TÜVRheinland®

**Produkte**
*Products*

| | | |
|---|---|---|
| **Prüfbericht - Nr.:** *Test Report No.:* | **15049495 001** | **Seite 1 von 55** *Page 1 of 55* |
| **Auftraggeber:** *Client:* | **Amp'ed RF Technology Inc.** 1879 Lundy Ave, Suite 138, San Jose, CA95131, USA | |
| **Gegenstand der Prüfung:** *Test Item:* | **Bluetooth Module** | |
| **Bezeichnung:** *Identification:* | **BT33** | **Serien-Nr.:** *Serial No.:* **Engineering sample** |
| **Wareneingangs-Nr.:** *Receipt No.:* | **153186975** | **Eingangsdatum:** *Date of Receipt:* **2012-02-20** |
| **Prüfort:** *Testing Location:* | **TÜV Rheinland (Shanghai) Co., Ltd.** Building 2, No. 777 Guangzhong Road West, Shanghai 200072, P.R. China | |
| **Prüfgrundlage:** *Test Specification:* | **FCC 47 CFR Part 15, Subpart C, Section 15.247 (October 1, 2009)** ANSI C63.4-2003 Public Notice DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems (March 30, 2000) **RSS-210 (Issue 8): 2010** **RSS-Gen (Issue 3): 2010** | |
| **Prüfergebnis:** *Test Result:* | **Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).** *The test item passed the test specification(s).* | |
| **Prüflaboratorium:** *Testing Laboratory:* | **TÜV Rheinland (Shanghai) Co., Ltd.** 10-15/F, Huatsing Building, No.88, Lane 777, Guangzhong Road West, Shanghai 200072, P.R. China | |

| **geprüft/** *tested by:* | | | **kontrolliert/** *reviewed by:* | | |
|---|---|---|---|---|---|
| 2012-04-12 | Shi Li / Inspector | Shi Li | 2012-04-12 | Kong Xiangming / Reviewer | Kong Xiangming |
| **Datum** *Date* | **Name/Stellung** *Name/Position* | **Unterschrift** *Signature* | **Datum** *Date* | **Name/Stellung** *Name/Position* | **Unterschrift** *Signature* |

**Sonstiges /** *Other Aspects:*

| *Abkürzungen:* | | | | *Abbreviations:* | | | |
|---|---|---|---|---|---|---|---|
| | *P(ass)* | = | *entspricht Prüfgrundlage* | | *P(ass)* | = | *passed* |
| | *F(ail)* | = | *entspricht nicht Prüfgrundlage* | | *F(ail)* | = | *failed* |
| | *N/A* | = | *nicht anwendbar* | | *N/A* | = | *not applicable* |
| | *N/T* | = | *nicht getestet* | | *N/T* | = | *not tested* |

# TEST SUMMARY

**3.2.1 VOLTAGE REQUIREMENTS, FCC 15.31(E)**
*RESULT: PASS*

**3.2.2 ANTENNA REQUIREMENTS, FCC 15.203, FCC 15.204 AND RSS-GEN 7.1.4**
*RESULT: PASS*

**5.1.1 CONDUCTED OUTPUT POWER, FCC 15.247(B)(1) AND RSS-210 A8.4(2)**
*RESULT: PASS*

**5.1.2 CARRIER FREQUENCY SEPARATION, FCC 15.247(A)(1) AND RSS-210 A8.1(B)**
*RESULT: PASS*

**5.1.3 20DB BANDWIDTH, FCC 15.247(A)(1) AND RSS-210 A8.1(A)**

**5.1.4 99% BANDWIDTH, RSS-GEN 4.6.1**

**5.1.5 NUMBER OF HOPPING FREQUENCIES, FCC 15.247(A)(1)(III) AND RSS-210 A8.1(D)**
*RESULT: PASS*

**5.1.6 AVERAGE TIME OF OCCUPANCY, FCC 15.247(A)(1)(III) AND RSS-210 A8.1(D)**
*RESULT: PASS*

**5.1.7 CONDUCTED SPURIOUS EMISSION, FCC 15.247(D) AND RSS-210 A8.5**
*RESULT: PASS*

**5.1.8 BAND EDGE COMPLIANCE OF RF CONDUCTED EMISSION, FCC 15.247(D) AND RSS-210 A8.5**
*RESULT: PASS*

**6.1.1 BAND EDGE RADIATED EMISSION, FCC 15.205, FCC 15.209, FCC 15.247(D), RSS-210 2.2, RSS-210 2.6 AND RSS-210 A8.5**
*RESULT: Pass*

**6.1.2 RADIATED SPURIOUS EMISSION OF TRANSMITTER, FCC 15.205, FCC 15.209, FCC 15.247(D), RSS-210 2.2, RSS-210 2.6 AND RSS-210 A8.5**
*RESULT: PASS*

**6.2.1 RADIATED SPURIOUS EMISSION OF RECEIVER, FCC 15.109, RSS-210 2.2, RSS-210 2.6, RSS-210 A8.5, RSS-GEN 7.2.3.2**
*RESULT: PASS*

**7.1.1 AC POWER LINE CONDUCTED EMISSION, FCC 15.207 AND RSS-GEN 7.2.2**
*RESULT: PASS*

# Contents

# 1. General Remarks

## 1.1 Complementary Materials

All attachments are integral parts of this test report.

# 2. Test Sites

## 2.1 Test Facilities

TÜV Rheinland (Shanghai) Co., Ltd.
10-15/F, Huatsing Building, No.88, Lane 777, West Guangzhong Road, Zhabei District
Shanghai 200072, P.R. China

The used test equipment is in accordance with CISPR 16 for measurement of radio interference.

The Federal Communications Commission has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance with the requirements of section 2.948 of the FCC rules. The description of the test facility is listed under FCC registration number 657274.

The Industry Canada has reviewed the technical characteristics of the radiated and conducted emission facility, and has found these test facilities to be in compliance. The description of the test facility is listed under chambers filing number 2932F-1.

## 2.2 List of Test and Measurement Instruments

**Table 1: List of Test and Measurement Equipment**

| Equipment | Model | Serial no. | Cal. due date |
|---|---|---|---|
| 3m modified semi-anechoic chamber | SAC | N/A | 22.11.2012 |
| EMI test receiver | ESCI | 100280 | 22.11.2012 |
| broadband antenna | BTA-H | 040005H | 28.07.2013 |
| Spectrum analyzer | FSP30 | 100192 | 22.05.2012 |
| Broadband coaxial preamplifier | BBV 9718 | 9718-012 | 01.04.2012 |
| Double ridged broadband horn antenna | BBHA 9120 D | 9120D-433 | 15.05.2013 |
| EMI test receiver | ESIB26 | 100227 | 22.05.2012 |
| Artificial mains network | NNB 42 | 04/10048 | 15.02.2013 |

## 2.3 Measurement Uncertainty

**Table 2: Emission Measurement Uncertainty**

| Measurement Type | Frequency | Uncertainty |
|---|---|---|
| Antenna Port Conducted Emission | < 1GHz | ±0.39dB |
| | > 1GHz | ±0.68dB |
| Radiated Emission | 30MHz - 1GHz | ±5.34dB |
| | > 1GHz | ±5.40dB |
| AC Power Line Conducted Emission | 150kHz - 30MHz | ±3.0dB |

# 3. General Product Information

## 3.1 Product Function and Intended Use

The EUT (Equipment Under Test) is a surface mount Bluetooth module supplied on a 16 pin, 6-layer PCB.

## 3.2 System Details

| | |
|---|---|
| Radio standard: | Bluetooth |
| Specified output power: | 5dBm |
| Antenna gain: | 2.1dBi |
| Antenna type: | Internal antenna |
| Antenna mounting type: | Printed |
| Antenna cable length: | N/A |
| Frequency range: | 2402 – 2480MHz |
| Number of channels: | 79 |
| Channel spacing: | 1MHz |
| Modulation type: | GFSK, $\pi$/4-DQPSK or 8DPSK |
| | |
| Rated voltage: | 2.5V |
| Protection class: | III |
| | |
| Test voltage: | 2.5V |

### 3.2.1 Voltage Requirements, FCC 15.31(e)

**RESULT:** **PASS**

The EUT has an internal voltage regulator to supply the RF circuit. Hence it complies with the power supply requirements.

### 3.2.2 Antenna Requirements, FCC 15.203, FCC 15.204 and RSS-Gen 7.1.4

**RESULT:** **PASS**

The EUT has an internal antenna which is not user accessible. Hence it complies with the requirements.

## 3.3 Independent Operation Modes

The EUT was tested on a stand-alone basis (only attached to the test jig) and the test system was configured in a typical fashion (as a customer would normally use it).

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.4:2003. Testing was performed at the lowest operating frequency (2402MHz), at the operating frequency in the middle of the specified frequency band (2441MHz) and at the highest operating frequency (2480MHz) with different modulation types.

The basic operation modes are:

A. EUT transmits (TX mode), with full power, at lowest channel (2402MHz), a continuous modulated signal streaming with 100% duty cycle.

B. EUT transmits (TX mode), with full power, at middle channel (2441MHz), a continuous modulated signal streaming with 100% duty cycle.

C. EUT transmits (TX mode), with full power, at highest channel (2480MHz), a continuous modulated signal streaming with 100% duty cycle.

D. EUT receives (RX mode), at lowest channel (2402MHz)), continuously.

E. EUT receives (RX mode), at middle channel (2441MHz), continuously.

F. EUT receives (RX mode), at highest channel (2480MHz), continuously.

G. EUT transmits on pseudo-random sequence on all channels (hopping mode).

## 3.4 Clock Frequencies

The highest clock frequency generated by the EUT is 13 MHz.

## 3.5 Noise Suppressing Parts

Refer to schematics.

# 4. Test Set-up and Operation Modes

## 4.1 Test Methodology

The test methodology used is based on the requirements of 47 CFR Part 15, Sections 15.31, 15.33, 15.35, 15.205, 15.207, 15.209 and Public Notice DA 00-705.

The test methods, which have been used, are based on ANSI C63.4-2003 and RSS-Gen (Issue 3).

For details, see under each test item.

## 4.2 Physical Configuration for Testing

The EUT was designed to get into related working mode with the control of a laptop computer through RS 232 interface.
Notes:

One test sample was available. Both for antennas conducted measurements and for radiated measurements.

For antenna conducted measurements, the antenna was replaced by a 50Ω antenna connector.

For more details, refer to section: Photographs of the Test Set-Up.

## 4.3 Test Operation and Test Software

Software used for testing: A-COM2 115200 Baud –Amp'ed RF Firmware Test tool -4.2 by client.

This software was running on the laptop computer connected to the EUT. It was used to enable the test operation modes listed in section 3.3 as appropriate.

## 4.4 Special Accessories and Auxiliary Equipment

The product has been tested together with a power adapter (supply power for the module).

## 4.5 Countermeasures to achieve EMC Compliance

No additional measures were employed to achieve compliance.

# 5. Test Results of Conducted Measurements at Antenna Port

## 5.1 Transmitter Parameters

### 5.1.1 Conducted Output Power, FCC 15.247(b)(1) and RSS-210 A8.4(2)

**RESULT:** **PASS**

Date of testing: 2012-03-06

Ambient temperature: 20°C
Relative humidity: 39.6%
Atmospheric pressure: 101.5hPa

Requirements:

For frequency hopping systems operating in the 2400-2483.5MHz band employing at least 75 non-overlapping hopping channels, the maximum peak output power shall be 1W (30dBm). For other hopping systems operating in the 2400-2483.5MHz band, the maximum peak output power shall be 0.125W (21dBm).

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.8 and Public Notice DA 00-705.

The maximum peak output power (conducted) was measured at the antenna connector with a spectrum analyzer. The analyzer resolution bandwidth was set to 3MHz and the video bandwidth to 10MHz.The final measurement takes into account the loss generated by all the involved cables.

**Table 3: Conducted Output Power, Mode A (2402MHz)**

| Data Rate [Mbps] | Reading [dBm] | Correction Factor [dB] | RBW [MHz] | Output Power [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 4.45 | 0.63 | 3 | 4.45 | 21 | 16.55 |
| 2 | 1.82 | 0.63 | 3 | 1.82 | 21 | 19.18 |
| 3 | 1.75 | 0.69 | 3 | 1.75 | 21 | 19.25 |

Notes: Cable loss was included in reading as offset.

### Table 4: Conducted Output Power, Mode B (2441MHz)

| Data Rate [Mbps] | Reading [dBm] | Correction Factor [dB] | RBW [MHz] | Output Power [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 4.73 | 0.63 | 3 | 4.73 | 21 | 16.27 |
| 2 | 2.89 | 0.63 | 3 | 2.89 | 21 | 18.11 |
| 3 | 2.71 | 0.69 | 3 | 2.71 | 21 | 18.29 |

Notes: Cable loss was included in reading as offset.

### Table 5: Conducted Output Power, Mode C (2480MHz)

| Data Rate [Mbps] | Reading [dBm] | Correction Factor [dB] | RBW [MHz] | Output Power [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|
| 1 | 2.42 | 0.63 | 3 | 2.42 | 21 | 18.58 |
| 2 | 0.20 | 0.63 | 3 | 0.20 | 21 | 20.80 |
| 3 | 0.02 | 0.69 | 3 | 0.02 | 21 | 20.98 |

Notes: Cable loss was included in reading as offset.

Remark:

The above results show that the worst case output power is found at the data rate of 1Mbps. Therefore, all the other measurements for the evaluation of the radio properties of the EUT have been performed using this data rate.

