COMPAQ
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Contents

Reliability and Value of Purchasing Compaq Double Data Rate Memory

Abstract: *This white paper introduces the Compaq Double Data Rate (DDR) processor and its benefits into the Commercial Evo Desktop family. The paper also provides physical and performance comparisons of the DDR memory module to the SDRAM module and the RDRAM module.*

The paper provides background of how memory modules are produced and the key features of these modules that customers should consider before purchasing memory.

This paper is intended to provide that information to customers, vendors, VARs, and Compaq Field Systems Engineers.

Notice

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Introduction

Personal computer (PC)technology continues to evolve as performance demands grow, and system memory technology is no exception. Throughout the history of the PC, memory technology has steadily progressed in capacity and performance to meet the increasing requirements of other PC hardware subsystems and software. In the past, there have been relatively clear industry transitions from one memory technology to its successor. However, today there are multiple choices in memory technology, such as the PC133, RDRAM, and Double Data Rate (DDR) processors.

The road map, as shown in Table 1, offers an overview of the evolution of memory.

Table 1. Memory evolution overview

YEAR INTRODUCED	TECHNOLOGY	SPEED LIMIT
Mid 80s	FPM	50ns
Mid 90s	EDO	50ns
Mid 90s	PC66 SDRAM	66MHz
Late 90s	PC100 SDRAM	100MHz
Late 90s	RDRAM	800MHz
1999/2000	PC133 SRAM	133MHz
2000	DDR SDRAM	266MHz

The evolution to the DDR module has been widely supported by nearly all the industry giants on the memory side, while the industry also turned to the Joint Electron Device Engineering Council (JEDEC) to write the DDR memory module specifications. JEDEC has developed standards on thousands of electronic components in its forty years of existence and ensures industry-standard manufacturing of the DDR memory module.

The DDR memory module is suitable for virtually every segment of the PC market that includes the workstations, and high-performance, low-cost desktops. The DDR module offers the following benefits:

- excellent performance
- high capacity/density
- expected high-availability at a low cost

How does DDR differ from RDRAM and SDRAM?

So what's so new about the DDR module? The physical dimensions of a DDR memory module are identical to those of a standard DIMM — the same length, same pin pitch (spacing), same PCB thickness, and so forth. The difference in the module is in the channel. A standard SDRAM, now referred to as Single Data Rate or SDR, module has two keys, or notches, where there are no pins. The DDR DIMM module has only one key because it packs 16 extra pins into the space of the second channel. Therefore, the DDR module has 184 pins compared to the 168-pin SDRAM module. The new 184-pin module adds new strobes, clocks, and power and ground signals. A key factor in the pin changes means that no existing 168-pin SDRAM module will work in a 184-pin DDR motherboard.

A DDR module has the same number of pins as a 184-pin RDRAM module, however, that is where the similarities end. The two modules are keyed differently, have different pin pitch, and completely different architecture.

Table 2 provides a comparison of the pin count of the SDR, RDRAM, and the DDR processors.

Table 2. Processor pin count

Processor	Pin Count	Length
PC100 / SDR	168	133.4mm
PC133 / SDR	168	133.4mm
PC600 / RDRAM	184	133.4mm
PC800 / RDRAM	184	133.4mm
PC1600 / DDR	184	133.4mm
PC2100 / DDR	184	133.4mm

Note: The logical names for the DDR modules are PC1600 and PC2100, however, the new DDR modules are being called **DDR 200** and **DDR 266**, which are based on discretes rather than the data transfer rates. While some are still referring to the modules based on the transfer rates because those names are intuitive and simple, the correct names are those based on clock speeds.

Theoretical maximum data transfer rates of the PC100, PC133, PC600, PC800, PC1600, and PC2100 processors are provided in Table 3. This comparison indicates that the DDR memory module provides the maximum bandwidth of the existing memory technologies.

