# HCT CO., LTD.

## CERTIFICATE OF COMPLIANCE

### FCC Certification

**Applicant Name:**
SAMSUNG Electronics Co., Ltd.

**Address:**
129, Samsung-ro, Yeongtong-gu Suwon-si, Gyeonggi-do, 443-742 Rep. of Korea

**Date of Issue:**
June 26, 2014

**Test Site/Location:**
HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea.

**Report No.:** HCT-R-1406-F033-1

**HCT FRN:** 0005866421

| | |
|---|---|
| **FCC ID** | **: A3LSMG313HU** |
| **APPLICANT** | **: SAMSUNG Electronics Co., Ltd.** |

| | |
|---|---|
| **FCC Model(s):** | SM-G313HU/DS |
| **EUT Type:** | Mobile Phone |
| **Max. RF Output Power:** | Wi-Fi 802.11b(19.38 dBm) / Wi-Fi 802.11g (25.12 dBm) / Wi-Fi 802.11n (25.08 dBm) |
| **Frequency Range:** | 2412 MHz - 2462 MHz (2.4 GHz Band) |
| **Modulation type** | CCK/DSSS/OFDM |
| **FCC Classification:** | Digital Transmission System(DTS) |
| **FCC Rule Part(s):** | Part 15.247 |

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

**HCT CO., LTD.** Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

**Report prepared by**
**: Kyoung Houn Seo**
**Test Engineer of RF Team**

**Approved by**
**: Chang Seok Choi**
**Manager of RF Team**

This report only responds to the tested sample and may not be reproduced, except in full, without written approval of the HCT Co.,

# Version

| TEST REPORT NO. | DATE | DESCRIPTION |
|---|---|---|
| HCT-R-1406-F033 | June 18, 2014 | - First Approval Report |
| HCT-R-1406-F033-1 | June 26, 2014 | - Revised the test procedure<br>(KDB558074 04/09/2013 is changed to KDB558074 06/05/2014)<br>- Revised the frequency range on page 4 |
| | | |
| | | |

# Table of Contents


1. GENERAL INFORMATION ..... 4

2. EUT DESCRIPTION ..... 4

3. TEST METHODOLOGY ..... 5

3.1 EUT CONFIGURATION ..... 5
3.2 EUT EXERCISE ..... 5
3.3 GENERAL TEST PROCEDURES ..... 5
3.4 DESCRIPTION OF TEST MODES ..... 5

4. INSTRUMENT CALIBRATION ..... 6

5. FACILITIES AND ACCREDITATIONS ..... 6

5.1 FACILITIES ..... 6
5.2 EQUIPMENT ..... 6

6. ANTENNA REQUIREMENTS ..... 7

7. SUMMARY TEST OF RESULTS ..... 8

8. TEST RESULT ..... 9

8.1 DUTY CYCLE (802.11b/g/n) ..... 9
8.2 6dB BANDWIDTH (802.11b/g/n) ..... 11
8.3 OUTPUT POWER (802.11b/g/n) ..... 15
8.4 POWER SPECTRAL DENSITY (802.11b/g/n) ..... 22
8.5 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS ..... 26
8.6 RADIATED MEASUREMENT ..... 39
8.6.1 RADIATED SPURIOUS EMISSIONS ..... 39
8.6.2 RADIATED RESTRICTED BAND EDGES ..... 51
8.7 POWERLINE CONDUCTED EMISSIONS ..... 53

9. LIST OF TEST EQUIPMENT ..... 58

9.1 LIST OF TEST EQUIPMENT(Conducted Test) ..... 58
9.2 LIST OF TEST EQUIPMENT(Radiated Test) ..... 59

# 1. GENERAL INFORMATION

| | |
|---|---|
| **Applicant:** | SAMSUNG Electronics Co., Ltd. |
| **Address:** | 129, Samsung-ro, Yeongtong-gu Suwon-si, Gyeonggi-do, 443-742 Rep. of Korea |
| **FCC ID:** | A3LSMG313HU |
| **EUT Type:** | Mobile Phone |
| **Model name(s):** | SM-G313HU/DS |
| **Date(s) of Tests:** | May 31, 2014 ~ June 13, 2014 |
| **Place of Tests:** | HCT Co., Ltd.<br>74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea<br>(IC Recognition No. : 5944A-3) |

# 2. EUT DESCRIPTION

| | | |
|---|---|---|
| **EUT Type** | Mobile Phone | |
| **FCC Model Name** | SM-G313HU/DS | |
| **Power Supply** | DC 3.8 V | |
| **Battery type** | Li-ion Battery(Standard) | |
| **Frequency Range** | TX: 2412 MHz ~ 2462 MHz<br>RX: 2412 MHz ~ 2462 MHz | |
| **Max. RF Output Power** | Peak | Wi-Fi 802.11b(19.38 dBm) / Wi-Fi 802.11g (25.12 dBm) / Wi-Fi 802.11n (25.08 dBm) |
| | Average | Wi-Fi 802.11b(16.55 dBm) / Wi-Fi 802.11g (13.94 dBm) / Wi-Fi 802.11n (12.81 dBm) |
| **Modulation Type** | DSSS/CCK(802.11b), OFDM(802.11g, 802.11n) | |
| **Antenna Specification** | Manufacturer: ethertronics .com<br>Antenna type: INTERNAL ANTENNA<br>Peak Gain : -0.6 dBi | |

# 3. TEST METHODOLOGY

FCC KDB 558074 D01 DTS Meas Guidance v03r02 dated June 05, 2014 entitled "Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices(ANSI C63.4-2003) Operating Under §15.247" were used in the measurement.

## 3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

## 3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

## 3.3 GENERAL TEST PROCEDURES

**Conducted Emissions**

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4. (Version :2003) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

**Radiated Emissions**

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4. (Version: 2003)

**Conducted Antenna Terminal**

See Section from 9.1 to 9.2.(KDB 558074)

## 3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

# 4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

# 5. FACILITIES AND ACCREDITATIONS

## 5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2003) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated February 28, 2014 (Registration Number: 90661)

## 5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

# 6. ANTENNA REQUIREMENTS

**According to FCC 47 CFR §15.203:**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antennas of this E.U.T are permanently attached.

*The E.U.T Complies with the requirement of §15.203

# 7. SUMMARY TEST OF RESULTS

| Test Description | FCC Part Section(s) | Test Limit | Test Condition | Test Result |
|---|---|---|---|---|
| 6 dB Bandwidth | §15.247(a)(2) | > 500 kHz | CONDUCTED | PASS |
| Conducted Maximum Peak Output Power | §15.247(b)(3) | < 1 Watt | | PASS |
| Power Spectral Density | §15.247(e) | < 8 dBm / 3 kHz Band | | PASS |
| Band Edge(Out of Band Emissions) | §15.247(d) | Conducted > 20 dBc | | PASS |
| AC Power line Conducted Emissions | §15.207 | cf. Section 8.7 | | PASS |
| Radiated Spurious Emissions | §15.205, 15.209 | cf. Section 8.6.1 | RADIATED | PASS |
| Radiated Restricted Band Edge | §15.247(d), 15.205, 15.209 | cf. Section 8.6.2 | | PASS |

# 8. TEST RESULT

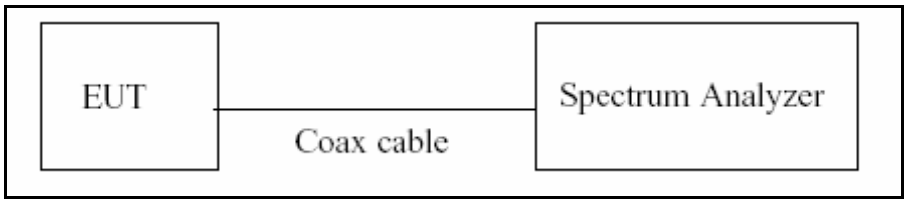
## 8.1 DUTY CYCLE (802.11b/g/n)

### ▣ TEST PROCEDURE

According to KDB 558074)6)b), issued 06/05/2014)

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

### ▣ TEST CONFIGURATION




### ▣ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We tested accroding to the zero-span measurement method, 6.0)b) in KDB 558074( issued 04/09/2013)

The largest availble value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are > 50/*T*.

1. RBW = 8 MHz (the largest availble value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure $T_{total}$ and $T_{on}$
8. Calculate Duty Cycle = $T_{on}$/ $T_{total}$ and Duty Cycle Factor = 10*log(1/Duty Cycle)

## ▣ Duty Cycle Factor

| Mode | Data Rate | $T_{on}$ (ms) | $T_{total}$ (ms) | Duty Cycle | Duty Cycle Factor (dB) |
|---|---|---|---|---|---|
| b | 1 Mbps | 8.580 | 8.730 | 0.98281787 | 0.075 |
| | 2 Mbps | 4.290 | 4.400 | 0.97500000 | 0.110 |
| | 5.5 Mbps | 1.620 | 1.720 | 0.94186047 | 0.260 |
| | 11 Mbps | 0.885 | 0.960 | 0.92187500 | 0.353 |
| g | 6 Mbs | 1.425 | 1.530 | 0.93137255 | 0.309 |
| | 9 Mbs | 0.995 | 1.060 | 0.93867925 | 0.275 |
| | 12 Mbs | 0.724 | 0.826 | 0.87651332 | 0.572 |
| | 18 Mbs | 0.492 | 0.592 | 0.83108108 | 0.804 |
| | 24 Mbs | 0.371 | 0.471 | 0.78768577 | 1.036 |
| | 36 Mbs | 0.256 | 0.357 | 0.71708683 | 1.444 |
| | 48 Mbs | 0.196 | 0.296 | 0.66216216 | 1.790 |
| | 54 Mbs | 0.180 | 0.281 | 0.64056940 | 1.934 |
| n | 6.5 Mbs | 1.332 | 1.434 | 0.92887029 | 0.320 |
| | 13 Mbs | 0.684 | 0.789 | 0.86692015 | 0.620 |
| | 19.5 Mbs | 0.470 | 0.572 | 0.82167832 | 0.853 |
| | 26 Mbs | 0.363 | 0.464 | 0.78232759 | 1.066 |
| | 39 Mbs | 0.256 | 0.357 | 0.71708683 | 1.444 |
| | 52 Mbs | 0.200 | 0.301 | 0.66445183 | 1.775 |
| | 58.5 Mbs | 0.184 | 0.284 | 0.64788732 | 1.885 |
| | 65 Mbs | 0.167 | 0.269 | 0.62081784 | 2.070 |

Note : Duty Cycle Factor = 10*log(1/Duty Cycle). where, Duty Cycle = $T_{on}$ / $T_{total}$

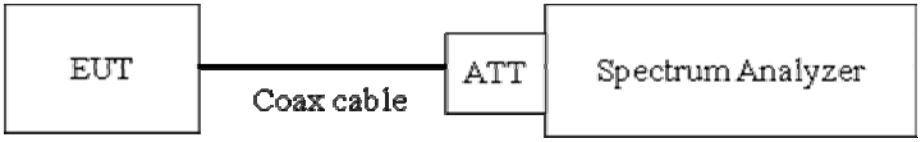
## 8.2 6dB BANDWIDTH (802.11b/g/n)

**Test Requirements and limit, §15.247(a)(2)**

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

**The minimum permissible 6dB bandwidth is 500 kHz.**

### ▣ TEST CONFIGURATION




### ▣ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to ( Page 5 in KDB 558074, issued 06/05/2014)

RBW = 100 kHz

VBW ≥ 3 x RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

Note : We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

## ▣ TEST RESULTS

**Conducted 6dB Bandwidth Measurements for 802.11b**

| 802.11b Mode | | Measured Bandwidth [MHz] | Minimum Bandwidth [MHz] | Pass / Fail |
|---|---|---|---|---|
| Frequency [MHz] | Channel No. | | | |
| 2412 | 1 | 8.605 | 0.500 | Pass |
| 2437 | 6 | 9.070 | 0.500 | Pass |
| 2462 | 11 | 9.088 | 0.500 | Pass |

**Conducted 6dB Bandwidth Measurements for 802.11g**

| 802.11g Mode | | Measured Bandwidth [MHz] | Minimum Bandwidth [MHz] | Pass / Fail |
|---|---|---|---|---|
| Frequency [MHz] | Channel No. | | | |
| 2412 | 1 | 15.09 | 0.500 | Pass |
| 2437 | 6 | 15.16 | 0.500 | Pass |
| 2462 | 11 | 15.05 | 0.500 | Pass |

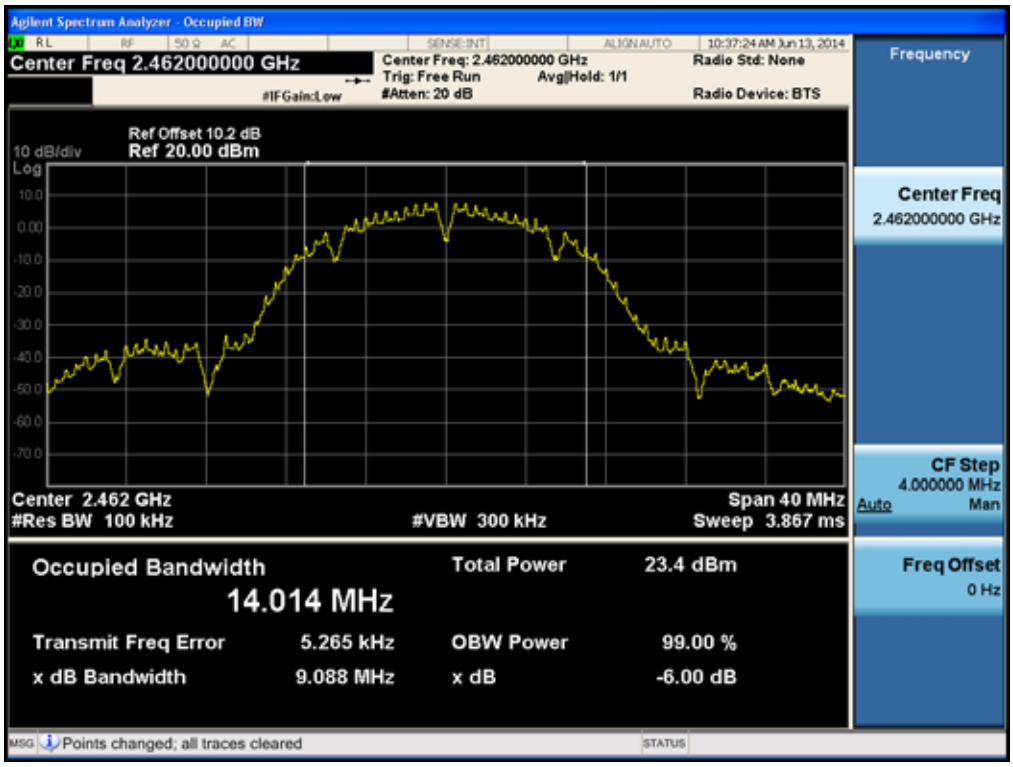
**Conducted 6dB Bandwidth Measurements for 802.11n**

| 802.11n Mode | | Measured Bandwidth [MHz] | Minimum Bandwidth [MHz] | Pass / Fail |
|---|---|---|---|---|
| Frequency [MHz] | Channel No. | | | |
| 2412 | 1 | 15.13 | 0.500 | Pass |
| 2437 | 6 | 15.12 | 0.500 | Pass |
| 2462 | 11 | 15.16 | 0.500 | Pass |

