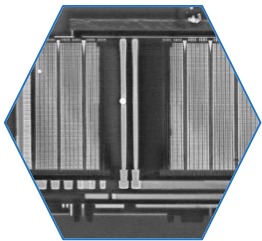
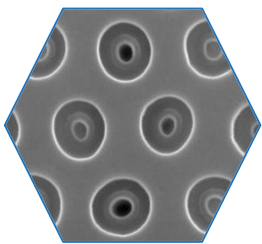


SK hynix 128-Layer NAND Memory

Second-generation PuC 3D NAND memory and cost comparison to 72-layer with periphery on the side.



Title: SK hynix 128-Layer NAND Memory

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The big data era continues to increase the demand for volatile and nonvolatile memories. NAND memory revenue reached \$56 billion US dollars in 2020, and bit growth and demand could drive NAND memory revenue up to \$70 billion US dollars in 2021.

SK hynix is one of the memory manufacturers dominating the NAND flash memory market, and its market share is expected to significantly increase after acquiring Intel's NAND memory business in 2020.

3D-NAND memories have a vertical structure which includes interlayer insulating layers and gate electrodes that alternate with each other. The storage capacity increases as the number of layers stacked through three-dimensional stacking increases. SK hynix's 128-layer, also referred to as the '4D NAND' by SK hynix, uses periphery under cell technology (PuC), wherein the CMOS periphery is built under the NAND array. PuC eliminates the area occupied by the CMOS transistors on the wafer, resulting in higher storage capacity per wafer and reduced bit cost. The die area can also be reduced, allowing SK hynix to provide the industry with smaller, denser dies. The number of layers increases from 96-layer TLC to 128-layer TLC – hence increasing bit productivity per wafer by almost 40%. Periphery under Cell reduces the area occupied by the CMOS transistors on the die, and this technology combined with

stacking 128 wordlines increased bit density by ~79% -- compared to periphery on the side with 72 wordlines, which reduced silicon die area by 40%.

This report includes a complete physical analysis of the memory package, accompanied by high-resolution TEM and SEM images of the die cross-section, and top view of the memory channel holes. Also included is the manufacturing process of the 128-layer NAND memory and the final assembly, as well as a cost analysis and price estimation of SK hynix's second-generation PuC NAND memory. Lastly, this report features a comparison that highlights the similarities and differences between the new PuC 128-layer NAND memory and the 72-layer NAND that uses periphery on the side NAND memory.

COMPLETE TEARDOWN WITH

- Detailed photos
- Precise measurements
- TEM cross-sections
- Materials analysis
- Manufacturing process flow
- Supply chain evaluation
- Manufacturing cost analysis
- Comparison of SK hynix 128-layer PuC 3D NAND to SK hynix 72-layer with periphery on the side 3D NAND

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AUTHOR



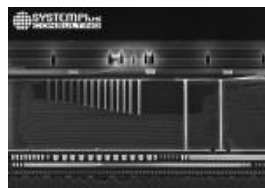
Belinda Dube is working for System Plus Consulting as an Engineer & Analyst, Semiconductor Memories. Belinda is also engaged in the development of reverse engineering & costing analyses with the power electronics and compound semiconductors team.

RELATED ANALYSES



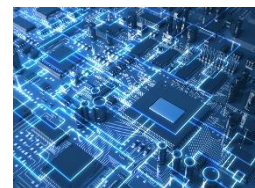
YMTC's 3D-NAND Flash Memory

Technology and cost analysis of YMTC's 64-layer 3D NAND with hybrid bonding.
July 2020



3D NAND Memory Comparison 2019

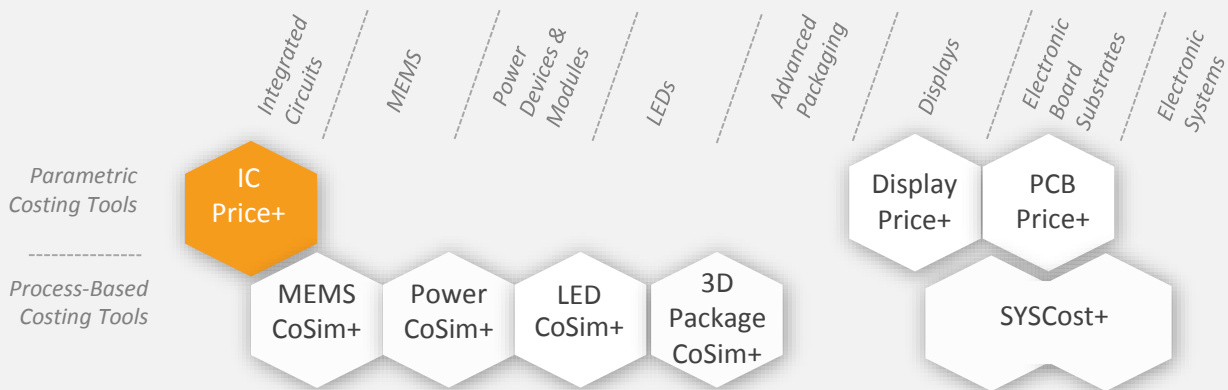
Complete technology and cost analysis of 3D NAND memories from Toshiba/SanDisk, Samsung, SK Hynix and Micron.
December 2019



Status of the Memory Industry 2021

NAND consolidation, China's bet on two key players, the rise of the CXL interface: as the memory business narrows, the market keeps growing and is poised to exceed \$200B in 2026.
June 2021

COSTING TOOLS



Our analysis is performed with our costing tool IC Price+.

System Plus Consulting offers powerful costing tools to evaluate the production cost and selling price from single chip to complex structures.

IC Price+

The tool performs the necessary cost simulation of any Integrated Circuit: ASICs, microcontrollers, DSP, memories, smartpower...

ABOUT SYSTEM PLUS CONSULTING

WHAT IS A REVERSE COSTING®?

Reverse Costing® is the process of disassembling a device (or a system) in order to identify its technology and calculate its manufacturing cost, using in-house models and tools.



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TERMS AND CONDITIONS OF SALES

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The present terms and conditions apply to the offers, sales and deliveries of services managed by System Plus Consulting except in the case of a particular written agreement.

Buyer must note that placing an order means an agreement without any restriction with these terms and conditions.

2. PRICES

Prices of the purchased services are those which are in force on the date the order is placed. Prices are in Euros and worked out without taxes. Consequently, the taxes and possible added costs agreed when the order is placed will be charged on these initial prices.

System Plus Consulting may change its prices whenever the company thinks it necessary. However, the company commits itself in invoicing at the prices in force on the date the order is placed.

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System Plus Consulting delivered services are to be paid within 30 days end of month by bank transfer except in the case of a particular written agreement.

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