# FCC Part 15 Subpart C Requirement and Industry Canada RSS-210

# Measurement and Test Report

For

## Sanwa Electronic Instrument Co., Ltd

1-2-50, Yoshida Honmachi, Higashi-Osaka, Osaka 578-0982, Japan

**FCC ID: L73-92011**
**IC: 7377A-92011**

August 24, 2011

| **This Report Concerns:** | **Equipment Type:** |
|---|---|
| ☒ Original Report | 2.4GHz Radio Control System |

| | |
|---|---|
| **Test Engineer:** | Bossco He |
| **Report Number:** | SE11H-036FI |
| **Test Date:** | August 16 to 19, 2011 |
| **Reviewed By:** | Karbon Y.Chung *(Senior Manager)* |
| **Prepared By:** | S&E Technologies Laboratory Ltd<br>Room 407, Block A Shennan Garden, Hi-Tech Industrial Park,<br>Shenzhen 518057, P.R. China.<br>Tel: 86-755-26636573, 26630631<br>Fax: 86-755-26630557 |

# Table of Contents

# 1- Test Result Certification

| | |
|---|---|
| Applicant: | Sanwa Electronic Instrument Co., Ltd |
| | 1-2-50, Yoshida Honmachi, Higashi-Osaka, |
| | Osaka 578-0982, Japan |
| Equipment Under Test: | 2.4GHz Radio Control System |
| Trade Mark: | *SANWA* |
| Model Number.: | 92011 |
| Type of Modulation: | FHSS |
| Number of Channels: | 76 |
| Channel Separation: | 1MHz |
| Operation Frequency: | 2403-2478MHz |
| Antenna Designation: | Non-user replaceable (fixed) |
| Power Supply: | DC6.0V [4*1.5V size “AA” batteries] |
| Date of Test: | August 16 to 19, 2011 |

| Applicable Standards | |
|---|---|
| Standard | Test Result |
| FCC 47 CFR Part 15 Subpart C, §15.247<br>Industry Canada: RSS-210 issue 8: 2010, Annex 8<br>Industry Canada: RSS-Gen issue 3: 2010 | No non-compliance noted |

## We hereby certify that:

The above equipment was tested at ATC Lab Co., Ltd (Guangdong, China). The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4-2003 and Public Notice DA 00-705. The energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15C: 2007, §15.247 and RSS-210 Issue 8, Annex 8.

The test results of this report relate only to the tested sample identified in this report.

# 2- EUT Description

| | |
|---|---|
| Product Name: | 2.4GHz Radio Control System |
| Trade Mark: | *SANWA* |
| Model Number: | 92011 |
| Model Difference: | N/A |
| Type of Modulation:: | FHSS |
| Number of Channels: | 76 |
| Channel Separation: | 1MHz |
| Power Supply: | 6.0V DC power from 4*1.5V size “AA” batteries |
| Frequency Range: | 2403 ~2478 MHz |
| Antenna Designation: | Non-user replaceable (fixed) |

***Remark:*** *This submittal(s) test report is intended for FCC ID: L73-92011, IC: 7377A-92011 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules and RSS-210 Issue 8, Annex 8.*

# 3-Test System

## 3.1 Test Mode

The compliance test was performed under test modes:

Mode 1: Transmitting at 2403MHz without hopping.

Mode 2: Transmitting at 2441MHz without hopping.

Mode 3: Transmitting at 2478MHz without hopping.

Mode 4: Transmitting with hopping.

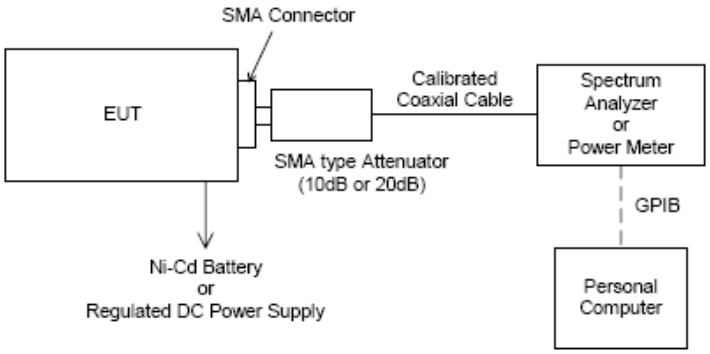
The EUT is designed both of horizontally placed and vertically placed. In radiated emission measurement, each condition was conducted.

As a result, the below operation that produce the maximum emission were reported.

a) Carrier Frequency Separation measurement ---Mode 4
b) Number of Hopping Frequencies measurement --- Mode 4
c) Time of Occupancy measurement --- Mode 4
d) Peak Output Power measurement --- Mode 1, Mode 2, Mode 3
e) Band Edge of RF Conducted measurement --- Mode 1, Mode 3 and Mode 4
f) Radiated Emission measurement --- Mode 1, Mode 2, Mode 3
g) Band Edge and Restricted Band of Radiated Emission measurement--- Mode 1, Mode 3
h) 99% Bandwidth measurement --- Mode 1, Mode 2, Mode 3

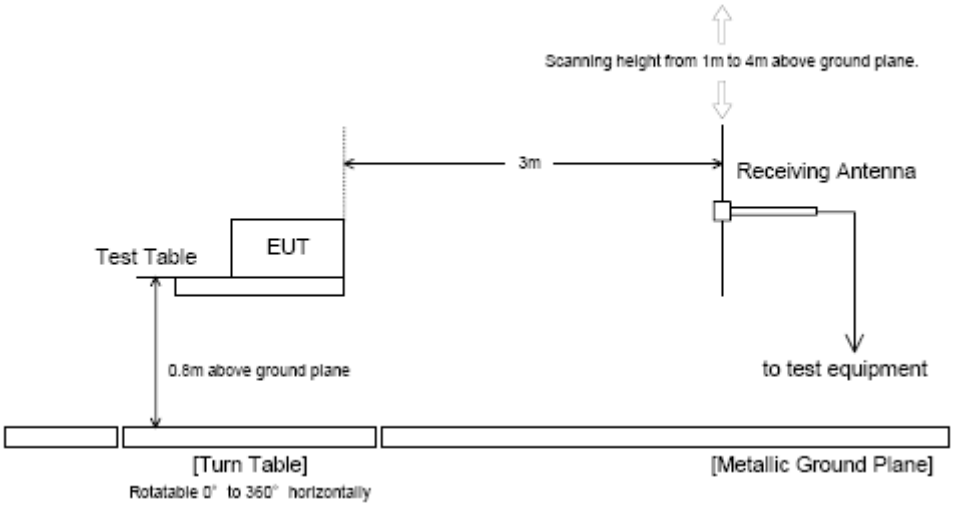
## 3.2 Test Setup Diagram

. Carrier Frequency Separation
. Number of Hopping Frequencies
. Time of Occupancy (Dwell Time)
. Peak Output Power
. Band Edge of RF Conducted Emission
. 99% Bandwidth

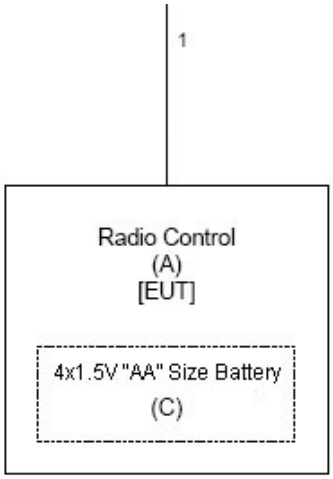



*Note: Regulated DC power supply is not used in this report.*

. Radiated Emission




## 3.3 Block Diagram of EUT System




## 3.4 List of Cables

| No | Cable Name | Shielded (Y/N) | Length (m) | Note | Remark |
|---|---|---|---|---|---|
| 1 | Antenna | Y | 0.21 | / | / |

# 4- Test Equipment and Calibration

| Equipment type | Manufacturer | Model | Serial Number | Calibration Due |
|---|---|---|---|---|
| Biconilog Antenna | ETS | 3142C | 00042672 | 2011/09 |
| Receiver | SCHAFFNER | SMR4503 | 11725 | 2012/07 |
| Spectrum Analyzer | R/S | FSP30 | 100755 | 2011/11 |
| Double-Ridged-Wave-guide Horn Antenna | ETS | 3115 | 6587 | 2012/08 |
| Amplifier | Agilent | 83017A | MY39500438 | 2011/11 |
| Band-pass Filter | Micro-Tronic | BRM50702 | S/N-030 | 2011/11 |

# 5- Laboratory Accreditations and Measurement Uncertainty

## 5.1 Laboratory Accreditation

FCC-Registration No.: 415467

ATC Lab Co., Ltd (Guangdong, China) EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 415467. Listing date October 10, 2008.

IC - Registration No.: 7949A

The 3m Alternate Test Site of ATC Lab Co., Ltd (Guangdong, China) has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 7949A on January 25th, 2011.

## 5.2 Measurement Uncertainty

of +/- 3×10-9 for Carrier Frequency Separation Measurement
of +/- 3×10-9 for Number of Hopping Frequencies Measurement
of +/- 3×10-9 for 20dB Bandwidth Measurement
of +/- 3×10-9 for Time of Occupancy (Dwell time) Measurement
of +/- 0.8 dB for Peak Output Power Measurement
of +/- 0.8 dB for Band Edge RF Conducted Measurement
of +/- 0.8 dB for Spurious RF Conducted Emission Measurement
of +/- 0.8 dB for Power Density
of +/- 4.8 dB for Radiated Emissions
of +/- 2.3 dB for Conducted Emissions

# 6- Technical Requirements and Results

## 6.1 Carrier Frequency Separation Measurement

**Applicable Standard:**

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater

According to RSS 210 issue 8, A8.1(b), frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

**Test Procedure:**

1. Connect the EUT RF output port to spectrum analyzer via calibrated coaxial cable and suitable attenuator (if necessary).
2. Activates the EUT System and execute the software prepared for test, if necessary.
3. To find out the maximum emission condition, the transmitting data rate of EUT is set to maximum data rate.
4. The Spectrums are scanned and allow the trace stabilized.
5. The separation between the peaks of the peaks of adjacent channel were measured by using delta-maker function of the spectrum analyzer

Spectrum analyzer setup condition :

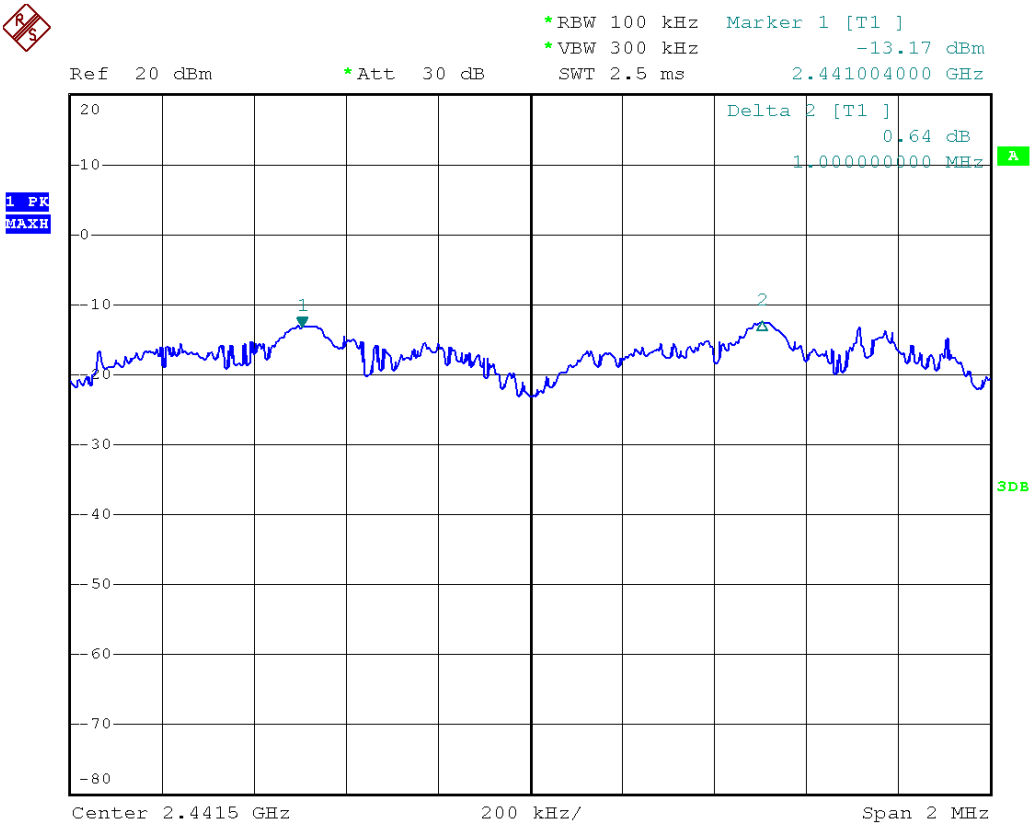
Frequency Span : 2MHz
Resolution bandwidth : 100kHz
Video bandwidth : ≧RBW
Sweep : Auto
Detector function : Peak
Trace Mode : Max Hold

