

# SPECIFICATION

**Product Name: Miniature NDIR C3H8 Sensor**

**Item No.: SBH**

**Date: 11th August, 2020**

## Miniature NDIR C3H8 Sensor SBH



### Application

Chemical  
Industrial safety  
Liquefied gas stations  
Environmental monitoring  
Gas drainage monitoring

### Introduction

Miniature NDIR C3H8 sensor SBH adopts NDIR technology to detect C3H8 concentration in serve industrial applications. It adopts advanced non-dispersive infrared technology (NDIR), which can be integrated in safety and alarming devices, able to be used for environmental monitoring, gas drainage monitoring, chemical, petroleum, metallurgy, oil depots, liquefied gas stations, paint jobs, gas transmission and distribution and other combustible gases, storage, indoor and outdoor use and easy to leak dangerous places.

The sensor contains all the necessary optics, electronics and firmware to provide a linearised, temperature-compensated output. It is with a heated infrared source inside a small chamber. In this case, the inside temperature of the gas sensor is much higher than the outside which can avoid condensing events and the high humidity influence. Besides, the PCB inside the gas sensor is specially treated for corrosion protection.

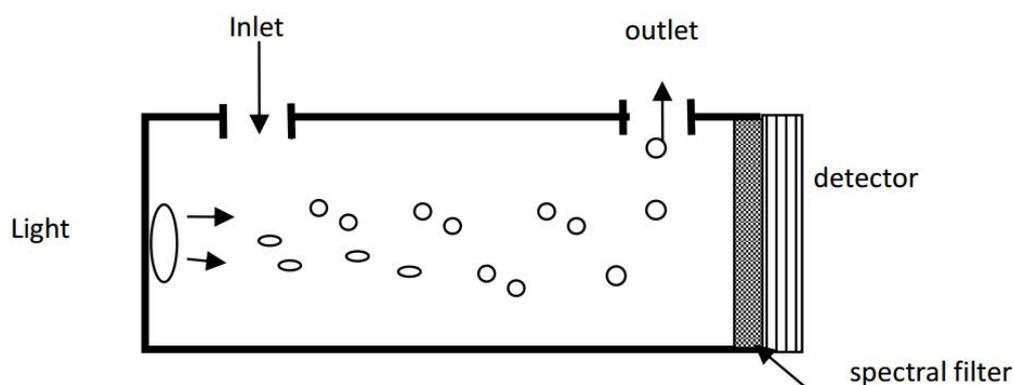
The sensor has features of long lifespan, compact size and easy handling. Also, it has high precision, less maintenance, fast response and stable performance. The sensor will process the raw signals to output a linear, temperature compensated signal proportional to the gas concentration applied. The output signal is available in digital and analogue forms.

### Main Features

- ✧ High resolution 0.01%
- ✧ Build-in Temperature compensation with good output linear
- ✧ The output signal is available in digital and analogue forms
- ✧ Working temperature -40°C~70°C
- ✧ Meet the explosion-proof level Exia IIC T4 Ga,Certificate No.GYB 191789

## Principle Of Measurement

Molecule like C<sub>3</sub>H<sub>8</sub> is composed of different types of atoms, it has absorption spectrum in infrared range. Absorption intensity abides by Lambert-Beer's Law. When light wave corresponded to certain gas with absorption spectrum passes through measured gas, the intensity of light wave will be significantly weakened. The intensity attenuation is related to concentration of measured gas. This relation follows Lambert-Beer's Law. Basic working principle of NDIR sensor is as below



Basic mathematical model : A majority of both organic and inorganic polyatomic gas have specific absorptive wavelength in infrared region. When infrared light passed by, the light transmissivity of this gas molecule to certain wavelength can be expressed by Lambert-Beer Law:

$I$  stands for light transmissivity,  $I = I_0 e^{-kpl}$

$i$  stands for light absorption intensity,  $i = I_0 - I = I_0 (1 - e^{-kpl})$

$I_0$ : incident light intensity.