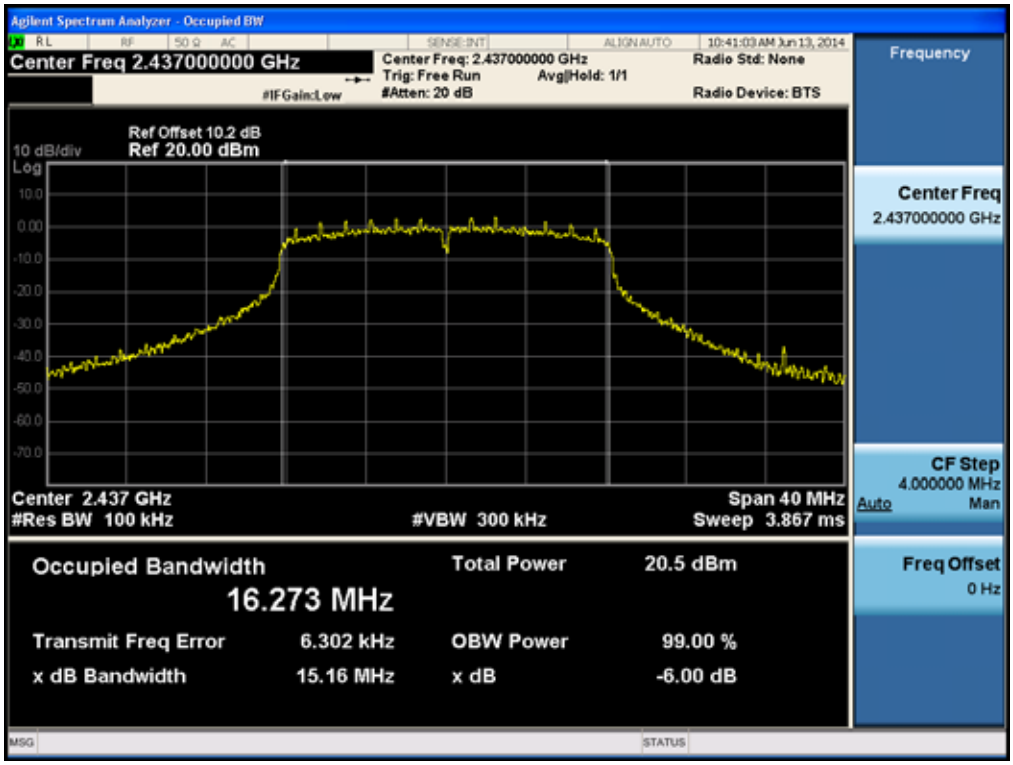
**Note : In order to simplify the report, attached plots were only the most wide 6 dB BW channel.**

## ▣ RESULT PLOTS

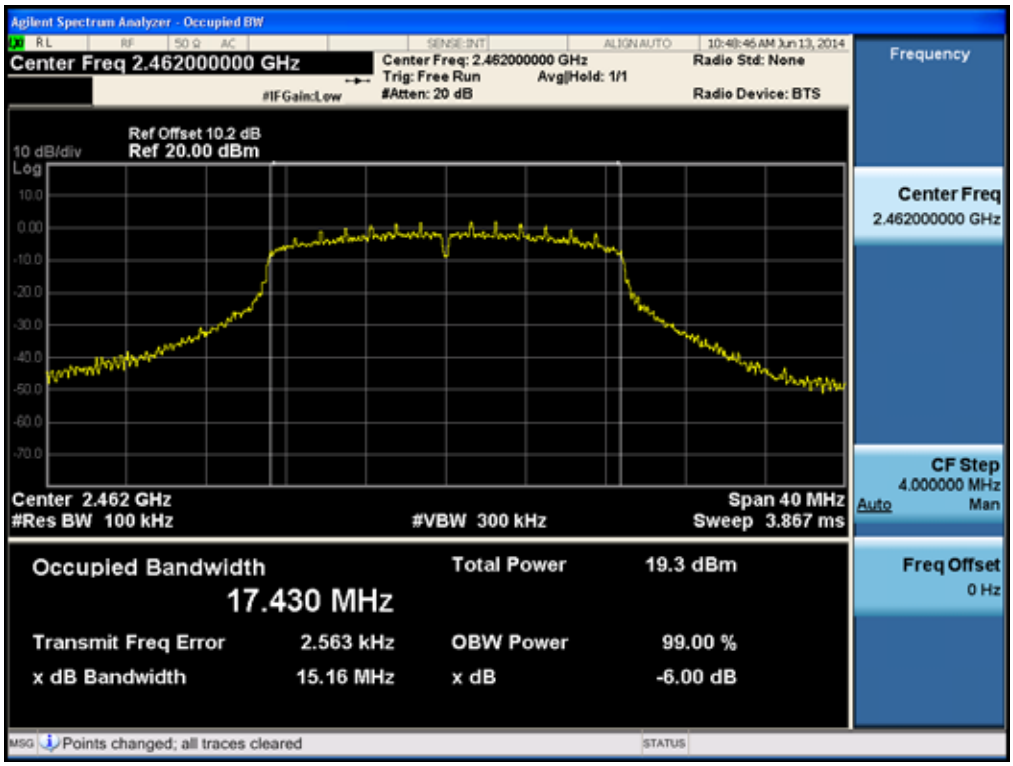
### 6dB Bandwidth plot (802.11b-CH 11)




### 6dB Bandwidth plot (802.11g-CH 6)



## 6dB Bandwidth plot (802.11n-CH 11)



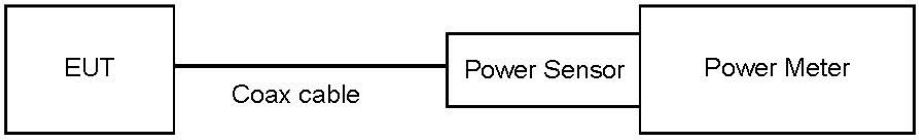
## 8.3 OUTPUT POWER (802.11b/g/n)

**Test Requirements and limit, §15.247(b)(3)**

The transmitter output is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

**The maximum permissible conducted output power is 1 Watt.**

### ▣ TEST CONFIGURATION(20 MHz BW)




### ▣ TEST PROCEDURE(20 MHz BW)

- Peak Power ( Procedure 9.1.2 in KDB 558074, issued 06/05/2014)
  1. Measure the peak power of the transmitter.
- Average Power ( Procedure 9.2.3.1 in KDB 558074, issued 06/05/2014)
  1. Measure the duty cycle.
  2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
  3. Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Note :

1. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 20.2 dB is offset for 2.4 GHz Band.
   Actual value of loss for the attenuator and cable combination is below table.

| Band | Frequency(MHz) | Loss(dB) |
|---|---|---|
| 2.4 GHz | 2412 | 20.21 |
| | 2437 | 20.24 |
| | 2462 | 20.24 |

(Actual value of loss for the attenuator and cable combination)

## ▣ TEST RESULTS-Peak

**Conducted Output Power Measurements (802.11b Mode)**

| 802.11b Mode | | Rate | Measured | Limit |
|---|---|---|---|---|
| Frequency[MHz] | Channel No. | (Mbps) | Power(dBm) | (dBm) |
| 2412 | 1 | 1 Mbps | 18.98 | 30 |
| | | 2 Mbps | 19.06 | 30 |
| | | 5.5 Mbps | 19.12 | 30 |
| | | 11 Mbps | 19.32 | 30 |
| 2437 | 6 | 1 Mbps | 19.02 | 30 |
| | | 2 Mbps | 19.19 | 30 |
| | | 5.5 Mbps | 19.24 | 30 |
| | | 11 Mbps | 19.38 | 30 |
| 2462 | 11 | 1 Mbps | 18.95 | 30 |
| | | 2 Mbps | 19.10 | 30 |
| | | 5.5 Mbps | 19.14 | 30 |
| | | 11 Mbps | 19.36 | 30 |

Conducted Output Power Measurements (802.11g Mode)

| 802.11g Mode | | Rate | Measured | Limit |
|---|---|---|---|---|
| Frequency[MHz] | Channel No. | (Mbps) | Power(dBm) | (dBm) |
| 2412 | 1 | 6 Mbps | 25.12 | 30 |
| | | 9 Mbps | 24.92 | 30 |
| | | 12 Mbps | 24.65 | 30 |
| | | 18 Mbps | 24.78 | 30 |
| | | 24 Mbps | 24.94 | 30 |
| | | 36 Mbps | 24.68 | 30 |
| | | 48 Mbps | 24.67 | 30 |
| | | 54 Mbps | 24.98 | 30 |
| 2437 | 6 | 6 Mbps | 24.91 | 30 |
| | | 9 Mbps | 24.98 | 30 |
| | | 12 Mbps | 24.83 | 30 |
| | | 18 Mbps | 24.62 | 30 |
| | | 24 Mbps | 24.91 | 30 |
| | | 36 Mbps | 24.84 | 30 |
| | | 48 Mbps | 24.55 | 30 |
| | | 54 Mbps | 24.97 | 30 |
| 2462 | 11 | 6 Mbps | 24.88 | 30 |
| | | 9 Mbps | 24.94 | 30 |
| | | 12 Mbps | 24.52 | 30 |
| | | 18 Mbps | 24.34 | 30 |
| | | 24 Mbps | 24.58 | 30 |
| | | 36 Mbps | 24.65 | 30 |
| | | 48 Mbps | 24.45 | 30 |
| | | 54 Mbps | 24.59 | 30 |

Conducted Output Power Measurements (802.11n Mode)

| 802.11n Mode | | Rate | Measured | Limit |
|---|---|---|---|---|
| Frequency[MHz] | Channel No. | (Mbps) | Power(dBm) | (dBm) |
| 2412 | 1 | 6.5 Mbps | 24.49 | 30 |
| | | 13 Mbps | 23.88 | 30 |
| | | 19.5 Mbps | 23.95 | 30 |
| | | 26 Mbps | 24.22 | 30 |
| | | 39 Mbps | 24.08 | 30 |
| | | 52 Mbps | 24.89 | 30 |
| | | 58.5 Mbps | 24.29 | 30 |
| | | 65 Mbps | 23.62 | 30 |
| 2437 | 6 | 6.5 Mbps | 24.58 | 30 |
| | | 13 Mbps | 25.08 | 30 |
| | | 19.5 Mbps | 24.75 | 30 |
| | | 26 Mbps | 24.31 | 30 |
| | | 39 Mbps | 24.36 | 30 |
| | | 52 Mbps | 24.88 | 30 |
| | | 58.5 Mbps | 24.18 | 30 |
| | | 65 Mbps | 23.83 | 30 |
| 2462 | 11 | 6.5 Mbps | 24.11 | 30 |
| | | 13 Mbps | 24.43 | 30 |
| | | 19.5 Mbps | 24.72 | 30 |
| | | 26 Mbps | 23.92 | 30 |
| | | 39 Mbps | 24.09 | 30 |
| | | 52 Mbps | 24.63 | 30 |
| | | 58.5 Mbps | 24.03 | 30 |
| | | 65 Mbps | 23.60 | 30 |

## ▣ TEST RESULTS-Average

**Conducted Output Power Measurements (802.11b Mode)**

| 802.11b Mode | | Rate (Mbps) | Measured Power(dBm) | Duty Cycle Factor | Measured Power(dBm) + Duty Cycle Factor | Limit (dBm) |
|---|---|---|---|---|---|---|
| Frequency [MHz] | Channel No. | | | | | |
| 2412 | 1 | 1 Mbps | 16.38 | 0.075 | 16.45 | 30 |
| | | 2 Mbps | 16.40 | 0.110 | 16.51 | 30 |
| | | 5.5 Mbps | 16.28 | 0.260 | 16.54 | 30 |
| | | 11 Mbps | 16.04 | 0.353 | 16.40 | 30 |
| 2437 | 6 | 1 Mbps | 16.38 | 0.075 | 16.46 | 30 |
| | | 2 Mbps | 16.38 | 0.110 | 16.49 | 30 |
| | | 5.5 Mbps | 16.29 | 0.260 | 16.55 | 30 |
| | | 11 Mbps | 16.05 | 0.353 | 16.41 | 30 |
| 2462 | 11 | 1 Mbps | 16.30 | 0.075 | 16.38 | 30 |
| | | 2 Mbps | 16.37 | 0.110 | 16.48 | 30 |
| | | 5.5 Mbps | 16.15 | 0.260 | 16.41 | 30 |
| | | 11 Mbps | 16.00 | 0.353 | 16.35 | 30 |

## Conducted Output Power Measurements (802.11g Mode)

| 802.11g Mode | | | | | | |
|---|---|---|---|---|---|---|
| Frequency [MHz] | Channel No. | Rate (Mbps) | Measured Power(dBm) | Duty Cycle Factor | Measured Power(dBm) + Duty Cycle Factor | Limit (dBm) |
| 2412 | 1 | 6 Mbps | 13.57 | 0.309 | 13.88 | 30 |
| | | 9 Mbps | 13.48 | 0.275 | 13.75 | 30 |
| | | 12 Mbps | 13.34 | 0.572 | 13.91 | 30 |
| | | 18 Mbps | 13.14 | 0.804 | 13.94 | 30 |
| | | 24 Mbps | 12.87 | 1.036 | 13.90 | 30 |
| | | 36 Mbps | 12.45 | 1.444 | 13.90 | 30 |
| | | 48 Mbps | 12.09 | 1.790 | 13.88 | 30 |
| | | 54 Mbps | 12.00 | 1.934 | 13.93 | 30 |
| 2437 | 6 | 6 Mbps | 13.57 | 0.309 | 13.88 | 30 |
| | | 9 Mbps | 13.43 | 0.275 | 13.71 | 30 |
| | | 12 Mbps | 13.29 | 0.572 | 13.87 | 30 |
| | | 18 Mbps | 13.12 | 0.804 | 13.92 | 30 |
| | | 24 Mbps | 12.84 | 1.036 | 13.88 | 30 |
| | | 36 Mbps | 12.42 | 1.444 | 13.86 | 30 |
| | | 48 Mbps | 12.10 | 1.790 | 13.89 | 30 |
| | | 54 Mbps | 11.96 | 1.934 | 13.90 | 30 |
| 2462 | 11 | 6 Mbps | 13.49 | 0.309 | 13.80 | 30 |
| | | 9 Mbps | 13.34 | 0.275 | 13.62 | 30 |
| | | 12 Mbps | 13.24 | 0.572 | 13.82 | 30 |
| | | 18 Mbps | 12.95 | 0.804 | 13.75 | 30 |
| | | 24 Mbps | 12.74 | 1.036 | 13.78 | 30 |
| | | 36 Mbps | 12.34 | 1.444 | 13.79 | 30 |
| | | 48 Mbps | 11.95 | 1.790 | 13.74 | 30 |
| | | 54 Mbps | 11.85 | 1.934 | 13.78 | 30 |

