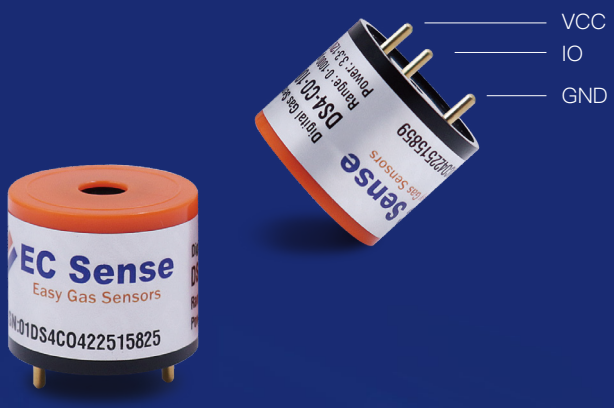
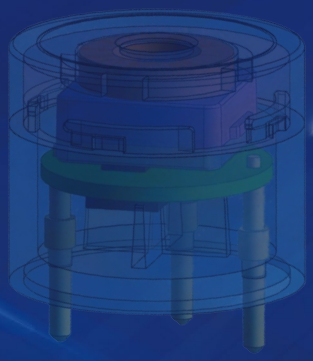
EC Sense
Easy Gas Sensors

DS4 Smart Gas Sensor

Manual





Easy Gas Sensor Solutions

Thank you for choosing to use the German EC Sense smart gas sensor, before use, please read the manual in detail in order to use the product correctly and effectively.

This manual is mainly used to guide users to better use DS4 smart gas sensor.

Warnning

Warning symbols are used to indicate that failure to follow these instructions may result in equipment damage, abnormal detection, or system failure.

EC Sense sensors are designed for a variety of environmental conditions, but in the process of storage, assembly and operation, due to the principle and characteristics of solid polymer electrochemical sensors, in order to ensure normal use, users should strictly follow this article when using the product, as well as the general type of PCB circuit board application method, violation of the application will not be covered by the warranty. Despite the high reliability of our products, we recommend checking the module's reaction to the target gas before use to ensure field use. At the end of the service life of the product, do not discard any product parts in domestic waste, and please dispose of them in accordance with the local government's e-waste recycling regulations.

Safety Statement

This product can only be used by properly qualified technicians in accordance with the instructions in this manual and relevant industry standards. If a fault cannot be eliminated, it must be stopped and accidental commissioning must be prevented.

EC Sense
Easy Gas Sensors

Overview

DS4 smart gas sensor is a German EC Sense smart digital output gas sensor, using a reliable printed solid polymer electrochemical gas sensor technology principle to measure gas concentration in the environment.

DS4 is an industrial-grade smart gas sensor with small size and compact structure design, high-performance microprocessor, high-precision analog-to-digital converter, and intelligent algorithm design, which can be easily used in instruments, integrated into the Internet of Things and other monitoring systems, and is widely used in industrial, commercial, civil and medical fields.

Features

- Low power consumption design, wide range of 3.3 to 12V DC power supply, 5V DC is recommended.
- It has a wide operating temperature range for humidity and temperature from -40℃ to +55℃.
- Fast power-on zero stabilization (in seconds).
- Strong zero long-term stability.
- It has a fast response time, which can quickly and timely capture changes in gas concentration.
- The linearity of the sensor is excellent.
- No leakage.
- It is resistant to poisoning and has a long life.
- Comply with RoHS standards.

Technology Specifications

Life Expectancy Parameters	
Long-Term Drift	< 1% / month
Expected Lifetime	> 3 years
Warranty	12 months from the date of delivery

Electrical Performance Parameters	
Output	UART 3.3V half duplex single bus. Baud rate: 9600 Data bit: 8 Stop bit: 1 Check bit: None
Supply Voltage	3.3 to 12V DC, Recommended 5V DC
Supply Current	0.65mA @ 5VDC
Peak Current	1mA @ 5V DC
Sleep Mode Current	0.35mA @ 5V DC
Power Consumption	≤ 5mW @ 5V DC

Note: The current data above will have slight differences due to the different stabilization times of different sensors at the first power-on. Please refer to the actual measurement data.

