

TDLAS200 Series Laser Methane Sensor

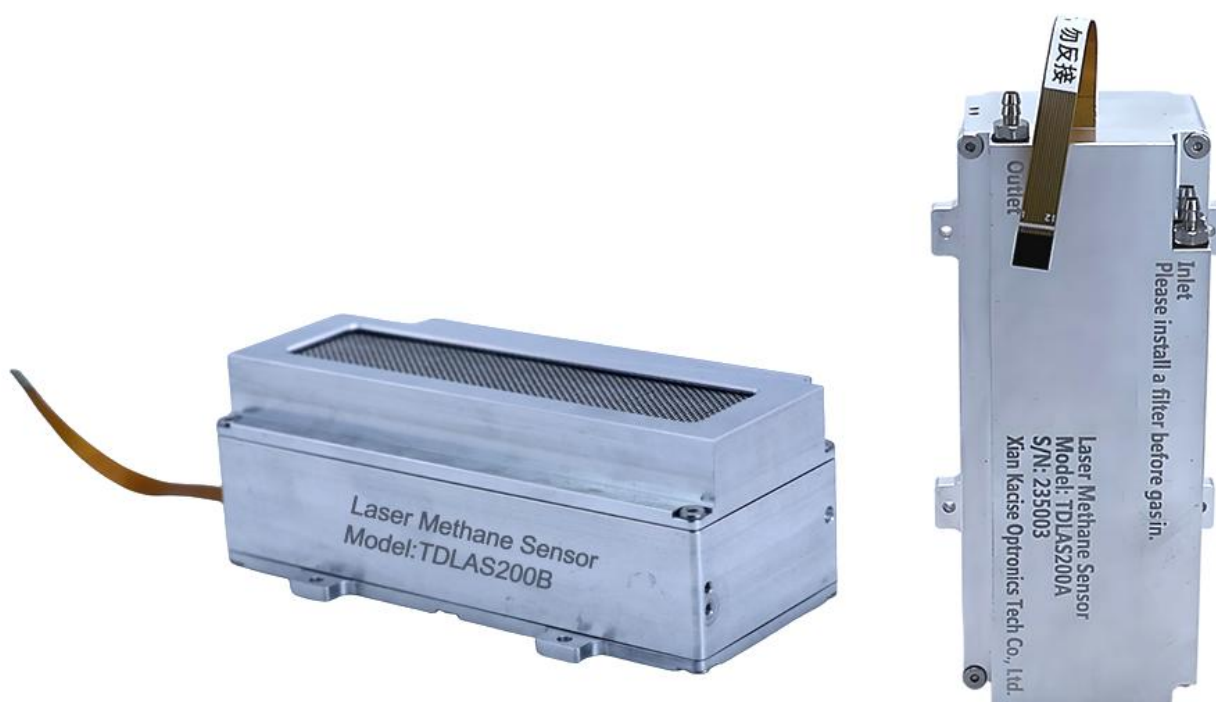


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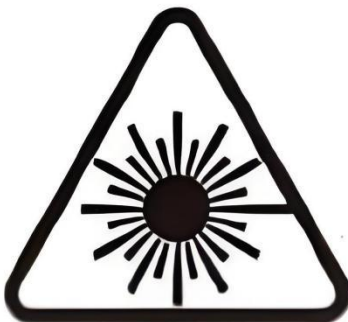
Please read the following carefully before using this product and ensure correct operation.



Please check the structure and assembly of the equipment before each use to promptly detect structural hazards such as deformation and breakage!



Do not attempt to repair or replace instrument parts by yourself ! When the instrument does not work properly or prompts an error message, please refer to the relevant descriptions in this manual to perform repair operations, or contact the manufacturer's technical staff.



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Package



1.Introduction

The TDLAS201 laser gas telemetry module is manufactured based on laser absorption spectroscopy technology. It emits a laser beam of a specific wavelength to detect whether there is a target gas in the optical path range of the laser, thereby obtaining the concentration of the target gas.