**Test Result:**

| | |
|---|---|
| Temperature: | 23 °C |
| Humidity: | 45% |
| EUT Operation: | Data Transmission (hopping) |
| Test Date: | August 16, 2011 |

| Carrier Frequency Separation [ MHz ] | [ MHz ] Limit |
|---|---|
| 1.000 | > 0.025 |
| Note: Test plot shown in figure 1 on page 10. | |

Figure 1: Channel Separation



## 6.2 Number of Hopping Frequencies Measurement

**Applicable Standard:**

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

According to RSS-210 issue 8, §A8.1(d), Frequency hopping systems operating in the 2400-2483.5MHz band shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

**Test Procedure:**

1. Connect the EUT RF output port to spectrum analyzer via calibrated coaxial cable and suitable attenuator (if necessary).
2. Activates the EUT System and executes the software prepared for test, if necessary.
3. To find out the maximum emission condition, the transmitting data rate of EUT is set to maximum data rate.
4. The spectrums are scanned and allow the trace to stabilize.
5. The number of hopping frequencies were counted on the spectrum analyzer and recorded.

Spectrum analyzer setup condition :

Resolution bandwidth :100KHz
Video bandwidth : ≧RBW
Sweep : Auto
Detector function : Peak
Trace Mode : Max Hold

**Test Result:**

| | |
|---|---|
| Temperature: | 23 °C |
| Humidity: | 45% |
| EUT Operation: | Data Transmission (hopping) |
| Test Date: | August 16, 2011 |

| Number of Hopping Frequencies | [ MHz ] Limit |
|---|---|
| 76 | > 15 |
| Note: Test plots shown in figures 2, 3 on page 12. | |

Figure 2: Number of Hopping Frequencies

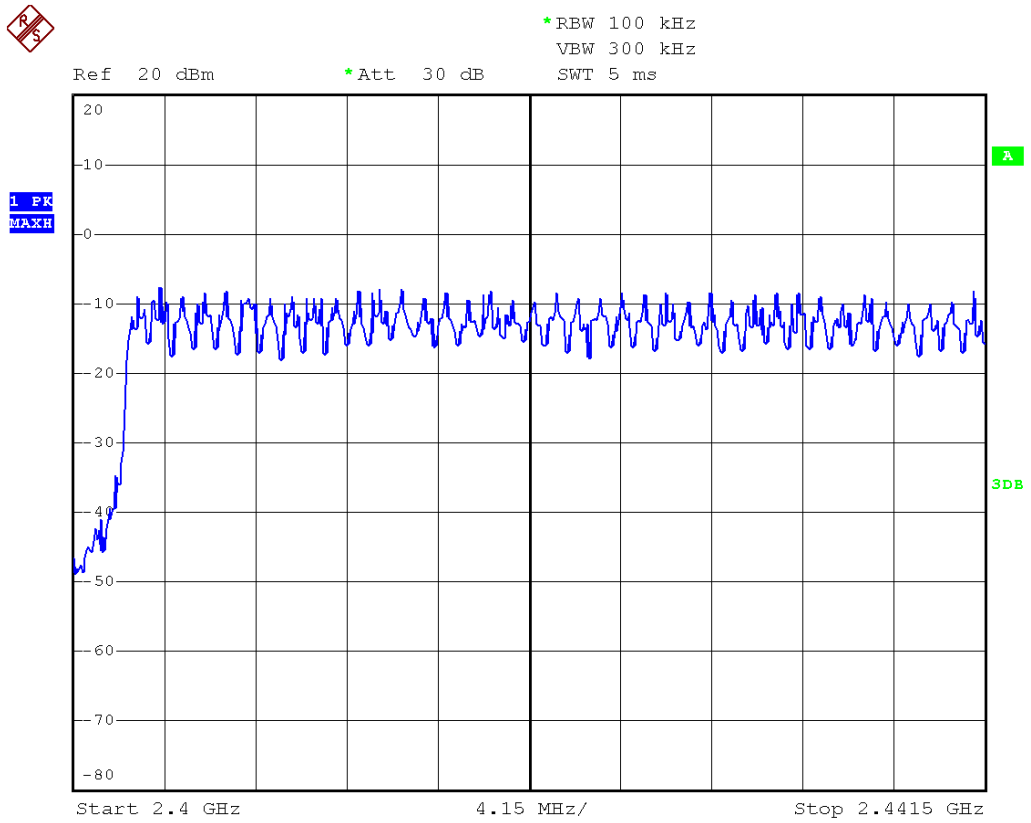
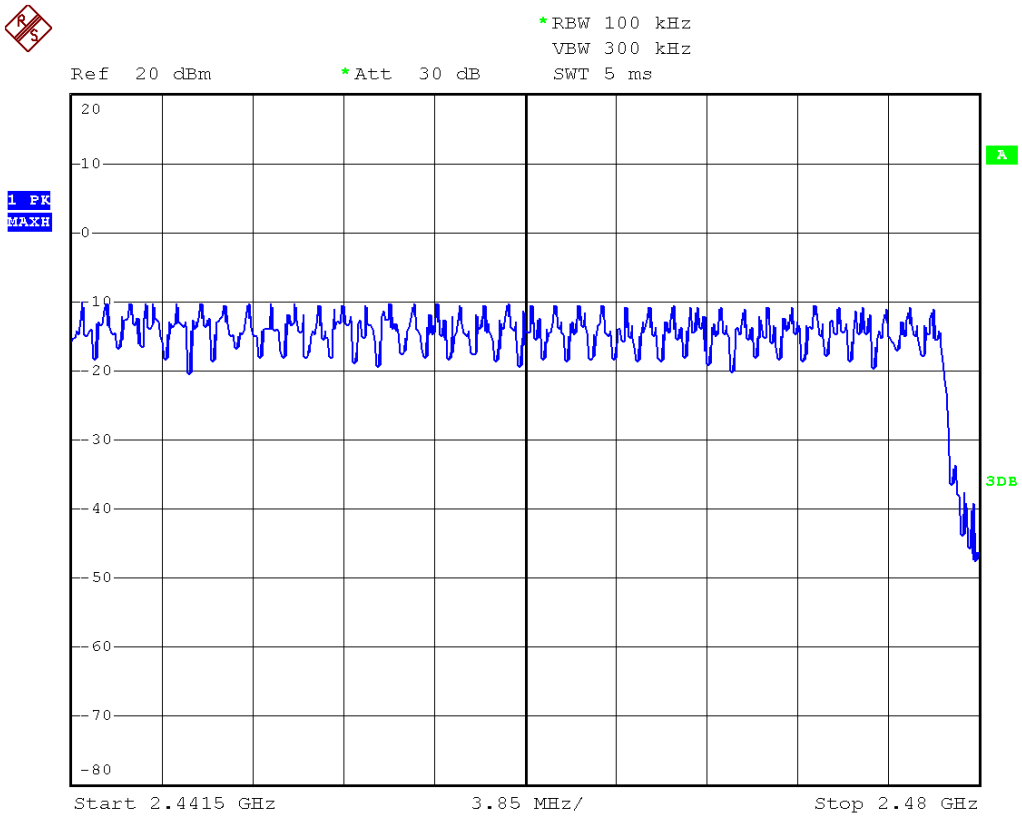



Figure 3: Number of Hopping Frequencies



## 6.3 Time of Occupy (Dwell Time) Measurement

**Applicable Standard:**

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

According to RSS-210 issue 8, §A8.1 (d), Frequency hopping systems operating in the 2400-2483.5MHz bands shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

.

**Test Procedure:**

1.Connect the EUT RF output port to spectrum analyzer via calibrated coaxial cable and suitable attenuator (if necessary).
2. Activates the EUT System and execute the software prepared for test, if necessary.
3. To find out the maximum emission condition, the transmitting data rate of EUT is set to maximum data rate.
4. The span of spectrum analyzer was set to zero (sweep time 30msec). The occupied time at center on a hopping frequency was observed and recorded as “Ton”.
5. The spectrums are scanned by using the spectrum analyzer (*1). And the numbers of occupied channel per Nsec (period of 0.4 seconds multiplied by the number of hopping channels employed) were counted by using the delta-marker function of spectrum analyzer and recorded as “N”.
6. The dwell time was calculated by Ton × N.

Spectrum analyzer setup condition:
Frequency Span : Zero span
Resolution bandwidth : 1MHz
Video bandwidth : ≧ RBW
Sweep : as necessary to capture the entire dwell time per hopping channel.
Detector function : Peak
Trace Mode : Max Hold

**Test Result:**

| | |
|---|---|
| Temperature: | 23 °C |
| Humidity: | 45% |
| EUT Operation: | Data Transmission (hopping) |
| Test Date: | August 16, 2011 |

| [ ms ]Dwell Time | [ ms ] Limit |
|---|---|
| 0.34ms x 304 = 104.72 | < 400 |
| Note: Test plots shown in figures 4, 5, 6 on pages 14, 15. | |

