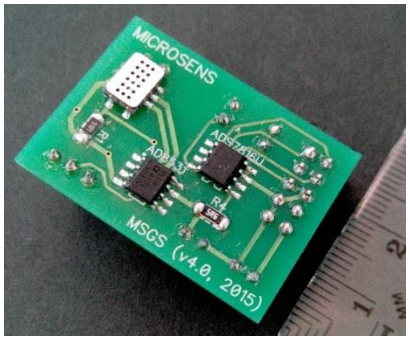
MICROSENS

Product Data Sheet

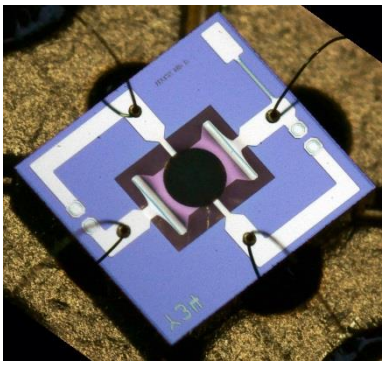
MGSM 5000

MICROSENS Miniature Gas Sensing Module

The MSGS Gas Sensing Module provides the necessary circuitry to drive the MSGS5000i gas sensor, integrated in the module.



- The sensor output is available in analogue format as well as digital format (SPI).
- The sensor temperature can be set to a default value or via an external voltage input.
- The MSGS sensor module can be powered by a 9V battery for short term use or any power supply providing a voltage between 8V and 16V.

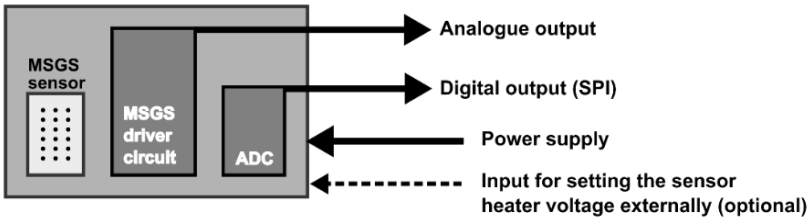


Integrated MSGS5000i sensor

- Miniature semiconductor gas sensor manufactured using standard micro-electronic technology and silicon micromachining techniques.
- Pre-set or externally set sensing temperature

Module Schematics

- The digital output can be connected to the SPI port of a microcontroller or to a PC via a suitable transceiver module (e.g. SPI-to-USB).



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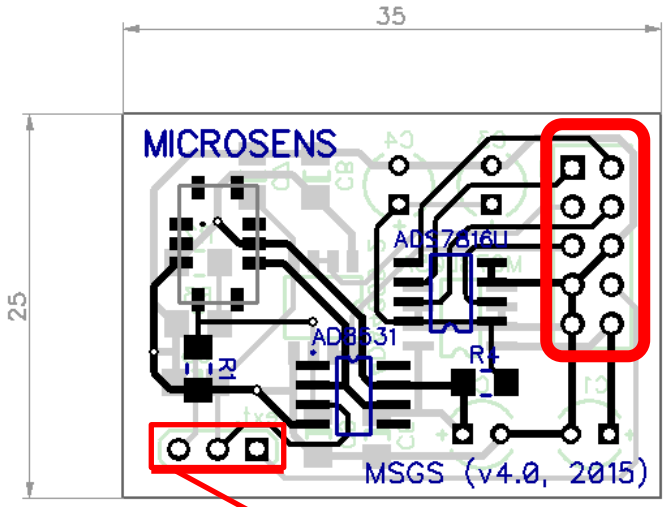
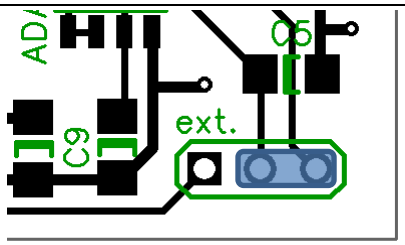
Dimensions and Pin Assignements



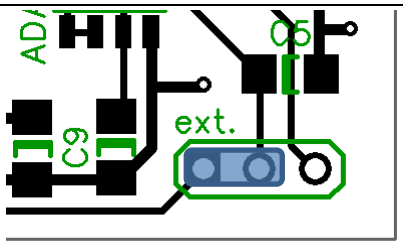
1: D_{out} (SPI)	**2: CS**
3: V_h (mon.)	**4: DCLK**
5: V_{out}	**6: GND**
7: GND	**8: V_h (ext.)**
9: GND	**10: V_{in}**

Pin	Name	Description
1	D_{out} (SPI)	The serial output data word is comprised of 12 bits of data. In operation the data is valid on the falling edge of DCLOCK. The second clock pulse after the falling edge of CS enables the serial output. After one null bit the data is valid for the next 12 edges.
2	CS/SHDN	Chip Select when LOW, Shutdown Mode when HIGH
3	V_h (mon.)	Analog output of the applied heater voltage for monitoring
4	DCLK	Data Clock synchronizes the serial data transfer and determines conversion speed.
5	V_{out}	Analogue sensor output voltage
6, 7, 9	GND	Ground
8	V_h (ext.)	Input for an externally set heater voltage (set jumper to external).
10	V_{in}	Power supply

Jumper settings (for heater voltage)



Heater voltage set to **default value** fixed by the circuit.



