



# Intel® Wi-Fi 6E AX210 and Intel® Wi-Fi 6E AX1675 (Killer) (Typhoon Peak 2)

**External Product Specification (EPS)**

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## Revision History

Revision	Description	Date
0.5	Initial release	January 13, 2020
0.51	Added a note about the module land pattern change to TyP2 1216 in (Section 4, "Mechanical Specifications," and a reference to the TyP2 1216 Drawings document in the Reference documents table	June 23, 2020
0.92	Added GND Pins for TyP2 1216 Added KPI data	September 24, 2020
0.93	Added Killer AX1675 SKU	October 29, 2020
0.95	Updated Section 6.2.1 for legacy bands Added regulatory Table 7-2, Scan capabilities Updated Section 7.3, Regulatory and safety certification (not final, subject to change) Updated Section 7.4.1, TyP2 2230 default max Tx power, for legacy bands Updated Section 7.4.2, TyP2 1216 default max Tx power for legacy bands Updated Section 7.6, SAR Tx power limits Updated Section 8.7, BIOS configuration	January 8, 2021
0.98	Updated Section 6.2.1 for UHB Updated Section 6.2.2 for UHB	January 20, 2021
1.0	Updated Section 6.2.1 for UHB Updated Section 6.2.2 for UHB Updated Tx power regulatory values for UHB in Section 7.4 Added max PPAG delta gain Limits in Section 7.5	January 27, 2021
1.1	Added comment for W_DISABLE2# Minimum Assertion Time Duration in Table 2-3 Removed 40MHz CCK, as it is not supported in this product Updated power tables per MCS for UHB Updated regulatory Tx values for UHB	March 2, 2021
1.2	Removed CCK DD values for 1216 and 2230 in Section 7.4 Updated SUSCLK pin voltage	April 9, 2021
1.3	Removed CCK DD from Table 7-12 Updated value for 1216 FCC Tx Power per MCS - UHB CH3/5965, MCS 11, 40MHz BW Table 6-4	April 19, 2021
1.4	Added UHB Wi-Fi Power KPIs to Table 6-10 Added channel 233 to 6GHz 20 MHz	June 28, 2021
1.5	Added "Linux Soft AP features" section, 9.2	August 2, 2021



## Abbreviations

Term	Description
AMT	Intel® Active Management Technology
API	Application Programmer's Interface
TyP	Typhoon Peak
CLINK	Control Link
CNV	Connectivity
CNVi	Integrated connectivity solution
Coex	Coexistence
DC	Direct Current
EIRP	Equivalent isotropically radiated power
GPIO	General Purpose Input/Output
HCI	Host Controller Interface
I/O	Input/Output
I2C	Inter-Integrated Circuit bus
IEEE	Institute of Electrical and Electronics Engineers, the standards body for setting Ethernet standards
IPA	Implementation Plan Approval – a meeting where the organization approves the program Plan of Record and commits resources to develop the product
ISH	Integrated Sensor Hub
ISV	Independent Software Vendor
LAN	Local Area Network
LDO	Low-Dropout Regulator
LLD	Low-Level Design – specifies implementation details so the product can be sustained
LTE	Long-term evolution (a mobile phone standard)
MAC	Media Access Controller
MRD	Marketing Requirements Document – provides the business case, marketing definition, target market, requested timeline and functional requirements for the product to be successful in the marketplace
NIC	Network Interface Card
OEM	Original Equipment Manufacturer
PAN	Personal Area Network
PCH	Platform Control Hub
PHY	Physical (layer)
RF	Radio Frequency
SoC	System on Chip
TDP	Thermal Design Power
UART	Universal Asynchronous Serial Bus

Term	Description
UI	User interface
USB	Universal Serial Bus
Wi-Fi	Wireless LAN

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# 1 Introduction

The Intel® Discrete Connectivity Wi-Fi 6E AX210, code named Typhoon Peak 2 or Typ2, is an M.2 connectivity module for notebooks, tablets, and PCs. Typhoon Peak 2 supports the following radio technologies:

- 802.11abgn+acR2+axR2(Pre-Standard) MIMO 2x2 – Supports Wi-Fi 6E and includes the new 6Ghz band
- Bluetooth® 5.2

The product is a highly-integrated solution, designed using a 28-nm process, and has an improved gen-over-gen architecture, providing a low-power solution, and set of advanced capabilities.

The product is designed to be part of the Intel® Tiger Lake and Rocket Lake previous and future Intel platforms, and supports Microsoft Windows 10\*, as well as the Google\* Chrome OS\* and Linux\*.

## 1.1 Key features

**Table 1-1 Key features**

Feature	Typhoon Peak 2
Platform	Tiger Lake Rocket Lake
Form factor and SKUs	<ul style="list-style-type: none"> <li>• M.2 2230 (Mainstream, vPro®, and Killer)</li> <li>• M.2 1216 soldered-down module (Mainstream, vPro®, and Killer)</li> </ul>
Wi-Fi	High-performance, low-power, dual-band Pre-Standard-802.11ax R2 2x2 – Wi-Fi 6E
Bluetooth®	Bluetooth® 5.2
Host interfaces	Wi-Fi: PCIe* v2.1 Gen2 Bluetooth®: USB 2.0 (optional UART on M.2 1216-SD, pending platform support) Intel® AMT: CLINK
Wi-Fi Alliance certifications	802.11a/b/g/n/ac R2/ax R2(PreStandard), WPA, WPA2, WPA3, WPS, PMF, WMM, WMM-PS, WFD, Wi-Fi Agile Multiband, Wi-Fi Optimized Connectivity, Wi-Fi Location, Wi-Fi TimeSync
Wi-Fi-Bluetooth® Coex	MIMO Tx/Tx and Rx/Rx Concurrency
LTE Coex	Real-Time (ready) and Non Real-Time
Security	Secured boot with enhanced security
Power	Lower active power based on improved process technology
Performance	Tx Burst, TCP packet reordering, MSIx for reduced multi-core CPU load upto MCS11, Increased aggregations allows TCP TPT > 2Gbps
vPro®	Intel® AMT 15
Smart SKU	Dynamic Regulatory SKU enabling automatic channel map and output power changes depending on the regulations of the country where it is operating
Operating systems	Windows 10*, Linux*, Chrome OS*

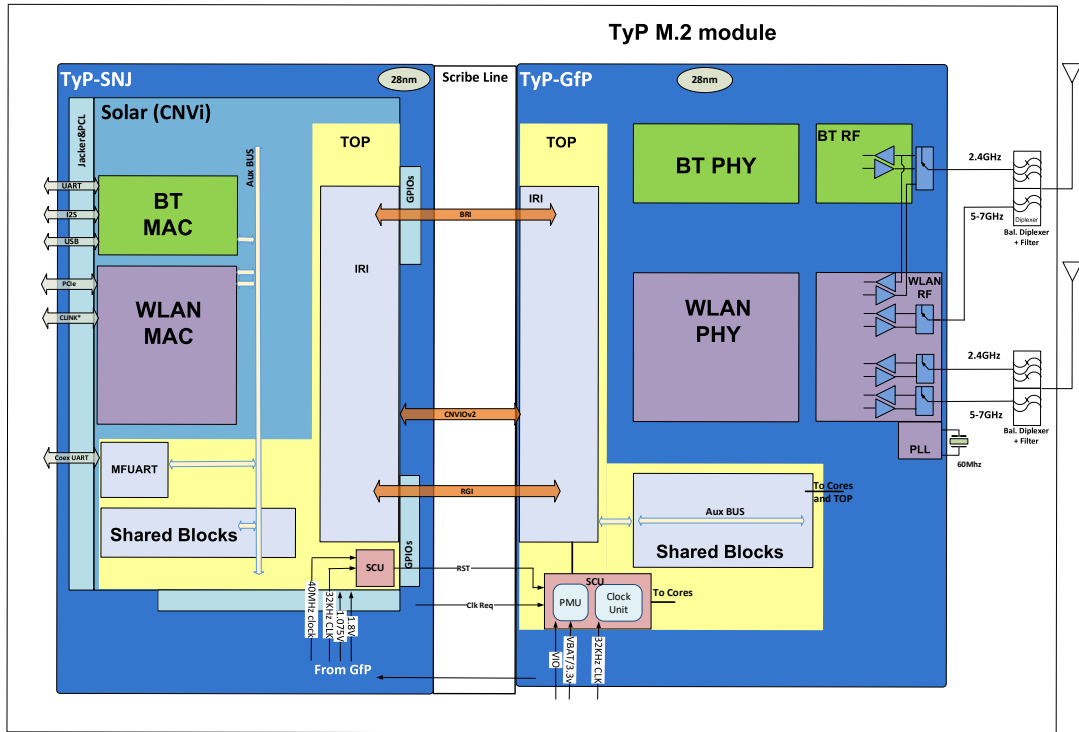
**NOTES:**

1. Additional future platform support is expected.

## 1.2 Typhoon Peak 2 block diagram

Figure 1-1 shows the Typhoon Peak 2 block diagram.

**Figure 1-1 Typhoon Peak 2 block diagram**



## 1.3 Typhoon Peak 2 module SKUs

**Note:** All SKUs are not final POR and may be subject to change.

**Table 1-2 Typhoon Peak 2 module SKUs**

SKU name	Form Factor	Interfaces	Front End
Typhoon Peak 2 AX210	2230 Key A-E S3	Bluetooth® – USB Wi-Fi – PCIe*	Integrated RF front end and balanced-diplexer
Typhoon Peak 2 AX210	1216-SD	Bluetooth® – USB Wi-Fi – PCIe*	Integrated RF front end and balanced-diplexer
Killer AX1675	2230 Key A-E S3	Bluetooth® – USB Wi-Fi – PCIe*	Integrated RF front end and balanced-diplexer
Killer AX1675	1216-SD	Bluetooth® – USB Wi-Fi – PCIe*	Integrated RF front end and balanced-diplexer



## 2 Product Architecture

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### 2.1 Host interfaces

#### 2.1.1 Wi-Fi PCIe\*

The product supports the Wi-Fi PCI Express\* (PCIe\*) host interface with the following highlights:

- PCIe 2.1 Gen2 support
- PCIe L1.2 Off state
- PCIe L1.1 snooze state
- Hardware-based latency tolerance reporting
- 64/128B transaction size

PCIe L1 substates and LTR are supported by the product, but also require platform support and BIOS enablement. For TyP2-targeted platforms, L1 substates and LTR are both supported.

For Linux-based OSES, the platform design should verify what is supported by specific OS/Platform combination.

#### 2.1.2 Wi-Fi CLINK

Controller Link (CLINK) is Intel's proprietary Wi-Fi host I/F for the purpose of Active Manageability Technology. CLINK is a 3-pin, 66-MHz, bidirectional, low-power I/F.

Table 2-1 lists the CLINK interface signals and their functionality.

**Table 2-1 CLINK interface pins and functionality**

M.2 Pin Name	Description
CLINK_DATA	WLAN CLINK sideband interface data
CLINK_CLK	WLAN CLINK sideband interface clock
CLINK_RESET	WLAN CLINK reset sideband input (active low)

For the specific pin number in each form factor, refer to Section 3.1.

For platforms that do not use AMT, the signals should be left unconnected on the platform side.

#### 2.1.3 Bluetooth® USB

The product supports the Bluetooth® USB host interface with the following highlights:

- USB 2.0
- Full-speed operational mode
- Self-powered, powered from the M.2 power supply
- Signaling level per USB 2.0 specification
- Support for the following features:
  - Selective suspend
  - Remote wake

It is recommended to attach to an XHCI controller root Hub. It is not recommended to attach via a rate-matching hub.

## 2.2 Wireless disable (RF kill)

### 2.2.1 Wi-Fi wireless disable

W\_DISABLE1# (pin 56 in M.2 2230 pinout) serves as HW RF kill for the Wi-Fi radio.

**Table 2-2 W\_DISABLE1# characteristics**

Characteristic	Description
Internal pull-up resistor	min 100 kOhm, max 200kOhm
VIL for asserting	min 0V, max 0.6V
VIH for de-asserting	min 1.26V, max 3.3V or float (not connected)

#### 2.2.1.1 Wi-Fi SW RF kill

The product supports Wi-Fi SW RF kill through relevant OS API. When in RF kill state all RF activities are terminated, and device goes into low power mode.

Chrome OS doesn't support SW RF kill. Airplane mode for Chrome OS is achieved by detaching the driver from the WPA Supplicant.

### 2.2.2 Bluetooth® wireless disable

The Bluetooth® radio will be active only if both HW RF kill pin and SW RF kill mechanisms are in enable state.

Chrome OS doesn't support HW RF kill or SW RF kill.

#### 2.2.2.1 Bluetooth® HW RF kill

W\_DISABLE2# (pin 54 in M.2 2230 pinout, pin 63 in M.2 1216SD pinout) serves as HW RF kill for the Bluetooth® radio.

Asserting W\_DISABLE2# 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.

**Table 2-3 W\_DISABLE2# characteristics**

Characteristic	Description
Internal pull-up resistor	min 100 kOhm, max 200kOhm
VIL for asserting	min 0V, max 0.6V
VIH for de-asserting	min 1.26V, max 3.3V or float (not connected)
Minimum Assertion Time Duration	> 105 mSec The signal should be asserted for at least 105 mSec to guarantee that the reset command is being propagated correctly to the Bluetooth® device

The recommendation is to use HW RF kill functionality by using a GPIO pin provided by the ACPI to turn on/off the radio of the Bluetooth® device. BIOS shall implement ACPI function for HW RF-Kill implementation in the OS, to error recovery by \_PRR(Power Resource Reset) function. For more information, please refer to Intel document 559910, *Intel Connectivity Platform BIOS Guidelines*, Section 3.1.5.6, "Bluetooth® RTD3 control."

#### 2.2.2.2 Bluetooth® SW RF kill

The product supports Bluetooth® SW RF kill. The behavior of the SW RF kill is similar to the HW RF kill: All RF activities are terminated, and the device goes into low power mode.

## 2.3 LED indicators

The product has two LED signals: Bluetooth® LED, and Wi-Fi LED.

The Bluetooth® LED functionality is as described below:

1. LED is OFF when the Bluetooth® is in HW or SW RF kill (SW RF kill also means 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 or in RF kill.
2. LED is ON otherwise.

**Note:** Chrome OS\* doesn't support or require the LED for communications. Hence the LED signals should remain disconnected in Chrome OS platforms.

## 2.4 32-KHz slow clock

This signal is optional. It comes from the platform 32kHz RTC clock. The TyP module can use either an internal 32kHz clock or this external 32KHz clock. Using an external 32KHz clock has power saving benefits compared to using an internal clock.

In order to enable the option to use the external 32KHz clock, this clock must be driven by the platform at any time. In addition, a BIOS/ACPI-based indication is needed to indicate to TyP that it can rely on the external 32KHz clock. (See Intel document number 559910, *Intel Connectivity Platforms BIOS Guidelines*).

The external 32kHz clock can come from a PCH pin or from a different source on the platform, depending on the platform used.

Note that the external 32kHz accuracy is assumed to be 20ppm.

If the BIOS does not indicate that the external 32KHz clock is valid, TyP will use its internal 32KHz clock.



## 3 Electrical Specifications

This section provides information about the electrical specifications for the product module. The specification covers the module hardware interface signals.

### 3.1 2230 and 1216 form-factor pinouts

There are two pinout lists, one for the platform side, and one for the module side. Note that some signals are crossed (such as UART Rx on platform side is connected to Tx on the module side).

**Note:** The module pinout is based on the *PCIe\* M.2 Electromechanical Specification*, with few changes to the pinout in order to support TyP-supported platforms.

Please refer to document 607872, TGL PDG, for explanations on hybrid configuration of both discrete and CRF on the same layout.

**Table 3-1 2230 key A-E platform and module pinout (M.2 revision for 2015)**

Pin #	Pin Name Platform Pinout	Pin Name Module Pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
1	GND	GND			
2	3.3 V	3.3 V	3.3 V	All	
3	USB_D+	USB_D+	3.3 V	Bluetooth®	
4	3.3 V	3.3 V	3.3 V	All	
5	USB_D-	USB_D-	3.3 V	Bluetooth®	
6	LED1	LED1	3.3v	WLAN	
7	GND	GND			
8	Connector key	Connector key			
9	Connector key	Connector key			
10	Connector key	Connector key			
11	Connector key	Connector key			
12	Connector key	Connector key			
13	Connector key	Connector key			
14	Connector key	Connector key			
15	Connector key	Connector key			
16	LED2	LED2	3.3v	Bluetooth®	
17	NC	NC	NA		
18	GND	GND			
19	NC	NC	NA		
20	NC	NC	NA		
21	NC	NC	NA		
22	NC	NC	NA		
23	NC	NC	NA		
24	Connector Key	Connector Key			

Pin #	Pin Name Platform Pinout	Pin Name Module Pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
25	Connector Key	Connector Key			
26	Connector Key	Connector Key			
27	Connector Key	Connector Key			
28	Connector Key	Connector Key			
29	Connector Key	Connector Key			
30	Connector Key	Connector Key			
31	Connector Key	Connector Key			
32	NC	NC	NA		
33	GND	GND			
34	NC	NC	NA		
35	PETp0	PERp0	PCIe* PHY	WLAN	PCIe* PHY signals, use PHY levels and not digital pins
36	NC	NC	NA		
37	PETn0	PERn0	PCIe* PHY	WLAN	PCIe* PHY signals, use PHY levels and not digital pins
38	CLINK RESET (O)(0/3.3 V)	CLINK RESET (I)(0/3.3 V)	3.3 V	WLAN	Also support 1.8 V electrical levels on this signal. For non-vPro® platforms, this signal must be left not-connected on the platform side.
39	GND	GND			
40	CLINK DATA	CLINK DATA	CLINK PHY (1 V)	WLAN	CLINK PHY. For non-vPro® platforms, this signal must be left not-connected on the platform side.
41	PERp0	PETp0	PCIe* PHY	WLAN	
42	CLINK CLK	CLINK CLK	CLINK PHY (1 V)	WLAN	CLINK PHY. For non-vPro® platforms, this signal must be left not-connected on the platform side.
43	PERn0	PETn0	PCIe PHY	WLAN	
44	COEX3(I/O) (0/1.8V)	COEX3(I/O) (0/1.8 V)	1.8 V	WLAN + Bluetooth®	N/A
45	GND	GND			
46	COEX2(I/O) (0/1.8V)	COEX2(I/O)(0/1.8V)	1.8 V	WLAN + Bluetooth®	Should be coming from LTE card
47	REFCLKP0	REFCLKP0	PCIe* PHY	WLAN	
48	COEX1 (I/O)(0/1.8 V)	COEX1 (I/O)(0/1.8V)	1.8 V	WLAN + Bluetooth®	Should be coming from LTE card
49	REFCLKN0	REFCLKN0	PCIe* PHY	WLAN	

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August 2021

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External Product Specification (EPS)

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Pin #	Pin Name Platform Pinout	Pin Name Module Pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
50	SUSCLK (32 kHz) (O)(0/3.3 V)	SUSCLK (32 kHz) (I)(0/3.3 V)	3.3V (Also supports 1.8 V electrical levels on this signal)	WLAN + Bluetooth®	
51	GND	GND			
52	PERST0# (O)(0/3.3 V)	PERST0# (I)(0/3.3 V)	3.3 V	WLAN	Also supports 1.8 V electrical levels on this signal
53	CLKREQ0# (IO)(0/3.3 V)	CLKREQ0# (IO)(0/3.3 V)	3.3 V	WLAN	Also supports 1.8 V electrical levels on this signal
54	W_DISABLE2# (O)(0/3.3 V)	W_DISABLE2# (I)(0/3.3 V)	3.3 V	Bluetooth®	Also supports 1.8 V electrical levels on this signal
55	PEWAKE0# (IO)(0/3.3 V)	PEWAKE0# (IO)(0/3.3 V)	3.3 V	WLAN	Also supports 1.8 V electrical levels on this signal
56	W_DISABLE1# (O)(0/3.3 V)	W_DISABLE1# (I)(0/3.3 V)	3.3v	WLAN	Also supports 1.8 V electrical levels on this signal
57	GND	GND			
58	I2C DATA (IO)/UART_RX (I)(0/1.8 V)	I2C DATA (IO)/UART_TX (O)(0/1.8 V)	1.8 V	WLAN + Bluetooth®	N/A
59	PETp1	PERp1	PCIe* PHY	N/A	N/A
60	I2C CLK/UART_TX (O)(0/1.8 V)	I2C CLK/UART_RX (I)(0/1.8 V)	1.8 V	WLAN + Bluetooth®	N/A
61	PETn1	PERn1	PCIe* PHY	N/A	N/A
62	ALERT#/UART_CTS (I)(0/1.8 V)	ALERT#/UART_RTS (O)(0/1.8 V)	1.8 V	WLAN + Bluetooth®	N/A.
63	GND	GND			
64	NFC_RESET#/UART_RTS (O)(0/1.8 V)	NFC_RESET#/UART_CTS (I)(0/1.8 V)	1.8 V	WLAN + Bluetooth®	N/A
65	PERp1	PETp1	PCIe* PHY	N/A	N/A
66	PERST1# (O)(0/3.3 V)	PERST1# (I)(0/3.3 V)	3.3 V	N/A	N/A
67	PERn1	PETn1	PCIe* PHY	N/A	N/A
68	CLKREQ1# (IO)(0/3.3 V)	CLKREQ1# (IO)(0/3.3 V)	3.3 V	N/A	N/A
69	GND	GND			
70	PEWAKE1# (IO)(0/3.3 V)	PEWAKE1# (IO)(0/3.3 V)	3.3 V	N/A	N/A
71	REFCLKP1	REFCLKP1	PCIe* PHY	N/A	N/A
72	3.3 V	3.3 V			



Pin #	Pin Name Platform Pinout	Pin Name Module Pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
73	REFCLKN1	REFCLKN1	PCIe* PHY	N/A	N/A
74	3.3 V	3.3 V			
75	GND	GND			

