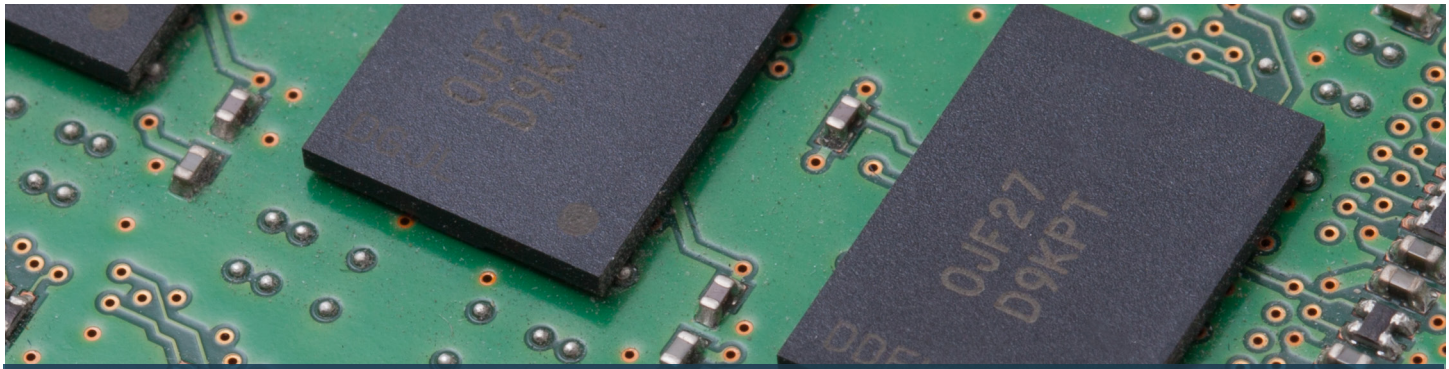


COMPUTER MEMORY

CURRENT TRENDS

- Remote work and education drove high demand for notebook computers, fueling growth of the dynamic random-access memory (DRAM) market in early 2021. DRAM suppliers exceeded shipment volume expectations despite frequent shortages of other electronic components,
- Automotive and data center industries have adopted solid-state drives (SSDs) using NAND flash storage, a non-volatile storage that does not require power to retain data. SSDs are the current standard for laptops and other mobile devices as well.
- Remote work and education fueled demand for notebook SSDs, increasing global NAND flash revenues in Q1 2021 and offsetting reduced NAND flash demand from the server and data center markets.
- The COVID-19 pandemic caused swings in demand, resulting in a shortage of DRAM, NAND and other semiconductor chips. The shortage, expected to last through the end of 2021, will increase costs for original equipment manufacturers and consumers.

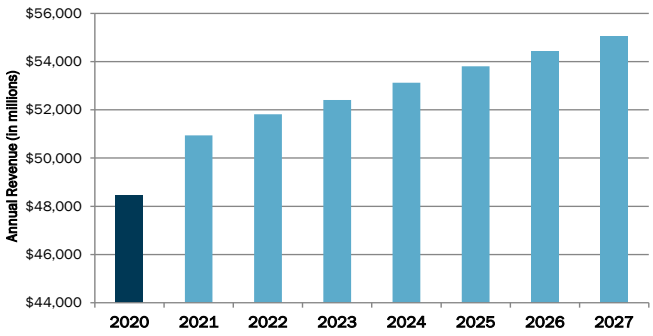
PROJECTED VALUES
(12-MONTH OUTLOOK)

APPROXIMATE NET RECOVERY ON COST

50-70%

finished chips and modules

U.S SEMICONDUCTOR & CIRCUIT MANUFACTURING
REVENUE AND FORECAST



Source: IBISWorld

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DRAM AND NAND MARKET GROWTH: Computer memory consists primarily of dynamic random-access memory (DRAM), which is used for temporary storage in personal computers, servers and mobile devices, and NAND flash, which is used for permanent storage in mobile devices. Solid-state drives (SSDs) using NAND flash have largely replaced hard drives in personal computers and servers due to their significantly faster access speed. Most of these products are bought and sold on the secondary market for a relatively high percentage of cost.

Remote work and education drove high demand for notebook computers, fueling growth of the DRAM market in early 2021. DRAM suppliers exceeded shipment volume expectations despite frequent shortages of other electronic components.

The NAND flash memory market rebounded by 4.6% over the previous year in Q1 2021, totaling revenues of $15.3 billion. Bit shipment increased by 12% for the same period, per data from global research firm Counterpoint Technology Market Research.

Research firm TrendForce predicts DRAM revenue for Q2 2021 will increase by more than 20% over the previous year. Contributing factors include a significant increase in average selling prices in Q1 and increased shipments. The firm also expects the DRAM market to fall 2.4% in 2021 over 2020, reflecting strong demand from cloud service providers for server DRAM, offset by weak demand and falling prices from the smartphone market.

The COVID-19 pandemic caused swings in demand, resulting in a shortage of DRAM, NAND, and other semiconductor chips. The shortage, expected to last through the end of 2021, will increase costs for original equipment manufacturers and consumers.

ONGOING VOLATILITY IN PRICING: Markets for DRAM and to a slightly lesser extent, NAND, see extreme volatility because of product commodification and fluctuations in demand. Lack of differentiation between manufacturers' products creates competition in both price and availability.

Prices and values decrease when availability is high; they stabilize and may increase when availability is scarce.

SSD MARKET GROWTH CONTINUES: SSDs using NAND flash storage are the current standard for laptops and other mobile devices. The automotive and data center industries, among others, are also adopting this standard. Remote work and education-fueled demand for notebook SSDs, increasing global NAND flash revenues in Q1 2021 and offsetting reduced NAND flash demand from the server and data center markets.

According to a newly published forecast of the market, the International Data Corporation is expecting an increase in worldwide solid-state drive revenue and shipments over the next four years.

The International Data Corporation expects SSD unit shipments to grow at a compound annual growth rate (CAGR) of 7.8%, and revenues are slated to increase at a CAGR of 9.2% from 2021 through 2025. As a result, the market will reach $51.5 billion in revenue by 2025, per IDC projections.

Advancements in technology have increased the need for larger and faster SSDs. Experts suggest SSDs may replace hard disk drives in data centers within the next decade as they offer greater computing power for big data and fewer limitations than hard disk drives.

Additionally, consumer demand continues to rise for smarter technology in mobile phones, automobiles, wireless applications and appliances, all of which require SSDs. However, increased demand may exceed NAND supply, which could result in an increase in SSD pricing of 10% to 30% by the end of 2021 based on data and analysis by MarketWatch.

EQUIPMENT IS VALUABLE: DRAM and NAND flash chip manufacturers represent a subset of the semiconductor industry. The semiconductor tool secondary market is significant, though the majority of DRAM and NAND flash chips are manufactured in Asia.

Module manufacturing consists of printed circuit board assembly (PCBA) lines, which typically include screen printers, high-speed chip placement machines, reflow ovens and automated optical inspection stations. PCBA lines are commonly found in U.S. electronics manufacturing. PCBA equipment offers a long useful life with a strong market for legacy equipment in developing countries.

The Expert: Paul Smith

Paul Smith specializes in the appraisal of high technology machinery and equipment and inventory for Gordon Brothers. His experience includes the valuation of equipment and inventory of manufacturers and resellers of computer memory, server and network equipment and solar power equipment. Read his full bio here.

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