Intel® Ethernet Controller I210

Specification Update

Ethernet Products Group (EPG)

January 2022

Revision 3.0
332763-014

Revision History

Revision	Date	Comments
3.0	January 25, 2022	**Miscellaneous Updates** • Updated Table 1-3, "MM Numbers".
2.9	November 17, 2020	**Software Clarifications added or updated:** • 1. While in TCP Segmentation Offload, Each Buffer is Limited to 64 KB (Updated)
2.8	June 2, 2020	**Errata added or updated:** • 39. PCIe: Premature Timeout in LTSSM Configuration State (Added)
2.7	January 17, 2020	**Specification Clarifications added or updated:** • 8. PCIe Separate Reference Clock with Independent Spread (SRIS) Support (Added) **Errata added or updated:** • 38. Device ID and MAC Address Cannot be Changed (Added) **Miscellaneous Updates** • Updated Table 1-3, "MM Numbers".
2.6	April 25, 2019	**Errata added or updated:** • 37. I210 Occasional Malfunction of Wake on LAN/Wake on Link when Transitioning from S4 on Windows 10 (Added)
2.5	June 20, 2018	**Miscellaneous Updates** • Updated Table 1-1, "Markings".
2.4	January 8, 2018	**Miscellaneous Updates** • Updated Table 1-1, "Markings". • Updated Table 1-2, "Device IDs". • Updated Table 1-3, "MM Numbers". • Added Figure 1-6, "I210 Production Top Marking Example (Automotive Industrial Temperature Fiber <20 DPM)". • Removed documentation updates from Table 2-3 and Section 2.3. All changes are incorporated in the latest revision of the *Intel® Ethernet Controller I210 Datasheet*.

Revision	Date	Comments
1.7	July 1, 2015	**Specification Clarifications added or updated:** • 7. WGI210CS Automotive Industrial Temperature Fiber Schematic (Added) **Miscellaneous Updates** • Added automotive industrial temperature fiber product information (WGI210CS).
1.6	April 1, 2015	**Miscellaneous Updates** • Revised Table 1-2, "Device IDs".
1.5	February 10, 2015	**Specification Changes added or updated:** • 6. Revision ID of A2 Stepping (Added) **Errata added or updated:** • 25. Slow System Clock (Updated) • 30. NC-SI Hardware Arbitration Hang **Miscellaneous Updates** • Revised Table 1-2, "Device IDs".
1.4	June 20, 2014	**Errata added or updated:** • 29. SMBus: Interference with Get UDID Directed to Another Device (Added)
1.3	December 20, 2013	**Specification Clarifications added or updated:** • 5. No Match Firmware Proxying Configuration (Added) • 6. WUFC/PROXYFC NS Bits (Added) **Specification Changes added or updated:** • 3. PCIe Timing Parameter Update (Added) • 4. Static Device Off Using PCIe Hot Reset (Added) • 5. Multicast Listener Discovery (MLD) Protocol Offload is Not Supported (Added) **Documentation Updates added or updated** • 2. Ethernet Controller I210 Supported Flash Parts (Added) **Errata added or updated:** • 18. Failure to Establish PCIe Link After Power Up (Added) • 19. Proxy: Neighbor Solicitation with Multicast Target Address is Not Dropped (Added) • 20. Proxy: Missing Target Link-Layer Address in Neighbor Advertisement (Added) • 21. NC-SI: Hardware Arbitration Disable is Not Preserved Across Firmware Reset

Revision	Date	Comments
1.1	January 31, 2013	**Errata added or updated:** • 8. Protocol Offload: Incorrect Response to MLDv2 Queries (Added) • 9. Writes to the VPD RW Area are Not Reliable (Added) • 10. NC-SI: Get NC-SI Pass-Through Statistics Response Might Contain Incorrect Packet Counts (Added) • 11. MCTP Commands from SMBus are Dropped (Added)
1.0	October 26, 2012	Initial release (Intel Public)

1. Introduction

This document applies to the Intel® Ethernet Controller I210.

This document is an update to a published specification, the *Intel® Ethernet Controller I210 Datasheet*. It is intended for use by system manufacturers and software developers. All product documents are subject to frequent revision, and new order numbers will apply. New documents may be added. Be sure you have the latest information before finalizing your design.