**Table 3–2 1216 platform module pinout**

Pin #	Pin Name platform pinout	Pin Name module pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
1	UIM_POWER_SRC/GPIO1	UIM_POWER_SRC/GPIO1	NA		Signal not used, leave NC in platform side
2	UIM_POWER_SNK	UIM_POWER_SNK	NA		Signal not used, leave NC in platform side
3	UIM_SWP	UIM_SWP	NA		Signal not used, leave NC in platform side
4	3.3 V	3.3 V			
5	3.3 V	3.3 V			
6	GND	GND			
7	NFC_RESET#	NFC_RESET#	NA		Signal not used, leave NC in platform side
8	ALERT#	ALERT#	NA		Signal not used, leave NC in platform side
9	I2C_CLK	I2C_CLK	NA		Signal not used, leave NC in platform side
10	I2C_DATA	I2C_DATA	NA		Signal not used, leave NC in platform side
11	COEX1	COEX1	1.8 V	WLAN + Bluetooth®	Should be coming from LTE card
12	COEX2	COEX2	1.8 V	WLAN + Bluetooth®	Should be coming from LTE card
13	COEX3	COEX3	1.8 V	WLAN + Bluetooth®	Signal not used, leave NC in platform side
14	SYSCLK/GNSS 0	SYSCLK/GNSS 0	NA		Signal not used, leave NC in platform side
15	TX_BLANKING/GNSS1	TX_BLANKING/GNSS1	1.8v		Signal not used, leave NC in platform side
16	RESERVED/VDDIO18	RESERVED/VDDIO18	Optional; 1.8 V, otherwise leave NC		Used to be a reserved signal, can be served as VDDIO1.8 V to the module. Requires alignment with the module vendor
17	GND	GND			
18	RESERVED/ISH 2_UART_TXD (O)(0/1.8 V)	RESERVED/ISH 2_UART_RXD (I)(0/1.8 V)	NA		Signal not used, leave NC in platform side
19	RESERVED/ISH 2_UART_RXD (I)(0/1.8 V)	RESERVED/ISH 2_UART_TXD (O)(0/1.8 V)	NA		Signal not used, leave NC in platform side

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Pin #	Pin Name platform pinout	Pin Name module pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
20	GND	GND			
21	RESERVED/ISH1_UART_RTS (O)(0/1.8 V)	ISH1_UART_CTS (I)(0/1.8 V)	1.8 V	WLAN + Bluetooth®	This pin was reserved, now used for ISH-UART 1.8 V
22	RESERVED/ISH1_UART_CTS (I)(0/1.8 V)	ISH1_UART_RTS (O)(0/1.8 V)	1.8 V	WLAN + Bluetooth®	This pin was reserved, now used for ISH-UART 1.8 V
23	GND	GND			
24	RESERVED/ISH1_UART_TXD (O)(0/1.8 V)	ISH1_UART_RXD (I)(0/1.8 V)	1.8 V	WLAN + Bluetooth®	This pin was reserved, now used for ISH-UART 1.8 V
25	RESERVED/ISH1_UART_RXD (I)(0/1.8 V)	ISH1_UART_TXD (O)(0/1.8 V)	1.8 V	WLAN + Bluetooth®	This pin was reserved, now used for ISH-UART 1.8 V
26	GND	GND			
27	SUSCLK (32 kHz)	SUSCLK (32 kHz)	3.3V (Also supports 1.8 V electrical levels on this signal)	WLAN + Bluetooth®	
28	W_DISABLE1#	W_DISABLE1#	3.3v	WLAN	Also support 1.8 V electrical levels on this signal
29	PEWAKE#	PEWAKE#	3.3 V	WLAN	Also support 1.8 V electrical levels on this signal
30	CLKREQ#	CLKREQ#	3.3 V	WLAN	Also support 1.8 V electrical levels on this signal
31	PERST#	PERST#	3.3 V	WLAN	Also support 1.8 V electrical levels on this signal
32	GND	GND			
33	REFCLKN0	REFCLKN0	PCIe* PHY	WLAN	PCIe* PHY signals, use PHY levels and not digital pins
34	REFCLKP0	REFCLKP0	PCIe* PHY	WLAN	PCIe* PHY signals, use PHY levels and not digital pins
35	GND	GND			
36	PERn0	PETn0	PCIe* PHY	WLAN	PCIe* PHY signals, use PHY levels and not digital pins
37	PERp0	PETp0	PCIe* PHY	WLAN	PCIe* PHY signals, use PHY levels and not digital pins
38	GND	GND			
39	PETn0	PERn0	PCIe* PHY	WLAN	PCIe* PHY signals, use PHY levels and not digital pins
40	PETp0	PERp0	PCIe* PHY	WLAN	PCIe* PHY signals, use PHY levels and not digital pins
41	GND	GND			

Pin #	Pin Name platform pinout	Pin Name module pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
42	CLINK_CLK	CLINK_CLK	CLINK PHY (1 V)	WLAN	CLINK PHY
43	CLINK_DATA	CLINK_DATA	CLINK PHY (1 V)	WLAN	CLINK PHY
44	CLINK_RESET	CLINK_RESET	3.3 V	WLAN	TyP also supports 1.8 V electrical levels on this signal
45	SDIO_RESET# (O)	SDIO_RESET# (I)	NA		Signal not used, leave NC in platform side
46	SDIO_WAKE# (I)	SDIO_WAKE# (O)	NA		Signal not used, leave NC in platform side
47	SDIO_DATA3 (IO)/WIGIG_UART_TXD (O)	SDIO_DATA3 (IO)/WIGIG_UART_RXD (I)	NA		Signal not used, leave NC in platform side
48	SDIO_DATA2 (IO)/WIGIG_UART_RXD (I)	SDIO_DATA2 (IO)/WIGIG_UART_TDX (O)	NA		Signal not used, leave NC in platform side
49	SDIO_DATA1 (IO)/WIGIG_UART_CTS (I)	SDIO_DATA1 (IO)/WIGIG_UART_RTS (O)	NA		Signal not used, leave NC in platform side
50	SDIO_DATA0 (IO)/WIGIG_UART_RTS (O)	SDIO_DATA0 (IO)/WIGIG_UART_CTS (I)	NA		Signal not used, leave NC in platform side
51	SDIO_CMD (IO)	SDIO_CMD (IO)	NA		Signal not used, leave NC in platform side
52	SDIO_CLK (O)	SDIO_CLK (I)	NA		Signal not used, leave NC in platform side
53	UART_WAKE# (3.3 V)	UART_WAKE# (3.3 V)	3.3 V	Bluetooth®	Also support 1.8 V electrical levels on this signal. On relevant SKUs
54	LPSS_UART_RTS	LPSS_UART_CTS	1.8 V	Bluetooth®	On relevant SKUs
55	LPSS_UART_RXD	LPSS_UART_TXD	1.8 V	Bluetooth®	On relevant SKUs
56	LPSS_UART_TXD	LPSS_UART_RXD	1.8 V	Bluetooth®	On relevant SKUs
57	LPSS_UART_CTS	LPSS_UART_RTS	1.8 V	Bluetooth®	On relevant SKUs
58	PCM_SYNC/I2S_WS	PCM_SYNC/I2S_WS	1.8 V	Bluetooth®	On relevant SKUs
59	PCM_OUT/I2S_SD_OUT	PCM_IN/I2S_SD_IN	1.8 V	Bluetooth®	On relevant SKUs
60	PCM_IN/I2S_SD_IN	PCM_OUT/I2S_SD_OUT	1.8 V	Bluetooth®	On relevant SKUs
61	PCM_CLK/I2S_SCK	PCM_CLK/I2S_SCK	1.8 V	Bluetooth®	On relevant SKUs
62	GND	GND			

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Pin #	Pin Name platform pinout	Pin Name module pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
63	W_DISABLE2#	W_DISABLE2#	3.3 V	Bluetooth®	Also support 1.8 V electrical levels on this signal
64	LED2#	LED2#	3.3 V	Bluetooth®	On relevant SKUs
65	LED1#	LED1#	3.3 V	WLAN	On relevant SKUs
66	RESERVED/ISH 2_UART_CTS (I)(0/1.8 V)	RESERVED/ISH 2_UART_RTS (O)(0/1.8 V)	NA		Signal not used, leave NC in platform side
67	RESERVED/ISH 2_UART_RTS (O)(0/1.8 V)	RESERVED/ISH 2_UART_CTS (I)(0/1.8 V)	NA		Signal not used, leave NC in platform side
68	GND	GND			
69	USB_D-	USB_D-	3.3 V	Bluetooth®	
70	USB_D+	USB_D+	3.3 V	Bluetooth®	
71	GND	GND			
72	3.3 V	3.3 V			
73	3.3 V	3.3 V			
74	GND	GND			
75	GND	GND			
76	GND	GND			
77	GND	GND			
78	GND	GND			
79	GND	GND			
80	GND	GND			
81	GND	GND			
82	GND	GND			
83	GND	GND			
84	GND	GND			
85	GND	GND			
86	GND	GND			
87	GND	GND			
88	GND	GND			
89	GND	GND			
90	GND	GND			
91	GND	GND			
92	GND	GND			
93	GND	GND			
94	GND	GND			
95	GND	GND			
96	GND	GND			

Pin #	Pin Name platform pinout	Pin Name module pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
G1	GND	GND			
G2	GND	GND			
G3	GND	GND			
G4	GND	GND			
GG1-72	GND	GND			Thermal ground pads
All below are vendor-specific pinouts					
A07	GND	GND			
A08	A4WP_IRQ#	Not used			
A09	A4WP_CLK	Not used			
A10	A4WP_DATA	Not used			
A11	RESERVED	Not used			
A12	RESERVED	Not used			
A13	RESERVED	Not used			
A14	RESERVED	Not used			
A15	LNA_EN	Not used			
A16	RESERVED	Not used			
A17	RESERVED	Not used			
A18	RESERVED	Not used			
A19	WT_CLKP	Not used			
A20	WT_CLKN	Not used			
A21	WT_D0P	Not used			
A22	WT_D0N	Not used			
A23	WT_D1P	Not used			
A24	WT_D1N	Not used			
A25	C_P32K	Not used			
A26	GND	GND			
A27	RESERVED	Not used			
A28	RESERVED	Not used			
A29	RESERVED	Not used			
A30	RESERVED	Not used			
A31	GND	GND			
A32	WGR_CLKP	Not used			
A33	WGR_CLKN	Not used			
A34	WGR_D0P	Not used			
A35	WGR_D0N	Not used			
A36	WGR_D1P	Not used			

Pin #	Pin Name platform pinout	Pin Name module pinout	Voltage on Card Side	WLAN or Bluetooth®	Connection on Platform/Usage
A37	WGR_D1N	Not used			
A38	BRI_DT	Not used			
A39	BRI_RSP	Not used			
A40	RGI_DT	Not used			
A41	RGI_RSP	Not used			
A42	RF_RESET_B	Not used			
A43	CLKREQ0	Not used			
A44	REFCLK0	Not used			
A45	NO CONNECT	Not used			
A46	RESERVED	Not used			
A47	RESERVED	Not used			
A48	3.3V	Not used			
A49	3.3V	Not used			
A50	GND	GND			

## 3.2 Pinout variations

### 3.2.1 Unused Bluetooth®

When the product is used as Wi-Fi-only, the following changes in the pinout apply:

- Don't leave Bluetooth® USB signals of Typhoon Peak non-connected. Keep Bluetooth® USB signals connected to the USB host in the platform side, or connect the USB signals of Typhoon Peak to GND through a pull down.
  - **Rationale:** Prevent extra current due to keeping USB non-connected.
- Keep W\_Disable2# connected to GND.
  - **Rationale:** Keep Bluetooth® in reset.
- Other pinout connections stay the same as in the Wi-Fi and Bluetooth® cases.

### 3.2.2 Unused Intel® AMT

For platforms that do not use Intel® AMT, the CLINK signals should be left not-connected on the platform side.

### 3.3 Peak current consumption

Table 3–3 Peak current consumption

Name	Description	Value [mA]	Notes
Peak current	Peak current from 3.3 V supply (over 100uSec)	Total theoretical worst case: 2000	Theoretical for general M.2 Cards 4*500mA per Vcc pin, assuming peak of Max Current over average at 100uSec  Note that for TyP, the peak will be up to <b><u>1050mA (for typical conditions, material and terminated antenna)</u></b>

### 3.4 M.2 power and ripple limits

The following guideline is an addendum to the M.2 electrical spec regarding power supply rise sequence. The rise time of the power (0 V to 3.3 V) must not exceed 10 mSec, and must not have glitches or ramps. Figure 3–1 shows examples of the correct rise flow.

Figure 3–1 Power supply rise flow



#### 3.4.1 Power supply ripples

There must-not be a glitch higher than 0.3 V on the power supply. Any glitch that is higher than 0.3 V might be interpreted by the module as a *power-on reset*, which will cause the card to lose stored data and reboot.

During platform low-power modes, such as S3 (stand-by state) glitches, will lead to connection failure.

### 3.4.2 Platform state transitions

Platform designers should carefully design the transition from platform *on* state to platform *stand-by* state and vice versa, so that the power supply will remain stable and have no glitches.

**Table 3–4 M.2 power supply and ripple limits**

Platform Power Rail Requirements	
Power feed range <sup>1</sup>	3.3 V +/-0.165 V
Power rise time	<10 msec
Maximum ripple	200 mVPP, frequency 10–500 kHz
Allowed power rail noise	300 mVpp
Power down reset <sup>2</sup>	<100mV for minimum duration of 200ms

**NOTES:**

1. Although the TyP UART SKU might operate with a larger power feed range (as is sometimes required to support the platform feed directly from Vbat), this option is not allowed due to reliability issues on the TyP side.
2. Power down reset – Voltage level and duration required in order to insure full reset cycle. Power down cycles violating this spec can result in an unknown chip state.

### 3.5 M.2 ground (GND)

All ground pins are connected on the M.2 module to a common ground plane. The platform designer should connect all M.2 GND pins to the platform system GND.





## 4 Mechanical Specifications

### Notes:

- 1) The module's mechanical specifications adhere to the *PCIe\* M.2 Electromechanical Specification*.
- 2) The land (GND pins) pattern of the 1216 M.2 SKU for TyP2 has changed. Please refer to the TyP2 1216 Drawings document (see "Reference documents"), and to the PDG for appropriate design guidelines.

### 4.1 Weight

Table 4-1 shows the weights for the type 2230 and 1216 Typhoon Peak 2 modules.

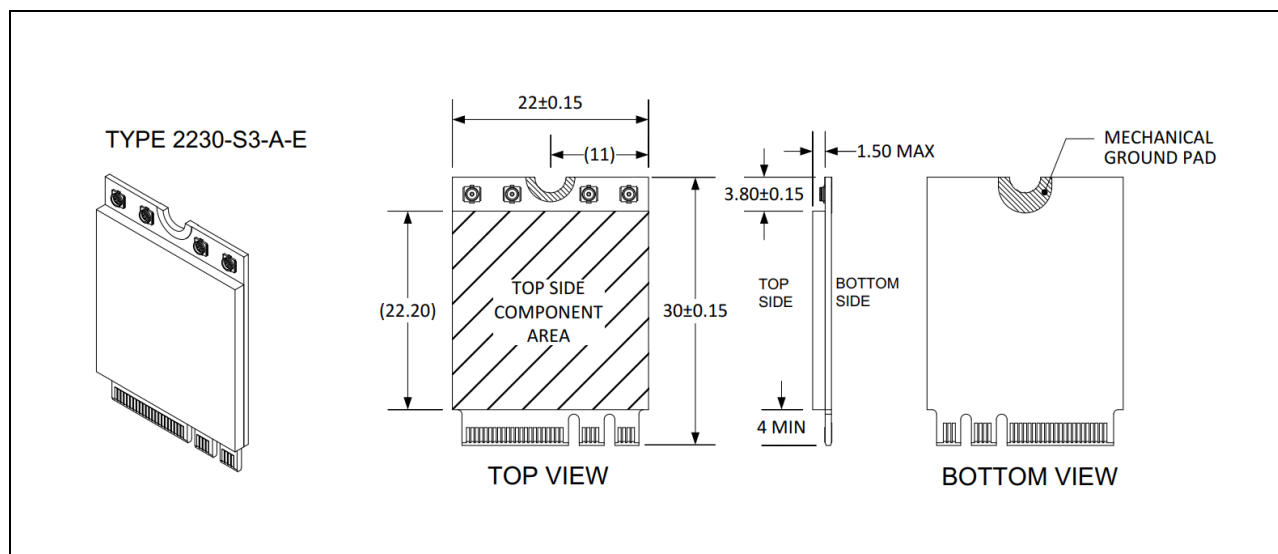
**Table 4-1 Weight of Cyclone Peak 2 modules**

Product SKU	Size (mm × mm)	Weight (g)
Typhoon Peak 2 2230	2230	~2.75 +-0.25
Typhoon Peak 2 1216	1216	~0.69 +-0.068

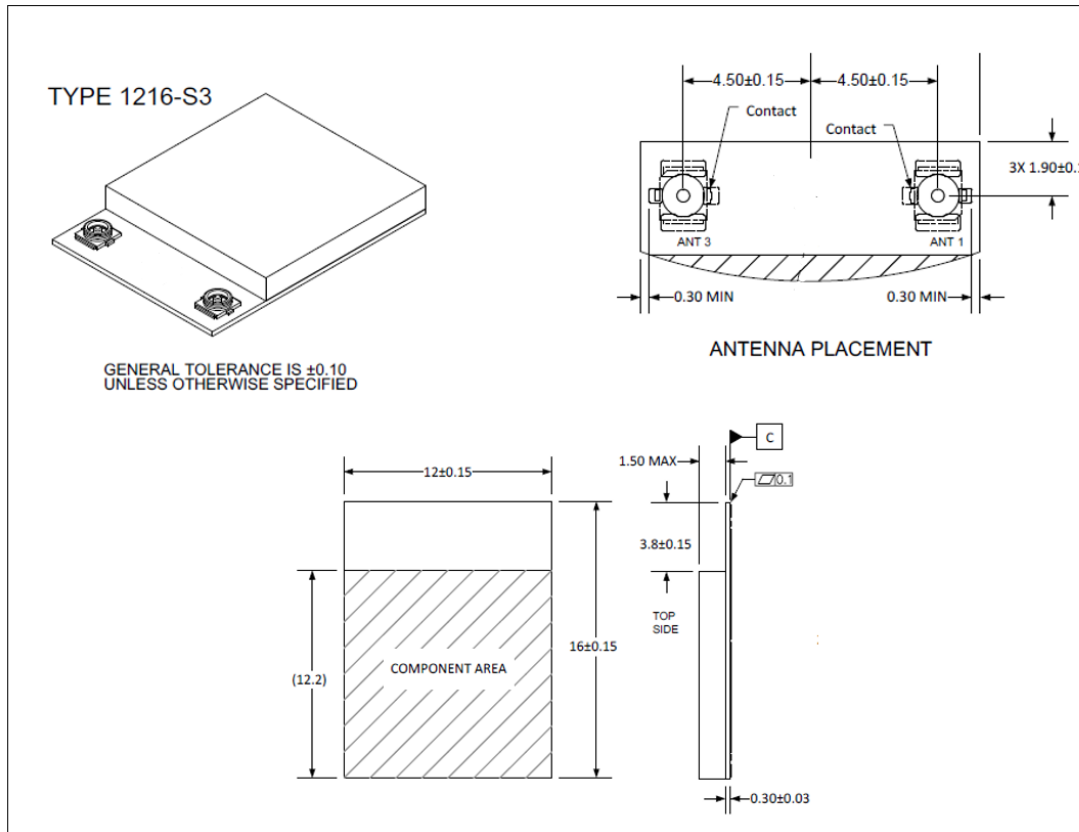
### 4.2 M.2 2230 and 1216 mechanical specification

Figure 4-1 shows the dimensions for type 2230. Figure 4-2 shows the dimensions for type 1216.

**Figure 4-1 Typhoon Peak 2 M.2 SKU dimensions (type 2230 A-E)**



**Figure 4–2 Typhoon Peak 2 M.2 SKU dimensions (type 1216 SD)**



### 4.3 Z height

Typhoon Peak 2 supports the S3 Z height module (1.5 mm from module surface). Please refer to drawing documents 626868 and 626869 for the exact mechanical schemes.

**Note:** The platform designer may choose to use various types of antenna coax cables and connectors in order to reduce Z height.

### 4.4 Antenna connector functionality

Antenna connector functionality for this form factor is listed in Table 4–2 and Table 4-3.

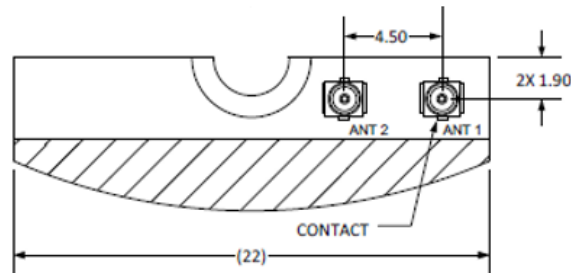
**Table 4–2 Type M.2 2230 antenna connector functionality**

Antenna connector functionality	
	M.2 2230
Wi-Fi (Chain A) + Bluetooth®	ANT1
Wi-Fi (Chain B)	ANT2

**Table 4-3 Type M.2 1216 antenna connector functionality**

Antenna connector functionality	
	M.2 1216
Wi-Fi (Chain A) + Bluetooth®	ANT1
Wi-Fi (Chain B)	ANT3

Figure 4-2 includes the Typhoon Peak 2 M.2 1216 SKU antenna configuration. Figure 4-3 shows the Typhoon Peak 2 M.2 2230 SKU antenna configuration.

**Figure 4-3 Typhoon Peak 2 M.2 2230 SKU antenna configuration**


Antenna connector functional allocation for this form factor is defined in Table 4-2. Note that this functionality is vendor-defined according to the M.2 spec.

