Infrared CO2 Sensor Module

(Model: MH-Z19B)

User's Manual

(Version: 1.4)

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Zhengzhou Winsen Electronics Technology Co., Ltd

ISO9001 certificated company

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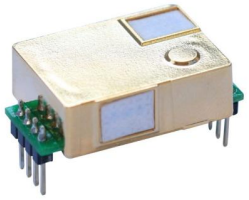
Zhengzhou Winsen Electronics Technology CO., LTD.

MH-Z19B NDIR CO2 Module

1. Profile



MH-Z19B NDIR infrared gas module is a common type, small size sensor, using non-dispersive infrared (NDIR) principle to detect the existence of CO 2 in the air, with good selectivity, non-oxygen dependent and long life. Built-in temperature compensation; and it has UART output and PWM output. It is developed by the tight integration of mature infrared absorbing gas detection technology, precision optical circuit design and superior circuit design.

2. Applications

*HVAC refrigeration *Air cleaner device *Indoor air quality monitoring

*Smart home *Ventilation system *School

3. Main Features

Chamber is gold plated, water-proof and anti-corrosion

High sensitivity, low power consumption

Good stability

Temperature compensation, excellent linear output

Multiple output modes: UART, DAC, PWM

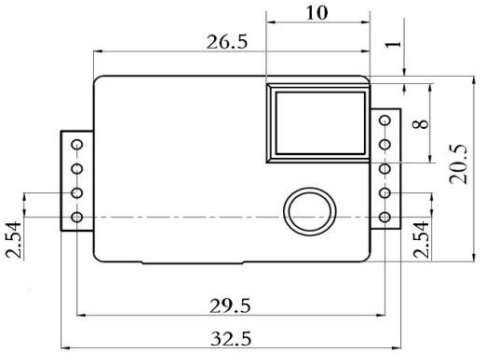
Long lifespan

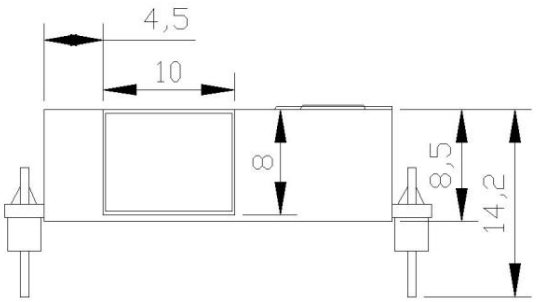
Anti-water vapor interference, anti-poisoning

4. Structure

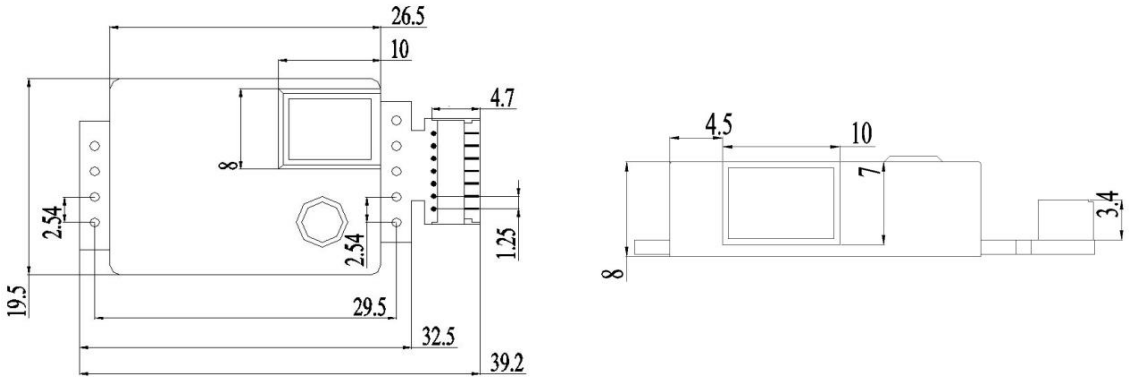
A. Pins connection type:

