



# Absolute Pressure Sensor Family IMS-APS

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## Features

IMS-APS is a monolithically integrated system for pressure measurement featuring:

- Absolute pressure measurement versus vacuum level
- 1% overall pressure accuracy after calibration
- On-chip sensors: surface micromachined capacitive pressure sensor and bipolar temperature sensor
- Ratiometric analog output voltage 10 % ... 90 % of supply voltage
- 5 pressure ranges from 0.5 to 350 bar with 5 sensor types
- Sensor signal processing: sensor readout, linearization, compensation of temperature sensitivity, piecewise linear interpolation
- Same user interface for all sensor types
- On-chip EEPROM-memory for calibration and identification data
- Analog and digital electronics in standard CMOS
- Automated parallel calibration for efficient fabrication
- Scan-Test interface
- Higher resolution, individual pressure range, other interfaces, differential pressure sensor - on request

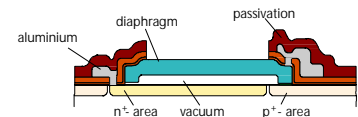


Fig. 1: Capacitive pressure sensor

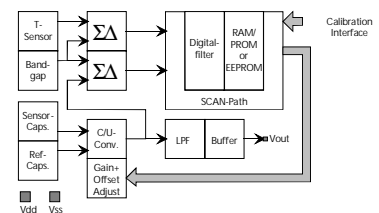


Fig. 2: Block diagram

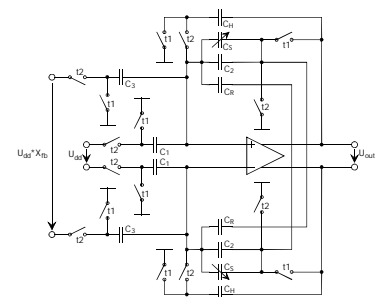


Fig. 3: C/U-converter

## Sensorsystem-concept

The absolute pressure sensor is build as a mechanically deflectable vacuum gap capacitor. It consists of a polysilicon diaphragm under a high doped fixed electrode in the silicon. Both electrodes are separated by a sealed vacuum cavity (fig. 1). In presence of an external pressure the diaphragm is deflected and a pressure dependent change of the capacitance is caused. By variation of the diameter of the diaphragm the pressure range can be adapted between 0.5 and 350 bar. In order to reduce parasitic influences pressure independent reference elements are used.

The signal processing circuit shown in fig. 2 contains of a temperature sensor, two  $\Sigma\Delta$ -modulators for digital conversion of temperature and pressure, and a digitally controlled C/U-converter (fig. 3) followed by a smoothing 3rd order Sallen-Key lowpass filter based on distributed RC-elements in order to optain a continuous-time output voltage. A serial scan-path-interface improves the testability of the entire sensor system and it is also used for the calibration process. The compensation curve for the non-linearity and the temperature dependence is stored by a few boundary nodes which are selected by the two  $\Sigma\Delta$ -modulators and adjust the gain and the offset of the C/U-converter.

The sensor system is fabricated in a 1.2  $\mu\text{m}$  n-well silicon-gate CMOS technology (fig. 4). The die area of the chip is 11.8 mm<sup>2</sup>.

## Calibration process

An efficient automatic and parallel calibration with only a few external components requires a testboard for each sensor system, a reference pressure sensor, a climate chamber and a PC for controlling. There is no need to reach an exact and static value for the pressure or temperature in order to calibrate because each sensor system detects its cali-bration points itselfs. 4 boundary nodes for temperature compensation and 12 boundary nodes for pressure linearization are used.

## Applications

- Measurement and instrumentation
- Industrial control
- Automotive

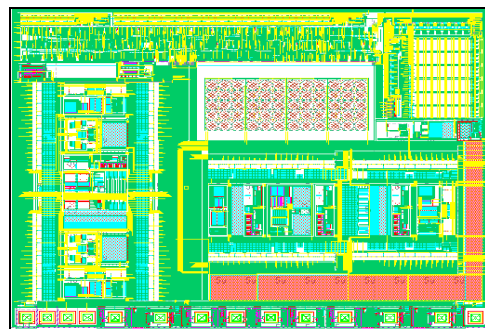


Fig. 4: Chippfoto of the sensor system

Fig. 5: Technical Data (preliminary)

Power supply voltage	5 V $\pm$ 10 %
Current consumption	<3 mA
Operating temperature range	-40 ° C ... 125 ° C
Available max. pressure range	1.5 bar 2 bar 20 bar 60 bar 350 bar
Output voltage	10 % ... 90 % of supply voltage
Output span	80 % of supply voltage
System bandwidth	1 kHz
Max. output resistance	<200 $\Omega$
Max. capacitive load	<10 nF
Chip dimensions (1.2 CMOS)	3.73mm x 3.16 mm
<b>Compensation precision</b>	
Zero offset	$\pm$ 0.25 %*
Resolution	$\pm$ 0.25 %*
Repeatability	$\pm$ 0.25 %*
Output span error	$\pm$ 0.25 %*
Non-linearity	$\pm$ 0.25 %*
Temperature error (-40 ° C ... 125 ° C)	$\pm$ 1.5 %*
Temperature error (0 ° C ... 85 ° C)	$\pm$ 0.5 %*
Non-conformity, terminal based	$\pm$ 1.0 %*

\* according to DIN 16086