Utilizing the Page Mode Am29PDS32x for Maximum Performance

Application Note

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The following document refers to Spansion memory products that are now offered by both Advanced Micro Devices and Fujitsu. Although the document is marked with the name of the company that originally developed the specification, these products will be offered to customers of both AMD and Fujitsu.

Continuity of Specifications

There is no change to this document as a result of offering the device as a Spansion product. Any changes that have been made are the result of normal documentation improvements and are noted in the document revision summary, where supported. Future routine revisions will occur when appropriate, and changes will be noted in a revision summary.

Continuity of Ordering Part Numbers

AMD and Fujitsu continue to support existing part numbers beginning with "Am" and "MBM". To order these products, please use only the Ordering Part Numbers listed in this document.

For More Information

Please contact your local AMD or Fujitsu sales office for additional information about Spansion memory solutions.

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Note: *This application note assumes that you have either read AMD's "Understanding Page Mode Flash Memory Devices" application note, or have a solid knowledge base of Page Mode devices.*

Advanced Micro Devices currently has a wide variety of flash memory devices to support several different market segments. Many new applications need high-speed access, high density, and are migrating to lower voltages to save power. But, higher density and lower voltage tend to reduce performance in a standard random access memory architecture. Therefore, AMD is using different architectural approaches to increasing performance in several new Flash memories. The Am29PDS32x Page Mode flash device provides the total solution for a low power, low voltage, high performance system.

FEATURES OF THE Am29PDS32x DEVICE

The Am29PDS32x is a 16-bit wide device that provides fast access times and software flexibility, while at the same time consuming less power than other flash devices. Here is a list of some of the device's features:

- **Page Mode Operation**
  - Same page access times as fast as 45 ns
  - Typical random access times for this device are 115 ns
  - Page sizes of 4 words
- **Dual bank architecture**
  - One 4 Mbit bank, and one 28 Mbit bank (this bank split is for the Am29PDS322)
  - Able to program/erase from one bank while reading from another bank with zero latency
- **Ultra low power consumption(typical values)**
  - 2 mA active read current at 1 MHz
  - 16 mA active read current at 10 MHz
  - 2.5 mA active intra-Page read at 20 MHz
  - 200 nA in standby or automatic sleep mode

PAGE SIZES

The Am29PDS32x has page sizes of 4 words. The device has a 16-bit wide data bus, and address lines ranging from A20:A0. Address lines A20:A2 define the different pages within the device, while A1:A0 define one of the four words within the page. Table 1 shows how each word is defined.

Table 1. Word Mode

Word	A1	A0
Word 0	0	0
Word 1	0	1
Word 2	1	0
Word 3	1	1

IMPROVED OVERALL ACCESS TIMES

The Am29PDS32x device family can perform both standard, as well as Page Mode read operations. The first random access read from the page has a t_{ACC} of 115 ns, while all subsequent Page Mode read operations have an access time of 45 ns. Obviously, the more the system reads from the same page, the faster the average access time. The less the system reads from the same page, the slower the average access time. In order to obtain optimum performance from this device, the system's program should be structured such that as many consecutive reads as possible are from within the same page. This could involve aligning frequently accessed data structures or loop and jump labels to start on page boundaries.

By looking at an example comparing the Am29PDS322 and a standard flash device, the speed improvement can clearly be seen. Table 2 compares the Am29SL160 device with a random access time of 100 ns, and the Am29PDS322 with a random access time of 115 ns, and a page access time of 45 ns. This example shows the total time for each device to read four consecutive words.

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Table 2. Access Times

Word	Am29SL160	Am29PDS322
0	100 ns	115 ns
1	100 ns	45 ns
2	100 ns	45 ns
3	100 ns	45 ns
Total time	**400 ns**	**250 ns**

As the table clearly shows, the Am29PDS322 performs four read operations 38% faster than the standard flash device.

IMPROVED POWER CONSUMPTION AND ENERGY CONSUMPTION

The Am29PDS32x devices can reduce power in two ways. First, by reducing the time power must be at the higher active read consumption level. Second, by reducing the active read current requirement following the initial access time, such that the average power for a series of page reads is lower. A random access read operation consumes 16 mA at 10 MHz. However, once the page has been initially accessed, each subsequent page read only uses 2.5 mA at 20 MHz.