## 5.1.2 Carrier Frequency Separation, FCC 15.247(a)(1) and RSS-210 A8.1(b)

**RESULT:** **PASS**

| | |
|---|---|
| Date of testing: | 2012-03-06 |
| Ambient temperature: | 20°C |
| Relative humidity: | 39.6% |
| Atmospheric pressure: | 101.5hPa |

Requirements:

Frequency hopping systems operating in the 2400-2483.5MHz band shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. In case of an output power less than 125mW, the frequency hopping system may have channels separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

Test procedure:

ANSI C63.4-2003 and Public Notice DA 00-705.

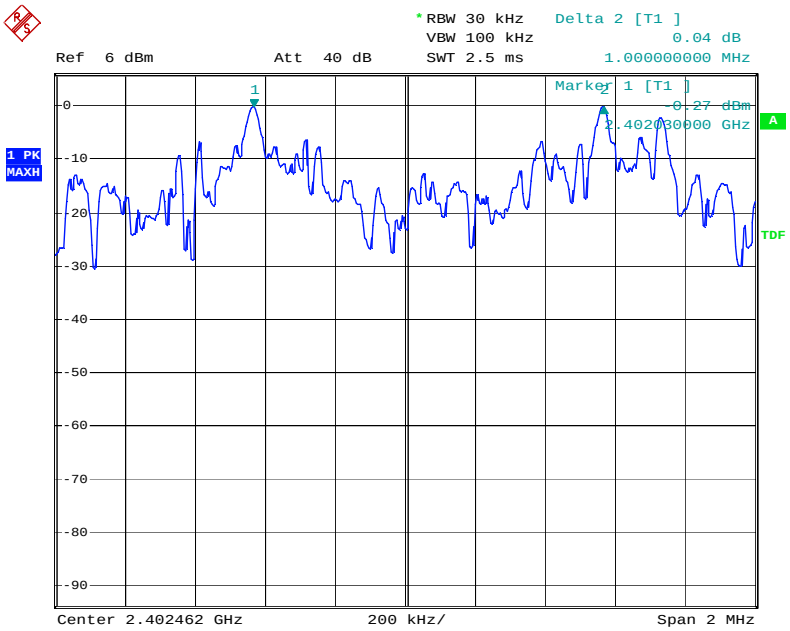
A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 30kHz and the video bandwidth to 100kHz. The Delta Marker function was used to determine the separation between the peaks of two adjacent channels.

## Table 6: Carrier Frequency Separation

| Channel | Channel Separation [kHz] | Limit [kHz] | 20dB Bandwidth [kHz](EDR) | 20dB Bandwidth [kHz](GFSK) |
|---|---|---|---|---|
| Low | 1000 | 818.67 | 1228 | 808 |
| Middle | 1000 | 818.67 | 1228 | 812 |
| High | 1004 | 818.67 | 1228 | 804 |

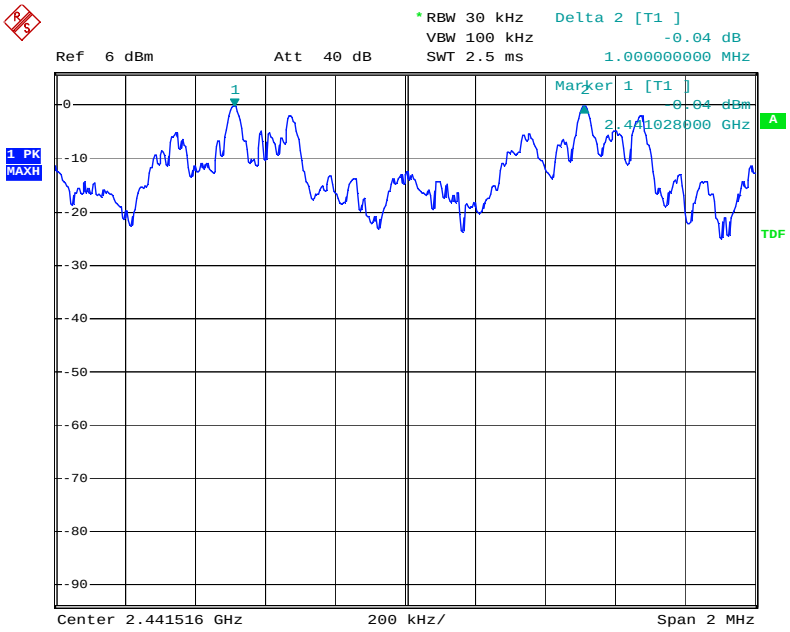
Notes: Limit = 20dB bandwidth(EDR) * 2/3 since the output power is less than 125mW.

## Figure 1: Carrier Frequency Separation-Low Channel



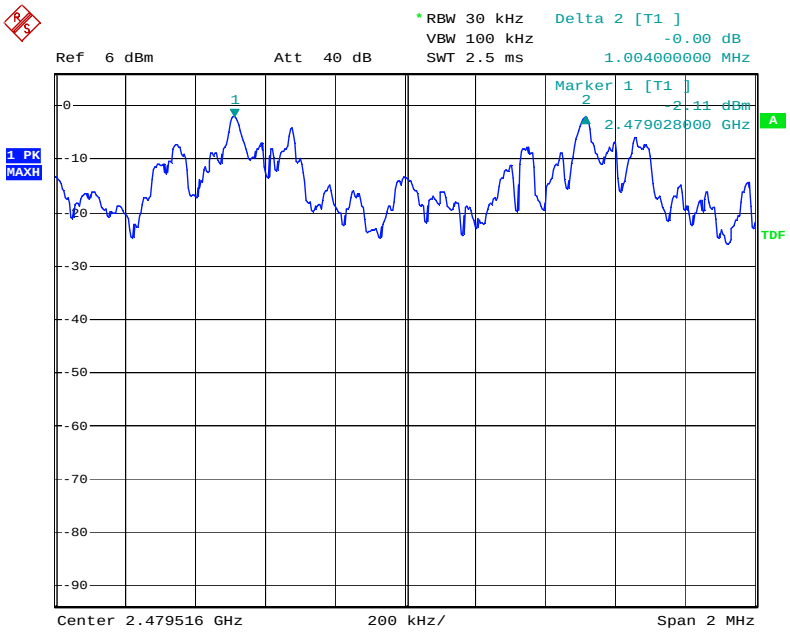

Date: 6.MAR.2012 12:40:28

## Figure 2: Carrier Frequency Separation-Middle Channel




Date: 6.MAR.2012 12:46:10

## Figure 3: Carrier Frequency Separation-High Channel




Date: 6.MAR.2012 12:51:28

## 5.1.3 20dB Bandwidth, FCC 15.247(a)(1) and RSS-210 A8.1(a)

| | |
|---|---|
| Date of testing: | 2012-04-11 |
| Ambient temperature: | 20°C |
| Relative humidity: | 39.6% |
| Atmospheric pressure: | 101.5hPa |

Requirements:

For frequency hopping systems operating in the 2400-2483.5MHz band, no bandwidth limit is specified. Test data is provided for reference.

Test procedure:

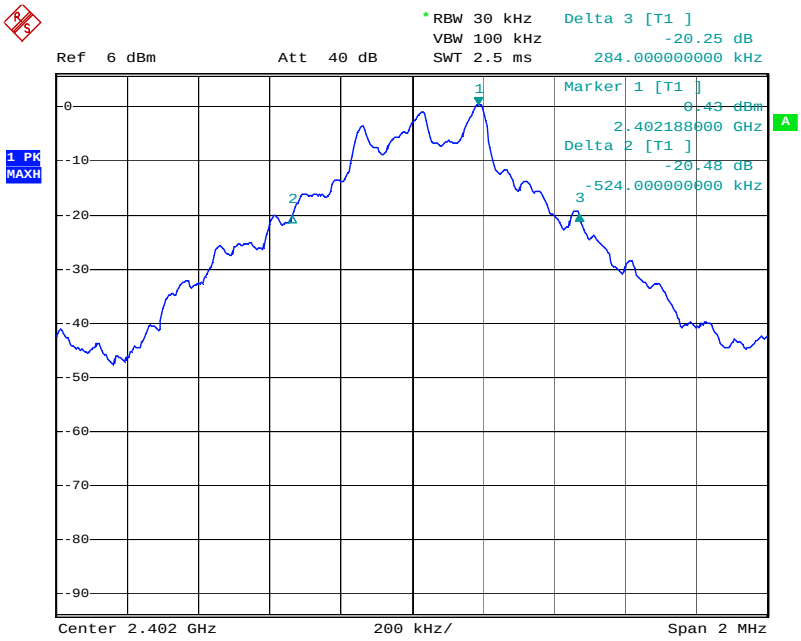
ANSI C63.4-2003, RSS-Gen 4.6.2 and Public Notice DA 00-705.

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 30kHz, the video bandwidth to 100kHz and the span to 2MHz.

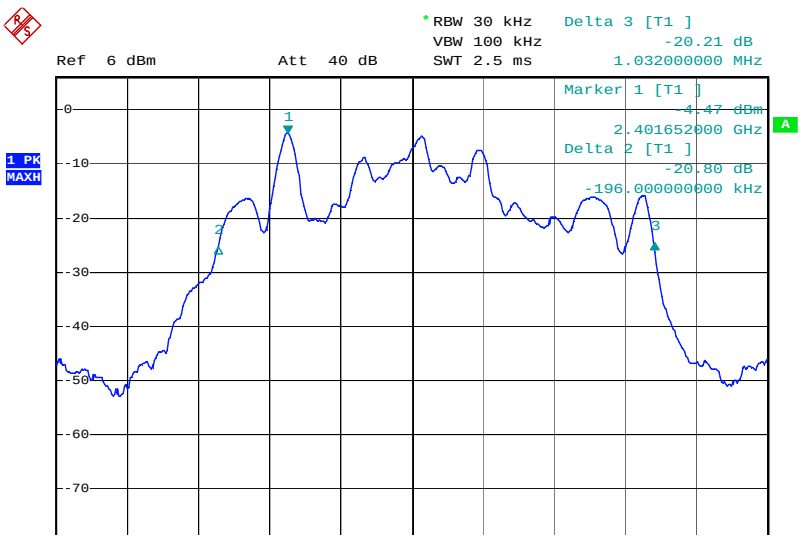
## Table 7: 20dB Bandwidth

| Operating Frequency [MHz] | 20dB Bandwidth [kHz](EDR) | 20dB Bandwidth [kHz](GFSK) |
|---|---|---|
| 2402 | 1228 | 808 |
| 2441 | 1228 | 812 |
| 2480 | 1228 | 804 |

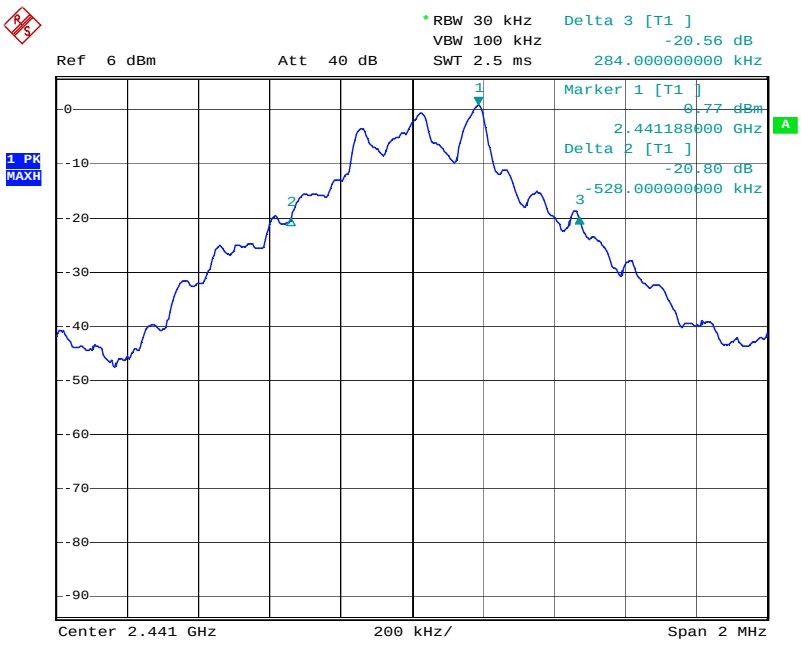
## Figure 4: 20dB Bandwidth, Mode A (2402MHz)



