

# **AMD Athlon™ XP Processor Benchmarking and Model Numbering Methodology**

**Updated for the AMD Athlon™ XP Processor 3200+ Launch**

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## Defining Performance

In 1981 the first x86 PC was offered for sale. As a result of its success, succeeding generations were quickly made available based on ever-higher performing engines: the 286, 386, and 486 microprocessors. With each new generation of processor, end users reaped the benefits of both better processor architectures and higher clock frequencies. Over the past 20 years end users have come to view higher performance (which is difficult to quantify) as being synonymous with higher frequency (which is much easier to quantify).

AMD believes that what people really care about, however, is not the frequency of their processor, but the performance it delivers from their applications. Consider the definition of microprocessor performance:

***Processor Performance = (Work Per Clock Cycle) x (Clock Speed)***

As you can see, while processor frequency contributes to overall CPU performance, it is not the only factor.

So how did frequency come to be the sole indicator of performance to consumers? The answer is simple. The first several generations of PC microprocessors from both AMD and Intel (i.e. the 8086, 286, 386, and 486) were based on the same internal architecture and therefore performed nearly an identical amount of work per clock cycle. As a result, the only variable in the performance equation was frequency; therefore frequency really was the primary determinant of CPU performance.

## Performance and Frequency

With the advent of the AMD Athlon™ processor and the Intel Pentium® 4 processor, the design architectures of these two companies fundamentally diverged. This design divergence has resulted in a difference in work done per clock cycle. Thus, microprocessors operating at identical frequencies may offer dramatically different levels of performance. Consequently, frequency is

no longer the most meaningful metric for judging relative microprocessor performance. Today's end users need a better approach for comparing relative processor performance. This new approach must recognize that end users:

- Care about the performance of the applications that they use and care less about the results of synthetic tests.
- Typically use a variety of application software.
- Care about the performance of the system that they purchase.
- Need the ability to easily and simply conduct comparative shopping.

AMD is driving the True Performance Initiative (TPI)—a strategic initiative with industry leaders and consumer advocates to develop a reliable processor performance metric that PC users can trust.

## **Benchmarking Methodology**

AMD is committed to accurately indicating the application performance of our processors, and has assembled a suite of industry standard benchmarks and applications that we believe reflect typical end user applications.

Specifically, AMD has identified three usage models which we believe best exemplify the commercial and consumer end user PC experience: Office Productivity, Digital Media, and 3DGaming. The following benchmarks and applications are used to represent these end user experiences:

**Office Productivity***Business Winstone™ 2001*

Microsoft® Office 2000 (Access, Excel, Frontpage, PowerPoint, Word),  
Microsoft Project 98, Lotus Notes R5, NicoMak WinZip, Norton AntiVirus,  
Netscape Communicator

*SYSmark™ 2001, Office Productivity*

Microsoft Office 2000 (Access, Excel, Outlook, PowerPoint, Word),  
Netscape Communicator 6.0, Dragon Naturally Speaking Preferred v.5,  
WinZip 8.0, McAfee VirusScan 5.13

**Digital Media***Content Creation Winstone™ 2001*

Adobe® Photoshop® 5.5, Adobe Premiere 5.1, Macromedia Director  
8.0, Macromedia Dreamweaver 3.0, Netscape Navigator 4.73, Sonic Foundry  
Sound Forge 4.5

*Content Creation Winstone™ 2002*

Adobe Photoshop 6.01, Adobe Premiere 6.0, Macromedia Director 8.5,  
Macromedia Dreamweaver UltraDev 4, Microsoft Windows Media Encoder  
7.01.00.3055, Netscape Navigator 6/6.01, Sonic Foundry Sound Forge 5.0c

*SYSmark2001, Internet Content Creation*

Adobe Photoshop 6.0, Adobe Premiere 6.0, Macromedia Dreamweaver  
4.0, Macromedia Flash 5, Microsoft Windows Media Encoder 7

**3DGaming**

3D WinBench™ 2000 (Hardware T&L)

3D WinBench 2000 (D3D software)

3DMark™ 2001 (Hardware T&L)

3DMark 2001 (D3D software)

## Games

AquaMark, DroneZ, Evolva, Expendable, Half-life Smokin', MDK2, QuakeIII, Serious Sam, Serious Sam: Second Encounter, Return to Castle Wolfenstein 3D, Unreal Tournament

The results of the individual tests within a usage model are equally weighted and averaged together to create a relative performance score for that usage model. The combined scores from each of the three usage models are then averaged together to provide a single metric that is designed to relate overall system performance (see Figure 1).

When viewing these benchmark results and attempting to analyze their meaning, a normalization process is useful. This normalization process provides a much easier way to compare the data for the reader and provides a simpler method for determining the significance or insignificance of any deltas in performance. Configurations for the AMD Athlon processor and AMD Athlon XP processor systems are identical and can be seen in Appendix D.

