USERS MANUAL

Infrared Methane Gas Sensor

For safety and alarms

CU-1000

CO2METER.COM
CO2 MEASUREMENT SPECIALISTS

Contents

CAUTION

1. Working environment：-40℃～70℃
2. The CU-1000 must be used with explosion-proof equipments; the system wiring must comply with the product and the instructions associated with the use of equipment requirements shall not take the wrong terminal. Safety parameters and the maximum content of the equivalent parameter table is displayed below:

Terminals	Max input voltage Ui(V)	Max input current summary ∑Ii(mA)	Max input consumption summary ∑Pi(W)	Maximum internal equivalent parameters	
				Ci(uF)	Li(mH)
Vi-GND	6	350	0.7	16	0
Uo-GND	6			16	0
Tx-Rx-GND	6			16	0

3. This product and associated equipment's connection cables should be protected by a sheath, the shield should be grounded.
4. Users shall not replace the product components; in conjunction with our technical staff together to solve the fault occurred in operation to prevent damage.

Main Features

- ✧ 0-5%
- ✧ GasLab exclusive power management function
- ✧ NDIR technology with Zero and Span calibration
- ✧ Provides for span adjustment, (expanded or compressed for a broad range of applications outside the direct CH4 LEL measurement.)
- ✧ ATEX for combustible environments
- ✧ Voltage and RS232 output available
- ✧ High precision, less maintenance, fast response, stable performance
- ✧ Internal temperature compensation
- ✧ Typical low power consumption
- ✧ Detective level at 100ppm
- ✧ Easy application integration

1 Introduction

1.1 Briefing

Thank you for purchasing the CU-1000 Infrared Methane Gas Sensor. This sensor has power management which enables you to stop the sensor measuring activity via software, making it useful for portable and hand-held operations. This sensor is reliable and can be easily integrated into a variety of applications including environmental monitoring, algae growth, decomposition, drainage monitoring, chemical, petroleum, metallurgy, oil depots, liquefied gas stations, paint jobs, or anywhere methane is produced.

Other applications include combustible gas storage safety, or anywhere Methane leaks can occur.

The sensor advantages include taking readings at user-defined intervals, the ability to detect refrigerants such as R32 or other hydrocarbons like propane gases. It is compatible with the GasLab software via UART interface of the GasBox. The sensor also, has a voltage output and RS232 output available.

This infrared methane sensor complies with Ex-proof Exia Ⅱ CT4. Ex-proof No. GYB14.1127. The certificate No. is GYB101873.

Infrared CH4 gas sensor	
Working voltage	3.5-6VDC
Working current	75-80mA
Output voltage	0.4V-2VDC
Measurement range	0-5%
Resolution	Measurement range A: 0 ～ 5%vol, resolution is 0.01% ; Measurement range B: 0%～100%vol 0-10% resolution for 0.01%; above 10% resolution is 0.1%
Warm-up	30s
Response time T90	<25s
Zero repeatability	±1%FS （20℃）
Sensitivity repeatability	0～5%vol：0.1% （20℃）
Zero drift	1%/month
Working condition	-40℃-70℃, 0-95%RH(non-condensing)
Storage temperature	-40℃-85℃
Digital signal format	Data bit:8; Stop bit: 1; Check bit: null
Standard baud rate	9600bps
Dimensions	Φ20 x 19mm（except pin）
Output pin	5pin
Lifespan	>5year
Signal Output	UART_TTL; Analogue output: 0.4V-2VDC
Accuracy	0-1%Vol: ±0.06%Vol absolute value 1-5%vol : ±6% of reading
Weight	18g

