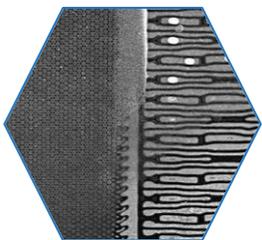
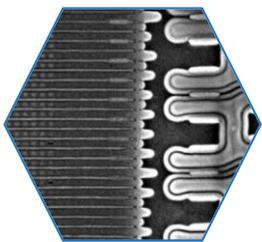
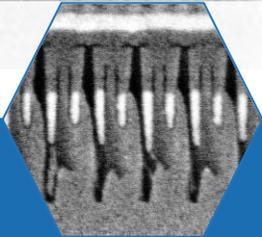


Samsung 16Gb LPDDR5 1z DRAM Memory

Analysis of Samsung's 16Gb low-power DRAM memory using 10nm-class technology (1z generation).



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DRAM revenue is estimated to grow by 43% in 2021, owing to an increase in DRAM prices. Moreover, the price of DRAM memory is expected to increase by 16.2% in 2021 compared to 2020. Samsung Electronics, the world leader in advanced memory technology, dominated the DRAM market with a 44% share in Q3 2021.

Samsung's highest-density (Gb/die) LPDDR5 memory die, with a capacity of 16Gb and built on Samsung's third-generation 10nm-class (1z) process, is analyzed in this report. Samsung is the first DRAM manufacturer to use EUV in DRAM memory manufacturing. EUV technology reduces some difficulties associated with DRAM cell scaling. EUV lithography eliminates multiple patterning in the manufacturing process, resulting in reduced manufacturing time and improved and accurate patterning. Also, high yields and higher-volume manufacturing are experienced when EUV lithography is applied.

The 1z LPDDR5 memory has up to 20% power reduction for improved device battery life, and it is 1.5x faster than the previous LPDDR4X. Samsung's K3LK7K7OBM LPDDR5 16Gb memory dies use a thin silicon substrate – only four dies are integrated in the 8GB package. The 1z generation produces 15% more memory capacity per 300mm wafer, compared to Samsung's 1y LPDDR5 generation. Furthermore, 1z technology allows Samsung to increase its manufacturing productivity. It is estimated that Samsung's DRAM memory using 1z process node will be its predominant node in 2022 and 2023.

This report analyzes the Samsung K3LK7K7OBM LPDDR5 memory used in today's flagship mobile devices, including the SAMSUNG Galaxy S21 5G, OnePlus 9 Pro 5G, and SAMSUNG Galaxy S21+ 5G(international version). Details on package teardown include the package X-ray and cross-section, which reveals the die placement and package opening. Also included in this report is a full analysis of the die, accompanied by optical and high-resolution SEM images of the memory die cross-section that identifies the die placement, the CMOS region, the capacitors, and the metal layers. Also furnished is the manufacturing process of the DRAM memory and the DRAM cost analysis. Finally, this report briefly compares Samsung's 1y 12Gb LPDDR5 to Samsung's 1z 16Gb LPDDR5.

COMPLETE TEARDOWN WITH:

- Detailed photos
- Precise measurements
- Materials analysis
- Manufacturing process flow
- Supply chain evaluation
- Manufacturing cost analysis
- Comparison of 1y and 1z Samsung LPDDR5 memory

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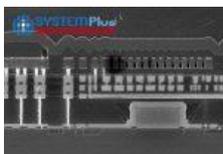


Belinda Dube is working for System Plus Consulting as an Engineer & Analyst, Semiconductor Memories, especially DRAM and 3D NAND flash memory. At the same time, she also investigates IC technologies as well as advanced packaging. Belinda is also engaged in the development of reverse engineering & costing analyses with the power electronics and compound semiconductors team.



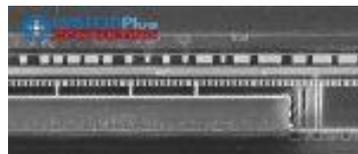
Véronique Le Troadec has joined System Plus Consulting as a laboratory engineer. Coming from Atmel Nantes, she has extensive knowledge in failure analysis of components and in deprocessing of integrated circuits.

