

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: L73-90100**  
**IC: 7377A-90100**

April 22, 2009

<b>This Report Concerns:</b> <input checked="" type="checkbox"/> Original Report	<b>Equipment Type:</b> 2.4GHz Radio Control System
<b>Test Engineer:</b>	Bosco He
<b>Report Number:</b>	SE09D-052F1
<b>Test Date:</b>	April 03-06, 2009
<b>Reviewed By:</b>	<i>Louis</i>
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**Note:** This test report is limited to the above client company and the product model only. It may not be duplicated without prior written consent of S&E Technologies Laboratory Ltd.

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# 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 Name: SANWA

Model: 90100

Type of Modulation: FHSS

Number of Channels: 76 (FH3 mode)  
 51 (FH1 mode)

Channel Separation: 1MHz

Operation Frequency: 2403 ~2478MHz (FH3 mode)  
 2415 ~2465MHz (FH1 mode)

*Note: The above two operation modes can be converted into another by setup menu.*  
*FH3 mode:*  
*data rate: 125kbps*  
*packet rate: 6ms*  
*FH1 mode:*  
*data rate: 15.625kbps*  
*packet rate: 23.8ms*

Antenna Designation: Non-user replaceable (fixed)

Battery Voltage: DC7.2V [1.2V\*6 "AA" Ni-MH battery]

Date of Test: April 03-06, 2009

Applicable Standards	
Standard	Test Result
FCC 47 CFR Part 15 Subpart C, §15.247 Industry Canada: RSS-210 issue 7:2007, Annex 8 Industry Canada: RSS-Gen issue 2:2007	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 and 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 7, Annex 8.

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

## 2- EUT Description

Product	2.4GHz Radio Control System
Trade Name	SANWA
Model Number	90100
Model Difference	N/A
Type of Modulation:	FHSS
Number of Channels:	77 (FH3 mode) 51 (FH1 mode)
Channel Separation:	1MHz
Power Supply	7.2V DC power from [1.2V*6 "AA" Ni-MH battery]
Operation Frequency:	2403 ~2478MHz (FH3 mode) 2415 ~2465MHz (FH1 mode)
Antenna Designation	Non-user replaceable (fixed)

**Remark:** This submittal(s) test report is intended for FCC ID: L73-90100, IC: 7377A-90100 filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules and RSS-210 Issue 7, Annex 8.

## 3-Test System

### 3.1 Test Mode

The compliance test was performed under test modes:

Mode 1: Transmitting at 2403MHz without hopping at FH3 mode.

Mode 2: Transmitting at 2441MHz without hopping at FH3 mode.

Mode 3: Transmitting at 2478MHz without hopping at FH3 mode.

Mode 4: Transmitting with hopping at FH3 mode.

Mode 5: Transmitting at 2415MHz without hopping at FH1 mode.

Mode 6: Transmitting at 2441MHz without hopping at FH1 mode.

Mode 7: Transmitting at 2465MHz without hopping at FH1 mode.

Mode 8: Transmitting with hopping at FH1 mode.

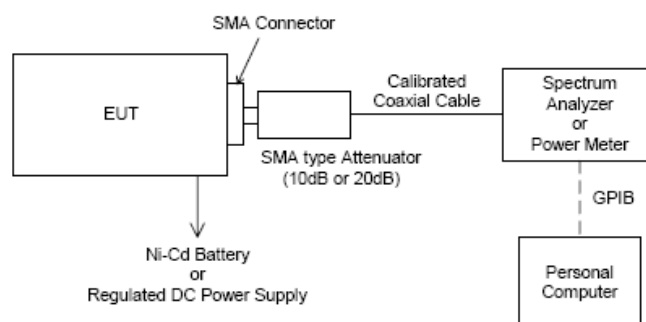
The EUT is designed both of horizontally placed and vertically place. In radiated emission measurement, each condition was conducted.

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

- a) Carrier Frequency Separation measurement ---Mode 4, Mode 8
- b) Number of Hopping Frequencies measurement --- Mode 4, Mode 8
- c) Time of Occupancy measurement --- Mode 4, Mode 8
- d) Peak Output Power measurement --- Mode 1, Mode 2, Mode 3, Mode 5, Mode 6, Mode 7
- e) Band Edge of RF Conducted measurement --- Mode 4, Mode 8
- f) Radiated Emission measurement --- Mode 1, Mode 2, Mode 3, Mode 5, Mode 6, Mode 7
- g) 99% Bandwidth measurement --- Mode 1, Mode 2, Mode 3, Mode 5, Mode 6, Mode 7

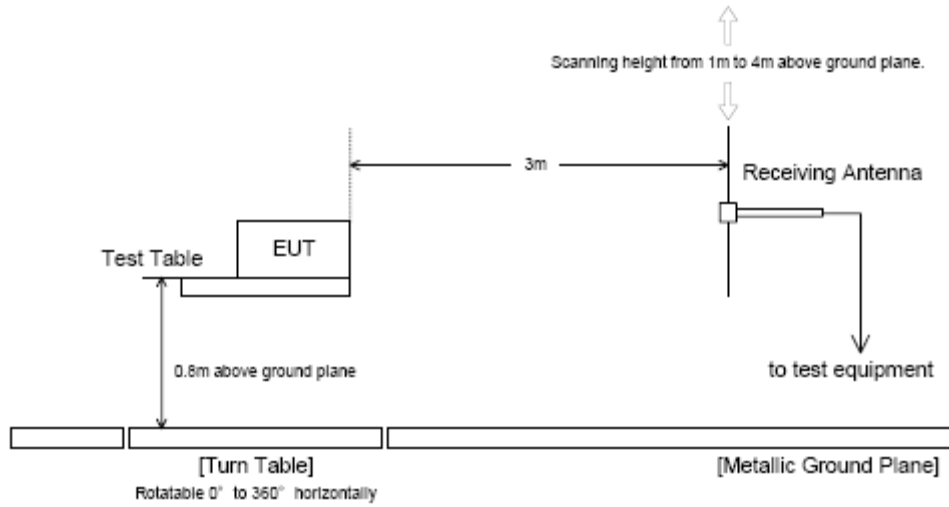
### 3.2 Test Setup Diagram

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

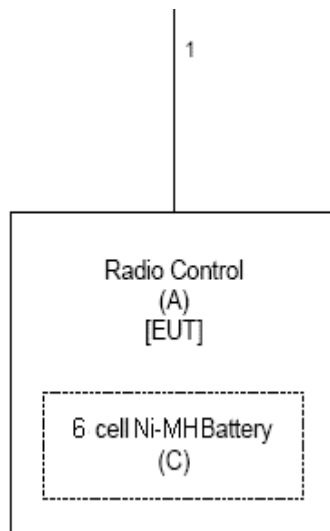


*Note: Regulated DC power supply is not used in this report.*

. Radiated Emision



3.3 Block Diagram of EUT System



3.4 List of Cables

No	Cable Name	Shielded (Y/N)	Length (m)	Note	Remark
-					

#### 4- Test Equipment and Calibration

Equipment type	Manufacturer	Model	Serial Number	Calibration Due
Biconilog Antenna	ETS	3142C	00042672	2009/09/26
Receiver	SCHAFFNER	SMR4503	11725	2009/07/08
Spectrum Analyzer	R/S	FSP30	100755	2009/11/26
Double-Ridged-Wave-guide Horn Antenna	ETS	3115	6587	2009/08/02
Amplifier	Agilent	83017A	MY39500438	2009/11/26

## 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 Oct. 29th, 2008.

### 5.2 Measurement Uncertainty

of +/-  $3 \times 10^{-9}$  for Carrier Frequency Separation Measurement  
of +/-  $3 \times 10^{-9}$  for Number of Hopping Frequencies Measurement  
of +/-  $3 \times 10^{-9}$  for 20dB Bandwidth Measurement  
of +/-  $3 \times 10^{-9}$  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 minimum of 25KHz or the 20dB bandwidth of the hopping channel, whichever is greater.

According to RSS 210 issue 7, 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 : 300KHz  
 Sweep : Auto  
 Detector function : Peak  
 Trace Mode : Max Hold

#### Test Result:

Temperature:	25 °C
Humidity:	48%
EUT Operation:	Data Transmission (hopping)
Test Date:	April 03, 2009

Test Mode	Carrier Frequency Separation [ MHz ]	[ MHz ] Limit
FH3	1.036MHz	> 0.025
FH1	1.076MHz	> 0.025
Note: Test plots shown in figures 1, 2 on page 10.		

Figure 1: Channel Separation at FH3 Mode

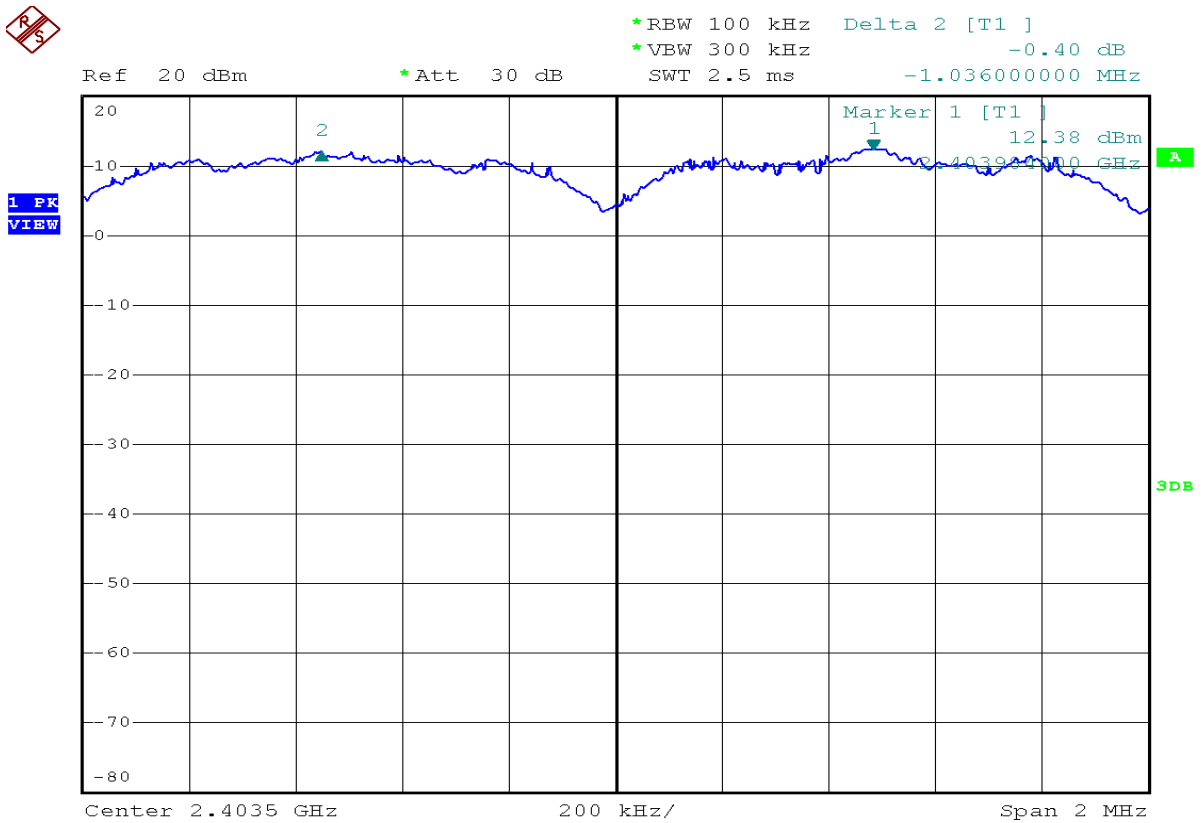
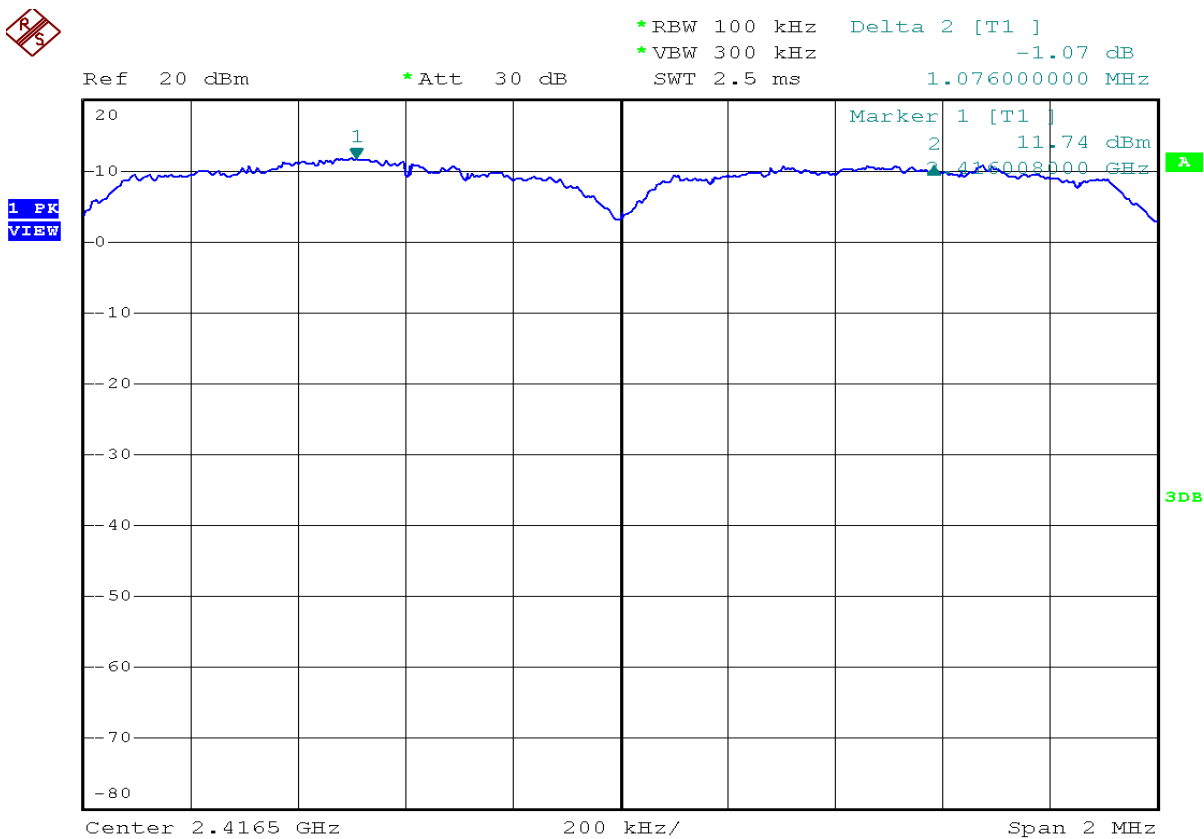


Figure 2: Channel Separation at FH1 Mode



## 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 7, §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 :

Frequency Span : 81MHz  
 Resolution bandwidth : 300KHz  
 Sweep : Auto  
 Detector function : Peak  
 Trace Mode : Max Hold

### Test Result:

Temperature:	25 °C
Humidity:	48%
EUT Operation:	Data Transmission (hopping)
Test Date:	April 03, 2009

Test Mode	Number of Hopping Frequencies	[ MHz ] Limit
FH3	76	> 15
FH1	51	> 15

Note: Test plots shown in figures 3, 4 on page 12.