Heater voltage set by an **external voltage** (max. 3.0V) applied at the corresponding pin (Pin 8).

ATTENTION: Verify that the jumper is properly set before switching the circuit on. Do not remove the jumper while the circuit is active. Using the circuit without the jumper in place will damage the integrated MSGS sensor.

DC Specifications

Maximum Settings

	max	Unit
V_{in}		V
I_{out}		mA
V_h (external)	3.5	V
Temperature	105	°C

Input

	min	typical	max	Unit
V_{in}	7	9	16	V
I_{in}	40		60	mA
V_h (external)	1.5		3.2	V

Analog Output

	min	default	max	Unit
V_{out}	0		5	V
V_h (monitored)	1.5	2.9	3.2	V

Digital Output (SPI)

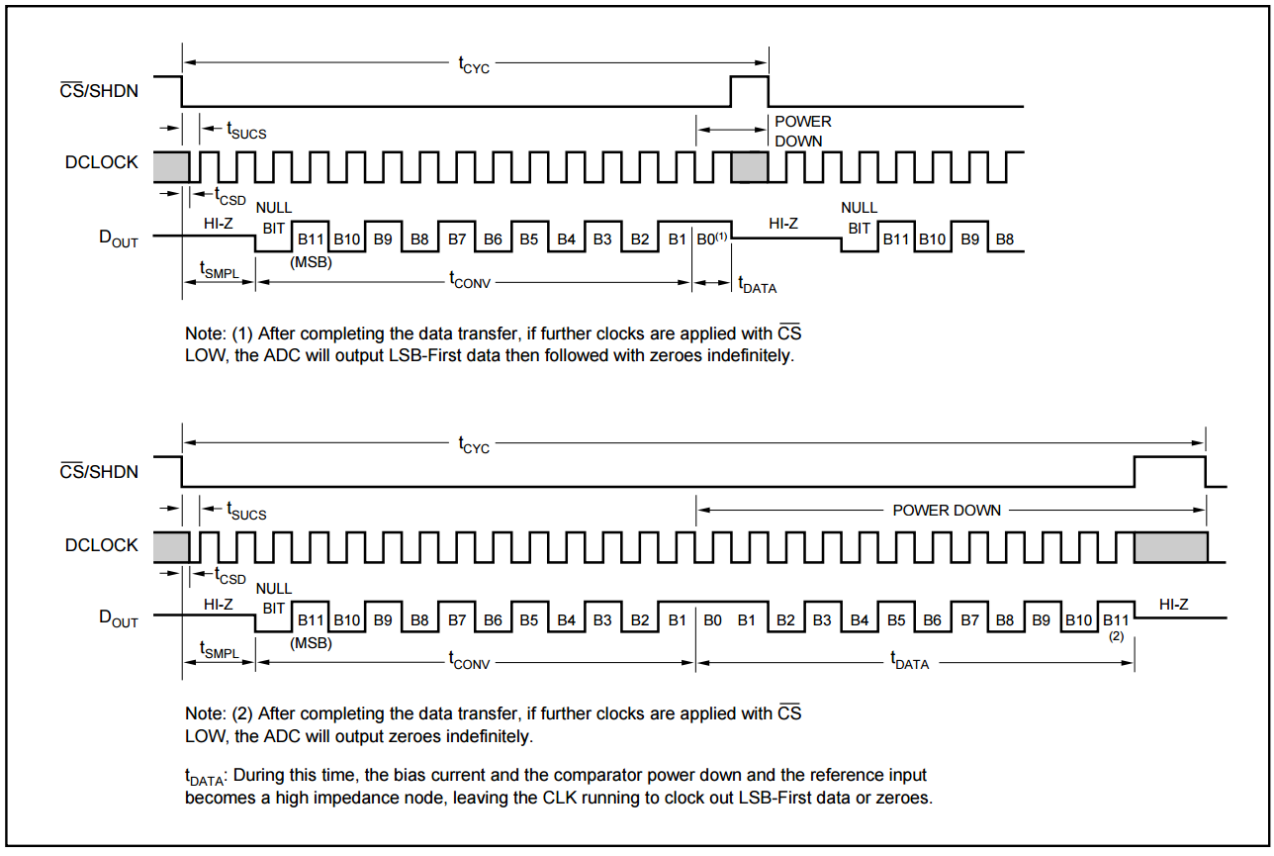
	min	default	max	Unit
V_{IH}	3		5.3	V
V_{IL}	-0.3		0.8	V
V_{OH}	3.5			V
V_{OL}			0.4	V
Data Format	Straight binary			

Digital Interface

Serial Parallel Interface (SPI)

