



# FCC RF Test Report

**APPLICANT** : Texas Instruments Incorporated  
**EQUIPMENT** : WiFi and Bluetooth Module  
**BRAND NAME** : Texas Instruments  
**MODEL NAME** : WL18MODGI  
**FCC ID** : Z64-WL18DBMOD  
**STANDARD** : FCC Part 15 Subpart C §15.247  
**CLASSIFICATION** : (DSS) Spread Spectrum Transmitter

The product was received on Oct. 09, 2014 and testing was completed on Dec. 10, 2014. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

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Reviewed by: Joseph Lin / Supervisor

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Approved by: Jones Tsai / Manager



## **SPORTON INTERNATIONAL INC.**

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**SPORTON INTERNATIONAL INC.**

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FCC ID : Z64-WL18DBMOD

Page Number : 1 of 71

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## SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(a)(1)	RSS-210 A8.4(2)	Number of Channels	≥ 15Chs	Pass	-
3.2	15.247(a)(1)	RSS-210 A8.1(b)	Hopping Channel Separation	≥ 2/3 of 20dB BW	Pass	-
3.3	15.247(a)(1)	RSS-210 A8.1(d)	Dwell Time of Each Channel	≤ 0.4sec in 31.6sec period	Pass	-
3.4	15.247(a)(1)	RSS-210 A8.1(a)	20dB Bandwidth	NA	Pass	-
3.4	-	RSS-Gen 4.6.1	99% Bandwidth	-	Pass	-
3.5	15.247(b)(1)	RSS-210 A8.1(b)	Peak Output Power	≤ 125 mW	Pass	-
3.6	15.247(d)	RSS-210 A8.5	Conducted Band Edges	≤ 20dBc	Pass	-
3.7	15.247(d)	RSS-210 A8.5	Conducted Spurious Emission	≤ 20dBc	Pass	-
3.8	15.247(d)	RSS-210 A8.5	Band Edges and Spurious Emission in the Restricted Band	15.209(a) & 15.247(d)	Pass	Under limit 13.41 dB at 897.100 MHz
3.9	15.207	RSS-Gen 7.2.4	AC Conducted Emission	15.207(a)	Pass	Under limit 15.10 dB at 0.150 MHz
3.10	15.203 & 15.247(b)	RSS-210 A8.4	Antenna Requirement	N/A	Pass	-



# 1 General Description

## 1.1 Applicant

**Texas Instruments Incorporated**

12500 TI Boulevard, M/S 8751, Dallas, TX 75243, USA

## 1.2 Manufacturer

**Jorjin Technologies Inc**

17F, No. 239, Sec. 1, Datong Rd., Xizhi Dist., New Taipei City 221, Taiwan

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	WiFi and Bluetooth Module
Brand Name	Texas Instruments
Model Name	WL18MODGI
FCC ID	Z64-WL18DBMOD
EUT supports Radios application	WLAN 11a/b/g/n HT20/HT40 Bluetooth v4.0 EDR/LE
HW Version	WG7837-T0B
EUT Stage	Identical Prototype

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.



### 1.4 Product Specification subjective to this standard

Product Specification subjective to this standard	
Tx/Rx Frequency Range	2402 MHz ~ 2480 MHz
Number of Channels	79
Carrier Frequency of Each Channel	2402+n*1 MHz; n=0~78
Maximum Output Power to Antenna	Bluetooth BR(1Mbps) : 11.64 dBm (0.0146 W) Bluetooth EDR (2Mbps) : 9.37 dBm (0.0086 W) Bluetooth EDR (3Mbps) : 9.71 dBm (0.0094 W)
99% Occupied Bandwidth	Bluetooth BR(1Mbps) : 0.808MHz Bluetooth EDR (2Mbps) : 1.172MHz Bluetooth EDR (3Mbps) : 1.160MHz
Type of Modulation	Bluetooth BR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK Bluetooth EDR (3Mbps) : 8-DPSK

Antenna Information			
Antenna Type	Brand	2.4GHz~2.5GHz	4.9GHz~5.8GHz
PCB	Ethertronics	-0.6	4.5
Dipole	LSR	2	2
PCB	Laird	2	4
Chip	Pulse	3.2	4.2
PIFA	LSR	2	3
Chip	TDK	2.4	3.96

### 1.5 Modification of EUT

No modifications are made to the EUT during all test items.

### 1.6 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1022 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

Test Site	SPORTON INTERNATIONAL INC.		
Test Site Location	No. 52, Hwa Ya 1 <sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978		
Test Site No.	Sporton Site No.		
	TH02-HY	CO05-HY	03CH07-HY

**Note:** The test site complies with ANSI C63.4 2009 requirement.





## 1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC Public Notice DA 00-705
- ♦ ANSI C63.10-2009

### **Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.





## 2 Test Configuration of Equipment Under Test

### 2.1 Descriptions of Test Mode

Preliminary tests were performed in different data rates and recorded the RF output power in the following table:

Channel	Frequency	Bluetooth RF Output Power		
		Data Rate / Modulation		
		GFSK	$\pi/4$ -DQPSK	8-DPSK
		1Mbps	2Mbps	3Mbps
Ch00	2402MHz	11.64 dBm	9.37 dBm	9.71 dBm
Ch39	2441MHz	11.26 dBm	9.15 dBm	9.53 dBm
Ch78	2480MHz	11.16 dBm	8.83 dBm	9.23 dBm

**Remark:**

1. All the test data for each data rate were verified, but only the worst case was reported.
  2. The data rate was set in 1Mbps for all the test items due to the highest RF output power.
- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction (150 kHz to 30 MHz), radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).
  - b. AC power line Conducted Emission was tested under maximum output power.



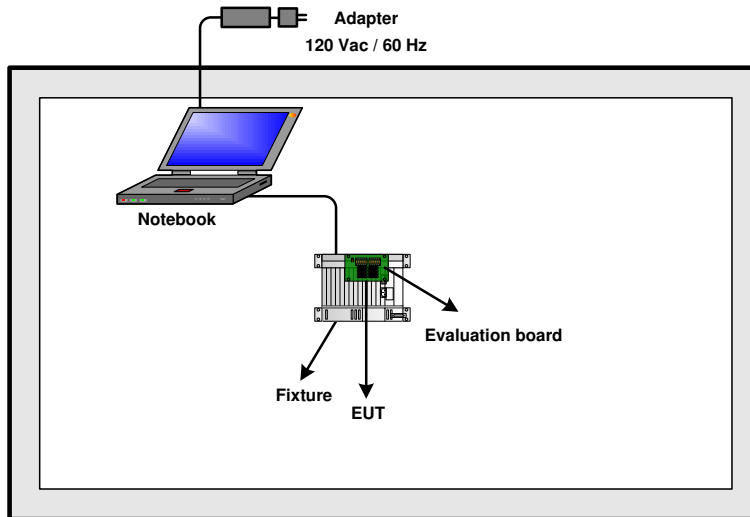
## 2.2 Test Mode

The following summary table is showing all test modes to demonstrate in compliance with the standard.

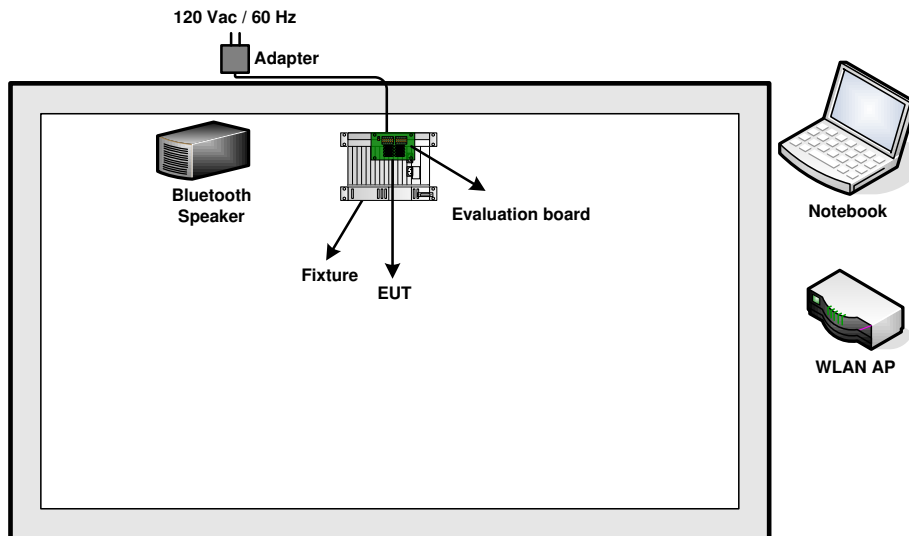
Summary table of Test Cases			
Test Item	Data Rate / Modulation		
	Bluetooth BR 1Mbps GFSK	Bluetooth EDR 2Mbps $\pi/4$ -DQPSK	Bluetooth EDR 3Mbps 8-DPSK
<b>Conducted Test Cases</b>	Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz	Mode 4: CH00_2402 MHz Mode 5: CH39_2441 MHz Mode 6: CH78_2480 MHz	Mode 7: CH00_2402 MHz Mode 8: CH39_2441 MHz Mode 9: CH78_2480 MHz
<b>Radiated Test Cases</b>	<b>Bluetooth BR 1Mbps GFSK</b> Mode 1: CH00_2402 MHz Mode 2: CH39_2441 MHz Mode 3: CH78_2480 MHz		
<b>AC Conducted Emission</b>	Mode 1 :WLAN (2.4GHz) Link + Bluetooth Link + Adapter		
<p><b>Remark:</b> For radiated test cases, the worst mode data rate 1Mbps was reported only, because this data rate has the highest RF output power at preliminary tests, and the conducted spurious emissions and conducted band edge measurement for each data rate are no worse than 1Mbps, and no other significantly frequencies found in conducted spurious emission.</p>			

## 2.3 Connection Diagram of Test System

### <Bluetooth Tx Mode>



### <AC Conducted Emission Mode>





### 2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	D-Link	DIR-628	KA2DIR628A2	N/A	Unshielded, 1.8 m
2.	Notebook	DELL	Latitude E6320	FCC DoC/ Contains FCC ID: QDS-BRCM1054	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
3.	Notebook	Lenovo	M490S	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	Bluetooth Speaker	MI	MDZ-03-AC	N/A	N/A	N/A
5.	Fixture	N/A	N/A	N/A	N/A	N/A
6.	Evaluation board	N/A	WG1300BE00	N/A	N/A	N/A

### 2.5 EUT Operation Test Setup

For Bluetooth function, programmed RF utility, "HCI Tester" installed in the notebook make the EUT provide functions like channel selection and power level for continuous transmitting and receiving signals.

### 2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

*Offset = RF cable loss + attenuator factor.*

Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

$$\begin{aligned}
\text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\
&= 4.2 + 10 = 14.2 \text{ (dB)}
\end{aligned}$$

### 3 Test Result

#### 3.1 Number of Channel Measurement

##### 3.1.1 Limits of Number of Hopping Frequency

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

##### 3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

##### 3.1.3 Test Procedure

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW  $\geq$  1% of the span; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. The number of hopping frequency used is defined as the number of total channel.
7. Record the measurement data derived from spectrum analyzer.

##### 3.1.4 Test Setup

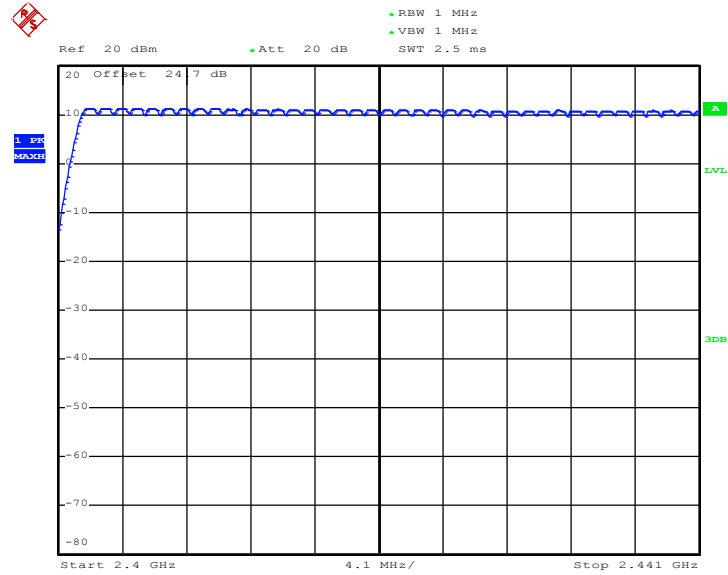


##### 3.1.5 Test Result of Number of Hopping Frequency

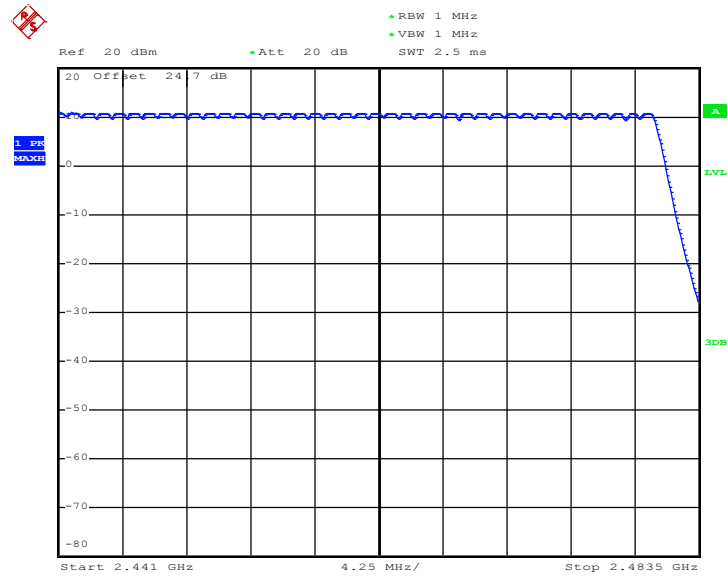
<b>Test Mode :</b>	1Mbps	<b>Temperature :</b>	24~26°C
<b>Test Engineer :</b>	Kenny Chen	<b>Relative Humidity :</b>	48~51%
<b>Number of Hopping (Channel)</b>	<b>Adaptive Frequency Hopping (Channel)</b>	<b>Limits (Channel)</b>	<b>Pass/Fail</b>
79	20	> 15	Pass



Number of Hopping Channel Plot on Channel 00 - 78



Date: 28.NOV.2014 14:26:43



Date: 28.NOV.2014 14:27:52

## 3.2 Hopping Channel Separation Measurement

### 3.2.1 Limit of Hopping Channel Separation

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.