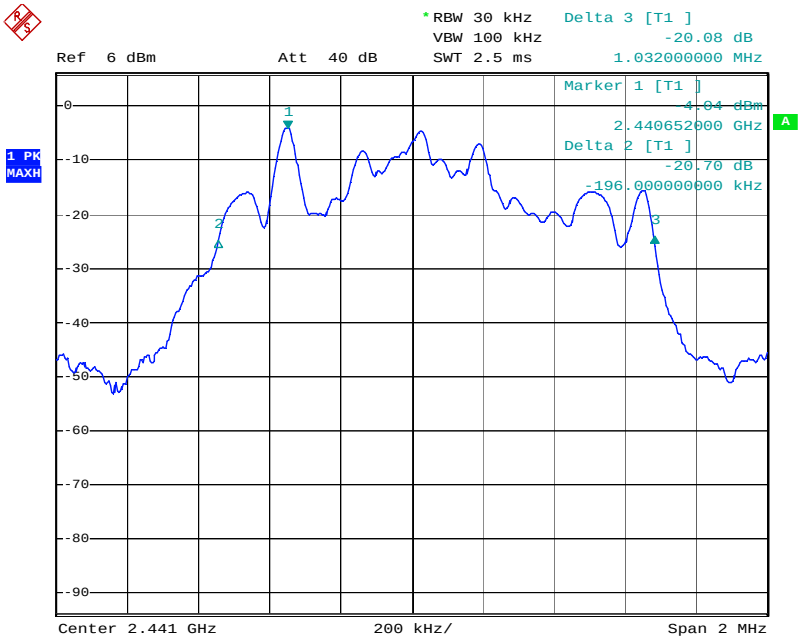

Date: 11.APR.2012 15:35:08



## Figure 5: 20dB Bandwidth, Mode B (2441MHz)

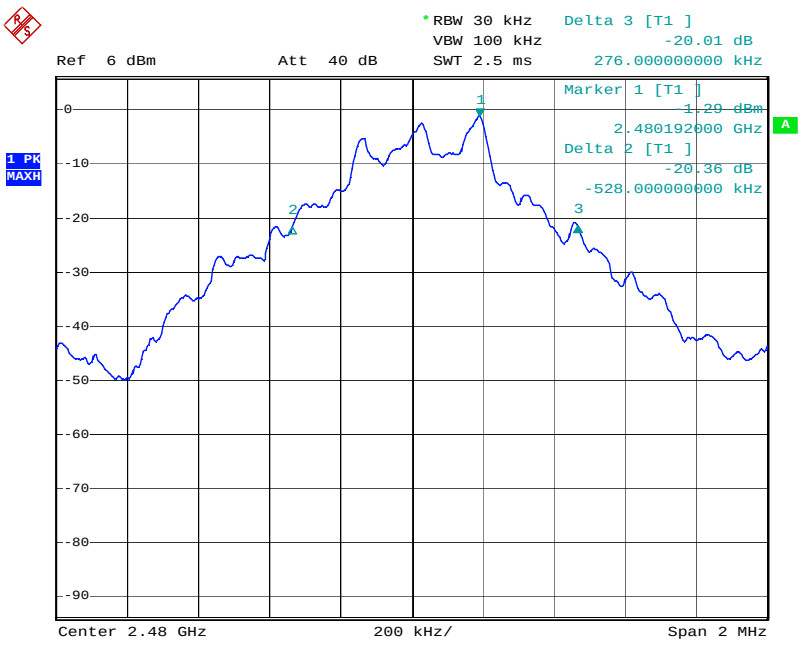



Date: 11.APR.2012 15:32:18

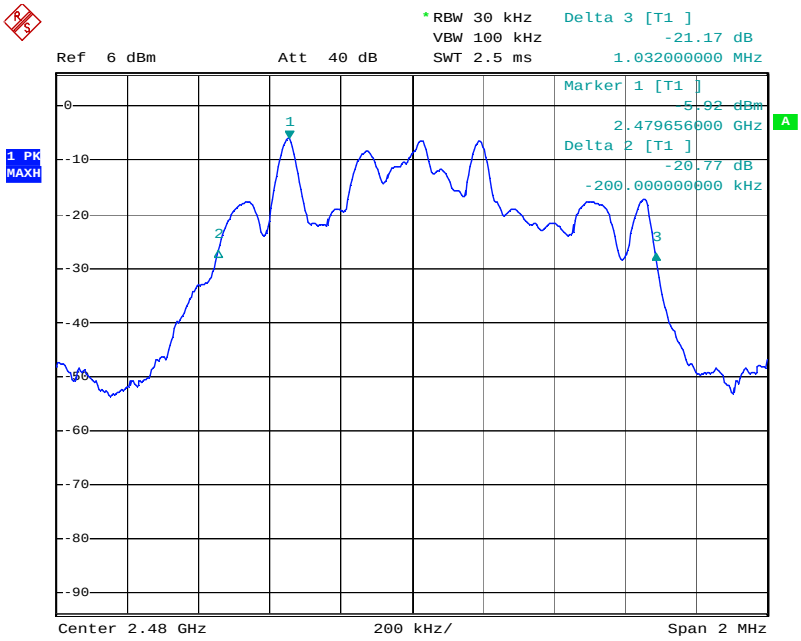



Date: 11.APR.2012 15:40:37

## Figure 6: 20dB Bandwidth, Mode C (2480MHz)




Date: 11.APR.2012 15:36:56




Date: 11.APR.2012 15:39:12

## 5.1.4 99% Bandwidth, RSS-Gen 4.6.1

| | |
|---|---|
| Date of testing: | 2012-04-12 |
| Ambient temperature: | 20°C |
| Relative humidity: | 39.6% |
| Atmospheric pressure: | 101.5hPa |

Requirements:

The 99% bandwidth shall be reported according to RSS-Gen 4.6.1.

Test procedure:

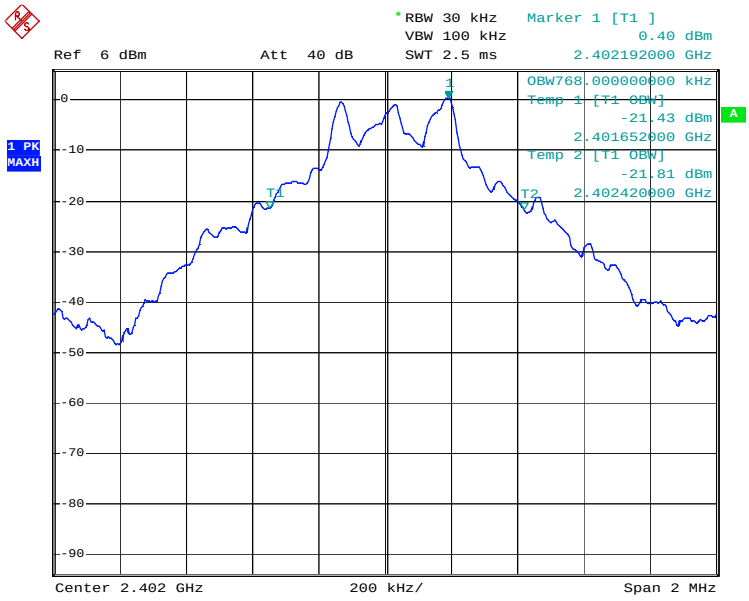
RSS-Gen 4.6.1.

A spectrum analyzer was connected to the antenna port of the EUT. The spectrum analyzer resolution bandwidth was set to 1% of the span (2MHz). The 99% bandwidth was measured by using the OBW function of the analyzer with a 99% coverage setting.

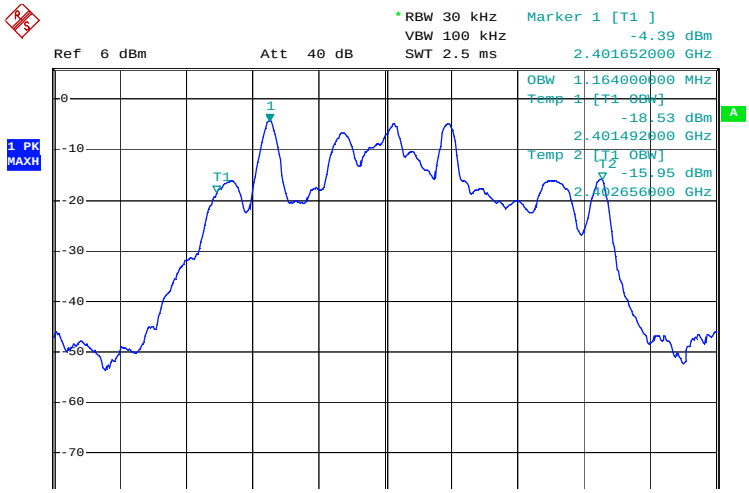
## Table 8: 99% Bandwidth

| Operating Frequency [MHz] | 99% Bandwidth [MHz](EDR) | 99% Bandwidth [MHz](GFSK) |
|---|---|---|
| 2402 | 1.164 | 0.768 |
| 2441 | 1.172 | 0.764 |
| 2480 | 1.172 | 0.800 |

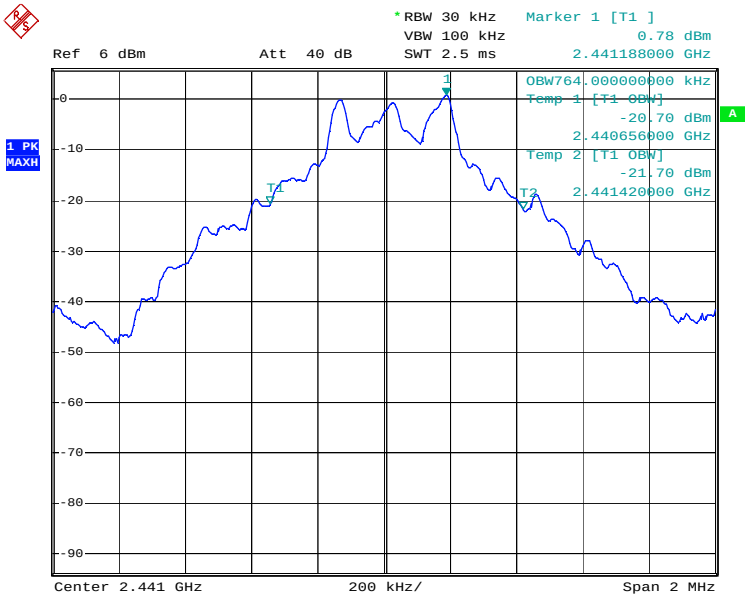
## Figure 7: 99% Bandwidth, Mode A (2402MHz)



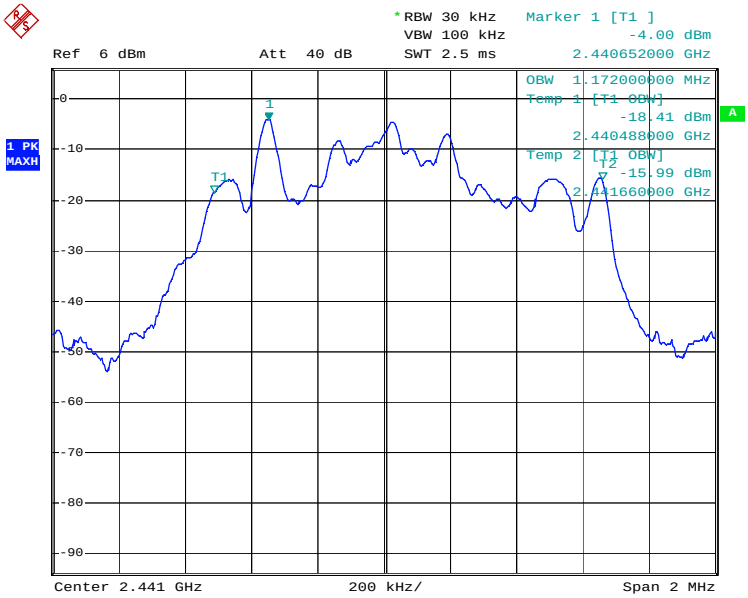

Date: 11.APR.2012 15:44:16



## Figure 8: 99% Bandwidth, Mode B (2441MHz)

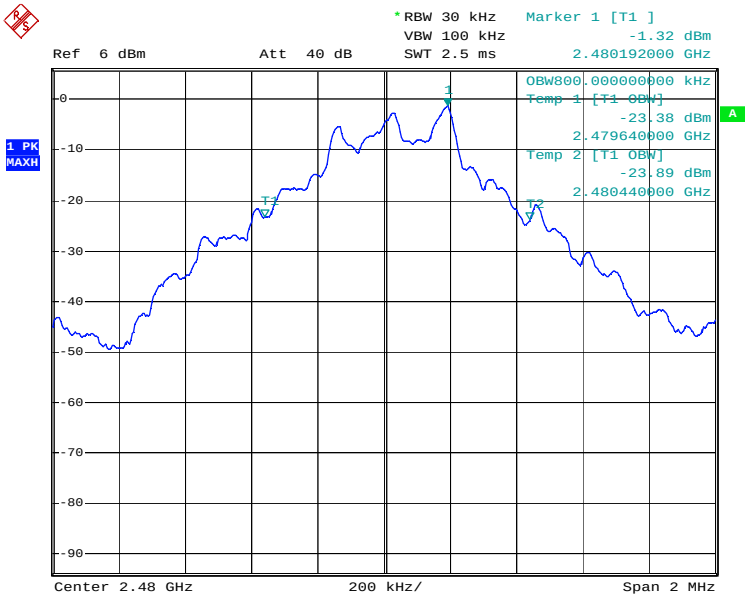



Date: 11.APR.2012 15:50:19

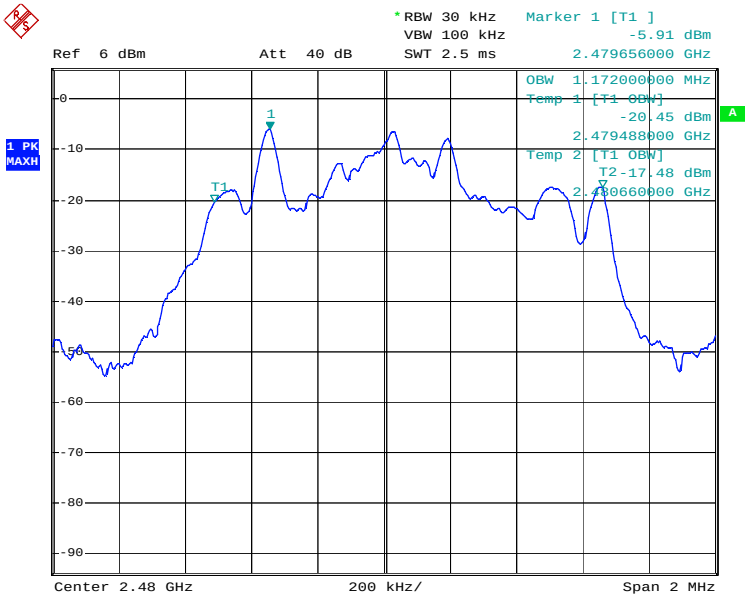



Date: 11.APR.2012 15:49:21

## Figure 9: 99% Bandwidth, Mode C (2480MHz)




Date: 11.APR.2012 15:53:18




Date: 11.APR.2012 15:54:33

## 5.1.5 Number of Hopping Frequencies, FCC 15.247(a)(1)(iii) and RSS-210 A8.1(d)

**RESULT:** **PASS**

Date of testing: 2012-03-06

Ambient temperature: 20°C
Relative humidity: 39.6%
Atmospheric pressure: 101.5hPa

Requirements:

Frequency hopping systems operating in the 2400-2483.5MHz band shall use at least 15 channels.

