Intel® Dual Band Wireless AC 7265
Intel® Dual Band Wireless-N 7265
Intel® Wireless-N 7265
(Stone Peak M.2 2230)

External Product Specification (EPS)

April 2014

Revision 2.0

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Revision History

Revision	Description	Date
0.8	Initial release.	October 3, 2013
1.0	**Added:** Section 1 – Android* POR note Section 6 –receive sensitivity targets Section 7.2.6 –note regarding SAR SKU transmit power setting **Updated:** Section 3.4 –power consumption targets	November 12, 2013
1.1	**Added:** Section 7 Wi-Fi Throughput Targets	December 4, 2013
2.0	**Added:** Section 3.4.3.1 –L1 PM substates Control Register **Updated:** Section 3.4 –power consumption tables Section 3.6 –regarding LED open drain status Section 6 –RX sensitivity tables Section 8 –TX power tables	April 3, 2014

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1 Introduction

Targeting the Ultrabook™, notebook, and desktop platform intercept for BTS'14, Intel shall provide a Very High throughput (VHT-5G, IEEE802.11ac compliant) Wi-Fi and Bluetooth (BT) combination product as well as a Discrete Wireless LAN (Wi-Fi) that meets Ultrabook™ and Microsoft* Windows* 8.1 Connected Standby requirements.

Intel® Dual Band Wireless-AC 7265 (code name Stone Peak 2 or StP2) shall be the VHT-5G Wi-Fi 2x2 and Bluetooth combination single chip solution. StP2 shall use Intel's 2nd generation 802.11ac Wi-Fi solution and shall support both 2.4 and 5.2 GHz bands. On the 5.2 GHz band it shall operate on an 80 MHz wide channel reaching PHY rates of up to 867 Mbps. StP2 shall use a Bluetooth core that shall support Bluetooth 4.0 standard including Bluetooth 4.0 Low Energy (BLE). StP2 shall have 2 antenna ports: one shall be Wi-Fi only and the second will be shared between Wi-Fi and Bluetooth. Wi-Fi shall support Rx antenna diversity.

The following are Stone Peak 2 SKUs:

Note:

- AMT applicable for Microsoft Windows OS only
- 802.11 AC POR TBD for non-Microsoft Windows OS
- Android* POR is TBD

Table 1-1 Stone Peak SKUs

Product/Technology	FF	Model #	Interfaces	Target Platforms	OS	CS*	AMT
Intel® Dual Band Wireless-AC 7265 (2x2 AC + BT 4.0)[1]	M.2 1216	7265D2W	PCIe/USB	Broadwell U/Y Braswell	Windows 7 Windows 8 Windows 8.1	Y	Y
Intel® Dual Band Wireless-AC 7265 (2x2 AC + BT 4.0)	M.2 2230	7265NGW	PCIe/USB	Broadwell U/Y Haswell Refresh Braswell	Windows 7 Windows 8 Windows 8.1	Y	Y
Intel® Dual Band Wireless-N 7265 (2x2 AGN + BT 4.0)	M.2 2230	7265NGW AN	PCIe/USB	Broadwell U/Y Haswell Refresh Braswell	Windows 7 Windows 8 Windows 8.1	Y	Y
Intel® Dual Band Wireless-N 7265 (2x2 AGN) [1]	M.2 2230	7265NGW NB	PCIe	Broadwell U/Y Haswell Refresh Braswell	Windows 7 Windows 8 Windows 8.1	Y	Y
Intel® Wireless-N 7265 (2x2 BGN + BT 4.0)	M.2 2230	7265NGW BN	PCIe/USB	Broadwell U/Y Haswell Refresh Braswell	Windows 7 Windows 8 Windows 8.1	Y	N

From a host interface perspective, Wi-Fi COM will use the legacy PCIe* interface. The Bluetooth part of StP2 shall support USB interfaces.

All Stone Peak SKUs use the same Si, board and software. The only difference is the module label and EEPROM (to disable .11ac, .11a, and/or BT functionality).

StP2 modules shall be offered in M.2 form-factors:

- M.2: StP2 Wi-Fi shall support PCIe. For Bluetooth, USB interface shall be supported.

Table 1-2 Intel® Dual Band wireless-AC product features

Feature	Stone Peak 2
Wi-Fi standard	802.11ac 2x2
Antennas	2
Wi-Fi TX/RX chains	2x2 chains
Supported Bands	2.4 GHz, 5 GHz
Antenna Allocation	a. Wi-Fi Only b. Shared Wi-Fi-BT
Wi-Fi TX/RX Throughput	867 Mbps
Bluetooth Core	Bluetooth 4.0
Intel® WiDi Support	Intel® WiDi 5
Single/Dual chip	Single
Windows OS AOAC	Microsoft CS and Intel® Smart Connect Technology
OS	Microsoft Windows 7, Microsoft Windows 8, Windows 8.1, Linux*, Android JB 4.2 & 4.3, Chrome* OS v29

1.1 Key features

Table 1-3 lists key features of Intel products.

Note: Not all products support all the features listed.

Table 1-3 Key Intel product features

Feature	Description
Operating system support	Microsoft Windows 7, Microsoft Windows 8, Windows 8.1, Linux, Android JB 4.2 & 4.3, Chrome OS v29
Platform compatibility	Broadwell, Haswell refresh, Braswell
Wi-Fi Alliance certifications for Windows OS	802.11ac, 802.11n, 802.11w, StPA, StPS, WMM, WFD, Wi-Fi Direct
Wi-Fi Alliance certifications for Chrome OS	802.11n, StPA, WMM,
Wi-Fi Alliance certifications for Android OS	802.11n, StPA, StPS, WMM,
Microsoft certifications	Microsoft Windows 8.1 Logo, Microsoft Windows 7 Logo, Windows 8.1 Connected Standby Logo
Android certifications	Comply with CDD and CTS
Chrome certification	Pass AVL
Bluetooth	Integrated Bluetooth Intel Bluetooth Core Bluetooth certification BT4.0 LE – Smart Ready – Intel responsible for BT certification for Android and Windows only.
Software compatibility for Windows based OS	Intel® PRO/Set Wireless Software v17.X and later.

Feature	Description
Software compatibility for Android	Support based on Kernel 3.9 and with Compat wireless For Wi-Fi – working with Intel's StPA_SUPPLICANT For BT – support for Bluedroid*.
Software compatibility for Chrome	Adapt our Wi-Fi/BT solution to work with Kernel 3.8 and without Compat. For Wi-Fi – we provide our driver + our MAC80211 BT stack supported BlueZ 5.3.
Intel® Active Management Technology v9.5 (Windows only)	Support for Intel® AMT 10.0 on Broadwell Y and Broadwell U.
Cisco Compatible Extensions -CCX. (Windows only)	Support for CCX4 and on Microsoft Windows 7, CCX Lite** on Microsoft Windows 8 **Pending Cisco* program definition and rollout Note: CCX supported only when the host OS is windows.
Advanced Bluetooth-Wi-Fi co-existence	Intel's coexistence scheme, implementing internal messaging protocol, and supporting a tight/loose coexistence scheme for different antenna isolations. **NOTE**: No support for external Wi-Fi-Bluetooth coexistence signaling.
Platform power / Extending battery life	Intel Power Optimizer (CPPM) For Linux based OS – no support for RTD3.

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2 System Architecture

Stone Peak 2 contains a single chip for Wi-Fi + Bluetooth, including Wi-Fi MAC and PHY as well as Bluetooth MAC and PHY.

The modules are M.2 format.

Supported interfaces:

- Wi-Fi: PCIe
- Bluetooth: USB

Figure 2-1 Stone Peak 2 schematic architecture

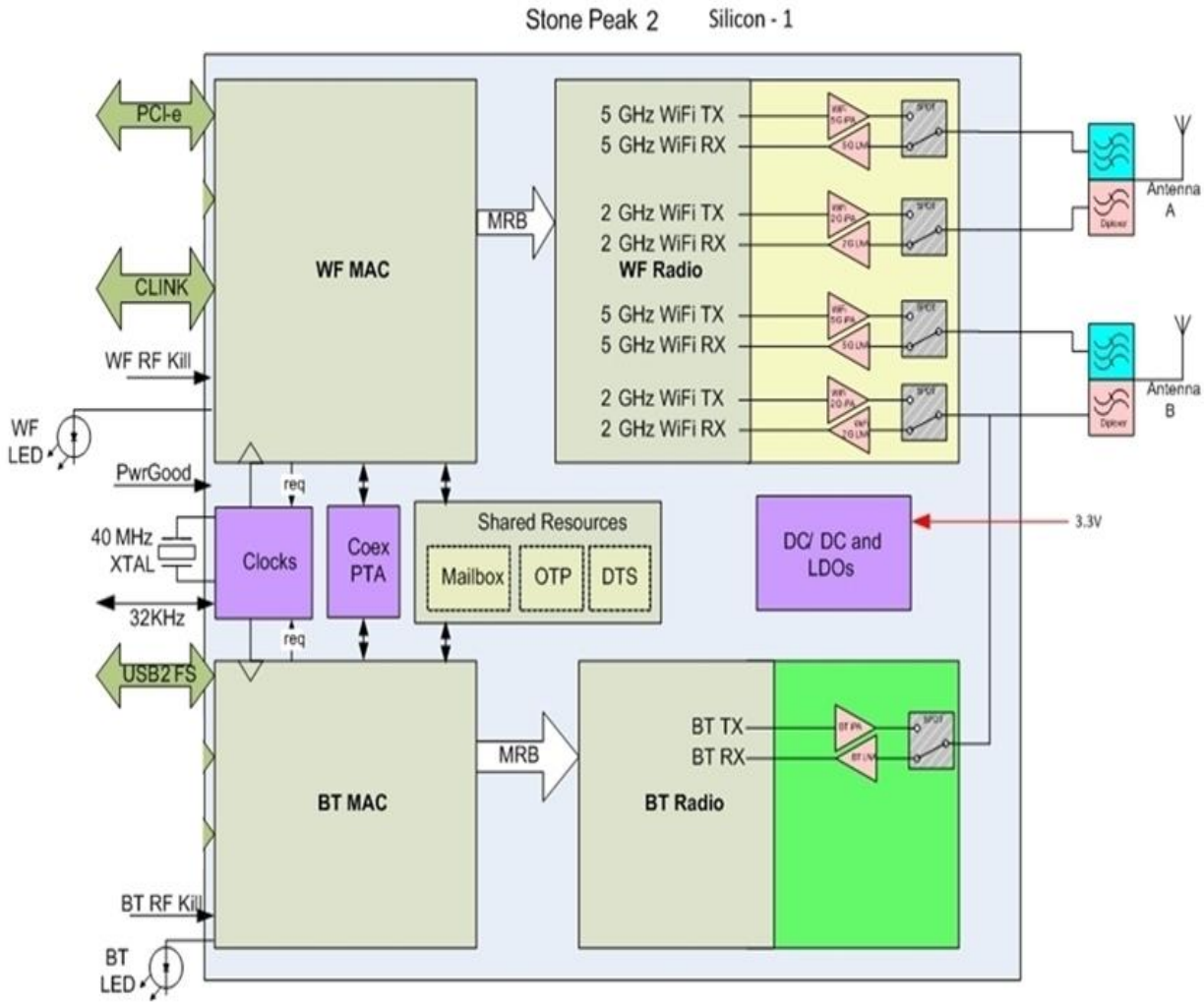
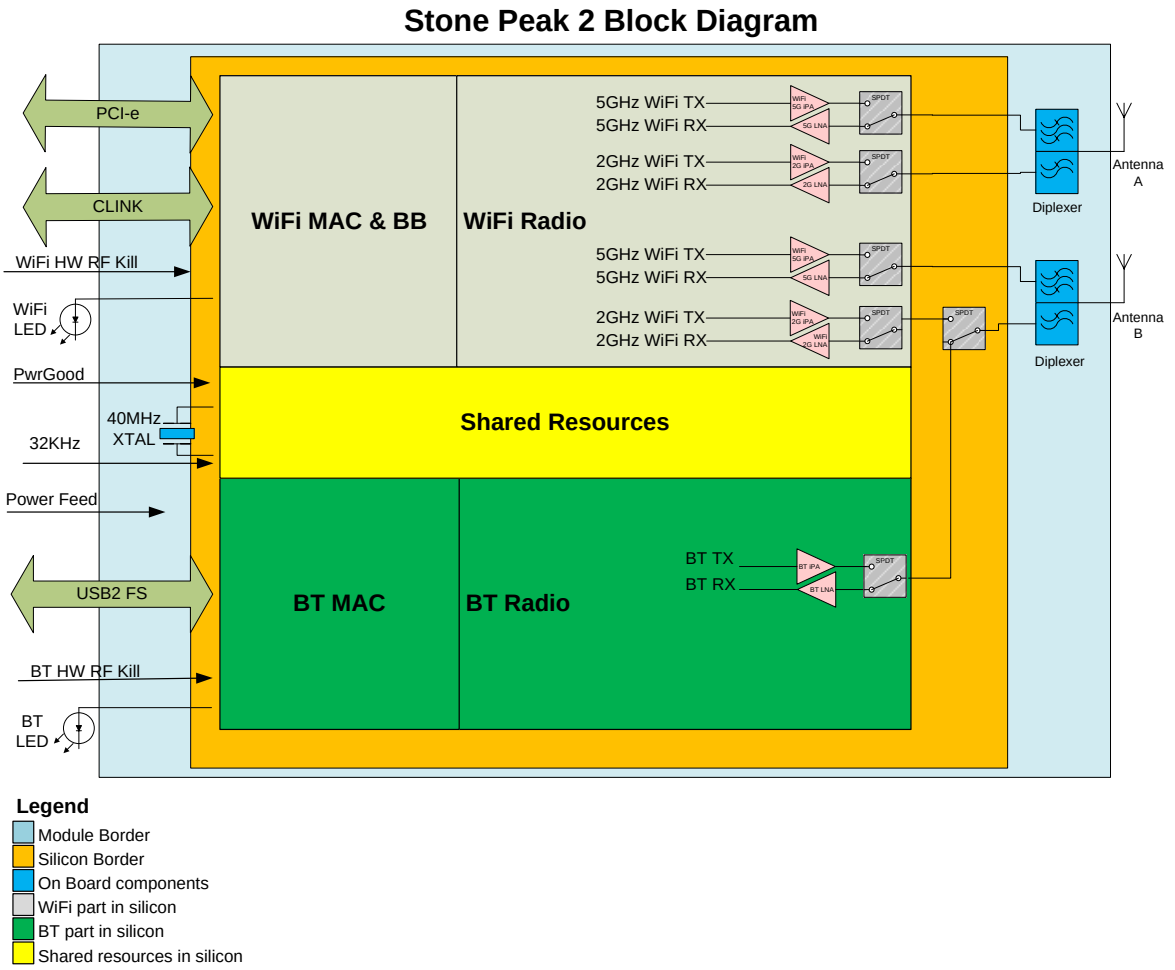


Figure 2-2 Stone Peak 2 block diagram



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3 Electrical Specifications

This section provides electrical specification information for the product's hardware. The specification covers the module Hardware Interface Signals, Power Consumption, and DC/AC characteristics.

3.1 PCIe* hardware interface signals

The hardware design is based on the PCI Express* Mini Card Electromechanical Specification. Table 3-1 describes the system interface signals. For more details see the PCI Express Mini Card Electromechanical Specification.

3.2 M.2 form factor

The M.2 form factor (M.2), is the designated codename for the NIC, used for mobile add-in cards. The M.2 is a natural transition from the Mini 5 Card and Half Mini Card to a smaller form factor in both size and volume. M.2 is a form factor that will enable integration of functions into a single module solution.

M.2 modules and the corresponding system interconnect based on a 67/49-pin edge card connection scheme and a 69-pad soldered down scheme for system 5 interfaces. Alternative solutions accommodating implementations of on-card antennas or remotely connected off-card antennas are also defined.

See the latest M.2 Specification document under the PCISIG releases:
http://www.pcisig.com/specifications/pciexpress/review_zone/#M.2

3.3 M.2 hardware interface signals

Table 3-1 M.2 pinout

74	3.3V	GND	75
72	3.3V	N/C	73
70	N/C	N/C	71
68	N/C	GND	69
66	N/C	N/C	67
64	RESERVED	N/C	65
62	N/C	GND	63
60	N/C	N/C	61
58	N/C	N/C	59
56	W_DISABLE1# (I)(0/3.3V)	GND	57
54	W_DISABLE2# (I)(0/3.3V)	PEWake 0# (IO)(0/3.3V)	55
52	PERST0#(I)(0/3.3V)	CLKREK0# (IO)(0/3.3V)	53
50	SUSCLK (32kHz) (I)(0/3.3V)	GND	51
48	COEX1 (I/O)(0/1.8V)	REFCLKN0	49
46	COEX2 (I/O)(0/1.8V)	REFCLKP0	47

44	COEX3 (I/O)(0/1.8V)	GND	45
42	CLink CLK (I/O)	PETn0	43
40	CLink DATA (I/O)	PETp0	41
38	CLink Reset (I)(0/3.3V)	GND	39
36	N/C	PERn0	37
34	N/C	PERp0	35
32	N/C	GND	33
	Module Key	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
22	N/C	N/C	23
20	N/C	N/C	21
18	GND	N/C	19
16	LED2# (O)(OD)	N/C	17
	Module Key	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
	Module Key	Module Key	
6	LED1# (O)(OD)	GND	7
4	3.3V	USB_D-	5
2	3.3V	USB_D+	3
		GND	1

NOTES: For more details see "Broadwell ULT Platform – Design Guide"

3.3.1 M.2 power pins

The module is fed by 3.3 V aux rail. Pins 2, 4, 72, 74.

Generation of PME, reporting status and enabling PME: The M.2 PCIe module uses a PME to request a change from a power savings state (S3/S4) to a fully operational state (full power) -> Wake-up Event (WoME, WoWLAN).

Note: Connecting active signals to the input pins is not allowed unless a power supply is provided to the power rails pins.

3.3.2 M.2 power and ripple limits

All power pins are connected to a power bus that should be tied to 3.3 v +/- -0.15 v Vaux via the connector. Maximum Rise Time (0v to 3.3 v) shall be up-to 10 mSec.

For all voltage rails (3.3 V), Intel recommends not exceeding 200 mVpp ripple in the frequency range of 10-500 KHz.

The card was tested under power rail noise up to 300 mVpp (10% of the nominal supply) w/o performance degradation.

3.3.3 Ground (GND)

All ground pins are connected to a common ground bus that should be tied to system ground via the connector.

3.3.4 No BT SKUs

For SKUs without BT:

LED2#: NC

W_DISABLE2#: Connect to GND

USB_D-: NC

USB_D+: NC

3.4 Module level power consumption

3.4.1 Power consumption definitions

Module power consumption: 3.3 v rail power consumption.

Note: Power consumption numbers define the total consumed power, including 3.3 v and 1.5 v power rails (the 1.5 v power rail is not in use.)

- Unless stated otherwise, power consumption refers to the highest average power consumption value over any 1-second period.
- Meter: measured using current probe loop on the power rails of the mini-card (or half mini-card interface/pins.)
- PCI-e ASPM (L1) and L1 sub states are enabled. (Note that L0s is not used.)

Idle state assumes no scans. Scans will add ~15 mW to power consumption.

- Transmit output power is assumed to be 15 dBm.
- Platform is running on battery and power index is set to max power save (battery life.)

Table 3-2 M.2 power consumption (mW) targets

Test	Benchmark	Description	Max Power [mW] WiFi + Bluetooth
1	Comms HW disabled HW RF kill	All of the wireless devices on this card are disabled by HW RF-Kill.	< 2
2	Comms SW disabled SW RF kill	All of the wireless devices on this card are disabled by SW RF-Kill. (PCI at L1 Off / L2, USB at L2)	< 2
3	Connected standby logo tests	Wi-Fi is in connected standby (D0i3), low band, with no scan. Bluetooth core not paired (Windows OOB).	<4
4	Windows idle associated, low band	W-iFi is idle associated in low band. BT is running active A2DP profile (linked to stereo headset) but with no traffic.	16.5
5	Skype* video	Wi-Fi is running Skype conference (2 people, SISO LB 20 MHz, 1.5 Mbps full duplex.)	160

Test	Benchmark	Description	Max Power [mW] WiFi + Bluetooth
	conferencing	Bluetooth paired with HFP (audio eSCO S2/S3.)	
6	Video streaming (LB)	Wi-Fi is running unidirectional Rx, 720/1080p @ 30fps (8 mbps) on low band. Bluetooth paired with A2DP @ 345 kbps.	385
7	WiDi DCM scenario	Laptop is streaming WiDi content (max resolution) – 12 Mbps. Wi-Fi BSS client on LB, WiDi on HB (40 MHz channel.) BT is connected to a mouse (HID)	290
8	Comms excursion (modeled)	Wi-Fi - 802.11n link at 200 mbps, FTP transmitting 90% and FTP receiving 10%. Bluetooth - A2DP, 375 Kbps (Tx).	<1440

The modules are implemented according to the ACPI v3.0 Specification, supporting the peripheral power states D0 and D3 as listed in Table 3-3.

D3 hot means D3 with PERST# high (de-asserted) and power on.

