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Project No: CB10409107

Maximum Permissible Exposure Report

| | |
|------------------------|--|
| Applicant's company | Broadcom Corporation |
| Applicant Address | 190 Mathilda Place Sunnyvale CA 94086 U.S.A. |
| FCC ID | QDS-BRCM1084 |
| Manufacturer's company | Broadcom Corporation |
| Manufacturer Address | 190 Mathilda Place Sunnyvale CA 94086 U.S.A. |

| | |
|------------------|--|
| Product Name | Broadcom 802.11a/b/g/n WLAN+ Bluetooth PCI-E NGFF2230 card |
| Brand Name | Broadcom |
| Model Name | BCM943228Z |
| Ref. Standard(s) | 47 CFR FCC Part 2 Subpart J, section 2.1091 |
| Received Date | Apr. 01, 2014 |
| Final Test Date | Jul. 22, 2015 |
| Submission Type | Class II Change |



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History of This Test Report

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|-------------|---------|-------------------------|---------------|
| FA440181-03 | Rev. 01 | Initial issue of report | Sep. 10, 2015 |
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1. GENERAL DESCRIPTION

1.1. EUT General Information

| RF General Information | | | |
|------------------------|--|--|---|
| Evaluation Mode | Frequency Range (MHz) | Operating Frequency (MHz) | Modulation Type |
| 2.4GHz WLAN | 2400-2483.5 | 2412-2462 | 802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) |
| 5GHz WLAN | 5150-5250 5250-5350 5470-5725 5725-5850 | 5180-5240 5260-5320 5500-5700 5745-5825 | 802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) |
| Bluetooth | 2400-2483.5 | 2402-2480 | BR / EDR: FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK) LE: DSSS (GFSK) |

1.2. Table for Class II Change

This product is an extension of original one reported under Sporton project number: 440181

Below is the table for the change of the product with respect to the original one.

| Modifications | Performance Checking |
|--|----------------------|
| Adding two sets dipole antennas for the device. The EUT now is limited to mobile use only. | MPE |

1.3. Testing Location

| Testing Location | | |
|-------------------------------------|--------|--|
| <input type="checkbox"/> | HWA YA | ADD : No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL : 886-3-327-3456 FAX : 886-3-327-0973 |
| <input checked="" type="checkbox"/> | JHUBEI | ADD : No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C. TEL : 886-3-656-9065 FAX : 886-3-656-9085 |

2. MAXIMUM PERMISSIBLE EXPOSURE

2.1. Limit of Maximum Permissible Exposure

(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/ cm ²) | 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/ cm ²) | 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

2.2. MPE Calculation Method

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

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

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

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

2.3. Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

For 5GHz Band (NII):

Antenna Type : Dipole antenna

Conducted Power for IEEE 802.11n MCS0 (HT40): 21.51dBm

| Distance (cm) | Test Freq. (MHz) | Antenna Gain (dBi) | Antenna Gain (numeric) | The maximum combined Average Output Power | | Power Density (S) (mW/cm ²) | Limit of Power Density (S) (mW/cm ²) | Test Result |
|---------------|------------------|--------------------|------------------------|---|----------|---|--|-------------|
| | | | | (dBm) | (mW) | | | |
| 20 | 5270 | 1.58 | 1.4388 | 21.51 | 141.6896 | 0.040578 | 1 | Complies |

For 5GHz Band (DTS):

Antenna Type : Dipole antenna

Conducted Power for IEEE 802.11n MCS0 (HT40): 20.17dBm

| Distance (cm) | Test Freq. (MHz) | Antenna Gain (dBi) | Antenna Gain (numeric) | The maximum combined Average Output Power | | Power Density (S) (mW/cm ²) | Limit of Power Density (S) (mW/cm ²) | Test Result |
|---------------|------------------|--------------------|------------------------|---|----------|---|--|-------------|
| | | | | (dBm) | (mW) | | | |
| 20 | 5795 | 1.09 | 1.2853 | 20.17 | 103.8798 | 0.026576 | 1 | Complies |

For 2.4GHz Band:

Antenna Type : Dipole antenna

Conducted Power for IEEE 802.11n MCS0 (HT20): 22.66dBm

| Distance (cm) | Test Freq. (MHz) | Antenna Gain (dBi) | Antenna Gain (numeric) | The maximum combined Average Output Power | | Power Density (S) (mW/cm ²) | Limit of Power Density (S) (mW/cm ²) | Test Result |
|---------------|------------------|--------------------|------------------------|---|----------|---|--|-------------|
| | | | | (dBm) | (mW) | | | |
| 20 | 2437 | 1.26 | 1.3366 | 22.66 | 184.4796 | 0.049079 | 1 | Complies |

<Bluetooth>

Antenna Type : Dipole antenna

Conducted Power for EDR ($\pi/4$ -DQPSK) 2 Mbps: -2.05dBm

| Distance (m) | Antenna Gain (dBi) | Antenna Gain (numeric) | Average Output Power | | Power Density (S) (mW/cm ²) | Limit of Power Density (S) (mW/cm ²) | Test Result |
|--------------|--------------------|------------------------|----------------------|--------|---|--|-------------|
| | | | (dBm) | (mW) | | | |
| 20 | 1.26 | 1.3366 | -2.05 | 0.6237 | 0.000166 | 1 | Complies |

Conclusion:

Both of the WLAN 5GHz Band + Bluetooth and WLAN 2.4GHz Band + Bluetooth can transmit simultaneously, the formula of calculated the MPE is:

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation are $0.040578 / 1 + 0.000166 / 1 = 0.040744$ for WLAN 5GHz Band + Bluetooth and $0.049079 / 1 + 0.000166 / 1 = 0.049245$ for WLAN 2.4GHz Band + Bluetooth, which are less than "1". This confirmed that the device complies.