



<b>Product Name</b>	GAOTek Qualcomm Chip Wi-Fi Bluetooth Module
<b>Product SKU</b>	GAOTek-IDK-357
<b>Product URL</b>	<a href="https://gaotek.com/product/gaotek-qualcomm-chip-wi-fi-bluetooth-module/">https://gaotek.com/product/gaotek-qualcomm-chip-wi-fi-bluetooth-module/</a>

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## GAOTek Qualcomm Chip Wi-Fi Bluetooth Module

### 1. Overview

#### 1.1 Introduction

The device is a highly integrated module supporting 802.11ax Wi-Fi and Bluetooth (BT) Milan. The device supporting simultaneous operation on 2.4 GHz and 5 GHz, or 6 GHz, also known as Dual Band Simultaneous (DBS).

The wireless module complies with IEEE 802.11 a/b/g/n/ac/ax 2x2 MIMO standard and it can achieve up to a speed of 2975.6Mbps (5/6G 2x2 160MHz 11ax +2.4G 2x2 40MHz 11ax DBS). The integrated module provides PCIe interface for Wi-Fi, UART/PCM or USB interface for Bluetooth.

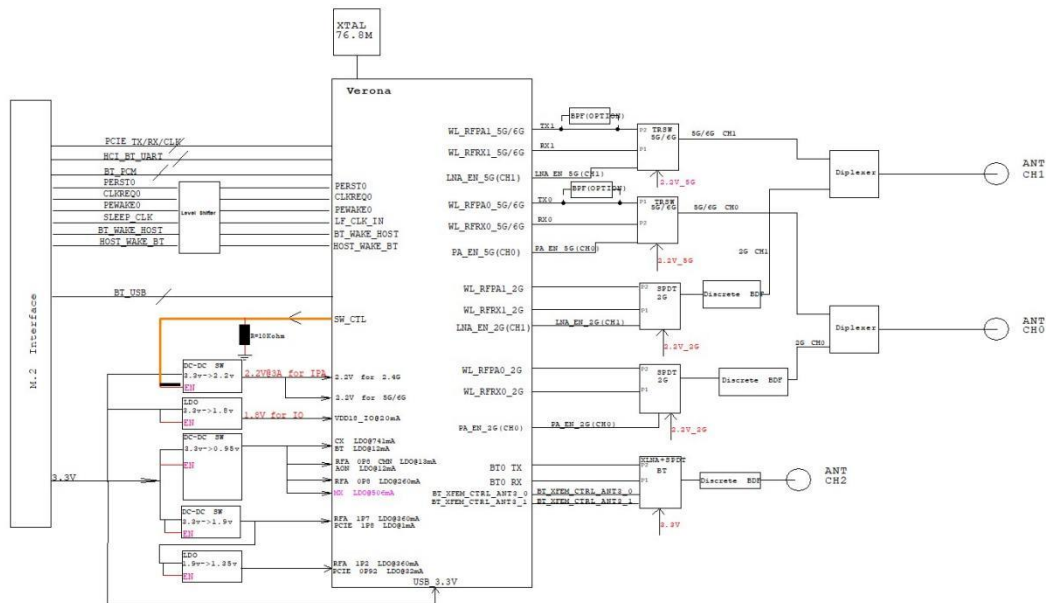
#### 1.2 Features

- Supports 2x2 Multi-User Multiple-Input Multiple-Output (MU-MIMO).
- Dual Band Simultaneous (DBS), up to 3 Gbps data rate (5/6G 2x2 160MHz 11ax +2.4G2x2 40MHz 11ax DBS).
- Tri-band 2.4 GHz/5 GHz/6 GHz support.
- 20MHz/40MHz channel bandwidth for 2.4 GHz and 20MHz/40MHz/80MHz/160 MHz channel bandwidth for 5 GHz/6 GHz.
- Seamless antenna sharing with Bluetooth, LTE, LTE-U, and 5G.
- Dynamic Frequency Selection (DFS master and DFS slave, radar detection for master and slave).
- Offloading traffic for minimal host utilization at 802.11ac/ ax speeds.
- Low-power PCIe (with L1 substate) interface.
- Integrated close-loop power detector.

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- Supports 2 Mbps Bluetooth Low Energy (BLE), BLE Long Range.
- Split ACL support for A2DP true stereo (earbuds) .
- Dedicated Bluetooth antenna, and concurrent with 5G WLAN.
- Dual eSCO and dual A2DP streams.
- Backward - compatible with previous Bluetooth standards.
- Standard M.2 2230 Key E Golden Finger interface.