**Note:** In Typ 1216, antenna ANT2 is not present.

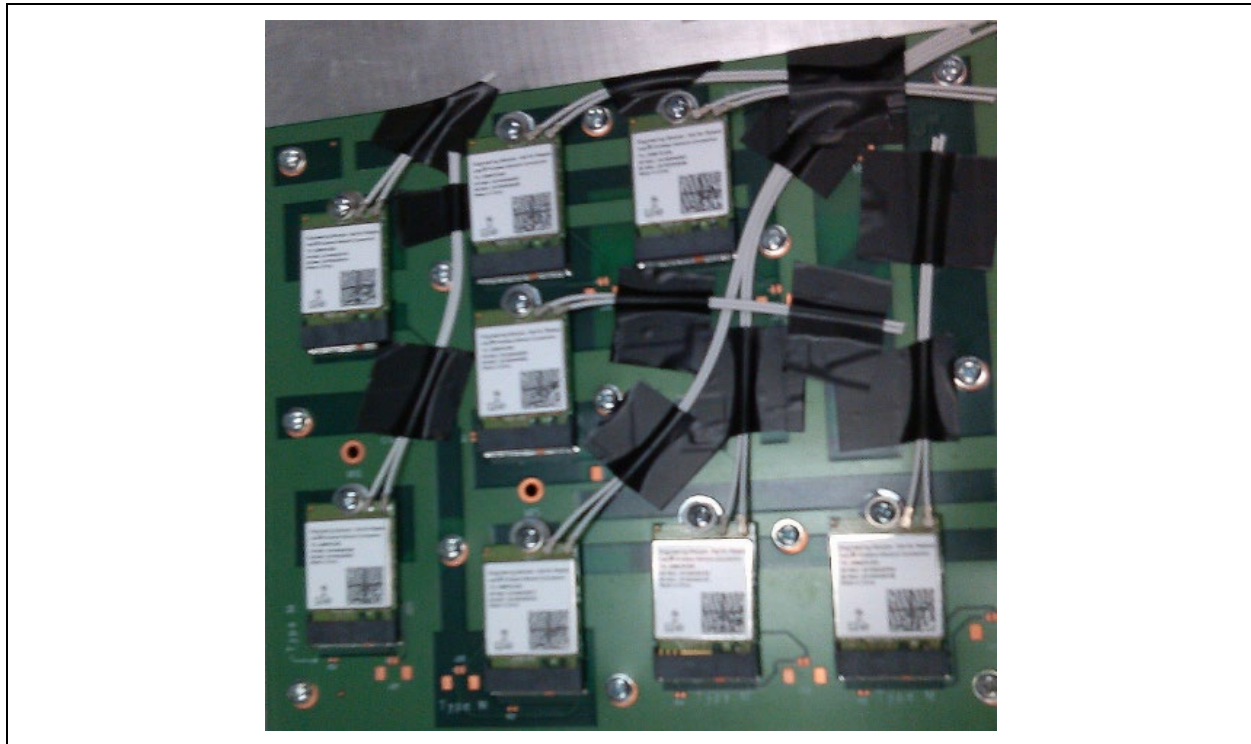
## 4.5 M.2 antenna retention

### 4.5.1 Recommended method for retention of M.2 cable

It's recommended to restrain the antenna cables of M.2 products within the first 25 mm or less of cable length, leaving the RF connectors on the module.

It's recommended to use 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, as shown in Figure 4-4.

**Figure 4-4 Retention of M.2 cables**



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## 5 Thermal Specifications

**Note:** The numbers in this section are not final, and are subject to change.

### 5.1 Thermal dissipation

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

**Table 5-1 Thermal dissipation**

Use Case		PC (mW)	
Wi-Fi	Bluetooth®	Wi-Fi	Bluetooth®
<b>Worst case TDP:</b> Based on average power consumption measurement over five minutes with max TCP/IP throughput activity	<b>Worst case TDP:</b> Based on average power consumption measurement over five minutes A2DP throughput activity	2880	100

**NOTES:**

1. Not applicable for scenarios that may only be exercised using lab or OEM support software tools.
2. Worst case TDP value for Wi-Fi is for HB; for UHB, it's +250mW.
3. Values are for typical conditions, material and terminated antenna.

### 5.2 Thermal specifications

Table 5-2 describes thermal management performance.

**Table 5-2 Thermal management**

Name	Description
Thermal shield performance targets	Full performance at shield temperatures up to 80 °C. Testing conditions: <b>High temperture limit:</b> 50 °C (ambient) under controlled environment (oven), with no air flow (inside a box). <b>Low temperture limit:</b> 0 °C (starting point) under controlled environment (oven), with no air flow (inside a box).
Thermal silicon protection (CT-Kill)	Thermal silicon protection will not be activated below 85 °C T-shield temperature

### 5.3 Thermal management

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

When the product is heating up and nearing CT Kill, it will start decreasing the Wi-Fi activity in order to prevent the unit from heating further and reaching critical temperature. In such case, connectivity will be maintained but performance might be degraded gradually.

### 5.4 Module placement recommendations

The module disperses excess heat through the RF shield and the screws that ground the module to the chassis.

## Thermal Specifications

Correct module placement will ensure optimal thermal performance:

- The module orientation should be shield up.
- The module connection to chassis should be with a single metal screw.

### 5.5 Nonoperational module thermal storage

Table 5-3 describes nonoperational module thermal storage conditions.

**Table 5-3 Storage conditions**

Environment	Limits
Storage Temperature (Non-Operational)	-40 °C to 70 °C (external direct temperture)
Humidity (Non-Operational)	50% to 90% non-condensing (at temperatures of 25 °C to 35 °C)



## 6 Performance KPIs

The performance information in this section is either estimated or TBD.

### 6.1 Wi-Fi channels

Supporting 2.4GHz (Low Band), 5GHz (High Band) and 6GHz (Ultra High Band) bands according to the regulations.

**Note:** Pending FCC approval, TyP may add 5.9GHz channels (currently DSRC channels).

### 6.2 RF KPIs

#### 6.2.1 Wi-Fi Tx power

Table 6-1 TyP 2x2 2230 LB and HB Tx power

TyP 2x2 2230 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Defaults Profile 0 [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11b	LB	20MHz	2412	1	11	15	15	20	20	15	15
.11b	LB	20MHz	2417	2	11	15	15	20	20	15	15
.11b	LB	20MHz	2422	3	11	15	15	20	20	15	15
.11b	LB	20MHz	2427	4	11	15	15	20	20	15	15
.11b	LB	20MHz	2432	5	11	15	15	20	20	15	15
.11b	LB	20MHz	2437	6	11	15	15	20	20	15	15
.11b	LB	20MHz	2442	7	11	15	15	20	20	15	15
.11b	LB	20MHz	2447	8	11	15	15	20	20	15	15
.11b	LB	20MHz	2452	9	11	15	15	20	20	15	15
.11b	LB	20MHz	2457	10	11	15	15	20	20	15	15
.11b	LB	20MHz	2462	11	11	15	15	20	20	15	15
.11b	LB	20MHz	2467	12	11	15	15	18	18	15	15
.11b	LB	20MHz	2472	13	11	15	15	16.5	16	15	15
.11g	LB	20MHz	2412	1	6	16	16	17.5	17	14	14
.11g	LB	20MHz	2412	1	54	16	16	16.75	16	14	14
.11g	LB	20MHz	2417	2	6	16	16	18.75	18.75	16	16
.11g	LB	20MHz	2417	2	54	16	16	17.25	17	16	16

TyP 2x2 2230 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Defaults Profile 0 [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11g	LB	20MHz	2422	3	6	16	16	19.25	19	16	16
.11g	LB	20MHz	2422	3	54	16	16	17.75	17.75	16	16
.11g	LB	20MHz	2427	4	6	16	16	20	19.25	16	16
.11g	LB	20MHz	2427	4	54	16	16	17.75	17.75	16	16
.11g	LB	20MHz	2432	5	6	16	16	20	20	16	16
.11g	LB	20MHz	2432	5	54	16	16	17.75	17.75	16	16
.11g	LB	20MHz	2437	6	6	16	16	20	20	16	16
.11g	LB	20MHz	2437	6	54	16	16	17.75	17.75	16	16
.11g	LB	20MHz	2442	7	6	16	16	20	20	16	16
.11g	LB	20MHz	2442	7	54	16	16	17.75	17.75	16	16
.11g	LB	20MHz	2447	8	6	16	16	19.25	19.25	16	16
.11g	LB	20MHz	2447	8	54	16	16	17.75	17.75	16	16
.11g	LB	20MHz	2452	9	6	16	16	18.5	18.5	16	16
.11g	LB	20MHz	2452	9	54	16	16	17.75	17.5	16	16
.11g	LB	20MHz	2457	10	6	16	16	18.25	18.25	16	16
.11g	LB	20MHz	2457	10	54	16	16	16.75	16.75	16	16
.11g	LB	20MHz	2462	11	6	16	16	16.75	15.75	16	15.75
.11g	LB	20MHz	2462	11	54	16	16	16	15.5	16	15.5
.11g	LB	20MHz	2467	12	6	16	16	13	13	13	13
.11g	LB	20MHz	2467	12	54	16	16	13	13	13	13
.11g	LB	20MHz	2472	13	6	16	16	11	11	11	11
.11g	LB	20MHz	2472	13	54	16	16	11	11	11	11
.11n	LB	20MHz	2412	1	7	16	16	15.75	15	14	14
.11n	LB	20MHz	2417	2	7	16	16	16.75	16.5	16	16
.11n	LB	20MHz	2422	3	7	16	16	17.5	17.25	16	16
.11n	LB	20MHz	2427	4	7	16	16	17.5	17.5	16	16
.11n	LB	20MHz	2432	5	7	16	16	17.5	17.5	16	16
.11n	LB	20MHz	2437	6	7	16	16	17.5	17.5	16	16
.11n	LB	20MHz	2442	7	7	16	16	17.5	17.5	16	16



TyP 2x2 2230 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Defaults Profile 0 [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11n	LB	20MHz	2447	8	7	16	16	17.5	17.5	16	16
.11n	LB	20MHz	2452	9	7	16	16	17.25	17.25	16	16
.11n	LB	20MHz	2457	10	7	16	16	16.5	16	16	16
.11n	LB	20MHz	2462	11	7	16	16	15	14.75	15	14.75
.11n	LB	20MHz	2467	12	7	16	16	13	13	13	13
.11n	LB	20MHz	2472	13	7	16	16	11	11	11	11
.11ax	LB	20MHz	2412	1	11	15.75	15.5	14.75	14.25	14	14
.11ax	LB	20MHz	2437	6	11	15.75	15.5	15.75	15.5	15.75	15.5
.11ax	LB	20MHz	2462	11	11	15.625	15.5	14	13.5	14	13.5
.11ax	LB	20MHz	2467	12	11	15.625	15.5	12.75	12.5	12.75	12.5
.11ax	LB	20MHz	2472	13	11	15.625	15.5	11	11	11	11
.11a	HB	20MHz	5180	36	6	15	15	17	18	15	15
.11a	HB	20MHz	5180	36	54	15	15	17.25	17	15	15
.11a	HB	20MHz	5200	40	6	15	15	20	20	15	15
.11a	HB	20MHz	5200	40	54	15	15	18.5	18.5	15	15
.11a	HB	20MHz	5220	44	6	15	15	20	20	15	15
.11a	HB	20MHz	5220	44	54	15	15	18.5	18.5	15	15
.11a	HB	20MHz	5240	48	6	15	15	20	20	14	14
.11a	HB	20MHz	5240	48	54	15	15	18.5	18.5	14	14
.11a	HB	20MHz	5260	52	6	15	15	20	20	14.5	15
.11a	HB	20MHz	5260	52	54	15	15	18.5	18.5	14.5	15
.11a	HB	20MHz	5280	56	6	15	15	20	20	15	15
.11a	HB	20MHz	5280	56	54	15	15	18.5	18.5	15	15
.11a	HB	20MHz	5300	60	6	15	15	20	20	15	15
.11a	HB	20MHz	5300	60	54	15	15	18.5	18.5	15	15
.11a	HB	20MHz	5320	64	6	15	15	18.25	18.75	15	15
.11a	HB	20MHz	5320	64	54	15	15	17	17	15	15
.11a	HB	20MHz	5500	100	6	15	15	19.25	19	14	14
.11a	HB	20MHz	5500	100	54	15	15	17.75	17	14	14

TyP 2x2 2230 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Defaults Profile 0 [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11a	HB	20MHz	5785	157	6	7.5	7.5	20	20	7.5	7.5
.11a	HB	20MHz	5785	157	54	7.5	7.5	18.5	18.5	7.5	7.5
.11a	HB	20MHz	5805	161	6	7.5	7.5	20	20	7.5	7.5
.11a	HB	20MHz	5805	161	54	7.5	7.5	18.5	18.5	7.5	7.5
.11a	HB	20MHz	5825	165	6	7.5	7.5	20	20	7.5	7.5
.11a	HB	20MHz	5825	165	54	7.5	7.5	18.5	18.5	7.5	7.5
.11n	HB	20MHz	5180	36	7	15	15	16.5	16.5	15	15
.11n	HB	20MHz	5200	40	7	15	15	18.25	18.25	15	15
.11n	HB	20MHz	5500	100	7	15	15	17.75	17	14	14
.11n	HB	20MHz	5580	116	7	15	15	18.25	18.25	14	14
.11n	HB	20MHz	5825	165	7	7.5	7.5	18.25	18.25	7.5	7.5
.11ac	HB	20MHz	5200	40	8	15	15	17.875	18	15	15
.11ac	HB	20MHz	5500	100	8	15	15	17.25	16.5	14	14
.11ac	HB	20MHz	5805	161	8	7.5	7.5	17.875	17.875	7.5	7.5
.11ax	HB	20MHz	5180	36	11	15	15	16.25	16	15	15
.11ax	HB	20MHz	5320	64	11	15	15	16	16	15	15
.11ax	HB	20MHz	5745	149	11	7.5	7.5	15.75	16	7.5	7.5
.11n	HB	40MHz	5190	38	7	16.5	16.5	15	14.75	15	14.75
.11n	HB	40MHz	5230	46	7	16.5	16.5	19	18.875	13.5	13.5
.11n	HB	40MHz	5510	102	7	16.5	16.5	15.5	15.25	14	14
.11n	HB	40MHz	5795	159	7	7.5	7.5	19	18.125	7.5	7.5
.11ac	HB	40MHz	5230	46	9	16.5	16.5	17.625	17.25	13.5	13.5
.11ac	HB	40MHz	5510	102	9	16.5	16.5	15	14.75	14	14
.11ac	HB	40MHz	5795	159	9	7.5	7.5	17.875	14.5	7.5	7.5
.11ax	HB	40MHz	5190	38	11	16	15.875	14.75	14.5	14.75	14.5
.11ax	HB	40MHz	5510	102	11	16.25	15.625	15	14.75	14	14
.11ax	HB	40MHz	5755	151	11	7.5	7.5	14.75	14.375	7.5	7.5
.11ac	HB	80MHz	5210	42	9	16.5	16.5	15.25	15	15.25	15
.11ac	HB	80MHz	5530	106	9	16.5	16.5	15.5	15	14	14

TyP 2x2 2230 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Defaults Profile 0 [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11ac	HB	80MHz	5775	155	9	7.5	7.5	16	16.75	7.5	7.5
.11ax	HB	80MHz	5210	42	11	15.5	15.75	15.25	14.75	15.25	14.75
.11ax	HB	80MHz	5290	58	11	15.5	15.75	14.5	13.5	14.5	13.5
.11ax	HB	80MHz	5530	106	11	15.75	15.625	15.25	14.75	14	14
.11ax	HB	80MHz	5610	122	11	15.75	15.75	15.75	15.75	14	14
.11ax	HB	80MHz	5690	138	11	15.375	15.875	15.375	15.875	15.375	15.875
.11ax	HB	80MHz	5775	155	11	7.5	7.5	15.125	15.5	7.5	7.5
.11ac	HB	160MHz	5250	50	9	15.5	15.25	12	11.25	12	11.25
.11ac	HB	160MHz	5570	114	9	15.375	15.5	14	13	14	13
.11ax	HB	160MHz	5250	50	11	14.375	12.375	12	11.25	12	11.25
.11ax	HB	160MHz	5570	114	11	13.25	13.125	13.25	13	13.25	13

**Table 6-2 TyP 2x2 2230 UHB FCC Tx power – LPI**

TyP 2x2 2230 Tx Power per MCS								
Accuracy: ~ +/-1dB								
						FCC (US)[dBm]		
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	MIMO AB
.11n	UHB	20MHz	5955	1	0	4.5	4.5	1.5
.11n	UHB	20MHz	6435	97	0	4.5	4.5	1.5
.11n	UHB	20MHz	6675	145	0	3.75	3.75	0.75
.11n	UHB	20MHz	7055	221	0	3.75	3.75	0.75
.11ac	UHB	20MHz	5955	1	0	4.5	4.5	1.5
.11ac	UHB	20MHz	6435	97	0	4.5	4.5	1.5
.11ac	UHB	20MHz	6675	145	0	3.75	3.75	0.75
.11ac	UHB	20MHz	7055	221	0	3.75	3.75	0.75

Typ 2x2 2230 Tx Power per MCS								
Accuracy: ~ +/-1dB								
						FCC (US)[dBm]		
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	MIMO AB
.11ax	UHB	20MHz	5955	1	0	4.5	4.5	1.5
.11ax	UHB	20MHz	5955	1	11	4.5	4.5	1.5
.11ax	UHB	20MHz	6435	97	0	4.5	4.5	1.5
.11ax	UHB	20MHz	6435	97	11	4.5	4.5	1.5
.11ax	UHB	20MHz	6675	145	0	3.75	3.75	0.75
.11ax	UHB	20MHz	6675	145	11	3.75	3.75	0.75
.11ax	UHB	20MHz	7055	221	0	3.75	3.75	0.75
.11ax	UHB	20MHz	7055	221	11	3.75	3.75	0.75
.11n	UHB	40MHz	5965	3	0	7.75	7.75	4.75
.11n	UHB	40MHz	6445	99	0	7.75	7.75	4.75
.11n	UHB	40MHz	6685	147	0	7	7	4
.11n	UHB	40MHz	7045	219	0	7	7	4
.11ac	UHB	40MHz	5965	3	0	7.75	7.75	4.75
.11ac	UHB	40MHz	6445	99	0	7.75	7.75	4.75
.11ac	UHB	40MHz	6685	147	0	7	7	4
.11ac	UHB	40MHz	7045	219	0	7	7	4
.11ax	UHB	40MHz	5965	3	0	7.75	7.75	4.75
.11ax	UHB	40MHz	5965	3	11	7.75	7.75	4.75
.11ax	UHB	40MHz	6445	99	0	7.75	7.75	4.75
.11ax	UHB	40MHz	6445	99	11	7.75	7.75	4.75
.11ax	UHB	40MHz	6685	147	0	7	7	4
.11ax	UHB	40MHz	6685	147	11	7	7	4
.11ax	UHB	40MHz	7045	219	0	7	7	4
.11ax	UHB	40MHz	7045	219	11	7	7	4
.11ac	UHB	80MHz	5985	7	0	10.25	10.25	7.25
.11ac	UHB	80MHz	5985	7	7	10.25	10.25	7.25
.11ac	UHB	80MHz	5985	7	9	10.25	10.25	7.25
.11ac	UHB	80MHz	6465	103	0	10.25	10.25	7.25
.11ac	UHB	80MHz	6465	103	7	10.25	10.25	7.25
.11ac	UHB	80MHz	6465	103	9	10.25	10.25	6.5

Typ 2x2 2230 Tx Power per MCS								
Accuracy: ~ +/-1dB								
						FCC (US)[dBm]		
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	MIMO AB
.11ac	UHB	80MHz	6705	151	0	9.5	9.5	6.5
.11ac	UHB	80MHz	6705	151	7	9.5	9.5	6.5
.11ac	UHB	80MHz	6705	151	9	9.5	9.5	6.5
.11ac	UHB	80MHz	7025	215	0	9.5	9.5	6.5
.11ac	UHB	80MHz	7025	215	7	9.5	9.5	6.5
.11ac	UHB	80MHz	7025	215	9	9.5	9.5	6.5
.11ax	UHB	80MHz	5985	7	0	10.25	10.25	7.25
.11ax	UHB	80MHz	5985	7	7	10.25	10.25	7.25
.11ax	UHB	80MHz	5985	7	9	10.25	10.25	7.25
.11ax	UHB	80MHz	5985	7	11	10.25	10.25	7.25
.11ax	UHB	80MHz	6465	103	0	10.25	10.25	7.25
.11ax	UHB	80MHz	6465	103	7	10.25	10.25	7.25
.11ax	UHB	80MHz	6465	103	9	10.25	10.25	7.25
.11ax	UHB	80MHz	6465	103	11	10.25	10.25	7.25
.11ax	UHB	80MHz	6705	151	0	9.5	9.5	6.5
.11ax	UHB	80MHz	6705	151	7	9.5	9.5	6.5
.11ax	UHB	80MHz	6705	151	9	9.5	9.5	6.5
.11ax	UHB	80MHz	6705	151	11	9.5	9.5	6.5
.11ax	UHB	80MHz	7025	215	0	9.5	9.5	6.5
.11ax	UHB	80MHz	7025	215	7	9.5	9.5	6.5
.11ax	UHB	80MHz	7025	215	9	9.5	9.5	6.5
.11ax	UHB	80MHz	7025	215	11	9.5	9.5	6.5
.11ac	UHB	160MHz	6025	15	0	13	13	10
.11ac	UHB	160MHz	6025	15	7	13	13	10
.11ac	UHB	160MHz	6025	15	9	13	13	10
.11ac	UHB	160MHz	6505	111	0	13	13	10
.11ac	UHB	160MHz	6505	111	7	13	13	10
.11ac	UHB	160MHz	6505	111	9	13	13	10
.11ac	UHB	160MHz	6665	143	0	12.25	12.25	9.25
.11ac	UHB	160MHz	6665	143	7	12.25	12.25	9.25

