

Flash Memory Component Forecast:

2Q 2008

Report Number

CS200CF2-28

Executive Summary

'To everything there is a season; a time to build, a time to buy, a time to wait, a time to invest' is a rough recap of the theme of the Flash market. The downswing cycle is now upon us. As DRAM has succumbed to 'build-bust' memory cycles for decades, Flash is facing similar challenges in 2008 and 2009. Flash has become the technology leader, the bit growth leader, and soon the revenue leader for all the memory markets. As the perceived leader in the industry, can Flash pursue its own destiny or will it suffer continued pressure from investors during downturns as DRAM has for decades?

Although, the U.S. economy, the electronics market, and the semiconductor industry are facing selective fallout from potential domestic recession, long term effects are still unknown. In terms of the global economy, escalating energy prices and the credit crisis that emerged from the 'sub-prime' mortgage and housing market bust, coupled with adjusting mortgage rates, tighter lending and potential global recession, has definitely affected disposable income; first in the U.S. and rippling out internationally. Even if America does avoid a recession, how far has the American economy fallen behind in relation to the incredible growth of markets in Europe, Asia and even Latin America?

In the past, the Flash market was dependent on, and in a small degree, could be linked to the American economy. Flash is now expanding beyond its American base and the future depends on being highly interdependent on other markets and the world economy to sustain growth. The following disconnect will likely happen. Most companies are losing money on current production so they will shut down the older 8" or 200mm fabs, reduce operating expenses and cut back or postpone future Fab expansion; as they cannot raise enough capital for these long term investments. This limitation on production expansion may save the smaller companies over the next few months; others may go under or be bought. As most applications are expected to increase their use of Flash in the next few years, especially in 2010 and beyond, it does not appear that the manufacturers will have invested enough capital to expand production to meet this increased demand.

In 1Q 2008, MLC NAND Flash prices have declined approximately 40-50% since Apple reduced its orders and the NAND vendors were left with too much inventory. 2Q prices continued downward, although at not as steep of a curve as 1Q. Some of this excess was consumed by large OEMs that are 'buying ahead' at reduced prices and Samsung, Hynix, and Micron began assembling larger volumes of their own branded Flash cards instead of selling components below cost. Today's dilemma is that it is too expensive for many manufacturers to reduce production and then not be able to ramp it up once new demand appears, nor is it viable to produce product and then sell it at prices that cover only half your cost.

In terms of creating additional demand for Flash that will likely hit the market in the second half of 2008, there are a few devices that could make an impact. For the long term, Apple has placed its marketing vision and bets on NAND. Full market adoption of affordable SSDs for notebooks will come once the MLC NAND version of SSDs begin shipping in 32GB, 64GB, 128GB, and maybe 256GB capacities during the second half of the year. DRAM has hopes to make a rebound in 2009 as users begin to finally upgrade their Windows operating system to Vista and add more DRAM to their PCs. Looking forward into 2008 and beyond, what drivers and inhibitors will depict an accurate growth rate for Flash in both memory and storage? For the memory or NOR Flash market, the driver for low density NOR applications like HDDs, DVD, Bluetooth, modems, PC BIOS, and monitors will rapidly shift usage from parallel interfaced Flash to serial Flash.

The Flash market is currently forecast to have negative growth in 2008 and then modified growth through 2013, with a percentage growth rate that starts in the teens in 2009 and then oscillates in the remaining years to the thirties and back to single digits. This rejuvenated demand should result in a healthy revenue growth through 2013 producing Flash Revenue Compound Annual Growth Rate (CAGR) of 17.8% whereby 2013 Flash revenues should generate \$55.2 billion.

Analysis and Reporting Methodology

The Flash Memory Component Forecast – quarterly for 2Q 2008 provides revenue, units, and Average Selling Prices (ASP) by density for NOR, MLC NOR, Serial NOR, EcoRAM, Combo (Flash + xRAM) NOR, Combo NAND, NAND, and MLC NAND Flash. Quarterly forecasts by density are presented for 2007, 2008, and 2009, while annual forecasts extend from 2006 through 2013. Pricing for Flash Components is listed by density, voltage, organization, and read access speed.

