AMD Processor Recognition

Application Note

Publication # **20734**	Revision: **3.00**
Issue Date: **April 2003**	

© 1997-2003 Advanced Micro Devices, Inc. All rights reserved.
The contents of this document are provided in connection with Advanced Micro Devices, Inc. (“AMD”) products. AMD makes no representations or warranties with respect to the accuracy or completeness of the contents of this publication and reserves the right to make changes to specifications and product descriptions at any time without notice. No license, whether express, implied, arising by estoppel or otherwise, to any intellectual property rights is granted by this publication. Except as set forth in AMD’s Standard Terms and Conditions of Sale, AMD assumes no liability whatsoever, and disclaims any express or implied warranty, relating to its products including, but not limited to, the implied warranty of merchantability, fitness for a particular purpose, or infringement of any intellectual property right.

AMD’s products are not designed, intended, authorized or warranted for use as components in systems intended for surgical implant into the body, or in other applications intended to support or sustain life, or in any other application in which the failure of AMD’s product could create a situation where personal injury, death, or severe property or environmental damage may occur. AMD reserves the right to discontinue or make changes to its products at any time without notice.

Trademarks

AMD, the AMD Arrow logo, AMD Athlon, AMD Duron, AMD Opteron and combinations thereof, AMD-K7, 3DNow! AMD PowerNow! are trademarks and AMD-K6, AMD-K6-2, AMD-K6-III, and Am486 are registered trademarks of Advanced Micro Devices, Inc.

HyperTransport is a licensed trademark of the HyperTransport Technology Consortium.

MMX is a trademark of Intel Corporation.

Microsoft is a registered trademark of Microsoft Corporation.

Other product names used in this publication are for identification purposes only and may be trademarks of their respective companies.

Contents

List of Figures

List of Tables

Revision History

Date	Revision	Description
April 2003	3.00	Added content for the AMD Opteron™ processor. Changed to new AMD technical document format, which includes new look and feel as well as new revision system.
November 2002	W-1	Revised Table 12 in Appendix A
November 2002	W	Revised Table 7: Added additional model numbers — 2600+, a 2700+, and a 2800+
August 2002	V	Added 2400+ and 2600+ models to table 4.
August 2002	U	Added AMD Athlon™ processor model 8 information to the following: Table 2, “Summary of CPUID Functions in AMD Athlon™ and AMD Duron™ Processors” Table 3, “Summary of Processor Signatures for AMD Processors,” on page 9 Table 6, “Recommended Name String by Platform Segment for AMD Athlon™ and AMD Duron™ Family of Processors Models 6 and Above,” on page 15 Table 7, “Model Number Mappings for AMD Athlon™ Family of Processors,” on page 16 Table 9, “Standard Feature Flag Descriptions for the AMD Athlon™ Processors” Table 12, “Extended Feature Flag Descriptions for AMD Athlon™ Processors” Table 26, “Values Returned By the AMD Athlon™ and AMD Duron™ Processors models 6 and 7, and 8”

Date	Revision	Description
January 2002	T	Added the following: “Name String Supports up to 48 Characters” on page 14 “Differentiation of Processors of the Same Model Number” on page 14 “S3 State Considerations” on page 14 “Recommended Name String” on page 14 Table 5, “Processor Name Strings for AMD Athlon™ and AMD Duron™ Family of Processors Through Model 4,” on page 14 Revised the following: Table 2, “Summary of CPUID Functions in AMD Athlon™ and AMD Duron™ Processors,” on page 6 “Testing For Extended Functions” on page 7 Table 3, “Summary of Processor Signatures for AMD Processors,” on page 8 Table 4, “Summary of Standard and Extended Feature Bits,” on page 10 Table 6, “Recommended Name String by Platform Segment for AMD Athlon™ and AMD Duron™ Family of Processors Models 6 and Above,” on page 16 Table 7, “Model Number Mappings for AMD Athlon™ Family of Processors,” on page 17 Table 9, “Standard Feature Flag Descriptions for the AMD Athlon™ Processors,” on page 35 Table 10, “Standard Feature Flag Descriptions for the AMD Duron™ Processors,” on page 36 Table 12, “Extended Feature Flag Descriptions for AMD Athlon™ Processors,” on page 39 Table 13, “Extended Feature Flag Descriptions for AMD Duron™ Processors,” on page 41 Table 26, “Values Returned By the AMD Athlon™ and AMD Duron™ Processors Models 6 and 7,” on page 52 Table 27, “Values Returned by the Mobile AMD Athlon™ Processors Models 6, 7, and 8, and the Mobile AMD Duron™ Processors Models 3, 6, and 7,” on page 55
July 2001	S	Added information about the mobile AMD Athlon™ 4 processor, the AMD Athlon™ MP processor, and the mobile AMD Duron™ processors.
June 2000	R	Added information about the AMD Duron™ processor throughout the document. Revised “CPUID Instruction Overview” on page 3. Added “The AMD Duron™ Processor” on page 2. Added Table 5, “Processor Name Strings for the AMD Duron™ Processor,” on page 13.

Date	Revision	Description
June 2000	Q	Added information about the AMD Athlon™ processor Model 4 throughout the document. Revised “CPUID Instruction Overview” on page 3. Revised Table 5, “Processor Name String,” on page 15. Added code sample to “Code Samples” on page 17. Added “Displaying the AMD Athlon™ or AMD Duron™ Processor Name String” on page 25 and “DisplayK7NameString Subroutine” on page 26. Revised information about bit 15 in Table 4, “Summary of Standard and Extended Feature Bits,” on page 11. Revised name string for AMD Athlon™ processor Model 1 in Table 5, “Processor Name String,” on page 15. Made Table 6, “Standard Feature Flag Descriptions for the AMD-K6®-2 and AMD-K6-III Processors,” on page 32 is specific to these processors. Added Table 6, “Standard Feature Flag Descriptions for the AMD Athlon™ Processors,” on page 31, which is specific to these processors. Clarified instruction family and generation being derived from function 1 and function 8000_0001 respectively. Made Table 9, “Extended Feature Flag Descriptions for the AMD-K6®-2 and AMD-K6-III Processors,” on page 36 is specific to these processors. Added Table 8, “Extended Feature Flag Descriptions for the AMD Athlon™ Processors,” on page 34, which is specific to these processors. Revised Table 21, “Values Returned By the AMD Athlon™ Processor,” on page 42.
Dec 1999	P	Added the AMD Athlon processor Model 2 information throughout document. Model 1 refers to the AMD Athlon processor manufactured with 0.25-micron process technology and Model 2 refers to the AMD Athlon processor manufactured with 0.18-micron process technology.
Nov 1999	O	Clarified usage of “Code Samples” on page 17. Added “Example Function Call” on page 25.
August 1999	N	Merged standard and extended feature bits into one table. See Table 4, “Summary of Standard and Extended Feature Bits,” on page 11. Revised Table 21, “Values Returned By the AMD Athlon™ Processor,” on page 42.
August 1999	M	Added the AMD Athlon™ processor information throughout document. Added url www.amd.com/products/cpg/bin, where codes samples and utilities are available. Revised “Testing for the CPUID Instruction” on page 4. Revised “Determining Instruction Set Support” on page 13. Revised Tables 12 through 22 to cross-reference new section—“Associativity Field Definitions” on page 45.

Date	Revision	Description
May 1999	L	In Table 11 on page 18, changed function 8000_0001h EDX entries for Models 6 and 7 from 0080_01BFh to 0080_05BFh.
May 1999	L	Added note about the name string for the AMD-K6-2 processor to Table 11 on page 18.
Feb 1999	K	Added L2 cache information to Table 1 on page 4. Added Function 8000_0006h to “Displaying Cache Information” on page 10. Added Function 8000_0006h — L2 Cache Information and Table 10, “ECX Format Returned by Function 8000_0006h,” on page 17. Added AMD-K6-III processor Model 9 values and three notes to Table 11 on page 18.
Nov 1998	J	In “Standard Functions” on page 12, clarified AMD’s vendor identification string stored in registers EBX, EDX, and ECX. In Table 11, “Values Returned By AMD-K6® Processors,” on page 18, changed function 8000_0001h, EDX value for the AMD-K6 processor Model 7 and deleted note 2.
May 1998	I	Revised “Functions 8000_0002h, 8000_0003h, and 8000_0004h — Processor Name String” on page 16. Added return values for AMD-K6 processor Model 9 to Table 10 on page 18. Divided Appendix B table into two separate tables.
Jan 1998	H	Added revised bit 31 description and alternate test for AMD-K6-2 to “Identifying Supported Features” on page 6.
Dec 1997	G	Changed part names for AMD-K6 processor Models 8 and 9 in Table 2 on page 5. Added 3DNow!™ instructions feature (bit 31) to Table 4 on page 8 and Table 6 on page 15. Added AMD-K6®-2 processor return values to Table 12 on page 21.
Sept 1997	F	Moved SYSCALL/SYSRET instruction feature bit (in extended feature function 8000_0001h) from bit 10 to bit 11. See Table 6 on page 15 and Table 12 on page 21.
Sept 1997	F	Added bit 31 to the extended feature function 8000_0001h for a new feature. See Table 4 on page 8 and Table 6 on page 15.
Sept 1997	F	Added support for AMD-K6® processor Models 7, 8, and 9 to Table 1 on page 4 and Table 2 on page 5.
Sept 1997	F	Added return values for AMD-K6 processor Model 7 to Table 12 on page 21.

Chapter 1 Introduction

As the number of choices available in the x86 Instruction Set Architecture (ISA) processor marketplace grew, the need for a simple way for hardware and software to identify the type of processor and its feature set became critical. The CPUID instruction was added to the x86 instruction set for this purpose. This document contains information on how to use the CPUID instruction to identify AMD processors and their features.

After detecting the processor and its capabilities, software can be tuned to the system for maximum performance and benefit to users. For example, software can roughly determine the performance level of a particular processor by detecting the type or speed of the processor. If the performance level is high enough, the software can enable additional capabilities or more advanced algorithms. Another example involves testing for the presence of 3DNow!™ instruction, SSE, or MMX™ instruction support on the processor. (The combined support of 3DNow! instruction extensions and SSE is known as 3DNow! Professional technology.) If the software finds these features present when it checks the feature bits, it can utilize these more powerful extensions for dramatically better performance on new multimedia software.

Chapter 2 CPUID Instruction Overview

Software operating at any privilege level can execute the CPUID instruction to identify the processor and its feature set. The CPUID instruction implements multiple functions, each providing different information about the processor, including the vendor, model number, revision (stepping), features, cache organization, and processor name. The multiple-function approach allows the CPUID instruction to return a complete picture of the processor and its capabilities—more detailed information than could be returned by a single function. In addition to gathering all the information by calling multiple functions, the CPUID instruction provides the flexibility of making only one call to obtain the specific data requested.

The functions are divided into two types: *standard functions* and *extended functions*. Standard functions provide a simple method for software to access information common to all x86 ISA processors. Extended functions provide information on extensions specific to a vendor's processor (for example, AMD family processors).

The flexibility of the CPUID instruction allows for the addition of new CPUID functions in future generations of processors. Chapter 5, "CPUID Instruction Definition," contains a detailed description of the CPUID instruction.

Chapter 3 Using CPUID Instructions

3.1 Testing for the CPUID Instruction

To use the CPUID instruction, software must first determine if the processor supports the CPUID instruction.

Note: *All AMD family processors, beginning with the Am486® DX4 processor, support the CPUID instruction.*

CPUID support is determined in one of the following ways:

- *Illegal Instruction Exception*: Execute the CPUID instruction and check whether an illegal instruction exception occurs. If an exception occurs, the processor does not have CPUID support.
- *EFLAGS ID-Bit*: Check if the ID bit (bit 21) of the EFLAGS register is writable. If the bit is writable (that is, it can be modified), the CPUID instruction is supported.

The Operating System (OS) environment determines which approach is more appropriate. These methods are described in the following sections.

3.1.1 Illegal Instruction Exception Method

This method requires a way for a user program to detect and handle illegal instruction exceptions. Where such capabilities are present, this method represents a reliable way of detecting support for the CPUID instruction. The CPUID sample code starting on page 34 uses this method.

3.1.2 EFLAGS ID-Bit Method

This method retrieves the contents of EFLAGS using the PUSHFD instruction, toggles the ID bit, and uses the POPFD instruction to write the modified value of the ID bit into the EFLAGS register. It then retrieves the contents of EFLAGS using a second PUSHFD instruction and checks whether the value of the ID bit differs from the original value. If the value has changed, the CPUID instruction is available for identifying the processor and its features. The following code sample demonstrates the way a program uses the PUSHFD and POPFD instructions to test the ID bit.

```
pushfd              ; Save EFLAGS to stack
pop eax             ; Store EFLAGS in EAX
movebx, eax         ; Save in EBX for testing later
xoreax, 00200000h   ; Switch bit 21
pusheax             ; Copy changed value to stack
popfd               ; Save changed EAX to EFLAGS
pushfd              ; Push EFLAGS to top of stack
popeax              ; Store EFLAGS in EAX
cmpeax, ebx         ; See if bit 21 has changed
jz NO_CPUID         ; If no change, no CPUID
```

A potential problem with this method is that an interrupt or a trap (such as a debug trap) can occur between the POPFD and the following PUSHFD, and that the interrupt or trap handler code destroys the value of the ID bit. Where possible, the preceding code should be preceded by a CLI instruction and followed by an STI instruction, which ensures that no interrupts occur between the POPFD and the PUSHFD. However, traps can still occur, even if the code is preceded by a CLI instruction and followed by an STI instruction.

3.2 Using CPUID Functions

When software uses the CPUID instruction to identify a processor, it is important that the software uses the instruction appropriately. The instruction has been defined to make it easy to identify the type and features of x86 ISA processors manufactured by many different vendors.

The standard functions (EAX=0 and EAX=1) are the same for all processors. Having standard functions simplifies the software task of testing for and implementing features common to x86 ISA processors. Software can test for these features and, as new x86 processors are released, benefit from these capabilities immediately.

Extended functions are specific to a vendor’s processor. These functions provide additional information about AMD processors that software can use to identify enhanced features and functions. To test for extended functions, software checks for a value of at least 8000_0001h in the EAX register returned by function 8000_0000h.

Within the AMD family of processors, different members can execute a different number of functions. Table 1 on page 21, Table 2 on page 22, and Table 3 on page 23 summarize the CPUID functions currently implemented on AMD processors.

Table 1. Summary of CPUID Functions for the AMD Opteron™ Processor

Standard Function	Extended Function	Description	AMD Opteron™ Processors Model 5
0	—	Vendor String and Largest Standard Function Value	X
1	—	Processor Signature and Standard Feature Bits	X
—	8000_0000h	Largest Extended Function Value	X
—	8000_0001h	Extended Processor Signature and Extended Feature Bits	X
—	8000_0002h	Processor Name	X
—	8000_0003h	Processor Name	X
—	8000_0004h	Processor Name	X
—	8000_0005h	L1 TLB[1]/Cache Information	X
—	8000_0006h	L2 TLB/Cache Information	X
—	8000_0007h	Advanced Power Management Feature Flags	X
—	8000_0008h	Physical Address and Linear Address Size	X
—	8000_0009h through 8000_0009h	Vendor-Specific Feature Flags	X

Notes:

Future versions of these processors may implement additional functions.

Chapter 5, "CPUID Instruction Definition," contains detailed descriptions of the functions.

1. TLB = Translation Lookaside Buffer.

Table 2. Summary of CPUID Functions in AMD Athlon™ and AMD Duron™ Processors

Standard Function	Extended Function	Description	AMD Athlon™ Processor Models 1, 2, and 4	AMD Duron™ Processor Model 3	AMD Athlon and AMD Duron Processors Model 6[2]	AMD Duron Processor Model 7[3]	AMD Athlon Processor Model 8[4]	AMD Athlon Processor Model 10[4]
0	—	**Vendor String and Largest Standard Function Value**	X	X	X	X	X	X
1	—	**Processor Signature and Standard Feature Bits**	X	X	X	X	X	X
—	8000_0000h	**Largest Extended Function Value**	X	X	X	X	X	X
—	8000_0001h	**Extended Processor Signature and Extended Feature Bits**	X	X	X	X	X	X
—	8000_0002h	**Processor Name**	X	X	X	X	X	X
—	8000_0003h	**Processor Name**	X	X	X	X	X	X
—	8000_0004h	**Processor Name**	X	X	X	X	X	X
—	8000_0005h	**L1 TLB[1]/Cache Information**	X	X	X	X	X	X
—	8000_0006h	**L2 TLB/Cache Information**	X	X	X	X	X	X
—	8000_0007h	**Advanced Power Management Feature Flags**	—	—	X	X	X	X
—	8000_0008h	**Physical Address and Linear Address Size**	—	—	X	X	X	X

Notes:

Future versions of these processors may implement additional functions.

Chapter 5, 'CPUID Instruction Definition' contains detailed descriptions of the functions.

1. *TLB = Translation Lookaside Buffer.*
2. *The AMD Athlon™ processor model 6 includes the AMD Athlon MP processor, the AMD Athlon XP processor, and the mobile AMD Athlon 4 processor. The AMD Duron™ processor model 6 includes the AMD Duron processor and the mobile AMD Duron processor.*
3. *The AMD Duron processor model 7 includes both the AMD Duron processor and the mobile AMD Duron processor.*
4. *The AMD Athlon processor models 8 and 10 include the AMD Athlon MP processor, the AMD Athlon XP processor, and the mobile AMD Athlon XP-M processor.*

Table 3. Summary of CPUID Functions in AMD Processors

Standard Function	Extended Function	Description	AMD-K5 Processor (Model 0), Am486®DX4, and Am5$_x$86 Processors	AMD-K5 Processor (Models 1, 2, and 3)	AMD-K6® Processor (Models 6, 7) AMD-K6-2 Processor (Model 8)	AMD-K6®-III Processor (Model 9)
0	–	**Vendor String and Largest Standard Function Value**	X	X	X	X
1	–	**Processor Signature and Standard Feature Bits**	X	X	X	X
–	8000_0000h	**Largest Extended Function Value**	–	X	X	X
–	8000_0001h	**Extended Processor Signature and Extended Feature Bits**	–	X	X	X
–	8000_0002h	**Processor Name**	–	X	X	X
–	8000_0003h	**Processor Name**	–	X	X	X
–	8000_0004h	**Processor Name**	–	X	X	X
–	8000_0005h	**L1 TLB*/Cache Information**	–	X	X	X
–	8000_0006h	**L2 TLB/Cache Information**	–	–	–	X
–	8000_0007h	**Advanced Power Management Feature Flags**	–	–	–	–
–	8000_0008h	**Physical Address and Linear Address Size**	–	–	–	–

Notes:

Future versions of these processors may implement additional functions.

