# AGS2616 Instruction Manual

## Hydrogen Sensor

• High sensitivity •
Low power
consumption • Quick
response • Strong anti-
interference ability • Excellent long-
term stability • Long service life

### Product Description

The hydrogen sensor is a sensor based on the MEMS principle and is used to monitor the concentration of hydrogen gas. The sensor has a built-in high-performance semiconductor silicon-based resistive sensor chip, and uses dedicated digital module acquisition technology and gas induction sensing technology to ensure that the product has extremely high reliability and excellent long-term stability. It has the characteristics of low power consumption, high sensitivity, low cost, and simple driving circuit. The sensor has been fully tested before leaving the factory.

Fully calibrated and tested to meet customers' large-scale applications.

### Application

AGS2616 is suitable for hydrogen leak detection in hydrogen production equipment, hydrogen storage equipment, hydrogen transportation equipment, etc.

Figure 1. Product image

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## 1. Working Principle

The sensor uses advanced MEMS technology to make a micro hot plate on a silicon substrate. The gas-sensitive material used is an electric

Metal oxide semiconductor materials with low conductivity. When the sensor works in an air environment, the conductivity of the gas-sensitive material changes with the detected

The conductivity of the gas-sensitive material changes with the concentration of the gas being detected. The higher the concentration of the gas being detected, the higher the conductivity of the gas-sensitive material.

Using a dedicated integrated circuit, the change in conductivity is converted into an output signal corresponding to the gas concentration.

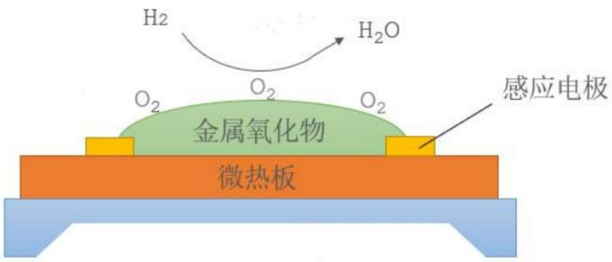



Figure 2. Schematic diagram

## 2. Sensor characteristics

Table 1 Sensor characteristics

| | |
|---|---|
| Operating voltage | 4.75ÿ5.25VDC |
| Working current | 24±4mA |
| Sampling period | ÿ2s |
| Measuring range | 30ÿ3000ppm |
| Output Interface | I 2C |
| Typical Accuracy ÿ25ÿ/50%RHÿ | ±(30ppm+40%RD) |
| Warm-up time | ÿ120s |
| Response characteristics | When the gas concentration is 3000ppm, the response time does not exceed 30 seconds |
| Operating temperature | -25ÿ60ÿ |
| Working | 20ÿ95%RH (no condensation) |
| humidity size (Length × Width × Height) | 12mm 12mm 13.5mm |
| weight | About 1.2g |
| life | More than 10 years (25°C, clean air) |

3. Interface definition

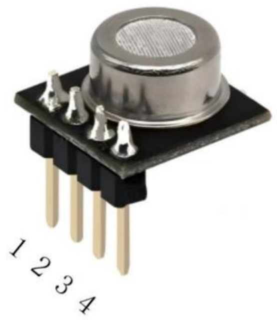



Figure 3. Pin diagram

Table 2 Pin definition table name

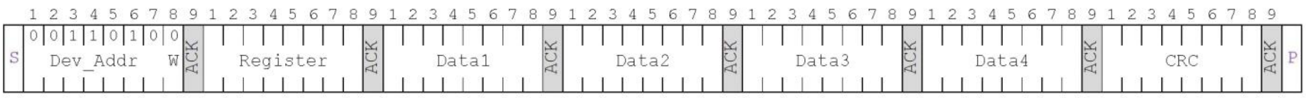
| Pinout | | describe |
|---|---|---|
| 1 | VCC | Power supply (5VDC) |
| 2 | SDA | Communication data |
| 3 | GND | Power Ground |
| 4 | SCL | Communication clock |

4. Communication Protocol

The sensor uses the standard I2C communication protocol and is suitable for a variety of devices. The physical interface of I2C includes a serial data signal (SDA) and a serial clock signal (SCL). Both interfaces need to be pulled up to VCC through a 1kÿ~10kÿ resistor. SDA is used to read and write sensor data. SCL must be kept high when powered on until I2C communication starts, otherwise it will cause poor I2C communication. When I2C is communicating, SCL is used to synchronize the communication between the host and the sensor. Multiple I2C devices can share the bus, but only one host device is allowed to appear on the bus. The sensor I2C device address is uli (7-bit), the write instruction is uh, and the read instruction is uhÿ. The communication rate is no higher than 100kHz.

