

Episode 10

World Top Position in DRAM

In the field of DRAM, fierce competition was repeated along with generation changes every three years, since 1K bit product (1103) was developed by Intel in 1970.

The competitions were so fierce that it even affected the rise and fall of the nations and enterprises, as well as individual's semiconductor life. I cannot escape from my feel that demons are hiding in DRAM. There was such a sense of tension. I myself was promoted by the help of good DRAM business performance one time, and in the other time, I went through a great hardship of demotion and relegation.

Hitachi's first development of DRAM was in 1973, which was delayed to Intel by three years. It was 1K bit DRAM compatible with Intel's 1103. At that time, many of semiconductor companies developed compatible product with Intel's 1103, and it became the de facto standard. Therefore, Intel became by far the leader in this generation.

However, in the 4Kbit DRAM generation, the situation changed completely. As each company, mainly in the US, brought out products of different specifications, a big mess occurred from the viewpoint of standardization.

When it came to pin arrangement of packages, for example, different products were introduced to the market from different companies, such as 22-pin type from Intel and Motorola, 18-pin type from TI, and 16-pin type from Mosteck.

In addition, various types of memory cell architectures were introduced such as 4-MOS type, 3-MOS type, and 1-MOS type, competing with their advantages and disadvantages in speed, power and die area.

Among such fierce battles, the product of "1-MOS cell, 16-pin package" developed by Mosteck was the most refined, and it would go toward aggregation as mainstream.

The development plan of 4K bit DRAM at Hitachi was also confusing with many changes corresponding to the products which appeared in the market one after another. As a result, as many as 6 different series of products were developed only in this generation, causing scattered resources and performance degradation.

The diversification of products in the 4Kbit generation and the confusion of specifications became major reflections in the industry, and the standardization activities were strengthened to avoid these kinds of confusions in the generations to follow.

I first learned about these activities through Reith Brown (Semiconductor Staff Engineer at Burroughs) in November 1976. He invited me to the standardization meeting of IEEE in the Eastern District and I gained many suggestive hints. And this movement would be handed over to JEDEC (Joint Electronic Device Engineering Council) at a later date, and I also attended the JEDEC meeting in April 1977.

After that, at Hitachi, we regarded this meeting as a very important meeting, and we not only attended the meetings, but also tried to actively make proposals.

In 16K DRAM generation, we paid careful attention to product planning so as not to follow the mistake in the previous generation of 4K DRAM. We decided, after detailed studies, the product specifications; power supply voltage, package outline, pin arrangement, etc., based on the feedback from the industry trend and from the customer information

In the 16K generation, Mosteck became the definite top runner. And in Hitachi, our products were well received by domestic and oversea customers, and the monthly production level reached more than 100 thousand in mid-1978.

In such circumstances, a new business opportunity came to us with the scale we had never experienced before. It was from the largest computer manufacturer, IBM. The project was officially launched in June 1979 after several meetings with the customer, and its code name was named "Caribou Project" by IBM. Caribou is a kind of reindeer living in North America. The product of Caribou Project was a memory of 32 Kbits with two 16K DRAMs, one 16K stacked on top of the other, and it may be said as the predecessor of today's PoP (Package on Package).

It was one of the most important projects for IBM, and in February 1980, the executives of the company came to Japan to visit our assembly factory in Hakodate, Hokkaido. The photo 10.1 below was taken at that time. I clearly remember that snow was piled up outside the factory.



Photo 10.1 Members of the Caribou Project that gathered in Hakodate.

3rd person from the left is Dick English (Hitachi), and to the right, Hideaki Ito (Hitachi), Al Cicman (IBM), Jim Heenan (IBM), Akira Sugiyama (Hitachi), and the author (February, 1980)

The forecast of the production quantity presented by IBM was to reach 4 million pieces in 1981, the first year, 10 million pieces in the second year. Those figures were larger by an order of magnitude from our common knowledge at the time. In Hitachi, we worked with all our full power including design, manufacturing, quality control, sales and others. Thousands of samples were prepared for the qualification with thorough tests.

