intel. ®

Intel® Processor Serial Number

CONTENTS

1.0. INTRODUCTION

As the Intel Architecture evolves with the addition of new generations and models of processors, it is essential that Intel provide an increasingly sophisticated means with which software can identify the features available   on each processor. This identification mechanism has evolved in conjunction with the Intel Architecture as follows:

1. Originally, Intel published code sequences that could detect minor implementation or architectural differences to identify processor generations.

2. Later, with the advent of the Intel386™ processor, Intel implemented processor signature identification which provided the processor family, model, and stepping numbers to software, but only upon reset.

3. As the Intel Architecture evolved, Intel extended the processor signature identification into the CPUID instruction. The CPUID instruction not only provides the processor signature, but also provides information about the features supported by and implemented on the Intel processor.

The evolution of processor identification was necessary because, as the Intel Architecture proliferates, the computing market must be able to tune processor functionality across processor generations and models that have differing sets of features. Anticipating that this trend will continue with future processor generations, the Intel Architecture

implementation of the CPUID instruction is extensible.

The Pentium® III Processor, and Pentium® III Xeon™ Processors extend the concept of processor identification with the addition of processor serial number. Processor serial number is a 96-bit number accessible through the CPUID instruction. Processor serial number can be used by applications to identify a system.

The processor serial number creates a software accessible identity for an individual processor. The processor serial number, combined with other qualifiers, could be applied to user identification. Applications include, membership authentication, data backup/restore protection, removable storage data protection, managed access to files, or to   confirm document exchange between appropriate users.

Processor serial number is another tool for use in asset management, product tracking, remote systems load and configuration, or to aid in boot-up configuration. In the case of system service, processor serial number could be used to differentiate users during help desk access, or track error reporting.

Processor serial number provides an identifier for the processor, but should not be assumed to be unique in itself. There are potential modes in which erroneous processor serial numbers may be reported. For example, in the event a processor is operated outside its recommended operating specification, the processor serial number may not be correctly read from the processor. This   could lead to possible erroneous or duplicate processor serial

intel.

numbers being reported. System manufacturers may strengthen the robustness of the feature by including redundancy features, or other fault tolerant methods.

Processor serial number used as a qualifier for another independent number could be used to create an electrically accessible number which is likely to be distinct. Processor serial number is one building block useful for the purpose of enabling the trusted, connected PC.

This application note explains how to use the CPUID instruction to gain access to the processor serial number. By taking advantage of processor serial number, software developers can create applications and tools capable of further qualifying system identity.

1.1. Update Support

Further information concerning new Intel processors may be available from the developer's manual, programmer's reference manual or appropriate documentation for the processor. Contact your Intel representative for more information, or visit Intel's website at http://developer.intel.com/ .

2.0. DETECTING THE CPUID INSTRUCTION

Starting with the Intel486™ family and subsequent Intel processors, Intel provides a straightforward method for determining whether the processor's internal architecture is able to execute the CPUID instruction. This method uses the ID flag in bit 21 of the EFLAGS register. If software can change the

value of this flag, the CPUID instruction is executable. See Figure 1.
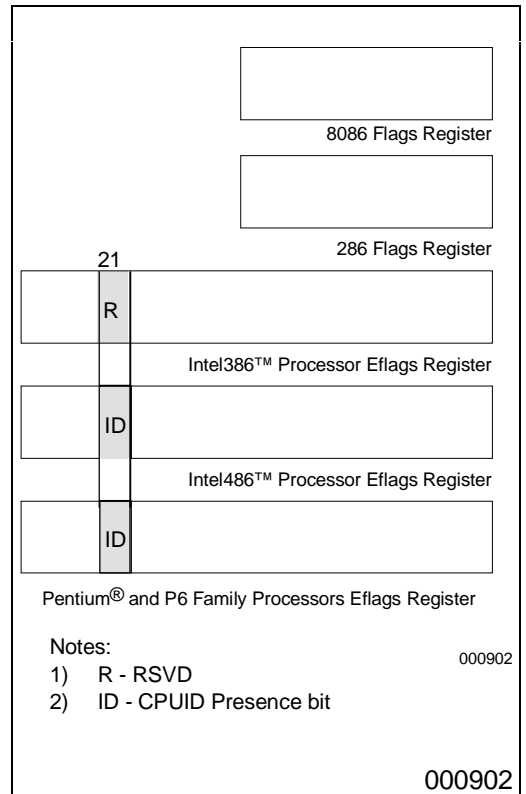
Figure 1. Flag Register Evolution

The POPF, POPFD, PUSHF, and PUSHFD instructions are used to access the Flags, Eflags register.