4.1 I2C communication protocol command format

The host write command format is as follows:



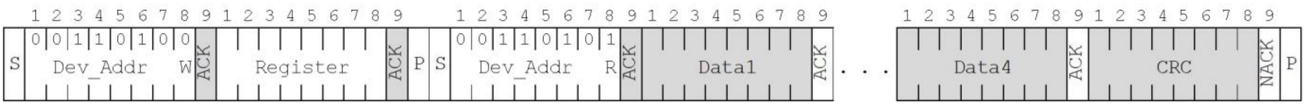

According to the I2C transmission protocol: high bit first, low bit last;

Master signal Slave signal S: Start signal P: Stop signal ACK: Acknowledge signal NACK: Non-acknowledge signal

Register: register address of the operation

CRC: The verification result from Data1 to Data4. For the calculation method, please refer to the "CRC Calculation" section below.

Host read command format:




The host simplified read command format is as follows:

Read the last operation register Register address, the default Register=u on power-on

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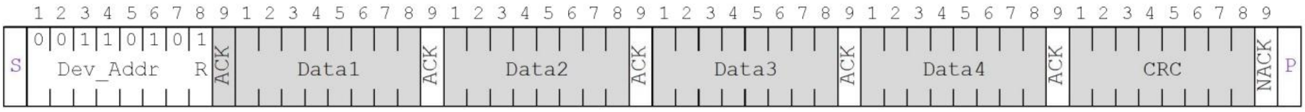
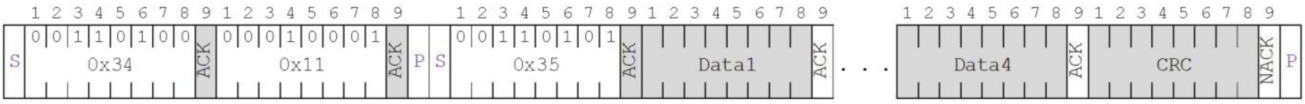
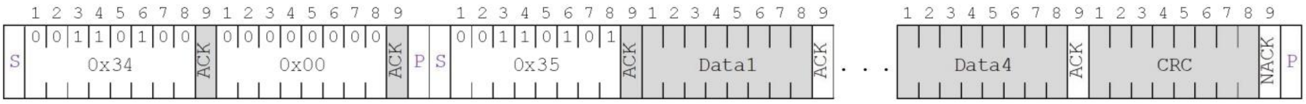



4.2 Reading the version number

The sensor version number can be obtained through the following command.




4.3 Reading concentration data




Data1~Data4 are described in detail as follows:

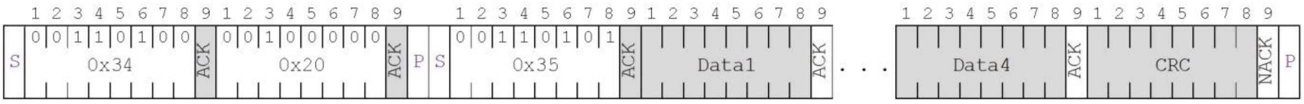
| Data1 | | | | | | | | Data2 | | | | | | | | Data3 | | | | | | | | Data4 | | | | | | | | CRC | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Status | | | | | | | | Conc | | | | | | | | | | | | | | | | | | | | | | | | CRC | | | | | | | |
| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| | | | | | | | RDY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Status is described in detail as follows:

| | | |
|---|---|---|
| Bit7ÿBit1 | Reserved | Reserved bit, always 0 |
| Bit0 | RDY | Data ready bit; RDY=0, data has been updated; RDY=1, data has not been updated or is being preheated |

4.4 Read the current resistance value

The current resistance value of the sensor can be obtained through the following command.




The resistance values are described as follows:

| Data1 | | | | | | | | Data2 | | | | | | | | Data3 | | | | | | | | Data4 | | | | | | | | CRC | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Res | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | CRC | | | | | | | |
| 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |

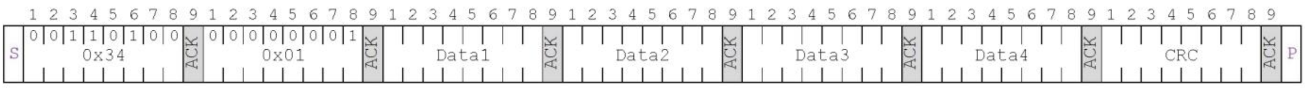
Actual resistance = ÿ l, unit ÿ

4.5 Zero point calibration (reserved)

The sensor has been zero-point calibrated before leaving the factory. Users can recalibrate the zero point as needed during use. The calibration data is not

The data will be saved and lost after power failure. Place the sensor in fresh air and power it on for 5 minutes, then send the following calibration command to complete the zero point calibration.

calibration.




