**SPORTON International Inc.**
No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, TaoYuan Hsien, Taiwan, R.O.C.
Ph: 886-3-327-3456 / FAX: 886-3-327-0973 / www.sporton.com.tw

# FCC RADIO TEST REPORT

| | |
|---|---|
| Applicant's company | **Broadcom Corporation** |
| Applicant Address | 190 Mathilda Place, Sunnyvale, CA 94086 USA |
| FCC ID | **QDS-BRCM1067** |
| Manufacturer's company | **Hon Hai PRECISION IND. CO., LTD.** |
| Manufacturer Address | 5F-1, 5 Hsin-An road Hsinchu, Science-Based Industrial Park, Taiwan, R.O.C. |

| | |
|---|---|
| Product Name | 802.11abgn WLAN + Bluetooth Card |
| Brand Name | Broadcom |
| Model Name | BCM94330LGA |
| Test Rule | 47 CFR FCC Part 15 Subpart C § 15.247 |
| Test Freq. Range | 2400 ~ 2483.5MHz |
| Received Date | Jun. 04, 2012 |
| Final Test Date | Jul. 17, 2012 |
| Submission Type | Original Equipment |

## Statement

**Test result included is only for the Bluetooth part of the product.**

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.10-2009** and **47 CFR FCC Part 15 Subpart C** and KDB 558074 – 20120118.

The test equipment used to perform the test is calibrated and traceable to NML/ROC.

Testing Laboratory
1190

# Table of Contents

# History of This Test Report

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FR260412AD | Rev. 01 | Initial issue of report | Jul. 25, 2012 |
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Certificate No.: CB10107094

# 1. CERTIFICATE OF COMPLIANCE

| | | |
|---|---|---|
| Product Name | : | 802.11abgn WLAN + Bluetooth Card |
| Brand Name | : | Broadcom |
| Model Name | : | BCM94330LGA |
| Applicant | : | Broadcom Corporation |
| Test Rule Part(s) | : | 47 CFR FCC Part 15 Subpart C § 15.247 |

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on Jun. 04, 2012 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.

Jordan Hsiao

Jordan Hsiao
SPORTON INTERNATIONAL INC.

## 2. SUMMARY OF THE TEST RESULT

| Applied Standard: 47 CFR FCC Part 15 Subpart C | | | | |
|---|---|---|---|---|
| **Part** | **Rule Section** | **Description of Test** | **Result** | **Under Limit** |
| 4.1 | 15.207 | AC Power Line Conducted Emissions | Complies | 18.49 dB |
| 4.2 | 15.247(b)(1) | Maximum Peak Conducted Output Power | Complies | 22.20 dB |
| 4.3 | - | Average Output Power | - | - |
| 4.4 | 15.247(a)(1) | Hopping Channel Separation | Complies | - |
| 4.5 | 15.247(b)(1) | Number of Hopping Frequency | Complies | - |
| 4.6 | 15.247(a)(1) | Dwell Time | Complies | - |
| 4.7 | 15.247(d) | Radiated Emissions | Complies | 4.46 dB |
| 4.8 | 15.247(d) | Band Edge Emissions | Complies | 9.52 dB |
| 4.9 | 15.203 | Antenna Requirements | Complies | - |

| Test Items | Uncertainty | Remark |
|---|---|---|
| AC Power Line Conducted Emissions | ±2.3dB | Confidence levels of 95% |
| Maximum Peak Conducted Output Power | ±0.8dB | Confidence levels of 95% |
| Hopping Channel Separation | $\pm 8.5\times10^{-8}$ | Confidence levels of 95% |
| Radiated Emissions (9kHz~30MHz) | ±0.8dB | Confidence levels of 95% |
| Radiated Emissions (30MHz~1000MHz) | ±1.9dB | Confidence levels of 95% |
| Radiated / Band Edge Emissions (1GHz~18GHz) | ±1.9dB | Confidence levels of 95% |
| Radiated Emissions (18GHz~40GHz) | ±1.9dB | Confidence levels of 95% |
| Temperature | ±0.7℃ | Confidence levels of 95% |
| Humidity | ±3.2% | Confidence levels of 95% |
| DC / AC Power Source | ±1.4% | Confidence levels of 95% |

# 3. GENERAL INFORMATION

## 3.1. Product Details

| Items | Description |
|---|---|
| Power Type | From host sysytem |
| Modulation | FHSS (GFSK / π/4-DQPSK / 8DPSK) |
| Data Rate (Mbps) | GFSK: 1 ; π/4-QPSK: 2 ; 8DPSK: 3 |
| Frequency Range | 2400 ~ 2483.5MHz |
| Channel Number | 40 (37 hopping + 3 advertising channel) |
| Channel Band Width (99%) | 1.05 MHz |
| Peak Conducted Output Power | 7.80 dBm |
| Carrier Frequencies | Please refer to section 3.4 |
| Antenna | Please refer to section 3.3 |

## 3.2. Accessories

N/A

## 3.3. Table for Filed Antenna

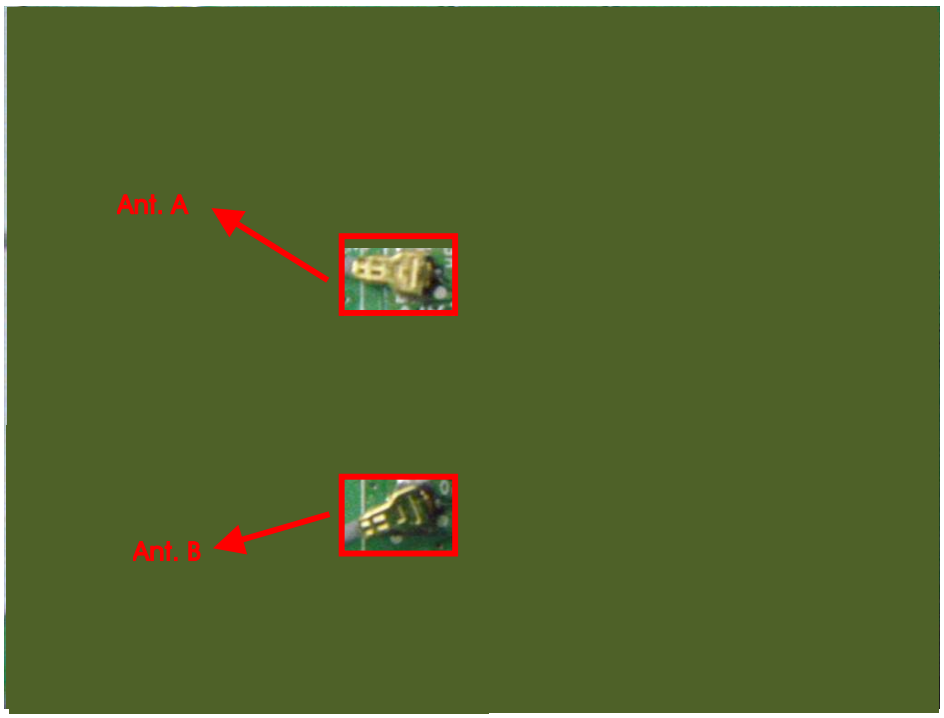
| Ant. | Brand | Model Name | Antenna Type | Connector | Gain (dBi) | |
|---|---|---|---|---|---|---|
| A | WhaYu | - | PIFA Antenna | I-pex | 2.4GHz | 3 |
| B | WhaYu | - | PIFA Antenna | I-pex | 5GHz | 4.3 |

Note: The EUT has two antennas. One for 2.4GHz band use, the other for 5GHz band use.

<2.4GHz WALN function with Bluetooth function:>

For IEEE 802.11b/g/n Mode: (1TX, 1RX)

Only Ant. A can be used as transmitting/receiving antenna.




## 3.4. Table for Carrier Frequencies

| Frequency Band | Channel No. | Frequency | Channel No. | Frequency |
|---|---|---|---|---|
| 2400~2483.5MHz | 0 | 2402 MHz | 20 | 2442 MHz |
| | 1 | 2404 MHz | : | : |
| | 2 | 2406 MHz | 37 | 2476 MHz |
| | : | : | 38 | 2478 MHz |
| | 18 | 2438 MHz | 39 | 2480 MHz |
| | 19 | 2440 MHz | - | - |

## 3.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

| Test Items | Mode | Data Rate | Channel | Antenna |
|---|---|---|---|---|
| AC Power Conducted Emissions | Normal Link | 1 Mbps | Hopping 0~39 | - |
| Max. Peak Conducted Output Power | GFSK | 1 Mbps | 0/19/39 | A |
| Average Output Power | GFSK | 1 Mbps | 0/19/39 | A |
| Hopping Channel Separation | GFSK | 1 Mbps | 0~1/19~20/38~39 | A |
| Number of Hopping Frequency | GFSK | 1 Mbps | 0~39 | A |
| Dwell Time | LBT | 1 Mbps | 0/19/39 | A |
| Radiated Emissions Below 1GHz | GFSK | 1 Mbps | 19 | A |
| Radiated Emissions Above 1GHz | GFSK | 1 Mbps | 0/19/39 | A |
| Band Edge Emissions | GFSK | 1 Mbps | 0/39 | A |

## 3.6. Table for Testing Locations

| Test Site No. | Site Category | Location | FCC Reg. No. | IC File No. |
|---|---|---|---|---|
| 03CH01-CB | SAC | Hsin Chu | 262045 | IC 4086D |
| CO01-CB | Conduction | Hsin Chu | 262045 | IC 4086D |
| TH01-CB | OVEN Room | Hsin Chu | - | - |

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC); Fully Anechoic Chamber (FAC).

Please refer section 6 for Test Site Address.

## 3.7. Table for Supporting Units

| Support Unit | Brand | Model | FCC ID |
|---|---|---|---|
| Notebook | DELL | M1330 | E2K4965AGNM |
| Notebook | DELL | LATITUDE E6500 | PDN:5JNCT A00 |
| Mouse | Logitech M90 | M-U0026 | DoC |
| Wireless AP | BELKIN | WG7016G22-LF-AK | DoC |
| EARPHONES | E-books | E-EPC040 | N/A |

## 3.8. Table for Parameters of Test Software Setting

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

**Power Parameters of Bluetooth**

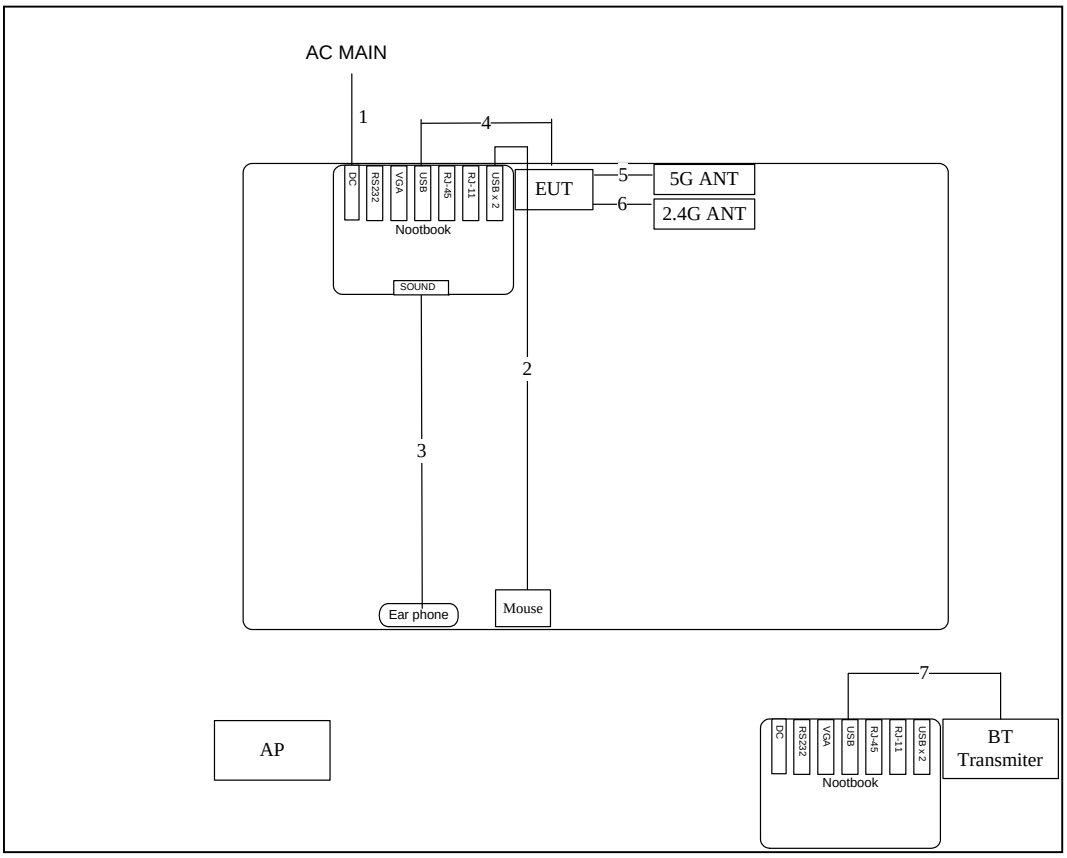
| Test Software Version | Bluetest | | |
|---|---|---|---|
| Frequency | 2402 MHz | 2440 MHz | 2480 MHz |
| Power Parameters | Default | Default | Default |

During the test, "Bluetest" under WIN XP was executed the test program to control the EUT continuously transmit RF signal.