Web-Feet Research (WFR) utilizes three levels of research in this report. Flash memory manufacturers were surveyed to obtain their respective Flash component OEM, distributor, and large contract prices. Each supplier's input was consolidated and averaged with the other manufacturer reported prices. The quarterly Flash memory market forecast was compared with the Semiconductor Industry Association/World Semiconductor Trade Statistics (SIA/WSTS) bluebook totals for the 1Q – 2Q 2008 revenue and unit breakouts by density for Flash components only.

For the quarterly and annual forecasts, Web-Feet Research uses the Flash Memory Reporting Association (FMRA) Flash component and Flash combo (Flash + xRAM) device shipments. Each of the Flash manufacturers were asked to provide Flash component and Flash combo revenue and units by each density and segmented into NOR and NAND categories. The main purpose in establishing the FMRA is to provide the Flash industry with more accurate and detailed Flash reporting in covering all densities of Flash (256Kbit-32Gbit), segmenting the Flash into NOR and NAND markets, and listing separately the Flash combo shipments.

The FMRA results are compiled from seventeen of the top Flash vendors and identify the Flash revenue by each density and type of Flash as well as the Flash Combo revenue. In 2Q 2008, the number of manufacturers consolidated, with the finalization of the merger of Intel (NOR) and STMicroelectronics Flash division in forming Numonyx occurred on March 28, 2008. Although, the two companies were separate for 1Q they will be treated as one entity in terms of actual shipments for all of 2008. Although Qimonda exited the market in 2006, any leftover inventory sold in 2008 is listed in the Other category. Powerchip Semiconductor Corporation (PSC) is selling their own product separate from their obligated shipments to Renesas, so they have been added to the list of Flash vendors. A small amount of Flash NROM component shipments arose from the (Saifun) now Spansion and SMIC production relationship, which is sold through SMIC in China in 2008.

In terms of methodology, WFR has added a chapter on Bit shipments to show the size of the demand forecast in terms of NOR and NAND Mbits. This demand calculation can then be compared to the production capacity calculation that is also forecast by Web-Feet Research in its Flash Memory Production Capacity Forecast studies.

Table of Contents

Table of Contents	iii	6. Flash Unit Shipment	
List of Figures	iv	Forecasts	41
List of Tables	v	6.1. Flash Unit Shipments by	
1. Executive Summary	1	Density	43
2. Methodology	6	7. Flash Average Selling Prices	51
3. Flash Memory Market		(ASPs)	
Forecast	8	7.1. Flash ASPs by Density	54
4. Flash Memory Reporting		8. Flash Megabit Shipments	60
Association	18	(Mbit)	
4.1. FMRA Quarterly Rankings	25	8.1. Flash Mbits by Density	61
5. Flash Revenue Forecasts	28	9. Appendix A	65
		10. Appendix B: Biography	78
5.1. Flash Revenue Shipments by			
Density	32	11. Appendix C: About WFR	79

About Web-Feet Research

Web-Feet Research (WFR) is a professional services organization that assists clients in the semiconductor, electronics and finance industries build value, solve complex business problems, and enhance their ability to improve performance.

The company has consistently identified the emerging trends in the electronics industry and has been the first to forecast their impact in the Flash and nonvolatile memory markets since its inception in 2000. Some of WFR's firsts are in the following areas: SSD, Flash cache/Hybrid Flash, Embedded Flash Drives, Ultra Low Cost PC, Mobile storage, MP3, NAND MCP, USB Drives, Flash SIM cards, micro Flash cards, and serial NOR Flash.

The company offers a full complement of technology consulting services, management consulting services and market research for nonvolatile memory, solid state storage technologies and mobile hard disk drive products. Special emphasis has been focused on the development and growth of Flash memory, Flash cards and SSD markets.

The subscription services offered by Web-Feet Research concentrate on the Non-Volatile Memory and Storage Portfolio, which is segmented into three services: Manufacturing / Technology, Storage Systems, and Memory Components.

The company also organizes annual public and on-site presentations, the NVM conferences, which supplement the consulting and research services. These conferences focus on technology evolution, product development, storage markets and industry / economic trends.

Web-Feet Research also provides custom studies, technology evaluation and competitive analyses of mobile, portable and stationary technologies, products and industry trends. The professional services and syndicated studies give Web-Feet Research, its clients and its clients' clients a competitive edge in their respective markets.