Table 3. Processor bandwidth comparison

Processor	Clock Speed (MHz)	Width (bits)	Data Latching	Bandwidth (MB/sec)
PC100 / SDR	100	64	Single-edge	800
PC133 / SDR	133	64	Single-edge	1066
PC600 / RDRAM	300	16	Double-edge	1200
PC800 / RDRAM	400	16	Double-edge	1600
PC1600 / DDR	100	64	Double-edge	1600
PC2100 / DDR	133	64	Double-edge	2100

Another factor that affects the memory module performance is latency, or the time that lapses between when the data is requested and when the first byte of data is ready to be read, as illustrated in Figure 1. The RDRAM module is known for wasting a lot of clock cycles while preparing data for a read operation. Therefore, the RDRAM module has a relatively high latency that slows down overall memory performance, especially when reading small blocks of data from different areas of memory. The PC2100 DDR module has a relatively low latency, thereby, providing overall good memory performance.

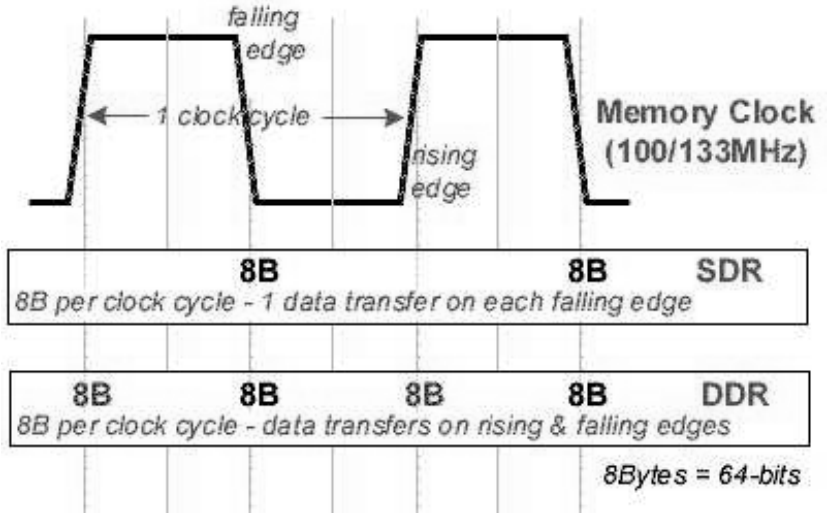

Figure 1: Memory clock performance

What does all this comparative data mean? These comparative testings indicate that the PC2100 DDR memory has superior bandwidth and latency to the RDRAM memory module and double the bandwidth of the PC133 memory module.

Conclusion

Technically, it is truly an evolution of the current SDRAM technology with performance enhancements using a few additional signals. The DDR memory module offers double the bandwidth of the SDRAM memory module with similar latency. The DDR module will leverage the vast existing infrastructure of SDRAM memory processes, which will help speed both industry acceptance and production ramp-up of the DDR module while keeping costs close to SDRAM module.

Why Customers Should Not Risk Using Memory Other Than Compaq

Desktops and workstations memory chip failures can cause desktop system crashes that can result in the permanent loss of business data. With memory failure contributing to costly downtime, customers are demanding higher levels of fault tolerance. Compaq emphasizes the importance of using high-quality memory and, more specifically, using ONLY Compaq memory for Compaq products.

What Key Features Customers Should Consider Before Buying Memory

Regardless of which supplier customers may choose, they should consider the following features before buying memory:

- **Compaq Qualification Procedures** — Prior to purchasing memory modules from a DIMM manufacturer, Compaq qualifies that supplier's module design and manufacturing processes. This qualification procedure involves the following three key parts:
  - Testing modules provided by that supplier on every model of a Compaq desktop or workstation currently shipping (not just each chipset as other resellers do to save money).
  - Ensuring that a sophisticated, rigorous suite of tests has been instituted by the supplier in the manufacturing process to insure continuous quality of the modules. (Due to the cost of conducting these tests, they are usually conducted only on those modules being sold to Compaq, not on all modules produced by that supplier).
  - Re-qualifying every module manufacturer each time Compaq offers a new processor speed or a new platform.

  The result is a continuous process of module manufacturer qualification and re-qualification with the suite of production quality tests being continuously improved.
- **Compaq Testing Procedures** — In addition to the rigorous testing that manufacturers are required to conduct by the Compaq qualification procedures, Compaq performs further testing of memory modules as follows:
  - Every single module that is placed in a desktop or workstation for shipment goes through run-in testing. That module is tested in a Compaq desktop or workstation model in which it will be installed.
  - A Product Integrity Audit (PIA) is conducted on all memory modules placed in option kits. This PIA consists of testing a statistically accurate sampling of modules in all Compaq systems using both standard and maximum memory configurations on those systems.
  - Therefore, Compaq ensures that every module branded a Compaq memory module has passed an extensive series of tests to ensure its quality and reliability to work with all Compaq desktops and workstations. No other reseller has the resources to conduct such extensive testing on Compaq equipment.