The MSGS gas sensor module communicates with microprocessors and other digital systems via a synchronous 3-wire serial interface (SPI) of the ADS7816 (Burr-Brown). The DCLOCK signal synchronizes the data transfer with each bit being transmitted on the falling edge of DCLOCK. Most receiving systems will capture the bitstream on the rising edge of DCLOCK. However, if the minimum hold time for DOUT is acceptable, the system can use the falling edge of DCLOCK to capture each bit. A falling CS signal initiates the conversion and data transfer. The first 1.5 to 2.0 clock periods of the conversion cycle are used to sample the input signal. After the second falling DCLOCK edge, DOUT is enabled and will output a LOW value for one clock period. For the next 12 DCLOCK periods, DOUT will output the conversion result, most significant bit first. After the least significant bit (B0) has been output, subsequent clocks will repeat the output data but in a least significant bit first format. After the most significant bit (B11) has been repeated, DOUT will tri-state. Subsequent clocks will have no effect on the converter. A new conversion is initiated only when CS has been taken HIGH and returned LOW.

SYMBOL	DESCRIPTION	MIN	TYP	MAX	UNITS
t_{SMPL}	Analog Input Sample TIme	1.5		2.0	Clk Cycles
t_{CONV}	Conversion Time		12		Clk Cycles
t_{CYC}	Throughput Rate			200	kHz
t_{CSD}	$\overline{CS}$ Falling to DCLOCK LOW			0	ns
t_{SUCS}	$\overline{CS}$ Falling to DCLOCK Rising	30			ns
t_{hDO}	DCLOCK Falling to Current D_{OUT} Not Valid	15			ns
t_{dDO}	DCLOCK Falling to Next D_{OUT} Valid		85	150	ns
t_{dis}	$\overline{CS}$ Rising to D_{OUT} Tri-State		25	50	ns
t_{en}	DCLOCK Falling to D_{OUT} Enabled		50	100	ns
t_f	D_{OUT} Fall Time		70	100	ns
t_r	D_{OUT} Rise Time		60	100	ns



Basic timing diagrams of the digital interface.

Data Format

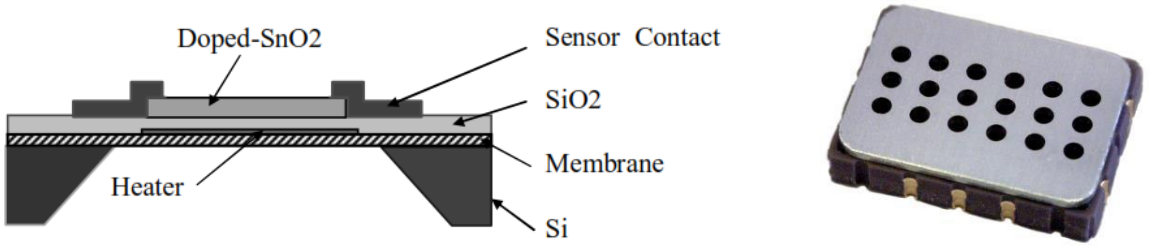
The output data from the on-board ADS7816 is in Straight Binary format as shown in the following table. This table represents the ideal output code for the given input voltage and does not include the effects of offset, gain error, or noise.

DESCRIPTION	ANALOG VALUE	DIGITAL OUTPUT: STRAIGHT BINARY	
		BINARY CODE	HEX CODE
Full Scale Range	V_{REF}	1111 1111 1111	FFF
Least Significant Bit (LSB)	$V_{REF}/4096$	1000 0000 0000	800
Full Scale	V_{REF} –1 LSB	0111 1111 1111	7FF
Midscale	$V_{REF}/2$	0000 0000 0000	000
Midscale – 1 LSB	$V_{REF}/2$ – 1 LSB		
Zero	0V		

Ideal Input Voltages and Output Codes (V_{REF} = 5V)

MSGS 5000i Integrated Sensor

- Miniature semiconductor gas sensor manufactured using standard microelectronic technology and silicon micromachining techniques.
- The sensitive element consists of a semiconducting metal oxide layer. The measurement of specific oxidizing or reducing gases is based on a reversible conductivity change of the sensing element at an appropriate working temperature.
- The thin semiconducting metal oxide is deposited on an integrated heater. The sensitive area is thermally insulated from the silicon substrate to minimize electrical power consumption.



Schematic drawing (left) and SMD packaging (right) of the MSGS5000i gas sensor

Specifications

Dimensions:

	Width	Length	Unit
Sensor chip	1.6	1.6	mm
Packaged sensor (SMD)	5.1	7.6	mm

Operating and Sensing conditions:

	Min	Typical	Max	Unit
P_H: heating power	71	88	100	mW
V_H: heating voltage	1.5	**2.5**(*)	2.8	V
I_H: Heating current		35		mA
R_H: Heater resistance	66	76	82	Ω
R_0: Sensing resistance in air	100		1500	kΩ
P_S: sensitive layer power dissipation			8	mW
T_{amb}: ambient operating temperature	-35		85	°C
R_H: Relative humidity	5		95	%RH

(*): This is the default value set by the MSGS gas sensing module's circuitry.