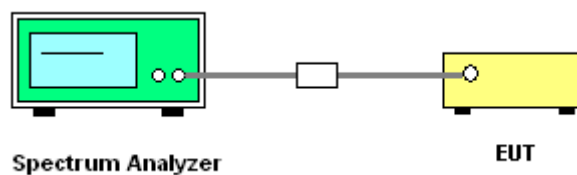
### 3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.2.3 Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peaks of two adjacent channels; RBW  $\geq$  1% of the span;  
VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

### 3.2.4 Test Setup



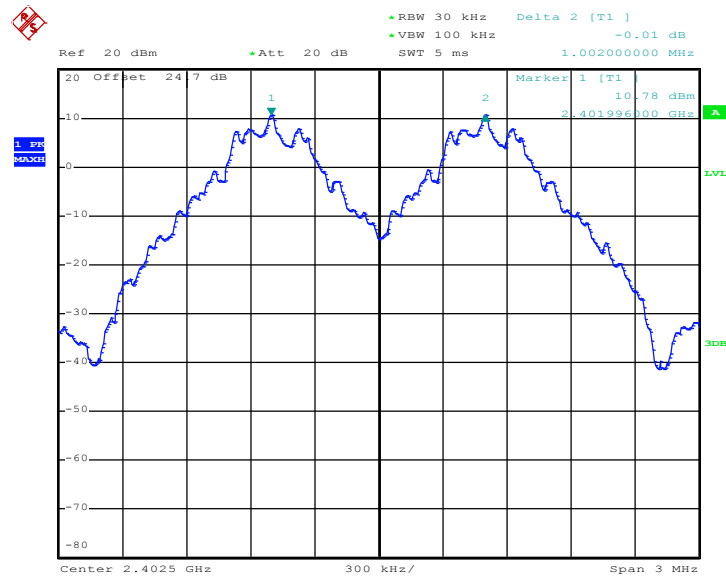


3.2.5 Test Result of Hopping Channel Separation

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	1.002	0.5093	Pass
39	2441	0.996	0.5093	Pass
78	2480	1.002	0.5307	Pass

Channel Separation Plot on Channel 00 - 01

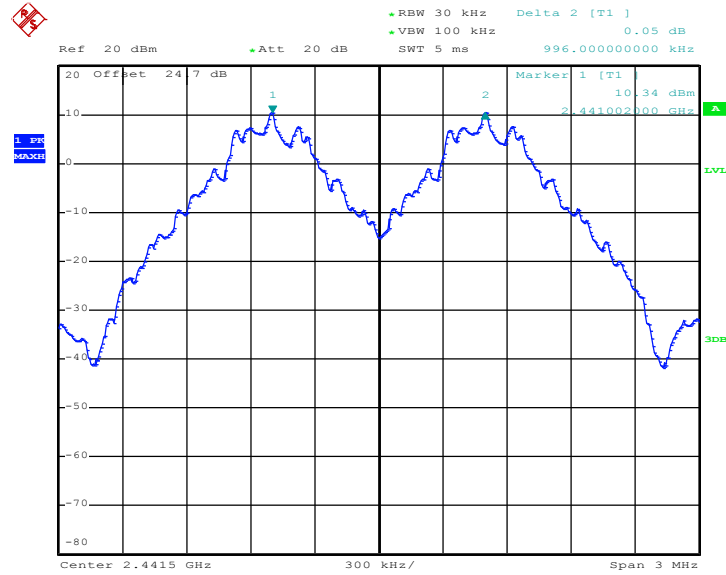


Date: 28.NOV.2014 11:53:15



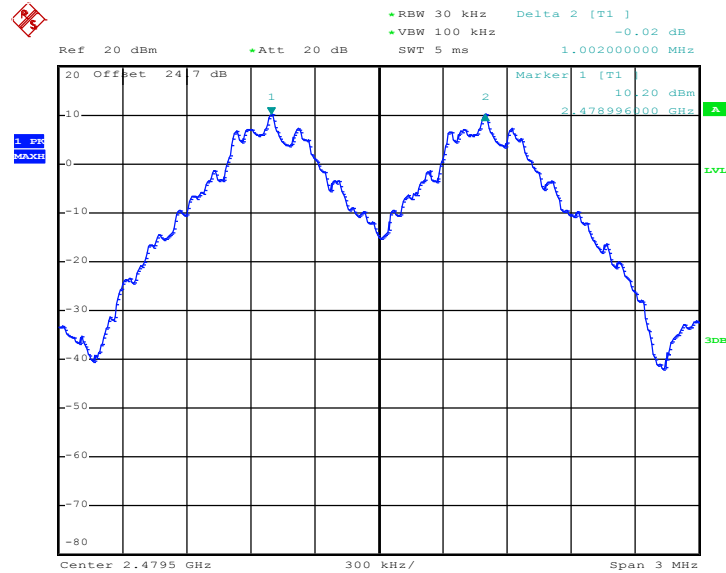


Channel Separation Plot on Channel 39 - 40



Date: 28.NOV.2014 11:54:10

Channel Separation Plot on Channel 77 - 78



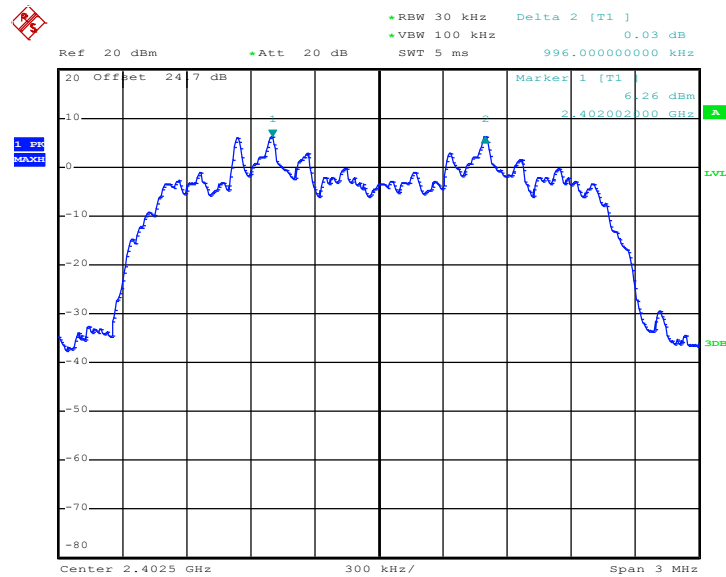
Date: 28.NOV.2014 11:56:22



Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	0.996	0.8320	Pass
39	2441	1.008	0.8320	Pass
78	2480	1.002	0.8360	Pass

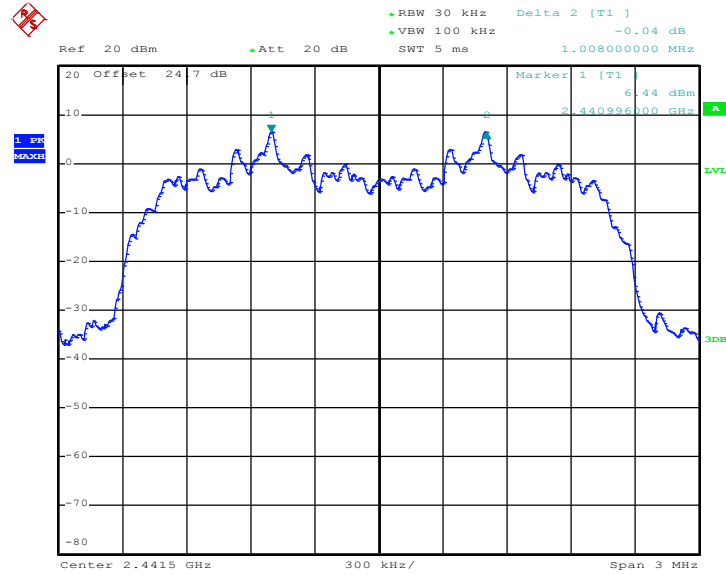
Channel Separation Plot on Channel 00 - 01



Date: 28.NOV.2014 11:57:07

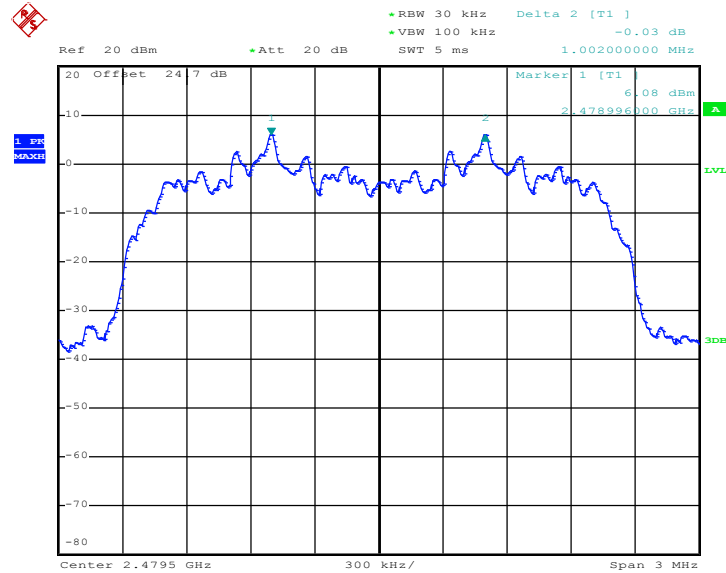


### Channel Separation Plot on Channel 39 - 40



Date: 28.NOV.2014 11:58:28

### Channel Separation Plot on Channel 77 - 78



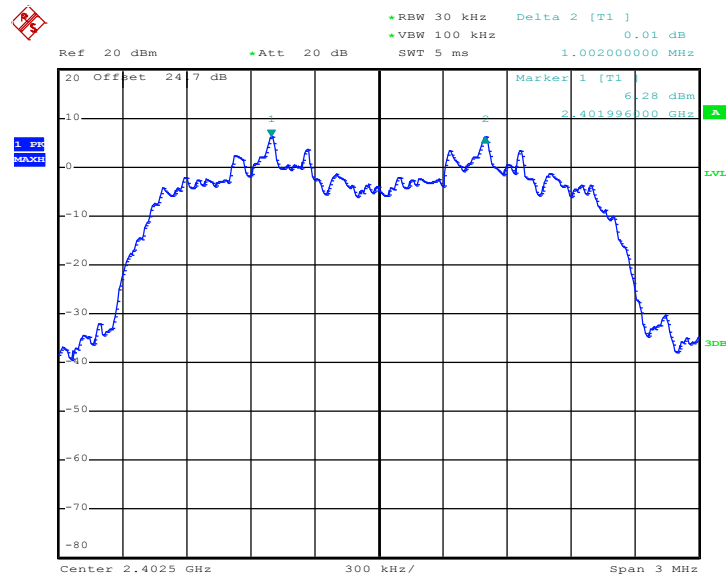
Date: 28.NOV.2014 12:00:11



Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	Frequency Separation (MHz)	(2/3 of 20dB BW) Limits (MHz)	Pass/Fail
00	2402	1.002	0.8160	Pass
39	2441	1.008	0.8120	Pass
78	2480	1.002	0.8160	Pass

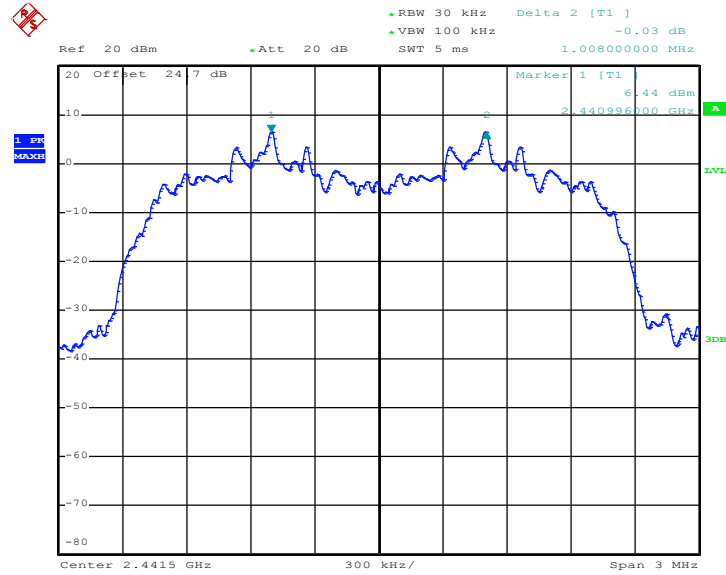
Channel Separation Plot on Channel 00 - 01



Date: 28.NOV.2014 12:01:13

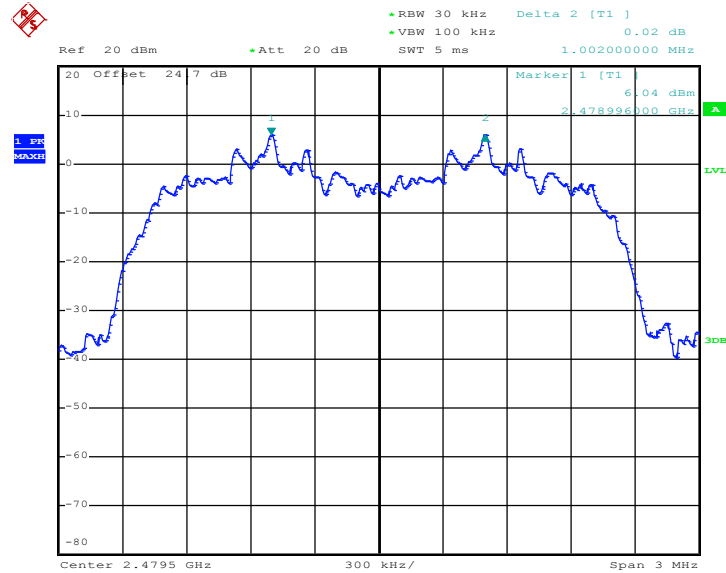


Channel Separation Plot on Channel 39 - 40



Date: 28.NOV.2014 12:02:08

Channel Separation Plot on Channel 77 - 78



Date: 28.NOV.2014 12:03:00

### 3.3 Dwell Time Measurement

#### 3.3.1 Limit of Dwell Time

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.

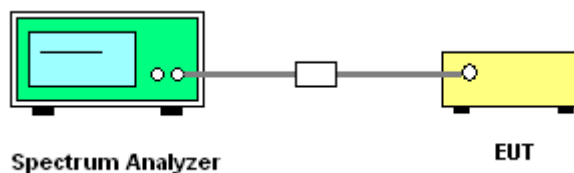
#### 3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.3.3 Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Enable the EUT hopping function.
5. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel; RBW = 1 MHz; VBW  $\geq$  RBW; Sweep = as necessary to capture the entire dwell time per hopping channel; Detector function = peak; Trace = max hold.
6. Measure and record the results in the test report.

#### 3.3.4 Test Setup





3.3.5 Test Result of Dwell Time

Test Mode :	DH5	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

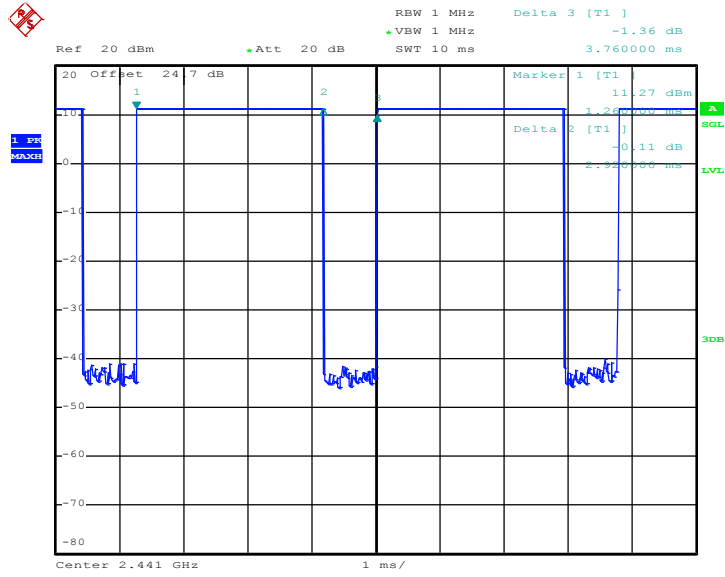
Mode	Hopping Channel Number	Hops Over Occupancy Time(hops)	Package Transfer Time (msec)	Dwell Time (sec)	Limits (sec)	Pass/Fail
Normal	79	106.67	2.92	0.31	0.4	Pass
AFH	20	53.33	2.92	0.16	0.4	Pass

Remark:

- In normal mode, hopping rate is 1600 hops/s with 6 slots in 79 hopping channels.  
With channel hopping rate (1600 / 6 / 79) in Occupancy Time Limit (0.4 x 79) (s),  
Hops Over Occupancy Time comes to (1600 / 6 / 79) x (0.4 x 79) = 106.67 hops.
- In AFH mode, hopping rate is 800 hops/s with 6 slots in 20 hopping channels.  
With channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 x 20) (s),  
Hops Over Occupancy Time comes to (800 / 6 / 20) x (0.4 x 20) = 53.33 hops.
- Dwell Time(s) = Hops Over Occupancy Time (hops) x Package Transfer Time



Package Transfer Time Plot



Date: 27.NOV.2014 23:34:41



### 3.4 20dB and 99% Bandwidth Measurement

#### 3.4.1 Limit of 20dB and 99% Bandwidth

Reporting only

#### 3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.4.3 Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Use the following spectrum analyzer settings for 20dB Bandwidth measurement.  
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel;  
RBW  $\geq$  1% of the 20 dB bandwidth; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak;  
Trace = max hold.
5. Use the following spectrum analyzer settings for 99 % Bandwidth measurement.  
For 99% Bandwidth measurement, the RBW=30kHz, and VBW = 100kHz. Sweep = auto ;  
Detector function = sample. Trace = max hold.
6. Measure and record the results in the test report.

