

Intel® Atom™ Processor 200^Δ Series

Specification Update

April 2010

Revision 004



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The Intel® Atom™ Processor 200 Sequence may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Δ Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. Go to: <http://www.intel.com/products/processor%5Fnumber/>

Contact your local Intel sales office or your distributor to obtain the latest specifications and before placing your product order.

Enhanced Intel SpeedStep® Technology for specified units of this processor available Q2/06. See the Processor Spec Finder at <http://processorfinder.intel.com> or contact your Intel representative for more information.

Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, virtual machine monitor (VMM) and, for some uses, certain computer system software enabled for it. Functionality, performance or other benefits will vary depending on hardware and software configurations and may require a BIOS update. Software applications may not be compatible with all operating systems. Please check with your application vendor.

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Revision History

Revision	Description	Date
001	<ul style="list-style-type: none">Initial Release	April 2008
002	<ul style="list-style-type: none">Added AAF31, AAF32, AAF33, AAF34, AAF35, AAF36, AAF37, AAF38, AAF39, AAF40, AAF41, AAF42	February 2009
003	<ul style="list-style-type: none">Added Errata AAF42, AAF43	June 2009
004	<ul style="list-style-type: none">Added Errata AAF44, AAF 45 and AAF 46	April 2010

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Preface

This document is an update to the specifications contained in the documents listed in the following Affected Documents/Related Documents table. It is a compilation of device and document errata and specification clarifications and changes, and is intended for hardware system manufacturers and for software developers of applications, operating system, and tools.

Information types defined in the Nomenclature section of this document are consolidated into this update document and are no longer published in other documents. This document may also contain information that has not been previously published.

Affected Documents

Document Title	Document Number/Location
<i>Intel Atom Processor 200 Series Datasheet</i>	319977-001

Related Documents

Document Title	Document Number/Location
<i>Intel® 64 and IA-32 Architectures Software Developer's Manual Documentation Changes</i>	252046
<i>Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 1: Basic Architecture</i>	253665
<i>Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 2A: Instruction Set Reference, A-M</i>	253666
<i>Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 2B: Instruction Set Reference, N-Z</i>	253667
<i>Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 3A: System Programming Guide</i>	253668
<i>Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 3B: System Programming Guide</i>	253669
<i>IA-32 Intel® Architectures Optimization Reference Manual</i>	248966
<i>Intel® Processor Identification and the CPUID Instruction Application Note (AP-485)</i>	241618
<i>Intel® 64 and IA-32 Architectures Application Note TLBs, Paging-Structure Caches, and Their Invalidation</i>	317080



Nomenclature

Errata are design defects or errors. These may cause the Intel® Atom™ Processor 200 Sequence on 45-nm process behavior to deviate from published specifications. Hardware and software designed to be used with any given stepping must assume that all errata documented for that stepping are present on all devices.

S-Spec Number is a five-digit code used to identify products. Products are differentiated by their unique characteristics, e.g., core speed, L2 cache size, package type, etc. as described in the processor identification information table. Read all notes associated with each S-Spec number.

QDF Number is a four digit code used to distinguish between engineering samples. These samples are used for qualification and early design validation. The functionality of these parts can range from mechanical only to fully functional. This document has a processor identification information table that lists these QDF numbers and the corresponding product details.

Specification Changes are modifications to the current published specifications. These changes will be incorporated in any new release of the specification.

Specification Clarifications describe a specification in greater detail or further highlight a specification's impact to a complex design situation. These clarifications will be incorporated in any new release of the specification.

Documentation Changes include typos, errors, or omissions from the current published specifications. These will be incorporated in any new release of the specification.

Note: Errata remain in the specification update throughout the product's lifecycle, or until a particular stepping is no longer commercially available. Under these circumstances, errata removed from the specification update are archived and available upon request. Specification changes, specification clarifications and documentation changes are removed from the specification update when the appropriate changes are made to the appropriate product specification or user documentation (datasheets, manuals, etc.).

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Summary Tables of Changes

The following table indicates the Specification Changes, Errata, Specification Clarifications or Documentation Changes, which apply to the listed steppings. Intel intends to fix some of the errata in a future stepping of the component, and to account for the other outstanding issues through documentation or Specification Changes as noted. This table uses the following notations:

Codes Used in Summary Table

Stepping

- X: Erratum, Specification Change or Clarification that applies to this stepping.
- (No mark) or (Blank Box): This erratum is fixed in listed stepping or specification change does not apply to list stepping.

Status

- Doc: Document change or update that will be implemented.
- Plan Fix: This erratum may be fixed in a future stepping of the product.
- Fixed: This erratum has been previously fixed.
- No Fix: There are no plans to fix this erratum.

Row

- Shaded: This item is either new or modified from the previous version of the document.



Note: Each Specification Update item is prefixed with a capital letter to distinguish the product. The key below details the letters that are used in Intel's microprocessor Specification Updates:

- A = Dual-Core Intel® Xeon® processor 7000 sequence
- C = Intel® Celeron® processor
- D = Dual-Core Intel® Xeon® processor 2.80 GHz
- E = Intel® Pentium® III processor
- F = Intel® Pentium® processor Extreme Edition and Intel® Pentium® D processor
- I = Dual-Core Intel® Xeon® processor 5000 series
- J = 64-bit Intel® Xeon® processor MP with 1-MB L2 Cache
- K = Mobile Intel® Pentium® III processor
- L = Intel® Celeron® D processor
- M = Mobile Intel® Celeron® processor
- N = Intel® Pentium® 4 processor
- O = Intel® Xeon® processor MP
- P = Intel® Xeon® processor
- Q = Mobile Intel® Pentium® 4 processor supporting Hyper-Threading Technology on 90-nm process technology
- R = Intel® Pentium® 4 processor on 90 nm process
- S = 64-bit Intel® Xeon® processor with 800 MHz system bus (1 MB and 2 MB L2 cache versions)
- T = Mobile Intel® Pentium® 4 processor-M
- U = 64-bit Intel® Xeon® processor MP with up to 8MB L3 Cache
- V = Mobile Intel® Celeron® processor on .13 Micron Process in Micro-FCPGA Package
- W = Intel® Celeron®-M processor
- X = Intel® Pentium® M processor on 90-nm process with 2-MB L2 cache and Intel® Processors A100 and A110 with 512-KB L2 cache
- Y = Intel® Pentium® M processor
- Z = Mobile Intel® Pentium® 4 processor with 533 MHz system bus
- AA = Intel® Pentium® D Processor 900 Sequence and Intel® Pentium® processor Extreme Edition 955, 965
- AB = Intel® Pentium® 4 processor 6x1 Sequence
- AC = Intel® Celeron® processor in 478 pin package
- AD = Intel® Celeron® D processor on 65 nm process
- AE = Intel® Core™ Duo processor and Intel® Core™ Solo processor on 65nm process
- AF = Dual-Core™ Intel® Xeon® processor LV
- AG = Dual-Core Intel® Xeon® processor 5100 Series
- AH = Intel® Core™2 Duo mobile processor
- AI = Intel® Core™2 Extreme processor X6800^A and Intel® Core™2 Duo Desktop processor E6000 and E4000 Sequence
- AJ = Quad-Core Intel® Xeon® processor 5300 Series
- AK = Intel® Core™2 Extreme quad-core processor QX6700 and Intel® Core™2 Quad processor Q6600
- AL = Dual-Core Intel® Xeon® processor 7100 Series