## Conducted Output Power Measurements (802.11n Mode)

| 802.11n Mode | | Rate (Mbps) | Measured Power(dBm) | Duty Cycle Factor | Measured Power(dBm) + Duty Cycle Factor | Limit (dBm) |
|---|---|---|---|---|---|---|
| Frequency [MHz] | Channel No. | | | | | |
| 2412 | 1 | 6.5 Mbps | 12.45 | 0.320 | 12.77 | 30 |
| | | 13 Mbps | 12.19 | 0.620 | 12.81 | 30 |
| | | 19.5 Mbps | 11.93 | 0.853 | 12.78 | 30 |
| | | 26 Mbps | 11.69 | 1.066 | 12.76 | 30 |
| | | 39 Mbps | 11.37 | 1.444 | 12.81 | 30 |
| | | 52 Mbps | 11.00 | 1.775 | 12.78 | 30 |
| | | 58.5 Mbps | 10.88 | 1.885 | 12.76 | 30 |
| | | 65 Mbps | 10.69 | 2.070 | 12.76 | 30 |
| 2437 | 6 | 6.5 Mbps | 12.35 | 0.320 | 12.67 | 30 |
| | | 13 Mbps | 12.07 | 0.620 | 12.69 | 30 |
| | | 19.5 Mbps | 11.84 | 0.853 | 12.69 | 30 |
| | | 26 Mbps | 11.64 | 1.066 | 12.71 | 30 |
| | | 39 Mbps | 11.34 | 1.444 | 12.79 | 30 |
| | | 52 Mbps | 10.85 | 1.775 | 12.63 | 30 |
| | | 58.5 Mbps | 10.80 | 1.885 | 12.68 | 30 |
| | | 65 Mbps | 10.69 | 2.070 | 12.76 | 30 |
| 2462 | 11 | 6.5 Mbps | 12.29 | 0.320 | 12.61 | 30 |
| | | 13 Mbps | 12.02 | 0.620 | 12.64 | 30 |
| | | 19.5 Mbps | 11.79 | 0.853 | 12.64 | 30 |
| | | 26 Mbps | 11.51 | 1.066 | 12.57 | 30 |
| | | 39 Mbps | 11.17 | 1.444 | 12.61 | 30 |
| | | 52 Mbps | 10.82 | 1.775 | 12.59 | 30 |
| | | 58.5 Mbps | 10.75 | 1.885 | 12.64 | 30 |
| | | 65 Mbps | 10.56 | 2.070 | 12.63 | 30 |

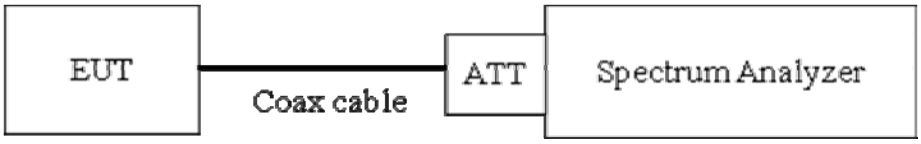
## 8.4 POWER SPECTRAL DENSITY (802.11b/g/n)

**Test Requirements and limit, §15.247(e)**

The peak power spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

**Minimum Standard – the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.**

### ▣ TEST CONFIGURATION




### ▣ TEST PROCEDURE

We tested according to Procedure 10.2 in KDB 558074, issued 06/05/2014

The spectrum analyzer is set to :

Set analyzer center frequency to DTS channel center frequency.

Span = 1.5 times the DTS channel bandwidth.

RBW = 3 kHz ≤ RBW ≤ 100 kHz.

VBW ≥ 3 x RBW.

Sweep = auto couple

Detector = peak

Trace Mode = max hold

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

### ▣ Sample Calculation

PSD = Reading Value + ATT loss + Cable loss(1 ea)

Output Power = -5 dBm + 10 dB + 0.8 dB = 5.8 dBm

Note :

1. Spectrum reading values are not plot data. The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.2 dB is offset for 2.4 GHz Band.

   Actual value of loss for the attenuator and cable combination is below table.

| Band | Frequency(MHz) | Loss(dB) |
|---|---|---|
| 2.4 GHz | 2412 | 10.21 |
| | 2437 | 10.24 |
| | 2462 | 10.24 |

(Actual value of loss for the attenuator and cable combination)

## ▣ TEST RESULTS

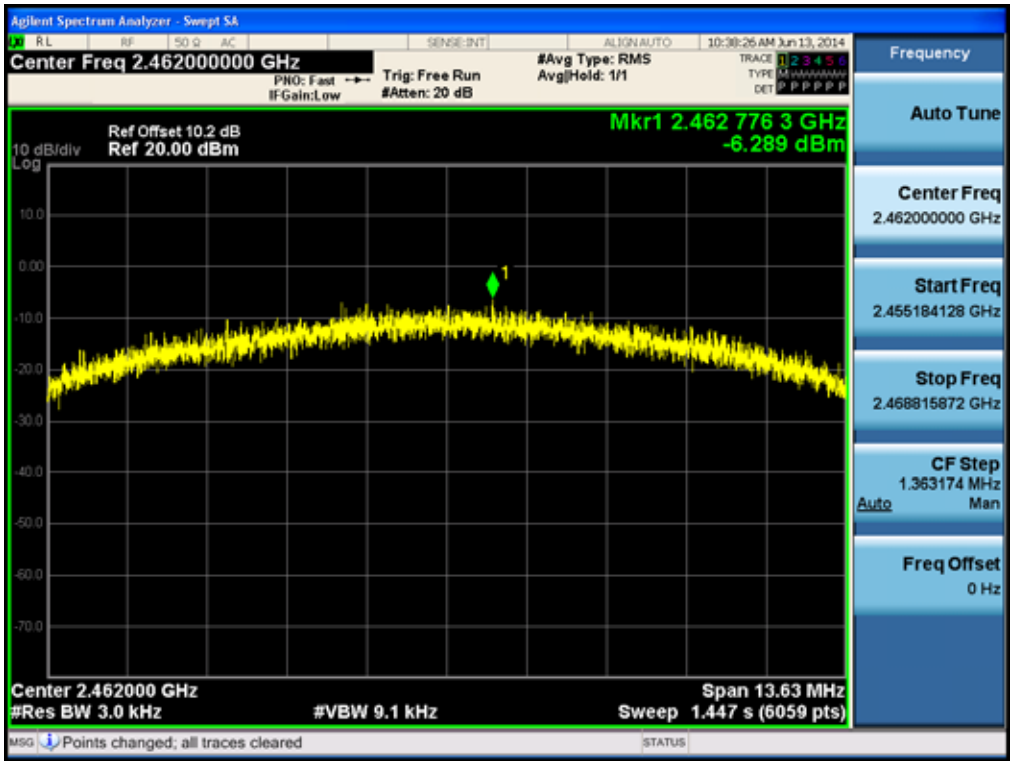
**Conducted Power Density Measurements**

| Frequency (MHz) | Channel No. | Mode | Test Result | | |
|---|---|---|---|---|---|
| | | | PSD (dBm) | Limit (dBm) | Pass/Fail |
| 2412 | 1 | 802.11b | -6.585 | 8 | Pass |
| 2437 | 6 | | -6.673 | 8 | Pass |
| 2462 | 11 | | -6.289 | 8 | Pass |
| 2412 | 1 | 802.11g | -10.371 | 8 | Pass |
| 2437 | 6 | | -11.149 | 8 | Pass |
| 2462 | 11 | | -11.196 | 8 | Pass |
| 2412 | 1 | 802.11n | -12.918 | 8 | Pass |
| 2437 | 6 | | -11.930 | 8 | Pass |
| 2462 | 11 | | -12.196 | 8 | Pass |

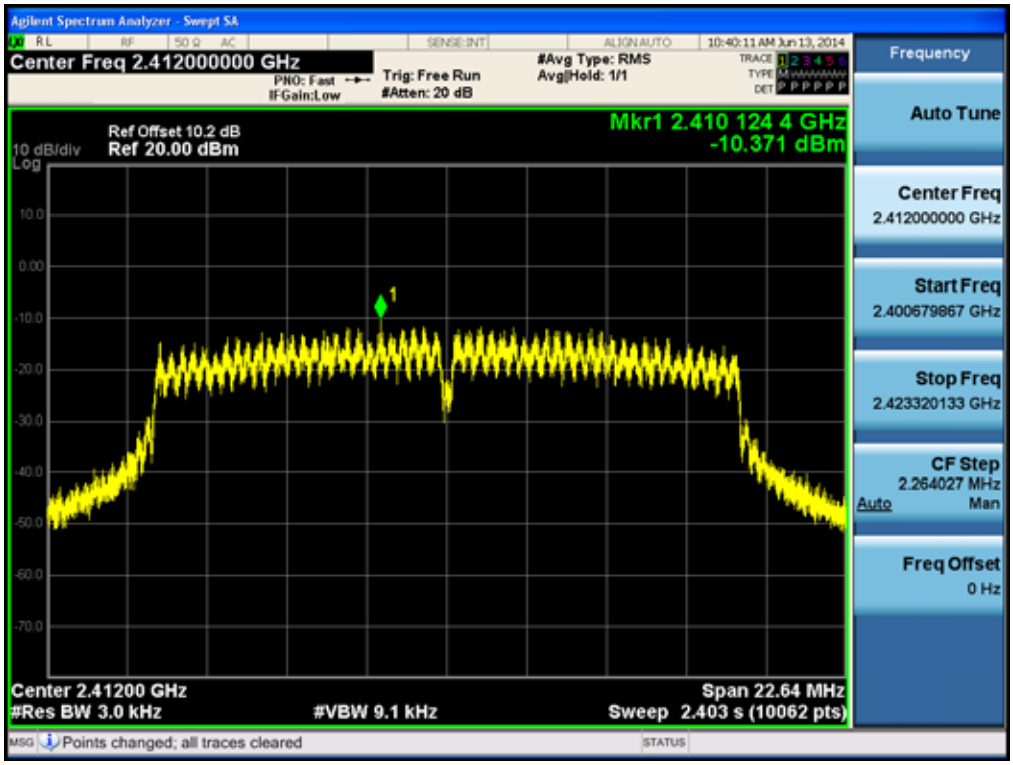
**Note : In order to simplify the report, attached plots were only the highest PSD channel.**

## ▣ RESULT PLOTS

### Power Spectral Density (802.11b-CH 11)




### Power Spectral Density (802.11g-CH 1)



## Power Spectral Density (802.11n-CH 6)

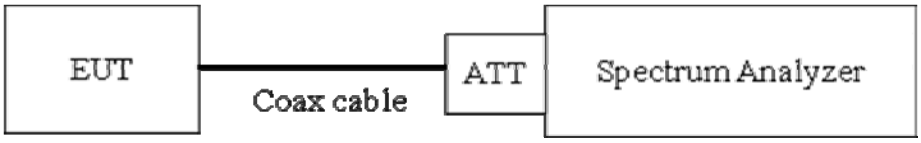
## 8.5 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

**Test Requirements and limit, §15.247(d)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

**Limit : 20 dBc**

**▣ TEST CONFIGURATION**




**▣ TEST PROCEDURE**

The transmitter output is connected to the spectrum analyzer. (Procedure 11.0 in KDB 558074, issued 06/05/2014)

RBW = 100 kHz

VBW ≥ 3 x RBW

Set span to encompass the spectrum to be examined

Detector = Peak

Trace Mode = max hold

Sweep time = auto couple

Ensure that the number of measurement points ≥ Span/RBW

Allow trace to fully stabilize.

Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 10$^{th}$ harmonic range with the transmitter set to the lowest, middle, and highest channels.

Note :

1. The band edge results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.2 dB is

offset for 2.4 GHz Band. Actual value of loss for the attenuator and cable combination is below table.

| Band | Frequency(MHz) | Loss(dB) |
|---|---|---|
| 2.4 GHz | 2412 | 10.21 |
| | 2437 | 10.24 |
| | 2462 | 10.24 |

(Actual value of loss for the attenuator and cable combination)

4. In case of conducted spurious emissions test, please check factors blow table.

5. In order to simplify the report, attached plots were only the worst case channel.

## ▣ FACTORS FOR FREQUENCY

| Freq(MHz) | Factor(dB) |
|---|---|
| 30 | 9.95 |
| 100 | 10.01 |
| 200 | 10.03 |
| 300 | 10.04 |
| 400 | 10.05 |
| 500 | 10.04 |
| 600 | 10.03 |
| 700 | 10.09 |
| 800 | 10.10 |
| 900 | 10.08 |
| 1000 | 10.11 |
| 2000 | 10.25 |
| 2400* | 10.19 |
| 2500* | 10.26 |
| 3000 | 10.27 |
| 4000 | 10.22 |
| 5000 | 10.48 |
| 5700* | 10.42 |
| 5800* | 10.48 |
| 6000 | 10.48 |
| 7000 | 10.57 |
| 8000 | 10.45 |
| 9000 | 10.50 |
| 10000 | 10.64 |
| 11000 | 10.69 |
| 12000 | 10.75 |

| | |
|---|---|
| 13000 | 10.92 |
| 14000 | 11.90 |
| 15000 | 11.00 |
| 16000 | 11.03 |
| 17000 | 10.93 |
| 18000 | 10.96 |
| 19000 | 10.85 |
| 20000 | 12.11 |
| 21000 | 11.17 |
| 22000 | 10.99 |
| 23000 | 11.12 |
| 24000 | 11.10 |
| 25000 | 11.42 |

Note : 1. '*' is fundamental frequency range.

