

## Flash Memory Component Forecast:

**4Q 2008-1Q 2009**

*Report Number*

*CS200CF4-28/CF1-29*

**Web-Feet Research, Inc.**

## *Key Findings*

The beauty about Flash memory is its capability to be reprogrammed. Understandably it is not so easy to reprogram the Flash market itself. Although, at the end of first quarter 2009 we are seeing a type of resetting of the semiconductor industry and maybe the economy as it begins the climb back to recovery. In the last few months there has been too much 'doom and gloom' as the memory market went through its worst market downturn ever, and the world economy suffered from the most widespread financial upheaval since the 'Great Depression' of the 1920's. By dwelling on the negatives of the financial crisis and its impact on the world economies and memory markets it becomes difficult to see whether our 'down' perceptions are self fulfilling and prolonging the 'Great Recession' or if the restructuring of flawed markets is occurring and the market is beginning its rebound. Although, DRAM has experienced 'boom-bust' memory cycles for decades, Flash is now facing these similar patterns, but compounded.

Currently, the Flash market is in the process of resetting itself by reducing supply, which has resulted in increasing prices but even if the Flash market positions itself for a recovery will it come. With consumers reacting to the poor economy, they have been saving and are not buying much, so with the news that the market has hit bottom will the consumers trust it and begin to consume again. And when they start again are consumers resetting their own consumption patterns at a lower or different pattern than before. As consumers return to the market will they buy enough Flash to sustain Flash production this year and in the next couple of years will the Flash market be able to react to the new market applications and be able to produce enough.

In 1Q 2009, NAND Flash prices have increased approximately 40-90% since the manufacturers reduced production and inventory. 2Q prices are continuing to climb upward, although this is mainly spot and less contract, but the increase is less than in 1Q. Expectations are that this supply-demand reset business model will continue for the rest of 2009 and into 2010. Under normal circumstances this market rebalancing should self correct. As manufacturers cut back on production, supply is reduced and then as normal demand returns there is less inventory, and prices would increase. Today's dilemma is that manufacturers were caught in producing too much inventory that was selling below cost so they reduced production and are monitoring how much inventory can be released to be just below the new demand requirements. Therefore, the hope for the manufacturers is for market demand to return gradually, while they try to cover their fixed costs at reduced volumes. This recovery scenario is predicated on being able to hold prices relatively flat, maintaining just enough supply, demand returning and recovering financially in a couple of years.

Looking further out beyond next year, Toshiba and SanDisk believe that adding additional bits, using 3-bit/cell and 4-bit/cell NAND technology, will be enough to satisfy the current and future demand requirements. Adding more bits per cell is one of four methods and the least expensive to increase overall bit production. Using 3b/c and 4b/c NAND is viable in storing media files that need minimal read, write, endurance, and

retention to safeguard the content. High performance applications related to computing and high speed video transfers as well as other high performance applications are not well suited for the low speed and low endurance of 3b/c and 4b/c NAND. Consequently, even with the shift in manufacturing of high volumes of 3b/c and 4b/c NAND there will still be so much demand for computing applications needing 1b/c and 2b/c that current manufacturers cannot produce enough without more capex coming on-line in the early part of the next decade. This capex investment would add more fab lines and continue the process geometry shrinks to make larger die at a high cost. Unfortunately, only Samsung and Toshiba/SanDisk have the financial resources to invest in additional fab lines and that may not be enough.

If the current manufacturers do not increase capex in 2010 and beyond, then they will extend the process geometry for a couple of more years until 2012 or 2013 before migrating to 2xnm. Flash production will have to be allocated in order to produce enough parts at 1-b/c and 2-b/c as well as a means to maintain margins.

The Flash market is currently forecast to have negative growth in 2009 and then modified growth through 2015, with a percentage growth rate that starts in single digits to the twenties as it oscillates in the remaining years. Hopefully, 2009 is the year of bottoming out where consumers can retrench and start over. Whether they will continue to buy throughout the next year even in the midst of the 'Great recession' will make the difference in stimulating enough demand to rejuvenate the semiconductor markets. This revitalized demand should result in a gradual revenue growth through 2015 producing Flash Revenue Compound Annual Growth Rate (CAGR) of 12.7% whereby 2015 Flash revenues should generate \$36.1 billion.

## *Analysis and Reporting Methodology*

The Flash Memory Component Forecast – quarterly for 4Q 2008/1Q 2009 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 2007 through 2015. The Flash units forecast were compiled and modified from the Flash Applications and Markets bottoms up forecast and latter based on supplier inputs, while the pricing has been adjusted quarterly.

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 – 4Q 2008 revenue and unit breakouts by density for Flash components only. Next quarter, the quarterly Flash memory market forecast will be based on 2009 shipments and forecast by quarter.

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 31, 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. 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 Spansion and SMIC production relationship, which is sold through SMIC in China in 2008.

## *Table of Contents*

Table of Contents	iii	5.1.	Flash Revenue Shipments by Density	35	
List of Figures	iv	6.	Flash Unit Shipment Forecasts	43	
List of Tables	v	6.1.	Flash Unit Shipments by Density	45	
1.	Executive Summary	1	7.	Flash Average Selling Prices (ASPs)	53
2.	Methodology	7	7.1.	Flash ASPs by Density	56
3.	Flash Memory Market Forecast	9	8.	Flash Megabit Shipments (Mbit)	62
4.	Flash Memory Reporting Association	19	8.1.	Flash Mbits by Density	64
4.1.	FMRA Quarterly Rankings	26	9.	Appendix A	68
5.	Flash Revenue Forecasts	30	10.	Appendix B: Biography	81
			11.	Appendix C: About WFR	82

### *About Web-Feet Research*

**Web-Feet Research (WFR)** 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 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, 3-bit/4-bit per cell NAND, serial NOR Flash and Storage Class Memories.

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.



**Web-Feet Research, Inc.**