And it was on 27th of January, 1981, more than six months after the start of the qualification tests, when we received the news from IBM; "Caribou has been successfully qualified!" This was the moment that we all waited for, and it was an event which happened in a dawn of Hitachi's achievement of world top position in DRAM.

A little before this, 64K DRAM development project was kicked-off on July 4, 1978. To promote this development as a company-wide project, it was designated as "Special Research Project" (a company-wide special research project system of Hitachi) with the support of Hiroshi Watanabe (deceased), top executive officer of Hitachi's R&D

There was enthusiasm for the whole company of Hitachi to raise the total power in order to achieve the world top position of 64K DRAM. At the center of this development were Kiyoo Ito of Central Research Laboratories, Kenji Taniguchi and Hiroshi Kawamoto of Device Development Center, and young engineers of the Musashi Factory. My role was to organize the whole project including development, manufacturing and all the way down to sales. In May 1979, the development of 64K DRAM was successfully completed and it was released to the press.

In 1980, many inquiries came in to our 64K DRAM from domestic and overseas customers. In addition to medium-sized computer manufacturers such as DEC, Burroughs and HP in the United States, extra-big deal was again from IBM. Since the situation developed extremely well up to the customer qualification stage, bold measures were also taken on the production side to increase the volume. The production quantity started rising at the beginning of 1981.

In July 1981, a research company Dataquest reported the top three for 64K DRAM as follows (Quarterly quantities in parentheses): 1st place Hitachi (200 thousand), 2nd place Motorola (125 thousand), 3rd place Fujitsu (100 thousand pieces).

Three years passed since the Special Project had started, and it was now confirmed that Hitachi was in the top position in the world, which had always been our sincere wish.

Now, the rapid progress of Japan in 64K DRAM became a major concern for the US semiconductor industry, and it was taken up largely by the mass media.

In Fortune magazine issued in December 1981, a reporter, Gene Bylinsky wrote, setting alarm bells ringing, "If we lose in 64K DRAM, the leading-edge device, threats are not only for semiconductors but also for the computer industry, the largest industry in the United States."

The magazine reported the market share of Japan and US manufacturers in 64KDRAM in 1981 as follows: "69.5% for Japanese companies including 40% for Hitachi and 20% for Fujitsu, and 30.5% for US companies including 20% for Motorola and 17% for TI."

Hitachi achieved the world top position for the first time in the 64K generation. It impressed "Japanese victory", and we cannot deny a side effect of putting fire to wariness to Japan. We were approaching to the time that could be called the eve of the Japan - US semiconductor war.

There is noteworthy thing at this time when Hitachi's memory got stronger and its global presence increased. It was the fact that young engineers grew greatly. When I visited overseas customers, it was common for several engineers to accompany me. They were well versed in detailed

technology, good at English, and they could communicate with customer engineers in in-depth technical discussions. One of the presidents of our sales agents (abbreviated as “Rep”) in the United States would call them “Young Lions of Hitachi” and praised them. The picture 10.2 below is one of Young Lions’ customer visits during such a breakthrough period in the early 1980’s.



Photo 10.2 A scene of customer visit in the eastern region of the US in October 1980. From left, the author, Satoru Ito, Akira Endo, Masamichi Ishihara)

In the picture above, Satoru Ito, Akira Endo and Masamichi Ishihara were all DRAM engineers, but there were well over 10 of Young Lions, a galaxy of able young guys, including Tokumasa Yasui in SRAM, Toshimasa Kihara in EPROM, Akira Mogami and Naotake Motoki in quality control. Later on, they all would grow up as the core people of Hitachi semiconductor group.

However, some of them were technology specialists, yet not particularly good at English, and “spoke by guts”. Let me introduce one such episode.

One of selling points of Hitachi’s DRAM was a “single 5-volt power supply”. Prior to that, two or three power supplies were common, but we succeeded in making it to single 5-volt power supply. When one of the Young Lions spoke to a customer in English, he said, “single go-boruto (meaning single five-volt in English)”, so it was totally impossible for the customer to understand. They finally went to the blackboard, and started to make conversation by means of writing, and finally “single five-volt” was understood.

There were almost uncountable number of such episodes in the transitional period of globalization of our business, but young energy aiming at the world top enabled them to overcome such difficulties like surging waves.

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