## 3.9. Test Configurations

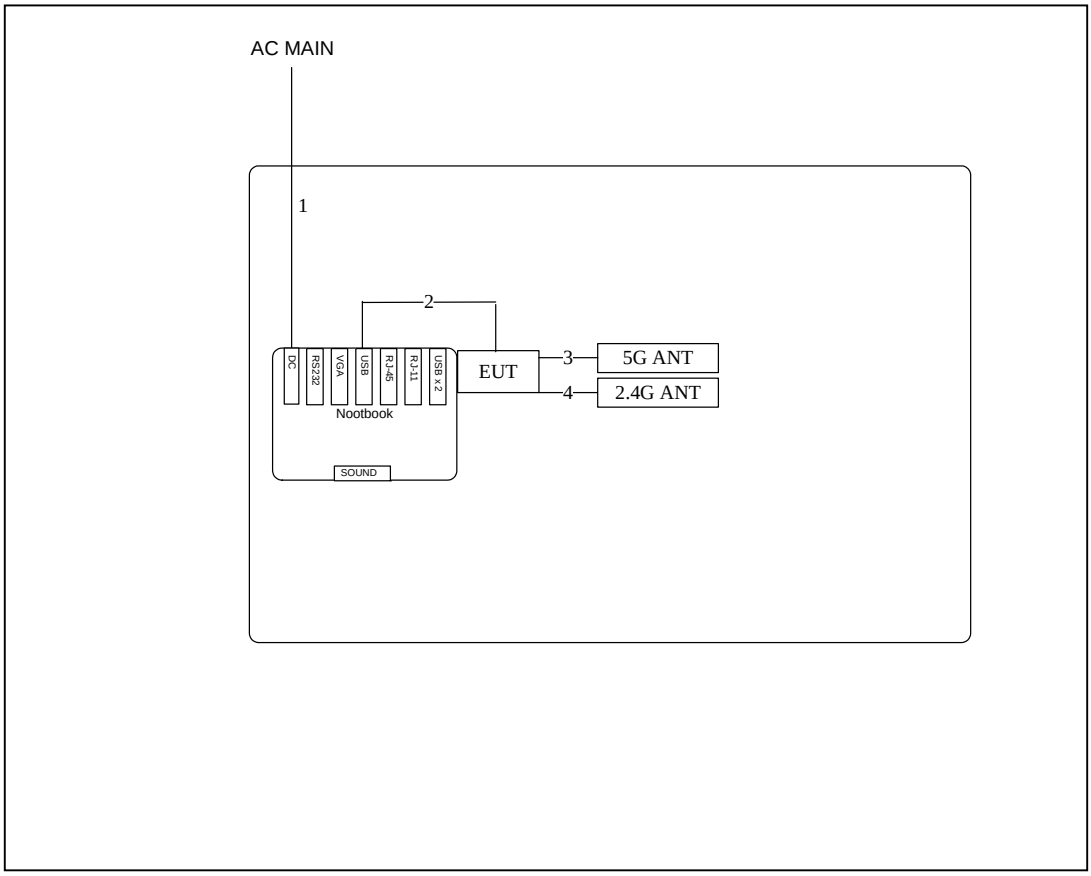
### 3.9.1. Radiation Emissions Test Configuration

Test Configuration: 30MHz~1GHz



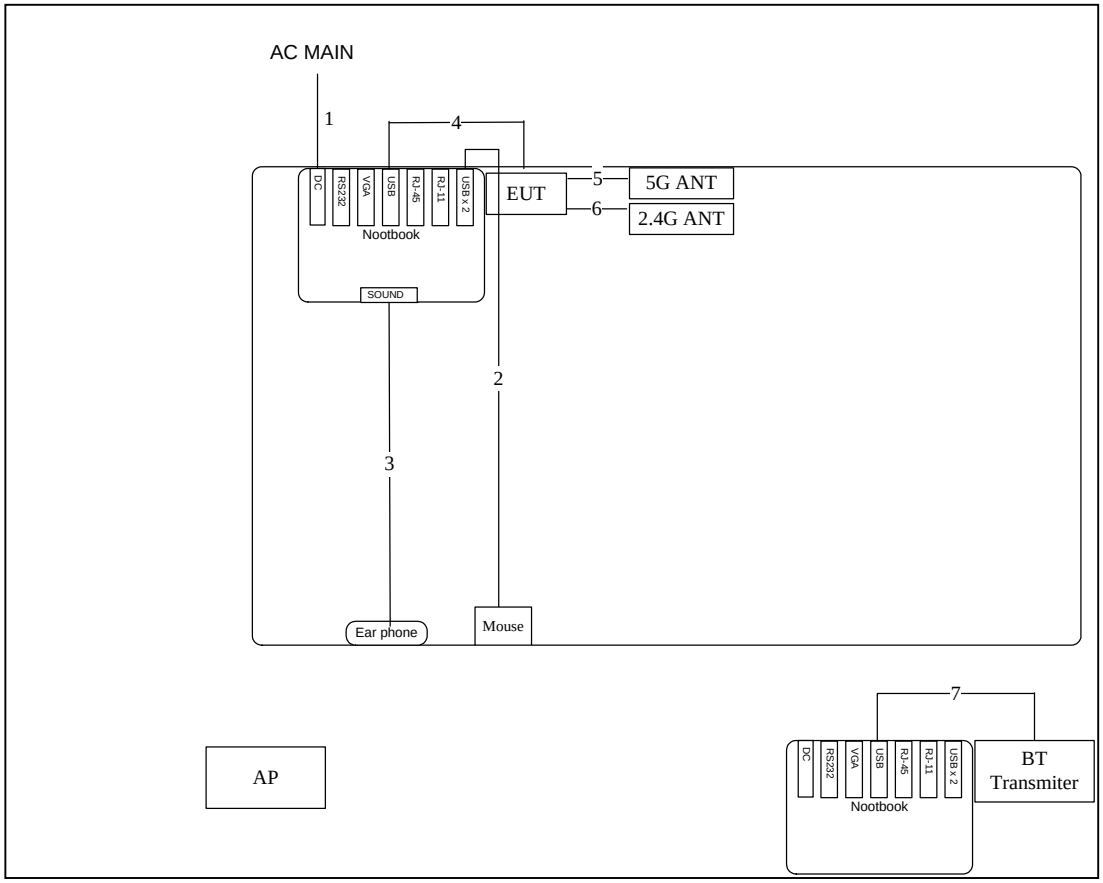

| Item | Connection | Shield | Length |
|---|---|---|---|
| 1 | Power cable | No | 2.6M |
| 2 | USB cable | No | 1.8M |
| 3 | Earphone cable | No | 1.1M |
| 4 | RS-232 cable | Yes | 1.95M |
| 5 | Antenna cable | Yes | 0.11M |
| 6 | Antenna cable | Yes | 1.8M |
| 7 | RS-232 cable | Yes | 1.95M |

Test Configuration: above 1GHz




| Item | Connection | Shield | Length |
|---|---|---|---|
| 1 | Power cable | No | 2.6M |
| 2 | Antenna cable | Yes | 0.11M |
| 3 | Antenna cable | Yes | 1.8M |
| 4 | RS-232 cable | Yes | 1.95M |

### 3.9.2. AC Power Line Conduction Emissions Test Configuration




| Item | Connection | Shield | Length |
|---|---|---|---|
| 1 | Power cable | No | 2.6M |
| 2 | USB cable | No | 1.8M |
| 3 | Earphone cable | No | 1.1M |
| 4 | RS-232 cable | Yes | 1.95M |
| 5 | Antenna cable | Yes | 0.11M |
| 6 | Antenna cable | Yes | 1.8M |
| 7 | RS-232 cable | Yes | 1.95M |

# 4. TEST RESULT

## 4.1. AC Power Line Conducted Emissions Measurement

### 4.1.1. Limit

For a Low-power Radio-frequency Device which is designed to be connected to the AC power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed below limits table.

| Frequency (MHz) | QP Limit (dBuV) | AV Limit (dBuV) |
|---|---|---|
| 0.15~0.5 | 66~56 | 56~46 |
| 0.5~5 | 56 | 46 |
| 5~30 | 60 | 50 |

### 4.1.2. Measuring Instruments and Setting

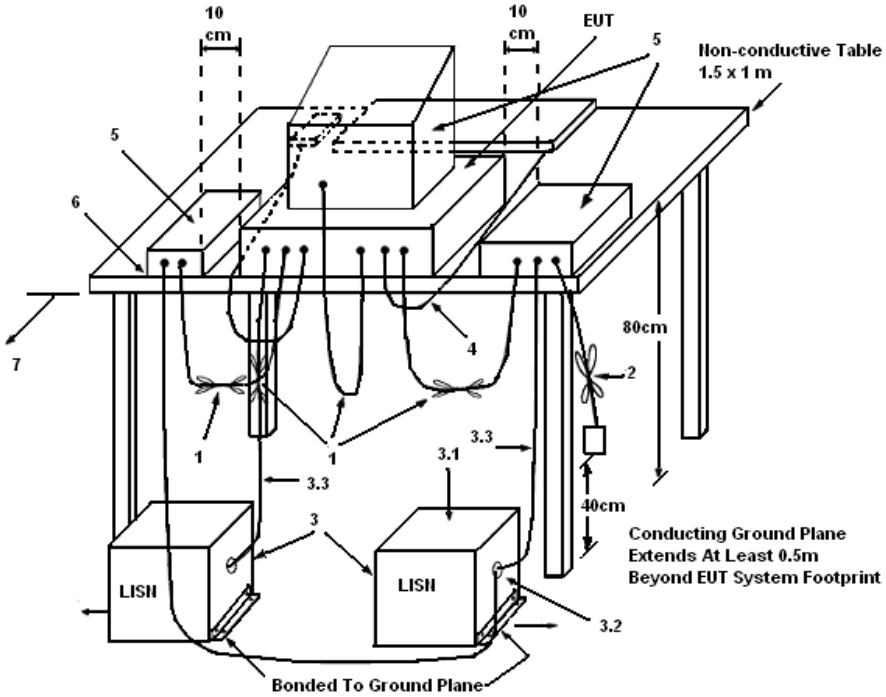
Please refer to section 5 of equipments list in this report. The following table is the setting of the receiver.

| Receiver Parameters | Setting |
|---|---|
| Attenuation | 10 dB |
| Start Frequency | 0.15 MHz |
| Stop Frequency | 30 MHz |
| IF Bandwidth | 9 KHz |

### 4.1.3. Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 KHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.

### 4.1.4. Test Setup Layout




LEGEND:

(1) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

(2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

(3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference ground plane.

(3.1) All other equipment powered from additional LISN(s).

(3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

(3.3) LISN at least 80 cm from nearest part of EUT chassis.

(4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

(5) Non-EUT components of EUT system being tested.

(6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

(7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.

### 4.1.5. Test Deviation

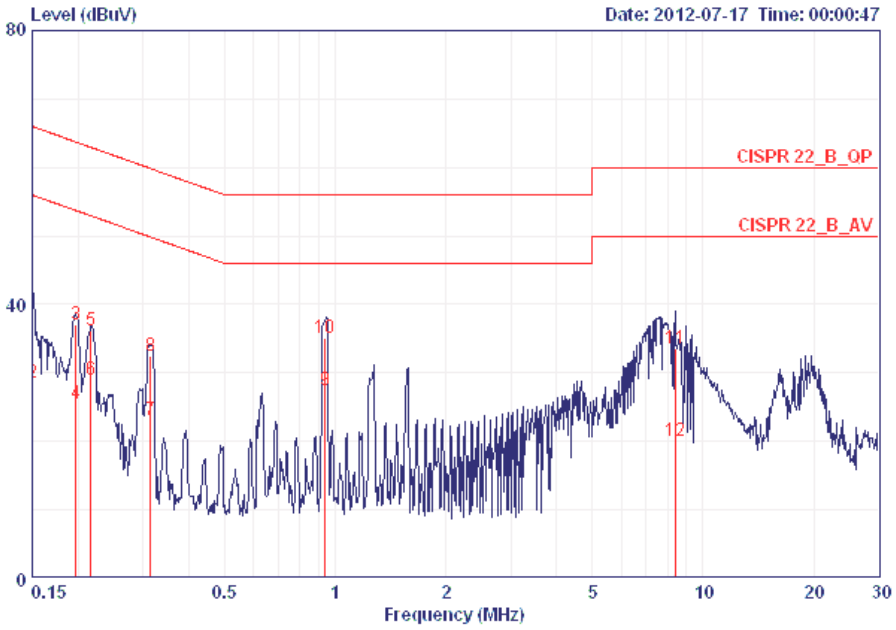
There is no deviation with the original standard.

### 4.1.6. EUT Operation during Test

The EUT was placed on the test table and programmed in normal function.