D3 cold means D3 with PERST# low (asserted) and auxiliary power on.

Table 3-3 Supported D-states

Device power states	Description
D0 (Uninitiated and Active)	Supported
D3 (hot and cold)	Supported for PCIe

3.4.2 Enabling Ethernet controllers with ASPM

ASPM defines the "L" states of the PCIe connections, L0, L0s, L1 and L2; among all those states, L0s has very low power saving vs. high complexity and risk. As a result the StP w/Bluetooth hardware devices shall not support PCI Express* ASPM L0s power state, and shall support the L1 state that has high value as a power saving state.

StP supports ASPM optionality ECN, allowing support of L1 without L0s. No special BIOS actions are required.

3.4.3 Intel® Power Optimizer

With the Broadwell platform Intel has introduced new initiatives to significantly reduce platform power consumption. The Intel Power Optimizer is a power management framework that allows for usage of deep, long latency platform power management states through new bus extensions.

Table 3-4 Stone Peak 2 family Intel® Power Optimizer capability

Family	Technology	Form Factor	Interface	LTR	RTD3[1]	L1 States (L1.1, L1.2)
7265.NGWG	2x2 AC + BT	M.2	PCIe/USB	Yes	Yes	Yes
7265.NGWANG	2X2 AGN + BT	M.2	PCIe/USB	Yes	Yes	Yes
7265.NGWNBG	2X2 AGN (No BT)	M.2	PCIe	Yes	Yes	Yes
7265.NGWBNG	2x2 BGN + BT	M.2	PCIe/USB	Yes	Yes	Yes

NOTES: 1. Connected standby systems only.

Note: PCIe L1 states and LTR are supported by the NIC but also require platform support and BIOS enablement. For Linux based OSes, check what is supported by specific OS/Platform combination. For HSW-ULT L1 off is supported, and most likely LTR.

3.4.3.1 T_power_on_scale value in "L1 PM Substates Control 2 Register"

Current implementation in StP supports only the value of "00" in the T_power_on_scale field (bits 1:0). Other settings are not supported.

Details: According to the PCIe standard, the "L1 PM Substates Control 2 Register" (Offset 0Ch) can accept several scale range values. Wilkins Peak supports only the default value of "00b" which indicates range of 2 uSec.

Impact: most of the customers take the Intel reference design, which is set by default to "00b" in this field, so no impact. Other customers need to make sure they set the value to "00b".

3.5 Wireless disable

3.5.1 Wi-Fi RF disable

Note: Chrome OS doesn't support HW RF kill or SW RF kill. Airplane mode for Chrome OS is achieved by detaching the driver from StPA_Supplicant.

The W_Disable# input signal on Pin 20 of the mini card system connector and pin 56 on M.2 connector allows the hardware to disable the Wi-Fi RF circuitry.

The W_Disable# signal is an active low signal that when driven low by the platform disables Wi-Fi radio operation. The assertion and de-assertion of the W_Disable# signal is asynchronous to any platform clock. All transients resulting from mechanical switches need to be de-bounced by platform circuitry.

This signal is capable of:

Minimum sink current to ground = 1 mA per card

Note: The 1 mA value is taken from the PCI Express Mini Card electrical Specification. However, StP should be able to drive a much lower current when the W_Disable# signal is active low (less than 50 uA).

In normal operation, the card must stop any RF activity within seconds after the W_Disable# signal is asserted. The hardware must assure that the disable operation is not dependent on SW state. The card should resume normal operation within seconds of de-assertion of the W_Disable# signal.

SW RF kill: StP also supports SW RF kill. The behavior of the SW RF kill is similar to the HW RF kill: all RF activities are terminated, LED is turned off and device goes into low power mode.

Note: The Wi-Fi radio will be active only if both HW RF kill pin and SW RF kill mechanism are in "enable" state.

The system is required to assure that W_Disable# is in a deterministic state (asserted or de-asserted) whenever power is applied to the card (i.e., whenever either +3.3 V is present).

Note: If this signal is not used, Intel recommends not connecting it on the platform level.

The internal pull up resistor on this pin is >100 Kohm typical value.

The operation of the signal is as follows:

Float = Radio is on.

Off (Active low: Vil = 0.0 v [+/-0.3]) = Radio transmitter is turned off and incapable of transmitting.

Table 3-5 Hardware RF disable logic

Software setting	Hardware switch	Radio transmitter function
Enabled	Enabled/float	Enabled
Enabled	Disabled/low	Disabled
Disabled	Enabled/float	Disabled
Disabled	Disabled/low	Disabled

3.5.2 Bluetooth RF disable

3.5.2.1 M.2 Bluetooth hardware RF disable

W_DISABLE#_2 (pin 54) is the HW RF kill for the Bluetooth radio.

Asserting W_DISABLE#_2 signal will result in a complete shutdown of the Bluetooth part. The result from the user perspective is similar to removing the Bluetooth device from the laptop.

The W_DISABLE#_2 internal pull up resistor is ~130 Kohm typical value.

3.5.3 Bluetooth software RF disable

StP also supports Bluetooth SW RF kill. The behavior of the SW RF kill is similar to the HW RF kill: all RF activities are terminated, LED is turned off and device goes into low power mode.

Note: The BT radio will be active only if both HW RF kill pin and SW RF kill mechanism are in "enable" state.

Note: RF kill not supported with Chrome OS.

3.6 LED indicators

StP2 products have 2 LEDs signals each: A Bluetooth LED, and a Wi-Fi LED.

Bluetooth LED functionality:

1. LED is OFF when the Bluetooth is in HW or SW RF kill (SW RF kill means also driver disable, etc.).
2. LED is ON otherwise.

Wi-Fi LED functionality:

1. LED is OFF when the Wi-Fi is not powered or in RF kill.
2. LED is ON otherwise.

Note: Chrome OS doesn't support or require LED for comms. Hence the LED signals should remain disconnected.

Note: The LED output pins (for both Wi-Fi and Bluetooth) are not open drain pins. Therefore, it is not allowed to Wire-Or the two LED pins and connect them to a single LED without glue logic. This is applicable to both StP and Wilkins Peak.

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4 Host Interface Description

4.1 PCIe* interface

The product supports the PCIe interface as implemented in the M.2 form factor cards.

This host interface supports PCIe version 2.1 features.

see the PCIe v2.1 Spec for specific PCIe related data:
PCI Express Base 2.1 Specification.

4.1.1 Squelch detect mechanism

The Squelch (SQ) detect mechanism in StP may not consistently identify PCH "wake" signaling (TS1 symbols) as valid above SQ Max threshold of 175 mV, as defined in the PCIe spec.

It is important to follow proper platform design and layout guidelines as defined in the PCIe CEM specification to ensure PCH wake signaling (Electrical Idle Detect Threshold - 'Vrx-idle-det-diff-p-p' parameter) in the range of:

- 65 mV to 280 mV for StP2

Customers should design/plan appropriately for all adapters that may be used in a given platform.

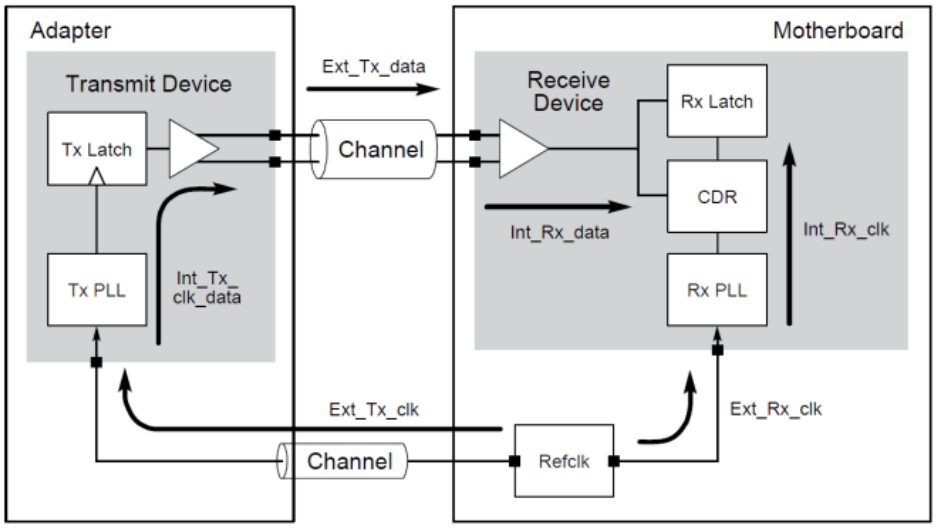
4.1.2 Voltage maximums

Maximum PCIe DC voltage should be 3.6 V as specified in the PCIe specification, and maximum spike should not exceed 5.4 V as specified in the JEDEC spec JESD78.

4.1.3 Common clock configuration

The PCIe on both the platform side (PCH) and the WLAN NIC side must operate using common clock configuration. Both PCH and WLAN NIC are configured for this by default (bit 6 is set in registers 0x50 and 0xF0). From a hardware perspective, the same reference clock (Refclk) must be used for both the PCH and the Wi-Fi card.

Figure 4-1 Common clock configuration



Source: PCI Express Rev 2.0 spec (PCI_Express_Base_Rev_2.0_20Dec06a, figure 4-50)

4.2 USB interface

Table 4-1 describes the main characteristics of the Bluetooth USB interface.

Table 4-1 USB interface signal description

USB interface	Description
USB version	Supports 2.0 version.
Operational mode	Full speed modes.
Power	Powered from PCI Express interface (3.3 V power rail).
Signaling level	See USB 2.0 specifications.
Suspend support	According to the USB 2.0 spec, the host may enter the interface into suspend mode, allowing the device to save power by switching to low power mode.

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5 Thermal Specifications

5.1 Thermal dissipation

Max thermal dissipation is based on the assumption that both Wi-Fi and Bluetooth communication are active. Table 5-1 and Table 5-2 describe the thermal dissipation and targets per operated mode.

Table 5-1 Stone Peak 1 thermal dissipation

Name	Description
TDP limit functional targets	Worst case TDP shall not be higher than 1400 mW for StP. The worst case TDP shall be based on average power consumption measurement over five minutes with max TCP/IP throughput activity.

Table 5-2 Stone Peak 2 thermal dissipation

Name	Description
TDP limit functional targets	Worst case TDP shall not be higher than 1650 mW for StP2. The worst case TDP shall be based on average power consumption measurement over five minutes with max TCP/IP throughput activity.

Note: Functional modes include all product operation scenarios that can be accessed using end users distribution software (scenarios that may only be exercised using lab or OEM support software tools are not included.)

5.2 Thermal specifications

Stone Peak thermal is derived from its components MAC baseband and the radio chipset.