- AN = Intel® Pentium® Dual-Core processor
- AO = Quad-Core Intel® Xeon® processor 3200 Series
- AP = Dual-Core Intel® Xeon® processor 3000 Series
- AQ = Intel® Pentium® Dual-Core Desktop Processor E2000 Sequence
- AR = Intel® Celeron® Processor 500 Series
- AR = Intel® Celeron processor 500 series
- AS = Intel® Xeon® processor 7200, 7300 series
- AV = Intel® Core™2 Extreme processor QX9000 sequence and Intel® Core™2 Quad processor Q9000 Series
- AW = Intel® Core™ 2 Duo
- AX =Quad-Core Intel® Xeon® processor 5400 series
- AY =Dual-Core Intel® Xeon® processor 5200 series
- AZ =Intel® Core™2 Duo processor and Intel® Core™2 Extreme processor on 45nm process
- AAE = Intel® Atom™ processor Z5xx series
- AAF = Intel® Atom™ Processor 200 series
- AAG = Intel® Atom™ processor N series
- AAH = Intel® Atom™ processor 300 series
- AAI = Intel® Xeon® Processor 7400 Series
- AAJ = Intel® Core™ i7 and Intel® Core™ i7 Extreme Edition
- AAL = Intel® Pentium Dual-Core Processor E5000Δ Series
- AAR = Intel® Atom™ processor D400 series
- AAS = Intel® Atom™ processor N400 series
- AAV = Intel® Atom™ processor D500 series

Note: Intel processor numbers are not a measure of performance. Processor numbers differentiate features within each processor family, not across different processor families. See http://www.intel.com/products/processor_number for details.



Number	Stepping	PLAN	ERRATA
	C0		
AAAF1	X	No Fix	A Write to an APIC Register Sometimes May Appear to Have Not Occurred
AAAF2	X	No Fix	An xTPR Update Transaction Cycle, if Enabled, May be Issued to the FSB after the Processor has Issued a Stop-Grant Special Cycle
AAAF3	X	No Fix	The Processor May Report a #TS Instead of a #GP Fault
AAAF4	X	No Fix	Writing the Local Vector Table (LVT) when an Interrupt is Pending May Cause an Unexpected Interrupt
AAAF5	X	No Fix	MOV To/From Debug Registers Causes Debug Exception
AAAF6	X	No Fix	Using 2M/4M Pages When A20M# Is Asserted May Result in Incorrect Address Translations
AAAF7	X	No Fix	Values for LBR/BTS/BTM will be Incorrect after an Exit from SMM
AAAF8	X	No Fix	Incorrect Address Computed For Last Byte of FXSAVE/FXRSTOR Image Leads to Partial Memory Update
AAAF9	X	No Fix	A Thermal Interrupt is Not Generated when the Current Temperature is Invalid
AAAF10	X	No Fix	Programming the Digital Thermal Sensor (DTS) Threshold May Cause Unexpected Thermal Interrupts
AAAF11	X	No Fix	Returning to Real Mode from SMM with EFLAGS.VM Set May Result in Unpredictable System Behavior
AAAF12	X	No Fix	Fault on ENTER Instruction May Result in Unexpected Values on Stack Frame
AAAF13	X	No Fix	With TF (Trap Flag) Asserted, FP Instruction That Triggers an Unmasked FP Exception May Take Single Step Trap before Retirement of Instruction
AAAF14	X	No Fix	An Enabled Debug Breakpoint or Single Step Trap May Be Taken after MOV SS/POP SS Instruction if it is Followed by an Instruction That Signals a Floating Point Exception
AAAF15	X	No Fix	Code Segment Limit/Canonical Faults on RSM May be Serviced before Higher Priority Interrupts/Exceptions and May Push the Wrong Address Onto the Stack
AAAF16	X	No Fix	BTS(Branch Trace Store) and PEBS(Precise Event Based Sampling) May Update Memory outside the BTS/PEBS Buffer
AAAF17	X	No Fix	Single Step Interrupts with Floating Point Exception Pending May Be Mishandled
AAAF18	X	No Fix	Unsynchronized Cross-Modifying Code Operations Can Cause Unexpected Instruction Execution Results
AAAF19	X	No Fix	IO_SMI Indication in SMRAM State Save Area May be Set Incorrectly
AAAF20	X	No Fix	Writes to IA32_DEBUGCTL MSR May Fail when FREEZE_LBRS_ON_PMI is Set
AAAF21	X	No Fix	Address Reported by Machine-Check Architecture (MCA) on L2 Cache Errors May be Incorrect



Number	Stepping	PLAN	ERRATA
	C0		
AAF22	X	No Fix	Pending x87 FPU Exceptions (#MF) Following STI May Be Serviced Before Higher Priority Interrupts
AAF23	X	No Fix	Benign Exception after a Double Fault May Not Cause a Triple Fault Shutdown
AAF24	X	No Fix	IA32_MC1_STATUS MSR Bit[60] Does Not Reflect Machine Check Error Reporting Enable Correctly
AAF25	X	No Fix	Split Locked Stores or Locked Stores Through Certain Segments May not Trigger the Monitoring Hardware
AAF26	X	No Fix	When BIST is Enabled, Warm Reset Incorrectly Clears IA32_FEATURE_CONTROL MSR and the Last Exception Record MSRs
AAF27	X	No Fix	LBR/BTM/BTS Information Immediately After a Transition From Legacy/Compatibility Mode to 64-bit Mode May be Incorrect
AAF28	X	No Fix	CPUID Instruction Returns Incorrect Brand String
AAF29	X	No Fix	A Logical Processor May Incorrectly Clear Thermal Status Log Indicator During Intel Deep Power Down Technology State Transition
AAF30	X	No Fix	The Instruction Cache Does Not Respond to Snoops When All Logical Processors on a Core Are in an Inactive State
AAF31	X	No Fix	LINT0 Assertion and Deassertion During an Inactive State May Cause Unexpected Operation When APIC is Disabled
AAF32	X	No Fix	Processor May Not Wake Up from an Inactive State When an Enhanced Intel® SpeedStep Technology Transition is Pending
AAF33	X	No Fix	IRET under Certain Conditions May Cause an Unexpected Alignment Check Exception
AAF34	X	No Fix	Thermal Interrupts are Dropped During and While Exiting Intel® Deep Power-Down State
AAF35	X	No Fix	Corruption of CS Segment Register During RSM While Transitioning From Real Mode to Protected Mode
AAF36	X	No Fix	CPUID Instruction Returns Incorrect Value For Leaf 0xA
AAF37	x	No Fix	GP and Fixed Performance Monitoring Counters With AnyThread Bit Set May Not Accurately Count Only OS or Only USR Events
AAF38	X	No Fix	PMI Request is Not Generated on a Counter Overflow if Its OVF Bit is Already Set in IA32_PERF_GLOBAL_STATUS
AAF39	X	No Fix	CPUID Indicates Wrong L2 Associativity in Leaf 80000006H
AAF40	X	No Fix	Code Fetch May Occur to Incorrect Address After a Large Page is Split Into 4-KByte Pages
AAF41	X	No Fix	Processor May Contain Incorrect Data and Hang Upon a Snoop When Combined with Specific Other Internal Conditions
AAF42	X	No Fix	Processor May Use an Incorrect Translation if the TLBs Contain Two Different Translations For a Linear Address
AAF43	X	No Fix	CPUID Feature Flag Incorrectly Indicates TM2 as Supported



