

55 YEARS DRAM INNOVATION



MEMPHIS
WE KNOW MEMORY

NO.5 JUNE 23 MEMPHIS MEMORY ESSENTIALS

Everything you need to know about the semiconductor memory industry, from legacy technologies to latest innovations.

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DRAM Innovation goes on even after 55 years!

In June 1968, the patent for a single transistor, single capacitor DRAM cell design idea was granted. This is reason enough for us to celebrate this amazing technology by dedicating this edition to DRAM and its triumphal advance which really is quite unique if you think of it. Not many technologies have a lifespan that covers several decades, especially in semiconductors.

We probably wouldn't talk about DRAM today if it wasn't for the continuous innovation that enabled DRAM to scale and evolve pushing the limits of what's possible. There's almost no embedded system or even industrial design that can do without DRAM. And while engineers and masterminds continue to work on ways to shrink DRAM cells to 10nm and below, most older DRAM generations are still being used today, as many of our customers know.

And we are proud to say that we have one of the most comprehensive DRAM portfolios in the market in both components and modules. This is thanks to the multiple DRAM vendors among the 18 memory manufacturers that we carry. But did you know that we configure DRAM modules based on your requirements from basically all DRAM components that are available on the market? Reach out if you are interested to hear more.

Also, now is the perfect time to buy the DRAM memories that you need. Prices are still down as manufacturers still have a lot of stock. But with 20% production cuts this year, Garner expects a sharp increase in prices in 2024. So speak with us and get your supply while prices are low.

Now enjoy our DRAM special. We're sure you will learn things you weren't aware of before!

Ranking	Company	1Q23	4Q22	QoQ	1Q23	4Q22
1	Samsung	4,170	5,510	-24.7%	43.2%	45.2%
2	Micron	2,732	2,829	-3.8%	28.2%	23.1%
3	SK hynix	2,312	3,386	-31.7%	35.9%	37.6%
4	Nanya	211	224	-6.7%	2.2%	2.1%
5	Winbond	95	104	-8.8%	1.0%	0.8%
6	PSiLOC	20	23	-12.3%	0.2%	0.2%
	Others	133	133	0.0%	1.3%	1.0%
	Total	9,663	12,209	-21.2%	100.0%	100.0%

Notes:
1. 4Q22 USD 1 = ¥1001.2159, USD 1 = ¥170.313
2. 1Q23 USD 1 = ¥1001.2159, USD 1 = ¥170.313
3. The data related to the revenue for 4Q22 has been retrospectively adjusted in accordance with the latest update to SK hynix's financial report.
Source: TrendForce, May, 2023

Company	1Q23	QoQ (%)	1Q23	4Q22
Samsung	2,990.0	-15.8%	34.0%	33.8%
Kioxia	1,831.4	-5.9%	21.5%	19.1%
SK Group (SK hynix + Solidigm)	1,315.5	-24.6%	15.5%	17.0%
WDC	1,307.0	21.1%	15.2%	16.1%
Micron	853.0	-19.8%	10.3%	10.7%
Others	337.1	4.2%	3.9%	3.1%
Total	8,624.1	-16.1%	100.0%	100.0%

Notes:
1. 4Q22 average exchange rate: USD 1 = ¥171.414; USD 1 = ¥1001.2159
2. 1Q23 average exchange rate: USD 1 = ¥171.414; USD 1 = ¥1001.2159
3. The data related to the revenue for 4Q22 has been retrospectively adjusted in accordance with the latest update to SK hynix's financial report.
Source: TrendForce, Jan, 2023

DRAM Revenue Declines 21.1% in Q1 2023

TrendForce reports a dramatic 21.2% QoQ decline in Q1 revenues for the DRAM industry, bringing total revenue down to US\$9.663 billion. This significant dip represents the third consecutive quarter where revenues have fallen. An enduring oversupply issue, which has led to an ongoing slump in prices, is the chief culprit behind the decline.

TrendForce's earlier prediction of the big three shifting from profitability to loss in 1Q23 due to a swift ASP decline came true. With DRAM prices continuing to fall, it's anticipated that Q2 operating profit margins will remain in the red. In response to this, all three major suppliers have started implementing production cuts, with Q2 capacity utilization rates expected to fall to 77% for Samsung, 74% for Micron, and 82% for SK hynix.

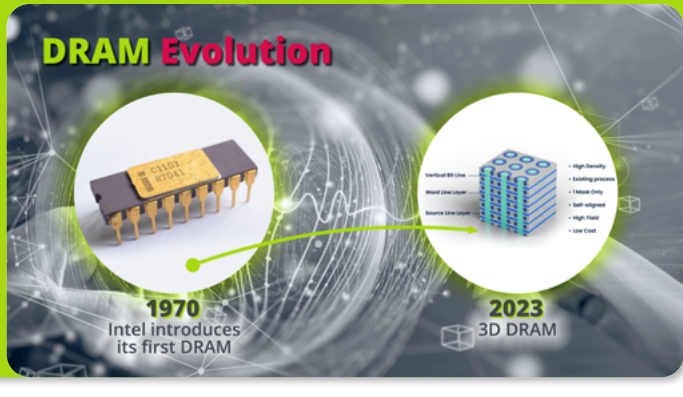
Read the full press release [here](#).