### 1.3 Block Diagram



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### 1.4 General Specification

<b>Model Name</b>	O2066PM
<b>Product Description</b>	Support WiFi6E+BT5.2
<b>Dimension</b>	L x W x H: 22 x 30 x 2.7 (typical) mm
<b>Wi-Fi Interface</b>	M.2 2230 Key E
<b>BT Interface</b>	UART/PCM or USB
<b>Operating temperature</b>	-30°C to 85°C (-22°F to 185°F)
<b>Storage temperature</b>	-40°C to 125°C (-40°F to 257°F)

Note: The maximum ambient temperature of 802.11ax 160M MCS11 for long-term stable operation is less than or equal to 82°C (179.6°F).

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## 1.5 Recommended Operating Rating

Feature	Minimum	Type	Maximum	Units
Operating Temperature	-30	25	85	°C
VCC	3.20	3.3	3.45	V
Power Consumption (TypeVCC)	TX (2.4G HE40)	531 mA		
	RX (2.4G HE40)	187 mA		
	TX (5G HE160)	736 mA		
	RX (5G HE160)	202 mA		
	Power Up	118 mA		
	BT TX ( 1M@7dBm)	147 mA		
	BT RX	136 mA		

## 2. RF Specification

### 2.1 Wi-Fi RF Specification

Feature	Description
Operating Frequency	2.400-2.4835GHz
Standards	Wi-Fi: IEEE 802.11b/g/n/ac/ax & Wi-Fi compliant
Operating Channel	2.4GHz: Ch1-14

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802.11b: CCK

802.11 g/n/ac/ax: OFDM /1024-QAM, 256-QAM, 64-QAM, 16-QAM, QPSK, BPSK

**Modulation**

<b>PHY Data rates</b>	Wi-Fi:802.11b:11,5.5,2,1Mbps 802.11g:54,48,36,24,18,12,9,6Mbps 802.11n: up to 300Mbps
-----------------------	--

802.11ac: up to 400Mbps

802.11ax: up to 3 Gbps data rate (2.4G 2x2+5G or 6G 2x2 11axDBS)

**Output Power, tolerance ± 1.5 dB**

Protocol Standard	Data Rate	Spec.(dBm)	EVM(dBm)
802.11b	@ 11Mbps	16	≤-9
<b>802.11g</b>	@54Mbps	17	≤-25
<b>802.11n</b>	@HT40 MCS 7	17	≤-28
<b>802.11ac</b>	@vHT40 MCS 9	15.5	≤-32
<b>802.11ax</b>	@HE40 MCS 11	13.5	≤-35

**Receiver Sensitivity, CCK modulation PER≤8%、OFDM modulation PER≤10%**

Protocol Standard	Data Rate	Spec.(dBm)
<b>802.11b(20MHz)</b>	1Mbps	-82
	11Mbps	-76
<b>802.11g(20MHz)</b>	6Mbps	-82
	54Mbps	-64

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802.11n(20MHz)	MCS 0 NSS1	-82
	MCS 7 NSS1	-64
802.11n(40MHz)	MCS 0 NSS1	-79
	MCS 7 NSS1	-61
802.11ac(20MHz)	MCS 0 NSS1	-82
	MCS 9 NSS1	-59
802.11ac(40MHz)	MCS 0 NSS1	-79
	MCS 9 NSS1	-57
802.11ax(20MHz)	MCS 0 NSS1	-82
	MCS 11 NSS1	-52
802.11ax(40MHz)	MCS 0 NSS1	-79
	MCS 11 NSS1	-49

5GHz RF Specification

Feature	Description
Operating Frequency	5G:5.15 GHz ~ 5.845 GHz (5.0 GHz ISM Band)
Standards	Wi-Fi: IEEE 802.11 a/n/ac/ax 2x2, Wi-Fi compliant
Modulation	802.11 a/n/ac/ax: OFDM /1024-QAM、256-QAM、64-QAM、16-QAM、QPSK、BPSK
PHY Data rates	Wi-Fi: 802.11a:54,48,36,24,18,12,9,6Mbps 802.11n: up to 300Mbps 802.11ac: up to 800Mbps (5G 2x2 VHT80) 802.11ax: up to 3 Gbps data rate (2.4G 2x2+5G 2x2 11ax DBS)