Unit: mm

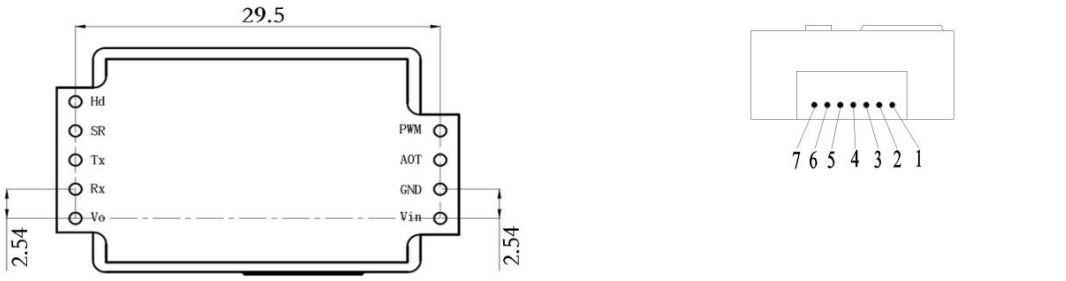




B. Terminal connection type:



Pins definition:



Pin version **Terminal connection version**

Pin	Pin Definition
Vin (Pin4)	Positive pole of power (Vin)
GND (Pin3)	Negative pole of power (GND)
Vo (Pin2)	Analog output(0.4～2 V) (0~3V range could be customized)
PWM (Pin7)	PWM
HD (Pin1)	HD(zero point calibration, low level lasting for over 7s is effective)
Rx (Pin5)	UART(RXD)TTL Level data input
Tx (Pin6)	UART(TXD)TTL Level data output

Pin	Terminal pin Definition
Pin 1	Anolog Output Vo
Pin 2	None
Pin 3	Negtive Pole(GND)
Pin 4	Positive Pole(Vin)
Pin 5	UART(RXD)TTL Level data input
Pin 6	UART(TXD)TTL Level data output
Pin 7	None

Note: The analog output Vo has a default output range of 0.4V to 2V. It is configurable from 0V to 3V.

5. Detection range and accuracy

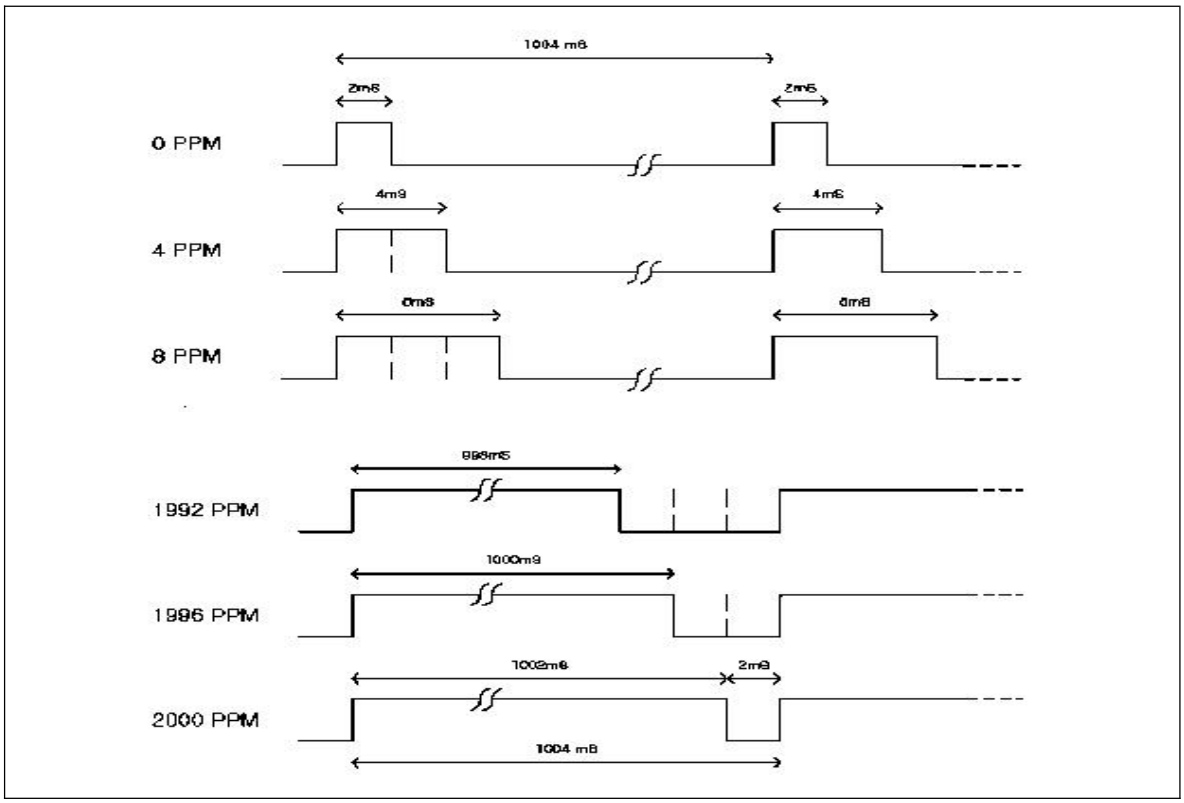
Detection Gas	Formula	Detection Range	Accuracy
Carbon Dioxide	CO2	0~2000ppm	± (50ppm+5% reading value)
		0~5000ppm	
		0~10000ppm	