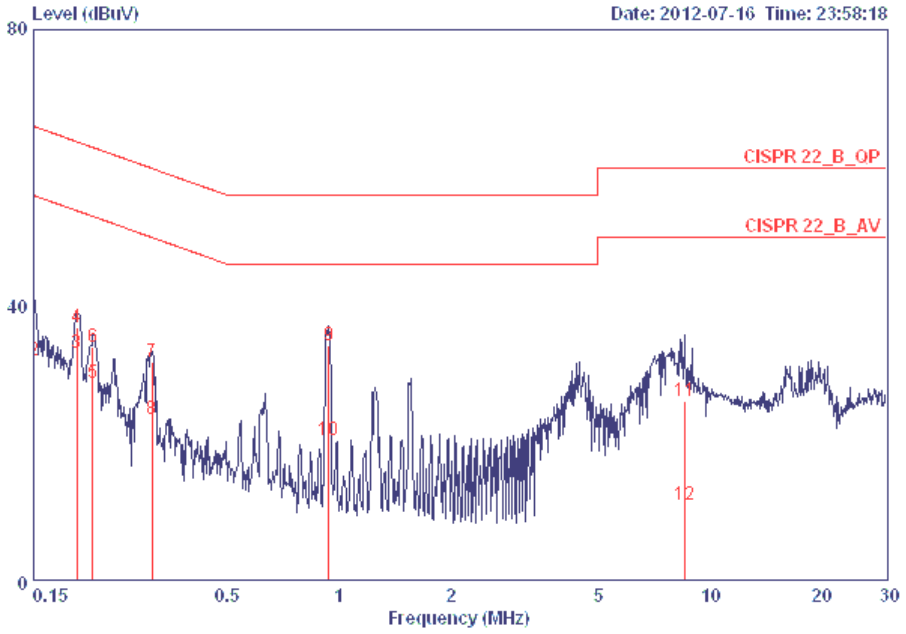
## 4.1.7. Results of AC Power Line Conducted Emissions Measurement

| Temperature | 22°C | Humidity | 57% |
|---|---|---|---|
| Test Engineer | Kane Liu | Phase | Line |
| Configuration | Normal Link | | |




| | Freq | Level | Over Limit | Limit Line | Read Level | LISN Factor | Cable Loss | Pol/Phase | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV | dB | dBuV | dBuV | dB | dB | | |
| 1 | 0.15000 | 39.38 | -26.62 | 66.00 | 39.02 | 0.16 | 0.20 | LINE | QP |
| 2 | 0.15000 | 28.47 | -27.53 | 56.00 | 28.11 | 0.16 | 0.20 | LINE | AVERAGE |
| 3 | 0.19758 | 36.95 | -26.76 | 63.71 | 36.60 | 0.15 | 0.20 | LINE | QP |
| 4 | 0.19758 | 25.45 | -28.26 | 53.71 | 25.10 | 0.15 | 0.20 | LINE | AVERAGE |
| 5 | 0.21620 | 36.23 | -26.73 | 62.96 | 35.88 | 0.15 | 0.20 | LINE | QP |
| 6 | 0.21620 | 28.93 | -24.03 | 52.96 | 28.58 | 0.15 | 0.20 | LINE | AVERAGE |
| 7 | 0.31495 | 23.15 | -26.69 | 49.84 | 22.80 | 0.15 | 0.20 | LINE | AVERAGE |
| 8 | 0.31495 | 32.58 | -27.26 | 59.84 | 32.23 | 0.15 | 0.20 | LINE | QP |
| 9 @ | 0.94009 | 27.51 | -18.49 | 46.00 | 27.14 | 0.17 | 0.20 | LINE | AVERAGE |
| 10 | 0.94009 | 35.20 | -20.80 | 56.00 | 34.83 | 0.17 | 0.20 | LINE | QP |
| 11 | 8.412 | 33.56 | -26.44 | 60.00 | 32.93 | 0.31 | 0.32 | LINE | QP |
| 12 | 8.412 | 20.08 | -29.92 | 50.00 | 19.45 | 0.31 | 0.32 | LINE | AVERAGE |

| Temperature | 22°C | Humidity | 57% |
|---|---|---|---|
| Test Engineer | Kane Liu | Phase | Neutral |
| Configuration | Normal Link | | |




| | Freq | Level | Over Limit | Limit Line | Read Level | LISN Factor | Cable Loss | Pol/Phase | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV | dB | dBuV | dBuV | dB | dB | | |
| 1 | 0.15000 | 38.47 | -27.53 | 66.00 | 38.19 | 0.08 | 0.20 | NEUTRAL | QP |
| 2 | 0.15000 | 32.00 | -24.00 | 56.00 | 31.72 | 0.08 | 0.20 | NEUTRAL | AVERAGE |
| 3 | 0.19654 | 33.16 | -20.60 | 53.76 | 32.88 | 0.08 | 0.20 | NEUTRAL | AVERAGE |
| 4 | 0.19654 | 36.82 | -26.94 | 63.76 | 36.54 | 0.08 | 0.20 | NEUTRAL | QP |
| 5 | 0.21620 | 28.77 | -24.19 | 52.96 | 28.49 | 0.08 | 0.20 | NEUTRAL | AVERAGE |
| 6 | 0.21620 | 33.94 | -29.02 | 62.96 | 33.66 | 0.08 | 0.20 | NEUTRAL | QP |
| 7 | 0.31328 | 31.88 | -28.00 | 59.88 | 31.60 | 0.08 | 0.20 | NEUTRAL | QP |
| 8 | 0.31328 | 23.63 | -26.25 | 49.88 | 23.35 | 0.08 | 0.20 | NEUTRAL | AVERAGE |
| 9 | 0.93810 | 34.19 | -21.81 | 56.00 | 33.90 | 0.09 | 0.20 | NEUTRAL | QP |
| 10 | 0.93810 | 20.51 | -25.49 | 46.00 | 20.22 | 0.09 | 0.20 | NEUTRAL | AVERAGE |
| 11 | 8.546 | 26.19 | -33.81 | 60.00 | 25.68 | 0.21 | 0.30 | NEUTRAL | QP |
| 12 | 8.546 | 11.19 | -38.81 | 50.00 | 10.68 | 0.21 | 0.30 | NEUTRAL | AVERAGE |

Note: Level = Read Level + LISN Factor + Cable Loss.

## 4.2. Peak Output Power Measurement

### 4.2.1. Limit

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, the limit for peak output power is 1Watt (30dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts (21dBm). The limited has to be reduced by the amount in dB that the gain of the antenna exceed 6dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

### 4.2.2. Measuring Instruments and Setting

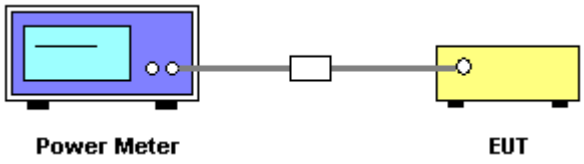
Please refer to section 5 of equipments list in this report. The following table is the setting of the power meter.

| Power Meter Parameter | Setting |
|---|---|
| Filter No. | Auto |
| Measurement time | 0.135 s ~ 26 s |
| Used Peak Sensor | MA2411B |

### 4.2.3. Test Procedures

1. The transmitter output (antenna port) was connected to the power meter.
2. Turn on the EUT and power meter and then record the peak power value.
3. Repeat above procedures on all channels needed to be tested.

### 4.2.4. Test Setup Layout




### 4.2.5. Test Deviation

There is no deviation with the original standard.

### 4.2.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 4.2.7. Test Result of Maximum Peak Output Power

| Temperature | 24°C | Humidity | 63% |
|---|---|---|---|
| Test Engineer | Satoshi Yang | Configurations | GFSK |
| Test Date | Jul. 20, 2012 | | |

For Bluetooth 4.0 :

| Channel | Frequency | Conducted Power (dBm) | Max. Limit (dBm) | Result |
|---|---|---|---|---|
| 0 | 2402 MHz | 6.98 | 30.00 | Complies |
| 19 | 2440 MHz | 7.43 | 30.00 | Complies |
| 39 | 2480 MHz | 7.80 | 30.00 | Complies |

## 4.3. Hopping Channel Separation Measurement

### 4.3.1. Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

### 4.3.2. Measuring Instruments and Setting

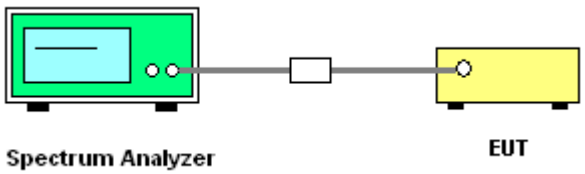
Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Span Frequency | > Measurement Bandwidth or Channel Separation |
| RB | 30 kHz (20dB Bandwidth) / 100 kHz (Channel Separation) |
| VB | 100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation) |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

### 4.3.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilized for 20 dB bandwidth measurement.
3. The resolution bandwidth of 100 kHz and the video bandwidth of 300 kHz were utilized for channel separation measurement.

### 4.3.4. Test Setup Layout




### 4.3.5. Test Deviation

There is no deviation with the original standard.

### 4.3.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 4.3.7. Test Result of Hopping Channel Separation

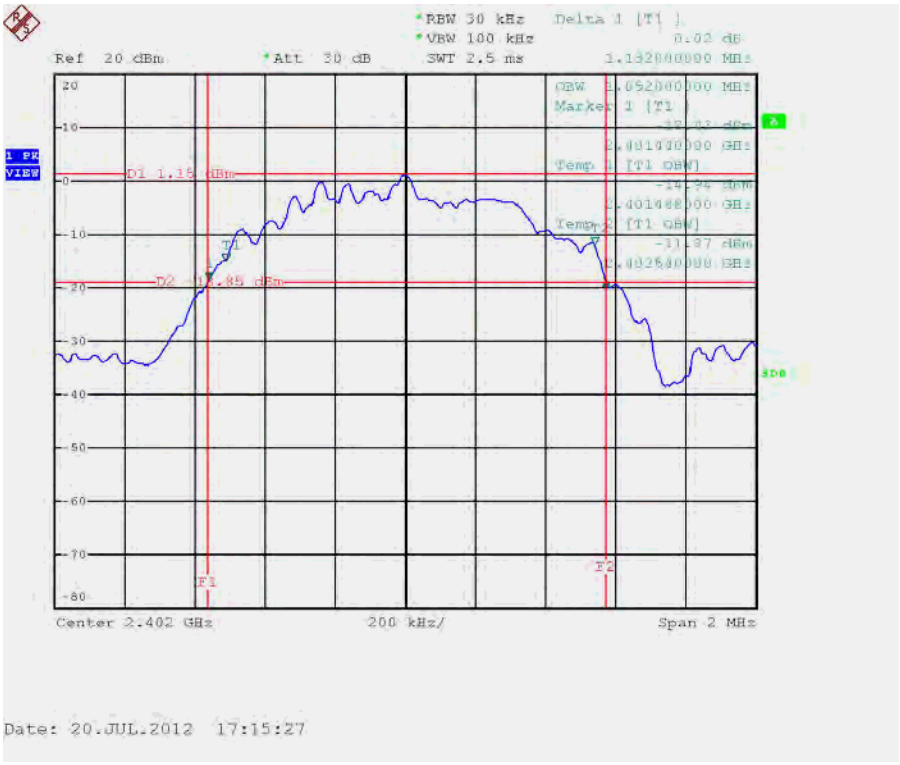
| Temperature | 24°C | Humidity | 63% |
|---|---|---|---|
| Test Engineer | Satoshi Yang | Configurations | GFSK |

**For Bluetooth 4.0 :**

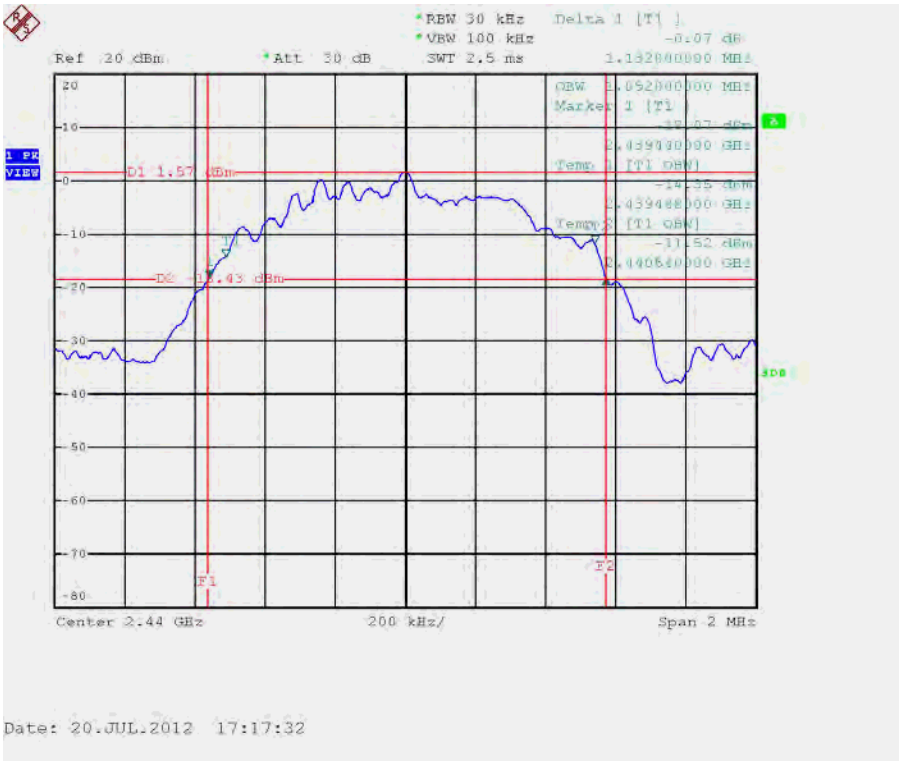
| Frequency | Ch. Separation (MHz) | 20dB Bandwidth (MHz) | 2/3 of 20dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) | Result |
|---|---|---|---|---|---|
| 2402 MHz | 1.00 | 1.13 | 0.75 | 1.05 | Complies |
| 2440 MHz | 1.00 | 1.13 | 0.75 | 1.05 | Complies |
| 2480 MHz | 1.00 | 1.14 | 0.76 | 1.05 | Complies |

**Ch. Separation Limits: >20dB bandwidth or >2/3 of 20dB bandwidth**

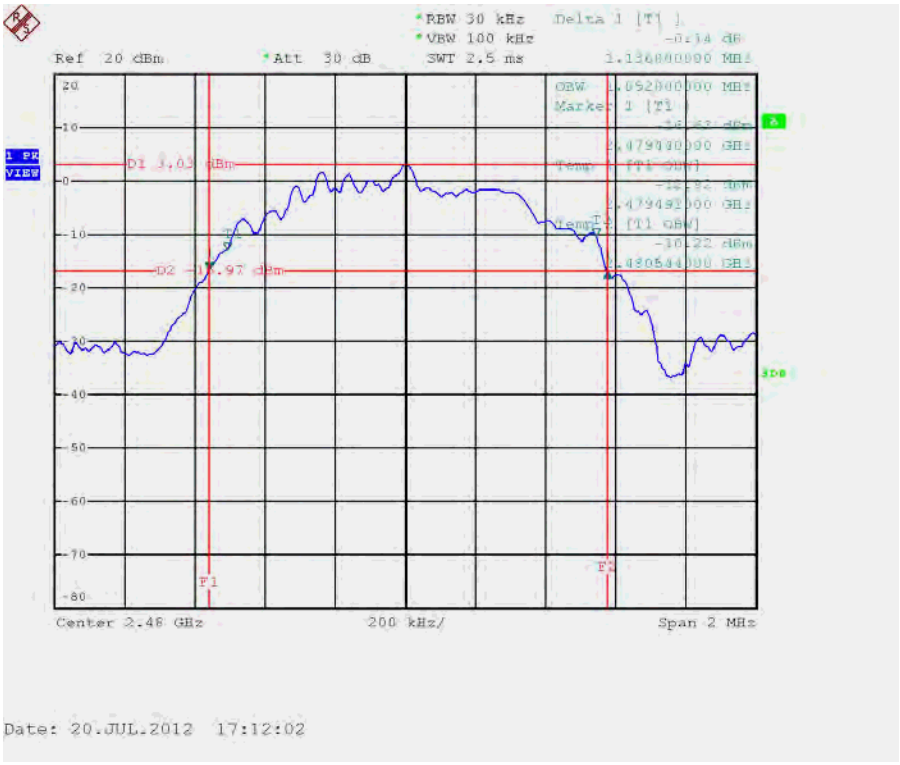
### 20 dB Bandwidth Plot on Channel 0 / 2402 MHz