2.Features

- High sensitivity, only responds to the target gas
- Built-in reference cell, can be automatically calibrated
- Easy to integrate, digital interface directly outputs status and concentration

3.Measuring Principle

"Methane molecules absorb light of a specific wavelength"

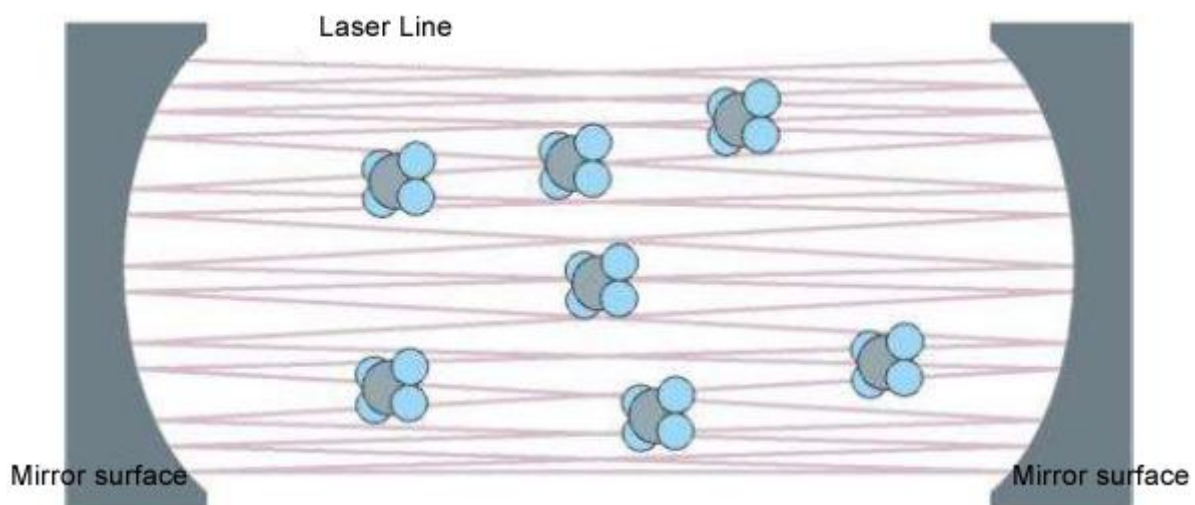
--Molecular absorption spectrum

"The amount of light absorbed by a transparent medium (methane gas mass) is proportional to the thickness and concentration of the gas mass"

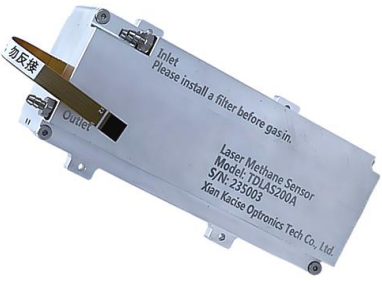
--Beer-Lambert's law

According to the above physical principles, a beam of light of a specific wavelength can be used to penetrate the leaking methane gas mass. According to the degree of weakening of the beam, the concentration of methane in the gas mass can be measured, and it only responds to methane (unique selectivity).

Using a detection cell with multiple reflections and allowing the laser to repeatedly pass through the gas being measured can multiply the detection sensitivity.



4. Technical Parameters

Product model	TDLAS200A(Pump)	TDLAS200B(Diffusion)
		
Detection object	Methane (CH ₄)	
Measurement principle	Laser absorption spectrum (TDLAS)	
Static detection limit	0.5ppm@25℃ 5SPS (typical value, please contact us for details)	
Volume	53ml	
Fastest response time	0.2s	90s
Measurement range	0~5000ppm,0-10000ppm	
Measurement deviation	0~200 ppm: ±2 ppm of the true value 200~1000 ppm: ±1% of the true value 1000~5000 ppm: ±2% of the true value 5000~10000 ppm: ±3% of the true value	
12hrs drift	+/-1.5ppm	
Operating temperature	-20~50℃	
Power supply	5-12VDC 1W (typical) 6W (maximum) Recommended 12V 1A	
Dimensions	115×59×38mm	115×59×40mm
Gas inlet/outlet port	Pagoda direct M-5AU-4	

