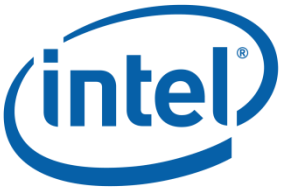

Intel® Centrino® Wireless-N 105 (Canyon Peak)
Intel® Centrino® Wireless-N 135 (Canyon Peak w/Bluetooth)
Intel® Centrino® Wireless-N 2200 (Marble Peak)
Intel® Centrino® Wireless-N 2230 (Jackson Peak 1)
Intel® Centrino® Advanced-N 6235 (Jackson Peak 2)

Hardware Specification

Revision 2.2
December 20, 2011

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Document Revision History

Document Number	Document Revision Number	Date	Comments
473288	1.0	April 7, 2011	Initial release
473288	2.0	August 18, 2011	**Added:** 4.2 PCI Interface 7.2 Antenna Gain for Product and Country Certifications **Updates:** Table 2 Key Intel® Wireless Features 8.1 Half Mini Card Weight and Dimensions
473288	2.1	December 9, 2011	**Updated** Table 4 Host Interface Pinout 6 LED Indicators 8.2 Antenna Receptacles **Added** 3.3.3 Wi-Fi Power Consumption 3.3.4 Bluetooth Power Consumption 7.1.5 Channel Configuration Tables/RF Output Power
473288	2.2	December 20, 2011	**Updated** Table 5 Power Consumption Wi-Fi States (mW) **Added** Table 6 NetDetect Power Consumption

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1 Introduction

The Intel® Centrino® Wireless Products include the following products:

- Intel® Centrino® Wireless-N 105 – code name Canyon Peak (CyP) – is a discrete 1x1 Wi-Fi single chip solution. Canyon Peak uses Intel's 5th generation 802.11n Wi-Fi solution and supports 2.4GHz band. It operates on a 40MHz wide channel, reaching PHY rates of up to 150Mbps.
- Intel® Centrino® Wireless-N 135 – code name Canyon Peak w/Bluetooth (CyP w/BT) – is the Wireless LAN (Wi-Fi) and Bluetooth (BT) combination product that supports WiFi 1x1 802.11n in the 2.4GHz band. It operates on a 40MHz wide channel, reaching PHY rates of up to 150Mbps. Canyon Peak w/Bluetooth uses CSR Bluetooth 8th generation core that supports Bluetooth 3.0 standard, and Bluetooth low energy technology (BLE). In addition, Canyon Peak w/Bluetooth supports the Bluetooth 4.0 standard (which includes BLE and Bluetooth 3.0+HS)
- Intel® Centrino® Wireless-N 2200 – code name Marble Peak (MP) – is a discrete 2x2 Wi-Fi single chip solution. Marble Peak uses Intel's 5th generation 802.11n WiFi solution and supports the 2.4GHz band. It operates on a 40MHz wide channel, reaching PHY rates of up to 300Mbps.
- Intel® Centrino® Wireless-N 2230 – code name Jackson Peak1 (JP1) – is the Wireless LAN (Wi-Fi) and Bluetooth (BT) combination single chip supporting the 2.4GHz band. It operates on a 40MHz wide channel, reaching PHY rates of up to 300Mbps. In addition, Jackson Peak1 supports Bluetooth 4.0 standard (which includes BLE and Bluetooth 3.0+HS).
- Intel® Centrino® Advanced-N 6235 – code name Jackson Peak2 (JP2) – is a Wireless LAN (WiFi) and Bluetooth (BT) combination dual chip solution supporting both 2.4GHz and 5GHz bands. It operates on a 40MHz wide channel, reaching PHY rates of up to 300Mbps. Jackson Peak2 supports Bluetooth 4.0 standard (which includes BLE and Bluetooth 3.0+HS).
- Table 1 summarizes the differences between the different products.

Table 1: Feature Differences Between Intel® Wireless Products

Feature	Jackson Peak 1	Jackson Peak 2	Canyon Peak / Canyon Peak w/Bluetooth	Marble Peak
Wi-Fi standard	2x2 bgn	2x2 agn	1x1 bgn	2x2 bgn
Antennas	2	2	2	2
Wi-Fi TX chains	2 chain	2 chains	1 Chain	2 chains
Wi-Fi RX Chains	2 chains	2 Chains	1 chain	2 Chains
Antenna Diversity	N/A	N/A	Enabled when Bluetooth is inactive	N/A

Feature	Jackson Peak 1	Jackson Peak 2	Canyon Peak / Canyon Peak w/Bluetooth	Marble Peak
Antenna Allocation	a. Wi-Fi Only b. Shared Wi-Fi w/Bluetooth	a. Wi-Fi Only b. Shared Wi-Fi w/Bluetooth	a. Wi-Fi Only b. Bluetooth (When Bluetooth is inactive, used as Wi-Fi RX diversity antenna)	a. Wi-Fi Only b. Wi-Fi Only
Wi-Fi Rx Throughput	300Mbps	300Mbps	150Mbps	300Mbps
Wi-Fi Tx Throughput	300Mbps	300Mbps	150Mbps	300Mbps
Bluetooth Core	Bluetooth 4.0	Bluetooth 4.0	Bluetooth 4.0 (for CyP/BT)	N/A
Intel® WiDi Support	Yes	Yes	No	Yes
Intel® AMT Support	No	AMT8.0	No	No
Single/Dual chip	Single	Dual	Single	Single

*Canyon Peak has antenna diversity

**For Bluetooth, a separate antenna is allocated

1.1 Key Features

Key features of Intel products are listed in Table 2.

Note: Not all products support all the features listed in Table 2.

Table 2: Key Intel Product Features

Feature	Description
Operating System Support	Microsoft Windows 7, Microsoft Windows 8, Linux Microsoft Windows XP and Microsoft Windows Vista shall be supported on legacy (AGN) products
Platform Compatibility	Netbook: Cedar Trail, SW support for Pine Trail Notebook: Chief River, SW support for Huron River, Sugar Bay, Calpella, and Montevina)
Wi-Fi Alliance Certifications	802.11n, 802.11w, WPA, WPS, WMM, WFD, Wi-Fi Direct
Microsoft Certifications	Microsoft Windows 8 Logo, Microsoft Windows 7 Logo. Legacy: Premium Logo (Microsoft Windows Vista), Designed for Microsoft Windows XP

Feature	Description
Bluetooth	Integrated Bluetooth CSR Bluetooth on JP1, JP2 and CyP + Bluetooth Bluetooth Certification BT3.0 HS - AMP Subsystem End Product BT4.0 LE – Smart Ready
Intel® Smart Connect Technology	Instant connectivity <1sec; Always Updated with NetDetect Wake On WLAN (and later SCT Always Reachable)
Intel® Wireless Display	Wi-Di Professional- Phase 1 – Laptop as GO, supporting user eviction and Roam to non-DFS channel when activated (limited to same channel)
Software Compatibility	Intel® PRO/Set Wireless Software v15.0
Intel® Active Management Technology v8.0	Support for Intel® AMT 8.0 on Chief River Platforms with Cougar Point
Cisco Compatible Extensions (CCX)	Support for CCX1-4 on XP, Vista, Win7, and Win8
Advanced Bluetooth-Wi-Fi Co-Existence	3-wire based, UART Messaging, auto tight/loose Coexistence scheme
Platform Power / Extending battery life	Adaptive Snoozing, Smart FIFO, beacon filtering, reduced interrupts per packet (also part of Windows 8 logo requirements)
Security	uCode SRAM Program memory lock

2 System Architecture

Jackson Peak1 and Canyon Peak with Bluetooth contain a single chip for Wi-Fi+Bluetooth, including Wi-Fi MAC and PHY as well as Bluetooth MAC and PHY. Jackson Peak 2 is a 2 chip solution. All the modules are HMC (Half Mini Card) format. Marble Peak and Canyon Peak are both WiFi only solutions.

2.1 Frequency Stability

The 40MHz clock has 20ppm maximum frequency stability. It is multiplied up to generate the transmit signal. Hence when operating in the b/g band at 2.412GHz we will have an error of 2.412GHz*20ppm when tuned to the lower channel and at the extreme it will be 2.484GHz * 20ppm when tuned to the upper channel. When operating in the band, it has a frequency error of the operation frequency *20ppm.

2.2 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. Several special packets (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 aforementioned packets is being transmitted.

The below schemes are used to depict the solution, and are not necessarily the architecture requirements and design.