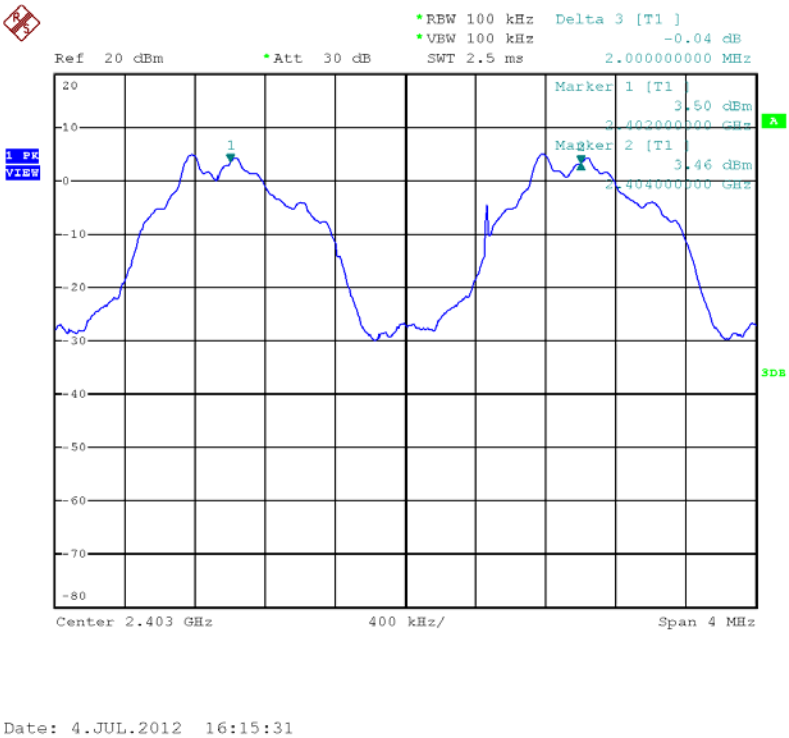

### 20 dB Bandwidth Plot on Channel 19 / 2440 MHz



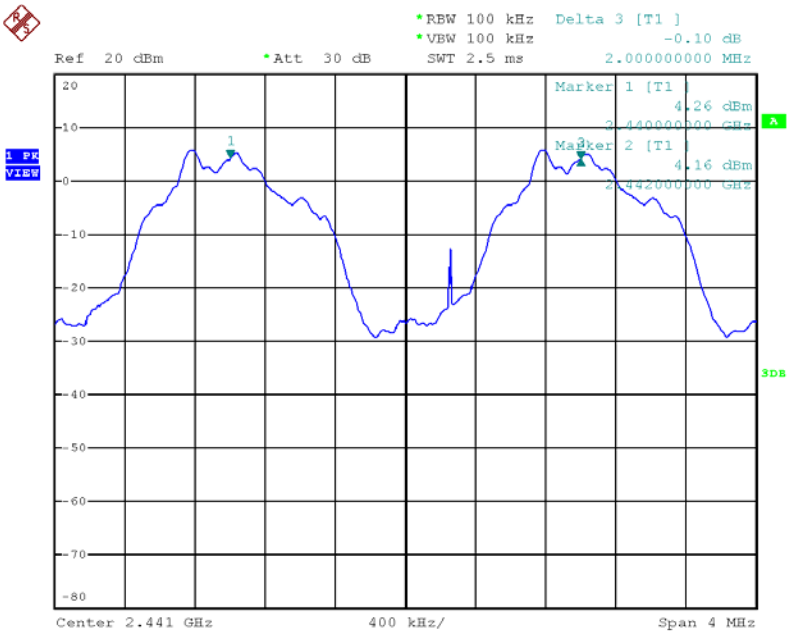
## 20 dB Bandwidth Plot on Channel 39 / 2480 MHz




## Channel Separation Plot on Channel 0~1 / 2402 MHz ~ 2404 MHz

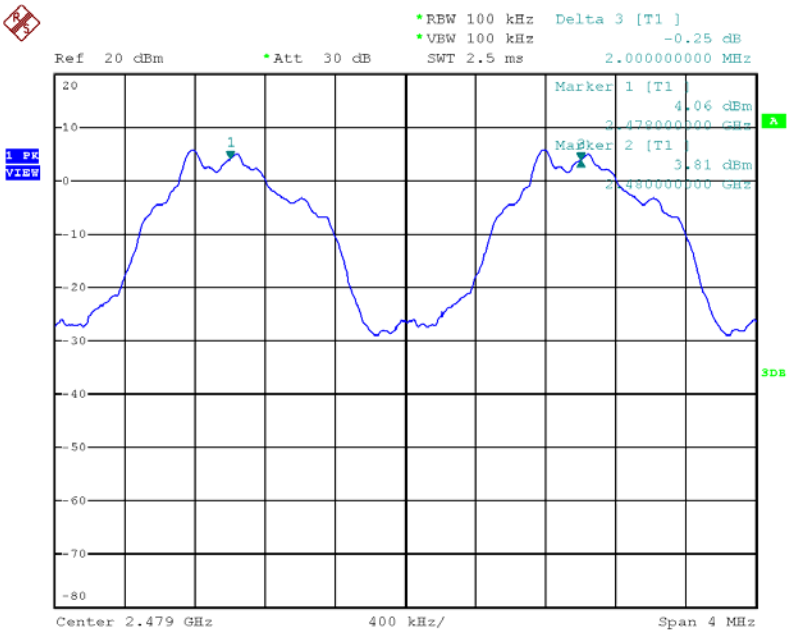


## Channel Separation Plot on Channel 19~20 / 2440 MHz ~ 2442 MHz




Date: 4.JUL.2012 16:14:02

## Channel Separation Plot on Channel 38~39 / 2478 MHz ~ 2480 MHz




Date: 4.JUL.2012 16:11:47

## 4.4. Number of Hopping Frequency Measurement

### 4.4.1. Limit

At least 15 hopping frequencies, and should be equally spaced.

### 4.4.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

| Spectrum Parameters | Setting |
|---|---|
| Attenuation | Auto |
| Span Frequency | > Operating Frequency Range |
| RB | 1MHz |
| VB | 1MHz |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

### 4.4.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
2. The resolution bandwidth of 1MHz and the video bandwidth of 1MHz were utilized.
3. Observe frequency hopping in 2400MHz~2483.5MHz, there are at least 75 non-overlapping channels.

### 4.4.4. Test Setup Layout


### 4.4.5. Test Deviation

There is no deviation with the original standard.

### 4.4.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

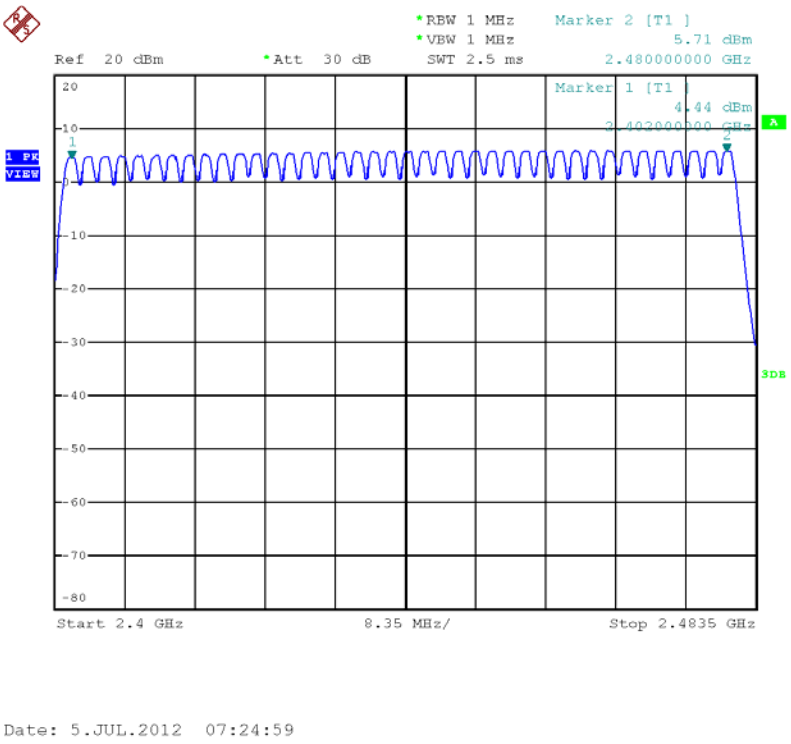
## 4.4.7. Test Result of Number of Hopping Frequency

| Temperature | 24°C | Humidity | 63% |
|---|---|---|---|
| Test Engineer | Satoshi Yang | Configurations | GFSK |

**For Bluetooth 4.0 :**

| Modulation Type | Channel No. | Frequency (MHz) | Hopping Ch. (Channels) | Min. Limit (Channels) | Test Result |
|---|---|---|---|---|---|
| GFSK | 0 ~ 39 | 2402 ~ 2480 | 40 | 15 | Complies |

**Number of Hopping Channel Plot on Channel 0~39 / 2402 MHz ~ 2480 MHz**



## 4.5. Dwell Time Measurement

### 4.5.1. Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

### 4.5.2. Measuring Instruments and Setting

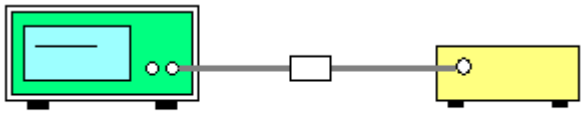
Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Span Frequency | 0 MHz |
| RB | 1000 kHz |
| VB | 1000 kHz |
| Detector | Peak |
| Trace | Single Trigger |

### 4.5.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer
2. Set RBW of spectrum analyzer to 1000kHz and VBW to 1000kHz.
3. Use a video trigger with the trigger level set to enable triggering only on full pulses.
4. Sweep Time is more than once pulse time.
5. Set the center frequency on any frequency would be measure and set the frequency span to zero span.
6. Measure the maximum time duration of one single pulse.
7. Set the EUT for 3DH5, 3DH3 and 3DH1 packet transmitting.
8. Measure the maximum time duration of one single pulse.

### 4.5.4. Test Setup Layout




### 4.5.5. Test Deviation

There is no deviation with the original standard.

### 4.5.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 4.5.7. Test Result of Dwell Time

| Temperature | 24°C | Humidity | 63% |
|---|---|---|---|
| Test Engineer | Satoshi Yang | Configurations | Bluetooth / LBT |

| Data Packet | Frequency (MHz) | Pulse Duration (ms) | Dwell Time (s) | Limits (s) | Test Result |
|---|---|---|---|---|---|
| LBT | 2402 MHz | 0.3940 | 0.1261 | 0.4000 | Complies |
| LBT | 2440 MHz | 0.3940 | 0.1261 | 0.4000 | Complies |
| LBT | 2480 MHz | 0.3940 | 0.1261 | 0.4000 | Complies |

**Note: Pulse Duration * Number of Pulses*(Dwell time / measure time)**

**Remark:**

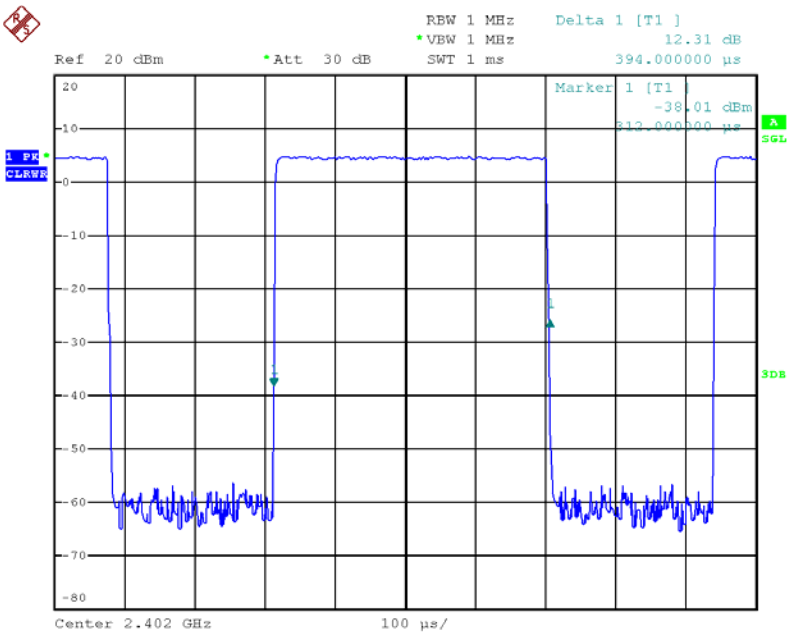
Dwell Time=40(channels) x 0.4(s) x average hopping channel x package transfer time (us)

40 channels come from the Hopping Channel number.

