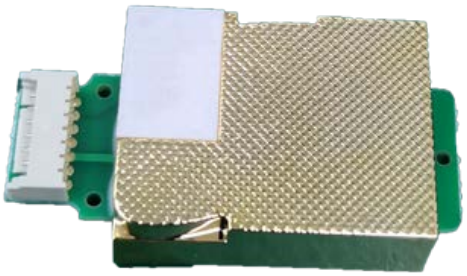
# Infrared CO2 Sensor Module

## NDIR CO2 Module

### Profile

MH-Z19C-DZ NDIR infrared gas module is a common type, small size sensor, using non-dispersive infrared (NDIR) principle to detect the existence of CO2 in the air, with good selectivity, non-oxygen dependent and long life. Built-in temperature compensation; and it has UART output and PWM output. It is developed by the tight integration of mature infrared absorbing gas detection technology, precision optical circuit design and superior circuit design.



### Main Features

- Chamber is gold plated
- 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

### Applications

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



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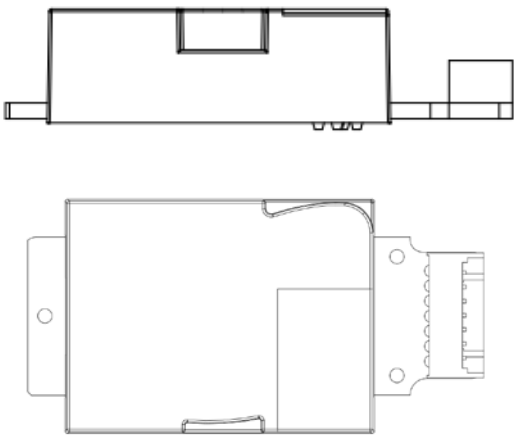
## Main parameters

| | |
|---|---|
| Model No. | MH-Z19C-DZ |
| Detection Gas | CO2 |
| Working voltage | DC(5.0±0.1)V |
| Average current | < 40mA (@5V power supply) |
| Peak current | 125mA (@5V power supply) |
| Interface level | 3.3 V (Compatible with 5V) |
| Detection Range | 400~5000ppm(optional)(400~10000ppm range could be customized) |
| Output signal | Serial Port (UART) (TTL level 3.3V) |
| | PWM |
| | Analog output(DAC) (default 0.4~2V)<br>(0~3V range could be customized) |
| Preheat time | 2.5min |
| Response Time | $T_{90}$ < 120s |
| Working temperature | -10℃～50℃ |
| Storage temperature | -20℃～60℃ |
| Working humidity | 0 ~ 95% RH (No condensation) |
| Weight | 5 g |
| Lifespan | > 5 years |



**Structure**

## Detection range and accuracy

| Detection Gas | Formula | Detection Range | Accuracy |
|---|---|---|---|
| Carbon Dioxide | $CO_2$ | 400～2000 ppm | ±(50ppm+5% reading value) |
| | | 400～5000 ppm | |



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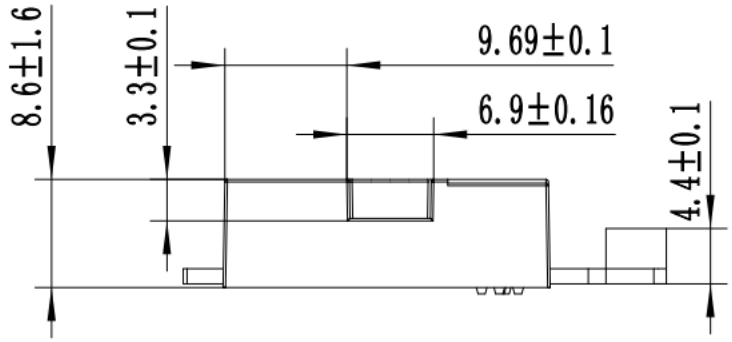
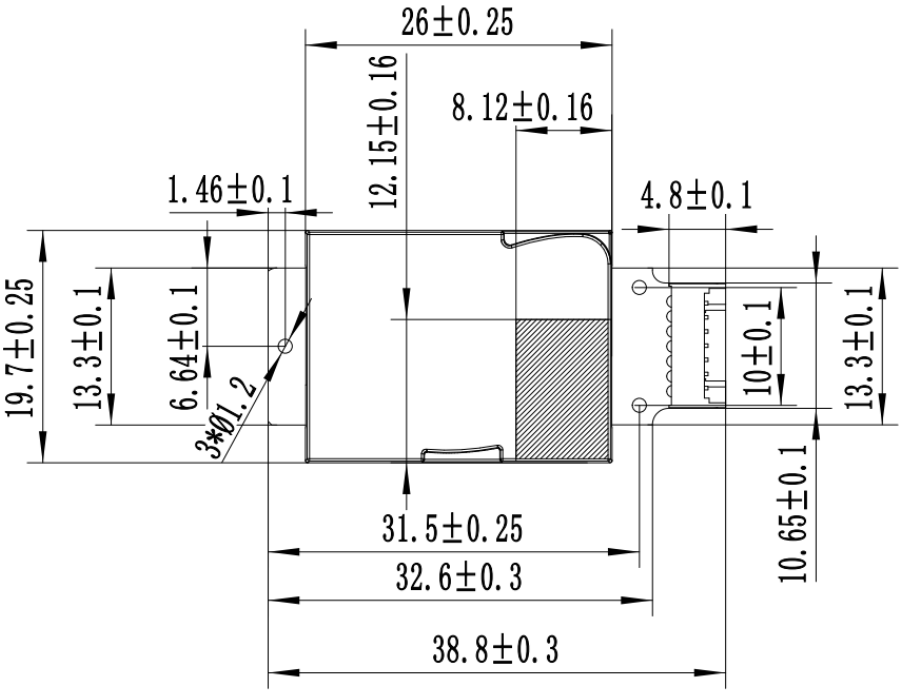
## Dimension




