# Analysis of automation through sensors through gas sensors in different directions

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**Abstract.** The MQ2 and MQ4 sensors are highly popular gas sensors utilized in a wide range of applications for the detection and measurement of various gases. Renowned for their simplicity, affordability, and ease of use, MQ sensors have become a preferred choice among hobbyists, students, and professionals. In this article, we will delve into a comprehensive comparison between these two types of gas sensors, aiming to unveil the desired outcomes. In conclusion, the MQ2 and MQ4 sensors are widely recognized for their simplicity, affordability, and ease of use in detecting and measuring various gases. While the MQ2 sensor is versatile in its gas detection capabilities, the MQ4 sensor specializes in methane gas detection. Both sensors display commendable levels of sensitivity, stability, and repeatability, guaranteeing accurate and dependable gas measurements. By conducting a thorough comparison of these gas sensors, we have shed light on their unique features and functionalities, facilitating informed decision-making for potential users. **Keywords.** gas sensors, MQ2, MQ4, methane, propane, butane.

## 1 Introduction

A gas sensor is a device used to detect the presence of gases in the surrounding environment. With a wide range of applications, including security systems in refineries, industrial centers, and even homes, these sensors play a crucial role in ensuring safety. They have the ability to detect various types of gases, such as combustible gases, toxic gases, and pollutants.

There are different methods for gas detection, but the most commonly employed method is through the use of electrochemical sensors. These sensors work by measuring the concentration of a specific gas through a chemical reaction that takes place on their heated electrodes. The resulting electric current provides a measurement of the gas concentration.

Gas sensors are vital in various industries where the detection of gases is essential for maintaining a safe environment. They provide early warning systems that enable quick response and action to be taken in the event of gas leaks or other hazardous situations. By

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continuously monitoring the presence of gases, these sensors contribute significantly to preventing accidents and protecting human lives.

The difference between the various types of MQ Series sensors lies in their sensitivity to specific ranges of gases. While they may be more sensitive to some gases than others, they are designed to detect more than just one gas. Therefore, it is necessary to review the datasheets to choose the right sensor for our specific applications.

One particularly popular choice is the MQ2 gas sensor, which finds wide usage across multiple fields. It is commonly employed for home protection, industrial monitoring, and environmental monitoring purposes.

The MQ2 gas sensor is highly reliable and offers an affordable solution for gas detection. Its versatility makes it suitable for a variety of applications, making it a favored option among professionals in need of an efficient and cost-effective gas sensor.[1-8]

The mq gas sensor series is renowned as the most widely used and recognized gas sensor range in the industry. These sensors offer exceptional reliability and accuracy in detecting various gases, catering to a diverse range of applications. With their extensive models, the mq gas sensor series ensures effective and efficient gas detection for different gases of concern.

The following table highlights some of the key gases that can be detected by the mq gas sensor series:

- MQ-2: This model is specifically designed to detect gases such as LPG, propane, methane, hydrogen, and various other combustible gases. It is commonly used in gas leak detection systems, gas detectors, and industrial safety applications.
- MQ-3: The MQ-3 sensor excels in detecting alcohol vapors. It is commonly utilized in breathalyzer devices, as well as in the automotive industry for alcohol detection systems in cars.
- MQ-4: This particular model is dedicated to detecting natural gas (methane). Suitable for applications in homes, kitchens, and industrial environments, the MQ-4 ensures reliable monitoring and early warning of potential gas leaks.
- MQ-5: The MQ-5 sensor is specifically designed for detecting flammable gases, including natural gas, LPG, and hydrogen. It finds extensive use in gas leakage detection systems, as well as in safety applications in various industries.
- MQ-6: Dedicated to detecting the presence of liquefied petroleum gas (LPG), the MQ-6 sensor is widely applied in gas leakage detectors, gas alarms, and other industrial safety systems.
- MQ-7: With its exceptional sensitivity to carbon monoxide (CO) gas, the MQ-7 sensor plays a crucial role in ensuring safety in environments where the presence of this toxic gas is a concern. It finds applications in carbon monoxide detection systems, smoke detectors, and industrial safety equipment.