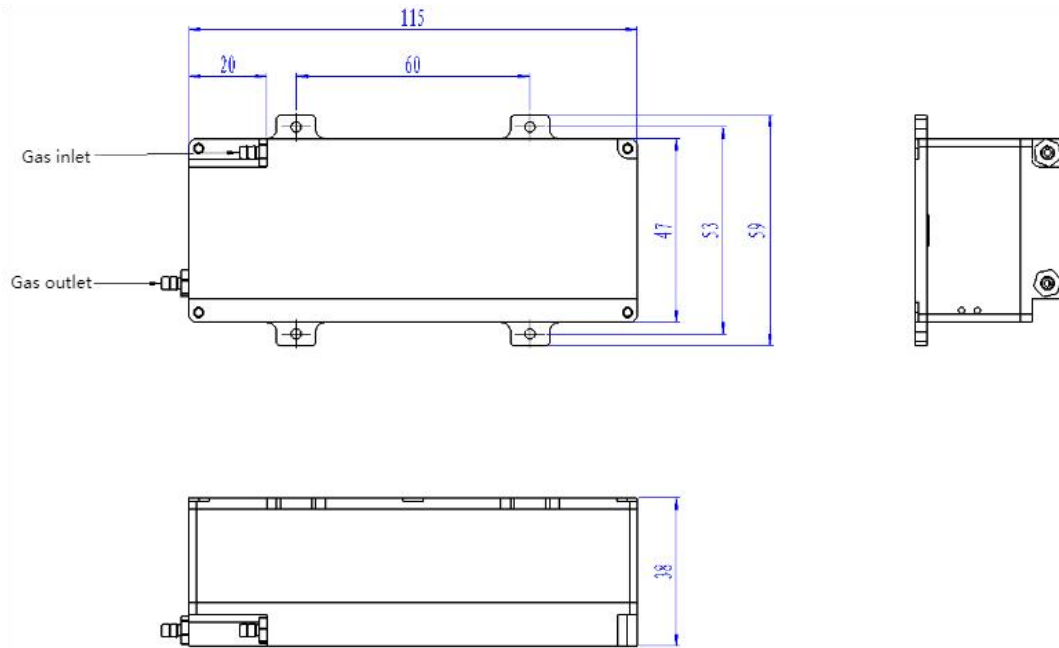
*1 Please ensure that the power input voltage of the module is not less than 5V

*2 Pump selection recommendation <500ml/min

5.Composition of the Detection Module

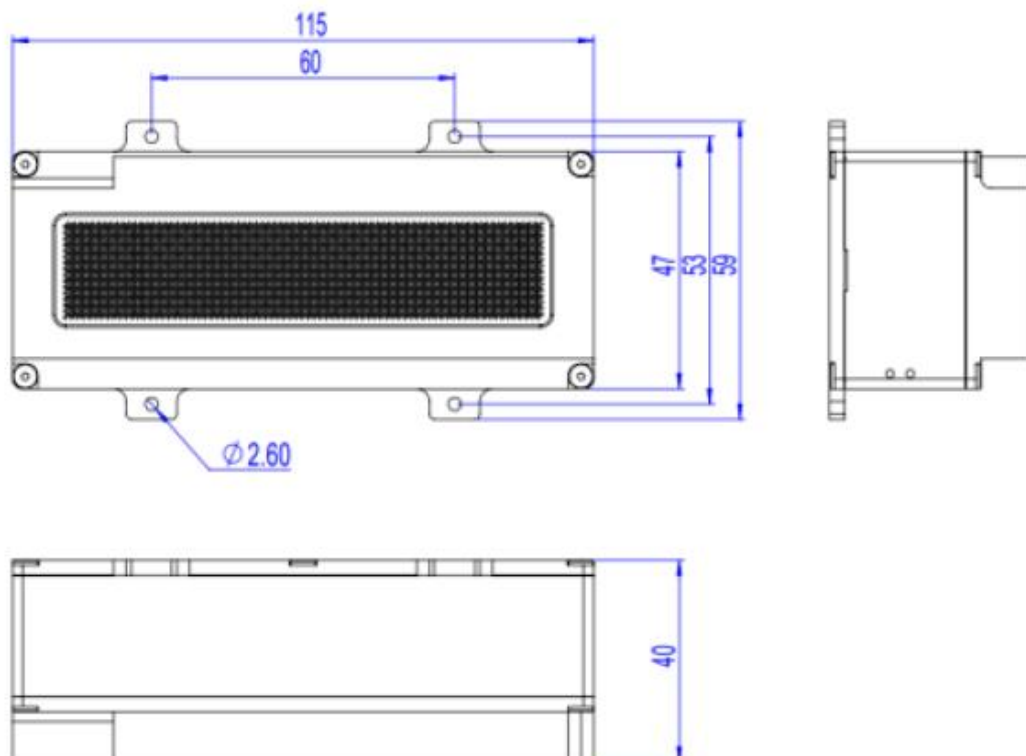
5.1 Dimensions of the Detection Module

(1) TDLAS200A (Pump) detection module host size 115 × 59 × 38mm (excluding cables and gas connectors).



It is recommended to add a 0.45 μ m PTFE hydrophobic filter at the gas inlet; connect a pump and a muffler filter at the gas outlet.