TyP 2x2 2230 Tx Power per MCS								
Accuracy: ~ +/-1dB								
						FCC (US)[dBm]		
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	MIMO AB
.11ac	UHB	160MHz	6665	143	9	12.25	12.25	9.25
.11ac	UHB	160MHz	6985	207	0	12.25	12.25	9.25
.11ac	UHB	160MHz	6985	207	7	12.25	12.25	9.25
.11ac	UHB	160MHz	6985	207	9	12.25	11.5	9.25
.11ax	UHB	160MHz	6025	15	0	13	13	10
.11ax	UHB	160MHz	6025	15	7	13	13	10
.11ax	UHB	160MHz	6025	15	9	13	13	10
.11ax	UHB	160MHz	6025	15	11	12.25	13	10
.11ax	UHB	160MHz	6505	111	0	13	13	10
.11ax	UHB	160MHz	6505	111	7	13	13	10
.11ax	UHB	160MHz	6505	111	9	13	13	10
.11ax	UHB	160MHz	6505	111	11	11.375	10.625	10
.11ax	UHB	160MHz	6665	143	0	12.25	12.25	9.25
.11ax	UHB	160MHz	6665	143	7	12.25	12.25	9.25
.11ax	UHB	160MHz	6665	143	9	12.25	12.25	9.25
.11ax	UHB	160MHz	6665	143	11	11.25	10.5	9.25
.11ax	UHB	160MHz	6985	207	0	12.25	12.25	9.25
.11ax	UHB	160MHz	6985	207	7	12.25	12.25	9.25
.11ax	UHB	160MHz	6985	207	9	12.25	12.25	9.25

Table 6-3 TyP 2x2 1216 LB and HB Tx power

TyP 2x2 1216 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Default EU [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11b	LB	20MHz	2412	1	11	15.5	15.5	20	19.75	15.5	15.5
.11b	LB	20MHz	2417	2	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2422	3	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2427	4	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2432	5	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2437	6	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2442	7	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2447	8	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2452	9	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2457	10	11	15.5	15.5	20	20	15.5	15.5
.11b	LB	20MHz	2462	11	11	15.5	15.5	19.75	20	15.5	15.5
.11b	LB	20MHz	2467	12	11	15.5	15.5	18	17.75	15.5	15.5
.11b	LB	20MHz	2472	13	11	15.5	15.5	15	14.75	15	14.75
.11g	LB	20MHz	2412	1	6	16	16	17	16.5	14	14
.11g	LB	20MHz	2412	1	54	16	16	16.75	16.5	14	14
.11g	LB	20MHz	2417	2	6	16	16	19	18.75	16	16
.11g	LB	20MHz	2417	2	54	16	16	17.5	17	16	16
.11g	LB	20MHz	2422	3	6	16	16	19.25	19.25	16	16
.11g	LB	20MHz	2422	3	54	16	16	18.25	17.75	16	16
.11g	LB	20MHz	2427	4	6	16	16	19.5	19.5	16	16
.11g	LB	20MHz	2427	4	54	16	16	18.25	18	16	16
.11g	LB	20MHz	2432	5	6	16	16	20	20	16	16
.11g	LB	20MHz	2432	5	54	16	16	18.25	18	16	16
.11g	LB	20MHz	2437	6	6	16	16	20	20	16	16
.11g	LB	20MHz	2437	6	54	16	16	18.25	18	16	16
.11g	LB	20MHz	2442	7	6	16	16	19.75	19.5	16	16
.11g	LB	20MHz	2442	7	54	16	16	18.375	18.25	16	16
.11g	LB	20MHz	2447	8	6	16	16	19.5	19.25	16	16
.11g	LB	20MHz	2447	8	54	16	16	18.375	18.25	16	16

Typ 2x2 1216 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Default EU [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11g	LB	20MHz	2452	9	6	16	16	18.75	18.75	16	16
.11g	LB	20MHz	2452	9	54	16	16	17.75	17.5	16	16
.11g	LB	20MHz	2457	10	6	16	16	18.5	18.5	16	16
.11g	LB	20MHz	2457	10	54	16	16	16.75	16.75	16	16
.11g	LB	20MHz	2462	11	6	16	16	16.5	17.25	16	16
.11g	LB	20MHz	2462	11	54	16	16	16.25	16	16	16
.11g	LB	20MHz	2467	12	6	16	16	13.25	13	13.25	13
.11g	LB	20MHz	2467	12	54	16	16	13.25	13	13.25	13
.11g	LB	20MHz	2472	13	6	16	16	11.5	11	11.5	11
.11g	LB	20MHz	2472	13	54	16	16	11.5	11	11.5	11
.11n	LB	20MHz	2412	1	7	16	16	15.5	15	14	14
.11n	LB	20MHz	2417	2	7	16	16	17	16.5	16	16
.11n	LB	20MHz	2422	3	7	16	16	17.625	17.375	16	16
.11n	LB	20MHz	2427	4	7	16	16	17.625	17.375	16	16
.11n	LB	20MHz	2432	5	7	16	16	17.625	17.375	16	16
.11n	LB	20MHz	2437	6	7	16	16	17.625	17.375	16	16
.11n	LB	20MHz	2442	7	7	16	16	17.625	17.625	16	16
.11n	LB	20MHz	2447	8	7	16	16	17.625	17.625	16	16
.11n	LB	20MHz	2452	9	7	16	16	17.5	17.25	16	16
.11n	LB	20MHz	2457	10	7	16	16	16.5	16.25	16	16
.11n	LB	20MHz	2462	11	7	16	16	15.25	14.5	15.25	14.5
.11n	LB	20MHz	2467	12	7	16	16	13.25	13	13.25	13
.11n	LB	20MHz	2472	13	7	16	16	11.5	11	11.5	11
.11ax	LB	20MHz	2412	1	11	15.625	15.25	14.75	14.25	14	14
.11ax	LB	20MHz	2437	6	11	15.625	15.25	15.625	15.25	15.625	15.25
.11ax	LB	20MHz	2462	11	11	15.625	15.25	14.5	14	14.5	14
.11ax	LB	20MHz	2467	12	11	15.625	15.25	13.25	13	13.25	13
.11ax	LB	20MHz	2472	13	11	15.625	15.25	11.5	11	11.5	11
.11a	HB	20MHz	5180	36	6	15	15	18	18	14.5	14.75
.11a	HB	20MHz	5180	36	54	15	15	16.75	16.5	14.5	14.75



TyP 2x2 1216 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Default EU [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11a	HB	20MHz	5200	40	6	15	15	20	20	14.5	15
.11a	HB	20MHz	5200	40	54	15	15	18.75	18.875	14.5	15
.11a	HB	20MHz	5220	44	6	15	15	20	20	15	15
.11a	HB	20MHz	5220	44	54	15	15	18.75	18.875	15	15
.11a	HB	20MHz	5240	48	6	15	15	20	20	14	14
.11a	HB	20MHz	5240	48	54	15	15	18.75	18.875	14	14
.11a	HB	20MHz	5260	52	6	15	15	20	20	14.5	15
.11a	HB	20MHz	5260	52	54	15	15	18.75	18.875	14.5	15
.11a	HB	20MHz	5280	56	6	15	15	20	20	15	15
.11a	HB	20MHz	5280	56	54	15	15	18.75	18.875	15	15
.11a	HB	20MHz	5300	60	6	15	15	20	20	15	15
.11a	HB	20MHz	5300	60	54	15	15	18.75	18.875	15	15
.11a	HB	20MHz	5320	64	6	15	15	18	18.25	15	15
.11a	HB	20MHz	5320	64	54	15	15	17	17	15	15
.11a	HB	20MHz	5500	100	6	15.5	15.5	18.5	18.5	14	14
.11a	HB	20MHz	5500	100	54	15.5	15.5	18	17.75	14	14
.11a	HB	20MHz	5520	104	6	15.5	15.5	20	20	14	14
.11a	HB	20MHz	5520	104	54	15.5	15.5	18.5	18.75	14	14
.11a	HB	20MHz	5785	157	6	7.5	7.5	20	20	7.5	7.5
.11a	HB	20MHz	5785	157	54	7.5	7.5	18.5	18.5	7.5	7.5
.11a	HB	20MHz	5805	161	6	7.5	7.5	20	20	7.5	7.5
.11a	HB	20MHz	5805	161	54	7.5	7.5	18.5	18.5	7.5	7.5
.11a	HB	20MHz	5825	165	6	7.5	7.5	20	20	7.5	7.5
.11a	HB	20MHz	5825	165	54	7.5	7.5	18.625	18.5	7.5	7.5
.11n	HB	20MHz	5180	36	7	15	15	16.75	16.5	14.5	14.75
.11n	HB	20MHz	5200	40	7	15	15	18.25	18.5	14.5	15
.11n	HB	20MHz	5500	100	7	15.5	15.5	18	18	14	14
.11n	HB	20MHz	5580	116	7	15.5	15.5	18.125	18.375	14	14
.11n	HB	20MHz	5825	165	7	7.5	7.5	18.125	18.125	7.5	7.5
.11ac	HB	20MHz	5200	40	8	15	15	17.375	17.375	14.5	15

TyP 2x2 1216 Tx Power per MCS											
Accuracy: ~ +/-1dB											
						ETSI (EU) [dBm]		FCC (US) [dBm]		Default EU [dBm]	
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	SISO A	SISO B	SISO A	SISO B
.11ac	HB	20MHz	5500	100	8	15.5	15.5	17.5	17.5	14	14
.11ac	HB	20MHz	5805	161	8	7.5	7.5	17.125	17.25	7.5	7.5
.11ax	HB	20MHz	5180	36	11	13.875	14	13.875	14	13.875	14
.11ax	HB	20MHz	5320	64	11	13.875	14	13.875	14	13.875	14
.11ax	HB	20MHz	5745	149	11	7.5	7.5	13.5	13.625	7.5	7.5
.11n	HB	40MHz	5190	38	7	17	17	14.5	14.5	14.5	14.5
.11n	HB	40MHz	5230	46	7	17	17	18.5	18.5	16.5	16.5
.11n	HB	40MHz	5510	102	7	17	17	16.25	15.75	14	14
.11n	HB	40MHz	5795	159	7	7.5	7.5	18.375	18.375	7.5	7.5
.11ac	HB	40MHz	5230	46	9	17	17	17	17.125	16.5	16.5
.11ac	HB	40MHz	5510	102	9	17	17	15.5	15.25	14	14
.11ac	HB	40MHz	5795	159	9	7.5	7.5	16.75	16.875	7.5	7.5
.11ax	HB	40MHz	5190	38	11	15	14.875	14.25	14	14.25	14
.11ax	HB	40MHz	5510	102	11	14.75	14.5	14.75	14.5	14	14
.11ax	HB	40MHz	5755	151	11	7.5	7.5	14.75	14.875	7.5	7.5
.11ac	HB	80MHz	5210	42	9	16.75	16.625	15.5	15	15.5	15
.11ac	HB	80MHz	5530	106	9	16.5	16.875	15.5	15.5	14	14
.11ac	HB	80MHz	5775	155	9	7.5	7.5	16.375	16.25	7.5	7.5
.11ax	HB	80MHz	5210	42	11	14.875	15	14.875	15	14.25	15
.11ax	HB	80MHz	5290	58	11	14.875	15	14.875	14.5	14.875	14.5
.11ax	HB	80MHz	5530	106	11	14.625	14.375	14.625	14.375	14	14
.11ax	HB	80MHz	5610	122	11	14.875	14.25	14.875	14.25	14	14
.11ax	HB	80MHz	5690	138	11	14	14.25	14	14.25	14	14.25
.11ax	HB	80MHz	5775	155	11	7.5	7.5	14.75	14.25	7.5	7.5
.11ac	HB	160MHz	5250	50	9	15	15.375	13.5	13.25	13.5	13.25
.11ac	HB	160MHz	5570	114	9	15.75	15.625	15.5	15	14	14
.11ax	HB	160MHz	5250	50	11	12.125	13.25	12.125	11.75	11.75	11.75
.11ax	HB	160MHz	5570	114	11	13.25	13.125	13.25	13.125	12.75	13

Table 6-4 TyP 2x2 1216 UHB Tx power - LPI

TyP 2x2 1216 Tx Power per MCS								
Accuracy: ~ +/-1dB								
						FCC (US)[dBm]		
Modulation	Band	BW	Channel	Channel index	MCS	SISO A	SISO B	MIMO AB
.11n	UHB	20MHz	5955	1	0	4.5	4.5	1.5
.11n	UHB	20MHz	6435	97	0	4.5	4.5	1.5
.11n	UHB	20MHz	6675	145	0	3.75	3.75	0.75
.11n	UHB	20MHz	7055	221	0	3.75	3.75	0.75
.11ac	UHB	20MHz	5955	1	0	4.5	4.5	1.5
.11ac	UHB	20MHz	6435	97	0	4.5	4.5	1.5
.11ac	UHB	20MHz	6675	145	0	3.75	3.75	0.75
.11ac	UHB	20MHz	7055	221	0	3.75	3.75	0.75
.11ax	UHB	20MHz	5955	1	0	4.5	4.5	1.5
.11ax	UHB	20MHz	5955	1	11	4.5	4.5	1.5
.11ax	UHB	20MHz	6435	97	0	4.5	4.5	1.5
.11ax	UHB	20MHz	6435	97	11	4.5	4.5	1.5
.11ax	UHB	20MHz	6675	145	0	3.75	3.75	0.75
.11ax	UHB	20MHz	6675	145	11	3.75	3.75	0.75
.11ax	UHB	20MHz	7055	221	0	3.75	3.75	0.75
.11ax	UHB	20MHz	7055	221	11	3.75	3.75	0.75
.11n	UHB	40MHz	5965	3	0	7.75	7.75	4.75
.11n	UHB	40MHz	6445	99	0	7.75	7.75	4.75
.11n	UHB	40MHz	6685	147	0	7	7	4
.11n	UHB	40MHz	7045	219	0	7	7	4
.11ac	UHB	40MHz	5965	3	0	7.75	7.75	4.75
.11ac	UHB	40MHz	6445	99	0	7.75	7.75	4.75
.11ac	UHB	40MHz	6685	147	0	7	7	4
.11ac	UHB	40MHz	7045	219	0	7	7	4
.11ax	UHB	40MHz	5965	3	0	7.75	7.75	4.75
.11ax	UHB	40MHz	5965	3	11	7.75	7.75	4.75
.11ax	UHB	40MHz	6445	99	0	7.75	7.75	4.75
.11ax	UHB	40MHz	6445	99	11	7.75	7.75	4.75
.11ax	UHB	40MHz	6685	147	0	7	7	4
.11ax	UHB	40MHz	6685	147	11	7	7	4

Typ 2x2 1216 Tx Power per MCS								
Accuracy: ~ +/-1dB								
						FCC (US)[dBm]		
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	MIMO AB
.11ax	UHB	40MHz	7045	219	0	7	7	4
.11ax	UHB	40MHz	7045	219	11	7	7	4
.11ac	UHB	80MHz	5985	7	0	10.25	10.25	7.25
.11ac	UHB	80MHz	5985	7	7	10.25	10.25	7.25
.11ac	UHB	80MHz	5985	7	9	10.25	10.25	7.25
.11ac	UHB	80MHz	6465	103	0	10.25	10.25	7.25
.11ac	UHB	80MHz	6465	103	7	10.25	10.25	7.25
.11ac	UHB	80MHz	6465	103	9	10.25	10.25	7.25
.11ac	UHB	80MHz	6705	151	0	9.5	9.5	6.5
.11ac	UHB	80MHz	6705	151	7	9.5	9.5	6.5
.11ac	UHB	80MHz	6705	151	9	9.5	9.5	6.5
.11ac	UHB	80MHz	7025	215	0	9.5	9.5	6.5
.11ac	UHB	80MHz	7025	215	7	9.5	9.5	6.5
.11ac	UHB	80MHz	7025	215	9	9.5	9.5	6.5
.11ax	UHB	80MHz	5985	7	0	10.25	10.25	7.25
.11ax	UHB	80MHz	5985	7	7	10.25	10.25	7.25
.11ax	UHB	80MHz	5985	7	9	10.25	10.25	7.25
.11ax	UHB	80MHz	5985	7	11	10.25	10.25	7.25
.11ax	UHB	80MHz	6465	103	0	10.25	10.25	7.25
.11ax	UHB	80MHz	6465	103	7	10.25	10.25	7.25
.11ax	UHB	80MHz	6465	103	9	10.25	10.25	7.25
.11ax	UHB	80MHz	6465	103	11	10.25	10.25	7.25
.11ax	UHB	80MHz	6705	151	0	9.5	9.5	6.5
.11ax	UHB	80MHz	6705	151	7	9.5	9.5	6.5
.11ax	UHB	80MHz	6705	151	9	9.5	9.5	6.5
.11ax	UHB	80MHz	6705	151	11	9.5	9.5	6.5
.11ax	UHB	80MHz	7025	215	0	9.5	9.5	6.5
.11ax	UHB	80MHz	7025	215	7	9.5	9.5	6.5
.11ax	UHB	80MHz	7025	215	9	9.5	9.5	6.5
.11ax	UHB	80MHz	7025	215	11	9.5	9.5	6.5
.11ac	UHB	160MHz	6025	15	0	13	13	10

Typ 2x2 1216 Tx Power per MCS								
Accuracy: ~ +/-1dB								
						FCC (US)[dBm]		
Modulation	Band	BW	Channel	Channel Index	MCS	SISO A	SISO B	MIMO AB
.11ac	UHB	160MHz	6025	15	7	13	13	10
.11ac	UHB	160MHz	6025	15	9	13	13	10
.11ac	UHB	160MHz	6505	111	0	13	13	10
.11ac	UHB	160MHz	6505	111	7	13	13	10
.11ac	UHB	160MHz	6505	111	9	12.5	12.25	10
.11ac	UHB	160MHz	6665	143	0	12.25	12.25	9.25
.11ac	UHB	160MHz	6665	143	7	12.25	12.25	9.25
.11ac	UHB	160MHz	6665	143	9	12.25	12.25	9.25
.11ac	UHB	160MHz	6985	207	0	12.25	12.25	9.25
.11ac	UHB	160MHz	6985	207	7	12.25	12.25	9.25
.11ac	UHB	160MHz	6985	207	9	12.25	12.25	9.25
.11ax	UHB	160MHz	6025	15	0	13	13	10
.11ax	UHB	160MHz	6025	15	7	13	13	10
.11ax	UHB	160MHz	6025	15	9	13	13	10
.11ax	UHB	160MHz	6025	15	11	13	13	10
.11ax	UHB	160MHz	6505	111	0	13	13	10
.11ax	UHB	160MHz	6505	111	7	13	13	10
.11ax	UHB	160MHz	6505	111	9	12.5	12.25	10
.11ax	UHB	160MHz	6505	111	11	9.5	9.75	9.5
.11ax	UHB	160MHz	6665	143	0	12.25	12.25	9.25
.11ax	UHB	160MHz	6665	143	7	12.25	12.25	9.25
.11ax	UHB	160MHz	6665	143	9	12.25	12.25	9.25
.11ax	UHB	160MHz	6665	143	11	8.75	9.75	8.75
.11ax	UHB	160MHz	6985	207	0	12.25	12.25	9.25
.11ax	UHB	160MHz	6985	207	7	12.25	12.25	9.25
.11ax	UHB	160MHz	6985	207	9	12.25	12.25	9.25

## 6.2.2 Wi-Fi Rx sensitivity

Table 6–5 lists TyP 2230 Wi-Fi Rx sensitivity values; Table 6–6 lists TyP 1216 Wi-Fi Rx sensitivity values.