1.1 Product Code and Device Identification

Product Codes: WGI210AT (Commercial Temperature Range)
WGI210IT/WGI210IS (Industrial Temperature Range)
WGI210CS (Automotive Industrial Temperature Range)
WGI210CL (Automotive Industrial Temperature Range <20 DPM)

The following tables and drawings describe the various identifying markings on each device package:

Table 1-1. Markings

Device	Stepping	Top Marking	Description
I210	A2	WGI210AT	Production (Commercial Copper)
I210	A2	WGI210AT	Production (Industrial Temperature Copper) Designation "I" on the 4th line of the package indicates industrial temperature).
I210	A2/A3	WGI210AS	Production (Industrial Temperature Fiber) Designation "I" on the 4th line of the package indicates industrial temperature).

Table 1-3. MM Numbers

Product	MM Number	Spec	Media
WGI210AT - Production (Commercial Copper)	925131	SLJXQ	Tape and Reel
	925132	SLJXR	Tray
WGI210IT - Production (Copper and Industrial Temperature Range)	925133	SLJXS	Tape and Reel
	925138	SLJXT	Tray
WGI210IS - Production (Fiber and Industrial Temperature Range)	925142	SLJXW	Tape and Reel
	925143	SLJXX	Tray
WGI210CS - Production (Automotive, Fiber and Industrial Temperature Range)	937549	SLKKM	Tape and Reel
	937548	SLKKL	Tray
WGI210CL - Production (Automotive, Fiber and Industrial Temperature Range <20 DPM)	958497	SLM8V	Tape and Reel
	958496	SLM8U	Tray

1.1.1 Identifying the A3 Stepping

The A3 stepping only applies to the Fiber (IS/CS/CL) products. The A3 stepping can be identified by the Fab Lot Trace Code marking on the package or by the iNVM contents.

- Fab Lot Trace Codes starting with 1638 or greater are A3 devices.
- Bit 1 of INVM_DATA[61] (0x12214) is 1b on A3 devices.

Figure 1-1 shows an example:

1.2 Marking Diagrams

Figure 1-2. I210 Production Top Marking Example (Commercial Temperature Copper)

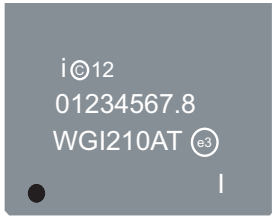


Figure 1-3. I210 Production Top Marking Example (Industrial Temperature Copper)

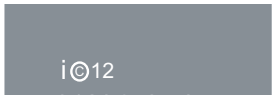


Figure 1-6. I210 Production Top Marking Example (Automotive Industrial Temperature Fiber <20 DPM)

Notes:

- Line 1: With no spaces, "i"©YY
- Line 2: Fab Lot Trace Code 0123456.78 (10-char max)
- Line 3: S-Spec Code and Pb-free mark (e3 or e1)
- Line 4: "I" in lower-right corner for industrial temperature rated devices

1.3 Nomenclature Used in This Document

This document uses specific terms, codes, and abbreviations to describe changes, errata, and/or clarifications that apply to silicon/steppings. See Table 1-4 for a description.

Table 1-4. Nomenclature

Name	Description
Specification Clarifications	Greater detail or further highlights concerning a specification's impact to a complex design situation. These clarifications will be incorporated in the next release of the specifications.
Specification Changes	Modifications to the current published specifications. These changes will be incorporated in the next release of the specifications.
Errata	Design defects or errors. Errata may cause device 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.
Documentation Updates	Typos, errors, or omissions from the current published specifications. These changes will be incorporated in the next release of the specifications.
Doc	Document change or update that will be implemented.
Fixed	This erratum has been fixed.
Fix Planned	This erratum is intended to be fixed in a future stepping of the component.
NoFix	There are no plans to fix this erratum.
Fixed in NVM	This erratum has been fixed in NVM X.XX.
Fix Planned in NVM	This erratum is intended to be fixed in a future NVM version.
Eval	Plans to fix this erratum are under evaluation.
(No mark) or (Blank box)	This erratum is fixed in listed stepping or specification change does not apply to listed stepping.

2. Hardware Clarifications, Changes, Updates and Errata

See Section 1.3 for an explanation of terms, codes, and abbreviations.