## Independent Benchmark Auditing

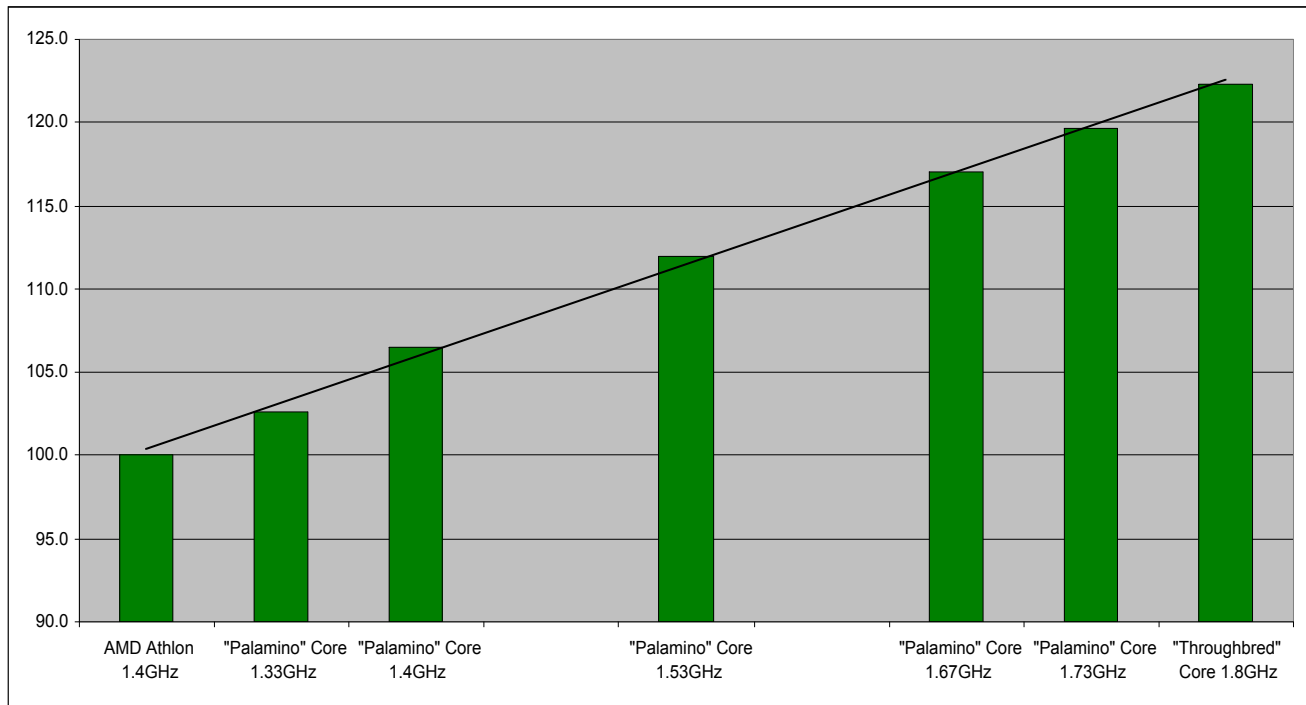
To ensure customer confidence in AMD benchmarking methodology, Arthur Andersen L.L.P. is independently examining the AMD Athlon XP processor 2200+ performance benchmarks. This examination includes independent observation and tests of the system configuration, benchmark procedures<sup>1</sup>, and the recording of results. A full report detailing the results of the auditing process is available on the AMD website.

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<sup>1</sup> Please see "Appendix A - Individual Benchmarking Test Methodology" for detailed methodology used to generate audited individual tests.

## Improving Architectural Performance

As shown in the chart on the following page comparing the older AMD Athlon processor and the newer AMD Athlon XP processors, performance advances can be made through internal architecture enhancements that are not solely dependent on frequency.



**Figure 1:** Desktop Overall Performance

Since frequency should no longer be the sole indicator of performance, more information must be provided to the end user to better understand a processor's performance capabilities. The most useful information is that which communicates relative real-world performance on a variety of software applications.