**Table 6–5 TyP 2230 Wi-Fi Rx sensitivity**

				TyP 2230					
Band	Mode	BW [MHz]	Condi-tions	Chain A (dBm, accuracy +/- 0.5 dB)			Chain B (dBm, accuracy +/- 0.5 dB)		
				LB/LHB/LUHB	MHB/MUHB	HHB/HUHB	LB/LHB/LUHB	MHB/MUHB	HHB/HUHB
LB	11b	20	CCK, 1Mbps	-96.75			-96.75		
		20	CCK, 11 Mbps	-88.75			-88.75		
	11g	20	Rate 6Mbps	-93.5			-93.75		
		20	Rate 12Mbps	-91.25			-91.25		
		20	Rate 54Mbps	-76.75			-76.75		
	11n LDPC	20	MCS0	-93.75			-93.75		
		20	MCS6	-78			-78		
		20	MCS7	-75.75			-75.75		
	11n LDPC	40	MCS0	-92.25			-92.25		
		40	MCS6	-74.75			-74.75		
		40	MCS7	-72.25			-72.25		
	11ax LDPC	20	MCS0	-93.5			-93.5		
		20	MCS9	-69.75			-69.75		
		20	MCS10	-66.25			-66		
		20	MCS11	-63.75			-63.5		
	11ax LDPC	40	MCS0	-91.75			-91.75		
		40	MCS9	-66.75			-66.75		
		40	MCS10	-63.25			-63		
40		MCS11	-60.75			-60.5			
HB	11a	20	Rate 6Mbps	-95	-95.25	-95.25	-94.5	-94.5	-94.5
		20	Rate 12Mbps	-92.75	-93	-93.25	-92.5	-92.25	-92.25
		20	Rate 54Mbps	-77.75	-78	-78	-77.5	-77.5	-77.25
	11n LDPC	20	MCS0	-95	-95.25	-95.25	-94.5	-94.5	-94.5
		20	MCS6	-79	-79.25	-79.25	-78.75	-78.75	-78.5
		20	MCS7	-76.75	-77	-77	-76.5	-76.5	-76.25

				Typ 2230					
Band	Mode	BW [MHz]	Condi-tions	Chain A (dBm, accuracy +/- 0.5 dB)			Chain B (dBm, accuracy +/- 0.5 dB)		
				LB/LHB/LUHB	MHB/MUHB	HHB/HUHB	LB/LHB/LUHB	MHB/MUHB	HHB/HUHB
HB	11n LDPC	40	MCS0	-93.5	-93.75	-93.75	-93	-93.25	-93
		40	MCS6	-76	-76.25	-76.25	-75.75	-75.75	-75.5
		40	MCS7	-73.5	-73.75	-73.75	-73.25	-73.25	-73
	11ac LDPC	20	MCS0	-95	-95.25	-95.25	-94.5	-94.5	-94.5
		20	MCS8	-73.25	-73.75	-73.75	-73	-73	-73
	11ac LDPC	40	MCS0	-93.5	-93.75	-93.75	-93.25	-93.25	-93
		40	MCS7	-74.5	-74.75	-74.75	-74	-74.25	-74
		40	MCS8	-70.5	-70.75	-70.75	-70	-70.25	-70
		40	MCS9	-68.75	-69.25	-69.25	-68.5	-68.75	-68.5
	11ac LDPC	80	MCS0	-90	-90.25	-90.25	-89.75	-89.75	-89.5
		80	MCS7	-71.5	-71.75	-71.75	-71.25	-71	-71
		80	MCS8	-66.75	-67	-67.25	-66.75	-66.5	-66.5
		80	MCS9	-65	-65.25	-65.25	-64.5	-64.5	-64.5
	11ac LDPC	160	MCS0	-87	-87.25		-86.75	-86.75	
		160	MCS7	-68	-68		-67.75	-67.75	
		160	MCS8	-63.5	-63.75		-63.5	-63.25	
		160	MCS9	-61.5	-61.75		-61.5	-61.25	
	11ax LDPC	20	MCS0	-94.75	-95	-95	-94.25	-94.25	-94.25
		20	MCS9	-71	-71.25	-71.25	-70.5	-70.5	-70.5
		20	MCS10	-67.25	-67.5	-67.5	-66.75	-66.75	-66.5
		20	MCS11	-64.75	-65	-65	-64.25	-64	-64
	11ax LDPC	40	MCS0	-93	-93.25	-93.25	-92.5	-92.75	-92.5
		40	MCS9	-68	-68.25	-68.25	-67.5	-67.5	-67.25
		40	MCS10	-64.25	-64.5	-64.5	-63.75	-63.75	-63.5
		40	MCS11	-61.75	-62	-62	-61.25	-61.25	-61
	11ax LDPC	80	MCS0	-89.5	-89.75	-89.75	-89.25	-89	-89
		80	MCS10	-60.75	-61	-61	-60.5	-60.25	-60.25
		80	MCS11	-58.5	-58.75	-58.75	-58	-57.75	-57.75
	11ax LDPC	160	MCS0	-86.75	-87		-86.5	-86.25	
		160	MCS9	-62	-62.25		-61.75	-61.5	
		160	MCS10	-58	-58.25		-57.5	-57.5	
		160	MCS11	-55.75	-56		-55.25	-55	
UHB	11a	20	Rate 6Mbps	-95	-94.5	-93.75	-94.5	-94.25	-93.5

				Typ 2230					
Band	Mode	BW [MHz]	Conditions	Chain A (dBm, accuracy +/- 0.5 dB)			Chain B (dBm, accuracy +/- 0.5 dB)		
				LB/LHB/LUHB	MHB/MUHB	HHB/HUHB	LB/LHB/LUHB	MHB/MUHB	HHB/HUHB
UHB		20	Rate 12Mbps	-93	-92.5	-91.5	-92.25	-92	-91
		20	Rate 54Mbps	-77.75	-77.5	-76.75	-77.5	-77.25	-76.5
	11n LDPC	20	MCS0	-95	-94.5	-93.75	-94.5	-94.5	-93.5
		20	MCS6	-79.25	-78.75	-78	-78.75	-78.5	-77.75
		20	MCS7	-76.75	-76.5	-75.5	-76.5	-76.25	-75.25
	11n LDPC	40	MCS0	-93.5	-93	-92.25	-93.25	-93	-92
		40	MCS6	-76	-75.5	-75	-75.75	-75.5	-74.75
		40	MCS7	-73.5	-73	-72.5	-73.25	-73	-72
	11ac LDPC	20	MCS0	-95	-94.5	-93.75	-94.5	-94.5	-93.5
		20	MCS8	-73.5	-73	-72.25	-73	-72.75	-72
	11ac LDPC	40	MCS0	-93.5	-93	-92.25	-93.25	-93	-92
		40	MCS7	-74.5	-74	-73.25	-74	-74	-73
		40	MCS8	-70.5	-70	-69.25	-70	-70	-69
		40	MCS9	-69	-68.5	-67.75	-68.5	-68.25	-67.5
	11ac LDPC	80	MCS0	-90.25	-89.75	-89	-89.75	-89.75	-89
		80	MCS7	-71.75	-71.25	-70.5	-71.25	-71	-70.25
		80	MCS8	-67	-66.5	-66	-66.5	-66.25	-65.5
		80	MCS9	-65.25	-64.5	-64	-64.5	-64.5	-63.5
	11ac LDPC	160	MCS0	-87.25	-87	-86	-86.75	-86.75	-86
		160	MCS7	-68	-68	-67	-67.75	-67.75	-67
		160	MCS8	-63.75	-63.5	-62.75	-63.5	-63.5	-62.5
		160	MCS9	-61.75	-61.5	-60.75	-61.25	-61.25	-60.5
	11ax LDPC	20	MCS0	-94.75	-94.25	-93.5	-94.25	-94.25	-93.25
		20	MCS9	-71	-70.5	-69.5	-70.5	-70.25	-69.25
		20	MCS10	-67.25	-66.75	-65.75	-66.75	-66.5	-65.5
		20	MCS11	-64.75	-64.25	-63.25	-64	-63.75	-62.75
	11ax LDPC	40	MCS0	-93	-92.5	-91.75	-92.5	-92.5	-91.5
		40	MCS9	-68	-67.5	-66.75	-67.5	-67.25	-66.25
		40	MCS10	-64.25	-63.75	-63	-63.5	-63.25	-62.5
		40	MCS11	-61.75	-61.25	-60.25	-61	-60.75	-59.75
11ax LDPC	80	MCS0	-89.75	-89	-88.5	-89.25	-89	-88.25	
	80	MCS9	-64.75	-64.25	-63.5	-64.25	-64	-63	



				TyP 2230					
Band	Mode	BW [MHz]	Conditions	Chain A (dBm, accuracy +/- 0.5 dB)			Chain B (dBm, accuracy +/- 0.5 dB)		
				LB/LHB/LUHB	MHB/MUHB	HHB/HUHB	LB/LHB/LUHB	MHB/MUHB	HHB/HUHB
UHB		80	MCS10	-61	-60.5	-59.75	-60.25	-60	-59.25
		80	MCS11	-58.75	-58.25	-57.5	-58	-57.5	-56.5
	11ax LDPC	160	MCS0	-86.75	-86.5	-85.75	-86.25	-86.25	-85.5
		160	MCS9	-62.25	-62	-61	-61.75	-61.5	-60.5
		160	MCS10	-58.25	-58	-57	-57.5	-57.5	-56.5
		160	MCS11	-56	-55.75	-54.75	-55	-55	-53.75

**Table 6-6 TyP 1216 Wi-Fi Rx sensitivity**

				TyP 1216					
Band	Mode	BW [MHz]	Conditions	Chain A (dBm, accuracy +/- 0.5 dB)			Chain B (dBm, accuracy +/- 0.5 dB)		
				LB/LHB/LUHB	MHB/MUHB	HHB/HUHB	LB/LHB/LUHB	MHB/MUHB	HHB/HUHB
LB	11b	20	CCK, 1Mbps	-96.75			-96.75		
		20	CCK, 11 Mbps	-89			-89		
	11g	20	Rate 6Mbps	-93.75			-93.75		
		20	Rate 12Mbps	-91.75			-91.25		
		20	Rate 54Mbps	-77			-76.75		
	11n LDPC	20	MCS0	-93.75			-93.75		
		20	MCS6	-78.25			-78		
		20	MCS7	-76			-75.75		
	11n LDPC	40	MCS0	-92.5			-92.25		
		40	MCS6	-75			-75		
		40	MCS7	-72.5			-72.5		
	11ax LDPC	20	MCS0	-93.5			-93.5		
		20	MCS9	-70			-70		
		20	MCS10	-66.5			-66.25		
		20	MCS11	-64			-63.75		
	11ax LDPC	40	MCS0	-92			-91.75		
		40	MCS9	-67			-66.75		
		40	MCS10	-63.5			-63.25		

Intel® Wi-Fi 6E AX210 and Intel® Wi-Fi 6E AX1675 (Killer) (Typhoon Peak 2)

				Typ 1216					
Band	Mode	BW [MHz]	Condi-tions	Chain A (dBm, accuracy +/- 0.5 dB)			Chain B (dBm, accuracy +/- 0.5 dB)		
				LB/LHB /LUHB	MHB/ MUHB	HHB/ HUHB	LB/LHB /LUHB	MHB/ MUHB	HHB/ HUHB
LB		40	MCS11	-61			-60.75		
HB	11a	20	Rate 6Mbps	-95	-94.75	-95	-95	-95	-95
		20	Rate 12Mbps	-92.75	-93	-93	-92.75	-92.75	-93
		20	Rate 54Mbps	-78	-77.75	-77.75	-77.75	-77.75	-77.75
	11n LDPC	20	MCS0	-95	-95	-95	-95	-95	-95
		20	MCS6	-79.25	-79.25	-79.25	-79.25	-79.25	-79.25
		20	MCS7	-77	-76.75	-76.75	-76.75	-76.75	-77
	11n LDPC	40	MCS0	-93.75	-93.5	-93.75	-93.5	-93.5	-93.75
		40	MCS6	-76.25	-76	-76.25	-76	-76	-76.25
		40	MCS7	-73.75	-73.5	-73.5	-73.5	-73.5	-73.5
	11ac LDPC	20	MCS0	-95	-95	-95	-95	-95	-95.25
		20	MCS8	-73.5	-73.5	-73.5	-73.5	-73.5	-73.5
	11ac LDPC	40	MCS0	-93.75	-93.5	-93.75	-93.5	-93.5	-93.75
		40	MCS8	-70.75	-70.5	-70.5	-70.5	-70.5	-70.75
		40	MCS9	-69.25	-69	-69.25	-69	-69	-69.25
	11ac LDPC	80	MCS0	-90.25	-90	-90.25	-90	-90.25	-90.25
		80	MCS7	-71.75	-71.5	-71.5	-71.5	-71.5	-71.75
		80	MCS8	-67	-67	-67	-67	-67	-67.25
		80	MCS9	-65	-65	-65	-65	-65	-65.25
	11ac LDPC	160	MCS0	-87.25	-87.25		-87.25	-87.25	
		160	MCS7	-68	-68		-68	-68.25	
		160	MCS8	-63.75	-63.75		-63.75	-64	
		160	MCS9	-61.75	-61.5		-61.75	-61.75	
	11ax LDPC	20	MCS0	-94.75	-94.75	-94.75	-94.75	-94.75	-94.75
		20	MCS9	-71	-71	-71	-71	-71	-71
		20	MCS10	-67.25	-67.25	-67.25	-67.25	-67	-67
		20	MCS11	-65	-64.75	-64.75	-64.5	-64.25	-64.25
11ax LDPC	40	MCS0	-93	-93	-93	-93	-93	-93	
	40	MCS9	-68.25	-68	-68	-67.75	-68	-68	
	40	MCS10	-64.5	-64.25	-64.25	-64	-64	-64	
	40	MCS11	-62	-61.75	-61.75	-61.5	-61.5	-61.5	
		80	MCS0	-89.5	-89.5	-89.75	-89.5	-89.75	

				TyP 1216					
Band	Mode	BW [MHz]	Condi-tions	Chain A (dBm, accuracy +/- 0.5 dB)			Chain B (dBm, accuracy +/- 0.5 dB)		
				LB/LHB /LUHB	MHB/ MUHB	HHB/ HUHB	LB/LHB /LUHB	MHB/ MUHB	HHB/ HUHB
HB	11ax LDPC	80	MCS9	-64.75	-64.75	-64.75	-64.5	-64.5	-64.5
		80	MCS10	-61	-60.75	-60.75	-60.75	-60.75	-60.75
		80	MCS11	-58.75	-58.5	-58.5	-58.25	-58.25	-58.25
	11ax LDPC	160	MCS0	-86.75	-86.75		-86.75	-87	
		160	MCS9	-62.25	-62		-62	-62.25	
		160	MCS10	-58.25	-58		-58	-58	
		160	MCS11	-55.75	-55.75		-55.5	-55.75	
UHB	11a	20	Rate 6Mbps	-95	-95	-94.5	-95	-95	-94.25
		20	Rate 12Mbps	-93	-93	-92	-92.75	-93	-92
		20	Rate 54Mbps	-77.75	-78	-77.25	-77.75	-78	-77.25
	11n LDPC	20	MCS0	-95	-95	-94.5	-95	-95	-94.5
		20	MCS6	-79.25	-79.25	-78.5	-79.25	-79.25	-78.5
		20	MCS7	-76.75	-77	-76.5	-76.75	-77	-76.25
	11n LDPC	40	MCS0	-93.5	-93.5	-93	-93.5	-93.5	-93
		40	MCS6	-76.25	-76.25	-75.75	-76	-76.25	-75.5
		40	MCS7	-73.5	-73.5	-73	-73.5	-73.75	-73
	11ac LDPC	20	MCS0	-95	-95	-94.5	-95	-95	-94.5
		20	MCS8	-73.25	-73.5	-72.75	-73.5	-73.5	-72.75
	11ac LDPC	40	MCS0	-93.5	-93.5	-93	-93.5	-93.5	-93
		40	MCS8	-70.5	-70.5	-70	-70.5	-70.5	-70
		40	MCS9	-69	-69	-68.5	-69	-69	-68.5
	11ac LDPC	80	MCS0	-90.25	-90.25	-90	-90	-90.25	-89.75
		80	MCS7	-71.5	-71.5	-71.25	-71.5	-71.5	-71.25
		80	MCS8	-67	-67	-66.75	-66.75	-67	-66.5
		80	MCS9	-65	-65	-64.5	-64.75	-65	-64.5
	11ac LDPC	160	MCS0	-87.25	-87.5	-86.75	-87.25	-87.5	-86.75
		160	MCS8	-63.75	-64	-63.5	-63.75	-64	-63.5
160		MCS9	-61.75	-62	-61.25	-61.75	-62	-61.25	
11ax LDPC	20	MCS0	-94.75	-94.75	-94.25	-94.75	-94.75	-94	
	20	MCS9	-71	-71	-70.25	-70.75	-71	-70.25	
	20	MCS10	-67.25	-67.25	-66.5	-67	-67	-66.25	
	20	MCS11	-64.75	-64.75	-64	-64.25	-64	-63.5	

				TyP 1216					
Band	Mode	BW [MHz]	Condi-tions	Chain A (dBm, accuracy +/- 0.5 dB)			Chain B (dBm, accuracy +/- 0.5 dB)		
				LB/LHB /LUHB	MHB/MUHB	HHB/HUHB	LB/LHB /LUHB	MHB/MUHB	HHB/HUHB
UHB	11ax LDPC	40	MCS0	-93	-93	-92.5	-93	-93	-92.5
		40	MCS9	-68	-68	-67.5	-68	-68	-67.25
		40	MCS10	-64.25	-64.25	-63.5	-64	-64	-63.25
		40	MCS11	-61.75	-61.5	-61	-61.5	-61.25	-60.75
	11ax LDPC	80	MCS0	-89.5	-89.5	-89.25	-89.5	-89.5	-89.25
		80	MCS9	-64.5	-64.5	-64	-64.5	-64.5	-64
		80	MCS10	-60.75	-60.75	-60.25	-60.5	-60.75	-60.25
		80	MCS11	-58.5	-58.25	-58	-58.25	-58	-57.75
	11ax LDPC	160	MCS0	-87	-87	-86.5	-86.75	-87	-86.25
		160	MCS9	-62.25	-62.25	-61.75	-62.25	-62.25	-61.5
		160	MCS10	-58.25	-58.25	-57.5	-58	-58	-57.5
		160	MCS11	-56	-55.75	-55.25	-55.5	-55.5	-54.75

## 6.2.3 Bluetooth® Tx power

Table 6-7 TyP Bluetooth® Tx power

TyP Bluetooth® Tx Power	Tx 2230 Power (dBm, acc: +/- 1.5 dB)	Notes
<b>BR</b>	9.7	Typical Conditions
<b>EDR2</b>	6.0	Typical Conditions
<b>EDR3</b>	6.0	Typical Conditions
<b>Bluetooth® Low Energy (LR-125k)</b>	5.5	Typical Conditions
<b>Bluetooth® Low Energy (LR-500k)</b>	5.5	Typical Conditions
<b>Bluetooth® Low Energy 1M</b>	5.5	Typical Conditions
<b>Bluetooth® Low Energy 2M</b>	5.5	Typical Conditions

Typical operating conditions are defined as:

1. Temperature of 25°C and nominal supply voltage.
2. Typical process.
3. Average power level over the frequency band.
4. The power levels are specified at the product antenna port.

## 6.2.4 Bluetooth® sensitivity

**Table 6–8 TyP Bluetooth® sensitivity**

TyP Bluetooth® Tx Power	TyP2 2230 (dBm, acc: +/-1.5 dB)	Notes
<b>BR</b>	-95	Typical Conditions
<b>EDR2</b>	-94	Typical Conditions
<b>EDR3</b>	-87	Typical Conditions
<b>Bluetooth® Low Energy (LR-125k)</b>	-103.5	Typical Conditions
<b>Bluetooth® Low Energy (LR-500k)</b>	-100	Typical Conditions
<b>Bluetooth® Low Energy 1M</b>	-97	Typical Conditions
<b>Bluetooth® Low Energy 2M</b>	-91.5	Typical Conditions

Typical operating conditions are defined as:

1. Nominal BQB test conditions. In addition the following definitions apply:
2. Temperature of 25°C and nominal supply voltage
3. Typical process
4. Spectrally clean (i.e., non-spur) channels
5. The sensitivity is specified at the product antenna port.
6. Assuming all co-located cores are disabled.
7. Averaged value across frequency

## 6.3 Throughput KPIs

### 6.3.1 Max throughput

**Table 6–9 Max throughput**

Scenario	Min	Target
Conductive Best Attenuation 11b LB Rx TCP	5.4	6
Conductive Best Attenuation 11g LB Rx TCP	22	23
Conductive Best Attenuation 11a HB Rx TCP	22	23
Conductive Best Attenuation 11b LB Tx TCP	5.4	6
Conductive Best Attenuation 11g LB Tx TCP	20	23
Conductive Best Attenuation 11a HB Tx TCP	20	23
Conductive Best Attenuation 11n LB 20 MHz Rx TCP	114	123
Conductive Best Attenuation 11n HB 40 MHz Rx TCP	238	252
Conductive Best Attenuation 11ac HB 80 MHz Rx TCP	650	750
Conductive Best Attenuation 11ac HB 160 MHz Rx TCP	1231	1380

Scenario	Min	Target
Conductive Best Attenuation 11n LB 20 MHz Tx TCP	108	118
Conductive Best Attenuation 11n HB 40 MHz Tx TCP	198	222
Conductive Best Attenuation 11ac HB 80 MHz Tx TCP	698	748
Conductive Best Attenuation 11ac HB 160 MHz Tx TCP	1265	1398
Conductive Best Attenuation 11n HB 20 MHz Rx TCP	116	125
Conductive Best Attenuation 11n LB 40 MHz Rx TCP	234	247
Conductive Best Attenuation 11n HB 20 MHz Tx TCP	110	120
Conductive Best Attenuation 11n LB 40 MHz Tx TCP	194	218
Conductive Best Attenuation 11ac HB 20 MHz Rx TCP	146	153
Conductive Best Attenuation 11ac HB 40 MHz Rx TCP	321	351
Conductive Best Attenuation 11ac HB 20 MHz Tx TCP	140	148
Conductive Best Attenuation 11ac HB 40 MHz Tx TCP	319	339
Conductive Best Attenuation 11ax LB 20 MHz Tx TCP	223	232
Conductive Best Attenuation 11ax LB 20 MHz Rx TCP	228	239
Conductive Best Attenuation 11ax LB 40 MHz Tx TCP	430	469
Conductive Best Attenuation 11ax LB 40 MHz Rx TCP	410	469
Conductive Best Attenuation 11ax HB 20 MHz Tx TCP	232	246
Conductive Best Attenuation 11ax HB 20 MHz Rx TCP	234	253
Conductive Best Attenuation 11ax HB 40 MHz Tx TCP	470	498
Conductive Best Attenuation 11ax HB 40 MHz Rx TCP	466	494
Conductive Best Attenuation 11ax HB 80 MHz Tx TCP	942	1034
Conductive Best Attenuation 11ax HB 80 MHz Rx TCP	903	1061
Conductive Best Attenuation 11ax HB 80 MHz Tx UDP	1001	1054
Conductive Best Attenuation 11ax HB 80 MHz Rx UDP	945	995
Conductive Best Attenuation 11ax HB 160 MHz Tx TCP	2000	2077
Conductive Best Attenuation 11ax HB 160 MHz Rx TCP	2000	2077
Conductive Best Attenuation 11ax HB 160 MHz Tx UDP	2069	2178

Scenario	Min	Target
Conductive Best Attenuation 11ax HB 160 MHz Rx UDP	2069	2178
Conductive Best Attenuation 11ax UHB 20 MHz Tx TCP	232	247
Conductive Best Attenuation 11ax UHB 20 MHz Rx TCP	232	247
Conductive Best Attenuation 11ax UHB 40 MHz Tx TCP	465	495
Conductive Best Attenuation 11ax UHB 40 MHz Rx TCP	465	495
Conductive Best Attenuation 11ax UHB 80 MHz Tx TCP	973	1033
Conductive Best Attenuation 11ax UHB 80 MHz Rx TCP	973	1033
Conductive Best Attenuation 11ax UHB 80 MHz Tx UDP	1001	1054
Conductive Best Attenuation 11ax UHB 80 MHz Rx UDP	945	995
Conductive Best Attenuation 11ax UHB 160 MHz Tx TCP	2000	2077
Conductive Best Attenuation 11ax UHB 160 MHz Rx TCP	2000	2077
Conductive Best Attenuation 11ax UHB 160 MHz Tx UDP	2069	2178
Conductive Best Attenuation 11ax UHB 160 MHz Rx UDP	2069	2178
Over the Air Best Conditions 11ac HB 80 MHz MU-MIMO Rx TCP 4 SSS 4 STAs	970	1025

**NOTES:**

1. All minimum values (besides 160MHz and UHB) reflect achievable throughput with current features on Asus\* AsusRT-AX880U AP.
2. 160MHz and UHB values were tested with TyP Soft AP, should be achieved with AP that supports 256BA/UHB, respectively.

