



# Intelligent Infrared Carbon Dioxide Module (Model: MH-Z14A)

## User's Manual V1.2

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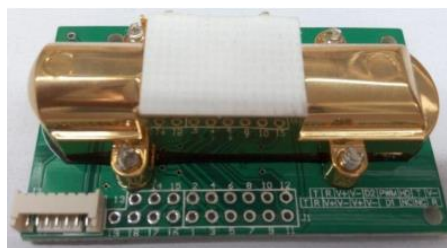
Please keep the manual properly, in order to get help if you have questions during the usage in the future.

Zhengzhou Winsen Electronics Technology CO., LTD

# MH-Z14A NDIR CO2 Module

## 1. Profile

MH-Z14A NDIR Infrared gas module is a common type, small size sensor, using non-dispersive infrared (NDIR) principle to detect the existence of CO<sub>2</sub> 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, analog voltage output and PWM 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.



## 3. Main Features

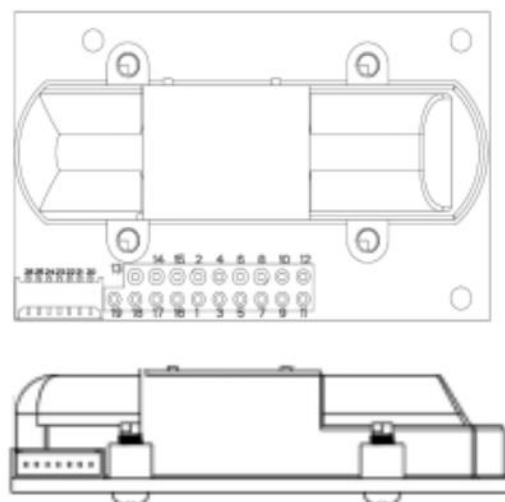
- Chamber is gold plated, water-proof and anti-corrosion
- High sensitivity, low power consumption
- Good stability
- Temperature compensation, excellent linear output
- Multiple output modes: UART, DAC, PWM
- Long lifespan
- Anti-water vapor interference, anti-poisoning

## 2. Applications

- \*HVAC refrigeration
- \*Smart home
- \*Air cleaner device
- \*Ventilation system
- \*Indoor air quality monitoring
- \*School

