# Vishwakarma Institute of Information Technology

## A Report on the Project

## Smoke Detector Using 8051 Microcontroller

PBL presentation for Skills and Competency Evaluation(SCE)

Microcontroller And Applications (ETUA22202)(SY ETC SEM-II AY 22-23 )

Name of instructor:

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# Introduction:

In a year around 1.6 million fire accidents occur with a cost of 27000 lives in India alone. This number become very huge if we consider the fire accidents around the globe. Commercial and residential spaces are subjected to several fire hazards and incidents due to a lack of awareness, building layout, and the right instruments. Though it remains one of the most preventable mishaps Fire results in the loss of life and property. While the decline in fire-related fatalities and injuries is promising, the significantly higher proportion of deaths relative to injuries is concerning. This could indicate the severity & nature of the fire accidents resulting in higher mortality.

Modern buildings must have smoke detectors because they can alert occupants to the presence of a fire and possibly save lives. We suggest creating a smoke detector system based on the 8051 microcontrollers in this project. Due to its simplicity, low power consumption, and adaptability, the 8051 microcontroller is a popular option for many embedded systems.

A smoke sensor module will be utilised by our suggested smoke detector system to find smoke in the surrounding area. The 8051 microcontrollers, which will oversee processing the sensor output and raising an alert in the event of smoke detection, will be interfaced with the smoke sensor module. In addition, the system will have a keypad for user input and an LCD display to provide visual feedback.

Designing and implementing a smoke detector system that is dependable, accurate, and affordable is the primary objective of this project. The technology will be designed to work in a variety of settings, including office and residential buildings. The project will use a variety of hardware and software components, including the LCD display, keyboard, smoke sensor module, and 8051 microprocessors.

Overall, this project can make a substantial contribution to the field of fire prevention by creating a reliable, effective, and affordable smoke detector system.

The study could have a substantial impact on the design of future fire alarm systems and will offer useful insights into the usage of microcontroller-based gadgets for smoke detection.

In this project, a fire detection device prototype will be made using a smoke sensor. If the smoke sensor detects the smoke, then the message of smoke detection will be displayed on the LCD screen.
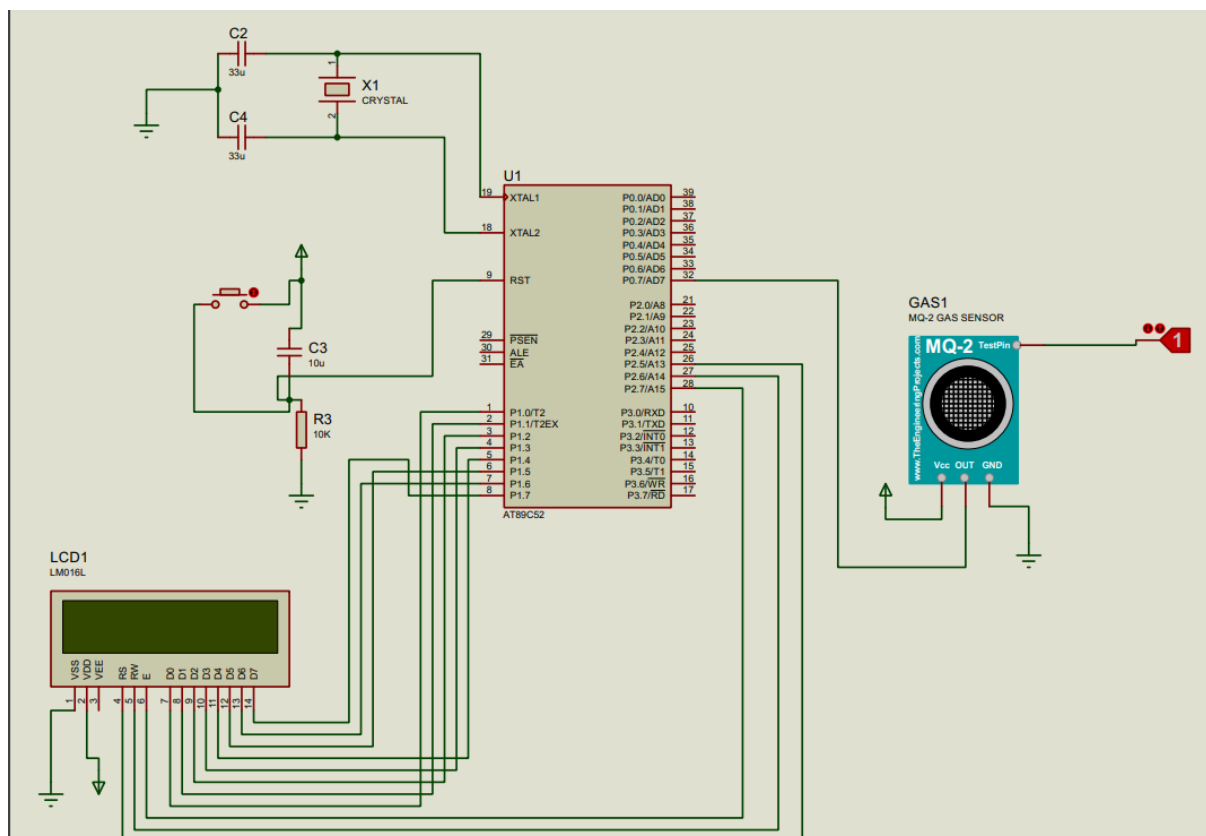
# System Requirements:

Based on the requirements of the system, our projects design must be able to meet the following functional requirements:

1. The device can detect smoke using MQ2 sensors.
2. The sensor can transmit data of the smoke detection to the microcontroller 8051.
3. The data is sent in the digital form to the controller.
4. 8051 can process the data sent by the MQ2 sensor.
5. 8051 can send the commands to the LCD display to tell whether the smoke is detected or not.
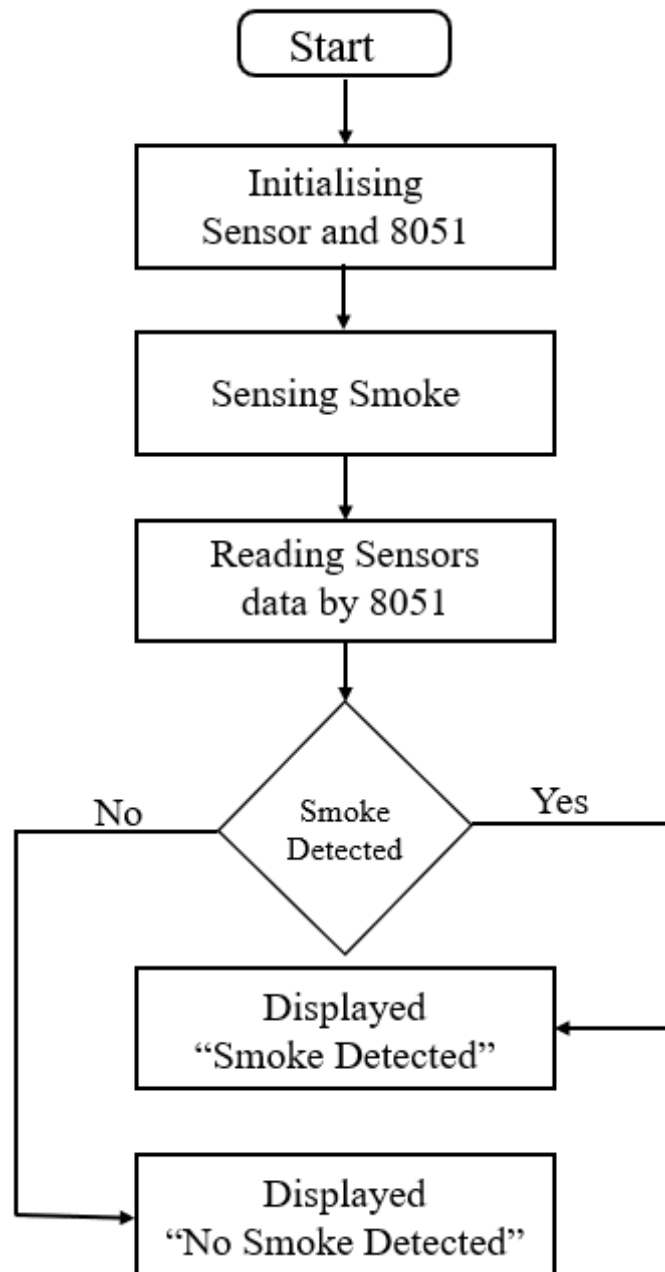
In the hardware AT89C52 microcontroller is used and this belongs to 8051 family. AT89C52 has 8KB of Flash programmable and erasable read only memory (PEROM) and 256 bytes of RAM. It has 1000 Write/erase cycles which means that it can be erased and programmed to a maximum of 1000 times.