3.0. PROCESSOR SERIAL NUMBER AND THE CPUID INSTRUCTION

Figure 2 summarizes the outputs of the CPUID instruction. The function of the CPUID instruction is fully dependent upon the contents of the EAX register. This means, by placing different values in the EAX register and then executing CPUID, the CPUID instruction will perform a specific function dependent upon whatever value is resident in the EAX register (see Table 1). In order to determine the highest acceptable value for the EAX register input and CPUID operation, the program should set the EAX register parameter value to "0" and then execute the CPUID instruction as follows

        MOV EAX, 00H
        CPUID

After the execution of the CPUID instruction, a return value will be present in the EAX register. Always use an EAX parameter value that is equal to or greater than zero and less than or equal to this highest EAX "returned" value, prior to executing the CPUID instruction.

Table 1. Effects of EAX Contents on CPUID Instruction Output

Parameter	Outputs of CPUID
EAX = 0	EAX ← Highest value recognized by CPUID instruction
	EBX:EDX:ECX ← Vendor identification string
EAX = 1	EAX ← Processor signature, or Upper 32 bits of 96-bit processor serial number
	EDX ← Feature flags
	EBX:ECX ← Intel reserved (Do not use.)
EAX = 2	EAX:EBX:ECX:EDX ← Processor configuration parameters
EAX = 3	EDX:ECX ← lower 64-bits of 96-bit processor serial number
4 ≤ EAX ≤ highest value	Intel Reserved
EAX > highest value	EAX:EBX:ECX:EDX ← Undefined (Do not use.)

intel®

		31		0
Output of CPUID if EAX = 0

Highest Value EAX | Highest Integer Value |

		31	23	15	7	0
	ECX	l (6C)	e (65)	t (74)	n (6E)
Vendor ID	EDX	I (49)	e (65)	n (6E)	i (69)
	EBX	u (75)	n (6E)	e (65)	G (47)

ASCII String (with Hexadecimal)

Output of CPUID if EAX = 1

Processor Signature, or Upper 32 bits of 96-bit processor serial number EAX

Zeros

Processor Type
Family
Model
Stepping

Feature Flags EDX* Bit Array (Refer to Table 4)

Output of CPUID if EAX = 2

EAX
EBX
EDX
ECX

Configuration Parameters

Output of CPUID if EAX = 3

Lower 64-bits of 96-bit processor serial number EDX Upper 32-bits (of Lower 64-bits)
ECX Lower 32-bits (of Lower 64-bits)
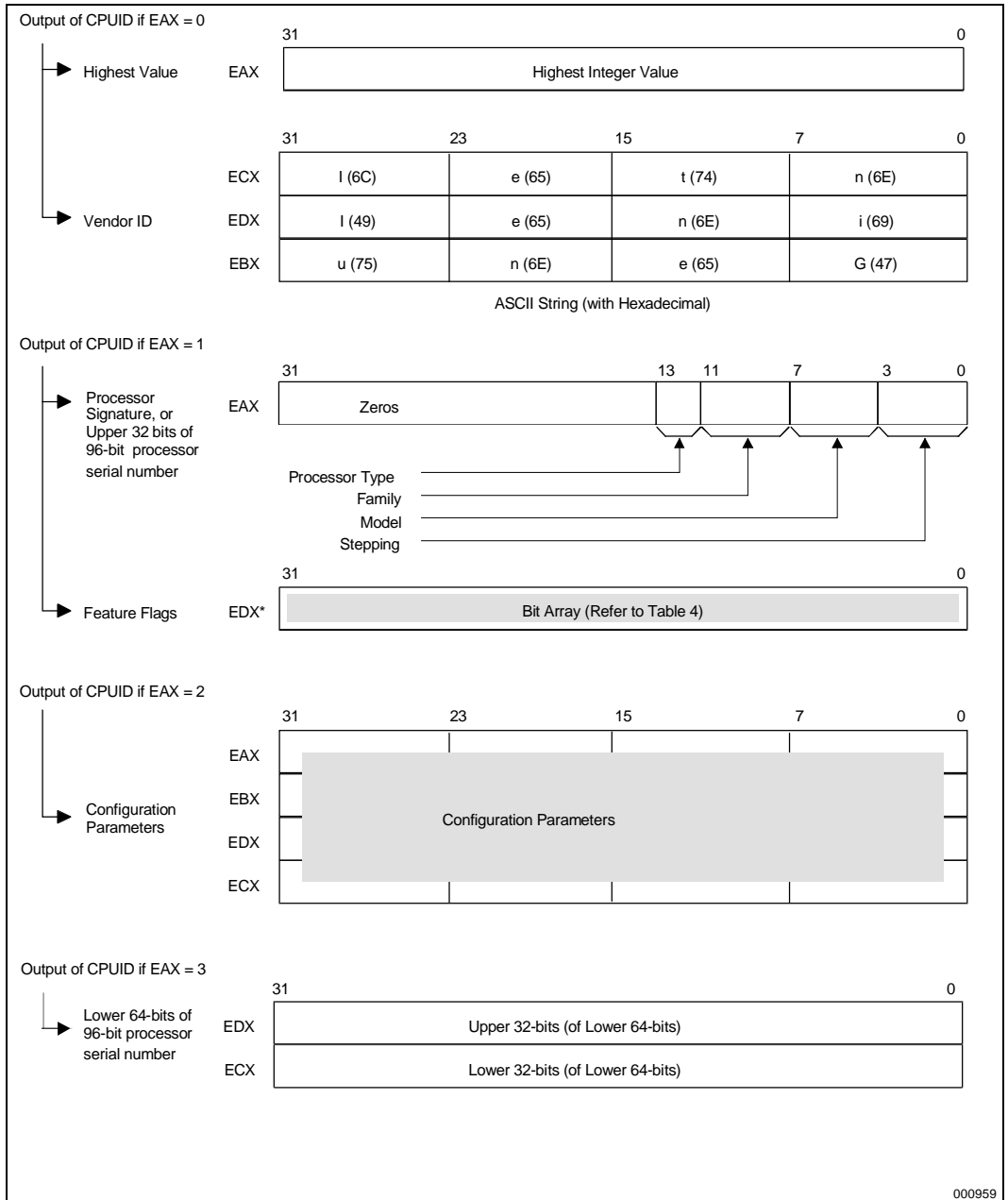
000959