#### 3.4.4 Test Setup



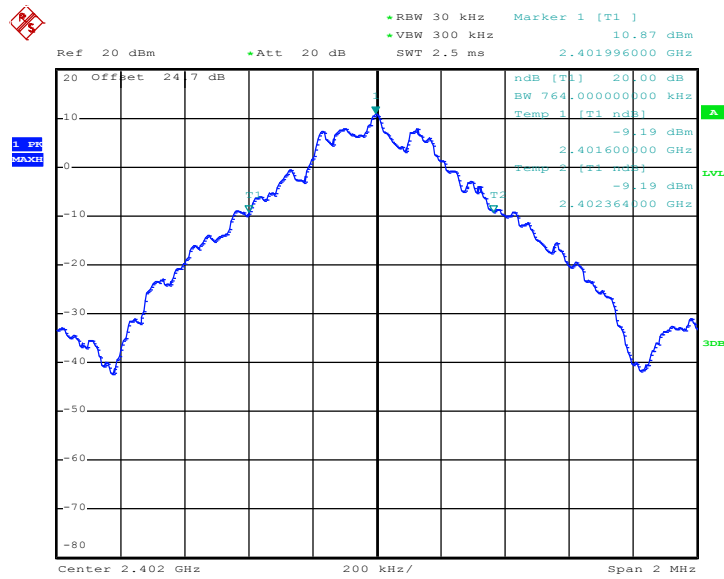


3.4.5 Test Result of 20dB Bandwidth

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	0.764
39	2441	0.764
78	2480	0.796

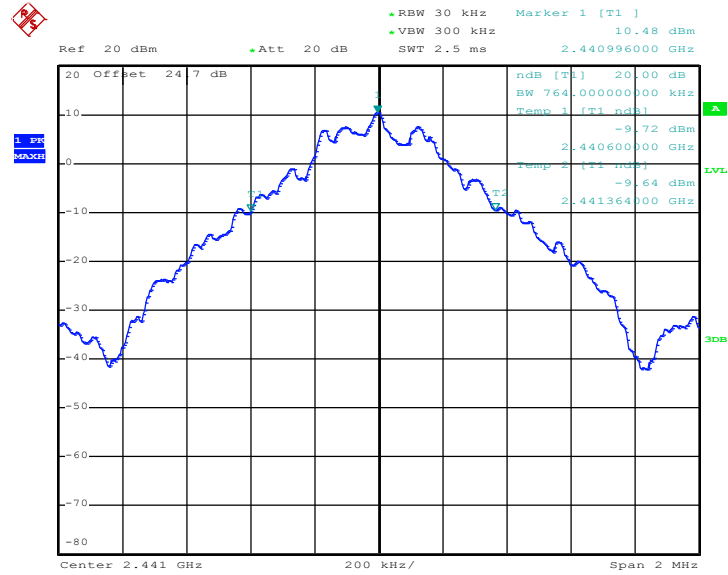
20 dB Bandwidth Plot on Channel 00



Date: 28.NOV.2014 12:03:19

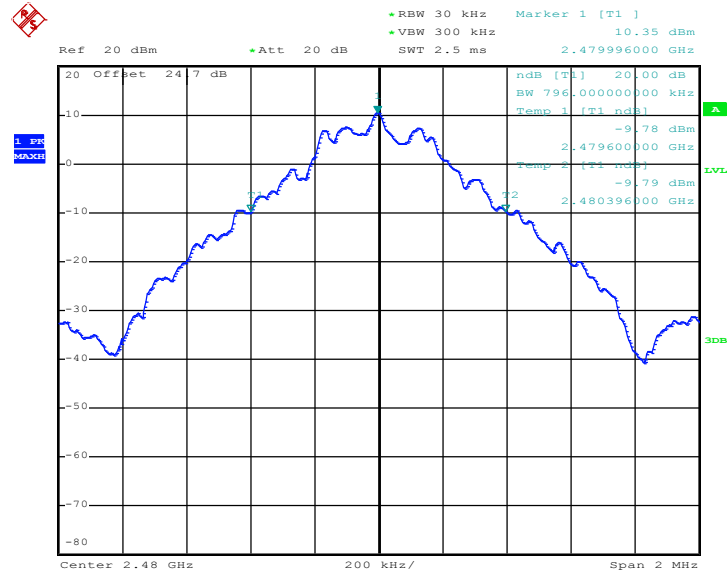


20 dB Bandwidth Plot on Channel 39



Date: 28.NOV.2014 12:03:41

20 dB Bandwidth Plot on Channel 78



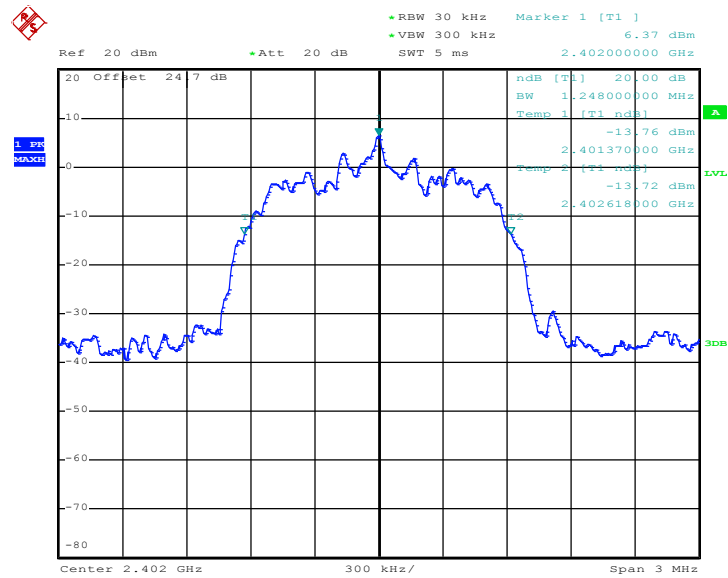
Date: 28.NOV.2014 13:30:55



Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	1.248
39	2441	1.248
78	2480	1.254

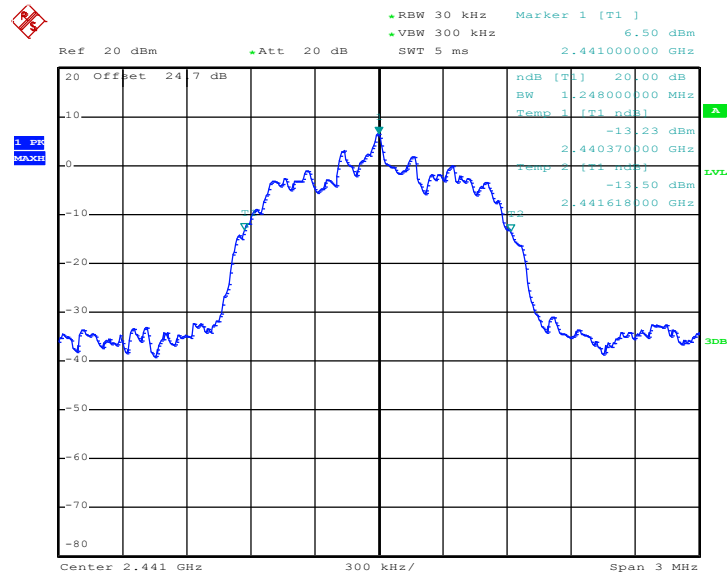
20 dB Bandwidth Plot on Channel 00



Date: 28.NOV.2014 13:31:12

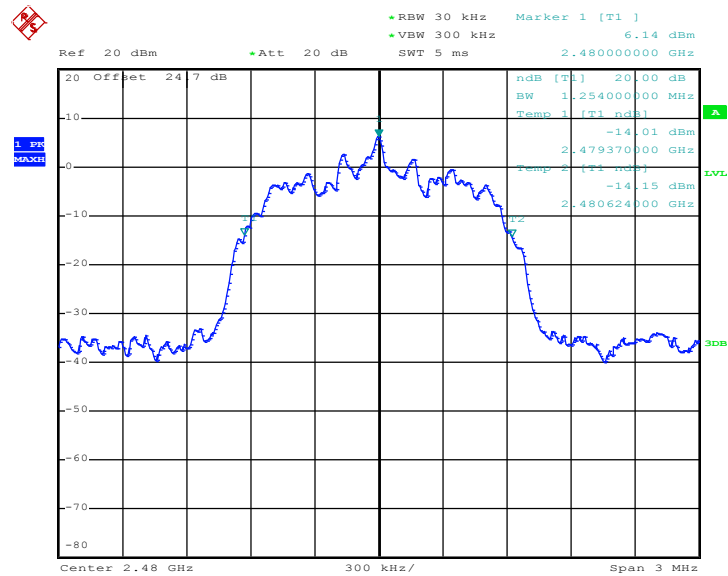


20 dB Bandwidth Plot on Channel 39



Date: 28.NOV.2014 13:31:30

20 dB Bandwidth Plot on Channel 78



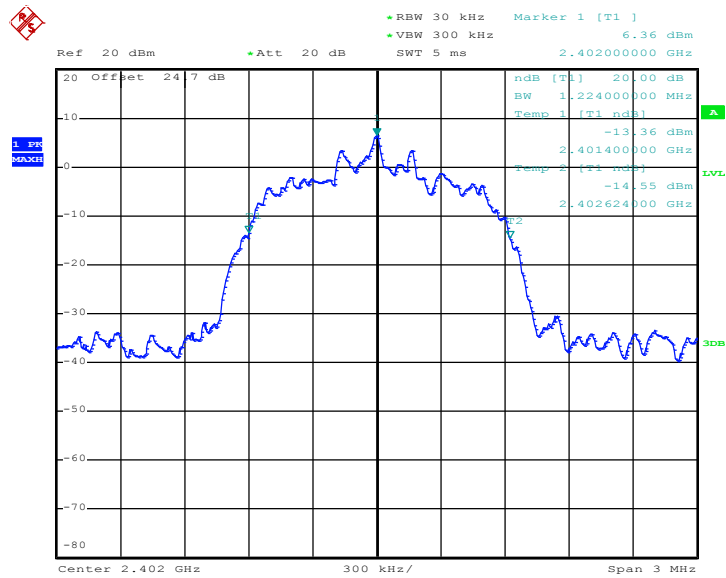
Date: 28.NOV.2014 13:31:50



Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
00	2402	1.224
39	2441	1.218
78	2480	1.224

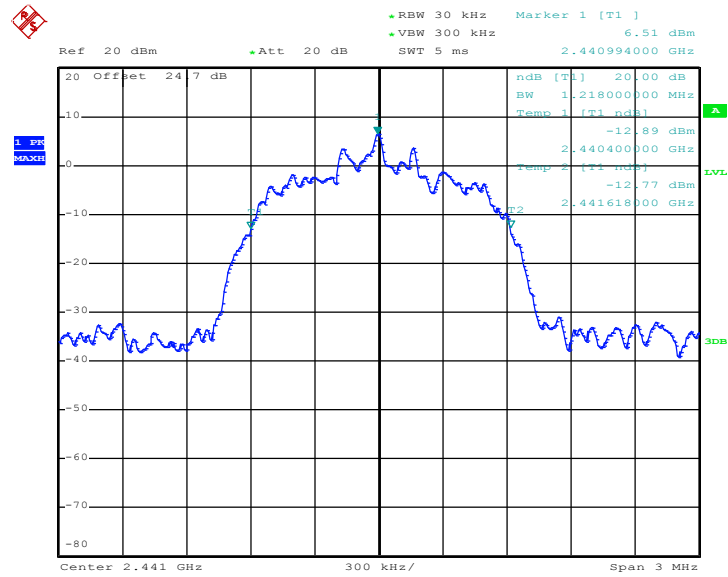
20 dB Bandwidth Plot on Channel 00



Date: 28.NOV.2014 13:32:21

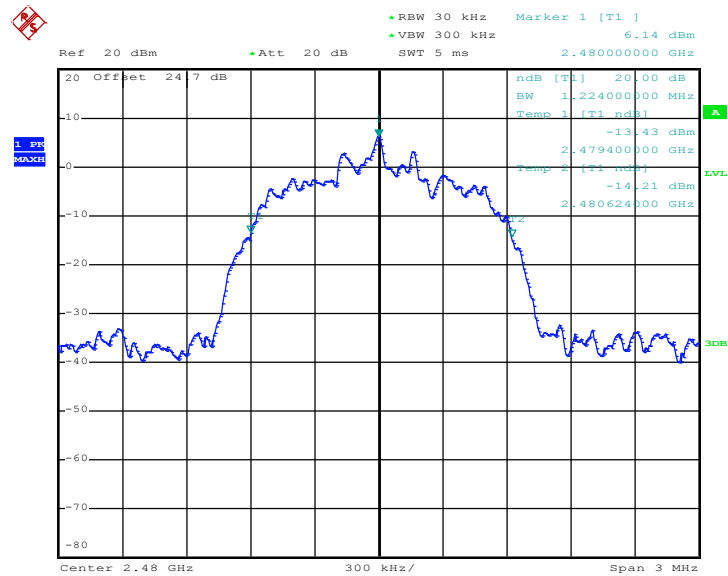


20 dB Bandwidth Plot on Channel 39



Date: 28.NOV.2014 13:32:42

20 dB Bandwidth Plot on Channel 78



Date: 28.NOV.2014 13:33:01

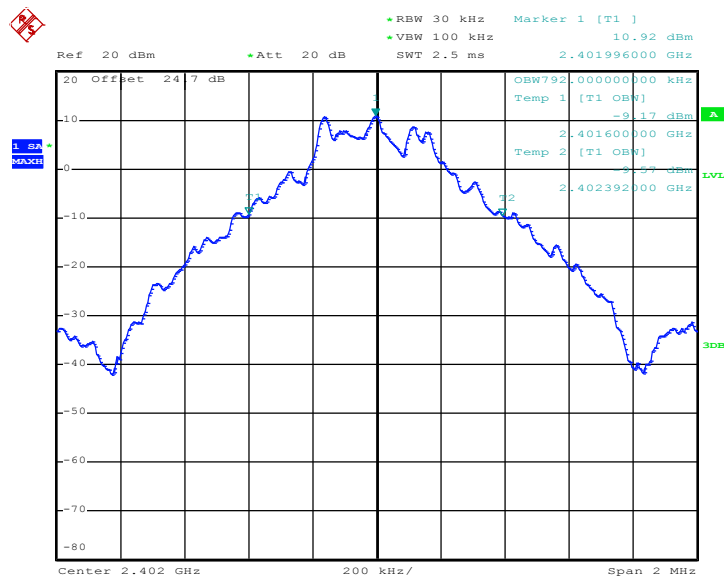


### 3.4.6 Test Result of 99% Occupied Bandwidth

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	0.792
39	2441	0.808
78	2480	0.808

99% Occupied Bandwidth Plot on Channel 00

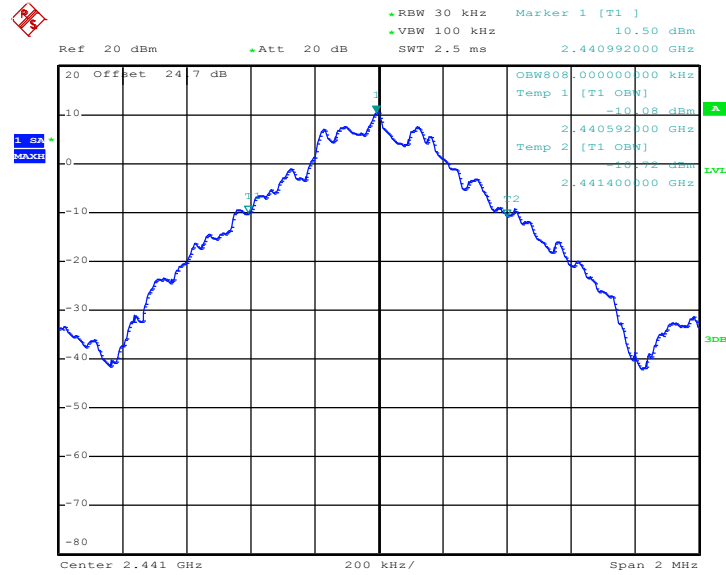


Date: 28.NOV.2014 13:33:55



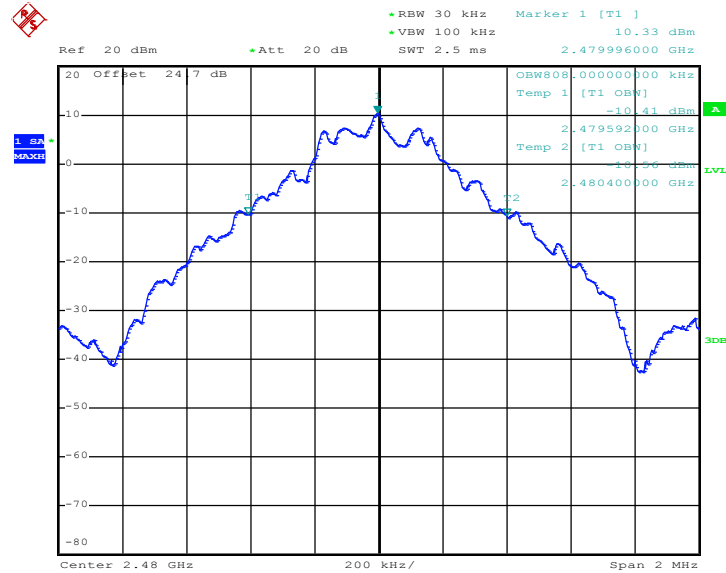


99% Occupied Bandwidth Plot on Channel 39



Date: 28.NOV.2014 13:34:31

99% Occupied Bandwidth Plot on Channel 78



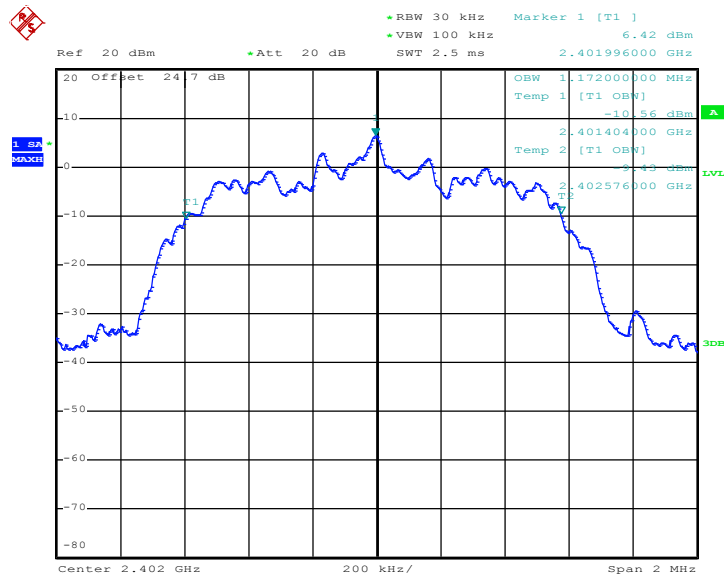
Date: 28.NOV.2014 13:37:53



Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	1.172
39	2441	1.172
78	2480	1.164