(2) TDLAS200B (Diffusion) detection module main unit size 115×59×40mm (excluding cables and gas connectors)



5.2 Detection Module Interface

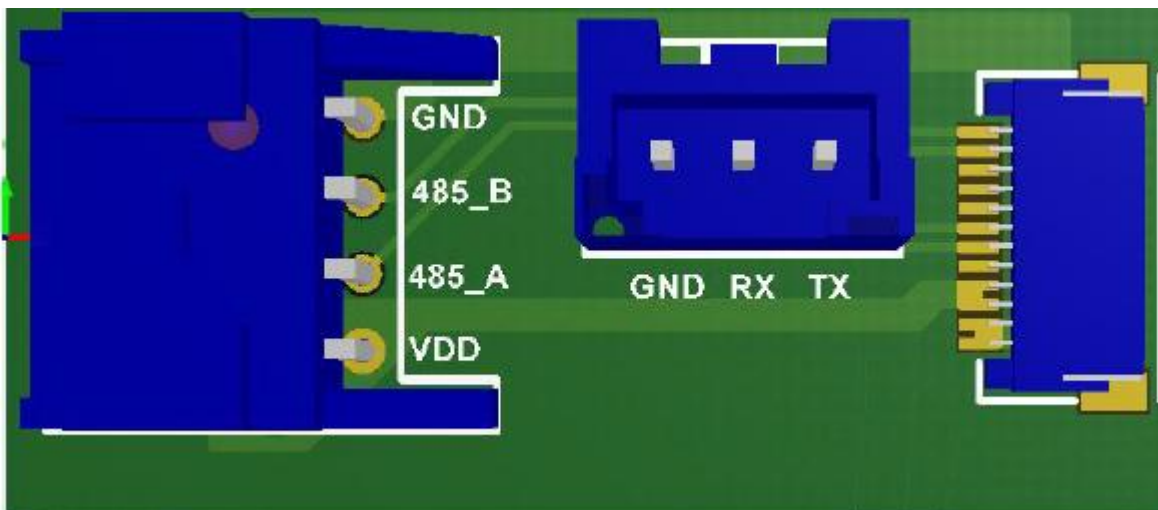
The original interface of the module is a 12-pin flexible circuit board with a spacing of 0.5. The interface definition is as follows:

- [1] 485B
- [2] 485A
- [3] Reserved
- [4] Reserved
- [5] Reserved
- [6] TX: module data transmission
- [7] RX: module data reception
- [8] Power_EN: input high level module shutdown, low level and floating to start, 3.3V logic
- [9] VDD: 12V
- [10] VDD
- [11] GND
- [12] GND

*Please refer to the silk screen of the flexible circuit board carefully to determine the position of pin 1

The module provides a circuit adapter board to facilitate users to convert the FPC to a common plug-in output.

The interface definition after conversion is as follows:



The adapter board converts the user-related interface in the 12-pin 0.5-pitch flexible circuit board into a 4-pin power and data interface, and a 3-pin data interface.

5.3 Detection Module Use

Interface 1: Follow the standard modbus protocol

Connection method:

Power interface: This interface only needs to connect pins 1 and 4 to the power supply, VDD connects to the positive power supply, and GND connects to the negative power supply.

Data interface: The level is 485 serial port, the baud rate is set to 115200bps, the data bit is 8bit, the stop bit is 1bit, and there is no check.

[1] VDD

[2] 485A (485+)

[3] 485B (485-)

[4] GND

Interface 2: TTL serial port

Connect the power supply to the module. The detection module will actively push the concentration and status data through the communication interface by default.

Connection method:

Power interface: This interface only needs to connect pins 1 and 4 to the power supply, VDD connects to the positive power supply, and GND connects to the negative power supply.

Data interface: The level is TTL serial port (3.3V), the baud rate is set to 115200bps, the data bit is 8bit, the stop bit is 1bit, and there is no check.

[1] GND reference ground

[2] RX module receives

[3] TX module sends

Connect the three pins to the computer through the serial port module, or directly connect to the microprocessor.

6.TTL Serial Communication Protocol

6.1 Active Subscription Mode

The active subscription mode provides users with basic concentration data and status in hexadecimal numbers. The format is as follows:

Data Bits	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Description	Frame Header	Data Length	Function Code		Concentration				Status				Light Intensity		Checksum	Frame Tail
Typical Value	0x01	1byte	2byte		4byte				4byte				2byte		1byte	0x3B

Explanation:

Data Length: It refers to the length of the bits for Concentration + Status + Light Intensity. In this frame, it is 0x0A.

Function Code: It is equivalent to the address. Different addresses correspond to different functional instructions. In this frame, it is for subscription.

Concentration: It is a 32-bit signed number, with the unit being 0.1 ppm. For example, if it is 0x00000065, the concentration is 10.1 ppm.