$l$ : thickness of gaseous medium

$p$ : gas concentration

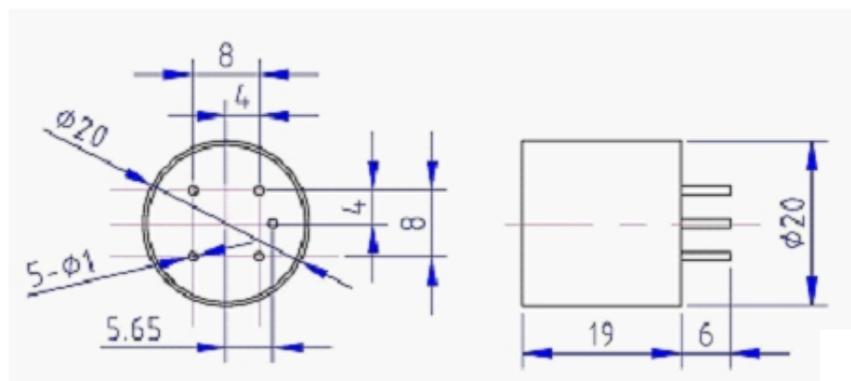
$k$ : absorption coefficient

## Technical Parameters

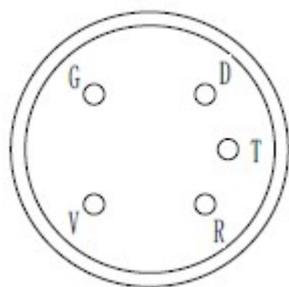
Table 1 specifications	
Working voltage	3.5-5.5VDC
Working current	75-80mA
Signal output	UART_TTL; Analogue output: 0.4V-2VDC
Measurement range	0-100%LEL
Accuracy	≤±5%LEL
Resolution	1%LEL
Warm-up time	30s
Response time T90	<15s
Zero repeatability	±1%LEL (20°C)
Zero drift	2%FS/month
Working condition	-40°C-70°C 0-95%RH(non-condensing)
Storage temperature	-40°C-85°C
Digital signal format	Data bit:8; Stop bit: 1; Check bit: null
Ex-proof Level	ExiaIICT4
Ex-proof No.	GYB14.1127
Standard baud rate	9600bps
Dimensions	Φ20 x 19mm (except pin)
Output pin	5pin
Lifespan	8-10 years (Continuous working )
Weight	15g
*Note	measurement range customization 0-75%vol

## Configuration&Pin Definition

### 1.Appearance size(unit: mm, tolerance: $\pm 0.2$ mm)



### 2.Pin Definition



pin	name	description
V	Vi	Power input (Vi: DC3.3V~5.5V (recommend Vi=5V))
R	RX	Serial port terminal (circuit board serial port receiver)
T	TX	Serial port terminal (circuit board serial port sender)
D	Vout	Voltage output terminal
G	GND	Power input terminal (ground terminal)

## Typical Application Circuit Diagram

Digital output:TTL electrical level,voltage signal is 0 or 2.5v.

Note: pay attention to level switching.

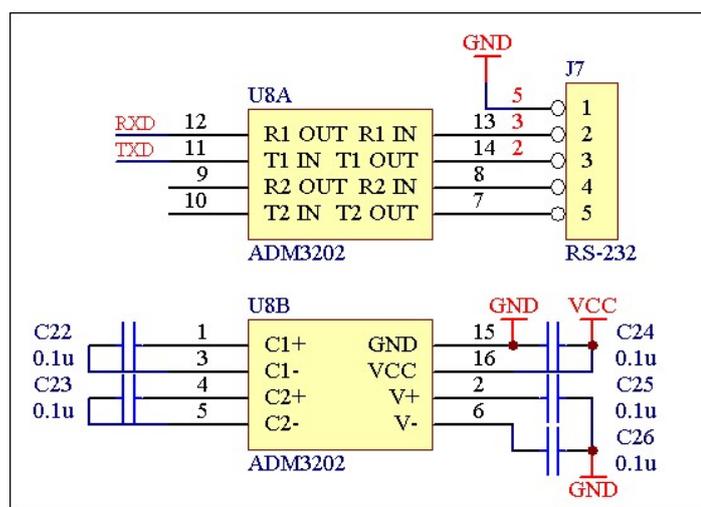
### 1. when connecting external circuit, computer circuit is illustrated below:

