SPECIFICATION

Product Name: TDLAS CH4 Sensor

Item No.: Gasboard-2501-100D

Version: V20240417

Date: April 17th, 2024

Revision

No.	Version	Content	Date
1	V20240417	Preliminary version	2024.04.17

TDLAS CH4 Sensor

Gasboard-2501-100D

Applications

- Utility tunnel or utility trench
- Underground well (electric manhole covers, gas well)
- Voltage regulator cabinet
- Industrial combustible gas leakage monitoring

Description

Gasboard-2501-100D is a methane gas sensor based on Cubic self-developed Tunable Diode Laser Absorption Spectroscopy (TDLAS) technology. Cubic TDLAS gas sensor contains high performance probe and special processing gas chamber with advantages of high accuracy, high sensitivity, wide working temperature range, long life time and high stable performance etc. With optimized temperature compensation algorithm, the anti-interference performance is excellent, which makes it can work stably at hazardous conditions and complex gas environments.

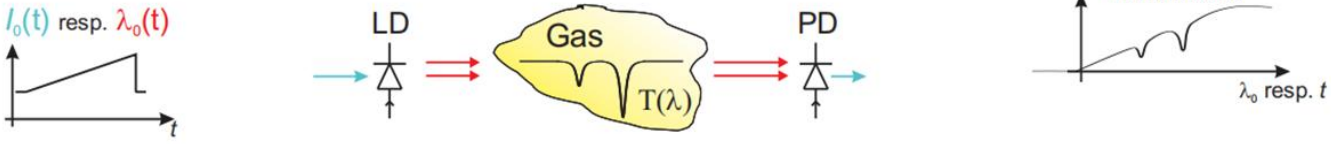
The sensor is easy to install and maintain as it adopts modular and low power consumption design and can be calibrated through TTL communication interface.

Features

- 0~100%Vol measurement range
- Fast response, high accuracy, long life span
- TDLAS technique drive unique methane selectivity, no interference from other gases, water vapor, dust particles
- Low power consumption, modular design, ease of integration

Working Principle

TDLAS sensor mainly consists of a laser light source, an air chamber, and a laser detector, etc. A specified wavelength transmitted by the laser light source will change periodically as the input current being modulated periodically. Scan the wavelength to make the laser output a center wavelength that equals to the absorption peak of the gas to be measured. The gas concentration can be calculated from the spectral intensity signal after absorption.



Specifications

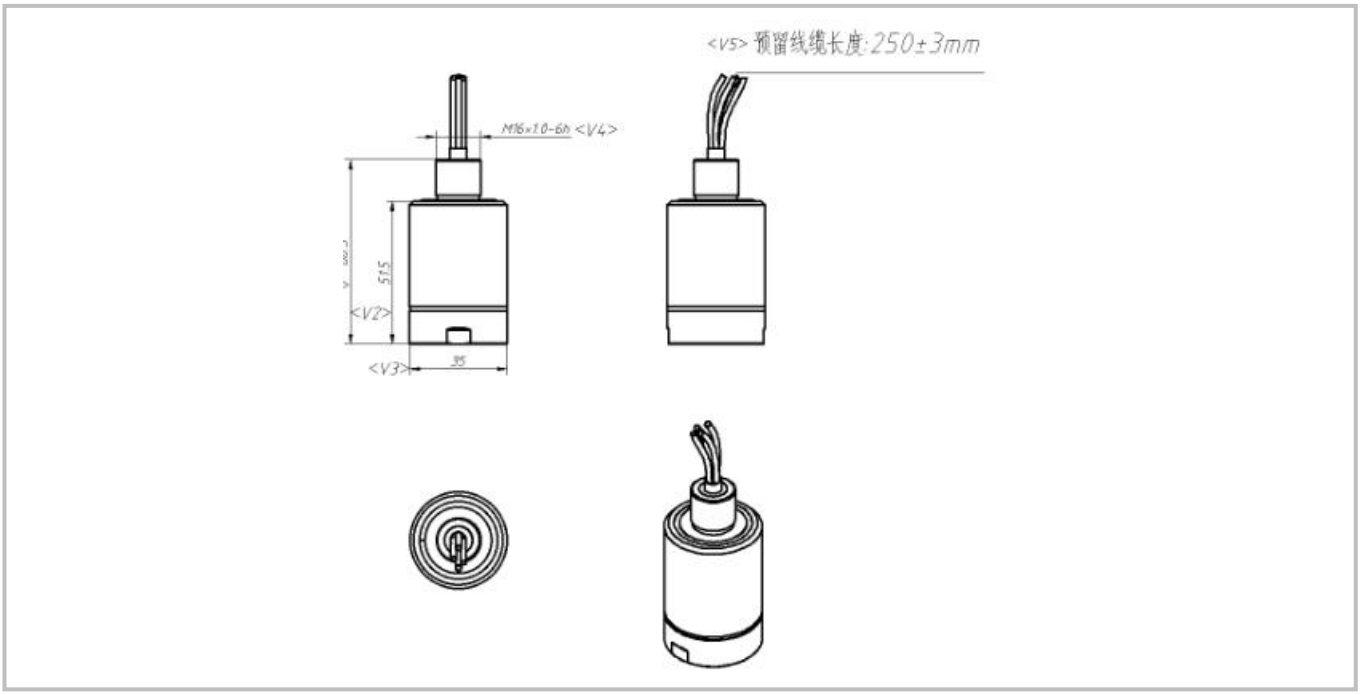
Gasboard-2501-100D Gas Sensor Specification	
Target gas	Methane (CH4)
Working principle	Tunable Diode Laser Absorption Spectroscopy (TDLAS)
Measurement range	0~100%Vol
Accuracy	0~1%Vol: ≤±0.1%Vol 1%~100%Vol: ≤±10%FS
Resolution	0.01%Vol
Warm-up [1)]	<10s
Response time (T90)	T90 < 20s
Working temperature	-25 ~ 55℃
Working humidity	0~98%RH (non-condensing)
Working pressure range	80 kPa~120kPa
Working voltage	3.2V~5.5V
Working current	<30mA (@ 25℃,3.3V)
Output	UART_TTL (3V)
IP Grade	IP66
Storage condition	-40 ~ +85℃; 0~98%RH (non-condensing)
Dimension	35mm*66.5mm (diameter*length)