Figure 1: Canyon Peak Single Chip Schematic Architecture

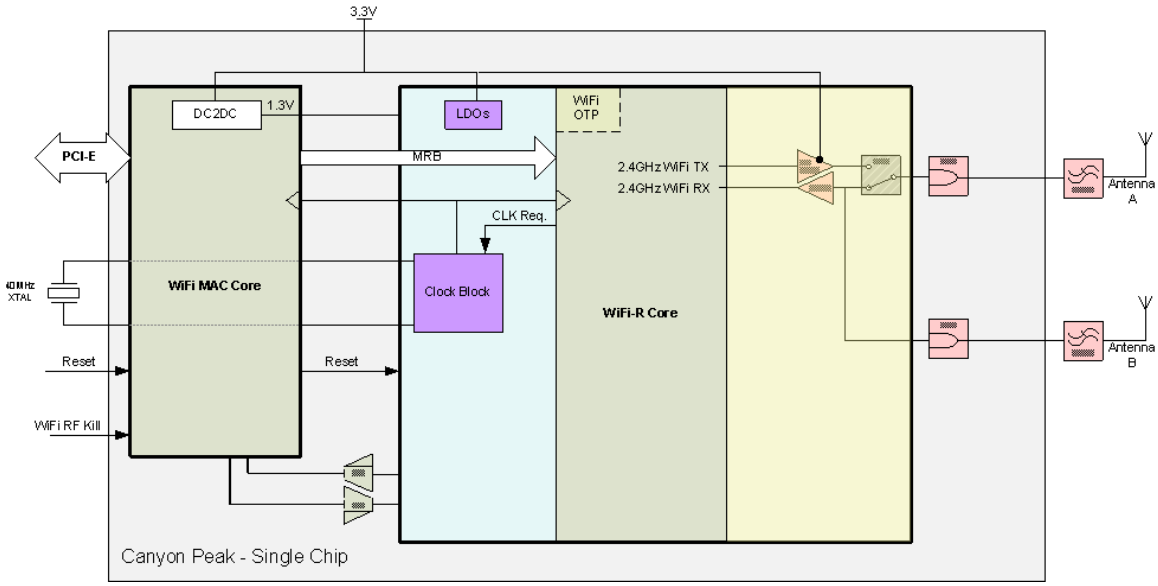


Figure 2: Canyon Peak w/Bluetooth Single Chip Schematic Architecture

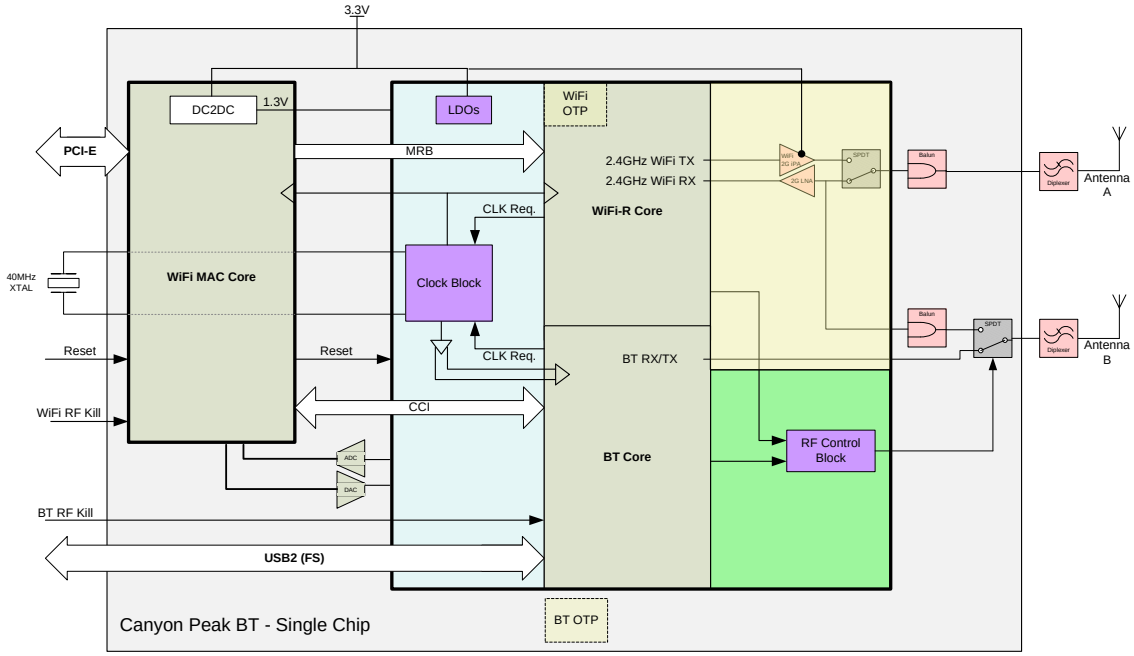


Figure 3: Marble Peak Single Chip Schematic Architecture:

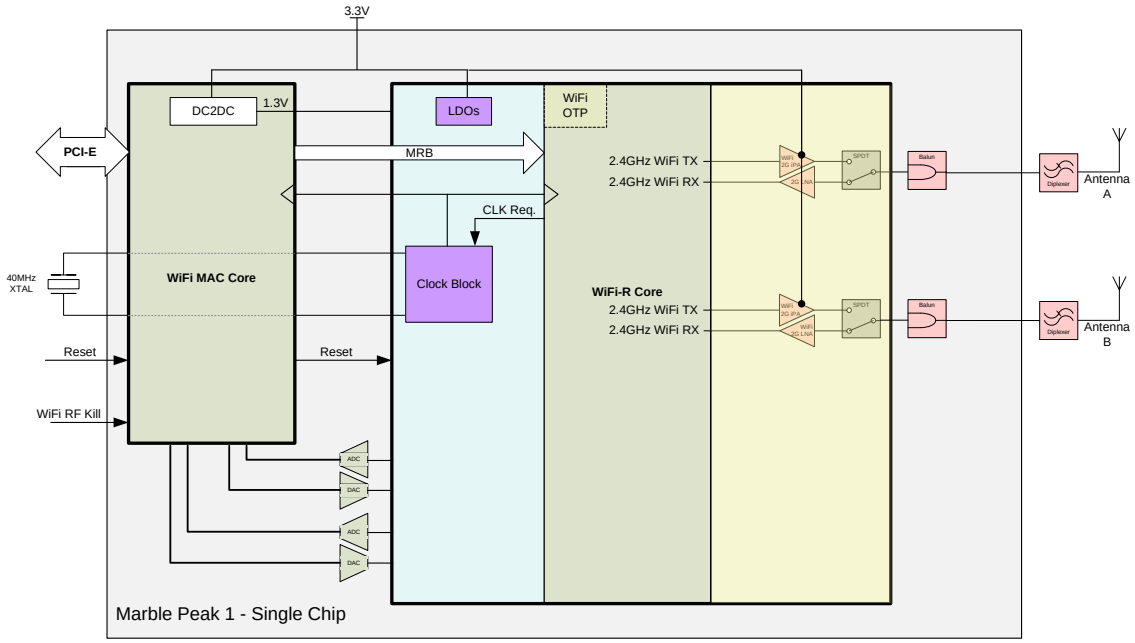


Figure 4: Jackson Peak 1 Single Chip Schematic Architecture:

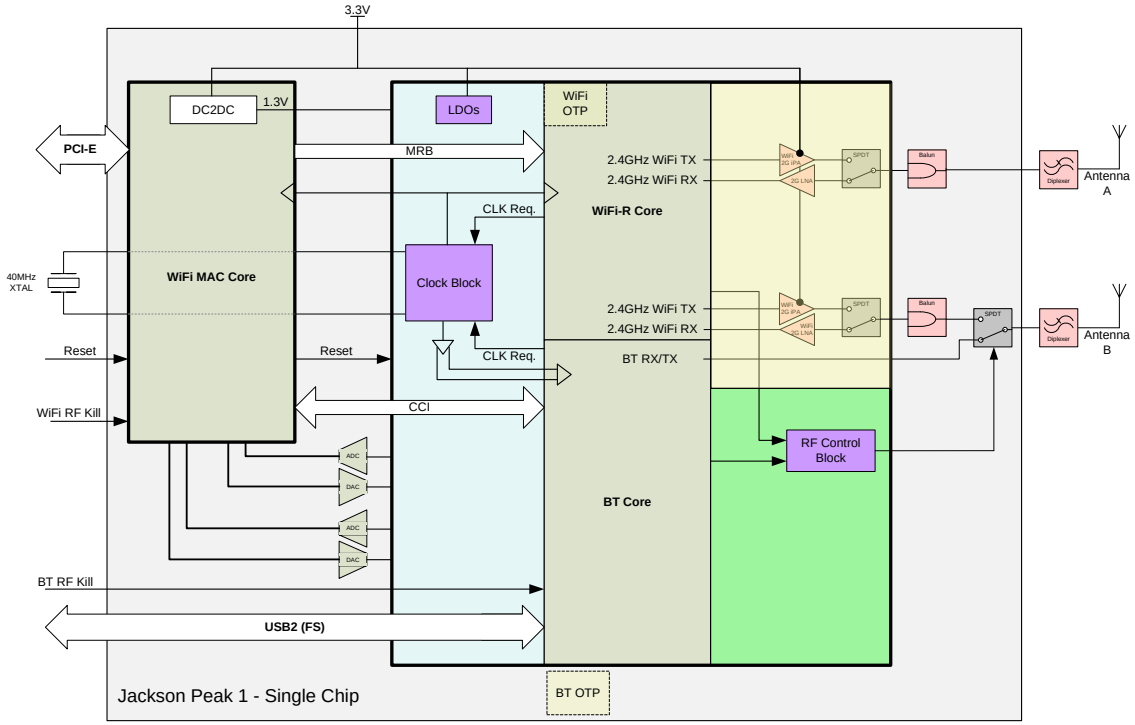
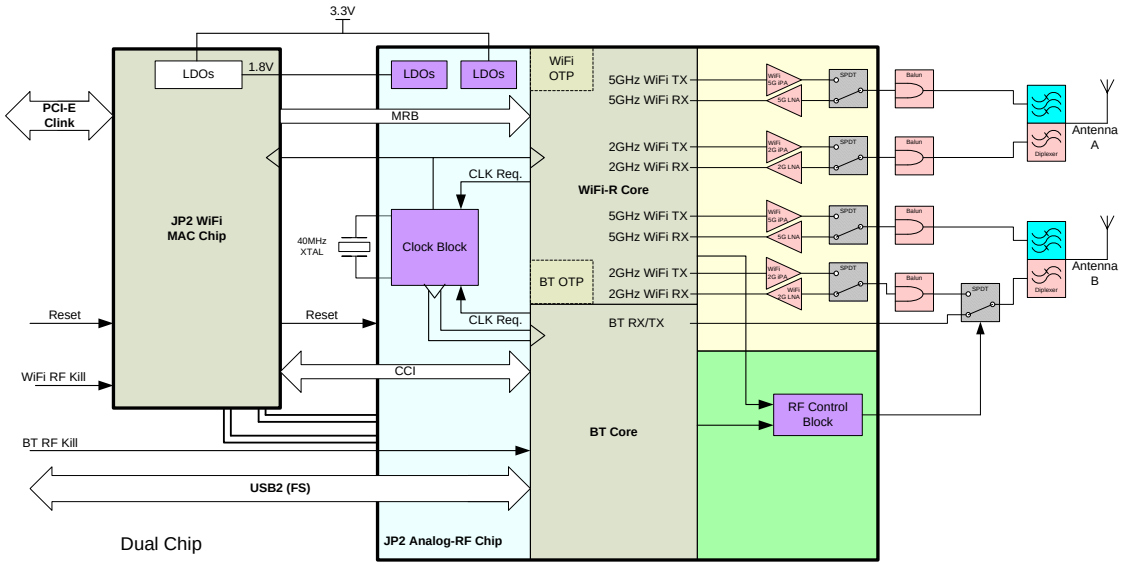


Figure 5: Jackson Peak 2 Schematic Architecture:



3 Electrical Specifications

This section provides information about the electrical specifications for the products hardware. The specification covers the module Hardware Interface Signals, Power Consumption, and DC/AC characteristics. For more details please refer to the PCI Express Mini Card Electromechanical Specification, Revision 1.2 and the PCI Express Base Specification, Revision 1.2. Mostly this is common to all 5 products. Whenever there is any change specific to one of the products, it will be highlighted in the comments column

3.1 Hardware Interface Signals

The Hardware design is based on PCI Express Mini Card Electromechanical Specification. System interface signals are described in the table below.

The Wi-Fi core implements PCI express, compliance to PCIe v1.2 specifications. Bluetooth uses USB 2.0 Full Speed. The Wi-Fi core connects to the PCH through dedicated Clink interface for OOB.

Table 3: PCI Express Mini Card System Interface Signals

Signal Group	Signal	Direction	Description	Comments
Auxiliary Signals (3.3V Compliant)	PERST#	Input	Functional Reset to the card.	
	CLKREQ#	Output	Reference clock request signal.	
	WAKE#	Output	Open Drain active low signal. This signal is used to request that the system return from a sleep/suspended state to service a function initiated wake event.	
PCI Express	REFCLK+, REFCLK-	Input	PCI Express differential reference clock (100 MHz).	
	PETp0, PETn0 PERp0, PERn0	Input/Output	PCI Express x1 data interface: One differential transmit pair and one differential receive pair.	
USB	USB_D+	Input/Output	Comply with USB 2.0 specifications.	
	USB_D-	Input/Output		
SBD	USB Side Band Deferring	Output	Active Low, indicating device has data to send to host.	

Signal Group	Signal	Direction	Description	Comments
Power +3.3Vaux	+3.3 V (4 pins)	Input	3.3 V source (Pin#24 not connected on the card). Total power 3.3V Pins (4).	
	+1.5 V (3 pins)	Not Connected	Not used	
	GND (14 pins)	N/A	Return current path.	
LED	LED_WLAN#	Output	WLAN status indicator.	
	LED_WPAN#	Output	Bluetooth status indicator.	
C-Link	Clink_RST	Input	Intel® Active Management Technology (Intel® AMT) usage - Manageability communication across the platform occurs over C-link (Controller Link).	
	Clink_DAT	Input/Output		
	C-Link_CLK	Input/Output		
Wireless Disable	W_Disable#	Input	Disables Wi-Fi RF portion.	
	W_Disable_2#	Input	Disables Bluetooth RF portion.	
GND	9, 15, 21, 27, 29, 35, 37, 43 4, 18, 26, 34, 40, 50`		Ground pins.	
NC	3, 5, 6, 17, 8,10,12,14,16, 24,28, 30,32, ,42, 48, (15 pins)		All NC pins are unused. These pins include signals that are defined as optional by the PCI Express Mini Card Electromechanical Specification as well as reserved pins that are currently not in use.	