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Output Power, tolerance  $\pm 1.5$  dB

Protocol Standard	Data Rate	Spec.(dBm)	EVM(dBm)
802.11a	@54Mbps	17	$\leq -25$
802.11n	@HT40 MCS 7	16.5	$\leq -28$
802.11ac	@vHT80 MCS 9	14	$\leq -32$
802.11ax	@HE160 MCS 11	12	$\leq -35$

Receiver Sensitivity, OFDM modulation PER  $\leq 10\%$

Protocol Standard	Data Rate	Spec.(dBm)
802.11a(20MHz)	6Mbps	-82
	54Mbps	-64
802.11n(20MHz)	MCS 0 NSS1	-82
	MCS 7 NSS1	-64
802.11n(40MHz)	MCS 0 NSS1	-79
	MCS 7 NSS1	-64
802.11ac(20MHz)	MCS 0 NSS1	-82
	MCS 9 NSS1	-57
802.11ac(40MHz)	MCS 0 NSS1	-79
	MCS 9 NSS1	-54
802.11ac(80MHz)	MCS 0 NSS1	-76
	MCS 9 NSS1	-51
802.11ax(20MHz)	MCS 0 NSS1	-82
	MCS 11 NSS1	-52

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802.11ax(40MHz)	MCS 0 NSS1	-79
	MCS 11 NSS1	-49
802.11ax(80MHz)	MCS 0 NSS1	-76
	MCS 11 NSS1	-46
802.11ax(160MHz)	MCS 0 NSS1	-73
	MCS 11 NSS1	-43

6GHz RF Specification

Feature	Description
Operating Frequency	6G: 5.925 GHz ~ 7.125 GHz
Standards	Wi-Fi: IEEE 802.11 a/ax 2x2, Wi-Fi compliant
Modulation	802.11 a/ax : OFDM /1024-QAM、256-QAM、64-QAM、16-QAM、QPSK、BPSK
PHY Data rates	Wi-Fi: OFDM:54,48,36,24,18,12,9,6Mbps 802.11ax:up to 3 Gbps data rate (2.4G 2x2+6G 2x2 11ax DBS)

Output Power, tolerance  $\pm 1.5$  dB

Protocol Standard	Data Rate	Spec.(dBm)	EVM(dBm)
OFDM 54M	@54Mbps	14.5	$\leq -25$
802.11ax	@HE40 MCS 11	12	$\leq -35$

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802.11ax @HE80 MCS 11 11.5  $\leq -35$

802.11ax	@HE160 MCS 11	11	$\leq -35$
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Receiver Sensitivity, OFDM modulation PER $\leq$ 10%

Protocol Standard	Data Rate	Spec.(dBm)
802.11a(20MHz)	6Mbps	-82
	54Mbps	-64
802.11ax(20MHz)	MCS 0 NSS1	-82
	MCS 11 NSS1	-52
802.11ax(40MHz)	MCS 0 NSS1	-79
	MCS 11 NSS1	-49
802.11ax(80MHz)	MCS 0 NSS1	-76
	MCS 11 NSS1	-46
802.11ax(160MHz)	MCS 0 NSS1	-73
	MCS 11 NSS1	-43

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## 2.2 BT RF Specifications

Feature	Description		
Operating Frequency	2.402 - 2.480GHz		
Number of Channels	79 channels		
Standards	Bluetooth V5.2		
Modulation	8DPSK, $\pi/4$ DQPSK, GFSK		
PHY Data rates	Supports 2Mbps Bluetooth Low Energy (BLE), BLE Long Range		
Output Power	Min(dBm)	Typical(dBm)	Max(dBm)
		7	10
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-92	
Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)		-92	
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)		-85	

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### 3. Pin Assignments

#### 3.1 Pin Outline



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### 3.2 Pin Definition

#### Top side

NO	Name	Type	Description	Voltage
1	GND1	-	Ground	
3	BT USB D+	I/O	The usb1.1 interface is only valid for BT USB modules	
5	BT USB D1	I/O	The usb1.1 interface is only valid for BT USB modules	
7	GND2	-	Ground	
9	NC	-		
11	NC	-		
13	NC	-		
15	NC	-		
17	NC	-		
19	NC	-		
21	NC	-		
23	NC	-		
33	GND3	-	Ground	
35	PERP0	I	PCIe RX differential signals	
37	PERN0	I		
39	GND4	-	Ground	
41	PETP0	O	PCIe TX differential signals	
43	PETN0	O		