Environmental Parameters	
Operating Temperature	-40 to +55℃
Operating Humidity	15-95% RH. Non-condensing
Operating Pressure	Atmospheric pressure ± 10%
Storage Temperature	0 to 20℃

Mechanical and Packaging Parameters	
Material	ABS
Weight	4.56g
Package	Blister independent packaging

Principle

Solid Polymer Electrochemical Sensing Technology. The principle is to place two reaction electrodes, a working electrode and a counter electrode, and a reference electrode in a specific electrolyte, and then apply sufficient voltage between the reaction electrodes to make the gas to be measured passing through the heavy metal catalyst film carry out redox reactions. Then, the electric current generated during gas electrolysis is measured through the circuit system in the instrument, and then the gas concentration is calculated by the microprocessor in it.

Expressed by the first Fick's law: i = nFDC

Thus, the current flowing is proportional to the concentration of the target gas, and the reference electrode and potentiostat maintain a constant potential.

For example, carbon monoxide (CO) sensors, the following chemical reaction will occur: $CO + H_2O \longrightarrow CO_2 + 2H^+ + 2e^-$

The proton diffuses to the opposite electrode, where oxygen is reduced to water: $2H^+ + 2e^- + O_2 \longrightarrow H_2O$

The working principle of the intelligent gas sensor is to convert the original weak current signal of the sensor into a standard digital signal output through the internal integrated circuit chip and intelligent algorithm.

Typical Function

Standard Industrial Dimensions

The sensor has a standard industrial 4-series size design, with a 20 x 16.6mm cylindrical outer casing. Users can easily iterate new product designs and can be used for fixed gas detectors and portable detection instruments, saving the cost of redesigning the housing for new product upgrades. The sensor has standard three electrode pin sizes for VCC (power positive), GND (power negative), and IO (data receiving and sending).

User-defined Encryption Code Function

Users can customize their own unique user code, which can be used for instrument identification. When another type of sensor is inserted, the instrument can automatically detect whether the user code is correct. If the user code is incorrect, the instrument can display an error message to remind the user to insert the correct sensor.

Low-power Sleep Function

The sensor has a sleep mode function that allows users to customize the sleep and wake-up modes, making it suitable for low-power battery or IoT applications.

Self-identification Function

The DS4 sensor outputs identity information such as gas type and detection range, which is useful for designing self-identification features, providing more flexibility in usage.

Easy Maintenance

The sensor is plug-and-play and can be hot-swapped with power attached. It also has an open calibration protocol that supports secondary offline calibration for after-sales service and one-key reset to factory calibration. The plug-and-play feature enables offline calibration, which eliminates the need to bring dangerous gases into the testing environment to calibrate the instrument, thereby avoiding safety risks and pollution to the site environment. It makes maintenance safer, more convenient, and simpler.

Use Without Preheating

The intelligent hardware design ensures that the gas sensor remains operational even when it is not powered, ensuring that gas monitoring can be carried out immediately after power is supplied, regardless of the time and place. This is particularly useful in applications where the sensors are part of an IoT or battery-powered system, where energy efficiency and low power consumption are critical concerns. Users need not worry about long preheating times or slow data acquisition in energy-efficient and low-power design.

Accurate Factory Pre-calibration

Each DS4 intelligent gas sensor undergoes professional gas calibration in the factory, and the calibration information is stored in the internal chip of the product, so users can use it directly without the need for additional gas calibration. The factory calibration uses a diffusion gas calibration and an analog environment climate calibration, which is closer to the users' actual application environment, thus improving the accuracy of data obtained from the gas detection instrument using a diffusion measurement method. (When using a pump-suction measurement method, a secondary calibration is required according to the design parameters of the instrument system.)

Lifespan and Performance Testing

The intelligent gas sensor has a self-check function to periodically perform self-diagnosis on the lifespan and performance indicators, whether in the presence or absence of the test gas. The sensor will output warning signals to prompt sensor maintenance or replacement. This function provides reliable basic data for the design of intelligent instruments, making gas detection instruments safe, reliable, and capable of remote maintenance. Users can obtain sensor fault information, such as normal operation, weak performance, failure, or detachment, through commands. This provides users with early warning of sensor abnormalities, greatly improving safety assurance.