RELATED ANALYSES



Samsung LPDDR5 12GB Mobile Memory

In-depth physical and cost analysis of Samsung's '1y-nm' low power DRAM.
August 2020



Micron LPDDR5 12GB Mobile Memory

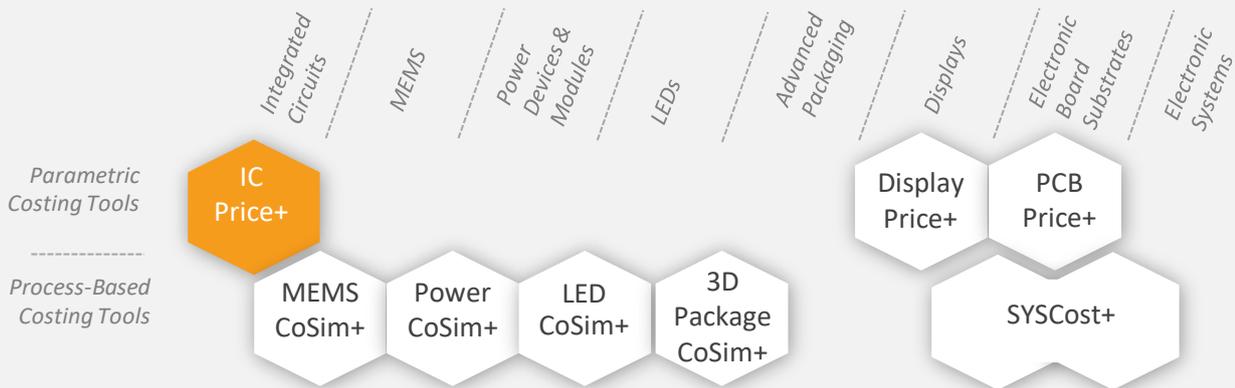
Physical and cost analysis of Micron's fifth-generation low-power DRAM memory.
October 2020



DRAM Quarterly Market Monitor

The DRAM rocket ship is fueled up and ready for blast off to reach 120B\$ by 2022 due to limited supply coupled with resurgent demand.
September 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.

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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.



CONTACTS

Headquarters
22, bd Benoni Goullin
Nantes Biotech
44200 Nantes
France
+33 2 40 18 09 16
sales@systemplus.fr

Europe Sales Office
Lizzie LEVENEZ
Frankfurt am Main
Germany
+49 151 23 54 41 82
lizzie.levenez@yole.fr

America Sales Office
Hal LEVY
Western USA & Canada
+1 408 334 0554
hal.levy@yole.fr

Chris YOUMAN
Eastern USA & Canada
+1 919-607-9839
chris.youman@yole.fr

Asia Sales Office
Takashi ONOZAWA
Japan & Rest of Asia
+81 80 4371 4887
onozawa@yole.fr

Mavis WANG
Greater China
TW +886 979 336 809
CN +8613661566824
wang@yole.fr

Peter OK
Korea
+82 10 4089 0233
peter.ok@yole.fr

System Plus Consulting is specialized in the cost analysis of electronics from semiconductor devices to electronic systems.

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- **COSTING SERVICES**
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TERMS AND CONDITIONS OF SALES

1. INTRODUCTION

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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The quoted prices already include the rebates and discounts that System Plus Consulting could have granted according to the number of orders placed by the Buyer, or other specific conditions. No discount is granted in case of early payment.

4. TERMS OF PAYMENT

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.

If the payment does not reach System Plus Consulting on the deadline, the Buyer has to pay System Plus Consulting a penalty for late payment the amount of which is three times the legal interest rate. The legal interest rate is the current one on the delivery date. This penalty is worked out on the unpaid invoice amount, starting from the invoice deadline. This penalty is sent without previous notice.

When payment terms are over 30 days end of month, the Buyer has to pay a deposit which amount is 10% of the total invoice amount when placing his order.

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System Plus Consulting remains sole owner of the delivered services until total payment of the invoice.

6. DELIVERIES

The delivery schedule on the purchase order is given for information only and cannot be strictly guaranteed. Consequently any reasonable delay in the delivery of services will not allow the buyer to claim for damages or to cancel the order.

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The transport costs and risks are fully born by the Buyer. Should the customer wish to ensure the goods against lost or damage on the base of their real value, he must imperatively point it out to System Plus Consulting when the shipment takes place. Without any specific requirement, insurance terms for the return of goods will be the carrier current ones (reimbursement based on good weight instead of the real value).

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System Plus Consulting responsibility will not be involved in non execution or late delivery of one of its duties described in the current terms and conditions if these are the result of a force majeure case. Therefore, the force majeure includes all external event unpredictable and irresistible as defined by the article 1148 of the French Code Civil?

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As a rule, all information handed by customers to system Plus Consulting are considered as strictly confidential.

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The Buyer is responsible for the use and interpretations he makes of the reports delivered by System Plus Consulting. Consequently, System Plus Consulting responsibility can in no case be called into question for any direct or indirect damage, financial or otherwise, that may result from the use of the results of our analysis or results obtained using one of our costing tools.

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