EC Sense
Easy Gas Sensors

DS4-LEL Digital Combustible Gas Sensor

Manual

Easy Gas Sensor Solutions

Thank you for using the DS4 Digital Combustible Gas Sensor. Please read this product specification carefully before use to ensure correct utilization.

This product specification is primarily designed to guide users in the optimal use of the DS4-LEL Digital Combustible Gas Sensor.

Warnings

The warning symbol is used to indicate that nonobservance of these instructions may result in equipment damage, false detection or system failure.

EC Sense sensors are designed for use in various environmental conditions. However, due to the principles and characteristics of the sensor, strict adherence to this document and the general application methods of PCB circuit boards is required during storage, assembly, and operation to ensure proper use. Any unauthorized use will not be covered by the warranty. Although our product are highly reliable, we recommend checking the module's reaction to the target gas before use to ensure on-site usability. When the product reaches the end of its service life, please do not dispose of any product components as household waste. Instead, adhere to local government regulations for electronic waste recycling.

Safety Instructions

This product should only be used by technically qualified personnel, following the instructions in this manual and relevant industry standards. In the event of an unresolvable error, usage must be stopped and inadvertent debugging should be prevented.

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Product Description

The DS4-LEL Digital Combustible Gas Sensor is a high-performance product. Its high-quality catalytic combustion sensor, combined with advanced digital processing technology, enables continuous and comprehensive monitoring of combustible gases in indoor and outdoor environments. The sensor outputs monitoring signals to gas detection centers or other signal acquisition devices. It can also be easily integrated into other secondary instruments and control systems. Its housing is made of high-temperature-resistant PPO material suitable for various environments. It is widely used in industries such as petroleum, chemical, metallurgy, refining, gas transmission, biochemistry and pharmaceutical.

Measurement Principle

The catalytic combustion detection principle is based on a Wheatstone bridge structure. The measurement bridge is coated with a catalyst material, which remains unaltered throughout the measurement process. Even if the concentrations of gases and vapors are well below the Lower Explosion Limit (LEL), catalytic combustion reactions occur at this bridge. During the measurement, voltage is applied to both the reference and measurement bridge to heat them, initiating the catalytic reaction at a temperature of approx. 500 °C or higher. Under normal conditions, the bridge is balanced, i.e. V1=V2, resulting in a zero output. When combustible gas is present, its oxidation process heats the measurement bridge and increases its temperature, while the reference bridge's temperature remains constant. The circuit detects the resistance change between them (V2>V1). The output voltage is directly proportional to the concentration of the measured gas.

Functions and Characters

- The sensors output gas concentration with a digital signal and are supplied pre-calibrated from the factory for a quick installation and use.
- Flexible application in combustible gas alarm systems and combustible gas concentration detectors.
- Excellent stability.
- Real-time monitoring of sensor errors.
- Excellent repeatability and consistency.
- Good linearity for different gas concentrations.
- Excellent resistance to poisonous gases.

Technical Parameters

Measurement	
Measurement Principle	Catalytic combustion gas detection technology
Target Gases	Combustible gases
Measuring Range	3% vol to 100% vol
Linearity	Linear
Response Time (T90)*	≤ 30 s

Environmental Parameters	
Temperature Range	-20 ℃ to +55 ℃
Humidity Range	15 to 95% RH. non-condensing
Pressure Range	800 to 1200 hPa
Recommended Storage Conditions	Stored in original packaging under 0 ℃ to 30 ℃ (0 to 30% RH)

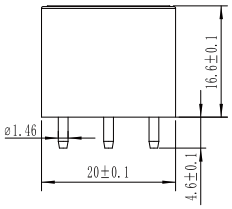
Electrical Parameters	
Communication Interface	UART Communication
Communication Protocol	Attachment
Supply Voltage	3.3 V- 5 V
Current	200 mA
Output Signal	UART single-wire half-duplex 3.3 V, baud rate 9600

Lifetime Parameters	
Ideal Lifetime	2 years in the air
Storage Duration	12 months from the date of delivery
Warranty	12 months from the date of delivery
Weight	Typical value: 5.5 g
Housing Material	PPO

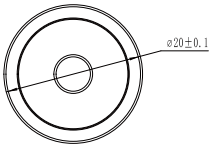
Product Structure Diagram (unit: mm)

- Product Diagram

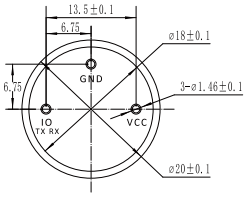
- Front View



- Top View



- Bottom View



Usage

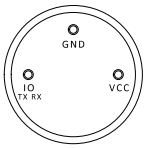
Connection

The DS4-LEL Digital Combustible Gas Sensor contains electronic components and must be handled in accordance with proper electrostatic discharge precautions.