Light Intensity: Value range 0-100%. It represents the light return intensity inside the gas cell. A too low value indicates that impurities have been sucked in.

Checksum: It is the cumulative sum of data bits from 0 to 11.

Status: The status of the detection module is shown in the following table. It has a total of 32 bits, with bit 31 being the most significant bit and bit 0 being the least significant bit.

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24
-	-	-	-	SYSOK	INDLED	-	ALARM
Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
-	-	-	-	-	-	-	-
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8
-	-	-	-	Peak	TOAR	TBSTB	TASTB
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
-	-	-	TSYSOR	TATO	TBTO	LHOR	LLOR

The description of the detection module status is shown in the following table:

Bit	Abbreviation	1 Status	0 Status
0	LLOR	Light Low Over Range	Normal
1	LHOR	Light High Over Range	Normal
2	TBTO	Temperaure B Time Out	Normal
3	TATO	Temperaure A Time Out	Normal
4	TSYSOR	Temperaure System Over Range	Normal
8	TASTB	Temperaure A Stable	Initializing
9	TBSTB	Temperaure B Stable	Initializing
10	TAOR	Temperaure A Over Range	Normal
24	ALARM	Alarm threshold exceeded	No alarm
26	INDLED	-	-
27	SYSOK	System OK	Initializing

*Temperaure A:TLD First-stage Temperaure

*Temperaure B:TLD Second-stage Temperaure

6.2 Question-Answer Read-Write Mode

The detection module can send frames to the detection module:

Send: 01 04 12 02 00 00 00 00 19 3B

Receive: 01 00 12 02 01 3B

Exit the subscription mode and enter the question-answer mode. Under the question-answer mode, the frame format is as follows.

Data Bits	0	1	2	3	4	5	6	7	8	9
Description	Frame Header	Data Length	Function Code		Data				Checksum	Frame Tail
Typical Value	0x01	1byte	2byte		4byte				1byte	0x3B

When in the read mode, the data segment is 0. When in the write mode, the data segment is the target value.

Send: 01 04 12 02 00 00 00 01 1A 3B

Receive: 01 00 12 02 01 3B

Return to the subscription mode. The subscription mode supports question and answer. Users need to distinguish subscription frames from question and answer frames by using the function code.

6.3 Typical Read-Write Instructions

To start the active subscription mode:

Send: 01 04 12 02 00 00 00 01 1A 3B

Receive: 01 00 12 02 01 3B

To turn off the active subscription mode, that is, to enter the question and answer mode:

Send: 01 04 12 02 00 00 00 00 19 3B

Receive: 01 00 12 02 01 3B

To reset the indication value:

Send: 01 04 20 02 00 00 00 00 27 3B

Receive: 01 00 20 02 01 3B

7. Modbus Communication Protocol

7.1 RS485 Settings

Set the serial port baud rate to 115200 bps, the number of data bits to 8 bits, the number of stop bits to 1 bit, and with no parity. The default refresh frequency of the serial port data is 10 Hz. The RS485 address is set to 01 by default and can be modified (the modification method is shown in the attachment).

7.2 Communication Contents and Functions

The detection module can read the real-time concentration and status of the equipment through MODBUS. It can also set the alarm limit and run the calibration procedure.

- | | | |
|-----|---------------------------|--|
| 【1】 | Real - time Concentration | Unit: 0.1ppm |
| 【2】 | Return Light Intensity | Unit: % |
| 【3】 | Alarm Limit | Unit: ppm |
| 【4】 | Equipment Status | The 32 - bit data is defined as follows. |

Tips

The equipment status has a total of 32 bits, with bit 31 being the most significant bit and bit 0 being the least significant bit.

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24
-	-	-	-	SYSOK	INDLED	-	ALARM
Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
-	-	-	-	-	-	-	-
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8
-	-	-	-	Peak	TAOR	TBSTB	TASTB
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
-	-	-	TSYSOR	TATO	TBTO	LHOR	LLOR

Appendix: Equipment Status Decomposition Look - up Table

Bit	Abbreviation	1 Status	0 Status
0	LLOR	Light Low Over Range	Normal
1	LHOR	Light High Over Range	Normal
2	TBTO	Temperaure B Time Out	Normal
3	TATO	Temperaure A Time Out	Normal
4	TSYSOR	Temperaure System Over Range	Normal
8	TASTB	Temperaure A Stable	Initializing
9	TBSTB	Temperaure B Stable	Initializing
10	TAOR	Temperaure A Over Range	Normal
24	ALARM	Alarm threshold exceeded	No alarm
26	INDLED	-	-
27	SYSOK	System OK	Initializing

*Temperaure A:TLD First-stage Temperaure

*Temperaure B:TLD Second-stage Temperaure

7.3 Communication Addresses and Data Analysis

Tips

The Modbus protocol stipulates that when writing a single coil, it is actually a word operation. Writing 0xFF00 to a certain address is 1, and writing 0x0000 is 0.

