AMD Processor Performance Evaluation Guide

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Revision History

Date	Revision	Description
March 2007	3.74	Incorporated legal and grammatic edits.
February 2007	3.73	Updated for the AMD Athlon™ 64 FX-62, AMD Athlon 64 FX-70, AMD Athlon 64 FX-72, and AMD Athlon 64 FX-74 dual-core processors.
		Replaced Office Productivity, Digital Media, and Gaming categories with categories for Windows Vista™ with 64-bit applications, Windows Vista with 32-bit applications, and Windows® XP Professional with 32-bit applications.
		Removed the following benchmarks:
		• BAPCO® SYSmark® 2004 SE Office Productivity
		• Business Winstone® 2004, Version 1.01*
		• Business Winstone 2004 Multitasking, Version 1.01
		• Worldbench
		• Remote Collaboration Scenario
		• Travel-Ready Scenario
		• BAPCO SYSmark 2004 SE Internet Content Creation
		• Content Creation Winstone® 2004, Version 1.01*
		• iTunes, Version 6.0.4
		• Protected High Definition Viewing Scenario
		• 3DMark™05, Build 1.2.0 (Hardware and Software)
		• City of Villains, Version 10.2
		• Serious Sam II
		• Half-Life 2, Version 1.0.1.0
		• Quake 4, Version 1.04
		• Unreal Tournament 2004, Version 3369
		• Tom Clancy's Splinter Cell Chaos Theory, Version 1.2b
		• Far Cry, Version 1.3.1
		• Doom 3, Version 1.1
		Updated the following benchmarks:
		• Vegas, Version 6.0 (to 7.0)
		• Crafty, Version 19.19 (to four-thread version)
		Added the following benchmarks:
		• CINEBENCH 9.5
		• POV-Ray, version 3.7beta-14
		• High Performance Gaming and Multimedia Scenario
		Updated application information in Chapter 3.
		Changed the recommended system configurations in Chapter 4.
		Updated Chapter 5 to reflect changes in system configuration and tests.
		Updated performance graphics in Chapter 6.
		Made minor grammatic changes to improve readability.
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Date	Revision	Description
June 2006	3.72	Updated document format to comply with latest AMD standards.
		Updated for the AMD Athlon™ 64 FX-62 processor, the AMD Athlon 64 processor 5000+, and the AMD Athlon 64 processor X2 3800+, relative to the Intel Pentium® D 950 processor and the Intel Pentium EE 955 processor.
		Added information about DDR2 memory latency to Chapter 2.
		Removed the following benchmarks:
		• WinRAR, version 3.42
		• RazorLAME, version 1.1.5
		• POV-Ray, version 3.7.4
		• Microsoft® Movie Maker, version 5.1
		• 3DMark®03, build 3.6.0 (hardware and software)
		• Pain Killer, version 1.64
		• Quake III, version 1.11 (replaced by Quake 4)
		• Return to Castle Wolfenstein Enemy Territory, version 2.60
		• Star Wars- Jedi Knight II: Jedi Outcast, version 1.04
		Updated the following benchmarks:
		• SYSMark® 2004, version 1.02, patch 2 updated to SYSMark 2004 SE
		• Unreal Tournament 2004, version 3355 updated to version 3369
		Added the following benchmarks:
		• iTunes, version 6.0.4
		• Cakewalk Sonar, version 5
		• Protected High Definition Viewing Scenario
		• 3DMark06, build 1.0.2 (hardware and software)
		• Serious Sam II
		• City of Villains, version 10.2
		• Quake 4, version 1.04 (replaces Quake 3)
		Updated application information in Chapter 3.
		Changed the recommended system configurations in Chapter 4.
		Updated procedures in Chapter 5 to reflect changes in system configuration and addition/removal of tests.
		Removed individual data tables, increased graph size, and added data summary table to Chapter 6.
		Removed Appendix A Listings because listing source files are available directly from AMD.
June 2005	3.71	Corrected title for Travel Ready Scenario.
June 2005	3.70	Updated for the AMD Athlon™ 64 FX-57 processor and the AMD Athlon 64 processor 4800+ relative to the Intel Pentium® 4 550 processor, which operates at 3.8 GHz.
		Removed the Performance Analysis (64-bit) section, as these tests will be shown in a separate document.
		Removed obsolete processor information.
October 2004	3.61	Incorporated documentation edits.

Date	Revision	Description
October 2004	3.60	Updated for the AMD Athlon™ 64 FX-55 processor and the AMD Athlon 64 processor 4000+ relative to the Intel Pentium® 4 550 processor, which operates at 3.4 GHz. Removed obsolete processor information. Added the following tests to the standard benchmarking suite: • Dr. DivX, version 1.0.6 (Replaces RawAVI to MPEG2 and Xmpeg) • Return to Castle Wolfenstein Enemy Territory, version 2.60 (Replaces Return to Castle Wolfenstein) • FarCry, version 1.3.1 • FarCry pier **Note:** *The two FarCry benchmarks were combined in revision 3.70.* • Painkiller, version 1.64 Within the Performance Analysis test suite, 64-bit versus 32-bit test results have been combined with the 32-bit and 64-bit results, where applicable. **Note:** *These changes are obsolete, as the Performance Analysis test suite has been removed from this document.*
June 2004	3.50	Updated to reflect the AMD Athlon™ 64 FX-53 (939) processor and the 3700+ and 3800+ processors relative to the Intel Pentium® 4 Extreme Edition 3.4 GHz and the Pentium 4 3.4 GHz processors. Removed obsolete processor information. Added the following tests to the Performance Analysis test suite: • Table 64, "Panorama Factory Ver. 3.1 64-Bit Benchmark" on page 69 • Table 65, "Crafty Ver. 19.12 64-Bit Benchmark" on page 69 • Table 64, "Panorama Factory Ver. 3.1 Benchmark Results" on page 72 • Table 65, "Crafty Ver. 19.12 64-Bit Benchmark Results" on page 72 **Note:** *These changes are obsolete, as the Performance Analysis test suite has been removed from this document.*
March 2004	3.43	Updated legal attribution for various benchmarks.
March 2004	3.41	As of revision 3.60, these tables are obsolete. Updated the following tables: • Table 35 on page 63 • Table 45 on page 66 • Table 48 on page 68 • Table 51 on page 69 • Table 77 on page 78
March 2004	3.40	Replaced the obsolete AMD Athlon™ 64 FX-51 processor information with the AMD Athlon 64 FX-53 processor. This change affects Table 3 on page 24 and each benchmark result. Replaced the older Intel Pentium® 4 3.2 GHz configuration and performance data with the Intel Pentium 4 3.2 GHz Extreme Edition Processor. This change affects Table 4 on page 22 and each benchmark result. Replaced the benchmark result tables with graphs and corresponding tables.

Date	Revision	Description
January 2004	3.32	Corrected instructions for "Ziff Davis Media Inc. Business Winstone® 2004" on page 32, "Ziff Davis Media, Inc. Business Multitasking Winstone® 2004" on page 33 and "Ziff Davis Media Inc.'s Content Creation Winstone® 2004" on page 39.*
		Moved 64-Bit performance results from non-optimized rows to optimized rows in Table 7 on page 49 and Table 8 on page 51.
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		Note: *These changes are obsolete, as the Performance Analysis test suite has been removed from this document.*
January 2004	3.31	Updated performance results for Table 7 on page 49 and Table 8 on page 51.
		Corrected minor typos throughout.
December 2003	3.30	Updated to reflect 3400+ launch.
		Figure 3 was removed.
		Additional instructions were added for the DivX Encoder for 64-Bit installation and run. Now refer to "Mini-GZIP" on page 61.
December 2003	3.25	Removed Revision bars.
December 2003	3.24	On Page 15, removed references to WinACE, because it is no longer tested.
		Within "Operating System Configuration" on page 27, added instructions to skip steps 12 and 13 because they do not apply if Microsoft® Windows® is not yet installed. Instead, skip to step 14.
		On page 30 added notations that ASUS and MSI drivers are applicable only to their respective motherboards.
December 2003	3.23	Updated benefits for 64-bit processing in "64-bit processing" on page 16.
		Note: *This change is now obsolete, as the Performance Analysis test suite has been removed from this document.*
		Corrected attribution in "WinZip Computing WinZip 8.1" on page 20.
November 2003	3.22	Added figure label to Figure 3 on page 46. Corrected two column format balancing in various locations.
November 2003	3.21	Applied new document template.
October 2003	3.2	Revision to Table 3 on page 24 to correct memory manufacturer.
		Revision to update configuration steps for *To install the video clip to use for DivX Encoder* on page 45.
September 2003	3.1	Revision to include NVIDIA® video driver and ASUS chipset installation.
September 2003	3.0	Initial Public Release

About This Document

This guide describes AMD processor performance test methodology and presents performance test results based on that methodology.

Audience

The guide provides information for those interested in evaluating the performance of AMD64 technology, with particular emphasis on members of the hardware review community.

Life of Document

This document provides information about the performance of these processors:

- AMD Athlon™ 64 FX-62 dual-core processor
- AMD Athlon 64 FX-70 dual-core processor
- AMD Athlon 64 FX-72 dual-core processor
- AMD Athlon 64 FX-74 dual-core processor

This document may become obsolete or may be revised as new speed grades become available.

AMD64 Single Socket Processor Architecture

Detailed knowledge of AMD 64-bit processor architecture is not required to perform optimal benchmarking. However, the benchmarks demonstrate the advantages of key architectural features. This overview provides information about those features and shows how the benchmarks demonstrate the exceptional performance of AMD processors.

AMD 64-bit processors include the following architectural improvements specifically designed to increase the number of instructions per clock (IPC).

- AMD64 Technology

    When the AMD64 Instruction Set Architecture is utilized, 64-bit mode offers:

    – Support for 64-bit operating systems that provide full, transparent, and simultaneous 32-bit and 64-bit platform application multitasking.

    – A physical address space that supports up to 1 TB of installed RAM, shattering the 4 GB RAM barrier on current x86 systems.

    – Sixteen 64-bit general-purpose integer registers, four times as much general-purpose register space for applications and device drivers as traditional x86 architectures.

    – Sixteen 128-bit XMM registers for enhanced multimedia performance, double the register space of current SSE/SSE2/SSE3 implementations.

- An integrated DDR2 memory controller (see Figure 1).

    – The integrated controller reduces memory latency and increases overall system performance.

    – When comparing platforms with different types of memory, test memory bandwidth and latency first. The results help to clarify the sometimes surprising results of more complex, application-based benchmarks.

    Memory is marked/marketed on bandwidth. As Table 1 shows, during tests, DDR2-800 memory can provide up to 35% more bandwidth than DDR1-400.

Table 1. Memory Bandwidth

	AMD Athlon™ 64 FX-62 Dual-Core Processor, DDR2-800	AMD Athlon 64 FX-60 Processor, DDR1-400
Sciencemark 2.0 Bandwidth (MB/s)	6779.3	4472.6
Sciencemark 2.0 Latency (ns)	46.5	52.5

AMD Athlon™ 64 Single Socket
Dual-Core Processor Architecture

Replaces Address, Data, and Control Bus

The industry's first true on-die dual-core x86 processor

- Inter-core communication at CPU speed
- Direct access to memory controller and HyperTransport™ technology links

Enhanced Virus Protection for Windows® XP SP2

- Designed to help prevent the spread of certain viruses, like MSBlaster and Slammer
- Designed to reduce the cost and down time associated with similar viruses and improves the protection of computers and personal information against certain PC viruses

AMD64 Architecture delivers leading-edge software performance

- Both high-performance and 32- and 64-bit computing
- Experience dual-core performance today with no hardware changes

DDR2 Memory Controller

HyperTransport Technology

Crossbar Switch

System Request Queue

L2 Cache 0

L2 Cache 1

L1 Instruction Cache 0

L1 Data Cache 0

L1 Instruction Cache 1

L1 Data Cache 1

AMD64 Processor Core 0

AMD64 Processor Core 1

HyperTransport™ technology accelerates the system bus for high-speed I/O communication

- 8.0 GB/s of available bidirectional system bandwidth
- 2.0 GHz Bi-directional
- Systems can include multiple links

AMD Athlon™ 64 Dual-Core Processors are true dual core

- Independent L2 cache
- Intelligent System Request Queue and integrated Crossbar Switch

Cool'n'Quiet™ technology for quieter operation and lower power costs

- Recognized by the U.S. Environmental Protection Agency for advancement of energy-efficient computer technology
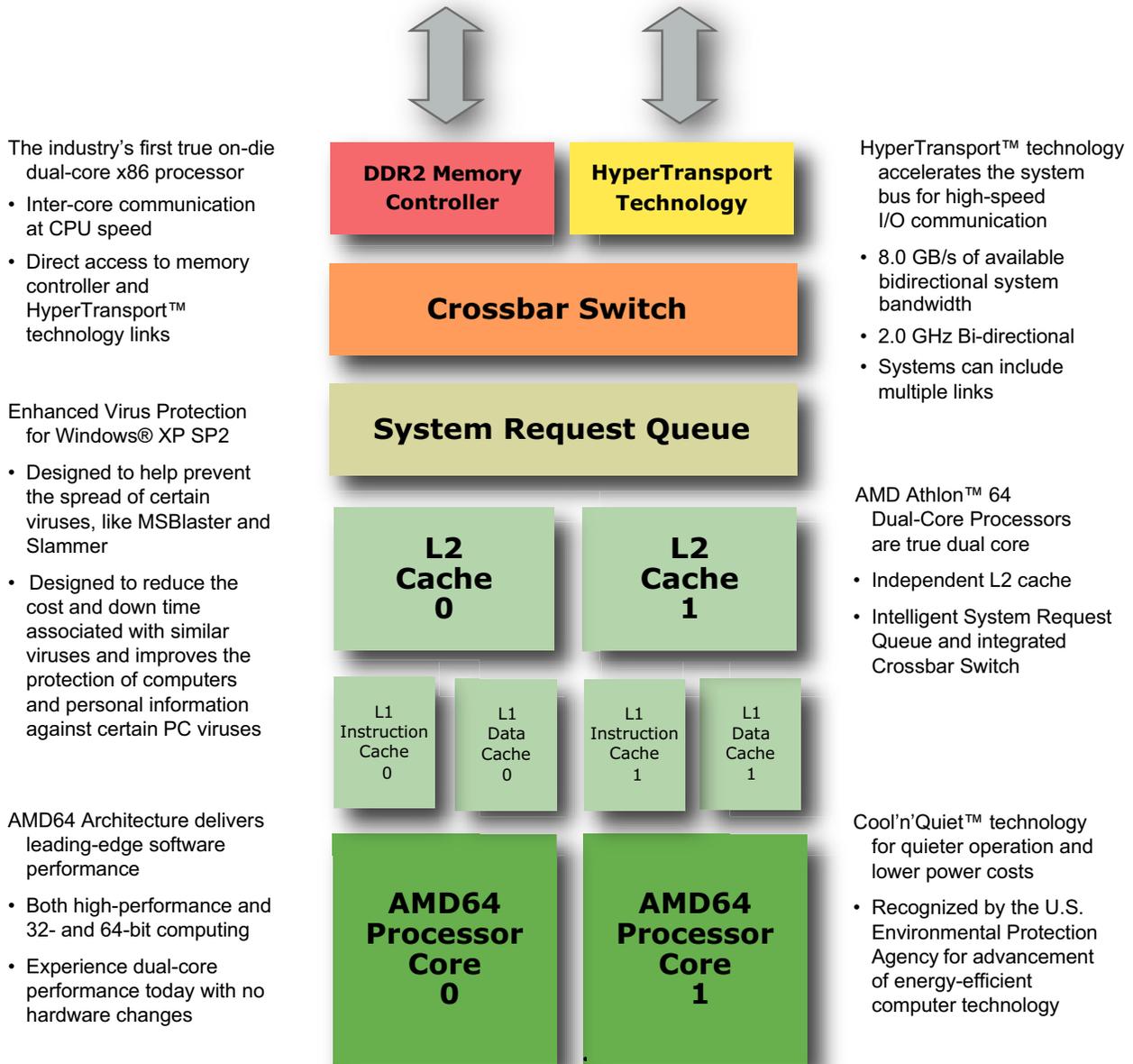
Figure 1. Dual-Core Processor Architecture

For discrete graphics configurations, memory bandwidth has a smaller impact on end performance. For example, changing from dual-channel to single-channel memory (halving the marketed bandwidth) on an otherwise identical system reduces performance only 2-3% (see Table 2).