Nand Marginal Growth Despite Price Cuts

The NAND Flash market has decelerated during 1Q23. Despite suppliers aggressively slashing prices to stimulate sales, the bit shipment volume of NAND Flash witnessed only a marginal growth of 2.1% over the quarter.

Looking ahead to 2Q23, TrendForce anticipates an increase in buyer purchasing intentions, spurred in part by Samsung's recent foray into production reduction. In particular, module manufacturers and PC OEMs appear to be leading the charge, with total NAND Flash bit shipment volume predicted to rise by 5.2% QoQ.

Read the full press release [here](#).



The amazing DRAM Evolution

It took a couple of years from the filing of the patent to the first DRAM memory. But once the teething problems were overcome, there was no stopping DRAM:

- Capacity has reached up to 32 Gb, which means an improvement by a factor of 32 million.
- The technology moved from 8µm process to sub-20nm.
- Performance increased by a factor of 100 in data access rate (from 60ns 1979 to 0,06 ns in future DDR6) and overall bandwidth scaled to +4800 MT/s today.

And while DRAM technology continues to scale and improve in performance, new technologies try to challenge its position in the sector of memories with fast access time. Still, so far, none of them succeeded and if DRAM successfully manages to move to 3D, then there's no end of its victory in sight. Find out more highlights [here](#).



What is a Process Node?

If you read our DRAM stories, you will have noticed that they mention process nodes a lot in connection with scaling. A process node is a number used to refer to the physical dimensions of a transistor, which manufacturers try to shrink when creating a new process. But like many tech specs, the process node is much more complicated than a simple number that is rarely explained.

Considering that a new process can make a chip smaller, give it a clock speed boost, and make it more efficient, all without making any major changes to design or architecture, it's obvious why processes are so important. However, there's no real reason to estimate a chip's competence based solely on its process. Speed and power efficiency are also important factors. XDA gives an overview of what you need to know about process nodes and what they mean for computer chips.

Read more [here](#).



What's hot in DRAM for Winbond?

Winbond is one of the top 5 memory suppliers globally thanks to its expert capabilities of product design, R&D and manufacturing of customer-driven products. To commemorate the 55th DRAM anniversary, we asked Winbond what's hot in DRAM for them now and what milestones they are proud of.

Did you know that Winbond is an established supplier of Known Good Die? And do you know that Winbond eases 2.5D/3D back-end-of-line (BEOL) assembly with its 3D CUBE as a Service (3DCaaS) platform?

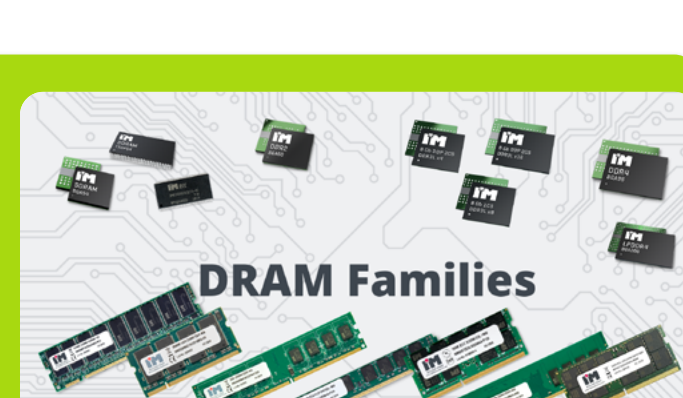
Find out what's hot for Winbond and why [here](#).



Longsys, a Late Entrant that Hit the Ground Running

Longsys entered DRAM comparably late in 2010 but took the market on really quickly. In just a couple of years the Foresee memory brand for industrial usage featured a full product range. And when starting industrial grade DDR3 promotion in 2020, within two years, Foresee had achieved more than 60 Din cases.

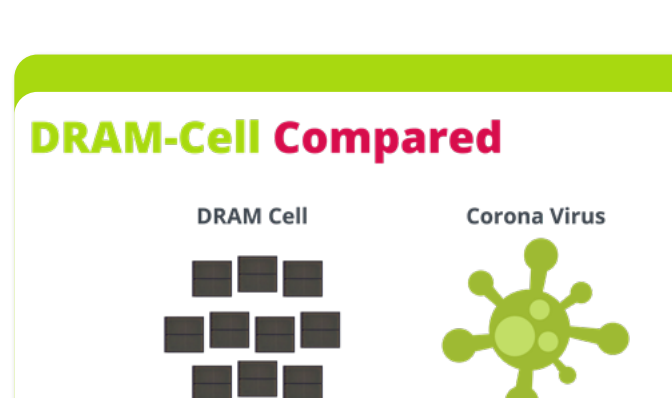
Industrial applications won't easily adopt new DRAM products because of its harsh requirement on reliability, we had successfully verified our industrial grade DDR3 products on kinds of industrial applications which indicated the quality control capability and technical innovation capability of Longsys. Find out more about Longsys and what they have lined up in DRAM [here](#).



