Frontend with microcontroller

Evaluation kit for CMUTs

Objective

Our customer evaluation kit (»CEK CMUT Rev02«) enables customers to test and verify the function of Capacitive Micromechined Ultrasonic Transducers (CMUTs) in a controlled environment. This system allows the specification-compliant application of CMUTs and the assessment of the device performance. The evaluation kit includes an analog frontend, a microcontroller board, a basic control software and one or two probes with arbitrary CMUT devices out of stock.

Advantages

- **Freedom of design** in any 2D-shape for single element transducers or arrays by microfabricated CMUT structures
- **High sensitivity** at low transmitting voltages
- Fully integrable in **CMOS-technology**
- Good **impedance matching** in fluids and air
- Free from toxic materials – **RoHS conformity**
- Cost-efficient in **high-volume production**

Applications

- Near distance measuring
- Proximity and tactile sensing
- Flow measuring
- Acoustic spectroscopy
- Ultrasound microscopy
- Customized sensors

Fraunhofer IPMS has established a process that can deliver small series and pilot productions of CMUTs and enables the development of customer-specific sensor devices.

Scope of Delivery

- one or two CMUT probes (upon request)
- Analog front-end for CMUTs
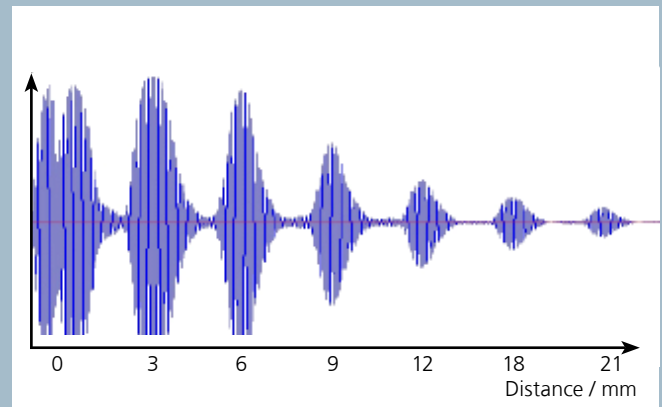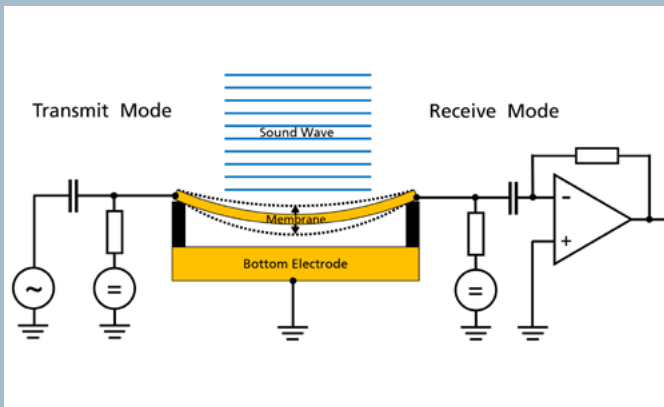- Microcontroller (Red Pitaya® starter kit)
- Control software (SDK on request)

(no additional parts needed)

Contact

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![Forschungsfabrik Mikroelektronik Deutschland]

CMUT in transmit and receive mode   *Multiple echos in air*

Components

The analog front-end enables the generation of arbitrary transmitter signals in the typical frequency and voltage range for CMUTs. It allows the transmitting and receiving of ultrasonic waves with high sensitivity and resolution and provides an ESD protection for the connected CMUT. A commercially available microcontroller board is used for the analog-to-digital conversion and the control of the analog front-end. The complete system is easily manageable by a basic web application via an Ethernet or an optionally WIFI connection.

Principle of CMUTs

The CMUT device is able to transmit and receive ultrasonic waves. In transmit mode the flexible membrane is deflected by an electrostatic force between both electrodes. An ultrasonic wave is emitted, when an AC pulse excites the membrane to oscillate with the resonance frequency of the electromechanical structure. In receive mode the mechanical wave deflects the membrane and thus changes the capacitance of both electrodes. This continuous variation of the capacitance with an applied DC bias voltage generates an AC current, which can be converted into a measuring voltage by a transimpedance amplifier.

Parameter	Min.	Typ	Max.	Unit
Capacitance Load	0		100	pF
Bias Voltage (DC)	0		100	V
Transmitting Voltage	0		Bias Voltage	V
Frequency Range (-3dB)	0.3 (optional 0.01)		4.5 (optional 25)	MHz
Input Noise		20		pA/$\sqrt{}$Hz
Transimpedance		220		kΩ
Variable Gain	-34		62	dB
Pulse Repetition Frequency			200	Hz
Digital Analog Converter				
Resolution			14	Bit
Amplitude			2	Vpp
Sampling Frequency		125		MHz
Signal Length			16,384	Sample
Analog Digital Converter				
Resolution			14	Bit
Amplitude			2	Vpp
Sampling Frequency	125 and 15.625 (optional 1.953125)			MHz
Recording Length			16,384	Sample
Power Supply (DC)				
Voltage		5		V
Current			2	A
Dimensions (assembled incl. coax cables)	Single channel: 130 x 70 x 55; Double channel: 130 x 70 x 75			mm
PC Interface	Gigabit-LAN or WIFI with USB dongle			
Probe Connector	MCX jack			