Test procedure:

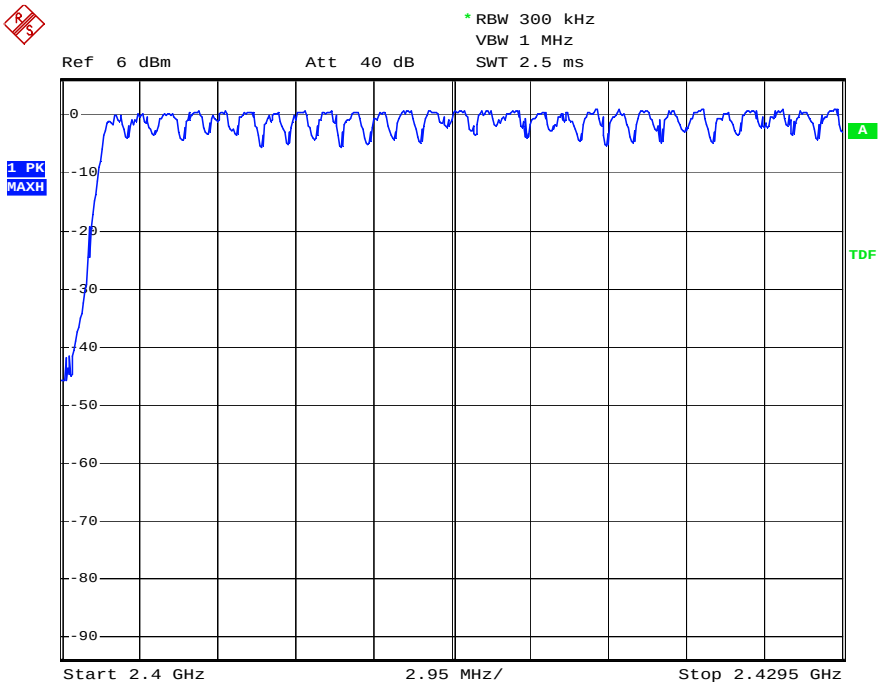
ANSI C63.4-2003 and Public Notice DA 00-705.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 300kHz and video bandwidth was set to 1MHz. The spectrum was broken in three plots to show all the hopping frequencies.

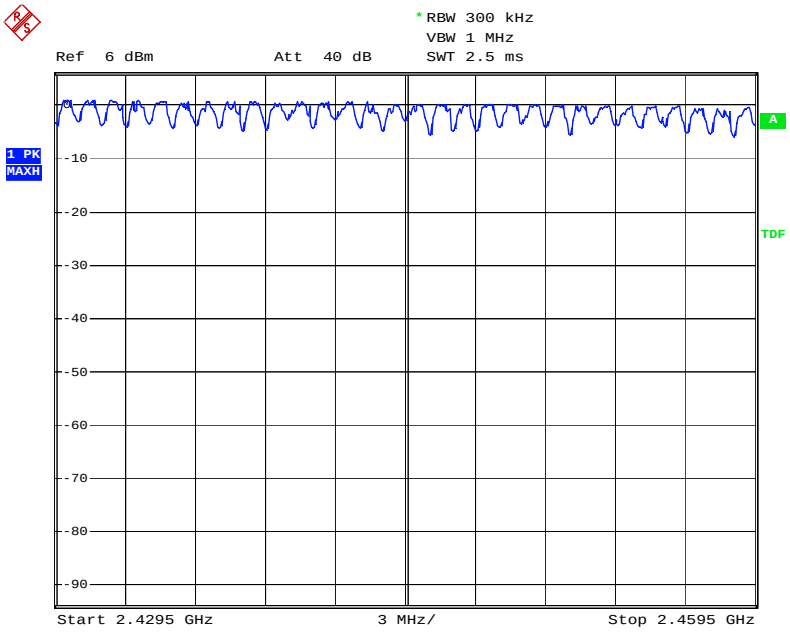
## Table 9: Number of Hopping Frequencies

| Number of Hopping Frequencies | Limit |
|---|---|
| 79 | 15 |

## Figure 10: Hopping Frequencies up to 2429.5MHz, Mode G (Hopping)

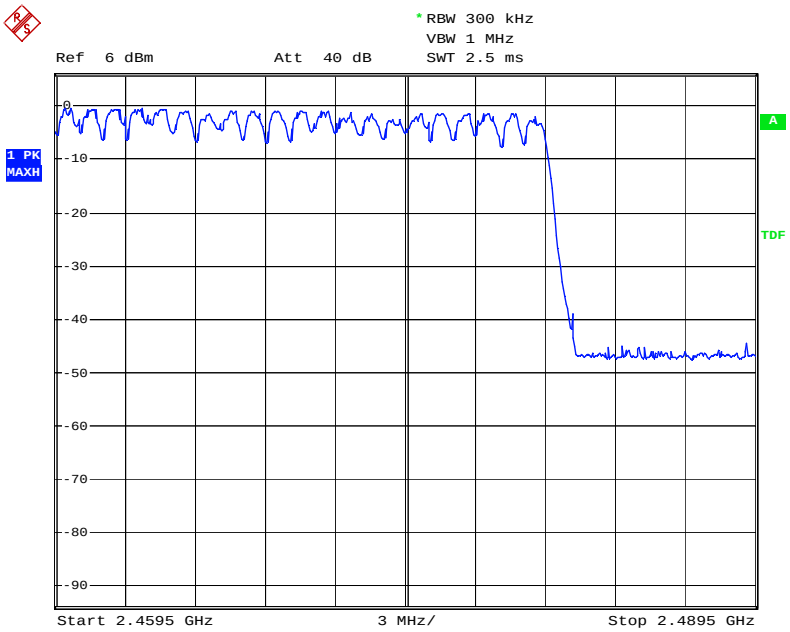


## Figure 11: Hopping Frequencies up to 2459.5MHz, Mode G (Hopping)




Date: 6.MAR.2012 12:27:01

## Figure 12: Hopping Frequencies up to 2489.5MHz, Mode G (Hopping)




Date: 6.MAR.2012 12:28:46

## 5.1.6 Average Time of Occupancy, FCC 15.247(a)(1)(iii) and RSS-210 A8.1(d)

**RESULT:** **PASS**

| | |
|---|---|
| Date of testing: | 2012-03-13 |
| Ambient temperature: | 20°C |
| Relative humidity: | 39.6% |
| Atmospheric pressure: | 101.5hPa |

Requirements:

For frequency hopping systems operating in the 2400-2483.5MHz band, the average time of occupancy on any channel shall not be greater than 0.4s within a period of 0.4s multiplied by the number of hopping channels employed.

Test procedure:

ANSI C63.4-2003 and Public Notice DA 00-705.

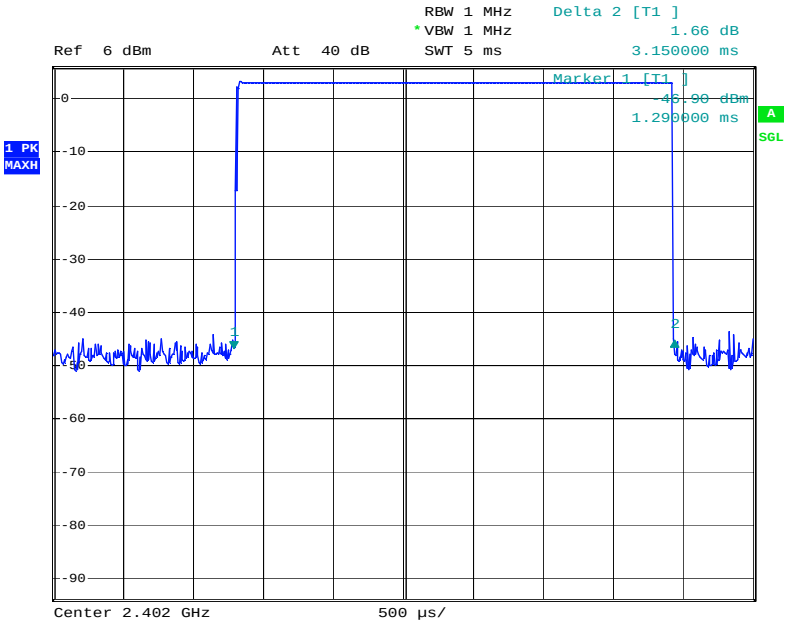
A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth and video bandwidth were set to 1MHz. The average time of occupancy was obtained by measuring first the dwell time of a single packet with the Delta Marker function using a zero span centered on a hopping channel and by counting then the number of hops per channel in a 31.6s period (0.4s times the number of hopping channels).

## Table 10: Average Time of Occupancy

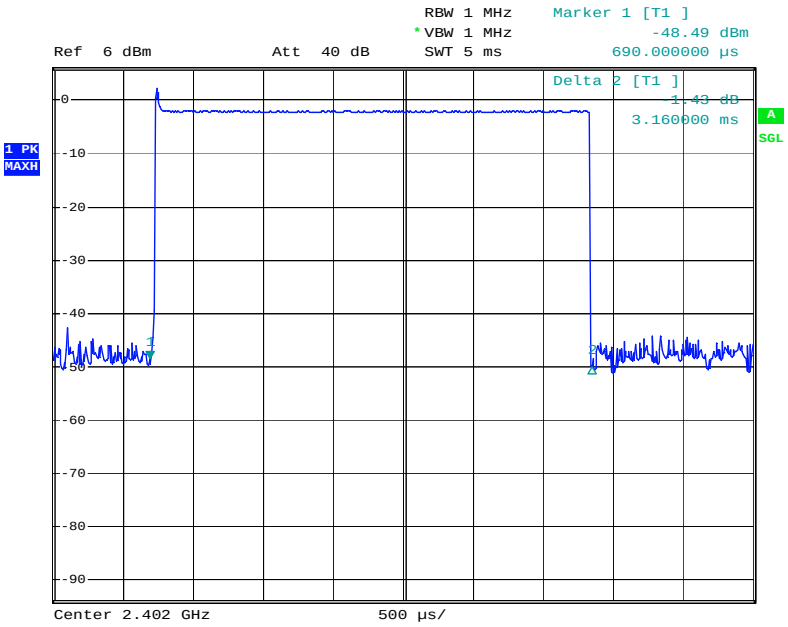
| Channel | Packet Type | Packet Duration [ms] | Number of Hops per Channel in a 31.6s Period | Average Time of Occupancy [ms] | Limit [ms] |
|---|---|---|---|---|---|
| Low | DH5 | 3.15 | 106.81 | 336.45 | 400 |
| | 2-DH5 | 3.16 | 106.81 | 337.52 | 400 |
| | 3-DH5 | 3.16 | 106.81 | 337.52 | 400 |
| Mid | DH5 | 3.14 | 106.81 | 335.38 | 400 |
| | 2-DH5 | 3.17 | 106.81 | 338.59 | 400 |
| | 3-DH5 | 3.15 | 106.81 | 336.45 | 400 |
| High | DH5 | 3.16 | 106.81 | 337.52 | 400 |
| | 2-DH5 | 3.16 | 106.81 | 337.52 | 400 |
| | 3-DH5 | 3.16 | 106.81 | 337.52 | 400 |

Notes: Average time of occupancy = Packet duration * Number of hops per channel in a 31.6s period

