ATO

Gas Sensor

Application Specification

Catalog

Overview

This series of gas sensor module is an integrated sensor module with high performance and versatility. The module adopts high-performance microprocessor, equipped with high-precision analog-to-digital converter, built-in temperature sensor and accurate full-range temperature compensation algorithm, which can accurately detect the ambient gas concentration.

The module will be a variety of different types of gas sensors unified interface, unified packaging, factory accurate calibration, at the same time with digital output and analog voltage output, easy to use. It solves the problems of many kinds of gases, incompatibility of sensors of various species, complexity of production calibration, and limitation of core device replacement. Customers do not need to use the secondary development, no need to calibrate again, you can directly collect the standard signal for data transmission, online monitoring.

Applicable to portable, fixed gas detector and gas detection and other equipment, largely reducing the complexity of the development of gas detection equipment, providing strong support for the modular design of equipment.

Product Features

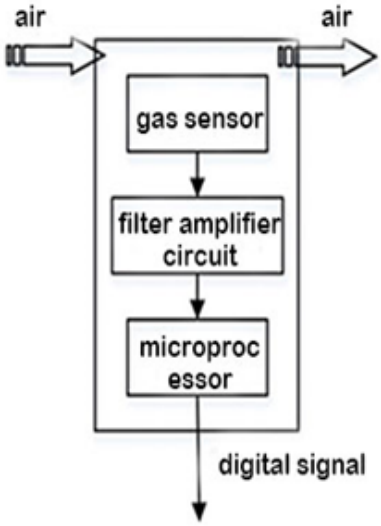
- with electric hot plugging and unplugging operation
- full-range temperature compensation, factory accurate calibration, use without further calibration
- digital (UART) and analog output at the same time, easy to use
- standard MODBUS communication protocol
- Compatible with infrared, electrochemical sensors

Product Application Scenario

1. Intelligent Public Toilet Gas Detection Project
2. Intelligent agriculture gas detection project
3. Intelligent pipeline corridor and tunnel project
4. Intelligent well cover gas detection project
5. intelligent tunnel highway and road gas detection project
6. Intelligent Farming Gas Detection Project
7. Intelligent grain silo gas detection project
8. Underground garage gas detection project
9. Scientific research projects, environmental monitoring projects
10. Industrial intelligent gas detection projects such as inspection robots, etc.
11. Automotive electronics, intelligent firefighting, testing instruments and meters

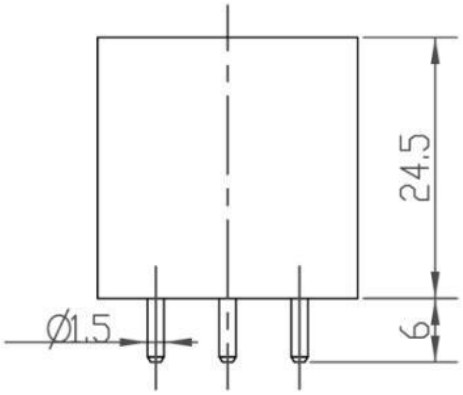
Working Principle

The signals from various gas sensors are amplified and filtered, and then the microprocessor performs theoretical calculations on the signals and outputs digital signals. For different sensors, the filtering and amplification circuits are also different.

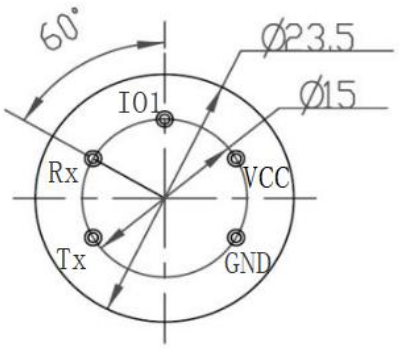


module function block diagram

Appearance and Interface Definition



Exterior Dimension Drawing



Bottom View Dimension Drawing

Pin Definition	Functional Description	(MIN) V	(TYP) V	(MAX) V
GND	Power Ground	0	0.0	----
IO1	Analog Signal Measurement	0	2.0	3.0
VCC	Power	4.5	5	5.5
TX	Serial Send	0	3.0	----
RX	Serial Receive	0	3.0	----