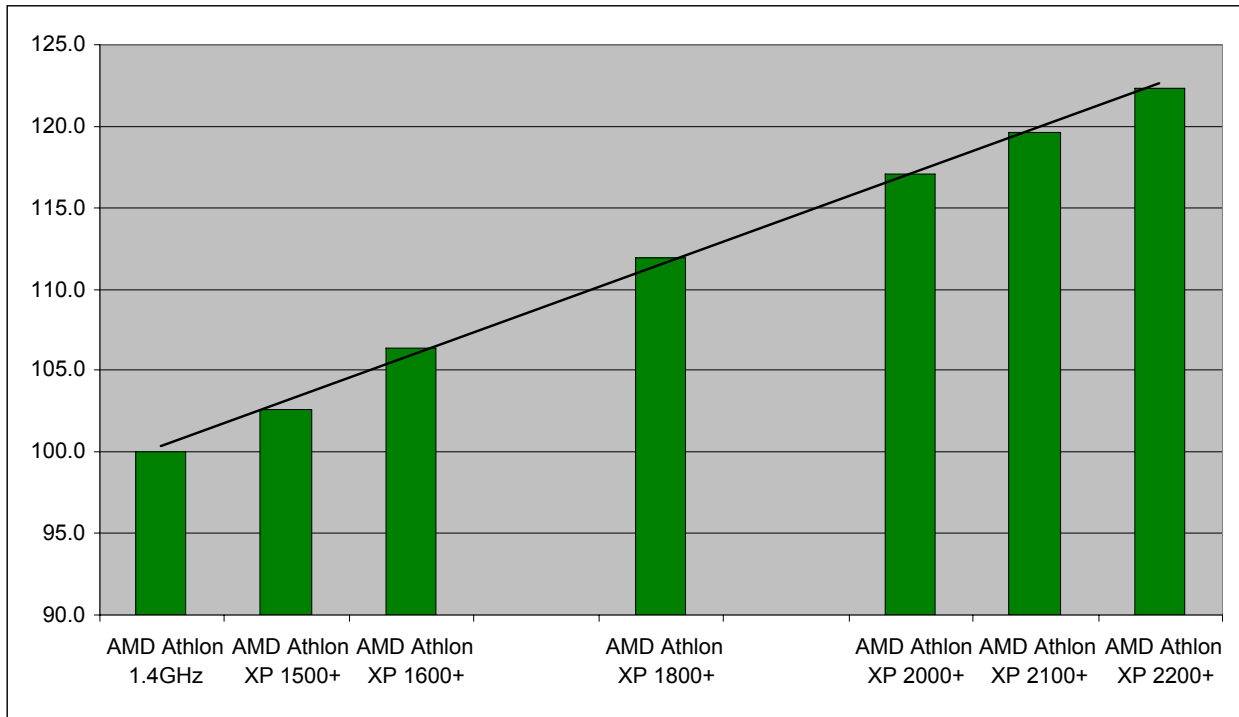
## Model Number Approach

AMD has used model numbers to distinguish versions of the AMD Athlon XP processors. Higher numbers equate to higher performance. The first member of the AMD Athlon XP processor family, the AMD Athlon XP processor 1500+, provides better performance than the older 1.4GHz AMD Athlon processor.

The AMD Athlon XP processor models and their corresponding frequencies are shown below:

<b><u>Processor and Model Number</u></b>	<b><u>Core Operating Frequency</u></b>
AMD Athlon XP 1500+	1.33GHz
AMD Athlon XP 1600+	1.40GHz
AMD Athlon XP 1700+	1.47GHz
AMD Athlon XP 1800+	1.53GHz
AMD Athlon XP 1900+	1.60GHz
AMD Athlon XP 2000+	1.67GHz
AMD Athlon XP 2100+	1.73GHz
AMD Athlon XP 2200+	1.80GHz

The relative application performance improvement between different members of the AMD Athlon XP processor family is supported in the following benchmark graphs.



**Figure 2:** Overall Desktop Performance with Model Numbers

Approximately three percentage points on this normalized overall desktop performance scale represent the typical performance difference that exists between different system price bands in the market today<sup>2</sup>.

As can be seen by Figure 2, AMD Athlon XP processors exceed the performance level of older AMD Athlon processors. The AMD Athlon XP processor model number system provides an easy and clear metric indicating relative application performance of members of the AMD Athlon XP family of processors.

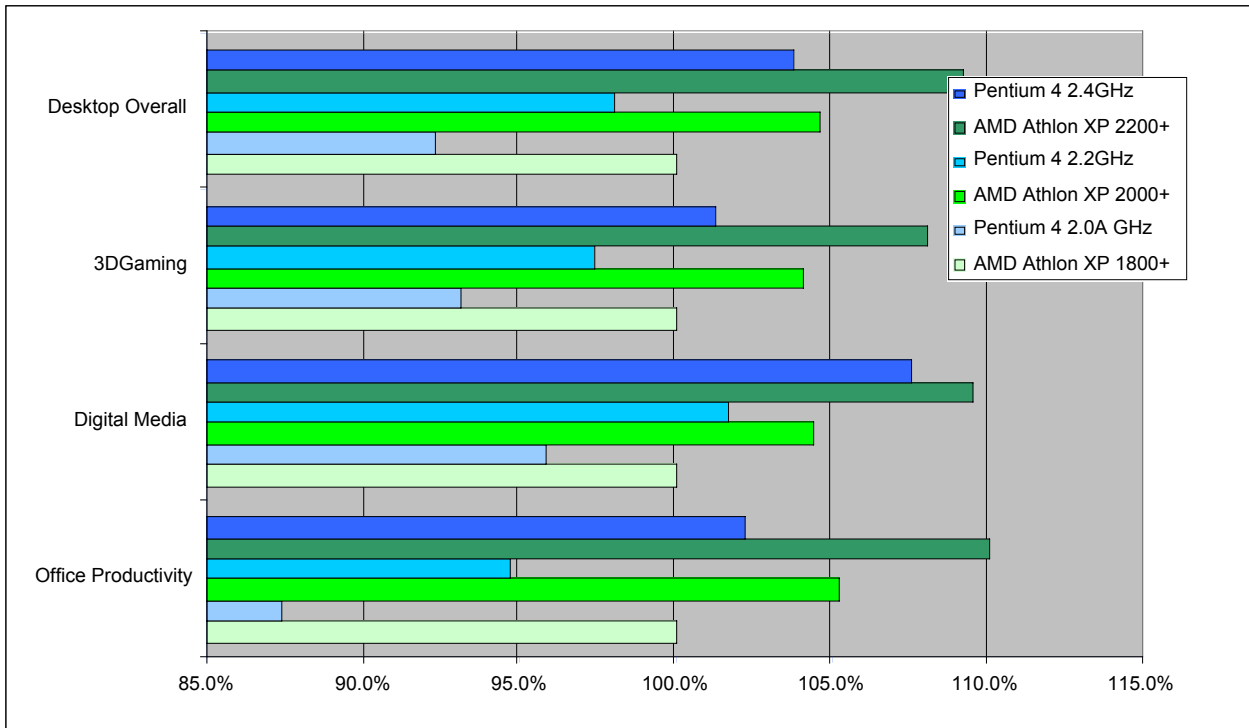
<sup>2</sup> See Appendix B for Raw Benchmarking Data.



## Competitive Comparison

It is also important to consider how AMD Athlon XP processors perform relative to competitive PC processors. In order to provide an accurate comparison between systems based on the AMD Athlon XP processor and on the Pentium 4 processor, systems are configured similarly. The details of the system configurations utilized in this analysis are listed in Appendix D. For the purposes of this comparison, AMD has used DDR memory system configurations for both the AMD and Intel processor-based systems. DDR was chosen because it has been adopted as the mainstream memory system configuration whereas RDRAM has been relegated to high-end systems and is expected to account for less than 10 percent of the market, according to industry analysts. Appendix C includes a comparison using the RDRAM memory system configuration for the Pentium 4.