Table 2-1. Summary of Specification Clarifications

Specification Clarification	Status
1. PCIe Completion Timeout Mechanism Compliance	N/A
2. Padding on Transmitted SCTP Packets	N/A
3. Dynamic LED Modes Can Only be Used in an Active Low Configuration	N/A
4. Flash Update Integrity Firmware Enhancements	N/A
5. No Match Firmware Proxying Configuration	N/A
6. WUFC/PROXYFC NS Bits	N/A
7. WGI210CS Automotive Industrial Temperature Fiber Schematic	N/A
8. PCIe Separate Reference Clock with Independent Spread (SRIS) Support	N/A

Table 2-2. Summary of Specification Changes

Specification Change	Status
1. Proxy: Wake Up on Link Down/Up with MDNS Offload	N/A

Table 2-4. Summary of Errata; Errata Include Steppings (Continued)

Erratum	Status
6. Marginal Low 10 Mb Amplitude	A2=Yes, A3=Yes; NoFix
7. Non-Monotonic Integrated SVR Ramp	A2=Yes, A3=Yes; NoFix
8. Protocol Offload: Incorrect Response to MLDv2 Queries	N/A
9. Writes to the VPD RW Area are Not Reliable	A2=Yes, A3=Yes; Fixed in NVM 3.16
10. NC-SI: Get NC-SI Pass-Through Statistics Response Might Contain Incorrect Packet Counts	A2=Yes, A3=Yes; NoFix
11. MCTP Commands from SMBus are Dropped	A2=Yes, A3=Yes; Fixed in NVM 3.16
12. VPD Access During Shadow RAM Load to Flash Causes Firmware Reset and VPD Hang	A2=Yes, A3=Yes; Fixed in NVM 3.20
13. NC-SI: Repeated Pause Time After Receiving XOFF	A2=Yes, A3=Yes; NoFix
14. NC-SI: Set Link Command Failure in Low Power State in SerDes Modes	A2=Yes, A3=Yes; Fixed in NVM 3.20
15. NC-SI: Maximum XOFF Renewal Interval Might be Exceeded	A2=Yes, A3=Yes; Fixed in NVM 3.20
16. NC-SI: Set Link and Get Link Status Commands Not Supported in 1000BASE-KX Link Mode	A2=Yes, A3=Yes; Fixed in NVM 3.20
17. Proxy: Invalid Neighbor Advertisement Packet with VLAN Tag and SNAP Header	A2=Yes, A3=Yes; Fixed in NVM 3.20
18. Failure to Establish PCIe Link After Power Up	A2=Yes, A3=Yes; NoFix
19. Proxy: Neighbor Solicitation with Multicast Target Address is Not Dropped	A2=Yes, A3=Yes; Fixed in NVM 3.25
20. Proxy: Missing Target Link-Layer Address in Neighbor Advertisement	A2=Yes, A3=Yes; Fixed in NVM 3.25

Table 2-4. Summary of Errata; Errata Include Steppings (Continued)

Erratum	Status
35. NC-SI Get Link Status Command Not Supported when Using SGMII	A2=Yes, A3=Yes; NoFix
36. Internal Clock Malfunction	A2=Yes, A3=No; Fixed
37. I210 Occasional Malfunction of Wake on LAN/Wake on Link when Transitioning from S4 on Windows 10	A2=Yes, A3=Yes; NoFix
38. Device ID and MAC Address Cannot be Changed	A2=Yes, A3=Yes; NoFix
39. PCIe: Premature Timeout in LTSSM Configuration State	A2=Yes, A3=Yes; NoFix

2.1 Specification Clarifications

1. PCIe Completion Timeout Mechanism Compliance

The I210 Completion Timeout Value[3:0] must be properly set by the system BIOS in the I210 PCIe Configuration Space Device Control 2 register (0xC8; W). Failure to do so can cause unexpected completion timeouts.

The I210 complies with the PCIe 2.0 specification for the completion timeout mechanism and programmable timeout values. The PCIe 2.0 specification provides programmable timeout ranges between 50 µs to 64 s with a default time range of 50 µs to 50 ms. The I210 defaults to a range of 16 ms to 32 ms.

Workaround:

3. Dynamic LED Modes Can Only be Used in an Active Low Configuration

In any of the dynamic LED modes (FILTER_ACTIVITY, LINK/ACTIVITY, COLLISION, ACTIVITY, PAUSED), LED blinking should only be enabled if the LED signal is configured as an active low output.

4. Flash Update Integrity Firmware Enhancements

The I210 Flash Update integrity feature (Section 3.3.10 of the *Intel® Ethernet Controller I210 Datasheet*) ensures only Intel digitally signed updates can be applied to I210 products post manufacturing. This is achieved by a combination of hardware and firmware capabilities. NVM image release 3.20 includes firmware enhancements to improve the resilience of this feature.