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45 GND5 - Ground

47	REFCLKP0	I	PCIe clock differential input signal	
49	REFCLKN0	I		

51 GND6 Ground

53	CLKREQ0#(I/O)(0/3.3V) ①	I/O	PCIe reference clock request signal, open drain, active low	3.3V
55	PEWAKE0#(I/O)(0/3.3V) ①	I/O	PCIe wake up host, open drain, active low	3.3V
57	GND7	-	Ground	
59	RESERVED_PERP1	-	NC	
61	RESERVED_PERN1	-	NC	
63	GND8	-	Ground	
65	RESERVED_PETP1	-	NC	
67	RESERVED_PETN1	-	NC	
69	GND9	-	Ground	
71	RESERVED_REFCLKP1	-	NC	
73	RESERVED_REFCLKN1	-	NC	
75	GND9	-	Ground	

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## Bottom Side

NO	Name	Type	Description	Voltage
2	3_3V_1	P	Power supply	3.3V
4	3_3V_2	P	Power supply	3.3V
6	NC	-	RESERVED	
8	PCM_CLK	I/O	BT PCM clock (Only valid for UART modules )	1.8V
10	PCM_SYNC	I/O	BT PCM sync (Only valid for UART modules)	1.8V
12	PCM_OUT	O	BT PCM data out (Only valid for UART modules)	1.8V
14	PCM_IN	I	BT PCM data in (Only valid for UART modules )	1.8V
16	NC	-	RESERVED	
18	GND11	-	Ground	
20	UART_WAKE_N ①	O	BT wake up host signal ( Only valid for UART modules )	3.3V
22	UART_TXD(O)(0/1.8V)	O	BT UART interface Only valid for UART modules )	1.8V
32	UART_RXD(I)(0/1.8V)	I		1.8V

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34 UART\_RTS(O)(0/1.8V) O BT UART request to send 1.8V  
 Only valid for UART modules  
 )

36	UART_CTS(I)(0/1.8V)	I	BT UART clear to send ( Only valid for UART modules )	1.8V
38	NC	-		
40	NC	-		
42	NC	-		
44	WAKE_BT ①	I	Host wake up BT signal	3.3V
46	LTE_COEX_TXD	O	RESERVED/LTE coexistence UART TXD	1.8V
48	LTE_COEX_RXD	I	RESERVED/LTE coexistence UART RXD	1.8V
50	SUSCLK_32KHZ ①	I	Sleep clock input	3.3V
52	PERST0#(I)(0/3.3V) ①	I	PCIe reset module, internal weakpull down	3.3V
54	NC	-	RESERVED	
56	NC	-	RESERVED	
58	NC	-	RESERVED	
60	NC	-	RESERVED	
62	NC	-		
64	NC	-		
66	NC	-		
68	NC	-		

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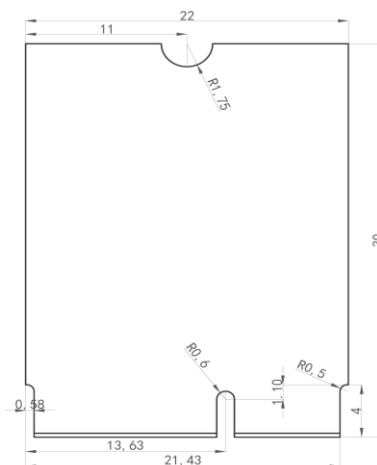
69	3_3V_3	P	Power supply	3.3V
70	3_3V_4	P	Power supply	3.3V


Note: The I/O level of the pin marked ① is 3.3V, and the other I/O level is 1.8V。