Number	Stepping	PLAN	ERRATA
	C0		
AAF44	X	No Fix	IA32_MC2_STATUS [OVERFLOW] Bit is Not Set When Single-Bit Correctable ECC Error Occurs
AAF45	X	No Fix	FP Data Operand Pointer May Be Incorrectly Calculated After an FP Access Which Wraps a 4-Gbyte Boundary in Code That Uses 32-Bit Address Size in 64-bit Mode
AAF46	X	No Fix	FP Data Operand Pointer May Be Incorrectly Calculated After an FP Access Which Wraps a 64-Kbyte Boundary in 16-Bit Code

Number	SPECIFICATION CHANGES
	There are no Specification Changes in this revision of the specification Update

Number	SPECIFICATION CLARIFICATIONS
	There are no Specification Clarifications in this revision of the specification Update

Number	DOCUMENTATION CHANGES
	There are no Documentation Changes in this revision of the specification Update



Identification Information

The Intel® Atom™ Processor 200 Series on 45-nm process stepping can be identified by the following register contents:

Table 1. Component Identification via Programming Interface

Reserved	Extended Family ¹	Extended Model ²	Reserved	Processor Type ³	Family Code ⁴	Model Number ⁵	Stepping ID ⁶
31:28	27:20	19:16	15:13	12	11:8	7:4	3:0
	0000000b	0001b		0b	0110b	1100b	XXXXb

NOTES:

1. The Extended Family, bits [27:20] are used in conjunction with the Family Code, specified in bits [11:8], to indicate whether the processor belongs to the Intel386®, Intel486®, Pentium®, Pentium Pro, Pentium 4, or Intel Core processor family.
2. The Extended Model, bits [19:16] in conjunction with the Model Number, specified in bits [7:4], are used to identify the model of the processor within the processor’s family.
3. The Processor Type, specified in bits [13:12] 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).
4. The Family Code corresponds to bits [11:8] of the EDX register after RESET, bits [11:8] of the EAX register after the CPUID instruction is executed with a 1 in the EAX register, and the generation field of the Device ID register accessible through Boundary Scan.
5. The Model Number corresponds to bits [7:4] of the EDX register after RESET, bits [7:4] of the EAX register after the CPUID instruction is executed with a 1 in the EAX register, and the model field of the Device ID register accessible through Boundary Scan.
6. The Stepping ID in bits [3:0] indicates the revision number of that model. See Table 2 for the processor stepping ID number in the CPUID information.

When EAX is initialized to a value of 1, the CPUID instruction returns the Extended Family, Extended Model, Type, Family, Model and Stepping value in the EAX register. Note that the EDX processor signature value after reset is equivalent to the processor signature output value in the EAX register.



Component Marking Information

The Intel® Atom™ Processor 200 Series may be identified by the following component markings.

Figure 1. Intel® Atom™ Processor 200 Series (Micro-FCPGA/FCBGA) Markings

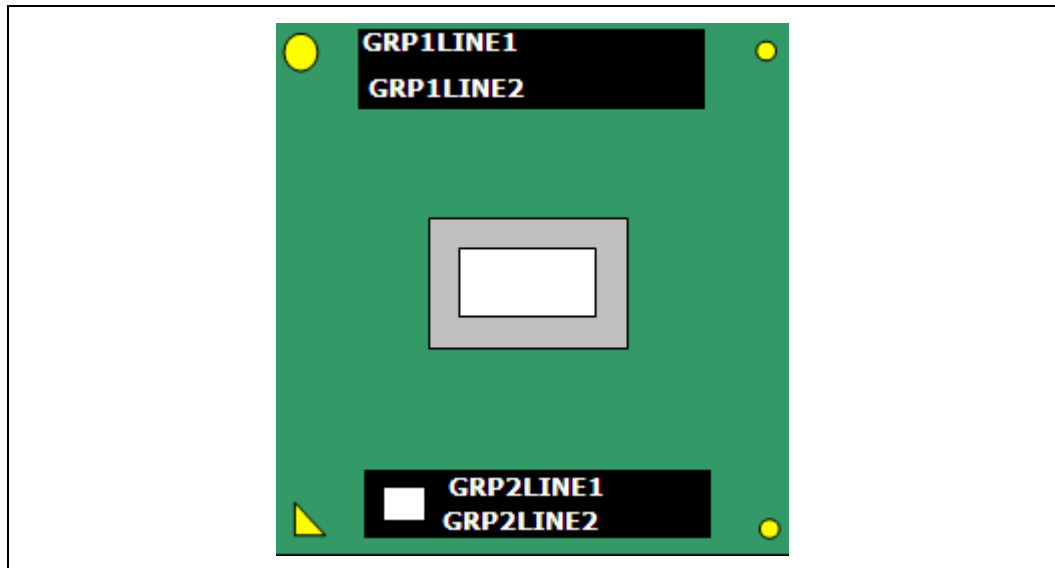


Table 2. Identification Table for Intel® Atom™ Processor 200 Series

QDF/ S-spec	Product Stepping	HFM TDP (W)	Process sor #	FSB Frequenc y	Processor Signature	Core Speed	Package Micro- FCBGA-Pb= μ- BGA Lead Free	MCU
						Fused		
SLB6Z ¹	C0	4W	230	533 MHz	000106C2h	1.60 GHz	FCBGA 437	M04106C220A
QGZR ¹	C0	4W	230	533 MHz	000106C2h	1.60GHz	FCBGA 437	M01106C2218

NOTES:

1. These are frequency locked samples. Default ratio is 1:12 (1.60GHz).

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Errata

AAF1 A Write to an APIC Register Sometimes May Appear to Have Not Occurred

Problem: With respect to the retirement of instructions, stores to the uncacheable memory based APIC register space are handled in a non-synchronized way. For example if an instruction that masks the interrupt flag, e.g. CLI, is executed soon after an uncacheable write to the Task Priority Register (TPR) that lowers the APIC priority, the interrupt masking operation may take effect before the actual priority has been lowered. This may cause interrupts whose priority is lower than the initial TPR, but higher than the final TPR, to not be serviced until the interrupt enabled flag is finally set, i.e. by STI instruction. Interrupts will remain pending and are not lost.