Chapter 5, "CPUID Instruction Definition," contains detailed descriptions of the functions.

* *TLB = Translation Lookaside Buffer.*

3.3 Identifying the Processor Vendor

Software must execute the standard function EAX=0. The CPUID instruction returns a 12-character string that identifies the vendor of the processor. The instruction also returns the largest standard function input value defined for the CPUID instruction on the processor.

For AMD processors, function 0 returns a vendor string of "AuthenticAMD". This string informs the software to follow AMD's definition for subsequent CPUID functions and the registers returned for those functions.

Once the software identifies the vendor of the processor, it knows the definition for all the functions supplied by the CPUID instruction. By using these functions, the software obtains the processor information needed to tune its functionality to the capabilities of the processor.

3.4 Testing For Extended Functions

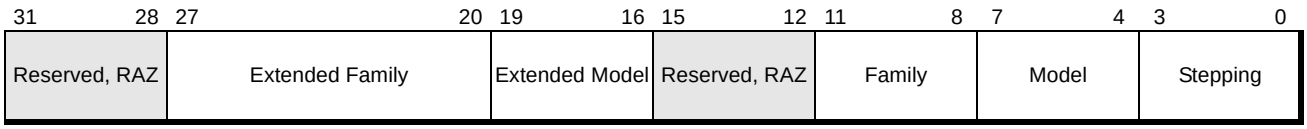
Software must test for extended functions with function 8000_0000h. The EAX register returns the largest extended function input value defined for the CPUID instruction on the processor. If this value is at least 8000_0001h, extended functions are supported.

3.5 Determining the Processor Signature

Standard function 1 (EAX=1) of the CPUID instruction returns the standard processor signature and feature bits. The standard processor signature is returned in the EAX register and provides information regarding the specific revision (stepping) and model of the processor and the instruction family level supported by the processor. The revision level can be used to determine if the processor supports specific features. However, it is not recommended that the revision level be used in this manner unless this information is not available through the standard or extended feature bits.

The AMD Opteron™ processors model 5 belongs to family F. All AMD Athlon™ processor models and the AMD Duron™ processor belong to instruction family 6. All AMD-K6® processor models belong to instruction family 5 (as returned in EAX by function 1).

Figure 1 shows the contents of the EAX register obtained from the AMD Opteron processor by function 1.



Bits	Mnemonic	Definition
31–28	Reserved	RAZ
27–20	Extended Family[1]	if (Family = 0Fh), provides additional family information
19–16	Extended Model[1]	if (Family = 0Fh), provides additional model information
15–12	Reserved	RAZ
11–8	Family	Processor/Instruction Family
7–4	Model	Processor Model
3–0	Stepping	Processor Stepping (revision)

Note: *1. These bit fields are supported only on the AMD Opteron™ processors. For the AMD Athlon and AMD Duron processors, and earlier AMD processors, these bit fields are reserved and RAZ.*

Figure 1. Contents of EAX Register Returned by Function 1 and 8000_0001h

Table 4 summarizes the specific processor signature values returned for all AMD processors.

Table 4. Summary of Processor Signatures for AMD Processors

Processor	Extended Instruction Family [27:20]	Extended Model [19:16]	Instruction Family [11:8]	Model [7:4]	Stepping ID[2] [3:0]
Am486® and Am5$_x$86 Processors	0	0	0100b (4h)	yyyy[1]	xxxx
AMD-K5 Model 0	0	0	0101b (5h)	0000b (0h)	xxxx
AMD-K5 Model 1	0	0	0101b (5h)	0001b (1h)	xxxx
AMD-K5 Model 2	0	0	0101b (5h)	0010b (2h)	xxxx
AMD-K5 Model 3	0	0	0101b (5h)	0011b (3h)	xxxx
AMD-K6® Model 6	0	0	0101b (5h)	0110b (6h)	xxxx
AMD-K6 Model 7	0	0	0101b (5h)	0111b (7h)	xxxx
AMD-K6®-2 Model 8	0	0	0101b (5h)	1000b (8h)	xxxx
AMD-K6®-III Model 9	0	0	0101b (5h)	1001b (9h)	xxxx
AMD Athlon™ Model 1	0	0	0110b (6h)	0001b (1h)	xxxx
AMD Athlon Model 2	0	0	0110b (6h)	0010b (2h)	xxxx
AMD Duron™ Model 3	0	0	0110b (6h)	0011b (3h)	xxxxb
AMD Athlon Model 4	0	0	0110b (6h)	0100b (4h)	xxxxb
AMD Athlon MP Model 6	0	0	0110b (6h)	0110b (6h)	xxxxb
AMD Athlon XP Model 6	0	0	0110b (6h)	0110b (6h)	xxxxb
Mobile AMD Athlon 4 Model 6	0	0	0110b (6h)	0110b (6h)	xxxxb
AMD Duron Model 6	0	0	0110b (6h)	0110b (6h)	xxxxb
Mobile AMD Duron Model 6	0	0	0110b (6h)	0110b (6h)	xxxxb
AMD Duron Model 7	0	0	0110b (6h)	0111b (7h)	xxxxb
Mobile AMD Duron Model 7	0	0	0110b (6h)	0111b (7h)	xxxxb
AMD Athlon XP Model 8	0	0	0110b (6h)	1000b (8h)	xxxxb
AMD Athlon MP Model 8	0	0	0110b (6h)	1000b (8h)	xxxxb
Mobile AMD Athlon XP–M Model 8	0	0	0110b (6h)	1010b (Ah)	xxxxb
Mobile AMD Athlon XP–M (LV) Model 8	0	0	0110b (6h)	1010b (Ah)	xxxxb
AMD Athlon XP Model 10	0	0	0110b (6h)	1010b (Ah)	xxxxb
AMD Athlon MP Model 10	0	0	0110b (6h)	1010b (Ah)	xxxxb
Mobile AMD Athlon XP–M Model 10	0	0	0110b (6h)	1010b (Ah)	xxxxb

Notes:

1. *Contact your AMD representative for model identifier information.*
2. *Stepping ID may change. Consult the appropriate processor revision guide, or contact your AMD representative for the latest stepping information. AMD Athlon processors of the same model numbers share the same revision guide. AMD Duron processors of the same model number share the same Revision Guide.*

Table 4. Summary of Processor Signatures for AMD Processors (Continued)

Processor	Extended Instruction Family [27:20]	Extended Model [19:16]	Instruction Family [11:8]	Model [7:4]	Stepping ID[2] [3:0]
Mobile AMD Athlon XP–M (LV) Model 10	0	0	0110b (6h)	1010b (Ah)	xxxxb
AMD Opteron™ Model 5	0	0	1111b (fh)	0101b (5h)	xxxxb

Notes:

1. *Contact your AMD representative for model identifier information.*
2. *Stepping ID may change. Consult the appropriate processor revision guide, or contact your AMD representative for the latest stepping information. AMD Athlon processors of the same model numbers share the same revision guide. AMD Duron processors of the same model number share the same Revision Guide.*

3.6 Identifying Supported Features

The feature bits are returned in the EDX register for two CPUID functions: standard function 1 and extended function 8000_0001h. Each bit corresponds to a specific feature and indicates if that feature is present on the processor. For table summaries of the standard and extended feature bits, view the tables 10 through 7 in Chapter 5 “CPUID Instruction Definition”.

Before using any of the enhanced features added to the latest generation of processors, software should test each feature bit returned by functions 1 and 8000_0001h to identify the capabilities available on the processor. For example, software must test feature bit 23 to determine if the processor executes the MMX™ technology instructions. Attempting to execute an unavailable feature can cause errors and exceptions.

Bit 31, as returned by extended function 8000_0001h, designates the presence of 3DNow!™ technology. Other processor vendors have adopted this technology, so bit 31 is now considered an open standard. Chapter 5, “CPUID Instruction Definition,” and Appendix A, “Register Values Returned by the AMD Family Processors,” contain details on bit locations and values.

3.6.1 Determining Instruction Set Support

It is preferable to use CPUID feature flags as much as possible, rather than deriving capabilities from vendor specifiers combined with CPUID model numbers.

To simplify the detection of the new instructions supported in the AMD Opteron™ processor or in different models of AMD Athlon™ and AMD Duron™ family of processors, including the original 3DNow! and MMX instructions, Enhanced 3DNow!, and 3DNow! Professional (combining 3DNow! and SSE support), use the following algorithm.

CPUID Test

1. Establish that the processor has support for CPUID. See “Using CPUID Instructions” on page 19.

Standard Function Test

2. Execute CPUID function 0, which returns the processor vendor string and the highest standard function supported.

3. If step 2 indicates that the highest standard function is at least 1, execute CPUID function 1, which returns the standard feature flags in the EDX register.

MMX™ Test

4. If bit 23 of the standard feature flags is set to "1", MMX™ technology is supported. MMX instruction support is the basic minimum processor feature required to support other instruction extensions.

SSE Test

5. If bit 25 of the standard feature flags is set to "1" on an AMD Opteron™ processor or on either an AMD Athlon™ or AMD Duron™ processor model 6 or greater, SSE instructions are supported. Optionally, if bit 25 of the standard feature flags is set on any previous AMD processor, it has streaming SIMD extensions (SSE) capabilities. Further qualification of SSE is done by checking for OS support. SSE support might be present in the processor but is not usable due to a lack of OS support for the additional architected registers.

Extended Functions Test

6. Execute CPUID extended function 8000_0000h. This function returns the highest extended function supported in EAX. If EAX=0, there is no support for extended functions.

7. If the highest extended function supported is at least 8000_0001h, execute CPUID function 8000_0001h. This function returns the extended feature flags in EDX.

3DNow!™ Instruction Test

8. If bit 31 of the extended feature flags is set to "1", the 3DNow!™ instructions are supported.

3DNow!™ Instruction Extensions Test

9. If bit 30 of the extended feature flags is set to "1", the additions to the 3DNow! instruction set are supported.

MMX™ Extensions Test

10. If bit 22 of the extended feature flags is set to "1", the new multimedia enhancement instructions that augment the MMX instruction set are supported.

Long Mode Test

11. If bit 29 of the extended feature flags is set to "1", then the "long mode" (including 64-bit mode) of the x86-64 ISA is supported.

No-Execute Page Protection Test

12. If bit 20 of the extended feature flags is set to “1”, then the No-Execute Page feature of the processor can be enabled.

3.6.2 AMD Processor Signature (Extended Function)

Extended function 8000_0001h returns the AMD processor signature. The signature is returned in the EAX register and provides generation, model, and stepping information for AMD processors. Starting with the AMD Opteron processor, the 8000_0001h function supplements the family and model numbers with two new fields: *extended family* and *extended model* fields. These new fields expand the family and model numbering scheme.

Figure 1 on page 24 shows the contents returned in the EAX register.

The terms *effective family* and *effective model* describe the expanded 8-bit family and 8-bit model numbers as computed using the extended family, family, extended model, and model fields.

Software that displays or uses the processor family and model must be aware of how the extended family and extended model fields combine with the family and model fields to produce the effective family and effective model numbers. *Software must use the computed 8-bit effective family and effective model numbers when displaying or using the processor’s family and model numbers. Failure to do so results in the display or use of incorrect values.*

If the family field (EAX bits 11–8) is equal to 1111b (0Fh), use the extended family and extended model fields to compute the 8-bit effective family and effective model numbers as shown in the following sample code:

```
EAX = CPUID(0000_0001)
Family = EAX.11:8
Model  = EAX.7:4
ExtendedFamily = EAX.27:20  /* 8 bits */
ExtendedModel  = EAX.19:16  /* 4 bits */

IF (Family == 0Fh)

   EFFECTIVE_FAMILY = ExtendedFamily       /* 8 bits */
                    + Family           /* 4 bits, zero extended to 8 bits */
   EFFECTIVE_MODEL  = (ExtendedModel << 4) /* 8 bits */
                    + Model                  /* 4 bits, zero extended to 8 bits */
```

3.6.3 Displaying the Processor Name

Functions 8000_0002h, 8000_0003h, and 8000_0004h return an ASCII string containing the name of the processor. These functions eliminate the need for software to search for the processor name in a lookup table, a process requiring a large block of memory and frequent updates. Instead, software can

simply call these three functions to obtain the name string (48 ASCII characters in little-endian format) and display it on the screen. Although the name string can be up to 48 characters in length, shorter names have the remaining byte locations filled with the ASCII NULL character (00h). To simplify the display routines and avoid using screen space, software only needs to display characters until a NULL character is detected.

Note: *The processor name string supports up to 48 characters, but not all name strings are 48 characters. For example, the name string "`AMD Athlon(tm)`" uses 14 characters. Future name strings may be longer, so BIOS vendors should take this into consideration when displaying the name string on boot-up or in a system configuration screen.*

Unlike previous generations of AMD processors, AMD Opteron processors do not have a pre-programmed default name string. These processors return 48 ASCII NULLs until the name string is programmed by BIOS.

Therefore, AMD Opteron processors must have the processor name string programmed by the BIOS before any general purpose application or OS software uses the extended functions that read the name string. All processors support a set of MSRs for programming the processor name string. For information about programming the name string, see Appendix B "Programming the Name String of the AMD Opteron™ Processor".

The AMD Opteron processors implement extended functions 8000_0002h, 8000_0003h, and 8000_0004h in the same manner as previous AMD processors; therefore, it is not necessary to change software that displays the processor name string.

For sample code to display the name string, "Displaying the AMD Opteron™ Processor, AMD Athlon™ Processor, or the AMD Duron™ Processor Name String" on page 43 for an example of how to properly obtain and display the processor name string.

3.6.3.1 Differentiation of Processors of the Same Model Number

AMD Athlon and AMD Duron processors model 6 and higher must have the name string programmed properly according to the values in Table 5 on page 30 depending on the processor's L2 cache size. If the L2 cache size value reported by extended function 8000_0006h ECX bits[31:16] is 256 or greater, then the processor is an AMD Athlon family processor. If the L2 cache size reported is less than 256, then the processor is an AMD Duron family processor.

3.6.3.2 S3 State Considerations

Before entering the S3—Suspend to RAM (STR)—state, the BIOS must save off the processor name string MSRs. Upon exiting the S3 state, the BIOS must then reload the processor name string back into the appropriate MSRs.

3.6.3.3 Recommended Name String

The namestring of the AMD Opteron processor must be programmed into the processor by the BIOS. See Appendix B "Programming the Name String of the AMD Opteron™ Processor" for more information.

Table 5 summarizes the recommended name strings for AMD Athlon and AMD Duron processors through models 6 and above.

Table 5. Recommended Name String by Platform Segment for AMD Athlon™ and AMD Duron™ Family of Processors Models 6 and Above

Processor	CPUID	MP Capable (bit 19 of Extended Feature Flags)	Platform Segment	Recommended Name String[1]
AMD Athlon™ Model 6	660 or 661	Reserved	Multiprocessing	AMD Athlon(tm) MP
AMD Athlon Model 6	660 or 661	Reserved	Desktop	AMD Athlon(tm)
AMD Athlon Model	660 or 661	Reserved	Mobile	mobile AMD Athlon(tm) 4
AMD Athlon Model 6	662	0	Multiprocessing	AMD Athlon(tm) XP [xxxxx][2]
AMD Athlon Model 6	662	1	Multiprocessing	AMD Athlon(tm) MP [xxxxx][2]
AMD Athlon Model 6	662	N/A	Desktop	AMD Athlon(tm) XP [xxxxx][2]
AMD Athlon Model 6	662	N/A	Mobile	mobile AMD Athlon(tm) 4
AMD Duron™ Model 6	N/A[3]	N/A	Desktop	AMD Duron(tm)
AMD Duron Model 6	N/A[3]	N/A	Mobile	mobile AMD Duron(tm)
AMD Duron Model 7	N/A[3]	Reserved	Desktop	AMD Duron(tm)
AMD Duron Model 7	N/A[3]	Reserved	Mobile	mobile AMD Duron(tm)
AMD Athlon Model 8	N/A[3]	0	Multiprocessing	AMD Athlon(tm) XP [xxxxx][2]
AMD Athlon Model 8	N/A[3]	1	Multiprocessing	AMD Athlon(tm) MP [xxxxx][2]
AMD Athlon Model 8	N/A[3]	0	Desktop	AMD Athlon(tm) XP [xxxxx][2]
AMD Athlon Model 8	N/A[3]	1	Desktop	AMD Athlon(tm) MP [xxxxx][2]
AMD Athlon Model 8	N/A[3]	N/A	Mobile	mobile AMD Athlon(tm) XP [xxxxx][2]
AMD Athlon Model 10	N/A[3]	0	Desktop	AMD Athlon(tm) XP [xxxxx][2]
AMD Athlon Model 10	N/A[3]	1	Multiprocessing	AMD Athlon(tm) MP [xxxxx][2]
AMD Athlon Model 10	N/A[3]	N/A	OPGA Mobile	mobile AMD Athlon(tm) XP–M [xxxxx][2]
AMD Athlon Model 10	N/A[3]	N/A	µPGA Mobile	mobile AMD Athlon(tm) XP–M (LV) [xxxxx][2]

Notes:

1. *This name string must be programmed into the processor by the BIOS. See the document,* Displaying and Programming the Processor Name String BIOS Application Note*, order# 90056.*
2. *See Table 7 on page 32 and Table 5 on page 30 for proper model number to insert into name string.*
3. *Recommended name strings for the AMD Duron™ processors models 6 and 7 and the AMD Athlon™ processors models 8 and 10 do not vary by CPUID stepping value.*

Table 6 summarizes the recommended name strings for AMD Athlon and AMD Duron processors through model 4.

Table 6. Processor Name Strings for AMD Athlon™ and AMD Duron™ Family of Processors Through Model 4

Processor	ASCII Name String
AMD Athlon™ Model 1	AMD-K7(tm) processor
AMD Athlon Model 2	AMD Athlon(tm) processor
AMD Duron™ Model 3	AMD Duron(tm)[1]
Mobile AMD Duron Model 3	mobile AMD Duron(tm)[1]
AMD Athlon Model 4	AMD Athlon(tm)[1]

Notes:

1. *This name string must be programmed into the processor by the BIOS. See the document,* Displaying and Programming the Processor Name String BIOS Application Note*, order# 90056.*

Table 7 and Table 8 on page 33 summarizes the recommended name strings for AMD Athlon processors through model 6 through 10.