Note:

1) Sensor outputs measured concentration 5 seconds after powered-on, and provides status after warm-up completed.

Product Dimensions and Pin Definition

1. Dimensions (Unit: mm)



2. Pin Definition

Pin	Name	Color	Description
1	V	Red	Power Input(3.2V~5.5V)
2	GND	Black	Power Ground
3	TX	Green	Serial Port Send
4	RX	Blue	Serial Port Receive

3. Connector

Mating Connector	PCB Connector	Pin Pitch	Manufacturer
HX25012-4Y	HX25013-4A	2.5mm	HongXing Electrical

Precautions

1. During transportation, the sensor is not allowed to be subjected to severe mechanical shock and exposure to the sun and rain, and is strictly prevented from falling, rolling, and heavy pressure;
2. Please read the manual before use to understand the performance and usage to avoid accident or damage to the instrument caused by incorrect operation. Avoid large shocks and vibrations, so as not to affect the service life of the sensor;
3. In order to ensure good detection accuracy, the power supply of the sensor must be within the range of technical parameters and use the correct power supply;
4. Before a ventilation and calibration operation, clean stains (include water stains) on the sensor;
5. It is not allowed to disassemble the sensor for maintenance. please contact the manufacturer in time if you encounter problems that cannot be solved.
6. It is forbidden to weld the connection of the sensor's wiring interface when it is powered-on;
7. Make sure that there is no large static electricity (larger than 3000V) remaining on the connected device before the sensor is connected, especially when connecting it to a PC serial port;
8. When testing independently, it is recommended to connect the test adapter.

Communication Protocol

1. Protocol Overview

The sensor communicates with other devices via serial port with settings as below:

Configuration	Parameter	Remark
Baud rate	115200	3V/DC
Data bit	8	
Stop bit	1	
Parity	None	
Flow control	None	

2. Sensor's Active Data Format

The sensor will send length variable string data actively when it is in working mode. The data format as below:

Format	[Concentration] [Space] [Temperature] [Space] [Pressure] [Space] [Status Code] [Space] [Checksum]<CR><LF>											
Meaning	Conc.	Space	Temp.	Temp. Sign	Space	Baro. Press.	Baro. Sign	Space	Status Byte	Space	Checksum	Carriage Return	Line Feed
Example	0.00	<SP>	9.0	℃	<SP>	1012.01	mbar	<SP>	21	<SP>	9c	<CR>	<LF>
ASCII(Hex)	30 2E 30 30	20	39 2E 30	A1 E6	20	31 30 31 32 2E 30 31	6D 62 61 72	20	32 31	20	36 63	0D	0A

Note:

1. Displayed concentration range is from 0 to 1.2*F.S. Resolution and unit are the same as sensor's specifications.
2. Temperature range: -40.0~85.0
3. Barometric pressure range: 200.00~1200.00

Checksum calculation:

Checksum = 0x100 – (sum of the bytes from start of the frame to the byte before last space) %100

The checksum calculation for the example above is shown as below:

Checksum =

100–(30+2E+30+30+20+39+2E+30+A1+E6+20+31+30+31+32+2E+30+31+6D+62+61+72+20+32+31) %100 = 6C

ASCII "6**C**" = Hex(**36 63**).

Status byte:

Bit	7	6	5	4	3	2	1	0
Description	Reserved	TEC Temperature Abnormal	Calibration Data Abnormal	Temperature Over Range	Warming Up	Baro. Pressure Abnormal	Temperature Abnormal	Optical Path Malfunction

Description: The status code is 8-bit hexadecimal data, with each 1 bit representing 1 alarm type, 0 indicating invalid and 1 indicating valid. Multiple states may exist simultaneously,

Example: 'A' corresponds to binary 00001010, indicating that preheating is in progress and the temperature is abnormal; 0 corresponds to binary 000000, indicating normal operation.