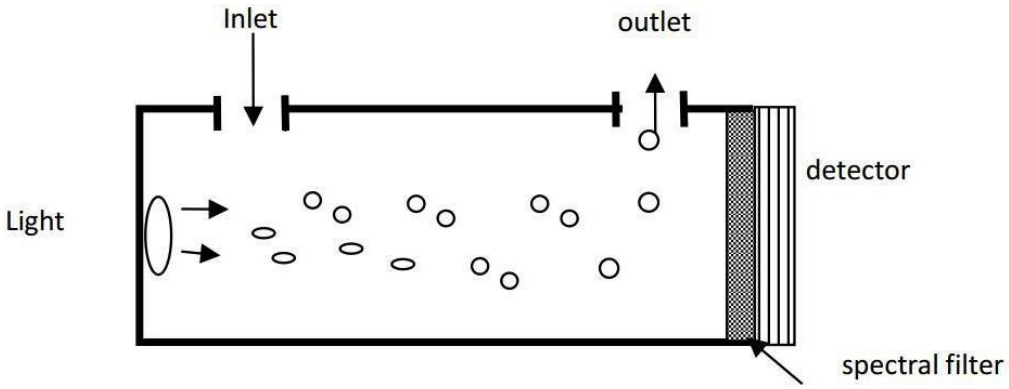
1.3 Configuration

Parts	Pictures	Description
Gas sensor		CU-1000 Infrared gas sensor

Picture is only for reference

1.4 Principle of measurement

Molecule like CH4 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, $\boldsymbol{I = I_0 e^{-kpl}}$

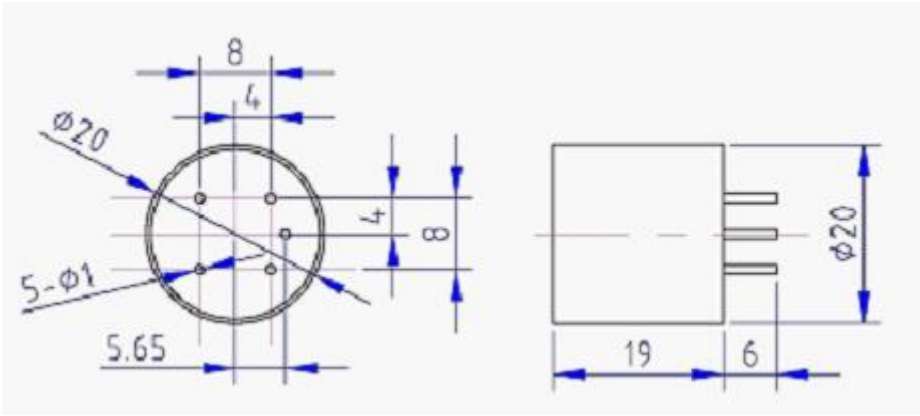
i stands for light absorption intensity, $\mathbf{i = I_0 - I = I_0 (1 - e^{-kpl})}$

$\boldsymbol{I_0}$**:** incident light intensity.
l: thickness of gaseous medium
p: gas concentration
k: absorption coefficient