- **Impact of Memory on System Warranty** — Compaq's superior testing and certification procedures allow Compaq to offer a three-year pre-failure warranty on Compaq memory, drives, and processors.[1] The Compaq warranty does not cover service or parts damage resulting from the use of non-Compaq brand memory. Only Compaq brand memory has been extensively tested and certified for use in Compaq Desktops and Workstations.
- **Price and Value** — Although Compaq memory is thought of as being more expensive than other memory modules, price is relative to the value of the product. Avoiding system downtime or data loss caused by memory failure and the financial impact such situations cause far outweighs the momentary benefit of paying less for the initial purchase of memory.
- **Single Supplier Convenience** – Compaq offers everything customers need for Compaq systems and verifies that all of these components work together, ensuring the quality of all of its products from beginning to end.

Summary

So why buy Compaq memory?

The main reasons a Compaq customer should buy Compaq-branded memory are:

- The assurance you have the highest quality memory made.
- The reassurance that your memory is qualified and rigorously tested to work on your Desktop and Workstations.
- The peace of mind a Compaq warranty can provide you.
- Only Compaq has the facilities and the procedures to test, verify, and certify memory to Compaq standards.

[1] Certain conditions exist.. Call 1-800-OK COMPAQ for more information.

Appendix A

Table 4. Compaq versus Other Memory Resellers

	Compaq Memory	Other Memory Resellers
Qualification Procedures	Prior to purchasing memory modules from a DIMM manufacturer, Compaq qualifies the manufacturer's module design and manufacturing processes. This qualification procedure involves three key parts: • Testing the modules on all models • Ensuring rigorous tests have been instituted by the supplier • Re-qualifying every module manufacturer The result is a continuous process of module manufacturer qualification and re-qualification with the suite of production quality tests being continuously improved.	Other resellers only test each chipset – not every model – for qualification. These resellers do not have the resources to test on every model.
Testing Procedures	In addition to the rigorous testing manufacturers are required to conduct according to the Compaq qualification procedures, Compaq performs additional testing of the memory modules as follows: • Every module placed in a desktop or workstation for shipment goes through run-in testing. • A Product Integrity Audit (PIA) is conducted on all memory modules going into option kits. These testings allow Compaq to ensure that every module branded a Compaq memory module has passed an extensive series of tests ensuring quality and reliability in all Compaq desktops and workstations.	Other resellers do not have the test equipment or the capability to acquire sufficient combinations of Compaq systems to adequately verify and certify SDRAM memory for Compaq products. Some manufacturers and resellers have component-only testing. This is inadequate to identify randomly occurring memory problems.
Impact of Memory on System Warranty[i]	Due to the superior testing and certification procedures, Compaq is able to offer a three-year pre-failure warranty on Compaq memory, drives, and processors. The Compaq warranty does not cover service or parts damage resulting from the use of non-Compaq brand memory. Only Compaq-brand memory has been extensively tested and certified for use in Compaq desktops or workstations.	Other resellers do not offer a pre-failure warranty on memory. No other company offers such comprehensive warranty coverage as Compaq.
Price and Value	Even though Compaq memory is thought of as more expensive than other memory modules, price is relative to the value of the product. Avoiding PC downtime or data loss caused by memory failure and the financial impact such situations cause far outweighs the momentary benefit of paying less for the initial purchase of memory.	Paying less money at purchase can cost more in the long run from downtime caused by memory failure.
Single Supplier Convenience	Using Compaq as a single supplier, allows customers the ease of mind that Compaq will not only test the desktop or workstations but Compaq also verifies that all of the components work together. This ensures the quality of all Compaq products from beginning to end.	Other resellers do not have the resources or expertise to ensure that their memory is compatible with all configurations of desktops or workstations.

[1]Certain conditions exist. Compaq Insight Manager must be used for Pre-Failure Warranty. Call 1-800-OK COMPAQ for more information.