



THE ECONOMY

COMPUTER TECHNOLOGY

New Memory Chips Don't Forget

By **Simson L. Garlinkel**

Staff writer of The Christian Science Monitor

BOSTON

A FIVE-YEAR-OLD company with a patented technology is trying to challenge the giant chipmaking Intel Corp. to set the next standard for the way computers store information.

The battle ground is memory chips, little devices inside computers used to hold data and programs. Most of today's chips are "volatile" — they are erased when the power is turned off. Data for later reuse must be stored on magnetic disks.

But advances in memory chips might make magnetic storage obsolete within the next decade. Chips can be more than 10,000 times faster than disks and are more reliable, having no moving parts.

"It ultimately promises the perfect memory device," says Michael Gumpert, a senior electronics analyst at Drexel Burnham Lambert Inc. "I think that they are making good progress, but there is still a very long way to go," referring to the work of Ramtron International, Intel's

Australian competitor.

Ross-Lyndon James, Ramtron's president, set out five years ago to create non-volatile memory chips using ferroelectrics, a technology that combines magnetism and electronics. With \$60 million in start-up capital, Ramtron is now building a research and development factory in Colorado and has already produced its first chips. The Krysalis Corporation in California is another start-up company working with the same technology.

At the heart of Ramtron's integrated circuits is an extremely thin ceramic film made from crystals of lead-zirconate-titanate (PZT). Each PZT crystal holds a single titanium atom. A tiny electric field can flip the atom between two positions, like a microscopic toggle switch. This allows writing on the chip in the binary code that computers understand. The thousands of atomic-switches on the chip remain in position even after the power is turned off.

Competing technology

Ferroelectrics face steep competition from the flash memory, a non-volatile system that has been developed by Intel, Seeq Technology of San Jose, Calif., and Toshiba in Japan. Flash memory stores information using a device called a floating gate, which is like a tiny box that can

hold an electrical charge. It also has two positions: empty or full. The electric charge remains inside the box even when the power is off.

Both flash and ferroelectric technologies have drawbacks. Ramtron's chip works at the normal high speeds of volatile memory chips, but some engineers question whether or not its flipping atoms will be susceptible to fatigue.

Flash memories can be read at normal chip speed but are a thousand times slower at remembering new information, slower even than a hard disk (though faster than a floppy).

Intel leads the race to market. Currently, Ramtron's chips can only store 4,096 bits, or a quarter-page of text, making them practical only for a few applications. One of the first will be an electronic odometer for automobiles, Mr. James says. Ramtron doesn't expect to be in production of a 1 megabit ferroelectric memory chip until 1990, says Richard Horton, president of Ramtron's Colorado facility.

Intel, by contrast, will have the satisfaction of seeing its flash memories for sale in the Psion hand-held computers this fall. "We are in production with 1 megabit today," says Bruce McCormick, the flash-memory marketing manager at Intel. "That is

a big difference between flash and ferroelectric."

(This fall, two other computer manufacturers introduced hand-held computers that use wallet-size cards containing memory chips to store documents and programs. But the chips aren't truly volatile, because they are powered by tiny batteries. When the batteries fail, the data is lost.)

Moving target

Ferroelectrics will be chasing a moving target in seeking to catch up to flash technology, says Stefan Lai, who is managing Intel's 16-megabit flash memory effort. "Our current technology will allow us to do a 4-megabit right now," says Dr. Lai. He expects Intel to complete its 16-megabit design in 1992.

James is confident that Ramtron will find it easier to push ferroelectrics to higher memory densities than has been the experience of other companies working with conventional designs. "The smaller we make it, the better it works," he says. Other chipmakers, by contrast, have often needed to redesign their circuits totally to achieve higher storage capacity.

Intel manufactures and sells its flash memories directly. Ramtron hopes to license its ferroelectric technology to other chip manufacturers.

The company's 13 patents, James contends, mean that "anybody who wants to go apply [ferroelectrics] to memory will have to come into an arrangement with Ramtron."

To make hard disks obsolete, however, chipmakers will have to make their chips much cheaper and dramatically increase the storage capacity.

