

- 1 *Layout of multi-channel capacitance IC*
- 2 *Stocking with dielectric elastomer pressure sensors*

Integrated Capacitive Measurement Solutions

ASIC SOLUTIONS FOR CAPACITANCE TO DIGITAL CONVERSION CDC

Capacitive measurement principles are used for many sensor signal and human machine interface applications in industry, consumer and life style products.

Fraunhofer IIS offers a deep know-how and a broad range of application based solutions for capacitive sensor signal conversion. A strong emphasis lays on the miniaturisation and integration of capacitive to digital converters (CDC) for applications, which require high resolution and broad bandwidth.

measurement resolutions with more than 16 bits are possible.

Fast Capacitance Measurement

In line production applications, fast vibration or spatial dislocation or other systems which require a fast reaction, need a broad measurement bandwidth up to the MHz range. Our CDC architectures allow tradeoffs between signal resolution and bandwidth.

High Resolution Sensor Readouts

The delta sigma modulator based CDC solutions from Fraunhofer IIS offer very high capacitance signal resolution down to a few attofarad, even for a base capacitance ten thousand times higher. The well known noise shaping principle of the $\Delta\Sigma$ -modulator is applied for the capacitance to digital conversion. Due to this new approach

Robust and Safe

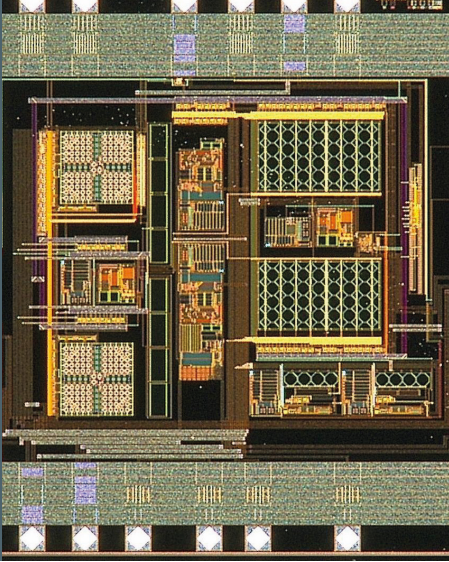
Basic research was conducted by Fraunhofer IIS to increase the EMI and EMC of CDC systems. For proximity sensors and obstacle detection systems an improved field excitation was developed, which allows a higher detection range with simultaneously reduced electromagnetic radiation.

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3 *Layout of capacitance to digital converter CDC*

4 *Automotive application of CDC-ASIC*

Impedance Spectroscopy

Many dielectrical materials show a frequency dependency. This effect can be exploited by multi-frequency capacitance measurement systems. $\Delta\Sigma$ -based CDC systems offer excellent possibility to change the excitation frequency from measurement to measurement value. This effect was already exploited for the distinction of water and a hand in an anti-trap system as well as for the detection of plastic fibers in cotton fabric.

Multi-Channel Sensor ASICs

For a new class of textile-integrated laminar elastomer pressure and strains sensors a 40 channel capacitive measurement ASIC was developed. Since the base capacitance of these sensors may vary over magnitudes due to size and thickness each channel can be adjusted to a broad range of base capacitances. Multi-channel sensor ASICs are also needed for biological and chemical sensors or for future highly miniaturised MEMS/NEMS-sensors.

Applications

- Pressure and strain sensors
- Vibration and displacement sensors
- Proximity and obstacle detection
- Material detection and distinction
- MEMS and NEMS based sensors
- Humidity sensors
- Fluid level detection
- Detection of chemical traces
- Biological sensors
- Lab on chip
- Gesture detection
- Human Machine Interface
- Artificial nose

Our Offer

- System analysis and simulation
- System partitioning
- Specification and design of CDC-ASICs
- Transfer to production
- Small volume production
- Qualification

Makro Blocks

CDC 1

Based on $\Delta\Sigma$ 1st order

- Cap Range: 10 – 500 pF
- Resolution: 1 fF
- Bandwidth: 1 kHz

CDC 2

Based on $\Delta\Sigma$ 4th order

- Cap Range: 10 – 500 pF
- Resolution: 20 aF
- Bandwidth: 10 kHz

CAP40

Based on current integrator

- Cap Range: 10 – 1000 pF
- Resolution: 10 fF
- Bandwidth: 100 Hz