6. Main parameters

Model No.	MH-Z19B
Detection Gas	CO2
Working voltage	4.5 ~ 5.5 V DC
Average current	< 20mA (@5V power supply)
Peak current	150mA (@5V power supply)
Interface level	3.3 V (Compatible with 5V)
Detection Range	Please refer to Part5.
Output signal	Serial Port (UART) (TTL level 3.3V)
	PWM
	Analog output(DAC) (default 0.4~2V) (0~3V range could be customized)
Preheat time	3 min
Response Time	T_{90} < 120 s
Working temperature	-10 ~ 50 ℃
Working humidity	0 ~ 90% RH (No condensation)
Weight	5 g
Lifespan	> 5 years

7. Output

PWM output	
Take 0~2000ppm for example	
CO2 output range	0~2000ppm
Cycle	1004ms±5%
Cycle start high level output	2ms(theoretical value)
The middle cycle	1000ms±5%
cycle end low level output	2ms(theoretical value)
CO2 concentration: Cppm=2000×(TH-2ms)/(TH+TL-4ms)	
C_{ppm}: CO2 concentration could be calculated by PWM output TH high level output time during cycle TL low level output time during cycle	



Serial port output (UART)

Hardware connection

Connect module's Vin-GND-RXD-TXD to users' 5V-GND-TXD-RXD.

(Users must use TTL level. If RS232 level, it must be converted.)

Software setting

Set serial port baud rate be 9600, data bit 8 bytes, stop bit 1byte, parity bit null.

Commands	
0x86	Read CO2 concentration
0x87	Calibrate Zero Point (ZERO)
0x88	Calibrate Span Point (SPAN)
0x79	ON/OFF Self-calibration function for zero point
0x99	Detection range setting

0x86- Read CO2 concentration								
Sending command								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	-	-	-	-	-	Checksum
0xFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	0x79
Return value								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Command	Concentration	Concentration	-	-	-	-	Checksum

		(High 8 Byte)	(Low 8 Byte)					
0xFF	0x86	HIGH	LOW	-	-	-	-	Checksum

CO2 concentration = HIGH * 256 + LOW

For example:

Send command FF 01 86 00 00 00 00 00 79, Return value FF 86 02 20 00 00 00 00 58

How to calculate concentration: convert hexadecimal 02 into decimal 2, hexadecimal 20 into decimal 32, then 2*256+32=544ppm

0x79- On/Off Self-calibration for Zero Point

Send command-No return value

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	-	-	-	-	-	Checksum
0xFF	0x01	0x79	0xA0/0x00	0x00	0x00	0x00	0x00	Checksum

For example:

ON this function, send command: FF 01 79 A0 00 00 00 00 E6

OFF this function, send command: FF 01 79 00 00 00 00 00 86

NOTE: This function is on when Byte3 is 0xA0 while this function is off when Byte3 is 0x00.

Default status is "this function is on".

0x99- Detection range setting

Send command-No return value

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	Reserved	Detection range 24~32 bit	Detection range 16~23 bit	Detection range 8~15 bit	Detection range 0~7 bit	Checksum
0xFF	0x01	0x99	0x00	Data 1	Data 2	Data 3	Data 4	Checksum

Note: Detection range should be 0~2000, 0~5000, or 0~10000ppm.