MQ2 smoke sensor is a sensor from MQ sensor series. It is a MOS (Metal Oxide Semiconductor) sensor. Its sensing is based on the change in resistance of the sensing material when exposed to gases. MQ2 gas sensor operates at 5V DC and consumes around 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations ranging from 200 to 10000 ppm. It detects multiple gases, but cannot identify them.

LCD LM016L is used to display the message whether smoke is detected or not. It is 16x2 LCD which operates at 4.7V-5.3V.

# Flowchart:

```
                    ┌──────────────┐
                    │    Start     │
                    └──────┬───────┘
                           │
                           ▼
              ┌─────────────────────────┐
              │      Initialising       │
              │    Sensor and 8051      │
              └────────────┬────────────┘
                           │
                           ▼
              ┌─────────────────────────┐
              │      Sensing Smoke      │
              └────────────┬────────────┘
                           │
                           ▼
              ┌─────────────────────────┐
              │     Reading Sensors     │
              │      data by 8051       │
              └────────────┬────────────┘
                           │
                           ▼
                         ╱╲
              No       ╱    ╲       Yes
         ┌───────────<  Smoke  >───────────┐
         │            ╲ Detected╱          │
         │              ╲    ╱             │
         │                ╲╱               │
         │                                 │
         │          ┌──────────────────┐   │
         │          │    Displayed      │◄──┘
         │          │ "Smoke Detected"  │
         │          └──────────────────┘
         │
         │          ┌──────────────────────┐
         └─────────►│      Displayed        │
                    │ "No Smoke Detected"   │
                    └──────────────────────┘
```

# Working:

The MQ2 sensor is one of the most widely used in the MQ sensor series. It is a MOS (Metal Oxide Semiconductor) sensor. Metal oxide sensors are also known as Chemiresistors because sensing is based on the change in resistance of the sensing material when exposed to gasses.

The MQ2 gas sensor operates on 5V DC and consumes approximately 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations ranging from 200 to 10000 ppm.

This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless-steel mesh. Sensing element has six connecting legs attached to it. Two leads are responsible for heating the sensing element, the other four are used for output signals.

Oxygen gets adsorbed on the surface of sensing material when it is heated in air at high temperature. Then donor electrons present in tin oxide are attracted towards this oxygen, thus preventing the current flow.

When reducing gases are present, these oxygen atoms react with the reducing gases thereby decreasing the surface density of the adsorbed oxygen. Now current can flow through the sensor, which generated analog voltage values.

These voltage values are measured to know the concentration of gas. Voltage values are higher when the concentration of gas is high.

The sensor's analog output voltage (at the A0 pin) varies in proportion to the concentration of smoke/gas. The higher the concentration, the higher the output voltage; the lower the concentration, the lower the output voltage.

*MQ2 sensor Module: -*

PIN 0: VCC supplies power to the module. Connect it to the 5V output

PIN 1: GND is the ground pin.