Table 2. Effect of Memory Bandwidth on Performance

	AMD Athlon™ 64 Processor 3800+, Dual-Channel Memory	AMD Athlon 64 Processor 3800+, Single-Channel Memory
Office Productivity	101.3%	100.0%
Digital Media	101.9%	100.0%
Computer Gaming	104.1%	100.0%
Overall	102.4%	100.0%

Memory latency is more critical to performance. As Table 3 shows, an AMD Athlon™ 64 FX-62 dual-core processor with DDR2-800 memory has approximately 4% better performance than an AMD Athlon 64 FX-60 dual-core processor with DDR1-400 memory. In general, each 5-10% reduction in latency improves performance by 1-2%.

Table 3. Effect of Memory Latency on Performance

	AMD Athlon™ 64 FX-62 Dual-Core Processor, DDR2-800	AMD Athlon 64 FX-60 Processor, DDR1-400
Office Productivity	103.5%	100.0%
Digital Media	105.6%	100.0%
Computer Gaming	104.5%	100.0%
Overall	104.6%	100.0%

- An advanced HyperTransport™ technology link (see Figure 2)
  - Dramatically improves I/O bandwidth, enabling faster access to peripherals such as hard disk drives, USB 2.0, and gigabit Ethernet cards.
  - Data compression benchmarks illustrate higher processor performance due to a reduced I/O interface throttle.
- Large first-level (L1) and second-level (L2) on-die caches
  - 128 KB of L1 cache and 1 MB of L2 cache allow the AMD Athlon 64 processor to excel at performing matrix calculations on arrays.
  - Benchmarks that use intensive, large matrix calculations benefit from having the entire matrix available in the L2 cache.
- Processor core clock-for-clock improvements
  - Larger translation look-aside buffers (TLB) with reduced latencies.
  - A global history counter with four times the number of bimodal counters as seventh-generation processors, to improve branch prediction.
  - These features drive IPC improvements and provide a more efficient pipeline for CPU-intensive applications.
  - CPU-intensive games such as Unreal Tournament benefit from these core improvements.
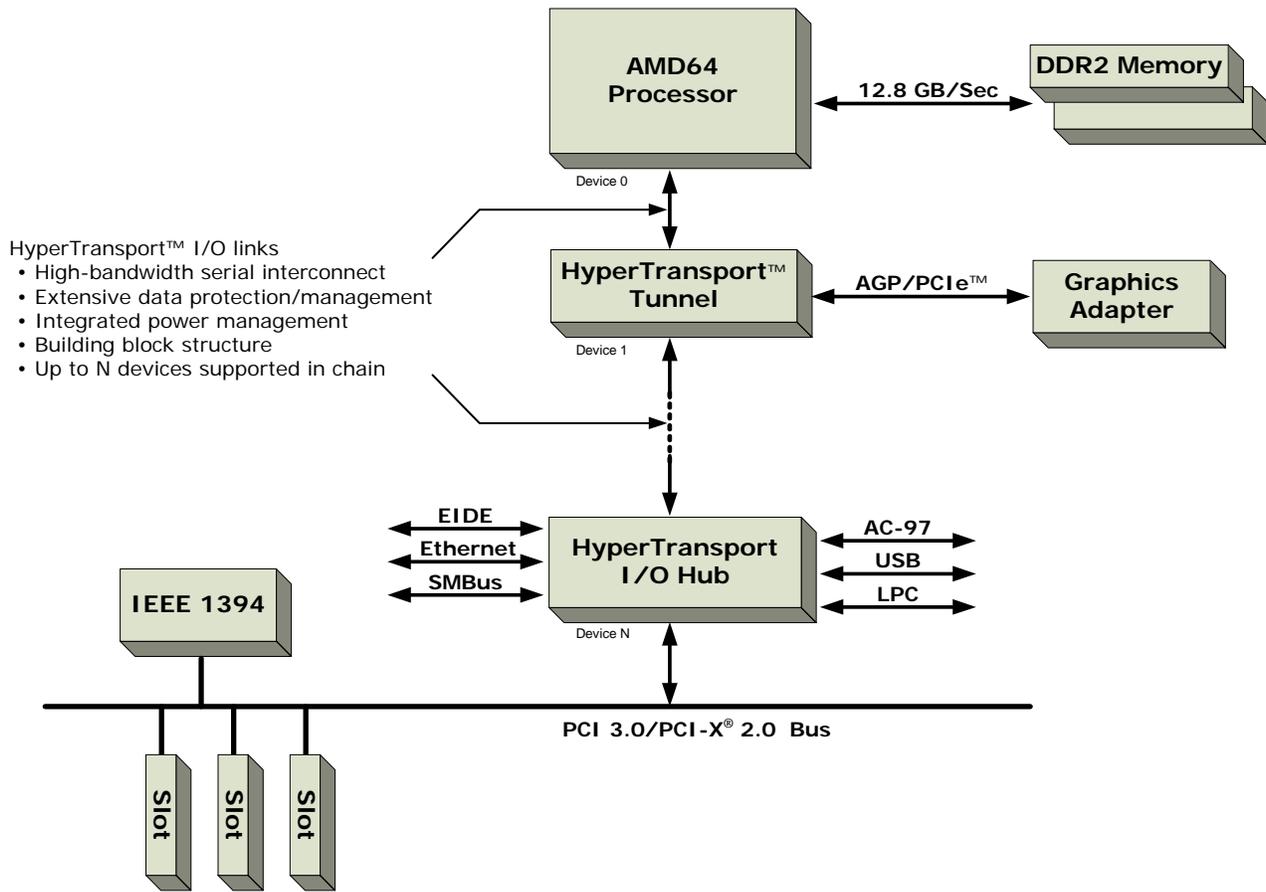
HyperTransport™ I/O links
• High-bandwidth serial interconnect
• Extensive data protection/management
• Integrated power management
• Building block structure
• Up to N devices supported in chain

Figure 2. HyperTransport™ Technology Block Diagram

- The SSE3 instruction set and 3DNow!™ Professional (SSE and 3DNow! Enhanced) support all industry-standard x86 32-bit instruction set extensions.

- 64-bit processing

  – A 64-bit address and data set enables processing in the terabyte space.

  – Microsoft Windows® XP Professional 64-Bit Edition for 64-Bit Extended Systems supports up to 32 GB of RAM and up to 16 TB of virtual memory.

  – Gamers can preload entire three-dimensional worlds into memory for a fully immersive experience.

  – Home video enthusiasts can easily edit video recordings, with professional-quality results.

  – The 64-bit space is designed to bring home the digital experience.

- The first true on-die dual core x86 PC processor

  – Inter-core communication at CPU speed

  – Direct access to memory controller and HyperTransport™ technology link

AMD Quad FX Platform with Dual Socket Direct Connect Architecture

The AMD Quad FX Platform with Dual Socket Direct Connect Architecture (see Figure 3) is a two-socket, four-core processing solution that features high-bandwidth processor-to-processor communication between matched pairs of AMD Athlon™ 64 FX-70, FX-72, and FX-74 dual-core processors.
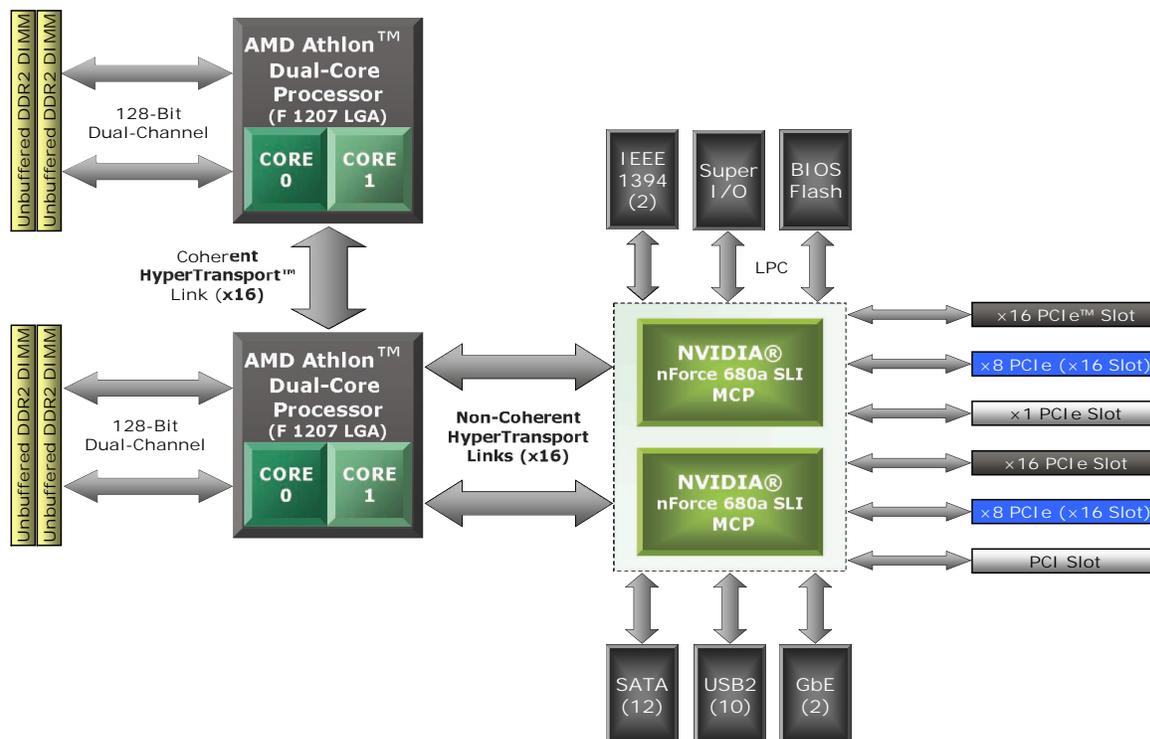
Figure 3. AMD Quad FX Platform with Dual Socket Direct Connect Architecture

The platform enhances the personal computing experience by exploiting the full potential of the latest multi-threaded applications running under Windows Vista™. Currently-shipping motherboards include the following features.

- Twelve SATA RAID interfaces
- Two Gigabit Ethernet (GbE) interfaces
- Ten USB 2.0 interfaces
- Two IEEE 1394 interfaces
- UAA HD Audio, External CODEC
- SP/PP/PS2 connections
- Optical/Coax SPDIF connections

Benchmarking Methodology

This chapter describes the benchmarks used to generate the performance scores shown in this guide. The benchmarks are chosen with the following points in mind.

- AMD Athlon™ 64 processors can run multiple tasks very efficiently.

- Systems based on AMD Athlon 64 processors can take advantage of unique architectural features to deliver outstanding performance for media creation and playback.

- The high performance of AMD Athlon 64 processors can significantly enhance the three-dimensional display capabilities of a gaming system[1].

AMD recommends these benchmarks for proper, balanced, real-world performance analysis.

Benchmark Description

Two versions of the Microsoft Windows® operating system are used to run three sets of benchmark applications.

- 64-bit Windows Vista™ running 64-bit applications

- 64-bit Windows Vista running 32-bit applications

- 32-bit Windows® XP Professional running 32-bit applications

For some applications, both a 64-bit version and a 32-bit version are run. The descriptions that follow indicate which versions are used. Table 4 summarizes the sets of applications.

- MAXON Computer GmbH, CINEBENCH 9.5

  – Multiprocessor video performance benchmarking[2]
  – Tested as a 64-bit application running under Windows Vista, a 32-bit application running under Windows Vista, and a 32-bit application running under Windows XP Professional

- Robert M. Hyatt, Crafty, Version 19.19 (Four-Thread Version)

  – High-level, computation-intensive chess
  – Tested as a 64-bit application running under Windows Vista, a 32-bit application running under Windows Vista, and a 32-bit application running under Windows XP Professional

- Smoky City Design, LLC, Panorama Factory, Version 4.4

  – Photo stitching
  – Tested as a 64-bit application running under Windows Vista and a 32-bit application running under Windows XP Professional

- Persistence of Vision Raytracer Pty. Ltd., POV-Ray 3.7beta-14
  - 3D graphic creation
  - Tested as a 64-bit application running under Windows Vista, a 32-bit application running under Windows Vista, and a 32-bit application running under 32-bit Windows XP Professional

- Futuremark Inc., 3DMark™06, Build 1.0.2
  - 3D game performance benchmarking
  - Only the CPU tests are run[2]
  - Tested as a 32-bit application running under Windows Vista™ and a 32-bit application running under Windows® XP Professional

- Twelve Tone Systems, Inc., Cakewalk Sonar, Version 5
  - Music composition
  - Tested as a 32-bit application running under Windows Vista and a 32-bit application running under Windows XP Professional

- DivX, Inc., Dr. DivX, Version 2.0 (DivX Codec 6.4)
  - Video encoding
  - Tested as a 32-bit application running under Windows Vista and a 32-bit application running under Windows XP Professional

- Sony Corporation of America, Vegas, Version 7.0
  - Video file conversion
  - Tested as a 32-bit application running under Windows Vista and a 32-bit application running under Windows XP Professional

- High Performance Gaming and Multimedia Experience operating scenario (NCsoft Corporation, City of Villains, Version 10.2 and Microsoft, Inc., Windows Media Encoder, Version 9.00.00.2980)
  - High-performance online gaming[1] and video encoding
  - City of Villains is launched and on-line game play is initiated
  - Windows Media Encoder converts an MPEG2 file to MPEG4 format
  - Tested as a 32-bit application running under Windows XP Professional

1. Computer gaming benchmarks may reveal the limitations of a graphics card and may not truly represent relative processor performance.

2. The term "Central Processing Unit (CPU)" often refers to devices with a single processing unit. AMD uses the term "processor" to designate a computing device that contains one or more processing units, or "cores". The term "multiprocessor" refers to a computer system that contains more than one core, either in a single device or in multiple devices. The CINEBENCH benchmark and the 3DMark06 CPU benchmark can test single or multiprocessor systems.

Table 4. Benchmark Application Sets

Windows Vista™, 64-bit Applications
CINEBENCH 9.5
Crafty 19.19 (four-thread version)
Panorama Factory 4.4
POV-Ray 3.7beta-14
Windows Vista™, 32-bit Applications
3DMark™06 1.02 (CPU)
Cakewalk Sonar 5
CINEBENCH 9.5
Crafty 19.19 (four-thread version)
Dr.DivX 2.0 (DivX Codec 6.4)
POV-Ray 3.7beta-14
Vegas 7.0
Windows® XP Professional, 32-bit Applications
3DMark06 1.02 (CPU)
Cakewalk Sonar 5
CINEBENCH 9.5
Crafty 19.19 (4-thread version)
Dr.DivX 2.0) (DivX Codec 6.4)
High Performance Gaming and Multimedia Experience
Panorama Factory 4.4
POV-Ray 3.7beta-14
Vegas 7.0

Benchmarking System Configuration

This chapter describes the system configurations used for benchmarking and provides setup procedures for the AMD Athlon™ 64 processors in this document.

