RESEARCH OUTCOME

SELECTED ABSTRACTS

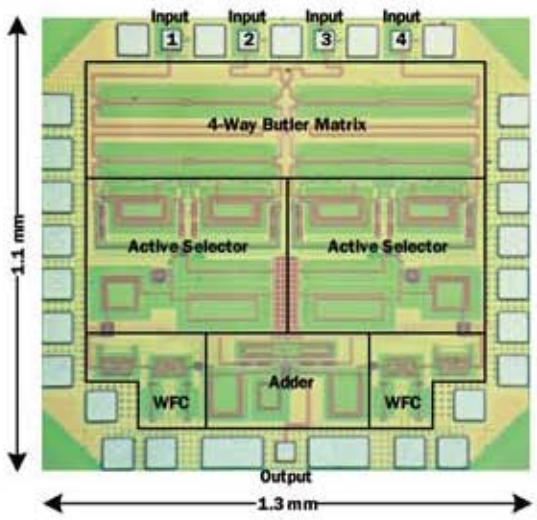
MMIC / RFIC

■ A 25-GHz Compact Low-Power Phased-Array Receiver With Continuous Beam Steering in CMOS Technology

T.-Y. Chin, S.-F. Chang, J.-C. Wu, and C.-C. Chang

IEEE J. of Solid-State Circuits, vol 45, no.11, pp.2273-2282, Nov., 2010.

A CMOS phased array receiver front-end with continuous beam steering is proposed based on the subsector beam steering technique. The entire beam steering range is divided into five subsectors from four characteristic beams of the Butler matrix. In each subsector the receive beam is steered by weighted combination of the received signals from array antennas. The proposed architecture has lower circuit complexity and less power consumption because no challenging CMOS 360° variable phase shifters and multi-phase voltage-controlled oscillators are required. The phased array MMIC implemented in 0.13-μm CMOS technology has 17–21 dB receiving gain and 8.9–10.7 dB noise figure in 25–26 GHz. The measurement results show that continuous beam steering within a spatial range of ±90° is achieved with very low power consumption of 30 mW and compact chip size of 1.43 mm2, demonstrating significant improvement compared to the relevant works in literature.

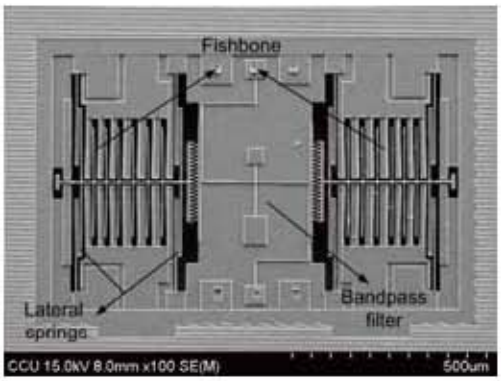


Design of Millimeter-Wave MEMS-based Reconfigurable Front-end Circuits Using the Standard CMOS Technology

C.-C. Chang, S.-C. Hsieh, C.-H. Chen, C.-Y. Huang and C.-C. Lin

Journal of Micromechanics and Microengineering, 21 (2011) 125011

Three V-/W-band reconfigurable CMOS-MEMS front-end circuits, including a bandstop filter, a filter-integrated switch, and a slot antenna, are demonstrated using standard 0.35-μm and 0.18-μm CMOS processes. The suspended MEMS structure is released through the post-CMOS micromachining. To achieve circuit reconfigurability, dual-state and multi-state fishbone-beam-drive actuators are proposed herein. Several miniaturizing techniques, such as H-type resonant, stepped impedance, and grounded pedestal, are applied in those circuits to achieve a compact chip size. Those circuits demonstrate good RF performance, thereby enabling a great potential for future single-chip transceiver.

