TECHNICAL DATA MQ-6 GAS SENSOR

FEATURES

* High sensitivity to LPG, iso-butane, propane
* Small sensitivity to alcohol, smoke.
* Fast response . * Stable and long life * Simple drive circuit

APPLICATION

They are used in gas leakage detecting equipments in family and industry, are suitable for detecting o LPG, iso-butane, propane, LNG, avoid the noise of alcohol and cooking fumes and cigarette 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
P_L	Load resistance	20KΩ	
R_H	Heater resistance	33Ω±5%	Room Tem
P_H	Heating consumption	less than 750mw	

B. Environment condition

Symbol	Parameter name	Technical condition	Remarks
Tao	Using Tem	-10℃-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	10KΩ - 60KΩ (1000ppm LPG)	Detecting concentration scope: 200-10000ppm LPG , iso-butane, propane, LNG
α (1000ppm/ 4000ppm LPG)	Concentration slope rate	≤0.6	
Standard detecting condition	Temp: 20℃±2℃ Vc:5V±0.1 Humidity: 65%±5% Vh: 5V±0.1		
Preheat time	Over 24 hour		

D. Strucvure and configuration, basic measuring circuit

	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
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

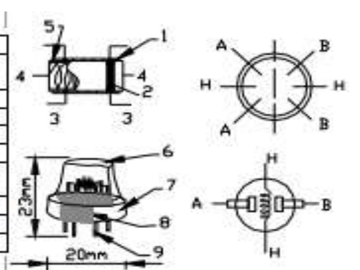


Fig. 1

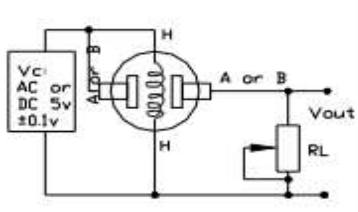
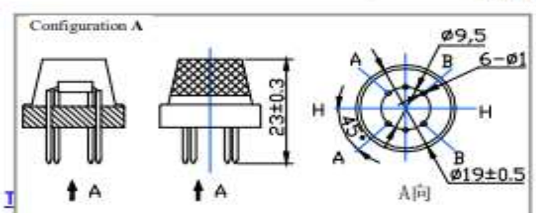
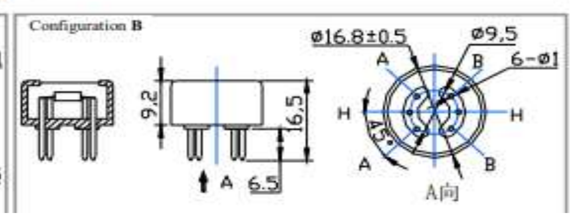


Fig.2





Structure and configuration of MQ-6 gas sensor is shown as Fig. 1 (Configuration A or B), sensor composed by micro AL_2O_3 ceramic tube, Tin Dioxide (SnO_2) 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-6 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.2 sensitivity characteristics of the MQ-6

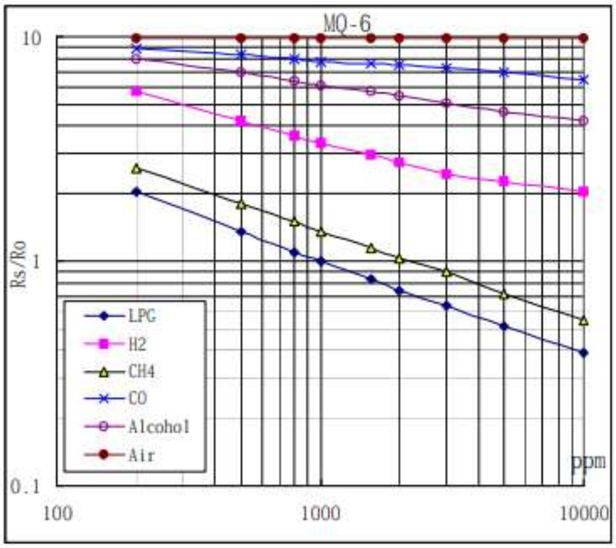


Fig.3 is shows the typical sensitivity characteristics of the MQ-6 for several gases.

in their: Temp: 20℃、
Humidity: 65%、
O_2 concentration 21%
RL=20k Ω

Ro: sensor resistance at 1000ppm of LPG in the clean air.