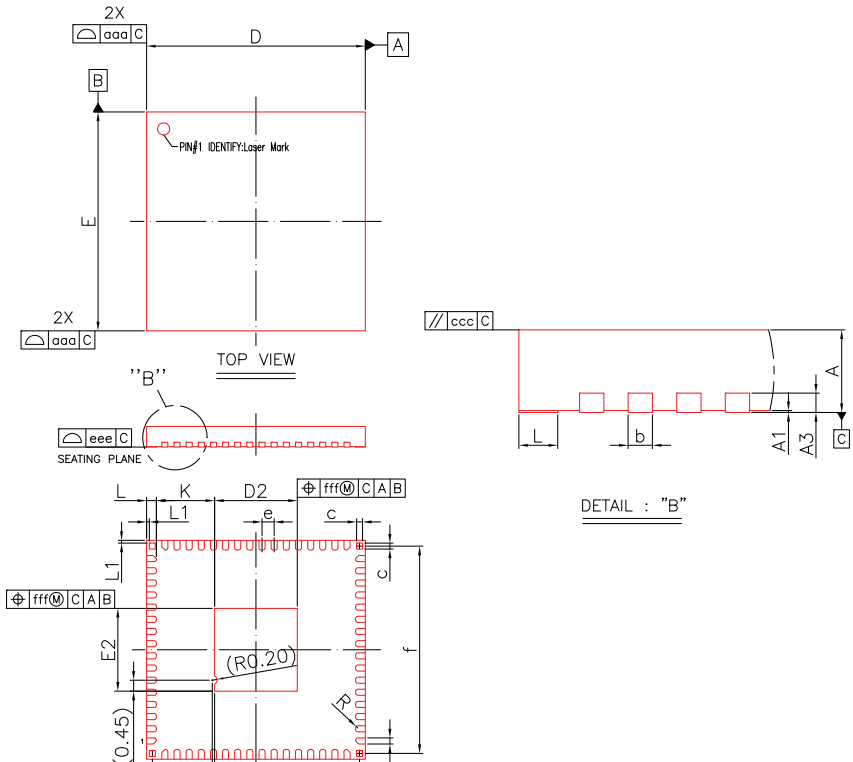
5. No Match Firmware Proxying Configuration

When the Set Firmware Proxying Configuration command is used and the No Match Data field is 0x01, any packet that passes the hardware proxy filters and cannot be processed by the firmware causes a wake up event. Care should be taken when using this setting to prevent the possibility of unintended wake-ups.

6. WUFC/PROXYFC NS Bits

The NS and NS Directed bits in both the WUFC and PROXYFC registers enable filters that pass Neighbor Solicitation packets. These filters do not check the ICMPv6 Type field, so they actually pass any ICMPv6 packet that meets all the other requirements. For example, ICMP Echo Request packets can pass these filters. Care should be exercised when setting these bits in WUFC to avoid unintentional system wake-ups.

7. WGI210CS Automotive Industrial Temperature Fiber Schematic



Symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.85	0.90	0.031	0.033	0.035
A1	0.00	0.02	0.05	0.000	0.001	0.002
A3	0.20 REF			0.008 REF		
b	0.18	0.25	0.30	0.007	0.010	0.012
c	0.195	0.245	0.295	0.008	0.010	0.012
D	8.90	9.00	9.10	0.350	0.354	0.358
E	8.90	9.00	9.10	0.350	0.354	0.358
D2	3.30	3.40	3.50	0.130	0.134	0.138
E2	3.30	3.40	3.50	0.130	0.134	0.138
e	0.50 BSC			0.020 BSC		
f	8.525 BSC			0.336 BSC		
L	0.30	0.40	0.50	0.012	0.016	0.020
L1	0.115 REF			0.005 REF		
K	0.20	---	---	0.008	---	---
R	0.09	---	0.14	0.004	---	0.006
aaa	0.15			0.006		
bbb	0.10			0.004		
ccc	0.10			0.004		
ddd	0.05			0.002		
eee	0.08			0.003		
fff	0.10			0.004		

NOTE:

1. CONTROLLING DIMENSION : MILLIMETER
2. REFERENCE DOCUMENT: JEDEC MO-220.

2.2 Specification Changes

1. Proxy: Wake Up on Link Down/Up with MDNS Offload

As described in the *Intel® Ethernet Controller I210 Datasheet*, when mDNS proxy offload is active, the I210 wakes the system if the LAN link is lost and then re-established. Starting from NVM image release 3.20, the wake-up does not occur unless the link was down for at least 120 seconds. This prevents a spurious wake up triggered by the power state change from D0a to D3 or Dr.