2. Factor = Cable loss + Attenuator loss

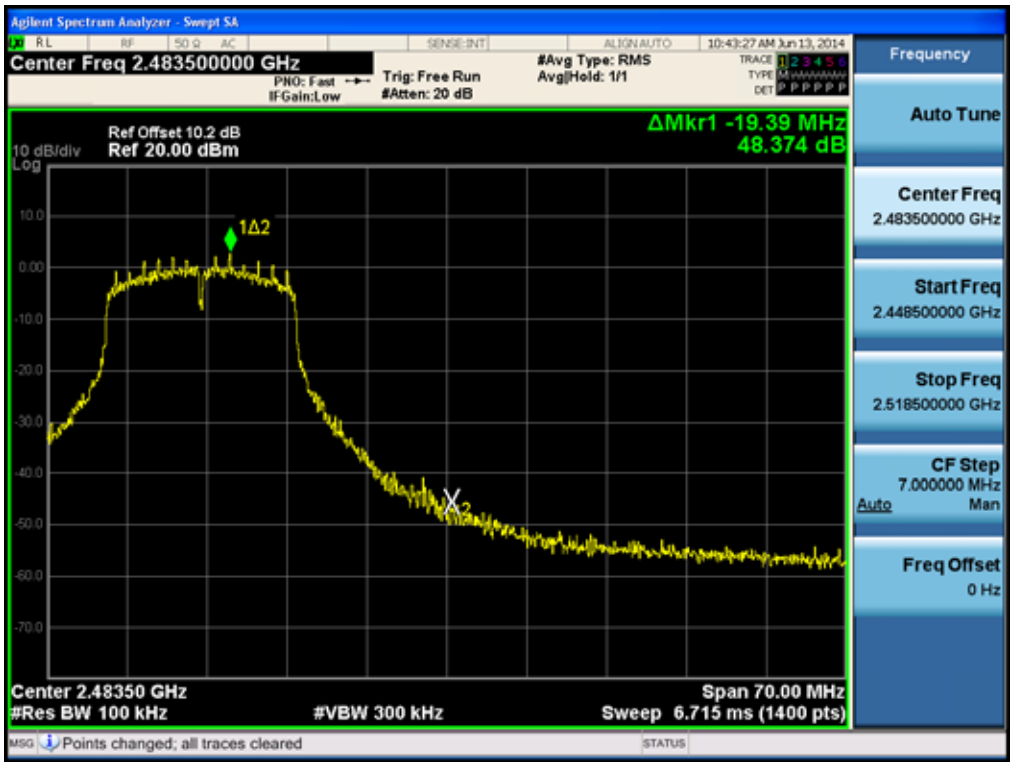
## ▣ RESULT PLOTS

### BandEdge (802.11b-CH1)

### BandEdge (802.11b-CH11)

## BandEdge (802.11g-CH1)

## BandEdge (802.11g-CH11)

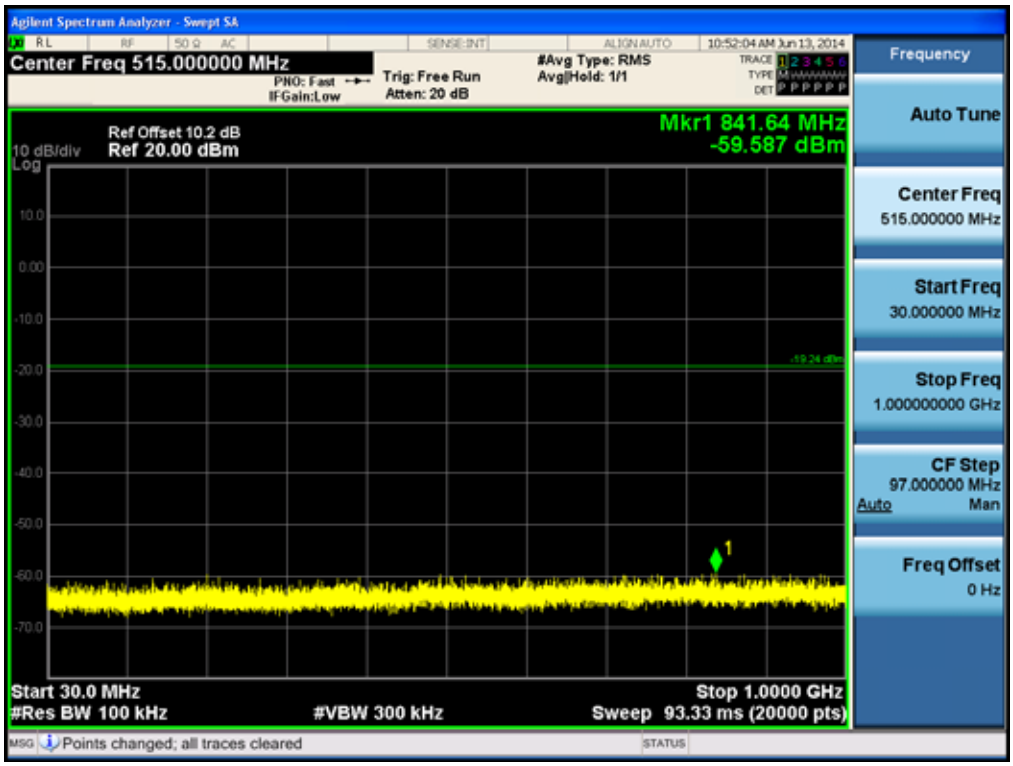


## Band Edge (802.11n-CH1)

## Band Edge (802.11n-CH11)

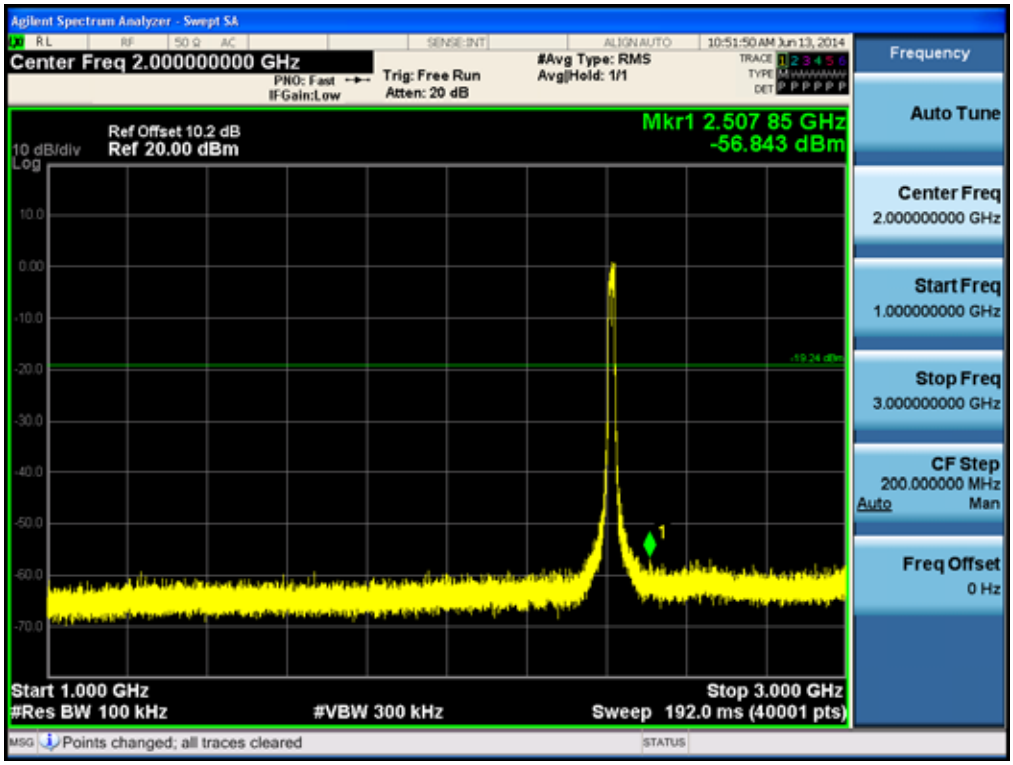
30 MHz ~ 1 GHz

Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



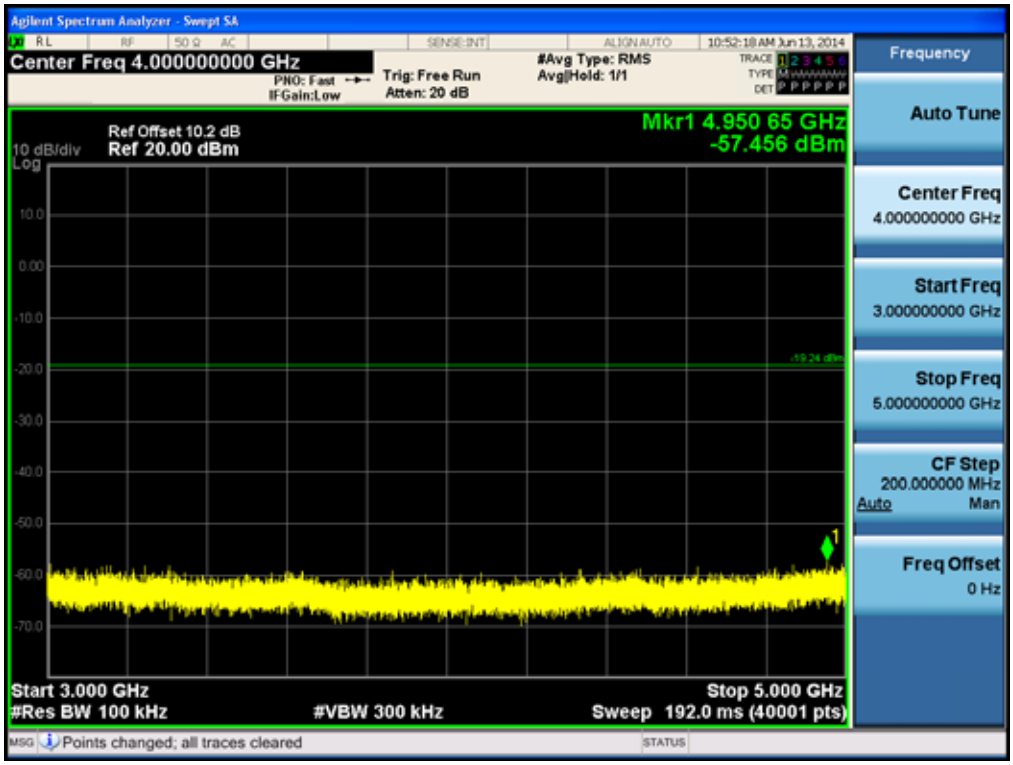

1 GHz ~ 3 GHz

Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



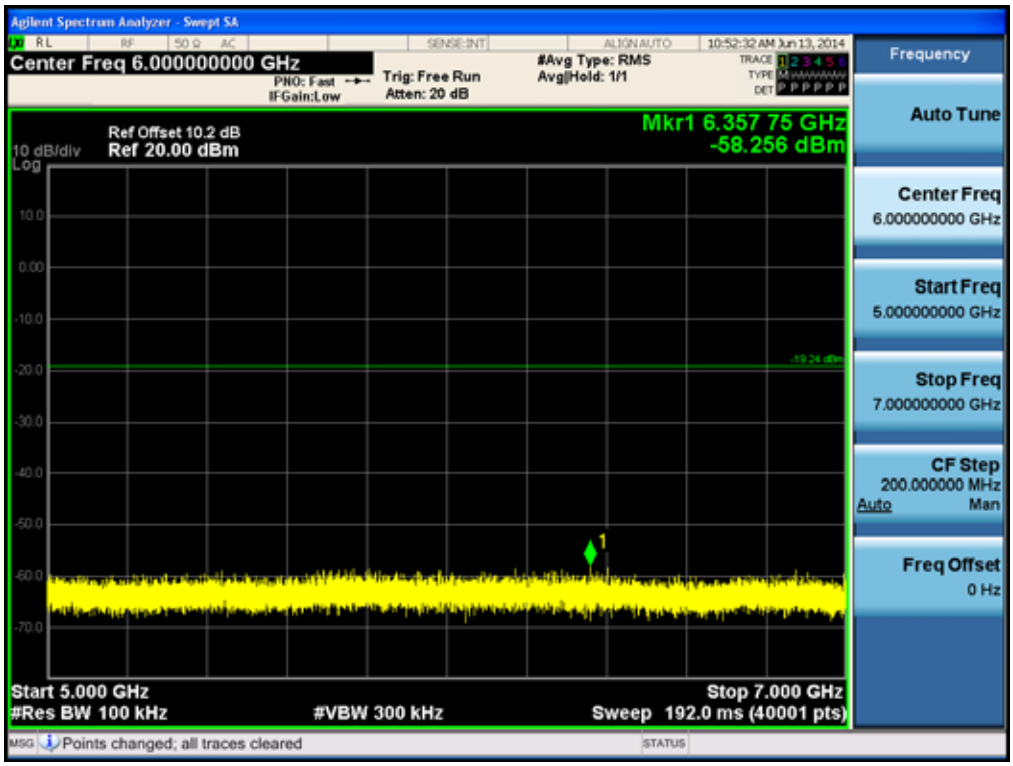
### 3 GHz ~ 5 GHz

**Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)**



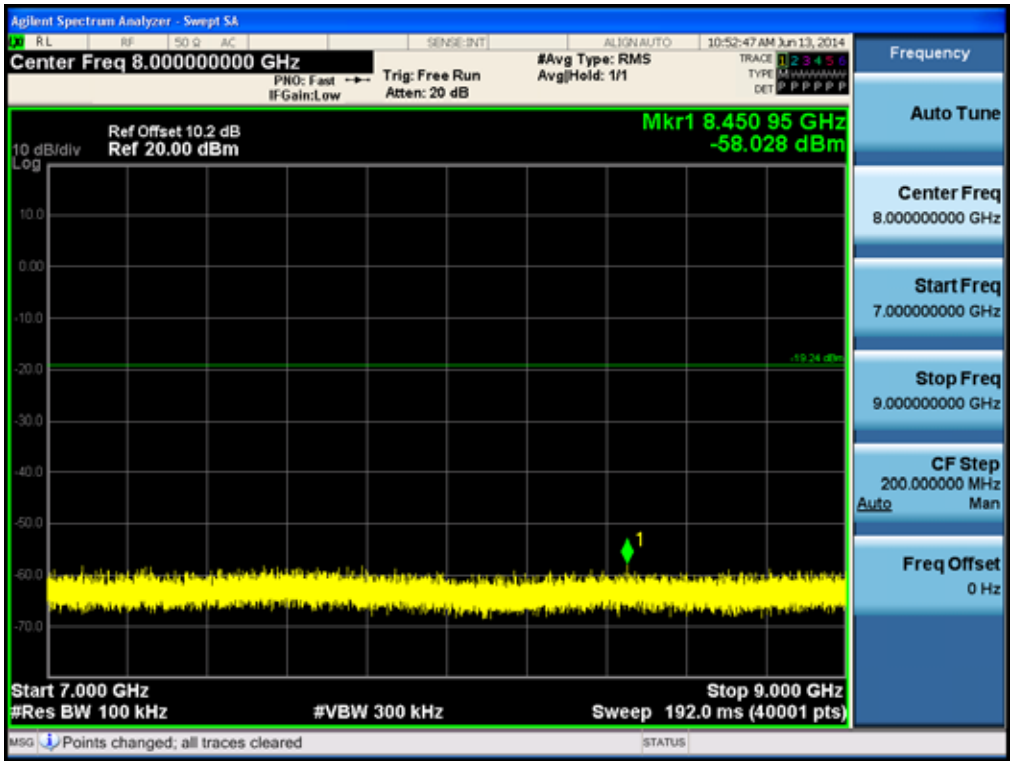

### 5 GHz ~ 7 GHz

**Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)**



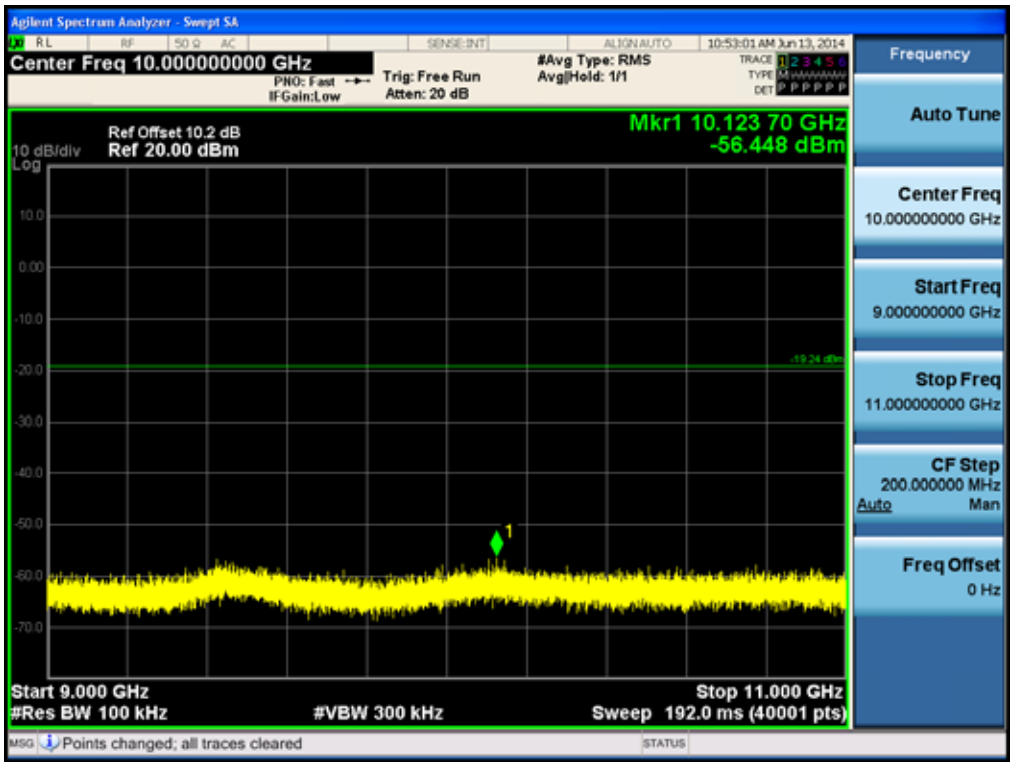
## 7 GHz ~ 9 GHz

### Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



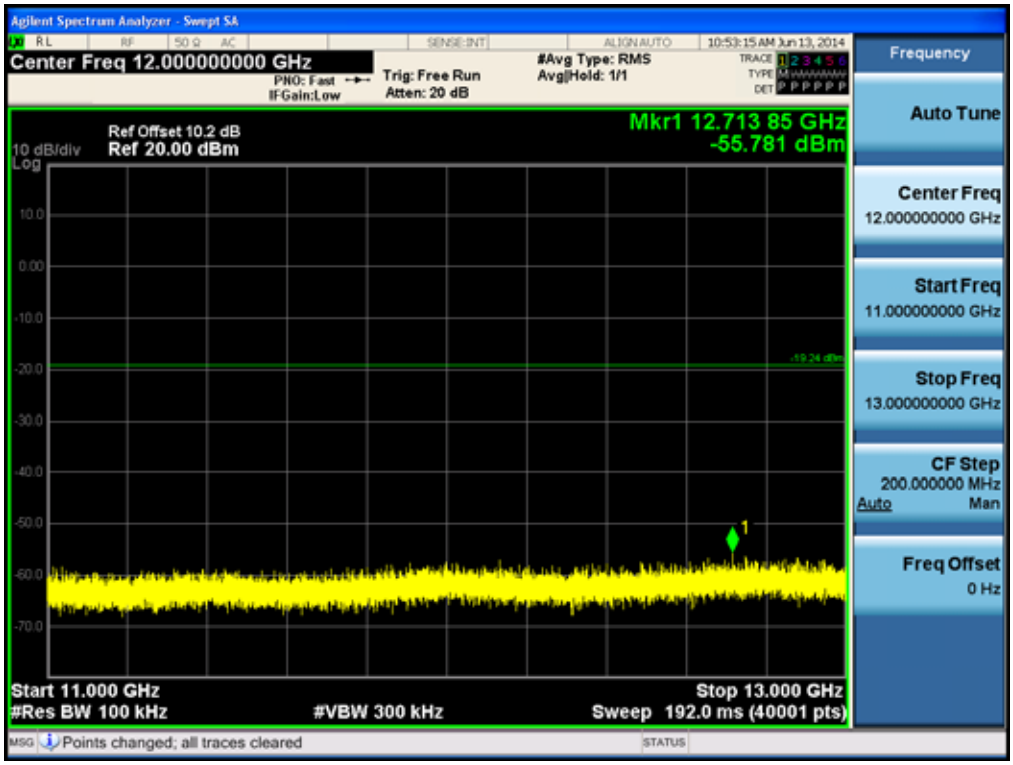

## 9 GHz ~ 11 GHz

### Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



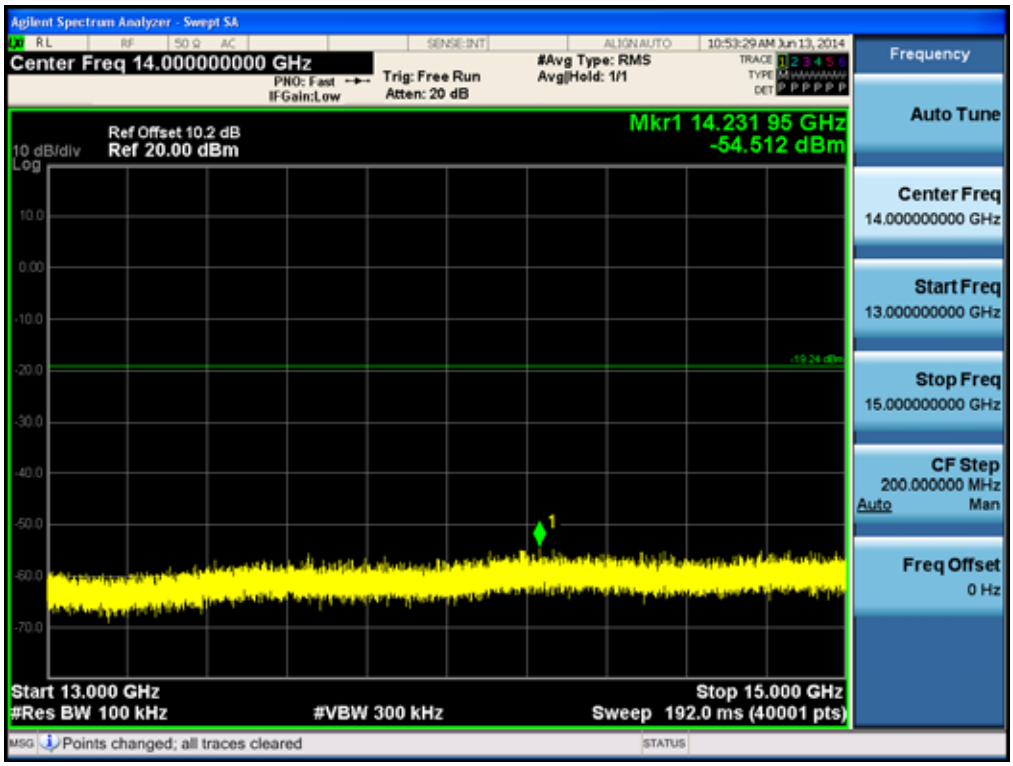