Figure 4: Duration of One Transmission

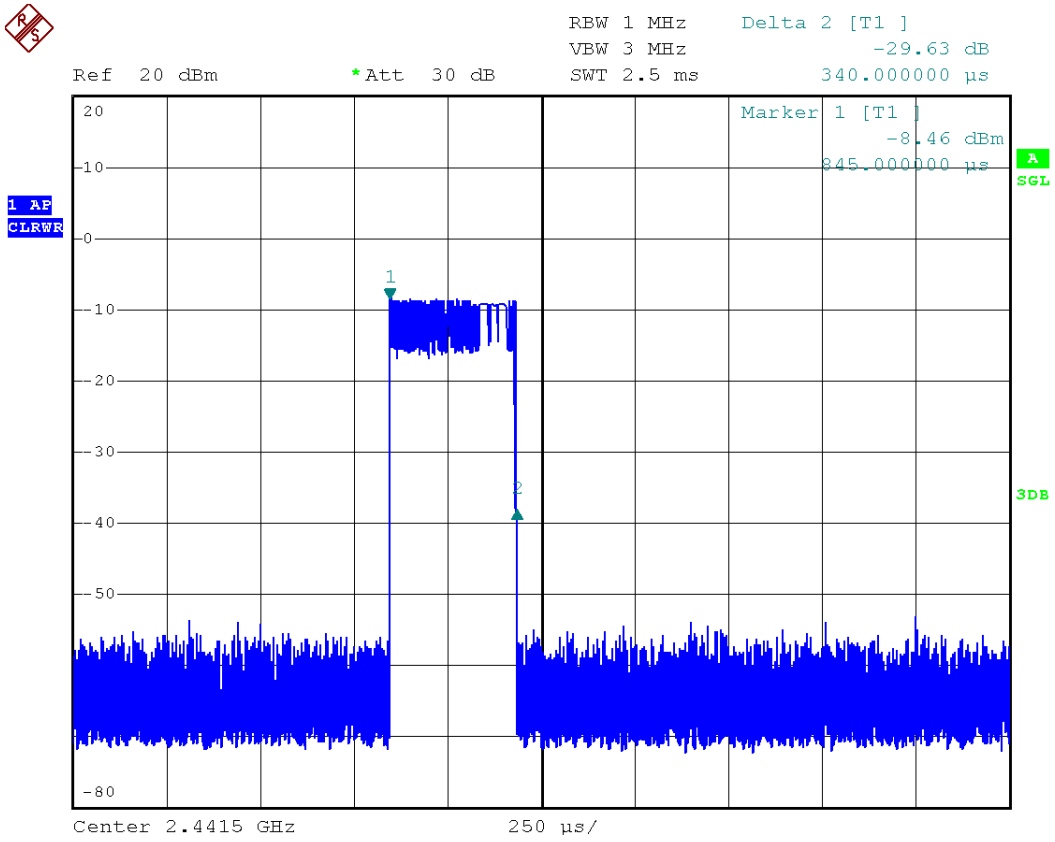



Figure 5: Number of Transmission at 30.4 s

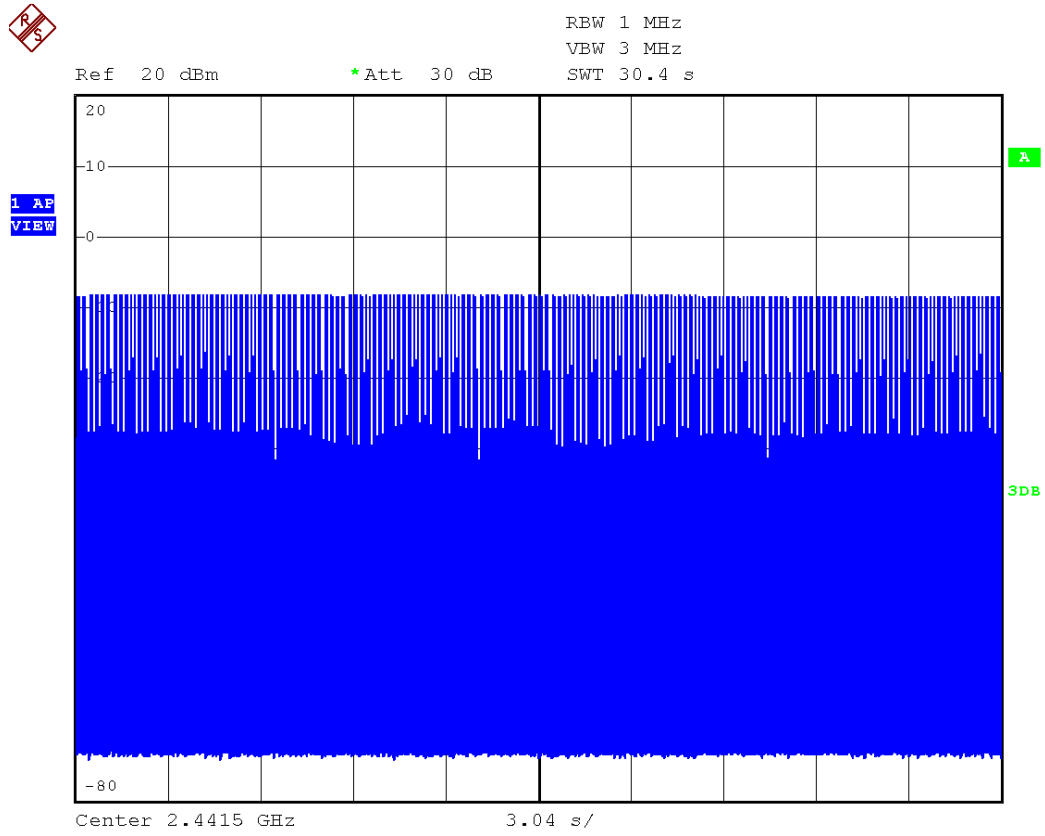
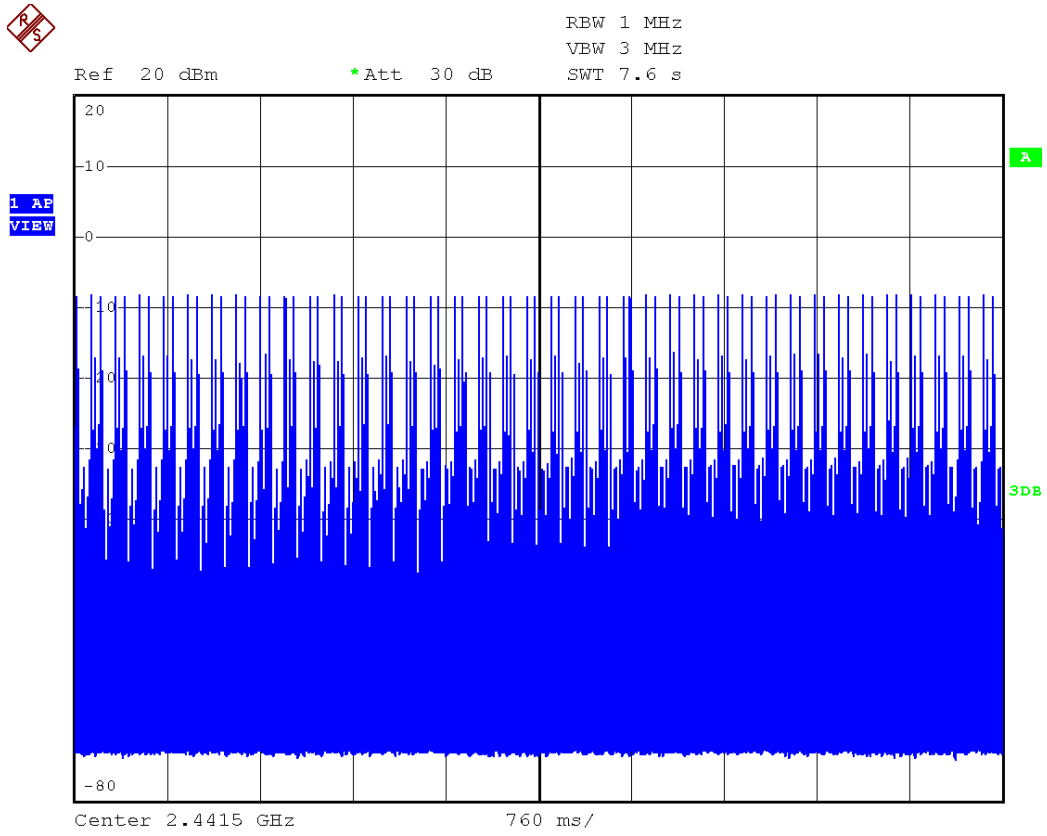


Figure 6: Number of Transmission at 7.6 s



## 6.4 Peak Output Power Measurement

**Applicable Standard:**

According to §15.247(b), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1Watt. For all other frequency hopping systems in the 2400-2483.5MHz band: 0.125 Watts.

According to RSS-210 issue 8, §A8.4 (2), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, the maximum conducted output power shall not exceed 1 W. For all other frequency hopping systems, the maximum peak conducted output power shall not exceed 0.125 W.

.

**Test Procedure:**

1. Connect the EUT RF output port to spectrum analyzer via calibrated coaxial cable and suitable attenuator (if necessary).
2. Activates the EUT System and executes the software prepared for test, if necessary.
3. To find out the worst case, the transmitting data rate of EUT is varied with the different modes of operation. The final test condition is recorded in this report.
4. The spectrums are scanned and allow the trace to stabilize.
5. The peak output power was determined by using the marker-data function of spectrum analyzer or peak type power meter.

Spectrum Analyzer Set Up Conditions
Frequency Span : 5 times 20dB bandwidth of the emission being measured
Resolution bandwidth : 3MHz
Video bandwidth : ≧RBW
Sweep : Auto
Detector function : Peak
Trace Mode : Max Hold

**Test Result:**

| | |
|---|---|
| Temperature: | 23 °C |
| Humidity: | 45% |
| EUT Operation: | Data Transmission (without hopping) |
| Test Date: | August 18, 2011 |

| Frequency | Factor | Reading | Power | Limit | Margin |
|---|---|---|---|---|---|
| [ MHz ] | [ dB ] | [ dBm ] | [ dBm ] | [ dBm ] | [ dB ] |
| 2403 | 1.0 | -7.01 | -7.01 | 30.00 | 37.01 |
| 2441 | 1.0 | -9.26 | -8.26 | 30.00 | 38.26 |
| 2478 | 1.0 | -9.72 | -8.72 | 30.00 | 38.72 |
| Note: Test plots shown in figures 7, 8, 9 on pages 17, 18. | | | | | |