2. No Firmware Reset via HICR in Secure Mode

When the I210 is operating in Secure Mode, the value of the Enable Firmware Reset NVM bit is ignored and firmware reset via the Host Interface Control Register (HICR) is disabled.

This change is implemented starting from NVM image release 3.20.

3. PCIe Timing Parameter Update

In Section 5.5.6 of the *Intel® Ethernet Controller I210 Datasheet*, the maximum value of timing parameter $t_{ppg\text{-}clkint}$ (PCIe PE_RST de-assertion to internal PLL lock) has been updated to 5 ms.

4. Static Device Off Using PCIe Hot Reset

Starting with NVM image release 3.25, the sequence for entering the static device off state can use a PCIe Hot Reset instead of an assertion of the PE_RST_N pin. This change removes the implicit

6. Revision ID of A2 Stepping

The Revision ID of the A2 stepping is either 0x02 or 0x03. The value of the least-significant bit is indeterminate.

This affects the following fields that can be read from the I210:

- Step Rev ID field in the Mirrored Revision ID (MREVID) CSR.
- Revision ID register in the PCIe configuration space.
- Version field read by the IDCODE and USERCODE JTAG instructions.
- Silicon Revision ID field in the SMBus ARP UDID.
- Silicon Revision field returned by the Get Controller Information SMBus command.
- LS-Byte of the Firmware Version field returned by the Get Version ID NC-SI command.
- Rev ID field returned by the Get Controller Information NC-SI OEM command.

2.3 Documentation Updates

None.

2.4 Errata

1. I^2C Data Out Hold Time Violation

Problem:

The I210 should provide a data out hold time of 50 ns on the SFP_I2C_Data pin. The actual hold time is about 16 ns.

Implication:

Timing specification violation. There have been no reports of failures resulting from this timing.

Note: The data input hold time required is zero, so the provided output hold time should be more than enough as long as the I^2C CLK and DATA signals are reasonably matched on the board.

Workaround:

None.

Status: A2=Yes, A3=Yes; NoFix

2. NC-SI Hardware Arbitration Issues

Problem:

1. During normal operation, the I210 might get FLUSH commands with a smaller ID than the device ID. The I210 should pass on the received FLUSH, but it sends its own ID for ~2 µs and then passes

Implication:

1. No implication in actual operation. Eventually, the lower IDs pass and arbitration succeeds.
2. The issue is not expected to cause problems because the timeout period is longer. Minor NC-SI compliance violation related to hardware arbitration.
3. The MC is released by the XOFF timer expiration. Minor NC-SI compliance violation related to hardware arbitration.
4. Longer than expected timeout (no specification violation).
5. No implication.
6. Slight delay in traffic coming from the MC but no platform implication.

Workaround:

None.

Status: A2=Yes, A3=Yes; NoFix

3. SGMII: Counters Incorrectly Increment on Collision

Problem:

In SGMII mode/half duplex, the following statistics counters incorrectly increment when a collision occurs:

Name	Definition	Location
RLEC	Length error counter	0x4040

Workaround:

Add the O2BGPTC count to the HGPTC count to get the accurate number of packets sent by the host. Add the B2OGPRC count to the RPTHC count to get the accurate number of packets received by the host.

Status: A2=Yes, A3=Yes; NoFix

5. Device Off Deadlock

Problem:

If firmware resets (such as due to a parity error) after entering device off, the I210 does not detect the error and should enter device off but not shut the device down.

This happens only after a firmware reset.

Implication:

The chances of such an event happening while moving to device off are minimal.

Workaround:

None.

Status: A2=Yes, A3=Yes; NoFix

6. Marginal Low 10 Mb Amplitude

Workaround:

None.

Status: A2=Yes, A3=Yes; NoFix

7. Non-Monotonic Integrated SVR Ramp

Problem:

On some designs, both the 0.9 V and 1.5 V SVR show a non-monotonic start up.

Implication:

No functional impact for systems using an internal SVR, because the system is not vulnerable at the specific time that this non-monotonicity occurs.

Workaround:

None.

Status: A2=Yes, A3=Yes; NoFix

8. Protocol Offload: Incorrect Response to MLDv2 Queries

Superseded by Specification Change #5.