Figure 3: Number of Hopping Frequencies at FH3 Mode

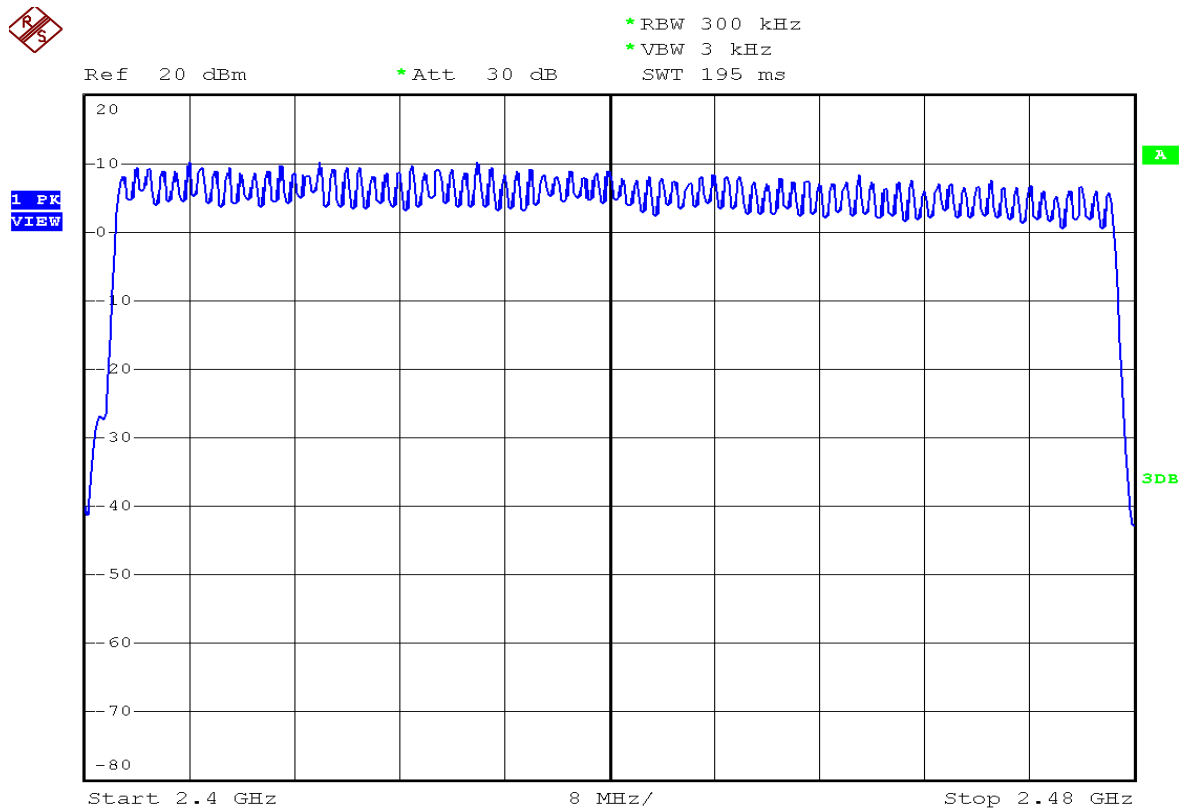
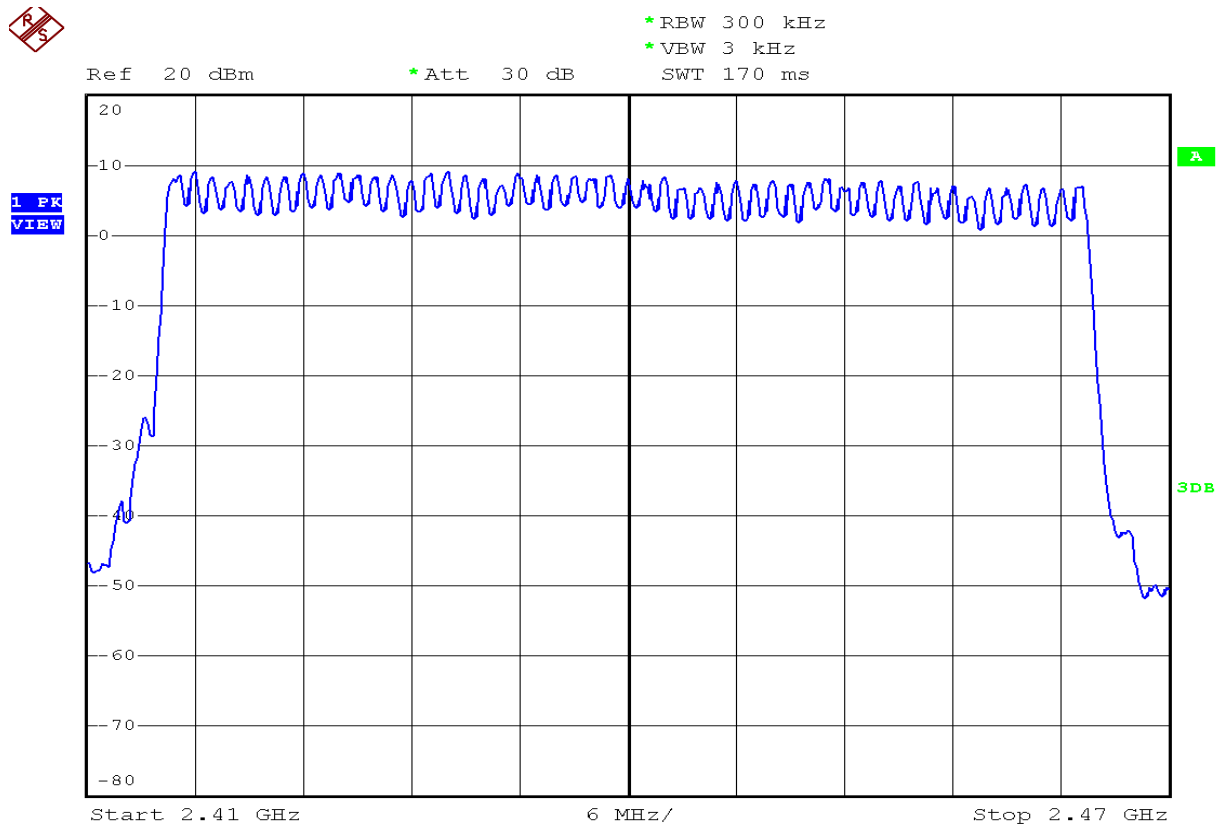


Figure 4: Number of Hopping Frequencies at FH1 Mode



### 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 7, §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  $Ton \times N$ .

Spectrum analyzer setup condition:

Frequency Span : Zero span

Resolution bandwidth : 10KHz

Video bandwidth : 3MHz

Sweep : as necessary to capture the entire dwell time per hopping channel.

Detector function : Peak

Trace Mode : Max Hold

#### Test Result:

Temperature:	25 °C
Humidity:	48%
EUT Operation:	Data Transmission (hopping)
Test Date:	April 03, 2009

Test Mode	[ ms ]Dwell Time	[ ms ] Limit
FH3	2.19ms x134 = 293.46	< 400
FH1	10.4ms x 34 = 353.60	< 400

Note: Test plots shown in figures 5, 6 , 7 , 8 on pages 14, 15.