## 11 GHz ~ 13 GHz

### Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



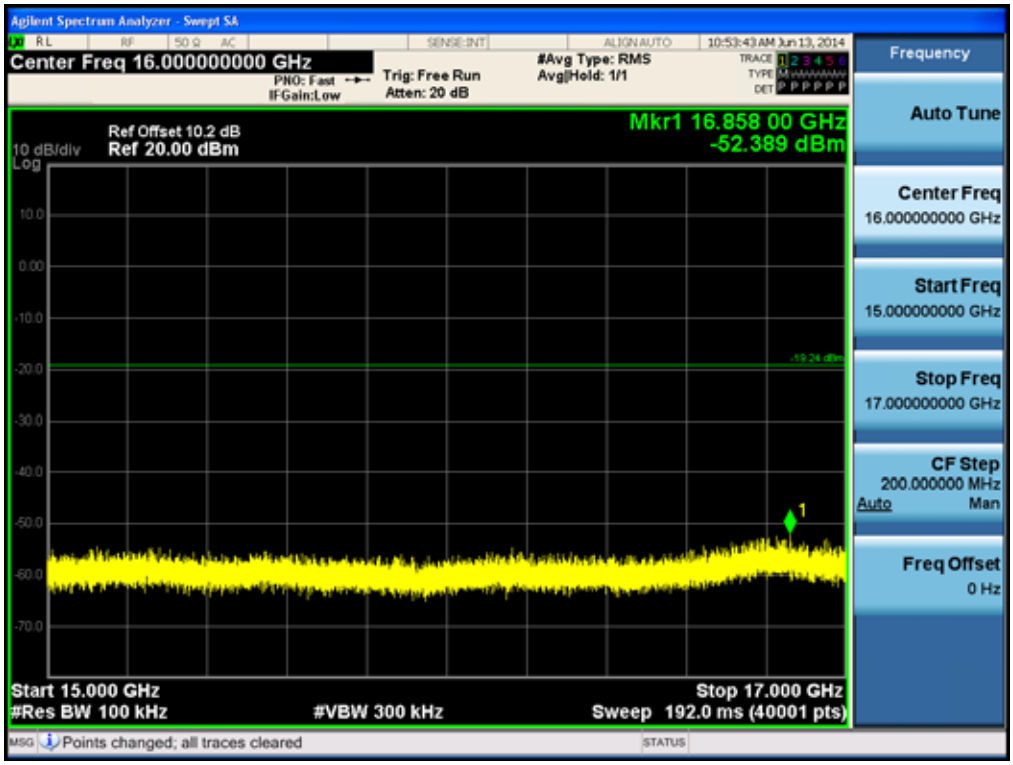

## 13 GHz ~ 15 GHz

### Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



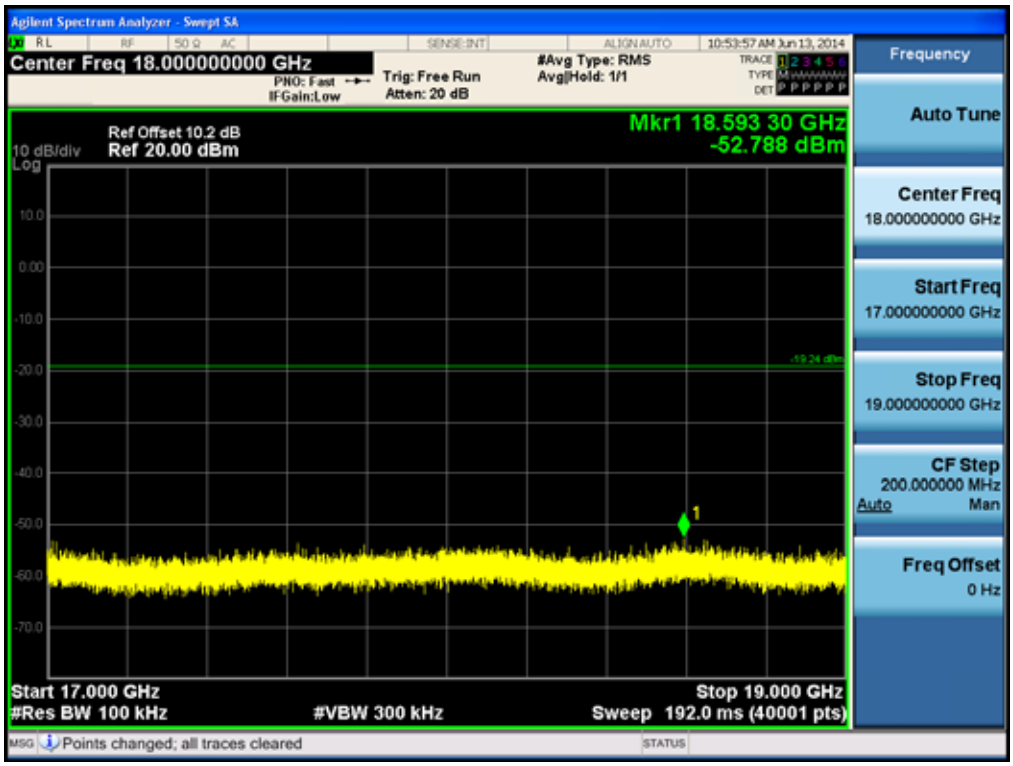
## 15 GHz ~ 17 GHz

### Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



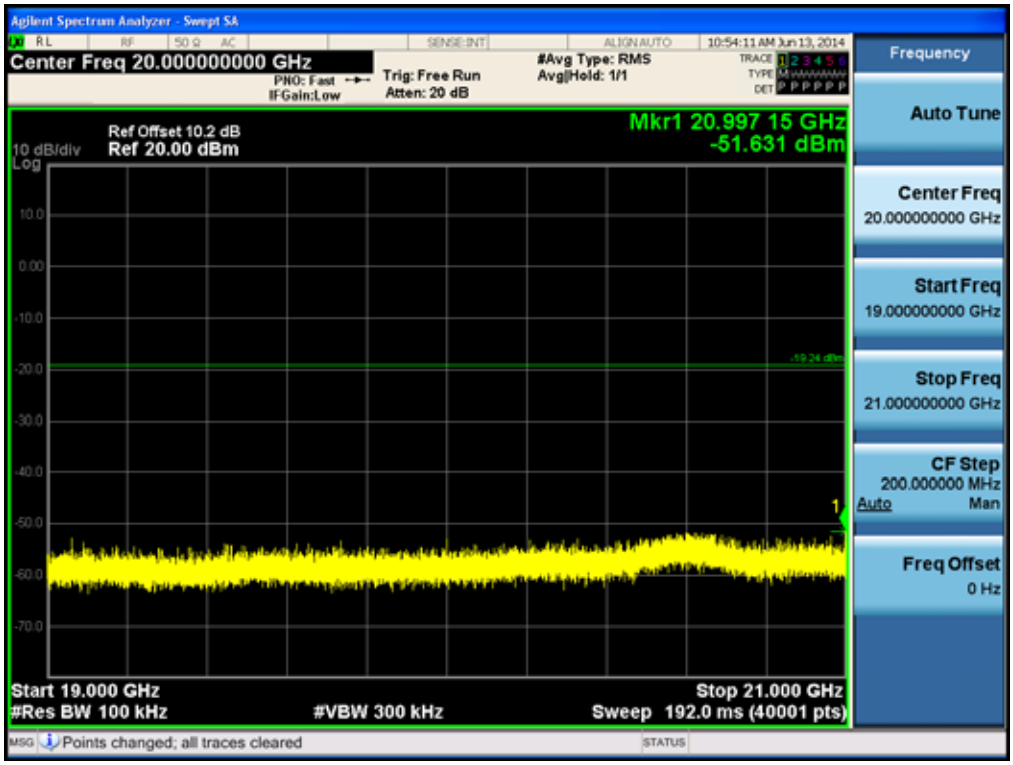

## 17 GHz ~ 19 GHz

### Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



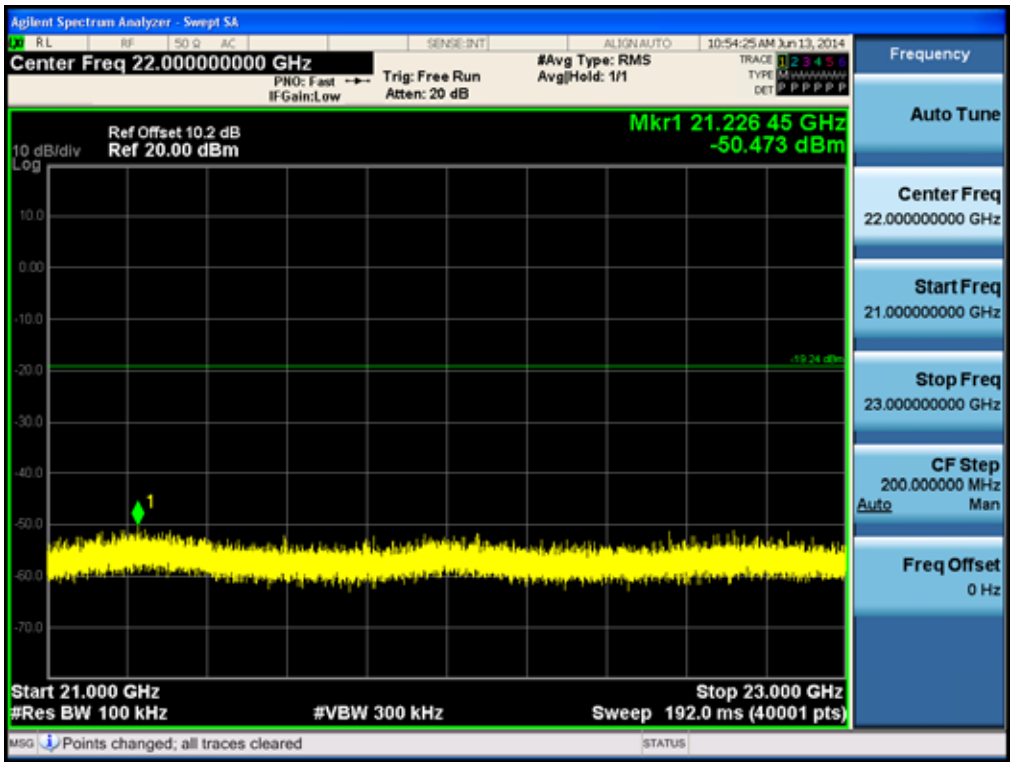
## 19 GHz ~ 21 GHz

### Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



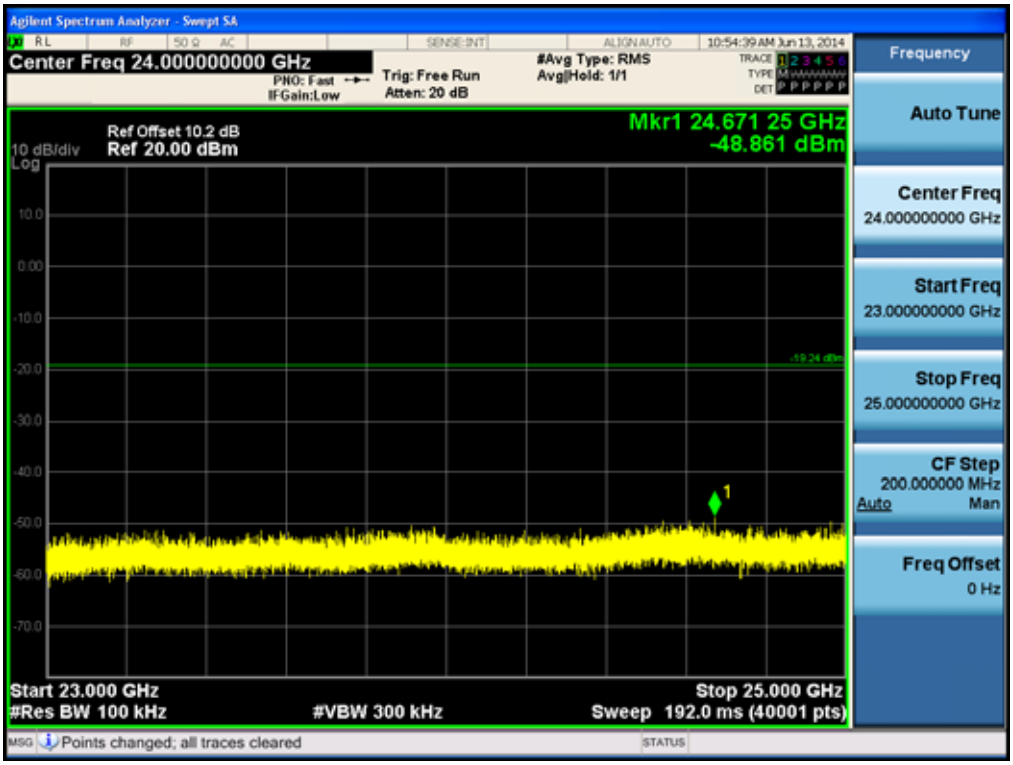

## 21 GHz ~ 23 GHz

### Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)



23 GHz ~ 25 GHz

**Conducted Spurious Emission (802.11g_Ch.1_6 Mbps)**



## 8.6 RADIATED MEASUREMENT.

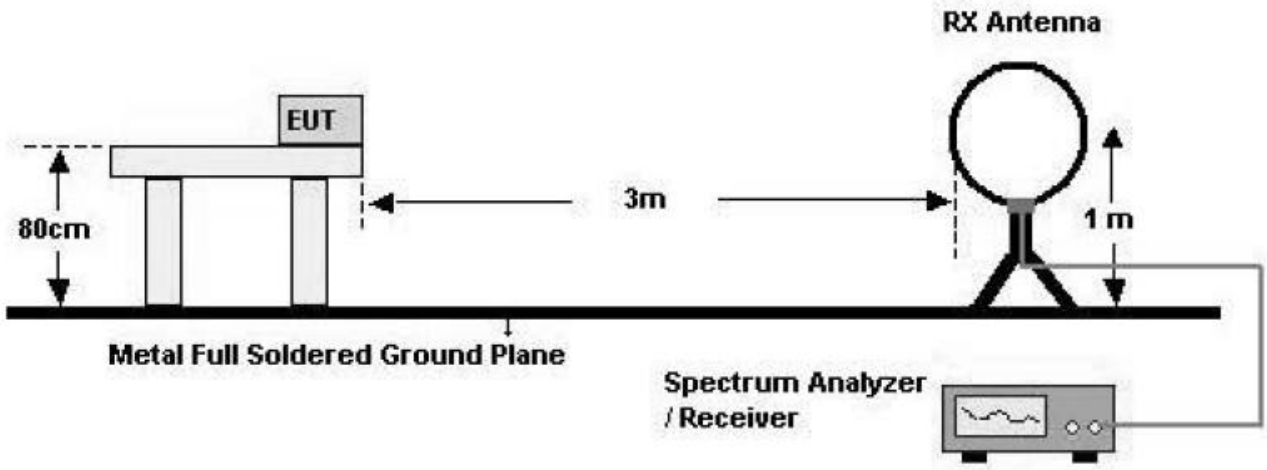
### 8.6.1 RADIATED SPURIOUS EMISSIONS.

**Test Requirements and limit, §15.205, §15.209**

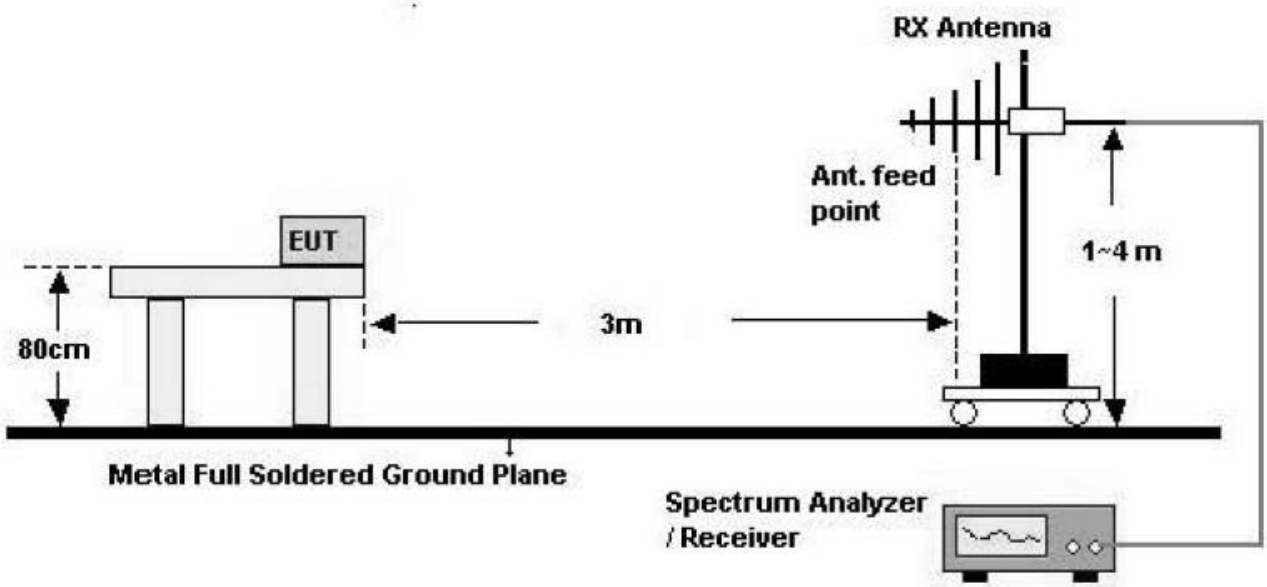
| Frequency (MHz) | Field Strength (uV/m) | Measurement Distance (m) |
|---|---|---|
| 0.009 – 0.490 | 2400/F(kHz) | 300 |