9. Writes to the VPD RW Area are Not Reliable

Implication:

If a PCIe reset or port reset has occurred since the previous Get NC-SI Pass-Through Statistics Response, the packet count values could be lower than the actual packet counts because the counters were cleared.

Workaround:

The packet counts in the Get NC-SI Pass-Through Statistics Response can be used for debug purposes, but they should not be used for maintaining reliable statistics.

Status: A2=Yes, A3=Yes; NoFix

11. MCTP Commands from SMBus are Dropped

Problem:

The DMTF MCTP SMBus/I^2C Transport Binding Specification requires that the LSB of the 4th byte of an MCTP over SMBus packet be 1b. Such a packet is dropped by the I210.

Implication:

MCTP over SMBus is not functional since all commands are dropped.

Workaround:

None.

Status: A2=Yes, A3=Yes; Fixed in NVM 3.16

13. NC-SI: Repeated Pause Time After Receiving XOFF

Problem:

If the I210 receives an XOFF packet from the Manageability Controller (MC) and the next packet is an NC-SI command, the pause timer is restarted when the command is received.

Implication:

The response to the command is delayed until the pause timer expires, which could cause the MC to detect a timeout of the command.

Workaround:

The MC should send an XON packet to explicitly re-enable transmission from the I210 at the end of each congestion event and should not rely on expiration of the pause time in the XOFF packet.

Status: A2=Yes, A3=Yes; NoFix

14. NC-SI: Set Link Command Failure in Low Power State in SerDes Modes

Problem:

The I210 checks the Disable 1000 in non-D0a and Disable 100 in non-D0a bits of the PHPM register when determining if the speed(s) requested in a Set Link command are valid in the non-D0a states. If there is a conflict, the command fails with a Set Link Power Mode Conflict status.

This behavior is correct when using the internal PHY, but it is incorrect when using the other link modes.

Implication:

Workaround:

None.

Status: A2=Yes, A3=Yes; Fixed in NVM 3.20

16. NC-SI: Set Link and Get Link Status Commands Not Supported in 1000BASE-KX Link Mode

Problem:

When the CTRL_EXT.*LINK_MODE* is set to 01b (1000BASE-KX), the NC-SI Set Link and Get Link Status commands do not function correctly.

Implication:

The MC cannot properly control the link in 1000BASE-KX link mode.

Workaround:

None.

Status: A2=Yes, A3=Yes; Fixed in NVM 3.20

17. Proxy: Invalid Neighbor Advertisement Packet with VLAN Tag and SNAP Header

Problem:

Implication:

Failure to establish PCIe link.

Workaround:

Ensure that the duration of the first de-assertion of PE_RST_N after power-up is at least 5 ms.

A firmware workaround for this issue is included in NVM image release 3.25.

Status: A2=Yes, A3=Yes; NoFix

19. Proxy: Neighbor Solicitation with Multicast Target Address is Not Dropped

Problem:

According to Section 7.1.1 of RFC 4861, a Neighbor Solicitation packet with a multicast Target Address field should be silently dropped. The I210 accepts and responds to such a packet if the Target Address corresponds to the Solicited Node address provided by the host.

Implication:

No implication when the network is functioning correctly since this is not a valid packet. Reduced immunity to invalid inputs.

Workaround:

None.

Status: A2=Yes, A3=Yes; Fixed in NVM 3.25

21. NC-SI: Hardware Arbitration Disable is Not Preserved Across Firmware Reset

Problem:

If NC-SI hardware arbitration is enabled from the NVM and it is disabled by the Select Package command, the hardware arbitration is enabled after a firmware reset.

Implication:

NC-SI interface hang in this situation.

Workaround:

Hardware arbitration should be disabled in the NVM if it is not required. The Select Package command should not be used to disable hardware arbitration.

Status: A2=Yes, A3=Yes; Fixed in NVM 3.25

22. NC-SI: Count of Dropped Control Packets Could be Incorrect

Problem:

The NC-SI Control Packets Dropped counter in the Get NC-SI Statistics Response packet does not include control packets that were dropped due to a checksum error.

Implication:

Misleading statistics when debugging.

24. Failure of Flash Update from Shadow RAM

Problem:

If a Flash update from a shadow RAM procedure is performed while there is a management command or proxy packet pending, the Flash update fails and no further updates are performed. This failure is indicated by the value 0x05 in FWSM.*Ext_Err_Ind*.

During typical operation, this is a low-probability scenario since Flash updates from the shadow RAM are rarely performed and management commands and proxy packets also do not arrive at a high rate.