Test System Configurations

Systems that are configured as described in the following tables are most likely to demonstrate optimal system performance.

Table 5. AMD Athlon™ 64 Single Socket Dual-Core Processor System

Component	Manufacturer	Model	Description
Processor	AMD	AMD Athlon™ 64 FX-62 Dual-Core Processor	2.8 GHz clock frequency
Operating System	Microsoft®	Windows® XP Professional Windows Vista™	Version 2002 (Service Pack 2) RC2
Motherboard	ASUS	M2N32-SLI Deluxe	NVIDIA® nForce 590 SLI MCP SATA Driver 5.10.2600.652
BIOS	ASUS	Crashfree BIOS 3	Version 3092
Hard Drive (2)	Western Digital	Raptor WD1500ADFD	SATA RAID 0 10k RPM 150 GB
RAM (4)	Corsair	CM2X1024-8500SD	1 GB PC8500 DDR2 DIMM 800 MHz
Video Card (2)	NVIDIA	7950 GX2 (Quad SLI mode) 1600x1200	1 GB GDDR3 Onboard RAM, Video Driver 6.14.10.9371

Table 6. AMD Quad FX Platform with
Dual Socket Direct Connect Architecture

Component	Manufacturer	Model	Description
Processor (2)	AMD	AMD Athlon™ 64 FX-70 Dual-Core Processor	2.4 GHz clock frequency
		AMD Athlon 64 FX-72 Dual-Core Processor	2.6 GHz clock frequency
		AMD Athlon 64 FX-74 Dual-Core Processor	2.8 GHz clock frequency
Operating System	Microsoft®	Windows® XP Professional Windows Vista™	Version 2002 (Service Pack 2) RC2
Motherboard	ASUS	LIN64-SLI WS	NVIDIA® nForce 590 SLI MCP SATA Driver 5.1.2600.667
BIOS	ASUS	Crashfree BIOS 3	Version 0120
Hard Drive (2)	Western Digital	Raptor WD1500ADFD	SATA RAID 0 10K RPM 150 GB
RAM (4)	Corsair	CM2X1024-8500SD	1 GB PC8500 DDR2 DIMM 800 MHz
Video Card (2)	NVIDIA	7950 GX2 (Quad SLI Mode) 1600x1200	1 GB GDDR3 Onboard RAM, Video Driver 6.14.10.9371

Windows Vista™ Installation

Configure the BIOS, RAID, OS, and drivers as follows to achieve optimal system performance. These procedures apply to all processors.

BIOS Configuration

> *Note:* *These instructions apply only to the ASUS M2N32-SLI Deluxe and L1N64-SLI WS motherboards. Refer to the BIOS configuration utility help for additional information about configuration menus and key combinations used to change BIOS settings.*

1. Start the computer.
2. Press **Delete** to enter the BIOS configuration utility.
3. Select the **Exit** menu.
    a. Select **Load setup defaults**.
    b. Press **OK**.
    c. Press **ESC** to return to the **Main** menu.

4.   Select the **Main** menu.
a. Set **Date** and **Time**.
i. Select the **IDE Configuration** menu.
ii. Enable **OnChip RAID1 Function**.
iii. Enable **SATA 1** through **SATA 6**.
b. Press **ESC** to return to the **Main** menu.
5.   Select the **Advanced** menu.
a. Select the **JumperFree Configuration** menu.
i. Set **AI Overclocking** to **Manual**.
ii. Press **ESC** to return to the **Advanced** menu.
b. Select the **CPU Configuration** menu.
i. Disable **Secure Virtual Machine**.
ii. Press **ESC** to return to the **Advanced** menu.
c. Select the **Chipset** menu.
i. Select the **Memory Controller** menu.
ii. Set **Memclock Mode** to **Manual**.
iii. Set **Memclock Value** to **800 MHz**.
iv. Set **CAS Latency (CL)** to **4.0**.
v. Set **TRCD** to **4 CLK**.
vi. Set **TRP** to **4 CLK**.
vii. Set **TRAS** to **12 CLK**.
viii. Set **Node Interleaving** to **Disabled**.
ix. Press **ESC** to return to the **Chipset** menu.
d. Select the **SouthBridge Configuration** menu.
i. Disable **OnChip LAN2**.
ii. Press **ESC** to return to the **Chipset** menu.
e. Press **ESC** to return to the **Advanced** menu.
f. Select the **Onboard Device Configuration** menu.
i. Disable **Serial Port1 Addr**.
ii. Disable **Parallel Port Addr**.
iii. Disable **OnBoard VT6308 1394**.
iv. Disable **OnBoard Sil3531 eSATA**.
v. Press **ESC** to return to the **Advanced** menu.
g. Select the **PCIPnP** menu.
i. Set **Plug and Play O/S** to **Yes**.
ii. Press **ESC** to return to the **Advanced** menu.

      h. Select the **Power** menu.

         i. Set **ACPI Version Features** to **v3.0**.

         ii. Press **ESC** to return to the **Advanced** menu.

      i. Press **Esc** to return to the **Main** menu.

6. Select the **Boot** menu.

      a. Select the **Boot Settings Configuration** menu.

      b. Set **Full Screen Logo** to **Disable**.

7. Press **F10** to save and exit.

8. Press **OK**.

RAID Configuration

1. Power up the computer.
2. Press the **F10** key to enter the **RAID Settings** screen.
3. Press the right-arrow cursor control key twice to move both disk drives into the **Array Disks** pane.
4. Change **RAID-mode** to **Striping**.
5. Press the **TAB** key until **Striping block** is selected.
6. Change the block size value to **64K**.
7. Press the **F7** key.
8. At the prompt, type "Y" to clear disk data.

Operating System Configuration

1. Delete all existing partitions.
2. Create two new NTFS partitions of equal size (logical drives C: and D:).
3. Install Windows Vista in `C:\`.
4. Restart the computer when installation is complete.
5. Disable the sidebar by right-clicking the vacant area adjacent to the right edge of the screen, then selecting **Close sidebar**.
6. Right-click the corresponding task bar icon, then click **Exit**.
7. Unselect the option, then confirm the corresponding pop-up.
8. Disable User Account Control (UAC) as follows.

      a. Click **Start**, then click **Control Panel**.

         i. Click **User Accounts and Family Safety**.

         ii. Click **User Accounts**, then click **Turn User Account Control...**

         iii. A pop-up opens. Click **Continue**.

         iv. Unselect **Use User Account Control**.

         v. A pop-up opens. Click **Restart now**.

      b. The computer restarts and the **Welcome Center** window opens.

9. Unselect **Run at startup (Welcome Center....** at the bottom of the **Welcome Center** window, and close the window.

10. Disable the screen saver and adjust the power and display settings as follows.

   a. Right-click a vacant area of the desktop, then select **Personalize**.

   b. The **Personalization** window opens.

   c. Select **Screensaver**.

   d. The **Screen Saver Settings** window opens.

   e. Select **(None)**.

   f. Click **Change power settings**.

      i. The **Power Settings** window opens.

      ii. Select **High performance**, then click **Change plan settings**.

      iii. Under **Turn off the display**, select **Never**.

      iv. Under **Put the computer to sleep**, select **Never**.

      v. Click **Save changes**, and close the **Power Settings** window.

   g. Click **OK** on the **Screen Saver Settings** window.

   h. Click **Display settings**.

      i. the **Display Settings** window opens.

      ii. Use the slide control to select **1280 by 1024 pixels**.

      iii. Click **OK**.

   i. Close the **Personalization** window.

11. Enable best performance and disable system restore as follows.

   a. Click **Start**, then click **Control Panel**.

   b. Click **System Maintenance**.

   c. Click **System**.

      i. Click **Advanced System Settings** in left panel.

      ii. Click **Performance Settings**.

      iii. Select **Adjust for Best Performance**.

      iv. Click **OK**.

      v. Select the **System Protection** tab.

      vi. Unselect all selected HDD.

   d. A pop-up opens.

   e. Click **Turn System Restore Off**.

   f. Click **OK**.

   g. Close the control panel window.

12. Disable security alerts and automatic updating as follows.

   a. Click **Start**, then click **Control Panel**.

   b. Click **Security**.

   c. Click **Security Center**.

    d. The **Security Center** window opens.

      i. Click **Change the way Security Center alerts me** on the left panel, then select **Don't notify and don't display…**

      ii. Close the **Security Center** window.

    e. Click **Turn automatic updating on or off**.

    f. A window opens.

      i. Select **Never check for updates**.

      ii. Click **OK**.

    g. Click **Turn firewall on or off**.

    h. A window opens.

      i. Select **Off**.

      ii. Click **OK**.

    i. Close the control panel window.

Windows® XP Professional Installation

BIOS Configuration

> ***Note:*** *These instructions apply only to the ASUS M2N32-SLI Deluxe and L1N64-SLI WS motherboards. Refer to the BIOS configuration utility help for additional information about configuration menus and key combinations used to change BIOS settings.*

1. Power up the computer.
2. Press **Delete** to enter the BIOS configuration utility.
3. Select the **Exit** menu.
   a. Select **Load setup defaults**.
   b. Press **OK**.
   c. Press **ESC** to return to the **Main** menu.
4. Select the **Main** menu.
   a. Set **Date** and **Time**.
      i. Select the **IDE Configuration** menu.
      ii. Enable **OnChip RAID1 Function**.
      iii. Enable **SATA 1** through **SATA 6**.
   b. Press **ESC** to return to the **Main** menu.
5. Select the **Advanced** menu.
   a. Select the **JumperFree Configuration** menu.
      i. Set **AI Overclocking** to **Manual**.
      ii. Press **ESC** to return to the **Advanced** menu.
   b. Select the **CPU Configuration** menu.
      i. Disable **Secure Virtual Machine**.
      ii. Press **ESC** to return to the **Advanced** menu.
   c. Select the **Chipset** menu.
      i. Select the **Memory Controller** menu.
      ii. Set **Memclock Mode** to **Manual**.
      iii. Set **Memclock Value** to **800 MHz**.
      iv. Set **CAS Latency (CL)** to **4.0**.
      v. Set **TRCD** to **4 CLK**.
      vi. Set **TRP** to **4 CLK**.
      vii. Set **TRAS** to **12 CLK**.
      viii. Set **Node Interleaving** to **Auto**.
      ix. Press **ESC** to return to the **Chipset** menu.

    d. Select the **SouthBridge Configuration** menu.

       i. Disable **OnChip LAN2**.

       ii. Press **ESC** to return to the **Chipset** menu.

    e. Press **ESC** to return to the **Advanced** menu.

    f. Select the **Onboard Device Configuration** menu.

       i. Disable **Serial Port1 Addr**.

       ii. Disable **Parallel Port Addr**.

       iii. Disable **OnBoard VT6308 1394**.

       iv. Disable **OnBoard Sil3531 eSATA**.

       v. Press **ESC** to return to the **Advanced** menu.

    g. Select the **PCIPnP** menu.

       i. Set **Plug and Play O/S** to **Yes**.

       ii. Press **ESC** to return to the **Advanced** menu.

    h. Select the **Power** menu.

       i. Set **ACPI Version Features** to **v2.0**.

       ii. Press **ESC** to return to the **Advanced** menu.

    i. Press **Esc** to return to the **Main** menu.

6. Select the **Boot** menu.

    a. Select the **Boot Settings Configuration** menu.

    b. Set **Full Screen Logo** to **Disable**.

7. Press **F10** to save and exit.

8. Press **OK**.

RAID Configuration

1. Power up the computer.
2. Press the **F10** key to enter the **RAID Settings** screen.
3. Press the right-arrow cursor control key twice to move both disk drives into the **Array Disks** pane.
4. Change **RAID-mode** to **Striping**.
5. Press the **TAB** key until **Striping block** is selected.
6. Change the block size value to **64K**.
7. Press the **F7** key.
8. At the prompt, type "Y" to clear disk data.

Operating System Configuration

Install and configure the operating system as follows.

> *Note:* *Use only Microsoft® Windows® XP Professional with Service Pack 2.*
> *The system being configured must have a floppy disk drive.*

1.   Copy the contents of the directory
     `drivers\chipset\32-bit\ide\winXP\sataraid`
     `from` the driver and utility CD-ROM supplied with the motherboard to a floppy disk.
2.   Place the floppy disk in the floppy disk drive.
3.   Place the OS installation disk in the CD drive.
4.   Start the computer.
5.   Press **F8** to access the boot device menu.
6.   Select **CD-ROM** and press the space bar.
7.   Press **F6** to install third-party SATA RAID drivers.
8.   Select **WinXP NVIDIA Class Raid Driver** and press **Enter**.
9.   Press **S** to specify an additional device.
10. Select **WinXP NVIDIA Nforce Storage Controller** and press **Enter**.
11. When driver installation is complete, press **Enter** to continue.
12. Eject the floppy disk, then restart the computer.
13. Delete all existing partitions.
14. Create two new NTFS partitions of equal size (logical drives C: and D:).
15. Install Windows XP Professional in `C:\`.
16. Click **Yes** to verify installation of serial all ATA drivers.
17. Click **Next** to continue with **Regional and Language Options**.
18. Type in your name and organization.
19. Type in a valid Windows XP product key and click **Next**.
20. Type in the administrator password twice and click **Next**.
21. Type in a user name and click **Next**.
22. Click **Finish**.
23. Restart the system and log in.
24. The **Help Protect MY PC** screen opens.
25. Select **Not right Now** and click **Next.**
26. Close the balloon **Your computer might be at risk** in the security center window.
27. Select **Windows firewall** under **manage security settings***.*
28. Select **Off** and click **Ok.**
29. Select **Change the way security center alerts me**, under **Resources**.
30. Deselect all the boxes on the dialog box, and click **OK.**
31. Close the window.
32. Right-click on **My Computer** on the Desktop.
33. Select **Properties** and click the **Advanced** tab.
34. Select **Performance Options**.

35. Click **Settings** and click **Advanced**.

36. Click **Change for Virtual Memory**.

37. Select drive **C:**.

38. Select **No paging file** under **Change virtual memory (paging file)**.

39. Click **Set**.

40. Select drive **D:**

41. Select **Custom size**.

42. Type **2046** MB for Initial Size.

43. Type **4092** MB for Maximum Size.

44. Click **Set**.

45. Click **Ok** and restart computer.

46. Right-click **My Computer** on the desktop.

47. Select **Properties** and click **Automatic Updates**.

48. Select **Turn off Automatic Updating. I want to update my computer manually**.

49. Click **Apply**.

50. Click **System Restore** and select **Turn off System Restore on all drives**.

51. Click **Apply**.

52. Click **Yes** to verify Turn Off System Restore.

53. Right-click **My Computer** icon on the desktop.

54. Select **Properties** and click the **Advanced** tab.

55. Click **Settings** under **Performance**.

56. Select **Adjust for best performance**.

57. Click **Apply**.

58. Right-click the task bar and select **Properties**.

59. Deselect **Keep the taskbar on top of other Windows**.

60. Click **Apply**.

61. Open the **Control Panel** and double-click **Power Options**.

62. Select **Always On** from **Power Schemes** and select **Never** to **Turn off monitor**.

63. Click **Apply**.

64. Right-click on the desktop and select **Properties**.

65. Click **Screen Saver** and select **None**.

66. Click **Apply**.

Driver Installation

1. Install the Windows® XP Professional processor drivers as follows.

   a. Go to http://www.amd.com/us-en/Processors/TechnicalResources.

   b. Click the **Utilities and Drivers** link under **Support**.

   c. Click the appropriate link under **AMD Athlon™ 64/FX Processors**.

   d. Click the *Download Now!* link next to **AMD Athlon 64 Processor Driver for Windows XP and Windows Server 2003** to download the installer file (amdcpusetup.exe).

   e. Click the *Download Now!* link next to **AMD Dual-Core Optimizer for Windows XP** to download the installer file (tscsetup.exe).

   f. Double-click the amdcpusetup.exe installer file.

   g. Click **Yes** to acknowledge the license agreement.

   h. Choose a destination folder and click **Next**.

   i. Click **Finish**, then click **Yes** (the system restarts).

   j. Double-click the tscsetup.exe installer file.

   k. Click **Next**.

   l. Click **Finish**.