Figure 5: Duration of one transmission at FH3 Mode

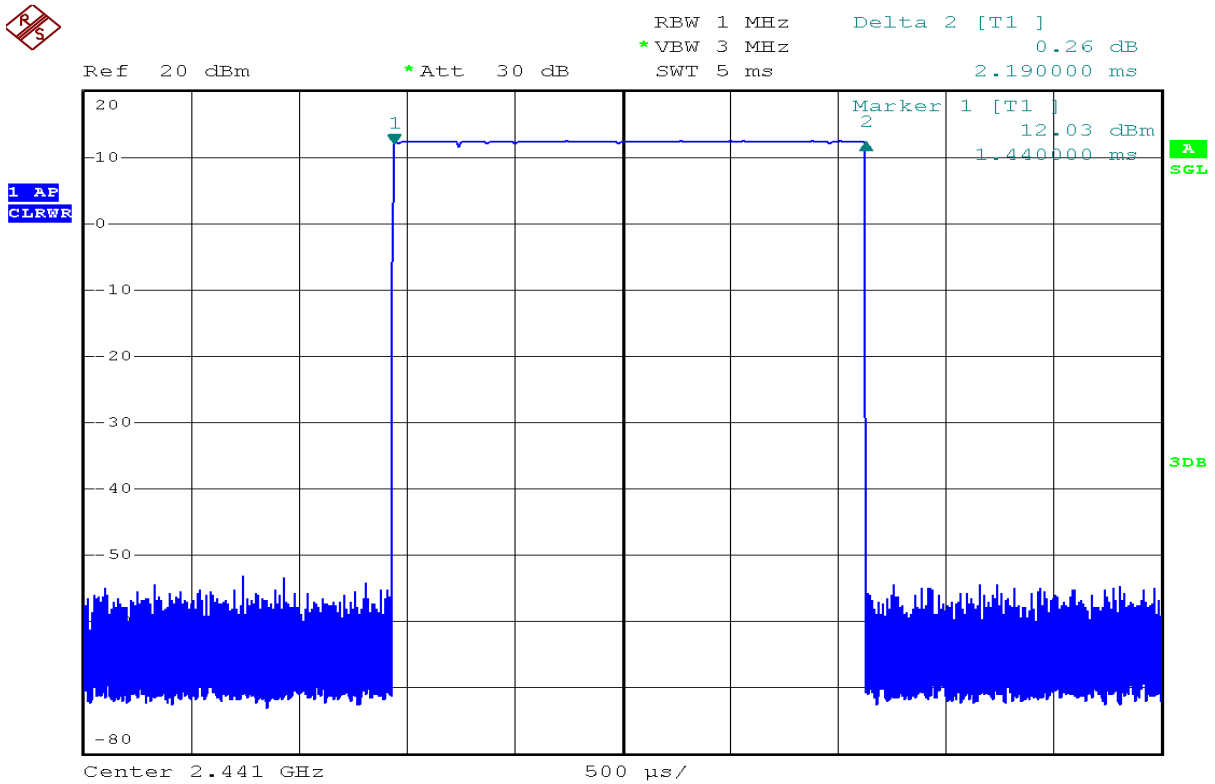


Figure 6: Number of Transmission at 15.2 s at FH3 Mode

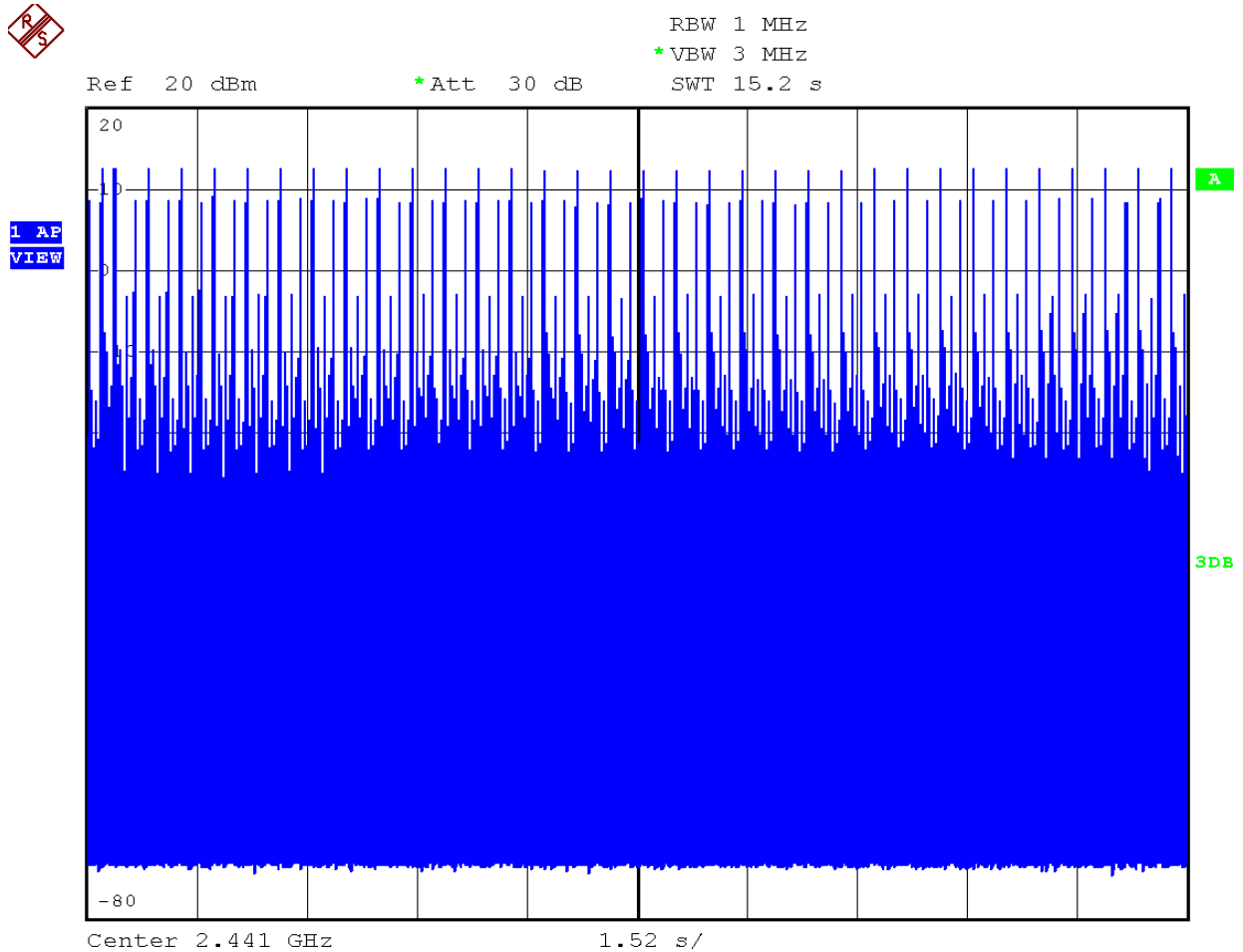


Figure 7: Duration of one transmission at FH1 Mode

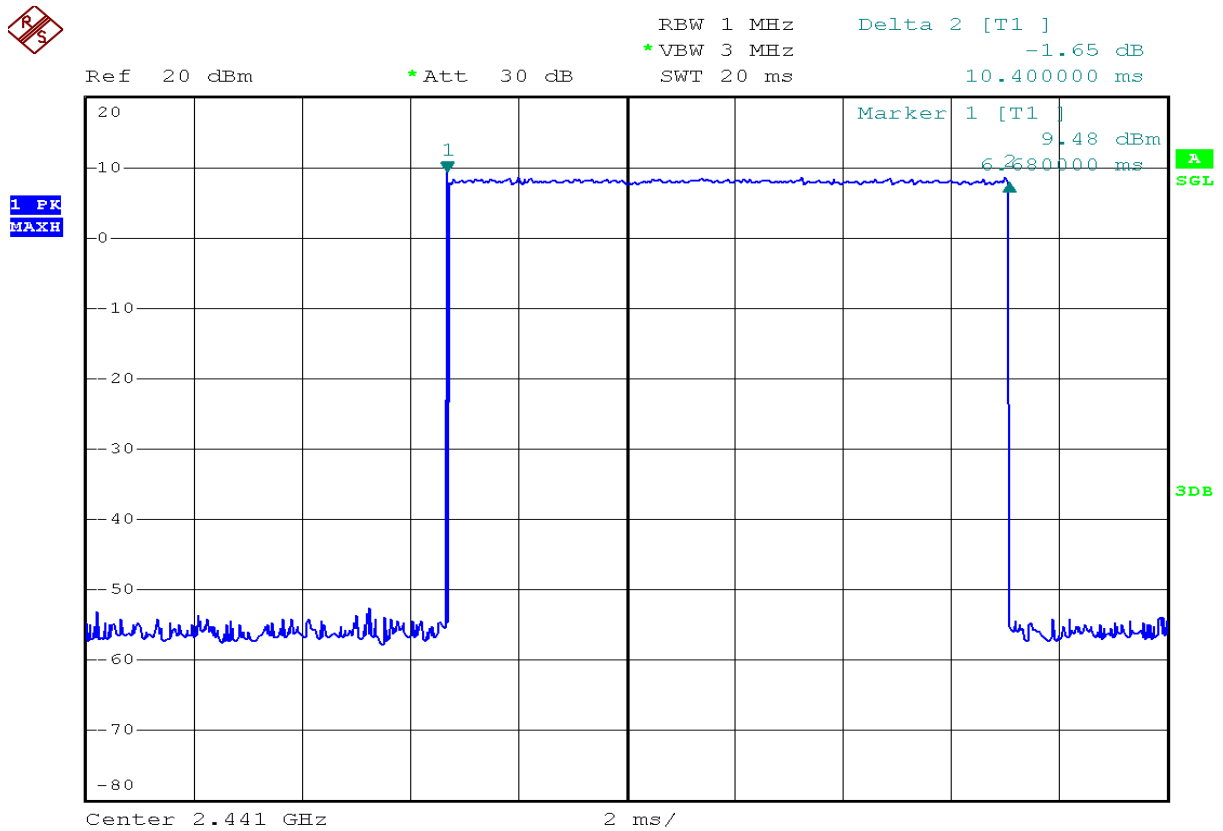
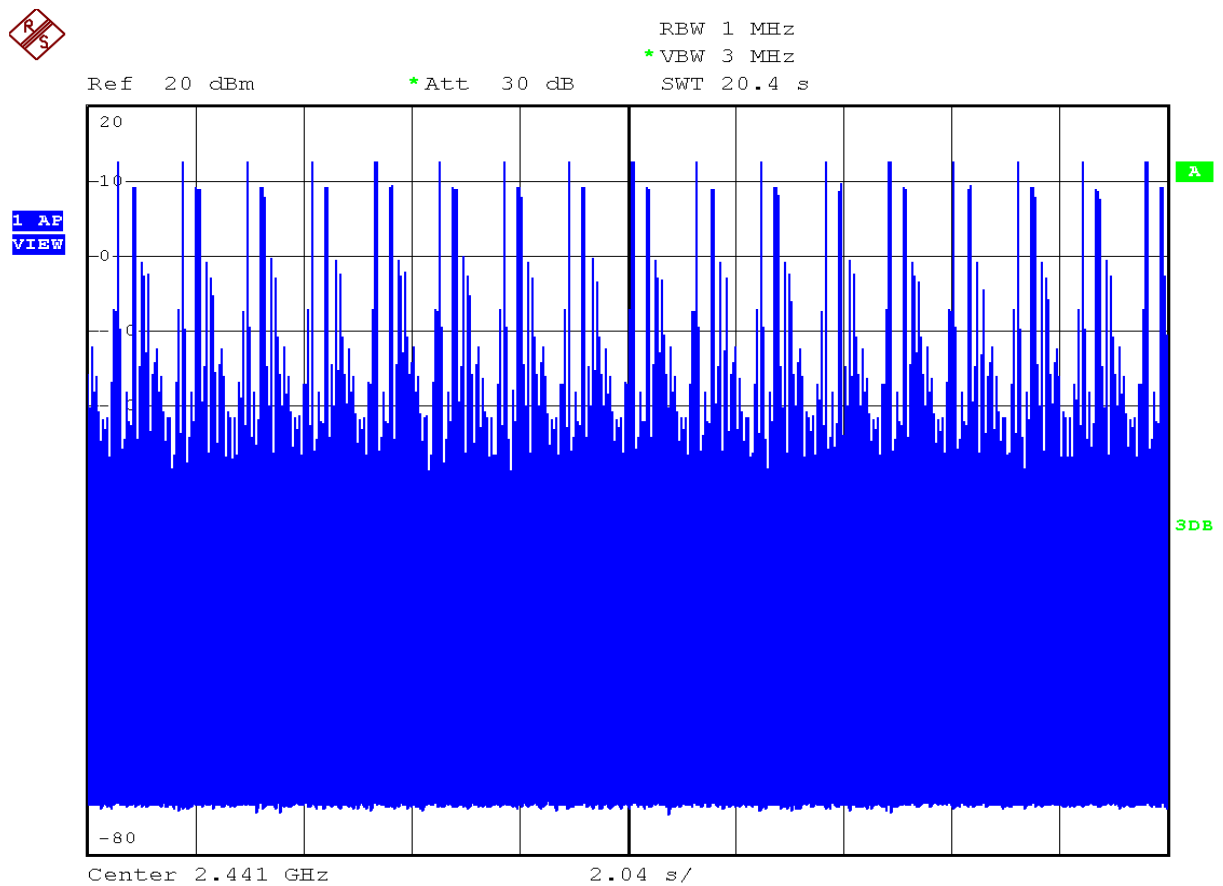


Figure 8: Number of Transmission at 20.4 s with FH1 Mode



## 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 7, §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 : above 20dB bandwidth of the emission being measured

Resolution bandwidth : 3MHz

Video bandwidth : 3MHz

Sweep : Auto

Detector function : Peak

Trace Mode : Max Hold



**Test Result:**

Temperature:	25 °C
Humidity:	48%
EUT Operation:	Data Transmission (without hopping)
Test Date:	April 03, 2009

FH3 Mode					
Frequency	Factor	Reading	Power	Limit	Margin
[ MHz ]	[ dB ]	[ dBm ]	[ dBm ]	[ dBm ]	[ dB ]
2403	2.50	11.92	14.42	20.97	6.55
2441	2.50	11.97	14.47	20.97	6.50
2478	2.50	10.00	12.50	20.97	8.47

Note: Test plots see next page figures 9, 10 and 11.

FH1 Mode					
Frequency	Factor	Reading	Power	Limit	Margin
[ MHz ]	[ dB ]	[ dBm ]	[ dBm ]	[ dBm ]	[ dB ]
2415	2.50	12,52	15.02	20.97	5.95
2441	2.50	11.83	14.33	20.97	6.64
2465	2.50	10.78	13.28	20.97	7.69

Note: Test plots shown in figures 12, 13,14 on pages 18,19,20.