PIN 2: D0 indicates the presence of combustible gasses. D0 becomes LOW when the gas concentration exceeds the threshold value (as set by the potentiometer), and HIGH otherwise.

PIN 3: A0 produces an analog output voltage proportional to gas concentration, so a higher concentration results in a higher voltage and a lower concentration result in a lower voltage.

LCD is used to indicate situations of the system composed of 2 modes of working state, regular working mode and fire mode.

Graphic output states are displayed on LCD by using software 'Keil uVision3', interfacing with microcontroller.

Input signal coming from the normally opened warning devices such as smoke detector is sent into a detectable instrument to separate the mode of working state.

 After that, output signal is dispatched to 8051 microcontrollers for analysis.

This microcontroller can transfer data and display the situation of detector in 4 zones. Thus, the environment of the zones is exposed on LCD

*The 16×2 LCD pinout is as follows:*

Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.

Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.

Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.

Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).

Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).

Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.

Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.

Pin15 (+ve pin of the LED): This pin is connected to +5V

Pin 16 (-ve pin of the LED): This pin is connected to GND.

The Vcc and GND of MQ2 sensor are connected to the respective connections.

Configuration for AT89C52 is as follows:

1. The MQ2 sensor Dout is connected to the pin 32 of microcontroller.
2. MQ2 sensor output is a digital signal.
3. Pin 26, 27, 28 are connected to the Rs, Rw, E pins of the LCD display.
4. Pin 1 to 8 are connected to the D0-D7 pins of the display.
5. Pin 9 is connected to the switch for reset function.
6. Pin 18 and 19 are connected to the crystal.

When the Sensor output is HIGH then the LCD will be displaying "Smoke Detected" and if Sensor output is low then the LCD will be displaying "No Smoke Detected."

# Conclusion:

In conclusion, the Smoke Detector using 8051 microcontroller is an effective and reliable solution for detecting smoke in indoor environments. The system is designed to quickly detect smoke and trigger an alarm to alert individuals to evacuate the building in case of a fire.

The implementation of the 8051 microcontroller provides a powerful and efficient platform for the Smoke Detector system to function. The 8051's ability to handle complex algorithms, coupled with its low power consumption, makes it an ideal choice for this application.

Furthermore, the Smoke Detector system is designed to be easy to install and maintain, making it a practical solution for both residential and commercial environments. The use of readily available components and simple circuitry ensures that the system is affordable and can be easily replicated.

Overall, the Smoke Detector using 8051 microcontroller is a valuable addition to any building's safety system. Its ability to detect smoke and alert individuals to potential fires can help save lives and minimize property damage. As such, it is a recommended solution for anyone looking to enhance their fire safety measures.

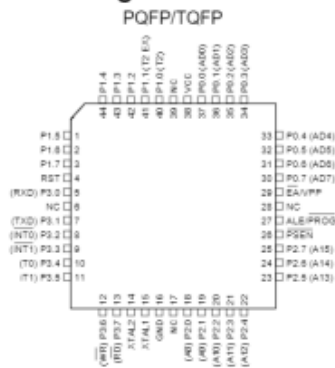# Appendix:

*AT89C52 Microcontroller Datasheet:*

## Features

- Compatible with MCS-51™ Products
- 8K Bytes of In-System Reprogrammable Flash Memory
- Endurance: 1,000 Write/Erase Cycles
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 256 x 8-bit Internal RAM
- 32 Programmable I/O Lines
- Three 16-bit Timer/Counters
- Eight Interrupt Sources
- Programmable Serial Channel
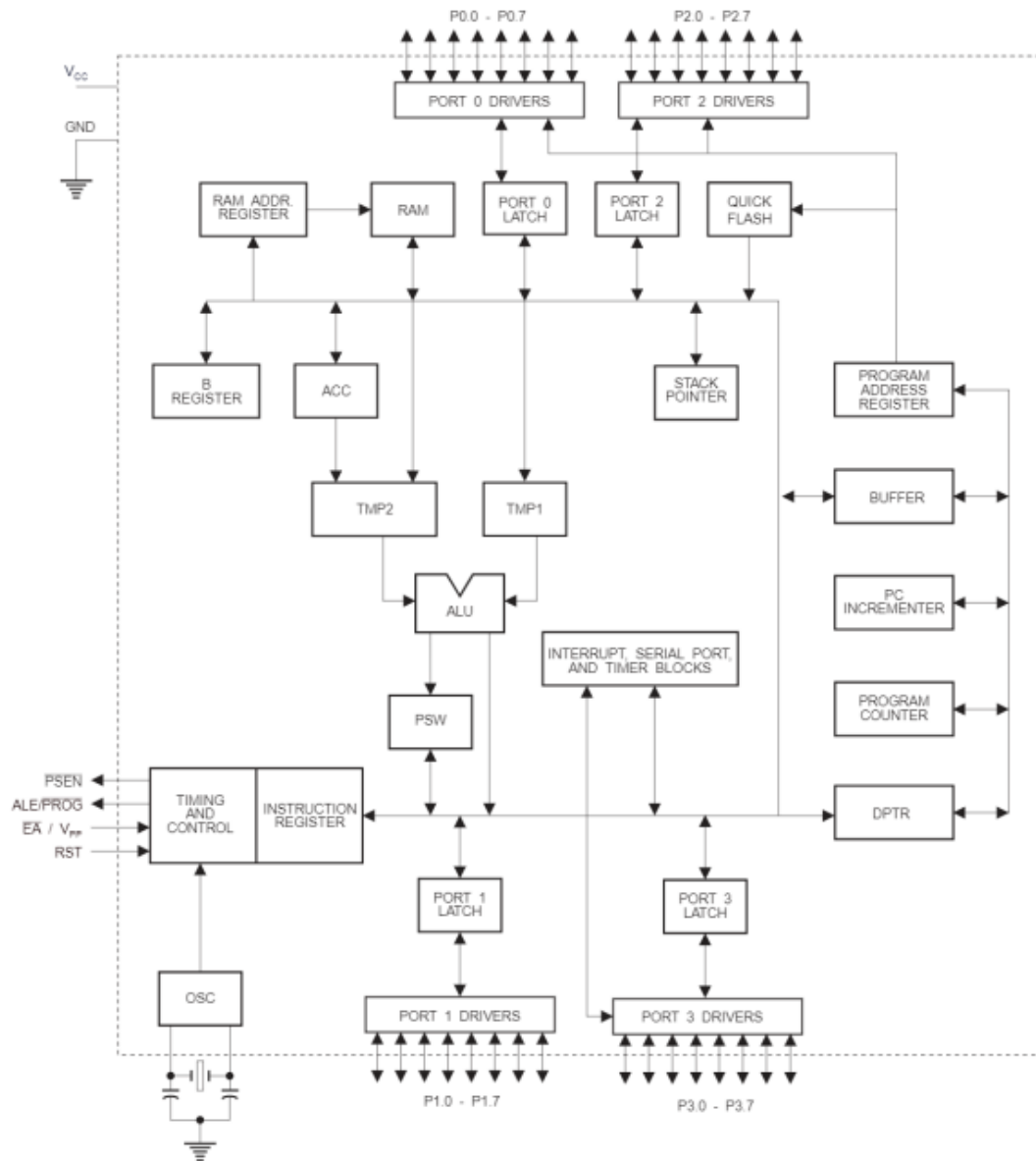- Low-power Idle and Power-down Modes

## Description

The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density nonvolatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set and pinout. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications.

### ATMEL

**8-bit Microcontroller with 8K Bytes Flash**

**AT89C52**

**Not Recommended for New Designs. Use AT89S52.**

## Pin Configurations

## Block Diagram

# *MQ2 Sensor Datasheet:*

# TECHNICAL DATA     MQ-2   GAS SENSOR

## FEATURES

| | |
|---|---|
| Wide detecting scope | Fast response and High sensitivity |
| Stable and long life | Simple drive circuit |

## APPLICATION

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, i-butane, propane, methane ,alcohol, Hydrogen, smoke.