2. Install the October 2006 version of Microsoft DirectX End-User Runtime as follows.

   a. Download the installer file (directx_oct2006_redist.exe) from http://www.microsoft.com/downloads/details.aspx?FamilyID=013C0F78-3C9B-44DC-B8BE-46783BCAC3CB&displaylang=en.

   b. Double-click the installer file.

   c. Select **I accept the agreement** to acknowledge the license agreement, then click **Next** to download and install the complete DirectX package.

   d. Click **Finish** (the system restarts).

3. Install the video drivers as follows.

   a. Place the installation disk supplied with the motherboard in the CD drive.

   b. Navigate to the NVIDIA GeForce graphics driver installer file (93.71_forceware_winxp2k_english_whql.exe).

   c. Double-click the installer file.

   d. Click **Yes** to acknowledge the license agreement.

   e. Click **Next** on the next two screens.

   f. Click **Finish** to complete the installation.

   g. Click **Yes** (the system restarts).

   Note: *Make sure an SLI-related message is shown in the system tray after restart.*

4.　Install the chipset drivers as follows.

   a. Place the installation disk supplied with the motherboard in the CD drive.

   b. Navigate to the chipset driver (`setup.exe`).

   c. Double-click the `setup.exe` file.

   d. Click **Next** on the next three screens.

   e. Click **Yes** to acknowledge the **NVIDIA ISE SW drivers** window.

   f. Click **No** to **Forceware Network Access Manager**.

   g. Click **Finish** (the system restarts).

5.　Install the audio drivers as follows.

   a. Place the installation disk supplied with the motherboard in the CD drive.

   b. Navigate to the audio driver (`setup.exe`).

   c. Double-click the `setup.exe` file.

   d. Click **Next**.

   e. Click **Finish** to complete the installation.

Video Card Setup

1.　Right-click the desktop, then select **Properties**.
2.　The **NVIDIA Control Panel** opens.
3.　Choose **Display**.
4.　Change **Resolution Attributes** to 1600 X 1200.

Benchmark Installation and Testing

To achieve accurate scores, carefully follow the procedures in this chapter. Make sure the computer system is properly configured (see Benchmarking System Configuration) before installing and running benchmarks.

The benchmarks run a variety of applications under two operating systems. Unless other instructions are provided, the complete benchmark is contained on a distribution disk provided by AMD, and executed by a script created by AMD.

Each application is subject to the licensing terms contained therein, and each application on the distribution disk is provided subject to its respective licensing terms. It is the responsibility of the person running the tests to comply with the licensing terms for the applications on the disk, and to obtain licensed copies of the other applications and the operating systems.

To obtain a copy of the distribution disk or of individual scripts, please send an email to AMD64.info@AMD.com. To expedite the request, please use the subject line "Benchmark request" and list the requested items in the body of the message.

Windows Vista™, 64-Bit Applications

Before beginning benchmarking, disable the network adapter and disconnect the network cable from the computer.

For all benchmarks, if a negative number is displayed in the results, the benchmark must be run again.

CINEBENCH

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `cinebench_9.6_64bit.exe`.

   Note: The benchmark displays version 9.5 when it starts.
3. Select the **Rendering (x CPU)** benchmark from the panel on the left.
4. Click **Run**.
5. Benchmark results are shown next to the **Run** button when testing is complete.

Crafty

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `crafty_bench_0.01.exe`.
3. Benchmark results are written to the `results\` folder when testing is complete.

Panorama Factory

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `panoFact_bench-beta03.exe`.
3. Benchmark results are written to `results.csv` when testing is complete.

POV-Ray

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `povray-bench_0.01.exe`.
3. Benchmark results are written to the `results\` folder.

Windows Vista™, 32-Bit Applications

Before beginning benchmarking, disable the network adapter and disconnect the network cable from the computer.

For all benchmarks, if a negative number is displayed in the results, the benchmark must be run again.

3DMark™06

1. Obtain a licensed copy of 3DMark06 Advanced Edition (Build 1.0.2).

    Note: The application can be purchased and downloaded from http://www.futuremark.com/download/.

2. Double-click `3dmark06_V102_installer.exe`.

3. The installer window opens at the **Welcome** screen. Click **Next**.

4. The **License Agreement** screen opens. Click **I accept the terms of the license agreement** and click **Next**.

5. The **Destination Location** screen opens. Click **Next**.

6. Another screen opens. Click **Install**.

7. The **Open AL** screen opens. Click **OK**.

8. The **DirectX** screen opens. Click **OK**.

9. Another screen opens. Click **Install** to continue.

10. The **Registration Code** screen opens. Enter the code and click **OK**.

11. When prompted, click **Finish**.

Run the Hardware Benchmark

1. Double-click the **3DMark06** shortcut on the desktop.

2. The **Tip of the day** window opens.

3. Check **Do not show this dialog again** and click **Close**.

4. The **Tests** window opens.

5. Adjust the following settings?
    a. Select **Settings**>**Change**>**16x12**.
    b. Select **texture-filtering**>**anisotropic level 16**.
    c. Select t**ests**>**only CPU**.

6. Click **Run 3DMark**.

7. When testing is complete, the results are displayed in a pop-up window.

Cakewalk Sonar

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).

2. Execute `sonar5_bench_0.05.exe` with the appropriate 32-bit switch.

3. Benchmark results are written to the `results\` folder.

CINEBENCH

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `cinebench_9.5.exe`.
3. Select the **Rendering (x CPU)** benchmark from the panel on the left.
4. Click **Run**.
5. Benchmark results are shown next to the **Run** button when testing is complete.

Crafty

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `crafty_bench_0.01.exe` with the appropriate switch.
3. Benchmark results are written to the `results\` folder when testing is complete.

Dr. DivX

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `divX_bench-beta04.exe` with the appropriate switch.
3. Benchmark results are written to `divX_results.csv` when testing is complete.

POV-Ray

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `povray-bench_0.01.exe` with the appropriate switch.
3. Benchmark results are written to the `results\` folder.

Vegas

   Note: This program must not be confused with Sony Vegas Movie Studio 7.

Install the Benchmark

1. Obtain a licensed copy of Vegas.
2. Install the application on the HDD (`c:\`).
3. Register the application.

Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `sony-vegas7-bench_0.01.exe` with the appropriate switch.
3. Benchmark results are written to the `results\` folder.

Windows® XP Professional, 32-Bit Applications

Before beginning benchmarking, disable the network adapter and disconnect the network cable from the computer.

For all benchmarks, if a negative number is displayed in the results, the benchmark must be run again.

3DMark™06

1. Obtain a licensed copy of 3DMark06 Advanced Edition (Build 1.0.2).

    *Note: The application can be purchased and downloaded from
    http://www.futuremark.com/download/.*

2. Double-click `3dmark06_V102_installer.exe`.

3. The installer window opens at the **Welcome** screen. Click **Next**.

4. The **License Agreement** screen opens. Click **I accept the terms of the license agreement** and click **Next**.

5. The **Destination Location** screen opens. Click **Next**.

6. Another screen opens. Click **Install**.

7. The **Open AL** screen opens. Click **OK**.

8. The **DirectX** screen opens. Click **OK**.

9. Another screen opens. Click **Install** to continue.

10. The **Registration Code** screen opens. Enter the code and click **OK**.

11. When prompted, click **Finish**.

Run the Hardware Benchmark

1. Double-click the **3DMark06** shortcut on the desktop.

2. The **Tip of the day** window opens.

3. Check **Do not show this dialog again** and click **Close**.

4. The **Tests** window opens.

5. Adjust the following settings?
    a. Select **Settings**>**Change**>**16x12.**
    b. Select **texture-filtering**>**anisotropic level 16**.
    c. Select t**ests**>**only CPU**.

6. Click **Run 3DMark**.

7. When testing is complete, the results are displayed in a pop-up window.

Cakewalk Sonar

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).

2. Execute `sonar5_bench_0.05.exe` with the appropriate 32-bit switch.

3. Benchmark results are written to the `results\` folder.

CINEBENCH

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `cinebench_9.5.exe`.
3. Select the **Rendering (x CPU)** benchmark from the panel on the left.
4. Click **Run**.
5. Benchmark results are shown next to the **Run** button when testing is complete.
6. score is displayed when testing is complete.

Crafty

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `crafty_bench_0.01.exe` with the appropriate 32-bit switch.
3. Benchmark results are written to the `results\` folder when testing is complete.

Dr. DivX

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Execute `divX_bench-beta04.exe`.
3. Benchmark results are written to `divX_results.csv` when testing is complete.

High Performance Gaming and Multimedia Experience (City of Villains and Windows® Media Encoder 9)

Install the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).
2. Download the Windows Media Encoder 9 installer file (WMEncoder.exe) from http://www.microsoft.com/downloads/details.aspx?FamilyID=5691ba02-e496-465a-bba9-b2f1182cdf24&DisplayLang=en.
3. Install Windows Media Encoder 9 as follows.
   a. Double-click the `WMEncoder.exe` installer file.
   b. The **Welcome** screen opens. Click **Next**.
   c. The **License Agreement** screen opens. Click **I accept the terms in the License Agreement**, then click **Next**.
   d. The **Default Installation Directory** screen opens. Click **Next**.
   e. The **Ready to Install** screen opens. Click **Next**.
   f. When installation is complete, click **Finish**.

Run the Benchmark

1. Execute `cov-wme-bench-2.00)`.

2. City of Villains benchmark results for Game 1 and Game 2 are written to the `results\` folder as the test runs and the Windows Media Encoder 9 Encode Time Panorama Factory

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).

2. Execute `panoFact_bench-beta03.exe`.

3. Benchmark results are written to `results.csv` when testing is complete.

POV-Ray

Install and Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).

2. Execute `povray-bench_0.01.exe`.

3. Benchmark results are written to the `results\` folder.

Vegas

   Note: This program must not be confused with Sony Vegas Movie Studio 7.

Install the Benchmark

1. Obtain a licensed copy of Vegas.

2. Install the application on the HDD (`c:\`).

3. Register the application.

Run the Benchmark

1. Transfer the contents of the install folder on the distribution disk to the HDD (`c:\`).

2. Execute `sony-vegas7-bench_0.01.exe`.

3. Benchmark results are written to the `results\` folder.

Benchmarking Results

The performance data presented in this section is obtained using the methods, configurations, and procedures described in Benchmarking Methodology, Benchmarking System Configuration, and Benchmark Installation and Testing.

An overall performance graph presents all the performance data. Each set of benchmarks has an overall performance graph and graphs for each test in the set. Table 7 summarizes all the performance data.

Please contact AMD if you have questions about AMD processor performance.

Overall Performance
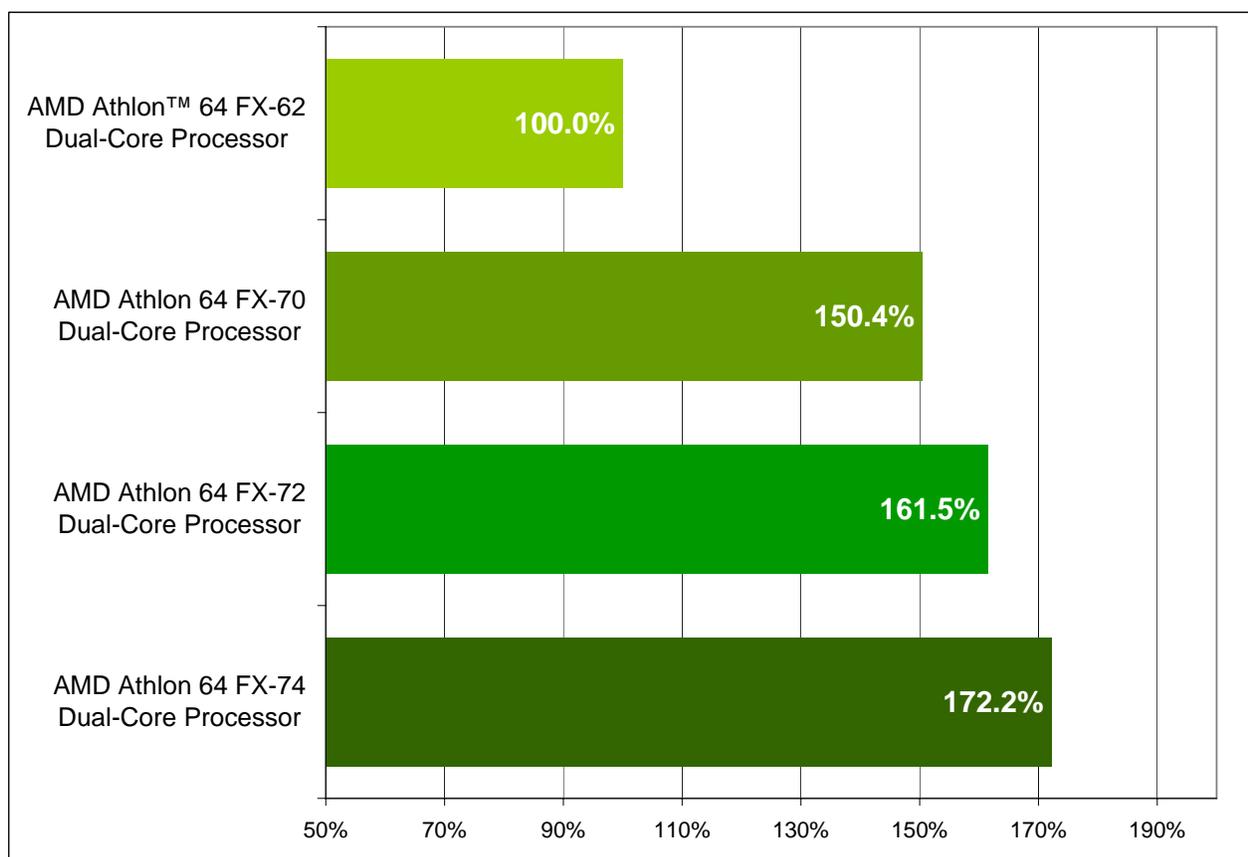
Figure 4. Overall Performance