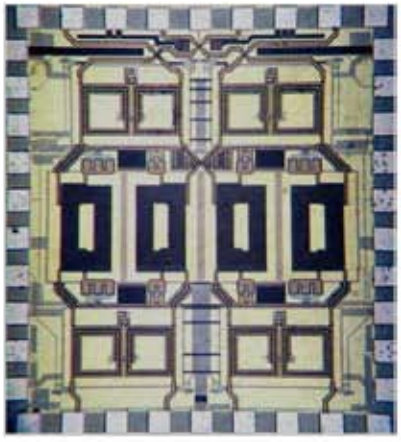


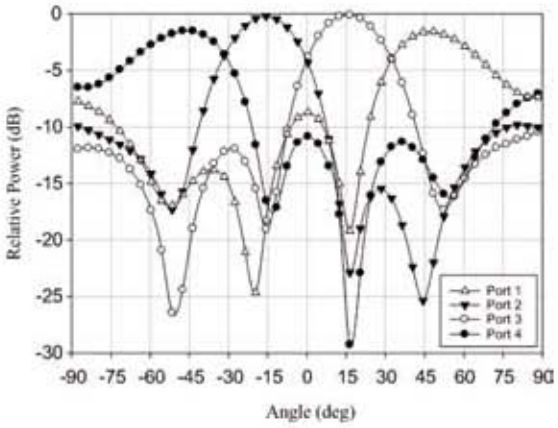
Novel Design of a 2.5-GHz Fully-Integrated CMOS Butler Matrix for Smart-Antenna Systems

C.-C. Chang, T.-Y. Chin, J.-C. Wu, and S.-F. Chang

IEEE Tran. on Microw. Theory Tech., vol.56, no.8, pp.1757-1763, Aug., 2008.

A novel design of monolithic 2.5-GHz 4x4 Butler matrix in 0.18-μm CMOS technology is presented. To achieve a single-chip smart-antenna system, the proposed Butler matrix is designed with the phase-compensated transformer-based quadrature couplers and reflection-type phase shifters. The measurements show an accurate phase distribution with amplitude imbalance <1.5 dB. The antenna beamforming capability is also demonstrated by integrating the Butler matrix with a 1x4 monopole antenna array. The generated beam directions agree very well with the predictions. This Butler matrix consumes no dc power and only occupies the chip area of 1.36x1.47 mm2. According to our knowledge, this is the first CMOS Butler matrix reported to date.





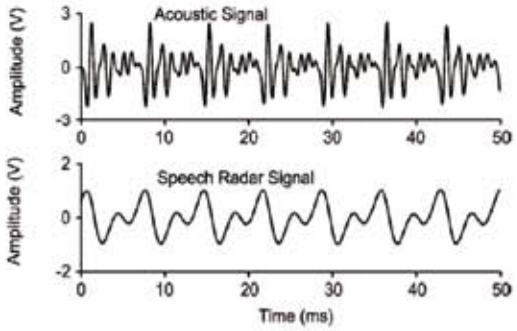
Microwave/Millimeter Wave Systems

Microwave Human Vocal Vibration Signal Detection Based on Doppler Radar Technology

C.-S. Lin, S.-F. Chang, C.-C. Chang, and C.-C. Lin

IEEE Tran. Microw. Theory Tech., vol. 58, no.8, pp.2299-2306, Aug. 2010

A speech radar system is presented for extracting speech information from the vocal vibration signal of a human subject. Due to the tiny glottis motion of several millimeters, a coherent homodyne demodulator with high sensitivity is developed to detect reflected radio signal, phase modulated by the vibrating vocal cords. The signal detection quality and system circuit design are described. Measurements of vowels and words, both with the speech radar system and the conventional acoustic microphone system, were conducted and compared. The speech radar is essentially immune to background acoustic noise so that the essential speech information can be reliably obtained, making it more appealing for speech applications in high background acoustic noise environment.



A 71-80 GHz medium power amplifier using 4-mil 0.15-μm GaAs-PHEMT technology

Z.-M. Tsai, K.-Y. Lin, and H. Wang

2011 Asia-Pacific Microw. Conf. Tech. Dig., pp. 1130-1133, Dec. 2011.

A matching network with benefit of realization and wide bandwidth for millimeter-wave power amplifiers is proposed. With the proposed matching network, the characteristic impedance of the λ/4 transformers are increased and the length of the λ/4 transformers are reduced. A 71-80 GHz medium power power amplifier using 4-mil 0.15-μm HEMT is demonstrated based on the proper matching network. A 18.8-dBm output power with 10.7% peak PAE has been achieved and reveals that this matching is suitable for millimeter-wave power amplifier designs.