| 0.490 – 1.705 | 24000/F(kHz) | 30 |
| 1.705 – 30 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

## Test Configuration

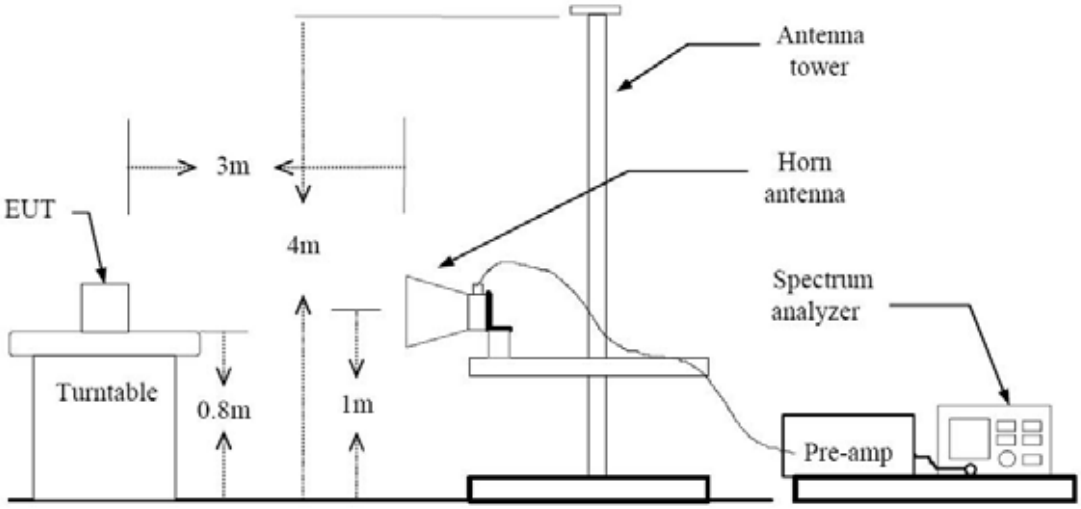
### Below 30 MHz




### 30 MHz - 1 GHz



**Above 1 GHz**




## TEST PROCEDURE USED

Method 12.1 in KDB 558074, issued 06/05/2014

Spectrum Setting

- Peak

Peak emission levels are measured by setting the instrument as follows:

RBW = cf. Table 1.

VBW ≥ 3 x RBW.

Detector = Peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweeps to continue until the trace stabilizes.

(Note that the required measurement time may be longer for low duty cycle applications).

**Table 1 —RBW as a function of frequency**

| Frequency | RBW |
|---|---|
| 9-150 kHz | 200-300 Hz |
| 0.15-30 MHz | 9-10 kHz |
| 30-1000 MHz | 100-120 kHz |
| > 1000 MHz | 1 MHz |

- Average

Set RBW = 1 MHz

Set VBW ≥ 1/T.( at least 100 times less than the resolution bandwidth, but no less than 10 Hz.)

Select spectrum analyzer linear display mode.

Detector = Peak.

Sweep time = auto.

Trace mode = max hold.