Table 7. Model Number Mappings for AMD Athlon™ Family of Processors with 256-Kbyte L2 Cache

Frequency[1] (MHz)	Model Number
950[2]	1100+
1000[2]	1200+
1100[2]	1300+
1200[2]	1400+
1300[3,4]	1500+
1333	1500+
1400	1600+
1467	1700+
1500[4]	1800+
1533	1800+
1600	1900+
1667	2000+
1733	2100+
1800	2200+
2000	2400+
2083[5]	2600+
2133	2600+
2167[5]	2700+
2250[5, 6]	2800+

Notes:

1. *It is recommended that the BIOS display the processor name string, including the model number, whenever displaying processor information during a bootup. If the processor frequency is displayed, the processor name string, including the model number, must also be displayed. Motherboards will not pass AMD validation or be posted on the AMD recommended motherboard Web site, if during a bootup the processor frequency is displayed by the BIOS without also displaying the name string and model number for the AMD Athlon™ model 6, model 8, or model 10 processors having frequencies with corresponding model numbers.*
2. *The model number at 1200 MHz, 1100 MHz, 1000 MHz, and 950 MHz should be displayed only on the mobile AMD Athlon™ model 8 processor.*
3. *For mobile AMD Athlon™ model 6 processors, at any frequency below 1300 MHz, no model number should be shown in the name string. Also, mobile AMD Athlon™ model 6 processors below 1300 MHz have a name string of "mobile AMD Athlon(tm) 4".*
4. *Frequencies of 1300 MHz and 1500 MHz are only offered as mobile or low-power desktop processors using a 200 Front Side Bus.*
5. *Frequencies of 2083 MHz, 2167 MHz, and 2250 MHz are only offered as desktop processors using a 333 Front Side Bus.*
6. *At any frequency above 2250 MHz, the model number should be omitted from the name string to show simply "AMD Athlon(tm) MP" for the multiprocessing segment, "AMD Athlon(tm) XP" for desktop and low-power desktop, "mobile AMD Athlon(tm) XP–M" for OPGA mobile, or "mobile AMD Athlon(tm) XP–M (LV)" for µPGA mobile.*

Table 8. Model Number Mappings for AMD Athlon™ Family Processors with 512-Kbyte L2 Cache

Frequency[1] (MHz)	Model Number
1300[2]	1700+
1400[2]	1800+
1467[2]	1900+
1533[2]	2000+
1600[2]	2100+
1667[2]	2200+
1800[2]	2400+
1833[3]	2500+
1867[2]	2500+
1917[3]	2600+
2000[2]	2600+
2083[3]	2800+
2133[4]	2800+
2167[3,5]	3000+

Notes:

1. *It is recommended that the BIOS display the processor name string, including the model number, whenever displaying processor information during a bootup. If the processor frequency is displayed, the processor name string, including the model number, must also be displayed. Motherboards will not pass AMD validation or be posted on the AMD recommended motherboard Web site, if during a bootup the processor frequency is displayed by the BIOS without also displaying the name string and model number for the AMD Athlon™ model 10 processors having frequencies with corresponding model numbers.*
2. *Frequencies of 1300 MHz, 1400 MHz, 1467 MHz, 1533 MHz, 1600 MHz, 1667 MHz, 1800 MHz, 1867 MHz, and 2000 MHz are only offered as mobile processors using a 266 Front Side Bus.*
3. *Frequencies of 1833 MHz, 1917 MHz, 2083 MHz, and 2167 MHz are only offered as desktop processors using a 333 Front Side Bus.*
4. *Frequency of 2133 MHz is offered in mobile and workstation/server processors using a 266 Front Side Bus.*
5. *At any frequency above 2167 MHz, the model number should be omitted from the name string to show simply "AMD Athlon(tm) MP" for the multiprocessing segment, "AMD Athlon(tm) XP" for desktop and low-power desktop, "mobile AMD Athlon(tm) XP–M" for OPGA mobile, or "mobile AMD Athlon(tm) XP–M (LV)" for µPGA mobile.*

3.6.4 Displaying Cache Information

Functions 8000_0005h and 8000_0006h provide cache information for the processor, although function 8000_0006h is only supported on the AMD Opteron processors, the AMD Athlon processors, the AMD Duron processors, and on the AMD-K6®-III processor model 9. Some

diagnostic software displays information about the system and the processor configuration. It is common for this type of software to provide cache size and organization of information.

Functions 8000_0005h and 8000_0006h provide a simple way for software to obtain information about the on-chip cache and Translation Lookaside Buffer (TLB) structures. The size and organization information is returned in the registers as described in Chapter 5, “CPUID Instruction Definition.” Software can simply display these values, eliminating the need for large pieces of code to test the memory structures.

3.6.5 Determining Power Management Capabilities

The AMD Opteron processors support the detection of power management features through the use of function 8000_0007h. These features include software thermal control, thermal monitoring, a thermal trip, on-chip thermal diode, Voltage ID transitioning, and Frequency ID transitioning.

The AMD Athlon family of processors model 6 or greater and the AMD Duron family of processors model 7 also support the detection of power management features through the use of function 8000_0007h. These features include an on-chip thermal diode, Voltage ID transitioning, and Frequency ID transitioning. Desktop varieties of model 6 and model 7 processors will have support only for the thermal diode. Mobile varieties of model 6 and model 7 processors support the thermal diode, Voltage ID (VID) transitioning, and Frequency ID (FID) transitioning.

3.6.6 Determining Maximum Physical and Linear Address Size

The AMD Opteron processors, the AMD Athlon family of processors model 6 or greater, and the AMD Duron family processors model 7 support function 8000_0008h, which provides the maximum physical and maximum linear address size supported by the processor.

3.6.7 Determining Vendor-Specific Feature Flags

The AMD Opteron processor introduces several new Extended CPUID functions. Functions 8000_0009h through 8000_0018h are reserved for future expansion of vendor-specific feature flags. See Chapter 5“CPUID Instruction Definition” for more information.

3.7 Code Samples

Developers who want to create their own processor-features detection code should follow the sample code described in “Example CPUID Code.”

A more elaborate function call, which detects the full range of CPUID information, is provided as sample code in “Example Function Call” on page 42.

3.7.1 Example CPUID Code

Developers who want to create their own processor detection program should follow the algorithm in the “cpuid_ex” program. The code sample is available from AMD’s website at the following URL:

http://www.amd.com/products/cpg/bin/cpuid_ex.zip

The source code is included, along with an executable that is compiled with Microsoft® Visual Studio C/C++ Versions 5 and 6. This example provides a simple algorithm for the developer to follow and can be accommodated by many different processors. The source code, cpuid_ex.c, follows the recommendations described in this document.

To display a list of supported features for the processor, run the program by typing
`cpuid_ex`

For convenience, the example CPUID code is displayed as follows:

```
/* The following code follows the guidelines described in this document,
It is meant to serve as only an example, as there are other ways to accomplish
processor detection. */

#include <stdio.h>
#include <excpt.h>

/* Symbolic constants for feature flags in CPUID standard feature flags */

#define CPUID_STD_FPU          0x00000001
#define CPUID_STD_VME          0x00000002
#define CPUID_STD_DEBUGEXT     0x00000004
#define CPUID_STD_4MPAGE       0x00000008
#define CPUID_STD_TSC          0x00000010
#define CPUID_STD_MSR          0x00000020
#define CPUID_STD_PAE          0x00000040
#define CPUID_STD_MCHKXCP      0x00000080
#define CPUID_STD_CMPXCHG8B    0x00000100
#define CPUID_STD_APIC         0x00000200
#define CPUID_STD_SYSENTER     0x00000800
#define CPUID_STD_MTRR         0x00001000
#define CPUID_STD_GPE          0x00002000
#define CPUID_STD_MCHKARCH     0x00004000
#define CPUID_STD_CMOV         0x00008000
#define CPUID_STD_PAT          0x00010000
#define CPUID_STD_PSE36        0x00020000
#define CPUID_STD_MMX          0x00800000
#define CPUID_STD_FXSAVE       0x01000000
#define CPUID_STD_SSE          0x02000000



/* Symbolic constants for feature flags in CPUID extended feature flags */

#define CPUID_EXT_3DNOW        0x80000000
#define CPUID_EXT_AMD_3DNOWEXT 0x40000000
#define CPUID_EXT_AMD_MMXEXT   0x00400000


/* Symbolic constants for application specific feature flags */

#define FEATURE_CPUID          0x00000001
#define FEATURE_STD_FEATURES   0x00000002
#define FEATURE_EXT_FEATURES   0x00000004
#define FEATURE_TSC            0x00000010
#define FEATURE_MMX            0x00000020
#define FEATURE_CMOV           0x00000040
#define FEATURE_3DNOW          0x00000080
#define FEATURE_3DNOWEXT       0x00000100
#define FEATURE_MMXEXT         0x00000200
```

```
#define FEATURE_SSEFP          0x00000400
#define FEATURE_K6_MTRR        0x00000800
#define FEATURE_P6_MTRR        0x00001000

/* Older compilers do not support the CPUID instruction in inline assembly */

#define cpuid _asm _emit 0x0f _asm _emit 0xa2


/* get_feature_flags extracts all features the application wants to know
   about from CPUID information and returns a bit string of application
   specific feature bits. The following design criteria apply:

   1. Processor capabilities should be directly derived from CPUID feature bits
      wherever possible, instead of being derived from vendor strings and
      processor signatures. However, some features are not indicated by CPUID
      feature flags (whether basic or extended) and do require looking at
      vendor strings and processor signatures. Applications may also choose to
      implement pseudo capabilities, for example indicating performance
      levels.
   2. The basic feature flags returned by CPUID function #1 are compatible
      across all x86 processor vendors with very few exceptions and therefore
      common feature checks for things like MMX or TSC support do not require
      a vendor check before evaluating the basic feature flag information.
      If unsure about a particular feature, review the processor vendor's
      literature.
   3. 3DNow! technology is an open standard. Therefore 3DNow! instruction
      capabilities are indicated by bit 31 in the extended feature flags
      regardless of processor vendor.
   4. Applications should always treat the floating-point part of SSE and
      the MMX part of SSE as separate capabilities because SSE FP requires
      OS support that might not be available, while SSE MMX works with all
      operating systems.
*/


unsigned int get_feature_flags(void)
{
   unsigned int result    = 0;
   unsigned int signature = 0;
      char vendor[13]       = "UnknownVendr";  /* Needs to be exactly 12 chars */

   /* Define known vendor strings here */

   char vendorAMD[13]     = "AuthenticAMD";  /* Needs to be exactly 12 chars */
      /*;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
         ;; Step 1: Check if processor has CPUID support. The processor faults
         ;; with an illegal instruction exception if the instruction is not
         ;; supported. This step catches the exception and immediately returns
         ;; with feature string bits with all 0s, if the exception occurs.
         ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;*/
```

```
__try {
      __asm xor    eax, eax
      __asm xor    ebx, ebx
      __asm xor    ecx, ecx
      __asm xor    edx, edx
      __asm cpuid
}

__except (EXCEPTION_EXECUTE_HANDLER) {
      return (0);
}

result |= FEATURE_CPUID;

_asm {

   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
   ;; Step 2: Check if CPUID supports function 1 (signature/std features)
   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

   xor     eax, eax                     ; CPUID function #0
   cpuid                                ; largest std func/vendor string
   mov     dword ptr [vendor], ebx      ; save
   mov     dword ptr [vendor+4], edx    ;  vendor
   mov     dword ptr [vendor+8], ecx    ;   string
   test    eax, eax                     ; largest standard function==0?
   jz      $no_standard_features        ; yes, no standard features func
   or      [result], FEATURE_STD_FEATURES; does have standard features

   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
   ;; Step 3: Get standard feature flags and signature
   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

   mov     eax, 1                       ; CPUID function #1
   cpuid                                ; get signature/std feature flgs
   mov     [signature], eax             ; save processor signature

   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
   ;; Step 4: Extract desired features from standard feature flags
   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

   ;; Check for time stamp counter support

   mov     ecx, CPUID_STD_TSC           ; bit 4 indicates TSC support
   and     ecx, edx                     ; supports TSC ? CPUID_STD_TSC:0
   neg     ecx                          ; supports TSC ? CY : NC
   sbb     ecx, ecx                     ; supports TSC ? 0xffffffff:0
   and     ecx, FEATURE_TSC             ; supports TSC ? FEATURE_TSC:0
   or      [result], ecx                ; merge into feature flags

   ;; Check for MMX support
```

```
mov     ecx, CPUID_STD_MMX              ; bit 23 indicates MMX support
and     ecx, edx                        ; supports MMX ? CPUID_STD_MMX:0
neg     ecx                             ; supports MMX ? CY : NC
sbb     ecx, ecx                        ; supports MMX ? 0xffffffff:0
and     ecx, FEATURE_MMX                ; supports MMX ? FEATURE_MMX:0
or      [result], ecx                   ; merge into feature flags

;; Check for CMOV support

mov     ecx, CPUID_STD_CMOV             ; bit 15 indicates CMOV support
and     ecx, edx                        ; supports CMOV?CPUID_STD_CMOV:0
neg     ecx                             ; supports CMOV ? CY : NC
sbb     ecx, ecx                        ; supports CMOV ? 0xffffffff:0
and     ecx, FEATURE_CMOV               ; supports CMOV ? FEATURE_CMOV:0
or      [result], ecx                   ; merge into feature flags

;; Check support for P6-style MTRRs

mov     ecx, CPUID_STD_MTRR             ; bit 12 indicates MTRR support
and     ecx, edx                        ; supports MTRR?CPUID_STD_MTRR:0
neg     ecx                             ; supports MTRR ? CY : NC
sbb     ecx, ecx                        ; supports MTRR ? 0xffffffff:0
and     ecx, FEATURE_P6_MTRR            ; supports MTRR ? FEATURE_MTRR:0
or      [result], ecx                   ; merge into feature flags

;; Check for initial SSE support. There can still be partial SSE
;; support. Step 9 will check for partial support.

mov     ecx, CPUID_STD_SSE              ; bit 25 indicates SSE support
and     ecx, edx                        ; supports SSE ? CPUID_STD_SSE:0
neg     ecx                             ; supports SSE ? CY : NC
sbb     ecx, ecx                        ; supports SSE ? 0xffffffff:0
and     ecx, (FEATURE_MMXEXT+FEATURE_SSEFP) ; supports SSE ?
                                        ; FEATURE_MMXEXT+FEATURE_SSEFP:0
or      [result], ecx                   ; merge into feature flags

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;; Step 5: Check for CPUID extended functions
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

mov     eax, 0x80000000                 ; extended function 0x80000000
cpuid                                   ; largest extended function
cmp     eax, 0x80000000                 ; no function > 0x80000000 ?
jbe     $no_extended_features           ; yes, no extended feature flags
or      [result], FEATURE_EXT_FEATURES; does have ext. feature flags

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;; Step 6: Get extended feature flags
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
```

```
    mov     eax, 0x80000001             ; CPUID ext. function 0x80000001
    cpuid                               ; EDX = extended feature flags
    ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
    ;; Step 7: Extract vendor independent features from extended flags
    ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

    ;; Check for 3DNow! instruction support (vendor independent)

    mov     ecx, CPUID_EXT_3DNOW        ; bit 31 indicates 3DNow! support
    and     ecx, edx                  ; supports 3DNow! ?CPUID_EXT_3DNOW:0
    neg     ecx                         ; supports 3DNow! ? CY : NC
    sbb     ecx, ecx                    ; supports 3DNow! ? 0xffffffff:0
    and     ecx, FEATURE_3DNOW          ; support 3DNow!?FEATURE_3DNOW:0
    or      [result], ecx               ; merge into feature flags

    ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
    ;; Step 8: Determine CPU vendor
    ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

    lea     esi, vendorAMD              ; AMD's vendor string
    lea     edi, vendor                 ; this CPU's vendor string
    mov     ecx, 12                     ; strings are 12 characters
    cld                                 ; compare lowest to highest
    repe    cmpsb                       ; current vendor string == AMD's ?
    jnz     $not_AMD                    ; no, CPU vendor is not AMD

    ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
    ;; Step 9: Check AMD specific extended features
    ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

    mov     ecx, CPUID_EXT_AMD_3DNOWEXT ; bit 30 indicates 3DNow! ext.
    and     ecx, edx                    ; 3DNow! ext?
    neg     ecx                         ; 3DNow! ext ? CY : NC
    sbb     ecx, ecx                    ; 3DNow! ext ? 0xffffffff : 0
    and     ecx, FEATURE_3DNOWEXT       ; 3DNow! ext?FEATURE_3DNOWEXT:0
    or      [result], ecx               ; merge into feature flags

    test    [result], FEATURE_MMXEXT    ; determined SSE MMX support?
    jnz     $has_mmxext                 ; yes, don't need to check again

    ;; Check support for AMD's multimedia instruction set additions

    mov     ecx, CPUID_EXT_AMD_MMXEXT   ; bit 22 indicates MMX extension
    and     ecx, edx                    ; MMX ext?CPUID_EXT_AMD_MMXEXT:0
    neg     ecx                         ; MMX ext? CY : NC
    sbb     ecx, ecx                    ; MMX ext? 0xffffffff : 0
    and     ecx, FEATURE_MMXEXT         ; MMX ext ? FEATURE_MMXEXT:0
    or      [result], ecx               ; merge into feature flags

$has_mmxext:
```

```
      ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
      ;; Step 10: Check AMD-specific features not reported by CPUID
      ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

      ;; Check support for AMD-K6 processor-style MTRRs

      mov     eax, [signature] ; get processor signature
      and     eax, 0xFFF ; extract family/model/stepping
      cmp     eax, 0x588 ; CPU < AMD-K6-2/CXT ? CY : NC
      sbb     edx, edx ; CPU < AMD-K6-2/CXT ? 0xffffffff:0
      not     edx ; CPU < AMD-K6-2/CXT ? 0:0xffffffff
      cmp     eax, 0x600 ; CPU < AMD Athlon ? CY : NC
      sbb     ecx, ecx ; CPU < AMD-K6 ? 0xffffffff:0
      and     ecx, edx ; (CPU>=AMD-K6-2/CXT)&&
                       ; (CPU<AMD Athlon) ? 0xffffffff:0
      and     ecx, FEATURE_K6_MTRR ; (CPU>=AMD-K6-2/CXT)&&
                       ; (CPU<AMD Athlon) ? FEATURE_K6_MTRR:0
      or      [result], ecx ; merge into feature flags

      jmp     $all_done ; desired features determined

   $not_AMD:

      /* Extract features specific to non AMD CPUs */

   $no_extended_features:
   $no_standard_features:
   $all_done:
}

/* The FP part of SSE introduces a new architectural state and therefore
   requires support from the operating system. So even if CPUID indicates
   support for SSE FP, the application might not be able to use it. If
   CPUID indicates support for SSE FP, check here whether it is also
   supported by the OS, and turn off the SSE FP feature bit if there
   is no OS support for SSE FP.

   Operating systems that do not support SSE FP return an illegal
   instruction exception if execution of an SSE FP instruction is performed.
   Here, a sample SSE FP instruction is executed, and is checked for an
   exception using the (non-standard) __try/__except mechanism
   of Microsoft Visual C.
*/

if (result & FEATURE_SSEFP) {
    __try {
       __asm _emit 0x0f
       __asm _emit 0x56
       __asm _emit 0xC0    ;; orps xmm0, xmm0
       return (result);
    }
```

```
        __except (EXCEPTION_EXECUTE_HANDLER) {
           return (result & (~FEATURE_SSEFP));
        }
   }
   else {
      return (result);
   }
}



/* The  sample "application" */

int main (void)
{
   unsigned int capabilities = get_feature_flags();

   printf ("features = %08x\n", capabilities);
   printf ("CPU supports CPUID:       %c\n",
           capabilities & FEATURE_CPUID ? 'y' : 'n');
   printf ("CPU supports CPUID STD:   %c\n",
           capabilities & FEATURE_STD_FEATURES ? 'y' : 'n');
   printf ("CPU supports CPUID EXT:   %c\n",
           capabilities & FEATURE_EXT_FEATURES ? 'y' : 'n');
   printf ("CPU supports TSC:         %c\n",
           capabilities & FEATURE_TSC ? 'y' : 'n');
   printf ("CPU supports CMOV:        %c\n",
           capabilities & FEATURE_CMOV ? 'y' : 'n');
   printf ("CPU supports MMX:         %c\n",
           capabilities & FEATURE_MMX ? 'y' : 'n');
   printf ("CPU supports 3DNOW:       %c\n",
           capabilities & FEATURE_3DNOW ? 'y' : 'n');
   printf ("CPU supports 3DNOW_EXT:   %c\n",
           capabilities & FEATURE_3DNOWEXT ? 'y' : 'n');
   printf ("CPU supports AMD-K6-MTRR: %c\n",
           capabilities & FEATURE_K6_MTRR ? 'y' : 'n');
   printf ("CPU supports P6-MTRR:     %c\n",
           capabilities & FEATURE_P6_MTRR ? 'y' : 'n');
   printf ("CPU supports SSE MMX:     %c\n",
           capabilities & FEATURE_MMXEXT ? 'y' : 'n');
   printf ("CPU supports SSE FPU:     %c\n",
           capabilities & FEATURE_SSEFP ? 'y' : 'n');
   return (0);
}
```