However, when the Restore MAC Address feature is enabled in the NVM, a Flash update from the shadow RAM is triggered after power-up. If the MC is also polling for the presence of the device at this time, this failure can occur with high probability.

Implication:

Flash updates (by writing EEC.*FLUPD*) cannot be performed. In Non-Secure Mode the flash can instead be updated directly by software, using the FLSWCTL and FLSWDATA registers.

Workaround:

If the Restore MAC Address feature is enabled in the NVM, the MC should wait 500 ms after power is applied to the I210 before sending commands to the I210.

If this failure is observed, as indicated by FWSM.*Ext_Err_Ind*, contact your Intel representative.

Status: A2=Yes, A3=Yes; Fixed in NVM 3.25

25. Slow System Clock

Note: If a failure occurs, there is no link before the software runs, so APM WoL is not totally reliable in these applications.

1. Acquire the PHY semaphore.
2. Set MDICNFG.*Destination* to 0b.
3. Read PHY register 14 from page 252:
   a. Write 0xFC to PHY register 22 (dec) using MDIC.
   b. Wait at least 20 μs.
   c. Read from PHY register 14 (dec) using MDIC.
   d. Wait at least 20 μs.
   e. Write 0b to PHY register 22 (dec) using MDIC.

   If bits 7:0 of the PHY register read in sub-step (c) != 0xFF, go to Step 15.

   If the value is 0xFF after several (5) attempts to fix it (loops through Step 14), exit with a fatal error.
4. Set CTRL.*PHY_RST* to 1b.
5. Set both CTRL_EXT.*PHY_Power_Down_Enable* and CTRL_EXT.*SerDes_Low_Power_Enable* to 1b.
6. Clear WUC.
7. Determine the value of auto-load word 0x0A. If this word exists in the iNVM, use that value. Otherwise, use the hardware default value, 0x202F.
8. Perform a bitwise OR of 0x0010 with the value from the Step 6 and write it as an auto-load of 0x0A using EEARBC.
9. Set PCIe configuration space register PMCSR bits 1:0 to 11b. (D3 state)

Implication:

Incorrect indication of link mode. Other fields in the response might be interpreted incorrectly as a result.

Workaround:

The MC should use another method to determine the link mode.

Status: A2=Yes, A3=Yes; Fixed in NVM 3.25

27. Dynamic Device Off is Not Functional

Problem:

The I210 does not actually enter the Dynamic Device Off state even if all the necessary conditions are satisfied.

This does not apply to flash-less applications.

Implication:

Power consumption is higher than expected.

Workaround:

None.

Status: A2=Yes, A3=Yes; NoFix

29. SMBus: Interference with Get UDID Directed to Another Device

Problem:

If the I210 shares an SMBus connection with other slave devices, it interferes with Get UDID commands directed to the other devices.

Implication:

Failure of Get UDID (directed) commands on a shared SMBus.

Workaround:

Do not use Get UDID (directed) commands when the I210 is on a shared SMBus. The standard SMBus ARP flow does not require the Get UDID (directed) command, so this restriction should not interfere with the ability to perform SMBus ARP.

Status: A2=Yes, A3=Yes; NoFix

30. NC-SI Hardware Arbitration Hang

Problem:

When using NC-SI hardware arbitration, the arbitration state machine of the device with the lowest Package ID could hang. This can only occur during PCIe reset following power-up of the device and only with the following NVM settings:

- *APM Enable* = 0b (Word 0x24)
- *EN_PHY_IN_D3* = 0b (Common Firmware Parameters 2 word)

Workaround:

Set bit 16 (*IPv6_ExDis*) in the RFCTL register to disable the processing of received IPv6 extension headers.

Note: With this bit set, checksum calculation and RSS are disabled for IPv6 packets containing extension headers.

This workaround has been implemented in Intel drivers starting from Release 20.2.

Status: A2=Yes, A3=Yes; NoFix

32. NC-SI Output Signals Have Indeterminate Value After Power Up

Problem:

The NC-SI output signals have an indeterminate value after power up until the first rising edge of the NC-SI input clock. The signals could be tri-stated or driven high or low.

Implication:

Current leakage through the NC-SI I/O buffers.

Workaround:

If the NC-SI input clock is not driven after power up, connect the NC-SI clock input pin so that there is a rising edge after power has stabilized. For example, it could be connected via a resistor to a power-good indication on the board.