MODBUS Function	Register Address	PLC Address Bit	Equipment Function	Equipment Function	Unit	Value Range	Description
Read Input Registers (04H)	0	30001	Read concentration	signed 16	ppm	-32768-32767	-
	1	30002	Read high bits of status	unsigned 16	None	Refer to 7.2	Status Register
	2	30003	Read low bits of status	unsigned 16	None	Refer to 7.2	Status Register
	3	30004	Read return light intensity	unsigned 16	%	0~100	Return Light Intensity
	4	30005	Read the calibration progress	unsigned 16	%	0~100	See 8.1
	5	30005	Read high bits of full scale	Unsigned 16-bit.	0.1ppm	0 - 65536	High bits of concentration >> 16 + low bits.
	6	30006	Read low bits of full scale	Unsigned 16-bit.	0.1ppm	0 - 65536	After splicing the concentration, handle it as signed.

Write a Single Coil (05H)	0	1	Laser indicated by the switch	1bit	None	0 or 1	1 for ON, 0 for OFF.
	1	2	Start calibration	1bit	None	0 or 1	1 for start
	2	3	Save calibration parameters	1bit	None	0 or 1	1 for save, 0 for cancel.
	3	4	Select a communication protocol.	1bit	None	0 or 1	1 Modbus, 0 UDP
	4	5	Reset the indication value	1bit	None	0 or 1	Write 0 to clear the indication in the no-gas state
Read a Single Coil (01H)	0	1	Indicate the laser status	-	None	0 or 1	OFF
	1	2	Calibration status	-	None	0 or 1	1: calibrating 0: detection mode
	2	3	Save calibration parameters	-	None	0 or 1	Always 0.
Read a Single Holding Register (03H)	0	40001	Read the alarm limit	Unsigned 16	ppm	0~5000	When the value is exceeded, the device will trigger an alarm and bit 24 of the status register will be set.
Write a Single Holding Register (06H)	0	40001	Modify the alarm limit	Unsigned 16	ppm	0~5000	

8. Maintenance

8.1 Routine Maintenance of the Equipment

To ensure that the equipment is in good working condition, please follow the suggestions below for routine maintenance:

【1】	Turn off the power supply.	During maintenance and when the equipment is not in use.
【2】	Clean the outer surface.	When necessary.
【3】	Ensure that no dust, moisture or foreign objects enter the detection chamber.	Use filters and check the pipelines. Seal the pipelines properly when they are not connected.

8.2 Calibration

8.2.1 TTL Serial - Port Calibration

[1] After waiting for the equipment to work stably, continuously introduce nitrogen gas at a flow rate less than or equal to 0.5L/min to empty the equipment. Wait for the equipment to display zero (if it can't return to zero within 5 minutes, send a zero - clearing command, see 6.3).

Zero - clearing of indication value: 01042002 00 00 00 00 27 3B

Received: 0100 20 02 013B

[2] Continuously introduce standard gas (such as 1000ppm) at a flow rate less than or equal to 0.5L/min, and send a calibration start command to begin calibration:

Sent: 01 0421 21 00 00 00 00 47 3B

Received: 01 00 21 21 01 3B

[3] After starting the calibration, the calibration status can be monitored by reading the calibration progress. The data value range is 0 - 100. If a value exceeding 100 appears, the calibration fails and the gas and module status need to be checked.

Sent: 01 042c44 00 00 00 00 75 3b

Received: 01042c44 00 00 00 xx yy 3b, xx represents the calibration progress and yy represents the checksum.

[4] After the calibration is completed, the read progress is 100. Send a calibration data - saving command to save the calibration data of this time. If a value greater than 100 appears, send a calibration - cancelling command or re - power the module.

Calibration - cancelling: 01 0421 22 00 00 00 00 48 3B

Received: 01 00 21 22 01 3B

Calibration - saving: 0104 21 23 00 00 00 00 49 3B

8.2.2 MODBUS Communication Calibration

1) Calibration of a Single Concentration Coefficient

When concentration calibration is required, coefficient calibration can be used to calibrate the overall concentration. The steps are as follows:

[1] After waiting for the equipment to work stably, empty the equipment with pure nitrogen gas and wait for the equipment to display zero (if it can't return to zero within 5 minutes, please clear it manually).