Explanation to status:

- **Optical Path Malfunction:** might be caused by condensation, pollution, or obstruction on the mirror surface, and maintenance is required;
- **Temperature / Barometric Pressure Abnormal:** temperature and barometric pressure that used for correction is abnormal which needs to be investigated before use;
- **Warming Up:** sensor is pre-heating process;
- **Temperature Over Range:** working temperature exceeds the allowable temperature of the sensor which may cause big error to the measurement results.
- **Calibration Data Abnormal:** requires resetting to factory settings and re-calibration;
- **TEC Temperature Abnormal:** refers to abnormal internal temperature control, and it is necessary to check whether the power supply meets the requirements.

3. Host Send Data Format

Sensor supports hex format data frame to set the parameters. The parameters include: zero adjustment, user calibration and reset. Please be noted that:

1) Concentration below the set zero-point threshold will output as 0.
2) Proceed calibration after gas concentration stabilized;
3) The value for user calibration should be scaled according to resolution. For instance, when making a calibration on a sensor with resolution 0.01%Vol with 100%Vol standard gas, the calibration value should be set as 10000.

Host send data frame format shown as below:

Start	Command	Data1	Data2	Checksum	0x0D	0x0A

Data frame length is 7 bytes. Detailed description as below:

Start: start byte of the frame, fixed to 0x3A in hex format.

Command: command character which is described as below:

No.	Command Function		Char	Hex	Description
1	**Read Measurement Results**		'0'	0x30	Read measurement results
2	**Set Zero Point Threshold**		'1'	0x31	Set the zero-point threshold
3	**User Calibration**	Zero Point Calibration	'7'	0x37	Calibrate zero point
		Full Scale Point Calibration	'3'	0x33	Calibrate full scale point
4	**Reset to Factory Settings**		'5'	0x35	Restore zero adjustment and full-scale point calibration parameters.

Data1 and Data2: form a 16-bit signed integer with Data1 as higher byte and Data2 lower byte. The value of them should be scaled according to sensor's resolution. Example:

For a sensor with measuring range 100% and resolution 0.01%, the scaled multiple is 100. Data1 and Data2 value in each command will be set as below:

1) Read Measurement Results: Data1 = 0x00, Data2= 0x00
2) Set Zero Point Threshold: if it needs to set zero-point threshold to 10%Vol, then the set value is 10 * 100 = 1000, Data1 = 0x03, Data2 = 0xE8.

3) User Calibration: if the sensor is out of the specified accuracy after a long-term use, a user calibration can be conducted. User calibration contains zero-point calibration and full-scale point calibration and they should be performed together and the time interval between them should be as short as possible.
   - Zero Point Calibration: use standard N2 to calibrate the zero point. The set value is 0 * 10 = 0. Therefore, Data1 = 0x00, Data2 = 0x00.
   - Full Scale Point Calibration: use a 100%Vol standard gas to calibrate the full-scale point, the set value is 100 * 100 = 10000. Therefore, Data1 = 0x27, Data2 = 0x10;
4) Reset to Factory Settings: Data1 and Data2 can be set to any numeric value.

Checksum: an 8-bit check byte which is the cumulative sum of the hexadecimal values of the command and data (reserve the lower 8 bits).
Note: Checksum = Command + Data1 + Data2

0x0D 0x0A: End character

4. Sensor's Response Data Format

Sensor's response data format to each command is shown as below:

Start	Command	Flag	Checksum	0x0D	0x0A

Data frame length is 6 bytes. Detailed description as below:

Start: start byte of the frame, fixed to 0x3A in hex format.

Command: command character which is described as below:

No.	Command Function		Char	Hex
1	**Read Measurement Results**		Format same as active data output	
2	**Set Zero Point Threshold**		'2'	0x32
3	**User Calibration**	Zero Point Calibration	'8'	0x38
		Full Scale Point Calibration	'4'	0x34
4	**Reset to Factory Settings**		'6'	0x36

Flag: status of the command's execution. Character '1' means success, character '0' means fail.

Checksum: an 8-bit check byte which is the cumulative sum of the hexadecimal values of the command and flag (reserve the lower 8 bits).
Note: Checksum = Command + Flag;

0x0D 0x0A: End character

Example:

Command	Host Send Data Format	Sensor Response Data Format
Read Measurement Results	0x3a 0x30 0x00 0x00 0x30 0x0d 0x0a	Format same as active data output
Set Zero Point Threshold	0x3a 0x31 0x00 0x00 0x31 0x0d 0x0a	0x3a 0x32 0x31 0x63 0x0d 0x0a
Zero Point Calibration	0x3a 0x37 0x00 0x00 0x37 0x0d 0x0a	0x3a 0x38 0x31 0x69 0x0d 0x0a
Full Scale Point Calibration	0x3a 0x33 0x27 0x10 0x6a 0x0d 0x0a	0x3a 0x34 0x31 0x65 0x0d 0x0a
Reset to Factory Settings	0x3a 0x35 0x00 0x00 0x35 0x0d 0x0a	0x3a 0x36 0x31 0x67 0x0d 0x0a

Note: Full scale point calibration in the example above is to calibrate the sensor to 100%Vol.

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