Rs:sensor resistance at various concentrations of gases.

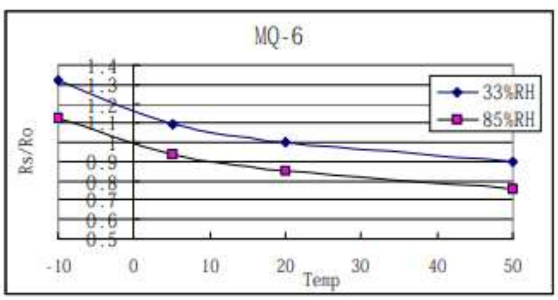


Fig.4 is shows the typical dependence of the MQ-6 on temperature and humidity.

Ro: sensor resistance at 1000ppm of LPG in air at 33%RH and 20 degree.

Rs: sensor resistance at 1000ppm of LPG in air at different temperatures and humidities.

SENSITVITY ADJUSTMENT

Resistance value of MQ-6 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 of LPG concentration in air and use value of Load resistance (R_L) about 20K Ω (10K Ω to 47K Ω).

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

TECHNICAL DATA MQ-7 GAS SENSOR

FEATURES

* High sensitivity to carbon monoxide
* Stable and long life

APPLICATION

They are used in gas detecting equipment for carbon monoxide(CO) in family and industry or car.

SPECIFICATIONS

A. Standard work condition

Symbol	Parameter name	Technical condition	Remark
Vc	circuit voltage	5V±0.1	Ac or Dc
V_H (H)	Heating voltage (high)	5V±0.1	Ac or Dc
V_H (L)	Heating voltage (low)	1.4V±0.1	Ac or Dc
R_L	Load resistance	Can adjust	
R_H	Heating resistance	33Ω±5%	Room temperature
$T_{H(H)}$	Heating time (high)	60±1 seconds	
$T_{H(L)}$	Heating time (low)	90±1 seconds	
PH	Heating consumption	About 350mW	

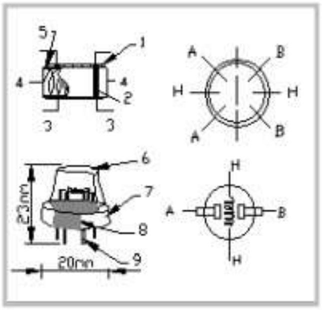
b. Environment conditions

Symbol	Parameters	Technical conditions	Remark
Tao	Using temperature	-20℃-50℃	
Tas	Storage temperature	-20℃-50℃	Advice using scope
RH	Relative humidity	Less than 95%RH	
O_2	Oxygen concentration	21%(stand condition) the oxygen concentration can affect the sensitivity characteristic	Minimum value is over 2%

c. Sensitivity characteristic

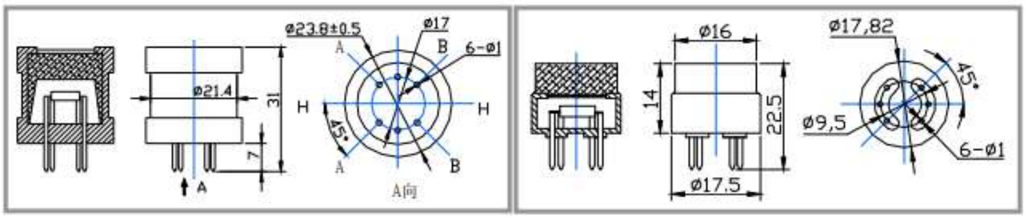
symbol	Parameters	Technical parameters	Remark
Rs	Surface resistance Of sensitive body	2-20k	In 100ppm Carbon Monoxide
α (300/100ppm)	Concentration slope rate	Less than 0.5	Rs (300ppm)/Rs(100ppm)
Standard working condition	Temperature -20℃±2℃ relative humidity 65%±5% RL:10KΩ±5%		
	Vc:5V±0.1V VH:5V±0.1V VH:1.4V±0.1V		
Preheat time	No less than 48 hours	Detecting range: 20ppm-2000ppm carbon monoxide	

6 pin ,4 of them are used to fetch signals, and other 2 are used for providing heating current.



