

Four New Players Join 3D NAND Market



OBJECTIVE ANALYSIS SEMICONDUCTOR MARKET RESEARCH

Intel, Micron, SanDisk, & Toshiba Join In

On March 25, 2015, SanDisk and Toshiba announced sampling of their 3D NAND flash technology, a 128Gb (gigabit) 48-layer second-generation product based on the BiCS technology that the companies pioneered in 2007. Pilot production will begin in the second half of 2015 with meaningful production targeted for 2016.

This release was issued at the same time that Intel and Micron were briefing the press and analysts for a March 26 announcement of their own 3D NAND offering (pictured), which is currently sampling with select customers, and is to enter full production by year-end. The Micron-Intel chip is a 32-layer 256Gb device, which the companies proudly point out is the densest flash chip in the industry.

Similarities and Differences

These two joint ventures (Intel-Micron and SanDisk-Toshiba) are taking very different approaches to 3D, both of which also differ from Samsung's product. Toshiba and SanDisk are staying very true to the BiCS ("Bit Cost Scaling") charge trap architecture that Toshiba first announced in 2007, while Micron and Intel are using a floating gate design whose details have not yet been revealed. Hynix disclosed a means of creating a floating gate vertical structure at the IEDM conference in December 2013, but Objective Analysis doesn't know whether the Intel-Micron process is similar.

Meanwhile, Samsung's 3D "VNAND" chip uses the company's TCAT ("Terabit Cell Array Transistor") charge-trap process that is similar to, but more complex than, the BiCS approach. A charge trap is a convenient way of circumventing any need to pattern a floating gate. Since it is difficult to pattern any vertical structure, most NAND makers see a charge trap as the simplest way to produce a 3D NAND string.

Micron and Intel argue that their approach takes advantage of years of floating gate experience, and this is true, since the first EPROMs used a floating gate 44 years ago back in 1971. The two companies also claim that their 3D structure

allows as many electrons to fit onto the floating gate as did their 50nm planar product, supporting 3-bit cells to give the chip three times the density of competing 128Gb 3D NAND chips. Both the Toshiba 128Gb and the Micron 256Gb 3D NAND chips are 2-bit MLC, while Samsung's 128Gb part stores three bits per cell.

Samsung's Leadership Threatened

Although Samsung has been shipping its VNAND-based 850 series of SSDs since July, many in the industry suspect that the chip has not yet proven profitable, but serves more as a means of boosting the company's image as a technology leader. SanDisk and Micron have both explained that they have no intention of ramping their 3D technologies until they become cost-competitive with existing planar devices. Although today's announcement indicates that the companies expect their 3D products to become cost competitive in the near future, they employ a significant number of new, untried processes, and this leads Objective Analysis to doubt that they can stay on schedule. We expect for the industry as a whole to struggle with 3D yields for at least another year before discovering how to make the chips at a competitive cost.

Only SK hynix Left

There are only six leading NAND flash suppliers, and the only one that has not yet announced 3D NAND product availability is SK hynix. The company has predicted sampling plans in the past, and we believe that it is making good progress in that area, but so far it has made no announcements that it is sampling a part.

Coincidental Timing

We have to make some mention of the timing of these two announcements. Like the Samsung and SK hynix DRAM 8Gb LPDDR4 announcements in December 2013, which were released only an hour apart, the timing of these announcements leads to questions about whether there was a leak from one camp that drove a response from the other. There is no indication of any other triggering event that would have caused these announcements to be synchronized.

Why 3D? Why Now?

Some recipients of this Alert may not know what 3D NAND is and why it's important. In brief: Conventional planar NAND flash is approaching its "scaling limit", a point beyond which it can no longer be cost-reduced by shrinking the production process. 3D NAND is the industry's approach to continue to cost-reduce NAND flash along its current trajectory for another few generations. An [in-depth explanation](#) of this technology is available on The Memory Guy blog.

Objective Analysis publishes reports detailing NAND flash and SSD markets. These reports can be purchased for immediate download from our [website](#).

Jim Handy

OBJECTIVE ANALYSIS

Semiconductor Market Research

www.Objective-Analysis.com

TheSSDguy.com

TheMemoryGuy.com

PO Box 440

Los Gatos, CA 95031-0440

USA

+1 (408) 356-2549