Figure 2. CPUID Instruction Outputs

3.1. Presence of processor serial number

To determine if the processor serial number feature is supported, the program should set the EAX register parameter value to "1" and then execute the CPUID instruction as follows:

```
MOV EAX, 01H
CPUID
```

After execution of the CPUID instruction, the EDX register contains the Feature Flags. If Feature Flags bit 18 equals "1", then the processor serial number feature is supported, and enabled. If Feature Flags bit 18 equals "0", the processor serial number feature is either not supported or disabled.

3.1.1. Vendor ID String

In addition to returning the highest value in the EAX register, the Intel Vendor-ID string can be simultaneously verified as well. If the EAX register contains an input value of 0, the CPUID instruction also returns the vendor identification string in the EBX, EDX, and ECX registers (see Figure 2). These registers contain the ASCII string:

GenuineIntel

While competitive processors can provide the CPUID instruction, only Intel can legitimately claim its processors are genuine Intel. So the presence of the GenuineIntel string is an assurance that the CPUID instruction and the processor signature are implemented as described in this document. If the "GenuineIntel" string is not returned after execution of the CPUID instruction, do not rely upon the information described in this document to interpret the information returned by the CPUID instruction.

3.1.2. Processor Signature

Beginning with the Intel486™ processor family, the processor will return a processor identification signature value after reset in the EDX register.
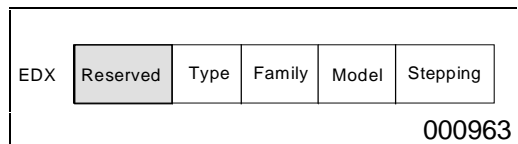
Figure 3. EDX Register Value after RESET

Processors that implement the CPUID instruction also return the processor identification signature after reset; however, the CPUID instruction gives you the flexibility of checking the processor signature at any time. The EDX processor signature value after reset is equivalent to the processor signature output value in the EAX register in Figure 2. Table 2 shows the values returned in the EAX register for processors which implement the processor serial number feature.

The processor type, specified in bit positions 12 and 13 of Table 3, indicates whether the processor is an original OEM processor, an OverDrive® processor, or a dual processor (capable of being used in a dual processor system). Table 3 shows the processor type values returned in bits 12 and 13 of the EAX register.

The family values, specified in bit positions 8 through 11, indicates whether the processor belongs to the Intel386™, Intel486™, Pentium® or P6 family of processors.

The model number, specified in bits 4 though 7, indicates the processor's family model number, while the stepping number in bits 0 through 3 indicates the revision number of that model.

3.2. Forming the 96-bit processor serial number

The 96-bit processor serial number is the concatenation of three 32-bit entities.

To access the most significant 32-bits of the processor serial number the program should set the EAX register parameter value to "1" and then execute the CPUID instruction as follows:

```
MOV EAX, 01H
CPUID
```

After execution of the CPUID instruction, the EAX register contains the Processor Signature. The Processor Signature comprises the most significant 32-bits of the Processor serial number. The value in EAX should be saved prior to gathering the remaining 64-bits of the processor serial number.