3.2 Pinout Definitions

Table 4: Host Interface Pinout

Pin #	Name	Buffer /State (Power-Up Reset)	Pin #	Name	Buffer/State (Power-Up Reset)
1	WAKE#	Open Drain/Tri-State	2	+3.3Vaux	
3	NC		4	GND	
5	NC		6	NC	
7	CLKREQ#	Open Drain	8	NC	
9	GND		10	NC	
11	REFCLK-		12	NC	
13	REFCLK+		14	NC	
15	GND		16	NC	
17	NC		18	GND	
19	NC. See note below		20	W_DISABLE#	For JP2 the internal pull up resistor on this pin is ~37Kohm typical value (Min 25Kohm, Max 58Kohm). For JP1, CyP, MP, CyP+Bluetooth the internal pull up resistor on this pin is ~45Kohm typical value (Min 34Kohm, Max 71Kohm).
21	GND		22	PERST#	Open Drain/Tri-State
23	PETn0		24	NC	
25	PETp0		26	GND	
27	GND		28	NC	
29	GND		30	NC	
31	PERn0		32	NC	
33	PERp0		34	GND	
35	GND		36	USB D -	

Pin #	Name	Buffer /State (Power-Up Reset)	Pin #	Name	Buffer/State (Power-Up Reset)
37	GND		38	USB D +	
39	+3.3Vaux		40	GND	
41	+3.3Vaux		42	NC	
43	GND		44	LED_WLAN#	Open Drain
45	C-Link_CLK	-Internal Pull – Down ~100 kΩ - Clink pins should not be used in non – Intel®AMT platforms	46	LED_WPAN#	Open drain
47	C-Link_DAT		48	NC	
49	C-Link_RST#	-CL_RST is active low - CL_RST is 'low' when AMT is disabled	50	GND	
51	W_DISABLE#_2.	Internal Pull – Up ~59K typical (Minimum: 42K. Maximum: 88K)	52	+3.3Vaux	

Note: Pins 37, 43 will be driven to GND state (This complies with Mini Card Specification rev 1.1 Input Power ECN).

Note: The led pins (Pin#44 LED_WLAN# and Pin #46 LED_WPAN) configure to true open drain output (disconnect the Internal Pull – Down resistor) after the device is powered. Open Drain output means that these pins output is either '0' (GND) or tri-state (Hi-Z).

Note: Pin #24 is disconnected on board, as in previous product generations.

3.2.1 No Connect (NC) Signals

All NC pins are "unused". These pins include signals that are defined as optional by the PCI Express Mini Card Electromechanical Specification as well as reserved pins that are currently not in use.

3.2.2 Power

All power pins are connected to a power bus that should be tied to 3.3V Vaux via the connector.

3.2.3 Ground (GND)

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

3.3 Module level Power Consumption

3.3.1 Power Pins

Power consumption is measured on the following pins:

3.3V AUX: Pins 2, 24 (NC on card), 39, 41, and 52 are the same rail called Vaux.

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

Note: It is not allowed to connect active signals to the Mini Card input pins unless there is a power supply provided to the power rails pins.

3.3.2 Power Consumption Definitions

Module power consumption: 3.3v rail power consumption.

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

Normal: unless stated otherwise, power consumption refers the highest averaged power consumption value over any 1-second period.

Peak: The highest averaged value over any 10-millisecond period according to PCI Express Mini Card Electromechanical Specification1.2.

3.3.3 Wi-Fi Power Consumption

Scale: MilliWatt (mW)
Meter: measured using Current Probe loop on the Power rails of the Mini-card (or Half Mini-card interface/Pins)
The following tables provide product power consumption at 802.11 states. Power consumption refers to the total consumed power, over 3.3v and 1.5v power rails (Note that the 1.5v Power rail is not in use). Power consumption targets refer to all channels in all frequency bands for both Netbook and Notebook supported platforms
Accuracy of power consumption values is as follows:

- Values for the low power states are Mean values ±4mW.
- Values for Tx and Rx power consumption are mean values ±5%.

Assumptions:

- PCI-e ASPM (L1) is enabled.(Note that L0s is not used)
- Transmit output power, is assumed to be 15dBm
- Platform is running on Battery and Power Index is set to Max Power save (battery Life)

Table 5: Power Consumption – Wi-Fi States (mW)

Name	Description	Power Consumption Requirements (mW)					
		CyP	CyP+BT	JP1	JP2		MP
		LB	LB	LB	LB	HB	LB
MM05/07	Mobile Mark 2005/2007 (Power	70	85	43	105	105	35

Name	Description	Power Consumption Requirements (mW)					
		CyP	CyP+BT	JP1	JP2		MP
		LB	LB	LB	LB	HB	LB
	Index =3;balanced)						
Idle associated	Idle associated (1 scan) (PI=3)	65	80	43	100	100	35
Idle Unassociated	Idle unassociated (1 Scan)	22	24	24	85	85	22
Disabled/RF-Kill/uninitialized	Disable/RF-Kill/uninitialized	16	18	18	55	55	16
WoWLAN	Platform at S3. with WoWLAN Associated (1 Scan)	45	80	80	80	80	45
Average Tx legacy/1SS	Average TCP/IP legacy or 1 SS Transmit during 60sec, no rate limitation	1100	1100	1050	1075	1215	1050
Average Rx Legacy/1SS	Average TCP/IP Legacy or 1SS Receive during 60sec, no rate limitation.	700	700	700	715	775	700
Average Tx 2SS	Average TCP/IP 2 SS Transmit during 60sec, no rate limitation	NA	NA	1850	1825	1835	1850
Average Rx 2SS	Average TCP/IP 2 SS Receive during 60sec, no rate limitation.	NA	NA	1050	1065	1155	1050
Max WiFi TDP	Average power consumption during 60 sec transmission at max TCP/IP throughput.	1100	1150	1920	NA	1920	1900

Table 6: NetDetect Power Consumption

Scan Period	Marble Peak (mW) LB	Jackson Peak 1 (mW) LB	Jackson Peak 2 (mW) LB+HB	Jackson Peak 2 (mW) LB
30s	47.56	55.24	114.26	64.72
60s	33.78	41.12	75.63	50.86

Scan Period	Marble Peak (mW) LB	Jackson Peak 1 (mW) LB	Jackson Peak 2 (mW) LB+HB	Jackson Peak 2 (mW) LB
180s	24.59	31.71	49.88	41.62
300s	22.76	29.82	44.73	39.77
600s	21.38	28.41	40.86	38.39
1200s	20.69	27.71	38.93	37.69

Table 7: Power Consumption – AMT States

Power Consumption		
Name	**Description**	**JP2**
AMT8.0 Power Consumption S0-Hx / M0, Mla, Rx	AMT is taking ownership of the NIC in Hx, while actively receiving Legacy (802.11g) mode. Traffic Scenario of TCP/IP, 1 Rx chain, No aggregation	920
AMT8.0 Power Consumption S0-Hx / M0, Mla, Tx	AMT is taking ownership of the NIC in Hx, while actively transmitting in Legacy (802.11g) mode. Traffic Scenario of TCP/IP, 1 Tx chain, No aggregation	960
AMT8.0 Power Consumption S0-Hx / M0, MLs, Host driver enabled	AMT is taking ownership of the NIC in Hx, while idle between Tx and Rx and Host Driver is enabled. Test conditions: PC at room temperature, Two minutes average, Max Power Save Mode, One Scan.	135
AMT8.0 Power Consumption S0-Hx / M0, MLs, Host driver disabled	AMT is taking ownership of the NIC in Hx, while idle between Tx and Rx, and Host Driver is disabled. Test conditions: PC at room temperature, Two minutes average, Max Power Save Mode, One Scan.	155
AMT8.0 Power Consumption S0 / M0-idle Driver disabled	AMT is taking ownership of the NIC and the Host driver is disabled. Test conditions: PC at room temperature, Two minutes average, Max Power Save Mode, One Scan.	120
AMT8.0 Power Consumption Sx-PP3(M1), LP=31	AMT is taking ownership of the NIC in Sx, at idle associate state power down.	100
AMT8.0 Power Consumption Sx, PP2(Moff) LP=31WoWLAN	AMT is taking ownership of the NIC in Sx, and WoWLAN is enabled	150

3.3.4 Bluetooth Power Consumption

Canyon Peak w/BT, Jackson Peak 1, Jackson Peak 2 Bluetooth core shall have the following power consumption as listed in the table below.
Tests conditions:

- Module will be installed as an embedded module in a laptop
- Bluetooth COM only. WiFi shall be disabled by using driver disable from device manager. AMT shall be disabled.

- The total power consumption for the module shall be:
  - Bluetooth only power rails
  - WiFi disable power consumption (22mW according to WiFi core requirements)
  - Crystal power (15mW)
- Data shall be average over 10 seconds.
- Tests shall be done in HCI level and in system level.

Table 8: Bluetooth Power Consumption - HCI Level

State	Packet Type	Role	WLAN NIC Bluetooth Power Consumption (mW)					
					CrP+BT	CyP+Bt	JP1	JP2
USB suspended by OS					1	1	1	1
HW RF Kill					1	1	1	1
USB connected, device in idle					17	17	17	17
Connectable non discoverable Page scan (1280mS interval)					17	17	17	17
Connectable and discoverable Inquiry and Page Scan (inquiry 2560ms interval, Page scan 1280ms interval)					19	19	19	19
Connectable and Add new device Inquiry (2560ms interval), Page scan (1280ms interval)					93	93	93	93
Sniff mode 40mS interval, 1 attempt	DH1	Master			22	22	22	22
Sniff mode 40mS interval, 1 attempt	0x331E	Slave			24	24	24	24
Sniff mode 1280mS interval, 1 attempt	DH1	Master			19	19	19	19
Sniff mode 1280mS interval, 1 attempt	0x331E	Slave			20	20	20	20
SCO	HV1	Master			129	129	129	129
SCO	HV1	Slave			129	129	129	129
SCO	HV3	Master			47	47	47	47
SCO	HV3	Slave			57	57	57	57