In this example the processor may allow interrupts to be accepted but may delay their service.

This non-synchronization can be avoided by issuing an APIC register read after the APIC register write. This will force the store to the APIC register before any subsequent instructions are executed. No commercial operating system is known to be impacted by this erratum.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF2 An xTPR Update Transaction Cycle, if Enabled, May be Issued to the FSB after the Processor has Issued a Stop-Grant Special Cycle

Problem: According to the FSB (Front Side Bus) protocol specification, no FSB cycles should be issued by the processor once a Stop-Grant special cycle has been issued to the bus. If xTPR update transactions are enabled by clearing the IA32_MISC_ENABLE[bit 23] at the time of Stop-Clock assertion, an xTPR update transaction cycle may be issued to the FSB after the processor has issued a Stop Grant Acknowledge transaction.

When this erratum occurs in systems using C-states C2 (Stop-Grant State) and higher the result could be a system hang.

Workaround: BIOS must leave the xTPR update transactions disabled (default).

Status: For the steppings affected, see the Summary Tables of Changes.

AAF3 Processor May Report a #TS Instead of a #GP Fault

Problem: A jump to a busy TSS (Task-State Segment) may cause a #TS (invalid TSS exception) instead of a #GP fault (general protection exception).

Operation systems that access a busy TSS may get invalid TSS fault instead of a #GP fault. Intel has not observed this erratum with any commercially available software.

None

Status: For the steppings affected, see the Summary Tables of Changes.

**AAF4 Writing the Local Vector Table (LVT) when an Interrupt is Pending May Cause an Unexpected Interrupt**

Problem: If a local interrupt is pending when the LVT entry is written, an interrupt may be taken on the new interrupt vector even if the mask bit is set.

An interrupt may immediately be generated with the new vector when a LVT entry is written, even if the new LVT entry has the mask bit set. If there is no Interrupt Service Routine (ISR) set up for that vector the system will GP fault. If the ISR does not do an End of Interrupt (EOI) the bit for the vector will be left set in the in-service register and mask all interrupts at the same or lower priority.

Any vector programmed into an LVT entry must have an ISR associated with it, even if that vector was programmed as masked. This ISR routine must do an EOI to clear any unexpected interrupts that may occur. The ISR associated with the spurious vector does not generate an EOI, therefore the spurious vector should not be used when writing the LVT.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF5 MOV To/From Debug Registers Causes Debug Exception

Problem: When in V86 mode, if a MOV instruction is executed to/from a debug registers, a general-protection exception (#GP) should be generated. However, in the case when the general detect enable flag (GD) bit is set, the observed behavior is that a debug exception (#DB) is generated instead.

With debug-register protection enabled (i.e., the GD bit set), when attempting to execute a MOV on debug registers in V86 mode, a debug exception will be generated instead of the expected general-protection fault.

In general, operating systems do not set the GD bit when they are in V86 mode. The GD bit is generally set and used by debuggers. The debug exception handler should check that the exception did not occur in V86 mode before continuing. If the exception did occur in V86 mode, the exception may be directed to the general-protection exception handler.

Status: For the steppings affected, see the Summary Tables of Changes.



AAF6 Using 2M/4M Pages When A20M# Is Asserted May Result in Incorrect Address Translations

Problem: An external A20M# pin if enabled forces address bit 20 to be masked (forced to zero) to emulate real-address mode address wraparound at 1 megabyte. However, if all of the following conditions are met, address bit 20 may not be masked.

- paging is enabled
- a linear address has bit 20 set
- the address references a large page
- A20M# is enabled

When A20M# is enabled and an address references a large page the resulting translated physical address may be incorrect. This erratum has not been observed with any commercially available operating system.

Operating systems should not allow A20M# to be enabled if the masking of address bit 20 could be applied to an address that references a large page. A20M# is normally only used with the first megabyte of memory.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF7 Values for LBR/BTS/BTM will be Incorrect after an Exit from SMM

Problem: After a return from SMM (System Management Mode), the CPU will incorrectly update the LBR (Last Branch Record) and the BTS (Branch Trace Store), hence rendering their data invalid. The corresponding data if sent out as a BTM on the system bus will also be incorrect.

Note: This issue would only occur when one of the 3 above mentioned debug support facilities are used.

The value of the LBR, BTS, and BTM immediately after an RSM operation should not be used.

None

Status: For the steppings affected, see the Summary Tables of Changes.

**AAF8 Incorrect Address Computed For Last Byte of FXSAVE/FXRSTOR Image Leads to Partial Memory Update**

Problem: A partial memory state save of the 512-byte FXSAVE image or a partial memory state restore of the FXRSTOR image may occur if a memory address exceeds the 64KB limit while the processor is operating in 16-bit mode or if a memory address exceeds the 4GB limit while the processor is operating in 32-bit mode.

FXSAVE/FXRSTOR will incur a #GP fault due to the memory limit violation as expected but the memory state may be only partially saved or restored.

Software should avoid memory accesses that wrap around the respective 16-bit and 32-bit mode memory limits.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF9 A Thermal Interrupt is Not Generated when the Current Temperature is Invalid

Problem: When the DTS (Digital Thermal Sensor) crosses one of its programmed thresholds it generates an interrupt and logs the event (IA32_THERM_STATUS MSR (019Ch) bits [9,7]). Due to this erratum, if the DTS reaches an invalid temperature (as indicated IA32_THERM_STATUS MSR bit[31]) it does not generate an interrupt even if one of the programmed thresholds is crossed and the corresponding log bits become set.

When the temperature reaches an invalid temperature the CPU does not generate a Thermal interrupt even if a programmed threshold is crossed.

None

Status: For the steppings affected, see the Summary Tables of Changes.

AAF10 Programming the Digital Thermal Sensor (DTS) Threshold May Cause Unexpected Thermal Interrupts

Problem: Software can enable DTS thermal interrupts by programming the thermal threshold and setting the respective thermal interrupt enable bit. When programming DTS value, the previous DTS threshold may be crossed. This will generate an unexpected thermal interrupt.

Software may observe an unexpected thermal interrupt occur after reprogramming the thermal threshold.

In the ACPI/OS implement a workaround by temporarily disabling the DTS threshold interrupt before updating the DTS threshold value.

Status: For the steppings affected, see the Summary Tables of Changes.



AAF11 Returning to Real Mode from SMM with EFLAGS.VM Set May Result in Unpredictable System Behavior

Problem: Returning back from SMM mode into real mode while EFLAGS.VM is set in SMRAM may result in unpredictable system behavior.