Average Hopping Channel = hops / sweep time

**For Bluetooth 4.0 :**

**Dwell Time Plot on Channel 0 / LBT / 2402 MHz**

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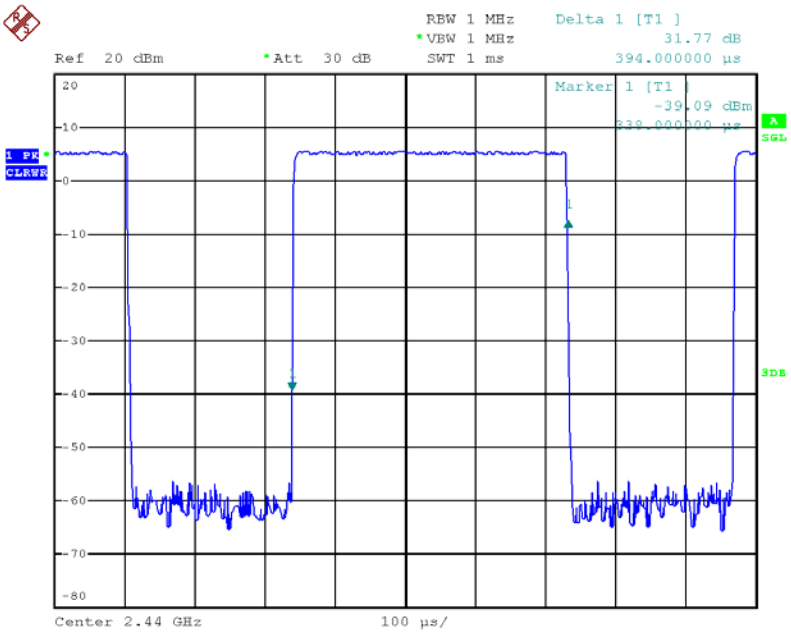
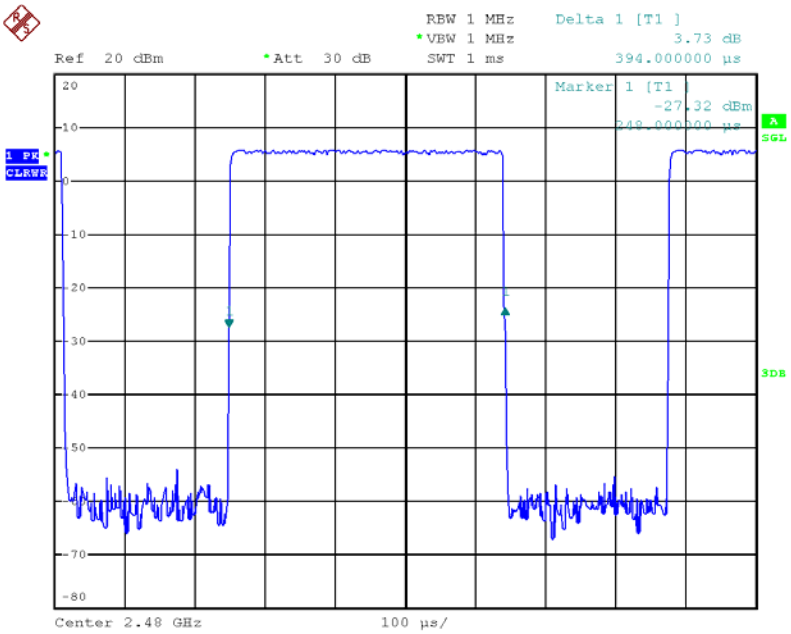
**Dwell Time Plot on Channel 19 / LBT / 2440 MHz**




Date: 10.JUL.2012 12:48:51

## Dwell Time Plot on Channel 39 / LBT / 2480 MHz




Date: 10.JUL.2012 12:49:47

## 4.6. Radiated Emissions Measurement

### 4.6.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

| Frequencies (MHz) | Field Strength (micorvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009~0.490 | 2400/F(KHz) | 300 |
| 0.490~1.705 | 24000/F(KHz) | 30 |
| 1.705~30.0 | 30 | 30 |
| 30~88 | 100 | 3 |
| 88~216 | 150 | 3 |
| 216~960 | 200 | 3 |
| Above 960 | 500 | 3 |

### 4.6.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Start Frequency | 1000 MHz |
| Stop Frequency | 10th carrier harmonic |
| RB / VB (Emission in restricted band) | 1MHz / 3MHz for Peak, 1 MHz / 10Hz for Average |
| RB / VB (Emission in non-restricted band) | 1MHz / 3MHz for peak |

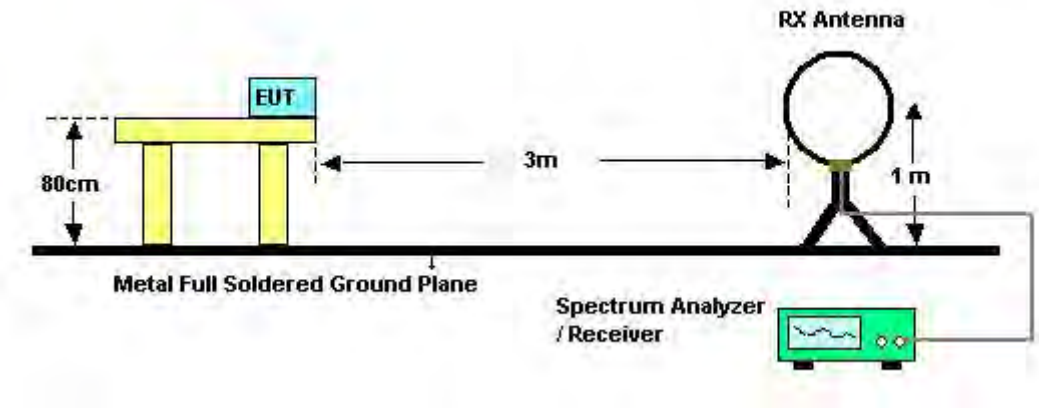
| Receiver Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Start ~ Stop Frequency | 9kHz~150kHz / RB 200Hz for QP |
| Start ~ Stop Frequency | 150kHz~30MHz / RB 9kHz for QP |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB 120kHz for QP |

### 4.6.3. Test Procedures

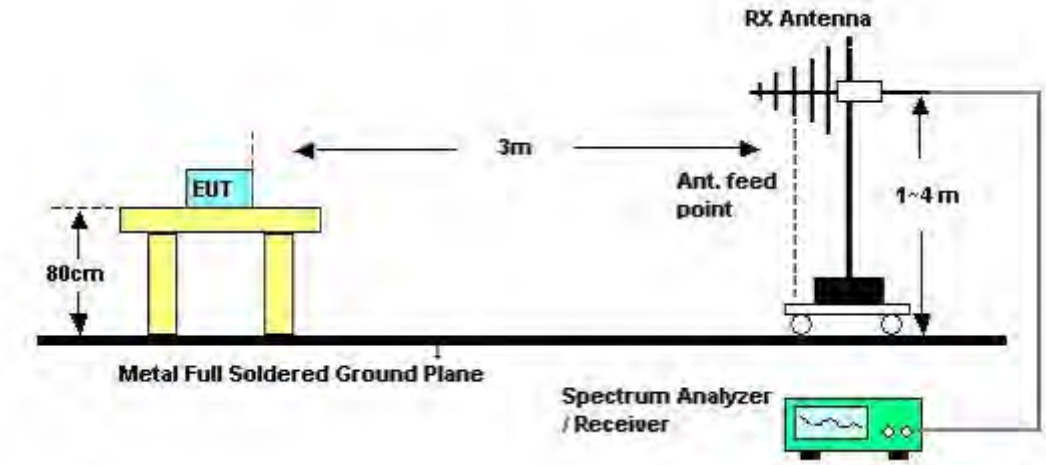
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 10Hz VBW for average reading in spectrum analyzer.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

### 4.6.4. Test Setup Layout

**For radiated emissions below 1GHz**




**For radiated emissions above 1GHz**




### 4.6.5. Test Deviation

There is no deviation with the original standard.

### 4.6.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

### 4.6.7. Results of Radiated Emissions (9kHz~30MHz)

| Temperature | 21°C | Humidity | 56.4% |
|---|---|---|---|
| Test Engineer | Benson Peng | Configurations | Normal Link |
| Test Date | Jul. 06, 2012 | | |

| Freq. (MHz) | Level (dBuV) | Over Limit (dB) | Limit Line (dBuV) | Remark |
|---|---|---|---|---|
| - | - | - | - | See Note |

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

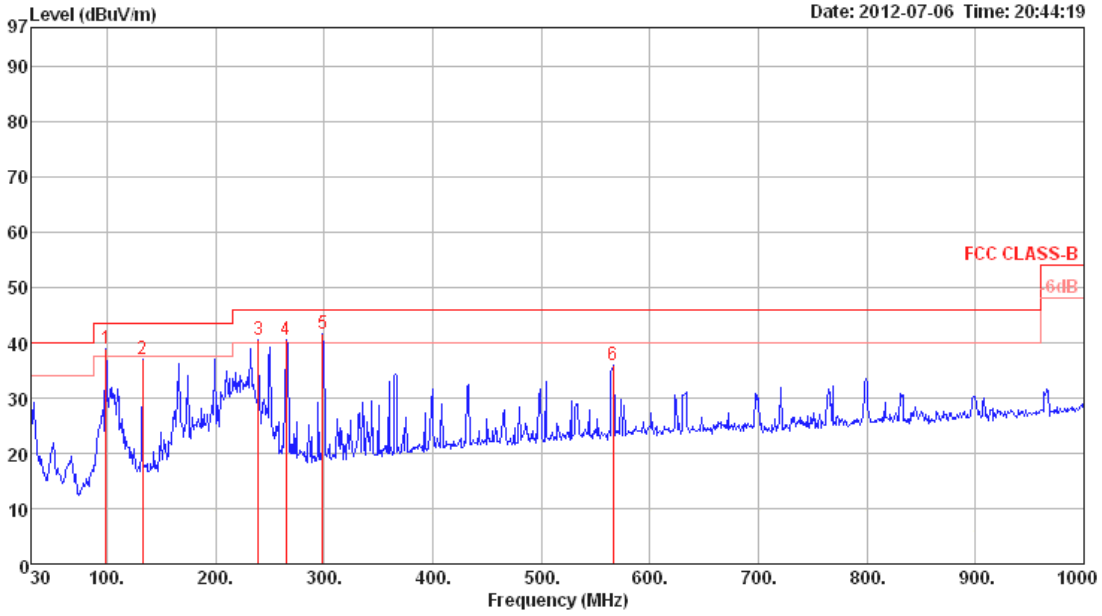
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

## 4.6.8. Results of Radiated Emissions (30MHz~1GHz)

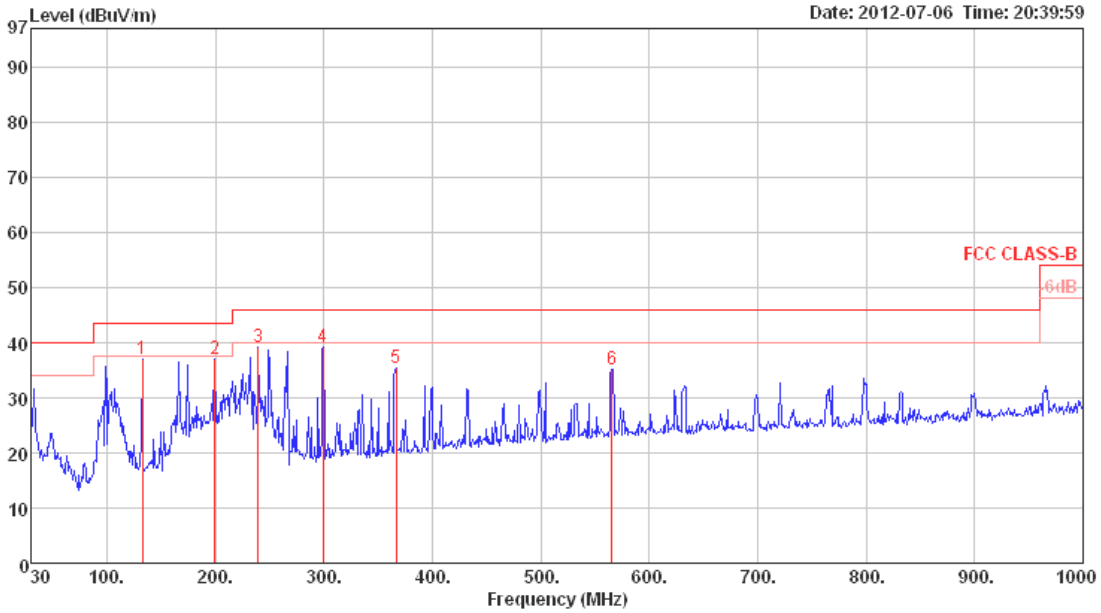
| Temperature | 21°C | Humidity | 56.4% |
|---|---|---|---|
| Test Engineer | Benson Peng | Configurations | Normal Link |

*Horizontal*




| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 98.87 | 38.89 | 43.50 | -4.61 | 54.53 | 1.18 | 10.79 | 27.61 | Peak | 100 | 0 | HORIZONTAL |
| 2 | 132.82 | 37.01 | 43.50 | -6.49 | 50.83 | 1.33 | 12.28 | 27.43 | Peak | 100 | 0 | HORIZONTAL |
| 3 | 239.52 | 40.60 | 46.00 | -5.40 | 53.78 | 1.86 | 11.98 | 27.02 | Peak | 100 | 0 | HORIZONTAL |
| 4 | 264.74 | 40.59 | 46.00 | -5.41 | 52.66 | 1.96 | 12.94 | 26.97 | Peak | 100 | 0 | HORIZONTAL |
| 5 | 298.69 | 41.54 | 46.00 | -4.46 | 52.99 | 2.10 | 13.35 | 26.90 | Peak | 100 | 0 | HORIZONTAL |
| 6 | 566.41 | 35.94 | 46.00 | -10.06 | 42.83 | 2.83 | 18.38 | 28.10 | Peak | 100 | 0 | HORIZONTAL |

***Vertical***




| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 132.82 | 37.02 | 43.50 | -6.48 | 50.84 | 1.33 | 12.28 | 27.43 | Peak | 400 | 0 | VERTICAL |
| 2 | 199.75 | 37.07 | 43.50 | -6.43 | 53.42 | 1.70 | 9.05 | 27.10 | Peak | 400 | 0 | VERTICAL |
| 3 | 239.52 | 39.09 | 46.00 | -6.91 | 52.27 | 1.86 | 11.98 | 27.02 | Peak | 400 | 0 | VERTICAL |
| 4 | 299.66 | 39.05 | 46.00 | -6.95 | 50.49 | 2.10 | 13.36 | 26.90 | Peak | 400 | 0 | VERTICAL |
| 5 | 366.59 | 35.27 | 46.00 | -10.73 | 45.24 | 2.23 | 15.17 | 27.37 | Peak | 400 | 0 | VERTICAL |
| 6 | 565.44 | 35.16 | 46.00 | -10.84 | 42.06 | 2.83 | 18.37 | 28.10 | Peak | 400 | 0 | VERTICAL |

