

Overview of the Microelectronic Systems Research



Advanced Electronic Devices and Systems

Purpose: The MSR Group bridges the gap between basic and applied research and acts as ORNL's technology and knowledge base in advanced electronic systems, particularly those involved at the interface of biological systems, analog signal processing, and nanostructured materials.

Sponsors: Department of Energy offices, Work for Others agencies, small and large industrial partners.

Complementary ORNL Facilities:

- Nanoscale Science and Technology Laboratory.
- Center for Nanophase Materials Sciences.

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The Microelectronic Systems Research (MSR) Group was formed in 1988 to add application-specific integrated circuit design technologies to an already mature analog and digital electronics capability.

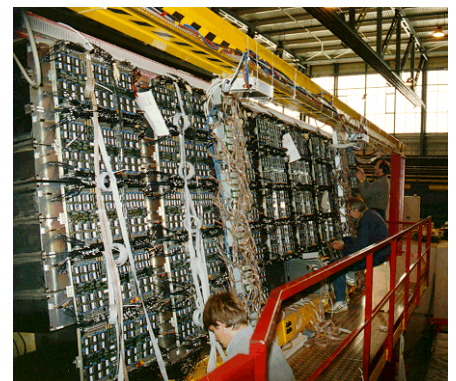
The group bridges the gap between basic and applied research and acts as Oak Ridge National Laboratory's (ORNL's) technology and knowledge base in advanced electronic systems, particularly those involved at the interface of biological systems, analog signal processing, and nanostructured materials. This is accomplished by continually assembling and nurturing a research team that is competent, innovative, collaborative, flexible, adaptable, and ready to quickly and effectively respond to multidisciplinary technical issues.

The MSR Group performs research and development of circuits and systems involving custom microelectronics and nanoelectronics, where sensors and circuits are typically integrated into miniature and low-power electronic systems. The group's primary emphasis has been the creation of large-scale, mixed-signal application-specific integrated circuits (ASICs) and the research and development of new techniques, devices, and structures to exploit monolithically constructed circuits and sensors for measurement, control, and communications applications. Current application domains for us include national security, experimental physics, and biomedical systems.

Capabilities

MSR uses a broad range of design, simulation, and testing tools.

Fabrication is accomplished by taking advantage of the latest semiconductor processes found in a number of foundries in the United States and abroad. The MSR Group has diverse expertise in analog, digital, radio-frequency, and mixed-signal integrated circuits. Different problems may require more or less speed, power, or size. To optimize a solution to a particular sponsor's requirements, MSR uses a variety of integrated circuit technologies including bulk CMOS, silicon-on-sapphire CMOS, low noise and high-speed silicon bipolar, silicon-germanium, and gallium-arsenide. These technologies are accessed through foundries that supply fabrication services for state-of-the-art semiconductor processes. Sometimes multiple integrated circuit technologies may be combined to achieve a required solution. In these cases, multiple ASIC's have been combined in miniature assemblies using chip-on-board printed circuit board or multi-chip-module techniques.



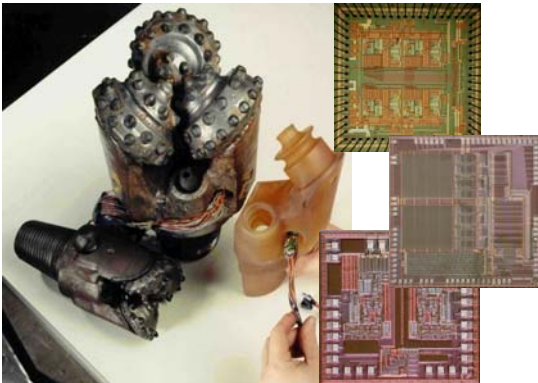
ASICs enable large national and international physics experiments.

Additional Nearby Facilities

- The Nanoscale Science and Technology Laboratory is a user facility incorporating roughly 1,200 square feet of clean room space, a Hitachi S-4700 scanning electron microscope, and a variety of semiconductor processing systems.
- The Center for Nanophase Materials Sciences is a collaborative nanoscience user research facility for the synthesis, characterization, theory/modeling/simulation, and design of nanoscale materials.

Current Application Domains

- Experimental physics detector systems.
- Bioscience instrumentation.
- Distributed sensor systems.
- Harsh environment electronics.
- National security.
- Nanoscale electronics/systems.



High-temperature ASICs for petroleum exploration applications.

Distinguishing Features

Although the group works with technologies that push the envelope and possesses deep as well as broad



A systems perspective and multidiscipline fluency continue to be distinguishing features of MSR staff.

expertise in electronic device and systems development, these are not necessarily the features that distinguish the group from other institutions and laboratories. Instead, the following characteristics tend to be the distinguishing features of the MSR Group.

- Ability to rapidly produce working prototypes of proof-of-principle units/systems.
- Ability to work from first principles.
- Staff who are fluent in other disciplines (e.g., biology, physics).
- Ability to conceive and conceptualize from a systems perspective.