3.7.2 Example Function Call

The function call code sample detects the full range of CPUID information and allows the user to query capabilities through a simple function call. The code sample is available from AMD's website at the following URL:

http://www.amd.com/products/cpg/bin/getcpu_caps.zip

The zip file contains two files—DETECT.C and ADETECT.H. Follow these steps to use the function call:

1. Copy DETECT.C and ADETECT.H into your project directory.
2. Add DETECT.C to your source project.

Now the user can make calls to GetCPUCaps() in any module that includes ADETECT.H. Add the function call with the following statement:

```
#include "ADETECT.H"
```

This source code compiles under Microsoft® Visual Studio C/C++ Versions 5 and 6.

3.7.3 Displaying the AMD Opteron™ Processor, AMD Athlon™ Processor, or the AMD Duron™ Processor Name String

The AMD Opteron processor and all AMD Athlon and AMD Duron family of processors support CPUID extended functions 8000_0002h, 8000_0003h, and 8000_0004h. These functions return an ASCII string containing the name of the processor. These functions eliminate the need for operating systems and application software to search for the processor name in a look-up table. Instead, software can simply call these three functions to obtain the name string (up to 48 ASCII characters in little-endian format) and display it on the screen. The character string is terminated with a 00h (ASCII null character).

The following code samples illustrate methods that can be used to display the processor name string as required by the AMD Opteron, AMD Athlon, and AMD Duron processors branding strategy.

3.7.4 DisplayNameString Subroutine

The name string of theAMD Opteron processor as well as the AMD Athlon and AMD Duron family of processors can be displayed by calling the subroutine DisplayNameString. The following code sample displays the processor name string.

```
;-----------------------------------------------------------------------
; DisplayNameString:
;
;
; Returns:
;     cf=0 all 48 possible characters displayed
;     cf=1 end of string reached
;-----------------------------------------------------------------------
DisplayNameString proc near   ;
      push  eax               ;
      push  ebx               ;
      push  ecx               ;
      push  edx               ;
```

```
      mov   eax, 80000002h
      db    0Fh, 0A2h         ;CPUID instruction
      call  DisplayNameSubstring;
      jc    @f                ;End of string?
      mov   eax, 80000003h
      db    0Fh, 0A2h         ;CPUID instruction
      call  DisplayNameSubstring;
      jc    @f                ;End of string?
      mov   eax, 80000004h
      db    0Fh, 0A2h         ;CPUID instruction
      call  DisplayNameSubstring;
@@:   pop   edx               ;
      pop   ecx               ;
      pop   ebx               ;
      pop   eax               ;
      ret                     ;
DisplayNameString endp        ;
;-------------------------------------------------------------------------
```

3.7.5 DisplayNameSubstring

The DisplayNameSubstring subroutine is called up to three times to display the ASCII characters returned by each CPUID function call.

```
;-------------------------------------------------------------------------
; DisplayNameSubstring:
;
;
; Returns:
;     cf=0 no errors
;     cf=1 end of string reached
;-------------------------------------------------------------------------
DisplayNameSubstring proc near;Displays eax, ebx, ecx, edx
      call  DisplayEaxAscii   ; eax
      jc    @f                ;End of string?
      xchg  eax, ebx          ;
      call  DisplayEaxAscii   ; ebx
      jc    @f                ;End of string?
      xchg  eax, ecx          ;
      call  DisplayEaxAscii   ; ecx
      jc    @f                ;End of string?
      xchg  eax, edx          ;
      call  DisplayEaxAscii   ; edx
@@:   ret                     ;
DisplayNameSubstring endp     ;
;-------------------------------------------------------------------------
```

DisplayEaxAscii

The DisplayNameSubstring subroutine calls the DisplayEaxAscii subroutine up to four times. DisplayEaxAscii displays the four bytes of the EAX register as ASCII characters starting with the least-significant byte (little endian). The subroutine DisplayAlChar used in the example is a generic name for a subroutine that displays the value in the AL register as an ASCII character. This type of subroutine is common to all type of BIOS under a variety of names.

```
;-----------------------------------------------------------------------
; DisplayEaxAscii:
;
; Returns:
;     cf=0 no errors
;     cf=1 end of string reached
;-----------------------------------------------------------------------
DisplayEaxAscii proc near     ;
      push  eax               ;
      push  cx                ;
      mov   cx, 4             ;
;---------------------------------------;
@@:   or    al, al            ;End of string?
      stc                     ;(assume end of string)
      jz    @f                ; YES--assumed correctly
      call  DisplayAlChar     ; NO---display character
      ror   eax, 8            ;next char in al
      loop  @b                ;repeat
;---------------------------------------;
      clc                     ;
@@:   pop   cx                ;Restore regs
      pop   eax               ;
      ret                     ;
DisplayEaxAscii endp          ;
;-----------------------------------------------------------------------
```

Chapter 4 Summary of CPUID Differences

The CPUID instruction provides complete information about the processor (vendor, type, name, etc.) and its features. The CPUID instruction is designed to be flexible and extensible, so that it can provide new information for future generations of processors.

The AMD Opteron™ processors introduce several new CPUID functions, as well as changes to existing functions. This section summarizes new features and changes.

Chapter 5 “CPUID Instruction Definition” on page 51 for a detailed description of each CPUID function.

4.1 Changed Functions

The CPUID instruction implements multiple functions, each providing information about specific processor features. The following sections describe changes to the CPUID functions as they exist on the AMD Athlon™ and the AMD Duron™ family of processors.

4.1.1 Standard Function 0000_0001h—Processor Version Information and Feature Flags

Standard Function 1 has been enhanced to return the following new fields and flags.

4.1.1.1 Extended Family and Extended Model (in EAX)

These new fields, in conjuction with the existing family and model fields, expand the family and model numbering scheme to 8 bits. See “AMD Processor Signature (Extended Function)” on page 28 for important information about calculating and displaying family and model numbers for the AMD Opteron processors.

4.1.1.2 8-Bit Brand ID (in EBX)

On certain models, the brand ID is an 8-bit field that identifies a processor with a unique set of features as a specific brand. Other models have a 12-bit Brand ID. See “12-Bit Brand ID (in EBX)” on page 48 for details.The BIOS can use the 8-bit or 12-bit brand ID to program the ASCII processor name string to be returned by CPUID functions 8000_0002h, 8000_0003h, and 8000_0004h. See “8-Bit Brand ID” on page 54 for details.

4.1.1.3 CLFLUSH size (in EBX)

This field reports the size of the cache line flushed by the CLFLUSH instruction. See “CLFLUSH Size” on page 54 for details.

4.1.1.4 Initial APIC_ID (in EBX)

The Initial APIC ID field reports the node ID. See “Initial APIC_ID” on page 54 for details.

4.1.1.5 Standard Feature Flags (in EDX)

The AMD Opteron processors report the same standard features as the AMD Athlon XP processor, with the following additions:

EDX bit 19	CLFLUSH instruction
EDX bit 26	SSE2

4.1.2 Extended Function 8000_0000h—Highest Extended Function Available

The AMD Opteron processors return 8000_0018h as the highest extended function available.

4.1.3 Extended Function 8000_0001h—Processor Version Information and Extended Feature Flags

Extended Function 8000_0001h has been enhanced to return several new fields and flags.

4.1.3.1 Extended Family and Extended Model (in EAX)

These new fields, in conjuction with the existing family and model fields, expand the family and model numbering scheme to 8 bits. See “AMD Processor Signature (Extended Function)” on page 28 for important information on calculating and displaying the family and model numbers for AMD Opteron processors.

4.1.3.2 12-Bit Brand ID (in EBX)

On certain models, the brand ID is a 12-bit field that identifies a processor with a unique set of features as a specific brand. Other models have an 8-bit brand ID. See “8-Bit Brand ID (in EBX)” on page 47 for details. The BIOS can use the 8-bit or 12-bit brand ID to program the ASCII processor name string to be returned by CPUID functions 8000_0002h, 8000_0003h, and 8000_0004h. See “EBX—12-bit Brand ID” on page 61 for details.

4.1.3.3 Extended Feature Flags (in EDX)

The AMD Opteron processors add these new extended feature flags:

EDX bit 20	No-execute page protections (NX)
EDX bit 29	Long Mode capable (LM)

See “Function 8000_0001h—Processor Version Information and Extended Feature Flags” on page 60 for details.

4.1.4 Extended Functions 8000_0005h and 8000_0006h—Cache and TLB Information

These functions return information about the processor TLBs and caches. The format for the information returned by these functions is identical to the AMD Athlon and the AMD Duron processors, although the field values may differ. See “Extended Function 8000_0005h—L1 Cache and L1 TLB Information forAMD Opteron™, AMD Athlon™, and AMD Duron™ Processors” on page 70 and “Function 8000_0006h—L2 Cache Information for the AMD-K6®-III Processor” on page 74 for details.

4.1.5 Extended Function 8000_0007h—Advanced Power Management Information

This function returns the following new flags:

EDX bit 3	Thermal Trip (TTP)
EDX bit 4	Thermal Monitoring (TM)
EDX bit 5	Software Thermal Control (STC)

4.1.6 Extended Function 8000_0008h—Address Size Information

The AMD Opteron processors return 48 bits (30h) for the maximum linear address (Virtual Address) size and 40 bits (28h) for the maximum physical address size. See “Function 8000_0008h — Physical Address and Linear Address Size” on page 76 for details.

4.2 New Functions

The AMD Opteron processors introduce several new extended CPUID functions.

4.2.1 Extended Functions 8000_0009h–8000_0018h—Vendor-Specific Feature Flags

Functions 8000_0009h through 8000_0018h are reserved for future expansion of vendor-specific feature flags. Each function is reserved for a specific vendor. See “Extended Functions 8000_0009h–8000_0018h—Vendor-Specific Feature Flags” on page 77 for details.

Chapter 5 CPUID Instruction Definition

This chapter contains a detailed description of the CPUID instruction.

5.1 CPUID Instruction

Mnemonic	*Opcode*	*Description*
CPUID	0F A2h	Identify the processor and its feature set
Privilege:	none	
Registers Affected:	EAX, EBX, ECX, EDX	
Flags Affected:	none	
Exceptions Generated:	none	

The CPUID instruction is an application-level instruction that software executes to identify the processor and its feature set. This instruction offers multiple functions, each providing a different set of information about the processor. The CPUID instruction can be executed from any privilege level. Software can use the information returned by this instruction to tune its functionality for the specific processor and its features.

Not all processors implement the CPUID instruction. Therefore, software must test to determine if the instruction is present on the processor. If the ID bit (21) in the EFLAGS register is writeable, the CPUID instruction is implemented.

The CPUID instruction supports multiple functions. The information associated with each function is obtained by executing the CPUID instruction with the function number in the EAX register. Functions are divided into two types: standard functions and extended functions. Standard functions are found in the low function space, 0000_0000h through 7FFF_FFFFh. In general, all x86 processors have the same standard function definitions.

Extended functions are defined specifically for processors supplied by the vendor listed in the vendor identification string. Extended functions are found in the high function space, 8000_0000h through 8FFF_FFFFh. Because not all vendors have defined extended functions, software must test for their presence on the processor. AMD processors have extended functions if the 8000_0000h function returns a value of at least 8000_0001h in the EAX register.

5.2 Standard Functions

Standard functions provide a simple method for software to access information common to all x86 ISA processors.

5.2.1 Function 0—Largest Standard Function Input Value and Vendor Identification String

Input: EAX = 0

Output: EAX = Largest function input value recognized by the CPUID instruction
EBX, EDX, ECX = Vendor identification string

This is a standard function found in all processors implementing the CPUID instruction. It returns two values. The first value is returned in the EAX register and indicates the largest standard function value recognized by the processor. The second value is the vendor identification string. This 12-character ASCII string is returned in the EBX, EDX, and ECX registers in little endian format. AMD processors return a vendor identification string of “AuthenticAMD” as follows:

EBX				**EDX**				**ECX**				← Registers
h	t	u	A	i	t	n	e	D	M	A	c	← Alpha Characters
68	74	75	41	69	74	6E	65	44	4D	41	63	← ASCII Codes

Software uses the vendor identification string as follows:

- To identify the processor as an AMD processor
- To apply AMD’s definition of the CPUID instruction for all additional function calls

5.2.2 Function 1—Processor Signature and Standard Feature Flags

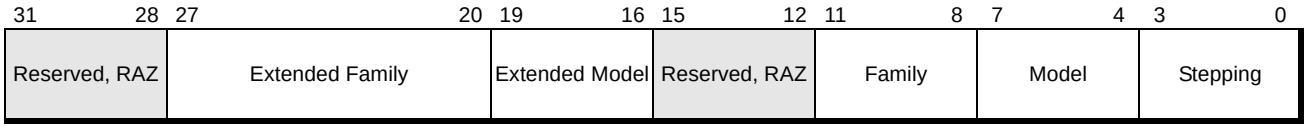
Function 1 returns two values—the Processor Signature and the Standard Feature Flags.

Input: EAX = 0000_0001h
Output: EAX = Version (family, model and stepping) information
EBX = 8-Bit Brand ID, CLFLUSH and APIC information[1]
ECX = 0 (Reserved)
EDX = Standard Feature Flags

Note: *1. EBX is Reserved in the AMD Athlon™, AMD Duron™, and earlier AMD processors*

5.2.2.1 EAX—Version (Family, Model and Stepping) Information

A processor belongs to a certain family of processors (for example—AMD-K6® microprocessor, AMD Athlon, AMD Opteron™ processors). Within that family, several models may exist. Additionally, each processor has a stepping or revision number. This function returns information about the processor instruction family, model, and stepping numbers in the EAX register, as shown in Figure 2.



Bits	Mnemonic	Definition
31–28	Reserved	RAZ
27–20	Extended Family[1]	If (Family = 0Fh), provides additional family information
19–16	Extended Model[1]	If (Family = 0Fh), provides additional model information
15–12	Reserved	RAZ
11–8	Family	Processor/Instruction Family
7–4	Model	Processor Model
3–0	Stepping	Processor Stepping (revision)

Note: *1. These bits are only returned for the AMD Opteron™ processors. For the AMD Athlon™ and AMD Duron™ processors these bits are reserved.*

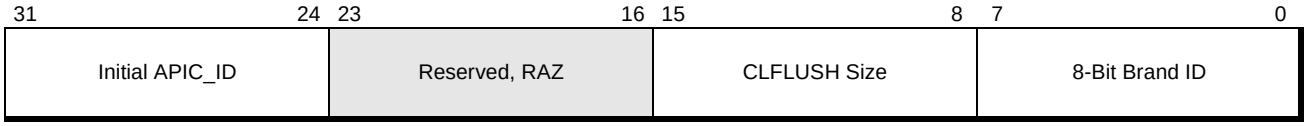
Figure 2. EAX Bit Fields for Standard Function 0000_0001h and Extended Function 8000_0001h

The *extended family* and *extended model* fields are new to the AMD Opteron processors and will be implemented in all future processor families.

These fields, in conjunction with the existing family and stepping fields, form an 8-bit *effective family* and *effective model* number as described in “AMD Processor Signature (Extended Function)” on page 28 .

5.2.2.2 EBX—8-Bit Brand ID, CFLUSH, and APIC Information

This function returns information regarding the processor brand in the EBX register, along with CLFLUSH and APIC information, as shown in Figure 3.