All tests were run on the Microsoft Windows XP operating system, as AMD expects it will be relevant to most purchasers of x86 PCs over the next several years. The results on the following pages were obtained when the three suites of benchmarks and applications were run following the aforementioned methodology. All results have been normalized to the AMD Athlon XP processor 1800+. Again, when viewing benchmark results and attempting to analyze their meaning, a normalization process is useful. Detailed scores and individual results for all AMD Athlon XP processors can be seen in Appendix B. The following chart summarizes these normalized results.



**Figure 3:** Normalized Competitive Benchmark Results<sup>3</sup>

The AMD Athlon XP processor clearly provides a performance advantage in the varying system price bands relative to competitive PC processors available on the market. The chart above demonstrates the different relative performance of AMD Athlon XP processors and Pentium 4 processors.

<sup>3</sup> For a detailed breakdown of benchmark categories see pages 3 and 4.

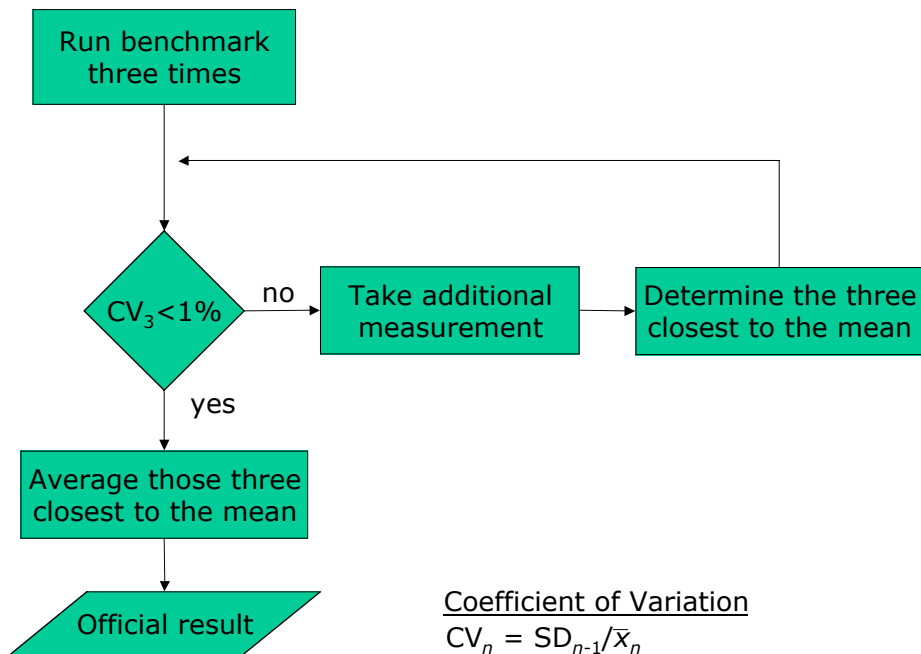
## Summary

Over the past 20 years, processor frequency has been used as the proxy for comparing system performance. The use of frequency by itself to determine processor performance has become antiquated due to the fundamental architectural differences that exist between Intel and AMD processors. AMD processors benchmarked in this comparison outperform their Intel counterparts by a noticeable margin.

AMD believes that the idea of solely using a processor's frequency to compare performance between AMD and Intel processors needs to be replaced by a new approach to measure processor performance.

## Appendix A – Individual Benchmarking Test Methodology

The PC is a dynamic environment, and the asynchronous nature of how PC's perform tasks leads to small inconsistencies in benchmark results. For example, every time a benchmark (or any application) is run, changes are made to the location of data on the hard drive. These changes (called fragmentation) can result in minor differences in the score of benchmarks that depend on disk performance (e.g. Business Winstone™ 2001). With that in mind, AMD designed the following audited procedure to ensure consistency and accuracy for all of our individual benchmark results.



**Figure 4:** AMD Benchmarking Value Test Flowchart

The coefficient of variation is a measure of the relative dispersion of the data points. Designing the test to yield three data points so that their coefficient of variation is less than one percent means the data points are grouped together very tightly, thus the test is designed to reveal repeatable and accurate results.

## Appendix B: Raw Benchmarking Data

Below is the actual benchmark data used for the benchmark results on the AMD website. This includes the audited benchmark results for the AMD Athlon XP processor 2200+. The next chart below contains the same benchmark data normalized to the 1.4GHz AMD Athlon processor. System configurations utilized are listed in Appendix D.