Intelligent Memory Dedicated to DRAM for Three Decades

Intelligent Memory was founded in 1991 and started its business with DRAM memory modules. Today it has grown into a fabless memory manufacturer for not only DRAM modules, but also for DRAM components and Flash products. While Intelligent Memory has been creating DRAM memory for over three decades, its success started when it broadened its portfolio to DRAM components and provided a full range of DRAM standard products: SDRAM, DDR, DDR2, DDR3, DDR4, LPDDR4. Apart from the standard DRAM components, IM also offers very unique DRAM components with ECC embedded features as well and was one of the first manufacturer to launch a high-density, DDR3 8Gb full product series. Want to know more?

Read more [here](#).

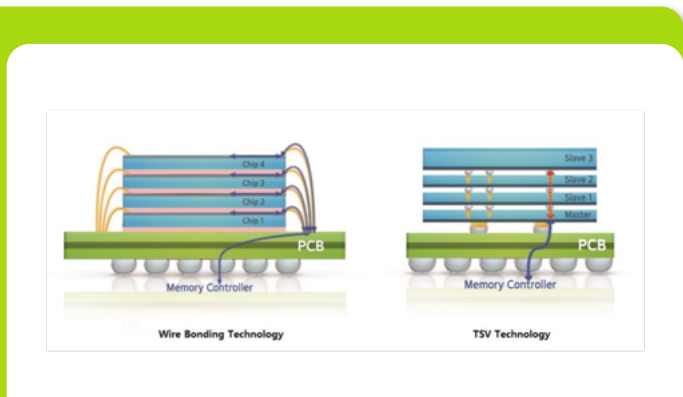


How many DRAMs in a Corona Virus?

Did you know that the first five DRAM generations had a very low yield? This was because the analog behavior of the DRAM cell only started to reveal. While the memory cell itself contains a digital signal (0 or 1), in order to produce a digital signal, an analog signal must be read out, amplified and written back. It has been a long way from the 8000-nm process where assistants would plot the DRAM masks on foils, and then the masks were scaled down to the size needed with a simple camera.

The scaling we have seen in the past years is nothing but amazing. Did you know that with today's processing nodes, you can squeeze 10 DRAM cells in 1 coronavirus?

Read more anecdotes and interesting facts on DRAM [here](#).



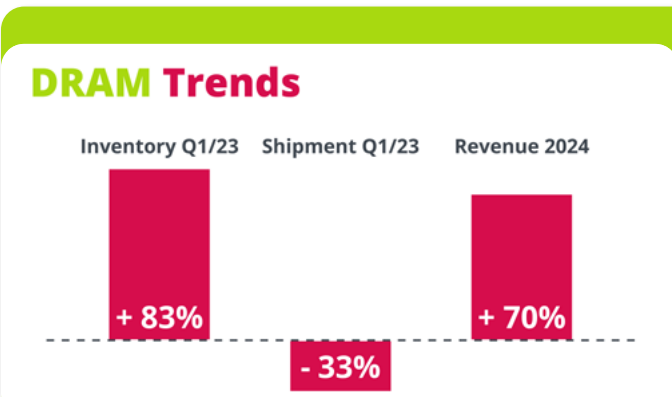
Is 3D DRAM just around the corner?

According to digitimes, SK hynix officials predicted at recent technology symposiums that memory technology will evolve from HBM (high bandwidth memory) to PIM (processing-in-memory) and CIM (computing-in-memory). With the introduction of highly intelligent AI, the amount of data collected and processed will experience explosive growth. To meet this demand, new platforms like 3D DRAM are needed along with innovations in patterning, cell capacitance and low-resistance wiring.

SK hynix 3D DRAM concept of 3D DRAM is similar to that of 3D NAND. While 3D DRAM is still in its early stage of development it expects concrete development directions will emerge in the next 2-3 years.

So let's wait and see. In the meantime, we can provide you with the memory technologies that you need for your current designs.

Read more [here](#).



Get your memory while stockpiles keep prices low

According to The Register, there was a significant drop in revenues for all DRAM manufacturers during the first quarter of 2023 which was largely due to high inventory levels of DDR4 and LPDDR5. In response to this, the major suppliers have implemented production cuts, with utilization of manufacturing capacity expected to fall to 77 percent for Samsung, 74 percent for Micron, and 82 percent for SK hynix.

Buyers should take advantage of falling prices while they can, because the cyclical nature of the semiconductor market and memory, means that demand will pick up again and once those stockpiles are exhausted, prices will start to rise once more. In fact, Garner forecasts that the memory market is likely to "bounce back with a vengeance" predicting that memory companies will enjoy a 70 percent growth in 2024.

Read the full story [here](#) and reach out when you are ready to plan your demand.

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