Bits	Mnemonic	Description
31-24	Initial APIC_ID	Initial local APIC physical ID
23-16	Reserved	RAZ
15-8	CLFLUSH Size	Cache line size (in quadwords)
7-0	8-Bit Brand ID	Processor Brand Identification

Figure 3. EBX Bit Fields for Standard Function 0000_0001h

5.2.2.2.1 8-Bit Brand ID

On certain models, the brand ID is an 8-bit field that identifies a processor with a unique set of features as a specific brand. Other models have a 12-bit brand ID. See “EBX—12-bit Brand ID” on page 61 for details. The BIOS can use the 8-bit or 12-bit brand ID to program the processor’s ASCII name string to be returned by CPUID functions 8000_0002h, 8000_0003h, and 8000_0004h. See “Extended Functions 8000_0002h, 8000_0003h, and 8000_0004h—Processor Name String” on page 69 for details. A value of 0 in this field indicates either that the processor reports a 12-bit brand ID through CPUID function 8000_0001h or that it is an engineering sample.

BIOS programmers should see Appendix B on page 95 for information about the procedure to program the processor name string that corresponds to each brand ID value.

This field is new to the AMD Opteron processors.

5.2.2.2.2 CLFLUSH Size

The 8-bit CLFLUSH Size field reports the size of the cache line flushed by the CLFLUSH instruction. The number reported is the cache line size in quadword (8-byte) increments.

This field is implemented only if the CLFLUSH instruction is supported. Software must test the CLFLUSH feature bit in the standard feature flags returned in EDX to determine if the CLFLUSH instruction is implemented. For information about the returned flag values, see “EDX—Standard Feature Flags.”

This field is new to the AMD Opteron processors.

5.2.2.2.3 Initial APIC_ID

The 8-bit initial APIC_ID field contains the initial value of the processor’s local APIC physical ID. The AMD Opteron processors derive the initial value of the local APIC physical ID from the node ID.

Subsequent writes by software to the local APIC ID register do not change the initial APIC ID value returned by the CPUID instruction, as shown in Table 9. This value continues to reflect the node ID.

Table 9. Initial APIC_ID Bit Definitions

Bit	Name	Function
26–24	NodeID	Node ID
31–27	Reserved	

This field is new to the AMD Opteron processors.

5.2.2.3 EDX—Standard Feature Flags

The standard feature flags are returned in the EDX register and indicate the presence of specific features. In most cases, a “1” indicates the feature is present, and a “0” indicates the feature is not present.

Table 10 on page 55 contains a list of the currently defined standard feature flags for the AMD Opteron processors .Table 11 on page 57 contains a list of the currently defined standard feature flags for the AMD Athlon family of processors. Table 12 on page 58 contains a list of the currently defined standard feature flags for the AMD Duron family of processors. Table 13 on page 59 contains a list of the currently defined standard feature flags for the AMD-K6® processor models 8 and 9. (See Table 32 through Table 36 in Appendix A, “Register Values Returned by the AMD Family Processors,” for all K86 family processor register definitions, including the AMD-K6 processor models 6 and 7.) Reserved bits will be used for new features as they are added. For more information, see “CPUID Instruction Overview”.

Table 10. Standard Feature Flag Descriptions for AMD Opteron™ Processors

Bit	Feature[1]	AMD Opteron™ Processors
		Models 0, 1, 4, 5, and 8
0	Floating-Point Unit	1
1	Virtual Mode Extensions	1
2	Debugging Extensions	1
3	Page Size Extensions (4-Mbyte pages)	1
4	Time Stamp Counter (with RDTSC and CR4 disable bit)	1
5	AMD K86 Family of Processors Model-Specific Registers (with RDMSR and WRMSR)	1
6	PAE (Page Address Extensions)	1
7	Machine Check Exception	1

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC for bit 9 to return a 1 (supported).*
3. *The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*

Table 10. Standard Feature Flag Descriptions for AMD Opteron™ Processors

Bit	Feature[1]	AMD Opteron™ Processors
		Models 0, 1, 4, 5, and 8
8	CMPXCHG8B Instruction	1
9	APIC	1[2]
10	Reserved on all AMD processors	0
11	SYSENTER/SYSEXIT Instructions[3]	1
12	MTRR (Memory Type Range Registers)	1
13	Global Paging Extension	1
14	Machine Check Architecture	1
15	Conditional Move Instruction	1
16	PAT (Page Attribute Table)	1
17	PSE-36 (Page Size Extensions)	1
18	Reserved on all AMD processors	0
19	CLFLUSH Instruction	1
20–22	Reserved on all AMD processors	0
23	MMX™ Instructions	1
24	FXSAVE/FXRSTOR	1
25	SSE Instructions	1
26	SSE2	1
27–31	Reserved on all AMD processors	0

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC for bit 9 to return a 1 (supported).*
3. *The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*

Table 11. Standard Feature Flag Descriptions for AMD Athlon™ Processors

Bit	Feature[1]	AMD Athlon™ Processor					
		Model 1	Model 2	Model 4	Model 6	Model 8	Model 10
0	Floating-Point Unit	1	1	1	1	1	1
1	Virtual Mode Extensions	1	1	1	1	1	1
2	Debugging Extensions	1	1	1	1	1	1
3	Page Size Extensions (4-Mbyte pages)	1	1	1	1	1	1
4	Time Stamp Counter (with RDTSC and CR4 disable bit)	1	1	1	1	1	1
5	AMD K86 Family of Processors Model-Specific Registers (with RDMSR and WRMSR)	1	1	1	1	1	1
6	PAE (Page Address Extensions)	1	1	1	1	1	1
7	Machine Check Exception	1	1	1	1	1	1
8	CMPXCHG8B Instruction	1	1	1	1	1	1
9	APIC	0	1[2]	1[2]	1[2]	1[2]	1[2]
10	Reserved on all AMD processors	0	0	0	0	0	0
11	SYSENTER/SYSEXIT[3]	1	1	1	1	1	1
12	MTRR (Memory Type Range Registers)	1	1	1	1	1	1
13	Global Paging Extension	1	1	1	1	1	1
14	Machine Check Architecture	1	1	1	1	1	1
15	Conditional Move Instruction	1	1	1	1	1	1
16	PAT (Page Attribute Table)	1	1	1	1	1	1
17	PSE-36 (Page Size Extensions)	0	1	1	1	1	1
18–22	Reserved on all AMD processors	0	0	0	0	0	0
23	MMX™ Instructions	1	1	1	1	1	1
24	FXSAVE/FXRSTOR	0	1	1	1	1	1
25	SSE Instructions[4]	0	0	0	1	1	1
26–31	Reserved on all AMD processors	0	0	0	0	0	0

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC in order for bit 9 to return a 1 (supported).*
3. *The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*
4. *SSE instruction support is only present when the processor is set up to support it by the BIOS. See the* AMD Athlon™ and AMD Duron™ Processor BIOS, Software, and Debug Developers Guide, *order# 21656*.

Table 12. Standard Feature Flag Descriptions for AMD Duron™ Processors

Bit	Feature[1]	AMD Duron™ Processor		
		Model 3	Model 6	Model 7
0	Floating-Point Unit	1	1	1
1	Virtual Mode Extensions	1	1	1
2	Debugging Extensions	1	1	1
3	Page Size Extensions (4-Mbyte pages)	1	1	1
4	Time Stamp Counter (with RDTSC and CR4 disable bit)	1	1	1
5	AMD K86 Family of Processors Model-Specific Registers (with RDMSR and WRMSR)	1	1	1
6	PAE (Page Address Extensions)	1	1	1
7	Machine Check Exception	1	1	1
8	CMPXCHG8B Instruction	1	1	1
9	APIC	1[2]	1[2]	1[2]
10	Reserved on all AMD processors	0	0	0
11	SYSENTER/SYSEXIT[3]	1	1	1
12	MTRR (Memory Type Range Registers)	1	1	1
13	Global Paging Extension	1	1	1
14	Machine Check Architecture	1	1	1
15	Conditional Move Instruction	1	1	1
16	PAT (Page Attribute Table)	1	1	1
17	PSE-36 (Page Size Extensions)	1	1	1
18–22	Reserved on all AMD processors	0	0	0
23	MMX™ Instructions	1	1	1
24	FXSAVE/FXRSTOR	1	1	1
25	SSE Instructions[4]	0	1	1
26–31	Reserved on all AMD processors	0	0	0

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC in order for bit 9 to return a 1 (supported).*
3. *The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*
4. *SSE instruction support is only present when the processor is set up to support it by the BIOS. See the* AMD Athlon™ and AMD Duron™ Processor BIOS, Software, and Debug Developers Guide, *order# 21656.*

Table 13. Standard Feature Flag Descriptions for AMD-K6®-2 and AMD-K6®-III Processors

Bit	Feature[1]	AMD-K6®-2 Processor (Model 8)	AMD-K6®-III Processor (Model 9)
0	Floating-Point Unit	1	1
1	Virtual Mode Extensions	1	1
2	Debugging Extensions	1	1
3	Page Size Extensions (4-Mbyte pages)	1	1
4	Time Stamp Counter (with RDTSC and CR4 disable bit)	1	1
5	K86 Family of Processors Model-Specific Registers (with RDMSR and WRMSR)	1	1
6	PAE (Page Address Extensions)	0	0
7	Machine Check Exception	1	1
8	CMPXCHG8B Instruction	1	1
9	APIC	0	0
10	Reserved on all AMD-K6® processors	0	0
11	SYSENTER/SYSEXIT[2]	0	0
12	Memory Type Range Registers	0	0
13	Global Paging Extension	1[3]	1
14	Machine Check Architecture	0	0
15	Conditional Move Instruction	0	0
16	PAT (Page Attribute Table)	0	0
17	PSE-36 (Page Size Extensions)	0	0
18–22	Reserved on all AMD-K6 processors	0	0
23	MMX™ Instructions	1	1
24	FXSAVE/FXRSTOR	0	0
25–31	Reserved on all AMD-K6 processors	0	0

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*
3. *See Table 35 on page 90 for more information about Global Paging Extensions in the AMD-K6®-2 processor model 8.*

5.3 Extended Functions

Extended functions provide information on extensions specific to a vendor's processor.

5.3.1 Function 8000_0000h—Largest Extended Function Input Value

Extended function 8000_0000h returns the highest extended function input value defined for the processor. Software must test for the existence of extended functions by using this function. If the value (reported in EAX) is at least 8000_0000h, the processor supports extended functions.

Input: EAX = 8000_0000h

Output: EAX = 8000_0018h
EBX = Reserved
ECX = Reserved
EDX = Reserved

5.3.2 Function 8000_0001h—Processor Version Information and Extended Feature Flags

Function 8000_0001h of the CPUID instruction returns two types of information about the processor—version and features. The version information identifies the specific processor by providing its family, model, and revision (stepping). This information is the same as that provided by function 1. This function also returns the extended feature flags, which indicate the presence of specific features introduced in AMD processors.

Input: EAX = 8000_0001h
Output: EAX = Version (family, model, and stepping) information
EBX = 0 or 12-bit Brand ID[1]
ECX = 0 (Reserved for Future Features)
EDX = Extended Feature Flags

Note: *1. This EBX field is only returned for the AMD Opteron™ processors. It is reserved on the AMD Athlon™, AMD Duron™, and earlier AMD processors.*

5.3.2.1 EAX—Version (Family, Model, and Stepping) Information

A processor belongs to a certain family of processors (for example—AMD-K6 microprocessor, AMD Athlon, and AMD Opteron processors). Within that family, several models may exist. Additionally each processor has a revision number or stepping number. This function returns information about the processor instruction family, model, and stepping numbers in the EAX register.

This information is identical to that returned in EAX by standard function 1. For a diagram of the EAX bit fields, see Figure 2 on page 53.

5.3.2.2 EBX—12-bit Brand ID

On certain models of the AMD Opteron processor, the brand ID is a 12-bit field that identifies a processor with a unique set of features as a specific brand. Other models have an 8-bit brand ID. See“8-Bit Brand ID” on page 54 for details. The BIOS can use the 8-bit or 12-bit brand ID to program the processor’s ASCII name string to be returned by CPUID functions 8000_0002h, 8000_0003h, and 8000_0004h. See “Extended Functions 8000_0002h, 8000_0003h, and 8000_0004h—Processor Name String” on page 69 for details. A value of 0 in this field indicates either that the processor reports an 8-bit brand ID through CPUID function 0000_0001h or that it is an engineering sample.

BIOS programmers should see Appendix B “Programming the Name String of the AMD Opteron™ Processor” on page 95 for information about the procedure to program the processor name string that corresponds to each Brand ID value.

This field is new to the AMD Opteron processors. This bit is reserved on the AMD Athlon, AMD Duron, and earlier AMD processors.

5.3.2.3 ECX—Extended Feature Flag

ECX is reserved for future AMD features.

5.3.2.4 EDX—Extended Feature Flags

The extended feature flags are returned in the EDX register. Each bit corresponds to a specific feature. A ‘1’ indicates that the feature is present, and a ‘0’ indicates that feature is not present.

Most of the standard feature bits from function 1 (See “Function 1—Processor Signature and Standard Feature Flags” on page 52) are replicated in the extended feature flags, along with bits for specific AMD extensions to the x86 architecture. See Table 18 for a list of the differences between the standard function feature flags and the extended function feature flags.

Table 14 on page 62 shows the complete extended feature flags for the AMD Opteron processors.

Table 14. Extended Feature Flags—AMD Opteron™ Processors

Bit	Feature[1]	AMD Opteron™ Processors
		Models 0, 1, 4, 5, and 8
0	Floating-Point Unit	1
1	Virtual Mode Extensions	1
2	Debugging Extensions	1
3	Page Size Extensions (4-Mbyte Pages)	1
4	Time Stamp Counter (with RDTSC and CR4 disable bit)	1
5	AMD K86 Family of Processors Model-Specific Registers (with RDMSR and WRMSR)	1
6	PAE (Page Address Extensions)	1
7	Machine Check Exception	1
8	CMPXCHG8B Instruction	1
9	APIC	1[2]
10	Reserved on all AMD processors	0
11	SYSCALL and SYSRET Instructions[3]	1
12	MTRR (Memory Type Range Registers)	1
13	Global Paging Extension	1
14	Machine Check Architecture	1
15	Conditional Move Instruction	1
16	PAT (Page Attribute Table)	1
17	PSE-36 (Page Size Extensions)	1
18	Reserved on all AMD Opteron™ processors	0
19	Reserved on all AMD Opteron processors	0
20	No-execute Page Protection (NX)	1
21	Reserved on all AMD processors	0
22	AMD Extensions to the MMX™ Instruction Set	1
23	MMX Instructions	1
24	FXSAVE/FXRSTOR Instructions	1

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC in order for bit 9 to return a 1 (supported).*
3. *The implementation of the SYSCALL and SYSRET instructions is the same on the AMD Opteron processors, AMD Athlon, AMD Duron processor and the AMD-K6® processor models 8 through D. The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*

Table 14. Extended Feature Flags—AMD Opteron™ Processors (Continued)

Bit	Feature[1]	AMD Opteron™ Processors
		Models 0, 1, 4, 5, and 8
25–28	Reserved on all AMD processors	0
29	Long Mode Capable (LM)	1
30	3DNow!™ Instruction Extensions	1
31	3DNow! Instructions	1

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC in order for bit 9 to return a 1 (supported).*
3. *The implementation of the SYSCALL and SYSRET instructions is the same on the AMD Opteron processors, AMD Athlon, AMD Duron processor and the AMD-K6® processor models 8 through D. The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*

Table 15 contains a list of the currently defined feature flags for the AMD Athlon processors.

Table 15. Extended Feature Flag Descriptions for AMD Athlon™ Processors

Bit	Feature[1]	AMD Athlon™ Processor					
		Model 1	Model 2	Model 4	Model 6	Model 8	Model 10
0	Floating-Point Unit	1	1	1	1	1	1
1	Virtual Mode Extensions	1	1	1	1	1	1
2	Debugging Extensions	1	1	1	1	1	1
3	Page Size Extensions (4-Mbyte Pages)	1	1	1	1	1	1
4	Time Stamp Counter (with RDTSC and CR4 disable bit)	1	1	1	1	1	1
5	AMD K86 Family of Processors Model-Specific Registers (with RDMSR and WRMSR)	1	1	1	1	1	1
6	PAE (Page Address Extensions)	1	1	1	1	1	1
7	Machine Check Exception	1	1	1	1	1	1
8	CMPXCHG8B Instruction	1	1	1	1	1	1
9	APIC	0	1[2]	1[2]	1[2]	1[2]	1[2]
10	Reserved on all AMD processors	0	0	0	0	0	0
11	SYSCALL and SYSRET Instructions[3]	1	1	1	1	1	1
12	MTRR (Memory Type Range Registers)	1	1	1	1	1	1
13	Global Paging Extension	1	1	1	1	1	1
14	Machine Check Architecture	1	1	1	1	1	1
15	Conditional Move Instruction	1	1	1	1	1	1
16	PAT (Page Attribute Table)	1	1	1	1	1	1
17	PSE-36 (Page Size Extensions)	0	1	1	1	1	1
18	Reserved on all AMD processors	0	0	0	0	0	0
19	Multiprocessing Capable	0	0	0	1[4]	1[5]	1[5]

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC in order for bit 9 to return a 1 (supported).*
3. *The implementation of the SYSCALL and SYSRET instructions is the same on the AMD Athlon™ processors, the AMD Duron™ processors, as well as on the AMD-K6® processors models 8 and 9. The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*
4. *This value is a "1" on AMD Athlon™ MP model 6 processors with a CPUID value of 662 or greater. Although the value is a "0" for all AMD Athlon MP processors model 6 with a CPUID value of 660 or 661, these processors are also multiprocessing capable. AMD reserves the right to report a "0" or a "1" for all other model 6 processors which are not tested, supported, or intended by AMD to be used for operation in multiprocessing platforms. See the* AMD Athlon Processor Model 6 Revision Guide, *order# 24332, for the processor revision information corresponding to these model 6 CPUID values.*
5. *This value is a "1" for AMD Athlon MP model 8 and model 10 processors and is a "0" for all other AMD Athlon model 8 and model 10 processors, including the AMD Athlon XP processor and mobile AMD Athlon XP processor.*

Table 15. Extended Feature Flag Descriptions for AMD Athlon™ Processors

Bit	Feature[1]	AMD Athlon™ Processor					
		Model 1	Model 2	Model 4	Model 6	Model 8	Model 10
20–21	Reserved on all AMD processors	0	0	0	0	0	0
22	AMD Extensions to the MMX™ Instruction Set	1	1	1	1	1	1
23	MMX Instructions	1	1	1	1	1	1
24	FXSAVE/FXRSTOR Instructions	0	1	1	1	1	1
25–29	Reserved on all AMD processors	0	0	0	0	0	0
30	3DNow!™ Instruction Extensions	1	1	1	1	1	1
31	3DNow! Instructions	1	1	1	1	1	1

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC in order for bit 9 to return a 1 (supported).*
3. *The implementation of the SYSCALL and SYSRET instructions is the same on the AMD Athlon™ processors, the AMD Duron™ processors, as well as on the AMD-K6® processors models 8 and 9. The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*
4. *This value is a "1" on AMD Athlon™ MP model 6 processors with a CPUID value of 662 or greater. Although the value is a "0" for all AMD Athlon MP processors model 6 with a CPUID value of 660 or 661, these processors are also multiprocessing capable. AMD reserves the right to report a "0" or a "1" for all other model 6 processors which are not tested, supported, or intended by AMD to be used for operation in multiprocessing platforms. See the* AMD Athlon Processor Model 6 Revision Guide, *order# 24332, for the processor revision information corresponding to these model 6 CPUID values.*
5. *This value is a "1" for AMD Athlon MP model 8 and model 10 processors and is a "0" for all other AMD Athlon model 8 and model 10 processors, including the AMD Athlon XP processor and mobile AMD Athlon XP processor.*

Table 16 contains a list of the currently defined feature flags for the AMD Duron processor.

