to the low-level output time in output cycle.



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Mounting precautions

1. Module metal shell has conduction with the internal power ground. It shall be noted to avoid short connection to other circuits or case shell.
2. The plane of air inlet and air outlet sticks close to the inner wall of user receiver and connects to the external air hole, which is deemed as the optimal mounting method. In case of failing to achieve that, there is no shield within 2cm range around the air outlet. There shall be structure between air inlet and air outlet to isolate airflow and avoid the airflow directly backflowing to the air inlet from air outlet in the user receiver.
3. The air vent opened on inner wall of user receiver for air inlet shall be no less than that size of air inlet.
4. If the module is applied in the purifier product, it is necessary to avoid directly putting module in own air duct of purifier as far as possible. Otherwise, an independent structure space shall be set separately, and the module is put in it so that it can separate from its own air duct of purifier.
5. If the module is applied in the purifier or fixed detection equipment, its position shall be over 20cm above ground. Otherwise, the module may be polluted by the large dust particle close to the ground and even floccule, causing the fan is twined.
6. If the module is applied in the outdoor fixed equipment, the equipment shall be responsible for protecting it in sandstorm, rain, snow, willows catkin, etc.
7. The module is a whole element. Users can't dismantle it, including the metal shielding shell to prevent irreversible damage.

Version history

Date	Version	Changes
2022.3.28	1.00	Initial version