## 6.4 Wi-Fi power KPIs

**Table 6-10 Wi-Fi power KPIs**

Use Case	Units	Target	max
Tx Average <sup>1</sup> – 11ac 2x2 HB/160	mW	1011	1730
Rx Average – 11ac 2x2 HB/160	mW	837	1249
Tx Average <sup>1</sup> – 11ax 2x2 HB/160	mW	1072	1806
Rx Average – 11ax 2x2 HB/160	mW	936	1458
Tx Average <sup>1</sup> – 11n 2x2 LB/20	mW	928	1246
Rx Average – 11n 2x2 LB/20	mW	442	562
Tx Average <sup>1</sup> – 11n 2x2 HB/40	mW	984	1480
Rx Average – 11n 2x2 HB/40	mW	574	719
Tx Average <sup>1</sup> – 11ac 2x2 HB/80	mW	1121	1613
Rx Average – 11ac 2x2 HB/80	mW	698	953

Use Case	Units	Target	max
Core Power Down	mW	2.7	5.3
Unassociated average	mW	8.8	11.4
Idle associated 2.4GHz (consumer) OOB	mW	6	8.2
Idle associated 5.2GHz (enterprise) OOB	mW	7.2	8.9
Idle associated 2.4GHz (consumer) benchmark	mW	4.9	7.5
Idle associated 5.2GHz (enterprise) benchmark	mW	5.9	8
Device in Dx 2.4 GHz (armed for WAKE) – RW	mW	3.4	4
Device in Dx 5.2 Ghz (armed for WAKE) – RW	mW	3.4	4
Web browsing 2.4GHz (consumer)	mW	17.7	20.2
Web browsing 5.2GHz (enterprise)	mW	19	22.4
VOIP 2.4GHz (consumer)	mW	233	308
VOIP 5.2GHz (enterprise)	mW	267	352
Video Conference 2.4GHz (consumer)	mW	248	327
Video Conference 5.2GHz (enterprise)	mW	275	361
Video Streaming 2.4GHz (consumer)	mW	30.5	39.5
Video Streaming 5.2GHz (enterprise)	mW	33.8	44.3
WiDi SCM Local Content Streaming (BSS STA @ 2.4GHz, Miracast Source as P2P GO @ 2.4GHz)	mW	246	270.5
WiDi SCM Presentation (BSS STA @ 5.2GHz, Miracast Source as P2P GO @ 5.2GHz)	mW	80.1	98
WiDi DCM Local Content Streaming (BSS STA @ 2.4GHz, Miracast Source as P2P client @ 5.2GHz)	mW	417	458
WiDi DCM Presentation (BSS STA @ 5.2GHz, Miracast Source as P2P client @ 5.2GHz)	mW	269	296
UHB Tx 160MHz TCP traffic	mW	1724	1896
UHB Rx 160MHz TCP traffic	mW	1349	1484

**NOTES:**

1. All of the above Tx usages assume Tx Power at 0dBm (typical in a testing environment); to estimate the power consumption at the Max Tx Power case, add 700mW.
2. Power model have changed from previous generation



## 6.5 Bluetooth® power KPIs

**Table 6–11 Bluetooth® power KPIs**

KPI	KPI Description	TyP POR [mW] Max :: Target
eSCO	Power Consumption 1 eSCO (@Class 2)	71.77 :: 65.11
MP3 use case scenario	Power Consumption MP3 playback BT A2DP	74.40 :: 67.08
HID Bluetooth® Low Energy connected idle	Power Consumption HID connected idle	27.58 :: 25.85
BLE advertising	Power Consumption Bluetooth® Low Energy Advertising	10.17:: 7.84
BLE scanning	Power Consumption Bluetooth® Low Energy Scanning	8.18 :: 5.75
OPP Rx	Power Consumption OPP Rx	141.10 :: 125.04
OPP Tx	Power Consumption OPP Tx	139.77 :: 123.37
Windows 10* RS5 OOB Bluetooth® Power	Windows 10 RS5 OOB Bluetooth® Power (100ms Bluetooth® Low Energy Adv + Bluetooth® Low Energy Passive Scan 10% duty cycle + page scan)	28.35 :: 27



## 7 Regulatory

### 7.1 Regulatory channel support and output power

Typhoon Peak 2 provides regulatory compliance via a static configuration or DRS (Dynamic Regulatory Solution).

UHB regulatory part will be updated on the later version upon completion of regulatory process.

### 7.2 Wi-Fi channel configuration

#### 7.2.1 Channel configuration – RF output power

The values listed in the power table (EEPROM table) represent the target power for the calibration process, taking into account the reference antenna gain. This value has been verified to ensure a margin from the regulatory limit, based on post-EEPROM factory calibration measurements using a diagnostic tool (DRTU) that sets the WLAN module at a ~99% duty cycle for both main and auxiliary antenna ports.

As part of the factory test process, Tx output power is being measured for each unit. Units that exceed the maximum limits (EEPROM + 0.5 dB) will not pass the factory test. During operational mode, the module adjusts Tx power using a closed-loop Tx power calibration algorithm, using the power detector and temperature sensor.

Intel uses the reference antenna gain values listed in Table 7–1 for product and country certification work.

**Table 7–1 Reference antenna gain**

Antenna Type	Antenna Peak Gain 2.4GHz (dBi)	Antenna Peak Gain 5.2GHz (dBi)	Antenna Peak Gain 5.5GHz (dBi)	Antenna Peak Gain 5.8GHz (dBi)	Antenna Peak Gain 6GHz (dBi) – UNII5-6	Antenna Peak Gain 6GHz (dBi) – UNII7-8
<b>Design target</b>	3	5	5	5	5	5
<b>PIFA</b>	3.24	3.73	4.77	4.97	4.83	5.59
<b>Dipole</b>	2.89	3.19	4.41	4.22	4.97	5.34

Intel also incorporates a lower limit to ensure that compliance of the WLAN card is maintained. The minimum limits are set by factory process.

## 7.2.2 Channel configuration scan

Table 7–2 relates to worldwide global support capabilities, and to the special case of the Indonesia regulatory domain. Please refer to the DRS documentation for further details about support capabilities in different geographic locations.

**Table 7–2 Scan capabilities**

	Channel Profile (DIS/PAS/ACT)									6GHz <sup>1</sup>
	Sub-Band 2G4-A	Sub-Band 2G4-B	Sub-Band 5G2	Sub-Band 5G3	Sub-Band 5G4	Sub-Band 5G5	Sub-Band 5G8-A	Sub-Band 5G8-B	Sub-Band 5G9	
	[25:24]	[27:26]	[29:28]	[31:30]	[33:32]	[35:34]	[37:36]	[39:28]	[41:40]	
Default	2	2	1	1	0	1	1	1	0	0
FCC	2	2	1	1	0	1	2	1	0	0
USA TW	2	2	2	1	0	1	2	2	0	0
Canada IC	2	2	1	1	0	1	2	2	0	0
ETSI + 5G8SRD	2	2	1	1	0	1	2	2	0	0
Japan	2	2	1	1	0	1	1	1	0	0
Brazil	2	2	1	1	0	1	2	2	0	0
Indonesia	2	2	0	0	0	0	2	0	0	0
South-Korea	2	2	2	1	0	1	2	2	0	0
Chile	2	2	1	1	0	1	2	1	0	0
USA	2	2	1	1	0	1	2	1	0	1

<sup>1</sup>Currently, TyP supports 6GHz for FCC USA only. Once other Geos are supported, 6GHz will be separated to sub-bands.

## 7.2.3 Output power restrictions for main geographies

Table 7–3 describes the output power restrictions for main geographies.

**Table 7–3 Output power restrictions, main geographies**

Country/Geo	Output Power (dBm)							Unit
	2.4 GHz	5.15 – 5.25 GHz	5.25 – 5.35 GHz	5.47 – 5.65 GHz	5.65 – 5.725 GHz	5.725 – 5.85 GHz	6-7GHz	
EU Countries EIRP	20	23	23	23 <sup>3</sup>	23 <sup>3</sup>	14 SRD		dBm
> EU Countries Cond. <sup>1</sup>	17	18	18	18	18	9 SRD		dBm
United States <sup>2</sup> Cond.	1000	250	250	250	250	1000		mW
> United States <sup>2</sup> Cond.	30	24	24	24	24	30	18	dBm
Canada <sup>2</sup> Cond.	1000	200 EIRP	250	250	250	1000		mW
Canada <sup>2</sup> Cond.	30	23 EIRP	24	24	24	30		dBm
India	30	23 EIRP	23 EIRP	N/A	N/A	23 EIRP		dBm
China Cond.		18	18	24	24	27		dBm
China EIRP	20	23	23	30	30	33		dBm
Worst Case Cond. mW <sup>2</sup>	100	50	200	250	250	100		mW
Worst Case Cond. dBm <sup>1</sup>	17	18	18	18	18	18		dBm

### NOTES:

1. Assuming max. antenna gain 3 dBi for 2.4 GHz and 5 dBi for 5,6,7 GHz.
2. Allowance of up to a 6 dBi antenna allowed, if antenna is > 6 dBi, then output power must be reduced by 1 dB per dBi of antenna gain.
3. As DFS slave device (30 dBm for master).
4. For Ukraine, The conducted value is the same as for the EU, assuming antenna peak gain is below 3dBi, EIRP should be below 20dBm.

## 7.3 Regulatory and safety certification (not final, subject to change)

The regulatory and safety information in this section is not final and is subject to change.

**Table 7-4 Wi-Fi safety and regulatory USA (not final, subject to change)**

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, and 15.247) FCC Part 15, Subpart E (Section 15.407)
	Safety	UL 60950-1 and UL 62368-1

**Table 7-5 Wi-Fi safety and regulatory Europe (not final, subject to change)**

Europe	Requirements	Criteria
	EMC	EN301489-1, EN 301489-17
	RF	EN300 328, EN300 440 and EN301-893 as DFS slave terminal
	Safety	EN60950-1 & IEC 62368-1 via CB Report (IEC60950-1) R&TTE Health Requirement referring to the EN 50566-2017 and 62209-2:2010

**Table 7-6 Wi-Fi safety and regulatory Japan (not final, subject to change)**

Japan	Requirements	Criteria
	EMI	VCCI Class B
	RF	STD T66, STD T71, ARIB W52, W53, W56
	Safety	EN60950-1 & IEC 62368-1 via CB Report (IEC60950-1) R&TTE Health Requirement referring to the EN 50566-2017 and 62209-2:2010

**Table 7-7 Wi-Fi safety and regulatory Australia/New Zealand (not final, subject to change)**

Australia/ New Zealand	Requirements	Criteria
	EMC	EU test reports
	RF	Radio communications (EMR) Standard 2003; EU test reports + Delta AS-NZ4268
	Safety	CB Cert. and Report (IEC60950-1)

**Table 7-8 Wi-Fi safety and regulatory other geographies (not final, subject to change)**

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.

## 7.4 Tx power regulatory limits

### 7.4.1 TyP2 2230 default max Tx power

TyP default Tx power limits are calculated in FW as the minimum of FCC, ETSI, and ROW tables.

The values listed here present maximum values based on regulatory testing. Actual Tx power might be slightly lower, in order to ensure margins.

**Table 7-9 TyP2 2230 FCC max Tx power**

2.4GHz-20MHz 2230 FCC									
		20MHz CCK				20MHz OFDM			
Central Freq.	Control / Central Channel		CCK SISO A	CCK SISO B			OFDM SISO A	OFDM SISO B	OFDM MIMO
2412	1		20	20			17.5	17.5	15.75
2417	2		20	20			19.5	19.25	17.75
2422	3		20	20			19.75	19.5	18.75
2427	4		20	20			20	20	19
2432	5		20	20			20	20	19.5
2437	6		20	20			20	20	19.5
2442	7		20	20			20	20	19.5
2447	8		20	20			20	19.5	18.75
2452	9		20	20			19.25	19	18.5
2457	10		20	20			18.5	18.5	18
2462	11		20	20			16.75	16.5	15
2467	12		18	18			13	13	12
2472	13		16.5	16			11	11	9.75

**Note:** 40MHz CCK is not supported by this product.

2.4GHz-40MHz 2230 FCC					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
2422	3		15.75	15.25	14
2427	4		17.25	15.75	13.75
2432	5		17.75	16.75	14.5
2437	6		18	17.75	15.75
2442	7		16	16	14.75
2447	8		15.75	16.75	14

2.4GHz-40MHz 2230 FCC					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
2452	9		15.25	15	13.75
2457	10		10.75	10.75	8
2462	11		11	10.5	8.75

5GHz-20MHz 2230 FCC					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5180	36		18.5	18	16.5
5200	40		20	20	18
5220	44		20	20	18
5240	48		20	20	17.75
5260	52		20	20	18
5280	56		20	20	18
5300	60		20	20	18
5320	64		19	18.75	17
5340	68		Not supported		
5360	72		Not supported		
5380	76		Not supported		
5400	80		Not supported		
5420	84		Not supported		
5440	88		Not supported		
5460	92		Not supported		
5480	96		Not supported		
5500	100		19.5	19	17
5520	104		20	20	18
5540	108		20	20	18
5560	112		20	20	18
5580	116		20	20	18
5600	120		20	20	18
5620	124		20	20	18
5640	128		20	20	18

5GHz–20MHz 2230 FCC					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5660	132		20	20	18
5680	136		20	20	18
5700	140		19	19	18
5720	144		20	20	18
5745	149		20	20	20
5765	153		20	20	20
5785	157		20	20	20
5805	161		20	20	20
5825	165		20	20	20
5845	169		Not supported		
5865	173		Not supported		
5885	177		Not supported		
5905	181		Not supported		

6GHz–20MHz 2230 FCC – LPI					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5955	1		4.5	4.5	1.5
5975	5		4.5	4.5	1.5
5995	9		4.5	4.5	1.5
6015	13		4.5	4.5	1.5
6035	17		4.5	4.5	1.5
6055	21		4.5	4.5	1.5
6075	25		4.5	4.5	1.5
6095	29		4.5	4.5	1.5
6115	33		4.5	4.5	1.5
6135	37		4.5	4.5	1.5
6155	41		4.5	4.5	1.5
6175	45		4.5	4.5	1.5
6195	49		4.5	4.5	1.5
6215	53		4.5	4.5	1.5



6GHz–20MHz 2230 FCC – LPI					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6235	57		4.5	4.5	1.5
6255	61		4.5	4.5	1.5
6275	65		4.5	4.5	1.5
6295	69		4.5	4.5	1.5
6315	73		4.5	4.5	1.5
6335	77		4.5	4.5	1.5
6355	81		4.5	4.5	1.5
6375	85		4.5	4.5	1.5
6395	89		4.5	4.5	1.5
6415	93		4.5	4.5	1.5
6435	97		4.5	4.5	1.5
6455	101		4.5	4.5	1.5
6475	105		4.5	4.5	1.5
6495	109		4.5	4.5	1.5
6515	113		4.5	4.5	1.5
6535	117		3.75	3.75	0.75
6555	121		3.75	3.75	0.75
6575	125		3.75	3.75	0.75
6595	129		3.75	3.75	0.75
6615	133		3.75	3.75	0.75
6635	137		3.75	3.75	0.75
6655	141		3.75	3.75	0.75
6675	145		3.75	3.75	0.75
6695	149		3.75	3.75	0.75
6715	153		3.75	3.75	0.75
6735	157		3.75	3.75	0.75
6755	161		3.75	3.75	0.75
6775	165		3.75	3.75	0.75
6795	169		3.75	3.75	0.75
6815	173		3.75	3.75	0.75
6835	177		3.75	3.75	0.75
6855	181		3.75	3.75	0.75
6875	185		4	4	1
6895	189		4	4	1

6GHz–20MHz 2230 FCC – LPI					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6915	193		4	4	1
6935	197		4	4	1
6955	201		4	4	1
6975	205		4	4	1
6995	209		4	4	1
7015	213		4	4	1
7035	217		4	4	1
7055	221		4	4	1
7075	225		4	4	1
7095	229		4	4	1
7115	233		-1.5	-1.5	-4.5

6GHz–40MHz 2230 FCC					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5965	3		7.75	7.75	4.75
6005	11		7.75	7.75	4.75
6045	19		7.75	7.75	4.75
6085	27		7.75	7.75	4.75
6125	35		7.75	7.75	4.75
6165	43		7.75	7.75	4.75
6205	51		7.75	7.75	4.75
6245	59		7.75	7.75	4.75
6285	67		7.75	7.75	4.75
6325	75		7.75	7.75	4.75
6365	83		7.75	7.75	4.75
6405	91		7.75	7.75	4.75
6445	99		7.75	7.75	4.75
6485	107		7.75	7.75	4.75
6525	115		7.75	7.75	4.75
6565	123		7	7	4
6605	131		7	7	4

6GHz–40MHz 2230 FCC					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6645	139		7	7	4
6685	147		7	7	4
6725	155		7	7	4
6765	163		7	7	4
6805	171		7	7	4
6845	179		7	7	4
6885	187		7.25	7.25	4.25
6925	195		7.25	7.25	4.25
6965	203		7.25	7.25	4.25
7005	211		7.25	7.25	4.25
7045	219		7.25	7.25	4.25
7085	227		7.25	7.25	4.25

5GHz–80MHz 2230 FCC					
		80MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5210	42		17	17	15
5290	58		16.5	16.5	13.5
5370	74		Not supported		
5450	90		Not supported		
5530	106		17.75	17.25	15.25
5610	122		20	20	20
5690	138		20	20	20
5775	155		19	19	18
5855	171		Not supported		

6GHz–80MHz 2230 FCC					
		80MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5985	7		10.25	10.25	7.25
6065	23		10.25	10.25	7.25
6145	39		10.25	10.25	7.25
6225	55		10.25	10.25	7.25
6305	71		10.25	10.25	7.25
6385	87		10.25	10.25	7.25
6465	103		10.25	10.25	7.25
6545	119		10.25	10.25	7.25
6625	135		9.5	9.5	6.5
6705	151		9.5	9.5	6.5
6785	167		9.5	9.5	6.5
6865	183		9.75	9.75	6.75
6945	199		9.75	9.75	6.75
7025	215		9.75	9.75	6.75

5GHz–160MHz 2230 FCC					
		160MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5250	50		14.5	14.25	12.5
5410	82		Not supported		
5570	114		15.75	14.5	13.5
5815	163		Not supported		

6GHz–160MHz 2230 FCC					
		160MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6025	15		13	13	10
6185	47		13	13	10
6345	79		13	13	10

6GHz–160MHz 2230 FCC					
		160MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6505	111		13	13	10
6665	143		12.25	12.25	9.25
6825	175		12.5	12.5	9.5
6985	207		12.5	12.5	9.5

**Table 7–10 TyP2 2230 EU max Tx power**

2.4GHz–20MHz 2230 EU									
		20MHz CCK				20MHz OFDM			
Central Freq.	Control / Central Channel		CCK SISO A	CCK SISO B			OFDM SISO A	OFDM SISO B	OFDM MIMO
2412	1		15	15			16	16	13
2417	2		15	15			16	16	13
2422	3		15	15			16	16	13
2427	4		15	15			16	16	13
2432	5		15	15			16	16	13
2437	6		15	15			16	16	13
2442	7		15	15			16	16	13
2447	8		15	15			16	16	13
2452	9		15	15			16	16	13
2457	10		15	15			16	16	13
2462	11		15	15			16	16	13
2467	12		15	15			16	16	13
2472	13		15	15			16	16	13

2.4GHz–40MHz 2230 EU					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
2422	3		16	16	13
2427	4		16	16	13
2432	5		16	16	13

2.4GHz-40MHz 2230 EU					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
2437	6		16	16	13
2442	7		16	16	13
2447	8		16	16	13
2452	9		16	16	13
2457	10		16	16	13
2462	11		16	16	13

5GHz-20MHz 2230 EU					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5180	36		15	15	12
5200	40		15	15	12
5220	44		15	15	12
5240	48		15	15	12
5260	52		15	15	12
5280	56		15	15	12
5300	60		15	15	12
5320	64		15	15	12
5340	68		Not supported		
5360	72		Not supported		
5380	76		Not supported		
5400	80		Not supported		
5420	84		Not supported		
5440	88		Not supported		
5460	92		Not supported		
5480	96		Not supported		
5500	100		15	15	12
5520	104		15	15	12
5540	108		15	15	12
5560	112		15	15	12
5580	116		15	15	12

5GHz–20MHz 2230 EU					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5600	120		15	15	12
5620	124		15	15	12
5640	128		15	15	12
5660	132		15	15	12
5680	136		15	15	12
5700	140		15	15	12
5720	144		15	15	12
5745	149		7.5	7.5	4.5
5765	153		7.5	7.5	4.5
5785	157		7.5	7.5	4.5
5805	161		7.5	7.5	4.5
5825	165		7.5	7.5	4.5
5845	169		Not supported		
5865	173		Not supported		

5GHz–40MHz 2230 EU					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5190	38		16.5	16.5	13.5
5230	46		16.5	16.5	13.5
5270	54		16.5	16.5	13.5
5310	62		16.5	16.5	13.5
5350	70		Not supported		
5390	78		Not supported		
5430	86		Not supported		
5470	94		Not supported		
5510	102		16.5	16.5	13.5
5550	110		16.5	16.5	13.5
5590	118		16.5	16.5	13.5
5630	126		16.5	16.5	13.5
5670	134		16.5	16.5	13.5

5GHz-40MHz 2230 EU					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5710	142		16.5	16.5	13.5
5755	151		7.5	7.5	4.5
5795	159		7.5	7.5	4.5
5835	167		Not supported		
5875	175		Not supported		

5GHz-80MHz 2230 EU					
		80MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5210	42		16.5	16.5	13.5
5290	58		16.5	16.5	13.5
5370	74		Not supported		
5450	90		Not supported		
5530	106		16.5	16.5	13.5
5610	122		16.5	16.5	13.5
5690	138		16.5	16.5	13.5
5775	155		7.5	7.5	4.5
5855	171		Not supported		

5GHz-160MHz 2230 EU					
		160MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5250	50		16.5	16.5	13.5
5410	82		Not supported		
5570	114		16.5	16.5	13.5
5815	163		Not supported		



## 7.4.2 TyP2 1216 default max Tx power

TyP default Tx power limits are calculated in FW as the minimum of FCC, ETSI and ROW tables.