Table 16. Extended Feature Flag Descriptions for AMD Duron™ Processors

Bit	Feature[1]	AMD Duron™ Processor		
		Model 3	Model 6	Model 7
0	Floating-Point Unit	1	1	1
1	Virtual Mode Extensions	1	1	1
2	Debugging Extensions	1	1	1
3	Page Size Extensions (4-Mbyte Pages)	1	1	1
4	Time Stamp Counter (with RDTSC and CR4 disable bit)	1	1	1
5	AMD K86 Family of Processors Model-Specific Registers (with RDMSR and WRMSR)	1	1	1
6	PAE (Page Address Extensions)	1	1	1
7	Machine Check Exception	1	1	1
8	CMPXCHG8B Instruction	1	1	1
9	APIC	1[2]	1[2]	1[2]
10	Reserved on all AMD processors	0	0	0
11	SYSCALL and SYSRET Instructions[3]	1	1	1
12	MTRR (Memory Type Range Registers)	1	1	1
13	Global Paging Extension	1	1	1
14	Machine Check Architecture	1	1	1
15	Conditional Move Instruction	1	1	1
16	PAT (Page Attribute Table)	1	1	1
17	PSE-36 (Page Size Extensions)	1	1	1
18	Reserved on all AMD processors	0	0	0
19	Multiprocessing Capable	0	0[4]	0[4]

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC in order for bit 9 to return a 1 (supported).*
3. *The implementation of the SYSCALL and SYSRET instructions is the same on the AMD Athlon™ proceessors and the AMD Duron™ processors,as well as on the AMD-K6® processors models 8 and 9. The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*
4. *AMD reserves the right to report a "0" or a "1" for all AMD Duron model 6 and model 7 processors which are not tested, supported, or intended by AMD to be used for operation in multiprocessing platforms.*

Table 16. Extended Feature Flag Descriptions for AMD Duron™ Processors (Continued)

Bit	Feature[1]	AMD Duron™ Processor		
		Model 3	Model 6	Model 7
20–21	Reserved on all AMD processors	0	0	0
22	AMD Extensions to the MMX™ Instruction Set	1	1	1
23	MMX Instructions	1	1	1
24	FXSAVE/FXRSTOR Instructions	1	1	1
25–29	Reserved on all AMD processors	0	0	0
30	3DNow!™ Instruction Extensions	1	1	1
31	3DNow! Instructions	1	1	1

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The AMD processor contains a local APIC. The BIOS must enable the local APIC in order for bit 9 to return a 1 (supported).*
3. *The implementation of the SYSCALL and SYSRET instructions is the same on the AMD Athlon™ proceessors and the AMD Duron™ processors,as well as on the AMD-K6® processors models 8 and 9. The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*
4. *AMD reserves the right to report a "0" or a "1" for all AMD Duron model 6 and model 7 processors which are not tested, supported, or intended by AMD to be used for operation in multiprocessing platforms.*

Table 17 contains a list of the currently defined feature flags for the AMD-K6 processor models 8 and 9.

Table 17. Extended Feature Flag Descriptions for AMD-K6®-2 and AMD-K6®-III Processors

Bit	Feature[1]	AMD-K6®-2 Processor (Model 8)	AMD-K6®-III Processor (Model 9)
0	Floating-Point Unit	1	1
1	Virtual Mode Extensions	1	1
2	Debugging Extensions	1	1
3	Page Size Extensions (4-Mbyte Pages)	1	1
4	Time Stamp Counter (with RDTSC and CR4 disable bit)	1	1
5	K86 Family of Processors' Model-Specific Registers (with RDMSR and WRMSR)	1	1
6	PAE (Page Address Extensions)	0	0
7	Machine Check Exception	1	1
8	CMPXCHG8B Instruction	1	1
9	APIC	0	0
10	Reserved on all AMD-K6® processors	0	0
11	SYSCALL and SYSRET Instructions[2]	1	1
12	Memory Type Range Registers	0	0
13	Global Paging Extension	1	1
14	Machine Check Architecture	0	0
15	Conditional Move Instruction	0	0
16	PAT (Page Attribute Table)	0	0
17	PSE-36 (Page Size Extensions)	0	0
18–21	Reserved on all AMD-K6 processors	0	0
22	AMD Extensions to the MMX™ Instruction Set	0	0
23	MMX Instructions	1	1
24	FXSAVE/FXRSTOR	0	0
25–29	Reserved on all AMD-K6 processors	0	0
30	3DNow!™ Instruction Extensions	0	0
31	3DNow! Instructions	1	1

Notes:

1. *Bit definitions: 0 = No Support, 1 = Support.*
2. *The SYSENTER and SYSEXIT instructions have different implementations than the SYSCALL and SYSRET instructions.*

Before the AMD Opteron processors, most standard feature bits returned by function 1 were duplicated in the extended feature flags returned by function 8000_0001h. Starting with the AMD Opteron processors, new standard feature bits will not be replicated in the extended feature flags. Extended feature bits are only added for AMD extensions to the x86 architecture. Table 18 lists the differences between the standard function feature flags and the extended function feature flags.

Table 18. Standard Feature Flags Versus Extended Feature Flags

Bit	Standard Feature Flag	Extended Feature Flag
11	SYSENTER and SYSEXIT Instructions	SYSCALL and SYSRET Instructions
19	CFLUSH Instruction	Reserved
20	Reserved	No-execute Page Protection (NX)
22	Reserved	MMX™ Instruction Extensions
25	SSE Instructions	Reserved
26	SSE2	Reserved
29	Reserved	Long Mode Capable (LM)
30	Reserved	3DNow!™ Instruction Extensions
31	Reserved	3DNow! Instructions

Features that are compatible with extensions made by other vendors will be reported in the feature function reserved for that vendor. For details, see “Extended Functions 8000_0009h–8000_0018h—Vendor-Specific Feature Flags” on page 77.

See Tables 32 through 36 in Appendix A, “Register Values Returned by the AMD Family Processors” on page 79 for all K86 family processor register definitions.

5.3.3 Extended Functions 8000_0002h, 8000_0003h, and 8000_0004h—Processor Name String

Functions 8000_0002h, 8000_0003h and 8000_0004h each return part of the processor name string in the EAX, EBX, ECX, and EDX registers.

Input: EAX = 8000_0002h, 8000_0003h, or 8000_0004h

Output: EAX = Processor Name String
EBX = Processor Name String
ECX = Processor Name String
EDX = Processor Name String

These three functions use four registers to return an ASCII string of up to 48 characters in little-endian byte order. Function 8000_0002h returns the first 16 characters of the processor name. The first character resides in the least significant byte of EAX, and the last character (of this group of 16) resides in the most significant byte of EDX. Functions 8000_0003h and 8000_0004h return the

second and third group of 16 characters in a similar fashion. The ASCII NUL character (00h) indicates the end of the processor name string.

With the AMD Opteron processor, the processor name string is set to NULs (ASCII 00h) upon reset and must be programmed by the BIOS during system initialization. See Appendix B “Programming the Name String of the AMD Opteron™ Processor” for information about how to program the processor name string.

For some versions of the AMD Athlon and the AMD Duron processors, the processor name string must be reprogrammed.

5.3.4 Extended Function 8000_0005h—L1 Cache and L1 TLB Information forAMD Opteron™, AMD Athlon™, and AMD Duron™ Processors

Function 8000_0005h returns L1 cache and L1 TLB information.

Input: EAX = 8000_0005h

Output: EAX = L1 TLB Large Page Information
EBX = L1 TLB 4-Kbyte Page Information
ECX = L1 Data Cache Information
EDX = L1 Instruction Cache Information

Function 8000_0005h returns information about the processor L1 TLBs and caches. The format for the information returned by the 8000_0005h function for the AMD Opteron processors is the same as the format used by AMD Athlon and the AMD Duron processors, although the field values may differ. Table 19 through Table 22 on page 71 list the values returned by function 8000_0005h for the AMD Opteron, AMD Athlon, and the AMD Duron processors.

Table 19. EAX Format Returned by Function 8000_0005h

	Two-Mbyte/4-Mbyte Pages			
	Data TLB		Instruction TLB	
	Associativity[1]	# Entries[2]	Associativity[1]	# Entries[2]
EAX	Bits 31–24	Bits 23–16	Bits 15–8	Bits 7–0

Notes:

1. *See “Associativity for L1 Caches and L1 TLBs” on page 74 for more information.*
2. *The number of entries returned is the number of entries available for 2-Mbyte large pages. Because 4-Mbyte large pages require two 2-Mbyte entries, the number of entries available for 4-Mbyte large pages is one-half the returned value.*

Table 20. EBX Format Returned by Function 8000_0005h

	Four-Kbyte Pages			
	Data TLB		Instruction TLB	
	Associativity*	# Entries	Associativity*	# Entries
EBX	Bits 31–24	Bits 23–16	Bits 15–8	Bits 7–0

Note:
* *See "Associativity for L1 Caches and L1 TLBs" on page 74 for more information.*

Table 21. ECX Format Returned by Function 8000_0005h

	L1 Data Cache			
	Size (Kbytes)	Associativity*	Lines per Tag	Line Size (bytes)
ECX	Bits 31–24	Bits 23–16	Bits 15–8	Bits 7–0

Note:
* *See "Associativity for L1 Caches and L1 TLBs" on page 74 for more information.*

Table 22. EDX Format Returned by Function 8000_0005h

	L1 Instruction Cache			
	Size (Kbytes)	Associativity*	Lines per Tag	Line Size (bytes)
EDX	Bits 31–24	Bits 23–16	Bits 15–8	Bits 7–0

Note:
* *See "Associativity for L1 Caches and L1 TLBs" on page 74 for more information.*

5.3.5 Function 8000_0005h—L1 Cache Information for AMD-K5 and All AMD-K6® Processors

Input: EAX = 8000_0005h

Output: EAX = Reserved
EBX = TLB Page Information
ECX = L1 Data Cache Information
EDX = L1 Instruction Cache Information

Function 8000_0005h returns information about the processor's on-chip L1 caches and associated TLBs. Tables 23, 24, and 25 provide the format for the information returned by the 8000_0005h function for the AMD-K5 and all AMD-K6® processors.

Table 23. EBX Format Returned by Function 8000_0005h

	Data TLB		Instruction TLB	
	Associativity*	**# Entries**	**Associativity***	**# Entries**
EBX	Bits 31–24	Bits 23–16	Bits 15–8	Bits 7–0

Note:
* *See "Associativity for L1 Caches and L1 TLBs" on page 74 for more information.*

Table 24. ECX Format Returned by Function 8000_0005h

	L1 Data Cache			
	Size (Kbytes)	**Associativity***	**Lines per Tag**	**Line Size (bytes)**
ECX	Bits 31–24	Bits 23–16	Bits 15–8	Bits 7–0

Note:
* *See "Associativity for L1 Caches and L1 TLBs" on page 74 for more information.*

Table 25. EDX Format Returned by Function 8000_0005h

	L1 Instruction Cache			
	Size (Kbytes)	**Associativity***	**Lines per Tag**	**Line Size (bytes)**
EDX	Bits 31–24	Bits 23–16	Bits 15–8	Bits 7–0

Note:
* *See "Associativity for L1 Caches and L1 TLBs" on page 74 for more information.*

5.3.6 Extended Function 8000_0006h—L2 Cache and L2 TLB Information for the AMD Opteron™, AMD Athlon™, and AMD Duron™ Processors

Note: *The L2 cache for the AMD Athlon processor model 1 and model 2 must be configured prior to invoking this function.*

Function 8000_0006h returns information about the processor L2 TLBs and L2 cache. The format for the information returned by the 8000_0006h function for the AMD Opteron processors is the same as the format used by AMD Athlon and the AMD Duron processors, although the field values may differ. Tables 26 through 28 list the values returned by function 8000_0006h for the AMD Opteron processors.

Input: EAX = 8000_0006h

Output: EAX = L2 TLB Large Page Information
EBX = L2 TLB 4-Kbyte Page Information
ECX = L2 Unified Cache Information
EDX = Reserved (0)

Table 26. EAX Format Returned by Function 8000_0006h

	Two-Mbyte/4-Mbyte Pages			
	L2 Data TLB[2]		L2 Instruction or Unified TLB	
	Associativity[1]	# Entries	Associativity[1]	# Entries
EAX	Bits 31–28	Bits 27–16	Bits 15–12	Bits 11–0

Notes:

1. *See "Associativity for L2 Caches and L2 TLBs" on page 74 for more information.*
2. *A unified L2 TLB is indicated by a value of 0000h in the upper 16 bits of the EBX register. Unified TLB information is then referenced in the lower 16 bits of the EBX register.*

Table 27. EBX Format Returned by Function 8000_0006h

	Four-Kbyte Pages			
	L2 Data TLB[2]		L2 Instruction or Unified TLB	
	Associativity[1]	# Entries	Associativity[1]	# Entries
EBX	Bits 31–28	Bits 27–16	Bits 15–12	Bits 11–0

Notes:

1. *See "Associativity for L2 Caches and L2 TLBs" on page 74 for more information.*
2. *A unified L2 TLB is indicated by a value of 0000h in the upper 16 bits of the EBX register. Unified TLB information is then referenced in the lower 16 bits of the EBX register.*

Table 28. ECX Format Returned by Function 8000_0006h

	L2 Cache			
	Size (Kbytes)	Associativity*	Lines per Tag	Line Size (bytes)
ECX	Bits 31–16	Bits 15–12	Bits 11–8	Bits 7–0

Note:

* *See "Associativity for L2 Caches and L2 TLBs" on page 74 for more information.*

5.3.7 Function 8000_0006h—L2 Cache Information for the AMD-K6®-III Processor

Function 8000_0006h returns information about the processor's L2 cache.

Input: EAX = 8000_0006h

Output: EAX = Reserved (0)
EBX = Reserved (0)
ECX = L2 Unified Cache Information
EDX = Reserved (0)

Table 29 provides the format for the information returned by the 8000_0006h function.

Table 29. ECX Format Returned by Function 8000_0006h for the AMD-K6®-III Processor

	L2 Cache			
	Size (Kbytes)	**Associativity***	**Lines per Tag**	**Line Size (bytes)**
ECX	Bits 31–16	Bits 15–12	Bits 11–8	Bits 7–0

Note:
* *See "Associativity for L2 Caches and L2 TLBs" on page 74 for more information.*

5.3.7.1 Associativity Field Definitions

This section describes the values returned in the associativity fields.

5.3.7.1.1 Associativity for L1 Caches and L1 TLBs

The associativity fields for the L1 data cache, L1 instruction cache, L1 data TLB, and L1 instruction TLB are all eight bits wide. Except for 00h (Reserved) and FFh (Full), the number returned in the associativity field represents the actual number of ways, with a range of 01h through FEh. For example, a returned value of 02h indicates two-way associativity and a returned value of 04h indicates four-way associativity.

5.3.7.1.2 Associativity for L2 Caches and L2 TLBs

The associativity fields for the L2 cache, L2 data TLB, and L2 instruction TLB are four bits wide. Table 30 shows the values returned in these associativity fields.

Table 30. Associativity Values For L2 Caches and TLBs

Bits 15–12	Associativity
0000b	L2 off
0001b	Direct mapped

Table 30. Associativity Values For L2 Caches and TLBs

Bits 15–12	Associativity
0010b	2-way
0011b	*Reserved*
0100b	4-way
0101b	*Reserved*
0110b	8-way
0111b	*Reserved*
1000b	16-way
1001b	*Reserved*
1010b	*Reserved*
1011b	*Reserved*
1100b	*Reserved*
1101b	*Reserved*
1110b	*Reserved*
1111b	Full

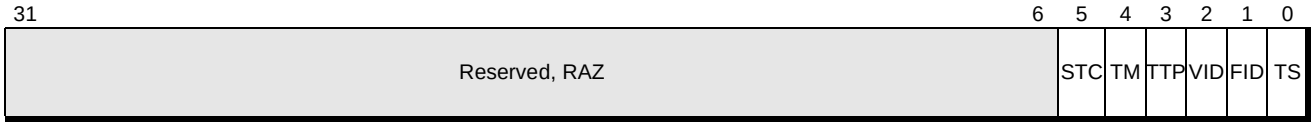
5.3.8 Function 8000_0007h — Advanced Power Management Feature Flags

Function 8000_0007h returns information about the advanced power management features supported by the processor. The function returns the power management feature flags in the EDX register, as shown in Figure 4. Each bit corresponds to a specific feature. A 1 indicates that the feature is present and a 0 indicates that the feature is not present.

EAX, EBX, and ECX are reserved for future advanced power management features.

Input EAX = 8000_0007h

Output EAX = Reserved
EBX = Reserved
ECX = Reserved
EDX = Advanced Power Management feature flags



Bits	Mnemonic	Definition	Value
31–6	Reserved	RAZ	
5	STC	Software Thermal Control[1]	1
4	TM	Thermal Monitoring[1]	1
3	TTP	Thermal Trip[1]	1*
2	VID	Voltage ID Control	1
1	FID	Frequency ID Control	1
0	TS	Temperature Sensor	1*

Note:

1. *These functions are available only on the AMD Opteron™ processors.*

* These bits are 0 for models 0 and 1.