If SMM software changes the values of the EFLAGS.VM in SMRAM, it may result in unpredictable system behavior. Intel has not observed this behavior in commercially available software.

SMM software should not change the value of EFLAGS.VM in SMRAM.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF12 Fault on ENTER Instruction May Result in Unexpected Values on Stack Frame

Problem: The ENTER instruction is used to create a procedure stack frame. Due to this erratum, if execution of the ENTER instruction results in a fault, the dynamic storage area of the resultant stack frame may contain unexpected values (i.e. residual stack data as a result of processing the fault).

Data in the created stack frame may be altered following a fault on the ENTER instruction. Please refer to "Procedure Calls For Block-Structured Languages" in IA-32 Intel® Architecture Software Developer's Manual, Vol. 1, Basic Architecture, for information on the usage of the ENTER instructions. This erratum is not expected to occur in ring 3. Faults are usually processed in ring 0 and stack switch occurs when transferring to ring 0. Intel has not observed this erratum on any commercially available software.

Workaround: None

Status: For the steppings affected, see the Summary Tables of Changes.

AAF13 With TF (Trap Flag) Asserted, FP Instruction That Triggers an Unmasked FP Exception May Take Single Step Trap before Retirement of Instruction

Problem: If an FP instruction generates an unmasked exception with the EFLAGS.TF=1, it is possible for external events to occur, including a transition to a lower power state. When resuming from the lower power state, it may be possible to take the single step trap before the execution of the original FP instruction completes.

A Single Step trap will be taken when not expected.

Workaround: None

Status: For the steppings affected, see the Summary Tables of Changes.



AAF14 An Enabled Debug Breakpoint or Single Step Trap May Be Taken after MOV SS/POP SS Instruction if it is Followed by an Instruction That Signals a Floating Point Exception

Problem: A MOV SS/POP SS instruction should inhibit all interrupts including debug breakpoints until after execution of the following instruction. This is intended to allow the sequential execution of MOV SS/POP SS and MOV [r/e]SP, [r/e]BP instructions without having an invalid stack during interrupt handling. However, an enabled debug breakpoint or single step trap may be taken after MOV SS/POP SS if this instruction is followed by an instruction that signals a floating point exception rather than a MOV [r/e]SP, [r/e]BP instruction. This results in a debug exception being signaled on an unexpected instruction boundary since the MOV SS/POP SS and the following instruction should be executed atomically.

This can result in incorrect signaling of a debug exception and possibly a mismatched Stack Segment and Stack Pointer. If MOV SS/POP SS is not followed by a MOV [r/e]SP, [r/e]BP, there may be a mismatched Stack Segment and Stack Pointer on any exception. Intel has not observed this erratum with any commercially available software, or system.

As recommended in the IA32 Intel® Architecture Software Developer's Manual, the use of MOV SS/POP SS in conjunction with MOV [r/e]SP, [r/e]BP will avoid the failure since the MOV [r/e]SP, [r/e]BP will not generate a floating point exception. Developers of debug tools should be aware of the potential incorrect debug event signaling created by this erratum.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF15 Code Segment Limit/Canonical Faults on RSM May be Serviced before Higher Priority Interrupts/Exceptions and May Push the Wrong Address Onto the Stack

Problem: Normally, when the processor encounters a Segment Limit or Canonical Fault due to code execution, a #GP (General Protection Exception) fault is generated after all higher priority Interrupts and exceptions are serviced. Due to this erratum, if RSM (Resume from System Management Mode) returns to execution flow that results in a Code Segment Limit or Canonical Fault, the #GP fault may be serviced before a higher priority Interrupt or Exception (e.g. NMI (Non-Maskable Interrupt), Debug break(#DB), Machine Check (#MC), etc.). If the RSM attempts to return to a non-canonical address, the address pushed onto the stack for this #GP fault may not match the non-canonical address that caused the fault.

Operating systems may observe a #GP fault being serviced before higher priority Interrupts and Exceptions. Intel has not observed this erratum on any commercially available software.

None

Status: For the steppings affected, see the Summary Tables of Changes.



AAF16 BTS(Branch Trace Store) and PEBS(Precise Event Based Sampling) May Update Memory outside the BTS/PEBS Buffer

Problem: If the BTS/PEBS buffer is defined such that:

- The difference between BTS/PEBS buffer base and BTS/PEBS absolute maximum is not an integer multiple of the corresponding record sizes
- BTS/PEBS absolute maximum is less than a record size from the end of the virtual address space
- The record that would cross BTS/PEBS absolute maximum will also continue past the end of the virtual address space

A BTS/PEBS record can be written that will wrap at the 4G boundary (IA32) or 2^{64} boundary (EM64T mode), and write memory outside of the BTS/PEBS buffer.

Software that uses BTS/PEBS near the 4G boundary (IA32) or 2^{64} boundary (EM64T mode), and defines the buffer such that it does not hold an integer multiple of records can update memory outside the BTS/PEBS buffer.

Define BTS/PEBS buffer such that BTS/PEBS absolute maximum minus BTS/PEBS buffer base is integer multiple of the corresponding record sizes as recommended in the IA-32 Intel® Architecture Software Developer's Manual, Volume 3.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF17 Single Step Interrupts with Floating Point Exception Pending May Be Mishandled

Problem: In certain circumstances, when a floating point exception (#MF) is pending during single-step execution, processing of the single-step debug exception (#DB) may be mishandled.

When this erratum occurs, #DB will be incorrectly handled as follows:

- #DB is signaled before the pending higher priority #MF (Interrupt 16)
- #DB is generated twice on the same instruction

None

Status: For the steppings affected, see the Summary Tables of Changes.



AAF18 Unsynchronized Cross-Modifying Code Operations Can Cause Unexpected Instruction Execution Results

Problem: The act of one processor, or system bus master, writing data into a currently executing code segment of a second processor with the intent of having the second processor execute that data as code is called cross-modifying code (XMC). XMC that does not force the second processor to execute a synchronizing instruction, prior to execution of the new code, is called unsynchronized XMC. Software using unsynchronized XMC to modify the instruction byte stream of a processor can see unexpected or unpredictable execution behavior from the processor that is executing the modified code.

In this case, the phrase "unexpected or unpredictable execution behavior" encompasses the generation of most of the exceptions listed in the Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 3A: System Programming Guide, including a General Protection Fault (#GP) or other unexpected behaviors.

In order to avoid this erratum, programmers should use the XMC synchronization algorithm as detailed in the Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 3A: *System Programming Guide*, Section: Handling Self- and Cross-Modifying Code.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF19 IO_SMI Indication in SMRAM State Save Area May be Set Incorrectly

Problem: The IO_SMI bit in SMRAM's location 7FA4H is set to "1" by the CPU to indicate a System Management Interrupt (SMI) occurred as the result of executing an instruction that reads from an I/O port. Due to this erratum, the IO_SMI bit may be incorrectly set by:

- A SMI that is pending while a lower priority event is executing
- A REP I/O read
- A I/O read that redirects to MWAIT

SMM handlers may get false IO_SMI indication.