## Pin Definition

| Pin | Terminal pin Definition |
|---|---|
| Pin 1 | HD |
| Pin 2 | Analog Output Vo |
| Pin 3 | Negative Pole(GND) |



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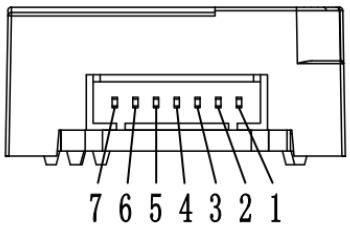
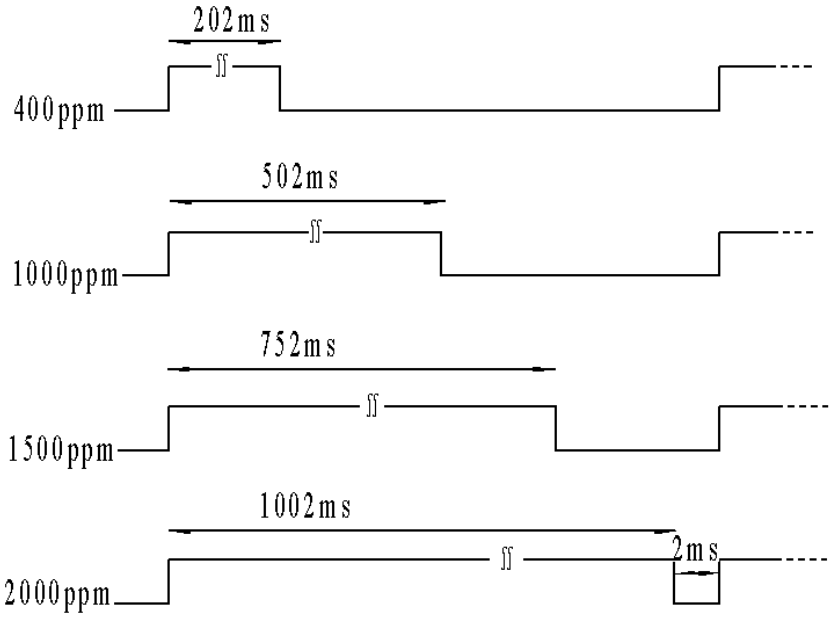
| | |
|---|---|
| Pin 4 | Positive Pole(Vin) |
| Pin 5 | UART(RXD)TTL Level data input |
| Pin 6 | UART(TXD)TTL Level data output |
| Pin 7 | PWM |




**Terminal connection version**

## Output

| **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)/(T-4ms) | |
| $C_{ppm}$: CO2 concentration could be calculated by PWM output<br>TH high level output time during cycle<br>T output time during cycle(1004ms±5%) | |



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## 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) |

**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 |

**For example: CO2 concentration = HIGH * 256 + LOW**

How to calculate concentration: convert hexadecimal 01 into decimal 1, hexadecimal F4 into decimal 244, then 1*256+244=500ppm

## Analog Voltage Output (Vo)

Conversion between analog voltage output and concentration, take 0.4V~2V as an example:
Vo(V)=0.4V+(2.0V-0.4V)*C(concentration ppm) / range(ppm)

**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 |



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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;
}
```

## 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**:

serial port (URAT). Zero and SPAN point calibration commands are as follows:

**0x87-Zero Point Calibration**

Sending 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 return value

**For example: Zero Point means 400ppm, put the module in 400ppm standard CO2 gas for at least 30 minutes. When calibration is done, the sensor concentration value is about 400ppm**

**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.



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## Notes

- Please avoid the pressure of its gilded plastic chamber from any direction, during welding, installation, and use.
- When placed in small space, the space should be well ventilated, especially for diffusion window.
- 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 work normally.)
- The module should be away from heat, and avoid direct sunlight or other heat radiation.
- The module should be calibrated termly, the suggested period is no longer than 6 months.
- Do not use the sensor in the high dusty environment for long time.
- During the zero-point calibration procedure by manual or sending command, the sensor must work in stable gas environment (400ppm) for over 30 minutes.
- Forbid using wave soldering for the sensor.
- When soldering with soldering iron, set the temperature to be (350 ± 5) ° C, and soldering time must be within 3 seconds.



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