The sensor provides a digital output without the need for any additional analog signal conditioning circuits. It can be connected directly to the microcontroller interface via a UART 3.3V half-duplex single bus signal. The permissible supply voltage range is from 3.3V to 12V DC, whereby 5V DC is recommended. An operating voltage beyond this range may result in malfunction or sensor failure.

⚠ Please adhere closely to all wiring instructions, as incorrect wiring may result in a permanent damage to the sensor.

Pin Definitions:
(Pin connection as above)



Pin Description

Pin Definition	Pin Description	Min Value	Typical Value	Max Value
VCC	Power Positive	3.3 V	3.3 V	3.5 V
IO	Serial Data Sending and Receiving	0 V	-	3.3 V
GND	Power Ground	-	0 V	-

Pin Socket

The sensor has three output pins. Users can choose standard pin sockets and solder them onto the PCB, allowing for convenient insertion and removal of the sensor. Direct soldering of the sensor is not recommended as it hinders future maintenance. It is prohibited to bend or break the pins, as it may damage the internal structure of the sensor.

4 Series Sensor Pin Socket

Order Number: 03-SOCKET-4S-C3604-01

Stabilization Time upon First Power-Up

The stabilization time for the sensor output is normally short at the first power-up. Since the sensor is equipped with a plug-and-play function, the internal circuitry keeps the sensor in a working state, avoiding the long stabilization time typically associated with conventional electrochemical gas sensors. Nevertheless, the sensor and electronic components require a brief start-up and equilibration period.

If the gas concentration is high due to contamination during storage, transportation or in the field environment, a longer stabilization time can be expected. The higher the contamination concentration, the longer the stabilization time required.

The strong air convection in the field environment can lead to data fluctuations, especially during low-concentration detection. It is important to monitor the ambient conditions closely. When the environmental conditions stabilize, without strong convection or air exchange (e.g. opening windows or doors, using fans, air conditioning, ventilation, purification systems, etc.), and the output signal stabilizes, it indicates that normal detection can commence.

Stabilization Time after Waking from Sleep Mode

The sensor remains operational during sleep mode. Therefore, measurement and data transmission can commence immediately after waking up without stabilization time.

Calibration Conditions

The sensors might need calibration under the following conditions:

- Stored in warehouse for more than 12 months.
- Continuously used for 12 months.
- Frequently exposed in high-concentration gases.
- The measurement error exceeds the acceptable range.

Please adhere to the following instructions before calibration:

- Use standard gases with standard substance certificate which are within validity period.
- Must perform zero-point correction before sensitivity calibration to ensure calibration accuracy.
- You can calibrate the DS4 Digital Combustible Gas Sensor individually with the optional user calibration software provided by EC Sense or through calibration via command operations using the communication protocol. For batch calibration of sensors, you can purchase the EC Sense 25-channel test kit, enabling simultaneous calibration of up to 25 sensors.

Zero Point Correction

The zero point correction can be performed in clean air or in indoor environments with good air quality (no measured or interfering gas).

Ventilation Calibration Steps

Step 1:

Attach the 4S Sensor Flow Cap (optional accessory) or the 25-Channel Evaluation Kit to the DS4 Digital Combustible Gas Sensor. Then connect the zero gas outlet pipe to the inlet port of the flow cap or evaluation kit.

Step 2:

Introduce the zero gas into the system. When using the 4S Sensor Flow Cap, introduce clean air at a flow rate of 400 ml/min. When using the 25-Channel Evaluation Kit, introduce clean air at a flow rate of 2000 ml/min.

Step 3:

After continuous ventilation for 3 minutes, click the zero point correction button when the reading of the user software or device is stable. At this point, the current value is reset to 0 and written on the chip inside the gas sensor.

Step 4:

Stop and remove the zero gas supply. Take off the flow cap and place the sensor in the air.

Sensitivity Calibration

During the sensitivity calibration, it is necessary to supply standard gas from a gas cylinder with a known concentration. The gas concentration should be selected to be lower than the maximum detection range of the sensor, typically around 50% to 80%.