Status: A2=Yes, A3=Yes; NoFix

34. PCIe Throughput with Few Credits

Problem:

A received Update FC DLLP is not always processed immediately. It sometimes stalls in the I210 until the next TLP or DLLP is received.

Implication:

Reduced PCIe throughput when the number of credits provided by the PCIe port to which the I210 is connected is too small for continuous PCIe traffic.

Workaround:

Connect the I210 to a PCIe port that provides enough PCIe credits for continuous PCIe traffic.

Status: A2=Yes, A3=Yes; NoFix

35. NC-SI Get Link Status Command Not Supported when Using SGMII

Problem:

When CTRL_EXT.*LINK_MODE* is 10b (SGMII), the NC-SI Get Link Status command is not supported.

Implication:

The I210 connecting via SGMII to an external PHY does not pass link status to the MC.

Workaround:

37. I210 Occasional Malfunction of Wake on LAN/Wake on Link when Transitioning from S4 on Windows 10

Problem:

While host initiates L2/L3 low-power entering request (PME_Turn_Off), the device replies with the PME_TO_ACK as expected. However, sometimes a PM Enter L1 is followed while the spec requirement is to send PM_Enter_L23 when the device is ready to go into low power. It was shown that the 8th Gen Intel® Core™ processors with additional PCIe device (for example, graphics card) is connected, the host waits the TO timer value as defined, and goes to recovery state (instead of low power since the PME_Turn_Off handshake sequence not complete) and suddenly goes to electrical Idle mode.

This behavior caused I210 LTSSM to move to polling and detect states, since there is no signal detected on its receiver. At this state there is an internal reset and it also caused NVM to auto-load, thus the APM bits are updated from the NVM even when previously disabled. At this stage the APM disable setting by software is not valid, as a new value being read by the NVM. This why if APM is enabled by NVM, the device Wakes on LAN although this feature was unchecked before.

Implication:

8th Gen Intel® Core™ processors (Desktop S-series) system might have unexpected wake-up events even though Wake on LAN is disabled from the software/driver in Windows 10.

Workaround:

The PCIe specification defines a mechanism when endpoints do not enter the L2 state. To avoid deadlock where one or more devices do not respond with a PME_TO_Ack Message and then put Links into the L2/L3 Ready state, the power manager must implement a timeout after waiting for a certain amount of time, after which it proceeds as if the Message had been received and all Links are put into the L2/L3 Ready state. The recommended limit for this timer is in the range of 1 ms to 10 ms.

38. Device ID and MAC Address Cannot be Changed

Problem:

As part of the implementation of *Recovery Mode for Intel® Ethernet Products*, starting firmware version 3.30, the device will not change Device ID fields (VID, DID, SVID and SSID) and MAC Address fields after the original factory programming.

Implication:

After the original factory NVM programming, Device IDs and MAC Address cannot be changed starting NVM version 3.30.

Workaround:

None.

Status: A2=Yes, A3=Yes; NoFix

39. PCIe: Premature Timeout in LTSSM Configuration State

Problem:

In the process of establishing a PCIe link, while in the *Configuration.Lanenum.Wait* state, the I210 Link Training and Status State Machine (LTSSM) is supposed to wait up to 2 ms to receive two consecutive TS2 Ordered Sets from the upstream port. In some cases, the LTSSM times out after a much shorter time, thereby aborting the link establishment.

Implication:

3. Software Clarifications

Table 3-1. Summary of Software Clarifications

Software Clarification	Status
1. While in TCP Segmentation Offload, Each Buffer is Limited to 64 KB	N/A
2. Serial Interfaces Programmed by Bit Banging	N/A

1. While in TCP Segmentation Offload, Each Buffer is Limited to 64 KB

The I210 supports 256 KB TCP packets. However, each buffer is limited to 64 KB since the data length field in the transmit descriptor is only 16 bits. This restriction increases driver implementation complexity if the operating system passes down a scatter/gather element greater than 64 KB in length. This can be avoided by limiting the offload size to 64 KB.

Investigation has concluded that the increase in data transfer size does not provide any noticeable improvements in LAN performance. As a result, Intel network software drivers limit the data transfer size in all drivers to 64 KB.

Please note that Linux operating systems only support 64 KB data transfers.

2. Serial Interfaces Programmed by Bit Banging

When bit-banging on a serial interface (such as SPI, I^2C, or MDIO), it is often necessary to perform consecutive register writes with a minimum delay between them. However, simply inserting a software

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