Table 5-3 Thermal management

Name	Description
Thermal shield performance targets	StP2 shall have full performance at shield temperatures up to 80 ºC. Testing conditions: System environmental conditions: High limit: ~50 ºC under controlled environment (oven), with no air flow (inside a box). Low limit: 0 ºC (starting point) under controlled environment (oven), with no air flow (inside a box).
Thermal Silicon protection	StP2 shall have silicon protection mechanism (CT-kill). Thermal silicon protection will not be activated below 85 ºC T-shield temperature.

5.2.1 Thermal management and critical shutdown

The device thermal management cuts off RF operation once a maximum temperature Critical Temperature termination (CT-Kill) threshold has been exceeded. After the cutoff point is reached, the RF remains at the off position until it cools down to the thermal activation threshold, during which the host cannot set the RF back to on.

5.2.2 Wi-Fi thermal throttling

When StP is heating up and nearing CT Kill, StP will start throttling in order to prevent the unit from heating further and reaching critical temperature.

During throttling, StP performance might be degraded gradually (connectivity will be maintained.)

5.2.3 Thermal NIC placement recommendations

The two main NIC heat dispersal methods are from the RF shield and through the screws that ground the PCB to the chassis.

Correct NIC placement will ensure optimal thermal performance:

- NIC orientation should be shield up.
- M.2 NIC connection to chassis should be with a single metal screw.

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6 Wi-Fi Sensitivity Targets

6.1 Wi-Fi sensitivity table

- Typical material at room temperature.
- Resolution is 0.5 dB (inaccuracy of up to +-0.25 dB).
- Numbers refer to AVG over all channels. LB variance is +-0.25 dB, HB variance is +-1 dB.

Table 6-1 Wi-Fi sensitivity table

Name	Target	Scale
LB 11b 20 MHz Rate 1 Chain A	-96	dBm
LB 11b 20 MHz Rate 1 Chain B	-94.5	dBm
LB 11b 20 MHz Rate 1 MRC	-96	dBm
LB 11b 20 MHz Rate 11 Chain A	-89	dBm
LB 11b 20 MHz Rate 11 Chain B	-87.5	dBm
LB 11b 20 MHz Rate 11 MRC	-90.5	dBm
LB 11g 20 MHz Rate 6 Chain A	-93.5	dBm
LB 11g 20 MHz Rate 6 Chain B	-92	dBm
LB 11g 20 MHz Rate 6 MRC	-94.5	dBm
LB 11g 20 MHz Rate 12 Chain A	-91	dBm
LB 11g 20 MHz Rate 12 Chain B	-89.5	dBm
LB 11g 20 MHz Rate 12 MRC	-93	dBm
LB 11g 20 MHz Rate 54 Chain A	-76	dBm
LB 11g 20 MHz Rate 54 Chain B	-74.5	dBm
LB 11g 20 MHz Rate 54 MRC	-77.5	dBm
LB 11n 20 MHz MCS 0 Chain A	-93	dBm
LB 11n 20 MHz MCS 0 Chain B	-91.5	dBm
LB 11n 20 MHz MCS 0 MRC	-93	dBm
LB 11n 20 MHz MCS 0 LDPC A	-93.5	dBm
LB 11n 20 MHz MCS 0 LDPC B	-92	dBm
LB 11n 20 MHz MCS 7 Chain A	-74	dBm
LB 11n 20 MHz MCS 7 Chain B	-73	dBm
LB 11n 20 MHz MCS 7 MRC	-76	dBm
LB 11n 20 MHz MCS 7 LDPC A	-75.5	dBm
LB 11n 20 MHz MCS 7 LDPC B	-74.5	dBm
LB 11n 20 MHz MCS 15 MIMO	-73	dBm
LB 11n 20 MHz MCS 15 MIMO DPC	-75	dBm
LB 11n 40 MHz MCS 0 Chain A	-90	dBm
LB 11n 40 MHz MCS 0 Chain B	-89	dBm

Name	Target	Scale
LB 11n 40 MHz MCS 0 MRC	-91	dBm
LB 11n 40 MHz MCS 0 LDPC A	-90.5	dBm
LB 11n 40 MHz MCS 0 LDPC B	-89.5	dBm
LB 11n 40 MHz MCS 7 Chain A	-71.5	dBm
LB 11n 40 MHz MCS 7 Chain B	-70	dBm
LB 11n 40 MHz MCS 7 MRC	-73	dBm
LB 11n 40 MHz MCS 7 LDPC A	-73	dBm
LB 11n 40 MHz MCS 7 LDPC B	-71.5	dBm
LB 11n 40 MHz MCS 15 MIMO	-70	dBm
LB 11n 40 MHz MCS 15 MIMO DPC	-72	dBm
HB 11a 20 MHz Rate 6 Chain A	-91	dBm
HB 11a 20 MHz Rate 6 Chain B	-91	dBm
HB 11a 20 MHz Rate 6 MRC	-92.5	dBm
HB 11a 20 MHz Rate 12 Chain A	-88.5	dBm
HB 11a 20 MHz Rate 12 Chain B	-88.5	dBm
HB 11a 20 MHz Rate 12 MRC	-90.5	dBm
HB 11a 20 MHz Rate 54 Chain A	-73.5	dBm
HB 11a 20 MHz Rate 54 Chain B	-73.5	dBm
HB 11a 20 MHz Rate 54 MRC	-76	dBm
HB 11n 20 MHz MCS 0 Chain A	-91	dBm
HB 11n 20 MHz MCS 0 Chain B	-91	dBm
HB 11n 20 MHz MCS 0 MRC	-93	dBm
HB 11n 20 MHz MCS 0 LDPC A	-91	dBm
HB 11n 20 MHz MCS 0 LDPC B	-91	dBm
HB 11n 20 MHz MCS 7 Chain A	-72	dBm
HB 11n 20 MHz MCS 7 Chain B	-72	dBm
HB 11n 20 MHz MCS 7 MRC	-74.5	dBm
HB 11n 20 MHz MCS 7 LDPC A	-7	dBm
HB 11n 20 MHz MCS 7 LDPC B	-73.5	dBm
HB 11n 20 MHz MCS 15 MIMO	-72	dBm
HB 11n 20 MHz MCS 15 MIMO DPC	-73.5	dBm
HB 11n 40 MHz MCS 0 Chain A	-88	dBm
HB 11n 40 MHz MCS 0 Chain B	-88	dBm
HB 11n 40 MHz MCS 0 MRC	-89.5	dBm
HB 11n 40 MHz MCS 0 LDPC A	-88.5	dBm
HB 11n 40 MHz MCS 0 LDPC B	-88.5	dBm

Name	Target	Scale
HB 11n 40 MHz MCS 7 Chain A	-68.5	dBm
HB 11n 40 MHz MCS 7 Chain B	-69	dBm
HB 11n 40 MHz MCS 7 MRC	-71.5	dBm
HB 11n 40 MHz MCS 7 LDPC A	-70	dBm
HB 11n 40 MHz MCS 7 LDPC B	-70.5	dBm
HB 11n 40 MHz MCS 15 MIMO	-68	dBm
HB 11n 40 MHz MCS 15 MIMO DPC	-70.5	dBm
HB 11ac 80 MHz MCS0 Chain A	-84.5	dBm
HB 11ac 80 MHz MCS0 Chain B	-84.5	dBm
HB 11ac 80 MHz MCS0 MIMO	-84.5	dBm
HB 11ac 80 MHz MCS0 MRC	-86	dBm
HB 11ac 80 MHz MCS0 LDPC A	-86	dBm
HB 11ac 80 MHz MCS0 LDPC B	-86	dBm
HB 11ac 80 MHz MCS0 LDPC MIMO	-85.5	dBm
HB 11ac 80 MHz MCS8 Chain A	-60.5	dBm
HB 11ac 80 MHz MCS8 Chain B	-61	dBm
HB 11ac 80 MHz MCS8 MIMO	-61	dBm
HB 11ac 80 MHz MCS8 MRC	-62.5	dBm
HB 11ac 80 MHz MCS8 LDPC A	-62.5	dBm
HB 11ac 80 MHz MCS8 LDPC B	-63	dBm
HB 11ac 80 MHz MCS8 LDPC MIMO	-62	dBm
HB 11ac 80 MHz MCS9 Chain A	-58.5	dBm
HB 11ac 80 MHz MCS9 Chain B	-58.5	dBm
HB 11ac 80 MHz MCS9 MIMO	-58.5	dBm
HB 11ac 80 MHz MCS9 MRC	-60.5	dBm
HB 11ac 80 MHz MCS9 LDPC A	-60.5	dBm
HB 11ac 80 MHz MCS9 LDPC B	-60.5	dBm
HB 11ac 80 MHz MCS9 LDPC MIMO	-59.5	dBm

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7 Wi-Fi Throughput Targets

Targets are provided with and without Aggregated Mac Protocol Data Unit (AMPDU) because not all APs support AMPDU.

Table 7-1 Conductive without AMPDU

			Conductive, Best Attenuation, BE, TCP, AMPDU disabled				
			RX		TX		
Protocol	Band	Channel	Target	Min	Target	Min	Units
11b	LB	20 MHz	5.8	5.7	5.8	5.7	mbps
11g	LB	20 MHz	22.2	22.1	22.7	22.5	mbps
11a	HB	20 MHz	22.6	22.5	23.1	22.9	mbps
11n	LB	20 MHz	99	94	100	96	Mbps
11n	HB	40 MHz	198	188	200	190	Mbps
11ac	HB	80 MHz	552	504	486	442	Mbps

Table 7-2 Conductive with AMPDU

			Conductive, Best Attenuation, BE, TCP, ANPDU disabled				
			RX		TX		
Protocol	Band	Channel	Target	Min	Target	Min	Units
11b	LB	20 MHz	5.8	5.7	5.8	5.7	mbps
11g	LB	20 MHz	22.2	22.1	22.7	22.5	mbps
11a	HB	20 MHz	22.6	22.5	23.1	22.9	mbps
11n	LB	20 MHz	99	94	100	96	mbps
11n	HB	40 MHz	198	188	200	190	mbps
11ac	HB	80 MHz	552	504	514	493	mbps

Table 7-3 OTA performance targets

Scott Church House, Consumer Environment, NLOS OTA, AMPDU disabled						
Protocol	Band	Channel	Station	RX	TX	Units
11n	LB	20 MHz	SCH1 L0	80	80	Mbps
			SCH1 L1	60	60	Mbps
			SCH1 L2	40	40	Mbps
			SCH1 L3	25	25	Mbps

Scott Church House, Consumer Environment, NLOS OTA, AMPDU disabled						
Protocol	**Band**	**Channel**	**Station**	**RX**	**TX**	**Units**
11n	HB	40 MHz	SCH1 L0	150	150	Mbps
			SCH1 L1	100	100	Mbps
			SCH1 L2	20	20	Mbps
			SCH1 L3	10	10	Mbps
11ac	HB	80 MHz	SCH1 L0	400	370	Mbps
			SCH1 L1	320	280	Mbps
			SCH1 L2	100	100	Mbps
			SCH1 L3	20	20	Mbps