## 4. Dimensions

### 4.1 Physical Dimensions and Module Photo

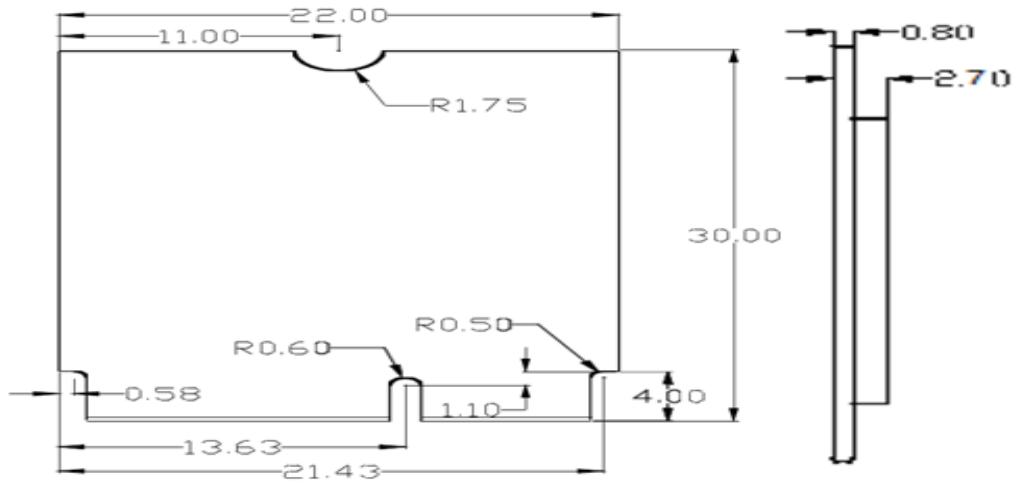
L x W: 30 x 22(+0.3/-0.1) mm



H: 2.7 (±0.2) mm	
Weight	7.5g

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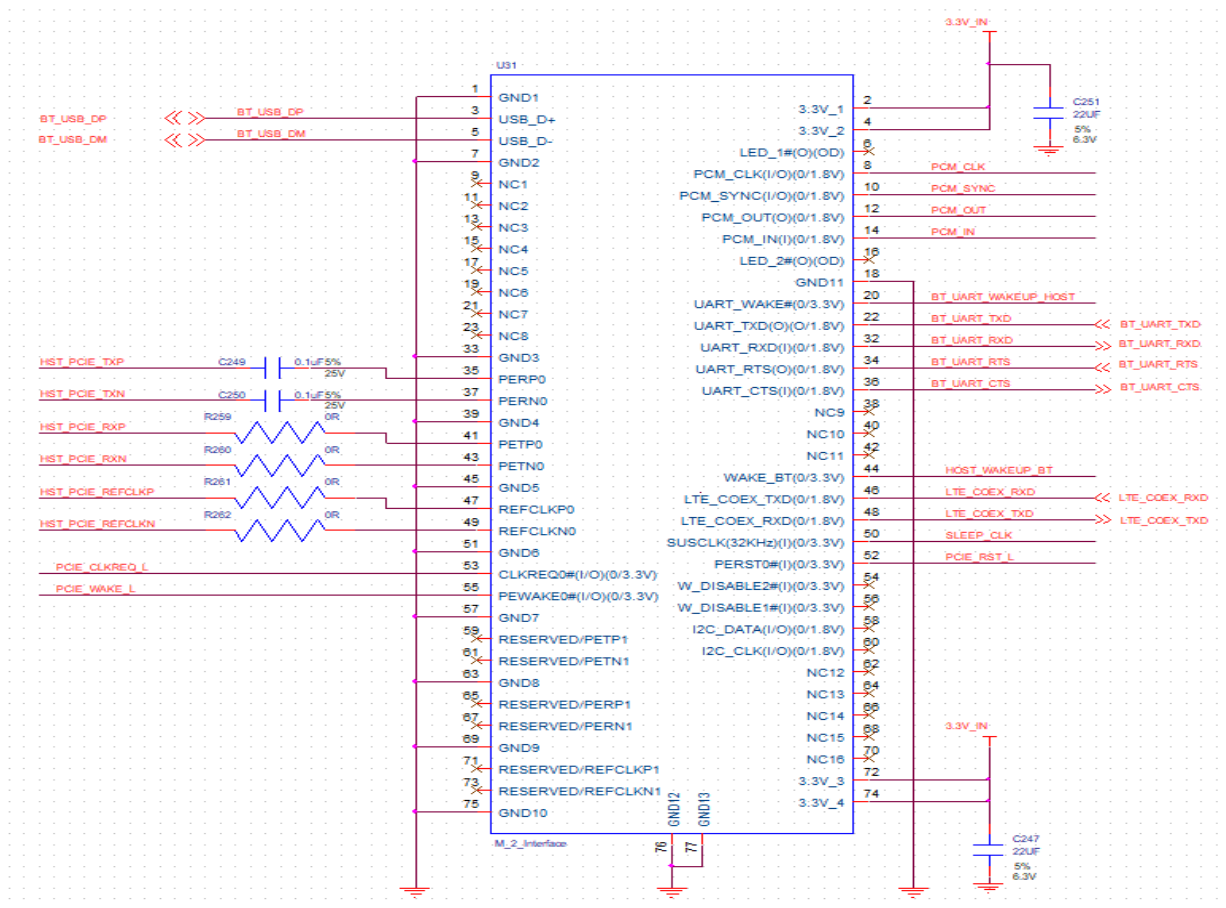
## 4.2 Module Physical Dimensions