Step 1:

Attach the 4S Sensor Flow Cap or the 25-Channel Evaluation Kit to the DS4 Digital Combustible Gas Sensor. Then connect the gas outlet pipe of the standard gas to the inlet port of the flow cap or evaluation kit.

Step 2:

Introduce the standard gas into the airflow. When using the 4S Sensor Flow Cap, introduce methane standard gas into the airflow at a flow rate of 100 ml ~ 500 ml/min. When using the 25-Channel Evaluation Kit, introduce methane standard gas into the airflow at a flow rate of 2000 ml/min.

Step 3:

After continuous ventilation for 3 minutes, input the standard gas concentration into the user calibration software or device. Once the sensor reading stabilizes, click on the sensitivity calibration button.

Step 4:

Stop and remove the standard gas supply. Remove the flow cap and place the sensor in ambient air to restore the zero point.

Product List

Product Name	Order Number	Range	Response Time (T90)*	Notes
Digital Combustible Gas Sensor	04-DS4-LEL-100%-01	3% - 100%	≤ 30 s	/
	04-DS4-LEL-100%-PR-01	3% - 100%	≤ 30 s	PR: Poison Resistant
	04-DS4-LEL-100%-LP-01	3% - 100%	≤ 30 s	LP: Lower Power

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Cross Sensitivity

Gas	Formula	LEL (% vol)	Relative Sensitivity
Methanee	CH_4	5	100
Propane	C_3H_8	2.1	58
Isobutane	C_4H_{10}	1.8	48
n-Heptane	C_7H_{16}	1.1	28
Xylene	C_8H_{10}	1	17
Methanol	CH_3OH	5.5	18
Acetic Acid	CH_3COOH	4	3
n-Pentane	C_5H_{12}	1.7	47
Phenylethane	C_8H_8	1.1	14
Methylbenzene	C_7H_8	1.2	37
Acetone	C_3H_6O	2.5	9
Ethanol	C_2H_5OH	3.3	11
Ethyl Acetate	$C_4H_8O_2$	2	9
Hydrogen	H_2	4	74
n-Hexane	C_6H_{14}	1.2	42
Isopropanol	C_3H_8O	2	31
Cyclohexane	C_6H_{12}	1.3	42

Note: The relative cross sensitivity is provided for reference only. Calibration with the target gas is recommended. We do not guarantee the accuracy of the calibration and measurement if the sensor is calibrated with cross-sensitive gases.

1. All above performances are measured at 20°C, 50% relative humidity and atmospheric pressure.
2. It is recommended to calibrate the sensor with the target gas. We do not guarantee the accuracy of the calibration and measurement if the sensor is calibrated with cross-sensitive gases.
3. The cross sensitivity may fluctuate by up to ±30% and may vary with different production batches and the sensor lifetime.
4. The above cross sensitivity includes, but is not limited to, the gases mentioned. The sensor may also respond to other gases.

Storage and Transportation

Please refer to the recommended storage environment conditions and cycles as described above.

Additionally, the storage environment should maintain clean air, free from contaminating gases, high-concentration organic gases, dust and smoke. It is recommended to avoid storing the sensors with high concentrations of alcohol (ethanol), perfume, sodium silicate, polyurethane-based liquids and solids.

Storing the sensors beyond the recommended conditions may lead to damage and prolonged storage or exposure to maximum conditions may affect the sensor reliability. It is recommended to adhere to the recommended storage time.

During transportation, use sealed packaging and provide protection with shock-absorbing bubble wrap or odorless environmentally friendly sponge.

Long exposure to direct sunlight and water penetration should be avoided during transportation.

Pay attention to the height of the product placement to prevent falls, compression and strong vibrations.

Warranty

Disassembly of the sensor or alteration of its appearance, including labels, markings, and structural components, is strictly prohibited. Any such action will result in automatic voiding of the warranty coverage and period.

Disclaimer

The above EC Sense performance data is based on data obtained using EC Sense gas distribution systems and AQS testing software. In order to continuously improve products, EC Sense reserves the right to change design features and specifications without prior notice. We are not responsible for any loss, injury, or damage caused thereby. EC Sense shall not be liable for any indirect loss, injury, or damage caused by the incorrect use of this document, the information contained therein, or any omissions or errors. This document does not constitute an offer for sale. The data contained herein is for reference purposes only and should not be construed as a guarantee. The use of any given data must be evaluated and determined by the user to comply with federal, state, and local laws and regulations. All specifications outlined are subject to change without notice.

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