Figure 7: Peak Output Power - low channel

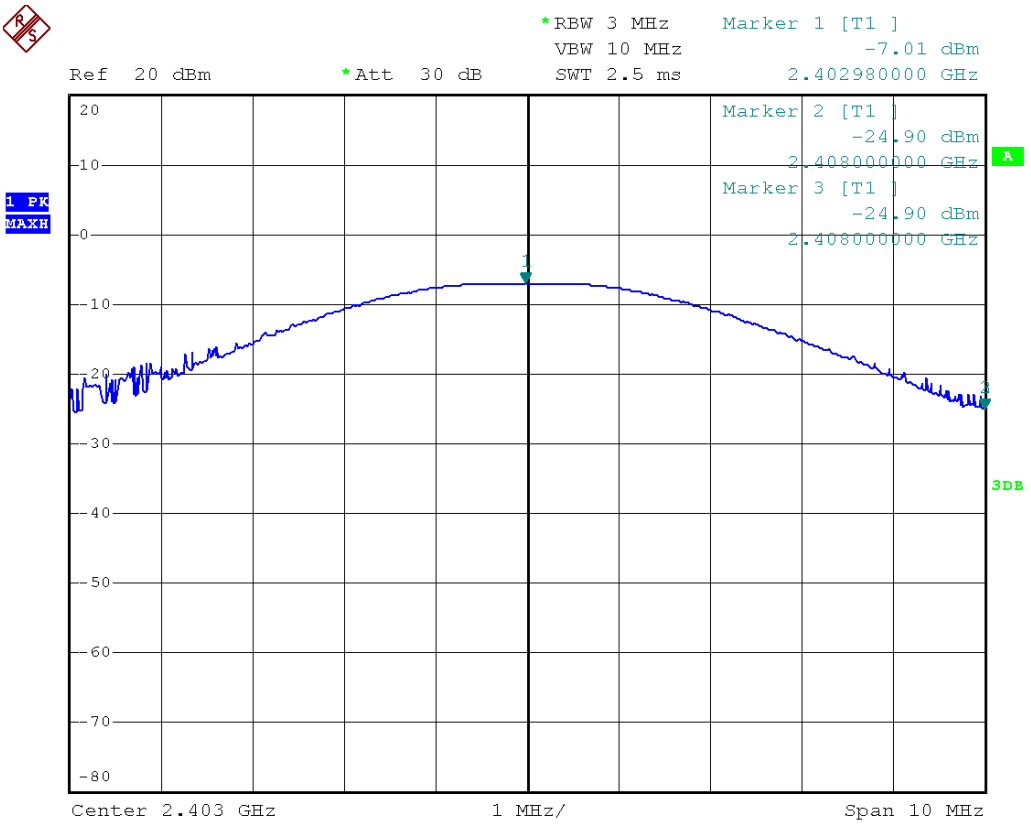



Figure 8: Peak Output Power - middle channel

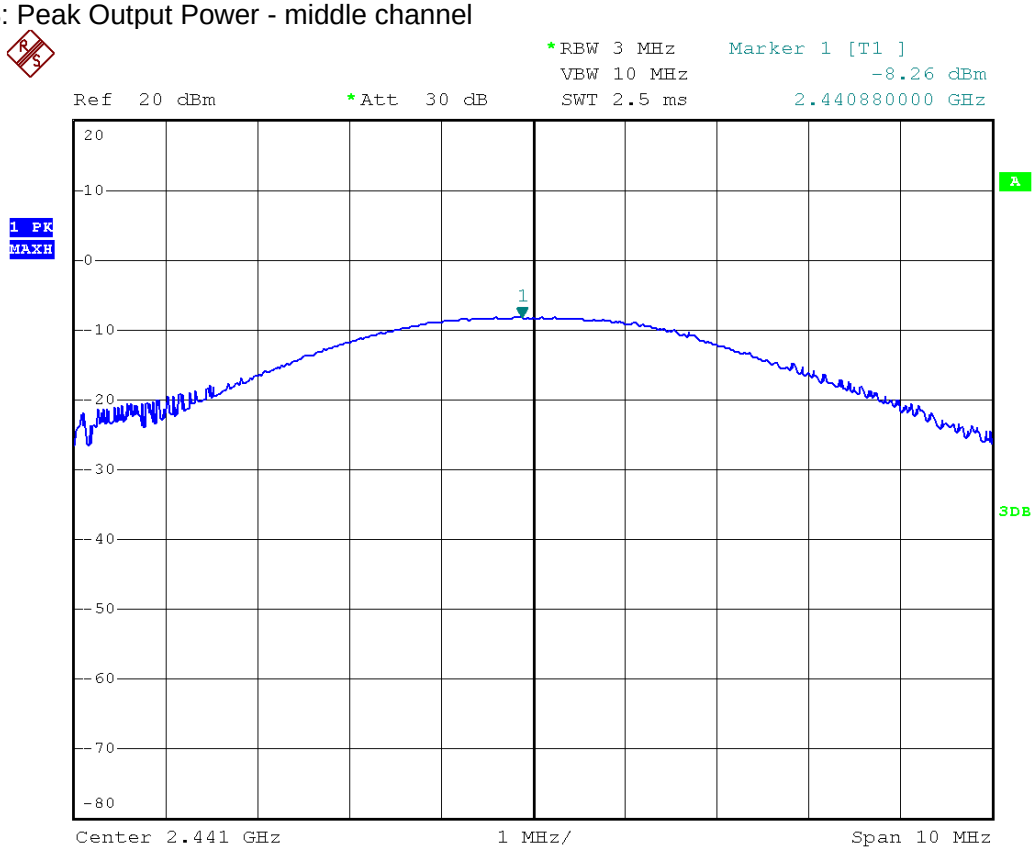
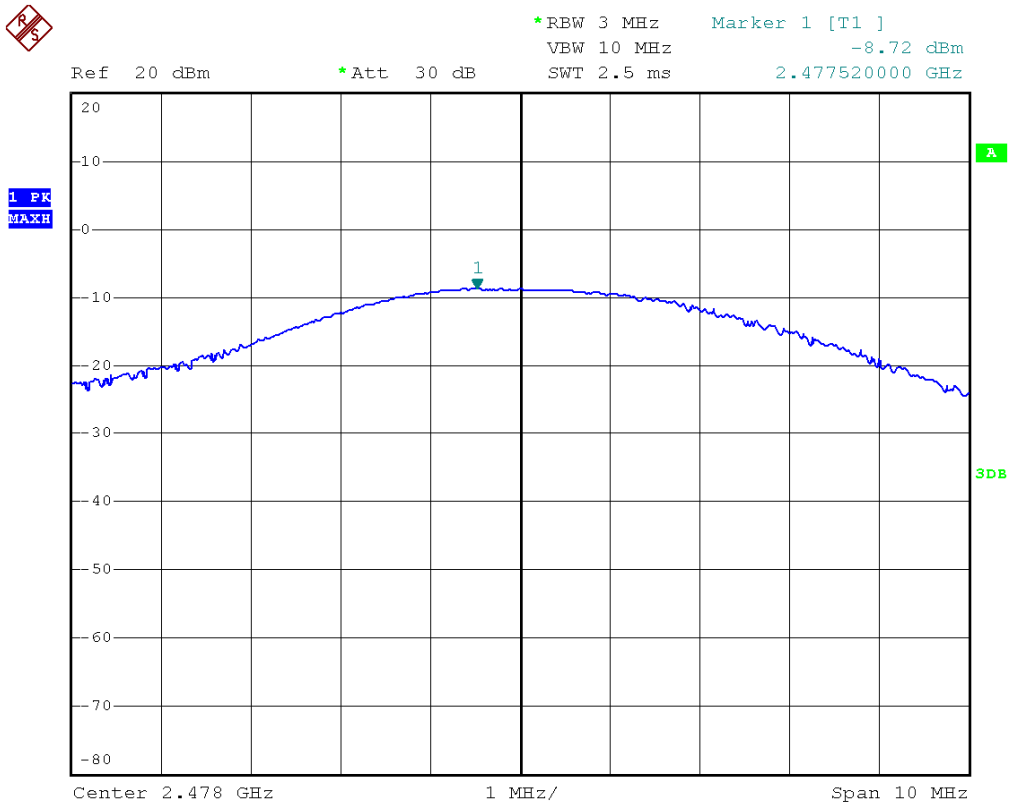


Figure 9: Peak Output Power - high channel



## 6.5 Band Edge of Conducted Emission and Spurious RF Conducted Emissions

**Applicable Standard:**

According to §15.247(d), in any 100 KHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, 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 in15.209(a).

According to RSS-210 issue 8, §A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

.

**Test Procedure:**

1. Connect the EUT RF output port to the spectrum analyzer via calibrated coaxial cable and suitable attenuator (if necessary).
2. Activates the EUT System and executes the software prepared for test, if necessary.
3. To find out the maximum emission condition, the transmitting data rate of EUT is set to maximum data rate.
4. The spectrum are scanned.
5. The emission at the band edge or the highest modulation product outside of band were measured by using the marker function of spectrum analyzer (*1).
6. The peak of the in-band emission were measured by using the marker to peak function of spectrum analyzer.
7. Above measurement were repeated at other side band edge.

Frequency Span : Wide enough to capture the peak level of emission on the band edge
Resolution bandwidth : 100kHz
Video bandwidth : ≧RBW
Sweep : Auto
Detector function : Peak
Trace Mode : Max Hold

| | |
|---|---|
| Temperature: | 23 °C |
| Humidity: | 45% |
| EUT Operation: | Data Transmission (hopping and without hopping) |
| Test Date: | August 18, 2011 |

The unit does meet the requirements.
Test plots shown in figures 10, 11, 12, 13, 14, 15, 16 on pages 20, 21, 22, 23, 24.