Windows Vista™, 64-Bit Applications
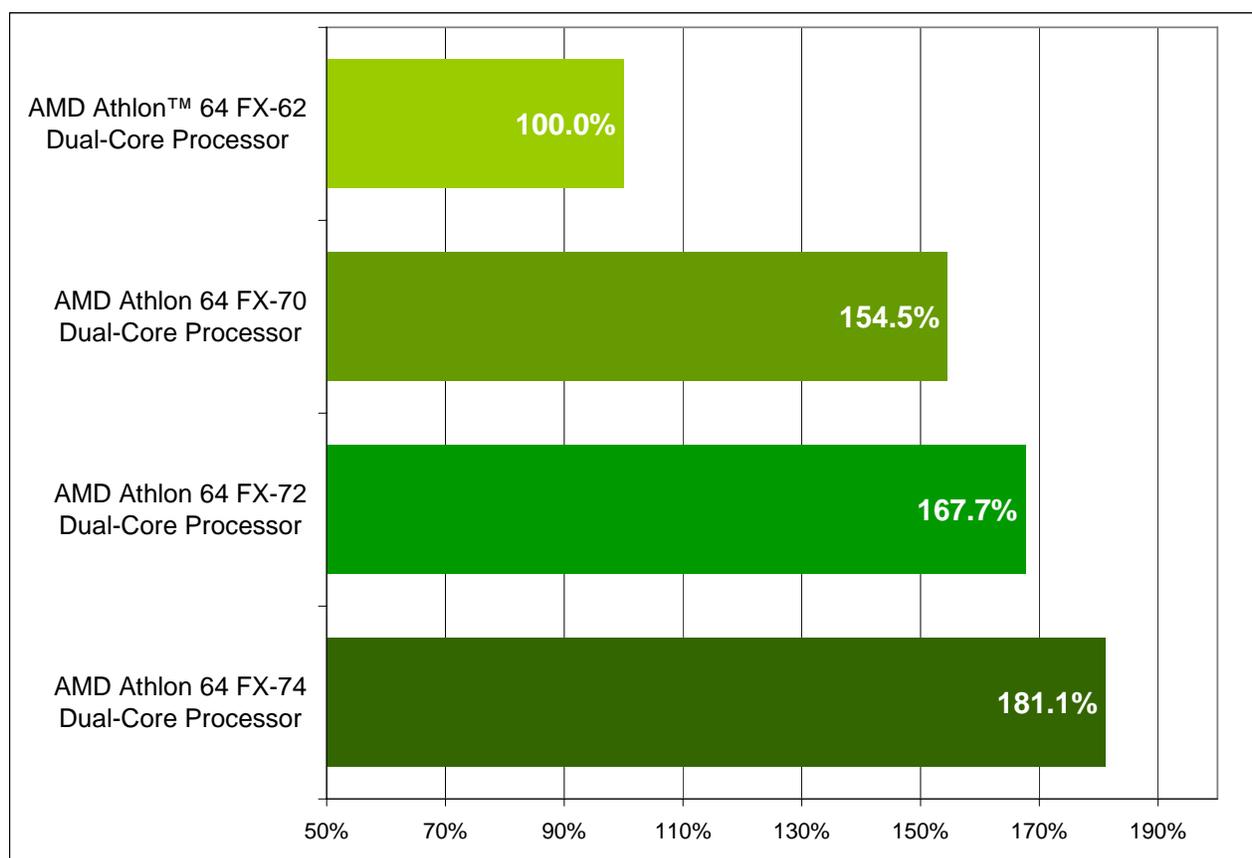
Figure 5. Overall Performance, Windows Vista™, 64-Bit Applications
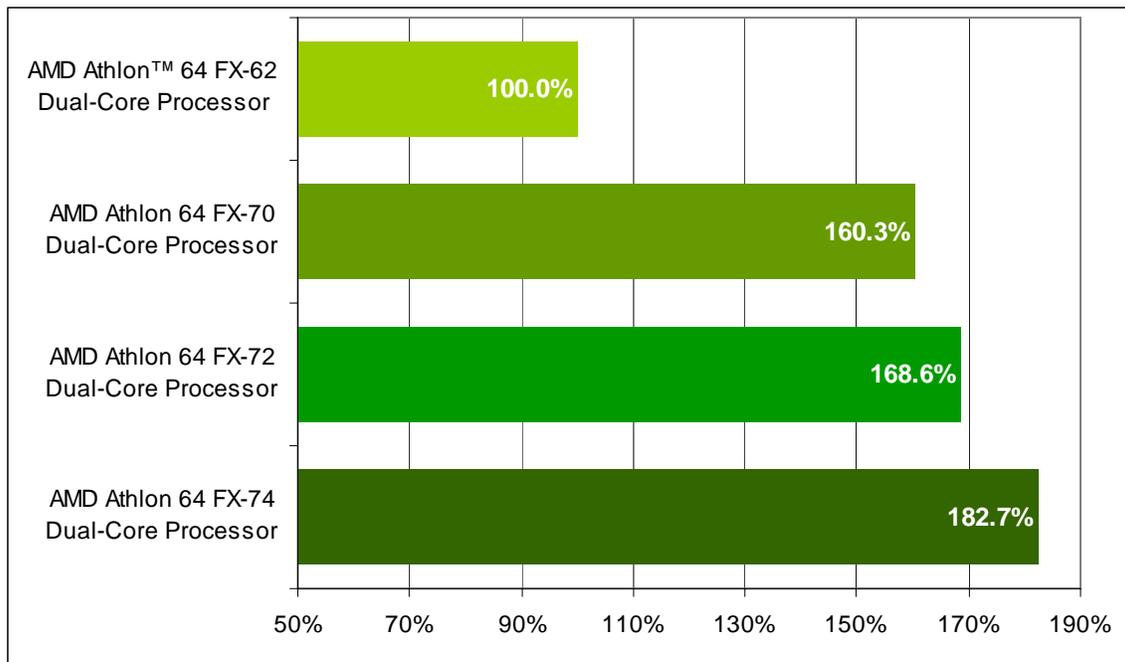
Figure 6. CINEBENCH Performance
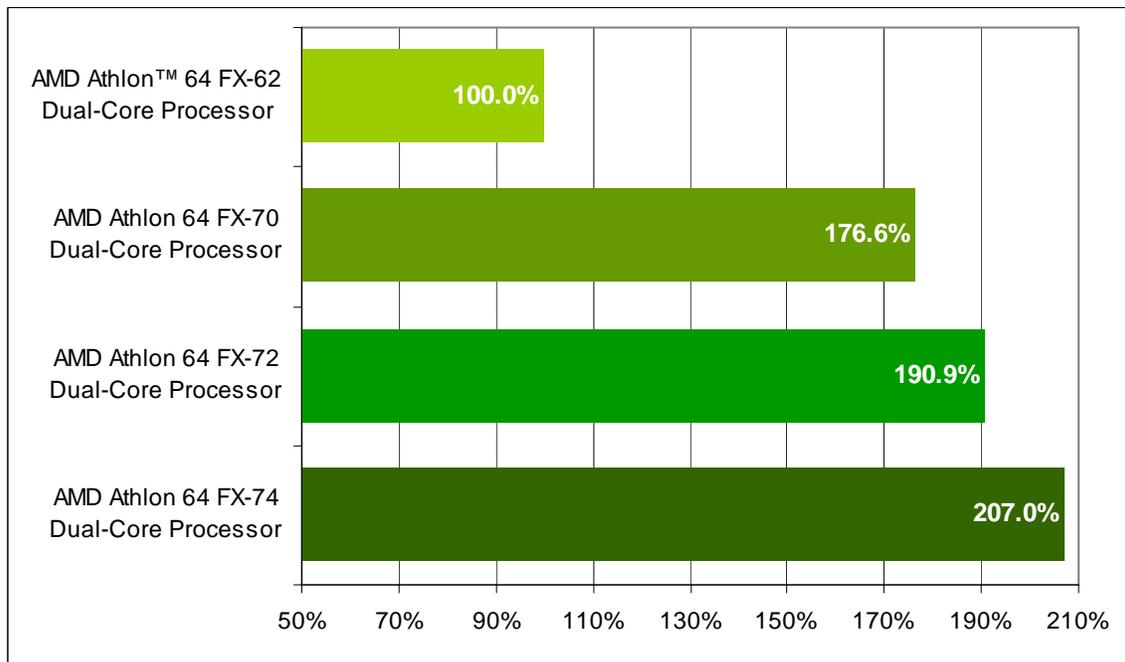
Figure 7. Crafty Performance¹