**Note :**

1. We are performed the RSE and radiated band edge using standard radiated method.
2. The actual setting value of VBW for 802.11 b/g/n

| Mode | Worst Data rate (Mbps) | $T_{on}$ (ms) | $T_{total}$ (ms) | Duty Cycle (%) | VBW(1/T) (Hz) | The actual setting value of VBW (Hz) |
|---|---|---|---|---|---|---|
| b | 1 | 8.580 | 8.730 | 98.28 | 117 | 1000 |
| g | 6 | 1.425 | 1.530 | 93.14 | 702 | 1000 |
| n | 6.5 | 1.332 | 1.434 | 92.89 | 751 | 1000 |

**9 kHz – 30MHz**

**Operation Mode:** Normal Mode

| Frequency | Reading | Ant. factor | Cable loss | Ant. POL | Total | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | dBμV | dB /m | dB | (H/V) | dBμV/m | dBμV/m | dB |
| No Critical peaks found | | | | | | | |

**Notes:**

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

**Below 1 GHz**

**Operation Mode:** Normal Mode

| Frequency | Reading | Ant. factor | Cable loss | Ant. POL | Total | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | dBμV | dB /m | dB | (H/V) | dBμV/m | dBμV/m | dB |
| No Critical peaks found | | | | | | | |

**Notes:**

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

**Above 1 GHz**

| | |
|---|---|
| Operation Mode: | 802.11 b |
| Transfer Rate: | 1 Mbps |
| Operating Frequency | 2412 |
| Channel No. | 01 Ch |

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4824 | 52.01 | -4.25 | V | 47.76 | 73.98 | 26.22 | PK |
| 4824 | 38.63 | -4.25 | V | 34.38 | 53.98 | 19.60 | AV |
| 7236 | 53.90 | 5.21 | V | 59.11 | 73.98 | 14.87 | PK |
| 7236 | 42.46 | 5.21 | V | 47.67 | 53.98 | 6.31 | AV |
| 4824 | 52.69 | -4.25 | H | 48.44 | 73.98 | 25.54 | PK |
| 4824 | 41.23 | -4.25 | H | 36.98 | 53.98 | 17.00 | AV |
| 7236 | 52.51 | 5.21 | H | 57.72 | 73.98 | 16.26 | PK |
| 7236 | 38.87 | 5.21 | H | 44.08 | 53.98 | 9.90 | AV |

| | |
|---|---|
| Operation Mode: | 802.11 g |
| Transfer Rate: | 6 Mbps |
| Operating Frequency | 2412 |
| Channel No. | 01 Ch |

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4824 | 52.33 | -4.25 | V | 48.08 | 73.98 | 25.90 | PK |
| 4824 | 38.48 | -4.25 | V | 34.23 | 53.98 | 19.75 | AV |
| 7236 | 51.29 | 5.21 | V | 56.50 | 73.98 | 17.48 | PK |
| 7236 | 41.65 | 5.21 | V | 46.86 | 53.98 | 7.12 | AV |
| 4824 | 52.79 | -4.25 | H | 48.54 | 73.98 | 25.44 | PK |
| 4824 | 38.63 | -4.25 | H | 34.38 | 53.98 | 19.60 | AV |
| 7236 | 51.58 | 5.21 | H | 56.79 | 73.98 | 17.19 | PK |
| 7236 | 38.43 | 5.21 | H | 43.64 | 53.98 | 10.34 | AV |

| | |
|---|---|
| Operation Mode: | 802.11 n |
| Transfer Rate: | 6.5 Mbps |
| Operating Frequency | 2412 |
| Channel No. | 01 Ch |

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4824 | 52.43 | -4.25 | V | 48.18 | 73.98 | 25.80 | PK |
| 4824 | 38.21 | -4.25 | V | 33.96 | 53.98 | 20.02 | AV |
| 7236 | 53.29 | 5.21 | V | 58.50 | 73.98 | 15.48 | PK |
| 7236 | 41.29 | 5.21 | V | 46.50 | 53.98 | 7.48 | AV |
| 4824 | 52.49 | -4.25 | H | 48.24 | 73.98 | 25.74 | PK |
| 4824 | 38.44 | -4.25 | H | 34.19 | 53.98 | 19.79 | AV |
| 7236 | 51.77 | 5.21 | H | 56.98 | 73.98 | 17.00 | PK |
| 7236 | 38.07 | 5.21 | H | 43.28 | 53.98 | 10.70 | AV |

**Notes:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Operation Mode: 802.11 b

Transfer Rate: 1 Mbps

Operating Frequency 2437

Channel No. 06 Ch

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4874 | 51.58 | -3.93 | V | 47.65 | 73.98 | 26.33 | PK |
| 4874 | 38.11 | -3.93 | V | 34.18 | 53.98 | 19.80 | AV |
| 7311 | 53.21 | 4.97 | V | 58.18 | 73.98 | 15.80 | PK |
| 7311 | 41.95 | 4.97 | V | 46.92 | 53.98 | 7.06 | AV |
| 4874 | 51.75 | -3.93 | H | 47.82 | 73.98 | 26.16 | PK |
| 4874 | 39.24 | -3.93 | H | 35.31 | 53.98 | 18.67 | AV |
| 7311 | 52.18 | 4.97 | H | 57.15 | 73.98 | 16.83 | PK |
| 7311 | 38.12 | 4.97 | H | 43.09 | 53.98 | 10.89 | AV |

Operation Mode: 802.11 g

Transfer Rate: 6 Mbps

Operating Frequency 2437

Channel No. 06 Ch

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4874 | 51.33 | -3.93 | V | 47.40 | 73.98 | 26.58 | PK |
| 4874 | 37.83 | -3.93 | V | 33.90 | 53.98 | 20.08 | AV |
| 7311 | 54.79 | 4.97 | V | 59.76 | 73.98 | 14.22 | PK |
| 7311 | 39.56 | 4.97 | V | 44.53 | 53.98 | 9.45 | AV |
| 4874 | 51.70 | -3.93 | H | 47.77 | 73.98 | 26.21 | PK |
| 4874 | 37.97 | -3.93 | H | 34.04 | 53.98 | 19.94 | AV |
| 7311 | 52.25 | 4.97 | H | 57.22 | 73.98 | 16.76 | PK |
| 7311 | 37.80 | 4.97 | H | 42.77 | 53.98 | 11.21 | AV |

| | |
|---|---|
| Operation Mode: | 802.11 n |
| Transfer Rate: | 6.5 Mbps |
| Operating Frequency | 2437 |
| Channel No. | 06 Ch |

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4874 | 52.65 | -3.93 | V | 48.72 | 73.98 | 25.26 | PK |
| 4874 | 37.45 | -3.93 | V | 33.52 | 53.98 | 20.46 | AV |
| 7311 | 51.43 | 4.97 | V | 56.40 | 73.98 | 17.58 | PK |
| 7311 | 39.94 | 4.97 | V | 44.91 | 53.98 | 9.07 | AV |
| 4874 | 51.56 | -3.93 | H | 47.63 | 73.98 | 26.35 | PK |
| 4874 | 37.78 | -3.93 | H | 33.85 | 53.98 | 20.13 | AV |
| 7311 | 51.94 | 4.97 | H | 56.91 | 73.98 | 17.07 | PK |
| 7311 | 38.20 | 4.97 | H | 43.17 | 53.98 | 10.81 | AV |

**Notes:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Operation Mode: 802.11 b

Transfer Rate: 1 Mbps

Operating Frequency 2462

Channel No. 11 Ch

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4924 | 51.24 | -3.75 | V | 47.49 | 73.98 | 26.49 | PK |
| 4924 | 38.02 | -3.75 | V | 34.27 | 53.98 | 19.71 | AV |
| 7386 | 53.05 | 5.60 | V | 58.65 | 73.98 | 15.33 | PK |
| 7386 | 42.21 | 5.60 | V | 47.81 | 53.98 | 6.17 | AV |
| 4924 | 51.23 | -3.75 | H | 47.48 | 73.98 | 26.50 | PK |
| 4924 | 37.91 | -3.75 | H | 34.16 | 53.98 | 19.82 | AV |
| 7386 | 52.68 | 5.60 | H | 58.28 | 73.98 | 15.70 | PK |
| 7386 | 40.43 | 5.60 | H | 46.03 | 53.98 | 7.95 | AV |

Operation Mode: 802.11 g

Transfer Rate: 6 Mbps

Operating Frequency 2462

Channel No. 11 Ch

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4924 | 51.49 | -3.75 | V | 47.74 | 73.98 | 26.24 | PK |
| 4924 | 38.25 | -3.75 | V | 34.50 | 53.98 | 19.48 | AV |
| 7386 | 53.87 | 5.60 | V | 59.47 | 73.98 | 14.51 | PK |
| 7386 | 41.98 | 5.60 | V | 47.58 | 53.98 | 6.40 | AV |
| 4924 | 51.53 | -3.75 | H | 47.78 | 73.98 | 26.20 | PK |
| 4924 | 37.39 | -3.75 | H | 33.64 | 53.98 | 20.34 | AV |
| 7386 | 52.41 | 5.60 | H | 58.01 | 73.98 | 15.97 | PK |
| 7386 | 38.56 | 5.60 | H | 44.16 | 53.98 | 9.82 | AV |

| | |
|---|---|
| Operation Mode: | 802.11 n |
| Transfer Rate: | 6.5 Mbps |
| Operating Frequency | 2462 |
| Channel No. | 11 Ch |

| Frequency [MHz] | Reading dBuV | AN.+CL-AMP G [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 4924 | 51.48 | -3.75 | V | 47.73 | 73.98 | 26.25 | PK |
| 4924 | 38.16 | -3.75 | V | 34.41 | 53.98 | 19.57 | AV |
| 7386 | 53.24 | 5.60 | V | 58.84 | 73.98 | 15.14 | PK |
| 7386 | 42.02 | 5.60 | V | 47.62 | 53.98 | 6.36 | AV |
| 4924 | 51.72 | -3.75 | H | 47.97 | 73.98 | 26.01 | PK |
| 4924 | 37.52 | -3.75 | H | 33.77 | 53.98 | 20.21 | AV |
| 7386 | 52.29 | 5.60 | H | 57.89 | 73.98 | 16.09 | PK |
| 7386 | 38.61 | 5.60 | H | 44.21 | 53.98 | 9.77 | AV |

**Notes:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
5. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

## 8.6.2 RADIATED RESTRICTED BAND EDGES

### Test Requirements and limit, §15.247(d) §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c)).

| | |
|---|---|
| Operation Mode: | 802.11g |
| Transfer Rate: | 6 Mbps |
| Operating Frequency | 2412 MHz, 2462 MHz |
| Channel No. | 01 Ch, 11 Ch |

| Frequency [MHz] | Reading dBuV | AN.+CL [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 2390.0 | 31.52 | 33.90 | H | 65.42 | 73.98 | 8.56 | PK |
| 2390.0 | 15.35 | 33.90 | H | 49.25 | 53.98 | 4.73 | AV |
| 2390.0 | 28.54 | 33.90 | V | 62.44 | 73.98 | 11.54 | PK |
| 2390.0 | 14.11 | 33.90 | V | 48.01 | 53.98 | 5.97 | AV |
| 2483.5 | 32.84 | 33.99 | H | 66.83 | 73.98 | 7.15 | PK |
| 2483.5 | 14.43 | 33.99 | H | 48.42 | 53.98 | 5.56 | AV |
| 2483.5 | 27.62 | 33.99 | V | 61.61 | 73.98 | 12.37 | PK |
| 2483.5 | 12.58 | 33.99 | V | 46.57 | 53.98 | 7.41 | AV |

Operation Mode: 802.11b

Transfer Rate: 1 Mbps

Operating Frequency 2412 MHz, 2462 MHz

Channel No. 01 Ch, 11 Ch

| Frequency [MHz] | Reading dBuV | AN.+CL [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 2390.0 | 27.17 | 33.90 | H | 61.07 | 73.98 | 12.91 | PK |
| 2390.0 | 16.09 | 33.90 | H | 49.99 | 53.98 | 3.99 | AV |
| 2390.0 | 26.59 | 33.90 | V | 60.49 | 73.98 | 13.49 | PK |
| 2390.0 | 15.48 | 33.90 | V | 49.38 | 53.98 | 4.60 | AV |
| 2483.5 | 25.88 | 33.99 | H | 59.87 | 73.98 | 14.11 | PK |
| 2483.5 | 13.42 | 33.99 | H | 47.41 | 53.98 | 6.57 | AV |
| 2483.5 | 25.64 | 33.99 | V | 59.63 | 73.98 | 14.35 | PK |
| 2483.5 | 12.98 | 33.99 | V | 46.97 | 53.98 | 7.01 | AV |

Operation Mode: 802.11n

Transfer Rate: 6.5 Mbps

Operating Frequency 2412 MHz, 2462 MHz

Channel No. 01 Ch, 11 Ch

| Frequency [MHz] | Reading dBuV | AN.+CL [dB] | ANT. POL [H/V] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Measurement Type |
|---|---|---|---|---|---|---|---|
| 2390.0 | 28.35 | 33.90 | H | 62.25 | 73.98 | 11.73 | PK |
| 2390.0 | 14.79 | 33.90 | H | 48.69 | 53.98 | 5.29 | AV |
| 2390.0 | 27.87 | 33.90 | V | 61.77 | 73.98 | 12.21 | PK |
| 2390.0 | 13.84 | 33.90 | V | 47.74 | 53.98 | 6.24 | AV |
| 2483.5 | 27.49 | 33.99 | H | 61.48 | 73.98 | 12.50 | PK |
| 2483.5 | 13.59 | 33.99 | H | 47.58 | 53.98 | 6.40 | AV |
| 2483.5 | 27.12 | 33.99 | V | 61.11 | 73.98 | 12.87 | PK |
| 2483.5 | 12.68 | 33.99 | V | 46.67 | 53.98 | 7.31 | AV |

**Notes:**

1. Total = Reading Value + Antenna Factor + Cable Loss
2. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

## 8.7 POWERLINE CONDUCTED EMISSIONS

**Test Requirements and limit, §15.207**

For an intentional radiator which is designed to be connected to the public utility (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 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

| Frequency Range (MHz) | Limits (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

**Test Configuration**

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

**TEST PROCEDURE**

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.
5. We are performed the AC Power Line Conducted Emission test for 6 Mbps, Ch.1 and 802.11g Because 802.11g mode is worst case.

## ▣ RESULT PLOTS

### Conducted Emissions (Line 1)

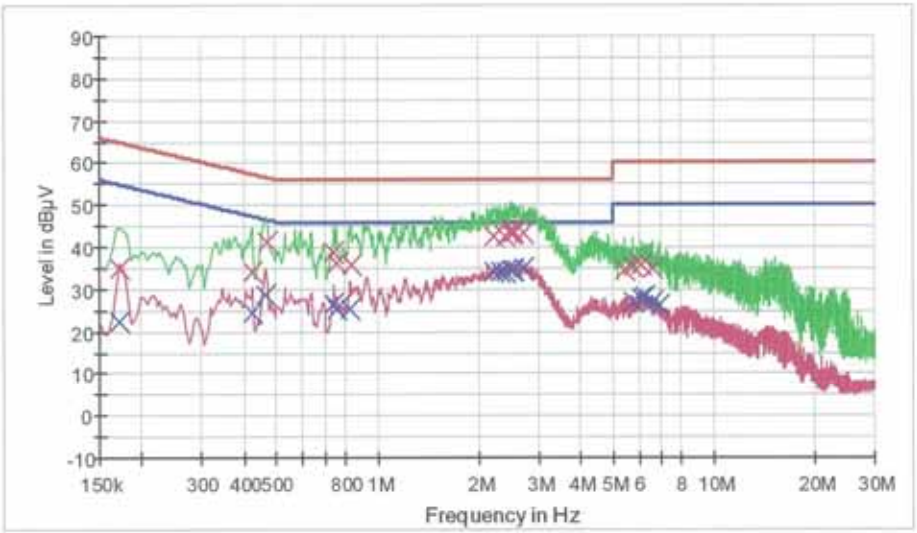
EMI Auto Test(2) 1 / 2

# HCT TEST Report

## Common Information

| | |
|---|---|
| EUT: | SM-G313HU/DS |
| Manufacturer: | SAMSUNG |
| Test Site: | SHIELD ROOM |
| Operating Conditions: | WLAN MODE |
| Operator Name: | KH-SEO |

FCC CLASS B




FCC CLASS B_QP
Preview Result 2-AVG
FCC CLASS B_AV
Final Result 1-QPK
Preview Result 1-PK+
Final Result 2-CAV

