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WITH FEWER DEFENSE CONTRACTS, ROCKWELL LOOKS FOR COMMERCIAL MEMS SPINOFFS

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By Rosemary Clandos
 Small Times West Coast Correspondent

THOUSAND OAKS, Calif. -- If a gadget is useful for the defense industry, there's a good chance it will be even more useful for businesses.

Think of telephones, for example. The power amplifier technology initially used for defense communications is now snug inside most of the world's digital cellular phones. And consider telescopes: the infrared imaging devices in some of the world's largest telescopes were developed for military satellites and missiles.

With a reduction in the number of defense contracts in recent years, researchers at Rockwell Science Center, a division of Rockwell International Corporation, are using their smarts to scout for ways MEMS could be licensed for products developed by private enterprises.

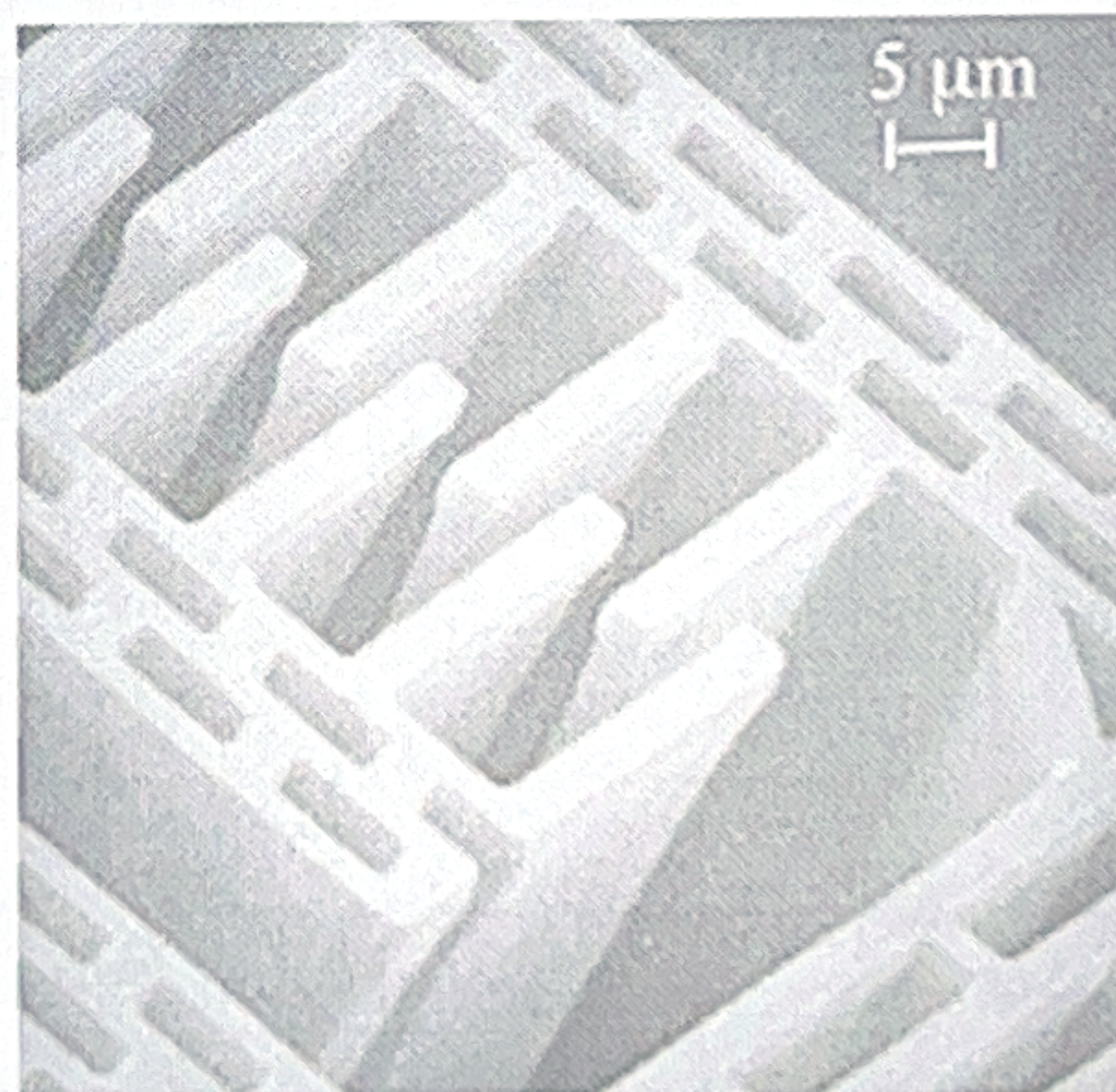
"Rockwell's biggest focus is on activity in broad reaching technology," said Jeffrey F. DeNatale, Rockwell's manager of microelectromechanical systems. Since researchers at the Science Center have worked with a large number of businesses, the U.S. government and Rockwell's other business divisions, they have developed a portfolio of technology and intellectual property that can be applied to several fields.