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## 5. Reference Design

### 5.1 Reference schematic



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- A. C247, C251 should be closed to host.
- B. The power supply “3.3V\_IN” switching noise is less than 100mV and the ripple is less than 30 mV.
- C. PCIe differential signals should be followed 100 Ohm impedance.
- D. For the I/O interface voltage, please refer to chapter 5 pin definition.
- E. For the 1.8V interface, such as PCM, UART and some I/O, if the host voltage level is 3.3V or 5V, need to add level shift circuit.

## 5.2 External Antenna

When the customer selects an external antenna, the external antenna selected must meet the parameter requirements specified, Impedance 50Ω.

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## 5.3 Real-world Testing

### 2.4G Real-world Testing

Protocol Standard		channel	Power (dBm)	EVM (dB)	Rx Sensitivity (dBm)
802.11g(54Mbps)	ANT0	2412	16.7	-36.7	-72
		2437	16.7	-36	-73
		2472	16.4	-36.6	-73
	ANT1	2412	17	-36	-73
		2437	16.7	-34.6	-73
		2472	16.1	-35.6	-73
802.11ax (HE20_MCS11)	ANT0	2412	14.5	-41	-58
		2437	14.3	-37.8	-58
		2472	14.2	-41.6	-58
	ANT1	2412	14.6	-36.9	-58
		2437	14.5	-36.9	-58
		2472	13.9	-38.6	-58

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802.11ax (HE40_MCS11 )	ANT0	2422	13.2	-40.3	-55
	ANT1	2422	13.3	-40.7	-55
		2457	13	-41	-55

5G Real-world Testing

Protocol Standard		channel	Power (dBm)	EVM (dB)	Rx Sensitivity (dBm)
802.11a(54Mps)	ANT0	5180	16.9	-39.4	-73
		5600	17.4	-32	-73

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		5825	17.1	-30.6	-73
	ANT1	5180	17.2	-35.5	-73
		5600	17.3	-31.8	-73
		5825	16.7	-32.7	-73
802.11ax (HE20_MCS11)	ANT0	5180	12.9	-42.1	-59
		5600	13.6	-41.4	-59
		5825	13.5	-40.3	-59
	ANT1	5180	13.3	-41.8	-59
		5600	13.2	-41.3	-59
		5825	13	-39.2	-59
802.11ax (HE80_MCS11)	ANT0	5290	12.9	-40.7	-54
		5690	13	-39	-54
		5775	13.8	-38.3	-54
	ANT1	5290	13.4	-38.9	-54
		5690	13.5	-38.9	-54
		5775	13.3	-37.3	-54
802.11ax (HE160_MCS1 1)	ANT0	5250	12.5	-38.2	-51
		5570	12.7	-38	-50
	ANT1	5250	13	-37.6	-51
		5570	12.4	-38.2	-51

6G Real-world Testing

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Protocol Standard		channel	Power (dBm)	EVM (dB)	Rx Sensitivity (dBm)
802.11a(54Mbps)	ANT0	5955	14.8	-33	-73
		6695	13.2	-35.3	-73
		7115	14.4	-32.9	-73
		5955	14.6	-33	-73
	ANT1	6695	13.7	-37.5	-73
		7115	13.7	-33.9	-73
802.11ax (HE80_MCS11)	ANT0	5985	11.9	-36.9	-54
		6545	11	-37.6	-54
		7025	11.5	-37.9	-54
	ANT1	5985	11.5	-38.9	-54
		6545	11	-40.2	-53
		7025	10.2	-37.9	-54
802.11ax (HE160_MCS11) 1)	ANT0	6025	10.9	-37.5	-51
		6505	10.7	-37.1	-50
		6985	10	-36.8	-50
	ANT1	6025	10.5	-38	-51
		6505	10.6	-39.3	-50
		6985	10.3	-36.9	-50