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Technical Specifications

Working Voltage	DC 5V±0.5V
Power Wastage	≤1W
Working Temperature	-20℃-+50℃
Working Humidity	10%-95%RH (no condensation)
Mode of Adoption	Natural proliferation
Gas Detection	See schedule
Detection Range	See schedule
Resolution	See schedule
Technical Principle	Electrochemical
Communication Format	UART baud rate 9600, data bit: 8; stop bit: 1; check bit: none
Analog Output	0-2V
Warm-up Time	30s (user adjustable)
Lifetime	2 years
Size	Ø23.5mm*24.5mm
Weight	10g

Transport Protocols

Baud Rate	9600
Data Bit	8-bit
Stop Bit	1-bit
Check Digit	none

Read Data:

Host sends frame format

Address	Function Codes	Register Start Address High Byte	Register Start Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	CRC Low Byte	CRC High Byte
0xFF (default)	0x03						

Successful return to frame

Address	Function Codes	Data Item	Data1	Data2	.....	Datan	CRC Low Byte	CRC High Byte
0xFF (default)	0x03							

Error return frame format

Address	Error Response Function Code	Error Code	CRC Low Byte	CRC High Byte
0xFF (default)	0x83			

Write Data

Host sends frame format

Address	Function Code	Register Start Address High Byte	Register Start Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	Data Item	Data High Byte	Data Low Byte	CRC Low Byte	CRC High Byte
0xFF (default)	0x10									

SSuccessful return frame format

Address	Function Code	Register Start Address High Byte	Register Start Address Low Byte	Number of Registers High Byte	Number of Registers Low Byte	CRC Low Byte	CRC High Byte

0xFF (default)	0x10						

Modbus-RTU communication protocol，CRC16 is ModbusCRC16

Register Logical Address Description

Logical Address	Register Description	Number of Registers	Note	Mode
02011	xodule Communication I1	1	MODBUS communication address 0-254	read and write
0x2027	Gas Name Code		Schedule 1	read-only
0x202b	Range	1		read-only
0x2030	Unit Code	1	Schedule 2	read and write
0x2031	Number of Decimal Points	1		read and write
0x6000	Alarm Status	1	Schedule 4	read-only
0x6001	Numerical Value	1		read-only
0x6002	AD Value	1		read-only
0x6006	Operational Status	1	Schedule 5	read-only
	Command Parameters	1	Schedule 6	

Example: (refer to Write Data and Read Data frame formats for details)

0x6001-read the concentration value

Send command

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
SensorID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High 8 Bits	Number of Registers Low 8 Bits	CRC Low Byte	CRC High Byte
FF	03	60	01	00	01	DE	14

Return Value

SensorID	Function Code	Data Item	Data1 (high 8 bits）	Data 2 (low 8 bits）	CRC Low Byte	CRC High Byte
FF	03	02	-	-	-	-

Example:
Send: FF 03 60 01 00 01 DE 14
Return: FF 03 02 00 05 51 93
Represents the return value is 5, the concentration value = return value / 10 ^ number of decimal places, assuming that the number of decimal places read is 1, then the concentration value = 5/10 = 0.5, read the number of decimal places is 2, then the concentration value = 5/100 = 0.05

0x2031 - read number of decimal places

Send command

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Sensor ID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High 8 Bits	Number of Registers Low 8 Bits	CRC Low Byte	CRC High Byte

FF	03	20	31	00	01	CB	DB
Return Value							
Sensor ID	Function Code	Data Item	Data 1 (8 decimal places higher)	Data 2 (8 decimal places lower)		CRC Low Byte	CRC High Byte
FF	03	02	-	-		-	-
Example: Send： FF 03 20 31 00 01 CB DB Return： FF 03 02 00 01 50 50 Means that the number of decimal places returned is 1 Note: For a decimal number of 1, divide the concentration reading by 10, for a decimal number of 2, divide the concentration reading by 100, and so on.							