Figure 4. EDX Bit Fields for Extended Function 8000_0007h

For more details, see the *BIOS Requirements for AMD PowerNow!™ Technology Application Note*, order# 25264, and the *BIOS Requirements for AMD PowerNow!™ Technology Low-Power Desktop Processors Application Note*, order# 25541.

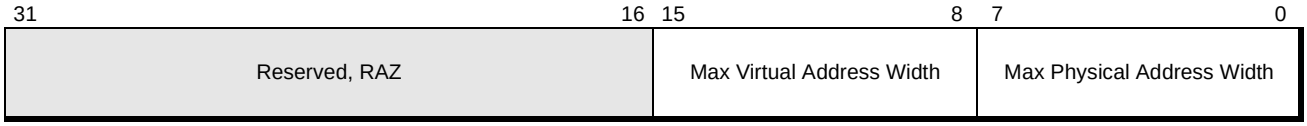
5.3.9 Function 8000_0008h — Physical Address and Linear Address Size

Function 8000_0008h returns information about the maximum physical and linear address width (in bits) supported by the processor, as shown in Figure 5 on page 77. The width reported is the maximum supported in any mode. For long mode capable processors, the size reported is independent of whether long mode is enabled.

Input: EAX = 8000_0008h

Output: EAX = Max Physical and Linear Address Width
EBX = Reserved
ECX = Reserved
EDX = Reserved

The AMD Opteron processors return 30h (48 bits) for the maximum linear address (Virtual Address) size and 28h (40 bits) for the maximum physical address size.



Bits	Definition	Value
31–16	Reserved	RAZ
15–8	Maximum Virtual Address Width	30h (48 bits)
7–0	Maximum Physical Address Width	28h (40 bits)

Figure 5. EAX Bit Fields for Extended Function 8000_0008h

5.3.10 Extended Functions 8000_0009h–8000_0018h—Vendor-Specific Feature Flags

Functions 8000_0009h through 8000_0018h are reserved for future expansion of vendor-specific feature flags. Each function is reserved for a specific vendor.

Input: EAX = 8000_0009h to 8000_0018h

Output: EAX = 0 (Reserved for vendor-specific features)
EBX = 0 (Reserved for vendor-specific features)
ECX = 0 (Reserved for vendor-specific features)
EDX = 0 (Reserved for vendor-specific features)

Features that are compatible with extensions made by other vendors will be reported in the feature function reserved for that vendor. So, to check for a certain feature across multiple vendors, software need only check the vendor-specific feature flags for the vendor that first implemented that feature.

Currently, Intel features are reported by function 0000_0001h and AMD features are reported by function 8000_0001h. Functions 8000_0009h and 8000_000Ah are reserved for expansion by Intel and AMD respectively.

- 8000_0009h reserved for Intel feature flag expansion
- 8000_000Ah reserved for AMD feature flag expansion
- 8000_000B–8000_0018h reserved for vendors to be determined

Appendix A Register Values Returned by the AMD Family Processors

Tables 31–36 contain all the values returned for AMD processors by the CPUID instruction.

A.1 AMD Opteron™ Processor Values

Table 31. Values Returned by the AMD Opteron™ Processors

Function Register	Processor (Model 5)
Function: 0	
EAX	0000_0001h
EBX	6874_7541h
ECX	444D_4163h
EDX	6974_6E65h
Function: 1	
EAX	0000_066Xh
EBX	Reserved
ECX	Reserved
EDX	078B_F9FFh[1]
Function: 8000_0000h	
EAX	8000_0018h
EBX	Reserved
ECX	Reserved
EDX	Reserved
Function: 8000_0001h	
EAX	0000_076Xh
EBX	Reserved[2]
ECX	Reserved
EDX	E1D3_F9FFh

Notes:

1. *The AMD Opteron processor contains an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 078B_FBFFh.*
2. *8000_0001h returns the 12-bit Brand ID in EBX. For more information, see Appendix B "Programming the Name String of the AMD Opteron™ Processor".*
3. *8000_0002/3/4 all return 0 until the name string is programmed by the BIOS. For more information, see Appendix B "Programming the Name String of the AMD Opteron™ Processor".*

Table 31. Values Returned by the AMD Opteron™ Processors (Continued)

Function Register	Processor (Model 5)
Function: 8000_0002h[3]	
EAX	0000_0000h
EBX	0000_0000h
ECX	0000_0000h
EDX	0000_0000h
Function: 8000_0003h[3]	
EAX	0000_0000h
EBX	0000_0000h
ECX	0000_0000h
EDX	0000_0000h
Function: 8000_0004h[3]	
EAX	0000_0000h
EBX	0000_0000h
ECX	0000_0000h
EDX	0000_0000h
Function: 8000_0005h	
EAX	0408_FF08h
EBX	FF20_FF10h
ECX	4002_0140h
EDX	4002_0140h
Function: 8000_0006h	
EAX	0000_0000h
EBX	4100_4100h
ECX	0400_8140h
EDX	Reserved

Notes:

1.The AMD Opteron processor contains an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 078B_FBFFh.

2. 8000_0001h returns the 12-bit Brand ID in EBX. For more information, see Appendix B "Programming the Name String of the AMD Opteron™ Processor".

3. 8000_0002/3/4 all return 0 until the name string is programmed by the BIOS. For more information, see Appendix B "Programming the Name String of the AMD Opteron™ Processor".

Table 31. Values Returned by the AMD Opteron™ Processors (Continued)

Function Register	Processor (Model 5)
Function: 8000_0007h	
EAX	Reserved
EBX	Reserved
ECX	Reserved
EDX	****_***Fh
Function: 8000_0008h	
EAX	0000_3028h
EBX	Reserved
ECX	Reserved
EDX	Reserved
Function: 8000_0009h	
EAX	0000_0000h
EBX	0000_0000h
ECX	0000_0000h
EDX	0000_0000h
Function: 8000_000Ah	
EAX	0000_0000h
EBX	0000_0000h
ECX	0000_0000h
EDX	0000_0000h
Function: 8000_000Bh–8000_0018h	
EAX	0000_0000h
EBX	0000_0000h
ECX	0000_0000h
EDX	0000_0000h

Notes:

1. *The AMD Opteron processor contains an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 078B_FBFFh.*
2. *8000_0001h returns the 12-bit Brand ID in EBX. For more information, see Appendix B "Programming the Name String of the AMD Opteron™ Processor".*
3. *8000_0002/3/4 all return 0 until the name string is programmed by the BIOS. For more information, see Appendix B "Programming the Name String of the AMD Opteron™ Processor".*

A.2 AMD Athlon™ Processor and AMD Duron™ Processor Values

Table 32. Values Returned by AMD Athlon™ and AMD Duron™ Processors Models 6 and Higher

Function / Register	Processor (Model 6)[1]	Processor (Model 7)[1]	Processor (Model 8)[1]	Processor (Model 10)[1]
Function: 0				
EAX	0000_0001h	0000_0001h	0000_0001h	0000_0001h
EBX	6874_7541h	6874_7541h	6874_7541h	6874_7541h
ECX	444D_4163h	444D_4163h	444D_4163h	444D_4163h
EDX	6974_6E65h	6974_6E65h	6974_6E65h	6974_6E65h
Function: 1				
EAX	0000_066Xh	0000_067Xh	0000_068Xh	0000_068Xh
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	0183_F9FFh[2]	0183_F9FFh[2]	0183_F9FFh[2]	0183_F9FFh[2]
Function: 8000_0000h				
EAX	8000_0008h	8000_0008h	8000_0008h	8000_0008h
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	Reserved	Reserved	Reserved	Reserved
Function: 8000_0001h				
EAX	0000_076Xh	0000_077Xh	0000_078Xh	0000_078Xh
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	C1C3_F9FFh[3]	C1C3_F9FFh[3]	C1C3_F9FFh[3]	C1C3_F9FFh[3]

Notes:

1. *The returned values for the AMD Athlon™ and AMD Duron™ processors models 6 and higher are for all non-mobile processors, including the AMD Athlon XP, AMD Athlon MP, AMD Duron processors.*
2. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 0183_FBFFh.*
3. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be C1C3_FBFFh. This value also varies based on the setting of the MP bit 19. See Table 15 on page 64 and Table 16 on page 66 for details.*
4. *The L2 cache size and associativity on AMD processors are product specific. AMD Athlon processor model 10 has an L2 cache size of 512-Kbyte with 16-way set associativity. AMD Athlon processor models 6 and 8 have an L2 cache size of 256-Kbyte with 16-way set associativity. AMD Duron processor models 6 and greater have an L2 cache size of 64-Kbyte with 16-way set associativity.*

Table 32. Values Returned by AMD Athlon™ and AMD Duron™ Processors Models 6 and Higher (Continued)

Function / Register	Processor (Model 6)[1]	Processor (Model 7)[1]	Processor (Model 8)[1]	Processor (Model 10)[1]
Function: 8000_0002h				
EAX	2044_4D41h	2044_4D41h	2044_4D41h	2044_4D41h
EBX	6C68_7441h	6F72_7544h	6C68_7441h	6C68_7441h
ECX	7428_6E6Fh	6D74_286Eh	7428_6E6Fh	7428_6E6Fh
EDX	5020_296Dh	7250_2029h	5020_296Dh	5020_296Dh
Function: 8000_0003h				
EAX	6563_6F72h	7365_636Fh	6563_6F72h	6563_6F72h
EBX	726F_7373h	0072_6F73h	726F_7373h	726F_7373h
ECX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EDX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0004h				
EAX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EBX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
ECX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EDX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0005h				
EAX	0408_FF08h	0408_FF08h	0408_FF08h	0408_FF08h
EBX	FF20_FF10h	FF20_FF10h	FF20_FF10h	FF20_FF10h
ECX	4002_0140h	4002_0140h	4002_0140h	4002_0140h
EDX	4002_0140h	4002_0140h	4002_0140h	4002_0140h

Notes:

1. *The returned values for the AMD Athlon™ and AMD Duron™ processors models 6 and higher are for all non-mobile processors, including the AMD Athlon XP, AMD Athlon MP, AMD Duron processors.*
2. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 0183_FBFFh.*
3. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be C1C3_FBFFh. This value also varies based on the setting of the MP bit 19. See Table 15 on page 64 and Table 16 on page 66 for details.*
4. *The L2 cache size and associativity on AMD processors are product specific. AMD Athlon processor model 10 has an L2 cache size of 512-Kbyte with 16-way set associativity. AMD Athlon processor models 6 and 8 have an L2 cache size of 256-Kbyte with 16-way set associativity. AMD Duron processor models 6 and greater have an L2 cache size of 64-Kbyte with 16-way set associativity.*

Table 32. Values Returned by AMD Athlon™ and AMD Duron™ Processors Models 6 and Higher (Continued)

Function / Register	Processor (Model 6)[1]	Processor (Model 7)[1]	Processor (Model 8)[1]	Processor (Model 10)[1]
Function: 8000_0006h				
EAX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EBX	4100_4100h	4100_4100h	4100_4100h	4100_4100h
ECX	****_*140h[4]	****_*140h[4]	****_*140h[4]	****_*140h[4]
EDX	Reserved	Reserved	Reserved	Reserved
Function: 8000_0007h				
EAX	Reserved	Reserved	Reserved	Reserved
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	****_***1h	****_***1h	****_***1h	****_***1h
Function: 8000_0008h				
EAX	0000_2022h	0000_2022h	0000_2022h	0000_2022h
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	Reserved	Reserved	Reserved	Reserved

Notes:

1. *The returned values for the AMD Athlon™ and AMD Duron™ processors models 6 and higher are for all non-mobile processors, including the AMD Athlon XP, AMD Athlon MP, AMD Duron processors.*
2. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 0183_FBFFh.*
3. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be C1C3_FBFFh. This value also varies based on the setting of the MP bit 19. See Table 15 on page 64 and Table 16 on page 66 for details.*
4. *The L2 cache size and associativity on AMD processors are product specific. AMD Athlon processor model 10 has an L2 cache size of 512-Kbyte with 16-way set associativity. AMD Athlon processor models 6 and 8 have an L2 cache size of 256-Kbyte with 16-way set associativity. AMD Duron processor models 6 and greater have an L2 cache size of 64-Kbyte with 16-way set associativity.*

Table 33. Values Returned by Mobile AMD Athlon™ Processors Models 6 Higher, and Mobile AMD Duron™ Processors Models 3, 6, and 7

Function / Register	Mobile AMD Duron™ Processor (Model 3)[1]	Mobile Processor (Model 6)[1]	Mobile Processor (Model 7)[1]	Mobile Processor (Model 8)[1]	Mobile Processor (Model 10)[1]
Function: 0					
EAX	0000_0001h	0000_0001h	0000_0001h	0000_0001h	0000_0001h
EBX	6874_7541h	6874_7541h	6874_7541h	6874_7541h	6874_7541h
ECX	444D_4163h	444D_4163h	444D_4163h	444D_4163h	444D_4163h
EDX	6974_6E65h	6974_6E65h	6974_6E65h	6974_6E65h	6974_6E65h
Function: 1					
EAX	0000_063Xh	0000_066Xh	0000_067Xh	0000_066Xh	0000_066Xh
EBX	Reserved	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved	Reserved
EDX	0183_F9FFh[2]	0183_F9FFh[2]	0183_F9FFh[2]	0183_F9FFh[2]	0183_F9FFh[2]
Function: 8000_0000h					
EAX	8000_0006h	8000_0008h	8000_0008h	8000_0008h	8000_0008h
EBX	Reserved	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved	Reserved
EDX	Reserved	Reserved	Reserved	Reserved	Reserved
Function: 8000_0001h					
EAX	0000_073Xh	0000_076Xh	0000_077Xh	0000_076Xh	0000_076Xh
EBX	Reserved	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved	Reserved
EDX	C1C3_F9FFh[3]	C1C3_F9FFh[3]	C1C3_F9FFh[3]	C1C3_F9FFh[3]	C1C3_F9FFh[3]

Notes:

1. *The returned values for mobile AMD Athlon™ processors models 6 and higher, and AMD Duron™ processors models 3, 6, and 7 are for the mobile AMD Athlon™ 4, mobile AMD Athlon XP, and mobile AMD Duron™ processors.*
2. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 0183_FBFFh.*
3. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be C1C3_FBFFh. This value also varies based on the setting of the MP bit 19. See Tables 7 and 8 for details.*
4. *The L2 cache size and associativity on AMD processors are product specific. AMD Athlon processor model 10 has an L2 cache size of 512-Kbyte with 16-way set associativity. AMD Athlon processor models 6 and 8 have an L2 cache size of 256-Kbyte with 16-way set associativity. AMD Duron processor models 6 and greater have an L2 cache size of 64-Kbyte with 16-way set associativity. The Mobile AMD Duron processor model 3 has an L2 cache size of 64-Kbyte with 16-way set associativity.*

Table 33. Values Returned by Mobile AMD Athlon™ Processors Models 6 Higher, and Mobile AMD Duron™ Processors Models 3, 6, and 7 (Continued)

Function / Register	Mobile AMD Duron™ Processor (Model 3)[1]	Mobile Processor (Model 6)[1]	Mobile Processor (Model 7)[1]	Mobile Processor (Model 8)[1]	Mobile Processor (Model 10)[1]
Function: 8000_0002h					
EAX	2044_4D41h	2044_4D41h	2044_4D41h	2044_4D41h	2044_4D41h
EBX	6F72_7544h	6C68_7441h	6F72_7544h	6C68_7441h	6C68_7441h
ECX	6D74_286Eh	7428_6E6Fh	6D74_286Eh	7428_6E6Fh	7428_6E6Fh
EDX	7250_2029h	5020_296Dh	7250_2029h	5020_296Dh	5020_296Dh
Function: 8000_0003h					
EAX	7365_636Fh	6563_6F72h	7365_636Fh	6563_6F72h	6563_6F72h
EBX	0072_6F73h	726F_7373h	0072_6F73h	726F_7373h	726F_7373h
ECX	0000_0000h	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EDX	0000_0000h	0000_0000h	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0004h					
EAX	0000_0000h	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EBX	0000_0000h	0000_0000h	0000_0000h	0000_0000h	0000_0000h
ECX	0000_0000h	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EDX	0000_0000h	0000_0000h	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0005h					
EAX	0408_FF08h	0408_FF08h	0408_FF08h	0408_FF08h	0408_FF08h
EBX	FF18_FF10h	FF20_FF10h	FF20_FF10h	FF20_FF10h	FF20_FF10h
ECX	4002_0140h	4002_0140h	4002_0140h	4002_0140h	4002_0140h
EDX	4002_0140h	4002_0140h	4002_0140h	4002_0140h	4002_0140h

Notes:

1. *The returned values for mobile AMD Athlon™ processors models 6 and higher, and AMD Duron™ processors models 3, 6, and 7 are for the mobile AMD Athlon™ 4, mobile AMD Athlon XP, and mobile AMD Duron™ processors.*
2. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 0183_FBFFh.*
3. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be C1C3_FBFFh. This value also varies based on the setting of the MP bit 19. See Tables 7 and 8 for details.*
4. *The L2 cache size and associativity on AMD processors are product specific. AMD Athlon processor model 10 has an L2 cache size of 512-Kbyte with 16-way set associativity. AMD Athlon processor models 6 and 8 have an L2 cache size of 256-Kbyte with 16-way set associativity. AMD Duron processor models 6 and greater have an L2 cache size of 64-Kbyte with 16-way set associativity. The Mobile AMD Duron processor model 3 has an L2 cache size of 64-Kbyte with 16-way set associativity.*

Table 33. Values Returned by Mobile AMD Athlon™ Processors Models 6 Higher, and Mobile AMD Duron™ Processors Models 3, 6, and 7 (Continued)

Function / Register	Mobile AMD Duron™ Processor (Model 3)[1]	Mobile Processor (Model 6)[1]	Mobile Processor (Model 7)[1]	Mobile Processor (Model 8)[1]	Mobile Processor (Model 10)[1]
Function: 8000_0006h					
EAX	0000_0000h	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EBX	4100_4100h	4100_4100h	4100_4100h	4100_4100h	4100_4100h
ECX	****_*140h[4]	****_*140h[4]	****_*140h[4]	****_*140h[4]	****_*140h[4]
EDX	Reserved	Reserved	Reserved	Reserved	Reserved
Function: 8000_0007h					
EAX	Not Supported	Reserved	Reserved	Reserved	Reserved
EBX		Reserved	Reserved	Reserved	Reserved
ECX		Reserved	Reserved	Reserved	Reserved
EDX		****_***7h	****_***7h	****_***7h	****_***7h
Function: 8000_0008h					
EAX	Not Supported	0000_2022h	0000_2022h	0000_2022h	0000_2022h
EBX		Reserved	Reserved	Reserved	Reserved
ECX		Reserved	Reserved	Reserved	Reserved
EDX		Reserved	Reserved	Reserved	Reserved