Description: the test environment is: temperature 25 humidity 60%

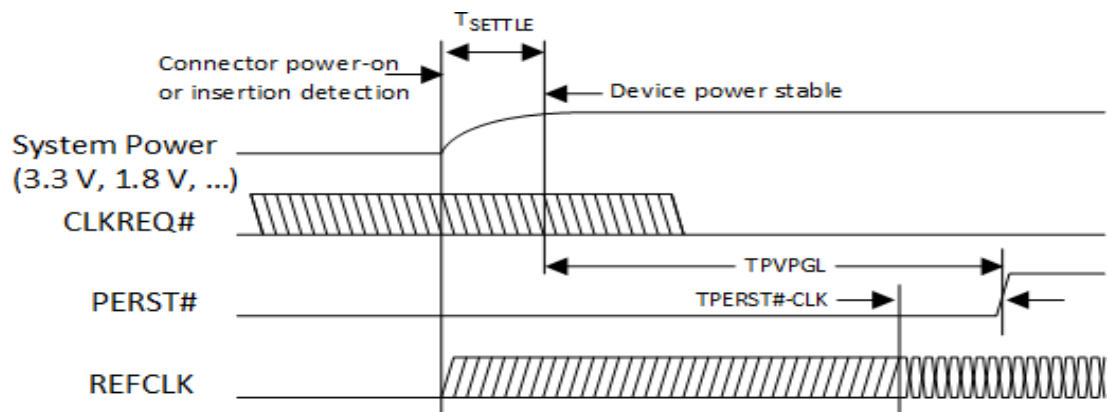
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## 6. Host Interface Timing Diagram

### 6.1 PCIe power-up sequence timing

Supports PCIe Gen 3 interface for WLAN. Compliant to PCIe Gen 3 powerup sequence timing.

## 7. Package

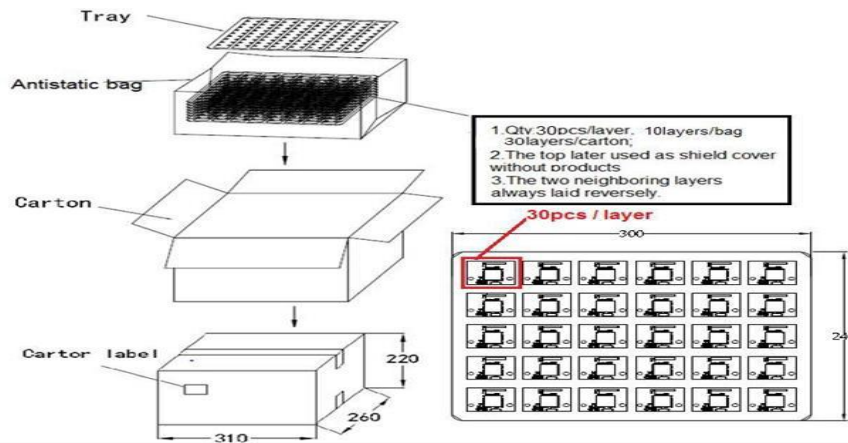


Symbol	Parameter	Min	Max	Units
$T_{PVGL}$	Power Valid* to PERST# input inactive	Implementation specific; recommended 50 ms		ms
$T_{PERST\#-CLK}$	REFCLK stable before PERST# inactive	100		$\mu$ s

**Note:** \*Power Valid when all the voltage supply rails have reached their respective  $V_{min}$ .

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## 7.1 Reel



## 7.2 Storage Temperature and Humidity

The Modules is a Moisture Sensitive Device level 3, in according with standard IPC/JEDEC J-STD-020, take care all the relatives' requirements for using this kind of components

Moreover, the customer has to take care of the following conditions:

A. Calculated shelf life in sealed bag: 12 months at <math>40^{\circ}\text{C}</math> and <math>90\%</math> relative humidity(RH).

B. Environmental condition during the production:  $30^{\circ}\text{C}$  / 60% RH according to IPC/JEDEC J-STD-033A paragraph 5.

C. The maximum time between the opening of the sealed bag and the reflow process must be 168 hours if condition.

D. "IPC/JEDEC J-STD-033A paragraph 5.2" is respected.

E. Baking is required if conditions b) or c) are not respected.

F. Baking is required if the humidity indicator inside the bag indicates 10% RH or more.

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