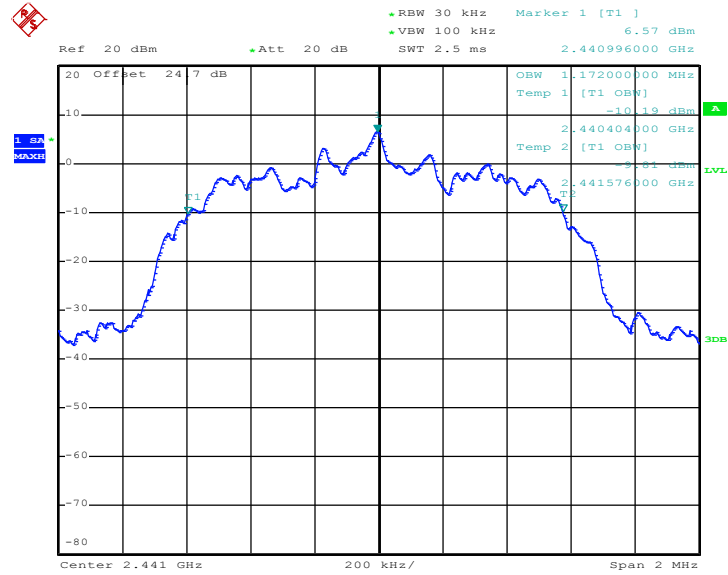
99% Occupied Bandwidth Plot on Channel 00



Date: 28.NOV.2014 13:39:26

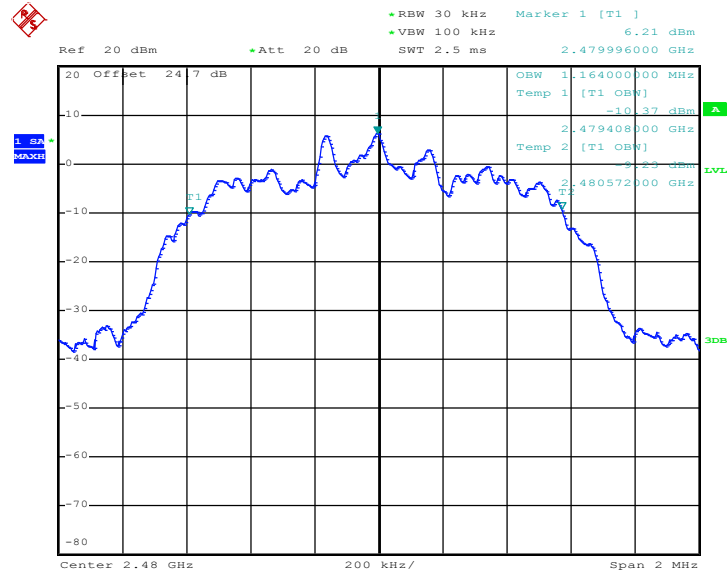


99% Occupied Bandwidth Plot on Channel 39



Date: 28.NOV.2014 13:40:11

99% Occupied Bandwidth Plot on Channel 78



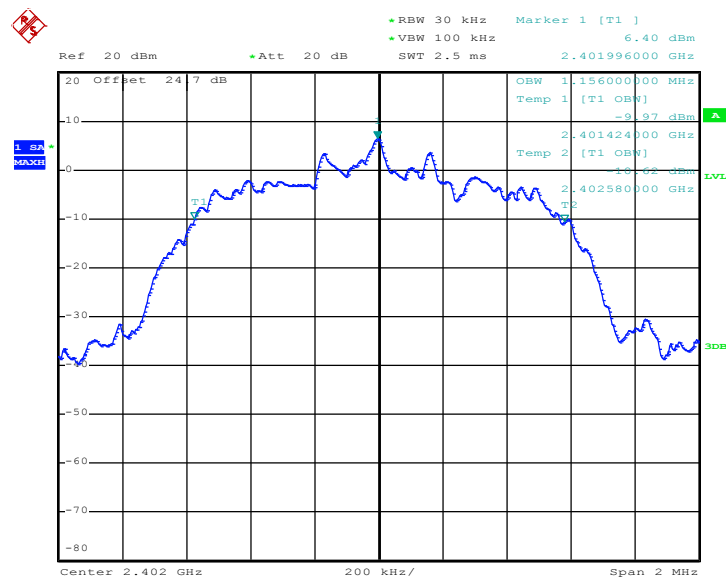
Date: 28.NOV.2014 13:38:37



Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	99% Occupied Bandwidth (MHz)
00	2402	1.156
39	2441	1.156
78	2480	1.160

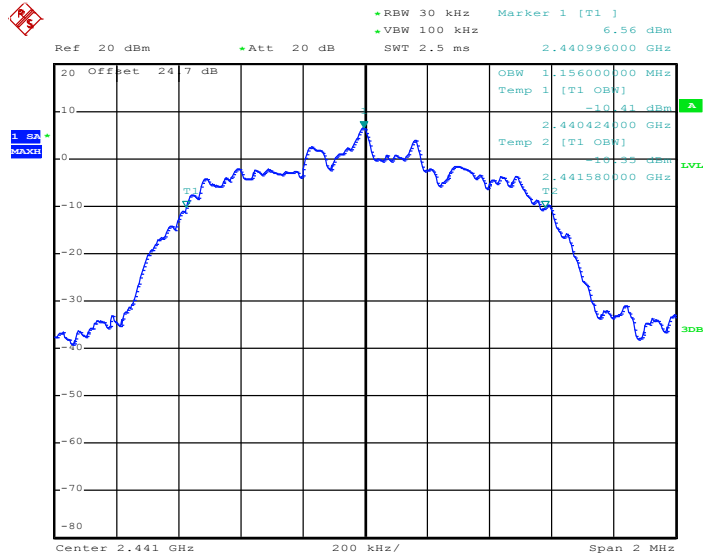
99% Occupied Bandwidth Plot on Channel 00



Date: 28.NOV.2014 13:41:23

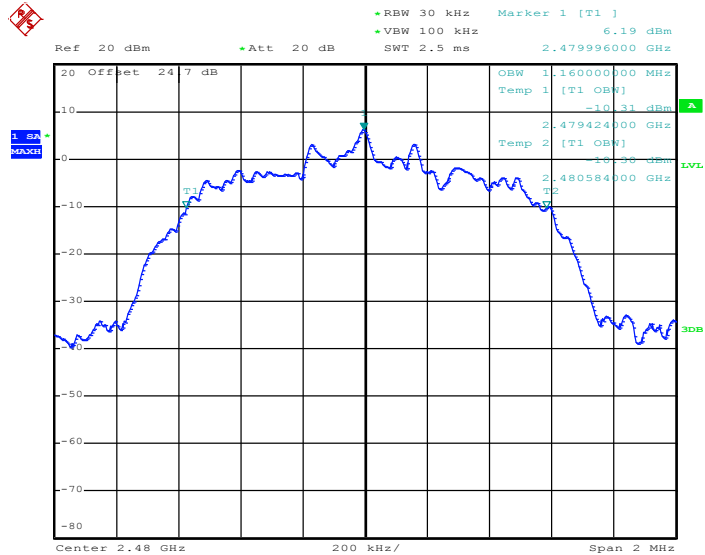


99% Occupied Bandwidth Plot on Channel 39



Date: 28.NOV.2014 13:40:46

99% Occupied Bandwidth Plot on Channel 78



Date: 28.NOV.2014 13:42:00

**Note:** The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

### 3.5 Peak Output Power Measurement

#### 3.5.1 Limit of Peak Output Power

Section 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following: (1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band 0.125 watts. The power limit for 1Mbps is 1watt, and for 2Mbps, 3Mbps and AFH are 0.125 watts.

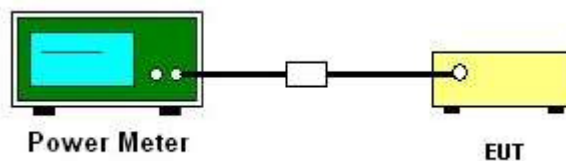
#### 3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.5.3 Test Procedures

1. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power with cable loss and record the results in the test report.
5. Measure and record the results in the test report.

#### 3.5.4 Test Setup





3.5.5 Test Result of Peak Output Power

Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	RF Power (dBm)		
		GFSK	Max. Limits (dBm)	Pass/Fail
		1 Mbps		
00	2402	11.64	20.97	Pass
39	2441	11.26	20.97	Pass
78	2480	11.16	20.97	Pass

Note: For AFH mode using 20 hopping channels, the maximum output power limit is 20.97dBm.

Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	RF Power (dBm)		
		$\pi/4$ -DQPSK	Max. Limits (dBm)	Pass/Fail
		2 Mbps		
00	2402	9.37	20.97	Pass
39	2441	9.15	20.97	Pass
78	2480	8.83	20.97	Pass

Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

Channel	Frequency (MHz)	RF Power (dBm)		
		8-DPSK	Max. Limits (dBm)	Pass/Fail
		3 Mbps		
00	2402	9.71	20.97	Pass
39	2441	9.53	20.97	Pass
78	2480	9.23	20.97	Pass

## 3.6 Conducted Band Edges Measurement

### 3.6.1 Limit of Band Edges

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

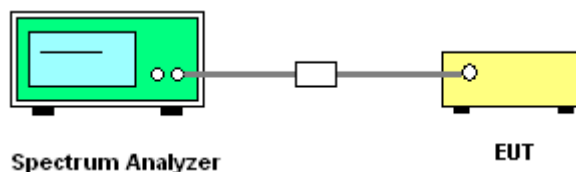
### 3.6.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.6.3 Test Procedures

1. The testing follows the guidelines in Band-edge Compliance of RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Set RBW = 100kHz ( $\geq 1\%$  span=10MHz ), VBW = 300kHz ( $\geq$  RBW). Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW. The attenuation shall be 30 dB instead of 20 dB when RMS conducted output power procedure is used.
4. Enable hopping function of the EUT and then repeat step 2. and 3.
5. Measure and record the results in the test report.

### 3.6.4 Test Setup



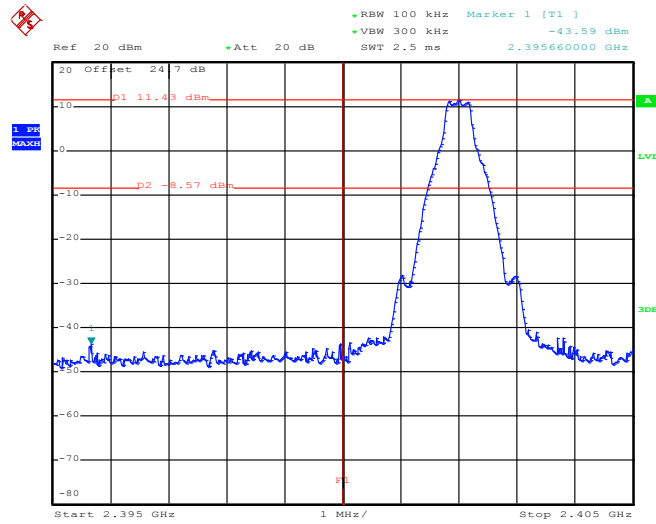




### 3.6.5 Test Result of Conducted Band Edges

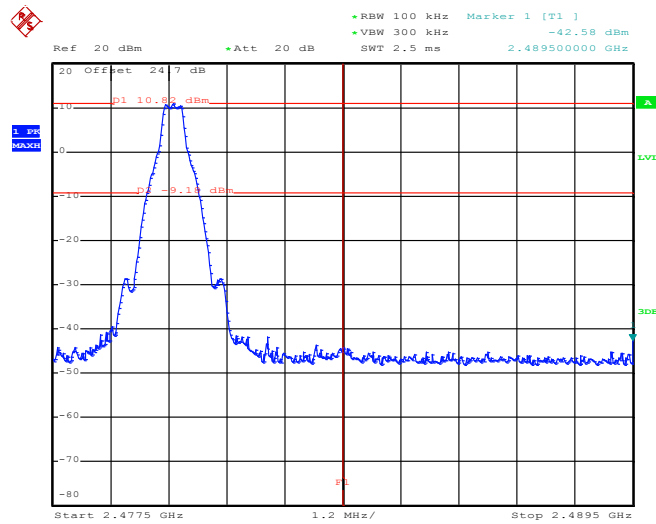
Test Mode :	1Mbps	Temperature :	24~26°C
Test Channel :	00 and 78	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

Low Band Edge Plot on Channel 00



Date: 28.NOV.2014 13:43:19

High Band Edge Plot on Channel 78

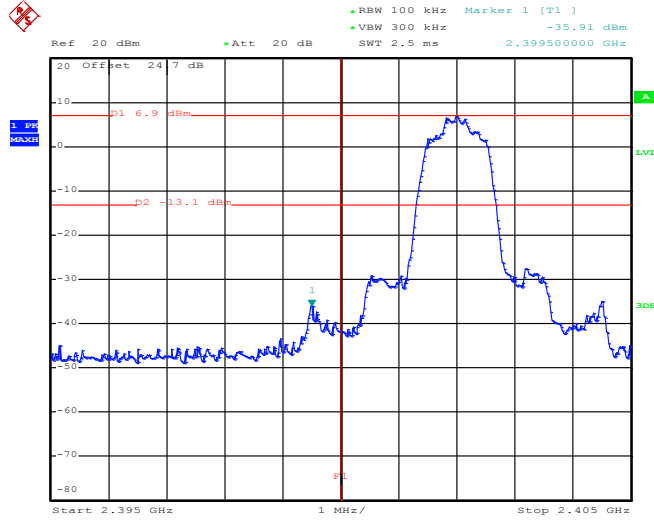


Date: 28.NOV.2014 13:47:22



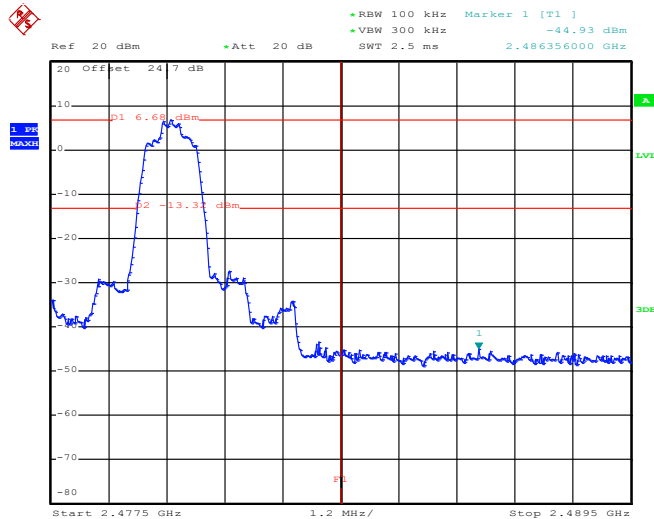
Test Mode :	2Mbps	Temperature :	24~26°C
Test Channel :	00 and 78	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