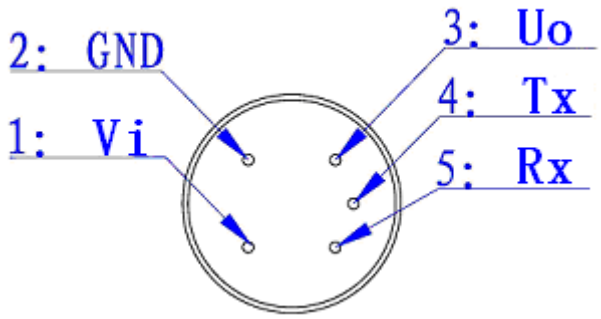
2. Functions & Operation

2.1Appearane & I/O definition

2.1.1Appearance



2.1.2 I/O definition



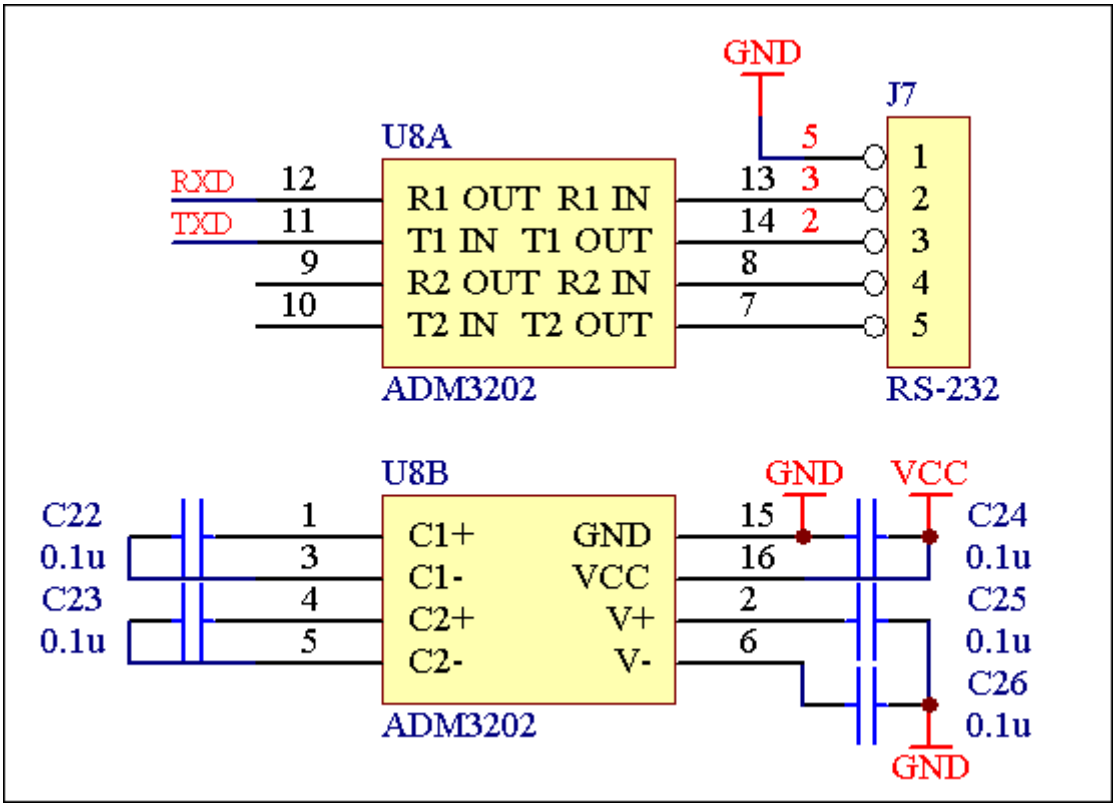
Vi：DC3.5V～6V（recommend: Vi=5V）

Number	Name	Description
①	Vi	Power input（Vi：DC3.5V～6V（Recommend Vi=5V）
②	GND	Power input(ground terminal)
③	UO	Voltage output
④	TX	UART-TX output
⑤	RX	UART-RX input

2.1.3 Digital output interface circuit (reference)

Digital output：TTL electrical level，voltage signal is 0 or 2.5v，
1. Connect with PC : Pay attention to level switching when connecting external circuit, computer circuit is illustrated below：

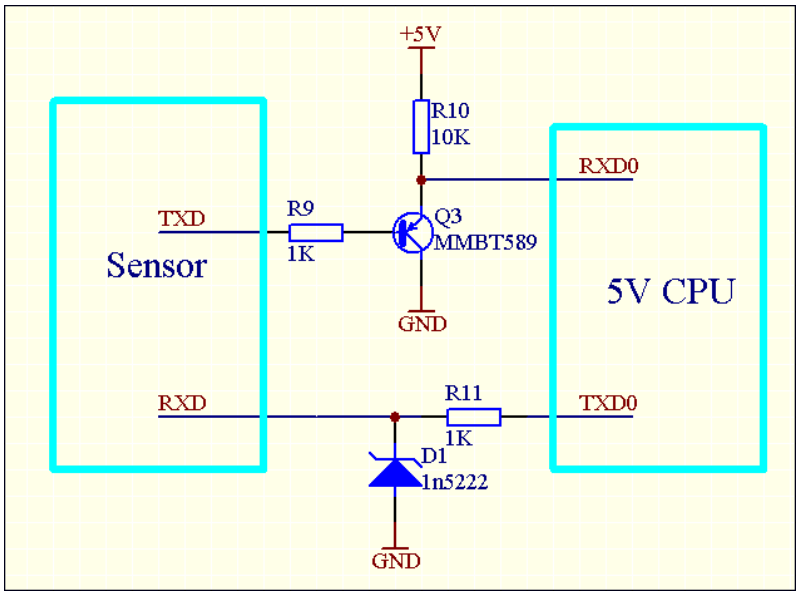
Baud rate：9600bps
Data bit：8
Stop bit：1
Check bit：null



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

A. If CPU is powered by 2.5 – 3.3V, CH4 gas sensor can be connected directly and make communication. Note: RXD of CH4 gas sensor is connected to TXD of CPU. TXD of CH4 gas sensor is connected to RXD of CPU.