The SMM handler has to evaluate the saved context to determine if the SMI was triggered by an instruction that read from an I/O port. The SMM handler must not restart an I/O instruction if the platform has not been configured to generate a synchronous SMI for the recorded I/O port address.

Status: For the steppings affected, see the Summary Tables of Changes.

**AAAF20** **Writes to IA32_DEBUGCTL MSR May Fail when FREEZE_LBRS_ON_PMI is Set**

Problem: When the FREEZE_LBRS_ON_PMI, IA32_DEBUGCTL MSR (1D9H) bit [11], is set, future writes to IA32_DEBUGCTL MSR may not occur in certain rare corner cases. Writes to this register by software or during certain processor operations are affected.

Under certain circumstances, the IA32_DEBUGCTL MSR value may not be updated properly and will retain the old value. Intel has not observed this erratum with any commercially available software.

Do not set the FREEZE_LBRS_ON_PMI bit of IA32_DEBUGCTL MSR.

Status: For the steppings affected, see the Summary Tables of Changes.

AAAF21 **Address Reported by Machine-Check Architecture (MCA) on L2 Cache Errors May be Incorrect**

Problem: When an L2 Cache error occurs (Error code 0x010A or 0x110A reported in IA32_MCi_STATUS MSR bits [15:0]), the address is logged in the MCA address register (IA32_MCi_ADDR MSR). Under some scenarios, the address reported may be incorrect.

Software should not rely on the value reported in IA32_MCi_ADDR MSR for L2 Cache errors.

None

Status: For the steppings affected, see the Summary Tables of Changes.

AAAF22 **Pending x87 FPU Exceptions (#MF) Following STI May Be Serviced Before Higher Priority Interrupts**

Problem: Interrupts that are pending prior to the execution of the STI (Set Interrupt Flag) instruction are normally serviced immediately after the instruction following the STI. An exception to this is if the following instruction triggers a #MF. In this situation, the interrupt should be serviced before the #MF. Because of this erratum, if following STI, an instruction that triggers a #MF is executed while STPCLK#, Enhanced Intel SpeedStep Technology transitions or Thermal Monitor events occur, the pending #MF may be serviced before higher priority interrupts.

Software may observe #MF being serviced before higher priority interrupts.

None

Status: For the steppings affected, see the Summary Tables of Changes.



AAF23 Benign Exception after a Double Fault May Not Cause a Triple Fault Shutdown

Problem: According to the Intel® 64 and IA-32 Architectures Software Developer's Manual, Volume 3A, "Exception and Interrupt Reference", if another exception occurs while attempting to call the double-fault handler, the processor enters shutdown mode. Due to this erratum, any benign faults while attempting to call double-fault handler will not cause a shutdown. However Contributory Exceptions and Page Faults will continue to cause a triple fault shutdown.

If a benign exception occurs while attempting to call the double-fault handler, the processor may hang or may handle the benign exception. Intel has not observed this erratum with any commercially available software.

None

Status: For the steppings affected, see the Summary Tables of Changes.

AAF24 IA32_MC1_STATUS MSR Bit [60] Does Not Reflect Machine Check Error Reporting Enable Correctly

Problem: IA32_MC1_STATUS MSR (405H) bit[60] (EN- Error Enabled) is supposed to indicate whether the enable bit in the IA32_MC1_CTL MSR (404H) was set at the time of the last update to the IA32_MC1_STATUS MSR. Due to this erratum, IA32_MC1_STATUS MSR bit [60] instead reports the current value of the IA32_MC1_CTL MSR enable bit.

IA32_MC1_STATUS MSR bit [60] may not reflect the correct state of the enable bit in the IA32_MC1_CTL MSR at the time of the last update.

None

Status: For the steppings affected, see the Summary Tables of Changes.

AAF25 Split Locked Stores or Locked Stores Through Certain Segments May not Trigger the Monitoring Hardware

Problem: Logical processors normally resume program execution following the MWAIT, when another logical processor performs a write access to a WB cacheable address within the address range used to perform the MONITOR operation. Due to this erratum, a logical processor may not resume execution until the next targeted interrupt event or O/S timer tick following a locked store within the monitored address range that either spans across cache lines or uses a segment register whose segment base is non-cacheline aligned.

The logical processor that executed the MWAIT instruction may not resume execution until the next targeted interrupt event or O/S timer tick in the case where the monitored address is written by a locked store which is either split across cache lines or through a segment whose segment base bits 5 to 0 are non-zero.

Avoid accessing the monitored address range using either locked stores that split cache lines or locked stores that use a segment with a non-cacheline aligned segment base. It is possible for the BIOS to contain a workaround for this erratum

Status: For the steppings affected, see the Summary Tables of Changes.



AAF26 When BIST is Enabled, Warm Reset Incorrectly Clears IA32_FEATURE_CONTROL MSR and the Last Exception Record MSRs

Problem: IA32_FEATURE_CONTROL MSR (3AH), MSR_LER_FROM_LIP MSR (1DDH), and MSR_LER_TO_LIP MSR (1DEH) are cleared during warm reset when BIST (Built-In Self Test) is enabled. These MSRs should only be cleared on a power-up reset and not on a warm reset. A warm reset is different from a power-up reset in that PWRGOOD remains active throughout the assertion of RESET#.

Due to this erratum, any warm reset will clear IA32_FEATURE_CONTROL MSR, MSR_LER_FROM_LIP MSR, and MSR_LER_TO_LIP MSR content when BIST is enabled.

BIOS or other firmware software must save IA32_FEATURE_CONTROL MSR, MSR_LER_FROM_LIP MSR, and MSR_LER_TO_LIP MSR information before warm reset and restore and reprogram the MSRs after the warm reset.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF27 LBR/BTM/BTS Information Immediately After a Transition From Legacy/Compatibility Mode to 64-bit Mode May be Incorrect

Problem: If a transition from legacy/compatibility mode to 64-bit mode occurs and another branch event occurs before the first instruction executes (for example an external interrupt or trap) then any FROM address recorded by LBR (Last Branch Record), BTM (Branch Trace Message) or BTS (Branch Trace Store) on that second event may incorrectly report the upper 32-bits as zero.

Due to this erratum, bits 63:32 of the 'FROM' value for LBR/BTM/BTS may be improperly zeroed after a transition to 64 bit mode when the RIP (Instruction Pointer Register) is greater than 4 Gigabyte.

None identified. This erratum may be detected by a 'FROM' address having its upper 32-bits zero but its lower 32-bits matching the previous 'TO' address recorded.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF28 CPUID Instruction Returns Incorrect Brand String

Problem: When a CPUID instruction is executed with EAX = 80000002H, 80000003H and 80000004H on an Intel® Atom™ processor, the return value contains the brand string *Intel(R) Core(TM) CPU* when it should have *Intel(R) Atom(TM) CPU*.

