Intelligent Infrared Carbon Dioxide Module

(Model: MH-Z14A)

User's Manual V1.2

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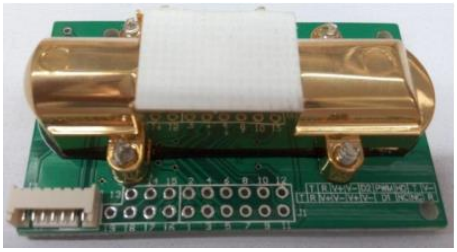
MH-Z14A NDIR CO2 Module

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_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, 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

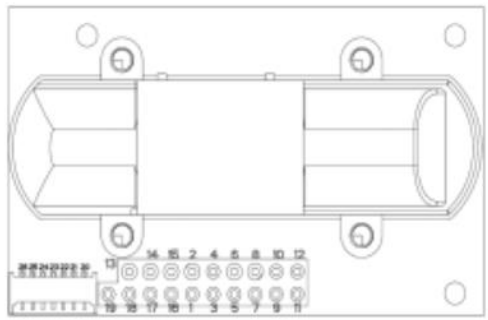
Chamber is gold plated, water-proof and anti-corrosion
High sensitivity, low power consumption
Good stability
Temperature compensation, excellent linear output
Multiple output modes: UART, DAC, PWM
Long lifespan
Anti-water vapor interference, anti-poisoning

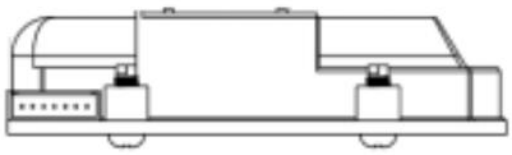
2. Applications

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

4. Main technical parameters

Model No.	MH-Z14A
Detection Gas	CO2 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℃ ~ 50℃
Working humidity	0~95%RH(no condensation)
Weight	15 g
Lifespan	>5 years
Dimension	57.5×34.7×16mm（L×W×H）





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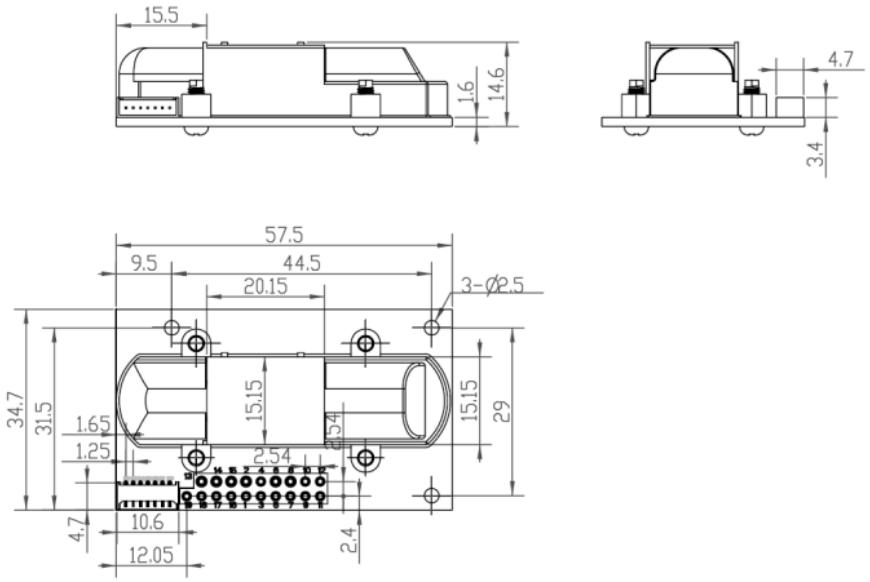
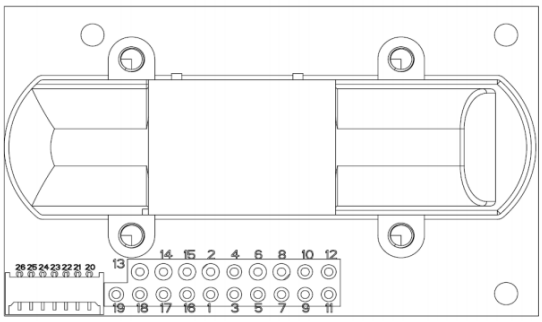
Target Gas	Measuring Range	Accuracy
Carbon Dioxide (CO2)	0~2000ppm	±(50ppm +5%reading value)
	0~5000ppm	
	0~10000ppm	±10%reading value

5. Structure



6. Definition for pins

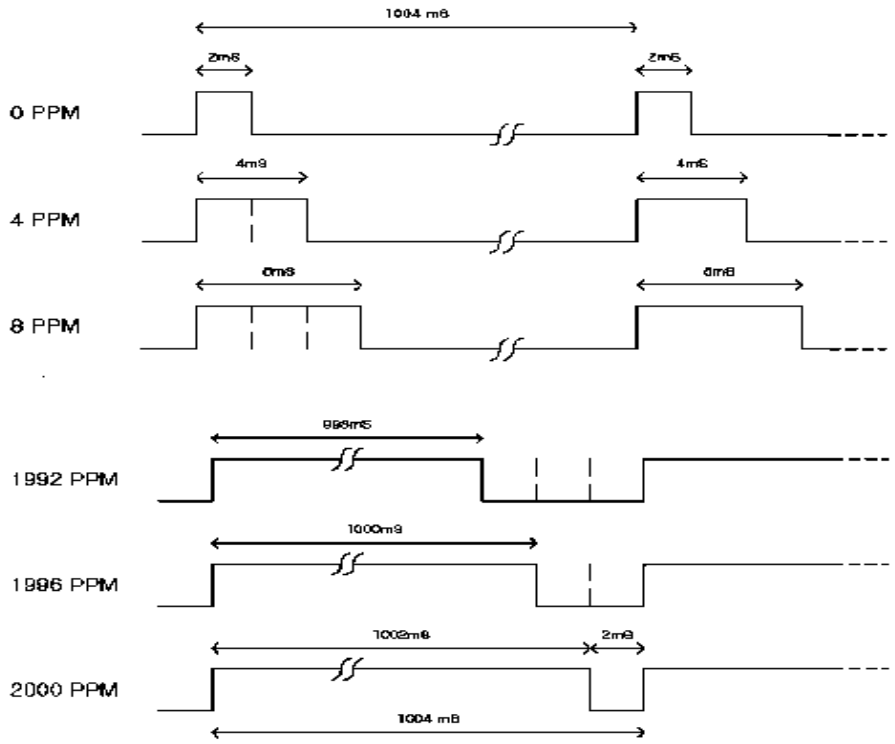


PIN No	Description
1,15,17,23	Power positive (Vin)
2,3,12,16,22	Power negative (GND)
4,5,21	Analog output
6,26	PWM
8, 20	HD(for zero-point calibration, low level lasting for over 7 sec is effective)
7,9	NC
11, 14,18,24	UART（RXD） TTL data input
10,13,19,25	UART（TXD）TTL data output

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: 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	



● Analog voltage output Vo

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

C ppm=(Vo(V)-0.4V)*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	Check sum
0xFF	0x01	0x99	0x00	Data 1	Data 2	Data 3	Data 4	Check sum

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	-	-	-	-	-	Check sum
0xFF	0x01	0x86	0x00	0x00	0x00	0x00	0x00	Check sum

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.