Baud rate: 9600bps

Data bit: 8

Stop bit: 1

Check bit: null

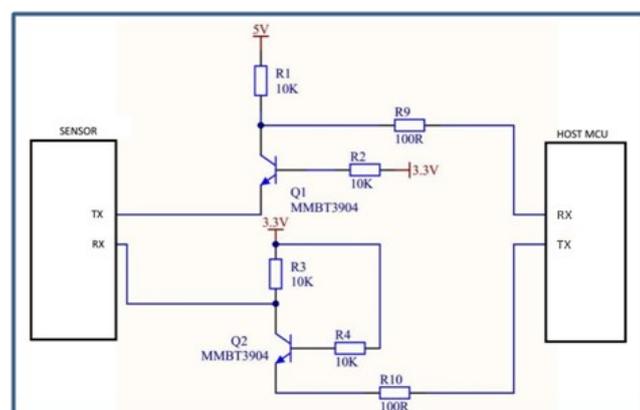


### 2. Connect with CPU(SCM), baud rate: 9600bps

A. If CPU is powered by 2.5–3.3V, C3H8 gas sensor can be connected directly and make communication.

Note: RXD of C3H8 gas sensor is connected to TXD of CPU. TXD of C3H8 gas sensor is connected to RXD of CPU.

B. If CPU is 5V, please change as per below communication circuit.



## Precautions For Use

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1. Working temperature: - 40 °C ~ 70 °C
2. The connecting cable shall be shielded cable with insulating sheath, and its shielding layer shall be grounded.
3. Users should not replace the components of this product without authority. To avoid damaging product, please kindly solve the problems in operation with our engineers.
4. Installation, use and maintenance of this product should comply with relevant provisions of product instruction, GB3836.13-1997 "Electrical equipment for explosive gas environment Part 13: Explosion Overhaul of electrical equipment for explosive gas environment ", GB3836.15-2000 "Explosive gas environmental electrical equipment Part 15: Electrical installation in hazardous places (coal) Mine)", GB3836.16-2006 "Explosive Gas Environmental Electrical Equipment Part 16: Inspection and maintenance of electrical installations (except coal mines)" and GB50257-1996 "Electrical installation engineering explosion and fire hazard environment Electrical installation and acceptance specifications".

# Communication Protocol

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## 1. General Statement

1. The data in the explanation are all hex data. Such as 46 is hexadecimal [70]
2. [xx] is single byte data(no symbol,0-255) ;(xx) is double byte data, signed integer (-32768 to +32767),the top one is ahead. “—— “ followed by explanation;
3. All the data are integer. It has (100,10,1) times relationship with true data.
4. The length of command byte is [ LB]+3.

# Communication Protocol

## 2. Communication Protocol Format

Send: [IP] [LB] [CMD] [DF] [CS]

[IP] address (fixed as 11)。

[LB] byte length followed does not include CS

[CMD] command

[DF] parameter items with command, optional

[CS] CS= — (IP +LB+CMD +DF)

Response:

a. When the command is implemented correctly, it responses

[ACK] [LB] [CMD] [DF] [CS]

[ACK]=0X16 right command

[LB] byte length followed does not include CS

[CMD] command

[DF] parameter items with command, optional

[CS] CS=— (ACK +LB+CMD+DF)

b. When the command is not implemented correctly, it responses

[NAK] [LB] [CMD] [EC] [CS]

[NAK]=0X06 Command is not implemented correctly

[LB]=2 byte length followed does not include CS

[CMD] command

[EC] the error code that command is not implemented correctly

[CS] CS= — (NAK +LB+CMD+DF)

[EC]

- 1 Order length is wrong
- 2 The command is not correct
- 3 Can't implement this command under current status.

