MH-Z16

Intelligent Infrared Gas Module

User's Manual

(Version: 2.4)

Issue Date: 2019.04.29

Zhengzhou Winsen Electronics Technology CO., LTD

Statement

This manual's copyright belongs to Zhengzhou Winsen Electronics Technology Co., LTD. Without the written permission, any part of this manual shall not be copied, translated, stored in database or retrieval system, also can't spread through electronic, copying, record ways.

Thanks for purchasing our products. In order to have customers use it better and reduce the faults caused by misuse, please read the manual carefully and operate it correctly in accordance with the instructions. If users disobey the terms or remove, disassemble, change the components inside of the sensor, we shall not be responsible for the loss.

The specific such as color, appearance, sizes &etc., please in kind prevail.

We are devoting ourselves to products development and technical innovation, so we reserve the right to improve the products without notice. Please confirm it is the valid version before using this manual. At the same time, users' comments on optimized using way are welcome.

Please keep the manual properly, in case you need help during the usage in the future.

Zhengzhou Winsen Electronics Technology CO., LTD.

MH-Z16 Intelligent Infrared Gas Module

1. Profile:

MH-Z16 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 digital output and PWM wave output. This common type infrared gas sensor is developed by the tight integration of mature infrared absorbing gas detection technology, precision optical circuit design and superior circuit design.

2. Main features：

●High sensitivity, High resolution, Low power consumption
●Output method: UART, PWM wave &etc
●Quick response, Good stability
●Temperature compensation,
●Excellent linear output
●Long lifespan
●Anti-water vapor interference
●No poisoning

3. Application:

●HVAC equipment ● air quality monitoring equipment ● fresh air system●air purification equipment

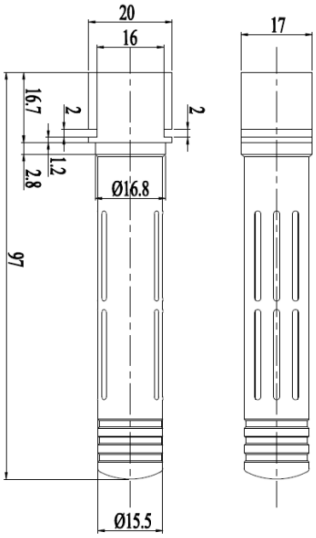
● intelligent home ● education system●animal husbandry production ● safety protection monitoring

4. Main technical parameters

Model No.	MH-Z16
Detection Gas	CO2 gas
Working voltage	4.5 V ~ 5.5V DC
Average current	<85mA
Interface level	3.3 V
Measuring range	0~5%vol range selectable (refer to table2.)
Output signal	UART
	PWM
	Analog output DAC (0.4~2V)
Preheat time	3 mins
Response Time	T_{90} < 30s
Working temperature	-10℃ ~ 50℃
Working humidity	0~95%RH (no condensation)
Size	97*20*17mm (L*W*H)
Weight	21 g
Lifespan	>5 years

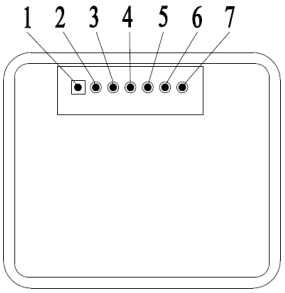
Target Gas	Measuring Range	Accuracy	Mark
Carbon Dioxide (CO2)	0~2000ppm	±（100ppm＋6% reading value）	Temperature compensation
	0~5000ppm		Temperature compensation
	0~1%VOL		Temperature compensation
	0~3%VOL		Temperature compensation
	0~5%VOL		Temperature compensation
	0~10% VOL		Temperature compensation
	0~15% VOL		Temperature compensation

5. Structure



6. Pin Definition

PIN No.	Description
PIN 4	Vin (Voltage Input)
PIN 3	GND
PIN 2	Vout（0.4~2V）
PIN 7	PWM
PIN 1	HD (Zero calibration, keep low electrical level for more than 7 seconds)
PIN 5	UART（RXD） TTL electrical level data input
PIN 6	UART（TXD） TTL electrical level data output



7. Output methods

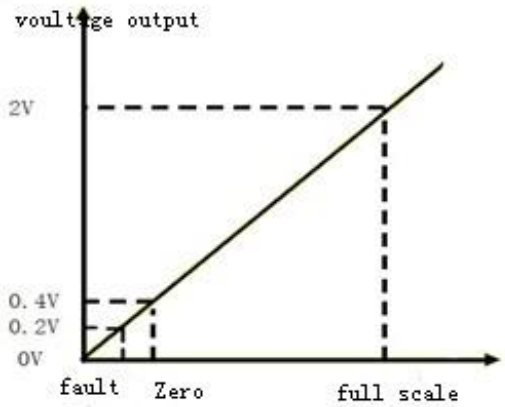
Analog output way (customized)

The Vout is proportional to the gas concentration,0.4-2V output stands for 0 to full scale.

Connection: Vin –5V, GND- Power Ground, Vout-input of ADC.

After warm-up, Vout will show the voltage standing for the gas concentration.

