



Intel[®] 400 Series Chipset Family Platform Controller Hub (PCH)

Specification Update

August 2021

Revision 007



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Revision History

| Revision Number | Description | Release Date |
|-----------------|---|----------------|
| 001 | <ul style="list-style-type: none">Initial Release | April 2020 |
| 002 | <ul style="list-style-type: none">Added the following errata:<ul style="list-style-type: none">Intel® Serial I/O Controller DMA LLP 4 GB Boundary AlignmentSystem May Hang with USB-C* Power Adapter | May 2020 |
| 003 | <ul style="list-style-type: none">Added the following Specification Clarification<ul style="list-style-type: none">PCIe Precision Time Measurement (PTM) Byte Order | June 2020 |
| 004 | <ul style="list-style-type: none">Added the following erratum:<ul style="list-style-type: none">Audio Global Time Synchronization Register Access | July 2020 |
| 005 | <ul style="list-style-type: none">Added the following erratum:<ul style="list-style-type: none">Phase Lock Loop (PLL) Feedback Circuit | September 2020 |
| 006 | <ul style="list-style-type: none">Added the following Specification Clarification<ul style="list-style-type: none">SX_EXIT_HOLDOFF# Not Functional with eSPI Enabled | November 2020 |
| 007 | <ul style="list-style-type: none">Added the following Specification Clarification:<ul style="list-style-type: none">xHCI D3 Exit Timing | August 2021 |

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Preface

This document is an update to the specifications contained in the Affected Documents table below. This document is a compilation of device and documentation errata, specification changes and Specification clarifications. It is intended for hardware system manufacturers and software developers of applications, operating systems, or tools.

Information types defined in nomenclature are consolidated into the specification update and are no longer published in other documents.

This document may also contain information that was not previously published.

Affected Documents

| Title | Document Number |
|--|--|
| Intel® 400 Series Chipset Family Platform Controller Hub Datasheet | 620854 (Vol1) 620855 (Vol2) |

Nomenclature

Errata are design defects or errors. Errata may cause the behavior of the PCH 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 in all devices.

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



Summary Tables of Changes

The following tables indicate the errata, specification changes, specification clarifications, or documentation changes which apply to the product. Intel may fix some of the errata in a future stepping of the component and account for the other outstanding issues through documentation or specification changes as noted. These tables use the following notations:

Codes Used in Summary Tables

Status

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

Errata Summary Table

| Erratum ID | Stepping | Errata |
|------------|----------|---|
| | A0 | |
| 1 | No Fix | USB DbC or Device Mode Port When Resuming from S3, S4, S5, or G3 State |
| 2 | No Fix | xHCI Minor Revision Value |
| 3 | No Fix | xHCI Link Error Count Field |
| 4 | No Fix | xHCI U1 Exit LFPS Duration |
| 5 | No Fix | xHCI Power Management Link Timer |
| 6 | No Fix | DbC (Debug Capability) Device Fails To Enumerate When Connected To USB 3.2 Gen 2x1 Port |
| 7 | No Fix | SDXC CRC Detection |
| 8 | No Fix | Intel® Trace Hub Pipe Line Empty |
| 9 | No Fix | SPI SFDP Program Suspend and Program Resume Instruction Fields Not Used |
| 10 | No Fix | PCIe* Root Port CLKREQ# Asserted Low to Clock Active Timing |
| 11 | No Fix | xHCI USB 2.0 ISOCH Device Missed Service Interval |
| 12 | No Fix | xHCI Link Protocol Field Value |
| 13 | No Fix | xHCI Short Packet Event Using Non-Event Data TRB |
| 14 | No Fix | eSPI SBLCL Register Bit Not Cleared by PLTRST# |
| 15 | No Fix | xHCI Host Controller Reset May Cause a System Hang |
| 16 | No Fix | xHCI Protocol Speed ID Count Field |
| 17 | No Fix | SATA Enclosure Management LED Messaging |
| 18 | No Fix | Intel® Serial I/O Controller DMA LLP 4 GB Boundary Alignment |
| 19 | No Fix | System May Hang with USB-C* Power Adapter |

| Erratum ID | Stepping | Errata |
|------------|----------|---|
| | A0 | |
| 20 | No Fix | Audio Global Time Synchronization Register Access |
| 21 | No Fix | Phase Lock Loop (PLL) Feedback Circuit |