Low Band Edge Plot on Channel 00



Date: 28.NOV.2014 13:54:25

High Band Edge Plot on Channel 78

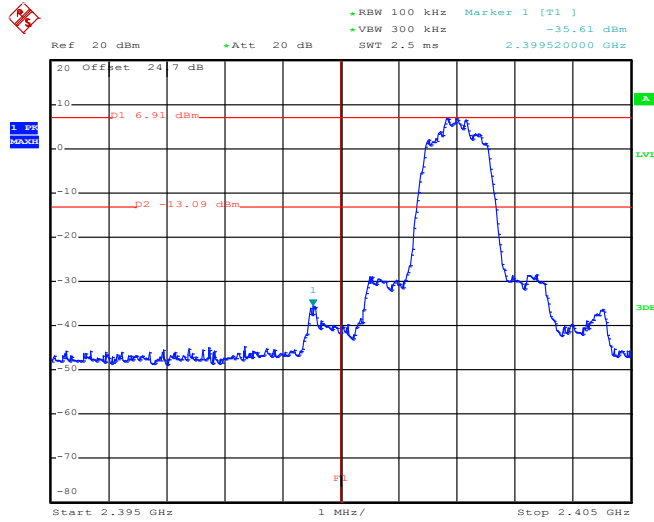


Date: 28.NOV.2014 13:50:27



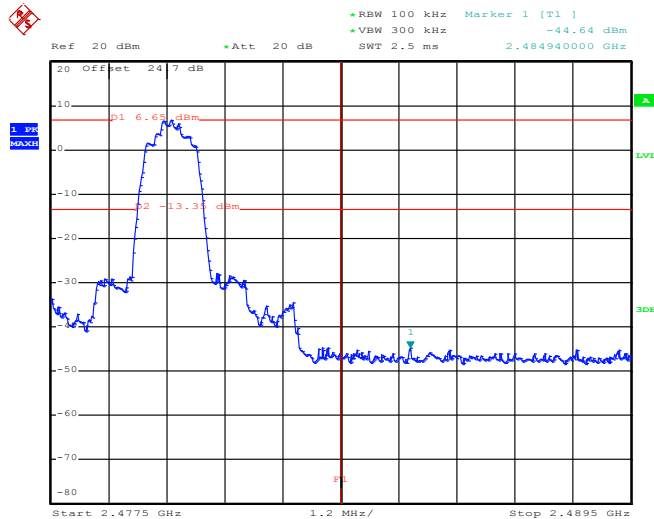
Test Mode :	3Mbps	Temperature :	24~26°C
Test Channel :	00 and 78	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

Low Band Edge Plot on Channel 00



Date: 28.NOV.2014 13:57:29

High Band Edge Plot on Channel 78



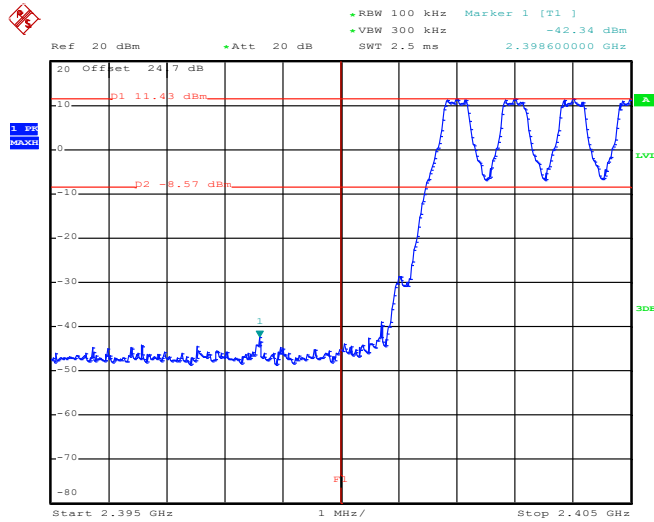
Date: 28.NOV.2014 14:11:43



### 3.6.6 Test Result of Conducted Hopping Mode Band Edges

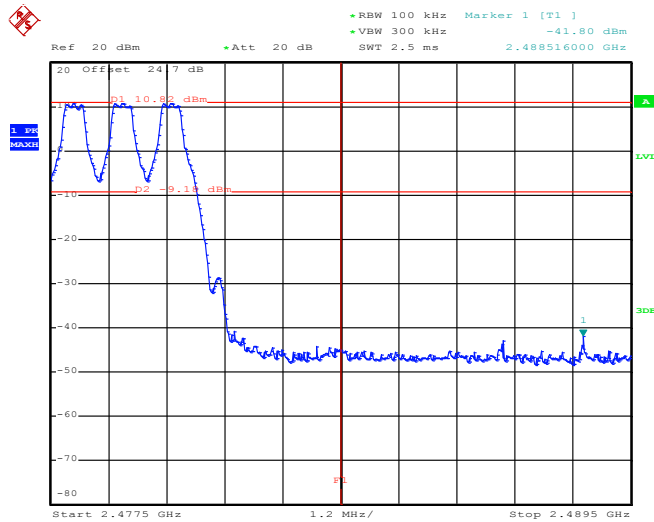
Test Mode :	1Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

1Mbps Hopping Mode Low Band Edge Plot



Date: 28.NOV.2014 13:42:39

1Mbps Hopping Mode High Band Edge Plot

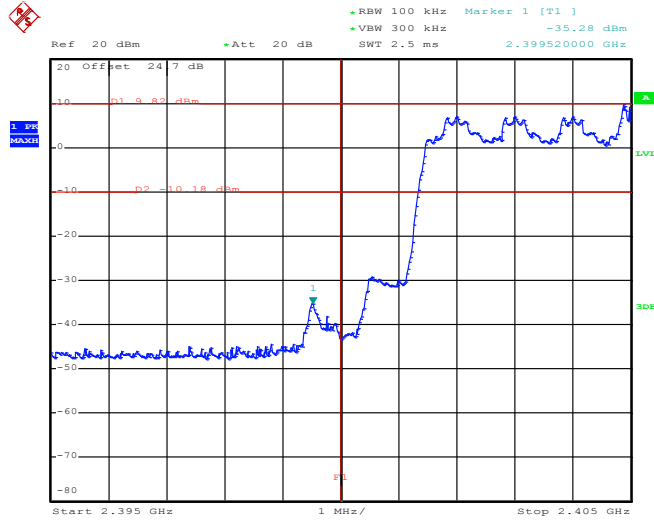


Date: 28.NOV.2014 13:47:01



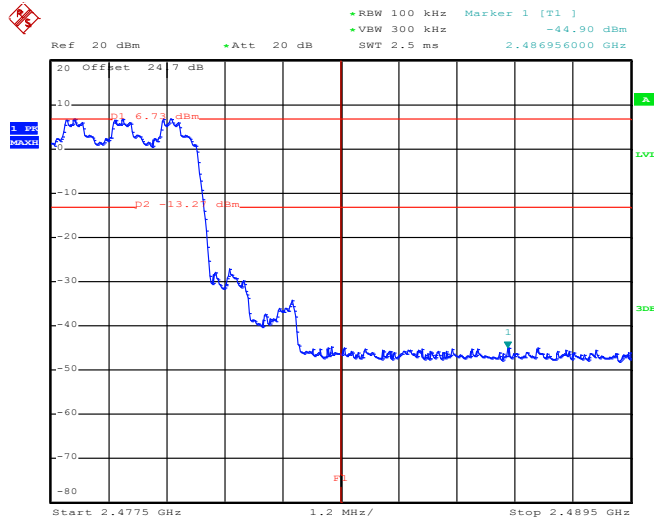
Test Mode :	2Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

2Mbps Hopping Mode Low Band Edge Plot



Date: 28.NOV.2014 13:54:07

2Mbps Hopping Mode High Band Edge Plot

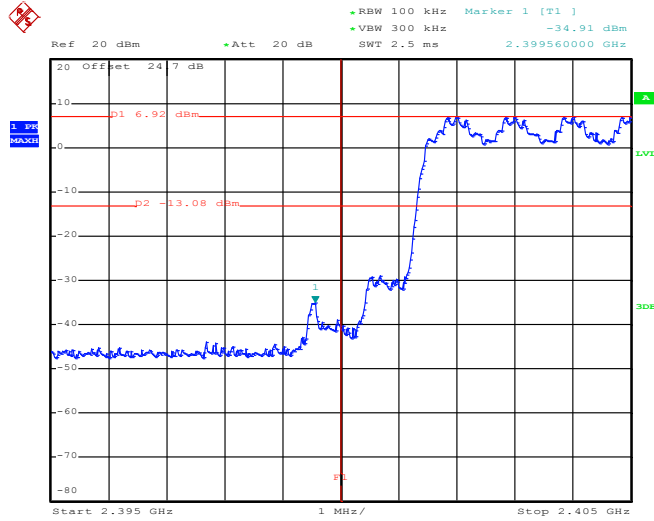


Date: 28.NOV.2014 13:50:09



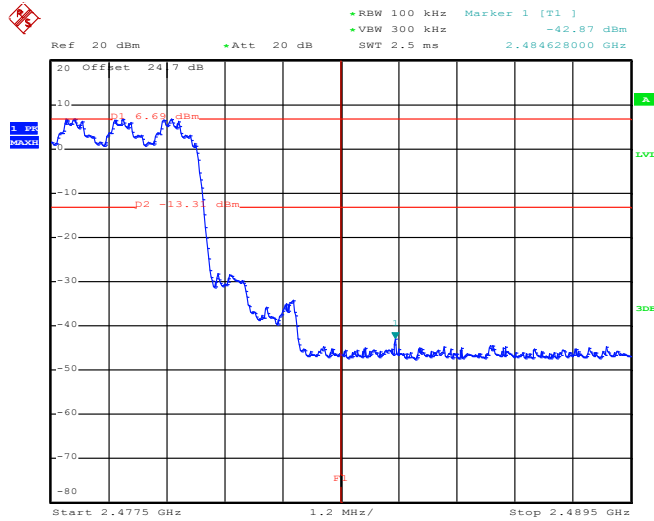
Test Mode :	3Mbps	Temperature :	24~26°C
Test Engineer :	Kenny Chen	Relative Humidity :	48~51%

3Mbps Hopping Mode Low Band Edge Plot



Date: 28.NOV.2014 13:57:07

3Mbps Hopping Mode High Band Edge Plot



Date: 28.NOV.2014 14:11:26

## 3.7 Conducted Spurious Emission Measurement

### 3.7.1 Limit of Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits.

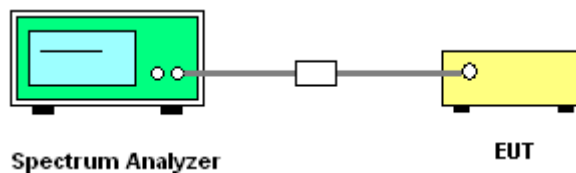
### 3.7.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.7.3 Test Procedure

1. The testing follows the guidelines in Spurious RF Conducted Emissions of FCC Public Notice DA 00-705 Measurement Guidelines
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW = 300kHz, scan up through 10th harmonic. All harmonics / spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

### 3.7.4 Test Setup

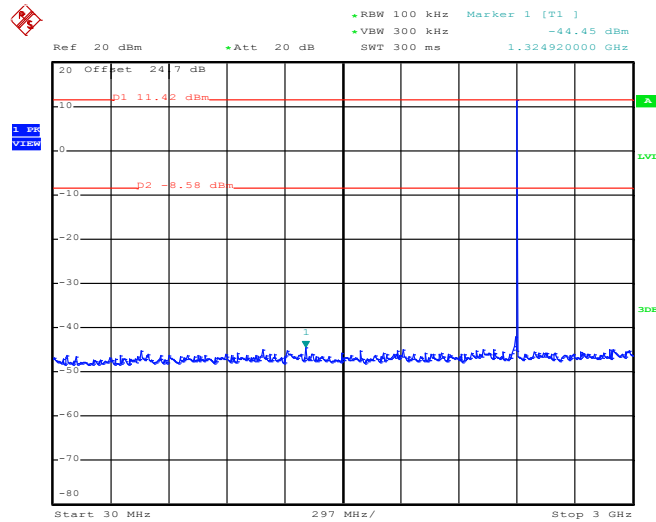




### 3.7.5 Test Result of Conducted Spurious Emission

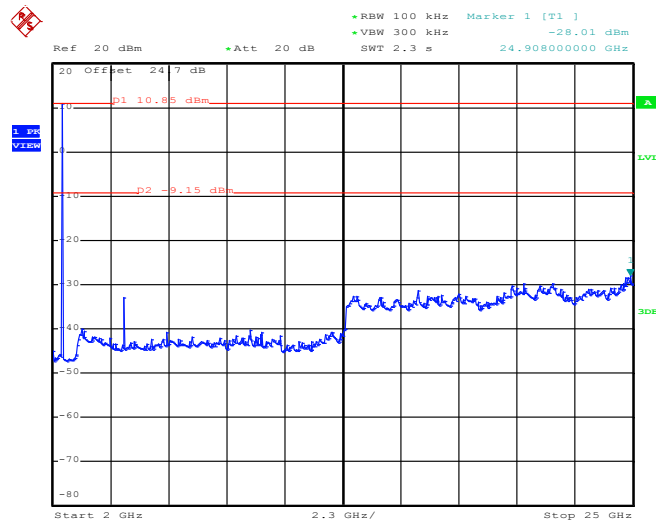
Test Mode :	1Mbps	Temperature :	24~26°C
Test Channel :	00	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

1Mbps CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 28.NOV.2014 13:59:58

1Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz



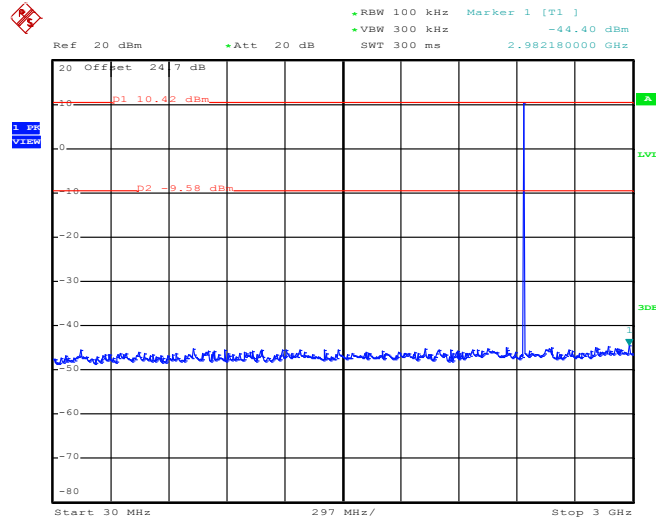
Date: 28.NOV.2014 14:00:19





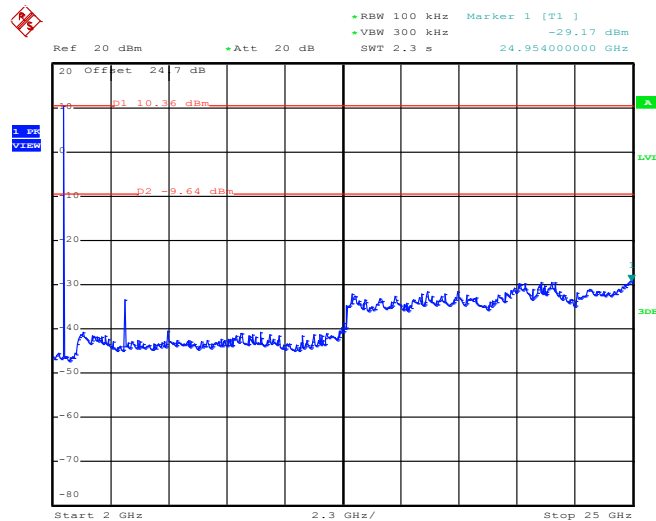
Test Mode :	1Mbps	Temperature :	24~26°C
Test Channel :	39	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

1Mbps CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 28.NOV.2014 14:02:11

1Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

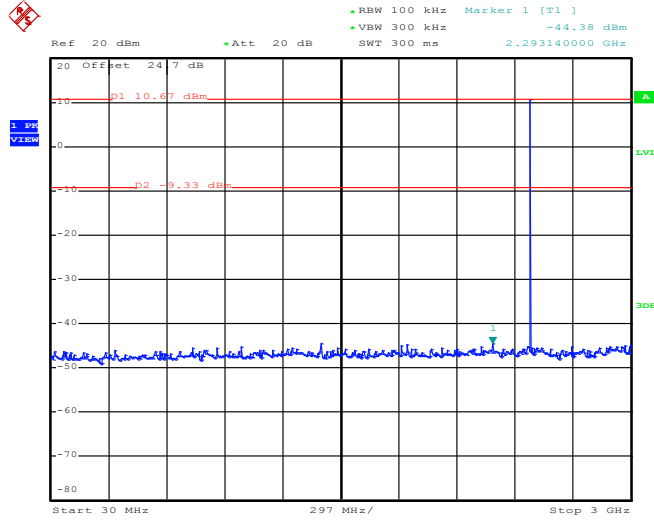


Date: 28.NOV.2014 14:02:33



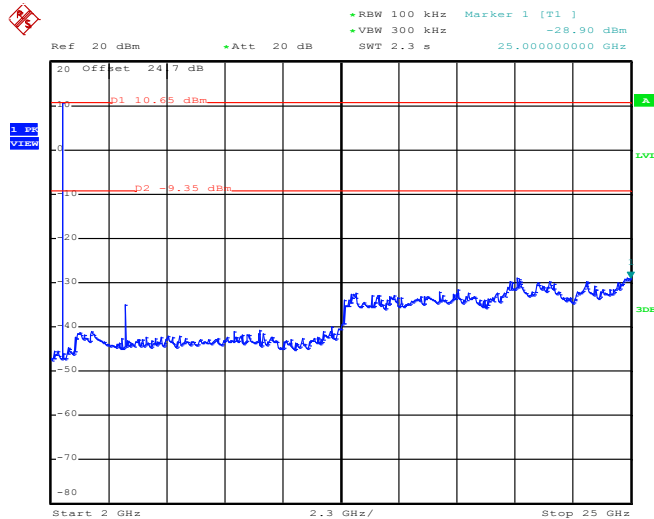
Test Mode :	1Mbps	Temperature :	24~26°C
Test Channel :	78	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

