Capacitive Pressure Sensors

Main Features
- micro machined capacitive sensor element
- poly-silicon membrane on fused silica substrate
- very small chip size: 1.2mm x 0.6mm x 0.5 mm
- 2 measurement ranges: 0.3 - 1.3 bar and 2 - 8 bar
- high sensitivity
- minimum hysteresis
- low power consumption
- customized products
  - bare dies
  - sensor in SMD package
  - calibrated sensor systems
- applications, e.g.
  - barometric pressure measurement
  - medical implants

General Description
Protron's absolute pressure sensor consist of an ultra small capacitor array with 16 deformable poly-silicon membranes on top of insulated bottom electrodes. The non-conducting fused silica material minimizes all parasitic capacitances to the substrate. The sensor design ensures a high sensitivity, minimum hysteresis and a very low power consumption compared to piezo-resistive pressure sensors.

The dielectric insulation between the electrodes allows the sensor to be operated in normal mode for barometric measurements (typical range 0.3 - 1.3 bar) or in touch mode for high pressure measurements (typical range 2 - 8 bar).

Protron offers the pressure sensors as bare dies with or without package and as calibrated sensor systems with sensor chip and ASIC in a ceramic package. Furthermore evaluation boards for test purposes are available.

Dimensions of Capacitive Sensor Die
- width \( W = 0.6 \) mm
- length \( L = 1.2 \) mm
- height \( H = 0.5 \) mm
- bond pad length \( L_{BP} = 210 \) µm
- bond pad width \( W_{BP} = 530 \) µm
- bond pad pitch \( D_{BP} = 960 \) µm
- topography on die \( H_{BP} < 5 \) µm
- sensitive area length \( L_{S} = 690 \) µm
- sensitive area width \( W_{S} = 370 \) µm
- bond pad material aluminum (gold possible)

Pressure sensor with ASIC in a 5x5mm² package

Pressure sensor die
Specifications of Sensor Die

Barometric pressure range
- Pressure range: 0.3 - 1.3 bar
- Reference pressure: $P_{ref} = 1.0$ bar
- Temperature range: $T = -40...+85 \, ^\circ C$
- Capacitance at $P_{ref}$: $C_{ref} = \text{approx. } 6 \, \text{pF}$
- Sensitivity at $P_{ref}$: $S = \text{ca. } 1 \, \text{fF/mbar}$

High pressure range
- Pressure range: 2 - 8 bar
- Reference pressure: $P_{ref} = 4 $ bar
- Temperature range: $T = -40...+85 \, ^\circ C$
- Capacitance at $P_{ref}$: $C_{ref} = \text{ca. } 10 \, \text{pF}$
- Sensitivity at $P_{ref}$: $S = \text{ca. } 1 \, \text{fF/mbar}$

Pressure Sensor Systems

Protron developed two sensor systems with capacitance-to-digital converters and I²C digital output. An evaluation board with a 24 bit high resolution AD7745 ASIC from Analog Devices and a sensor system in a 5x5mm² ceramic package with 14 bit analog-to-digital converter.

Typical parameters for barometric pressures:
- Pressure range: 0.3 - 1.3 bar
- Resolution @ 1bar: +/- 0.05 mbar
- Absolute accuracy: +/- 1 mbar

Protron offers

- Capacitive sensor dies
- Sensors dies in ceramic package
- Evaluation board with 24 bit AD7745 ASIC and microcontroller board with test software
- Sensor system with 14bit ASIC in ceramic package

Protron offers customized developments based on the current sensor design, e.g. for low power and high resolution applications or for medical use.

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