Write sensor address: send the unprotect command first, followed by the write address command										
0x4FFF-Write-Protect Release										
Send Order										
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10
Sensor ID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High 8 Bits	Number of Registers Low 8 Bits	Data Item	Data High Byte	Data Low Byte	CRC Low Byte	CRC High Byte
FF	10	4F	FF	00	01	02	55	AA	FB	D0
Return Value										
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7			
SensorID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High 8 Bits	Number of Registers Low 8 Bits	CRC Low Byte	CRC High Byte			
FF	10	4F	FF	00	01	32	F3			
0x2011-Setting the Sensor ID Number										
Send Order										
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10
Sensor ID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High 8 Bits	Number of Registers Low 8 Bits	Data Item	Register Address High Byte	Register Address Low Byte	CRC Low Byte	CRC High Byte
FF	10	20	11	00	01	02	-	-	-	-
Return Value										
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7			
Sensor ID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Register Address High Byte	Number of Registers Low 8 Bits	CRC Low Byte	CRC High Byte			
FF	10	4F	FF	00	01	-	-			
Example: (Set Sensor ID to 1) Send Unlock Write Protect first.										

Send：FF 10 4F FF 00 01 02 55 AA FB D0
Return：FF 10 4F FF 00 01 32 F3
Send the write sensor ID after
Send：FF 10 20 11 00 01 02 00 01 0D 77
Return：FF 10 20 11 00 01 4F D2

Calibration: first send unprotect command, then send calibration command, then send read calibration success command.

0x4FFF-Write-Protect Release

Send Order

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9	Byte10
Sensor ID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High 8 Bits	Number of Registers Low 8 Bits	Data Item	Data High Byte	Data Low Byte	CRC Low Byte	CRC High Byte
FF	10	4F	FF	00	01	02	55	AA	FB	D0

Return Value

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Sensor ID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High Bits	Number of Registers Low Bits	CRC Low Byte	CRC High Byte
FF	10	4F	FF	00	01	32	F3

0x6006-Write Calibration Commands(without regard to the return value)

Send Order

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11	Byte 12
Sensor ID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High Bits	Number of Registers Low Bits	Data Item	Command Parameter High Byte (Exhibit 6)	Command Parameter Low Byte (Exhibit 6)	Data high byte (calibration concentration value high byte)	Data high byte (calibration concentration value high byte)	CRC Low Byte	CRC Low Byte
FF	10	60	06	00	02	04	-	-	-	-	-	-

0x6006-Read calibration success command

Send Order

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Sensor ID	Function Code	Register Address High 8 Bits	Register Address Low 8 Bits	Number of Registers High Bits	Number of Registers Low Bits	CRC Low Byte	CRC High Byte
FF	03	60	06	00	01	6F	D5

Return Value

Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6

SensorID	Function Code	Data Item	Data 1	Data 2 (refer to schedule 5)	CRC Low Byte	CRC High Byte
FF	03	02	00	-	-	-

Example: (mark zero)
Send unlock write protect first

Send: FF 10 4F FF 00 01 02 55 AA FB D0返
Back: FF 10 4F FF 00 01 32 F3
Post-send write calibration

Send: FF 10 60 06 00 02 04 10 00 00 00 E8 AC resend
Read whether the calibration was successful or not

Send: FF 03 60 06 00 01 6F D5
Back: FF 03 02 00 01 50 50 (Data 01 means the calibration is successful, refer to Attachment 5 for others.)
Note: The parameters of the calibration sending command are shown in Attachment 6, and up to 6 points can be calibrated.