For example: set 0~2000ppm detection range, send command: FF 01 99 00 00 00 07 D0 8F

set 0~10000ppm detection range, send command: FF 01 99 00 00 00 27 10 2F

Analog Voltage Output(Vo)

Conversion between analog voltage output and concentration, take 0.4V~2V as an example:
Vo(V)=0.4V+(2.0V-0.4V)*C(concentration ppm) / range(ppm)

1. Checksum calculation method

Checksum = (Negative (Byte1+Byte2+Byte3+Byte4+Byte5+Byte6+Byte7))+1

For example:

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	-	-	-	-	-	Checksum
0xFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	Checksum

Calculating Checksum：

1、Add Byte 1 to Byte 7: 0x01 + 0x86 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 = 0x87

2、Negative: 0xFF - 0x87 = 0x78

3、Then+1：0x78 + 0x01 = 0x79

C language

```
char getCheckSum(char *packet)
{
    char i, checksum;
    for( i = 1; i < 8; i++)
    {
        checksum += packet[i];
    }
    checksum = 0xff – checksum;
    checksum += 1;
    return checksum;
}
```

8.Zero Point Calibration

About zero point calibration:

This module has three methods for zero point calibration: hand-operated method, sending command method and self-calibration. All the zero point is at 400ppm CO2.

Hand-operated method: Connect module's HD pin to low level(0V), lasting for 7 seconds at least. Before calibrating the zero point, please ensure that the sensor is stable for more than 20 minutes at 400ppm ambient environment.

Sending command method:

Zero and Span point calibration can be achieved by sending a calibration command to the sensor via the serial port (URAT). Zero and SPAN point calibration commands are as follows:

0x87-ZERO POINT CALIBRATION								
Send command-no return value								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	-	-	-	-	-	Checksum
0xFF	0x01	0x87	0x00	0x00	0x00	0x00	0x00	0x78
For example: **Put the module in 400ppm standard CO2 gas or clean outdoor environment for at least 20 min;** **Send command FF 01 87 00 00 00 00 00 78 for zero point calibration.** **Caution: Forbid sending this command in other environment except above.**								

0x88- SPAN POINT CALIBRATION								
Send command-no return value								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	Span(High 8 Byte)	Span(low 8 Byte)	-	-	-	Checksum
0xFF	0x01	0x88	HIGH	LOW	0x00	0x00	0x00	Checksum
For example: **Put the module in 2000ppm CO2 gas, stability for 20 min at least.** **If span value is 2000ppm, then HIGH=2000/256, LOW = 2000 % 256** **Send command FF 01 88 07 D0 00 00 00 A0 for span calibration** **Caution: Zero calibration should be done before span calibration.** **It is recommended to use 2000ppm as the SPAN calibration value.** **If lower value as the span value is needed, choose a value above 1000ppm.**								

Self-calibration:

After the module works for some time, it can judge the zero point intelligently and do the zero calibration automatically. The calibration cycle is every 24 hours since the module is power on. The zero point is 400ppm. This method is suitable for office and home environment, not suitable for agriculture greenhouse, farm, refrigerator, etc.. If the module is used in latter environment, please turn off this function.

9. Notes

9.1 Please avoid the pressure of its gilded plastic chamber from any direction, during welding, installation, and use.

9.2 When placed in small space, the space should be well ventilated, especially for diffusion window.

9.3 The module should be away from heat, and avoid direct sunlight or other heat radiation.

9.4 The module should be calibrated termly, the suggested period is not longer than 6 months.

9.5 Do not use the sensor in the high dusty environment for long time.

9.6 To ensure the normal work, the power supply must be among 4.5V~5.5V DC rang, the power current must be not less than 150mA. Out of this range, it will result in the failure of the sensor. (The concentration output is low, or the sensor can not work normally.)

9.7 During the zero point calibration procedure by manual, the sensor must work in stable gas environment (400ppm) for over 20 minutes. Connect the HD pin to low level (0V) for over 7 seconds.

9.8 Forbid using wave soldering for the sensor.

9.9 When soldering with soldering iron, set the temperature to be (350 ± 5) ° C, and soldering time must be within 3 seconds.

9.0 As for pin version sensor, it is recommended to use soldering socket to directly insert or remove sensors for convenient maintenance.