Figure 10: Band Edge - low frequency side without hopping

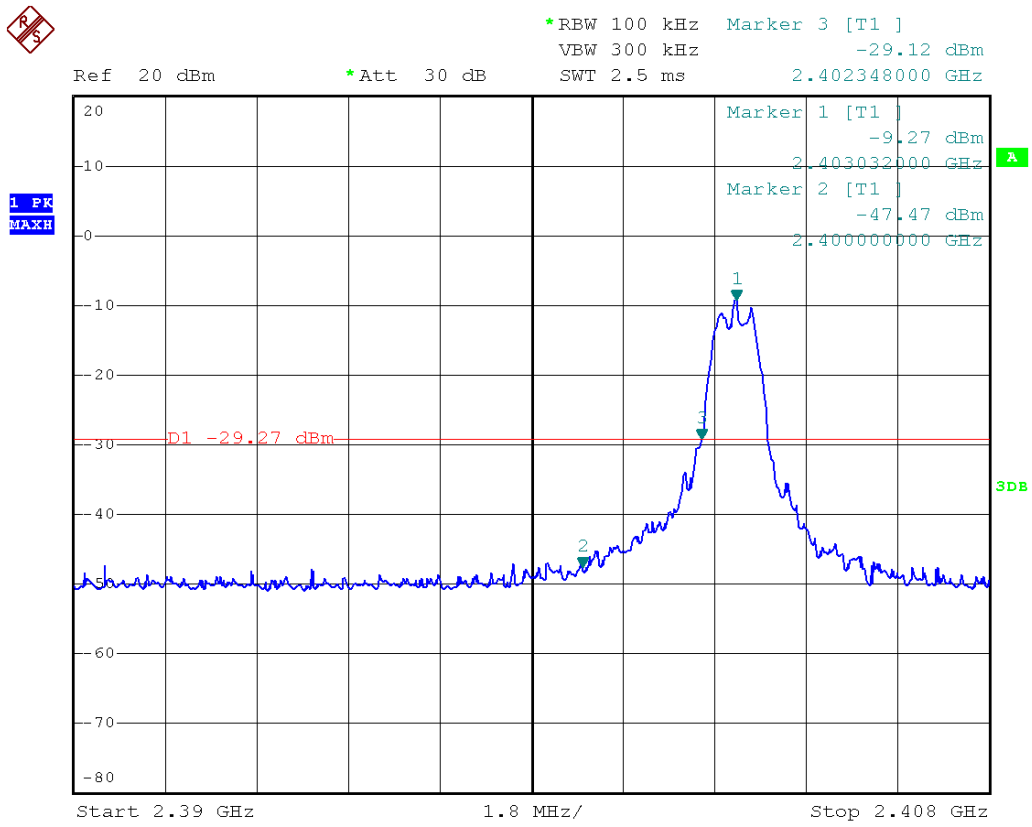



Figure 11: Band Edge – high frequency side without hopping

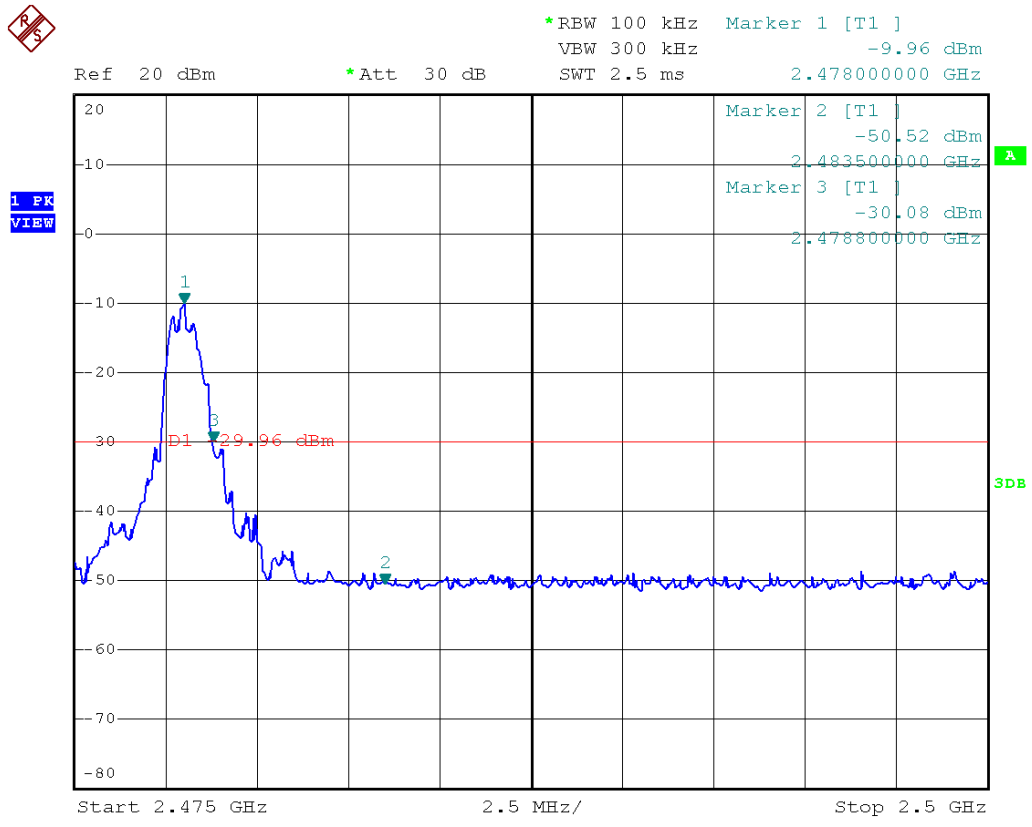


Figure 12: Band Edge – low frequency side with hopping

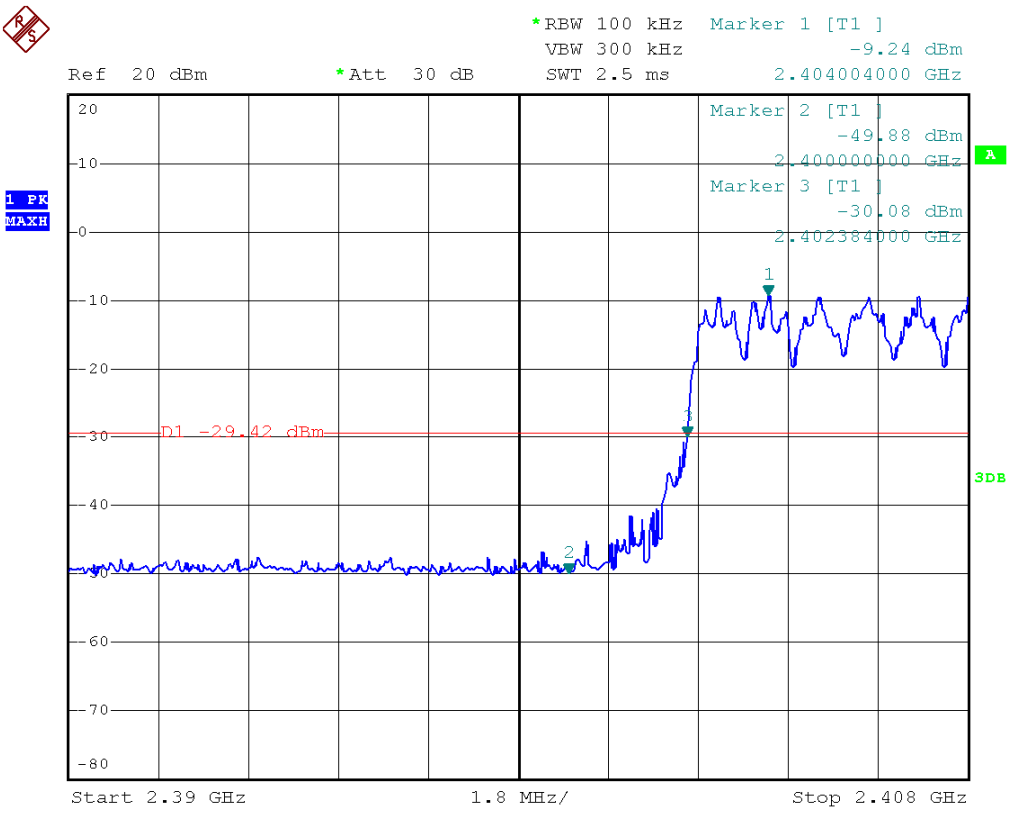



Figure 13: Band Edge – high frequency side with hopping

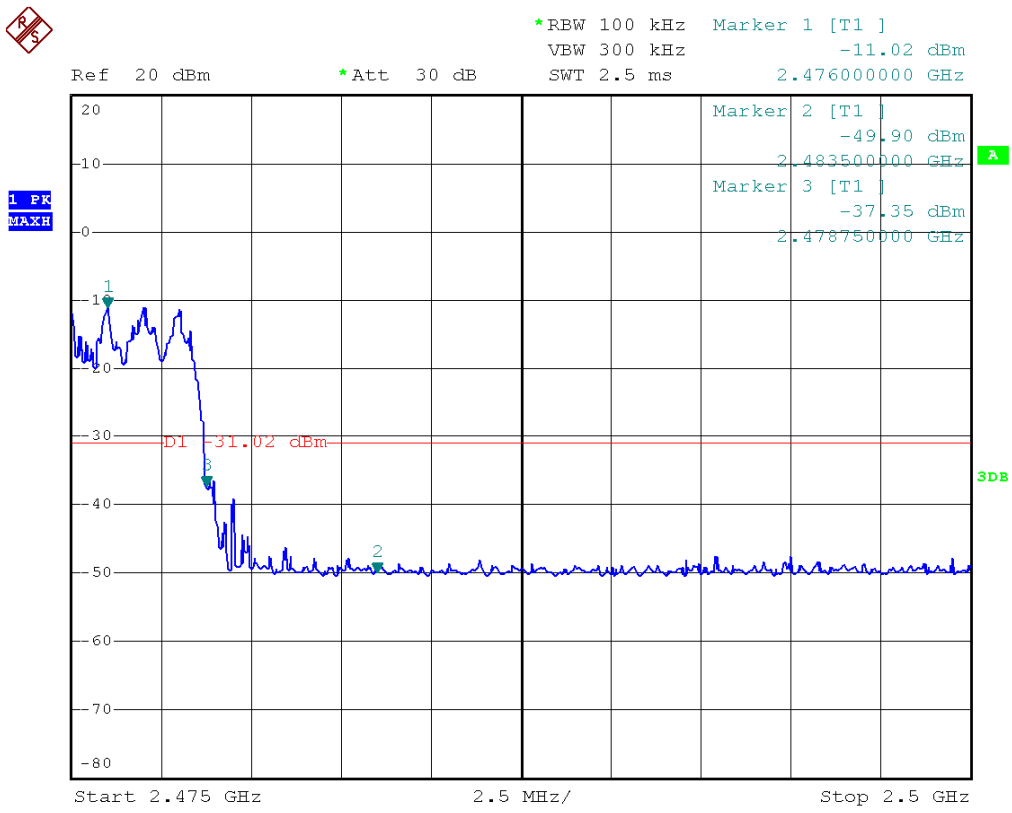


Figure 14 Conducted Spurious Emissions, low channel

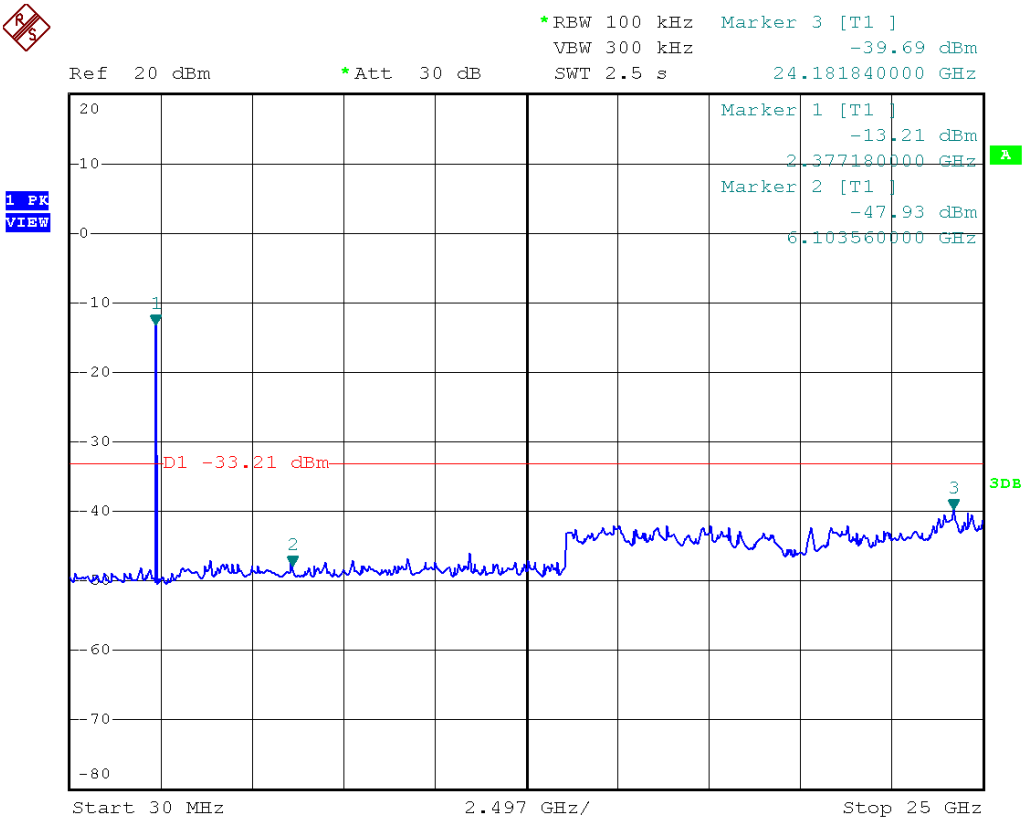



Figure 15 Conducted Spurious Emissions, mid channel

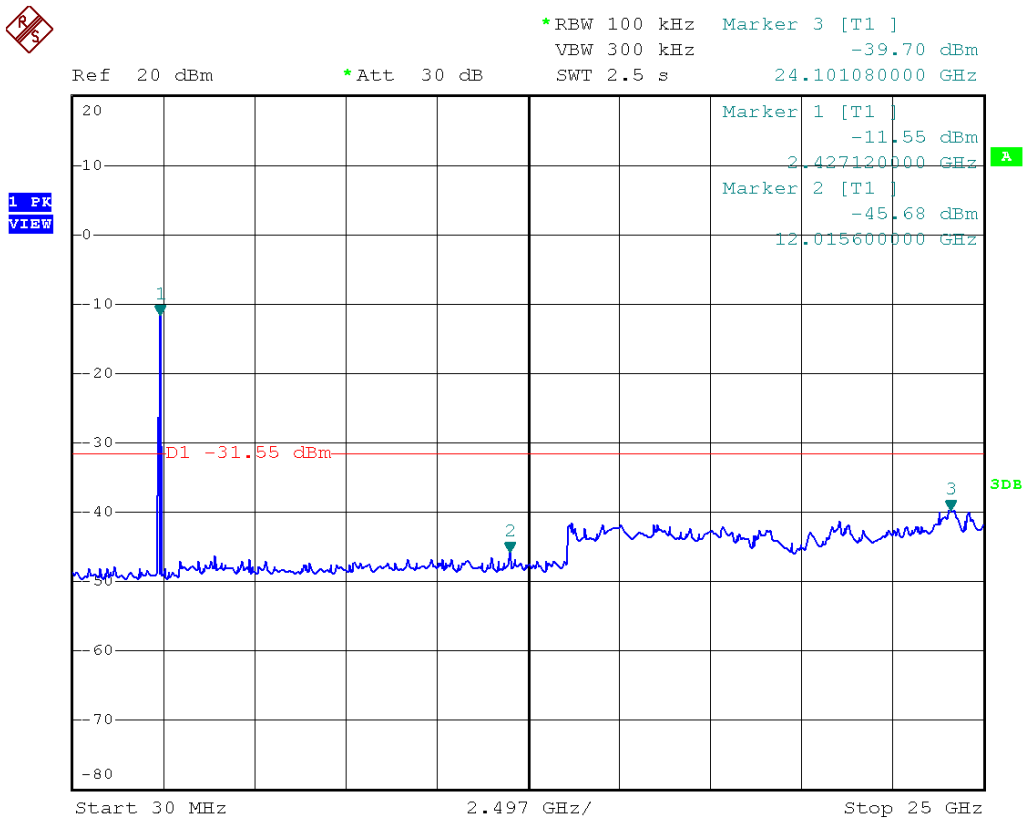
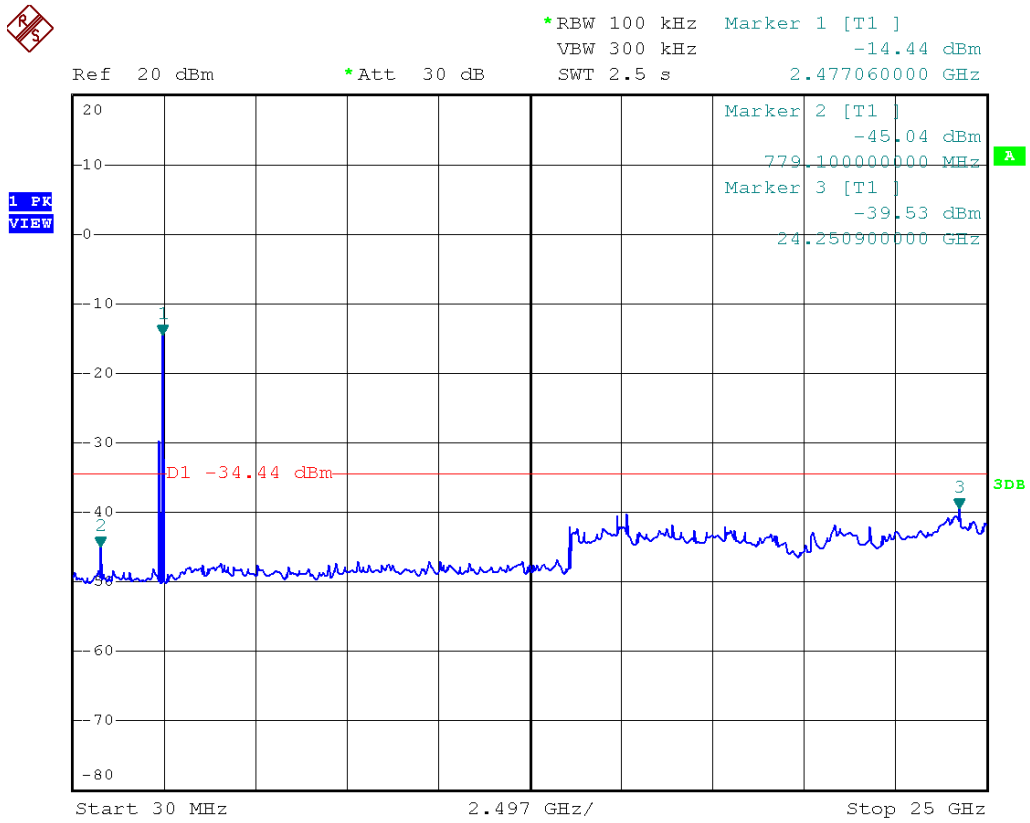