Send: 0105 00 04 00 00 8C 0B

Receive: 01 05 02 00 00 B8 CC

[2] Continuously introduce methane standard gas (such as 1000ppm) at a flow rate less than or equal to 0.5L/min. After waiting for the reading to become stable, write the concentration value of this standard gas using the 06H instruction. The register address is 11 and the data is 1000 (the unit is ppm and the data will be saved automatically).

Send: 01 06 00 0B 03 E8 F8 B6

Receive: 01 06 02 03 E8 B8 36

2) Curve Calibration

When it is necessary to recalibrate all concentrations within the full scale range, the curve calibration method is used. The steps are as follows:

[1] After waiting for the equipment to work stably, empty the equipment with pure nitrogen gas and

wait for the equipment to display zero (if it can't return to zero within 5 minutes, please clear it manually).

Send: 01 05 00 04 00 00 8C 0B

Receive: 01 05 02 00 00 B8 CC

[2] Execute the start curve calibration instruction, the 05H instruction. The register address is 6 and the data is 0 to clear the original curve calibration data.

Send: 01 05 00 06 00 00 2D CB

Receive: 01 05 02 00 00 B8 CC

[3] Continuously introduce the first kind of methane standard gas at a flow rate less than or equal to 0.5L/min. About 1 minute later, write the concentration value of this standard gas. Taking 1000ppm as an example, use the 06H instruction. The register address is 1 and the data is 1000 (the unit for writing is ppm).

Send: 01 06 00 01 03 E8 D8 B4

Receive: 01 06 02 03 E8 B8 36

[4] Continuously introduce the second kind of methane standard gas at a flow rate less than or equal to 0.5L/min. About 1 minute later, write the concentration value of this standard gas. Taking 2000ppm as an example, use the 06H instruction. The register address is 2 and the data is 2000 (the unit for writing is ppm).

Send: 01 06 00 02 07 D0 2BA6

Receive: 01 06 02 07 D0 BB 24

[5] Follow the methods in steps [3] and [4] to complete the tests of all available standard gases. A maximum of 10 standard gases are supported. Please choose them within the range by yourself. Attachment Table 1 provides instructions for concentrations from 1000 to 10000ppm. For other concentrations, you need to generate Modbus instructions by yourself.

[6] Save the results of curve calibration, using the 05H instruction. The register address is 2 and the data is 0XFF00. If you want to cancel the calibration results, power off and restart the equipment.

Tips:

If the calibration fails due to incorrect operations in the above steps, please restart the equipment and re-execute the steps to ensure the detection ability.

The recommended range for gas supply flow rate is between 0.2L/min and 0.5L/min. Note that the smaller the gas flow rate is, the longer the waiting time before writing the concentration value of the standard gas should be.

Attachment 1

Examples of Serial Port Source Code for MODBUS Data Reading and Writing

Reading Data (04H)

[1] Reading Concentration

Send: 01 04 00 00 00 01 31 CA

Receive: 01 04 02 04 E8 BB BE

Read value: 0x04E8, that is 1256ppm (reading the integer part of the concentration)

Send: 01 04 00 05 00 07 A1 C9

Receive: 01 04 04 00 00 00 2C FA 59

Read value: 0x002C, that is 4.4ppm (reading the concentration with one decimal place)

[2] Read status high 16 bits (ventilation status)

Send: 01 04 00 01 00 01 60 0A

Receive: 01 04 02 09 00 BF 60

Read value: 0x0900, see 7.3 for details

[3] Read status low 16 bits (ventilation status)

Send: 01 04 00 02 00 01 90 0A

Receive: 01 04 02 4B 00 8F C0

Read value: 0x4B00, see 7.3 for details

[4] Reading the Return Light Intensity

Send: 01 04 00 03 00 01 C1 CA

Receive: 01 04 02 00 54 B8 CF

Read value: 0x0054, that is 84%

[5] Read the high end of the full range concentration:

Send: 01 04 00 05 00 01 21 CB

Receive: 01 04 02 00 0B F8 F7

Read value: 0x000B

[6] Read the bottom of the full range concentration

Send: 01 04 00 06 00 01 D1 CB

Receive: 01 04 02 04 E8 BB BE

Read value: 0x04E8

That is, the concentration is $0x000B04E8$, which is $722152 \times 0.1\text{ppm} = 72215.2\text{ppm} = 7.22\%\text{VOL}$

[7] Read calibration progress

Send: 01 04 00 04 00 01 70 0B

Receive: 01 04 02 00 0B F8 F7

Read value: 0x000B, that is 11%

Writing Instructions (05H)