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8 Regulatory

8.1 Regulatory channel support and output power

8.2 Wi-Fi channel configuration

8.2.1 Channel configuration tables

Figure 8-1 Scan details

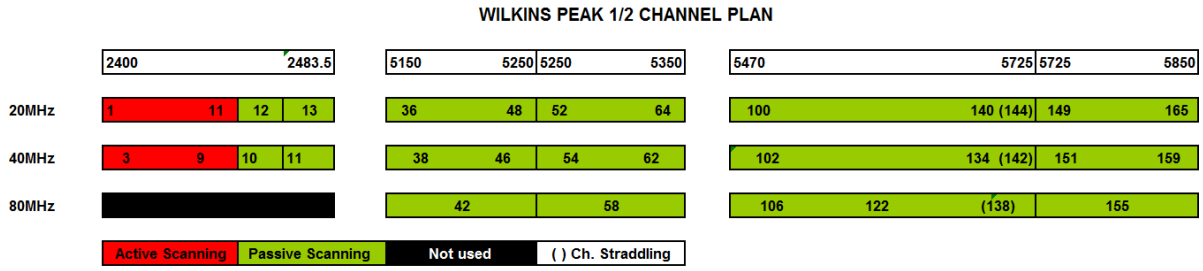

Figure 8-2 Scan details, Indonesia SKU

8.2.2 Output power restrictions (main geo's)

Figure 8-3 Output power restrictions, main geographies

Country/Geo	2.4GHz	5.15 - 5.25GHz	5.25 - 5.35GHz	5.47 - 5.725GHz	5.725 - 5.85GHz	Output Power Spectral Density
Canada	1W **	50mW **	250mW **	250mW **	1W **	Output Power
Canada	8dBm/3kHz **	4dBm/MHz **	11dBm/MHz **	11dBm/MHz **	8dBm/3kHz **	Spectral Density
EU Countries	100mW EIRP	200mW EIRP	200mW EIRP	1W EIRP	N/A	Output Power
EU Countries	10dBm/MHz EIRP	10dBm/MHz EIRP	10dBm/MHz EIRP	17dBm/MHz EIRP	N/A	Spectral Density
Japan	12.14dBm/MHzEIRP	10dBm/MHz EIRP	10dBm/MHz EIRP	14dBm/MHz EIRP	N/A	Spectral Density
S. Korea *	10dBm/MHz ** No averaging	4dBm/MHz ** No Averaging	10dBm/MHz ** No Averaging	10dBm/MHz ** No Averaging 5.65 - 5.725GHz Not Allowed	10dBm/MHz ** No Averaging Channel 165 -5.825GHz Not Allowed	Spectral Density
United States	1W **	50mW **	250mW **	250mW **	1W **	Output Power
United States	8dBm/3kHz **	4dBm/MHz **	11dBm/MHz **	11dBm/MHz **	8dBm/3kHz **	Spectral Density

** Allowance of up to a 6dBi antenna allowed, if antenna is > 6dBi output power must be reduced by 1dB per dBi of antenna gain

* Levels valid for 20 MHz channels. To be divided by 2 (reduce 3dB) for 40 MHz channels.

NOTES: Reference antenna gain: Max. Antenna Gain 3 dBi for 2.4 GHz and 5 dBi for 5 GHz

8.2.3 Channel configuration tables / RF output power

The values listed in the power table (EEPROM table) represent the target power for the calibration process without antennae gain. This value has been verified to ensure margin from the regulatory limit based on post EEPROM factory calibration measurements using a diagnostic tool that operates the WLAN card at a ~99% DC (Duty Cycle) taken on both the main and auxiliary antenna ports.

As part of the factory test process, Intel measures the output power of every card. Any cards that exceed the maximum limits (EEPROM + 1.25 dB) will not pass the factory test. While in operation the card adjusts TX power using a closed loop TX power calibration algorithm. To do so, a power detector and temperature sensor are used. This algorithm adjusts the power to within +/-0.5 dB from the target, over temperature and voltage.

Intel uses the following antennae gain value for product and country certification work: 3 dbi for 2.4 GHz and 5 dBi for 5 GHz.

Intel also incorporates a lower limit to ensure that compliance of the WLAN card is maintained. The minimum limits are set by factory process. In MIMO mode this value is the sum limit. Generally if sum=15 then Tx1 limit=12 dBm and Tx2 limit=12 dBm (exception for some channels according to the table below.)

Note: The SAR SKU is expected to have similar values to 7260 / Wilkins Peak SAR SKU. It is limited to max output power of 15.0 dBm for the 2.4 GHz band and 13.5 dBm for the 5 GHz band. This is required in order to pass the 0.8 W/kg threshold at 5 mm separation.

FCC SKU

Table 8-1 Stone Peak 2 FCC M.2, CCK mode configuration

Ch	Channel center in GHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	SISO Ant A Tx Power (dBm)	SISO Ant B Tx Power (dBm)
1	2.412	Y	Y	Y	N	N	15	15
2	2.417	Y	Y	Y	N	N	16	16
3	2.422	Y	Y	Y	N	N	16	16
4	2.427	Y	Y	Y	N	N	16	16
5	2.432	Y	Y	Y	N	N	16	16
6	2.437	Y	Y	Y	N	N	16	16
7	2.442	Y	Y	Y	N	N	16	16
8	2.447	Y	Y	Y	N	N	16	16
9	2.452	Y	Y	Y	N	N	16	16
10	2.457	Y	Y	Y	N	N	16	16
11	2.462	Y	Y	Y	N	N	15	15
12	2.467	N	N	Y	N	N	10.5	12
13	2.472	N	N	Y	N	N	9.5	11

	Note - Prior to production phase the Tx power setting is not set accurately.

Table 8-2 Stone Peak 2 FCC M.2, OFDM mode configuration

Ch	Channel center in GHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	SISO Ant A Tx Power	SISO Ant B Tx Power	MIMO 2 Chains Tx Power
1	2.412	Y	Y	Y	N	N	12.5	13	10.5
2	2.417	Y	Y	Y	N	N	14	14	12
3	2.422	Y	Y	Y	N	N	16	16	16
4	2.427	Y	Y	Y	N	N	16	16	16
5	2.432	Y	Y	Y	N	N	16	16	16
6	2.437	Y	Y	Y	N	N	16	16	16
7	2.442	Y	Y	Y	N	N	16	16	16
8	2.447	Y	Y	Y	N	N	16	16	16
9	2.452	Y	Y	Y	N	N	16	16	16
10	2.457	Y	Y	Y	N	N	14	14	12
11	2.462	Y	Y	Y	N	N	11	11	10.5
12	2.467	N	N	Y	N	N	8.5	7.5	5.5
13	2.472	N	N	Y	N	N	0	0	0
36	5.180	N	N	Y	N	Y	12.5	12.5	10
40	5.200	N	N	Y	N	Y	13.5	13.5	10
44	5.220	N	N	Y	N	Y	13.5	13.5	10
48	5.240	N	N	Y	N	Y	13.5	13.5	10
52	5.260	N	N	N	Y	N	14.5	15	12
56	5.280	N	N	N	Y	N	14.5	15	12
60	5.300	N	N	N	Y	N	14.5	15	12
64	5.320	N	N	N	Y	N	12	12	10
100	5.500	N	N	N	Y	N	12	12	9
104	5.520	N	N	N	Y	N	14.5	15	13
108	5.540	N	N	N	Y	N	14.5	15	13
112	5.560	N	N	N	Y	N	14.5	15	13
116	5.580	N	N	N	Y	N	14.5	15	13
120	5.600	N	N	N	Y	N	14.5	15	13
124	5.620	N	N	N	Y	N	14.5	15	13
128	5.640	N	N	N	Y	N	14.5	15	13

Ch	Channel center in GHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	SISO Ant A Tx Power	SISO Ant B Tx Power	MIMO 2 Chains Tx Power
132	5.660	N	N	N	Y	N	14.5	15	13
136	5.680	N	N	N	Y	N	14.5	15	13
140	5.700	N	N	N	Y	N	11.5	11.5	9.5
144	5.720	N	N	N	Y	N	14.5	14	12
149	5.745	N	N	Y	N	Y	14.5	14	12
153	5.765	N	N	Y	N	Y	14.5	14	12
157	5.785	N	N	Y	N	Y	14.5	14	12
161	5.805	N	N	Y	N	Y	14.5	14	12
165	5.825	N	N	Y	N	Y	14.5	14	12
3n40	2.422	Y	Y	Y	N	N	12	12	8
4n40	2.427	Y	Y	Y	N	N	13	13	10
5n40	2.432	Y	Y	Y	N	N	14	14	10.5
6n40	2.437	Y	Y	Y	N	N	15	15	12
7n40	2.442	Y	Y	Y	N	N	15	13	12
8n40	2.447	Y	Y	Y	N	N	14.5	12	10
9n40	2.452	Y	Y	Y	N	N	11	10	8
10n40	2.457	N	N	Y	N	N	9	8	6
11n40	2.462	N	N	Y	N	N	0	0	0
38n40	5.190	N	N	Y	N	Y	10.5	12	8.5
46n40	5.230	N	N	Y	N	Y	15	15	13
54n40	5.270	N	N	N	Y	N	15	15	15
62n40	5.310	N	N	N	Y	N	12	12	10
102n40	5.510	N	N	N	Y	N	12	12.5	10
110n40	5.550	N	N	N	Y	N	15	15	15
118n40	5.590	N	N	N	Y	N	15	15	15
126n40	5.630	N	N	N	Y	N	15	15	15
134n40	5.670	N	N	N	Y	N	15	15	15
142n40	5.710	N	N	N	Y	N	15	15	15
151n40	5.755	N	N	Y	N	Y	15	15	15
159n40	5.795	N	N	Y	N	Y	15	15	15
42ac80	5.210	N	N	Y	N	N	12	12	10
58ac80	5.290	N	N	N	Y	N	12	12	10

Ch	Channel center in GHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	SISO Ant A Tx Power	SISO Ant B Tx Power	MIMO 2 Chains Tx Power
106ac80	5.530	N	N	N	Y	N	12	12	10
122ac80	5.610	N	N	N	Y	N	15	15	15
138ac80	5.690	N	N	N	Y	N	15	15	15
155ac80	5.775	N	N	Y	N	Y	15	15	15

Table 8-3 Stone Peak 2 FCC/SAR M.2, CCK mode configuration

Ch	Channel center in GHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	SISO Ant A Tx Power (dBm)	SISO Ant B Tx Power (dBm)
1	2.412	Y	Y	Y	N	N	13.5	13.5
2	2.417	Y	Y	Y	N	N	13.5	13.5
3	2.422	Y	Y	Y	N	N	13.5	13.5
4	2.427	Y	Y	Y	N	N	13.5	13.5
5	2.432	Y	Y	Y	N	N	13.5	13.5
6	2.437	Y	Y	Y	N	N	13.5	13.5
7	2.442	Y	Y	Y	N	N	13.5	13.5
8	2.447	Y	Y	Y	N	N	13.5	13.5
9	2.452	Y	Y	Y	N	N	13.5	13.5
10	2.457	Y	Y	Y	N	N	13.5	13.5
11	2.462	Y	Y	Y	N	N	13.5	13.5
12	2.467	N	N	Y	N	N	10.5	12
13	2.472	N	N	Y	N	N	9.5	11
	Note - Prior to production phase the Tx power setting is not set accurately.							