Figure 9: Peak Output Power-low channel at FH3 Mode

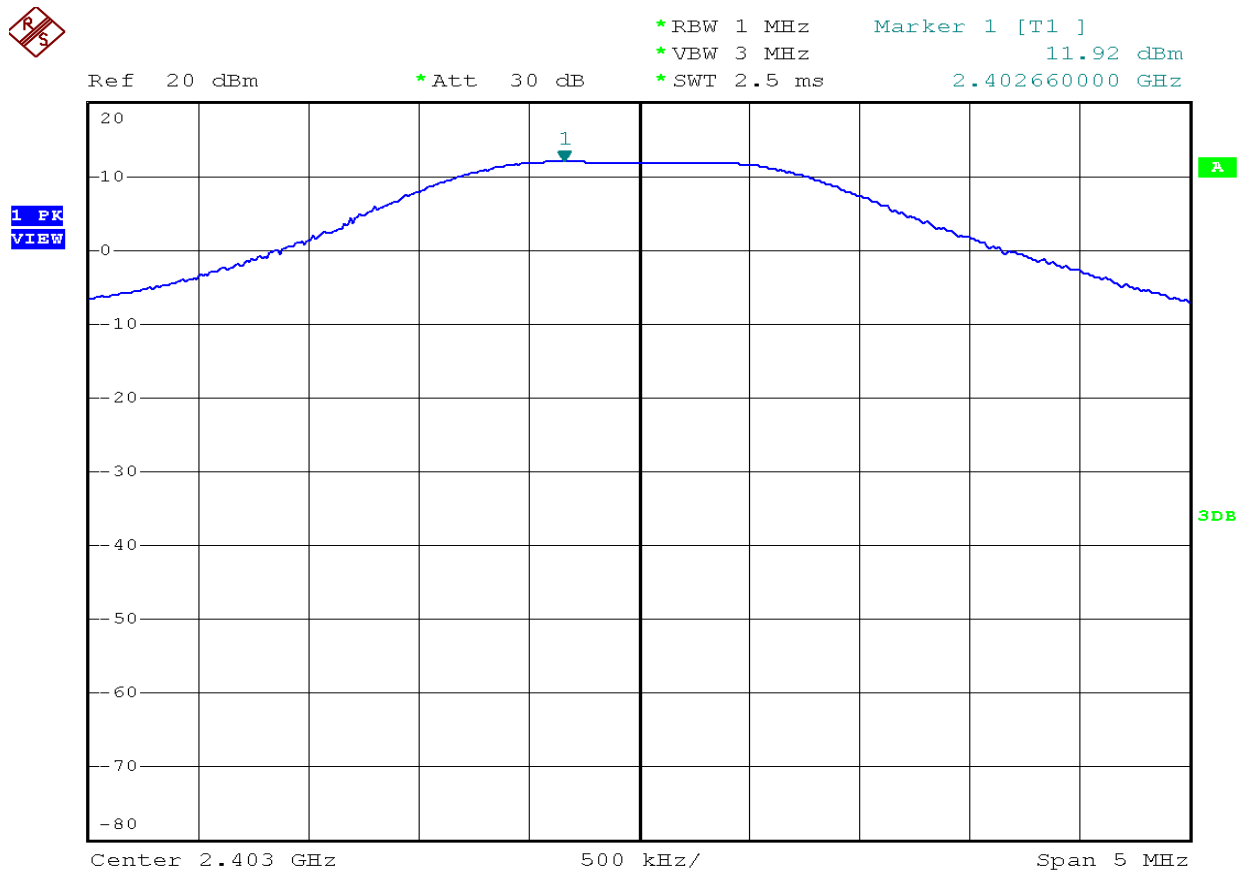


Figure 10: Peak Output Power-mid channel at FH3 Mode

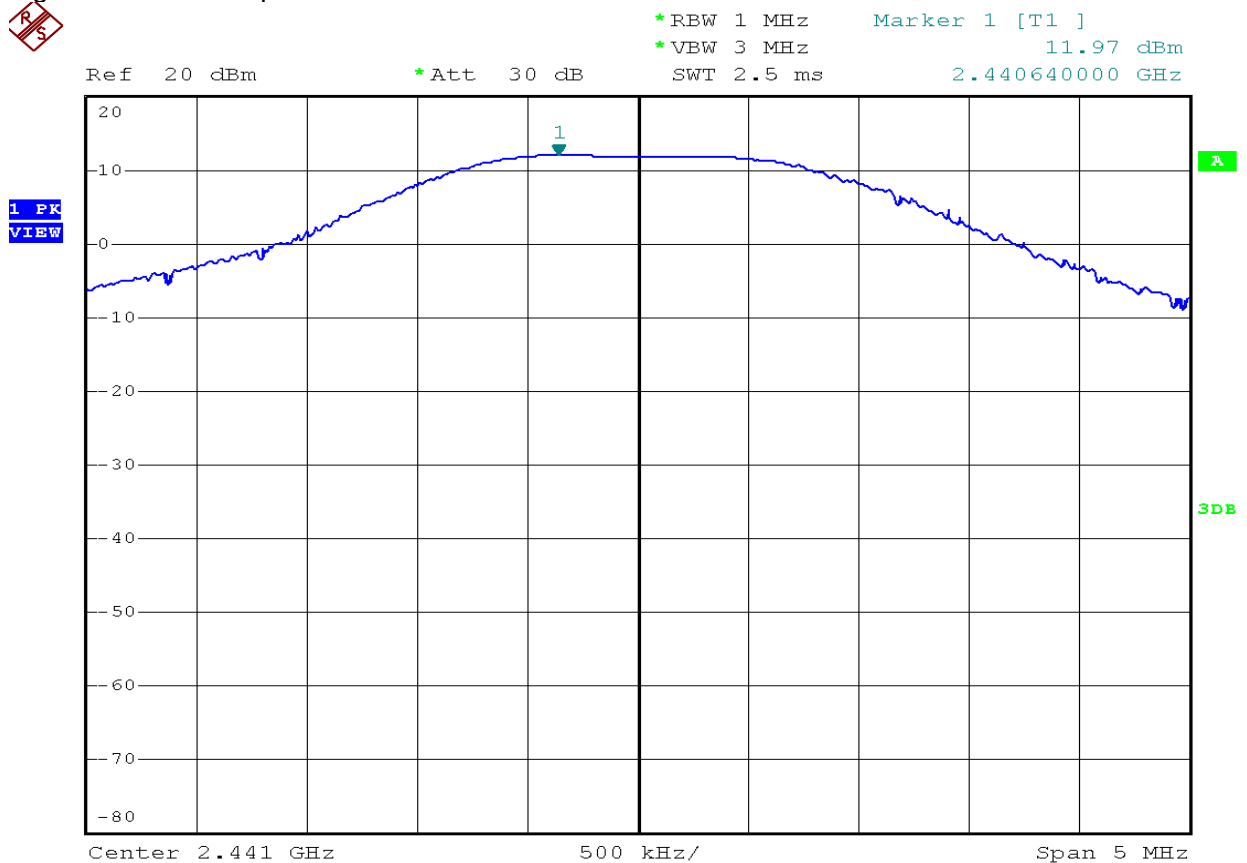


Figure 11: Peak Output Power-high channel at FH3 Mode

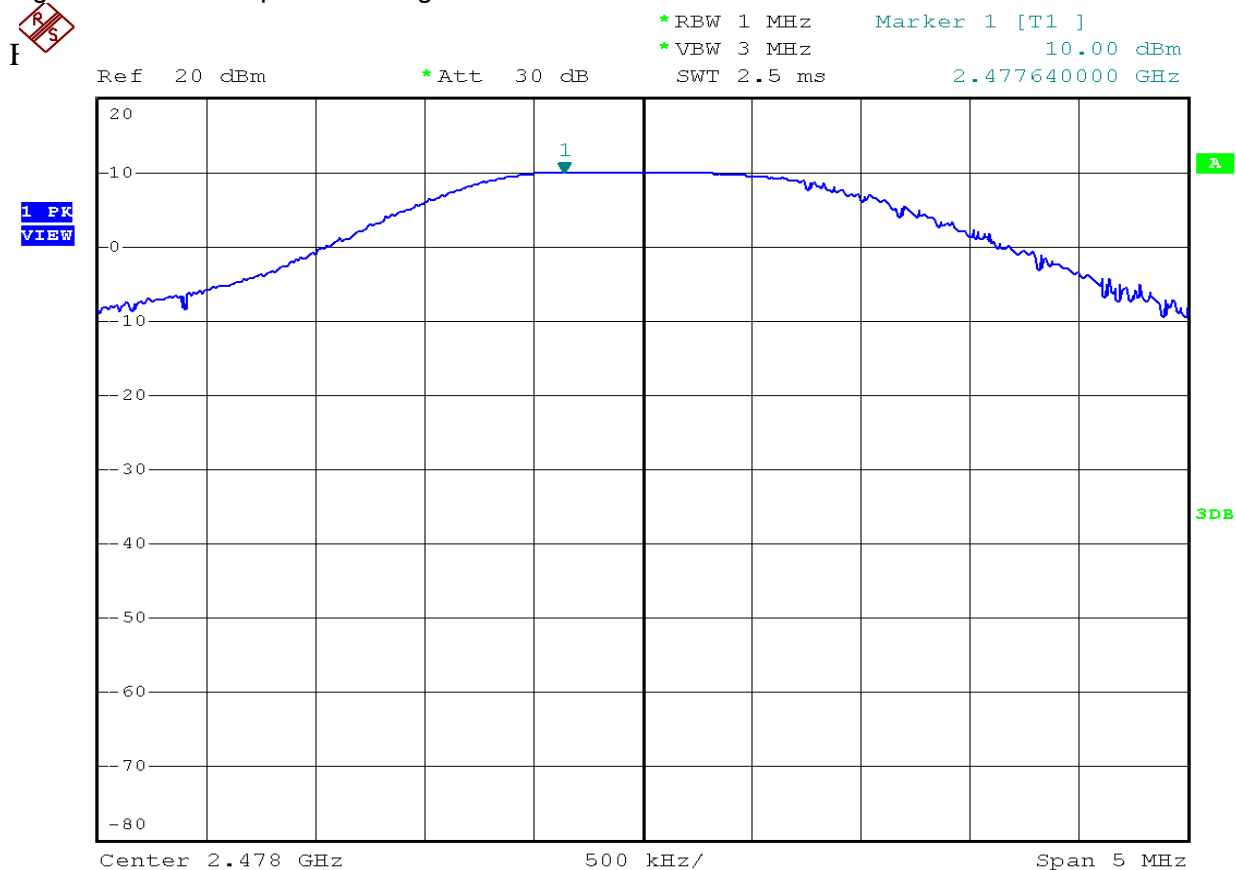


Figure 12: Peak Output Power-low channel at FH1 Mode

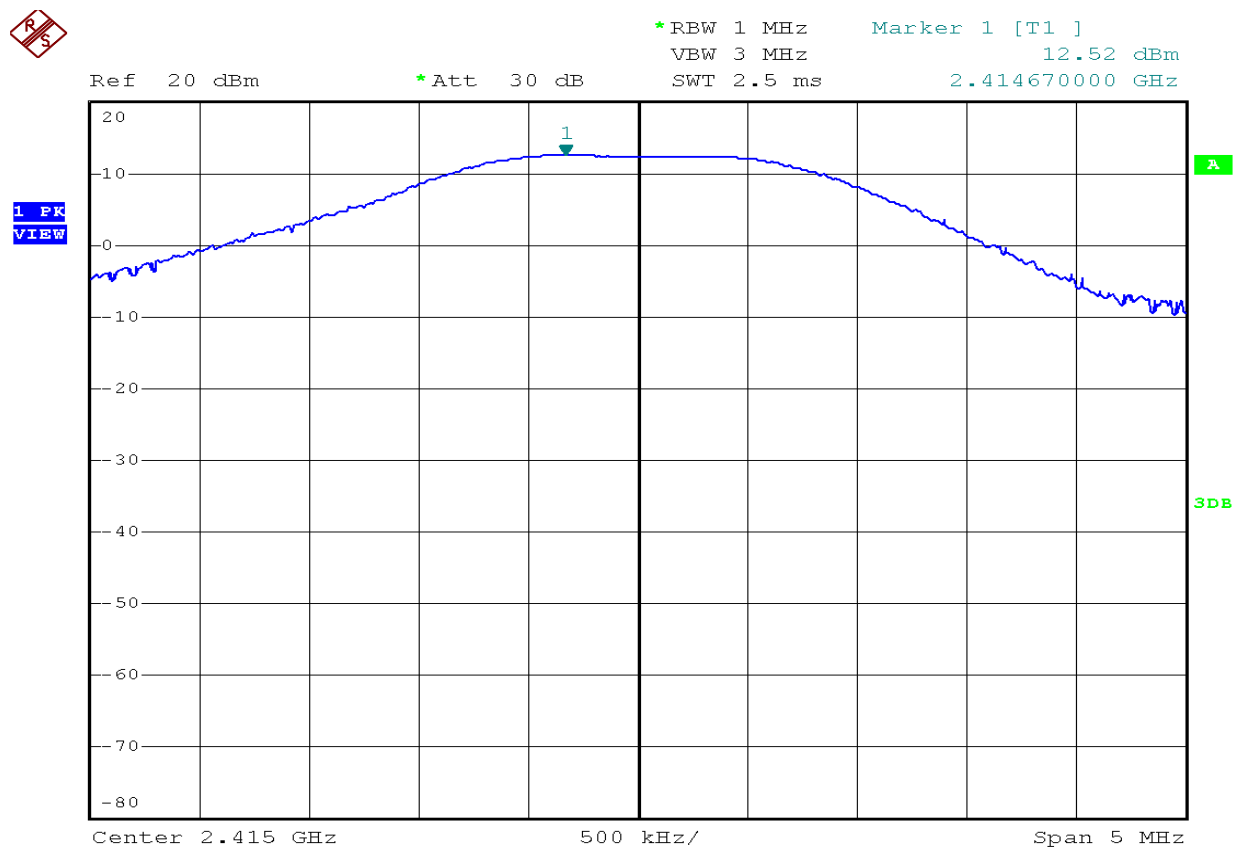


Figure 13: Peak Output Power-mid channel at FH1 Mode

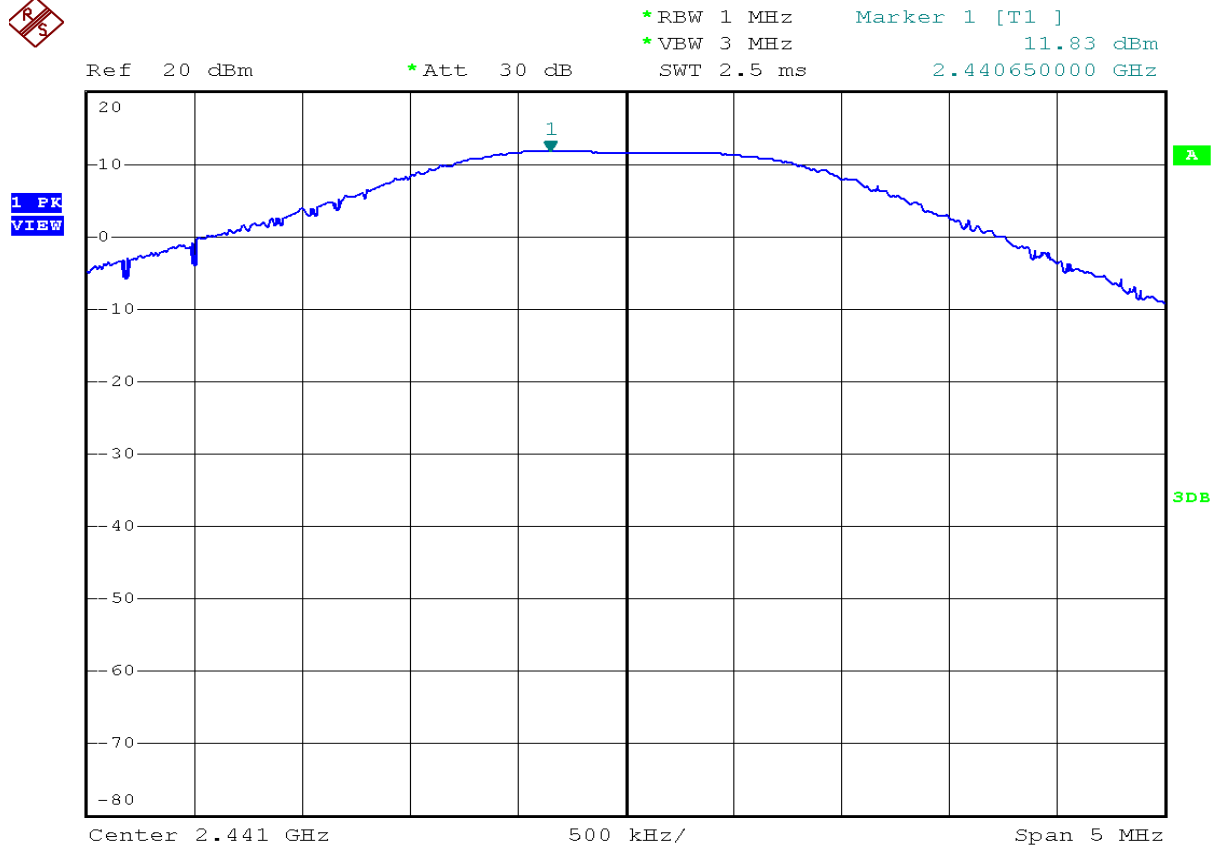
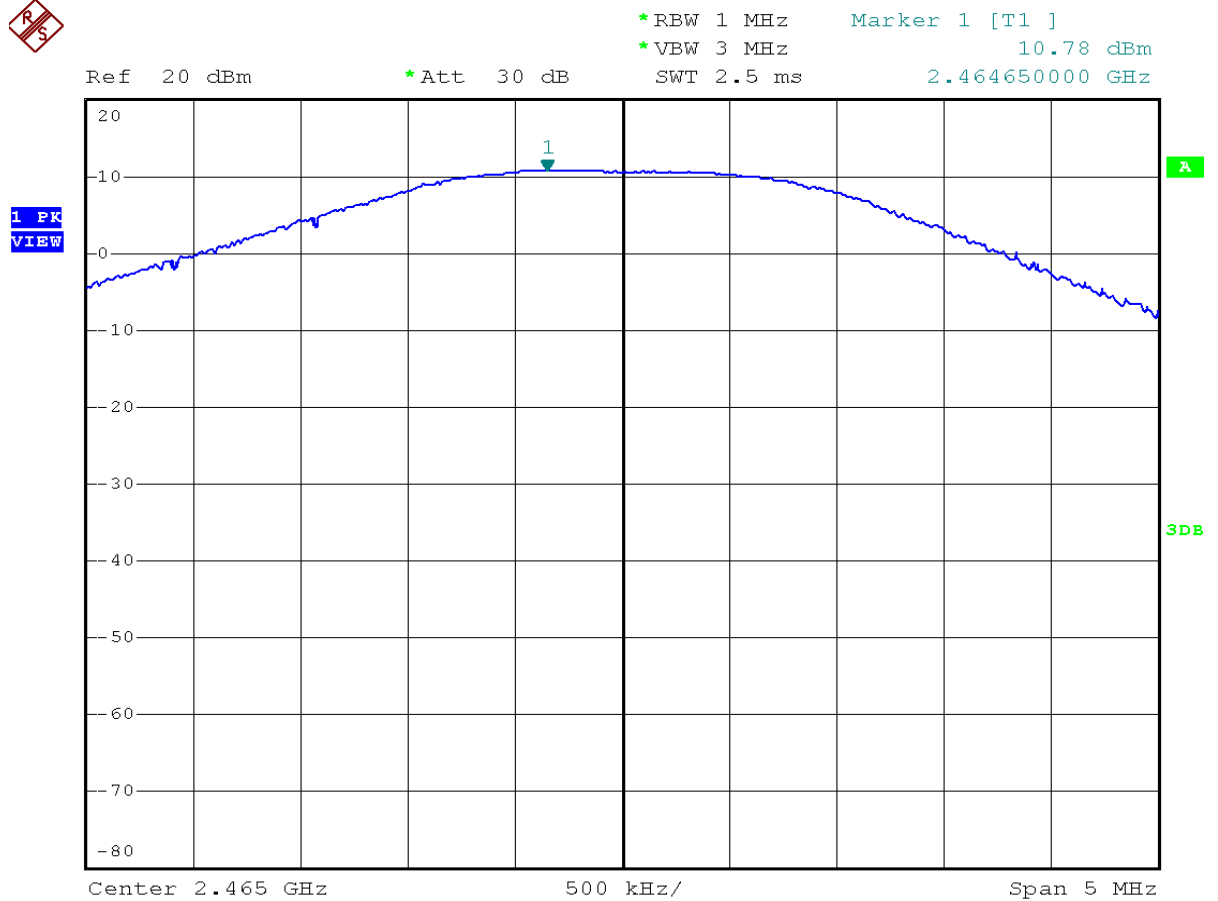


Figure 14: Peak Output Power-high channel at FH1 Mode



### 6.5 Band Edge of Conducted Emission

**Applicable Standard:**

According to §15.247(d), in any 100 KHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is 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 in 15.209(a).

According to RSS-210 issue 7, §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 : 300KHz  
 Sweep : Auto  
 Detector function : Peak  
 Trace Mode : Max Hold

Temperature:	25 °C
Humidity:	48%
EUT Operation:	Data Transmission (without hopping)
Test Date:	April 03, 2009

The unit does meet the requirement.  
 Test plots shown in figures 15, 16, 17, 18 on pages 22, 23.

