HHG2023 Analog gas sensor

1 Features

- Detection of 3 different gases
- Integrated heating resistor and temperature sensor
- Operational for a wide range of temperature and voltages
- Compact design for easy integration
- Analog design

2 Applications

- Internet of Things (IoT) smart objects
- Safety (leak detection, industrial, …)
- Environmental monitoring

3 Description

The HHG2023 is a simple gas sensor capable of identifying several different gases. It is an analog sensor making it very versatile and adaptable for many applications such as IoT and security.
The sensor is composed of two identical interdigitated combs of silicon substrate with a thin tungsten trioxide nanoparticles (WO_3) deposit.
A resistor is used to heat the sensor to improve readings and a thermistor is embedded to control the temperature.

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4 Revision history

This is the first version of the HHG2023 datasheet.

5 Pin configuration and functions

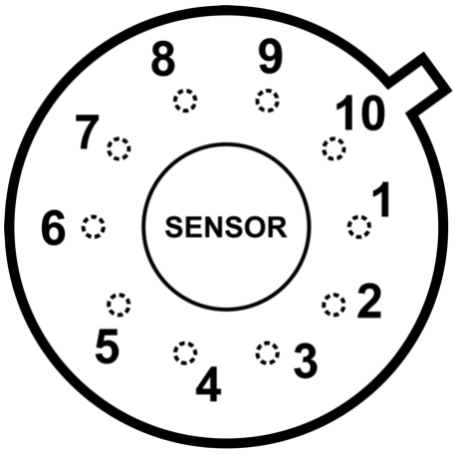

Figure 5-1. TO-5 10-pin top view

PIN		DESCRIPTION
NO.	NAME	
1	$TEMP_A$	Thermistor
6	$TEMP_B$	
2	$GAS1_A$	Gas sensor resistor 1
4	$GAS1_B$	
7	$GAS2_A$	Gas sensor resistor 2
9	$GAS2_B$	
3	RES_A	Heating resistor, apply voltage between these pins to heat the sensor up
8	RES_B	
5,10	N.C.	

6 Specifications

6.1 Absolute maximum ratings

NAME	DESCRIPTION	MIN	MAX	UNIT
V_{RES}	Applied Voltage on RES_A/RES_B (heating resistor)	0	20	V

6.2 Recommended operating conditions.

NAME	DESCRIPTION	MIN	NOM	MAX	UNIT
V_{RES}	Applied Voltage on RES_A/RES_B (heating resistor)	10	12	20	V
V_{GAS}	Applied Voltage on $GAS\#_A$/$GAS\#_B$ (sensing element)	-	5	-	V

6.3 Typical characteristics

Testing conditions

DESCRIPTION	VALUE	UNIT
Air composition	80/20	$\%N_2/O_2$
Temperature	20	°C
Humidity	50	%

NAME	DESCRIPTION	MIN	NOM	MAX	UNIT
R_{GAS}	Resistance of the gas sensor	10	12	20	GΩ
R_{TEMP}	Resistance of the thermistor	-	60	-	Ω
R_{HEAT}	Resistance of the heater resistor	-	85	-	Ω