CRC Calibration value calculation

```
const u16 u16CrcTalbeAbs[] = {

   0x0000,  0xCC01,  0xD801,  0x1400,  0xF001,
   0x3C00,  0x2800,  0xE401,  0xA001,  0x6C00,
   0x7800,  0xB401,  0x5000,  0x9C01,  0x8801,
};  0x4400,


u16 Crc16(u8p pchMsg, u8
wDataLen){
   u16 wCRC =
   0xFFFF; u8
   chChar;
     while( wDataLen-- )
   {
      chChar = *pchMsg++;
      wCRC = u16CrcTalbeAbs[(chChar ^ wCRC) & 15] ^ (wCRC >>
      4); wCRC = u16CrcTalbeAbs[((chChar >> 4) ^ wCRC) & 15] ^
   }  (wCRC >> 4);


   return wCRC;
}
```

Cautionary note

1. Prohibit plugging and unplugging the sensors on the module.

2. It is prohibited to weld the pins of the module directly, and the tube base of the pins can be welded.

3. avoid contacting with organic solvents (including silicone and other adhesives), paints, chemicals, oils and highly concentrated gases.

4. The module should not be subjected to excessive impact or vibration. 5.

5. The module should be warmed up for more than 5 minutes when it is first powered on, and it is recommended to warm up for more than 24 hours when it has not been used for a long time.

6. The modules should not be placed in high concentration organic gas for a long time.

7. When choosing modules, different ranges should be selected according to different application fields and occasions.

Schedules

Schedule 1 Gas Name Codes

Number	Code	Gas Type	Number	Code	Gas Type
1	0x01	（CO）	2	0x02	H2S）
3	0x03	(EX)	4	0x04	(O2)
5	0x05	(SO2)	6	0x06	(CH4)
7	0x07	(NO)	8	0x08	(NO2)
9	0x09	(CL2)	10	0x0A	(NH3)
11	0x0B	(H2)	12	0x0C	(HCN)
13	0x0D	(HCL)	14	0x0E	(PH3)
15	0x0F	(O3)	16	0x10	(CLO2)
17	0x11	(C2H4O)	18	0x12	(CO2)
19	0x13	(C6H6)	20	0x14	(CH2O)
21	0x15	(VOC)	22	0x16	(C7H8)
23	0x17	(C8H10)	24	0x18	(NOx)
25	0x19	(C6H14)	26	0x1A	(HF)
27	0x1B	(xF)	28	0x1C	(CH3OH)
29	0x1D	(C3H8)	30	0x1E	(C7H8O)
31	0x1F	(C2H6)	32	0x20	(C4H10O)
33	0x21	(CH4)	34	0x22	(CS2)
35	0x23	(SiH4)	36	0x24	(C2H2)
37	0x25	(CH3CL)	38	0x26	(N2)
39	0x27	（C8H8)	40	0x28	(AsH3)
41	0x29	(C2H6O)	42	0x2A	(C2H3CL)
43	0x2B	(C2H4Cl2)	44	0x2C	(C4H8O2)
45	0x2D	(CH2Cl2)	46	0x2E	(C3H3N)
47	0x2F	(C6H7N)	48	0x30	(EX)
49	0x31	(Br2)	50	0x32	(COCL2)

51	0x33	N2H4	52	0x34	CHOOH
53	0x35	HBr	54	0x36	CH4S
55	0x37	C4H8	56	0x38	C2H4
57	0x39	C3H6	58	0x3A	C4H602
59	0x3B	C3H80	60	0x3C	C2H40
61	0x3D	C4H6	62	0x3E	COS
63	0x3F	C2H6S	64	0x40	C4H8S
65	0x41	C2H50CL	66	0x42	CHCL3
67	0x43	CCL4	68	0x44	WF6
69	0x45	SNCL4	70	0x46	H202
71	0x47	C4H80	72	0x48	CnH2n
73	0x49	S02F2	74	0x4A	TVOC(TVOC)
75	0x4B	VOCs(VOCs)	76	0x4C	(C6H120)
77	0x4D	(F2)	78	0x4E	(HCN)
79	0x4F	((CH30)2S02)	80	0x50	(C3H7NO)
81	0x51	(PCL3)	82	0x52	(POCL3)
83	0x53	(CH3COOR)	84	0x54	PM2.5
85	0x55	PM10	86	0x56	PM1.0
87	0x57	(HC)	88	0x58	N2H4H20
89	0x59	C3H40	90	0x60	C3H8