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

## 4.6.9. Results for Radiated Emissions (1GHz~10th Harmonic)

| Temperature | 21°C | Humidity | 56.4% |
|---|---|---|---|
| Test Engineer | Benson Peng | Configurations | Channel 0 |
| Test Date | Jul. 09, 2012 | | |

*Horizontal*

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 4803.12 | 32.76 | 54.00 | -21.24 | 28.39 | 6.21 | 33.36 | 35.20 | Average | 100 | 121 | HORIZONTAL |
| 2 | 4803.36 | 46.14 | 74.00 | -27.86 | 41.77 | 6.21 | 33.36 | 35.20 | Peak | 100 | 121 | HORIZONTAL |

*Vertical*

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 4803.13 | 32.72 | 54.00 | -21.28 | 28.35 | 6.21 | 33.36 | 35.20 | Average | 100 | 124 | VERTICAL |
| 2 | 4804.73 | 45.91 | 74.00 | -28.09 | 41.54 | 6.21 | 33.36 | 35.20 | Peak | 100 | 124 | VERTICAL |

| Temperature | 21°C | Humidity | 56.4% |
|---|---|---|---|
| Test Engineer | Benson Peng | Configurations | Channel 19 |
| Test Date | Jul. 09, 2012 | | |

*Horizontal*

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 4879.00 | 33.03 | 54.00 | -20.97 | 28.46 | 6.29 | 33.48 | 35.20 | Average | 112 | 120 | HORIZONTAL |
| 2 | 4879.24 | 49.10 | 74.00 | -24.90 | 44.53 | 6.29 | 33.48 | 35.20 | Peak | 112 | 120 | HORIZONTAL |

*Vertical*

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 4879.50 | 48.87 | 74.00 | -25.13 | 44.30 | 6.29 | 33.48 | 35.20 | Peak | 101 | 298 | VERTICAL |
| 2 | 4880.47 | 32.90 | 54.00 | -21.10 | 28.33 | 6.29 | 33.48 | 35.20 | Average | 101 | 298 | VERTICAL |

| Temperature | 21℃ | Humidity | 56.4% |
|---|---|---|---|
| Test Engineer | Benson Peng | Configurations | Channel 39 |
| Test Date | Jul. 09, 2012 | | |

*Horizontal*

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 4959.60 | 45.86 | 74.00 | -28.14 | 41.05 | 6.37 | 33.64 | 35.20 | Peak | 100 | 97 | HORIZONTAL |
| 2 | 4960.94 | 31.13 | 54.00 | -22.87 | 26.32 | 6.37 | 33.64 | 35.20 | Average | 100 | 97 | HORIZONTAL |

*Vertical*

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 4959.00 | 46.34 | 74.00 | -27.66 | 41.53 | 6.37 | 33.64 | 35.20 | Peak | 100 | 171 | VERTICAL |
| 2 | 4959.68 | 32.38 | 54.00 | -21.62 | 27.57 | 6.37 | 33.64 | 35.20 | Average | 100 | 171 | VERTICAL |

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

## 4.7. Band Edge Emissions Measurement

### 4.7.1. Limit

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

| Frequencies (MHz) | Field Strength (micorvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009~0.490 | 2400/F(KHz) | 300 |
| 0.490~1.705 | 24000/F(KHz) | 30 |
| 1.705~30.0 | 30 | 30 |
| 30~88 | 100 | 3 |
| 88~216 | 150 | 3 |
| 216~960 | 200 | 3 |
| Above 960 | 500 | 3 |

### 4.7.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Span Frequency | 100 MHz |
| RB / VB (Emission in restricted band) | 1MHz / 3MHz for Peak, 1 MHz / 10Hz for Average |
| RB / VB (Emission in non-restricted band) | 100 KHz /100 KHz for Peak |

### 4.7.3. Test Procedures

1. The test procedure is the same as section 4.5.3, only the frequency range investigated is limited to 100MHz around bandedges.

### 4.7.4. Test Setup Layout

This test setup layout is the same as that shown in section 4.6.4.

### 4.7.5. Test Deviation

There is no deviation with the original standard.

### 4.7.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

## 4.7.7. Test Result of Band Edge and Fundamental Emissions

| Temperature | 21°C | Humidity | 56.4% |
|---|---|---|---|
| Test Engineer | Benson Peng | Configurations | Channel 0, 19, 39 |
| Test Date | Jul. 09, 2012 | | |

**Channel 0**

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 2388.60 | 55.91 | 74.00 | -18.09 | 23.72 | 4.14 | 28.05 | 0.00 | Peak | 134 | 162 | HORIZONTAL |
| 2 | 2390.00 | 43.69 | 54.00 | -10.31 | 11.50 | 4.14 | 28.05 | 0.00 | Average | 134 | 162 | HORIZONTAL |
| 3 | 2401.90 | | | | 19.80 | 4.14 | 28.09 | 0.00 | Average | 134 | 162 | HORIZONTAL |
| 4 | 2402.30 | | | | 67.77 | 4.14 | 28.09 | 0.00 | Peak | 134 | 162 | HORIZONTAL |

Item 3, 4 are the fundamental frequency at 2402 MHz.

**Channel 19**

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 2387.90 | 55.21 | 74.00 | -18.79 | 23.02 | 4.14 | 28.05 | 0.00 | Peak | 100 | 99 | VERTICAL |
| 2 | 2390.00 | 43.67 | 54.00 | -10.33 | 11.48 | 4.14 | 28.05 | 0.00 | Average | 100 | 99 | VERTICAL |
| 3 | 2440.00 | | | | 20.08 | 4.18 | 28.18 | 0.00 | Average | 100 | 99 | VERTICAL |
| 4 | 2440.30 | | | | 69.50 | 4.18 | 28.18 | 0.00 | Peak | 100 | 99 | VERTICAL |
| 5 | 2483.50 | 44.03 | 54.00 | -9.97 | 11.56 | 4.21 | 28.26 | 0.00 | Average | 100 | 99 | VERTICAL |
| 6 | 2485.30 | 55.82 | 74.00 | -18.18 | 23.31 | 4.21 | 28.30 | 0.00 | Peak | 100 | 99 | VERTICAL |

Item 3, 4 are the fundamental frequency at 2440 MHz.

**Channel 39**

| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 2480.00 | | | | 20.12 | 4.21 | 28.26 | 0.00 | Average | 100 | 96 | VERTICAL |
| 2 | 2480.30 | | | | 69.28 | 4.21 | 28.26 | 0.00 | Peak | 100 | 96 | VERTICAL |
| 3 | 2483.50 | 44.48 | 54.00 | -9.52 | 12.01 | 4.21 | 28.26 | 0.00 | Average | 100 | 96 | VERTICAL |
| 4 | 2483.60 | 56.52 | 74.00 | -17.48 | 24.05 | 4.21 | 28.26 | 0.00 | Peak | 100 | 96 | VERTICAL |

Item 1, 2 are the fundamental frequency at 2480 MHz.

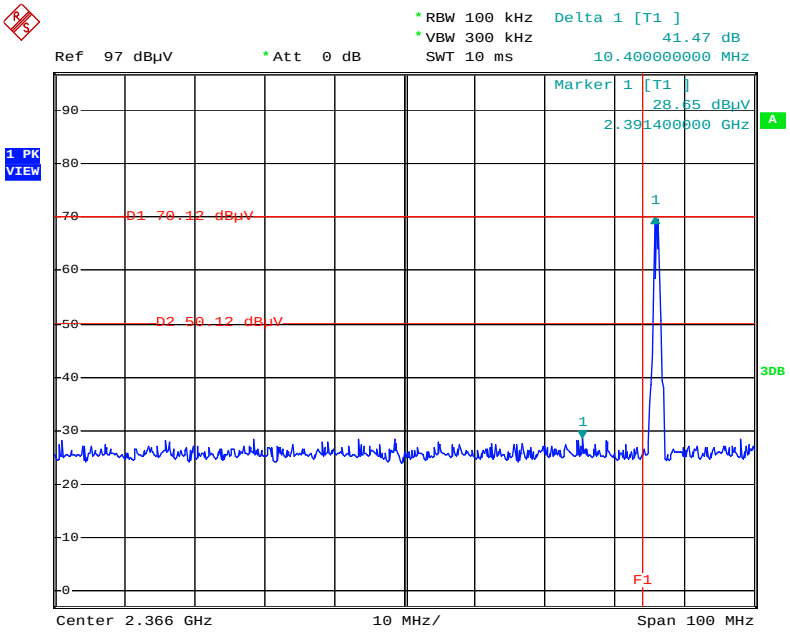
Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

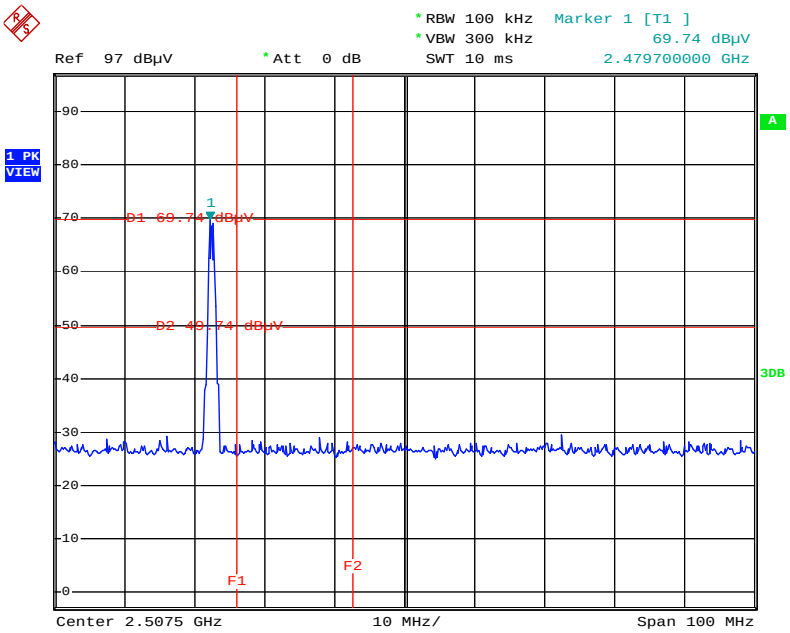
## For Emission not in Restricted Band

### Plot on Channel 0 / 2402 MHz




Date: 7.JUL.2012 00:04:53

### Plot on Channel 39 / 2480 MHz




Date: 7.JUL.2012 00:01:32

## 4.8. Antenna Requirements

### 4.8.1. Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

### 4.8.2. Antenna Connector Construction

Please refer to section 3.3 in this test report, antenna connector complied with the requirements.

# 5. LIST OF MEASURING EQUIPMENTS

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Remark |
|---|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESCS 30 | 100377 | 9kHz ~ 2.75GHz | Sep. 14, 2011 | Conduction (CO01-CB) |
| LISN | F.C.C. | FCC-LISN-50-16-2 | 04083 | 150kHz ~ 100MHz | Nov. 14, 2011 | Conduction (CO01-CB) |
| V- LISN | Schwarzbeck | NSLK 8127 | 8127-478 | 9K ~ 30MHz | Jun. 22, 2012 | Conduction (CO01-CB) |
| PULSE LIMITER | R&S | ESH3-Z2 | 100430 | 9K~30MHz | Feb. 03, 2012 | Conduction (CO01-CB) |
| COND Cable | Woken | Cable | 01 | 0.15MHz~30MHz | Dec. 4, 2011 | Conduction (CO01-CB) |
| BILOG ANTENNA | Schaffner | CBL6112D | 22021 | 20MHz ~ 2GHz | Jan. 11, 2012 | Radiation (03CH01-CB) |
| Horn Antenna | EMCO | 3115 | 00075790 | 750MHz~18GHz | Nov. 25, 2011 | Radiation (03CH01-CB) |
| Horn Antenna | SCHWARZBEAK | BBHA 9170 | BBHA9170252 | 15GHz ~ 40GHz | Nov. 22, 2011 | Radiation (03CH01-CB) |
| Pre-Amplifier | Agilent | 8447D | 2944A10991 | 0.1MHz ~ 1.3GHz | Nov. 17, 2011 | Radiation (03CH01-CB) |
| Pre-Amplifier | Agilent | 8449B | 3008A02310 | 1GHz ~ 26.5GHz | Nov. 29, 2011 | Radiation (03CH01-CB) |
| Pre-Amplifier | WM | TF-130N-R1 | 923365 | 26.5GHz ~ 40GHz | Jul. 29, 2011 | Radiation (03CH01-CB) |
| Spectrum analyzer | R&S | FSP40 | 100056 | 9KHz~40GHz | Nov. 03, 2011 | Radiation (03CH01-CB) |
| EMI Test Receiver | R&S | ESCS 30 | 100355 | 9KHz ~ 2.75GHz | Mar. 20, 2012 | Radiation (03CH01-CB) |
| Loop Antenna | Teseq | HLA 6120 | 24155 | 9 kHz - 30 MHz | Sep. 09, 2010* | Radiation (03CH01-CB) |
| Turn Table | INN CO | CO 2000 | N/A | 0 ~ 360 degree | N/A | Radiation (03CH01-CB) |
| Antenna Mast | INN CO | CO2000 | N/A | 1 m - 4 m | N/A | Radiation (03CH01-CB) |
| RF Cable-low | Woken | Low Cable-1 | N/A | 30 MHz - 1 GHz | Nov. 17, 2011 | Radiation (03CH01-CB) |
| RF Cable-high | Woken | High Cable-1 | N/A | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Radiation (03CH01-CB) |
| RF Cable-high | Woken | High Cable-2 | N/A | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Radiation (03CH01-CB) |
| RF Cable-high | Woken | High Cable-3 | N/A | 1 GHz - 40 GHz | Nov. 17, 2011 | Radiation (03CH01-CB) |
| RF Cable-high | Woken | High Cable-4 | N/A | 1 GHz - 40 GHz | Nov. 17, 2011 | Radiation (03CH01-CB) |
| Signal analyzer | R&S | FSV40 | 100979 | 9KHz~40GHz | Sep. 26, 2011 | Conducted (TH01-CB) |
| Temp. and Humidity Chamber | Ten Billion | TTH-D3SP | TBN-931011 | -30~100 degree | Jun. 05, 2012 | Conducted (TH01-CB) |
| Thermo-Hygro Meter | N/A | HC 520 | #1 | 15~70 degree | Nov. 02, 2011 | Conducted (TH01-CB) |
| Signal Generator | R&S | SMR40 | 100302 | 10MHz-40GHz | Nov. 22, 2011 | Conducted (TH01-CB) |