## Communication Protocol

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### 3. Function List

No	Function	CMD	Description
1	measuring results check	0x01	Besides measuring data, it also has status information
2	Close the light source		
3	Open the light source		
4	Zeroing	0x03	
5	Calibration		
5.1	zero calibration	0x4B	
5.2	span calibration	0x4C	
6	Reset to factory model	0x4D	
7	software version check	0x1E	
8	sensor serial No. check	0x1F	

# Communication Protocol

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## 4. Detailed Description

### 1. Check measurement result

**Send:** 11 01 01 ED

**Response:** [ACK] 05 01 [DF1] [DF2] [ST1] [ST2] [CS]

**Remarks:**

1).Gas concentration =  $(DF1*256+ DF2) / 100$

2).[STx] is reserved.

### 2. Zeroing

**Send:** 11 01 03 EB

**Response:** [ACK] 01 03 [CS]

**Remark:** Stream N2 for over 30s then send the zeroing command to the sensor.

### 3. Calibration

We suggest to perform calibration to the sensor in application when it has drift problem.

The calibration method is as below:

**Send:** 11 04 4B 00 [DF1] [DF2] [CS]

**Response:** [ACK] 01 4B [CS]

**Remark:**

Gas concentration =  $(DF1*256+ DF2) / 100$

**Span calibration** (4C): the same as zero calibration but to replace 4B by 4C.

Note : We suggest to perform zero and span calibration together to ensure its accuracy, below is the example of zero calibration and span calibration.

#### 3.1. Zero calibration (4B)

**Send:** 11 04 4B 00 00 00 A0

**Response:** [ACK] 01 4B [CS]

**Remark:**

Before sending zero calibration command, please inlet N2 into the sensor over 2mins .

#### 3.2. Span calibration

**Send:** 11 04 4C 00 0 C8 AA

**Response:** [ACK] 01 4C [CS]

**Remark:**

Before sending span calibration command, please inlet 2%VOL C3H8 into the sensor over 2mins .

Note :

1:After zero calibration is done, please do span calibration immediately. Zero calibration and span calibration should be performed together.

2: If you would like to calibrate in the middle point, please calibrate the zero point and middle point together to ensure its accuracy.

## 4. Calibration data reset

**Send:** 11 02 4D 00 [CS]

**Response:** [ACK] 01 4D [CS]

**Remark:**

Remove users calibration data and reset to factory calibration data .

## 5. Software version check

**Send:** 11 01 1E D0

**Response:** [ACK] [LB] 1E [CH1] [CH2] [CH3] [C3H8] [CH5] .....[CHx] [CS]

**Remark:**

1: [CHx] is ASCLL II code.

2: LB is bite length, LB= X+1

Example of response : 16 0E 1E 53 65 6E 73 6F 72 2D 36 2E 31 35 5F 31 BD

## 6. Series number check

**Send:** 11 01 1F CF

**Response:** [ACK] 0B 1F (SN1) (SN2) (SN3) (SN4) (SN5) [CS]

**Remark:**

(SNn) is from 0-9999, five integer consists of 20 bits series number

Example of response: 16 0B 1F 07 0E 00 96 0C E4 23 35 00 00 CD

## Failure output pattern analysis

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The sensor will begin the measurement after it is power on and warm up, then the user can get the C3H8 concentration value through digital output and voltage output.

Different voltage output means C3H8 sensor is in different status. The detailed description is as below :

U <sub>o</sub> voltage output	Description
0V	When the voltage output is 0V, the sensor malfunctioned.
0.2V	When the voltage output is 0.2V, the sensor was still in warm-up process.
0.4V	When the voltage output is 0.4V, the sensor measurement value is 0.
2V	When the voltage output is 2V, the sensor measurement value should be full scale value.
2.2V	When the voltage output is 2.2V, the sensor measurement value should be full scale value.

## After-sales Services And Consultancy

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