State	Packet Type	Role	WLAN NIC Bluetooth Power Consumption (mW)					
					CrP+BT	CyP+Bt	JP1	JP2
SCO sniff mode (30ms interval, 1 attempt)	HV3	Master			50	50	50	50
SCO sniff mode (30ms interval, 1 attempt)	HV3	Slave			47	47	47	47
eSCO (setting S2)	EV3	Master			40	40	40	40
eSCO (setting S2)	0x3c8	Slave			53	53	53	53
eSCO (setting S1)	EV5	Master			33	33	33	33
eSCO (setting S1)	0x3e0	Slave			47	47	47	47
eSCO (setting S5)	2EV3	Master			37	37	37	37
eSCO (setting S5)	0x380	Slave			52	52	52	52
eSCO (setting S5) + Sniff mode (100ms, 1 attempt)	2EV3	Master			35	35	35	35
eSCO (setting S5) + Sniff mode (100ms, 1 attempt)	0x380	Slave			37	37	37	37
ACL	DH1	Master (Tx)			106	106	106	106
ACL	0x331	Slave (Rx)			109	109	109	109
ACL (BR ~700kbps)	DH5	Master (Tx)			149	149	149	149
ACL (BR ~700kbps)	0xb30e	Slave (Rx)			165	165	165	165
ACL (EDR2 1.4Mbps)	2DH5	Master (Tx)			149	149	149	149
ACL (EDR2 1.4Mbps)	0x230e	Slave (Rx)			165	165	165	165
ACL (EDR3 2.0Mbps)	3DH5	Master (Tx)			149	149	149	149
ACL (EDR3 2.0Mbps)	0x130e	Slave (Rx)			165	165	165	165

Table 9: Bluetooth Power Consumption - System Level

Name	Packet type	Role	Power Consumption (mW)			
			CrP+BT	CyP+BT	JP1	JP2
SW RF Kill			1	1	1	1
USB connected, device in idle (no scan nor connection)			17	17	17	17
Connectable non discoverable Page scan (1280mS interval)			17	17	17	17
Connectable and discoverable Inquiry and Page Scan (inquiry 1280ms interval, Page scan 1280ms interval)			19	19	19	19
Connectable and Add new device Inquiry (2560ms interval), Page scan (1280ms interval)			93	93	93	93
SCO - link established, no traffic	HV1	Master	20	20	20	20
SCO - link established, no traffic	HV1	Slave	20	20	20	20
SCO voice to mono headset (HFP) , 1m distance	HV1	Master	129	129	129	129
SCO voice to mono headset (HFP) , 1m distance	HV1	Slave	129	129	129	129
SCO voice to mono headset (HFP), 1m distance	HV3	Master	50	50	50	50
SCO voice to mono headset (HFP), 1m distance	HV3	Slave	60	60	60	60
eSCO (voice to mono headset HFP, 1m distance)	EV3	Master	40	40	40	40
eSCO (voice to mono headset HFP, 1m distance)	EV3	Slave	53	53	53	53

Name	Packet type	Role	Power Consumption (mW)			
			CrP+BT	CyP+BT	JP1	JP2
eSCO (voice to mono headset HFP, 1m distance)	2EV3	Master	37	37	37	37
eSCO (voice to mono headset HFP, 1m distance)	2EV3	Slave	52	52	52	52
eSCO (voice to mono headset, 1m distance+ Sniff mode	2EV3	Master	35	35	35	35
eSCO (voice to mono headset, 1m distance+ Sniff mode	2EV3	Slave	37	37	37	37
ACL - paired but no traffic	DH1	Master (Tx)	24	24	24	24
ACL - paired but no traffic	DH1	Slave (Rx)	47	47	47	47
ACL FTP basic rate	DH1	Master (Tx)	106	106	106	106
ACL FTP basic rate	DH1	Slave (Rx)	109	109	109	109
ACL FTP basic rate	DH5	Master (Tx)	149	149	149	149
ACL FTP basic rate	DH5	Slave (Rx)	165	165	165	165
ACL FTP EDR rate 1.4Mbps	2DH5	Master (Tx)	149	149	149	149
ACL FTP EDR rate 1.4Mbps	2DH5	Slave (Rx)	165	165	165	165
ACL FTP EDR2 rates 2.0Mbps	3DH5	Master (Tx)	149	149	149	149
ACL FTP EDR2 rates 2.0Mbps	3DH5	Slave (Rx)	165	165	165	165
ACL A2DP Basic Rate - profile active no traffic	??	Master (Tx)	24	24	24	24
ACL A2DP Basic Rate - profile active no traffic	??	Slave (Rx)	47	47	47	47

Name	Packet type	Role	Power Consumption (mW)			
			CrP+BT	CyP+BT	JP1	JP2
ACL A2DP Basic Rate - stream audio to stereo headset, 1 m distance	??	Master (Tx)	106	106	106	106
ACL A2DP Basic Rate - stream audio to stereo headset, 1 m distance	??	Slave (Rx)	109	109	109	109

Table 10: BLE Power Consumption Targets

Connection Type	Test info	Power Consumption (mW)		
		CyP+BT	JP1	JP2
Sleep	Deep sleep with host connection	13	13	13
BTLE Advertising	BTLE Advertising NonConnectable 1280ms interval 15byte payload	14	14	14
BTLE Advertising	BTLE Advertising Discoverable 1280ms interval 15byte payload	14	14	14
BTLE Advertising	BTLE Advertising Connectable 1280ms interval 15byte payload	14	14	14
BTLE Scanning	BTLE Scanning 1280ms interval	20	20	20
BTLE Connection	Master BTLE connected 500ms interval	22	22	22
BTLE Connection	Slave BTLE connected 500ms interval	19	19	19

3.3.5 ACPI Device State Support

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

Table 11: Supported D-States

Device Power States	Description
D0 (Uninitiated and Active)	Supported
D3 (hot and cold)	Supported

3.3.6 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 so, the JP1, JP2, MP,

CyP, CYP 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.

Not supporting L0s leads to measures that need to be taken in the Platform level to disable the L0s ability in the Root side (chip-set/ICH side) or else a system hang may occur;

For these devices below steps must be taken to limit the L0s ASPM State

During normal ASPM initialization:

Scan each PCI Express* Root Port for the JP1, JP2, MP, Cy or CyP+Bluetooth Wireless Ethernet Controller PCI Vendor/Device IDs.

For all Controllers listed above, when enabling ASPM, disable L0s for the root port (ICH Side) regardless of the support reported. Disabling L0s for the root port should be done via the Link Control Register (Offset 10h) [1:0]. These values should be restored during an S3 resume.

> ***Note:*** The device driver shall disable the L0s on its side (endpoint) and shall enable L1a to maintain low Power consumption capabilities.

Repeat the steps for all applicable network controllers in the system.

Microsoft Windows Vista* (and Microsoft Windows 7*) may Override the BIOS ASPM Settings:

JP1, JP2, MP, CyP or CyP+Bluetooth (need to be replaced with official naming/Part Number) hardware devices present and native PCI Express support is enabled via _OSC method, and then the FACP Bit IAPC_BOOT_ARCH (bit 4) needs to be set. This will leave ASPM control in the hands of the platform/system BIOS.

FACP bit, if set, indicates to the OSPM that it must not enable OSPM ASPM control on the platform.

No issue is expected with BIOS that does not use OSC method.

Please see the "Advanced Configuration and Power Interface" Specification for more information regarding the IAPC_BOOT_ARCH bit.

3.4 Mini Card DC Specifications

For Mini Card DC Specification refer to PCI Express Mini Card Electromechanical Specification and Input Power and Voltage Tolerance ECN. The Max Power (as max defined in the Mini Card Spec) is 2000mW =>667mA (need at least 2 Power Pins of the 5 exists in the Mini Card spec, Max limit for each Pin is 500mA).

3.5 Wireless Disable

3.5.1 Wi-Fi Hardware RF Disable

The W_Disable# input signal on Pin 20 of the Mini Card system 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 1mA value is taken from the PCI Express Mini Card electrical Specification. However, the JP1, JP2, MP, CyP, CyP w/Bluetooth case should be able to drive a much lower current when the W_Disable# signal is active low (~50uA).

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. Note: Due to the potential of a software disable state, 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# be in a deterministic state (asserted or de-asserted) whenever power is applied to the Card (i.e., whenever either +3.3V is present).

For JP2 the internal pull up resistor on this pin is ~37Kohm typical value (Min 25Kohm, Max 58Kohm).

For JP1, CyP, MP, CyP+Bluetooth the internal pull up resistor on this pin is ~45Kohm typical value (Min 34Kohm, Max 71Kohm).

The operation of the signal is as following

Float = Radio is on.

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

Table 12: 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 Hardware RF Disable

W_DISABLE#_2 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 like removing the Bluetooth device from the laptop.

The W_DISABLE#_2 internal pull up resistor is 59Kohm typical value (Min 42Kohm, Max 88Kohm).

Optional SW RF Kill: This feature can be enabled during installation using a special command. See TPS for more details

As opposed to the HW RF kill which is similar to device removal, the SW RF kill is actually a Bluetooth driver disable command.

The following table summarizes the differences between SW and HW RF kill options:

Option	Bluetooth HW RF Kill	Bluetooth SW RF Kill
RF Activity	Off	Off
USB Interface	Off	On
LED State	Off	On

(*) Assuming WiFi is in RF Kill too.

Please note, that conflicts between Bluetooth SW and HW RF kill commands might occur. The SW stack does not handle such conflicts. Therefore, a recommended practice is not to enable both mechanisms. If the OEM does wish to enable both Bluetooth SW and HW RF Kill mechanisms, it is recommended to at least to pop up a message that user needs to make sure both are set to "on" in order to enable Bluetooth activity.

3.6 Auxiliary Signal (PERST#, WAKE#, REFCLK)

For more information, please refer to the PCI Express Card Electromechanical Specification, Rev. 1.1.

3.7 Mini Card Supply Ripple Limits

For all Mini Card voltage rails (3.3V), it is recommended not to exceed 200mVpp ripple in the frequency range of 10-500 KHz.

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

4 Host interface Description

4.1 USB Interface

Table 10 describes the Bluetooth USB interface's main characteristics.

Table 13: USB Interface Signal Description

USB Interface	Description
USB Version	Supports 2.0 version.
Operational Mode	Full Speed modes.
Power	Powered from PCI Express interface (3.3V 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.

4.2 PCI Interface

Squelch Detect Mechanism

The Squelch (SQ) Detect mechanism in JP/MP/CyP may not consistently identify PCH "wake" signaling (TS1 symbols) as valid above "SQ Max" threshold of 175 mV, as defined by 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:

- 65mV to 450mV for JP2
- 65mV to 280mV for JP1/MP/CyP/CyP_BT

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

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 below describes the Thermal dissipation and the targets per operated mode.

Table 14: Jackson Peak1 Thermal Dissipation

Name	Description
TDP Limit Functional targets	Worst case TDP shall not be higher than 1850mW. The worst case TDP shall be based on Average Power consumption measurement over 5 Minutes with Max TCP/IP Throughput activity.

Table 15: Jackson Peak2 Thermal Dissipation

Name	Description
TDP Limit Functional targets	Worst case TDP shall not be higher than 1450mW. The Worst case TDP shall be based on Average Power consumption measurement over 5 Minutes with Max TCP/IP Throughput activity.

Table 16: Canyon Peak Thermal Dissipation

Name	Description
TDP Limit Functional targets	Worst case TDP shall not be higher than 1850mW. The worst case TDP shall be based on Average Power consumption measurement over 5 Minutes with Max TCP/IP Throughput activity.

Table 17: Canyon Peak with Bluetooth Thermal Dissipation

Name	Description
TDP Limit Functional targets	Worst case TDP shall not be higher than 1850mW. The worst case TDP shall be based on Average Power consumption measurement over 5 Minutes with Max TCP/IP Throughput activity.

Table 18: Marble Peak Thermal Dissipation

Name	Description

Name	Description
TDP Limit Functional targets	Worst case TDP shall not be higher than 1850mW. The worst case TDP shall be based on Average Power consumption measurement over 5 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

JacksonPeak1, JacksonPeak2, Marble Peak, Canyon Peak and Canyon Peak with Bluetooth thermal is derived from its components MAC Baseband and the Radio chipset.