Table 8-4 Stone Peak 2 FCC/SAR M.2, OFDM mode configuration

Ch	Channel center in GHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	SISO Ant A Tx Power	SISO Ant B Tx Power	MIMO 2 Chains Tx Power
1	2.412	Y	Y	Y	N	N	12.5	13	10.5
2	2.417	Y	Y	Y	N	N	13.5	13.5	12
3	2.422	Y	Y	Y	N	N	13.5	13.5	13.5
4	2.427	Y	Y	Y	N	N	13.5	13.5	13.5
5	2.432	Y	Y	Y	N	N	13.5	13.5	13.5

Ch	Channel center in GHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	SISO Ant A Tx Power	SISO Ant B Tx Power	MIMO 2 Chains Tx Power
6	2.437	Y	Y	Y	N	N	13.5	13.5	13.5
7	2.442	Y	Y	Y	N	N	13.5	13.5	13.5
8	2.447	Y	Y	Y	N	N	13.5	13.5	13.5
9	2.452	Y	Y	Y	N	N	13.5	13.5	13.5
10	2.457	Y	Y	Y	N	N	13.5	13.5	12
11	2.462	Y	Y	Y	N	N	11	11	10.5
12	2.467	N	N	Y	N	N	8.5	7.5	5.5
13	2.472	N	N	Y	N	N	0	0	0
36	5.180	N	N	Y	N	Y	12	12	10
40	5.200	N	N	Y	N	Y	12	12	10
44	5.220	N	N	Y	N	Y	12	12	10
48	5.240	N	N	Y	N	Y	12	12	10
52	5.260	N	N	N	Y	N	12	12	12
56	5.280	N	N	N	Y	N	12	12	12
60	5.300	N	N	N	Y	N	12	12	12
64	5.320	N	N	N	Y	N	12	12	10
100	5.500	N	N	N	Y	N	12	12	9
104	5.520	N	N	N	Y	N	12	12	12
108	5.540	N	N	N	Y	N	12	12	12
112	5.560	N	N	N	Y	N	12	12	12
116	5.580	N	N	N	Y	N	12	12	12
120	5.600	N	N	N	Y	N	12	12	12
124	5.620	N	N	N	Y	N	12	12	12
128	5.640	N	N	N	Y	N	12	12	12
132	5.660	N	N	N	Y	N	12	12	12
136	5.680	N	N	N	Y	N	12	12	12
140	5.700	N	N	N	Y	N	11.5	11.5	9.5
144	5.720	N	N	N	Y	N	12	12	12
149	5.745	N	N	Y	N	Y	12	12	12
153	5.765	N	N	Y	N	Y	12	12	12
157	5.785	N	N	Y	N	Y	12	12	12
161	5.805	N	N	Y	N	Y	12	12	12

Ch	Channel center in GHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	SISO Ant A Tx Power	SISO Ant B Tx Power	MIMO 2 Chains Tx Power
165	5.825	N	N	Y	N	Y	12	12	12
3n40	2.422	Y	Y	Y	N	N	12	12	8
4n40	2.427	Y	Y	Y	N	N	13	13	10
5n40	2.432	Y	Y	Y	N	N	13.5	13.5	10.5
6n40	2.437	Y	Y	Y	N	N	13.5	13.5	12
7n40	2.442	Y	Y	Y	N	N	13.5	13	12
8n40	2.447	Y	Y	Y	N	N	13.5	12	10
9n40	2.452	Y	Y	Y	N	N	11	10	8
10n40	2.457	N	N	Y	N	N	9	8	6
11n40	2.462	N	N	Y	N	N	0	0	0
38n40	5.190	N	N	Y	N	Y	10.5	12	8.5
46n40	5.230	N	N	Y	N	Y	12	12	12
54n40	5.270	N	N	N	Y	N	12	12	12
62n40	5.310	N	N	N	Y	N	12	12	10
102n40	5.510	N	N	N	Y	N	12	12	10
110n40	5.550	N	N	N	Y	N	12	12	12
118n40	5.590	N	N	N	Y	N	12	12	12
126n40	5.630	N	N	N	Y	N	12	12	12
134n40	5.670	N	N	N	Y	N	12	12	12
142n40	5.710	N	N	N	Y	N	12	12	12
151n40	5.755	N	N	Y	N	Y	12	12	12
159n40	5.795	N	N	Y	N	Y	12	12	12
42ac80	5.210	N	N	Y	N	N	12	12	10
58ac80	5.290	N	N	N	Y	N	12	12	10
106ac80	5.530	N	N	N	Y	N	12	12	10
122ac80	5.610	N	N	N	Y	N	12	12	12
138ac80	5.690	N	N	N	Y	N	12	12	12
155ac80	5.775	N	N	Y	N	Y	12	12	12

8.3 Regulatory and safety certification

The following regulatory and safety information is subject to change.

Table 8-5 Wi-Fi safety and regulatory USA

USA	Requirements	Criteria
	EMI	FCC Part 15, Subpart B, Class B (CISPR 22 Limits at 10 m)
	RF	FCC Part 15, Subpart C (Sections 15.205, 15.207, 15.209, & 15.247) FCC Part 15, Subpart E (Section 15.407)
	Safety	UL 60950-1

Table 8-6 Wi-Fi safety and regulatory Europe

Europe	Requirements	Criteria
	EMC	EN301489-1, EN 301489-17
	RF	EN300 328 & EN301-893 as DFS slave terminal
	Safety	EN60950-1 via CB Report (IEC60950-1) R&TTE Health Requirement article 1(a) referring to the EU EN50371

Table 8-7 Wi-Fi safety and regulatory Japan

Europe	Requirements	Criteria
	EMI	VCCI Class B
	RF	STD T66, STD T71, ARIB W52, W53, W56
	Safety	EN60950-1 via CB Report (IEC60950-1) R&TTE Health Requirement article 1(a) referring to the EU EN50371

Table 8-8 Wi-Fi safety and regulatory Australia/New Zealand

Europe	Requirements	Criteria
	EMC	EU test reports
	RF	Radio communications (EMR) Standard 2003
	Safety	CB Cert. & Report (IEC60950-1)

Table 8-9 Wi-Fi safety and regulatory Other Geographies

Other Geographies	Requirements	Criteria
	Priority 2 Countries	To be covered in MWG Regulatory WW Country Coverage
	Priority 3 Countries	To be covered in MWG Regulatory WW Country Coverage

Note: Regulatory pre-scans and certification are tested using a combo Bluetooth/Wi-Fi reference antenna. For reference antenna characteristics refer to "Reference Antenna Characteristics" section.

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9 Mechanical Specifications

This section provides information about the mechanical specifications.

9.1 Weight

Table 9-1 Weight

	StP2 M.2 PCIe/USB
Average of weight (grams)	TBD

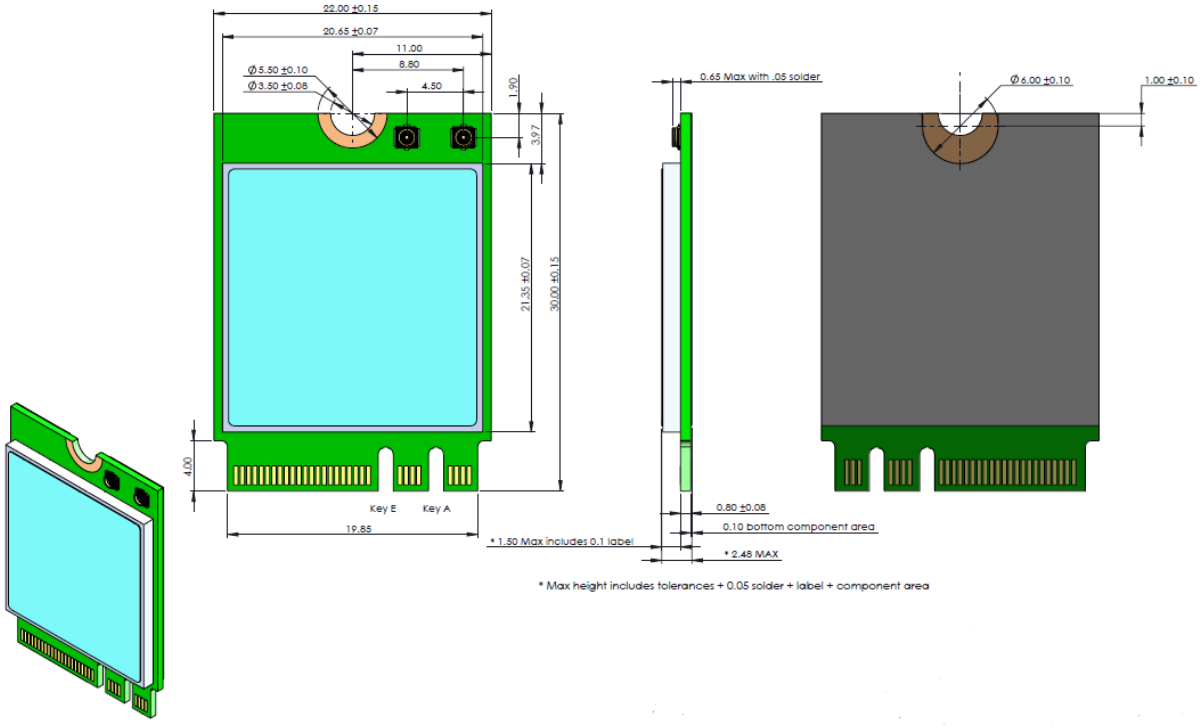
9.2 M.2 mechanical specification

Stone Peak SKUs will be available in M.2.