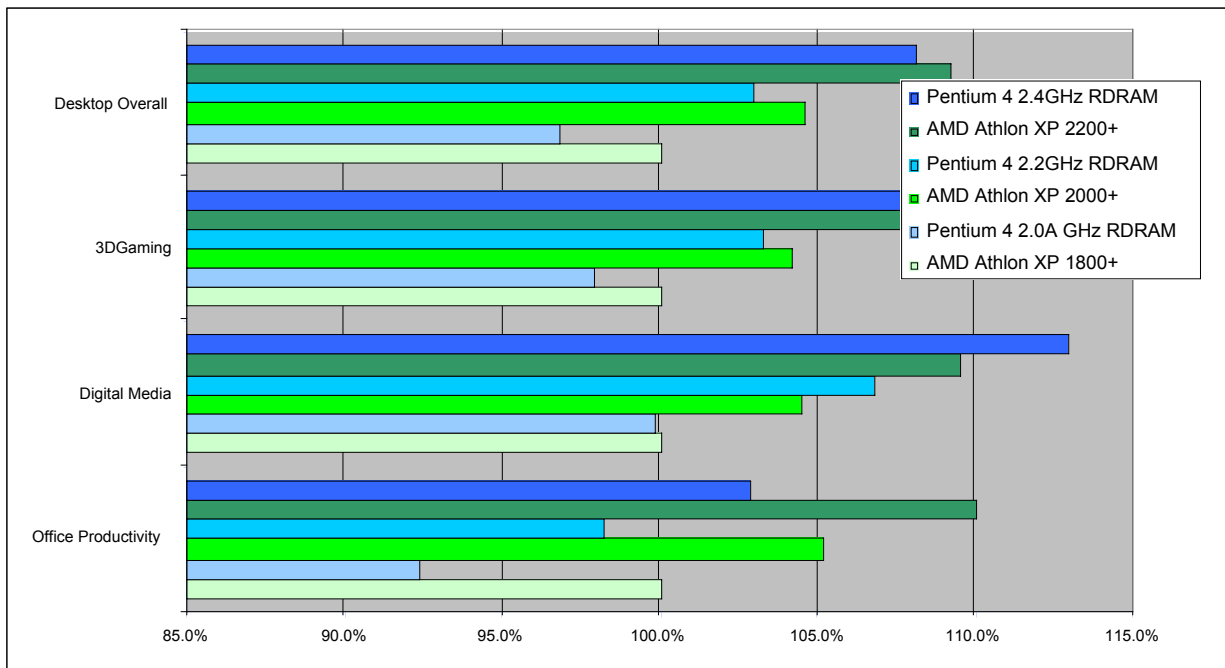
Metric	AMD Athlon 1.4GHz	AMD Athlon XP 1500+	AMD Athlon XP 1600+	AMD Athlon XP 1800+	AMD Athlon XP 2000+	AMD Athlon XP 2100+	AMD Athlon XP 2200+	Intel P4 2.04 GHz	Intel P4 2.26GHz	Intel P4 2.4GHz	Intel P4 2.04 GHz RDRAM	Intel P4 2.26GHz RDRAM	Intel P4 2.4GHz RDRAM
Business Winstone™ 2001	61.8	59.4	62.1	65.3	68.6	69.9	70.9	50.9	56.2	60.9	54.7	57.8	60.3
SYSMark™ 2001 Office Productivity	180.0	178.7	184.0	193.0	203.3	208.7	213.3	186.7	199.0	214.3	194.3	207.7	218.3
Content Creation Winstone™ 2001	77.2	76.3	79.7	84.1	86.6	89.0	89.3	73.7	77.7	82.5	77.5	82.7	85.5
Content Creation Winstone™ 2002	29.7	32.1	33.1	35.1	36.4	37.3	38.2 *	33.6	35.5	37.2	35.1	37.8	40.0
SYSMark™ 2001 Internet Content Creation	160.3	160.3	201.3	214.3	228.0	233.0	239.0 *	220.0	235.0	250.0	227.3	242.0	257.7
3D WinBench™ 2000 (D3D Software)	214.0	215.0	217.0	222.0	225.7	227.0	227.0	221.0	226.0	230.0	229.0	234.7	240.7
3D WinBench™ 2000 (Hardware T&L)	294.0	296.0	301.0	309.7	318.3	324.0	321.0	295.0	304.3	312.0	299.3	309.7	320.0
3DMark™ 2001 (D3D software)	4409.7	4532.7	4693.3	4938.7	5160.3	5269.0	5276.3	4769.3	5044.0	5289.7	4967.0	5283.3	5583.7
3DMark™ 2001 (Hardware T&L)	9545.3	9623.7	9841.0	10076.0	10395.7	10548.3	10562.0	9803.0	10090.3	10405.0	9857.3	10239.3	10556.7
AquaMark (1024x768x32)	69.7	67.9	70.7	72.8	74.9	75.8	76.1	71.1	73.0	75.0	69.4	72.0	74.4
Dronez Generic (1024x768x32 Generic)	193.7	189.2	188.3	171.9	176.4	179.6	180.3	179.8	186.9	189.7	209.2	220.2	227.2
Evolva - Benchmark (1024x768x32)	183.6	182.7	185.5	191.7	196.5	199.0	198.9	185.0	190.5	195.5	191.4	198.3	203.2
Expendable (1024x768x32)	123.9	125.8	130.1	137.0	143.4	148.0	150.4	113.5	121.9	128.4	119.8	127.3	136.2
Half-life Smokin' (1024x768x32)	74.3	74.3	77.0	83.0	88.7	91.5	92.8	72.7	78.0	82.7	75.1	80.8	85.3
MDK2 (1024x768x32)	195.4	189.8	172.7	184.4	194.6	199.4	203.8	168.3	178.0	185.3	177.1	189.9	202.2
QuakeIII Demo2 (640x480x16)	200.1	206.3	212.4	223.0	231.5	235.7	237.7	231.6	241.0	251.9	247.7	262.5	275.1
Return to Castle Wolfenstein 3D (1024x768x32)	80.0	81.2	84.2	88.5	93.6	95.6	96.9	84.1	89.6	94.4	87.6	94.5	99.6
Serious Sam (1024x768x32)	112.5	113.6	117.8	124.9	132.1	136.5	137.3	98.4	106.9	112.9	104.8	113.1	119.7
Serious Sam: Second Encounter (1024x768x32)	130.7	132.1	136.0	143.1	151.6	155.4	157.4	122.8	128.6	136.5	128.6	137.7	146.6
Unreal Tournament (1024x768x32)	71.3	71.5	73.4	76.5	78.8	80.0	78.3	65.2	66.5	68.3	72.9	75.8	77.7