Figure 16 Conducted Spurious Emissions, high channel



## 6.6 Spurious Radiated Emission Measurement

**Applicable Standard:**

According to §15.247(c), all other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

According to RSS-210 issue 8,§A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which falls in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

Test Procedure:

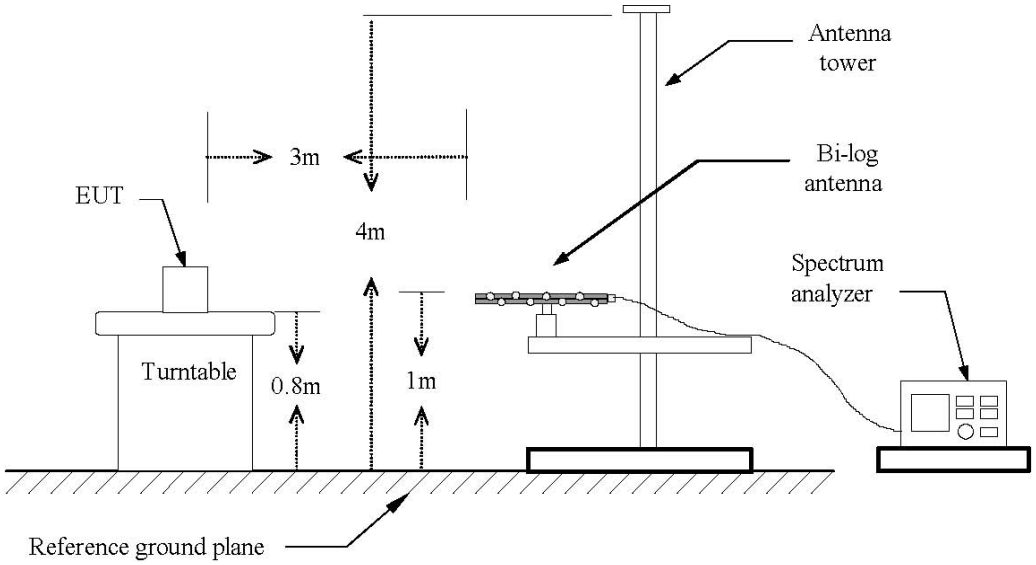
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until all frequency measured were complete.

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

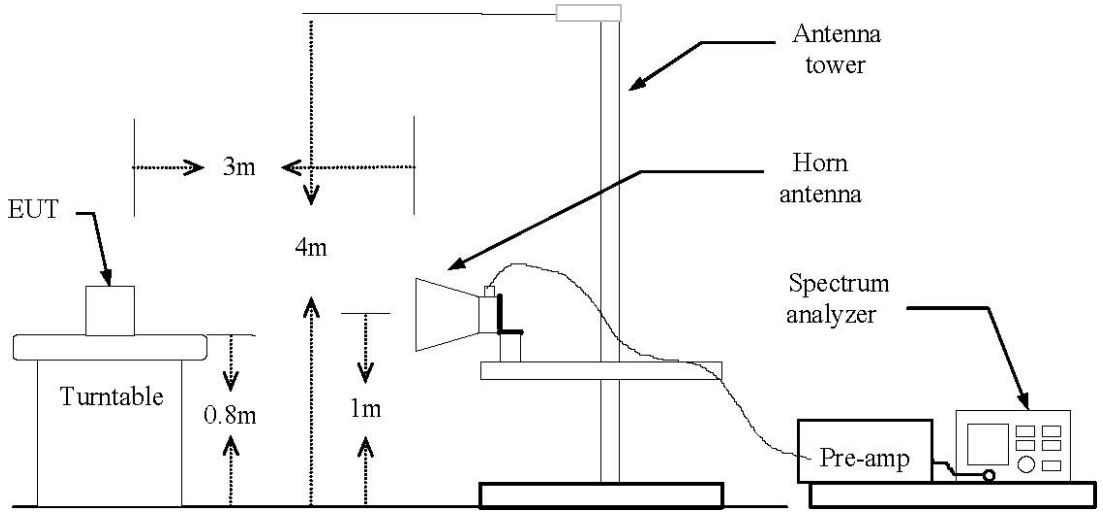
FS = RA + AF + CL - AG

| | |
|---|---|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude | AG = Amplifier Gain |
| AF = Antenna Factor | |

Test Configuration Below 1 GHz:




Test Configuration Above 1 GHz:




## Test Results:

| | |
|---|---|
| Temperature: | 25°C |
| Humidity: | 55% |
| EUT Operation: | Data Transmission (without hopping) |
| Test Date: | August 18, 2011 |

## Spurious Emission In the Frequency Rang Below 1GHz:

Fc= 2403MHz Transmitting Operation

| Freq. (MHz) | Ant.Pol. (H/V) | Detector Mode (PK/QP) | Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS (dBuV/m) | Limit 3m (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 33.20 | H | QP | 10.9 | 12.3 | 23.2 | 40.0 | -16.8 |
| 823.36 | H | QP | 17.6 | 22.5 | 40.1 | 46.0 | -5.9 |
| 32.96 | V | QP | 8.2 | 12.3 | 20.5 | 40.0 | -19.5 |
| 144.00 | V | QP | 11.0 | 9.1 | 20.1 | 43.5 | -23.4 |
| 822.00 | V | QP | 7.3 | 22.5 | 29.8 | 46.0 | -16.2 |

Fc= 2441MHz Transmitting Operation

| Freq. (MHz) | Ant.Pol. (H/V) | Detector Mode (PK/QP) | Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS (dBuV/m) | Limit 3m (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 35.60 | H | QP | 14.2 | 12.0 | 26.2 | 40.0 | -13.8 |
| 824.60. | H | QP | 16.3 | 22.5 | 38.8 | 46.0 | -7.2 |
| 32.54 | V | QP | 10.0 | 12.3 | 22.3 | 40.0 | -17.7 |
| 319.76 | V | QP | 5.2 | 14.9 | 20.1 | 46.0 | -23.9 |
| 821.34 | V | QP | 6.3 | 22.5 | 28.7 | 46.0 | -17.3 |

Fc= 2478MHz Transmitting Operation

| Freq. (MHz) | Ant.Pol. (H/V) | Detector Mode (PK/QP) | Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS (dBuV/m) | Limit 3m (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 34.18 | H | QP | 12.2 | 12.3 | 24.5 | 40.0 | -15.5 |
| 820.33 | H | QP | 14.8 | 22.0 | 36.8 | 46.0 | -9.2 |
| 33.08 | V | QP | 9.1 | 12.3 | 21.4 | 40.0 | -18.6 |
| 324.00 | V | QP | 7.8 | 15.0 | 22.8 | 46.0 | -23.2 |
| 826.00 | V | QP | 7.4 | 22.7 | 30.1 | 46.0 | -15.9 |

**Note:** For spurious emission measurement, the compliance tests were performed both of horizontally placed and vertically placed in EUT (X position, Y position, Z position). As a result, the data of operation mode that produce the maximum emission were reported. The other emissions are more than 25dB below the limit.

## Spurious Emission In the Frequency Rang above 1GHz:

Fc= 2403MHz Transmitting Operation- Horizontal

| Freq. (MHz) | Peak Reading (dBuV) | AV Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS | | Peak Limit (dBuV/m) | AV Limit (dBuV/m) | Margin |
|---|---|---|---|---|---|---|---|---|
| | | | | Peak (dBuV/m) | AV (dBuV/m) | | | |
| 4792.00 | 46.99 | 32.47 | 1.20 | 49.19 | 33.67 | 74.00 | 54.00 | -20.33 |
| 7216.00 | 54.30 | 35.97 | 4.22 | 58.52 | 40.19 | 74.00 | 54.00 | -13.81 |
| - | | | | | | | | |

Fc= 2403MHz Transmitting Operation- Vertical

| Freq. (MHz) | Peak Reading (dBuV) | AV Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS | | Peak Limit (dBuV/m) | AV Limit (dBuV/m) | Margin |
|---|---|---|---|---|---|---|---|---|
| | | | | Peak (dBuV/m) | AV (dBuV/m) | | | |
| 4792.00 | 51.37 | 33.26 | 1.20 | 52.57 | 34.46 | 74.00 | 54.00 | -19.54 |
| 7216.00 | 55.20 | 36.34 | 4.22 | 59.42 | 40.56 | 74.00 | 54.00 | -13.44 |
| - | | | | | | | | |

Fc= 2441MHz Transmitting Operation- Horizontal

| Freq. (MHz) | Peak Reading (dBuV) | AV Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS | | Peak Limit (dBuV/m) | AV Limit (dBuV/m) | Margin |
|---|---|---|---|---|---|---|---|---|
| | | | | Peak (dBuV/m) | AV (dBuV/m) | | | |
| 4882.00 | 45.12 | 30.20 | 0.92 | 46.04 | 31.12 | 74.00 | 54.00 | -22.88 |
| 7330.00 | 50.28 | 33.19 | 4.22 | 54.50 | 37.41 | 74.00 | 54.00 | -16.59 |
| - | | | | | | | | |

Fc= 2441MHz Transmitting Operation- Vertical

| Freq. (MHz) | Peak Reading (dBuV) | AV Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS | | Peak Limit (dBuV/m) | AV Limit (dBuV/m) | Margin |
|---|---|---|---|---|---|---|---|---|
| | | | | Peak (dBuV/m) | AV (dBuV/m) | | | |
| 4882.00 | 49.21 | 31.78 | 0.92 | 50.13 | 32.70 | 74.00 | 54.00 | -21.30 |
| 7330.00 | 55.34 | 34.72 | 4.22 | 59.56 | 38.94 | 74.00 | 54.00 | -14.44 |
| - | | | | | | | | |

Fc= 2478MHz Transmitting Operation- Horizontal

| Freq. (MHz) | Peak Reading (dBuV) | AV Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS | | Peak Limit (dBuV/m) | AV Limit (dBuV/m) | Margin |
|---|---|---|---|---|---|---|---|---|
| | | | | Peak (dBuV/m) | AV (dBuV/m) | | | |
| 4952.00 | 43.29 | 30.11 | 0.92 | 44.21 | 31.03 | 74.00 | 54.00 | -22.97 |
| 7464.00 | 50.67 | 33.85 | 4.22 | 54.89 | 38.07 | 74.00 | 54.00 | -15.93 |
| - | | | | | | | | |

Fc= 2478MHz Transmitting Operation- Vertical

| Freq. (MHz) | Peak Reading (dBuV) | AV Reading (dBuV) | Ant./CL/ Amp.CF (dB) | Actual FS | | Peak Limit (dBuV/m) | AV Limit (dBuV/m) | Margin |
|---|---|---|---|---|---|---|---|---|
| | | | | Peak (dBuV/m) | AV (dBuV/m) | | | |
| 4952.00 | 46.33 | 30.87 | 0.92 | 47.25 | 32.79 | 74.00 | 54.00 | -21.21 |
| 7464.00 | 54.69 | 31.54 | 4.22 | 58.91 | 35.76 | 74.00 | 54.00 | -15.09 |
| - | | | | | | | | |

**Note:** Data of measurement within this frequency range shown "--- " in the table above means the reading of emissions are attenuated more than 25dB below the permissible limits or the field strength is too small to be measured.