All M.2 SKUs can be installed on a platform with host connector type 1-SD Key E

- StP2 (Wi-Fi PCIe, BT USB)

Figure 9-1 Stone Peak 2 PCIe SKU dimensions (Type 2230)[1]



NOTES:
1. Max component heights include tolerance + .05 soldier + .10 for label height.
2. DIMENSIONS ARE IN MM.
3. DO NOT SCALE DRAWING.
4. TOLERANCES
   ANGLES +/- 1 DEGREES
   X.X +/- 0.25MM
   X.XX +/- 0.150MM
   X.XXX +/- 0.100MM

9.3 Antenna receptacles

A U.FL or equivalent micro coax connector will be used on the Stone Peak hardware and will be compatible with other standard U.FL micro coax cable connectors.

The antenna connectors will be labeled 1 and 2 on the label where:

Stone Peak 2 M.2

2 = Main, Left: Wi-Fi Tx/Rx

1 = Aux, Right: Wi-Fi Tx/Rx, Bluetooth Tx/Rx

9.4 M.2 antenna retention

9.4.1 Recommended method for retention of M.2 cable

- Intel recomends restraining the antenna cables of M.2 products within the first 25 mm or less of cable length leaving the RF connectors on the module.
- Intel recommends using a robust tape or adhesive to secure the cables so they do not move or pull on the RF connector during shock and vibration of the system.

Figure 9-2 M.2 cable retention

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10 Environmental Specifications

Table 10-1 and Table 10-2provide operating condition and maximum rating requirements for the Stone Peak hardware.

Table 10-1 Operating conditions

Environment	Limits
Operating Temperature	0 ºC – 80 ºC

NOTES: Environmental temperature is measured on the card shield cover.

Table 10-2 Storage conditions

Environment	Limits
Storage Temperature (Non-Operational)	-40 ºC to 70 ºC
Humidity (Non-Operational)	50% to 90% non-condensing (at temperatures of 25 ºC to 35 ºC)

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11 Certification Requirements

A preliminary list of certification requirements includes the following:

Table 11-1 Certification requirements

Requirement	Detail description
Bluetooth USB-IF	All products shall pass chapter 9 of USB-IF in order get USB-IF certification for Microsoft Windows8 logo requirements
Mini CEM add-in card	Mini CEM add-in card PCI-SIG conformance[1]
WHQL	Microsoft Windows 7 and Microsoft Windows 8/8.1 WHQL/WHCK tests for networking device
Wi-Fi certification for Windows* OS	Microsoft Windows 7 and Microsoft Windows 8/8.1
Bluetooth certifications	Bluetooth SIG certification for the device and the SW stack delivered with it.
Android* certification	The products shall meet Android CDD requirements and shall pass associated CTS
Chrome* certification	The device shall pass Chrome AVL tests.

NOTES: 1. Not submitted to external certification lab for PCI-SIG specification compliance, however PCI compliance is tested internally (within Intel Corporation).

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12 Antenna Design Considerations

12.1 Antenna port impedance

Nominal antenna port impedance specification is 50 ohm.

12.2 Antennas frequency bands

See the Broadwell Platform Design Guide.

12.3 Antenna gain

See the Broadwell Platform Design Guide.

12.4 Antenna characteristics

See the Broadwell Platform Design Guide.

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13 Wireless Features and Properties

13.1 HW RF kill considerations

If for some reason the platform doesn't support HW signal for wireless disable, Intel recommends not connecting any signal to the wireless disable pins on the module.

13.2 Data transmission

Data transmission is always initiated by software, which is then passed down through the MAC, through the digital and analog baseband, and finally to the RF chip. This is true for both Wi-Fi and Bluetooth.

Several special packets (for Wi-Fi: ACKs, CTS, PS Poll, etc.) are initiated by the MAC. These are the only ways the digital baseband portion will turn on the RF transmitter, which it then turns off at the end of the packet. Therefore, the transmitter will be "ON" only while one of the packets is transmitted.

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14 Platform and Host Interface Requirements

14.1 Host interface directives

See Section 4.0.

14.2 Mechanical directives

For M.2, see: "PCI EXPRESS M.2 ELECTROMECHANICAL SPECIFICATION" Electricals and Signals connections directives.

14.2.1 Power lines

In the HMC case: at least three of the power lines, (+3.3 Vaux), need to be connected, except Pin24 that is not connected on the card laval.

The ramp time of the power (0 v to 3.3 v) must not exceed 10 mSec, and should not be based on a level's ramps. Example:

Notice that there must-not be a glitch on the power supply that is higher than 0.3 v; any glitch that is higher than 0.3 v may cause a power-on reset to the card, and in stand-by mode it means the card shall lose it connection maintenance ability. This is most venerable when the platform switches from "On" state to "Stand-By" state.

14.2.2 PCIe auxiliary signals

See Section 3.1.9.

14.2.3 USB signals

The BT functionality of the card operated using the USB signals as the host interface bas.

As defined by the USB standard, when the platform gets to stand-by mode the card operate its USB in a selective suspend mode. This means that the D+ signal is kept as logical "1" value by an internal pull-up.

14.2.4 Drop and replacement

For connected standby platforms that are M.2 compliant platforms and that intend to support Wi-Fi SDIO and BT UART/I2S, Intel Recommends also routing the PCIe for Wi-Fi, and the USB for the BT. This will enable "drop and replacement." In the future these platforms will be able to include the M.2 PCIe/USB cards instead of SDIO/UART modules. In order to enable the "drop and replacement", the host connector should be A-SD Key E.

14.2.5 Clink signals

The Clink signal are specific for Intel® AMT based platforms; for those that do not support AMT, those signals MUST-NOT be used; and should be kept disconnected on the platform level.

14.2.6 Wireless disable

See Section 3.5.

§

A Document References

Table A-1 Document references

Document name	Location
Wireless LAN MAC and PHY Specifications, 802.11b	*http://standards.ieee.org/getieee802/download/802.11b-1999_Cor1-2001.pdf*
Wireless LAN MAC and PHY Specifications, 802.11g	*http://standards.ieee.org/getieee802*
Wireless LAN MAC and PHY Specifications, 802.11a	*http://standards.ieee.org/getieee802*
Wireless LAN MAC and PHY Specifications, 802.11n-2009	*http://standards.ieee.org/getieee802*
PCI Express Base Specification, Rev 1.2	*http://www.pcisig.com/specifications/pciexpress*
PCI Express Card Electromechanical Specification, Rev 1.2	*http://www.pcisig.com/specifications/pciexpress*
PCI Express Mini Card Electromechanical Specification, Rev 1.2	*http://www.pcisig.com/specifications/pciexpress*
PCI Local Bus Specification Rev. 2.3	*http://www.pcisig.com/specifications/conventional/conventional_pci*
PCI Bus Power Management Interface Specification Rev 1.1	*http://www.pcisig.com/specifications/conventional/pci_bus_power_management_interface*
Advanced Configuration and Power Interface Version 3.0	*http://www.acpi.info/spec.htm*
Microsoft Hardware Device Class Power Management Specification	*http://www.microsoft.com/whdc/hwdev/resources/specs/pmref/default.mspx*
M.2 specification	*http://www.pcisig.com/apps/org/workgroup/pciexpress/miniexpress/documents.php*

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Information To Be Supplied to the End User by the OEM or Integrator

The following regulatory and safety notices must be published in documentation supplied to the end user of the product or system incorporating the Intel® wireless adapter, in compliance with local regulations. Host system must be labeled with "Contains FCC ID: MSQ7265NG", IC: 3568A -7265NG, FCC ID displayed on label.

The Intel® wireless adapter must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product. Intel Corporation is not responsible for any radio or television interference caused by unauthorized modification of the devices included with the wireless adapter kit or the substitution or attachment of connecting cables and equipment other than that specified by Intel Corporation. The correction of interference caused by such unauthorized modification, substitution or attachment is the responsibility of the user. Intel Corporation and authorized resellers or distributors are not liable for any damage or violation of government regulations that may arise from the user failing to comply with these guidelines.

Local Restriction of 802.11a, 802.11b, 802.11g, 802.11n, and 802.11e Radio Usage

The following statement on local restrictions must be published as part of the compliance documentation for all 802.11a, 802.11b, 802.11g, 802.11n, and 802.11e products.

Caution: Due to the fact that the frequencies used by 802.11a, 802.11b, 802.11g, 802.11n, and 802.16e wireless LAN devices may not yet be harmonized in all countries, 802.11a, 802.11b, 802.11g, 802.11n, and 802.16e products are designed for use only in specific countries, and are not allowed to be operated in countries other than those of designated use. As a user of these products, you are responsible for ensuring that the products are used only in the countries for which they were intended and for verifying that they are configured with the correct selection of frequency and channel for the country of use. The device transmit power control (TPC) interface is part of the Intel® PROSet/Wireless WiFi Connection Utility Software. Operational restrictions for Equivalent Isotropic Radiated Power (EIRP) are provided by the system manufacturer. Any deviation from the permissible power and frequency settings for the country of use is an infringement of national law and may be punished as such.

INFORMATION FOR THE USER

Safety Notices

USA FCC Radio Frequency Exposure

The FCC with its action in ET Docket 96-8 has adopted a safety standard for human exposure to radio frequency (RF) electromagnetic energy emitted by FCC certified equipment. The wireless adapter meets the Human Exposure limits found in OET Bulletin 65, supplement C, 2001, and ANSI/IEEE C95.1, 1992. Proper operation of this radio according to the instructions found in this manual will result in exposure substantially below the FCC’s recommended limits.

The following safety precautions should be observed:

- Do not touch or move antenna while the unit is transmitting or receiving.

- Do not hold any component containing the radio such that the antenna is very close or touching any exposed parts of the body, especially the face or eyes, while transmitting.
- Do not operate the radio or attempt to transmit data unless the antenna is connected; this behavior may cause damage to the radio.
- Use in specific environments:
    - The use of wireless adapters in hazardous locations is limited by the constraints posed by the safety directors of such environments.
    - The use of wireless adapters on airplanes is governed by the Federal Aviation Administration (FAA).
    - The use of wireless adapters in hospitals is restricted to the limits set forth by each hospital.

Explosive Device Proximity Warning

 **Warning**: Do not operate a portable transmitter (including this wireless adapter) near unshielded blasting caps or in an explosive environment unless the transmitter has been modified to be qualified for such use.

Antenna Warnings

 **Warning**: The wireless adapter is not designed for use with high-gain directional antennas.

Use On Aircraft Caution

 **Caution**: Regulations of commercial airline operators may prohibit airborne operation of certain electronic devices equipped with radio-frequency wireless devices (wireless adapters) because their signals could interfere with critical aircraft instruments.

Other Wireless Devices

Safety Notices for Other Devices in the Wireless Network: See the documentation supplied with wireless adapters or other devices in the wireless network.