[1] Turn on the Indicating Laser [Ignore this instruction if there is no indicating laser module]

Send: 01 05 00 00 FF 00 8C 3A

Receive: 01 05 02 FF 00 F9 3C

[2] Turn off the indicating laser [Ignore this instruction if there is no indicating laser module]

Send: 01 05 00 00 00 00 CD CA

Receive: 01 05 02 00 00 B8 CC

[3] Start calibration

Send: 0105 00 01 FF 00 DD FA

Receive: 01 05 02 FF 00 F9 3C

[4] Save calibration parameters

Send: 01 05 00 02 FF 00 2D FA

Receive: 01 05 02 FF 00 F9 3C

[5] Select communication protocol

Send: 01 05 00 03 FF 00 7C 3A

Receive: 01 05 02 FF 00 F9 3C

[6] Clear the indication value

Send: 01 05 00 04 FF 00 CD FB

Receive: 01 05 02 FF 00 F9 3C

Read Status (01H)**[1] Status of the indicating laser**

Read: 0101 00 00 00 01 FD CA

Receive: 0101 01 01 90 48 (On); 01 01 01 00 51 88 (Off)

[2] Read calibration status

Read: 0101 00 01 00 01 AC 0A

Receive: 0101 01 01 90 48 (Calibrating); 01 01 01 00 51 88 (Not started)

Read Alarm Threshold (03H)

Send: 01 03 00 00 00 01 84 0A

Receive: 01 03 02 00 32 39 91

Modify the alarm threshold to 50 (06H)

Send: 0106 00 00 00 32 08 1F

Receive: 01 06 02 00 32 39 5D

Curve Calibration Instructions**[1] Start curve calibration**

Send: 0105 00 06 00 00 2D CB

Receive: 01 05 02 00 00 B8 CC

[2] Zero the equipment

Send: 0105 00 04 00 00 8C 0B

Receive: 01 05 02 00 00 B8 CC

[3] Concentration 1 (1000ppm)

Send: 0106 00 01 03 E8 D8 B4

Receive: 01 06 02 03 E8 B8 36

[4] Concentration 2 (2000ppm)

Send: 01 06 00 02 07 D0 2B A6

Receive: 01 06 02 07 D0 BB 24

[5] Concentration 3 (3000ppm)

Send: 01 06 00 03 0B B8 7E 88

Receive: 0106 02 0B B8 BF CA
[6] Concentration 4 (4000ppm)
Send: 01 06 00 04 0F A0 CD 83
Receive: 01 06 02 0F A0 BD 00
[7] Concentration 5 (5000ppm)
Send: 01 06 00 05 13 88 94 9D
Receive: 01 06 02 13 88 B5 DE
[8] Concentration 6 (6000ppm)
Send: 0106 00 06 17 70 67 DF
Receive: 01 06 02 17 70 B6 9C
[9] Concentration 7 (7000ppm)
Send: 01 06 00 07 1B 58 33 01
Receive: 01 06 02 1B 58 B3 82
[10] Concentration 8 (8000ppm)
Send: 01 06 00 08 1F 40 01 C8
Receive: 01 06 02 1F 40 B1 48
[11] Concentration 9 (9000ppm)
Send: 01 06 00 09 23 28 40 E6
Receive: 01 06 02 23 28 A1 A6
[12] Concentration 10 (10000ppm)
Send: 01 06 00 0A 27 10 B3 F4
Receive: 01 06 02 27 10 A2 B4
[13] Save data
Send: 01 05 00 02 FF 00 2D FA
Receive: 01 05 02 FF 00 F9 3C

Attachment 2

Modify the 485 Address

Restart the module and send the serial port instruction within 1 minute after the module is powered on:

- [1] Set the address to 1
F5 04 47 10 21 82 00 00 00 01 00 69 AA
- [2] Set the address to 2
F5 04 47 10 21 82 00 00 00 02 30 0A AA
- [3] Set the address to 3
F5 04 47 10 21 82 00 00 00 03 20 2B AA
- [4] Set the address to 4
F5 04 47 10 21 82 00 00 00 04 50 CC AA
- [5] Set the address to 5
F5 04 47 10 21 82 00 00 00 05 40 ED AA
- [6] Set the address to 6
F5 04 47 10 21 82 00 00 00 06 70 8E AA
- [7] Set the address to 7
F5 04 47 10 21 82 00 00 00 07 60 AF AA
- [8] Set the address to 8
F5 04 47 10 21 82 00 00 00 08 91 40 AA