**Table 7–11 TyP2 1216 FCC max Tx power**

2.4GHz–20MHz 1216 FCC									
		20MHz CCK				20MHz OFDM			
Central Freq.	Control / Central Channel		CCK SISO A	CCK SISO B		OFDM SISO A	OFDM SISO B	OFDM MIMO	
2412	1		20	19.75		17	16.5	16.75	
2417	2		20	20		19.5	19.25	18.5	
2422	3		20	20		19.75	19.5	19	
2427	4		20	20		20	20	19	
2432	5		20	20		20	20	19	
2437	6		20	20		20	20	19	
2442	7		20	20		19.75	19.5	18.5	
2447	8		20	20		19.75	19.5	18.5	
2452	9		20	20		19.25	19	18	
2457	10		20	20		19.25	18.75	17	
2462	11		19.75	20		16.5	17.25	15.25	
2467	12		18	17.75		13.25	13	11.25	
2472	13		15	14.75		11.5	11	8	

**Note:** 40MHz CCK is not supported by this product.

2.4GHz–40MHz 1216 FCC					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
2422	3		15.75	15.5	15
2427	4		17.25	17.5	15
2432	5		17.5	17.75	15.5
2437	6		17.75	17.5	16.25
2442	7		16.25	15.5	14.5
2447	8		16.75	16	14.25
2452	9		15.25	15.25	14.5
2457	10		12.25	11	9.75
2462	11		11	10.75	7.5

5 GHz–20MHz 1216 FCC					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5180	36		18	18	16.5
5200	40		20	20	18
5220	44		20	20	18
5240	48		20	20	18
5260	52		20	20	18
5280	56		20	20	18
5300	60		20	20	18
5320	64		18	18.25	16.75
5340	68		Not supported		
5360	72		Not supported		
5380	76		Not supported		
5400	80		Not supported		
5420	84		Not supported		
5440	88		Not supported		
5460	92		Not supported		
5480	96		Not supported		
5500	100		18.5	18.5	18
5520	104		20	20	18
5540	108		20	20	18
5560	112		20	20	18
5580	116		20	20	18
5600	120		20	20	18
5620	124		20	20	18
5640	128		20	20	18
5660	132		20	20	18
5680	136		20	20	18
5700	140		18.5	18.5	18
5720	144		20	20	18
5745	149		20	20	20
5765	153		20	20	20
5785	157		20	20	20
5805	161		20	20	20
5825	165		20	20	20
5845	169		Not supported		

6GHz-20MHz 1216 FCC – LPI					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5955	1		4.5	4.5	1.5
5975	5		4.5	4.5	1.5
5995	9		4.5	4.5	1.5
6015	13		4.5	4.5	1.5
6035	17		4.5	4.5	1.5
6055	21		4.5	4.5	1.5
6075	25		4.5	4.5	1.5
6095	29		4.5	4.5	1.5
6115	33		4.5	4.5	1.5
6135	37		4.5	4.5	1.5
6155	41		4.5	4.5	1.5
6175	45		4.5	4.5	1.5
6195	49		4.5	4.5	1.5
6215	53		4.5	4.5	1.5
6235	57		4.5	4.5	1.5
6255	61		4.5	4.5	1.5
6275	65		4.5	4.5	1.5
6295	69		4.5	4.5	1.5
6315	73		4.5	4.5	1.5
6335	77		4.5	4.5	1.5
6355	81		4.5	4.5	1.5
6375	85		4.5	4.5	1.5
6395	89		4.5	4.5	1.5
6415	93		4.5	4.5	1.5
6435	97		4.5	4.5	1.5
6455	101		4.5	4.5	1.5
6475	105		4.5	4.5	1.5
6495	109		4.5	4.5	1.5
6515	113		4.5	4.5	1.5
6535	117		3.75	3.75	0.75
6555	121		3.75	3.75	0.75
6575	125		3.75	3.75	0.75
6595	129		3.75	3.75	0.75

6GHz–20MHz 1216 FCC – LPI					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6615	133		3.75	3.75	0.75
6635	137		3.75	3.75	0.75
6655	141		3.75	3.75	0.75
6675	145		3.75	3.75	0.75
6695	149		3.75	3.75	0.75
6715	153		3.75	3.75	0.75
6735	157		3.75	3.75	0.75
6755	161		3.75	3.75	0.75
6775	165		3.75	3.75	0.75
6795	169		3.75	3.75	0.75
6815	173		3.75	3.75	0.75
6835	177		3.75	3.75	0.75
6855	181		3.75	3.75	0.75
6875	185		4	4	1
6895	189		4	4	1
6915	193		4	4	1
6935	197		4	4	1
6955	201		4	4	1
6975	205		4	4	1
6995	209		4	4	1
7015	213		4	4	1
7035	217		4	4	1
7055	221		4	4	1
7075	225		4	4	1
7095	229		4	4	1
7115	233		-1.5	-1.5	-5.25

5GHz–40MHz 1216 FCC					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5190	38		17.25	17	14.25
5230	46		20	20	19

5GHz–40MHz 1216 FCC					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5270	54		20	20	17.5
5310	62		15.5	15.25	13.75
5350	70		Not supported		
5390	78		Not supported		
5430	86		Not supported		
5470	94		Not supported		
5510	102		18.25	18.25	16
5550	110		20	20	20
5590	118		20	20	20
5630	126		20	20	20
5670	134		19.25	19.25	18
5710	142		20	20	20
5755	151		20	20	20
5795	159		20	20	20
5835	167		Not supported		
5875	175		Not supported		

6GHz–40MHz 1216 FCC – LPI					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5965	3		7.75	7.75	4.75
6005	11		7.75	7.75	4.75
6045	19		7.75	7.75	4.75
6085	27		7.75	7.75	4.75
6125	35		7.75	7.75	4.75
6165	43		7.75	7.75	4.75
6205	51		7.75	7.75	4.75
6245	59		7.75	7.75	4.75
6285	67		7.75	7.75	4.75
6325	75		7.75	7.75	4.75
6365	83		7.75	7.75	4.75

6GHz-40MHz 1216 FCC - LPI					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6405	91		7.75	7.75	4.75
6445	99		7.75	7.75	4.75
6485	107		7.75	7.75	4.75
6525	115		7.75	7.75	4.75
6565	123		7	7	4
6605	131		7	7	4
6645	139		7	7	4
6685	147		7	7	4
6725	155		7	7	4
6765	163		7	7	4
6805	171		7	7	4
6845	179		7	7	4
6885	187		7.25	7.25	4.25
6925	195		7.25	7.25	4.25
6965	203		7.25	7.25	4.25
7005	211		7.25	7.25	4.25
7045	219		7.25	7.25	4.25
7085	227		7.25	7.25	4.25

5GHz-80MHz 1216 FCC					
		80MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5210	42		17.75	17	13.75
5290	58		16.5	16	14.25
5370	74		Not supported		
5450	90		Not supported		
5530	106		18	17.75	15
5610	122		19.5	19.5	18.75
5690	138		20	20	20
5775	155		18.25	18.5	17.5
5855	171		Not supported		

6GHz–80MHz 1216 FCC – LPI					
		80MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5985	7			10.25	7.25
6065	23		10.25	10.25	7.25
6145	39		10.25	10.25	7.25
6225	55		10.25	10.25	7.25
6305	71		10.25	10.25	7.25
6385	87		10.25	10.25	7.25
6465	103		10.25	10.25	7.25
6545	119		10.25	10.25	7.25
6625	135		9.5	9.5	6.5
6705	151		9.5	9.5	6.5
6785	167		9.5	9.5	6.5
6865	183		9.75	9.75	6.75
6945	199		9.75	9.75	6.75
7025	215		9.75	9.75	6.75

5 GHz–160MHz 1216 FCC					
		160MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5250	50		14	13.25	12.25
5410	82		Not supported		
5570	114		16	15.5	13
5815	163		Not supported		

6GHz–160MHz 1216 FCC – LPI					
		160MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6025	15		13	13	10
6185	47		13	13	10

6GHz–160MHz 1216 FCC – LPI					
		160MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
6345	79		13	13	10
6505	111		13	13	10
6665	143		12.25	12.25	9.25
6825	175		12.5	12.5	9.5
6985	207		12.5	12.5	9.5

**Table 7–12 TyP2 1216 EU max Tx power**

2.4GHz–20MHz 1216 EU									
		20MHz CCK				20MHz OFDM			
Central Freq.	Control / Central Channel		CCK SISO A	CCK SISO B			OFDM SISO A	OFDM SISO B	OFDM MIMO
2412	1		15.5	15.5			16	16	13
2417	2		15.5	15.5			16	16	13
2422	3		15.5	15.5			16	16	13
2427	4		15.5	15.5			16	16	13
2432	5		15.5	15.5			16	16	13
2437	6		15.5	15.5			16	16	13
2442	7		15.5	15.5			16	16	13
2447	8		15.5	15.5			16	16	13
2452	9		15.5	15.5			16	16	13
2457	10		15.5	15.5			16	16	13
2462	11		15.5	15.5			16	16	13
2467	12		15.5	15.5			16	16	13
2472	13		15.5	15.5			16	16	13

2.4GHz–40MHz 1216 EU					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
2422	3		16	16	13
2427	4		16	16	13



2.4GHz-40MHz 1216 EU					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
2432	5		16	16	13
2437	6		16	16	13
2442	7		16	16	13
2447	8		16	16	13
2452	9		16	16	13
2457	10		16	16	13
2462	11		16	16	13

5GHz-20MHz 1216 EU					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5180	36		15	15	12
5200	40		15	15	12
5220	44		15	15	12
5240	48		15	15	12
5260	52		15	15	12
5280	56		15	15	12
5300	60		15	15	12
5320	64		15	15	12
5340	68		Not supported		
5360	72		Not supported		
5380	76		Not supported		
5400	80		Not supported		
5420	84		Not supported		
5440	88		Not supported		
5460	92		Not supported		
5480	96		Not supported		
5500	100		15.5	15.5	12.5
5520	104		15.5	15.5	12.5
5540	108		15.5	15.5	12.5
5560	112		15.5	15.5	12.5

5GHz–20MHz 1216 EU					
		20MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5580	116		15.5	15.5	12.5
5600	120		15.5	15.5	12.5
5620	124		15.5	15.5	12.5
5640	128		15.5	15.5	12.5
5660	132		15.5	15.5	12.5
5680	136		15.5	15.5	12.5
5700	140		15.5	15.5	12.5
5720	144		15.5	15.5	12.5
5745	149		7.5	7.5	4.5
5765	153		7.5	7.5	4.5
5785	157		7.5	7.5	4.5
5805	161		7.5	7.5	4.5
5825	165		7.5	7.5	4.5
5845	169		7.5	7.5	4.5
5865	173		Not supported		
5885	177		Not supported		
5905	181		Not supported		

5GHz–40MHz 1216 EU					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5190	38		17	17	14
5230	46		17	17	14
5270	54		17	17	14
			17	17	14
5310	62		Not supported		
5350	70		Not supported		
5390	78		Not supported		
5430	86		Not supported		
5510	102		17	17	14
5550	110		17	17	14

5GHz-40MHz 1216 EU					
		40MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5590	118		17	17	14
5630	126		17	17	14
5670	134		17	17	14
5710	142		17	17	14
5755	151		7.5	7.5	4.5
5795	159		7.5	7.5	4.5
5835	167	Not supported			
5875	175	Not supported			

5GHz-80MHz 1216 EU					
		80MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5210	42		17	17	14
5290	58		17	17	14
5370	74	Not supported			
5450	90	Not supported			
5530	106		17	17	14
5610	122		17	17	14
5690	138		17	17	14
5775	155		7.5	7.5	4.5
5855	171	Not supported			

5GHz-160MHz 1216 EU					
		160MHz OFDM			
Central Freq.	Control / Central Channel		OFDM SISO A	OFDM SISO B	OFDM MIMO
5250	50		17	17	14
5410	82	Not supported			
5570	114		17	17	14
5815	163	Not supported			

## 7.5 Max PPAG delta gain limits

Intel Connectivity module compensates Tx power for the case of low platform antenna gain. If the platform antenna's gain is lower than the assumed reference antenna gain (as described in Table 7-1), OEMs can use a table in the BIOS with the actual antenna gain. Based on location, the Intel Wi-Fi connectivity device will increase the Tx power to compensate for the lower antenna gain. Please refer to the Intel Connectivity BIOS Guidelines documentation (#559910) for BIOS antenna gain tables (PPAG).

Table 7-13 shows the maximum antenna gain compensation allowed for the TyP2 AX210 device, based on regulatory tests. (Antenna gain compensation = Assumed max antenna gain – Actual platform antenna gain).

**Table 7-13 Max antenna gain compensation**

Max antenna gain compensation [dB]			TyP2 2230	TyP2 1216
2.4GHz Ch1-13	20MHz	SISO A	3	3
		SISO B	3	3
		MIMO	2.5	3
	40MHz	SISO A	3	3
		SISO B	3	3
		MIMO	3	3
5.2-5.3GHz Ch36-64	20MHz	SISO A	2.5	2.5
		SISO B	2.5	3
		MIMO	2.5	3
	40MHz	SISO A	3	3
		SISO B	3	2.5
		MIMO	3	3
	80MHz	SISO A	3	3
		SISO B	3	3
		MIMO	3	3
	160MHz	SISO A	3	2
		SISO B	3	2.5
		MIMO	3	3
5.6GHz Ch100-144	20MHz	SISO A	2.5	2
		SISO B	2.5	2
		MIMO	2.5	3
	40MHz	SISO A	3	3
		SISO B	3	3
		MIMO	3	3
	80MHz	SISO A	3	3

Max antenna gain compensation [dB]			TyP2 2230	TyP2 1216
		SISO B	3	2.5
		MIMO	2.5	3
	160MHz	SISO A	3	0.5
		SISO B	3	0.5
		MIMO	3	3
5.8GHz Ch149-173	20MHz	SISO A	0	0
		SISO B	0	0
		MIMO	0	0
	40MHz	SISO A	7	7
		SISO B	7	7
		MIMO	7	7
	80MHz	SISO A	7	7
		SISO B	7	7
		MIMO	7	7
	160MHz	SISO A	N/A	N/A
		SISO B	N/A	N/A
		MIMO	N/A	N/A

## 7.6 SAR Tx power limits

OEMs who implement SAR limitations on their platforms can use the values in Table 7–14 for Tx power limits based on antenna-to-human body separation distance. Using these limits will enable OEMs to have minimized C1PC paperwork. In the case of shorter distances, specific platform tests and a C2PC approval process will be needed.

**Table 7–14 SAR Tx power limits dependency on distance**

d = Antenna to Human Body Separation [mm]	Value [dBm] for Both Chain A and B acc: +/- 0.5dB		Required OEM SAR Regulatory Process
	2.4GHz	5GHz	
TyP 2230: d >= 13 TyP 1216: d >= 17	No need for BIOS SAR limits		None
8 <= d < (13 for 2230, 17 for 1216)	17.5	16	C1PC
5 <= d < 8	15	13.5	C1PC
<5	OEM to set sepcific BIOS SAR limits		C2PC

**NOTE:**

1. The values in the table are per chain. Both chains can transmit at the stated power simultaneously.
2. The C1PC process is allowed only if the same antenna "Type" has already been filed. If for any reason an OEM files for a new antenna "Type," the C2PC process is required, even if the Tx



## 8 Dynamic Regulatory Solution

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### 8.1 Overview

Beginning with the Intel® Dual Band Wireless 7265 module (Stone Peak 2 or StP2), Intel introduced a new Dynamic Regulatory Solution (DRS) which offers worldwide regulatory compliance on one hardware SKU, while offering optimizations to country regulations based on geo-location discovery. These Wi-Fi optimizations includes the following benefits:

- More robust regulatory compliance
- Consolidation to a single worldwide regulatory SKU
- Country-specific channel optimizations
- Minimized OEM effort on enablement, production, and inventory management
- Ability to meet changing regulations and field support with software updates
- Simpler worldwide procurement and distribution for enterprise customers

The new dynamic solution provides a significant improvement in compliance reliability by ensuring the compliance always aligns to the adapter's location. It also provides the ability to react more quickly to changing regulations, both in new product shipments as well as field upgrades. Changing regulations can be applied precisely to the relevant country or countries without impacting optimizations to any other country.

### 8.2 11ax and Wi-Fi 6E enablement

DRS mechanism is used to enable 11ax support and usage of Wi-Fi 6E band (6 GHz) based on the specific country regulatory certification defined in the time the module is released.

Therefore, in certain countries 11ax and/or 6 GHz band will not be enabled by default.

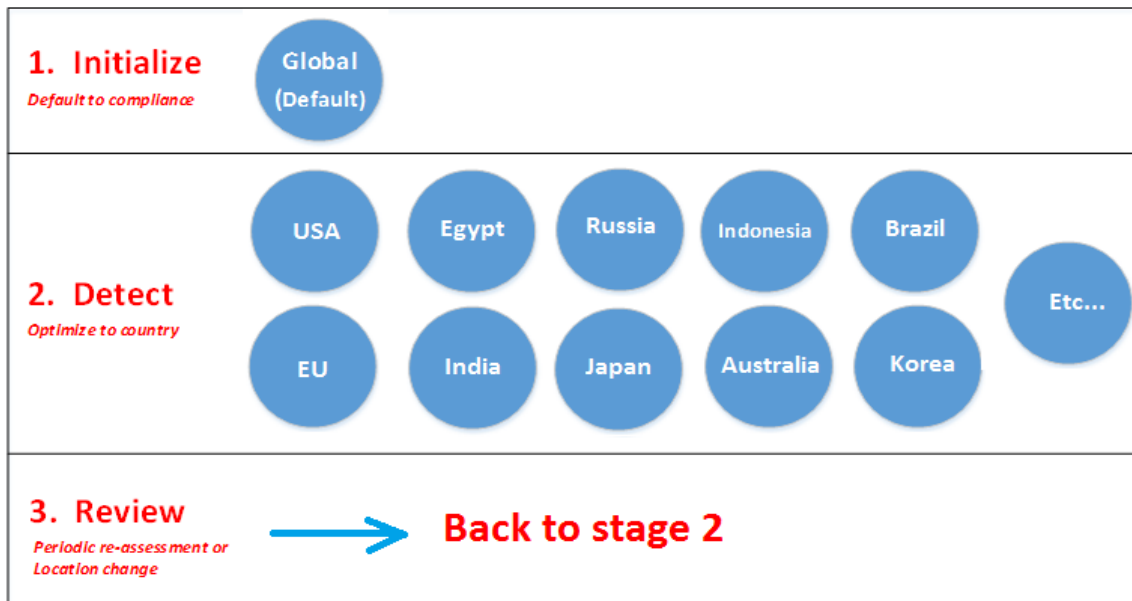
In case those countries will enable 11ax and/or Wi-Fi 6E band in the future, Intel will provide customers mechanisms to enable these features whenever possible, based on regulatory approval

### 8.3 Operation

DRS utilizes a proprietary country detection mechanism that, through a combination of field surveys and theoretical analysis, demonstrated >99.9999% accuracy. DRS's basic operational flow consists of initializing the adapter to a most-of-world (MoW) or "Default" configuration, detecting and optimizing to a specific country, and using a feedback loop to periodically review the location and change the configuration as necessary. This operational flow is designed to ensure an optimized environment of regulatory compliance and user experience:

1. **Initialize:** Configure the adapter to MoW compliance by using minimum channel configurations to meet both FCC and ETSI regulations. This MoW configuration is used to ensure a good user experience.
2. **Detect:** Utilizing the proprietary country detection mechanism, configure to an optimized channel map for the given country detected. In most cases, the adapter will optimize around FCC regulations or ETSI regulations. In exceptions, the adapter will disable channels (for example, Indonesia), channel widths for 802.11ac (such as Russia before its adoption in 2016), or bands (such as Tunisia). When no country is detected, the adapter will remain in the "Default" configuration. Country maps and channel configurations are detailed in the subsequent section.
3. **Review:** Periodically reassess the location to ensure the configuration is valid or determine that it should change. The reviews are triggered under any condition that indicates a user has changed location. Since Wi-Fi is a local-area networking technology, this can be achieved by using network connectivity changes (system power on/resume, profile change, airplane mode, etc.) to trigger the review. DRS also uses a 1-hour timer to reassess the location and ensure continual monitoring.

**Figure 8-1 DRS flow**



In addition to the operational flow described, a regulatory exception exists where:

- (1) There are significant channel restrictions from the MoW configuration, and
- (2) System (platform) approvals are required that place the regulatory responsibility on OEMs.