## Figure 13: Dwell Time, Mode G (Hopping), DH5, Low channel

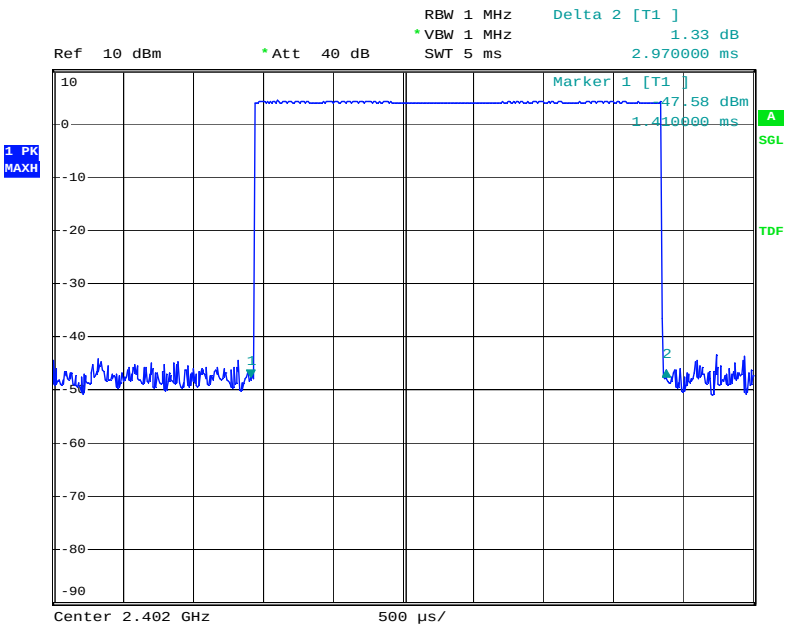


## Figure 14: Dwell Time, Mode G (Hopping),2-DH5, Low channel



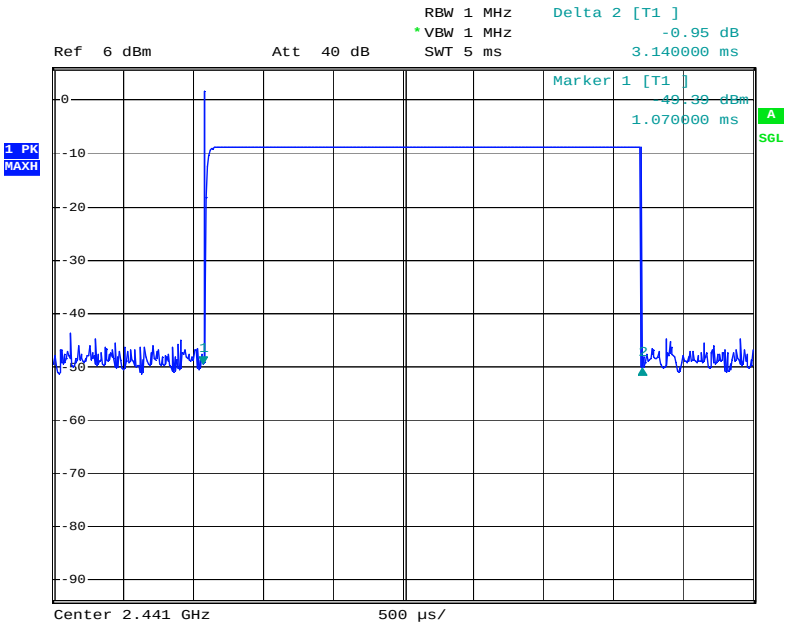

Date: 13.MAR.2012 08:49:28

## Figure 15: Dwell Time, Mode G (Hopping), 3-DH5, Low channel



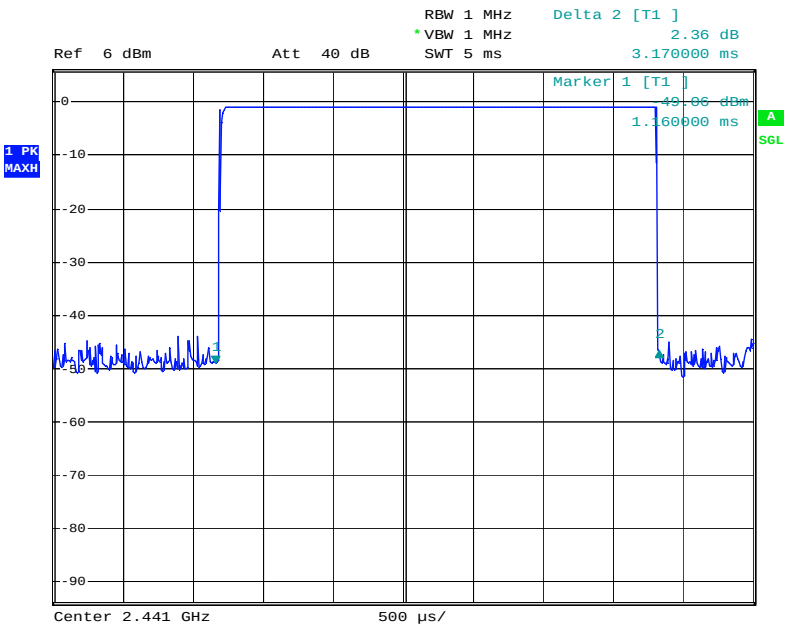

Date: 9.AUG.2011 16:52:01

## Figure 16: Dwell Time, Mode G(Hopping), DH5, Mid channel



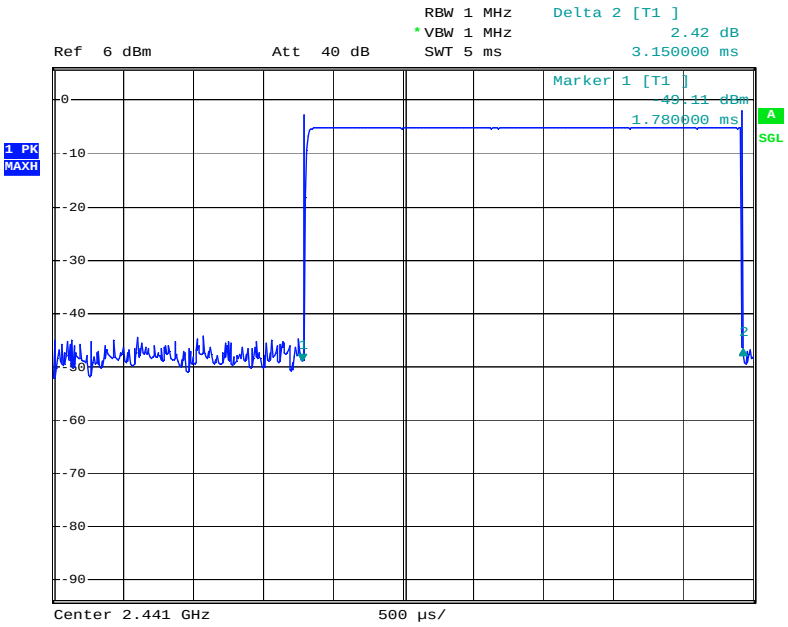

Date: 13.MAR.2012 08:54:15

## Figure 17: Dwell Time, Mode G (Hopping), 2-DH5, Mid channel



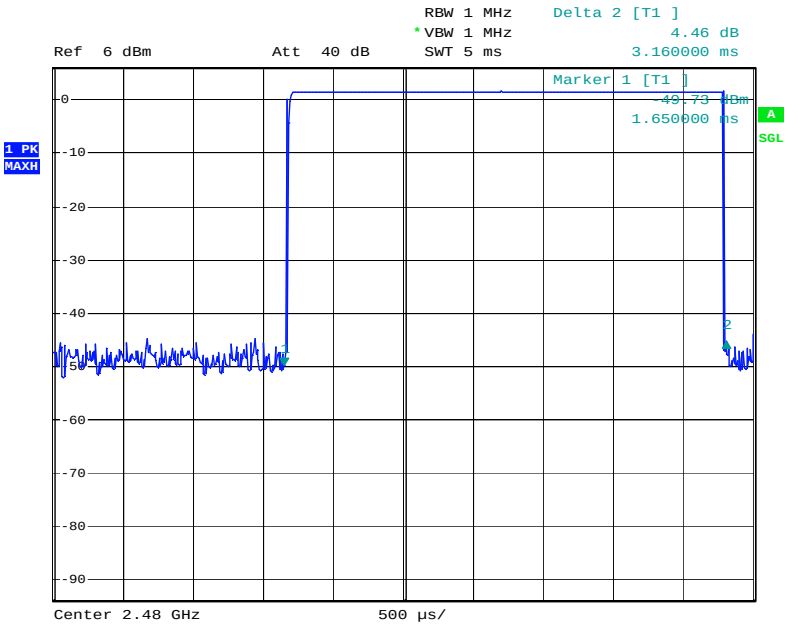

Date: 13.MAR.2012 08:55:23

## Figure 18: Dwell Time, Mode G (Hopping), 3-DH5, Mid channel



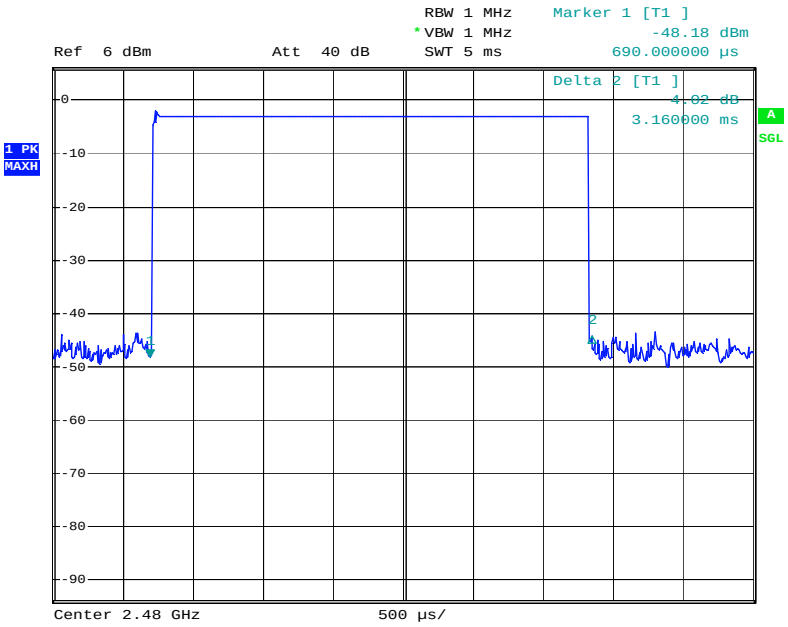

Date: 13.MAR.2012 09:02:02

## Figure 19: Dwell Time, Mode G(Hopping), DH5, High channel



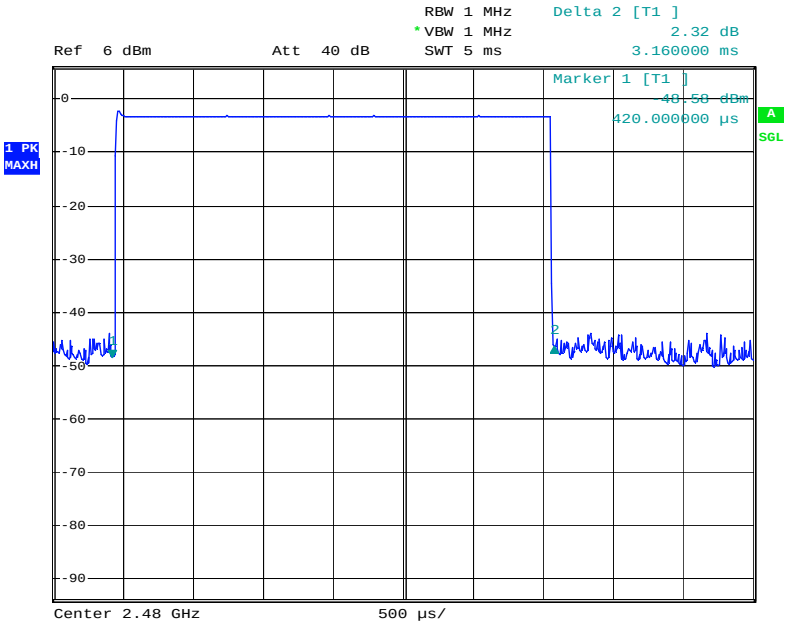

Date: 13.MAR.2012 09:03:51

## Figure 20: Dwell Time, Mode G (Hopping), 2-DH5, High channel




Date: 13.MAR.2012 09:04:54

## Figure 21: Dwell Time, Mode G (Hopping),3- DH5, High channel




Date: 13.MAR.2012 09:06:50

## 5.1.7 Conducted Spurious Emission, FCC 15.247(d) and RSS-210 A8.5

**RESULT:** **PASS**

Date of testing: 2012-03-06

Ambient temperature: 20°C
Relative humidity: 39.6%
Atmospheric pressure: 101.5hPa

Requirements:

In any 100kHz bandwidth outside the frequency band, the RF power shall be at least 20dB below that of the maximum in-band 100kHz emission.

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.9 and Public Notice DA 00-705.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 100kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30MHz to 25GHz ($10^{th}$ harmonics).

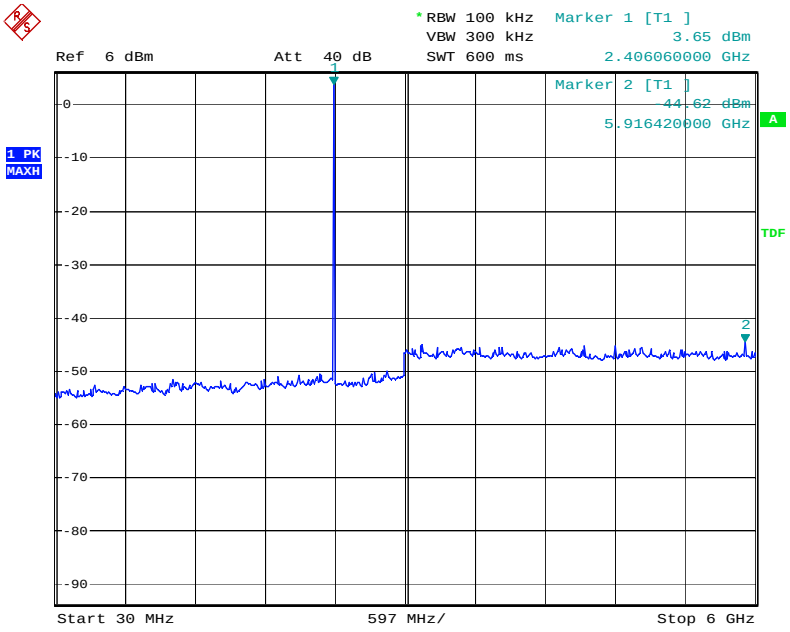
The final measurement takes into account the loss generated by all the involved cables.