Method of Use

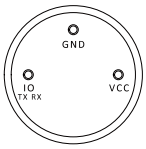
Connection

The DS4 smart gas sensor contains electronic components that must be handled in accordance with the correct electrostatic protection measures.

The sensor is a digital output, does not require additional analog signal conditioning circuit, is directly connected to the microcontroller interface, through the UART 3.3V half-duplex single-bus level signal. The allowed minimum and maximum supply voltage range is 3.3 to 12V DC, and 5V DC is recommended, as the operating voltage outside this range will cause a fault or the sensor will not work properly.

Please follow all wiring instructions carefully, incorrect wiring may cause permanent damage to the sensor.

Pins are defined as follows:



Pin Description

Pin Definitions	Pin Description	Minimum Value	Typical Value	Maximum Value
VCC	Positive terminal of power supply	3.3V	5V	12V
IO	Serial data transceiver	-0.3V	3.3V	3.3V
GND	Ground of power supply	-0.3V	0	-

Pin Socket

The three output pins of the sensor, the user can choose a standard pin socket, the pin socket is welded on the PCB board, the sensor can be easily inserted and removed, it is not recommended to weld the sensor directly, which is not conducive to subsequent after-sales maintenance. Do not break or bend the pin, which may damage the internal structure of the sensor.

4 series sensor pin sockets

Partnumber: 03-SOCKET-4S-C3604-01

First Power-on Stability Time

When the sensor is powered for the first time, the stable output of the sensor is usually very short, because the sensor is designed with a plug and play function, the internal circuit always keeps the sensor in the working state, avoiding the problem of long stability time of the traditional electrochemical principle of the gas sensor. But sensors and electronics still need a short start-up and balancing time.

If the concentration of contaminated gas is higher in the storage process, during transportation or in the on-site environment, the stabilization time will increase, and the higher the concentration of pollution, the longer the stabilization time is required.

If the air convection in the field environment is large, the data fluctuation will also change from time to time, especially for low concentration detection, please pay close attention to the site environmental state, when the environmental state tends to be stable, there is no strong convection and air exchange, such as: opening the window, opening the door, fans, air conditioners, fresh air, purification system, etc., the output signal is marked to enter the normal detection.

The stability time of oxygen on power is longer than that of other gases, mainly because the sensor has a-500mV bias voltage, and the sensor and electronics need to balance the time.

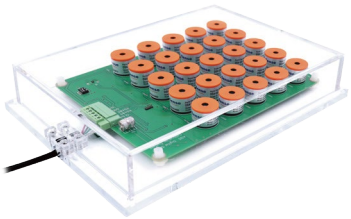
Sleep Wake Up Stable Time

When the sensor enters the sleep state, the sensor is still in the working state, so the sensor can be measured and data transmission without stable time after waking up.

Gas Response Test

The smart gas sensor has been calibrated by the factory gas. If the gas response verification is required, a dedicated standard gas should be used, and the concentration of the gas used must be allowed within the maximum inspection range of the sensor.

The 4S sensor flow cap specially designed by EC Sense and the 25-channel test kit can be used for testing.



25 channel test suite

4S Sensor Flow Cap

Sensor calibration may be required in the following situations:

- Stored in the warehouse for more than 12 months
- After 12 months of continuous use
- Sensors are often exposed to high concentrations of gas.

Follow these guidelines before calibrating the sensor:

- Calibration accuracy depends on the accuracy of calibration gas. It is recommended to use high quality calibration gas. Gas with qualified traceable accuracy can help improve the effectiveness of calibration.
- When calibrating zero point, it can only be done in pure air without the target gas (except for oxygen sensors).
- The zero point should be calibrated first, and then the sensitivity should be calibrated, otherwise the calibration accuracy will be affected.
- The DS4 smart gas sensor user calibration software of EC Sense can be used to calibrate the sensor, or the communication protocol can be controlled to operate the calibration.

Zero Calibration

Zero calibration can be performed in clean air (in the absence of measured and interfering gases) or through zero gas (99.99% vol nitrogen).