Implication: When this erratum occurs, the processor will report the incorrect brand string.

Workaround: It is possible for the BIOS to contain a workaround for this erratum.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF29 A Logical Processor May Incorrectly Clear Thermal Status Log Indicator During Intel Deep Power Down Technology State Transition

Problem: When a logical processor enters the Intel Deep Power Down Technology State (e.g. as requested by MWAIT or I/O redirection), it may incorrectly clear the sticky Thermal Status Log flag (bit 1) in IA32_THERM_STATUS MSR (19CH). This erratum will not occur when Hyper-Threading (HT) is disabled.



Implication: When Hyper-Threading is enabled, a logical processor may incorrectly indicate that the thermal sensor has not tripped since last power-up.

Workaround: It is possible for the BIOS to contain a workaround for this erratum.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF30 The Instruction Cache Does Not Respond to Snoops When All Logical Processors on a Core Are in an Inactive State

Problem: When all logical processors on a core enter an inactive state (e.g. MWAIT or HLT), the processor may incorrectly stop flushing lines in its instruction cache in response to snoops. This may cause the processor to not detect that memory has been modified and to execute the old instructions after waking up instead of the new contents of memory.

Implication: The processor may execute incorrect instructions after waking up from an inactive state.

Workaround: It is possible for the BIOS to contain a workaround for this erratum.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF31 LINT0 Assertion and Deassertion During an Inactive State May Cause Unexpected Operation When APIC is Disabled

Problem: An interrupt delivered via LINT0 pins when the APIC is hardware disabled (IA32_APIC_BASE MSR (1BH) bit [11] is cleared) will usually keep the pin asserted until after the interrupt is acknowledged. However, if LINT0 is asserted and then deasserted before the interrupt is acknowledged and both of the following are true;

- the APIC is hardware disabled (IA32_APIC_BASE MSR bit [11] is clear) and
- the processor is in an inactive state that was requested by MWAIT, I/O redirection, VM-entry or RSM, then the processor may operate incorrectly.

Implication: Due to this erratum, the processor may run unexpected code and/or generate an unexpected exception. Intel has not observed this erratum with any commercially available software.

Workaround: If LINT0 is used, it is recommended to either leave the APIC enabled (IA32_APIC_BASE MSR bit [11] set to 1) or do not use MWAIT, I/O redirection, VM-entry or RSM to enter an inactive state.

Status: For the steppings affected, see the Summary Tables of Changes.

**AAAF32 Processor May Not Wake Up from an Inactive State When an Enhanced Intel® SpeedStep Technology Transition is Pending**

Problem: Due to this erratum, the processor may hang in rare scenarios when it is in an inactive state and there is an Enhanced Intel® SpeedStep Technology transition pending.

Implication: The processor may hang and be unable to resume execution. A processor reset will be needed to restart processor execution. Intel has not observed this erratum with any commercially available software.

Workaround: It is possible for the BIOS to contain a workaround to this erratum.

Status: For the steppings affected, see the Summary Tables of Changes.

AAAF33 IRET under Certain Conditions May Cause an Unexpected Alignment Check Exception

Problem: In IA-32e mode, it is possible to get an Alignment Check Exception (#AC) on the IRET instruction even though alignment checks were disabled at the start of the IRET. This can only occur if the IRET instruction is returning from CPL3 code to CPL3 code. IRETs from CPL0/1/2 are not affected. This erratum can occur if the EFLAGS value on the stack has the AC flag set, and the interrupt handler's stack is misaligned. In IA-32e mode, RSP is aligned to a 16-byte boundary before pushing the stack frame.

Implication: In IA-32e mode, under the conditions given above, an IRET can get a #AC even if alignment checks are disabled at the start of the IRET. This erratum can only be observed with a software generated stack frame.

Workaround: Software should not generate misaligned stack frames for use with IRET.

Status: For the steppings affected, see the Summary Tables of Changes.

AAAF34 Thermal Interrupts are Dropped During and While Exiting Intel® Deep Power-Down State

Problem: Thermal interrupts are ignored while the processor is in Intel Deep Power-Down State as well as during a small window of time while exiting from Intel Deep Power-Down State. During this window, if the PROCHOT signal is driven or the internal value of the sensor reaches the programmed thermal trip point, then the associated thermal interrupt may be lost.

Implication: In the event of a thermal event while a processor is waking up from Intel Deep Power-Down State, the processor will initiate an appropriate throttle response. However, the associated thermal interrupt generated may be lost.

Workaround: None identified.

Status: For the steppings affected, see the Summary Tables of Changes.



AAF35 Corruption of CS Segment Register During RSM While Transitioning From Real Mode to Protected Mode

Problem: During the transition from real mode to protected mode, if an SMI (System Management Interrupt) occurs between the MOV to CR0 that sets PE (Protection Enable, bit 0) and the first far JMP, the subsequent RSM (Resume from System Management Mode) may cause the lower two bits of CS segment register to be corrupted.

Implication: The corruption of the bottom two bits of the CS segment register will have no impact unless software explicitly examines the CS segment register between enabling protected mode and the first far JMP. *Intel® 64 and IA-32 Architectures Software Developer's Manual Volume 3A: System Programming Guide, Part 1*, in the section titled "Switching to Protected Mode" recommends the far JMP immediately follows the write to CR0 to enable protected mode. Intel has not observed this erratum with any commercially available software.

Workaround: None identified.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF36 CPUID Instruction Returns Incorrect Value For Leaf 0xA

Problem: When a CPUID instruction is executed with EAX = 0AH, the value returned in EDX is 0x2501, which reports support for only one fixed-function performance counter and also has an undefined bit [bit 13] set. The value of EDX should be 0x0503, reflecting that three fixed-function performance counters are supported.

Implication: When this erratum occurs, the processor will report an incorrect value in EDX.

Workaround: None

Status: For the steppings affected, see the Summary Tables of Changes.

AAF37 GP and Fixed Performance Monitoring Counters With AnyThread Bit Set May Not Accurately Count Only OS or Only USR Events

Problem: A fixed or GP (general purpose) performance counter with the AnyThread bit (IA32_FIXED_CTR_CTRL MSR (38DH) bit [2] for IA32_FIXED_CTR0, bit [6] for IA32_FIXED_CTR1, bit [10] for IA32_FIXED_CTR2; IA32_PERFEVTSEL0 MSR (186H)/ IA32_PERFEVTSEL1 MSR (187H) bit [21]) set may not count correctly when counting only OS (ring 0) events or only USR (ring >0) events. The counters will count correctly if they are counting both OS and USR events or if the AnyThread bit is clear.

Implication: A performance monitor counter may be incorrect when it is counting for all logical processors on that core and not counting at all privilege levels. This erratum will only occur on processors supporting multiple logical processors per core.

Workaround: None

Status: For the steppings affected, see the Summary Tables of Changes.