Table 19: JacksonPeak1, JacksonPeak2, Marble Peak, Canyon Peak and Canyon Peak with Bluetooth Thermal Management

Name	Description
Thermal Shield Performance targets	JP1, JP2, MP, CyP and CyP w/Bluetooth shall have full performance at shield temperatures up to 80ºC. Testing conditions: • System environmental conditions: 1. High limit: ~50-55ºC under controlled environment (Oven), with no air flow (inside a Box). 2. Low limit: 0ºC (starting point) under controlled environment (Oven), with no air flow (inside a Box).
Thermal Silicon protection	JP1, JP2, MP, CyP and CyP w/Bluetooth shall have silicon protection mechanism (CT-Kill). Thermal Silicon protection will not be activated below 95ºC T-shield temperature.

5.2.1 Thermal Management and Critical Shutdown

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

5.2.2 Wi-Fi Thermal Throttling

The Product implements an autonomous Thermal throttling algorithm, to protect the Silicon from permanent thermal damage, and ensure (as much as possible) connectivity even in hard Thermal conditions.

- Rx throttling – Use the set the Power Index (Power saving Modes) according to Temp' measurement
- Tx throttling – Use the MIMO Mode according to Temp' measurement thresholds
- CT Kill – Shut down the card when reaching a Critical Temperature

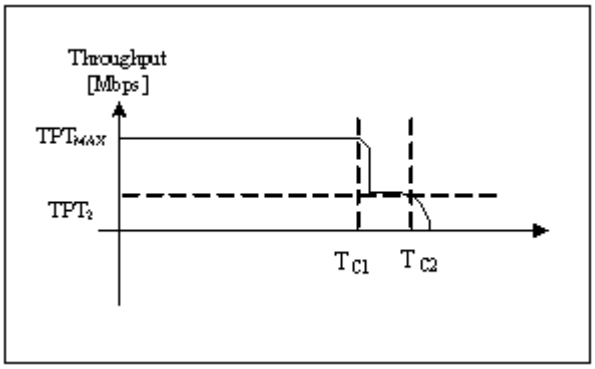
Definitions:

1. T-ambient is the system Environment temperature in the card surrounding, with no air flow; T-ambient is platform related value and can be different from Platform to Platform; so it cannot be used for validation, see T-oven for comparable value
2. T-oven is the temperature in the immediate surroundings of the card when it is in thermal oven (the temperate is constant in the Card surrounding, +/-1c) with NO Air-Flow (the card is inside a closed box, inside the Oven)
3. T-Shield is the temperature on the Shield of the card (on the Shield) above the Radio unit (The Hot-spot of the Card) – this is the real deterministically measurable meter.

The Tx Throttling is guaranteeing the Wi-Fi functionality, and meet quality and reliability requirements at thermal constraints While maximal performance (at high Shield temperature) is reduced, as described in this section.

<table>
<tr>
<td>

TPTmax – maximum throughput
TPT2 – the minimum throughput after the throttling
Ts1 (appears as Tc1) – the shield temperature that allows Max TPT, above Ts1 max TPT may not be available
Ts2 (appears as Tc2) – the shield temperature that allows Wi-Fi functionality, above Ts2 Wi-Fi functionality may not be available
To1/To2 are the equivalent Oven temperature (assuming no Air flow) to Ts1 and Ts2

</td>
<td> 
</td>
</tr>
<tr>
<td>TPTmax = 300Mbps (Phy rate)
TPT2 = 54Mbps (Legacy Phy rate)</td>
<td>Ts1 = 80°c (To1 =~ 50°c, No air-flow)
Ts2 = 95°c (To2 =~ 70°c, No air-flow)</td>
</tr>
</table>

6 LED Indicators

JP1, JP2, CyP+Bluetooth products have 2 LEDs signals each: A Bluetooth LED, and a Wi-Fi LED.

MP, CyP products have WiFi LED only (no Bluetooth supported)

The signals are open drain.

The Bluetooth LED functionality is as described below:

1. LED is OFF when the Bluetooth is in HW RF Kill (including idle, SW RF Kill = driver disable, etc.).
2. LED is ON otherwise

The Wi-Fi LED functionality is as described below:

1. LED is OFF when the Wi-Fi is not powered
2. LED is ON when Powered, associated, and authenticated but not transmitting or receiving.

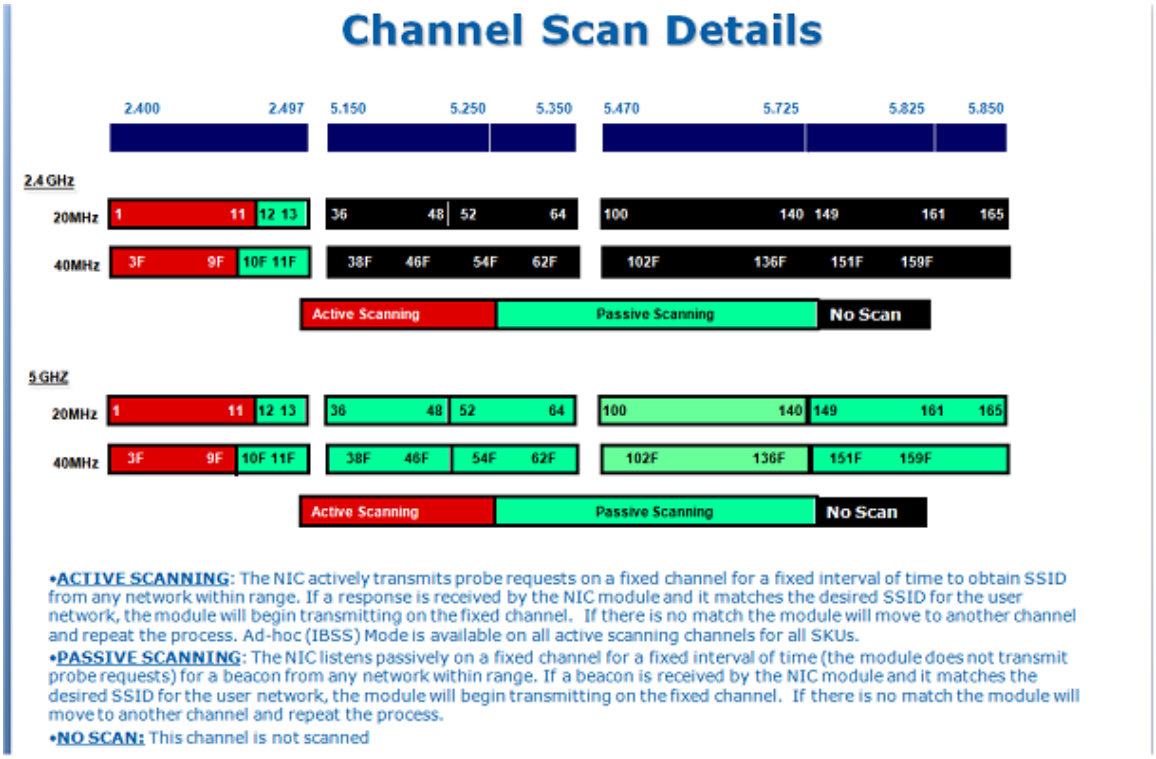
7 Regulatory Channel Support and Output Power

7.1 Wi-Fi Channel Configuration

7.1.1 Channel Configuration Tables

See table below.

Table 20: JacksonPeak1, JacksonPeak2, Marble Peak, Canyon Peak and Canyon eak with Bluetooth Scan Details



7.1.2 Antenna Gain for Product and Country Certifications

Intel uses the following antenna max gain for product and country certification:

- 3dBi for the 2.4Ghz
- 5dBi for the 5Ghz

Antenna gain above includes cable loses.

7.1.3 Maximum Legacy and MIMO RF Output Power

JacksonPeak1, JacksonPeak2, Marble Peak, Canyon Peak and Canyon Peak with Bluetooth TX power shall be up-to16.5 dB assuming power is combined from all antennas.

7.1.4 Maximum Bluetooth Output Power

Output power for Bluetooth will be documented in future release of this EPS.

7.1.5 Output Power Restrictions (Main Geo's)

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.						

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

7.1.6 Channel Configuration Tables / RF Output Power

The values listed in the power table (EEPROM table) below represent the target power for the calibration process without antennae gain. This value has been verified to ensure margin to the regulatory limit based on post EEPROM factory calibration measurements using a diagnostic tool which 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 and any cards that exceed the maximum limits (EEPROM + 1.5dB) will not pass factory test. While in operation the card adjusts its 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 +/-1dB from the target, over temperature and voltage.

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

Intel also incorporates a lower limit to ensure that the 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).

Table 21: Canyon Peak, Canyon Peak + BT, CCK-Mode Configuration

Ch	Channel center in MHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	Tx Power (dBm) CyP	Tx Power (dBm) CyP+BT
1	2.412	Y	Y	Y	N	N	15	14.5
2	2.417	Y	Y	Y	N	N	15	15
3	2.422	Y	Y	Y	N	N	15	15

Ch	Channel center in MHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	Tx Power (dBm) CyP	Tx Power (dBm) CyP+BT
4	2.427	Y	Y	Y	N	N	15	15
5	2.432	Y	Y	Y	N	N	15	15
6	2.437	Y	Y	Y	N	N	15	15
7	2.442	Y	Y	Y	N	N	15	15
8	2.447	Y	Y	Y	N	N	15	15
9	2.452	Y	Y	Y	N	N	15	15
10	2.457	Y	Y	Y	N	N	15	15
11	2.462	Y	Y	Y	N	N	15	15
12	2.467	N	N	Y	N	N	15	15
13	2.472	N	N	Y	N	N	14.5	14
	Note - Prior to Production phase the Tx Power setting is not set accurately;							

Table 22: Canyon Peak, Canyon Peak + BT, OFDM-mode .11n Configuration

Ch	Channel center in MHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	Tx Power (dBm) CyP	Tx Power (dBm) CyP+BT
1	2.412	Y	Y	Y	N	N	13	13
2	2.417	Y	Y	Y	N	N	15	15
3	2.422	Y	Y	Y	N	N	15	15
4	2.427	Y	Y	Y	N	N	15	15
5	2.432	Y	Y	Y	N	N	15	15
6	2.437	Y	Y	Y	N	N	15	15
7	2.442	Y	Y	Y	N	N	15	15
8	2.447	Y	Y	Y	N	N	15	15
9	2.452	Y	Y	Y	N	N	15	15
10	2.457	Y	Y	Y	N	N	15	15
11	2.462	Y	Y	Y	N	N	12.5	13
12	2.467	N	N	Y	N	N	15	15
13	2.472	N	N	Y	N	N	13.5	13.5
Note - Prior to Production phase the Tx Power setting is not set accurately;								