Figure 15: Band Edge - Low Frequency Side at FH3 Mode

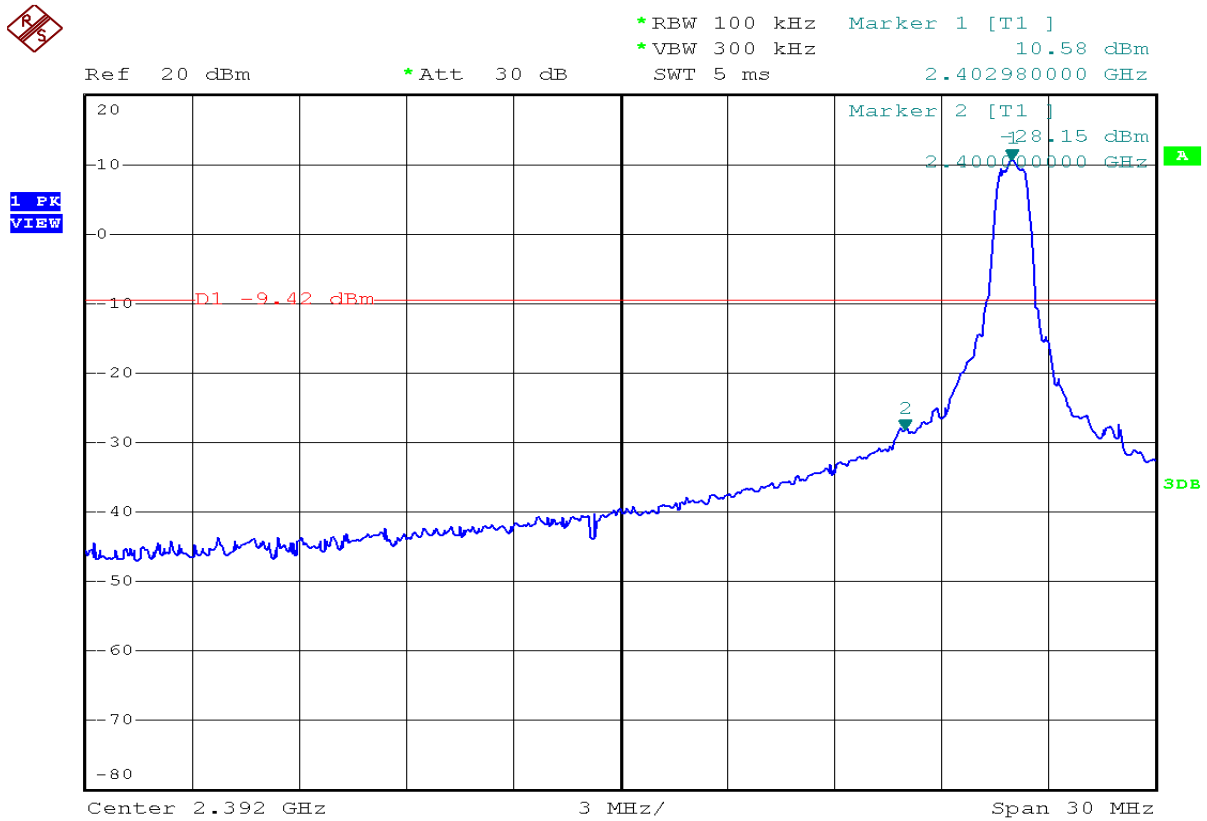


Figure 16: Band Edge – High Frequency Side at FH3 Mode

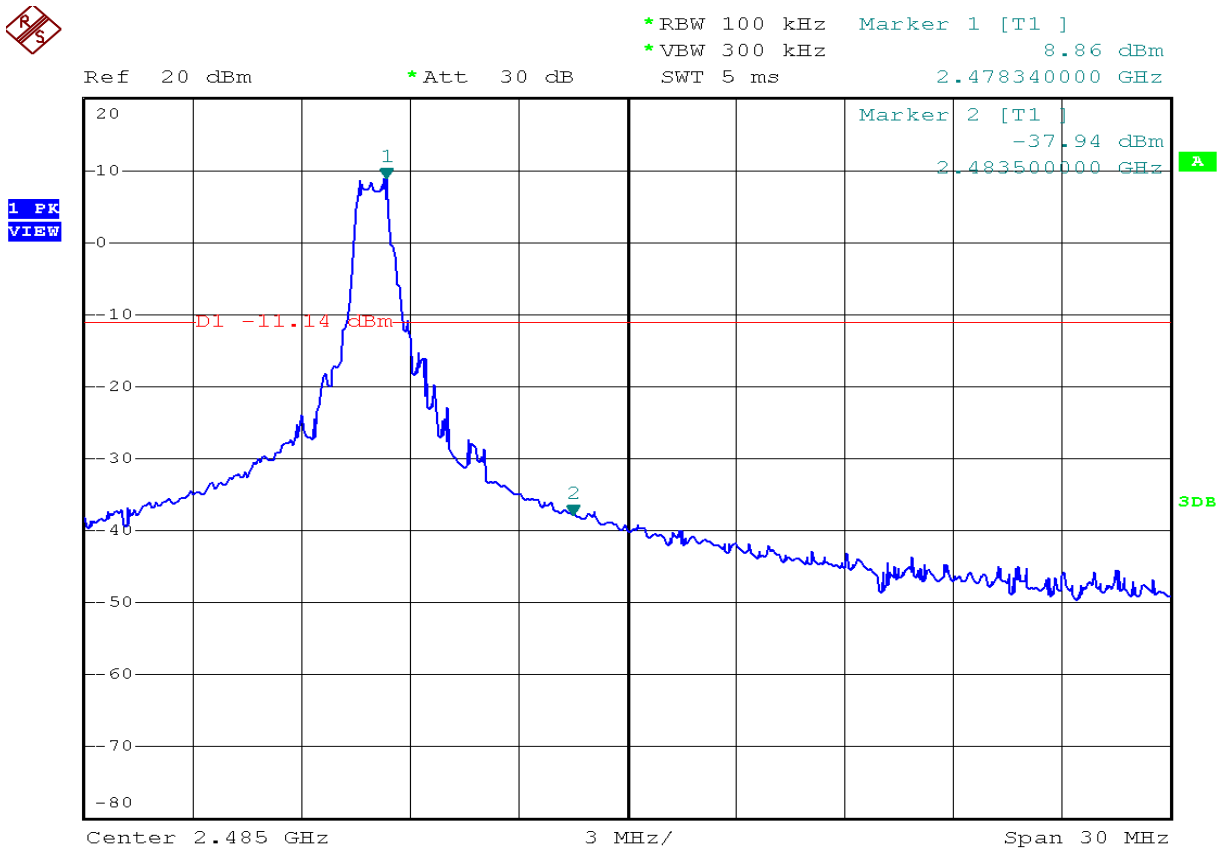


Figure 17: Band Edge – Low Frequency Side at FH1 Mode

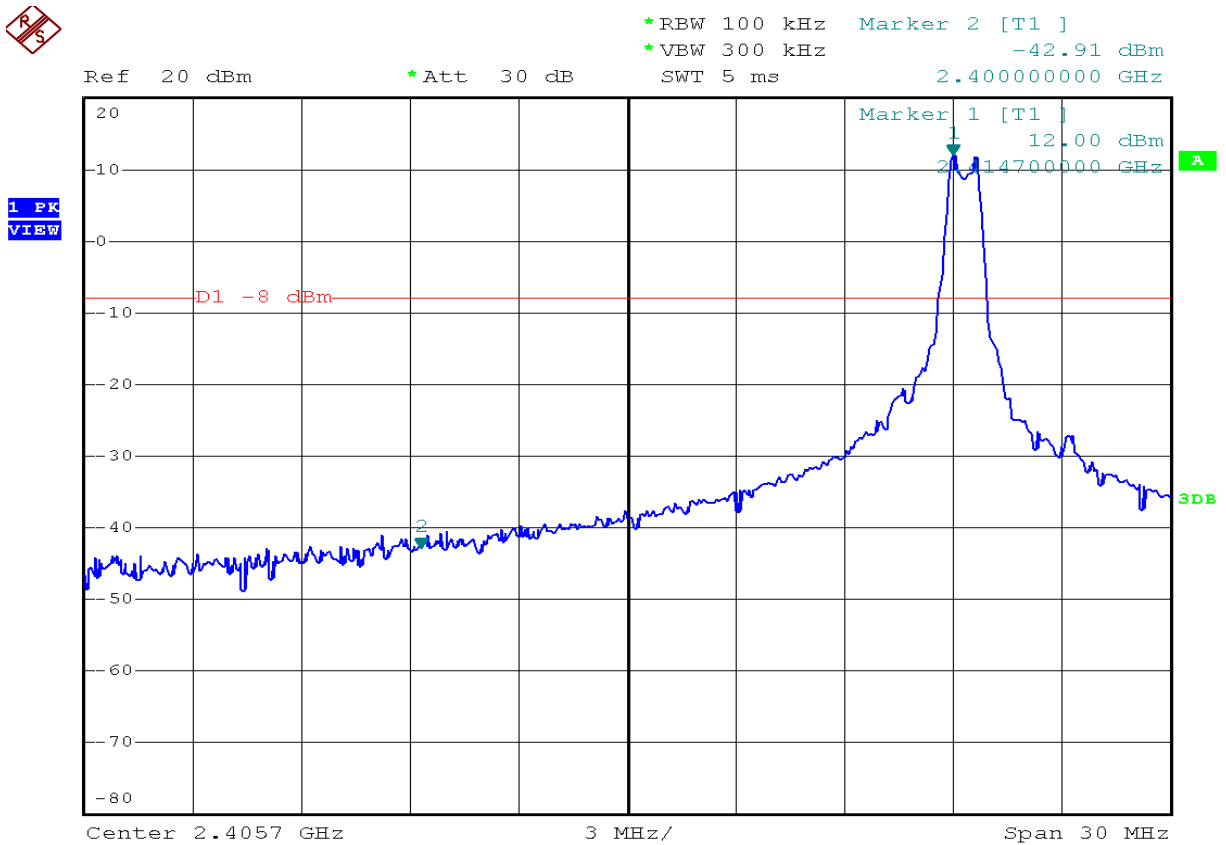
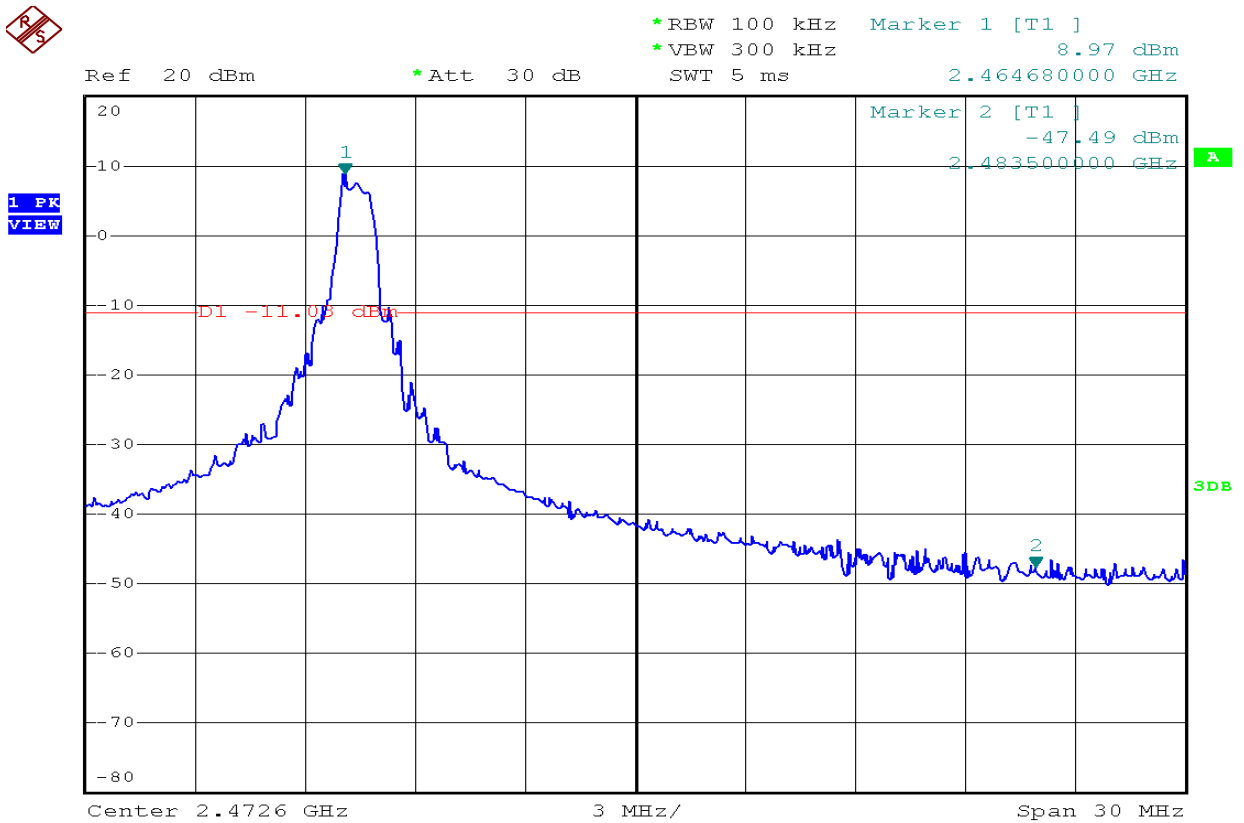


Figure 18: Band Edge – High Frequency Side at FH1 Mode



## 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 7, §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. 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.

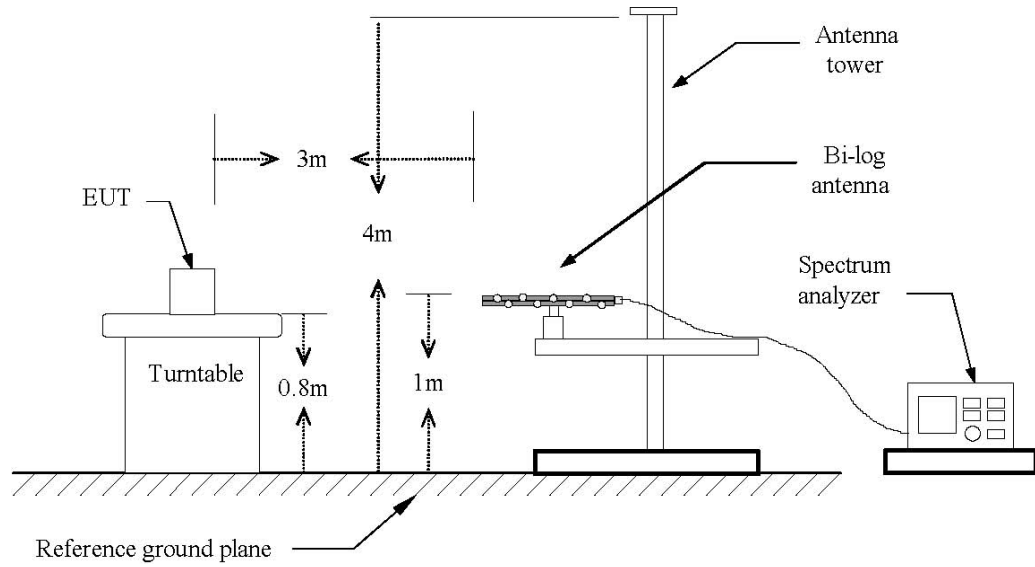
The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

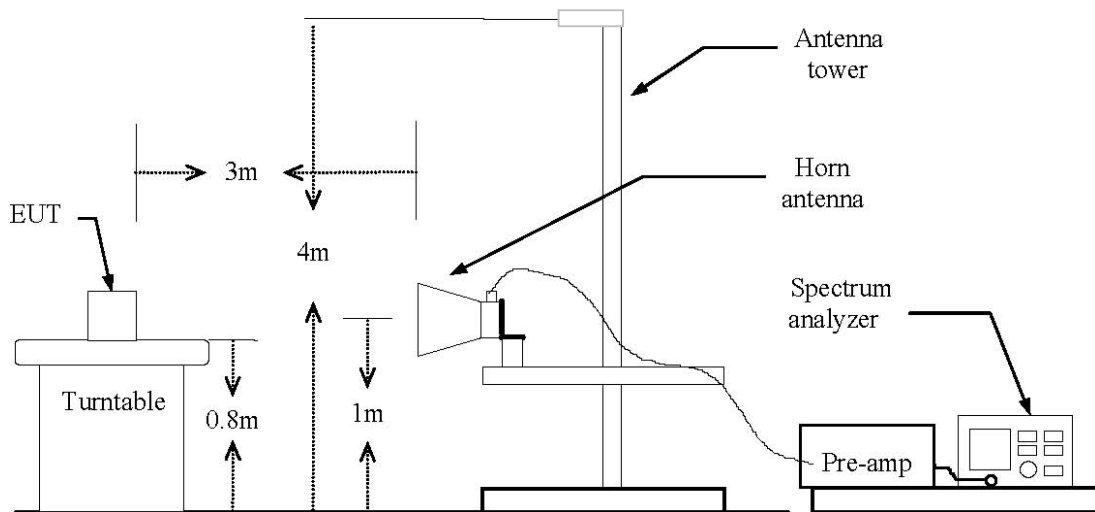
Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	



Test Configuration Below 1 GHz:



Test Configuration Above 1 GHz:



Test Results:

Temperature:	25°C
Humidity:	48%
EUT Operation:	Data Transmission (without hopping)
Test Date:	April 06, 2009

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

At FH3 Mode: 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)
170.00	H	QP	12.7	11.4	24.1	43.5	-19.4
206.00	H	QP	16.4	8.7	25.1	43.5	-18.4
442.05	H	QP	7.9	17.4	25.3	46.0	-20.7
150.00	V	QP	19.0	9.6	28.6	43.5	-14.9
166.00	V	QP	29.0	11.1	30.1	43.5	-13.4
438.00	V	QP	22.4	17.4	39.8	46.0	-6.2

At FH3 Mode: 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)
210.05	H	QP	13.1	8.7	21.8	43.5	-21.7
454.05	H	QP	9.1	17.8	26.9	46.0	-19.1
578.00	H	QP	17.6	19.3	26.9	46.0	-19.1
166.00	V	QP	18.2	11.1	29.3	43.5	-14.2
458.05	V	QP	21.3	17.8	39.1	46.0	-6.9
498.05	V	QP	15.4	17.9	33.3	46.0	-12.7

At FH3 Mode: 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)
202.05	H	QP	15.4	8.3	23.7	43.5	-19.8
214.00	H	QP	15.0	8.7	23.7	43.5	-19.8
430.05	H	QP	6.6	17.4	24.0	46.0	-22.0
162.00	V	QP	17.3	10.5	28.8	43.5	-14.7
458.00	V	QP	20.0	17.8	37.8	46.0	-8.2
498.00	V	QP	14.9	17.9	32.8	46.0	-13.2

At FH1 Mode: Fc= 2415MHz 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)
162.05	H	QP	7.9	10.5	18.4	43.5	-25.1
210.05	H	QP	15.1	8.7	23.8	43.5	-19.7
924.75	H	QP	2.8	23.0	25.8	46.0	-20.2