## Table 11: Conducted Spurious Emission, Mode A (2402MHz)

| Frequency [MHz] | Reading [dBm] | Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|
| 5916.42 | -44.62 | -44.62 | -16.35 | 28.27 |
| 7178 | -34.51 | -34.51 | -16.35 | 18.16 |
| 24354 | -28.09 | -28.09 | -16.35 | 11.74 |
| 2406.06 | 3.65 | 3.65 | N/A | N/A |

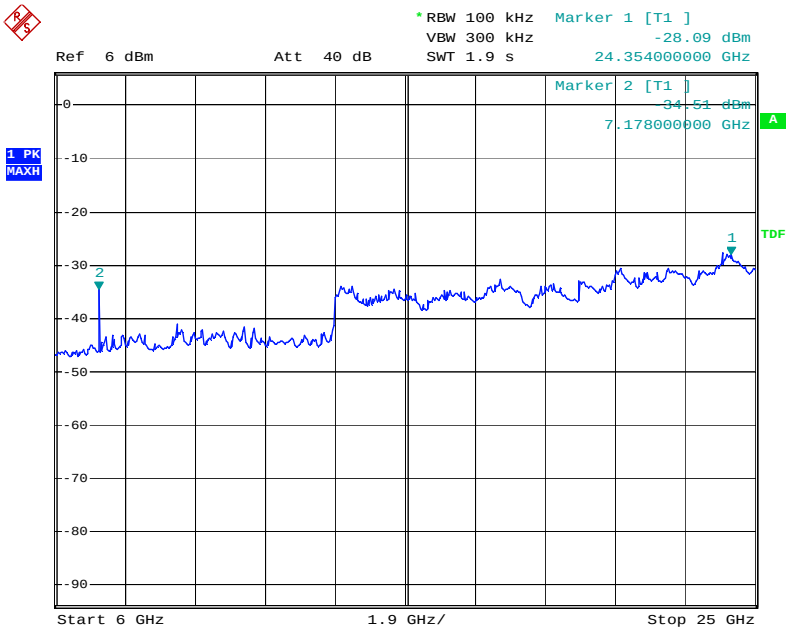
Notes: Cable loss was included in reading as offset.
Limit = Reading of fundamental + Correction factor – 20dB

## Figure 22: Conducted Spurious Emission, 30MHz – 6GHz, Mode A (2402MHz)




Date: 6.MAR.2012 08:41:56

## Figure 23: Conducted Spurious Emission, 6 – 25GHz, Mode A (2402MHz)



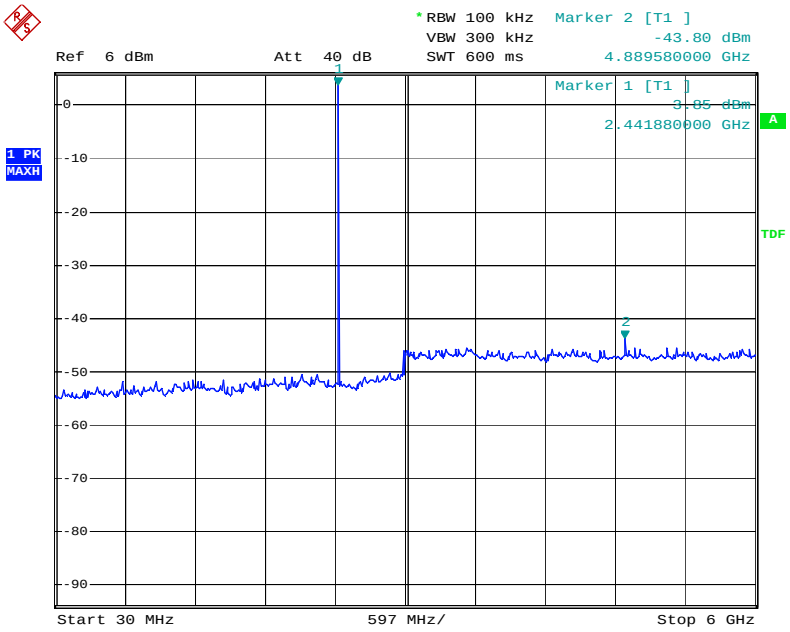

Date: 6.MAR.2012 08:43:54

## Table 12: Conducted Spurious Emission, Mode B (2441MHz)

| Frequency [MHz] | Reading [dBm] | Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|
| 4889.88 | -43.8 | -43.8 | -16.15 | 27.65 |
| 7292 | -34.44 | -34.44 | -16.15 | 18.29 |
| 24278 | -28.56 | -28.56 | -16.15 | 12.41 |
| 2441.88 | 3.85 | 3.85 | NA | N/A |

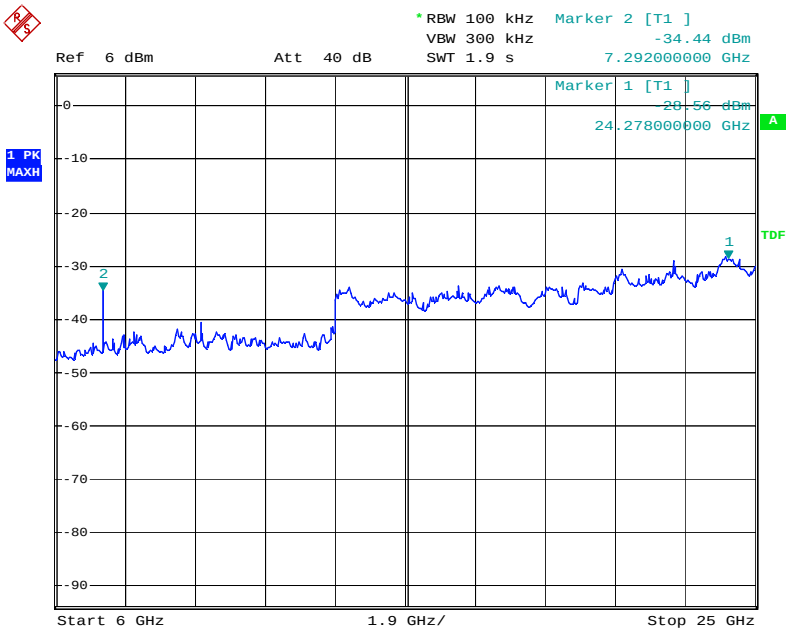
Notes: Cable loss was included in reading as offset.
Limit = Reading of fundamental + Correction factor – 20dB

## Figure 24: Conducted Spurious Emission, 30MHz – 6GHz, Mode B (2441MHz)




Date: 6.MAR.2012 08:45:21

## Figure 25: Conducted Spurious Emission, 6 – 25GHz, Mode B (2441MHz)



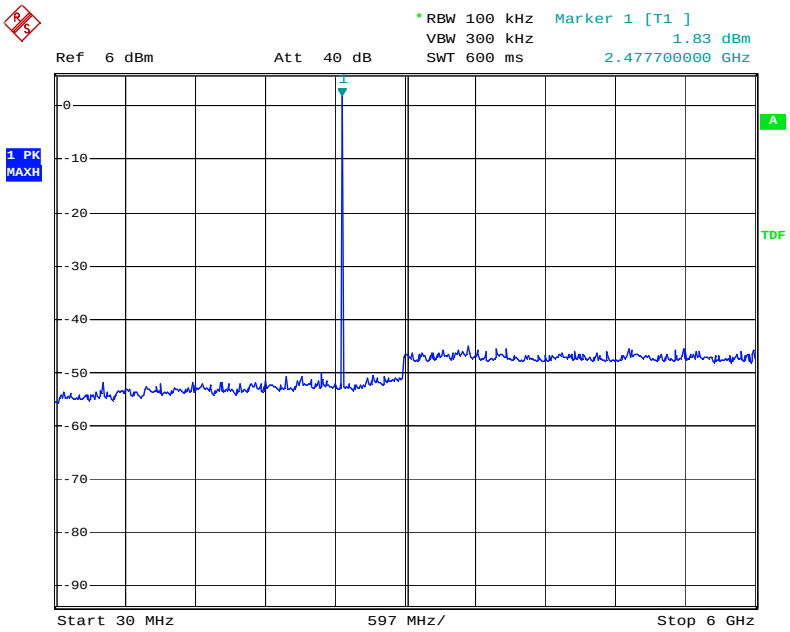

Date: 6.MAR.2012 08:46:31

## Table 13: Conducted Spurious Emission, Mode C (2480MHz)

| Frequency [MHz] | Reading [dBm] | Emission Level [dBm] | Limit [dBm] | Margin [dB] |
|---|---|---|---|---|
| 24240 | -28.33 | -28.33 | -18.17 | 10.16 |
| 2477.7 | 1.83 | 1.83 | N/A | N/A |

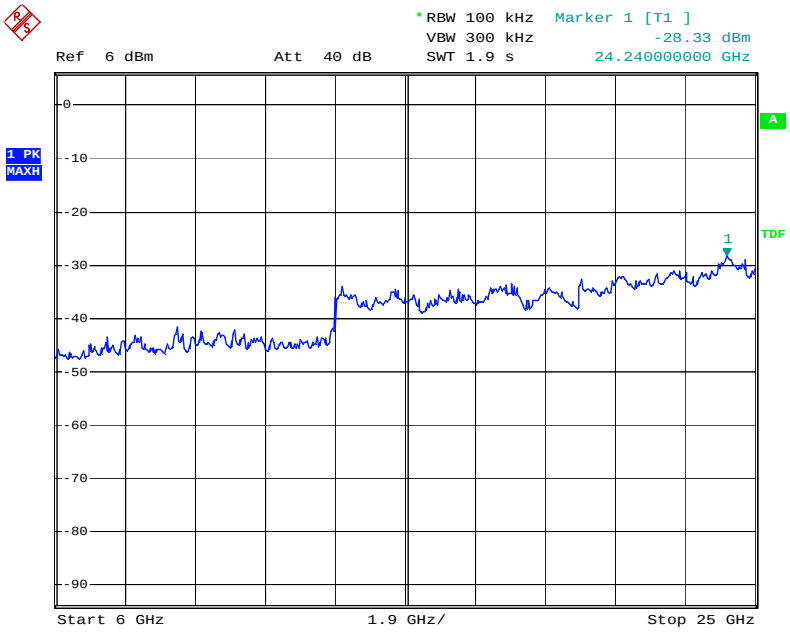
Notes: Cable loss was included in reading as offset.
Limit = Reading of fundamental + Correction factor – 20dB

## Figure 26: Conducted Spurious Emission, 30MHz – 6GHz, Mode C (2480MHz)




Date: 6.MAR.2012 08:47:31

## Figure 27: Conducted Spurious Emission, 6 – 25GHz, Mode C (2480MHz)




Date: 6.MAR.2012 08:48:09

## 5.1.8 Band Edge Compliance of RF Conducted Emission, FCC 15.247(d) and RSS-210 A8.5

**RESULT:** **PASS**

| | |
|---|---|
| Date of testing: | 2012-03-13 |
| Ambient temperature: | 20°C |
| Relative humidity: | 39.6% |
| Atmospheric pressure: | 101.5hPa |

Requirements:

In any 100kHz bandwidth outside the frequency band, the RF power shall be at least 20dB below that of the maximum in-band 100kHz emission.

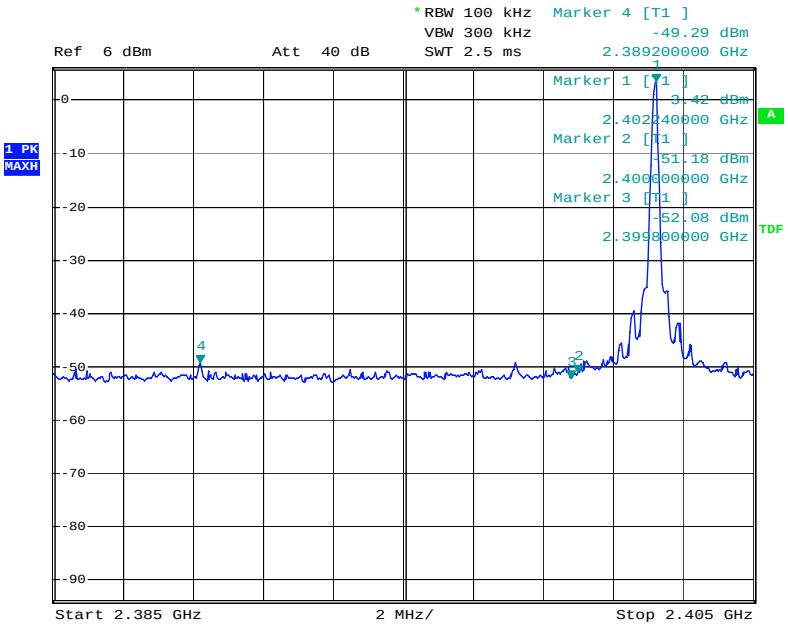
Test procedure:

ANSI C63.4-2003 and Public Notice DA 00-705.