Metric	AMD Athlon 1.4GHz	AMD Athlon XP 1500+	AMD Athlon XP 1600+	AMD Athlon XP 1800+	AMD Athlon XP 2000+	AMD Athlon XP 2100+	AMD Athlon XP 2200+	Intel Pentium 4 2.0A GHz	Intel Pentium 4 2.2GHz	Intel Pentium 4 2.4GHz	Intel Pentium 4 2.0A GHz RDRAM	Intel Pentium 4 2.2GHz RDRAM	Intel Pentium 4 2.4GHz RDRAM	Weight
Business Winstone™ 2001	100.0	96.2	100.6	105.7	111.0	113.1	114.8	82.4	91.0	98.7	88.6	93.6	97.7	0.50
SYSMark™ 2001 Office Productivity	100.0	99.3	102.2	107.2	113.0	115.9	118.5	103.7	110.6	119.1	108.0	115.4	121.3	0.50
<b>Office Productivity</b>	100.0	97.7	101.4	106.4	112.0	114.5	116.7	93.0	100.8	108.9	98.3	104.5	109.5	1.00
Content Creation Winstone™ 2001	100.0	98.8	103.2	108.9	112.1	114.0	115.7	95.4	100.6	106.8	100.3	107.1	111.9	0.33
Content Creation Winstone™ 2002	100.0	108.0	111.4	118.0	122.3	125.4	128.6*	112.9	119.5	125.1	117.9	127.1	134.5	0.33
SYSMark™ 2001 Internet Content Creation	100.0	118.7	125.6	133.7	142.2	145.3	149.1*	137.2	146.6	155.9	141.8	150.9	160.7	0.33
<b>Digital Media</b>	100.0	108.5	113.4	120.2	125.5	128.3	131.1	115.2	122.2	129.3	120.0	128.4	135.7	1.00
3D WinBench™ 2000 (D3D Software)	100.0	100.5	101.4	103.7	105.5	106.1	103.3	105.6	107.5	107.0	109.7	112.5	112.5	0.07
3D WinBench™ 2000 (Hardware T&L)	100.0	100.7	102.4	105.3	108.3	110.2	109.2	100.3	103.5	106.1	101.8	105.3	108.8	0.07
3DMark™ 2001 (D3D software)	100.0	103.2	106.4	112.0	117.0	119.5	119.7	108.2	114.4	120.0	112.6	119.8	126.6	0.07
3DMark™ 2001 (Hardware T&L)	100.0	100.8	103.1	105.6	108.9	110.5	110.7	102.7	105.7	109.0	103.3	107.3	110.6	0.07
AquaMark (1024x768x32)	100.0	97.4	101.5	104.5	107.4	108.9	109.2	102.0	104.7	107.7	99.6	103.3	106.8	0.07
Dronez Generic (1024x768x32 Generic)	100.0	107.5	109.5	111.8	114.8	116.8	117.3	116.9	121.6	123.4	136.1	143.3	147.8	0.07
Evolva - Benchmark (1024x768x32)	100.0	99.5	101.5	104.4	107.0	108.4	108.3	100.8	103.8	106.5	104.2	108.0	110.6	0.07
Expendable (1024x768x32)	100.0	101.5	105.0	110.6	115.8	119.4	121.4	91.6	98.3	103.6	96.7	102.8	110.0	0.07
Half-life Smokin' (1024x768x32)	100.0	100.0	103.5	111.7	119.3	123.1	124.9	97.8	105.0	111.3	101.1	108.7	116.1	0.07
MDK2 (1024x768x32)	100.0	106.7	111.2	118.7	125.2	128.3	131.2	108.3	114.6	119.3	114.0	122.2	130.2	0.07
QuakeIII Demo2 (640x480x16)	100.0	103.1	106.1	111.5	115.7	117.8	118.8	115.8	120.5	125.9	123.8	131.2	137.5	0.07
Return to Castle Wolfenstein 3D (1024x768x32)	100.0	101.5	105.2	110.6	117.0	120.8	121.1	105.1	112.0	118.0	109.5	118.1	124.5	0.07
Serious Sam (1024x768x32)	100.0	101.0	104.8	111.1	117.5	120.5	122.1	87.5	95.1	100.4	93.2	100.5	106.4	0.07
Serious Sam: Second Encounter (1024x768x32)	100.0	101.1	104.1	109.5	116.0	118.9	120.5	94.0	98.4	104.4	98.4	105.4	112.2	0.07
Unreal Tournament (1024x768x32)	100.0	100.3	103.0	107.3	110.5	112.2	109.8	91.5	93.3	95.8	102.3	106.3	109.0	0.07
<b>3DGaming</b>	100.0	101.7	104.6	109.2	113.7	116.1	116.7	101.7	106.4	110.6	106.9	112.8	118.0	1.00
<b>Desktop Overall</b>	100.0	102.6	106.5	112.0	117.1	119.6	121.5	103.3	109.8	116.2	108.4	115.2	121.1	3.00

\*These numbers use the software patch in Windows Media Encoder and are not audited.

## Appendix C: RDRAM Competitive Comparison

The competitive comparison in the main body of this white paper compares the AMD Athlon XP processor to the Pentium 4 processor in DDR memory configurations. These comparisons represent the highest performance DDR memory configurations from AMD and Intel. In contrast, this appendix compares the AMD DDR solution to the Intel RDRAM solution to demonstrate the completeness of our modeling number system. The details of the system configurations utilized in this analysis are listed in Appendix D and the raw benchmarking data is in Appendix B. The AMD Athlon XP processor again clearly provides a performance advantage in the varying system price bands relative to competitive PC processors available on the market.