Specification Change

| Number | Stepping | Specification Change |
|--------|----------|---|
| | A0 | |
| | | No specification changes in this revision of the Specification Update |

Specification Clarification

| Number | Specification Clarification |
|--------|---|
| 1 | PCIe Precision Time Measurement (PTM) Byte Order |
| 2 | SX_EXIT_HOLDOFF# Not Functional with eSPI Enabled |
| 3 | xHCI D3 Exit Timing |

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Errata

1. USB DbC or Device Mode Port When Resuming from S3, S4, S5, or G3 State

Problem: If a PCH USB Type-C* port is configured in Device Mode (or in DbC mode) and connected to an external USB 3.2 host controller, it may cause the USB port to go into a non-functional state in the following scenarios:

1. The PCH resumes from S3, S4, or S5 state, the port may remain in U2.
2. The port is connected to a USB 3.2 Gen 1x1 host controller when resuming from S3, S4, S5 or G3, the port may enter into Compliance Mode or an inactive state if Compliance mode is disabled.
3. The port is connected to a USB 3.2 Gen 2x1 host controller when resuming from S3, S4, S5 or G3, the port may enter an inactive state.

Implication: PCH USB Type-C port configured in Device Mode (or in DbC mode) may fail to enumerate or become unavailable.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

2. xHCI Minor Revision Value

Problem: The PCH reports USB Minor Revision in the XECP_SUPP_USB3_0 register (offset 8020h) as 01h. The USB-IF released a ECN to update the minor revision to 10h.

Implication: USB-IF xHCI CV TD 1.5 may report a failure. Intel has obtained a waiver for TD 1.5.

Note: No functional impact is expected.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

3. xHCI Link Error Count Field

Problem: The xHCI Link Error Count Field in the USB 3.0 Port X Link Info – (PORTLI) register is implemented as Read/Write instead of Read Only as defined by the xHCI specification.

Implication: USB-IF xHCI CV TD 3.17 may report a failure. Intel has obtained a waiver for TD 3.17.

Note: No functional impact is expected.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

4. xHCI U1 Exit LFPS Duration

Problem: The xHCI U1 Exit LFPS (t13-t11) duration timing is implemented as 0.6 us to 0.9 us. The USB-IF released a ECN updating this timing value to 0.9 us to 1.2 us.

Implication: USB-IF xHCI CV TD 7.18 may report a failure. Intel has obtained a waiver for TD 7.18.

Note: No functional issues are expected.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

5. xHCI Power Management Link Timer

Problem: The xHCI implements the Power Management Link Timer (PM LC Timer) Timeout value as 10 us instead of 4 us as defined by the USB 3.2 specification.

Implication: USB-IF xHCI CV TD 7.21 may report a failure. Intel has obtained a waiver for TD 7.21.

Note: No functional issues are expected.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

6. DbC (Debug Capability) Device Fails To Enumerate When Connected To USB 3.2 Gen 2x1 Port

Problem: The PCH DbC (Debug Capability) Device may fail to enumerate if connected to a USB host controller's USB 3.2 Gen 2x1 port.

Implication: The PCH DbC may not function.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

7. SDXC CRC Detection

Problem: The SDXC controllers may fail to detect a CRC error if a bit error occurs on the DATA3 signal during read operations when in SDXC DDR50 mode. CRC detection on other DATA signals is not impacted.

Implication: The controller will not flag the CRC error to the driver or application, which could result in data integrity issues. Bit errors on SDXC DATA signals are not expected on platforms that follow Intel recommended design guidelines and tuning processes.

Workaround: None identified. To mitigate the issue, SDXC SDR50 modes can be used instead of DDR50.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

8. Intel® Trace Hub Pipe Line Empty

Problem: The Intel® Trace Hub Pipe Line Empty bit (CSR_MTB_BAR, Offset D4h) for a given output port may be set while the Input Buffer Empty for the associated output port is not set. This will only happen when the captureDone signal is de-asserted by clearing the ForceCaptureDone bit (CSR_MTB_BAR, Offset D8h) is cleared or the StoreQual[0] signal is de-asserted by the Trigger Unit before the pipe line is empty, and the destination is either system memory or USB (DCI).

Implication: There may be valid trace data in the trace source input buffer which did not get sent to the destination (output port).