A spectrum analyzer was connected to the antenna port of the EUT. The analyzer resolution bandwidth was set to 100kHz and video bandwidth was set to 300kHz. Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

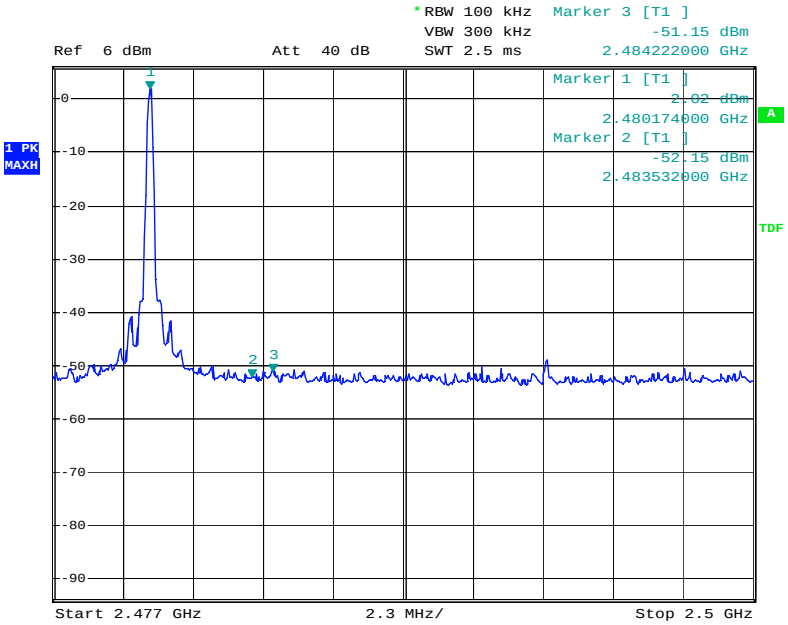
The final measurement takes into account the loss generated by all the involved cables.

## Figure 28: Lower Band Edge Conducted, Hopping Disenabled



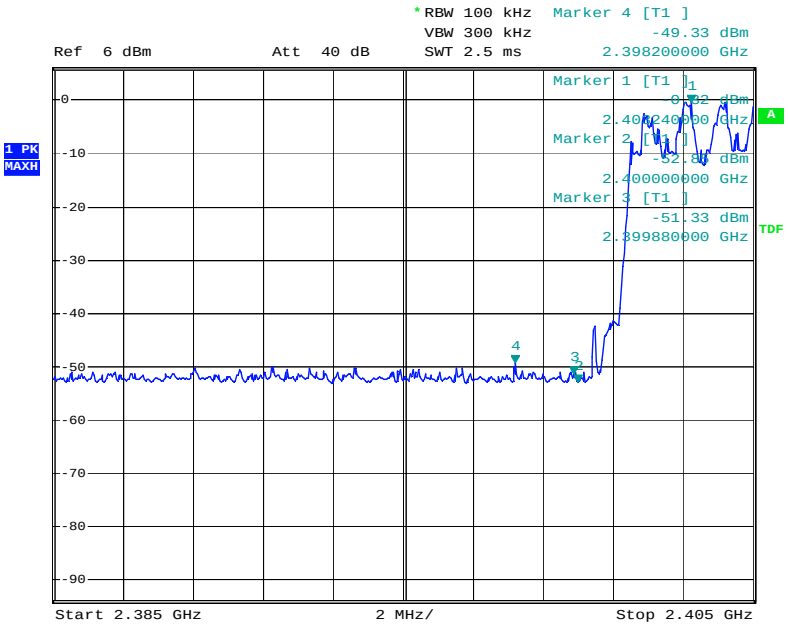

Date: 13.MAR.2012 08:26:29

## Figure 29: Upper Band Edge Conducted, Hopping Disenabled



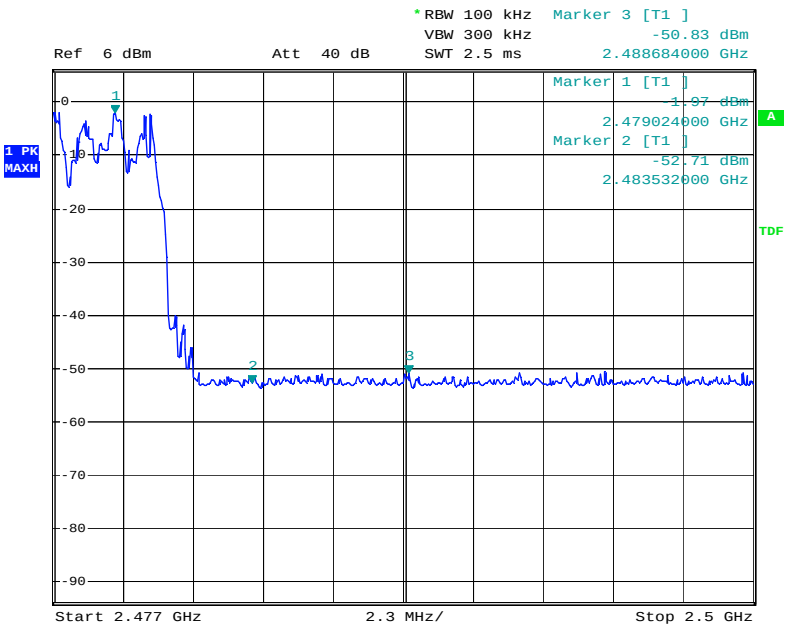

Date: 13.MAR.2012 08:30:55

## Figure 30: Lower Band Edge Conducted, Hopping Enabled




Date: 13.MAR.2012 08:36:26

## Figure 31: Upper Band Edge Conducted, Hopping Enabled




Date: 13.MAR.2012 08:40:45

# 6. Test Results of Radiated Measurements

## 6.1 Transmitter Parameters

### 6.1.1 Band Edge Radiated Emission, FCC 15.205, FCC 15.209, FCC 15.247(d), RSS-210 2.2, RSS-210 2.6 and RSS-210 A8.5

**RESULT:** **Pass**

| | |
|---|---|
| Date of testing: | 2012-03-05 |
| Ambient temperature: | 23.5°C |
| Relative humidity: | 45% |
| Atmospheric pressure: | 101.5hPa |
| Measurement distance: | 3m |
| Kind of test site: | Semi Anechoic Chamber |

Requirements:

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-210 2.7 (Table 1), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-210 2.7 (Table 2 and 3).

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.9 and Public Notice DA 00-705.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Measurements were made at 3m distance. The EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level.

Measurements were taken using both horizontal and vertical antenna polarizations for 3 EUT orientations (X, Y and Z).

Measurements were performed using a spectrum analyzer with a suitable span to encompass the peak of the fundamental and using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

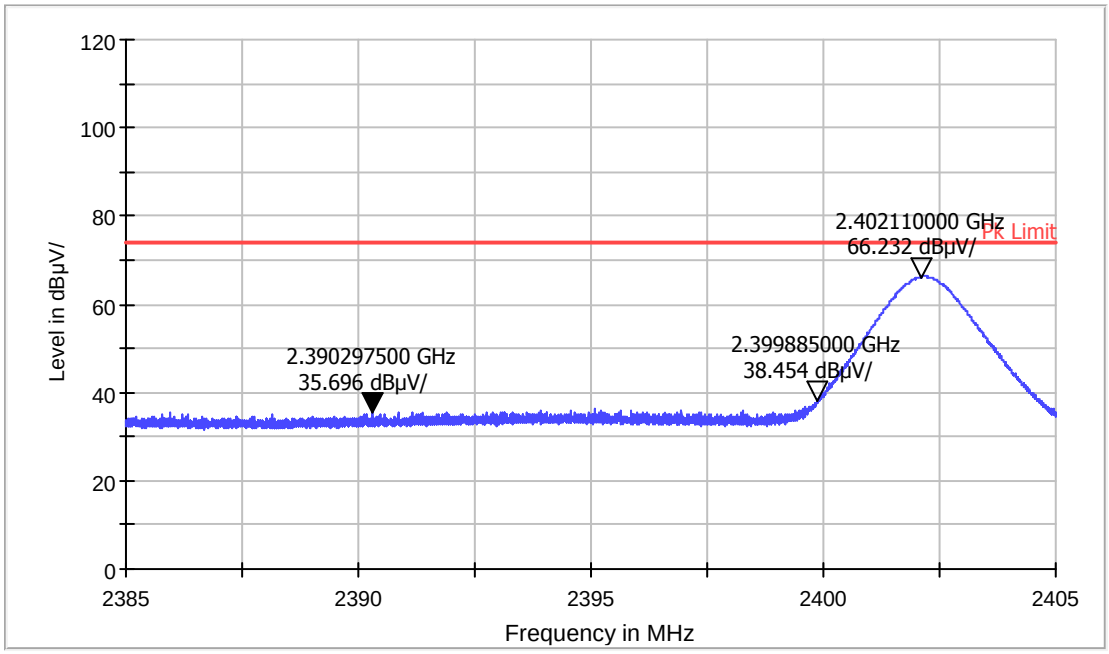
## Table 14: Band Edge Radiated Emission

| Operating Frequency [MHz] | EUT / Antenna Orient. | Average Value [dBµV/m] | Peak Value [dBµV/m] | Average Limit [dBµV/m] | Peak Limit [dBµV/m] | Average Margin [dB] | Peak Margin [dB] |
|---|---|---|---|---|---|---|---|
| 2399.9000 | X/H | No peak found | 35.394 | 54 | 74 | N/A | 38.606 |
| 2319.3500 | X/H | No peak found | 35.833 | 54 | 74 | N/A | 38.167 |
| 2399.8850 | X/V | No peak found | 38.454 | 54 | 74 | N/A | 35.546 |
| 2390.2975 | X/V | No peak found | 35.696 | 54 | 74 | N/A | 38.304 |
| 2483.4429 | X/H | No peak found | 34.283 | 54 | 74 | N/A | 39.717 |
| 2490.8719 | X/H | No peak found | 34.599 | 54 | 74 | N/A | 39.401 |
| 2483.4318 | X/V | No peak found | 34.626 | 54 | 74 | N/A | 39.374 |
| 2487.5398 | X/V | No peak found | 34.379 | 54 | 74 | N/A | 39.621 |

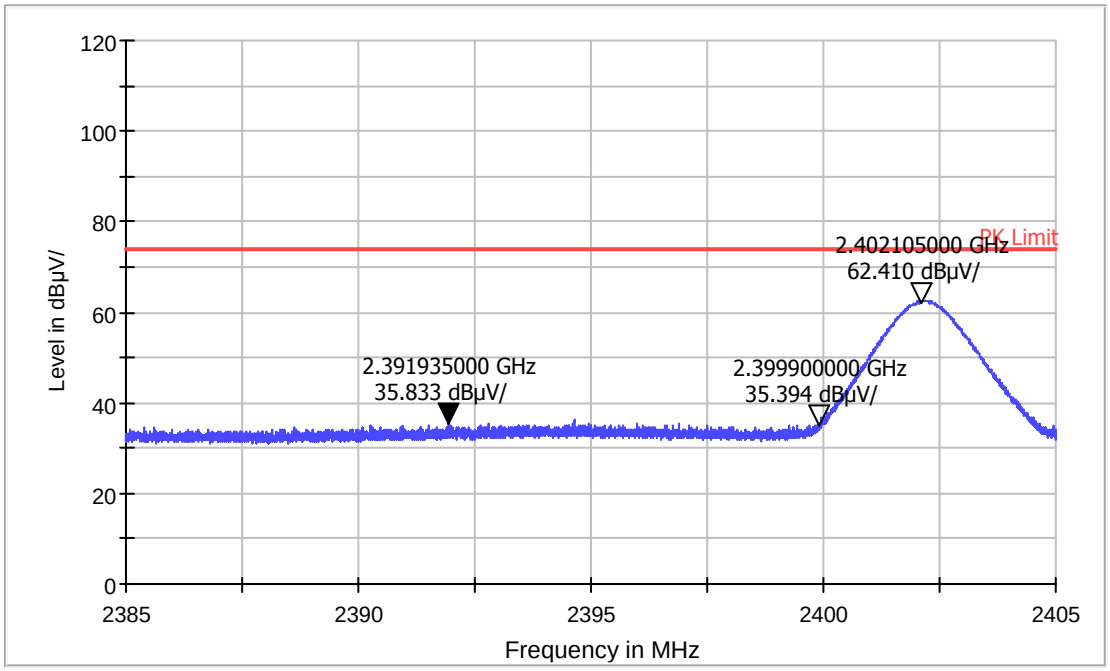
Notes: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.
Average limit in dBuV/m is calculated as follows: Average limit = 20 x log(500uV/m).
Peak limit in dBuV/m is calculated as follows: Peak limit = Average limit + 20dB.