Table 23: Canyon Peak, Canyon Peak + BT, OFDM-mode .11n Configuration

Ch	Channel center in MHz	Active Scanning Allowed	IBSS Allowed	MWT in same channel mode allowed	DFS applicable	Uniform Spreading	Tx Power (dBm) CyP	Tx Power (dBm) CyP+BT
1	2.412	Y	Y	Y	N	N	12.5	12
2	2.417	Y	Y	Y	N	N	15	15
3	2.422	Y	Y	Y	N	N	15	15
4	2.427	Y	Y	Y	N	N	15	15
5	2.432	Y	Y	Y	N	N	15	15
6	2.437	Y	Y	Y	N	N	15	15
7	2.442	Y	Y	Y	N	N	15	15
8	2.447	Y	Y	Y	N	N	15	15
9	2.452	Y	Y	Y	N	N	15	15
10	2.457	Y	Y	Y	N	N	15	15
11	2.462	Y	Y	Y	N	N	12.5	12.5
12	2.467	N	N	Y	N	N	15	15
13	2.472	N	N	Y	N	N	13.5	13
(1,1) (5,-1)	2.422	Y	Y	Y	N	N	9.5	9.5
(2,1) (6,-1)	2.427	Y	Y	Y	N	N	10.5	10.5
(3,1) (7,-1)	2.432	Y	Y	Y	N	N	12	11.5
(4,1) (8,-1)	2.437	Y	Y	Y	N	N	11.5	12
(5,1) (9,-1)	2.442	Y	Y	Y	N	N	11	11
(6,1) (10,-1)	2.447	Y	Y	Y	N	N	10	10
(7,1) (11,-1)	2.452	Y	Y	Y	N	N	9	9.5
(8,1) (12,-1)	2.457	N	N	Y	N	N	14	14.5
(9,1) (13,-1)	2.462	N	N	Y	N	N	13	13

Table 24: Jackson Peak2, CCK-Mode Configuration

Ch	Channel center in MHz	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	14	14
2	2.417	Y	Y	Y	N	N	14.5	14
3	2.422	Y	Y	Y	N	N	14.5	14
4	2.427	Y	Y	Y	N	N	14.5	14
5	2.432	Y	Y	Y	N	N	14.5	14
6	2.437	Y	Y	Y	N	N	14.5	14
7	2.442	Y	Y	Y	N	N	14.5	14
8	2.447	Y	Y	Y	N	N	14.5	14
9	2.452	Y	Y	Y	N	N	14.5	14
10	2.457	Y	Y	Y	N	N	14.5	14
11	2.462	Y	Y	Y	N	N	14.5	14
12	2.467	N	N	Y	N	N	14.5	14
13	2.472	N	N	Y	N	N	14	14
	Note - Prior to Production phase the Tx Power setting is not set accurately;							

Table 25: Jackson Peak2, OFDM-mode non-.11n Configuration

Ch	Channel center in MHz	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	12.5	12
2	2.417	Y	Y	Y	N	N	15	15
3	2.422	Y	Y	Y	N	N	15	15
4	2.427	Y	Y	Y	N	N	15	15
5	2.432	Y	Y	Y	N	N	15	15
6	2.437	Y	Y	Y	N	N	15	15
7	2.442	Y	Y	Y	N	N	15	15
8	2.447	Y	Y	Y	N	N	15	15
9	2.452	Y	Y	Y	N	N	15	15
10	2.457	Y	Y	Y	N	N	15	15

Ch	Channel center in MHz	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)
11	2.462	Y	Y	Y	N	N	12.5	12
12	2.467	N	N	Y	N	N	15	15
13	2.472	N	N	Y	N	N	13	13
36	5.18	N	N	Y	N	Y	13	14
40	5.2	N	N	Y	N	Y	14.5	14.5
44	5.22	N	N	Y	N	Y	14.5	14.5
48	5.24	N	N	Y	N	Y	14.5	14.5
52	5.26	N	N	N	Y	N	14.5	14.5
56	5.28	N	N	N	Y	N	14.5	14.5
60	5.3	N	N	N	Y	N	14.5	14.5
64	5.32	N	N	N	Y	N	14.5	14.5
100	5.5	N	N	N	Y	N	14.5	14.5
104	5.52	N	N	N	Y	N	14.5	14.5
108	5.54	N	N	N	Y	N	14.5	14.5
112	5.56	N	N	N	Y	N	14.5	14.5
116	5.58	N	N	N	Y	N	14.5	14.5
120	5.6	N	N	N	Y	N	14.5	14.5
124	5.62	N	N	N	Y	N	14.5	14.5
128	5.64	N	N	N	Y	N	14.5	14.5
132	5.66	N	N	N	Y	N	14.5	14.5
136	5.68	N	N	N	Y	N	14.5	14.5
140	5.7	N	N	N	Y	N	14.5	14.5
149	5.745	N	N	Y	N	Y	14.5	14.5
153	5.765	N	N	Y	N	Y	14.5	14.5
157	5.785	N	N	Y	N	Y	14.5	14.5
161	5.805	N	N	Y	N	Y	14.5	14.5
165	5.825	N	N	Y	N	Y	14.5	14.5
Note - Prior to Production phase the Tx Power setting is not set accurately;								

Table 26: Jackson Peak 2, OFDM-mode .11n Configuration

Ch	Channel center in MHz	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	11.5	11	11
2	2.417	Y	Y	Y	N	N	15	15	12
3	2.422	Y	Y	Y	N	N	15	15	12
4	2.427	Y	Y	Y	N	N	15	15	12
5	2.432	Y	Y	Y	N	N	15	15	12
6	2.437	Y	Y	Y	N	N	15	15	12
7	2.442	Y	Y	Y	N	N	15	15	12
8	2.447	Y	Y	Y	N	N	15	15	12
9	2.452	Y	Y	Y	N	N	15	15	12
10	2.457	Y	Y	Y	N	N	15	15	12
11	2.462	Y	Y	Y	N	N	11	11	10
12	2.467	N	N	Y	N	N	15	15	12
13	2.472	N	N	Y	N	N	13	13	11.5
36	5.18	N	N	Y	N	Y	12.5	13.5	11.5
40	5.2	N	N	Y	N	Y	14.5	14.5	11.5
44	5.22	N	N	Y	N	Y	14.5	14.5	11.5
48	5.24	N	N	Y	N	Y	14.5	14.5	11.5
52	5.26	N	N	N	Y	N	14.5	14.5	11.5
56	5.28	N	N	N	Y	N	14.5	14.5	11.5
60	5.3	N	N	N	Y	N	14.5	14.5	12
64	5.32	N	N	N	Y	N	14	14	12
100	5.5	N	N	N	Y	N	14.5	14.5	12
104	5.52	N	N	N	Y	N	14.5	14.5	11.5
108	5.54	N	N	N	Y	N	14.5	14.5	11.5
112	5.56	N	N	N	Y	N	14.5	14.5	11.5
116	5.58	N	N	N	Y	N	14.5	14.5	11.5
120	5.6	N	N	N	Y	N	14.5	14.5	12
124	5.62	N	N	N	Y	N	14.5	14.5	11.5
128	5.64	N	N	N	Y	N	14.5	14.5	11.5

Ch	Channel center in MHz	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	5.66	N	N	N	Y	N	14.5	14.5	11.5
136	5.68	N	N	N	Y	N	14.5	14.5	11.5
140	5.7	N	N	N	Y	N	14.5	14.5	12
149	5.745	N	N	Y	N	Y	14.5	14.5	11.5
153	5.765	N	N	Y	N	Y	14.5	14.5	11.5
157	5.785	N	N	Y	N	Y	14.5	14.5	11.5
161	5.805	N	N	Y	N	Y	14.5	14.5	11.5
165	5.825	N	N	Y	N	Y	14.5	14.5	11.5
(1,1) (5,-1)	2.422	Y	Y	Y	N	N	8	7.5	6
(2,1) (6,-1)	2.427	Y	Y	Y	N	N	9	8	8
(3,1) (7,-1)	2.432	Y	Y	Y	N	N	11	10.5	10
(4,1) (8,-1)	2.437	Y	Y	Y	N	N	12	11	11
(5,1) (9,-1)	2.442	Y	Y	Y	N	N	10	10	9
(6,1) (10,-1)	2.447	Y	Y	Y	N	N	9.5	8.5	7.5
(7,1) (11,-1)	2.452	Y	Y	Y	N	N	8.5	7.5	6.5
(8,1) (12,-1)	2.457	N	N	Y	N	N	13	12	11.5
(9,1) (13,-1)	2.462	N	N	Y	N	N	12	11.5	11
(36,1) (40,-1)	5.19	N	N	Y	N	Y	10	10	8
(44,1) (48,-1)	5.23	N	N	Y	N	Y	14	14	12
(52,1) (56,-1)	5.27	N	N	N	Y	N	14	14	12
(60,1) (64,-1)	5.31	N	N	N	Y	N	10	10.5	8.5
(100,1) (104,-1)	5.51	N	N	N	Y	N	13	13	11

Ch	Channel center in MHz	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
(108,1) (112,-1)	5.55	N	N	N	Y	N	14.5	14.5	11.5
(116,1) (120,-1)	5.59	N	N	N	Y	N	14.5	14.5	11.5
(124,1) (128,-1)	5.63	N	N	N	Y	N	14.5	14.5	11.5
(132,1) (136,-1)	5.67	N	N	N	Y	N	14.5	14.5	11.5
(149,1) (153,-1)	5.755	N	N	Y	N	Y	14.5	14.5	11.5
(157,1) (161,-1)	5.795	N	N	Y	N	Y	14.5	14.5	11.5

Table 27: Jackson Peak1, CCK-Mode Configuration

Ch	Channel center in MHz	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	14.5	13.5
3	2.422	Y	Y	Y	N	N	14.5	13.5
4	2.427	Y	Y	Y	N	N	14.5	13.5
5	2.432	Y	Y	Y	N	N	14.5	13.5
6	2.437	Y	Y	Y	N	N	14.5	13.5
7	2.442	Y	Y	Y	N	N	14.5	13.5
8	2.447	Y	Y	Y	N	N	14.5	13.5
9	2.452	Y	Y	Y	N	N	14.5	13.5
10	2.457	Y	Y	Y	N	N	14.5	13.5
11	2.462	Y	Y	Y	N	N	14.5	13.5
12	2.467	N	N	Y	N	N	14.5	13.5
13	2.472	N	N	Y	N	N	14.5	13.5
Note - Prior to Production phase the Tx Power setting is not set accurately;								

Table 28: Jackson Peak1 OFDM-mode non-.11n Configuration

Ch	Channel center in MHz	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	12.5
2	2.417	Y	Y	Y	N	N	15.0	14.5
3	2.422	Y	Y	Y	N	N	15.5	15.5
4	2.427	Y	Y	Y	N	N	15.5	15.5
5	2.432	Y	Y	Y	N	N	15.5	15.5
6	2.437	Y	Y	Y	N	N	15.5	15.5
7	2.442	Y	Y	Y	N	N	15.5	15.5
8	2.447	Y	Y	Y	N	N	15.5	15.5
9	2.452	Y	Y	Y	N	N	15.5	15.5
10	2.457	Y	Y	Y	N	N	15.5	15.5
11	2.462	Y	Y	Y	N	N	13.0	13.0
12	2.467	N	N	Y	N	N	15.5	15.5
13	2.472	N	N	Y	N	N	13.0	13.0
Note - Prior to Production phase the Tx Power setting is not set accurately;								

Table 29: Jackson Peak1 OFDM-mode .11n Configuration

Ch	Channel center in MHz	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	13.0	12.5	10.0
2	2.417	Y	Y	Y	N	N	14.5	14.5	12.0
3	2.422	Y	Y	Y	N	N	15.5	15.5	12.0
4	2.427	Y	Y	Y	N	N	15.5	15.5	12.0
5	2.432	Y	Y	Y	N	N	15.5	15.5	12.0
6	2.437	Y	Y	Y	N	N	15.5	15.5	12.0
7	2.442	Y	Y	Y	N	N	15.5	15.5	12.0
8	2.447	Y	Y	Y	N	N	15.5	15.5	12.0
9	2.452	Y	Y	Y	N	N	15.5	15.5	12.0
10	2.457	Y	Y	Y	N	N	15.5	15.5	12.0