	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
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



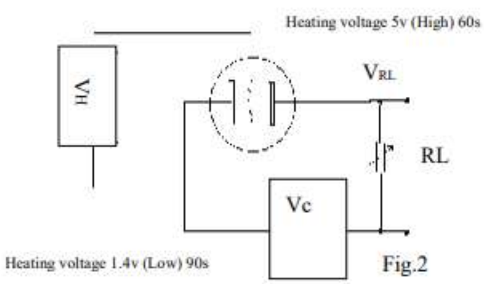


Fig.2

Standard circuit:

As shown in Fig 2, standard measuring circuit of MQ-7 sensitive components consists of 2 parts. one is heating circuit having time control function (the high voltage and the low voltage work circularly). The second is the signal output circuit, it can accurately respond changes of surface resistance of the sensor.

Electric parameter measurement circuit is shown as Fig.2

E. Sensitivity characteristic curve

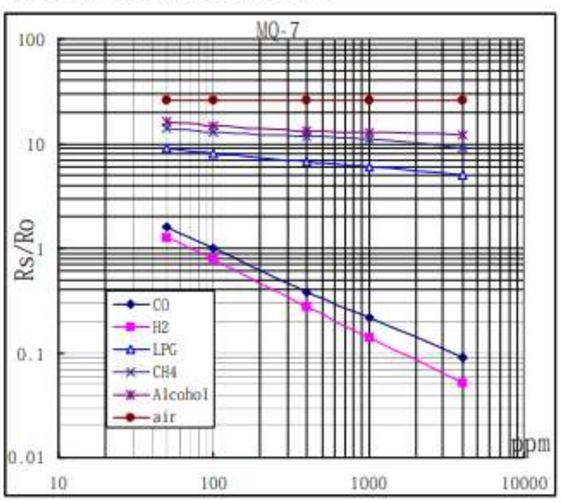


Fig.3 sensitivity characteristics of the MQ-7

Fig.3 is shows the typical sensitivity characteristics of the MQ-7 for several gases.

in their: Temp: 20℃、

Humidity: 65%、

O_2 concentration 21%

RL=10k Ω

Ro: sensor resistance at 100ppm CO in the clean air.

Rs: sensor resistance at various concentrations of gases.

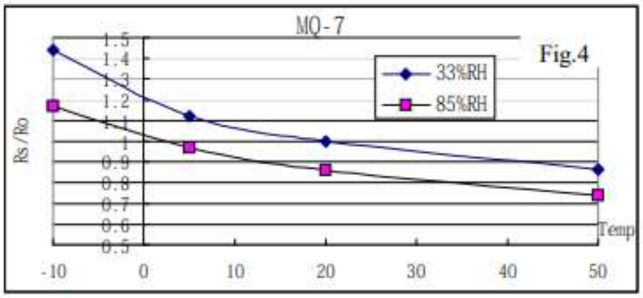


Fig.4 is shows the typical dependence of the MQ-7 on temperature and humidity.

Ro: sensor resistance at 100ppm CO in air at 33%RH and 20degree.

Rs: sensor resistance at 100ppm CO at different temperatures and humidities.

OPERATION PRINCIPLE

. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

$$Rs \backslash RL = (Vc-VRL) / VRL$$

Fig. 5 shows alterable situation of RL signal output measured by using Fig. 2 circuit output

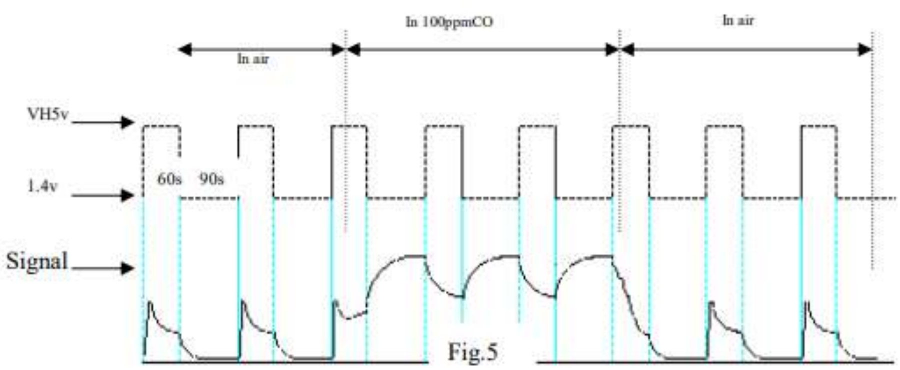


Fig.5

signal when the sensor is shifted from clean air to carbon monoxide (CO) , output signal measurement is made within one or two complete heating period (2.5 minute from high voltage to low voltage).