1Mbps CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 28.NOV.2014 14:03:01

1Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

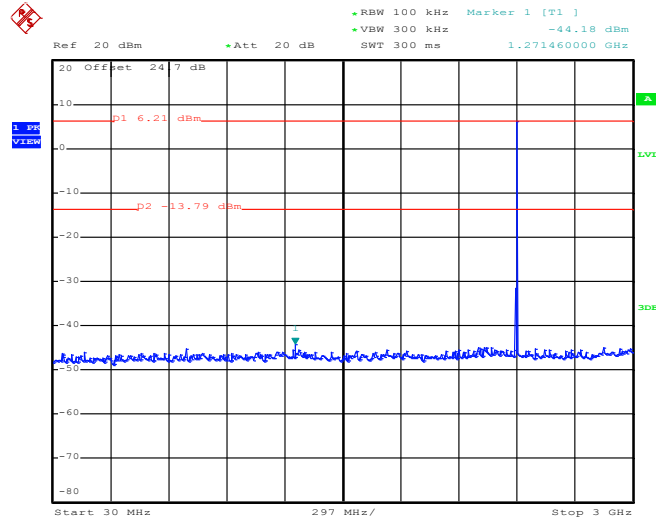


Date: 28.NOV.2014 14:03:23



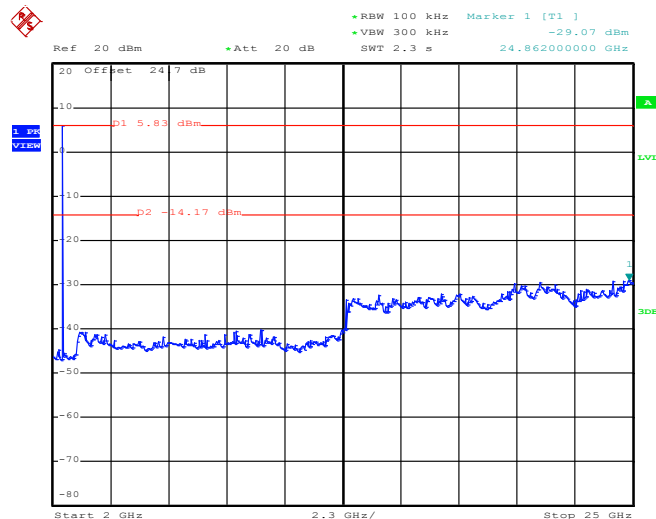
Test Mode :	2Mbps	Temperature :	24~26°C
Test Channel :	00	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

2Mbps CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 28.NOV.2014 14:08:03

2Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz

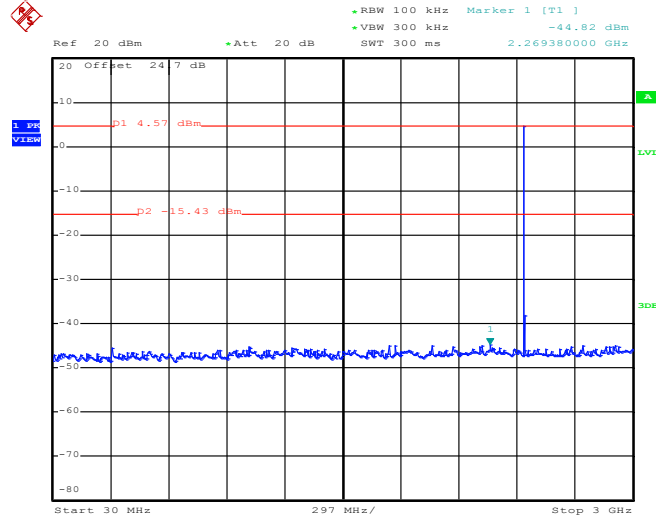


Date: 28.NOV.2014 14:08:25



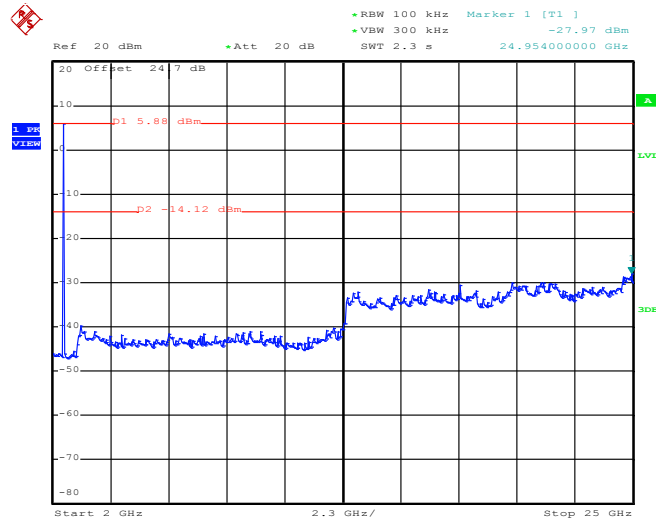
Test Mode :	2Mbps	Temperature :	24~26°C
Test Channel :	39	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

2Mbps CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 28.NOV.2014 14:06:41

2Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

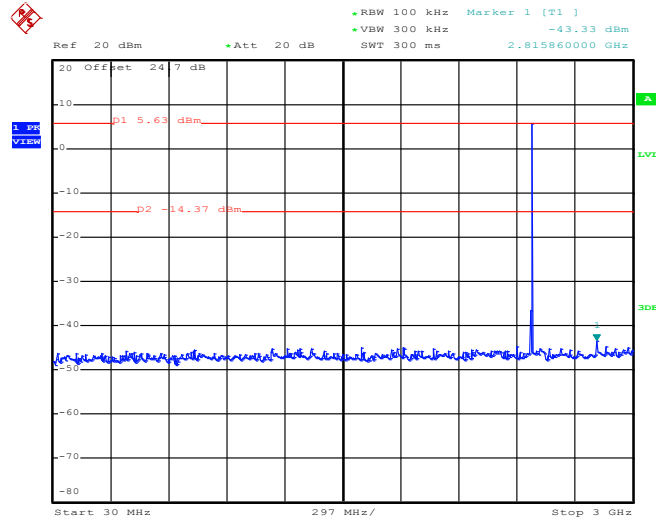


Date: 28.NOV.2014 14:07:03



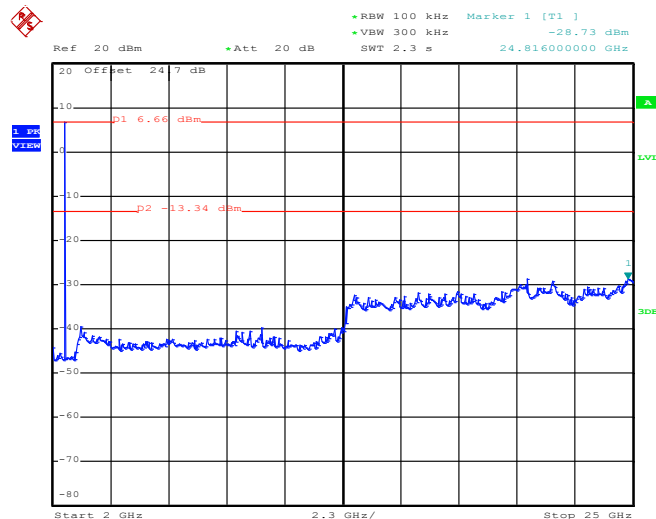
Test Mode :	2Mbps	Temperature :	24~26°C
Test Channel :	78	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

2Mbps CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 28.NOV.2014 14:05:52

2Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz

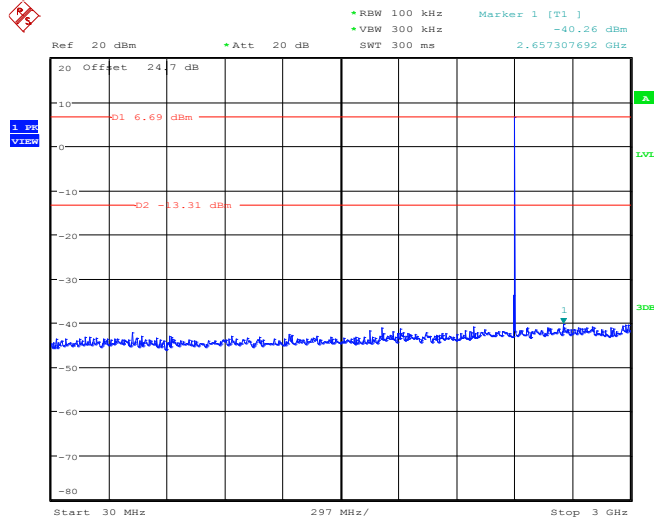


Date: 28.NOV.2014 14:06:14



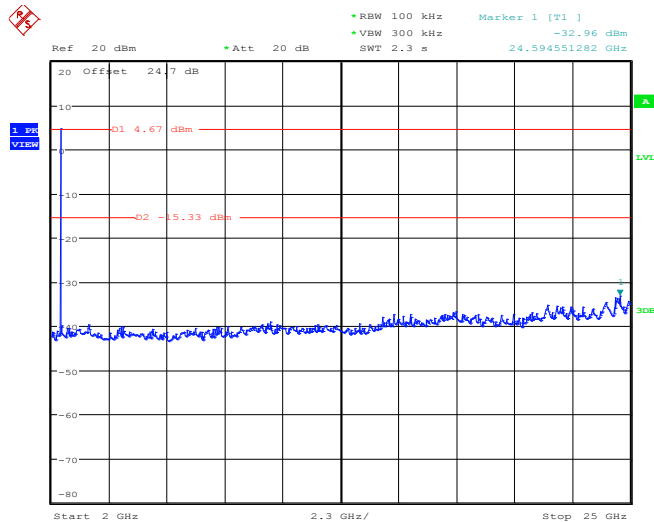
Test Mode :	3Mbps	Temperature :	24~26°C
Test Channel :	00	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

3Mbps CSE Plot on Ch 00 between 30MHz ~ 3 GHz



Date: 10.DEC.2014 00:48:18

3Mbps CSE Plot on Ch 00 between 2 GHz ~ 25 GHz

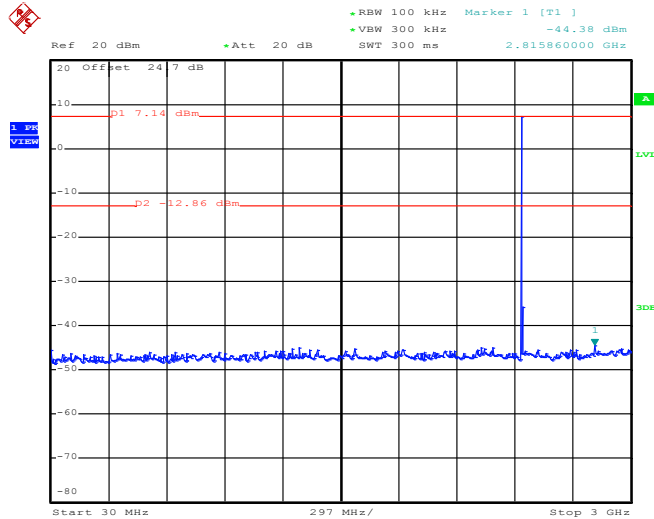


Date: 10.DEC.2014 00:48:39



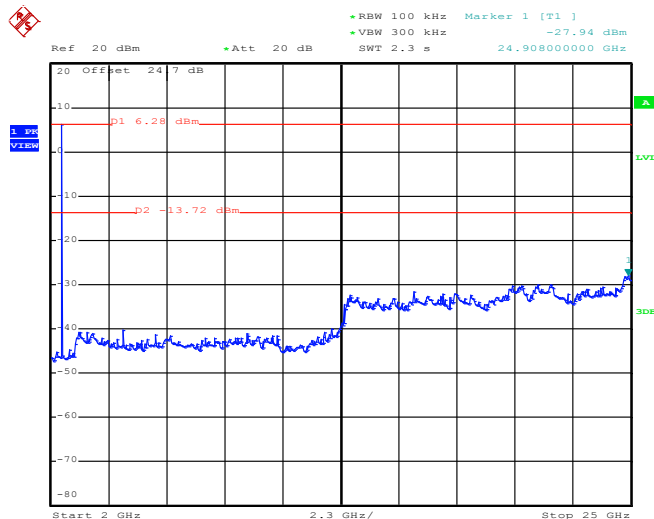
Test Mode :	3Mbps	Temperature :	24~26°C
Test Channel :	39	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

3Mbps CSE Plot on Ch 39 between 30MHz ~ 3 GHz



Date: 28.NOV.2014 14:09:16

3Mbps CSE Plot on Ch 39 between 2 GHz ~ 25 GHz

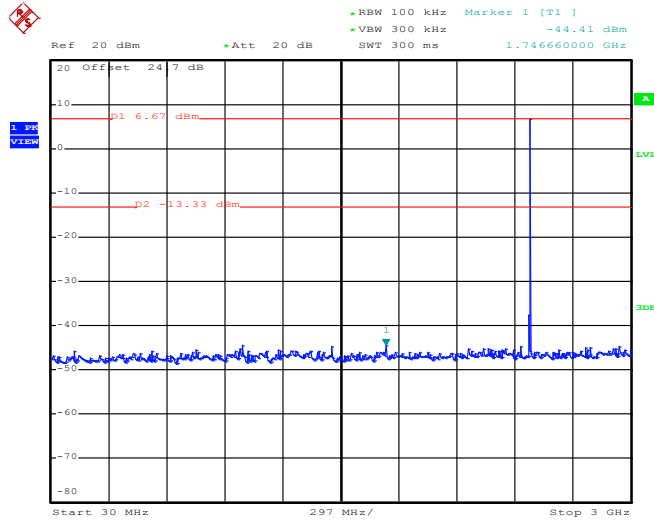


Date: 28.NOV.2014 14:09:37



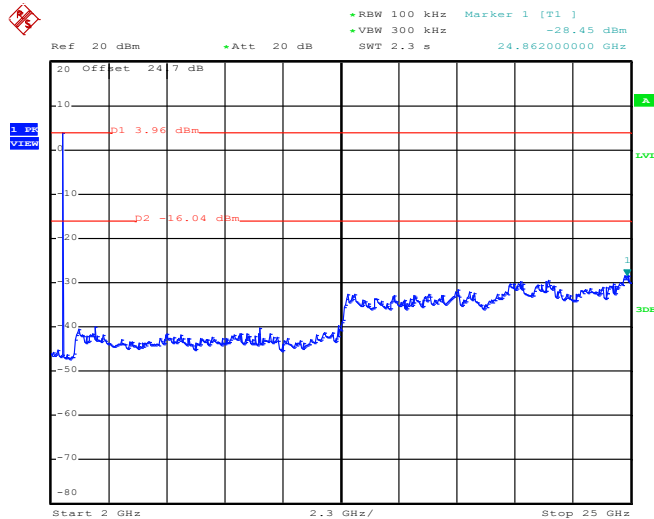
Test Mode :	3Mbps	Temperature :	24~26°C
Test Channel :	78	Relative Humidity :	48~51%
		Test Engineer :	Kenny Chen

3Mbps CSE Plot on Ch 78 between 30MHz ~ 3 GHz



Date: 28.NOV.2014 14:13:04

3Mbps CSE Plot on Ch 78 between 2 GHz ~ 25 GHz



Date: 28.NOV.2014 14:13:26





### 3.8 Band Edges and Spurious Emission in the Restricted Band

#### 3.8.1 Limit of Band Edges and Spurious Emission in the Restricted Band

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Conducted Band Edges and Spurious Emission in the Restricted Band

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

#### 3.8.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.



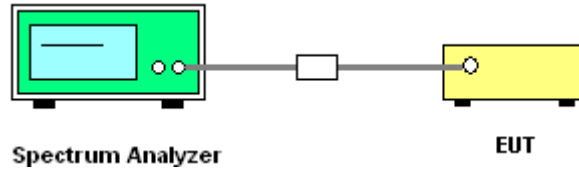
### 3.8.3 Test Procedures

1. The testing follows the guidelines in Spurious Radiated Emissions of FCC Public Notice DA 00-705 Measurement Guidelines.
2. The EUT was placed on a turntable with 0.8 meter above ground.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1$  GHz, RBW=1MHz for  $f > 1$ GHz ; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c).  
Duty cycle = On time/100 milliseconds  
On time =  $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$   
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level +  $20 * \log(\text{Duty cycle})$
7. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

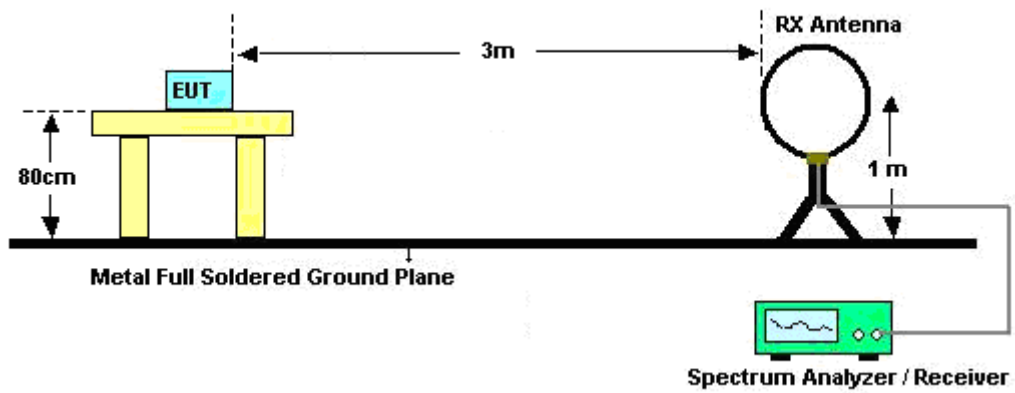
Note: The average levels were calculated from the peak level corrected with duty cycle correction factor (-47.74dB) derived from  $20 \log(\text{dwell time}/100\text{ms})$ . This correction is only for signals that hop with the fundamental signal, such as band-edge and harmonic. Other spurious signals that are independent of the hopping signal would not use this correction.