Schedule 2 Unit Codes

Code No.	Unit Name	Notes
1	%LEL	lower explosive limit
2	ppm	parts per million (international units)
3	ppb	1 part per billion
4	%VOL	percentage of total volume
5	umol/mol	parts per million (domestic units)
6	mg/m3	mass body mass volume
7	ug/m3	mass-to-volume ratio
8	℃	temperature
9	%RH	humidity
10	m/s	speed
11	kpa	air pressure

12	lx	Light Intensity

Schedule 3 Parameter List of Detected Gases

Name of Gas Detected	Measurement Range (standard)	Accurate	Resolution (standard)
Oxidation	0-30%VOL	±3%FS	0.1%VOL
Carbon Monoxide	0-1000ppm	±10%FS	1ppm
Hydrogen Sulfide	0-100ppm	±10%FS	1ppm
Nitrogen Dioxide	0-20ppm	±5%FS	1ppm
Nitric Oxide	0-250ppm	±5%FS	1ppm
Sulfur Dioxide	0-20ppm	±3%FS	1ppm
Ammonia	0-100ppm	±10%FS	1ppm
Hydrofluoric Acid	0-10ppm	±3%FS	1ppm
Ozone	0-20ppm	±12%FS	1ppm
Hydrogen Cyanide	0-50ppm	±5%FS	1ppm
Formaldehyde	0-10ppm	±5%FS	0.1ppm
Benzene	0-100ppm	±10%FS	1ppm
Chlorine	0-50ppm	±10%FS	1ppm
Gas/Methane	0-100%LEL	±3%FS	1%LEL
Hydrogen	0-1000ppm	±3%FS	1ppm
Carbon Dioxide	0-5%VOL	50ppm±5%FS	0.01%VOL

Note: The names of gases listed in the table can be detected, and the specific gas parameters are not listed.

Schedule 4 Alarm Status Definitions

Main State	Bit State	Status Description
Bit15 = 0 warming up Lower 15 bits are output as whole word	Bit14 – 0 Output is a countdown to the warm-up time	Time=*0.1s
Bit15 = 1 Warm-up Complete	Bit14	Spare
	Bit13	Spare
	Bit12	Spare

Low 15-bit per-bit output	Bit11	Spare
	Bit10	Spare
	Bit9	Spare
	Bit8	Spare
	Bit7	Spare
	Bit6	High concentration protection
	Bit5	Missing or damaged sensors
	Bit4	Overrange
	Bit3	TWA Alarm
	Bit2	STEL Alarm
	Bit1	Ultra High Alarm
	(LSB)Bit0	Ultra Low Alarm

Schedule5 State Definition

value	Instruction
0x0000	Module busy, warming up or executing commands
0x0001	Module idle or successful execution
0x0002	Execution failure
0x0003	Unsupported commands
0x0004	Invalid parameter
0x0005	Execution Timeout
0x0100	Execute command step 0
0x0101	Execute command step 1
0x0102	Execute command step 2
0x0103	Execute command step 3

Schedule 6 Command Parameters

Value	Instruction
0x1000	Multi-concentration calibration 0 points, parameter values do not matter
0x1001	Multi-concentration calibration 1 point, parameterized by calibration concentration
0x1002	Multi-concentration calibration 2 point, parameterized by calibration concentration
0x1003	Multi-concentration calibration 3 point, parameterized by calibration concentration
0x1004	Multi-concentration calibration 4 point, parameterized by calibration concentration
0x1005	Multi-concentration calibration 5 point, parameterized by calibration concentration