MH-Z16

Intelligent Infrared Gas Module

User's Manual

(Version: 2.4)

Valid from: 2017.05.24

Zhengzhou Winsen Electronics Technology CO., LTD

Statement

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.

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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 and analog (DAC)
●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

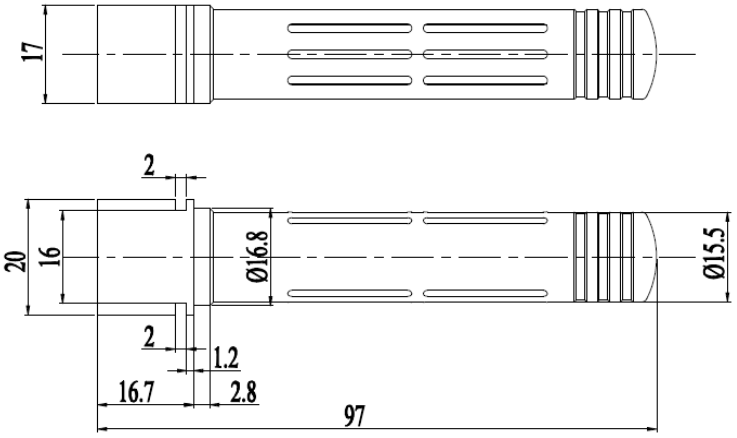
● intelligent home ● education system●animal husbandry production ● safety protection monitoring

4. Main technical parameters

Working voltage	4.5 V ~ 5.5V DC
Average current	< 60mA（5VDC）
Peak current	150mA（5VDC）
Interface level	3.3 V（Compatible with 5V）
Measuring range	0~50000ppm (refer to below table)
Output signal	PWM
	UART （TTL level）
Resolution	1 ppm
Preheat time	3 mins
Response Time	T_{90} < 60s
Working temperature	-20℃ ~ 60℃
Working humidity	0~95%RH (no condensation)
Size	97*20*17mm (L*W*H)
Weight	21 g
Lifespan	>5 years

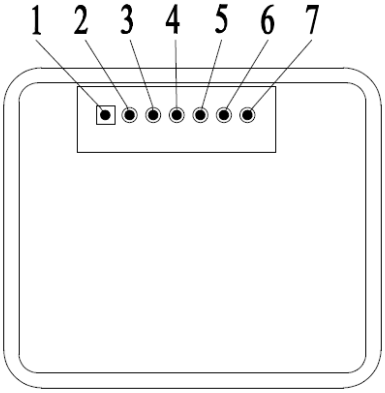
Target Gas	Measuring Range	Accuracy
Carbon Dioxide (CO2)	0~5000ppm	±(50ppm+5% reading)
	0~1%VOL	±(100ppm+5% reading)
	0~5%VOL	±15% reading
	Over 5%vol	Observation Measurement only