Local Restrictions on 802.11a, 802.11b, 802.11g, 802.11n, and 802.11ac **Radio Usage**

 **Caution**: Due to the fact that the frequencies used by 802.11a, 802.11b, 802.11g, 802.11n, and 802.11ac wireless LAN devices may not yet be harmonized in all countries, 802.11a, 802.11b, 802.11g, 802.11n, and 802.11ac products are designed for use only in specific countries, and are not allowed to be operated in countries other than those of designated use. As a user of these products, you are responsible for ensuring that the products are used only in the countries for which they were intended and for verifying that they are configured with the correct selection of frequency and channel for the country of use. The device transmit power control (TPC) interface is part of the Intel® PROSet/Wireless WiFi Connection Utility Software. Operational restrictions for Equivalent Isotropic Radiated Power (EIRP) are provided by the

system manufacturer. Any deviation from the permissible power and frequency settings for the country of use is an infringement of national law and may be punished as such.

Wireless Interoperability

See Specifications for more information. The wireless adapter is designed to be interoperable with other wireless LAN products that are based on direct sequence spread spectrum (DSSS) radio technology and to comply with the following standards:

- IEEE Std. 802.11b compliant Standard on Wireless LAN
- IEEE Std. 802.11g compliant Standard on Wireless LAN
- IEEE Std. 802.11a compliant Standard on Wireless LAN
- IEEE Std. 802.11n compliant Standard on Wireless LAN
- IEEE Std. 802.11ac draft compliant on Wireless LAN
- Wireless Fidelity certification, as defined by the Wi-Fi Alliance

The Wireless Adapter and Your Health

The wireless adapter, like other radio devices, emits radio frequency electromagnetic energy. The level of energy emitted by the wireless adapter, however, is less than the electromagnetic energy emitted by other wireless devices such as mobile phones. The wireless adapter operates within the guidelines found in radio frequency safety standards and recommendations. These standards and recommendations reflect the consensus of the scientific community and result from deliberations of panels and committees of scientists who continually review and interpret the extensive research literature. In some situations or environments, the use of the wireless adapter may be restricted by the proprietor of the building or responsible representatives of the applicable organization. Examples of such situations may include:

- Using the wireless adapter on board airplanes, or
- Using the wireless adapter in any other environment where the risk of interference with other devices or services is perceived or identified as being harmful.

If you are uncertain of the policy that applies to the use of wireless adapters in a specific organization or environment (an airport, for example), you are encouraged to ask for authorization to use the adapter before you turn it on.

REGULATORY INFORMATION

USA - Federal Communications Commission (FCC)

This wireless adapter is restricted to indoor use due to its operation in the 5.15 to 5.25 and 5.470 to 5.75GHz frequency ranges. FCC requires this wireless adapter to be used indoors for the frequency ranges 5.15 to 5.25GHz and 5.470 to 5.75GHz to reduce the potential for harmful interference to co-channel mobile satellite systems. No configuration controls are provided for

Intel® wireless adapters allowing any change in the frequency of operations outside the FCC grant of authorization for U.S. operation according to Part 15.407 of the FCC rules.

- Intel® wireless adapters are intended for OEM integrators only.
- Intel® wireless adapters cannot be co-located with any other transmitter unless approved by the FCC.

This wireless adapter complies with Part 15 of the FCC Rules. Operation of the device is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference that may cause undesired operation.

NOTE: The radiated output power of the adapter is far below the FCC radio frequency exposure limits. Nevertheless, the adapter should be used in such a manner that the potential for human contact during normal operation is minimized. To avoid the possibility of exceeding the FCC radio frequency exposure limits, you should keep a distance of at least 20cm between you (or any other person in the vicinity), or the minimum separation distance as specified by the FCC grant conditions, and the antenna that is built into the computer. Details of the authorized configurations can be found at http://www.fcc.gov/oet/ea/ by entering the FCC ID number on the device.

Class B Device Interference Statement

This wireless adapter has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This wireless adapter generates, uses, and can radiate radio frequency energy. If the wireless adapter is not installed and used in accordance with the instructions, the wireless adapter may cause harmful interference to radio communications. There is no guarantee, however, that such interference will not occur in a particular installation. If this wireless adapter does cause harmful interference to radio or television reception (which can be determined by turning the equipment off and on), the user is encouraged to try to correct the interference by taking one or more of the following measures:

- Reorient or relocate the receiving antenna of the equipment experiencing the interference.
- Increase the distance between the wireless adapter and the equipment experiencing the interference.
- Connect the computer with the wireless adapter to an outlet on a circuit different from that to which the equipment experiencing the interference is connected.
- Consult the dealer or an experienced radio/TV technician for help.

NOTE: The adapter must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes

with the product. Any other installation or use will violate FCC Part 15 regulations.

Safety Approval Considerations

This device has been safety approved as a component and is for use only in complete equipment where the acceptability of the combination is determined by the appropriate safety agencies. When installed, consideration must be given to the following:

- It must be installed into a compliant host device meeting the requirement of UL/EN/IEC 60950-1 2nd edition including the general provisions of enclosure design 1.6.2 and specifically paragraph 1.2.6.2 (Fire Enclosure).
- The device shall be supplied by a SELV source when installed in the end-use equipment.
- A heating test shall be considered in the end-use product for meeting the requirement of UL/EN/IEC 60950-1 2nd edition.

Low Halogen

Applies only to brominated and chlorinated flame retardants (BFRs/CFRs) and PVC in the final product. Intel components as well as purchased components on the finished assembly meet JS-709 requirements, and the PCB / substrate meet IEC 61249-2-21 requirements. The replacement of halogenated flame retardants and/or PVC may not be better for the environment.

Canada – Industry Canada (IC)

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil se conforme aux normes Canada d'Industrie de RSS permis-exempt. L'utilisation est assujetti aux deux conditions suivantes: (1) cet appareil ne peut pas causer d'interférences, et (2) cet appareil doit accepter des interférences , y compris des interférences qui peuvent causer desopérations non désirées de l'appareil.

Caution: When using IEEE 802.11a wireless LAN, this product is restricted to indoor use due to its operation in the 5.15- to 5.25-GHz frequency range. Industry Canada requires this product to be used indoors for the frequency range of 5.15GHz to 5.25GHz to reduce the potential for harmful interference to co-channel mobile satellite systems. High power radar is allocated as the primary user of the 5.25- to 5.35-GHz and 5.65 to 5.85-GHz bands. These radar stations can

cause interference with and/or damage to this device. The maximum allowed antenna gain for use with this device is 6dBi in order to comply with the E.I.R.P limit for the 5.25- to 5.35 and 5.725 to 5.85GHz frequency range in point-to-point operation. To comply with RF exposure requirements all antennas should be located at a minimum distance of 20cm, or the minimum separation distance allowed by the module approval, from the body of all persons.

Attention: l'utilisation d'un réseau sans fil IEEE802.11a est restreinte à une utilisation en intérieur à cause du fonctionnement dans la bande de fréquence 5.15-5.25GHz. Industry Canada requiert que ce produit soit utilisé à l'intérieur des bâtiments pour la bande de fréquence 5.15-5.25GHz afin de réduire les possibilités d'interférences nuisibles aux canaux co-existants des systèmes de transmission satellites. Les radars de puissances ont fait l'objet d'une allocation primaire de fréquences dans les bandes 5.25-5.35GHz et 5.65-5.85GHz. Ces stations radar peuvent créer des interférences avec ce produit et/ou lui être nuisible. Le gain d'antenne maximum permissible pour une utilisation avec ce produit est de 6 dBi afin d'être conforme aux limites de puissance isotropique rayonnée équivalente (P.I.R.E.) applicable dans les bandes 5.25-5.35GHz et 5.725-5.85GHz en fonctionnement point-à-point. Pour se conformer aux conditions d'exposition de RF toutes les antennes devraient être localisées à une distance minimum de 20 cm, ou la distance de séparation minimum permise par l'approbation du module, du corps de toutes les personnes.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Selon les règlements de Canada d'Industrie, cet émetteur de radio peut seulement fonctionner en utilisant une antenne du type et de gain maximum (ou moindre) que le gain approuvé pour l'émetteur par Canada d'Industrie. Pour réduire lesinterférences radio potentielles avec les autres utilisateurs, le type d'antenne et son gain devraient être choisis de façon à ce que la puissance isotrope rayonnée équivalente(P.I.R.E.) ne soit pas supérieure à celle qui est nécessaire pour une communication réussie.

European Union

The low band 5.15 -5.35GHz is for indoor use only.

This equipment complies with the essential requirements of the European Union directive 1999/5/EC. See Statements of European Union Compliance.

European Union Declarations of Conformity

To view the European Union Declaration of Conformity for your adapter, perform these steps.

1. Open this web site: http://developer.intel.com/design/litcentr/ce_docs/index.htm
2. Under the **Wireless Products** menu select your adapter.
3. Click **Go**.

To view additional regulatory information for your adapter, perform these steps:

1. Open this web site: http://www.intel.com/support/wireless/wlan/
2. Click on the link for your adapter.
3. Click **Document and Guides**.
4. Under **Regulatory Information**, click Regulatory documents for your adapter.

Waste Electrical and Electronic Equipment Directive (WEEE)

Restriction of Hazardous Substances Directive (RoHS) Compliant

All products described herein are compliant with the European Union's RoHS Directive.

For CE Mark-Related Questions related to the wireless adapter, contact:

Intel Corporation Attn: Corporate Quality 2200 Mission College Blvd. Santa Clara, CA 95054-1549 USA

Japan

Indoor use only in the 5Ghz band.

Korea

당해 무선설비는 운용 중 전파혼신 가능성이 있음

Mexico

La operación de este equipo está sujeta a las siguientes dos condiciones: (1) es posible que este equipo o dispositivo no cause interferencia perjudicial y (2) este equipo o dispositivo debe aceptar cualquier interferencia, incluyendo la que pueda causar su operación no deseada.

Morocco

The operation of this product in the radio channel 2 (2417 MHz) is not authorized in the following cities: Agadir, Assa-Zag, Cabo Negro, Chaouen, Goulmima, Oujda, Tan Tan, Taourirt, Taroudant and Taza.

The operation of this product in the radio channels 4, 5, 6 et 7 (2425 - 2442 MHz) is not authorized in the following cities: Aéroport Mohamed V, Agadir, Aguelmous, Anza, Benslimane, Béni Hafida, Cabo Negro, Casablanca, Fès, Lakbab, Marrakech, Merchich, Mohammédia, Rabat, Salé, Tanger, Tan Tan, Taounate, Tit Mellil, Zag.

Pakistan

"PTA APPROVED MODEL"

Taiwan

第十二條

經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

第十四條

低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。
前項合法通信，指依電信法規定作業之無線電通信。
低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

在5.25-5.35 秭赫頻帶內操作之無線資訊傳輸設備，限於室內使用。
