ICSS Research Needs: Circuit Design 2010

The SRC GRC member companies are pleased to release this document that describes the research needs in the thrust of Circuit Design including that for Texas Analog Center of Excellence (TxACE). Incorporated into this document are the Grand Challenges from the International Technology Roadmap for Semiconductors (http://public.itrs.net) as well as needs identified through the ICSS strategic planning process, TxACE workshops and joint discussions.

Addressing the challenges in the ITRS requires the focus of circuit design research in three main areas: management and optimization of circuit power and energy, design of robust circuits, and design of high-performance circuits. These challenges are evident in both advanced processing nodes as well as circuits for particular application areas. The members have an increased focus on analog/power/RF/mixed-signal design as designing complex circuits in those areas has become more difficult than in the past. This complements the emphasis on circuit design to take advantage of technology scaling.

There are five general categories identified, along with three additional categories aimed at two specific application spaces, which are areas of emerging importance to the members. Each category then contains several subcategories which describe the need in more detail. Even so, these are written to be broad in nature. With the formation of the TxACE, the end applications that might take advantage of these research results are broader than they have been in the past.

The needs in the circuit design space cover a broad range of applications, including high performance processors for data centers, low-power processors for mobile computing and communication, healthcare devices, and efficient energy usage and management systems. Investigators are encouraged to link the results of their work with a potential application to help describe the relevance of the proposed work.

White Papers for all the categories below will be considered for funding. Please note the categories in bold were highlighted by member companies for this 2010 solicitation as being particularly valuable to the industry.

2010 Circuit Design Needs Categories	
C1	**Circuit Power/Energy Management/Optimization**
C1.1	**Very low power digital and analog circuits**
C1.2	**Circuits used for power management, including regulators, converters, and controllers, power efficient audio amps**
C1.3	**Thermal management circuitry including high accuracy compact temperature sensors**
C1.4	Control or exploitation of gate and channel leakage
C2	**Circuit Design Robustness (Analog, Digital and RF)**
C2.1	**Circuits for increased tolerance and adaptability to manufacturing/process variability**
C2.2	**Increasing reliability with unreliable components and soft errors by design**
C2.3	**Noise tolerant and aging tolerant circuits/isolation techniques, signal integrity, robust ESD**
C2.4	Configurable Modular analog and high-speed I/O architectures that improve reuse in SOC products
C3	**High Performance Circuits**
C3.1	**On-chip interconnect scaling, including high-speed signaling techniques and interconnect driven design techniques**
C3.2	**Circuits for high-speed communications including ultra high speed ADC (>10 Gsps) links**
C3.3	**Adaptive analog, digital, and memory circuits**
C3.4	**High performance digital circuit design**
C3.5	**Circuit techniques for analog/RF BIST/DFT**
C3.6	High dynamic range analog front-ends for metering applications
C3.7	Clocking: Scaling, multiple clock domains, and asynchronous
C4	**Circuits in Advanced Technologies**
C4.1	**Analog/RF design in scaled "digital" technologies**
C4.2	**Digital circuits with low I_{on}/I_{off} in extreme scaled CMOS**
C4.3	**Low voltage digital and analog circuit design including subthreshold design**
C4.4	Circuit design techniques with advanced CMOS device structures
C5	**Bridging Research Across Disciplines**
C5.1	**Semiconductor materials/processes/device and circuit design interactions/co-development, including novel non-CMOS devices**
C5.2	**Device and interconnect modeling in advanced technologies**
C5.3	**Package and circuit interactions – high frequency, low noise, EMI management, cost effective packaging**
C5.4	Design productivity – CAD and circuit interactions
C5.5	Mixed-signal isolation technologies for SoC and SiP
C5.6	Non-traditional application areas for silicon circuitry
C6	**Medical Applications**
C6.1	Adaptive circuits that sense and take corrective action when a medical device is approaching boundaries that could harm a patient
C6.2	Affordable CMOS-based high voltage (+/-100v) power amplifiers, line drivers and transmit/receive switches to interface ultrasound transducers
C6.3	Non-Nyquist ADC's for compressed sensing
C7	**Energy Efficiency Applications**
C7.1	Efficient circuits for driving LED strings in parallel for display applications
C7.2	Affordable 120-V LED Current Driver
C7.3	High efficiency of DC-DC converters across all operating conditions
C7.4	Circuits for better power density management
C7.5	Self-adaptive fast DC-DC converters
C8	**Needs Applying to both Medical and Energy Efficiency Applications**
C8.1	Reliable power efficient antenna, and wireless power transmit and receive circuits
C8.2	Stable efficient ultra low power timing circuits for control of sleep/wake sequences
C8.3	Built in calibration system with subtraction of background interference
C8.4	Power efficient linear regulators including ultra low power (less than 100 ☐W)
C8.5	Power management circuits in nano-scale CMOS
C8.6	Power efficient programmable and adaptive integrated system solutions that can accomplish measurement, signal processing and communication of medical information
C8.7	Circuits for low input voltage and self-starting energy harvesting
C8.8	Managing multiple energy sources that are not well behaved