Data1 and Data2 are fixed to u and u.

| Data3 Data4 | describe |
|---|---|
| uhh uhh | Restore to factory zero resistance value |
| uh | Get the current sensor resistance as the zero point |
| u uhh | passes in the specified resistance value uhh as the zero point (actual resistance value/10) |

## 4.6 Calculation of CRC

The sensor uses CRC8 verification, the initial value is uhh, and the polynomial is uhl (uuʸ ul), the code is as follows:

```
//********************************************************************* //Function name: Calc_CRC8 //Function: CRC8 calculation, initial value: 0xFF,

polynomial: 0x31(x 8 //Parameters:
unsigned char *dat: the first address of the data to be verified; unsigned char Num:     5 + x     4 + x     + 1)
CRC verification data length // //Return: crc: calculated verification value //
                    *********************************************************************
unsigned char Calc_CRC8(unsigned char *dat,
unsigned char Num) {

        unsigned char i, byte, crc=0xFF;

        for(byte=0; byte<Num; byte++) {

                crc^=(dat[byte]); for(i=0;i<8;i++) {

                        if(crc & 0x80)
                                crc=(crc<<1)^0x31; else

                                crc=(crc<<1);
                }

        } return crc;
}
```

## 5. Product size diagram

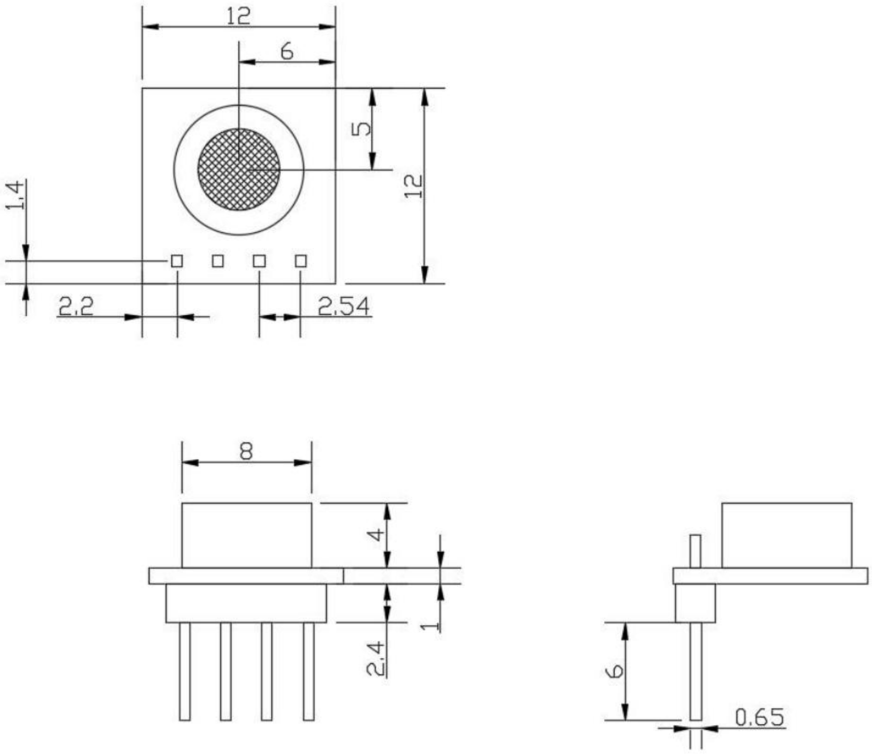



Figure 4. Product dimensions (unit: mm)

Tolerances see table below

Table 3 Dimension tolerance table

| Size range **D/mm** | Dimensional tolerance **T/** |
|---|---|
| 0.5ÿDÿ3 | **mm** ±0.2 |
| 3ÿDÿ6 | ±0.3 |
| 6ÿDÿ30 | ±0.5 |

# 6. Notes

6.1 Water environment

(1) Water splashing onto the sensor or immersing the sensor in water will cause the sensor's performance to degrade or even damage it. (2) If water condenses on the surface of the gas-sensitive material and remains there for a period of time, the sensor's performance will degrade. (3) Ice on the sensor surface will cause the sensor material layer to break and lose its sensitive properties.

6.2 High concentration VOC gas

(1) Regardless of whether the sensor is powered on or not, long-term exposure to high-concentration VOC gas will affect the sensor performance. For example, blowing butane from a lighter directly onto the sensor will cause great damage to the sensor; or placing the sensor in high-concentration hydrocarbons, hydrogen and other gases for a long time will cause serious damage to the sensor.

(2) When the CO2 gas concentration is too high, it will have a slight impact on the sensor.

6.3 Excessive airflow or direct airflow

Avoid measuring the sensor in places with excessive airflow or direct airflow, such as ventilation holes or fans blowing directly from the front, as this will cause inaccurate measurements.

6.4 High Voltage and Polarity Reversal

(1) When the voltage applied to the sensor is too high, for example, the voltage applied exceeds 5.5V, it will cause permanent damage to the sensor. (2) When the positive and negative polarities of the sensor are connected in reverse, it will also cause permanent damage to the sensor circuit.