## Final Result 1

| Frequency (MHz) | QuasiPeak (dBµV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|
| 0.172500 | 34.8 | 9.000 | Off | L1 | 9.7 | 30.0 | 64.8 |
| 0.424500 | 34.2 | 9.000 | Off | L1 | 9.7 | 23.2 | 57.4 |
| 0.469500 | 41.4 | 9.000 | Off | L1 | 9.7 | 15.1 | 56.5 |
| 0.743000 | 38.7 | 9.000 | Off | L1 | 9.7 | 17.3 | 56.0 |
| 0.756500 | 36.3 | 9.000 | Off | L1 | 9.7 | 19.7 | 56.0 |
| 0.837500 | 35.9 | 9.000 | Off | L1 | 9.7 | 20.1 | 56.0 |
| 2.223500 | 42.5 | 9.000 | Off | L1 | 9.9 | 13.5 | 56.0 |
| 2.408000 | 42.7 | 9.000 | Off | L1 | 9.9 | 13.3 | 56.0 |
| 2.493500 | 43.3 | 9.000 | Off | L1 | 9.9 | 12.7 | 56.0 |
| 2.511500 | 44.2 | 9.000 | Off | L1 | 9.9 | 11.8 | 56.0 |
| 2.556500 | 43.3 | 9.000 | Off | L1 | 9.9 | 12.7 | 56.0 |
| 2.723000 | 43.3 | 9.000 | Off | L1 | 9.9 | 12.7 | 56.0 |
| 5.423000 | 34.6 | 9.000 | Off | L1 | 10.1 | 25.4 | 60.0 |
| 5.733500 | 35.5 | 9.000 | Off | L1 | 10.2 | 24.5 | 60.0 |
| 6.071000 | 35.6 | 9.000 | Off | L1 | 10.2 | 24.4 | 60.0 |
| 6.089000 | 35.8 | 9.000 | Off | L1 | 10.2 | 24.2 | 60.0 |

6/10/2014 11:28:12

EMI Auto Test(2) 2 / 2

| Frequency (MHz) | QuasiPeak (dBµV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|
| 6.107000 | 35.9 | 9.000 | Off | L1 | 10.2 | 24.1 | 60.0 |
| 6.548000 | 35.0 | 9.000 | Off | L1 | 10.2 | 25.0 | 60.0 |

## Final Result 2

| Frequency (MHz) | CAverage (dBµV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|
| 0.172500 | 22.2 | 9.000 | Off | L1 | 9.7 | 32.6 | 54.8 |
| 0.424500 | 24.5 | 9.000 | Off | L1 | 9.7 | 22.9 | 47.4 |
| 0.465000 | 28.5 | 9.000 | Off | L1 | 9.7 | 18.1 | 46.6 |
| 0.743000 | 26.4 | 9.000 | Off | L1 | 9.7 | 19.6 | 46.0 |
| 0.756500 | 25.5 | 9.000 | Off | L1 | 9.7 | 20.5 | 46.0 |
| 0.833000 | 25.4 | 9.000 | Off | L1 | 9.7 | 20.6 | 46.0 |
| 2.219000 | 33.9 | 9.000 | Off | L1 | 9.9 | 12.1 | 46.0 |
| 2.313500 | 34.2 | 9.000 | Off | L1 | 9.9 | 11.8 | 46.0 |
| 2.412500 | 34.0 | 9.000 | Off | L1 | 9.9 | 12.0 | 46.0 |
| 2.507000 | 34.5 | 9.000 | Off | L1 | 9.9 | 11.5 | 46.0 |
| 2.556500 | 34.3 | 9.000 | Off | L1 | 9.9 | 11.7 | 46.0 |
| 2.723000 | 34.9 | 9.000 | Off | L1 | 9.9 | 11.1 | 46.0 |
| 5.733500 | 27.1 | 9.000 | Off | L1 | 10.2 | 22.9 | 50.0 |
| 5.756000 | 27.0 | 9.000 | Off | L1 | 10.2 | 23.0 | 50.0 |
| 6.089000 | 27.9 | 9.000 | Off | L1 | 10.2 | 22.1 | 50.0 |
| 6.224000 | 28.0 | 9.000 | Off | L1 | 10.2 | 22.0 | 50.0 |
| 6.570500 | 27.1 | 9.000 | Off | L1 | 10.2 | 22.9 | 50.0 |
| 6.849500 | 26.0 | 9.000 | Off | L1 | 10.2 | 24.0 | 50.0 |

6/10/2014 11:28:12

## Conducted Emissions (Line 2)

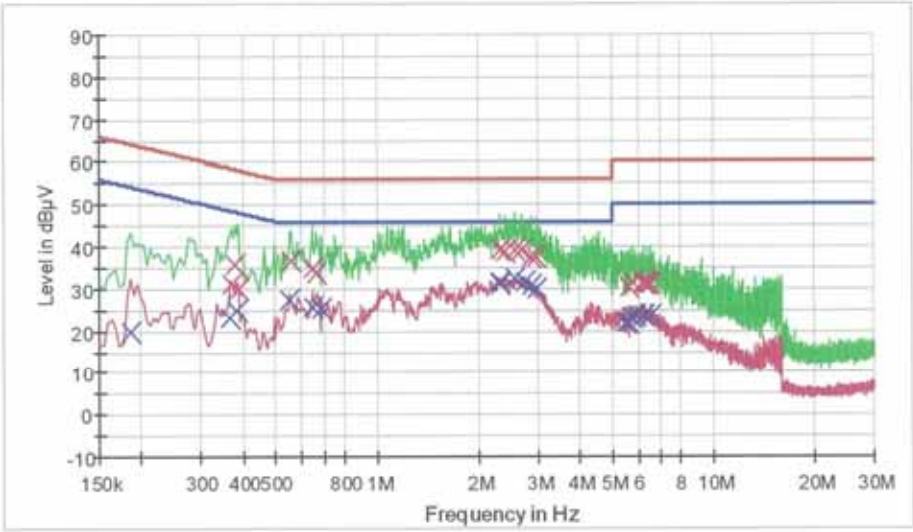
EMI Auto Test(2) 1 / 2

# HCT TEST Report

### Common Information

| | |
|---|---|
| EUT: | SM-G313HU/DS |
| Manufacturer: | SAMSUNG |
| Test Site: | SHIELD ROOM |
| Operating Conditions: | WLAN MODE |
| Operator Name: | KH-SEO |

FCC CLASS B




FCC CLASS B_QP — FCC CLASS B_AV — Preview Result 1-PK+
Preview Result 2-AVG — Final Result 1-QPK — Final Result 2-CAV

### Final Result 1

| Frequency (MHz) | QuasiPeak (dBµV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|
| 0.370500 | 31.3 | 9.000 | Off | N | 9.7 | 27.2 | 58.5 |
| 0.379500 | 35.6 | 9.000 | Off | N | 9.7 | 22.7 | 58.3 |
| 0.388500 | 29.8 | 9.000 | Off | N | 9.7 | 28.3 | 58.1 |
| 0.558500 | 36.7 | 9.000 | Off | N | 9.7 | 19.3 | 56.0 |
| 0.644000 | 35.1 | 9.000 | Off | N | 9.7 | 20.9 | 56.0 |
| 0.662000 | 33.6 | 9.000 | Off | N | 9.7 | 22.4 | 56.0 |
| 2.327000 | 39.2 | 9.000 | Off | N | 9.9 | 16.8 | 56.0 |
| 2.412500 | 38.7 | 9.000 | Off | N | 9.9 | 17.3 | 56.0 |
| 2.565500 | 39.4 | 9.000 | Off | N | 9.9 | 16.6 | 56.0 |
| 2.687000 | 39.2 | 9.000 | Off | N | 9.9 | 16.8 | 56.0 |
| 2.867000 | 37.7 | 9.000 | Off | N | 9.9 | 18.3 | 56.0 |
| 2.975000 | 37.3 | 9.000 | Off | N | 9.9 | 18.7 | 56.0 |
| 5.648000 | 30.4 | 9.000 | Off | N | 10.2 | 29.6 | 60.0 |
| 5.715500 | 31.6 | 9.000 | Off | N | 10.2 | 28.4 | 60.0 |
| 6.188000 | 31.5 | 9.000 | Off | N | 10.2 | 28.5 | 60.0 |
| 6.215000 | 31.0 | 9.000 | Off | N | 10.2 | 29.0 | 60.0 |

6/10/2014 11:40:55

EMI Auto Test(2) 2 / 2

| Frequency (MHz) | QuasiPeak (dBµV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|
| 6.332000 | 31.1 | 9.000 | Off | N | 10.2 | 28.9 | 60.0 |
| 6.512000 | 31.1 | 9.000 | Off | N | 10.2 | 28.9 | 60.0 |

## Final Result 2

| Frequency (MHz) | CAverage (dBµV) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|
| 0.186000 | 19.9 | 9.000 | Off | N | 9.7 | 34.3 | 54.2 |
| 0.366000 | 23.3 | 9.000 | Off | N | 9.7 | 25.3 | 48.6 |
| 0.384000 | 24.7 | 9.000 | Off | N | 9.7 | 23.5 | 48.2 |
| 0.554000 | 27.2 | 9.000 | Off | N | 9.7 | 18.8 | 46.0 |
| 0.644000 | 25.7 | 9.000 | Off | N | 9.7 | 20.3 | 46.0 |
| 0.684500 | 25.4 | 9.000 | Off | N | 9.7 | 20.6 | 46.0 |
| 2.318000 | 31.2 | 9.000 | Off | N | 9.9 | 14.8 | 46.0 |
| 2.327000 | 31.6 | 9.000 | Off | N | 9.9 | 14.4 | 46.0 |
| 2.583500 | 32.5 | 9.000 | Off | N | 9.9 | 13.5 | 46.0 |
| 2.741000 | 31.6 | 9.000 | Off | N | 9.9 | 14.4 | 46.0 |
| 2.894000 | 30.6 | 9.000 | Off | N | 9.9 | 15.4 | 46.0 |
| 2.970500 | 29.9 | 9.000 | Off | N | 9.9 | 16.1 | 46.0 |
| 5.486000 | 21.7 | 9.000 | Off | N | 10.1 | 28.3 | 50.0 |
| 5.648000 | 21.8 | 9.000 | Off | N | 10.2 | 28.2 | 50.0 |
| 5.715500 | 23.1 | 9.000 | Off | N | 10.2 | 26.9 | 50.0 |
| 5.895500 | 23.6 | 9.000 | Off | N | 10.2 | 26.4 | 50.0 |
| 6.215000 | 23.6 | 9.000 | Off | N | 10.2 | 26.4 | 50.0 |
| 6.516500 | 23.7 | 9.000 | Off | N | 10.2 | 26.3 | 50.0 |

6/10/2014 11:40:55

# 9. LIST OF TEST EQUIPMENT

## 9.1 LIST OF TEST EQUIPMENT(Conducted Test)

| Manufacturer | Model / Equipment | Calibration Date | Calibration Interval | Calibration Due | Serial No. |
|---|---|---|---|---|---|
| Rohde & Schwarz | ENV216/ LISN | 01/29/2014 | Annual | 01/29/2015 | 100073 |
| Agilent | E4440A/ Spectrum Analyzer | 04/09/2014 | Annual | 04/09/2015 | US45303008 |
| Agilent | N9020A/ SIGNAL ANALYZER | 05/23/2014 | Annual | 05/23/2015 | MY51110063 |
| Agilent | N1911A/Power Meter | 01/24/2014 | Annual | 01/24/2015 | MY45100523 |
| Agilent | N1921A /POWER SENSOR | 07/11/2013 | Annual | 07/11/2014 | MY45241059 |
| Hewlett Packard | 11636B/Power Divider | 10/22/2013 | Annual | 10/22/2014 | 11377 |
| Agilent | 87300B/Directional Coupler | 12/18/2013 | Annual | 12/18/2014 | 3116A03621 |
| Hewlett Packard | 11667B / Power Splitter | 01/27/2014 | Annual | 01/27/2015 | 10545 |
| DIGITAL | EP-3010 /DC POWER SUPPLY | 10/29/2013 | Annual | 10/29/2014 | 3110117 |
| ITECH | IT6720 / DC POWER SUPPLY | 11/05/2013 | Annual | 11/05/2014 | 010002156287001199 |
| TESCOM | TC-3000C / BLUETOOTH TESTER | 04/11/2014 | Annual | 04/11/2015 | 3000C000276 |
| Rohde & Schwarz | CBT / BLUETOOTH TESTER | 05/07/2014 | Annual | 05/07/2015 | 100422 |
| Agilent | 8493C / Attenuator(10 dB) | 07/24/2013 | Annual | 07/24/2014 | 76649 |
| WEINSCHEL | 2-3 / Attenuator(3 dB) | 10/28/2013 | Annual | 10/28/2014 | BR0617 |

## 9.2 LIST OF TEST EQUIPMENT(Radiated Test)

| Manufacturer | Model / Equipment | Calibration Date | Calibration Interval | Calibration Due | Serial No. |
|---|---|---|---|---|---|
| Schwarzbeck | VULB 9160/ TRILOG Antenna | 12/17/2012 | Biennial | 12/17/2014 | 3150 |
| Rohde & Schwarz | ESCI / EMI TEST RECEIVER | 01/24/2014 | Annual | 01/24/2015 | 100584 |
| HD | MA240/ Antenna Position Tower | N/A | N/A | N/A | 556 |
| EMCO | 1050/ Turn Table | N/A | N/A | N/A | 114 |
| HD GmbH | HD 100/ Controller | N/A | N/A | N/A | 13 |
| HD GmbH | KMS 560/ SlideBar | N/A | N/A | N/A | 12 |
| Rohde & Schwarz | SCU-18/ Signal Conditioning Unit | 09/10/2013 | Annual | 09/10/2014 | 10094 |
| CERNEX | CBL18265035 / POWER AMP | 07/24/2013 | Annual | 07/24/2014 | 22966 |
| CERNEX | CBL26405040 / POWER AMP | 04/04/2014 | Annual | 04/04/2015 | 19660 |
| Schwarzbeck | BBHA 9120D/ Horn Antenna | 07/05/2013 | Biennial | 07/05/2015 | 1151 |
| Schwarzbeck | BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz) | 10/30/2012 | Biennial | 10/30/2014 | BBHA9170124 |
| Rohde & Schwarz | FSP / Spectrum Analyzer | 01/24/2014 | Annual | 01/24/2015 | 839117/011 |
| Wainwright Instrument | WHF3.0/18G-10EF / High Pass Filter | 02/03/2014 | Annual | 02/03/2015 | F6 |
| Wainwright Instrument | WHNX6.0/26.5G-6SS / High Pass Filter | 04/09/2014 | Annual | 04/09/2015 | 1 |
| Wainwright Instrument | WHNX7.0/18G-8SS / High Pass Filter | 04/04/2014 | Annual | 04/04/2015 | 29 |
| Wainwright Instrument | WRCJ2400/2483.5-2370/2520-60/14SS / Band Reject Filter | 06/24/2013 | Annual | 06/24/2014 | 1 |
| TESCOM | TC-3000C / BLUETOOTH TESTER | 04/11/2014 | Annual | 04/11/2015 | 3000C000276 |
| Rohde & Schwarz | CBT / BLUETOOTH TESTER | 05/07/2014 | Annual | 05/07/2015 | 100422 |
| Rohde & Schwarz | LOOP ANTENNA | 08/14/2012 | Biennial | 08/14/2014 | 100179 |
| CERNEX | CBL06185030 / POWER AMP | 07/24/2013 | Annual | 07/24/2014 | 22965 |
| CERNEX | CBLU1183540 / POWER AMP | 07/24/2013 | Annual | 07/24/2014 | 22964 |