Ch	Channel center in MHz	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
11	2.462	Y	Y	Y	N	N	12.0	12.0	10.5
12	2.467	N	N	Y	N	N	15.5	15.5	12.0
13	2.472	N	N	Y	N	N	13.0	13.0	11.5
(1,1) (5,-1)	2.422	Y	Y	Y	N	N	9.5	8.5	7.0
(2,1) (6,-1)	2.427	Y	Y	Y	N	N	10.5	9.5	8.0
(3,1) (7,-1)	2.432	Y	Y	Y	N	N	11.5	11.0	9.5
(4,1) (8,-1)	2.437	Y	Y	Y	N	N	12.5	13.0	11.5
(5,1) (9,-1)	2.442	Y	Y	Y	N	N	12.0	12.5	11.0
(6,1) (10,-1)	2.447	Y	Y	Y	N	N	10.5	11.0	9.5
(7,1) (11,-1)	2.452	Y	Y	Y	N	N	9.5	9.5	7.5
(8,1) (12,-1)	2.457	N	N	Y	N	N	14.0	14.0	12.0
(9,1) (13,-1)	2.462	N	N	Y	N	N	13.5	13.5	12.0

Table 30: Marble Peak CCK-Mode Configuration

Ch	Channel center in MHz	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	14.0	13.5
2	2.417	Y	Y	Y	N	N	14.5	14.0
3	2.422	Y	Y	Y	N	N	14.5	14.0
4	2.427	Y	Y	Y	N	N	14.5	14.0
5	2.432	Y	Y	Y	N	N	14.5	14.0
6	2.437	Y	Y	Y	N	N	14.5	14.0
7	2.442	Y	Y	Y	N	N	14.5	14.0
8	2.447	Y	Y	Y	N	N	14.5	14.0

Ch	Channel center in MHz	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)
9	2.452	Y	Y	Y	N	N	14.5	14.0
10	2.457	Y	Y	Y	N	N	14.5	14.0
11	2.462	Y	Y	Y	N	N	14.5	14.0
12	2.467	N	N	Y	N	N	14.5	14.0
13	2.472	N	N	Y	N	N	14.0	13.5
Note - Prior to Production phase the Tx Power setting is not set accurately;								

Table 31: Marble Peak OFDM-mode non-.11n Configuration

Ch	Channel center in MHz	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	13.0	12.5
2	2.417	Y	Y	Y	N	N	15.0	14.5
3	2.422	Y	Y	Y	N	N	15.0	15.0
4	2.427	Y	Y	Y	N	N	15.0	15.0
5	2.432	Y	Y	Y	N	N	15.0	15.0
6	2.437	Y	Y	Y	N	N	15.0	15.0
7	2.442	Y	Y	Y	N	N	15.0	15.0
8	2.447	Y	Y	Y	N	N	15.0	15.0
9	2.452	Y	Y	Y	N	N	15.0	15.0
10	2.457	Y	Y	Y	N	N	15.5	15.5
11	2.462	Y	Y	Y	N	N	13.0	13.0
12	2.467	N	N	Y	N	N	15.0	15.0
13	2.472	N	N	Y	N	N	14.0	12.5
Note - Prior to Production phase the Tx Power setting is not set accurately;								

Table 32: Marble Peak OFDM-mode .11n Configuration

Ch	Channel center in MHz	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

Ch	Channel center in MHz	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	12.0	11.5	10.5
2	2.417	Y	Y	Y	N	N	14.5	14.0	12.0
3	2.422	Y	Y	Y	N	N	15.0	15.0	12.0
4	2.427	Y	Y	Y	N	N	15.0	15.0	12.0
5	2.432	Y	Y	Y	N	N	15.0	15.0	12.0
6	2.437	Y	Y	Y	N	N	15.0	15.0	12.0
7	2.442	Y	Y	Y	N	N	15.0	15.0	12.0
8	2.447	Y	Y	Y	N	N	15.0	15.0	12.0
9	2.452	Y	Y	Y	N	N	15.0	15.0	12.0
10	2.457	Y	Y	Y	N	N	15.5	15.5	12.0
11	2.462	Y	Y	Y	N	N	12.0	11.5	10.5
12	2.467	N	N	Y	N	N	15.0	15.0	12.0
13	2.472	N	N	Y	N	N	12.0	12.0	11.5
(1,1) (5,-1)	2.422	Y	Y	Y	N	N	9.0	8.5	7.0
(2,1) (6,-1)	2.427	Y	Y	Y	N	N	10.0	9.5	8.5
(3,1) (7,-1)	2.432	Y	Y	Y	N	N	11.5	10.5	9.5
(4,1) (8,-1)	2.437	Y	Y	Y	N	N	12.5	12.5	11.5
(5,1) (9,-1)	2.442	Y	Y	Y	N	N	11.5	11.5	11.0
(6,1) (10,-1)	2.447	Y	Y	Y	N	N	10.5	10.5	9.5
(7,1) (11,-1)	2.452	Y	Y	Y	N	N	9.5	9.0	8.5
(8,1) (12,-1)	2.457	N	N	Y	N	N	14.0	13.5	12.0

Ch	Channel center in MHz	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
(9,1) (13,-1)	2.462	N	N	Y	N	N	13.0	13.0	11.5

7.2 Bluetooth Channel Configuration

Shall support Bluetooth 3.0 and should be able to scan and operate in all the standard legal channels as defined by the Bluetooth-SIG.

The Bluetooth device supports power class 1 specifications of the Bluetooth SIG.

The channel hopping scheme supports AFH mechanism.

8 Mechanical Specifications

This section provides information about the mechanical specifications.

8.1 Half Mini Card Weight and Dimensions

The hardware is designed to comply with the dimensions specified in the PCI Express Mini Card Electromechanical Specification. Table 21 lists the weights (grams) of Intel® Centrino® Wireless Products.

Table 33: Intel® Centrino® Wireless Product Weights

Intel® Centrino® Wireless Product	Weight (g)
Marble Peak	3
Jackson Peak 1	3.45
Jackson Peak 2	3.7
Canyon Peak	2.9
Canyon Peak + Bluetooth	2.9

The dimensions in the Figure 6 and Figure 7 below include the top (which includes the shield) and side views. The dimensions for Intel Centrino Wireless Products are:

26.80 mm x 30.00 mm x 2.4 mm Max (Top Side) / 1.35 mm Max (Bottom Side)

Figure 6: Top Side View of Half Mini Card Dimensions

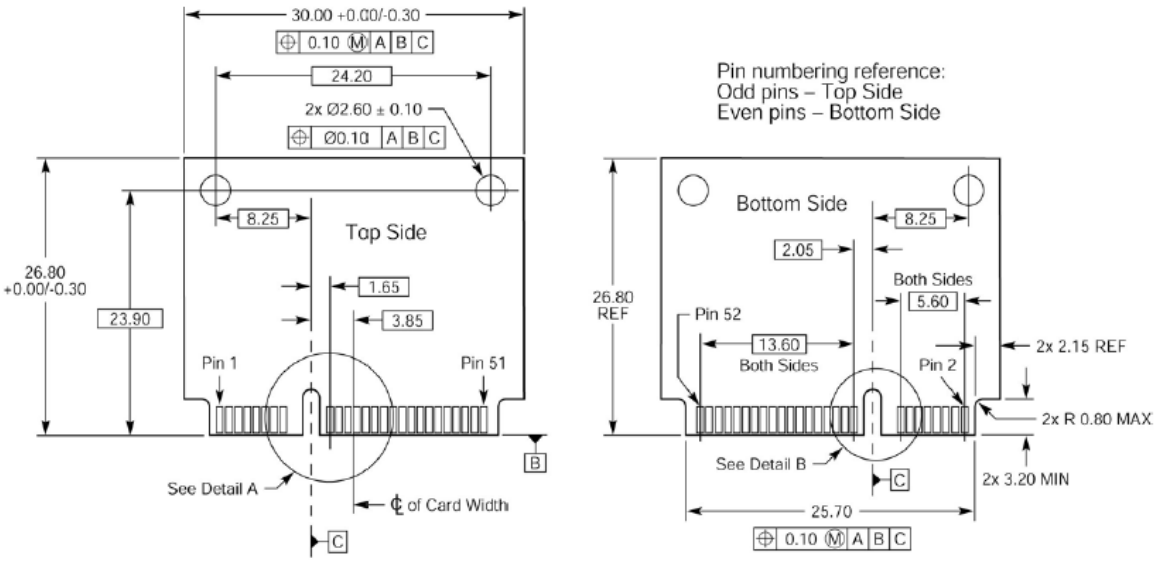


Figure 7: Bottom Side View Half Mini Card Dimensions

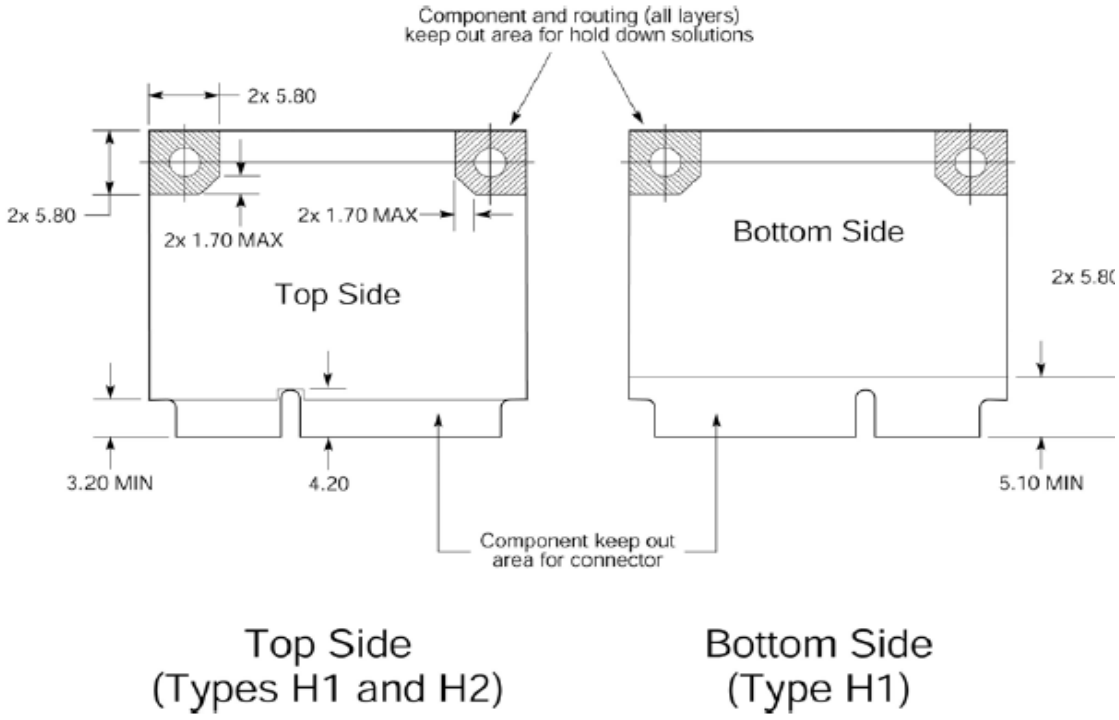


Table 34: Z-height (Components on Board Location)

Form Factor	Z-height(max)
HMC	CS – 2.4 mm PS - 1.35 mm

8.2 Antenna Receptacles

A U.FL or equivalent micro coax connector will be used on the Jackson Peak1, Jackson Peak2, Marble Peak, Canyon Peak and Canyon Peak with Bluetooth hardware and will be compatible with other standard U.FL micro coax cable connectors.