1. Computer gaming benchmarks may reveal the limitations of a graphics card and may not truly represent relative processor performance.
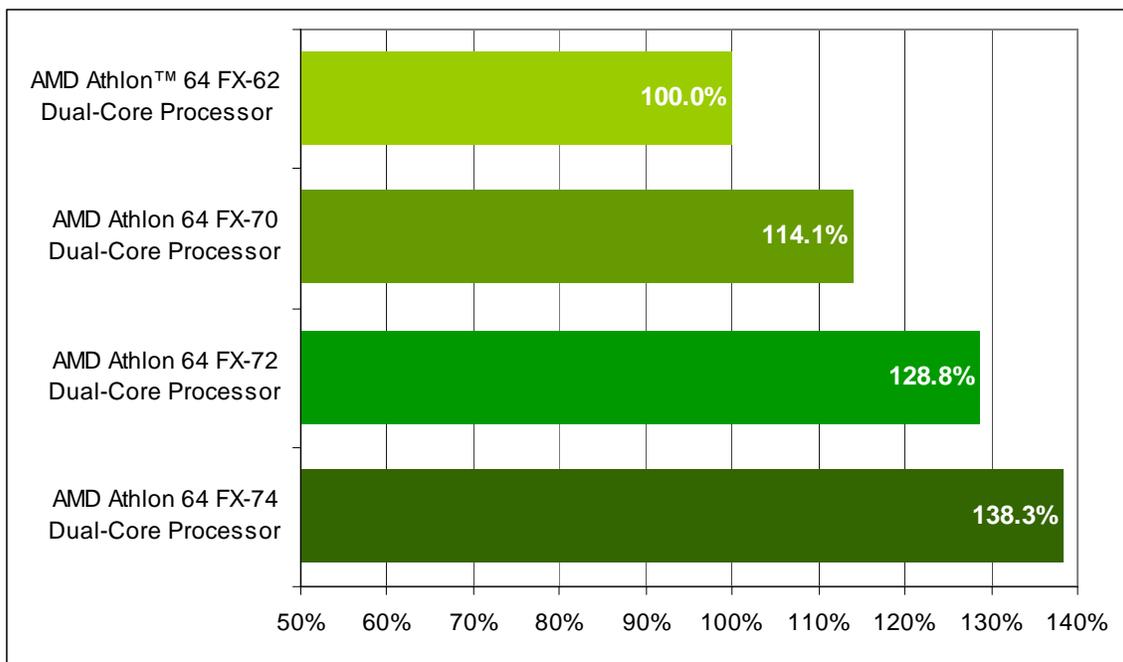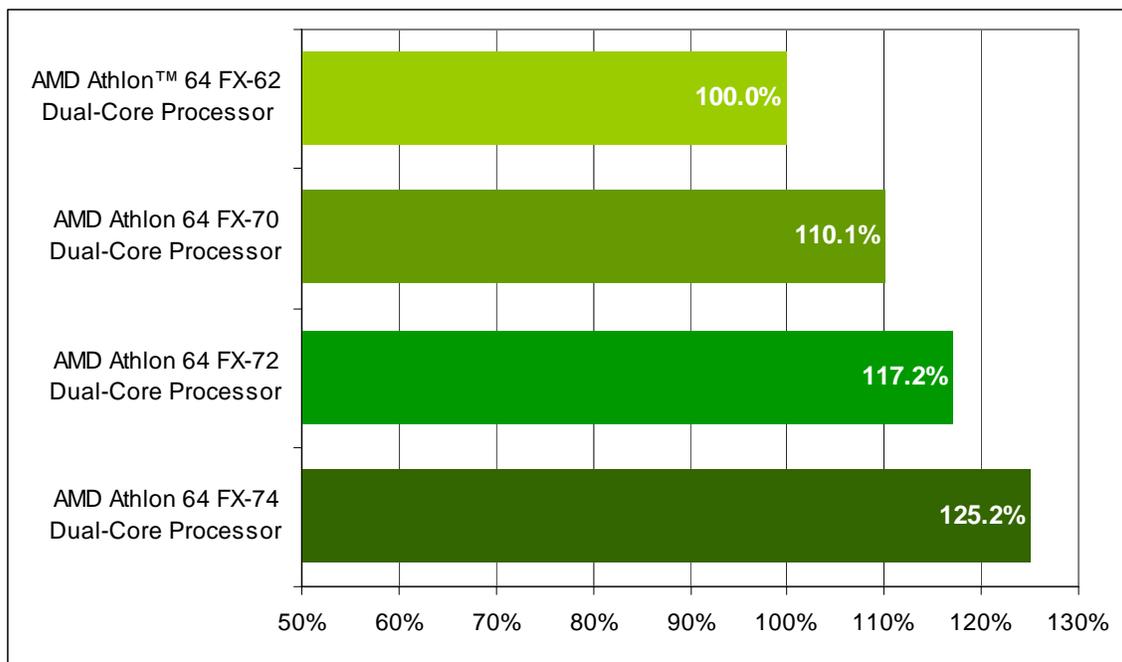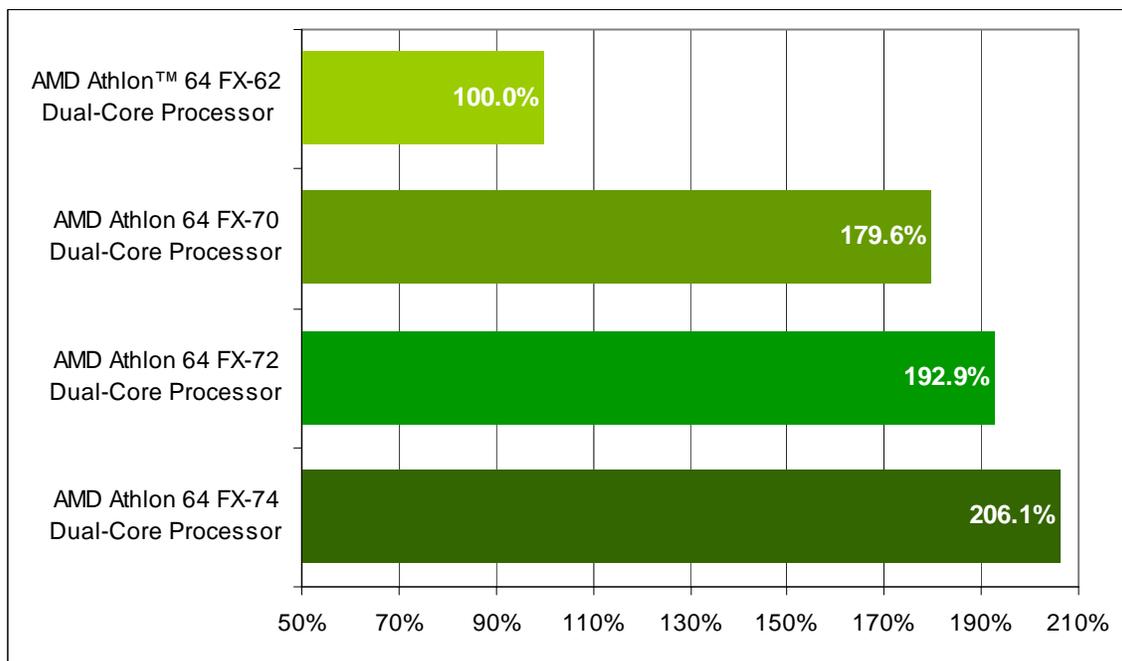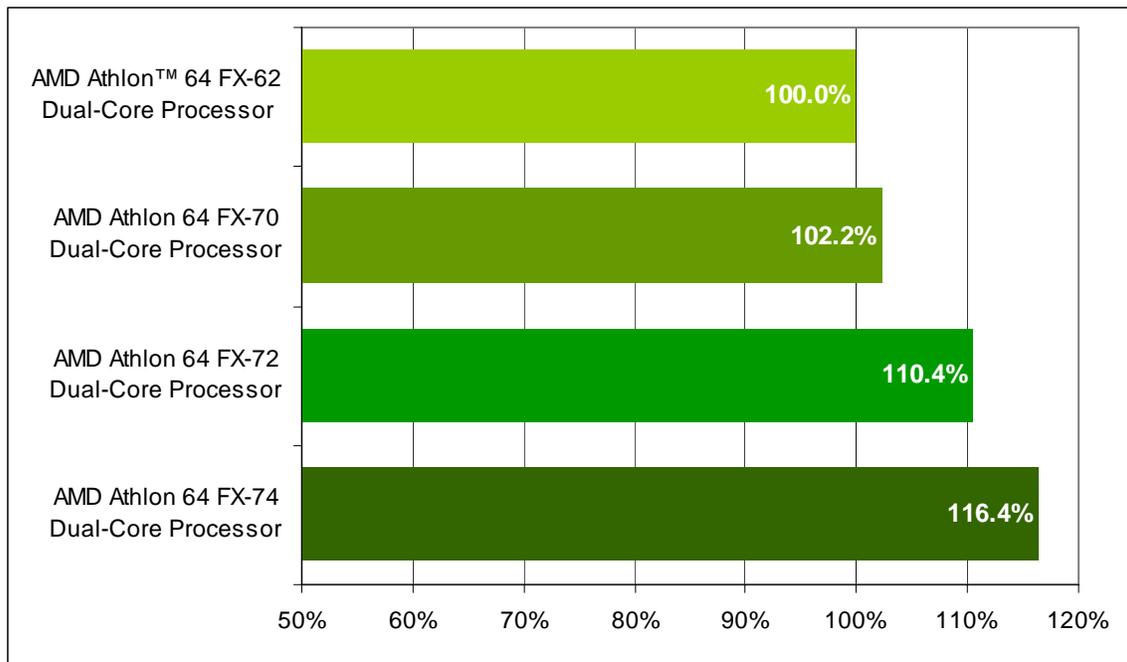
Figure 8. Panorama Factory Performance
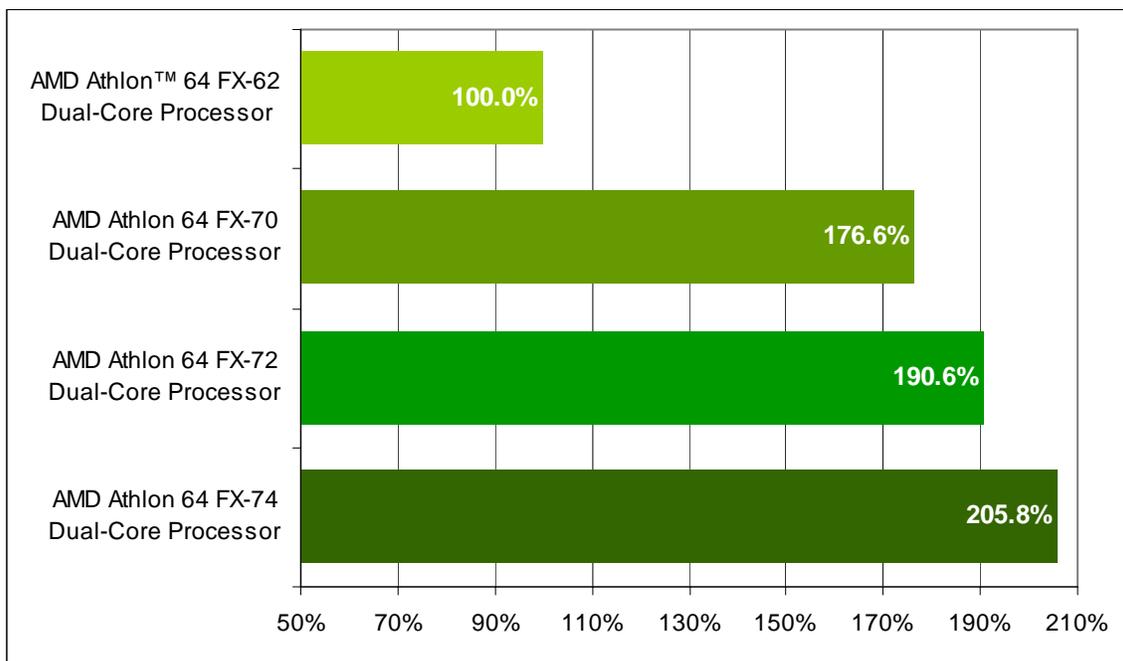
Figure 9. POV-Ray Performance
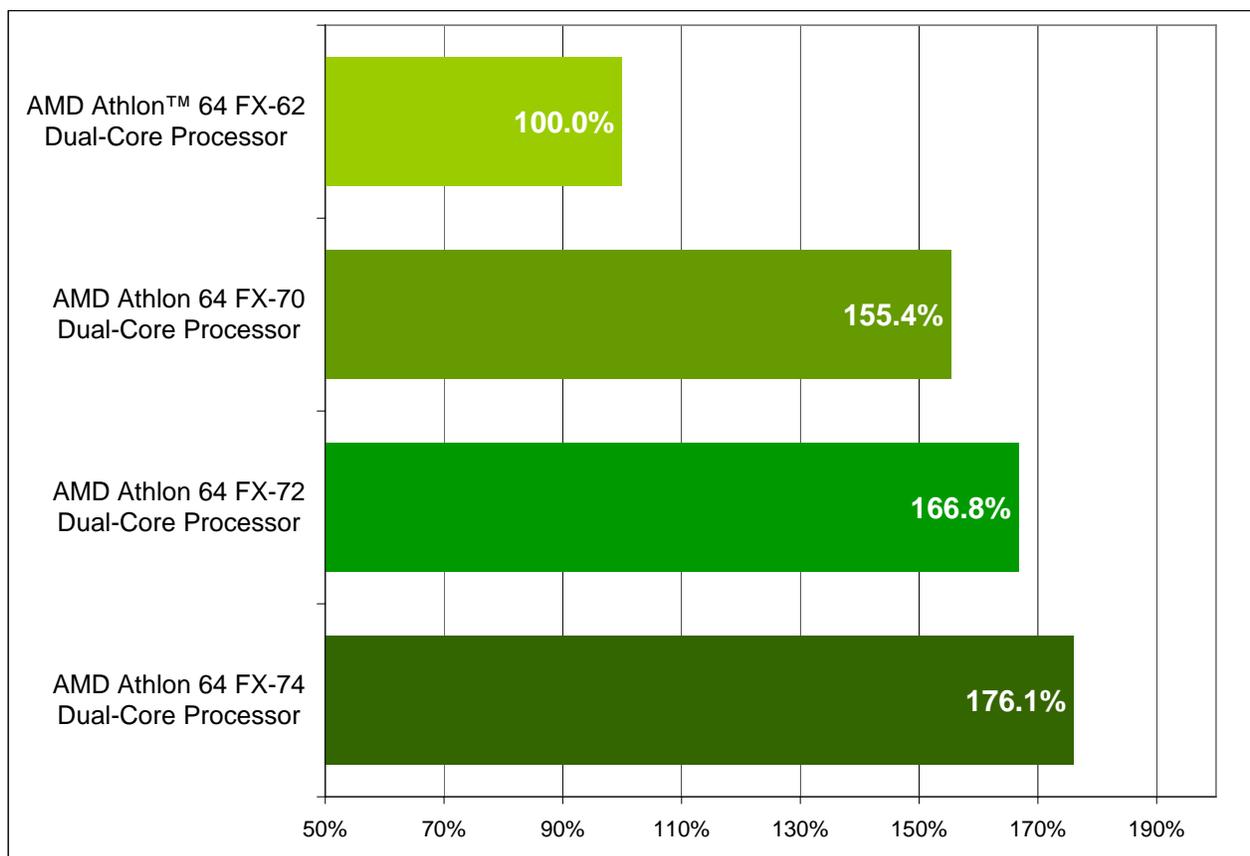
Windows Vista™, 32-Bit Applications
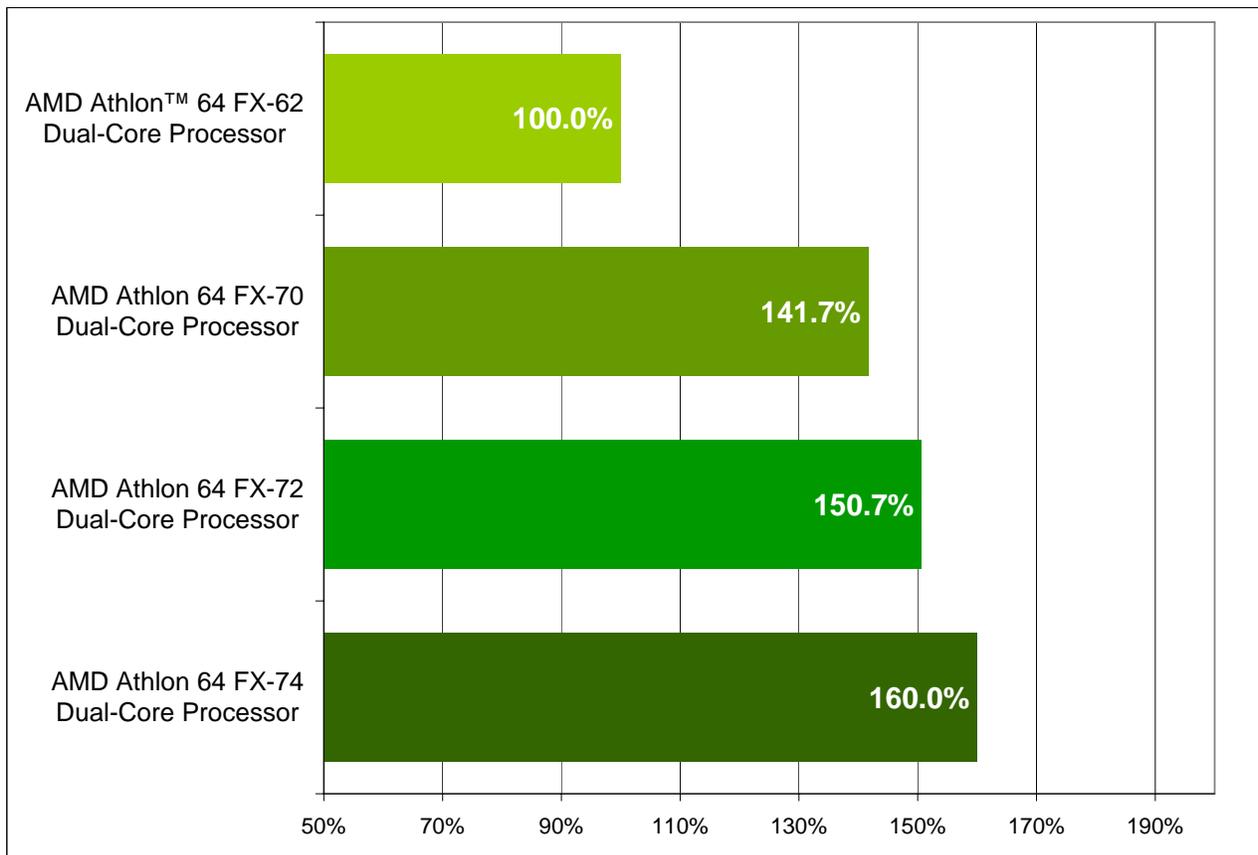
Figure 10. Overall Performance, Windows Vista™, 32-Bit Applications
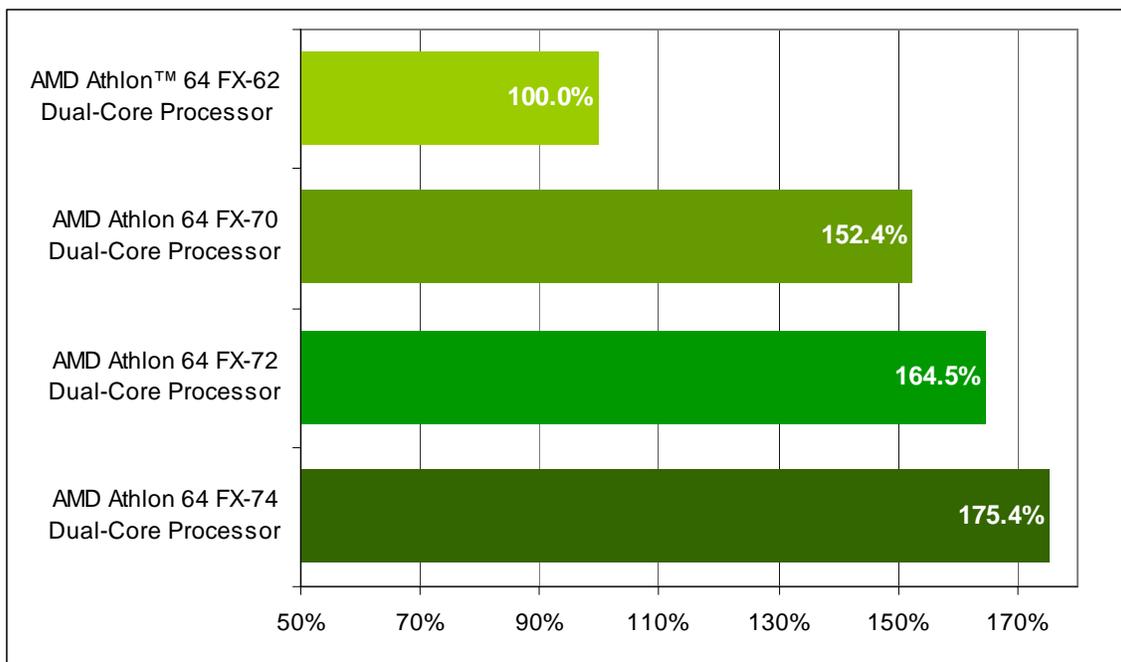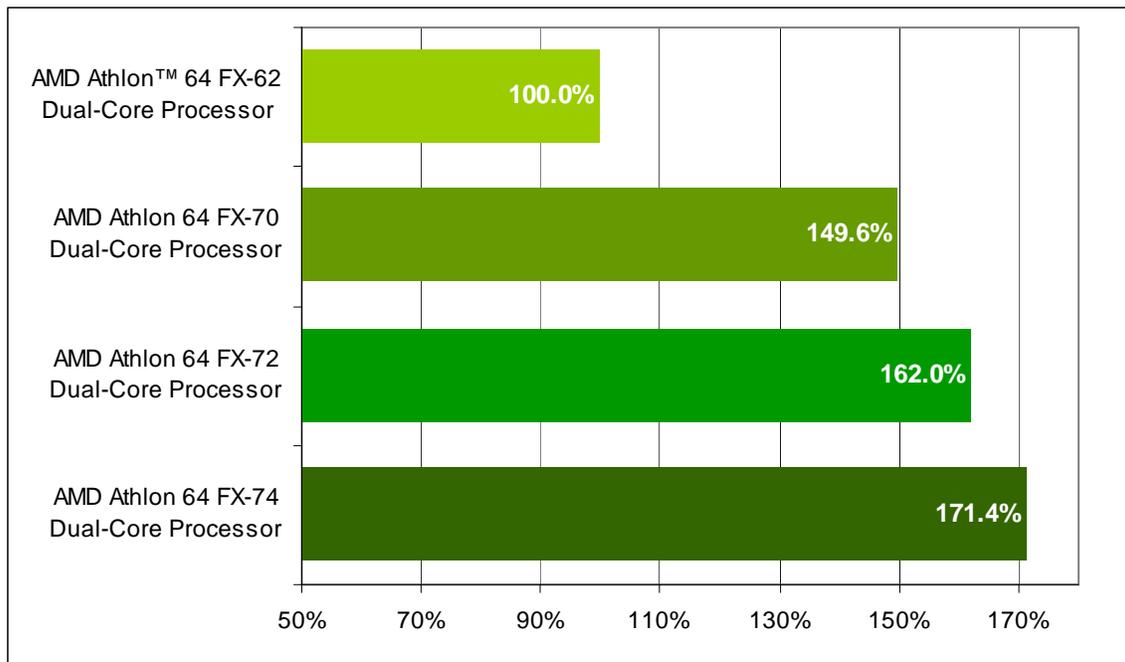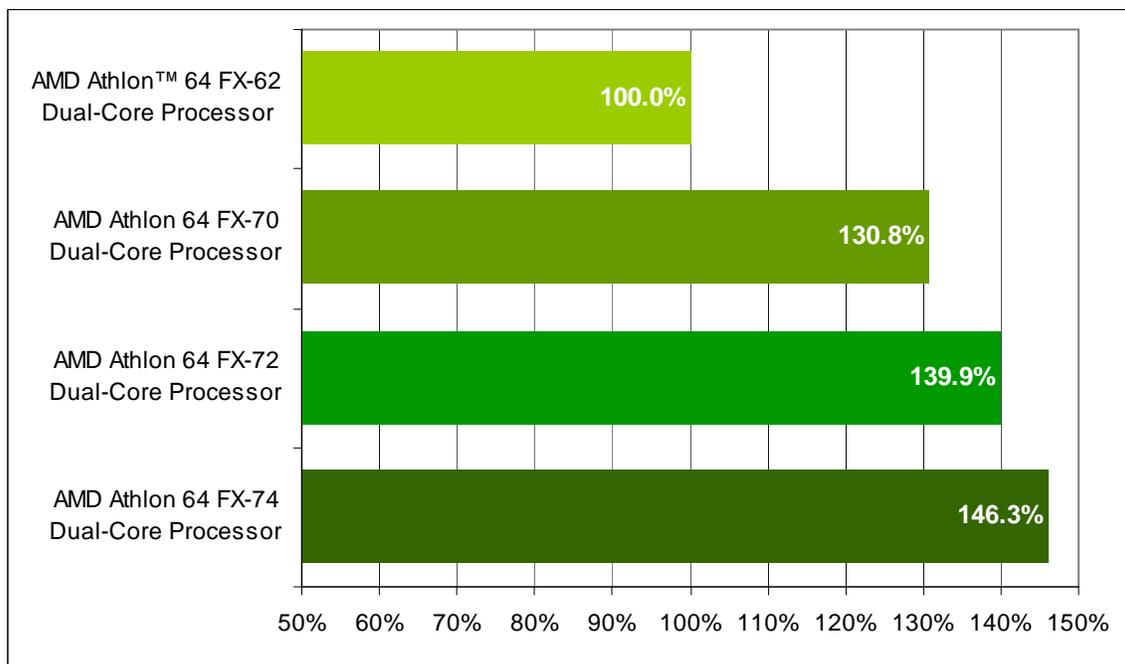
Figure 11. 3DMark™06 Performance¹
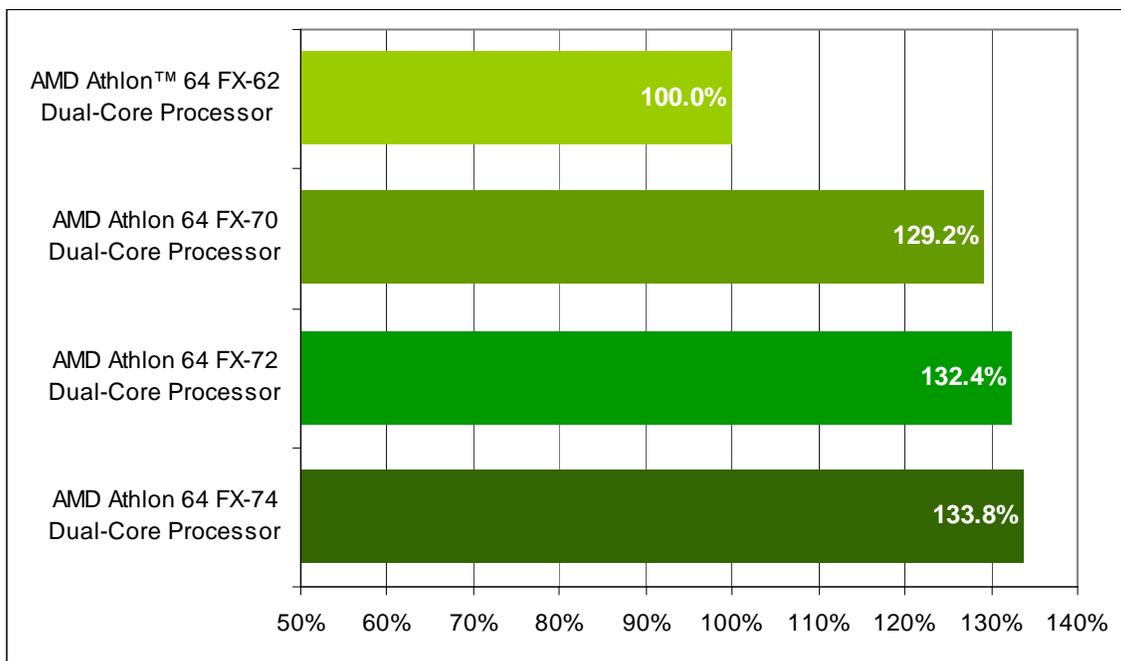
Figure 12. Cakewalk Sonar Performance