The intelligent oxygen sensor cannot be calibrated at zero point in the air, and must be injected with 99.99% vol nitrogen for zero point calibration.

Ventilation Calibration Procedure

Step 1: Attach the smart gas sensor to the 4S sensor flow cap, or the 25-channel test and evaluation kit, and connect the zero gas outlet line to the air intake of the flow cap or test and evaluation kit.

Step 2: When the 4S sensor flow cap is selected, nitrogen is injected at a flow rate of 400ml/min. When the 25-channel test evaluation kit is selected, nitrogen is injected at a flow rate of 1000ml/min.

Step 3: After continuous ventilation for 3 minutes, observe the stability of the sensor value on the user calibration software or equipment and click the zero calibration button. At this time, the current value will be 0 by default and written into the internal chip of the smart gas sensor.

Step 4: Close and remove the zero gas, remove the flow cap, and place the sensor in the air.

Sensitivity Calibration

When calibrating the sensitivity of the smart gas sensor, the standard cylinder gas with known concentration must be passed into the cylinder gas. The cylinder gas of the gas with strong adsorption must choose nitrogen as the background gas to ensure the stability of the gas. Carbon monoxide and hydrogen in the 1000ppm detection range must choose oxygen as the background gas to ensure the oxygen demand of the chemical reaction.

The concentration of standard gas must be selected lower than the maximum detection range of the sensor, usually 50% to 80% of the maximum detection range.

Step 1: Attach the smart gas sensor to the 4S sensor flow cap, or the 25-channel test and evaluation kit, and connect the standard gas outlet line to the air intake of the flow cap or test and evaluation kit.

Step 2: When the 4S sensor flow cap is selected, nitrogen is injected at a flow rate of 100ml to 500ml/min. When the 25-channel test and evaluation kit is selected, nitrogen is injected at a flow rate of 1000ml/min. When the gas with strong adsorption is calibrated, the flow rate of 1000ml/min must be injected, and the saturation ventilation of the gas path must be carried out continuously for not less than 5 minutes.

Step 3: After continuous ventilation for 3 minutes, write the standard gas concentration in the user calibration software or equipment, and click the sensitivity calibration button after observing the stability of the sensor value.

Step 4: Close and remove the standard gas, remove the flow cap, and place the sensor in the air to return to zero.

Gas Sensor Manual

Gas Flow Effect

Diffuse Use

When the sensor is used for gas detection with natural diffusion, the natural gas diffusion is only inside the sensor. In this case, it is necessary to ensure that the sensor air intake can fully contact the gas for the first time, and do not block the air intake. In the design of the instrument housing, it is necessary to pay attention to the anti-adsorption materials around the sensor when detecting the gas with strong adsorption or low concentration. Avoid material adsorption that prevents the sensor from detecting gas.

Affecting the diffusion rate of gas molecules, various conditions described in the technical specification, such as temperature and humidity, pressure, will affect the response speed, performance and life of the sensor.

The output of the sensor can be disturbed by sudden changes in the gas flow rate. If the gas flow rate changes greatly, the output signal will increase due to the increase in pressure caused by the increase in flow rate and the contact of the sensor with more gas molecules, resulting in an increase in the output value.

The gas flow rate should be stable at 300-500ml/min.

Temperature Effect

The sensor is allowed to work at-40°C to 55°C, and the good working temperature condition is 20 to 25°C.

The sensor output changes slightly with the change of temperature, the temperature increase signal increases, the temperature decrease signal decreases, if you need to modify the temperature, please contact us for relevant data or get the correct test guidance.

It is not recommended that the sensor work in the extreme high temperature environment, continuous high temperature will cause excessive evaporation of water in the solid electrolyte inside the sensor, resulting in the inability of electrons to flow, weak signal, or no signal, which will lead to physical damage for a long time.

It is not recommended that the sensor work in the extreme low temperature environment, continuous low temperature will cause the sensor to respond to the gas longer, the signal will become smaller.