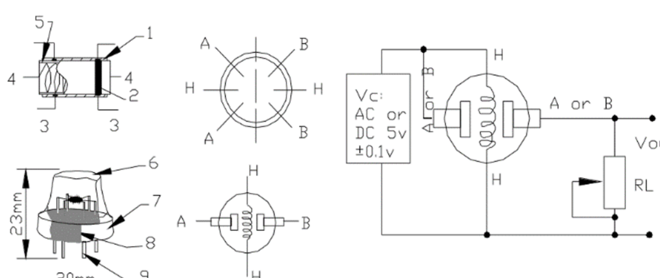


**Fig. 1.** Schematic diagram of MQ2 and MQ4 gas sensors

The aforementioned models represent just a fraction of the mq gas sensor series' capabilities in detecting various gases. These sensors provide a reliable and efficient solution for gas detection needs across multiple industries, contributing to enhanced safety and prevention of potential hazards.[9-15]

## 2 Methods

In the realm of data analysis, advanced techniques including regression models, classifiers, deep learning techniques, and machine learning have revolutionized the process of transforming inherent data characteristics into valuable insights. Effective feature extraction and selection methods have significantly enhanced the efficiency and accuracy of data-driven algorithms. This section presents a comprehensive overview of the cutting-edge feature and model-based approaches that have emerged in recent years specifically in the field of gas sensors.

In order to calibrate, it is necessary to determine the ro value during the measurement of clean air. Considering that we have determined the ratio of clean air from the graph as 9.83, we can then calculate the ro value using the following equation:

Gas ratio:

$$Ratio = \frac{R_s}{R_o}$$

When measuring at clean air, ratio=9.83

$$R_o = \frac{R_s}{9.83}$$

## 3 Results and Discussions

MQ2 and MQ4 are two types of gas sensors that are commonly used to detect various gases in the environment. While they share a common operating pattern, they differ in their detection capabilities and the specific gases for which they are designed. Here are the main differences between the MQ2 and MQ4 gas sensors:

Gas sensitivity: MQ2: MQ2 is designed to detect a variety of gases including methane (CH4), propane (C3H8), carbon monoxide (CO) and smoke. It has a wide sensitivity range, making it suitable for detecting multiple gases. MQ4: MQ4 is mainly sensitive to methane and natural gas. It is specifically optimized for the detection of gases such as methane (CH4) and butane (C4H10).

Material detection: Both sensors use a semiconductor material to detect gas, usually based on tin dioxide (SnO2). This material changes conductivity when in contact with certain gases, resulting in changes in electrical resistance.

Application: MQ2: With its wide sensitivity range, the MQ2 is widely used in applications that require detection of a variety of gases, including smoke and flammable gases. It is used in gas leak detectors, industrial safety systems and air quality monitoring. MQ4: The MQ4 is specifically used in applications where methane and natural gas detection is critical. Common applications include gas leak alarms in homes, industrial gas detectors, and systems to prevent gas-related accidents.

Selectivity: MQ2: The MQ2 exhibits some selectivity towards different gases, but its wide sensitivity range means it can respond to multiple gases simultaneously. This makes it suitable for applications where general detection of various gases is required. MQ4: MQ4 is more selective towards methane and natural gas, providing a higher degree of specificity for these gases. This selectivity is useful in applications where the target gas is well defined.

Cross sensitivity: Both sensors may exhibit some cross-sensitivity, meaning they may react to gases other than their primary target. However, the degree of cross-sensitivity may vary depending on the specific model and the concentration of gases present.

Cost: Generally, the MQ4 may be slightly more cost effective than the MQ2 due to its specialization in detecting certain gases.

When choosing between MQ2 and MQ4, it is important to consider the target gases for the intended application. While the MQ2 offers a wider range of gas detection, the MQ4 is more specialized and suitable for situations where methane and natural gas detection is a primary concern.

During the extensive research conducted, the working principles and parameters of the MQ2 and MQ4 gas sensors were thoroughly examined. These gas sensors play a crucial role in detecting various harmful gases in different environments.

In order to gather accurate information, comprehensive experiments and tests were conducted to assess their functionality and reliability. Both sensors were subject to a series of controlled experiments, simulating real-life scenarios to determine their efficiency in gas detection (table 1).