1. Computer gaming benchmarks may reveal the limitations of a graphics card and may not truly represent relative processor performance.
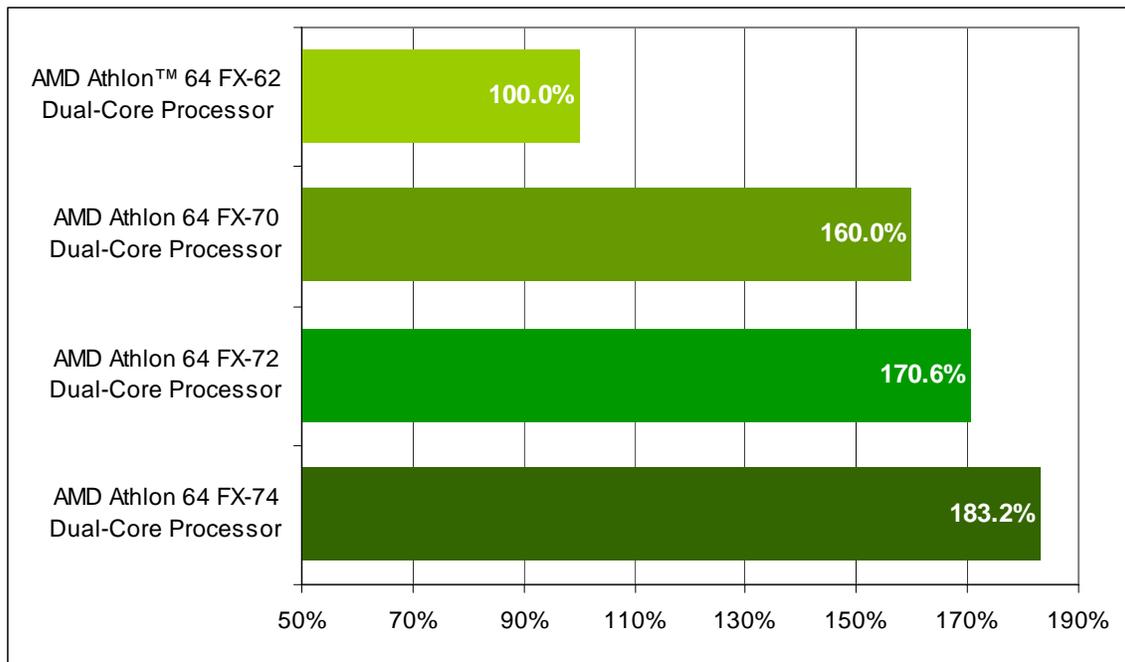
Figure 13. CINEBENCH Performance
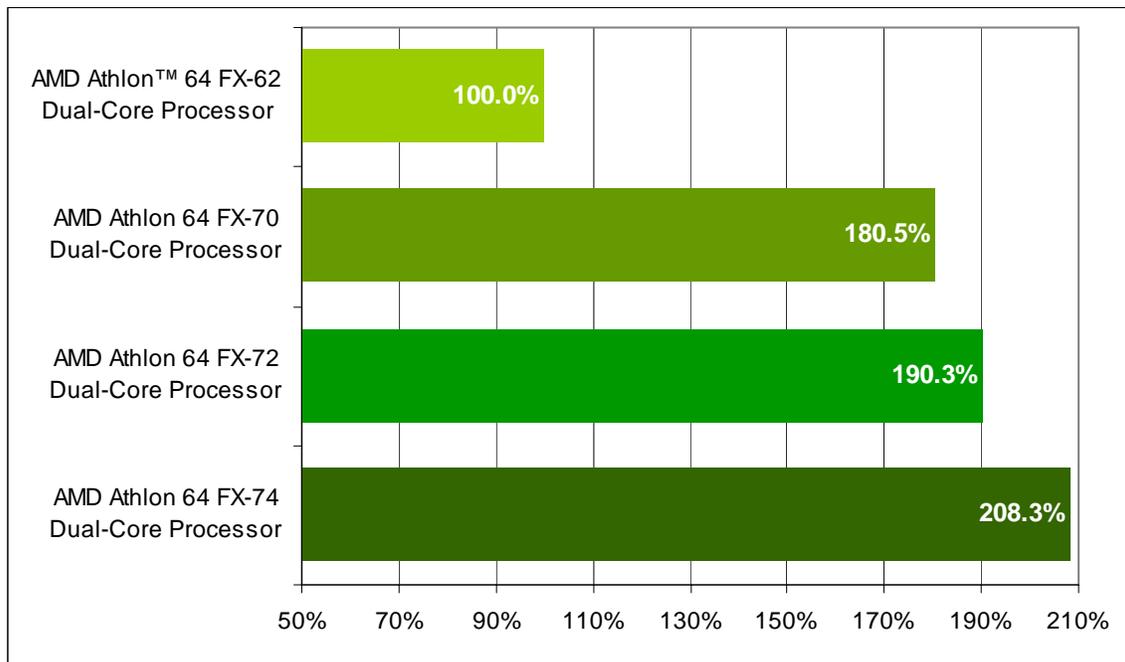
Figure 14. Crafty Performance¹

1. Computer gaming benchmarks may reveal the limitations of a graphics card and may not truly represent relative processor performance.
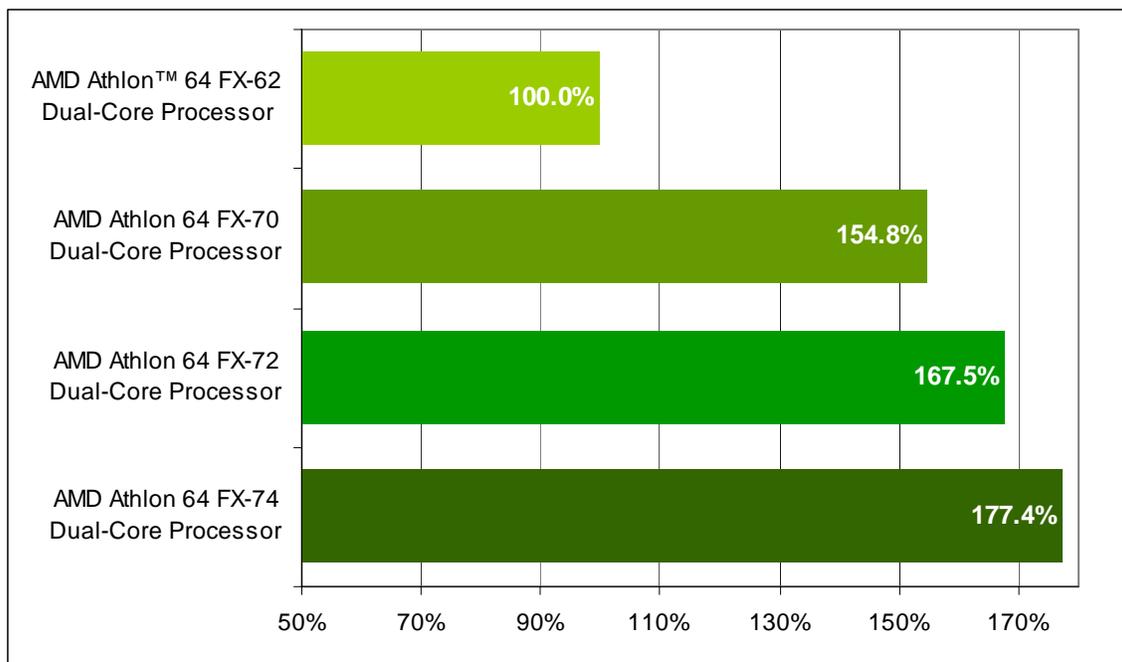
Figure 15. Dr. DivX Performance

Figure 16. POV-Ray Performance

Figure 17. Vegas Performance

Windows® XP Professional, 32-Bit Applications

Figure 18. Overall Performance, Windows® XP Professional, 32-Bit Applications

Figure 19. 3DMark™06 Performance¹

Figure 20. Cakewalk Sonar Performance

1. Computer gaming benchmarks may reveal the limitations of a graphics card and may not truly represent relative processor performance.
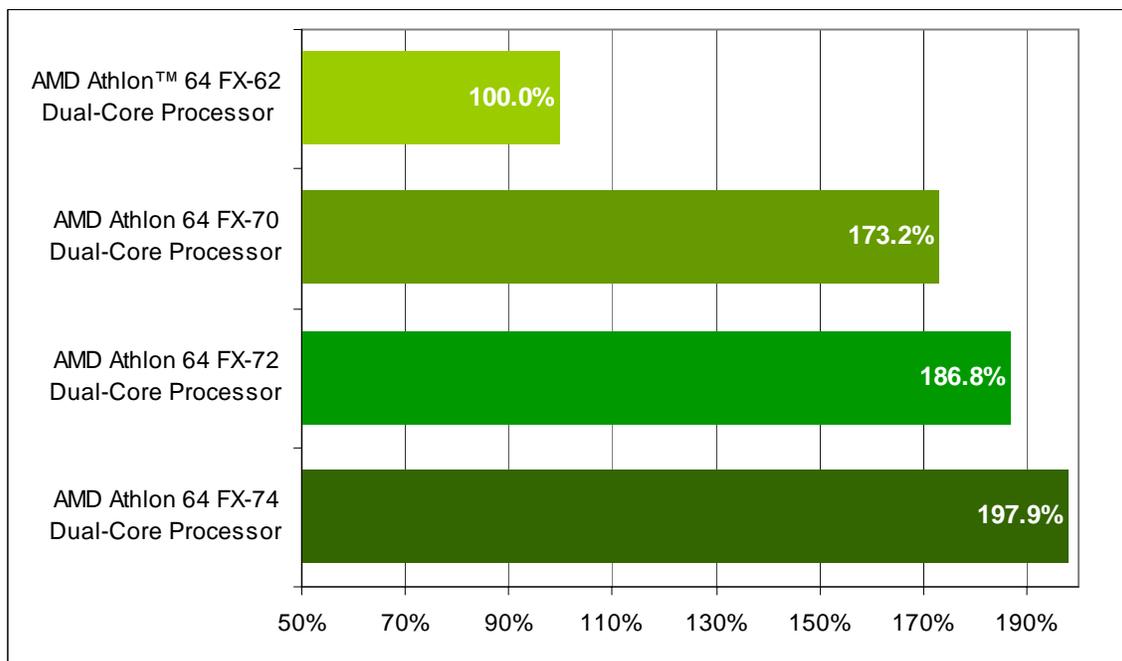
Figure 21. CINEBENCH Performance