The output of the sensor can be disturbed by sudden changes in temperature, and if the ambient temperature and gas temperature change suddenly large, the output signal will instantly increase. The signal increases sharply when the temperature rises sharply, and decreases sharply when the temperature drops sharply. When the temperature change is stable, the sensor output signal will become stable. In the process of using the sensor, pay attention to the sudden change in temperature will lead to abnormal fluctuations in the sensor data, the sensor has a good adaptability to the environment, generally in 5-10 minutes can fully adapt to the new environment and stabilize, and can be normal detection.

Do not use the sensor for a long time in a high temperature and low humidity environment where the humidity is lower than 15% and the temperature is higher than 45°C. Otherwise, the sensor service life may deteriorate, or the sensor may fail, or the test data may be invalid.

The sensor housing is made of ABS resin, and the temperature exceeding the working upper limit will affect the performance of the material, or the structural gap, resulting in the seal becoming unstable.

Humidity Effect

The sensor allows the humidity operating range of 15% to 95% relative humidity, and non-condensing, good humidity conditions are 45% to 55% RH.

The sensor is not recommended for long-term use in extremely dry environments (< 15%RH), the sensor inside the solid electrolyte in the water will be excessive evaporation, resulting in electrons can not flow, the signal is weak, or no signal, long time will lead to physical damage, in the short term humidity return to 50%RH sensor may return to normal work.

Not recommended for long-term use in extremely humid environments (> 90%RH), the change in temperature difference in a high humidity environment is easy to lead to the generation of condensate, the condensate in the air intake at the white filter membrane will be ducking the air inlet, resulting in gas can not diffuse into the sensor inside, and some easily soluble gas dissolved into the water, the sensor can not detect the gas. High humidity also causes the electrolyte inside the sensor to inhale more wet steam, which is not conducive to the life of the internal material.

It is not recommended to use in the environment of rapid changes in humidity. When the humidity changes sharply, the sensor will also have a sudden sharp change in output (different gases may change in different directions, which may be positive or negative). When the humidity is stabilized, the sensor will gradually balance and the output will stabilize. The constant change of unstable humidity will bring aging to some materials inside the sensor, thereby shortening the life. To avoid this problem, the sensor should prevent rapid humidity changes.

The sensor is strictly prohibited in low humidity and high temperature environment, especially (< 15% RH) High temperature (> 45°C), the water in the electrolyte inside the sensor will quickly evaporate, resulting in the inability of electrons to flow, weak signal, or no signal, which will lead to physical damage for a long time.

Pressure Effect

The pressure range that allows the sensor to work is ± 10% of atmospheric pressure, and when the pressure exceeds the upper limit, the sensor may become unstable due to contact with more gas, or a larger pressure will cause physical damage to the sensor. When the pressure exceeds the lower limit, it may cause physical damage to the sensor.

The change of pressure is usually proportional to the change of sensor signal, the pressure increases the signal increases, the pressure changes unsteadily, and the signal changes unsteadily.

The good working condition of the sensor is 1 standard atmosphere, and the pressure is stable.

Dust Effect

The sensor needs to be used in a clean environment. When used in a seriously polluted dust environment, it is easy to cause large dust or long-term accumulation of dust to block the air inlet on the surface of the sensor, resulting in gas unable to enter the sensor content, and the gas concentration cannot be detected. Or the measured gas adsorbs to the dust particles, causing the sensor to fail to detect the gas.

The vent surface of the sensor should not be blocked or contaminated, and sometimes hole blockage leads to reduced sensitivity, slow response time, or no response.

Regular air purging or adding a dust filter membrane can be used, and the dust filter membrane can be replaced regularly to ensure the clean surface of the sensor intake hole.

High Concentration Gas Effect

If the sensor is used for a long time in a high concentration gas environment close to or beyond the measurement range, it may lead to a slow recovery to the initial state, and the recovery speed is proportional to the multiple of the overrange. The longer the exposure to the high concentration, the slower the recovery will be. However, the sensor usually does not have the phenomenon of poisoning, but there may be a situation where the zero point cannot recover the original value. In this case, you need to re-calibrate the zero point.

