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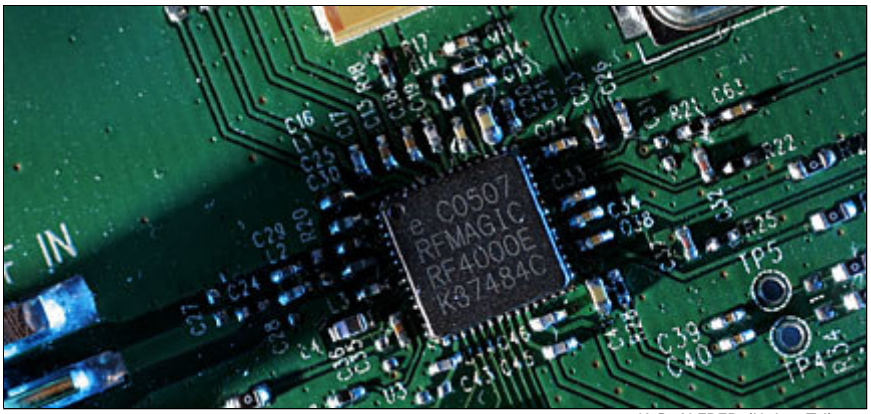

K.C. ALFRED /Union-Tribune
RF Magic thinks its silicon TV tuner technology could also be used for laptop and desktop computers.

TECHNOLOGY INC. | SEMICONDUCTORS

Critical mass of talent

S.D. a design center for tiny chips that are the future of electronics

By Mike Freeman
STAFF WRITER

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In a small lab in Sorrento Mesa, a group of engineers practices what's been called the black magic of the wireless technology world.

They're designing radio frequency integrated circuits – tiny chips that process signals for everything from cell phones to televisions.

In the lab at RF Magic – a 4-year-old chip maker that has raised $40 million in venture capital – engineers test chips that will handle television signals at very high speeds known as broadband.

K.C. ALFRED / Union-Tribune
Yanlan Li tested equipment at RF Magic, which focuses on chips for the broadband consumer-electronics market.

They're the type of chips that are increasingly finding their way into set-top boxes and other television equipment – replacing canned tuners that are slightly bigger than pack of gum with a piece of silicon smaller than a fingernail.

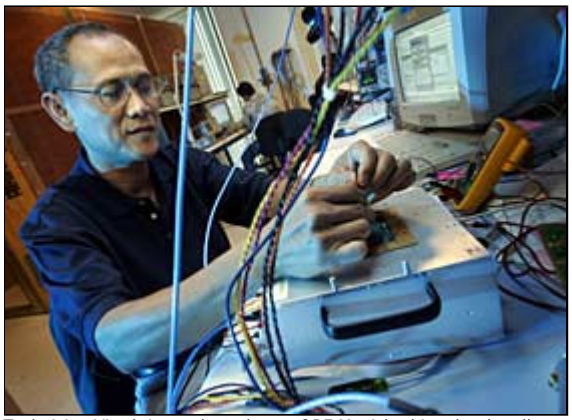
"We're enabling the next generation of consumer electronics," said Mark Foley, chief executive of RF Magic, which employs 68 workers.

San Diego is home to a cluster of startup companies designing radio frequency chips. In addition to RF Magic, Sequoia Communications in Rancho Bernardo, Quorum Systems of Sorrento Mesa and MaxLinear of Carlsbad are making chips used in everything from cable set-top boxes to cell phones and broadband wireless modems.

In fact, wireless chips are increasely becoming the big growth story in the semiconductor industry – taking over from computer chips, which led the industry in the '90s.

Only a few thousand engineers worldwide have the expertise to excel at radio frequency chip design, industry experts say. Silicon Valley has a good number of RF chip engineers working on emerging wireless hot spots such as Wi-Max.

In San Diego, the RF chip expertise tends to center on the cellular market.