### 3.8.4 Test Setup

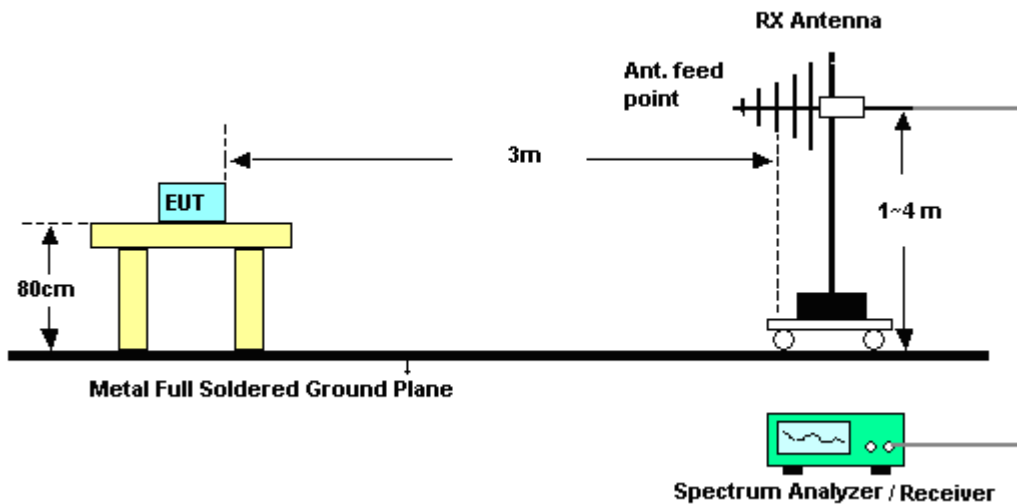
For Conducted Measurement Setup:



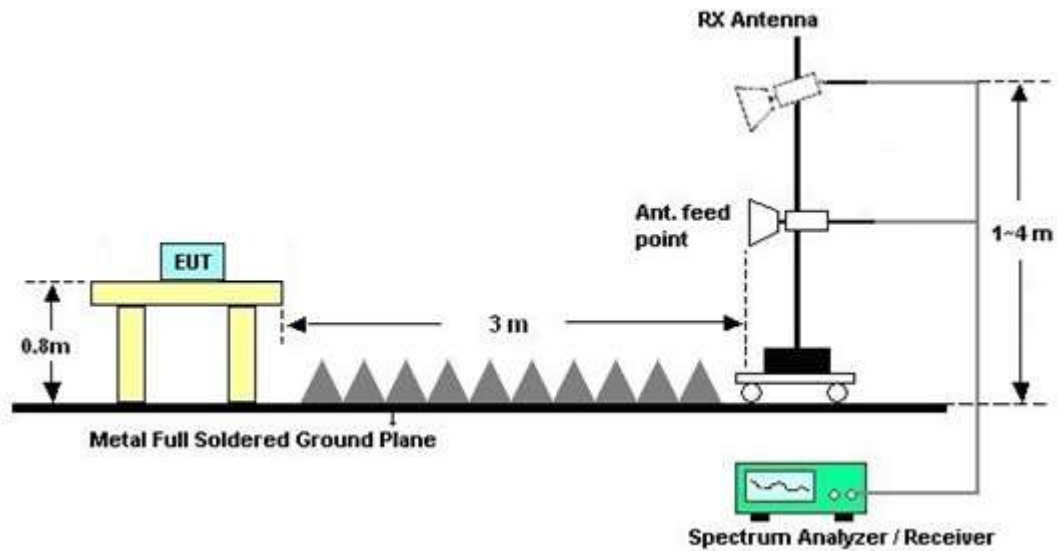
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



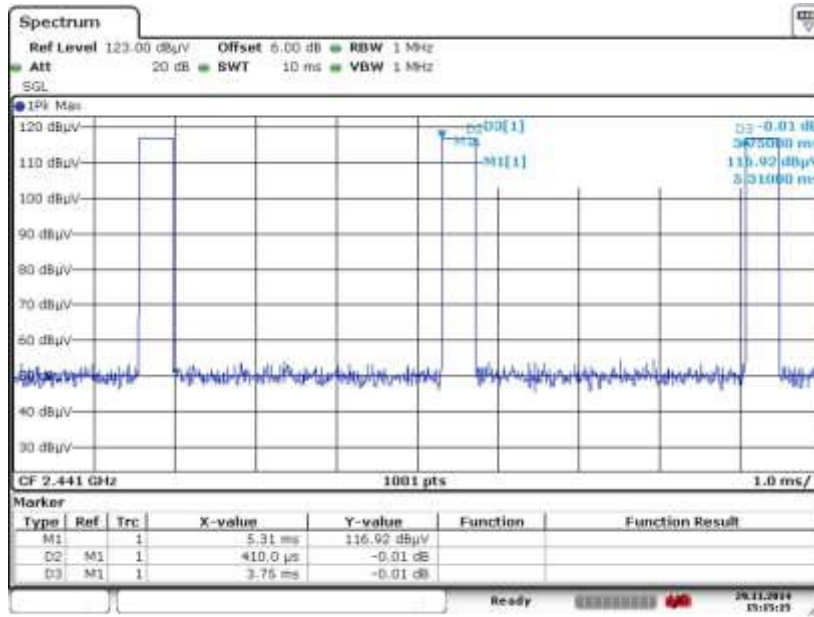
### 3.8.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.



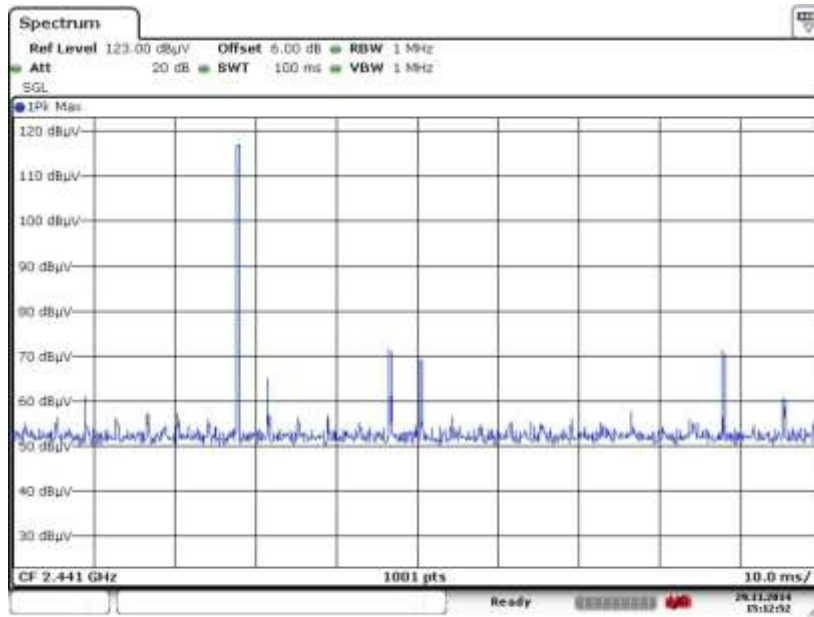
### 3.8.6 Duty cycle correction factor for average measurement

DH5 on time (One Pulse) Plot on Channel 39



Date: 29.NOV.2014 15:15:13

DH5 on time (Count Pulses) Plot on Channel 39



Date: 29.NOV.2014 15:12:53

**Note:**

1. Worst case Duty cycle = on time/100 milliseconds =  $1 * 0.41 / 100 = 0.41 \%$
2. Worst case Duty cycle correction factor =  $20 * \log(\text{Duty cycle}) = -47.74 \text{ dB}$
3. DH5 has the highest duty cycle worst case and is reported.



3.8.7 Test Result of Conducted Spurious at Band Edges in the Restricted Band

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Grounding	Peak
		( MHz )	( dBµV/m )	( dB )	( dBµV/m )	( dBµV )	( dBi )	( dB )	( dB )	( P/A )
BT CH00 2402MHz		2377.34	-30.46	-9.26	-21.2	-36.16	3.2	2.5	0	P
		2377.34	-78.2	-37	-41.2	-	-	-	0	A
	*	2402.04	15.9	-	-	10.2	3.2	2.5	0	P
	*	2402.04	-31.84	-	-	-	-	-	0	A
BT CH39 2441MHz		2389.61	-39.18	-17.98	-21.2	-44.88	3.2	2.5	0	P
		2389.61	-86.92	-45.72	-41.2	-	-	-	0	A
	*	2441.1	15.53	-	-	9.83	3.2	2.5	0	P
	*	2441.1	-32.21	-	-	-	-	-	0	A
		2492.02	-37.54	-16.34	-21.2	-43.24	3.2	2.5	0	P
		2492.02	-85.28	-44.08	-41.2	-	-	-	0	A
BT CH78 2480MHz	*	2480.05	15.5	-	-	9.8	3.2	2.5	0	P
	*	2480.05	-32.24	-	-	-	-	-	0	A
		2484.46	-35.29	-14.09	-21.2	-40.99	3.2	2.5	0	P
		2484.46	-83.03	-41.83	-41.2	-	-	-	0	A



3.8.8 Test Result of Conducted Spurious Emission in the Restricted Band

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Grounding	Peak
		( MHz )	( dBµV/m )	( dB )	( dBµV/m )	( dBµV )	( dBi )	( dB )	( dB )	( P/A )
BT CH00 2402MHz		84.81	-67.9	-12.7	-55.2	-78.3	3.2	2.5	4.7	P
		162.57	-66.74	-15.04	-51.7	-77.14	3.2	2.5	4.7	P
		244.92	-67.85	-18.65	-49.2	-78.25	3.2	2.5	4.7	P
		433	-68.29	-19.09	-49.2	-78.69	3.2	2.5	4.7	P
		598.9	-65.59	-16.39	-49.2	-75.99	3.2	2.5	4.7	P
		800.5	-53.14	-3.94	-49.2	-63.54	3.2	2.5	4.7	P
		4806	-27.72	-6.52	-21.2	-38.12	3.2	2.5	0	P
		4806	-75.46	-34.26	-41.2	-	-	-	0	A
BT CH39 2441MHz		58.62	-68.72	-13.52	-55.2	-79.12	3.2	2.5	4.7	P
		126.39	-68.19	-16.49	-51.7	-78.59	3.2	2.5	4.7	P
		233.04	-66.32	-17.12	-49.2	-76.72	3.2	2.5	4.7	P
		407.1	-68.41	-19.21	-49.2	-78.81	3.2	2.5	4.7	P
		571.6	-66.68	-17.48	-49.2	-77.08	3.2	2.5	4.7	P
		813.8	-53.12	-3.92	-49.2	-63.52	3.2	2.5	4.7	P
		4884	-27.13	-5.93	-21.2	-37.53	3.2	2.5	0	P
		4884	-74.87	-33.67	-41.2	-	-	-	0	A
		7323	-50.11	-28.91	-21.2	-55.81	3.2	2.5	0	P
		7323	-97.85	-56.65	-41.2	-	-	-	0	A
BT CH78 2480MHz		75.9	-67.56	-12.36	-55.2	-77.96	3.2	2.5	4.7	P
		182.28	-68.16	-16.46	-51.7	-78.56	3.2	2.5	4.7	P
		240.06	-67.54	-18.34	-49.2	-77.94	3.2	2.5	4.7	P
		434.4	-67.85	-18.65	-49.2	-78.25	3.2	2.5	4.7	P
		566	-67.46	-18.26	-49.2	-77.86	3.2	2.5	4.7	P
		827.1	-52.46	-3.26	-49.2	-62.86	3.2	2.5	4.7	P
		4962	-28.75	-7.55	-21.2	-34.45	3.2	2.5	0	P
		4962	-76.49	-35.29	-41.2	-	-	-	0	A
		7440	-49.36	-28.16	-21.2	-55.06	3.2	2.5	0	P
		7440	-97.1	-55.9	-41.2	-	-	-	0	A



### **3.8.9 Test Result of Cabinet Radiated Spurious at Band Edges**

Please refer to Appendix A.

### **3.8.10 Test Result of Cabinet Radiated Spurious Emission (30MHz ~ 10<sup>th</sup> Harmonic)**

Please refer to Appendix A.





### 3.9 AC Conducted Emission Measurement

#### 3.9.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

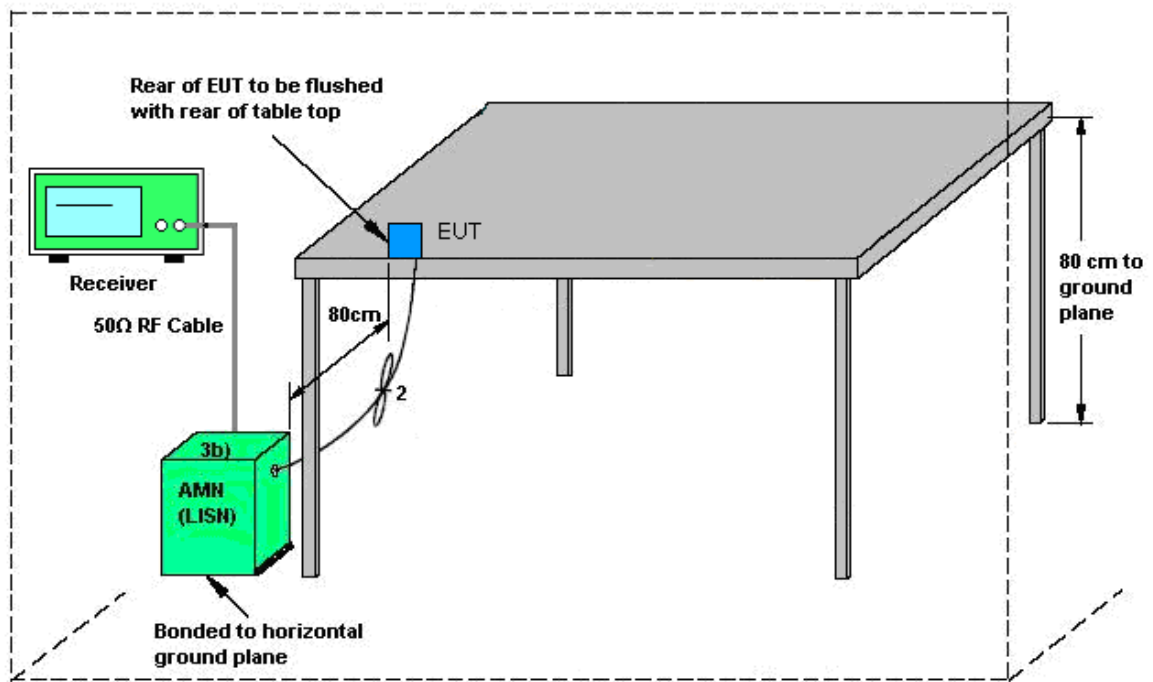
#### 3.9.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.9.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