By looking at an example comparing the Am29PDS322 and a standard flash device, the power consumption difference can clearly be seen. Table 3 compares the Am29SL160 device which consumes 8 mA at 10 MHz for a random access read, and the Am29PDS322 which also consumes 16 mA at 10 MHz for a random access read, but consumes 2.5 mA for an intra-page read. This example shows the average power consumed for each device to read four consecutive words.

Table 3. Average Power Consumed To Read Four Words

Word	Am29SL160	Am29PDS322
0	8 mA	16 mA
1	8 mA	2.5 mA
2	8 mA	2.5 mA
3	8 mA	2.5 mA
Average power	**8 mA**	**5.875 mA**

This table shows that the Page Mode device consumes 27% less power than a standard flash device to read four words.

In addition to the lower average power, the Am29PDS322 is also active for a shorter amount of time. As stated before, the Am29SL160 would have to consume 8 mA for 400 ns, whereas the Am29PDS322 is only active for 250 ns. This means that the Page Mode device consumes less average power, and for a shorter amount of time. This leads to lower energy consumption. Figure 1 compares the power consumption and energy consumption of the Am29SL160 and the Am29PDS322

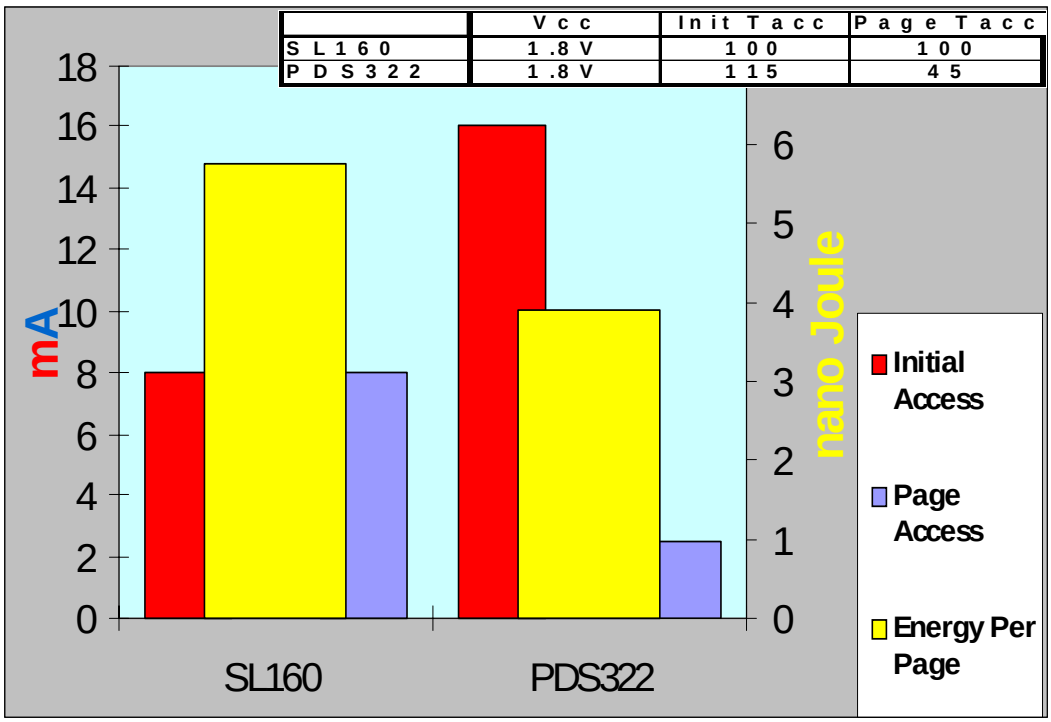

Figure 1. Power and Energy Comparison

The Page Mode device consumes less energy because it consumes less power for a shorter amount of time. The graph shows that the Am29PDS322 consumes 3.9 nJ, while the Am29SL160 consumes 5.8 nJ.

SUMMARY

The Am29PDS32x Page Mode flash memory device was developed to increase system performance in spite of the market demands for higher density and lower voltage, that would otherwise tend to reduce memory performance. Using the Am29PDS32x Page Mode flash memory device correctly will drastically improve system performance while reducing cost and overall power consumption. The Page Mode device performs reads up to 38% faster, consumes up to 27% less power, and uses up to 33% less energy. The Am29PDS32x device is the total solution for low power, low voltage, high performance systems.

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