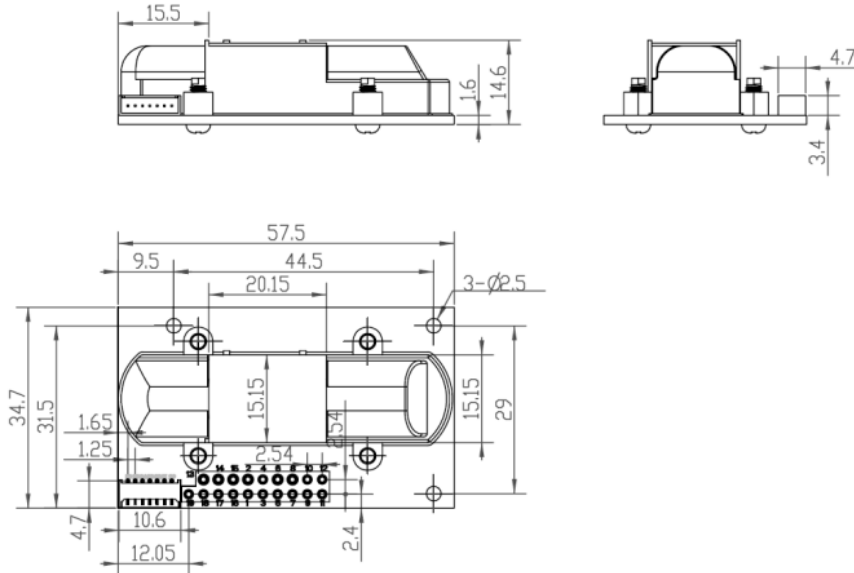
## 4. Main technical parameters

|                     |   |
|---------------------|---|
| Model No.           | MH-Z14A                                 |
| Detection Gas       | CO <sub>2</sub> gas                     |
| Working voltage     | 4.5 V ~ 5.5V DC                         |
| Average current     | < 60 mA (@5V supply)                    |
| Peak current        | 150mA (@5V supply)                      |
| Interface level     | 3.3 V (5V compatible)                   |
| Measuring range     | 0~10000ppm optional                     |
| Output signal       | Serial port(UART) (TTL)                 |
|                     | PWM                                     |
|                     | Analog output (DAC) (default is 0.4~2V) |
| Preheat time        | 3min                                    |
| Response Time       | T90 < 120s                              |
| Working temperature | -10°C ~ 50°C                            |
| Working humidity    | 0~95%RH(no condensation)                |
| Weight              | 15 g                                    |
| Lifespan            | >5 years                                |
| Dimension           | 57.5×34.7×16mm (L×W×H)                  |

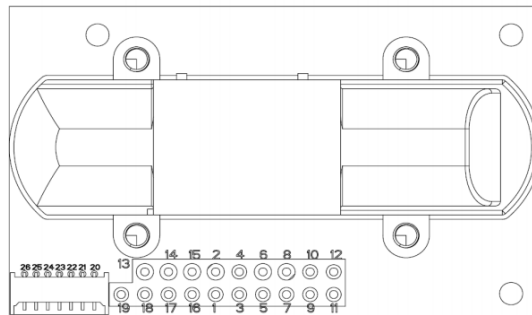


| Target Gas                           | Measuring Range | Accuracy                     |
|--------------------------------------|-----------------|------------------------------|
| Carbon Dioxide<br>(CO <sub>2</sub> ) | 0~2000ppm       | ±(50ppm<br>+5%reading value) |
|                                      | 0~5000ppm       |                              |
|                                      | 0~10000ppm      | ±10%reading value            |

## 5. Structure



## 6. Definition for pins



| PIN No       | Description   |
|--------------|---|
| 1,15,17,23   | Power positive (Vin)  |
| 2,3,12,16,22 | Power negative (GND)  |
| 4,5,21       | Analog output   |
| 6,26         | PWM   |
| 8, 20        | HD(for zero-point calibration, low level lasting for over 7 sec is effective) |
| 7,9          | NC  |
| 11, 14,18,24 | UART (RXD) TTL data input   |
| 10,13,19,25  | UART (TXD) TTL data output  |

## 7.Three Output ways

### ● 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: $C_{ppm} = 2000 \times (TH - 2ms) / (TH + TL - 4ms)$ |                        |
| C <sub>ppm</sub> : CO2 concentration could be calculated by PWM output  |                        |
| TH high level output time during cycle                                  |                        |
| TL low level output time during cycle                                   |                        |
|   |                        |

### ● Analog voltage output Vo

The V<sub>out</sub> is proportional to the gas concentration, 0.4~2V output stands for 0 to full scale.

$$C_{ppm} = (V_o(V) - 0.4V) \times \text{detection range(ppm)} / (2.0V - 0.4V)$$

## ●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.

### Command List:

|      |   |
|------|---|
| 0x86 | Gas 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 (High 8 Byte) | Concentration (Low 8 Byte) | -     | -     | -     | -     | Checksum |
| 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             |          |         |          |                           |                           |                          |                         |          |

### 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 CO<sub>2</sub>.

**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     |
| <b>For example:</b><br><b>Put the module in 400ppm standard CO<sub>2</sub> gas or clean outdoor environment for at least 20 min;</b><br><b>Send command FF 01 87 00 00 00 00 00 78 for zero point calibration.</b><br><b>Caution: Forbid sending this command in other environment except above.</b> |          |         |       |       |       |       |       |          |

| 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 |
| <b>For example:</b><br><b>Put the module in 2000ppm CO<sub>2</sub> gas, stability for 20 min at least.</b><br><b>If span value is 2000ppm, then HIGH=2000/256, LOW = 2000 % 256</b><br><b>Send command FF 01 88 07 D0 00 00 00 A0 for span calibration</b><br><b>Caution: Zero calibration should be done before span calibration.</b><br><b>It is recommended to use 2000ppm as the SPAN calibration value.</b><br><b>If lower value as the span value is needed, choose a value above 1000ppm.</b> |          |         |                   |                  |       |       |       |          |

### 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  $(350 \pm 5)$  °C, and soldering time must be within 3 seconds.

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