SENSIRION
THE SENSOR COMPANY

Datasheet SGP30
Sensirion Gas Platform

- Multi-pixel gas sensor for indoor air quality applications
- Outstanding long-term stability
- I²C interface with TVOC and CO_2eq output signals
- Very small 6-pin DFN package: 2.45 x 2.45 x 0.9 mm³
- Low power consumption: 48 mA at 1.8V
- Tape and reel packaged, reflow solderable

Product Summary

The SGP30 is a digital multi-pixel gas sensor designed for easy integration into air purifier, demand-controlled ventilation, and IoT applications. Sensirion's CMOSens® technology offers a complete sensor system on a single chip featuring a digital I²C interface, a temperature controlled micro hotplate, and two preprocessed indoor air quality signals. As the first metal-oxide gas sensor featuring multiple sensing elements on one chip, the SGP30 provides more detailed information about the air quality.

The sensing element features an unmatched robustness against contaminating gases present in real-world applications enabling a unique long-term stability and low drift. The very small 2.45 x 2.45 x 0.9 mm³ DFN package enables applications in limited spaces. Sensirion's state-of-the-art production process guarantees high reproducibility and reliability. Tape and reel packaging, together with suitability for standard SMD assembly processes make the SGP30 predestined for high-volume applications.

Block Diagram

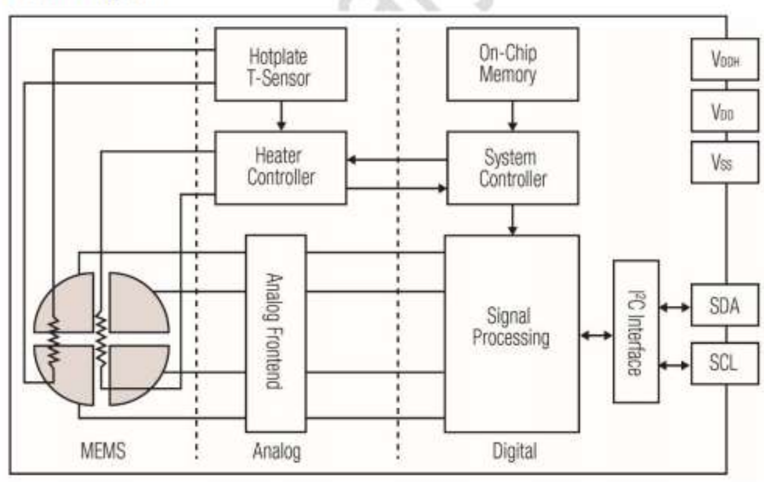


Figure 1 Functional block diagram of the SGP30.

1 Sensor Performance

1.1 Gas Sensing Performance

Parameter	Signal	Values	Comments	
Measurement range[1]	Ethanol signal	0 ppm to 1000 ppm		
	H_2 signal	0 ppm to 1000 ppm		
Specified measurement range	Ethanol signal	0.3 ppm to 30 ppm	The specifications below are defined for this measurement range[2]. The specified measurement range covers the gas concentrations expected in indoor air quality applications.	
	H_2 signal	0.5 ppm to 10 ppm		
Accuracy[3]	Ethanol signal	see **Figure 2** typ.: 15% of meas. value	Accuracy of the concentration c determined by $\ln\left(c/c_{ref}\right) = \frac{(s_{ref}-s_{out})}{a}$ $a = 512$ s_{out}: EthOH/H_2 signal output at concentration c s_{ref}: EthOH/H_2 signal output at 0.5 ppm H_2	c_{ref} = 0.4 ppm
	H_2 signal	see **Figure 3** typ.: 10% of meas. value		c_{ref} = 0.5 ppm
Long-term drift[3,4]	Ethanol signal	see **Figure 4** typ.: 1.3% of meas. value	Change of accuracy over time: Siloxane accelerated lifetime test[5]	
	H_2 signal	see **Figure 5** typ.: 1.3% of meas. value		
Resolution	Ethanol signal	0.2 % of meas. value	Resolution of Ethanol and H_2 signal outputs in relative change of the measured concentration	
	H_2 signal			
Sampling frequency	Ethanol signal	Max. 40 Hz	Compare with minimum measurement duration in **Table 10**	
	H_2 signal			

Table 1 Gas sensing performance. Specifications are at 25°C, 50% RH and typical VDD.