6.5 Alkaline, acidic environments and contamination by halogenated substances

(1) When the sensor is contaminated by alkaline or acidic liquid spray, or exposed to halogen-containing substances, the sensor performance will be degraded. (2) When the sensor is exposed to high concentrations of corrosive gases (such as H2S, SO2, Cl2, HCl, etc.), not only will the sensor voltage be degraded, but also the sensor voltage will be degraded. Corrosion or destruction of the pipeline can also cause irreversible damage to the gas-sensitive materials.

6.6 Exposure to volatile silicon vapors

The sensor should avoid being exposed to silicone adhesives, hair spray, silicone rubber, putty or other places with volatile silicone compounds. If the surface of the sensor is adsorbed with silicone compound vapor, the sensitive material of the sensor will be covered, inhibiting the sensitivity of the sensor and it cannot be restored.

6.7 Long-term power outage

When the sensor is not powered on for a long time, its resistance will have a reversible drift, which is related to the environment in which the sensor is located. Sensors that have been powered off for a long time need to be powered on for a longer time before use to reach a stable state. The power-off time and the corresponding power-on stabilization time are recommended as shown in Table 4.

Table 4 Power-off duration and recommended power-on stability time Table

| Power-off duration | Recommended power-on stabilization time |
|---|---|
| Less than 1 week | No less than 30 minutes |
| More than 1 week | No less than 60 minutes |

### 6.8 Long-term exposure to extreme environments

Regardless of whether the sensor is powered on or not, if it is exposed to extreme conditions for a long time, such as high humidity, high temperature or high pollution, the sensor Performance will be severely affected and unrecoverable.

### 6.9 Vibration

Frequent and excessive vibration may cause the solder joints of the sensor's internal leads to fall off. Use a pneumatic screwdriver or Ultrasonic welders create these vibrations.

### 6.10 Impact

Strong impact (such as falling) can cause sensor components to loosen and lead wires to fall off.

### 6.11 Soldering and Cleaning

(1) For sensors, manual soldering is the most ideal soldering method. The recommended soldering conditions are as follows: Flux: chlorine-free resin

flux; Soldering temperature: temperature less than 250°C,

time less than 5 seconds.

(2) When using liquids such as alcohol or washing water for cleaning, do not allow the liquid to flow into or splash into the sensor to prevent the sensor performance from being affected. (3) In the instrument, the sensor detection hole should be exposed to the external airflow as much as possible to avoid interference with the measurement accuracy caused by the flux inside the instrument.

### 6.12 Wiring

The quality of the signal cable will affect the communication distance and quality. It is recommended to use high-quality shielded cables.

## 7. Common fault guide

### 7.1 The sensor is powered on for the first time and the measured value is too high

When the sensor is powered on for the first time or after the user has powered off the sensor for a long time, it is necessary to perform a power-on stabilization test according to the power-on stabilization time recommended in Table 4. The sensor readings will return to normal levels.

### 7.2 After powering on according to the recommended power-on stabilization time in Table 4, the sensor measurement value is still too high

(1) The sensor may be in a polluted environment. If you place the sensor outdoors or in fresh air, the value will return to normal. (2) The sensor may be in a high temperature and high humidity environment. It is recommended to avoid using it in a high temperature and high humidity environment.

### 7.3 Sensor measurement values are too low

The sensor is placed in an environment with convection or there are obstacles blocking the sensor's air holes.

### 7.4 The host cannot communicate with the sensor

(1) Hardware problem: The sensor SDA and SCL are not connected to pull-up resistors or the power supply voltage is less than 5V. (2)

Software problem: The slave address sent by the host is incorrect (the initial value is uli); the CRC checksum sent by the host is incorrect; the register address (Register) sent by the host is incorrect; the communication speed is greater than 100kHz.

### 7.5 Using intermittent power supply leads to inaccurate measurement values (too high/too low)

When continuous measurement is required, continuous power supply is required. Using intermittent power supply will result in inaccurate measurement values.

## Warning and Personal Injury

Do not use this product in safety protection devices or emergency stop devices, or in any other application where personal injury may occur due to failure of this product, unless there is a specific purpose or authorization for use. Refer to the product data sheet and instructions before installing, handling, using or maintaining this product. Failure to follow the advice may result in death or serious personal injury. The company will not be liable for all compensation for personal injury and death caused thereby, and will exempt any claims that may arise from the company's managers and employees, affiliated agents, distributors, etc., including: various costs, claims, attorney fees, etc.

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Shelf life description

| Product Categories | Shelf life |
|---|---|
| Hydrogen Sensor | 12 months |

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We do not provide any guarantee for use in special scenarios other than those recommended. We do not make any promises about the reliability of our products when used in other products or circuits not supported by our company.

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