Workaround: None identified. CaptureDone should be cleared or de-asserted after the pipe line is empty.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

9. SPI SFDP Program Suspend and Program Resume Instruction Fields Not Used

Problem: For flash device suspend / resume opcodes, the SPI controller does not use JEDEC SFDPs 13th DWORD bits [15:0], Program Suspend Instruction and Program Resume Instruction fields. The controller only uses bits [31:16], Suspend Instruction and Resume Instruction fields, to obtain the suspend / resume opcodes.

Implication: If the SPI flash requires bits [15:0] to be different than bits [31:16], then the suspend / resume feature is not functional. In this case, system behavior varies depending on what the suspend / resume instruction is and when it is generated.

Note: Major flash vendors have been using the same value for bits [31:16] and bits [15:0].

Workaround: None identified.
If a device requires bits [15:0] to be different than bits [31:16], then disable the device suspend / resume via the SPI Suspend / Resume Enable soft strap.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

10. PCIe* Root Port CLKREQ# Asserted Low to Clock Active Timing

Problem: During L1 exit, the PCH PCIe* Root Ports may exceed the CLKREQ# asserted low to clock active maximum specification due to PCH PCIe clock un-gate path delays.

Implication: PCIe end point device L1 exit instabilities may be observed.

Note: PCIe end point devices that message LTR latency greater than or equal to 1 μ s are not affected by this.

Workaround: None identified.

- Platforms not supporting S0ix with PCIe end point devices that do not support LTR may disable the associated PCH SRCCLKREQ# signal to keep the PCIe clock active during L1.
- Platforms supporting S0ix with PCIe end point devices that have LTR latencies less than 1 μ s may disable the associated PCH SRCCLKREQ# signal to keep the PCIe clock active during L1.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

11. xHCI USB 2.0 ISOCH Device Missed Service Interval

Problem: When the xHCI controller is stressed with concurrent traffic across multiple USB ports, the xHCI controller may fail to service USB 2.0 Isochronous IN endpoints within the required service interval.

Implication: USB 2.0 isochronous devices connected to the xHCI controller may experience dropped packets.

Note: This issue has only been observed in a synthetic environment.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

12. xHCI Link Protocol Field Value

Problem: The xHCI Host Controller reports the Link Protocol (LP) bits [15:14] as 0x0h in the XECP_SUPP_USB3_5 Super Speed Plus register (xHCI MMIO offset 8034h). The xHCI spec rev 1.1 (published in Nov. 2017) defines this bit should be set to 0x1h for SuperSpeed USB 10 Gbps port.

Implication: USB-IF xHCI CV TD 1.9 may report a failure. The failure was not observed during the USB certification for the xHCI USB host controller and thus a waiver was not required.

Note: No functional impact is expected.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

13. xHCI Short Packet Event Using Non-Event Data TRB

Problem: The xHCI may generate an unexpected short packet event for the last transfer's Transfer Request Block (TRB) when using Non-Event Data TRB with multiples TRBs.

Implication: Transfer may fail due to the packet size error.

Note: This issue has only been observed in an synthetic environment. No known implication has been identified with commercial software.

Workaround: None identified.

Intel recommends software to use Data Event TRBs for short packet completion.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

14. eSPI SBLCL Register Bit Not Cleared by PLTRST#

Problem: The IOSF-SB eSPI Link Configuration Lock (SBLCL) bit (offset 4000h, bit 27 in eSPI PCR space) is reset by RSMRST# assertion instead of PLTRST# assertion.

Implication: If the SBLCL bit is set to 1, software will not be able to access the eSPI device Capabilities and Configuration register in the reserved address range (0h - 7FFh) until RSMRST# asserts.

Workaround: None identified.

If software needs to access the eSPI device reserved range 0h - 7FFh while SBLCL bit is set to 1, a RSMRST# assertion should be performed.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

15. xHCI Host Controller Reset May Cause a System Hang

Problem: The xHCI host controller may fail to response if either of the two actions are performed:

1. Accessing xHCI configuration space within 1 ms of setting the xHCI HCRST (Host Controller Reset) bit of the USB Command Register (xHC IBAR, offset 80h, Bit[1]), or
2. Setting the HCRST bit two times within 120 ms.

Implication: The system may hang.

Workaround: None identified.

Note: Software must not make any accesses to the xHCI Host Controller registers for 1 ms after setting the HCRST bit 1 of the USB Command Register (xHCI BAR + 80h) and must add a 120 ms delay in between consecutive xHCI host controller resets.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

16. xHCI Protocol Speed ID Count Field

Problem: The xHCI Host Controller reports an incorrect protocol Speed ID Count value for the USB 3.2 Supported Protocol Capability register -xHCI MMIO offset 8028 bits [31:28].