162.00	V	QP	18.4	10.5	28.9	43.5	-14.6
454.05	V	QP	22.5	17.8	40.3	46.0	-5.7
510.00	V	QP	16.5	17.9	34.4	46.0	-11.6

At FH1 Mode: 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)
206.00	H	QP	16.7	8.7	25.4	43.5	-18.1
454.00	H	QP	7.6	17.8	25.4	46.0	-20.6
570.05	H	QP	9.3	18.8	28.1	46.0	-17.9
166.00	V	QP	18.0	11.3	29.3	40.0	-10.7
458.00	V	QP	22.5	17.8	40.3	46.0	-5.7
498.05	V	QP	19.1	17.9	37.0	46.0	-9.0

At FH1 Mode: Fc= 2465MHz 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)
210.05	H	QP	15.0	8.8	23.8	43.5	-19.7
454.00	H	QP	7.7	17.8	25.5	46.0	-20.5
804.05	H	QP	16.0	22.8	28.8	46.0	-17.2
150.00	V	QP	18.9	9.6	28.5	43.5	-15.0
458.00	V	QP	22.5	17.9	40.4	46.0	-5.6
506.00	V	QP	17.6	17.9	35.5	46.0	-10.5

**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 20dB below the limit.

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

At FH3 Mode: 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)			
4806.00	39.48	-	2.70	42.18	-	74.00	-	-31.82
7209.00	49.37	-	3.70	53.07	-	74.00	-	-20.93
9612.00	42.19	-	6.70	48.89	-	74.00	-	-25.11
12015.00	42.12	-	9.20	51.32	-	74.00	-	-22.68
14418.00	-	-	-	-	-	-	-	-
16821.00	-	-	-	-	-	-	-	-
19224.00	-	-	-	-	-	-	-	-
21627.00	-	-	-	-	-	-	-	-
24150.00	-	-	-	-	-	-	-	-

At FH3 Mode: 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)			
4806.00	38.27	-	2.70	40.97	-	74.00	-	-33.03
7209.00	46.28	-	3.70	49.98	-	74.00	-	-24.02
9612.00	40.44	-	6.70	47.14	-	74.00	-	-26.86
12015.00	44.70	-	9.20	53.90	-	74.00	-	-20.10
14418.00	-	-	-	-	-	-	-	-
16821.00	-	-	-	-	-	-	-	-
19224.00	-	-	-	-	-	-	-	-
21627.00	-	-	-	-	-	-	-	-
24150.00	-	-	-	-	-	-	-	-

**Note:** Data of measurement within this frequency range shown “—” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

At FH3 Mode: 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	39.13	-	2.70	41.83	-	74.00	-	-32.17
7323.00	45.12	-	3.70	48.82	-	74.00	-	-25.18
9764.00	41.47	-	7.20	48.67	-	74.00	-	-25.33
12205.00	41.44	-	9.10	50.54	-	74.00	-	-23.46
14646.00	-	-	-	-	-	-	-	-
17087.00	-	-	-	-	-	-	-	-
19528.00	-	-	-	-	-	-	-	-
21969.00	-	-	-	-	-	-	-	-
24410.00	-	-	-	-	-	-	-	-