Notes:

1. *The returned values for mobile AMD Athlon™ processors models 6 and higher, and AMD Duron™ processors models 3, 6, and 7 are for the mobile AMD Athlon™ 4, mobile AMD Athlon XP, and mobile AMD Duron™ processors.*
2. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 0183_FBFFh.*
3. *The AMD processors models 6 and higher contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be C1C3_FBFFh. This value also varies based on the setting of the MP bit 19. See Tables 7 and 8 for details.*
4. *The L2 cache size and associativity on AMD processors are product specific. AMD Athlon processor model 10 has an L2 cache size of 512-Kbyte with 16-way set associativity. AMD Athlon processor models 6 and 8 have an L2 cache size of 256-Kbyte with 16-way set associativity. AMD Duron processor models 6 and greater have an L2 cache size of 64-Kbyte with 16-way set associativity. The Mobile AMD Duron processor model 3 has an L2 cache size of 64-Kbyte with 16-way set associativity.*

Table 34. Values Returned by AMD Athlon™ Processors Models 1, 2, and 4, and AMD Duron™ Processors Model 3

Function Register	AMD Athlon™ Processor (Model 1)	AMD Athlon Processor (Model 2)	AMD Athlon Processor (Model 4)	AMD Duron™ Processor (Model 3)
Function: 0				
EAX	0000_0001h	0000_0001h	0000_0001h	0000_0001h
EBX	6874_7541h	6874_7541h	6874_7541h	6874_7541h
ECX	444D_4163h	444D_4163h	444D_4163h	444D_4163h
EDX	6974_6E65h	6974_6E65h	6974_6E65h	6974_6E65h
Function: 1				
EAX	0000_061Xh	0000_062Xh	0000_064Xh	0000_063Xh
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	0081_F9FFh	0183_F9FFh[1]	0183_F9FFh[1]	0183_F9FFh[1]
Function: 8000_0000h				
EAX	8000_0006h	8000_0006h	8000_0006h	8000_0006h
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	Reserved	Reserved	Reserved	Reserved
Function: 8000_0001h				
EAX	0000_071Xh	0000_072Xh	0000_074Xh	0000_073Xh
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	C0C1_F9FFh	C1C3_F9FFh[2]	C1C3_F9FFh[2]	C1C3_F9FFh[2]
Function: 8000_0002h				
EAX	2D44_4D41h	2044_4D41h	2044_4D41h	2044_4D41h
EBX	7428_374Bh	6C68_7441h	6C68_7441h	6F72_7544h
ECX	5020_296Dh	7428_6E6Fh	7428_6E6Fh	6D74_286Eh
EDX	6563_6F72h	5020_296Dh	5020_296Dh	7250_2029h

Notes:

1. *The AMD Duron™ processor and AMD Athlon™ processor models 2 and 4 contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 0183_FBFFh.*
2. *The AMD Duron processor and AMD Athlon processor models 2 and 4 contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be C1C3_FBFFh.*
3. *The L2 cache size and associativity on AMD processors are product specific. The AMD Athlon processor models 1 and 2 have an L2 cache size of 512-Kbyte with two-way set associativity. The AMD Athlon processor model 4 has an L2 cache size of 256-Kbyte with 16-way set associativity. The AMD Duron processor has an L2 cache size of 64-Kbyte with 16-way set associativity.*

Table 34. Values Returned by AMD Athlon™ Processors Models 1, 2, and 4, and AMD Duron™ Processors Model 3 (Continued)

Function Register	AMD Athlon™ Processor (Model 1)	AMD Athlon Processor (Model 2)	AMD Athlon Processor (Model 4)	AMD Duron™ Processor (Model 3)
Function: 8000_0003h				
EAX	726F_7373h	6563_6F72h	6563_6F72h	7365_636Fh
EBX	0000_0000h	726F_7373h	726F_7373h	0072_6F73h
ECX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EDX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0004h				
EAX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EBX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
ECX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EDX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0005h				
EAX	0408_FF08h	0408_FF08h	0408_FF08h	0408_FF08h
EBX	FF18_FF10h	FF18_FF10h	FF18_FF10h	FF18_FF10h
ECX	4002_0140h	4002_0140h	4002_0140h	4002_0140h
EDX	4002_0140h	4002_0140h	4002_0140h	4002_0140h
Function: 8000_0006h				
EAX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EBX	4100_4100h	4100_4100h	4100_4100h	4100_4100h
ECX	****_*140h[3]	****_*140h[3]	****_*140h[3]	****_*140h[3]
EDX	Reserved	Reserved	Reserved	Reserved

Notes:

1. *The AMD Duron™ processor and AMD Athlon™ processor models 2 and 4 contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be 0183_FBFFh.*
2. *The AMD Duron processor and AMD Athlon processor models 2 and 4 contain an APIC, but it is not reflected in this value. If the BIOS enables the APIC, the value would be C1C3_FBFFh.*
3. *The L2 cache size and associativity on AMD processors are product specific. The AMD Athlon processor models 1 and 2 have an L2 cache size of 512-Kbyte with two-way set associativity. The AMD Athlon processor model 4 has an L2 cache size of 256-Kbyte with 16-way set associativity. The AMD Duron processor has an L2 cache size of 64-Kbyte with 16-way set associativity.*

A.3 AMD-K6® Processor Values

Table 35. Values Returned by AMD-K6® Processors

Function / Register	AMD-K6® Processor (Model 6)	AMD-K6 Processor (Model 7)	AMD-K6®-2 Processor (Model 8)	AMD-K6®-III Processor (Model 9)
Function: 0				
EAX	0000_0001h	0000_0001h	0000_0001h	0000_0001h
EBX	6874_7541h	6874_7541h	6874_7541h	6874_7541h
ECX	444D_4163h	444D_4163h	444D_4163h	444D_4163h
EDX	6974_6E65h	6974_6E65h	6974_6E65h	6974_6E65h
Function: 1				
EAX	0000_056Xh	0000_057Xh	0000_058Xh	0000_059Xh
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	0080_01BFh	0080_01BFh	0080_21BFh[1]	0080_21BFh
Function: 8000_0000h				
EAX	8000_0005h	8000_0005h	8000_0005h	8000_0006h
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	Reserved	Reserved	Reserved	Reserved
Function: 8000_0001h				
EAX	0000_066Xh	0000_067Xh	0000_068Xh	0000_069Xh
EBX	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved
EDX	0080_05BFh	0080_05BFh	8080_29BFh[2]	8080_29BFh

Notes:

1. *AMD-K6®-2 processor model 8/[F:8], EDX = 0080_21BFh – Global Paging Extension supported. AMD-K6-2 processor model 8/[7:0], EDX = 0080_01BFh.*
2. *AMD-K6-2 processor model 8/[F:8], EDX = 8080_29BFh – Global Paging Extension supported. AMD-K6-2 processor model 8/[7:0], EDX = 8080_09BFh.*
3. *Extended functions 8000_0002h, 8000_0003h, and 8000_0004h each return part of the processor name string. Some AMD-K6-2 processors may have the following name string: function 8000_0002h, ECX = 322D_296Dh and EDX = 6F72_5020h, and function 8000_0003h, EAX = 7373_6563h and EBX = 0000_726Fh.*
4. *Extended functions 8000_0002h, 8000_0003h, and 8000_0004h each return part of the processor name string. Some AMD-K6-III processors may have the following name string: function 8000_0002h, ECX = 492D_296Dh and EDX = 5020_4949h, and function 8000_0003h, EAX = 6563_6F72h and EBX = 726F_7373h.*

Table 35. Values Returned by AMD-K6® Processors (Continued)

Function / Register	AMD-K6® Processor (Model 6)	AMD-K6 Processor (Model 7)	AMD-K6®-2 Processor (Model 8)	AMD-K6®-III Processor (Model 9)
Function: 8000_0002h				
EAX	2D44_4D41h	2D44_4D41h	2D44_4D41h	2D44_4D41h
EBX	6D74_364Bh	6D74_364Bh	7428_364Bh	7428_364Bh
ECX	202F_7720h	202F_7720h	3320_296Dh[3]	3320_296Dh[4]
EDX	746C_756Dh	746C_756Dh	7270_2044h[3]	5020_2B44h[4]
Function: 8000_0003h				
EAX	6465_6D69h	6465_6D69h	7365_636Fh[3]	6563_6F72h[4]
EBX	6520_6169h	6520_6169h	0072_6F73h[3]	726F_7373h[4]
ECX	6E65_7478h	6E65_7478h	0000_0000h	0000_0000h
EDX	6E6F_6973h	6E6F_6973h	0000_0000h	0000_0000h
Function: 8000_0004h				
EAX	0000_0073h	0000_0073h	0000_0000h	0000_0000h
EBX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
ECX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
EDX	0000_0000h	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0005h				
EAX	Reserved	Reserved	Reserved	Reserved
EBX	0280_0140h	0280_0140h	0280_0140h	0280_0140h
ECX	2002_0220h	2002_0220h	2002_0220h	2002_0220h
EDX	2002_0220h	2002_0220h	2002_0220h	2002_0220h
Function: 8000_0006h				
EAX	Undefined	Undefined	Undefined	Reserved
EBX	Undefined	Undefined	Undefined	Reserved
ECX	Undefined	Undefined	Undefined	0100_4220h
EDX	Undefined	Undefined	Undefined	Reserved

Notes:

1. *AMD-K6®-2 processor model 8/[F:8], EDX = 0080_21BFh – Global Paging Extension supported. AMD-K6-2 processor model 8/[7:0], EDX = 0080_01BFh.*
2. *AMD-K6-2 processor model 8/[F:8], EDX = 8080_29BFh – Global Paging Extension supported. AMD-K6-2 processor model 8/[7:0], EDX = 8080_09BFh.*
3. *Extended functions 8000_0002h, 8000_0003h, and 8000_0004h each return part of the processor name string. Some AMD-K6-2 processors may have the following name string: function 8000_0002h, ECX = 322D_296Dh and EDX = 6F72_5020h, and function 8000_0003h, EAX = 7373_6563h and EBX = 0000_726Fh.*
4. *Extended functions 8000_0002h, 8000_0003h, and 8000_0004h each return part of the processor name string. Some AMD-K6-III processors may have the following name string: function 8000_0002h, ECX = 492D_296Dh and EDX = 5020_4949h, and function 8000_0003h, EAX = 6563_6F72h and EBX = 726F_7373h.*

A.4 Am486®, Am5$_x$86, and AMD-K5 Processor Values

Table 36. Values Returned by Am486®, Am5$_x$86, and AMD-K5 Processors

Function Register	Am486® and Am5$_x$86 Processors	AMD-K5 Processor (Model 0)	AMD-K5 Processor (Model 1)	AMD-K5 Processor (Model 2)	AMD-K5 Processor (Model 3)
Function: 0					
EAX	0000_0001h	0000_0001h	0000_0001h	0000_0001h	0000_0001h
EBX	6874_7541h	6874_7541h	6874_7541h	6874_7541h	6874_7541h
ECX	444D_4163h	444D_4163h	444D_4163h	444D_4163h	444D_4163h
EDX	6974_6E65h	6974_6E65h	6974_6E65h	6974_6E65h	6974_6E65h
Function: 1					
EAX	0000_04XXh	0000_050Xh	0000_051Xh	0000_052Xh	0000_053Xh
EBX	Reserved	Reserved	Reserved	Reserved	Reserved
ECX	Reserved	Reserved	Reserved	Reserved	Reserved
EDX	0000_0001h	0000_03BFh*	0000_21BFh	0000_21BFh	0000_21BFh
Function: 8000_0000h					
EAX	0000_0000h	0000_0000h	8000_0005h	8000_0005h	8000_0005h
EBX	Undefined	Undefined	Reserved	Reserved	Reserved
ECX	Undefined	Undefined	Reserved	Reserved	Reserved
EDX	Undefined	Undefined	Reserved	Reserved	Reserved
Function: 8000_0001h					
EAX	Undefined	Undefined	0000_051Xh	0000_052Xh	0000_053Xh
EBX	Undefined	Undefined	Reserved	Reserved	Reserved
ECX	Undefined	Undefined	Reserved	Reserved	Reserved
EDX	Undefined	Undefined	0000_21BFh	0000_21BFh	0000_21BFh
Function: 8000_0002h					
EAX	Undefined	Undefined	2D44_4D41h	2D44_4D41h	2D44_4D41h
EBX	Undefined	Undefined	7428_354Bh	7428_354Bh	7428_354Bh
ECX	Undefined	Undefined	5020_296Dh	5020_296Dh	5020_296Dh
EDX	Undefined	Undefined	6563_6F72h	6563_6F72h	6563_6F72h

Note:

* *The AMD-K5 processor model 0 reserves bit 13 and implements feature bit 9 to indicate support for Global Paging Extensions instead of support for APIC.*

Table 36. Values Returned by Am486®, Am5$_x$86, and AMD-K5 Processors

Function Register	Am486® and Am5$_x$86 Processors	AMD-K5 Processor (Model 0)	AMD-K5 Processor (Model 1)	AMD-K5 Processor (Model 2)	AMD-K5 Processor (Model 3)
Function: 8000_0003h					
EAX	Undefined	Undefined	726F_7373h	726F_7373h	726F_7373h
EBX	Undefined	Undefined	0000_0000h	0000_0000h	0000_0000h
ECX	Undefined	Undefined	0000_0000h	0000_0000h	0000_0000h
EDX	Undefined	Undefined	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0004h					
EAX	Undefined	Undefined	0000_0000h	0000_0000h	0000_0000h
EBX	Undefined	Undefined	0000_0000h	0000_0000h	0000_0000h
ECX	Undefined	Undefined	0000_0000h	0000_0000h	0000_0000h
EDX	Undefined	Undefined	0000_0000h	0000_0000h	0000_0000h
Function: 8000_0005h					
EAX	Undefined	Undefined	Reserved	Reserved	Reserved
EBX	Undefined	Undefined	0480_0000h	0480_0000h	0480_0000h
ECX	Undefined	Undefined	0804_0120h	0804_0120h	0804_0120h
EDX	Undefined	Undefined	1004_0120h	1004_0120h	1004_0120h

Note:

* *The AMD-K5 processor model 0 reserves bit 13 and implements feature bit 9 to indicate support for Global Paging Extensions instead of support for APIC.*

Appendix B Programming the Name String of the AMD Opteron™ Processor

This section, for BIOS programmers, describes how to program the *processor name string* that is returned by the CPUID instruction.

The AMD Opteron™ processor supports a set of MSRs for programming the processor name string, which can be read with the CPUID functions 8000_0002h, 8000_0003h, and 8000_0004h. The default value of the name string is 48 ASCII NUL characters. See “Extended Functions 8000_0002h, 8000_0003h, and 8000_0004h—Processor Name String” on page 69 for details concerning the name string functions.

The AMD Opteron processor requires that the BIOS code properly program the processor name string according to the values shown in Table 37 on page 96.

Note: *Motherboards that do not program the proper processor name string and model number will not pass AMD validation and will not be posted on the AMD Recommended Motherboard Website.*

It is common practice for the BIOS to display the processor name string and model number whenever it displays processor information during boot up.

B.1 Brand ID

The BIOS code uses the brand ID value to construct the proper name string from tables of ASCII name string information. The brand ID is either an 8-bit field returned in by CPUID function 1 (see “8-Bit Brand ID” on page 54) or a 12-bit field returned by CPUID function 8000_0001h (see “EBX—12-bit Brand ID” on page 61). The brand ID field is new to the AMD Opteron processors and will be implemented in future AMD processor families as well.

The brand ID uniquely identifies a collection of processor features as a particular brand of the AMD Opteron processor. Further, each brand has an associated processor name string that is required by the AMD branding strategy.

The BIOS reads the 8-bit brand ID using CPUID function 1 and the 12-bit brand ID using CPUID function 8000_0001h, and uses whichever is non-zero to index into a name string table and a model number table. The BIOS then constructs the name string from the entries in these tables and uses the resulting string to program the processor name string using a set of Model Specific Registers (MSRs) described below.

If the 8-bit brand ID and the 12-bit brand ID are both zero, the processor is an engineering sample. All AMD Opteron processors support the brand ID.

B.2 Constructing the Name String

The BIOS must construct the processor name string from information in a table that is a BIOS data structure. The bulk of the name string comes from the name string table, which contains the required processor name string for each AMD Opteron processor with placeholders for the specific model number.

To construct the full processor name string, use either the three most significant bits of an 8-bit brand ID or the four most significant bits of a 12-bit brand ID to index into the name strings listed in Table 37. Then use either the five least significant bits of an 8-bit brand ID or the eight least significant bits of a 12-bit brand ID to calculate two digits of the model number to be inserted into the appropriate name string.

The processor name string should be NUL terminated and no longer than 48 bytes including the NUL.

Table 37. Processor Name String Values for AMD Opteron™ Processors

Brand ID	Decimal	Name String	Processor
011b	3	`AMD Opteron(tm) Processor 1YY`[1]	UP Server
100b	4	`AMD Opteron(tm) Processor 2YY`[1]	2P Server
101b	5	`AMD Opteron(tm) Processor 8YY`[1]	MP Server

Notes: *For more information, see "8-Bit Brand ID" on page 54 and "EBX—12-bit Brand ID" on page 61.*
*1. YY = 38 + 2 * NN. For example, 00001b stands for "40" and 11110b stands for "98". Encoding 11111b is reserved.*

BIOS software must be prepared to handle these cases:

- The brand ID value returned indexes to a reserved entry. This case can occur if the user has upgraded his or her processor, but not the BIOS. For this case, it is recommended that the BIOS program the name string as "`AMD Opteron(tm) Processor - model unknown`".
- The 8-bit brand ID and the 12-bit brand ID are both zero, indicating that the processor is an engineering sample.

B.3 Programming the Processor Name String

After the BIOS has found the proper string in the name table and inserted the correct model number, the BIOS programs the processor name string by writing to six MSRs.

These MSRs (C001_0030h through C001_0035h) are used to set the 48 character processor name string returned by CPUID functions 8000_0002h, 8000_0003h, and 8000_0004h. Each MSR sets eight of the 48 characters in little-endian byte order. The first character resides in the least significant byte of MSR C001_0030h and the last character (always a NUL) resides in the most significant byte of MSR C001_0035h.