**AAF38 PMI Request is Not Generated on a Counter Overflow if Its OVF Bit is Already Set in IA32_PERF_GLOBAL_STATUS**

Problem: If a performance counter overflows and software does not clear the corresponding OVF (overflow) bit in IA32_PERF_GLOBAL_STATUS MSR (38Eh) then future overflows of that counter will not trigger PMI (Performance Monitoring Interrupt) requests.

Implication: If software does not clear the OVF bit corresponding to a performance counter then future counter overflows may not cause PMI request.

Workaround: Software should clear the IA32_PERF_GLOBAL_STATUS.OVF bit in the PMI handler

Status: For the steppings affected, see the Summary Tables of Changes.

AAF39 CPUID Indicates Wrong L2 Associativity in Leaf 8000006H

Problem: When a CPUID instruction is executed with EAX= 8000006H on a processor with a 512K L2 cache, it incorrectly returns 08H in ECX[15:12] which indicates a 16-way set associative L2. The return value in ECX[15:12] should have been 06H to indicate a 8-way set associative L2.

Implication: CPUID will report the L2 set associativity as 16-way when it should report 8-way.

Workaround: None

Status: For the steppings affected, see the Summary Tables of Changes.

AAF40 Code Fetch May Occur to Incorrect Address After a Large Page is Split Into 4-KByte Pages

Problem: If software clears the PS (page size) bit in a present PDE (page directory entry), that will cause linear addresses mapped through this PDE to use 4-KByte pages instead of using a large page after old TLB entries are invalidated. Due to this erratum, if a code fetch uses this PDE before the TLB entry for the large page is invalidated then it may fetch from a different physical address than specified by either the old large page translation or the new 4-KByte page translation. This erratum may also cause speculative code fetches from incorrect addresses.

Implication: The processor may fetch code from an incorrect address after a large page is converted into 4-Kbyte pages.

Workaround: None

Status: For the steppings affected, see the Summary Tables of Changes.

**AAF41 Processor May Contain Incorrect Data and Hang Upon a Snoop When Combined with Specific Other Internal Conditions**

Problem: In a specific corner case a snoop to a processor may cause incorrect data that will be followed by a hang.

Implication: Due to this erratum, the processor may contain incorrect data and hang in this specific circumstance.

Workaround: It is possible for the BIOS to contain a workaround for this erratum

Status: For the steppings affected, see the Summary Tables of Changes.

AAF42 Processor May Use an Incorrect Translation if the TLBs Contain Two Different Translations For a Linear Address

Problem: The TLBs may contain both ordinary and large-page translations for a 4-KByte range of linear addresses. This may occur if software modifies a PDE (page-directory entry) that is marked present to set the PS bit (this changes the page size used for the address range). If the two translations differ with respect to page frame, permissions, or memory type, the processor may use a page frame, permissions, or memory type that corresponds to neither translation.

Implication: Due to this erratum, software may not function properly if it sets the PS flag in a PDE and also changes the page frame, permissions, or memory type for the linear addresses mapped through that PDE.

Workaround: Software can avoid this problem by ensuring that the TLBs never contain both ordinary and large-page translations for a linear address that differ with respect to page frame, permissions, or memory type.

Status: For the steppings affected, see the Summary Tables of Changes.

AAF43 CPUID Feature Flag Incorrectly Indicates TM2 as Supported

Problem: Processors with no support for TM2 (Intel® Thermal Monitor 2) falsely report support for TM2 as indicated by TM2 (bit 8) being set in the Feature Flag returned in ECX when executing CPUID with EAX=01H.

Implication: CPUID Feature Flag TM2 cannot be used to identify processors where TM2 is not supported.

Workaround: None identified.

Status: For the steppings affected, see the Summary Tables of Changes.

**AAAF44 IA32_MC2_STATUS [OVERFLOW] Bit is Not Set When Single-Bit Correctable ECC Error Occurs**

Problem: The OVERFLOW bit should be set if the VAL bit (IA32_MC2_STATUS (409H) bit [63]) is set when a new error occurs. Due to this erratum, the OVERFLOW bit (IA32_MC2_STATUS (409H) bit [62]) is only set when a prior uncorrected error (as indicated by the UC bit (IA32_MC2_STATUS (409H) bit [61])) is present at the time the second error occurs.

Implication: Any L2 correctable error will not set the IA32_MC2_STATUS.OVERFLOW bit when overwriting a prior L2 correctable error.

Workaround: The frequency of occurrence of this problem is reduced greatly if an operating system regularly polls and clears the machine check banks as this reduces the likelihood of an overflow condition

Status: For the steppings affected, see the Summary Tables of Changes.

AAAF45 FP Data Operand Pointer May Be Incorrectly Calculated After an FP Access Which Wraps a 4-Gbyte Boundary in Code That Uses 32-Bit Address Size in 64-bit Mode

Problem: The FP (Floating Point) Data Operand Pointer is the effective address of the operand associated with the last non-control FP instruction executed by the processor. If an 80-bit FP access (load or store) uses a 32-bit address size in 64-bit mode and the memory access wraps a 4-Gbyte boundary and the FP environment is subsequently saved, the value contained in the FP Data Operand Pointer may be incorrect

Implication: Due to this erratum, the FP Data Operand Pointer may be incorrect. Wrapping an 80-bit FP load around a 4-Gbyte boundary in this way is not a normal programming practice. Intel has not observed this erratum with any commercially available software

Workaround: If the FP Data Operand Pointer is used in a 64-bit operating system which may run code accessing 32-bit addresses, care must be taken to ensure that no 80-bit FP accesses are wrapped around a 4-Gbyte boundary

Status: For the steppings affected, see the Summary Tables of Changes.



AA46 FP Data Operand Pointer May Be Incorrectly Calculated After an FP Access Which Wraps a 64-Kbyte Boundary in 16-Bit Code

Problem: The FP (Floating Point) Data Operand Pointer is the effective address of the operand associated with the last non-control FP instruction executed by the processor. If an 80-bit FP access (load or store) occurs in a 16-bit mode other than protected mode (in which case the access will produce a segment limit violation), the memory access wraps a 64-Kbyte boundary, and the FP environment is subsequently saved, the value contained in the FP Data Operand Pointer may be incorrect

Implication: Due to this erratum, the FP Data Operand Pointer may be incorrect. Wrapping an 80-bit FP load around a segment boundary in this way is not a normal programming practice. Intel has not observed this erratum with any commercially available software

Workaround: If the FP Data Operand Pointer is used in an operating system which may run 16-bit FP code, care must be taken to ensure that no 80-bit FP accesses are wrapped around a 64-Kbyte boundary

Status: For the steppings affected, see the Summary Tables of Changes.

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Specification Changes

There are no specification changes in this revision of the specification update.

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Specification Clarifications

There are no specification clarifications in this revision of the specification update.

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Documentation Changes

There are no document changes in this revision of the specification update.

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