## 6.7 Band Edge and Restricted Band of Radiated Emission Measurement

**Applicable Standard:**

According to §15.247(d), radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in15.209(a).

According to RSS-210 issue 8,§A8.5, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

According to DA 00-705, n making radiated band-edge measurements, the following technique for determining band-edge compliance.

STEP 1) Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function required by C63.4 and our Rules for the frequency being measured. For transmitters operating above 1 GHz, use a 1 MHz RBW, a 1 MHz VBW, and a peak detector (as required by Section 15.35). Repeat the measurement with an average detector (i.e., 1 MHz RBW with 10 Hz VBW).

STEP 2) Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement, it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.

STEP 3) Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by Section 15.205.

STEP 4) The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured.

Test Procedure:

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the highest emissions in restricted band to ensure EUT compliance.

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

| | |
|---|---|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude | AG = Amplifier Gain |
| AF = Antenna Factor | |

## Test Results:

| | |
|---|---|
| Temperature: | 21°C |
| Humidity: | 52% |
| EUT Operation: | Data Transmission (without hopping) |
| Test Date: | August 19, 2011 |

The unit does meet the requirements.
Test plots shown in figures 17, 18, 19, 20 on pages 31, 32.

Figure 17 Band Edge of Radiated Emission – low frequency side with hopping
Peak measurement in horizontal polarization

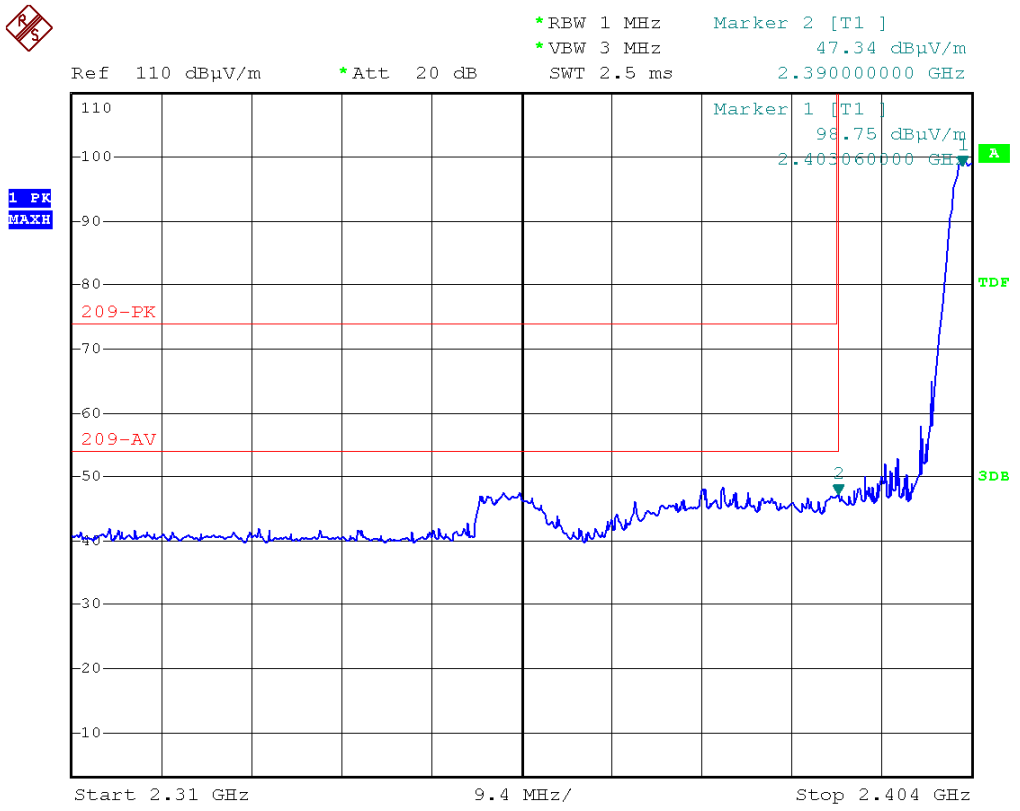



Figure 18 Band Edge of Radiated Emission – low frequency side with hopping
Peak measurement in vertical polarization

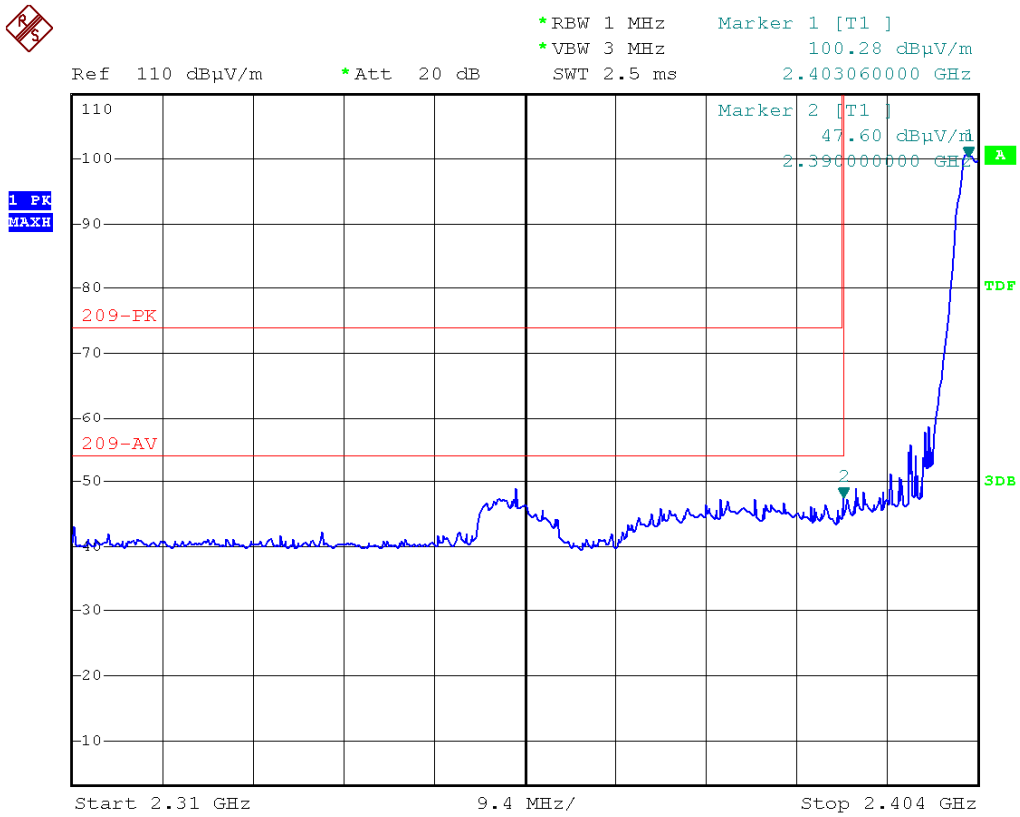


Figure 19 Band Edge of Radiated Emission – high frequency side with hopping
Peak measurement in horizontal polarization

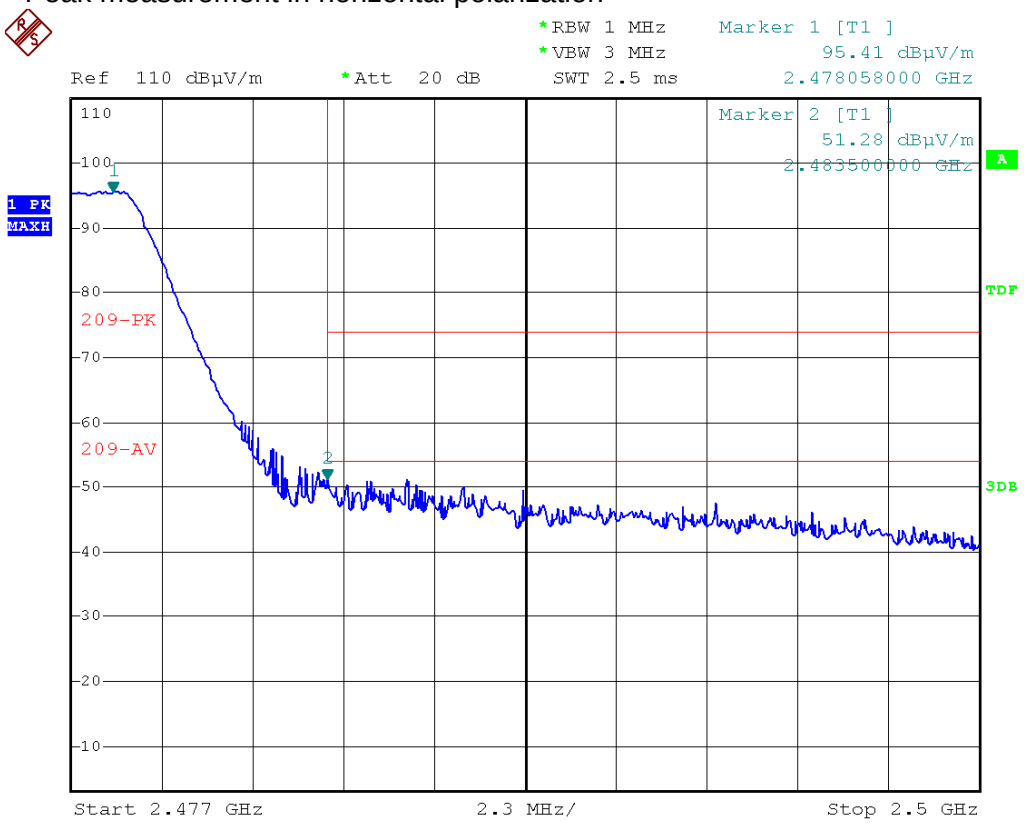
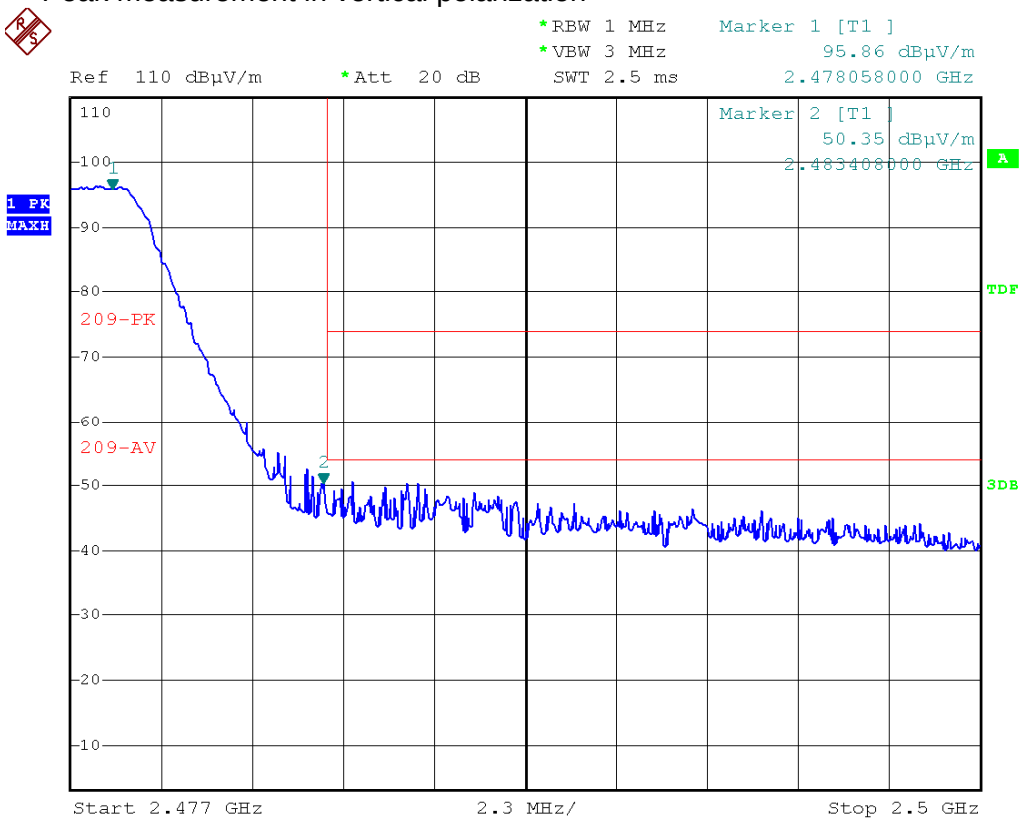