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Remark |
|---|---|---|---|---|---|---|
| RF Power Divider | HP | 11636A | 00306 | 2GHz ~ 18GHz | N/A | Conducted (TH01-CB) |
| RF Power Splitter | Anaren | 44100 | 1839 | 2GHz ~ 18GHz | N/A | Conducted (TH01-CB) |
| RF Power Splitter | Anaren | 42100 | 17930 | 2GHz ~ 18GHz | N/A | Conducted (TH01-CB) |
| Signal generator | R&S | SMU200A | 102782 | 10MHz-40GHz | Jun. 07, 2012 | Conducted (TH01-CB) |
| Horn Antenna | COM-POWER | AH-118 | 071187 | 1GHz – 18GHz | May 09, 2012 | Conducted (TH01-CB) |
| Horn Antenna | COM-POWER | AH-118 | 071042 | 1GHz – 18GHz | Nov. 01, 2011 | Conducted (TH01-CB) |
| RF Cable-high | Woken | High Cable-7 | - | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Conducted (TH01-CB) |
| RF Cable-high | Woken | High Cable-8 | - | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Conducted (TH01-CB) |
| RF Cable-high | Woken | High Cable-9 | - | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Conducted (TH01-CB) |
| RF Cable-high | Woken | High Cable-10 | - | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Conducted (TH01-CB) |
| RF Cable-high | Woken | High Cable-11 | - | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Conducted (TH01-CB) |
| RF Cable-high | Woken | High Cable-12 | - | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Conducted (TH01-CB) |
| RF Cable-high | Woken | High Cable-13 | - | 1 GHz – 26.5 GHz | Nov. 17, 2011 | Conducted (TH01-CB) |
| Power Sensor | Anritsu | MA2411B | 0917223 | 300MHz~40GHz | Nov. 01, 2011 | Conducted (TH01-CB) |
| Power Meter | Anritsu | ML2495A | 1035008 | 300MHz~40GHz | Nov. 01, 2011 | Conducted (TH01-CB) |

Note: Calibration Interval of instruments listed above is one year.

Note: "*" Calibration Interval of instruments listed above is two years.

# 6. TEST LOCATION

| | | | |
|---|---|---|---|
| SHIJR | ADD | : | 6Fl., No. 106, Sec. 1, Shintai 5th Rd., Shijr City, Taipei, Taiwan 221, R.O.C. |
| | TEL | : | 886-2-2696-2468 |
| | FAX | : | 886-2-2696-2255 |
| 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 | : | 886-3-318-0055 |
| LINKOU | ADD | : | No. 30-2, Dingfu Tsuen, Linkou Shiang, Taipei, Taiwan 244, R.O.C |
| | TEL | : | 886-2-2601-1640 |
| | FAX | : | 886-2-2601-1695 |
| DUNGHU | ADD | : | No. 3, Lane 238, Kangle St., Neihu Chiu, Taipei, Taiwan 114, R.O.C. |
| | TEL | : | 886-2-2631-4739 |
| | FAX | : | 886-2-2631-9740 |
| JUNGHE | ADD | : | 7Fl., No. 758, Jungjeng Rd., Junghe City, Taipei, Taiwan 235, R.O.C. |
| | TEL | : | 886-2-8227-2020 |
| | FAX | : | 886-2-8227-2626 |
| NEIHU | ADD | : | 4Fl., No. 339, Hsin Hu 2nd Rd., Taipei 114, Taiwan, R.O.C. |
| | TEL | : | 886-2-2794-8886 |
| | FAX | : | 886-2-2794-9777 |
| 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 |

# 7. TAF CERTIFICATE OF ACCREDITATION

Certificate No. : L1190-110702

財團法人全國認證基金會
Taiwan Accreditation Foundation

## Certificate of Accreditation

This is to certify that

**Sporton International Inc.**
**EMC & Wireless Communications Laboratory**
No.52, Hwa Ya 1st Road, Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

**is accredited in respect of laboratory**

| | | |
|---|---|---|
| **Accreditation Criteria** | : | ISO/IEC 17025:2005 |
| **Accreditation Number** | : | 1190 |
| **Originally Accredited** | : | December 15, 2003 |
| **Effective Period** | : | January 10, 2010 to January 09, 2013 |
| **Accredited Scope** | : | Testing Field, see described in the Appendix |
| **Specific Accreditation Program** | : | Accreditation Program for Designated Testing Laboratory for Commodities Inspection<br>Accreditation Program for Telecommunication Equipment Testing Laboratory<br>Accreditation Program for BSMI Mutual Recognition Arrangment with Foreign Authorities |

Jay-San Chen
President, Taiwan Accreditation Foundation
Date : July 02, 2011

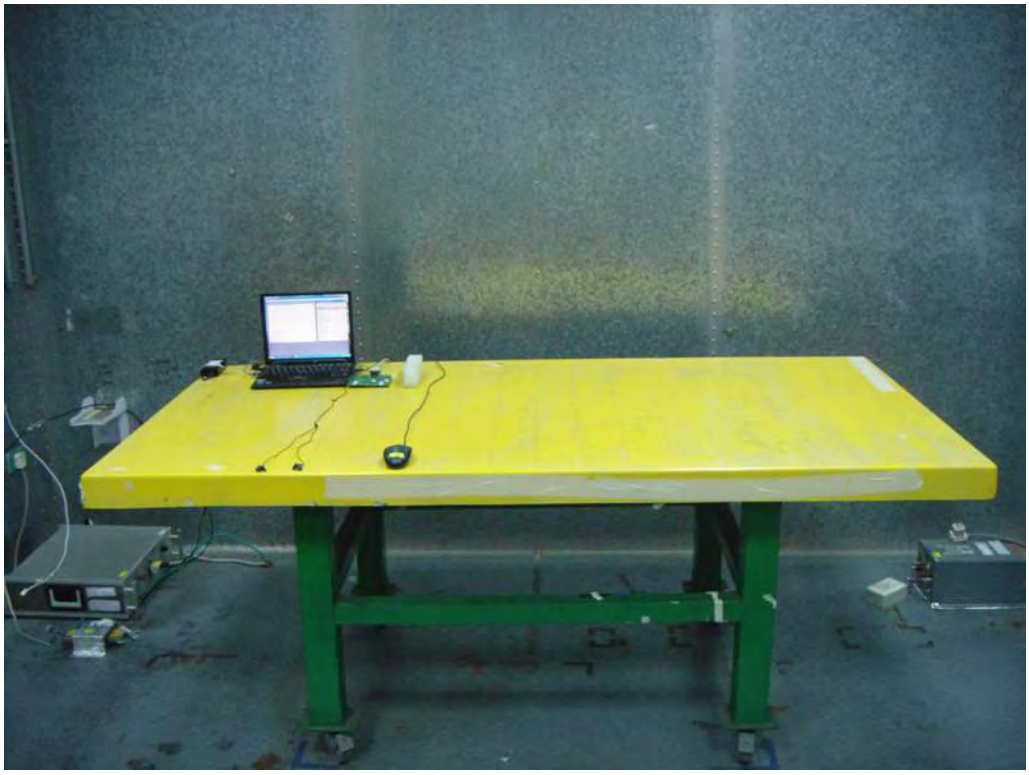
P1, total 22 pages

The Appendix forms an integral part of this Certificate, which shall be invalid when use without the Appendix