## SPECIFICATIONS

### A. Standard work condition

| Symbol | Parameter name | Technical condition | Remarks |
|---|---|---|---|
| Vc | Circuit voltage | 5V±0.1 | AC OR DC |
| $V_H$ | Heating voltage | 5V±0.1 | ACOR DC |
| $R_L$ | Load resistance | can adjust | |
| $R_H$ | Heater resistance | 33 Ω ±5% | Room Tem |
| $P_H$ | Heating consumption | less than 800mw | |

### B. Environment condition

| Symbol | Parameter name | Technical condition | Remarks |
|---|---|---|---|
| Tao | Using Tem | -20℃-50℃ | |
| Tas | Storage Tem | -20℃-70℃ | |
| $R_H$ | Related humidity | less than 95%Rh | |
| $O_2$ | Oxygen concentration | 21%(standard condition)Oxygen concentration can affect sensitivity | minimum value is over 2% |

### C. Sensitivity characteristic

| Symbol | Parameter name | Technical parameter | Remarks |
|---|---|---|---|
| Rs | Sensing Resistance | 3KΩ -30KΩ (1000ppm iso-butane ) | Detecting concentration scope： 200ppm-5000ppm |
| α (3000/1000) isobutane | Concentration Slope rate | ≤0.6 | LPG and propane 300ppm-5000ppm butane |
| Standard Detecting Condition | Temp: 20℃ ±2℃   Vc:5V±0.1 Humidity: 65%±5%   Vh: 5V±0.1 | | 5000ppm-20000ppm methane 300ppm-5000ppm H₂ |
| Preheat time | Over 24 hour | | 100ppm-2000ppm Alcohol |

### D. Structure and configuration, basic measuring circuit



| | Parts | Materials |
|---|---|---|
| 1 | Gas sensing layer | SnO₂ |
| 2 | Electrode | Au |
| 3 | Electrode line | Pt |
| 4 | Heater coil | Ni-Cr alloy |
| 5 | Tubular ceramic | Al₂O₃ |
| 6 | Anti-explosion network | Stainless steel gauze (SUS316 100-mesh) |
| 7 | Clamp ring | Copper plating Ni |
| 8 | Resin base | Bakelite |
| 9 | Tube Pin | Copper plating Ni |

Fig. 1

Fig.2



Configuration A
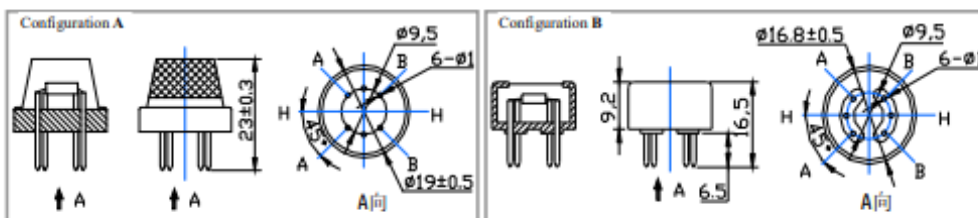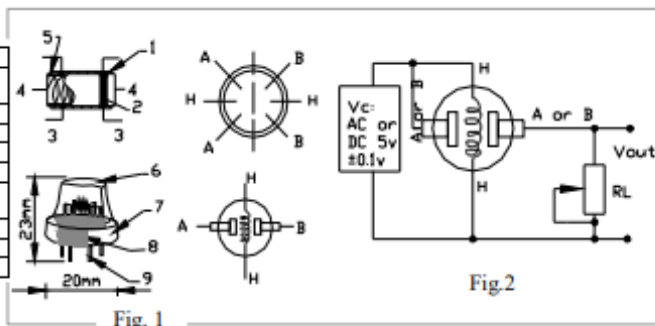
Configuration B

Structure and configuration of MQ-2 gas sensor is shown as Fig. 1 (Configuration A or B), sensor composed by micro AL₂O₃ ceramic tube, Tin Dioxide (SnO₂) sensitive layer, measuring electrode and heater are fixed into a

crust    made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-2 have 6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current.