5. Structure



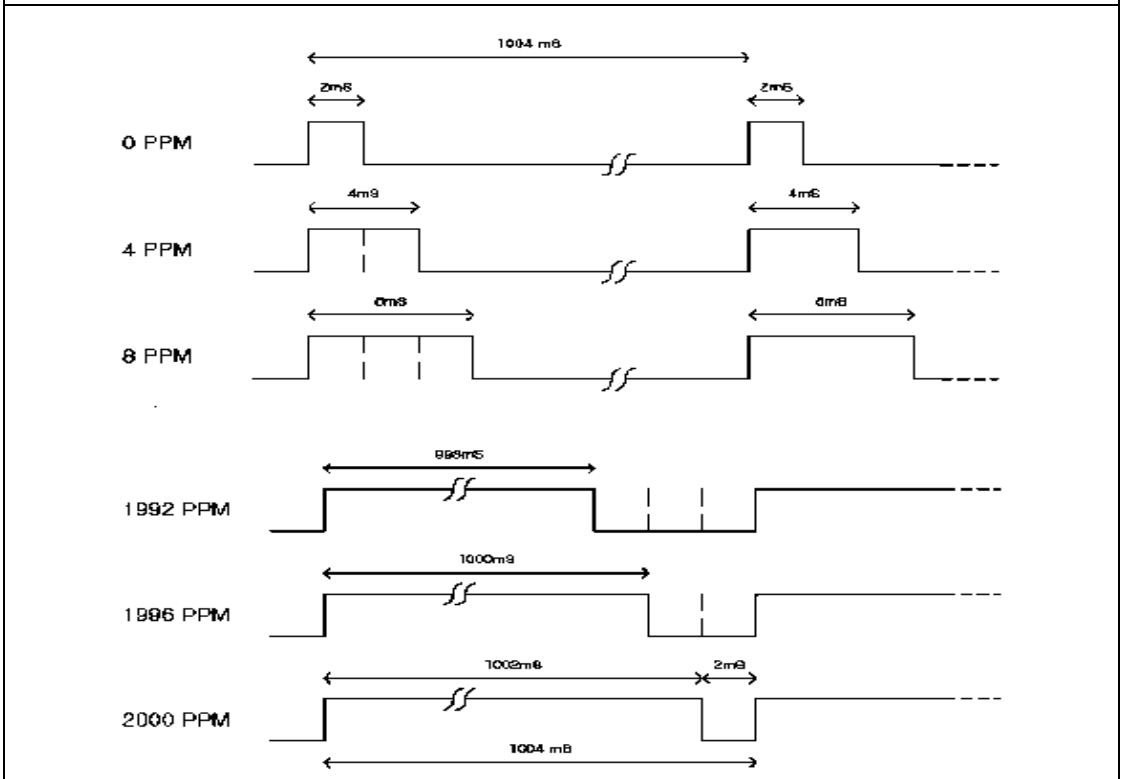
6. Pin Definition

PIN	Description
PIN 4	Vin (Voltage Input)
PIN 3	GND
PIN 2	Vout（0.4-2V） need to be customized
PIN 7	PWM
PIN 1	HD (Zero calibration, low level for more than 7 seconds)
PIN 5	UART（RXD） 0～3.3V digital input
PIN 6	UART（TXD） 0～3.3V digital output



7. Output methods:

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 bit null.

Commands	
0x86	Read CO2 concentration
0x87	Calibrate Zero Point (ZERO)
0x88	Calibrate Span Point (SPAN)
0x79	ON/OFF Self-calibration function
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
Received command								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Command	Concentrati	Concentrati	-	-	-	-	Checksum

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

CO2 concentration = HIGH * 256 + LOW

For example:

1.Please connect the hardware correctly.

2.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

Caution: Checkvalue please refer to Checksum method.

0x87-ZERO POINT CALIBRATION

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 received command

For example:

1.Put the module in 400ppm standard CO2 gas or clean outdoor environment for at least 20 min;

2.Send command FF 01 87 00 00 00 00 00 78 for zero point calibration.

Caution: *Forbid sending this command in environment except 1.

***This calibration command is required when there is a large deviation in the sensor zero point.**

0x88- SPAN POINT CALIBRATION

Send command

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Start Byte	Reserved	Command	Span (High 8 bit)	Span (low 8 bit)	-	-	-	Checksum
0xFF	0x01	0x88	HIGH	LOW	0x00	0x00	0x00	Checksum

No received command. 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.**

***It is recommended to use 2000 ppm as the SPAN value for calibration. If you want to use a lower value as the span value, select a value above 1000 ppm.**

*** If you can not establish the corresponding concentration of the environment, please stop SPAN calibration, otherwise it will lead to sensor failure. It is forbidden to send this command without putting the sensor under standard gas.**

0x79- ON/OFF Self-calibration for zero point								
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
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 on.**								

0x99- Detection range resetting								
Send command								
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	HIGH	Data 1	Data 2	Data 3	Data 4	Checksum
No Received command **For example:** ***Set 2000ppm detection range, send command: FF 01 99 00 00 00 07 D0 8F** ***Set 10000ppm detection range, send command: FF 01 99 00 00 00 27 10 2F** **Note:** ***Range Bit 24-31=Range>>24(low 8 bit); Range bit 16-23=Range>>16(**low 8 bit**);** **Range bit 8-15=Range>>8(**low 8 bit**): Range bit 0-7** low 8 bit ***Send command is Hexadecimal data**								

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、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.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 at least 7 seconds. Please ensure that the sensor is stable for at least 20 minutes under 400ppm standard gas before calibrating the products.

Sending command method: See the command above.

Auto-calibration method:

Auto-calibration function means, after the sensor running in the working place for period, it can judge the zero point intelligently and do the zero calibration automatically. After power on the sensors for at least 24 hours, the self-calibration function will operate automatically in every 24 hours and the calibration point is 400ppm.

This method is suitable for office and home environment, not suitable for agriculture greenhouse, farm, refrigerator. If the module is used in latter environment, please turn off this function. If close this function, please do zero-point calibration terminally, if necessary, please do it by hands or by command.

9. Cautions:

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 sensor should be calibrated regularly and the calibration cycle is recommended for no more 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 cannot operate properly)

9.7 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.

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