Figure 20 Band Edge of Radiated Emission – high frequency side with hopping
Peak measurement in vertical polarization



## 6.8 99% Bandwidth Measurement

### Standard Applicable:

RSS-Gen §4.4.1, the transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

### Test Procedure:

Use the following spectrum analyzer settings:

Span = 5MHz
Resolution Bandwidth = 30KHz
Video Bandwidth = 100KHz
Sweep = auto
Detector function = peak
Trace = max hold

### Test Results:

| | |
|---|---|
| Temperature: | 23°C |
| Humidity: | 54% |
| EUT Operation: | Data Transmission (without hopping) |
| Test Date: | August 19, 2011 |

| Frequency (MHz ) | 99% Bandwidth (MHz) |
|---|---|
| 2403 | 1.110 |
| 2441 | 1.200 |
| 2478 | 1.260 |
| Note: Test plots shown in figures 21, 22, 23 on pages 34, 35. | |

Figure 21- 99% Bandwidth Measurement (fc=2403MHz)

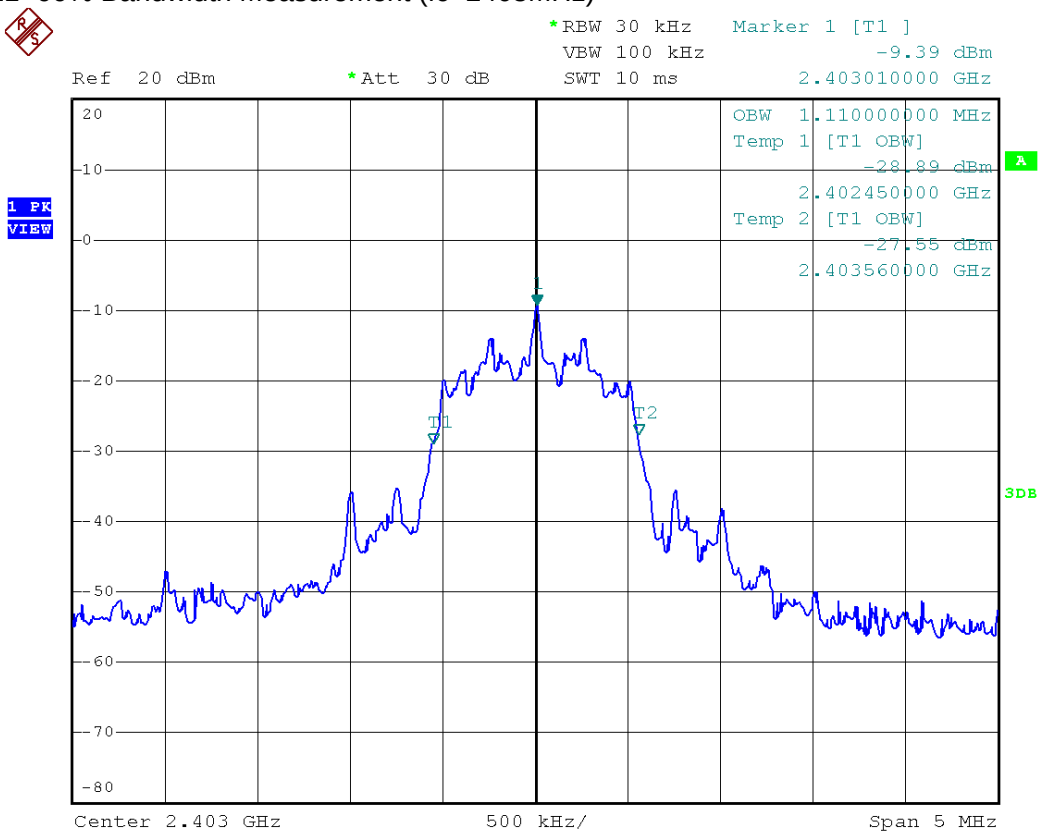



Figure 22- 99% Bandwidth Measurement (fc=2441MHz)

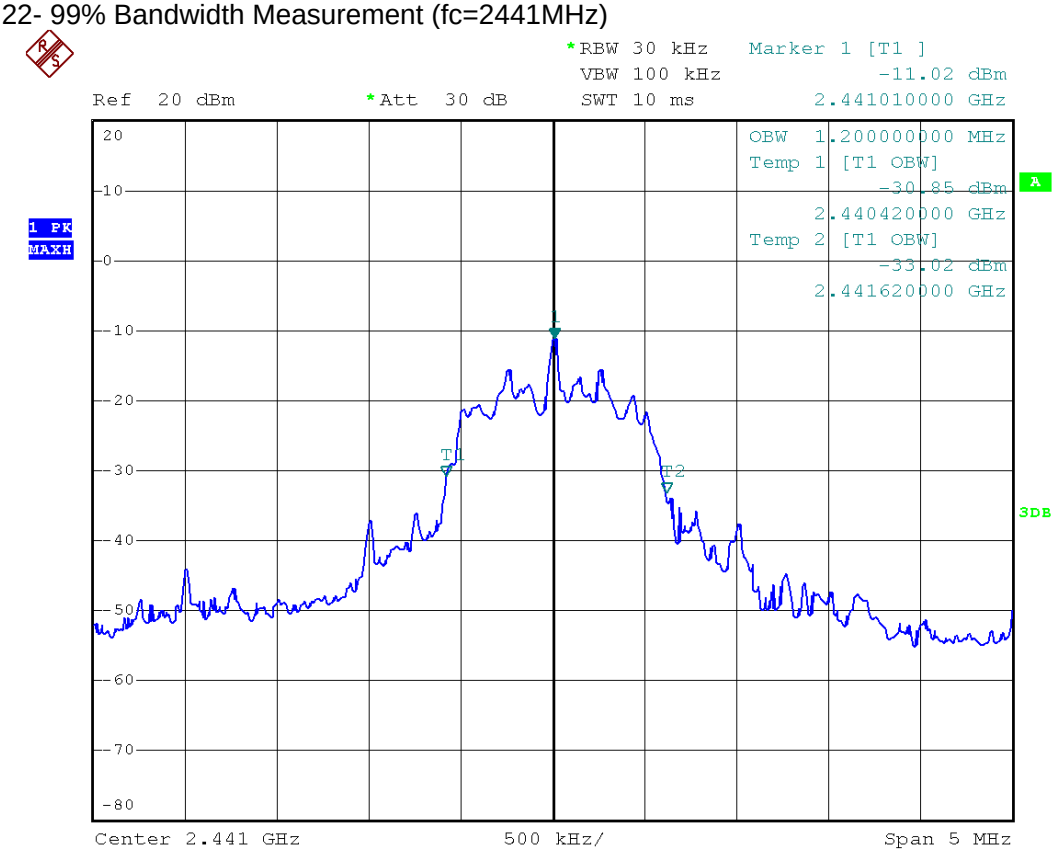
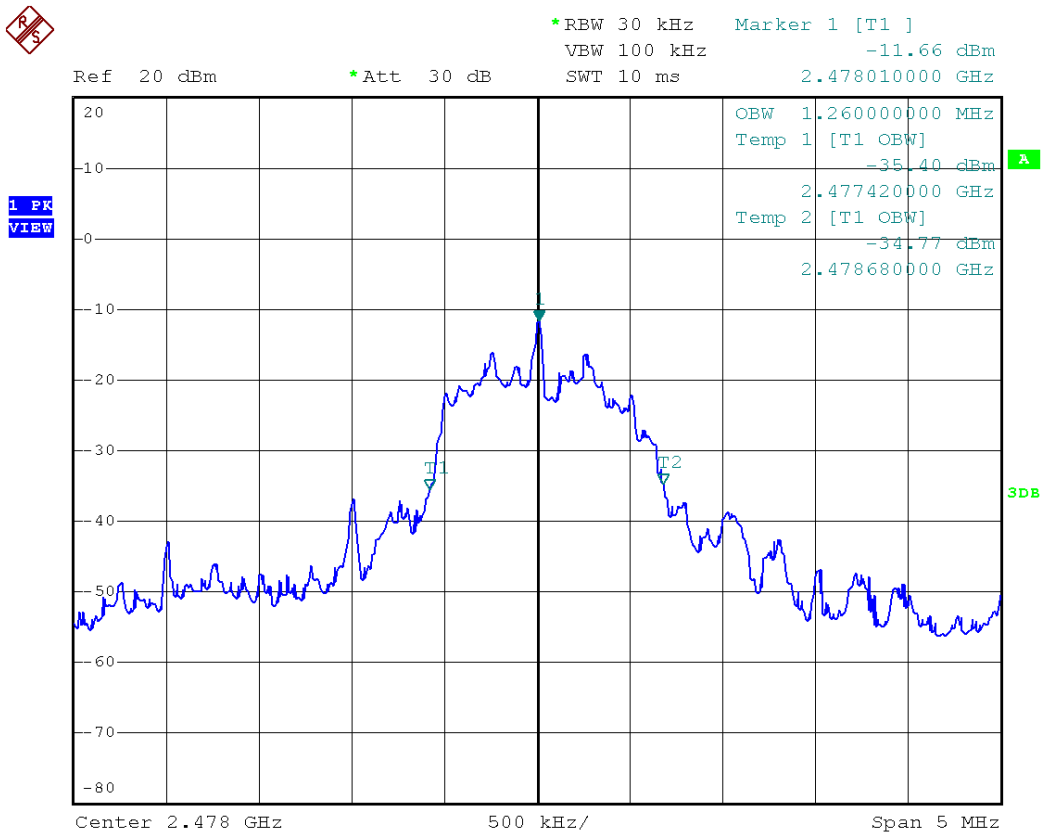


Figure 23- 99% Bandwidth Measurement (fc=2478MHz)



## 6.9 RF Exposure

### Standard Applicable

According to 1.1307 (b)(1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a portable device.

### Measurement Result:

This is a portable device and the max peak output power is -6.01dBm = (0.251mW), lower than low threshold 60/f GHz mW = (24.969mW), d <2.5 cm general population category.

The SAR/MPE measurement is not necessary.

## 6.10 Antenna Requirement

### Standard Applicable

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device. And according to §15.246(1), if transmitting antennas of directional gain greater than 6dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to RSS-GEN 7.1.4, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

### Antenna Construction:

The directional gins of antenna used for transmitting is 1.8 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Please see EUT photo for details.

The unit does meet the requirement.