B. **If CPU is 5V, please change PWL.** Here is for reference: （Or use the other PWL conversion circuit, for example, optocoupler, converted IC etc）



2.2Operation

2.2.1 Power on

Be sure the preparation is OK before Power on:

- ✓ Power connection is right
- ✓ I/O ports connection is right

2.2.2 Power off

The sensor must be powered off in standby mode. Power off is not allowed when during zeroing and calibration.

Before powering off the gas sensor should be in fresh air for 1 to 3 minutes to ensure the gas cell is empty and avoid possible measurement error by the rest gas or dust.

2.2.3 Measurement

After warm up, the gas sensor is in standby mode. In this case, the sensor can measure CH4 concentration in an existing environment, and the concentration can be by voltage output or RS232.

If the gas sensor appears at zero drift in the fresh air (or pure Nitrogen), but the drift is smaller than the max error it permits, zeroing should be carried out first. If in fresh air or If the drift is larger the max error, calibration needs to be done. All of these operations will assure measurement precision.

2.3 Digital output Communication protocol

Summary:

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.

Command 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.

Function list

No	Function	CMD	Description
1.	**measuring results check**	0x01	Besides measuring data, it also has status information
2.	**Zero**		
2.1	**Zeroing**	0x03	
3.	**Calibration**		
3.1	**zero calibration**	0x4B	
3.2	**span calibration**	0x4C	
4	**Reset to factory model**	0x4D	
5	**software version check**	0x1E	
6	**sensor serial No. check**	0x1F	
7	**Gas measurement property check**	0x0D	

1. Look up measurement result

Send： 11 01 01 ED

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

Function： Look up measurement result.

Remarks：

1).Gas 1 concentration = （DF1*256+ DF2）/ (corresponding multiple)

2).[ST] means status of system, which give the information of working status of it. For example: to check whether it need zeroing, sampling signal is correct, users options.

2. Look up voltage result

Send： 11 02 02 [TVM] EB

Response： [ACK] 0A 02 [TVM] [FV1] [FV2] [FV3] [FV4] (refVpp) (testVpp) [CS]

Function： Look up voltage result.

Remarks：

1). [TVM] gas measurement voltage.

2). [FV1] [FV2] [FV3] [FV4] to calculate voltage. Four bytes consist of floating type

3). (refVpp) is referred voltage peak, its range is about 0-4 or 5 k

4). (testVpp) is measurement voltage peak

3. Zero

Send： 11 01 08 E6

Response： [ACK] 01 08 [CS]

Function： Zeroing

Remark： When the sensor received zeroing command you sent, please ensure zero gas is inlet for at least 40 seconds.

4. Calibration

After the bench is used for some time, it need calibration.

4.1. Zero calibration （4B）

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

Response： [ACK] 01 **4B** [CS]

Function： Zero calibration for the bench

Remark：

1) [GasNum] means indicator bit of gas calibration.

TVM	Description
00	doing zero calibration for CH4

2) Gas concentration = （DF1*256+ DF2）/ (multiple)

3) Before sending zero calibration command, please inlet N2 into the bench over 2mins .

After zero calibration is done, please do span calibration immediately. If do zero calibration or span calibration only, calibration is invalid.

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

5. Calibration data reset

Send： 11 02 4D [GasNum] [CS]

Response： [ACK] 01 4D [CS]

Function：

Remark：

1. Reset users calibration data to factory calibration data
2. [GasNum] means indicator bit of gas calibration.

6. Software version check

Send： 11 01 1E D0

Response： [ACK] 0C 1E [CH1] [CH2] [CH3] [CH4] [CH5] [CH6] [CH7] [CH8][CH9][CH10][CH11][CH12] [CS]

Function： to check software version

Remark：

[CHx] is ASCLL II code.