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

Jackson Peak 1, Jackson Peak 2

1 = Main, left connector: Wi-Fi Tx/Rx only

2 = Aux, right connector: Wi-Fi Tx/Rx, Bluetooth Tx/Rx.

Marble Peak

1 = Main, left connector: Wi-Fi Tx/Rx

2 = Aux, right connector: Wi-Fi Tx/Rx

Canyon Peak

1 = Main, left connector: Wi-Fi Tx/Rx

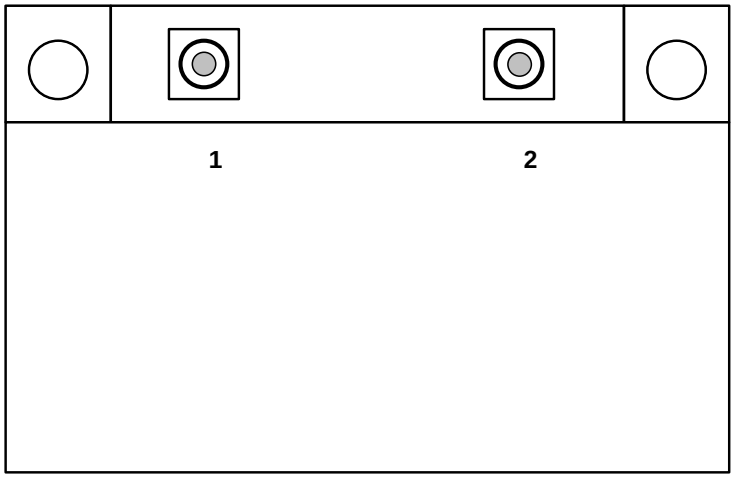
2 = Aux, right connector: Wi-Fi Rx only

Canyon Peak + Bluetooth

1 = Main, left connector: Wi-Fi Tx/Rx

2 = Aux, right connector: Wi-Fi Rx only, Bluetooth Tx/Rx

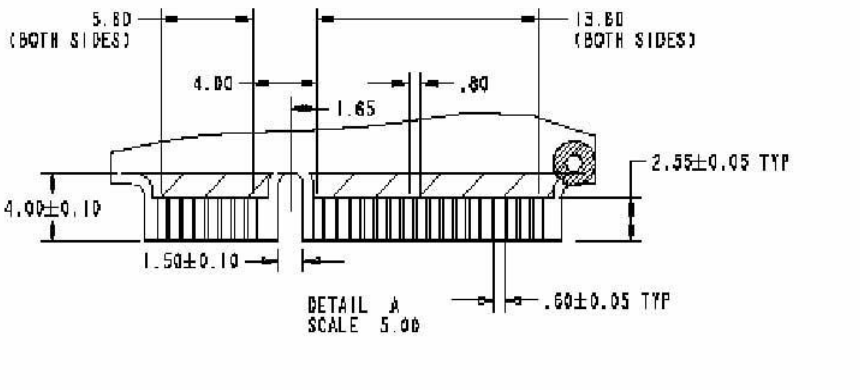
Figure 8: Jackson Peak1, Jackson Peak2, Marble Peak, Canyon Peak and Canyon Peak with Bluetooth



8.3 Connector Interface

The diagram in the figure below is excerpted from the PCI Express Mini Card Electromechanical Specification, Rev. 1.2, published by the PCI-SIG, of which Intel Corporation is a member. It contains the mechanical information for the Mini Card edge connector. The following sections of this document detail Intel's deviations from this specification to improve the contact reliability for our customers. Measurement references below are in millimeters.

Figure 9: Mini Card Edge Connector



9 Environmental Specifications

The following tables provide operating condition and maximum rating requirements for the Jackson Peak1, Jackson Peak2, Marble Peak, Canyon Peak and Canyon Peak with Bluetooth hardware.

Table 35: Operational Conditions

Environment	Limits
Operating Temperature	0 ºC – 80 ºC

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

Table 36: 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)

Jackson Peak1, Jackson Peak2, Marble Peak, Canyon Peak and Canyon Peak with Bluetooth temperature conditions for storage (packaged) in warehouse are -40c to +70c, which should be divided into two parts:

1. Temperature condition for storage (packaged) in warehouse –Maximum 40°C Up to 6 months.
2. Temperature condition for shipping /storage for short duration high temperature exposure –Maximum 70°C Up to 24 hours.

10 Safety

The following regulatory and safety information is subject to change.

Table 37: Wi-Fi Safety and Regulatory USA

	Requirements	Criteria
USA	EMI	FCC Part 15, Subpart B, Class B (CISPR 22 Limits at 10m)
	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 38: Wi-Fi Safety and Regulatory Europe

	Requirements	Criteria
Europe	EMC	EN301489-1, EN 301489-17
	RF	EN300 328 v.1.7.1 & EN301-893 v.1.5.1 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 39: Wi-Fi Safety and Regulatory Japan

	Requirements	Criteria
Japan	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 40: Wi-Fi Safety and Regulatory Australia / New Zealand

	Requirements	Criteria
Australia / New Zealand	EMC	EU Test reports.
	RF	Radio communications (EMR) Standard 2003
	Safety	CB Cert. & Report (IEC60950-1)

Table 41: Wi-Fi Safety and Regulatory Other Geographies

	Requirements	Criteria
Other Geographies	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.

11 Certification Requirements

A preliminary list of certification requirements includes the following:

Table 42: Jackson Peak1, Jackson Peak2, Marble Peak, Canyon Peak and Canyon Peak with Bluetooth 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 XP, Microsoft Windows Vista and Microsoft Windows 7 WDKWHQL tests for networking device
Wi-Fi certification	The same as Intel® Centrino 6200 Series certification
Bluetooth certifications	Bluetooth SIG certification for the device and the SW stack delivered with it.

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

12 Antenna Design Considerations

12.1 Antenna Port Impedance

Nominal antenna port impedance specification is 50 ohm.

12.2 Antennas Frequency Bands

Refer to Chief River Platform Design Guide.

12.3 Antenna Gain

Refer to Chief River Platform Design Guide.

12.4 Antenna Characteristics

Refer to Chief River Platform Design Guide.

13 HW RF Kill Considerations

The Wi-Fi RF Kill is supported via Pin #20 (W_Disable), and this is similar to previous products.

The Bluetooth RF Kill is supported via Pin #51 (W_Disable#2)

Since both RF Kill signals are active low, and there is an internal pull up this means that they can be left not connected, and both Wi-Fi and Bluetooth will be enabled.

To disable the Bluetooth, a logic "0" (Vil = 0.0v [+/-0.3]) should be applied to the W_disable#2 pin.

To disable the Wi-Fi, a logic "0" (Vil = 0.0v [+/-0.3]) should be applied to the W_disable# pin.

In order to test Intel Wireless on legacy platforms (prior to Huron River), the W_disable#2 pin will have to be either float (not connected) on the platform, or connected to logic "1".

If for any reason, the W_disable#2 pin is driven to logic "0" on the platform then Bluetooth would be disabled.

Appendix A References and Acronyms

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

A.2 Acronyms and Definitions

The following list defines key terms and acronyms used in this document.

Term	Definition
ACPI	Advanced Configuration Power Interface
ADC	Analog-to-Digital Converter
AES	Advanced Encryption Standard
AGC	Automatic Gain Control
AP	Access Point
BCWS	Business Class Wireless Suite
BLE	Bluetooth low energy technology
BPF	Band Pass Filter
CCK	Complementary Code Keying
BT	Bluetooth

Term	Definition
DAC	Digital-to-Analog Converter
DBPSK	Differential Bi-phase Shift Keying
DC	Direct Current
DMA	Direct Memory Access
DQPSK	Differential Quadrature Phase Shift Keying
DSP	Digital Signal Processor
DSSS	Direct Sequence Spread Spectrum
D - States	ACPI (Advanced Control and Power Interface) Peripheral Device power states
ETSI	European Telecommunication Standards Institute
GI	Guard Interval
GND	Ground Signal
GUI	Graphical User Interface
HID	Human Interface Devices
IC	Integrated Circuit
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
Intel® AMT	Intel® Active Management Technology
I/O	Input/Output
I/Q	In-Phase/Quadrature Phase
ISM	Industrial, Scientific, and Medical (Band)
LED	Light Emitting Diode (Signal)
LNA	Low Noise Amplifier
L – States	ASPM (Active State Power Management). Link States is a hardware based capability to manage the PCI Express Link between the root device on the system board and the Mini Card.
MAC	Media Access Control
MCS	Modulation Coding Scheme
Mbps	Megabits Per Second
MIMO	Multiple Input, Multiple Output
MOW	Most of World
MS	Mobile Station
NC	Not Connected (Signal)
NIC	Network Interface Card
OFDM	Orthogonal Frequency Division Multiplexing

Term	Definition
OTA	Over the Air
PA	Power Amplifier
PCI	Peripheral Component Interconnect
PCI Express Mini Card	PCI Express Mini Card mobile form factor
PHY	Physical Layer
PLCP	Physical Layer Convergence Protocol
PLL	Phase Locked Loop
PSP	Power Save Polling
QoS	Quality of Service
RF	Radio Frequency
RISC	Reduced Instruction Set Computing
ROW	Rest of World
Rx	Receive
SISO	Single Input, Single Output. Antenna implementation using a single antenna at a given time versus a MIMO (Multiple Input, Multiple Output) antenna configuration
SKU	Stock Keeping Unit
SRAM	Static Random Access Memory
STBC	Space Time Block Codes
TBTT	Target Beacon Transmission Time
Tx	Transmit
Wake-up	A mechanism used by a component to request the reapplication of main power when in the L2 Link state. Two such mechanisms are defined in the PCIe Base Specification: Beacon and WAKE#. This specification requires the use of WAKE# for the Mini Card and system board that supports wakeup functionality.
WCS	Wireless Coexistence System for Bluetooth*
WEP	Wired Equivalent Privacy
WFA	Wi-Fi Alliance*
WHQL	(Microsoft) Windows Hardware Quality Labs
Wi-Fi	Wireless Fidelity
WLAN	Wireless Local Area Network
XTAL	40-MHz Crystal

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment 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 equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment 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 one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This module can be use with **Getac Notebook: B320** or similar platform with similar dimension, antenna location and RF characteristic.

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed at same location as tested in the certification filing.
2) The transmitter module may not be co-located with any other transmitter or antenna.
3) For portable usage condition, this module has been SAR evaluated in **Getac Notebook: B320** host with compliance result and can be used with this specific hast as described in the certification filing. Other host or platform needs separate approval.

As long as 3 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

Note: Operations in the 5.15-5.25GHz band are restricted to indoor usage only.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

The final end product must be labeled in a visible area with the following: "**Contains FCC ID: QYL6235**". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.