To access the remaining 64-bits of the processor serial number the program should set the EAX register parameter value to "3" and then execute the CPUID instruction as follows:

```
MOV EAX, 03H
CPUID
```

After execution of the CPUID instruction, the EDX register contains the middle 32-bits, and the ECX register contains the least significant 32-bits of the processor serial number. Software may then concatenate the saved Processor Signature, EDX, and ECX before returning the complete 96-bit processor serial number.

Processor serial number should be displayed as 6 groups of 4 hex nibbles (Ex. XXXX-XXXX-XXXX-XXXX-XXXX-XXXX where X represents a hex digit). Alpha hex characters should be displayed as capital letters.

3.3. Disabling processor serial number

The processor serial number feature may be disabled by setting bit 21 of the BBL_CR_CTL MSR (model-specific register address 119h) to "1". Once set, bit 21 of the BBL_CR_CTL may not be cleared. This bit is write-once. The processor serial number feature will be disabled until the processor is reset. The following code is an example of how to disable the processor serial number feature:

```
MOV ECX, 119H
RDMSR                    ;loads
EDX:EAX
OR EAX, 0020 0000h
WRMSR
```

Once the processor serial number feature is disabled, bit 18 of the Feature Flags register

is cleared indicating the processor no longer supports the processor serial number feature. Another indication that the processor serial number feature is no longer supported is the "Highest Integer value" returned in EAX when the CPUID instruction is executed with EAX=0. The "Highest Integer value" returned in EAX will be less than 3.

Table 2.   Processor Signatures

Type	Family	Model	Stepping	Description
00	0110	0111	xxxx	Pentium® III Processor, and Pentium® III Xeon™ Processors, model 7

NOTES:

1. Please see the *Intel Processor Identification and CPUID Instruction Application Note AP-485* (Order Number 241618-012) for more information

Table 3. Processor Type (Bit Positions 13 and 12)

Value	Description
00	Original OEM processor
01	OverDrive® processor
10	Dual processor
11	Intel reserved (Do not use.)

3.4.   Feature Flags

When the EAX register contains a value of 1, the CPUID instruction (in addition to loading the processor signature in the EAX register) loads the EDX register with the feature flags. The current feature flags (when Flag = "1") indicate what features the processor supports. Table 4 lists the currently defined feature flag values.

For future processors, refer to the programmer's reference manual, user's manual, or the appropriate documentation for the latest feature flag values.

Use the feature flags in your applications to determine which processor features are supported. By using the CPUID feature flags to predetermine processor features, your software can detect and avoid incompatibilities.

the CPUID instruction need only be executed once (with EAX = 2) to obtain a complete image of the processor configuration.

Table 4. Feature Flag Values

Bit	Name	Description when Flag = 1	Comments
18	processo	processor serial	The processor supports the 96-bit processor

Table 4. Feature Flag Values

Bit	Name	Description when Flag = 1	Comments
	r serial number	number is present and enabled	serial number feature, and the feature is enabled.

NOTE:

1. Please see the *Intel Processor Identification and CPUID Instruction Application Note AP-485* (Order Number 241618-012) for the definition of other Feature Flag bits.

4.0. USAGE GUIDELINES

- Do not assume processor serial number is   a unique number without further qualifiers.

- Display processor serial number as 6 groups of 4 hex nibbles (Ex. XXXX-XXXX-XXXX-XXXX-XXXX-XXXX where X represents a hex digit).

- Display alpha hex characters as capital letters.

- Please see the *Intel Processor Identification and CPUID Instruction Application Note AP-485* (Order Number 241618-012) for further information concerning usage of the CPUID instruction.

intel®

UNITED STATES, Intel Corporation
2200 Mission College Blvd., P.O. Box 58119, Santa Clara, CA 95052-8119
Tel: +1 408 765-8080

JAPAN, Intel Japan K.K.
5-6 Tokodai, Tsukuba-shi, Ibaraki-ken 300-26
Tel: + 81-29847-8522

FRANCE, Intel Corporation S.A.R.L.
1, Quai de Grenelle, 75015 Paris
Tel: +33 1-45717171

UNITED KINGDOM, Intel Corporation (U.K.) Ltd.
Pipers Way, Swindon, Wiltshire, England SN3 1RJ
Tel: +44 1-793-641440

GERMANY, Intel GmbH
Dornacher Strasse 1
85622 Feldkirchen/ Muenchen
Tel: +49 89/99143-0

HONG KONG, Intel Semiconductor Ltd.
32/F Two Pacific Place, 88 Queensway, Central
Tel: +852 2844-4555

CANADA, Intel Semiconductor of Canada, Ltd.
190 Attwell Drive, Suite 500
Rexdale, Ontario M9W 6H8
Tel: +416 675-2438