At FH3 Mode: 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	38.93	-	2.70	41.63	-	74.00	-	-32.37
7323.00	48.83	-	3.70	52.53	-	74.00	-	-21.47
9764.00	40.77	-	7.20	47.97	-	74.00	-	-26.03
12205.00	42.21	-	9.10	51.31	-	74.00	-	-22.69
14646.00	-	-	-	-	-	-	-	-
17087.00	-	-	-	-	-	-	-	-
19528.00	-	-	-	-	-	-	-	-
21969.00	-	-	-	-	-	-	-	-
24410.00	-	-	-	-	-	-	-	-

**Note:** Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

At FH3 Mode: 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)			
4956.00	39.11	-	2.70	41.81	-	74.00	-	-32.19
7434.00	46.61	-	3.90	50.51	-	74.00	-	-23.49
9912.00	41.62	-	7.70	49.32	-	74.00	-	-24.68
12390.00	42.74	-	8.20	50.94	-	74.00	-	-23.06
14868.00	-	-	-	-	-	-	-	-
17346.00	-	-	-	-	-	-	-	-
19824.00	-	-	-	-	-	-	-	-
22302.00	-	-	-	-	-	-	-	-
24780.00	-	-	-	-	-	-	-	-

At FH3 Mode: 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)			
4956.00	41.26	-	2.70	43.96	-	74.00	-	-30.04
7434.00	46.00	-	3.90	49.90	-	74.00	-	-24.10
9912.00	41.07	-	7.70	48.77	-	74.00	-	-25.23
12390.00	43.54	-	8.20	51.74	-	74.00	-	-22.26
14868.00	-	-	-	-	-	-	-	-
17346.00	-	-	-	-	-	-	-	-
19824.00	-	-	-	-	-	-	-	-
22302.00	-	-	-	-	-	-	-	-
24780.00	-	-	-	-	-	-	-	-

**Note:** Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

At FH1 Mode: Fc= 2415MHz 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)			
4830.00	47.63	-	2.70	50.33	-	74.00	-	-23.67
7245.00	52.00	-	3.70	55.70	-	74.00	-	-18.30
9660.00	-	-	-	-	-	-	-	-
12075.00	47.42	-	9.10	56.52	-	74.00	-	-17.48
14490.00	-	-	-	-	-	-	-	-
16905.00	-	-	-	-	-	-	-	-
19320.00	-	-	-	-	-	-	-	-
21735.00	-	-	-	-	-	-	-	-
24150.00	-	-	-	-	-	-	-	-

At FH1 Mode: Fc= 2415MHz 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)			
4806.00	46.27	-	2.70	48.97	-	74.00	-	-25.03
7209.00	51.69	-	3.70	55.39	-	74.00	-	-18.61
9660.00	-	-	-	-	-	-	-	-
12075.00	47.61	-	9.10	56.71	-	74.00	-	-17.29
14490.00	-	-	-	-	-	-	-	-
16905.00	-	-	-	-	-	-	-	-
19320.00	-	-	-	-	-	-	-	-
21735.00	-	-	-	-	-	-	-	-
24150.00	-	-	-	-	-	-	-	-

**Note:** Data of measurement within this frequency range shown “—” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

At FH1 Mode: 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	39.03	-	2.70	41.73	-	74.00	-	-32.27
7323.00	44.48	-	3.70	48.18	-	74.00	-	-25.82
9764.00	-	-	-	-	-	-	-	-
12205.00	39.48	-	9.10	48.58	-	74.00	-	-25.42
14646.00	-	-	-	-	-	-	-	-
17087.00	-	-	-	-	-	-	-	-
19528.00	-	-	-	-	-	-	-	-
21969.00	-	-	-	-	-	-	-	-
24410.00	-	-	-	-	-	-	-	-

At FH1 Mode: 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	45.06	-	2.70	47.76	-	74.00	-	-26.24
7323.00	50.28	-	3.70	53.98	-	74.00	-	-20.02
9764.00	-	-	-	-	-	-	-	-
12205.00	45.84	-	9.10	54.94	-	74.00	-	-19.06
14646.00	-	-	-	-	-	-	-	-
17087.00	-	-	-	-	-	-	-	-
19528.00	-	-	-	-	-	-	-	-
21969.00	-	-	-	-	-	-	-	-
24410.00	-	-	-	-	-	-	-	-

**Note:** Data of measurement within this frequency range shown “--” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.



At FH1 Mode: Fc= 2465MHz 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)			
4930.00	41.66	-	2.70	44.36	-	74.00	-	-29.64
7495.00	46.07	-	3.90	49.97	-	74.00	-	-24.03
9860.00	-	-	-	-	-	-	-	-
12325.00	39.76	-	8.80	48.56	-	74.00	-	-25.44
14790.00	-	-	-	-	-	-	-	-
17255.00	-	-	-	-	-	-	-	-
19720.00	-	-	-	-	-	-	-	-
22185.00	-	-	-	-	-	-	-	-
24650.00	-	-	-	-	-	-	-	-

At FH1 Mode: Fc= 2465MHz 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)			
4930.00	39.58	-	2.70	42.28	-	74.00	-	-31.72
7495.00	46.07	-	3.90	49.97	-	74.00	-	-24.03
9860.00	-	-	-	-	-	-	-	-
12325.00	39.76	-	8.80	48.56	-	74.00	-	-25.44
14790.00	-	-	-	-	-	-	-	-
17255.00	-	-	-	-	-	-	-	-
19720.00	-	-	-	-	-	-	-	-
22185.00	-	-	-	-	-	-	-	-
24650.00	-	-	-	-	-	-	-	-

**Note:** Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

### 6.7 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 = 2MHz
- Resolution Bandwidth = 30KHz
- Video Bandwidth = 100KHz
- Sweep = auto
- Detector function = peak
- Trace = max hold

#### Test Results:

Temperature:	23°C
Humidity:	47%
EUT Operation:	Data Transmission (without hopping)
Test Date:	April 06, 2009

Operation Mode	Frequency	99% Bandwidth
	[ MHz ]	(MHz)
FH3	2403	1.172
	2441	1.220
	2478	1.376
FH1	2415	1.124
	2441	1.256
	2465	1.336

Note: Test plots shown in figures 19, 20, 21, 22, 23, 24 on pages 35, 36, 37.

Figure 19- 99% bandwidth Measurement (fc=2403MHz) at FH3 Mode

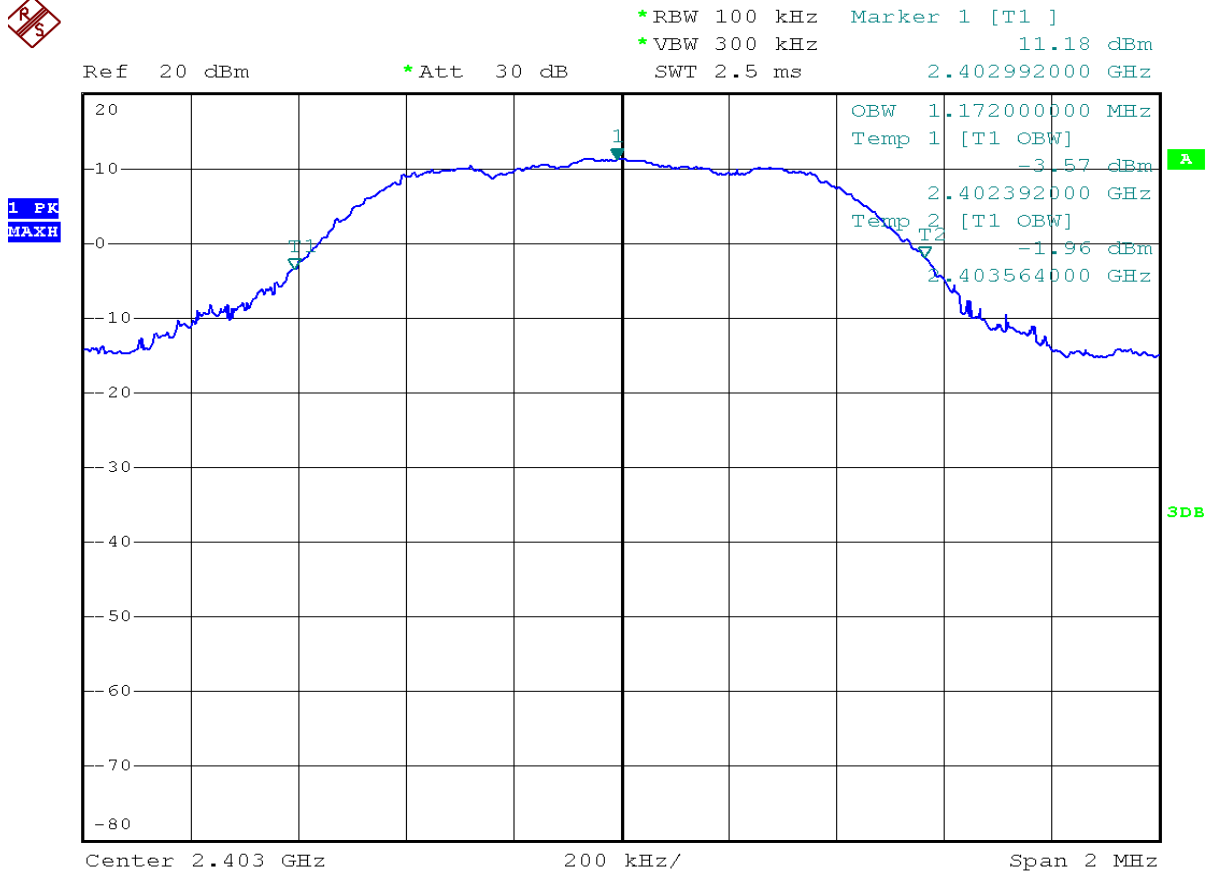


Figure 20- 99% bandwidth Measurement (fc=2441MHz) at FH3 Mode

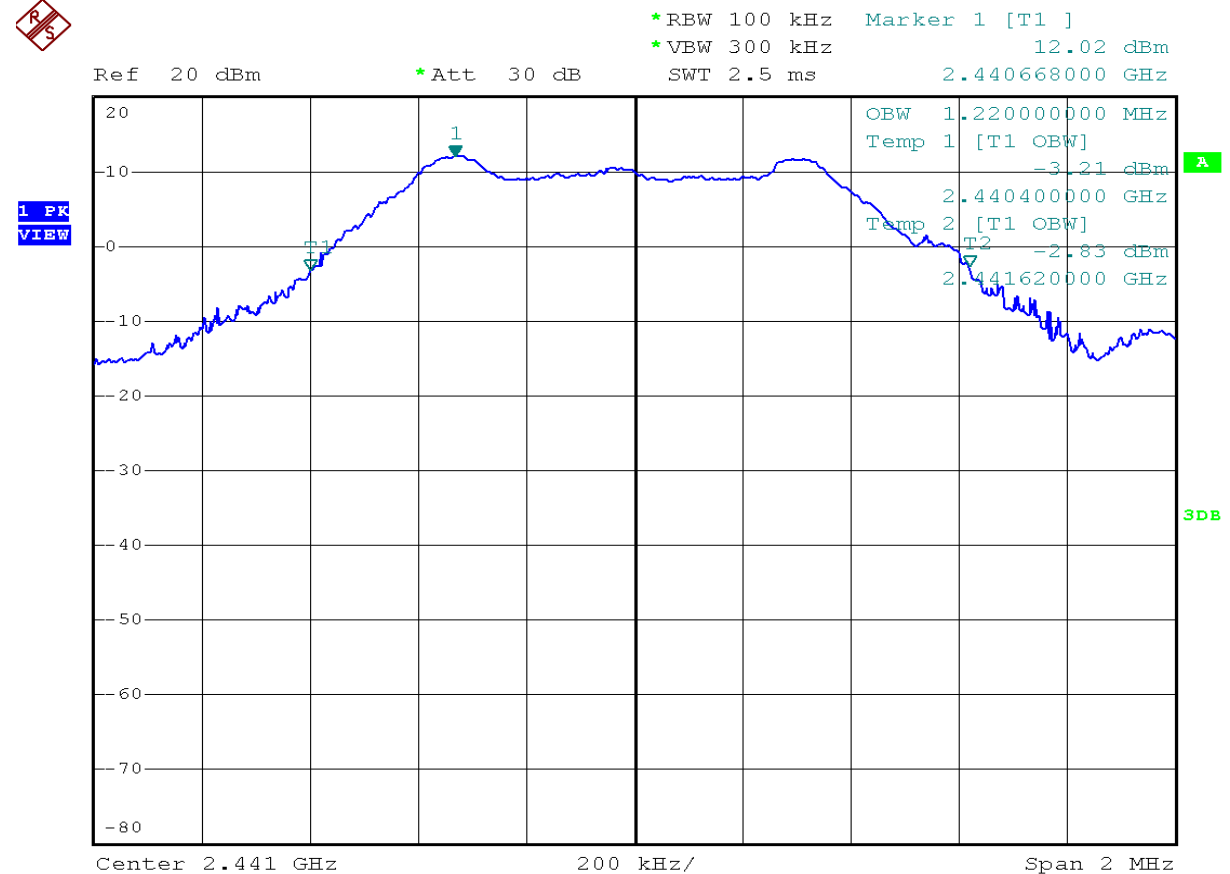
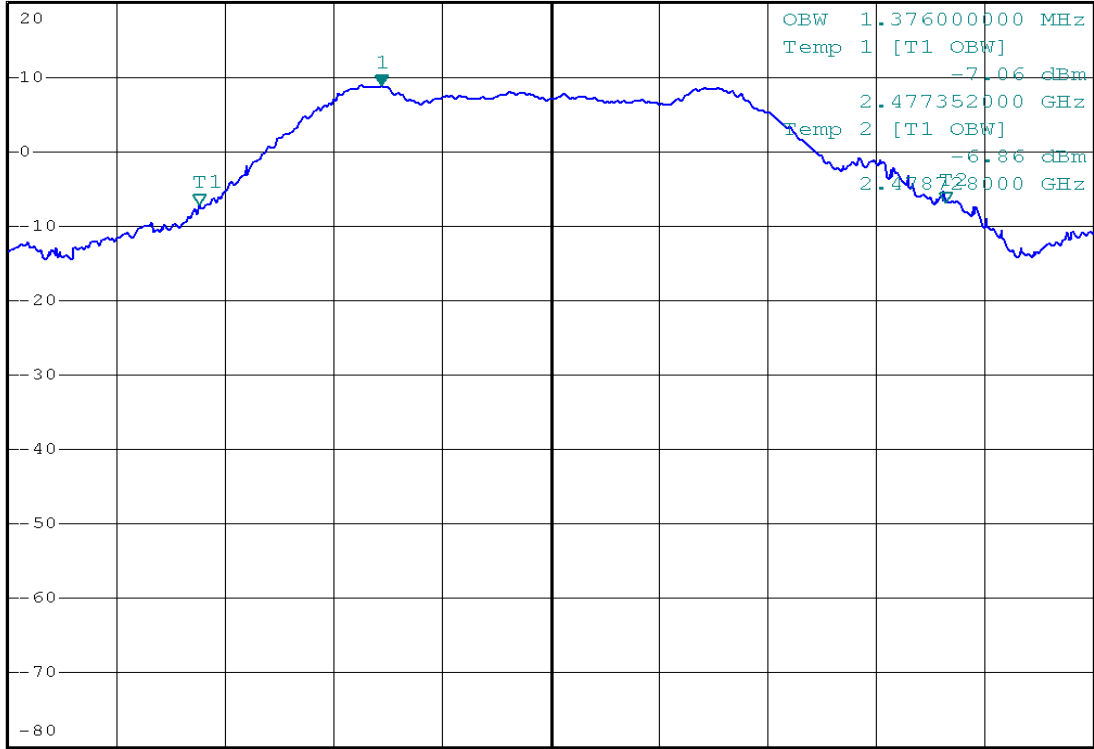


