

Transceiver ASIC for Micromachined Ultrasonic Transducers

*Measurement setup for an eight-channel ultrasonic transceiver chip. ©Fraunhofer EMFT/
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Application

Ultrasound has been a powerful tool for imaging applications for decades. Compared to conventional piezo-based ultrasound transducers, capacitive micromechanical ultrasound transducers (CMUT) offer entirely new opportunities in terms of miniaturization, high-frequency operation and degree of integration with interface electronics.

Application fields include:

- Medical imaging
- Non destructive evaluation
- Robotics
- Consumer application (Fingerprint sensors, gesture control)
- Automotive

Technical innovation

To exploit the unique advantages of such CMUTs, researchers at Fraunhofer EMFT are developing an application-specific integrated circuit (ASIC) for the interface transceiver with low power consumption and area efficiency. A multi-channel ASIC with integrated high-voltage driver circuits and low-noise preamplifiers can be interfaced with a 2D array of CMUTs for various applications. This also enables monolithic or hybrid integration of sensor electronics into a small system.

CMUTs require a high voltage biasing during the transmit and receive operation. Conventionally this high biasing voltage is applied externally using a low-pass filter.

The new approach developed at Fraunhofer EMFT eliminates the need for external components to bias the CMUTs by using a two-level pulse scheme.

Another advantage is that no bulky highvoltage isolation switches are needed in the receive path, which improves the noise performance of the preamplifier. Low power design techniques were adopted which ensures that no static power is consumed from the high voltage supplies. This helps to keep the power consumption and heating effects within the safe limits. Integrated high voltage linear regulators provide all the required high voltage biasing on chip. The chip can be configured using a standard SPI serial communication protocol. On chip programmable clock divider enables interfacing with transducers of different resonance frequency from a single external clock source. It can be programmed to generate pulse burst of up to 64 pulses.

Outlook

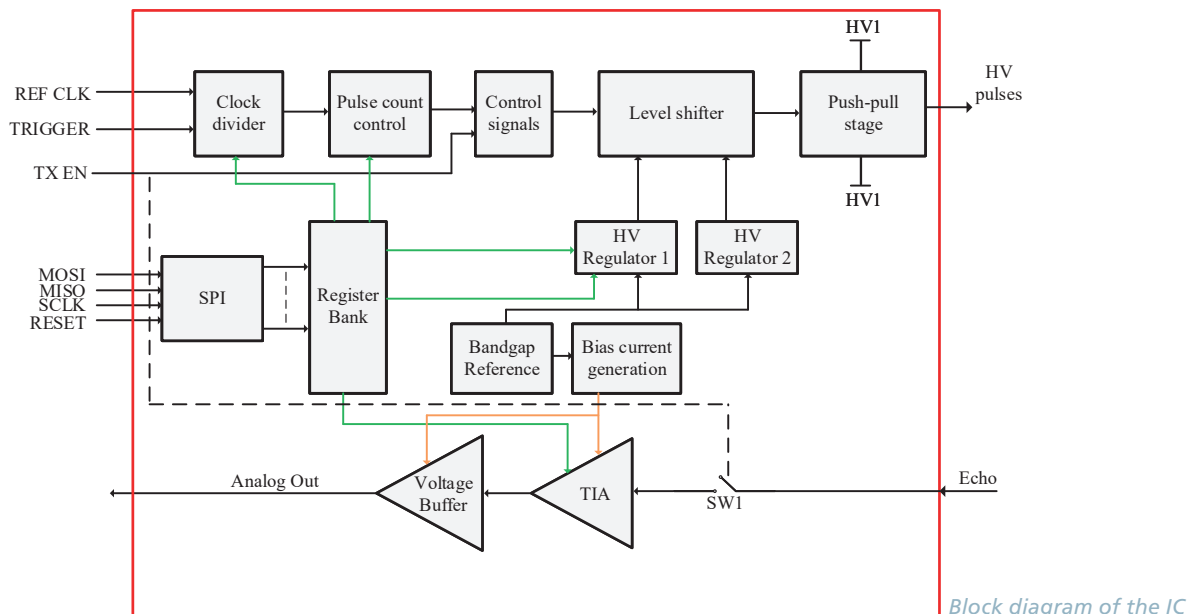
An 8 channel HV transceiver ASIC to interface CMUTs were designed and evaluated.

Further integration of functional blocks for beamsteering and signal processing are foreseen. The evaluation of different types of MUT devices like PMUT's and the required adaption of the existing solution is planned in the next development steps.

A testing and evaluation platform for the overall characterization of the ultrasonic platform is in work.

Funding program

The work is funded by the Fraunhofer-Gesellschaft as part of the MAVO project 5 ProTaktilus.



Technical data

Two versions of the chip has been designed and evaluated. A full transceiver operation of the system was also demonstrated with a CMUT. The chip is packaged in a standard 80 pin QFN package with dimensions of 12 mm x 12 mm.

An electronics evaluation platform was developed with 16 channels. On board programmable DCDC converters can generate the required high voltage levels.

Technical data of the chip:

- Area ~ 16 sq.mm
- Number of transceiver channels = 8
- Maximum HV level = 100 V.
- Serial communication with SPI protocol
- Programmable frequency divider and pulse count control digital blocks

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