Infrared Carbon Dioxide Module
(Model: MH-Z14B)

User's Manual V1.1

Valid from June 18th,2021

Zhengzhou Winsen Electronics Technology CO., LTD.

Statement

Thanks for purchasing our product. In order to enable customers to better use the product 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 order to get help if you have questions during the usage in the future.

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MH-Z14B NDIR CO2 Module

1. Profile

MH-Z14 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 sensor can do temperature compensation; and it has digital output and analog voltage output. This 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. Applications:

- HVAC equipment
- air quality monitoring equipment
- Ventilation system
- air purification equipment
- Smart home

3. Main functions and features:

- Gold plating technology for cavity, waterproof and anti-corrosion
- High sensitivity, low power consumption
- Good stability, long lifespan
- Temperature compensation, excellent linear output
- Output modes: UART, PWM
- Anti-water vapor interference, no poisoning

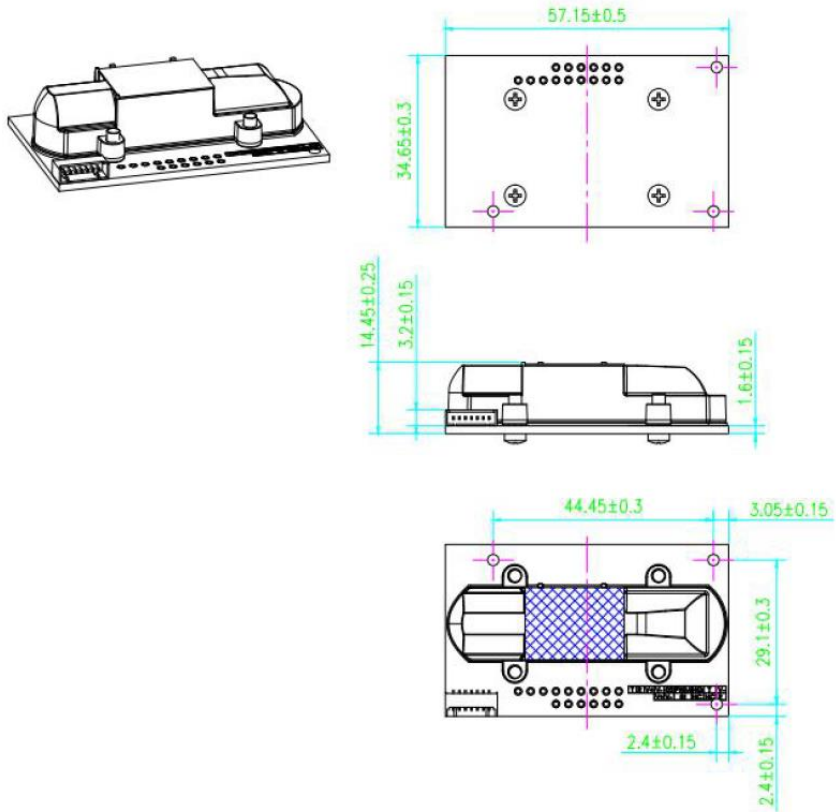
4.Main technical parameters

Model No.	MH-Z14B
Detection Gas	CO2
Working voltage	DC (5.0±0.1) V
Average current	< 60 mA(@5V power supply)
Peak current	150 mA（@5V power supply）
Interface level	3.3 V (Compatible with 5V)
Measuring range	0~10000ppm (max 50000ppm can be extended)
Output signal	UART (TTL 3.3V)
	PWM
Preheat time	10S
Response Time	T_{90} < 90s
Working temperature	-10℃ ~ 50℃
Working humidity	0~95%RH
Storage temperature	-20℃ ~ 60℃
Weight	<15 g
Lifespan	>10 years

Detection range and accuracy

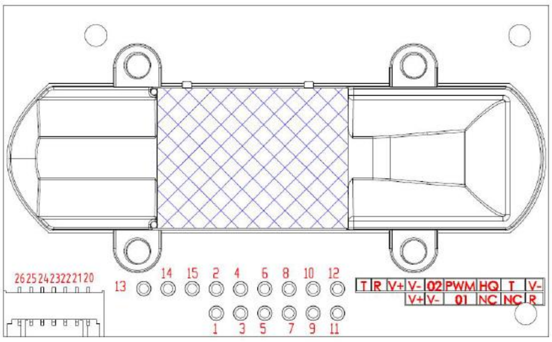
Target Gas	Measuring Range	Solution	Accuracy
Carbon Dioxide (CO_2)	0~2000ppm	1ppm	±(50ppm +5%reading value)
	0~5000ppm		
	0~10000ppm		

5. Sensor Structure



6. Definition for pins

PIN No.	Description
Pin1/Pin15/Pin23	Power positive(Vin)
Pin2/Pin3/ Pin12/Pin22	Power negative(GND)
Pin4/Pin5/ Pin21	NC
Pin6/Pin26	PWM
Pin8/Pin20	HD (Zero calibration, keep low electrical level for more than 7 seconds))
Pin7/Pin9	NC
Pin11/Pin14/Pin24	UART（RXD）data input
Pin10/Pin13/Pin25	UART（TXD）data output



7. Output

PWM output (taking 2000ppm PWM output as example):

CO2 output range: 0ppm-2000ppm
Cycle: 1004ms ±5%
High power output for beginning: 2ms (Theoretical value)
Middle of cycle: 1000ms ±5%
Low power output for ending: 2ms（Theoretical value）

Account formula for CO2 concentration which gets through PWM:

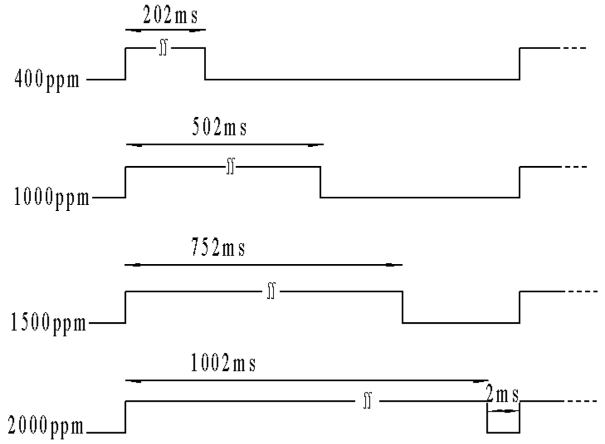
$$C_{ppm} = 2000 \times (T_H - 2ms)/(T_H + T_L - 4ms)$$

Among:

C_{ppm} is calculated CO2 concentration, unit is ppm;

T_H is time for high level during an output cycle;

T_L is time for low level during an output cycle.



UART output

Hardware connection:

Vin-5V power
GND- GND
RXD connect sensor TXD
TXD connect sensor RXD
(The user terminal must use TTL level, if it is RS232 level, it must be converted)
You can read gas concentration via UART, no need to calculate.

Software connection:

General Settings

Baud rate	9600
Date bits	8
Stop bits	1
Parity	none

Command

Each command or return：

Contains 9 bytes (byte 0 ~ 8)

Starting byte fixed 0 XFF

Command contains sensor number (factory default to 0 x01) to check and end

Command List:

0x86	Read Gas concentration
0x87	Calibrate zero point（ZERO）

Read gas concentration

Send command								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Starting byte	Sensor No.	command	-	-	-	-	-	Check value
0XFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	0x79

Return value

Return								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Starting byte	command	High level concentration	Low level concentration	-	-	-	-	Check value
0XFF	0x86	0x02	0x60	0x47	0x00	0x00	0x00	0xD1

Gas concentration= high level *256+low level

Example: Convert hexadecimal to decimal: 01 is 01, F4 is 244;

CO2 level:01*256+244=500ppm

Checksum calculation method								
Checksum = (Invert (Byte1+Byte2+Byte3+Byte4+Byte5+Byte6+Byte7))+1								
For example：								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Starting byte	No.	**Command**	-	-	-	-	-	**Check value**
0xFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	Checksum
The calculation is as follows: 1. Add from Byte1 to Byte7: 0x01 + 0x86 + 0x00 + 0x00 + 0x00 + 0x00 + 0x00 = 0x87 2. Invert: 0xFF-0x87 = 0x78Add 1 after the inversion: 0x78 + 0x01 = 0x79								
Program: C language								

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

Zero Point Calibration:

In order to facilitate the user to calibrate the zero point, the sensor has two zero calibration methods: manual zero calibration and command zero calibration. The zero point calibration function refers to calibrating 400ppm.

①Manual zero point calibration

Manual zero point calibration is to input low level (0V) to the HD pin of the sensor to calibrate zero point. The low level needs to last more than 7 seconds. Before calibrating the zero point, make sure that the sensor runs stably for more than 20 minutes at a concentration of 400ppm.

②Command calibration

Send a calibration command to the sensor through the serial port (URAT) to achieve the sensor zero point calibration. The zero point calibration command is as follows:

Send command								
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8
Starting byte	reserved	command	-	-	-	-	-	Check value
0XFF	0x01	0x87	0x00	0x00	0x00	0x00	0x00	0x78

No return values

Note: The zero point refers to 400ppm. Before sending the zero point calibration command, please ensure that the sensor runs stably for more than 20 minutes at a concentration of 400ppm.

③Self-calibration function:

The self-calibration function means that after the sensor runs continuously for a period, it can intelligently determine the zero point according to the environmental concentration and calibrate itself. The calibration cycle is automatic calibration every 24 hours since power-on operation. The zero point of automatic calibration is 400ppm. The self-calibration function is suitable for office environment and home environment. However, it is not suitable for agricultural greenhouses, breeding farms, cold storage and other places. In such places, self-calibration function should be turned off. After the shutdown, users are required to periodically perform zero-point detection on the sensors, and if necessary, perform zero calibration or manual zero calibration.

9、Notes for maintenance

- The gold-plated plastic cavity of the sensor should not be subjected to pressure in any direction during the welding, installation, and use of the sensor.
- If the sensor needs to be placed in a small space, this space should be well ventilated, especially the two

diffusion windows should be in a well-ventilated position.

- The sensor should be far away from heat sources and avoid direct sunlight or other heat radiation.
- The sensor should be calibrated regularly, and the calibration period is recommended to be no more than 6 months.
- Do not use the sensor for a long time in an environment with high dust density.
- In order to ensure that the sensor can work normally, the power supply voltage must be maintained in the range of (5.0±0.1)V DC, and the power supply current must not be less than 150mA. If it is not within this range, the sensor may malfunction, the sensor output concentration is low or the sensor cannot be normal jobs.
- When you manually calibrate the zero point or send a command to calibrate the zero point, you must work continuously for more than 20 minutes in a stable gas environment (400ppm).
- Wave soldering is prohibited for the sensor.
- When soldering with a soldering iron, the temperature setting must be (350±5)℃, and the soldering time must be less than 3S.
- When you use the sensors, we suggest to solder sockets into PCB for convenient inserting and plugging the sensors.