Implication: USB-IF xHCI CV TD 1.9 may report a failure.

Note: No Functional impact is expected.

Workaround: None Identified

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

17. SATA Enclosure Management LED Messaging

Problem: When sending a SATA enclosure LED message and all SATA ports are either idle or disabled, the PCH may not transmit the LED message due to an internal clock gating issue.

Implication: The LED status for SATA enclosure may be incorrect.

Workaround: None identified.

Note: Enclosure Management SW can poll the Enclosure Management (EM_CTL) - Offset 20h bit 8 register for a 0 value immediately before writing LED messages.

Status: For the steppings affected, refer to the .

18. Intel® Serial I/O Controller DMA LLP 4 GB Boundary Alignment

Problem: If software assigns a 4 GB-aligned address to the Linked List Pointer (LLP_LOn = 0h) for Intel® Serial I/O Controller DMA engine, then the DMA engine interprets this as an empty link list and will not perform DMA transfers.

Implication: An Intel® Serial IO controller (i.e. I²C, GSPI, or UART) may stop operating which may cause the system to hang.

Workaround: Driver software should not assign LLP to a 4 GB-aligned address.

Note: This issue has been addressed in the Intel Serial IO drivers in the following versions or later: For Microsoft* Windows* 10, I²C device driver rev 30.100.1724.2, SPI device driver rev 30.100.1725.1, and UART device driver rev 30.100.1725.1.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

19. System May Hang with USB-C* Power Adapter

Problem: Connecting a USB-C* power adapter to a PCH USB port may cause a race condition that can result in a xHCI controller hang. This issue only occurs on designs where the USB-C Power Delivery (PD) implements OOB messaging to communicate with the PCH for port mapping.

Implication: The system may hang.

Note: This issue does not occur when the system is in Sx state and has only been observed when repeatedly connecting a USB-C power adapter.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

20. Audio Global Time Synchronization Register Access

Problem: Disabling the audio DSP through the Intel High Definition Audio Function Configuration Register Offset 530h in the PCH Private Configuration Space by setting bit 2 to '1' will block accesses to Audio Global Time Synchronization registers in MMIO space (Offset 500h - 55Fh).

Implication: Audio Global Time Synchronization registers may not be accessible and any attempted accesses may result in a system hang.

Workaround: None identified.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

21. Phase Lock Loop (PLL) Feedback Circuit

Problem: The Main PLL and USBPCIe PLL have independent feedback circuits. A feedback circuit timing marginality may result in a momentary jitter excursion in the corresponding PLL and downstream circuitry.

Implication: If the Main PLL loses lock, then the system may hang. If the USBPCIe PLL loses lock, USB 3.1 / SATA / PCIe / integrated GbE / DMI / CLKOUT_PCIE interfaces may experience errors, including correctable errors, interface downtrains, or hangs.

Workaround: A fix has been identified for this erratum and may be available in a software update.

Status: For the steppings affected, refer to the [Summary Tables of Changes](#).

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Specification Change

There are no Specification Changes in this revision of the Specification Update.

Specification Clarification

1. **PCIe Precision Time Measurement (PTM) Byte Order**

Added the following note to the Intel® 400 Series Chipset Family Platform Controller Hub (PCH) Datasheet Volume 1 of 2 (#620854) in the section Precision Time Measurement (PTM):

PCIe Root Ports transmit the lower byte [7:0] of the Propagation Delay Field first instead of the upper byte [31:24] within their PTM DelayResponseD (Response with Data) messages.

2. **SX_EXIT_HOLDOFF# Not Functional with eSPI Enabled**

Added the following note to the Intel® 400 Series Chipset Family Platform Controller Hub (PCH) Datasheet Volume 1 of 2 (#620854) in the Power Management chapter Signal Description section:

When eSPI is enabled, SX_EXIT_HOLDOFF# functionality is not available, and assertion of the signal will not impact Sx exit flows.

3. **xHCI D3 Exit Timing**

Added the following text to the Intel® 400 Series Chipset Family Platform Controller Hub (PCH) Datasheet Volume 2 of 2 (#620855) in the Power Management Control/Status (PM_CS) register summary, bits 1:0, 'PowerState (POWERSTATE)' field description section:

Software should wait for 100 ms before requesting the xHCI controller to re-enter D3 after a D3 exit.

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