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Project No: CB10410059

Maximum Permissible Exposure

Applicant's company	Broadcom Corporation
Applicant Address	190 Mathilda Place Sunnyvale CA 94086 U.S.A.
FCC ID	QDS-BRCM1090
Manufacturer's company	Broadcom Corporation
Manufacturer Address	190 Mathilda Place Sunnyvale CA 94086 U.S.A.

Product Name	Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E/SDIO NGFF 2230 Card
Brand Name	Broadcom
Model Name	BCM94371ZAE
Part No.	BCM94371ZAE, BCM94371Z
Ref. Standard(s)	47 CFR FCC Part 2 Subpart J, section 2.1091
EUT Freq. Range	2400 ~ 2483.5MHz / 5150 ~ 5350MHz / 5470 ~ 5725MHz / 5725 ~ 5850MHz
Received Date	Jul. 31, 2014
Final Test Date	Jan. 07, 2016
Submission Type	Original Equipment

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Testing Laboratory
1190

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History of This Assessment Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA473142-07AA	Rev. 01	Initial issue of report	Jan. 12, 2016

1. TABLE FOR MULTIPLE LIST

1.1. Table for Multiple List

The EUT has three part numbers which are identical to each other in all aspects except for the following table:

EUT	Model No.	Part No.	Description
EUT 1	BCM94371ZAE	BCM94371Z	M.2 E Key connector which support PCIe/USB interface.
EUT 2		BCM94371Z	M.2 E Key connector which support SDIO/UART/PCIe/USB interface.
EUT 3		BCM94371ZAE	M.2 A key + E Key connector which support PCIe/USB interface.

From the above models, EUT 1 was selected as representative model.

2. MAXIMUM PERMISSIBLE EXPOSURE

2. 1. Applicable Standard

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm²)	Averaging Time |E|², |H|² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	6
30-300	61.4	0.163	1.0	6
300-1500			F/300	6
1500-100,000			5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm²)	Averaging Time |E|², |H|² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

Note: f = frequency in MHz ; *Plane-wave equivalent power density

2.2. MPE Calculation Method

E (V/m) = $\frac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

E = Electric field (V/m)

P = Peak RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

Pd = $\frac{30 \times P \times G}{377 \times d^2}$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

2.3. Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

For 5GHz UNII Band:

Antenna Type : WLAN/BT antenna

Conducted Power for IEEE 802.11ac VHT20: 21.73dBm

Distance (m)	Directional Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			(dBm)	(mW)			
0.2	9.22	8.3560	21.7254	148.7798	0.247454	1	Complies

Note: $DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$ =9.22dBi

For 2.4GHz Band:

<WLAN>

Antenna Type : WLAN/BT antenna

Conducted Power for IEEE 802.11b: 23.55dBm

Distance (m)	Antenna Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			(dBm)	(mW)			
0.2	3.33	2.1528	23.5512	226.5287	0.097067	1	Complies

<Bluetooth>

Antenna Type : WLAN/BT antenna

Conducted Power for BR (GFSK) 1Mbps: 11.48dBm

Distance (m)	Antenna Gain (dBi)	Antenna Gain (numeric)	Average Output Power		Power Density (S) (mW/cm²)	Limit of Power Density (S) (mW/cm²)	Test Result
			(dBm)	(mW)			
0.2	3.33	2.1528	11.4800	14.0605	0.006025	1	Complies

Conclusion:

For EUT 1 Both of the WLAN 5GHz Band + Bluetooth and WLAN 2.4GHz Band + Bluetooth can transmit simultaneously, the formula of calculatedthe MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ...etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation are 0.247454 / 1 + 0.006025 / 1 = 0.253479 for WLAN 5GHz Band + Bluetooth and 0.097067 / 1 + 0.006025 / 1 = 0.103092 for WLAN 2.4GHz Band + Bluetooth, which are less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.