Accuracy ethanol signal

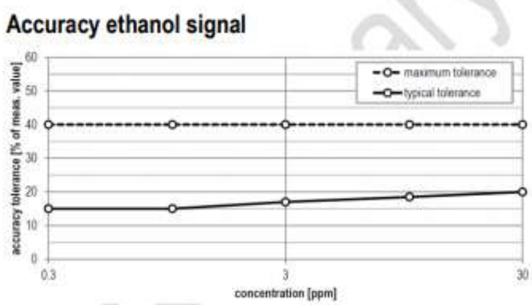


Figure 2 Typical and maximum accuracy tolerance in % of measured value at 25°C, 50% RH and typical VDD. The sensors have been operated for at least 24h before the characterization.

Accuracy H_2 signal

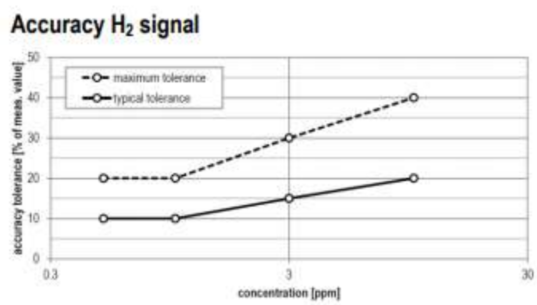


Figure 3 Typical and maximum accuracy tolerance in % of measured value at 25°C, 50% RH and typical VDD. The sensors have been operated for at least 60h before the characterization.

[1] Exposure to ethanol and H_2 concentrations up to 1000 ppm have been tested. For applications requiring the measurement of higher gas concentrations please contact Sensirion.
[2] ppm: parts per million. 1 ppm = 1000 ppb (parts per billion)
[3] 90% of the sensors will be within the typical accuracy tolerance, >99% are within the maximum tolerance.
[4] The long-term drift is stated as change of accuracy per year of operation.
[5] Test conditions: operation in 250 ppm Decamethylcyclopentasiloxane (D5) for 200h simulating 10 years of operation in an indoor environment.

Long-term drift Ethanol signal

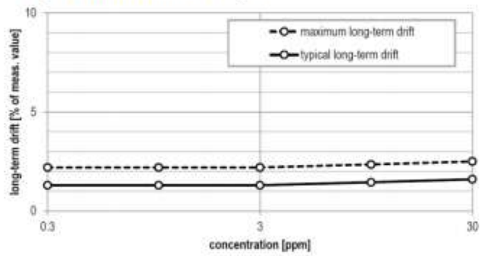


Figure 4 Typical and maximum long-term drift in % of measured value at 25°C, 50% RH and typical VDD. The sensors have been operated for at least 24h before the first characterization.

Long-term drift H_2 signal

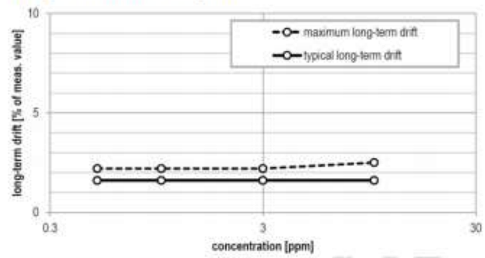


Figure 5 Typical and maximum long-term drift in % of measured value at 25°C, 50% RH and typical VDD. The sensors have been operated for at least 60h before the first characterization.