Figure 21- 99% bandwidth Measurement (fc=2478MHz) at FH3 Mode



Ref 20 dBm      \*Att 30 dB      \*RBW 100 kHz      Marker 1 [T1]      8.75 dBm  
 \*VBW 300 kHz      2.477688000 GHz  
 SWT 2.5 ms

1 PK  
VIEW



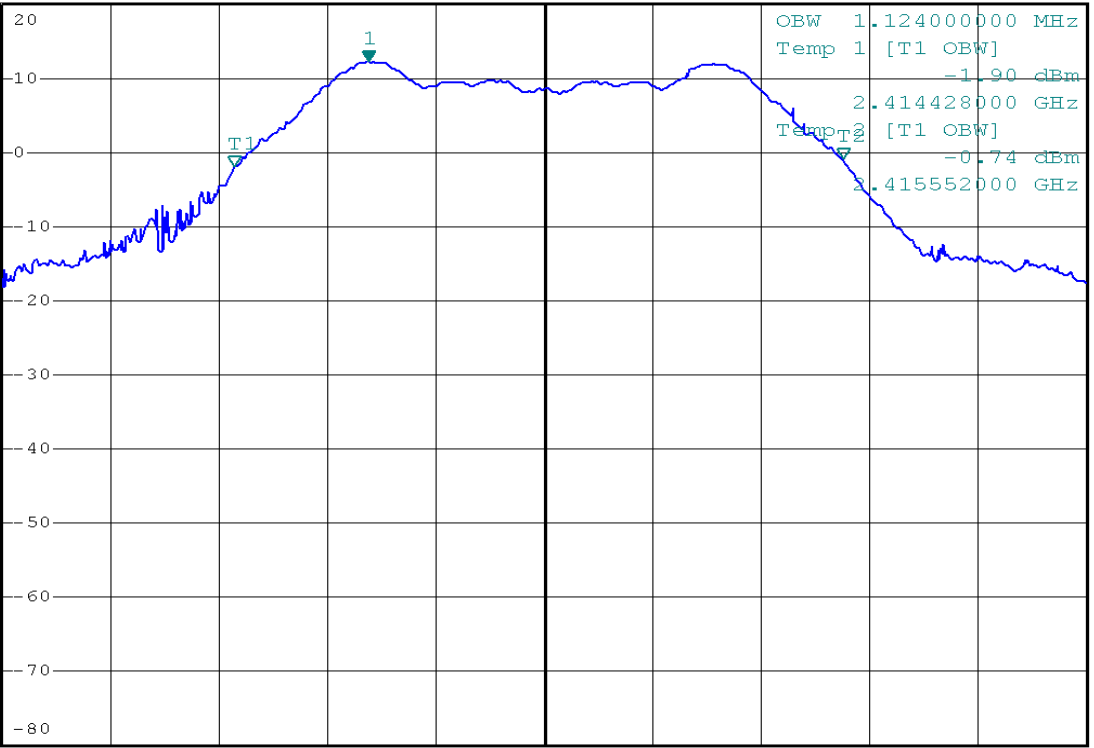
Center 2.478 GHz      200 kHz/      Span 2 MHz

Figure 22- 99% bandwidth Measurement (fc=2415MHz) at FH1 Mode



Ref 20 dBm      \*Att 30 dB      \*RBW 100 kHz      Marker 1 [T1]      12.16 dBm  
 \*VBW 300 kHz      2.414676000 GHz  
 SWT 2.5 ms

1 PK  
VIEW



Center 2.415 GHz      200 kHz/      Span 2 MHz

Figure 23- 99% bandwidth Measurement (fc=2441MHz) at FH1 Mode

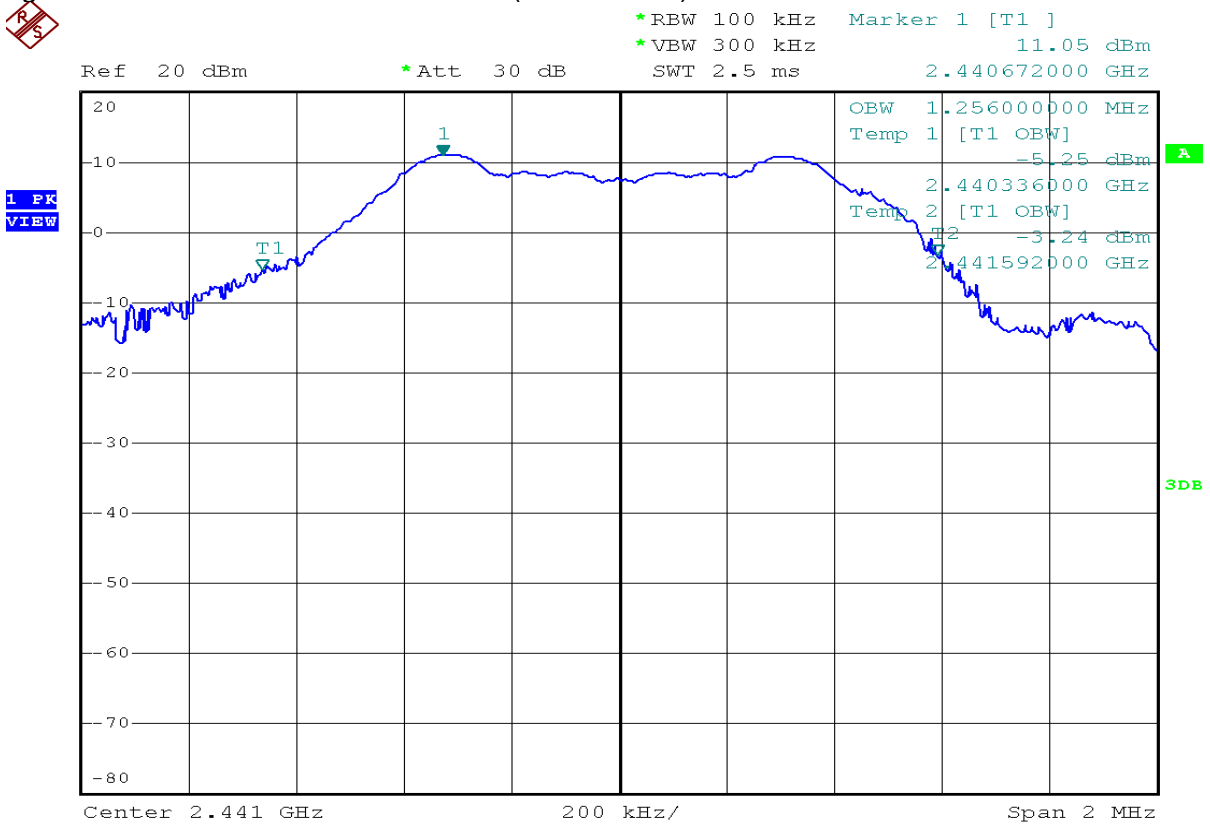
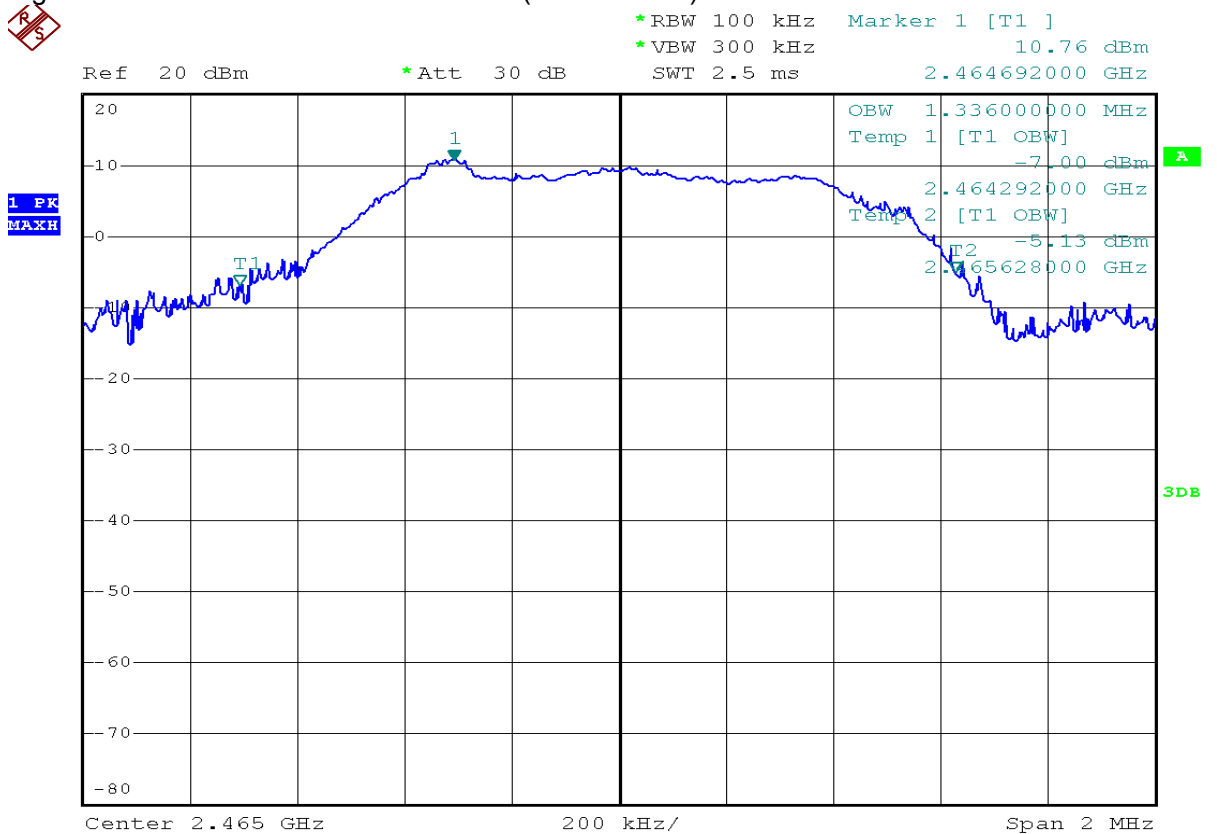


Figure 24- 99% bandwidth Measurement (fc=2465MHz) at FH1 Mode



## 6.8 RF Exposure

### Standard Applicable

Systems operating under the provisions of the section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance 0.2cm normally can be maintained between the user and the device.

The maximum permissible exposure is defined in 47 CFR 1.1310 with 1mW/cm<sup>2</sup> Subpart J, section 2.1091 this device has been defined as a portable device whereby a dista

### Test Results:

The maximum measured power output is 31.77mW (15.02 dBm), the maximum antenna gain is +1.5 dBi = numeric gain 1.41

The maximum permitted level is calculated using the general equation:  $S = P \cdot G / 4\pi R^2$

P= 31.77mW , G= 1.55 , R=20cm ,  $\pi=3.1416$

Solving for S, the power density at 20cm is 0.0089116mW/cm<sup>2</sup>

The unit does meet the requirement.

## 6.9 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 1.5 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.