     Electric parameter measurement circuit is shown as    Fig.2

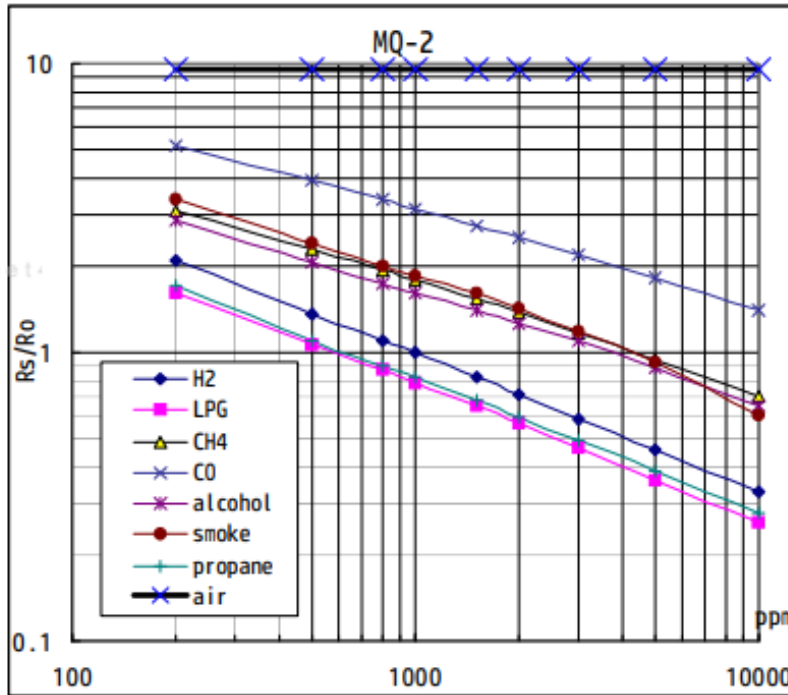     E. Sensitivity characteristic curve



Fig.3 is shows the typical sensitivity characteristics of the MQ-2 for several gases.
    in their: Temp: 20℃、
    Humidity: 65%、
    $O_2$ concentration 21%
    RL=5k$\Omega$
Ro: sensor resistance at 1000ppm of $H_2$ in the clean air.
Rs:sensor resistance at various concentrations of gases.
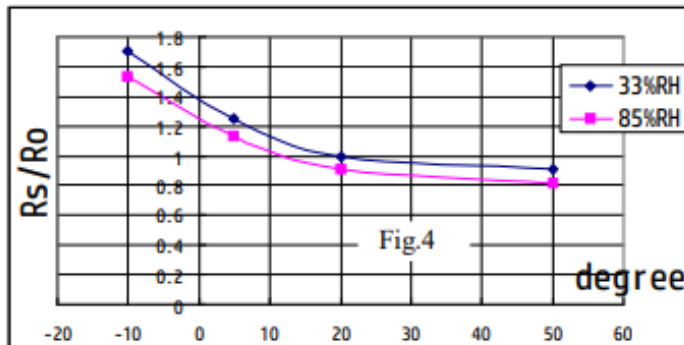
Fig.2 sensitivity characteristics of the MQ-2



Fig.4 is shows the typical dependence of the MQ-2 on temperature and humidity.
Ro: sensor resistance at 1000ppm of $H_2$ in air at 33%RH and 20 degree.
Rs: sensor resistance at 1000ppm of $H_2$ at different temperatures and humidities.

## SENSITVITY ADJUSTMENT

     Resistance value of MQ-2 is difference to various kinds and various concentration gases. So,When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 1000ppm liquified petroleum gas<LPG>,or 1000ppm iso-butane<i-$C_4H_{10}$>concentration in air and use value of Load resistance that( $R_L$) about 20 K$\Omega$ (5K$\Omega$   to 47 K$\Omega$ ).

     When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

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