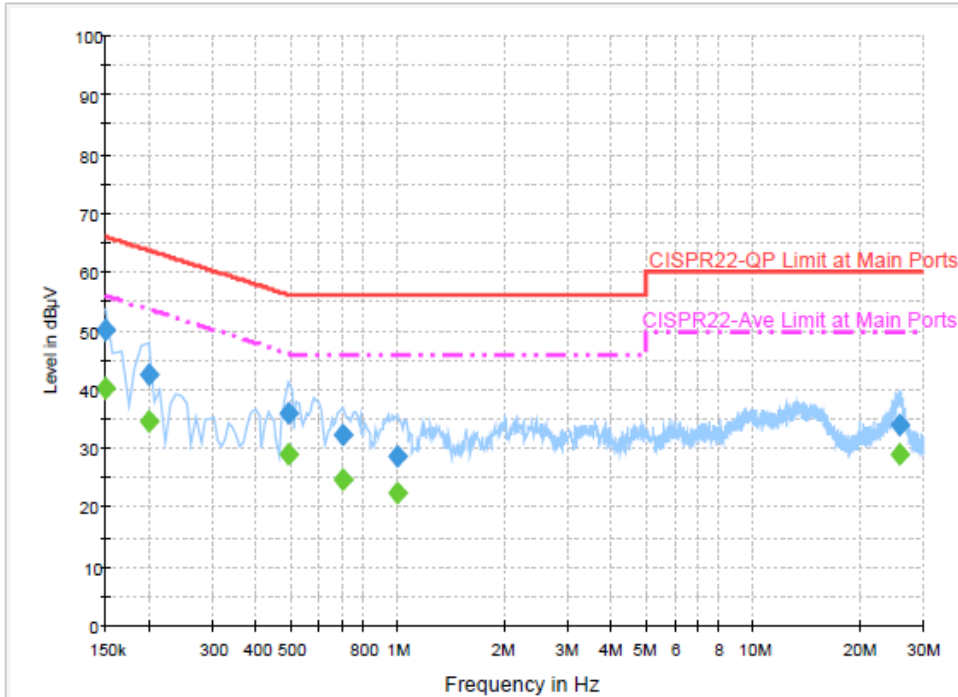
### 3.9.4 Test Setup



AMN = Artificial mains network (LISN)  
 AE = Associated equipment  
 EUT = Equipment under test  
 ISN = Impedance stabilization network

### 3.9.5 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Kai-Chun Chu	Relative Humidity :	46~48%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	WLAN (2.4GHz) Link + Bluetooth Link + Adapter		



#### Final Result : Quasi-Peak

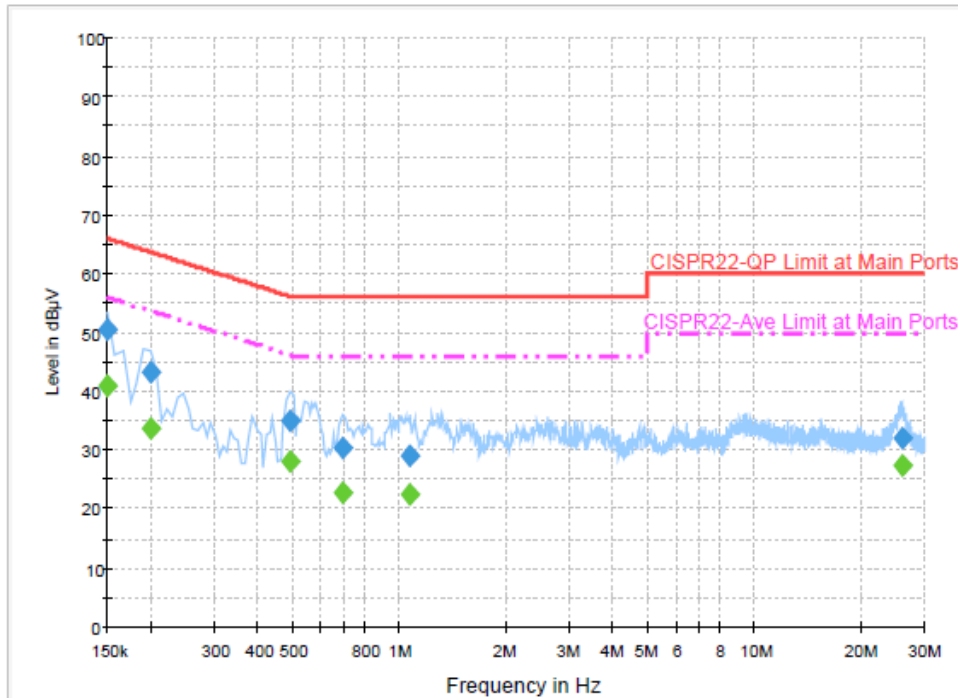
Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	50.1	Off	L1	19.5	15.9	66.0
0.198000	42.5	Off	L1	19.4	21.2	63.7
0.494000	36.0	Off	L1	19.4	20.1	56.1
0.702000	32.5	Off	L1	19.6	23.5	56.0
0.990000	28.9	Off	L1	19.5	27.1	56.0
25.766000	34.0	Off	L1	19.9	26.0	60.0

#### Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	40.3	Off	L1	19.5	15.7	56.0
0.198000	34.6	Off	L1	19.4	19.1	53.7
0.494000	29.2	Off	L1	19.4	16.9	46.1
0.702000	24.9	Off	L1	19.6	21.1	46.0
0.990000	22.5	Off	L1	19.5	23.5	46.0
25.766000	29.0	Off	L1	19.9	21.0	50.0



Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Kai-Chun Chu	Relative Humidity :	46~48%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	WLAN (2.4GHz) Link + Bluetooth Link + Adapter		



**Final Result : Quasi-Peak**

Frequency (MHz)	Quasi-Peak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	50.6	Off	N	19.5	15.4	66.0
0.198000	43.2	Off	N	19.4	20.5	63.7
0.494000	35.1	Off	N	19.4	21.0	56.1
0.694000	30.3	Off	N	19.6	25.7	56.0
1.070000	29.0	Off	N	19.6	27.0	56.0
25.982000	31.9	Off	N	20.1	28.1	60.0

**Final Result : Average**

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	40.9	Off	N	19.5	15.1	56.0
0.198000	33.7	Off	N	19.4	20.0	53.7
0.494000	28.1	Off	N	19.4	18.0	46.1
0.694000	22.7	Off	N	19.6	23.3	46.0
1.070000	22.4	Off	N	19.6	23.6	46.0
25.982000	27.3	Off	N	20.1	22.7	50.0



## **3.10 Antenna Requirements**

### **3.10.1 Standard Applicable**

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

### **3.10.2 Antenna Anti-Replacement Construction**

Non-standard antenna connector is used.

### **3.10.3 Antenna Gain**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



## 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	Rohde & Schwarz	FSP40	100055	9kHz~40GHz	Jun. 09, 2014	Oct. 22, 2014 ~ Dec. 10, 2014	Jun. 08, 2015	Conducted (TH02-HY)
Power Meter	Agilent	E4416A	GB41292344	300MHz~40GHz	Jan. 28, 2014	Oct. 22, 2014 ~ Dec. 10, 2014	Jan. 27, 2015	Conducted (TH02-HY)
Power Sensor	Agilent	E9327A	US40441548	300MHz~40GHz	Jan. 28, 2014	Oct. 22, 2014 ~ Dec. 10, 2014	Jan. 27, 2015	Conducted (TH02-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9 kHz~7 GHz	Aug. 30, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Aug. 29, 2015	Radiation (03CH07-HY)
Spectrum Analyzer	Rohde & Schwarz	FSV30	101749	10Hz ~ 30GHz	Feb. 10, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Feb. 09, 2015	Radiation (03CH07-HY)
Loop Antenna	R&S	HFH2-Z2	100315	9 kHz~30 MHz	Jul. 28, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Jul. 27, 2015	Radiation (03CH07-HY)
Bilog Antenna	Schaffner	CBL6111C	2726	30MHz ~ 1GHz	Sep. 27, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Sep. 26, 2015	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	75962	1GHz~18GHz	Aug. 19, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Aug. 18, 2015	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	18GHz~40GHz	Oct. 02, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Oct. 01, 2015	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10 MHz ~ 1000MHz	Mar. 17, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Mar. 16, 2015	Radiation (03CH07-HY)
Preamplifier	Agilent	8449B	3008A02362	1 GHz~26.5 GHz	Oct. 21, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Oct. 20, 2015	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590074	DC~18 GHz	Jul. 07, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Jul. 06, 2015	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590075	DC~18 GHz	Apr. 21, 2014	Nov. 29, 2014 ~ Dec. 10, 2014	Apr. 20, 2015	Radiation (03CH07-HY)
Turn Table	ChainTek	ChainTek 3000	N/A	0 ~ 360 degree	N/A	Nov. 29, 2014 ~ Dec. 10, 2014	N/A	Radiation (03CH07-HY)
Antenna Mast	ChainTek	ChainTek 3000	N/A	N/A	N/A	Nov. 29, 2014 ~ Dec. 10, 2014	N/A	Radiation (03CH07-HY)
EMI Test Receiver	Rohde & Schwarz	ESCS 30	100356	9kHz ~ 2.75GHz	Nov. 12, 2014	Dec. 10, 2014	Nov. 11, 2015	Conduction (CO05-HY)
LISN (for auxiliary equipment)	Rohde & Schwarz	ENV216	100081	9kHz ~ 30MHz	Dec. 12, 2013	Dec. 10, 2014	Dec. 11, 2014	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz ~ 30MHz	Dec. 02, 2014	Dec. 10, 2014	Dec. 01, 2015	Conduction (CO05-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Dec. 10, 2014	N/A	Conduction (CO05-HY)



## 5 Uncertainty of Evaluation

### Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	2.26
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### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.50
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## Appendix A. Radiated Spurious Emission

Test Engineer :	Derreck Chen	Temperature :	23~25°C
		Relative Humidity :	48~51%

15C 2.4GHz 2400~2483.5MHz

BT (Band Edge @ 3m)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	Limit Line	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
BT CH00 2402MHz		2316.63	47.86	-26.14	74	43.21	32.07	6.8	34.22	100	0	P	H	
		2316.63	0.12	-53.88	54	-	-	-	-	-	-	A	H	
	*	2402	44.75	-	-	39.96	32.18	6.91	34.3	100	0	P	H	
	*	2402	-2.99	-	-	-	-	-	-	-	-	A	H	
													H	
													H	
			2327.68	46.57	-27.43	74	41.9	32.09	6.8	34.22	100	0	P	V
			2327.68	-1.17	-55.17	54	-	-	-	-	-	-	A	V
	*	2402	45.52	-	-	-	40.73	32.18	6.91	34.3	100	0	P	V
	*	2402	-2.22	-	-	-	-	-	-	-	-	-	A	V
													V	
													V	
BT CH 39 2441MHz		2363.96	47.24	-26.76	74	42.49	32.13	6.87	34.25	100	0	P	H	
		2363.96	-0.5	-54.5	54	-	-	-	-	-	-	A	H	
	*	2441	44.24	-	-	39.44	32.24	6.95	34.39	100	0	P	H	
	*	2441	-3.5	-	-	-	-	-	-	-	-	A	H	
			2487.27	46.52	-27.48	74	41.67	32.28	7	34.43	100	0	P	H
			2487.27	-1.22	-55.22	54	-	-	-	-	-	-	A	H
			2340.78	46.87	-27.13	74	42.17	32.11	6.84	34.25	100	0	P	V
			2340.78	-0.87	-54.87	54	-	-	-	-	-	-	A	V
	*	2441	45.21	-	-	-	40.41	32.24	6.95	34.39	100	0	P	V
	*	2441	-2.53	-	-	-	-	-	-	-	-	-	A	V
		2494.49	46.49	-27.51	74	41.67	32.3	7	34.48	100	0	P	V	
		2494.49	-1.25	-55.25	54	-	-	-	-	-	-	A	V	





BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	(P/A)	(H/V)	
BT CH 78 2480MHz	*	2480	44.47	-	-	39.62	32.28	7	34.43	100	0	P	H	
	*	2480	-3.27	-	-	-	-	-	-	-	-	A	H	
		2498.04	47.5	-26.5	74	42.68	32.3	7	34.48	100	0	P	H	
		2498.04	-0.24	-54.24	54	-	-	-	-	-	-	A	H	
													H	
													H	
	*	2480	44.55	-	-	39.7	32.28	7	34.43	100	0	P	V	
	*	2480	-3.19	-	-	-	-	-	-	-	-	-	A	V
		2497.97	44.92	-29.08	74	40.1	32.3	7	34.48	100	0	P	V	
		2497.97	-2.82	-56.82	54	-	-	-	-	-	-	A	V	
													V	
													V	
<b>Remark</b>	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.													



15C 2.4GHz 2400~2483.5MHz

BT (Harmonic @ 3m)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	(P/A)	(H/V)
BT CH 00 2402MHz		4806	40.63	-33.37	74	54.23	34.25	11.11	58.96	100	0	P	H
		4806	-7.11	-61.11	54	-	-	-	-	-	-	A	H
													H
													H
		4806	41.44	-32.56	74	55.04	34.25	11.11	58.96	100	0	P	V
		4806	-6.3	-60.3	54	-	-	-	-	-	-	A	V
													V
													V
BT CH 39 2441MHz		4884	41.24	-32.76	74	54.56	34.3	11.21	58.83	100	0	P	H
		4884	-6.5	-60.5	54	-	-	-	-	-	-	A	H
		7323	42.19	-31.81	74	49.25	35.6	15.08	57.74	100	0	P	H
		7323	-5.55	-59.55	54	-	-	-	-	-	-	A	H
		4884	42.04	-31.96	74	55.36	34.3	11.21	58.83	100	0	P	V
		4884	-5.7	-59.7	54	-	-	-	-	-	-	A	V
		7323	41.73	-32.27	74	48.79	35.6	15.08	57.74	100	0	P	V
		7323	-6.01	-60.01	54	-	-	-	-	-	-	A	V
BT CH 78 2480MHz		4962	40.92	-33.08	74	53.89	34.37	11.32	58.66	100	0	P	H
		4962	-6.82	-60.82	54	-	-	-	-	-	-	A	H
		7440	42.02	-31.98	74	49.14	35.6	15.13	57.85	100	0	P	H
		7440	-5.72	-59.72	54	-	-	-	-	-	-	A	H
		4962	41.72	-32.28	74	54.69	34.37	11.32	58.66	100	0	P	V
		4962	-6.02	-60.02	54	-	-	-	-	-	-	A	V
		7440	41.14	-32.86	74	48.26	35.6	15.13	57.85	100	0	P	V
		7440	-6.6	-60.6	54	-	-	-	-	-	-	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



15C Emission below 1GHz

2.4GHz BT (LF)

BT	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.	
		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )	
2.4GHz BT LF		74.28	9.06	-30.94	40	31.4	6.8	2.06	31.2			P	H	
		118.83	20.36	-23.14	43.5	37.74	11.35	2.38	31.11			P	H	
		240.06	14.12	-31.88	46	30.76	11.4	2.96	31			P	H	
		415.5	20.36	-25.64	46	31.21	16.45	3.52	30.82			P	H	
		568.8	22.22	-23.78	46	29.18	19.75	4.01	30.72			P	H	
		866.3	25.74	-20.26	46	28.37	23.08	4.66	30.37	102	23	P	H	
													H	
													H	
													H	
													H	
													H	
													H	
			65.91	10.28	-29.72	40	33.36	6.08	2.06	31.22			P	V
			154.47	12.42	-31.08	43.5	30.24	10.72	2.61	31.15			P	V
			245.46	16.79	-29.21	46	32.93	11.9	2.96	31			P	V
			396.6	27.36	-18.64	46	38.98	15.78	3.52	30.92			P	V
			666.8	30.09	-15.91	46	35.85	20.36	4.35	30.47			P	V
			897.1	32.59	-13.41	46	35.13	23.11	4.66	30.31	198	269	P	V
													V	
													V	
													V	
													V	
													V	
													V	
Remark	1. No other spurious found. 2. All results are PASS against limit line.													



**Note symbol**

*	<b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency per 15.209(c).
!	Test result is <b>over limit</b> line.
P/A	<b>Peak</b> or <b>Average</b>
H/V	<b>Horizontal</b> or <b>Vertical</b>



A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

- Level(dBμV/m) =  
Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
- Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

- Level(dBμV/m)  
= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)  
= 55.45 (dBμV/m)
- Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 55.45(dBμV/m) – 74(dBμV/m)  
= -18.55(dB)

**For Average Limit @ 2390MHz:**

- Level(dBμV/m)  
= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)  
= 43.54 (dBμV/m)
- Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 43.54(dBμV/m) – 54(dBμV/m)  
= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.

## Appendix B. Setup Photographs

### <Conducted Emission>



<Radiated Emission>

LF



HF