**Table 1.**Technical data:

| Model No. | | | MQ-2 | MQ-4 |
|---|---|---|---|---|
| Sensor Type | | | Semiconductor | Semiconductor |
| Standard Encapsulation | | | Bakelite (Black Bakelite) | Bakelite (Black Bakelite) |
| Detection Gas | | | Combustible gas and smoke | Natural gas/ Methane |
| Concentration | | | 300-10000ppm (Combustible gas) | 300-10000ppm(Natural gas / Methane) |
| Circuit | Loop Voltage | <24V DC | <24V DC | <24V DC |
| | Heater Voltage | 5.0V±0.2V ACorDC | 5.0V±0.2V ACORDC | 5.0V±0.2V ACorDC |
| | Load Resistance | Adjustable | Adjustable | Adjustable |
| Character | Heater Resistance | RH | 31Q±3Q (Room Tem.) | 28.5Q±3Q (Room Tem.) |
| | Heater consumption | PH | <900mW | <900mW |
| | Sensing Resistance | Rs | 2KQ-20KQ(in 2000ppm C3H8 ) | 2KQ-20KQ(in 5000ppm CH4 ) |
| | Sensitivity | S | Rs(in air)/Rs(1000ppm isobutane)>5 | Rs(in air)/Rs(5000ppm CH4)>5 |
| | Slope | a | <0.6(R5000ppm/R3000ppmCH4) | <0.6(R5000ppm/R3000ppm CH4) |

The above is the basic test circuit of the sensor. The sensor requires two voltage inputs: the heater voltage (Vh) and the test voltage (Vc). Vh is used to supply the certified working temperature to the sensor, while Vc is used to detect the voltage (Vrl) on the load resistance (Rl) which is in series with the sensor. The sensor has light polarity, and Vc requires a DC power source. Both Vc and Vh can use the same power circuit, with a precondition to ensure the performance of the sensor. In order to enhance the sensor's performance, a suitable value for Rl is required.[16-22]

Power of Sensitivity body($P_s$):

$$P_s = V^2 * R_s/(R_s + R_L)^2$$

Resistance of sensor($R_s$):

$$R_s = \left(\frac{V_s}{VR_L} - 1\right) * R_L$$

## 4 Conclusions

The MQ2 gas sensor, known for its ability to detect noxious gases such as carbon monoxide, methane, and alcohol, was analyzed in great detail. A variety of conditions were tested to evaluate its sensitivity and response time in detecting the presence of these gases. The sensor demonstrated remarkable accuracy and responsiveness, making it an excellent choice for a wide range of applications related to safety and environmental monitoring. On the other hand, the MQ4 gas sensor specializes in the detection of natural gas and liquefied petroleum gas (LPG). Its performance was evaluated under varying conditions, such as different gas concentrations, temperatures, and humidity levels. The sensor proved to be highly reliable and sensitive, effectively detecting the presence of natural gas and LPG in a timely manner.

After conducting a thorough comparison between the MQ2 and MQ4 gas sensors, different results were obtained. It was observed that the MQ2 sensor displayed higher accuracy in detecting carbon monoxide and alcohol, while the MQ4 sensor excelled in detecting natural gas and LPG. Furthermore, the MQ2 sensor exhibited a faster response time compared to the MQ4 sensor.

Based on these results, it can be concluded that both the MQ2 and MQ4 gas sensors are highly efficient and dependable in their respective areas of gas detection. The choice between these sensors would depend on the specific requirements and gases that need to be monitored. In conclusion, the study of the working principles and parameters of the MQ2 and MQ4 gas sensors resulted in valuable insights into their performance and capabilities. Their accuracy, sensitivity, and response time were thoroughly analyzed, leading to conclusions that can assist in making informed decisions regarding their usage in various industries and applications.

As a result of the experiments, the results were obtained and analyzed using the Power of Sensitivity body($P_s$) and Resistance of sensor($R_s$) formulas. Heater consumption 31Q±3Q (Room Tem.) and 28.5Q±3Q (Room Tem.). It was found that MQ2 and MQ4 differ in gas sensors. Experiments have shown that both can detect methane in Detection Gas. When evaluating the gas content in the air, a ratio of 9.83 was employed to gauge the gas levels collected from the MQ2 and MQ4 gas sensors. The outcomes of this comparison revealed that both sensors produced nearly identical results.

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