**Figure 5:** RDRAM Competitive Comparison

<sup>4</sup> For a detailed breakdown of benchmark categories see pages 3 and 4.

## Appendix D: Benchmark System Configurations

### Intel Pentium® 4 Processor RDRAM Memory System Configuration

#### Operating System

Name: Microsoft Windows XP Professional  
 Version: RTM, no service packs / updates installed  
 Build #: 2600  
 DirectX Version: DirectX 8.1 (4.08.01.0810)  
 Processor: Pentium 4 2.2GHz, 2.4GHz

#### Processor

#### Hardware

Motherboard: Intel D850MD  
 BIOS Info: MV85010A.86A.0011.P05.0111141737  
 Is BIOS publicly available? Yes X No  
 Chipset: i850 Chipset

#### Memory

Manufacturer & Type: Viking Rambus 800-45 R64168Z8N2-40 G100  
 Quantity & Size: (each)/(MB) Qty. (2), 128MB RIMM Modules  
 Total Memory Size: (MB) 256MB total

#### Hard Drive

Model Name: Western Digital Caviar  
 Model Number: WD1200  
 Hard Drive Size: 120GB  
 Transfer Mode: UDMA 100  
 Other Info: NTFS was used to format the hard disk:

#### Network Card

Name: Allied Telesyn 10/100  
 Model Number: AT-2700TX

#### Sound Card

Manufacturer's Name: Creative Labs - Sound Blaster Live!  
 Model Number: CT4670

#### Video Card

Graphics Adapter: Visiontek GeForce4 Titanium 4600  
 Memory Size (MB) and Type: 128MB DDR

#### Drivers

AGP Miniport Publisher Name: Provided by Operating System  
 EIDE Publisher Name: Provided by Operating System  
 DMA Enabled: Yes X No N/A  
 Network Card Publisher Name: Provided by Operating System  
 Sound Card Publisher Name: Provided by Operating System  
 Video Card Publisher Name: NVIDIA  
 Version: 6.13.10.2832  
 Date if applicable: 3/8/2002  
 Graphics Resolution: 1024x768  
 Color Depth: 32 bit Refresh Rate: 100Hz  
 Texture Format: n/a

## Intel Pentium® 4 Processor DDR Memory System Configuration

### Operating System

Name: Microsoft Windows XP Professional  
 Version: RTM, no service packs / updates installed  
 Build #: 2600  
 DirectX Version: DirectX 8.1 (4.08.01.0810)  
 Processor: Pentium 4 2.2GHz, 2.4GHz

### Processor

#### Hardware

Motherboard: Intel D845BG  
 BIOS Info: PT84510A.86A.0012.P01  
 Is BIOS publicly available? Yes X No  
 Chipset: i845 Chipset

### Memory

Manufacturer & Type: Corsair XMS2400 CM64SD256-2400C2  
 Quantity & Size: (each)/(MB) Qty (1) 256MB DIMM Module  
 Total Memory Size: (MB) 256MB total

### Hard Drive

Model Name: Western Digital Caviar  
 Model Number: WD1200  
 Hard Drive Size: 120GB  
 Transfer Mode: UDMA 100  
 Other Info: NTFS was used to format the hard disk:

### Network Card

Name: Allied Telesyn 10/100  
 Model Number: AT-2700TX

### Sound Card

Manufacturer's Name: Creative Labs - Sound Blaster Live!  
 Model Number: CT4670

### Video Card

Graphics Adapter: Visiontek GeForce4 Titanium 4600  
 Memory Size (MB) and Type: 128MB DDR

### Drivers

AGP Miniport  
 EIDE  
 Network Card  
 Sound Card  
 Video Card

Publisher Name: Provided by Operating System  
 Publisher Name: Provided by Operating System  
 DMA Enabled: Yes X No N/A  
 Publisher Name: Provided by Operating System  
 Publisher Name: Provided by Operating System  
 Publisher Name: NVIDIA  
 Version: 6.13.10.2832  
 Date if applicable: 3/8/2002  
 Graphics Resolution: 1024x768  
 Color Depth: 32 bit Refresh Rate: 100Hz  
 Texture Format: n/a



## AMD Athlon™ XP & AMD Athlon Processor DDR Memory System Configurations

### Operating System

Name: Microsoft Windows XP Professional  
 Version: RTM, no service packs / updates installed  
 Build #: 2600  
 DirectX Version: DirectX 8.1 (4.08.01.0810)

### Processor

AMD Athlon XP 2000+, 2100+, 2200+

### Hardware

Motherboard: Gigabyte GA-7VRXP  
 BIOS Info: 7VRXP F4  
 Is BIOS publicly available? Yes X No  
 Chipset: Via KT333A Chipset

### Memory

Manufacturer & Type: Twinmos PC2700 (DDR/CL2.5)  
 Quantity & Size: (each)/(MB) Qty (1) 256MB DIMM Module  
 Total Memory Size: (MB) 256MB total

### Hard Drive

Model Name: Western Digital Caviar  
 Model Number: WD1200  
 Hard Drive Size: 120GB  
 Transfer Mode: UDMA 100  
 Other Info: NTFS was used to format the hard disk:

### Network Card

Name: Allied Telesyn 10/100  
 Model Number: AT-2700TX

### Sound Card

Manufacturer's Name: Creative Labs - Sound Blaster Live!  
 Model Number: CT4670

### Video Card

Graphics Adapter: Visiontek GeForce4 Titanium 4600  
 Memory Size (MB) and Type: 128MB DDR

### Drivers

AGP Miniport  
 EIDE  
 Network Card  
 Sound Card  
 Video Card

Publisher Name: Provided by Operating System  
 Publisher Name: Provided by Operating System  
 DMA Enabled: Yes X No N/A  
 Publisher Name: Provided by Operating System  
 Publisher Name: Provided by Operating System  
 Publisher Name: NVIDIA  
 Version: 6.13.10.2832  
 Date if applicable: 3/8/2002  
 Graphics Resolution: 1024x768  
 Color Depth: 32 bit Refresh Rate: 100Hz  
 Texture Format: n/a

### Software

Name: Windows Media Encoder 7.0\*  
 Other: Updated Windows® Media Encoder Results contain a software update which enables 3DNow!™ Professional technology in version 7.0 of Microsoft® Windows Media Encoder.

\*The Windows Media Encoder 7.0 software update is not used in the audited AMD Athlon 2200+ results.

## Addendum: Changes to the AMD Performance Suite

AMD maintains a comprehensive benchmarking suite comprised of industry standard benchmarks and popular applications. AMD works closely with the benchmarking industry and continually reviews the latest benchmarks, applications, and our benchmarking practices. The AMD benchmark suite is updated periodically to maintain its relevance to a broad range of end users. This document covers the updates effective with the launch of the AMD Athlon XP processor 3200+.

AMD believes that application benchmarks representing end-user applications continue to provide the best measurement of expected system performance. AMD has not changed the method by which overall performance scores are determined. Each benchmark result is normalized and the average is taken in each category. The categories are then equally weighed to determine the overall score.

AMD updates focus on including the latest application benchmarks and are intended to reflect trends in end user computer usage. AMD has added Futuremark's 3DMark<sup>®</sup> 03 to its suite to provide a forward-looking view of graphics performance, and Multimedia Content Creation Winstone<sup>®</sup> 2003 to capture the performance of more advanced gaming capabilities and productivity applications. In addition, AMD varied the mix in the gaming suite to better reflect today's games. See Table 1 for a complete list of benchmarks now used in the benchmarking suite.

AMD continues to use a third-party firm to audit the benchmarks to ensure customer confidence in our testing methodology. Beginning with the launch of model 3000+, AMD has contracted with PricewaterhouseCoopers for auditing services.

AMD plans to continue to make additional changes to the benchmarking suite as computer usage evolves. Please visit [www.amd.com](http://www.amd.com) to see benchmarking results for AMD processor releases.

<b>Office Productivity</b>	eTesting Labs Inc. Business Winstone™ 2001, v1.0.2
	<i>eTesting Labs Inc. Business Winstone 2002, v1.0</i>
	BAPCO™ SYSmark™ 2001 Office Productivity* (Mod as needed)
<b>Digital Media</b>	eTesting Labs Inc. Content Creation Winstone™ 2002, v1.0.1*
	<i>Multimedia Content Creation Winstone® 2003 (WME 8.2 upgrade installed)</i>
	BAPCO™ SYSmark™ 2001 Internet Content Creation* (Mod as needed)
<b>3D Gaming</b>	<i>3DMark® 2001 SE (D3D Hardware T&amp;L)</i>
	<i>3DMark 2001 SE (D3D Software T&amp;L)</i>
	<i>3DMark 03 Hardware Vertex</i>
	<i>3DMark 03 Software Vertex</i>
	<i>AquaMark (1024x768)</i>
	<i>Comanche 4 Demo (1024x768x32)</i>
	<i>Half-life Smokin' (1024x768x32)</i>
	<i>Jedi Knights II Demo (1024x768x32)</i>
	<i>MDK2 (1024x768x32) Avg.</i>
	<i>QuakeIII Demo2 (1024x768x32)</i>
	<i>Return to Castle Wolfenstein 3D (1024x768x32)</i>
	<i>Serious Sam: Karnak: Peaceful Night Coup Demo (1024x768x32)</i>
	<i>Serious Sam: Second Encounter-Demo Version: Little Trouble Demo (1024x768x32)</i>
	<i>Unreal Tournament (1024x768x32)</i>
	<i>Unreal Tournament 2003 Demo Flyby (1024x768x32)</i>
<i>Unreal Tournament 2003 Demo Botmatch (1024x768x32)</i>	

\* Updated Windows Media Encoder Results contain a software update that enables already present 3DNow!™ Professional technology in version 7.0 of Microsoft Windows Media Encoder. This software update is not publicly available. All subsequent versions of Microsoft Windows Media Encoder properly recognize 3DNow! Professional technology.

**Table 1:** Updated Benchmark Suite (new or updated tests in italics)

The following benchmarks were eliminated from the performance measurement suite effective with the launch of the AMD Athlon XP processor 3200+: Content Creation Winstone™ 2001, 3D WinBench™ 2000 (Hardware T&L, D3D software), DroneZ, Evolva, and Expendable. Additionally, AMD has moved to the second edition of 3DMark 2001 since the last update of the Benchmarking and Model Numbering Methodology white paper.

## About AMD

Founded in 1969 and based in Sunnyvale, California, AMD (NYSE: AMD) is a global supplier of integrated circuits for the personal and networked computer and communications markets with manufacturing facilities in the United States, Europe, Japan, and Asia. AMD, a Standard & Poor's 500 company, produces microprocessors, Flash memory devices, and silicon-based solutions for communications and networking applications.

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