Figure 22. Crafty Performance¹

1. Computer gaming benchmarks may reveal the limitations of a graphics card and may not truly represent relative processor performance.
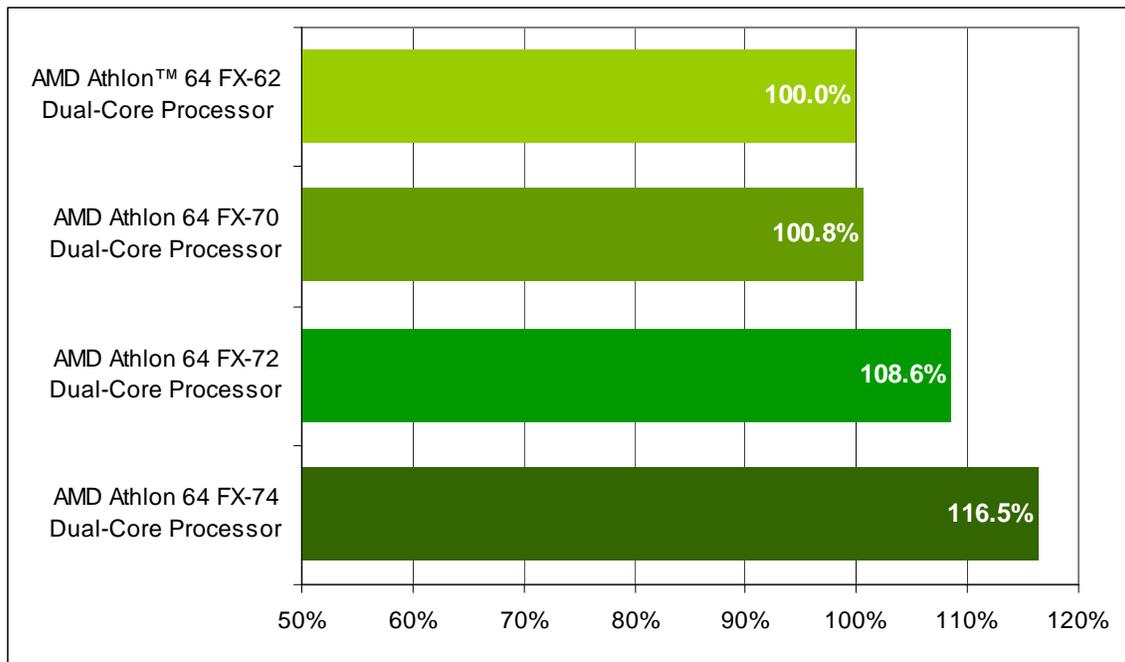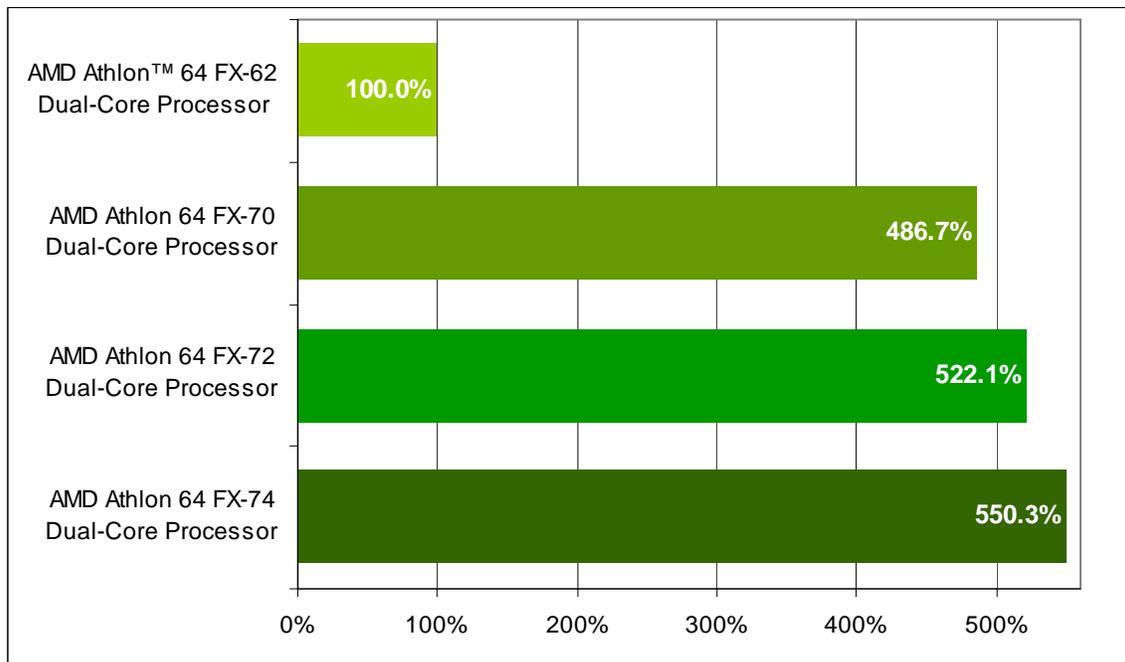
Figure 23. Dr. DivX Performance

Figure 24. High Performance Gaming and Multimedia Performance[1,2]

1. Computer gaming benchmarks may reveal the limitations of a graphics card and may not truly represent relative processor performance.

2. This score is a composite of five tests. It is a geometric mean of normalized scores rather than a geometric mean of absolute scores because City of Villains is scored in frames-per-second, while Media Encoder is scored in seconds.
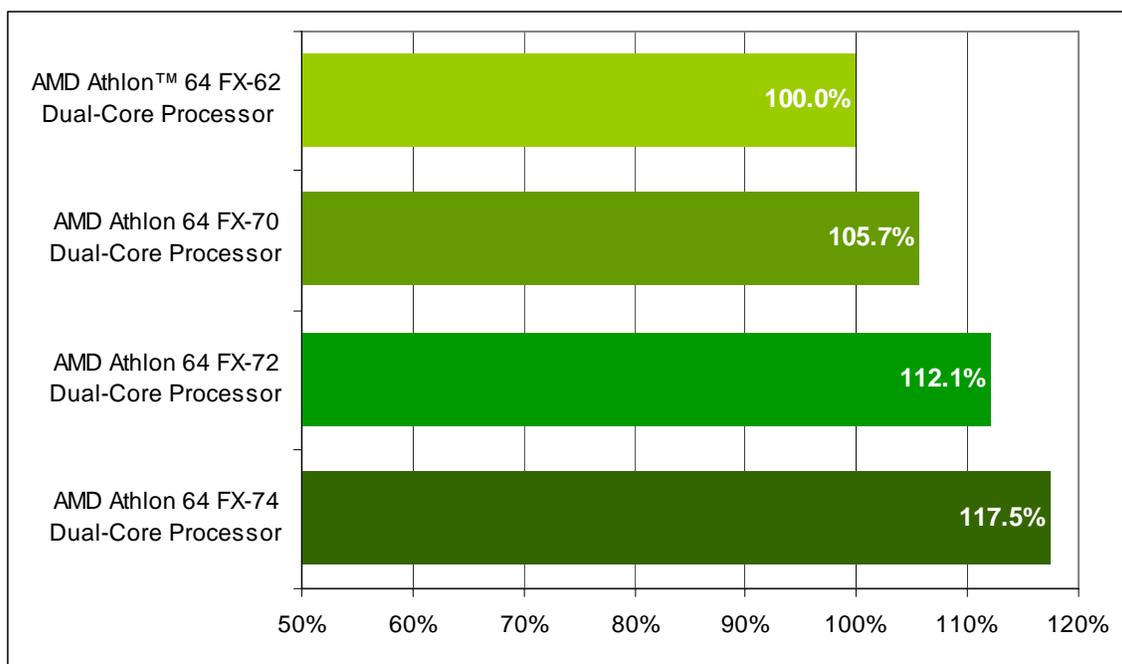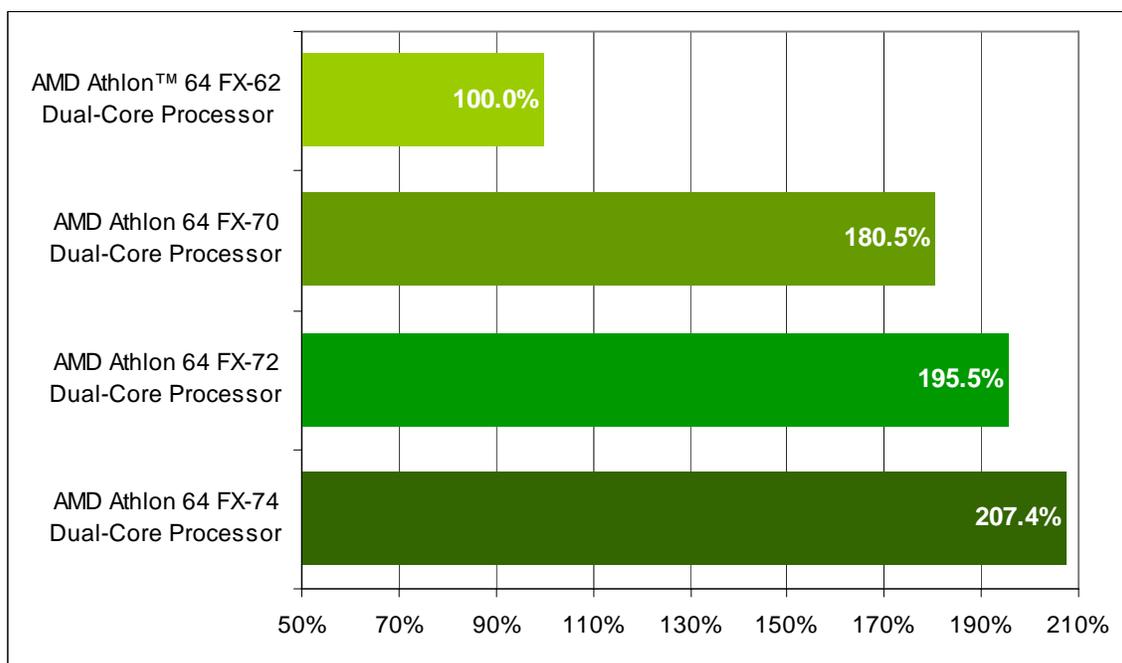
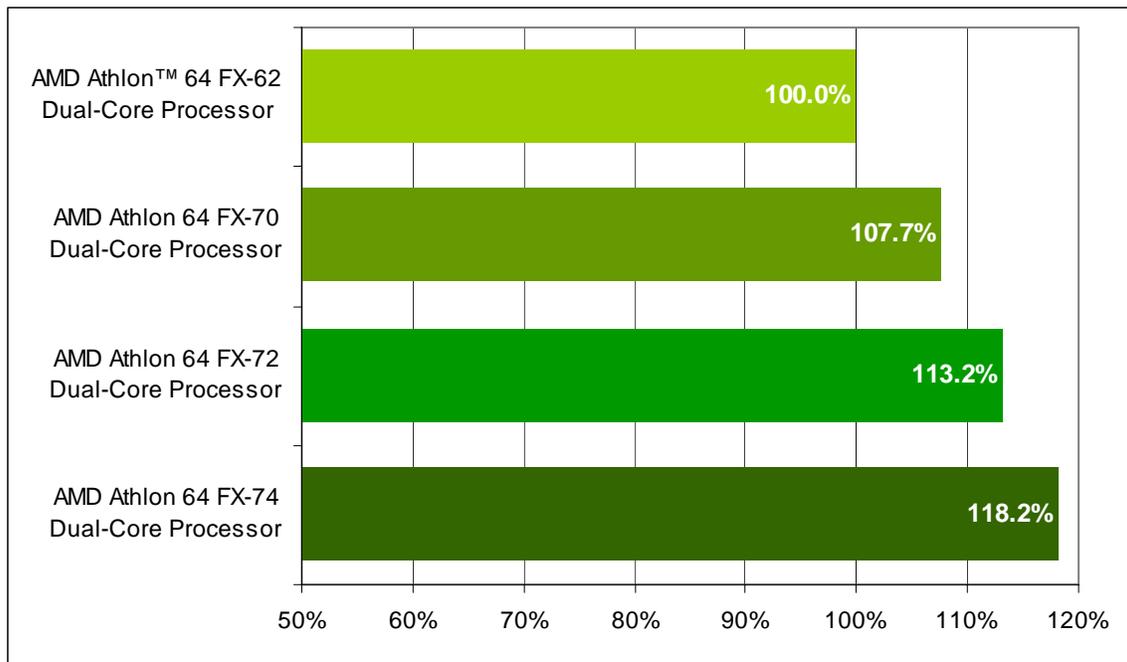**Figure 25. Panorama Factory Performance**

Figure 26. POV-Ray Performance

Figure 27. Vegas Performance

Table 7. Performance Summary

Benchmarks	AMD Athlon™ 64 FX-62 Dual-Core Processor 2.8 GHz 1 MB L2 (2) ASUS M2N32SLI D DDR2 (800 MHz)	AMD Athlon™ 64 FX-70 Dual-Core Processor (2) 2.6 GHz 1 MB L2 (2) ASUS L1N64-SLI WS DDR2 (800 MHz)	AMD Athlon™ 64 FX-72 Dual-Core Processor (2) 2.8 GHz 1 MB L2 (2) ASUS L1N64-SLI WS DDR2 (800 MHz)	AMD Athlon™ 64 FX-74 Dual-Core Processor (2) 3.0 GHz 1 MB L2 (2) ASUS L1N64-SLI WS DDR2 (800 MHz)
Windows Vista™, 64-bit Applications				
CINEBENCH	880.0	1411.0	1483.7	1607.7
Crafty	3709451.3	6549983.0	7080078.3	7678606.3
Panorama Factory	57.2	50.1	44.4	41.3
POV-Ray	781.3	1380.0	1489.0	1608.0
Windows Vista™, 32-bit Applications				
3DMark™06	2050.7	3125.3	3374.3	3597.0
Cakewalk Sonar	218.4	169.0	165.0	163.2
CINEBENCH	786.0	1257.7	1340.7	1440.0
Crafty	2679881.0	4836622.0	5099036.3	5581378.3
Dr.DivX	232.0	210.7	198.0	185.3
POV-Ray	689.3	1238.3	1330.0	1421.0
Vegas	310.7	304.0	281.3	267.0
Windows® XP Professional, 32-bit Applications				
3DMark06	2125.0	3180.0	3443.0	3643.0
Cakewalk Sonar	252.8	193.2	180.6	172.8
CINEBENCH	761.0	1177.7	1275.0	1350.3
Crafty	2685908.7	4652978.0	5018303.7	5315476.7
Dr.DivX	223.7	222.0	206.0	192.0
Gaming and Multimedia (Game 1)[1]	4.9	49.5	50.5	56.9
Gaming and Multimedia (Game 2)[1]	4.6	53.0	60.0	60.0
Gaming and Multimedia (WME 9 Encode Time)[1]	285.0	289.7	271.0	260.7
Gaming and Multimedia (Average)[1]	—	—	—	—
Panorama Factory	71.5	67.6	63.7	60.8
POV-Ray	684.3	1235.4	1338.0	1419.4
Vegas	164.7	152.9	145.5	139.3

[1]High Performance Gaming and Multimedia scores are a geometric mean of normalized scores rather than a geometric mean of absoute scores because City of Villains is scored in frames-per-second, while Media Encoder is scored in seconds.