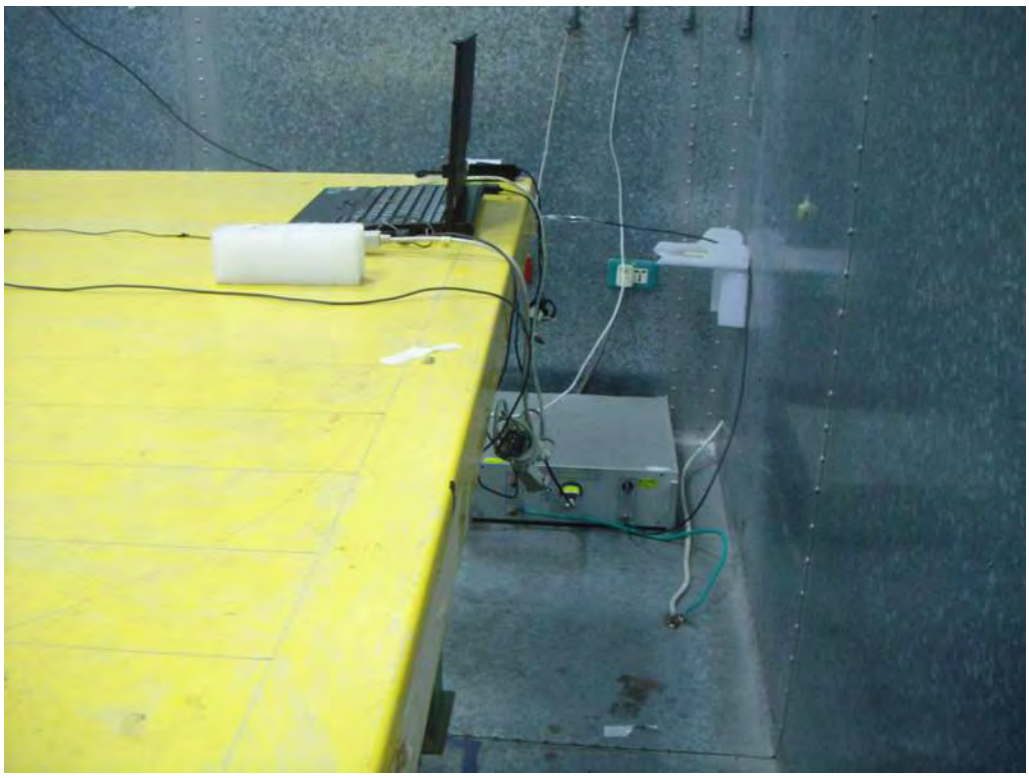
# Appendix A. Test Photos

# 1. Photographs of Conducted Emissions Test Configuration

**FRONT VIEW**



**REAR VIEW**



# 2. Photographs of Radiated Emissions Test Configuration

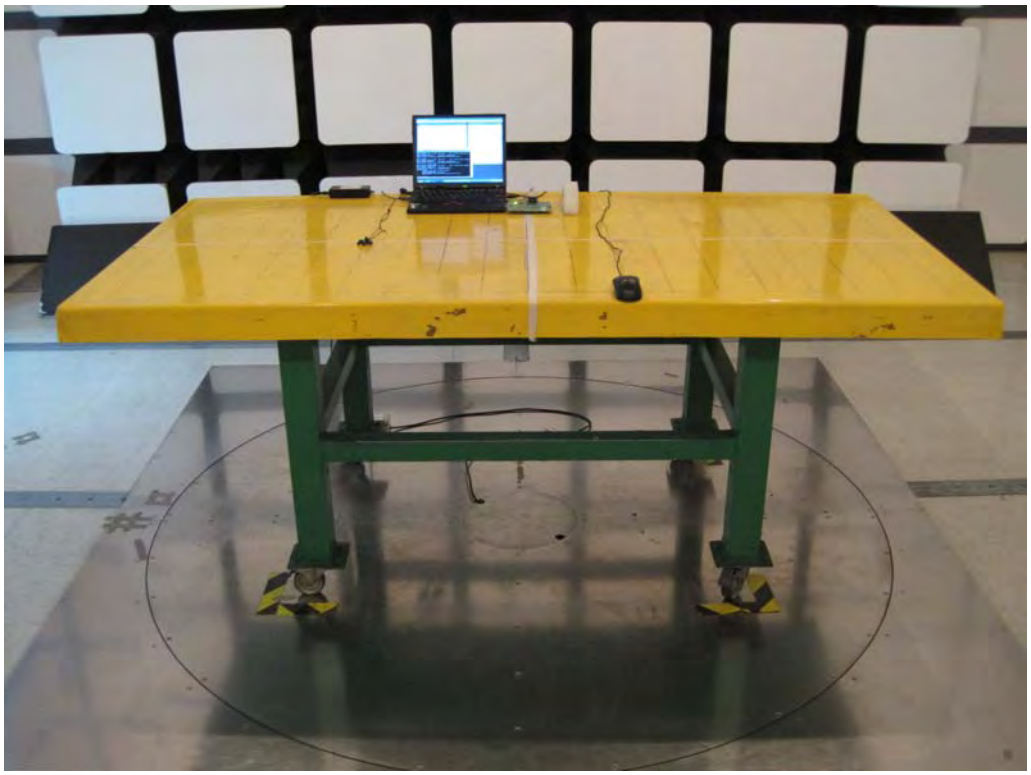
**Test Configuration: 9kHz ~30MHz**

**FRONT VIEW**

**REAR VIEW**

**Test Configuration: 30MHz~1GHz**

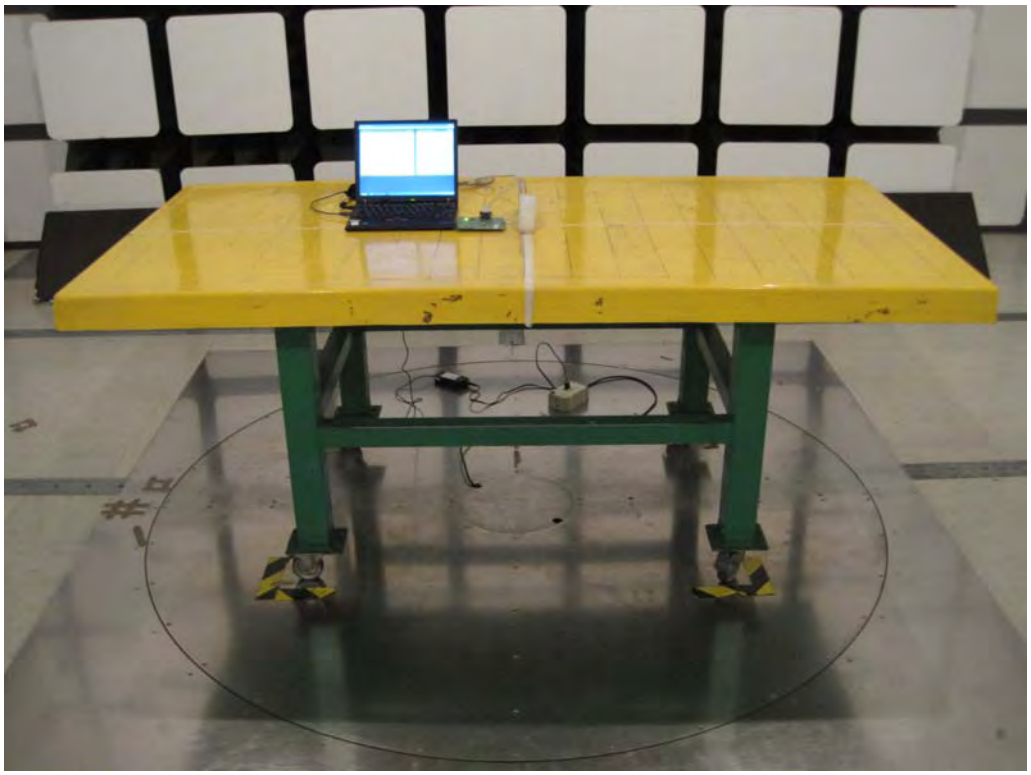
**FRONT VIEW**



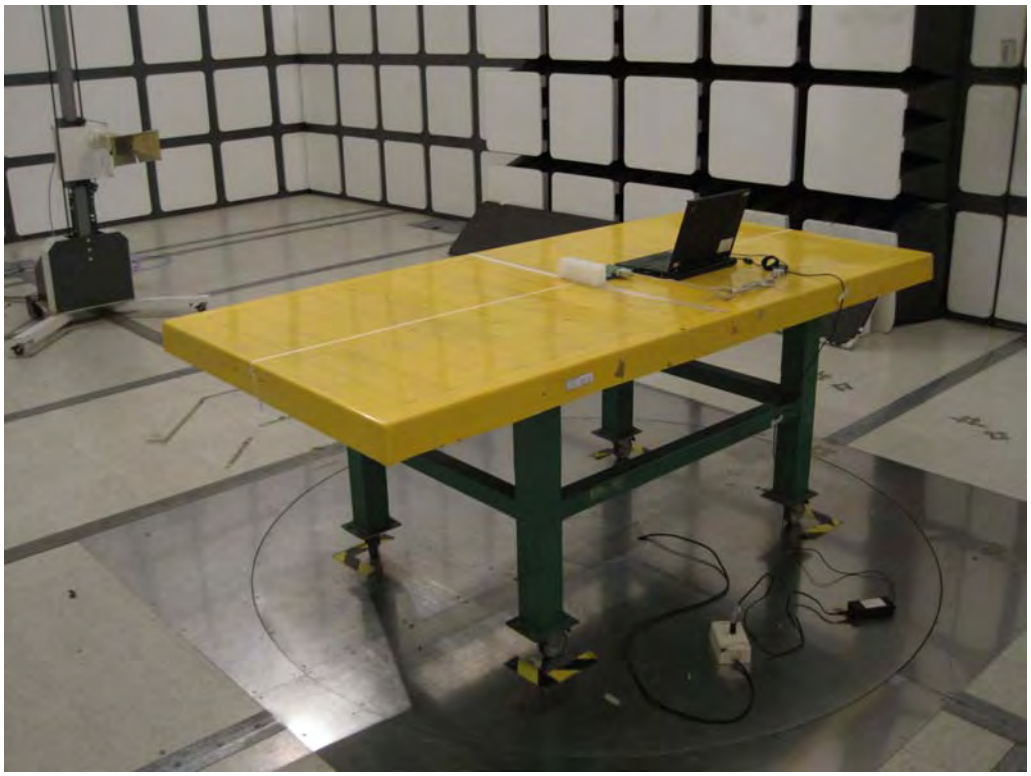
**REAR VIEW**

**Test Configuration: Above 1GHz**

**FRONT VIEW**



**REAR VIEW**



# Appendix B. Maximum Permissible Exposure

# 1. Maximum Permissible Exposure

## 1.1. 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 0.25 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

## 1.2. 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** = Average 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.

## 1.3. Calculated Result and Limit

**For 5GHz UNII Band:**

**Antenna Type : PIFA Antenna**

**Max Conducted Power for IEEE 802.11a : 13.38dBm**

| Directional Antenna Gain (dBi) | Antenna Gain (numeric) | Average Output Power (dBm) | Average Output Power (mW) | Power Density (S) (mW/cm²) | Limit of Power Density (S) (mW/cm²) | Test Result |
|---|---|---|---|---|---|---|
| 4.30 | 2.6915 | 13.3800 | 21.7771 | 0.011667 | 1 | Complies |

Note: Directional Antenna Gain = Test Antenna Gain + 10 log (Antenna quantity)

**For 5GHz ISM Band:**

**Antenna Type : PIFA Antenna**

**Max Conducted Power for IEEE 802.11a: 13.25dBm**

| Directional Antenna Gain (dBi) | Antenna Gain (numeric) | Average Output Power (dBm) | Average Output Power (mW) | Power Density (S) (mW/cm²) | Limit of Power Density (S) (mW/cm²) | Test Result |
|---|---|---|---|---|---|---|
| 4.30 | 2.6915 | 13.2500 | 21.1349 | 0.011323 | 1 | Complies |

Note: Directional Antenna Gain = Test Antenna Gain + 10 log (Antenna quantity)

**For 2.4GHz Band:**

**Antenna Type : PIFA Antenna**

**Max Conducted Power for IEEE 802.11b : 15.82 dBm**

| Directional Antenna Gain (dBi) | Antenna Gain (numeric) | Average Output Power (dBm) | Average Output Power (mW) | Power Density (S) (mW/cm²) | Limit of Power Density (S) (mW/cm²) | Test Result |
|---|---|---|---|---|---|---|
| 3 | 1.9953 | 15.8200 | 38.1944 | 0.015169 | 1 | Complies |

Note: Directional Antenna Gain = Test Antenna Gain + 10 log (Antenna quantity)

**For Bluetooth 1.0 :**

**Antenna Type : PIFA Antenna**

**Max Conducted Power for Bluetooth : 9.32 dBm**

| Antenna Gain (dBi) | Antenna Gain (numeric) | Average Output Power (dBm) | Average Output Power (mW) | Power Density (S) (mW/cm²) | Limit of Power Density (S) (mW/cm²) | Test Result |
|---|---|---|---|---|---|---|
| 3 | 1.9953 | 9.3200 | 8.5507 | 0.003396 | 1 | Complies |

**For Bluetooth 2.1+EDR :**

**Antenna Type : PIFA Antenna**

**Max Conducted Power for Bluetooth : 9.50 dBm**

| Antenna Gain (dBi) | Antenna Gain (numeric) | Average Output Power (dBm) | Average Output Power (mW) | Power Density (S) (mW/cm²) | Limit of Power Density (S) (mW/cm²) | Test Result |
|---|---|---|---|---|---|---|
| 3 | 1.9953 | 9.5000 | 8.9125 | 0.003540 | 1 | Complies |

**For Bluetooth 4.0 :**

**Antenna Type : PIFA Antenna**

**Max Conducted Power for Bluetooth : 7.80 dBm**

| Antenna Gain (dBi) | Antenna Gain (numeric) | Average Output Power (dBm) | Average Output Power (mW) | Power Density (S) (mW/cm²) | Limit of Power Density (S) (mW/cm²) | Test Result |
|---|---|---|---|---|---|---|
| 3 | 1.9953 | 7.8000 | 6.0256 | 0.002393 | 1 | Complies |

**CONCULSION:**

Both of the WLAN 5GHz Band and 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**

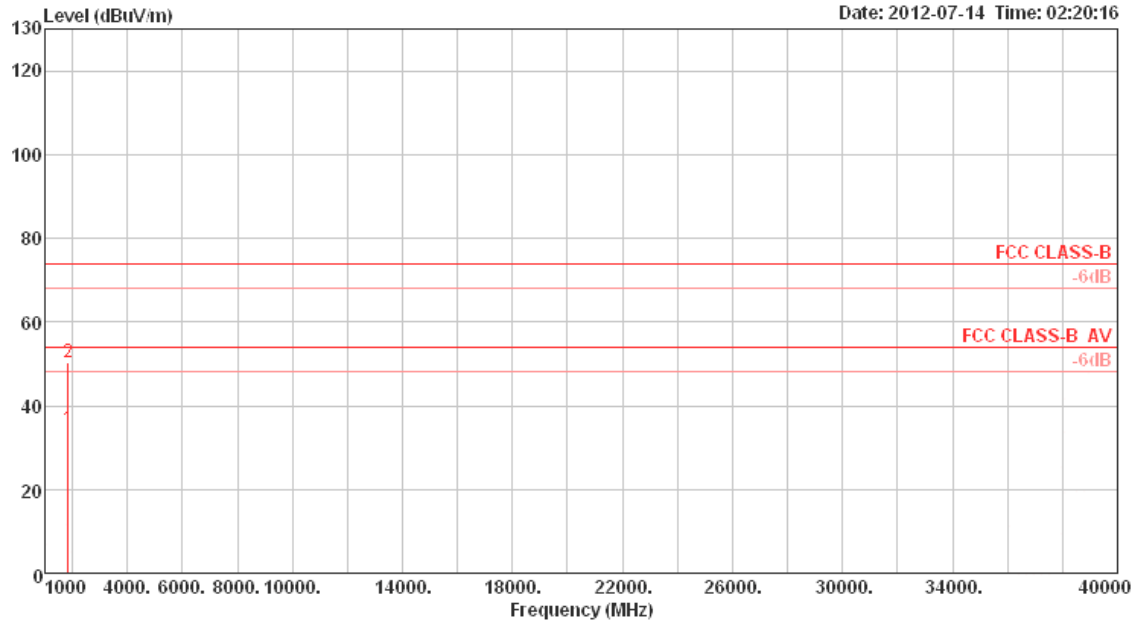
Therefore, the worst-case situation is 0.011667 / 1 + 0.003540 / 1 =0.015207, which isless than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

# Appendix C. Co-location

# 1. Results of Radiated Emissions for Co-located

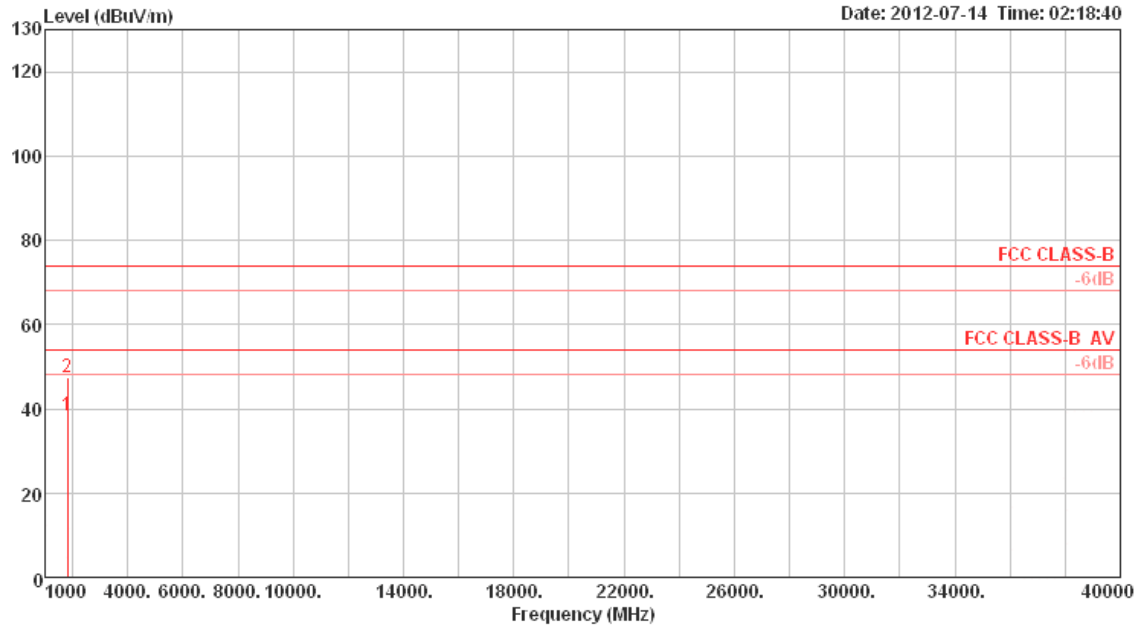
| Temperature | 21°C | Humidity | 56.4% |
|---|---|---|---|
| Test Engineer | Benson Peng | Configurations | 5G + BT |

Horizontal




| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 1842.20 | 34.56 | 54.00 | -19.44 | 38.98 | 3.85 | 26.63 | 34.90 | Average | 100 | 351 | HORIZONTAL |
| 2 | 1842.20 | 50.16 | 74.00 | -23.84 | 54.58 | 3.85 | 26.63 | 34.90 | Peak | 100 | 351 | HORIZONTAL |

## Vertial




| | Freq | Level | Limit Line | Over Limit | Read Level | Cable Loss | Antenna Factor | Preamp Factor | Remark | A/Pos | T/Pos | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV/m | dBuV/m | dB | dBuV | dB | dB/m | dB | | cm | deg | |
| 1 | 1808.20 | 38.45 | 54.00 | -15.55 | 43.02 | 3.80 | 26.53 | 34.90 | Average | 105 | 228 | VERTICAL |
| 2 | 1808.20 | 47.60 | 74.00 | -26.40 | 52.17 | 3.80 | 26.53 | 34.90 | Peak | 105 | 228 | VERTICAL |