Technician Virath Lo evaluated one of RF Magic's chips that handle television signals at the very high speeds known as broadband. K.C. ALFRED / Union-Tribune

It's mostly guesswork as to how many RF chip designers work in the region. But because of the research being done locally at such companies as Nokia, Qualcomm, Texas Instruments and Motorola, coupled with the wireless design brainpower at University of California San Diego, the region has a healthly percentage of the world's radio frequency chip designers.

"I would say at least a quarter of the world's RF integrated circuit talent is in San Diego," said Bernard Xavier, chief executive of Quorum Systems, a 2½-year-old company that is designing radio frequency chips for cell phones and broadband network wireless systems.

This concentration of RF engineering is part of the reason San Diego County startups got 60 percent of the venture capital funding in Southern California last year, beating out Los Angeles and Orange counties, according to a survey conducted by PricewaterhouseCoopers.

What makes radio frequency design akin to black magic?

"The tasks required of today's wireless circuits are extremely challenging," said Ian Galton, a professor at UCSD's Center for Wireless Communications. "For example, the receiver in a typical cellular telephone must be able to recover a very, very tiny signal in the presence of much larger interference signals. The power of the signals you don't want can be tens of millions of times more powerful than the signal you do want, so these are incredibly sensitive systems."

Second, unlike non-radio chips, RF designs can't be easily tested on a computer.

"With some other technologies in the high-tech world, you can actually very accurately simulate it on the computer and know what you're building before you build it," said Dave Shepard, chief executive of Sequoia Communications, which designs chips for cell phones. "In RF, you can't do that. You're not relying on the software to do the work for you. It's really the engineer's brainpower."

Finally, RF designers must build chips that don't drain too much from a battery or take up too much room in the cell phone.

"The RF integrated circuit business is extremely competitive, with razor-thin margins," said Galton, the UCSD professor. "These companies are under intense pressure to minimize the circuit area and power consumption of their chips.

"On the other hand," he continued, "volumes can be enormous, so a winning design can be extremely lucrative."

While several companies are working on RF chips locally, three startups in particular have popped up on the radar screen lately – Quorum Systems, RF Magic and Sequoia Communications.

Each is taking a different approach in the RF chip market, which is expected to reach $8 billion in sales by 2008, according to industry experts.

RF Magic aims at broadband consumer electronics. The privately held company already has shipped more than 2.5 million chips, Foley said. Its silicon is used in digital broadcast satellite equipment, broadband wireless modems and cable set-top boxes.

With satellite television, RF Magic's chip allows homeowners to watch a show and record a different show on their TiVo – all through one cable from dish to the set-up box. Without the chip, a second cable would be needed to record on the TiVo.

At Quorum Systems, which has raised $24.3 million in venture capital, the focus is mostly on cellular markets and wireless networking equipment, said Xavier, a co-founder of the company.

But eventually, television signals also might be incorporated into its radio chips.

As with all of these companies, the buzzword is multi-mode chips. Today if a cellular company wanted to add a feature to a phone, such as global positioning or streaming music, it would have to add another chip or another layer of circuitry to an existing chip. That process eats up power and takes up room in the ever-shrinking cell phone.

With multi-mode, RF chip designers aim to pack all these features on one chip through shared circuitry.

"If you look at Quorum, what's different about us is we're focused on the convergence of all these applications onto

one chip," Xavier said. "We converge cellular and networking and eventually television into our radio chips."

At Sequoia Communications, the focus is more on the next generation of services coming to cellular phones, known as 3G. It is developing chip architecture that aims to shorten the time it takes to design new functions into a phone. The company has raised $20 million in venture capital and employs 38 workers.

Shepard, the chief executive, said wireless design talent at big wireless companies is likely to spawn more RF startups, as engineers with good ideas leave to pursue projects that are too risky for large companies to fund.

"Very big established companies create a feeding ground for startups," Shepard said. "Very few cities in the world have a critical mass of RF designers. San Diego is one of them."

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