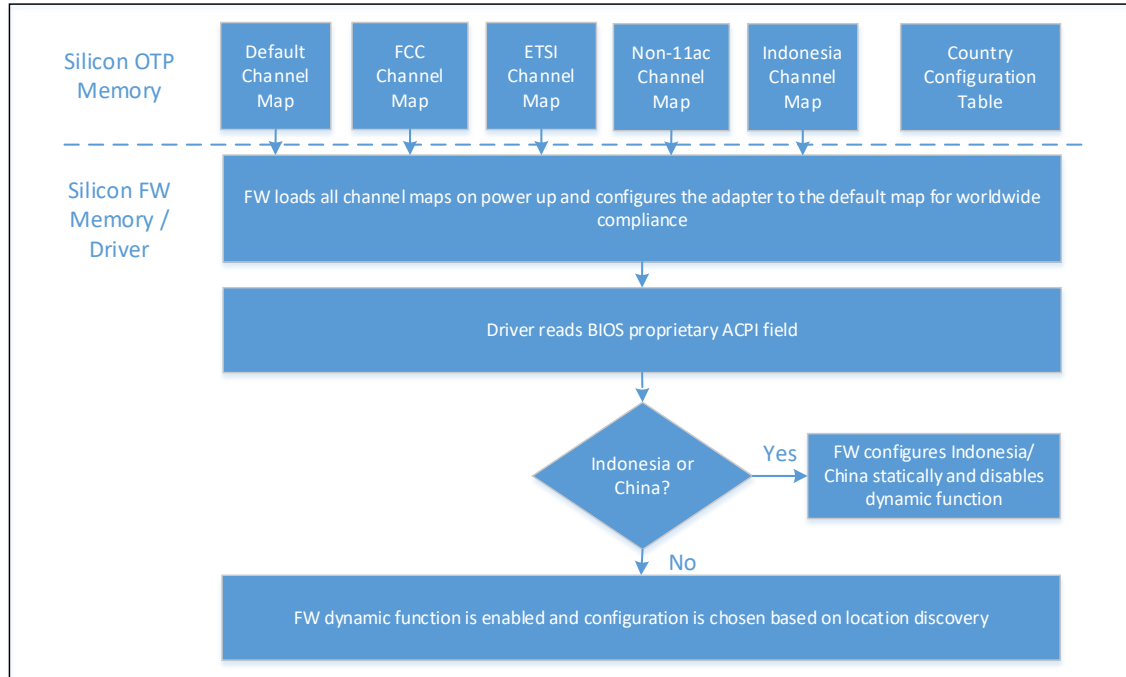
In this case (and for any future scenarios that may require this capability), DRS provides the ability to configure the adapter at the system level to a static channel map that complies with the specific country restrictions (example is Indonesia restrictions). The system (platform) configuration is done by indication that specify the specific country target through a custom BIOS ACPI setting. Please refer to Section 8.7 for details on programming the BIOS. For example, when the BIOS is configured to Indonesia, the device driver is designed to read this setting, disable the dynamic location detection mechanism, and statically configure the adapter to the Indonesia channel map.



## 8.4 DRS architecture

The DRS architecture, including the optional BIOS configuration, is shown in Figure 8–2. DRS leverages multiple product components.

**Figure 8–2 Dynamic regulatory architecture**



### 8.4.1 Regulatory Tx values tables

The device supports 6 tables of full Tx channel map:

- Table 0 – Default table that is used before country location is confirmed. It represents the minimum values of the other tables.
- Table 1 – US FCC and alike
- Table 2 – ETSI Limits and alike
- Table 3 – Japan and alike
- Table 4 – South Korea and alike
- Table 5 – Contains other remaining Tx Power limitations

### 8.4.2 Geo profiles

The device supports up to 31 geo profiles. Each profile defines which Tx Power table to use per sub-band.

### 8.4.3 Mapping country code to geo profile

The device contains a table mapping each country code (total of 129) to the relevant profile.

### 8.4.4 Determining the location

The Intel Wi-Fi driver and firmware execute a proprietary mechanism to determine the location. Based on the location found, the firmware chooses the geo profile bases on the table mapping country code to profile.

If the platform BIOS is configured to the regulatory static configuration, driver and firmware set the location accordingly, and disable the location detection mechanism.

## 8.5 Validation of regulatory compliance

Intel owns the validation of the DRS feature. This includes validation of the location detection mechanism, choosing the correct geo profile, and enabling/disabling of the allowed/not-allowed channels and bandwidth.

## 8.6 Performance testing

When the adapter cannot determine the regulatory domain, it will default to the global "Default" profile. This can result in lower Tx performance than the maximum the adapter is capable of. If performance testing with other profiles is desired, customer is encouraged to:

1. Order a limited number of adapters hard coded to other domain profiles (such as FCC). Please contact your Wireless TAM for availability.
2. Use the ANT tool and force regulatory domain for testing performance. The ANT tool uses a command line function to set DRS's MCC (Mobile Country Code) to a specific country configuration. It runs over the standard driver to ensure the adapter's production configuration is tested. Details are included in the tool's user guide. Please note that this configuration is time-limited and the device will disconnect after the timer expires, to prevent bypassing the DRS mechanism.
3. For PHY parameters tests (Tx power, EVM), use the DRTU tool. The DRTU tool supports configuration to a specific country code.

## 8.7 BIOS configuration

The device supports BIOS configuration to support regulatory special cases, as follows:

1. Static regulatory setting – Set to a specific country and disable the dynamic regulatory scan
2. Static SAR tables to configure the platform to have specific SAR limits (per antenna, per sub-band)
3. Dynamic SAR tables – Choose the SAR limits based on platform triggers (requires application that support this mode)

For additional information on updated BIOS configuration, please refer to the BIOS guidelines doc.

**Figure 8–3 Regulatory domain (WRDD) object definition**

```

Name (WRDD, Package())
{
    // Field Name          Field Type
    Revision,              // DWordConst

    Package()              // Default Configuration
    {
        DomainType,        // WiFi = 0x7
        RegulatoryDomain,   // Country identifier as defined in ISO/IEC 3166-1
                           // Default(AP)=0x4150, Indonesia(ID) = 0x4944
    },
}) // End of WRDD object
    
```

**Table 8–1 WRDD field descriptions**

Field	Format	Description
Revision	DWordConst	Revision identifier for this structure. Set to 0 always.
DomainType	DWordConst	Identifies the domain this object is providing default configuration data for. The domain type identifies a bitmap-based value, so that default values for a combination of domains can be specified. Use 0x7 for Wi-Fi in this instance.
RegulatoryDomain	WordConst	Defines the regulatory domain to be used: <b>Default(AP) = 0x4150</b> // Device ignores and resumes dynamic operation <b>Indonesia(ID) = 0x4944</b> // Device configures statically to Indonesia

Additional details, including a sample configuration, can be found in the *BIOS Reference Spec:*

*Platform Reference Code for 5th Generation Intel® Core™ Processor Platforms (codenamed Broadwell)*

The WRDD object is referenced in the following locations within the spec:

*BroadwellRcPkg\AcpiTables\DsdT\GlobalNvs.asl*

*BroadwellRcPkg\Cpu\SampleCode\Include\Protocol\GlobalNvsArea.h*

*BroadwellRcPkg\AcpiTables\SampleCode\AcpiPlatform\Dxe\AcpiPlatform.c*

*BroadwellRcPkg\AcpiTables\SampleCode\Library\PlatformAcpiLib\AcpiGnvsInitLib.c*

**Note:** There are two instances of the WRDD object in the reference spec. Only the first instance needs to be created in this scenario.



## 9 Appendix

### 9.1 Killer AX1675 features

Major Killer AX1675 features are

- **Killer Prioritization Engine:** Delivers low-latency gaming by automatically detecting, classifying, and prioritizing critical network traffic.
- **DoubleShot Pro:** Enables Wi-Fi and Ethernet to be used simultaneously for massive throughput and an optimal online experience.
- **Killer Intelligence Engine:** Automatically analyzes the network and makes adjustments to improve the overall online experience. For items that cannot be fixed automatically, the Killer Intelligence Engine makes recommendations to the user on how to best optimize their home network for ideal performance.

### 9.2 Linux Soft AP features

While used in Soft AP mode, the product supports the features and performance indicators listed in Table 9–1, Table 9–2, and Table 9–3.

**Table 9–1 Linux Soft AP key features**

Feature	Typhoon Peak 2
Platform	Tiger Lake Rocket Lake
Form factor and SKUs	<ul style="list-style-type: none"> <li>• M.2 2230 (Mainstream)</li> <li>• M.2 1216 soldered-down module (Mainstream)</li> </ul>
Wi-Fi	High-performance, low-power, dual-band Pre-Standard-802.11ax R2 2x2 – Wi-Fi 6E
P2P GO and Soft AP Client SMPS support	Supported
P2P GO and Soft AP Multi-client support	Supported
P2P GO and Soft AP legacy AM/PS multi-client power management	Supported
P2P GO and Soft AP legacy PS-Poll single client power management	Supported
P2P GO and Soft AP Indoor Channel support	Supported
P2P GO and Soft AP QoS support	IEEE 802.11e EDCA capabilities as a P2P GO and Soft AP
P2P GO and Soft AP 11ac support	VHT capabilities as a P2P GO and Soft AP
Multiple Virtual MAC support	Concurrent operation of Multiple Virtual MACs
2 SS Soft AP	Dual spatial stream Mobile AP operation
Soft AP Multi-client support	Multiple clients as Soft AP
Soft AP open security support	open security when operating as Soft AP
Soft AP WPA2 Personal support	WPA2/Personal security when operating as Soft AP
P2P and Soft AP Channel selection	GO and Soft AP operating channel selection in accordance with other VMAC active channels and regulatory rules
Soft AP a,b,g,n,ac,ax support	Soft AP operation including WMM and WPA2/Personal over a,b,g,n,ac and ax MAC/PHY in the 2.4GHz and 5GHz bands

Feature	Typhoon Peak 2
SRD compliant Soft AP and P2P device	Compliance with applicable SRD regulatory constraints in Soft AP, P2P GO, and P2P Client modes
Wi-Fi GO and Soft AP Bluetooth® Coex	Coexistence of Wi-Fi GO and Soft AP transmissions and receptions with Bluetooth®

**Table 9–2 Linux Soft AP Wi-Fi TpT KPIs**

Use Case	Minimum	Typical	Units
Conductive Best Attenuation Bidirectional TpT with Soft AP: 11n 20 MHz TCP STA->Soft AP	47	52	Mbps
Conductive Best Attenuation Bidirectional TpT with Soft AP: 11ac 80 MHz UDP STA->Soft AP	303	337	Mbps
Conductive Best Attenuation Bidirectional TpT with Soft AP: 11ac 80 MHz UDP Soft AP->STA	303	337	Mbps
Conductive Best Attenuation Bidirectional TpT with Soft AP: 11ac 80 MHz TCP STA->Soft AP	297	330	Mbps
Conductive Best Attenuation Bidirectional TpT with Soft AP: 11n 20 MHz TCP Soft AP->STA	47	52	Mbps
Conductive Best Attenuation Bidirectional TpT with Soft AP: 11n 20 MHz UDP Soft AP->STA	50	56	Mbps
Conductive Best Attenuation Bidirectional TpT with Soft AP: 11ac 80 MHz TCP Soft AP->STA	297	330	Mbps
Conductive Best Attenuation Bidirectional TpT with Soft AP: 11n 20 MHz UDP STA->Soft AP	50	56	Mbps
Conductive Best Attenuation Single station – Soft AP HB 160 MHz 11ax TCP Tx	2000	2077	Mbps
Conductive Best Attenuation Single station – Soft AP HB 160 MHz 11ax TCP Rx	2000	2077	Mbps
Conductive Best Attenuation Single station – Soft AP HB 80 MHz 11ax TCP Tx	870	920	Mbps
Conductive Best Attenuation Single station – Soft AP HB 80 MHz 11ax TCP Rx	858	898	Mbps
Conductive Best Attenuation Single station – Soft AP LB 20 MHz 11n TCP Rx	113	117	Mbps
Conductive Best Attenuation Single station – Soft AP LB 20 MHz 11n TCP Tx	113	117	Mbps
Conductive Best Attenuation Single station – Soft AP HB 80 MHz 11ac TCP Tx	522	543	Mbps
Conductive Best Attenuation Single station – Soft AP HB 80 MHz 11ac TCP Rx	673	698	Mbps
Aggregated 11ax HB 40 MHz Soft AP with 10 Clients Rx TCP	294	305	Mbps
Aggregated 11ax HB 80 MHz Soft AP with 10 Clients Rx TCP	568	590	Mbps
Aggregated 11ax HB 80 MHz Soft AP with 10 Clients Tx TCP	474	491	Mbps
Aggregated 11ax HB 40 MHz Soft AP with 10 Clients Tx TCP	223	231	Mbps
Aggregated 11n LB 20 MHz Soft AP with 10 Clients Tx UDP	92	95	Mbps
Aggregated 11ax HB 80 MHz Soft AP with 10 Clients Tx UDP	533	553	Mbps
Aggregated 11ax HB 40 MHz Soft AP with 10 Clients Tx UDP	246	255	Mbps
Aggregated 11n LB 20 MHz Soft AP with 10 Clients Tx TCP	87	90	Mbps

**Table 9–3 Connection time and reliability for Linux Soft AP Wi-Fi KPIs**

Use Case	Minimum	Typical	Units
Connection time to Open Network Soft AP – 1 client	20	110	mSec
Connection time to Private Network Soft AP – 1 Client	20	150	mSec
Connection reliability at Noisy environment (Open Network Soft AP)	95	100	%
Connection reliability at Noisy environment (Private Network Soft AP)	90	100	%
Connection reliability at Silent environment (Open Network Soft AP)	99	100	%
Connection reliability at Silent environment (Private Network Soft AP)	98	100	%
Connection reliability with maximal number of active clients (Open Network Soft AP)	90	100	%
Connection reliability with maximal number of active clients (Private Network Soft AP)	85	100	%
Connection reliability on resume and reconnection of the maximal number of supported clients (Open Network Soft AP)	90	100	%
Connection reliability on resume and reconnection of the maximal number of supported clients (Private Network Soft AP)	85	100	%

## 9.3 Reference documents

**Table 9–4 Reference documents**

Document Name	Location
<i>Wireless LAN MAC and PHY Specifications, 802.11b</i>	<a href="http://standards.ieee.org/getieee802/download/802.11b-1999_Cor1-2001.pdf">http://standards.ieee.org/getieee802/download/802.11b-1999_Cor1-2001.pdf</a>
<i>Wireless LAN MAC and PHY Specifications, 802.11g</i>	<a href="http://standards.ieee.org/getieee802">http://standards.ieee.org/getieee802</a>
<i>Wireless LAN MAC and PHY Specifications, 802.11a</i>	<a href="http://standards.ieee.org/getieee802">http://standards.ieee.org/getieee802</a>
<i>Wireless LAN MAC and PHY Specifications, 802.11n-2009</i>	<a href="http://standards.ieee.org/getieee802">http://standards.ieee.org/getieee802</a>
<i>PCI Express* Base Specification, Rev 1.2</i>	<a href="http://www.pcisig.com/specifications/pciexpress">http://www.pcisig.com/specifications/pciexpress</a>
<i>PCI Local Bus Specification Rev. 2.3</i>	<a href="http://www.pcisig.com/specifications/conventional/conventional_pci">http://www.pcisig.com/specifications/conventional/conventional_pci</a>
<i>PCI Bus Power Management Interface Specification Rev 1.1</i>	<a href="http://www.pcisig.com/specifications/conventional/pci_bus_power_management_interface">http://www.pcisig.com/specifications/conventional/pci_bus_power_management_interface</a>
<i>Advanced Configuration and Power Interface Version 3.0</i>	<a href="http://www.acpi.info/spec.htm">http://www.acpi.info/spec.htm</a>
<i>Microsoft Hardware Device Class Power Management Specification</i>	<a href="http://www.microsoft.com/whdc/hwdev/resources/specs/pmref/default.mspx">http://www.microsoft.com/whdc/hwdev/resources/specs/pmref/default.mspx</a>
<i>PCIe* M.2 Electromechanical Specification Rev 1.0</i>	<a href="http://www.pcisig.com/apps/org/workgroup/pciexpress/miniexpress/documents.php">http://www.pcisig.com/apps/org/workgroup/pciexpress/miniexpress/documents.php</a>
<i>Intel Connectivity Platforms BIOS Guidelines</i>	Intel document 559910
<i>Intel® Wi-Fi 6E AX210 (Typhoon Peak 2) 2D/3D 1216 Drawings</i>	Intel document 626868

Document Name	Location
Intel® Wi-Fi 6E AX210 (Typhoon Peak 2) 2D/3D 2230 Drawings	Intel document 626869
Tiger Lake UP3/UP4 Platform Design Guide	Intel document 607872

## 9.4 PCIe\* host interface errata

This section includes several important implementation aspects about PCIe\* host interface. The platform designer should take these items into account as part of the platform design.

### 9.4.1 Squelch detect mechanism

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

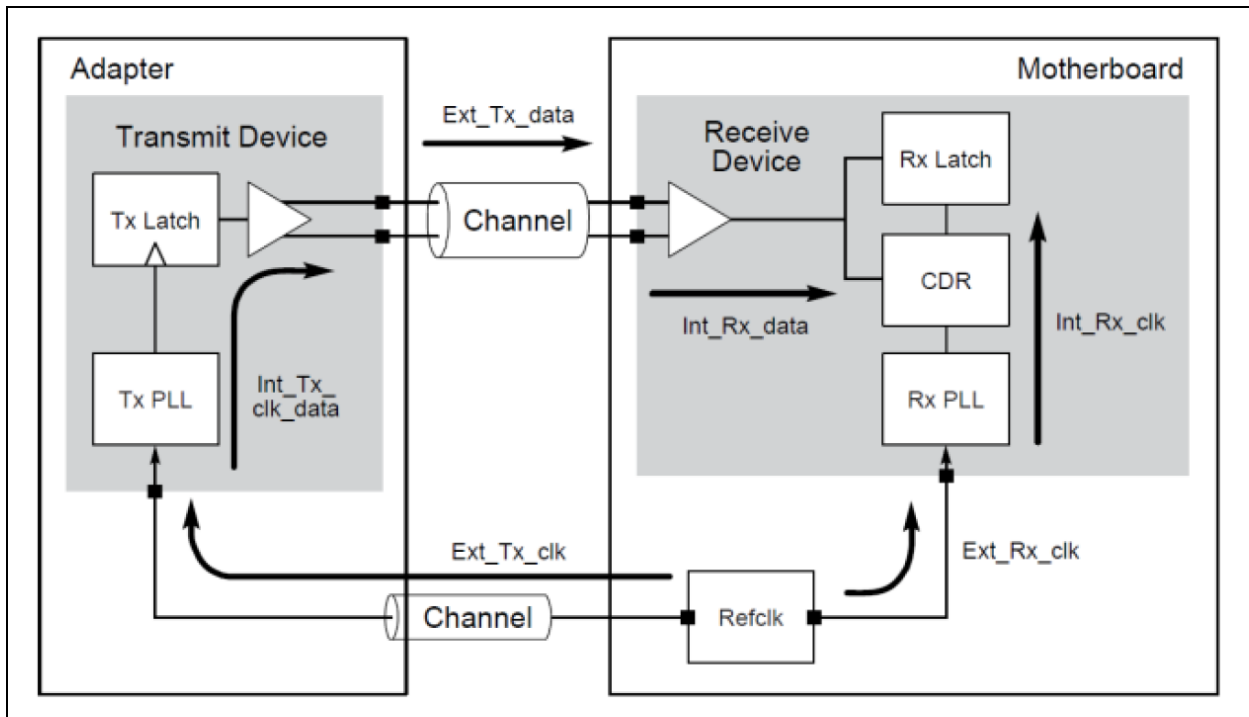
It is important to follow proper platform design and layout guidelines as defined in the PCIe\* CEM specification to ensure PCH wake signaling (Electrical Idle Detect Threshold - *Vrx-idle-det-diff-p-p* parameter) in the range of **65 mV to 280 mV**.

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

### 9.4.2 Common clock configuration

PCIe\* on both the platform side (PCH) and WLAN side must operate using a common clock configuration. Both PCH and WLAN are configured for this by default (bit 6 is set in registers 0x50). From a hardware perspective, the same reference clock (Refclk) must be used for both PCH and Wi-Fi card, as shown in Figure 9-1.

Figure 9-1 PCIe\* common clock configuration



Source: PCI Express\* Rev 2.0 specification (*PCI\_Express\_Base\_Rev\_2.0\_20Dec06a*, figure 4-50)

### 9.4.3 Enabling PCIe\* controllers with ASPM

ASPM defines the L states of the PCIe\* connections, L0, L0s, L1 and L2.

The device supports L1 state, and does not support L0s. This is in order to benefit from the power saving that is achieved with L1 state, while avoiding platform integration complexity which is involved with using L0s state.

The device supports ASPM optionality ECN, allowing support of L1 without L0s. Therefore, there is no need for special BIOS actions as with previous Intel’s wireless products.

### 9.4.4 CLKREQ# timing

The latest PCIe M.2 spec does not specify a constraint regarding when the PCIe device should assert CLKREQ# after Power Valid (which is the point where the V3.3 rail reaches the nominal level). Although the timing of CLKREQ# is not defined, it is required that the PCI device will enter DETECT state within 20ms of PERST# de-assertion. Cyclone Peak 2 asserts CLKREQ# within 12ms from Power Valid, and is compliant with the requirement to enter DETECT within 20ms of PERST# de-assertion.

### 9.4.5 PERST# rise-time timing

The PERST# signal rise time needs to meet the limitations listed in Table 9–2. This guarantees robust out-of-reset flow of the device and better immunity to noise that can be carried by this signal. In addition, it is required that this signal rise in a monotonic way and avoid a step-like rise.

**Table 9–5 PERST# rise time**

PERST# Rise Time	
PERST# rise time	<150 nSec monotonic rise
PERST# ripple/glitch during rise time	<100mV glitch during the rise time phase

### 9.4.6 PCI setting for Gen2 and De-emphasis

Some platforms experienced difficulties enumerating the Wi-Fi device after warm boot. The cause of this issue is the ability to choose the right PCI interface speed (Gen1/2). A workaround for this issue is to disable the PCI De-emphasis option in the BIOS and set speed to Gen2.

1. De-emphasis disabled
2. Speed – AUTO (to allow Gen2 speed)

### 9.4.7 D3 wake-up flow

When the platform wakes up (resumes) from D3 Cold state, the RC (Root Complex, actually the BIOS) should perform a CFG write to the End Point device to restore BDF (Bus Device Function) after the link is alive (after the credits exchange). Following this BDF restore, the Wi-Fi device will send a PM\_PME message.