When detecting the sensor, the gas with high concentration and strong adsorption should be avoided from contacting the sensor for a long time. The gas will be attached to all the surface of the material, the surface of the instrument housing, and the surface of the gas path inside the sensor. The desorption time needs to be very long, so the sensor will return to zero for a long time.

Gas Cross Interference

The types of cross-interference gases listed in each sensor technical specification are not detailed, and the interference data will also bring differences in data due to the test conditions of the sensor (environmental temperature and humidity, pressure, flow, air source, test method, etc.), batch nature, sensitivity, sensor storage environmental conditions and laboratory conditions during the test. Please contact us if there is a large deviation.

If you wish to apply to gases outside the cross interference list, please contact us for advice on the appropriate test method, and you should test with the sensor you wish to use to obtain actual interference data.

Sensor Cleaning

The main function of the gas sensor is to detect the composition and content of the gas, please do not let any part of the sensor contact the liquid.

The white or yellow sheet on the sensor is a waterproof breathable film, please be careful not to scratch or remove it.

Clean if necessary, use a damp cloth to clean the outer surface of the sensor housing.

- Do not immerse the sensor in any cleaning medium.
- Do not use alcohol.

Vibration Effect

No excessive impact or vibration, such as the shell cracking, exposing the internal structure, the output will not be guaranteed to be effective.

When no output signal is found, you can check whether the contact between the sensor three pins and the socket is good.

Storage

Good storage environment: temperature -5°C to +30°C, relative humidity 25% to 95% (non-condensating).

Solid polymer sensor in humidity 20 to 95%, temperature -5 to +30°C environment storage time can reach more than 12 months, as far as possible to ensure that the storage environment without high concentration of pollution gas, sensor storage time more than 6 months of the first energized polarization time in more than 12 hours can fully activate the electrolyte activity, restore the best detection state. Especially when used from low temperature to normal temperature environment, there may be surface condensation. It is necessary to ensure that the surface is completely dry before ventilation.

Storage environment should keep the air clean, no pollution gas, no high concentration of organic gas, no dust, no smoke, should avoid high concentration of alcohol (ethanol), perfume, sodium silicate and polyurethane component liquid and solid storage together.

When the storage environment exceeds the above range, it may cause damage to the device. Long-term storage and maximum value conditions may affect the reliability of the sensor, so it is recommended to store within the recommended range.

Transport by Packing

Packing: sealed packing for transportation.

During the transportation process, avoid long-term direct sunlight and rain infiltration. The transportation packaging should be protected by shockproof bubble film or non-odor environmental protection sponge.

During long-distance transportation for a long time, the temperature in the sensor package should be kept within-5 to +40°C as far as possible, the maximum temperature should not exceed 55°C (can not be stored at this temperature for a long time), and the humidity should not be lower than 15% RH.

It is necessary to ensure that the sensor is sealed during the transportation of the finished product to prevent polluting gases from entering the sensor interior, resulting in high values in the first use of the product, or too long stability time.

Disposal

DS4 smart gas sensors do not contain harmful substances and comply with RoHS standards. They should be treated as e-waste, please comply with local regulations.

Warranty Description

Disassembling the sensor is prohibited. Doing so may damage the sensor and is not covered by the warranty.

Disclaimer

Since the user application is not under the control of EC Sense GmbH, the information provided does not bear any legal liability and the customer should carry out the tests under his own conditions to ensure that the sensor is suitable for his intended application.

The EC Sense performance data stated above is based on data obtained under test conditions using the EC Sense gas distribution system and AQS test software. In the interest of continuous product improvement, EC Sense reserves the right to change design features and specifications without notice. We are not responsible for any loss, injury or damage caused by this. EC Sense assumes no responsibility for any indirect loss, injury or damageresulting from the use of this document, the information contained therein or any omissions or errors herein. This document does not constitutean offer to sell. The data it contains are for informational purposes only and cannot be considered a guarantee. Any use of the given data must beevaluated and determined by the user to comply with federal, state and local laws and regulations. All specifications outlined are subject to change without notice.

This technical specification document is translated directly from the Chinese version, and there may be certain differences in the expression of some words compared to the Chinese version. If there are any issues, please contact the manufacturer directly for communication. This version is temporary.

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