1.2 Air Quality Signals

Parameter	Signal	Values		Comments
Output range	TVOC signal	0 ppb to 60000 ppb		Maximum possible output range. The gas sensing performance is specified for the measurement range as defined in **Table 1**
	CO_2eq signal	400 ppm to 60000 ppm		
Resolution	TVOC signal	0 ppb - 2008 ppb	1 ppb	
		2008 ppb – 11110 ppb	6 ppb	
		11110 ppb – 60000 ppb	32 ppb	
	CO_2eq signal	400 ppm – 1479 ppm	1 ppm	
		1479 ppm – 5144 ppm	3 ppm	
		5144 ppm – 17597 ppm	9 ppm	
		17597 ppm – 60000 ppm	31 ppm	
Sampling rate	TVOC signal	1 Hz		The on-chip baseline compensation algorithm has been optimized for this sampling rate. The sensor shows best performance when used with this sampling rate.
	CO_2eq signal	1 Hz		

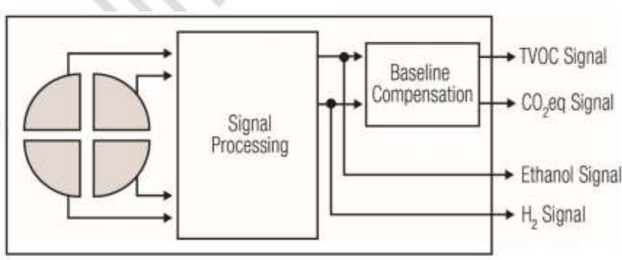


Figure 6 Simplified version of the functional block diagram (compare **Figure 1**) showing the signal paths of the SGP30.

1.3 Recommended Operating Conditions

The sensor shows best performance when operated within recommended normal temperature and humidity range of 5 – 55 °C and 4 –20 g/m^3, respectively. Long-term exposure (operated and not operated) to conditions outside the recommended range, especially at high humidity, may affect the sensor performance. Prolonged exposure to extreme conditions may accelerate aging. To ensure stable operation of the gas sensor, the conditions described in the document *SGP Handling and Assembly Instructions* regarding exposure to exceptionally high concentrations of some organic or inorganic compounds have to be met, particularly during operation. Please also refer to the *Design-in Guide* for optimal integration of the SGP30.

2 Electrical Specifications

Parameter	Min.	Typ.	Max.	Unit	Comments
Supply voltage V_{DD}	1.62	1.8	1.98	V	Minimal voltage must be guaranteed also for the maximum supply current specified in this table.
Hotplate supply voltage V_{DDH}	1.62	1.8	1.98	V	
Supply current in measurement mode[6]		48.2		mA	The measurement mode is activated by sending an "Init_air_quality" or "Measure_raw_signal" command. Specified at 25°C and typical VDD.
Sleep current		2	10	µA	The sleep mode is activated after power-up or after a soft reset. Specified at 25°C and typical VDD.
LOW-level input voltage	-0.5		0.3*VDD	V	
HIGH-level input voltage	0.7*VDD		VDD+0.5	V	
Vhys hysteresis of Schmitt trigger inputs			0.05*VDD	V	
LOW-level output voltage			0.2*VDD	V	(open-drain) at 2mA sink current
Communication	Digital 2-wire interface, I²C fast mode.				

Table 3 Electrical specifications.

3 Interface Specifications

The SGP30 comes in a 6-pin DFN package, see **Table 4**.

Pin	Name	Comments
1	V_{DD}	Supply voltage
2	V_{SS}	Ground
3	SDA	Serial data, bidirectional
4	R	Connect to ground (no electrical function)
5	V_{DDH}	Supply voltage, hotplate
6	SCL	Serial clock, bidirectional

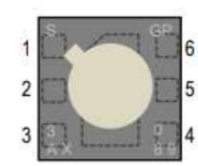


Table 4 Pin assignment (transparent top view). Dashed lines are only visible from the bottom.

[6] A 20% higher current is drawn during 5ms on V_{DDH} after entering the measurement mode.

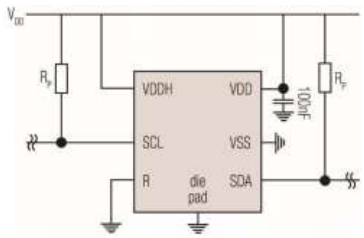


Figure 7 Typical application circuit (for better clarity in the image, the positioning of the pins does not reflect the positions on the real sensor).

The electrical specifications of the SGP30 are shown in **Table 3**. The power supply pins must be decoupled with a 100 nF capacitor that shall be placed as close as possible to pin VDD – see **Figure 7**. The required decoupling depends on the power supply network connected to the sensor. We also recommend VDD and VDDH pins to be shorted[7].