## Figure 32: Band Edge Radiated Emission, Spectral Diagram, Mode A (2402MHz)

2011of FCC 1.0-18G_FSP 30+BBV9718 NEW BAND EDGE

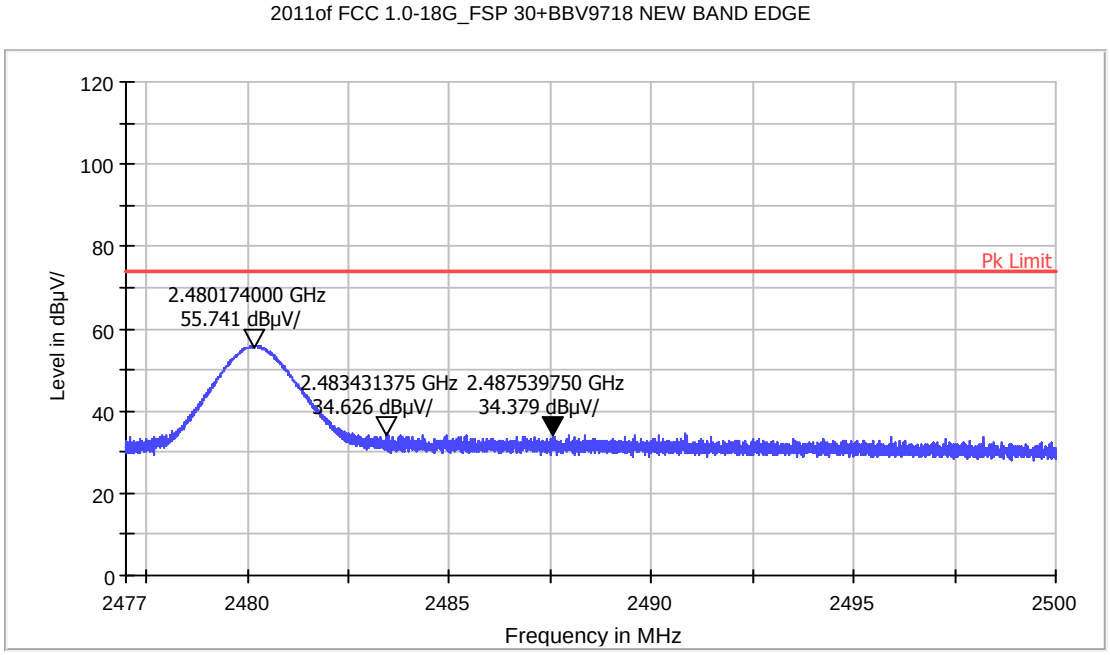


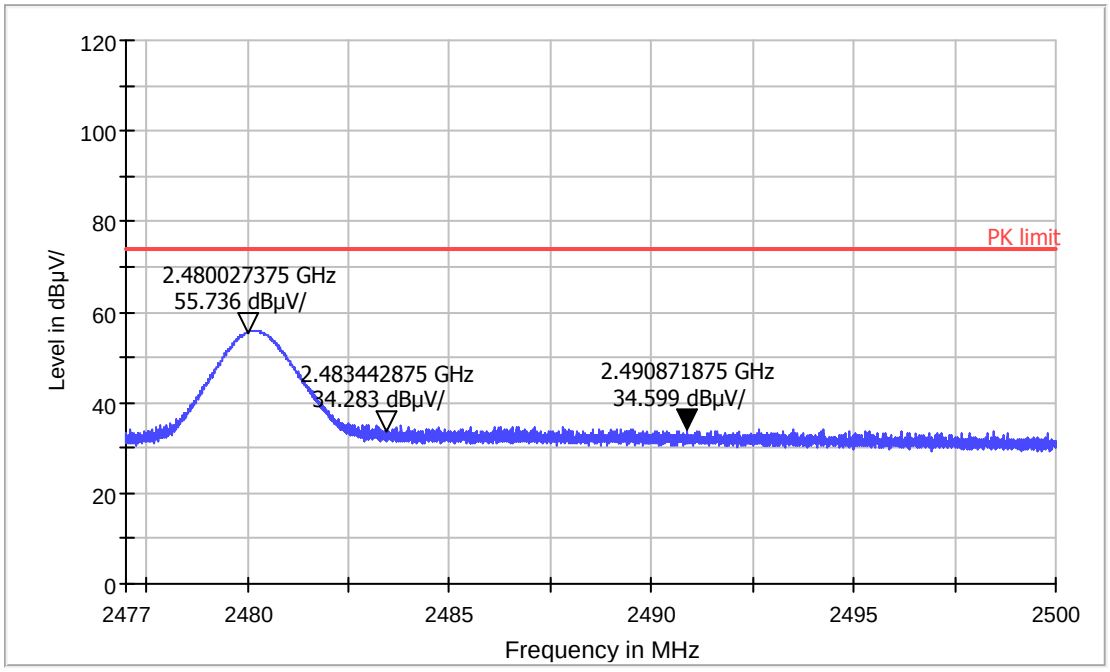

2011of FCC 1.0-18G_FSP 30+BBV9718 NEW BAND EDGE




Note: The upper diagram shows the vertical peak value and the lower diagram shows the horizontal value.

## Figure 33: Band Edge Radiated Emission, Spectral Diagram, Mode C (2480MHz)




Note: The upper diagram shows the vertical peak value and the lower diagram shows the horizontal value.

## 6.1.2 Radiated Spurious Emission of Transmitter, FCC 15.205, FCC 15.209, FCC 15.247(d), RSS-210 2.2, RSS-210 2.6 and RSS-210 A8.5

**RESULT:** **PASS**

| | |
|---|---|
| Date of testing: | 2012-03-05 |
| Ambient temperature: | 23.5°C |
| Relative humidity: | 45% |
| Atmospheric pressure: | 101.5hPa |
| Frequency range: | 30MHz – 25GHz |
| Measurement distance: | 3m |
| Kind of test site: | Semi Anechoic Chamber |

Requirements:

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-210 2.7 (Table 1), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-210 2.7 (Table 2 and 3).

Test procedure:

ANSI C63.4-2003, RSS-Gen 4.9 and Public Notice DA 00-705.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The EUT was pretested in floor-standing condition and in the table position and the worst case condition was table position which was used for the final measurements. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to the 10th harmonic of the highest fundamental transmitter frequency (25GHz). Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

For frequencies between 30MHz and 1GHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1GHz, measurements were performed using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

### Table 15: Radiated Emission, Average and Peak Data, 1 – 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (2402MHz)

| Freq. [MHz] | EUT / Antenna Orientation | Level AV [dBµV/m] | Level PK [dBµV/m] | Limit AV [dBµV/m] | Limit PK [dBµV/m] | Margin AV [dB] | Margin PK [dB] |
|---|---|---|---|---|---|---|---|
| 7207 | X/V | 44.344 | 48.863 | 54 | 74 | 9.656 | 25.137 |

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

### Table 16: Radiated Emission, Average and Peak Data, 1 – 25GHz, Horizontal and Vertical Antenna Orientations, Mode B (2441MHz)

| Freq. [MHz] | EUT / Antenna Orientation | Level AV [dBµV/m] | Level PK [dBµV/m] | Limit AV [dBµV/m] | Limit PK [dBµV/m] | Margin AV [dB] | Margin PK [dB] |
|---|---|---|---|---|---|---|---|
| 7324 | X/H | 35.748 | 44.474 | 54 | 74 | 18.252 | 29.526 |
| 7324 | X/V | 46.083 | 48.673 | 54 | 74 | 7.917 | 25.327 |

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

### Table 17: Radiated Emission, Average and Peak Data, 1 – 25GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)

| Freq. [MHz] | EUT / Antenna Orientation | Level AV [dBµV/m] | Level PK [dBµV/m] | Limit AV [dBµV/m] | Limit PK [dBµV/m] | Margin AV [dB] | Margin PK [dB] |
|---|---|---|---|---|---|---|---|
| No peak found | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

Note: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values.

# 6.2 Receiver Parameters

## 6.2.1 Radiated Spurious Emission of Receiver, FCC 15.109, RSS-210 2.2, RSS-210 2.6, RSS-210 A8.5, RSS-Gen 7.2.3.2

**RESULT:** **PASS**

| | |
|---|---|
| Date of testing: | 2012-03-05 |
| Ambient temperature: | 23.5°C |
| Relative humidity: | 45% |
| Atmospheric pressure: | 101.5hPa |
| Frequency range: | 30MHz – 12.5GHz |
| Measurement distance: | 3m |
| Kind of test site: | Semi Anechoic Chamber |

Requirements:

The emissions from the unintentional radiator shall not exceed the field strength specified in 15.109(a) and RSS-210 Table 2 (and RSS-Gen Table 1).

Test procedure:

ANSI C63.4-2003 and RSS-Gen 4.10.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The EUT was pretested in floor-standing condition and in the table position and the worst case condition was table position which was used for the final measurements. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 30MHz to the 5th harmonic of the highest fundamental operation frequency (12.5GHz). Final radiated emission measurements were made at 3m distance.

Measurements were taken using both horizontal and vertical antenna polarizations.

For frequencies between 30MHz and 1GHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1GHz, measurements were performed using the following settings: Peak: RBW & VBW = 1MHz, Average: RBW = 1MHz, VBW = 10Hz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. No spurious emission was found in the range 30MHz – 12500MHz.

# 7. Test Results of AC Power Line Conducted Measurements

## 7.1.1 AC Power Line Conducted Emission, FCC 15.207 and RSS-Gen 7.2.2

**RESULT:** **PASS**

| | |
|---|---|
| Date of testing: | 2012-03-23 |
| Ambient temperature: | 23.0°C |
| Relative humidity: | 45% |
| Atmospheric pressure: | 101.5hPa |
| Frequency range: | 0.15 – 30MHz |
| Kind of test site: | Shielded Room |

Requirements:

The AC power line conducted emission on any frequency within the band 150 kHz to 30MHz shall not exceed the limits specified in FCC 15.207 and RSS-Gen 7.2.2.

Test procedure:

ANSI C63.4-2003.

The EUT was placed on a wooden table raised 80cm above the reference ground plane. A vertical conducting plane of the screened room was located 40cm to the rear of the EUT. The AC adapter of the EUT was connected to a Line Impedance Stabilization Network (LISN).

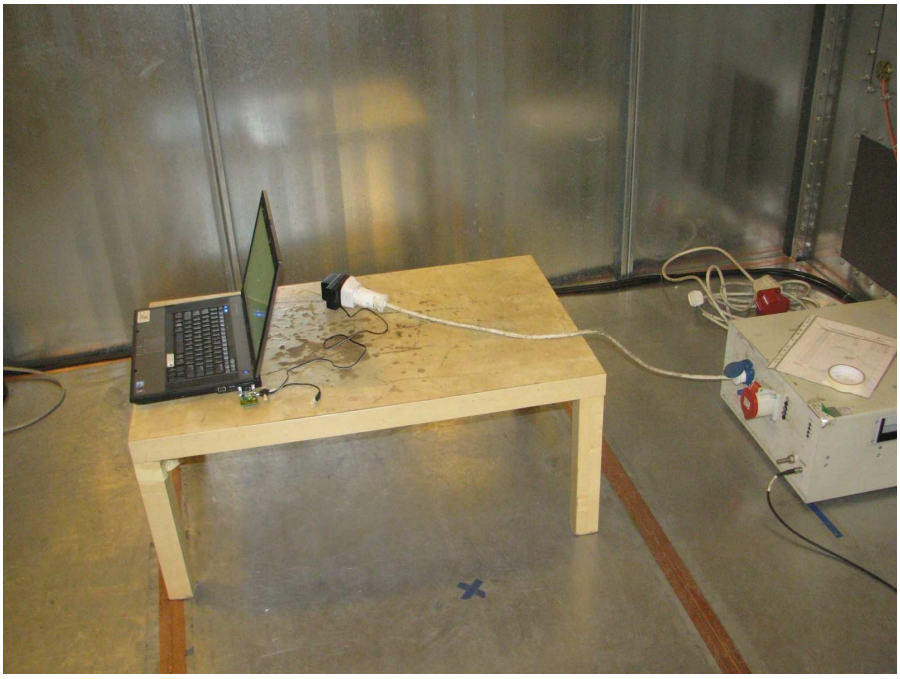
The physical arrangement of the test system and associated cabling was varied to determine the effect on the EUT's emissions in amplitude and frequency in order to ensure that maximum emission amplitudes were attained.

The measurements were performed with the receiver operating in the CISPR quasi-peak and average detection modes.

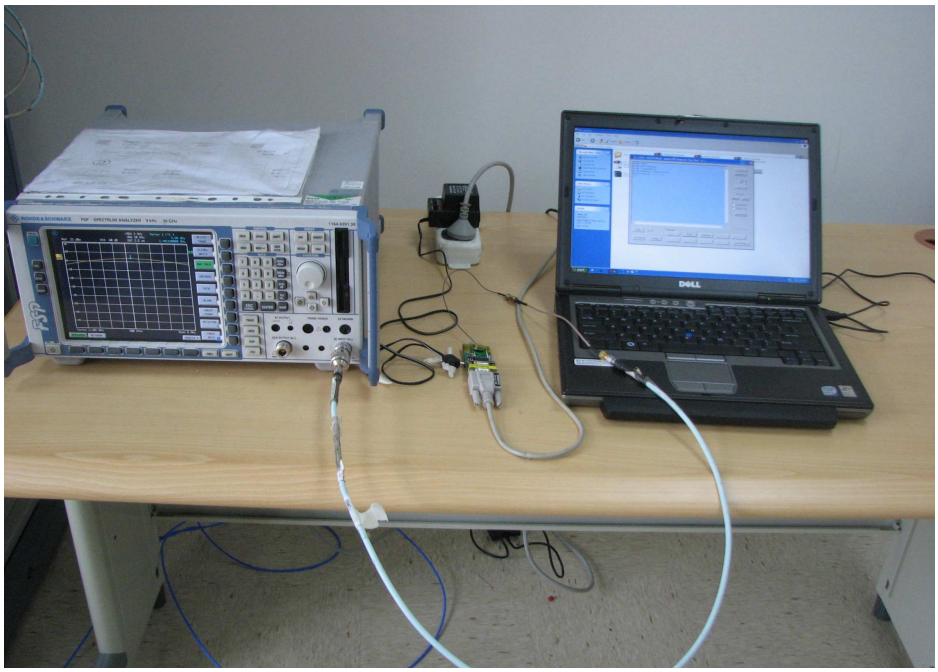
No disturbances found or not detectable.

# 8. Photographs of the Test Setup

**Photograph 1: Set-up for AC Power Line Conducted Emission**



**Photograph 2: Set-up for Conducted Emission at Antenna Port**



**Photograph 3: Set-up for Radiated Emission, 30MHz-1000MHz**

**Photograph 4: Set-up for Radiated Emission, 1G-18GHz**

# 9. List of Tables



# 10. List of Figures

# 11. List of Photographs