7. Series number check

Send： 11 01 1F CF

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

Function： to check the series number of the bench

Remark：

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

8. Gas measurement property Check

Send： 11 01 0D [CS]

Response： [ACK] 06 0D [DF0] [DF1] [DF2] [DF3] [DF4] [CS]

Function： to check gas measurement range, decimal digitals, gas components, unit and so on

Remark：

1. Gas concentration=[DF0]*256+[DF1])/multiple (it is decided by decimal digital)
2. The definitions of [DF2] and [DF3] are as follows：

[DF-2]	description of decimal digital	[DF3]	Gas component
0	0000, means 1 time	0	CH4
1	000.0 means 10 times	1	CO2
2	00.00 means 100 times	2	CO
3	0.000 means 1000 times	3	

3. the definitions of [DF4] is as follows：

[DF-4]	Description of unit		
0	ppm		

Warm-Up Time

The Warm-Up Time for the NDIR sensor is 30 seconds after each power "ON" or every time when we are changing from Configuration to Normal/Engineering Mode. During this time data are not valid.

The Warm-Up time is not including the period that the sensor needs to reach the ambient temperature. The sensor though is capable of producing readings during the Warm-Up but with a much higher error than specifications.

Digital Interface/Communication

In terms of the Software implementation, we will need a way to read the Digital Output by using a Microcontroller (MCU) or a Personal Computer (PC) is required. The Software with the Evaluation Kit is compatible with Windows Operating System only and at the moment is not possible to read the Analogue output by using the evaluation Software.

Faults Monitoring/Error States

The Error monitoring and Fault generation happens every second transmitted by the UART. Regularly check all the Faults generated from the sensor to ensure errorless communication and rise appropriate alarms depending on the Fault code.

Analogue Output

The Analogue Output is updated every one second.

Analogue voltage is directly related with the concentration.

INTENDED USE

This device has been designed to be used as component together with instruments to detect either flammable gas or carbon dioxide of certain concentrations.

WARNING

In addition, please pay attention to the following conditions as they will void immediately the WARRANTY:

1. Do not allow water condensing into the sensor or deep the sensor into water.
2. Do not over voltage or over current the sensor; always observe the correct polarity of the input.
3. Do not solder directly onto the pins, pads or the external body of the sensor.
4. Do not use in acid environment or operate under gases containing acid vapours or particles.

ESD PRECAUTION

ESD (Electrostatic Discharge) sensitive device.

Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary subjected circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Warning! Plugging or unplugging the Sensor while in operation may damage the device beyond repair. Always power down the instrument when performing maintenance.

HANDLING PRECAUTIONS

3. Do not drop the NDIR CH4 sensor on the floor as this could cause damage to the pins or internal components.

4. Avoid mechanical force against pins or sockets. Protect from dust and sprayed acidic particles.

5. Do not immerse in water or other fluids.

6. Do not solder the module directly onto a pcb or to wires. Excessive heat could cause damage.

ROHS COMPLIANCE

Under the EU Directives, compliance testing is necessary for Pb, Cd, Hg, Cr (VI) and Br. The RoHS directive is effective since July 1, 2006.

The regulations prohibit the use of these hazardous substances in new products sold after July 2003.

WEEE DIRECTIVE

WEEE (Waste from Electrical and Electronic Equipment) is a directive that controls how electric and electronic equipment is handled and recycled effective since August 13, 2005.

NDIR CH4 sensors do not need to have a recycling scheme in place but manufacturers may need WEEE compliance for their systems.

ATEX/IECEx CERTIFICATIONS

The ATEX directive consists of two EU directives describing what equipment is allowed in an environment with an explosive atmosphere. The NDIR CH4 sensor is certified for Exia II CT4.

Contact us: We're here to help!

If the troubleshooting guide above doesn't help you solving your problem or for more information, please contact us using the information below.

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See CO2Meter, Inc. Terms & Conditions at:
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