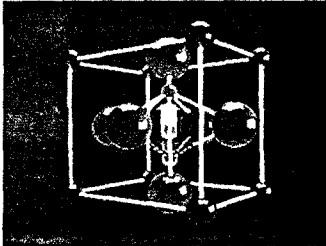
A typical 3 1/2-inch hard disk that can store more than 200 megabytes of information (about 100,000 typed pages) costs \$1,000-\$2,000. To store that much information on today's state-of-the-art chips would cost more than five times as much and require 1,600 chips.

"I would probably say that we are looking at a good decade before we see hard disk technology easily eclipsed by a solid-state solution," says Liz Baird, a spokeswoman for Quantum, a maker of disk drives.

Other technologies such as optical storage will complicate the picture, making it likely that no single solution will be adopted. Ms. Baird contends.

"What we really think is going to happen is that there will emerge a lot of complementary ways for these technologies to work together. . . . We think that the hard disk business has a long life ahead of it."

RAMTRON CORPORATION



ATOMIC SWITCH: Ramtron's ferroelectric chips contain titanium atoms that can be moved between two positions — the basis for the binary language that computers read and write. Unlike conventional memory chips, the Ramtron chip is not erased by turning off the computer. It works at conventional chip speed — 10,000 times faster than reading from and writing to magnetic storage media like hard or floppy disks.

Canadians Tire of Paying More for Groceries

By **Fred Langan**

Special to The Christian Science Monitor

MANSONVILLE, QUEBEC

AGRICULTURAL marketing boards in Canada are facing two tests. One is from GATT, the international organization that addresses trade issues. The other is from ordinary Canadians who are tired of paying up to double the United States price for food staples.

A package of Kraft Philadelphia cream cheese costs C\$2.25 at Jacques Ducharme's grocery store in Mansonville, Quebec. Two miles south, in the US, the identical brand goes for 95 US cents — about \$1.12 in Canadian money.

Dairy products can cost almost double on the Canadian side of the border. It's the same story with chicken, turkey, and eggs. The reason is marketing boards which guarantee a return for farmers and set the price for shoppers.

"Marketing boards are dead in the water," says Michael Walker, economist with the Fraser Institute in Vancouver, British Columbia. "What will kill them is free trade, because it is chipping away at monopolies such as marketing boards."

Marketing boards were not touched by the Canada-US Free Trade Agreement, which came into effect at the start of this year and will eliminate tariffs on trade between the two nations over 10 years. But they are coming under pressure anyway.

The chipping away has started with yogurt and ice cream. A GATT panel has issued a preliminary ruling that Canada must remove tariffs on those products. A final decision will be made by the full GATT council meeting in Geneva later this month.

Removing marketing board restrictions would allow more efficient American producers into the Canadian market. Marketing boards are preparing to battle for their preservation.

"Canada's not lily white in this thing but you can't put the blame on marketing boards," says Ken Wilson of the Ontario Milk Marketing Board. "The Americans subsidize their dairy farmers with direct state and federal programs."

Mr. Walker agrees that American farmers receive large subsidies but he says Canadian subsidies are greater.

Marketing boards hold that they provides farmers with price stability. Few dairy farmers go broke. The same is true for those in the chicken, egg, and turkey business. The prices are set by monitoring the

costs of 150 randomly chosen dairy farmers.

But to stabilize prices, the milk producers have to keep foreign competition out. "Obviously we have to have effective border controls or the system wouldn't work," Mr. Wilson says.

But Walker argues marketing boards keep out young farmers who must buy the right to go into the business.

"For example, in British Columbia you would need about a million dollars to buy [a production] quota to start a 50-cow herd," he says. The cost of buying the right to milk a cow effectively keeps many newcomers out of the dairy business. "Marketing boards benefit rich farmers," Walker says.

It is even more expensive to get into turkeys and broiler hens. It costs about \$12 to buy the right to own a laying hen. Anyone owning more than 100 can be fined.

Meanwhile, a lot of people in this border town drive south for bargains. Canadian customs officers allow small amounts of groceries to enter without asking any questions.

And while they do a little shopping in the US, Canadians fill up on gasoline. It costs almost half what it sells for on the Canadian side.