SCL is used to synchronize the communication between the microcontroller and the sensor. The SDA pin is used to transfer data to and from the sensor. For safe communication, the timing specifications defined in the I²C manual[8] must be met. Both SCL and SDA lines are open-drain I/Os with diodes to VDD and VSS. They should be connected to external pull-up resistors. To avoid signal contention, the microcontroller must only drive SDA and SCL low. The external pull-up resistors (e.g. $R_p = 10\ k\Omega$) are required to pull the signal high. For dimensioning resistor sizes please take bus capacity and communication frequency into account (see for example Section 7.1 of NXPs I²C Manual for more details[8]). It should be noted that pull-up resistors may be included in I/O circuits of microcontrollers.

The die pad or center pad is electrically connected to GND. Hence, electrical considerations do not impose constraints on the wiring of the die pad. However, for mechanical stability it is recommended to solder the center pad to the PCB.

4 Absolute Minimum and Maximum Ratings

Stress levels beyond those listed in **Table 5** may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these conditions cannot be guaranteed. Exposure to the absolute maximum rating conditions for extended periods may affect the reliability of the device.

Parameter	Rating
Supply voltage V_{DD}	-0.3 V to +2.16 V
Supply voltage V_{DDH}	-0.3 V to +2.16 V
Storage temperature range	-40 to +125°C
Operating temperature range	-40 to +85°C
Humidity Range	10% - 95% (non-condensing)
ESD HBM	2 kV
ESD CDM	500 V
Latch up, JESD78 Class II, 125˚C	100 mA

Table 5 Absolute minimum and maximum ratings.

Please contact Sensirion for storage, handling and assembly instructions.

[7] If VDD and VDDH are not shorted, it is required that VDD is always powered when VDDH is powered. Otherwise, the sensor might be damaged.

[8] http://www.nxp.com/documents/user_manual/UM10204.pdf

5 Timing Specifications

5.1 Sensor System Timings

The timings refer to the power up and reset of the ASIC part and do not reflect the usefulness of the readings.

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Comments
Power-up time	t_{PU}	After hard reset, $V_{DD} \geq V_{POR}$	-	0.4	0.6	ms	-
Soft reset time	t_{SR}	After soft reset	-	0.4	0.6	ms	-

Table 6 System timing specifications.

5.2 Communication Timings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units	Comments
SCL clock frequency	f_{SCL}	-	0	-	400	kHz	-
Hold time (repeated) START condition	$t_{HD;STA}$	After this period, the first clock pulse is generated	0.6	-	-	µs	-
LOW period of the SCL clock	t_{LOW}	-	1.3	-	-	µs	-
HIGH period of the SCL clock	t_{HIGH}	-	0.6	-	-	µs	-
Set-up time for a repeated START condition	$t_{SU;STA}$	-	0.6	-	-	µs	-
SDA hold time	$t_{HD;DAT}$	-	0	-	-	ns	-
SDA set-up time	$t_{SU;DAT}$	-	100	-	-	ns	-
SCL/SDA rise time	t_R	-	-	-	300	ns	-
SCL/SDA fall time	t_F	-	-	-	300	ns	-
SDA valid time	$t_{VD;DAT}$	-	-	-	0.9	µs	-
Set-up time for STOP condition	$t_{SU;STO}$	-	0.6	-	-	µs	-
Capacitive load on bus line	C_B	-			400	pF	-

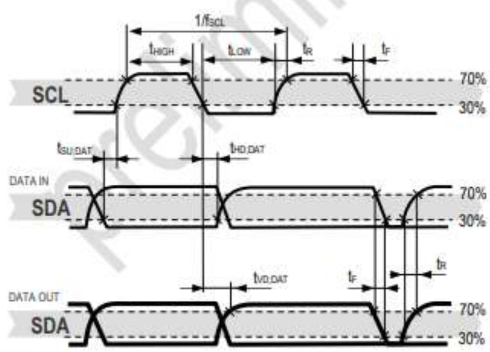


Figure 8 Timing diagram for digital input/output pads. SDA directions are seen from the sensor. Bold SDA lines are controlled by the sensor; plain SDA lines are controlled by the micro-controller. Note that SDA valid read time is triggered by falling edge of preceding toggle.