Cronos Integrated Microsystems, a business unit of JDS Uniphase Corp., recently entered a licensing agreement with Rockwell for radio frequency (RF) switches that solve energy loss and leak problems. The MEMS device is only 100 microns -- roughly the diameter of a human hair -- and can be used to shut energy on and off, and to switch to different components for tuning, DeNatale said.

Replacing an electronic switch, the MEMS device provides a parts reduction; in one demonstration it used 42 percent fewer than its predecessor, said DeNatale. The size, weight and material reductions are benefits, along with decreased manufacturing costs: 4,000 of the minuscule machines can be fabricated on a four-inch wafer.

"As time goes on there will be a lot of other RF applications," said MEMS industry analyst Roger Grace in San Francisco. "Now, switches are the first real commercial application of MEMS."

In 2000, there were approximately 400 million cell phones in consumers' pockets and purses. This year, the projected 470 million to 500 million cell phones will increase market

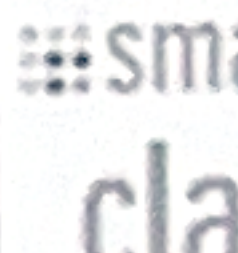


Detail of Rockwell MEMS Tunable Capacitor

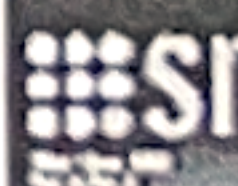
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potential for MEMS technology, Grace said.

"That's not to say that all these phones will have the MEMS switches in them," he added. "It will be a gradual migration process of MEMS into cell phones, with the more function-rich phones receiving the MEMS first."

Future applications for the RF switches include picosatellites -- wee things that weigh about a half-pound and measure a little bigger than a deck of cards. They were originally used by the government for space environment testing and it is conceivable that they can be used for telecom satellites, DeNatale said.

Cronos also licensed a tunable capacitor which fine-tunes radio frequencies. Although the device was created for military radios, it could allow cell phone users to receive better signals more quickly and add capabilities to phones that are operating on many frequencies. Compact high-performance radios will also benefit from improved tuning performance.

"There's a tremendous amount of long-term exploratory work going on with MEMS that has a path to commercialization, but it is not expected to be commercialized within the next two or three years," DeNatale said.

For example, wireless sensors using MEMS components can be placed on factory floors to remotely monitor potential machine breakdowns. In the future, whole factories can be monitored from a computer. Other MEMS devices can be used in thermal management -- cooling computer and electronic components.

Some of the original technology was developed with funds from the Defense Advanced Research Projects Agency (DARPA), a U.S. Department of Defense program. DARPA generally gives commercial rights and retains some rights for its own interests, said Rockwell's spokesman Jerry Risto.

William Tang, Ph.D., program manager at DARPA's Microsystems Technology Office, has said that the long-term goal of the DARPA MEMS program is to merge information processing with sensing and actuation and to realize new systems and strategies. In the short-term, DARPA wants to demonstrate MEMS technologies, develop and insert the products into commercial and defense systems, and lower the barriers to access and commercialization by catalyzing a shared MEMS infrastructure.

"They reap the benefit of commercialization because they can buy more advanced systems and components at lower prices. Once it reaches the communications market, the value goes up and prices go down," said Risto.

The biggest obstacle to commercialization, DeNatale says, is that MEMS technology is evolving much faster than industry is used to, making it difficult for commercial applications to keep pace.

"It's a different approach that gets drastically different results, rather than continuous upward improvements," DeNatale said. "The order of magnitude improvements, rather than gradual improvements, is a factor of 10 to 100. So it's 10 times to 100 times better."

Grace said that although the technology is not part of a continuous evolutionary process, it is becoming more widely used. "Over the next five to 10 years, it won't be considered a discontinuous technology," he said.

In the meantime, researchers are looking for ways to cut packaging and handling costs. "It is costly at the present time, but it will progressively change as volumes increase -- then packaging solutions will improve," DeNatale said.

As MEMS technology sheds its university-curiosity image, its viability as a commercial technology is expected to grow.

"The competitive factors are certainly primary," Grace said. "People want to produce the best products they can. MEMS is enabling products to be produced that have lower costs, higher performance and higher reliability. And that enables new products to be created at price points that are dictated by the market."

"RF switches are just the tip of the iceberg," he said. "There are a number of other high volume opportunities. This is just the beginning of the story; this is the preface of the book."

IMAGES:

-- **Cover photo:** Micrograph of Rockwell MEMS RF Switch. Micron-scale motions are used to make and break contact across the signal line, providing low closed-state loss and high open-state isolation.

-- **Detail of Rockwell MEMS Tunable Capacitor:** By mechanically varying the relative overlap of the interdigitated comb fingers, the device capacitance can be controllably tuned over a large range.

