

MQ-4 Gas Sensor: Overview and Working Principle

The **MQ-4** gas sensor is a semiconductor-based sensor designed for detecting **Methane (CH₄) and Natural Gas (CNG)**. It is widely used in **gas leakage detection systems, industrial safety applications, and home security devices**. The sensor operates at a voltage of **5V** and provides an **analog output** proportional to the concentration of gas in the air.

How the MQ-4 Sensor Works

The MQ-4 sensor operates using a **metal oxide semiconductor (MOS) sensing element**, specifically **SnO₂ (Tin Dioxide)**, which reacts with methane gas. The working process is as follows:

1. **Heating Process:**
 - The internal **heating element** warms the sensor to a specific operating temperature (~200-300°C).
 - This heat allows the metal oxide surface to interact with gases effectively.
2. **Gas Interaction:**
 - When **methane (CH₄) or natural gas (CNG)** is present, it **reduces the resistance** of the SnO₂ sensing element.
 - The more gas present, the **greater the reduction in resistance**.
3. **Electrical Signal Generation:**
 - The change in resistance alters the sensor's **analog output voltage**, which can be read using an **Arduino or microcontroller**.
 - The higher the gas concentration, the higher the output signal.

Gases Detected by MQ-4

The MQ-4 sensor is **highly sensitive to Methane (CH₄) and Natural Gas (CNG)** but can also detect other gases with lower sensitivity:

Gas	Sensitivity Level
Methane (CH ₄)	High
Natural Gas (CNG)	High
LPG (Propane, Butane)	Medium
Hydrogen (H ₂)	Low
Alcohol (Ethanol)	Low
Carbon Monoxide (CO)	Very Low

Applications of MQ-4 Sensor

The MQ-4 sensor is widely used in various gas detection applications:

Pin	Function
VCC	Power supply (5V)
GND	Ground
A0 (Analog Output)	Outputs an analog voltage proportional to gas concentration
D0 (Digital Output)	Outputs HIGH (1) or LOW (0) based on a threshold value (adjustable via potentiometer)

Difference Between MQ-4 and Other Gas Sensors

Sensor	Detects	Best For
MQ-2	LPG, Methane, Smoke, CO, Hydrogen	General gas leak detection
MQ-3	Alcohol (Ethanol)	Breathalyzer, Alcohol detection
MQ-4	Methane (CH ₄), CNG	Natural gas leak detection
MQ-7	Carbon Monoxide (CO)	CO poisoning prevention

Primary Uses of the MQ-4 Sensor

- **Methane Gas Detection:** Used in industries and households to detect methane leaks.
- **Natural Gas Leak Monitoring:** Helps prevent potential gas explosions in homes and workplaces.
- **Gas Safety Systems:** Integrated into automated gas leak detection systems.
- **Industrial Applications:** Used in factories where methane is processed or stored.

The MQ-4 sensor works by detecting **changes in gas concentration** using a **tin dioxide (SnO₂) sensing layer**, which alters its resistance when exposed to methane or natural gas.

Conclusion

The **MQ-4 sensor** is a reliable and cost-effective **methane and natural gas detector** used for **home, industrial, and automotive safety applications**. It provides both **analog and digital outputs**, making it **easy to integrate** with Arduino and microcontrollers for gas monitoring and alarm systems.

[MQ4 Methane Gas Sensor : Pin Configuration & Its Applications](#)

[How to Use MQ-4 Methane Gas Sensor](#)