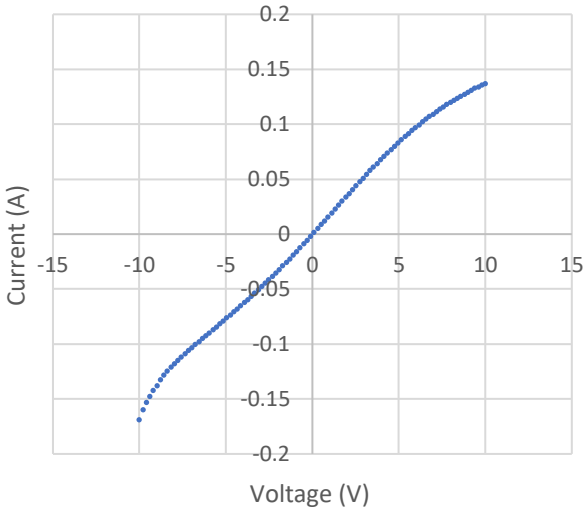

Figure 6-1. Sensibility curve for the thermistor

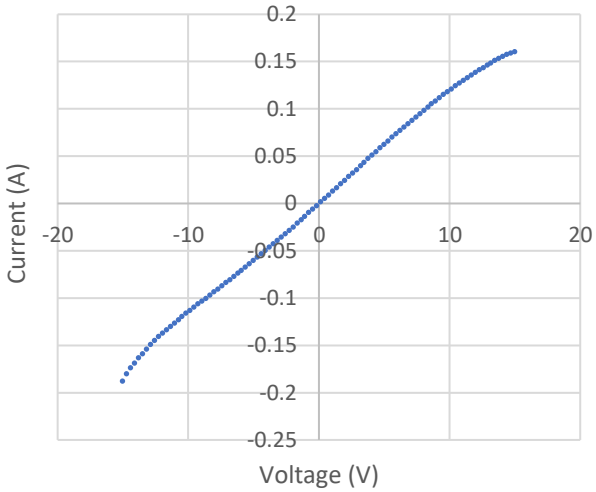

Figure 6-2. Sensibility curve for the heater

7 Application and implementation

7.1 Typical application

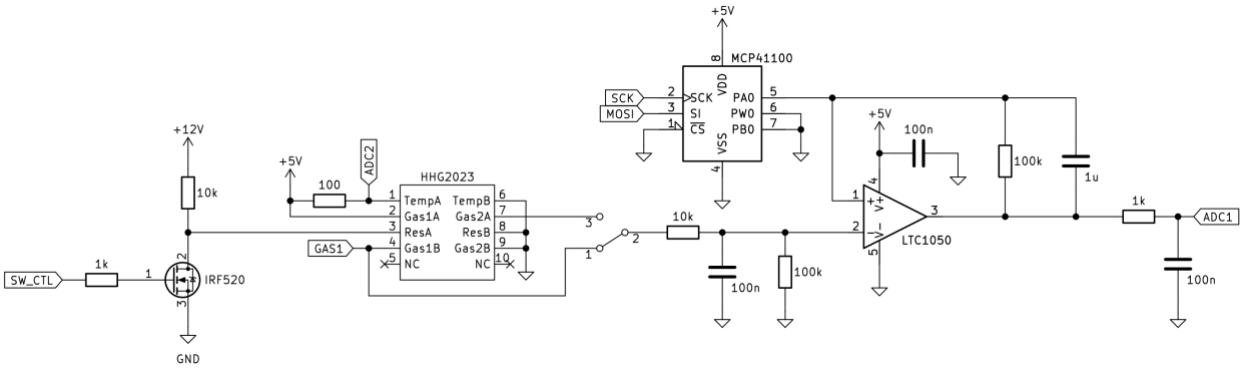

Figure 7-1. Example application of the HHG2023

To use the HHG2023 sensor as a smart sensor, a circuit similar to Figure 7-1 is recommended. An amplifying circuit should be used before reading results, for which we used a LTC1050 operational amplifier. A MCP41100 potentiometer was used to calibrate the amplifier. As the MCP41100 requires SPI, a microcontroller with SPI communication is required for this specific implementation.
For power saving reasons, a IRF520 NMOS acts as a switch on the power supply.

NAME	DESCRIPTION
SW_CTRL	Activate or deactivate the power supply to the sensor
ADC1	Connect to microcontroller ADC. Used to check temperature and read gas measures
ADC2	Connect to microcontroller ADC. If saturation of the signal, regenerate
SCK	Connect to SCK pin of microcontroller
MOSI	Connect to MOSI pin of microcontroller

7.2 Functional state diagram

The following state diagram is suggested to make the most of the capabilities of the HHG2023 sensor. The HHG2023 is then capable of calibrating, checking its temperature, regenerate if necessary, and measure for various gases.

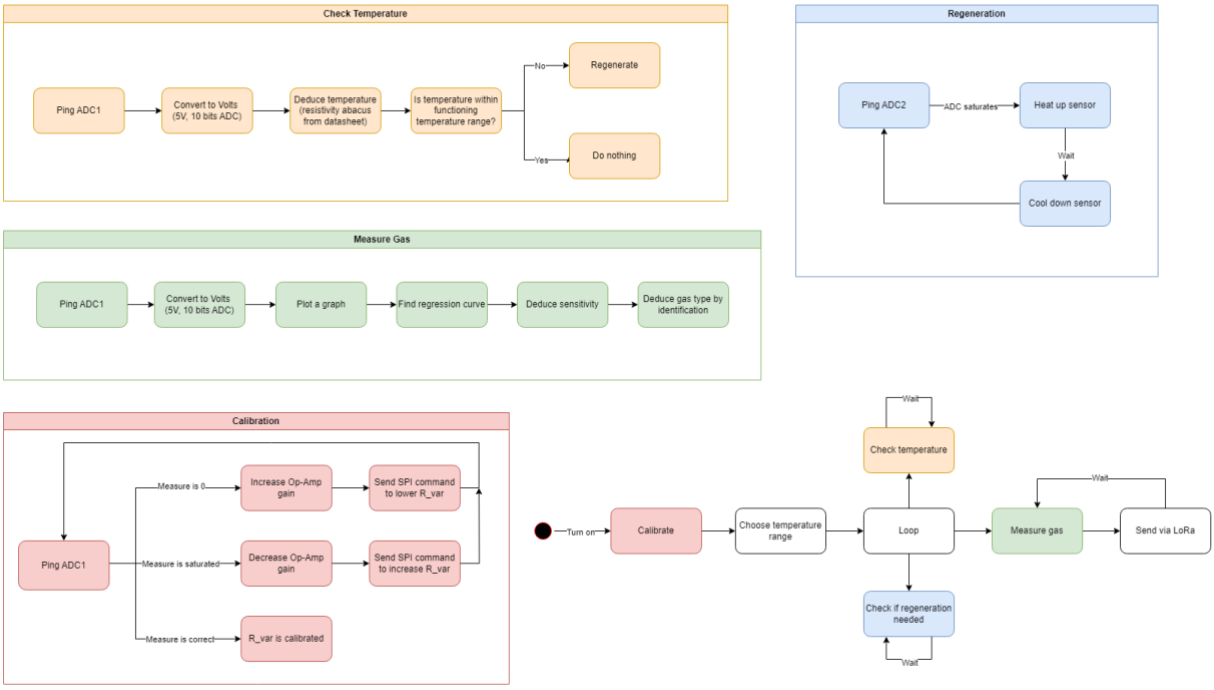

Figure 7-2. Finite state diagram

7.3 Gas identification

The HHG2023 sensor is capable to recognize different gases: Ethanol, and Ammonia. This is done by comparing the sensibility regression curve of the measured gas (in Volts) to known values for both of these gases.

8 Layout

The sensor should not be covered as the gas needs to come into contact with the semiconductor component.
As the pins are in a circle pattern, the traces going from the different pins should be tangent to the circle as follows:

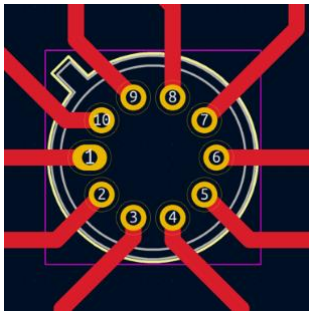

Figure 8-1. Recommended layout