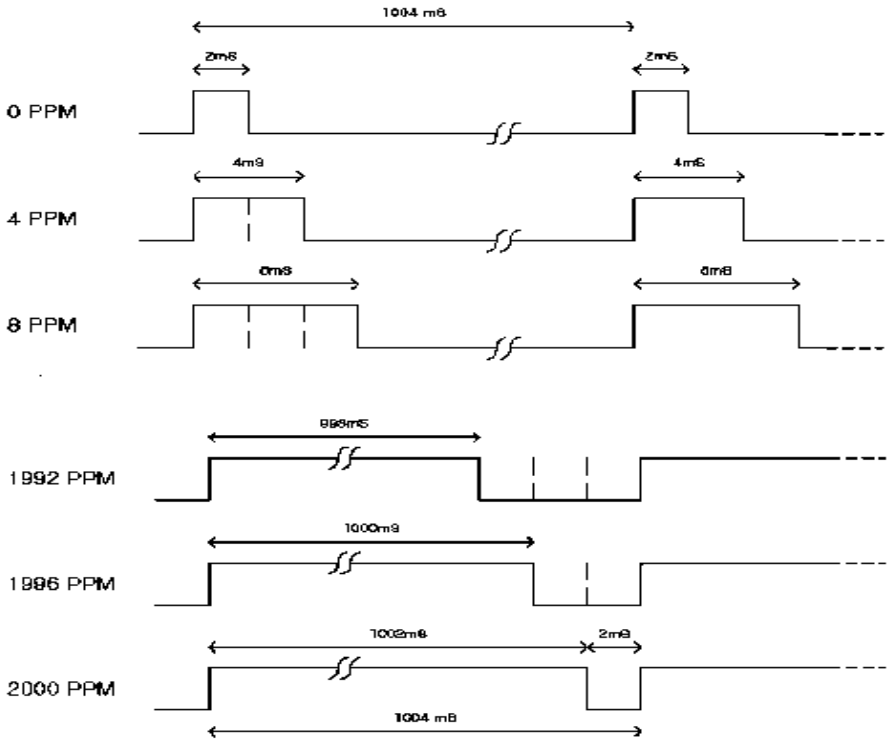
If self-checking detects a fault, the output voltage is 0V.



Analog voltage output(Vo)

CO2 Concentration(ppm)= (Vo-0.4V)*full scale/(2.0V-0.4V)

PWM output	
Take 0~2000ppm for example	
CO_2 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)
CO_2 concentration: $C_{ppm}=2000\times(T_H-2ms)/(T_H+T_L-4ms)$	
C_{ppm}: CO2 concentration could be calculated by PWM output T_H high level output time during cycle T_L 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 check byte is null.

Commands	
0x86	To read CO2 concentration
0x87	To calibrate Zero Point (ZERO)
0x88	To calibrate Span Point (SPAN)
0x79	To Turn ON/OFF self-calibration function
0x99	To set detection range

0x86- To read CO2 concentration

To send command

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	No.	**Command**	-	-	-	-	-	Checksum
0xFF	0x01	**0x86**	0x00	0x00	0x00	0x00	0x00	0x79

Returned value

Byte0	Byte1	**Byte2**	**Byte3**	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	No	**Concentration (High 8 bit)**	**Concentration (Low 8 bit)**	-	-	-	-	Checksum
0xFF	0x86	**HIGH**	**LOW**	-	-	-	-	Checksum

CO2 concentration = HIGH * 256 + LOW

For example: 1. Please connect the hardware correctly.

2.To send command: FF 01 86 00 00 00 00 00 79, Returned 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-To turn on/off self-calibration function

To send command

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

No returned value

Mark: Byte 3 is 0xA0, self-calibration function is on; Byte 3 is 0x00, self-calibration function is off.

0x99-To set detection range

To send command

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start byte	Reserved	Command	reserved	range 24~31 bits	range 16~23 bits	range 8~15 bits	range 0~7 bits	checksum
0xFF	0x01	0x99	0x00	Data1	Data2	Data3	Data4	checksum

No returned value.

Three methods to calibrate zero point (400ppm)

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.

1. 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.

2.To send command

0x87-To calibrate zero point								
Send command								
Byte0	Byte1	**Byte2**	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	reserved	**Command**	-	-	-	-	-	Checksum
0xFF	0x01	**0x87**	0x00	0x00	0x00	0x00	0x00	Checksum
No returned value **Caution:** zero-point means 400ppm, please ensure the module works in 400ppm CO2 gas stably for 20 min at least before send the command								

0x88- To calibrate span point								
Send command								
Byte0	Byte1	Byte2	**Byte3**	**Byte4**	Byte5	Byte6	Byte7	Byte8
Start Byte	No.	Command	**Span (High 8 bits)**	**Span (low 8 bits)**	-	-	-	Checksum
0xFF	0x01	0x88	**HIGH**	**LOW**	0x00	0x00	0x00	Checksum
No returned value. If SPAN value is 2000ppm, HIGH=2000/256; LOW=2000%256 Take 2000ppm as SPAN calibration point for example: Put the module in 2000ppm CO2 gas, stability for at least 20 min. Send command FF 01 88 **07 D0** 00 00 00 A0 for span calibration **Caution:** * Please do Zero calibration before SPAN calibration. *Before sending the SPAN calibration command, please ensure that the sensor is stable for more than 20 minutes at the corresponding concentration.								

3.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.

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	No.	Command	-	-	-	-	-	Checksum
0xFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	Checksum

Calculating Checksum：

1、Add from 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. Cautions:

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

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

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

8.4 The sensor should be calibrated regularly and the calibration cycle is recommended for no more than 6 months.

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

8.6 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 cannot operate properly)

8.7 During manual zero calibration, 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.